EXHIBIT C

EXHIBIT C
Wetlands/Waters Impact Assessment
Proposed Warehouse Distribution Facility Project
2780 Long Road
Town of Grand Island, Erie County, New York

Existing Conditions

A Wetland Delineation Report dated August 27, 2019 (the "Wetland Report") Site by Wilson Environmental Technologies, Inc., ("WET") on behalf of the Owner, a copy of which is annexed hereto. The delineation was prepared in accordance with federal delineation methodology outlined under the U.S. Army Corps of Engineers ("USACE") Wetlands Delineation Manual and Northcentral and Northeast Regional Supplement. The Wetland Report is based on an evaluation of the Site during several weeks in July and August of 2019.

Two jurisdictional watercourses/drainage ditches and eleven jurisdictional wetlands are present on the Site. See Figure 1 attached. The first ditch bisects the Site from north to south, the second ditch is located in the southeastern corner of the Site. The north-south ditch continues offsite and along Long Road, eventually to the Niagara River. Onsite wetlands generally consist of scrub-shrub and emergent wetlands and the regulated wetland areas within the Site total approximately 5.07 acres.

Based on recent discussions with the USACE, seven of the eleven wetlands (Wetlands J, L, N, P, Q, R and T), totaling approximately 4.56 acres, are subject to regulation by the USACE. In addition, two of the ditches – the ditch that bisects the Site from north to south (approximately 3,200 linear feet) and the ditch located in the southeastern corner of the Site (approximately 475 linear feet) are subject to regulation by the USACE. A regulatory jurisdiction confirming the wetlands and water boundaries is forthcoming.

Based on the recent issuance of a NYSDEC Wetland Delineation Verification dated January 23, 2020, six of the eleven wetlands (Wetlands M, R, S, T, U and V), totaling approximately 1.0 acres, are subject to regulation by the NYSDEC. NYSDEC freshwater wetlands contain a 100-foot regulated adjacent area (buffer). None of the NYSDEC jurisdictional wetlands, nor any of their 100-foot buffer, will be disturbed by the Project. The watercourses/drainage ditches are not identified by the NYSDEC and, based on feedback by the NYSDEC, are not considered protected streams under the NYSDEC's Protection of Waters Program.

In addition, the two USACE watercourses/drainage ditches have also been designated by the Town as a "Feeder Creek" (3,200 linear feet) and a "Collector Creek" (475 linear feet).

Wetlands/Waters Impacts

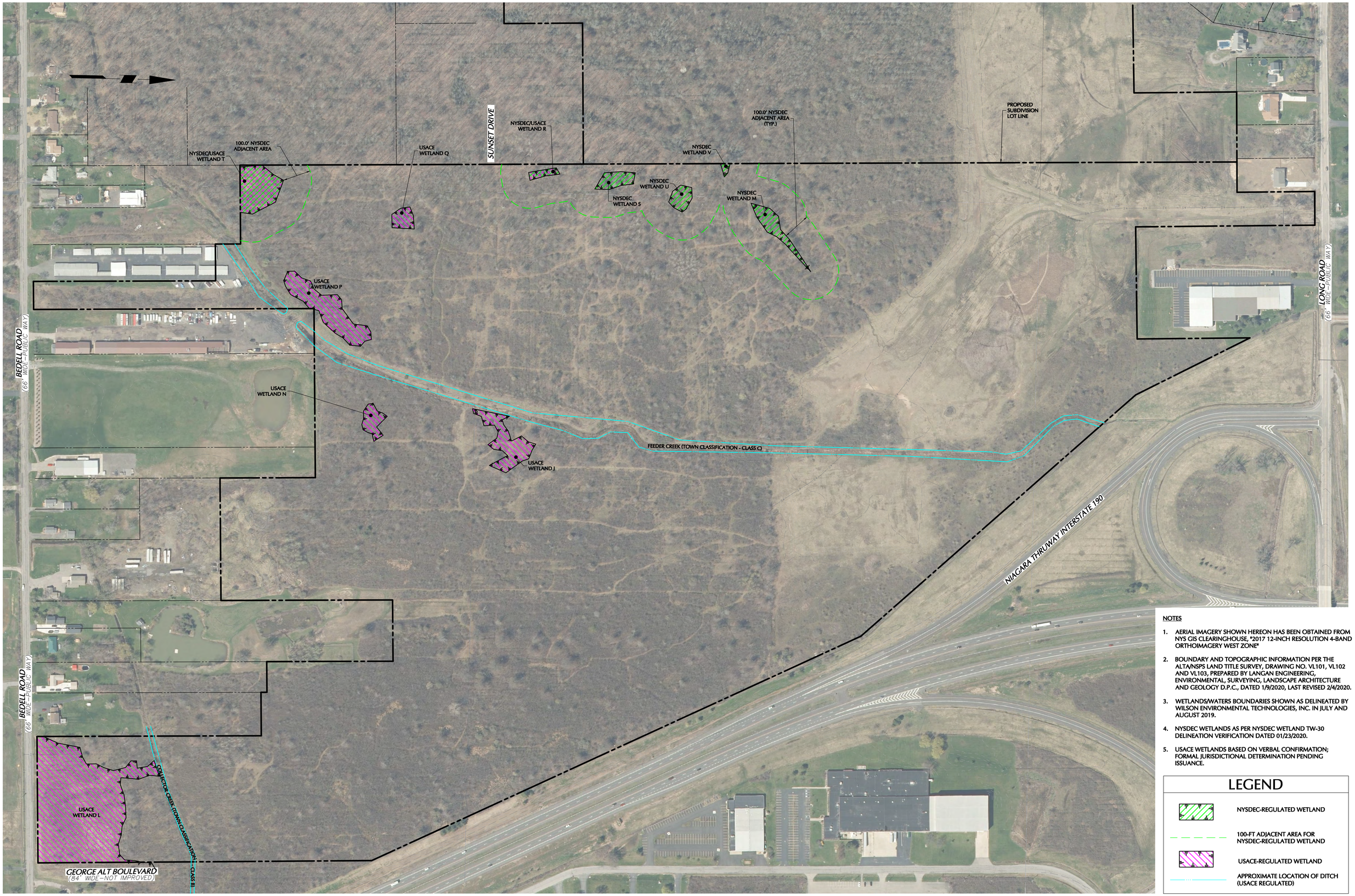
The Project will require limited impacts to jurisdictional wetlands/waters (approximately 0.79 acres) for the construction of parking areas, access roads, the Facility and stormwater basins. The Project will impact approximately 0.42 acres of Wetland J, approximately 0.23 acres of Wetland L, approximately 0.12 acres of Wetland Q, and approximately 0.02 acres of a portion of the Collector Creek. Wetland L consists of an emergent wetland located along Bedell Road, and Wetlands J and Q comprise small, depressional wetlands characterized by scrub-shrub

vegetation and located on the interior of the Site. The Project will also require relocation of the Feeder Creek to the western portion of the Site.

The Collector Creek road crossing has been designed and will be constructed to maintain low flow and potential aquatic life movement and will also be sized/designed to provide adequate capacity and stability for various flood flows. The Feeder Creek will be relocated to the western portion of the Site and has been designed with a similar length and longitudinal slope as the current feature to maintain similar stream flow. Based on a flood analysis, the relocation will not adversely impact flood conditions. As shown on the Conceptual Floodplain Wetlands Creation Plan (Drawing CP-01), based on feedback provided by the USACE at a pre-application meeting on 2/13/2020, additional flood storage is expected to be provided along the stream corridor through the creation of adjacent floodplain wetlands and oversized stormwater basins that will provide additional flood storage under certain conditions. The floodplain wetland design has not yet been completed but is expected to contain a similar area of disturbance as shown on Drawing CP-01. Additionally, as shown in Exhibit B, appropriate stormwater management measures have been designed to avoid potential degradation of on-Site and downstream surface waters. Accordingly, based on the limited area of wetlands/waters impacts and incorporated design elements, the Project is not expected to significantly impact wetlands/waters.

Based on a joint pre-application meeting with USACE and NYSDEC, and as required by the USACE under Section 404 of the Clean Water Act, compensatory wetland mitigation for the Project is anticipated to be satisfied through the purchase of 1.58 wetland mitigation credits from the Ducks Unlimited – Niagara River In-Lieu Fee Program. Moreover, for the purpose of USACE regulation, the stream relocation will be considered in-kind mitigation that will be supplemented by the creation of new floodplain wetlands immediately adjacent. A wetlands/waters mitigation proposal and design will be submitted to the USACE/NYSDEC as part of a joint permit application. Finally, TC Buffalo will continue to work with the USACE and the NYSDEC and will comply with all applicable state and federal requirements.

Accordingly, based on the limited area of wetlands/waters impacts, the incorporated design elements, and the proposed mitigation measures, the Project is not expected to significantly impact wetlands/waters.



NOTES

1. AERIAL IMAGERY SHOWN HEREON HAS BEEN OBTAINED FROM NYS GIS CLEARINGHOUSE, "2017 12-INCH RESOLUTION 4-BAND ORTHOIMAGERY WEST ZONE"
2. BOUNDARY AND TOPOGRAPHIC INFORMATION PER THE ALTA/NSPS LAND TITLE SURVEY, DRAWING NO. VL101, VL102 AND VL103, PREPARED BY LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING, LANDSCAPE ARCHITECTURE AND GEOLOGY D.P.C., DATED 1/9/2020, LAST REVISED 2/4/2020.
3. WETLANDS/WATERS BOUNDARIES SHOWN AS DELINEATED BY WILSON ENVIRONMENTAL TECHNOLOGIES, INC. IN JULY AND AUGUST 2019.
4. NYSDEC WETLANDS AS PER NYSDEC WETLAND TW-30 DELINEATION VERIFICATION DATED 01/23/2020.
5. USACE WETLANDS BASED ON VERBAL CONFIRMATION; FORMAL JURISDICTIONAL DETERMINATION PENDING ISSUANCE.

LEGEND

- NYSDEC-REGULATED WETLAND
- 100-FT ADJACENT AREA FOR NYSDEC-REGULATED WETLAND
- USACE-REGULATED WETLAND
- APPROXIMATE LOCATION OF DITCH (USACE REGULATED)

120 0 60 120
SCALE: 1 INCH = 120 FEET

WARNING:
IT IS A VIOLATION OF THE NYS EDUCATION LAW ARTICLE 145 FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS ITEM IN ANY WAY.

LANGAN
Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.
300 Kimball Drive
Parsippany, NJ 07054
T: 973.560.4900 F: 973.560.4901 www.langan.com
NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400

Project: PROJECT OLIVE
SECTION No. 23.00, BLOCK No. 1, LOT Nos. 50 & 26.1
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title: WETLANDS/ WATERS MAP

Project No. 100785901
Date 11/11/2019
Drawn By TLK
Checked By RB
Drawing No. 1
Sheet 1 of 1

LANGAN
PROJECT NO. 100785901

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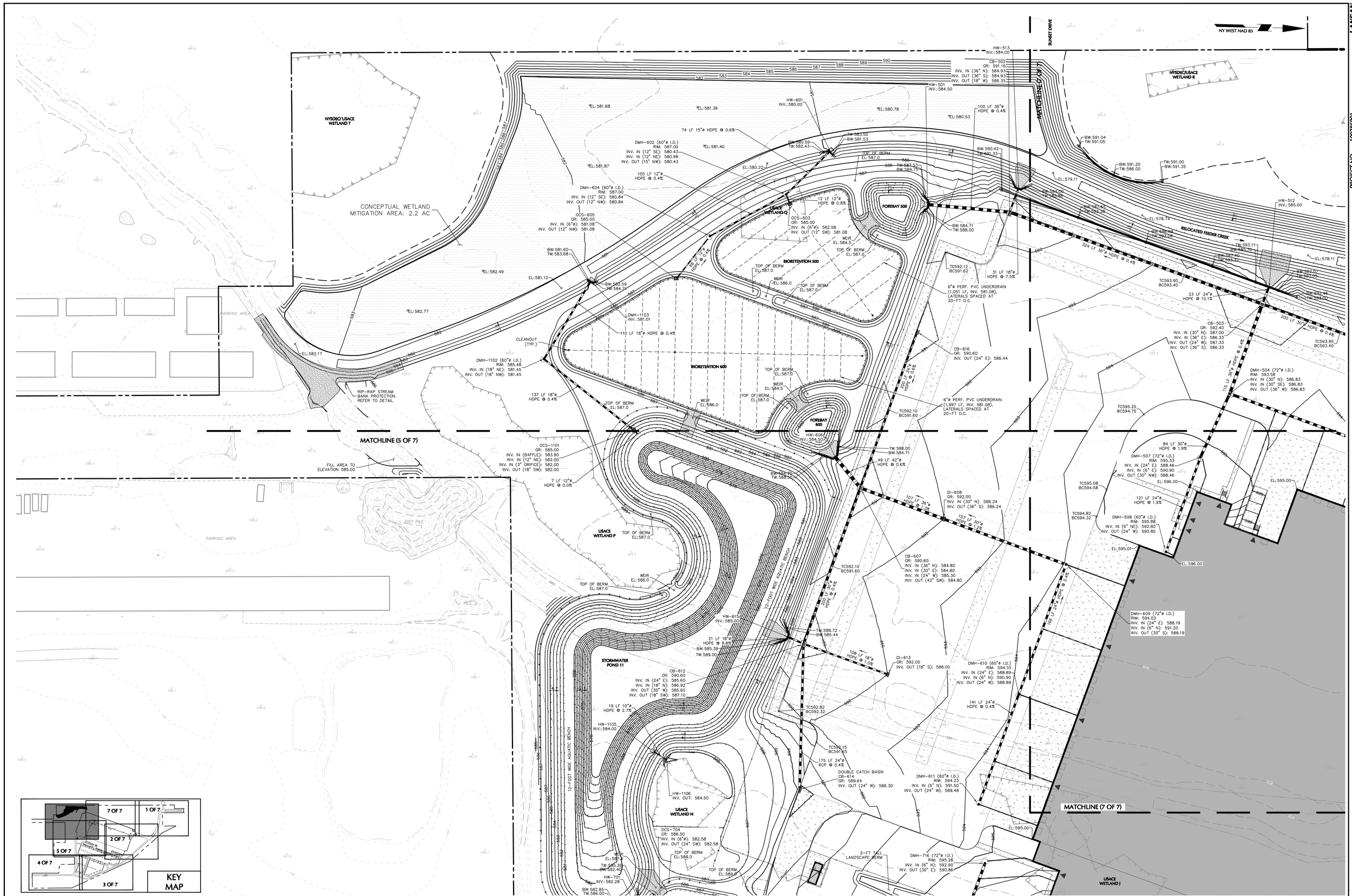
Filename: \\langan.com\data\PAR\data\I\100785901\Project Data\CAD\01\SheetFiles\Figures\100785901-WL101-0101-update02-19-2020.dwg Date: 2/19/2020 Time: 14:09 User: sparks Style Table: Langan.stb Layout: Concept Plan



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Date	Description	No.
REVISIONS		

SIGNATURE DATE SIGNED
MICHAEL FINAN
PROFESSIONAL ENGINEER NY Lic. No. 081473-1

LANGAN
Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.
One North Broadway, Suite 910
White Plains, NY 10601
T: 914.323.7400 F: 914.323.7401 www.langan.com

Project
PROJECT OLIVE
BLOCK No. 1, LOT No.50 & 26.1
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title
CONCEPTUAL FLOODPLAIN WETLANDS CREATION PLAN

Project No. 100785901
Date FEBRUARY 21, 2020
Drawn By LM/SS
Checked By CZ/MF

Drawing No. CP-01
Sheet 1 of 1

LANGAN
PROJECT NO. 100785901

Filename: \\langan.com\data\PAR\data9\100785901\Project Data\CAD\01\SheetFiles\SPA\100785901-CG101-0101 - wetland mitigation.dwg Date: 2/20/2020 Time: 11:21 User: mchecca Style Table: Langan.stb Layout: CG106

WILSON
ENVIRONMENTAL
TECHNOLOGIES, INC.

WETLAND DELINEATION REPORT

GRAND ISLAND COMMERCE CENTER
TOWN OF GRAND ISLAND

PREPARED FOR
AQUEST COMPANIES

CLIENT:
ACQUEST COMPANIES
5554 MAIN STREET.
WILLIAMSVILLE, NY 14221

PROJECT NAME:
GRAND ISLAND COMMERCE CENTER

PROJECT LOCATION:
SOUTH OF AND ADJACENT TO LONG ROAD
NORTH OF AND ADJACENT TO BEDELL ROAD
WEST OF AND ADJACENT TO NYS I-190
TOWN OF GRAND ISLAND
ERIE COUNTY, NEW YORK

ACTION:
SECTION 404 WETLAND DELINEATION REPORT

PREPARED BY:
WILSON ENVIRONMENTAL TECHNOLOGIES INC.
1879 WHITEHAVEN ROAD, SUITE 3
GRAND ISLAND, NEW YORK 14072
OFFICE (716) 565-3000 FAX (716) 775-9140

DATE:
08 / 27 / 2019

WET PROJECT NO.:
399.05

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EXECUTIVE SUMMARY

Wilson Environmental Technologies, Inc (WET) has been retained by *Aquest Development* to evaluate and define wetlands subject to jurisdiction under Section 404 of the Clean Water Act and Article 24 of the New York State Environmental Conservation Law on lands located between Long and Bedell Roads, west of and adjacent to the New York State Thruway I-190 in the Town of Grand Island. Approximately 144± acres of undeveloped land were delineated as the scope of this project.

This represents a redelineation of the same property which WET previously delineated in 2007. At that time the wetland delineation was issued a Jurisdiction Determination (JD) by the U.S. Army Corps of Engineers. That JD has since expired. The current delineation examined the same 144± acres during several weeks in July and August, 2019. As a result of the onsite field investigation, sixteen (16) wetlands totaling 10.536± acres were identified within the site. The wetland delineation results were based on the presence of hydric soils, hydrophytic vegetation and wetland hydrology found within the site boundaries. The wetlands were flagged at the time of the field work and the locations of the wetlands were surveyed by a licensed land surveying firm. The site wetlands are depicted on the attached Wetland Survey as prepared by the firm of *Niagara Boundary and Mapping Services PC*.

The subject site consists largely of shrublands with areas of mixed forested woodlands. A significant area of the north end had been a borrow pit for the I-190 construction project decades earlier. A recently constructed sanitary sewer line crosses the site from south to north. Numerous recreational ATV/hunting access trails have been mowed using brushhog or hydro-axe equipment. A man made intermittent tributary to the Niagara River bisects the site in a north/south direction, exiting the parcel to the area of the I-190 off-ramp before running west, parallel along Long Road to the Niagara River. Wetlands were identified throughout all areas of the site. The majority of wetlands identified are small and isolated emergent microdepression wetlands in areas of slightly lower topography.

This report is intended for the use of the property owner(s), their agents and assigns as a planning aid in the development of this parcel. Results of the Wetland Delineation are subject to review by both the New York State Department of Environmental Conservation under Article 24 of the NYS Environmental Conservation Law, and the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act, along with the Town of Grand Island. This Wetland Delineation Report is a representation of WET's assessment of Federal and State wetlands. The review of this document by the U.S. Army Corps of Engineers and State Department of Conservation could produce alterations in the delineated boundary as determined by WET. The wetlands, as delineated by WET, were completed to the best of our ability and in compliance with the guidelines presented in the Corps of Engineers Wetlands Delineation Manual Technical Report Y-87-1 (U.S. Waterways Experiment Station, 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region*, dated January 2012; accepted as the current methodology in delineation practice.

Wilson Environmental Technologies, Inc.
1879 Whitehaven Rd. Suite 3, Grand Island, NY 14072
Office 716.565.3000 Fax 716.775.9140

1.0 INTRODUCTION

Wilson Environmental Technologies, Inc. (WET) has been retained by *Aquest Development* to evaluate and define wetlands subject to jurisdiction under Section 404 of the Clean Water on a 144± acre area in the Town of Grand Island, Erie County, New York. This report presents the results of the on-site field investigation which was conducted to determine if the United States Army Corps of Engineers (USACE) and New York State Department of Environmental Conservation (NYSDEC) permit relative to Section 404 of the Clean Water Act and Article 24 of the New York State Environmental Conservation Law would be required for development within the parcel. Based on the results of the investigation, WET determined that sixteen (16) wetlands are located within the site. The determination was based on the presence of hydric soils, hydrophytic vegetation and wetland hydrology.

The subject site consists largely of shrublands with areas of mixed forested woodlands. A significant area of the north end had been a borrow pit for the I-190 construction project decades earlier. A recently constructed sanitary sewer line crosses the site from south to north. Numerous recreational ATV/hunting access trails have been mowed using brushhog or hydro-axe equipment. A man-made intermittent tributary to the Niagara River bisects the site in a north/south direction, exiting the parcel to the I-190 off-ramp before running west, parallel along Long Road to the Niagara River. The results of the Wetland Delineation was surveyed and contained in Appendix D of this report.

1.1 ACCEPTED DELINEATION METHODOLOGY

The Code of Federal Regulations defines a wetland as an area having hydric soils, wetland hydrology and supporting vegetation dominated by hydrophytes. All three of these criteria must be present for an area to qualify as a wetland. Hydrophytic vegetation has been defined as species which due to morphological, physiological, and/or reproductive adaptation(s), have the ability to grow, effectively compete, reproduce, and/or persist in anaerobic soil conditions. These species have been given an indicator status defining their probability of occurring in a wetland. These indicators statuses are defined as Obligate Wetland (OBL), Facultative Wetland (FACW) and Facultative (FAC). Non-hydrophytic species are assigned an indicator status of Facultative Upland (FACU) or Obligate Upland (UPL).

WET performs wetland delineations in accordance with the 1987 *Corps of Engineers Wetland Delineation Manual* and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region*, dated January 2012. The development of this supplement follows the recommendations of the National Research Council to increase the regional sensitivity of wetland delineation methods.

Wilson Environmental Technologies, Inc.
1879 Whitehaven Rd. Suite 3, Grand Island, NY 14072
Office 716.565.3000 Fax 716.775.9140

2.0 AGENCY RESOURCE INFORMATION

Prior to initiation of the on-site investigation, available environmental information was gathered and reviewed. The results of the review are summarized as follows.

2.1 USGS QUADRANGLE MAP (FIGURE 1)

The U.S. Geological Service has produced geological maps for every county of the United States. These maps are useful in wetland delineation for the purposes of identifying areas of concern within a parcel. In addition to civil works and boundaries, indicators of marshes, swamps, perennial and intermittent streams, and contours are depicted. The Tonawanda West, New York (7.5 minute) quadrangle map were referenced for this parcel.

2.2 NATIONAL WETLANDS INVENTORY MAP (FIGURE 2)

NWI maps were produced by the U.S. Department of the interior, Fish and Wildlife Service in the years 1977 to present day. These maps provide the approximate configurations and community types of suspected Federal wetlands. Although they serve as useful guidelines, they are incomplete due to compilation methods primary utilizing aerial photography which contain an inherent margin of error, only reflect conditions the year in which they were taken and some wetlands areas too small of obscured by dense forest may not be depicted. The Erie County On-Line Mapping System was referenced for this site. Federal wetlands are mapped within the site.

2.3 NYSDEC FRESHWATER WETLANDS MAP (FIGURE 3)

The New York State Department of Environmental Conservation (DEC) has developed criterion for wetland identification based on vegetation cover with minimum acreage requirements. Identified wetlands have been promulgated with the production and distribution of Freshwater Wetlands Maps (FWW). The boundaries of identified wetlands are approximations and require surveying of a field delineation performed by a DEC representative to determine exact boundaries and acreage. The NYSDEC Resource Mapping System was referenced for this site. State FWW TW-30 is mapped within the extreme west portion of the site.

2.4 NRCS SOILS MAP (FIGURE 4)

The Natural Resources Conservation Service (former U.S. Soil Conservation Service) has performed a soils identification study on a county by county basis. Aerial photography plates have been utilized in conjunction with field testing to identify soil types and locations in various counties. The results have been compiled and published in county-specific Soil Surveys. Also included in the surveys is information pertaining to the various soils identified within the county which includes, but is not limited to, texture, range of chroma colors, range of mottle colors, subgroup and drainage classification. Most counties in New York State have been completed and published, though a few are still in progress. The NRCS Web Soil Survey along with the Soil Survey of Erie County was referenced to determine the likelihood of encountering soils with hydric characteristic or which may contain hydric inclusions.

Wilson Environmental Technologies, Inc.
1879 Whitehaven Rd. Suite 3, Grand Island, NY 14072
Office 716.565.3000 Fax 716.775.9140

The site is located within the Urban Land soil map unit. This unit is defined as dominantly nearly level urbanized areas and areas of well drained to poorly drained soils and disturbed soils; on lowland plains. This map unit is composed of areas that are highly developed for commercial, industrial, or residential uses.

The following soil series are mapped within the limits of the delineation area:

SYMBOL	SERIES	SUBGROUP	DRAINAGE
La	Lakemont silt loam	Udollic Ochraqualfs	poorly
Od	Odessa silt loam	Aeric Ochraqualfs	somewhat poorly
Oe	Odessa/Lakemont complex	Aeric Ochraqualfs	somewhat poorly
SaA, SaB	Schoharie silt loam	Typic Hapludalfs	well to moderately well

The soil symbols associated with the detailed soils map indicates the soil series and the slope associated with that mapped unit. For example, Sa identified the soil series as Schoharie. The last capital letter of any symbol identifies the slope range for that soil unit. A represents a slope of 0 to 3 percent, B represents 3 to 8 percent slope, C represents 8 to 15 percent, D corresponds to a slope of 15 to 25 percent and E represents a slope of 25 to 35 percent. No third letter designation indicates no slope or nearly level.

The Lakemont series consists of deep, poorly to very poorly drained soils in nearly level areas or in depressional areas of the lowland lake plain in the northern part of the county. These soils formed in reddish lacustrine deposits dominated by clay and silt . Slope ranges from 0 to 3 percent but is dominantly 0 to 1 percent. Soil colorations in the B Horizon are a brown 7.5YR5/2 with many medium distinct light gray 10YR7/1 and strong brown 7.5YR5/6 mottling. The B2 Horizon of these soils has a hue ranging from 2.5Y to 7.5YR, value of 3 through 6, and chroma of 1 through 4. Texture in the B Horizon is a silt clay. The Ap Horizon is a very dark brown 10YR3/2 silt loam. Associated soils include Canandaigua, Getzville, Wayland, and Cheektowaga soils.

The Odessa series consists of deep, somewhat poorly drained soils on the lowland plain in the northern part of the county. This soil formed in red glacial lake sediment deposits high in clay and silt content. Slope ranges from 0 to 3 percent, but 0 to 2 percent is most common. The Ap Horizon is a very dark brown 10YR3/2 silt loam. Soil colorations in the B Horizon consist of a reddish brown 5YR5/3 with common fine distinct strong brown 7.5YR5/6 and common medium distinct gray 5YR5/1 mottles. The B2 Horizon has a hue of 5YR to 2.5YR, values of 3 to 6, and chroma of 2 to 4, except some subhorizons have a 7.5YR hue. Texture in the B2 horizon is silty clay loam to clay. Associated soils include Churchville, Niagara, Cosad Ovid and Rhinebeck soils.

Wilson Environmental Technologies, Inc.
1879 Whitehaven Rd. Suite 3, Grand Island, NY 14072
Office 716.565.3000 Fax 716.775.9140

The Odessa-Lakemont complex consists of the nearly level, somewhat poorly drained Odessa soils and poorly drained Lakemont soil in broad, flat areas that were the bottoms of glacial lakes. The complex is about 65 percent Odessa silt loam, 30 percent Lakemont silt loam and 5 percent other soils.

The Schoharie series consists of deep, well drained and moderately well drained soils on convex knolls and ridges and on dissected land forms in the northern part of the lowland lake plains. These soils formed in reddish glacial lake sediments having a high clay content. Slope ranges from 0 to 15 percent but 0 to 8 percent is most common. Soil colorations in the B Horizon are a reddish brown 5YR5/4 with few, medium faint light brown 7.5YR6/4 mottles. Texture in the B Horizon is a silty clay loam. The Ap Horizon is a very dark brown 10YR3/2 silt loam. The B2 Horizon has a hue of 2.5YR to 5YR, value of 3 to 6, and chroma of 2 to 4, with subhorizons having a 7.5YR hue. Associated soils include Churchville, Cayuga and Niagara soil.

2.5 AGENCY RESOURCE CONCLUSIONS

The mapping of poorly drained soils indicated the necessity to perform a field investigation at the site to ascertain the extent of any federally protected wetlands that may exist on the parcel. The wetlands delineation was performed in accordance with the 1987 *Corps of Engineers Wetland Delineation Manual* and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region*, dated January 2012. Procedures, results and conclusions of the wetland delineation field study are presented in the remainder of this report.

Wilson Environmental Technologies, Inc.
1879 Whitehaven Rd. Suite 3, Grand Island, NY 14072
Office 716.565.3000 Fax 716.775.9140

3.0 SITE DESCRIPTION

The subject site consists of 144± acres of land situated between Long Road and Bedell Road in the Town of Grand Island. To the west is Interstate I-190 and to the east lies vacant land. Existing single family homes from along a portion of Bedell Road in addition to commercial development with equipment storage yards boarder south. A small commercial business company forms a portion of the northeast property line. The subject parcel is vacant land.

The topography of the site is sloping south to north with the lowest elevations within the northeast portion of the site. Site elevations range from low of 571feet USGS in the north portion of the site to high of 590 feet USGS in the southwest portion of the site. (Figure 1).

3.1 SITE ECOLOGY

The ecology of the site consists of a successional shrubland, a small sapling-shrub area and a large disturbed area. An excavated area exists in the northern one third of the site. This disturbance is a result of fill material being borrowed for the construction of Interstate I-190. The borrow/disturbance area continues off site to the west. This area is now reverting to an old field shrubland mix.

A maintained man-made drainage ditch extends through the central portion of the site, flowing south to north. This drainage channel is tributary to the Niagara River, but has been channelized as part of a Town drainage improvement project decades earlier, between 1959-1964. The maintenance of the drainage way has resulted in the excavated sidecast material being mounded along the west side of the drainage and is rated as R4SBCx intermittent tributary. The drainage enters the parcel approximately 650 feet north of Bedell Road and exits the parcel along the I-190 Thruway in the northeast portion of the site.

The Riverine System (R) includes all wetlands and deepwater habitats contained within a channel. A channel is an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water. The Intermitten (4) Subsystem includes channels that contain flowing water only part of the year. When the water is not flowing, it may remain in isolated pools or surface water may be absent. The subclass streambed (SB) includes all wetlands contained within the Intermittent Subsystem of the Riverine System. The water regime seasonally flooded (C) meaning that surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated to the surface to a water table well below the ground surface. The (x) is used to identify channels that are excavated.

Wilson Environmental Technologies, Inc.
1879 Whitehaven Rd. Suite 3, Grand Island, NY 14072
Office 716.565.3000 Fax 716.775.9140

The upland successional shrubland makes up a majority of the site. Successional shrubland is best defined as a community that occurs on sites that have been cleared or otherwise disturbed. Typically this community will have at least 50% cover of shrubs. Shrubs commonly found in this vegetation community and on this parcel include gray stem dogwood (*Cornus racemosa*, FAC), English hawthorn (*Crataegus monoghna*, FACU), honeysuckle (*Lonicera tartarica*, FACU), glossy buckthorn *(Frangula alnus*, FAC) and common buckthorn (*Rhamnus cathartica*, FACU). Herbaceous species found in this community would include teasel (*Dipsacus sylvestris*, FACU), Canada goldenrod (*Solidago canadensis*, FACU), white avens (*Geum canadense*, FACU),common cinquefoil (*Potentilla simplex*, FACU), Virginia creeper (*Parthenocissus quinquefolia*, FACU), flat-stembluegrass (*Poa compressa*, FACU), flat top goldenrod *(Euthamia graminifolia*, FACU), speedwell (*Veronica arvensis,* UPL), field mustard (*Brassica rapa*, UPL), common strawberry (*Fragaria virginiana, FACU), king devil (Hieracium pratense, UPL),* sweet vernal grass *(Anthoxanthum odoratum*, FACU) and others.

A woodlot community is located west of tributary and continues west, off site. Trees and saplings in upland areas of the site are dominated by shagbark hickory (*Carya ovata*, FACU), English hawthorn (*Crataegus monogyna*, FACU), red maple (*Acer rubrum,* FAC), wild pear (*Pyrus communis*, UPL), red oak (*Quercus rubra;* FACU) and American basswood (*Tilia americana*, FACU in the tree stratum; with gray dogwood (*Cornus racemosa*, FAC), Allegheny blackberry (*Rubus allegheniensis*, FACU) and common red raspberry (*Rubus ideaus*, FACU) dominant in the shrub stratum. Dominant species found in the herbaceous stratum include white avens (*Geum canadense*, FACU), common strawberry (*Fragaria virginiana*, FACU), ground ivy (*Glechoma hederacea*, FACU), red fescue (*Festuca rubra*, FACU), and Canada goldenrod (*Solidago canadensis*, FACU).

Sixteen (16) wetlands were located on site. The wetlands were grouped into three habitat classifications in accordance with Federal criteria. Wetlands A, C, D. E, and L are palustrine emergent, narrow leaved persistent, seasonally saturated, (PEM1E) wetlands. Wetland A has a subclass of 5 designating a dominance of *Phargmites australis* – PEM5E. Wetlands B, F, G, H, J, and N are palustrine shrub-scrub, broad-leaved deciduous leaved seasonally saturated (PSS1E) community. Wetlands I, K, M, O, P are palustrine forested/shrub scrub, broad leaved deciduous, seasonally saturated (PFO/SS1E) wetlands.

The (PSS1E) wetlands include white meadow sweet (*Spiraea alba*, FACW) silky dogwood (*Cornus amomum*, FACW), pussy willow (*Salix discolor,* FACW) glossy buckthorn *(Frangula alnus*, FAC). Species identified in the sometimes dense herbaceous layer would include rough bedstraw (*Galium asprellum*, OBL), cottongrass bulrush (*Scirpus cyperinus*, FACW), broad leaf cattail (*Typha latifolia*, OBL), narrow leaf cattail (*Typha angustifolia*, OBL), lamp rush (*Juncus effusus*, FACW), purple loosestrife (*Lythrum salicaria*, OBL), Pennsylvanica smartweed (*Polygonum pennsylvanicum*, FACW), rough goldenrod (*Solidago rugosa*, FAC), sensitive fern (*Onoclea sensibilis*, FACW), common reed (*Phragmites australis*, FACW) and others.

Wetlands A, C, D. E, and L are palustrine emergent, narrow leaved persistent, seasonally saturated, (PEM1E) wetlands. Wetland A is associated with the borrow area of the site and is dominated by common reed grass (*Phragmites australis*, FACW), narrow leaf cattail (*Typha angustifolia*, OBL) and purple loosestrife (*Lythrum salicaria*, OBL). Wetlands C, D, E, and L are dominated with narrow leaf

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cattail (*Typha angustifolia*, OBL), lamp rush (*Juncus effusus*, FACW), cottongrass bulrush (Scirpus cyprinus, OBL), and purple loosestrife (*Lythrum salicaria*, OBL).

Wetlands B, F, G, H, J, and N are palustrine shrub-scrub, broad-leaved deciduous leaved seasonally saturated (PSS1E) community. Shrub species common to these wetlands would include white meadow sweet (*Spiraea alba*, FACW), silky dogwood (*Cornus amomum*, FACW), and pussy willow (Salix discolor, FACW). Green ash (*Fraxinus pennsylvanica*, FACW) dominate in the tree and sapling stratum. Dominant species identified in the herbaceous stratum include sensitive fern (*Onoclea sensibilis*, FACW), spotted touch-me-not (*Impatiens capensis,* FACW)

Wetlands I, K, M, O, P are defined by green ash (*Fraxinus pennsylvanica*, FACW), pin oak (*Quercus palustris*, FACW), and eastern cottonwood (*Populus deltoides*, FAC) in the tree stratum; with gray dogwood (*Cornus racemosa*, FAC) in the shrub stratum. Dominant species identified in the herbaceous stratum include shallow sedge (*Carex lurida*, OBL), melic manna grass (*Glyceria melicaria*, OBL), lamp rush (*Juncus effusus*, FACW), and cottongrass bulrush (*Scirpus cyperinus*, FACW).

A complete list of vegetation identified on both parcels is presented in *Table 1* of this report.

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4.0 METHODS

The Code of Federal Regulations defines a wetland as an area having hydric soils, wetland hydrology and supporting vegetation dominated by hydrophytes. All three of these criteria must be present for an area to qualify as a federal wetland. The routine determination methods for onsite investigations are described in Subsection 2, Section D of Chapter IV in the *Wetland Delineation Manual,1987*.

Prior to initiating sampling, a site walk-over was performed to identify the general site topography relative to drainage patterns, major plant communities, and potential areas of disturbance. Wetlands were marked in the field with survey flags and labeled as A1, A2, etc. (for those flags demarcating 'Wetland A') along the wetland/upland perimeter. The sample points, which support the location of the wetland/upland perimeter, were labeled with the first letter representing the wetland being sampled; the following number corresponds to the boundary flag in between the sample pair; the second letter signifies whether it is an upland (U) or wetland (W) sample; and the final number represents the order in which the samples were taken. Information on vegetation, soils, and hydrology was collected at each sample point and recorded on field data forms which are included as Appendix B of this report.

Vegetation units were sampled using standard quadrat analysis procedures. For sampling purposes vegetation is divided into separate strata; a stratum being defined as having 5 percent or more total plant cover. The tree stratum consists of woody plants 3 in. (7.6 cm) or more in diameter; a diameter less than 3 inches would designate a plant as part of the sapling/shrub stratum. The herbaceous stratum consists of all non-woody plants regardless of size and woody plants less than 3.28 feet tall. Woody vines consist of all woody vines greater than 3.28 feet in height. Trees and woody vines are observed within a 30 foot radius, saplings and shrubs are observed within a radius of 15 feet, and herbaceous vegetation is observed at a range of 5 feet. Vegetation data was recorded for all strata at each data point. Dominance was measured by visually estimating the percent areal coverage occupied by each species. Each species was ranked in order by decreasing value of percent areal cover.

The dominant species for each strata category are defined as those plants with the highest ranking which, when cumulatively totaled, immediately exceed 50 percent of the total dominance measuring for the category; plus any additional plant species comprising 20 percent or more of the total dominance measure for the category. The federal indicator status of each species was determined by referencing the *National List of Plant Species That Occur in Wetlands: Northeast (Region 1)* (Reed 1988). A data point was considered to have wetland vegetation if it met one of four indicators ((1)Rapid, (2)Dominance, (3)Prevalence index, (4)Morphological adaptations). These indicators are applied in numerical order until one is met; if one is not met the data point is designated as upland. Further information on the procedure for using hydrophytic vegetation indicators can be found in Chapter 2 of the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region*.

Soil samples and hydrology information were also collected at each data point. Soil samples were obtained through the use of a stainless steel drain spade. The soil pits were examined to depths of at least 16 inches. The soil samples were inspected for the presence of hydric soil indicators; introduced in the *2009, Interim Regional Supplement Manual.* The presence of one or more indicators would

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identify the soil as hydric, while the absence of any indicators would conclude that the soil is non-hydric. Hydrology information was visually assessed during the soils investigation and included, but was not limited to, observations of inundation, soil saturation, water marks on trees, drainage patterns, drift lines, water-stained leaves, and oxidized rhizospheres on living roots.

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5.0 RESULTS

Field work for the federal delineation was conducted during several weeks in July and August, 2019. A total of 53 field points were sampled and recorded which support the location of the wetland/upland boundary. Based on the results of the sampling, sixteen (16) wetlands were identified on the subject parcel.

Wetland A has a subclass of 5 designating a dominance of *Phargmites australis* – PEM5E*.* This wetland is located within the borrow area associated with the I-190 construction. Narrow leaf cattail (*Typha angustifolia*, OBL) and purple loosestrife (*Lythrum salicaria*, OBL) are also dominant .Hydrology in Wetland A appears to be derived from precipitation and runoff from surrounding uplands. Positive hydrology indicators identified in Wetland A include oxidized rhizospheres on living roots, and saturated soil conditions. The area of Wetland A totals 2.619± acres.

Wetlands C, D, E, and L are dominated with narrow leaf cattail (*Typha angustifolia*, OBL), soft rush (*Juncus effusus*, FACW), cottongrass bulrush (*Scirpus cyprinus*, OBL), and purple loosestrife (*Lythrum salicaria*, OBL). These wetlands are depressional, deriving the hydrology from precipitation and runoff from surrounding uplands. Positive hydrology indicators identified in these wetlands include water stained leaves, oxidized rhizospheres on living roots, and saturated soil conditions. The total area of Wetlands C, D, E, and L totals 3.205± acres with Wetland L being the largest at 2.755 acres.

Wetlands B, F, G, H, J, and N are palustrine shrub-scrub, broad-leaved deciduous leaved seasonally saturated (PSS1E) community. These were small depressional wetlands dominated by white meadow sweet (*Spiraea alba*, FACW) silky dogwood (*Cornus amomum*, FACW), pussy willow (*Salix discolor,* FACW) glossy buckthorn *(Frangula alnus*, FAC) shrub strata. Tree and sapling species such as swamp white oak(*Quercus bicolor* us, FACW), pin oak (*Quercus palustris*, FACW) and green ash (*Fraxinus pennsylvanica*, FACW). Due to the dense canopy a small variety of herbaceous species were described, these include fringed sedge (*Carex crinita*, OBL), lamp rush (*Juncus effusus*, FACW), sensitive fern (*Onoclea sensibilis*, FACW), melic manna grass (*Glyceria melicaria*, OBL) and others. These wetlands are depressional, deriving the hydrology from precipitation and runoff from surrounding uplands. Positive hydrology indicators identified in these wetlands include water stained leaves, oxidized rhizospheres on living roots, and saturated soil conditions. Total size these wetlands are 2.019± acres.

Wetlands I, K, M, O, and P are small vernal pool wetlands located in the western and central regions of the site. These wetlands are classified as deciduous forest wetlands that are seasonally flooded (PFO1E). Dominant trees include swamp white oak (*Quercus bicolor* us, FACW), pin oak (*Quercus palustris*, FACW), eastern cottonwood (*Populus deltoides*, FAC) and green ash (*Fraxinus pennsylvanica*, FACW). Dominant species identified in the herbaceous stratum include shallow sedge (*Carex lurida*, OBL), melic manna grass (*Glyceria melicaria*, OBL), lamp rush (*Juncus effusus*, FACW), and cottongrass bulrush (*Scirpus cyperinus*, FACW). These wetlands are depressional, deriving the hydrology from precipitation and runoff from surrounding uplands. Positive hydrology indicators identified in these wetlands include water stained leaves, watermarks on trunks, oxidized rhizospheres on living roots, and saturated soil conditions. Total sizes for wetland I, M, O, and P are 0.994± acres. Wetland K is 1.693± acres.

A maintained drainage ditch extends through the central portion of the site, flowing south to north. The intermittent tributary to the Niagara River is listed as R4SBCx, but has been channelized as part of a Town drainage improvement project decades earlier. The straight drainage way is incised into the landscape. The maintenance of the drainage way has resulted in the excavated sidecast material being mounded along the west side of the drainage.

Soils identified within the upland areas of the site corresponded to the somewhat poorly drained Odessa series or the moderately well drained Schoharie series. The Odessa series consists of deep, somewhat poorly drained soils on the lowland plain in the northern part of the county. This soil formed in red glacial lake sediment deposits high in clay and silt content. Slope ranges from 0 to 3 percent, but 0 to 2 percent is most common. The Ap Horizon is a very dark brown 10YR3/2 silt loam. Soil colorations in the B Horizon consist of a reddish brown 5YR5/3 with common fine distinct strong brown 7.5YR5/6 and common medium distinct gray 5YR5/1 mottles. The B2 Horizon has a hue of 5YR to 2.5YR, values of 3 to 6, and chroma of 2 to 4, except some subhorizons have a 7.5YR hue. Texture in the B2 horizon is silty clay loam to clay. Associated soils include Churchville, Niagara, Cosad Ovid and Rhinebeck soils.

Soils identified within the wetlands of the site correspond to the somewhat poorly drained Lakemont series. The Lakemont series consists of deep, poorly to very poorly drained soils in nearly level areas or in depressional areas of the lowland lake plain in the northern part of the county. These soils formed in reddish lacustrine deposits dominated by clay and silt . Slope ranges from 0 to 3 percent but is dominantly 0 to 1 percent. Soil colorations in the B Horizon are a brown 7.5YR5/2 with many medium distinct light gray 10YR7/1 and strong brown 7.5YR5/6 mottling. The B2 Horizon of these soils has a hue ranging from 2.5Y to 7.5YR, value of 3 through 6, and chroma of 1 through 4. Texture in the B Horizon is a silt clay. The Ap Horizon is a very dark brown 10YR3/2 silt loam. Associated soils include Canandaigua, Getzville, Wayland, and Cheektowaga soils.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Based on the results of the field investigation, sixteen (16) wetlands have been identified within the parcel. The wetland areas are best defined as:

WETLAND AREA	SIZE (ACRES)	FEDERAL DESIGNATION
Wetland Area A	0.2.619±	PEM5E
Wetland Area B	0.228±	PSS1E
Wetland Area C	0.123±	PEM1E
Wetland Area D	0.220±	PEM1E
Wetland Area E	0.107±	PEM1E
Wetland Area F	0.257±	PSS1E
Wetland Area G	0.736±	PSSIE
Wetland Area H	0.231±	PSS1E
Wetland Area I	0.073±	PFO/SS
Wetland Area J	0.415±	PSS1E
Wetland Area K	1.699±	PFO/SS1E
Wetland Area L	2.755±	PEM1E
Wetland Area M	0.209±	PFO/SS1E
Wetland Area N	0.152±	PSS1E
Wetland Area O	0.091±	PFO/SS1E
Wetland Area P	0.621±	PFO/SS1E
Man-Made Tributary	3433± LFT	R4SBCx

Wetland A is a man induced wetland depressional wetland created within a borrow area for the I-190 construction project, which was completed in 1964. The wetland is dominated by common reed grass (*Phragmites austrials*), a State and Federal listed invasive species. The wetland is isolated from any overland ditches which would convey flow to the tributary or the Niagara River.

Wetlands B, C, D, E, H, I, K, M, and O are isolated wetland, confined within relatively small to medium sized depression on the landscape scattered across the site. Wetlands F, G, H, & I are vernal pool wetlands that are isolated within

the subject site. No direct nexus was observed connecting Wetlands F, G, H, or I to other waters of the United States. These wetlands are isolated from any overland ditches which would convey flow to the tributary or the Niagara River.

The balance of the site wetlands (Wetlands F, J, N, and P) are associated with tributary drainage to the Niagara River.

Total wetland area within the site is 10.536± acres. Wetland M would likely be included as part of the existing state regulated wetlands TW-30 which extents onto the project site. New York State Department of Environmental Conservation Freshwater Wetland TW-30 continues off site to the west of the parcel limit. The NYSDEC requires a wetland be 12.4 acres in order to regulate under Article 24 of the Freshwater Wetlands Act.

6.2 RECOMMENDATIONS

As a result of our investigation it is our professional opinion that the on-site wetlands are considered federally jurisdictional based on meeting the required Federal criteria. It is the U.S. Army Corps of Engineers responsibility to make the jurisdictional determination based on a field or office review.

With the issuance of Federal Register, Volume 77, Number 34, the U.S. Army Corps of Engineers reissued it Nationwide Permit program (NWP). The reason for the amendment was to reduce the impacts to wetland as well as reduce the regulatory effort expended in governing the activities associated with minimal environmental impacts. These amendments went into effect on March 17, 2017 when the Corps of Engineers reissued the existing NWPs.

The NWP most often utilized by the public is the Nationwide permits (NWP 39) for the discharge of dredge or fill material into waters of the United States; this includes wetlands. This permit allows for the placement of fill material into waters of the United States as long as that discharge does not result in the loss (negative impact) of greater than 1/2 acres, nor cause the loss of waters of the United States for a distance of greater than 300 linear feet of stream bed. An application must be submitted to the USACE for approval prior to any disturbance of jurisdictional area.

In August 2015, the EPA promulgated a new definition of waters of the United States, known as the WOTUS rule. Litigation ensued in multiple courts around the country. Soon thereafter, the Court of Appeals for the Sixth Circuit enjoined the WOTUS rule nationwide, which prevented its implementation. Thus, the 1986 definition is still in effect. This definition effectively puts an end to "*isolated wetlands*," which are wetlands that do not contain a significant nexus to a Navigable Water of the Waters of the United States (significant nexus in our region would be tributaries to Lake Eire, Lake Ontario and the Niagara River).

Should you elect to submit this report to the U.S. Army Corps of Engineers (USACE) for review, a site visit may be scheduled to verify the reported findings. If the USACE agrees with the results of the delineation, a letter of agreement will then be forwarded to you that you can use to satisfy a portion of the federal wetland regulatory concerns of the Town of Grand Island. This release from the USACE jurisdiction does not relieve you from the necessity of complying with other federal, state, or local regulations that may be applicable at the site.

INFORMATIONAL REFERENCES

Andrus, R.E. 1980. Sphagnaceae (Peat Moss Family) of New York State. Contributions to a flora of New York State III, R.S. Mitchel (Ed.), Bull. 442, New York State Museum, Albany, N.Y. 89 pp.

Britton, N.L. and H.A. Brown. 1970. An Illustrated Flora of the Northern United States and Canada, Volumes 1, 2 and 3. Dover Publications, Inc., New York. 2062 pp.

Brown, Lauren. 1979. Grasses-An identification guide. Peterson Nature Library. Houghton Mifflin Co., Boston.240 pp.

Cobb, Boughton. 1963. A Field Guide to the Ferns and Their Related Families. Houghton Mifflin Co., Boston. 281 pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. Laroe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service, Washington, D.C. FWS/OBS-79-31. 103 pp.

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1, US Army Engineers Waterways Experiment Station, Vicksburg, Miss.

Federal Interagency Committee for Wetland Delineation. 1989. Federal Manual for Identifying and Delineating Jurisdictional Wetlands. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U. S. D. A. Soil Conservation Service, Washington, D.C. Cooperative technical publication. 76 pp. Plus appendices.

Hotchkiss, Neil. 1970. Common Marsh Plants of the United States and Canada. U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Washington, D.C., Resource Publication 93. 99 pp.

Little, E.L. 1980. The Audubon Society Field Guide to North American Trees (Eastern Region). Alfred A. Knopf, New York. 714 pp.

Munsell Color Chart. (Munsell Color 1994).

National Wetland Inventory maps. U.S. Department of the Interior, Fish and Wildlife Service, National Wetland Inventory, St. Petersburg, Florida.

New York State Code of Rules and Regulations (NYCRR). 1989. Protected Native Plants. NYCRR Part 193.3, June, 1989. New York State Department of Environmental Conservation.

New York Natural Heritage Program. 1989. New York Rare Plant Status List, February,1989. Steven E. Clements, (Ed.), New York State Department of Environmental Conservation and The Nature Conservancy publication. 26 pp.
Newcomb, L. 1977. Newcomb's Wildflower Guide. Little, Brown and Co., Boston. 490 pp.

Ogden, E.C. 1981. Field Guide to Northeastern Ferns. Contributions to a flora of New York State III, R.S. Mitchell (Ed.), Bull. 444, New York State Museum, Albany, NY 122 pp.

Peterson, Roger T. and Margaret McKenny. 1968. A Field Guide to Wildflowers of Northeastern and North-central North America. Houghton Mifflin Co., Boston. 420 pp.

Petrides, George A. 1968. A Field Guide to Trees and Shrubs. Houghton Mifflin Co., Boston MA 428 pp.

Prescott, G.W. 1969. How to Know the Aquatic Plants, Second Edition. William C. Brown Co., Dubuque, Iowa. 171 pp.

Reed, Porter B. Jr. 1988. National List of Plant Species That Occur in Wetlands: Northeast (Region 1). U.S. Fish and Wildlife Service, Washington, D.C. Biol. Rept. 88 (26.1). 112 pp.

Soil Conservation Service. 1988. New York Hydric Soils and Soils with Hydric Inclusions, revised July, 1988, Soil Conservation Service, Syracuse, New York, Technical Guide, Section II. 23 pp.

Soil Conservation Service. 1986. Soil Survey of Erie County, New York. U. S. D. A., Soil Conservation Service. 384 pp.

Simonds, R.L. and H.H. Tweedie. 1978. Wildflowers of the Great Lakes Region. Chicago Review Press, Chicago. 96 pp.

Symonds, G. W. D. 1968. The Tree Identification Book. Quill, New York. 272 pp.

Symonds, G. W. D. 1963. The Shrub Identification Book. William Morrow & Company, New York. 379 pp.

United States Geological Survey maps, Denver, Colorado

TABLES

TABLE 1
Vegetation Identified
During Wetland Deliniation

Scientifice Name	Common Name	Federal Status
Herbaceous		
Alisma subcordatum	American water plantain	OBL
Anthoxanthum odoratum	Large sweet vernal grass	FACU
Bidens frondosa	Devil's pitchfork	FACW
Carex crinita	Fringed sedge	OBL
Carex intumescens	Greater baldder sedge	OBL
Carex laxiflora	Broad looseflower sedge	UPL
Carex scoparia	Pointed broom sedge	FACW
Carex tribuloides	Blunt broom sedge	FACW
Carex vulpinoidea	Common fox sedge	OBL
Centaurea stoebe	Spotted knapweed	UPL
Cirsium altissimum	Tall thistle	UPL
Cirsium vulgare	Bull thistle	FACU
Dactylis glomerata	Orchard grass	FACU
Daucus carota	Queen anne's lace	UPL
Dipsacus fullonum	Fuller's teasel	FACU
Erigeron annuus	Eastern daisy fleabane	FACU
Eupatorium perfoliatum	Common boneset	FACW
Euthamia graminifolia	Flat top goldentop	FAC
Festuca rubra	Red fescue	FACU
Fragaria virginiana	Virginia strawberry	FACU
Geum canadense	White avens	FAC
Glechoma hederacea	Groundivy	FACU
Glyceria melicaria	Melic mannagrass	OBL
Impatiens capensis	Spotted touch me not	FACW
Juncus effusus	Lamp rush	OBL
Juncus tenuis	Lesser poverty rush	FAC
Lotus corniculatus	Garden bird's foot trefoil	FACU
Lythrum salicaria	Purple loosestrife	OBL
Onoclea sensibilis	Sensitive fern	OBL
Parthenocissus quinquefolia	Virginia creeper	FACU
Penstemon digitalis	Foxglove beardtongue	FAC
Persicaria virginiana	Jumpseed	FAC
Phleum pratense	Common timothy	FACU
Phragmites australis	Common reed	FACW
Poa compressa	Flat stem bluegrass	FACU
Potentilla simplex	Oldfield cinquefoil	FACU
Prunella vulgaris	Common selfheal	FAC
Pycnanthemum virginianum	Virginia mountain mint	FACW
Rumex crispus	Curly dock	FAC
Scirpus cyperinus	Cottongrass bulrush	OBL

Herbaceous (Cont.)

Solidago altissima	Tall goldenrod	FACU
Solidago canadensis	Canadian goldenrod	FACU
Solidago gigantea	Late goldenrod	FACW
Solidago rugosa	Wrinkle leaf goldenrod	FAC
Symphyotrichum lanceolatum	White panicled american aster	FACW
Toxicodendron radicans	Eastern poison ivy	FAC
Trifolium repens	White clover	FACU
Typha angustifolia	Narrowleaf cattail	OBL
Verbena hastata	Simpler's joy	FACW

Shrub

Cornus amomum	Silky dogwood	FACW
Cornus racemosa	Gray dogwood	FAC
Frangula alnus	Glossy false buckthorn	FAC
Lonicera tatarica	Twinsisters	FACU
Rhamnus cathartica	European buckthorn	FAC
Rosa multiflora	Rambler rose	FACU
Rubus allegheniensis	Allegheny blackberry	FACU
Rubus flagellaris	Whiplash dewberry	FACU
Salix discolor	Pussy willow	FACW
Spiraea alba	White meadowsweet	FACW
Viburnum recognitum	Southern arrow wood	FAC

Tree

Acer rubrum	Red maple	FAC
Acer saccharum	Sugar maple	FACU
Crataegus monogyna	English hawthorn	FACU
Fraxinus pennsylvanica	Green ash	FACW
Malus coronaria	Sweet crabapple	UPL
Populus deltoides	Eastern cottonwood	FAC
Pyrus communis	Common pear	UPL
Quercus palustris	Pin oak	FACW
Salix nigra	Black willow	OBL
Ulmus americana	American elm	FACW

Vine

Vitis aestivalis	Summer grape	FACU

APPENDIX A

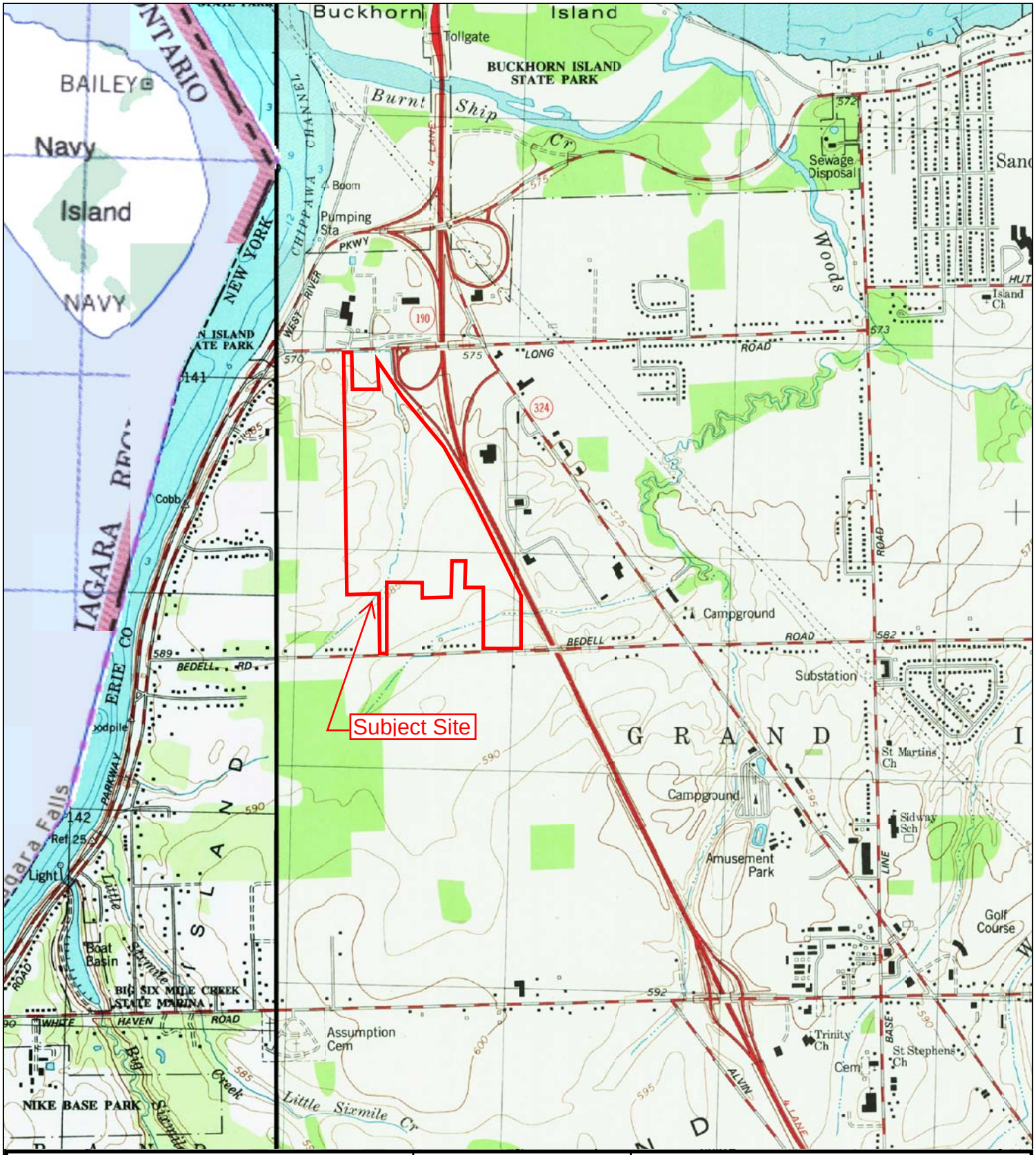


Figure 1: USGS Quadrangle Map

Tonawanda West Quadrangle

Scale 1:24,000

N
W E
S

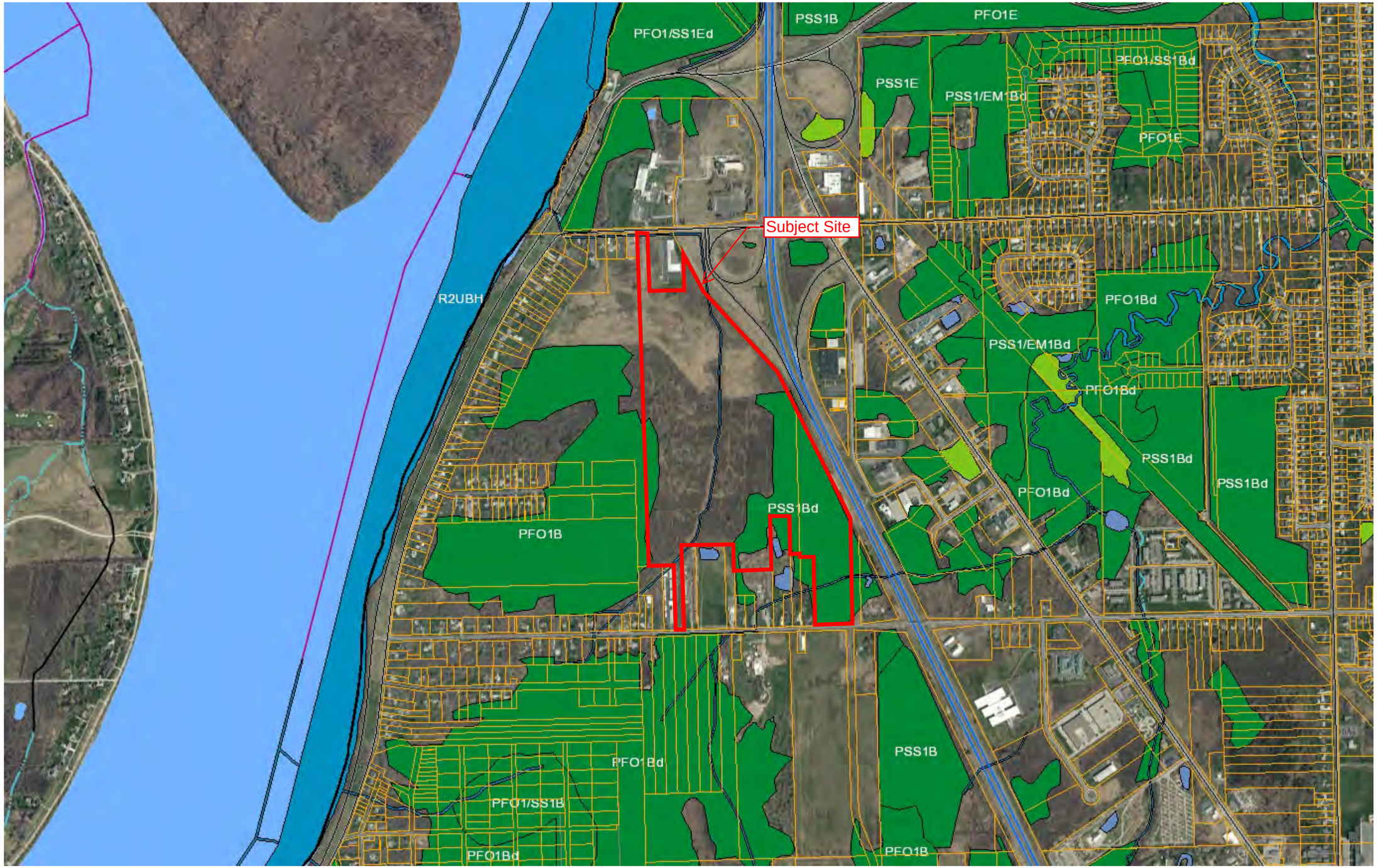
Prepared for:

Aquest Development LLC

Town of Grand Island

Erie County, New York

Figure 2: National Wetlands Inventory Map



Legend

- Parcels
- Streets and Highways
  - Interstate
  - Primary State Road
  - Secondary State Road
  - County Road
  - Local Road
- National Wetland Inventory
  - Estuarine and Marine Deepwater
  - Estuarine and Marine Wetland
  - Freshwater Emergent Wetland
  - Freshwater Forested/Shrub Wetlan
  - Freshwater Pond
  - Lake
  - Other
  - Riverine
- Flowline - Large Scale
  - Perennial
  - Intermittent
  - Ephemeral
  - Artificial Path
  - Canal Ditch
  - Coastline
  - Connector
  - Pipeline
  - Underground Conduit

N
W E
S

1: 18,056

0.6 0 0.28 0.6 Miles

WGS_1984_Web_Mercator_Auxiliary_Sphere
THIS MAP IS NOT TO BE USED FOR NAVIGATION

ERIE COUNTY
DEPARTMENT OF ENVIRONMENT & PLANNING
OFFICE OF GIS

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

Environmental Resource Mapper

Figure 3: NYSDEC Freshwater Wetlands Map

On-site Wetland: FWW TW-30

Class: 2

1:36,112

0 0.45 0.9 1.8 mi

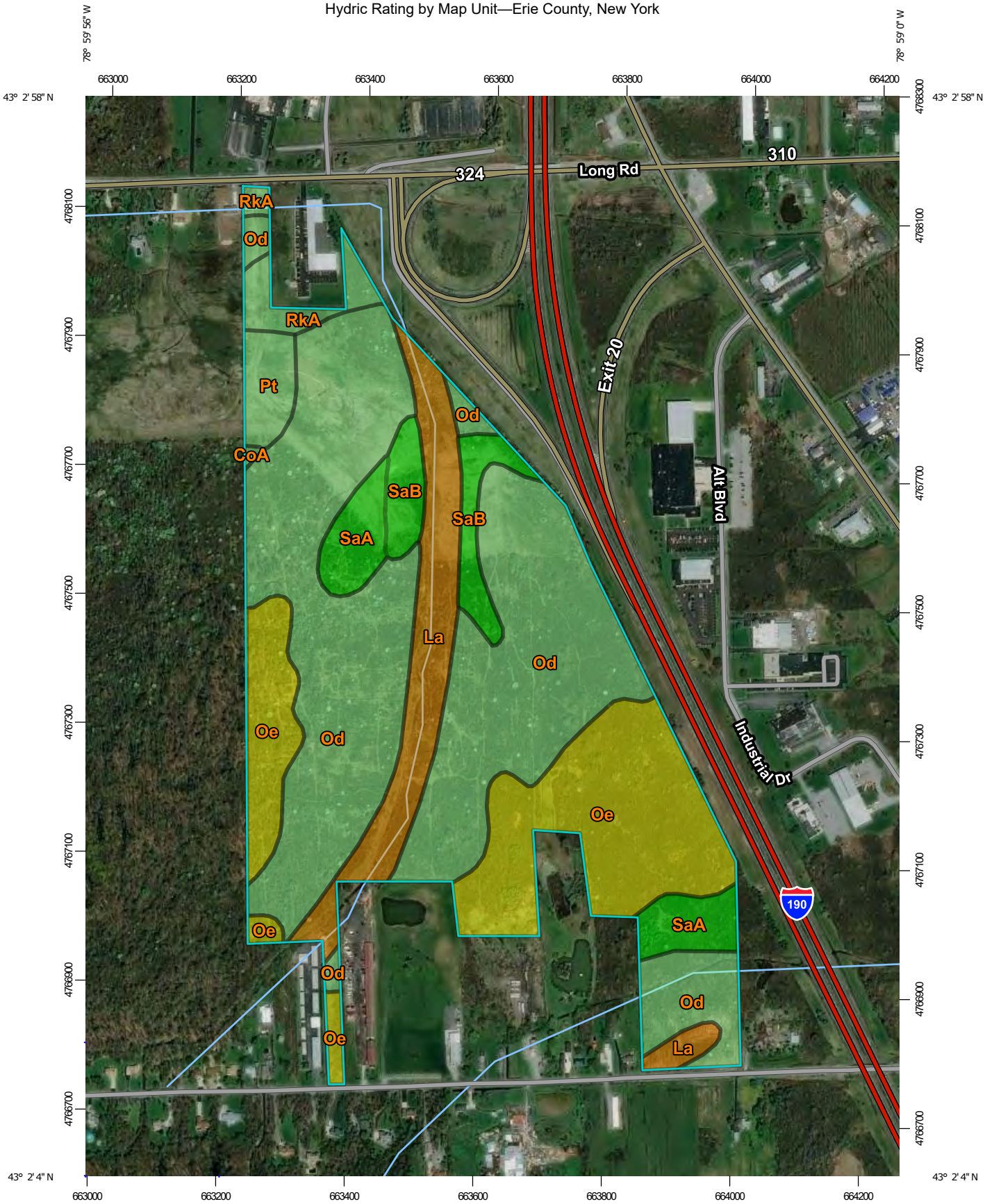
0 0.5 1 2 km

N W E S

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

NYS Department of Environmental Conservation
Not a legal document

Hydric Rating by Map Unit—Erie County, New York



Map Scale: 1:8,160 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

Description

This rating indicates the percentage of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is rated based on its respective components and the percentage of each component within the map unit.

The thematic map is color coded based on the composition of hydric components. The five color classes are separated as 100 percent hydric components, 66 to 99 percent hydric components, 33 to 65 percent hydric components, 1 to 32 percent hydric components, and less than one percent hydric components.

In Web Soil Survey, the Summary by Map Unit table that is displayed below the map pane contains a column named 'Rating'. In this column the percentage of each map unit that is classified as hydric is displayed.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hydric Rating by Map Unit

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CoA	Churchville silt loam, 0 to 3 percent slopes	5	0.1	0.1%
La	Lakemont silt loam, 0 to 3 percent slopes	95	14.9	10.7%
Od	Odessa silt loam, 0 to 3 percent slopes	5	74.3	53.1%
Oe	Odessa-Lakemont complex, 0 to 3 percent slopes	37	30.8	22.0%
Pt	Pits, borrow	5	3.3	2.3%
RkA	Rhinebeck gravelly loam, 0 to 3 percent slopes	5	3.4	2.4%
SaA	Schoharie silt loam, 0 to 3 percent slopes	0	6.9	5.0%
SaB	Schoharie silt loam, 3 to 8 percent slopes	0	6.2	4.4%
Totals for Area of Interest			**139.9**	**100.0%**

APPENDIX B

APPENDIX C

Site Photos

East, into Wetland A from sample point A21U1.

West, into upland meadow from sample point A21U1.

South, into upland meadow from sample point A15U3..

West, showing upland meadow between Wetlands A & B.

East, into Wetland B from sample point B1W6.

Northeast, into upland shrubland from sample point B9U7.

South, into upland meadow from sample point C8U9.

East, into Wetland C from sample point C8W10.

East, into upland shrubland from sample point UPL13.

Upland soil sample from point UPL13.

West, into Wetland D from sample point D3W12.

South, into Wetland F from sample point F2W16.

Upland soil sample from point UPL17.

South into upland shrubland from sample point UPL17.

East, into Wetland I from sample point 1W18.

East, into Wetland H from sample point H9W20.

Upland soil sample from point G16U23.

West, into upland shrubland from sample point G18U23.

South, into Wetland L from sample point L24W24.

North, into upland shrubland from sample point L24U25.

Upland soil sample from point UPL26.

North, into upland shrubland from sample point UPL26.

South, into Wetland K from sample point K68W28.

North, into upland shrubland from sample point K68U27.

North, into Wetland N from sample point N2W34.

Northwest, into Wetland J from sample point J26W36.

East, into upland shrubland from sample point J26U35.

South into upland shrubland from sample point UPL37.

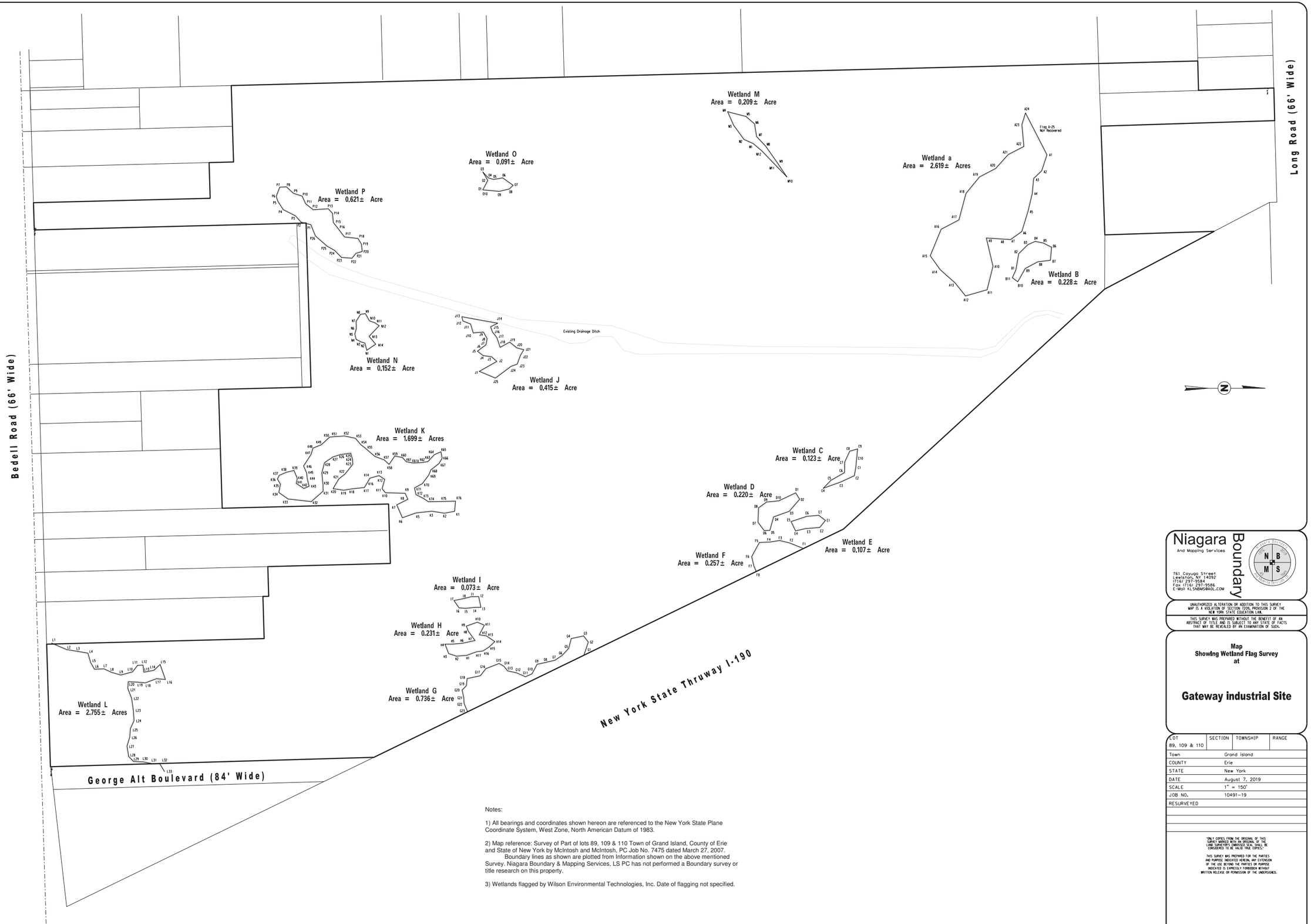
North, into upland shrublands from sample point P19U44.

East, into upland shrubland from sample point O9U46.

South, into Wetland M from sample point M6W47.

North, into upland shrubland from sample point M6U48

APPENDIX D



Notes:

1) All bearings and coordinates shown hereon are referenced to the New York State Plane Coordinate System, West Zone, North American Datum of 1983.

2) Map reference: Survey of Part of lots 89, 109 & 110 Town of Grand Island, County of Erie and State of New York by McIntosh and McIntosh, PC Job No. 7475 dated March 27, 2007.
Boundary lines as shown are plotted from Information shown on the above mentioned Survey. Niagara Boundary & Mapping Services, LS PC has not performed a Boundary survey or title research on this property.

3) Wetlands flagged by Wilson Environmental Technologies, Inc. Date of flagging not specified.

Niagara Boundary
And Mapping Services
761 Cayuga Street
Lewiston, NY 14092
(716) 297-9584
Fax (716) 297-9586
E-Mail KLSNBMS@AOL.COM

UNAUTHORIZED ALTERATION OR ADDITION TO THIS SURVEY MAP IS A VIOLATION OF SECTION 7209, PROVISION 2 OF THE NEW YORK STATE EDUCATION LAW.

THIS SURVEY WAS PREPARED WITHOUT THE BENEFIT OF AN ABSTRACT OF TITLE AND IS SUBJECT TO ANY STATE OF FACTS THAT MAY BE REVEALED BY AN EXAMINATION OF SUCH.

Map
Showing Wetland Flag Survey
at

Gateway industrial Site

LOT	SECTION	TOWNSHIP	RANGE
89, 109 & 110			

Town	Grand Island
COUNTY	Erie
STATE	New York
DATE	August 7, 2019
SCALE	1" = 150'
JOB NO.	10491-19
RESURVEYED	

"ONLY COPIES FROM THE ORIGINAL OF THIS SURVEY MARKED WITH AN ORIGINAL OF THE LAND SURVEYOR'S EMBOSSED SEAL SHALL BE CONSIDERED TO BE VALID TRUE COPIES."

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Kenneth L. Slaugenhoupt Lic. No. 50349

FILE: Z:\Forms (Nbsvr01) (2)\ACTIVE_PROJECT\10491\10491.dgn

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EXHIBIT D

EXHIBIT I
Threatened and Endangered Species Assessment
Proposed Warehouse Distribution Facility Project
2780 Long Road
Town of Grand Island, Erie County, New York

Existing Conditions

Based on a response from the New York State Department of Environmental Conservation (NYSDEC) Natural Heritage Program (NHP), see attached, there are no documented occurrences of rare or state-listed animals, plants or significant natural communities on the project site. The NHP response indicates the presence of blacknose shiner (*Notropis heterolepis*) – rare; not state-listed - within the vicinity of the site (Niagara River). A historical record of the short-eared owl (*Asio flammeus*), which is a state endangered species, was also noted and observed in 1979 in the vicinity of the site. Lastly, the NHP response identifies the silver maple-ash swamp located in Buckhorn Island State Park, approximately 0.35 miles north of the Site as a significant natural community.

An Official Species List was generated for the site in November 2019 using the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool, a copy of which is annexed hereto. The Official Species List identifies northern long-eared bat as a species that should be considered in an effects analysis for the project.

Threatened and Endangered Species Evaluation

Blacknose Shiner
According to the NHP, blacknose shiners have been documented within the nearby Niagara River. Blacknose shiners are typically found in creeks, small rivers, and ponds with submerged aquatic vegetation typically with sandy bottoms. While the Feeder Creek onsite drains to the Niagara River, it is separated by a series of roadside ditches that do not provide consistent water levels or habitat that would provide an opportunity for fisheries to utilize the onsite watercourses/drainage ditches. Furthermore, the onsite features do not consistently contain standing water and stream flow required to support and sustain fish populations. As a result, it is unlikely the blacknose shiner is present onsite and therefore the Project is not expected to impact this species.

Short-eared Owl
According to the NHP, the short-eared owl was documented in the vicinity of the Site as late as 1979 and there is uncertainty regarding its continued presence. The short-eared owl prefers expansive, open areas such as grasslands and marshes. The U.S. Fish and Wildlife Service Short-Eared Owl Habitat Model[1] states that the greatest potential for breeding and wintering for this species occurs in open land 50 hectares (ha) (~125 acres) or larger; however, patches as small as 8 ha may be used in winter. The Short-eared owl is typically sensitive to disturbance and developed areas.

Based on our review of historic aerials, the Site historically afforded large areas of open space that may have been considered suitable habitat at that time. However, the Site is currently

1. USFWS; Gulf of Maine Program. 2001. Short-eared Owl Habitat in the Gulf of Maine. https://www.fws.gov/r5gomp/gom/habitatstudy/metadata/short-eared_owl_model.htm

dominated by scrub-shrub, successional stage and mature wooded areas that are not conducive to short-eared owl habitat. Only the northern portion of the Site has limited grassy, open areas, and this portion of the Site has been subject to land disturbance for construction of an 8-inch diameter sanitary sewer force main, several manholes associated with the line, and a concrete vault associated with the sanitary sewer. .

Open areas comprise approximately 9 hectares (~22 acres) of the Site. Some portions of the open area in the northern portion of the Site are either disturbed or devoid of vegetation; whereas other areas are grassland type habitats. Based on the limited size of open vegetated areas coupled with its proximity to adjacent commercial and residential development and roadways such as the West River Parkway, West River Road, Long Road, Bedell Road and Interstate 190, the Site does not provide suitable habitat for Short-eared owl; therefore, the Project is not expected to impact this species.

It should be noted that during a pre-application meeting with NYSDEC/USACE on 2/13/2020, NYSDEC supported the absence of suitable onsite habitat for short-eared owl consistent with the basis presented above.

Silver Maple – Ash Swamp
According to the NHP, the silver maple-ash swamp is documented within 0.35 miles north of the Site, in Buckhorn Island State Park, and is designated by NYSDEC as a significant natural community. This silver maple-ash swamp community is a moderately large, mature hardwood swamp in a protected, 450 acre natural area. Based on the distance between the Site and this community, the Project is not expected to directly or indirectly impact the silver maple-ash swamp.

Northern Long-eared Bat (NLEB)
While the NLEB is considered a threatened species by the USFWS, there is no critical habitat present on the Site. According to the NHP determination, there are no known occurrences of the NLEB on or within close proximity to the Site. As such, the Project is not expected to remove any known, occupied maternity roost trees, any trees within 150 feet of a known occupied maternity roost tree or any trees within 0.25 miles of a NLEB hibernaculum that would result in a prohibited taking pursuant to the federal 4(d) rule under the Endangered Species Act.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Fish and Wildlife, New York Natural Heritage Program
625 Broadway, Fifth Floor, Albany, NY 12233-4757
P: (518) 402-8935 | F: (518) 402-8925
www.dec.ny.gov

December 1, 2019

Sarah Parks
Langan Engineering and Environmental Services
300 Kimball Drive, 4th floor
Parsippany, NJ 07054-217

Re: Project Olive
County: Erie Town/City: Grand Island

Dear Ms. Parks:

In response to your recent request, we have reviewed the New York Natural Heritage Program database with respect to the above project.

Enclosed is a report of rare or state-listed animals and plants, and significant natural communities that our database indicates occur in the vicinity of the project site.

For most sites, comprehensive field surveys have not been conducted; the enclosed report only includes records from our database. We cannot provide a definitive statement as to the presence or absence of all rare or state-listed species or significant natural communities. Depending on the nature of the project and the conditions at the project site, further information from on-site surveys or other sources may be required to fully assess impacts on biological resources.

Our database is continually growing as records are added and updated. If this proposed project is still under development one year from now, we recommend that you contact us again so that we may update this response with the most current information.

The presence of the plants and animals identified in the enclosed report may result in this project requiring additional review or permit conditions. For further guidance, and for information regarding other permits that may be required under state law for regulated areas or activities (e.g., regulated wetlands), please contact the NYS DEC Region 9 Office, Division of Environmental Permits at dep.r9@dec.ny.gov, (716) 851-7165.

Sincerely,

Heidi Krahling
Environmental Review Specialist
New York Natural Heritage Program

1305

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

The following rare animal and significant natural community have been documented in the vicinity of the project site.

We recommend that potential impacts of the proposed project on these species or communities be addressed as part of any environmental assessment or review conducted as part of the planning, permitting and approval process, such as reviews conducted under SEQR. Field surveys of the project site may be necessary to determine the status of a species at the site, particularly for sites that are currently undeveloped and may still contain suitable habitat. Final requirements of the project to avoid, minimize, or mitigate potential impacts are determined by the lead permitting agency or the government body approving the project.

The following animal, while not listed by New York State as Endangered or Threatened, is rare in New York and is of conservation concern.

COMMON NAME	*SCIENTIFIC NAME*	*NY STATE LISTING*	*HERITAGE CONSERVATION STATUS*
Fish			
Blacknose Shiner	*Notropis heterolepis*	Unlisted	Imperiled in NYS

Documented in a nearby stretch of the Niagara River and so could occur in the vicinity of the project site. 2016-07-26. 14848

The following natural community is considered significant from a statewide perspective by the NY Natural Heritage Program. By meeting specific, documented criteria, the NY Natural Heritage Program considers this community occurrence to have high ecological and conservation value.

COMMON NAME	*SCIENTIFIC NAME*	*NY STATE LISTING*	*HERITAGE CONSERVATION STATUS*
Wetland/Aquatic Communities			
Silver Maple-Ash Swamp			High Quality Occurrence of Uncommon Community Type

Documented within 0.35 mile north of the project site at Buckhorn Island State Park: This is a moderately large, mature hardwood swamp in a protected, 450 acre natural area. The surrounding landscape is predominantly residential. Restoration efforts are underway to reduce Rhamnus and other invasives and prevent further spread. Many ash dying or dead from emerald ash borer. 7295

This report only includes records from the NY Natural Heritage database. For most sites, comprehensive field surveys have not been conducted, and we cannot provide a definitive statement as to the presence or absence of all rare or state-listed species. Depending on the nature of the project and the conditions at the project site, further information from on-site surveys or other sources may be required to fully assess impacts on biological resources.

If any rare plants or animals are documented during site visits, we request that information on the observations be provided to the New York Natural Heritage Program so that we may update our database.

Information about many of the rare animals and plants in New York, including habitat, biology, identification, conservation, and management, are available online in Natural Heritage's Conservation Guides at www.guides.nynhp.org, from NatureServe Explorer at www.natureserve.org/explorer, and from USDA's Plants Database at http://plants.usda.gov/index.html (for plants).

Information about many of the natural community types in New York, including identification, dominant and characteristic vegetation, distribution, conservation, and management, is available online in Natural Heritage's Conservation Guides at www.guides.nynhp.org. For descriptions of all community types, go to www.dec.ny.gov/animals/97703.html for Ecological Communities of New York State.

The following rare animal has a historical record in the vicinity of the project site.

The following rare animal was documented in the vicinity of the project site at one time, but has not been documented there since 1979 or earlier, and/or there is uncertainty regarding its continued presence. There is no recent information on this animal in the vicinity of the project site and its current status there is unknown. In most cases the precise location of the animal in this vicinity at the time it was last documented is also unknown.

If suitable habitat for this animal is present in the vicinity of the project site, it is possible that it may still occur there. We recommend that any field surveys to the site include a search for this species, particularly at sites that are currently undeveloped and may still contain suitable habitat.

COMMON NAME	*SCIENTIFIC NAME*	*NYS LISTING*	*HERITAGE CONSERVATION STATUS*
Birds			
Short-eared Owl	*Asio flammeus*	Endangered	Imperiled in NYS
Nonbreeding			
1979-winter: Bedell Road Grand Island. The birds were observed in fields.			11088

This report only includes records from the NY Natural Heritage database. For most sites, comprehensive field surveys have not been conducted, and we cannot provide a definitive statement as to the presence or absence of all rare or state-listed species. Depending on the nature of the project and the conditions at the project site, further information from on-site surveys or other sources may be required to fully assess impacts on biological resources.

If any rare plants or animals are documented during site visits, we request that information on the observations be provided to the New York Natural Heritage Program so that we may update our database.

Information about many of the rare animals and plants in New York, including habitat, biology, identification, conservation, and management, are available online in Natural Heritage's Conservation Guides at www.guides.nynhp.org, from NatureServe Explorer at www.natureserve.org/explorer, and from USDA's Plants Database at http://plants.usda.gov/index.html (for plants).

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New York Ecological Services Field Office
3817 Luker Road
Cortland, NY 13045-9385
Phone: (607) 753-9334 Fax: (607) 753-9699
http://www.fws.gov/northeast/nyfo/es/section7.htm

In Reply Refer To: November 05, 2019
Consultation Code: 05E1NY00-2020-SLI-0423
Event Code: 05E1NY00-2020-E-01402
Project Name: Project Olive - updated project boundary 11/5/2019

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). This list can also be used to determine whether listed species may be present for projects without federal agency involvement. New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list.

Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the ESA, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC site at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list. If listed, proposed, or candidate species were identified as potentially occurring in the project area, coordination with our office is encouraged. Information on the steps involved with assessing potential impacts from projects can be found at: http://www.fws.gov/northeast/nyfo/es/section7.htm

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/

eagle_guidance.html). Additionally, wind energy projects should follow the Services wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the ESA. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New York Ecological Services Field Office
3817 Luker Road
Cortland, NY 13045-9385
(607) 753-9334

Project Summary

Consultation Code: 05E1NY00-2020-SLI-0423

Event Code: 05E1NY00-2020-E-01402

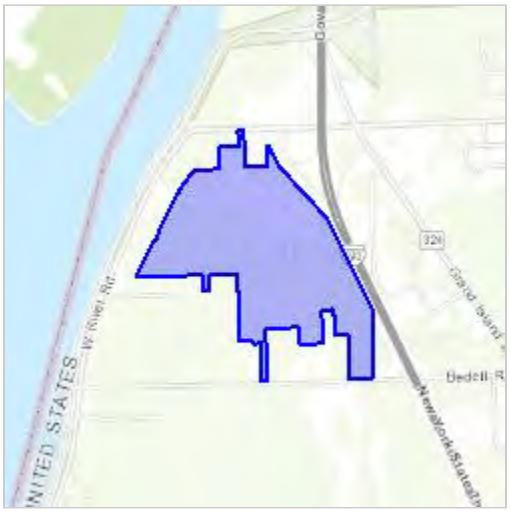
Project Name: Project Olive - updated project boundary 11/5/2019

Project Type: ** OTHER **

Project Description: due diligence services

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/43.04212542622871N78.99568821439728W



Counties: Erie, NY

Endangered Species Act Species

There is a total of 1 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

EXHIBIT E

EXHIBIT E
Visual Impact Assessment
Proposed Warehouse Distribution Facility Project
2780 Long Road
Town of Grand Island, Erie County, New York

To evaluate any potential aesthetic impacts resulting from the Project, the Applicant conducted a detailed Visual Assessment of the Site from various viewpoints in the surrounding area. These viewpoints include various locations in the Town of Grand Island, and views from aesthetic resources such as State and local parks and scenic byways. To complete this Visual Assessment, a balloon test was conducted using two sets of balloons as follows:

1. Red balloons set at the four corners of the building, raised to the proposed building height.
2. Additionally, one set of yellow balloons were raised approximately 200 feet in the middle of the facility to enable identification of the site from the study viewpoints.

The photographs were from various viewpoints in the Town comprising residential, commercial and park areas. Photographs were also taken from State park and parkway areas located across the Niagara River to the north.

There are 10 sets of photographs included in this Exhibit, with the "before" photograph showing the existing view toward the Site from a specific location and the "after' photograph demonstrating the anticipated view from that location toward the Site when the Facility is constructed. Where there is a view of the Facility, the "after" photograph includes the portion of the building within the viewshed.

As part of a review under the State Environmental Quality Review Act, agencies are required to evaluate "aesthetic impacts" to the environment, meaning the consequence of a visual impact on the public's use and enjoyment of the appearance or qualities of a listed resource. It is not the size of the structure alone that determines adverse impact. The setting of a proposed building or structure and its impact on a designated resource is what needs to be determined.

The 10 sets of photographs are from various viewpoint within a five mile radius of the Site, with a view toward the Site, are as follows:

1. View 1: Niagara State Parkway Overlook, 53rd Street Fisherman's Park. The Site is approximately 2.4 miles south-southeast of the Niagara State Parkway overlook along the Niagara River. The existing view consists of the Niagara River, electric transmission towers crossing the river, and Buckhorn Island State Park. The view of the Facility is obscured by the wooded areas in Buckhorn Island State Park and the distance of 2.4 miles from the Site. Accordingly, no significant adverse visual impact to aesthetic resources is anticipated from View 1.

2. View 2: I-190 Southbound North of Exit 20A, Buckhorn Island Toll Booth. The Site is approximately 0.75 miles south of this viewpoint. The before photograph shows I-190 and the overpass for Long Road (NYS Route 324). Also in this viewshed is a building and an electric transmission tower. The

overpass is obscuring some of the Site, although there is no tree line between this viewpoint and the Site.

The after photograph shows the top portion of the Facility above the Long Road overpass. This view is from I-190 where traffic is traveling at a 65 mile per hour (MPH) limit as the roadway passes the Site. There is no specific aesthetic resource that is being obscured from this viewpoint as indicated in the View 2 before and after photographs. As such, no significant adverse visual impact to aesthetic resources is anticipated from View 2.

3. View 3: Bedell Road West of Proposed Access Roadway. The Site is approximately 2,000 feet north of this viewpoint. The existing north facing view is between two industrial uses which face north on an east-west roadway. During the balloon test, the red balloons could be seen from this viewpoint. The after photograph shows that the Facility can be seen from Bedell Road between two light industrial buildings. There is no specific aesthetic resource that is being obscured from this viewpoint as indicated in the before photograph. As such, no significant adverse visual impact to aesthetic resources is anticipated from View 3.

4. View 4: Bedell Road East of Proposed Access Roadway. The Site is approximately 2,000 feet north of this viewpoint. The existing view shows some wooded area and existing vegetation. The after photograph demonstrates the Facility would not be seen from this viewpoint. Given the distance between this viewpoint and the vegetation present, even with trees leaf off, in View 4, the proposed Facility would be obscured from this viewpoint. No significant adverse visual impact to aesthetic resources is anticipated from View 4.

5. View 5: Grand Island Boulevard near Grand Island Manor Apartments at CrossRiver Tabernacle Church. View 5 is located on Grand Island Boulevard (NYS Route 324). The Site is approximately 2,000 feet west of this viewpoint. The Grand Island Manor Apartments is located in the photograph. I-190 is located between this viewpoint and the Site. There is no substantial tree line between this viewpoint and the Site. During the balloon test, the red balloon could be seen from this viewpoint.

   The after photograph shows the view of the Facility frontage along I-190. During leaf-on conditions, the existing trees will obscure a portion of the Facility. There is no specific aesthetic resource that is being obscured from this viewpoint, as the primary view is toward I-190 and the Site which is intended for light industrial use in the Town Zoning Code. Accordingly, no significant adverse visual impact to aesthetic resources is anticipated from View 5.

6. View 6: Long Road Proposed Main Entrance. The existing conditions viewpoint is at the south side of Long Road near the proposed driveway entrance to the Site. On the left side of the photograph is the parking area for the neighboring light industrial use. During the balloon test, the red balloons could be seen from this viewpoint. The after photograph shows the proposed access road and the evergreen screening that would line the roadway and screen the neighboring parking

lot and most of the view of the proposed Facility from the road. No significant adverse visual impact is anticipated from View 6.

7. View 7: Niagara Falls State Park, Parking Lot 3. The Site is approximately four miles southeast of Niagara Falls State Park. When facing southeast across the Niagara River, the view is consists of the Niagara River and Navy Island. During the balloon test, neither balloon could be seen from this viewpoint. In the after photograph, the Facility does not appear on the horizon and is behind the wooded area across the Niagara River. No significant adverse visual impact to aesthetic resources is anticipated from View 7.

8. View 8: West River Parkway. The Site is approximately 2,000 feet west of this viewpoint. Between this east facing viewpoint and the houses on the east side of West River Parkway is the approximately 62 acres of the West Parcel where no development is proposed and the existing screening from wooded areas will remain, fully obscuring this viewpoint. During the balloon test, no balloons could be seen from this viewpoint. As such, no significant adverse visual impact to aesthetic resources is anticipated from View 8.

9. View 9: Burger King, Route 324, Grand Island. The Site is approximately three miles northwest of this viewpoint. While the terrain between this northwest facing viewpoint and the Project site is relatively flat, there is surrounding commercial development and wooded areas between this viewpoint and the Site. During the balloon test, no balloons could be seen from this viewpoint. The after photograph demonstrates that the Facility will be fully obscured by the neighboring commercial development and other factors such as distance and wooded areas. Accordingly, no significant adverse visual impact to aesthetic resources is anticipated from View 9.

10. View 10: Beaver Island State Park, Golf Course Roundabout. The Site is approximately five miles north-northwest of this viewpoint, which is from the east side of South Parkway. Existing conditions show each side of the road with wooded areas. During the balloon test, no balloons could be seen from this viewpoint. The after photograph demonstrates that the Facility is not visible from this location, as it is fully screened by the wooded areas and the substantial distance from the Site. As such, no significant adverse visual impact to aesthetic resources is anticipated from View 10.

In addition to the Visual Assessment detailed above, Exhibit D provides architectural plans with the elevations and the proposed façade of the Facility to demonstrate what the Facility will look like. In addition, no development is proposed on the West Parcel, which, contains approximately 62 acres of land which will remain wooded to provide screening of the Facility. In addition to screening from wooded areas, the Project proposes a substantial landscape plan for the Site along the interior roadway, parking areas, stormwater ponds, detention basin and access driveway roads. There are approximately 816 new evergreen trees proposed at the Site, in addition to approximately 415 shade trees, 230 ornamental trees,

and perennials, ornamental grasses, evergreen shrubs, deciduous shrubs and conifers, to further enhance the Site design. The landscape plan complies with the applicable landscape ordinance requirements of the Town Zoning Code.

As demonstrated in the Visual Assessment, despite the scale of the Facility, the Facility is generally not visible from surrounding areas and most of the visual impact will be along the NYS Thruway where visual sensitivity is lowest. While the Facility has a proposed footprint of approximately 822,522 SF and a proposed height of 98.23 feet, due to the Facility location on the Site, the size of the overall Site where the Facility will be developed, setbacks from surrounding lot lines, the distance from surrounding development, and screening provided by existing wooded area, such that there are no significant adverse impacts to the surrounding community. In addition, the proposed extensive landscaping provides aesthetic benefits to surrounding areas.

For the reasons noted above, any potential adverse aesthetic impacts from the Project have been sufficiently mitigated, and the Project will not have significant adverse impact on views from various viewpoints in Grand Island and the surrounding area, including residential areas and State and local aesthetic resources such as parks, parkways, and scenic byways.

VIEW 1 - BEFORE

VIEW 1 - AFTER
APPROXIMATE LOCATION OF PROPOSED BUILDING BEYOND EXISTING FEATURES TO REMAIN IS NOT VISIBLE IN THIS VIEW
NOTE:
THE DASHED OUTLINE OF THE PROPOSED BUILDING BEYOND EXISTING FEATURES TO REMAIN IS SHOWN FOR APPROXIMATE LOCATION PURPOSES ONLY. THE PROPOSED BUILDING IS NOT VISIBLE IN THIS VIEW AND IS LOCATED APPROXIMATELY 11,450 FEET FROM THIS VIEW LOCATION.

VIEW 2 - BEFORE

VIEW 2 - AFTER

EXIT 20B
324 EAST
Long Rd
Grand Is Blvd
EXIT 20A
West River
Road
PASSENGER CARS ONLY
BEGIN
SPEED
LIMIT
65
UNPAID TOLL
SUBJECT TO
REGISTRATION
SUSPENSION
BEGIN
SPEED
LIMIT
65

VIEW 3 - BEFORE
B.A.D.

VIEW 3 - AFTER
B.A.D.

VIEW 4 - BEFORE

VIEW 4 - AFTER

NOTE:
THE DASHED OUTLINE OF THE PROPOSED BUILDING BEYOND EXISTING FEATURES TO REMAIN IS SHOWN FOR APPROXIMATE LOCATION PURPOSES ONLY. THE PROPOSED BUILDING IS NOT VISIBLE IN THIS VIEW AND IS LOCATED APPROXIMATELY 2,090 FEET FROM THIS VIEW LOCATION.

VIEW 5 - BEFORE

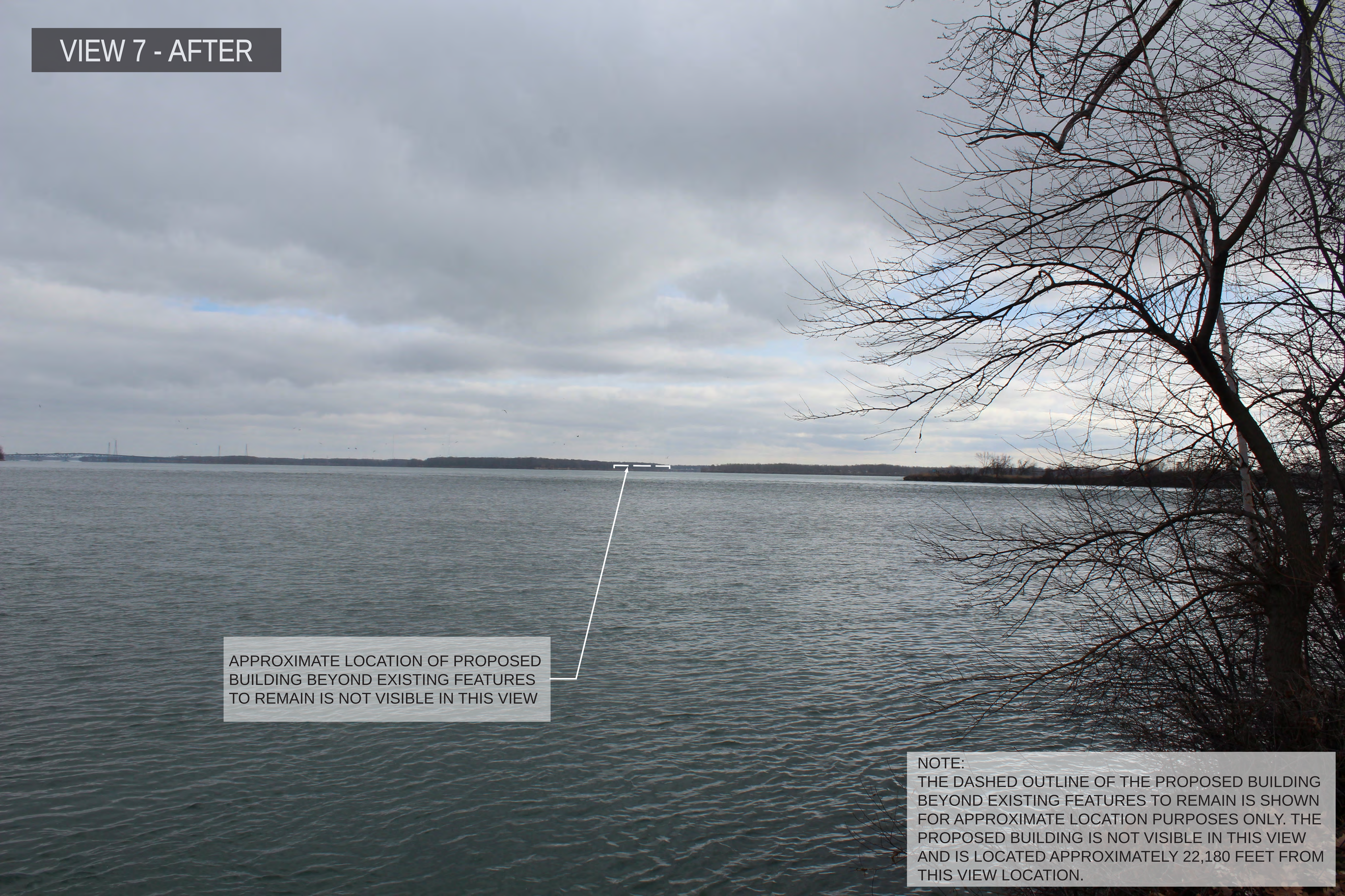
VIEW 5 - AFTER

VIEW 6 - BEFORE

VIEW 6 - AFTER

VIEW 7 - BEFORE

VIEW 7 - AFTER



NOTE:
THE DASHED OUTLINE OF THE PROPOSED BUILDING BEYOND EXISTING FEATURES TO REMAIN IS SHOWN FOR APPROXIMATE LOCATION PURPOSES ONLY. THE PROPOSED BUILDING IS NOT VISIBLE IN THIS VIEW AND IS LOCATED APPROXIMATELY 22,180 FEET FROM THIS VIEW LOCATION.

VIEW 8 - BEFORE

VIEW 8 - AFTER

NOTE:
THE DASHED OUTLINE OF THE PROPOSED BUILDING BEYOND EXISTING FEATURES TO REMAIN IS SHOWN FOR APPROXIMATE LOCATION PURPOSES ONLY. THE PROPOSED BUILDING IS NOT VISIBLE IN THIS VIEW AND IS LOCATED APPROXIMATELY 2,540 FEET FROM THIS VIEW LOCATION.

VIEW 9 - BEFORE

VIEW 9 - AFTER

APPROXIMATE LOCATION OF PROPOSED BUILDING BEYOND EXISTING FEATURES TO REMAIN IS NOT VISIBLE IN THIS VIEW

NOTE:
THE DASHED OUTLINE OF THE PROPOSED BUILDING BEYOND EXISTING FEATURES TO REMAIN IS SHOWN FOR APPROXIMATE LOCATION PURPOSES ONLY. THE PROPOSED BUILDING IS NOT VISIBLE IN THIS VIEW AND IS LOCATED APPROXIMATELY 16,610 FEET FROM THIS VIEW LOCATION.

VIEW 10 - BEFORE

VIEW 10 - AFTER

APPROXIMATE LOCATION OF PROPOSED BUILDING BEYOND EXISTING FEATURES TO REMAIN IS NOT VISIBLE IN THIS VIEW

NOTE:
THE DASHED OUTLINE OF THE PROPOSED BUILDING BEYOND EXISTING FEATURES TO REMAIN IS SHOWN FOR APPROXIMATE LOCATION PURPOSES ONLY. THE PROPOSED BUILDING IS NOT VISIBLE IN THIS VIEW AND IS LOCATED APPROXIMATELY 27,520 FEET FROM THIS VIEW LOCATION.

EXHIBIT F

PHASE IA ARCHAEOLOGICAL SURVEY
Project Olive
2780 Long Road
Town of Grand Island
Erie County, NY

Prepared For:

Langan Engineering & Environmental Services, Inc.
300 Kimball Drive, 4th Floor
Parsippany, NJ 07054-2172

Submitted To:

The New York State Historic Preservation Office
Peebles Island Resource Center
P.O. Box 189
Waterford, NY 12188-0189

Prepared By:

Michael Audin, RPA & Jessica Novak
Archaeology & Historic Resource Services, LLC.
605 Twin Arch Road
Rock Tavern, NY, 12575

ARCHAEOLOGY & HISTORIC RESOURCE SERVICES

February 2020

MANAGEMENT SUMMARY

SHPO Project Review Number):

Involved State and Federal Agencies: **NYDEC, USACE & SEQRA**

Phase of Survey: **Phase IA Archaeological Survey**

Location Information
Location: **2780 Long Road**
Minor Civil Division: **Town of Grand Island**
County: **Erie**

Survey Area
Length: **varies up to 1,616 feet (754 meters)**
Width: **varies up to 2,504 feet (335 meters)**
Number of Acres Surveyed: **Approximately 145-acres (25.74 hectares)**

USGS 7.5 Minute Quadrangle Map: **Tonawanda West, NY**

Archaeological Survey Overview
Number & Interval of Shovel Tests: **N/A**
Number & Size of Units: **N/A**
Width of Plowed Strips: **N/A**
Surface Survey Transect Interval: **N/A**

Results of Archaeological Survey
Number & name of precontact sites identified: **N/A**
Number & name of historic, sites identified: **N/A**
Number & name of sites recommended for Phase n/Avoidance: **N/A**

Report Authors(s): **Michael Audin, M.A., R.P.A. and Jessica Novak, Archaeology & Historic Resource Services, LLC, 605 Twin Arch Road, Rock Tavern, NY 12575**

Date of Report: **February 2020**

EXECUTIVE SUMMARY

Archaeology & Historic Resource Services, LLC (AHRS) was retained by Langan Engineering & Environmental Services, Inc. (Langan) to conduct a Phase IA Archaeological Survey for a proposed e-commerce storage and distribution center (Project) at 2780 Long Road, Grand Island, Erie County, New York (Project Site). The assessment was conducted to support the project's environmental assessment under the State Environmental Quality Review Act (SEQRA) and U.S. Army Corps of Engineers Permit to fill wetlands.

The approximately 145-acre Project Site is located at 2780 Long Road, Block No 1, Lot No. 50, Town of Grand Island, Erie County, New. The Project Site is bound to the north by Long Road; to the east Interstate 190 (I-190); to the south by commercial buildings and Bedell Road; and to the west by landscaped and forested area. The Project is to construct an approximately 3,783,124 SF, 5-story commercial warehouse with 69 loading docks, 219 trailer parking stalls, 1,855 car parking stalls and 16 motorcycle parking. It will also include bioretention basins, water tanks, stormwater ponds and landscaped areas.

This Phase IA Archaeological survey includes an assessment of archaeological sensitivity as well as a review of buildings adjacent to the archaeological-Area of Potential Effect (APE). The background research for this Phase IA Archaeological survey consisted of a review of the New York State Cultural Resource Information System (CRIS) website as well as various primary and secondary resources, including historic maps and atlases, aerial photographs and local histories.

The CRIS system listed a total of seven archaeological sites within a one-mile radius of the archaeological-APE. All seven of the sites are prehistoric. In addition, five previous archaeological surveys have been performed within one mile of the archaeological-APE. All of the Phase IA (and IA/IB) surveys reviewed concluded that there was potential for prehistoric archaeological sites. However, none of the surveys reviewed found any cultural material or features of prehistoric occupation.

In addition, the CRIS website identified seven historic properties and two historic districts within a one-mile radius of the architectural-APE. Six historic properties are listed as not eligible and one is list as undetermined, furthermore one historic district is listed as eligible and the other is listed as undetermined for listing on the State or National Register of Historic Places (NRHP). There are no known historic properties on or adjacent to the Project Site. An architectural review was conducted to determine whether any of the buildings located within the architectural-APE could be considered eligible for the National Register of Historic Places.

Archaeology

The archaeological-APE is a relatively flat area with small rises. A stream runs through the approximate center of the archaeological-APE, roughly north-south. The Niagara River is approximately 1,200 feet to the west of the archaeological-APE. Together these would provide a year-round water source. The soils in the archaeological-APE vary from moderately well drained

poorly drained with the majority of the site being somewhat poorly drained. The area was most likely forested until cleared for farming in the 19th century.

The area would have been able to support at least seasonal settlement and temporary encampments. However, the soil complexes identified in the archaeological-APE and the distance to the Niagara River would have most likely prevented long term encampment in this area. The one known archaeological site is comprised of one stray find and supports this theory.

According to the current property owner, soil was removed from the northern part of the archaeological-APE in the 80's, before they acquired the property. The 1995 aerial photograph depicts the disturbance in the northern portion of the archaeological-APE. This disturbance would have most likely removed or destroyed any archaeological materials in this northern area.

Based on the topography, location of resources and the somewhat poorly drained soils the archaeological-APE is considered to have a low to moderate sensitivity for long term prehistoric camps or villages and a moderate to high sensitivity for prehistoric sites ranging from stray finds to short term camps or kill sites. However, in the northern portion of the archaeological-APE we conclude that there is a low to no sensitivity for archaeological materials and features based on the previous disturbance.

Background research did not reveal any known historic archaeological sites within a one-mile radius (1.6 km) of the archaeological-APE. It does appear that the archaeological-APE was farmed at one point but never built on. Based on the available information, as documented above, we conclude that there is a low to no sensitivity for historic archaeological materials or features within the archaeological-APE.

Based on the archaeological sensitivity we recommend Phase IB Subsurface testing to determine the absence or presence of prehistoric archaeological materials, with the exception of the northern portion of the archaeological-APE, which appears to have been previously distrubed. The Phase IB subsurface testing should be conducted in areas of the archaeological-APE where soil disturbance is anticipated. A testing plan for the subsurface testing is included in Appendix C for OPRHP review and approval prior to subsurface testing.

Architecture

Research on the CRIS confirmed that there are no previously identified historic structures on or adjacent to the archaeological-APE. An architectural review was conducted to determine whether any of the buildings located on or adjacent to the archaeological-APE could be considered eligible for the National Register of Historic Places. There were no buildings identified 50 years or older that would be impacted by the Project due to screening by trees.

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APPENDICES

Appendix A Qualifications of Preparers
Appendix B Concept Plan of the Project Site
Appendix C Phase IB Testing Plan

1.0 INTRODUCTION

Archaeology & Historic Resource Services, LLC (AHRS) was retained by Langan Engineering & Environmental Services, Inc. (Langan) to conduct a Phase IA Archaeological Survey for a proposed e-commerce storage and distribution center (Project), also known as Project Olive, located at 2780 Long Road, Town of Grand Island, Erie County, New York. The assessment was conducted to support the Project's environmental assessment under the State Environmental Quality Review Act (SEQRA) and United States Army Corps (USACE) Permit to fill wetlands.

This report was prepared in accordance with the *Secretary of the Interior Standards and Guidelines for Archaeology and Historic Preservation 1983*, the *New York State Historic Preservation Act of 1980, Section 14.09,* the *New York Archaeological Council's Standards for Cultural Resource Investigations and the Curation of Archaeological Collections in New York State* (1994), the *New York State Office of Parks, Recreation and Historic Preservation (OPRHP) Phase I Archaeological Report Format Guidelines* (2005). All work was conducted by AHRS cultural resource professionals that meet or exceed the Secretary of the Interior Professional Qualifications (36 CFR 61). Resumes of key project personnel are presented in Appendix A.

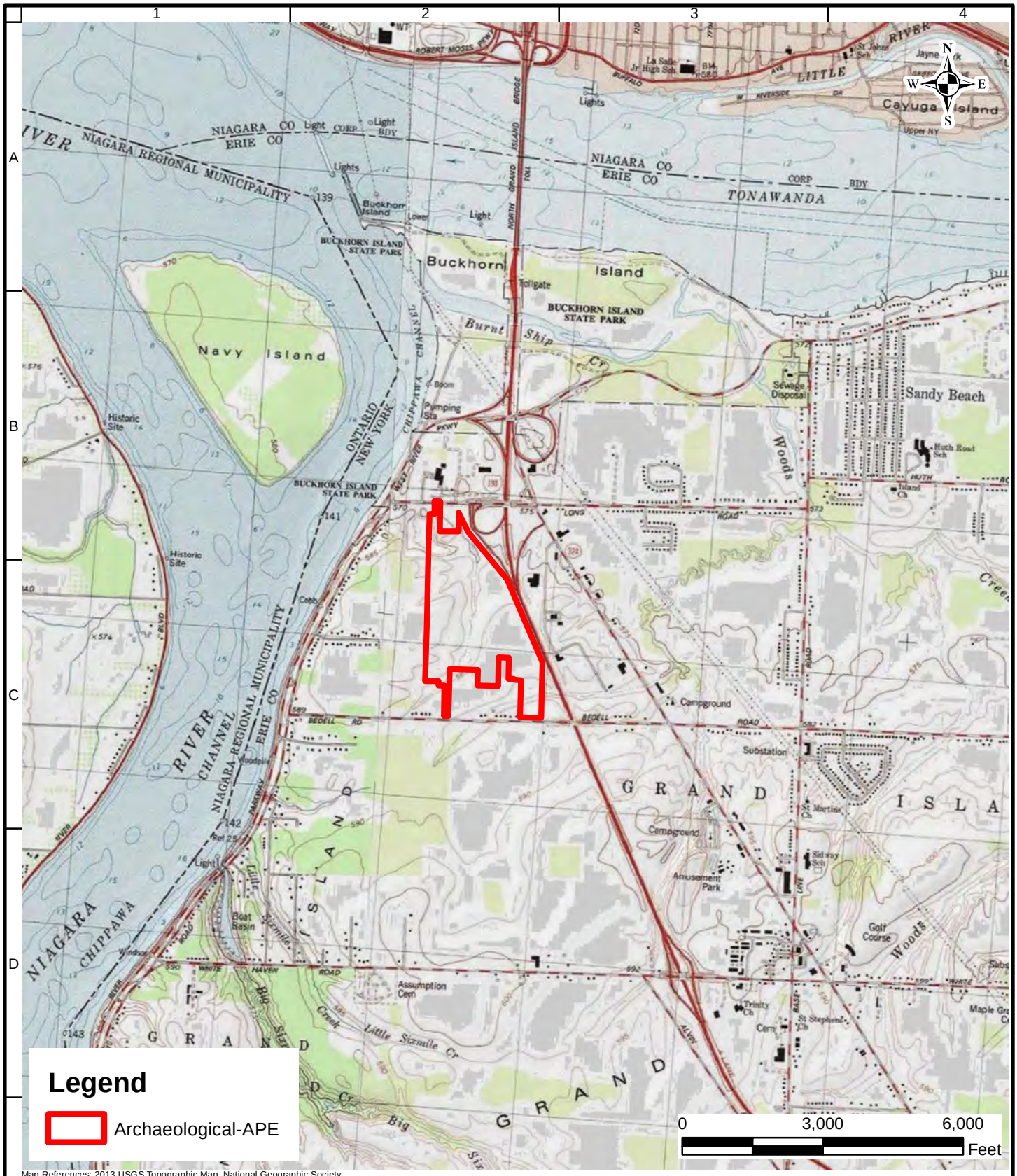
1.1 Site and Project Description

The approximately 145-acre Project Site is located at 2780 Long Road, Block No 1, Lot No. 50, Town of Grand Island, Erie County, New York (Figures 1 and 2). The Project Site is bound to the north by Long Road; to the east Interstate 190 (I-190); to the south by commercial buildings and Bedell Road; and to the west by landscaped and forested area.

The Project is to construct an approximately 3,783,124SF, 5 -story e-commerce storage and distribution center with 69 loading docks, 219 trailer parking stalls, 1,855 car parking stalls and 16 motorcycle parking. It will also include bioretention basins, water tanks, stormwater ponds and landscaped areas.

1.2 Area of Potential Effect

The Area of Potential Effect (APE) is defined in 36 CFR 800.16(d) as: "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking."



Map References: 2013 USGS Topographic Map, National Geographic Society

AHRS ARCHAEOLOGY & HISTORIC RESOURCE SERVICES	Project **PROJECT OLIVE** 2780 LONG ROAD BLOCK No. 1 LOT No. 50 TOWN OF GRAND ISLAND ERIE COUNTY NEW YORK	Drawing Title **USGS TOPOGRAPHIC MAP**	Project No. Date 02/04/2020 Scale See Above Drawn By MA	Figure 1

Map References: 2013 USGS Topographic Map, National Geographic Society

ARCHAEOLOGY & HISTORIC RESOURCE SERVICES

Project
PROJECT OLIVE
2780 LONG ROAD
BLOCK No. 1
LOT No. 50
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title
2016 AERIAL PHOTO

Project No.

Date 02/04/2020

Scale See Above

Drawn By MA

Figure 2

The APE includes locations that may potentially be impacted by the construction or that may experience effects once construction is completed. Included in the APE are all locations where project activities may result in ground disturbance, areas that the elements of a project may be visible and where the activity may result in changes to traffic patterns, land use and public access, etc. Project effects on historic resources can include both physical effects and contextual effects. Physical effects could include physical destruction, demolition, damage or alteration of a historic resource. Contextual effects can include isolation of a property from its surrounding environment; the introduction of visual or audible elements that are out of character with the property or that alter its setting and context; or, elimination of publicly accessible views to the resource. An APE was delineated for archaeology and for architecture as part of this Phase IA Archaeological Survey (Figure 2).

Archaeological

The archaeological-APE encompasses any locations where project activities have the potential to disturb soils through activities such as excavation or grading. The archaeological-APE was defined where ground disturbing activities are proposed and any associated disturbances. For this survey the archaeological-APE consists of the entire 145-acre Project Site, although the potential area of ground disturbance is approximately 117-acres.

Architectural

The architectural-APE is defined as any area where the proposed project areas may have impact on historic structures or alter their context or integrity, such as impacts to the viewshed. Therefore, the architectural-APE often extends beyond the Project Site boundary in order to determine the proposed development's potential impact on the surrounding viewshed. No Architectural-APE was delineated for the Project Site as there is a clear buffer of trees, roadways and highways separating potential buildings over 50 years of age.

2.0 RESEARCH GOALS AND DESIGN

This chapter describes the general research goals and design for the assessment of the significance of archaeological and architectural resources to determine potential eligibility for nomination to the National Register of Historic Places.

2.1 Archaeology

The preliminary Phase IA archaeological survey begins with identifying the areas where project activities have the potential to affect archaeological sites through below-ground disturbance, referred to as the archaeological-APE as described in section 1.2. After defining the APE, documentary research is conducted to determine which locations could have been used during prehistoric (Native American) or historic times. The research assists in identifying areas where intact archaeological evidence, foundations, structural remains, Native American artifacts or activity areas might be present. A site visit or reconnaissance is then conducted to observe the existing conditions and determine the extent to which the original topography is still present and the effects that landscape alterations may have had on potential archaeological resources. Archaeologically sensitive areas based on topographic features, vegetation and soils are noted as well as any disturbances that would compromise archaeological resources. The result of the site visit is to determine whether archaeological testing is necessary and, if so, to develop an appropriate testing strategy.

Phase IB subsurface archaeological testing (Phase I level) is then conducted in archaeologically sensitive locations and elsewhere in the archaeological-APE to identify whether potentially significant archaeological resources are present. The presence of a potentially significant Native American or historic period site requires a subsequent survey (Phase II level) to evaluate the significance or importance of the identified site, unless the site can be avoided. Usually, an archaeological site has to have the potential to yield important new information in history or prehistory to be considered significant (National Register of Historic Places Criterion D). Evaluations for significance are dependent upon the quality of archaeological data retrieved from the ground, the integrity or intactness of the deposits, prior research activities in the region and the development of historic or prehistoric contexts that identifies gaps in archaeological research that further work at the site might address.

2.2 Historic Architecture

The architectural review usually begins with the definition of the architectural-APE, the area that will experience physical or contextual effects from the project. However, for this survey only buildings and structures adjacent to the archaeological-APE were reviewed.

3.0 ENVIRONMENTAL SETTING

This chapter briefly describes the ecological characteristics of the project area including physiography, geology, soils, and flora and fauna of the area. The Project Site is located at 2780 Long Road, Town of Grand Island, Erie County, New York. Grand Island is 1,227 square miles of land and water and located on the western portion of the State. It is boarded by Lake Erie to the west, Niagara County and Canada to the north, Genesee County and Wyoming County to the east, and Cattaraugus and Chautauqua Counties to the south. The lowland part of the county has an elevation of 572 feet above sea level at the shore of Lake Erie to approximately 850 feet at the base of the Appalachian Plateau. The upland region, known as the Cattaraugus Hills or the Allegheny Plateau, cover 80% of the county with hills, ridgelines, and valleys. Most of the uplands have an elevation of 1,600 to 1,800 feet (Moss 2005).

3.1 Topography

The Project Site topography is characterized by a combination of flat undeveloped land and dense vegetation. The northern portion of the archaeological-APE is flat and was historically most likely farmland. Moving south the archaeological-APE begins to slope upward approximately three to four feet along an uneven line near the center of the archaeological-APE (Figure 2). This continues until the southern boundary of the archaeological-APE. The central/southern portions of the archaeological-APE also contain multiple dirt paths and several small drainage features.

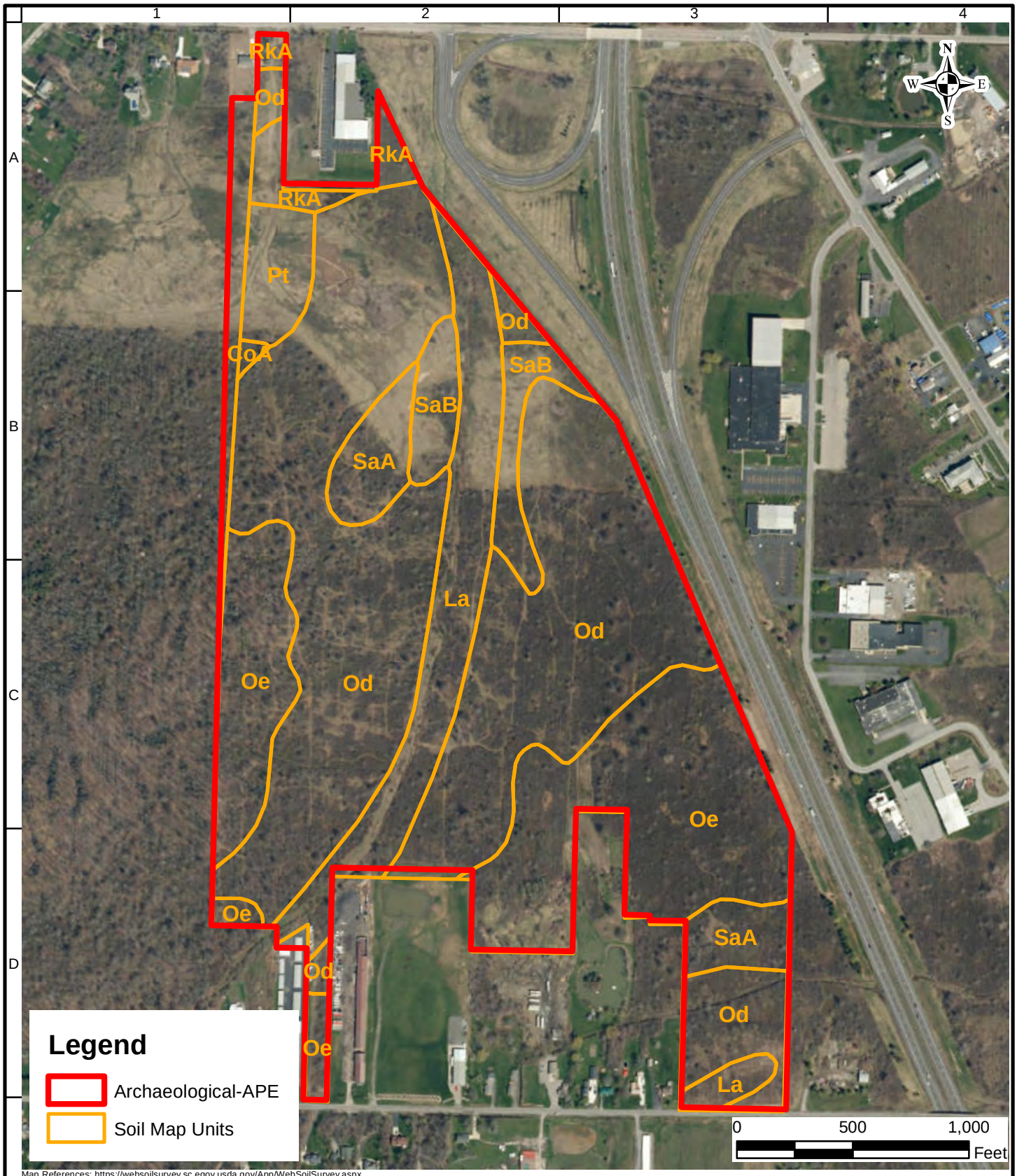
3.2 Physiography and Geology

The Project Site is located within the northern half at the western edge of Erie County in the Erie-Ontario Lake plan province. The southern part of the county is in the Allegheny Plateau province. Erie County is underlain by bedrock of the upper Silurian and the Middle and Upper Devonian periods (USDA 1968). The bedrock is oldest in the northern portion of Erie County. Grand Island consist of the oldest bedrock formation called the Salina Group, which is a 5 to 6-mile-wide band of Silurian-age shale and dolomite (USDA 1968).

3.3 Soils

The 2019 Natural Resources Conservation Service (NRCS) Web Soil Survey of Erie County identifies multiple soil types in the Project Site (Figure 3). The soils represented are:

Lakemont silt loam (La) – Lakemont silt loam is poorly drained soil with 0 to 3 percent slopes. The down-slope shape and the across-shape is concave. The parent material consists of red clayey glaciolacustrine deposits derived from calcareous shale. The natural drainage is classified as poorly drained having a very low runoff class with the capacity of the most limiting layer to transmit water. A typical stratigraphic profile for this soil type is described in Table 1.



Map References: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

AHRS
ARCHAEOLOGY & HISTORIC RESOURCE SERVICES

Project
PROJECT OLIVE
2780 LONG ROAD
BLOCK No. 1
LOT No. 50
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title
USDA-NRCS SOILS MAP

Project No.	
Date	02/04/2020
Scale	See Above
Drawn By	MA
Figure	3

Table 1 – Lakemont silt loam (La)

Name	Soil Horizon Depth (inches)	Texture	Slope	Drainage	Landform
Lakemont (La)	0 to 9 9 to 13 13 to 18 18 to 29 29 to 79	Silt loam Silty clay loam Silty clay Silty clay Silty clay loam	0 to 3%	Poorly drained	Depressions

Churchville slit loam (CoA) – Churchville silt loam is somewhat poorly drained soil with 0 to 3 percent slopes. The down-slope shape is concave and the across-shape is linear. The parent material consists of clayey glaciolacustrine deposits over loamy till. The natural drainage is classified as somewhat poorly drained with the capacity of the most limiting layer to transmit water. A typical stratigraphic profile for this soil type is described in Table 2.

Table 2 – Churchville silt loam (CoA)

Name	Soil Horizon Depth (inches)	Texture	Slope	Drainage	Landform
Churchville (CoA)	0 to 11 11 to 26 26 to 60	Silt loam Silty clay Gravelly loam	0 to 3%	Somewhat poorly drained	Lake plains till plains

Schoharie silt loam (SaB) – Schoharie silt loam is moderately well drained soil with 3 to 8 percent slopes. The down-slope shape and the across-shape is concave. The parent material consists of red clayey glaciolacustrine deposits derived from calcareous shale. The natural drainage is classified as moderately well drained having a low runoff class with the capacity of the most limiting layer to transmit water. A typical stratigraphic profile for this soil type is described in Table 3.

Table 3 – Schoharie silt loam (SaB)

Name	Soil Horizon Depth (inches)	Texture	Slope	Drainage	Landform
Schoharie (SaB)	0 to 8 8 to 11 11 to 18 18 to 33 33 to 52 52 to 70	Silt loam Silt loam Silty clay Clay Silty clay Silty clay	3 to 8%	Moderately well drained	Lake terraces

Odessa silt loam (Od) – Odessa silt loam is somewhat poorly drained soil with 0 to 3 percent slopes. The down-slope shape is concave and the across-shape is linear. The parent material consists of red clayey glaciolacustrine deposits derived from calcareous shale. The natural drainage is classified as somewhat poorly drained having a very high runoff class with the capacity of the most limiting layer to transmit water. A typical stratigraphic profile for this soil type is described in Table 4.

Table 4 – Odessa silt loam (Od)

Name	Soil Horizon Depth (inches)	Texture	Slope	Drainage	Landform
Odessa (Od)	0 to 8 8 to 10 10 to 15 15 to 25 25 to 79	Silt loam Silty clay loam Silty clay Silty clay Silty clay	0 to 3%	Somewhat poorly drained	Lake terraces

Schoharie silt loam (SaA) – Schoharie silt loam is moderately well drained soil with 0 to 3 percent slopes. The down-slope shape and the across-shape is convex. The parent material consists of red clayey glaciolacustrine deposits derived from calcareous shale. The natural drainage is classified as moderately well drained having a low runoff class with the capacity of the most limiting layer to transmit water. A typical stratigraphic profile for this soil type is described in Table 5.

Table 5 – Schoharie silt loam (SaA)

Name	Soil Horizon Depth (inches)	Texture	Slope	Drainage	Landform
Schoharie (SaA)	0 to 8 8 to 11 11 to 18 18 to 33 33 to 52 52 to 70	Silt loam Silt loam Silty clay Clay Silty clay Silty clay	0 to 3%	Moderately well drained	Lake terraces

Odessa-Lakemont complex (Oe) – Odessa-Lakemont complex is somewhat poorly drained soil with 0 to 3 percent slopes. The down-slope shape is concave and the across-shape is linear. The parent material consists of red clayey glaciolacustrine deposits derived from calcareous shale. The natural drainage is classified as somewhat poorly drained having a very high runoff class with the capacity of the most limiting layer to transmit water. A typical stratigraphic profile for this soil type is described in Table 6.

Table 6 – Odessa-Lakemont complex (Oe)

Name	Soil Horizon Depth (inches)	Texture	Slope	Drainage	Landform
Odessa-Lakemont (Oe)	0 to 8 8 to 10 10 to 15 15 to 25 25 to 79	Silt loam Silt loam Silty clay Clay Silty clay	0 to 3%	Somewhat poorly drained	Lake terraces

Rhinebeck gravelly loam (RkA) – Rhinebeck gravelly loam is somewhat poorly drained soil with 0 to 3 percent slopes. The down-slope shape is concave and the across-shape is linear. The parent material consists of clayey and silty glaciolacustrine deposits. The natural drainage is classified as somewhat poorly drained with the capacity of the most limiting layer to transmit water. A typical stratigraphic profile for this soil type is described in Table 7.

Table 7 – Rhinebeck gravelly loam (RkA)

Name	Soil Horizon Depth (inches)	Texture	Slope	Drainage	Landform
Rhinebeck (RkA)	0 to 9 9 to 37 37 to 70	Gravelly loam Silty clay Silty clay	0 to 3%	Somewhat poorly drained	Lake plains

Pits, borrow (Pt) – Pits, borrow is not prime farmland. No slope percentages are available. Pits, borrow map unit composition is 75 percent with 25 percent minor components. These estimates are based on observations, descriptions, and transects of the map unit. A typical stratigraphic profile for this soil type is described in Table 8.

Table 8 – Pits (Pt)

Name	Soil Horizon Depth (inches)	Texture	Slope	Drainage	Landform
Pits (Pt)	N / A	N / A	N / A	N / A	N / A

3.4 Climate

Grand Island experiences seasonal variations for temperature, precipitation, and other weather conditions, such as humidity and dew points. Temperatures are very temperate during the summer season and very cold during the winter season. During the months of May through September, the warmest parts of the year for Grand Island, temperatures rarely reach above eighty-eight degrees Fahrenheit (weatherspark.com). At times the daytime humidity levels can be muggy and oppressive hovering around the ninety percent mark. Nights can be equally humid. Alternately the colder months, December through March, will have lower humidity levels with temperatures rarely falling below three degrees Fahrenheit. The amount of sun and clouds that

permeate the sky during any given season can average amounts of daylight can average from nine hours in the ladder part of the year to fifteen hours for a day during the month of the June. The daily chance of precipitation has a varying degree of expectancy throughout the calendar year. Although Grand Island receives on average 2.8 inches of rainfall, the highest expectancy is usually around thirty-five percent. The average snowfall for Grand Island is between 5 and 10 times the liquid-equivalent, as long as the ground isn't frozen (weatherspark.com).

3.5 Flora and Fauna

Flora and fauna contribute to the soil formation and its quality and impact the overall ecological conditions of the area. Ecological conditions, on the other hand, stimulate human activities. Vegetation also influences erosion by limiting the runoff rate and increasing the available water capacity. Various animal species were present in the study area in prehistoric and historic times and were included into subsistence patterns, providing a variety of biologically and economically significant items such as meat, furs, hide, marrow, bones, antler, etc. In this context, the types and distribution of the region's fauna are important to interpretations of the archaeological record. The following discussion concerns the vegetation and wildlife population over the landscape of Erie County.

As of the 1968 USDA Erie County soil survey, approximately 30% of Erie County was forested and nearly all of the forest land was classified as commercial. Approximately 33% of forest land is owned by farmers and roughly 65% was held by private owners and 2% were publicly owned. There are six forest types within Erie County, which are Maple-Beech forest, Elm-ash-red maple forest, Oak forest, Aspen forest, White pine forest, as well as other softwood plantations. Hard wood trees that produce nuts or other fruit, buds, catkins, twigs and foliage would include oak, poplar, cherry, apple, hawthorn, dogwood, hickory, blackberry and blueberry. Coniferous plants would include pine, spruce, fir, cedar and juniper.

There are domestic grains and seed producing herbaceous plants that include corn, wheat, oats and barley. Grasses and legumes plants would include fescue, bromegrass, clover and alfalfa and wild herbaceous plants that are native or naturally established grasses would include asters, goldenrod, beggarweed and quackgrass. Wetland plants are annual and wild herbaceous plants that grow on moist or wet sites. Wetland plants include smartweed, wild millet, wildrice, rushes, sedges and reeds.

Wildlife populations in Erie County vary by habitat. Open landscapes of pastures and meadows attract pheasant, meadowlark, field sparrow, cottontail and red fox. Wooded areas attract wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer and bear. Wetland areas attract ducks, geese, herons, shore birds, muskrat, mink and beaver.

This brief discussion of the ecological and physiographic conditions presently existing in Erie County suggests that human groups could have lived in the county in the past and would have been able to support themselves either through foraging or subsistence farming. Except for temperature, there is no evidence that those ecological conditions drastically changed over the

course of the Holocene, therefore, it is possible to assume that human groups could have found favorable ecological and climatic conditions within the Project Site in the past. Therefore, the presence of archaeological sites is possible. Due to the use of the Project Site as plowed farmland, however, some prehistoric sites might remain in form of surface scatters of artifacts, while others could still exist as subsurface deposits.

4.0 BACKGROUND RESEARCH

Background research was conducted to locate previously identified cultural resources and to evaluate previously unidentified cultural resources within an appropriate historic context. Research was conducted on the New York State Office of Parks, Recreation and historic Preservation (OPRHP) Cultural Resource Information System (CRIS) to identify known architectural and archaeological resources within or adjacent to the archaeological-APE that are listed on or eligible for the State or National Register of Historic Places. In addition, a review of previously conducted cultural resources surveys and the location of known archaeological sites was also conducted. Primary and secondary research, including maps, atlases and local county histories, was conducted at the Grand Island Memorial Library, NY Heritage Digital Collections, David Rumsey Online Cartography Collection and historicaerials.com. Aerial photographs were also reviewed.

4.1 Archaeology

On January 30, 2020, AHRS conducted a search for known archaeological sites and previous surveys inventoried on the OPRHP CRIS website. A total of seven known archaeological sites have been identified within a one-mile radius of the archaeological-APE; all are prehistoric sites and two of them have human remains associated with them. In addition, one site, the Commerce Center Stray site (2914.000091), is located within the archaeological-APE in the southern western portion. This site is comprised of a single stray find of chert debitage shatter. One site Table 3 lists the known sites within a one-mile radius of the archaeological-APE.

Table 9 – Known archaeological sites within one mile of the archaeological-APE.

Site#	Prehistoric /Historic	Site Name	Proximity to APE (feet)/ Direction	Period	SHPO Determination	Description
2914.000091	Prehistoric	COMMERCE CENTER STRAY	Located within APE	Unknown	Not Eligible	1 piece of chert debitage shatter
2914.000024	Prehistoric	UB 298	1,000 feet west	Unknown	Undetermined	Chert waste flakes, shatter, core, and biface
2914.000142	Prehistoric	NPP2	1,400 feet west	Unknown	Eligible	
2914.00018	Prehistoric W/Human Remains	UB 246 HOOKER MOUND SITE	1,500 feet north	Unknown	Undetermined	Burial
2914.000111	Prehistoric	Buckhorn-Long (UB 3746)	1,600 feet north	Early Woodland	Eligible	Large lithic assemblage
2914.000021	Prehistoric w/Human Remains	Van Son Native American Village and Cemetery	2,300 feet north	Neutral (1635-45)	Undetermined	Burials

2914.0 00016	Prehistoric	UB 270 BURNT SHIP SITE	4,600 feet north	Middle to Late Archaic	Undeter mined	Ship

A total of twelve previous archaeological surveys have been conducted within a one-mile radius of the archaeological-APE. Archaeological sensitivity is discussed in detail in Section 5.0 below.

The first survey is (87SR58066) *Stage 1 Cultural Resource Investigation for the Grand Park Vue Subdivision, Town of Grand Island, Erie County, NY* by Hansen and Associates Archaeological Consulting Inc. in 1987. The report concluded that the archaeological sensitivity of the area is very high and that any potential construction would have serious impacts on the cultural resources. The report recommended that a Phase IB investigation be performed. It suggests first eliminating the post-glacial areas and then performing shovel tests in the remaining project area.

The second survey is (00SR50964) *Phase I Cultural Resources Investigation for the Proposed Adult Living Facility Along Grand Island Boulevard, Town of Grand Island, Erie County, New York* by Panamerican Consultants, Inc. in 2000. The investigation included an initial Phase IA investigation which concluded that the prehistoric sensitivity for the project area is high. The investigation also included a Phase IB investigation of 55 shovel tests which did not produce any cultural material. Therefore, no impacts will be made by any construction activities. The survey recommended that construction proceed according to plan.

The third survey is (04SR54979) *Phase I Cultural Resources Investigation for the Proposed Upper Niagara Remote Video Surveillance System Project in the City of Buffalo and the Towns of Grand Island, Hamburg, and Tonawanda, Erie County and the City of Niagara Falls, Niagara County, NY* by Panamerican Consultants, Inc. in 2004. The investigation included an initial Phase IA investigation which concluded that the prehistoric sensitivity for the project area is high. The investigation also included a Phase IB investigation of shovel tests which did not produce any cultural material. Therefore, no impacts will be made by any construction activities. The survey recommended that construction proceed according to plan.

The fourth survey is (05SR55607) *Cultural Resource Investigations Proposed Bike Trail Connect Project Buckhorn Island State Park, Town of Grand Island, Erie County, NY* by Heritage Preservation and Interpretation Inc. in 2005. A Phase IB was conducted along the proposed Bike Trail. No significant cultural artifacts were found in the eastern portion of the testing area. The report suggested that current construction plans can proceed as proposed. However, a large quantity of debitage was found in the eastern portion of the testing area. The report recommended that additional testing be performed before construction plans proceed.

The fifth survey is (05SR55217) *Phase I Archaeological Report for the Long Road Subdivision, Town of Grand Island, Erie County, NY* by Butterbaugh Archaeological Consulting, Inc. in 2005. The initial Phase IA survey suggested that the entire project area is highly sensitive for prehistoric material. However, the phase IB investigation did not find any cultural material or any sites/features. The report recommends that the proposed construction proceed as planned.

The sixth survey is (07SR57488) *Phase 1 A/B Cultural Resource Investigation, Niagara Falls Campground, Town of Grand Island, Erie County, New York* by Heritage Preservation and Interpretation Inc. in 2007. The report tested a 19-acre geographic area for a proposed campground. The investigation did not produce any historic or prehistoric artifacts. No sites were found during the investigation. The report recommended that proposed construction plans can proceed.

The seventh survey is (08SR57867) *Phase I Cultural Resources Investigation for the Proposed Long Road Cellular Communications Tower, Town of Grand Island, Erie County, NY* by Panamerican Consultants in 2008. The report tested a high-sensitivity prehistoric area. The investigation did not produce any historic or prehistoric artifacts. No sites or features were found during the investigation either. The report recommended that proposed construction plans could proceed.

The eighth survey is (10SR60264) *Phase I Cultural Resources Investigation for the Proposed Grand Island 2 Cellular Communications Tower, Town of Grand Island, Erie County, NY* by Panamerican Consultants in 2010. The report tested a high-sensitivity prehistoric area. The investigation did not produce any historic or prehistoric artifacts. No sites or features were found during the investigation either. The report recommended that proposed construction plans could proceed.

The ninth survey is (16SR00412) *Phase IA/IB Cultural Resource Investigation for the proposed Elderwood Grand Island Development Project, Town of Grand Island, Erie County, New York* by Duel Archaeology and CRM in 2016. The investigation included an initial Phase IA investigation which concluded that the prehistoric sensitivity for the project area is moderate. The investigation also included a Phase IB investigation of shovel tests which did not produce any cultural material. Therefore, no impacts will be made by any construction activities. The survey recommended that construction proceed according to plan.

The tenth survey is (17SR00677) *Phase 1 Cultural Resources Investigation For The Proposed 8.7-Acre Active Solar Project, 126 Industrial Drive, Town Of Grand Island, Erie County, New York* by Panamerican Consultants, Inc. in 2017. The investigation included an initial Phase IA investigation which concluded that the prehistoric sensitivity for the project area is high. The investigation also included a Phase IB investigation of shovel tests which did not produce any cultural material. Therefore, no impacts will be made by any construction activities. The survey recommended that construction proceed according to plan.

The eleventh survey is (17SR00646) *Phase I Cultural Resource Investigations for the Hidden Meadow Trail Apartments Project Town of Grand Island, Erie, County, NY* by Archaeological Consulting Experts, LLC in 2017. The investigation included an initial Phase IA investigation which concluded that the prehistoric sensitivity for the project area is moderate. The investigation also included a Phase IB investigation of shovel tests which did not produce any cultural material. Therefore, no impacts will be made by any construction activities. The survey recommended that construction proceed according to plan.

The twelfth survey is (17SR00067) *Phase 1 Archaeological Reconnaissance Survey of the Proposed Apartment Building Complex at 2984 Grand Island Boulevard* by Douglas J. Perreli, Ph.D in 2017. The report did not identify any archaeological sites or National Historic Landmarks within the project area. The area was assessed as having moderate sensitivity for short-term prehistoric sites and low sensitivity for long-term prehistoric sites. A Phase IB investigation was performed and no artifacts, prehistoric or historic, were recovered. Therefore, no impacts will be made by any construction activities. The survey recommended that construction proceed according to plan.

4.2 Known Historic Architecture

Research conducted on the CRIS website identified seven historic properties and two historic districts within a one-mile radius of the architectural-APE. Six historic properties are listed as not eligible and one is list as undetermined, furthermore one historic district is listed as eligible and the other is listed as undetermined for listing on the State or National Register of Historic Places (NRHP). These are listed in Table 4 below.

Table 10 – Historic properties within one mile of the Project Site.

USN	Name	Location	Distance/Direction from Project Site (feet)	Status
Historic Properties				
2914.000148	2770 Long Road, Grand Island	2770 Long Road 14174	100 feet north	Not Eligible
2914.000138	Elderwood	23850 Grand Island Blvd 14072	1,600 feet east	Not Eligible
2914.000033	Grand Island School #5/Storage	3121 Grand Island Blvd	1,700 feet east	Undetermined
2914.000139	Serene Gardens	2800 Grand Island Blvd 14072	1,900 feet east	Not Eligible
2914.000100	2514 Long Road		2,000 feet east	Not Eligible
2914.000099	2490 Long Road		2,500 feet east	Not Eligible
2914.000095	2761 Long Road, Grand Island	2761 Long Road 14072	1,100 feet south	Not Eligible
Historic Districts				
2914.000145	West River Parkway		500 feet west	Undetermined
2914.000146	West River Parkway		700 feet west	Eligible

4.3 Prehistoric Context

Since the late Pleistocene, humans have occupied all areas of the continental United States adapting to its regionally diverse ecosystems. Only the past 500 years are historically documented; most of the past 13,000 years can be recorded only through the study of prehistoric

archaeological sites. The prehistoric period is commonly divided into five major chronological sub periods; Paleo, Archaic, Transitional, Woodland and Contact.

Archaeologists are continuing to recover new data concerning the earliest peopling of the Americas. The exact timing and mode of transport is currently the subject of robust academic debate (e.g. Adovasio and Pedler 2014; Watson 2017). At least one group of people likely crossed the Beringian Gap between Asia and America beginning around 13,000 years before present (B.P.) and continuing until approximately 10,000 B.P. This is a period that saw dramatic changes in the environment (e.g. Pielou 1992), climate (e.g. Delcourt and Delcourt 1985), and animal species available for exploitation (e.g. Martin and Klein 1984). Considerable attention has been devoted to the Paleo-Indian life ways (e.g. Anderson 1990; Frison and Todd 1986; Haynes 1966; Tankersley and Isaac 1990).

Paleo-Indian Period (13,000 B.P. to 10,000 B.P.)

The Paleo-Indian period began around 13,000 B.P. and continued to ca. 10,000 B.P., coinciding with the end of the Pleistocene and the beginning of the Holocene. While evidence for earlier occupations is growing, the earliest well-documented inhabitants of the continental U.S. crossed from Asia sometime before 13,000 B.P. and rapidly colonized all of North and South America.

Archaeological research in various parts of the U.S. has documented numbers of surface finds of the fluted points diagnostic of this period. Far fewer Paleo-Indian sites with subsurface cultural materials have been documented. Recent analysis of Paleo-Indian tool assemblages has established chronologically significant tool types to identify three temporal subdivisions of the Paleo-Indian time period (Anderson 1990; Tankersley 1990).

Paleo-Indian occupation in New York area is no better known than in other parts of the country. Occupation of western New York appears to have begun at around 12,000 years B.P, a few thousand years after the first humans appeared on the North American continent. The earliest evidence of occupation in the New York area are the Clovis and other fluted points and several small possible camp-sites (Davis and Port Mobil, NY). Among best know are such sites as Potts in north-central NY and Kings Road recovered in the 1960's. Both sites are located west of the Hudson River in Greene County, New York. The most interesting part of the Kings Road site is the high percentage (10%) of imported flints from the west, south and north of the New York area (Ritchie and Funk 1973; Ritchie 1980).

In general, fluted points were found in certain locations in New York which are close to permanent source of water, like swamps or lakes, and sometimes slightly elevated. The distribution of points is primarily limited to the valleys of big rivers and their tributaries. Although few sites have been thoroughly excavated and reported, some information on Paleo-Indian life ways is available. Anderson (1990) has suggested two models of Paleo-Indian settlement patterns, one appropriate to the Northern Tundra-Spruce Parkland zone, and one to the Southern Boreal-Deciduous forest zone.

Anderson's model of Southeastern Paleo-Indians suggests that they were generalized foragers, exploiting the diverse plant and animal resources of the Boreal-Deciduous forests. As a result of this foraging strategy, the dense accumulation of animal bone and lithic materials that characterize sites in the Western plains (e.g. Olson-Chubbuck, Colby) and some of the Northeastern sites (e.g. Delbert, Vail, Bull Brook) is absent. According to Anderson, southeastern Paleo-Indian occupations are characterized by light lithic scatters, with some functional diversity in the tool assemblage. Although Anderson's model of Paleo-Indian period settlement is reasonable, several large Paleo-Indian sites or site clusters have been documented in the Southeast (e.g., Adams site, Big Bone Lick, Pine Tree, Quad, Flint Run complex, Well Creek Crater); yet, almost none have been intensively excavated (Daniel and Wisenbaker 1987; Gardner 1974, 1983). Additional excavations at the Thunderbird site in the Flint Run complex in Virginia may provide more detailed information on Paleo-Indian life ways in the Boreal-Deciduous Forest zone.

Paleo-Indian subsistence strategy was based on foraging. This type of subsistence includes the hunting of wild animals as well as the gathering of wild plants. The archaeological record confirms hunting activities, including hunting of big game, while gathering is not well documented for this period. The settlement distribution pattern of Paleo-Indian sites from Pennsylvania and elsewhere strongly suggests that indigenous people preferred well-drained, elevated locales in close proximity to a stable source of water. Such adaptation derives from the strategy of utilizing the ecosystem according to certain patterns. In addition to occupying lower terraces and sometimes flooded areas, other types of Paleo-Indian sites have been located near outcropping sources of chert (quarry sites), or in rock shelters (probably seasonal habitations), etc.

The Paleo-Indian settlement patterns cannot be fully recognized due to the adverse impact to these sites which was caused by the environmental change by the end of Pleistocene and the beginning of Holocene. As a consequence, the warmer climate during the Holocene period led to the retreat of glaciers and rise of sea levels, which covered many areas previously utilized by humans. This climatic transition also contributed to the change of the ecosystem, especially the distribution of faunal and floral elements. These changes subsequently encouraged new designs in the pattern of human migrations and alterations in the subsistence pattern characteristic for a new prehistoric period — the Archaic Period, ca. 10,000 to 3,700 BP. Compared to the Paleo-Indian period, a new type of culture developed, containing a greater variety of implements, especially used to process diverse foodstuffs (scrapers, knives, expedient tools, grinding stones, and the development of the earliest pottery).

<u>Archaic Period (10,000 B.P. to 3,700 B.P.)</u>

The Archaic period is divided into three sub periods, characterized by different cultural adaptation and typical tool-kits. These are briefly summarized below.

Early Archaic (10,000 B.P. to 8,000 B.P.)

The Early Archaic Period is distinguished from the preceding Paleo-Indian Period primarily on the basis of projectile point styles. These include the widespread Kirk and LeCroy points. Early Archaic

bifaces, in contrast with Paleo-Indian projectile points, are unfluted, and usually have a well-defined haft element (Justice 1987).

Very little is known of this early period of human settlement in the Americas, although some general inferences may be drawn. The widespread occurrence of similar point types over much of North America suggests that social groups were highly mobile, and probably maintained a fluid social organization, as many modern hunters and gatherers do. Given their mobility, these groups probably created very ephemeral sites, with little midden accumulation, and only light scatters of lithic and bone debris. Highly mobile societies are unlikely to invest time and energy in the creation of permanent storage facilities. Consequently, storage pits and houses from this period are unknown. It should be noted, however, that such archaeologically visible remains are known from the European and Eurasian Paleolithic period. Problems of identification and the rapid environmental changes associated with the European colonization of North America compound the difficulties of locating ephemeral sites in upland and alluvial settings.

Very few tool types, other than bifaces, are known for this period, although research in the Far Northeast and Southeast has identified a variety of expediently prepared tools (Petersen 1991; Starbuck and Bolian 1980; Tankersley 1990). Although the lack of ground stone tools in this period is frequently taken as an indication that Early Archaic people exploited few plant resources, it is more than likely that they, did use plant foods, but did not expend much energy in the preparation of the tools to exploit them. Ground stone tools are a hallmark of the Middle and Late Archaic and probably reflect not a change in resource use per se, but a more intensive and less mobile adaptation to a region. Chapman (1977), for example, documented the presence of basket fibers in an Early Archaic context at Icehouse Bottom, Tennessee, suggesting that knowledge and use of plant fibers was certainly a characteristic of the Early Archaic.

Few sites that date to this period have been excavated. Consequently, information about this period must be inferred from general models of hunters and gatherers or from the small number of sites that are reported. In both cases, such models have serious biases (cf. Jefferies 1990, for discussion on the Archaic Period in the Southeastern U.S.).

A cultural horizon that characterizes most of the Archaic period in New York and greater Northeast was identified as the Laurentian tradition. It is interesting to notice certain cultural unification identifiable within this horizon. This observation led some (for instance Ritchie) to suggest that the Laurentian might be the time when new indigenous social structure and political system emerged — tribal societies. One of the examples of the material evidence of such a claim could be the western New York phenomenon identified as the Lamoka culture with the subsequent Brewerton and Meadowood horizon linking the Archaic with the Early Woodland times. The sites Lamoka Lake, Geneva, Woodchuck Hill, and at Frontenac Island in Cayuga Lake are representative sites of Lamoka phase in New York. The large Lamoka Lake site is the only sizeable site from this time period. The evidence from the Ward's Point site suggests either an extended period of use or more likely the reuse of a known site over several years. Several

hearth-centered workshops have been identified at the site including tool making, cooking and hide-working.

In summary, the early Archaic is a poorly known period. Native Americans in the mid-continent must have had to adapt to a variety of local ecozones, which may have changed rapidly, sometimes within a generation, as a result of the Hypsithermal. During the Early Archaic Period new types of projectile points appeared which were smaller in size and in greater variety. The new styles include corner-notched points, stemmed points and bifurcate base points (Justice 1987). Such technological change probably indicates cultural transition manifested in diversified adaptation strategies that people must have followed during that time. New climatic conditions created more options in terms of exploiting diverse ecosystems and subsequently designing appropriate mobility patterns. A greater diversity in decision-making contributed to creation of diversified tool assemblages. Some researchers suggested however, that such technological change might not necessarily indicate a significant cultural change (e.g. Gardner 1974). The variety of tools, they argue, implies a technological rather than economic shift.

Middle Archaic (8,000 B.P. to 5,000 B.P.)

Although this sub period is somewhat longer than the Early Archaic and spans an important period of climatic and environmental change, archaeological investigations indicate that cultural adaptations did not differ markedly from the preceding period. More sites dating to the Middle Archaic have been identified than in the preceding period, although many are not thoroughly documented.

One of the most significant changes occurring sometime after 8,000 B.P. is the development of regional projectile point styles. In addition, a variety of ground stone tools were made for the first time, indicating a greater investment of time and energy in the manufacture of tools for the exploitation of plants. Such investments may be associated with an overall decrease in mobility, or a change in the rate of movement, or the distance between camps. Earlier Archaic hunters probably manufactured only a small portion of their tool assemblage from stone. Middle Archaic hunters created a greater variety of tools, although most were geared to the exploitation of plants.

Although some Middle Archaic sites are as ephemeral as those of the Early Archaic, others contain deep midden deposits with large and diverse assemblages. The presence of burials at some of these sites might be an indication of long term or repeated use of these site localities. Brown and Vierra (1983) have addressed these issues for sites in Illinois. Although the Middle Archaic differs in its stone tool assemblage, little information is available to determine if major differences exist in the life ways of Early and Middle Archaic Native Americans.

Late Archaic (5,000 B.P. to 3,000 B.P.)

Unlike the preceding sub-periods, the Late Archaic is a better-known period of Eastern Woodlands prehistory. In part this is a reflection of the greater preservation of artifacts and

features, and a larger number of sites, with more substantial deposits. The sites are diverse in their setting, artifact assemblages, and probable function. Late Archaic societies continued on the same cultural trajectories identified in the Middle Archaic: greater regionalization, an increase in overall population, and population densities in the river valleys. Other changes, however, represent innovations in technology, subsistence activities and social organization. Studies of projectile points document an increase in regional forms, perhaps representing stylistic innovations associated with stronger inter-societal boundaries.

Various authors (e.g. Jefferies 1990) have suggested that Late Archaic settlements were larger and occupied for longer periods of time than Middle Archaic settlements. The implication of such changes is that the subsistence regime may also have been significantly different.

The use of cultivars and 'encouraged' vascular plants is documented for many sites occupied during this period (e.g. Chomko and Crawford 1978; Watson 1985) although a variety of nuts formed an important component of the diet. The exploitation of such plants, which can be stored for later consumption, probably reduced the need to exploit geographically extensive resource territories, and resulted in the more intensive utilization of smaller areas. One consequence of such a change in subsistence strategy is the creation of archaeologically visible sites, many with a greater degree of alteration (i.e., pit features, hearths, house floors) and built up of thicker midden deposits. Such sites are more likely to be occupied over greater periods of time and to be revisited over many years. Localization of cultural behaviors also frequently resulted in a greater incidence of interment in a confined locality. More people died and were buried at a specific location: Late Archaic burial populations are much better known, and frequently larger, than Middle or Early Archaic burial populations for this reason. Human skeletal remains from this period form one of the most important sources of information on how Native American populations lived and died.

The excavation or surface collection of an archaeological assemblage provides information on raw material use, tool production and use, and subsistence activities. The collection of additional information on the spatial relationships among artifacts and cultural features has enormously increased our understanding of the internal organization of archaic communities, their use of space, and the identification of specific activity loci within the community (e.g. Whallon 1974). For these reasons, the investigation of surface and subsurface cultural remains, even in plowed fields, offer opportunities to collect information relevant to a number of research issues.

By about 3,700 years before present, the landscape was very similar to modern times. At this point a culture known as the Orient emerged in the New York area. This group is known for their complex funerary rituals and use of steatite (soapstone) bowls. The Throgs Neck Site is the best-known site in Long Island for this time period. Two hilltop cemeteries face the water and several habitation sites surround these cemeteries. The burials represent in-the-flesh burials, fleshed cremations and cremations of defleshed bone. The burials included several grave goods including broken steatite containers, fire-making kits, 'cosmetic' stones (used for their pigments), red ochre, woodworking kits, spear points and knives. This period appears to mark the beginning of distinct cemeteries and could be a sign of intense social changes, likely due to the drastic

environmental change which occurred during the Late Archaic. (Ritchie and Funk 1973; Ritchie 1980).

Transitional Period (3,700 B.P. to 3,000 B.P.)

Soapstone vessels is one of the characteristics distinguishes the Transitional period (ca 3,700-3,000 BP) from the Late Archaic. Even though relatively small mobile bands continued seasonal migration patterns and exploited local resources, some of the raw materials of the stone vessels and projectile points were sourced as far south as Virginia (Hohman 2004a; Versaggi and Knapp 2000). Broad-bladed and fishtailed points replacing the narrow-stemmed or side-notched projectile points is the second characteristics that distinguished the Transitional period. Transitional base camps are generally located near river or coastal areas with small special-purpose camps and processing locations located inland and upland (Ritchie and Funk 1973).

Woodland Period (3,000 B.P. to 400 B.P.)

The Woodland period, like the preceding Archaic is divided into three sub periods, although a greater number of cultural phases and spatially discrete societies are recognized. The major distinctions between the Woodland and Archaic periods are the development of ceramic technology and the use of ceramic vessels as part of everyday life. Coinciding with this is the development of complex, hierarchical societies in many parts of the Eastern Woodlands. Such societies appear to have developed after the adoption of a small number of native plants as cultivars. A reliance on these crops and the development of storage techniques enabled Native American populations to inhabit more restricted territories than hunters and gatherers.

The evolution of Woodland society from relatively noncomplex foragers to hierarchically organized chiefdoms is one of the major research foci of North American archaeology. Only a brief overview of the major characteristics of these three sub-periods is presented here.

Early and Middle Woodland (3,000 B.P. to 1,500 B.P.)

The Woodland period is marked in the Ohio and Mississippi valleys by extensive societies who built large earthworks, sedentary cities, and extensive roadways, over which vast trade networks formed. During this period the people occupying present-day New York were no different than the people located elsewhere in the country and the trend appears to be away from the small, highly mobile camps toward more sedentary camps. Though some researchers have dismissed the tidewater communities in New York as marginal due to the absence of complex societies and hierarchical organization, many still argue that the area was nonetheless culturally rich and incredibly significant (Ritchie and Funk 1973; Ritchie 1980).

Most notably, these Early and Middle Woodland periods are marked by the adoption of ceramic making technology by Native Americans and the use of cultivars as a major component of the diet (Cowan 1985; Watson 1985). They are considered here as a unit because the chronological

division between them is the subject of debate, and because activities such as mound building are associated with both periods.

Though agriculture had an effect on the life ways and settlement patterns of Woodland societies in Pennsylvania, New Jersey and New York, cultural change was not very dramatic as for example in the Ohio River Valley (e.g. the Hopewell tradition). The tidewater area of New York is often seen as being the most culturally marginal environment of all. However, the presence of goods which are not native to the region indicates that these people were either traveling or trading with peoples around Trenton and Southeastern Pennsylvania (Ritchie and Funk 1973; Ritchie 1980).

Sites of this time period tend to be relatively small and to have been occupied by a small group of people for a relatively short period of time. One of the major distinctions between Early Woodland society and Late Archaic society is a change in the social organization from a less complex to a more complex social system. Evidence for such changes can be documented by analysis of the mortuary program. Small numbers of individuals were buried in large well-built log tombs within burial mounds, while others were buried in adjacent areas or in caves. Artifacts found with these individuals are interpreted as evidence of differences in social status within society.

Although the primary habitation sites tend to be small homesteads which are removed from neighboring sites, occasionally archaeologists have documented large special purpose sites. These sites range from specialized settlements to sacred enclosures. Recent investigation of caves and rock shelters has documented intense utilization of these localities during this period.

Trends towards greater sedentism and subsistence specialization begun during the Terminal Archaic continued and were accompanied by experimentation with cultigens. The earliest ceramics are named the Mercey Creek and Ware Plain types and consist of flat-bottomed, straight-sided vessels with lugs or handles. The Vinette I type with characteristic conical bases, coarse grit tempered paste, and cord marks in the interior and exterior walls have followed these two types (Kraft 1975; Williams and Thomas 1982). Meadowood projectile points are typical of this time period.

During the Middle Woodland period (ca. 2000 to 1300 BP) decorated pottery replaced coarse tempered vessels. The usual decorative motifs include net impressions and the unusual zoned geometrical patterns from the Abbott Farm. Among projectile points, the Rossville, Fox Creek, and Jack's Reef Pentagonal types dominate the assemblage. Other tools include pestles, hammer stones, anvil stones, net sinkers, etc. (Ritchie and Funk 1973, Ritchie 1980).

Late Woodland (1,500 B.P. to 400 B.P.)

The activities that mark the Early and Middle Woodland period such as the extensive trade and construction of large burial mounds are not apparent during the Late Woodland. Habitations tend to be larger and agglomerated into circular villages in contrast with the preceding periods.

Ceramics associated with these occupations tend to lack decoration and appear to be utilitarian in function rather than associated with any particular ritual. Information on plant and animal food resources is available from numerous sites and indicates a reliance on cultivated foods, although hunted and gathered resources comprised an important component of the diet.

The largest sites are usually located on major rivers and probably represent permanently occupied base camps. Smaller sites are abundant along tributaries and near natural springs. These sites probably functioned as temporary or seasonal camps. An economic system based on horticulture was well established during this time period, although foraging and fishing persisted as the major subsistence activities. Hickory nuts, acorns, butternuts, and blueberries remained important wild foodstuffs. Gathering of freshwater foods like mussels found on sites along the Upper Delaware (Kinsey 1972; Kraft and Mournier 1982) contributed significantly to the daily diet.

The Late Woodland period is characterized by the intensification of horticulture with an emphasis on corn, beans, and squash. Large village sites were comprised of longhouses surrounded by palisade walls. Villages were located on high terraces and knolls, and were occupied year-round. During the Woodland period, the Seneca occupied Western New York (Ritchie and Funk 1973; Ritchie 1980). Culturally affiliated Late Woodland sites identified within 1 mile (1.6 km) of the APE include 3 camps and 1 village/camp.

Contact Period (post-400 B.P.)

At the time of European contact, Erie County was home to many Native Americans, but mainly the Seneca. In the early 17th Century, French explorers and traders began combing the land along Lake Erie, searching for a passage to the Ohio & Mississippi River systems, ultimately to the Gulf of Mexico. In 1615, Etienne Brule was the first European to discover Chautauqua Lake (Town of Westfield 2016). French and British colonists fought over the land around the Great Lakes for over a century. Due to instability and fear of retaliation from Native Americans, Euro-American settlement was delayed until after the American Revolution.

4.4 Historic Context

The following section provides historical background for Erie County and the Town of Grand Island.

4.4.1 Erie County History

Erie County, NY falls within two major physiographic provinces. It was reflective of its first inhabitants, the Erie people. Erie meaning “People of the Cat.” Many native American influences have been noted throughout Erie County’s history. Not only have the Erie people lived along the long, but so have the Seneca and the Neutral. The villages established along this area were used for hunting and fishing. With the presence of the English and the French, the Seneca were driven westward from the Genesee Valley to the Niagara Frontier. During this time the Native Americans were losing their claims to the lands to New York State (Eisenstadt, Moss and Huxley 2005).

Between 1792 and 1793, the Holland Land Company purchased most of western New York State. Significant battles of the War of 1812 were fought in Erie County, including the July 1813 Battle of Black Rock, in which the British destroyed shipyards and naval supplies (Eisenstadt, Moss and Huxley 2005).

Lake navigation made travel and commerce possible to this region of New York State. The canal brought explosive growth and spurred the creation of an intricate network of canal slips and basins along the Buffalo river and harbor, transforming he city into a major inland port (Eisenstadt, Moss and Huxley 2005).

With the completion of the Erie Canal 1825, factories and mills, slaughterhouses, tanneries, soap factories, lumberyards, and breweries strengthened the economic viability of this region. Hydroelectric power from Niagara Falls supported 20th century industries such as steel, automotive, and aircraft production (Eisenstadt, Moss and Huxley 2005).

As the industries developed and jobs became available immigrants began to settle in Erie County. The Native-born settlers from New England were the first to arrive in Erie County, followed by immigrants from Germany, then Ireland, and African Americans. Many African Americans settled in the Buffalo area of Erie County because of its proximity to the international border as well as being part of the Underground Railroad (Eisenstadt, Moss and Huxley 2005).

With the creation of a superhighway network, the Thruway now links towns and villages, and cities throughout of New York State.

4.4.2 Town of Grand Island

Grand Island lies within the Niagara River. Since 1655, the Iroquois Nation – Seneca Native Americans, who called the island, Ga-We-Not: meaning Great Island, used this island as a game preserve and as a Native American burying ground. Following a massacre upon a British wagon train, the Seneca Native Americans gave the islands in the Niagara River above the Falls to Sir William Johnson who then transferred title to the King of England. The Iroquois believed that ownership of the land transferred back to them once the British left the area. But in a strategic move to silence any arguments of ownership, the Mixed Boundary commission allowed New York State to purchase Grand Island and other small islands in the Niagara River for $1000 in 1815 (Niagara Falls Info accessed 2020).

The population of Grand Island grew with the availability of free land. A regular Ferry Service to and from the island made the island accessibility to many people for economic development and growth of its population. The Boston Company purchased 16,000 acres of land on Grand Island, at five dollars per share. The Company planned to cut the white oaks and sell the timber to the shipyards in Boston and New York (Niagara Falls Info accessed 2020).

Major Mordecai M. Noah, purchased 2,555 acres of land to develop a Jewish homeland he called Ararat on Grand Island, but the proposition was never fully supported by the community. In the

late 19th century private clubs and hotels were built, such as the Bedell House (1877), and the McComb House (1887). During Prohibition, Grand Island was used for rumrunning. (Eisenstadt, Moss and Huxley 2005)

In 1930, the population was approximate 626 (Census accessed 2020) and with the construction of two bridges connecting Grand Island to the mainland of New York State, the population grew in 1940 to 1,055 and so did tourism. The largest population growth was in 1960 by 210.9% by 6,517 residents. As of 2010 the population grew steady to 20,351 residents.

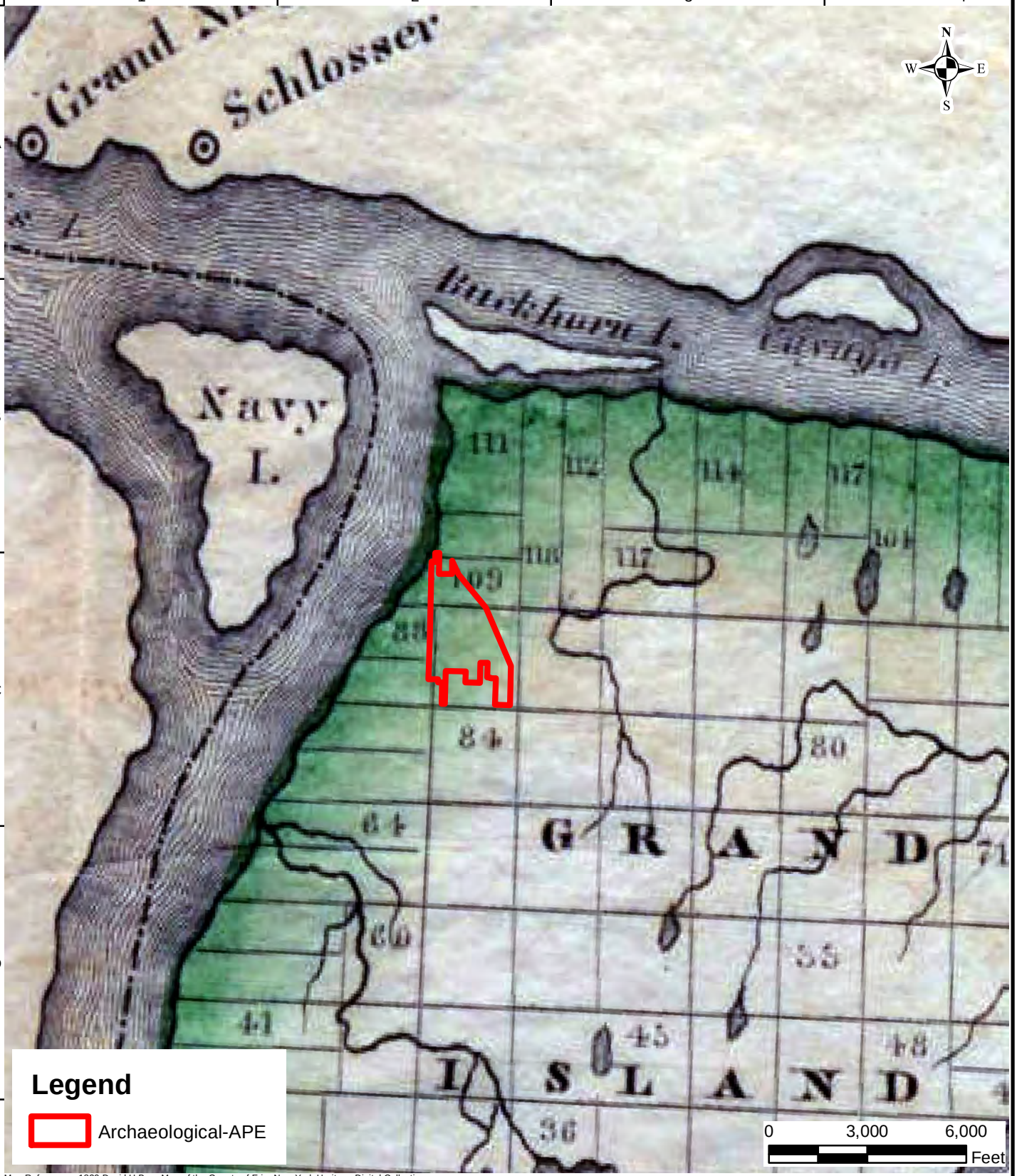
4.5 Land Use History of the Project Site

A review of historic maps, atlases and aerial photographs assisted in compiling a historic land use of the archaeological-APE. Historical maps, atlases, and USGS topographic quadrangles depicting the archaeological-APE and its surroundings from 1829, 1854, 1866, 1895, 1915, and 1948 (Figures 4 through 9) were reviewed along with aerial photographs from 1959, 1972, 1995, and 2016 (Figures 10 through 12 and 2). The maps and aerial photographs provide evidence for development and land use of the archaeological-APE from the mid-nineteenth-century, as described below.

The 1829 David Burr *Map of the County of Erie, New York* (Figure 4) depicts the archaeological-APE as being just east of the Niagara River. The archaeological-APE is shown as belonging in four separate unnamed plots of land. No buildings or structures are depicted on or adjacent to the archaeological-APE.

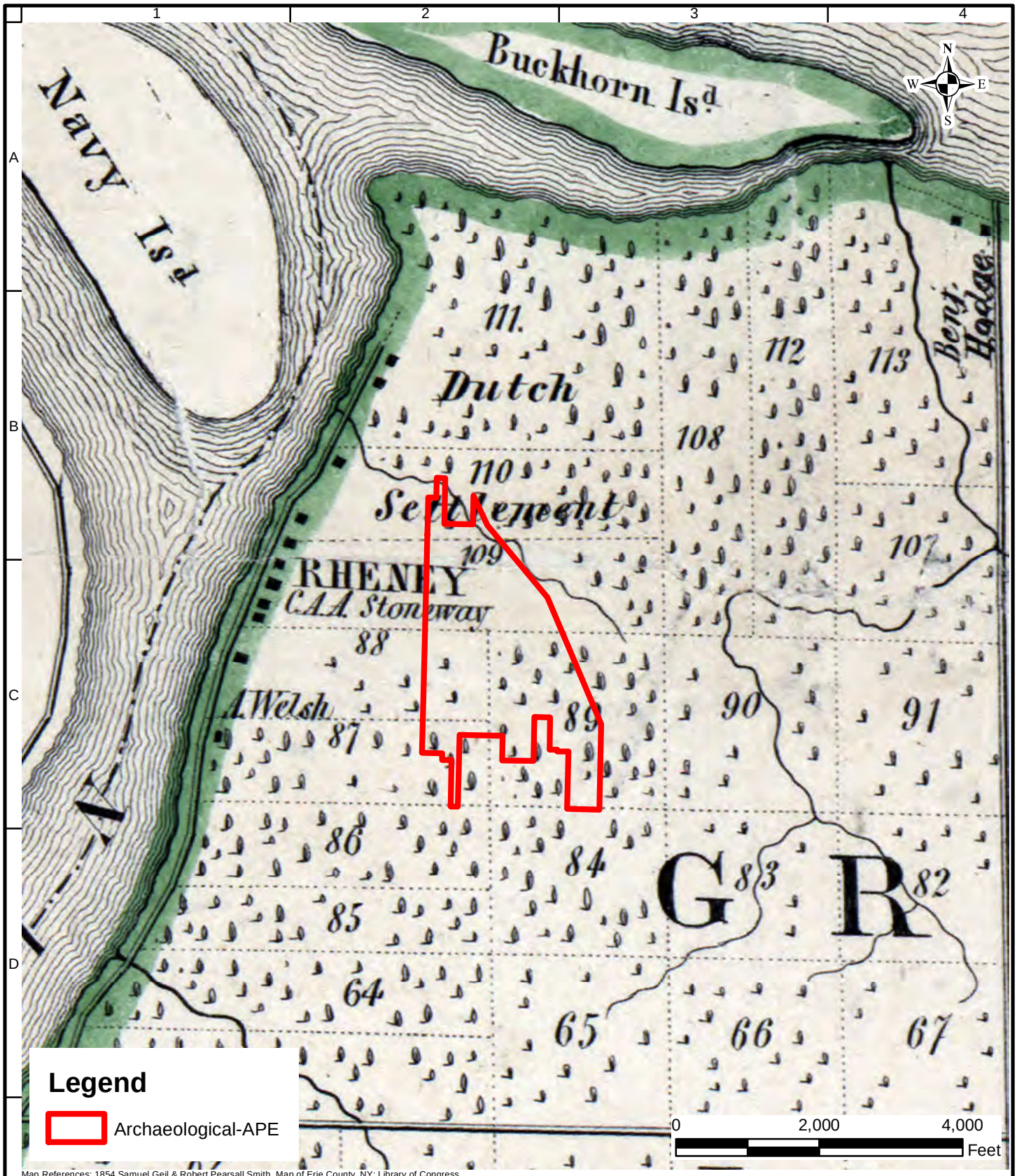
The 1854 Samuel Geil and Robert Pearsall Smith *Map of Erie County, NY* (Figure 5) depicts the archaeological-APE as being east of the Niagara River. Several buildings are now depicted along the river along a road, approximately 2,000 feet west of the archaeological-APE. The archaeological-APE is depicted as farmland, most likely associated with the buildings along the river. The archaeological-APE is depicted as being in five separate parcels of land, parcel numbers 84, 87 to 89, 109 and 110. Three of the parcels have no names associated with them, one is labeled A. Welsh, and another is labeled Rhenney with C.A.A. Stoneway below it. These are most likely names of families that own/live in the buildings depicted. A small stream is also depicted running through the northernmost portion of the archaeological-APE. No buildings or structures are depicted on or adjacent to the archaeological-APE.

The 1866 Stone and Stewart *New Topographic Atlas of Erie County, NY* (Figure 6) depicts the archaeological-APE with the unnamed road to the west being extended to the east just north of the archaeological-APE. This road would eventually be named, Long Road. The south of the archaeological-APE a second road was extended to the east that would eventually become Bedell Road. Two buildings are depicted on Bedell Road to the south of the archaeological-APE. According to the atlas, the only label is W. Zimmerman. The parcel numbers remain the same.



Map References: 1829 David H Burr, Map of the County of Erie, New York Heritage Digital Collection.

AHRS ARCHAEOLOGY & HISTORIC RESOURCE SERVICES	Project **PROJECT OLIVE** 2780 LONG ROAD BLOCK No. 1 LOT No. 50 TOWN OF GRAND ISLAND ERIE COUNTY NEW YORK	Drawing Title **1829 BURR MAP**	Project No. Date 02/04/2020 Scale See Above Drawn By MA	Figure 4



Map References: 1854 Samuel Geil & Robert Pearsall Smith, Map of Erie County, NY; Library of Congress

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Drawing Title
1854 GEIL & SMITH MAP

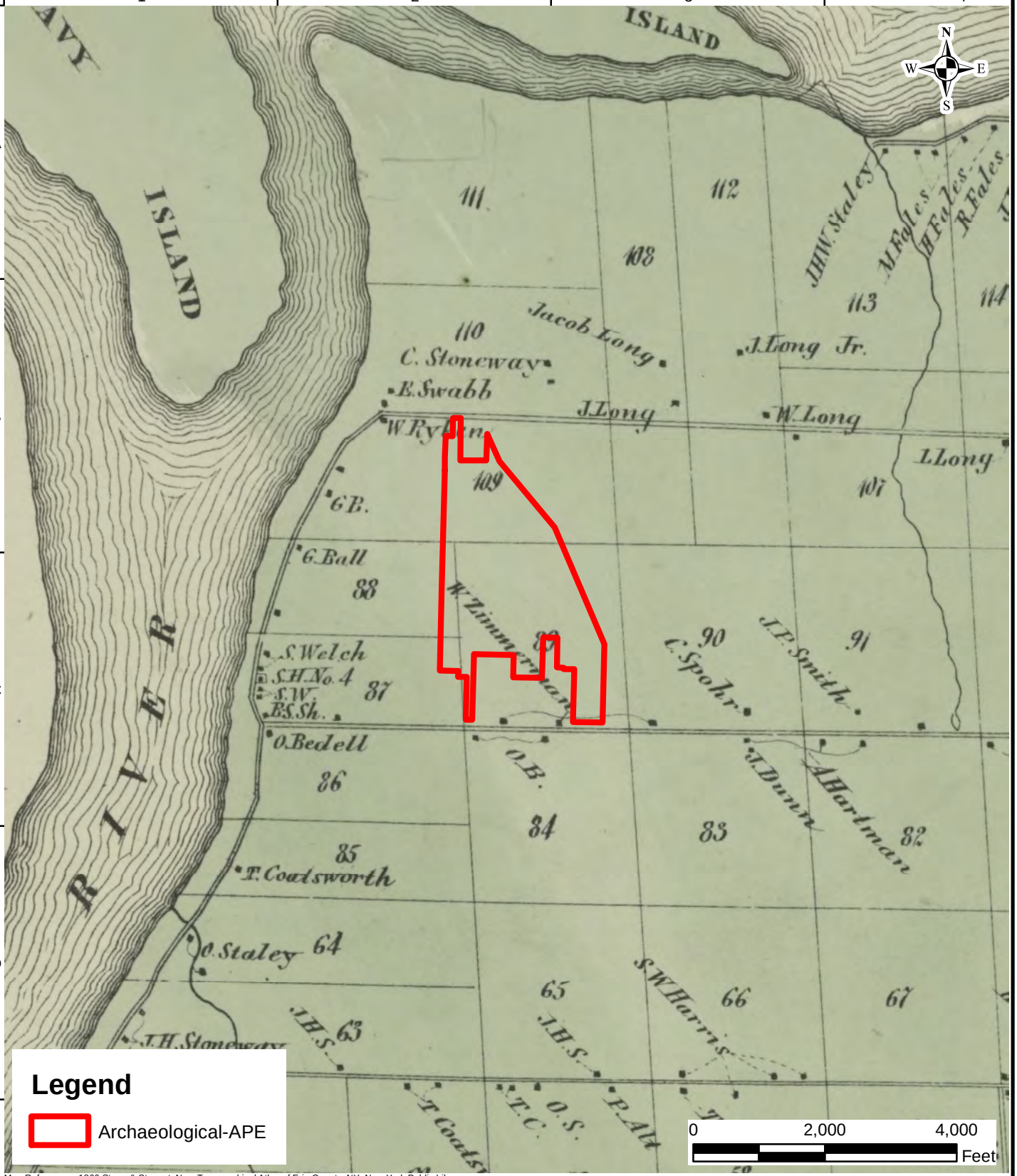
Project No.

Date 02/04/2020

Scale See Above

Drawn By MA

Figure 5



Map References: 1866 Stone & Stewart, New Topographical Atlas of Erie County, NY; New York Public Library

AHRS ARCHAEOLOGY & HISTORIC RESOURCE SERVICES	Project **PROJECT OLIVE** 2780 LONG ROAD BLOCK No. 1 LOT No. 50 TOWN OF GRAND ISLAND ERIE COUNTY NEW YORK	Drawing Title **1866 STONE & STEWART ATLAS**	Project No. Date 02/04/2020 Scale See Above Drawn By MA	Figure 6

The 1895 Julius Bien and Company *Niagara and Erie Counties* (Figure 7) depicts the archaeological-APE with Long Road to the north and Bedell Road to the south, both of which remain unnamed on the map. The map does not depict any of the buildings and structures shown on the previous figures.

The 1915 Albert Volk *Map of Town of Grand Island, Part of the town of Amherst, Buffalo, V3, Plate No. 27* (Figure 8) depicts the archaeological-APE as still being south of Long Road and north of Bedell Road, both of which are now labeled. The two buildings depicted to the south of the archaeological-APE, on the 1866 Stone and Stewart Atlas, are still present but are now labeled as E. Wende. The west of the Wende buildings are now two more buildings and labeled as H. Ehde. No buildings or structures are depicted within the archaeological-APE itself. Parcel 89 now seems to be broken up into five different lots

The 1948 USGS Topographic Map Tonawanda West Quadrangle (Figure 9) depicts the archaeological-APE with Long Road to the north and Bedell Road to the south. A stream is shown running North/South through the center of the archaeological-APE. Several unlabeled buildings are depicted along Bedell Road.

The 1959 Aerial Photograph (Figure 10) depicts the archaeological-APE as farmland with multiple fields. Long Road is to the north, Bedell Road is to the south and the I-190 roadway appears for the first time to the east of the archaeological-APE. I-190 borders the eastern portion of the archaeological-APE. The stream depicted on the 1948 Topographic Map is depicted in the same location on the aerial. No buildings or structures are depicted within the archaeological-APE itself.

The 1972 Aerial Photograph (Figure 11) still depicts the archaeological-APE as south of Long Road, North of Bedell Road, and west of I-190. Several structures are visible on Bedell Road. A thin stream is shown running roughly North/South through the center of the archaeological-APE. No buildings or structures are depicted within the archaeological-APE itself.

The 1995 Ortho Aerial Photograph (Figure 12) is similar to the 1972 aerial photograph. Several more buildings appear along Bedell Road, including warehouse-type buildings. A large building is also depicted adjacent on the Northernmost border of the archaeological-APE, along Long Road. Vegetation is visible in the central and southern portions of the archaeological-APE where the former farm fields are being reclaimed. The northern portion of the archaeological-APE and to the west appears to have been disturbed on this aerial. According to the current property owner soil was removed from this part of the property in the 80's, before they acquired the property. The soil removed was several feet of clay used to cover landfills.

The 2016 Aerial Photograph (Figure 2) is similar to the 1995 aerial. More buildings appear along Bedell Road, including more warehouse-type buildings. A house is now depicted to the west of the northeast portion of the archaeological-APE, along Long Road. The vegetation in the central and southern portions of the archaeological-APE grows denser and the clearings are visible in the northern portions.

Map References: 1895 Julius Bien & Company Niagara and Erie Counties, NY; David Rumsey Collection

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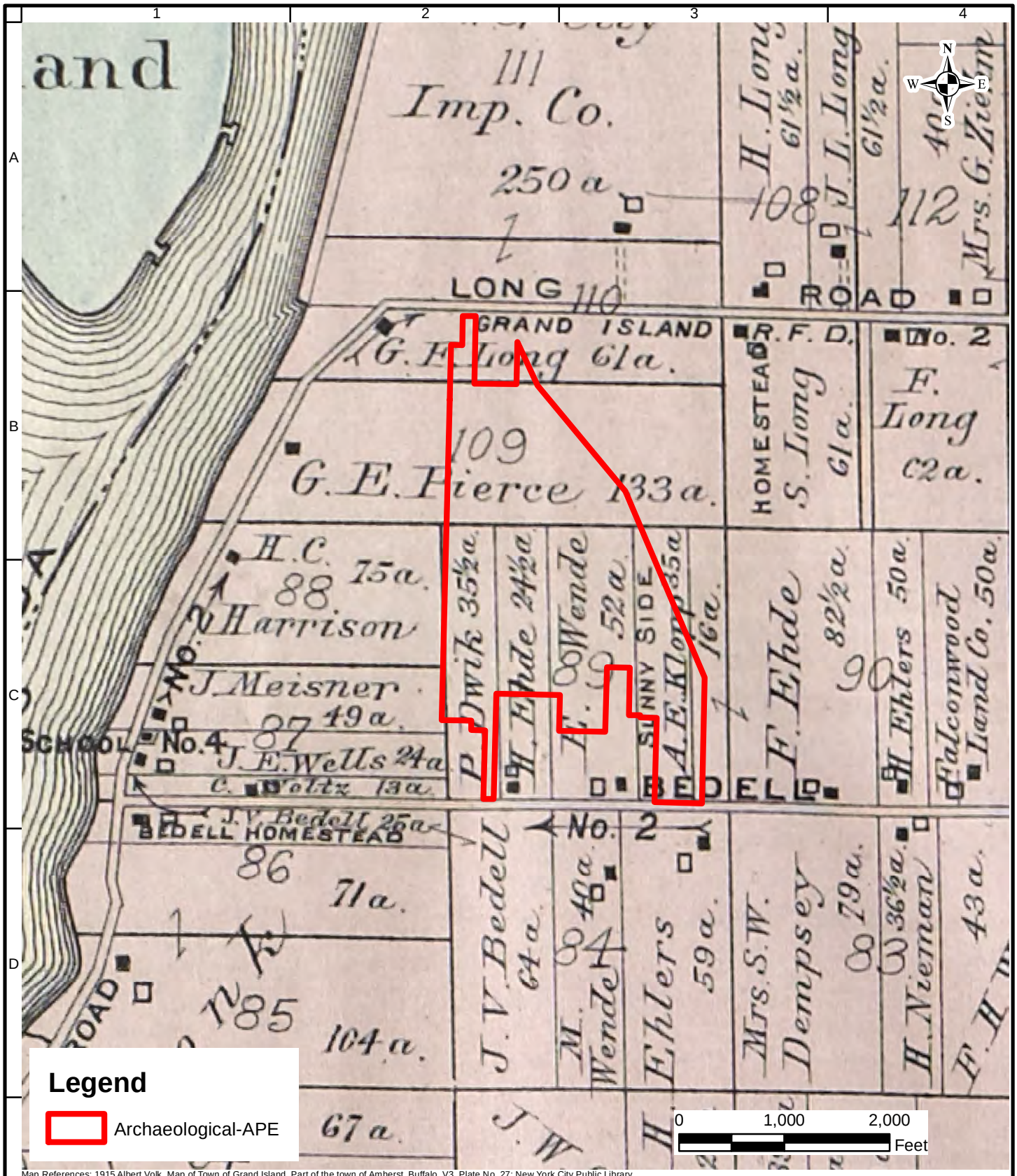
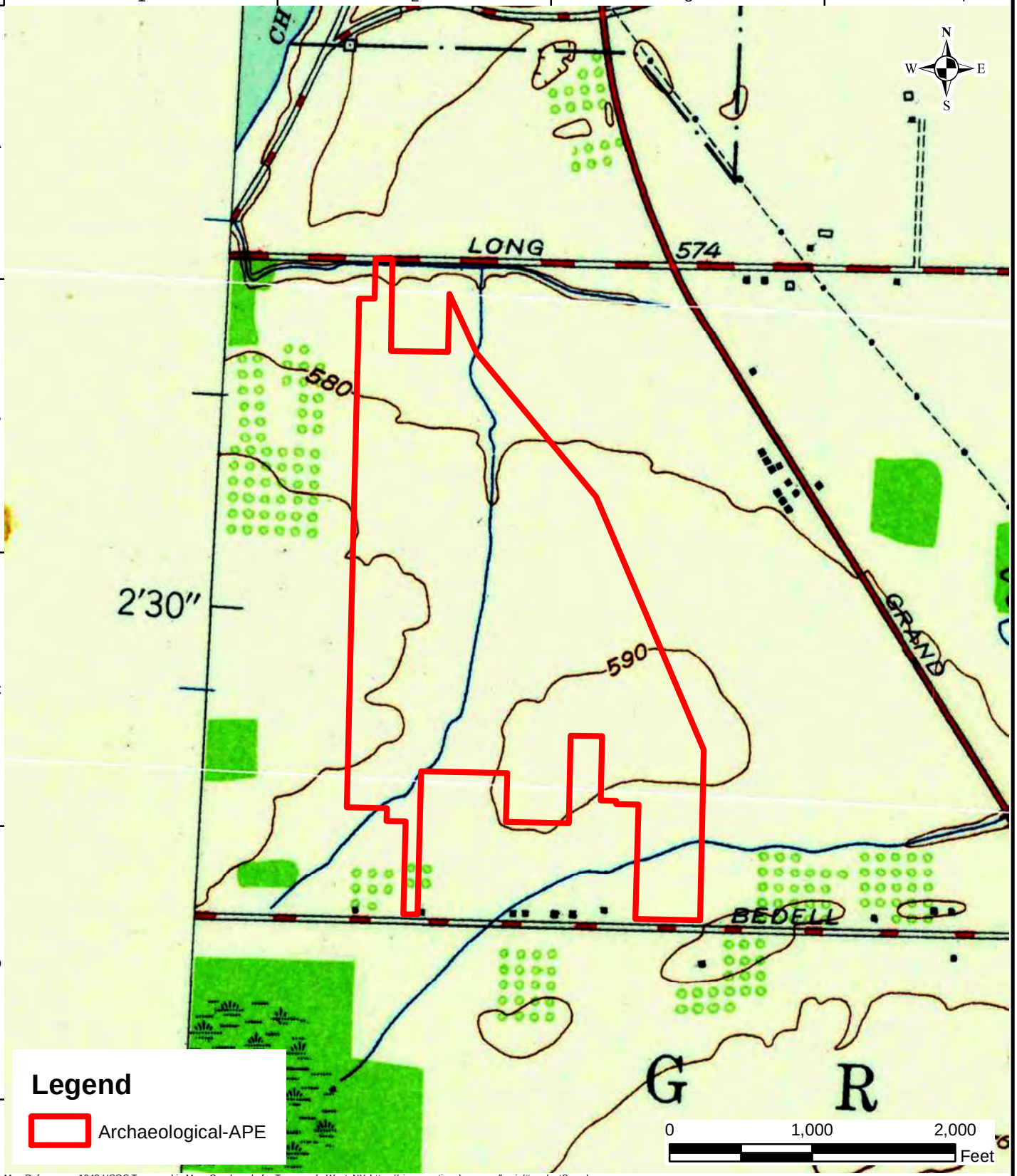


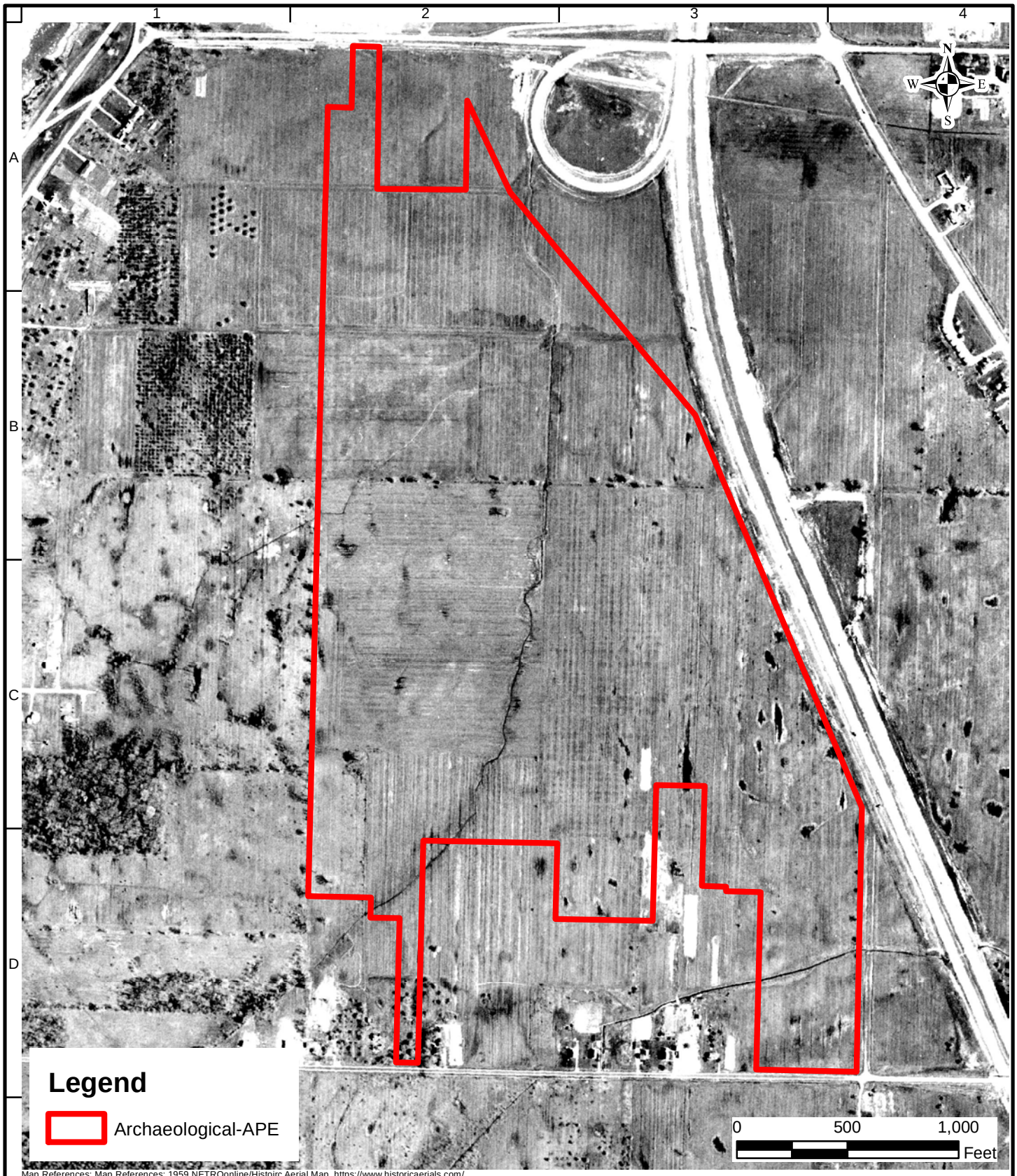
Map References: 1915 Albert Volk, Map of Town of Grand Island, Part of the town of Amherst, Buffalo, V3, Plate No. 27; New York City Public Library.

AHRS ARCHAEOLOGY & HISTORIC RESOURCE SERVICES	Project **PROJECT OLIVE** 2780 LONG ROAD BLOCK No. 1 LOT No. 50 TOWN OF GRAND ISLAND ERIE COUNTY NEW YORK	Drawing Title **1915 ALBERT VOLK MAP**	Project No. Date 02/04/2020 Scale See Above Drawn By MA Figure 8



Map References: 1948 USGS Topographic Map, Quadrangle for Tonawanda West, NY, https://viewer.nationalmap.gov/basic/#productSearch

AHRS ARCHAEOLOGY & HISTORIC RESOURCE SERVICES	Project **PROJECT OLIVE** 2780 LONG ROAD BLOCK No. 1 LOT No. 50 TOWN OF GRAND ISLAND ERIE COUNTY NEW YORK	Drawing Title **1948 USGS TOPO MAP**	Project No. Date 02/04/2020 Scale See Above Drawn By MA	Figure 9



Map References: Map References: 1959 NETROonline/Histoirc Aerial Map, https://www.historicaerials.com/

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1959 AERIAL PHOTO

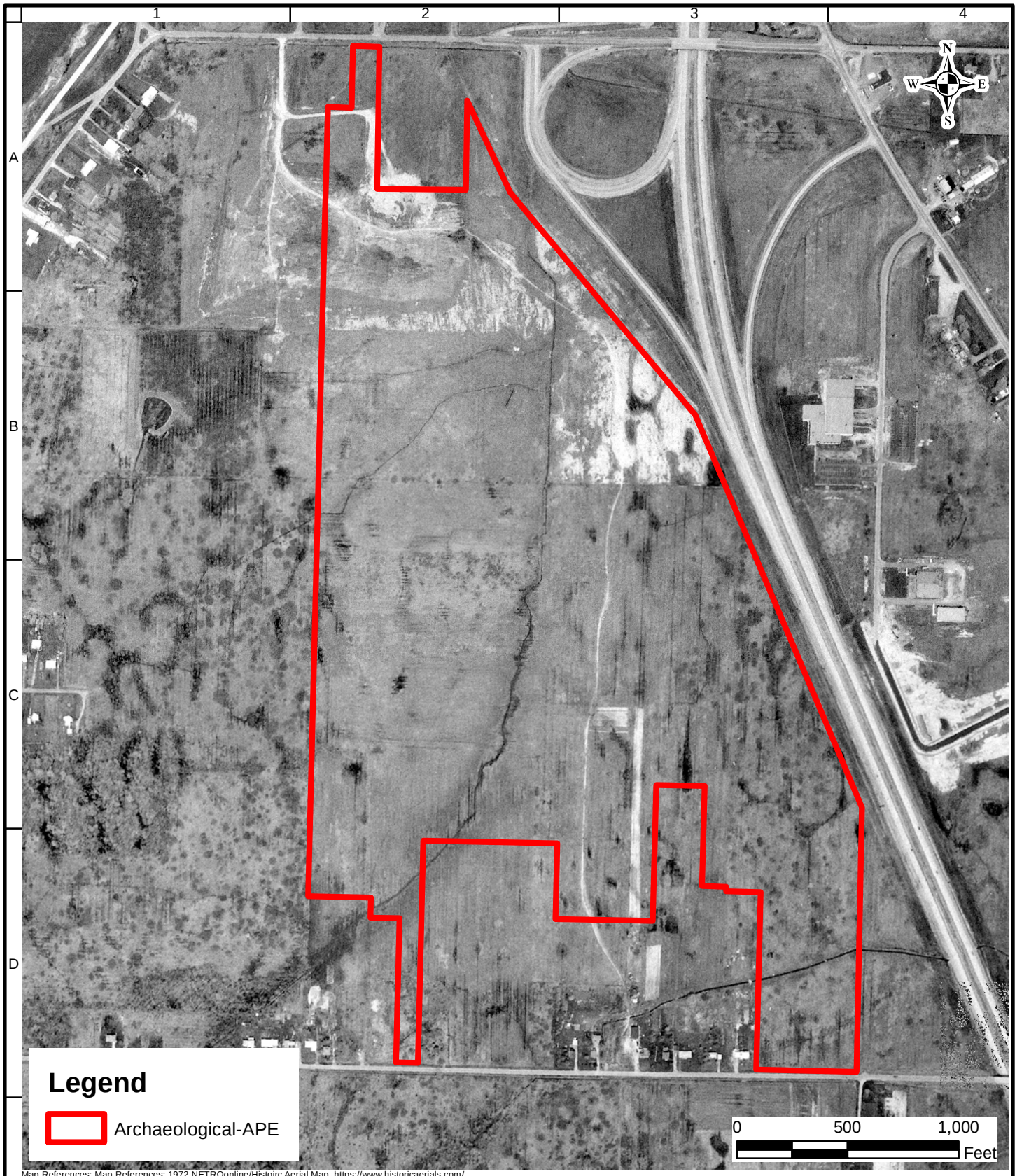
Project No.

Date 02/04/2020

Scale See Above

Drawn By MA

Figure 10



Map References: Map References: 1972 NETROonline/Histoirc Aerial Map, https://www.historicaerials.com/

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ERIE COUNTY NEW YORK

Drawing Title
1972 AERIAL PHOTO

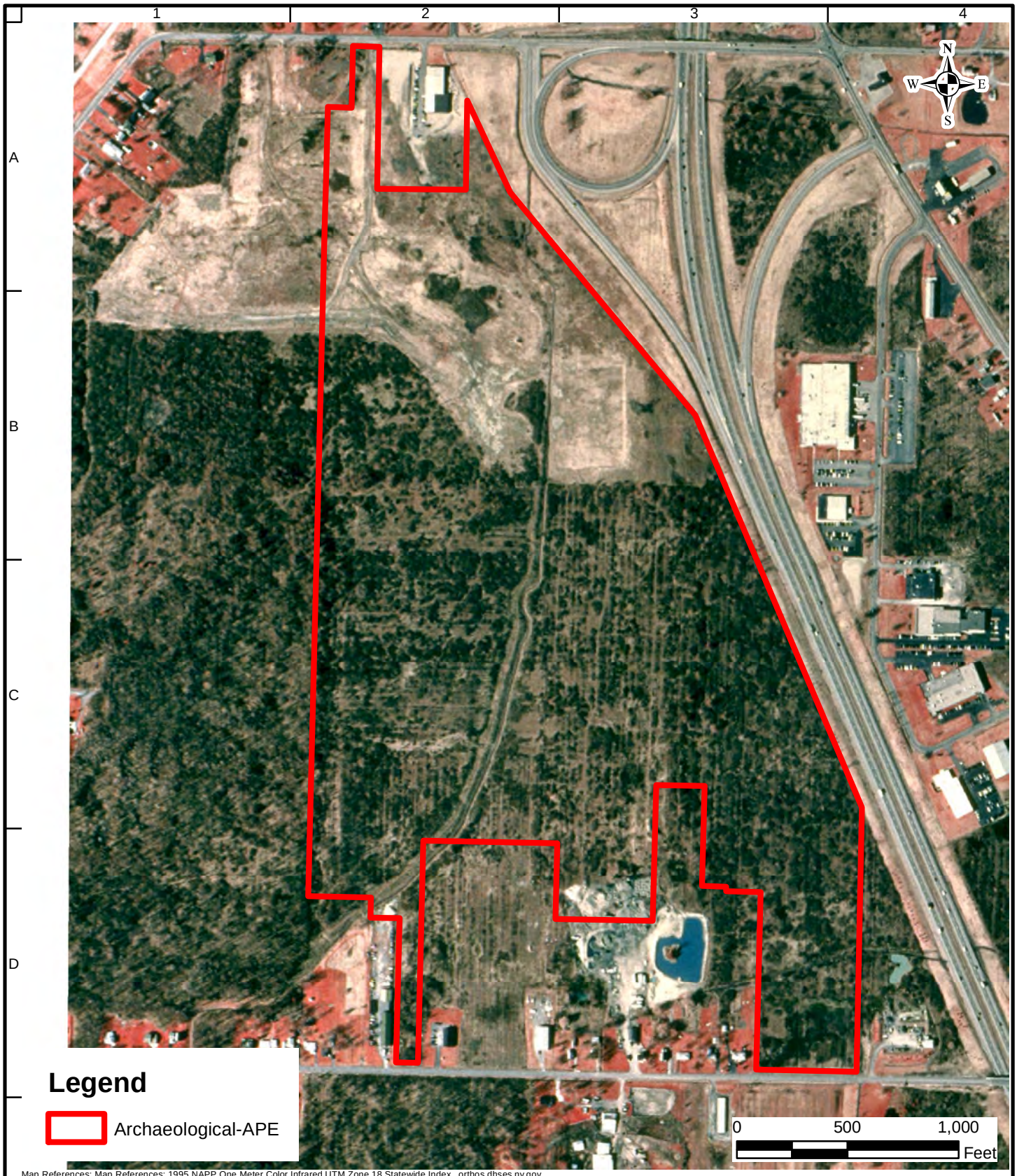
Project No.

Date 02/04/2020

Scale See Above

Drawn By MA

Figure 11



Map References: Map References: 1995 NAPP One Meter Color Infrared UTM Zone 18 Statewide Index., orthos.dhses.ny.gov.

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Project **PROJECT OLIVE** 2780 LONG ROAD BLOCK No. 1 LOT No. 50 TOWN OF GRAND ISLAND ERIE COUNTY NEW YORK	Drawing Title **1995 NYS ORTHO AERIAL PHOTO**	Project No. Date 02/04/2020 Scale See Above Drawn By MA	Figure 12

5.0 ARCHAEOLOGICAL SURVEY

This section discusses the research design, assessment of archaeological sensitivity and results of the site reconnaissance survey.

5.1 Research Design and Methodology

The research design for the Project includes background research and a site visit of the current conditions within the archaeological-APE. The background research was conducted before the site visit to determine the presence of any documented cultural resources and assess the potential to contain undocumented cultural resources in the archaeological-APE. This assessment combined with the background research was used to determine if archaeological testing would be recommended and to assist in devising a field-testing strategy to locate cultural resources within the archaeological-APE.

5.2 Site Visit

The site visit was conducted on February 8, 2020. Photographs 1 through 13 depict the current site conditions. The archaeological-APE is completely undeveloped with no existing buildings or structures. The north portion of the archaeological-APE is an area where soils seem to have been removed that is boarded to the south by a dense vegetated area. This transition occurs along a clear line on the aerial photographs going from east to west where the topography rises several feet in elevation. Several drainage features or old streams, including one running north-south through the site, are within the archaeological-APE. Ground visibility was fairly poor due to approximately 2-incehes of snow on the ground. A photo location log is included as Figure 13.

Photograph 1 – View of Archaeological-APE, facing northeast.
Photo taken by M. Audin on 2/8/2020.

Photograph 2 – View of Archaeological-APE, facing northwest.
Photo taken by M. Audin on 2/8/2020.

Photograph 3 – View of archaeological-APE, taken in the southwest corner, facing west.
Photo taken by M. Audin on 2/8/2020.

Photograph 4 – View of archaeological-APE, facing south.
Photo taken by M. Audin on 2/8/2020.

Photograph 5 – View of archaeological-APE, east of gravel road.
and south of wetlands, facing east. Photo taken by M. Audin on 2/8/2020.

Photograph 6 – View of steel girders, just before entrance at tree line, facing northeast.
Photo taken by M. Audin on 2/8/2020.

Photograph 7 – View of center of archaeological-APE on small path, approximately just before tree line, facing south. Photo taken by M. Audin on 2/8/2020.

Photograph 8 – View of stream going through **the** center of archaeological-APE, facing north. Photo taken by M. Audin on 2/8/2020.

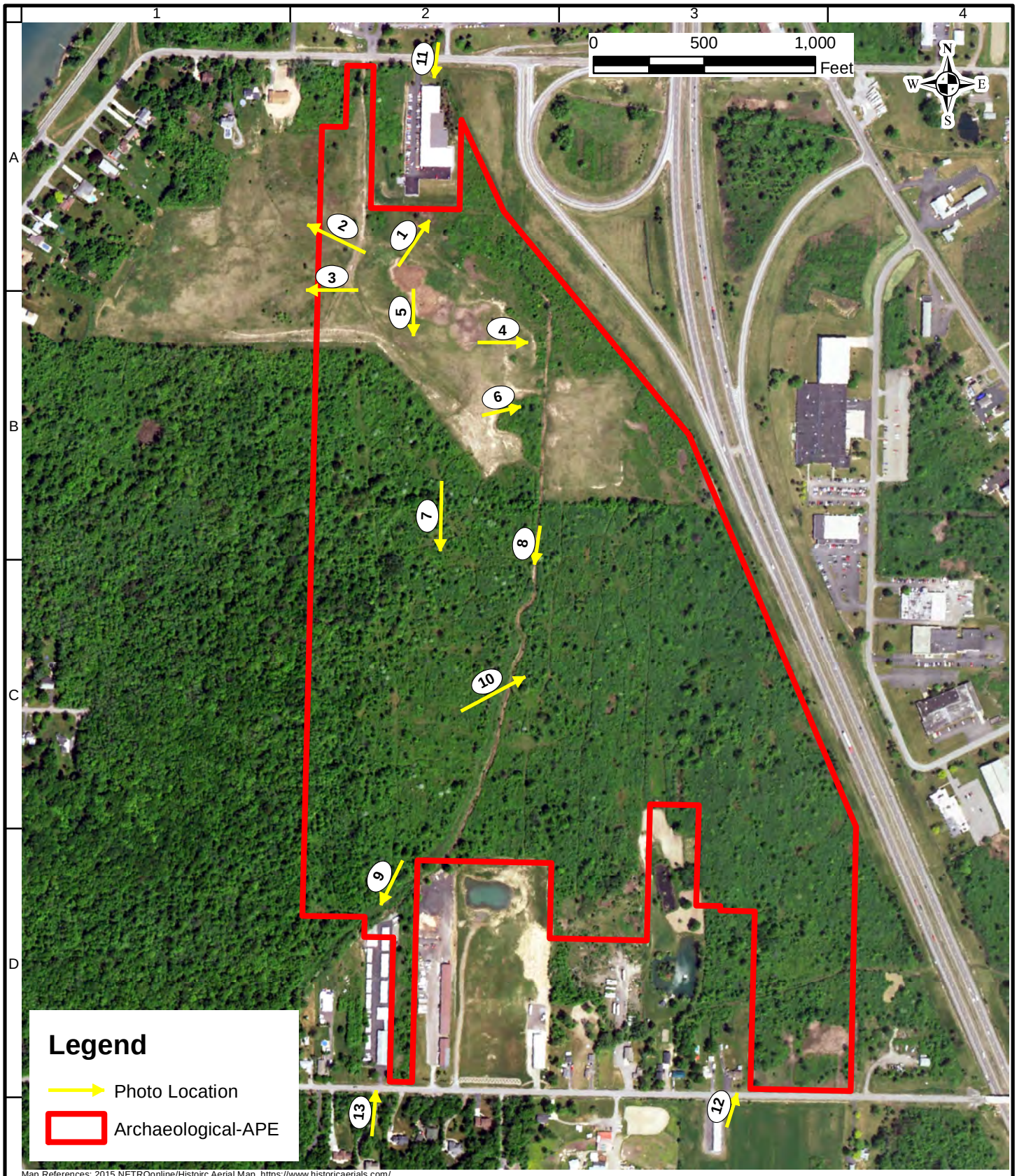
Photograph 9 - View of path, looking southwest.
Photo taken by M. Audin on 2/8/2020.

Photograph 10 - View into archaeological-APE, 600ft north of adjacent lot, facing east.
Photo taken by M. Audin on 2/8/2020.

Photograph 11 - View of 2770 Long Road, which is adjacent to the north and east of the archaeological-APE, facing south. Photo taken by M. Audin on 2/8/2020.

Photograph 12 - View of 2615 Bedel Road, which is adjacent to the south of the archaeological-APE, facing north. Photo taken by M. Audin on 2/8/2020.

Photograph 13 - View of 2761 Bedel Road, which is adjacent to the south of the archaeological-APE, facing north. Photo taken by M. Audin on 2/8/2020.



Map References: 2015 NETROonline/Histoirc Aerial Map, https://www.historicaerials.com/

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Project	Drawing Title	Project No.	Figure
PROJECT OLIVE 2780 LONG ROAD BLOCK No. 1 LOT No. 50 TOWN OF GRAND ISLAND ERIE COUNTY NEW YORK	**PHOTO LOCATION MAP**	Date 02/04/2020 Scale See Above Drawn By MA	13

5.3 Assessment of Archaeological Resource Sensitivity

The assessment of archaeological resource sensitivity is based on:

- The potential for archaeological sites to exist in a given area; and
- The sensitivity of that area to contain intact cultural resources.

In areas where no sites have been documented the potential presence of prehistoric resources is based primarily on environmental setting such as topography, proximity to water, other resources and soil quality. The potential for historic resources is usually determined through the analysis of historic sources especially cartographic materials. The presence of roads and railroads documented on historic maps usually increases the potential for historic sites.

The CRIS system shows a total of seven archaeological sites that have been identified within a one-mile radius of the archaeological-APE. All are prehistoric and two of them had human remains associated with them. One known archaeological site is located with the current archaeological-APE, a stray find consisting of one piece of chert debitage shatter. Two of the sites have been determined eligible for listing on the National Register, 2914.000111 and 2914.000142. In addition, twelve previous archaeological surveys have been performed within one mile of the archaeological-APE. All of the previous surveys reviewed concluded that there was a moderate to high sensitivity for for prehistoric archaeological sites.

<u>Prehistoric Archaeological Sensitivity</u>

The prehistoric sensitivity of an archaeological-APE is generally evaluated by the presence of level areas or slight slopes, observation of upland areas overlooking the surrounding landscape, the presence of well-drained soils, located within 500 feet of a freshwater source, lack of previous soil disturbance and proximity to other resources (wetlands, forest, lithic material sources, etc.). In addition, previously identified prehistoric archaeological sites are generally an indication of prehistoric archaeological sensitivity.

The archaeological-APE is relatively flat area with small rises. A stream runs through the approximate center of the archaeological-APE, roughly north-south. The Niagara River is approximately 1,200 feet to the west of the archaeological-APE. Together these would provide a year-round water source. The soils in the archaeological-APE vary from moderately well drained poorly drained with the majority of the archaeological-APE being somewhat poorly drained. The area was most likely forested until cleared for farming in the 19th century. The area would have been able to support at least seasonal settlement and temporary encampments. However, the soil complexes identified in the archaeological-APE would have most likely prevented long term encampment in this area in the wet season. Furthermore, the distance to the Niagara River is further than most predictive models would support. The known archaeological site, comprised of one stray find, in the archaeological-APE supports this theory.

According to the current property owner soil was removed from the northern part of the archaeological-APE in the 80's, before they acquired the property. The soil removed was clay

used to cover landfills. The 1995 aerial photograph seems to depict disturbance in the northern portion of the archaeological-APE. This disturbance would have most likely removed or destroyed any archaeological materials in this northern area.

Based on the topography, location of resources and the somewhat poorly drained soils the archaeological-APE is considered to have a low to moderate sensitivity for long term prehistoric camps or villages and a moderate to high sensitivity for prehistoric sites ranging from stray finds to short term camps or kill sites in the areas of undisturbed soils. However, in the northern portion of the archaeological-APE we conclude that there is a low to no sensitivity for archaeological materials and features based on the previous disturbance.

Historic Archaeological Sensitivity

The potential presence of historic cultural resources within an archaeological-APE must also be weighed against ground disturbing activities that may destroy the contextual integrity of the archaeological-APE. As with prehistoric cultural resources, the sensitivity for historic period cultural resources is derived by ascertaining the probable location of a potentially significant historic sites and comparing that with documented ground disturbances. Overall sensitivity to historic sites is a measure of the potential for intact cultural resources to be present within the archaeological-APE.

Background research did not reveal known historic archaeological sites within a one-mile radius (1.6 km) of the archaeological-APE. Furthermore, no buildings or structures were depicted on any of the historic maps of aerial photographs. It does appear that the archaeological-APE was farmed at one point. Based on the available information, as documented above, we conclude that there is a low to no sensitivity for historic archaeological materials within the archaeological-APE.

6.0 ARCHITECTURAL REVIEW

A windshield survey was conducted on February 8, 2019 for any buildings adjacent to the archaeological-APE. There were no buildings identified 50 years or older that would be impacted by the Project due to screening by trees.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Archaeology & Historic Resource Services, LLC (AHRS) was retained by Langan Engineering & Environmental Services, Inc. (Langan) to conduct a Phase IA Archaeological Survey for a proposed ecommerce storage and distribution center, also known as Project Olive, located at 2780 Long Road, Town of Grand Island, Erie County, New York. The assessment was conducted to support the Project's environmental assessment under SEQRA and USACE Permit to fill wetlands. The project is to construct an approximately 3,783,124 SF, 5 -story commercial warehouse with 69 loading docks, 219 trailer parking stalls, 1,855 car parking stalls and 16 motorcycle parking. It will also include bioretention basins, water tanks, stormwater ponds and landscaped areas.

Background research conducted for the archaeological-APE revealed that there is a total of seven known archaeological sites have been identified within a one-mile radius of the archaeological-APE listed on the CRIS system. All seven of the sites are prehistoric, one is located within the current archaeological-APE. In addition, twelve previous archaeological surveys have been performed within one mile of the archaeological-APE. All of the Phase IA (and IA/IB) surveys reviewed concluded that there was potential for prehistoric archaeological sites. A total of seven historic properties and two historic districts within a one-mile radius of the architectural-APE. Six historic properties are listed as not eligible and one is list as undetermined, furthermore one historic district is listed as eligible and the other is listed as undetermined for listing on the State or National Register of Historic Places (NRHP).

<u>Archaeology</u>

The archaeological-APE is relatively flat area with small rises. A stream runs through the approximate center of the archaeological-APE, roughly north-south. The Niagara River is approximately 1,200 feet to the west of the archaeological-APE. Together these would provide a year-round water source. The soils in the archaeological-APE vary from moderately well drained to poorly drained with the majority of the archaeological-APE being somewhat poorly drained. The area was most likely forested until cleared for farming in the 19th century.

The area would have been able to support at least seasonal settlement and temporary encampments. However, the soil complexes identified in the archaeological-APE and the distance to the Niagara River would have most likely prevented long term encampment in this area. The one known archaeological site is comprised of one stray find and supports this theory.

According to the current property owner, soil was removed from the northern part of the archaeological-APE in the 80's, before they acquired the property. The 1995 aerial photograph (Figure 12) depicts the disturbance in the northern portion of the archaeological-APE. This disturbance would have most likely removed or destroyed any archaeological materials in this northern area.

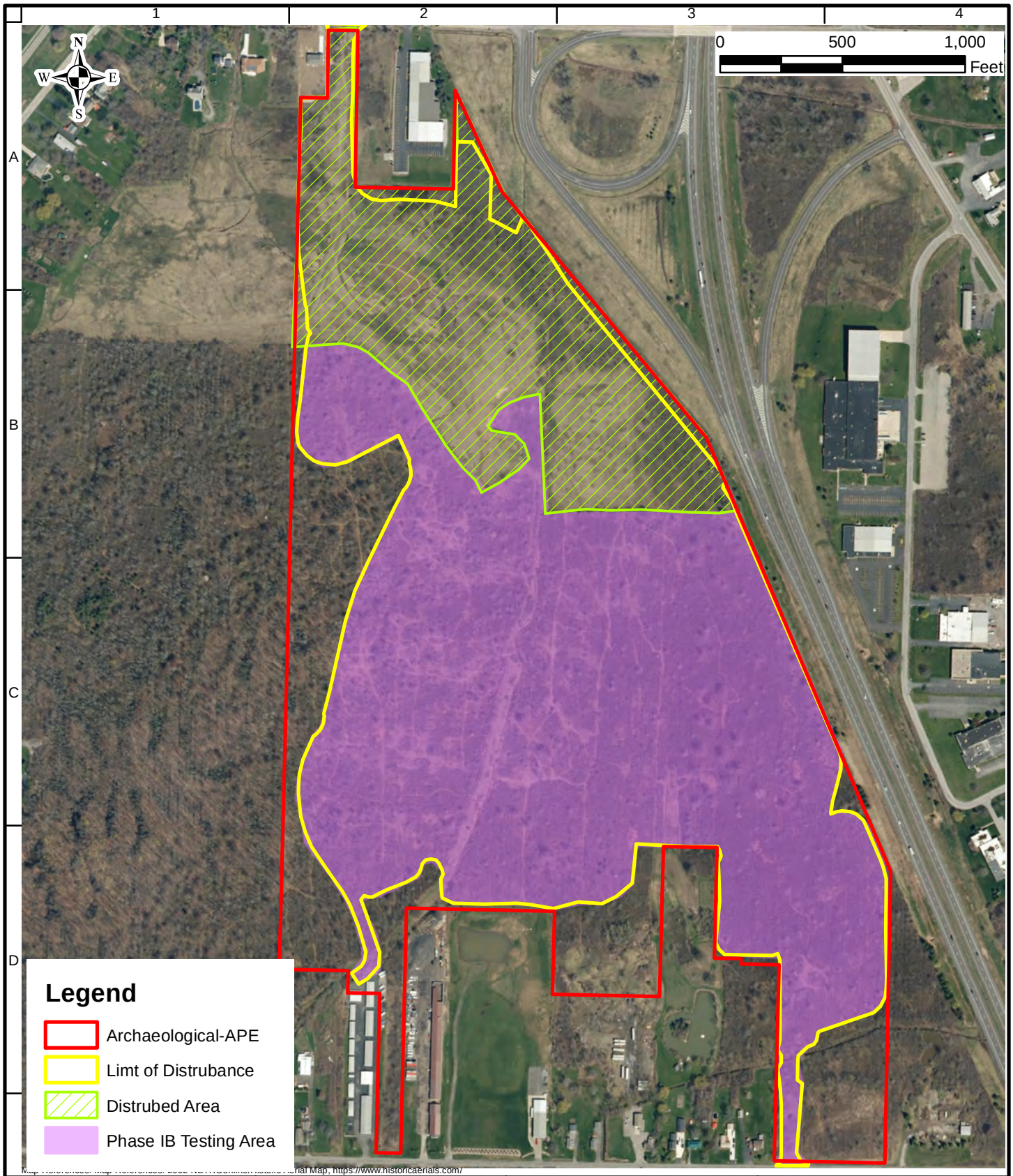
Based on the topography, location of resources and the somewhat poorly drained soils the archaeological-APE is considered to have a low to moderate sensitivity for long term prehistoric camps or villages and a moderate to high sensitivity for prehistoric sites ranging from stray finds to short term camps or kill sites. However, in the northern portion of the archaeological-APE we conclude that there is a low to no sensitivity for archaeological materials and features based on the previous disturbance.

Background research did not reveal any known historic archaeological sites within a one-mile radius (1.6 km) of the archaeological-APE. It does appear that the archaeological-APE was farmed at one point but never built on. Based on the available information, as documented above, we conclude that there is a low to no sensitivity for historic archaeological materials or features within the archaeological-APE.

Based on the archaeological sensitivity we recommend Phase IB Subsurface testing to determine the absence or presence of prehistoric archaeological materials, with the exception of the northern portion of the archaeological-APE (Figure 14). The Phase IB subsurface testing should be conducted in areas of the archaeological-APE where soil disturbance is anticipated. A testing plan for the subsurface testing is included in Appendix C for OPRHP review and approval prior to subsurface testing.

Architecture

Research on the CRIS confirmed that there are no previously identified historic structures on or adjacent to the archaeological-APE. An architectural review was conducted to determine whether any of the buildings located within or adjacent to the archaeological-APE could be considered eligible for the National Register of Historic Places. There were no buildings identified 50 years or older that would be impacted by the Project due to screening by trees.



AHRS
ARCHAEOLOGY & HISTORIC RESOURCE SERVICES

Project
PROJECT OLIVE
2780 LONG ROAD
BLOCK No. 1
LOT No. 50
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title
PROPOSED PHASE IB TESTING AREA

Project No.	
Date	02/04/2020
Scale	See Above
Drawn By	MA
Figure	14

8.0 BIBLIOGRAPHY

Adovasio, J.M. and D.R. Pedler
2014 Peopling of the Americas. In *Encyclopedia of Global Archaeology,* edited by C. Smith. Springer, New York, NY.

Anderson, D. G.
1990 The Paleoindian Colonization of Eastern North America. In *Early Paleoindian Economies of Eastern North America*, edited by K. B. Tankersley and B. L. Isaac. Research in Economic Anthropology, Supplement No. 5, JAI Press.

Archaeological Consulting Experts, LLC
2017 *Phase I Cultural Resource Investigations for the Hidden Meadow Trail Apartments Project Town of Grand Island, Erie, County, NY.* On file on the NYS CRIS.

Bien, Julius & Company
1895 *Niagara and Erie Counties, NY*. David Rumsey Collection.

Brown, J.A. and R.K. Vierra
1983 What Happened in the Middle Archaic? In *Archaic Hunters and Gatherers in the American Midwest*, edited by J.L. Phillips and J.A. Brown, pp. 105-195. Academic Press, New York.

Burr, David
1829 *Map of the County of Erie, New York.* David Rumsey Online Cartography Collection

Butterbaugh Archaeological Consulting, Inc.
2005 *Phase I Archaeological Report for the Long Road Subdivision, Town of Grand Island, Erie County, NY*. On file on the NYS CRIS.

Chapman, Jefferson
1977 *Archaic Period Research in the Lower Little Tennessee Valley-1975; Icehouse Bottom. Harrison Branch*. Thirty Calloway Island._Report of Investigations No. 18 Anthropology, University of Tennessee, Knoxville, and Anthropology No. 13, The Tennessee Valley Authority.

Chomko, S.A. and Crawford, G.W.
1978 *Plant husbandry in Prehistoric Eastern North America*. New Evidence for its Development. American Antiquity 43:405-408

Clark Patterson Lee
2016 Water District No. 5 Site Plans, Drawings S-01 through S-05. Rochester, NY.

Cowan, C. Wesley
1985 *Understanding Plant Husbandry in Eastern North America: Lessons from Botany, Ethnography, and Archaeology*. In Prehistoric Food Production in North America, edited by R. I. Ford, pp. 205-243. Anthropological Papers No. 75, University of Michigan, Museum of Anthropology, Ann Arbor.

Daniel, R and M. Wiesnbaker
1987 *Harney Flats: A Florida Paleo-Indian Site*. Raymond Publishing. Farmingdale, NY.

Delcourt, H.R. and P.A. Delcourt
1985 Dynamic landscapes of East Tennessee: an integration of paleoecology, geomorphology, and archaeology. University of Knoxville, Tennessee. *Studies in Geology* 9:191-220.

Duel Archaeology and CRM, Inc.
2016 *Phase IA/IB Cultural Resource Investigation for the proposed Elderwood Grand Island Development Project, Town of Grand Island, Erie County, New York.* On file at the NYS CRIS.

Eisenstadt, Peter and Laura-Eve Moss (Editors)
2005 *The Encyclopedia of New York State*. Syracuse University Press, Syracuse, NY

French, John Homer
1860 Historical and Statistical Gazetteer of New York State. Syracuse, NY.

Frison, G.C., and Todd, L.C.
1986 *The Colby Mammoth Site: Taphonomy and Archaeology of a Clovis Kill in Northern Wyoming*. University of New Mexico Press, Albuquerque.

Gardner, William
1974 *The Flint Run Paleo-Indian Complex: A Preliminary Report, 1971-1973 Seasons*. The Catholic University of America, Archaeology Laboratory, Occasional Publications 1.

1983 Stop me if you've heard this one before: The Flint Run Paleoindian complex revisited. *Archaeology of Eastern North America* 11:49-64.

Geil, Samuel and Robert Pearsall Smith
1854 *Map of Erie County, NY.* Library of Congress

Hansen and Associates Archaeological Consulting, Inc.
1987 *Stage 1 Cultural Resource Investigation for the Grand Park Vue Subdivision, Town of Grand Island, Erie County, NY.* On file on the NYS CRIS.

Haynes, C.V.
1966 *Elephant Hunting in North America*. Scientific American, 214:104-112

Heritage Preservation and Interpretation, Inc.
2005 *Cultural Resource Investigations Proposed Bike Trail Connect Project Buckhorn Island State Park, Town of Grand Island, Erie County, NY*. On file on the NYS CRIS.

2007 *Phase 1 A/B Cultural Resource Investigation, Niagara Falls Campground, Town of Grand Island, Erie County, New York.* On file on the NYS CRIS.

Jefferies, R.W.
1990 *Archaic Period,* In *The Archaeology of Kentucky: Past Accomplishments and Future Directions, Vol. 1*, edited by D. Pollack, pp. 143-246. Kentucky Heritage Council, State Historic Preservation Comprehensive Plan Report No. 1, Frankfort, Kentucky.

Justice, Noel
1987 *Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States: A Modern Survey and Reference*. Indiana University Press, Bloomington.

Lord, Philip
1979 Prehistoric Archaeology and the New York State Museum. Leaflet 22.

Martin, P.S. and Klein, R. G.
1984 *Quaternary Extinctions: A Prehistoric Revolution*. University of Arizona Press, Tucson, Arizona.

Moss, Laura-Eve (ed.)
2005 *Encyclopedia of New York State.* Syracuse University Press, Syracuse, NY.

NETR – Online @ https://www.historicaerials.com/
1959 Aerial Photograph
1972 Aerial Photograph

New York Archaeological Council
1994 *Standards for Cultural Resource Investigations and the Curation of Archaeological Collections in New York State*. New York Archaeological, Albany, New York.

New York State Discover GIS Data @ https://orthos.dhses.ny.gov/#
1995 Ortho Aerial Photograph

New York State Museum. New York State Historic Preservation Office Website
2016 Archaeological Sensitivity Map. Accessed at https://cris.parks.ny.gov.

New York Public Library Digital Collections
1866 Steward & Stone, New Topographical Atlas of Erie County, NY. Philadelphia, PA.
https://digitalcollections.nypl.org/items/510d47e3-1c3c-a3d9-e040-e00a18064a99

Niagara Falls Info
2020 https://www.niagarafallsinfo.com/niagara-falls-history/niagara-falls-geology/upper-niagara-river-islands/grand-island/. Accessed February 03, 2020.

NY State Office of Parks Recreation and Historic Preservation, Historic Preservation Office
2005 *New York State Historic Preservation Office, Phase I Archaeological Report Format Requirements.*

Panamerican Consultants, Inc.
2000 *Phase I Cultural Resources Investigation for the Proposed Adult Living Facility Along Grand Island Boulevard, Town of Grand Island, Erie County, New York.* On file on the NYS CRIS.

2004 *Phase I Cultural Resources Investigation for the Proposed Upper Niagara Remote Video Surveillance System Project in the City of Buffalo and the Towns of Grand Island, Hamburg, and Tonawanda, Erie County and the City of Niagara Falls, Niagara County, NY.* On file on the NYS CRIS.

2008 *Phase I Cultural Resources Investigation for the Proposed Long Road Cellular Communications Tower, Town of Grand Island, Erie County, NY*. On file on the NYS CRIS.

2010 *Phase I Cultural Resources Investigation for the Proposed Grand Island 2 Cellular Communications Tower, Town of Grand Island, Erie County, NY*. On file on the NYS CRIS.

2017 *Phase 1 Cultural Resources Investigation For The Proposed 8.7-Acre Active Solar Project, 126 Industrial Drive, Town Of Grand Island, Erie County, New York*. On file on the NYS CRIS.

Parker, Arthur C.
1920 *The Archaeological History of New York, Parts 1 and 2*. New York State Museum Bulletin Nos. 235, 236, 237, 238. University of the State of New York, Albany, NY.

1920 *The Archaeological History of New York, Part 21*. New York State Museum Bulletin Nos. 237, 238, University of the State of New York, Albany, NY.

Perrelli, D.J.
2017 *Phase 1 Archaeological Reconnaissance Survey of the Proposed Apartment Building Complex at 2984 Grand Island Boulevard*. On file on the NYS CRIS.

Petersen, J.
1991 *Archaeological Testing at the Sharrow Site: a Deeply Stratified Early to Late Holocene Cultural Sequence in Central Maine*. Occasional Publications in Maine Archaeology # 8. Maine Archaeological Society and Maine Historic Preservation Council, Augusta.

Pielou, E.C.
1992 *After the Ice Age: The Return of Life to Glaciated North America*. University of Chicago Press, Chicago.

Ritchie, William A.
1971 *A Typology and Nomenclature for New York Projectile Points.* Revised edition. New York State Museum Bulletin 384. The University of the State of New York, Albany.

1980 *The Archaeology of New York State.* Harbor Hills Books, Harrison, NY

1994 *The Archaeology of New York State*. Revised Edition. Purple Mountain Press, Fleishmann's New York.

Ritchie, William A. and Robert E. Funk
1973 *Aboriginal Settlement Patterns in the Northeast.* Memoir 20, New York state Museum and Science Service, The University of the State of New York, The State Education Department, Albany, NY.

Starbuck, D. R. and C. E. Bolian (eds.)
1980 *Early and Middle Archaic Cultures in the Northeast. Occasional Publications in Northeastern Anthropology*, No. 7. Dept. of Anthropology, Franklin Pierce College, Ringe, New Hampshire.

Stone & Steward
1866 *New Topographical Atlas of Erie County, NY. Philadelphia, PA*. New York Public Library Digital Collections. https://digitalcollections.nypl.org/items/510d47e3-1c3c-a3d9-e040-e00a18064a99

Tankersley, K. B., and Isaac, B. L.
1990 *Concluding Remarks on Paleoecology and Paleoeconomy. In Early Paleoindian Economies of Eastern North America*, edited by K. B. Tankersley and B. L. Isaac, pp. 337-355. Research in Economic Anthropology, Supplement No. 5, JAI Press.

Turner, Orsamus
1849 Pioneer History of the Holland Purchase of Western New York. Jewett, Thomas, & Co.: Buffalo, NY, and George H. Derby & Co.: Buffalo, NY.

1852 History of the Pioneer Settlement of Phelps & Gorham's Purchase, and Morris' Reserve. William Alling: Rochester, NY.

United States Department of Agriculture (USDA)
1968 Soil Survey of Erie County, New York.

United State Department of Agriculture (USDA)-Natural Resource Conservation Service (NRCS)
2017 Web Soil Survey of Erie County, New York. Accessed at http://websoilsurvey.nrcs.usda.gov.

United States Geological Survey (USGS)
1948 Grand Island, New York 7.5' Topographic Quadrangle.

Versaggi, Nina M.
1996 Prehistoric Hunter-Gatherer Settlement Models: Interpreting the Upper Susquehanna Valley. In A Golden Chronograph for Robert E. Funk, Occasional Publications in Northeastern Anthropology, No. 15: 129-140.

Versaggi, Nina M. and Timothy D. Knapp
2000 Steatite, Interaction, and Persistence: The Transitional Period of New York's Upper Susquehanna. Presented at the 65th Annual Meeting of the Society for American Archaeology. Philadelphia, PA.

Volk, Albert Volk
1915 *Map of Town of Grand Island, Part of the town of Amherst, Buffalo, V3, Plate No. 27*; New York City Public Library.

Watson, P. J.
1985 The Impact of Early Horticulture in the Upland Drainages of the Midwest and Midsouth. In *Prehistoric Food Production in North America*, edited by R. I. Ford, pp. 99-147. Anthropological Papers No. 75, University of Michigan, Museum of Anthropology, Ann Arbor, Michigan.

Watson, Traci
2017 Is theory about peopling of the Americas a bridge to far? *Proceedings of the National Academy of Sciences,* 114(22):5554-5557

Welcome to Grand Island New York
2020 "Welcome To Grand Island, New York". 2020. Grandislandny.Us. http://www.grandislandny.us/about_grand_island.php. Accessed February 03, 2020.

Whallon, R.
1974 Spatial Analysis of Occupation Surfaces II: the Application of Nearest Neighbor Approach. *American Antiquity* 59 (1):16-34.

Williams, L and R. Thomas
1982 The Early/Middle Woodland Period in New Jersey. In *New Jersey's Archaeological Resources: A Survey of Research Problems and Survey Priorities*, edited by Olga Chesler. New Jersey Department of Environmental Protection, Trenton.

APPENDIX A

Qualifications of Preparers

MICHAEL AUDIN, RPA

Archaeologist / Cultural Resource Specialist

Field Crew Management
Phase I, II and III Excavation
Human Remains/Burial Excavation
Site Preparation and Survey
Historic Research
Lithic Identification
Laboratory Analysis
Photographer/Field Illustration
Report Writing and Editing
Historic American Building Surveys

EDUCATION

Hunter College: M.A. Anthropology
William Paterson University: B.A. Anthropology
Archaeological Field School: Lenape Meadows, Somerset County Parks Commission, New Jersey

YEARS EXPERIENCE: 16

SUMMARY QUALIFICATIONS

Mr. Audin is a Registered Professional Archaeologist (RPA) who meets the Secretary of the Interiors Professional standards as an archaeologist and has been reviewed by several State Historic Preservation Offices as a Principal Investigator. Mr. Audin has over 16 years of professional experience in cultural resource management. Skills include extensive problem solving, management, analytical, evaluating, and creative resolutions. Management experience includes extensive customer relations, employee development, training, scheduling and mentoring staff.

Work experience includes coordination and implementation of archaeological/cultural resource assessments include NEPA Documentation, Environmental Assessments, Environmental Impact Statements, Section 106 Assessments, Phase I, II and III prehistoric and historic Archaeological Assessments, and Historic American Building Survey (HABS) photography and documentation. Created and implemented Archaeological Monitoring Plans, Scopes of Work, Research and Field Testing Plans, Programmatic Agreements, Memorandums of Agreement (MOA) and Memorandums of Understanding (MOU).

RELEVANT EXPERIENCE

Sailfish Warehouse Project, Phase IB & II Archaeological Survey, Montgomery, NY
Principal Investigator for prehistoric/historic site investigation for NY SEQR Review. Directed research, assessed prehistoric/historic archaeological potential, conducted supplemental field testing for previously untested areas (1,000 shovel test pits and 16 shovel test units), artifact analysis, writing and preparation of reports, editing and produced reports for submission. Identified the multiple area of potential prehistoric occupation.

New Jersey Executive State House (NJESH) Renovation Project, Phase IA & Archaeological Monitoring, Trenton, NJ
Principal Investigator for Phase IA Archaeological Assessment for the NJESH, a part of the State House Historic District, listed on the State and National Register of Historic Places. Coordinated and edited Phase IA Archaeological Survey. Developed the archaeological monitoring plan for monitoring during the excavation of geotechnical test pits and utilities trenching. The research and monitoring was conducted in advance of planned renovations and restorations to the NJESH building. Identified multiple historic archaeological sites.

45 Broad Street, Phase IA Archaeological Survey & Archaeological Monitoring, New York, NY
Principal Investigator for Phase IA Archaeological Assessment and archaeological monitoring for potential

17th-century features in advance of a proposed development site in Lower Manhattan. Coordinated and edited Phase IA Archaeological Survey and lead consultation for archaeology with the New York City Landmarks Preservation Commission to ensure project compliance. Developed archaeological monitoring plan and oversaw archaeological monitoring.

Gordon Road Phase IA & IB Archaeological Surveys, Robbinsville Township, NJ
Principal Investigator for Phase IA Archaeological Assessment and Phase IB field testing for archaeological resources in advance of warehouse development, including analysis of archaeological sensitivity, subsurface testing in areas of prehistoric sensitivity, post-excavation laboratory artifact processing and identification, and report writing and editing.

155 3rd Avenue Gowanus Canal Bulkhead and Cribbing Documentation, Brooklyn, NY
Principal Investigator for archaeological monitoring for test excavations conducted for the purpose of identifying the type of cribbing and bulkhead structure along the Gowanus Canal.

Gowanus Canal Remediation Project and Archaeological Monitoring, Brooklyn, NY
Principal Investigator for archaeological monitoring for debris removal and dredging in Turning Basin 4 of the National Register eligible nineteenth-century Gowanus Canal. Canal is currently a Superfund site and the remediation is coordinated by the US Environmental Protection Agency.

Southwest Park Block-12 Development, Phase IB & Archaeological Monitoring, Hoboken, NJ
Principal Investigator for Phase IB testing, archaeological monitoring in advance of stormwater retention park development in Hoboken, NJ. Recorded footings associated with an elevated railroad, nineteenth-century building foundations, and a Belgian Block cobblestone driveway. Wrote and implemented Memorandum of Agreement for project. Identified the North Hudson County Elevated Railway Footings historic archaeological site 28-Hd-54.

Green Brook Trail, Phase IB Archaeological Survey, Plainfield, New Jersey
Principal Investigator for New Jersey Historic Preservation Act and Freshwater Wetland Permit compliance. Conducted Phase IB archaeological survey in areas of prehistoric and historic archaeological sensitivity for the first section of a multi-use recreational trail. Completed field testing, artifact analysis, and report writing and editing.

Nissim Avenue Phase I & II Archaeological Survey, Bordentown, NJ
Principal Investigator for Phase I and Phase II survey of contributing prehistoric archaeological resources to the Abbot Farm Prehistoric Archaeological District in advance of residential development, including analysis of archaeological sensitivity, subsurface testing in areas of prehistoric sensitivity, and post-excavation laboratory artifact identification and cataloging. Project area is located within the Abbott Farm National Historic Landmark boundary. Identified the Nissiam Ave. prehistoric archaeological site 28-Bu-919.

Lincoln Industrial Park Phase IB Archaeological Survey, Piscataway, NJ
Principal Investigator for Phase IB survey on former Union Carbide/Dow Chemical property with team of HAZWOPER-qualified archaeologists to complete the testing. Testing consisted of over 1,000 shovel tests in areas of prehistoric sensitivity. Oversaw all aspects of fieldwork, artifact analysis, and report completion.

Riverside Buildings 4 & 5 Phase IB Archaeological Survey & Archaeological Monitoring, New York City
Principal Investigator for crew of eight (one supervisor and seven field technicians) responsible for archaeological monitoring, Phase IB shovel testing in areas of prehistoric sensitivity to determine absence or presence of prehistoric materials, and post-excavation laboratory work for a multimillion dollar development in Midtown Manhattan. Drafted memoranda and final reports for compliance with the New York City Landmark Preservation Commission's restrictive declaration.

Former Front Street Gas Works Site PSE&G Remediation Project, Archaeological Monitoring, City of Newark, NJ
Principal Investigator for historic site investigation for NJDEP Contaminated Site Remediation Project. Directed research, conducted field monitoring during excavation, writing and preparation of report, edited and produced report for submission. Discovered historic dock feature. Identified the Heddens Dock historic archaeological site 28-Ex-142.

FedEx Distribution Center Project, Phase I Archaeological Survey, Hamilton, NJ
Principal Investigator for prehistoric/historic site investigation for NJDEP Freshwater Wetlands Permit. Directed research, assessed prehistoric/historic archaeological potential, conducted field testing, artifact analysis, writing and preparation of report, editing and produced report for submission.

FedEx Distribution Center Project, Phase I Archaeological Survey, Montgomery, NY
Principal Investigator for prehistoric/historic site investigation for NY SEQR Review. Directed research, assessed prehistoric/historic archaeological potential, conducted field testing, artifact analysis, writing and preparation of report, editing and produced report for submission. Identified the Neelytown Road Historic Farmstead historic archaeological site USN Number 07112.000317.

Deerpark Substation Phase IB Survey, Orange County, New York
Principal Investigator for prehistoric supplemental Phase IB. Oversaw field testing, artifact analysis, conducted writing and preparation of report, editing and produced report for submission.

Pavilion at Locust Manor, Phase I Archaeological Survey, Jamaica, Queens, NY
Principal Investigator for prehistoric/historic site investigation for city housing development. Directed research, assessed prehistoric/historic archaeological potential, conducted field testing, writing and preparation of report, edited and produced report for submission.

Interstate Blvd. Development Project, Phase I Archaeological Survey, South Brunswick, NJ
Principal Investigator for prehistoric/historic site investigation for NJDEP Freshwater Wetlands Permit for warehouse development. Designed and directed research, assessed prehistoric/historic archaeological potential, conducted field testing (300 shovel test pits), artifact analysis, writing and preparation of report, edited and produced report for submission. Identified the Interstate Blvd./J. Dehart Farmstead historic archaeological site 28-Mi-266.

Princeton Pike Roadway Project, Phase I & II Archaeological Surveys, Lawrence, NJ
Principal Investigator for prehistoric/historic site investigation for NJDEP Freshwater Wetlands Permit. Directed research, assessed prehistoric/historic archaeological potential, conducted field testing, artifact analysis, writing and preparation of report, edited and produced report for submission.

Prasville Mills Restroom Project, Archaeological Monitoring, New Jersey
Principal Investigator for State and National Register listed Prallsville District archaeological investigation for NJ State Park improvements. Directed research, assessed prehistoric/historic archaeological potential, conducted field monitoring, artifact analysis, writing and preparation of report, edited and produced report for submission.

St. Marks AME Church Cemetery Project, Queens, New York
Principal Investigator for former African American cemetery on residential development site. Designed archaeological monitoring plan and scope of work, conducted archaeological monitoring and human remains excavation for mid-19th- to mid-20th-century cemetery in Queens.

Gloucester Premium Outlets, Phase I Cultural Resource Survey, Gloucester Township, NJ
Principal Investigator for prehistoric/historic site investigation for NJDEP Freshwater Wetlands Permit for 65 acre property. Directed research, assessed prehistoric/historic archaeological potential, conducted field testing, directed artifact analysis, writing and preparation of report, edited and produced report for submission.

The Basilica of St. Patrick's Old Cathedral Mausoleum Project, Archaeological Monitoring, New York
Principal Investigator for and archeological monitor for human remains during excavation for new mausoleum in southern part of a historic cemetery in New York City. Designed Monitoring plan, conducted monitoring for human remains during backhoe excavation, supervision of two archaeological assistants, determined method of avoidance or removal of human remains encountered and eventual reburial of disinterred remains, report writing and preparation

Washington Crossing Historic Park, Phase IB Archaeological Survey, Washington Crossing, Pennsylvania
Principal Investigator for prehistoric/historic site investigation for PHMC historic site drainage improvements. Directed research, subsurface field testing, artifact analysis, writing and preparation of report, edited and produced report for submission.

Hallets Court Senior Housing Project, Phase I Archaeological Investigation, Queens, NY
Principal Investigator for prehistoric/historic site investigation for city housing development. Directed research, subsurface field testing, writing and preparation of report, edited and produced report for submission.

Johnson Veterans Hospital Parking Garage Project, Phase IA & Phase IB Cultural Resource Investigation, Clarksburg, WV
Principal Investigator for prehistoric/historic site investigation for Section 106 Compliance and NEPA checklist. Conducted research, assessed prehistoric/historic archaeological potential, field testing of APE for prehistoric/historic archaeological sites, conducted site visit, writing and preparation of reports, edited and produced report for submission.

Gowanus Canal Historic Bulkhead Documentation, Brooklyn, NY
Principal Investigator for documentation of a historic bulkhead at four sites on the Gowanus Canal. Conducted field testing, photographic documentation, measured drawing, writing and preparation of report for submission.

Amtrak, High Speed Rail Improvements Project, Trenton to New Brunswick, NJ
Principal Investigator produced an prehistoric and historic archaeological sensitivity assessment and monitoring for Section 106 review of rail improvements for 23 mile section of the Northeast Corridor. Conducted research, site visits, writing and preparation of report.

Verizon Wireless Cell Tower Upgrades, Various Sites in NJ
Researcher/site reviewer for Section 106 reviews to upgrade cell tower antennas. Conducted research, site reconnaissance, writing and preparation of report.

NJ Transit, Phase IA Archaeological Survey, Train Station Upgrades, Elizabeth & Perth Amboy, NJ
Principal Investigator for Phase IA Investigation. Evaluation of handicap and other facility upgrades for NJ TRANIT train station. Conducted research, site reconnaissance, writing and preparation of report, edited and produced letter report for submission NJ SHPO.

St. Marks AME Church Cemetery Project, Queens, New York
Field director for unanticipated discovery of human remains during construction activities in former African American cemetery. Conducted archaeological monitoring and human remains excavation for mid-19th- to mid-20th-century cemetery in Queens.

The Basilica of St. Patrick's Old Cathedral Cemetery Stabilization Project, Archaeological Monitoring, NY
Principal Investigator for and archeological monitor for Landmarks Preservation Commission permit for brick wall stabilization around the north part of a historic cemetery in New York City. Conducted research, monitoring for human remains during backhoe excavation for new concrete supports, supervision of two archaeological assistants, determined method of avoidance or removal of human remains encountered and eventual reburial of disinterred remains, report writing and preparation.

Standard Chlorine Chemical Company, Archaeological Monitoring, Kearny, New Jersey
Principal Investigator for archaeological monitoring during construction of a 7,000 foot slurry wall as part of the Interim Action Work Plan for NJDEP and USEPA Superfund site. Conducted monitoring during backhoe trenching and screened samples for prehistoric lithic materials, writing and preparation of report, edited and produced report for submission. Identified the SCCC prehistoric archaeological site (28-Hd-44).

Renaissance Plaza Project, Phase I Archaeological Survey, Egg Harbor City, New Jersey
Principal Investigator for prehistoric/historic site investigation for NJ Pinelands Commission. Conducted research, conducted subsurface field testing for historic features, writing and preparation of report, edited and produced report for submission.

Alpha Water Works Upgrades Project, Phase II Archaeological Survey, Alpha, New Jersey
Principal Investigator for prehistoric/historic site investigation of prehistoric/historic archaeological site 28-Wa-673 for NJDEP Environmental Infrastructure Trust funding program. Conducted research, excavation of shovel test pits and units, laboratory analysis of artifacts, writing, preparation, editing and producing report for submission. The site was not recommended as eligible for National Register.

State University of New York, Ulster Campus, Phase I Archaeological Survey, Marbletown, New York
Principal Investigator for prehistoric/historic site investigation for NYS SEQR reviewed project. Conducted research, assessed prehistoric/historic archaeological potential, field testing, writing and preparation of report, edited and produced report for submission.

NJ Transit, Unanticipated Discovery Investigation, Market Street Garage, Paterson, NJ
Principal Investigator for unanticipated historic structure uncovered during excavation for a drainage pipe. Field work consisted of the excavation and documentation of a historic industrial feature partially exposed during excavation work. Recommended preservation in place with appropriate fill materials and submitted a technical memo to NJDEP SHPO.

EZ Automotive Services, Phase IA & IB Archaeological Surveys, Robbinsville, New Jersey
Principal Investigator for prehistoric/historic site investigation for NJDEP. Conducted research, assessed prehistoric/historic archaeological potential, conducted field testing, writing and preparation of reports, edited and produced report for submission.

The Basilica of St. Patrick's Old Cathedral Cemetery Stabilization Project, Archaeological Monitoring, NY
Principal Investigator for and archeological monitor for Landmarks Preservation Commission permit for brick wall stabilization around the south part of a historic cemetery in New York City. Conducted limited research, monitoring for human remains during backhoe excavation for new concrete supports, supervision of one

archaeological assistant, determined method of avoidance or removal of human remains encountered and eventual reburial, report writing and preparation.

Former Koppers Superfund Site, MOA, Newport, Delaware
Co-Author of Memorandum of Agreement between all interested parties for the property.

Pennsauken Country Club Water Reuse Project, Phase I Archaeological Survey, Pennsauken, New Jersey
Principal Investigator for prehistoric/historic site investigation for NJDEP Environmental Infrastructure Trust funding program. Conducted research, preparation of site, excavation of shovel test pits, laboratory analysis of artifacts, writing, preparation, editing and producing report for submission.

NYS Route 440 Pole Relocation Project, Phase I Archaeological Survey, Staten Island, New York
Principal Investigator for prehistoric/historic site investigation for Department of Transportation NEPA documentation and Section 106 reviewed project. Conducted research, assessed prehistoric/historic archaeological potential, conducted field testing, writing and preparation of report, edited and produced report for submission.

World Trade Center, Phase III, Potential Human Remains Recovery, Staten Island, New York
Field crew for recovery of potential human remains for the New York City Office of the Chief Medical Examiner. Conducted materials screening for human remains and artifacts relating to the 2001 attacks on the World Trade Center.

SCCC, Phase IB Cultural Resource Investigation, Kearny, New Jersey
Principal Investigator for historic investigations for NJDEP and USEPA Superfund site. Conducted additional research too prove the Jersey City Water Works was located outside of the project area and conducted backhoe trenching for historic drainage features related to the Hackensack Meadowlands, writing and preparation of report, edited and produced report for submission.

Lanning Square Elementary School, Level III HABS, Camden, New Jersey
Complier/Photographer for EO215 compliance for NJ Schools Development Authority. Conducted level III Historic American Building Survey (HABS) including photographic documentation of the Broadway Episcopal Methodist Church Parsonage to mitigate the proposed demolition of this building. The HABS was requested by the NJ HPO to satisfy the EO215 review.

Access to Regional Core (ARC), 3-D Laser Scanning, New York, New York
Field crew for documentation of historic and non-historic buildings for Section 106. Conducted 3-D laser scanning of all buildings in the project area. Collected field data of varying resolutions for buildings in project area, historic buildings were recorded at higher resolution.

Jersey City Walkway and DMAVA Park, Phase IA Archaeological Survey, Jersey City, New Jersey
Principal Investigator for prehistoric/historic site investigation for NJDEP and Section 106. Conducted research, assessed prehistoric/historic archaeological potential, monitored geotechnical sub surface investigation for archaeological remains, writing and preparation of report, edited and produced report for submission. Identified historic dock, cribbing and road features.

Route 33 Interchange Improvements, Phase I Archaeological Survey, Palmer Township, Pennsylvania
Principal Investigator for prehistoric/historic site investigation for Pennsylvania Department of Transportation and Section 106 reviewed project. Conducted research, site excavation of shovel test pits, laboratory analysis of artifacts, writing and preparation of report, and editing report for submission.

USDA, Health-Based Plant Genomics Facility, Phase IB Archaeological Survey, Cornell University, Ithaca, New York
Co-Principal Investigator for prehistoric/historic site investigation as part of a Section 106 Assessment for the addition to the Plant Genomics Laboratory Building site. Conducted research, excavation of shovel test pits, laboratory analysis of artifacts, writing and preparation of report, edited and produced report for submission.

SCCC, Phase IA Cultural Resource Investigation, Kearny, New Jersey
Principal Investigator for prehistoric/historic site investigation for NJDEP and USEPA Superfund site. Conducted research, assessed prehistoric/historic archaeological potential, writing and preparation of report, edited and produced report for submission.

GAC Adsorption Plant, Phase I Archaeological Survey, Pennsauken, New Jersey
Principal Investigator for prehistoric/historic site investigation for NJDEP Environmental Infrastructure Trust funding program. Conducted research, preparation of site, excavation of shovel test pits, laboratory analysis of artifacts, writing and preparation of report, edited and produced report for submission.

Penn Regional Business Center III, Phase I Archaeological, Smithfield, Pennsylvania
Principal Investigator for prehistoric/historic site investigation for Pennsylvania Funding Grant Application. Conducted research, preparation of site, excavation of shovel test pits, laboratory analysis of artifacts, writing and preparation of report, edited and produced report for submission.

Montauk Theater, Level III HABS and Architectural Salvage Plan, Passaic, New Jersey
Principal Investigator for EO215 compliance for NJ Schools Development Authority. Conducted level III Historic American Building Survey (HABS) including photographic documentation and an architectural Salvage Plan of the Montauk Theater to mitigate the proposed demolition of this building. The HABS and Salvage Plan were requested by the NJ HPO to satisfy the EO215 review.

Former Koppers Superfund Site, Additional Phase IB, Newport, Delaware
Crew chief and OSHA Site Safety Officer for prehistoric/historic site investigation for EPA compliance for superfund site during three month phase IB auger testing conducted by 13 archaeologists. Teamed with John Milner and Associates. Work included over 1,700 phase IB augers in a tidal marsh. Additional work included field tech training, and safety oversight. Identified multiple prehistoric and historic sites on site.

Dredge Stockpile Site, Phase I Archaeological Survey, Harmony, New Jersey
Field director, research coordinator, lab director and photographer for prehistoric/historic site investigation for Section 106 review of stockpile site for dredge materials from FEMA. Field duties include preparation of site, excavation of 32 shovel test pits and site survey. Post field work included laboratory analysis of artifacts, writing of sections of report and prepared, edited and produced report for submission.

Lowes, Phase I Archaeological Survey, Mansfield, Pennsylvania
Field director, research coordinator, lab director and photographer for prehistoric site investigation for review for big box retail store. Field duties include site preparation, excavation 60 shovel test pits of site and survey. Post field work included laboratory analysis of artifacts, writing of sections of report and prepared, edited and produced report for submission.

Former Jacobs Aircraft Engine Factory, HABS, Lower Pottsgrove, Pennsylvania
Principal Investigator/photographer for NPDES permit compliance. Conducted low level Historic American Building Survey (HABS) including photographical documenting of the former Jacobs Aircraft Engine Factory

and Administrative Building to mitigate the proposed demolition of these buildings. The photographic documentation was requested by PHMC to satisfy the NPDES permit review.

Queensboro Plaza, Phase I Archaeological Survey, Long Island City, New York
Field director, research coordinator, lab director and photographer for historic site investigation for cultural resources section 106 for a NEPA assessment and LPC review for bike path in the Queensboro Plaza. Includes an archaeological assessment, field testing and architectural evaluation of the current property. Field work included site preparation, the excavation of a two meter by two meter test pit and site survey. Post field work included laboratory analysis of artifacts, writing of sections of report and prepared, edited and produced report for submission. Identified historic trolley rail alignment during field work.

Lowes, Phase IB Supplemental Archaeological Survey, Montgomery, New York
Field director, research coordinator, lab director and photographer for prehistoric/historic site investigation for SEQRA review for retail store. Field work included the preparation of site, excavation of 60 shovel test pits and site survey. Post field work included laboratory analysis of artifacts, writing of sections of report, prepared, edited and produced report for submission.

Green Brook Trail, Application for Project Authorization/Preliminary Assessment, Plainfield, Green Brook, and North Plainfield, New Jersey
Principal Investigator for New Jersey Historic Preservation Act and Freshwater Wetland Permit compliance. Completed and submitted an Application for Project Authorization for Green Brook Park and Washington Park Historic District for a multi-use recreational trail. Additionally, completed a preliminary archaeological assessment for the proposed seven-mile trail, including research, analysis, and report writing.

Public School #3, Archaeological Monitoring, West New York, New Jersey
Archaeological Monitor/researcher for NJ Executive Order 215 Compliance for 1 day of archaeological monitoring for human remains and research on school site that found headstone during excavation. Post field activities included report writing for submission to state.

Former Koppers Superfund Site, Phase IB and II Archaeological Survey, Newport, Delaware
Crew chief and OSHA Site Safety Officer for EPA compliance for superfund site during six month phase IB and II field excavations conducted by 20 archaeologists, teamed with John Milner and Associates. Work included setting of testing grid and field testing of over 3000 phase IB auguring and STP units and over 180 phase II units. Additional work included lab work, field tech training, and safety oversight. Identified numerous prehistoric archaeological site.

Bronx River Park, Phase IA Archaeological Survey, Bronx, New York
Research coordinator, researcher and report production for New York City Parks Department for New York City Landmarks Preservation Commission Compliance. Assessed park land for prehistoric and historic archaeological potential.

USDA, Health-Based Plant Genomics Facility, Cornell University, Ithaca, NY.
Research coordinator, researcher and report production for archaeological resources Section 106 Assessment as part of a NEPA Screening on the Plant Genomics Laboratory Building site.

Weeksville Village, Phase IB Archaeological Monitoring, Brooklyn, New York
Archaeological Monitor for SEQRA review for village cultural center. Performed field duties, with Joan Geismar. Work included monitoring of back hoe trenching for foundations, yard features and artifact deposits associated with the Huntefly Houses.

Edgewater Colony, Phase II Archaeological Survey, Edgewater, New Jersey
Field director and lab director for or EIT storm water improvements loan consisting of the preparation of a Phase II prehistoric/historic site investigation. Included the direction of two field technicians excavating a total of 8 standard test units, photographer and the coordination of lab work. Other post-field responsibilities include writing sections, preparation and production of the final report for submittal to New Jersey DEP Municipal Finance and Technical Services.

Portion of the Northeast Business Park, Phase IA Archaeological Survey, Washington Township, New Jersey
Research coordinator, researcher, and report production for New Jersey Wetlands Permit. Assessed site for prehistoric and historic archaeological sensitivity.

Creighton Farm Bridge Crossing, Phase I Archaeological Survey, Willistown, Pennsylvania
Field director, research coordinator, lab director, photographer and report preparation for Army Corps of Engineers Permit. Post field work included laboratory analysis of artifacts, assisting with the writing, prepared, edited and produced report.

Camp Laughing Water, Phase I Archaeological Survey, New Hanover and Upper Fredrick, Pennsylvania
Field director, research coordinator, lab director, photographer and report preparation for Army Corps of Engineers Permit. Post field work included laboratory analysis of artifacts, assisting with the writing, prepared, edited and produced report.

Camp Hidden Falls, Phase I Archaeological Survey, Delaware and Lehman Townships, Pennsylvania
Field director, research coordinator, lab director, photographer and report preparation for Army Corps of Engineers Permit. Post field work included laboratory analysis of artifacts, assisting with the writing, prepared, edited and produced report.

Select Sires, Phase I Archaeological Survey, Eaton, Pennsylvania
Field director, research coordinator, lab director, photographer and report preparation for Pennsylvania section 105 Permit. Post field work included laboratory analysis of artifacts, assisting with the writing, prepared, edited and produced report.

Tournament World, Phase IB Archaeological Survey, Montgomery, New York
Field director, research coordinator, lab director, and photographer for SEQRA review. Field assessment for prehistoric and historic archaeological sites. Post-field work included laboratory analysis of artifacts, assisting with the writing, prepared, edited and produced report. Identified prehistoric archaeological site.

Former Old First Presbyterian Church Cemetery, Phase III Data Recovery, Newark, New Jersey
Project Manager/Field Director
Responsibilities included:

- Over sight of all field activities for 2.2 acre cemetery excavation
- Preparation and implementation of a comprehensive field plan for the locating human remains and associated artifacts
- Hiring and managing a field staff of 35
- Directing and coordinating sub contractor with field staff of 30
- Directing and coordinating 4 backhoes on site to move overburden and back fill site
- Over sight of cataloging all burials and artifacts
- Laboratory analysis of artifacts
- Writing, coordinating and editing of final report

Circulations Improvement Project, Phase IA and IB Archaeological Survey, Newark, New Jersey
Field director, research coordinator, photographer and lab director for NJ Executive Order 215 Compliance. Phase I background investigation and Phase IB field testing. Work included coordinating conducting research, conducting photographic pedestrian survey site, and conducting field testing. Post field work included laboratory analysis of artifacts and preparation of the final reports. Report preparation included writing sections of the report, preparation and production of final report for submittal.

Edgewater Colony, Phase IB Archaeological Survey, Edgewater, New Jersey
Field director, research coordinator, and photographer for Environmental Infrastructure Trust Financing Program (EIT). Preparation of a Phase IB prehistoric/historic site investigation. Included the direction of three field technicians digging a total of 139 standard test pits, project coordination with the principal investigator, photographer and the coordination of lab work. Other post-field responsibilities include assisting with the writing, preparation and production of the final report.

Former Central Railroad Terminal, Archaeological Monitoring, Newark, New Jersey
Crew Chief/Project Coordinator Application for project authorization compliance of 6 week archaeological monitoring during demolition of former railroad terminal for SHPO resolution on application for project authorization. Monitor for human remains associated with the Old First Presbyterian Church cemetery, identifying, excavating, cataloging and turn over to mortician for reburial. Post field work included lab analysis of artifacts.

Regional Biocontainment Laboratory – Newark Center, University of Medicine and Dentistry of New Jersey, Newark, New Jersey – Researcher and report writer for cultural resources section of Environmental Assessment in accordance with the requirements of NEPA for the construction of a new Regional Biocontainment Laboratory under a grant form the National Institutes of Health.

Newark Downtown Core Redevelopment and Circulations Improvement Plan, Newark, New Jersey
Responsibilities included:

- Preparing a multi-phased strategy for investigating, testing and mitigating the project area
- Conducting preliminary research regarding various aspects of the project area, including possible intact remains within the former First Presbyterian Church cemetery
- Supervising research
- Conducting field photo reconnaissance and preliminary visual assessment of all properties potentially eligible for listing on the State and National Register of Historic Places that may be impacted by the proposed project
- Contributing to the Application for Project Authorization regarding the proposed demolition of five historic structures located within the Four Corners Historic District

NJSCC School Development Program, New Jersey
Crew Chief, researcher, photographer and report writing and production for NJ Executive Order 215 Compliance and NJSCC Guidelines. Participated in the development and redevelopment of 20 new and existing school sites located throughout New Jersey. Responsibilities included:

- Conducting and overseeing background research at the New Jersey Historic Preservation Office, the New Jersey State Museum and local archives
- Conducting field photo reconnaissance and preliminary visual assessment of all properties potentially eligible for listing on the State and National Register of Historic Places that may be impacted by the proposed project

- Preparation and assistance in writing of the Cultural and Historical Resource Assessment section of Environmental Assessment and Environmental Impact Statement Reports and Phase IA background investigations
- Overseeing report production and preparing maps and figures
- Producing for internal departments/clients memos, letters and other documentation outlining potential issues and possible recommendations.

Pen Del Development, Phase IB and II, Pemberton, New Jersey
Field/Laboratory Technician of a Phase I & II prehistoric site investigation/excavation. Field responsibilities also included photographer and mapping excavation locations using GPS equipment. Laboratory Technician responsibilities included; cleaning, cataloging and photographing all artifacts. Other post-field responsibilities included assisting with the preparation and production of the final cultural resource report for submittal to New Jersey HPO.

Field School, Lenape Meadows, Phase II, Basking Ridge, New Jersey
Field and Laboratory Technician for phase II prehistoric excavation. Field work included daily preparation of site, field excavations, documentation of artifact finds, field crew management and the closing up the site for the winter. Laboratory work included cleaning, identifying, cataloging and photographic documentation of all artifacts.

Lithics Identification Project, William Paterson University, New Jersey
Volunteer. Conducted laboratory analysis, identification and cataloging, of over 5,000 stone fragments from the Wallkill River basin in Northern New Jersey, submitted to Dr. Janet Pollak. Research included identifying and cataloging human produced stone flakes and tools vs. naturally altered stone.

SELECTED PUBLICATIONS

Phase IA Cultural Resource Survey, Standard Chlorine Chemical Company Site, Interim Response Action Workplan, Town of Kearny, Hudson County, New Jersey. Michael Audin, RPA, Principal Investigator, 2009. MS on file at NJSHPO, Trenton, NJ.

Phase I Cultural Resource Investigation GAC Adsorption Plant, Pennsauken, Camden County, New Jersey. Michael Audin, RPA, Principal Investigator, 2009. MS on file at NJSHPO, Trenton, NJ.

Historic American Building Survey for the Montauk Theater, Passaic, Passaic County, New Jersey. Michael Audin, RPA, Principal Investigator, 2009. Submitted to the NJ HPO, Trenton, NJ.

Phase I Archaeological Investigation Montgomery Towne Square, Montgomery, Orange County, New York. Ludomir Lozny Principal Investigator, Michael Audin, and Sarah Hlubik, 2007. MS on file at OPRHP, Pebbles Island, NY.

Phase II Archaeological Investigation of the Edgewater Colony, Edgewater, Bergen County, New Jersey. Ludomir Lozny PI, Michael Audin, and Sarah Hlubik, 2007. MS on file at NJSHPO, Trenton, NJ.
Phase I Archaeological Investigation Eaton, Wyoming County, Pennsylvania. Ludomir Lozny PI, Michael Audin, and Erol Kavountzis, 2006. Ms on file at PHMC, Harrisburg, Pa.

Phase III Cemetery Excavation, Old First Presbyterian Church, Newark Downtown Core Redevelopment, Newark, Essex County, New Jersey. Michael Audin, Erol Kavountzis, and Sarah Hlubik, 2005. Manuscript on file at NJSHPO, Trenton NJ.

MICHAEL AUDIN, RPA
Archaeologist / Cultural Resource Specialist

AWARDS
NJ Historic Preservation Award, Innovative Techniques in Archaeology, May 2013

PRESENTATIONS
2011 "New Jersey's Iron Coffins" presented at the Archaeological Society of New Jersey Meeting.

2009 "The Montauk Theater: Last of the Seven Passaic Theaters" presented to a William Paterson University, Class on Material Culture.

2007 "Excavations at the Old First Presbyterian Cemetery in Newark, NJ" presented to William Paterson University's Anthropology Club.

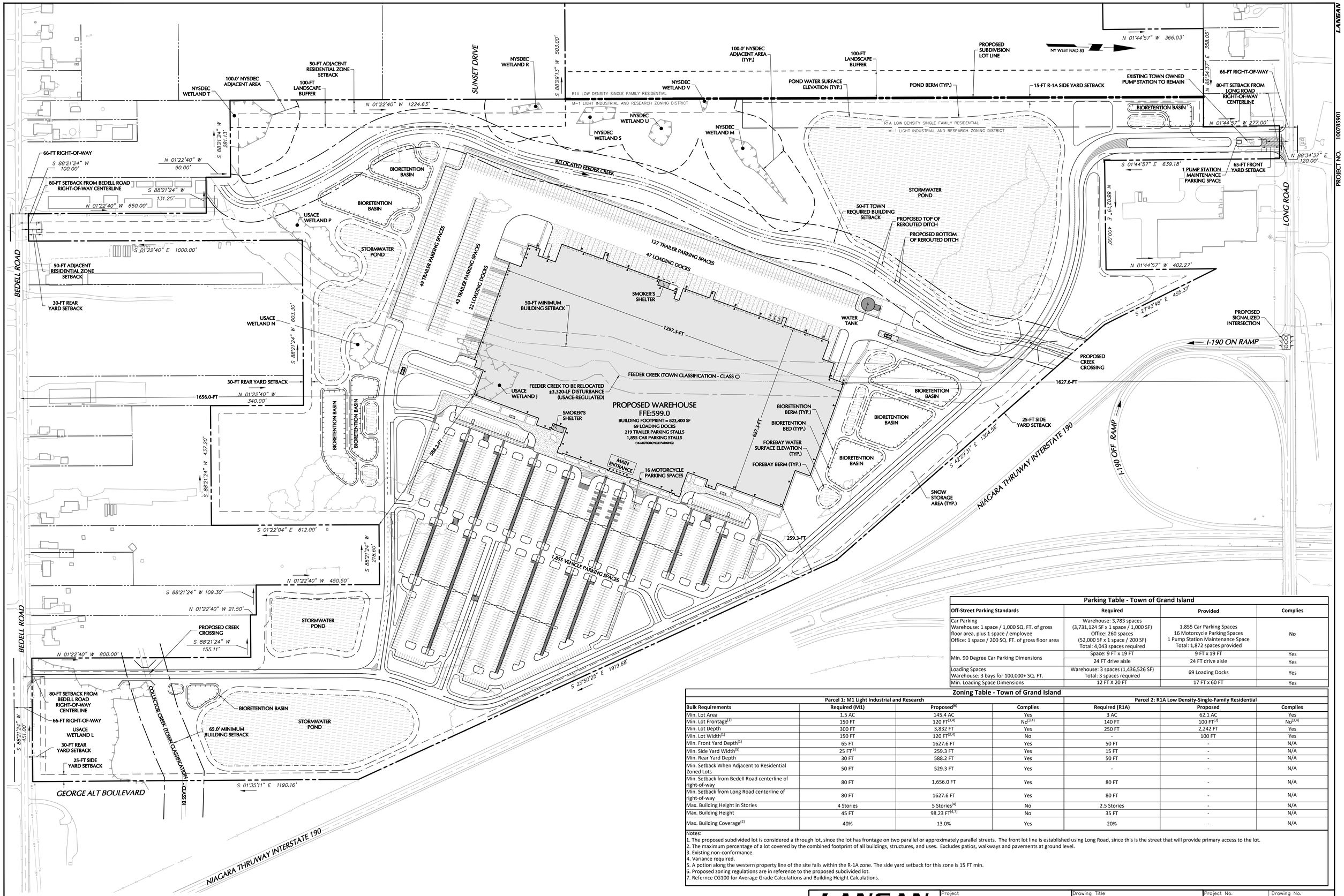
SUMMARY OF PROFESSIONAL ACTIVITIES
Mr. Audin has conducted field work in New Jersey, New York, Pennsylvania, Connecticut, Delaware and West Virginia. He is the author or co-author of over 150 archaeological/cultural resource reports in New Jersey, New York, Pennsylvania and West Virginia. In addition, have contributed to over 4 Environmental Impact Statements and 31 Environmental Assessments.

PROFESSIONAL DEVELOPMENT
Historic Preservation Research Course, Drew University, February 2005
OSHA 40 Hour Certified HAZWOPER Training (December, 2005) and refreshers
OSHA Site Supervisor Certified (June, 2007) and refreshers
OSHA 10-Hour Construction Certified for New York City, 2012
NJSHPO Cultural Resources Best Practices Workshop, October 2006
Preservation Planning in the Highlands, Drew University, March 2007
Section 106 Essentials Class with ACHP, July 2007
Pennsylvania Department of Transportation, Cultural Resource Handbook Class, April 2010
Federal Communications Training, Washington D.C. June 2011
Cultural Resource Essentials Series, Pennsylvania Historical & Museum Commission, July 2013

PROFESSIONAL AFFILIATIONS
Archaeological Society of New Jersey
Council for Northeast Historical Archaeology
National Trust for Historic Preservation
New York State Archaeological Association (Lifetime Member)
Register of Professional Archaeologists
Society of American Archaeology
Society for Historical Archaeology
Society for Industrial Archaeology
The Society for Pennsylvania Archaeology

APPENDIX B

Drawing and Plans of the Project Site



WARNING:
IT IS A VIOLATION OF THE NYS EDUCATION LAW ARTICLE 145 FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS ITEM IN ANY WAY.

Parking Table - Town of Grand Island

Off-Street Parking Standards	Required	Provided	Complies
Car Parking Warehouse: 1 space / 1,000 SQ. FT. of gross floor area, plus 1 space / employee Office: 1 space / 200 SQ. FT. of gross floor area	Warehouse: 3,783 spaces (3,731,124 SF x 1 space / 1,000 SF) Office: 260 spaces (52,000 SF x 1 space / 200 SF) Total: 4,043 spaces required	1,855 Car Parking Spaces 16 Motorcycle Parking Spaces 1 Pump Station Maintenance Space Total: 1,872 spaces provided	No
Min. 90 Degree Car Parking Dimensions	Space: 9 FT x 19 FT	9 FT x 19 FT	Yes
	24 FT drive aisle	24 FT drive aisle	Yes
Loading Spaces Warehouse: 3 bays for 100,000+ SQ. FT.	Warehouse: 3 spaces (1,436,526 SF) Total: 3 spaces required	69 Loading Docks	Yes
Min. Loading Space Dimensions	12 FT X 20 FT	17 FT x 60 FT	Yes

Zoning Table - Town of Grand Island

	Parcel 1: M1 Light Industrial and Research			Parcel 2: R1A Low Density-Single-Family Residential		
Bulk Requirements	Required (M1)	Proposed[6]	Complies	Required (R1A)	Proposed	Complies
Min. Lot Area	1.5 AC	145.4 AC	Yes	3 AC	62.1 AC	Yes
Min. Lot Frontage[1]	150 FT	120 FT[3,4]	No[3,4]	140 FT	100 FT[3]	No[3,4]
Min. Lot Depth	300 FT	3,832 FT	Yes	250 FT	2,242 FT	Yes
Min. Lot Width[1]	150 FT	120 FT[3,4]	No	-	100 FT	Yes
Min. Front Yard Depth[1]	65 FT	1627.6 FT	Yes	50 FT	-	N/A
Min. Side Yard Width[5]	25 FT[5]	259.3 FT	Yes	15 FT	-	N/A
Min. Rear Yard Depth	30 FT	588.2 FT	Yes	50 FT	-	N/A
Min. Setback When Adjacent to Residential Zoned Lots	50 FT	529.3 FT	Yes	-	-	N/A
Min. Setback from Bedell Road centerline of right-of-way	80 FT	1,656.0 FT	Yes	80 FT	-	N/A
Min. Setback from Long Road centerline of right-of-way	80 FT	1627.6 FT	Yes	80 FT	-	N/A
Max. Building Height in Stories	4 Stories	5 Stories[4]	No	2.5 Stories	-	N/A
Max. Building Height	45 FT	98.23 FT[4,7]	No	35 FT	-	N/A
Max. Building Coverage[2]	40%	13.0%	Yes	20%	-	N/A

Notes:
1. The proposed subdivided lot is considered a through lot, since the lot has frontage on two parallel or approximately parallel streets. The front lot line is established using Long Road, since this is the street that will provide primary access to the lot.
2. The maximum percentage of a lot covered by the combined footprint of all buildings, structures, and uses. Excludes patios, walkways and pavements at ground level.
3. Existing non-conformance.
4. Variance required.
5. A potion along the western property line of the site falls within the R-1A zone. The side yard setback for this zone is 15 FT min.
6. Proposed zoning regulations are in reference to the proposed subdivided lot.
7. Refernce CG100 for Average Grade Calculations and Building Height Calculations.

Date	Description	No.
	REVISIONS	

LANGAN
Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.
One North Broadway, Suite 910
White Plains, NY 10601
T: 914.323.7400 F: 914.323.7401 www.langan.com

Project: PROJECT OLIVE
BLOCK No. 1, LOT No.50 & 26.1
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title: OVERALL SITE PLAN

Project No. 100785901
Date FEBRUARY 21, 2020
Drawn By LM/SS
Checked By CZ/MF

Drawing No. CS100

Filename: \\langan.com\data\PAR\data\k\100785901\Project Data\CAD\01\SheetFiles\SPA\100785901-CS100-0101.dwg Date: 1/31/2020 Time: 09:13 User: lmcmahon Style Table: Langan.stb Layout: Overall Site Plan
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LANGAN PROJECT NO. 100785901

APPENDIX C

Scope of Work

Phase IB Archaeological Survey
Project Olive
2780 Long Road
Town of Grand Island, Erie County, NY
February 17, 2020

Archaeology & Historic Resource Services, LLC (AHRS) is submitting this Phase IB Archaeological Survey scope of work based on the recommendations contained in *Phase IA Cultural Resource Survey, Project Olive, 2780 Long Road, Town of Grand Island, Erie County, NY* dated February 2020. The primary goal of the Phase IB Survey is to determine the presence or absence of archaeological materials or sites within the areas of undisturbed ground where ground disturbance is proposed. The proposed project is to construct an approximately 823,000 SF, 5-story commercial warehouse with 69 loading docks, 219 trailer parking stalls, 1,855 car parking stalls and 16 motorcycle parking. It will also include bioretention basins, water tanks, stormwater ponds and landscaped areas.

The archaeological-Area of Potential Effect (APE) includes approximately 117-acre area of potential ground disturbance of an approximately 145-acre project site. The 117-acre archaeological-APE is further reduced by 32.5 acres in the northern portion, where soil removal was conducted in the past, for a total of 84.5 acres to be tested. Subsurface testing will occur on a 50-foot grid oriented on a north-south east-west axis. Based on the parcel size AHRS anticipates excavating approximately 1,481 shovel test pits (STPs) by hand to fulfill SHPO requirements for 17 STPs per acre plus linear corridors. We anticipate that it will take approximately 15 field days to complete the Phase IB fieldwork with a field crew consisting of one supervisor and 7 field technicians.

All work will be conducted in accordance with the *This report was prepared in accordance with the Secretary of the Interior Standards and Guidelines for Archaeology and Historic Preservation 1983, the New York State Historic Preservation Act of 1980, Section 14.09, the New York Archaeological Council's Standards for Cultural Resource Investigations and the Curation of Archaeological Collections in New York State (1994), and the New York State Office of Parks, Recreation and Historic Preservation (OPRHP) Phase I Archaeological Report Format Guidelines (2005).* Michael Audin, RPA will serve as the project's principal investigator, project manager and will oversee the fieldwork, analysis and report writing. All supervisory personnel meet or exceed the Secretary of the Interior criteria for Phase I Archaeological Survey.

Scope of Work for Phase I Archaeological Survey

The archaeological testing will consist of the hand excavations of approximately 1,481 STPs within the area of potential ground disturbance inside the archaeological-APE. The testing is designed to locate any prehistoric or historic period archaeological materials or sites. The fieldwork

methodology will follow the SHPO guidelines for a Phase IB Archaeological Survey. Recommendations for further work will be provided, should the Phase IB Archaeological Survey reveal the existence of prehistoric or historic materials either in the form of lithic scatters, stratified contexts, features or artifact deposits. Subsequently, a site form will be submitted to record any newly discovered archaeological site(s).

Prior to fieldwork:

- A detailed map of the project area will be prepared with the outline of the proposed archaeological-APE and proposed testing area with STP locations (Attachment A).

Phase IB Fieldwork:

- Fieldwork will entail the hand excavation of STPs; all STPs will be roughly 40 cm in diameter (16 inches). The distance between STPs will be no larger than 15 m (50 feet). All STPs will be laid out using a handheld GPS system, if possible.
- Hand excavation will proceed in 10 cm (3.9 inches) increments within the natural stratum until approximately 20 cm into the sterile soil. A small sample of STPs will be hand augured to a depth of approximately 1 meter to confirm there are no deeply buried A-horizons. The 10 cm increment will allow for a better control of artifact distribution within the stratum.
- All soil matrix will be screened through ¼ inch hardwire mesh. All STPs will be recorded on a standard STP form and sketches of profiles will be provided. All sketches will use the metric system. Sample profiles will be photographed using a digital camera.
- In STPs where significant archaeological materials or features are encountered, an additional 8 STPs at 1- and 3-meter intervals in the cardinal directions (N-S, E-W) will be excavated to attempt to determine the extent of the concentration. Additional STPs that fall outside of the APE will be either moved closer or not be excavated.
- If the STP reveals evidence of soil disturbance in 2 consecutive STPs, then every other STP (or STPs at 100-foot intervals) will be excavated until natural soils (plow zone or stratified) are again encountered at which time the 50-foot interval will again be used.
- A field journal will be kept to record all field activities.
- Any artifacts retained for further analysis will be bagged and bags will be labeled accordingly; a field bag log will be kept on site. Artifacts that are not retained (modern items) will be counted, recorded and returned to the STP.
- All STPs will be backfilled upon completion of hand excavations and returned as close to original condition as possible.
- If at the conclusion of the Phase IB survey a Phase II survey is needed, we would amend this testing plan, contact the client and SHPO to determine if transition into the Phase II survey for potential identified sites is warranted.

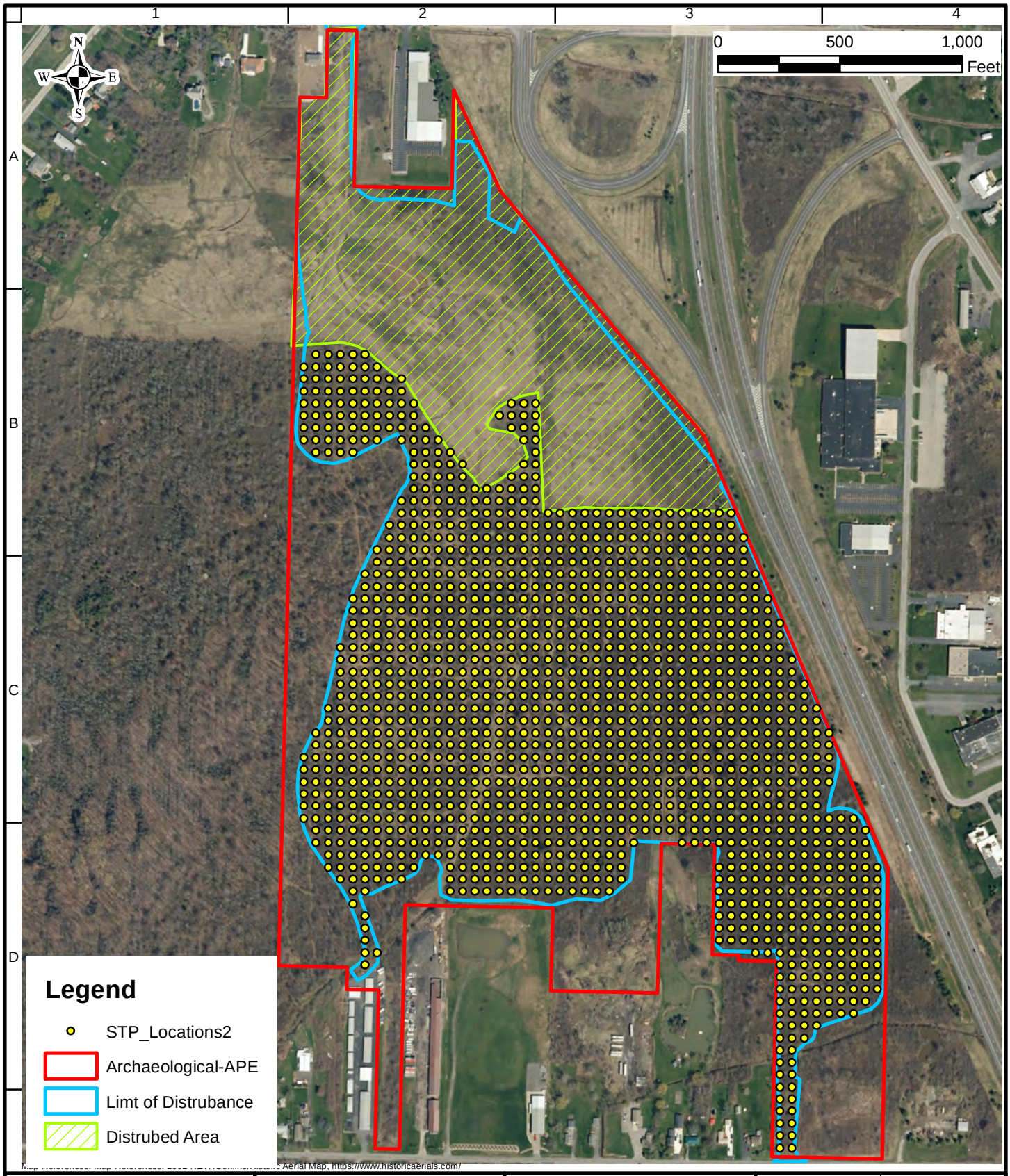
After fieldwork:

- A Phase IB Survey report will be prepared to summarize the field work, present findings, and make recommendations. If archaeological features are found, the report will also present recommendations for any additional archaeological work. The reports from

previous projects conducted in the area will be used for comparative studies on the project site.

- All field documentation and collected artifacts will be curated at AHRS for the duration of the project and report writing. Subsequently, if the artifacts recovered are of informational value they will need to be prepared for curation (not included in the current scope of work) and sent to a permanent curation facility with copies of all field forms and documentation. If the artifacts recovered are not of informational value they will be offered to an appropriate local repository of the client's choice.

\\AHRS-SERVER\AHRS-Data\NEW YORK\Projects\AHRS\Grand Island_NY_Phase IA_Langan\Phase IB\Testing Plan\PhaseIB_TestingPlan_GrandRapids_NY_2-2020.docx



AHRS
ARCHAEOLOGY & HISTORIC RESOURCE SERVICES

Project
PROJECT OLIVE
2780 LONG ROAD
BLOCK No. 1
LOT No. 50
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title
PROPOSED PHASE IB STP LOCATIONS

Project No.	
Date	02/17/2020
Scale	See Above
Drawn By	MA
Attachment	A

EXHIBIT G

Traffic Impact Study

for the proposed

Proposed Distribution Facility Project

Town of Grand Island
Erie County, New York

Project No. 39064

February 2020

Prepared For:

LANGAN

989 Lenox Drive
Suite 124
Lawrenceville, New Jersey 08648-2315
Attn: Dan Disario

Prepared By:

SRF ASSOCIATES
www.srfa.net
Transportation Planning / Engineering / Design

3495 Winton Place
Building E, Suite 110
Rochester, New York 14623

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A7. LEVEL OF SERVICE CALCULATIONS – FULL DEVELOPMENT CONDITIONS WITH PROJECT MODIFICATIONS AND IMPROVEMENTS

LIST OF REFERENCES

1. Highway Capacity Manual, Sixth Edition. Transportation Research Board. National Research Council, Washington, DC. 2016.
2. Manual on Uniform Traffic Control Devices for Street and Highways (MUTCD). Federal Highway Administration. 2009.
3. Trip Generation, Tenth Edition. Institute of Transportation Engineers. Washington D.C. 2017.
4. New York State Department of Transportation Traffic Data Viewer. Retrieved from https://www.dot.ny.gov/tdv. 2019.

EXECUTIVE SUMMARY

OVERVIEW

The purpose of this report is to identify and evaluate the potential traffic impacts associated with the Proposed Distribution Facility Project in the Town of Grand Island, New York. The operating characteristics of the proposed access point and impacts to the adjacent roadway network are identified and project modifications and improvements are provided to minimize potential capacity and safety concerns. To define traffic impacts, this analysis establishes existing traffic conditions, projects background traffic flow including area growth, and projects changes in traffic flow due to the Proposed Distribution Facility Project.

The proposed project includes the development of a multistory warehouse with a footprint of approximately 823,522± square feet to house a new distribution facility. The site will include 69± loading docks, 225± trailer parking stalls, and 1,800± employee parking stalls. Access to the proposed development will be provided via two (2) driveways; one driveway along Long Road that will provide access to the loading docks and trailer parking as well as the employee parking lot; and one driveway along Bedell Road that will only provide access to the car parking lot for employees.

Construction of the Proposed Distribution Facility Project is anticipated to reach full build-out in approximately 1-2 years. To account for normal increase in background traffic growth as well as any unforeseen developments in the project study area, a growth rate of 0.5% per year has been applied to the existing traffic volumes, based upon historical traffic growth derived from NYSDOT traffic volume data for the area, for the two-year build-out period.

The existing and future operating characteristics of the site access intersection and impacts to the adjacent roadway network are identified and improvements are provided to minimize and capacity or safety concerns.

CONCLUSIONS & RECOMMENDATIONS

This Traffic Impact Study identifies and evaluates the potential traffic impacts resulting from full build-out of the Proposed Distribution Facility Project. Based upon the comprehensive traffic analysis contained in this report, it is our firm's professional opinion that the results indicate that the Proposed Distribution Facility Project can be accommodated by the existing roadway network with the recommendations below being in place. The following sets forth our firm's conclusions and recommendations based upon the results of the comprehensive traffic analyses that have been conducted:

1. The proposed distribution facility is expected to generate approximately 707 (1,190) new trips during the AM (PM) study peak hours respectively inclusive of both passenger vehicles and trucks.

2. All truck traffic will travel directly to and from the NYS Thruway via Long Road and the I-190.

3. The following project modifications and improvements are recommended and, if approved by review agencies, will be constructed by the project sponsor:

a) Long Rd/I-190 SB Ramps
   - Install a new fully actuated three-color traffic signal.

b) Grand Island Blvd/I-190 NB Off-Ramp
   - Construct a new right turn lane for traffic exiting the I-190 Ramp.

4. The project sponsor should continue discussions with NFTA to provide transit service on-site.

I. INTRODUCTION

The purpose of this report is to identify and evaluate the potential traffic impacts with the Proposed Distribution Facility Project in the Town of Grand Island, New York. The operating characteristics of the proposed access point and impacts to the adjacent roadway network are identified and project modifications and improvements are provided to minimize potential capacity and safety concerns.

To define traffic impacts, this analysis establishes existing traffic conditions, projects background traffic flow including area growth, and projects changes in traffic flow due to the Proposed Distribution Facility Project.

II. LOCATION

The Proposed Distribution Facility Project is located west of I-190 South Bound ramp in the Town of Grand Island, Erie County, New York. The site is currently vacant. In order to ensure a comprehensive analysis of potential traffic impacts, a geographically broad study area was selected consisting of the following 8 existing driveways and 2 proposed driveways:

1. Long Road/Proposed Site Drive-Technology Camp of America Driveway
2. Long Road /I-190 On-Off Ramps
3. Long Road/Grand Island Boulevard
4. Grand Island Boulevard/I-190 NB Off-Ramp
5. Grand Island Boulevard/Bedell Road
6. Grand Island Boulevard/Baseline Road
7. Grand Island Boulevard/Whitehaven Road
8. Grand Island Boulevard/Staley Road (Roundabout)

The site location and study area are shown in **Figure 1** – Site Location and Study Area (all figures are included at the end of this report).

III. EXISTING HIGHWAY SYSTEM

Details of the existing roadway network in the vicinity of the project site are summarized in Table 1 below. The Annual Average Daily Traffic (AADT) counts referenced below were obtained based upon the most recent traffic counts collected by the New York State Department of Transportation (NYSDOT).

TABLE 1
EXISTING HIGHWAY SYSTEM

ROADWAY	ROUTE[1]	FUNC. CLASS[2]	JURIS.[3]	SPEED LIMIT[4]	# OF TRAVEL LANES[5]	TRAVEL PATTERN/ DIRECTION	EST. AADT[6]	AADT SOURCE[7]
Baseline Road (From Grand Island Blvd to Bedell Rd)	CR 249	Minor Arterial	NYSDOT/ Village of Grand Island	45	2	One-way/ North-South	7,423	NYSDOT (2015)
Bedell Road (From West River Pkwy to Grand Island Blvd)	N/A	Minor Arterial	ECDPW	45	2	One-way/ East-West	923	NYSDOT (2012)

ROADWAY	ROUTE[1]	FUNC. CLASS[2]	JURIS.[3]	SPEED LIMIT[4]	# OF TRAVEL LANES[5]	TRAVEL PATTERN/ DIRECTION	EST. AADT[6]	AADT SOURCE[7]
Long Road (From Grand Island Blvd to Baseline Rd)	CR 310	Major Collector	NYSDOT/ Village of Grand Island	40	2	One-way/ East-West	3,162	NYSDOT (2015)
Long Road (From I-190 SB to Grand Island Blvd)	CR 310	Major Collector	NYSDOT/ Village of Grand Island	40	2	One-way/ East-West	1,761	NYSDOT (2015)
Long Road (From West River Pkwy to I-190 SB)	CR 310	Major Collector	NYSDOT/ Village of Grand Island	40	2	One-way/ East-West	1,129	NYSDOT (2015)
Grand Island Boulevard (From Whitehaven Rd to I-190 NB)	NY 324	Minor Arterial	ECDPW	45	2	One-way/ North-South	9.899	NYSDOT (2016)
Grand Island Boulevard (From Long Rd to Whitehaven Rd)	NY 324	Minor Arterial	ECDPW	45	2	One-way/ North-South	5,870	NYSDOT (2014)
Staley Road (From Grand Island Blvd to Stoney Point Rd)	N/A	Major Collector	ECDPW	45	2	One-way/ East-West	8,188	NYSDOT (2014)
Whitehaven Road (From Grand Island Blvd to Stony Point Road)	CR 75	Major Collector	NYSDOT/ Village of Grand Island	45	2	One-way/ East-West	5,237	NYSDOT (2015)

Notes:
1. Route Name/Number: "NYS" = New York State.
2. State Functional Classification of Roadway: All are Urban.
3. Jurisdiction: "NYSDOT" = New York State Department of Transportation, "ECDPW" = Erie County Department of Public Works
4. Posted or Statewide Limit in Miles per Hour (MPH).
5. Excludes turning/auxiliary lanes developed at intersections.
6. Estimated AADT in Vehicles per Day (vpd).
7. Source (Year).

Figure 2 illustrates the lane geometry at each of the study intersections and the AADT volumes on the study roadways.

It is noted that consultation is ongoing with the NYS Thruway Authority regarding existing conditions of the bridges within the study area. A summary of the bridge information will be provided in a separate letter once the data has been evaluated.

PEDESTRIAN FACILITIES

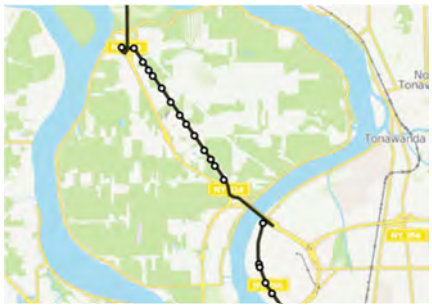
There are no existing pedestrian facilities in the vicinity of the site on either Long Road or Bedell Road.

BICYCLE FACILITIES

Currently, no dedicated bicycle facilities exist within the study area. Bicyclists are permitted to share the road on all roadways within the study area. However, future proposed bike routes include Grand Island Blvd from Staley Rd to Buckhorn Island State Park, Whitehaven Rd from I-190 to East River Rd, Bedell Rd from Baseline Rd to Stony Point Rd, and West River Rd (now closed to vehicular traffic) from Beaver Island State Park to Buckhorn Island State Park.

TRANSIT FACILITIES

Public transit service within the study area is provided by the Niagara Frontier Transit Metro System, Inc (NFTA). NFTA route 40 provides bus service between Buffalo and Niagara Falls. There are several bus stops along Grand Island Blvd and adjacent to the project site.



NFTA Bus Stops on Grand Island

IV. EXISTING TRAFFIC CONDITIONS

A. Peak Intervals for Analysis

Given the functional characteristics of the Proposed Distribution Facility Project, the peak hours selected for analysis are generally the weekday commuter AM and PM peaks. The combination of site traffic and adjacent through traffic produces the greatest demand during these time periods.

B. Existing Traffic Volume Data

Weekday AM (6:00-9:00 AM) and PM (4:00-7:00 PM) peak hour volumes were collected by SRF Associates (SRF) at the study area intersections listed in Section II above. Turning movement count data was collected by SRF at the study intersections on Wednesday, November 13, 2019. The count dates and actual peak hour traffic periods for each study intersection are noted in Table II below.

TABLE II
STUDY INTERSECTION COUNT DATES AND ACTUAL INTERSECTION PEAK HOURS

INTERSECTION	COUNT DATES	AM PEAK	PM PEAK
Grand Island Blvd/Baseline Road	Wednesday November 13, 2019	8:00-9:00 AM	4:00-5:00 PM
Grand Island Blvd/Bedell Road	Wednesday November 13, 2019	7:45-8:45 AM	4:30-5:30 PM
Grand Island Blvd/I-190 NB Ramps	Wednesday November 13, 2019	7:45-8:45 AM	4:30-5:30 PM
Grand Island Blvd/Staley Road	Wednesday November 13, 2019	6:30-7:30 AM	4:15-5:15 PM
Grand Island Blvd/Whitehaven Road	Wednesday November 13, 2019	7:00-8:00 AM	4:00-5:00 PM
Long Road/ Grand Island Blvd	Wednesday November 13, 2019	7:45-8:45 AM	4:30-5:30 PM
Long Road/I-190 Ramp	Wednesday November 13, 2019	7:45-8:45 AM	4:30-5:30 PM

INTERSECTION	COUNT DATES	AM PEAK	PM PEAK
Long Road/Proposed Site Driveway	Wednesday November 13, 2019	7:00-8:00 AM	4:30-5:30 PM

The peak hours for the potential project traffic are different from the actual intersection peak time periods as a result of the shift times for employees (see detailed discussion in Section VI of this report). Based upon the employee arrival and departure times for the defined shifts, the peak hours used for analysis were 6:30-7:30 AM and 5:30-6:30 PM. Intersection traffic volumes during these time periods are generally like and slightly lower than traffic volumes during the actual intersection peak hours.

All turning movement count data were collected on typical weekdays while local schools were in session. The traffic volumes were reviewed to confirm the accuracy and relative balance of the collective traffic counts. The 2019 weekday AM and PM peak hour existing traffic volumes are reflected in **Figure 3**.

C. Field Observations

The study intersections were observed during both peak intervals to assess current traffic operations. Signal timing information observed in the field were utilized to confirm peak hour phasing plans and phase durations during each interval. Signal timing information was also obtained from the NYSDOT. This information was used to support and/or calibrate capacity analysis models described in detail later in this report.

D. Existing Crash Investigation

A crash investigation at the study area intersections was conducted to assess the safety history from June 2016 through June 2019. The data was provided by the NYSDOT and Erie County Sheriff's Department through a Freedom of Information request.

A total of 52 crashes were documented during the investigation period (3 years) of which, a large portion of the crashes occurred at the signalized intersections of Grand Island Boulevard/Whitehaven Road and Grand Island Boulevard/Baseline Road. Several crashes also occurred at the un-signalized intersection of Grand Island Boulevard/Staley Road.

The severity of the 52 documented crashes are broken down as follows:

- 22 – Reportable - Injury
- 23 – Reportable – Non-Injury
- 7 – Non-Reportable

Reportable (non-injury, injury, and fatal injury) type crashes are defined as damage to one person's property in the amount of $1,001 or more. The Non-Reportable type crashes result in property damage of $1,000 or less.

The crash history was further investigated to identify high incident areas. **Table III** summarizes crashes occurring at each intersection. Based on the number of crashes at each intersection, crash rates were calculated and compared to the statewide average for similar facilities. The calculated rates and comparison to statewide averages are also summarized in Table III. Crash rate calculations are included in the Appendix. Intersection rates are listed as crashes per million entering vehicles (CRASH/MEV). It should be noted that NYSDOT average crash rates are based on reportable and non-reportable type crashes.

TABLE III
SUMMARY OF CRASHES AND COMPARISON OF RATES

INTERSECTION	TOTAL NO. OF CRASHES	ACTUAL PROJECT RATE	STATEWIDE AVERAGE RATE
Grand Island Boulevard/Long Road	3	0.40	0.54
Grand Island Boulevard/I-190 Off Ramp	2	0.37	0.18
Grand Island Boulevard/Bedell Road	5	0.74	0.54
Grand Island Boulevard/Baseline Road	14	1.18	0.54
Grand Island Boulevard/Whitehaven Road	17	1.18	0.54
Grand Island Boulevard/Staley Road	10	0.53	0.31
Long Road/I-190 Off Ramp	1	0.28	0.18

The intersections of Grand Island Boulevard/I-190 Off Ramp, Grand Island Boulevard/Bedell Road, Grand Island Boulevard/Baseline Road, Grand Island Boulevard/Whitehaven Road, Grand Island Boulevard/Staley Road, and Long Road/I-190 Off Ramp have crash rates that are higher than the state average. A majority of the crashes at these intersections are rear-end collisions, which could be associated with vehicle queuing and the current intersection geometry.

Given that several of the intersections have rates that exceed statewide averages, further investigation was performed to identify high incident areas and possible trends/causes of the crashes. It is noted that the high crash rates at the two Long Road intersections, the I-190 intersection at Grand Island Blvd and the Bedell Road intersection are attributed to the relatively low daily volume of traffic that travels through each of these intersections. All of these intersections had five or fewer crashes during the three-year study period. The results of the investigation are discussed in the following section.

#1: Grand Island Boulevard/Long Road

A total of three crashes were documented during the investigation period (3 years). The crashes that occurred were categorized as right angle (2) and rear end (1). No notable crash clusters were identified at this location. There are no inherent safety concerns at this intersection.

#2: Grand Island Boulevard/I-190 Off Ramp

A total of two crashes were documented at this intersection. The calculated crash rate is approximately two times the statewide average for other similar 3-legged un-signalized intersections. The crashes were both fixed object collisions. There are no inherent safety concerns at this intersection.

#3: Grand Island Boulevard/Bedell Road

A total of five crashes were documented at this intersection. The calculated crash rate is approximately 1.5 times higher than the statewide average for other similar 4-legged intersections. The crashes that occurred were categorized as other (2), sideswipe (1), fixed object (1), and right turn (1). No notable crash clusters were identified at this location. There are no inherent safety concerns at this intersection.

#4: Grand Island Boulevard/Baseline Road

A total of 14 crashes were documented at this intersection. The calculated crash rate is approximately two times higher than the statewide average for other similar 4-legged intersections. The majority of crashes involved were rear-end (4) collisions. The remaining crashes were categorized as other (3), left turn (3), right angle (2), head on (1), and fixed object (1). No notable crash clusters were identified at this location. Given the lack of crash clusters, there are no inherent safety concerns at this intersection.

#5: Grand Island Boulevard/Whitehaven Road

A total of 17 crashes were documented at this intersection. The calculated crash rate is approximately two times higher than the statewide average for other similar 4-legged intersections. The majority of crashes involved were right angle (5) collisions. The remaining crashes were categorized as bike/pedestrian (3), left turn (2), rear end (2), other (2), overtaking (1), head on (1), and fixed object (1). Notable crash clusters at this location include:

- 3 right angle collisions in the westbound direction. Two of the 3 right angle collisions occurred during evening hours when sun glare may have been a factor.

#6: Grand Island Boulevard/Staley Road

A total of 7 crashes were documented at this intersection. The calculated crash rate is approximately 1.5 times higher than the statewide average for other similar 4-legged intersections (there are no published crash rates specific to roundabouts). The majority of crashes involved were rear-end (4) collisions. The remaining crashes were categorized as fixed object (2), other (2), overtaking (1), and right angle (1). No notable crash clusters were identified at this location. Given the lack of crash clusters, there are no inherent safety concerns at this intersection.

#7: Long Road/I-190 Off Ramp

One crash categorized as a rear end traveling in the westbound direction was documented at this intersection.

The majority of crashes were caused by either driver inattention, following too closely, or slippery pavement. Human error contributing factors were the most prevalent causes of the crashes.

Based upon the crash details at the study intersections, the majority of crashes were rear-end collisions. These types of collisions are more common at traffic signals on high volume roadways. Recommended mitigation countermeasures may include optimizing the change intervals (yellow time) at the traffic signals (to increase the length of time between phase intervals) or improve the visibility of the traffic signals to make drivers more aware of the operating conditions. It should be noted that Grand Island Boulevard/I-190 Off Ramp, Long Road/I-190 Off Ramp, and Grand Island Boulevard/Long Road are un-signalized intersections. In addition, the number and type of crashes documented at these intersections do not indicate the need for signalization as they are not susceptible to correction by a traffic signal.

V. FUTURE AREA DEVELOPMENT AND LOCAL GROWTH

Construction of the Proposed Distribution Facility Project is anticipated to reach full build-out in approximately 2 years. To account for normal increases in background traffic growth, including any unforeseen developments in the project study area, a growth rate of 0.5 % per year has been applied to the existing traffic volumes, based upon historical traffic growth derived from NYSDOT traffic volume

data for the area, for the two-year build-out period. All ambient growth calculations are included in the appendix. The background traffic volumes are depicted in **Figure 4.**

VI. PROPOSED DEVELOPMENT

A. Description of the Proposed Distribution Facility Project

The proposed project includes the development of a multistory warehouse with a footprint of approximately 823,522± square feet to house a new distribution facility. The site will include 69± loading docks, 225± trailer parking stalls, and 1,800± employee parking stalls. Access to the proposed development will be provided via two (2) driveways; one driveway along Long Road that will provide access to the loading docks and trailer parking as well as the employee parking lot; and one driveway along Bedell Road that will only provide access to the car parking lot for employees. **Figure 5** illustrates the proposed concept plan.

B. Site Traffic Generation

The volume of traffic generated by a site is dependent on the intended land use and size of the development. Trip generation is an estimate of the number of trips generated by a specific building or land use. These trips represent the volume of traffic entering and exiting the development. Trip Generation, 10th Edition is used as a reference for this information. The trip rate for the peak hour of the generator may or may not coincide in time or volume with the trip rate for the peak hour of adjacent street traffic. In this case, volumes generated during the peak hour of the site represent a more critical volume when analyzing the capacity of the system; those intervals will provide the basis of this analysis. All trip generation information has been included in the appendix.

According to the Institute of Transportation Engineers (ITE), the following steps are recommended when determining trip generation for proposed land uses:

i. *Check for the availability of local trip generation rates for comparable uses.*

ii. *If local trip data for similar developments are not available and time and funding permit, conduct trip generation studies at sites with characteristics similar to those of the proposed development.*

Trip generation data for the Proposed Distribution Facility Project are based on employee count and truck traffic data for similar distribution facilities. From this data, peak hour passenger car and truck trips were calculated for Full Development Conditions.

These types of distribution facilities typically experience carpool and transit ridership that reduces the single-occupant vehicles traveling to and from the site by approximately 19%. However, review of transit and carpool statistics for Erie County indicates that approximately 8% of people carpool to work and 4% of people use public transportation. In addition, 3% of people walk to work while less than 1% of people use a bicycle to commute to work. For analysis purposes, and to be conservative, it was assumed that 9% of employees will either carpool or use public transportation. Hence, the total peak hour employee trips were reduced by 9%.

Table IV summarizes the peak hour trips during the peak hour of the generator (6:30-7:30 AM and 5:30-6:30 PM) based upon the shift times for these types of distribution facilities. This projection is based upon extensive data compiled by the developer for similar distribution facilities and is included the Appendix.

TABLE IV
PEAK HOUR SITE GENERATED TRIPS

DESCRIPTION	AM PEAK		PM PEAK	
	ENTER	EXIT	ENTER	EXIT
Distribution Center Employees	658	29	582	592
Distribution Center Trucks	10	10	8	8
Total Site Generated Trips (2,142 Total Employees)	668	39	590	600

Under Full Development Conditions, the proposed distribution facility project is anticipated to generate 668 entering/39 exiting vehicle trips during the AM peak hour of the generator and 590 entering/600 exiting vehicle trips during the weekday PM peak hour of the generator; these volumes include both passenger vehicles and truck trips as noted in Table III above.

C. Site Traffic Distribution

The cumulative effect of site traffic on the transportation network is dependent on the origins and destinations of that traffic and the location of the access drives serving the site. The proposed arrival/departure distribution of traffic to be generated at this site is considered a function of several parameters, including the following:

- Existing highway network;
- Proximity and access to local area highways;
- Population centers;
- Location of employee parking on the proposed site plan; and
- Existing traffic patterns, traffic conditions, and controls

Census data for Erie County were used to determine likely origin and destination areas for the potential employees. In addition, existing traffic patterns were reviewed in detail to determine likely travel routes. **Figure 6A** shows the anticipated truck trip distribution pattern percentages and **Figure 6B** shows the anticipated car trip distribution pattern percentages for employees at full build-out of the proposed distribution facility. All truck traffic will travel directly to and from the NYS Thruway via Long Road, Grand Island Blvd, and I-190. **Figure 7** shows the resulting total site generated traffic (including cars and trucks) as assigned to the study area intersections for the weekday AM and PM peak hour periods under full build-out conditions.

VII. FULL DEVELOPMENT VOLUMES

The projected design hour traffic volumes were developed for the weekday AM and PM peak hours by combining the future background traffic conditions (Figure 4), and projected site generated volumes for full build-out of the proposed site (Figures 7) in order to yield the total traffic conditions expected at full development. **Figure 8** illustrates the total weekday AM and PM peak hour volumes anticipated for the proposed development under full build-out conditions.

VIII. CAPACITY ANALYSIS

A. Description of Capacity Analysis

A capacity analysis is a technique used for determining a measure of effectiveness for a section of roadway and/or intersection based on the number of vehicles during a specific time period. The measure of effectiveness used for the capacity analysis is referred to as a Level of Service (LOS). Levels of Service are calculated to provide an indication of the amount of delay that a motorist experiences while traveling along a roadway or through an intersection. Since the most amount of delay to motorists usually occurs at intersections, capacity analysis focuses on intersections, as opposed to highway segments.

Six Levels of Service are defined for analysis purposes. They are assigned letter designations, from "A" to "F", with LOS "A" representing the conditions with little to no delay, and LOS "F" conditions with very long delays. Suggested ranges of service capacity and an explanation of Levels of Service are included in the Appendix.

The standard procedure for capacity analysis of signalized and un-signalized intersections is outlined in the Highway Capacity Manual (HCM 2016) published by the Transportation Research Board. Traffic analysis software, Synchro 10, which is based on procedures and methodologies contained in the HCM, was used to analyze operating conditions at study area intersections. The procedure yields a Level of Service based on the HCM 2010 as an indicator of how well intersections operate.

B. Capacity Analysis Results

Existing and background operating conditions during the peak study periods are evaluated to determine a basis for comparison with the projected future conditions. The projected future traffic volumes generated by the Proposed Distribution Facility Project were analyzed to assess the operations of the intersections in the study area.

Capacity results for existing, background and full development conditions are listed in **Table V**. The discussion following the table summarizes capacity conditions. All capacity analysis calculations are included in the Appendices.

TABLE V: CAPACITY ANALYSIS RESULTS

INTERSECTION	2019 EXISTING CONDITIONS				2021 BACKGROUND CONDITIONS				FULL BUILD CONDITIONS				FULL BUILD CONDITIONS W/ MITIGATION			
	AM		PM		AM		PM		AM		PM		AM		PM	
1. Long Road / Islechem Driveway / Proposed North Driveway (U)																
EB left – Long Road	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0
WB left – Long Road	-	-	-	-	-	-	-	-	A	8.4	A	8.0	A	8.4	A	8.0
NB - Proposed North Driveway	-	-	-	-	-	-	-	-	A	8.7	B	10.6	A	8.7	B	10.6
SB - Islechem Driveway	A	0.0	A	8.7	A	0.0	A	8.7	A	0.0	E	39.0	A	0.0	E	39.0
2. Long Road / 1-190 Ramp (U)																
EB - Long Road	-	-	-	-	-	-	-	-	-	-	-	-	A	5.3	B	11.8
WB - Long Road	A	7.6	A	7.3	A	7.6	A	7.3	A	7.7	A	8.7	B	13.6	B	11.3
NB - I-190 Ramp	B	12.3	A	9.6	B	12.4	A	9.7	E	40.8	F	67.0	B	15.0	B	15.9
Overall LOS	-	-	-	-	-	-	-	-	-	-	-	-	***B***	***13.2***	***B***	***12.7***
3. Long Road / Grand Island Boulevard (U)																
EB left/thru - Long Road	A	8.8	B	10.1	A	8.8	B	10.2	A	9.7	C	24.0	A	9.7	C	24.0
EB right - Long Road	A	8.1	A	9.0	A	8.1	A	9.0	A	9.1	B	10.3	A	9.1	B	10.3
WB - Long Road	A	9.8	A	8.9	A	9.8	A	9.0	B	11.6	B	10.9	B	11.6	B	10.9
NB - Grand Island Boulevard	A	9.7	B	11.3	A	9.7	B	11.4	B	14.5	C	23.8	B	14.5	C	23.8
SB - Grand Island Boulevard	A	8.2	A	8.1	A	8.2	A	8.1	A	8.8	A	9.5	A	8.8	A	9.5
4. Grand Island Boulevard / I-190 NB Ramp Off (U)																
EB (left) – I-190 Ramp	B	10.0	B	11.6	B	10.0	B	11.6	C	17.3	C	20.0	B	12.6	B	14.9
EB right - I-190 Ramp	-	-	-	-	-	-	-	-	-	-	-	-	B	10.8	B	10.8
5. Grand Island Boulevard / Bedell Road (S)																
EB - Bedell Road	A	5.1	A	7.7	A	5.1	A	7.7	A	5.7	A	8.6	A	5.7	A	8.6
WB - Bedell Road	A	8.6	A	8.0	A	8.7	A	8.0	B	10.9	B	10.7	B	10.9	B	10.7
NB - Grand Island Boulevard	A	6.4	A	5.6	A	6.4	A	5.6	A	7.3	A	7.0	A	7.3	A	7.0
SB - Grand Island Boulevard	A	5.6	A	6.5	A	5.6	A	6.6	A	3.7	A	8.0	A	3.7	A	8.0
Overall LOS	***A***	***6.9***	***A***	***6.6***	***A***	***6.9***	***A***	***6.6***	***A***	***6.4***	***A***	***8.2***	***A***	***6.4***	***A***	***8.2***
6. Grand Island Boulevard / Baseline Road (S)																
EB left – Grand Island Boulevard	A	0.0	B	11.3	A	0.0	B	11.3	A	0.0	B	11.8	A	0.0	B	11.8
EB thru/right – Grand Island Boulevard	B	10.1	B	11.1	A	10.0	B	11.1	A	10.0	B	11.1	A	10.0	B	11.1
WB left – Grand Island Boulevard	B	12.0	B	10.9	B	12.0	B	10.9	B	12.0	B	11.0	B	12.0	B	11.0
WB thru/right – Grand Island Boulevard	B	11.8	B	15.5	B	11.9	B	15.6	B	11.9	B	15.5	B	11.9	B	15.5
NB left – Baseline Road	A	8.8	B	13.7	A	9.1	B	13.8	A	9.2	B	14.6	A	9.2	B	14.6
NB thru/right – Baseline Road	A	7.5	B	11.7	A	7.7	B	11.2	A	7.8	B	11.3	A	7.8	B	11.3
SB left – Baseline Road	A	8.9	B	14.5	A	9.1	B	14.6	A	9.1	B	14.7	A	9.1	B	14.7
SB thru/right – Baseline Road	A	8.0	B	10.7	A	8.1	B	10.9	A	8.1	A	9.2	A	8.1	A	9.2
Overall LOS	***A***	***9.3***	***B***	***13.2***	***A***	***9.5***	***B***	***13.2***	***A***	***9.4***	***B***	***12.5***	***A***	***9.4***	***B***	***12.5***
7. Grand Island Boulevard / Whitehaven Road (S)																
EB left - Whitehaven Road	B	10.4	B	17.3	B	10.5	B	17.4	B	10.4	B	18.4	B	10.4	B	16.1
EB thru - Whitehaven Road	B	11.1	B	18.7	B	11.2	B	19.1	B	11.0	C	21.0	B	11.0	B	18.9
EB right - Whitehaven Road	A	4.5	A	6.0	A	4.5	A	6.0	A	4.4	A	6.0	A	4.4	A	5.5
WB left - Whitehaven Road	B	11.4	B	19.4	B	11.6	B	19.9	B	11.4	C	21.7	B	11.4	B	19.5
WB thru/right - Whitehaven Road	A	9.8	A	9.3	B	10.0	A	9.4	B	10.0	B	10.3	B	10.0	A	9.1
NB left - Grand Island Boulevard	B	10.5	A	8.1	B	10.9	A	8.1	B	11.4	A	8.1	B	11.4	A	8.5
NB thru/right - Grand Island Boulevard	A	9.9	B	12.6	B	10.3	B	13.1	B	10.8	B	11.9	B	10.8	B	12.3
SB left - Grand Island Boulevard	A	9.7	A	9.9	B	10.0	B	10.2	B	10.5	B	14.2	B	10.5	B	14.6
SB thru/right - Grand Island Boulevard	B	11.3	A	8.9	B	11.6	A	9.1	B	12.2	A	9.4	B	12.2	A	9.7
Overall LOS	***B***	***10.1***	***B***	***11.8***	***B***	***10.4***	***B***	***12.1***	***B***	***10.6***	***B***	***12.3***	***B***	***10.6***	***B***	***12.0***
8. Bedell Road / Proposed Site Driveway (U)																
EB left - Bedell Road	N/A				N/A				A	0.0	A	0.0	A	0.0	A	0.0
SB - Proposed South Driveway									A	9.5	B	12.7	B	10.1	B	12.7
9. Grand Island Boulevard / Staley Road (ROUNDABOUT)																
EB left - Staley Road	B	10.9	B	11.7	B	11.2	B	11.9	B	11.8	B	12.6	N/A			
EB thru - Staley Road	A	5.3	A	6.1	A	5.6	A	6.3	A	6.2	A	7.0				
EB right - Staley Road	A	5.8	A	6.9	A	6.1	A	7.1	A	6.7	A	7.8				
WB left - Staley Road	B	12.3	B	11.2	B	12.6	B	11.3	B	12.6	B	12.2				
WB thru - Staley Road	A	6.7	A	5.6	A	7.0	A	5.7	A	7.0	A	6.6				
WB right - Staley Road	A	7.3	A	6.4	A	7.6	A	6.5	A	7.6	A	7.4				
NB left - Grand Island Boulevard	B	12.5	A	9.6	B	13.3	A	9.7	B	14.4	B	10.6				
NB thru - Grand Island Boulevard	A	7.3	A	4.1	A	8.1	A	4.2	A	9.3	A	5.1				
NB right - Grand Island Boulevard	A	7.4	A	4.6	A	8.3	A	4.7	A	9.4	A	5.6				
SB left - Grand Island Boulevard	A	7.2	A	7.5	A	7.2	A	7.5	A	7.2	A	7.6				
SB thru - Grand Island Boulevard	A	1.6	A	1.9	A	1.6	A	1.9	A	1.6	A	2.0				
SB right - Grand Island Boulevard	A	2.4	A	2.7	A	2.4	A	2.7	A	2.4	A	2.8				
Overall LOS	***A***	***7.0***	***A***	***4.8***	***A***	***7.3***	***A***	***4.9***	***A***	***7.7***	***A***	***5.3***				

NOTES:

1. A(2.8) = Level of Service (Delay in seconds per vehicle)
2. (S) = Signalized; (U) = Unsignalized
3. N/A = Approach does not exist and/or was not analyzed during this condition
4. F(*) = Delay greater than 200 seconds per vehicle

The peak hour capacity analysis results indicate that in general, most of the approaches at the study intersections will operate similarly to 2021 Background Conditions with the proposed improvements in place.

1. Long Rd/Islechem Driveway-Proposed North Site Driveway

The existing intersection currently operates at LOS "A" on all approaches. Adding a fourth leg to the intersection results in a decrease in LOS for the Islechem Driveway, however, the peak times for traffic entering and exiting the Islechem Driveway do not coincide with the peak traffic times for the proposed site. Review of projected operating conditions and traffic volumes indicates that no improvements are warranted or recommended at this location as a result of the proposed development.

2. Long Rd/I-190 SB Ramps

The proposed development will add traffic both entering and exiting the I-190 ramps as well as through traffic on Long Rd. As a result, signalization of this intersection is recommended. No other improvements are warranted or recommended as a result of the proposed development.

3. Long Rd/Grand Island Blvd

The Long Rd/Grand Island Blvd intersection currently operates as an all-way stop controlled intersection with LOS "B" or better on all approaches. During the AM peak hour, the intersection will continue to operate at LOS "B" at full build out of the proposed development. During the PM peak hour at full development, the eastbound left turn/though movement and the northbound approach will decrease to LOS "C". Given that LOS "C" remains an acceptable operating condition with delays less than 25 seconds per vehicle, no improvements are recommended at this intersection.

4. Grand Island Blvd/I-190 NB Off-Ramp

Traffic volumes exiting the I-190 and using this ramp are expected to increase as a result of the proposed development. Given the projected traffic volume increases and resulting operating conditions, a right turn lane exiting the off-ramp should be constructed.

Intersections 5-9

The remaining intersections in the study area are projected to operate at LOS "B" or better for all movements during all peak hours studied. The Grand Island Blvd/Whitehaven Rd traffic signal may adjust on its own to increases in traffic volumes as a result of the fully actuated control. No improvements are warranted or recommended at these intersections as a result of the proposed development.

IX. CONCLUSIONS & RECOMMENDATIONS

This Traffic Impact Study identifies and evaluates the potential traffic impacts resulting from full build-out of the Proposed Distribution Facility Project. Based upon the comprehensive traffic analysis contained in this report, it is our firm's professional opinion that the results indicate that the Proposed Distribution Facility Project can be accommodated by the existing roadway network with the recommendations below being in place. The following sets forth our firm's conclusions and recommendations based upon the results of the comprehensive traffic analyses that have been conducted:

1. The proposed distribution facility is expected to generate approximately 707 (1,190) new trips during the AM (PM) study peak hours respectively inclusive of both passenger vehicles and trucks.

2. All truck traffic will travel directly to and from the NYS Thruway via Long Road and the I-190.

3. The following project modifications and improvements are recommended and, if approved by review agencies, will be constructed by the project sponsor:

   a) Long Rd/I-190 SB Ramps
      - Install a new fully actuated three-color traffic signal.

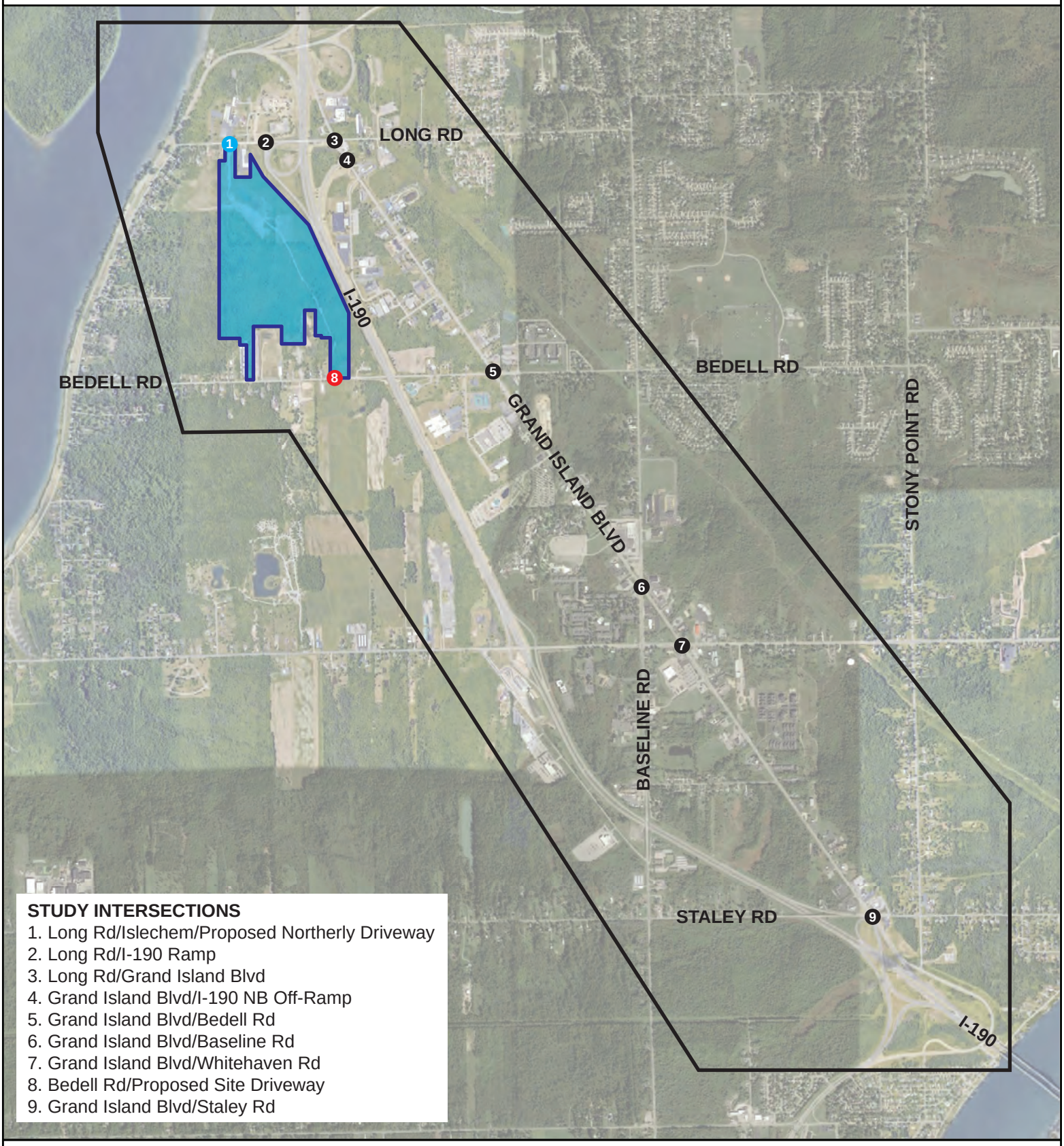
   b) Grand Island Blvd/I-190 NB Off-Ramp
      - Construct a new right turn lane for traffic exiting the I-190 Ramp.

4. The project sponsor should continue discussions with NFTA to provide transit service on-site.

X. FIGURES

Figures 1 through 8 are included on the following pages.

FIGURE 1 - SITE LOCATION & STUDY AREA



Legend

- Study Intersection
- Study/Proposed Intersection
- Proposed Intersection
- Site Location
- Study Area

PROPOSED
PROJECT OLIVE

TOWN OF GRAND ISLAND, NY

0 150 300 600
Feet

N

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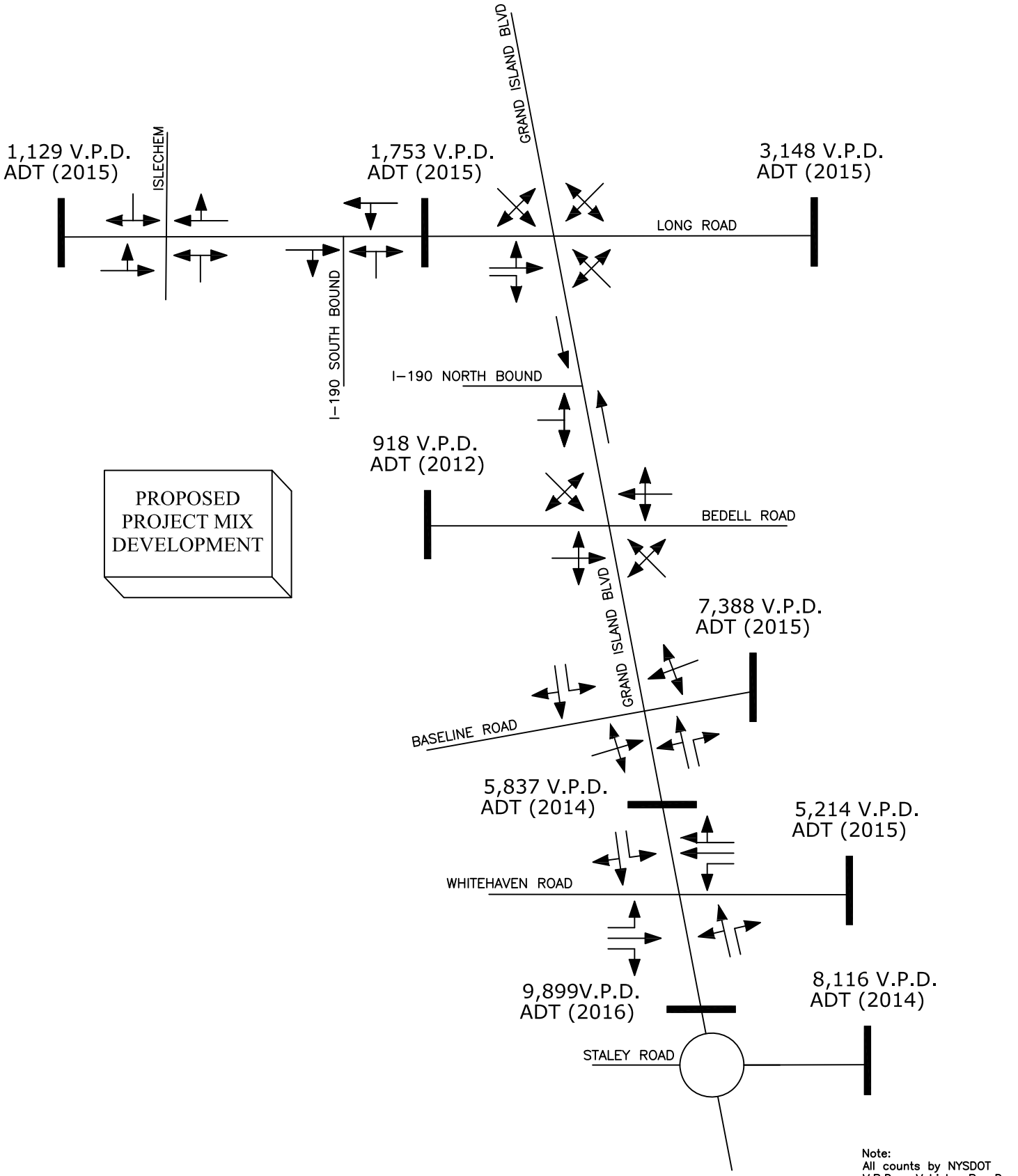

Note:
All counts by NYSDOT
V.P.D = Vehicles Per Day

PROJECT NO: 39064

KEY

N

NOT TO SCALE

FIGURE 2

LANE GEOMETRY &
AVERAGE DAILY TRAFFIC

PROJECT MIX DEVELOPMENT,
TOWN OF GRAND ISLAND, NY

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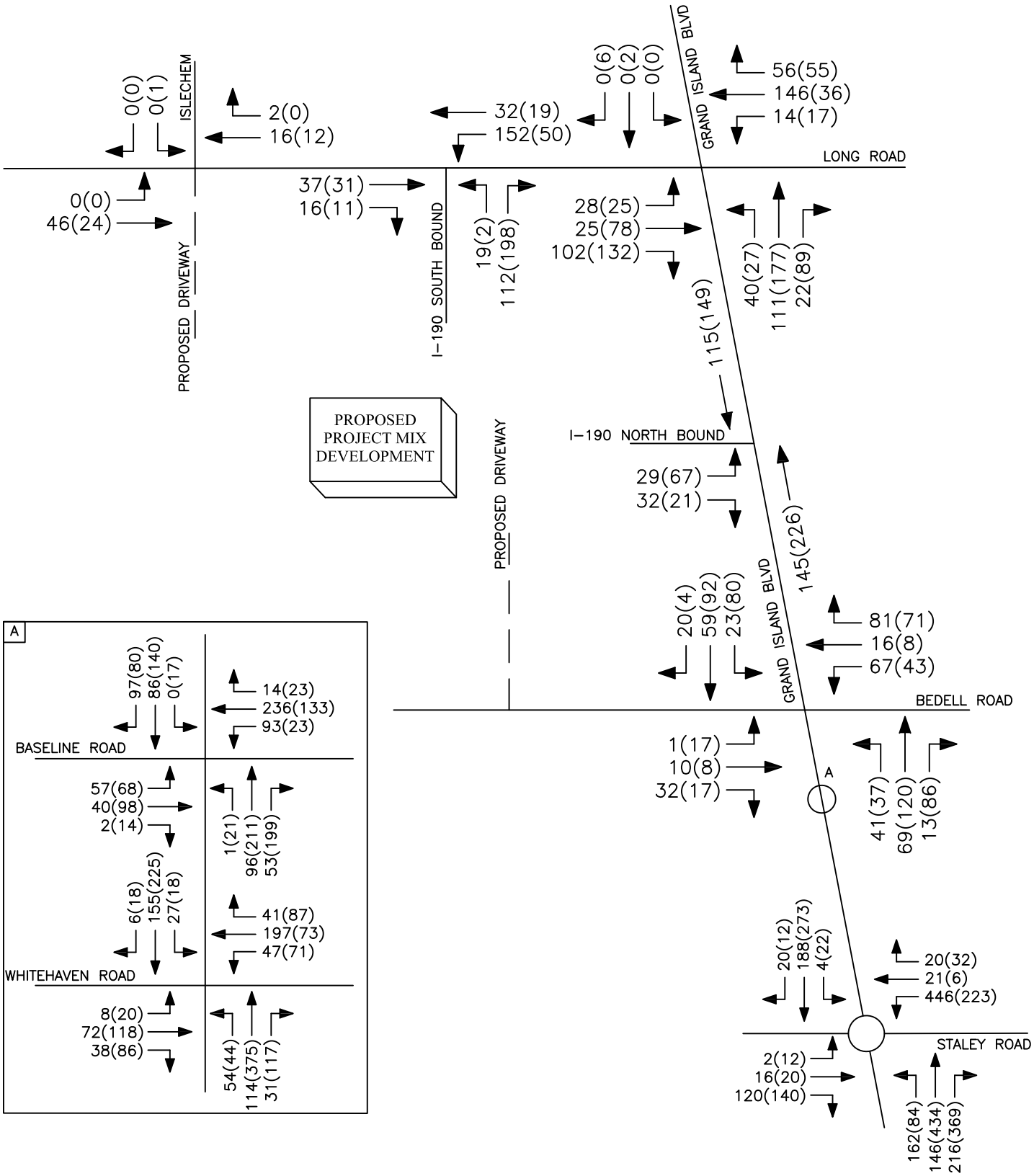

PROJECT NO: 39064

AM PEAK HOUR: 6:30AM–7:30AM
PM PEAK HOUR: 5:30PM–6:30PM

KEY

N

NOT TO SCALE

00(00) = AM(PM)

FIGURE 3

PEAK HOUR VOLUMES
2019 EXISTING CONDITIONS

PROJECT MIX DEVELOPMENT,
TOWN OF GRAND ISLAND, NY

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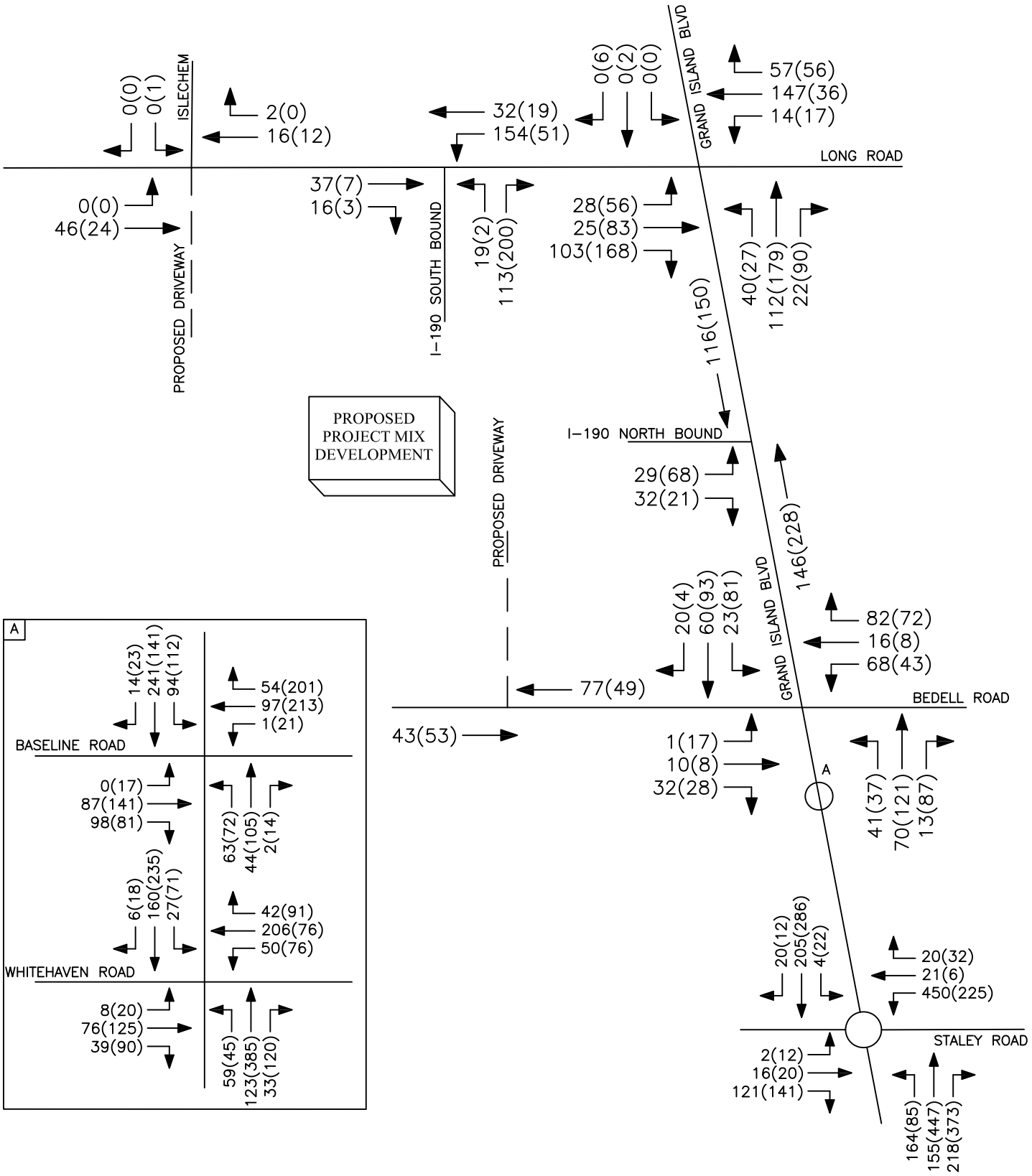

PROJECT NO: 39064

AM PEAK HOUR: 6:30AM–7:30AM
PM PEAK HOUR: 5:30PM–6:30PM

KEY

N

NOT TO SCALE

00(00) = AM(PM)

FIGURE 4

PEAK HOUR VOLUMES
2020 BACKGROUND CONDITIONS

PROJECT MIX DEVELOPMENT,
TOWN OF GRAND ISLAND, NY

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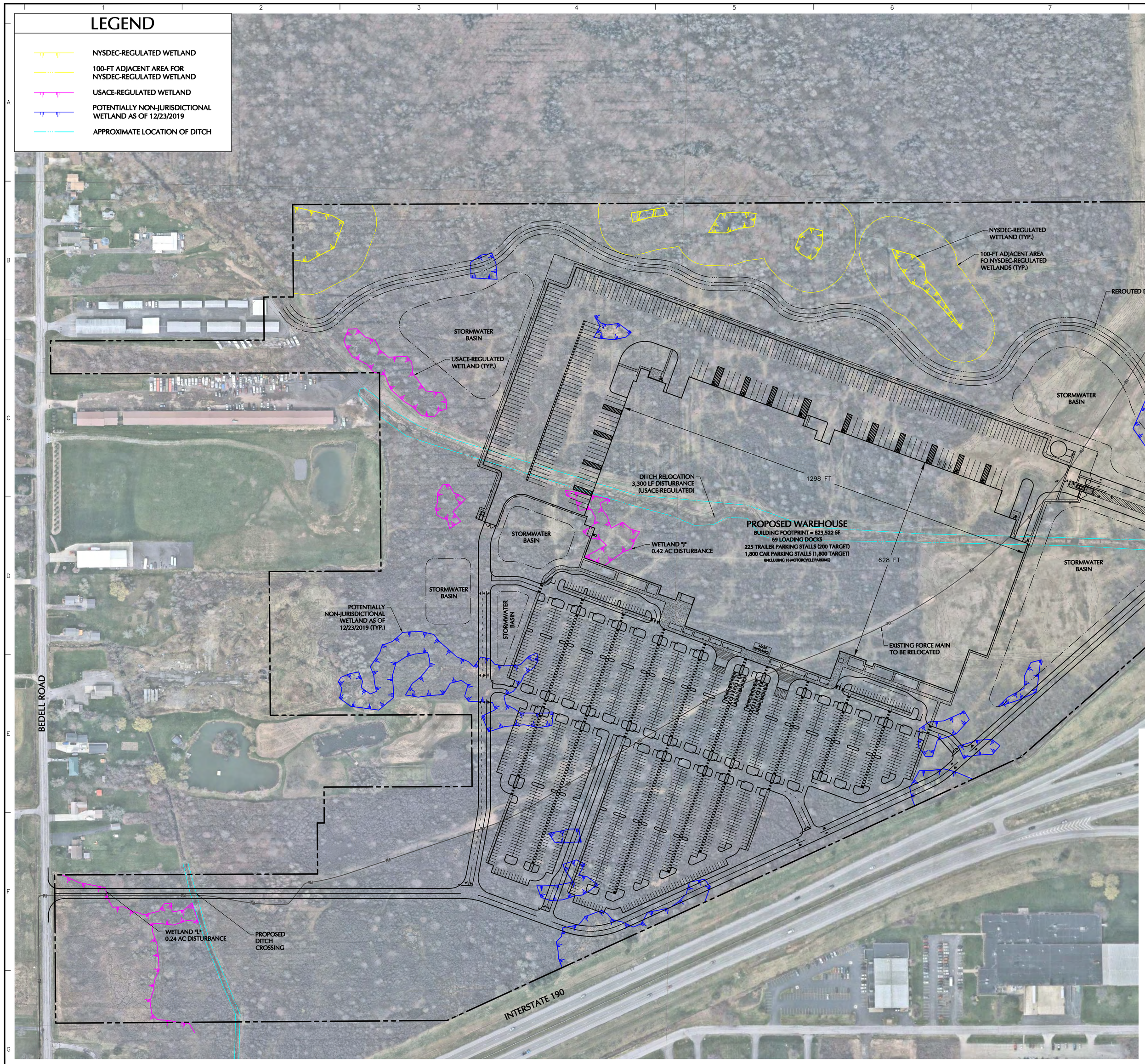


SCALE: 1 INCH = 120 FEET

Zoning Table - Town of Grand Island
M-1 Light Industrial and Research

Bulk Requirements	Required (M-1)	Proposed	Complies
Min. Lot Area	1.5 AC	145.4 AC	Yes
Min. Lot Frontage[1]	150 FT	120 FT[1,4]	No
Min. Lot Depth	300 FT	3,832 FT	Yes
Min. Lot Width[1]	150 FT	120 FT[1,4]	No
Min. Front Yard Depth[1]	65 FT	1,791 FT	Yes
Min. Side Yard Width	25 FT	263 FT	Yes
Min. Rear Yard Depth	30 FT	617 FT	Yes
Min. Setback When Adjacent to Residential Zoned Lots	50 FT	504 FT	Yes
Min. Setback from Bedell Road centerline of right-of-way	80 FT	1,689 FT	Yes
Min. Setback from Long Road centerline of right-of-way	80 FT	1,791 FT	Yes
Max. Building Height in Stories	4 Stories	5 Stories[4]	No
Max. Building Height	45 FT	85 ± FT[4]	No
Max. Building Coverage[2]	40%	13.0%	Yes

Notes:
1. The lot is considered a through lot, since the lot has frontage on two parallel or approximately parallel streets. The front lot line is established using Long Road, since this is the street that will provide primary access to the lot.
2. The maximum percentage of a lot covered by the combined footprint of all buildings, structures, and uses. Excludes patios, walkways and pavements at ground level.
3. Existing non-conformance.
4. Variance required.

Off-Street Parking Standards	Required	Provided	Complies
Car Parking Warehouse: 1 space / 1,000 SQ. FT. of gross floor area, plus 1 space / employee Office: 1 space / 200 SQ. FT. of gross floor area	Warehouse: 3,732 spaces (3,731,124 SF x 1 space / 1,000 SF) Office: 260 spaces (52,000 SF x 1 space / 200 SF) Total: 3,992 spaces required	1,800 spaces	No
Min. 90 Degree Parking Dimensions	Space: 9 FT x 19 FT	9 FT x 19 FT	Yes
	24 FT drive aisle	24 FT drive aisle	Yes
Loading Spaces Warehouse: 3 bays for 100,000+ SQ. FT.	Warehouse: 3 spaces (1,436,526 SF) Total: 3 spaces required	69 Loading Docks	Yes
Min. Loading Space Dimensions	12 FT X 20 FT	17 FT x 60 FT	Yes

WARNING:
IT IS A VIOLATION OF THE NYS EDUCATION LAW ARTICLE 145 FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS ITEM IN ANY WAY.

Date	Description	No.
REVISIONS		

DRAFT 12/5/2019

SIGNATURE DATE SIGNED
PROFESSIONAL XXXXXXXXXX
STATE LIC. No. XXXXX

LANGAN
Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.
300 Kimball Drive
Parsippany, NJ 07054
T: 973.560.4900 F: 973.560.4901 www.langan.com
NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400

Project
PROJECT OLIVE
SECTION No. 23.00, BLOCK No. 1, LOT Nos. 50 & 26.1
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title
CONCEPT PLAN 1

Project No. 100785901
Date 12/5/2019
Drawn By TLK
Checked By RB

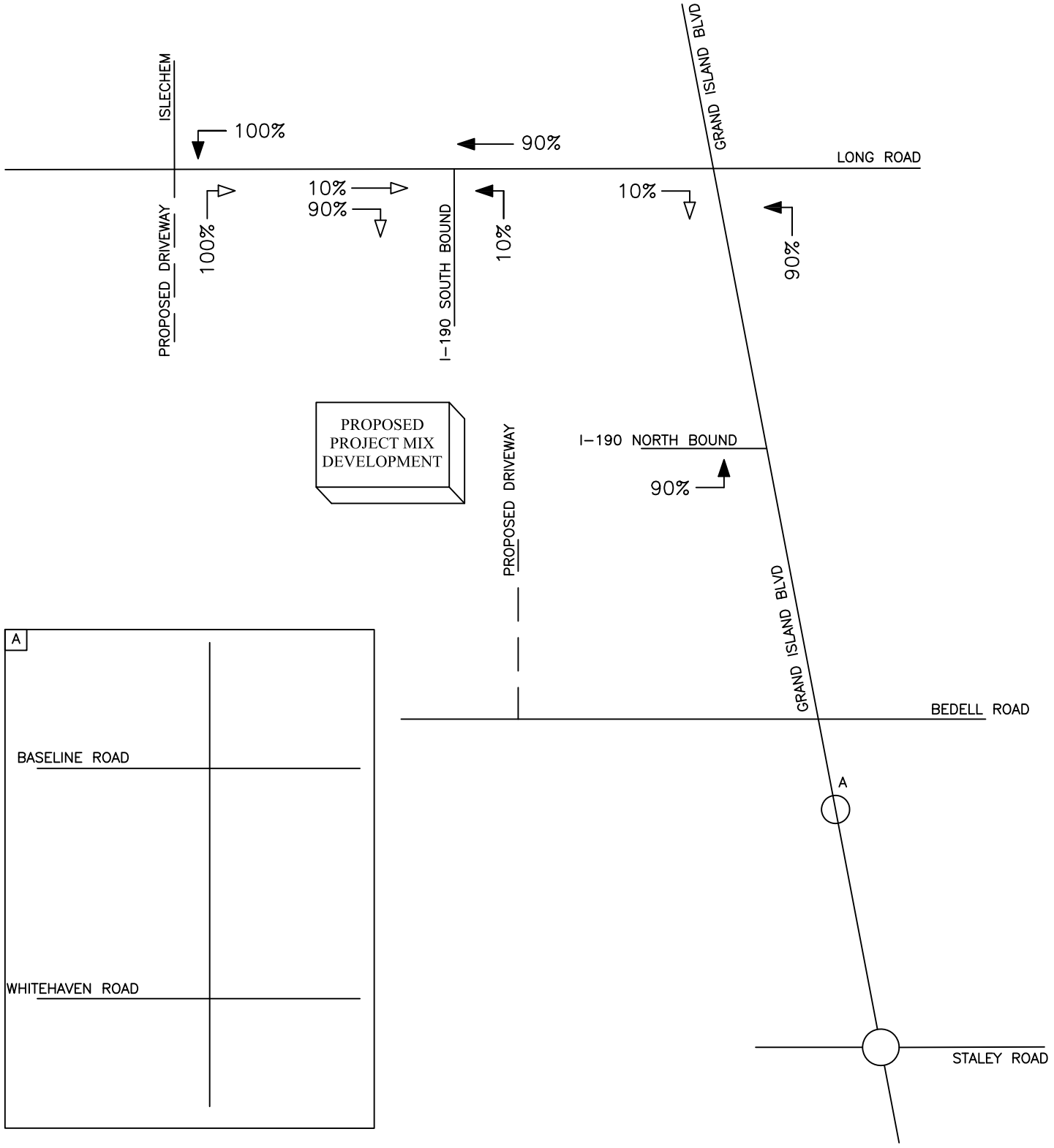
Drawing No.
CP-01
CS101

Sheet 1 of ###

© 2019 Langan

Filename: \\langan.com\data\PAR\data9\100785901\Project Data\CAD\01\Sheetfiles\Concepts\CP01-100785901-CS101-0101.dwg Date: 12/5/2019 Time: 21:50 User: tkuna Style Table: Langan.stb Layout: Concept Plan

LANGAN
PROJECT NO. 100785901



PROJECT NO: 39064

AM PEAK HOUR: 6:30AM–7:30AM
PM PEAK HOUR: 5:30PM–6:30PM

KEY

NOT TO SCALE

00(00) = AM(PM)

N

→ = ENTERING TRIPS

→ = EXITING TRIPS

FIGURE 6A

TRIP DISTRIBUTION
TRUCKS

PROJECT MIX DEVELOPMENT,
TOWN OF GRAND ISLAND, NY

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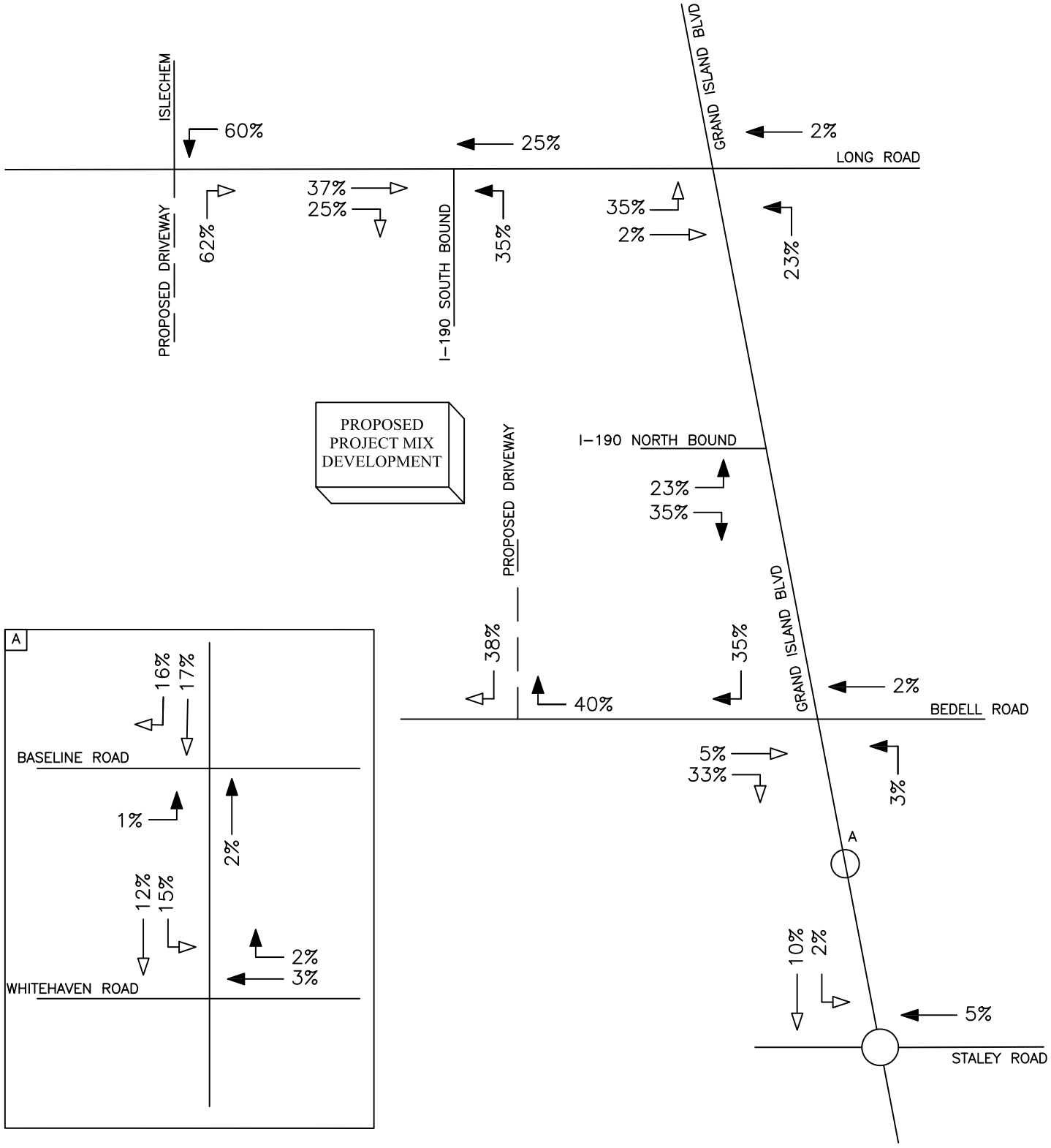

PROJECT NO: 39064

AM PEAK HOUR: 6:30AM–7:30AM
PM PEAK HOUR: 5:30PM–6:30PM

KEY

N

NOT TO SCALE

00(00) = AM(PM)

→ = ENTERING TRIPS

→ = EXITING TRIPS

FIGURE 6B

TRIP DISTRIBUTION
CARS

PROJECT MIX DEVELOPMENT,
TOWN OF GRAND ISLAND, NY

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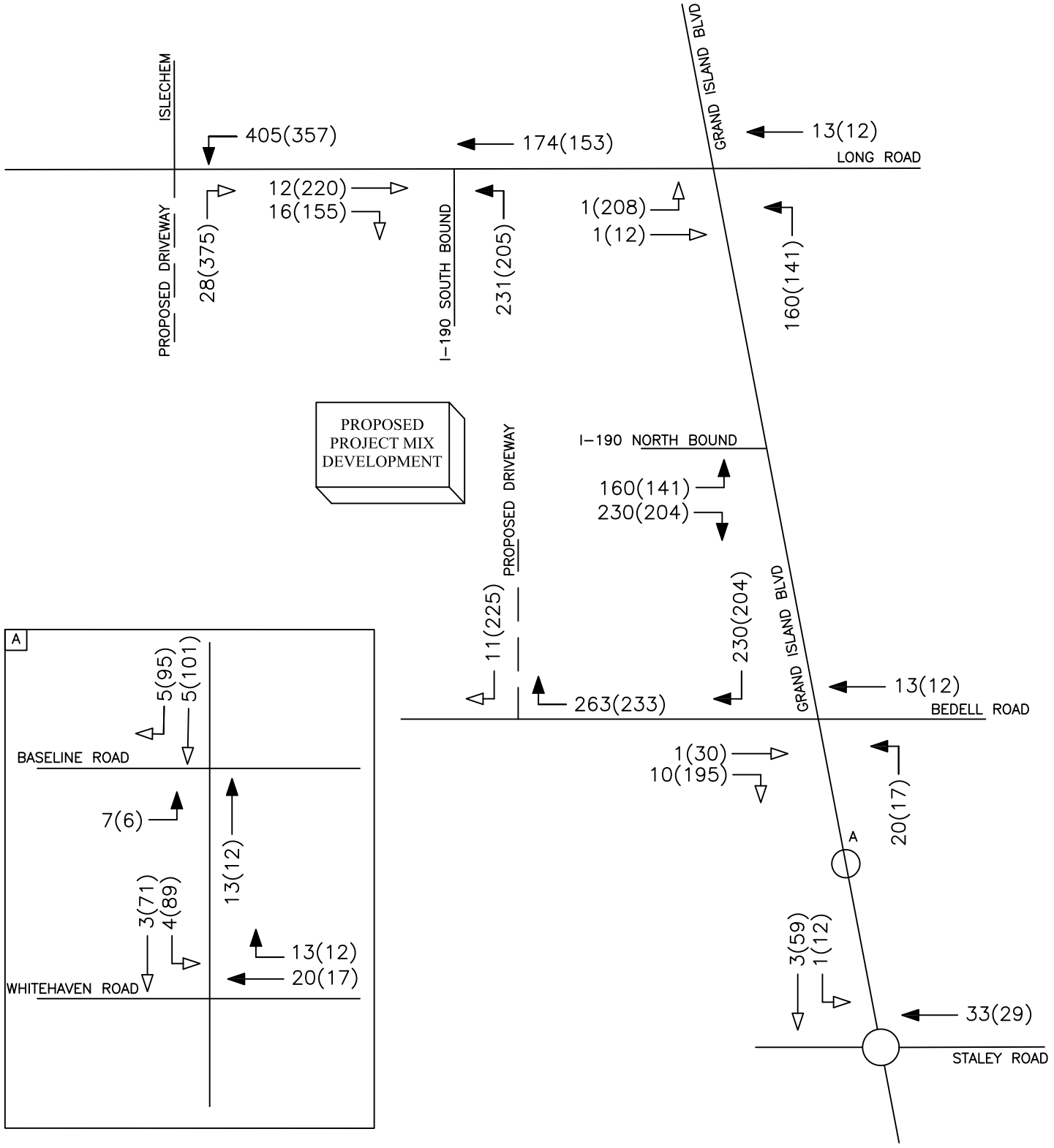

PROJECT NO: 39064

AM PEAK HOUR: 6:30AM–7:30AM
PM PEAK HOUR: 5:30PM–6:30PM

KEY

N

NOT TO SCALE

00(00) = AM(PM)

→ = ENTERING TRIPS

→ = EXITING TRIPS

FIGURE 7

TOTAL SITE GENERATED TRIPS

PROJECT MIX DEVELOPMENT,
TOWN OF GRAND ISLAND, NY

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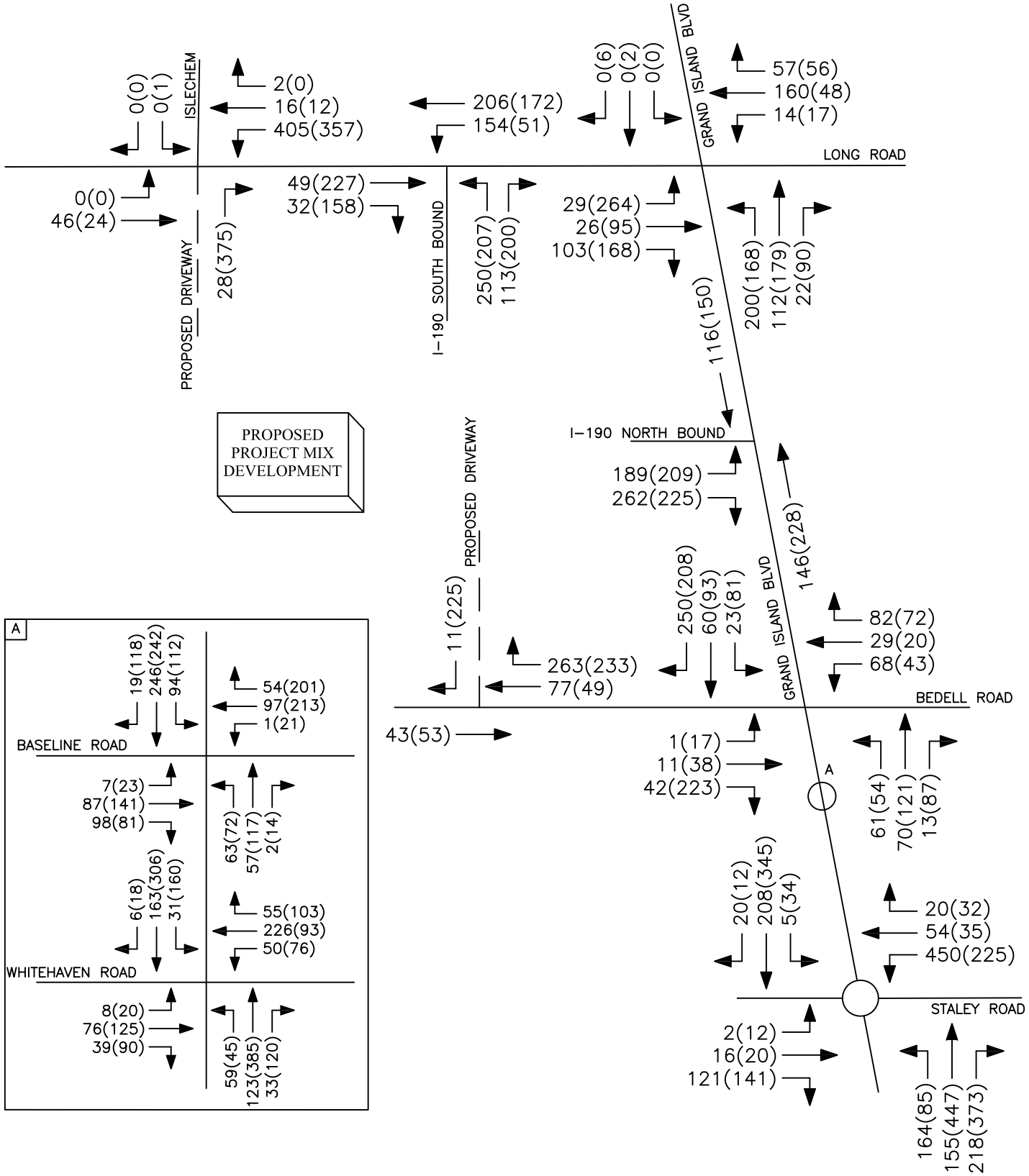

PROJECT NO: 39064

AM PEAK HOUR: 6:30AM–7:30AM
PM PEAK HOUR: 5:30PM–6:30PM

KEY

N

NOT TO SCALE

00(00) = AM(PM)

FIGURE 8

PEAK HOUR VOLUMES
FULL DEVELOPMENT CONDITIONS

PROJECT MIX DEVELOPMENT,
TOWN OF GRAND ISLAND, NY

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APPENDICES

A1

Collected Traffic Volume Data

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
Serving Transportation Professionals Since 1995

Grand Island, NY
Grand Island Blvd & Baseline Rd
Wednesday, November 13, 2019
Location: 43.024966, -78.96577

Count Name: Grand Island Blvd/Baseline Rd
Site Code:
Start Date: 11/13/2019
Page No: 1

Turning Movement Data

Start Time	Baseline Rd Southbound							Grand Island Blvd Westbound							Basline Rd Northbound							Grand Island Blvd Eastbound							
	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Int. Total
5:00 AM	1	0	4	4	0	1	9	1	1	4	0	0	0	6	0	0	1	2	0	0	3	3	0	4	0	0	0	7	25
5:15 AM	0	0	6	6	0	0	12	1	0	8	0	0	0	9	0	1	4	1	0	1	6	5	1	3	0	0	0	9	36
5:30 AM	0	0	17	5	0	0	22	2	2	3	0	0	0	7	0	0	1	8	0	1	9	6	2	6	0	0	1	14	52
5:45 AM	1	0	17	10	0	0	28	5	0	9	0	0	0	14	0	0	3	9	0	0	12	9	2	13	2	0	0	26	80
Hourly Total	2	0	44	25	0	1	71	9	3	24	0	0	0	36	0	1	9	20	0	2	30	23	5	26	2	0	1	56	193
6:00 AM	5	1	11	15	0	0	32	5	1	20	0	0	0	26	0	0	10	10	0	0	20	9	4	15	0	0	0	28	106
6:15 AM	2	1	19	17	0	0	39	8	2	19	0	0	0	29	0	2	14	12	0	0	28	8	2	22	3	0	0	35	131
6:30 AM	2	0	46	25	0	0	73	8	2	30	0	0	0	40	0	0	4	10	0	0	14	16	1	25	0	0	0	42	169
6:45 AM	4	0	48	25	0	0	77	10	1	23	0	0	0	34	0	0	14	20	0	0	34	16	6	22	0	0	0	44	189
Hourly Total	13	2	124	82	0	0	221	31	6	92	0	0	0	129	0	2	42	52	0	0	96	49	13	84	3	0	0	149	595
7:00 AM	4	2	76	21	0	0	103	18	0	19	0	0	0	37	0	1	13	10	0	0	24	24	6	19	0	1	0	50	214
7:15 AM	2	0	66	22	0	0	90	13	1	24	1	0	0	39	0	1	9	17	0	0	27	21	7	20	0	0	0	48	204
7:30 AM	4	0	52	13	0	0	69	9	0	40	1	0	0	50	1	1	10	29	0	0	41	18	6	16	0	0	0	40	200
7:45 AM	5	1	56	25	0	0	87	10	0	44	2	0	0	56	1	2	20	24	0	0	47	22	5	31	0	0	0	58	248
Hourly Total	15	3	250	81	0	0	349	50	1	127	4	0	0	182	2	5	52	80	0	0	139	85	24	86	0	1	0	196	866
8:00 AM	2	1	53	31	0	0	87	6	4	35	0	0	0	45	1	0	13	24	0	0	38	14	2	24	1	0	0	41	211
8:15 AM	5	1	37	26	0	0	69	17	7	42	3	0	0	69	1	1	25	21	0	0	48	24	3	17	2	0	0	46	232
8:30 AM	6	0	56	20	0	0	82	9	3	43	0	0	0	55	1	0	44	23	0	0	68	19	4	34	2	0	0	59	264
8:45 AM	4	3	54	53	0	0	114	30	2	31	3	0	0	66	2	2	39	15	0	0	58	15	3	30	5	0	0	53	291
Hourly Total	17	5	200	130	0	0	352	62	16	151	6	0	0	235	5	3	121	83	0	0	212	72	12	105	10	0	0	199	998
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:00 PM	6	3	33	31	0	1	73	60	3	66	5	0	1	134	2	4	40	14	0	2	60	19	2	64	1	0	0	86	353
4:15 PM	1	0	35	39	0	1	75	71	4	65	2	0	0	142	2	4	33	14	0	0	53	20	4	49	7	0	0	80	350
4:30 PM	2	0	24	36	0	0	62	64	4	64	3	0	0	135	1	3	52	35	0	0	91	31	1	62	3	0	0	97	385
4:45 PM	3	2	39	41	0	0	85	59	1	56	1	0	0	117	5	3	31	20	0	0	59	26	3	55	6	0	0	90	351
Hourly Total	12	5	131	147	0	2	295	254	12	251	11	0	1	528	10	14	156	83	0	2	263	96	10	230	17	0	0	353	1439
5:00 PM	0	4	30	27	0	0	61	50	2	69	6	0	0	127	1	4	45	13	0	0	63	24	4	62	2	0	0	92	343
5:15 PM	2	3	20	24	0	0	49	60	3	64	1	0	0	128	3	2	28	30	0	0	63	23	3	46	5	0	1	77	317
5:30 PM	0	2	28	26	0	0	56	50	5	44	6	0	0	105	2	2	20	13	0	0	37	24	0	39	5	0	0	68	266
5:45 PM	4	1	35	28	0	0	68	46	4	49	4	0	0	103	0	4	31	13	0	0	48	19	1	34	1	0	2	55	274
Hourly Total	6	10	113	105	0	0	234	206	14	226	17	0	0	463	6	12	124	69	0	0	211	90	8	181	13	0	3	292	1200
6:00 PM	1	6	33	27	0	0	67	42	1	55	4	0	0	102	1	2	21	23	0	0	47	12	7	35	6	0	0	60	276
6:15 PM	4	5	37	30	0	0	76	50	1	63	7	0	0	121	2	1	26	19	0	0	48	14	3	32	5	0	0	54	299
6:30 PM	3	2	15	31	0	0	51	41	11	45	0	0	0	97	1	2	10	15	0	0	28	13	0	33	3	0	0	49	225
6:45 PM	2	1	16	18	0	0	37	32	6	38	4	0	0	80	2	1	26	15	0	0	44	7	0	23	5	0	0	35	196
Hourly Total	10	14	101	106	0	0	231	165	19	201	15	0	0	400	6	6	83	72	0	0	167	46	10	123	19	0	0	198	996
7:00 PM	3	0	9	10	0	0	22	28	1	33	2	0	0	64	0	2	23	4	0	0	29	6	3	27	3	0	0	39	154
7:15 PM	1	1	11	15	0	0	28	26	6	40	3	0	0	75	0	0	16	12	0	0	28	9	2	24	3	0	0	38	169
7:30 PM	0	0	22	12	0	0	34	26	4	30	1	0	0	61	0	2	13	7	0	0	22	8	2	17	0	0	0	27	144
7:45 PM	0	0	18	12	0	1	30	29	8	21	2	0	0	60	0	2	13	2	0	0	17	11	0	22	1	0	0	34	141
Hourly Total	4	1	60	49	0	1	114	109	19	124	8	0	0	260	0	6	65	25	0	0	96	34	7	90	7	0	0	138	608
8:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
Grand Total	79	40	1023	725	0	4	1867	886	90	1196	61	0	1	2233	29	49	652	484	0	4	1214	495	89	926	71	1	4	1582	6896
Approach %	4.2	2.1	54.8	38.8	0.0	-	-	39.7	4.0	53.6	2.7	0.0	-	-	2.4	4.0	53.7	39.9	0.0	-	-	31.3	5.6	58.5	4.5	0.1	-	-	-
Total %	1.1	0.6	14.8	10.5	0.0	-	27.1	12.8	1.3	17.3	0.9	0.0	-	32.4	0.4	0.7	9.5	7.0	0.0	-	17.6	7.2	1.3	13.4	1.0	0.0	-	22.9	-
Lights	75	40	976	702	0	-	1793	866	89	1160	61	0	-	2176	29	49	612	474	0	-	1164	485	88	892	71	1	-	1537	6670
% Lights	94.9	100.0	95.4	96.8	-	-	96.0	97.7	98.9	97.0	100.0	-	-	97.4	100.0	100.0	93.9	97.9	-	-	95.9	98.0	98.9	96.3	100.0	100.0	-	97.2	96.7
Buses	2	0	33	16	0	-	51	11	0	17	0	0	-	28	0	0	33	3	0	-	36	3	0	17	0	0	-	20	135
% Buses	2.5	0.0	3.2	2.2	-	-	2.7	1.2	0.0	1.4	0.0	-	-	1.3	0.0	0.0	5.1	0.6	-	-	3.0	0.6	0.0	1.8	0.0	0.0	-	1.3	2.0
Trucks	2	0	14	7	0	-	23	9	1	19	0	0	-	29	0	0	7	7	0	-	14	7	1	17	0	0	-	25	91
% Trucks	2.5	0.0	1.4	1.0	-	-	1.2	1.0	1.1	1.6	0.0	-	-	1.3	0.0	0.0	1.1	1.4	-	-	1.2	1.4	1.1	1.8	0.0	0.0	-	1.6	1.3
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	0.0	-	-	-	-	-	-	0.0	-	-	-	-	-	-	0.0	-	-	-	-	-	-	0.0	-	-

Pedestrians	-	-	-	-	-	4	-	-	-	-	-	-	1	-	-	-	-	-	-	4	-	-	-	-	-	-	4	-	-
% Pedestrians	-	-	-	-	-	100.0	-	-	-	-	-	-	100.0	-	-	-	-	-	-	100.0	-	-	-	-	-	-	100.0	-	-

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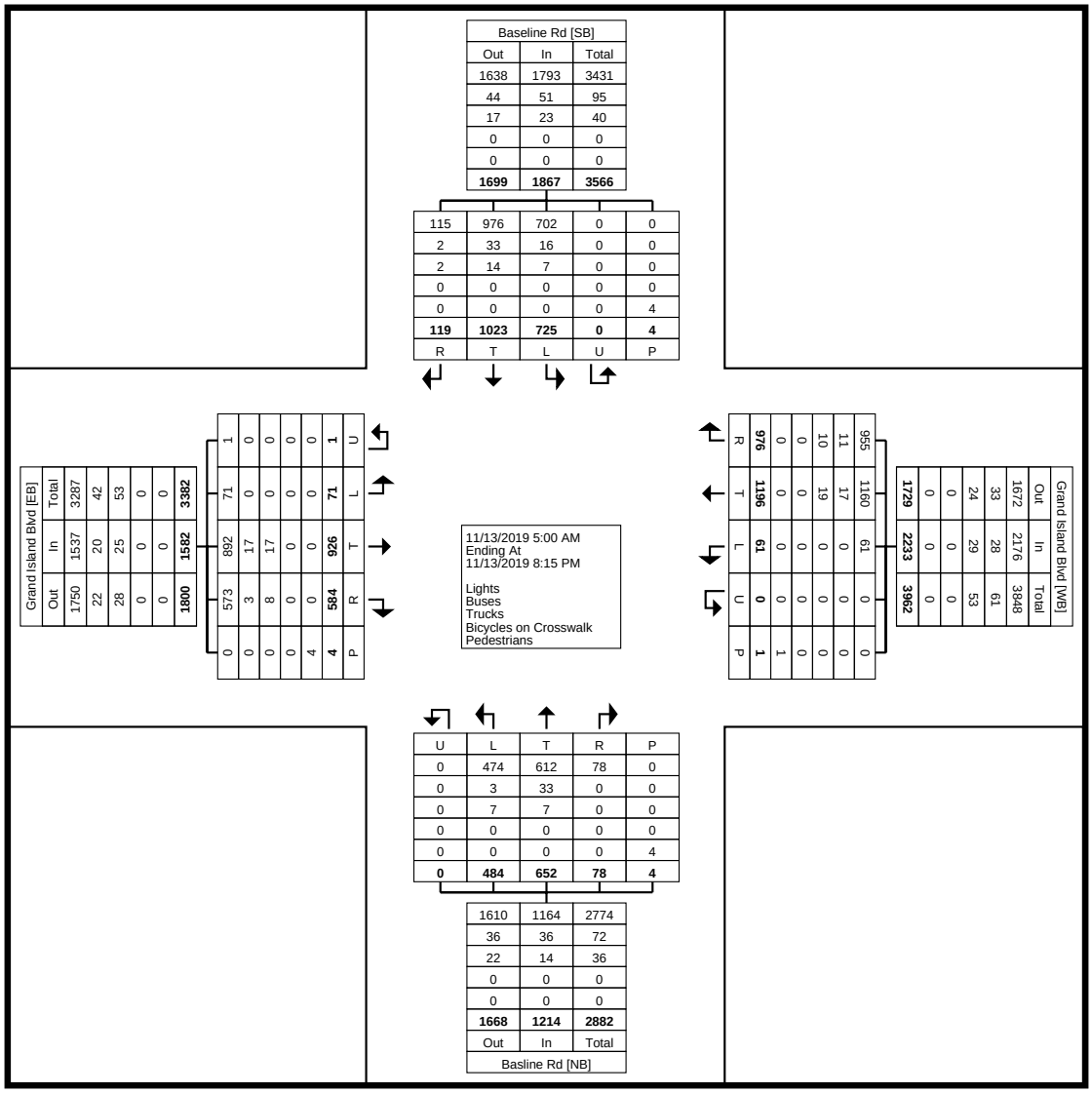
Grand Island, NY
Grand Island Blvd & Baseline Rd
Wednesday, November 13, 2019
Location: 43.024966, -78.96577

Count Name: Grand Island Blvd/Baseline Rd
Site Code:
Start Date: 11/13/2019
Page No: 3



Turning Movement Data Plot

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Grand Island, NY
Grand Island Blvd & Baseline Rd
Wednesday, November 13, 2019
Location: 43.024966, -78.96577

Count Name: Grand Island Blvd/Baseline Rd
Site Code:
Start Date: 11/13/2019
Page No: 4

Turning Movement Peak Hour Data (8:00 AM)

Start Time	Baseline Rd Southbound							Grand Island Blvd Westbound							Basline Rd Northbound							Grand Island Blvd Eastbound							
	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Int. Total
8:00 AM	2	1	53	31	0	0	87	6	4	35	0	0	0	45	1	0	13	24	0	0	38	14	2	24	1	0	0	41	211
8:15 AM	5	1	37	26	0	0	69	17	7	42	3	0	0	69	1	1	25	21	0	0	48	24	3	17	2	0	0	46	232
8:30 AM	6	0	56	20	0	0	82	9	3	43	0	0	0	55	1	0	44	23	0	0	68	19	4	34	2	0	0	59	264
8:45 AM	4	3	54	53	0	0	114	30	2	31	3	0	0	66	2	2	39	15	0	0	58	15	3	30	5	0	0	53	291
Total	17	5	200	130	0	0	352	62	16	151	6	0	0	235	5	3	121	83	0	0	212	72	12	105	10	0	0	199	998
Approach %	4.8	1.4	56.8	36.9	0.0	-	-	26.4	6.8	64.3	2.6	0.0	-	-	2.4	1.4	57.1	39.2	0.0	-	-	36.2	6.0	52.8	5.0	0.0	-	-	-
Total %	1.7	0.5	20.0	13.0	0.0	-	35.3	6.2	1.6	15.1	0.6	0.0	-	23.5	0.5	0.3	12.1	8.3	0.0	-	21.2	7.2	1.2	10.5	1.0	0.0	-	19.9	-
PHF	0.708	0.417	0.893	0.613	0.000	-	0.772	0.517	0.571	0.878	0.500	0.000	-	0.851	0.625	0.375	0.688	0.865	0.000	-	0.779	0.750	0.750	0.772	0.500	0.000	-	0.843	0.857
Lights	17	5	192	123	0	-	337	57	15	142	6	0	-	220	5	3	100	80	0	-	188	70	12	96	10	0	-	188	933
% Lights	100.0	100.0	96.0	94.6	-	-	95.7	91.9	93.8	94.0	100.0	-	-	93.6	100.0	100.0	82.6	96.4	-	-	88.7	97.2	100.0	91.4	100.0	-	-	94.5	93.5
Buses	0	0	8	7	0	-	15	0	0	4	0	0	-	4	0	0	21	2	0	-	23	0	0	6	0	0	-	6	48
% Buses	0.0	0.0	4.0	5.4	-	-	4.3	0.0	0.0	2.6	0.0	-	-	1.7	0.0	0.0	17.4	2.4	-	-	10.8	0.0	0.0	5.7	0.0	-	-	3.0	4.8
Trucks	0	0	0	0	0	-	0	5	1	5	0	0	-	11	0	0	0	1	0	-	1	2	0	3	0	0	-	5	17
% Trucks	0.0	0.0	0.0	0.0	-	-	0.0	8.1	6.3	3.3	0.0	-	-	4.7	0.0	0.0	0.0	1.2	-	-	0.5	2.8	0.0	2.9	0.0	-	-	2.5	1.7
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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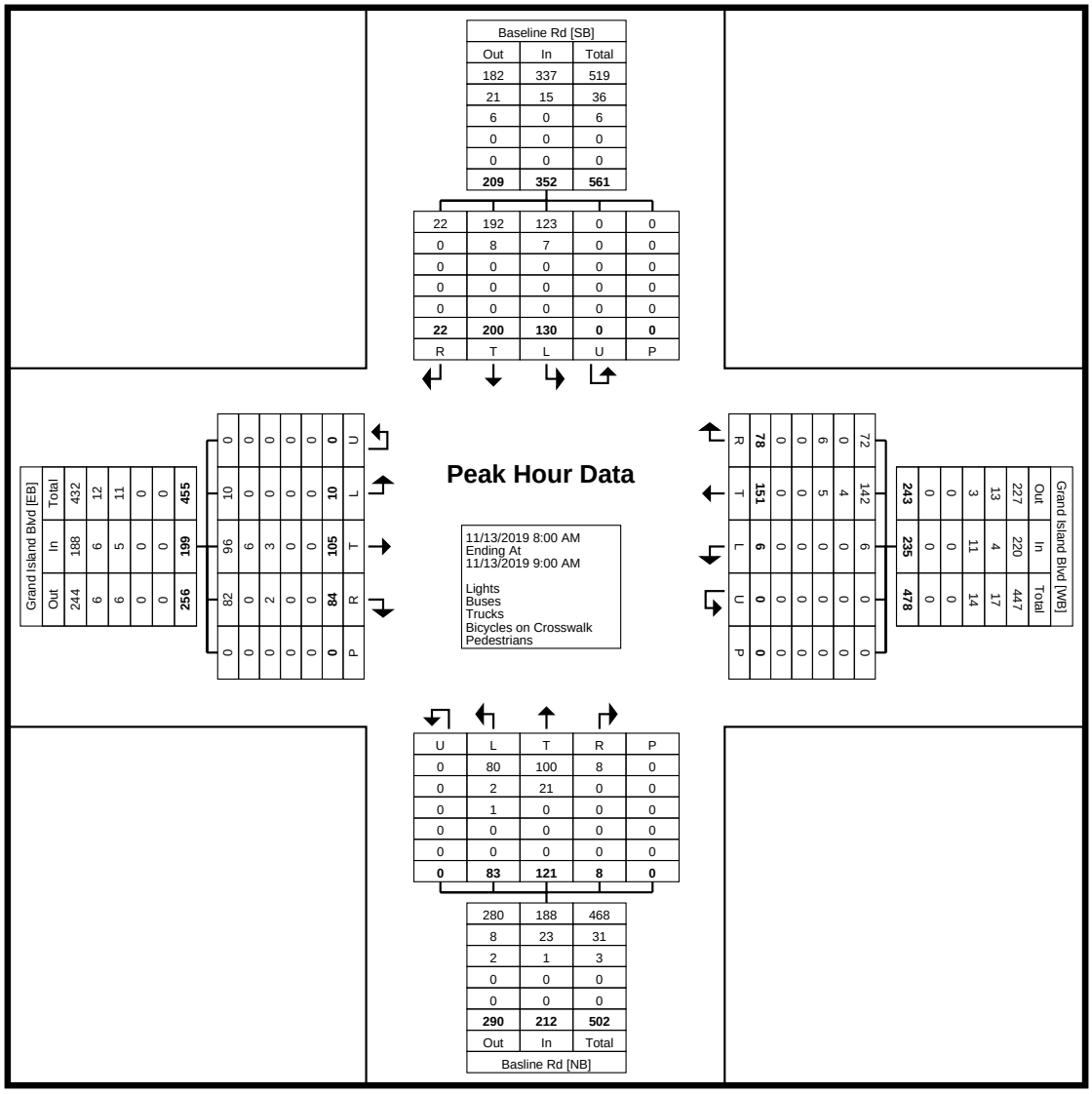
Grand Island, NY
Grand Island Blvd & Baseline Rd
Wednesday, November 13, 2019
Location: 43.024966, -78.96577

Count Name: Grand Island Blvd/Baseline Rd
Site Code:
Start Date: 11/13/2019
Page No: 5



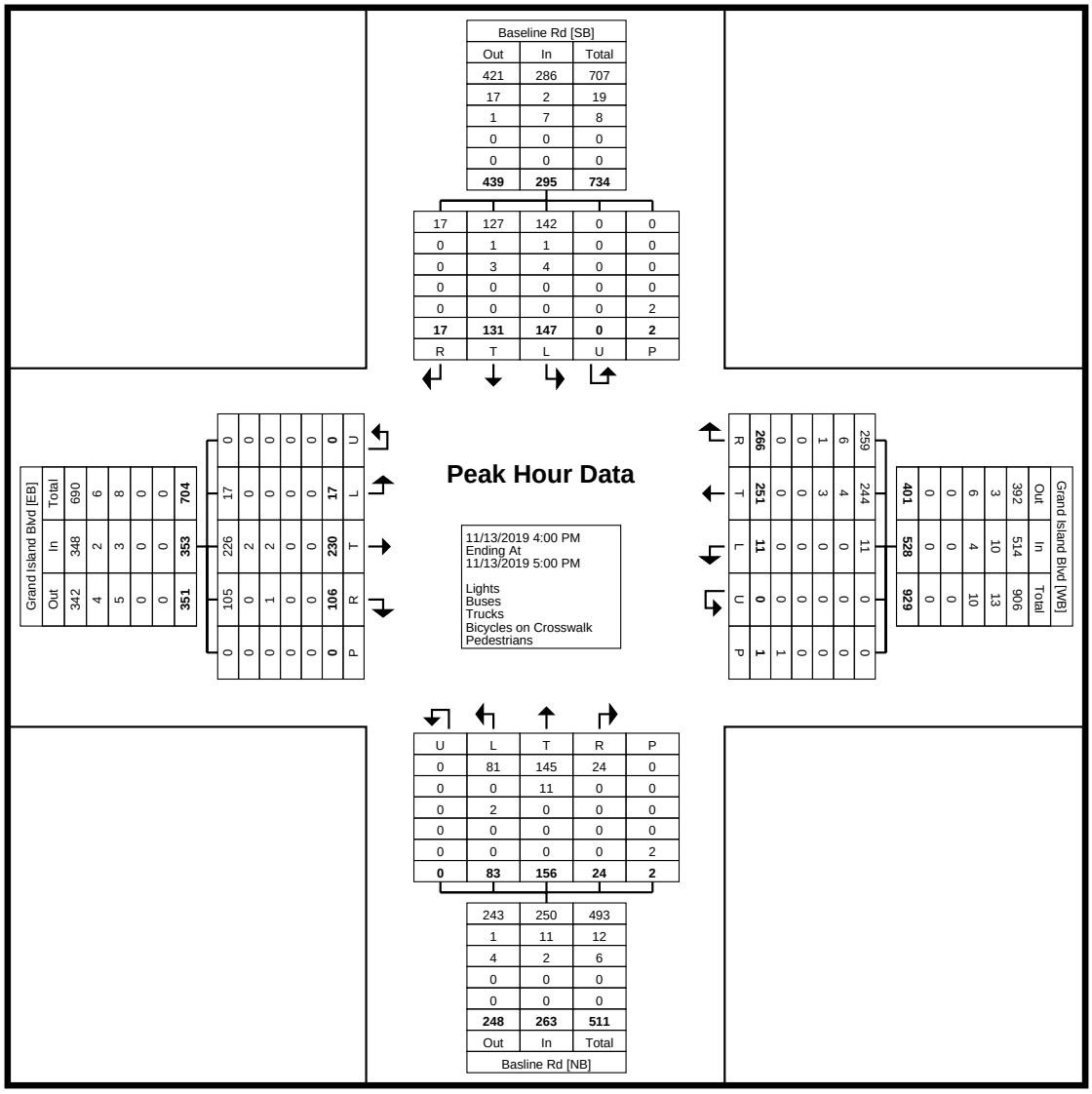
Turning Movement Peak Hour Data Plot (8:00 AM)

Grand Island, NY
Grand Island Blvd & Baseline Rd
Wednesday, November 13, 2019
Location: 43.024966, -78.96577

Count Name: Grand Island Blvd/Baseline Rd
Site Code:
Start Date: 11/13/2019
Page No: 6

Turning Movement Peak Hour Data (4:00 PM)

Start Time	Baseline Rd Southbound							Grand Island Blvd Westbound							Basline Rd Northbound							Grand Island Blvd Eastbound							
	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Int. Total
4:00 PM	6	3	33	31	0	1	73	60	3	66	5	0	1	134	2	4	40	14	0	2	60	19	2	64	1	0	0	86	353
4:15 PM	1	0	35	39	0	1	75	71	4	65	2	0	0	142	2	4	33	14	0	0	53	20	4	49	7	0	0	80	350
4:30 PM	2	0	24	36	0	0	62	64	4	64	3	0	0	135	1	3	52	35	0	0	91	31	1	62	3	0	0	97	385
4:45 PM	3	2	39	41	0	0	85	59	1	56	1	0	0	117	5	3	31	20	0	0	59	26	3	55	6	0	0	90	351
Total	12	5	131	147	0	2	295	254	12	251	11	0	1	528	10	14	156	83	0	2	263	96	10	230	17	0	0	353	1439
Approach %	4.1	1.7	44.4	49.8	0.0	-	-	48.1	2.3	47.5	2.1	0.0	-	-	3.8	5.3	59.3	31.6	0.0	-	-	27.2	2.8	65.2	4.8	0.0	-	-	-
Total %	0.8	0.3	9.1	10.2	0.0	-	20.5	17.7	0.8	17.4	0.8	0.0	-	36.7	0.7	1.0	10.8	5.8	0.0	-	18.3	6.7	0.7	16.0	1.2	0.0	-	24.5	-
PHF	0.500	0.417	0.840	0.896	0.000	-	0.868	0.894	0.750	0.951	0.550	0.000	-	0.930	0.500	0.875	0.750	0.593	0.000	-	0.723	0.774	0.625	0.898	0.607	0.000	-	0.910	0.934
Lights	12	5	127	142	0	-	286	247	12	244	11	0	-	514	10	14	145	81	0	-	250	95	10	226	17	0	-	348	1398
% Lights	100.0	100.0	96.9	96.6	-	-	96.9	97.2	100.0	97.2	100.0	-	-	97.3	100.0	100.0	92.9	97.6	-	-	95.1	99.0	100.0	98.3	100.0	-	-	98.6	97.2
Buses	0	0	1	1	0	-	2	6	0	4	0	0	-	10	0	0	11	0	0	-	11	0	0	2	0	0	-	2	25
% Buses	0.0	0.0	0.8	0.7	-	-	0.7	2.4	0.0	1.6	0.0	-	-	1.9	0.0	0.0	7.1	0.0	-	-	4.2	0.0	0.0	0.9	0.0	-	-	0.6	1.7
Trucks	0	0	3	4	0	-	7	1	0	3	0	0	-	4	0	0	0	2	0	-	2	1	0	2	0	0	-	3	16
% Trucks	0.0	0.0	2.3	2.7	-	-	2.4	0.4	0.0	1.2	0.0	-	-	0.8	0.0	0.0	0.0	2.4	-	-	0.8	1.0	0.0	0.9	0.0	-	-	0.8	1.1
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	0.0	-	-	-	-	-	-	0.0	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-	-	-	2	-	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	100.0	-	-	-	-	-	-	100.0	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-



Turning Movement Peak Hour Data Plot (4:00 PM)

Grand Island, NY
Grand Island Blvd/Bedell Rd
Wednesday, November 13, 2019
Location: 43.036221, -78.976504

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Count Name: Grand Island Blvd/Bedell Rd
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Start Date: 11/13/2019
Page No: 1

Turning Movement Data

Start Time	Grand Island Blvd Southbound							Bedell Rd Westbound							Grand Island Blvd Northbound							Bedell Rd Eastbound							
	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Int. Total
5:00 AM	1	0	1	1	0	0	3	0	1	1	2	0	0	4	0	0	2	4	0	0	6	0	0	0	1	0	0	1	14
5:15 AM	1	0	3	0	0	0	4	1	5	0	2	0	0	8	0	0	3	5	0	0	8	0	0	1	0	0	0	1	21
5:30 AM	2	0	11	1	0	0	14	1	8	0	4	0	0	13	0	0	6	2	0	0	8	0	0	0	1	0	1	1	36
5:45 AM	4	0	13	0	0	0	17	2	10	0	3	0	0	15	1	0	13	5	0	0	19	0	2	0	0	0	0	2	53
Hourly Total	8	0	28	2	0	0	38	4	24	1	11	0	0	40	1	0	24	16	0	0	41	0	2	1	2	0	1	5	124
6:00 AM	0	0	11	2	0	0	13	3	7	0	10	0	0	20	0	0	15	8	0	0	23	1	1	0	1	0	0	3	59
6:15 AM	0	1	19	2	0	0	22	5	6	0	10	0	1	21	1	0	16	7	0	1	24	1	4	1	3	0	0	9	76
6:30 AM	2	1	12	4	0	0	19	7	16	4	15	0	0	42	1	3	19	13	0	0	36	2	0	1	0	0	0	3	100
6:45 AM	2	3	17	5	0	0	27	9	10	6	17	0	0	42	0	1	19	10	0	0	30	4	4	4	0	0	0	12	111
Hourly Total	4	5	59	13	0	0	81	24	39	10	52	0	1	125	2	4	69	38	0	1	113	8	9	6	4	0	0	27	346
7:00 AM	2	2	12	5	0	0	21	13	9	4	18	0	0	44	3	1	16	12	0	0	32	4	9	4	0	0	0	17	114
7:15 AM	5	3	18	9	0	0	35	6	11	2	17	0	0	36	4	0	15	6	0	0	25	3	6	1	1	0	0	11	107
7:30 AM	5	2	19	5	0	0	31	13	23	3	15	0	0	54	7	1	28	20	0	0	56	0	2	0	1	0	0	3	144
7:45 AM	11	2	27	6	0	0	46	17	7	6	15	0	0	45	1	1	34	18	0	0	54	2	4	2	2	0	0	10	155
Hourly Total	23	9	76	25	0	0	133	49	50	15	65	0	0	179	15	3	93	56	0	0	167	9	21	7	4	0	0	41	520
8:00 AM	9	2	15	4	0	0	30	9	12	6	14	0	0	41	0	2	28	19	0	0	49	3	3	4	5	0	0	15	135
8:15 AM	11	0	20	15	0	0	46	16	10	2	16	0	0	44	5	0	27	17	0	0	49	9	5	4	1	0	0	19	158
8:30 AM	8	1	28	7	0	0	44	11	10	6	20	0	0	47	4	1	30	16	0	0	51	4	8	0	3	0	1	15	157
8:45 AM	4	1	25	7	0	0	37	9	10	5	4	0	0	28	3	1	18	13	0	0	35	9	4	5	2	0	0	20	120
Hourly Total	32	4	88	33	0	0	157	45	42	19	54	0	0	160	12	4	103	65	0	0	184	25	20	13	11	0	1	69	570
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1
4:00 PM	0	0	34	29	0	0	63	8	9	2	11	0	0	30	9	2	37	14	0	0	62	14	12	5	13	0	0	44	199
4:15 PM	2	0	25	25	0	0	52	15	8	5	4	0	0	32	19	5	34	8	0	0	66	4	11	5	6	0	0	26	176
4:30 PM	0	2	33	21	0	0	56	15	11	1	19	0	0	46	8	3	40	9	0	0	60	14	14	4	9	0	0	41	203
4:45 PM	2	0	32	27	0	0	61	9	11	5	5	0	0	30	16	5	39	11	0	0	71	9	5	7	4	0	0	25	187
Hourly Total	4	2	124	102	0	0	232	47	39	13	39	0	0	138	52	15	150	42	0	0	259	41	42	21	32	0	0	136	765
5:00 PM	1	1	43	30	0	0	75	10	9	4	18	0	0	41	14	2	52	5	0	0	73	15	7	8	8	0	0	38	227
5:15 PM	1	0	34	28	0	0	63	13	10	1	7	0	0	31	23	2	37	9	0	0	71	11	7	3	12	0	0	33	198
5:30 PM	1	0	26	14	0	0	41	13	6	0	7	0	0	26	14	5	33	7	0	0	59	5	4	1	6	0	0	16	142
5:45 PM	1	1	21	27	0	0	50	8	2	1	14	0	0	25	16	1	29	5	0	0	51	3	3	2	3	0	1	11	137
Hourly Total	4	2	124	99	0	0	229	44	27	6	46	0	0	123	67	10	151	26	0	0	254	34	21	14	29	0	1	98	704
6:00 PM	0	0	24	17	0	0	41	9	12	3	12	0	0	36	21	2	31	14	0	0	68	2	4	1	4	0	0	11	156
6:15 PM	1	0	21	22	0	0	44	10	11	4	10	0	0	35	21	6	27	11	0	0	65	2	5	4	4	0	0	15	159
6:30 PM	2	0	17	25	0	0	44	7	7	2	9	0	1	25	11	5	30	9	0	0	55	2	3	0	2	0	0	7	131
6:45 PM	0	0	10	19	0	0	29	5	8	3	4	0	0	20	11	1	26	4	0	0	42	0	0	5	0	0	0	5	96
Hourly Total	3	0	72	83	0	0	158	31	38	12	35	0	1	116	64	14	114	38	0	0	230	6	12	10	10	0	0	38	542
7:00 PM	2	0	23	11	0	0	36	6	7	2	5	0	0	20	9	1	22	7	0	0	39	1	3	2	0	0	0	6	101
7:15 PM	1	0	18	17	0	0	36	0	6	0	3	0	0	9	10	2	21	4	0	0	37	0	0	2	4	0	0	6	88
7:30 PM	3	0	13	15	0	0	31	2	8	0	8	0	0	18	20	0	19	3	0	0	42	0	1	1	1	0	0	3	94
7:45 PM	2	0	20	21	0	0	43	3	4	0	6	0	0	13	7	0	8	2	0	0	17	0	4	0	1	0	0	5	78
Hourly Total	8	0	74	64	0	0	146	11	25	2	22	0	0	60	46	3	70	16	0	0	135	1	8	5	6	0	0	20	361
8:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	86	22	645	421	0	0	1174	255	284	78	324	0	2	941	259	53	775	297	0	1	1384	124	135	77	98	0	3	434	3933
Approach %	7.3	1.9	54.9	35.9	0.0	-	-	27.1	30.2	8.3	34.4	0.0	-	-	18.7	3.8	56.0	21.5	0.0	-	-	28.6	31.1	17.7	22.6	0.0	-	-	-
Total %	2.2	0.6	16.4	10.7	0.0	-	29.8	6.5	7.2	2.0	8.2	0.0	-	23.9	6.6	1.3	19.7	7.6	0.0	-	35.2	3.2	3.4	2.0	2.5	0.0	-	11.0	-
Lights	80	21	611	408	0	-	1120	248	282	74	319	0	-	923	255	52	745	293	0	-	1345	120	132	67	94	0	-	413	3801
% Lights	93.0	95.5	94.7	96.9	-	-	95.4	97.3	99.3	94.9	98.5	-	-	98.1	98.5	98.1	96.1	98.7	-	-	97.2	96.8	97.8	87.0	95.9	-	-	95.2	96.6
Buses	0	0	18	7	0	-	25	4	1	3	3	0	-	11	4	0	17	0	0	-	21	0	0	9	0	0	-	9	66
% Buses	0.0	0.0	2.8	1.7	-	-	2.1	1.6	0.4	3.8	0.9	-	-	1.2	1.5	0.0	2.2	0.0	-	-	1.5	0.0	0.0	11.7	0.0	-	-	2.1	1.7
Trucks	6	1	16	6	0	-	29	3	1	1	2	0	-	7	0	1	13	4	0	-	18	4	3	1	4	0	-	12	66
% Trucks	7.0	4.5	2.5	1.4	-	-	2.5	1.2	0.4	1.3	0.6	-	-	0.7	0.0	1.9	1.7	1.3	-	-	1.3	3.2	2.2	1.3	4.1	-	-	2.8	1.7
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	0.0	-	-	-	-	-	-	0.0	-	-

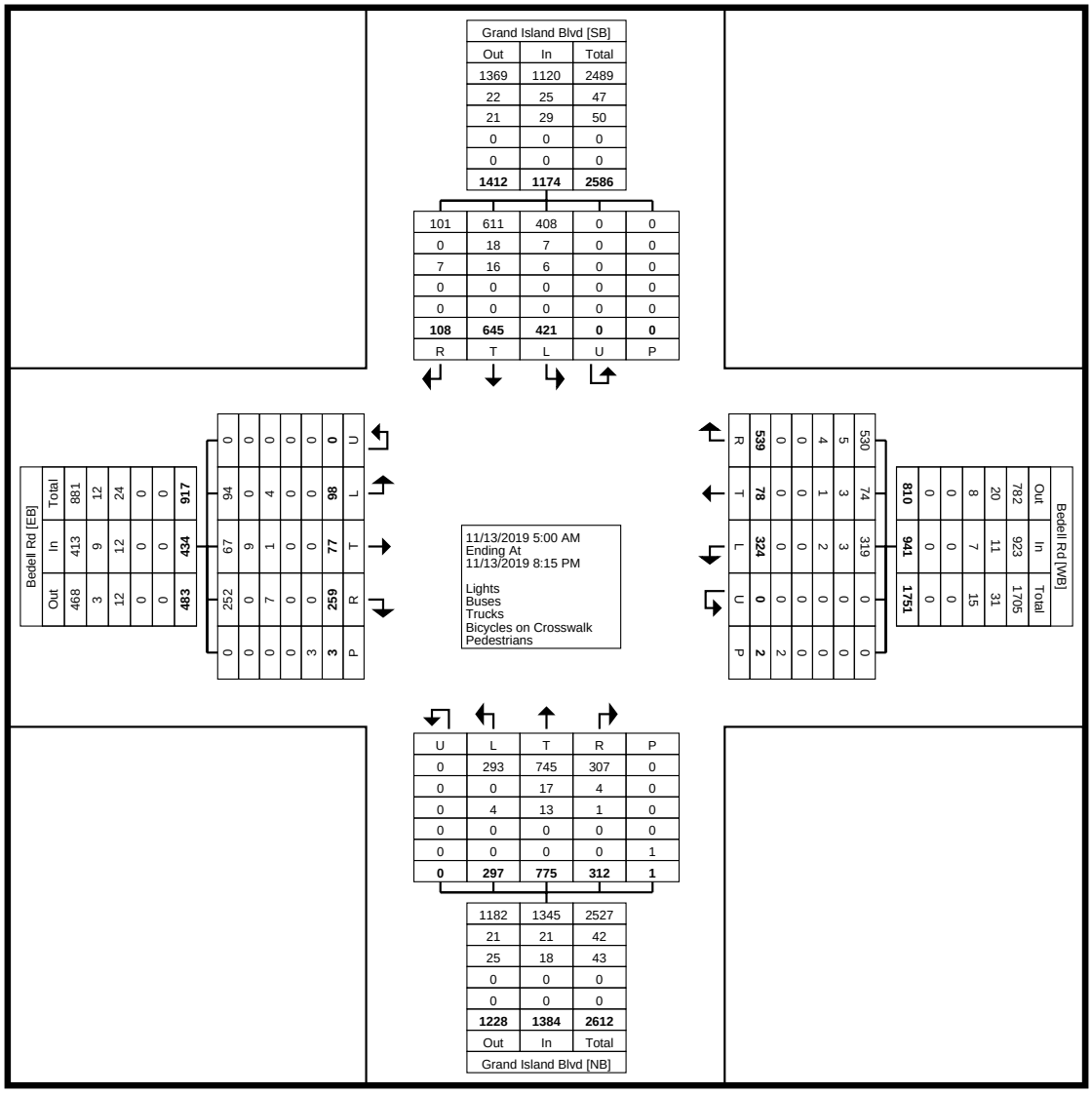
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-	-	-	3	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	100.0	-	-	-	-	-	-	100.0	-	-

Grand Island, NY
Grand Island Blvd/Bedell Rd
Wednesday, November 13, 2019
Location: 43.036221, -78.976504

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
Serving Transportation Professionals Since 1995

Count Name: Grand Island Blvd/Bedell Rd
Site Code:
Start Date: 11/13/2019
Page No: 3



Turning Movement Data Plot

Grand Island, NY
Grand Island Blvd/Bedell Rd
Wednesday, November 13, 2019
Location: 43.036221, -78.976504

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
Serving Transportation Professionals Since 1995

Count Name: Grand Island Blvd/Bedell Rd
Site Code:
Start Date: 11/13/2019
Page No: 4

Turning Movement Peak Hour Data (7:45 AM)

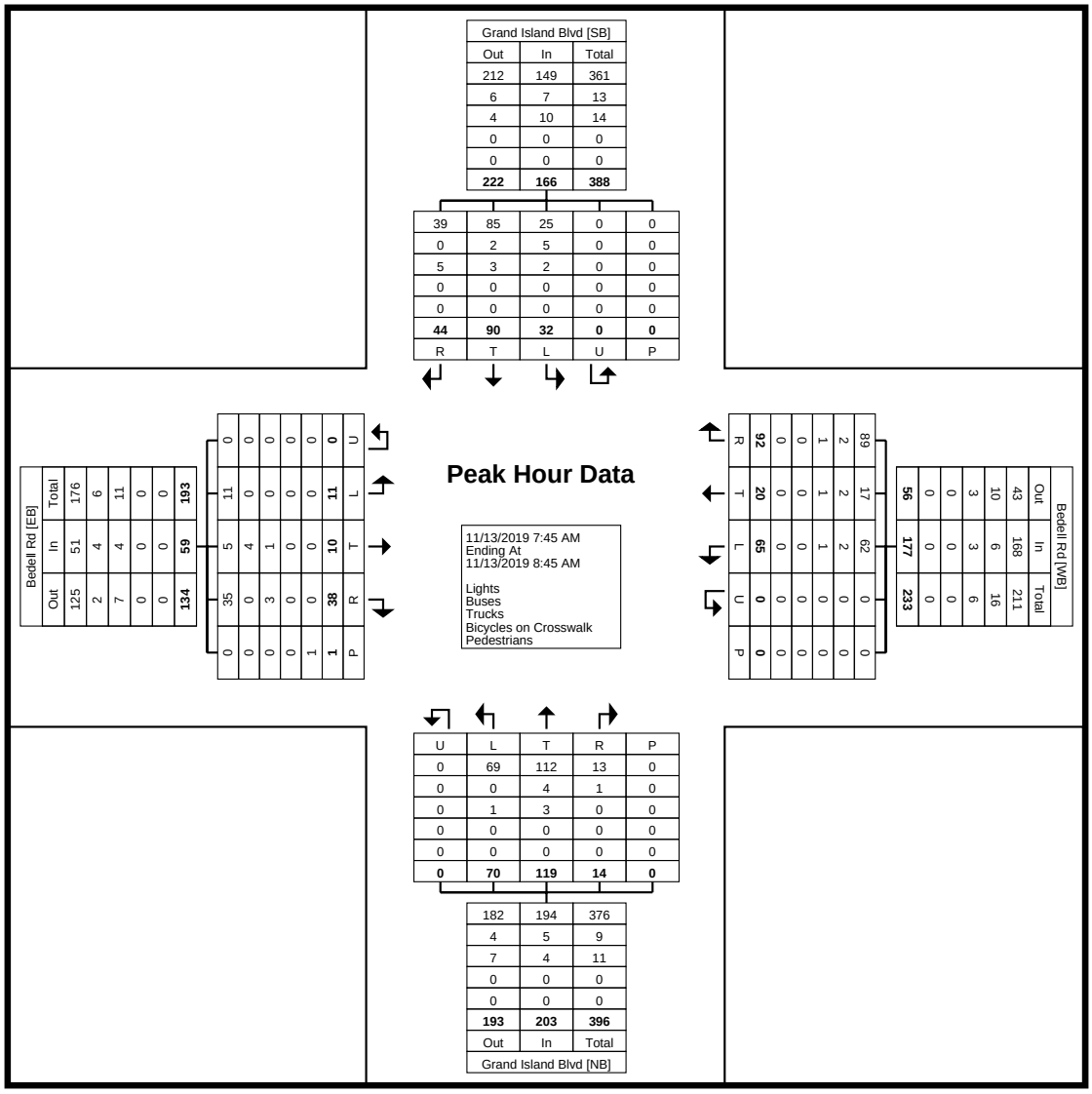
Start Time	Grand Island Blvd Southbound							Bedell Rd Westbound							Grand Island Blvd Northbound							Bedell Rd Eastbound							
	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Int. Total
7:45 AM	11	2	27	6	0	0	46	17	7	6	15	0	0	45	1	1	34	18	0	0	54	2	4	2	2	0	0	10	155
8:00 AM	9	2	15	4	0	0	30	9	12	6	14	0	0	41	0	2	28	19	0	0	49	3	3	4	5	0	0	15	135
8:15 AM	11	0	20	15	0	0	46	16	10	2	16	0	0	44	5	0	27	17	0	0	49	9	5	4	1	0	0	19	158
8:30 AM	8	1	28	7	0	0	44	11	10	6	20	0	0	47	4	1	30	16	0	0	51	4	8	0	3	0	1	15	157
Total	39	5	90	32	0	0	166	53	39	20	65	0	0	177	10	4	119	70	0	0	203	18	20	10	11	0	1	59	605
Approach %	23.5	3.0	54.2	19.3	0.0	-	-	29.9	22.0	11.3	36.7	0.0	-	-	4.9	2.0	58.6	34.5	0.0	-	-	30.5	33.9	16.9	18.6	0.0	-	-	-
Total %	6.4	0.8	14.9	5.3	0.0	-	27.4	8.8	6.4	3.3	10.7	0.0	-	29.3	1.7	0.7	19.7	11.6	0.0	-	33.6	3.0	3.3	1.7	1.8	0.0	-	9.8	-
PHF	0.886	0.625	0.804	0.533	0.000	-	0.902	0.779	0.813	0.833	0.813	0.000	-	0.941	0.500	0.500	0.875	0.921	0.000	-	0.940	0.500	0.625	0.625	0.550	0.000	-	0.776	0.957
Lights	35	4	85	25	0	-	149	50	39	17	62	0	-	168	9	4	112	69	0	-	194	16	19	5	11	0	-	51	562
% Lights	89.7	80.0	94.4	78.1	-	-	89.8	94.3	100.0	85.0	95.4	-	-	94.9	90.0	100.0	94.1	98.6	-	-	95.6	88.9	95.0	50.0	100.0	-	-	86.4	92.9
Buses	0	0	2	5	0	-	7	2	0	2	2	0	-	6	1	0	4	0	0	-	5	0	0	4	0	0	-	4	22
% Buses	0.0	0.0	2.2	15.6	-	-	4.2	3.8	0.0	10.0	3.1	-	-	3.4	10.0	0.0	3.4	0.0	-	-	2.5	0.0	0.0	40.0	0.0	-	-	6.8	3.6
Trucks	4	1	3	2	0	-	10	1	0	1	1	0	-	3	0	0	3	1	0	-	4	2	1	1	0	0	-	4	21
% Trucks	10.3	20.0	3.3	6.3	-	-	6.0	1.9	0.0	5.0	1.5	-	-	1.7	0.0	0.0	2.5	1.4	-	-	2.0	11.1	5.0	10.0	0.0	-	-	6.8	3.5
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-

Grand Island, NY
Grand Island Blvd/Bedell Rd
Wednesday, November 13, 2019
Location: 43.036221, -78.976504

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
Serving Transportation Professionals Since 1995

Count Name: Grand Island Blvd/Bedell Rd
Site Code:
Start Date: 11/13/2019
Page No: 5



Turning Movement Peak Hour Data Plot (7:45 AM)

Grand Island, NY
Grand Island Blvd/Bedell Rd
Wednesday, November 13, 2019
Location: 43.036221, -78.976504

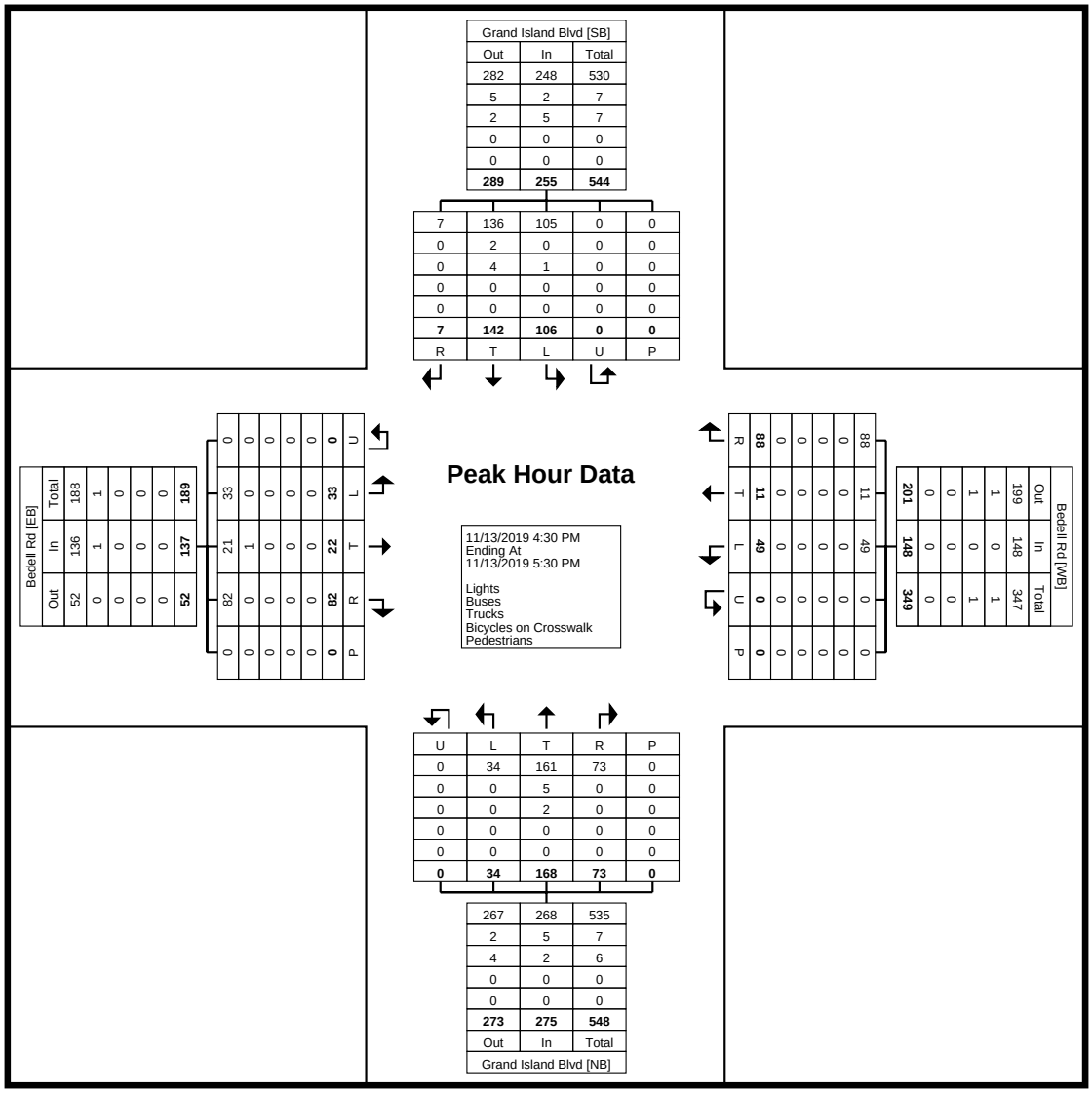
www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
Serving Transportation Professionals Since 1995

Count Name: Grand Island Blvd/Bedell Rd
Site Code:
Start Date: 11/13/2019
Page No: 6

Turning Movement Peak Hour Data (4:30 PM)

Start Time	Grand Island Blvd Southbound							Bedell Rd Westbound							Grand Island Blvd Northbound							Bedell Rd Eastbound							
	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Int. Total
4:30 PM	0	2	33	21	0	0	56	15	11	1	19	0	0	46	8	3	40	9	0	0	60	14	14	4	9	0	0	41	203
4:45 PM	2	0	32	27	0	0	61	9	11	5	5	0	0	30	16	5	39	11	0	0	71	9	5	7	4	0	0	25	187
5:00 PM	1	1	43	30	0	0	75	10	9	4	18	0	0	41	14	2	52	5	0	0	73	15	7	8	8	0	0	38	227
5:15 PM	1	0	34	28	0	0	63	13	10	1	7	0	0	31	23	2	37	9	0	0	71	11	7	3	12	0	0	33	198
Total	4	3	142	106	0	0	255	47	41	11	49	0	0	148	61	12	168	34	0	0	275	49	33	22	33	0	0	137	815
Approach %	1.6	1.2	55.7	41.6	0.0	-	-	31.8	27.7	7.4	33.1	0.0	-	-	22.2	4.4	61.1	12.4	0.0	-	-	35.8	24.1	16.1	24.1	0.0	-	-	-
Total %	0.5	0.4	17.4	13.0	0.0	-	31.3	5.8	5.0	1.3	6.0	0.0	-	18.2	7.5	1.5	20.6	4.2	0.0	-	33.7	6.0	4.0	2.7	4.0	0.0	-	16.8	-
PHF	0.500	0.375	0.826	0.883	0.000	-	0.850	0.783	0.932	0.550	0.645	0.000	-	0.804	0.663	0.600	0.808	0.773	0.000	-	0.942	0.817	0.589	0.688	0.688	0.000	-	0.835	0.898
Lights	4	3	136	105	0	-	248	47	41	11	49	0	-	148	61	12	161	34	0	-	268	49	33	21	33	0	-	136	800
% Lights	100.0	100.0	95.8	99.1	-	-	97.3	100.0	100.0	100.0	100.0	-	-	100.0	100.0	100.0	95.8	100.0	-	-	97.5	100.0	100.0	95.5	100.0	-	-	99.3	98.2
Buses	0	0	2	0	0	-	2	0	0	0	0	0	-	0	0	0	5	0	0	-	5	0	0	1	0	0	-	1	8
% Buses	0.0	0.0	1.4	0.0	-	-	0.8	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	3.0	0.0	-	-	1.8	0.0	0.0	4.5	0.0	-	-	0.7	1.0
Trucks	0	0	4	1	0	-	5	0	0	0	0	0	-	0	0	0	2	0	0	-	2	0	0	0	0	0	-	0	7
% Trucks	0.0	0.0	2.8	0.9	-	-	2.0	0.0	0.0	0.0	0.0	-	-	0.0	0.0	0.0	1.2	0.0	-	-	0.7	0.0	0.0	0.0	0.0	-	-	0.0	0.9
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Turning Movement Peak Hour Data Plot (4:30 PM)

Grand Island, NY
Grand Island Blvd & I-90 NB Ramps
Wednesday, November 13, 2019
Location: 43.047626, -78.987318

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
Serving Transportation Professionals Since 1995

Count Name: Grand Island Blvd/I-190 NB Off Ramp
Site Code:
Start Date: 11/13/2019

Turning Movement Data

Start Time	Grand Island Blvd Southbound				Grand Island Blvd Northbound				I-190 NB Off Ramp Eastbound				
	Thru	U-Turn	Peds	App. Total	Thru	U-Turn	Peds	App. Total	Right	Left	Peds	App. Total	Int. Total
5:00 AM	1	0	0	1	2	0	0	2	0	0	0	0	3
5:15 AM	5	0	0	5	9	0	0	9	1	1	0	2	16
5:30 AM	12	0	0	12	16	0	0	16	3	6	0	9	37
5:45 AM	13	0	0	13	15	0	0	15	3	5	0	8	36
Hourly Total	31	0	0	31	42	0	0	42	7	12	0	19	92
6:00 AM	13	0	0	13	28	0	0	28	5	6	0	11	52
6:15 AM	22	0	0	22	25	0	0	25	6	3	0	9	56
6:30 AM	19	0	0	19	40	0	0	40	6	3	0	9	68
6:45 AM	37	0	0	37	33	0	0	33	16	7	0	23	93
Hourly Total	91	0	0	91	126	0	0	126	33	19	0	52	269
7:00 AM	19	0	0	19	39	0	0	39	6	12	0	18	76
7:15 AM	40	0	0	40	33	0	0	33	4	7	0	11	84
7:30 AM	29	0	0	29	61	0	0	61	6	8	0	14	104
7:45 AM	46	0	0	46	64	0	0	64	16	12	0	28	138
Hourly Total	134	0	0	134	197	0	0	197	32	39	0	71	402
8:00 AM	36	0	0	36	49	0	0	49	18	14	0	32	117
8:15 AM	53	0	0	53	45	0	0	45	14	22	0	36	134
8:30 AM	37	0	0	37	46	0	0	46	11	18	1	29	112
8:45 AM	40	0	0	40	42	0	0	42	4	6	0	10	92
Hourly Total	166	0	0	166	182	0	0	182	47	60	1	107	455
9:00 AM	27	0	0	27	53	0	0	53	9	7	0	16	96
9:15 AM	34	0	0	34	32	0	0	32	2	7	0	9	75
9:30 AM	33	0	0	33	36	0	0	36	5	4	0	9	78
9:45 AM	26	0	0	26	46	0	0	46	2	6	0	8	80
Hourly Total	120	0	0	120	167	0	0	167	18	24	0	42	329
10:00 AM	27	0	0	27	35	0	0	35	4	10	0	14	76
10:15 AM	28	0	0	28	40	0	0	40	5	7	1	12	80
10:30 AM	20	0	0	20	42	0	0	42	3	7	0	10	72
10:45 AM	22	0	0	22	45	0	0	45	4	4	0	8	75
Hourly Total	97	0	0	97	162	0	0	162	16	28	1	44	303
11:00 AM	34	0	0	34	38	0	0	38	3	7	0	10	82
11:15 AM	28	0	0	28	52	0	0	52	5	10	0	15	95
11:30 AM	27	0	0	27	58	0	0	58	4	7	0	11	96
11:45 AM	34	0	0	34	69	0	0	69	2	7	0	9	112
Hourly Total	123	0	0	123	217	0	0	217	14	31	0	45	385
12:00 PM	39	0	0	39	50	0	0	50	5	9	0	14	103
12:15 PM	43	0	0	43	50	0	0	50	4	6	0	10	103
12:30 PM	38	0	0	38	56	0	0	56	5	8	0	13	107
12:45 PM	35	0	0	35	41	0	0	41	3	6	0	9	85
Hourly Total	155	0	0	155	197	0	0	197	17	29	0	46	398
1:00 PM	44	0	0	44	40	0	0	40	4	8	0	12	96
1:15 PM	37	0	0	37	31	0	0	31	4	8	0	12	80
1:30 PM	34	0	0	34	49	0	0	49	7	7	1	14	97
1:45 PM	35	0	0	35	44	0	0	44	6	5	0	11	90
Hourly Total	150	0	0	150	164	0	0	164	21	28	1	49	363
2:00 PM	44	0	0	44	41	0	0	41	3	6	0	9	94
2:15 PM	33	0	0	33	37	0	0	37	0	11	0	11	81
2:30 PM	31	0	0	31	49	0	0	49	5	6	0	11	91
2:45 PM	36	0	0	36	46	0	0	46	2	11	0	13	95
Hourly Total	144	0	0	144	173	0	0	173	10	34	0	44	361
3:00 PM	43	0	0	43	55	0	0	55	3	11	0	14	112
3:15 PM	44	0	0	44	52	0	0	52	3	22	0	25	121
3:30 PM	45	0	0	45	85	0	0	85	3	16	0	19	149
3:45 PM	49	0	0	49	55	0	0	55	1	17	0	18	122
Hourly Total	181	0	0	181	247	0	0	247	10	66	0	76	504
4:00 PM	41	0	0	41	72	0	0	72	4	23	0	27	140
4:15 PM	40	0	0	40	59	0	0	59	9	18	0	27	126
4:30 PM	43	0	0	43	97	0	0	97	3	21	0	24	164
4:45 PM	53	0	0	53	66	0	0	66	3	24	0	27	146
Hourly Total	177	0	0	177	294	0	0	294	19	86	0	105	576

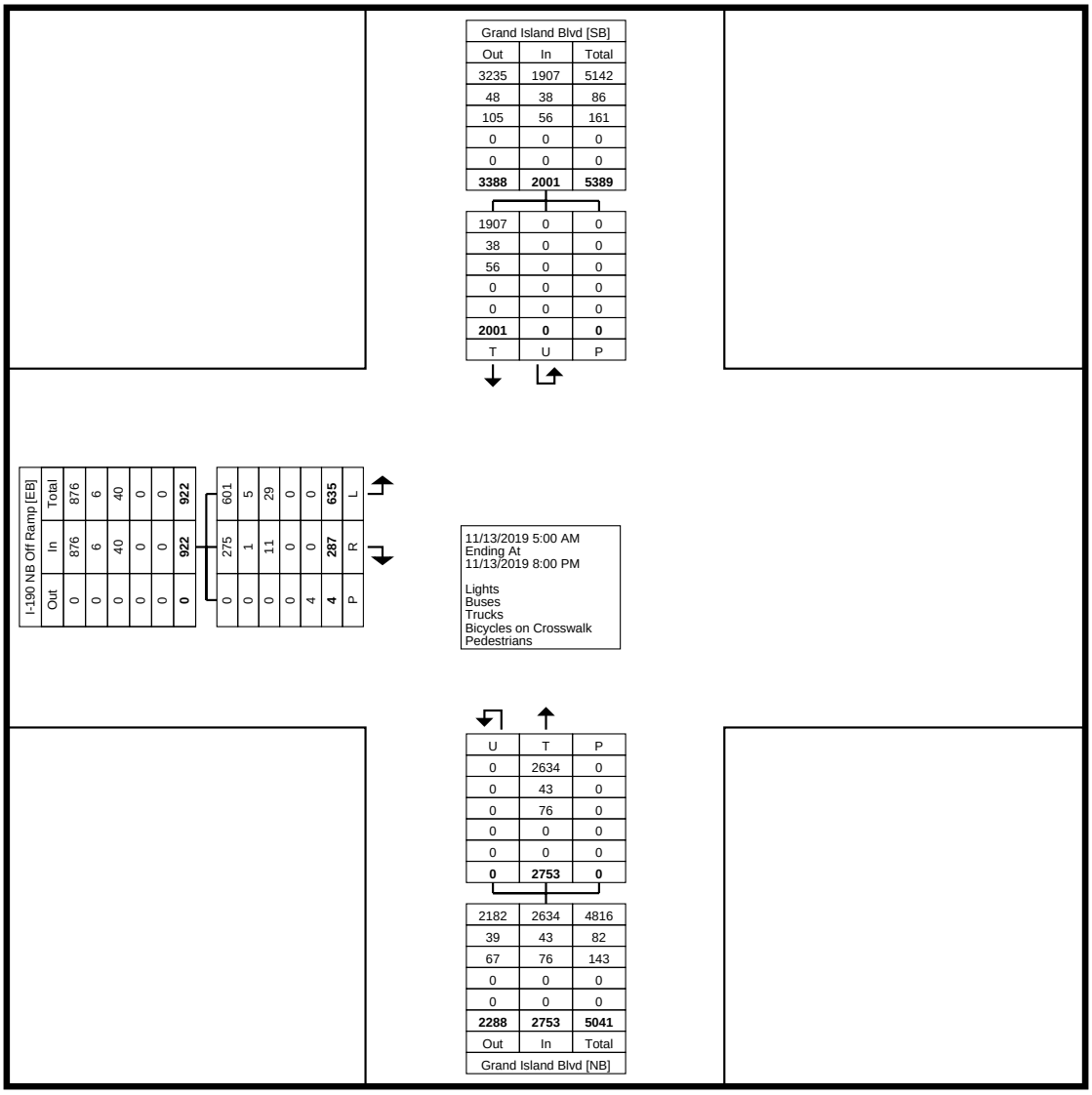
5:00 PM	55	0	0	55	95	0	0	95	5	28	1	33	183
5:15 PM	48	0	0	48	72	0	0	72	2	26	0	28	148
5:30 PM	33	0	0	33	61	0	0	61	9	25	0	34	128
5:45 PM	48	0	0	48	42	0	0	42	4	20	0	24	114
Hourly Total	184	0	0	184	270	0	0	270	20	99	1	119	573
6:00 PM	39	0	0	39	75	0	0	75	4	10	0	14	128
6:15 PM	29	0	0	29	48	0	0	48	4	12	0	16	93
6:30 PM	35	0	0	35	49	0	0	49	4	8	0	12	96
6:45 PM	28	0	0	28	32	0	0	32	3	5	0	8	68
Hourly Total	131	0	0	131	204	0	0	204	15	35	0	50	385
7:00 PM	29	0	0	29	32	0	0	32	1	11	0	12	73
7:15 PM	30	0	0	30	21	0	0	21	2	8	0	10	61
7:30 PM	21	0	0	21	38	0	0	38	4	11	0	15	74
7:45 PM	37	0	0	37	20	0	0	20	1	15	0	16	73
Hourly Total	117	0	0	117	111	0	0	111	8	45	0	53	281
Grand Total	2001	0	0	2001	2753	0	0	2753	287	635	4	922	5676
Approach %	100.0	0.0	-	-	100.0	0.0	-	-	31.1	68.9	-	-	-
Total %	35.3	0.0	-	35.3	48.5	0.0	-	48.5	5.1	11.2	-	16.2	-
Lights	1907	0	-	1907	2634	0	-	2634	275	601	-	876	5417
% Lights	95.3	-	-	95.3	95.7	-	-	95.7	95.8	94.6	-	95.0	95.4
Buses	38	0	-	38	43	0	-	43	1	5	-	6	87
% Buses	1.9	-	-	1.9	1.6	-	-	1.6	0.3	0.8	-	0.7	1.5
Trucks	56	0	-	56	76	0	-	76	11	29	-	40	172
% Trucks	2.8	-	-	2.8	2.8	-	-	2.8	3.8	4.6	-	4.3	3.0
Bicycles on Crosswalk	-	-	0	-	-	-	0	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	0	-	-	-	0	-	-	-	4	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	100.0	-	-

Grand Island, NY
Grand Island Blvd & I-90 NB Ramps
Wednesday, November 13, 2019
Location: 43.047626, -78.987318

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
Serving Transportation Professionals Since 1995

Count Name: Grand Island Blvd/I-190 NB Off Ramp
Site Code:
Start Date: 11/13/2019
Page No: 3



Turning Movement Data Plot

Grand Island, NY
Grand Island Blvd & I-90 NB Ramps
Wednesday, November 13, 2019
Location: 43.047626, -78.987318

www.TSTData.com
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Count Name: Grand Island Blvd/I-190 NB Off Ramp
Site Code:
Start Date: 11/13/2019
Page No: 4

Turning Movement Peak Hour Data (7:45 AM)

Start Time	Grand Island Blvd Southbound				Grand Island Blvd Northbound				I-190 NB Off Ramp Eastbound				
	Thru	U-Turn	Peds	App. Total	Thru	U-Turn	Peds	App. Total	Right	Left	Peds	App. Total	Int. Total
7:45 AM	46	0	0	46	64	0	0	64	16	12	0	28	138
8:00 AM	36	0	0	36	49	0	0	49	18	14	0	32	117
8:15 AM	53	0	0	53	45	0	0	45	14	22	0	36	134
8:30 AM	37	0	0	37	46	0	0	46	11	18	1	29	112
Total	172	0	0	172	204	0	0	204	59	66	1	125	501
Approach %	100.0	0.0	-	-	100.0	0.0	-	-	47.2	52.8	-	-	-
Total %	34.3	0.0	-	34.3	40.7	0.0	-	40.7	11.8	13.2	-	25.0	-
PHF	0.811	0.000	-	0.811	0.797	0.000	-	0.797	0.819	0.750	-	0.868	0.908
Lights	159	0	-	159	191	0	-	191	59	63	-	122	472
% Lights	92.4	-	-	92.4	93.6	-	-	93.6	100.0	95.5	-	97.6	94.2
Buses	7	0	-	7	6	0	-	6	0	0	-	0	13
% Buses	4.1	-	-	4.1	2.9	-	-	2.9	0.0	0.0	-	0.0	2.6
Trucks	6	0	-	6	7	0	-	7	0	3	-	3	16
% Trucks	3.5	-	-	3.5	3.4	-	-	3.4	0.0	4.5	-	2.4	3.2
Bicycles on Crosswalk	-	-	0	-	-	-	0	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	0	-	-	-	0	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	100.0	-	-

Grand Island, NY
Grand Island Blvd & I-90 NB Ramps
Wednesday, November 13, 2019
Location: 43.047626, -78.987318

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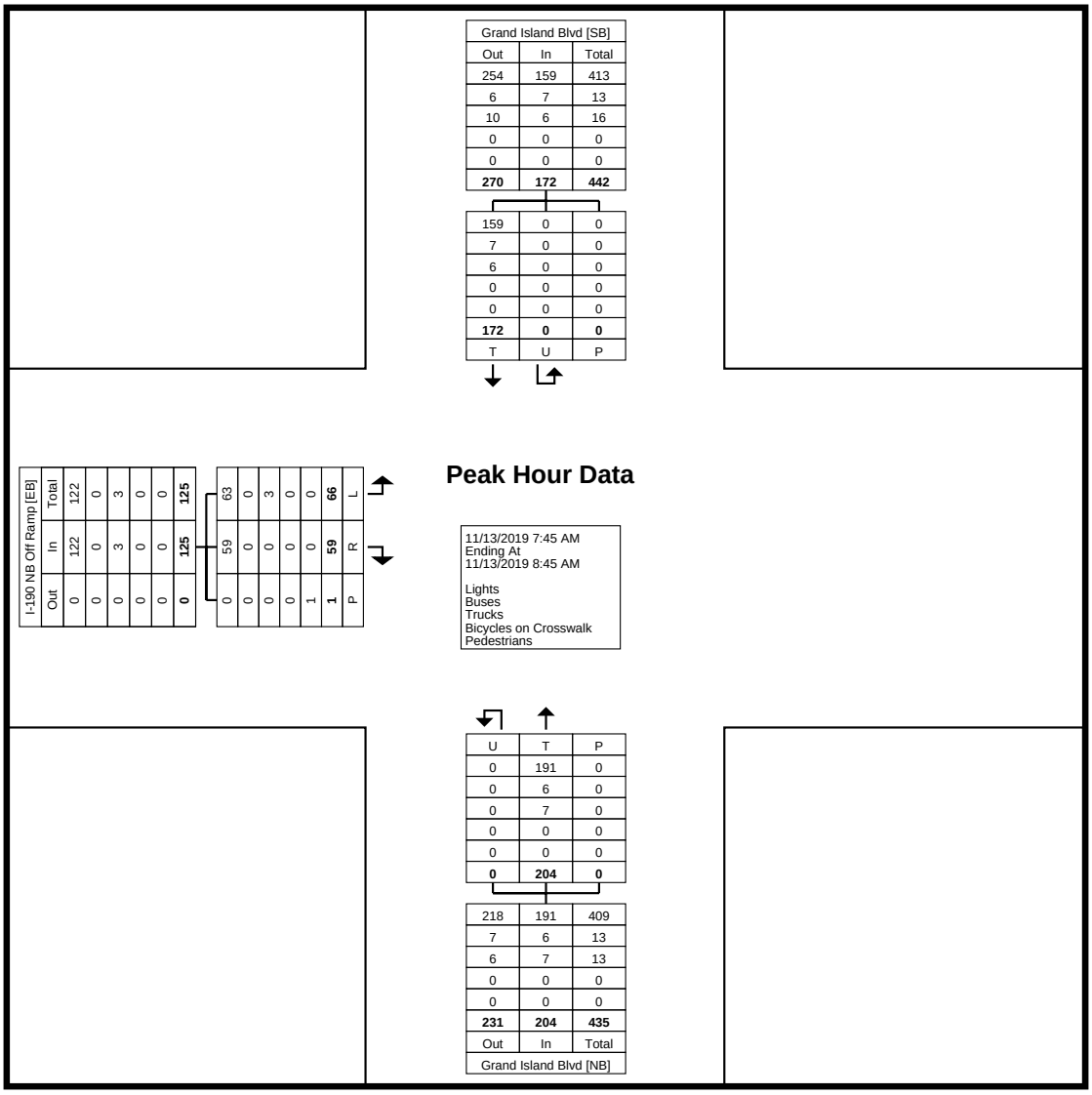
Count Name: Grand Island Blvd/I-190 NB Off Ramp
Site Code:
Start Date: 11/13/2019
Page No: 5



Turning Movement Peak Hour Data Plot (7:45 AM)

Grand Island, NY
Grand Island Blvd & I-90 NB Ramps
Wednesday, November 13, 2019
Location: 43.047626, -78.987318

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Count Name: Grand Island Blvd/I-190 NB Off Ramp
Site Code:
Start Date: 11/13/2019

Turning Movement Peak Hour Data (4:30 PM)

Start Time	Grand Island Blvd Southbound				Grand Island Blvd Northbound				I-190 NB Off Ramp Eastbound				
	Thru	U-Turn	Peds	App. Total	Thru	U-Turn	Peds	App. Total	Right	Left	Peds	App. Total	Int. Total
4:30 PM	43	0	0	43	97	0	0	97	3	21	0	24	164
4:45 PM	53	0	0	53	66	0	0	66	3	24	0	27	146
5:00 PM	55	0	0	55	95	0	0	95	5	28	1	33	183
5:15 PM	48	0	0	48	72	0	0	72	2	26	0	28	148
Total	199	0	0	199	330	0	0	330	13	99	1	112	641
Approach %	100.0	0.0	-	-	100.0	0.0	-	-	11.6	88.4	-	-	-
Total %	31.0	0.0	-	31.0	51.5	0.0	-	51.5	2.0	15.4	-	17.5	-
PHF	0.905	0.000	-	0.905	0.851	0.000	-	0.851	0.650	0.884	-	0.848	0.876
Lights	192	0	-	192	317	0	-	317	12	96	-	108	617
% Lights	96.5	-	-	96.5	96.1	-	-	96.1	92.3	97.0	-	96.4	96.3
Buses	2	0	-	2	6	0	-	6	0	0	-	0	8
% Buses	1.0	-	-	1.0	1.8	-	-	1.8	0.0	0.0	-	0.0	1.2
Trucks	5	0	-	5	7	0	-	7	1	3	-	4	16
% Trucks	2.5	-	-	2.5	2.1	-	-	2.1	7.7	3.0	-	3.6	2.5
Bicycles on Crosswalk	-	-	0	-	-	-	0	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	0	-	-	-	0	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	100.0	-	-

Grand Island, NY
Grand Island Blvd & I-90 NB Ramps
Wednesday, November 13, 2019
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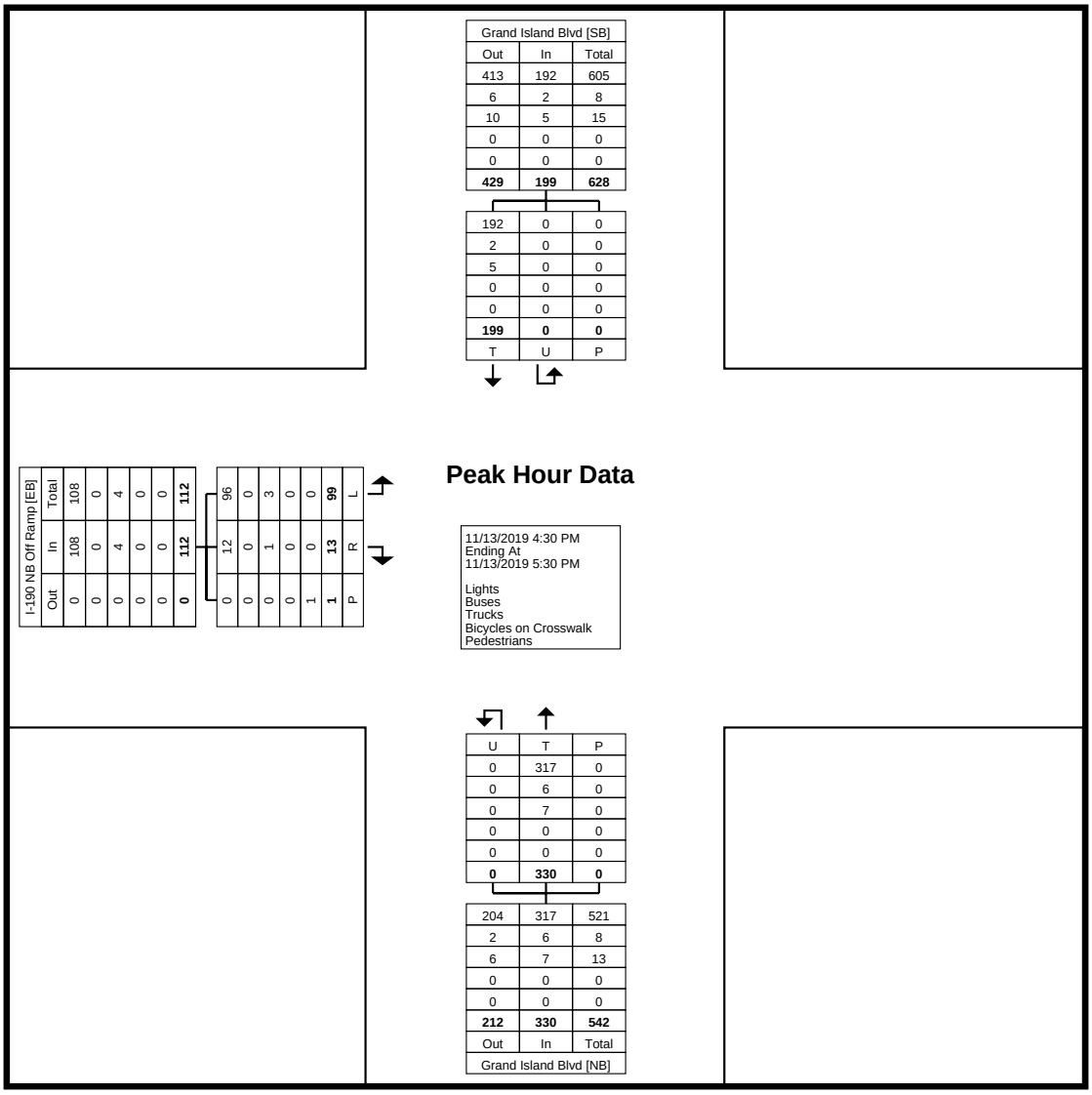
Count Name: Grand Island Blvd/I-190 NB Off Ramp
Site Code:
Start Date: 11/13/2019
Page No: 7



Turning Movement Peak Hour Data Plot (4:30 PM)

Grand Island, NY
Grand Island Blvd/Staley Rd
Wednesday, November 13, 2019
Location: 43.007309, -78.948926

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469 jvetterlein@tstdata.com
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Count Name: Grand Island Blvd/Staley Rd
Site Code:
Start Date: 11/13/2019
Page No: 1

Turning Movement Data

Start Time	Grand Island Blvd Southbound						Staley Rd Westbound						I-190 Ramp-South Pkwy Northbound						Staley Rd Eastbound						
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Int. Total
5:00 AM	1	12	0	0	0	13	0	4	13	0	0	17	5	9	14	0	0	28	5	1	0	0	0	6	64
5:15 AM	0	9	1	0	0	10	0	5	24	0	0	29	4	14	16	0	0	34	3	2	0	0	0	5	78
5:30 AM	1	19	1	0	0	21	1	7	22	0	0	30	4	8	35	0	0	47	4	0	2	0	0	6	104
5:45 AM	1	19	2	0	0	22	0	0	46	0	0	46	8	22	44	0	0	74	3	0	1	0	0	4	146
Hourly Total	3	59	4	0	0	66	1	16	105	0	0	122	21	53	109	0	0	183	15	3	3	0	0	21	392
6:00 AM	0	42	1	0	0	43	2	2	51	0	0	55	16	23	47	0	0	86	6	0	3	0	0	9	193
6:15 AM	2	45	1	1	0	49	6	7	82	0	0	95	17	28	46	0	0	91	17	0	0	0	0	17	252
6:30 AM	6	50	1	0	0	57	3	4	116	0	0	123	24	39	46	0	0	109	38	2	0	0	0	40	329
6:45 AM	4	40	2	0	0	46	5	11	150	0	1	166	41	34	53	1	0	129	26	5	0	0	0	31	372
Hourly Total	12	177	5	1	0	195	16	24	399	0	1	439	98	124	192	1	0	415	87	7	3	0	0	97	1146
7:00 AM	3	55	0	0	0	58	12	6	122	0	0	140	74	47	35	0	0	156	31	6	1	0	0	38	392
7:15 AM	7	43	1	0	0	51	0	0	58	0	0	58	77	26	28	5	0	136	25	3	1	0	0	29	274
7:30 AM	3	44	0	0	0	47	0	0	36	0	0	36	80	17	16	5	0	118	51	2	0	0	0	53	254
7:45 AM	1	47	2	0	0	50	2	1	40	0	0	43	85	15	30	0	0	130	20	2	0	0	0	22	245
Hourly Total	14	189	3	0	0	206	14	7	256	0	0	277	316	105	109	10	0	540	127	13	2	0	0	142	1165
8:00 AM	2	37	5	2	0	46	24	7	64	0	0	95	84	14	53	0	0	151	23	0	6	0	0	29	321
8:15 AM	4	46	3	2	0	55	12	1	75	0	0	88	72	30	61	17	0	180	12	0	5	0	0	17	340
8:30 AM	7	57	3	1	0	68	7	1	112	0	0	120	35	39	64	2	0	140	18	0	5	0	0	23	351
8:45 AM	5	55	3	0	0	63	5	6	80	0	0	91	25	70	56	1	0	152	13	4	2	0	0	19	325
Hourly Total	18	195	14	5	0	232	48	15	331	0	0	394	216	153	234	20	0	623	66	4	18	0	0	88	1337
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	4	92	8	0	0	104	7	6	49	0	0	62	98	126	16	1	0	241	44	3	3	0	0	50	457
4:15 PM	3	77	11	0	0	91	8	7	54	0	0	69	101	138	21	0	0	260	53	2	7	0	0	62	482
4:30 PM	6	85	4	0	0	95	7	7	52	0	0	66	115	132	23	0	0	270	59	7	2	0	0	68	499
4:45 PM	4	87	9	0	0	100	6	0	49	0	0	55	123	133	21	0	0	277	76	7	7	0	0	90	522
Hourly Total	17	341	32	0	0	390	28	20	204	0	0	252	437	529	81	1	0	1048	232	19	19	0	0	270	1960
5:00 PM	4	84	11	0	0	99	6	0	61	1	0	68	114	117	20	4	0	255	81	3	5	0	0	89	511
5:15 PM	4	74	1	0	0	79	5	8	49	0	0	62	119	133	30	0	0	282	49	4	3	0	0	56	479
5:30 PM	3	86	5	0	0	94	8	0	53	0	0	61	114	123	25	1	0	263	56	3	4	0	0	63	481
5:45 PM	4	67	7	0	0	78	10	1	53	0	0	64	102	105	25	0	0	232	42	9	0	0	0	51	425
Hourly Total	15	311	24	0	0	350	29	9	216	1	0	255	449	478	100	5	0	1032	228	19	12	0	0	259	1896
6:00 PM	4	58	6	0	0	68	10	0	68	0	0	78	89	106	13	5	0	213	19	2	6	0	0	27	386
6:15 PM	1	62	4	0	0	67	4	5	49	0	0	58	64	100	21	0	0	185	23	6	2	0	0	31	341
6:30 PM	3	57	5	0	0	65	5	7	39	0	0	51	62	88	15	0	0	165	18	5	2	0	0	25	306
6:45 PM	0	52	3	0	0	55	3	0	41	0	0	44	61	62	10	0	0	133	11	3	1	0	0	15	247
Hourly Total	8	229	18	0	0	255	22	12	197	0	0	231	276	356	59	5	0	696	71	16	11	0	0	98	1280
7:00 PM	5	46	2	0	0	53	5	2	42	0	0	49	56	71	8	0	0	135	11	4	5	0	0	20	257
7:15 PM	2	38	3	0	0	43	2	0	23	0	0	25	59	61	8	0	0	128	6	0	3	0	0	9	205
7:30 PM	3	29	6	0	0	38	5	4	30	0	0	39	54	56	10	0	0	120	8	2	2	0	0	12	209
7:45 PM	1	37	0	0	0	38	4	3	21	0	0	28	47	53	15	0	0	115	10	4	1	0	0	15	196
Hourly Total	11	150	11	0	0	172	16	9	116	0	0	141	216	241	41	0	0	498	35	10	11	0	0	56	867
8:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	98	1651	111	6	0	1866	174	112	1824	1	1	2111	2029	2039	925	42	0	5035	861	91	79	0	0	1031	10043
Approach %	5.3	88.5	5.9	0.3	-	-	8.2	5.3	86.4	0.0	-	-	40.3	40.5	18.4	0.8	-	-	83.5	8.8	7.7	0.0	-	-	-
Total %	1.0	16.4	1.1	0.1	-	18.6	1.7	1.1	18.2	0.0	-	21.0	20.2	20.3	9.2	0.4	-	50.1	8.6	0.9	0.8	0.0	-	10.3	-
Lights	96	1601	111	6	-	1814	167	105	1811	0	-	2083	2003	1987	909	37	-	4936	840	88	78	0	-	1006	9839
% Lights	98.0	97.0	100.0	100.0	-	97.2	96.0	93.8	99.3	0.0	-	98.7	98.7	97.4	98.3	88.1	-	98.0	97.6	96.7	98.7	-	-	97.6	98.0
Buses	1	15	0	0	-	16	4	5	6	1	-	16	6	18	3	3	-	30	3	2	1	0	-	6	68
% Buses	1.0	0.9	0.0	0.0	-	0.9	2.3	4.5	0.3	100.0	-	0.8	0.3	0.9	0.3	7.1	-	0.6	0.3	2.2	1.3	-	-	0.6	0.7
Trucks	1	35	0	0	-	36	3	2	7	0	-	12	20	34	13	2	-	69	18	1	0	0	-	19	136
% Trucks	1.0	2.1	0.0	0.0	-	1.9	1.7	1.8	0.4	0.0	-	0.6	1.0	1.7	1.4	4.8	-	1.4	2.1	1.1	0.0	-	-	1.8	1.4
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Grand Island, NY
Grand Island Blvd/Staley Rd
Wednesday, November 13, 2019
Location: 43.007309, -78.948926

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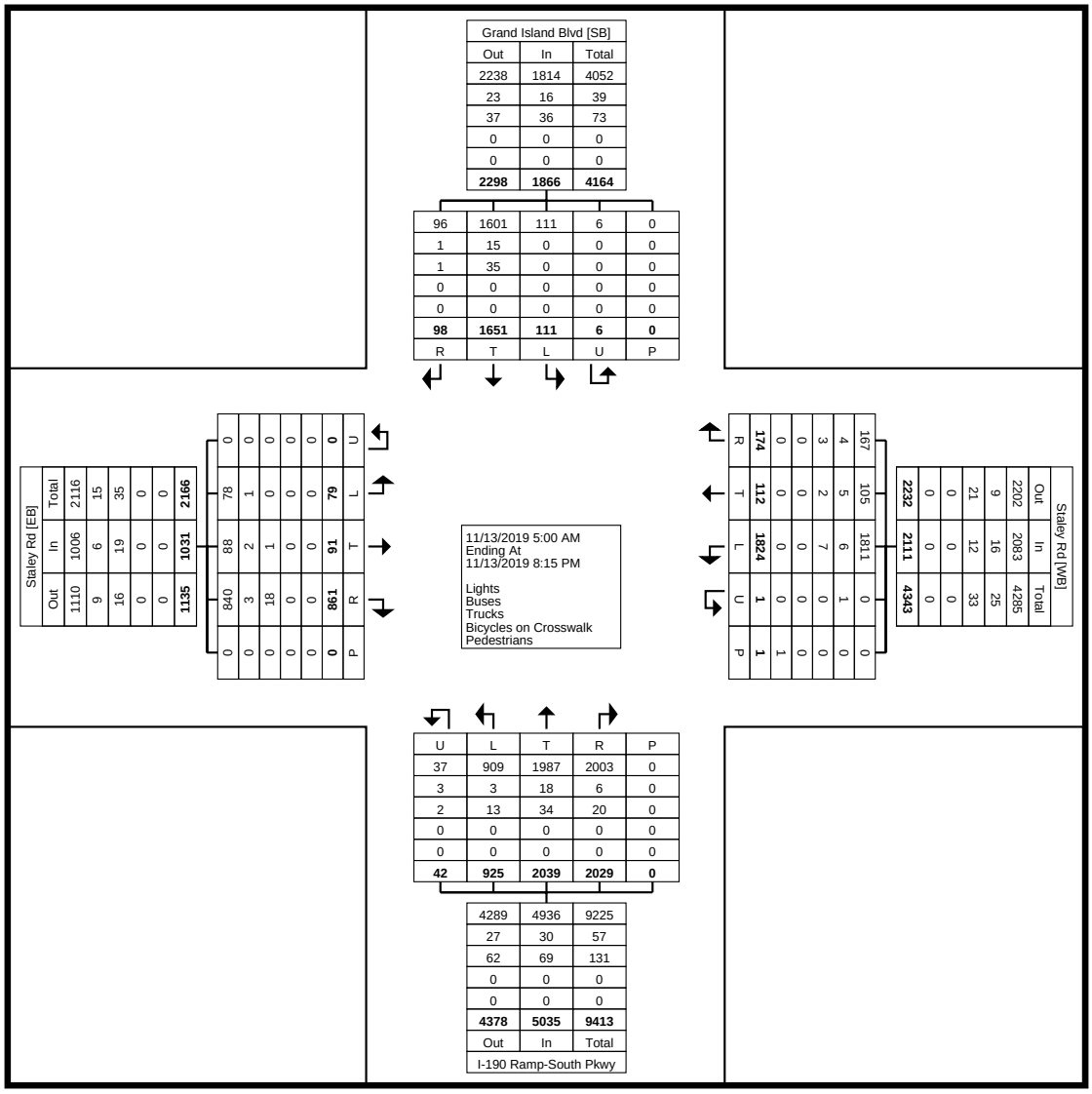

Turning Movement Data Plot

Grand Island, NY
Grand Island Blvd/Staley Rd
Wednesday, November 13, 2019
Location: 43.007309, -78.948926

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Count Name: Grand Island Blvd/Staley Rd
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Page No: 3

Approach Data

Start Time	Sb Street Southbound						Wb Street Westbound						Nb Street Northbound						Eb Street Eastbound					
	Peds CCW	Peds CW	Circulating	Out	In	Next	Peds CCW	Peds CW	Circulating	Out	In	Next	Peds CCW	Peds CW	Circulating	Out	In	Next	Peds CCW	Peds CW	Circulating	Out	In	Next
5:00 AM	0	0	31	10	13	1	0	0	22	6	17	0	0	0	1	31	27	5	0	0	25	19	6	5
5:15 AM	0	0	45	14	10	0	0	0	32	7	29	0	0	0	2	35	35	4	0	0	34	20	5	3
5:30 AM	0	0	65	14	21	1	0	0	40	6	29	1	0	0	2	46	44	4	0	0	43	45	5	4
5:45 AM	0	0	90	23	25	1	0	0	68	10	46	0	0	0	2	65	75	8	0	0	72	45	5	3
Hourly Total	0	0	231	61	69	3	0	0	162	29	121	1	0	0	7	177	181	21	0	0	174	129	21	15
6:00 AM	0	0	104	30	43	0	0	0	70	17	56	2	0	0	3	99	84	16	0	0	93	48	9	6
6:15 AM	0	0	137	35	51	2	0	0	75	18	96	6	0	0	1	143	91	17	0	0	132	55	17	17
6:30 AM	0	0	166	39	60	6	0	0	89	26	124	3	0	0	3	201	112	24	0	0	171	55	41	38
6:45 AM	0	0	209	38	46	4	1	0	90	48	164	5	0	0	8	217	130	41	0	0	194	70	32	26
Hourly Total	0	0	616	142	200	12	1	0	324	109	440	16	0	0	15	660	417	98	0	0	590	228	99	87
7:00 AM	0	0	166	58	55	3	0	0	89	81	142	12	0	0	8	211	159	74	0	0	168	42	38	31
7:15 AM	0	0	89	28	52	7	0	0	60	81	56	0	0	0	4	131	136	77	0	0	110	35	29	25
7:30 AM	0	0	51	14	41	3	0	0	41	83	34	0	0	0	1	143	121	80	0	0	75	20	51	51
7:45 AM	0	0	72	19	52	1	0	0	46	90	44	2	0	0	1	107	131	85	0	0	92	32	21	20
Hourly Total	0	0	378	119	200	14	0	0	236	335	276	14	0	0	14	592	547	316	0	0	445	129	139	127
8:00 AM	0	0	172	49	51	2	0	0	64	89	116	24	0	0	7	118	146	84	0	0	95	39	28	23
8:15 AM	0	0	176	57	55	4	0	0	101	77	93	12	0	0	4	150	172	72	0	0	137	56	14	12
8:30 AM	0	0	189	56	71	7	0	0	105	39	123	7	0	0	7	188	137	35	0	0	177	69	22	18
8:45 AM	0	0	144	81	63	5	0	0	125	33	90	5	0	0	10	151	150	25	0	0	138	68	19	13
Hourly Total	0	0	681	243	240	18	0	0	395	238	422	48	0	0	28	607	605	216	0	0	547	232	83	66
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4:00 PM	0	0	72	134	106	4	0	0	150	107	63	7	0	0	15	184	245	98	0	0	153	24	52	44
4:15 PM	0	0	85	152	94	3	0	0	170	113	71	8	0	0	19	181	263	101	0	0	145	28	63	53
4:30 PM	0	0	82	140	96	6	0	0	162	126	67	7	0	0	13	195	273	115	0	0	142	34	69	59
4:45 PM	0	0	72	149	102	4	0	0	160	140	55	6	0	0	23	212	277	123	0	0	147	26	90	76
Hourly Total	0	0	311	575	398	17	0	0	642	486	256	28	0	0	70	772	1058	437	0	0	587	112	274	232
5:00 PM	0	0	84	126	99	4	0	0	148	127	67	6	0	0	20	230	257	114	0	0	162	23	90	81
5:15 PM	0	0	90	145	79	4	0	0	159	125	61	5	0	0	8	175	278	119	0	0	122	41	55	49
5:30 PM	0	0	82	137	93	3	0	0	148	122	62	8	0	0	12	196	260	114	0	0	146	28	63	56
5:45 PM	0	0	78	114	79	4	0	0	131	118	64	10	0	0	16	162	232	102	0	0	129	30	51	42
Hourly Total	0	0	334	522	350	15	0	0	586	492	254	29	0	0	56	763	1027	449	0	0	559	122	259	228
6:00 PM	0	0	90	123	69	4	0	0	125	97	78	10	0	0	12	150	211	89	0	0	140	16	26	19
6:15 PM	0	0	78	107	67	1	0	0	121	75	59	4	0	0	12	136	184	64	0	0	113	27	30	23
6:30 PM	0	0	60	93	65	3	0	0	111	71	51	5	0	0	12	115	169	62	0	0	100	24	25	18
6:45 PM	0	0	51	66	54	0	0	0	73	67	44	3	0	0	7	105	133	61	0	0	95	11	15	11
Hourly Total	0	0	279	389	255	8	0	0	430	310	232	22	0	0	43	506	697	276	0	0	448	78	96	71
7:00 PM	0	0	51	81	53	5	0	0	84	61	48	5	0	0	11	98	136	56	0	0	91	16	20	11
7:15 PM	0	0	31	66	44	2	0	0	71	62	25	2	0	0	4	67	127	59	0	0	66	10	8	6
7:30 PM	0	0	44	62	38	3	0	0	69	62	39	5	0	0	10	68	121	54	0	0	65	17	12	8
7:45 PM	0	0	38	57	38	1	0	0	70	51	28	4	0	0	5	69	115	47	0	0	58	19	15	10
Hourly Total	0	0	164	266	173	11	0	0	294	236	140	16	0	0	30	302	499	216	0	0	280	62	55	35
8:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	0	0	2994	2317	1885	98	1	0	3069	2235	2141	174	0	0	263	4379	5031	2029	0	0	3630	1092	1026	861
Approach %	-	-	41.0	31.8	25.8	1.3	-	-	40.3	29.3	28.1	2.3	-	-	2.2	37.4	43.0	17.3	-	-	54.9	16.5	15.5	13.0
Total %	-	-	9.0	7.0	5.7	0.3	-	-	9.2	6.7	6.4	0.5	-	-	0.8	13.2	15.1	6.1	-	-	10.9	3.3	3.1	2.6
Lights	-	-	2953	2254	1829	96	-	-	2984	2206	2113	167	-	-	259	4277	4921	2003	-	-	3559	1068	1001	840
% Lights	-	-	98.6	97.3	97.0	98.0	-	-	97.2	98.7	98.7	96.0	-	-	98.5	97.7	97.8	98.7	-	-	98.0	97.8	97.6	97.6
Buses	-	-	16	25	24	1	-	-	24	8	15	4	-	-	3	28	29	6	-	-	36	8	6	3
% Buses	-	-	0.5	1.1	1.3	1.0	-	-	0.8	0.4	0.7	2.3	-	-	1.1	0.6	0.6	0.3	-	-	1.0	0.7	0.6	0.3
Trucks	-	-	25	38	32	1	-	-	61	21	13	3	-	-	1	74	81	20	-	-	35	16	19	18
% Trucks	-	-	0.8	1.6	1.7	1.0	-	-	2.0	0.9	0.6	1.7	-	-	0.4	1.7	1.6	1.0	-	-	1.0	1.5	1.9	2.1
Bicycles on Crosswalk	0	0	-	-	-	-	0	0	-	-	-	-	0	0	-	-	-	-	0	0	-	-	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	0	0	-	-	-	-	1	0	-	-	-	-	0	0	-	-	-	-	0	0	-	-	-	-
% Pedestrians	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Grand Island, NY
Grand Island Blvd/Staley Rd
Wednesday, November 13, 2019
Location: 43.007309, -78.948926

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469 jvetterlein@tstdata.com
Serving Transportation Professionals Since 1995

Count Name: Grand Island Blvd/Staley Rd
Site Code:
Start Date: 11/13/2019
Page No: 4

Turning Movement Peak Hour Data (6:30 AM)

Start Time	Grand Island Blvd Southbound						Staley Rd Westbound						I-190 Ramp-South Pkwy Northbound						Staley Rd Eastbound						
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Int. Total
6:30 AM	6	50	1	0	0	57	3	4	116	0	0	123	24	39	46	0	0	109	38	2	0	0	0	40	329
6:45 AM	4	40	2	0	0	46	5	11	150	0	1	166	41	34	53	1	0	129	26	5	0	0	0	31	372
7:00 AM	3	55	0	0	0	58	12	6	122	0	0	140	74	47	35	0	0	156	31	6	1	0	0	38	392
7:15 AM	7	43	1	0	0	51	0	0	58	0	0	58	77	26	28	5	0	136	25	3	1	0	0	29	274
Total	20	188	4	0	0	212	20	21	446	0	1	487	216	146	162	6	0	530	120	16	2	0	0	138	1367
Approach %	9.4	88.7	1.9	0.0	-	-	4.1	4.3	91.6	0.0	-	-	40.8	27.5	30.6	1.1	-	-	87.0	11.6	1.4	0.0	-	-	-
Total %	1.5	13.8	0.3	0.0	-	15.5	1.5	1.5	32.6	0.0	-	35.6	15.8	10.7	11.9	0.4	-	38.8	8.8	1.2	0.1	0.0	-	10.1	-
PHF	0.714	0.855	0.500	0.000	-	0.914	0.417	0.477	0.743	0.000	-	0.733	0.701	0.777	0.764	0.300	-	0.849	0.789	0.667	0.500	0.000	-	0.863	0.872
Lights	20	175	4	0	-	199	18	20	442	0	-	480	213	141	156	5	-	515	119	15	2	0	-	136	1330
% Lights	100.0	93.1	100.0	-	-	93.9	90.0	95.2	99.1	-	-	98.6	98.6	96.6	96.3	83.3	-	97.2	99.2	93.8	100.0	-	-	98.6	97.3
Buses	0	4	0	0	-	4	2	1	3	0	-	6	2	3	1	0	-	6	0	1	0	0	-	1	17
% Buses	0.0	2.1	0.0	-	-	1.9	10.0	4.8	0.7	-	-	1.2	0.9	2.1	0.6	0.0	-	1.1	0.0	6.3	0.0	-	-	0.7	1.2
Trucks	0	9	0	0	-	9	0	0	1	0	-	1	1	2	5	1	-	9	1	0	0	0	-	1	20
% Trucks	0.0	4.8	0.0	-	-	4.2	0.0	0.0	0.2	-	-	0.2	0.5	1.4	3.1	16.7	-	1.7	0.8	0.0	0.0	-	-	0.7	1.5
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Grand Island, NY
Grand Island Blvd/Staley Rd
Wednesday, November 13, 2019
Location: 43.007309, -78.948926

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469 jvetterlein@tstdata.com
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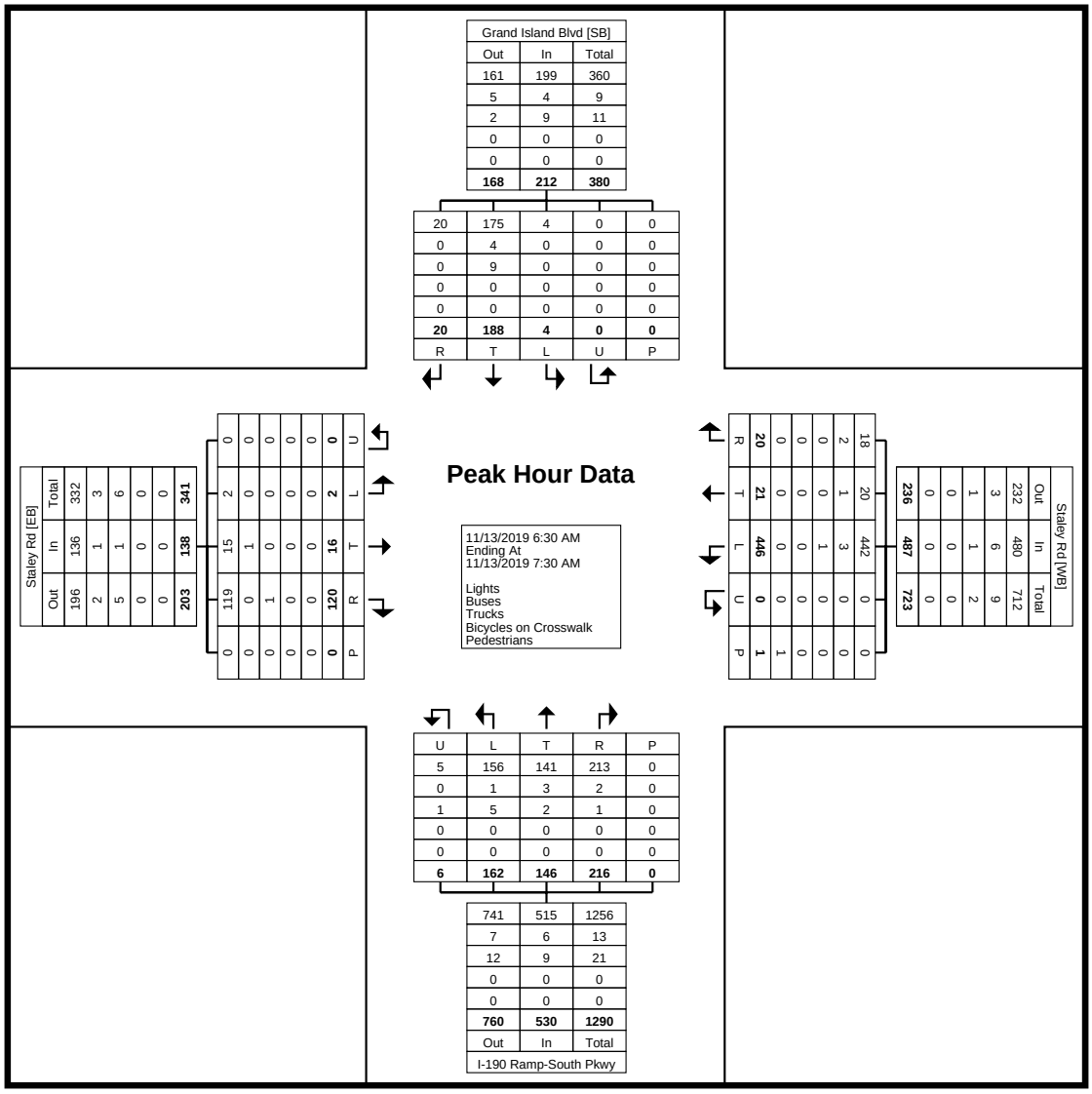

Turning Movement Peak Hour Data Plot (6:30 AM)

Grand Island, NY
Grand Island Blvd/Staley Rd
Wednesday, November 13, 2019
Location: 43.007309, -78.948926

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469 jvetterlein@tstdata.com
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Count Name: Grand Island Blvd/Staley Rd
Site Code:
Start Date: 11/13/2019
Page No: 6

Turning Movement Peak Hour Data (4:15 PM)

Start Time	Grand Island Blvd Southbound						Staley Rd Westbound						I-190 Ramp-South Pkwy Northbound						Staley Rd Eastbound						
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Int. Total
4:15 PM	3	77	11	0	0	91	8	7	54	0	0	69	101	138	21	0	0	260	53	2	7	0	0	62	482
4:30 PM	6	85	4	0	0	95	7	7	52	0	0	66	115	132	23	0	0	270	59	7	2	0	0	68	499
4:45 PM	4	87	9	0	0	100	6	0	49	0	0	55	123	133	21	0	0	277	76	7	7	0	0	90	522
5:00 PM	4	84	11	0	0	99	6	0	61	1	0	68	114	117	20	4	0	255	81	3	5	0	0	89	511
Total	17	333	35	0	0	385	27	14	216	1	0	258	453	520	85	4	0	1062	269	19	21	0	0	309	2014
Approach %	4.4	86.5	9.1	0.0	-	-	10.5	5.4	83.7	0.4	-	-	42.7	49.0	8.0	0.4	-	-	87.1	6.1	6.8	0.0	-	-	-
Total %	0.8	16.5	1.7	0.0	-	19.1	1.3	0.7	10.7	0.0	-	12.8	22.5	25.8	4.2	0.2	-	52.7	13.4	0.9	1.0	0.0	-	15.3	-
PHF	0.708	0.957	0.795	0.000	-	0.963	0.844	0.500	0.885	0.250	-	0.935	0.921	0.942	0.924	0.250	-	0.958	0.830	0.679	0.750	0.000	-	0.858	0.965
Lights	17	329	35	0	-	381	27	14	212	0	-	253	452	513	84	3	-	1052	267	18	21	0	-	306	1992
% Lights	100.0	98.8	100.0	-	-	99.0	100.0	100.0	98.1	0.0	-	98.1	99.8	98.7	98.8	75.0	-	99.1	99.3	94.7	100.0	-	-	99.0	98.9
Buses	0	0	0	0	-	0	0	0	2	1	-	3	1	4	0	1	-	6	0	1	0	0	-	1	10
% Buses	0.0	0.0	0.0	-	-	0.0	0.0	0.0	0.9	100.0	-	1.2	0.2	0.8	0.0	25.0	-	0.6	0.0	5.3	0.0	-	-	0.3	0.5
Trucks	0	4	0	0	-	4	0	0	2	0	-	2	0	3	1	0	-	4	2	0	0	0	-	2	12
% Trucks	0.0	1.2	0.0	-	-	1.0	0.0	0.0	0.9	0.0	-	0.8	0.0	0.6	1.2	0.0	-	0.4	0.7	0.0	0.0	-	-	0.6	0.6
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Grand Island, NY
Grand Island Blvd/Staley Rd
Wednesday, November 13, 2019
Location: 43.007309, -78.948926

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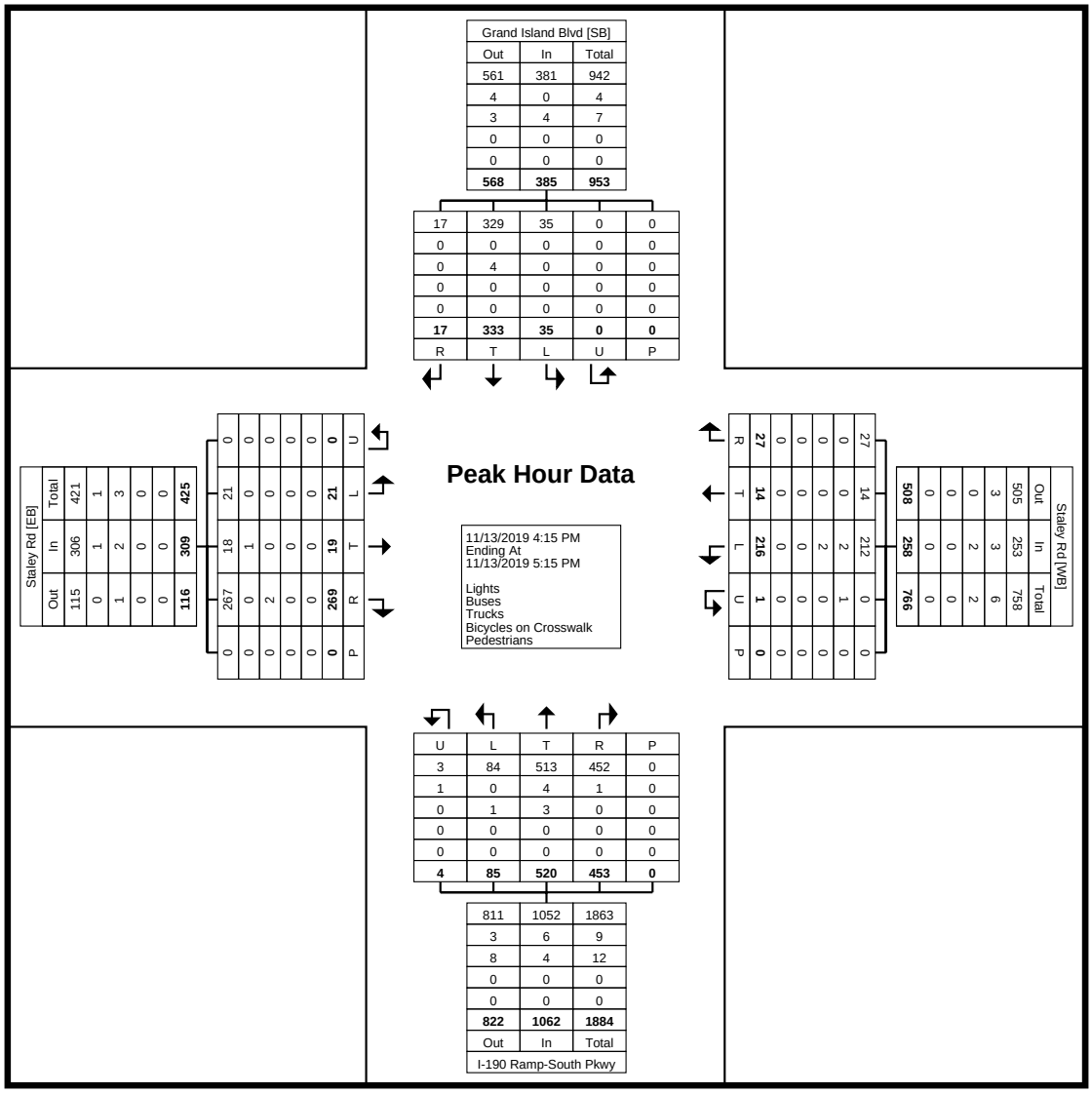

Turning Movement Peak Hour Data Plot (4:15 PM)

Grand Island, NY
Grand Island Blvd & Whitehaven Rd
Wednesday, November 13, 2019
Location: 43.021796, -78.962788

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Count Name: Grand Island Blvd/Whitehaven Rd
Site Code:
Start Date: 11/13/2019
Page No: 1

Turning Movement Data

Start Time	Grand Island Blvd Southbound							Whitehaven Rd Westbound							Grand Island Blvd Northbound							Whitehaven Rd Eastbound							
	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Int. Total
5:00 AM	0	0	6	0	0	0	6	0	0	2	0	0	0	2	0	0	7	3	0	0	10	1	1	1	0	0	0	3	21
5:15 AM	0	0	4	7	0	0	11	0	0	5	4	0	0	9	0	0	11	5	0	0	16	4	1	1	0	0	0	6	42
5:30 AM	0	0	11	0	0	0	11	2	0	2	2	0	0	6	1	0	5	1	0	0	7	3	0	0	0	0	0	3	27
5:45 AM	0	0	20	1	0	0	21	2	0	3	8	0	0	13	4	0	12	1	0	0	17	1	3	3	1	0	1	8	59
Hourly Total	0	0	41	8	0	0	49	4	0	12	14	0	0	30	5	0	35	10	0	0	50	9	5	5	1	0	1	20	149
6:00 AM	0	0	28	2	0	0	30	3	6	6	6	0	0	21	1	0	17	5	0	0	23	5	7	3	1	0	0	16	90
6:15 AM	1	0	31	5	0	0	37	5	3	9	3	0	0	20	2	0	24	5	0	0	31	0	3	4	0	0	0	7	95
6:30 AM	1	0	46	6	0	0	53	7	3	15	6	0	0	31	1	1	32	6	0	0	40	3	2	8	1	0	0	14	138
6:45 AM	0	0	41	5	0	0	46	3	1	23	10	0	1	37	2	1	29	8	0	0	40	6	8	11	3	0	0	28	151
Hourly Total	2	0	146	18	0	0	166	18	13	53	25	0	1	109	6	2	102	24	0	0	134	14	20	26	5	0	0	65	474
7:00 AM	4	0	39	4	0	0	47	8	4	77	16	0	0	105	13	2	25	15	0	0	55	6	2	33	2	0	0	43	250
7:15 AM	1	0	29	12	0	0	42	10	5	82	15	0	0	112	8	3	28	25	0	0	64	6	5	20	2	0	0	33	251
7:30 AM	0	2	29	5	0	0	36	10	8	96	14	0	0	128	2	5	32	14	0	0	53	10	1	16	6	0	0	33	250
7:45 AM	0	0	40	14	0	0	54	10	8	73	21	1	0	113	5	4	39	18	0	0	66	12	1	11	1	0	0	25	258
Hourly Total	5	2	137	35	0	0	179	38	25	328	66	1	0	458	28	14	124	72	0	0	238	34	9	80	11	0	0	134	1009
8:00 AM	0	1	46	9	0	0	56	7	6	50	22	0	0	85	4	1	35	19	0	0	59	4	8	12	2	0	0	26	226
8:15 AM	4	1	46	5	0	0	56	8	9	61	16	0	0	94	10	3	52	16	0	0	81	11	1	9	4	0	0	25	256
8:30 AM	1	0	38	10	0	0	49	10	5	52	12	0	0	79	9	3	46	26	0	0	84	11	3	21	4	0	0	39	251
8:45 AM	2	0	69	11	0	0	82	10	7	29	15	0	0	61	10	4	51	13	0	0	78	10	3	17	3	0	0	33	254
Hourly Total	7	2	199	35	0	0	243	35	27	192	65	0	0	319	33	11	184	74	0	0	302	36	15	59	13	0	0	123	987
9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*** BREAK ***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:00 PM	3	0	81	2	0	0	86	12	9	35	21	0	0	77	25	7	109	17	0	1	158	22	10	24	4	0	0	60	381
4:15 PM	3	0	73	19	0	0	95	9	4	25	29	0	1	67	28	4	122	15	0	0	169	22	10	30	7	0	0	69	400
4:30 PM	1	1	84	12	0	0	98	17	7	21	20	0	0	65	31	2	115	10	0	0	158	25	5	27	6	0	0	63	384
4:45 PM	2	1	82	18	0	0	103	12	7	16	20	0	0	55	17	4	113	14	0	0	148	24	5	30	4	0	0	63	369
Hourly Total	9	2	320	51	0	0	382	50	27	97	90	0	1	264	101	17	459	56	0	1	633	93	30	111	21	0	0	255	1534
5:00 PM	5	0	75	22	0	0	102	13	6	20	13	0	0	52	35	4	102	14	0	0	155	21	8	19	6	0	1	54	363
5:15 PM	4	1	69	13	0	0	87	7	6	21	26	0	0	60	22	1	123	11	0	0	157	18	11	35	7	0	1	71	375
5:30 PM	4	2	63	21	0	0	90	12	9	23	19	0	0	63	33	2	101	15	0	0	151	10	8	31	4	0	0	53	357
5:45 PM	2	0	51	16	0	0	69	11	12	17	17	0	0	57	31	3	88	15	0	0	137	11	8	35	5	0	0	59	322
Hourly Total	15	3	258	72	0	0	348	43	33	81	75	0	0	232	121	10	414	55	0	0	600	60	35	120	22	0	2	237	1417
6:00 PM	1	0	55	16	0	0	72	12	7	18	21	0	0	58	25	0	90	2	0	0	117	14	11	26	6	0	0	57	304
6:15 PM	7	2	56	15	0	0	80	15	9	15	14	0	0	53	20	3	96	12	0	0	131	10	14	26	5	0	0	55	319
6:30 PM	4	3	53	13	0	0	73	8	3	22	22	0	0	55	21	0	86	8	0	0	115	3	11	24	6	0	3	44	287
6:45 PM	0	2	43	9	0	0	54	5	4	13	14	0	0	36	20	3	63	10	0	0	96	6	7	17	1	0	0	31	217
Hourly Total	12	7	207	53	0	0	279	40	23	68	71	0	0	202	86	6	335	32	0	0	459	33	43	93	18	0	3	187	1127
7:00 PM	2	1	38	4	0	0	45	3	9	15	9	0	0	36	8	3	54	12	0	1	77	7	4	14	0	0	0	25	183
7:15 PM	2	1	37	9	0	0	49	1	3	8	2	0	0	14	8	1	65	4	0	0	78	6	7	9	2	0	0	24	165
7:30 PM	1	0	28	10	0	0	39	5	0	8	12	0	0	25	6	3	49	3	0	0	61	6	3	19	2	0	1	30	155
7:45 PM	2	1	33	10	0	0	46	6	3	12	3	0	0	24	12	0	48	8	0	0	68	4	4	12	2	0	0	22	160
Hourly Total	7	3	136	33	0	0	179	15	15	43	26	0	0	99	34	7	216	27	0	1	284	23	18	54	6	0	1	101	663
8:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Grand Total	57	19	1444	305	0	0	1825	243	163	874	432	1	2	1713	415	67	1869	350	0	2	2701	302	175	548	97	0	7	1122	7361
Approach %	3.1	1.0	79.1	16.7	0.0	-	-	14.2	9.5	51.0	25.2	0.1	-	-	15.4	2.5	69.2	13.0	0.0	-	-	26.9	15.6	48.8	8.6	0.0	-	-	-
Total %	0.8	0.3	19.6	4.1	0.0	-	24.8	3.3	2.2	11.9	5.9	0.0	-	23.3	5.6	0.9	25.4	4.8	0.0	-	36.7	4.1	2.4	7.4	1.3	0.0	-	15.2	-
Lights	56	19	1400	296	0	-	1771	232	161	843	425	1	-	1662	405	64	1828	334	0	-	2631	298	173	526	95	0	-	1092	7156
% Lights	98.2	100.0	97.0	97.0	-	-	97.0	95.5	98.8	96.5	98.4	100.0	-	97.0	97.6	95.5	97.8	95.4	-	-	97.4	98.7	98.9	96.0	97.9	-	-	97.3	97.2
Buses	0	0	28	6	0	-	34	8	0	13	4	0	-	25	4	1	21	2	0	-	28	2	0	12	0	0	-	14	101
% Buses	0.0	0.0	1.9	2.0	-	-	1.9	3.3	0.0	1.5	0.9	0.0	-	1.5	1.0	1.5	1.1	0.6	-	-	1.0	0.7	0.0	2.2	0.0	-	-	1.2	1.4
Trucks	1	0	16	3	0	-	20	3	2	18	3	0	-	26	6	2	20	14	0	-	42	2	2	10	2	0	-	16	104
% Trucks	1.8	0.0	1.1	1.0	-	-	1.1	1.2	1.2	2.1	0.7	0.0	-	1.5	1.4	3.0	1.1	4.0	-	-	1.6	0.7	1.1	1.8	2.1	-	-	1.4	1.4
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	0.0	-	-	-	-	-	-	0.0	-	-

Pedestrians	-	-	-	-	-	0	-	-	-	-	-	-	2	-	-	-	-	-	-	2	-	-	-	-	-	-	7	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	100.0	-	-	-	-	-	-	100.0	-	-

Grand Island, NY
Grand Island Blvd & Whitehaven Rd
Wednesday, November 13, 2019
Location: 43.021796, -78.962788

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469 jvetterlein@tstdata.com
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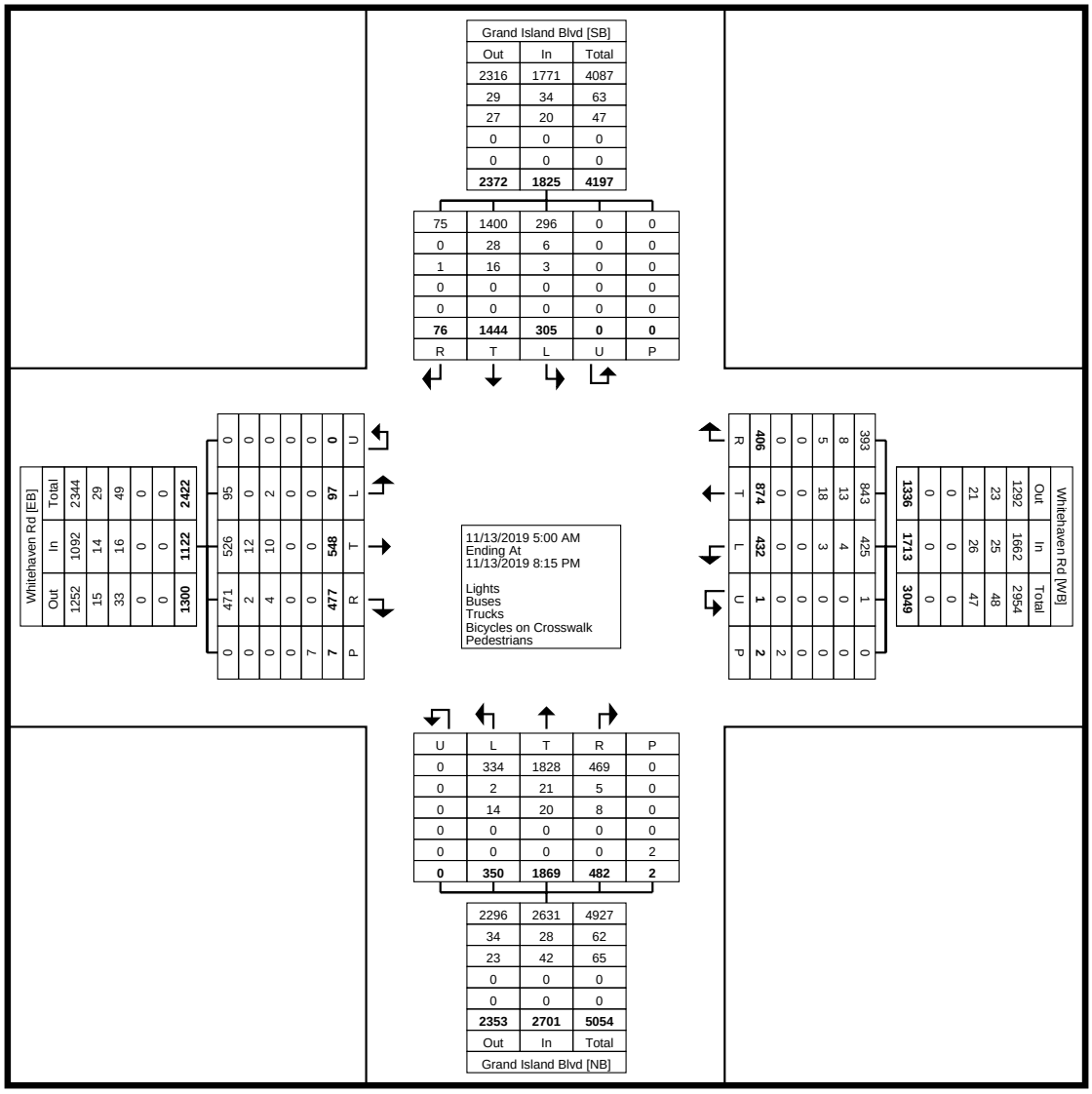
Count Name: Grand Island Blvd/Whitehaven Rd
Site Code:
Start Date: 11/13/2019
Page No: 3



Turning Movement Data Plot

Grand Island, NY
Grand Island Blvd & Whitehaven Rd
Wednesday, November 13, 2019
Location: 43.021796, -78.962788

www.TSTData.com
184 Baker Rd

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Count Name: Grand Island Blvd/Whitehaven Rd
Site Code:
Start Date: 11/13/2019
Page No: 4

Turning Movement Peak Hour Data (7:00 AM)

Start Time	Grand Island Blvd Southbound							Whitehaven Rd Westbound							Grand Island Blvd Northbound							Whitehaven Rd Eastbound							
	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Int. Total
7:00 AM	4	0	39	4	0	0	47	8	4	77	16	0	0	105	13	2	25	15	0	0	55	6	2	33	2	0	0	43	250
7:15 AM	1	0	29	12	0	0	42	10	5	82	15	0	0	112	8	3	28	25	0	0	64	6	5	20	2	0	0	33	251
7:30 AM	0	2	29	5	0	0	36	10	8	96	14	0	0	128	2	5	32	14	0	0	53	10	1	16	6	0	0	33	250
7:45 AM	0	0	40	14	0	0	54	10	8	73	21	1	0	113	5	4	39	18	0	0	66	12	1	11	1	0	0	25	258
Total	5	2	137	35	0	0	179	38	25	328	66	1	0	458	28	14	124	72	0	0	238	34	9	80	11	0	0	134	1009
Approach %	2.8	1.1	76.5	19.6	0.0	-	-	8.3	5.5	71.6	14.4	0.2	-	-	11.8	5.9	52.1	30.3	0.0	-	-	25.4	6.7	59.7	8.2	0.0	-	-	-
Total %	0.5	0.2	13.6	3.5	0.0	-	17.7	3.8	2.5	32.5	6.5	0.1	-	45.4	2.8	1.4	12.3	7.1	0.0	-	23.6	3.4	0.9	7.9	1.1	0.0	-	13.3	-
PHF	0.313	0.250	0.856	0.625	0.000	-	0.829	0.950	0.781	0.854	0.786	0.250	-	0.895	0.538	0.700	0.795	0.720	0.000	-	0.902	0.708	0.450	0.606	0.458	0.000	-	0.779	0.978
Lights	5	2	131	33	0	-	171	37	24	322	66	1	-	450	26	13	119	69	0	-	227	33	9	68	11	0	-	121	969
% Lights	100.0	100.0	95.6	94.3	-	-	95.5	97.4	96.0	98.2	100.0	100.0	-	98.3	92.9	92.9	96.0	95.8	-	-	95.4	97.1	100.0	85.0	100.0	-	-	90.3	96.0
Buses	0	0	2	1	0	-	3	1	0	3	0	0	-	4	1	0	4	0	0	-	5	0	0	9	0	0	-	9	21
% Buses	0.0	0.0	1.5	2.9	-	-	1.7	2.6	0.0	0.9	0.0	0.0	-	0.9	3.6	0.0	3.2	0.0	-	-	2.1	0.0	0.0	11.3	0.0	-	-	6.7	2.1
Trucks	0	0	4	1	0	-	5	0	1	3	0	0	-	4	1	1	1	3	0	-	6	1	0	3	0	0	-	4	19
% Trucks	0.0	0.0	2.9	2.9	-	-	2.8	0.0	4.0	0.9	0.0	0.0	-	0.9	3.6	7.1	0.8	4.2	-	-	2.5	2.9	0.0	3.8	0.0	-	-	3.0	1.9
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Grand Island, NY
Grand Island Blvd & Whitehaven Rd
Wednesday, November 13, 2019
Location: 43.021796, -78.962788

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469 jvetterlein@tstdata.com
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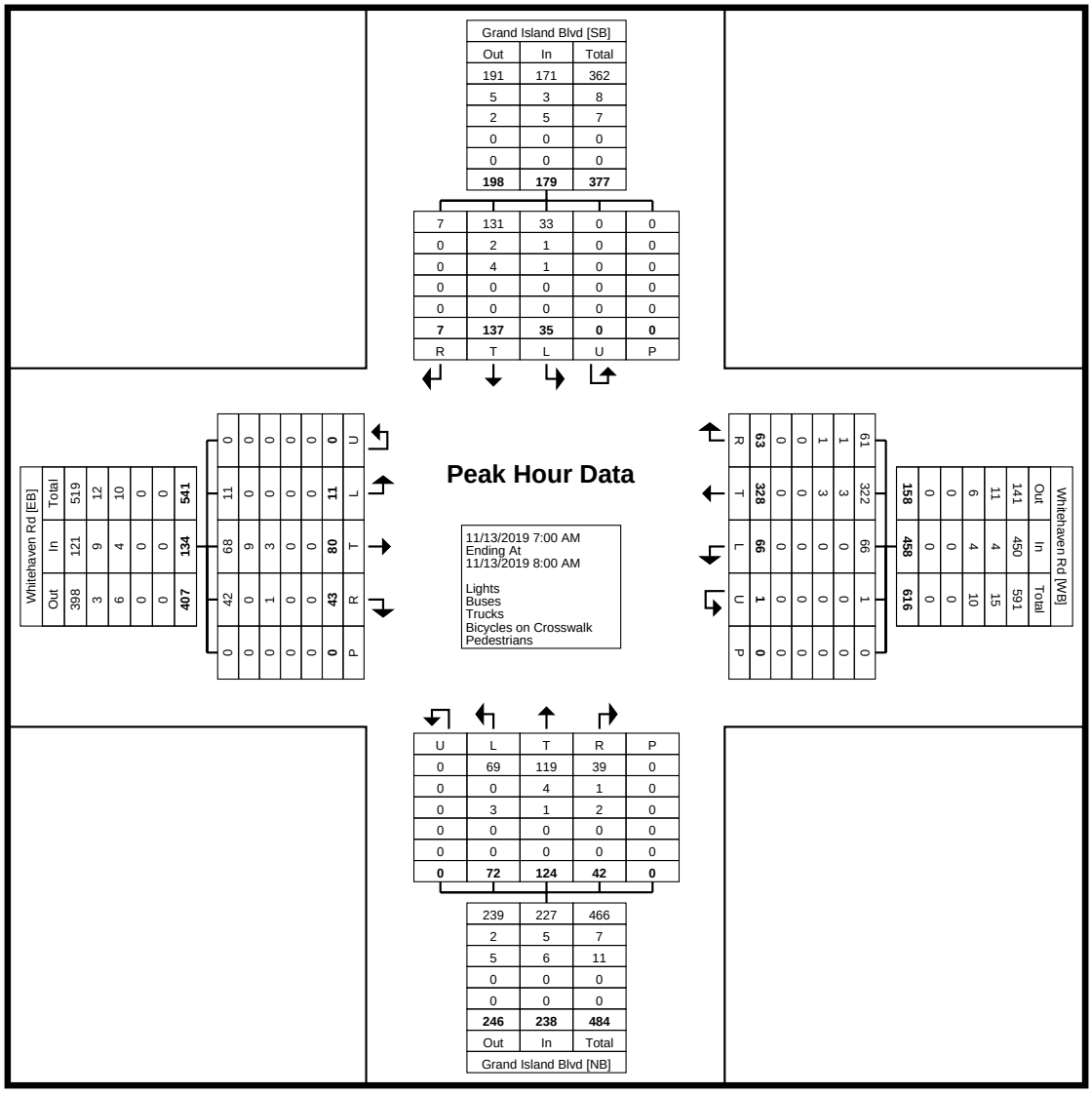
Count Name: Grand Island Blvd/Whitehaven Rd
Site Code:
Start Date: 11/13/2019
Page No: 5



Turning Movement Peak Hour Data Plot (7:00 AM)

Grand Island, NY
Grand Island Blvd & Whitehaven Rd
Wednesday, November 13, 2019
Location: 43.021796, -78.962788

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469 jvetterlein@tstdata.com
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Count Name: Grand Island Blvd/Whitehaven Rd
Site Code:
Start Date: 11/13/2019

Turning Movement Peak Hour Data (4:00 PM)

Start Time	Grand Island Blvd Southbound							Whitehaven Rd Westbound							Grand Island Blvd Northbound							Whitehaven Rd Eastbound							
	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Right	Right on Red	Thru	Left	U-Turn	Peds	App. Total	Int. Total
4:00 PM	3	0	81	2	0	0	86	12	9	35	21	0	0	77	25	7	109	17	0	1	158	22	10	24	4	0	0	60	381
4:15 PM	3	0	73	19	0	0	95	9	4	25	29	0	1	67	28	4	122	15	0	0	169	22	10	30	7	0	0	69	400
4:30 PM	1	1	84	12	0	0	98	17	7	21	20	0	0	65	31	2	115	10	0	0	158	25	5	27	6	0	0	63	384
4:45 PM	2	1	82	18	0	0	103	12	7	16	20	0	0	55	17	4	113	14	0	0	148	24	5	30	4	0	0	63	369
Total	9	2	320	51	0	0	382	50	27	97	90	0	1	264	101	17	459	56	0	1	633	93	30	111	21	0	0	255	1534
Approach %	2.4	0.5	83.8	13.4	0.0	-	-	18.9	10.2	36.7	34.1	0.0	-	-	16.0	2.7	72.5	8.8	0.0	-	-	36.5	11.8	43.5	8.2	0.0	-	-	-
Total %	0.6	0.1	20.9	3.3	0.0	-	24.9	3.3	1.8	6.3	5.9	0.0	-	17.2	6.6	1.1	29.9	3.7	0.0	-	41.3	6.1	2.0	7.2	1.4	0.0	-	16.6	-
PHF	0.750	0.500	0.952	0.671	0.000	-	0.927	0.735	0.750	0.693	0.776	0.000	-	0.857	0.815	0.607	0.941	0.824	0.000	-	0.936	0.930	0.750	0.925	0.750	0.000	-	0.924	0.959
Lights	9	2	312	51	0	-	374	44	26	93	89	0	-	252	100	17	452	55	0	-	624	91	30	107	21	0	-	249	1499
% Lights	100.0	100.0	97.5	100.0	-	-	97.9	88.0	96.3	95.9	98.9	-	-	95.5	99.0	100.0	98.5	98.2	-	-	98.6	97.8	100.0	96.4	100.0	-	-	97.6	97.7
Buses	0	0	3	0	0	-	3	5	0	1	0	0	-	6	0	0	5	0	0	-	5	2	0	0	0	0	-	2	16
% Buses	0.0	0.0	0.9	0.0	-	-	0.8	10.0	0.0	1.0	0.0	-	-	2.3	0.0	0.0	1.1	0.0	-	-	0.8	2.2	0.0	0.0	0.0	-	-	0.8	1.0
Trucks	0	0	5	0	0	-	5	1	1	3	1	0	-	6	1	0	2	1	0	-	4	0	0	4	0	0	-	4	19
% Trucks	0.0	0.0	1.6	0.0	-	-	1.3	2.0	3.7	3.1	1.1	-	-	2.3	1.0	0.0	0.4	1.8	-	-	0.6	0.0	0.0	3.6	0.0	-	-	1.6	1.2
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-

Grand Island, NY
Grand Island Blvd & Whitehaven Rd
Wednesday, November 13, 2019
Location: 43.021796, -78.962788

www.TSTData.com
184 Baker Rd

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Site Code:
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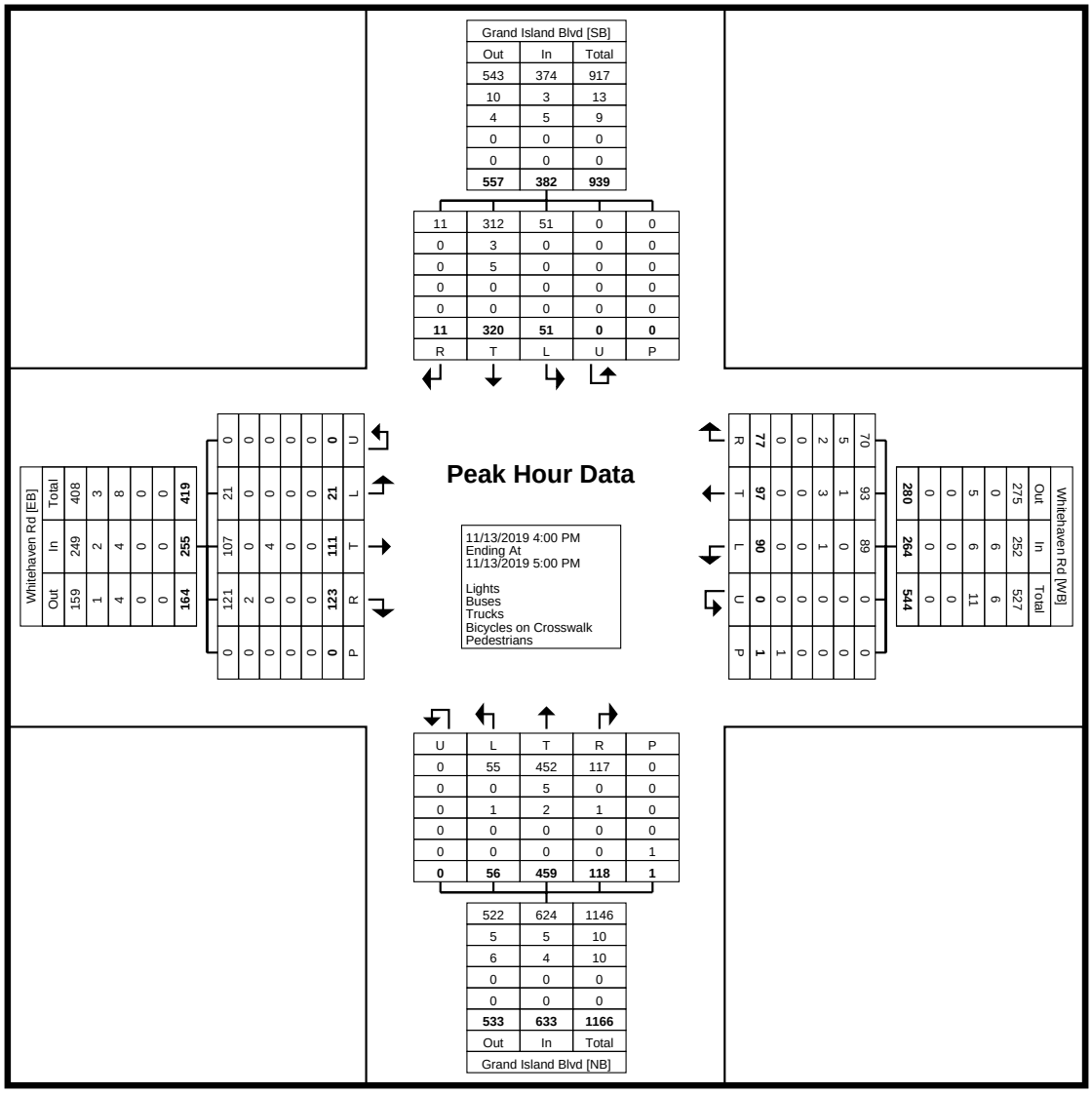
Page No: 7



Turning Movement Peak Hour Data Plot (4:00 PM)

Grand Island, NY
Long Rd & Grand Island Blvd
Wednesday, November 13, 2019
Location: 43.048687, -78.988125

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
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Count Name: Long Rd/Grand Island Blvd
Site Code:
Start Date: 11/13/2019
Page No: 1

Turning Movement Data

Start Time	Grand Island Blvd Southbound						Long Rd Westbound						Grand Island Blvd Northbound						Long Rd Eastbound						
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Int. Total
5:00 AM	0	0	0	0	0	0	3	4	0	0	0	7	0	1	1	0	0	2	1	0	1	0	0	2	11
5:15 AM	0	0	0	0	0	0	3	5	0	0	0	8	1	9	0	0	0	10	6	0	2	0	0	8	26
5:30 AM	0	0	0	0	0	0	4	4	0	0	0	8	2	18	2	0	0	22	12	0	8	0	0	20	50
5:45 AM	0	0	0	0	0	0	2	10	2	0	0	14	1	16	2	0	0	19	11	1	7	0	0	19	52
Hourly Total	0	0	0	0	0	0	12	23	2	0	0	37	4	44	5	0	0	53	30	1	18	0	0	49	139
6:00 AM	0	0	0	0	0	0	5	11	5	0	0	21	5	24	5	0	0	34	8	6	7	0	0	21	76
6:15 AM	0	0	0	0	0	0	17	10	6	0	0	33	2	21	6	0	0	29	15	2	4	0	0	21	83
6:30 AM	0	0	0	0	0	0	11	24	4	0	0	39	3	33	6	0	0	42	17	3	11	0	0	31	112
6:45 AM	0	0	0	0	0	0	10	27	2	0	0	39	5	26	9	0	0	40	36	7	4	0	0	47	126
Hourly Total	0	0	0	0	0	0	43	72	17	0	0	132	15	104	26	0	0	145	76	18	26	0	0	120	397
7:00 AM	0	0	0	0	0	0	17	59	6	0	0	82	8	27	17	0	0	52	12	7	5	0	0	24	158
7:15 AM	0	0	0	0	0	0	18	36	2	0	0	56	6	25	8	0	0	39	37	8	8	0	0	53	148
7:30 AM	0	2	0	0	0	2	20	23	3	0	0	46	4	57	9	0	0	70	25	7	13	0	0	45	163
7:45 AM	0	0	0	0	0	0	20	27	7	0	0	54	8	52	15	0	0	75	39	6	12	0	0	57	186
Hourly Total	0	2	0	0	0	2	75	145	18	0	0	238	26	161	49	0	0	236	113	28	38	0	0	179	655
8:00 AM	0	1	0	0	0	1	23	21	2	1	0	47	6	44	8	0	0	58	30	4	13	0	0	47	153
8:15 AM	0	4	0	0	0	4	21	27	5	0	0	53	7	42	17	0	0	66	46	8	6	0	0	60	183
8:30 AM	0	1	0	0	0	1	25	25	1	0	0	51	9	39	16	0	0	64	36	10	3	0	0	49	165
8:45 AM	1	0	0	0	0	1	29	13	8	0	0	50	5	36	6	0	0	47	31	5	6	0	0	42	140
Hourly Total	1	6	0	0	0	7	98	86	16	1	0	201	27	161	47	0	0	235	143	27	28	0	0	198	641
9:00 AM	0	0	1	0	0	1	8	19	3	0	0	30	18	36	6	0	0	60	23	9	6	0	0	38	129
9:15 AM	0	1	1	0	0	2	10	7	6	0	0	23	4	28	6	0	0	38	28	7	3	0	0	38	101
9:30 AM	0	0	0	0	0	0	14	10	5	0	0	29	7	30	3	0	0	40	27	8	3	0	0	38	107
9:45 AM	0	0	0	0	0	0	14	3	3	0	0	20	6	43	5	0	0	54	25	6	3	0	0	34	108
Hourly Total	0	1	2	0	0	3	46	39	17	0	0	102	35	137	20	0	0	192	103	30	15	0	0	148	445
10:00 AM	2	1	0	0	0	3	8	5	8	0	0	21	8	33	4	0	0	45	18	13	2	0	0	33	102
10:15 AM	0	0	0	0	0	0	9	9	4	0	0	22	10	36	1	0	0	47	21	7	4	0	0	32	101
10:30 AM	2	0	0	0	0	2	12	5	6	0	0	23	11	35	3	0	0	49	14	10	4	0	0	28	102
10:45 AM	0	0	0	0	0	0	10	6	2	0	0	18	7	40	2	0	0	49	22	4	4	0	0	30	97
Hourly Total	4	1	0	0	0	5	39	25	20	0	0	84	36	144	10	0	0	190	75	34	14	0	0	123	402
11:00 AM	1	0	0	0	0	1	9	3	4	0	0	16	9	34	3	0	0	46	31	11	4	0	0	46	109
11:15 AM	0	1	1	0	0	2	12	7	5	0	0	24	14	45	3	0	0	62	19	15	2	0	0	36	124
11:30 AM	2	4	0	0	0	6	7	3	5	0	0	15	9	48	10	0	0	67	21	8	4	0	0	33	121
11:45 AM	0	2	0	0	0	2	18	6	3	0	0	27	13	57	5	0	0	75	29	8	11	0	0	48	152
Hourly Total	3	7	1	0	0	11	46	19	17	0	0	82	45	184	21	0	0	250	100	42	21	0	0	163	506
12:00 PM	1	1	0	0	0	2	4	7	5	0	0	16	16	39	5	0	0	60	36	10	8	0	0	54	132
12:15 PM	0	2	0	0	0	2	5	1	3	0	0	9	10	38	8	0	0	56	33	17	5	0	0	55	122
12:30 PM	0	1	0	0	0	1	9	6	5	0	0	20	8	41	12	0	0	61	34	8	10	0	0	52	134
12:45 PM	0	2	1	0	0	3	13	1	6	0	0	20	4	40	4	0	0	48	26	10	7	0	0	43	114
Hourly Total	1	6	1	0	0	8	31	15	19	0	0	65	38	158	29	0	0	225	129	45	30	0	0	204	502
1:00 PM	0	1	0	0	0	1	11	8	8	0	0	27	11	32	5	0	0	48	36	10	5	0	0	51	127
1:15 PM	0	1	0	0	0	1	14	6	1	0	0	21	13	23	3	0	0	39	34	9	4	0	0	47	108
1:30 PM	0	1	0	0	0	1	5	5	6	0	0	16	11	37	8	0	1	56	29	19	6	0	0	54	127
1:45 PM	0	2	0	0	0	2	9	6	3	0	0	18	8	36	5	0	0	49	31	15	4	0	0	50	119
Hourly Total	0	5	0	0	0	5	39	25	18	0	0	82	43	128	21	0	1	192	130	53	19	0	0	202	481
2:00 PM	0	0	0	0	0	0	10	5	8	0	0	23	11	27	9	0	0	47	31	17	11	0	0	59	129
2:15 PM	1	1	0	0	0	2	10	4	2	0	0	16	14	28	6	0	0	48	33	11	8	0	0	52	118
2:30 PM	6	0	0	0	0	6	9	5	3	0	0	17	14	36	5	0	0	55	26	14	19	0	0	59	137
2:45 PM	1	2	0	0	0	3	7	5	4	0	0	16	16	39	3	0	0	58	28	15	6	0	0	49	126
Hourly Total	8	3	0	0	0	11	36	19	17	0	0	72	55	130	23	0	0	208	118	57	44	0	0	219	510
3:00 PM	2	1	0	0	0	3	13	9	4	0	0	26	11	43	12	0	0	66	36	17	12	0	0	65	160
3:15 PM	1	0	0	0	0	1	13	13	5	0	0	31	24	39	11	0	0	74	41	19	13	0	0	73	179
3:30 PM	0	0	0	0	0	0	12	9	1	0	0	22	28	61	16	0	0	105	44	24	20	0	0	88	215
3:45 PM	1	0	0	0	0	1	15	5	4	0	0	24	22	42	8	0	0	72	44	17	14	0	0	75	172
Hourly Total	4	1	0	0	0	5	53	36	14	0	0	103	85	185	47	0	0	317	165	77	59	0	0	301	726
4:00 PM	2	1	0	0	0	3	23	13	3	0	0	39	25	54	14	0	0	93	35	18	8	0	0	61	196
4:15 PM	0	1	0	0	0	1	14	9	3	0	0	26	19	46	11	0	0	76	36	18	9	0	0	63	166
4:30 PM	1	2	1	0	0	4	14	10	4	0	0	28	27	71	20	0	0	118	39	23	18	0	0	80	230
4:45 PM	0	4	0	0	0	4	16	15	7	0	0	38	26	53	9	0	0	88	44	12	8	0	0	64	194

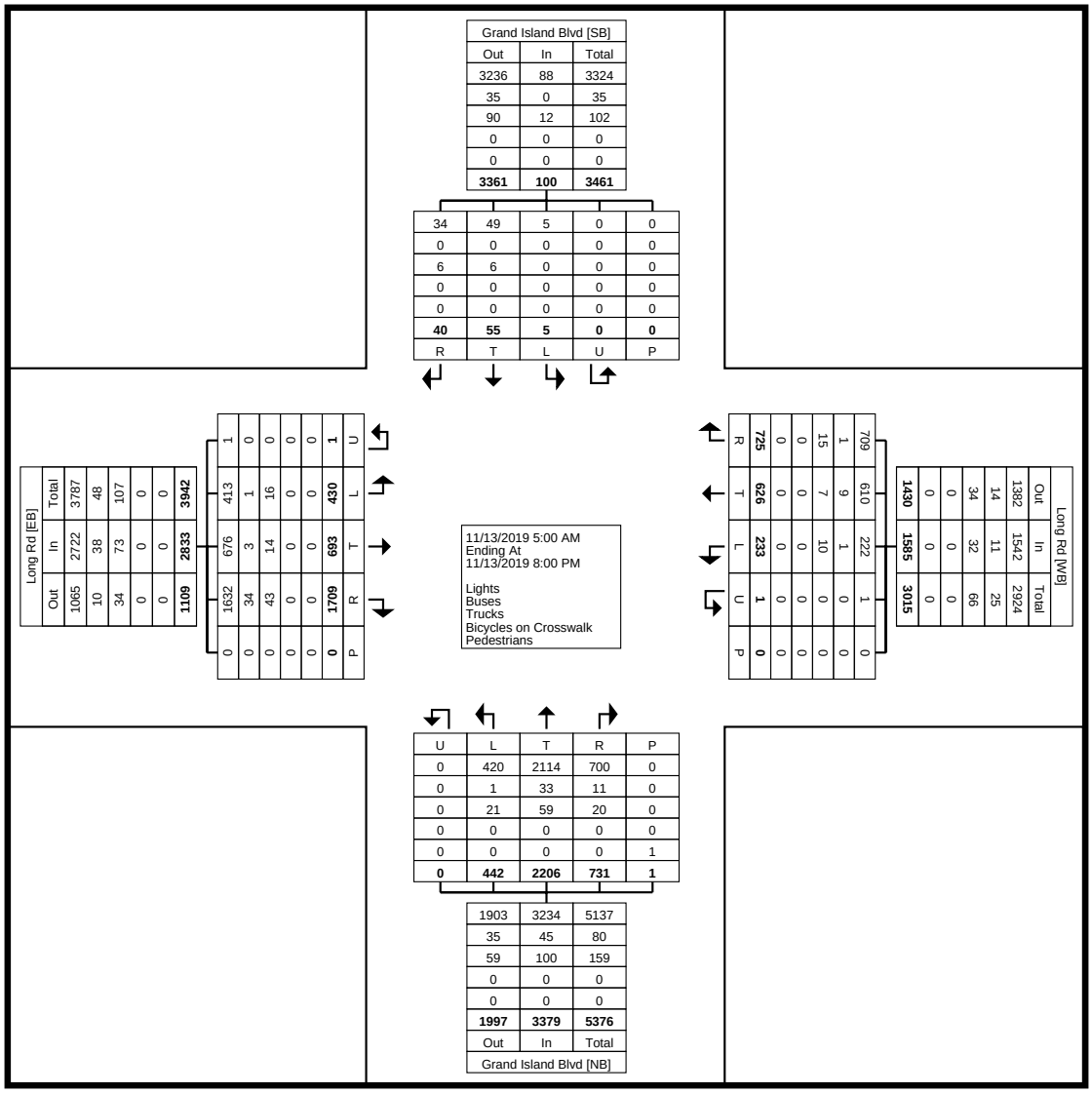
Hourly Total	3	8	1	0	0	12	67	47	17	0	0	131	97	224	54	0	0	375	154	71	43	0	0	268	786
5:00 PM	4	7	0	0	0	11	19	10	5	0	0	34	29	75	17	0	0	121	42	17	15	0	0	74	240
5:15 PM	3	2	0	0	0	5	12	9	5	0	0	26	32	51	14	0	0	97	41	30	14	1	0	86	214
5:30 PM	2	0	0	0	0	2	15	10	3	0	0	28	31	45	10	0	0	86	33	20	6	0	0	59	175
5:45 PM	1	2	0	0	0	3	10	5	5	0	0	20	25	31	6	0	0	62	40	18	6	0	0	64	149
Hourly Total	10	11	0	0	0	21	56	34	18	0	0	108	117	202	47	0	0	366	156	85	41	1	0	283	778
6:00 PM	1	0	0	0	0	1	18	10	6	0	0	34	15	62	7	0	0	84	32	16	8	0	0	56	175
6:15 PM	2	0	0	0	0	2	12	11	3	0	0	26	18	39	4	0	0	61	27	24	5	0	0	56	145
6:30 PM	1	0	0	0	0	1	8	4	2	0	0	14	13	41	3	0	0	57	30	17	6	0	0	53	125
6:45 PM	0	1	0	0	0	1	14	5	2	0	0	21	7	27	2	0	0	36	25	21	2	0	0	48	106
Hourly Total	4	1	0	0	0	5	52	30	13	0	0	95	53	169	16	0	0	238	114	78	21	0	0	213	551
7:00 PM	0	2	0	0	0	2	6	1	2	0	0	9	12	27	4	0	0	43	25	11	3	0	0	39	93
7:15 PM	1	1	0	0	0	2	8	4	2	0	0	14	9	14	6	0	0	29	26	13	6	0	0	45	90
7:30 PM	0	0	0	0	0	0	10	3	2	0	0	15	18	21	10	0	0	49	19	9	3	0	0	31	95
7:45 PM	1	0	0	0	0	1	8	3	4	0	0	15	16	13	7	0	0	36	33	14	1	0	0	48	100
Hourly Total	2	3	0	0	0	5	32	11	10	0	0	53	55	75	27	0	0	157	103	47	13	0	0	163	378
Grand Total	40	55	5	0	0	100	725	626	233	1	0	1585	731	2206	442	0	1	3379	1709	693	430	1	0	2833	7897
Approach %	40.0	55.0	5.0	0.0	-	-	45.7	39.5	14.7	0.1	-	-	21.6	65.3	13.1	0.0	-	-	60.3	24.5	15.2	0.0	-	-	-
Total %	0.5	0.7	0.1	0.0	-	1.3	9.2	7.9	3.0	0.0	-	20.1	9.3	27.9	5.6	0.0	-	42.8	21.6	8.8	5.4	0.0	-	35.9	-
Lights	34	49	5	0	-	88	709	610	222	1	-	1542	700	2114	420	0	-	3234	1632	676	413	1	-	2722	7586
% Lights	85.0	89.1	100.0	-	-	88.0	97.8	97.4	95.3	100.0	-	97.3	95.8	95.8	95.0	-	-	95.7	95.5	97.5	96.0	100.0	-	96.1	96.1
Buses	0	0	0	0	-	0	1	9	1	0	-	11	11	33	1	0	-	45	34	3	1	0	-	38	94
% Buses	0.0	0.0	0.0	-	-	0.0	0.1	1.4	0.4	0.0	-	0.7	1.5	1.5	0.2	-	-	1.3	2.0	0.4	0.2	0.0	-	1.3	1.2
Trucks	6	6	0	0	-	12	15	7	10	0	-	32	20	59	21	0	-	100	43	14	16	0	-	73	217
% Trucks	15.0	10.9	0.0	-	-	12.0	2.1	1.1	4.3	0.0	-	2.0	2.7	2.7	4.8	-	-	3.0	2.5	2.0	3.7	0.0	-	2.6	2.7
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	-

Grand Island, NY
Long Rd & Grand Island Blvd
Wednesday, November 13, 2019
Location: 43.048687, -78.988125

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
Serving Transportation Professionals Since 1995

Count Name: Long Rd/Grand Island Blvd
Site Code:
Start Date: 11/13/2019
Page No: 3



Turning Movement Data Plot

Grand Island, NY
Long Rd & Grand Island Blvd
Wednesday, November 13, 2019
Location: 43.048687, -78.988125

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
Serving Transportation Professionals Since 1995

Count Name: Long Rd/Grand Island Blvd
Site Code:
Start Date: 11/13/2019

Turning Movement Peak Hour Data (7:45 AM)

Start Time	Grand Island Blvd Southbound						Long Rd Westbound						Grand Island Blvd Northbound						Long Rd Eastbound						
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Int. Total
7:45 AM	0	0	0	0	0	0	20	27	7	0	0	54	8	52	15	0	0	75	39	6	12	0	0	57	186
8:00 AM	0	1	0	0	0	1	23	21	2	1	0	47	6	44	8	0	0	58	30	4	13	0	0	47	153
8:15 AM	0	4	0	0	0	4	21	27	5	0	0	53	7	42	17	0	0	66	46	8	6	0	0	60	183
8:30 AM	0	1	0	0	0	1	25	25	1	0	0	51	9	39	16	0	0	64	36	10	3	0	0	49	165
Total	0	6	0	0	0	6	89	100	15	1	0	205	30	177	56	0	0	263	151	28	34	0	0	213	687
Approach %	0.0	100.0	0.0	0.0	-	-	43.4	48.8	7.3	0.5	-	-	11.4	67.3	21.3	0.0	-	-	70.9	13.1	16.0	0.0	-	-	-
Total %	0.0	0.9	0.0	0.0	-	0.9	13.0	14.6	2.2	0.1	-	29.8	4.4	25.8	8.2	0.0	-	38.3	22.0	4.1	4.9	0.0	-	31.0	-
PHF	0.000	0.375	0.000	0.000	-	0.375	0.890	0.926	0.536	0.250	-	0.949	0.833	0.851	0.824	0.000	-	0.877	0.821	0.700	0.654	0.000	-	0.888	0.923
Lights	0	6	0	0	-	6	89	99	14	1	-	203	26	168	55	0	-	249	139	28	33	0	-	200	658
% Lights	-	100.0	-	-	-	100.0	100.0	99.0	93.3	100.0	-	99.0	86.7	94.9	98.2	-	-	94.7	92.1	100.0	97.1	-	-	93.9	95.8
Buses	0	0	0	0	-	0	0	1	1	0	-	2	2	3	0	0	-	5	5	0	1	0	-	6	13
% Buses	-	0.0	-	-	-	0.0	0.0	1.0	6.7	0.0	-	1.0	6.7	1.7	0.0	-	-	1.9	3.3	0.0	2.9	-	-	2.8	1.9
Trucks	0	0	0	0	-	0	0	0	0	0	-	0	2	6	1	0	-	9	7	0	0	0	-	7	16
% Trucks	-	0.0	-	-	-	0.0	0.0	0.0	0.0	0.0	-	0.0	6.7	3.4	1.8	-	-	3.4	4.6	0.0	0.0	-	-	3.3	2.3
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Grand Island, NY
Long Rd & Grand Island Blvd
Wednesday, November 13, 2019
Location: 43.048687, -78.988125

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
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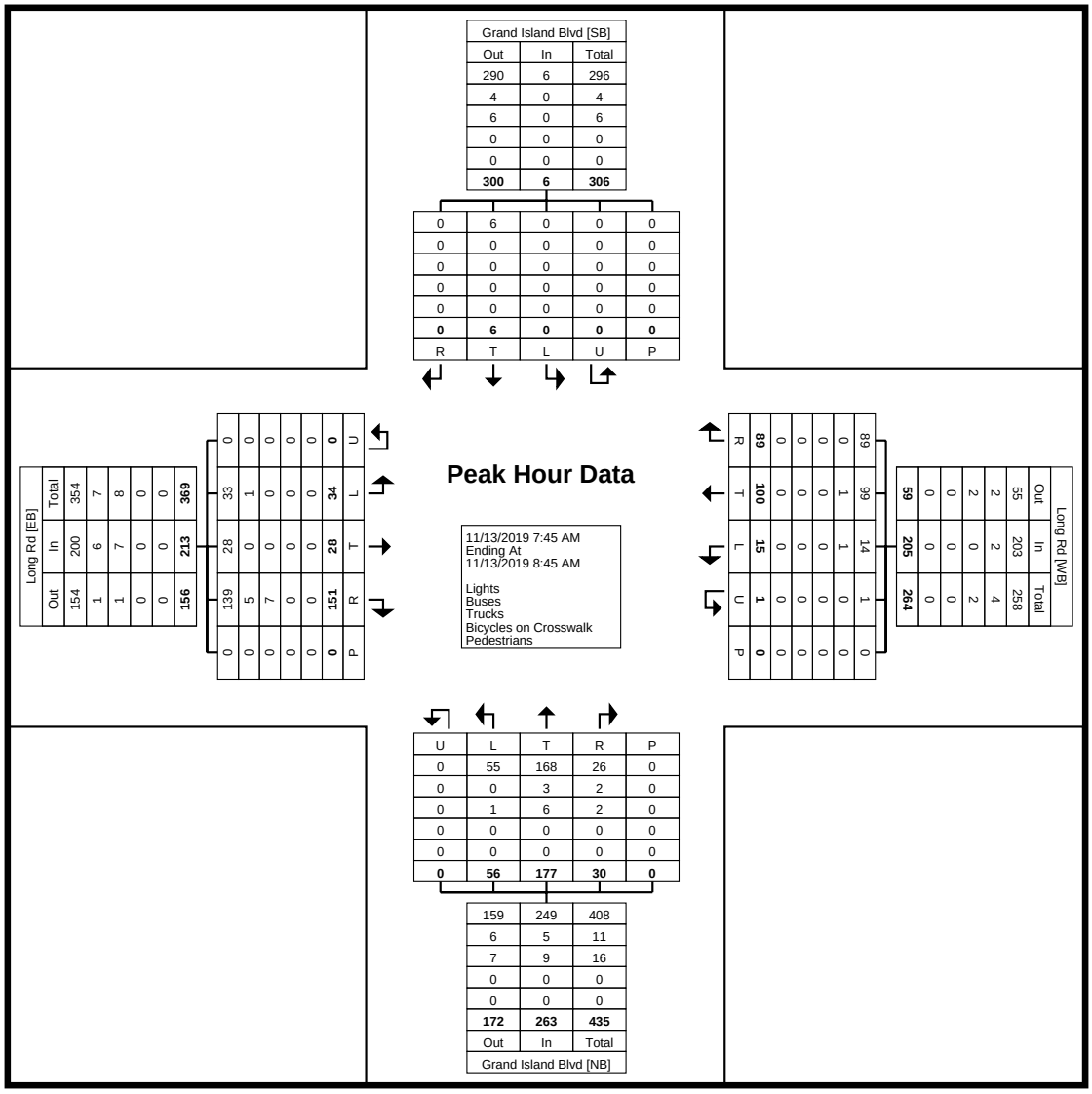
Count Name: Long Rd/Grand Island Blvd
Site Code:
Start Date: 11/13/2019
Page No: 5



Turning Movement Peak Hour Data Plot (7:45 AM)

Grand Island, NY
Long Rd & Grand Island Blvd
Wednesday, November 13, 2019
Location: 43.048687, -78.988125

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184 Baker Rd

Coatesville, Pennsylvania, United States 19320
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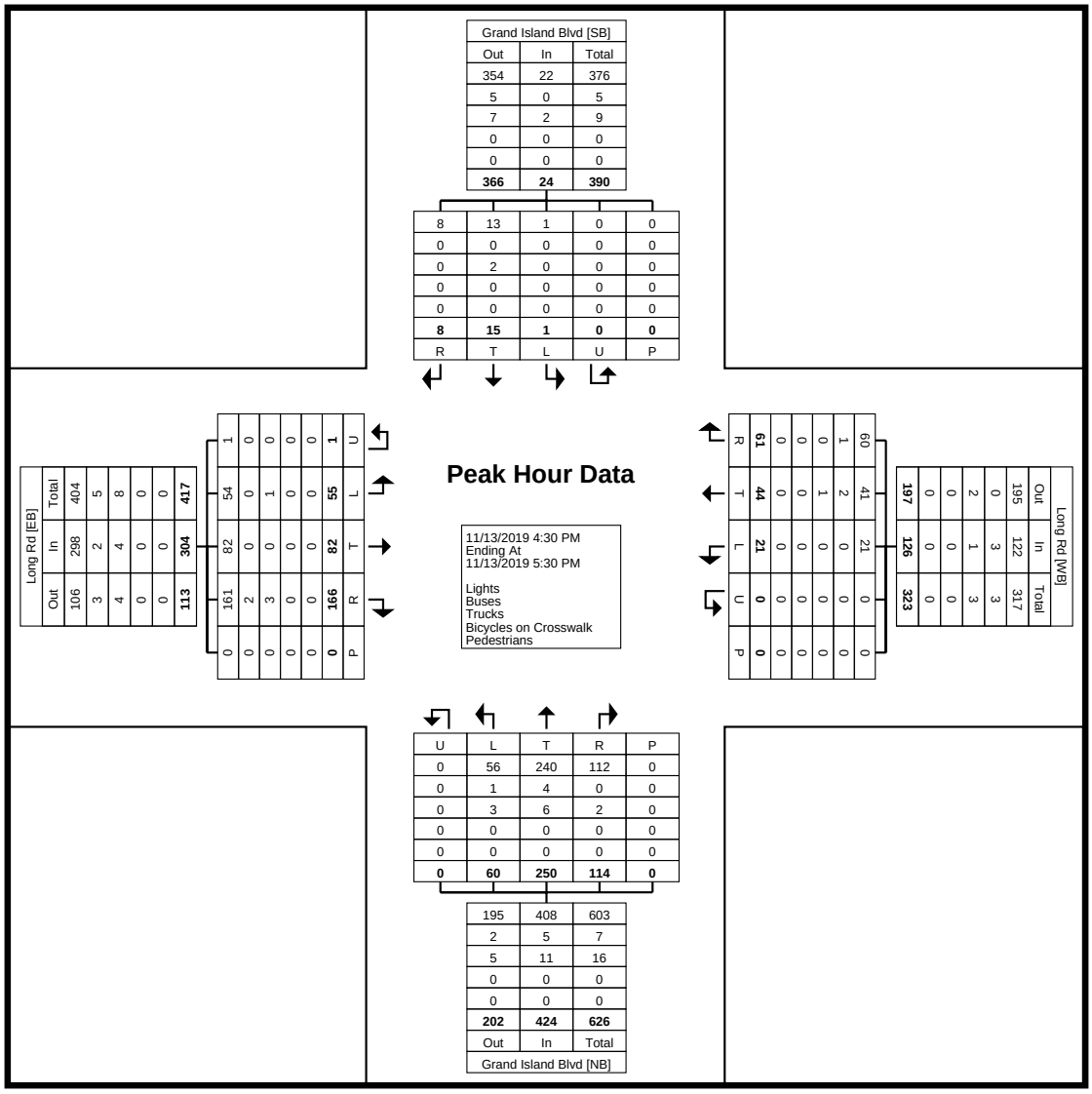
Serving Transportation Professionals Since 1995

Count Name: Long Rd/Grand Island Blvd
Site Code:
Start Date: 11/13/2019
Page No: 6

Turning Movement Peak Hour Data (4:30 PM)

Start Time	Grand Island Blvd Southbound						Long Rd Westbound						Grand Island Blvd Northbound						Long Rd Eastbound						
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Int. Total
4:30 PM	1	2	1	0	0	4	14	10	4	0	0	28	27	71	20	0	0	118	39	23	18	0	0	80	230
4:45 PM	0	4	0	0	0	4	16	15	7	0	0	38	26	53	9	0	0	88	44	12	8	0	0	64	194
5:00 PM	4	7	0	0	0	11	19	10	5	0	0	34	29	75	17	0	0	121	42	17	15	0	0	74	240
5:15 PM	3	2	0	0	0	5	12	9	5	0	0	26	32	51	14	0	0	97	41	30	14	1	0	86	214
Total	8	15	1	0	0	24	61	44	21	0	0	126	114	250	60	0	0	424	166	82	55	1	0	304	878
Approach %	33.3	62.5	4.2	0.0	-	-	48.4	34.9	16.7	0.0	-	-	26.9	59.0	14.2	0.0	-	-	54.6	27.0	18.1	0.3	-	-	-
Total %	0.9	1.7	0.1	0.0	-	2.7	6.9	5.0	2.4	0.0	-	14.4	13.0	28.5	6.8	0.0	-	48.3	18.9	9.3	6.3	0.1	-	34.6	-
PHF	0.500	0.536	0.250	0.000	-	0.545	0.803	0.733	0.750	0.000	-	0.829	0.891	0.833	0.750	0.000	-	0.876	0.943	0.683	0.764	0.250	-	0.884	0.915
Lights	8	13	1	0	-	22	60	41	21	0	-	122	112	240	56	0	-	408	161	82	54	1	-	298	850
% Lights	100.0	86.7	100.0	-	-	91.7	98.4	93.2	100.0	-	-	96.8	98.2	96.0	93.3	-	-	96.2	97.0	100.0	98.2	100.0	-	98.0	96.8
Buses	0	0	0	0	-	0	1	2	0	0	-	3	0	4	1	0	-	5	2	0	0	0	-	2	10
% Buses	0.0	0.0	0.0	-	-	0.0	1.6	4.5	0.0	-	-	2.4	0.0	1.6	1.7	-	-	1.2	1.2	0.0	0.0	0.0	-	0.7	1.1
Trucks	0	2	0	0	-	2	0	1	0	0	-	1	2	6	3	0	-	11	3	0	1	0	-	4	18
% Trucks	0.0	13.3	0.0	-	-	8.3	0.0	2.3	0.0	-	-	0.8	1.8	2.4	5.0	-	-	2.6	1.8	0.0	1.8	0.0	-	1.3	2.1
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Turning Movement Peak Hour Data Plot (4:30 PM)

Grand Island, NY
Long Rd & I-90 Ramps
Wednesday, November 13, 2019
Location: 43.048573, -78.992932

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
Serving Transportation Professionals Since 1995

Count Name: Long Rd/I-190 on-off Ramps
Site Code:
Start Date: 11/13/2019

Turning Movement Data

Start Time	Long Rd Westbound					I-190 on-off Ramps Northbound					Long Rd Eastbound					
	Thru	Left	U-Turn	Peds	App. Total	Right	Left	U-Turn	Peds	App. Total	Right	Thru	U-Turn	Peds	App. Total	Int. Total
5:00 AM	2	4	0	0	6	1	0	0	0	1	1	2	0	0	3	10
5:15 AM	0	3	0	0	3	7	0	0	0	7	0	1	0	0	1	11
5:30 AM	1	6	0	0	7	12	2	0	0	14	0	2	0	0	2	23
5:45 AM	6	8	0	0	14	21	3	0	0	24	2	1	0	0	3	41
Hourly Total	9	21	0	0	30	41	5	0	0	46	3	6	0	0	9	85
6:00 AM	1	9	0	0	10	16	1	0	0	17	1	5	0	0	6	33
6:15 AM	7	13	0	0	20	12	3	0	0	15	5	7	0	0	12	47
6:30 AM	4	21	0	0	25	18	7	0	0	25	3	9	0	0	12	62
6:45 AM	8	31	0	0	39	35	6	0	1	41	5	10	0	0	15	95
Hourly Total	20	74	0	0	94	81	17	0	1	98	14	31	0	0	45	237
7:00 AM	15	58	0	0	73	17	5	0	0	22	3	8	0	0	11	106
7:15 AM	5	42	0	0	47	42	1	1	0	44	5	10	0	0	15	106
7:30 AM	5	28	0	0	33	29	0	0	0	29	6	14	0	0	20	82
7:45 AM	9	27	0	0	36	45	4	0	0	49	6	14	0	0	20	105
Hourly Total	34	155	0	0	189	133	10	1	0	144	20	46	0	0	66	399
8:00 AM	12	26	0	0	38	32	5	0	0	37	3	13	0	0	16	91
8:15 AM	11	30	0	0	41	58	4	1	0	63	2	4	0	0	6	110
8:30 AM	15	27	0	0	42	45	4	0	0	49	4	6	0	0	10	101
8:45 AM	7	19	0	0	26	36	3	0	0	39	1	5	0	0	6	71
Hourly Total	45	102	0	0	147	171	16	1	0	188	10	28	0	0	38	373
9:00 AM	9	16	0	0	25	35	3	0	0	38	1	6	0	0	7	70
9:15 AM	4	12	0	0	16	34	2	0	0	36	2	4	0	0	6	58
9:30 AM	3	12	0	0	15	37	0	0	0	37	3	4	0	0	7	59
9:45 AM	5	4	0	0	9	27	1	0	1	28	1	2	0	1	3	40
Hourly Total	21	44	0	0	65	133	6	0	1	139	7	16	0	1	23	227
10:00 AM	2	6	0	0	8	28	3	0	0	31	2	7	0	0	9	48
10:15 AM	3	10	0	0	13	32	1	0	0	33	2	2	0	0	4	50
10:30 AM	5	5	0	0	10	22	1	1	0	24	1	7	0	0	8	42
10:45 AM	2	5	0	0	7	20	1	0	0	21	1	5	0	0	6	34
Hourly Total	12	26	0	0	38	102	6	1	0	109	6	21	0	0	27	174
11:00 AM	4	4	0	0	8	39	0	0	0	39	0	6	0	0	6	53
11:15 AM	1	9	0	0	10	34	1	0	0	35	2	5	0	0	7	52
11:30 AM	9	4	0	0	13	24	0	0	0	24	3	8	0	0	11	48
11:45 AM	4	10	0	0	14	35	1	0	0	36	3	8	0	0	11	61
Hourly Total	18	27	0	0	45	132	2	0	0	134	8	27	0	0	35	214
12:00 PM	7	5	0	0	12	44	0	0	0	44	4	16	0	0	20	76
12:15 PM	4	3	0	0	7	46	1	1	0	48	3	7	0	0	10	65
12:30 PM	11	10	0	0	21	44	5	0	0	49	4	11	0	0	15	85
12:45 PM	6	1	0	0	7	34	0	0	0	34	1	8	0	0	9	50
Hourly Total	28	19	0	0	47	168	6	1	0	175	12	42	0	0	54	276
1:00 PM	4	7	0	0	11	43	0	0	0	43	1	7	0	0	8	62
1:15 PM	2	7	0	0	9	43	0	0	0	43	1	2	0	0	3	55
1:30 PM	9	5	0	0	14	44	0	0	0	44	2	10	0	0	12	70
1:45 PM	4	7	0	0	11	43	1	0	0	44	0	8	0	0	8	63
Hourly Total	19	26	0	0	45	173	1	0	0	174	4	27	0	0	31	250
2:00 PM	1	9	0	0	10	50	2	0	0	52	3	9	0	0	12	74
2:15 PM	7	7	0	0	14	42	1	0	0	43	3	6	0	0	9	66
2:30 PM	3	14	0	0	17	38	1	0	0	39	10	24	0	0	34	90
2:45 PM	2	5	0	0	7	41	0	0	0	41	1	9	0	0	10	58
Hourly Total	13	35	0	0	48	171	4	0	0	175	17	48	0	0	65	288
3:00 PM	1	18	0	0	19	49	1	0	0	50	1	14	0	0	15	84
3:15 PM	13	14	0	0	27	59	0	0	1	59	4	13	0	0	17	103
3:30 PM	4	23	0	0	27	57	0	0	0	57	12	30	0	0	42	126
3:45 PM	3	11	0	0	14	53	4	0	0	57	8	22	0	0	30	101
Hourly Total	21	66	0	0	87	218	5	0	1	223	25	79	0	0	104	414
4:00 PM	10	19	0	0	29	53	2	0	0	55	4	8	0	0	12	96
4:15 PM	6	12	0	0	18	58	1	0	0	59	7	11	0	0	18	95
4:30 PM	8	24	0	0	32	50	1	0	0	51	8	24	0	0	32	115
4:45 PM	5	19	0	0	24	50	2	0	0	52	6	11	0	0	17	93

Hourly Total	29	74	0	0	103	211	6	0	0	217	25	54	0	0	79	399
5:00 PM	8	25	0	0	33	60	0	0	0	60	13	18	0	0	31	124
5:15 PM	4	23	0	0	27	68	2	0	0	70	8	21	1	0	30	127
5:30 PM	8	15	0	0	23	44	1	0	0	45	4	8	0	0	12	80
5:45 PM	7	9	0	0	16	59	0	0	0	59	2	8	0	0	10	85
Hourly Total	27	72	0	0	99	231	3	0	0	234	27	55	1	0	83	416
6:00 PM	1	11	0	0	12	43	0	0	0	43	2	8	0	0	10	65
6:15 PM	3	15	0	0	18	52	1	0	0	53	3	7	0	0	10	81
6:30 PM	2	9	0	0	11	51	0	0	0	51	2	5	0	0	7	69
6:45 PM	2	6	0	0	8	45	0	0	0	45	0	2	0	0	2	55
Hourly Total	8	41	0	0	49	191	1	0	0	192	7	22	0	0	29	270
7:00 PM	3	1	0	0	4	34	0	0	0	34	3	4	0	0	7	45
7:15 PM	6	6	0	0	12	44	1	0	0	45	1	5	0	0	6	63
7:30 PM	2	11	0	0	13	26	1	0	0	27	1	3	0	0	4	44
7:45 PM	5	4	0	0	9	47	0	0	0	47	0	1	0	0	1	57
Hourly Total	16	22	0	0	38	151	2	0	0	153	5	13	0	0	18	209
Grand Total	320	804	0	0	1124	2307	90	4	3	2401	190	515	1	1	706	4231
Approach %	28.5	71.5	0.0	-	-	96.1	3.7	0.2	-	-	26.9	72.9	0.1	-	-	-
Total %	7.6	19.0	0.0	-	26.6	54.5	2.1	0.1	-	56.7	4.5	12.2	0.0	-	16.7	-
Lights	301	776	0	-	1077	2236	84	1	-	2321	186	486	1	-	673	4071
% Lights	94.1	96.5	-	-	95.8	96.9	93.3	25.0	-	96.7	97.9	94.4	100.0	-	95.3	96.2
Buses	3	7	0	-	10	27	0	0	-	27	0	8	0	-	8	45
% Buses	0.9	0.9	-	-	0.9	1.2	0.0	0.0	-	1.1	0.0	1.6	0.0	-	1.1	1.1
Trucks	16	21	0	-	37	44	6	3	-	53	4	21	0	-	25	115
% Trucks	5.0	2.6	-	-	3.3	1.9	6.7	75.0	-	2.2	2.1	4.1	0.0	-	3.5	2.7
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	0.0	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	0	-	-	-	-	3	-	-	-	-	1	-	-
% Pedestrians	-	-	-	-	-	-	-	-	100.0	-	-	-	-	100.0	-	-

Grand Island, NY
Long Rd & I-90 Ramps
Wednesday, November 13, 2019
Location: 43.048573, -78.992932

www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
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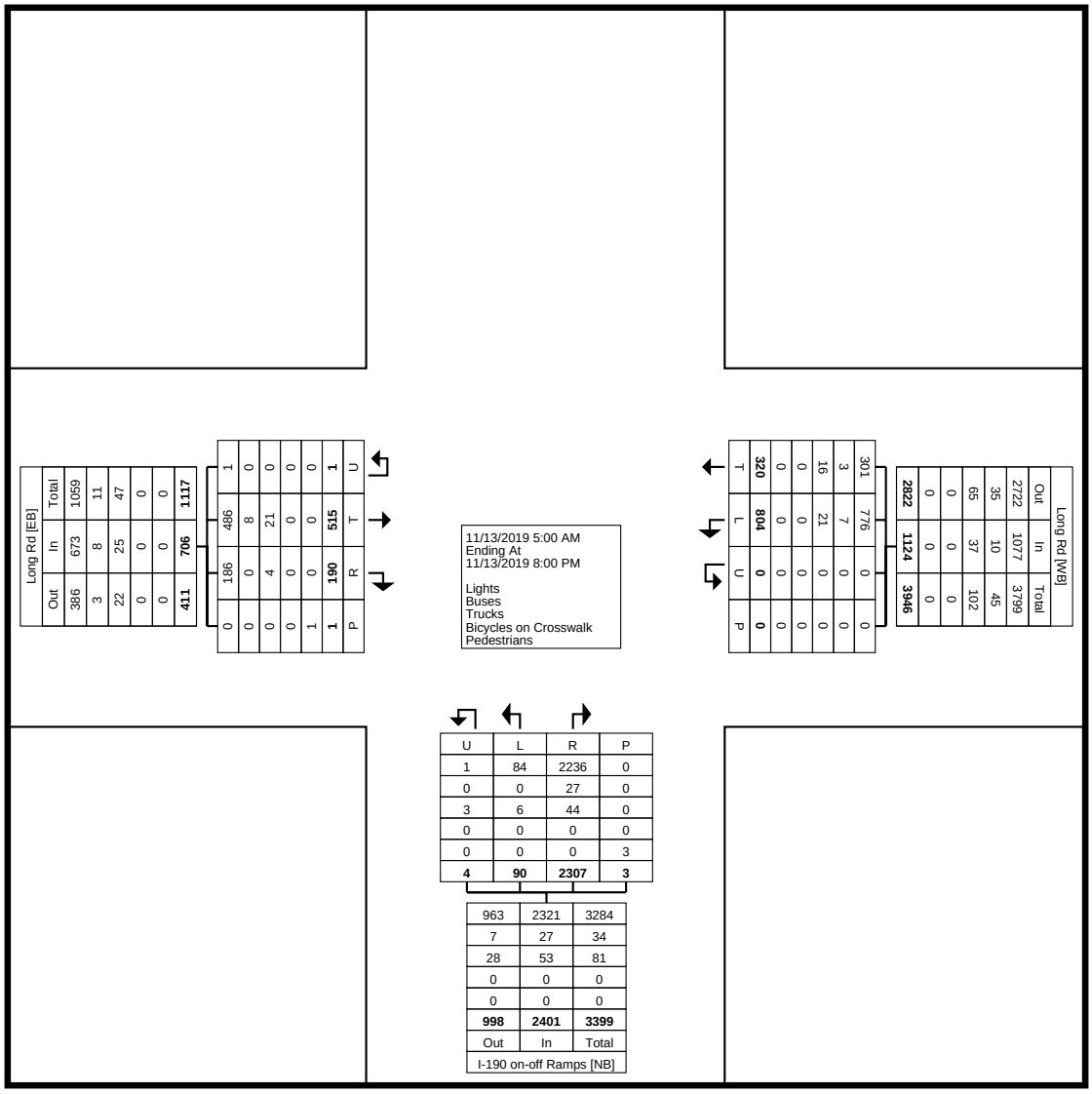
Count Name: Long Rd/I-190 on-off Ramps
Site Code:
Start Date: 11/13/2019
Page No: 3



Turning Movement Data Plot

Grand Island, NY
Long Rd & I-90 Ramps
Wednesday, November 13, 2019
Location: 43.048573, -78.992932

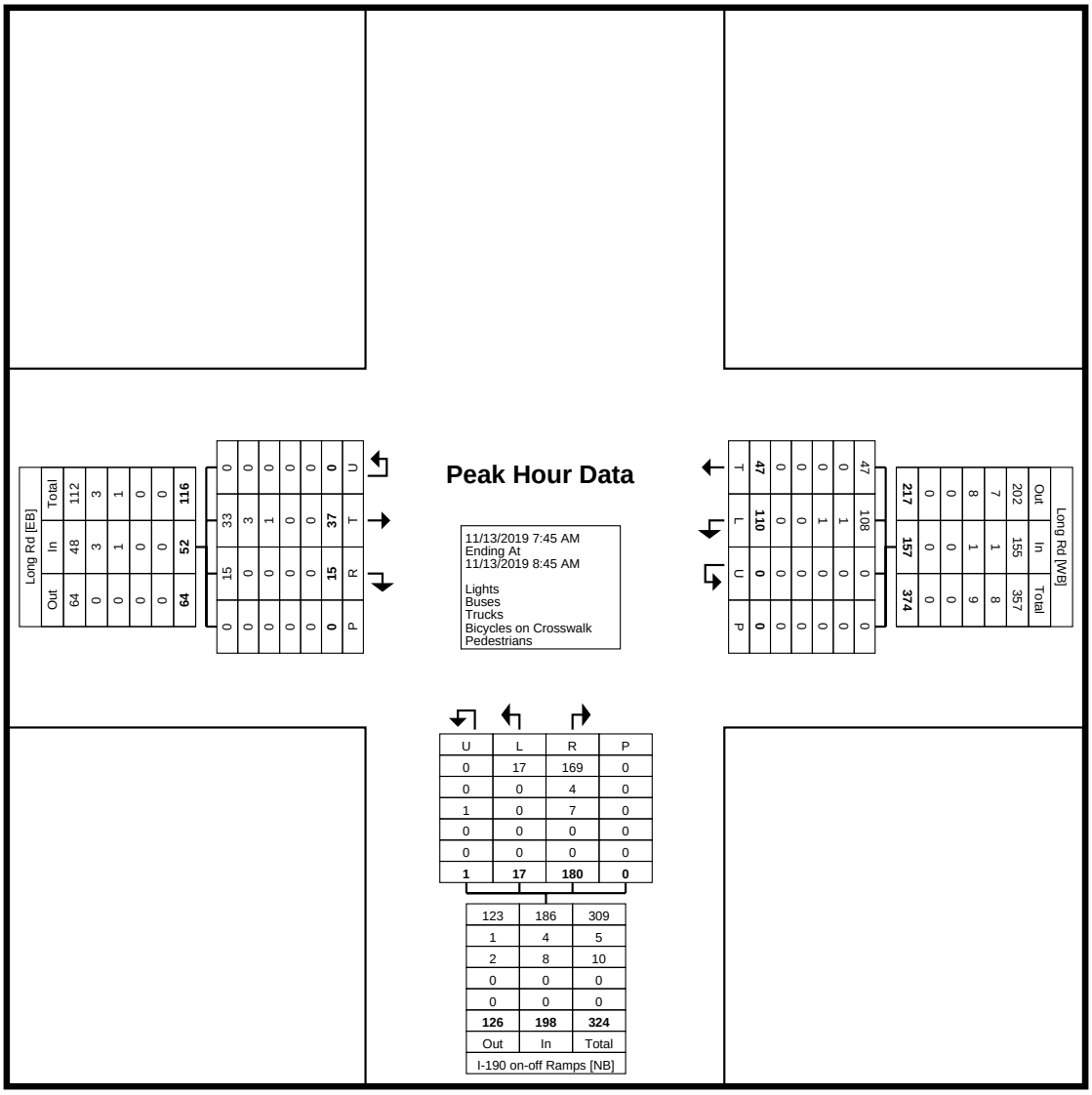
www.TSTData.com
184 Baker Rd

Coatesville, Pennsylvania, United States 19320
610-466-1469
Serving Transportation Professionals Since 1995

Count Name: Long Rd/I-190 on-off Ramps
Site Code:
Start Date: 11/13/2019
Page No: 4

Turning Movement Peak Hour Data (7:45 AM)

Start Time	Long Rd Westbound					I-190 on-off Ramps Northbound					Long Rd Eastbound					
	Thru	Left	U-Turn	Peds	App. Total	Right	Left	U-Turn	Peds	App. Total	Right	Thru	U-Turn	Peds	App. Total	Int. Total
7:45 AM	9	27	0	0	36	45	4	0	0	49	6	14	0	0	20	105
8:00 AM	12	26	0	0	38	32	5	0	0	37	3	13	0	0	16	91
8:15 AM	11	30	0	0	41	58	4	1	0	63	2	4	0	0	6	110
8:30 AM	15	27	0	0	42	45	4	0	0	49	4	6	0	0	10	101
Total	47	110	0	0	157	180	17	1	0	198	15	37	0	0	52	407
Approach %	29.9	70.1	0.0	-	-	90.9	8.6	0.5	-	-	28.8	71.2	0.0	-	-	-
Total %	11.5	27.0	0.0	-	38.6	44.2	4.2	0.2	-	48.6	3.7	9.1	0.0	-	12.8	-
PHF	0.783	0.917	0.000	-	0.935	0.776	0.850	0.250	-	0.786	0.625	0.661	0.000	-	0.650	0.925
Lights	47	108	0	-	155	169	17	0	-	186	15	33	0	-	48	389
% Lights	100.0	98.2	-	-	98.7	93.9	100.0	0.0	-	93.9	100.0	89.2	-	-	92.3	95.6
Buses	0	1	0	-	1	4	0	0	-	4	0	3	0	-	3	8
% Buses	0.0	0.9	-	-	0.6	2.2	0.0	0.0	-	2.0	0.0	8.1	-	-	5.8	2.0
Trucks	0	1	0	-	1	7	0	1	-	8	0	1	0	-	1	10
% Trucks	0.0	0.9	-	-	0.6	3.9	0.0	100.0	-	4.0	0.0	2.7	-	-	1.9	2.5
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



Turning Movement Peak Hour Data Plot (7:45 AM)

Grand Island, NY
Long Rd & I-90 Ramps
Wednesday, November 13, 2019
Location: 43.048573, -78.992932

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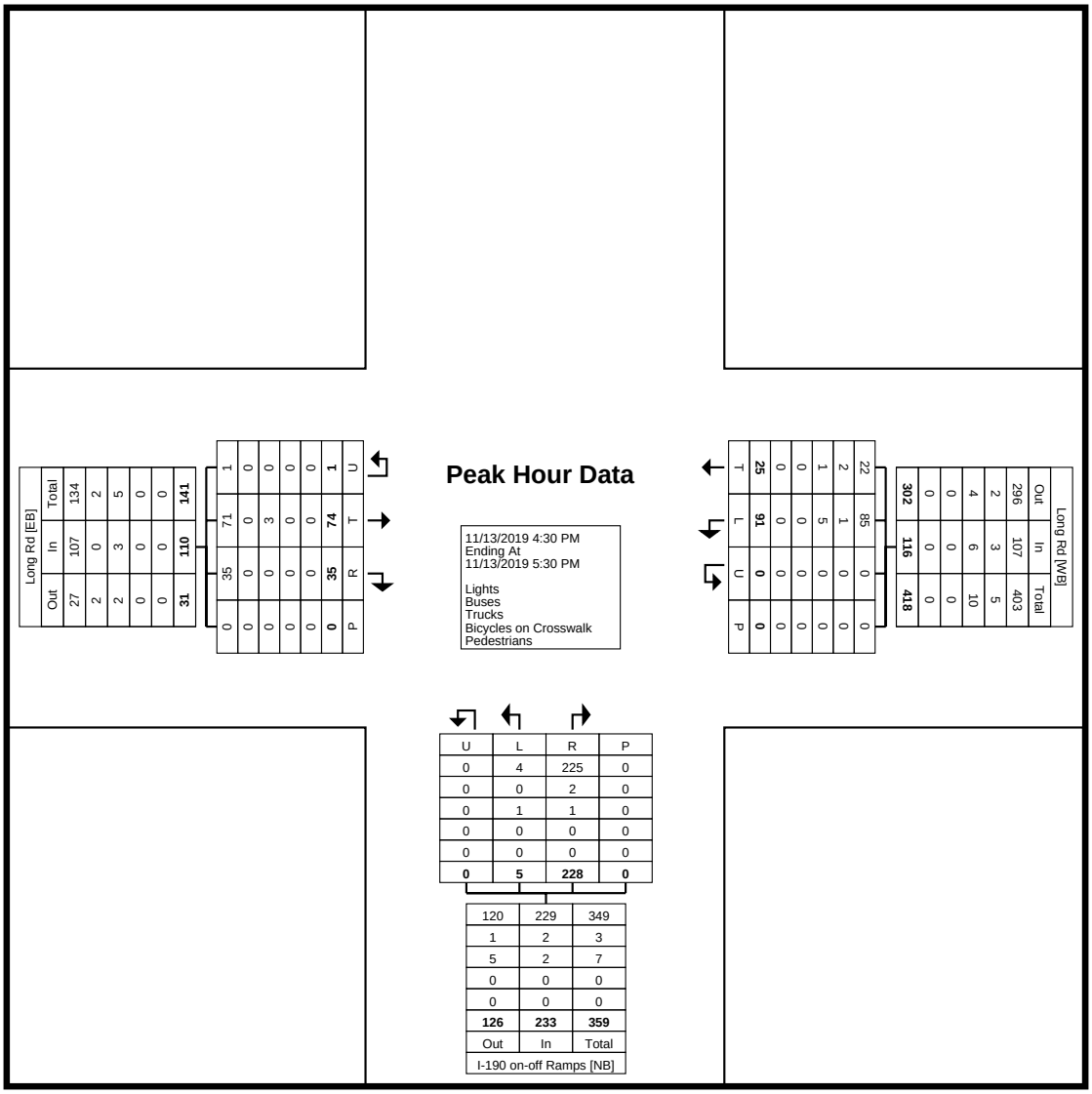
Count Name: Long Rd/I-190 on-off Ramps
Site Code:
Start Date: 11/13/2019
Page No: 6

Turning Movement Peak Hour Data (4:30 PM)

Start Time	Long Rd Westbound					I-190 on-off Ramps Northbound					Long Rd Eastbound					
	Thru	Left	U-Turn	Peds	App. Total	Right	Left	U-Turn	Peds	App. Total	Right	Thru	U-Turn	Peds	App. Total	Int. Total
4:30 PM	8	24	0	0	32	50	1	0	0	51	8	24	0	0	32	115
4:45 PM	5	19	0	0	24	50	2	0	0	52	6	11	0	0	17	93
5:00 PM	8	25	0	0	33	60	0	0	0	60	13	18	0	0	31	124
5:15 PM	4	23	0	0	27	68	2	0	0	70	8	21	1	0	30	127
Total	25	91	0	0	116	228	5	0	0	233	35	74	1	0	110	459
Approach %	21.6	78.4	0.0	-	-	97.9	2.1	0.0	-	-	31.8	67.3	0.9	-	-	-
Total %	5.4	19.8	0.0	-	25.3	49.7	1.1	0.0	-	50.8	7.6	16.1	0.2	-	24.0	-
PHF	0.781	0.910	0.000	-	0.879	0.838	0.625	0.000	-	0.832	0.673	0.771	0.250	-	0.859	0.904
Lights	22	85	0	-	107	225	4	0	-	229	35	71	1	-	107	443
% Lights	88.0	93.4	-	-	92.2	98.7	80.0	-	-	98.3	100.0	95.9	100.0	-	97.3	96.5
Buses	2	1	0	-	3	2	0	0	-	2	0	0	0	-	0	5
% Buses	8.0	1.1	-	-	2.6	0.9	0.0	-	-	0.9	0.0	0.0	0.0	-	0.0	1.1
Trucks	1	5	0	-	6	1	1	0	-	2	0	3	0	-	3	11
% Trucks	4.0	5.5	-	-	5.2	0.4	20.0	-	-	0.9	0.0	4.1	0.0	-	2.7	2.4
Bicycles on Crosswalk	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	0	-	-	-	-	0	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-



U	L	R	P
0	4	225	0
0	0	2	0
0	1	1	0
0	0	0	0
0	0	0	0
0	**5**	**228**	**0**

120	229	349
1	2	3
5	2	7
0	0	0
0	0	0
126	**233**	**359**
Out	In	Total
I-190 on-off Ramps [NB]		

Turning Movement Peak Hour Data Plot (4:30 PM)

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Grand Island, NY
Long Rd & Proposed Site Dr
Wednesday, November 13, 2019

Count Name: Long Rd/Proposed Site Drwy-Tech Camp Drwy
Site Code:
Start Date: 11/13/2019

Turning Movement Data

Start Time	Tech Camp Driveway Southbound						Long Rd Westbound						Proposed Site Driveway Northbound						Long Rd Eastbound						
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Int. Total
5:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2
5:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
5:30 AM	0	0	0	0	0	0	2	1	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	1	4
5:45 AM	0	0	0	0	0	0	4	2	0	0	0	6	0	0	0	0	0	0	0	3	0	0	0	3	9
Hourly Total	0	0	0	0	0	0	6	3	0	0	0	9	0	0	0	0	0	0	0	7	0	0	0	7	16
6:00 AM	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	5	7
6:15 AM	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	8	0	0	0	8	9
6:30 AM	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	13	0	0	0	13	16
6:45 AM	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	9	0	0	0	9	12
Hourly Total	0	0	2	0	0	2	0	7	0	0	0	7	0	0	0	0	0	0	0	35	0	0	0	35	44
7:00 AM	0	0	0	0	0	0	1	8	0	0	0	9	0	0	0	0	0	0	0	10	0	0	0	10	19
7:15 AM	0	0	0	0	0	0	1	2	0	0	0	3	0	0	0	0	0	0	0	14	0	0	0	14	17
7:30 AM	1	0	0	0	0	1	3	2	0	0	0	5	0	0	0	0	0	0	0	18	0	0	0	18	24
7:45 AM	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	14	0	0	0	14	16
Hourly Total	1	0	1	0	0	2	5	13	0	0	0	18	0	0	0	0	0	0	0	56	0	0	0	56	76
8:00 AM	0	0	0	0	0	0	0	2	2	1	0	5	0	0	0	0	0	0	0	12	0	0	0	12	17
8:15 AM	0	0	0	0	0	0	2	2	0	0	0	4	0	0	0	0	0	0	0	6	0	0	0	6	10
8:30 AM	0	0	0	0	0	0	1	3	0	1	0	5	0	0	0	0	0	0	0	5	0	0	0	5	10
8:45 AM	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	4	0	0	0	4	6
Hourly Total	0	0	0	0	0	0	3	9	2	2	0	16	0	0	0	0	0	0	0	27	0	0	0	27	43
9:00 AM	0	0	1	0	0	1	3	3	0	1	0	7	0	0	0	0	0	0	0	4	0	0	0	4	12
9:15 AM	0	0	0	0	0	0	0	1	1	0	0	2	1	0	0	0	0	1	0	3	0	0	0	3	6
9:30 AM	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	6	0	0	0	6	7
9:45 AM	0	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	0	0	3	0	0	0	3	8
Hourly Total	0	0	1	0	0	1	3	10	1	1	0	15	1	0	0	0	0	1	0	16	0	0	0	16	33
10:00 AM	0	0	2	0	0	2	1	1	0	0	0	2	0	0	0	0	0	0	0	6	0	0	0	6	10
10:15 AM	0	0	1	0	0	1	1	3	0	0	0	4	0	0	0	0	0	0	0	4	0	0	0	4	9
10:30 AM	0	0	1	0	0	1	2	0	0	0	0	2	0	0	0	0	0	0	1	4	0	0	0	5	8
10:45 AM	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	4	0	0	0	4	7
Hourly Total	0	0	4	0	0	4	4	7	0	0	0	11	0	0	0	0	0	0	1	18	0	0	0	19	34
11:00 AM	0	0	0	0	0	0	0	2	1	0	0	3	0	0	0	0	0	0	0	5	0	0	0	5	8
11:15 AM	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	4	0	0	0	4	6
11:30 AM	0	0	2	0	0	2	1	4	0	0	0	5	0	0	0	0	0	0	0	4	0	0	0	4	11
11:45 AM	0	0	1	0	0	1	3	1	0	0	0	4	0	0	0	0	0	0	0	5	0	0	0	5	10
Hourly Total	0	0	3	0	0	3	4	9	1	0	0	14	0	0	0	0	0	0	0	18	0	0	0	18	35
12:00 PM	0	0	3	0	0	3	0	4	0	0	0	4	0	0	0	0	0	0	0	10	0	0	0	10	17
12:15 PM	0	0	0	0	0	0	0	2	0	0	0	2	1	0	0	0	0	1	0	4	0	0	0	4	7
12:30 PM	0	0	2	0	0	2	1	5	1	0	0	7	0	0	0	0	0	0	0	10	0	0	0	10	19
12:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	7	7
Hourly Total	0	0	5	0	0	5	1	11	1	0	0	13	1	0	0	0	0	1	0	31	0	0	0	31	50
1:00 PM	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	4	5
1:15 PM	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	5	0	0	0	5	6
1:30 PM	0	0	0	0	0	0	1	4	0	0	0	5	0	0	0	0	0	0	0	7	0	0	0	7	12
1:45 PM	0	0	0	0	4	0	0	1	0	0	0	1	0	0	0	0	0	0	0	5	1	0	3	6	7
Hourly Total	0	0	0	0	4	0	1	7	0	0	0	8	0	0	0	0	0	0	0	21	1	0	3	22	30
2:00 PM	0	0	3	0	0	3	0	1	0	0	0	1	0	0	0	0	0	0	0	6	0	0	0	6	10
2:15 PM	0	0	4	0	0	4	3	2	0	0	0	5	0	0	0	0	0	0	0	1	0	0	0	1	10
2:30 PM	0	0	0	0	0	0	1	3	0	0	0	4	0	0	0	0	0	0	0	16	0	0	0	16	20
2:45 PM	0	0	1	0	0	1	0	2	0	0	0	2	0	0	0	0	0	0	0	9	0	0	0	9	12
Hourly Total	0	0	8	0	0	8	4	8	0	0	0	12	0	0	0	0	0	0	0	32	0	0	0	32	52
3:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	13	13
3:15 PM	0	0	0	0	0	0	1	7	0	0	0	8	0	0	0	0	0	0	0	9	0	0	0	9	17
3:30 PM	0	0	1	0	0	1	0	3	0	0	0	3	0	0	0	0	0	0	0	17	0	0	0	17	21
3:45 PM	0	0	4	0	0	4	1	4	0	0	0	5	0	0	0	0	0	0	0	14	0	0	0	14	23
Hourly Total	0	0	5	0	0	5	2	14	0	0	0	16	0	0	0	0	0	0	0	53	0	0	0	53	74
4:00 PM	0	0	1	0	0	1	0	7	0	0	0	7	0	0	0	0	0	0	0	10	0	0	0	10	18
4:15 PM	0	0	0	0	0	0	1	3	0	0	0	4	0	0	0	0	0	0	0	10	0	0	0	10	14
4:30 PM	0	0	3	0	0	3	2	5	0	0	0	7	2	0	0	0	0	2	0	21	0	0	0	21	33
4:45 PM	0	0	1	0	0	1	0	6	0	0	0	6	0	0	0	0	0	0	0	8	0	0	0	8	15

Hourly Total	0	0	5	0	0	5	3	21	0	0	0	24	2	0	0	0	0	2	0	49	0	0	0	49	80
5:00 PM	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	16	0	0	0	16	19
5:15 PM	0	0	2	0	0	2	0	4	0	0	0	4	0	0	0	0	0	0	0	18	0	0	0	18	24
5:30 PM	0	0	0	0	0	0	0	6	0	0	0	6	0	0	0	0	0	0	0	7	0	0	0	7	13
5:45 PM	0	0	1	0	0	1	0	3	0	0	0	3	0	0	0	0	0	0	0	5	0	0	0	5	9
Hourly Total	0	0	3	0	0	3	0	16	0	0	0	16	0	0	0	0	0	0	0	46	0	0	0	46	65
6:00 PM	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	7	0	0	0	7	8
6:15 PM	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	5	0	0	0	5	7
6:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	6	6
6:45 PM	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	3	5
Hourly Total	0	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	0	0	21	0	0	0	21	26
7:00 PM	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	2	4
7:15 PM	0	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	0	0	7	0	0	0	7	12
7:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	4
7:45 PM	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4
Hourly Total	0	0	1	0	0	1	0	10	0	0	0	10	0	0	0	0	0	0	0	13	0	0	0	13	24
Grand Total	1	0	38	0	4	39	36	150	5	3	0	194	4	0	0	0	0	4	1	443	1	0	3	445	682
Approach %	2.6	0.0	97.4	0.0	-	-	18.6	77.3	2.6	1.5	-	-	100.0	0.0	0.0	0.0	-	-	0.2	99.6	0.2	0.0	-	-	-
Total %	0.1	0.0	5.6	0.0	-	5.7	5.3	22.0	0.7	0.4	-	28.4	0.6	0.0	0.0	0.0	-	0.6	0.1	65.0	0.1	0.0	-	65.2	-
Lights	1	0	28	0	-	29	25	144	5	3	-	177	4	0	0	0	-	4	1	432	1	0	-	434	644
% Lights	100.0	-	73.7	-	-	74.4	69.4	96.0	100.0	100.0	-	91.2	100.0	-	-	-	-	100.0	100.0	97.5	100.0	-	-	97.5	94.4
Buses	0	0	0	0	-	0	0	3	0	0	-	3	0	0	0	0	-	0	0	7	0	0	-	7	10
% Buses	0.0	-	0.0	-	-	0.0	0.0	2.0	0.0	0.0	-	1.5	0.0	-	-	-	-	0.0	0.0	1.6	0.0	-	-	1.6	1.5
Trucks	0	0	10	0	-	10	11	3	0	0	-	14	0	0	0	0	-	0	0	4	0	0	-	4	28
% Trucks	0.0	-	26.3	-	-	25.6	30.6	2.0	0.0	0.0	-	7.2	0.0	-	-	-	-	0.0	0.0	0.9	0.0	-	-	0.9	4.1
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-
Pedestrians	-	-	-	-	4	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	3	-	-
% Pedestrians	-	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0	-	-

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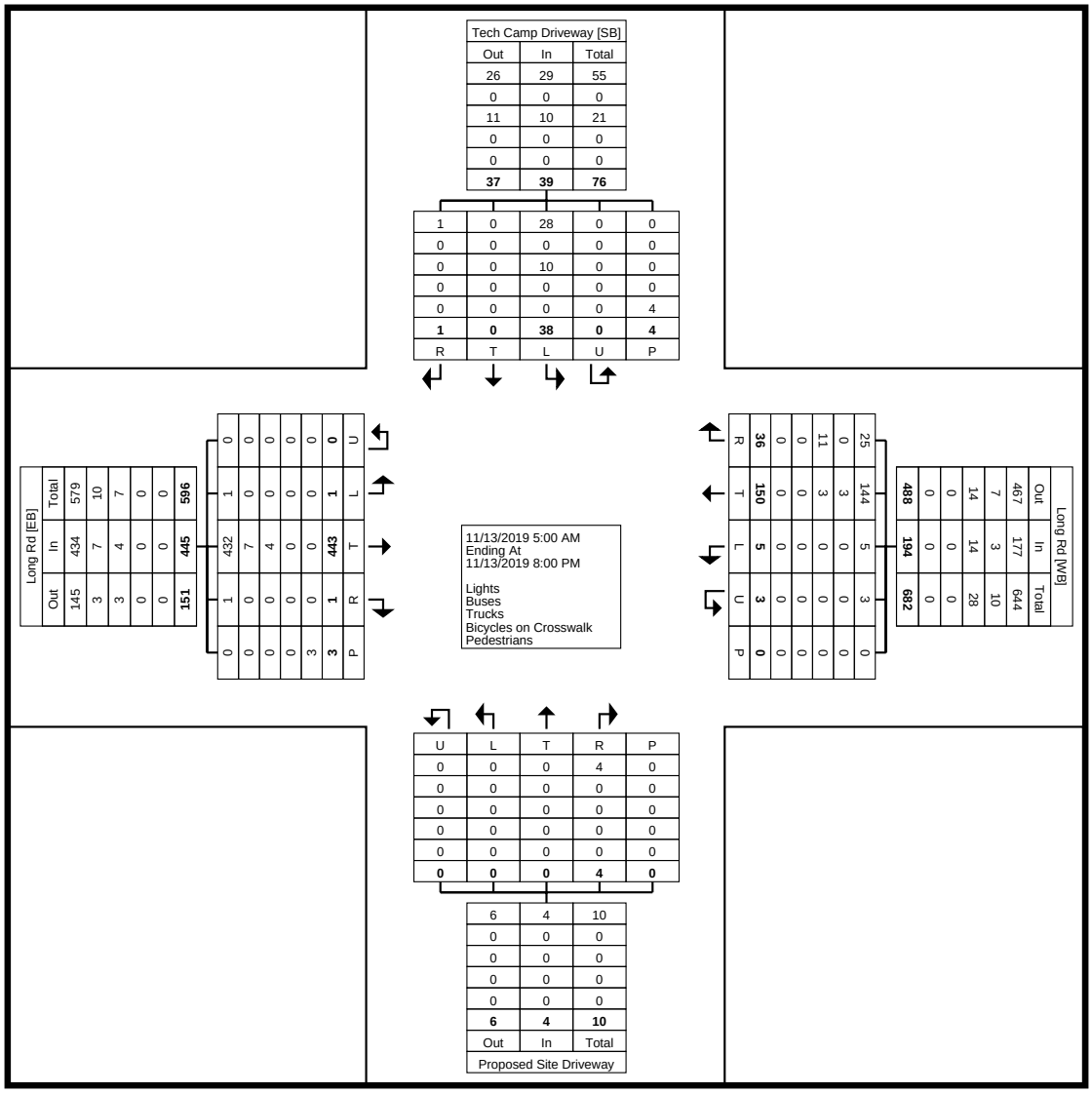
Grand Island, NY
Long Rd & Proposed Site Dr
Wednesday, November 13, 2019

Count Name: Long Rd/Proposed Site Drwy-Tech Camp Drwy
Site Code:
Start Date: 11/13/2019
Page No: 3



Turning Movement Data Plot

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Grand Island, NY
Long Rd & Proposed Site Dr
Wednesday, November 13, 2019

Count Name: Long Rd/Proposed Site Drwy-Tech Camp Drwy
Site Code:
Start Date: 11/13/2019

Turning Movement Peak Hour Data (7:00 AM)

Start Time	Tech Camp Driveway Southbound						Long Rd Westbound						Proposed Site Driveway Northbound						Long Rd Eastbound						
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Int. Total
7:00 AM	0	0	0	0	0	0	1	8	0	0	0	9	0	0	0	0	0	0	0	10	0	0	0	10	19
7:15 AM	0	0	0	0	0	0	1	2	0	0	0	3	0	0	0	0	0	0	0	14	0	0	0	14	17
7:30 AM	1	0	0	0	0	1	3	2	0	0	0	5	0	0	0	0	0	0	0	18	0	0	0	18	24
7:45 AM	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	14	0	0	0	14	16
Total	1	0	1	0	0	2	5	13	0	0	0	18	0	0	0	0	0	0	0	56	0	0	0	56	76
Approach %	50.0	0.0	50.0	0.0	-	-	27.8	72.2	0.0	0.0	-	-	0.0	0.0	0.0	0.0	-	-	0.0	100.0	0.0	0.0	-	-	-
Total %	1.3	0.0	1.3	0.0	-	2.6	6.6	17.1	0.0	0.0	-	23.7	0.0	0.0	0.0	0.0	-	0.0	0.0	73.7	0.0	0.0	-	73.7	-
PHF	0.250	0.000	0.250	0.000	-	0.500	0.417	0.406	0.000	0.000	-	0.500	0.000	0.000	0.000	0.000	-	0.000	0.000	0.778	0.000	0.000	-	0.778	0.792
Lights	1	0	1	0	-	2	5	13	0	0	-	18	0	0	0	0	-	0	0	56	0	0	-	56	76
% Lights	100.0	-	100.0	-	-	100.0	100.0	100.0	-	-	-	100.0	-	-	-	-	-	-	-	100.0	-	-	-	100.0	100.0
Buses	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Buses	0.0	-	0.0	-	-	0.0	0.0	0.0	-	-	-	0.0	-	-	-	-	-	-	-	0.0	-	-	-	0.0	0.0
Trucks	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0	0	0	0	-	0	0
% Trucks	0.0	-	0.0	-	-	0.0	0.0	0.0	-	-	-	0.0	-	-	-	-	-	-	-	0.0	-	-	-	0.0	0.0
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Grand Island, NY
Long Rd & Proposed Site Dr
Wednesday, November 13, 2019

Count Name: Long Rd/Proposed Site Drwy-Tech Camp Drwy
Site Code:
Start Date: 11/13/2019
Page No: 5

Peak Hour Data

11/13/2019 7:00 AM
Ending At
11/13/2019 8:00 AM

Lights
Buses
Trucks
Bicycles on Crosswalk
Pedestrians

Tech Camp Driveway [SB]

Out	In	Total
5	2	7
0	0	0
0	0	0
0	0	0
0	0	0
5	**2**	**7**

R	T	L	U	P
1	0	1	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
1	**0**	**1**	**0**	**0**

Long Rd [EB]

Out	In	Total
14	56	70
0	0	0
0	0	0
0	0	0
0	0	0
14	**56**	**70**

U	L	T	R	P
0	0	56	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	**0**	**56**	**0**	**0**

Long Rd [WB]

Out	In	Total
57	18	75
0	0	0
0	0	0
0	0	0
0	0	0
57	**18**	**75**

R	T	L	U	P
5	13	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
5	**13**	**0**	**0**	**0**

U	L	T	R	P
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	**0**	**0**	**0**	**0**

Out	In	Total
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	**0**	**0**

Proposed Site Driveway

Turning Movement Peak Hour Data Plot (7:00 AM)

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Grand Island, NY
Long Rd & Proposed Site Dr
Wednesday, November 13, 2019

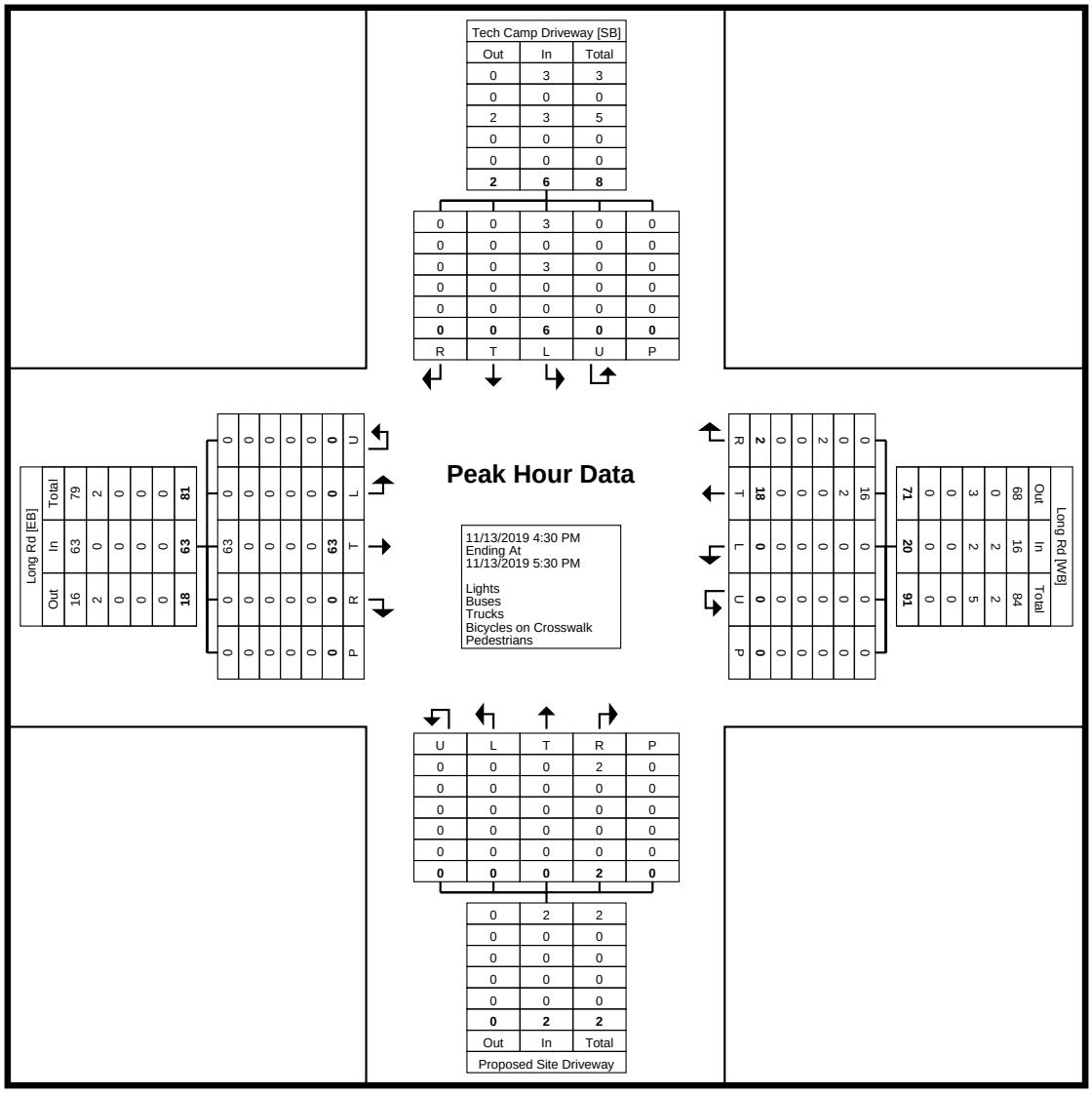
Count Name: Long Rd/Proposed Site Drwy-Tech Camp Drwy
Site Code:
Start Date: 11/13/2019

Turning Movement Peak Hour Data (4:30 PM)

Start Time	Tech Camp Driveway Southbound						Long Rd Westbound						Proposed Site Driveway Northbound						Long Rd Eastbound						
	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Right	Thru	Left	U-Turn	Peds	App. Total	Int. Total
4:30 PM	0	0	3	0	0	3	2	5	0	0	0	7	2	0	0	0	0	2	0	21	0	0	0	21	33
4:45 PM	0	0	1	0	0	1	0	6	0	0	0	6	0	0	0	0	0	0	0	8	0	0	0	8	15
5:00 PM	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	16	0	0	0	16	19
5:15 PM	0	0	2	0	0	2	0	4	0	0	0	4	0	0	0	0	0	0	0	18	0	0	0	18	24
Total	0	0	6	0	0	6	2	18	0	0	0	20	2	0	0	0	0	2	0	63	0	0	0	63	91
Approach %	0.0	0.0	100.0	0.0	-	-	10.0	90.0	0.0	0.0	-	-	100.0	0.0	0.0	0.0	-	-	0.0	100.0	0.0	0.0	-	-	-
Total %	0.0	0.0	6.6	0.0	-	6.6	2.2	19.8	0.0	0.0	-	22.0	2.2	0.0	0.0	0.0	-	2.2	0.0	69.2	0.0	0.0	-	69.2	-
PHF	0.000	0.000	0.500	0.000	-	0.500	0.250	0.750	0.000	0.000	-	0.714	0.250	0.000	0.000	0.000	-	0.250	0.000	0.750	0.000	0.000	-	0.750	0.689
Lights	0	0	3	0	-	3	0	16	0	0	-	16	2	0	0	0	-	2	0	63	0	0	-	63	84
% Lights	-	-	50.0	-	-	50.0	0.0	88.9	-	-	-	80.0	100.0	-	-	-	-	100.0	-	100.0	-	-	-	100.0	92.3
Buses	0	0	0	0	-	0	0	2	0	0	-	2	0	0	0	0	-	0	0	0	0	0	-	0	2
% Buses	-	-	0.0	-	-	0.0	0.0	11.1	-	-	-	10.0	0.0	-	-	-	-	0.0	-	0.0	-	-	-	0.0	2.2
Trucks	0	0	3	0	-	3	2	0	0	0	-	2	0	0	0	0	-	0	0	0	0	0	-	0	5
% Trucks	-	-	50.0	-	-	50.0	100.0	0.0	-	-	-	10.0	0.0	-	-	-	-	0.0	-	0.0	-	-	-	0.0	5.5
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pedestrians	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Grand Island, NY
Long Rd & Proposed Site Dr
Wednesday, November 13, 2019

Count Name: Long Rd/Proposed Site Drwy-Tech Camp Drwy
Site Code:
Start Date: 11/13/2019
Page No: 7



Turning Movement Peak Hour Data Plot (4:30 PM)

A2

Miscellaneous Traffic Data and Calculations

Grand Island Blvd/Baseline Rd - TMC

Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723155, Location: 43.024966, -78.96577

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Baseline Rd Southbound							Grand Island Blvd Westbound						
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*
2019-11-13 6:30AM	2	46	25	0	0	**73**	0	8	30	0	0	2	**40**	0
6:45AM	4	48	25	0	0	**77**	0	10	23	0	0	1	**34**	0
7:00AM	4	76	21	0	2	**103**	0	18	19	0	0	0	**37**	0
7:15AM	2	66	22	0	0	**90**	0	13	24	1	0	1	**39**	0
Total	12	236	93	0	2	**343**	0	49	96	1	0	4	**150**	0
% Approach	3.5%	68.8%	27.1%	0%	0.6%	**-**	-	32.7%	64.0%	0.7%	0%	2.7%	**-**	-
% Total	1.5%	30.4%	12.0%	0%	0.3%	**44.2%**	-	6.3%	12.4%	0.1%	0%	0.5%	**19.3%**	-
PHF	0.750	0.776	0.930	-	0.250	**0.833**	-	0.681	0.800	0.250	-	0.500	**0.938**	-
Lights	11	212	85	0	2	**310**	-	45	91	1	0	4	**141**	-
% Lights	91.7%	89.8%	91.4%	0%	100%	**90.4%**	-	91.8%	94.8%	100%	0%	100%	**94.0%**	-
Articulated Trucks and Single-Unit Trucks	0	2	0	0	0	**2**	-	1	3	0	0	0	**4**	-
% Articulated Trucks and Single-Unit Trucks	0%	0.8%	0%	0%	0%	**0.6%**	-	2.0%	3.1%	0%	0%	0%	**2.7%**	-
Buses	1	22	8	0	0	**31**	-	3	2	0	0	0	**5**	-
% Buses	8.3%	9.3%	8.6%	0%	0%	**9.0%**	-	6.1%	2.1%	0%	0%	0%	**3.3%**	-
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	0
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Baseline Rd - TMC

Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723155, Location: 43.024966, -78.96577

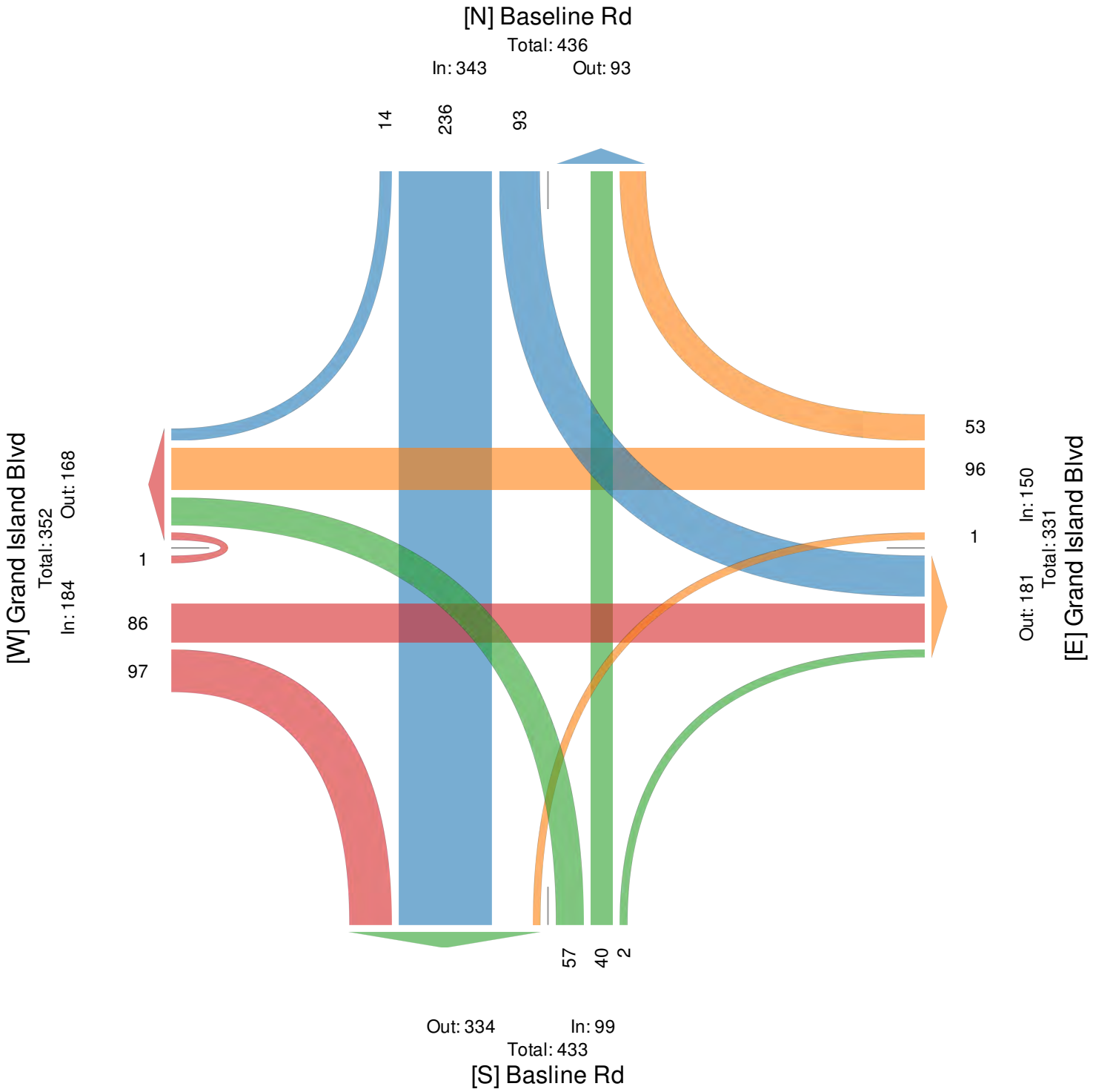
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Basline Rd Northbound							Grand Island Blvd Eastbound							
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*	**Int**
2019-11-13 6:30AM	0	4	10	0	0	**14**	0	16	25	0	0	1	**42**	0	**169**
6:45AM	0	14	20	0	0	**34**	0	16	22	0	0	6	**44**	0	**189**
7:00AM	0	13	10	0	1	**24**	0	24	19	0	1	6	**50**	0	**214**
7:15AM	0	9	17	0	1	**27**	0	21	20	0	0	7	**48**	0	**204**
Total	0	40	57	0	2	**99**	0	77	86	0	1	20	**184**	0	**776**
% Approach	0%	40.4%	57.6%	0%	2.0%	**-**	-	41.8%	46.7%	0%	0.5%	10.9%	**-**	-	**-**
% Total	0%	5.2%	7.3%	0%	0.3%	**12.8%**	-	9.9%	11.1%	0%	0.1%	2.6%	**23.7%**	-	**-**
PHF	-	0.714	0.713	-	0.500	**0.728**	-	0.802	0.860	-	0.250	0.714	**0.920**	-	0.907
Lights	0	36	54	0	2	**92**	-	76	79	0	1	19	**175**	-	718
% Lights	0%	90.0%	94.7%	0%	100%	**92.9%**	-	98.7%	91.9%	0%	100%	95.0%	**95.1%**	-	92.5%
Articulated Trucks and Single-Unit Trucks	0	3	3	0	0	**6**	-	0	3	0	0	1	**4**	-	16
% Articulated Trucks and Single-Unit Trucks	0%	7.5%	5.3%	0%	0%	**6.1%**	-	0%	3.5%	0%	0%	5.0%	**2.2%**	-	2.1%
Buses	0	1	0	0	0	**1**	-	1	4	0	0	0	**5**	-	42
% Buses	0%	2.5%	0%	0%	0%	**1.0%**	-	1.3%	4.7%	0%	0%	0%	**2.7%**	-	5.4%
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Baseline Rd - TMC
Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723155, Location: 43.024966, -78.96577

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Grand Island Blvd/Bedell Rd - TMC
Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723137, Location: 43.036221, -78.976504

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg	Grand Island Blvd							Bedell Rd						
Direction	Southbound							Westbound						
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*
2019-11-13 6:30AM	2	12	4	0	1	**19**	0	7	4	15	0	16	**42**	0
6:45AM	2	17	5	0	3	**27**	0	9	6	17	0	10	**42**	0
7:00AM	2	12	5	0	2	**21**	0	13	4	18	0	9	**44**	0
7:15AM	5	18	9	0	3	**35**	0	6	2	17	0	11	**36**	0
Total	11	59	23	0	9	**102**	0	35	16	67	0	46	**164**	0
% Approach	10.8%	57.8%	22.5%	0%	8.8%	**-**	-	21.3%	9.8%	40.9%	0%	28.0%	**-**	-
% Total	2.5%	13.7%	5.3%	0%	2.1%	**23.6%**	-	8.1%	3.7%	15.5%	0%	10.6%	**38.0%**	-
PHF	0.550	0.819	0.639	-	0.750	**0.729**	-	0.673	0.667	0.931	-	0.719	**0.932**	-
Lights	11	54	22	0	9	**96**	-	34	15	66	0	46	**161**	-
% Lights	100%	91.5%	95.7%	0%	100%	**94.1%**	-	97.1%	93.8%	98.5%	0%	100%	**98.2%**	-
Articulated Trucks and Single-Unit Trucks	0	1	0	0	0	**1**	-	1	0	0	0	0	**1**	-
% Articulated Trucks and Single-Unit Trucks	0%	1.7%	0%	0%	0%	**1.0%**	-	2.9%	0%	0%	0%	0%	**0.6%**	-
Buses	0	4	1	0	0	**5**	-	0	1	1	0	0	**2**	-
% Buses	0%	6.8%	4.3%	0%	0%	**4.9%**	-	0%	6.3%	1.5%	0%	0%	**1.2%**	-
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	0
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Bedell Rd - TMC
Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723137, Location: 43.036221, -78.976504

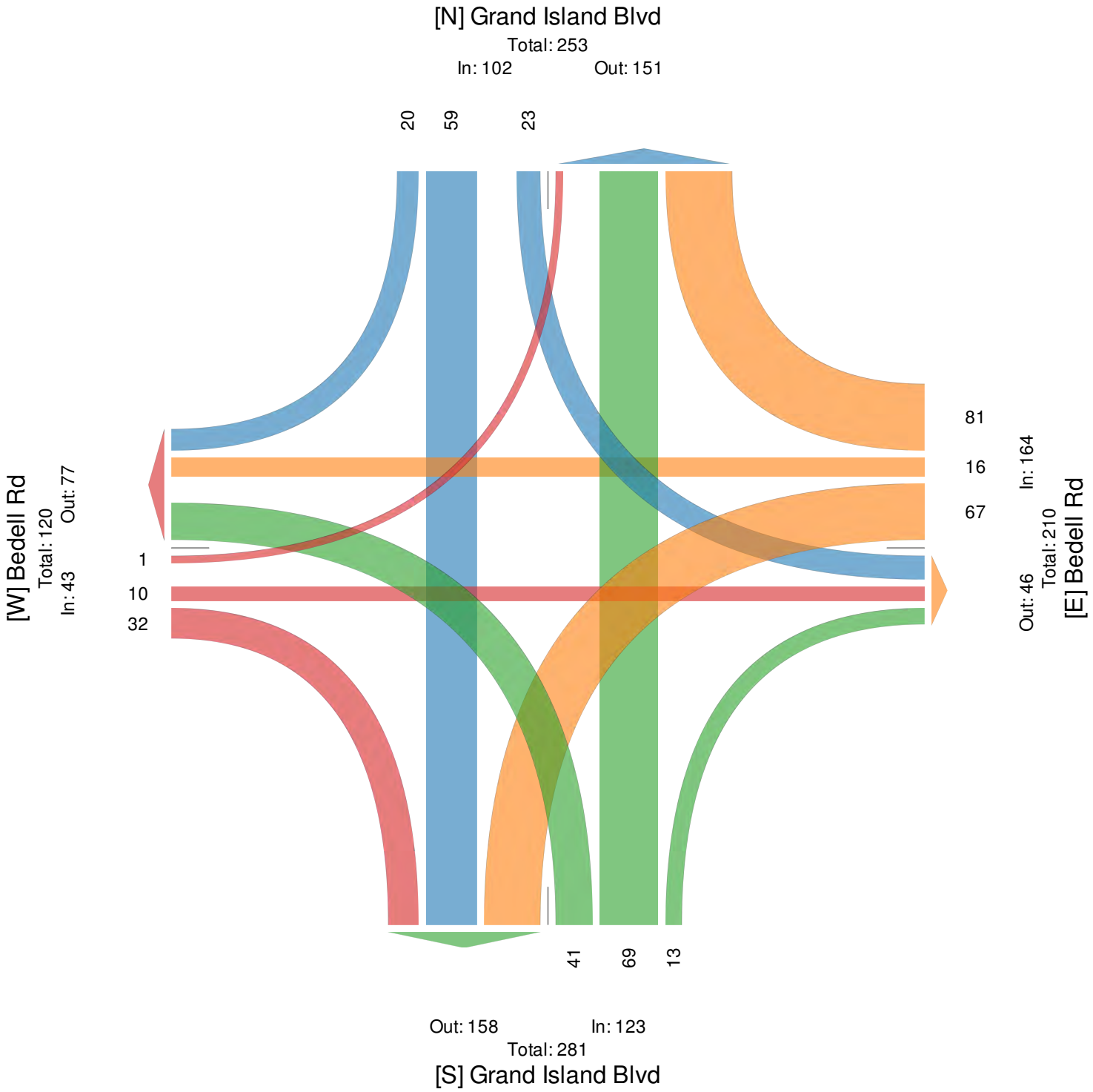
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Grand Island Blvd Northbound							Bedell Rd Eastbound							
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*	**Int**
2019-11-13 6:30AM	1	19	13	0	3	**36**	0	2	1	0	0	0	**3**	0	**100**
6:45AM	0	19	10	0	1	**30**	0	4	4	0	0	4	**12**	0	**111**
7:00AM	3	16	12	0	1	**32**	0	4	4	0	0	9	**17**	0	**114**
7:15AM	4	15	6	0	0	**25**	0	3	1	1	0	6	**11**	0	**107**
Total	8	69	41	0	5	**123**	0	13	10	1	0	19	**43**	0	**432**
% Approach	6.5%	56.1%	33.3%	0%	4.1%	**-**	-	30.2%	23.3%	2.3%	0%	44.2%	**-**	-	**-**
% Total	1.9%	16.0%	9.5%	0%	1.2%	**28.5%**	-	3.0%	2.3%	0.2%	0%	4.4%	**10.0%**	-	**-**
PHF	0.500	0.908	0.788	-	0.417	**0.854**	-	0.813	0.625	0.250	-	0.528	**0.632**	-	0.947
Lights	7	66	40	0	5	**118**	-	12	8	0	0	18	**38**	-	413
% Lights	87.5%	95.7%	97.6%	0%	100%	**95.9%**	-	92.3%	80.0%	0%	0%	94.7%	**88.4%**	-	95.6%
Articulated Trucks and Single-Unit Trucks	0	1	1	0	0	**2**	-	1	0	1	0	1	**3**	-	7
% Articulated Trucks and Single-Unit Trucks	0%	1.4%	2.4%	0%	0%	**1.6%**	-	7.7%	0%	100%	0%	5.3%	**7.0%**	-	1.6%
Buses	1	2	0	0	0	**3**	-	0	2	0	0	0	**2**	-	12
% Buses	12.5%	2.9%	0%	0%	0%	**2.4%**	-	0%	20.0%	0%	0%	0%	**4.7%**	-	2.8%
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Bedell Rd - TMC
Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723137, Location: 43.036221, -78.976504

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Grand Island Blvd/I-190 NB Off Ramp - TMC

Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723087, Location: 43.047626, -78.987318

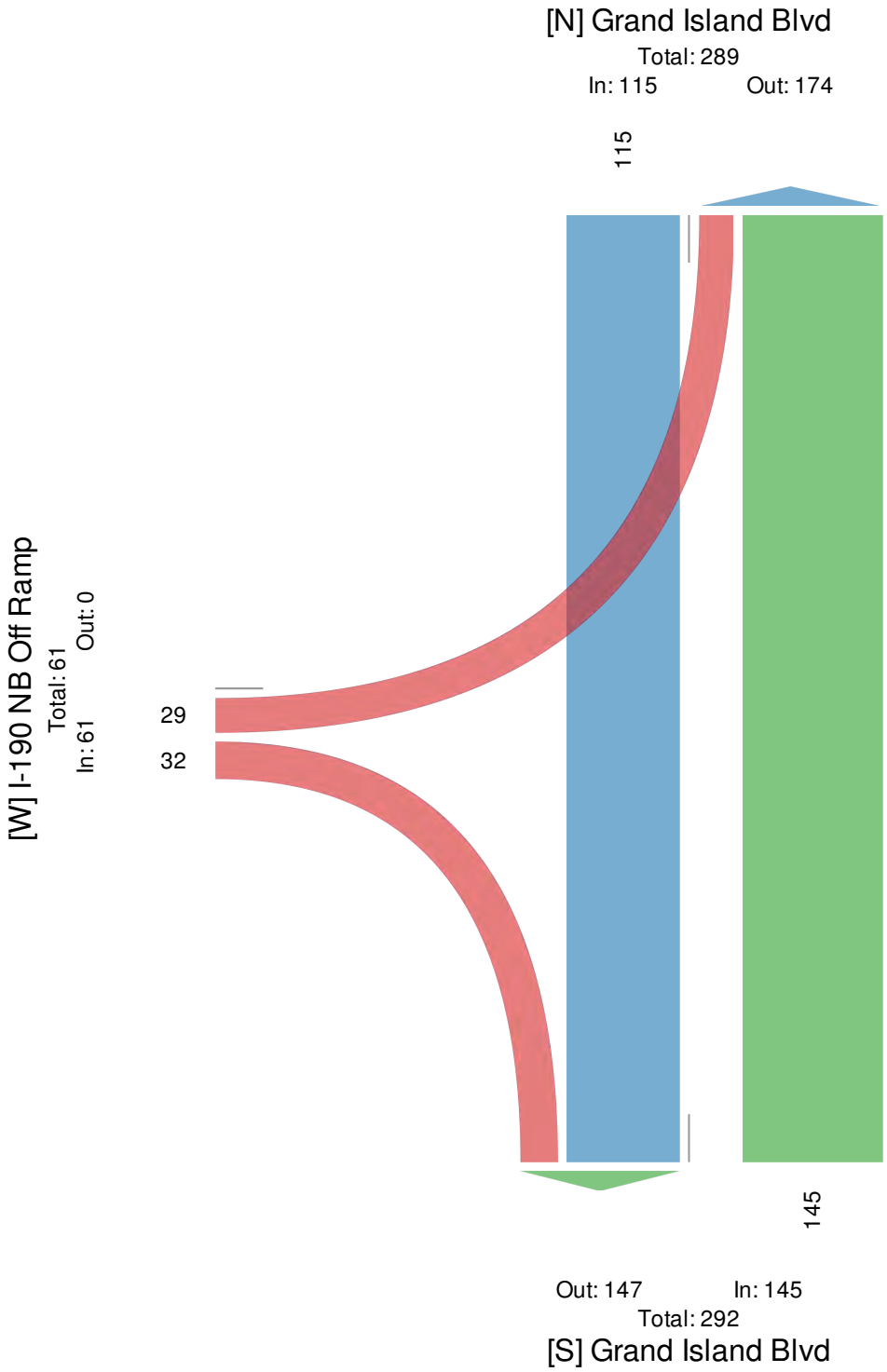
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Grand Island Blvd Southbound				Grand Island Blvd Northbound				I-190 NB Off Ramp Eastbound				
Time	T	U	**App**	Ped*	T	U	**App**	Ped*	R	L	**App**	Ped*	**Int**
2019-11-13 6:30AM	19	0	**19**	0	40	0	**40**	0	6	3	**9**	0	**68**
6:45AM	37	0	**37**	0	33	0	**33**	0	16	7	**23**	0	**93**
7:00AM	19	0	**19**	0	39	0	**39**	0	6	12	**18**	0	**76**
7:15AM	40	0	**40**	0	33	0	**33**	0	4	7	**11**	0	**84**
Total	115	0	**115**	0	145	0	**145**	0	32	29	**61**	0	**321**
% Approach	100%	0%	**-**	-	100%	0%	**-**	-	52.5%	47.5%	**-**	-	**-**
% Total	35.8%	0%	**35.8%**	-	45.2%	0%	**45.2%**	-	10.0%	9.0%	**19.0%**	-	**-**
PHF	0.719	-	**0.719**	-	0.906	-	**0.906**	-	0.500	0.604	**0.663**	-	0.863
Lights	110	0	**110**	-	140	0	**140**	-	32	28	**60**	-	310
% Lights	95.7%	0%	**95.7%**	-	96.6%	0%	**96.6%**	-	100%	96.6%	**98.4%**	-	96.6%
Articulated Trucks and Single-Unit Trucks	1	0	**1**	-	2	0	**2**	-	0	0	**0**	-	3
% Articulated Trucks and Single-Unit Trucks	0.9%	0%	**0.9%**	-	1.4%	0%	**1.4%**	-	0%	0%	**0%**	-	0.9%
Buses	4	0	**4**	-	3	0	**3**	-	0	1	**1**	-	8
% Buses	3.5%	0%	**3.5%**	-	2.1%	0%	**2.1%**	-	0%	3.4%	**1.6%**	-	2.5%
Pedestrians	-	-	-	0	-	-	-	0	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	0	-	-	-	0	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Grand Island Blvd/I-190 NB Off Ramp - TMC
Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723087, Location: 43.047626, -78.987318

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Grand Island Blvd/Staley Rd - TMC
Wed Nov 13, 2019
AM Peak, Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723194, Location: 43.007309, -78.948926

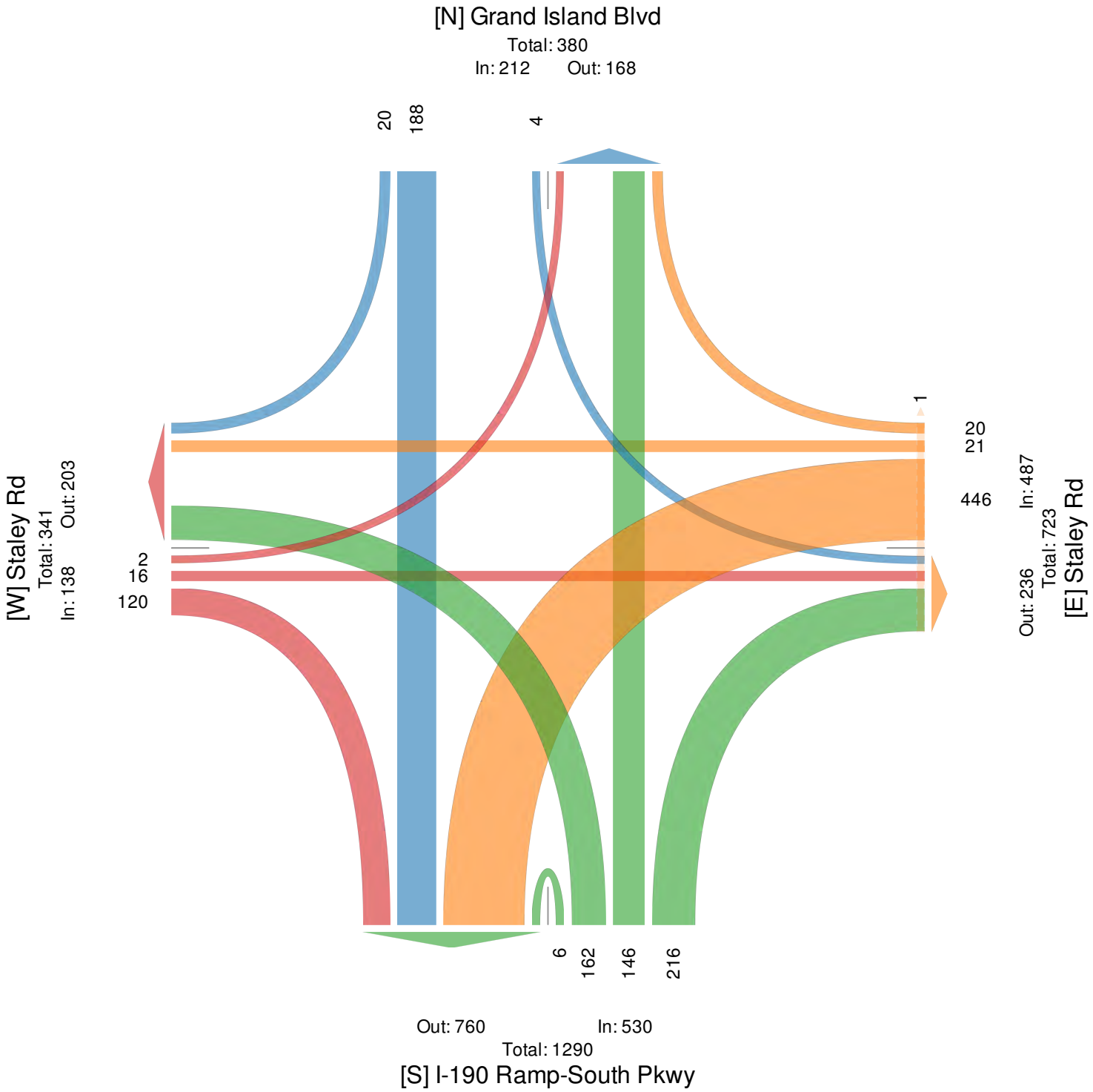
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road, Coatesville, PA, 19320, US

Leg	Grand Island Blvd						Staley Rd						I-190 Ramp-South Pkwy						Staley Rd						
Direction	Southbound						Westbound						Northbound						Eastbound						
Time	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	Int
2019-11-13 6:30AM	6	50	1	0	**57**	0	3	4	116	0	**123**	0	24	39	46	0	**109**	0	38	2	0	0	**40**	0	**329**
6:45AM	4	40	2	0	**46**	0	5	11	150	0	**166**	1	41	34	53	1	**129**	0	26	5	0	0	**31**	0	**372**
7:00AM	3	55	0	0	**58**	0	12	6	122	0	**140**	0	74	47	35	0	**156**	0	31	6	1	0	**38**	0	**392**
7:15AM	7	43	1	0	**51**	0	0	0	58	0	**58**	0	77	26	28	5	**136**	0	25	3	1	0	**29**	0	**274**
Total	20	188	4	0	**212**	0	20	21	446	0	**487**	1	216	146	162	6	**530**	0	120	16	2	0	**138**	0	**1367**
% Approach	9.4%	88.7%	1.9%	0%	**-**	-	4.1%	4.3%	91.6%	0%	**-**	-	40.8%	27.5%	30.6%	1.1%	**-**	-	87.0%	11.6%	1.4%	0%	**-**	-	**-**
% Total	1.5%	13.8%	0.3%	0%	**15.5%**	-	1.5%	1.5%	32.6%	0%	**35.6%**	-	15.8%	10.7%	11.9%	0.4%	**38.8%**	-	8.8%	1.2%	0.1%	0%	**10.1%**	-	**-**
PHF	0.714	0.855	0.500	-	**0.914**	-	0.417	0.477	0.743	-	**0.733**	-	0.701	0.777	0.764	0.300	**0.849**	-	0.789	0.667	0.500	-	**0.863**	-	0.872
Lights	20	175	4	0	**199**	-	18	20	442	0	**480**	-	213	141	156	5	**515**	-	119	15	2	0	**136**	-	1330
% Lights	100%	93.1%	100%	0%	**93.9%**	-	90.0%	95.2%	99.1%	0%	**98.6%**	-	98.6%	96.6%	96.3%	83.3%	**97.2%**	-	99.2%	93.8%	100%	0%	**98.6%**	-	97.3%
Articulated Trucks and Single-Unit Trucks	0	9	0	0	**9**	-	0	0	1	0	**1**	-	1	2	5	1	**9**	-	1	0	0	0	**1**	-	20
% Articulated Trucks and Single-Unit Trucks	0%	4.8%	0%	0%	**4.2%**	-	0%	0%	0.2%	0%	**0.2%**	-	0.5%	1.4%	3.1%	16.7%	**1.7%**	-	0.8%	0%	0%	0%	**0.7%**	-	1.5%
Buses	0	4	0	0	**4**	-	2	1	3	0	**6**	-	2	3	1	0	**6**	-	0	1	0	0	**1**	-	17
% Buses	0%	2.1%	0%	0%	**1.9%**	-	10.0%	4.8%	0.7%	0%	**1.2%**	-	0.9%	2.1%	0.6%	0%	**1.1%**	-	0%	6.3%	0%	0%	**0.7%**	-	1.2%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	100%	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	0%	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Grand Island Blvd/Staley Rd - TMC
Wed Nov 13, 2019
AM Peak, Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723194, Location: 43.007309, -78.948926

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Grand Island Blvd/Whitehaven Rd - TMC

Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723160, Location: 43.021796, -78.962788

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Grand Island Blvd Southbound							Whitehaven Rd Westbound						
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*
2019-11-13 6:30AM	1	46	6	0	0	**53**	0	7	15	6	0	3	**31**	0
6:45AM	0	41	5	0	0	**46**	0	3	23	10	0	1	**37**	1
7:00AM	4	39	4	0	0	**47**	0	8	77	16	0	4	**105**	0
7:15AM	1	29	12	0	0	**42**	0	10	82	15	0	5	**112**	0
Total	6	155	27	0	0	**188**	0	28	197	47	0	13	**285**	1
% Approach	3.2%	82.4%	14.4%	0%	0%	**-**	-	9.8%	69.1%	16.5%	0%	4.6%	**-**	-
% Total	0.8%	19.6%	3.4%	0%	0%	**23.8%**	-	3.5%	24.9%	5.9%	0%	1.6%	**36.1%**	-
PHF	0.375	0.842	0.563	-	-	**0.887**	-	0.700	0.601	0.734	-	0.650	**0.636**	-
Lights	6	147	23	0	0	**176**	-	25	192	46	0	12	**275**	-
% Lights	100%	94.8%	85.2%	0%	0%	**93.6%**	-	89.3%	97.5%	97.9%	0%	92.3%	**96.5%**	-
Articulated Trucks and Single-Unit Trucks	0	1	0	0	0	**1**	-	1	2	0	0	1	**4**	-
% Articulated Trucks and Single-Unit Trucks	0%	0.6%	0%	0%	0%	**0.5%**	-	3.6%	1.0%	0%	0%	7.7%	**1.4%**	-
Buses	0	7	4	0	0	**11**	-	2	3	1	0	0	**6**	-
% Buses	0%	4.5%	14.8%	0%	0%	**5.9%**	-	7.1%	1.5%	2.1%	0%	0%	**2.1%**	-
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	1
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100%
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	0%

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Whitehaven Rd - TMC

Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723160, Location: 43.021796, -78.962788

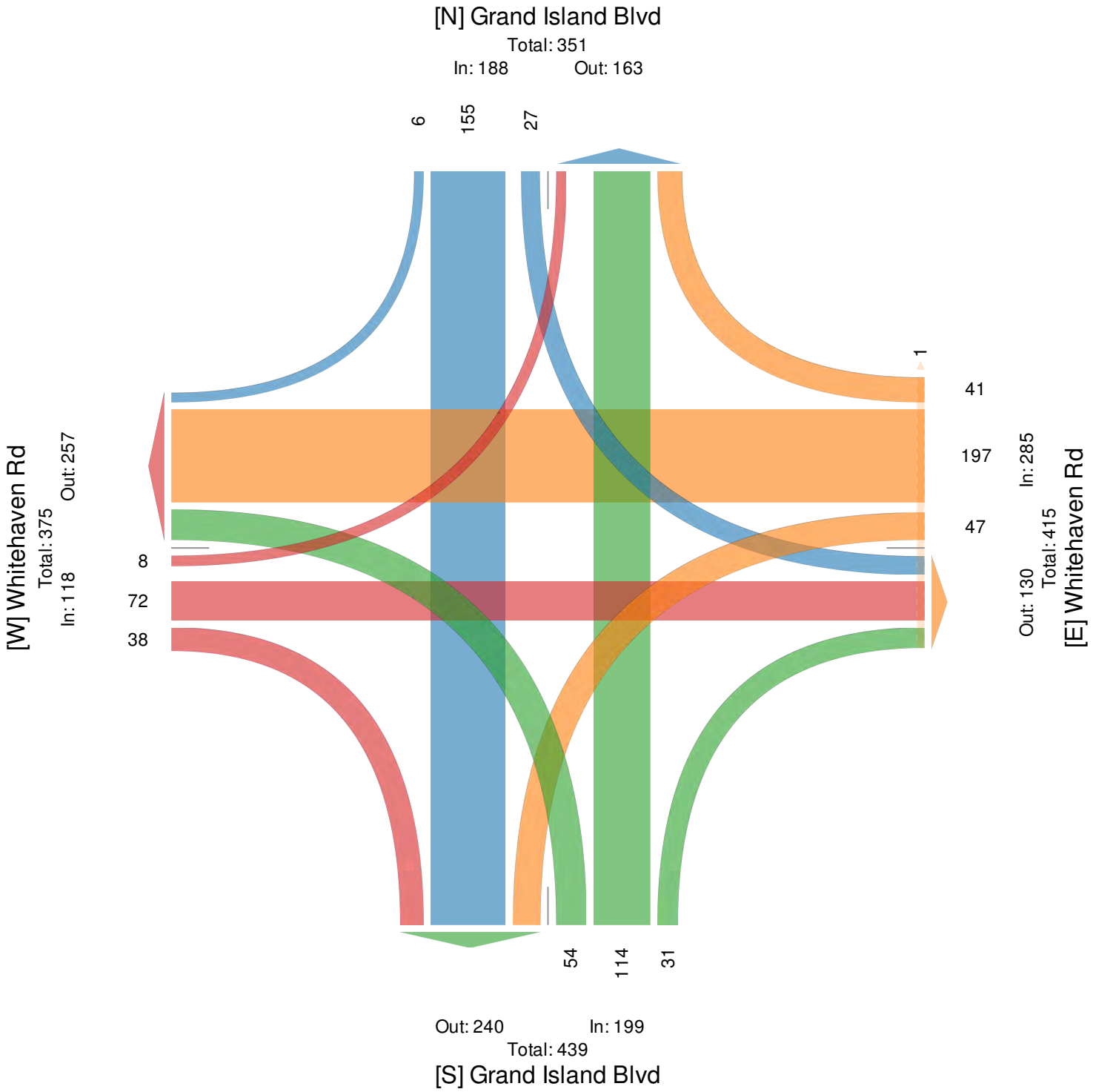
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Grand Island Blvd Northbound							Whitehaven Rd Eastbound							
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*	**Int**
2019-11-13 6:30AM	1	32	6	0	1	**40**	0	3	8	1	0	2	**14**	0	**138**
6:45AM	2	29	8	0	1	**40**	0	6	11	3	0	8	**28**	0	**151**
7:00AM	13	25	15	0	2	**55**	0	6	33	2	0	2	**43**	0	**250**
7:15AM	8	28	25	0	3	**64**	0	6	20	2	0	5	**33**	0	**251**
Total	24	114	54	0	7	**199**	0	21	72	8	0	17	**118**	0	**790**
% Approach	12.1%	57.3%	27.1%	0%	3.5%	**-**	-	17.8%	61.0%	6.8%	0%	14.4%	**-**	-	**-**
% Total	3.0%	14.4%	6.8%	0%	0.9%	**25.2%**	-	2.7%	9.1%	1.0%	0%	2.2%	**14.9%**	-	**-**
PHF	0.462	0.891	0.540	-	0.583	**0.777**	-	0.875	0.545	0.667	-	0.531	**0.686**	-	0.787
Lights	23	110	53	0	7	**193**	-	20	64	8	0	17	**109**	-	753
% Lights	95.8%	96.5%	98.1%	0%	100%	**97.0%**	-	95.2%	88.9%	100%	0%	100%	**92.4%**	-	95.3%
Articulated Trucks and Single-Unit Trucks	0	0	1	0	0	**1**	-	1	1	0	0	0	**2**	-	8
% Articulated Trucks and Single-Unit Trucks	0%	0%	1.9%	0%	0%	**0.5%**	-	4.8%	1.4%	0%	0%	0%	**1.7%**	-	1.0%
Buses	1	4	0	0	0	**5**	-	0	7	0	0	0	**7**	-	29
% Buses	4.2%	3.5%	0%	0%	0%	**2.5%**	-	0%	9.7%	0%	0%	0%	**5.9%**	-	3.7%
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Whitehaven Rd - TMC
Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723160, Location: 43.021796, -78.962788

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Long Rd/Grand Island Blvd - TMC
Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723093, Location: 43.048687, -78.988125

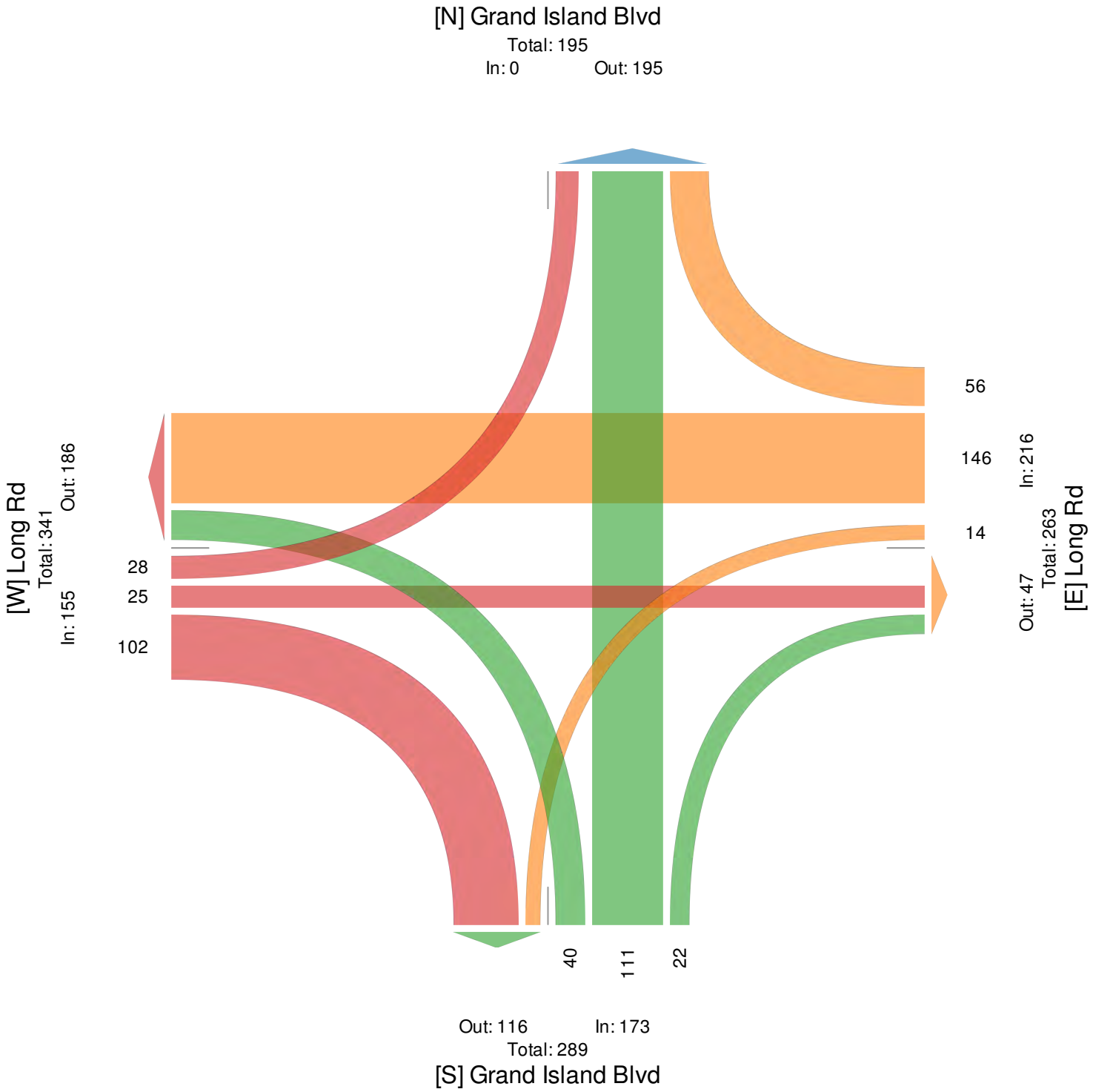
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg	Grand Island Blvd						Long Rd						Grand Island Blvd						Long Rd						
Direction	Southbound						Westbound						Northbound						Eastbound						
Time	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	Int
2019-11-13 6:30AM	0	0	0	0	**0**	0	11	24	4	0	**39**	0	3	33	6	0	**42**	0	17	3	11	0	**31**	0	**112**
6:45AM	0	0	0	0	**0**	0	10	27	2	0	**39**	0	5	26	9	0	**40**	0	36	7	4	0	**47**	0	**126**
7:00AM	0	0	0	0	**0**	0	17	59	6	0	**82**	0	8	27	17	0	**52**	0	12	7	5	0	**24**	0	**158**
7:15AM	0	0	0	0	**0**	0	18	36	2	0	**56**	0	6	25	8	0	**39**	0	37	8	8	0	**53**	0	**148**
Total	0	0	0	0	**0**	0	56	146	14	0	**216**	0	22	111	40	0	**173**	0	102	25	28	0	**155**	0	**544**
% Approach	0%	0%	0%	0%	**-**	-	25.9%	67.6%	6.5%	0%	**-**	-	12.7%	64.2%	23.1%	0%	**-**	-	65.8%	16.1%	18.1%	0%	**-**	-	-
% Total	0%	0%	0%	0%	**0%**	-	10.3%	26.8%	2.6%	0%	**39.7%**	-	4.0%	20.4%	7.4%	0%	**31.8%**	-	18.8%	4.6%	5.1%	0%	**28.5%**	-	-
PHF	-	-	-	-	**-**	-	0.778	0.619	0.583	-	**0.659**	-	0.688	0.841	0.588	-	**0.832**	-	0.689	0.781	0.636	-	**0.731**	-	0.861
Lights	0	0	0	0	**0**	-	56	143	14	0	**213**	-	20	108	40	0	**168**	-	97	23	28	0	**148**	-	529
% Lights	0%	0%	0%	0%	**-**	-	100%	97.9%	100%	0%	**98.6%**	-	90.9%	97.3%	100%	0%	**97.1%**	-	95.1%	92.0%	100%	0%	**95.5%**	-	97.2%
Articulated Trucks and Single-Unit Trucks	0	0	0	0	**0**	-	0	1	0	0	**1**	-	0	1	0	0	**1**	-	1	0	0	0	**1**	-	3
% Articulated Trucks and Single-Unit Trucks	0%	0%	0%	0%	**-**	-	0%	0.7%	0%	0%	**0.5%**	-	0%	0.9%	0%	0%	**0.6%**	-	1.0%	0%	0%	0%	**0.6%**	-	0.6%
Buses	0	0	0	0	**0**	-	0	2	0	0	**2**	-	2	2	0	0	**4**	-	4	2	0	0	**6**	-	12
% Buses	0%	0%	0%	0%	**-**	-	0%	1.4%	0%	0%	**0.9%**	-	9.1%	1.8%	0%	0%	**2.3%**	-	3.9%	8.0%	0%	0%	**3.9%**	-	2.2%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Long Rd/Grand Island Blvd - TMC
Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723093, Location: 43.048687, -78.988125

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Long Rd/I-190 on-off Ramps - TMC
Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723098, Location: 43.048573, -78.992932

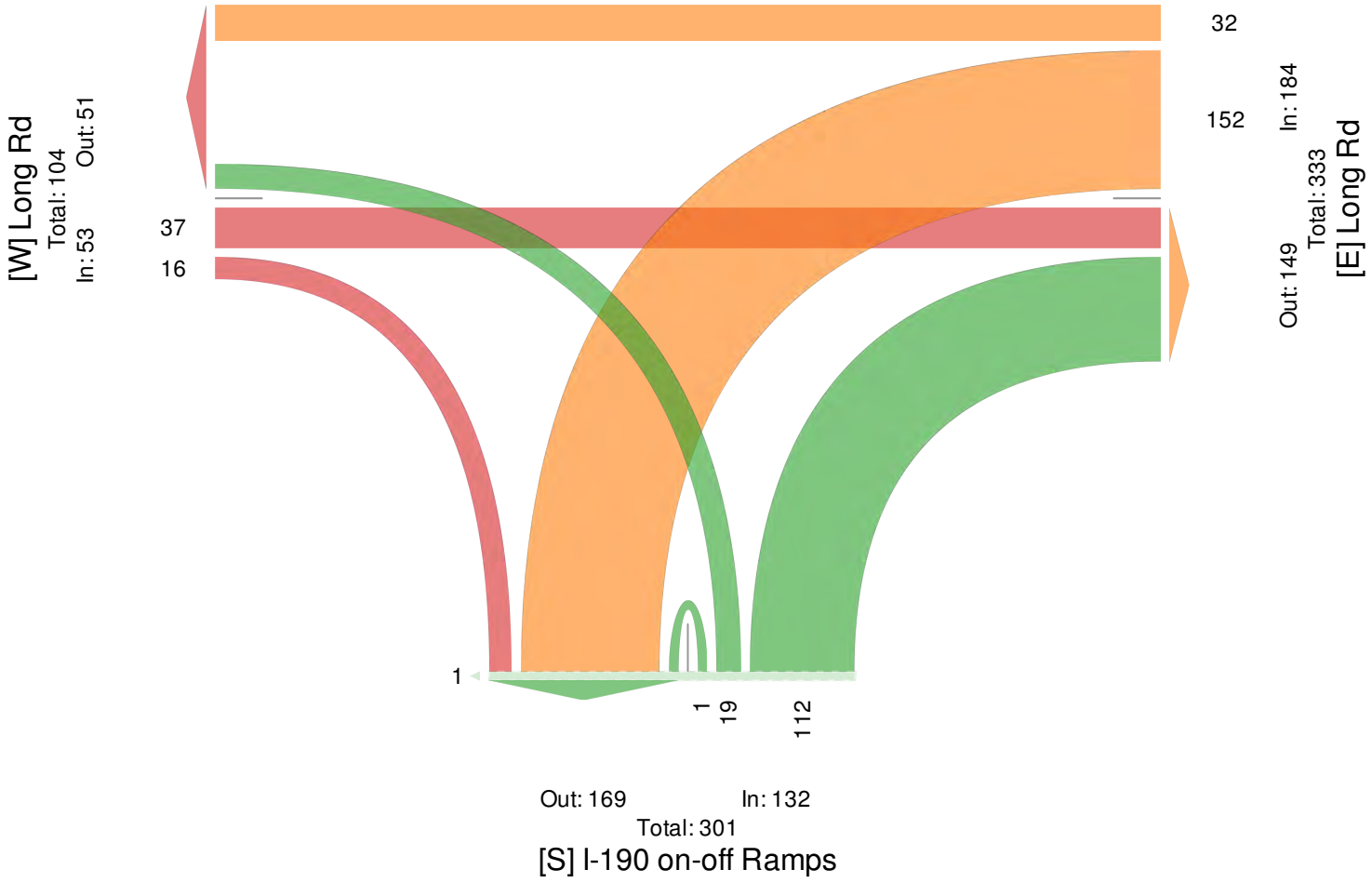
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Long Rd Westbound					I-190 on-off Ramps Northbound					Long Rd Eastbound					
Time	T	L	U	**App**	Ped*	R	L	U	**App**	Ped*	R	T	U	**App**	Ped*	**Int**
2019-11-13 6:30AM	4	21	0	**25**	0	18	7	0	**25**	0	3	9	0	**12**	0	**62**
6:45AM	8	31	0	**39**	0	35	6	0	**41**	1	5	10	0	**15**	0	**95**
7:00AM	15	58	0	**73**	0	17	5	0	**22**	0	3	8	0	**11**	0	**106**
7:15AM	5	42	0	**47**	0	42	1	1	**44**	0	5	10	0	**15**	0	**106**
Total	32	152	0	**184**	0	112	19	1	**132**	1	16	37	0	**53**	0	**369**
% Approach	17.4%	82.6%	0%	**-**	-	84.8%	14.4%	0.8%	**-**	-	30.2%	69.8%	0%	**-**	-	-
% Total	8.7%	41.2%	0%	**49.9%**	-	30.4%	5.1%	0.3%	**35.8%**	-	4.3%	10.0%	0%	**14.4%**	-	-
PHF	0.533	0.655	-	**0.630**	-	0.667	0.679	0.250	**0.750**	-	0.800	0.925	-	**0.883**	-	0.870
Lights	32	148	0	**180**	-	109	19	1	**129**	-	16	35	0	**51**	-	360
% Lights	100%	97.4%	0%	**97.8%**	-	97.3%	100%	100%	**97.7%**	-	100%	94.6%	0%	**96.2%**	-	97.6%
Articulated Trucks and Single-Unit Trucks	0	2	0	**2**	-	0	0	0	**0**	-	0	0	0	**0**	-	2
% Articulated Trucks and Single-Unit Trucks	0%	1.3%	0%	**1.1%**	-	0%	0%	0%	**0%**	-	0%	0%	0%	**0%**	-	0.5%
Buses	0	2	0	**2**	-	3	0	0	**3**	-	0	2	0	**2**	-	7
% Buses	0%	1.3%	0%	**1.1%**	-	2.7%	0%	0%	**2.3%**	-	0%	5.4%	0%	**3.8%**	-	1.9%
Pedestrians	-	-	-	-	0	-	-	-	-	1	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	100%	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	0%	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Long Rd/I-190 on-off Ramps - TMC
Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723098, Location: 43.048573, -78.992932

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Long Rd/Proposed Site Drwy-Tech Camp Drwy - TMC

Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723119, Location: 43.048512, -78.995838

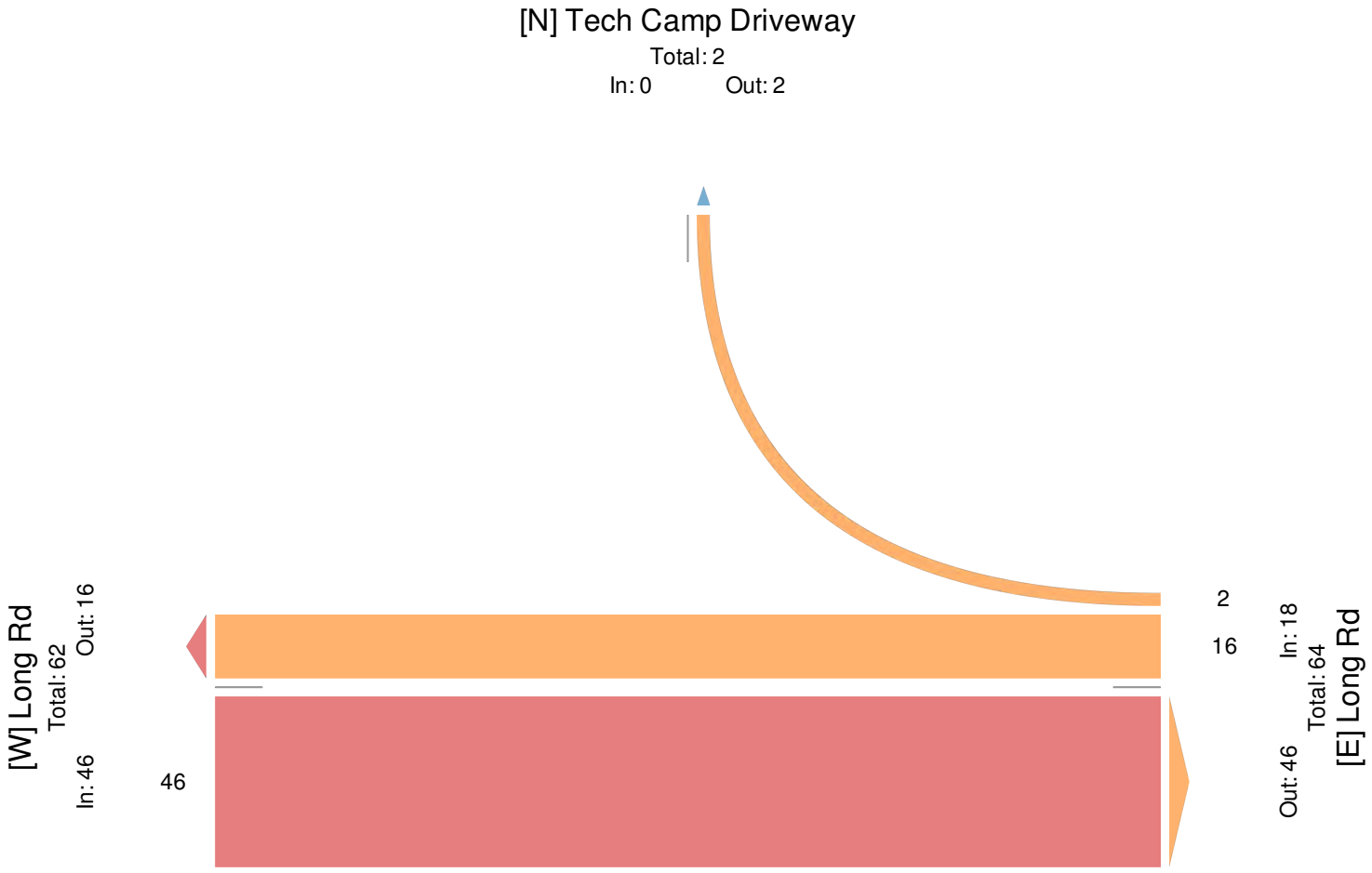
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Tech Camp Driveway Southbound						Long Rd Westbound						Proposed Site Driveway Northbound						Long Rd Eastbound						
Time	R	T	L	U	**App**	Ped*	R	T	L	U	**App**	Ped*	R	T	L	U	**App**	Ped*	R	T	L	U	**App**	Ped*	**Int**
2019-11-13 6:30AM	0	0	0	0	**0**	0	0	3	0	0	**3**	0	0	0	0	0	**0**	0	0	13	0	0	**13**	0	**16**
6:45AM	0	0	0	0	**0**	0	0	3	0	0	**3**	0	0	0	0	0	**0**	0	0	9	0	0	**9**	0	**12**
7:00AM	0	0	0	0	**0**	0	1	8	0	0	**9**	0	0	0	0	0	**0**	0	0	10	0	0	**10**	0	**19**
7:15AM	0	0	0	0	**0**	0	1	2	0	0	**3**	0	0	0	0	0	**0**	0	0	14	0	0	**14**	0	**17**
Total	0	0	0	0	**0**	0	2	16	0	0	**18**	0	0	0	0	0	**0**	0	0	46	0	0	**46**	0	**64**
% Approach	0%	0%	0%	0%	**-**	-	11.1%	88.9%	0%	0%	**-**	-	0%	0%	0%	0%	**-**	-	0%	100%	0%	0%	**-**	-	-
% Total	0%	0%	0%	0%	**0%**	-	3.1%	25.0%	0%	0%	**28.1%**	-	0%	0%	0%	0%	**0%**	-	0%	71.9%	0%	0%	**71.9%**	-	-
PHF	-	-	-	-	**-**	-	0.500	0.500	-	-	**0.500**	-	-	-	-	-	**-**	-	-	0.821	-	-	**0.821**	-	0.842
Lights	0	0	0	0	**0**	-	2	16	0	0	**18**	-	0	0	0	0	**0**	-	0	44	0	0	**44**	-	62
% Lights	0%	0%	0%	0%	**-**	-	100%	100%	0%	0%	**100%**	-	0%	0%	0%	0%	**-**	-	0%	95.7%	0%	0%	**95.7%**	-	96.9%
Articulated Trucks and Single-Unit Trucks	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0
% Articulated Trucks and Single-Unit Trucks	0%	0%	0%	0%	**-**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**-**	-	0%	0%	0%	0%	**0%**	-	0%
Buses	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	2	0	0	**2**	-	2
% Buses	0%	0%	0%	0%	**-**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**-**	-	0%	4.3%	0%	0%	**4.3%**	-	3.1%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Long Rd/Proposed Site Drwy-Tech Camp Drwy - TMC
Wed Nov 13, 2019
Forced Peak (6:30 AM - 7:30 AM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723119, Location: 43.048512, -78.995838

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Grand Island Blvd/Baseline Rd - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723155, Location: 43.024966, -78.96577

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Baseline Rd Southbound							Grand Island Blvd Westbound						
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*
2019-11-13 5:30PM	0	28	26	0	2	**56**	0	50	44	6	0	5	**105**	0
5:45PM	4	35	28	0	1	**68**	0	46	49	4	0	4	**103**	0
6:00PM	1	33	27	0	6	**67**	0	42	55	4	0	1	**102**	0
6:15PM	4	37	30	0	5	**76**	0	50	63	7	0	1	**121**	0
Total	9	133	111	0	14	**267**	0	188	211	21	0	11	**431**	0
% Approach	3.4%	49.8%	41.6%	0%	5.2%	**-**	-	43.6%	49.0%	4.9%	0%	2.6%	**-**	-
% Total	0.8%	11.9%	10.0%	0%	1.3%	**23.9%**	-	16.9%	18.9%	1.9%	0%	1.0%	**38.7%**	-
PHF	0.563	0.899	0.925	-	0.583	**0.878**	-	0.940	0.837	0.750	-	0.550	**0.890**	-
Lights	7	133	111	0	14	**265**	-	187	207	21	0	11	**426**	-
% Lights	77.8%	100%	100%	0%	100%	**99.3%**	-	99.5%	98.1%	100%	0%	100%	**98.8%**	-
Articulated Trucks and Single-Unit Trucks	2	0	0	0	0	**2**	-	1	0	0	0	0	**1**	-
% Articulated Trucks and Single-Unit Trucks	22.2%	0%	0%	0%	0%	**0.7%**	-	0.5%	0%	0%	0%	0%	**0.2%**	-
Buses	0	0	0	0	0	**0**	-	0	4	0	0	0	**4**	-
% Buses	0%	0%	0%	0%	0%	**0%**	-	0%	1.9%	0%	0%	0%	**0.9%**	-
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	0
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Baseline Rd - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723155, Location: 43.024966, -78.96577

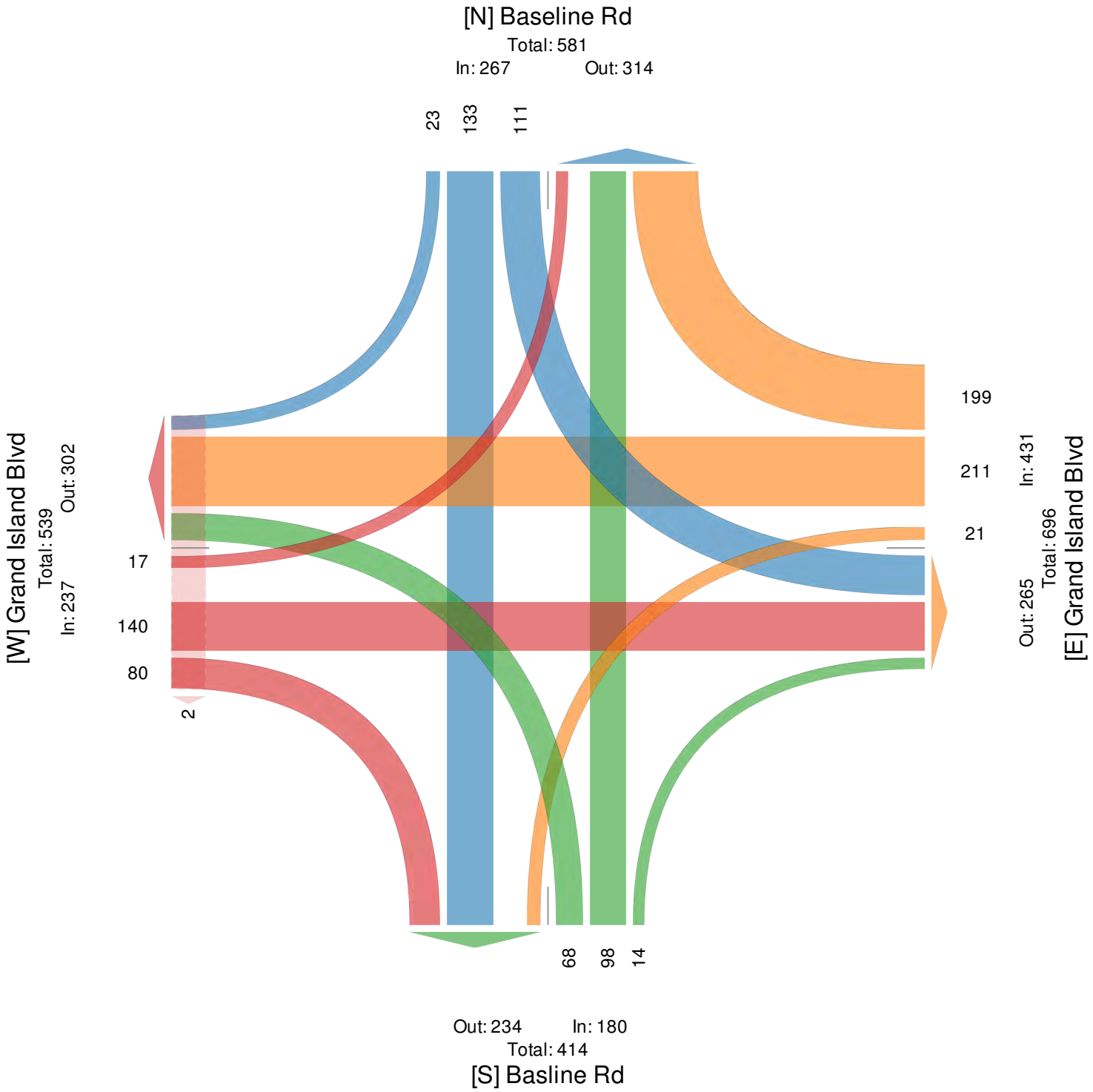
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Basline Rd Northbound							Grand Island Blvd Eastbound							
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*	**Int**
2019-11-13 5:30PM	2	20	13	0	2	**37**	0	24	39	5	0	0	**68**	0	**266**
5:45PM	0	31	13	0	4	**48**	0	19	34	1	0	1	**55**	2	**274**
6:00PM	1	21	23	0	2	**47**	0	12	35	6	0	7	**60**	0	**276**
6:15PM	2	26	19	0	1	**48**	0	14	32	5	0	3	**54**	0	**299**
Total	5	98	68	0	9	**180**	0	69	140	17	0	11	**237**	2	**1115**
% Approach	2.8%	54.4%	37.8%	0%	5.0%	**-**	-	29.1%	59.1%	7.2%	0%	4.6%	**-**	-	**-**
% Total	0.4%	8.8%	6.1%	0%	0.8%	**16.1%**	-	6.2%	12.6%	1.5%	0%	1.0%	**21.3%**	-	**-**
PHF	0.625	0.790	0.739	-	0.563	**0.938**	-	0.719	0.897	0.708	-	0.393	**0.871**	-	0.932
Lights	5	98	68	0	9	**180**	-	68	138	17	0	11	**234**	-	1105
% Lights	100%	100%	100%	0%	100%	**100%**	-	98.6%	98.6%	100%	0%	100%	**98.7%**	-	99.1%
Articulated Trucks and Single-Unit Trucks	0	0	0	0	0	**0**	-	0	1	0	0	0	**1**	-	4
% Articulated Trucks and Single-Unit Trucks	0%	0%	0%	0%	0%	**0%**	-	0%	0.7%	0%	0%	0%	**0.4%**	-	0.4%
Buses	0	0	0	0	0	**0**	-	1	1	0	0	0	**2**	-	6
% Buses	0%	0%	0%	0%	0%	**0%**	-	1.4%	0.7%	0%	0%	0%	**0.8%**	-	0.5%
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	2	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100%	-
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	0%	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Baseline Rd - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723155, Location: 43.024966, -78.96577

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Grand Island Blvd/Bedell Rd - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723137, Location: 43.036221, -78.976504

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg	Grand Island Blvd							Bedell Rd						
Direction	Southbound							Westbound						
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*
2019-11-13 5:30PM	1	26	14	0	0	**41**	0	13	0	7	0	6	**26**	0
5:45PM	1	21	27	0	1	**50**	0	8	1	14	0	2	**25**	0
6:00PM	0	24	17	0	0	**41**	0	9	3	12	0	12	**36**	0
6:15PM	1	21	22	0	0	**44**	0	10	4	10	0	11	**35**	0
Total	3	92	80	0	1	**176**	0	40	8	43	0	31	**122**	0
% Approach	1.7%	52.3%	45.5%	0%	0.6%	**-**	-	32.8%	6.6%	35.2%	0%	25.4%	**-**	-
% Total	0.5%	15.5%	13.5%	0%	0.2%	**29.6%**	-	6.7%	1.3%	7.2%	0%	5.2%	**20.5%**	-
PHF	0.750	0.885	0.741	-	0.250	**0.880**	-	0.769	0.500	0.768	-	0.646	**0.847**	-
Lights	3	90	80	0	1	**174**	-	40	8	43	0	31	**122**	-
% Lights	100%	97.8%	100%	0%	100%	**98.9%**	-	100%	100%	100%	0%	100%	**100%**	-
Articulated Trucks and Single-Unit Trucks	0	0	0	0	0	**0**	-	0	0	0	0	0	**0**	-
% Articulated Trucks and Single-Unit Trucks	0%	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	0%	**0%**	-
Buses	0	2	0	0	0	**2**	-	0	0	0	0	0	**0**	-
% Buses	0%	2.2%	0%	0%	0%	**1.1%**	-	0%	0%	0%	0%	0%	**0%**	-
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	0
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Bedell Rd - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723137, Location: 43.036221, -78.976504

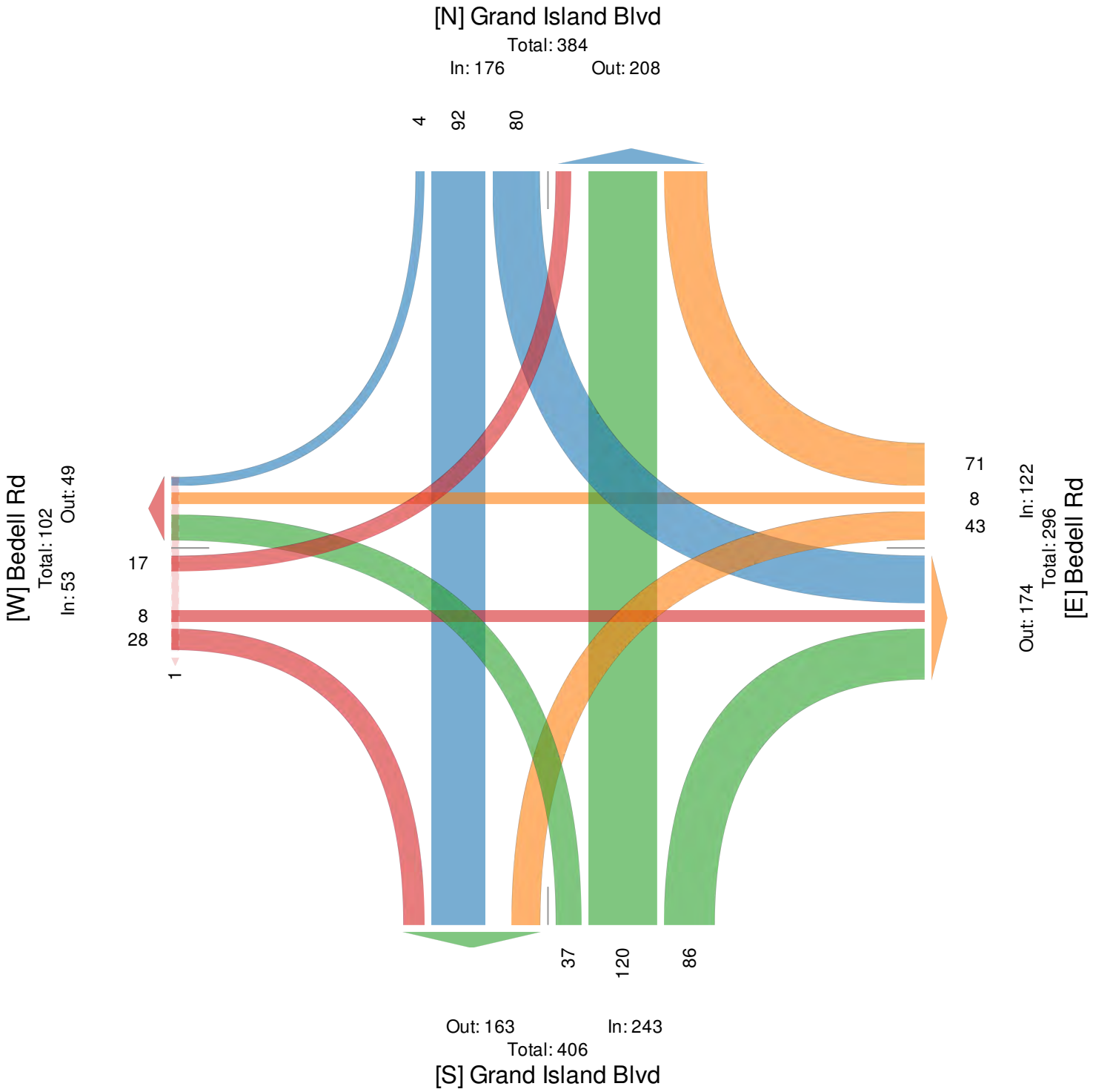
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Grand Island Blvd Northbound							Bedell Rd Eastbound							
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*	**Int**
2019-11-13 5:30PM	14	33	7	0	5	**59**	0	5	1	6	0	4	**16**	0	**142**
5:45PM	16	29	5	0	1	**51**	0	3	2	3	0	3	**11**	1	**137**
6:00PM	21	31	14	0	2	**68**	0	2	1	4	0	4	**11**	0	**156**
6:15PM	21	27	11	0	6	**65**	0	2	4	4	0	5	**15**	0	**159**
Total	72	120	37	0	14	**243**	0	12	8	17	0	16	**53**	1	**594**
% Approach	29.6%	49.4%	15.2%	0%	5.8%	**-**	-	22.6%	15.1%	32.1%	0%	30.2%	**-**	-	**-**
% Total	12.1%	20.2%	6.2%	0%	2.4%	**40.9%**	-	2.0%	1.3%	2.9%	0%	2.7%	**8.9%**	-	**-**
PHF	0.857	0.909	0.661	-	0.583	**0.893**	-	0.600	0.500	0.708	-	0.800	**0.828**	-	0.934
Lights	71	117	37	0	14	**239**	-	11	8	17	0	15	**51**	-	586
% Lights	98.6%	97.5%	100%	0%	100%	**98.4%**	-	91.7%	100%	100%	0%	93.8%	**96.2%**	-	98.7%
Articulated Trucks and Single-Unit Trucks	0	2	0	0	0	**2**	-	1	0	0	0	1	**2**	-	4
% Articulated Trucks and Single-Unit Trucks	0%	1.7%	0%	0%	0%	**0.8%**	-	8.3%	0%	0%	0%	6.3%	**3.8%**	-	0.7%
Buses	1	1	0	0	0	**2**	-	0	0	0	0	0	**0**	-	4
% Buses	1.4%	0.8%	0%	0%	0%	**0.8%**	-	0%	0%	0%	0%	0%	**0%**	-	0.7%
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	1	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	100%	-
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	0%	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Bedell Rd - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723137, Location: 43.036221, -78.976504

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Grand Island Blvd/I-190 NB Off Ramp - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723087, Location: 43.047626, -78.987318

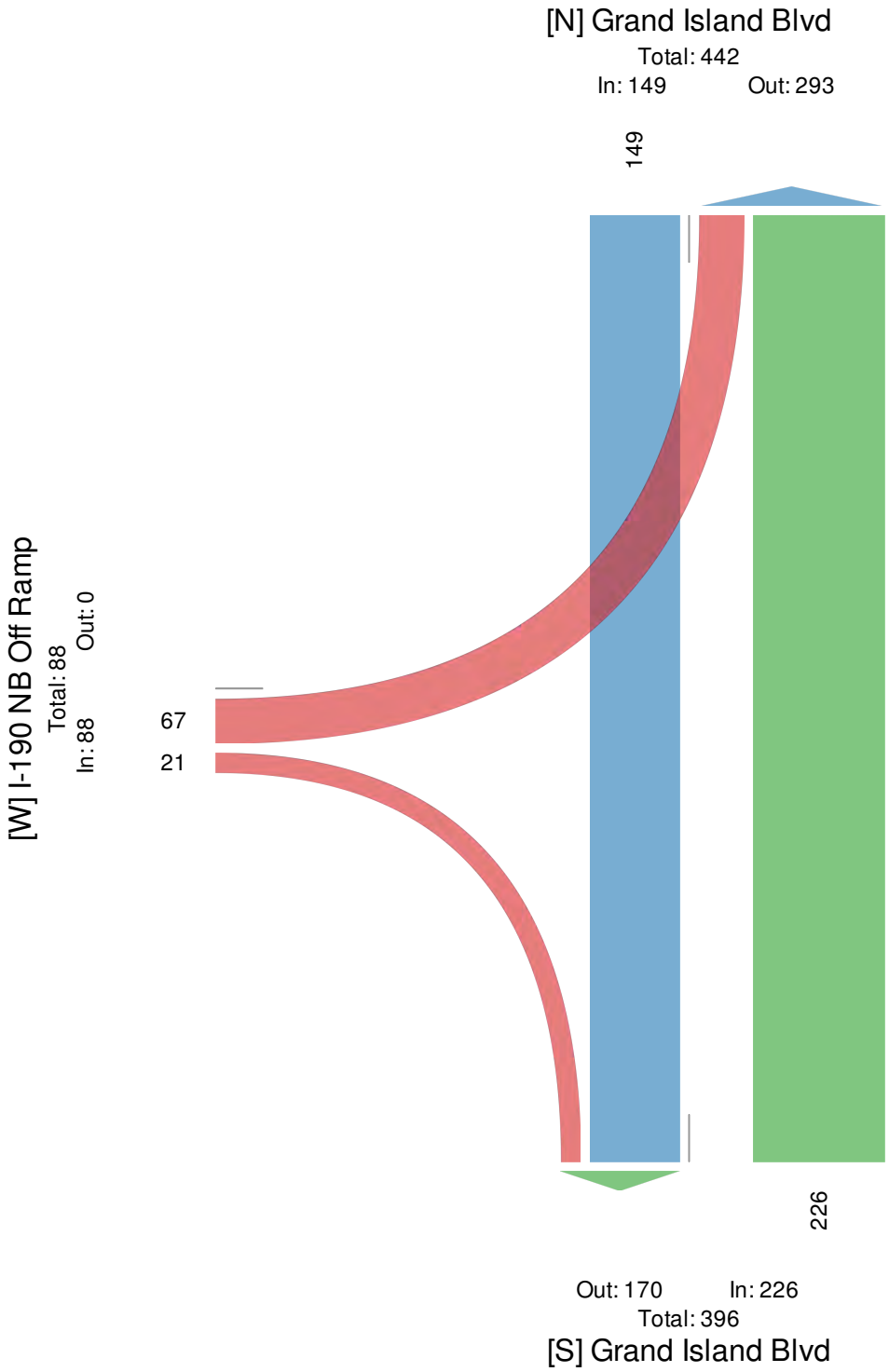
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Grand Island Blvd Southbound				Grand Island Blvd Northbound				I-190 NB Off Ramp Eastbound				
Time	T	U	**App**	Ped*	T	U	**App**	Ped*	R	L	**App**	Ped*	**Int**
2019-11-13 5:30PM	33	0	**33**	0	61	0	**61**	0	9	25	**34**	0	**128**
5:45PM	48	0	**48**	0	42	0	**42**	0	4	20	**24**	0	**114**
6:00PM	39	0	**39**	0	75	0	**75**	0	4	10	**14**	0	**128**
6:15PM	29	0	**29**	0	48	0	**48**	0	4	12	**16**	0	**93**
Total	149	0	**149**	0	226	0	**226**	0	21	67	**88**	0	**463**
% Approach	100%	0%	**-**	-	100%	0%	**-**	-	23.9%	76.1%	**-**	-	-
% Total	32.2%	0%	**32.2%**	-	48.8%	0%	**48.8%**	-	4.5%	14.5%	**19.0%**	-	-
PHF	0.776	-	**0.776**	-	0.753	-	**0.753**	-	0.583	0.670	**0.647**	-	0.904
Lights	147	0	**147**	-	222	0	**222**	-	20	67	**87**	-	456
% Lights	98.7%	0%	**98.7%**	-	98.2%	0%	**98.2%**	-	95.2%	100%	**98.9%**	-	98.5%
Articulated Trucks and Single-Unit Trucks	0	0	**0**	-	2	0	**2**	-	1	0	**1**	-	3
% Articulated Trucks and Single-Unit Trucks	0%	0%	**0%**	-	0.9%	0%	**0.9%**	-	4.8%	0%	**1.1%**	-	0.6%
Buses	2	0	**2**	-	2	0	**2**	-	0	0	**0**	-	4
% Buses	1.3%	0%	**1.3%**	-	0.9%	0%	**0.9%**	-	0%	0%	**0%**	-	0.9%
Pedestrians	-	-	-	0	-	-	-	0	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	0	-	-	-	0	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Grand Island Blvd/I-190 NB Off Ramp - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723087, Location: 43.047626, -78.987318

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Grand Island Blvd/Staley Rd - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723194, Location: 43.007309, -78.948926

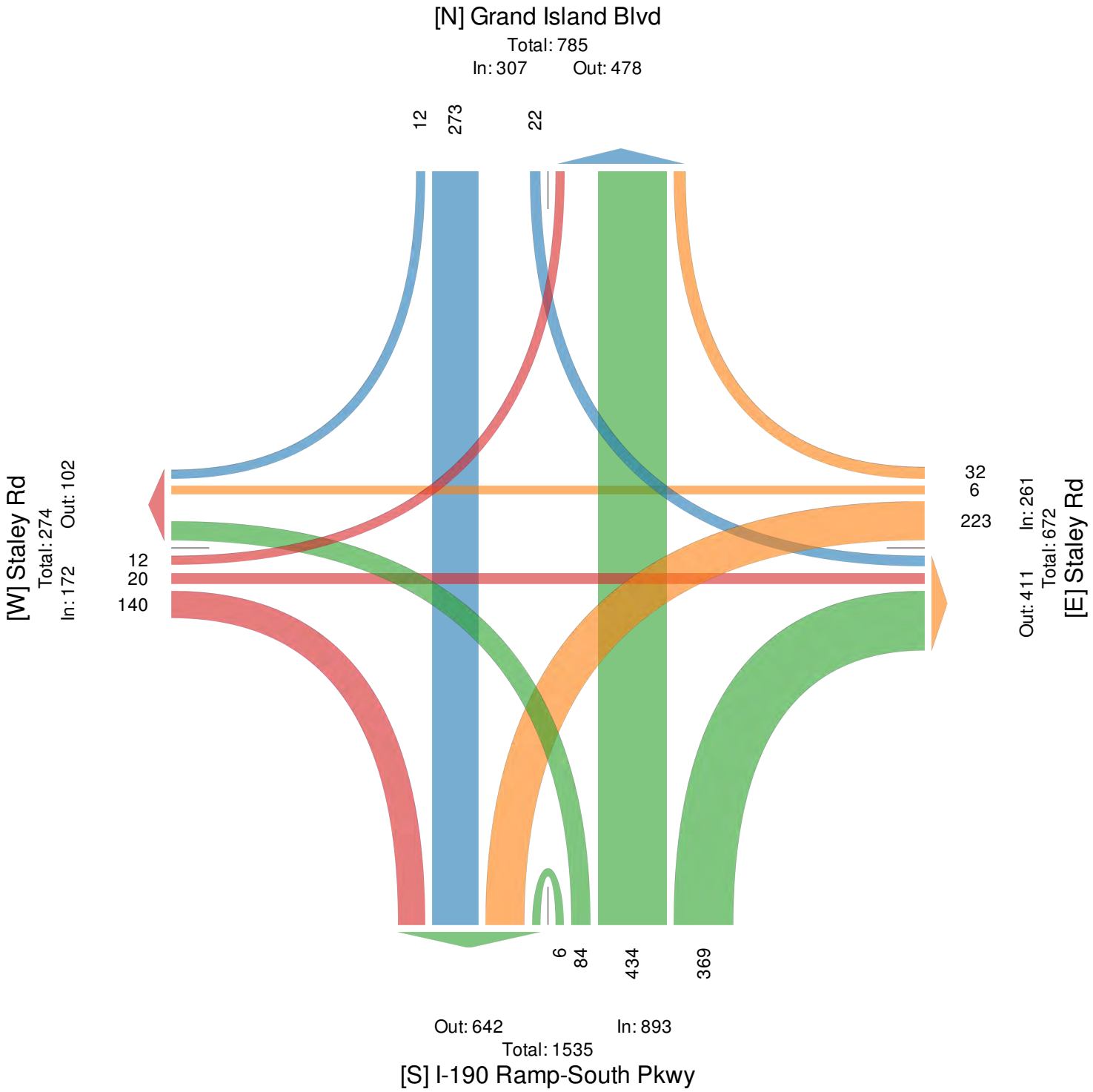
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road, Coatesville, PA, 19320, US

Leg	Grand Island Blvd						Staley Rd						I-190 Ramp-South Pkwy						Staley Rd						
Direction	Southbound						Westbound						Northbound						Eastbound						
Time	R	T	L	U	**App**	Ped*	R	T	L	U	**App**	Ped*	R	T	L	U	**App**	Ped*	R	T	L	U	**App**	Ped*	**Int**
2019-11-13 5:30PM	3	86	5	0	**94**	0	8	0	53	0	**61**	0	114	123	25	1	**263**	0	56	3	4	0	**63**	0	**481**
5:45PM	4	67	7	0	**78**	0	10	1	53	0	**64**	0	102	105	25	0	**232**	0	42	9	0	0	**51**	0	**425**
6:00PM	4	58	6	0	**68**	0	10	0	68	0	**78**	0	89	106	13	5	**213**	0	19	2	6	0	**27**	0	**386**
6:15PM	1	62	4	0	**67**	0	4	5	49	0	**58**	0	64	100	21	0	**185**	0	23	6	2	0	**31**	0	**341**
Total	12	273	22	0	**307**	0	32	6	223	0	**261**	0	369	434	84	6	**893**	0	140	20	12	0	**172**	0	**1633**
% Approach	3.9%	88.9%	7.2%	0%	**-**	-	12.3%	2.3%	85.4%	0%	**-**	-	41.3%	48.6%	9.4%	0.7%	**-**	-	81.4%	11.6%	7.0%	0%	**-**	-	-
% Total	0.7%	16.7%	1.3%	0%	**18.8%**	-	2.0%	0.4%	13.7%	0%	**16.0%**	-	22.6%	26.6%	5.1%	0.4%	**54.7%**	-	8.6%	1.2%	0.7%	0%	**10.5%**	-	-
PHF	0.750	0.794	0.786	-	**0.816**	-	0.800	0.300	0.820	-	**0.837**	-	0.809	0.882	0.840	0.300	**0.849**	-	0.625	0.556	0.500	-	**0.683**	-	0.849
Lights	12	270	22	0	**304**	-	31	6	223	0	**260**	-	367	427	84	6	**884**	-	135	20	12	0	**167**	-	1615
% Lights	100%	98.9%	100%	0%	**99.0%**	-	96.9%	100%	100%	0%	**99.6%**	-	99.5%	98.4%	100%	100%	**99.0%**	-	96.4%	100%	100%	0%	**97.1%**	-	98.9%
Articulated Trucks and Single-Unit Trucks	0	3	0	0	**3**	-	1	0	0	0	**1**	-	2	4	0	0	**6**	-	5	0	0	0	**5**	-	15
% Articulated Trucks and Single-Unit Trucks	0%	1.1%	0%	0%	**1.0%**	-	3.1%	0%	0%	0%	**0.4%**	-	0.5%	0.9%	0%	0%	**0.7%**	-	3.6%	0%	0%	0%	**2.9%**	-	0.9%
Buses	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	3	0	0	**3**	-	0	0	0	0	**0**	-	3
% Buses	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0.7%	0%	0%	**0.3%**	-	0%	0%	0%	0%	**0%**	-	0.2%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Grand Island Blvd/Staley Rd - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723194, Location: 43.007309, -78.948926

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Grand Island Blvd/Whitehaven Rd - TMC

Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723160, Location: 43.021796, -78.962788

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Grand Island Blvd Southbound							Whitehaven Rd Westbound						
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*
2019-11-13 5:30PM	4	63	21	0	2	**90**	0	12	23	19	0	9	**63**	0
5:45PM	2	51	16	0	0	**69**	0	11	17	17	0	12	**57**	0
6:00PM	1	55	16	0	0	**72**	0	12	18	21	0	7	**58**	0
6:15PM	7	56	15	0	2	**80**	0	15	15	14	0	9	**53**	0
Total	14	225	68	0	4	**311**	0	50	73	71	0	37	**231**	0
% Approach	4.5%	72.3%	21.9%	0%	1.3%	**-**	-	21.6%	31.6%	30.7%	0%	16.0%	**-**	-
% Total	1.1%	17.3%	5.2%	0%	0.3%	**23.9%**	-	3.8%	5.6%	5.5%	0%	2.8%	**17.7%**	-
PHF	0.500	0.893	0.810	-	0.500	**0.864**	-	0.833	0.793	0.845	-	0.771	**0.917**	-
Lights	14	222	68	0	4	**308**	-	50	70	70	0	37	**227**	-
% Lights	100%	98.7%	100%	0%	100%	**99.0%**	-	100%	95.9%	98.6%	0%	100%	**98.3%**	-
Articulated Trucks and Single-Unit Trucks	0	1	0	0	0	**1**	-	0	3	1	0	0	**4**	-
% Articulated Trucks and Single-Unit Trucks	0%	0.4%	0%	0%	0%	**0.3%**	-	0%	4.1%	1.4%	0%	0%	**1.7%**	-
Buses	0	2	0	0	0	**2**	-	0	0	0	0	0	**0**	-
% Buses	0%	0.9%	0%	0%	0%	**0.6%**	-	0%	0%	0%	0%	0%	**0%**	-
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	0
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Whitehaven Rd - TMC

Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723160, Location: 43.021796, -78.962788

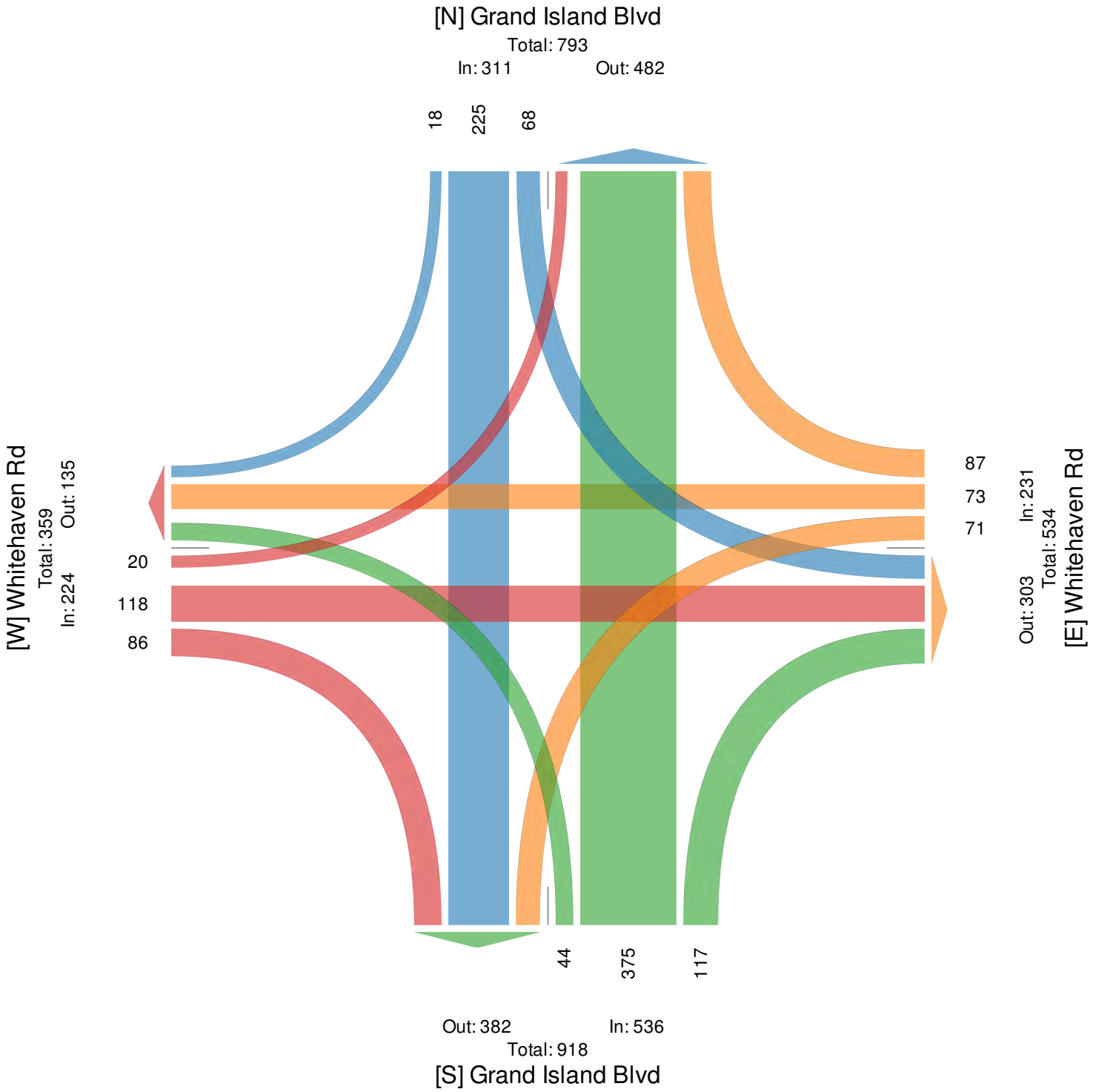
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Grand Island Blvd Northbound							Whitehaven Rd Eastbound							
Time	R	T	L	U	RR	**App**	Ped*	R	T	L	U	RR	**App**	Ped*	**Int**
2019-11-13 5:30PM	33	101	15	0	2	**151**	0	10	31	4	0	8	**53**	0	**357**
5:45PM	31	88	15	0	3	**137**	0	11	35	5	0	8	**59**	0	**322**
6:00PM	25	90	2	0	0	**117**	0	14	26	6	0	11	**57**	0	**304**
6:15PM	20	96	12	0	3	**131**	0	10	26	5	0	14	**55**	0	**319**
Total	109	375	44	0	8	**536**	0	45	118	20	0	41	**224**	0	**1302**
% Approach	20.3%	70.0%	8.2%	0%	1.5%	**-**	-	20.1%	52.7%	8.9%	0%	18.3%	**-**	-	**-**
% Total	8.4%	28.8%	3.4%	0%	0.6%	**41.2%**	-	3.5%	9.1%	1.5%	0%	3.1%	**17.2%**	-	**-**
PHF	0.826	0.928	0.733	-	0.667	**0.887**	-	0.804	0.843	0.833	-	0.732	**0.949**	-	0.912
Lights	109	370	44	0	8	**531**	-	45	118	20	0	41	**224**	-	1290
% Lights	100%	98.7%	100%	0%	100%	**99.1%**	-	100%	100%	100%	0%	100%	**100%**	-	99.1%
Articulated Trucks and Single-Unit Trucks	0	1	0	0	0	**1**	-	0	0	0	0	0	**0**	-	6
% Articulated Trucks and Single-Unit Trucks	0%	0.3%	0%	0%	0%	**0.2%**	-	0%	0%	0%	0%	0%	**0%**	-	0.5%
Buses	0	4	0	0	0	**4**	-	0	0	0	0	0	**0**	-	6
% Buses	0%	1.1%	0%	0%	0%	**0.7%**	-	0%	0%	0%	0%	0%	**0%**	-	0.5%
Pedestrians	-	-	-	-	-	-	0	-	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	-	0	-	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, RR: Right on red, T: Thru, U: U-Turn

Grand Island Blvd/Whitehaven Rd - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723160, Location: 43.021796, -78.962788

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Long Rd/Grand Island Blvd - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723093, Location: 43.048687, -78.988125

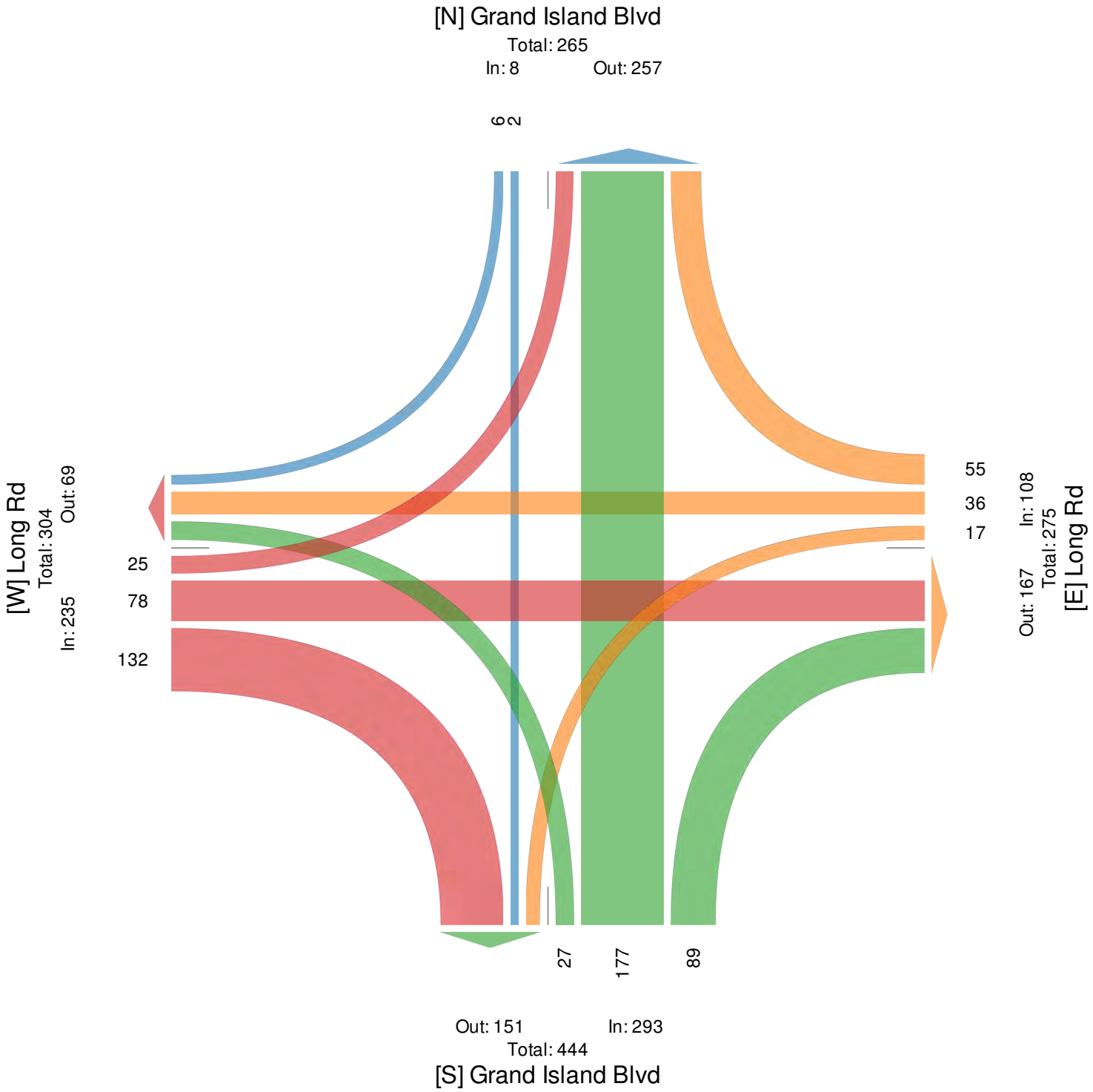
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road, Coatesville, PA, 19320, US

Leg	Grand Island Blvd						Long Rd						Grand Island Blvd						Long Rd						
Direction	Southbound						Westbound						Northbound						Eastbound						
Time	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	R	T	L	U	App	Ped*	Int
2019-11-13 5:30PM	2	0	0	0	**2**	0	15	10	3	0	**28**	0	31	45	10	0	**86**	0	33	20	6	0	**59**	0	**175**
5:45PM	1	2	0	0	**3**	0	10	5	5	0	**20**	0	25	31	6	0	**62**	0	40	18	6	0	**64**	0	**149**
6:00PM	1	0	0	0	**1**	0	18	10	6	0	**34**	0	15	62	7	0	**84**	0	32	16	8	0	**56**	0	**175**
6:15PM	2	0	0	0	**2**	0	12	11	3	0	**26**	0	18	39	4	0	**61**	0	27	24	5	0	**56**	0	**145**
Total	6	2	0	0	**8**	0	55	36	17	0	**108**	0	89	177	27	0	**293**	0	132	78	25	0	**235**	0	**644**
% Approach	75.0%	25.0%	0%	0%	**-**	-	50.9%	33.3%	15.7%	0%	**-**	-	30.4%	60.4%	9.2%	0%	**-**	-	56.2%	33.2%	10.6%	0%	**-**	-	**-**
% Total	0.9%	0.3%	0%	0%	**1.2%**	-	8.5%	5.6%	2.6%	0%	**16.8%**	-	13.8%	27.5%	4.2%	0%	**45.5%**	-	20.5%	12.1%	3.9%	0%	**36.5%**	-	**-**
PHF	0.750	0.250	-	-	**0.667**	-	0.764	0.818	0.708	-	**0.794**	-	0.718	0.714	0.675	-	**0.852**	-	0.825	0.813	0.781	-	**0.918**	-	0.920
Lights	6	2	0	0	**8**	-	55	36	17	0	**108**	-	89	173	27	0	**289**	-	130	78	25	0	**233**	-	638
% Lights	100%	100%	0%	0%	**100%**	-	100%	100%	100%	0%	**100%**	-	100%	97.7%	100%	0%	**98.6%**	-	98.5%	100%	100%	0%	**99.1%**	-	99.1%
Articulated Trucks and Single-Unit Trucks	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	2	0	0	**2**	-	0	0	0	0	**0**	-	2
% Articulated Trucks and Single-Unit Trucks	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	1.1%	0%	0%	**0.7%**	-	0%	0%	0%	0%	**0%**	-	0.3%
Buses	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	2	0	0	**2**	-	2	0	0	0	**2**	-	4
% Buses	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	1.1%	0%	0%	**0.7%**	-	1.5%	0%	0%	0%	**0.9%**	-	0.6%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Long Rd/Grand Island Blvd - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723093, Location: 43.048687, -78.988125

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Long Rd/I-190 on-off Ramps - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723098, Location: 43.048573, -78.992932

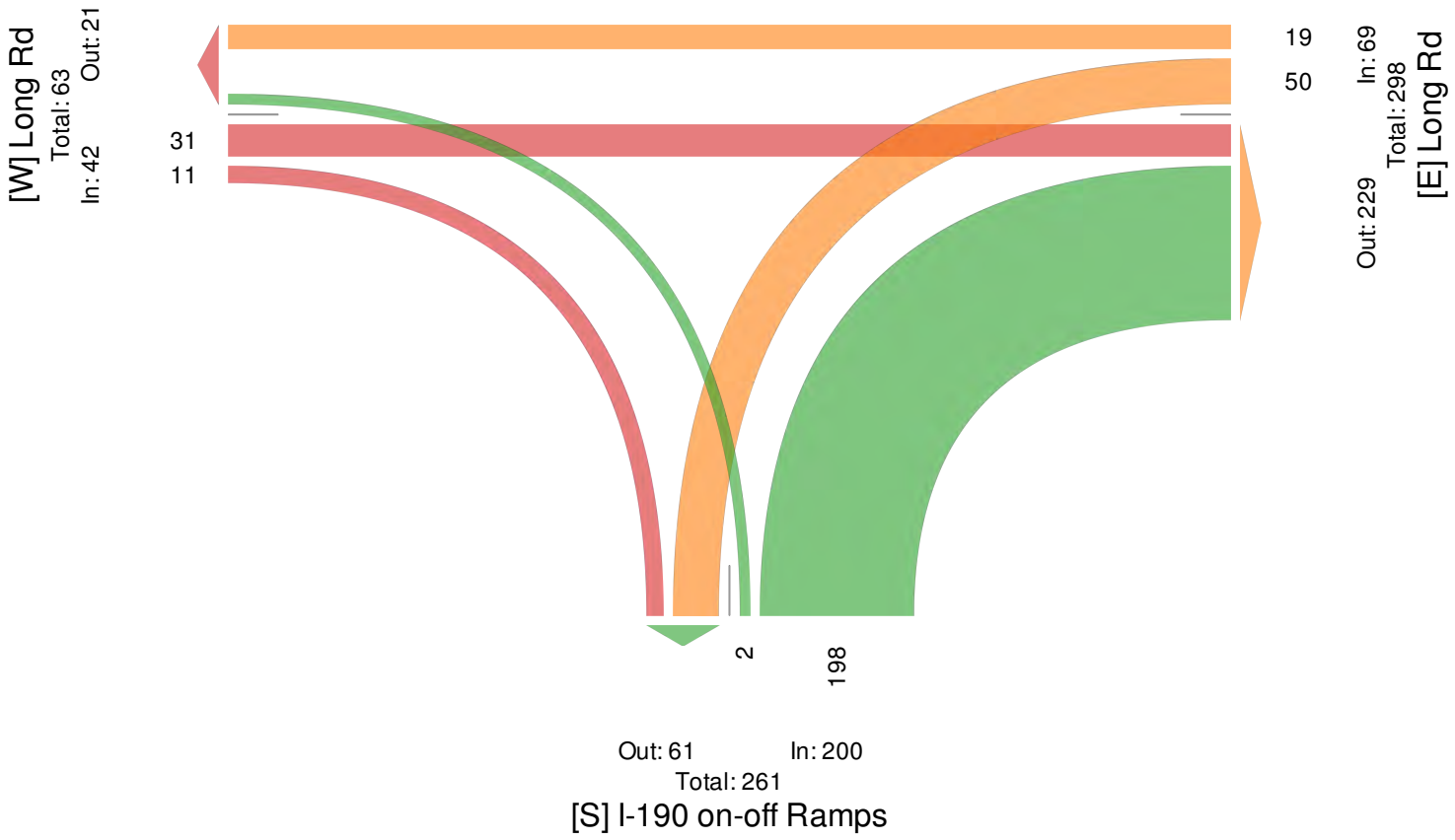
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg Direction	Long Rd Westbound					I-190 on-off Ramps Northbound					Long Rd Eastbound					
Time	T	L	U	**App**	Ped*	R	L	U	**App**	Ped*	R	T	U	**App**	Ped*	**Int**
2019-11-13 5:30PM	8	15	0	**23**	0	44	1	0	**45**	0	4	8	0	**12**	0	**80**
5:45PM	7	9	0	**16**	0	59	0	0	**59**	0	2	8	0	**10**	0	**85**
6:00PM	1	11	0	**12**	0	43	0	0	**43**	0	2	8	0	**10**	0	**65**
6:15PM	3	15	0	**18**	0	52	1	0	**53**	0	3	7	0	**10**	0	**81**
Total	19	50	0	**69**	0	198	2	0	**200**	0	11	31	0	**42**	0	**311**
% Approach	27.5%	72.5%	0%	**-**	-	99.0%	1.0%	0%	**-**	-	26.2%	73.8%	0%	**-**	-	-
% Total	6.1%	16.1%	0%	**22.2%**	-	63.7%	0.6%	0%	**64.3%**	-	3.5%	10.0%	0%	**13.5%**	-	-
PHF	0.594	0.833	-	**0.750**	-	0.839	0.500	-	**0.847**	-	0.688	0.969	-	**0.875**	-	0.915
Lights	19	50	0	**69**	-	196	2	0	**198**	-	11	31	0	**42**	-	309
% Lights	100%	100%	0%	**100%**	-	99.0%	100%	0%	**99.0%**	-	100%	100%	0%	**100%**	-	99.4%
Articulated Trucks and Single-Unit Trucks	0	0	0	**0**	-	1	0	0	**1**	-	0	0	0	**0**	-	1
% Articulated Trucks and Single-Unit Trucks	0%	0%	0%	**0%**	-	0.5%	0%	0%	**0.5%**	-	0%	0%	0%	**0%**	-	0.3%
Buses	0	0	0	**0**	-	1	0	0	**1**	-	0	0	0	**0**	-	1
% Buses	0%	0%	0%	**0%**	-	0.5%	0%	0%	**0.5%**	-	0%	0%	0%	**0%**	-	0.3%
Pedestrians	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	0	-	-	-	-	0	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Long Rd/I-190 on-off Ramps - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723098, Location: 43.048573, -78.992932

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Long Rd/Proposed Site Drwy-Tech Camp Drwy - TMC

Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723119, Location: 43.048512, -78.995838

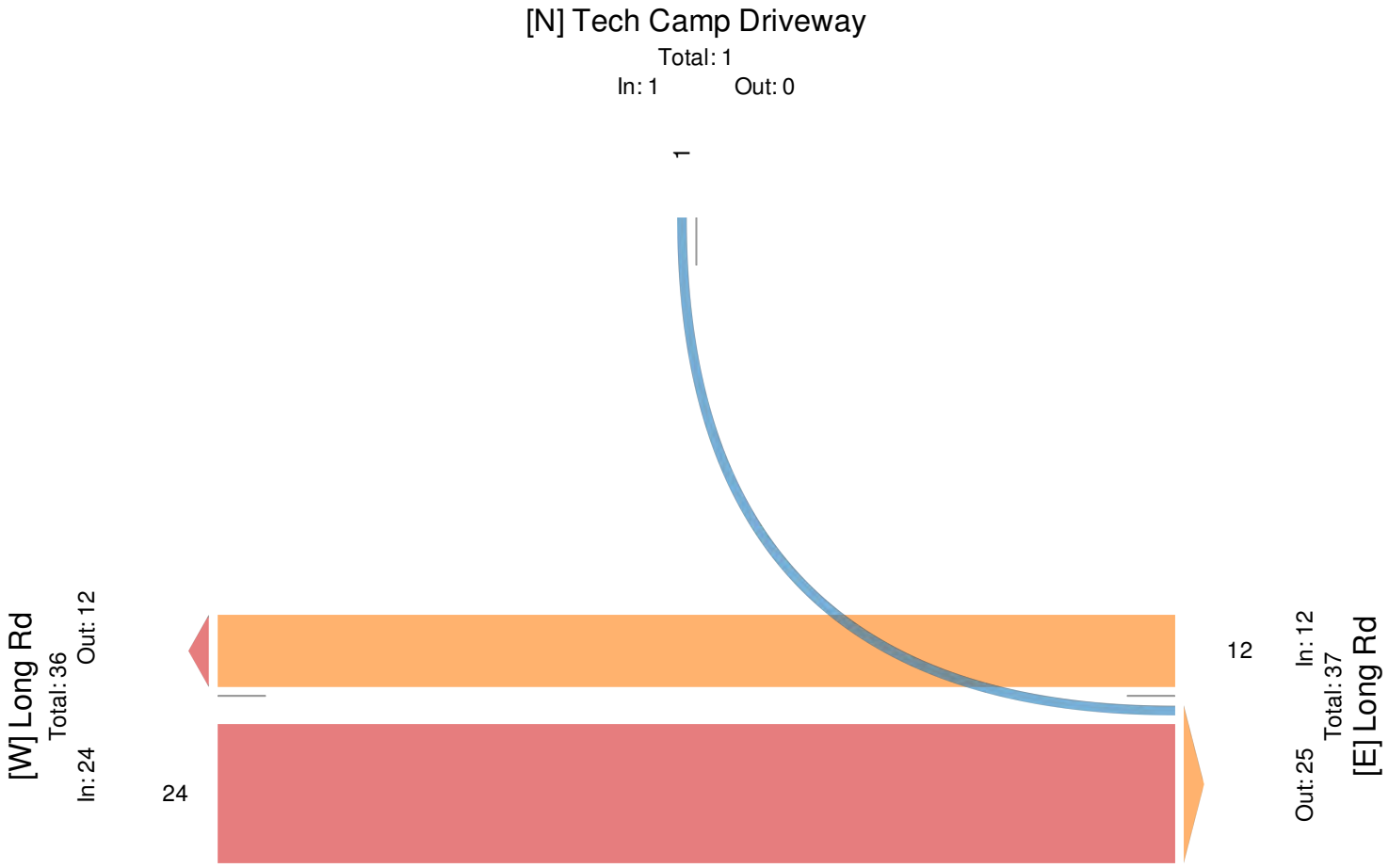
Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US

Leg	Tech Camp Driveway						Long Rd						Proposed Site Driveway						Long Rd						
Direction	Southbound						Westbound						Northbound						Eastbound						
Time	R	T	L	U	**App**	Ped*	R	T	L	U	**App**	Ped*	R	T	L	U	**App**	Ped*	R	T	L	U	**App**	Ped*	**Int**
2019-11-13 5:30PM	0	0	0	0	**0**	0	0	6	0	0	**6**	0	0	0	0	0	**0**	0	0	7	0	0	**7**	0	**13**
5:45PM	0	0	1	0	**1**	0	0	3	0	0	**3**	0	0	0	0	0	**0**	0	0	5	0	0	**5**	0	**9**
6:00PM	0	0	0	0	**0**	0	0	1	0	0	**1**	0	0	0	0	0	**0**	0	0	7	0	0	**7**	0	**8**
6:15PM	0	0	0	0	**0**	0	0	2	0	0	**2**	0	0	0	0	0	**0**	0	0	5	0	0	**5**	0	**7**
Total	0	0	1	0	**1**	0	0	12	0	0	**12**	0	0	0	0	0	**0**	0	0	24	0	0	**24**	0	**37**
% Approach	0%	0%	100%	0%	**-**	-	0%	100%	0%	0%	**-**	-	0%	0%	0%	0%	**-**	-	0%	100%	0%	0%	**-**	-	-
% Total	0%	0%	2.7%	0%	**2.7%**	-	0%	32.4%	0%	0%	**32.4%**	-	0%	0%	0%	0%	**0%**	-	0%	64.9%	0%	0%	**64.9%**	-	-
PHF	-	-	0.250	-	**0.250**	-	-	0.500	-	-	**0.500**	-	-	-	-	-	**-**	-	-	0.857	-	-	**0.857**	-	0.712
Lights	0	0	1	0	**1**	-	0	12	0	0	**12**	-	0	0	0	0	**0**	-	0	24	0	0	**24**	-	37
% Lights	0%	0%	100%	0%	**100%**	-	0%	100%	0%	0%	**100%**	-	0%	0%	0%	0%	**-**	-	0%	100%	0%	0%	**100%**	-	100%
Articulated Trucks and Single-Unit Trucks	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0
% Articulated Trucks and Single-Unit Trucks	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**-**	-	0%	0%	0%	0%	**0%**	-	0%
Buses	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0
% Buses	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**-**	-	0%	0%	0%	0%	**0%**	-	0%
Pedestrians	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Pedestrians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

Long Rd/Proposed Site Drwy-Tech Camp Drwy - TMC
Wed Nov 13, 2019
Forced Peak (5:30 PM - 6:30 PM)
All Classes (Lights, Articulated Trucks and Single-Unit Trucks, Buses, Pedestrians, Bicycles on Crosswalk)
All Movements
ID: 723119, Location: 43.048512, -78.995838

Provided by: Tri-State Traffic Data, Inc.
184 Baker Road,
Coatesville, PA, 19320, US



Proposed Project Olive Development, Town of Grand Island, Erie County, NY

Documentation of Ambient Traffic Volume Growth

Roadway	Segment starts at	Segment end at	1997	2001	2002	2003	2004	2005	2007	2008	2009	2010	2011	2012	2014	2015	2016	2017	Annual Growth
Grand Island Blvd	Whitehaven Rd	I-190 Start OLAP INT 18A	10,200	10,700			11,500		10,600			9,725					9,899		-0.16%
Grand Island Blvd	Grand Island Blvd	Whitehaven Rd				5,500	5,100			5,000			5,365		5,871				0.60%
Long Rd	I-190 SB Acc	Grand Island Blvd		2,400			2,900		3,000		3,850			3,857		2,966			1.52%
Bedell Rd	Grand Island Blvd	Baseline Rd						2,500		2,400			2,450			2,538			0.15%
Whitehaven Rd	I-190 ACC	Baseline Rd			7,400			7,700		7,250			7,816		7,755			8,254	0.58%

0.54%

S0801

COMMUTING CHARACTERISTICS BY SEX

2013-2017 American Community Survey 5-Year Estimates

Supporting documentation on code lists, subject definitions, data accuracy, and statistical testing can be found on the American Community Survey website in the Technical Documentation section.

Sample size and data quality measures (including coverage rates, allocation rates, and response rates) can be found on the American Community Survey website in the Methodology section.

Although the American Community Survey (ACS) produces population, demographic and housing unit estimates, it is the Census Bureau's Population Estimates Program that produces and disseminates the official estimates of the population for the nation, states, counties, cities, and towns and estimates of housing units for states and counties.

Subject	Erie County, New York						Niagara County, New York	
	Total		Male		Female		Total	
	Estimate	Margin of Error	Estimate	Margin of Error	Estimate	Margin of Error	Estimate	Margin of Error
Workers 16 years and over	438,166	+/-2,658	221,976	+/-1,810	216,190	+/-1,757	99,290	+/-1,090
MEANS OF TRANSPORTATION TO WORK								
Car, truck, or van	89.6%	+/-0.3	89.2%	+/-0.5	89.9%	+/-0.4	93.3%	+/-0.6
Drove alone	81.5%	+/-0.4	81.6%	+/-0.6	81.3%	+/-0.6	86.9%	+/-0.8
Carpooled	8.1%	+/-0.3	7.6%	+/-0.4	8.6%	+/-0.4	6.3%	+/-0.6
In 2-person carpool	6.6%	+/-0.3	6.1%	+/-0.4	7.2%	+/-0.4	5.1%	+/-0.5
In 3-person carpool	0.9%	+/-0.1	0.9%	+/-0.1	0.9%	+/-0.1	0.8%	+/-0.2
In 4-or-more person carpool	0.6%	+/-0.1	0.6%	+/-0.1	0.6%	+/-0.1	0.4%	+/-0.2
Workers per car, truck, or van	1.05	+/-0.01	1.05	+/-0.01	1.05	+/-0.01	1.04	+/-0.01
Public transportation (excluding taxicab)	3.8%	+/-0.2	3.4%	+/-0.3	4.2%	+/-0.3	0.9%	+/-0.2
Walked	2.7%	+/-0.2	3.0%	+/-0.3	2.4%	+/-0.2	1.9%	+/-0.3
Bicycle	0.4%	+/-0.1	0.6%	+/-0.1	0.2%	+/-0.1	0.3%	+/-0.1
Taxicab, motorcycle, or other means	0.7%	+/-0.1	0.8%	+/-0.1	0.6%	+/-0.1	1.0%	+/-0.2
Worked at home	2.8%	+/-0.2	3.0%	+/-0.2	2.7%	+/-0.2	2.6%	+/-0.4
PLACE OF WORK								
Worked in state of residence	99.5%	+/-0.1	99.4%	+/-0.1	99.6%	+/-0.1	99.5%	+/-0.1
Worked in county of residence	93.9%	+/-0.2	92.7%	+/-0.4	95.1%	+/-0.3	60.7%	+/-1.0
Worked outside county of residence	5.6%	+/-0.2	6.6%	+/-0.4	4.5%	+/-0.3	38.8%	+/-1.0
Worked outside state of residence	0.5%	+/-0.1	0.6%	+/-0.1	0.4%	+/-0.1	0.5%	+/-0.1

Subject	Erie County, New York						Niagara County, New York	
	Total		Male		Female		Total	
	Estimate	Margin of Error	Estimate	Margin of Error	Estimate	Margin of Error	Estimate	Margin of Error
Living in a place	65.2%	+/-0.4	64.1%	+/-0.6	66.4%	+/-0.6	57.6%	+/-0.7
Worked in place of residence	20.6%	+/-0.4	20.3%	+/-0.5	20.9%	+/-0.5	17.7%	+/-0.6
Worked outside place of residence	44.6%	+/-0.5	43.8%	+/-0.7	45.4%	+/-0.7	39.9%	+/-0.8
Not living in a place	34.8%	+/-0.4	35.9%	+/-0.6	33.6%	+/-0.6	42.4%	+/-0.7
Living in 12 selected states	100.0%	+/-0.1	100.0%	+/-0.1	100.0%	+/-0.1	100.0%	+/-0.1
Worked in minor civil division of residence	32.9%	+/-0.5	32.2%	+/-0.6	33.7%	+/-0.7	25.8%	+/-0.8
Worked outside minor civil division of residence	67.1%	+/-0.5	67.8%	+/-0.6	66.3%	+/-0.7	74.2%	+/-0.8
Not living in 12 selected states	0.0%	+/-0.1	0.0%	+/-0.1	0.0%	+/-0.1	0.0%	+/-0.1
Workers 16 years and over who did not work at home	425,774	+/-2,794	215,348	+/-1,869	210,426	+/-1,870	96,725	+/-1,172
TIME LEAVING HOME TO GO TO WORK								
12:00 a.m. to 4:59 a.m.	2.5%	+/-0.2	3.1%	+/-0.2	1.8%	+/-0.2	3.3%	+/-0.4
5:00 a.m. to 5:29 a.m.	2.3%	+/-0.2	3.3%	+/-0.3	1.3%	+/-0.2	2.8%	+/-0.4
5:30 a.m. to 5:59 a.m.	3.7%	+/-0.2	4.6%	+/-0.3	2.7%	+/-0.2	4.5%	+/-0.4
6:00 a.m. to 6:29 a.m.	7.4%	+/-0.3	8.8%	+/-0.4	6.0%	+/-0.4	10.1%	+/-0.7
6:30 a.m. to 6:59 a.m.	10.1%	+/-0.3	11.0%	+/-0.5	9.1%	+/-0.4	9.9%	+/-0.6
7:00 a.m. to 7:29 a.m.	14.0%	+/-0.4	13.5%	+/-0.5	14.6%	+/-0.5	13.8%	+/-0.8
7:30 a.m. to 7:59 a.m.	14.4%	+/-0.4	12.7%	+/-0.5	16.0%	+/-0.5	12.6%	+/-0.6
8:00 a.m. to 8:29 a.m.	12.5%	+/-0.3	11.2%	+/-0.4	13.8%	+/-0.5	10.3%	+/-0.6
8:30 a.m. to 8:59 a.m.	7.2%	+/-0.3	6.0%	+/-0.4	8.4%	+/-0.4	6.9%	+/-0.5
9:00 a.m. to 11:59 p.m.	26.1%	+/-0.5	25.9%	+/-0.6	26.3%	+/-0.7	25.8%	+/-0.9
TRAVEL TIME TO WORK								
Less than 10 minutes	13.9%	+/-0.4	12.7%	+/-0.5	15.1%	+/-0.6	14.0%	+/-0.8
10 to 14 minutes	15.8%	+/-0.4	15.3%	+/-0.6	16.2%	+/-0.6	17.2%	+/-0.7
15 to 19 minutes	18.0%	+/-0.5	18.0%	+/-0.6	18.0%	+/-0.5	16.1%	+/-0.7
20 to 24 minutes	18.6%	+/-0.4	18.6%	+/-0.6	18.6%	+/-0.6	14.0%	+/-0.8
25 to 29 minutes	8.8%	+/-0.3	9.0%	+/-0.3	8.7%	+/-0.4	8.9%	+/-0.6
30 to 34 minutes	12.6%	+/-0.4	13.1%	+/-0.5	12.2%	+/-0.5	12.9%	+/-0.6
35 to 44 minutes	5.3%	+/-0.2	5.6%	+/-0.4	5.1%	+/-0.3	8.4%	+/-0.6
45 to 59 minutes	3.8%	+/-0.2	4.0%	+/-0.3	3.6%	+/-0.3	6.0%	+/-0.5
60 or more minutes	3.1%	+/-0.2	3.6%	+/-0.3	2.6%	+/-0.2	2.6%	+/-0.3
Mean travel time to work (minutes)	21.3	+/-0.2	22.1	+/-0.3	20.5	+/-0.2	22.0	+/-0.3
VEHICLES AVAILABLE								
Workers 16 years and over in households	433,658	+/-2,633	219,900	+/-1,825	213,758	+/-1,727	98,619	+/-1,077
No vehicle available	5.2%	+/-0.3	5.1%	+/-0.3	5.4%	+/-0.4	3.6%	+/-0.5
1 vehicle available	25.0%	+/-0.5	22.4%	+/-0.7	27.6%	+/-0.7	21.0%	+/-0.9
2 vehicles available	44.3%	+/-0.6	45.9%	+/-0.7	42.6%	+/-0.8	45.0%	+/-1.3
3 or more vehicles available	25.5%	+/-0.6	26.6%	+/-0.7	24.4%	+/-0.6	30.3%	+/-1.3

Subject	Erie County, New York						Niagara County, New York	
	Total		Male		Female		Total	
	Estimate	Margin of Error	Estimate	Margin of Error	Estimate	Margin of Error	Estimate	Margin of Error
PERCENT ALLOCATED								
Means of transportation to work	7.7%	(X)	(X)	(X)	(X)	(X)	7.6%	(X)
Private vehicle occupancy	8.8%	(X)	(X)	(X)	(X)	(X)	8.9%	(X)
Place of work	10.3%	(X)	(X)	(X)	(X)	(X)	11.4%	(X)
Time leaving home to go to work	17.8%	(X)	(X)	(X)	(X)	(X)	23.2%	(X)
Travel time to work	11.6%	(X)	(X)	(X)	(X)	(X)	13.0%	(X)
Vehicles available	1.1%	(X)	(X)	(X)	(X)	(X)	1.7%	(X)

Subject	Niagara County, New York			
	Male		Female	
	Estimate	Margin of Error	Estimate	Margin of Error
Workers 16 years and over	50,512	+/-731	48,778	+/-806
MEANS OF TRANSPORTATION TO WORK				
Car, truck, or van	93.4%	+/-0.9	93.2%	+/-0.8
Drove alone	87.5%	+/-1.1	86.3%	+/-1.0
Carpooled	5.8%	+/-0.7	6.9%	+/-0.8
In 2-person carpool	4.8%	+/-0.6	5.5%	+/-0.7
In 3-person carpool	0.7%	+/-0.2	0.9%	+/-0.3
In 4-or-more person carpool	0.4%	+/-0.2	0.4%	+/-0.2
Workers per car, truck, or van	1.03	+/-0.01	1.04	+/-0.01
Public transportation (excluding taxicab)	0.6%	+/-0.2	1.2%	+/-0.4
Walked	2.2%	+/-0.5	1.6%	+/-0.3
Bicycle	0.5%	+/-0.2	0.2%	+/-0.1
Taxicab, motorcycle, or other means	0.9%	+/-0.3	1.2%	+/-0.3
Worked at home	2.4%	+/-0.6	2.7%	+/-0.4
PLACE OF WORK				
Worked in state of residence	99.3%	+/-0.2	99.7%	+/-0.1
Worked in county of residence	59.3%	+/-1.5	62.2%	+/-1.3
Worked outside county of residence	40.0%	+/-1.5	37.5%	+/-1.3
Worked outside state of residence	0.7%	+/-0.2	0.3%	+/-0.1
Living in a place	56.6%	+/-1.1	58.7%	+/-1.1
Worked in place of residence	16.9%	+/-0.9	18.6%	+/-0.9
Worked outside place of residence	39.7%	+/-1.2	40.1%	+/-1.2
Not living in a place	43.4%	+/-1.1	41.3%	+/-1.1
Living in 12 selected states	100.0%	+/-0.1	100.0%	+/-0.1
Worked in minor civil division of residence	25.0%	+/-1.2	26.6%	+/-1.1
Worked outside minor civil division of residence	75.0%	+/-1.2	73.4%	+/-1.1
Not living in 12 selected states	0.0%	+/-0.1	0.0%	+/-0.1
Workers 16 years and over who did not work at home	49,276	+/-799	47,449	+/-822
TIME LEAVING HOME TO GO TO WORK				
12:00 a.m. to 4:59 a.m.	4.2%	+/-0.6	2.4%	+/-0.5
5:00 a.m. to 5:29 a.m.	3.9%	+/-0.6	1.7%	+/-0.4
5:30 a.m. to 5:59 a.m.	6.0%	+/-0.6	3.0%	+/-0.5
6:00 a.m. to 6:29 a.m.	12.9%	+/-1.0	7.2%	+/-0.9
6:30 a.m. to 6:59 a.m.	11.3%	+/-0.9	8.4%	+/-0.8
7:00 a.m. to 7:29 a.m.	13.5%	+/-1.1	14.0%	+/-0.9
7:30 a.m. to 7:59 a.m.	10.8%	+/-0.9	14.5%	+/-1.1
8:00 a.m. to 8:29 a.m.	8.0%	+/-0.8	12.6%	+/-1.1
8:30 a.m. to 8:59 a.m.	4.3%	+/-0.6	9.6%	+/-0.9
9:00 a.m. to 11:59 p.m.	25.1%	+/-1.2	26.5%	+/-1.3

Subject	Niagara County, New York			
	Male		Female	
	Estimate	Margin of Error	Estimate	Margin of Error
TRAVEL TIME TO WORK				
Less than 10 minutes	12.7%	+/-1.0	15.4%	+/-1.1
10 to 14 minutes	17.1%	+/-1.0	17.2%	+/-1.1
15 to 19 minutes	16.1%	+/-0.8	16.1%	+/-1.1
20 to 24 minutes	14.5%	+/-1.2	13.4%	+/-1.0
25 to 29 minutes	8.9%	+/-0.8	8.9%	+/-0.9
30 to 34 minutes	13.0%	+/-0.8	12.8%	+/-1.1
35 to 44 minutes	8.8%	+/-0.9	8.0%	+/-0.8
45 to 59 minutes	6.1%	+/-0.7	5.9%	+/-0.7
60 or more minutes	2.9%	+/-0.4	2.3%	+/-0.4
Mean travel time to work (minutes)	22.5	+/-0.5	21.5	+/-0.5
VEHICLES AVAILABLE				
Workers 16 years and over in households	50,212	+/-733	48,407	+/-805
No vehicle available	3.5%	+/-0.6	3.8%	+/-0.7
1 vehicle available	19.4%	+/-1.2	22.7%	+/-1.2
2 vehicles available	44.5%	+/-1.6	45.5%	+/-1.7
3 or more vehicles available	32.6%	+/-1.5	28.1%	+/-1.4
PERCENT ALLOCATED				
Means of transportation to work	(X)	(X)	(X)	(X)
Private vehicle occupancy	(X)	(X)	(X)	(X)
Place of work	(X)	(X)	(X)	(X)
Time leaving home to go to work	(X)	(X)	(X)	(X)
Travel time to work	(X)	(X)	(X)	(X)
Vehicles available	(X)	(X)	(X)	(X)

Data are based on a sample and are subject to sampling variability. The degree of uncertainty for an estimate arising from sampling variability is represented through the use of a margin of error. The value shown here is the 90 percent margin of error. The margin of error can be interpreted roughly as providing a 90 percent probability that the interval defined by the estimate minus the margin of error and the estimate plus the margin of error (the lower and upper confidence bounds) contains the true value. In addition to sampling variability, the ACS estimates are subject to nonsampling error (for a discussion of nonsampling variability, see Accuracy of the Data). The effect of nonsampling error is not represented in these tables.

The 12 selected states are Connecticut, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Wisconsin.

Workers include members of the Armed Forces and civilians who were at work last week.

When information is missing or inconsistent, the Census Bureau logically assigns an acceptable value using the response to a related question or questions. If a logical assignment is not possible, data are filled using a statistical process called allocation, which uses a similar individual or household to provide a donor value. The "Allocated" section is the number of respondents who received an allocated value for a particular subject.

While the 2013-2017 American Community Survey (ACS) data generally reflect the February 2013 Office of Management and Budget (OMB) definitions of metropolitan and micropolitan statistical areas; in certain instances the names, codes, and boundaries of the principal cities shown in ACS tables may differ from the OMB definitions due to differences in the effective dates of the geographic entities.

Estimates of urban and rural populations, housing units, and characteristics reflect boundaries of urban areas defined based on Census 2010 data. As a result, data for urban and rural areas from the ACS do not necessarily reflect the results of ongoing urbanization.

Source: U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates

Explanation of Symbols:

1. An '**' entry in the margin of error column indicates that either no sample observations or too few sample observations were available to compute a standard error and thus the margin of error. A statistical test is not appropriate.
2. An '-' entry in the estimate column indicates that either no sample observations or too few sample observations were available to compute an estimate, or a ratio of medians cannot be calculated because one or both of the median estimates falls in the lowest interval or upper interval of an open-ended distribution.
3. An '-' following a median estimate means the median falls in the lowest interval of an open-ended distribution.
4. An '+' following a median estimate means the median falls in the upper interval of an open-ended distribution.
5. An '***' entry in the margin of error column indicates that the median falls in the lowest interval or upper interval of an open-ended distribution. A statistical test is not appropriate.
6. An '*****' entry in the margin of error column indicates that the estimate is controlled. A statistical test for sampling variability is not appropriate.
7. An 'N' entry in the estimate and margin of error columns indicates that data for this geographic area cannot be displayed because the number of sample cases is too small.
8. An '(X)' means that the estimate is not applicable or not available.

OnTheMap

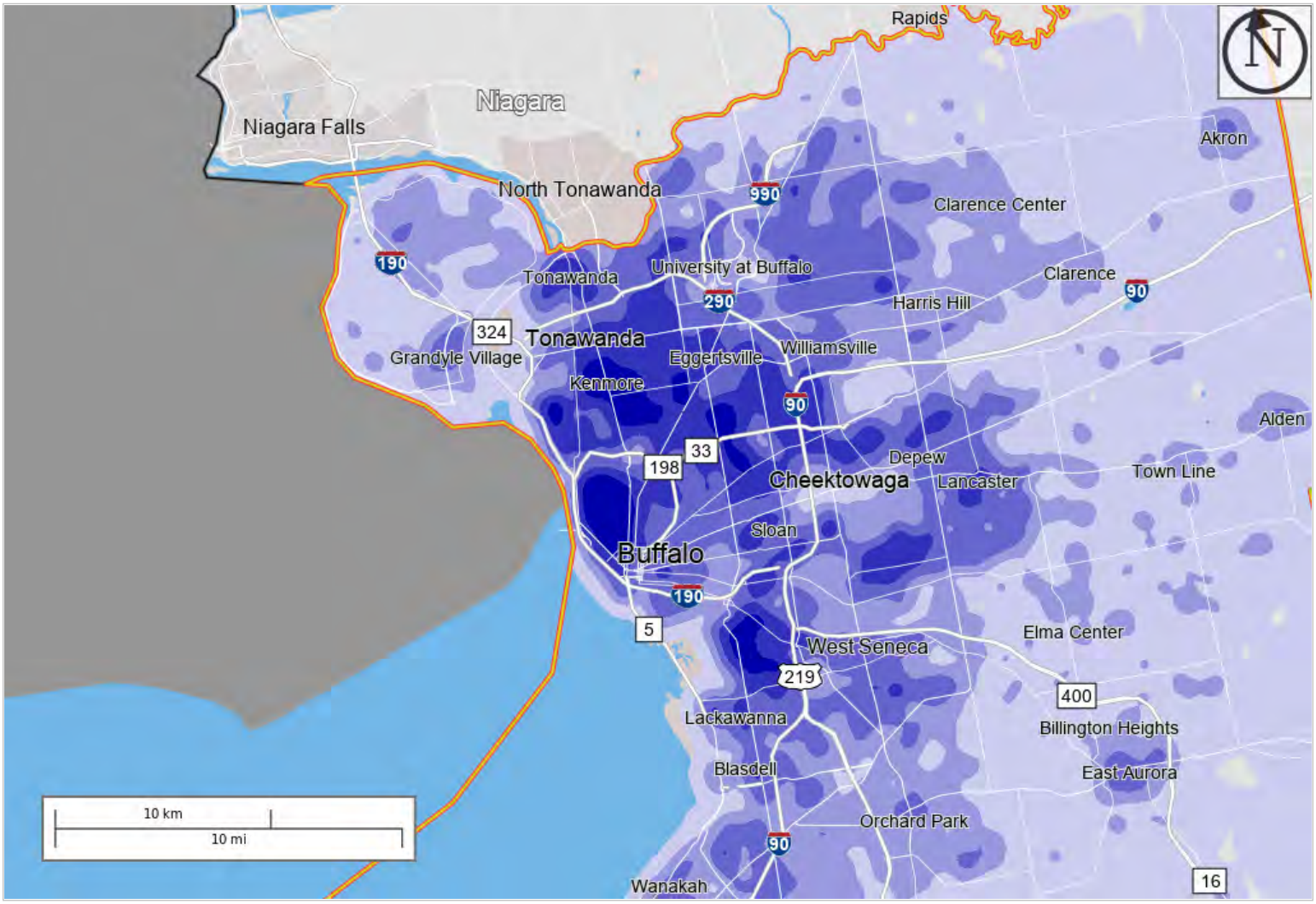
Home Area Profile Report

All Jobs for All Workers in 2017

Created by the U.S. Census Bureau's OnTheMap `https://onthemap.ces.census.gov` on 11/21/2019

Density of All Jobs in Home Selection Area in 2017

All Workers



Map Legend

Job Density [Jobs/Sq. Mile]

- 5 - 250
- 251 - 985
- 986 - 2,210
- 2,211 - 3,925
- 3,926 - 6,130

Selection Areas

- Analysis Selection

OnTheMap

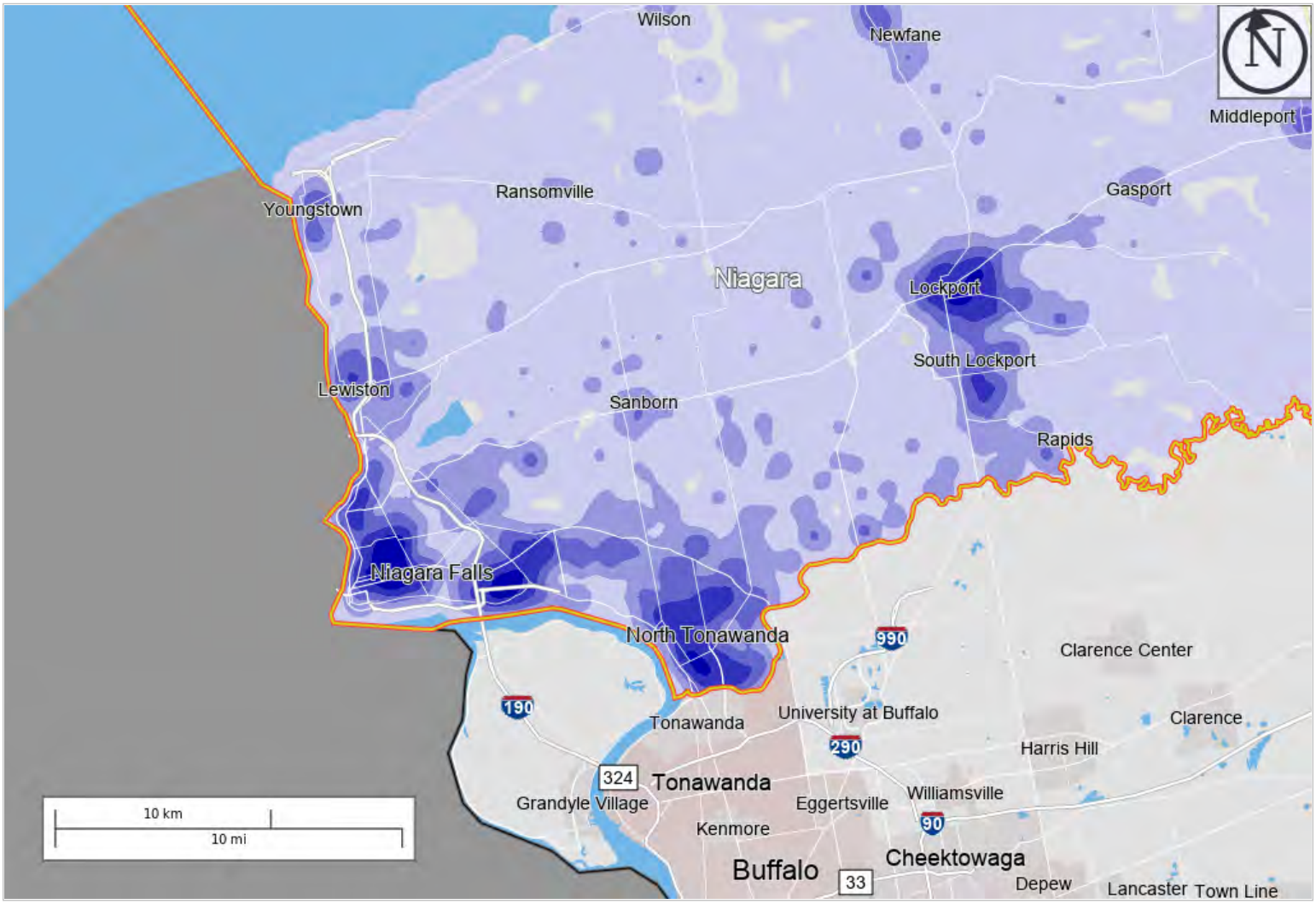
Home Area Profile Report

All Jobs for All Workers in 2017

Created by the U.S. Census Bureau's OnTheMap `https://onthemap.ces.census.gov` on 11/21/2019

Density of All Jobs in Home Selection Area in 2017

All Workers



Map Legend

Job Density [Jobs/Sq. Mile]

- 5 - 169
- 170 - 662
- 663 - 1,484
- 1,485 - 2,634
- 2,635 - 4,114

Selection Areas

- Analysis Selection

AR Sortable 640K FC

TRAFFIC DATA FOR ENTITLEMENT USE

Headcount

	Total
Headcount - Day Shift	993
Headcount - Night Shift	993

Shift Structure

		Start	End
Adjustment below accounts for	Day Shift - Inbound Employees	7:00:00 AM	5:30:00 PM
mass transit and carpool users.	Day Shift - Outbound Employees	7:30:00 AM	6:00:00 PM
Adjust as needed for jurisdiction	Night Shift - Inbound Employees	6:00:00 PM	4:30:00 AM
Net Cars Factor 91%	Night Shift - Outbound Employees	6:30:00 PM	5:00:00 AM

Traffic Schedule

Cars
Average Weekday

Time	In	Out	Total
00:00	3	7	10
01:00	1	4	5
02:00	5	14	19
03:00	8	14	22
04:00	18	190	208
05:00	39	503	542
06:00	29	17	46
06:15	77	18	95
06:30	134	10	144
06:45	180	7	187
07:00	178	10	188
07:15	231	5	236
07:30	34	7	41
07:45	8	6	14
08:00	27	19	46
09:00	17	10	27
10:00	21	18	39
11:00	40	43	83
12:00	11	18	29
13:00	14	15	29
14:00	12	26	38
15:00	31	40	71
16:00	48	34	82
17:00	28	35	63
17:15	53	16	69
17:30	117	136	253
17:45	151	78	229
18:00	189	261	450
18:15	183	176	359
18:30	24	117	141
18:45	5	43	48
19:00	19	37	56
20:00	8	8	16
21:00	16	16	32
22:00	18	23	41
23:00	3	6	9
	1,986	1,986	3,967

Trucks
Average Weekday

Time	In	Out	Total
00:00	9	9	18
01:00	15	15	30
02:00	6	6	12
03:00	12	12	24
04:00	6	6	12
05:00	9	9	18
06:00	2	2	4
06:15	2	2	4
06:30	2	2	4
06:45	2	2	4
07:00	3	3	6
07:15	3	3	6
07:30	3	3	6
07:45	3	3	6
08:00	12	12	24
09:00	21	21	42
10:00	12	12	24
11:00	13	13	26
12:00	13	13	26
13:00	8	8	16
14:00	8	8	16
15:00	8	8	16
16:00	9	9	18
17:00	2	2	4
17:15	2	2	4
17:30	2	2	4
17:45	2	2	4
18:00	2	2	4
18:15	2	2	4
18:30	2	2	4
18:45	2	2	4
19:00	7	7	14
20:00	11	11	22
21:00	8	8	16
22:00	11	11	22
23:00	8	8	16
	242	242	484

Total Vehicles
Cars + Trucks Average Weekday

	In	Out	Total
00:00	12	15	27
01:00	16	19	35
02:00	11	19	29
03:00	19	25	44
04:00	22	179	201
05:00	44	467	511
06:00	28	17	46
06:15	72	18	90
06:30	124	11	135
06:45	166	8	174
07:00	165	12	177
07:15	213	8	221
07:30	34	9	43
07:45	10	8	19
08:00	37	29	66
09:00	36	30	67
10:00	31	28	59
11:00	49	52	102
12:00	23	29	52
13:00	21	22	42
14:00	19	32	51
15:00	36	44	81
16:00	53	40	93
17:00	27	34	61
17:15	50	17	67
17:30	108	126	234
17:45	139	73	212
18:00	174	240	414
18:15	169	162	331
18:30	24	108	132
18:45	7	41	48
19:00	24	41	65
20:00	18	18	37
21:00	23	23	45
22:00	27	32	59
23:00	11	13	24
	2,044	2,050	4,094

Morning Peak Hour of Generator

	Enter	Exit	Total
06:30-07:30	668	39	707
Trucks	10	10	20

Evening Peak Hour of Generator

	Enter	Exit	Total
17:30-18:30	590	600	1,191
Trucks	8	8	16

PROPOSED PROJECT OLIVE DEVELOPMENT
TOWN OF GRAND ISLAND, NY
AM PEAK

LOCATION NUMBER	INTERSECTION DESCRIPTION	2019 Existing Volume (FIG 3)	Bkgd Volume (FIG 4)	Heron Pointe	2021 Background Volume (FIG 4)	Proposed Development - Trucks: Enter Dist. % (FIG 6)	Proposed Development - Trucks: Exit Dist. % (FIG 6)	Proposed Development - Trucks: Trips IN (FIG 6)	Proposed Development - Trucks: Trips OUT (FIG 6)	Proposed Development - Cars: Enter Dist. % (FIG 6)	Proposed Development - Cars: Exit Dist. % (FIG 6)	Proposed Development - Cars: Trips IN (FIG 6)	Proposed Development - Cars: Trips OUT (FIG 6)	Total Site Trips (FIG 7)	FULL Build Volumes (FIG 8)
			Num of yrs: 2												
			0.50%					10	10			658	29		
1	Long Road														
	Islechem Driveway														
	SR														
	ST														
	SL														
	WR	2	2		2										2
	WT	16	16		16										16
	WL					100%		10		60%		395		405	405
	NR						100%		10		62%		18	28	28
	NT														
	NL														
	ER														
	ET	46	46		46										46
	EL														
2	Long Road														
	I-190 SB Ramp														
	SR														
	ST														
	SL														
	WR														
	WT	32	32		32	90%		9		25%		165		174	206
	WL	152	154		154										154
	NR	112	113		113										113
	NT														
	NL	19	19		19	10%		1		35%		230		231	250
	ER	16	16		16		90%		9		25%		7	16	32
	ET	37	37		37		10%		1		37%		11	12	49
	EL														
3	Long Road														
	Grand Island Boulevard														
	SR														
	ST														
	SL														
	WR	56	57		57										57
	WT	146	147		147					2%		13		13	160
	WL	14	14		14										14
	NR	22	22		22										22
	NT	111	112		112										112
	NL	40	40		40	90%		9		23%		151		160	200
	ER	102	103		103										103
	ET	25	25		25						2%		1	1	26
	EL	28	28		28		10%		1		35%		10	1	29

PROPOSED PROJECT OLIVE DEVELOPMENT
TOWN OF GRAND ISLAND, NY
AM PEAK

LOCATION NUMBER	INTERSECTION DESCRIPTION	2019 Existing Volume (FIG 3)	Bkgd Volume (FIG 4)	Heron Pointe	2021 Background Volume (FIG 6)	Proposed Development - Trucks (FIG 6)				Proposed Development - Cars (FIG 6)				Total Site Trips (FIG 7)	FULL Build Volumes (FIG 8)
			Num of yrs: 2			Enter Dist. %	Exit Dist. %	Trips IN 10	Trips OUT 10	Enter Dist. %	Exit Dist. %	Trips IN 658	Trips OUT 29		
			0.50%												
4	Grand Island Boulevard I-190 NB Off-Ramp														
	SR														
	ST	115	116		116										116
	SL														
	WR														
	WT														
	WL														
	NR														
	NT	145	146		146										146
	NL														
	ER	32	32		32					35%		230		230	262
	ET														
	EL	29	29		29	90%		9		23%		151		160	189
5	Grand Island Boulevard Bedell Road														
	SR	20	20		20					35%		230		230	250
	ST	59	60		60										60
	SL	23	23		23										23
	WR	81	82		82										82
	WT	16	16		16					2%		13		13	29
	WL	67	68		68										68
	NR	13	13		13										13
	NT	69	70		70										70
	NL	41	41		41					3%		20		20	61
	ER	32	32		32						33%		10	10	42
	ET	10	10		10						5%		1	1	11
	EL	1	1		1										1
6	Grand Island Boulevard Baseline Road														
	SR	14	14		14						16%		5	5	19
	ST	236	238	3	241						17%		5	5	246
	SL	93	94		94										94
	WR	53	54		54										54
	WT	96	97		97										97
	WL	1	1		1										1
	NR	2	2		2										2
	NT	40	40	4	44					2%		13		13	57
	NL	57	58	5	63										63
	ER	97	98		98										98
	ET	86	87		87										87
	EL									1%		7		7	7

PROPOSED PROJECT OLIVE DEVELOPMENT
TOWN OF GRAND ISLAND, NY
AM PEAK

LOCATION NUMBER	INTERSECTION DESCRIPTION	2019 Existing Volume (FIG 3)	Bkgd Volume (Num of yrs: 2; 0.50%)	Heron Pointe	2021 Background Volume (FIG 4)	Proposed Development - Trucks (FIG 6): Enter Dist. %	Exit Dist. %	Trips IN 10	Trips OUT 10	Proposed Development - Cars (FIG 6): Enter Dist. %	Exit Dist. %	Trips IN 658	Trips OUT 29	Total Site Trips (FIG 7)	FULL Build Volumes (FIG 8)
7	Grand Island Boulevard														
	Whitehaven Road														
	SR	6	6		6										6
	ST	155	157	3	160						12%		3	3	163
	SL	27	27		27						15%		4	4	31
	WR	41	41	1	42					2%		13		13	55
	WT	197	199	7	206					3%		20		20	226
	WL	47	47	3	50										50
	NR	31	31	2	33										33
	NT	114	115	8	123										123
	NL	54	55	4	59										59
	ER	38	38	1	39										39
	ET	72	73	3	76										76
	EL	8	8		8										8

PROPOSED PROJECT OLIVE DEVELOPMENT
TOWN OF GRAND ISLAND, NY
AM PEAK

		FIG 3			FIG 4	FIG 6				FIG 6				FIG 7	FIG 8
			Num of yrs												
			2												
LOCATION NUMBER	**INTERSECTION DESCRIPTION**	**2019 Existing Volume**	**Bkgd Volume**	Heron Pointe	**2021 Background Volume**	**Proposed Development - Trucks**				**Proposed Development - Cars**				**Total Site Trips**	**FULL Build Volumes**
			0.50%			Enter Dist. %	Exit Dist. %	Trips IN 10	Trips OUT 10	Enter Dist. %	Exit Dist. %	Trips IN 658	Trips OUT 29		
8	Grand Island Boulevard														
	Staley Road														
	SR	20	20		20										20
	ST	188	190	15	205						10%		3	3	208
	SL	4	4		4						2%		1	1	5
	SU														
	WR	20	20		20										20
	WT	21	21		21					5%		33		33	54
	WL	446	450		450										450
	WU														
	NR	216	218		218										218
	NT	146	147	8	155										155
	NL	162	164		164										164
	NU	6	6		6										6
	ER	120	121		121										121
	ET	16	16		16										16
	EL	2	2		2										2
	EU														
9	Bedell Road														
	Proposed Site Driveway														
	SR														
	ST														
	SL										38%		11	11	11
	WR									40%		263		263	263
	WT	77	78		77										77
	WL														
	NR														
	NT														
	NL														
	ER														
	ET	43	43		43										43
	EL														

PROPOSED PROJECT OLIVE DEVELOPMENT
TOWN OF GRAND ISLAND, NY
PM PEAK

LOCATION NUMBER	INTERSECTION DESCRIPTION	2019 Existing Volume (FIG 3)	Bkgd Volume 0.50% (Num of yrs 2)	Heron Pointe	2021 Background Volume (FIG 4)	Proposed Development - Trucks (FIG 6): Enter Dist. %	Exit Dist. %	Trips IN 8	Trips OUT 8	Proposed Development - Cars (FIG 6): Enter Dist. %	Exit Dist. %	Trips IN 582	Trips OUT 592	Total Site Trips (FIG 7)	FULL Build Volumes (FIG 8)
1	Long Road														
	Islechem Driveway														
	SR	0	0		0									0	0
	ST	0	0		0									0	0
	SL	1	1		1									0	1
	WR	0	0		0									0	0
	WT	12	12		12									0	12
	WL	0	0		0	100%		8		60%		349		357	357
	NR	0	0		0		100%		8		62%		367	375	375
	NT	0	0		0									0	0
	NL	0	0		0									0	0
	ER	0	0		0									0	0
	ET	24	24		24									0	24
	EL	0	0		0									0	0
2	Long Road				0										
	I-190 Ramp				0										
	SR				0									0	0
	ST				0									0	0
	SL				0									0	0
	WR				0									0	0
	WT	19	19		19	90%		7		25%		146		153	172
	WL	50	51		51									0	51
	NR	198	200		200									0	200
	NT				0									0	0
	NL	2	2		2	10%		1		35%		204		205	207
	ER	3	3		3		90%		7		25%		148	155	158
	ET	7	7		7		10%		1		37%		219	220	227
	EL				0									0	0
3	Long Road				0										
	Grand Island Boulevard				0										
	SR	6	6		6									0	6
	ST	2	2		2									0	2
	SL	0	0		0									0	0
	WR	55	56		56									0	56
	WT	36	36		36					2%		12		12	48
	WL	17	17		17									0	17
	NR	89	90		90									0	90
	NT	177	179		179									0	179
	NL	27	27		27	90%		7		23%		134		141	168
	ER	166	168		168									0	168
	ET	82	83		83						2%		12	12	95
	EL	55	56		56		10%		1		35%		207	208	264
4	Grand Island Boulevard				0										
	I-190 NB Off-Ramp				0										
	SR				0									0	0
	ST	149	150		150									0	150
	SL				0									0	0
	WR				0									0	0
	WT				0									0	0
	WL				0									0	0
	NR				0									0	0
	NT	226	228		228									0	228
	NL				0									0	0
	ER	21	21		21					35%		204		204	225
	ET				0									0	0
	EL	67	68		68	90%		7		23%		134		141	209

5	Grand Island Boulevard				0										
	Bedell Road				0										
	SR	4	4		4					35%		204		204	208
	ST	92	93		93									0	93
	SL	80	81		81									0	81
	WR	71	72		72									0	72
	WT	8	8		8					2%		12		12	20
	WL	43	43		43									0	43
	NR	86	87		87									0	87
	NT	120	121		121									0	121
	NL	37	37		37					3%		17		17	54
	ER	28	28		28						33%		195	195	223
	ET	8	8		8						5%		30	30	38
	EL	17	17		17									0	17
6	Grand Island Boulevard				0										
	Baseline Road				0										
	SR	23	23		23						16%		95	95	118
	ST	133	134	7	141						17%		101	101	242
	SL	111	112		112									0	112
	WR	199	201		201									0	201
	WT	211	213		213									0	213
	WL	21	21		21									0	21
	NR	14	14		14									0	14
	NT	98	99	6	105					2%		12		12	117
	NL	68	69	3	72									0	72
	ER	80	81		81									0	81
	ET	140	141		141									0	141
	EL	17	17		17					1%		6		6	23
7	Grand Island Boulevard														
	Whitehaven Road														
	SR	18	18		18									0	18
	ST	225	227	8	235						12%		71	71	306
	SL	68	69	2	71						15%		89	89	160
	WR	87	88	3	91					2%		12		12	103
	WT	73	74	2	76					3%		17		17	93
	WL	71	72	4	76									0	76
	NR	117	118	2	120									0	120
	NT	375	379	6	385									0	385
	NL	44	44	1	45									0	45
	ER	86	87	3	90									0	90
	ET	118	119	6	125									0	125
	EL	20	20		20									0	20
8	Grand Island Boulevard														
	Staley Road														
	SR	12	12		12									0	12
	ST	273	276	10	286						10%		59	59	345
	SL	22	22		22						2%		12	12	34
	SU	0	0		0									0	0
	WR	32	32		32									0	32
	WT	6	6		6					5%		29		29	35
	WL	223	225		225									0	225
	WU	0	0		0									0	0
	NR	369	373		373									0	373
	NT	434	438	9	447									0	447
	NL	84	85		85									0	85
	NU	6	6		6									0	6
	ER	140	141		141									0	141
	ET	20	20		20									0	20
	EL	12	12		12									0	12
	EU	0	0		0									0	0
9	Bedell Road														
	Proposed Site Driveway														
	SR				0									0	0
	ST				0									0	0
	SL				0						38%		225	225	225
	WR				0					40%		233		233	233
	WT	49	49		49									0	49
	WL				0									0	0
	NR				0									0	0
	NT				0									0	0
	NL				0									0	0
	ER				0									0	0
	ET	53	54		53									0	53
	EL				0									0	0

Int #	Grand Island Boulevard and I-190 Ramp	Left turn	Rear-end	Overtaking	Right Angle	Right Turn	Head On	Side-swipe	Fixed Object	Backing	Other	Animal	Bike/Ped	Total	Injury	Non Injury	Non-Repo	Sum
1									2					2		2		2
	TOTALS	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**		**0**	**2**	**0**	

1. Grand Island Boulevard and I-190 Ramp

	Northbound	Southbound	Eastbound	Westbound	Unknown	Totals
Left turn						**0**
Rear-end						**0**
Overtaking						**0**
Right Angle						**0**
Right Turn						**0**
Head On						**0**
Side-swipe						**0**
Fixed Object		1	1			**2**
Backing						**0**
Other						**0**
Bike/Ped						**0**
Animal						**0**
Totals	**0**	**1**	**1**	**0**	**0**	**2**

---

1 **Grand Island Boulevard and I-190 Ramp - 36 months**

ADT = Peak hour entering volume / k factor

ADT = 463 VPH / 0.10 = 4873.68421 VPD

$$\text{Rate} = \frac{2 \text{ Acc.} \times 1{,}000{,}000}{4873.68421 \text{ VPD} \times 365 \text{ Days} \times 3.000 \text{ Yrs.}} = 0.37 \text{ Crash / MEV}$$

3

Int #

2 **Grand Island Boulevard and Long Road**

	Left turn	Rear-end	Overtaking	Right Angle	Right Turn	Head On	Side-swipe	Fixed Object	Backing	Other	Animal	Bike/Ped	**Total**	Injury	Non Injury	Non-Repo	**Sum**
		1		2									**3**	1	1	1	**3**
TOTALS	**0**	**1**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**1**	**1**	**1**	

2. Grand Island Boulevard and Long Road

	Northbound	Southbound	Eastbound	Westbound	Unknown	**Totals**
Left turn						**0**
Rear-end			1			**1**
Overtaking						**0**
Right Angle	1		1			**2**
Right Turn						**0**
Head On						**0**
Side-swipe						**0**
Fixed Object						**0**
Backing						**0**
Other						**0**
Bike/Ped						**0**
Animal						**0**
Totals	**1**	**0**	**2**	**0**	**0**	**3**

---

2 **Grand Island Boulevard and Long Road - 36 months**

ADT = Peak hour entering volume / k factor

ADT = 644 VPH / 0.10 = 6778.947 VPD

Rate = 3 Acc. x 1,000,000 / 6778.9474 VPD x 365 Days x 3.000 Yrs. = 0.40 Crash / MEV

Int #	Grand Island Boulevard and Bedell Road																
3	Left turn	Rear-end	Overtaking	Right Angle	Right Turn	Head On	Side-swipe	Fixed Object	Backing	Other	Animal	Bike/Ped	**Total**	Injury	Non Injury	Non-Repo	**Sum**
					1		1	1		2			**5**	1	2	2	**5**
TOTALS	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**2**	**0**	**0**		**1**	**2**	**2**	

3. Grand Island Boulevard and Bedell Road

	Northbound	Southbound	Eastbound	Westbound	Unknown	**Totals**
Left turn						**0**
Rear-end						**0**
Overtaking						**0**
Right Angle						**0**
Right Turn				1		**1**
Head On						**0**
Side-swipe	1					**1**
Fixed Object			1			**1**
Backing						**0**
Other	2					**2**
Bike/Ped						**0**
Animal						**0**
Totals	**3**	**0**	**1**	**1**	**0**	**5**

---

3 **Grand Island Boulevard and Bedell Road - 36 months**

ADT = Peak hour entering volume / k factor

ADT = 583 VPH / 0.10 = 6136.842 VPD

Rate = 5 Acc. x 1,000,000 / 6136.8421 VPD x 365 Days x 3.000 Yrs. = 0.74 Crash / MEV

Int #		Left turn	Rear-end	Overtaking	Right Angle	Right Turn	Head On	Side-swipe	Fixed Object	Backing	Other	Animal	Bike/Ped	Total	Injury	Non Injury	Non-Repo	Sum
4	**Grand Island Boulevard and Baseline Road**	3	4		2		1		1		3			**14**	6	7	1	**14**
TOTALS		**3**	**4**	**0**	**2**	**0**	**1**	**0**	**1**	**0**	**3**	**0**	**0**		**6**	**7**	**1**	

4. Grand Island Boulevard and Baseline Road

	Northbound	Southbound	Eastbound	Westbound	Unknown	**Totals**
Left turn	2	1				**3**
Rear-end	1	2		1		**4**
Overtaking						**0**
Right Angle	2					**2**
Right Turn						**0**
Head On	1					**1**
Side-swipe						**0**
Fixed Object		1				**1**
Backing						**0**
Other		1	2			**3**
Bike/Ped						**0**
Animal						**0**
Totals	**6**	**5**	**2**	**1**	**0**	**14**

---

4 **Grand Island Boulevard and Baseline Road - 36 months**

ADT = Peak hour entering volume / k factor

ADT = 1027 VPH / 0.10 = 10810.53 VPD

Rate = 14 Acc. x 1,000,000 / 10810.526 VPD x 365 Days x 3.000 Yrs. = 1.18 Crash / MEV

Int #		Left turn	Rear-end	Overtaking	Right Angle	Right Turn	Head On	Side-swipe	Fixed Object	Backing	Other	Animal	Bike/Ped	Total	Injury	Non Injury	Non-Repo	Sum
5	**Grand Island Boulevard and Whitehaven Road**	2	2	1	5		1		1		2		3	**17**	9	8		**17**
TOTALS		**2**	**2**	**1**	**5**	**0**	**1**	**0**	**1**	**0**	**2**	**0**	**3**		**9**	**8**	**0**	

5. Grand Island Boulevard and Whitehaven Road

	Northbound	Southbound	Eastbound	Westbound	Unknown	**Totals**
Left turn			1		1	**2**
Rear-end			1		1	**2**
Overtaking				1		**1**
Right Angle	1		1	3		**5**
Right Turn						**0**
Head On	1					**1**
Side-swipe						**0**
Fixed Object						**0**
Backing					1	**1**
Other		1		1		**2**
Bike/Ped		2		1		**3**
Animal						**0**
Totals	**2**	**3**	**3**	**6**	**3**	**17**

---

5 **Grand Island Boulevard and Whitehaven Road - 36 months**

ADT = Peak hour entering volume / k factor

ADT = 1252 VPH / 0.10 = 13178.95 VPD

Rate = $\frac{17 \text{ Acc.} \times 1{,}000{,}000}{13178.947 \text{ VPD} \times 365 \text{ Days} \times 3.000 \text{ Yrs.}}$ = 1.18 Crash / MEV

Int #		Left turn	Rear-end	Overtaking	Right Angle	Right Turn	Head On	Side-swipe	Fixed Object	Backing	Other	Animal	Bike/Ped	Total	Injury	Non Injury	Non-Repo	Sum
6	**Grand Island Boulevard and Staley Road**		4	1	1				2		2			**10**	4	3	3	**10**
TOTALS		**0**	**4**	**1**	**1**	**0**	**0**	**0**	**2**	**0**	**2**	**0**	**0**		**4**	**3**	**3**	

6. Grand Island Boulevard and Staley Road

	Northbound	Southbound	Eastbound	Westbound	Unknown	**Totals**
Left turn						**0**
Rear-end	1	1	2			**4**
Overtaking		1				**1**
Right Angle		1				**1**
Right Turn						**0**
Head On						**0**
Side-swipe						**0**
Fixed Object		2				**2**
Backing						**0**
Other	1	1				**2**
Bike/Ped						**0**
Animal						**0**
Totals	**2**	**6**	**2**	**0**	**0**	**10**

---

6 **Grand Island Boulevard and Staley Road - 36 months**

ADT = Peak hour entering volume / k factor

ADT = 1627 VPH / 0.10 = 17126.32 VPD

Rate = 10 Acc. x 1,000,000 / 17126.316 VPD x 365 Days x 3.000 Yrs. = 0.53 Crash / MEV

Int #		Left turn	Rear-end	Overtaking	Right Angle	Right Turn	Head On	Side-swipe	Fixed Object	Backing	Other	Animal	Bike/Ped	Total	Injury	Non Injury	Non-Repo	Sum
7	**Long Road and I-190**		1											**1**	1			**1**
TOTALS		**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**1**	**0**	**0**	

7. Long Road and I-190

	Northbound	Southbound	Eastbound	Westbound	Unknown	**Totals**
Left turn						**0**
Rear-end				1		**1**
Overtaking						**0**
Right Angle						**0**
Right Turn						**0**
Head On						**0**
Side-swipe						**0**
Fixed Object						**0**
Backing						**0**
Other						**0**
Bike/Ped						**0**
Animal						**0**
Totals	**0**	**0**	**0**	**1**	**0**	**1**

---

7 **Long Road and I190 - 36 months**

ADT = Peak hour entering volume / k factor

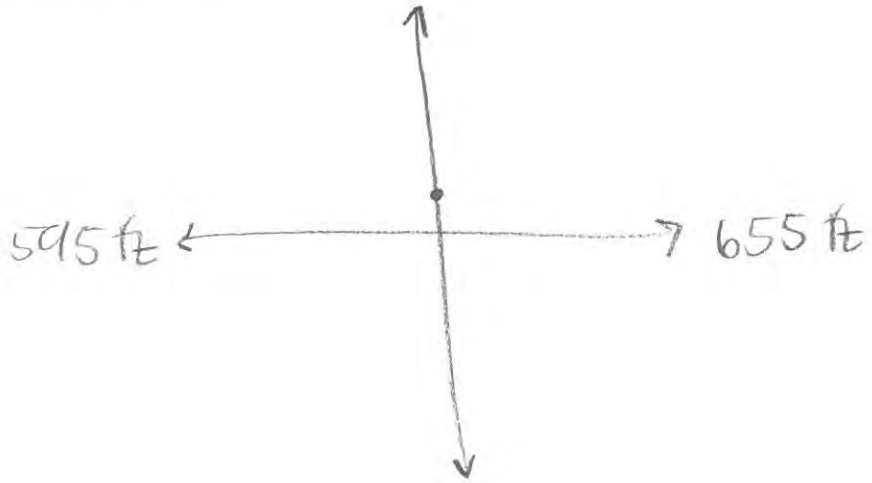
ADT = 311 VPH / 0.10 = 3273.684 VPD

Rate = $\frac{1 \text{ Acc.} \times 1{,}000{,}000}{3273.6842 \text{ VPD} \times 365 \text{ Days} \times 3.000 \text{ Yrs.}}$ = 0.28 Crash / MEV

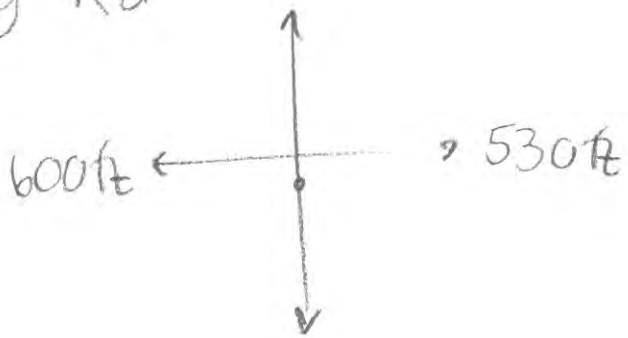
39064

Site distance 11/21

@ Bedell Rd



@ Long Rd



A3

Level of Service: Criteria and Definitions

Level of Service Criteria

Highway Capacity Manual 2016

SIGNALIZED INTERSECTIONS

Level of Service is a qualitative measure describing operational conditions within a traffic stream, based on service measures such as speed and travel time, freedom to maneuver, traffic interruptions, comfort, and convenience. Level of Service for signalized intersections is defined in terms of delay specifically, average total delay per vehicle for a 15 minute analysis period. The ranges are as follows:

Level of Service	Control Delay per vehicle (seconds)
A	< 10
B	10 – 20
C	20 – 35
D	35 – 55
E	55 – 80
F	>80

UNSIGNALIZED INTERSECTIONS

Level of Service for unsignalized intersections is also defined in terms of delay. However, the delay criteria are different from a signalized intersection. The primary reason for this is driver expectation that a signalized intersection is designed to carry higher volumes than an unsignalized intersection. The total delay threshold for any given Level of Service is less for an unsignalized intersection than for a signalized intersection. The ranges are as follows:

Level of Service	Control Delay per vehicle (seconds)
A	< 10
B	10 – 15
C	15 – 25
D	25 – 35
E	35 - 50
F	>50

A4

Level of Service Calculations: Existing Conditions

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	0	46	16	2	0	0
Future Vol, veh/h	0	46	16	2	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	0	55	19	2	0	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	21	0	-	0	75	20
Stage 1	-	-	-	-	20	-
Stage 2	-	-	-	-	55	-
Critical Hdwy	4.1	-	-	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	1608	-	-	-	933	1064
Stage 1	-	-	-	-	1008	-
Stage 2	-	-	-	-	973	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1608	-	-	-	933	1064
Mov Cap-2 Maneuver	-	-	-	-	933	-
Stage 1	-	-	-	-	1008	-
Stage 2	-	-	-	-	973	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	0
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1608	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	0	-	-	-	0
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	-

Intersection	
Int Delay, s/veh	5.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	37	16	152	32	19	0
Future Vol, veh/h	37	16	152	32	19	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	0	0	0	1	0	0
Mvmt Flow	43	18	175	37	22	0

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	61	0	439	-
Stage 1	-	-	-	-	52	-
Stage 2	-	-	-	-	387	-
Critical Hdwy	-	-	4.1	-	6.4	-
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	-
Pot Cap-1 Maneuver	-	-	1555	-	579	0
Stage 1	-	-	-	-	976	0
Stage 2	-	-	-	-	691	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1555	-	512	-
Mov Cap-2 Maneuver	-	-	-	-	512	-
Stage 1	-	-	-	-	976	-
Stage 2	-	-	-	-	612	-

Approach	EB	WB	NB
HCM Control Delay, s	0	6.3	12.3
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	512	-	-	1555	-
HCM Lane V/C Ratio	0.043	-	-	0.112	-
HCM Control Delay (s)	12.3	-	-	7.6	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0.4	-

Intersection	
Intersection Delay, s/veh	9.3
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	28	25	102	14	146	56	40	111	22	0	0	0
Future Vol, veh/h	28	25	102	14	146	56	40	111	22	0	0	0
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles, %	0	0	1	0	1	0	0	1	0	0	0	0
Mvmt Flow	33	29	119	16	170	65	47	129	26	0	0	0
Number of Lanes	0	1	1	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	2
HCM Control Delay	8.3	9.8	9.7	0
HCM LOS	A	A	A	-

Lane	NBLn1	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	23%	53%	0%	6%	0%
Vol Thru, %	64%	47%	0%	68%	100%
Vol Right, %	13%	0%	100%	26%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	173	53	102	216	0
LT Vol	40	28	0	14	0
Through Vol	111	25	0	146	0
RT Vol	22	0	102	56	0
Lane Flow Rate	201	62	119	251	0
Geometry Grp	2	7	7	5	2
Degree of Util (X)	0.27	0.094	0.149	0.319	0
Departure Headway (Hd)	4.837	5.494	4.522	4.57	5.16
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	740	651	791	786	0
Service Time	2.88	3.236	2.264	2.608	3.224
HCM Lane V/C Ratio	0.272	0.095	0.15	0.319	0
HCM Control Delay	9.7	8.8	8.1	9.8	8.2
HCM Lane LOS	A	A	A	A	N
HCM 95th-tile Q	1.1	0.3	0.5	1.4	0

Intersection	
Int Delay, s/veh	1.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	29	32	0	145	115	0
Future Vol, veh/h	29	32	0	145	115	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	0	0	0	1	1	0
Mvmt Flow	34	37	0	169	134	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	303	134	-	0	-	0
Stage 1	134	-	-	-	-	-
Stage 2	169	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	-	-
Pot Cap-1 Maneuver	693	920	0	-	-	0
Stage 1	897	-	0	-	-	0
Stage 2	866	-	0	-	-	0
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	693	920	-	-	-	-
Mov Cap-2 Maneuver	693	-	-	-	-	-
Stage 1	897	-	-	-	-	-
Stage 2	866	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10	0	0
HCM LOS	B		

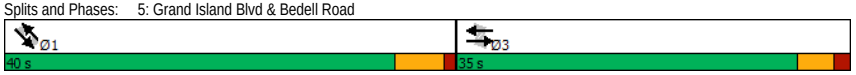
Minor Lane/Major Mvmt	NBT	EBLn1	SBT
Capacity (veh/h)	-	796	-
HCM Lane V/C Ratio	-	0.089	-
HCM Control Delay (s)	-	10	-
HCM Lane LOS	-	B	-
HCM 95th %tile Q(veh)	-	0.3	-

5: Grand Island Blvd & Bedell Road

Lane Group	EBL	EBT	WBL	WBT	SEL	SET	NWL	NWT
Lane Configurations								
Traffic Volume (vph)	1	10	67	16	23	59	41	69
Future Volume (vph)	1	10	67	16	23	59	41	69
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		3		3		1		1
Permitted Phases	3		3		1		1	
Detector Phase	3	3	3	3	1	1	1	1
Switch Phase								
Minimum Initial (s)	6.0	6.0	6.0	6.0	10.0	10.0	10.0	10.0
Minimum Split (s)	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Total Split (s)	35.0	35.0	35.0	35.0	40.0	40.0	40.0	40.0
Total Split (%)	46.7%	46.7%	46.7%	46.7%	53.3%	53.3%	53.3%	53.3%
Yellow Time (s)	3.2	3.2	3.2	3.2	4.3	4.3	4.3	4.3
All-Red Time (s)	1.6	1.6	1.6	1.6	1.2	1.2	1.2	1.2
Lost Time Adjust (s)		0.0		0.0		0.0		0.0
Total Lost Time (s)		4.8		4.8		5.5		5.5
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)		6.8		6.8		14.1		14.1
Actuated g/C Ratio		0.24		0.24		0.50		0.50
v/c Ratio		0.11		0.42		0.13		0.16
Control Delay		5.1		8.6		5.6		6.4
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		5.1		8.6		5.6		6.4
LOS		A		A		A		A
Approach Delay		5.1		8.6		5.6		6.4
Approach LOS		A		A		A		A

Intersection Summary	
Cycle Length: 75	
Actuated Cycle Length: 28.3	
Natural Cycle: 45	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.42	
Intersection Signal Delay: 6.9	Intersection LOS: A
Intersection Capacity Utilization 35.3%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 5: Grand Island Blvd & Bedell Road



6: Baseline Road & Grand Island Blvd

Lane Group	NBL	NBT	SBL	SBT	SET	NWL	NWT
Lane Configurations							
Traffic Volume (vph)	57	40	93	236	86	1	96
Future Volume (vph)	57	40	93	236	86	1	96
Turn Type	Perm	NA	Perm	NA	NA	Perm	NA
Protected Phases		1		1	3		3
Permitted Phases	1		1			3	
Detector Phase	1	1	1	1	3	3	3
Switch Phase							
Minimum Initial (s)	25.0	25.0	25.0	25.0	15.0	15.0	15.0
Minimum Split (s)	37.7	37.7	37.7	37.7	37.7	37.7	37.7
Total Split (s)	40.0	40.0	40.0	40.0	35.0	35.0	35.0
Total Split (%)	53.3%	53.3%	53.3%	53.3%	46.7%	46.7%	46.7%
Yellow Time (s)	4.3	4.3	4.3	4.3	4.3	4.3	4.3
All-Red Time (s)	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Lead/Lag							
Lead-Lag Optimize?							
Recall Mode	Min	Min	Min	Min	Min	Min	Min
Act Effct Green (s)	25.0	25.0	25.0	25.0	15.8	15.8	15.8
Actuated g/C Ratio	0.48	0.48	0.48	0.48	0.30	0.30	0.30
v/c Ratio	0.12	0.03	0.15	0.16	0.35	0.00	0.29
Control Delay	8.8	7.5	8.9	8.0	10.1	12.0	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	8.8	7.5	8.9	8.0	10.1	12.0	11.8
LOS	A	A	A	A	B	B	B
Approach Delay		8.3		8.2	10.1		11.8
Approach LOS		A		A	B		B

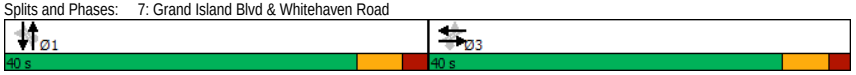
Intersection Summary	
Cycle Length: 75	
Actuated Cycle Length: 52.2	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.35	
Intersection Signal Delay: 9.3	Intersection LOS: A
Intersection Capacity Utilization 68.4%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 6: Baseline Road & Grand Island Blvd

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	8	72	38	47	197	54	114	27	155
Future Volume (vph)	8	72	38	47	197	54	114	27	155
Turn Type	Perm	NA	Perm	Perm	NA	Perm	NA	Perm	NA
Protected Phases		3			3		1		1
Permitted Phases	3		3	3		1		1	
Detector Phase	3	3	3	3	3	1	1	1	1
Switch Phase									
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0	10.0	10.0	10.0	10.0
Minimum Split (s)	35.5	35.5	35.5	35.5	35.5	36.8	36.8	36.8	36.8
Total Split (s)	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Yellow Time (s)	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2	2.5	2.5	2.5	2.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.5	6.5	6.5	6.5	6.5	6.8	6.8	6.8	6.8
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	None	Min	Min	Min	Min
Act Effct Green (s)	10.7	10.7	10.7	10.7	10.7	12.5	12.5	12.5	12.5
Actuated g/C Ratio	0.29	0.29	0.29	0.29	0.29	0.34	0.34	0.34	0.34
v/c Ratio	0.03	0.17	0.10	0.16	0.29	0.17	0.29	0.08	0.33
Control Delay	10.4	11.1	4.5	11.4	9.8	10.5	9.9	9.7	11.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.4	11.1	4.5	11.4	9.8	10.5	9.9	9.7	11.3
LOS	B	B	A	B	A	B	A	A	B
Approach Delay		8.9			10.1		10.0		11.1
Approach LOS		A			B		B		B

Intersection Summary	
Cycle Length: 80	
Actuated Cycle Length: 36.9	
Natural Cycle: 75	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.33	
Intersection Signal Delay: 10.1	Intersection LOS: B
Intersection Capacity Utilization 42.9%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 7: Grand Island Blvd & Whitehaven Road



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	24	12	0	1	0
Future Volume (vph)	0	24	12	0	1	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						
Flt Protected					0.950	
Satd. Flow (prot)	0	1863	1863	0	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	0	1863	1863	0	1770	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		305	680		378	
Travel Time (s)		6.9	15.5		8.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	26	13	0	1	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	26	13	0	1	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 13.3%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	0	24	12	0	1	0
Future Vol, veh/h	0	24	12	0	1	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	26	13	0	1	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	13	0	-	0	39	13
Stage 1	-	-	-	-	13	-
Stage 2	-	-	-	-	26	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1606	-	-	-	973	1067
Stage 1	-	-	-	-	1010	-
Stage 2	-	-	-	-	997	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1606	-	-	-	973	1067
Mov Cap-2 Maneuver	-	-	-	-	973	-
Stage 1	-	-	-	-	1010	-
Stage 2	-	-	-	-	997	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	8.7
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1606	-	-	-	973
HCM Lane V/C Ratio	-	-	-	-	0.001
HCM Control Delay (s)	0	-	-	-	8.7
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	7	3	50	19	2	0
Future Volume (vph)	7	3	50	19	2	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.961					
Flt Protected				0.965	0.950	
Satd. Flow (prot)	1826	0	0	1834	1805	0
Flt Permitted				0.965	0.950	
Satd. Flow (perm)	1826	0	0	1834	1805	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	680			268	304	
Travel Time (s)	15.5			6.1	6.9	
Peak Hour Factor	0.71	0.71	0.71	0.71	0.71	0.71
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	10	4	70	27	3	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	14	0	0	97	3	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 20.4%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	4.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	7	3	50	19	2	0
Future Vol, veh/h	7	3	50	19	2	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	71	71	71	71	71	71
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	10	4	70	27	3	0

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	14	0	179	-
Stage 1	-	-	-	-	12	-
Stage 2	-	-	-	-	167	-
Critical Hdwy	-	-	4.1	-	6.4	-
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	-
Pot Cap-1 Maneuver	-	-	1617	-	815	0
Stage 1	-	-	-	-	1016	0
Stage 2	-	-	-	-	867	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1617	-	779	-
Mov Cap-2 Maneuver	-	-	-	-	779	-
Stage 1	-	-	-	-	1016	-
Stage 2	-	-	-	-	829	-

Approach	EB	WB	NB
HCM Control Delay, s	0	5.3	9.6
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	779	-	-	1617	-
HCM Lane V/C Ratio	0.004	-	-	0.044	-
HCM Control Delay (s)	9.6	-	-	7.3	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0.1	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	82	166	17	36	55	27	177	89	0	2	6
Future Volume (vph)	55	82	166	17	36	55	27	177	89	0	2	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.931			0.959			0.895	
Flt Protected		0.980			0.992			0.995				
Satd. Flow (prot)	0	1862	1615	0	1755	0	0	1802	0	0	1674	0
Flt Permitted		0.980			0.992			0.995				
Satd. Flow (perm)	0	1862	1615	0	1755	0	0	1802	0	0	1674	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1099			662			615			522	
Travel Time (s)		25.0			15.0			14.0			11.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	2%
Adj. Flow (vph)	60	89	180	18	39	60	29	192	97	0	2	7
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	149	180	0	117	0	0	318	0	0	9	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 43.6%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	10.1
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	55	82	166	17	36	55	27	177	89	0	2	6
Future Vol, veh/h	55	82	166	17	36	55	27	177	89	0	2	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	0	0	0	0	0	0	0	1	0	0	0	2
Mvmt Flow	60	89	180	18	39	60	29	192	97	0	2	7
Number of Lanes	0	1	1	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	2
HCM Control Delay	9.5	8.9	11.3	8.1
HCM LOS	A	A	B	A

Lane	NBLn1	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	9%	40%	0%	16%	0%
Vol Thru, %	60%	60%	0%	33%	25%
Vol Right, %	30%	0%	100%	51%	75%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	293	137	166	108	8
LT Vol	27	55	0	17	0
Through Vol	177	82	0	36	2
RT Vol	89	0	166	55	6
Lane Flow Rate	318	149	180	117	9
Geometry Grp	2	7	7	5	2
Degree of Util (X)	0.421	0.233	0.236	0.16	0.012
Departure Headway (Hd)	4.762	5.622	4.714	4.917	4.906
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	752	634	756	722	720
Service Time	2.817	3.39	2.48	2.997	2.999
HCM Lane V/C Ratio	0.423	0.235	0.238	0.162	0.013
HCM Control Delay	11.3	10.1	9	8.9	8.1
HCM Lane LOS	B	B	A	A	A
HCM 95th-tile Q	2.1	0.9	0.9	0.6	0

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	67	21	0	226	149	0
Future Volume (vph)	67	21	0	226	149	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.968					
Flt Protected	0.963					
Satd. Flow (prot)	1750	0	0	1900	1881	0
Flt Permitted	0.963					
Satd. Flow (perm)	1750	0	0	1900	1881	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	283			4618	261	
Travel Time (s)	6.4			105.0	5.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	0%	5%	0%	0%	1%	0%
Adj. Flow (vph)	74	23	0	251	166	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	97	0	0	251	166	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	15			9
Sign Control	Stop			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 23.6%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	67	21	0	226	149	0
Future Vol, veh/h	67	21	0	226	149	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	0	5	0	0	1	0
Mvmt Flow	74	23	0	251	166	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	417	166	-	0	-	0
Stage 1	166	-	-	-	-	-
Stage 2	251	-	-	-	-	-
Critical Hdwy	6.4	6.25	-	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.345	-	-	-	-
Pot Cap-1 Maneuver	596	871	0	-	-	0
Stage 1	868	-	0	-	-	0
Stage 2	795	-	0	-	-	0
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	596	871	-	-	-	-
Mov Cap-2 Maneuver	596	-	-	-	-	-
Stage 1	868	-	-	-	-	-
Stage 2	795	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.6	0	0
HCM LOS	B		

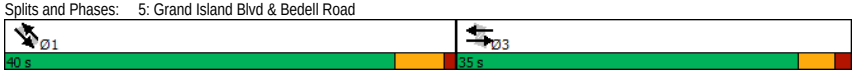
Minor Lane/Major Mvmt	NBT	EBLn1	SBT
Capacity (veh/h)	-	645	-
HCM Lane V/C Ratio	-	0.152	-
HCM Control Delay (s)	-	11.6	-
HCM Lane LOS	-	B	-
HCM 95th %tile Q(veh)	-	0.5	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	17	8	28	43	8	71	80	92	4	37	120	86
Future Volume (vph)	17	8	28	43	8	71	80	92	4	37	120	86
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.929			0.922			0.997			0.952	
Flt Protected		0.984			0.983			0.978			0.992	
Satd. Flow (prot)	0	1667	0	0	1722	0	0	1853	0	0	1777	0
Flt Permitted		0.845			0.861			0.767			0.933	
Satd. Flow (perm)	0	1431	0	0	1508	0	0	1453	0	0	1671	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		30			76			2			48	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		564			771			4618			5011	
Travel Time (s)		12.8			17.5			105.0			113.9	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	2%	0%
Adj. Flow (vph)	18	9	30	46	9	76	86	99	4	40	129	92
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	57	0	0	131	0	0	189	0	0	261	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3			1			1		
Detector Phase	3	3		3	3		1	1		1	1	
Switch Phase												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Minimum Initial (s)	6.0	6.0		6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	35.0	35.0		35.0	35.0		40.0	40.0		40.0	40.0	
Total Split (%)	46.7%	46.7%		46.7%	46.7%		53.3%	53.3%		53.3%	53.3%	
Maximum Green (s)	30.2	30.2		30.2	30.2		34.5	34.5		34.5	34.5	
Yellow Time (s)	3.2	3.2		3.2	3.2		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.6	1.6		1.6	1.6		1.2	1.2		1.2	1.2	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.8			4.8			5.5			5.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	2.0		2.0	2.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Act Effct Green (s)		6.6			6.6			16.5			16.5	
Actuated g/C Ratio		0.22			0.22			0.55			0.55	
v/c Ratio		0.17			0.34			0.24			0.28	
Control Delay		7.7			8.0			6.5			5.6	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		7.7			8.0			6.5			5.6	
LOS		A			A			A			A	
Approach Delay		7.7			8.0			6.5			5.6	
Approach LOS		A			A			A			A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 75			
Actuated Cycle Length: 30.2			
Natural Cycle: 45			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.34			
Intersection Signal Delay: 6.6		Intersection LOS: A	
Intersection Capacity Utilization 40.8%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 5: Grand Island Blvd & Bedell Road

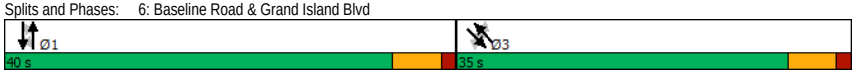


Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	68	98	14	111	133	23	17	140	80	21	211	199
Future Volume (vph)	68	98	14	111	133	23	17	140	80	21	211	199
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	145		0	165		0	200		0
Storage Lanes	1		0	2		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.981			0.978			0.946			0.927	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	3541	0	1805	3419	0	1805	1786	0	1805	1761	0
Flt Permitted	0.646			0.676			0.373			0.611		
Satd. Flow (perm)	1227	3541	0	1284	3419	0	709	1786	0	1161	1761	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		15			25			45			74	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		642			804			5011			1413	
Travel Time (s)		14.6			18.3			113.9			32.1	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	0%	0%	22%	0%	1%	0%	0%	0%	0%
Adj. Flow (vph)	73	105	15	119	143	25	18	151	86	23	227	214
Shared Lane Traffic (%)												
Lane Group Flow (vph)	73	120	0	119	168	0	18	237	0	23	441	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		1			1			3			3	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Permitted Phases	1			1			3			3		
Detector Phase	1	1		1	1		3	3		3	3	
Switch Phase												
Minimum Initial (s)	25.0	25.0		25.0	25.0		15.0	15.0		15.0	15.0	
Minimum Split (s)	37.7	37.7		37.7	37.7		37.7	37.7		37.7	37.7	
Total Split (s)	40.0	40.0		40.0	40.0		35.0	35.0		35.0	35.0	
Total Split (%)	53.3%	53.3%		53.3%	53.3%		46.7%	46.7%		46.7%	46.7%	
Maximum Green (s)	34.3	34.3		34.3	34.3		29.3	29.3		29.3	29.3	
Yellow Time (s)	4.3	4.3		4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.4	1.4		1.4	1.4		1.4	1.4		1.4	1.4	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.7	5.7		5.7	5.7		5.7	5.7		5.7	5.7	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0		4.0	4.0		6.0	6.0		6.0	6.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	25.2	25.2		25.2	25.2		23.4	23.4		23.4	23.4	
Actuated g/C Ratio	0.42	0.42		0.42	0.42		0.39	0.39		0.39	0.39	
v/c Ratio	0.14	0.08		0.22	0.12		0.07	0.33		0.05	0.60	
Control Delay	13.7	11.1		14.5	10.7		11.3	11.1		10.9	15.5	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	13.7	11.1		14.5	10.7		11.3	11.1		10.9	15.5	
LOS	B	B		B	B		B	B		B	B	
Approach Delay		12.1			12.3			11.1			15.3	
Approach LOS		B			B			B			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 75	
Actuated Cycle Length: 60.1	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.60	
Intersection Signal Delay: 13.2	Intersection LOS: B
Intersection Capacity Utilization 79.2%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 6: Baseline Road & Grand Island Blvd

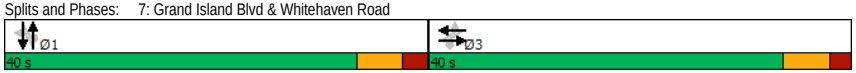


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	118	86	71	73	87	44	375	117	68	225	18
Future Volume (vph)	20	118	86	71	73	87	44	375	117	68	225	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		210	155		0	110		0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.918			0.964			0.989	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	1900	1615	1787	3255	0	1805	1832	0	1805	1879	0
Flt Permitted	0.641			0.674			0.595			0.386		
Satd. Flow (perm)	1218	1900	1615	1268	3255	0	1130	1832	0	733	1879	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			95		96			24			6	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		790			1017			5939			1413	
Travel Time (s)		18.0			23.1			135.0			32.1	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	0%	0%	0%	1%	4%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	22	130	95	78	80	96	48	412	129	75	247	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	22	130	95	78	176	0	48	541	0	75	267	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2		1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	3		3	3			1			1		
Detector Phase	3	3	3	3	3		1	1		1	1	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	35.5	35.5	35.5	35.5	35.5		36.8	36.8		36.8	36.8	
Total Split (s)	40.0	40.0	40.0	40.0	40.0		40.0	40.0		40.0	40.0	
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	33.5	33.5	33.5	33.5	33.5		33.2	33.2		33.2	33.2	
Yellow Time (s)	4.3	4.3	4.3	4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2		2.5	2.5		2.5	2.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.5	6.5	6.5	6.5	6.5		6.8	6.8		6.8	6.8	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None	None	None	None		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	22.0	22.0	22.0	22.0	22.0		23.0	23.0		23.0	23.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0		0	0	
Act Effct Green (s)	11.7	11.7	11.7	11.7	11.7		23.9	23.9		23.9	23.9	
Actuated g/C Ratio	0.24	0.24	0.24	0.24	0.24		0.48	0.48		0.48	0.48	
v/c Ratio	0.08	0.29	0.21	0.26	0.21		0.09	0.60		0.21	0.29	
Control Delay	17.3	18.7	6.0	19.4	9.3		8.1	12.6		9.9	8.9	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	17.3	18.7	6.0	19.4	9.3		8.1	12.6		9.9	8.9	
LOS	B	B	A	B	A		A	B		A	A	
Approach Delay		13.7			12.4			12.2			9.1	
Approach LOS		B			B			B			A	

Intersection Summary	
Area Type:	Other
Cycle Length: 80	
Actuated Cycle Length: 49.5	
Natural Cycle: 75	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.60	
Intersection Signal Delay: 11.8	Intersection LOS: B
Intersection Capacity Utilization 68.6%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 7: Grand Island Blvd & Whitehaven Road



Lane Group	EBT	EBR	WBL	WBT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	7	0	0	69	0	198
Future Volume (vph)	7	0	0	69	0	198
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	1863	0	0	1863	0	1611
Flt Permitted						
Satd. Flow (perm)	1863	0	0	1863	0	1611
Link Speed (mph)	30			30	30	
Link Distance (ft)	268			1099	401	
Travel Time (s)	6.1			25.0	9.1	
Peak Hour Factor	0.71	0.71	0.71	0.71	0.71	0.71
Adj. Flow (vph)	10	0	0	97	0	279
Shared Lane Traffic (%)						
Lane Group Flow (vph)	10	0	0	97	0	279
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 22.3%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	2	198	0	53	0	0
Future Volume (vph)	2	198	0	53	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.866					
Flt Protected						
Satd. Flow (prot)	1613	0	0	1863	0	0
Flt Permitted						
Satd. Flow (perm)	1613	0	0	1863	0	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	267			304	401	
Travel Time (s)	6.1			6.9	9.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	215	0	58	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	217	0	0	58	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 15.7%		ICU Level of Service A	
Analysis Period (min) 15			

MOVEMENT SUMMARY

Site: 1 [Grand Island Blvd @ Staley Road - 2019 AM SIDRA]

Grand Island Blvd @ Staley Road
Single Lane Roundabout
2019 AM - SIDRA Existing Conditions
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: Grand Island Blvd NB												
3	L2	186	3.0	0.235	7.2	LOS A	1.6	41.1	0.15	0.43	0.15	29.5
8	T1	168	1.4	0.235	1.6	LOS A	1.6	41.1	0.15	0.43	0.15	29.1
18	R2	248	0.5	0.184	2.4	LOS A	1.2	29.4	0.15	0.33	0.15	29.1
Approach		602	1.5	0.235	3.7	LOS A	1.6	41.1	0.15	0.39	0.15	29.2
East: Staley Road WB												
1	L2	513	0.2	0.568	10.9	LOS B	4.8	119.4	0.71	0.80	0.77	27.7
6	T1	24	0.0	0.568	5.3	LOS A	4.8	119.4	0.71	0.80	0.77	27.3
16	R2	23	0.0	0.568	5.8	LOS A	4.8	119.4	0.71	0.80	0.77	26.6
Approach		560	0.2	0.568	10.4	LOS B	4.8	119.4	0.71	0.80	0.77	27.6
North: Grand Island Blvd												
7	L2	5	0.0	0.356	12.5	LOS B	2.4	61.9	0.83	0.82	0.83	28.7
4	T1	216	4.8	0.356	7.3	LOS A	2.4	61.9	0.83	0.82	0.83	28.3
14	R2	5	0.0	0.356	7.4	LOS A	2.4	61.9	0.83	0.82	0.83	27.6
Approach		225	4.6	0.356	7.4	LOS A	2.4	61.9	0.83	0.82	0.83	28.3
West: Staley Road EB												
5	L2	2	0.0	0.239	12.3	LOS B	1.5	38.9	0.79	0.78	0.79	28.7
2	T1	18	0.0	0.239	6.7	LOS A	1.5	38.9	0.79	0.78	0.79	28.3
12	R2	138	0.8	0.239	7.3	LOS A	1.5	38.9	0.79	0.78	0.79	27.5
Approach		159	0.7	0.239	7.3	LOS A	1.5	38.9	0.79	0.78	0.79	27.6
All Vehicles		1546	1.4	0.568	7.0	LOS A	4.8	119.4	0.52	0.64	0.54	28.3

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [Grand Island Blvd @ Staley Road - 2019 PM SIDRA]

Grand Island Blvd @ Staley Road
Single Lane Roundabout
2019 AM - SIDRA Existing Conditions
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: Grand Island Blvd NB												
3	L2	99	0.0	0.411	7.5	LOS A	3.2	80.3	0.28	0.31	0.28	30.0
8	T1	511	0.9	0.411	1.9	LOS A	3.2	80.3	0.28	0.31	0.28	29.6
18	R2	434	0.5	0.333	2.7	LOS A	2.3	58.0	0.27	0.37	0.27	28.9
Approach		1044	0.6	0.411	2.8	LOS A	3.2	80.3	0.28	0.33	0.28	29.3
East: Staley Road WB												
1	L2	262	0.0	0.392	11.7	LOS B	2.6	64.6	0.76	0.83	0.76	27.5
6	T1	7	0.0	0.392	6.1	LOS A	2.6	64.6	0.76	0.83	0.76	27.1
16	R2	38	3.1	0.392	6.9	LOS A	2.6	64.6	0.76	0.83	0.76	26.5
Approach		307	0.4	0.392	11.0	LOS B	2.6	64.6	0.76	0.83	0.76	27.4
North: Grand Island Blvd SB												
7	L2	26	0.0	0.386	9.6	LOS A	2.6	66.3	0.65	0.55	0.65	29.3
4	T1	321	1.1	0.386	4.1	LOS A	2.6	66.3	0.65	0.55	0.65	28.9
14	R2	14	0.0	0.386	4.6	LOS A	2.6	66.3	0.65	0.55	0.65	28.1
Approach		361	1.0	0.386	4.5	LOS A	2.6	66.3	0.65	0.55	0.65	28.8
West: Staley Road EB												
5	L2	14	0.0	0.269	11.2	LOS B	1.7	42.5	0.72	0.73	0.72	29.0
2	T1	24	0.0	0.269	5.6	LOS A	1.7	42.5	0.72	0.73	0.72	28.6
12	R2	165	3.6	0.269	6.4	LOS A	1.7	42.5	0.72	0.73	0.72	27.8
Approach		202	2.9	0.269	6.6	LOS A	1.7	42.5	0.72	0.73	0.72	27.9
All Vehicles		1914	0.9	0.411	4.8	LOS A	3.2	80.3	0.47	0.50	0.47	28.7

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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A5

Level of Service Calculations: Background Conditions

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	46	16	2	0	0
Future Volume (vph)	0	46	16	2	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.987			
Flt Protected						
Satd. Flow (prot)	0	1900	1875	0	1900	0
Flt Permitted						
Satd. Flow (perm)	0	1900	1875	0	1900	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		305	701		314	
Travel Time (s)		6.9	15.9		7.1	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	0	55	19	2	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	55	21	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 6.7%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	0

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	0	46	16	2	0	0
Future Vol, veh/h	0	46	16	2	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	0	55	19	2	0	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	21	0	-	0	75	20
Stage 1	-	-	-	-	20	-
Stage 2	-	-	-	-	55	-
Critical Hdwy	4.1	-	-	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.2	-	-	-	3.5	3.3
Pot Cap-1 Maneuver	1608	-	-	-	933	1064
Stage 1	-	-	-	-	1008	-
Stage 2	-	-	-	-	973	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1608	-	-	-	933	1064
Mov Cap-2 Maneuver	-	-	-	-	933	-
Stage 1	-	-	-	-	1008	-
Stage 2	-	-	-	-	973	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	0
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1608	-	-	-	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	0	-	-	-	0
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	-

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	37	16	154	32	19	0
Future Volume (vph)	37	16	154	32	19	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.960					
Flt Protected				0.960	0.950	
Satd. Flow (prot)	1824	0	0	1821	1805	0
Flt Permitted				0.960	0.950	
Satd. Flow (perm)	1824	0	0	1821	1805	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	701			243	329	
Travel Time (s)	15.9			5.5	7.5	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%
Adj. Flow (vph)	43	18	177	37	22	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	61	0	0	214	22	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 26.9%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	5.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	37	16	154	32	19	0
Future Vol, veh/h	37	16	154	32	19	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	0	0	0	1	0	0
Mvmt Flow	43	18	177	37	22	0

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	61	0	443	-
Stage 1	-	-	-	-	52	-
Stage 2	-	-	-	-	391	-
Critical Hdwy	-	-	4.1	-	6.4	-
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	-
Pot Cap-1 Maneuver	-	-	1555	-	576	0
Stage 1	-	-	-	-	976	0
Stage 2	-	-	-	-	688	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1555	-	509	-
Mov Cap-2 Maneuver	-	-	-	-	509	-
Stage 1	-	-	-	-	976	-
Stage 2	-	-	-	-	608	-

Approach	EB	WB	NB
HCM Control Delay, s	0	6.3	12.4
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	509	-	-	1555	-
HCM Lane V/C Ratio	0.043	-	-	0.114	-
HCM Control Delay (s)	12.4	-	-	7.6	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0.4	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	28	25	103	14	147	57	40	112	22	0	0	0
Future Volume (vph)	28	25	103	14	147	57	40	112	22	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.965			0.983				
Flt Protected		0.974			0.997			0.989				
Satd. Flow (prot)	0	1851	1599	0	1816	0	0	1835	0	0	1900	0
Flt Permitted		0.974			0.997			0.989				
Satd. Flow (perm)	0	1851	1599	0	1816	0	0	1835	0	0	1900	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1103			662			615			522	
Travel Time (s)		25.1			15.0			14.0			11.9	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	0%	0%	1%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Adj. Flow (vph)	33	29	120	16	171	66	47	130	26	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	62	120	0	253	0	0	203	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 34.8%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	9.3
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	28	25	103	14	147	57	40	112	22	0	0	0
Future Vol, veh/h	28	25	103	14	147	57	40	112	22	0	0	0
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles, %	0	0	1	0	1	0	0	1	0	0	0	0
Mvmt Flow	33	29	120	16	171	66	47	130	26	0	0	0
Number of Lanes	0	1	1	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	2
HCM Control Delay	8.3	9.8	9.7	0
HCM LOS	A	A	A	-

Lane	NBLn1	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	23%	53%	0%	6%	0%
Vol Thru, %	64%	47%	0%	67%	100%
Vol Right, %	13%	0%	100%	26%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	174	53	103	218	0
LT Vol	40	28	0	14	0
Through Vol	112	25	0	147	0
RT Vol	22	0	103	57	0
Lane Flow Rate	202	62	120	253	0
Geometry Grp	2	7	7	5	2
Degree of Util (X)	0.272	0.094	0.151	0.322	0
Departure Headway (Hd)	4.844	5.499	4.527	4.572	5.169
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	738	650	789	783	0
Service Time	2.889	3.243	2.271	2.613	3.236
HCM Lane V/C Ratio	0.274	0.095	0.152	0.323	0
HCM Control Delay	9.7	8.8	8.1	9.8	8.2
HCM Lane LOS	A	A	A	A	N
HCM 95th-tile Q	1.1	0.3	0.5	1.4	0

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	29	32	0	146	116	0
Future Volume (vph)	29	32	0	146	116	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.930					
Flt Protected	0.977					
Satd. Flow (prot)	1726	0	0	1881	1881	0
Flt Permitted	0.977					
Satd. Flow (perm)	1726	0	0	1881	1881	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	327			4618	261	
Travel Time (s)	7.4			105.0	5.9	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	0%	0%	0%	1%	1%	0%
Adj. Flow (vph)	34	37	0	170	135	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	71	0	0	170	135	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	15			9
Sign Control	Stop			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 17.9%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	1.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	29	32	0	146	116	0
Future Vol, veh/h	29	32	0	146	116	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	0	0	0	1	1	0
Mvmt Flow	34	37	0	170	135	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	305	135	-	0	-	0
Stage 1	135	-	-	-	-	-
Stage 2	170	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	-	-
Pot Cap-1 Maneuver	691	919	0	-	-	0
Stage 1	896	-	0	-	-	0
Stage 2	865	-	0	-	-	0
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	691	919	-	-	-	-
Mov Cap-2 Maneuver	691	-	-	-	-	-
Stage 1	896	-	-	-	-	-
Stage 2	865	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10	0	0
HCM LOS	B		

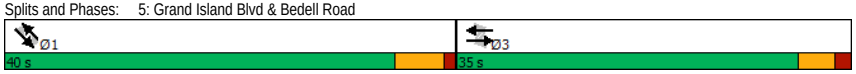
Minor Lane/Major Mvmt	NBT	EBLn1	SBT
Capacity (veh/h)	-	794	-
HCM Lane V/C Ratio	-	0.089	-
HCM Control Delay (s)	-	10	-
HCM Lane LOS	-	B	-
HCM 95th %tile Q(veh)	-	0.3	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	1	10	32	68	16	82	23	60	20	41	70	13
Future Volume (vph)	1	10	32	68	16	82	23	60	20	41	70	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.900			0.934			0.974			0.986	
Flt Protected		0.999			0.980			0.989			0.984	
Satd. Flow (prot)	0	1580	0	0	1714	0	0	1809	0	0	1821	0
Flt Permitted		0.988			0.845			0.922			0.882	
Satd. Flow (perm)	0	1563	0	0	1478	0	0	1687	0	0	1632	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		34			78			21			11	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3145			771			4618			5011	
Travel Time (s)		71.5			17.5			105.0			113.9	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	100%	0%	8%	0%	0%	3%	0%	2%	0%	2%	1%	0%
Adj. Flow (vph)	1	11	34	72	17	86	24	63	21	43	74	14
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	46	0	0	175	0	0	108	0	0	131	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3			1			1		
Detector Phase	3	3		3	3		1	1		1	1	
Switch Phase												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Minimum Initial (s)	6.0	6.0		6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	35.0	35.0		35.0	35.0		40.0	40.0		40.0	40.0	
Total Split (%)	46.7%	46.7%		46.7%	46.7%		53.3%	53.3%		53.3%	53.3%	
Maximum Green (s)	30.2	30.2		30.2	30.2		34.5	34.5		34.5	34.5	
Yellow Time (s)	3.2	3.2		3.2	3.2		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.6	1.6		1.6	1.6		1.2	1.2		1.2	1.2	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.8			4.8			5.5			5.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	2.0		2.0	2.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Act Effct Green (s)		6.9			6.9			14.1			14.1	
Actuated g/C Ratio		0.24			0.24			0.50			0.50	
v/c Ratio		0.11			0.42			0.13			0.16	
Control Delay		5.1			8.7			5.6			6.4	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		5.1			8.7			5.6			6.4	
LOS		A			A			A			A	
Approach Delay		5.1			8.7			5.6			6.4	
Approach LOS		A			A			A			A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 75			
Actuated Cycle Length: 28.3			
Natural Cycle: 45			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.42			
Intersection Signal Delay: 6.9		Intersection LOS: A	
Intersection Capacity Utilization 35.5%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 5: Grand Island Blvd & Bedell Road

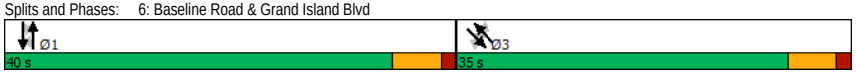


Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	63	44	2	94	241	14	0	87	98	1	97	54
Future Volume (vph)	63	44	2	94	241	14	0	87	98	1	97	54
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	145		0	165		0	200		0
Storage Lanes	1		0	2		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.994			0.992			0.921			0.947	
Flt Protected	0.950			0.950						0.950		
Satd. Flow (prot)	1752	3488	0	1805	3548	0	1900	1718	0	1805	1753	0
Flt Permitted	0.580			0.723						0.630		
Satd. Flow (perm)	1070	3488	0	1374	3548	0	1900	1718	0	1197	1753	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			10			89			43	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		642			804			5011			1413	
Travel Time (s)		14.6			18.3			113.9			32.1	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	3%	3%	0%	0%	1%	0%	0%	4%	0%	0%	3%	2%
Adj. Flow (vph)	69	48	2	103	265	15	0	96	108	1	107	59
Shared Lane Traffic (%)												
Lane Group Flow (vph)	69	50	0	103	280	0	0	204	0	1	166	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		1			1			3			3	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Permitted Phases	1			1			3			3		
Detector Phase	1	1		1	1		3	3		3	3	
Switch Phase												
Minimum Initial (s)	25.0	25.0		25.0	25.0		15.0	15.0		15.0	15.0	
Minimum Split (s)	37.7	37.7		37.7	37.7		37.7	37.7		37.7	37.7	
Total Split (s)	40.0	40.0		40.0	40.0		35.0	35.0		35.0	35.0	
Total Split (%)	53.3%	53.3%		53.3%	53.3%		46.7%	46.7%		46.7%	46.7%	
Maximum Green (s)	34.3	34.3		34.3	34.3		29.3	29.3		29.3	29.3	
Yellow Time (s)	4.3	4.3		4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.4	1.4		1.4	1.4		1.4	1.4		1.4	1.4	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.7	5.7		5.7	5.7		5.7	5.7		5.7	5.7	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0		4.0	4.0		6.0	6.0		6.0	6.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	25.0	25.0		25.0	25.0			16.0		16.0	16.0	
Actuated g/C Ratio	0.48	0.48		0.48	0.48			0.31		0.31	0.31	
v/c Ratio	0.14	0.03		0.16	0.16			0.35		0.00	0.29	
Control Delay	9.1	7.7		9.1	8.1			10.0		12.0	11.9	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	9.1	7.7		9.1	8.1			10.0		12.0	11.9	
LOS	A	A		A	A			B		B	B	
Approach Delay		8.5			8.4			10.0			11.9	
Approach LOS		A			A			B			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 75	
Actuated Cycle Length: 52.4	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.35	
Intersection Signal Delay: 9.5	Intersection LOS: A
Intersection Capacity Utilization 68.4%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 6: Baseline Road & Grand Island Blvd

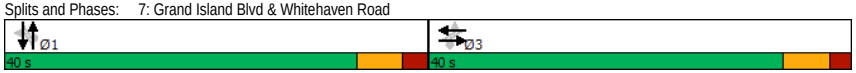


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	8	76	39	50	206	42	59	123	33	27	160	6
Future Volume (vph)	8	76	39	50	206	42	59	123	33	27	160	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		210	155		0	110		0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.975			0.968			0.994	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	1881	1538	1736	3491	0	1805	1831	0	1805	1802	0
Flt Permitted	0.561			0.695			0.626			0.633		
Satd. Flow (perm)	1066	1881	1538	1270	3491	0	1189	1831	0	1203	1802	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			52		37			21			3	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		790			1017			5939			1413	
Travel Time (s)		18.0			23.1			135.0			32.1	
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Heavy Vehicles (%)	0%	1%	5%	4%	1%	0%	0%	0%	2%	0%	5%	0%
Adj. Flow (vph)	10	96	49	63	261	53	75	156	42	34	203	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	10	96	49	63	314	0	75	198	0	34	211	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2		1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	3		3	3			1			1		
Detector Phase	3	3	3	3	3		1	1		1	1	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	35.5	35.5	35.5	35.5	35.5		36.8	36.8		36.8	36.8	
Total Split (s)	40.0	40.0	40.0	40.0	40.0		40.0	40.0		40.0	40.0	
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	33.5	33.5	33.5	33.5	33.5		33.2	33.2		33.2	33.2	
Yellow Time (s)	4.3	4.3	4.3	4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2		2.5	2.5		2.5	2.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.5	6.5	6.5	6.5	6.5		6.8	6.8		6.8	6.8	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None	None	None	None		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	22.0	22.0	22.0	22.0	22.0		23.0	23.0		23.0	23.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0		0	0	
Act Effct Green (s)	11.3	11.3	11.3	11.3	11.3		12.9	12.9		12.9	12.9	
Actuated g/C Ratio	0.30	0.30	0.30	0.30	0.30		0.34	0.34		0.34	0.34	
v/c Ratio	0.03	0.17	0.10	0.17	0.30		0.19	0.31		0.08	0.34	
Control Delay	10.5	11.2	4.5	11.6	10.0		10.9	10.3		10.0	11.6	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	10.5	11.2	4.5	11.6	10.0		10.9	10.3		10.0	11.6	
LOS	B	B	A	B	B		B	B		A	B	
Approach Delay		9.0			10.3			10.5			11.4	
Approach LOS		A			B			B			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 80	
Actuated Cycle Length: 37.9	
Natural Cycle: 75	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.34	
Intersection Signal Delay: 10.4	Intersection LOS: B
Intersection Capacity Utilization 43.3%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 7: Grand Island Blvd & Whitehaven Road



Lane Group	EBT	EBR	WBL	WBT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	37	0	0	186	0	113
Future Volume (vph)	37	0	0	186	0	113
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	1863	0	0	1863	0	1611
Flt Permitted						
Satd. Flow (perm)	1863	0	0	1863	0	1611
Link Speed (mph)	30			30	30	
Link Distance (ft)	243			1103	424	
Travel Time (s)	5.5			25.1	9.6	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	43	0	0	214	0	130
Shared Lane Traffic (%)						
Lane Group Flow (vph)	43	0	0	214	0	130
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 17.0%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	43	77	0	0	0
Future Volume (vph)	0	43	77	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						
Flt Protected						
Satd. Flow (prot)	0	1863	1863	0	0	0
Flt Permitted						
Satd. Flow (perm)	0	1863	1863	0	0	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		179	3145		393	
Travel Time (s)		4.1	71.5		8.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	47	84	0	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	47	84	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		0	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 7.4%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	19	113	0	170	0	0
Future Volume (vph)	19	113	0	170	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.885					
Flt Protected						
Satd. Flow (prot)	1649	0	0	1863	0	0
Flt Permitted						
Satd. Flow (perm)	1649	0	0	1863	0	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	179			329	424	
Travel Time (s)	4.1			7.5	9.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	21	123	0	185	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	144	0	0	185	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 12.3%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	24	12	0	1	0
Future Volume (vph)	0	24	12	0	1	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						
Flt Protected					0.950	
Satd. Flow (prot)	0	1863	1863	0	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	0	1863	1863	0	1770	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		305	695		378	
Travel Time (s)		6.9	15.8		8.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	26	13	0	1	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	26	13	0	1	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 13.3%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	0.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	0	24	12	0	1	0
Future Vol, veh/h	0	24	12	0	1	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	26	13	0	1	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	13	0	-	0	39	13
Stage 1	-	-	-	-	13	-
Stage 2	-	-	-	-	26	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1606	-	-	-	973	1067
Stage 1	-	-	-	-	1010	-
Stage 2	-	-	-	-	997	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1606	-	-	-	973	1067
Mov Cap-2 Maneuver	-	-	-	-	973	-
Stage 1	-	-	-	-	1010	-
Stage 2	-	-	-	-	997	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	8.7
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1606	-	-	-	973
HCM Lane V/C Ratio	-	-	-	-	0.001
HCM Control Delay (s)	0	-	-	-	8.7
HCM Lane LOS	A	-	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	7	3	51	19	2	0
Future Volume (vph)	7	3	51	19	2	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.961					
Flt Protected				0.965	0.950	
Satd. Flow (prot)	1826	0	0	1834	1805	0
Flt Permitted				0.965	0.950	
Satd. Flow (perm)	1826	0	0	1834	1805	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	695			248	327	
Travel Time (s)	15.8			5.6	7.4	
Peak Hour Factor	0.71	0.71	0.71	0.71	0.71	0.71
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	10	4	72	27	3	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	14	0	0	99	3	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 20.5%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	4.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	7	3	51	19	2	0
Future Vol, veh/h	7	3	51	19	2	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	71	71	71	71	71	71
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	10	4	72	27	3	0

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	14	0	183	-
Stage 1	-	-	-	-	12	-
Stage 2	-	-	-	-	171	-
Critical Hdwy	-	-	4.1	-	6.4	-
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	-
Pot Cap-1 Maneuver	-	-	1617	-	811	0
Stage 1	-	-	-	-	1016	0
Stage 2	-	-	-	-	864	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1617	-	775	-
Mov Cap-2 Maneuver	-	-	-	-	775	-
Stage 1	-	-	-	-	1016	-
Stage 2	-	-	-	-	825	-

Approach	EB	WB	NB
HCM Control Delay, s	0	5.3	9.7
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	775	-	-	1617	-
HCM Lane V/C Ratio	0.004	-	-	0.044	-
HCM Control Delay (s)	9.7	-	-	7.3	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0.1	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	56	83	168	17	36	56	27	179	90	0	2	6
Future Volume (vph)	56	83	168	17	36	56	27	179	90	0	2	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.930			0.959			0.895	
Flt Protected		0.980			0.992			0.996				
Satd. Flow (prot)	0	1862	1615	0	1753	0	0	1804	0	0	1674	0
Flt Permitted		0.980			0.992			0.996				
Satd. Flow (perm)	0	1862	1615	0	1753	0	0	1804	0	0	1674	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1104			662			615			522	
Travel Time (s)		25.1			15.0			14.0			11.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	2%
Adj. Flow (vph)	61	90	183	18	39	61	29	195	98	0	2	7
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	151	183	0	118	0	0	322	0	0	9	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 43.9%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	10.2
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	56	83	168	17	36	56	27	179	90	0	2	6
Future Vol, veh/h	56	83	168	17	36	56	27	179	90	0	2	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	0	0	0	0	0	0	0	1	0	0	0	2
Mvmt Flow	61	90	183	18	39	61	29	195	98	0	2	7
Number of Lanes	0	1	1	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	2
HCM Control Delay	9.5	9	11.4	8.1
HCM LOS	A	A	B	A

Lane	NBLn1	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	9%	40%	0%	16%	0%
Vol Thru, %	60%	60%	0%	33%	25%
Vol Right, %	30%	0%	100%	51%	75%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	296	139	168	109	8
LT Vol	27	56	0	17	0
Through Vol	179	83	0	36	2
RT Vol	90	0	168	56	6
Lane Flow Rate	322	151	183	118	9
Geometry Grp	2	7	7	5	2
Degree of Util (X)	0.427	0.236	0.24	0.162	0.012
Departure Headway (Hd)	4.773	5.634	4.725	4.93	4.925
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	750	633	754	720	717
Service Time	2.83	3.404	2.495	3.012	3.021
HCM Lane V/C Ratio	0.429	0.239	0.243	0.164	0.013
HCM Control Delay	11.4	10.2	9	9	8.1
HCM Lane LOS	B	B	A	A	A
HCM 95th-tile Q	2.1	0.9	0.9	0.6	0

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	68	21	0	228	150	0
Future Volume (vph)	68	21	0	228	150	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.969					
Flt Protected	0.963					
Satd. Flow (prot)	1753	0	0	1900	1881	0
Flt Permitted	0.963					
Satd. Flow (perm)	1753	0	0	1900	1881	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	283			4618	261	
Travel Time (s)	6.4			105.0	5.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	0%	5%	0%	0%	1%	0%
Adj. Flow (vph)	76	23	0	253	167	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	99	0	0	253	167	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	15			9
Sign Control	Stop			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 23.7%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	68	21	0	228	150	0
Future Vol, veh/h	68	21	0	228	150	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	0	5	0	0	1	0
Mvmt Flow	76	23	0	253	167	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	420	167	-	0	-	0
Stage 1	167	-	-	-	-	-
Stage 2	253	-	-	-	-	-
Critical Hdwy	6.4	6.25	-	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.345	-	-	-	-
Pot Cap-1 Maneuver	594	869	0	-	-	0
Stage 1	867	-	0	-	-	0
Stage 2	794	-	0	-	-	0
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	594	869	-	-	-	-
Mov Cap-2 Maneuver	594	-	-	-	-	-
Stage 1	867	-	-	-	-	-
Stage 2	794	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.6	0	0
HCM LOS	B		

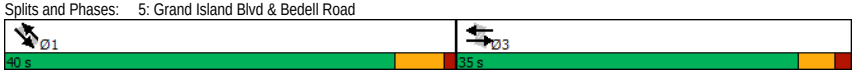
Minor Lane/Major Mvmt	NBT	EBLn1	SBT
Capacity (veh/h)	-	642	-
HCM Lane V/C Ratio	-	0.154	-
HCM Control Delay (s)	-	11.6	-
HCM Lane LOS	-	B	-
HCM 95th %tile Q(veh)	-	0.5	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	17	8	28	43	8	72	81	93	4	37	121	87
Future Volume (vph)	17	8	28	43	8	72	81	93	4	37	121	87
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.929			0.921			0.997			0.952	
Flt Protected		0.984			0.983			0.978			0.992	
Satd. Flow (prot)	0	1667	0	0	1720	0	0	1853	0	0	1777	0
Flt Permitted		0.845			0.861			0.765			0.933	
Satd. Flow (perm)	0	1431	0	0	1507	0	0	1449	0	0	1671	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		30			77			2			49	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3127			771			4618			5011	
Travel Time (s)		71.1			17.5			105.0			113.9	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	2%	0%
Adj. Flow (vph)	18	9	30	46	9	77	87	100	4	40	130	94
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	57	0	0	132	0	0	191	0	0	264	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3			1			1		
Detector Phase	3	3		3	3		1	1		1	1	
Switch Phase												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Minimum Initial (s)	6.0	6.0		6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	35.0	35.0		35.0	35.0		40.0	40.0		40.0	40.0	
Total Split (%)	46.7%	46.7%		46.7%	46.7%		53.3%	53.3%		53.3%	53.3%	
Maximum Green (s)	30.2	30.2		30.2	30.2		34.5	34.5		34.5	34.5	
Yellow Time (s)	3.2	3.2		3.2	3.2		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.6	1.6		1.6	1.6		1.2	1.2		1.2	1.2	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.8			4.8			5.5			5.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	2.0		2.0	2.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Act Effct Green (s)		6.6			6.6			16.5			16.5	
Actuated g/C Ratio		0.22			0.22			0.55			0.55	
v/c Ratio		0.17			0.34			0.24			0.28	
Control Delay		7.7			8.0			6.6			5.6	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		7.7			8.0			6.6			5.6	
LOS		A			A			A			A	
Approach Delay		7.7			8.0			6.6			5.6	
Approach LOS		A			A			A			A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 75			
Actuated Cycle Length: 30.2			
Natural Cycle: 45			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.34			
Intersection Signal Delay: 6.6		Intersection LOS: A	
Intersection Capacity Utilization 41.2%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 5: Grand Island Blvd & Bedell Road

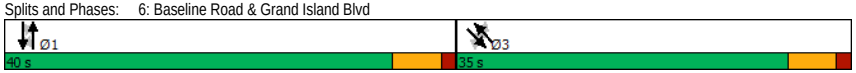


Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	72	105	14	112	141	23	17	141	81	21	213	201
Future Volume (vph)	72	105	14	112	141	23	17	141	81	21	213	201
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	145		0	165		0	200		0
Storage Lanes	1		0	2		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.982			0.979			0.945			0.927	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	3545	0	1805	3428	0	1805	1784	0	1805	1761	0
Flt Permitted	0.640			0.671			0.370			0.610		
Satd. Flow (perm)	1216	3545	0	1275	3428	0	703	1784	0	1159	1761	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		15			25			45			74	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		642			804			5011			1413	
Travel Time (s)		14.6			18.3			113.9			32.1	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	0%	0%	22%	0%	1%	0%	0%	0%	0%
Adj. Flow (vph)	77	113	15	120	152	25	18	152	87	23	229	216
Shared Lane Traffic (%)												
Lane Group Flow (vph)	77	128	0	120	177	0	18	239	0	23	445	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		1			1			3			3	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Permitted Phases	1			1			3			3		
Detector Phase	1	1		1	1		3	3		3	3	
Switch Phase												
Minimum Initial (s)	25.0	25.0		25.0	25.0		15.0	15.0		15.0	15.0	
Minimum Split (s)	37.7	37.7		37.7	37.7		37.7	37.7		37.7	37.7	
Total Split (s)	40.0	40.0		40.0	40.0		35.0	35.0		35.0	35.0	
Total Split (%)	53.3%	53.3%		53.3%	53.3%		46.7%	46.7%		46.7%	46.7%	
Maximum Green (s)	34.3	34.3		34.3	34.3		29.3	29.3		29.3	29.3	
Yellow Time (s)	4.3	4.3		4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.4	1.4		1.4	1.4		1.4	1.4		1.4	1.4	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.7	5.7		5.7	5.7		5.7	5.7		5.7	5.7	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0		4.0	4.0		6.0	6.0		6.0	6.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	25.2	25.2		25.2	25.2		23.6	23.6		23.6	23.6	
Actuated g/C Ratio	0.42	0.42		0.42	0.42		0.39	0.39		0.39	0.39	
v/c Ratio	0.15	0.09		0.23	0.12		0.07	0.33		0.05	0.61	
Control Delay	13.8	11.2		14.6	10.9		11.3	11.1		10.9	15.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	13.8	11.2		14.6	10.9		11.3	11.1		10.9	15.6	
LOS	B	B		B	B		B	B		B	B	
Approach Delay		12.2			12.4			11.1			15.3	
Approach LOS		B			B			B			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 75			
Actuated Cycle Length: 60.3			
Natural Cycle: 80			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.61			
Intersection Signal Delay: 13.2		Intersection LOS: B	
Intersection Capacity Utilization 79.4%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 6: Baseline Road & Grand Island Blvd

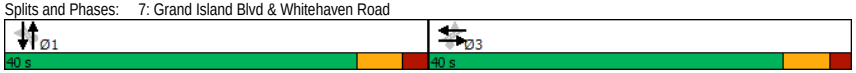


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	125	90	76	76	91	45	385	120	71	235	18
Future Volume (vph)	20	125	90	76	76	91	45	385	120	71	235	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		210	155		0	110		0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.918			0.964			0.989	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	1900	1615	1787	3255	0	1805	1832	0	1805	1879	0
Flt Permitted	0.636			0.669			0.589			0.372		
Satd. Flow (perm)	1208	1900	1615	1259	3255	0	1119	1832	0	707	1879	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			99		100			24			6	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		790			1017			5939			1413	
Travel Time (s)		18.0			23.1			135.0			32.1	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	0%	0%	0%	1%	4%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	22	137	99	84	84	100	49	423	132	78	258	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	22	137	99	84	184	0	49	555	0	78	278	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2		1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	3		3	3			1			1		
Detector Phase	3	3	3	3	3		1	1		1	1	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	35.5	35.5	35.5	35.5	35.5		36.8	36.8		36.8	36.8	
Total Split (s)	40.0	40.0	40.0	40.0	40.0		40.0	40.0		40.0	40.0	
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	33.5	33.5	33.5	33.5	33.5		33.2	33.2		33.2	33.2	
Yellow Time (s)	4.3	4.3	4.3	4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2		2.5	2.5		2.5	2.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.5	6.5	6.5	6.5	6.5		6.8	6.8		6.8	6.8	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None	None	None	None		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	22.0	22.0	22.0	22.0	22.0		23.0	23.0		23.0	23.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0		0	0	
Act Effct Green (s)	11.9	11.9	11.9	11.9	11.9		24.0	24.0		24.0	24.0	
Actuated g/C Ratio	0.24	0.24	0.24	0.24	0.24		0.48	0.48		0.48	0.48	
v/c Ratio	0.08	0.30	0.22	0.28	0.22		0.09	0.62		0.23	0.31	
Control Delay	17.4	19.1	6.0	19.9	9.4		8.1	13.1		10.2	9.1	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	17.4	19.1	6.0	19.9	9.4		8.1	13.1		10.2	9.1	
LOS	B	B	A	B	A		A	B		B	A	
Approach Delay		13.9			12.7			12.7			9.3	
Approach LOS		B			B			B			A	

Intersection Summary	
Area Type:	Other
Cycle Length: 80	
Actuated Cycle Length: 50	
Natural Cycle: 75	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.62	
Intersection Signal Delay: 12.1	Intersection LOS: B
Intersection Capacity Utilization 69.6%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 7: Grand Island Blvd & Whitehaven Road



Lane Group	EBT	EBR	WBL	WBT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	7	0	0	70	0	200
Future Volume (vph)	7	0	0	70	0	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	1863	0	0	1863	0	1611
Flt Permitted						
Satd. Flow (perm)	1863	0	0	1863	0	1611
Link Speed (mph)	30			30	30	
Link Distance (ft)	248			1104	422	
Travel Time (s)	5.6			25.1	9.6	
Peak Hour Factor	0.71	0.71	0.71	0.71	0.71	0.71
Adj. Flow (vph)	10	0	0	99	0	282
Shared Lane Traffic (%)						
Lane Group Flow (vph)	10	0	0	99	0	282
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 22.4%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	53	49	0	0	0
Future Volume (vph)	0	53	49	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						
Flt Protected						
Satd. Flow (prot)	0	1863	1863	0	0	0
Flt Permitted						
Satd. Flow (perm)	0	1863	1863	0	0	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		159	3127		387	
Travel Time (s)		3.6	71.1		8.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	58	53	0	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	58	53	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		0	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 6.7%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	2	200	0	54	0	0
Future Volume (vph)	2	200	0	54	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.866					
Flt Protected						
Satd. Flow (prot)	1613	0	0	1863	0	0
Flt Permitted						
Satd. Flow (perm)	1613	0	0	1863	0	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	180			327	422	
Travel Time (s)	4.1			7.4	9.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	217	0	59	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	219	0	0	59	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 15.8%		ICU Level of Service A	
Analysis Period (min) 15			

MOVEMENT SUMMARY

Site: 1 [Grand Island Blvd @ Staley Road - 2021 AM SIDRA - Background]

Grand Island Blvd @ Staley Road
Single Lane Roundabout
2021 AM - SIDRA Background Conditions
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: Grand Island Blvd NB												
3	L2	189	3.0	0.244	7.2	LOS A	1.7	43.1	0.15	0.42	0.15	29.6
8	T1	178	1.4	0.244	1.6	LOS A	1.7	43.1	0.15	0.42	0.15	29.2
18	R2	251	0.5	0.186	2.4	LOS A	1.2	30.0	0.15	0.33	0.15	29.1
Approach		617	1.5	0.244	3.7	LOS A	1.7	43.1	0.15	0.39	0.15	29.2
East: Staley Road WB												
1	L2	517	0.2	0.579	11.2	LOS B	5.0	125.1	0.72	0.82	0.80	27.6
6	T1	24	0.0	0.579	5.6	LOS A	5.0	125.1	0.72	0.82	0.80	27.2
16	R2	23	0.0	0.579	6.1	LOS A	5.0	125.1	0.72	0.82	0.80	26.5
Approach		564	0.2	0.579	10.8	LOS B	5.0	125.1	0.72	0.82	0.80	27.5
North: Grand Island Blvd												
7	L2	5	0.0	0.418	13.3	LOS B	3.0	78.7	0.86	0.89	0.91	28.4
4	T1	236	4.8	0.418	8.1	LOS A	3.0	78.7	0.86	0.89	0.91	28.0
14	R2	23	0.0	0.418	8.3	LOS A	3.0	78.7	0.86	0.89	0.91	27.3
Approach		263	4.3	0.418	8.2	LOS A	3.0	78.7	0.86	0.89	0.91	27.9
West: Staley Road EB												
5	L2	2	0.0	0.247	12.6	LOS B	1.6	40.6	0.80	0.80	0.80	28.6
2	T1	18	0.0	0.247	7.0	LOS A	1.6	40.6	0.80	0.80	0.80	28.2
12	R2	139	0.8	0.247	7.6	LOS A	1.6	40.6	0.80	0.80	0.80	27.4
Approach		160	0.7	0.247	7.6	LOS A	1.6	40.6	0.80	0.80	0.80	27.5
All Vehicles		1605	1.4	0.579	7.3	LOS A	5.0	125.1	0.53	0.66	0.57	28.2

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [Grand Island Blvd @ Staley Road - 2021 PM SIDRA - Background]

Grand Island Blvd @ Staley Road
Single Lane Roundabout
2021 AM - SIDRA Background Conditions
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: Grand Island Blvd NB												
3	L2	100	0.0	0.422	7.5	LOS A	3.3	83.9	0.28	0.31	0.28	30.0
8	T1	526	0.9	0.422	1.9	LOS A	3.3	83.9	0.28	0.31	0.28	29.6
18	R2	439	0.5	0.337	2.7	LOS A	2.4	59.2	0.27	0.37	0.27	28.9
Approach		1065	0.7	0.422	2.7	LOS A	3.3	83.9	0.28	0.33	0.28	29.3
East: Staley Road WB												
1	L2	265	0.0	0.401	11.9	LOS B	2.7	66.9	0.77	0.85	0.78	27.4
6	T1	7	0.0	0.401	6.3	LOS A	2.7	66.9	0.77	0.85	0.78	27.1
16	R2	38	3.1	0.401	7.1	LOS A	2.7	66.9	0.77	0.85	0.78	26.4
Approach		309	0.4	0.401	11.2	LOS B	2.7	66.9	0.77	0.85	0.78	27.3
North: Grand Island Blvd SB												
7	L2	26	0.0	0.404	9.7	LOS A	2.8	70.5	0.67	0.56	0.67	29.2
4	T1	336	1.1	0.404	4.2	LOS A	2.8	70.5	0.67	0.56	0.67	28.8
14	R2	14	0.0	0.404	4.7	LOS A	2.8	70.5	0.67	0.56	0.67	28.1
Approach		376	1.0	0.404	4.6	LOS A	2.8	70.5	0.67	0.56	0.67	28.8
West: Staley Road EB												
5	L2	14	0.0	0.276	11.3	LOS B	1.7	44.0	0.73	0.74	0.73	28.9
2	T1	24	0.0	0.276	5.7	LOS A	1.7	44.0	0.73	0.74	0.73	28.5
12	R2	166	3.6	0.276	6.5	LOS A	1.7	44.0	0.73	0.74	0.73	27.7
Approach		204	2.9	0.276	6.8	LOS A	1.7	44.0	0.73	0.74	0.73	27.9
All Vehicles		1954	0.9	0.422	4.9	LOS A	3.3	83.9	0.48	0.50	0.48	28.7

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

A6

Level of Service Calculations: Full Development Conditions

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	46	0	405	16	2	0	0	28	0	0	0
Future Volume (vph)	0	46	0	405	16	2	0	0	28	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.999			0.865				
Flt Protected					0.954							
Satd. Flow (prot)	0	1900	0	0	1777	0	0	1611	0	0	1863	0
Flt Permitted					0.954							
Satd. Flow (perm)	0	1900	0	0	1777	0	0	1611	0	0	1863	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		305			700			382			314	
Travel Time (s)		6.9			15.9			8.7			7.1	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.92	0.92	0.84	0.92	0.84
Heavy Vehicles (%)	0%	0%	2%	2%	0%	0%	2%	2%	2%	0%	2%	0%
Adj. Flow (vph)	0	55	0	482	19	2	0	0	30	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	55	0	0	503	0	0	30	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 40.1%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	7.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	46	0	405	16	2	0	0	28	0	0	0
Future Vol, veh/h	0	46	0	405	16	2	0	0	28	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	84	84	84	84	84	84	84	92	92	84	92	84
Heavy Vehicles, %	0	0	2	2	0	0	2	2	2	0	2	0
Mvmt Flow	0	55	0	482	19	2	0	0	30	0	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	21	0	0	55	0	0	1039	1040	55	1054	1039	20
Stage 1	-	-	-	-	-	-	55	55	-	984	984	-
Stage 2	-	-	-	-	-	-	984	985	-	70	55	-
Critical Hdwy	4.1	-	-	4.12	-	-	7.12	6.52	6.22	7.1	6.52	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.1	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.1	5.52	-
Follow-up Hdwy	2.2	-	-	2.218	-	-	3.518	4.018	3.318	3.5	4.018	3.3
Pot Cap-1 Maneuver	1608	-	-	1550	-	-	209	230	1012	206	231	1064
Stage 1	-	-	-	-	-	-	957	849	-	302	327	-
Stage 2	-	-	-	-	-	-	299	326	-	945	849	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1608	-	-	1550	-	-	158	158	1012	151	158	1064
Mov Cap-2 Maneuver	-	-	-	-	-	-	158	158	-	151	158	-
Stage 1	-	-	-	-	-	-	957	849	-	302	224	-
Stage 2	-	-	-	-	-	-	205	223	-	917	849	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	8	8.7	0
HCM LOS			A	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	1012	1608	-	-	1550	-	-	-
HCM Lane V/C Ratio	0.03	-	-	-	0.311	-	-	-
HCM Control Delay (s)	8.7	0	-	-	8.4	0	-	0
HCM Lane LOS	A	A	-	-	A	A	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	1.3	-	-	-

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	49	25	154	206	250	0
Future Volume (vph)	49	25	154	206	250	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.954					
Flt Protected				0.979	0.950	
Satd. Flow (prot)	1813	0	0	1850	1805	0
Flt Permitted				0.979	0.950	
Satd. Flow (perm)	1813	0	0	1850	1805	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	700			240	278	
Travel Time (s)	15.9			5.5	6.3	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%
Adj. Flow (vph)	56	29	177	237	287	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	85	0	0	414	287	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 46.5%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	16.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	49	25	154	206	250	0
Future Vol, veh/h	49	25	154	206	250	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	0	0	0	1	0	0
Mvmt Flow	56	29	177	237	287	0

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	85	0	662	-
Stage 1	-	-	-	-	71	-
Stage 2	-	-	-	-	591	-
Critical Hdwy	-	-	4.1	-	6.4	-
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	-
Pot Cap-1 Maneuver	-	-	1524	-	430	0
Stage 1	-	-	-	-	957	0
Stage 2	-	-	-	-	557	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1524	-	372	-
Mov Cap-2 Maneuver	-	-	-	-	372	-
Stage 1	-	-	-	-	957	-
Stage 2	-	-	-	-	482	-

Approach	EB	WB	NB
HCM Control Delay, s	0	3.3	40.8
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	372	-	-	1524	-
HCM Lane V/C Ratio	0.772	-	-	0.116	-
HCM Control Delay (s)	40.8	-	-	7.7	0
HCM Lane LOS	E	-	-	A	A
HCM 95th %tile Q(veh)	6.4	-	-	0.4	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	26	103	14	160	57	200	112	22	0	0	0
Future Volume (vph)	29	26	103	14	160	57	200	112	22	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.967			0.991				
Flt Protected		0.974			0.997			0.971				
Satd. Flow (prot)	0	1851	1599	0	1819	0	0	1822	0	0	1900	0
Flt Permitted		0.974			0.997			0.971				
Satd. Flow (perm)	0	1851	1599	0	1819	0	0	1822	0	0	1900	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1107			662			443			522	
Travel Time (s)		25.2			15.0			10.1			11.9	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	0%	0%	1%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Adj. Flow (vph)	34	30	120	16	186	66	233	130	26	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	64	120	0	268	0	0	389	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 44.3%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	12.4
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	29	26	103	14	160	57	200	112	22	0	0	0
Future Vol, veh/h	29	26	103	14	160	57	200	112	22	0	0	0
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles, %	0	0	1	0	1	0	0	1	0	0	0	0
Mvmt Flow	34	30	120	16	186	66	233	130	26	0	0	0
Number of Lanes	0	1	1	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	2
HCM Control Delay	9.3	11.6	14.5	0
HCM LOS	A	B	B	-

Lane	NBLn1	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	60%	53%	0%	6%	0%
Vol Thru, %	34%	47%	0%	69%	100%
Vol Right, %	7%	0%	100%	25%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	334	55	103	231	0
LT Vol	200	29	0	14	0
Through Vol	112	26	0	160	0
RT Vol	22	0	103	57	0
Lane Flow Rate	388	64	120	269	0
Geometry Grp	2	7	7	5	2
Degree of Util (X)	0.559	0.11	0.174	0.39	0
Departure Headway (Hd)	5.178	6.21	5.232	5.226	5.745
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	703	578	685	688	0
Service Time	3.178	3.945	2.967	3.257	3.788
HCM Lane V/C Ratio	0.552	0.111	0.175	0.391	0
HCM Control Delay	14.5	9.7	9.1	11.6	8.8
HCM Lane LOS	B	A	A	B	N
HCM 95th-tile Q	3.5	0.4	0.6	1.9	0

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	189	262	0	146	116	0
Future Volume (vph)	189	262	0	146	116	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.922					
Flt Protected	0.979					
Satd. Flow (prot)	1715	0	0	1881	1881	0
Flt Permitted	0.979					
Satd. Flow (perm)	1715	0	0	1881	1881	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	536			5051	443	
Travel Time (s)	12.2			114.8	10.1	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	0%	0%	0%	1%	1%	0%
Adj. Flow (vph)	220	305	0	170	135	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	525	0	0	170	135	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	15			9
Sign Control	Stop			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 40.9%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	10.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	189	262	0	146	116	0
Future Vol, veh/h	189	262	0	146	116	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	0	0	0	1	1	0
Mvmt Flow	220	305	0	170	135	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	305	135	-	0	-	0
Stage 1	135	-	-	-	-	-
Stage 2	170	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	-	-
Pot Cap-1 Maneuver	691	919	0	-	-	0
Stage 1	896	-	0	-	-	0
Stage 2	865	-	0	-	-	0
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	691	919	-	-	-	-
Mov Cap-2 Maneuver	691	-	-	-	-	-
Stage 1	896	-	-	-	-	-
Stage 2	865	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	17.3	0	0
HCM LOS	C		

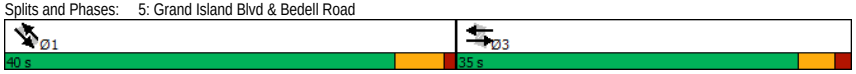
Minor Lane/Major Mvmt	NBT	EBLn1	SBT
Capacity (veh/h)	-	807	-
HCM Lane V/C Ratio	-	0.65	-
HCM Control Delay (s)	-	17.3	-
HCM Lane LOS	-	C	-
HCM 95th %tile Q(veh)	-	4.9	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	1	11	42	68	29	82	23	60	250	61	70	13
Future Volume (vph)	1	11	42	68	29	82	23	60	250	61	70	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.896			0.939			0.899			0.988	
Flt Protected		0.999			0.981			0.997			0.979	
Satd. Flow (prot)	0	1576	0	0	1727	0	0	1697	0	0	1814	0
Flt Permitted		0.992			0.850			0.973			0.754	
Satd. Flow (perm)	0	1565	0	0	1496	0	0	1656	0	0	1397	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		44			67			263			9	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3134			771			5051			5011	
Travel Time (s)		71.2			17.5			114.8			113.9	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	100%	0%	8%	0%	0%	3%	0%	2%	0%	2%	1%	0%
Adj. Flow (vph)	1	12	44	72	31	86	24	63	263	64	74	14
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	57	0	0	189	0	0	350	0	0	152	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3			1			1		
Detector Phase	3	3		3	3		1	1		1	1	
Switch Phase												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Minimum Initial (s)	6.0	6.0		6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	35.0	35.0		35.0	35.0		40.0	40.0		40.0	40.0	
Total Split (%)	46.7%	46.7%		46.7%	46.7%		53.3%	53.3%		53.3%	53.3%	
Maximum Green (s)	30.2	30.2		30.2	30.2		34.5	34.5		34.5	34.5	
Yellow Time (s)	3.2	3.2		3.2	3.2		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.6	1.6		1.6	1.6		1.2	1.2		1.2	1.2	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.8			4.8			5.5			5.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	2.0		2.0	2.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Act Effct Green (s)		7.7			7.7			14.2			14.2	
Actuated g/C Ratio		0.24			0.24			0.44			0.44	
v/c Ratio		0.14			0.47			0.40			0.25	
Control Delay		5.7			10.9			3.7			7.3	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		5.7			10.9			3.7			7.3	
LOS		A			B			A			A	
Approach Delay		5.7			10.9			3.7			7.3	
Approach LOS		A			B			A			A	

Intersection Summary	
Area Type:	Other
Cycle Length: 75	
Actuated Cycle Length: 32.5	
Natural Cycle: 45	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.47	
Intersection Signal Delay: 6.4	Intersection LOS: A
Intersection Capacity Utilization 52.5%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 5: Grand Island Blvd & Bedell Road

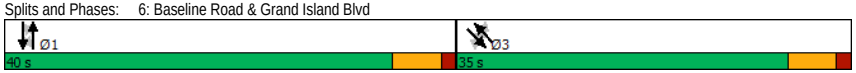


Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	63	57	2	94	246	19	0	87	98	1	97	54
Future Volume (vph)	63	57	2	94	246	19	0	87	98	1	97	54
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	145		0	165		0	200		0
Storage Lanes	1		0	2		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.995			0.989			0.921			0.947	
Flt Protected	0.950			0.950						0.950		
Satd. Flow (prot)	1752	3490	0	1805	3537	0	1900	1718	0	1805	1753	0
Flt Permitted	0.574			0.712						0.630		
Satd. Flow (perm)	1059	3490	0	1353	3537	0	1900	1718	0	1197	1753	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			14			89			43	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		642			804			5011			1413	
Travel Time (s)		14.6			18.3			113.9			32.1	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	3%	3%	0%	0%	1%	0%	0%	4%	0%	0%	3%	2%
Adj. Flow (vph)	69	63	2	103	270	21	0	96	108	1	107	59
Shared Lane Traffic (%)												
Lane Group Flow (vph)	69	65	0	103	291	0	0	204	0	1	166	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		1			1			3			3	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Permitted Phases	1			1			3			3		
Detector Phase	1	1		1	1		3	3		3	3	
Switch Phase												
Minimum Initial (s)	25.0	25.0		25.0	25.0		15.0	15.0		15.0	15.0	
Minimum Split (s)	37.7	37.7		37.7	37.7		37.7	37.7		37.7	37.7	
Total Split (s)	40.0	40.0		40.0	40.0		35.0	35.0		35.0	35.0	
Total Split (%)	53.3%	53.3%		53.3%	53.3%		46.7%	46.7%		46.7%	46.7%	
Maximum Green (s)	34.3	34.3		34.3	34.3		29.3	29.3		29.3	29.3	
Yellow Time (s)	4.3	4.3		4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.4	1.4		1.4	1.4		1.4	1.4		1.4	1.4	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.7	5.7		5.7	5.7		5.7	5.7		5.7	5.7	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0		4.0	4.0		6.0	6.0		6.0	6.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	25.0	25.0		25.0	25.0			16.0		16.0	16.0	
Actuated g/C Ratio	0.48	0.48		0.48	0.48			0.31		0.31	0.31	
v/c Ratio	0.14	0.04		0.16	0.17			0.35		0.00	0.29	
Control Delay	9.2	7.8		9.1	8.1			10.0		12.0	11.9	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	9.2	7.8		9.1	8.1			10.0		12.0	11.9	
LOS	A	A		A	A			B		B	B	
Approach Delay		8.5			8.3			10.0			11.9	
Approach LOS		A			A			B			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 75	
Actuated Cycle Length: 52.4	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.35	
Intersection Signal Delay: 9.4	Intersection LOS: A
Intersection Capacity Utilization 68.4%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 6: Baseline Road & Grand Island Blvd

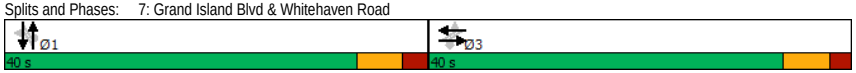


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	8	76	39	50	226	55	59	123	33	31	163	6
Future Volume (vph)	8	76	39	50	226	55	59	123	33	31	163	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		210	155		0	110		0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.971			0.968			0.994	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	1881	1538	1736	3477	0	1805	1831	0	1805	1802	0
Flt Permitted	0.539			0.695			0.624			0.633		
Satd. Flow (perm)	1024	1881	1538	1270	3477	0	1186	1831	0	1203	1802	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			52		46			21			3	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		790			1017			5939			1413	
Travel Time (s)		18.0			23.1			135.0			32.1	
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Heavy Vehicles (%)	0%	1%	5%	4%	1%	0%	0%	0%	2%	0%	5%	0%
Adj. Flow (vph)	10	96	49	63	286	70	75	156	42	39	206	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	10	96	49	63	356	0	75	198	0	39	214	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2		1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	3		3	3			1			1		
Detector Phase	3	3	3	3	3		1	1		1	1	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	35.5	35.5	35.5	35.5	35.5		36.8	36.8		36.8	36.8	
Total Split (s)	40.0	40.0	40.0	40.0	40.0		40.0	40.0		40.0	40.0	
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	33.5	33.5	33.5	33.5	33.5		33.2	33.2		33.2	33.2	
Yellow Time (s)	4.3	4.3	4.3	4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2		2.5	2.5		2.5	2.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.5	6.5	6.5	6.5	6.5		6.8	6.8		6.8	6.8	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None	None	None	None		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	22.0	22.0	22.0	22.0	22.0		23.0	23.0		23.0	23.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0		0	0	
Act Effct Green (s)	12.1	12.1	12.1	12.1	12.1		13.0	13.0		13.0	13.0	
Actuated g/C Ratio	0.31	0.31	0.31	0.31	0.31		0.33	0.33		0.33	0.33	
v/c Ratio	0.03	0.16	0.10	0.16	0.32		0.19	0.32		0.10	0.35	
Control Delay	10.4	11.0	4.4	11.4	10.0		11.4	10.8		10.5	12.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	10.4	11.0	4.4	11.4	10.0		11.4	10.8		10.5	12.2	
LOS	B	B	A	B	A		B	B		B	B	
Approach Delay		8.9			10.2			10.9			11.9	
Approach LOS		A			B			B			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 38.9			
Natural Cycle: 75			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.35			
Intersection Signal Delay: 10.6		Intersection LOS: B	
Intersection Capacity Utilization 43.5%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 7: Grand Island Blvd & Whitehaven Road



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	43	77	263	11	0
Future Volume (vph)	0	43	77	263	11	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.896			
Flt Protected					0.950	
Satd. Flow (prot)	0	1863	1669	0	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	0	1863	1669	0	1770	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		506	3134		384	
Travel Time (s)		11.5	71.2		8.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	47	84	286	12	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	47	370	0	12	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 30.2%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	0	43	77	263	11	0
Future Vol, veh/h	0	43	77	263	11	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	47	84	286	12	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	370	0	-	0	274	227
Stage 1	-	-	-	-	227	-
Stage 2	-	-	-	-	47	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1189	-	-	-	716	812
Stage 1	-	-	-	-	811	-
Stage 2	-	-	-	-	975	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1189	-	-	-	716	812
Mov Cap-2 Maneuver	-	-	-	-	716	-
Stage 1	-	-	-	-	811	-
Stage 2	-	-	-	-	975	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	10.1
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1189	-	-	-	716
HCM Lane V/C Ratio	-	-	-	-	0.017
HCM Control Delay (s)	0	-	-	-	10.1
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Lane Group	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	250	113	0	179	0	0
Future Volume (vph)	250	113	0	179	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.958					
Flt Protected						
Satd. Flow (prot)	1785	0	0	1863	0	0
Flt Permitted						
Satd. Flow (perm)	1785	0	0	1863	0	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	159			278	366	
Travel Time (s)	3.6			6.3	8.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	123	0	195	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	395	0	0	195	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 23.4%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	EBT	EBR	WBL	WBT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	49	0	0	360	0	113
Future Volume (vph)	49	0	0	360	0	113
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	1863	0	0	1863	0	1611
Flt Permitted						
Satd. Flow (perm)	1863	0	0	1863	0	1611
Link Speed (mph)	30			30	30	
Link Distance (ft)	240			1107	366	
Travel Time (s)	5.5			25.2	8.3	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	56	0	0	414	0	130
Shared Lane Traffic (%)						
Lane Group Flow (vph)	56	0	0	414	0	130
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 22.3%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	24	0	357	12	0	0	0	375	1	0	0
Future Volume (vph)	0	24	0	357	12	0	0	0	375	1	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt								0.865				
Flt Protected					0.954						0.950	
Satd. Flow (prot)	0	1863	0	0	1777	0	0	1611	0	0	1770	0
Flt Permitted					0.954						0.950	
Satd. Flow (perm)	0	1863	0	0	1777	0	0	1611	0	0	1770	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		305			700			497			378	
Travel Time (s)		6.9			15.9			11.3			8.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	26	0	388	13	0	0	0	408	1	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	26	0	0	401	0	0	408	0	0	1	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Free			Free			Stop			Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 57.0%	ICU Level of Service B
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	8.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	24	0	357	12	0	0	0	375	1	0	0
Future Vol, veh/h	0	24	0	357	12	0	0	0	375	1	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	26	0	388	13	0	0	0	408	1	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	13	0	0	26	0	0	815	815	26	1019	815	13
Stage 1	-	-	-	-	-	-	26	26	-	789	789	-
Stage 2	-	-	-	-	-	-	789	789	-	230	26	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1606	-	-	1588	-	-	296	312	1050	215	312	1067
Stage 1	-	-	-	-	-	-	992	874	-	384	402	-
Stage 2	-	-	-	-	-	-	384	402	-	773	874	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1606	-	-	1588	-	-	240	235	1050	107	235	1067
Mov Cap-2 Maneuver	-	-	-	-	-	-	240	235	-	107	235	-
Stage 1	-	-	-	-	-	-	992	874	-	384	303	-
Stage 2	-	-	-	-	-	-	290	303	-	473	874	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	7.7	10.6	39
HCM LOS			B	E

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	1050	1606	-	-	1588	-	-	107
HCM Lane V/C Ratio	0.388	-	-	-	0.244	-	-	0.01
HCM Control Delay (s)	10.6	0	-	-	8	0	-	39
HCM Lane LOS	B	A	-	-	A	A	-	E
HCM 95th %tile Q(veh)	1.9	0	-	-	1	-	-	0

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	227	158	51	172	207	0
Future Volume (vph)	227	158	51	172	207	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.945					
Flt Protected				0.989	0.950	
Satd. Flow (prot)	1796	0	0	1879	1805	0
Flt Permitted				0.989	0.950	
Satd. Flow (perm)	1796	0	0	1879	1805	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	700			270	291	
Travel Time (s)	15.9			6.1	6.6	
Peak Hour Factor	0.71	0.71	0.71	0.71	0.71	0.71
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	320	223	72	242	292	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	543	0	0	314	292	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 54.9%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	17.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	227	158	51	172	207	0
Future Vol, veh/h	227	158	51	172	207	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	71	71	71	71	71	71
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	320	223	72	242	292	0

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	543	0	818	-
Stage 1	-	-	-	-	432	-
Stage 2	-	-	-	-	386	-
Critical Hdwy	-	-	4.1	-	6.4	-
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	-
Pot Cap-1 Maneuver	-	-	1036	-	348	0
Stage 1	-	-	-	-	659	0
Stage 2	-	-	-	-	691	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1036	-	320	-
Mov Cap-2 Maneuver	-	-	-	-	320	-
Stage 1	-	-	-	-	659	-
Stage 2	-	-	-	-	636	-

Approach	EB	WB	NB
HCM Control Delay, s	0	2	67
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	320	-	-	1036	-
HCM Lane V/C Ratio	0.911	-	-	0.069	-
HCM Control Delay (s)	67	-	-	8.7	0
HCM Lane LOS	F	-	-	A	A
HCM 95th %tile Q(veh)	8.8	-	-	0.2	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	264	95	168	17	48	56	168	179	90	0	2	6
Future Volume (vph)	264	95	168	17	48	56	168	179	90	0	2	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.937			0.972			0.895	
Flt Protected		0.965			0.993			0.981				
Satd. Flow (prot)	0	1834	1615	0	1768	0	0	1804	0	0	1674	0
Flt Permitted		0.965			0.993			0.981				
Satd. Flow (perm)	0	1834	1615	0	1768	0	0	1804	0	0	1674	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1077			662			436			522	
Travel Time (s)		24.5			15.0			9.9			11.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	2%
Adj. Flow (vph)	287	103	183	18	52	61	183	195	98	0	2	7
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	390	183	0	131	0	0	476	0	0	9	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 63.8%	ICU Level of Service B
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	20.2
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	264	95	168	17	48	56	168	179	90	0	2	6
Future Vol, veh/h	264	95	168	17	48	56	168	179	90	0	2	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	0	0	0	0	0	0	0	1	0	0	0	2
Mvmt Flow	287	103	183	18	52	61	183	195	98	0	2	7
Number of Lanes	0	1	1	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	2
HCM Control Delay	19.6	10.9	23.8	9.5
HCM LOS	C	B	C	A

Lane	NBLn1	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	38%	74%	0%	14%	0%
Vol Thru, %	41%	26%	0%	40%	25%
Vol Right, %	21%	0%	100%	46%	75%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	437	359	168	121	8
LT Vol	168	264	0	17	0
Through Vol	179	95	0	48	2
RT Vol	90	0	168	56	6
Lane Flow Rate	475	390	183	132	9
Geometry Grp	2	7	7	5	2
Degree of Util (X)	0.749	0.712	0.278	0.223	0.015
Departure Headway (Hd)	5.676	6.565	5.481	6.109	6.292
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	637	550	654	585	564
Service Time	3.725	4.317	3.232	4.178	4.384
HCM Lane V/C Ratio	0.746	0.709	0.28	0.226	0.016
HCM Control Delay	23.8	24	10.3	10.9	9.5
HCM Lane LOS	C	C	B	B	A
HCM 95th-tile Q	6.7	5.7	1.1	0.8	0

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	209	225	0	228	150	0
Future Volume (vph)	209	225	0	228	150	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.930					
Flt Protected	0.976					
Satd. Flow (prot)	1681	0	0	1900	1881	0
Flt Permitted	0.976					
Satd. Flow (perm)	1681	0	0	1900	1881	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	447			5058	436	
Travel Time (s)	10.2			115.0	9.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	0%	5%	0%	0%	1%	0%
Adj. Flow (vph)	232	250	0	253	167	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	482	0	0	253	167	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	15			9
Sign Control	Stop			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 44.0%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	10.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	209	225	0	228	150	0
Future Vol, veh/h	209	225	0	228	150	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	0	5	0	0	1	0
Mvmt Flow	232	250	0	253	167	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	420	167	-	0	-	0
Stage 1	167	-	-	-	-	-
Stage 2	253	-	-	-	-	-
Critical Hdwy	6.4	6.25	-	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.345	-	-	-	-
Pot Cap-1 Maneuver	594	869	0	-	-	0
Stage 1	867	-	0	-	-	0
Stage 2	794	-	0	-	-	0
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	594	869	-	-	-	-
Mov Cap-2 Maneuver	594	-	-	-	-	-
Stage 1	867	-	-	-	-	-
Stage 2	794	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	20	0	0
HCM LOS	C		

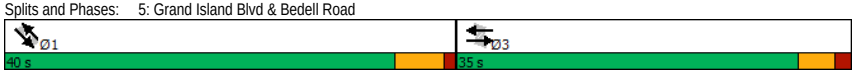
Minor Lane/Major Mvmt	NBT	EBLn1	SBT
Capacity (veh/h)	-	711	-
HCM Lane V/C Ratio	-	0.678	-
HCM Control Delay (s)	-	20	-
HCM Lane LOS	-	C	-
HCM 95th %tile Q(veh)	-	5.3	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	17	38	223	43	20	72	81	93	208	54	121	87
Future Volume (vph)	17	38	223	43	20	72	81	93	208	54	121	87
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.892			0.928			0.926			0.955	
Flt Protected		0.997			0.984			0.990			0.990	
Satd. Flow (prot)	0	1588	0	0	1735	0	0	1742	0	0	1780	0
Flt Permitted		0.970			0.796			0.867			0.854	
Satd. Flow (perm)	0	1545	0	0	1404	0	0	1525	0	0	1535	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		240			77			106			44	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3096			771			5058			5011	
Travel Time (s)		70.4			17.5			115.0			113.9	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	2%	0%
Adj. Flow (vph)	18	41	240	46	22	77	87	100	224	58	130	94
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	299	0	0	145	0	0	411	0	0	282	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3			1			1		
Detector Phase	3	3		3	3		1	1		1	1	
Switch Phase												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Minimum Initial (s)	6.0	6.0		6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	35.0	35.0		35.0	35.0		40.0	40.0		40.0	40.0	
Total Split (%)	46.7%	46.7%		46.7%	46.7%		53.3%	53.3%		53.3%	53.3%	
Maximum Green (s)	30.2	30.2		30.2	30.2		34.5	34.5		34.5	34.5	
Yellow Time (s)	3.2	3.2		3.2	3.2		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.6	1.6		1.6	1.6		1.2	1.2		1.2	1.2	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.8			4.8			5.5			5.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	2.0		2.0	2.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Act Effct Green (s)		8.0			8.0			16.2			16.2	
Actuated g/C Ratio		0.23			0.23			0.46			0.46	
v/c Ratio		0.56			0.38			0.54			0.39	
Control Delay		8.6			10.7			8.0			7.0	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		8.6			10.7			8.0			7.0	
LOS		A			B			A			A	
Approach Delay		8.6			10.7			8.0			7.0	
Approach LOS		A			B			A			A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 75			
Actuated Cycle Length: 35.1			
Natural Cycle: 45			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.56			
Intersection Signal Delay: 8.2		Intersection LOS: A	
Intersection Capacity Utilization 61.1%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 5: Grand Island Blvd & Bedell Road

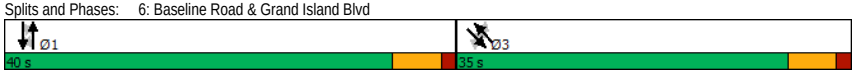


Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	72	117	14	112	242	118	23	141	81	21	213	201
Future Volume (vph)	72	117	14	112	242	118	23	141	81	21	213	201
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	145		0	165		0	200		0
Storage Lanes	1		0	2		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.984			0.951			0.945			0.927	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	3552	0	1805	3202	0	1805	1784	0	1805	1761	0
Flt Permitted	0.523			0.663			0.370			0.610		
Satd. Flow (perm)	994	3552	0	1260	3202	0	703	1784	0	1159	1761	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		15			127			45			74	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		642			804			5011			1413	
Travel Time (s)		14.6			18.3			113.9			32.1	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	0%	0%	22%	0%	1%	0%	0%	0%	0%
Adj. Flow (vph)	77	126	15	120	260	127	25	152	87	23	229	216
Shared Lane Traffic (%)												
Lane Group Flow (vph)	77	141	0	120	387	0	25	239	0	23	445	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		1			1			3			3	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Permitted Phases	1			1			3			3		
Detector Phase	1	1		1	1		3	3		3	3	
Switch Phase												
Minimum Initial (s)	25.0	25.0		25.0	25.0		15.0	15.0		15.0	15.0	
Minimum Split (s)	37.7	37.7		37.7	37.7		37.7	37.7		37.7	37.7	
Total Split (s)	40.0	40.0		40.0	40.0		35.0	35.0		35.0	35.0	
Total Split (%)	53.3%	53.3%		53.3%	53.3%		46.7%	46.7%		46.7%	46.7%	
Maximum Green (s)	34.3	34.3		34.3	34.3		29.3	29.3		29.3	29.3	
Yellow Time (s)	4.3	4.3		4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.4	1.4		1.4	1.4		1.4	1.4		1.4	1.4	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.7	5.7		5.7	5.7		5.7	5.7		5.7	5.7	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0		4.0	4.0		6.0	6.0		6.0	6.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	25.3	25.3		25.3	25.3		23.8	23.8		23.8	23.8	
Actuated g/C Ratio	0.42	0.42		0.42	0.42		0.39	0.39		0.39	0.39	
v/c Ratio	0.19	0.09		0.23	0.27		0.09	0.33		0.05	0.60	
Control Delay	14.6	11.3		14.7	9.2		11.8	11.1		11.0	15.5	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	14.6	11.3		14.7	9.2		11.8	11.1		11.0	15.5	
LOS	B	B		B	A		B	B		B	B	
Approach Delay		12.5			10.5			11.2			15.3	
Approach LOS		B			B			B			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 75	
Actuated Cycle Length: 60.6	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.60	
Intersection Signal Delay: 12.5	Intersection LOS: B
Intersection Capacity Utilization 79.4%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 6: Baseline Road & Grand Island Blvd

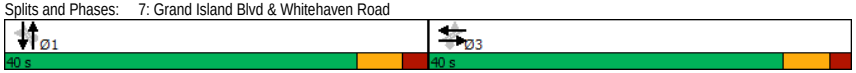


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	125	90	76	93	103	45	385	120	160	306	18
Future Volume (vph)	20	125	90	76	93	103	45	385	120	160	306	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		210	155		0	110		0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.921			0.964			0.992	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	1900	1615	1787	3263	0	1805	1832	0	1805	1885	0
Flt Permitted	0.617			0.669			0.548			0.383		
Satd. Flow (perm)	1172	1900	1615	1259	3263	0	1041	1832	0	728	1885	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			99		113			24			5	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		790			1017			5939			1413	
Travel Time (s)		18.0			23.1			135.0			32.1	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	0%	0%	0%	1%	4%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	22	137	99	84	102	113	49	423	132	176	336	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	22	137	99	84	215	0	49	555	0	176	356	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2		1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	3		3	3			1			1		
Detector Phase	3	3	3	3	3		1	1		1	1	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	35.5	35.5	35.5	35.5	35.5		36.8	36.8		36.8	36.8	
Total Split (s)	40.0	40.0	40.0	40.0	40.0		40.0	40.0		40.0	40.0	
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	33.5	33.5	33.5	33.5	33.5		33.2	33.2		33.2	33.2	
Yellow Time (s)	4.3	4.3	4.3	4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2		2.5	2.5		2.5	2.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.5	6.5	6.5	6.5	6.5		6.8	6.8		6.8	6.8	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None	None	None	None		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	22.0	22.0	22.0	22.0	22.0		23.0	23.0		23.0	23.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0		0	0	
Act Effct Green (s)	12.4	12.4	12.4	12.4	12.4		29.0	29.0		29.0	29.0	
Actuated g/C Ratio	0.22	0.22	0.22	0.22	0.22		0.53	0.53		0.53	0.53	
v/c Ratio	0.08	0.32	0.23	0.30	0.26		0.09	0.57		0.46	0.36	
Control Delay	18.4	21.0	6.0	21.7	10.3		8.1	11.9		14.2	9.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	18.4	21.0	6.0	21.7	10.3		8.1	11.9		14.2	9.4	
LOS	B	C	A	C	B		A	B		B	A	
Approach Delay		15.0			13.5			11.6			11.0	
Approach LOS		B			B			B			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 55.2			
Natural Cycle: 75			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.57			
Intersection Signal Delay: 12.3		Intersection LOS: B	
Intersection Capacity Utilization 70.2%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 7: Grand Island Blvd & Whitehaven Road



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	53	49	233	225	0
Future Volume (vph)	0	53	49	233	225	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.889			
Flt Protected					0.950	
Satd. Flow (prot)	0	1863	1656	0	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	0	1863	1656	0	1770	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		268	3096		641	
Travel Time (s)		6.1	70.4		14.6	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	0	62	58	274	265	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	62	332	0	265	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 36.1%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	5.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	0	53	49	233	225	0
Future Vol, veh/h	0	53	49	233	225	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	62	58	274	265	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	332	0	-	0	257	195
Stage 1	-	-	-	-	195	-
Stage 2	-	-	-	-	62	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1227	-	-	-	732	846
Stage 1	-	-	-	-	838	-
Stage 2	-	-	-	-	961	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1227	-	-	-	732	846
Mov Cap-2 Maneuver	-	-	-	-	732	-
Stage 1	-	-	-	-	838	-
Stage 2	-	-	-	-	961	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	12.7
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1227	-	-	-	732
HCM Lane V/C Ratio	-	-	-	-	0.362
HCM Control Delay (s)	0	-	-	-	12.7
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	1.7

Lane Group	EBT	EBR	WBL	WBT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	227	0	0	223	0	200
Future Volume (vph)	227	0	0	223	0	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	1863	0	0	1863	0	1611
Flt Permitted						
Satd. Flow (perm)	1863	0	0	1863	0	1611
Link Speed (mph)	30			30	30	
Link Distance (ft)	270			1077	408	
Travel Time (s)	6.1			24.5	9.3	
Peak Hour Factor	0.71	0.71	0.71	0.71	0.71	0.71
Adj. Flow (vph)	320	0	0	314	0	282
Shared Lane Traffic (%)						
Lane Group Flow (vph)	320	0	0	314	0	282
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 31.0%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	207	200	0	209	0	0
Future Volume (vph)	207	200	0	209	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.934					
Flt Protected						
Satd. Flow (prot)	1740	0	0	1863	0	0
Flt Permitted						
Satd. Flow (perm)	1740	0	0	1863	0	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	192			291	408	
Travel Time (s)	4.4			6.6	9.3	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	225	217	0	227	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	442	0	0	227	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 26.5%		ICU Level of Service A	
Analysis Period (min) 15			

MOVEMENT SUMMARY

Site: 1 [Grand Island Blvd @ Staley Road - 2021 AM SIDRA - Full Development]

Grand Island Blvd @ Staley Road
Single Lane Roundabout
2021 AM - SIDRA Full Development Conditions
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: Grand Island Blvd NB												
3	L2	189	3.0	0.244	7.2	LOS A	1.7	42.8	0.15	0.42	0.15	29.6
8	T1	178	1.4	0.244	1.6	LOS A	1.7	42.8	0.15	0.42	0.15	29.2
18	R2	251	0.5	0.186	2.4	LOS A	1.2	29.8	0.15	0.33	0.15	29.1
Approach		617	1.5	0.244	3.7	LOS A	1.7	42.8	0.15	0.39	0.15	29.2
East: Staley Road WB												
1	L2	517	0.2	0.618	11.8	LOS B	5.8	146.3	0.75	0.84	0.87	27.5
6	T1	62	0.0	0.618	6.2	LOS A	5.8	146.3	0.75	0.84	0.87	27.1
16	R2	23	0.0	0.618	6.7	LOS A	5.8	146.3	0.75	0.84	0.87	26.5
Approach		602	0.2	0.618	11.0	LOS B	5.8	146.3	0.75	0.84	0.87	27.4
North: Grand Island Blvd												
7	L2	6	0.0	0.450	14.4	LOS B	3.5	89.5	0.89	0.95	1.00	28.0
4	T1	239	4.8	0.450	9.3	LOS A	3.5	89.5	0.89	0.95	1.00	27.6
14	R2	23	0.0	0.450	9.4	LOS A	3.5	89.5	0.89	0.95	1.00	26.9
Approach		268	4.3	0.450	9.4	LOS A	3.5	89.5	0.89	0.95	1.00	27.6
West: Staley Road EB												
5	L2	2	0.0	0.251	12.6	LOS B	1.6	41.2	0.81	0.80	0.81	28.6
2	T1	18	0.0	0.251	7.0	LOS A	1.6	41.2	0.81	0.80	0.81	28.2
12	R2	139	0.8	0.251	7.6	LOS A	1.6	41.2	0.81	0.80	0.81	27.4
Approach		160	0.7	0.251	7.6	LOS A	1.6	41.2	0.81	0.80	0.81	27.5
All Vehicles		1647	1.4	0.618	7.7	LOS A	5.8	146.3	0.56	0.68	0.61	28.1

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 1 [Grand Island Blvd @ Staley Road - 2021 PM SIDRA - Full Development]

Grand Island Blvd @ Staley Road
Single Lane Roundabout
2021 AM - SIDRA Full Development Conditions
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: Grand Island Blvd NB												
3	L2	100	0.0	0.427	7.6	LOS A	3.3	83.4	0.31	0.32	0.31	29.9
8	T1	526	0.9	0.427	2.0	LOS A	3.3	83.4	0.31	0.32	0.31	29.5
18	R2	439	0.5	0.341	2.8	LOS A	2.4	59.1	0.30	0.38	0.30	28.8
Approach		1065	0.7	0.427	2.8	LOS A	3.3	83.4	0.31	0.34	0.31	29.3
East: Staley Road WB												
1	L2	265	0.0	0.448	12.6	LOS B	3.3	81.9	0.80	0.89	0.86	27.4
6	T1	41	0.0	0.448	7.0	LOS A	3.3	81.9	0.80	0.89	0.86	27.0
16	R2	38	3.1	0.448	7.8	LOS A	3.3	81.9	0.80	0.89	0.86	26.3
Approach		344	0.3	0.448	11.4	LOS B	3.3	81.9	0.80	0.89	0.86	27.2
North: Grand Island Blvd SB												
7	L2	40	0.0	0.510	10.6	LOS B	4.1	102.6	0.75	0.69	0.79	29.0
4	T1	406	1.1	0.510	5.1	LOS A	4.1	102.6	0.75	0.69	0.79	28.6
14	R2	14	0.0	0.510	5.6	LOS A	4.1	102.6	0.75	0.69	0.79	27.8
Approach		460	1.0	0.510	5.6	LOS A	4.1	102.6	0.75	0.69	0.79	28.6
West: Staley Road EB												
5	L2	14	0.0	0.305	12.2	LOS B	2.0	51.0	0.80	0.81	0.80	28.6
2	T1	24	0.0	0.305	6.6	LOS A	2.0	51.0	0.80	0.81	0.80	28.2
12	R2	166	3.6	0.305	7.4	LOS A	2.0	51.0	0.80	0.81	0.80	27.4
Approach		204	2.9	0.305	7.7	LOS A	2.0	51.0	0.80	0.81	0.80	27.6
All Vehicles		2072	0.9	0.510	5.3	LOS A	4.1	102.6	0.53	0.56	0.55	28.6

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Level of Service Calculations: Full Development Conditions With Project Modifications and Improvements

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	46	0	405	16	2	0	0	28	0	0	0
Future Volume (vph)	0	46	0	405	16	2	0	0	28	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.999			0.865				
Flt Protected					0.954							
Satd. Flow (prot)	0	1900	0	0	1777	0	0	1611	0	0	1863	0
Flt Permitted					0.954							
Satd. Flow (perm)	0	1900	0	0	1777	0	0	1611	0	0	1863	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		305			695			382			314	
Travel Time (s)		6.9			15.8			8.7			7.1	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.92	0.92	0.84	0.92	0.84
Heavy Vehicles (%)	0%	0%	2%	2%	0%	0%	2%	2%	2%	0%	2%	0%
Adj. Flow (vph)	0	55	0	482	19	2	0	0	30	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	55	0	0	503	0	0	30	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Free			Free			Stop			Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 40.1%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	7.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	46	0	405	16	2	0	0	28	0	0	0
Future Vol, veh/h	0	46	0	405	16	2	0	0	28	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	84	84	84	84	84	84	84	92	92	84	92	84
Heavy Vehicles, %	0	0	2	2	0	0	2	2	2	0	2	0
Mvmt Flow	0	55	0	482	19	2	0	0	30	0	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	21	0	0	55	0	0	1039	1040	55	1054	1039	20
Stage 1	-	-	-	-	-	-	55	55	-	984	984	-
Stage 2	-	-	-	-	-	-	984	985	-	70	55	-
Critical Hdwy	4.1	-	-	4.12	-	-	7.12	6.52	6.22	7.1	6.52	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.1	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.1	5.52	-
Follow-up Hdwy	2.2	-	-	2.218	-	-	3.518	4.018	3.318	3.5	4.018	3.3
Pot Cap-1 Maneuver	1608	-	-	1550	-	-	209	230	1012	206	231	1064
Stage 1	-	-	-	-	-	-	957	849	-	302	327	-
Stage 2	-	-	-	-	-	-	299	326	-	945	849	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1608	-	-	1550	-	-	158	158	1012	151	158	1064
Mov Cap-2 Maneuver	-	-	-	-	-	-	158	158	-	151	158	-
Stage 1	-	-	-	-	-	-	957	849	-	302	224	-
Stage 2	-	-	-	-	-	-	205	223	-	917	849	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	8	8.7	0
HCM LOS			A	A

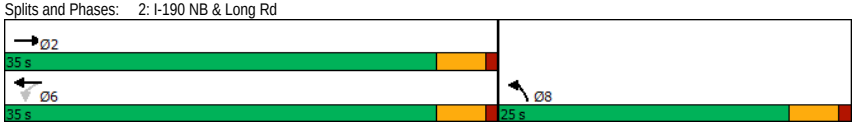
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	1012	1608	-	-	1550	-	-	-
HCM Lane V/C Ratio	0.03	-	-	-	0.311	-	-	-
HCM Control Delay (s)	8.7	0	-	-	8.4	0	-	0
HCM Lane LOS	A	A	-	-	A	A	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	1.3	-	-	-

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	49	25	154	206	250	0
Future Volume (vph)	49	25	154	206	250	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.954					
Flt Protected				0.979	0.950	
Satd. Flow (prot)	1813	0	0	1850	1805	0
Flt Permitted				0.822	0.950	
Satd. Flow (perm)	1813	0	0	1553	1805	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	29					
Link Speed (mph)	30			30	30	
Link Distance (ft)	695			259	291	
Travel Time (s)	15.8			5.9	6.6	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	0%	0%	0%	1%	0%	0%
Adj. Flow (vph)	56	29	177	237	287	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	85	0	0	414	287	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Number of Detectors	2		1	2	1	
Detector Template	Thru		Left	Thru	Left	
Leading Detector (ft)	100		20	100	20	
Trailing Detector (ft)	0		0	0	0	
Detector 1 Position(ft)	0		0	0	0	
Detector 1 Size(ft)	6		20	6	20	
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0		0.0	0.0	0.0	
Detector 1 Queue (s)	0.0		0.0	0.0	0.0	
Detector 1 Delay (s)	0.0		0.0	0.0	0.0	
Detector 2 Position(ft)	94			94		
Detector 2 Size(ft)	6			6		
Detector 2 Type	Cl+Ex			Cl+Ex		
Detector 2 Channel						
Detector 2 Extend (s)	0.0			0.0		
Turn Type	NA		Perm	NA	Prot	
Protected Phases	2			6	8	
Permitted Phases			6			
Detector Phase	2		6	6	8	
Switch Phase						

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Minimum Initial (s)	5.0		5.0	5.0	5.0	
Minimum Split (s)	22.5		22.5	22.5	22.5	
Total Split (s)	35.0		35.0	35.0	25.0	
Total Split (%)	58.3%		58.3%	58.3%	41.7%	
Maximum Green (s)	30.5		30.5	30.5	20.5	
Yellow Time (s)	3.5		3.5	3.5	3.5	
All-Red Time (s)	1.0		1.0	1.0	1.0	
Lost Time Adjust (s)	0.0			0.0	0.0	
Total Lost Time (s)	4.5			4.5	4.5	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Recall Mode	None		None	None	Min	
Walk Time (s)	7.0		7.0	7.0	7.0	
Flash Dont Walk (s)	11.0		11.0	11.0	11.0	
Pedestrian Calls (#/hr)	0		0	0	0	
Act Effct Green (s)	15.5			15.5	11.6	
Actuated g/C Ratio	0.42			0.42	0.32	
v/c Ratio	0.11			0.63	0.51	
Control Delay	5.3			13.6	15.0	
Queue Delay	0.0			0.0	0.0	
Total Delay	5.3			13.6	15.0	
LOS	A			B	B	
Approach Delay	5.3			13.6	15.0	
Approach LOS	A			B	B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 36.8			
Natural Cycle: 50			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.63			
Intersection Signal Delay: 13.2		Intersection LOS: B	
Intersection Capacity Utilization 47.4%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 2: I-190 NB & Long Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	29	26	103	14	160	57	200	112	22	0	0	0
Future Volume (vph)	29	26	103	14	160	57	200	112	22	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.967			0.991				
Flt Protected		0.974			0.997			0.971				
Satd. Flow (prot)	0	1851	1599	0	1819	0	0	1822	0	0	1900	0
Flt Permitted		0.974			0.997			0.971				
Satd. Flow (perm)	0	1851	1599	0	1819	0	0	1822	0	0	1900	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1093			662			443			522	
Travel Time (s)		24.8			15.0			10.1			11.9	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	0%	0%	1%	0%	1%	0%	0%	1%	0%	0%	0%	0%
Adj. Flow (vph)	34	30	120	16	186	66	233	130	26	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	64	120	0	268	0	0	389	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 44.3%	ICU Level of Service A
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	12.4
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	29	26	103	14	160	57	200	112	22	0	0	0
Future Vol, veh/h	29	26	103	14	160	57	200	112	22	0	0	0
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles, %	0	0	1	0	1	0	0	1	0	0	0	0
Mvmt Flow	34	30	120	16	186	66	233	130	26	0	0	0
Number of Lanes	0	1	1	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	2
HCM Control Delay	9.3	11.6	14.5	0
HCM LOS	A	B	B	-

Lane	NBLn1	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	60%	53%	0%	6%	0%
Vol Thru, %	34%	47%	0%	69%	100%
Vol Right, %	7%	0%	100%	25%	0%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	334	55	103	231	0
LT Vol	200	29	0	14	0
Through Vol	112	26	0	160	0
RT Vol	22	0	103	57	0
Lane Flow Rate	388	64	120	269	0
Geometry Grp	2	7	7	5	2
Degree of Util (X)	0.559	0.11	0.174	0.39	0
Departure Headway (Hd)	5.178	6.21	5.232	5.226	5.745
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	703	578	685	688	0
Service Time	3.178	3.945	2.967	3.257	3.788
HCM Lane V/C Ratio	0.552	0.111	0.175	0.391	0
HCM Control Delay	14.5	9.7	9.1	11.6	8.8
HCM Lane LOS	B	A	A	B	N
HCM 95th-tile Q	3.5	0.4	0.6	1.9	0

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	189	262	0	146	116	0
Future Volume (vph)	189	262	0	146	116	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				
Flt Protected	0.950					
Satd. Flow (prot)	1805	1615	0	1881	1881	0
Flt Permitted	0.950					
Satd. Flow (perm)	1805	1615	0	1881	1881	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	536			5051	443	
Travel Time (s)	12.2			114.8	10.1	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles (%)	0%	0%	0%	1%	1%	0%
Adj. Flow (vph)	220	305	0	170	135	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	220	305	0	170	135	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	15			9
Sign Control	Stop			Free	Free	

Intersection Summary		
Area Type:	Other	
Control Type: Unsignalized		
Intersection Capacity Utilization 29.0%		ICU Level of Service A
Analysis Period (min) 15		

Intersection	
Int Delay, s/veh	7.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	189	262	0	146	116	0
Future Vol, veh/h	189	262	0	146	116	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	0	0	0	1	1	0
Mvmt Flow	220	305	0	170	135	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	305	135	-	0	-	0
Stage 1	135	-	-	-	-	-
Stage 2	170	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	-	-
Pot Cap-1 Maneuver	691	919	0	-	-	0
Stage 1	896	-	0	-	-	0
Stage 2	865	-	0	-	-	0
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	691	919	-	-	-	-
Mov Cap-2 Maneuver	691	-	-	-	-	-
Stage 1	896	-	-	-	-	-
Stage 2	865	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.6	0	0
HCM LOS	B		

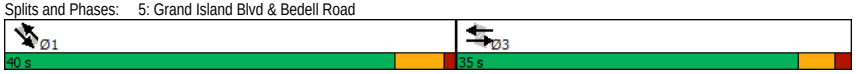
Minor Lane/Major Mvmt	NBT	EBLn1	EBLn2	SBT
Capacity (veh/h)	-	691	919	-
HCM Lane V/C Ratio	-	0.318	0.332	-
HCM Control Delay (s)	-	12.6	10.8	-
HCM Lane LOS	-	B	B	-
HCM 95th %tile Q(veh)	-	1.4	1.5	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	1	11	42	68	29	82	23	60	250	61	70	13
Future Volume (vph)	1	11	42	68	29	82	23	60	250	61	70	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.896			0.939			0.899			0.988	
Flt Protected		0.999			0.981			0.997			0.979	
Satd. Flow (prot)	0	1576	0	0	1727	0	0	1697	0	0	1814	0
Flt Permitted		0.992			0.850			0.973			0.754	
Satd. Flow (perm)	0	1565	0	0	1496	0	0	1656	0	0	1397	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		44			67			263			9	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3134			771			5051			5011	
Travel Time (s)		71.2			17.5			114.8			113.9	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	100%	0%	8%	0%	0%	3%	0%	2%	0%	2%	1%	0%
Adj. Flow (vph)	1	12	44	72	31	86	24	63	263	64	74	14
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	57	0	0	189	0	0	350	0	0	152	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3			1			1		
Detector Phase	3	3		3	3		1	1		1	1	
Switch Phase												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Minimum Initial (s)	6.0	6.0		6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	35.0	35.0		35.0	35.0		40.0	40.0		40.0	40.0	
Total Split (%)	46.7%	46.7%		46.7%	46.7%		53.3%	53.3%		53.3%	53.3%	
Maximum Green (s)	30.2	30.2		30.2	30.2		34.5	34.5		34.5	34.5	
Yellow Time (s)	3.2	3.2		3.2	3.2		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.6	1.6		1.6	1.6		1.2	1.2		1.2	1.2	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.8			4.8			5.5			5.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	2.0		2.0	2.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Act Effct Green (s)		7.7			7.7			14.2			14.2	
Actuated g/C Ratio		0.24			0.24			0.44			0.44	
v/c Ratio		0.14			0.47			0.40			0.25	
Control Delay		5.7			10.9			3.7			7.3	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		5.7			10.9			3.7			7.3	
LOS		A			B			A			A	
Approach Delay		5.7			10.9			3.7			7.3	
Approach LOS		A			B			A			A	

Intersection Summary	
Area Type:	Other
Cycle Length: 75	
Actuated Cycle Length: 32.5	
Natural Cycle: 45	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.47	
Intersection Signal Delay: 6.4	Intersection LOS: A
Intersection Capacity Utilization 52.5%	ICU Level of Service A
Analysis Period (min) 15	

Splits and Phases: 5: Grand Island Blvd & Bedell Road

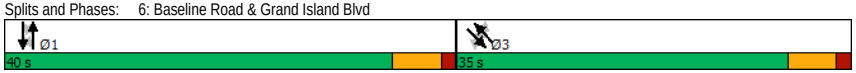


Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	63	57	2	94	246	19	0	87	98	1	97	54
Future Volume (vph)	63	57	2	94	246	19	0	87	98	1	97	54
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	145		0	165		0	200		0
Storage Lanes	1		0	2		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.995			0.989			0.921			0.947	
Flt Protected	0.950			0.950						0.950		
Satd. Flow (prot)	1752	3490	0	1805	3537	0	1900	1718	0	1805	1753	0
Flt Permitted	0.574			0.712						0.630		
Satd. Flow (perm)	1059	3490	0	1353	3537	0	1900	1718	0	1197	1753	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			14			89			43	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		642			804			5011			1413	
Travel Time (s)		14.6			18.3			113.9			32.1	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	3%	3%	0%	0%	1%	0%	0%	4%	0%	0%	3%	2%
Adj. Flow (vph)	69	63	2	103	270	21	0	96	108	1	107	59
Shared Lane Traffic (%)												
Lane Group Flow (vph)	69	65	0	103	291	0	0	204	0	1	166	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		1			1			3			3	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Permitted Phases	1			1			3			3		
Detector Phase	1	1		1	1		3	3		3	3	
Switch Phase												
Minimum Initial (s)	25.0	25.0		25.0	25.0		15.0	15.0		15.0	15.0	
Minimum Split (s)	37.7	37.7		37.7	37.7		37.7	37.7		37.7	37.7	
Total Split (s)	40.0	40.0		40.0	40.0		35.0	35.0		35.0	35.0	
Total Split (%)	53.3%	53.3%		53.3%	53.3%		46.7%	46.7%		46.7%	46.7%	
Maximum Green (s)	34.3	34.3		34.3	34.3		29.3	29.3		29.3	29.3	
Yellow Time (s)	4.3	4.3		4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.4	1.4		1.4	1.4		1.4	1.4		1.4	1.4	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.7	5.7		5.7	5.7		5.7	5.7		5.7	5.7	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0		4.0	4.0		6.0	6.0		6.0	6.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	25.0	25.0		25.0	25.0			16.0		16.0	16.0	
Actuated g/C Ratio	0.48	0.48		0.48	0.48			0.31		0.31	0.31	
v/c Ratio	0.14	0.04		0.16	0.17			0.35		0.00	0.29	
Control Delay	9.2	7.8		9.1	8.1			10.0		12.0	11.9	
Queue Delay	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Total Delay	9.2	7.8		9.1	8.1			10.0		12.0	11.9	
LOS	A	A		A	A			B		B	B	
Approach Delay		8.5			8.3			10.0			11.9	
Approach LOS		A			A			B			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 75	
Actuated Cycle Length: 52.4	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.35	
Intersection Signal Delay: 9.4	Intersection LOS: A
Intersection Capacity Utilization 68.4%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 6: Baseline Road & Grand Island Blvd

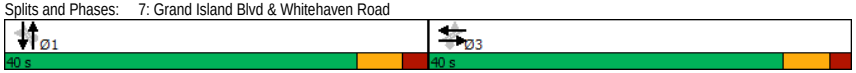


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	8	76	39	50	226	55	59	123	33	31	163	6
Future Volume (vph)	8	76	39	50	226	55	59	123	33	31	163	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		210	155		0	110		0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.971			0.968			0.994	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	1881	1538	1736	3477	0	1805	1831	0	1805	1802	0
Flt Permitted	0.539			0.695			0.624			0.633		
Satd. Flow (perm)	1024	1881	1538	1270	3477	0	1186	1831	0	1203	1802	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			52		46			21			3	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		790			1017			5939			1413	
Travel Time (s)		18.0			23.1			135.0			32.1	
Peak Hour Factor	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
Heavy Vehicles (%)	0%	1%	5%	4%	1%	0%	0%	0%	2%	0%	5%	0%
Adj. Flow (vph)	10	96	49	63	286	70	75	156	42	39	206	8
Shared Lane Traffic (%)												
Lane Group Flow (vph)	10	96	49	63	356	0	75	198	0	39	214	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2		1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	3		3	3			1			1		
Detector Phase	3	3	3	3	3		1	1		1	1	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	35.5	35.5	35.5	35.5	35.5		36.8	36.8		36.8	36.8	
Total Split (s)	40.0	40.0	40.0	40.0	40.0		40.0	40.0		40.0	40.0	
Total Split (%)	50.0%	50.0%	50.0%	50.0%	50.0%		50.0%	50.0%		50.0%	50.0%	
Maximum Green (s)	33.5	33.5	33.5	33.5	33.5		33.2	33.2		33.2	33.2	
Yellow Time (s)	4.3	4.3	4.3	4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2		2.5	2.5		2.5	2.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.5	6.5	6.5	6.5	6.5		6.8	6.8		6.8	6.8	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None	None	None	None		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	22.0	22.0	22.0	22.0	22.0		23.0	23.0		23.0	23.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0		0	0	
Act Effct Green (s)	12.1	12.1	12.1	12.1	12.1		13.0	13.0		13.0	13.0	
Actuated g/C Ratio	0.31	0.31	0.31	0.31	0.31		0.33	0.33		0.33	0.33	
v/c Ratio	0.03	0.16	0.10	0.16	0.32		0.19	0.32		0.10	0.35	
Control Delay	10.4	11.0	4.4	11.4	10.0		11.4	10.8		10.5	12.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	10.4	11.0	4.4	11.4	10.0		11.4	10.8		10.5	12.2	
LOS	B	B	A	B	A		B	B		B	B	
Approach Delay		8.9			10.2			10.9			11.9	
Approach LOS		A			B			B			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 38.9			
Natural Cycle: 75			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.35			
Intersection Signal Delay: 10.6		Intersection LOS: B	
Intersection Capacity Utilization 43.5%		ICU Level of Service A	
Analysis Period (min) 15			

Splits and Phases: 7: Grand Island Blvd & Whitehaven Road



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	43	77	263	11	0
Future Volume (vph)	0	43	77	263	11	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.896			
Flt Protected					0.950	
Satd. Flow (prot)	0	1863	1669	0	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	0	1863	1669	0	1770	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		506	3134		384	
Travel Time (s)		11.5	71.2		8.7	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	47	84	286	12	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	47	370	0	12	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 30.2%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	0	43	77	263	11	0
Future Vol, veh/h	0	43	77	263	11	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	47	84	286	12	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	370	0	-	0	274	227
Stage 1	-	-	-	-	227	-
Stage 2	-	-	-	-	47	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1189	-	-	-	716	812
Stage 1	-	-	-	-	811	-
Stage 2	-	-	-	-	975	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1189	-	-	-	716	812
Mov Cap-2 Maneuver	-	-	-	-	716	-
Stage 1	-	-	-	-	811	-
Stage 2	-	-	-	-	975	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	10.1
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1189	-	-	-	716
HCM Lane V/C Ratio	-	-	-	-	0.017
HCM Control Delay (s)	0	-	-	-	10.1
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Lane Group	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	250	113	0	179	0	0
Future Volume (vph)	250	113	0	179	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.958					
Flt Protected						
Satd. Flow (prot)	1785	0	0	1863	0	0
Flt Permitted						
Satd. Flow (perm)	1785	0	0	1863	0	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	134			291	395	
Travel Time (s)	3.0			6.6	9.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	123	0	195	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	395	0	0	195	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 23.4%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	EBT	EBR	WBL	WBT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	49	0	0	360	0	113
Future Volume (vph)	49	0	0	360	0	113
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	1863	0	0	1863	0	1611
Flt Permitted						
Satd. Flow (perm)	1863	0	0	1863	0	1611
Link Speed (mph)	30			30	30	
Link Distance (ft)	259			1093	395	
Travel Time (s)	5.9			24.8	9.0	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	56	0	0	414	0	130
Shared Lane Traffic (%)						
Lane Group Flow (vph)	56	0	0	414	0	130
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 22.3%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	24	0	357	12	0	0	0	375	1	0	0
Future Volume (vph)	0	24	0	357	12	0	0	0	375	1	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt								0.865				
Flt Protected					0.954						0.950	
Satd. Flow (prot)	0	1863	0	0	1777	0	0	1611	0	0	1770	0
Flt Permitted					0.954						0.950	
Satd. Flow (perm)	0	1863	0	0	1777	0	0	1611	0	0	1770	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		305			692			497			378	
Travel Time (s)		6.9			15.7			11.3			8.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	26	0	388	13	0	0	0	408	1	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	26	0	0	401	0	0	408	0	0	1	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Free			Free			Stop			Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 57.0%	ICU Level of Service B
Analysis Period (min) 15	

Intersection	
Int Delay, s/veh	8.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	24	0	357	12	0	0	0	375	1	0	0
Future Vol, veh/h	0	24	0	357	12	0	0	0	375	1	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	26	0	388	13	0	0	0	408	1	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	13	0	0	26	0	0	815	815	26	1019	815	13
Stage 1	-	-	-	-	-	-	26	26	-	789	789	-
Stage 2	-	-	-	-	-	-	789	789	-	230	26	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1606	-	-	1588	-	-	296	312	1050	215	312	1067
Stage 1	-	-	-	-	-	-	992	874	-	384	402	-
Stage 2	-	-	-	-	-	-	384	402	-	773	874	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1606	-	-	1588	-	-	240	235	1050	107	235	1067
Mov Cap-2 Maneuver	-	-	-	-	-	-	240	235	-	107	235	-
Stage 1	-	-	-	-	-	-	992	874	-	384	303	-
Stage 2	-	-	-	-	-	-	290	303	-	473	874	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	7.7	10.6	39
HCM LOS			B	E

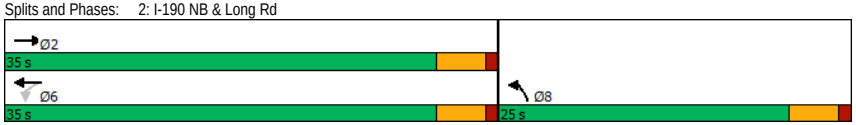
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	1050	1606	-	-	1588	-	-	107
HCM Lane V/C Ratio	0.388	-	-	-	0.244	-	-	0.01
HCM Control Delay (s)	10.6	0	-	-	8	0	-	39
HCM Lane LOS	B	A	-	-	A	A	-	E
HCM 95th %tile Q(veh)	1.9	0	-	-	1	-	-	0

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	227	158	51	172	207	0
Future Volume (vph)	227	158	51	172	207	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.945					
Flt Protected				0.989	0.950	
Satd. Flow (prot)	1796	0	0	1879	1805	0
Flt Permitted				0.763	0.950	
Satd. Flow (perm)	1796	0	0	1450	1805	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	85					
Link Speed (mph)	30			30	30	
Link Distance (ft)	692			268	277	
Travel Time (s)	15.7			6.1	6.3	
Peak Hour Factor	0.71	0.71	0.71	0.71	0.71	0.71
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	320	223	72	242	292	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	543	0	0	314	292	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Number of Detectors	2		1	2	1	
Detector Template	Thru		Left	Thru	Left	
Leading Detector (ft)	100		20	100	20	
Trailing Detector (ft)	0		0	0	0	
Detector 1 Position(ft)	0		0	0	0	
Detector 1 Size(ft)	6		20	6	20	
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	
Detector 1 Channel						
Detector 1 Extend (s)	0.0		0.0	0.0	0.0	
Detector 1 Queue (s)	0.0		0.0	0.0	0.0	
Detector 1 Delay (s)	0.0		0.0	0.0	0.0	
Detector 2 Position(ft)	94			94		
Detector 2 Size(ft)	6			6		
Detector 2 Type	Cl+Ex			Cl+Ex		
Detector 2 Channel						
Detector 2 Extend (s)	0.0			0.0		
Turn Type	NA		Perm	NA	Prot	
Protected Phases	2			6	8	
Permitted Phases			6			
Detector Phase	2		6	6	8	
Switch Phase						

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Minimum Initial (s)	5.0		5.0	5.0	5.0	
Minimum Split (s)	22.5		22.5	22.5	22.5	
Total Split (s)	35.0		35.0	35.0	25.0	
Total Split (%)	58.3%		58.3%	58.3%	41.7%	
Maximum Green (s)	30.5		30.5	30.5	20.5	
Yellow Time (s)	3.5		3.5	3.5	3.5	
All-Red Time (s)	1.0		1.0	1.0	1.0	
Lost Time Adjust (s)	0.0			0.0	0.0	
Total Lost Time (s)	4.5			4.5	4.5	
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Recall Mode	None		None	None	Min	
Walk Time (s)	7.0		7.0	7.0	7.0	
Flash Dont Walk (s)	11.0		11.0	11.0	11.0	
Pedestrian Calls (#/hr)	0		0	0	0	
Act Effct Green (s)	16.5			16.5	12.0	
Actuated g/C Ratio	0.43			0.43	0.31	
v/c Ratio	0.66			0.50	0.52	
Control Delay	11.8			11.3	15.9	
Queue Delay	0.0			0.0	0.0	
Total Delay	11.8			11.3	15.9	
LOS	B			B	B	
Approach Delay	11.8			11.3	15.9	
Approach LOS	B			B	B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 38.4			
Natural Cycle: 50			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.66			
Intersection Signal Delay: 12.7		Intersection LOS: B	
Intersection Capacity Utilization 56.2%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 2: I-190 NB & Long Rd



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	264	95	168	17	48	56	168	179	90	0	2	6
Future Volume (vph)	264	95	168	17	48	56	168	179	90	0	2	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.937			0.972			0.895	
Flt Protected		0.965			0.993			0.981				
Satd. Flow (prot)	0	1834	1615	0	1768	0	0	1804	0	0	1674	0
Flt Permitted		0.965			0.993			0.981				
Satd. Flow (perm)	0	1834	1615	0	1768	0	0	1804	0	0	1674	0
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1087			662			436			522	
Travel Time (s)		24.7			15.0			9.9			11.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	2%
Adj. Flow (vph)	287	103	183	18	52	61	183	195	98	0	2	7
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	390	183	0	131	0	0	476	0	0	9	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Sign Control		Stop			Stop			Stop			Stop	

Intersection Summary	
Area Type:	Other
Control Type: Unsignalized	
Intersection Capacity Utilization 63.8%	ICU Level of Service B
Analysis Period (min) 15	

Intersection	
Intersection Delay, s/veh	20.2
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	264	95	168	17	48	56	168	179	90	0	2	6
Future Vol, veh/h	264	95	168	17	48	56	168	179	90	0	2	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	0	0	0	0	0	0	0	1	0	0	0	2
Mvmt Flow	287	103	183	18	52	61	183	195	98	0	2	7
Number of Lanes	0	1	1	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	2
HCM Control Delay	19.6	10.9	23.8	9.5
HCM LOS	C	B	C	A

Lane	NBLn1	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	38%	74%	0%	14%	0%
Vol Thru, %	41%	26%	0%	40%	25%
Vol Right, %	21%	0%	100%	46%	75%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	437	359	168	121	8
LT Vol	168	264	0	17	0
Through Vol	179	95	0	48	2
RT Vol	90	0	168	56	6
Lane Flow Rate	475	390	183	132	9
Geometry Grp	2	7	7	5	2
Degree of Util (X)	0.749	0.712	0.278	0.223	0.015
Departure Headway (Hd)	5.676	6.565	5.481	6.109	6.292
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	637	550	654	585	564
Service Time	3.725	4.317	3.232	4.178	4.384
HCM Lane V/C Ratio	0.746	0.709	0.28	0.226	0.016
HCM Control Delay	23.8	24	10.3	10.9	9.5
HCM Lane LOS	C	C	B	B	A
HCM 95th-tile Q	6.7	5.7	1.1	0.8	0

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	209	225	0	228	150	0
Future Volume (vph)	209	225	0	228	150	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850				
Flt Protected	0.950					
Satd. Flow (prot)	1805	1538	0	1900	1881	0
Flt Permitted	0.950					
Satd. Flow (perm)	1805	1538	0	1900	1881	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	447			5058	436	
Travel Time (s)	10.2			115.0	9.9	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	0%	5%	0%	0%	1%	0%
Adj. Flow (vph)	232	250	0	253	167	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	232	250	0	253	167	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9	15			9
Sign Control	Stop			Free	Free	

Intersection Summary		
Area Type:	Other	
Control Type: Unsignalized		
Intersection Capacity Utilization 30.2%		ICU Level of Service A
Analysis Period (min) 15		

Intersection	
Int Delay, s/veh	6.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	209	225	0	228	150	0
Future Vol, veh/h	209	225	0	228	150	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	0	5	0	0	1	0
Mvmt Flow	232	250	0	253	167	0

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	420	167	-	0	-	0
Stage 1	167	-	-	-	-	-
Stage 2	253	-	-	-	-	-
Critical Hdwy	6.4	6.25	-	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.345	-	-	-	-
Pot Cap-1 Maneuver	594	869	0	-	-	0
Stage 1	867	-	0	-	-	0
Stage 2	794	-	0	-	-	0
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	594	869	-	-	-	-
Mov Cap-2 Maneuver	594	-	-	-	-	-
Stage 1	867	-	-	-	-	-
Stage 2	794	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12.8	0	0
HCM LOS	B		

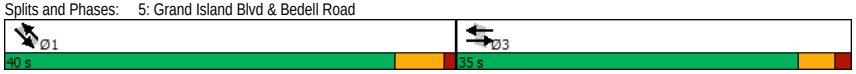
Minor Lane/Major Mvmt	NBT	EBLn1	EBLn2	SBT
Capacity (veh/h)	-	594	869	-
HCM Lane V/C Ratio	-	0.391	0.288	-
HCM Control Delay (s)	-	14.9	10.8	-
HCM Lane LOS	-	B	B	-
HCM 95th %tile Q(veh)	-	1.9	1.2	-

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	17	38	223	43	20	72	81	93	208	54	121	87
Future Volume (vph)	17	38	223	43	20	72	81	93	208	54	121	87
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.892			0.928			0.926			0.955	
Flt Protected		0.997			0.984			0.990			0.990	
Satd. Flow (prot)	0	1588	0	0	1735	0	0	1742	0	0	1780	0
Flt Permitted		0.970			0.796			0.867			0.854	
Satd. Flow (perm)	0	1545	0	0	1404	0	0	1525	0	0	1535	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		240			77			106			44	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3096			771			5058			5011	
Travel Time (s)		70.4			17.5			115.0			113.9	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	2%	0%
Adj. Flow (vph)	18	41	240	46	22	77	87	100	224	58	130	94
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	299	0	0	145	0	0	411	0	0	282	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	
Permitted Phases	3			3			1			1		
Detector Phase	3	3		3	3		1	1		1	1	
Switch Phase												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Minimum Initial (s)	6.0	6.0		6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	22.5	22.5		22.5	22.5		22.5	22.5		22.5	22.5	
Total Split (s)	35.0	35.0		35.0	35.0		40.0	40.0		40.0	40.0	
Total Split (%)	46.7%	46.7%		46.7%	46.7%		53.3%	53.3%		53.3%	53.3%	
Maximum Green (s)	30.2	30.2		30.2	30.2		34.5	34.5		34.5	34.5	
Yellow Time (s)	3.2	3.2		3.2	3.2		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.6	1.6		1.6	1.6		1.2	1.2		1.2	1.2	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		4.8			4.8			5.5			5.5	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	2.0		2.0	2.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Act Effct Green (s)		8.0			8.0			16.2			16.2	
Actuated g/C Ratio		0.23			0.23			0.46			0.46	
v/c Ratio		0.56			0.38			0.54			0.39	
Control Delay		8.6			10.7			8.0			7.0	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		8.6			10.7			8.0			7.0	
LOS		A			B			A			A	
Approach Delay		8.6			10.7			8.0			7.0	
Approach LOS		A			B			A			A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 75			
Actuated Cycle Length: 35.1			
Natural Cycle: 45			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.56			
Intersection Signal Delay: 8.2		Intersection LOS: A	
Intersection Capacity Utilization 61.1%		ICU Level of Service B	
Analysis Period (min) 15			

Splits and Phases: 5: Grand Island Blvd & Bedell Road

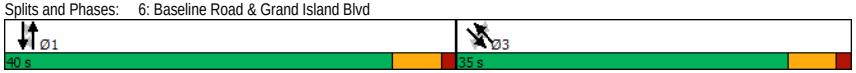


Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	72	117	14	112	242	118	23	141	81	21	213	201
Future Volume (vph)	72	117	14	112	242	118	23	141	81	21	213	201
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	145		0	165		0	200		0
Storage Lanes	1		0	2		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.984			0.951			0.945			0.927	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	3552	0	1805	3202	0	1805	1784	0	1805	1761	0
Flt Permitted	0.523			0.663			0.370			0.610		
Satd. Flow (perm)	994	3552	0	1260	3202	0	703	1784	0	1159	1761	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		15			127			45			74	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		642			804			5011			1413	
Travel Time (s)		14.6			18.3			113.9			32.1	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	0%	0%	22%	0%	1%	0%	0%	0%	0%
Adj. Flow (vph)	77	126	15	120	260	127	25	152	87	23	229	216
Shared Lane Traffic (%)												
Lane Group Flow (vph)	77	141	0	120	387	0	25	239	0	23	445	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		1			1			3			3	

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Permitted Phases	1			1			3			3		
Detector Phase	1	1		1	1		3	3		3	3	
Switch Phase												
Minimum Initial (s)	25.0	25.0		25.0	25.0		15.0	15.0		15.0	15.0	
Minimum Split (s)	37.7	37.7		37.7	37.7		37.7	37.7		37.7	37.7	
Total Split (s)	40.0	40.0		40.0	40.0		35.0	35.0		35.0	35.0	
Total Split (%)	53.3%	53.3%		53.3%	53.3%		46.7%	46.7%		46.7%	46.7%	
Maximum Green (s)	34.3	34.3		34.3	34.3		29.3	29.3		29.3	29.3	
Yellow Time (s)	4.3	4.3		4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	1.4	1.4		1.4	1.4		1.4	1.4		1.4	1.4	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	5.7	5.7		5.7	5.7		5.7	5.7		5.7	5.7	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0		4.0	4.0		6.0	6.0		6.0	6.0	
Recall Mode	Min	Min		Min	Min		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)	25.3	25.3		25.3	25.3		23.8	23.8		23.8	23.8	
Actuated g/C Ratio	0.42	0.42		0.42	0.42		0.39	0.39		0.39	0.39	
v/c Ratio	0.19	0.09		0.23	0.27		0.09	0.33		0.05	0.60	
Control Delay	14.6	11.3		14.7	9.2		11.8	11.1		11.0	15.5	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	14.6	11.3		14.7	9.2		11.8	11.1		11.0	15.5	
LOS	B	B		B	A		B	B		B	B	
Approach Delay		12.5			10.5			11.2			15.3	
Approach LOS		B			B			B			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 75	
Actuated Cycle Length: 60.6	
Natural Cycle: 80	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.60	
Intersection Signal Delay: 12.5	Intersection LOS: B
Intersection Capacity Utilization 79.4%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 6: Baseline Road & Grand Island Blvd

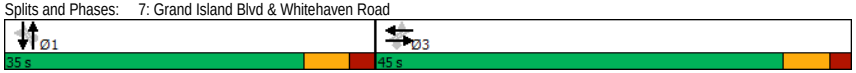


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	125	90	76	93	103	45	385	120	160	306	18
Future Volume (vph)	20	125	90	76	93	103	45	385	120	160	306	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		210	155		0	110		0
Storage Lanes	1		1	1		1	1		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.921			0.964			0.992	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1805	1900	1615	1787	3263	0	1805	1832	0	1805	1885	0
Flt Permitted	0.617			0.669			0.548			0.384		
Satd. Flow (perm)	1172	1900	1615	1259	3263	0	1041	1832	0	730	1885	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			99		113			22			4	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		790			1017			5939			1413	
Travel Time (s)		18.0			23.1			135.0			32.1	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	0%	0%	0%	1%	4%	0%	0%	0%	0%	0%	0%	0%
Adj. Flow (vph)	22	137	99	84	102	113	49	423	132	176	336	20
Shared Lane Traffic (%)												
Lane Group Flow (vph)	22	137	99	84	215	0	49	555	0	176	356	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2	1	1	2		1	2		1	2	
Detector Template	Left	Thru	Right	Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100	20	20	100		20	100		20	100	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Position(ft)	0	0	0	0	0		0	0		0	0	
Detector 1 Size(ft)	20	6	20	20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA		Perm	NA	
Protected Phases		3			3			1			1	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Permitted Phases	3		3	3			1			1		
Detector Phase	3	3	3	3	3		1	1		1	1	
Switch Phase												
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	35.5	35.5	35.5	35.5	35.5		36.8	36.8		36.8	36.8	
Total Split (s)	45.0	45.0	45.0	45.0	45.0		35.0	35.0		35.0	35.0	
Total Split (%)	56.3%	56.3%	56.3%	56.3%	56.3%		43.8%	43.8%		43.8%	43.8%	
Maximum Green (s)	38.5	38.5	38.5	38.5	38.5		28.2	28.2		28.2	28.2	
Yellow Time (s)	4.3	4.3	4.3	4.3	4.3		4.3	4.3		4.3	4.3	
All-Red Time (s)	2.2	2.2	2.2	2.2	2.2		2.5	2.5		2.5	2.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.5	6.5	6.5	6.5	6.5		6.8	6.8		6.8	6.8	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Recall Mode	None	None	None	None	None		Min	Min		Min	Min	
Walk Time (s)	7.0	7.0	7.0	7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	22.0	22.0	22.0	22.0	22.0		23.0	23.0		23.0	23.0	
Pedestrian Calls (#/hr)	0	0	0	0	0		0	0		0	0	
Act Effct Green (s)	12.1	12.1	12.1	12.1	12.1		28.4	28.4		28.4	28.4	
Actuated g/C Ratio	0.22	0.22	0.22	0.22	0.22		0.53	0.53		0.53	0.53	
v/c Ratio	0.08	0.32	0.23	0.30	0.26		0.09	0.57		0.46	0.36	
Control Delay	16.1	18.9	5.5	19.5	9.1		8.5	12.3		14.6	9.7	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	16.1	18.9	5.5	19.5	9.1		8.5	12.3		14.6	9.7	
LOS	B	B	A	B	A		A	B		B	A	
Approach Delay		13.5			12.0			12.0			11.4	
Approach LOS		B			B			B			B	

Intersection Summary	
Area Type:	Other
Cycle Length: 80	
Actuated Cycle Length: 53.9	
Natural Cycle: 75	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.57	
Intersection Signal Delay: 12.0	Intersection LOS: B
Intersection Capacity Utilization 70.2%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 7: Grand Island Blvd & Whitehaven Road



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	53	49	233	225	0
Future Volume (vph)	0	53	49	233	225	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.889			
Flt Protected					0.950	
Satd. Flow (prot)	0	1863	1656	0	1770	0
Flt Permitted					0.950	
Satd. Flow (perm)	0	1863	1656	0	1770	0
Link Speed (mph)		30	30		30	
Link Distance (ft)		268	3096		641	
Travel Time (s)		6.1	70.4		14.6	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	0	62	58	274	265	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	62	332	0	265	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		12	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 36.1%		ICU Level of Service A	
Analysis Period (min) 15			

Intersection	
Int Delay, s/veh	5.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	0	53	49	233	225	0
Future Vol, veh/h	0	53	49	233	225	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	62	58	274	265	0

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	332	0	-	0	257	195
Stage 1	-	-	-	-	195	-
Stage 2	-	-	-	-	62	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1227	-	-	-	732	846
Stage 1	-	-	-	-	838	-
Stage 2	-	-	-	-	961	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1227	-	-	-	732	846
Mov Cap-2 Maneuver	-	-	-	-	732	-
Stage 1	-	-	-	-	838	-
Stage 2	-	-	-	-	961	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	12.7
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1227	-	-	-	732
HCM Lane V/C Ratio	-	-	-	-	0.362
HCM Control Delay (s)	0	-	-	-	12.7
HCM Lane LOS	A	-	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	1.7

Lane Group	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	207	200	0	209	0	0
Future Volume (vph)	207	200	0	209	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.934					
Flt Protected						
Satd. Flow (prot)	1740	0	0	1863	0	0
Flt Permitted						
Satd. Flow (perm)	1740	0	0	1863	0	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	203			277	380	
Travel Time (s)	4.6			6.3	8.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	225	217	0	227	0	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	442	0	0	227	0	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 26.5%		ICU Level of Service A	
Analysis Period (min) 15			

Lane Group	EBT	EBR	WBL	WBT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	227	0	0	223	0	200
Future Volume (vph)	227	0	0	223	0	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.865
Flt Protected						
Satd. Flow (prot)	1863	0	0	1863	0	1611
Flt Permitted						
Satd. Flow (perm)	1863	0	0	1863	0	1611
Link Speed (mph)	30			30	30	
Link Distance (ft)	268			1087	380	
Travel Time (s)	6.1			24.7	8.6	
Peak Hour Factor	0.71	0.71	0.71	0.71	0.71	0.71
Adj. Flow (vph)	320	0	0	314	0	282
Shared Lane Traffic (%)						
Lane Group Flow (vph)	320	0	0	314	0	282
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	0	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Free	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 31.0%		ICU Level of Service A	
Analysis Period (min) 15			

EXHIBIT H

Water Distribution System Engineer's Report

for

Project Olive
2780 Long Road
Town of Grand Island, New York

Prepared For:

TC Buffalo Development Associates, LLC
600 Grant Street, Suite 4800
Pittsburgh, PA 15219

Prepared By:

Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.
One North Broadway, Suite 910
White Plains, New York 10601

Michael Finan, PE, LEED AP
Professional Engineer NY License No. 081473

February 21, 2020

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Appendix B: Water Distribution System Specifications
Appendix C: Water Main Appurtenances Cut Sheets

1 Executive Summary

This Water Distribution System Engineer's Report has been prepared for the Applicant, TC Buffalo Development Associates, LLC, who is proposing to develop ±145.4 acres of land located at 2780 Long Road ("Site"), in the Town of Grand Island ("Town"), New York for use as an e-commerce storage and distribution facility for consumer products ("Facility") by a single, prospective entity ("Project"). The Project, also known as Project Olive, is a commercial development that consists of a 5-story building with a ±823,400 square foot warehouse building footprint (±3,783,124 square feet total) with associated car and trailer parking (see Figure 1). The Site is currently owned by Grand Island Commerce Center Joint Venture ("Owner"). The Owner also owns ± 62.1 acres of land adjacent to the western boundary of the Site ("West Parcel"). No development is proposed in the West Parcel, and the West Parcel was not analyzed as part of this Report.

The water distribution portion of the Project involves installation of:

- Water Main
  - ±35 linear feet of 8-inch diameter C900 DR-18 PVC water main (measured from the reducer to the connection point on Bedell Road).
  - ±5,485 linear feet of 10-inch diameter C900 DR-18 PVC water main (measured from the connection point on Long Road to the 8-inch diameter reducer).
  - 15 fire hydrants along the water main.
  - Two air release valves.

- Water Service
  - ±330 linear feet of 1¼-inch diameter Type K copper water service line to guard houses.
  - ±330 linear feet of 6-inch diameter C900 DR-18 PVC water service line to warehouse facility.
  - ±545 linear feet of 8-inch diameter C900 DR-18 PVC water service line to fire suppression tank.
  - ±4,515 linear feet of 10-inch diameter C900 DR-18 PVC fire suppression line.
  - 12 fire hydrants around the building.
  - A fire suppression tank.
  - A water meter vault with a RPZ backflow preventer.

2 Project History

2012 Engineer's Report

The Site was previously part of a development called the Grand Island Gateway Center. According to the 2012 "Engineer's Report for Stormwater Management, Sanitary Sewer and Water Systems, Grand Island Gateway Center" prepared by C&S Engineers, Inc., hydrant flow tests were performed on March 26, 2008. They hydrant flow test data is as follows:

Existing 8-inch Water Main on Bedell Road
Static Pressure = 58 psi
Residual Pressure = 45 psi
Hydrant Flow = 965 gpm

Existing 12-inch Water Main on Long Road
Static Pressure = 64 psi
Residual Pressure = 54 psi
Hydrant Flow = 1,090 gpm

The project proposed to install a 10-inch diameter DR-18 PVC pipe that would tap the existing 8-inch diameter water main on the north side of Bedell Road and the 12-inch diameter water main on the south side of Long Road. See Appendix A for additional information.

3 Existing Conditions

3.1 Soils

The United States Department of Agriculture (USDA) Soil Conservation Service Soil Survey for Erie County has been reviewed. The surficial soil conditions are shown in Figure 2 and are summarized in the table below.

Table 3-1: USDA Soil Data

Map Symbol	Description	Depth to Groundwater (ft)	Depth to Bedrock (in)
CoA	Churchville silt loam, 0 to 3 percent slopes	0.5 – 1.5 (Dec – May)	>60
La	Lakemont silt loam, 0 to 3 percent slopes	0 – 0.5 (Nov – June)	>60
Od	Odessa silt loam, 0 to 3 percent slopes	0.5 – 1.5 (Dec – May)	>60
Oe	Odessa-Lakemont complex, 0 to 3 percent slopes	0.5 – 1.5 (Dec – May)	>60
Pt	Pits, borrow	>6.0	>60
RkA	Rhinebeck gravelly loam, 0 to 3 percent slopes	0.5 – 1.5 (Jan – May)	>60
SaA	Schoharie silt loam, 0 to 3 percent slopes	1.5 – 3.0 (Mar – May)	>60
SaB	Schoharie silt loam, 3 to 8 percent slopes	1.5 – 3.0 (Mar – May)	>60

A geotechnical field investigation was performed by Langan from November 12, 2019 to November 25, 2019 to determine the subsurface soil conditions in various locations throughout the Site. A total of eight borings, fourteen test pits and four percolation tests were performed.

- Boring depths ranged from 26 to 50 feet below existing grade. Groundwater and bedrock were not encountered in any of the borings.

- Test pit depths ranged from 6 to 1.5 feet below existing grade. Groundwater and bedrock were not encountered in any of the test pits.

- Percolation test depths were 5 feet below existing grade. Percolation rates were less than 0.1 inches per hour.

Refer to the Preliminary Geotechnical Engineering Study Report prepared by Langan for additional information.

3.2 Existing Conditions

The Site is bounded by Long Road and residential and commercial properties to the north; Interstate I-190 to the east; Bedell Road and residential and commercial properties to the south; and the West Parcel, which is predominantly wooded areas, to the west. The Site is currently vacant. The majority of the Site is wooded; however, there are areas that have been previously cleared. Several wetlands were identified on the Site during the previously performed wetland and waterbody delineations in October 1990 and 2019. Four wetlands are United States Army Corps of Engineers (USACE) jurisdictional wetlands and are identified on the plans as wetlands J, L, N, and P. Five wetlands are New York State Department of Environmental Conservation (NYSDEC) regulated wetlands and are identified on the plans as wetlands M, R, S, T, and U. The remaining wetlands are non-jurisdictional and are identified on the plans as wetlands A, B, C, D, E, F, G, H, I, K, O, and Q. In addition to the wetlands, three waterbodies were identified on the Site. One ditch flows through the central part of the Site, one ditch flows along Long Road, and the last ditch flows through the southern part of the Site near Bedell Road. The ditches ultimately join together and flow north along Long Road to the Niagara River.

There is an existing 8-inch diameter water main on the south side of Bedell Road and a 12-inch diameter water main on the south side of Long Road.

4 Water Distribution System

4.1 Projected Water Demand

At maximum, there will be up to 1,500 employees per shift during their peak season and will have two shifts. The water demand for the Project, based on peak season is:

Avg. Daily Flow = 1,500 employees/shift x 2 shifts x 15 gpd/employee = <u>45,000 gpd</u>.

4.2 Proposed Distribution System

<u>Water Main</u>

The proposed 10-inch diameter water main will connect to the existing 12-inch diameter water main on Long Road using a wet tap. To connect to the existing 8-inch diameter water main on the south side of Bedell Road, the proposed 10-inch diameter water main will be reduced to an 8-inch diameter and a tee with a valve will be installed. This will provide a loop and interconnect the water mains on Long Road and Bedell Road. The water main will the access driveway.

The proposed water distribution system will consist of ±35 linear feet of 8-inch diameter C900 PVC water main, ±5,485 linear feet of 10-inch diameter C900 PVC water main, 15 hydrants, and two air release valves. Isolation valves are placed at not more than 800-foot intervals. Hydrants have been provided approximately every 300 to 600 feet along the water main. The water distribution system has been designed in accordance with the requirements of *Ten States Recommended Standards for Water Works*, latest edition and the pipe and appurtenances will conform to AWWA Standard C900, latest revision.

Where the proposed water main will be parallel to the sanitary sewer or storm drainage, a minimum horizontal separation distance of 10 feet (wall-to-wall) was maintained. Where the proposed water line crosses the sanitary sewer or storm drainage system, a minimum vertical separation distance of 18 inches (wall-to-wall) was maintained. Additionally, a full pipe length was provided at vertical crossings so that both joints will be as far as possible from the sanitary sewer or storm drainage.

The water distribution system specifications are provided in Appendix B and cut sheets are provided in Appendix C.

Warehouse Facility Water Service

An 8-inch diameter water service line will connect to the 10-inch diameter water main, which will provide service to the fire storage tank. A 6-inch diameter water service line will provide water service to the building. A 1¼" Type K copper water service line will provide water service to the guard houses. A meter pit will be installed after approximately 125 feet south of connection to the 10-inch diameter water main. The water service line leaving the meter pit will be a private service line to provide water service. A fire suppression tank will be installed to provide the required fire suppression needs for the project. The fire suppression tank will provide water to the fire suppression line, which will loop around the building.

The proposed water service will consist of ±330 linear feet of 1¼-inch diameter Type K copper water service line, ±330 linear feet of 6-inch diameter C900 PVC water service line, ±545 linear feet of 8-inch diameter C900 PVC water service line, ±4,515 linear feet of 10-inch diameter C900 PVC fire suppression line, 12 hydrants, a fire suppression tank, and a water meter vault with a RPZ backflow preventer. Isolation valves are placed at not more than 800-foot intervals. Hydrants have been provided approximately every 300 to 600 feet along the water main. The water distribution system has been designed in accordance with the requirements of *Ten States Recommended Standards for Water Works*, latest edition and the pipe and appurtenances will conform to AWWA Standard C900, latest revision.

Where the proposed water service line will be parallel to the sanitary sewer or storm drainage, a minimum horizontal separation distance of 10 feet (wall-to-wall) was maintained. Where the proposed water line crosses the sanitary sewer or storm drainage system, a minimum vertical separation distance of 18 inches (wall-to-wall) was maintained. Additionally, a full pipe length was provided at vertical crossings so that both joints will be as far as possible from the sanitary sewer or storm drainage.

The water distribution system specifications are provided in Appendix B and cut sheets are provided in Appendix C.

4.3 Pressure Analysis

According to the March 26, 2008 hydrant flow test, the pressure at the 12-inch diameter water main is approximately 64 psi. The differential in grade between the connection point at the water main (elev. 565 feet) and the point at which the water service line enters the building (elev. 590 feet) is 25 feet. This equates to a pressure drop of:

Pressure drop = 25 ft x 62.4 lb/ft^3 / 144 in^2/sf = 10.8 psi.

Static Pressure at the Building = 64 psi – 10.8 psi = 53.2 psi.

The differential in grade between the connection point at the main (elev. 565 feet) and the lowest fire hydrant near the truck court access driveway (elev. 578 feet) on site is approximately 13 feet. This equates to a pressure drop of:

Pressure drop = 13 ft x 62.4 lb/ft^3 / 144 in^2/sf = 5.6 psi.

Static Pressure at the lowest hydrant = 64 psi – 5.6 psi = 58.4 psi.

The differential in grade between the connection point at the main (elev. 565 feet) and the highest fire hydrant near the parking area by ponds 12A and 12B (elev. 600 feet) on site is approximately 35 feet. This equates to a pressure drop of:

Pressure drop = 35 ft x 62.4 lb/ft^3 / 144 in^2/sf = 15.2 psi.

Static Pressure at the highest hydrant = 64 psi – 15.2 psi = 48.8 psi.

According to *Recommended Standards for Water Works*, latest edition, the system shall be designed to maintain a minimum pressure of 20 pound per square inch (psi) at all points in the distribution system under all conditions of flow. The minimum working pressure in the distribution system should be 35 psi and the normal working pressure should be approximately 60 to 80 psi. When static pressures exceed 100 psi, pressure reducing devices shall be provided. Based on the analysis, pressure reducing devices will not be required. The minimum working pressure of 35 psi has been meet; however, the pressure in the system is less than the normal working pressure range and a booster pump may be required.

4.4 Meter Pit

The meter pit can be accessed from access drive. Access to the meter pit will be provided through a 60-inch by 60-inch Bilco aluminum access hatch, model KD-4. Steps will be installed directly under the access hatch. The meter pit shall drain to daylight and terminate with a non-corrodible rodent screen. The minimum required drain from the meter vault is 5-inches, which can pass a flow of 350-gpm.

An 8-inch Badger FSAA water meter with domestic bypass disc meter will be installed. The water meter cut sheet is provided in Appendix C.

A reduced-pressure-zone (RPZ) backflow preventer will be installed after the meter. The RPZ shall be a Watts Model 957-OSY with resilient seated gate valves. The degree of hazard for the

backflow preventer is hazardous. An RPZ has been provided since it is required by the Town of Montgomery. The selected RPZ is an approved device as per the approved list generated by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research (FCCCHR). The RPZ cut sheet and excerpt from the FCCCHR approval list are provided in Appendix C.

The water service at the facility can be interrupted; therefore, parallel units are not necessary.

4.5 Hydrants

Fire hydrants cannot be installed unless they provide 500 gpm fire flow with a minimum residual pressure of 20 psi. The fire flows at the lowest and highest fire hydrants at 20 psi was evaluated. The fire flows at the lowest and highest fire hydrants at 20 psi was evaluated. The fire flow for the lowest fire hydrant at 20 psi is estimated to be:

Static Pressure at lowest hydrant = 58.4 psi (see Section 4.3)

Friction head loss for 10" C900 at 1,090 gpm = 0.27 psi/100 ft
Friction head loss through piping = 1,710 LF x 0.27 psi/100 ft = 4.7 psi

Residual Pressure = 54 psi – 4.7 psi = 49.3 psi

$Q_{20} = [(P_{static} – 20) / (P_{static} – P_{residual})]^{0.54} \times Q_F$
$Q_{20} = [(58.4 – 20) / (58.4 – 49.3)]^{0.54} \times 1{,}090$ gpm = 2,372 gpm.

The fire flow for the highest fire hydrant at 20 psi is estimated to be:

Static Pressure at highest hydrant = 48.8 psi (see Section 4.3)

Friction head loss for 10" C900 at 1,090 gpm = 0.27 psi/100 ft
Friction head loss through piping = 4,148 LF x 0.27 psi/100 ft = 11.2 psi

Residual Pressure = 54 psi – 11.2 psi = 42.8 psi

$Q_{20} = [(P_{static} – 20) / (P_{static} – P_{residual})]^{0.54} \times Q_F$
$Q_{20} = [(48.8 – 20) / (48.8 – 42.8)]^{0.54} \times 1{,}090$ gpm = 2,543 gpm.

As demonstrated above, the lowest and highest fire hydrants meet the required fire flow at a residual pressure of 20 psi.

5 Construction Specifications

The proposed water distribution system and appurtenance shall be installed in accordance with the construction specifications provided in Appendix B.

6 Testing

Prior to being placed into service, the water distribution system shall be tested in accordance with the testing procedures outlined on the project plans. A certification letter shall be provided to the Town and Erie County Department of Health once testing has been completed.

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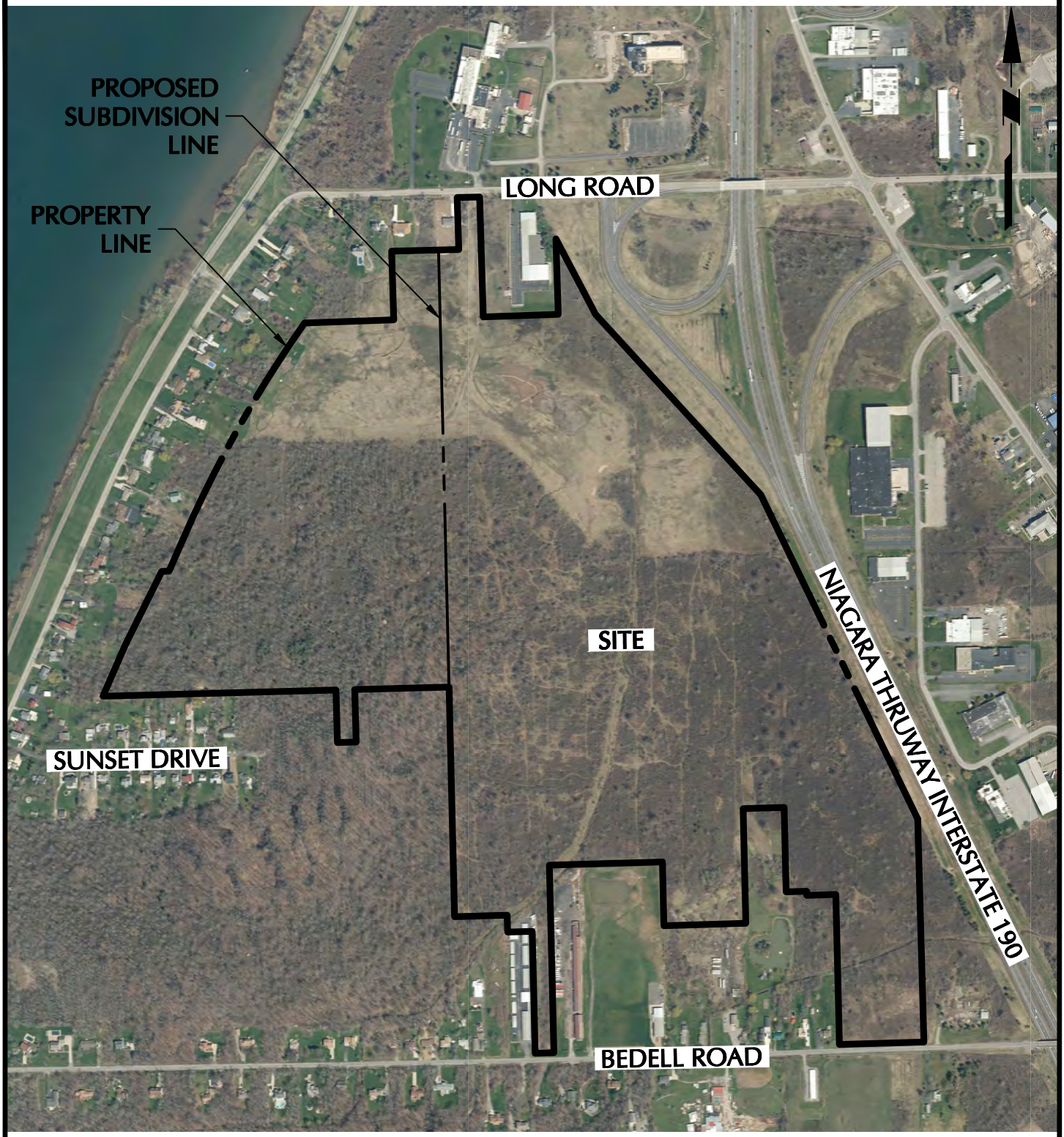
Figures



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SCALE: 1 INCH = 750 FEET

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Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.
One North Broadway, Suite 910
White Plains, NY 10601
T: 914.323.7400 F: 914.323.7401 www.langan.com

Project
PROJECT OLIVE
BLOCK No. 1, LOT No.50 & 26.1
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title
SITE LOCATION MAP

Project No. 100785901
Date 02-21-2020
Drawn By LM
Checked By CZ

Drawing No.
FG01
Sheet 1 of 1

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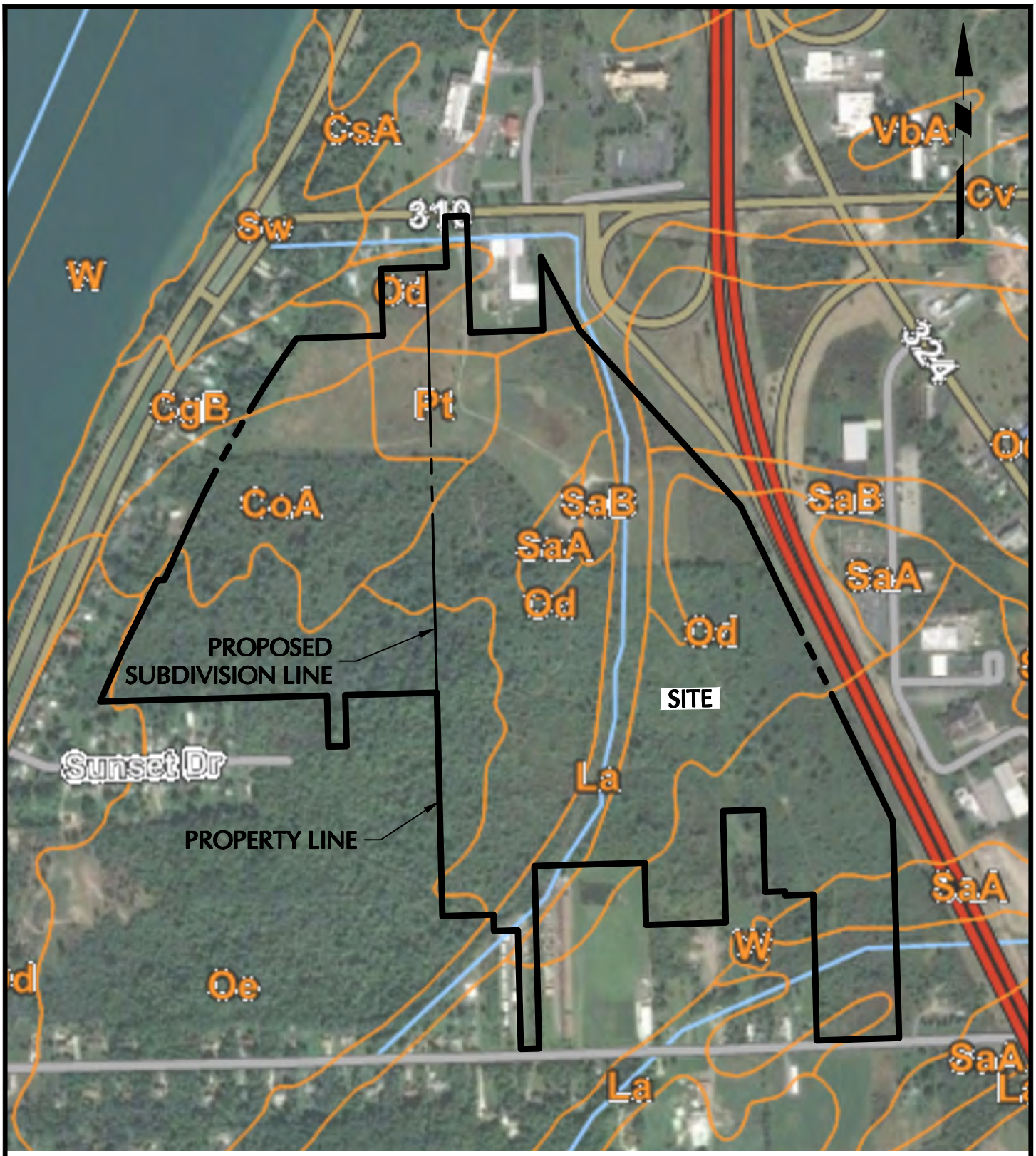
Filename: \\langan.com\data\PAR\data9\100785901\Project Data\CAD\01\SheetFiles\Figures\Water Report Figures\FG01-100785901-GI101-0101.dwg Date: 1/17/2020 Time: 09:52 User: lmcmahon Style Table: Langan.stb Layout: FG01



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White Plains, NY 10601

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Project	Drawing Title	Project No.	Drawing No.
PROJECT OLIVE BLOCK No. 1, LOT No.50 & 26.1 TOWN OF GRAND ISLAND ERIE COUNTY NEW YORK	SOILS MAP	100785901	FG02
		Date 02-21-2020	
		Drawn By LM	
		Checked By CZ	Sheet 1 of 1

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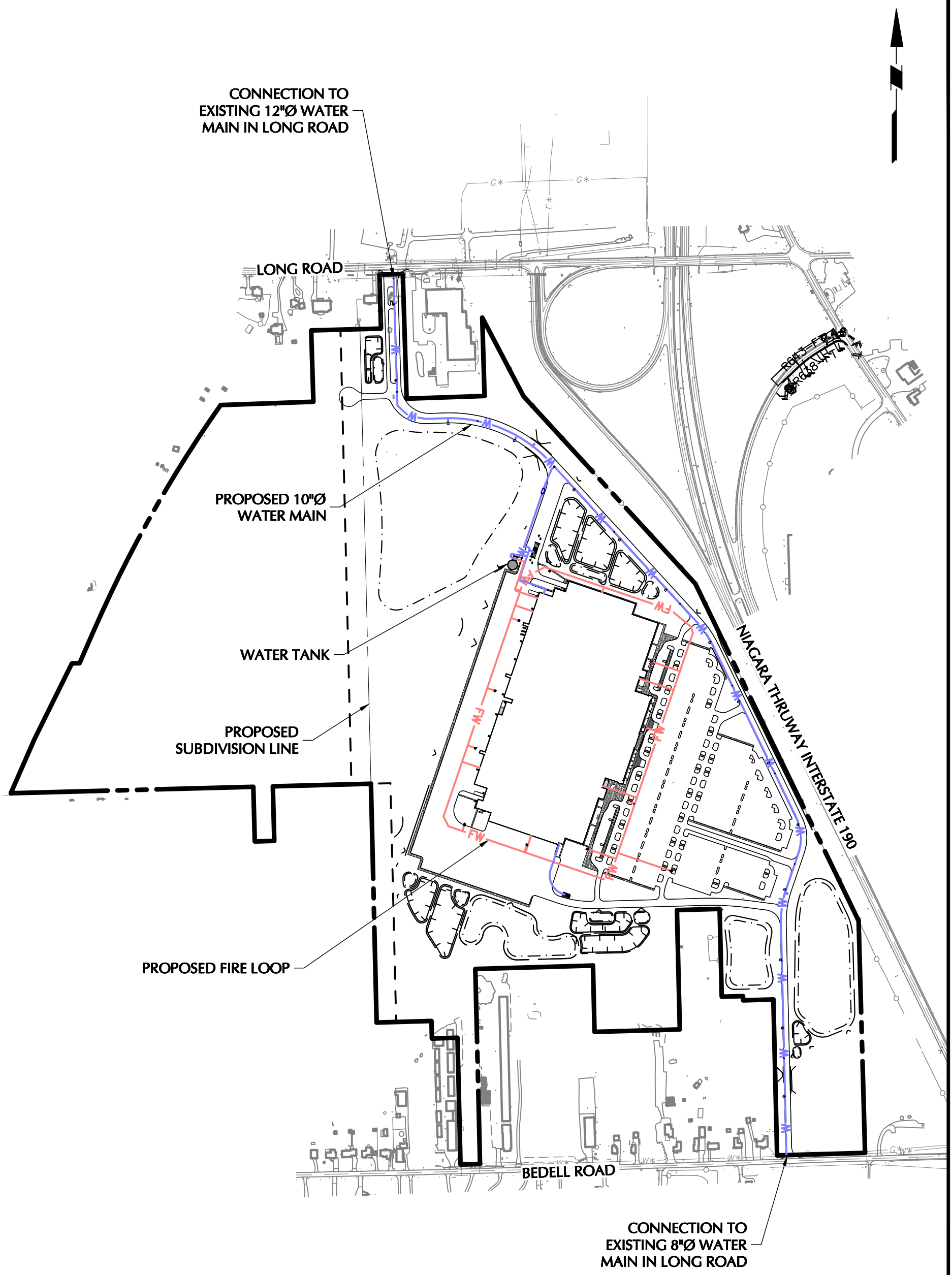

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One North Broadway, Suite 910
White Plains, NY 10601
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Project
PROJECT OLIVE
BLOCK No. 1, LOT No.50 & 26.1
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title
PROPOSED WATER SYSTEM

Project No. 100785901
Date 02-21-2020
Drawn By LM
Checked By CZ

Drawing No. FG03
Sheet 1 of 1

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Appendix A

2012 Engineer's Report prepared by C&S Engineers, Inc.

135A.001.001

105 + 100±

Engineer's Report
for
Stormwater Management, Sanitary Sewer and Water Systems

Grand Island Gateway Center
Grand Island, New York

General

This project consists of constructing the infrastructure for a 144+/-commercial and light industrial development in the Town of Grand Island, Erie County, New York. The project site is located between Bedell and Long Roads, and is bounded to the east by I-190 and to the west by residentially zoned undeveloped land. The existing site conditions consist of a combination of woods and brush. The northern section of the site was previously used as clay borrow area and is now an overgrown meadow.

The proposed land use for the development is estimated to be as follows:

Type	Land Use	Site Area (Acres)
General Office	30%	43.5
Light Industrial	70%	100.5

Drainage

The existing topography generally slopes from south to north, with a high point approximately 1,400' north of Bedell Road. There are two main drainage swales crossing the site. One is located south of the high point and generally flows to the east. This swale collects site runoff south of the high point and runoff from the existing frontage lots on Bedell Road as well as a significant area of undeveloped land south of Bedell. The other swale on the site flows north, bisecting the site, to Long Road. It collects runoff from the project site and off-site areas to the west and south.

The existing and proposed conditions drainage analyses were completed using HydroCAD, Version 8, a TR-20 based software. The calculations are based on SCS 24-hour rainfall, type-II

distribution. Refer to the attached drainage exhibits for a visual description of the drainage sub-catchments and flow/Tc paths used in the HydroCAD analysis.

The project will involve more than one acre of ground disturbance. Therefore, coverage under the SPDES General Permit for Stormwater Discharges from Construction Activities is required. This requires the development of a full Stormwater Pollution Prevention Plan (SWPPP) including erosion and sediment control during construction and permanent, post-construction, water quality and quantity controls and the submission of a Notice of Intent (NOI) to the New York State DEC.

The proposed stormwater management facilities for the project will consist of three wet ponds for each of the respective sub-areas they serve and will be designed to the requirements in the DEC Stormwater Management Design manual. The ponds will be sized to limit the peak rate of discharge to the pre-developed conditions for the 10 and 100-year storm events. In addition, the ponds will provide the necessary channel protection volume (CPv), consisting of extended detention of the 1-year, 24-hour storm. The required water quality volumes will be provided in the forebays and wet pools of the ponds. The discharge rates from the ponds will be controlled through a combination of reverse slope pipes and orifices for the CPv and 10-year events. During the 100-year event, some discharge will also occur over the spillways.

The south pond, denoted 4P in the analysis, will collect runoff from the site south of the high point and discharge to the south ditch.

Two ponds, denoted 2P and 3P in the analysis, are needed for the north half of the site due to the ditch bisecting it. Both of these ponds, in addition to upstream/offsite drainage areas from sub-areas 1A, 1B and 2A all eventually discharge to the ditch on the south side of Long Road. Therefore Long Road was chosen as the design point in the analysis. Area 1B is an off-site area that will be collected by the proposed drainage system and routed through pond 2P.

The following is a summary of the site discharges for the ponds:

Storm Event	**Pre-Developed Runoff to Long (1P) (cfs)**	**Post-Development Runoff to Long (1P) (cfs)**	**Pre-Developed Runoff to South Ditch (4P) (cfs)**	**Post-Developed Runoff to South Ditch (4P) (cfs)**
10	99.88	91.82	5.71	5.38
100	177.39	160.84	10.60	7.77

The following is a summary of the water quality requirements:

Pond	**Required WQv (CF)**	**Required Pretreatment (25% WQv) (CF)**	**Forebay Volume Provided (CF)**	**Total Volume Provided (CF)**
2P	159,403	39,851	134,044	481,021
3P	121,087	30,272	69,925	259,361
4P	32,837	8,209	24,038	31,175

The proposed road system will require culverts in three locations where it crosses the existing swales on the site. One location is at the south swale which we will denote Culvert 1; the second location is at the north flowing swale near the south end of the project, denoted Culvert 2 and the third is adjacent to pond 3P, also crossing the north flowing swale, denoted Culvert 3. The runoff/hydrology calculations for the culvert design were completed as part of the overall project drainage analysis using HydroCAD. Sub-area 3B drains to Culvert 1 and sub-area 2A to Culvert 2. Sub area 2A drains to Culvert 3. The culvert hydraulic calculations were completed using HY-8 software. All culverts as designed are able to pass a 100-year storm with out overtopping of the roadway.

Sanitary Sewer

The proposed sanitary sewer system will consist of an 8" SDR-35 PVC gravity sewer, which will convey flows south toward Long Road, consistent with site's natural topography. However, because of the lack of capacity and current condition of the sewer on Long Road, the Town of Grand Island Engineering Department required that the sewage from the development be discharged to the interceptor sewer located west of Baseline Road, requiring a pumping station.

The pump station will be constructed approximately 750'south of Long Road. Sewage from the development will be pumped through an 8" forcemain north to Bedell Road and then east to the 30" interceptor sewer. The forcemain will be constructed of SDR-18 PVC. Cleanouts and air relief valves will be provided as necessary.

A 24" steel casing pipe was pushed under I-190on the south side of Bedell Road in the early 1990's to facilitate development of the site, which will be used for the proposed forcemain.

Provisions have also been made in the design of the sewage collection and pumping systems to include sewage from the future development of the 27 acre former Dunlop site on the north side of Long Road and the 65 acres of residential property adjacent to the project site. Refer to calculations in Appendix C for additional information.

Design Parameters

General Office.....	15 gpd x 8,690 employees = 134,400gal/day
Industrial*	25 gpd x 112 employees = 2,800 gal/day
Future Residential.....	438 gpd x 98 units = 42,924 gal/day
Reduction for water saving fixtures.....	0.80
Design Flow.....	**140,862 gal/day**

The hydraulic loading rates per "Design Standard for Wastewater Treatment Works", 1988 NYSDEC.

**Assumes a single work shift and no major water consuming industry (process water).*

Water System

The proposed water main will consist of 10" DR-18 PVC Pipe (conforming to AWWA C900 Specifications) tapped to the existing 8" water main on the north side of Bedell Road and the 12" water main on the south side of Long Road. Valves will be provided at intersections and at a maximum interval of 1,000 feet. Hydrants will be provided at a maximum spacing of 500 feet. Water services will include curb stops or valves as required to suite the proposed development.

Victor O'Brien, P.E. and Ron Slazak of C&S Engineers, Inc. performed hydrant flow tests with the assistance of the Town of Grand Island Water Department Personnel on March 26, 2008 between 8:00 and 9:00 AM. The results are indicated below.

Design Parameters

Static Pressure at Exist. 8" main @ Bedell Road	58 psi
Residual Pressure at Exist. 8" Main @ Bedell Road	45 psi
Hydrant Flow = 965 gpm	
Static Pressure at Exist. 12" Main @ Long Road	64 psi
Residual Pressure at Exist. 10" Main @ Long Road	54 psi
Hydrant Flow = 1,090 gpm	
Peak Hourly Demand (Domestic Use)	350 gpm
Head Loss @ Peak Hourly Demand	1 psi
Minimum Available Fire Flow @ 20 psi (at center of development)	1,517 gpm

Refer to attached for further calculations on water services.

Disinfection of the water service following installation will be continuous feed, according to AWWA C-651, latest revision.

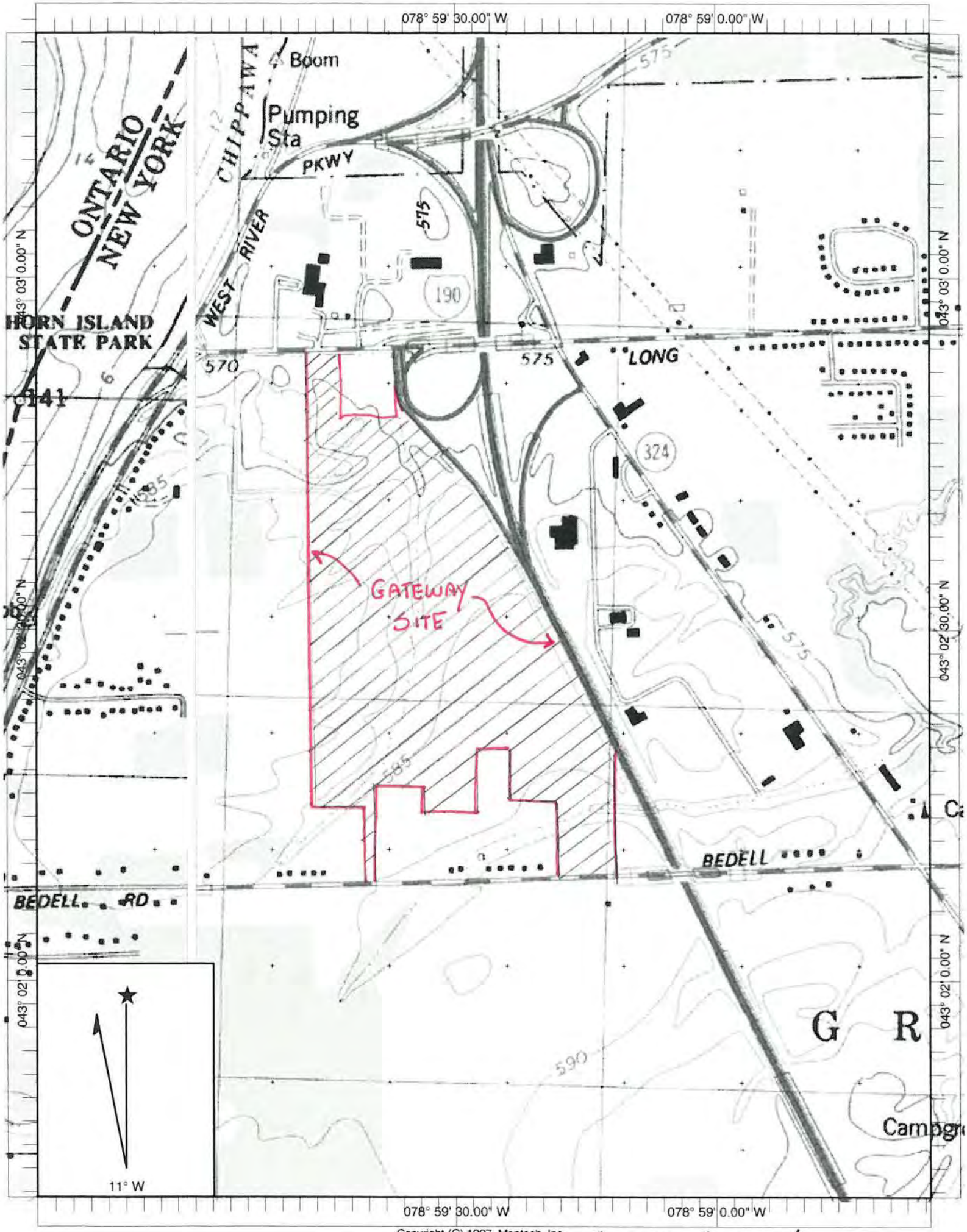
Respectfully submitted,

C&S ENGINEERS, INC.

Victor O'Brien, P.E.
Senior Project Engineer

Appendix A

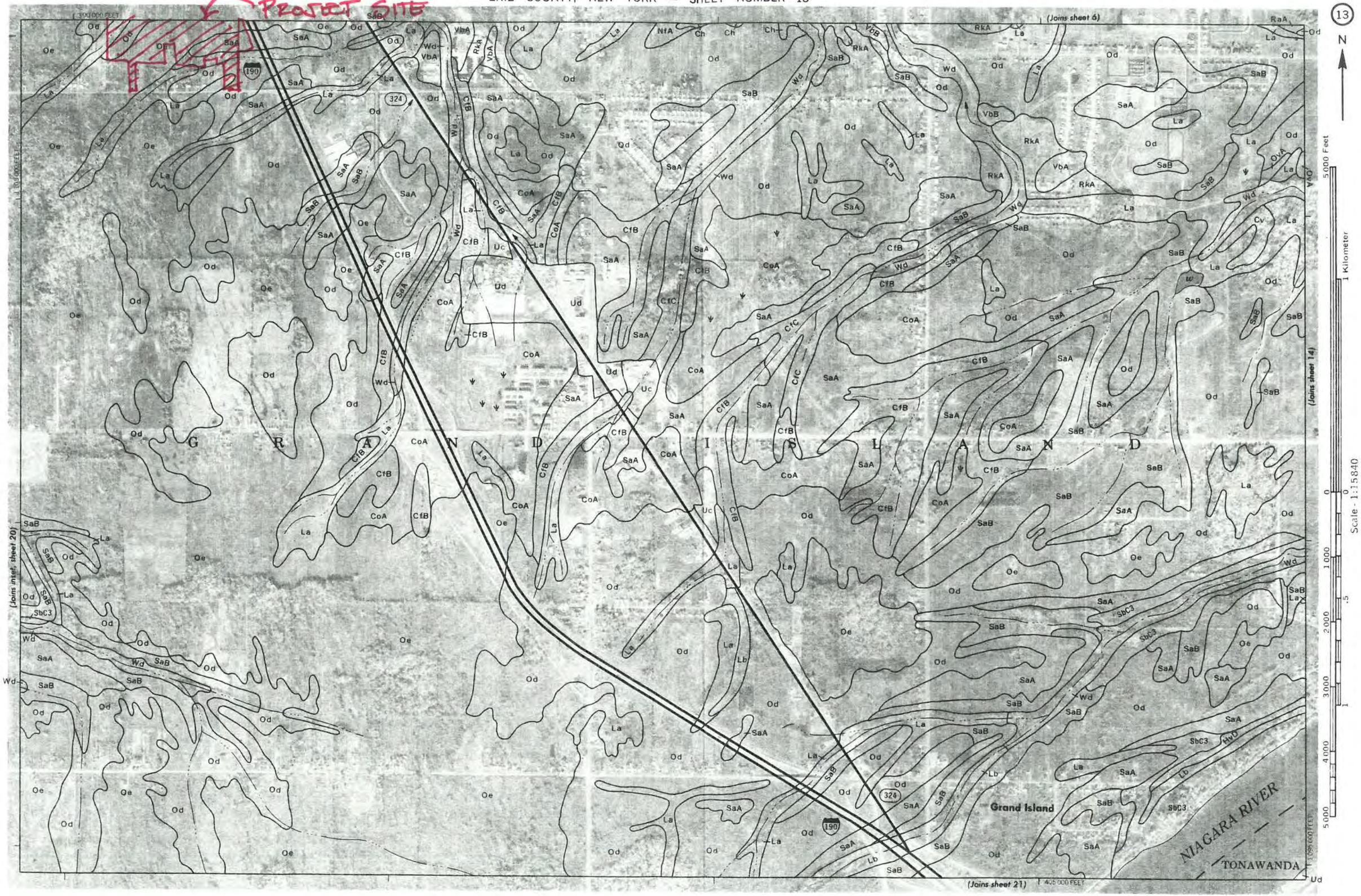
Site Location / USGS Map


078° 59' 30.00" W
078° 59' 0.00" W
043° 03' 0.00" N
043° 02' 30.00" N
043° 02' 0.00" N
Boom
Pumping Sta
CHIPPAWA
PKWY
WEST RIVER
ONTARIO
NEW YORK
HORN ISLAND STATE PARK
575
190
570
LONG
324
GATEWAY SITE
585
590
BEDELL
BEDELL RD
11° W
Copyright (C) 1997, Maptech, Inc.

SCALE: 1" = 1,000'

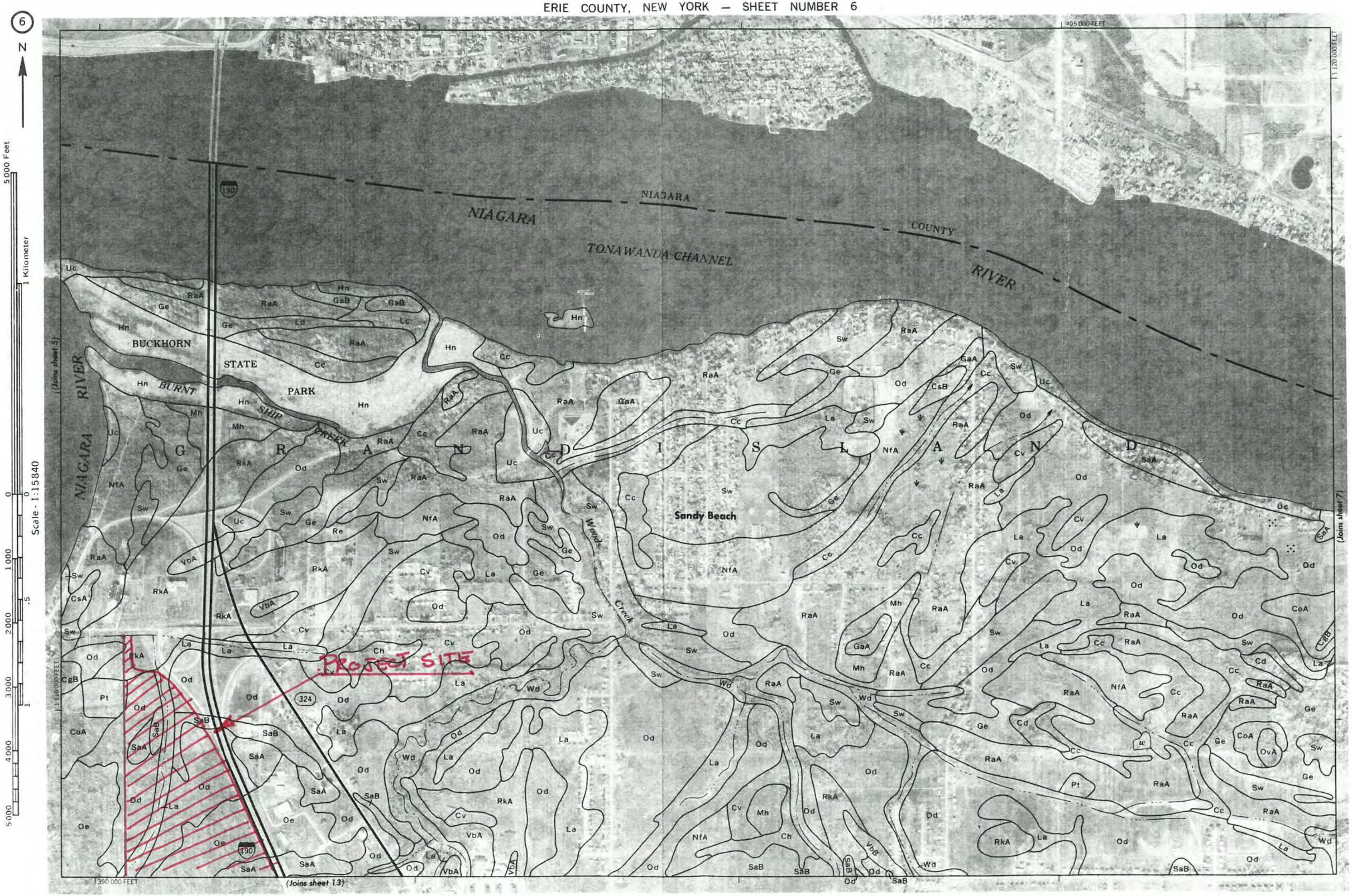
Appendix B

Drainage Calculations



ERIE COUNTY, NEW YORK NO. 13

This soil survey map was compiled by the U. S. Department of Agriculture, Soil Conservation Service, and cooperating agencies. Base maps are prepared from 1978 aerial photography. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This soil survey map was compiled by the U. S. Department of Agriculture, Soil Conservation Service, and cooperating agencies. Base maps are prepared from 1978 aerial photography. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

C&S Engineers, Inc.

PROJECT GIGC SHEET 1 OF

FILE NO.

PREPARED BY V.O. DATE CHECKED BY DATE

EXIST DRAINAGE:

SOIL TYPES
Od - ODESSA SILT LOAM "D"
Oe - ODESSA / LAKEMONT "D"
La - LAKEMONT SILT LOAM "D"
RKA - RHINEBECK SILTY CL LOAM "D"
Sa - SCHOHARIE SILT LOAM "C" (VERY SMALL AMOUNTS)

USE TYPE D

AREA #1 - PORTION OF SITE/OFFSITE ON WEST DRAINING TO LONG RD.

A = 106.35 AC

1A = 29.86 AC
1B = 76.49

1A Tc

100' SHEET FLOW OVER WOODS @ 0.75%
700' SHALLOW CONC OVER WOODS 0.75%
} $\frac{594-588}{800'}$

150' SHALLOW CONC OVER FIELD @ 6.6% $\frac{588-578}{150} = 6.6\%$

450' SHALLOW CONC FLOW / FIELD @ 0.7%
700' SWALE FLOW @ @ 0.7%
} $\frac{578-573}{700} = 0.7\%$

1B Tc

100' SHEET FLOW OVER WOODS @ 0.25% $\frac{3'}{1600} = 0.25$

1,500' SHALLOW CONC. FLOW OVER WOODS @ 0.25%

1,100' SWALE @ 0.9% $\frac{10'}{1,100'} = 0.9\%$ (AVE)

1200' SWALE @ 0.75% $\frac{9'}{1200} = 0.75\%$

700' SWALE @ 0.70%

C&S Engineers, Inc.

PROJECT GIGC SHEET 2 OF

FILE NO.

PREPARED BY VO DATE CHECKED BY DATE

EXIST DRAINAGE Cont-

AREA #2 - AREA DRAINING TO NORTH FLOWING DITCH ON SITE

A = 193.34 AC

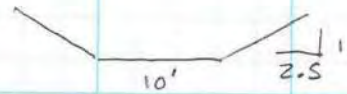
2A = 97.48 (OFFSITE)
2B = 95.86 AC (ON SITE ONLY)

TC (TOTAL AREA #2)

100' SHEET FLOW OVER WOODS @ 0.5%
1,100' SHALLOW CONC. FLOW/WOODS @ 0.5%

$\frac{593 - 586}{1200} = 0.5\%$

5,000' SWALE FLOW @ 0.275%



AREA #3 - 505.3 AC

3A = 18.66 AC
3B = 486.64

TC (TOTAL AREA #3)

100' SHEET FLOW OVER WOODS @ 1.0%

4,700' SHALLOW CONC FLOW OVER WOODS @ 0.3%

$\frac{15'}{4,700}$

2,900' SWALE FLOW @ 0.25%

C&S Engineers, Inc.

PROJECT GATEWAY CENTER
PROPOSED DRAINAGE

SHEET ____ OF ____
FILE NO. ____

PREPARED BY V.O. DATE ____ CHECKED BY ____ DATE ____

1A - SAME T_c, NEW AREA = 23.64 AC

1B - 49.53 AC, 5 ACRES 1± AC RES
44.53 WOODS

1C - 69.80 AC - 85% IMP. COMMERCIAL

2A - 100.69 AC

C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY SHEET ____ OF ____

FILE NO. ____

PREPARED BY V.O. DATE ____ CHECKED BY ____ DATE ____

POND 2P - NORTH POND

CpVol = 1-YR DEVELOPED STORM = 9.79 AC-FT (426,452 CF)

DISCHARGE OVER 24 hours = $\frac{426,452}{24 \times 60 \times 60}$ = 4.94 CFS

REQ'D ORIFICE AREA:

$Q = 0.6(A)\sqrt{2gH}$

FOR H, 9.79 AC-FT STORAGE ≈ ELEV 568.7±

Normal Pool = 566 , $H = \frac{568.7 - 566}{2} = 1.35$

$A = \frac{4.94}{(0.6)(\sqrt{2g(1.35)})} = 0.88$

TRY 3.5'W x 0.25'H orifice = 0.88 FT²

WQv

AREA = 114 AC, 47.4 AC IMPERVIOUS ∴ Rv = 0.05 + 0.009(42) = 0.428 (42%)

$WQv = \frac{PR_vA}{12} = \frac{0.9(0.428)114}{12} = 3.66$ AC-FT

WQv = 3.66 AC-FT OR 159,403 CF TOTAL

25% REQ'D AS PRETREATMENT IN FOREBAY = 39,851 CF

WQ PROVIDED:

	FOREBAY	MAIN POOL	
560	0	0	0
561	16,547	4,918	59,208
562	18,387	5,812	63,863
563	20,354	6,778	68,493
564	22,378	7,816	73,301
565	24,490	8,926	78,231
566	31,888	11,807	+ 91,868
	134,044 CF	(46,057 CF + 434,964 CF)	

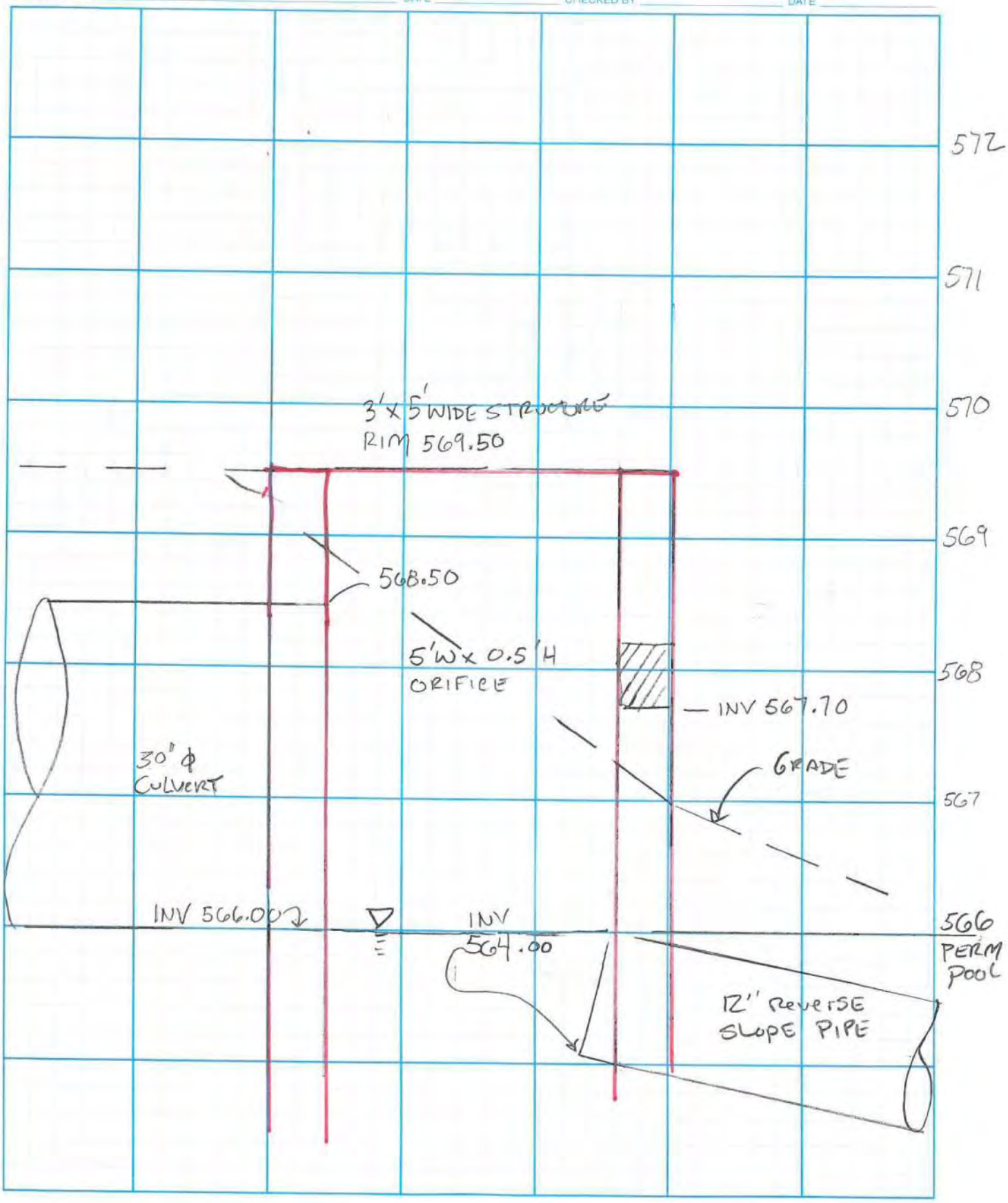
481,021

C&S Engineers, Inc.

PROJECT GATEWAY SHEET ____ OF ____

POND 2P OUTLET STRUCTURE FILE NO. ____

PREPARED BY UO. DATE ____ CHECKED BY ____ DATE ____



C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY SHEET OF

FILE NO.

PREPARED BY J.O. DATE CHECKED BY DATE

POND 3P - CENTER POND

CP VOL: 1-YR DEVELOPED STORM = 6.22 AC-FT (270,943 CF)

DISCHARGE OVER 24 hrs $= \frac{270,943}{24 \times 60 \times 60} = 3.14$ CFS

REQ'D ORIFICE AREA:

$Q = 0.6(A)\sqrt{2gH}$

ELEVATION @ 6.22 AC-FT STORAGE ≈ 577.7

AVE $H = \frac{577.7 - 574.0}{2} = 1.85$

$A = \frac{Q}{(.6)(\sqrt{2g(1.85)})} = 0.48$ SF

USE 10" Reverse SLOPE PIPE

WQV

AREA = 53.1 AC — 38 AC IMPERVIOUS OR 72%

$R_V = 0.05 + 0.009(72) = 0.698$

$WQ_V = \frac{0.9(0.698)\,53.1}{12} = 2.78$ AC-FT or 121,087 CF

25% PRETREATMENT = 30,272 CF

WQV PROV.:

	FOREBAY	MAIN POOL
568	0	0
569	7,893	24,686
570	9,208	26,795
571	10,604	28,987
572	12,080	31,260
573	13,636	33,615
574	16,504	44,093
	69,925 CF	189,436 CF

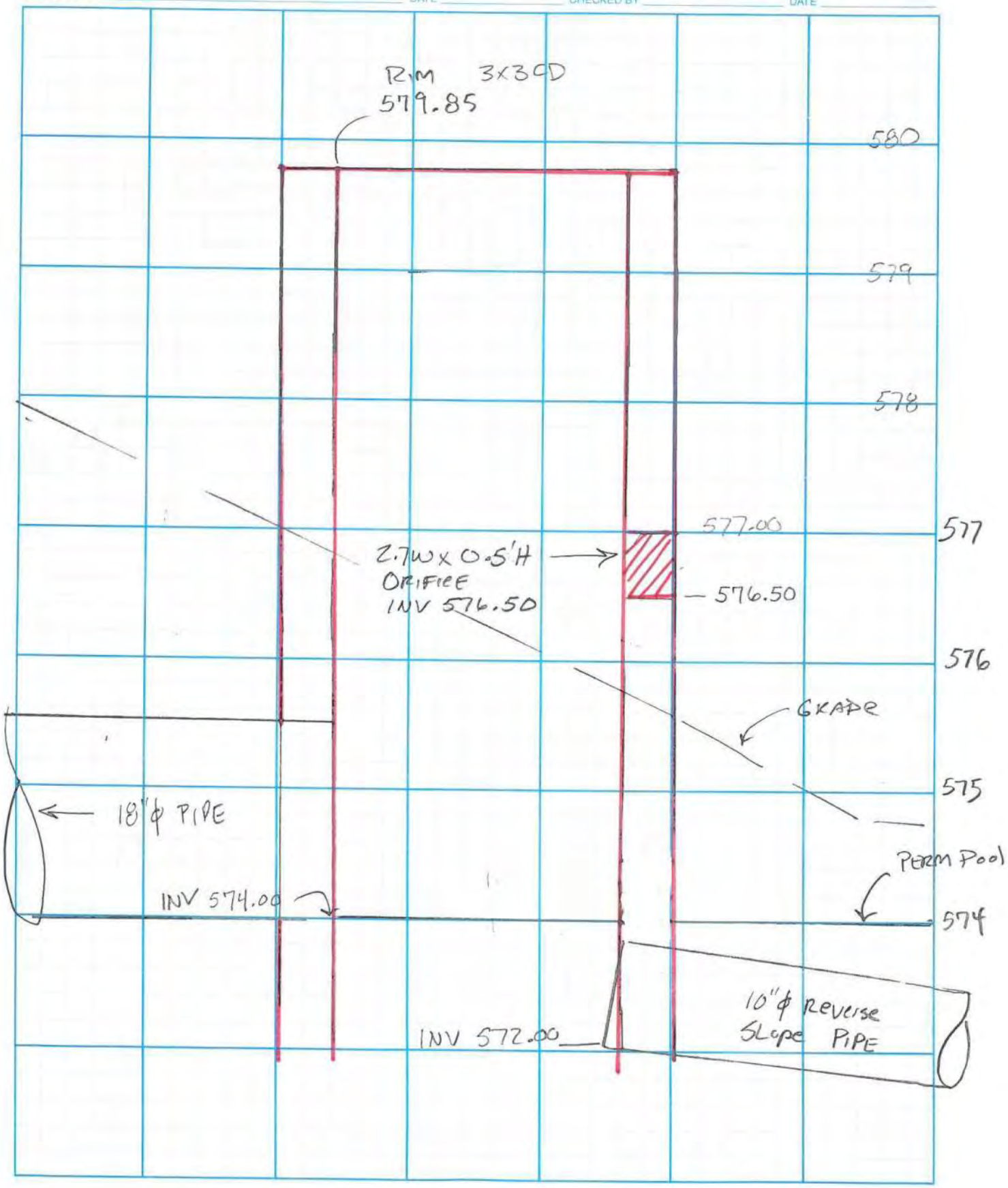
259,361 CF TOTAL ∴ OK

C&S Engineers, Inc.

PROJECT GATEWAY SHEET OF

POND 3P OUTLET STRUCTURE FILE NO

PREPARED BY UO. DATE CHECKED BY DATE



C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY SHEET ____ OF ____

FILE NO. ____

PREPARED BY V.O DATE ____ CHECKED BY ____ DATE ____

POND 4P - SOUTH POND

CP VOL: 1-YR DEVELOPED STORM = 1.68 AC-FT (73,181 CF)

DISCHARGE OVER 24 HRS = $\frac{1.68 \times 43{,}560}{24 \times 60 \times 60} = 0.85$ CFS

REQD ORIFICE DIAMETER:

$Q = 0.6(A)\sqrt{2gh}$

MAX DEPTH = 3', AVE DEPTH = 1.5'

$A = \frac{Q}{(0.6)\sqrt{2gh}} = \frac{0.85}{(0.6)\sqrt{2g(1.5)}} = 0.14\ FT^2$

$A = \pi D^2/4 \quad D = \sqrt{\frac{4A}{\pi}} = 0.42' = 5''\phi$ -

OR USE 0.7'W × 0.2'H RECT. ORIFICE

WQUALITY VOLUME

AREA = 14.4 AC, 72% IMPERVIOUS ∴ $R_V = 0.05 + 0.009(72) = 0.698$

$WQ_V = \frac{P R_V A}{12} = \frac{0.9\,(0.698)\,14.4}{12}$

$WQ_{V_{Req.}} = 0.75$ AC-FT OR 32,837 CF TOTAL

25% REQ IN FOREBAY = 8,209 CF

WQ PROVIDED:

	FOREBAY	MAIN POOL
577	0	3,265
578	2,997	4,201
579	3,825	5,252
580	4,731	6,419
581	5,714	7,702
582	6,771	10,298
	24,038 +	37,137 = 61,175 CF

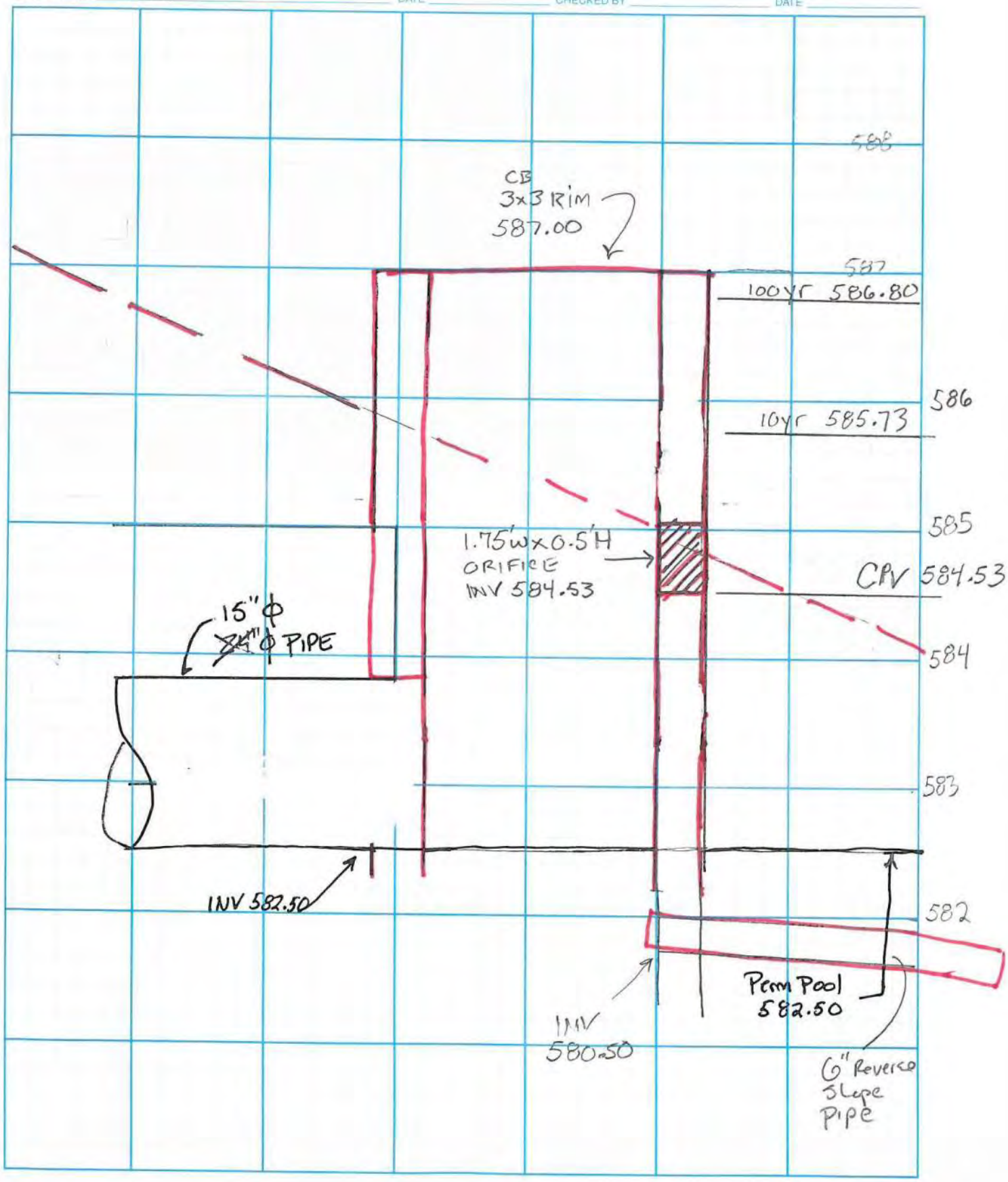
∴ OK

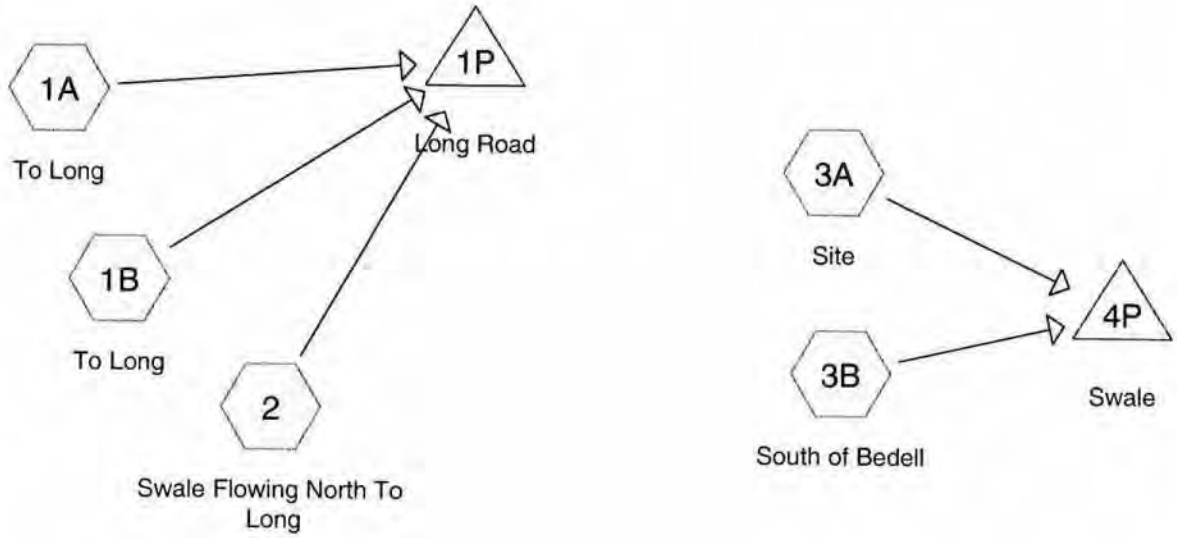
C&S Engineers, Inc.

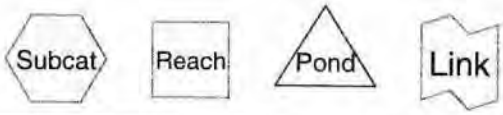
PROJECT GATEWAY SHEET ____ OF ____

POND 4P OUTLET STRUCTURE FILE NO. ____

PREPARED BY V.O. DATE ____ CHECKED BY ____ DATE ____







Drainage Diagram for existing

Prepared by {enter your company name here} 1/11/2008

HydroCAD® 8.00 s/n 002837 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
169.240	73	Brush, Good, HSG D (1A,1B,2,3A)
266.890	77	Woods, Good, HSG D (1A,1B,2,3B)
43.000	84	1 acre lots, 20% imp, HSG D (1B,2,3B)
479.130		

Subcatchment 1A: To Long

Open field & woods draining directly to long ditch

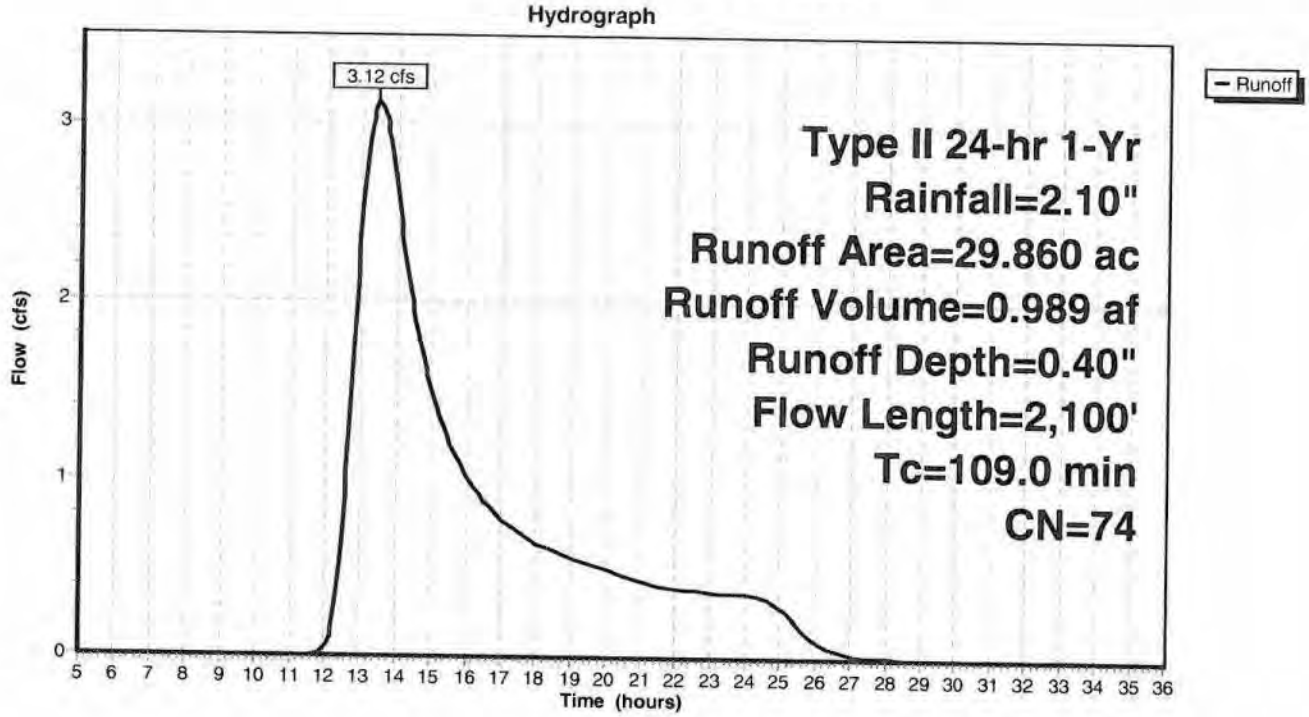
Runoff = 3.12 cfs @ 13.46 hrs, Volume= 0.989 af, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
7.650	77	Woods, Good, HSG D
22.210	73	Brush, Good, HSG D
29.860	74	Weighted Average
29.860		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods**
					Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field**
					Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope**
					Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field**
					Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale**
					Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: To Long



Subcatchment 1B: To Long

Open field & woods draining to 8" culverts on access road

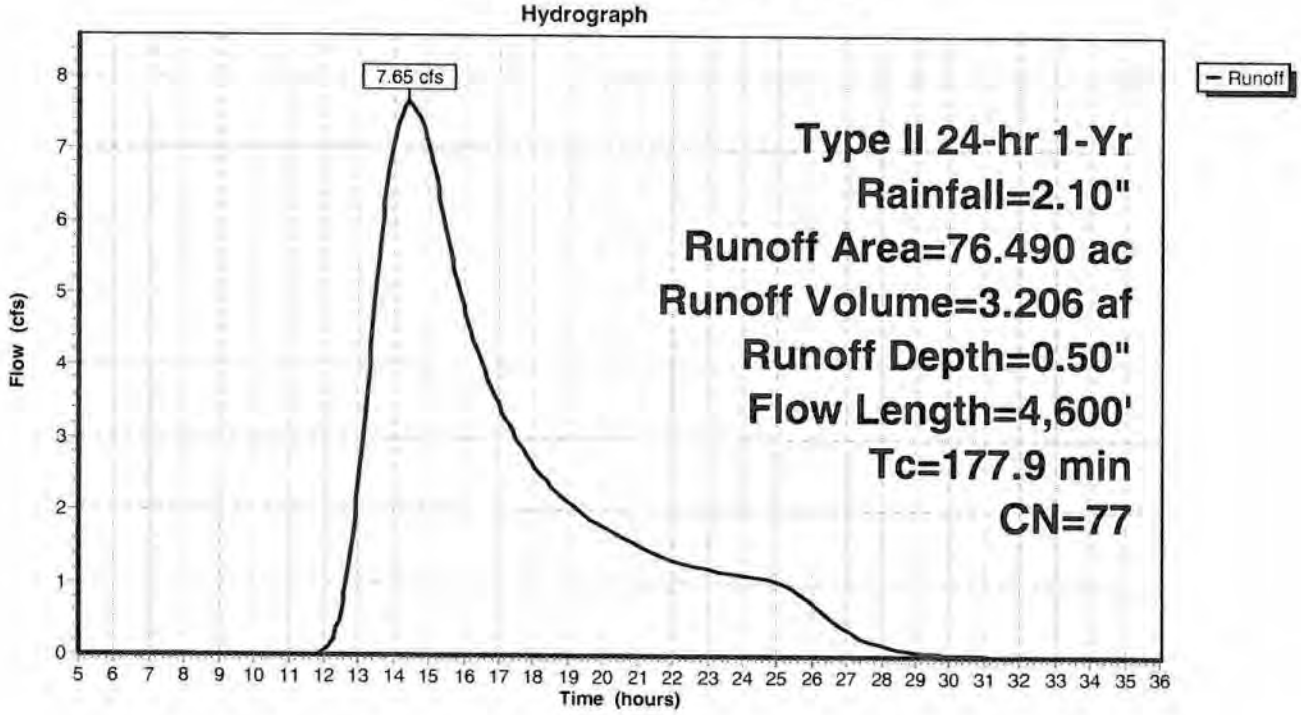
Runoff = 7.65 cfs @ 14.44 hrs, Volume= 3.206 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
56.420	77	Woods, Good, HSG D
15.070	73	Brush, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
76.490	77	Weighted Average
75.490		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
70.7	1,500	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
33.6	3,000	0.0080	1.49	4.47	**Channel Flow, Swale** Area= 3.0 sf Perim= 10.0' r= 0.30' n= 0.040
177.9	4,600	Total			

Subcatchment 1B: To Long



Subcatchment 2: Swale Flowing North To Long

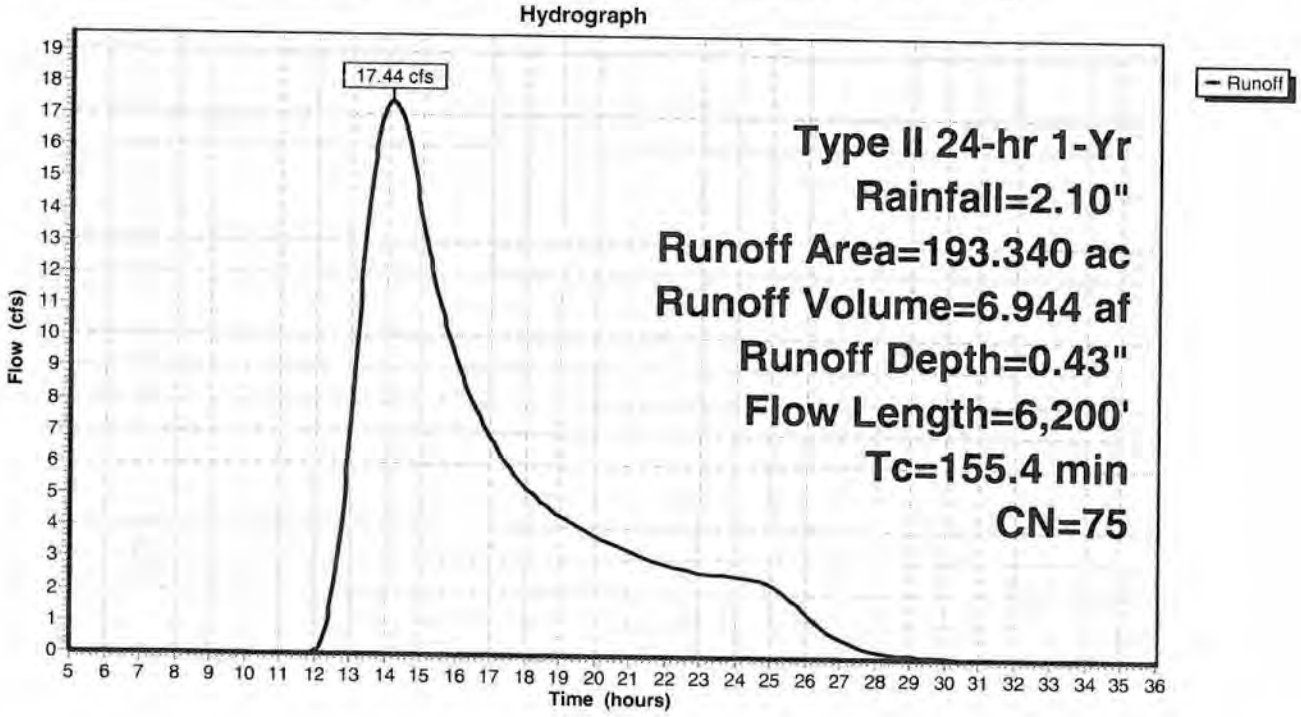
Runoff = 17.44 cfs @ 14.14 hrs, Volume= 6.944 af, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
119.340	73	Brush, Good, HSG D
61.000	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
193.340	75	Weighted Average
190.740		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2: Swale Flowing North To Long



Subcatchment 3A: Site

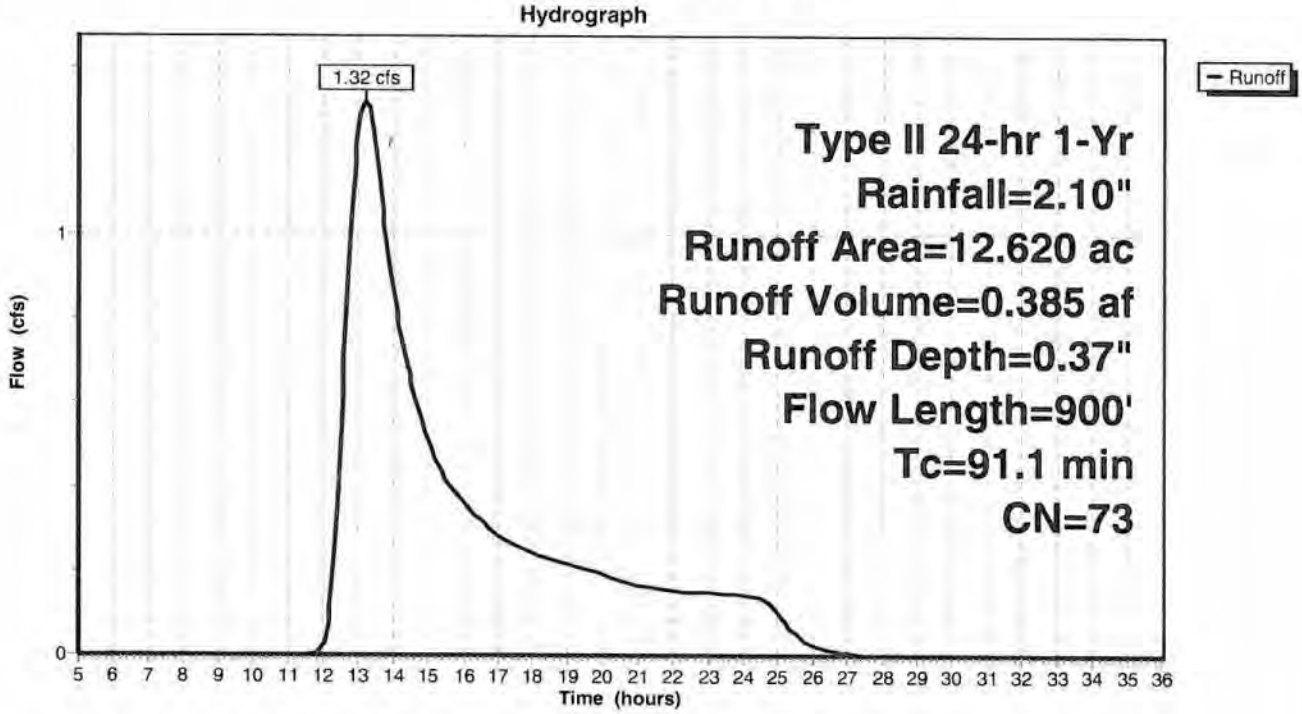
Runoff = 1.32 cfs @ 13.23 hrs, Volume= 0.385 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
12.620	73	Brush, Good, HSG D
12.620		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
64.4	100	0.0070	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.7	800	0.0100	0.50		**Shallow Concentrated Flow, Brush** Woodland Kv= 5.0 fps
91.1	900	Total			

Subcatchment 3A: Site



Subcatchment 3B: South of Bedell

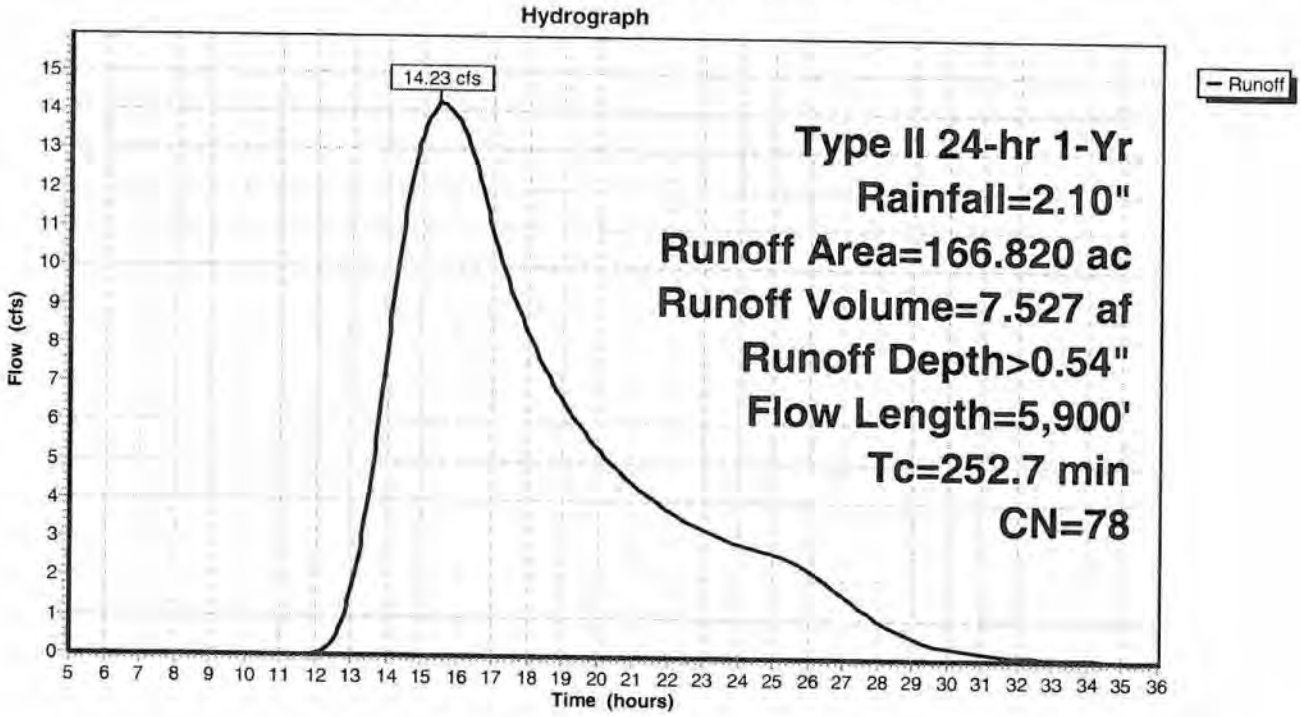
Runoff = 14.23 cfs @ 15.46 hrs, Volume= 7.527 af, Depth> 0.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B: South of Bedell

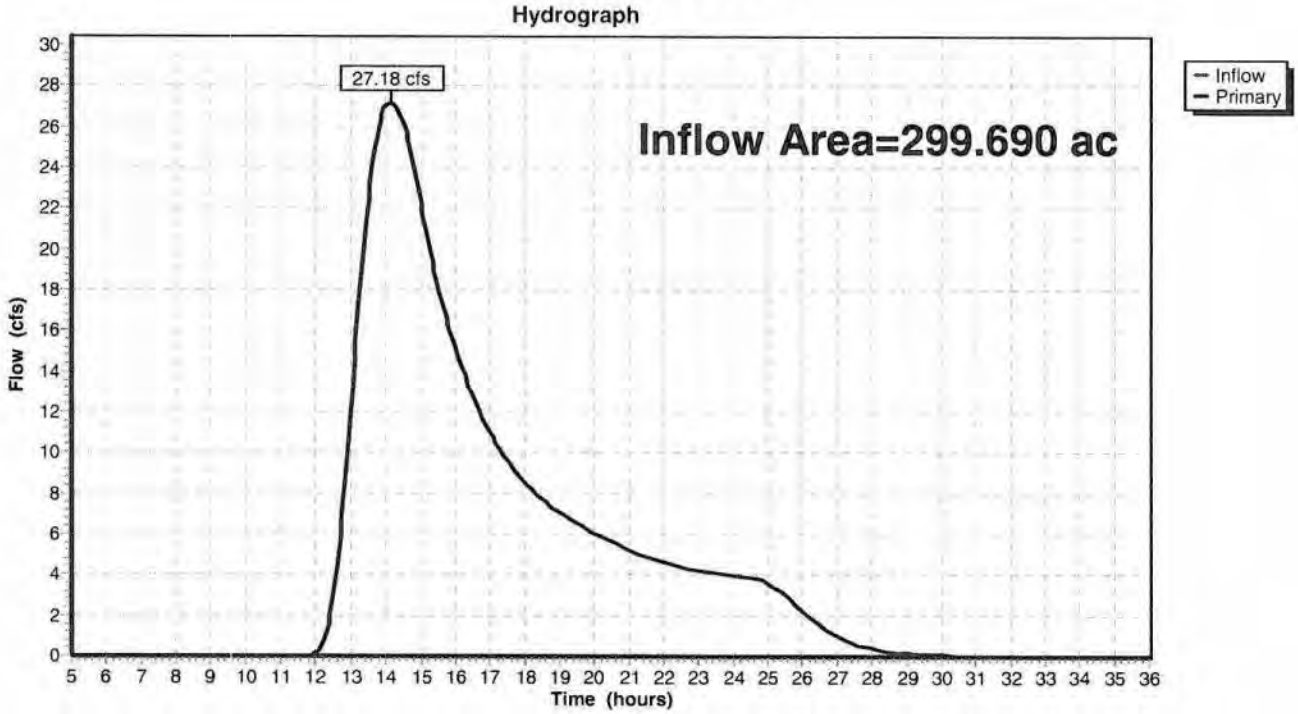


Pond 1P: Long Road

Inflow Area = 299.690 ac, Inflow Depth = 0.45" for 1-Yr event
Inflow = 27.18 cfs @ 14.13 hrs, Volume= 11.139 af
Primary = 27.18 cfs @ 14.13 hrs, Volume= 11.139 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road

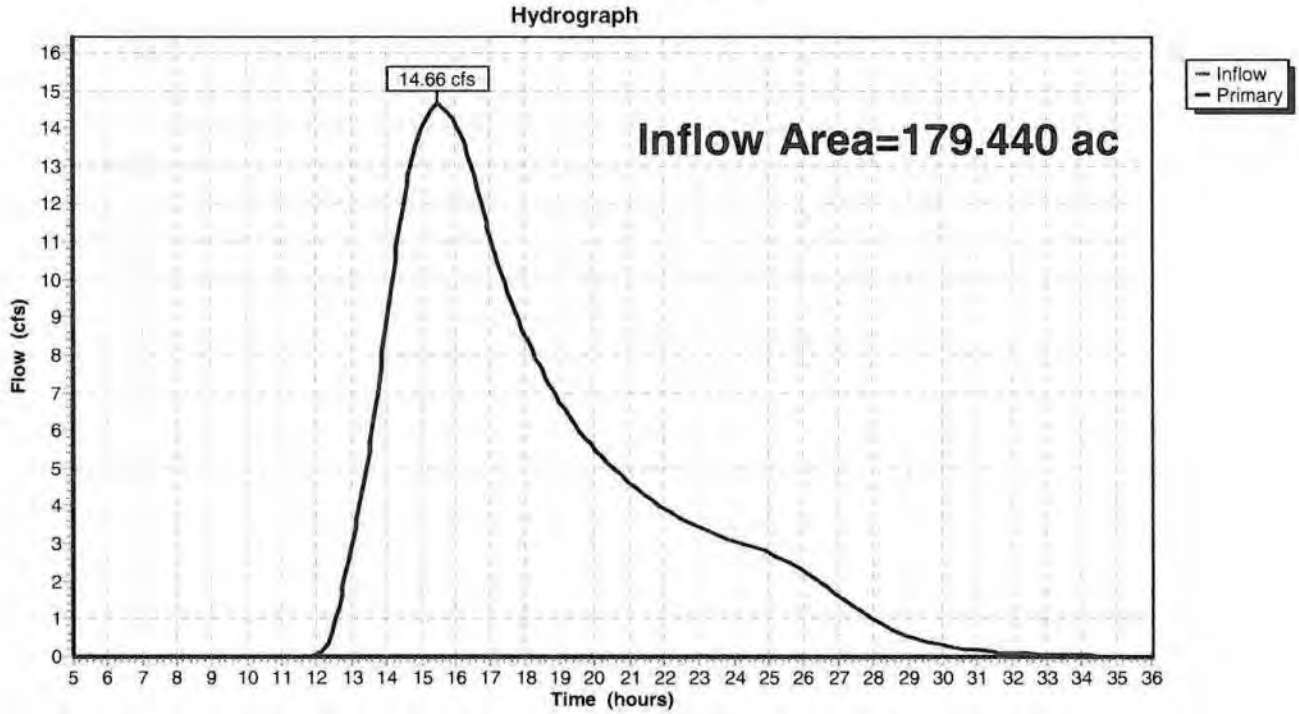


Pond 4P: Swale

Inflow Area = 179.440 ac, Inflow Depth > 0.53" for 1-Yr event
Inflow = 14.66 cfs @ 15.46 hrs, Volume= 7.912 af
Primary = 14.66 cfs @ 15.46 hrs, Volume= 7.912 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 4P: Swale



Subcatchment 1A: To Long

Open field & woods draining directly to long ditch

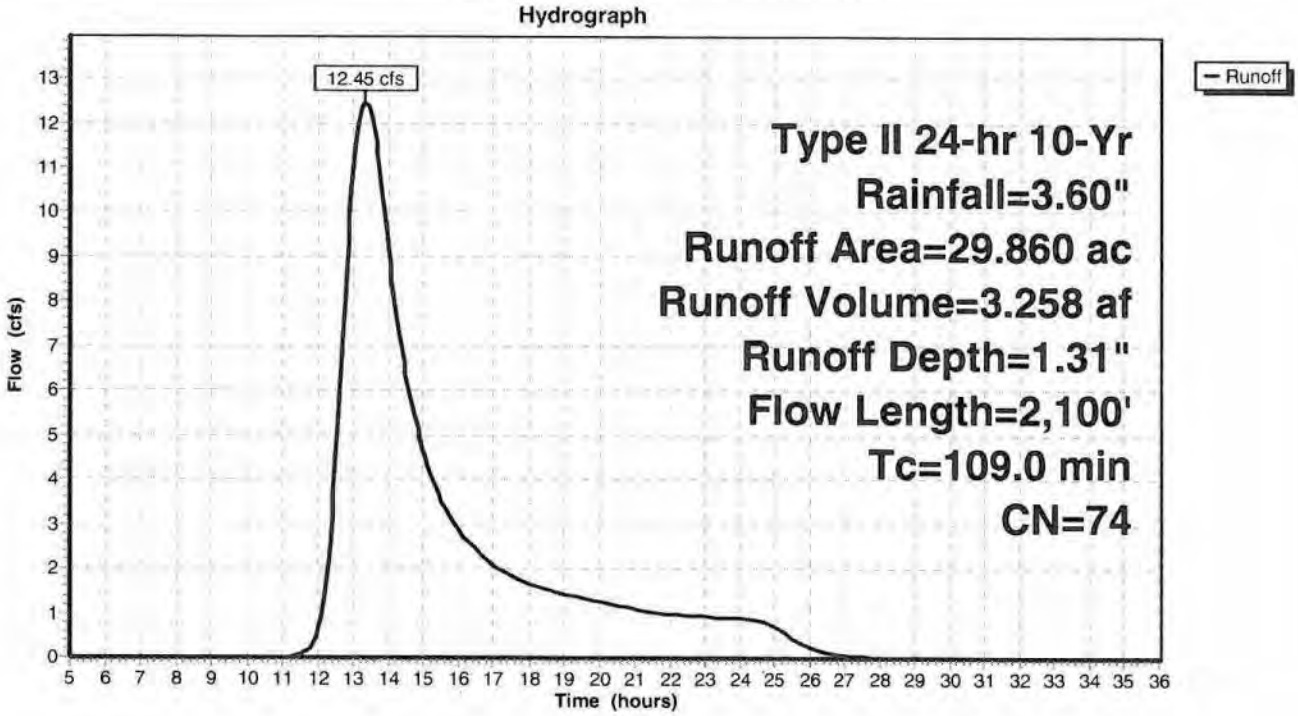
Runoff = 12.45 cfs @ 13.36 hrs, Volume= 3.258 af, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
7.650	77	Woods, Good, HSG D
22.210	73	Brush, Good, HSG D
29.860	74	Weighted Average
29.860		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods**
					Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field**
					Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope**
					Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field**
					Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale**
					Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: To Long



Subcatchment 1B: To Long

Open field & woods draining to 8" culverts on access road

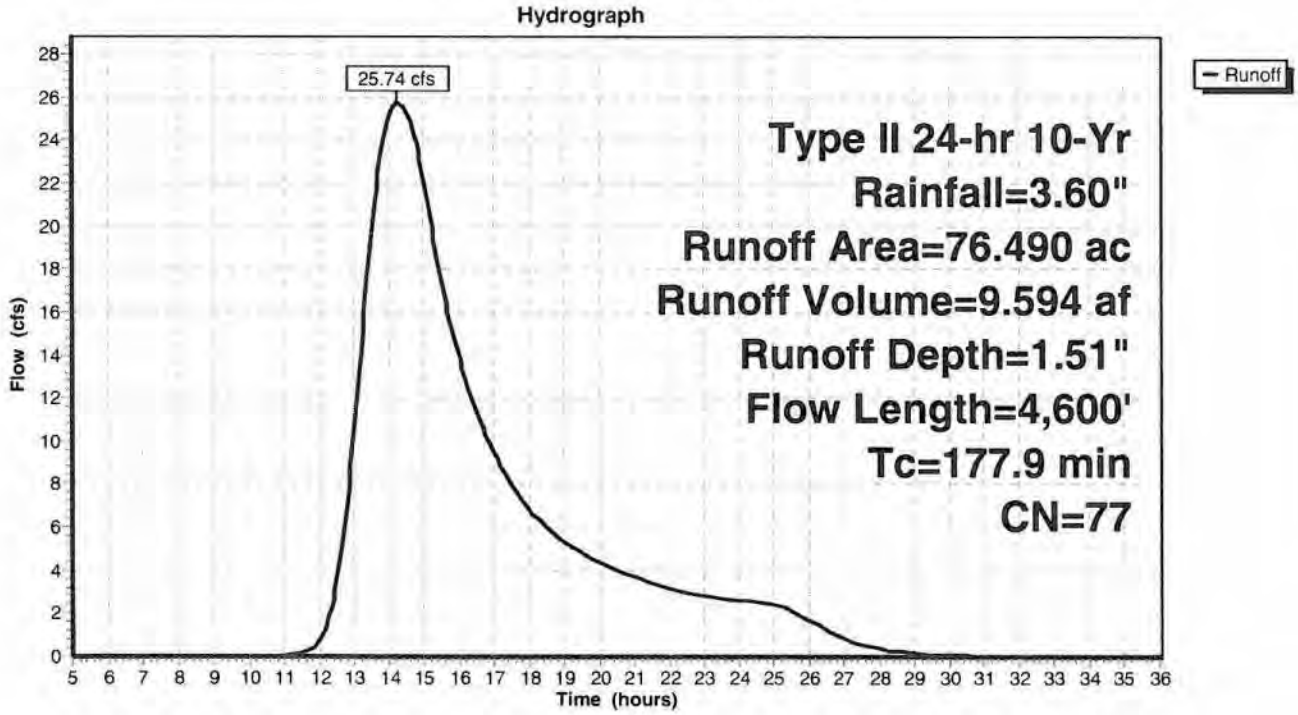
Runoff = 25.74 cfs @ 14.27 hrs, Volume= 9.594 af, Depth= 1.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
56.420	77	Woods, Good, HSG D
15.070	73	Brush, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
76.490	77	Weighted Average
75.490		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
70.7	1,500	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
33.6	3,000	0.0080	1.49	4.47	**Channel Flow, Swale** Area= 3.0 sf Perim= 10.0' r= 0.30' n= 0.040
177.9	4,600	Total			

Subcatchment 1B: To Long



Subcatchment 2: Swale Flowing North To Long

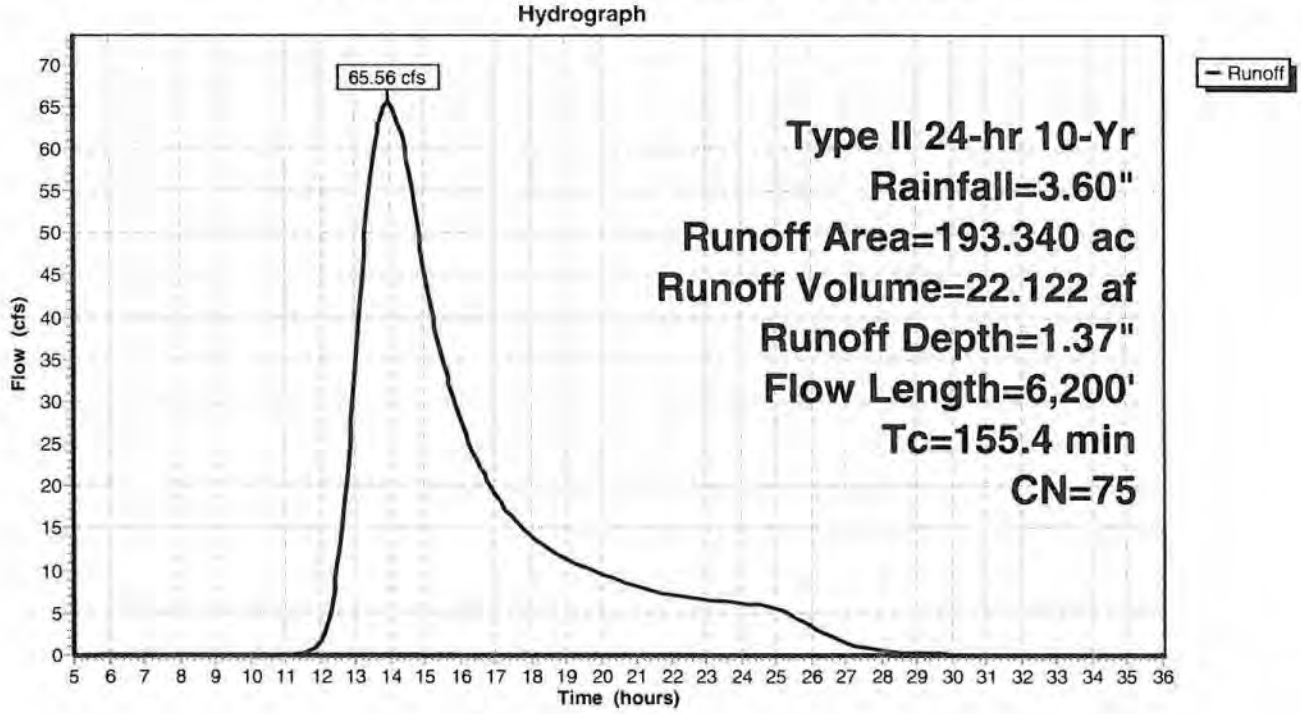
Runoff = 65.56 cfs @ 13.99 hrs, Volume= 22.122 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
119.340	73	Brush, Good, HSG D
61.000	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
193.340	75	Weighted Average
190.740		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2: Swale Flowing North To Long



Subcatchment 3A: Site

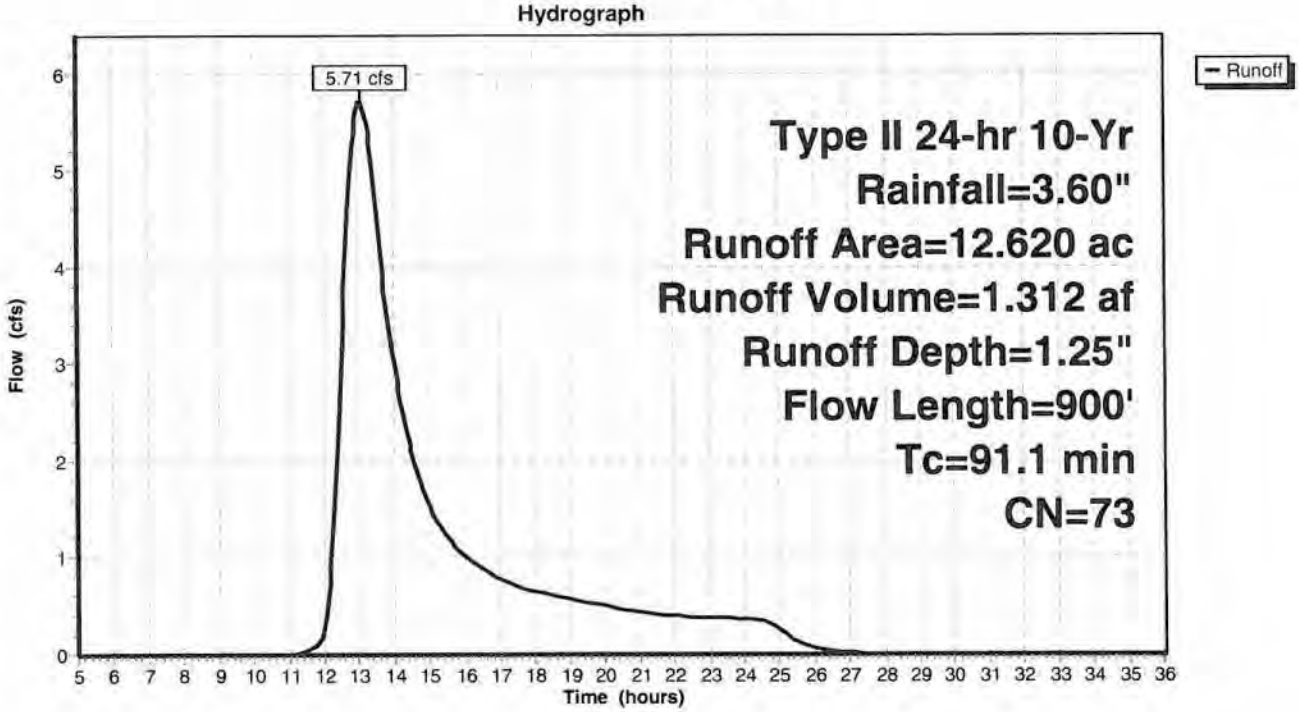
Runoff = 5.71 cfs @ 13.07 hrs, Volume= 1.312 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
12.620	73	Brush, Good, HSG D
12.620		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
64.4	100	0.0070	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.7	800	0.0100	0.50		**Shallow Concentrated Flow, Brush** Woodland Kv= 5.0 fps
91.1	900	Total			

Subcatchment 3A: Site



Subcatchment 3B: South of Bedell

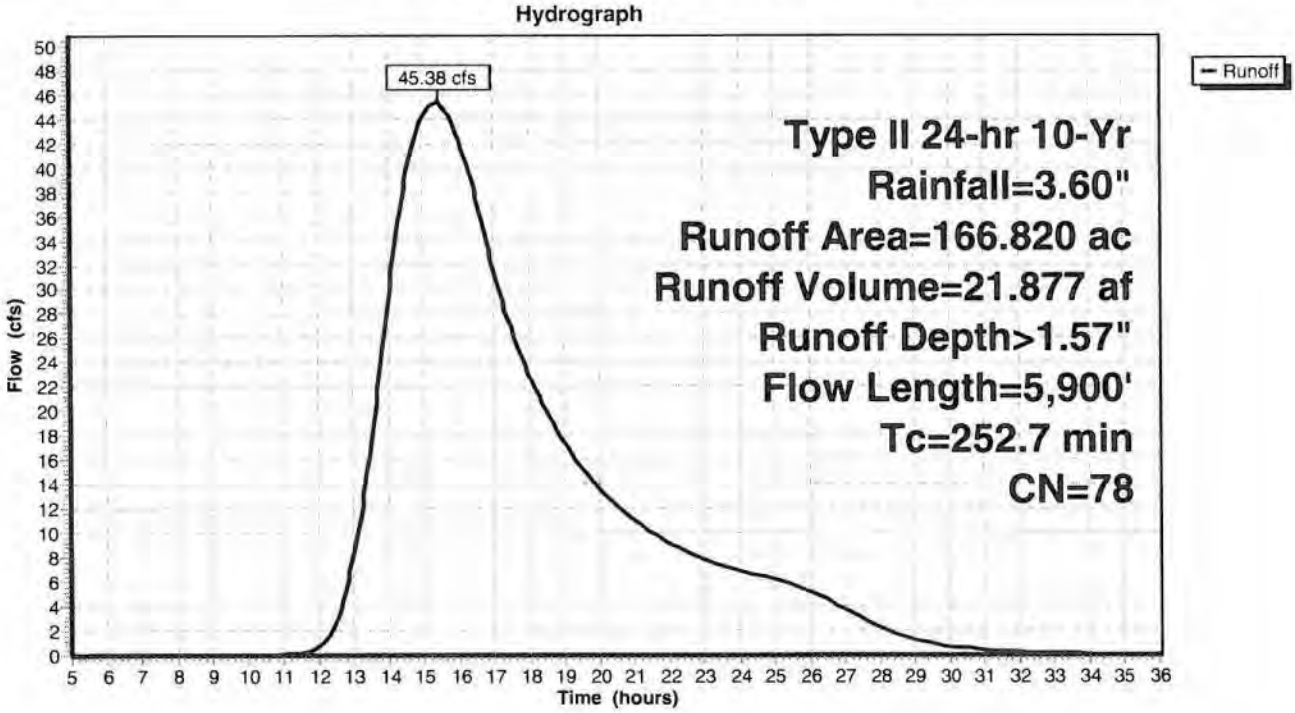
Runoff = 45.38 cfs @ 15.43 hrs, Volume= 21.877 af, Depth> 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B: South of Bedell

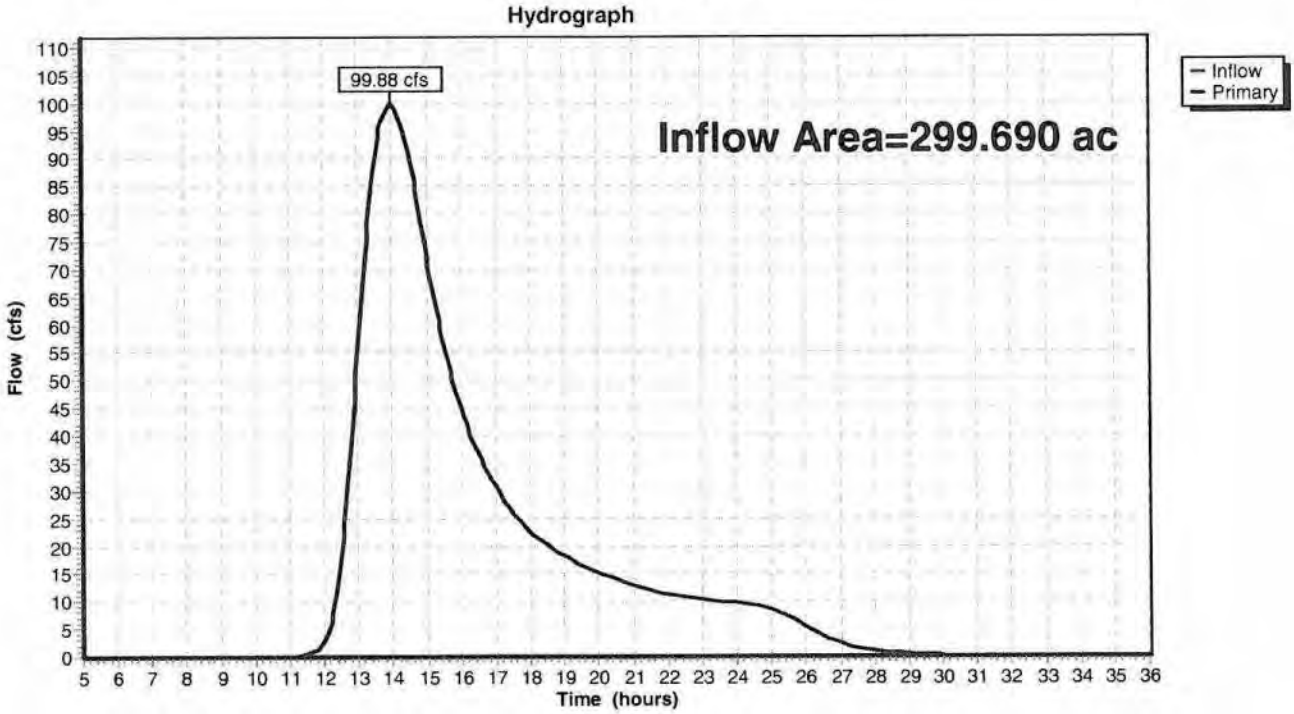


Pond 1P: Long Road

Inflow Area =	299.690 ac,	Inflow Depth =	1.40"	for	10-Yr event
Inflow =	99.88 cfs @	13.99 hrs,	Volume=	34.975 af	
Primary =	99.88 cfs @	13.99 hrs,	Volume=	34.975 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road

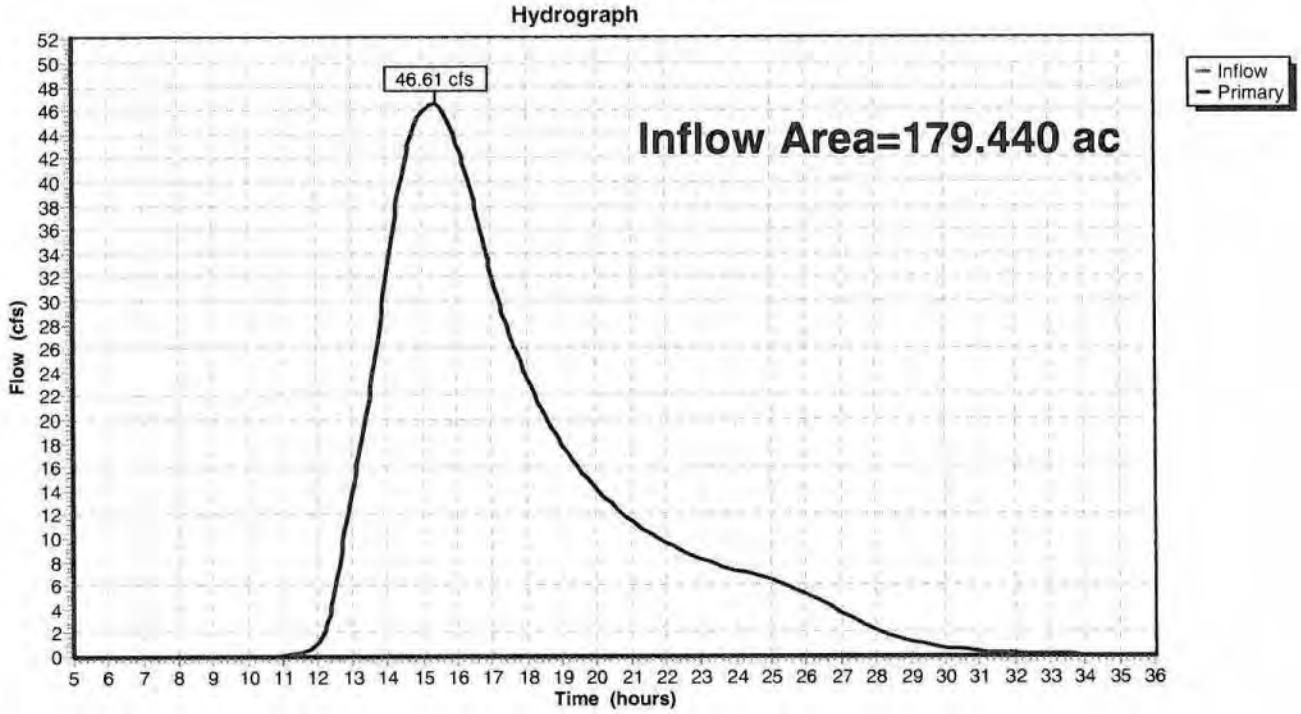


Pond 4P: Swale

Inflow Area = 179.440 ac, Inflow Depth > 1.55" for 10-Yr event
Inflow = 46.61 cfs @ 15.42 hrs, Volume= 23.189 af
Primary = 46.61 cfs @ 15.42 hrs, Volume= 23.189 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 4P: Swale



Subcatchment 1A: To Long

Open field & woods draining directly to long ditch

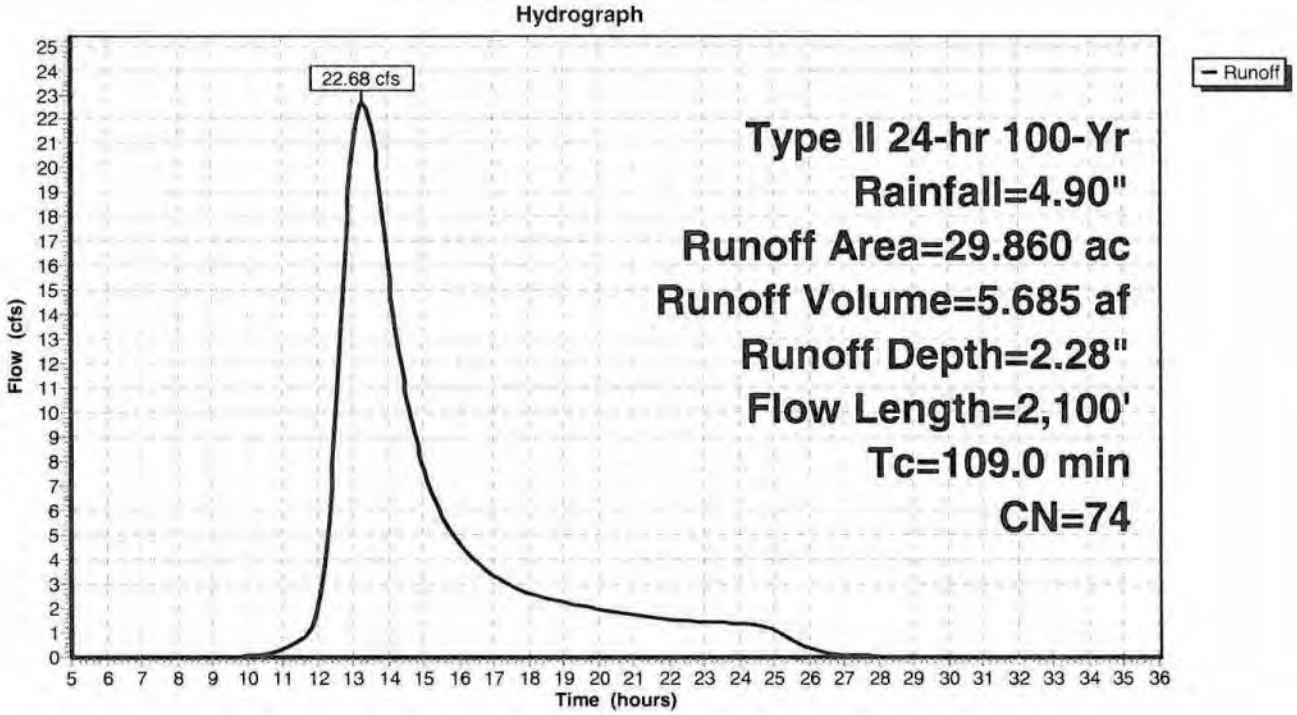
Runoff = 22.68 cfs @ 13.30 hrs, Volume= 5.685 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
7.650	77	Woods, Good, HSG D
22.210	73	Brush, Good, HSG D
29.860	74	Weighted Average
29.860		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope** Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field** Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: To Long



Subcatchment 1B: To Long

Open field & woods draining to 8" culverts on access road

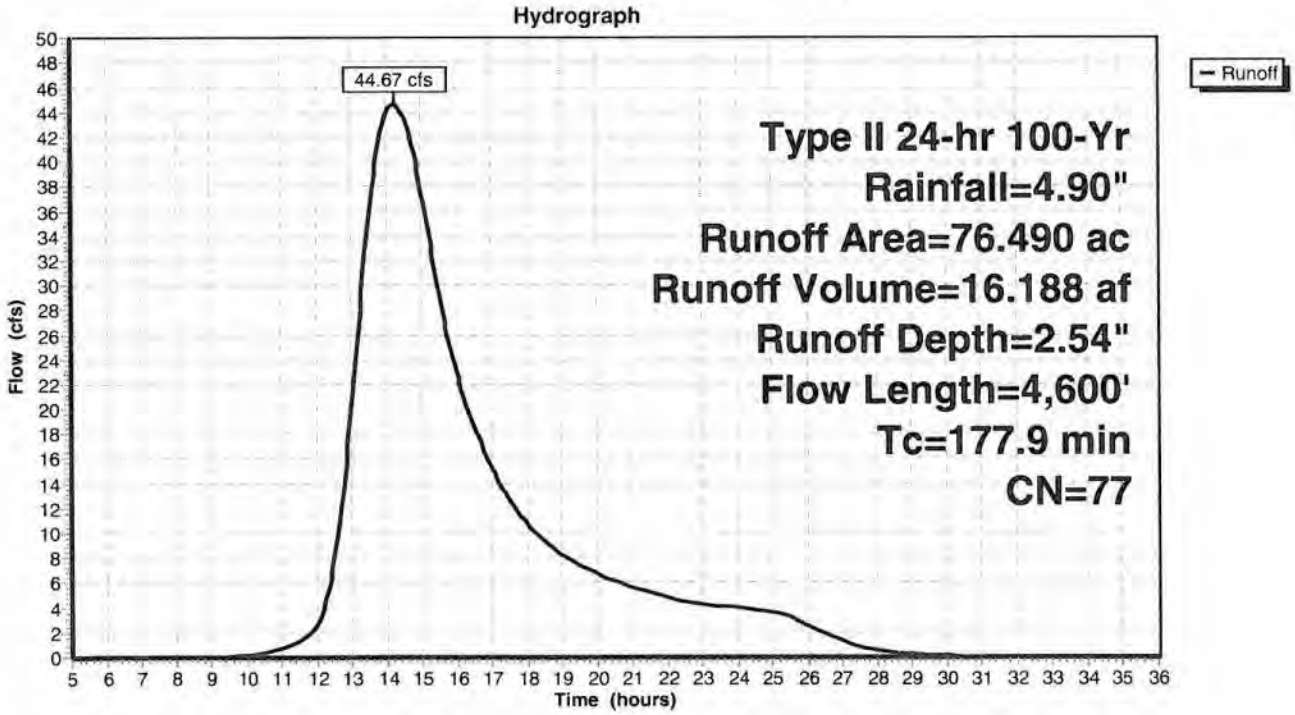
Runoff = 44.67 cfs @ 14.23 hrs, Volume= 16.188 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
56.420	77	Woods, Good, HSG D
15.070	73	Brush, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
76.490	77	Weighted Average
75.490		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
70.7	1,500	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
33.6	3,000	0.0080	1.49	4.47	**Channel Flow, Swale** Area= 3.0 sf Perim= 10.0' r= 0.30' n= 0.040
177.9	4,600	Total			

Subcatchment 1B: To Long



Subcatchment 2: Swale Flowing North To Long

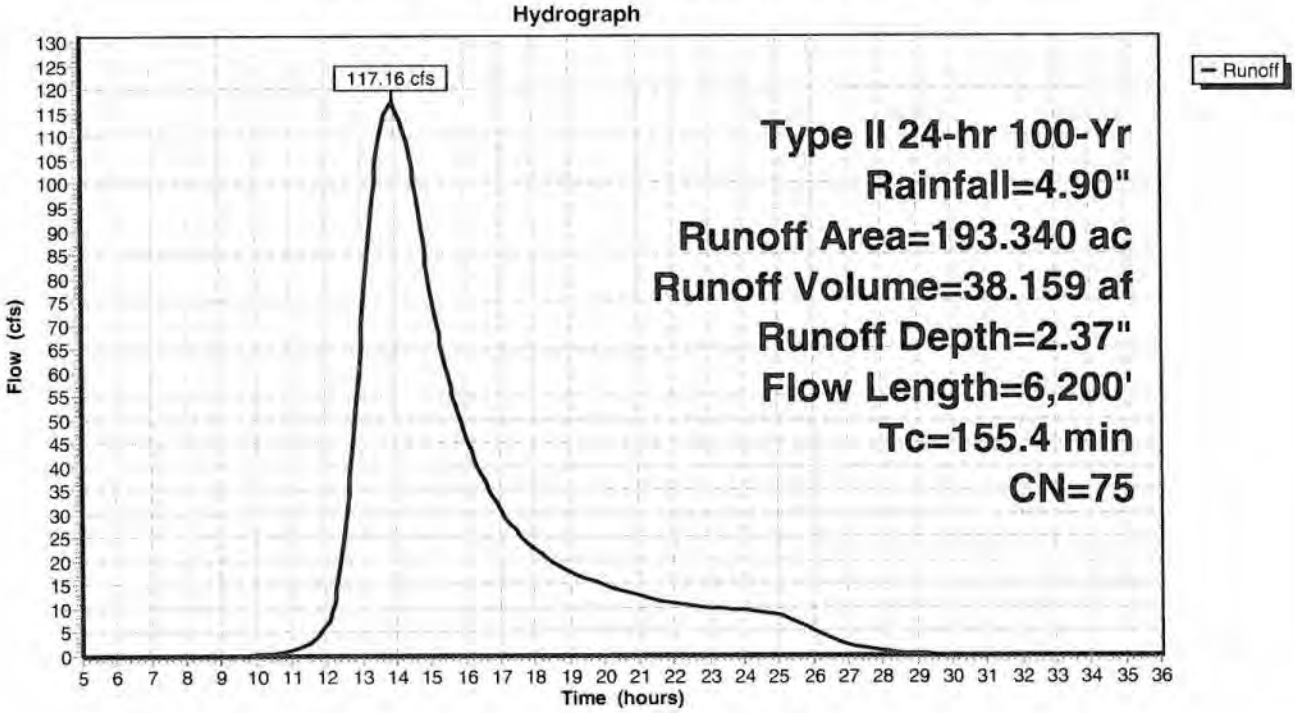
Runoff = 117.16 cfs @ 13.97 hrs, Volume= 38.159 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
119.340	73	Brush, Good, HSG D
61.000	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
193.340	75	Weighted Average
190.740		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2: Swale Flowing North To Long



Subcatchment 3A: Site

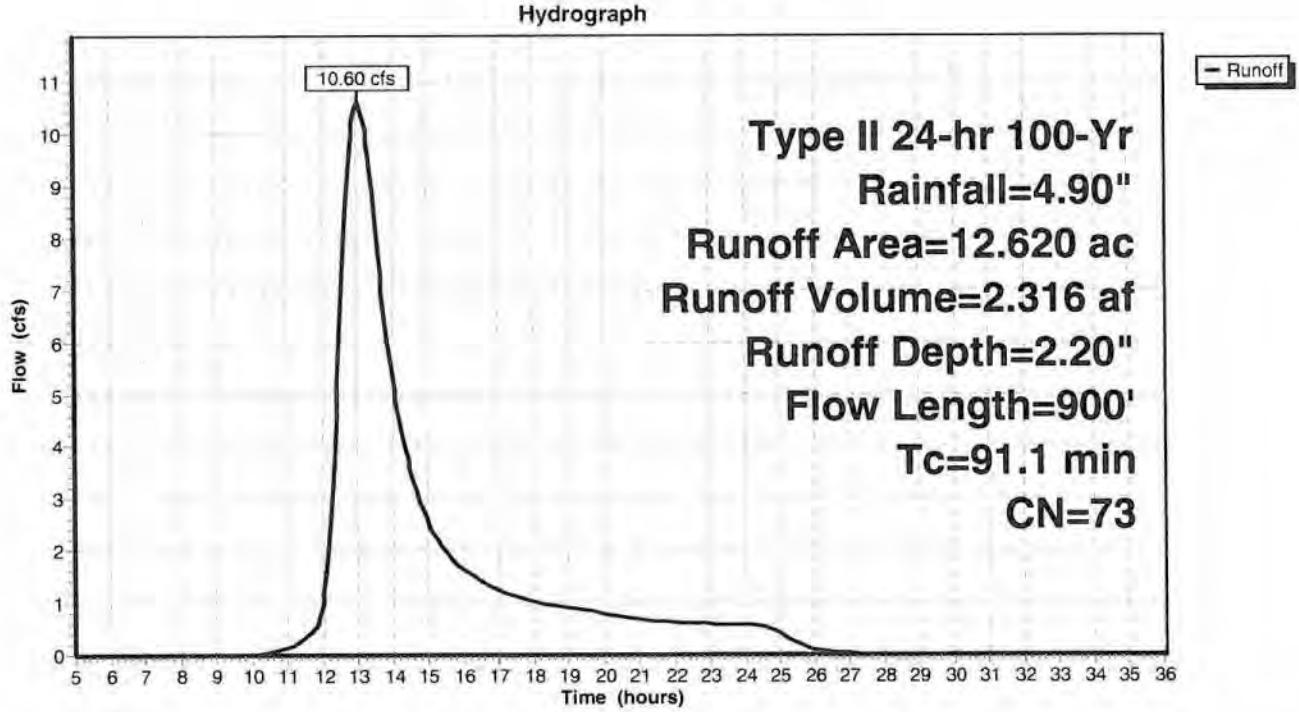
Runoff = 10.60 cfs @ 13.05 hrs, Volume= 2.316 af, Depth= 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
12.620	73	Brush, Good, HSG D
12.620		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
64.4	100	0.0070	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.7	800	0.0100	0.50		**Shallow Concentrated Flow, Brush** Woodland Kv= 5.0 fps
91.1	900	Total			

Subcatchment 3A: Site



Subcatchment 3B: South of Bedell

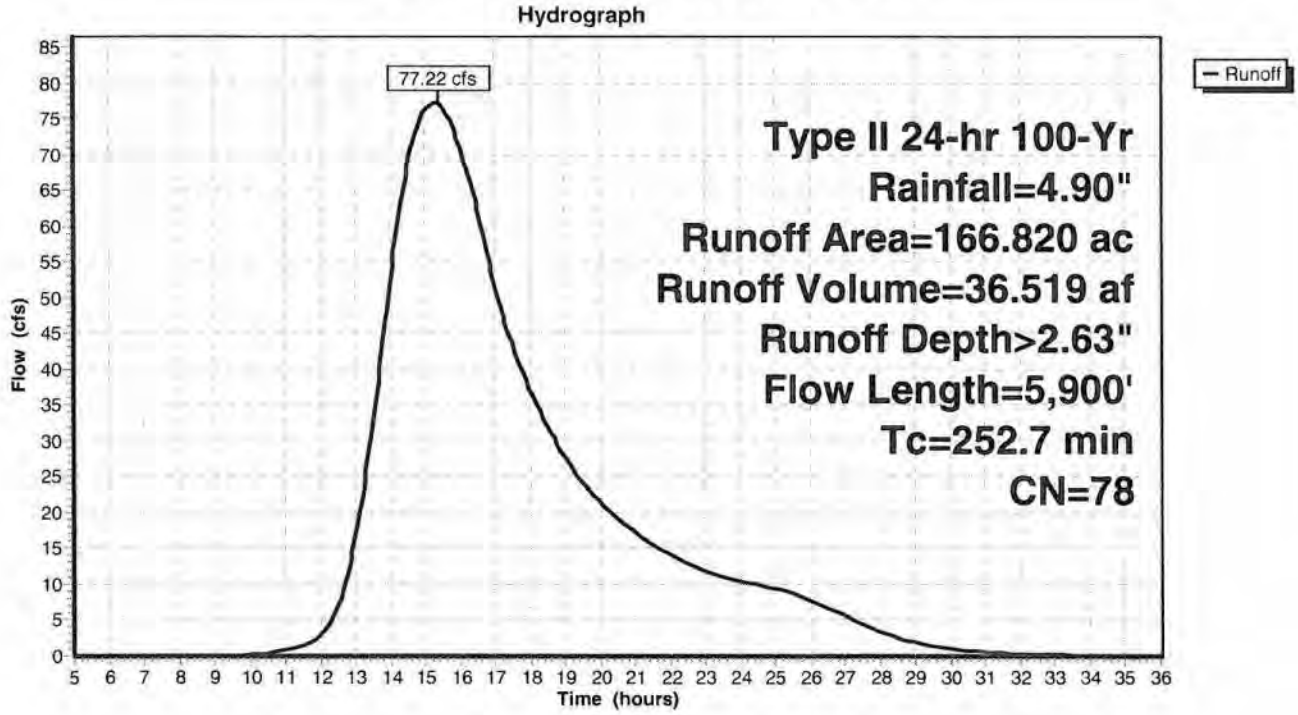
Runoff = 77.22 cfs @ 15.39 hrs, Volume= 36.519 af, Depth> 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B: South of Bedell

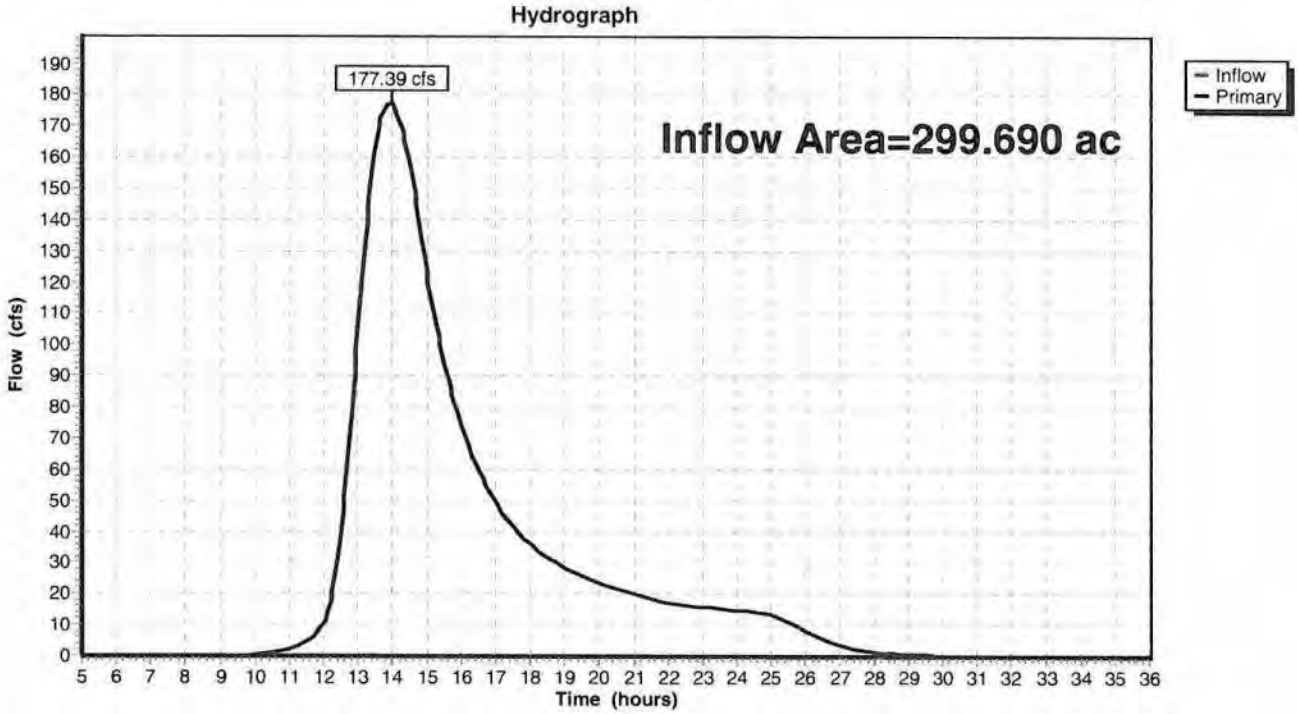


Pond 1P: Long Road

Inflow Area = 299.690 ac, Inflow Depth = 2.40" for 100-Yr event
Inflow = 177.39 cfs @ 13.95 hrs, Volume= 60.032 af
Primary = 177.39 cfs @ 13.95 hrs, Volume= 60.032 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road

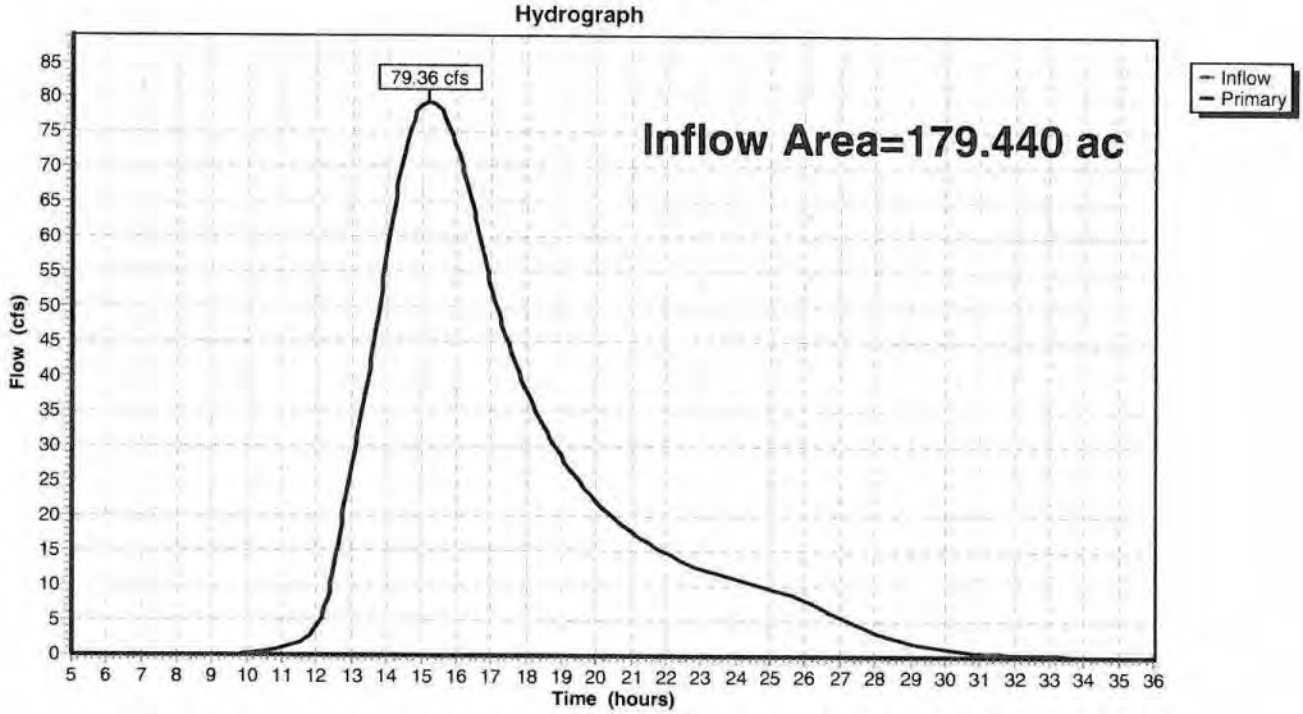


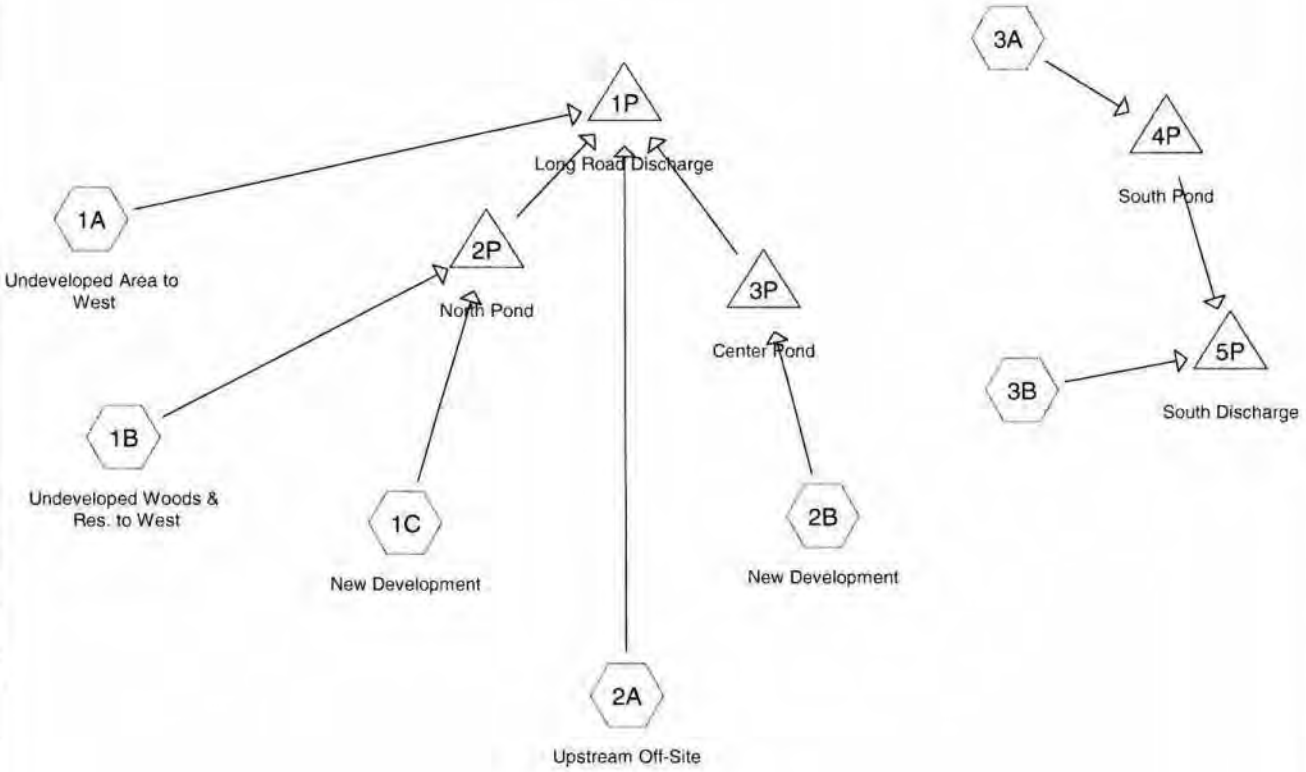
Pond 4P: Swale

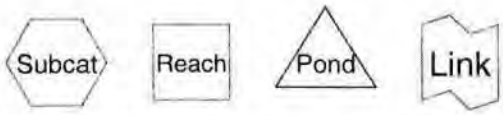
Inflow Area = 179.440 ac, Inflow Depth > 2.60" for 100-Yr event
Inflow = 79.36 cfs @ 15.21 hrs, Volume= 38.835 af
Primary = 79.36 cfs @ 15.21 hrs, Volume= 38.835 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 4P: Swale







Drainage Diagram for proposed
Prepared by {enter your company name here} 5/1/2008
HydroCAD® 8.00 s/n 002837 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
15.990	73	Brush, Good, HSG D (1A)
288.540	77	Woods, Good, HSG D (1A,1B,2A,3B)
43.000	84	1 acre lots, 20% imp, HSG D (1B,2A,3B)
131.840	93	Urban industrial, 72% imp, HSG D (1C,2B,3A)
479.370		

Subcatchment 1A: Undeveloped Area to West

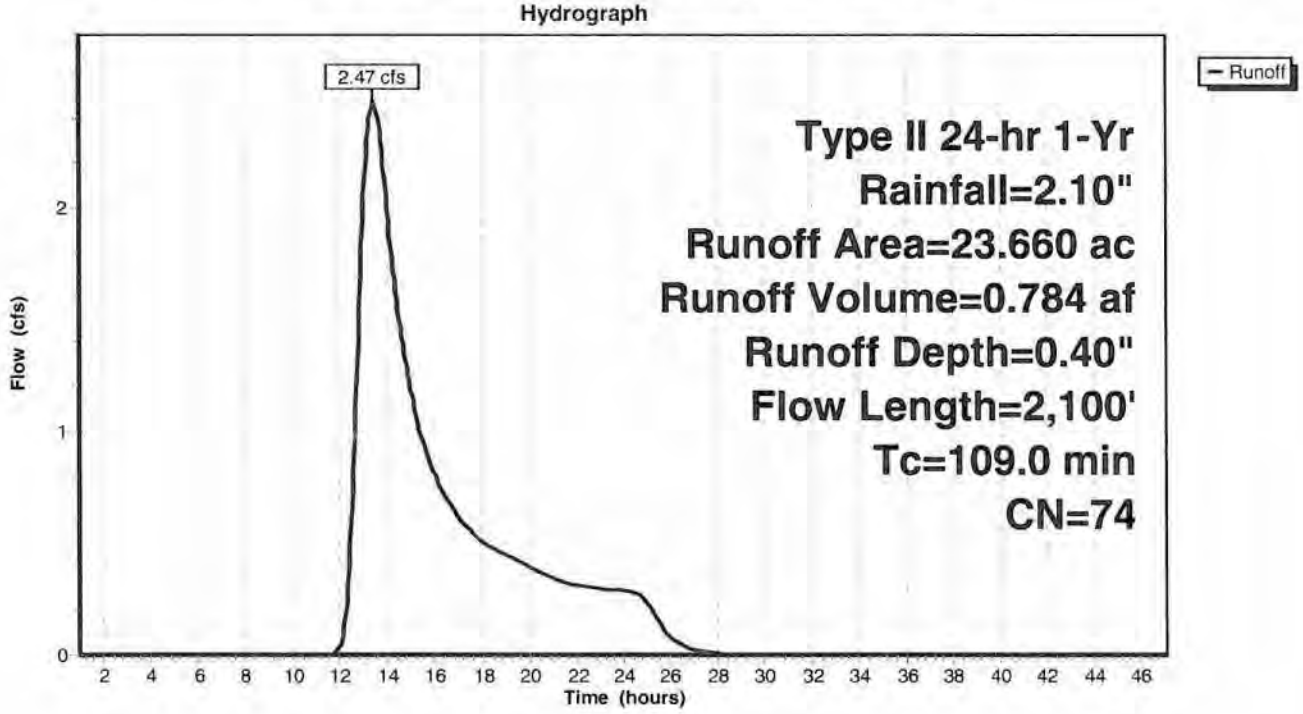
Runoff = 2.47 cfs @ 13.46 hrs, Volume= 0.784 af, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
7.670	77	Woods, Good, HSG D
15.990	73	Brush, Good, HSG D
23.660	74	Weighted Average
23.660		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope** Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field** Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: Undeveloped Area to West



Subcatchment 1B: Undeveloped Woods & Res. to West

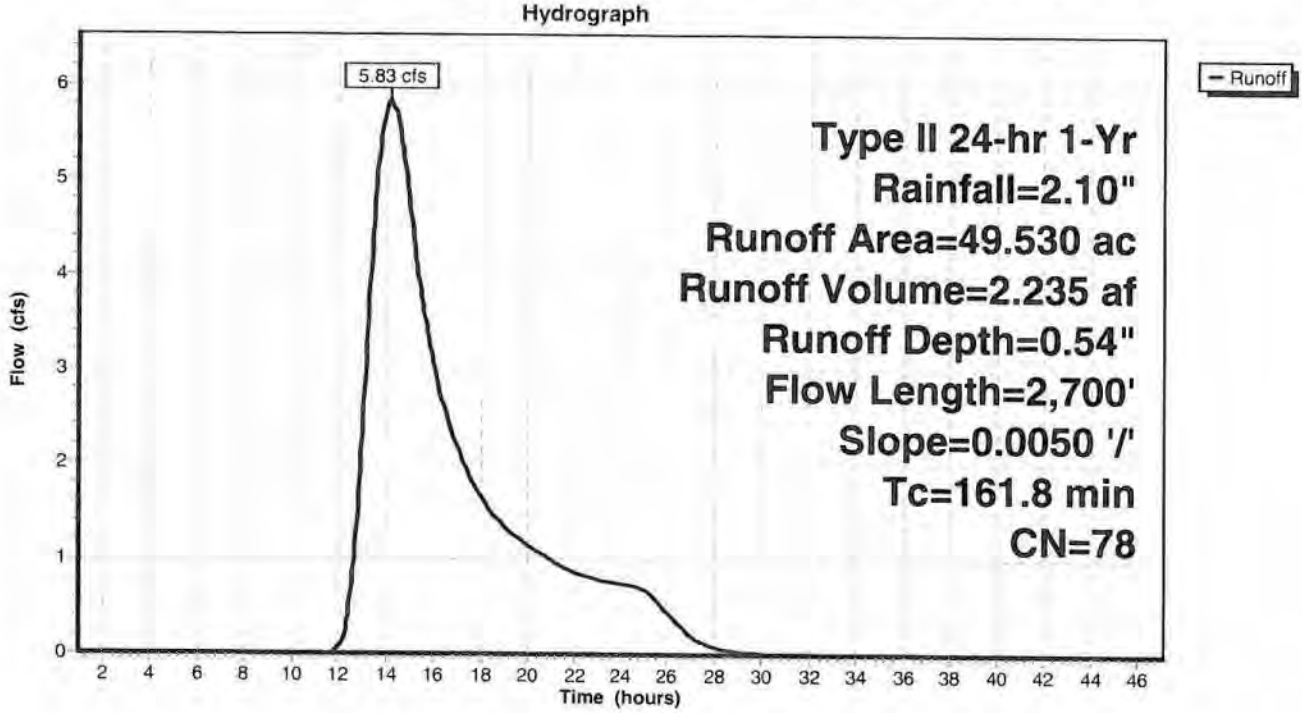
Runoff = 5.83 cfs @ 14.20 hrs, Volume= 2.235 af, Depth= 0.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
44.530	77	Woods, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
49.530	78	Weighted Average
48.530		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
84.9	1,800	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
3.3	800		4.00		**Direct Entry, Pipe Flow**
161.8	2,700	Total			

Subcatchment 1B: Undeveloped Woods & Res. to West



Subcatchment 1C: New Development

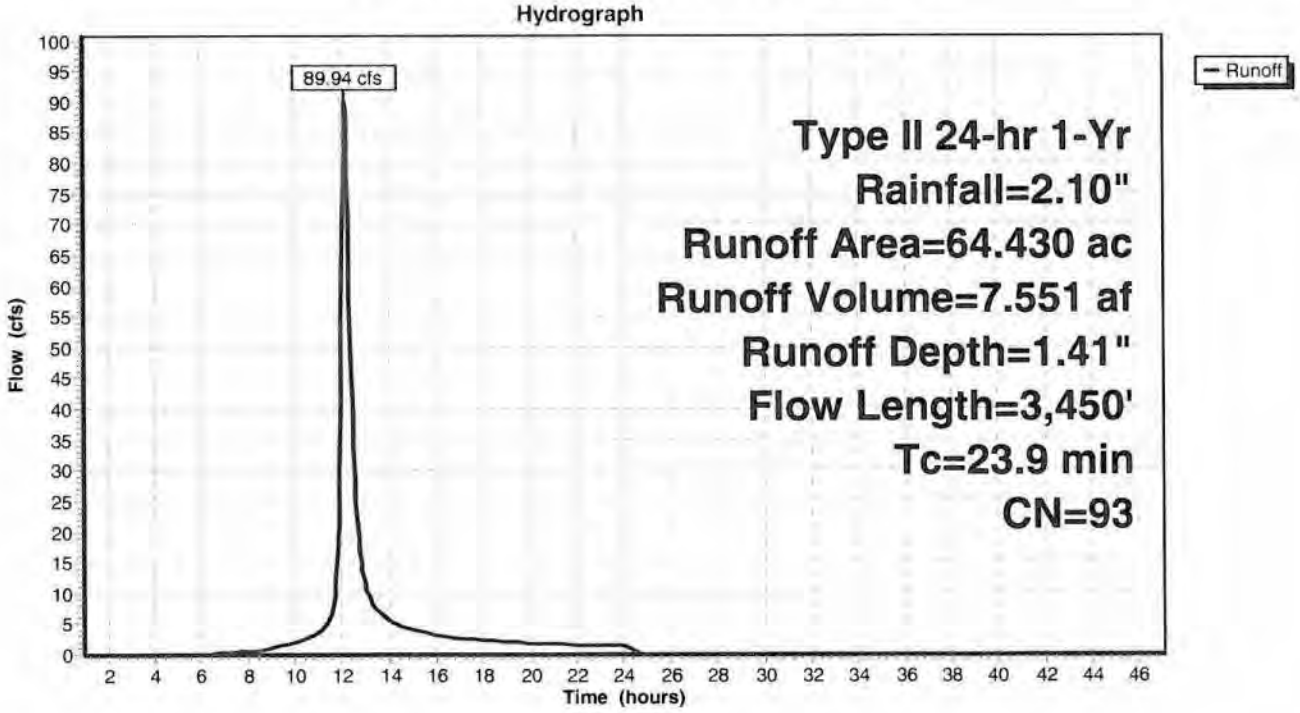
Runoff = 89.94 cfs @ 12.17 hrs, Volume= 7.551 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
64.430	93	Urban industrial, 72% imp, HSG D
18.040		Pervious Area
46.390		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
13.8	3,300		4.00		**Direct Entry, Pipe Flow**
23.9	3,450	Total			

Subcatchment 1C: New Development



Subcatchment 2A: Upstream Off-Site

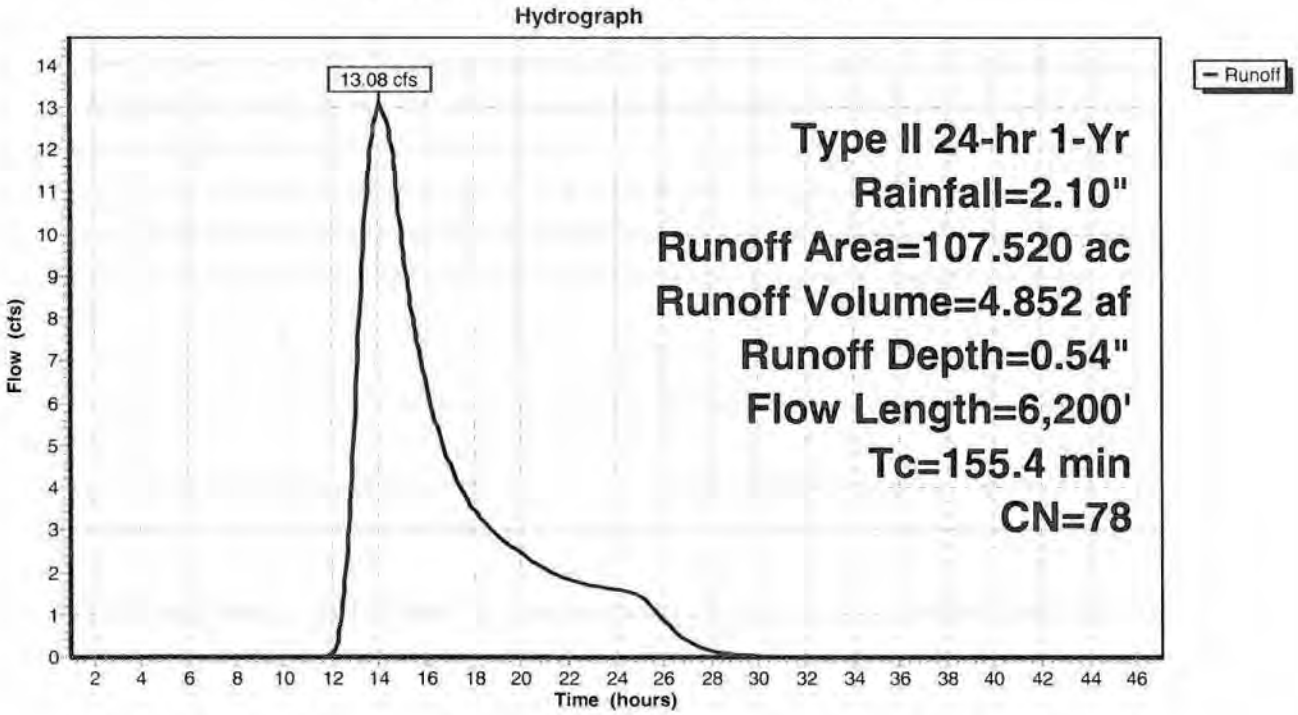
Runoff = 13.08 cfs @ 14.02 hrs, Volume= 4.852 af, Depth= 0.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
94.520	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
107.520	78	Weighted Average
104.920		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2A: Upstream Off-Site



Subcatchment 2B: New Development

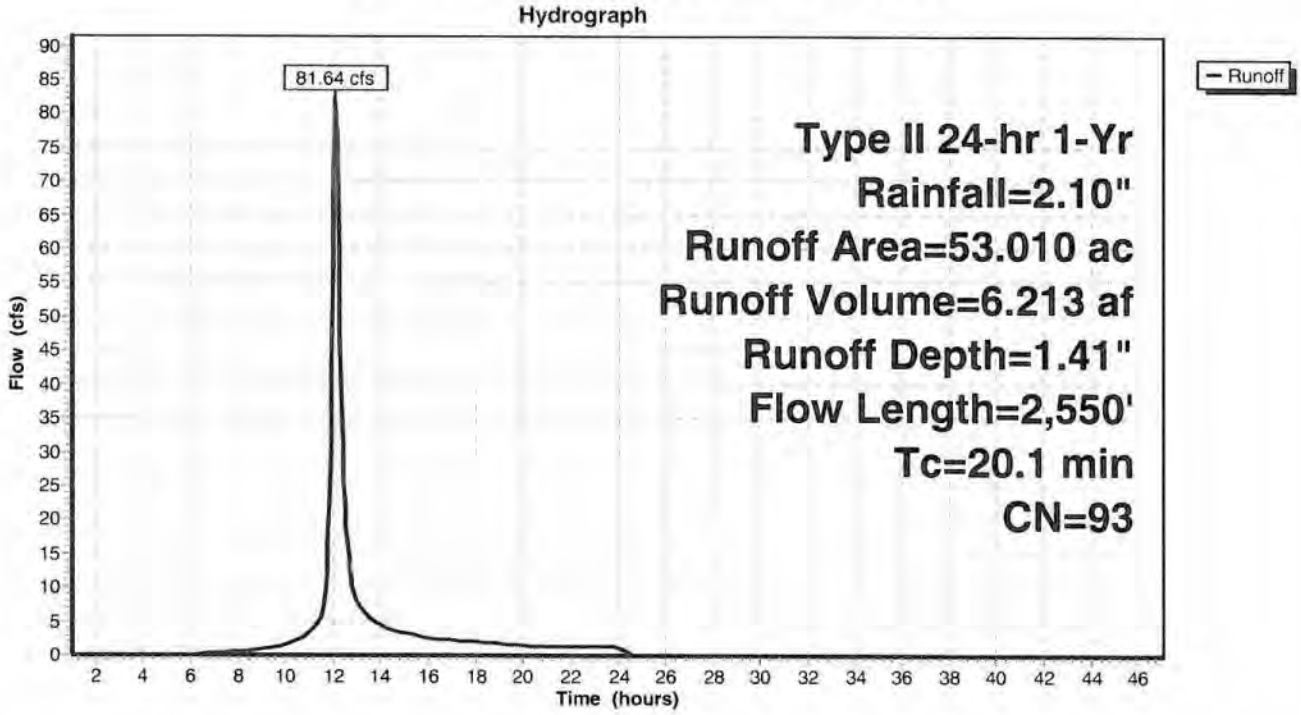
Runoff = 81.64 cfs @ 12.12 hrs, Volume= 6.213 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
53.010	93	Urban industrial, 72% imp, HSG D
14.843		Pervious Area
38.167		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass**
					Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement**
					Paved Kv= 20.3 fps
10.0	2,400		4.00		**Direct Entry, Pipe Flow**
20.1	2,550	Total			

Subcatchment 2B: New Development



Subcatchment 3A:

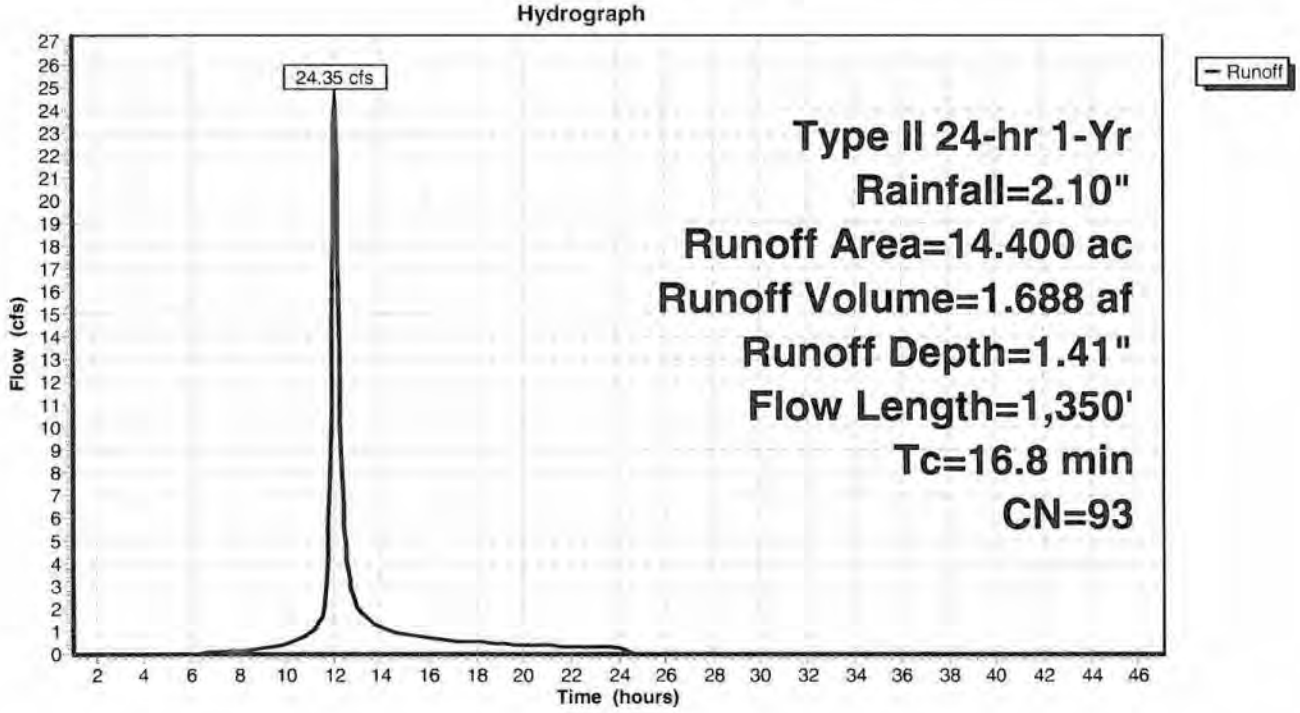
Runoff = 24.35 cfs @ 12.09 hrs, Volume= 1.688 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
14.400	93	Urban industrial, 72% imp, HSG D
4.032		Pervious Area
10.368		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Woods** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
6.7	1,200		3.00		**Direct Entry, Pipe Flow**
16.8	1,350	Total			

Subcatchment 3A:



Subcatchment 3B:

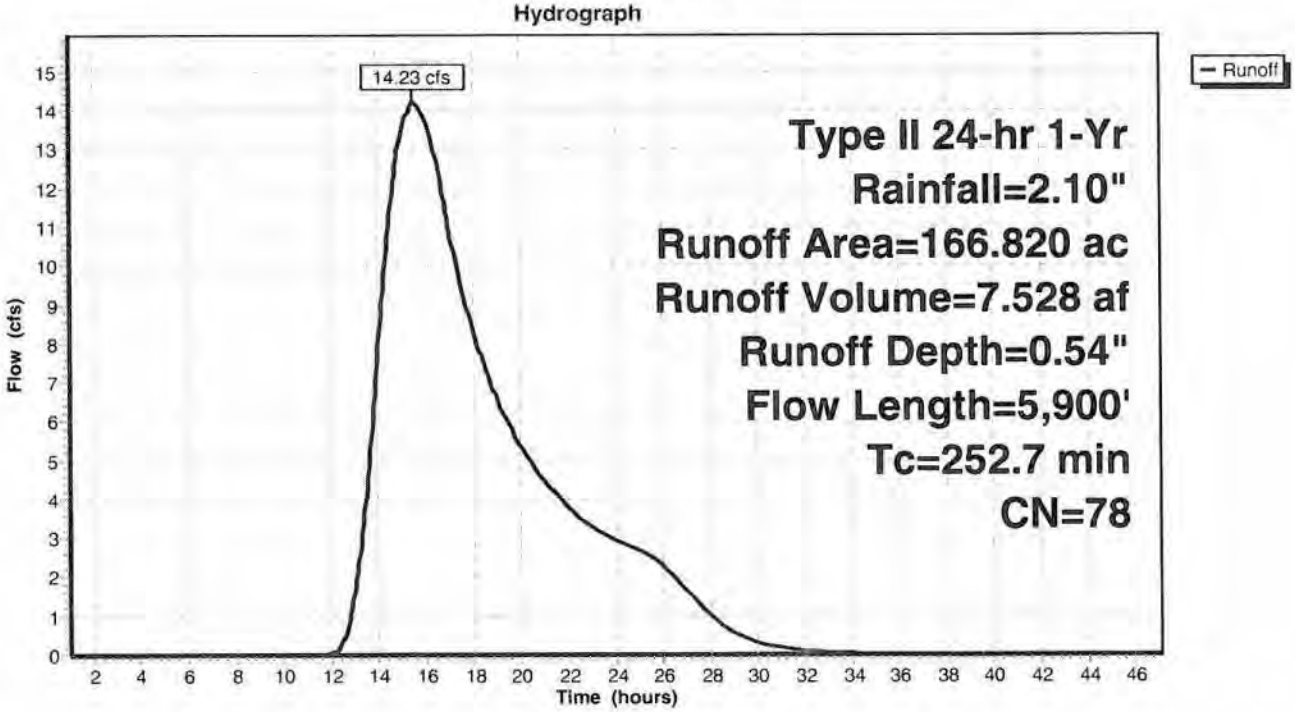
Runoff = 14.23 cfs @ 15.46 hrs, Volume= 7.528 af, Depth= 0.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B:

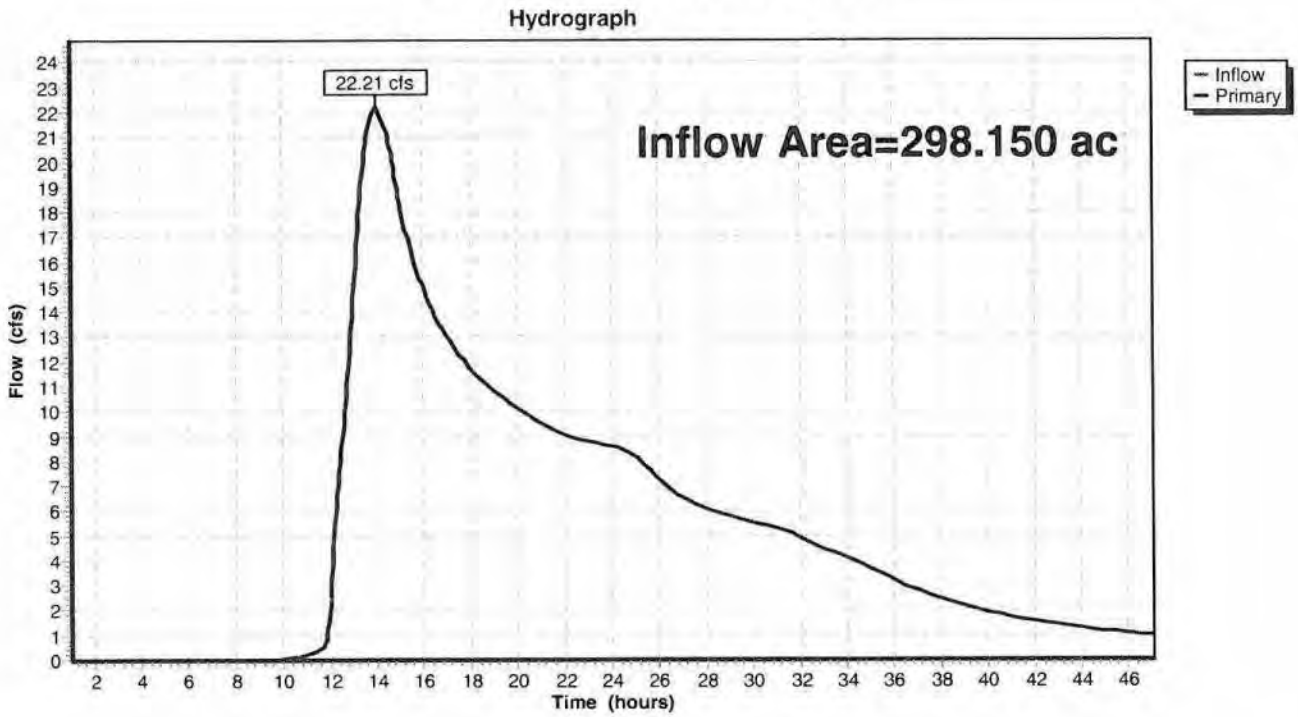


Pond 1P: Long Road Discharge

Inflow Area = 298.150 ac, Inflow Depth > 0.79" for 1-Yr event
Inflow = 22.21 cfs @ 13.99 hrs, Volume= 19.629 af
Primary = 22.21 cfs @ 13.99 hrs, Volume= 19.629 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road Discharge



Pond 2P: North Pond

Inflow Area =	113.960 ac,	Inflow Depth =	1.03"	for	1-Yr event
Inflow =	90.07 cfs @	12.17 hrs,	Volume=	9.786 af	
Outflow =	4.56 cfs @	17.29 hrs,	Volume=	8.343 af,	Atten= 95%, Lag= 307.2 min
Primary =	4.56 cfs @	17.29 hrs,	Volume=	8.343 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 567.81' @ 17.29 hrs Surf.Area= 162,847 sf Storage= 273,687 cf

Plug-Flow detention time= 742.6 min calculated for 8.343 af (85% of inflow)
Center-of-Mass det. time= 669.7 min (1,536.2 - 866.5)

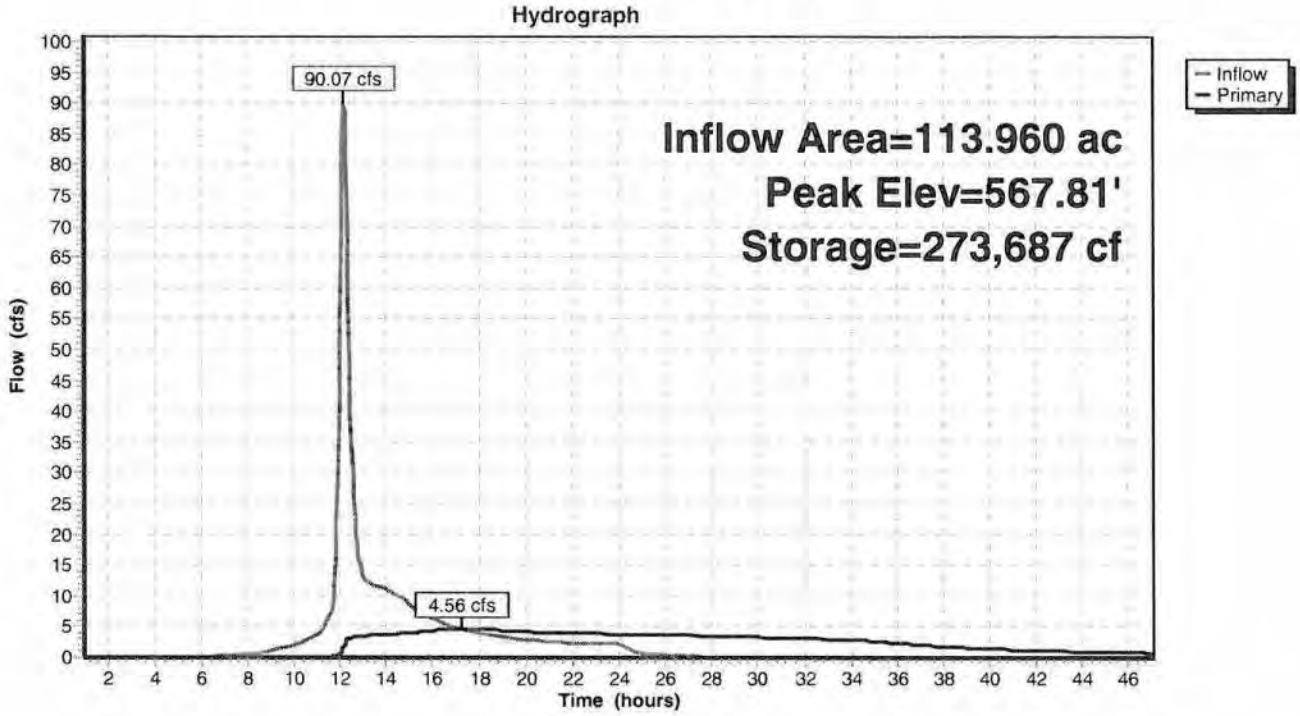
Volume	Invert	Avail.Storage	Storage Description
#1	566.00'	651,210 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
566.00	142,189	0	0
567.00	151,813	147,001	147,001
568.00	165,516	158,665	305,666
569.00	171,536	168,526	474,192
570.00	182,500	177,018	651,210

Device	Routing	Invert	Outlet Devices
#1	Primary	566.00'	**30.0" x 285.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 565.50' S= 0.0018 '/' Cc= 0.900 n= 0.012
#2	Device 1	561.00'	**12.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 564.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	567.70'	**5.00' W x 0.75' H Vert. Orifice/Grate** C= 0.600
#4	Primary	568.30'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.56 cfs @ 17.29 hrs HW=567.81' (Free Discharge)
- **1=Culvert** (Passes 4.56 cfs of 11.19 cfs potential flow)
  - **2=Culvert** (Inlet Controls 4.01 cfs @ 5.11 fps)
  - **3=Orifice/Grate** (Orifice Controls 0.55 cfs @ 1.04 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: North Pond



Pond 3P: Center Pond

Inflow Area =	53.010 ac,	Inflow Depth =	1.41"	for 1-Yr event	
Inflow =	81.64 cfs @	12.12 hrs,	Volume=	6.213 af	
Outflow =	3.38 cfs @	14.80 hrs,	Volume=	5.651 af,	Atten= 96%, Lag= 160.9 min
Primary =	3.38 cfs @	14.80 hrs,	Volume=	5.651 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 576.54' @ 14.80 hrs Surf.Area= 76,654 sf Storage= 177,282 cf

Plug-Flow detention time= 648.0 min calculated for 5.651 af (91% of inflow)
Center-of-Mass det. time= 600.8 min (1,418.9 - 818.1)

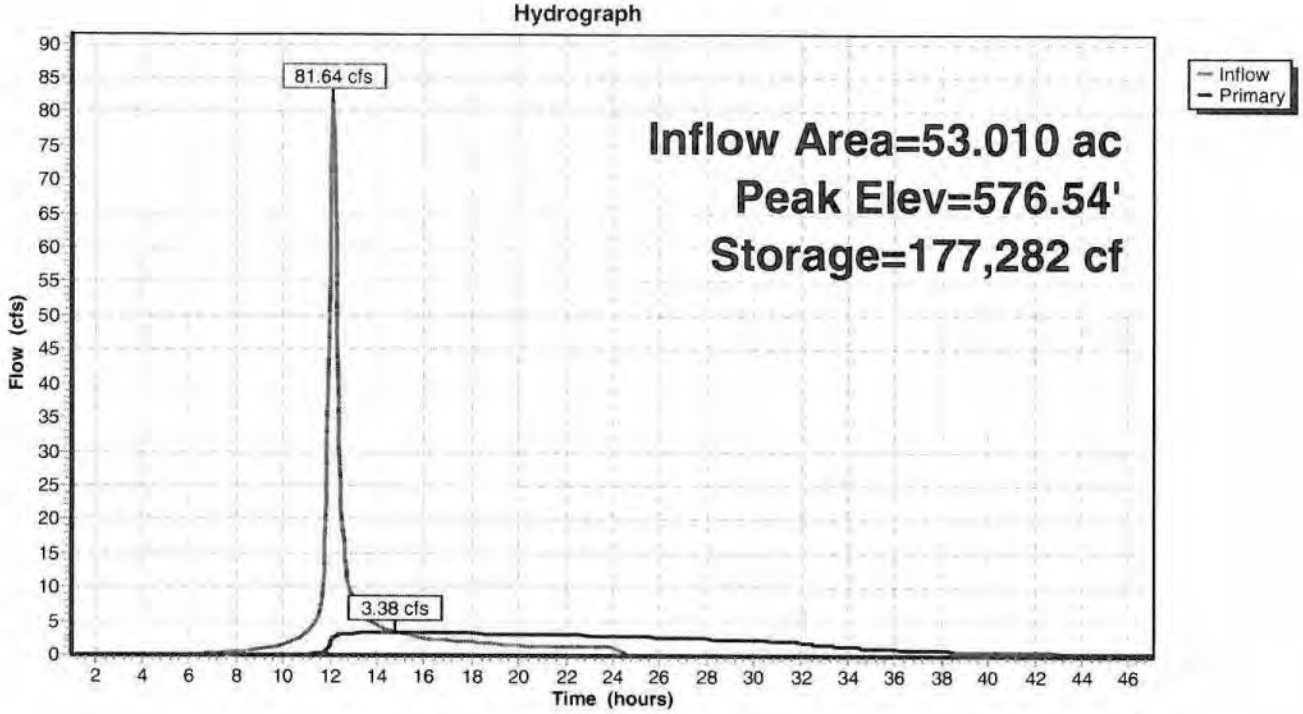
Volume	Invert	Avail.Storage	Storage Description
#1	574.00'	577,210 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
574.00	62,610	0	0
575.00	68,020	65,315	65,315
576.00	73,586	70,803	136,118
577.00	79,282	76,434	212,552
578.00	85,109	82,196	294,748
579.00	91,066	88,088	382,835
580.00	97,155	94,111	476,946
581.00	103,374	100,265	577,210

Device	Routing	Invert	Outlet Devices
#1	Primary	574.00'	**18.0" x 70.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 574.00' S= 0.0000 '/' Cc= 0.900 n= 0.012
#2	Device 1	569.00'	**10.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 572.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	576.50'	**2.70' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	579.00'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=3.37 cfs @ 14.80 hrs HW=576.54' (Free Discharge)
- **1=Culvert** (Passes 3.37 cfs of 8.36 cfs potential flow)
  - **2=Culvert** (Inlet Controls 3.30 cfs @ 6.06 fps)
  - **3=Orifice/Grate** (Orifice Controls 0.07 cfs @ 0.63 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Center Pond



Pond 4P: South Pond

Inflow Area =	14.400 ac,	Inflow Depth =	1.41"	for	1-Yr event
Inflow =	24.35 cfs @	12.09 hrs,	Volume=	1.688 af	
Outflow =	1.06 cfs @	14.18 hrs,	Volume=	1.624 af,	Atten= 96%, Lag= 125.3 min
Primary =	1.06 cfs @	14.18 hrs,	Volume=	1.624 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 584.52' @ 14.18 hrs Surf.Area= 28,340 sf Storage= 46,026 cf

Plug-Flow detention time= 538.2 min calculated for 1.624 af (96% of inflow)
Center-of-Mass det. time= 515.9 min (1,330.9 - 815.1)

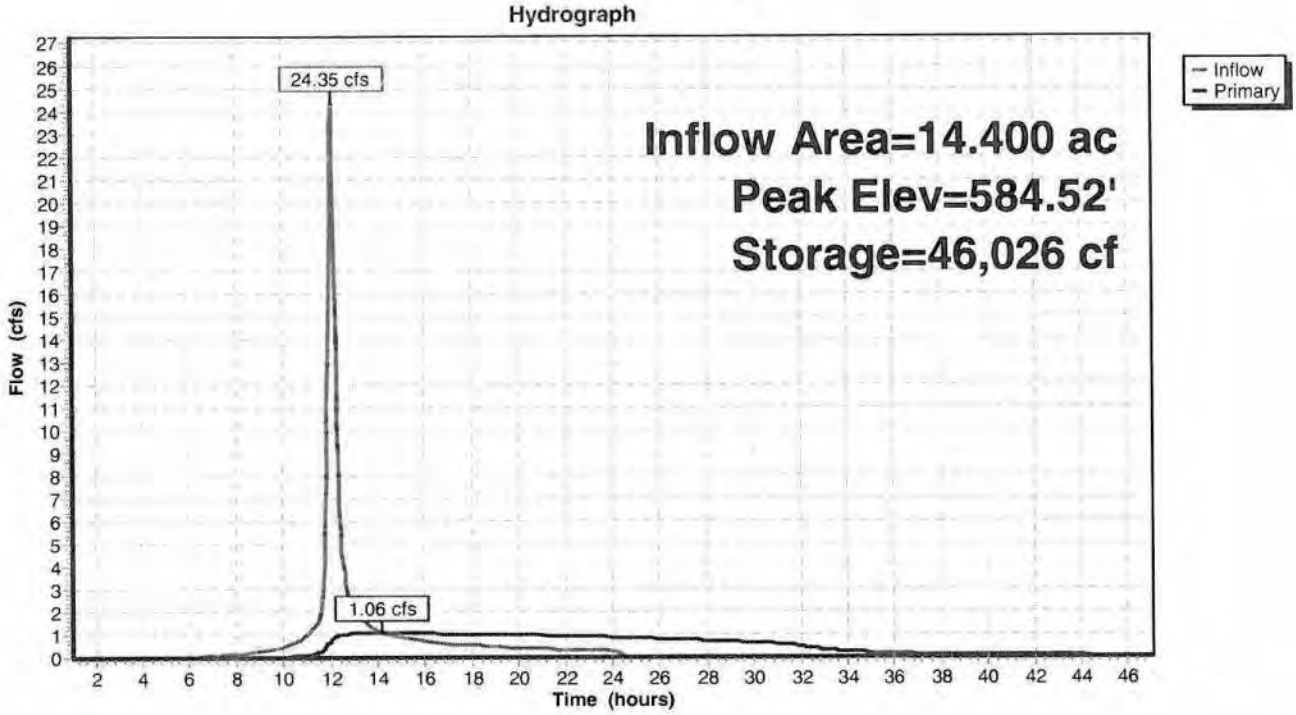
Volume	Invert	Avail.Storage	Storage Description
#1	582.50'	167,557 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
582.50	18,000	0	0
583.30	20,000	15,200	15,200
584.00	26,452	16,258	31,458
585.00	30,118	28,285	59,743
586.00	33,922	32,020	91,763
587.00	37,863	35,893	127,656
588.00	41,939	39,901	167,557

Device	Routing	Invert	Outlet Devices
#1	Primary	582.50'	**15.0" x 52.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 582.50' S= 0.0000 '/' Cc= 0.900 n= 0.011
#2	Device 1	579.00'	**6.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 580.50' S= -0.0750 '/' Cc= 0.900 n= 0.012
#3	Device 1	584.53'	**1.75' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	586.75'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=1.06 cfs @ 14.18 hrs HW=584.52' (Free Discharge)
- **1=Culvert** (Passes 1.06 cfs of 5.60 cfs potential flow)
  - **2=Culvert** (Inlet Controls 1.06 cfs @ 5.40 fps)
  - **3=Orifice/Grate** (Controls 0.00 cfs)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: South Pond

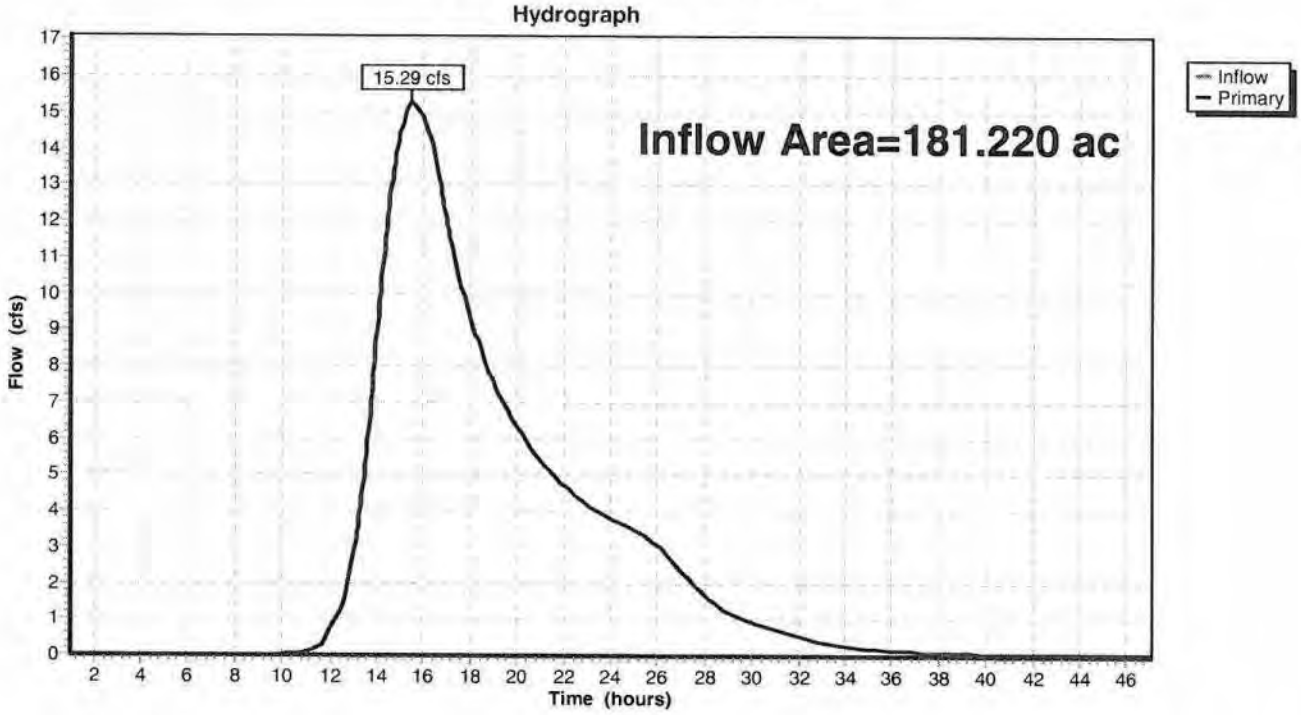


Pond 5P: South Discharge

Inflow Area = 181.220 ac, Inflow Depth > 0.61" for 1-Yr event
Inflow = 15.29 cfs @ 15.46 hrs, Volume= 9.152 af
Primary = 15.29 cfs @ 15.46 hrs, Volume= 9.152 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 5P: South Discharge



Subcatchment 1A: Undeveloped Area to West

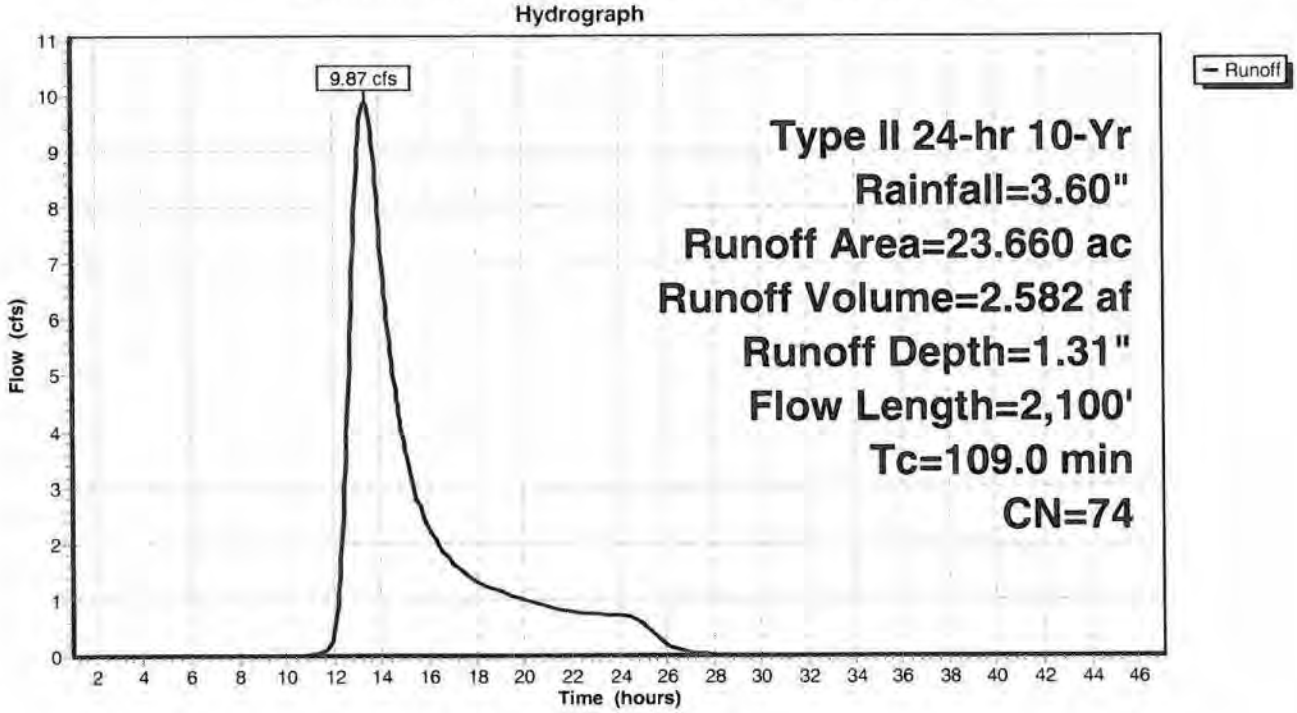
Runoff = 9.87 cfs @ 13.36 hrs, Volume= 2.582 af, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
7.670	77	Woods, Good, HSG D
15.990	73	Brush, Good, HSG D
23.660	74	Weighted Average
23.660		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope** Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field** Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: Undeveloped Area to West



Subcatchment 1B: Undeveloped Woods & Res. to West

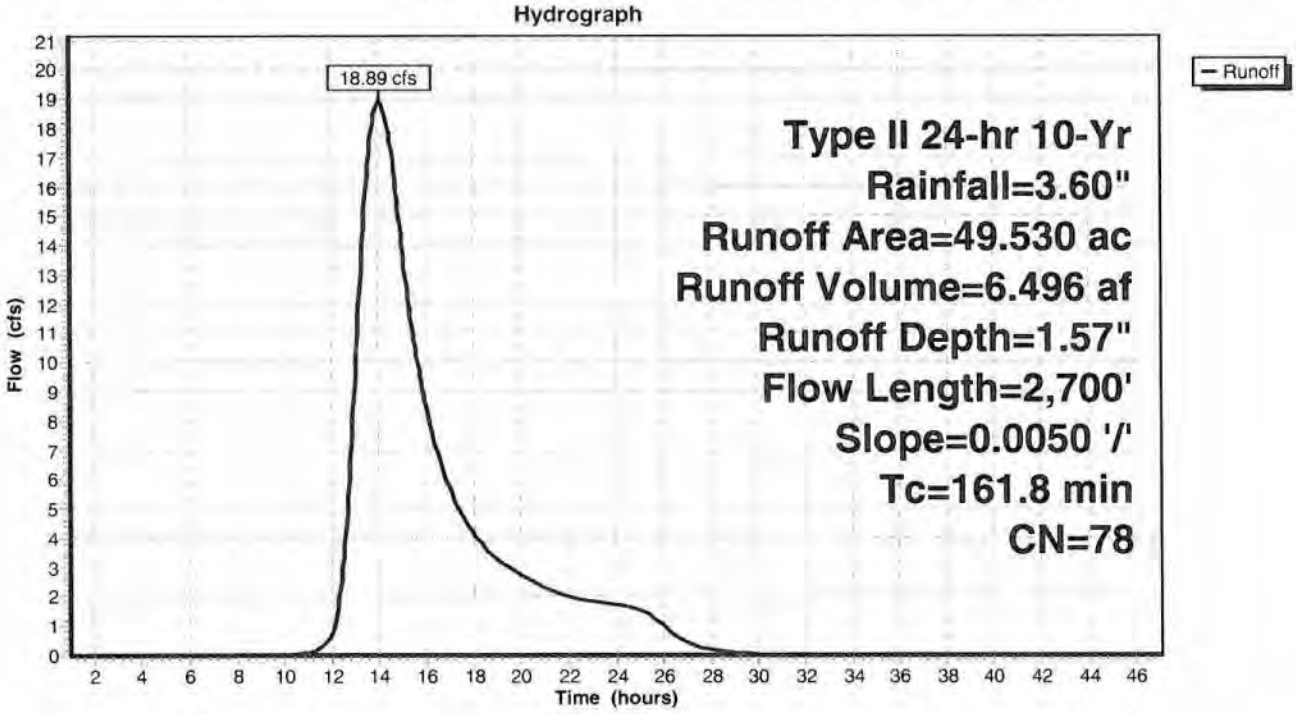
Runoff = 18.89 cfs @ 14.04 hrs, Volume= 6.496 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
44.530	77	Woods, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
49.530	78	Weighted Average
48.530		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
84.9	1,800	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
3.3	800		4.00		**Direct Entry, Pipe Flow**
161.8	2,700	Total			

Subcatchment 1B: Undeveloped Woods & Res. to West



Subcatchment 1C: New Development

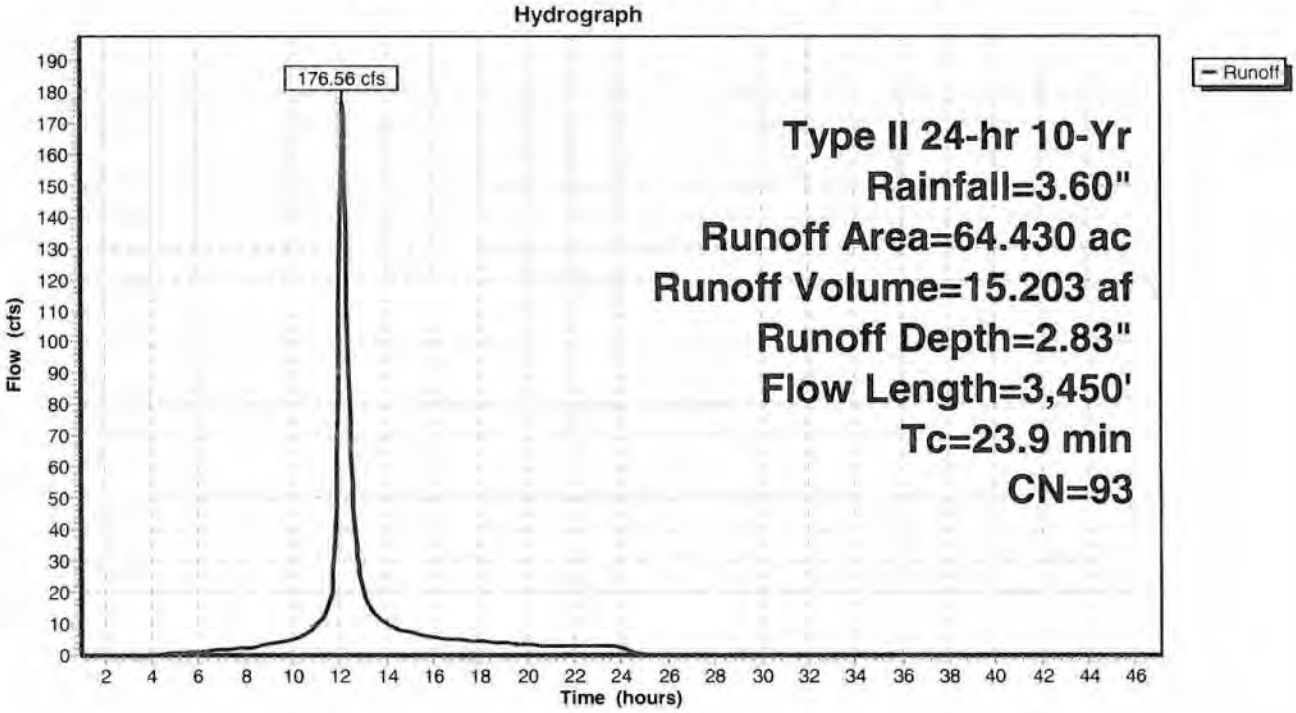
Runoff = 176.56 cfs @ 12.16 hrs, Volume= 15.203 af, Depth= 2.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
64.430	93	Urban industrial, 72% imp, HSG D
18.040		Pervious Area
46.390		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
13.8	3,300		4.00		**Direct Entry, Pipe Flow**
23.9	3,450	Total			

Subcatchment 1C: New Development



Subcatchment 2A: Upstream Off-Site

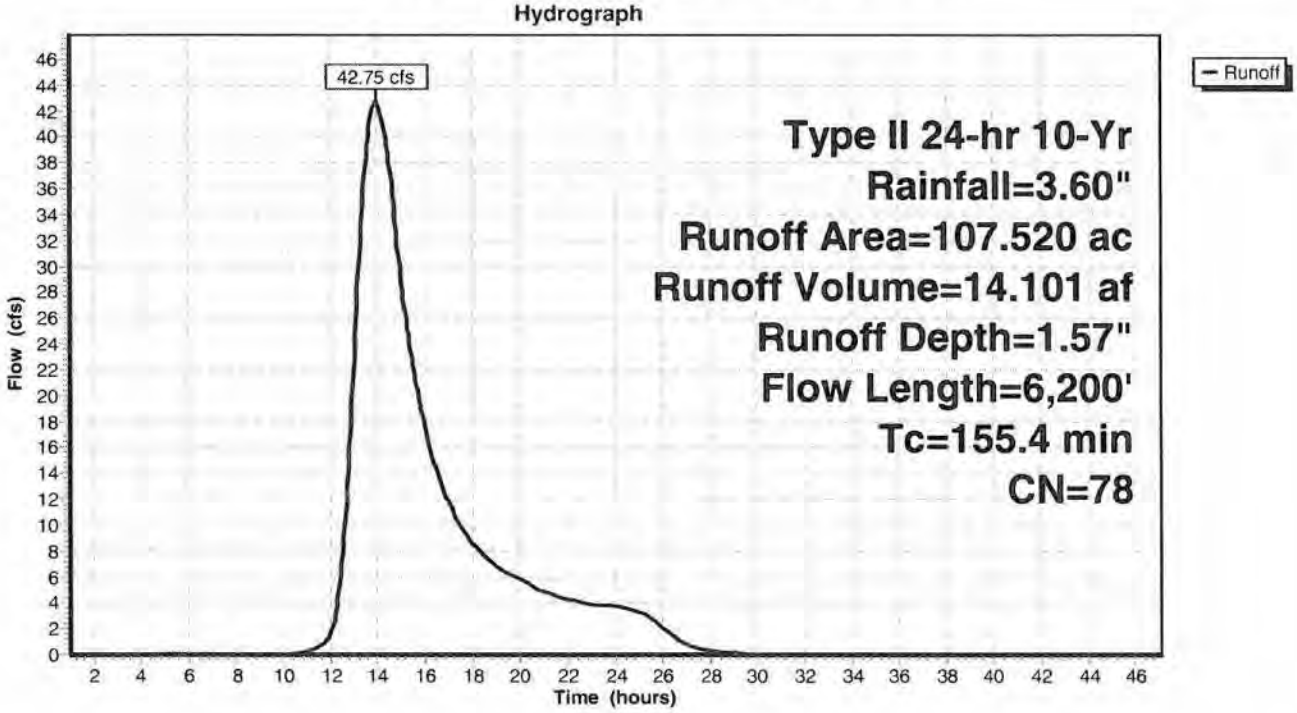
Runoff = 42.75 cfs @ 13.98 hrs, Volume= 14.101 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
94.520	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
107.520	78	Weighted Average
104.920		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2A: Upstream Off-Site



Subcatchment 2B: New Development

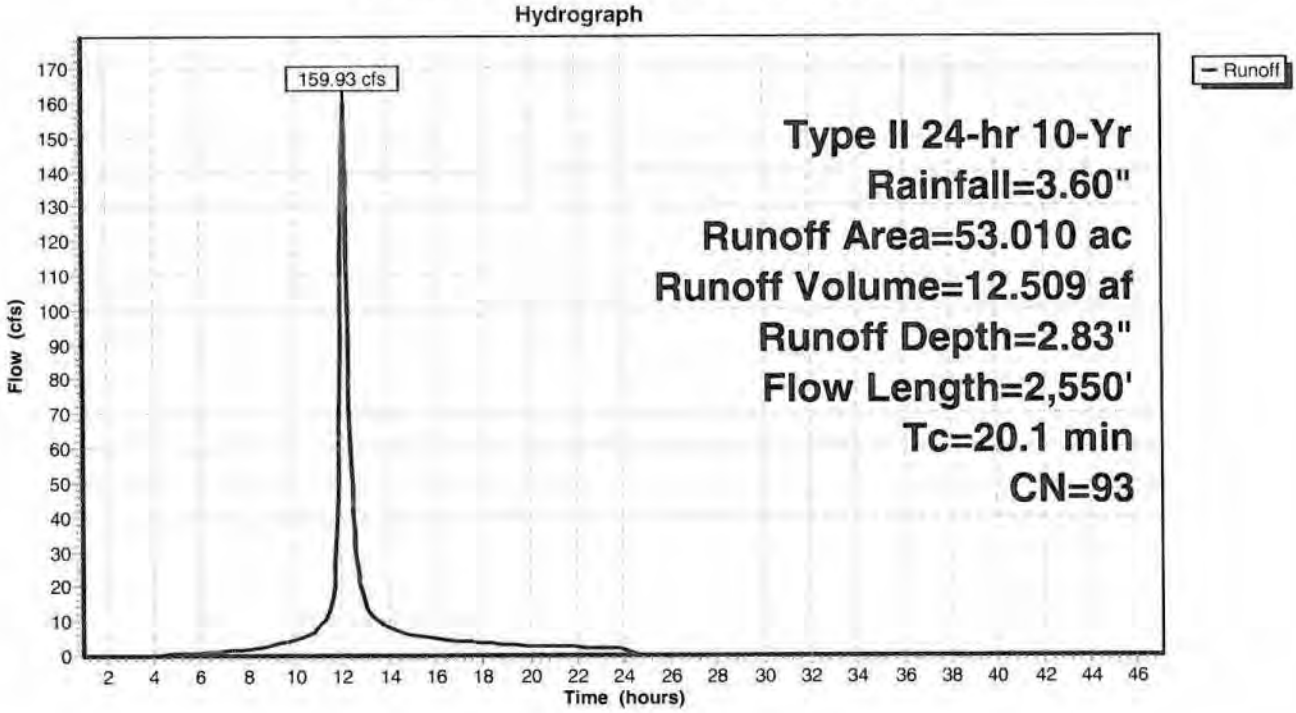
Runoff = 159.93 cfs @ 12.12 hrs, Volume= 12.509 af, Depth= 2.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
53.010	93	Urban industrial, 72% imp, HSG D
14.843		Pervious Area
38.167		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
10.0	2,400		4.00		**Direct Entry, Pipe Flow**
20.1	2,550	Total			

Subcatchment 2B: New Development



Subcatchment 3A:

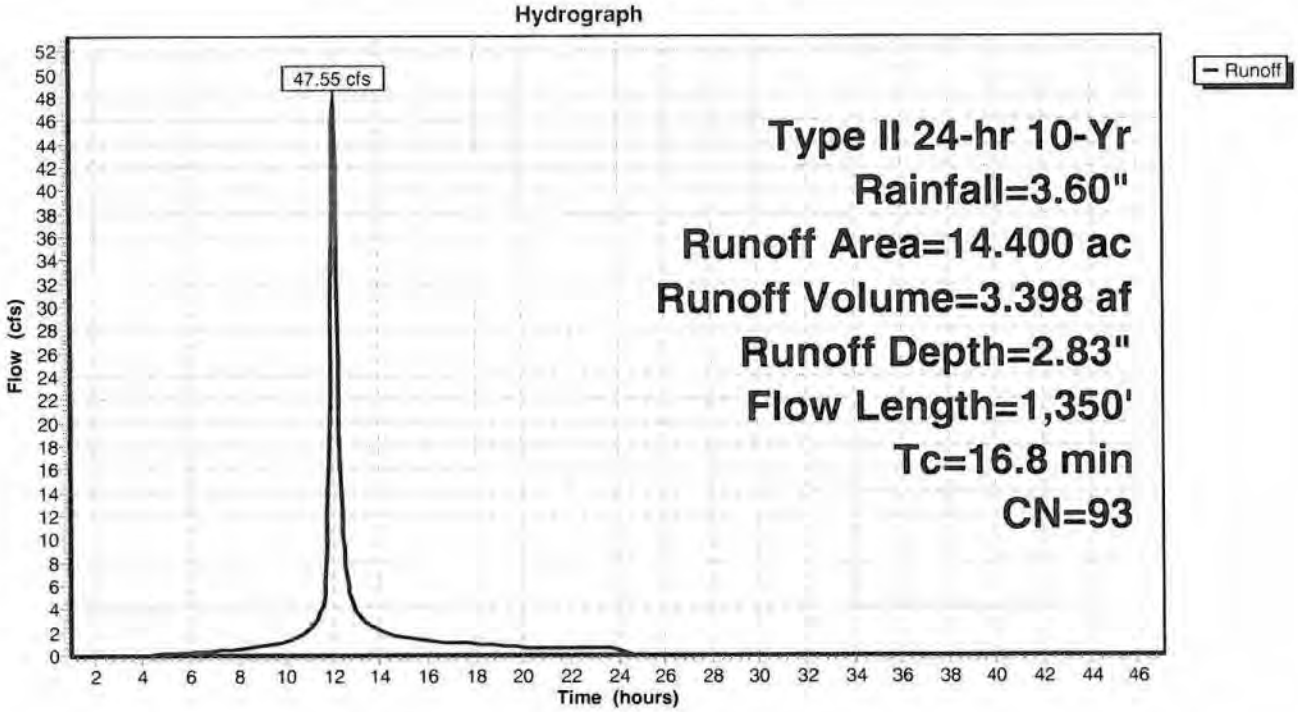
Runoff = 47.55 cfs @ 12.08 hrs, Volume= 3.398 af, Depth= 2.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
14.400	93	Urban industrial, 72% imp, HSG D
4.032		Pervious Area
10.368		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Woods** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
6.7	1,200		3.00		**Direct Entry, Pipe Flow**
16.8	1,350	Total			

Subcatchment 3A:



Subcatchment 3B:

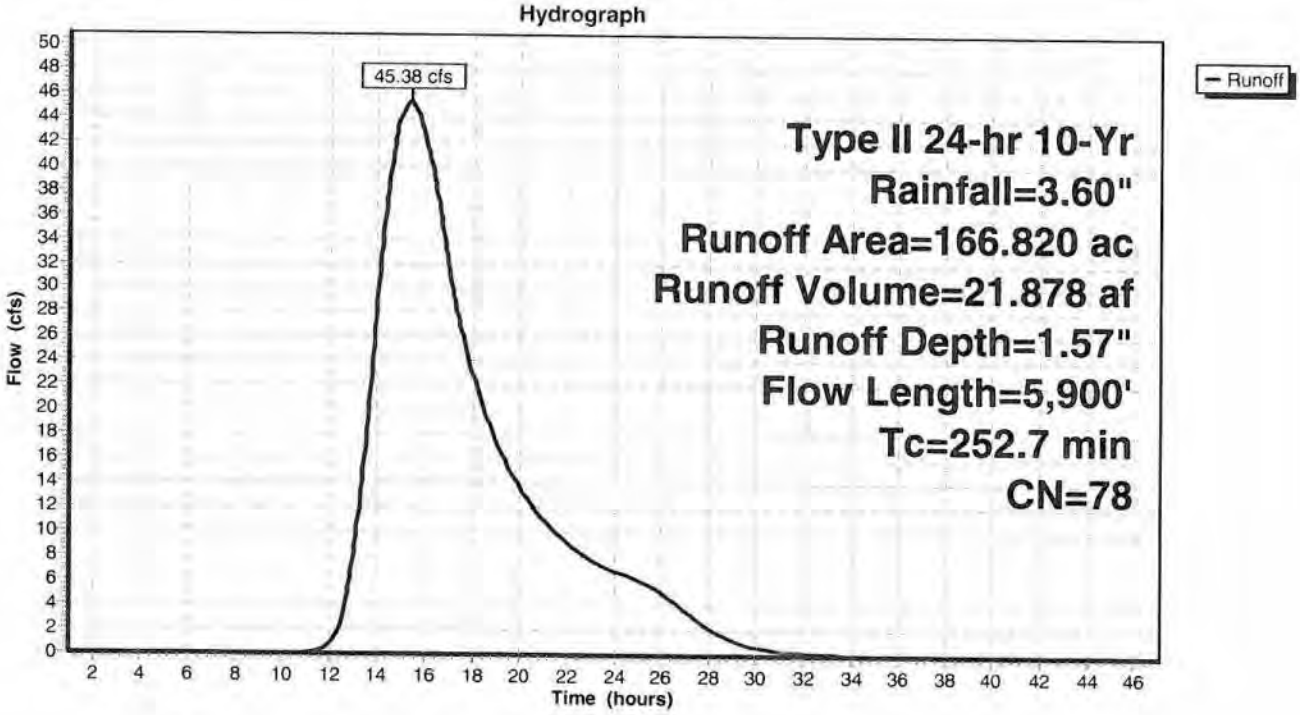
Runoff = 45.38 cfs @ 15.43 hrs, Volume= 21.878 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B:

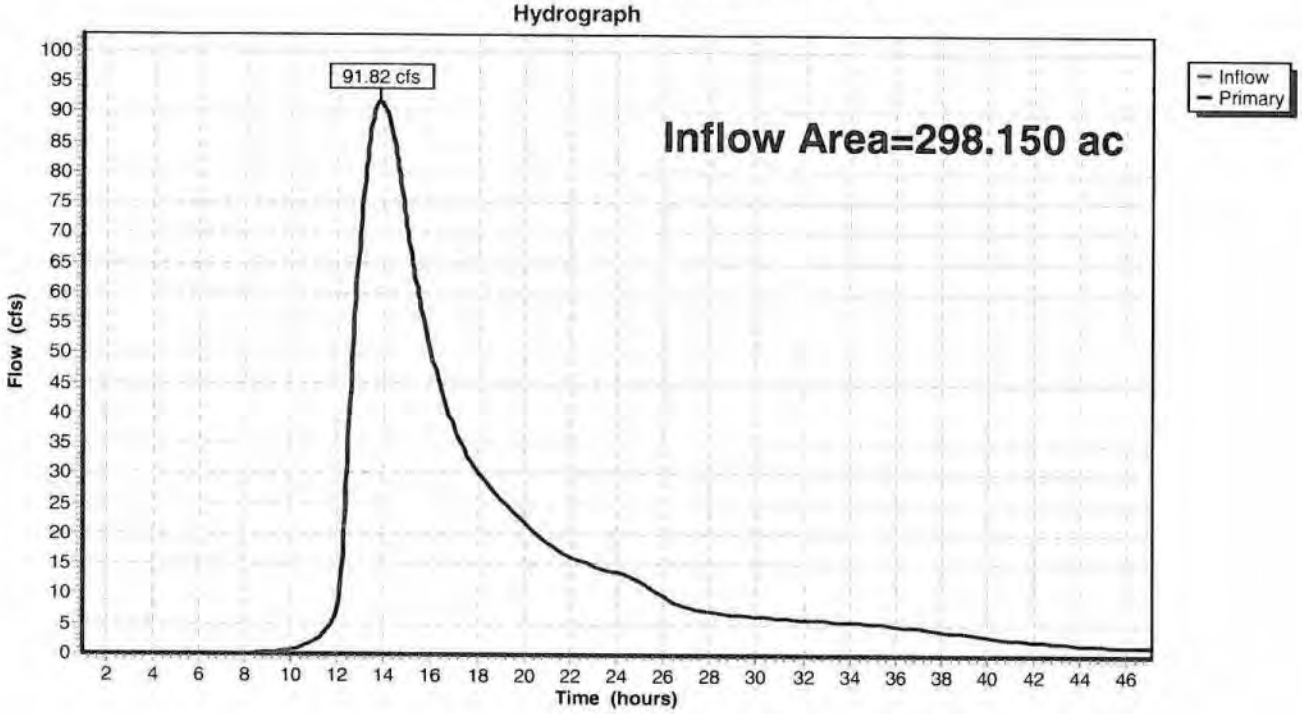


Pond 1P: Long Road Discharge

Inflow Area =	298.150 ac,	Inflow Depth >	1.95"	for	10-Yr event	
Inflow =	91.82 cfs @	13.82 hrs,	Volume=		48.540 af	
Primary =	91.82 cfs @	13.82 hrs,	Volume=		48.540 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road Discharge



Pond 2P: North Pond

Inflow Area =	113.960 ac,	Inflow Depth =	2.28"	for	10-Yr event
Inflow =	177.79 cfs @	12.16 hrs,	Volume=	21.699 af	
Outflow =	28.84 cfs @	14.00 hrs,	Volume=	20.018 af,	Atten= 84%, Lag= 110.1 min
Primary =	28.84 cfs @	14.00 hrs,	Volume=	20.018 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 568.61' @ 14.00 hrs Surf.Area= 169,204 sf Storage= 408,207 cf

Plug-Flow detention time= 440.7 min calculated for 19.996 af (92% of inflow)
Center-of-Mass det. time= 398.0 min (1,254.7 - 856.7)

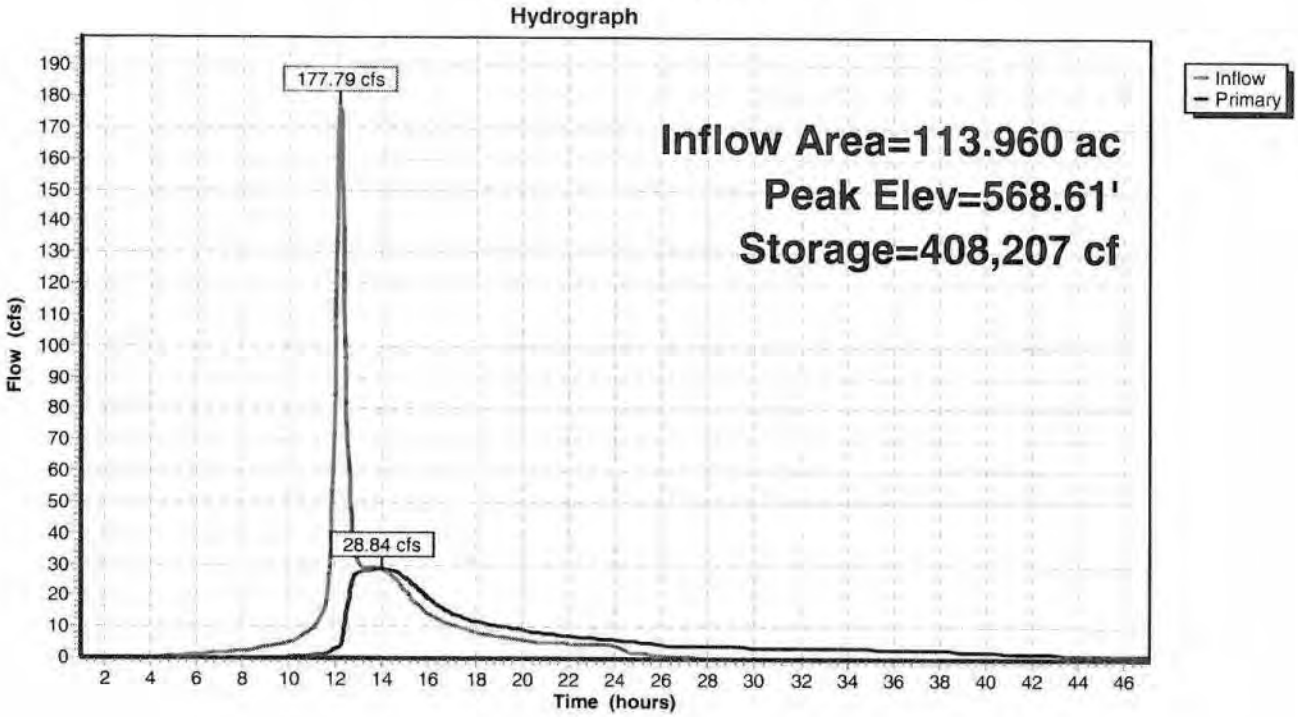
Volume	Invert	Avail.Storage	Storage Description
#1	566.00'	651,210 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
566.00	142,189	0	0
567.00	151,813	147,001	147,001
568.00	165,516	158,665	305,666
569.00	171,536	168,526	474,192
570.00	182,500	177,018	651,210

Device	Routing	Invert	Outlet Devices
#1	Primary	566.00'	**30.0" x 285.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 565.50' S= 0.0018 '/' Cc= 0.900 n= 0.012
#2	Device 1	561.00'	**12.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 564.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	567.70'	**5.00' W x 0.75' H Vert. Orifice/Grate** C= 0.600
#4	Primary	568.30'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=28.82 cfs @ 14.00 hrs HW=568.61' (Free Discharge)
- **1=Culvert** (Passes 17.77 cfs of 19.78 cfs potential flow)
  - **2=Culvert** (Inlet Controls 4.83 cfs @ 6.14 fps)
  - **3=Orifice/Grate** (Orifice Controls 12.94 cfs @ 3.45 fps)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 11.06 cfs @ 1.41 fps)

Pond 2P: North Pond



Pond 3P: Center Pond

Inflow Area =	53.010 ac,	Inflow Depth =	2.83"	for	10-Yr event
Inflow =	159.93 cfs @	12.12 hrs,	Volume=	12.509 af	
Outflow =	12.70 cfs @	13.16 hrs,	Volume=	11.839 af,	Atten= 92%, Lag= 62.6 min
Primary =	12.70 cfs @	13.16 hrs,	Volume=	11.839 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 578.40' @ 13.16 hrs Surf.Area= 87,509 sf Storage= 330,241 cf

Plug-Flow detention time= 495.7 min calculated for 11.839 af (95% of inflow)
Center-of-Mass det. time= 464.8 min (1,263.3 - 798.5)

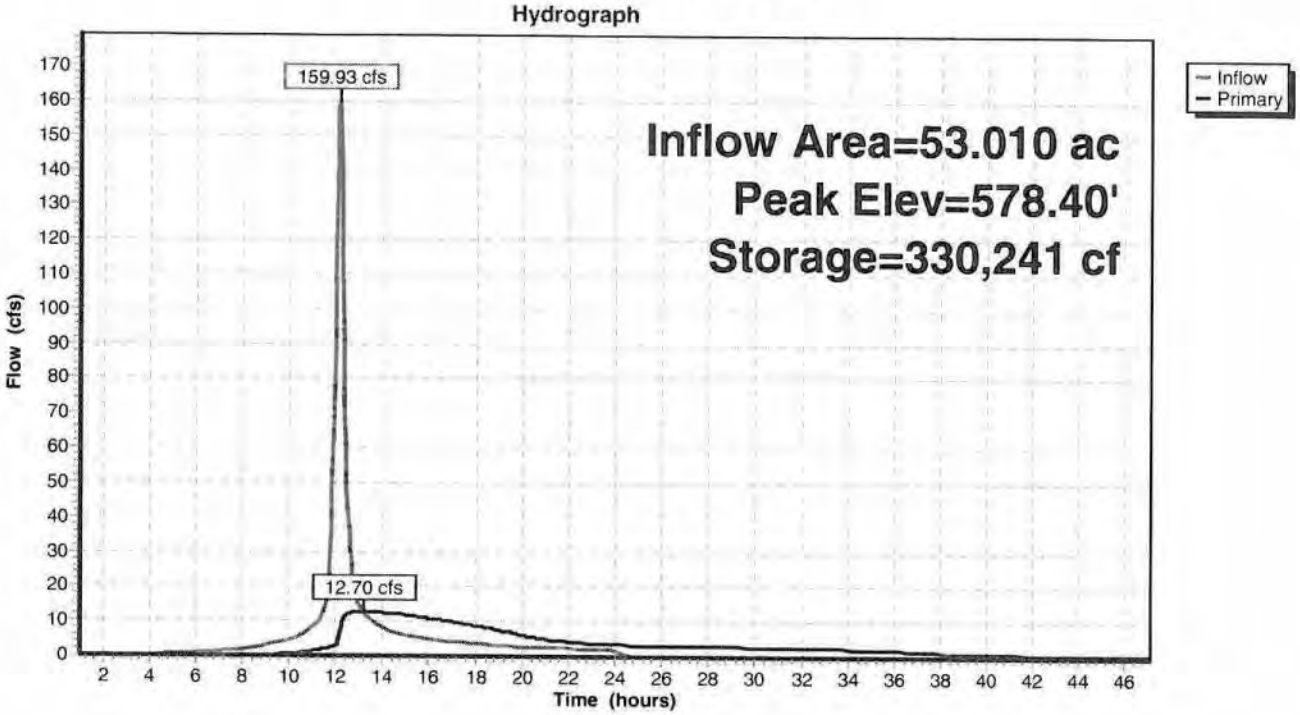
Volume	Invert	Avail.Storage	Storage Description
#1	574.00'	577,210 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
574.00	62,610	0	0
575.00	68,020	65,315	65,315
576.00	73,586	70,803	136,118
577.00	79,282	76,434	212,552
578.00	85,109	82,196	294,748
579.00	91,066	88,088	382,835
580.00	97,155	94,111	476,946
581.00	103,374	100,265	577,210

Device	Routing	Invert	Outlet Devices
#1	Primary	574.00'	**18.0" x 70.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 574.00' S= 0.0000 '/' Cc= 0.900 n= 0.012
#2	Device 1	569.00'	**10.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 572.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	576.50'	**2.70' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	579.00'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=12.70 cfs @ 13.16 hrs HW=578.40' (Free Discharge)
- **1=Culvert** (Passes 12.70 cfs of 12.84 cfs potential flow)
  - **2=Culvert** (Inlet Controls 4.35 cfs @ 7.98 fps)
  - **3=Orifice/Grate** (Orifice Controls 8.35 cfs @ 6.18 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Center Pond



Pond 4P: South Pond

Inflow Area =	14.400 ac,	Inflow Depth =	2.83"	for	10-Yr event
Inflow =	47.55 cfs @	12.08 hrs,	Volume=	3.398 af	
Outflow =	5.38 cfs @	12.71 hrs,	Volume=	3.323 af,	Atten= 89%, Lag= 37.4 min
Primary =	5.38 cfs @	12.71 hrs,	Volume=	3.323 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 585.71' @ 12.71 hrs Surf.Area= 32,815 sf Storage= 82,445 cf

Plug-Flow detention time= 402.6 min calculated for 3.323 af (98% of inflow)
Center-of-Mass det. time= 388.9 min (1,184.3 - 795.4)

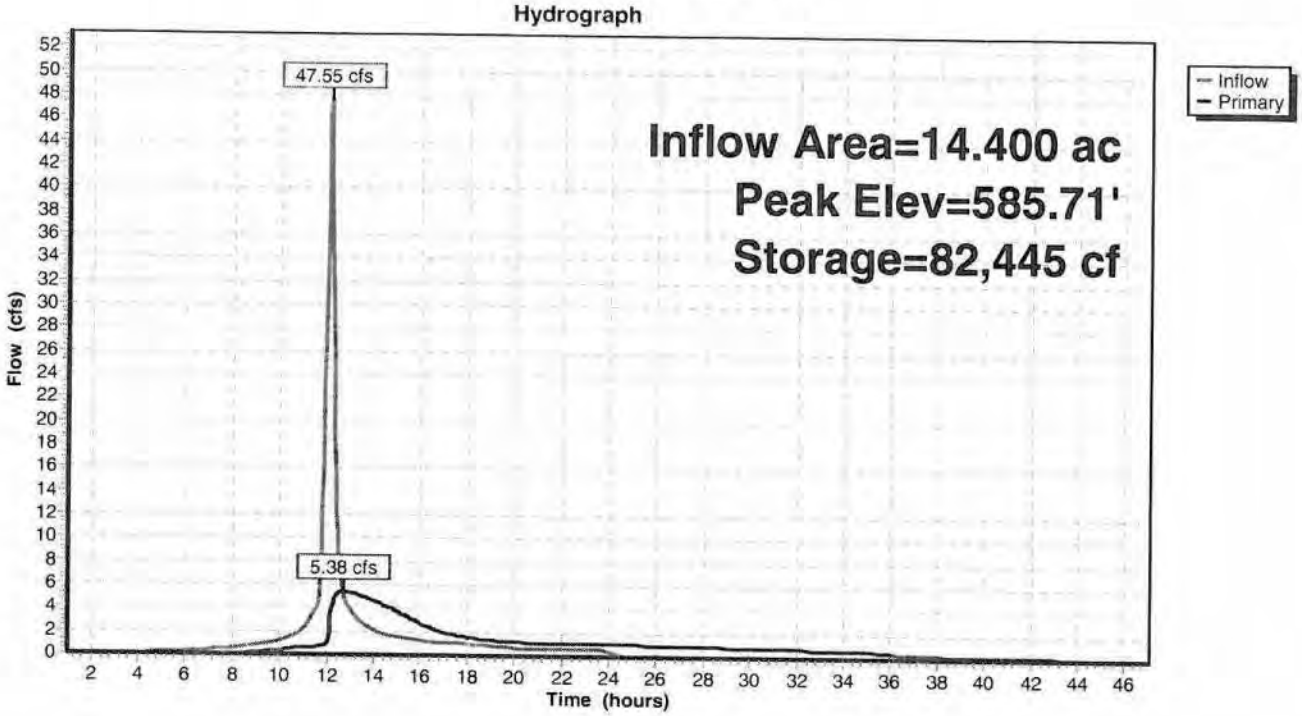
Volume	Invert	Avail.Storage	Storage Description
#1	582.50'	167,557 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
582.50	18,000	0	0
583.30	20,000	15,200	15,200
584.00	26,452	16,258	31,458
585.00	30,118	28,285	59,743
586.00	33,922	32,020	91,763
587.00	37,863	35,893	127,656
588.00	41,939	39,901	167,557

Device	Routing	Invert	Outlet Devices
#1	Primary	582.50'	**15.0" x 52.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 582.50' S= 0.0000 '/' Cc= 0.900 n= 0.011
#2	Device 1	579.00'	**6.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 580.50' S= -0.0750 '/' Cc= 0.900 n= 0.012
#3	Device 1	584.53'	**1.75' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	586.75'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.38 cfs @ 12.71 hrs HW=585.71' (Free Discharge)
- **1=Culvert** (Passes 5.38 cfs of 8.96 cfs potential flow)
  - **2=Culvert** (Inlet Controls 1.34 cfs @ 6.81 fps)
  - **3=Orifice/Grate** (Orifice Controls 4.05 cfs @ 4.63 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: South Pond

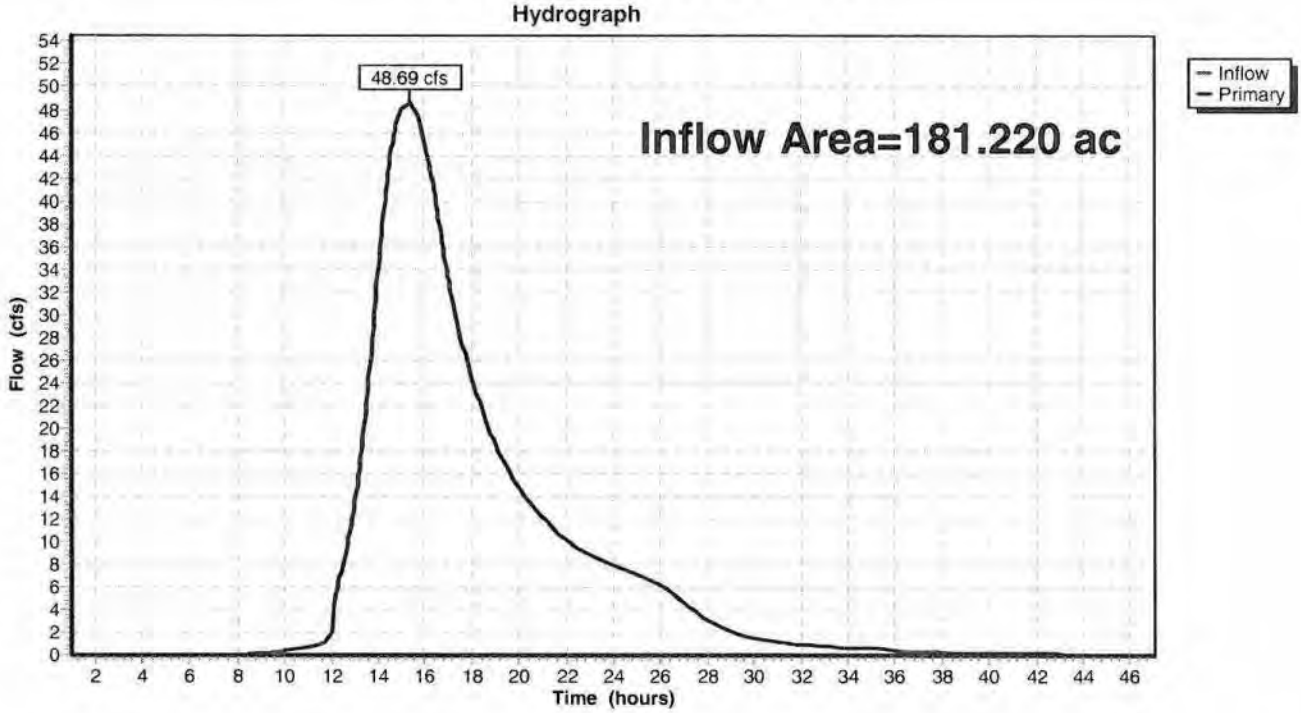


Pond 5P: South Discharge

Inflow Area =	181.220 ac,	Inflow Depth >	1.67"	for	10-Yr event
Inflow =	48.69 cfs @	15.40 hrs,	Volume=	25.201 af	
Primary =	48.69 cfs @	15.40 hrs,	Volume=	25.201 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 5P: South Discharge



Subcatchment 1A: Undeveloped Area to West

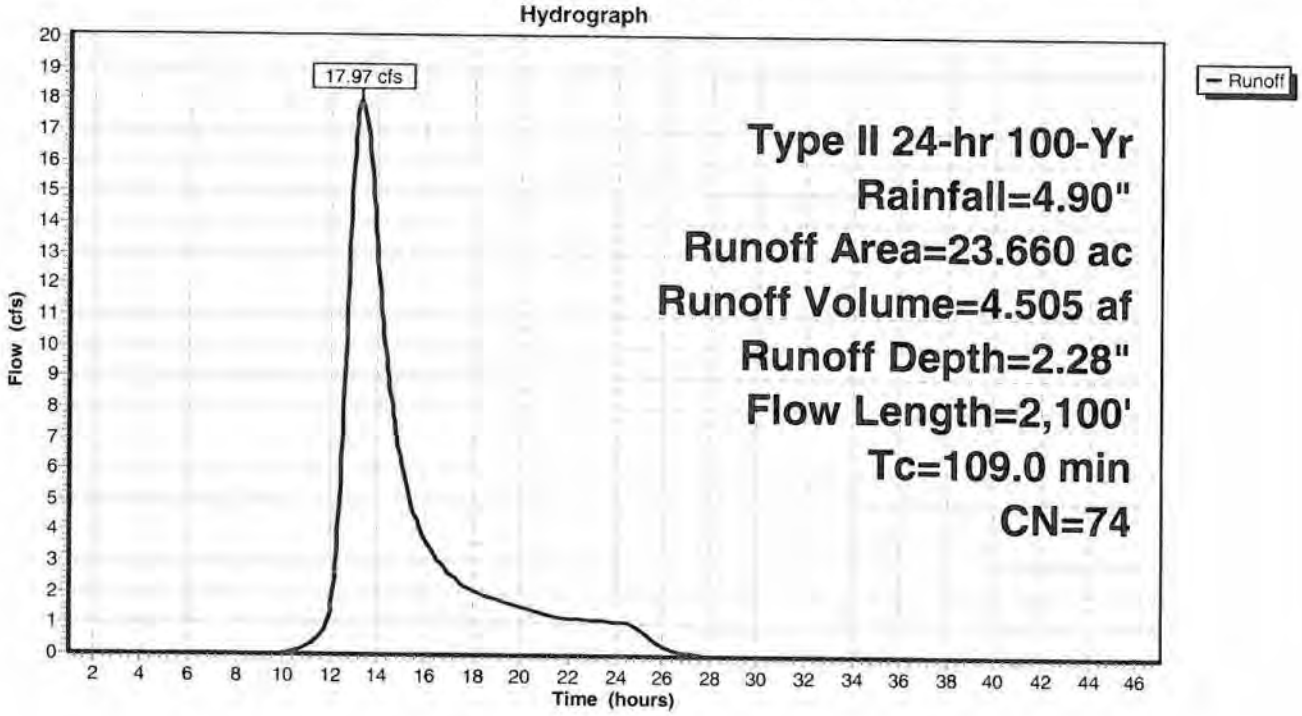
Runoff = 17.97 cfs @ 13.30 hrs, Volume= 4.505 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
7.670	77	Woods, Good, HSG D
15.990	73	Brush, Good, HSG D
23.660	74	Weighted Average
23.660		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope** Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field** Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: Undeveloped Area to West



Subcatchment 1B: Undeveloped Woods & Res. to West

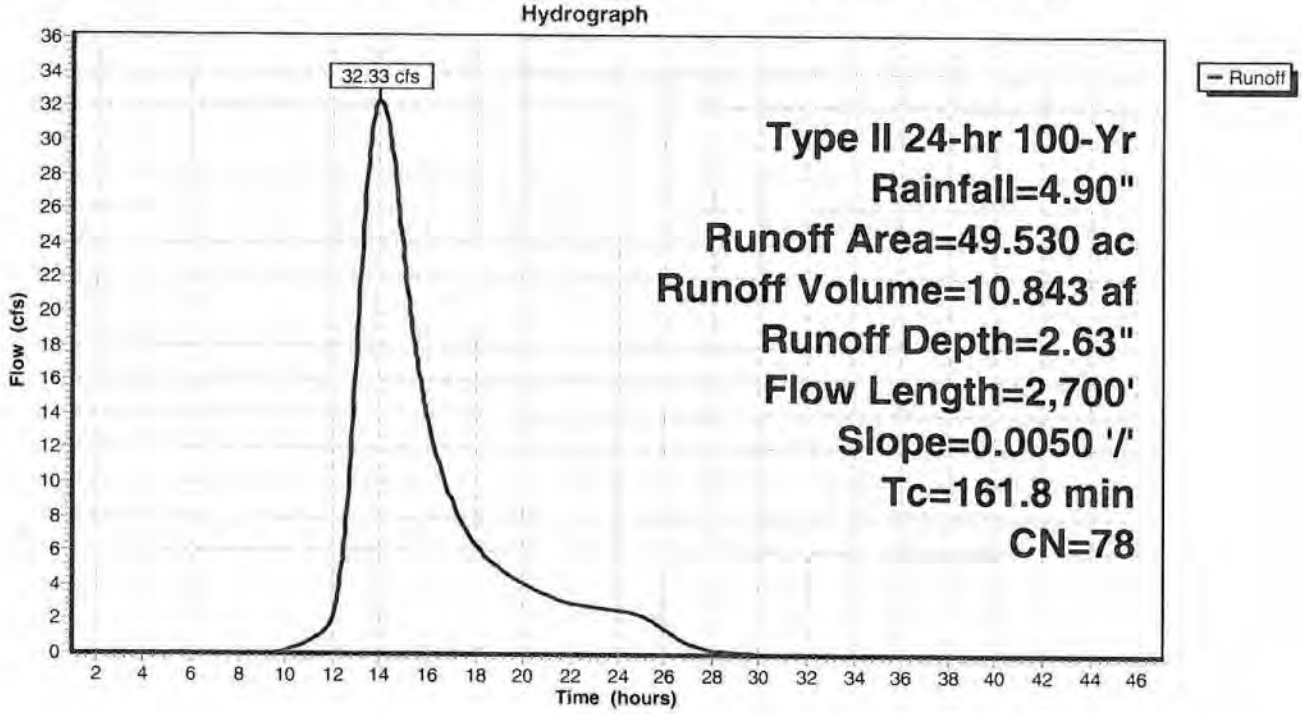
Runoff = 32.33 cfs @ 14.00 hrs, Volume= 10.843 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
44.530	77	Woods, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
49.530	78	Weighted Average
48.530		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
84.9	1,800	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
3.3	800		4.00		**Direct Entry, Pipe Flow**
161.8	2,700	Total			

Subcatchment 1B: Undeveloped Woods & Res. to West



Subcatchment 1C: New Development

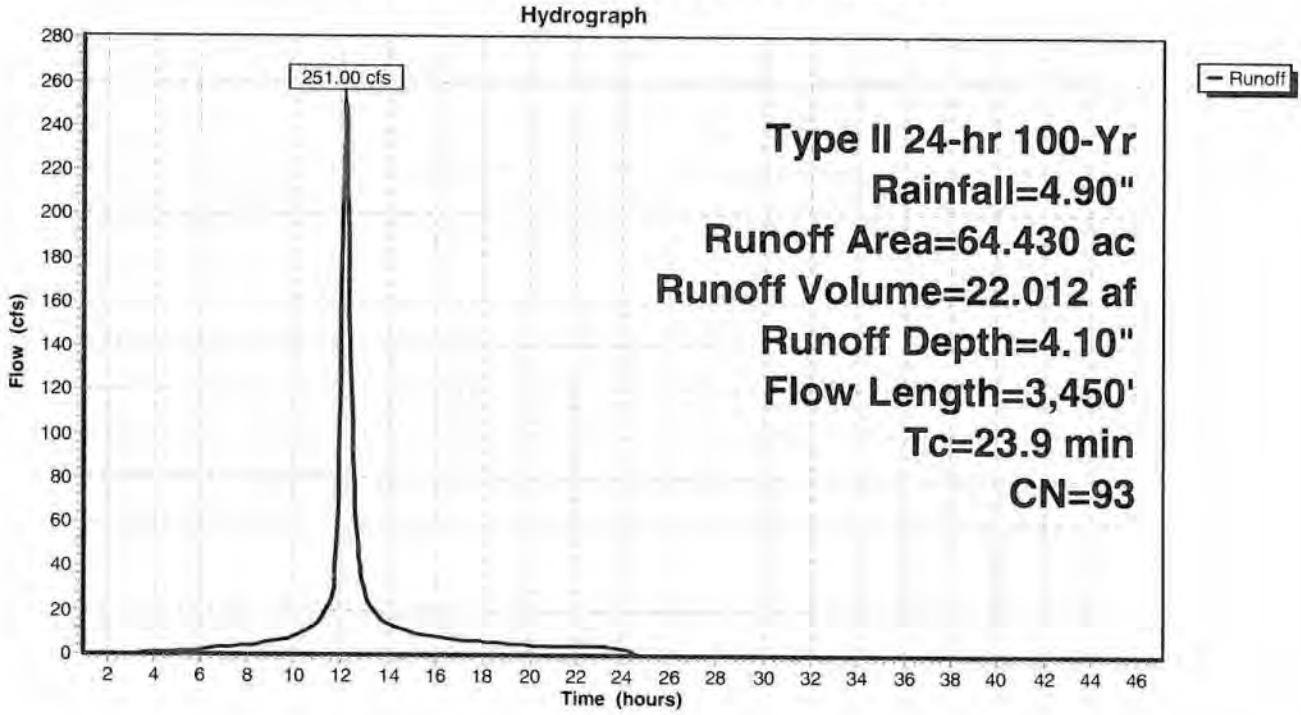
Runoff = 251.00 cfs @ 12.16 hrs, Volume= 22.012 af, Depth= 4.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
64.430	93	Urban industrial, 72% imp, HSG D
18.040		Pervious Area
46.390		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass**
					Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement**
					Paved Kv= 20.3 fps
13.8	3,300		4.00		**Direct Entry, Pipe Flow**
23.9	3,450	Total			

Subcatchment 1C: New Development



Subcatchment 2A: Upstream Off-Site

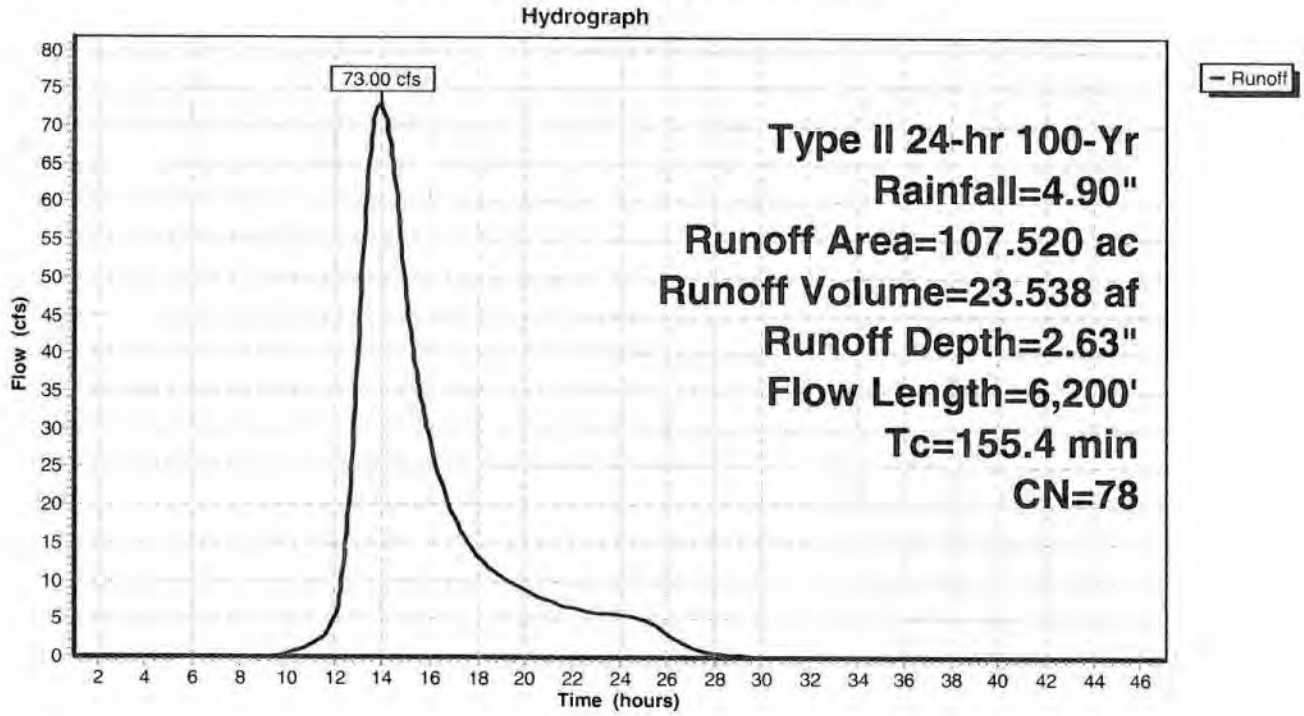
Runoff = 73.00 cfs @ 13.96 hrs, Volume= 23.538 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
94.520	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
107.520	78	Weighted Average
104.920		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2A: Upstream Off-Site



Subcatchment 2B: New Development

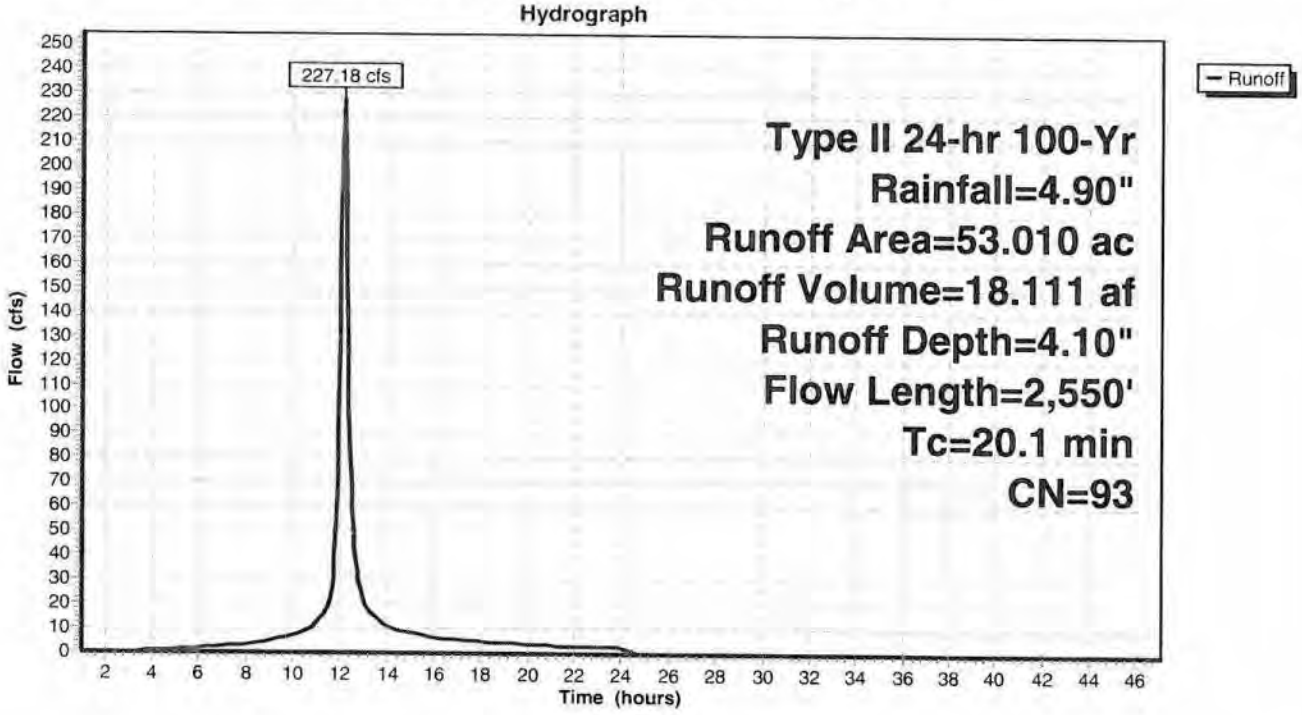
Runoff = 227.18 cfs @ 12.12 hrs, Volume= 18.111 af, Depth= 4.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
53.010	93	Urban industrial, 72% imp, HSG D
14.843		Pervious Area
38.167		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass**
					Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement**
					Paved Kv= 20.3 fps
10.0	2,400		4.00		**Direct Entry, Pipe Flow**
20.1	2,550	Total			

Subcatchment 2B: New Development



Subcatchment 3A:

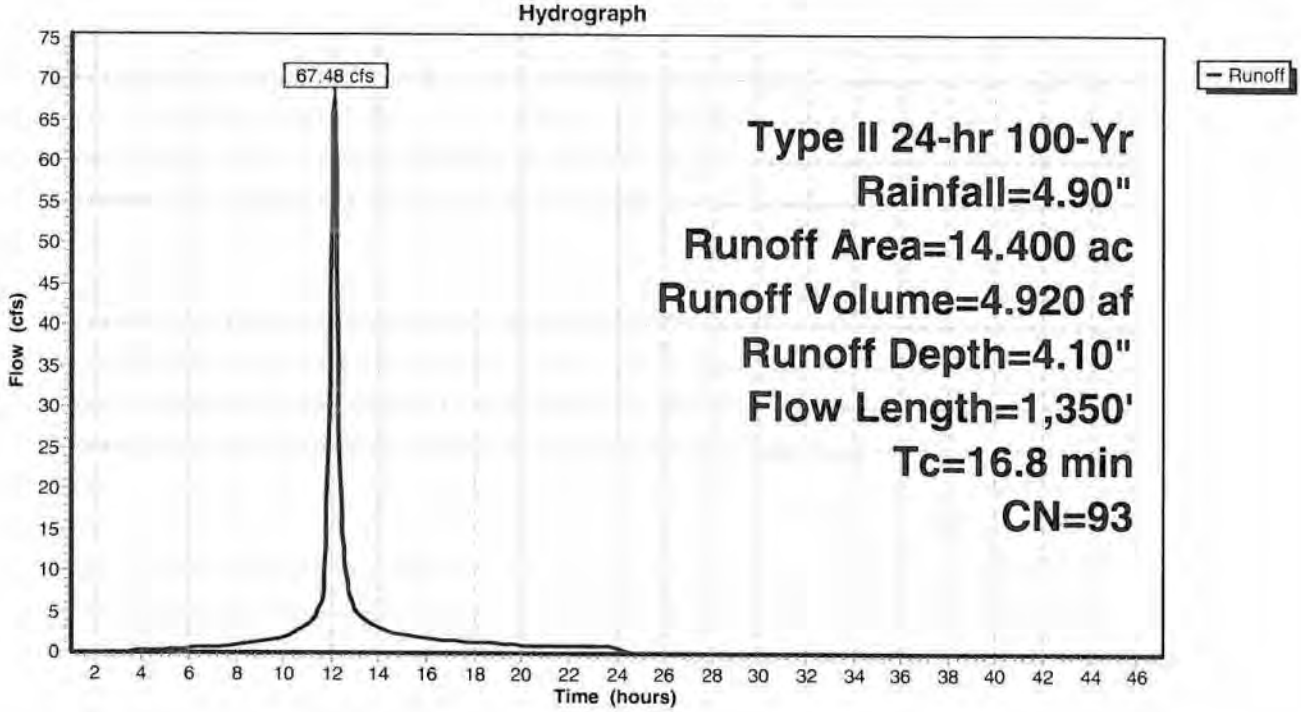
Runoff = 67.48 cfs @ 12.08 hrs, Volume= 4.920 af, Depth= 4.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
14.400	93	Urban industrial, 72% imp, HSG D
4.032		Pervious Area
10.368		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Woods** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
6.7	1,200		3.00		**Direct Entry, Pipe Flow**
16.8	1,350	Total			

Subcatchment 3A:



Subcatchment 3B:

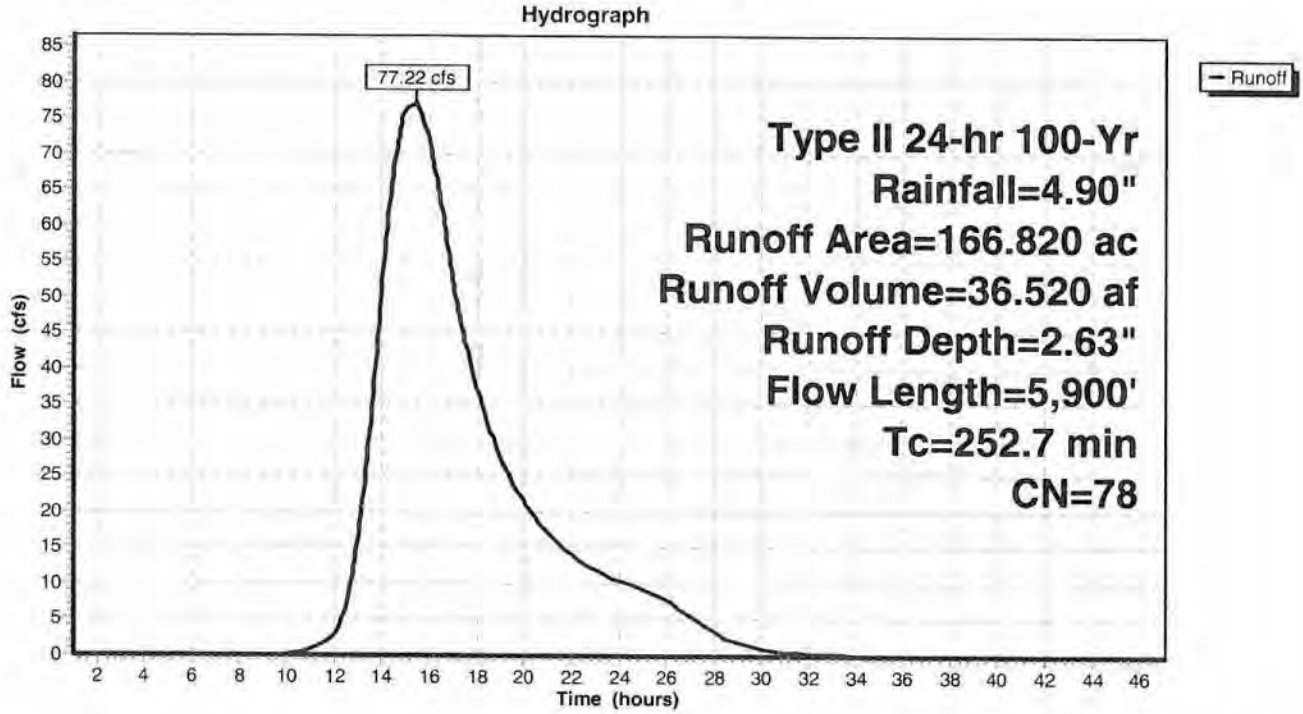
Runoff = 77.22 cfs @ 15.39 hrs, Volume= 36.520 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B:

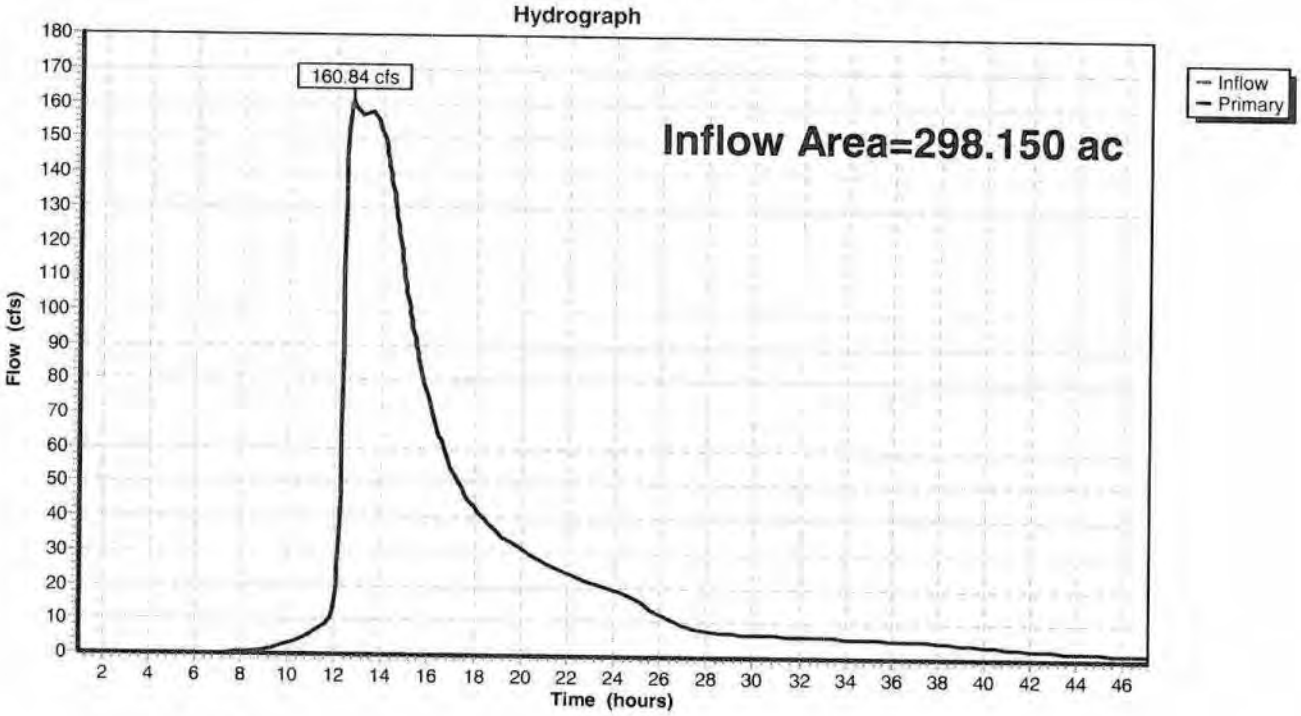


Pond 1P: Long Road Discharge

Inflow Area = 298.150 ac, Inflow Depth > 3.08" for 100-Yr event
Inflow = 160.84 cfs @ 12.66 hrs, Volume= 76.525 af
Primary = 160.84 cfs @ 12.66 hrs, Volume= 76.525 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road Discharge



Pond 2P: North Pond

Inflow Area = 113.960 ac, Inflow Depth = 3.46" for 100-Yr event
Inflow = 254.21 cfs @ 12.16 hrs, Volume= 32.855 af
Outflow = 81.70 cfs @ 12.57 hrs, Volume= 31.085 af, Atten= 68%, Lag= 24.3 min
Primary = 81.70 cfs @ 12.57 hrs, Volume= 31.085 af

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 569.20' @ 12.57 hrs Surf.Area= 173,772 sf Storage= 509,400 cf

Plug-Flow detention time= 319.7 min calculated for 31.085 af (95% of inflow)
Center-of-Mass det. time= 287.2 min (1,138.0 - 850.7)

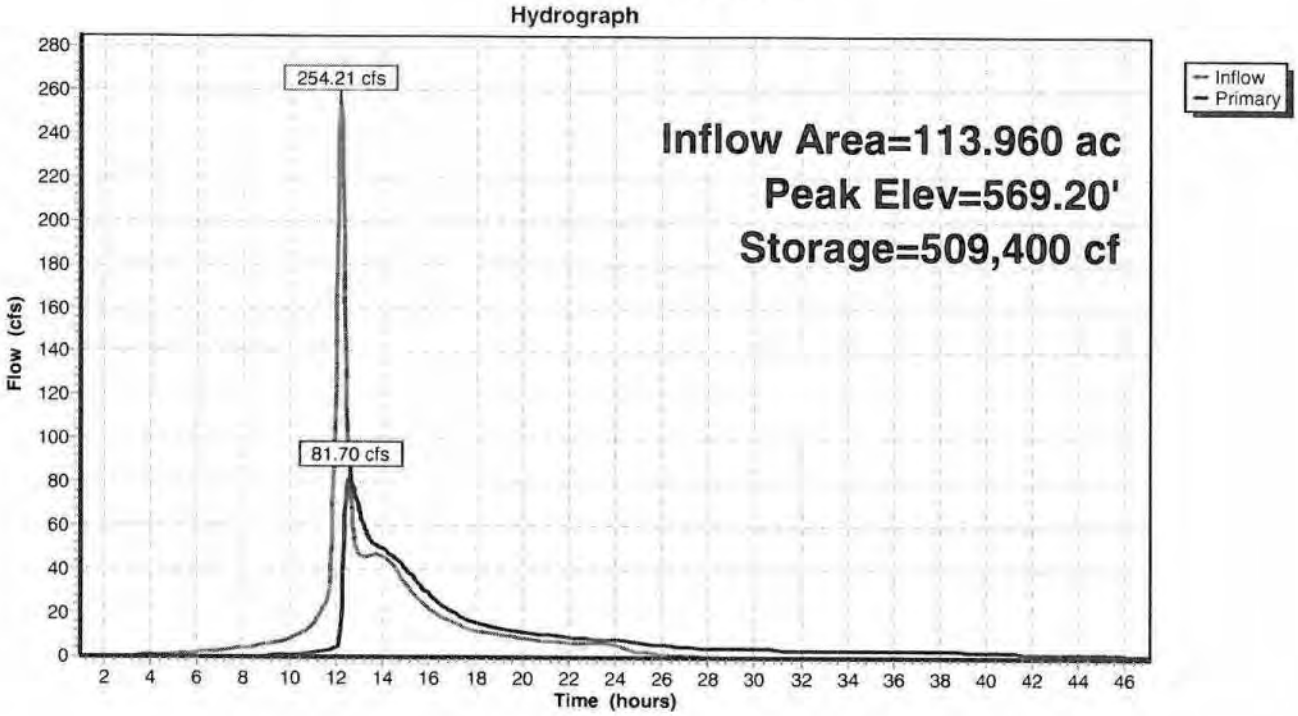
Volume	Invert	Avail.Storage	Storage Description
#1	566.00'	651,210 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
566.00	142,189	0	0
567.00	151,813	147,001	147,001
568.00	165,516	158,665	305,666
569.00	171,536	168,526	474,192
570.00	182,500	177,018	651,210

Device	Routing	Invert	Outlet Devices
#1	Primary	566.00'	**30.0" x 285.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 565.50' S= 0.0018 '/' Cc= 0.900 n= 0.012
#2	Device 1	561.00'	**12.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 564.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	567.70'	**5.00' W x 0.75' H Vert. Orifice/Grate** C= 0.600
#4	Primary	568.30'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=81.58 cfs @ 12.57 hrs HW=569.20' (Free Discharge)
- **1=Culvert** (Barrel Controls 24.02 cfs @ 4.96 fps)
  - **2=Culvert** (Passes < 5.34 cfs potential flow)
  - **3=Orifice/Grate** (Passes < 19.08 cfs potential flow)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 57.56 cfs @ 2.55 fps)

Pond 2P: North Pond



Pond 3P: Center Pond

Inflow Area =	53.010 ac,	Inflow Depth =	4.10"	for	100-Yr event
Inflow =	227.18 cfs @	12.12 hrs,	Volume=	18.111 af	
Outflow =	49.74 cfs @	12.55 hrs,	Volume=	17.397 af,	Atten= 78%, Lag= 26.2 min
Primary =	49.74 cfs @	12.55 hrs,	Volume=	17.397 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 579.57' @ 12.55 hrs Surf.Area= 94,556 sf Storage= 436,781 cf

Plug-Flow detention time= 416.1 min calculated for 17.397 af (96% of inflow)
Center-of-Mass det. time= 392.3 min (1,180.9 - 788.6)

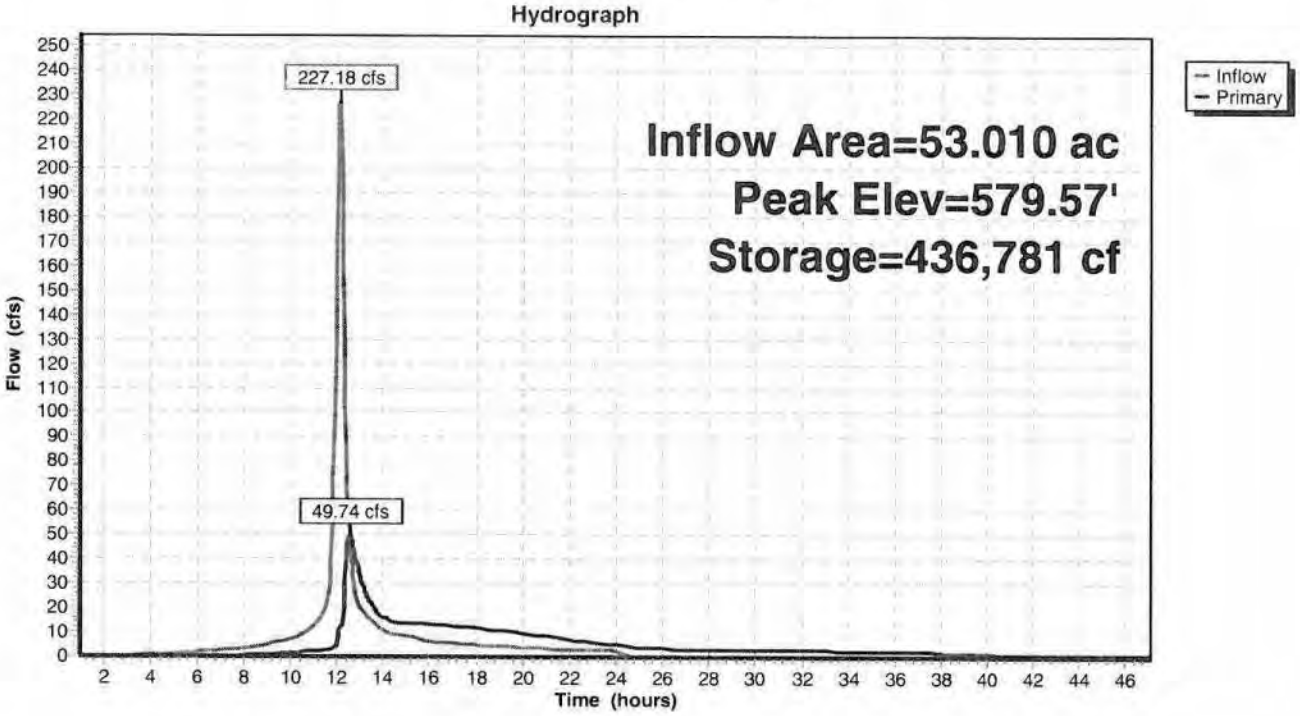
Volume	Invert	Avail.Storage	Storage Description
#1	574.00'	577,210 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
574.00	62,610	0	0
575.00	68,020	65,315	65,315
576.00	73,586	70,803	136,118
577.00	79,282	76,434	212,552
578.00	85,109	82,196	294,748
579.00	91,066	88,088	382,835
580.00	97,155	94,111	476,946
581.00	103,374	100,265	577,210

Device	Routing	Invert	Outlet Devices
#1	Primary	574.00'	**18.0" x 70.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 574.00' S= 0.0000 '/' Cc= 0.900 n= 0.012
#2	Device 1	569.00'	**10.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 572.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	576.50'	**2.70' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	579.00'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=49.60 cfs @ 12.55 hrs HW=579.57' (Free Discharge)
- **1=Culvert** (Inlet Controls 14.75 cfs @ 8.35 fps)
  - **2=Culvert** (Passes < 4.89 cfs potential flow)
  - **3=Orifice/Grate** (Passes < 10.92 cfs potential flow)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 34.85 cfs @ 2.03 fps)

Pond 3P: Center Pond



Pond 4P: South Pond

Inflow Area =	14.400 ac,	Inflow Depth =	4.10"	for	100-Yr event
Inflow =	67.48 cfs @	12.08 hrs,	Volume=	4.920 af	
Outflow =	7.77 cfs @	12.69 hrs,	Volume=	4.839 af,	Atten= 88%, Lag= 36.5 min
Primary =	7.77 cfs @	12.69 hrs,	Volume=	4.839 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 586.77' @ 12.69 hrs Surf.Area= 36,967 sf Storage= 119,493 cf

Plug-Flow detention time= 349.8 min calculated for 4.834 af (98% of inflow)
Center-of-Mass det. time= 340.5 min (1,126.0 - 785.5)

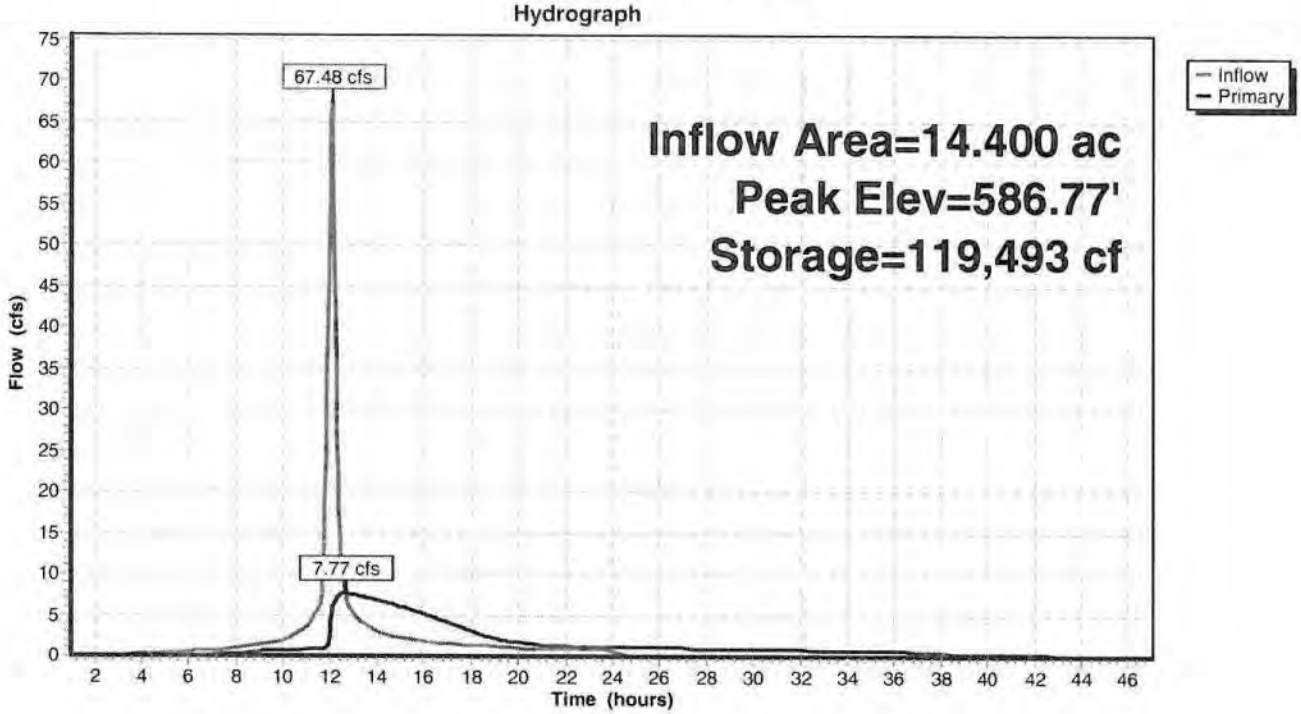
Volume	Invert	Avail.Storage	Storage Description
#1	582.50'	167,557 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
582.50	18,000	0	0
583.30	20,000	15,200	15,200
584.00	26,452	16,258	31,458
585.00	30,118	28,285	59,743
586.00	33,922	32,020	91,763
587.00	37,863	35,893	127,656
588.00	41,939	39,901	167,557

Device	Routing	Invert	Outlet Devices
#1	Primary	582.50'	**15.0" x 52.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 582.50' S= 0.0000 '/' Cc= 0.900 n= 0.011
#2	Device 1	579.00'	**6.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 580.50' S= -0.0750 '/' Cc= 0.900 n= 0.012
#3	Device 1	584.53'	**1.75' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	586.75'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=7.69 cfs @ 12.69 hrs HW=586.77' (Free Discharge)
- **1=Culvert** (Passes 7.49 cfs of 11.13 cfs potential flow)
  - **2=Culvert** (Inlet Controls 1.54 cfs @ 7.86 fps)
  - **3=Orifice/Grate** (Orifice Controls 5.94 cfs @ 6.79 fps)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 0.21 cfs @ 0.37 fps)

Pond 4P: South Pond

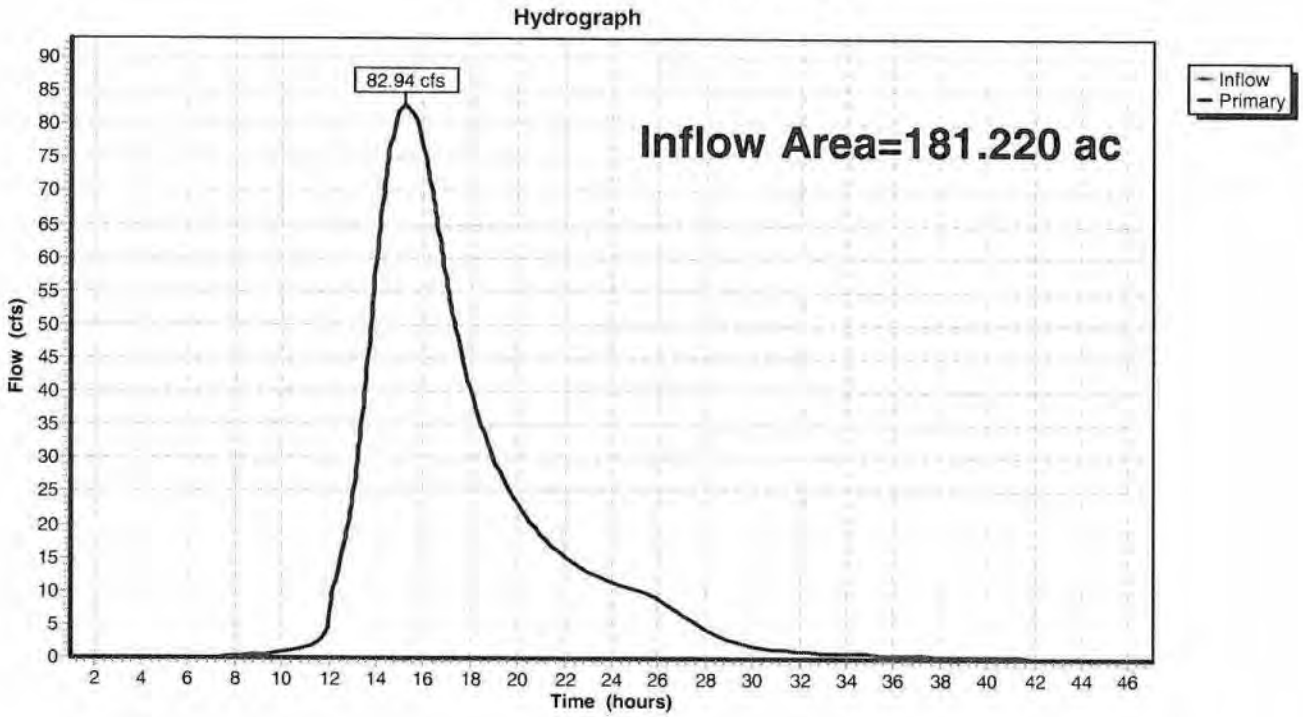


Pond 5P: South Discharge

Inflow Area =	181.220 ac,	Inflow Depth >	2.74"	for	100-Yr event
Inflow =	82.94 cfs @	15.22 hrs,	Volume=	41.359 af	
Primary =	82.94 cfs @	15.22 hrs,	Volume=	41.359 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 5P: South Discharge



HYDRAULIC SLOPE (%) 0.70

ROUGHNESS COEFF (N) 0.012

DIAMETER (IN)	AREA	WETTET PERM.	HYD. RADIUS	VELOCITY	FLOW
4	0.09	1.05	0.083	1.98	0.17
6	0.20	1.57	0.125	2.60	0.51
8	0.35	2.09	0.167	3.14	1.10
10	0.55	2.62	0.208	3.65	1.99
12	0.79	3.14	0.250	4.12	3.24
15	1.23	3.93	0.313	4.78	5.87
18	1.77	4.71	0.375	5.40	9.54
* 24	3.14	6.28	0.500	6.54	20.55
30	4.91	7.85	0.625	7.59	37.27
36	7.07	9.42	0.750	8.57	60.61
42	9.62	11.00	0.875	9.50	91.43
48	12.57	12.57	1.000	10.39	130.55
60	19.63	15.71	1.250	12.06	236.71

10YR RUNOFF FROM AREA 1B = 18.89 CFS

CULVERT1

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:08:45

FILE DATE: 12-31-2007
FILE NAME: SOUTHCUL

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	582.50	582.45	72.00	2 RCP	2.50	2.50	.015	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: SOUTHCUL DATE: 12-31-2007

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
582.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
583.57	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
584.04	15.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
584.42	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
584.76	30.8	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
585.10	38.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
585.43	46.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
585.92	53.9	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
585.48	61.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
585.80	69.3	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
586.17	77.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: SOUTHCUL DATE: 12-31-2007

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
582.50	0.000	0.00	0.00	0.00
583.57	0.000	7.70	0.00	0.00
584.04	0.000	15.40	0.00	0.00
584.42	0.000	23.10	0.00	0.00
584.76	0.000	30.80	0.00	0.00
585.10	0.000	38.50	0.00	0.00
585.43	0.000	46.00	0.00	0.00
585.92	0.000	53.90	0.00	0.00
585.48	0.000	61.60	0.00	0.00
585.80	0.000	69.30	0.00	0.00
586.17	0.000	77.00	0.00	0.00

CULVERT1

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:08:45

FILE DATE: 12-31-2007
FILE NAME: SOUTHCUL

PERFORMANCE CURVE FOR CULVERT 1 - 2(2.50 (ft) BY 2.50 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	582.50	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
7.70	583.57	0.84	1.07	3-M2t	1.11	0.63	0.95	0.95	2.25	1.03
15.40	584.04	1.27	1.54	3-M2t	1.72	0.92	1.35	1.35	2.84	1.25
23.10	584.42	1.61	1.92	3-M2t	2.50	1.13	1.65	1.65	3.35	1.40
30.80	584.76	1.90	2.26	3-M2t	2.50	1.32	1.90	1.90	3.85	1.51
38.50	585.10	2.16	2.60	3-M2t	2.50	1.49	2.11	2.11	4.36	1.60
46.00	585.43	2.41	2.93	3-M2t	2.50	1.63	2.30	2.30	4.85	1.68
53.90	585.92	2.68	3.42	3-M2t	2.50	1.77	2.48	2.48	5.52	1.75
61.60	585.48	2.98	2.58	3-M2t	2.50	1.88	2.48	2.63	6.31	1.81
69.30	585.80	3.30	2.73	3-M2t	2.50	2.00	2.48	2.78	7.09	1.87
77.00	586.17	3.67	2.87	3-M2t	2.50	2.08	2.48	2.92	7.88	1.92

El. inlet face invert 582.50 ft El. outlet invert 582.45 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	100.00 ft
INLET ELEVATION	582.50 ft
OUTLET STATION	172.00 ft
OUTLET ELEVATION	582.45 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0007
CULVERT LENGTH ALONG SLOPE	72.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.50 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.015
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

CULVERT 1

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:08:45

FILE DATE: 12-31-2007
FILE NAME: SOUTHCUL

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	5.00 ft
SIDE SLOPE H/V (X:1)	3.0
CHANNEL SLOPE V/H (ft/ft)	0.001
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	582.45 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	582.45 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	582.45	0.000	0.00	0.00	0.00
7.70	583.40	0.187	0.95	1.03	0.06
15.40	583.80	0.190	1.35	1.25	0.08
23.10	584.10	0.192	1.65	1.40	0.10
30.80	584.35	0.193	1.90	1.51	0.12
38.50	584.57	0.194	2.11	1.60	0.13
46.00	584.75	0.195	2.30	1.68	0.14
53.90	584.93	0.196	2.48	1.75	0.16
61.60	585.08	0.197	2.63	1.81	0.16
69.30	585.23	0.198	2.78	1.87	0.17
77.00	585.37	0.198	2.92	1.92	0.18

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	0.00 ft
CREST LENGTH	586.00 ft
OVERTOPPING CREST ELEVATION	100.00 ft

CULVERT 2

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:28:42

FILE DATE: 12-31-2007
FILE NAME: N-SDITCH

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	579.90	579.70	91.00	2 RCP	2.50	2.50	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: N-SDITCH DATE: 12-31-2007

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
579.90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
580.80	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
581.19	14.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
581.52	21.9	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
581.82	29.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
582.09	36.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
582.33	43.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
582.63	51.1	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
582.90	58.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
583.13	65.7	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
583.58	73.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: N-SDITCH DATE: 12-31-2007

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
579.90	0.000	0.00	0.00	0.00
580.80	0.000	7.30	0.00	0.00
581.19	0.000	14.60	0.00	0.00
581.52	0.000	21.90	0.00	0.00
581.82	0.000	29.20	0.00	0.00
582.09	0.000	36.50	0.00	0.00
582.33	0.000	43.00	0.00	0.00
582.63	0.000	51.10	0.00	0.00
582.90	0.000	58.40	0.00	0.00
583.13	0.000	65.70	0.00	0.00
583.58	0.000	73.00	0.00	0.00

CULVERT 2

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:28:42

FILE DATE: 12-31-2007
FILE NAME: N-SDITCH

PERFORMANCE CURVE FOR CULVERT 1 - 2(2.50 (ft) BY 2.50 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	579.90	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
7.30	580.80	0.81	0.90	2-M2c	0.70	0.62	0.62	0.55	3.85	1.15
14.60	581.19	1.23	1.29	2-M2c	1.02	0.89	0.89	0.81	4.65	1.45
21.90	581.52	1.56	1.62	2-M2c	1.29	1.10	1.10	1.02	5.25	1.65
29.20	581.82	1.84	1.92	2-M2c	1.54	1.28	1.28	1.19	5.75	1.80
36.50	582.09	2.10	2.19	2-M2c	1.82	1.44	1.44	1.35	6.22	1.93
43.00	582.33	2.31	2.43	2-M2c	2.15	1.57	1.57	1.47	6.62	2.02
51.10	582.63	2.58	2.73	2-M2c	2.50	1.72	1.72	1.62	7.10	2.13
58.40	582.90	2.85	3.00	2-M2c	2.50	1.84	1.84	1.73	7.57	2.21
65.70	583.13	3.14	3.23	2-M2c	2.50	1.95	1.95	1.85	8.03	2.29
73.00	583.58	3.47	3.68	2-M2c	2.50	2.04	2.04	1.95	8.50	2.36

El. inlet face invert 579.90 ft El. outlet invert 579.70 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	100.00 ft
INLET ELEVATION	579.90 ft
OUTLET STATION	191.00 ft
OUTLET ELEVATION	579.70 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0022
CULVERT LENGTH ALONG SLOPE	91.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.50 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

CULVERT 2

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:28:42

FILE DATE: 12-31-2007
FILE NAME: N-SDITCH

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	10.00 ft
SIDE SLOPE H/V (X:1)	3.0
CHANNEL SLOPE V/H (ft/ft)	0.002
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	579.70 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	579.70 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	579.70	0.000	0.00	0.00	0.00
7.30	580.25	0.274	0.55	1.15	0.07
14.60	580.51	0.283	0.81	1.45	0.10
21.90	580.72	0.288	1.02	1.65	0.13
29.20	580.89	0.290	1.19	1.80	0.15
36.50	581.05	0.292	1.35	1.93	0.17
43.00	581.17	0.294	1.47	2.02	0.18
51.10	581.32	0.295	1.62	2.13	0.20
58.40	581.43	0.296	1.73	2.21	0.22
65.70	581.55	0.297	1.85	2.29	0.23
73.00	581.65	0.298	1.95	2.36	0.24

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	28.00 ft
CREST LENGTH	588.00 ft
OVERTOPPING CREST ELEVATION	100.00 ft

CULVERT 3

CURRENT DATE: 04-01-2008
CURRENT TIME: 11:25:18

FILE DATE: 04-01-2008
FILE NAME: NORTHCUL

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	576.40	576.20	135.00	2 RCP	3.00	3.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: NORTHCUL DATE: 04-01-2008

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
576.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
577.45	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
577.91	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
578.29	31.8	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
578.63	42.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
578.91	53.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
579.20	62.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
579.55	74.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
579.86	84.8	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
580.10	95.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
580.57	106.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: NORTHCUL DATE: 04-01-2008

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
576.40	0.000	0.00	0.00	0.00
577.45	0.000	10.60	0.00	0.00
577.91	0.000	21.20	0.00	0.00
578.29	0.000	31.80	0.00	0.00
578.63	0.000	42.40	0.00	0.00
578.91	0.000	53.00	0.00	0.00
579.20	0.000	62.00	0.00	0.00
579.55	0.000	74.20	0.00	0.00
579.86	0.000	84.80	0.00	0.00
580.10	0.000	95.40	0.00	0.00
580.57	0.000	106.00	0.00	0.00

CULVERT 3

CURRENT DATE: 04-01-2008
CURRENT TIME: 11:25:18

FILE DATE: 04-01-2008
FILE NAME: NORTHCUL

PERFORMANCE CURVE FOR CULVERT 1 - 2(3.00 (ft) BY 3.00 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	576.40	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
10.60	577.45	0.93	1.05	2-M2c	0.88	0.71	0.71	0.68	4.12	1.30
21.20	577.91	1.40	1.51	2-M2c	1.28	1.02	1.02	1.00	4.98	1.63
31.80	578.29	1.79	1.89	2-M2c	1.62	1.27	1.27	1.25	5.60	1.85
42.40	578.63	2.11	2.23	2-M2c	1.95	1.48	1.48	1.46	6.11	2.02
53.00	578.91	2.40	2.51	2-M2c	2.33	1.66	1.66	1.65	6.62	2.15
62.00	579.20	2.63	2.80	2-M2c	3.00	1.80	1.80	1.79	6.98	2.25
74.20	579.55	2.93	3.15	2-M2c	3.00	1.97	1.97	1.97	7.53	2.37
84.80	579.86	3.21	3.46	2-M2c	3.00	2.12	2.12	2.11	7.94	2.46
95.40	580.10	3.52	3.70	3-M2t	3.00	2.24	2.24	2.24	8.44	2.54
106.00	580.57	3.85	4.17	3-M2t	3.00	2.36	2.37	2.37	8.87	2.62

El. inlet face invert 576.40 ft El. outlet invert 576.20 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	100.00 ft
INLET ELEVATION	576.40 ft
OUTLET STATION	235.00 ft
OUTLET ELEVATION	576.20 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0015
CULVERT LENGTH ALONG SLOPE	135.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	3.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

CULVERT 3

CURRENT DATE: 04-01-2008
CURRENT TIME: 11:25:18

FILE DATE: 04-01-2008
FILE NAME: NORTHCUL

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	10.00 ft
SIDE SLOPE H/V (X:1)	3.0
CHANNEL SLOPE V/H (ft/ft)	0.002
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	576.20 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	576.20 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	576.20	0.000	0.00	0.00	0.00
10.60	576.88	0.280	0.68	1.30	0.08
21.20	577.20	0.287	1.00	1.63	0.13
31.80	577.45	0.291	1.25	1.85	0.16
42.40	577.66	0.294	1.46	2.02	0.18
53.00	577.85	0.295	1.65	2.15	0.21
62.00	577.99	0.296	1.79	2.25	0.22
74.20	578.17	0.298	1.97	2.37	0.25
84.80	578.31	0.299	2.11	2.46	0.26
95.40	578.44	0.299	2.24	2.54	0.28
106.00	578.57	0.300	2.37	2.62	0.29

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	28.00 ft
CREST LENGTH	588.00 ft
OVERTOPPING CREST ELEVATION	100.00 ft

C&S Engineers, Inc.

PROJECT GATEWAY CENTER SHEET ____ OF ____

STORM DRAINAGE FILE NO. ____

PREPARED BY V.O. DATE ____ CHECKED BY ____ DATE ____

RATIONAL METHOD Q = CIA 10-YR STORM

DETERMINE C:

COMMERCIAL / LT INDUSTRIAL 85% IMPERVIOUS
HYDROLOGICAL SOIL TYPE "D"

C = 0.80 ASPHALT
C = 0.20 GRASS

C_W INDUSTRIAL SITES = 0.85(.80) + 0.15(.20) = 0.71

C_{ROW} (55% IMP) = 0.55(.80) + 0.45(.20) = 0.53

DETERMINE INITIAL Tc to FIRST INLETS

FOR COMMERCIAL/INDUSTRIAL SITE:

ASSUME: 20' GRASS @ 2% OVERLAND FLOW = 6 MIN
100' PAVEMENT @ 1% OVERLAND FLOW = 1 MIN
750' PIPE FLOW = 4 MIN

USE 10 MINUTES Tc

FOR R.O.W:

ASSUME: 20' GRASS @ 2% OVERLAND FLOW = 6 MIN
150' PAVEMENT FLOW = 2 MIN

USE 8 MINUTES Tc

Appendix C

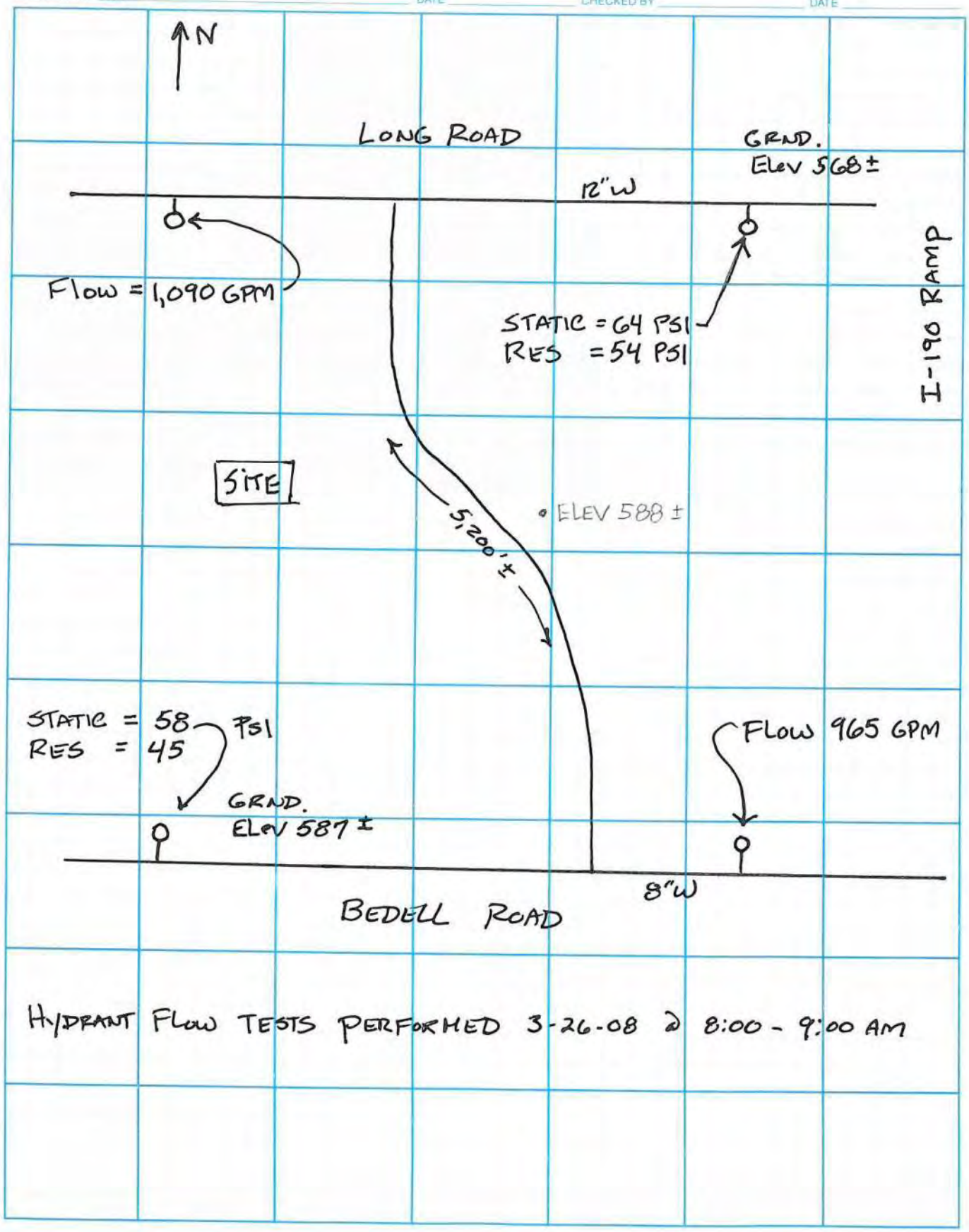
Water & Sanitary Sewer Calculations

C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY CENTER SHEET 1 OF

WATER CALCS FILE NO.

PREPARED BY J.O. DATE CHECKED BY DATE



HYDRANT FLOW TESTS PERFORMED 3-26-08 @ 8:00 - 9:00 AM

C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY CENTER SHEET 2 OF

WATER CALCS. FILE NO.

PREPARED BY U.O. DATE CHECKED BY DATE

- FLOW @ LONG = 1,090 GPM @ 54 PSI FROM HYD. FLOW TESTS.
- CENTER OF DEVELOPMENT IS APPROX $\frac{5,200'}{2}$ NORTH OF LONG = 2,600'
- DETERMINE AVAIL. FLOW @ 20 PSI
- HL THROUGH NEW MAIN (10"), PVC C = 130

L = 2600 + MINOR LOSSES SAY 10% L, ∴ L = 2,860 FT - EQUIV.

$HL = 12'/1000 \times 2,860 \times (0.62) = 21'$ OR 9 PSI (SEE NOMOGRAPH)

ELEVATION LOSS = 20' ± OR 9 PSI

∴ RESIDUAL PRESSURE @ CENTER OF SITE @ 1,090 GPM = 54 - 9 - 9 = 36 PSI

EQUIV FLOW @ 20 PSI = $1,090 \frac{(55\text{ PSI} - 20)^{0.54}}{(55\text{ PSI} - 36)^{0.54}}$ = 1,517 GPM (64-9)

∴ THE MINIMUM FLOW EXPECTED @ 20 PSI IS 1,517 GPM. THIS CONSERVATIVELY ASSUMES THAT THE FLOW FROM BEDELL ROAD MAIN IS Ø BECAUSE OF THE PRESSURE DROP IN THE SYSTEM.

C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY CENTER SHEET 3 OF

WATER CALCS. FILE NO.

PREPARED BY J.O DATE CHECKED BY DATE

DOMESTIC FLOW -

MAXIMUM DAILY DEMAND = 1.5 x AVE DAILY DEMAND

DAILY FLOW = 140,862 GPD

∴ MAXIMUM DAILY DEMAND = 140,862 x 1.5 = 211,293 GPD

PEAK HOURLY FLOW = 352 GPM (FROM SEWER CALCS)
(506,880 GPD)

HLD PEAK FLOW = 1.4'/1000 x 2,860(.62) = 2.5' = 1 PSI

WATER DISTRIBUTION—FLOW IN PIPES*—2

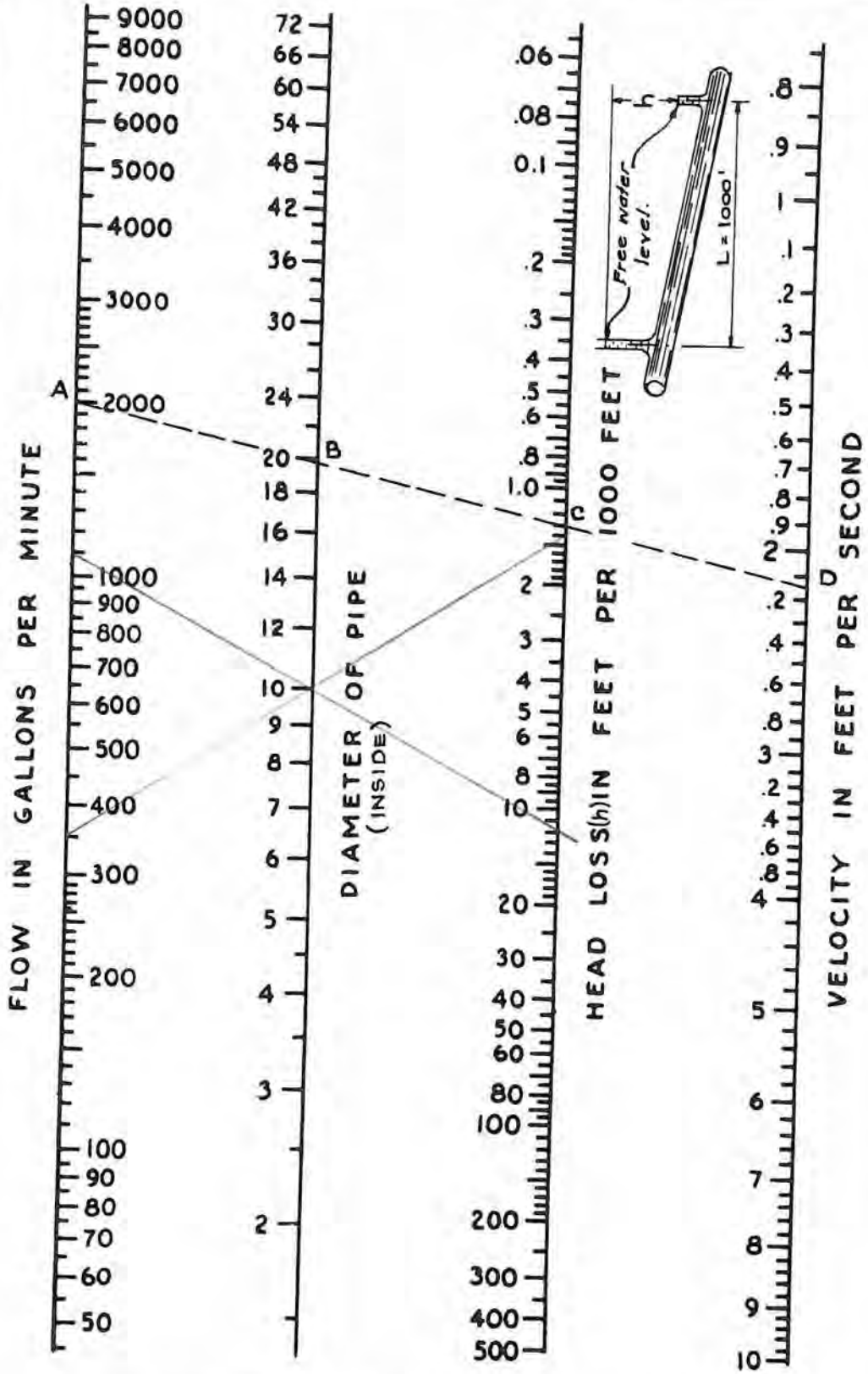


FIG. A - FLOW CHART "C" = 100*
(BASED ON HAZEN AND WILLIAMS FORMULA)

USE OF FIG. A *

Knowing any two o the following: FLO DIAMETER, HEAD LO. VELOCITY, the oth two values can b found by placing straight-edge on the factors knowr and reading desire factors (Known A & B desired C & D.)

TABLE B - CONVERSION OF FLOV

Gals/Min.	Cu.ft./Sec.	Gallons/Day
10	0.022	14,4
20	0.045	28,8
30	0.067	43,2
40	0.089	57,6
50	0.111	72,0
60	0.134	86,4
70	0.156	100,80
80	0.178	115,20
90	0.201	129,60
100	0.223	144,00
120	0.27	172,80
140	0.31	201,60
160	0.36	230,40
180	0.40	259,20
200	0.45	288,00
220	0.49	316,80
240	0.54	345,60
260	0.58	374,40
280	0.63	403,20
300	0.67	432,00
350	0.78	504,00
400	0.89	576,00
450	1.00	648,00
500	1.11	720,00
550	1.23	792,00
600	1.34	864,00
700	1.56	1,008,00
800	1.78	1,152,00
900	2.01	1,296,00
1000	2.23	1,440,00
1100	2.45	1,584,00
1200	2.67	1,728,00
1300	2.90	1,872,00
1400	3.12	2,016,00
1500	3.34	2,160,00
1600	3.57	2,304,00
1700	3.79	2,448,00
1800	4.01	2,592,00
1900	4.23	2,736,00
2000	4.46	2,880,00
3000	6.68	4,320,00
4000	8.92	5,760,00
5000	11.14	7,200,00
6000	13.36	8,640,00

*See Table B, Page 22-03, for use of Fig. A with values of "C" other than 100.

WATER DISTRIBUTION—FLOW IN PIPES—I

HAZEN & WILLIAMS FORMULA

$$V = 1.318\, C r^{0.63} S^{0.54}$$

Where V=mean Velocity in feet per second, r = hydraulic radius in feet, S=hy-aulic Slope in feet per foot of length, C=Hazen & Williams Coefficient of roughness.

QUANTITY OF FLOW FORMULA

$$Q = AV$$

Where Q = flow in cubic feet per second, A=cross-sectional Area of pipe in quare feet, V=mean Velocity in feet per second.

TABLE A – VALUES OF "C" IN HAZEN AND WILLIAMS FORMULA FOR VARIOUS KINDS OF PIPE.

KIND OF PIPE	"C"
CAST IRON	
lew well laid	130
to 6 years old	120
0 to 12 years old	110
3 to 20 years old	100
6 to 35 years old (4" to 10" sizes)	80
7 to 47 years old (12" to 60" sizes)	80
ASBESTOS-CEMENT	140
CEMENT-LINED PIPE	
pplied by hand	125
entrifugally applied	140
RIVETED STEEL PIPE	
ew (66" to 144" sizes)	110
years old (66" to 144" sizes)	100
ver 10 years old	95
, 2½" & 3" PIPE	
ry smooth & straight Brass, Tin	140
rdinary straight Brass, Tin, etc.	130
mooth New Iron	120
rdinary Iron	100

KIND OF PIPE	"C"
Old Iron	80
Very rough	60
Badly tuberculated	40
WROUGHT IRON (⅛" to 1½" Sizes)	
Very smooth and straight	140
Smooth New Iron	120
Ordinary Iron	100
Old Iron	80
Very rough	60
BRASS PIPE (0.03 to 1.2 Sizes) (May also be used for straight Lead, Tin & drawn Copper Pipes)	130
TILE (Good condition)	110
WOOD STAVE OR SMOOTH WOODEN PIPE	120
BRICK	100
CONCRETE	120
FIRE HOSE	
Extremely smooth	143
Rubber lined	125-140
Mill Hose	100-120
Unlined Linen Hose	85-95

TABLE B – RELATIVE CARRYING CAPACITY AND HEAD LOSS FOR VARIOUS VALUES OF "C" FOR USE WITH FLOW CHART, FIG. A-Pg.6-63.

"C"	"K_1"	"K_2"
40	5.46	0.40
60	2.58	0.60
80	1.51	0.80
90	1.22	0.90
00	1.00	1.00
110	0.84	1.10
120	0.71	1.20
130	0.62	1.30
40	0.54	1.40

Explanation:

1. To determine loss of head with value of "C" other than 100, multiply the loss of head found in Fig. A - Pg.22-04 by the "K_1" value given in table at left.

2. To determine quantity of flow with value of "C" other than 100, multiply the quantity of flow found in Figure A - Pg.22-04 by the "K_2" value given in table at left.

C&S Engineers, Inc.

PROJECT GATEWAY CENTER SAN SEWERS — SHEET 1 OF — FILE NO.

PREPARED BY V.O. — DATE — CHECKED BY — DATE

DETERMINE LOADING

REF: NYSDEC "DESIGN STANDARDS FOR WASTEWATER TREATMENT WORKS", 1988

DESIGN FACILITIES FOR ULTIMATE BUILDOUT OF THE FOLLOWING:

- 144 ACRE GATEWAY SITE (COMMERCIAL/LT. INDUSTRIAL)
- 27 ACRE FORMER DUNLOP SITE (COMMERCIAL/LT. INDUSTRIAL)
- 65 ACRE RESIDENTIAL PARCEL TO WEST

- ASSUME 171 ACRES (144+27) IS 70% COMMERCIAL/OFFICE
  30% LT. INDUSTRIAL (WAREHOUSE/MANF.)
- ASSUME SITE BUILDING COVERAGE = 25%

- ASSUME 50% OF COMMERCIAL/OFFICE IS 2 STORY

- COMMERCIAL/OFFICE – ASSUME 225 SF/EMPLOYEE

171 ACRES × 70% × 25% × 1.5 = 1,955,300 SF

1,955,300 SF ÷ 225 SF/EMPLOYEE × 15 GPD/EMP × 0.8 = 104,283 GPD

- LT. INDUSTRIAL/WAREHOUSE/MANUF

171 ACRES × 30% × 25% = 558,657 SF

ASSUME 1 EMPLOYEE PER 5,000 SF = $\frac{558,657}{5,000}$ = 112 EMPLOYEES

112 EMPLOYEES × 25 GPD × 0.8 = 2,240 GPD

- RESIDENTIAL

65 ACRES × 1.5 LOTS/ACRE = 98 LOTS

ASSUME 50% 3 BDRM & 50% 4 BDRM = 438 GPD AVE

98 × 438 × 0.8 = 34,339 GPD

TOTAL DAILY FLOW = 140,862 GPD

C&S Engineers, Inc.

PROJECT GATEWAY CENTER SHEET 2 OF

SAN SEWERS FILE NO.

PREPARED BY V.O. DATE CHECKED BY DATE

DETERMINE PEAK HOURLY FLOW

EQUIVALENT POPULATION = $\frac{140,862}{100}$

PEAK FACTOR = 3.6 (FIGURE 1, pg 10-5, 10 STATES STDS)

$Q_{peak} = \frac{140,862}{24 \times 60} \times 3.6 = \underline{352 \text{ GPM}}$

$Q_{peak} = 352 \text{ GPM} = 352^{GPM} \times \frac{1}{7.48 G/CF} \times \frac{1^{M}}{60 \text{ sec}} = 0.784 \text{ CFS}$

MIN. VELOCITY = 2.0 FPS

$A_{req} = \frac{Q}{V} = \frac{0.784}{2.0} = 0.392 \text{ SF}$

$0.39 = \frac{\pi D^2}{4}$ $D = \sqrt{\frac{4}{\pi}(.39)} = 0.7' = 8.4''$

TRY 6" ϕ FORCEMAIN

$A = \frac{\pi(.5)^2}{4} = 0.196 \text{ FT}^2$

$V = \frac{0.784}{0.196} = 4.0 \text{ FPS} > 2.0 < 10 \therefore \text{OK}$

DEVELOP HEAD DISCHARGE CURVE

- STATIC LIFT

BOTTOM OF PUMP STATION WET WELL 555
DISCHARGE ELEVATION 567
12'

- HL

10,300 LF FORCEMAIN

ADD 10% FOR MINOR LOSSES, TOTAL LENGTH = $\underline{11,330'}$

C&S Engineers, Inc.

PROJECT GATEWAY CENTER SAN SEWER — SHEET 3 OF — FILE NO.

PREPARED BY V.O. — DATE — CHECKED BY — DATE

C = 120, 6" PVC FORCEMAIN (C=120 MAX PER 48.6 10 ST. STDS.)

FLOW (gpm)	VELOCITY (FPS)	FRICTION LOSS FEET/100'	TOTAL H_L (11,330')	TDH (FT)
300	3.4	0.940	106.5	119
325				
350	3.98	1.245	141.1	153
375				
400	4.54	1.589	180.0	192

TRY 8" PVC FORCEMAIN, C = 120

300	1.93	0.23	26.1	38
325				
350	2.24	0.31	35.1	47
375				
400	2.56	0.39	44.2	56

h_L CALCULATIONS BASED HAZEN WILLIAMS

$$h_F = \frac{4.73\,(L)}{C^{1.85}\,D^{4.87}}\,Q^{1.85}$$

L = Length in Feet
C = 120
D = PIPE DIAMETER IN FEET
Q = FLOW IN CFS

GATEWAY CENTER - GRAND ISLAND, NY

DIVISION 11 - EQUIPMENT

SECTION 11502 - RECESSED WET WELL MOUNTED PUMP STATION

1.1 WORK DEFINED

A. Work of this section shall conform with all requirements of the Contract Documents.

B. The contractor shall furnish and install one (1) factory-built, automatic pumping station. The station shall be complete with all needed equipment, factory-installed and tested.

The principal items of equipment shall include station shell and base; hinged fiberglass covers; separate wet well entrance; two (2) vertical, close-coupled, motor driven, vacuum primed, non-clog pumps; valves; internal piping, central control panel with circuit breakers; motor starters and automatic pumping level controls; heater; ventilating blower; priming pumps and appurtenances; and all internal wiring.

C. The pump station for Gateway Center shall be a completely new installation as shown on the contract drawings.

1.2 SUBMITTALS

A. In accordance with the procedures outlined in the specifications, submit seven (7) copies of the following:

1. Manufacturer's catalog cuts, specifications, and recommended methods of installation.
2. Dimensional drawings.
3. Station layout drawings.
4. Catalog data on all accessories included with the pump station.
5. Assembly and foundation drawings.
6. Impeller opening drawing.
7. Wiring diagrams.
8. Operation and Maintenance Manual.
9. Current parts and price list.

1.3 QUALITY ASSURANCE

A. The manufacturer of the recessed wet well-mounted pump stations is Smith & Loveless, Inc. in accordance with the Town of Grand Island standardization resolution.

1.4 DESIGN CONDITIONS

A. Refer to attached "Pump Schedule" for sizes, capacities of pumps, and electrical characteristics. All openings and passages shall be large enough to permit the passage of a sphere 3" in diameter.

B. All drive equipment shall be non-overloading at all points along the performance curve. Minimum efficiencies will be strictly adhered to.

1.5 PUMP WARRANTY

A. The manufacturer shall guarantee the structure and all equipment to be free from defects in materials and workmanship per period of up to one year from the date of start up not to exceed 18 months from date of shipment. In addition to the standard warranty the impeller shall have a 20-year warranty and mechanical seal 3-year warranty. Should either of these components fail within the warranty period the manufacture shall provide replacement parts as well as the necessary labor for removal of the failed component and replacement of the new part without cost to the owner. Should manufacture's published maintenance schedule require replacement of these components within this warranty period they shall be provided as spare parts with the new station. Documentation shall be provided by the manufacture to confirm scheduled replacement.

B. Warranties and guarantees by the suppliers of various components in lieu of a single-source responsibility by the manufacturer will not be accepted. The manufacturer shall be solely responsible for the guarantee of the station and all components. Furnishing warranties and guarantees to the Owner shall be the Contractor's responsibility.

C. In the event the component fails to perform as specified or is proven defective in service during the guaranteed period, the manufacturer shall provide a replacement part without cost to the owner.

D. The manufacturer shall supply the services of a factory-trained technician to inspect the installation, test the equipment for proper performance and instruct maintenance personnel on the operation and care of the stations. This provision shall be the responsibility of the Contractor. The number of days of this service shall be as required by the Town of Grand Island public works department.

PART 2 - PRODUCTS

2.1 GENERAL

A. The factory-built recessed wet well-mounted automatic pumping station shall be complete with all needed equipment; factory installed as shown on the contract drawings or as specified in this section.

B. Precast wet well monobases, riser and top slab sections shall be designed per ASTM C-478 as shown on the drawings. O-ring joint shall meet ASTM C-443.

2.2 PRODUCT

A. Construction

1. Each station shall be constructed in one (1) complete factory-built assembly. It shall be sized to rest on the top of the wet well as detailed in the construction drawings. The supporting floor plate shall be minimum 3/8" thick steel. The shell shall be of 1/4" minimum thickness rolled to an inside diameter of 8'-6".

2. The equipment chamber shall be completely isolated from the wet well in a gas tight configuration. Wet well access shall be completely separate from the equipment chamber and shall be provided with the aluminum, slide away access man-way exposed only to the atmosphere. Access slide door shall be labeled for confined entry requirements of Town of Grand Island.

3. The equipment chamber shall be provided with a split fiberglass cover hinged at the partition wall separating the equipment chamber from the access man-way to the wet well. The fiberglass cover shall be formed with a drip-lip around the edge and a labyrinth at the top. Hinges, bolts, nuts, washers and reinforcing plates shall be stainless steel. Brackets shall be provided to support the cover in the open position and to restrain it under load. An aluminum ladder shall be located in the equipment chamber to provide easy access. Only one segment of the fiberglass cover need be opened for access into the equipment chamber. A Bilco "ladder up" extension shall be provided on the ladder in the equipment chamber.

4. The slide away aluminum wet well man-way shall be an integral part of the station head plate and shall provide access into the wet well.

5. Both equipment chamber and wet well access cover shall be provided with hasp and staple arrangement for padlocking.

6. A stanchion with removable lifting arm shall be provided to support a hoist to facilitate easy removal of the motors, impellers and pumps. The lifting arm shall be provided with a storage tube that shall be mounted behind the pump control panel. The lifting arm shall be stored within reach of a person at grade level

7. The top of the equipment chamber shall have a neoprene lip gasket, a minimum of 1/8" thick.

8. Factory mounting brackets for every piece of equipment to be mounted in the station shall be provided.

B. Welding

1. All steel and the station structure shall be jointed by electric arc welding with fillets of adequate section for the joint involved. Where required to exclude ground water, all welded joints on the exterior of the station shall be continuous throughout their length.

C. Protection Against Corrosion

1. After welding, all inside and outside surfaces of the structures, pumps and piping shall be steel shop blasted to a 2-mil minimum profile commercial blast. Immediately after cleaning, a single 6-mil minimum thickness insert coating shall be factory applied to all inside and outside surfaces. The coating shall be Versapox epoxy resin, formulated for abrasion and corrosion resistance. The dry coating shall contain a minimum of 85% epoxy resin with the balance being pigments and Thixotrobic agents. Four (4) 17-pound magnesium anodes shall also be provided and installed in accordance with manufacturer's recommendations.

D. Sewage Pumps

1. The pumps shall be vertical, non-clog sewage pumps of heavy cast iron construction, especially designed for the use of mechanical seals and vacuum priming. In order to minimize seal wear caused by lineal movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that endplay is limited to the clearance within the bearing. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump, the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter as outlined. The dimensions from lowest bearing to top of impeller shall not exceed 6 inches.

2. The bearing nearest the impeller shall be designed for the combined thrust and radial load. The upper bearing shall be free to move lineally with a thermal expansion of the shaft and shall carry only radial loads.

3. The shaft shall be solid stainless steel through the pump and bottom bearing to eliminate corrosion with the pump or mechanical seal. Stainless steel shaft sleeves will not be acceptable and minimum shaft diameters will be strictly adhered to

4. The pump impeller shall be specifically designed to handle high solids, problematic pumping applications. The impeller shall be of the enclosed type made of close-grained cast iron and shall be balanced. The impeller shall be keyed with a stainless steel key and secured to the motor shaft by a stainless steel cap screw equipped with a Nylock or other suitable self-locking device. The impeller shall not be screwed or pinned to the motor pump shaft and shall be readily removable without the use of special tools. To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter shall be trimmed inside the impeller shroud. The shroud shall remain full diameter so that close minimum clearances from shroud to the volute are maintained. Both the end of the shaft and bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft.

5. The pump shall be constructed so as to permit priming from the low-pressure area behind the impeller. Priming from the high-pressure connections, which allow solids to enter and to clog the priming system will not be acceptable. The priming bowl shall be transparent to enable the operator to monitor the priming level.

6. The pump shall be arranged so that the rotating element can easily be removed from the volute without disconnecting the electrical wiring or disassembling the motor, impeller, back head or seal, so that any foreign object may be removed from the pump or suction line.

7. The pump shaft shall be sealed against leakage by a single mechanical seal constructed so as to be automatically drained and primed each time the pump is drained and primed. Water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime, in order to allow both the pump and the seal to be drained, thereby preventing freezing and breakage of the seal during prolonged power outages in sub-freezing temperatures.

8. The seal shall be of carbon and ceramic materials with the mating surfaces lapped to a flatness tolerance of one light band. The rotating ceramic

shall be held in mating position with the stationary carbon by a stainless steel spring.

E. Motors

1. The motors shall be squirrel-cage induction type and shall have Class F insulation, suitable for temperatures up to 115 degrees C, but the motor shall have Class B temperature limits of 90 degrees C rise by resistance, at 115% of rated load. The motors shall have normal starting torque and low starting current, as specified for NEMA design B characteristics. They shall be open drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame. Leads shall be terminated in a cast connection box and shall be clearly identified.

2. The motors shall have 1.15 service factor. The service factor shall be reserved for the owner's protection. The motors shall not be overloaded beyond their nameplate rating, at the design condition, or at any head in the operating range as specified under operating conditions.

3. The motor-pump shaft shall be centered in relation to the motor base, within .005 inches. The shaft run-out shall not exceed .003 inches.

4. The motor shaft shall equal or exceed the diameter as specified above at all points from immediately below the top bearing to the top of the impeller hub.

5. The bearing cap shall be provided to hold the bottom motor bearing in a fixed position. Bearing housings shall be provided with fittings for lubrication as well as purging old lubricant.

6. The motors shall be fitted with heavy lifting eyes, each capable of supporting entire weight of the pump and motor.

F. Controls

1. The control equipment shall be mounted in a NEMA Type 1 steel enclosure two side hinged doors. The circuit breakers, starter-reset buttons, control switches, and D152 controller shall be operable without opening the doors, for dead front operation. Non-resetable elapsed time meter shall be provided for each pump. Starting and overload equipment shall be manufactured by Westinghouse, Square D or Allen Bradley.

2. A ground fault circuit interrupter duplex type outlet shall be provided on the face of the cabinet for operation of 115V AC devices.

3. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short circuit protection of all motor control and auxiliary circuits.

4. Magnetic across-the-line starters with under-voltage release, phase loss protection and overload coils for each phase shall be provided for each pump motor to give positive protection. Each single-phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker, or shall be impedance protected. All switches shall be labeled and a coded wiring diagram shall be provided.

5. To control the operation of the pumps with variations of sewage level in the wet well, an automatic pump and alarm controller, manufactured by USF/Control Systems Model D152 shall be supplied and installed in the pump station control panel.

   a) The D152 Pump and Alarm Controller shall provide full-range differential control of two pumps plus a High and Low level alarm in response to an electronic, level-proportional signal.

   b) The D152 shall operate on 120 VAC power. It shall incorporate a motor starter pilot circuit control contact for the operation of each of the two pumps. The abnormal level alarms (individually adjustable High and Low settings with a total of four set points) shall be outputted through a fail-safe load relay having a form C contact and an audible alarm driver circuit. A 10-second time delay to prevent a simultaneous after power outage shall be incorporated into the controller.

   c) The D152 Controller shall provide level indication on a 40-segment LED bar graph display. The control adjustments shall be easily changed by means of the plug-in programming pins. Each of the eight adjustments shall have forty possible positions relating to the segments of the level display.

   d) A manual override switch below the level display shall allow the actual output level signal to be overridden to confirm the performance of the controlled equipment. The switch shall be a spring-return-to-center type with raise-auto-lower positions. This shall allow operating personnel to simulate a false High or Low level and to observe the performance of the controlled pumps. The spring return feature shall assure that the station will not be left in a non-automatic state.

   e) An automatic alternator shall be provided that transposes the starting sequence of the two pumps on successive operations. The alternator

has a front panel override switch, allowing placement of the pumps in either fixed manual sequence or allows for automatic alternation.

f) An alarm silence pushbutton on the face of the Controller shall cancel the audible alarm driver output circuit while the failsafe alarm relay remains in the abnormal state until the condition has cleared.

g) Four LEDs across the top of the Controller indicate the On/Off State of each of the pump and alarm control circuits.

h) The submersible transducer shall be as manufactured by USF/Control Systems Model A1000. The transducer shall sense pressure caused by the height of liquid above its bottom face. The sensing area shall be a minimum of 3" in diameter. The lower unit body shall be stainless steel. The bottom shall have a molded reinforced synthetic rubber diaphragm with Teflon face. The stainless steel transducer and pipe shall be supported by a stainless steel cable with stainless steel weight kit and shall have a sealed breather system.

6. Provisions shall also be made for the pumps to operate in parallel should the level in the wet well continue to rise above the starting level of the low-level pump. Should the level continue to rise to the standby pump level, the standby pump shall start and the high water alarm shall be activated. It shall also activate a remote 110V AC red alarm light. This alarm light shall be provided by the station manufacturer, for mounting as shown on the Contract Drawings.

7. Lightning arrestors shall be provided as required.

8. Pump failure alarms shall be provided for each pump and shall be of the check valve limit switch type.

9. A 3KVA transformer shall be supplied in the station to convert the 230V/3Ø power to 115V/1Ø for control, if supply power is not 208V.

G. Vacuum Priming Systems

1. A separate and independent priming system shall be furnished for each sewage pump, providing complete standby operation. Each priming system shall include a separate vacuum pump. Vacuum pump shall have corrosion resistant internal components. They shall each be capable of priming the sewage pump and suction piping in not greater than 60 seconds, under rated static suction lift conditions of 20 feet at mean sea level.

2. Each priming system shall be complete with vacuum pump, vacuum controls, solenoid valve, prime level sensing probe, and a float operated check valve installed in the system ahead of the vacuum pump to prevent liquid from entering the vacuum pump. The float operated check valve shall have a transparent body for visual inspection of the liquid level and shall be automatically drained when the vacuum pump shuts off.

3. The priming system shall automatically provide positive lubrication of the mechanical seal each time the sewage pump is primed. To prevent excessive stoppage due to grease accumulation, no passageway in the priming system through which sewage must pass shall be smaller than the equivalent of 2-1/2" opening.

H. Ventilating Blower

1. A ventilating blower shall be provided capable of delivering (200 CFM) in the equipment chamber. The blower shall be rigidly mounted and shall discharge to atmosphere as shown on the plans. It shall be controlled by a thermostat and percentage timer.

I. Heater

1. This station shall be provided with a dual wattage forced air ceramic type heater with built-in thermostat to control operation. The heater wattage shall be 1300/1500, 110V. The heater shall have maximum dimensions of 10" high x 8" wide x 8" deep.

J. Lighting

1. A twin 20-watt fluorescent light fixture and guard shall be mounted opposite the control panel to provide adequate illumination for all areas within the equipment chamber. The fluorescent ballast shall be the cold-weather zero-degree Fahrenheit-starting type.

K. Sump Pump

1. A submersible sump pump with close-coupled motor shall be installed in the sump. It shall be rated 1000 GPH at design head. A mechanical seal on the shaft shall exclude water from the motor housing. The sump pump shall be controlled automatically by a float switch. It shall discharge into the entryway to the wet well through a steel pipe as shown on the drawings.

L. Sewage Piping and Valves

1. The pump suction shall be drilled and tapped for a 125 pound American standard flange for ready connection of the suction riser. The discharge line from each pump shall be fitted with a clapper type check valve and plug valve. Size, location, and quantity of check valves and plug valves shall be as shown on the construction drawings. The check valves shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against vacuum leaks. Check valves shall have stainless steel shaft with replaceable bronze shaft bushings and shall be sealed through the bearing with O-Rings, an operating wrench shall be provided for the plug valves. A compound pressure gauge shall be installed on each pump discharge. The gauge shall be rated for (0-30) PSI and vacuum and have bronze hardware with 1/4" NPT taps in corporation style.

2. All protrusions through the floor plate shall be welded gas-tight to effect sealing between the equipment chamber and the wet well. In order to prevent corrosive, noxious fumes from entering the station, the lift station manufacturer shall extend the suction connection below the floor plate at the factory, so that field connections can be made without disturbing the gas-tight seals.

3. The discharge pipe shall exit the station as shown on the drawings.

M. Mounting brackets for the telemetry system as well as a separate 1" conduit entrance and 20 amp circuit breaker shall be provided in the station.

N. The telemetry system as manufactured by Motorola shall be Model F6857 MOSCAD-L and be provided in accordance with the town standards by the station supplier.

O. An above-ground service entrance cabinet shall be provided as shown on the contract drawings. This shall be the 3M 4220 Series with double door. The service entrance cabinet shall include cabinet light, alarm light, GFI receptacle, heater, 200 amp main circuit breaker panel, and meter socket.

2.3 FACTORY TESTS

A. All components of the pump station shall be given an operational test of all equipment at the factory to check for excessive vibration, for leaks in all piping or seals, for correct operation of vacuum priming and control systems and all auxiliary equipment. Pumps shall take suction from a deep well simulating actual service conditions. The control panel shall undergo a dry logic test and a full operational test with all systems operating.

2.4 SPARE PARTS

A. A complete spare parts kit shall be furnished with each station. The kit shall include the following:

- One (1) mechanical seal and seal gasket
- One (1) volute gasket
- One (1) complete electrode assembly with electrical relay, capacitor, resistor and diode
- Touch up paint - One gallon in one quart containers

2.5 EXTENDED SERVICE

A. The manufacturer shall provide the Town of Grand Island a service contract for maintaining the pumping stations for two (2) years.

B. The service contract shall include checking each station twice per year to ensure correct operation, train operation personnel and spare parts review. A written report after each visit shall be provided to the Town of Grand Island.

2.6 BYPASS PIPING

A. Bypass piping shall be provided in accordance with the contract drawings, including suction and discharge lines with discharge plug valve and box. The bypass piping shall be ductile iron pipe, 4" male quick disconnects with chain and cap shall be provided.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of the pump chamber shall be done in accordance with the written instructions provided by the manufacturer.

B. Five (5) copies of Operation and Maintenance manuals shall be furnished which will include parts list of components and complete service procedures and trouble-shooting guide.

3.2 ELECTRICAL INSTALLATION

A. All field wiring and electrical installation shall be performed by licensed electricians and shall be in full accordance with the standards of the national electric code and the national board of fire underwriters.

B. All conduits shall have a minimum of 2' each cover. All wiring shall be suitably grounded. All fittings and electrical boxes shall be made watertight.

C. All station wiring shall be trained and routed in a workmanlike manner.

D. A single line diagram of the power shall be provided.

E. Equipment enclosures shall be identified to their function, to correspond with the single line diagram.

PUMP SCHEDULE

Manufacturer's Model #	Smith & Loveless 4B2B
Quantity	2

Physical Characteristics:

Pump Speed (RPM)	1760
Suction Size	4"
Discharge Size	4"
Solids Size	3"
Seal Type	Mechanical
Seal Material	Carbon/Ceramic
Impeller Size	7-3/4"
SS Shaft (min.)	1-7/8" diameter

Pumping Characteristics:

Condition #1	200 GPM @ 55.00' TDH – 55.0% Eff
Condition #2	350 GPM @ 49.50' TDH – 63.5% Eff
Condition #3	500 GPM @ 45.00' TDH – 67.0% Eff

Electrical Characteristics:

Max. Motor HP	10
Voltage	230
Phase	3
Wire	3

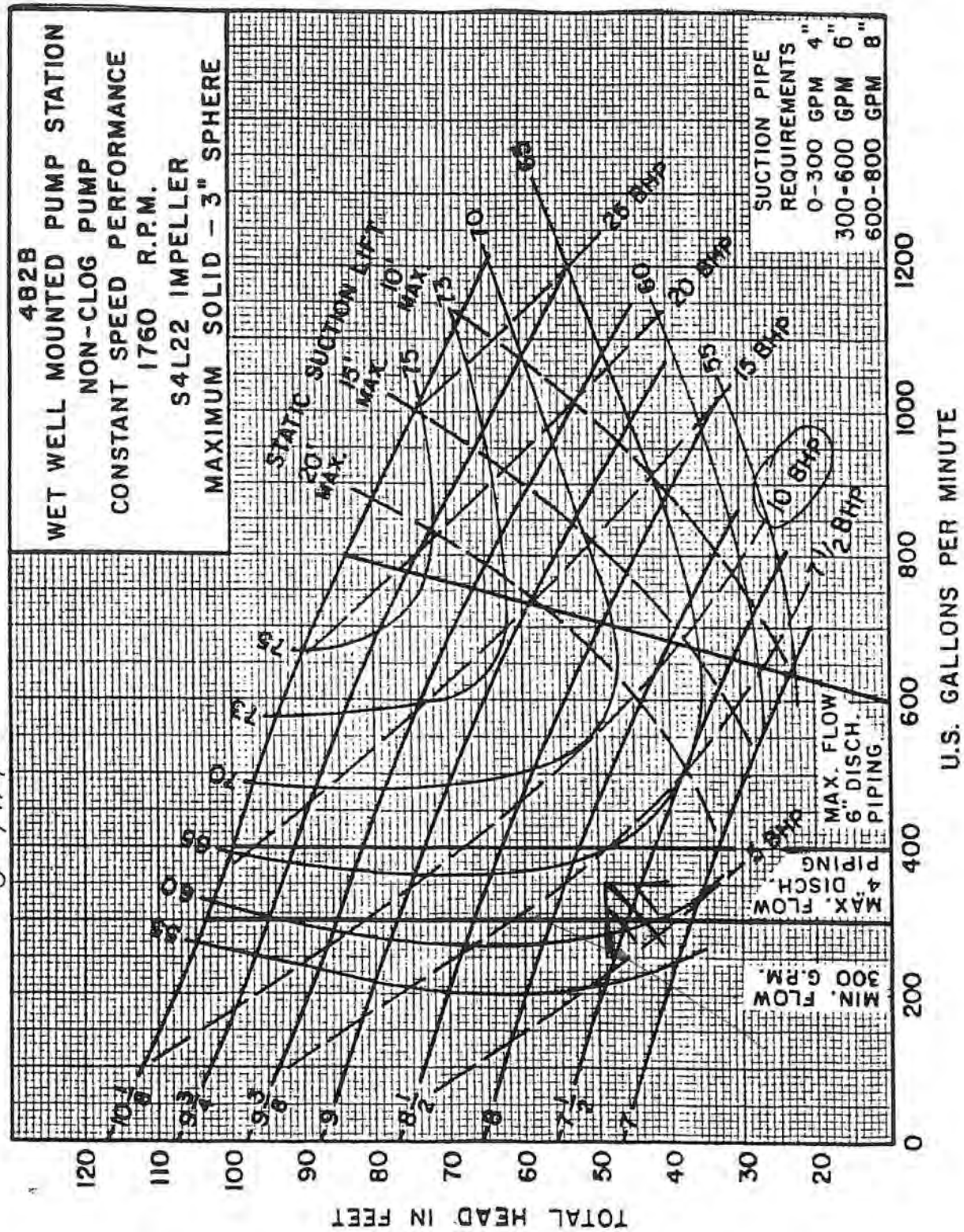
END OF SECTION

ENGINEERING DATA

Smith & Loveless, Inc.

14040 W. Santa Fe Trail Dr.
Lenexa, Kansas 66215

Vacuum Primed
Pump Performance Curves
Constant Speed
4B2B
1760 RPM
Page 3
January, 1988



8" F.M

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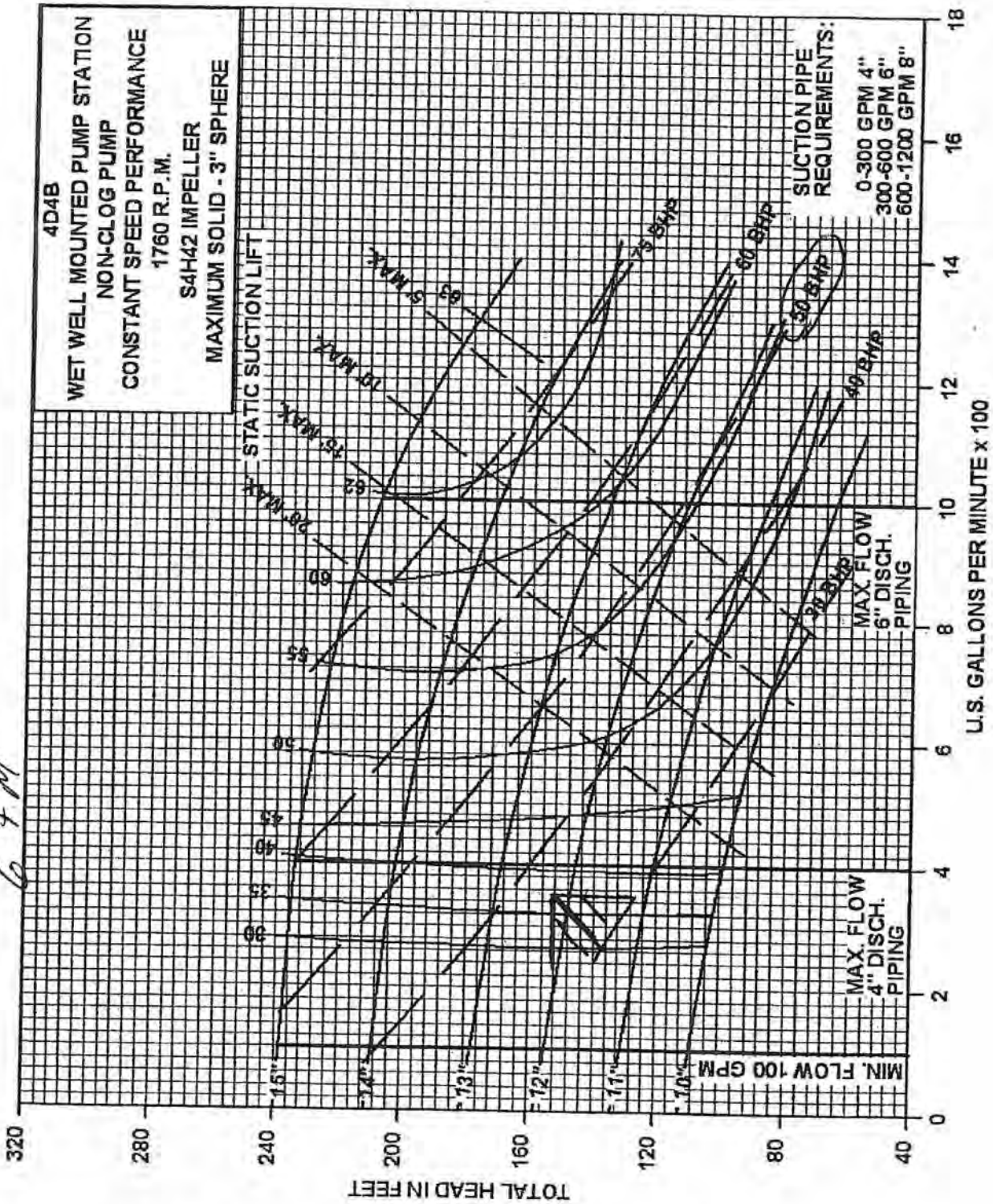
ENGINEERING DATA

Smith & Loveless, Inc.®

14040 West Santa Fe Trail Drive
Lenexa, Kansas 66215-1284

Vacuum Primed Pump
Performance Curves
Constant Speed
4D4B Non-Clog Pump
1760 RPM



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Project Olive
2780 Long Road
Town of Grand Island, New York

Appendix B

Water Distribution System Specifications

LANGAN

SECTION 331101

WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Water distribution piping.

B. Related Sections include the following:
   1. Section 033000 – Cast-In-Place Concrete.
   2. Section 310000 – Earthwork.
   3. Section 331216 – Water Utility Distribution Valves.
   4. Section 331219 – Utility Distribution Fire Hydrants.

1.3 REFERENCES

A. Recommended Standards for Water Works (Ten State Standards) latest Edition.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Piping specialties.

B. Field Quality-Control Test Reports: From Contractor. Identify the following:
   1. System Test: Conducted section-by-section or as an entire system.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements of utility company supplying water.
   2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
   3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
   4. Comply with the requirements of the American Water Works Association, AWWA.
      a. C104 – Cement-Mortar Lining for Ductile Iron Pipe and Fittings.
      b. C151 – Ductile Iron Pipe.
      c. C600 – Installation of Ductile Iron Water Mains and Their Appurtenances
      d. C605 – Underground Installation of Polyvinyl Chloride (PVC)
      e. C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fitting

5. Comply with Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, “Recommended Standards for Water Works”, latest edition.
6. Comply with Occupational Safety and Health Administration, OSHA, Standards 29 CFR, Section 1926, Subpart P and its latest revision.
7. Water and Sewer/Stormwater Line Separations:
   a. Horizontal Separation from Water Mains: 10 feet minimum clear.
   b. Vertical Separation from Water Mains: 18 inches minimum clear.
      1) If existing conditions prevent minimum vertical separation:
         a) Construct sewer of PVC pressure pipe material 10 feet on each side of the water main/sewer crossing. The sewer is to be pressure tested.
         b) Encase sewer pipe in concrete, 4 feet on each side of the water main/sewer crossing. Concrete encasement shall be a minimum of 6 inches around the sewer pipe.
   c. Where a water main crosses under a sewer, provide adequate structural support for sewer to maintain line and grade.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency. Defective pipe or fittings found after installation shall be removed and replaced by the Contractor at his own expense.

C. Disinfection of water mains and appurtenances: AWWA C651, excluding Section 5.1 covering the tablet method.

D. Inspection of pipes and appurtenances prior to backfilling.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane of lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points. Unload materials so as to avoid shock or damage. Handle and store all pipe in such a manner as to avoid deterioration or other injury thereto. Place no pipe within pipe of a larger size. Store pipe and fittings on sills above storm drainage level and delivery for laying after the trenches are excavated. Valves and hydrants shall be drained and stored to protect them from damage.

B. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

C. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

D. Protect flanges, fittings, and specialties from moisture, dirt, and falling debris.

E. Store plastic piping protected from direct sunlight. Support pipe to prevent sagging and bending.

F. Do not store or place materials on private property without written approval from the property owner.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Civil Engineer not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's and Civil Engineer's written permission.

1.8 COORDINATION

A. Coordinate connection to water main with utility company or Town Water and Sewer Superintendent.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. Ductile Iron Water Pipe: Shall be Class 52, cement lined rated for 350 psi minimum working pressure conforming to ANSI A21.10/AWWA C110 and their latest revisions. Pipe shall be manufactured by US Pipe, Riderwood, Maryland (410) 828-4686 or approved equal.

B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.
   1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.
   1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   2. Gaskets: AWWA C111, rubber.

D. Flanges: ASME 16.1, Class 125, cast iron.

E. Insulation
   1. Insulation shall be installed on all water piping that has less than 5 feet of cover over top of the water pipe. The insulation shall extend until 5 feet of cover can be provided.
   2. Insulation for the water mains shall be made of fiberglass, cellular glass, urethane or cellular phenol in accordance with the NYSDOT 2016 Standard Specifications and shall conform to the requirements of:

a.	Fiberglass Pipe Insulation	ASTM C547
b.	Cellular Glass Insulation	ASTM C552
c.	Urethane Foam Pipe Insulation	ASTM C591
d.	Spray Applied Urethane Insulation	ASTM C1029
e.	Rigid Cellular Phenolic Pipe Insulation	ASTM C1126, Type III
f.	Waterproof Jacket for Insulation	ASTM C1136

2.2 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Pipe Material: PVC 1120 meeting ASTM cell classification 12454-B.

B. PVC Pipe: Shall be AWWA C900 DR18 with material cell classification 12454-8 per ASTM D 1784, integral bell and spigot with elastomeric gasket and cast iron equivalent outside diameter.

1. Provide pipe in standard 20-foot laying lengths. Random lengths are not permitted.

C. Use AWG No. 8 stranded copper wire with high molecular weight polyethylene (HMW/PE) installation specifically designed for direct burial in corrosive soil or water. Polyethylene insulation shall confirm to ASTM D 1248, Type 3, Class C, Grade 5. Wires with cut or damaged insulation are not acceptable and replacement of the entire wire which has been damaged will be required at the Contractor's expense. All tracer wire shall be tested and verified by the Town Engineer.

D. When pipeline is located outside of paved street, provide marker for buried pipelines at 500 feet on center, horizontal change in pipe direction, or as directed by the Town Engineer. Use valve box top section and plug with lettering "WATER."

E. Mechanical-Joint Restraints shall be Factory Mutual Approved, shall meet or exceed the requirements of ASTM F1674 of the latest version, and shall be Series 2000PV produced by EBAA Iron Inc. or approved equal.

2.3 JOINT RESTRAINT SYSTEM

A. Restraining system shall include Field Lok gaskets as manufactured by Griffon Pipe Products Co., mechanical joints, restraining glands, lugs, clamps, rod couplings, nuts and washers as required or approved equal. All units shall be constructed of corrosion resistant material.

B. The mechanical joint restraint for PVC shall be EBAA Iron Inc., Series 1912 for PVC to PVC connections, Series 19MJ12 for PVC to PVC fittings, Series 2012PV for PVC to DI fittings, or approved equal.

C. Alternate: Concrete thrust block control at abrupt changes in pipeline grade, horizontal alignment, or reduction in pipe size. The pipe manufacturer’s recommendations for thrust control shall be followed.

2.4 COUPLING

A. The restrained coupling system shall be Series 3812 manufactured by EBAA Iron, Inc, or approved equal. Coupling for use on Ductile Iron Pipe (10 in.), and C900 PVC Pipe (10 in.)

B. Coupling to be used to prevent axial separation when connecting two plain ends of same or dissimilar materials.

C. The coupling sleeve internal surfaces shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of SBR. The coating and gaskets shall meet ANSI/NSF-61. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16. Ductile Iron components shall meet or exceed the

requirements of ASTM A536, and shall be tested in accordance with said standard.

D. The restrained mechanism shall incorporate a plurality of individually actuating gripping surfaces to maximize restraint capability, and have a torque limiting twist off nuts to insure proper actuating of the restraint devices. The restrained joining system shall meet the applicable requirements of AWWA C219, ANSI/AWWA C111/A21.11, and ASTM D2000.

2.5 PIPE BEDDING AND BACKFILL

A. Pipe Bedding: Mixture of crushed stone and gravel, free of soft, nondurable particles, organic materials and elongated particles. The maximum diameter of the large particles shall not exceed ¾ inches. When in ledge, use AASHTO No. 67 or approved equal processed sand and gravel, free of debris, clay lumps, organic, or other deleterious material.

B. Pipe Backfill: Mixture of crushed stone and gravel, free of soft, nondurable particles, organic materials and elongated particles. The maximum diameter of the large particles shall not exceed ¾ inches.

PART 3 - EXECUTION

3.1 EXCAVATION

A. For Utility Trenches:
   1. Excavate trenches to indicated gradients, lines, depths, and elevations.
   2. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
      a. Clearance: 12 inches each side of pipe or conduit.
   3. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
      a. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course.
   4. Trenches in Tree- and Plant-Protection Zones:
      a. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrowtine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
      b. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.2 INSTALLATION

A. Inspect pipe and fittings prior to installation to preclude installation of defective materials

B. Install Work in accordance with the Town of Grand Island, New York State Department of Health and the recommended Standards for Water Works (Ten State Standards) latest Edition.

C. Install piping as shown on the Drawings.

D. Install underground piping with restrained joints at horizontal and vertical changes in direction; additional concrete thrust blocks to be added as directed by the Town/Village for added strength. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.

E. All fittings shall be supported independently from the pipe in such a manner that no part of the weight of the fitting is held by the pipe.

F. Fittings and pipe within structures shall be placed to line and grade and properly supported before joints are made. The Contractor shall furnish all the necessary pipe supports, including stirrups, rods, clamps, hangers, pipe columns and piers, necessary to sustain the pipe and fittings in a firm and substantial manner to the lines and grades given.

G. Each valve and valve box shall be installed in accordance with the manufacturers' recommendations or as directed.

H. The Contractor shall construct and install hydrants in the locations shown on the Drawings and/or as directed.

I. Bury piping with depth of cover shown on the Drawings.

J. Install bedding at sides and over top of pipe. Pipe backfill to be installed a minimum of 12 inches overtop of the pipe and compacted in 6 inch loose lifts maximum.

3.3 ANCHORAGE INSTALLATION

A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches.

3.4 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Install detectable warning tape directly above utilities, 12 inches below finished grade.

3.5 IDENTIFICATION

A. For PVC pipe: Prior to backfill, install tracer wire on top and secure in place with 2-inch wide adhesive tape at maximum 10-foot interval. Maintain tracer wire on pipe centerline during trench backfill. Run tracer wire continuously along pipe and terminate in adjacent termination boxes. Location of all tracer wire termination boxes installed shall be noted on the field drawings. Provide 24-inches of coiled wire at access points for attachment of pipe locating equipment. Protect wire insulation from damage during installation and backfilling.

B. For DI pipe: After the pipe zone and the first 12-inches in the trench zone have been backfilled and compacted, place the marking tape on the compacted backfill and center over the pipe. Run tape continuously along the trench and tie ends of tape together. Wrap marking tape around valve box extension pipes and continue along pipe.

3.6 FIELD QUALITY CONTROL

A. All pipelines carrying water shall be tested for strength and tightness after installation. All testing shall conform to the Town of Grand Island and AWWA C600, latest edition.

B. The working pressure of the water main is at the point of extension is 92 psi.

C. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks (if present) have hardened sufficiently or as directed by the Town/Village. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Test pressure shall be 150 psi or 1.5 times working pressure, whichever is greater, or as directed by the Town/Village. All aspects of the test, duration, allowable leakage, etc., shall be in accordance with the latest AWWA standards. Use only potable water.

D. Hydrostatic Tests: Test at not less than one-and-one half times working pressure for two hours. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
   1. The hydrostatic pressure shall be 150 psi.

E. Prepare reports of testing activities.

3.7 CLEANING AND DISINFECTION

A. Disinfection will be performed after the pipe has passes any leakage tests.

B. The Municipality and Civil Engineer shall be notified at least 48 hours prior to the start of pressure testing, leakage testing, and disinfection.

C. Disinfection will be performed in accordance with the drawings and AWWA C651, excluding Section 5.1 covering the tablet method.

D. Prepare reports of disinfecting activities

END OF SECTION 331101

SECTION 331216

WATER UTILITY DISTRIBUTION VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Water distribution piping.

B. Related Sections include the following:
   1. Section 310000 – Earthwork
   2. Section 331101 – Water Utility Distribution Piping.
   3. Section 331219 – Utility Distribution Fire Hydrants.

1.3 REFERENCES

A. Recommended Standards for Water Works (Ten State Standards) latest Edition.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements of utility company supplying water.
   2. Comply with the requirements of the American Water Works Association, AWWA.
      a. C104 – Cement-Mortar Lining for Ductile Iron Pipe and Fittings.
      b. C151 – Ductile Iron Pipe.
      c. C600 – Installation of Ductile Iron Water Mains and Their Appurtenances
      d. C605 – Underground Installation of Polyvinyl Chloride (PVC)
      e. C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fitting
   3. Comply with Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, “Recommended Standards for Water Works”, latest edition.
   4. Comply with Occupational Safety and Health Administration, OSHA, Standards 29 CFR, Section 1926, Subpart P and its latest revision.
   5. Water and Sewer/Stormwater Line Separations:
      a. Horizontal Separation from Water Mains: 10 feet minimum clear.
      b. Vertical Separation from Water Mains: 18 inches minimum clear.

1) If existing conditions prevent minimum vertical separation:
   a) Construct sewer of PVC pressure pipe material 10 feet on each side of the water main/sewer crossing. The sewer is to be pressure tested.
   b) Encase sewer pipe in concrete, 4 feet on each side of the water main/sewer crossing. Concrete encasement shall be a minimum of 6 inches around the sewer pipe.

c. Where a water main crosses under a sewer, provide adequate structural support for sewer to maintain line and grade.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency. Defective pipe or fittings found after installation shall be removed and replaced by the Contractor at his own expense.

C. Disinfection of water mains and appurtenances: AWWA C651, excluding Section 5.1 covering the tablet method.

D. Inspection of pipes and appurtenances prior to backfilling.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
   1. Ensure that valves are dry and internally protected against rust and corrosion.
   2. Protect valves against damage to threaded ends and flange faces.
   3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
   2. Protect from weather. Store indoors and maintain temperatures higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane of lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points. Unload materials so as to avoid shock or damage. Handle and store all pipe in such a manner as to avoid deterioration or other injury thereto. Place no pipe within pipe of a larger size. Store pipe and fittings on sills above storm drainage level and delivery for laying after the trenches are excavated. Valves and hydrants shall be drained and stored to protect them from damage.

D. Protect flanges, fittings, and specialties from moisture, dirt, and falling debris.

E. Do not store or place materials on private property without written approval from the property owner.

PART 2 - PRODUCTS

2.1 COUPLING

A. The restrained coupling system shall be Series 3812 manufactured by EBAA Iron, Inc, or approved equal. Coupling for use on Ductile Iron Pipe (12 in.), and C900 PVC Pipe (12 in).

B. Coupling to be used to prevent axial separation when connecting two plain ends of same or dissimilar materials.

C. The coupling sleeve internal surfaces shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of SBR. The coating and gaskets shall meet ANSI/NSF-61. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16. Ductile Iron components shall meet or exceed the requirements of ASTM A536, and shall be tested in accordance with said standard.

D. The restrained mechanism shall incorporate a plurality of individuality actuating gripping surfaces to maximize restraint capability, and have a torque limiting twist off nuts to insure proper actuating of the restraint devices. The restrained joining system shall meet the applicable requirements of AWWA C219, ANSI/AWWA C111/A21.11, and ASTM D2000.

2.2 GATE VALVES

A. Nonrising-Stem, Resilient-Wedge Gate Valves:
   1. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      a. Standard: AWWA C509.
      b. Minimum Pressure Rating: 200 psig.
      c. End Connections: Mechanical joint.
      d. Interior Coating: Complying with AWWA C550.
      e. By Mueller Company or approved equivalent.

B. Nonrising-Stem, High-Pressure, Resilient-Wedge Gate Valves:
   1. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      a. Standard: AWWA C509.
      b. Minimum Pressure Rating: 250 psig.
      c. End Connections: Push on or mechanical joint.
      d. Interior Coating: Complying with AWWA C550.
      e. By Mueller Company or approved equivalent.

2.3 GATE VALVE BOX AND SPECIALTIES

A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, screw type adjustable extension of length required for depth of burial of valve, plug with lettering “WATER,” and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

B. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

C. Valve box cover directions to indicate right hand open and left hand close.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves of type and kind as indicated on the drawings, each complete with operator and accessory items as required by the actual location. Size valves the same size as the piping in which they are installed, unless otherwise indicated.

3.2 VALVE BOXES

A. Install a valve box and cover, extending from the valve to final grade, for each gate valve buried in the ground.

END OF SECTION 331216

SECTION 331219

WATER UTILITY DISTRIBUTION FIRE HYDRANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Water distribution piping.

B. Related Sections include the following:
   1. Section 310000 – Earthwork
   2. Section 331101 – Water Utility Distribution Piping.
   3. Section 331216 – Water Utility Distribution Valves.

1.3 REFERENCES

A. Recommended Standards for Water Works (Ten State Standards) latest Edition.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements of utility company supplying water.
   2. Comply with the requirements of the American Water Works Association, AWWA.
      a. C104 – Cement-Mortar Lining for Ductile Iron Pipe and Fittings.
      b. C151 – Ductile Iron Pipe.
      c. C600 – Installation of Ductile Iron Water Mains and Their Appurtenances
      d. C605 – Underground Installation of Polyvinyl Chloride (PVC)
      e. C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fitting
   3. Comply with Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, “Recommended Standards for Water Works”, latest edition.
   4. Comply with Occupational Safety and Health Administration, OSHA, Standards 29 CFR, Section 1926, Subpart P and its latest revision.

B. Disinfection of water mains and appurtenances: AWWA C651, excluding Section 5.1 covering the tablet method.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
   1. Ensure that valves are dry and internally protected against rust and corrosion.
   2. Protect valves against damage to threaded ends and flange faces.
   3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
   2. Protect from weather. Store indoors and maintain temperatures higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane of lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points. Unload materials so as to avoid shock or damage. Handle and store all pipe in such a manner as to avoid deterioration or other injury thereto. Place no pipe within pipe of a larger size. Store pipe and fittings on sills above storm drainage level and delivery for laying after the trenches are excavated. Valves and hydrants shall be drained and stored to protect them from damage.

D. Protect flanges, fittings, and specialties from moisture, dirt, and falling debris.

E. Do not store or place materials on private property without written approval from the property owner.

PART 2 - PART 2 PRODUCTS

2.1 FIRE HYDRANTS

A. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.

B. Standards: UL 246, FMG approved.
   1. Pressure Rating: 150 psig minimum 250 psig.
   2. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
   3. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
   4. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
   5. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.
   6. Manufacturer: Mueller Company, Super Centurion Model #A-423 or approved equal.
   7. Accessories
      a. Break-way flange

b. Integral storz connection

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate fire hydrants 5 feet from the edge of pavement in areas where there is no curb. Distance varies for fire hydrants in areas where there are curbs – refer to plans. Position steamer connections to face the road.

B. Set fire hydrants plumb with nozzle centerline elevations 18 inches minimum and 2 feet maximum above finished grade, or match gradeline indicated on barrel of hydrants with finished grade. Provide thrust blocks as indicated. Backfill with crushed stone around the waste or drip outlet with 1/2 of the stone below the outlet. Arrange remaining balance of stone around hydrant to prevent damage to the connections from mechanical shock and to insure hydrant stability.

C. Clean and paint all parts of the hydrants showing above the ground with two finish coats of paint.

END OF SECTION 331219

Appendix C

Water Main Appurtenances Cut Sheets

Recordall® Fire Series Assemblies (FSAA)

Cold Water Meter & Strainer with Disc Bypass

UL Certified & FM 1044 Standard Approved for Fire Service Applications

NSF/ANSI Standards 61 and 372 Certified

DESCRIPTION

Recordall® Fire Series assemblies meet or exceed all pressure and performance requirements as stated in the most recent revision of AWWA Standard C703. The assembly's primary turbine meter features cast iron housing, while the disc bypass meter is cast in a lead-free bronze alloy. Fire Series assemblies comply with the lead-free provisions of the Safe Drinking Water Act and are also certified to NSF/ANSI Standards 61 and 372. These assemblies carry the NSF-61 Mark, Trade Designation: FSAA-01.

Badger Meter® Fire Series assemblies also conform to UL 327 and FM 1004. The strainer conforms to UL 321 and FM 5551. The valve conforms to UL 312 and FM 1045.

Offered in five sizes, Fire Series assemblies are designed for revenue-generating flexibility and control on high volume fire service water measurement applications and feature:

- Direct coupled turbine based on an exclusive "floating rotor" design that reduces bearing friction—and associated wear and tear for optimal performance during fire service events.
- Disc meter bypass. The disc meter conforms to AWWA C700.
- Low head loss for optimum pressure during fire extinguishing.
- Integral fire service strainer to protect the meter element from debris and prevent downstream blockage.
- Tamper-resistant calibration vane allowing in-line accuracy adjustments while under pressure.
- Factory-calibrated and tested measuring elements that are unitized for simplified installation and inventory.
- Meters and encoders are compatible with Badger Meter ORION® family of endpoints and other approved technologies

Applications

Use the Recordall Fire Series assembly for measuring potable cold water in your vital fire protection systems. Select this assembly when the fire service main is used for both high-volume fire applications, such as sprinkler systems, and low-volume domestic services, such as general purpose plumbing.

Operation & Performance

If water enters the meter at a low flow rate, a spring-loaded check valve on the downstream side holds the clapper assembly in a closed position. Based on size of the assembly the water is diverted through either a 1inch, 1-1/2 inch or 2 inch disc bypass meter. This enables accurate registration of domestic use, leakage or misuse of water intended for stand-by fire protection. When a major flow is required, the resulting water pressure opens the check valve and allows water to flow through the main turbine chamber at full pipe capacity. A small amount of water continues to flow through the bypass when the clapper assembly is fully open.

Direct magnetic drive is achieved when the magnet carrier is driven by a gear train coupled to the rotor. The gear train consists of two sets of gears connected by a vertical transmission shaft. One gear set is at the magnet carrier, the other is a worm gear set at the rotor shaft. When water enters the main turbine chamber at high volume rates, it contacts a multi-vaned rotor. The resulting rotor rotation is then transmitted by magnetic coupling to a sealed register or encoder. The direct magnetic drive provides a reliable meter-to-registration coupling.

Construction

Recordall Fire Series assemblies consist of the following basic components: meter housing, an AWWA Class II measuring chamber, a check valve with bypass piping, valve assembly, two isolation valves, a disc bypass measuring chamber and sealed registers or encoders. The assembly also includes a strainer, which features an open area at least six times the area of the nominal pipe size. The strainer is equipped with a flushing outlet port (or optional valve) for flushing debris from the upstream side of the strainer screen.

To simplify maintenance, the registers or encoders and measuring elements can be removed without removing the meter housing. Interchangeability of certain parts between meters also minimizes spare parts inventory investment.

Tamper-Proof Features

Unauthorized removal of the register or encoder is inhibited by the optional tamper-detection seal wire screw, TORX® tamper-resistant seal screw or the proprietary tamper-resistant keyed seal screw. Each can be installed at the meter site or at the factory.

Meter Installation

The meter is designed for installations where flow is in one direction only. Companion flanges for installation of meters on various pipe types and sizes are available in cast iron or NL bronze as an option. See the *"Recordall® Fire Series Assemblies (FSAA) User Manual"* for installation guidelines.

FM APPROVED

UL LISTED

Product Data Sheet

SPECIFICATIONS

FSAA Model Includes Disc Bypass Meter	**4 in. (100 mm)**	**6 in. (150 mm)**	**6 in. (150 mm)**	**8 in. (200 mm)**	**10 in. (250 mm)**
Meter Flanges , AWWA C207 Class D	4 in. (100 mm)	6 in. (150 mm)	6 in. (150 mm)	8 in. (200 mm)	10 in. (250 mm)
Disc Bypass Meter	1 in. (25 mm)	1 in. (25 mm)	1-1/2 in. (38 mm)	2 in. (50 mm)	2 in. (50 mm)
Typical Operating Range (100% ± 1.5%)	1.25…1250 gpm (0.28…284 m^3/h)	1.25…2500 gpm (0.28…568 m^3/h)	2.5…2500 gpm (0.57…568 m^3/h)	2.5…4500 gpm (0.57…1022 m^3/h)	2.5…7000 gpm (0.57…1590 m^3/h)
Typical Low Flow (95% minimum)	0.75 gpm (0.17 m^3/h)	0.75 gpm (0.17 m^3/h)	1.5 gpm (0.34 m^3/h)	1.5 gpm (0.34 m^3/h)	1.5 gpm (0.34 m^3/h)
Maximum Continuous Flow	1000 gpm (227 m^3/h)	2000 gpm (454 m^3/h)	2000 gpm (454 m^3/h)	3500 gpm (795 m^3/h)	5500 gpm (1249 m^3/h)
Maximum Intermittent Flow	1250 gpm (284 m^3/h)	2500 gpm (568 m^3/h)	2500 gpm (568 m^3/h)	4500 gpm (1022 m^3/h)	7000 gpm (1590 m^3/h)
Maximum Operating Pressure	175 psi (12 bar)				
Maximum Operating Temperature	120° F (49° C)				
Pressure Loss at Crossover	3 psi (0.28 bar)				
Check Valve	Valve body conforms to UL 312 and FM 1044.				
Bypass Line	Specify right-facing (standard, as shown) or left-facing assembly.				
Strainer	Screen open area is at least six times the area of the nominal pipe size. Equipped with a 2 in. (4 in. model) or 3 in. (all other models) flushing port to flush debris from upstream side of strainer screen. Optional flush valve assembly available.				

MATERIALS

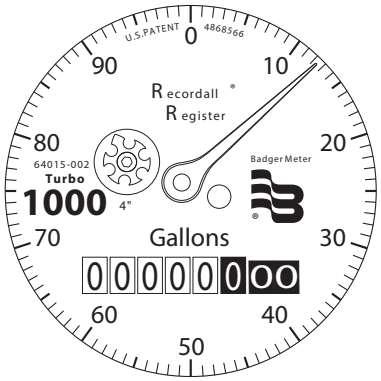
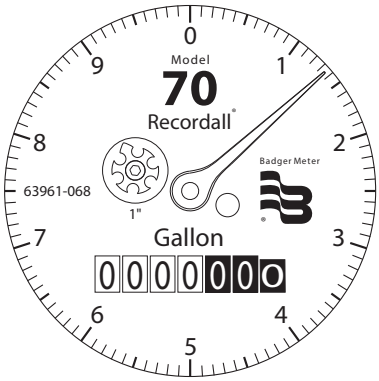
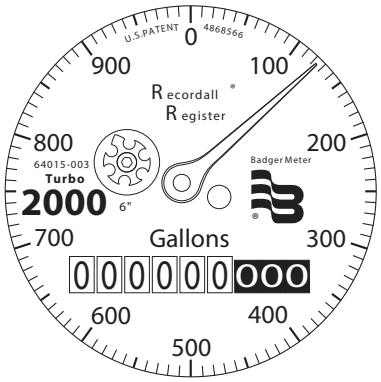
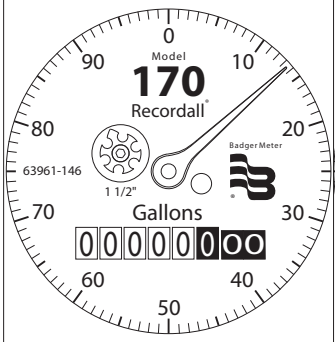
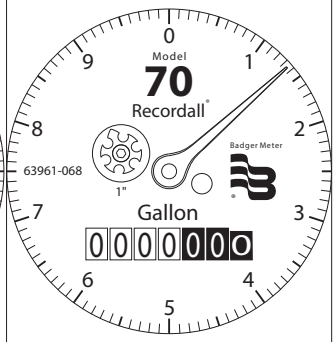
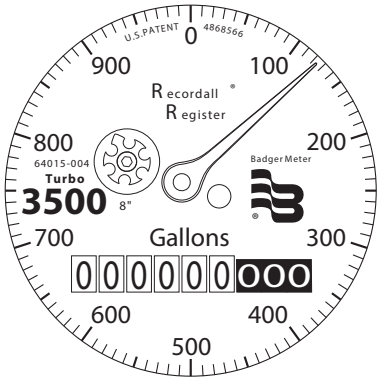
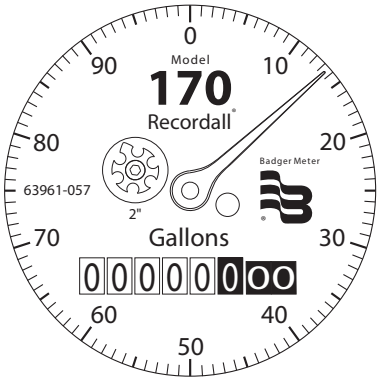
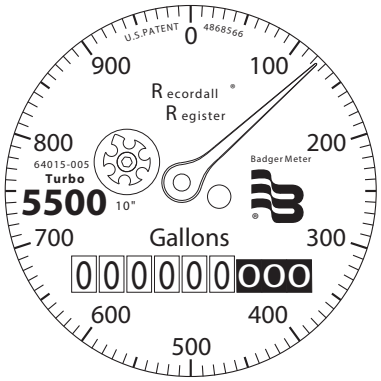
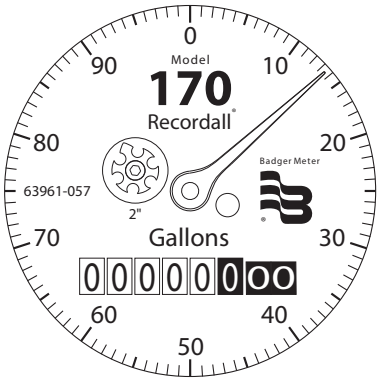
Meter Housing	Fusion-bonded epoxy coated ductile cast iron
Bypass Meter Housing & Cover	Lead-free bronze alloy
Bypass Measuring Chamber	Injection-molded thermoplastic
Bypass	Water works brass piping conforming to AWWA C800
Nose Cone & Straightening Vanes	Thermoplastic
Rotor	Thermoplastic
Rotor Radial Bearings	Lubricated thermoplastic
Rotor Thruster Bearing	Sapphire jewels
Rotor Bearing Pivots	Passivated 316 stainless steel
Calibration Mechanism	Stainless steel & thermoplastic
Magnet	Ceramic
Turbine Shaft & Bolts	Stainless steel
Clapper Assembly (clapper, spring, hinge & pins)	Stainless steel
Clapper Seal	Elastomeric, EPDM
Valve Seat	Stainless steel
Valve & Strainer Cover Plate	Fusion-bonded epoxy coated steel
Valve & Strainer Cover Plate Gasket	Elastomeric sheet / O-ring
Valve Body	Fusion-bonded epoxy coated steel / stainless steel
Strainer Screen & Trim	Stainless steel
Strainer Body	Fusion-bonded epoxy coated steel
Trim	Zinc-plated steel or (optional) all stainless steel

REGISTERS / ENCODERS

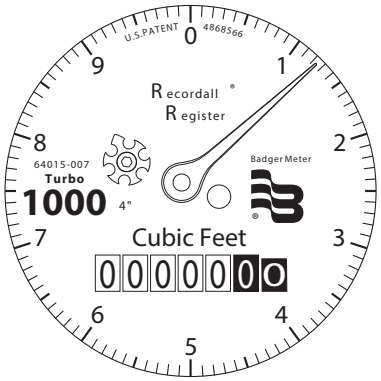
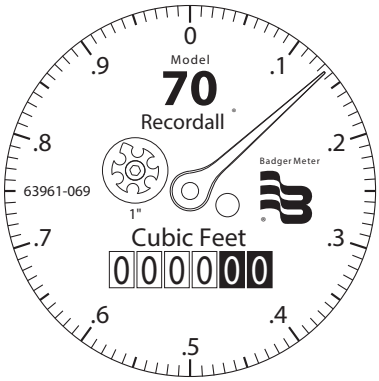
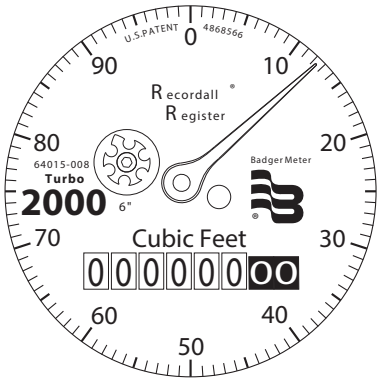
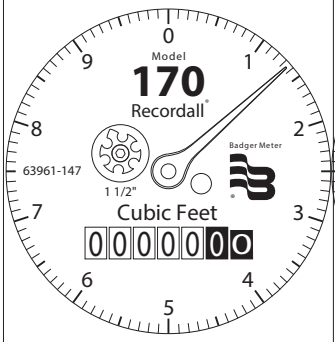
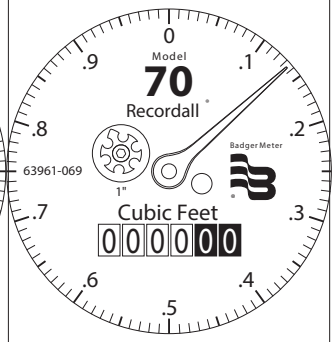
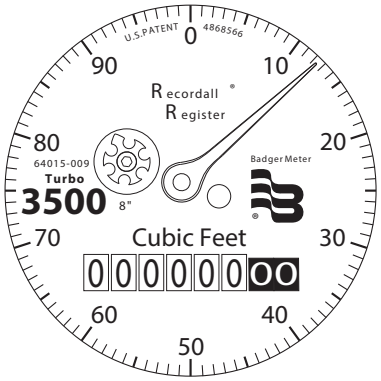
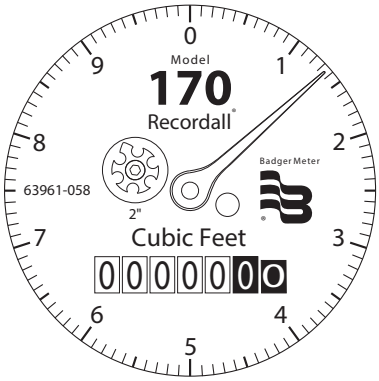
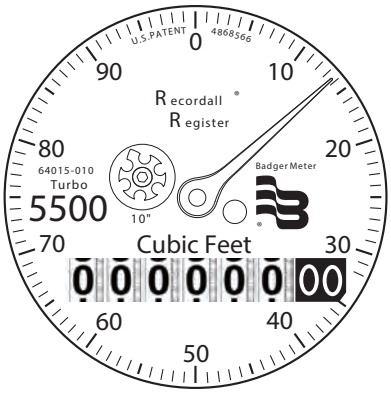
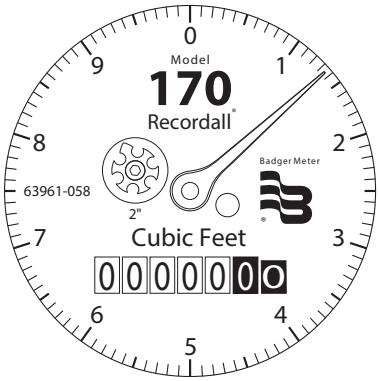
Standard—Sweep-Hand Registration

The standard register is a straight-reading, permanently sealed magnetic drive register. Dirt, moisture, tampering and lens fogging problems are eliminated. The register has a six-odometer wheel totalization display, 360° test circle with center sweep hand, and flow finder to detect leaks. Register gearing is made of self-lubricating engineered polymer, which minimizes friction and provides long life. The multi-position register simplifies meter installation and reading. The register capacity is 10,000,000 gallons (1,000,000 ft^3, 100,000 m^3).

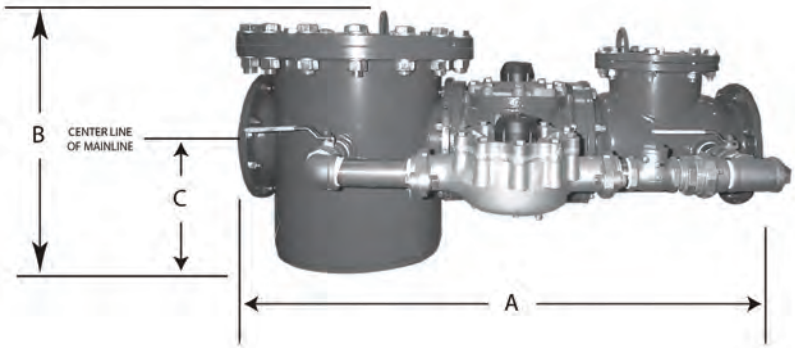
Registers—Gallons

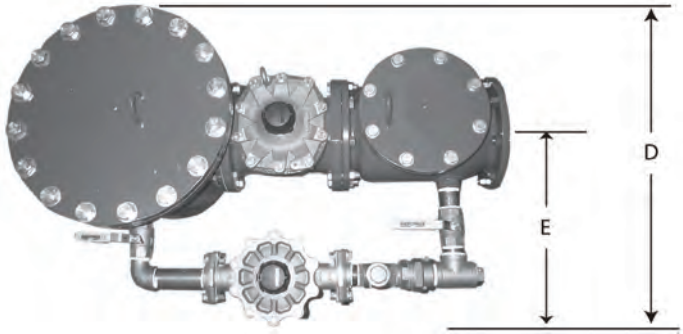
	High Flow	Low Flow	
4 in.			
6 in.			
8 in.			
10 in.			

Registers—Cubic Feet

	High Flow	Low Flow	
4 in.			
6 in.			
8 in.			
10 in.			

DIMENSIONS

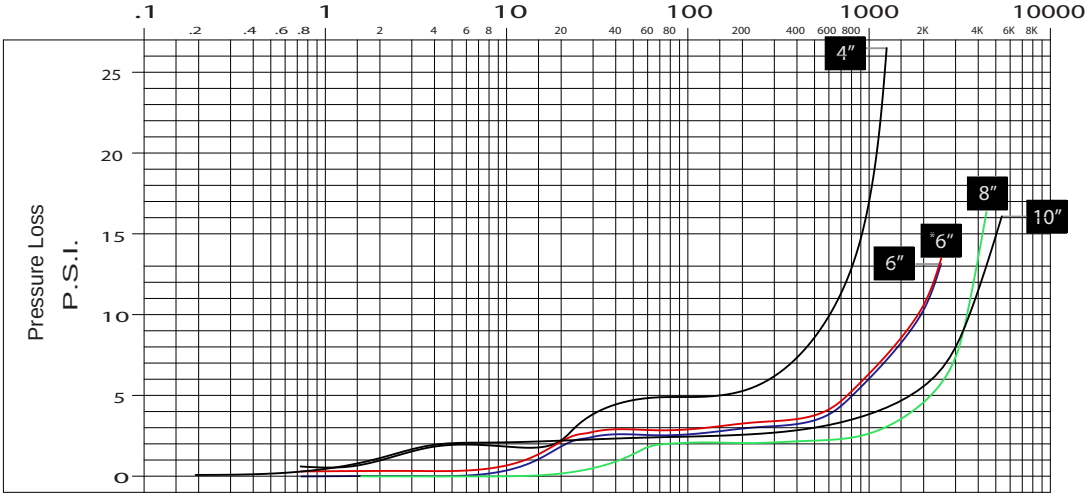




FSAA Model Includes Disc Bypass Meter	**4 in. (100 mm)**	**6 in. (150 mm)**	**6 in. (150 mm)**	**8 in. (200 mm)**	**10 in. (250 mm)**
Meter & Pipe Size	4 in. (100 mm)	—	6 in. (150 mm)	8 in. (200 mm)	10 in. (250 mm)
Disc Bypass Meter	1 in. (25 mm)	1 in. (25 mm)	1-1/2 in. (38 mm)	2 in. (50 mm)	2 in. (50 mm)
Shipping Weigh Fully Assembled	312 lb (142 kg)	507 lb (230 kg)	507 lb (230 kg)	767 lb (348 kg)	1073 lb (487 kg)
Length (A)	33 in. (838 mm)	45 in. (1143 mm)	45 in. (1143 mm)	53 in. (1346 mm)	68 in. (1727 mm)
Height (B)	20-5/8 in. (524 mm)	22-3/8 in. (568 mm)	22-3/8 in. (568 mm)	25-1/16 in. (637 mm)	25-5/16 in. (643 mm)
Height (C)	10-5/8 in. (270 mm)	11-1/16 in. (281 mm)	11-1/16 in. (281 mm)	12-1/16 in. (306 mm)	14-13/16 in. (376 mm)
Height (D)	23-3/16 in. (589 mm)	30 in. (762 mm)	34-1/4 in. (870 mm)	35-1/2 in. (902 mm)	34-1/2 in. (876 mm)
Height (E)	16-7/16 in. (418 mm)	20-1/2 in. (521 mm)	24-3/4 in. (629 mm)	23 in. (584 mm)	20-3/4 in. (527 mm)

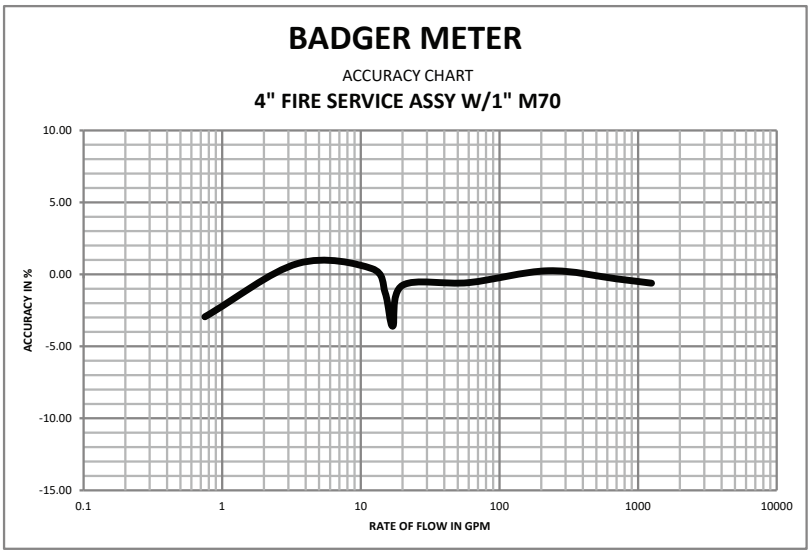
PRESSURE LOSS CHART

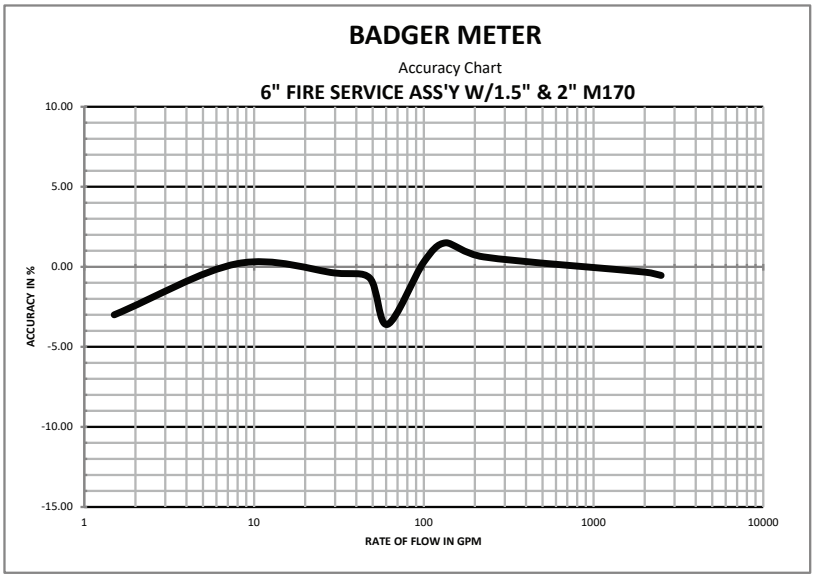
Rate of flow in gallons per minute (gpm).



ACCURACY CHARTS

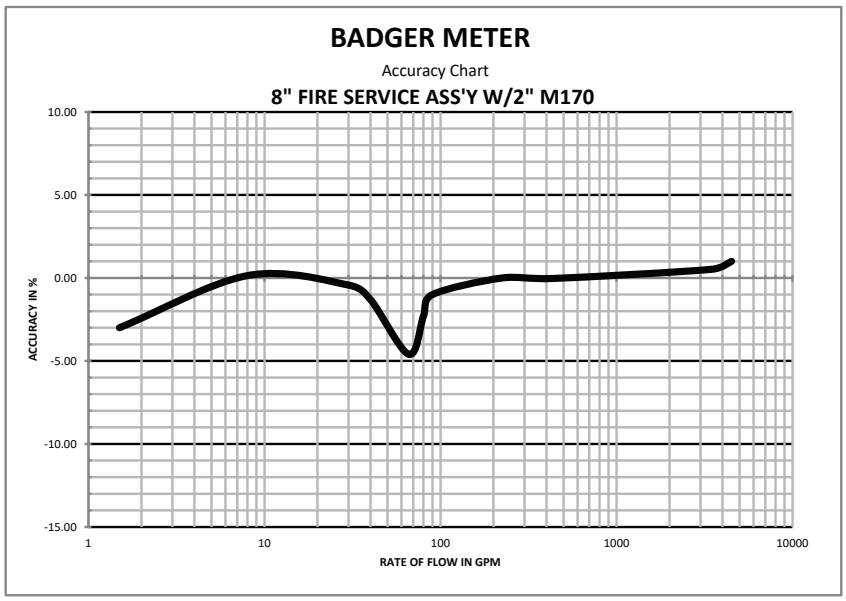
Rate of flow in gallons per minute (gpm).

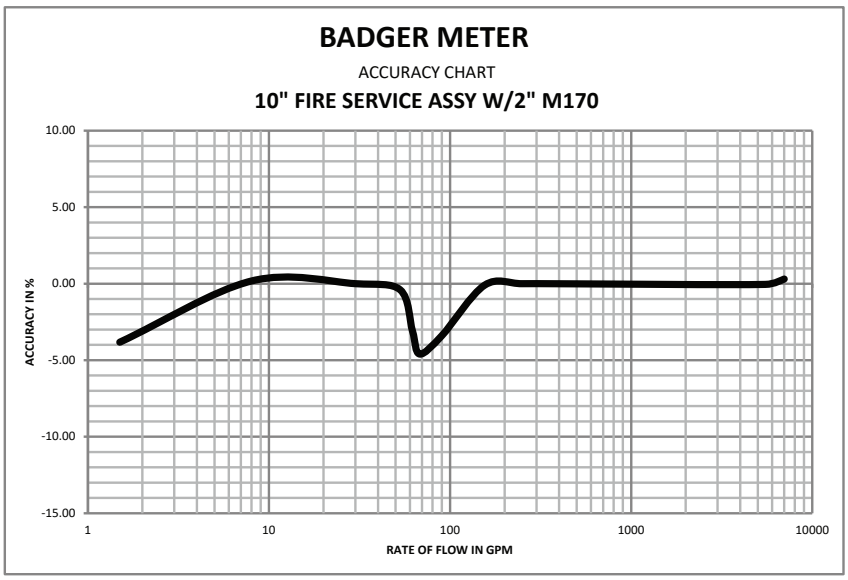




ACCURACY CHARTS (CONTINUED)

Rate of flow in gallons per minute (gpm).





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The Americas | Badger Meter | 4545 West Brown Deer Rd | PO Box 245036 | Milwaukee, WI 53224-9536 | 800-876-3837 | 414-355-0400
México | Badger Meter de las Americas, S.A. de C.V. | Pedro Luis Ogazón N°32 | Esq. Angelina N°24 | Colonia Guadalupe Inn | CP 01050 | México, DF | México | +52-55-5662-0882
Europe, Middle East and Africa | Badger Meter Europa GmbH | Nurtinger Str 76 | 72639 Neuffen | Germany | +49-7025-9208-0
Europe, Middle East Branch Office | Badger Meter Europe | PO Box 341442 | Dubai Silicon Oasis, Head Quarter Building, Wing C, Office #C209 | Dubai / UAE | +971-4-371 2503
Czech Republic | Badger Meter Czech Republic s.r.o. | Maříkova 2082/26 | 621 00 Brno, Czech Republic | +420-5-41420411
Slovakia | Badger Meter Slovakia s.r.o. | Racianska 109/B | 831 02 Bratislava, Slovakia | +421-2-44 63 83 01
Asia Pacific | Badger Meter | 80 Marine Parade Rd | 21-06 Parkway Parade | Singapore 449269 | +65-63464836
China | Badger Meter | 7-1202 | 99 Hangzhong Road | Minhang District | Shanghai | China 201101 | +86-21-5763 5412

Legacy Document Number: FSAA-DB-T-04, -06, -08, -10

For Health Hazard Applications

Job Name _____ Contractor _____

Job Location _____ Approval _____

Engineer _____ Contractor's P.O. No. _____

Approval _____ Representative _____

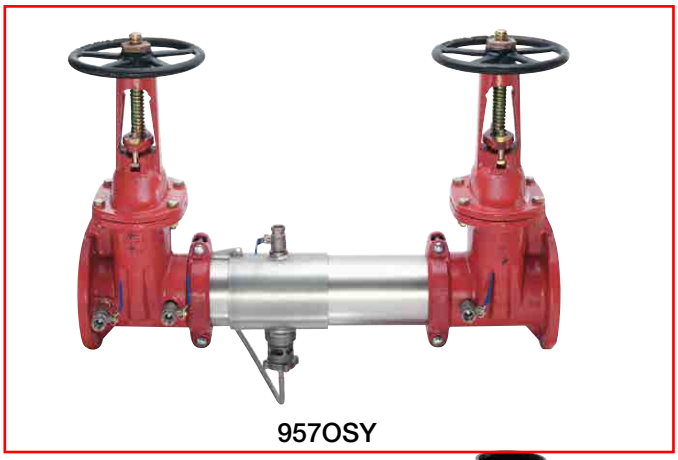
LEAD FREE*

Series 957, 957N, 957Z

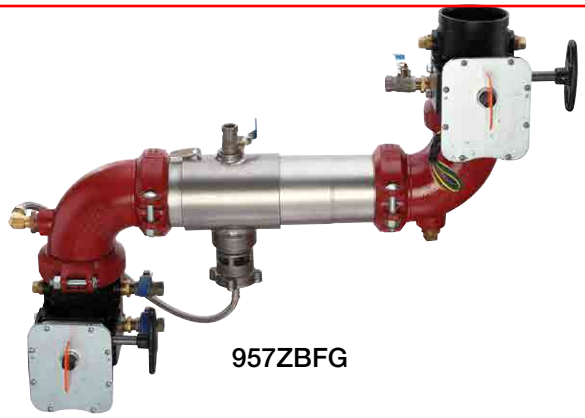
Reduced Pressure Zone Assemblies

Sizes: 2½" – 10" (65 – 250 mm)

Series 957, 957N, 957Z Reduced Pressure Zone Assemblies provide protection to the potable water system from contamination in accordance with national plumbing codes. Series 957, 957N, 957Z are normally used in health hazard applications for protection against backsiphonage or backpressure.



957OSY



957ZBFG

957QT

Features

- 2½", 3" and 4" (65, 80 and 100mm) sizes available with quarter-turn ball valve shutoffs
- Replaceable check disc rubber
- Extremely compact design
- 70% Lighter than traditional designs
- 304 (Schedule 40) stainless steel housing & sleeve
- Groove fittings allow integral pipeline adjustment
- Patented torsion spring checks provide lowest pressure loss
- Unmatched ease of serviceability
- Bottom mounted cast stainless steel relief valve
- Available with grooved butterfly valve shutoffs

Specifications

The Reduced Pressure Zone Assembly shall consist of two independent torsion spring check modules, a differential pressure relief valve located between and below the two modules, two drip tight shutoff valves, and required torsion spring check modules and relief valve shall be contained with a sleeve accessible single housing constructed from 304 (Schedule 40) stainless steel pipe with groove end connections. Torsion spring checks shall have replaceable elastomer discs and in operation produce drip tight closure against the reverse flow of liquid caused by backpressure or backsiphonage. Assembly shall be a Watts Regulator Company Series 957, 957N, 957Z.

NOTICE

Inquire with governing authorities for local installation requirements

***The wetted surface of this product contacted by consumable water contains less than 0.25% of lead by weight.**

NOTICE

The information contained herein is not intended to replace the full product installation and safety information available or the experience of a trained product installer. You are required to thoroughly read all installation instructions and product safety information before beginning the installation of this product.

Watts product specifications in U.S. customary units and metric are approximate and are provided for reference only. For precise measurements, please contact Watts Technical Service. Watts reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on Watts products previously or subsequently sold.

WATTS®

Available Models

Suffix:

NRS –	non-rising stem, resilient seated gate valves
OSY –	UL/FM outside stem and yoke resilient seated gate valves
BFG –	UL/FM grooved gear operated butterfly valves with tamper switch
QT –	2½" - 4" (65 - 100mm) quarter-turn ball valves
**OSY FxG –	Flanged inlet gate connection and grooved outlet gate connection
**OSY GxF –	Grooved inlet gate connection and flanged outlet gate connection
**OSY GxG –	Grooved inlet gate connection and grooved outlet gate connection

Available with grooved NRS gate valves - consult factory**
Post indicator plate and operating nut available - consult factory**
**Consult factory for dimensions

NOTICE

When installing a drain line on Series 957 backflow preventers, use 957AG air gaps. See ES-AG/EL/TC for additional information.

Materials

Housing & Sleeve: 304 (Schedule 40) Stainless Steel

Elastomers: EPDM, Silicone and Buna-N

Torsion Spring Checks: Noryl®, Stainless Steel

Check Discs: Reversible Silicone or EPDM

Test Cocks: Bronze Body Nickel Plated

Pins & Fasteners: 300 Series Stainless Steel

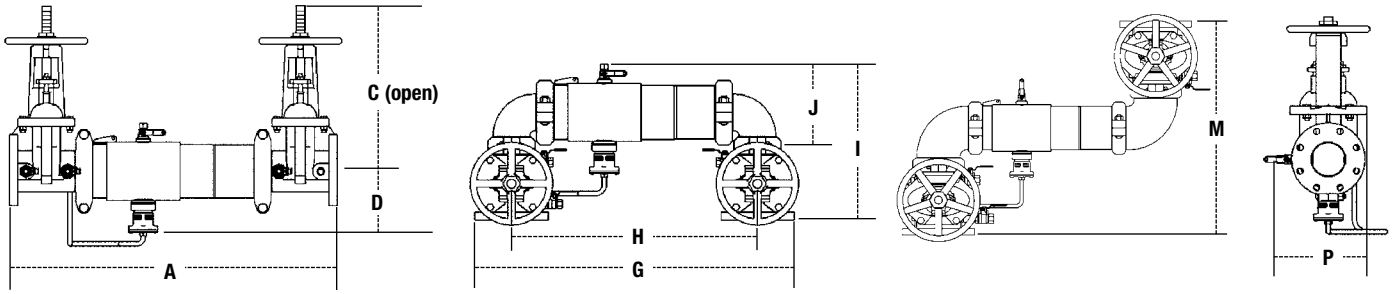
Springs: Stainless Steel

Pressure — Temperature

Temperature Range: 33°F – 140°F (0.5°C – 60°C)

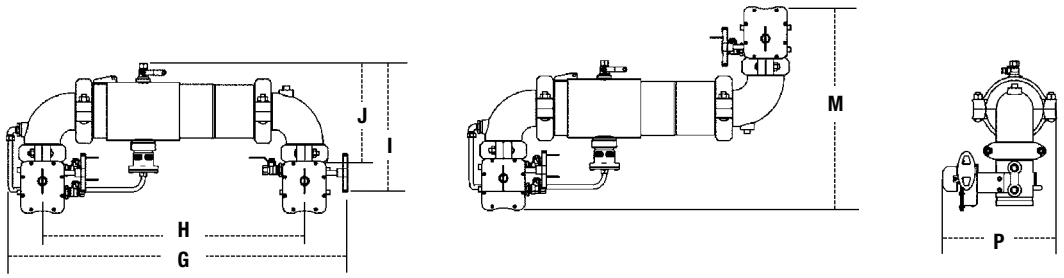
Maximum Working Pressure: 175psi (12.1 bar)

Dimensions — Weight



957, 957N, 957Z

SIZE (DN)		DIMENSIONS																						WEIGHT							
		A		C (OSY)		C (NRS)		D		G		H		I		J		M		P		957NRS		957OSY		957N NRS		957N OSY	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kgs.	lbs.	kgs.	lbs.	kgs.	lbs.	kgs.
2½	65	30¾	781	16⅜	416	9⅜	238	6½	165	29 1/16	738	21½	546	15½	393	8 13/16	223	21¼	540	9 3/16	234	118	54	128	58	126	57	136	62
3	80	31¾	806	18⅞	479	10¼	260	6 11/16	170	30¼	768	22¼	565	17⅛	435	9 3/16	233	23	584	10½	267	134	61	148	67	147	67	161	73
4	100	33¾	857	22¾	578	12 3/16	310	7	178	33	838	23½	597	18½	470	9 15/16	252	26¼	667	11 3/16	284	164	74	164	74	187	85	187	85
6	150	43½	1105	30⅛	765	16	406	8½	216	44¾	1137	35¼	895	23 3/16	589	13 1/16	332	34¼	870	15	381	276	125	298	135	317	144	339	154
8	200	49¾	1264	37¾	959	19 15/16	506	9 11/16	246	54⅛	1375	40⅛	1019	27 7/16	697	15 11/16	399	36⅞	937	17 3/16	437	441	200	483	219	516	234	558	253
10	250	57¾	1467	45¾	1162	23 13/16	605	11 3/16	285	66	1676	49½	1257	32½	826	17 5/16	440	44½	1124	20	508	723	328	783	355	893	405	950	431



957NBFG, 957ZBFG

SIZE (DN)		DIMENSIONS												WEIGHT	
		G		H		I		J		M		P		957N/957Z	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kgs.
2½	65	32½	826	23	584	15½	394	9½	241	19¾	502	11 13/16	300	67	30
3	80	34	864	24	610	16 5/16	414	10 1/16	256	21¼	540	12⅛	308	70	32
4	100	35⅝	905	25½	648	17 3/16	437	10 15/16	279	23½	597	12⅝	321	87	39
6	150	46½	1181	35¼	895	20½	521	13½	343	27¼	692	15	382	160	73

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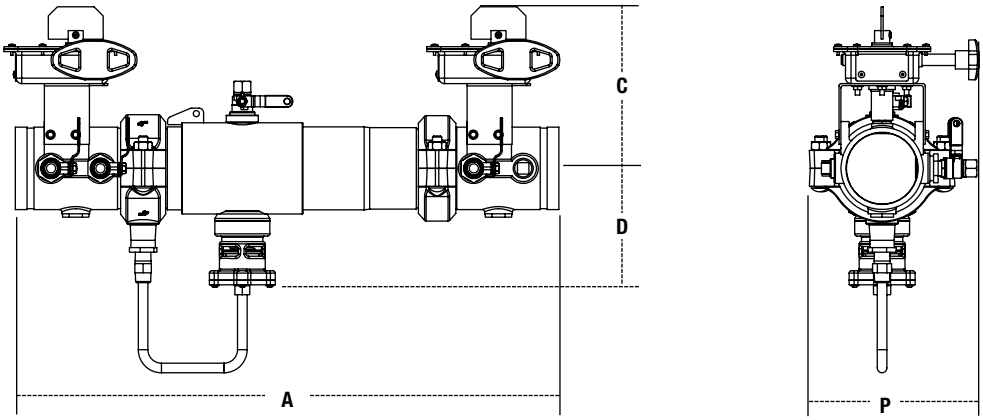
Approvals

- Approved by the Foundation for Cross-Connection Control and Hydraulic Research at The University of Southern California (FCCCHR-USC)

For additional approval information please contact the factory or visit our website at www.amesfirewater.com

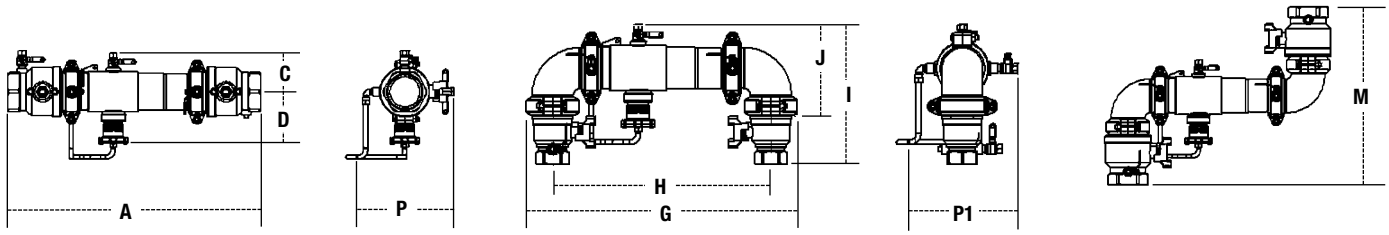
1013 B64.4 (**BFG & OSY Only)

Dimensions — Weight continued



957 BFG

SIZE (DN)		DIMENSIONS								WEIGHT	
		A		C		D		P			
in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*
4	100	29	737	7¾	197	6⅜	162	9½	241	66	30
6	150	36½	927	9 11/16	246	7 7/16	189	14¼	362	122	55



957QT

SIZE (DN)		DIMENSIONS																				WEIGHT			
		A		C		D		G		H		I		J		M		P		P1		QT		QTN	
in.	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*in.*	*mm*	*lbs.*	*kgs.*	*lbs.*	*kgs.*
2 1/2	65	27 1/2	698	4 7/8	124	6 7/8	175	30¼	768	21½	546	16 1/16	407	11⅜	289	19 7/8	505	11 5/16	287	11 5/16	287	46	21	57	26
3	80	28	711	4 7/8	124	6 7/8	175	30¼	768	22¼	565	16 9/16	420	11⅜	289	20 7/8	531	11 5/16	287	11 5/16	287	56	25	67	30
4	100	28¾	730	4 7/8	124	6 7/8	175	30¼	768	23½	597	18 5/16	465	11⅜	289	24 3/8	619	11 5/16	287	11 5/16	287	76	34	87	39

Capacity

Series 957, 957N, 957Z flow curves as tested by Underwriters Laboratory.

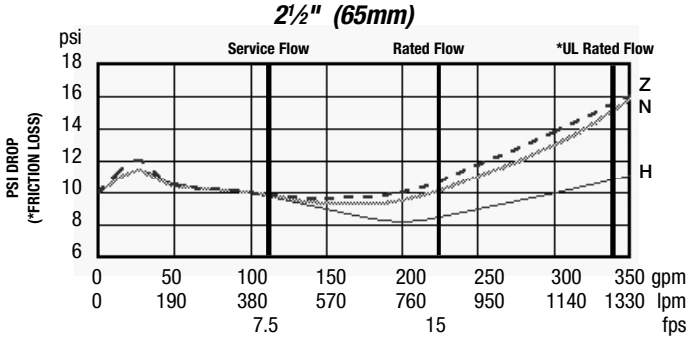
Flow characteristics collected using butterfly shutoff valves

——— Horizontal ——— N-Pattern - - - - - Z-Pattern

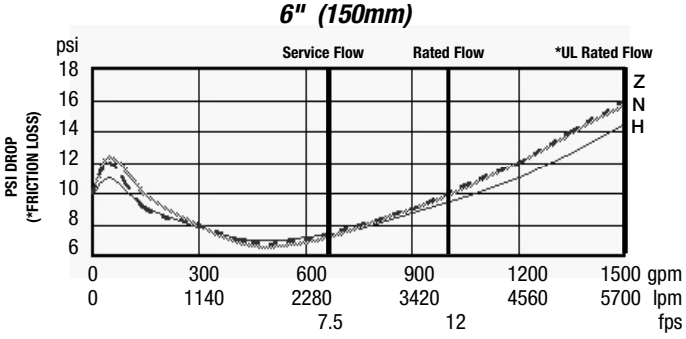
Flow capacity chart identifies valve performance based upon rated water velocity up to 25fps

- Service Flow is typically determined by a rated velocity of 7.5fps based upon schedule 40 pipe.
- Rated Flow identifies maximum continuous duty performance determined by AWWA.
- UL Flow Rate is 150% of Rated Flow and is not recommended for continuous duty.
- AWWA Manual M22 [Appendix C] recommends that the maximum water velocity in services be not more than 10fps.

2½" (65mm)



6" (150mm)



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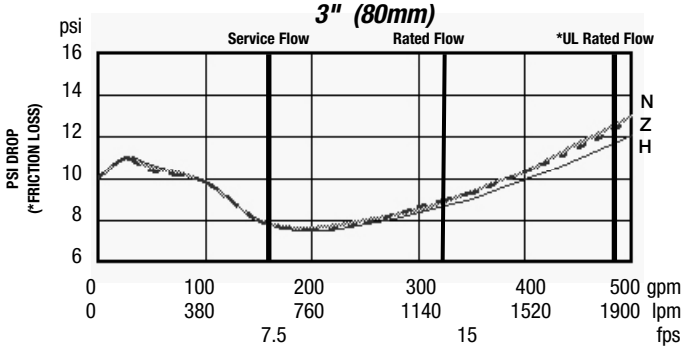

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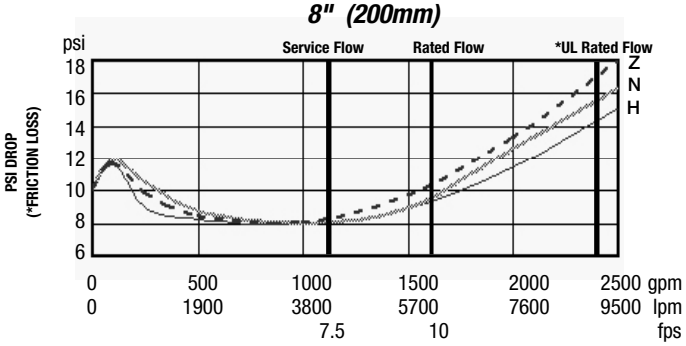

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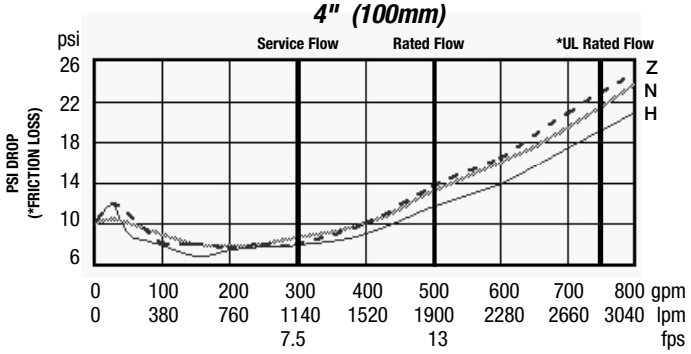
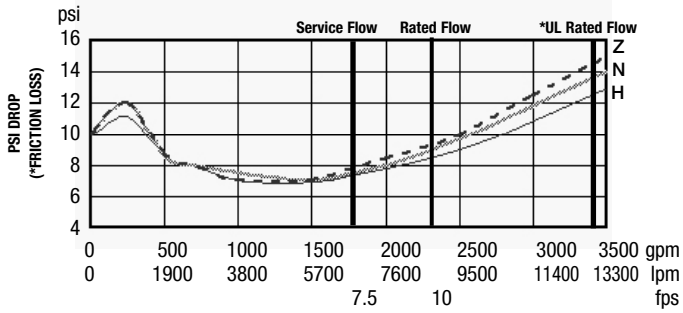
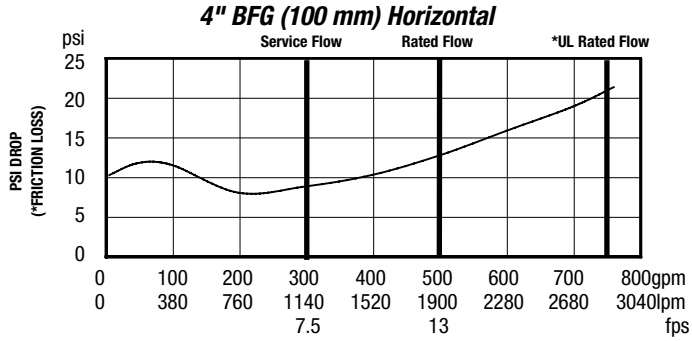


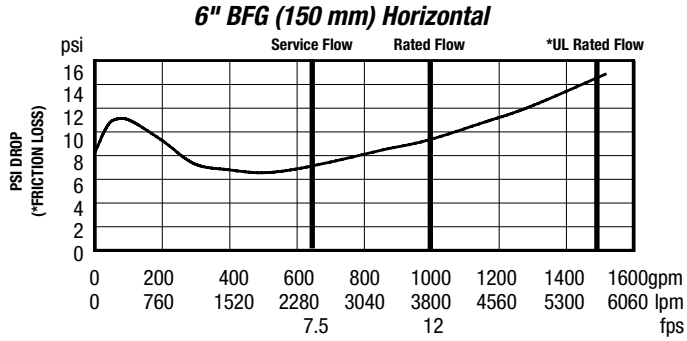
10" (250mm)



4" BFG (100 mm) Horizontal



6" BFG (150 mm) Horizontal



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Foundation for Cross-Connection Control and Hydraulic Research

2015

List of Approved Backflow Prevention Assemblies

The List is dated June 04, 2015. Additions to the List after June 04, 2015 may be found on the USC Foundation's website: fccchr.usc.edu

USC University of Southern California

Type: RP
Manufacturer: Watts
Model: 957
Size: 6
Orientation: H
Meters:
Manual: 9
0.25% Pb: No
Spare Parts Only: No
Approved: 20-Dec-2004
Renewed: 20-Dec-2013
Bypass:
Shutoffs: (ppp),qqq,aaaa,bbbb

Type: RP
Manufacturer: Watts
Model: 957
Size: 6
Orientation: H
Meters:
Manual: 9
0.25% Pb: Yes
Spare Parts Only: No
Approved: 20-Dec-2004
Renewed: 20-Dec-2013
Bypass:
Shutoffs: zzz,dddd,eeee,gggg,kkkk,llll,mmmm,nnnn,nnnnn

Type: RP
Manufacturer: Watts
Model: 957
Size: 8
Orientation: H
Meters:
Manual: 9
0.25% Pb: No
Spare Parts Only: No
Approved: 13-Aug-2007
Renewed: 13-Aug-2013
Bypass:
Shutoffs: (ppp),qqq,aaaa,bbbb

Type: RP
Manufacturer: Watts
Model: 957
Size: 8
Orientation: H
Meters:
Manual: 9
0.25% Pb: Yes
Spare Parts Only: No
Approved: 13-Aug-2007
Renewed: 13-Aug-2013
Bypass:
Shutoffs: zzz,cccc,dddd,eeee,gggg,kkkk,llll,mmmm,nnnn,nnnnn

Type: RP
Manufacturer: Watts
Model: 957
Size: 10
Orientation: H
Meters:
Manual: 9
0.25% Pb: No
Spare Parts Only: No
Approved: 22-Jul-2009
Renewed: 22-Jul-2012
Bypass:
Shutoffs: (ppp),qqq,aaaa,bbbb

Type: RP
Manufacturer: Watts
Model: 957
Size: 10
Orientation: H
Meters:
Manual: 9
0.25% Pb: Yes
Spare Parts Only: No
Approved: 22-Jul-2009
Renewed: 22-Jul-2012
Bypass:
Shutoffs: zzz,cccc,dddd,eeee,gggg,kkkk,llll,mmmm,nnnn,nnnnn

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For Health Hazard Applications

Job Name _____ Contractor _____

Job Location _____ Approval _____

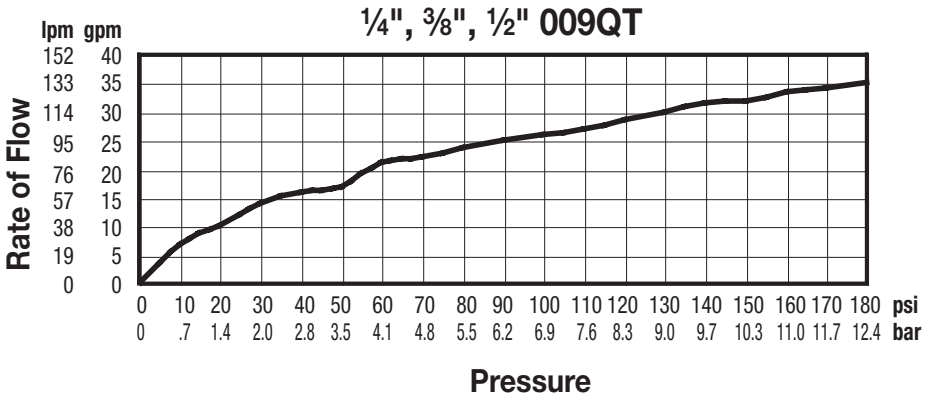
Engineer _____ Contractor's P.O. No. _____

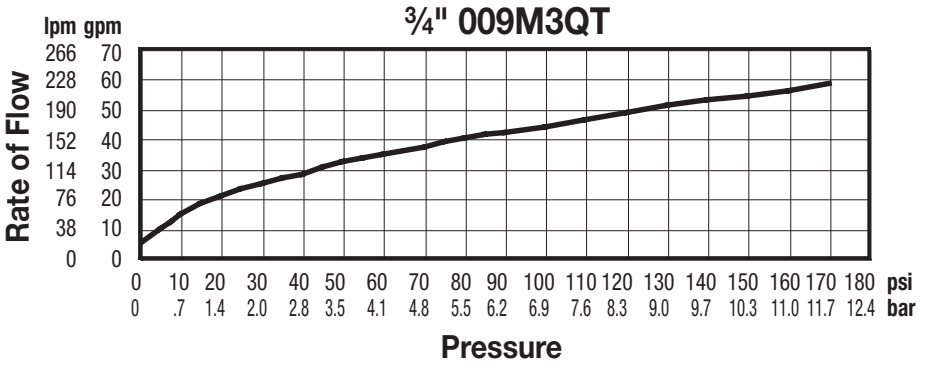
Approval _____ Representative _____

Series 009, 909, 919, 957 and 994

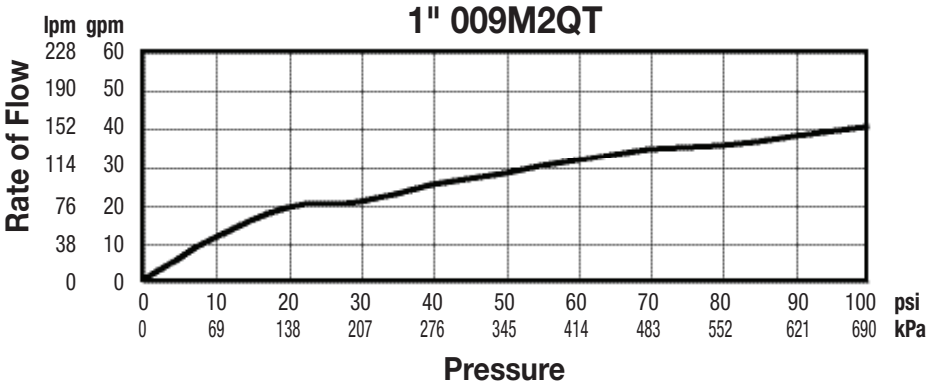
Reduced Pressure Zone Assemblies

Relief Valve Discharge Rates





Note: These curves represent catastrophic or worst case discharge rates. These curves were developed by pressurizing the outlet of the backflow preventer with the second check valve's internals removed from the body.



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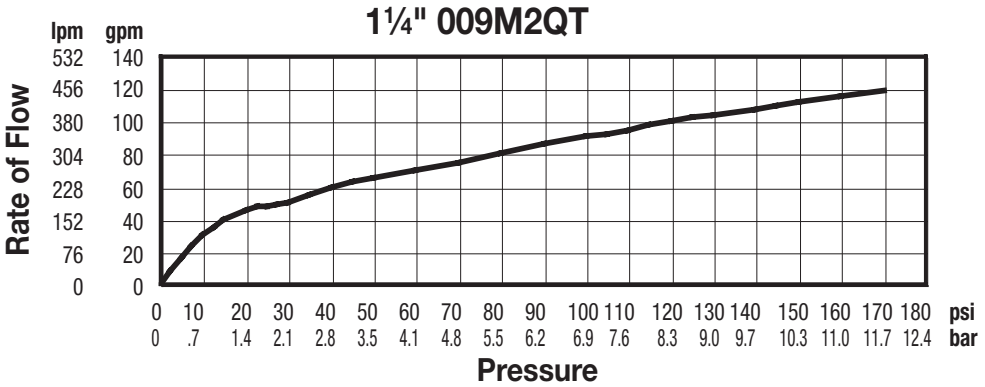
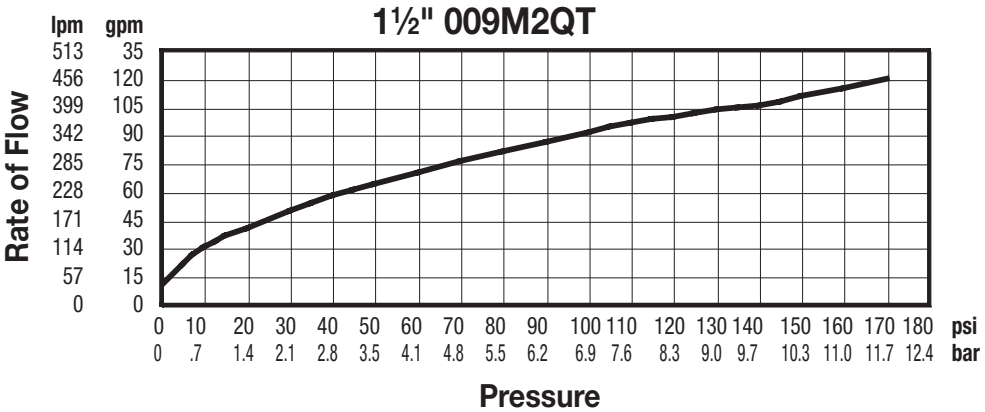
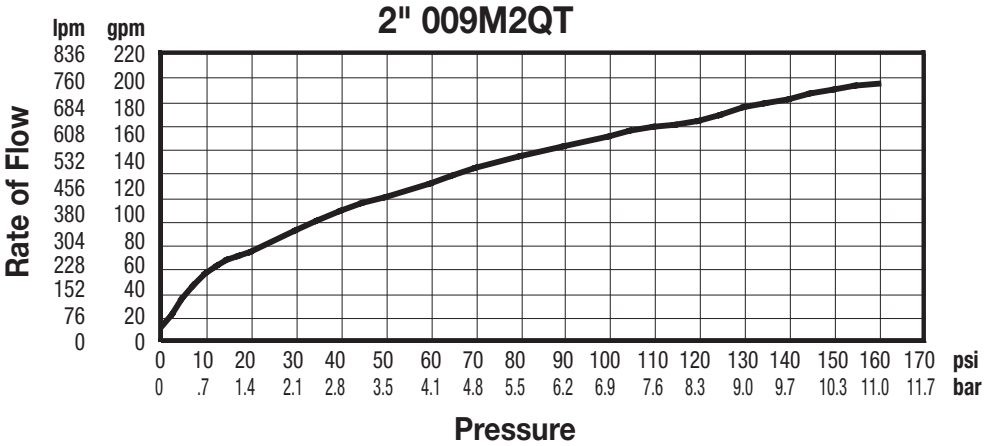
1¼" 009M2QT



1½" 009M2QT

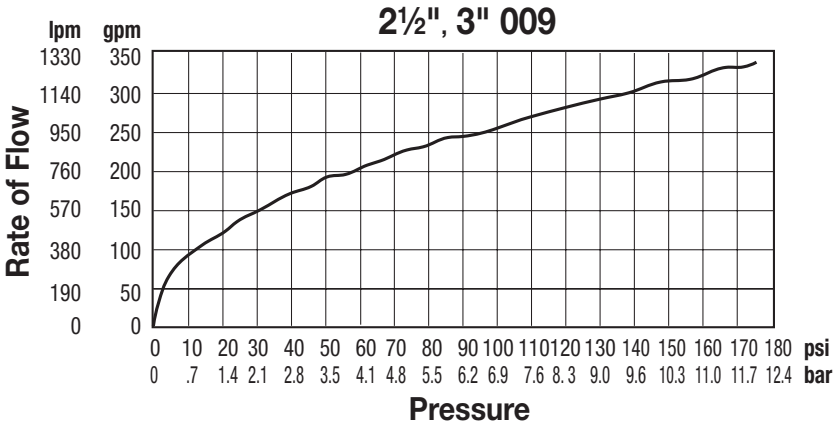


2" 009M2QT

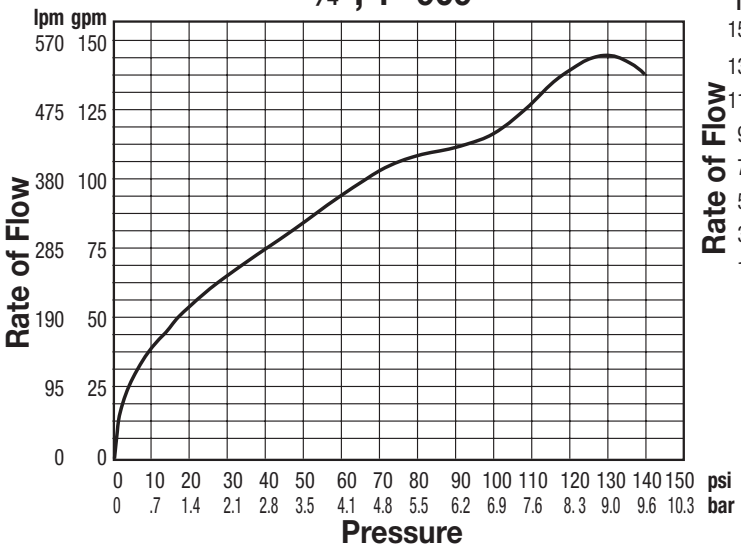


Note: These curves represent catastrophic or worst case discharge rates. These curves were developed by pressurizing the outlet of the backflow preventer with the second check valve's internals removed from the body.

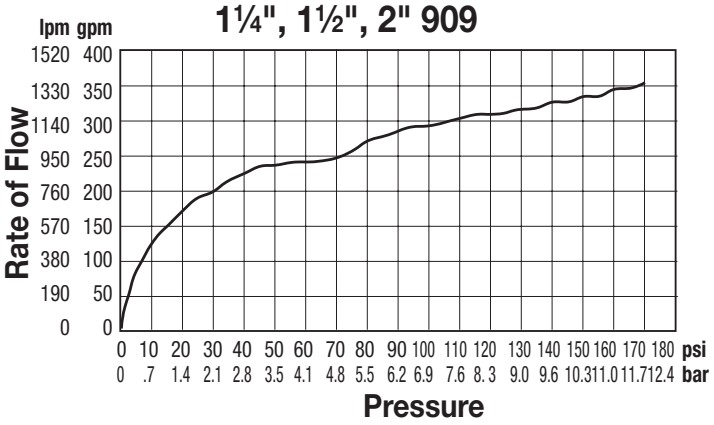
2½", 3" 009



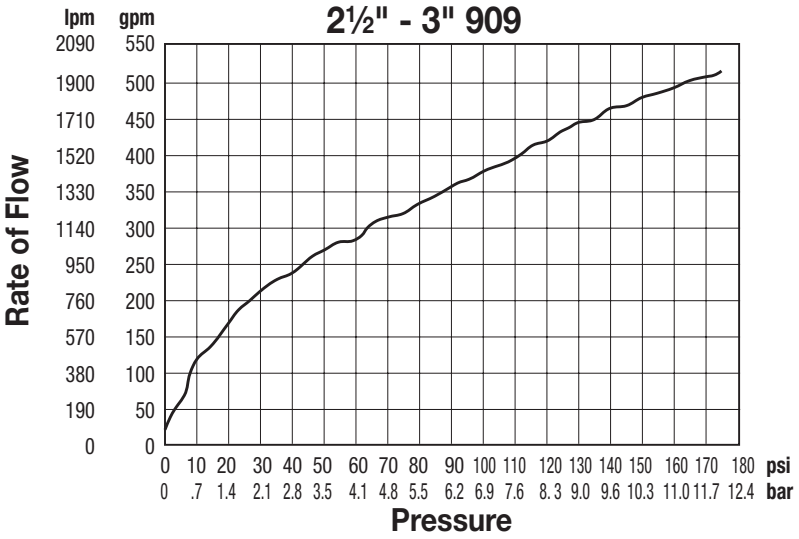
¾", 1" 909



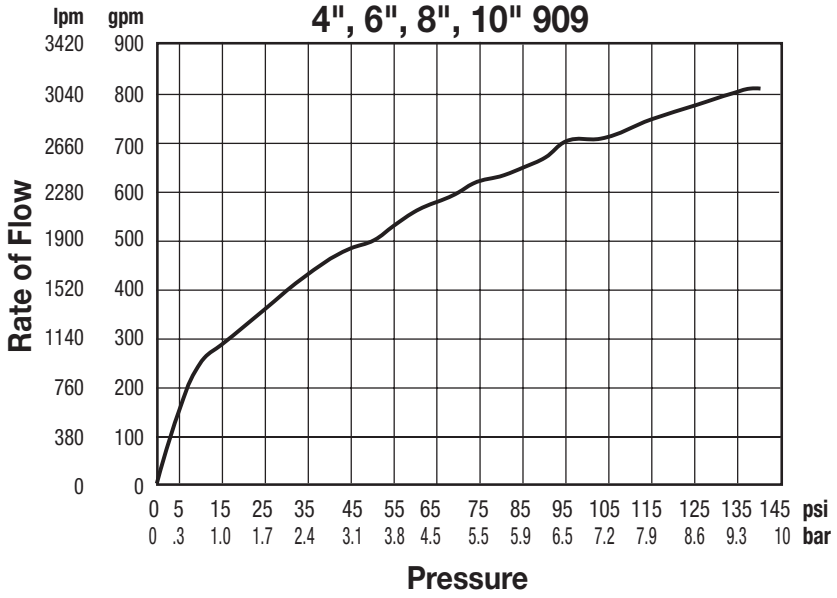
1¼", 1½", 2" 909



2½" - 3" 909

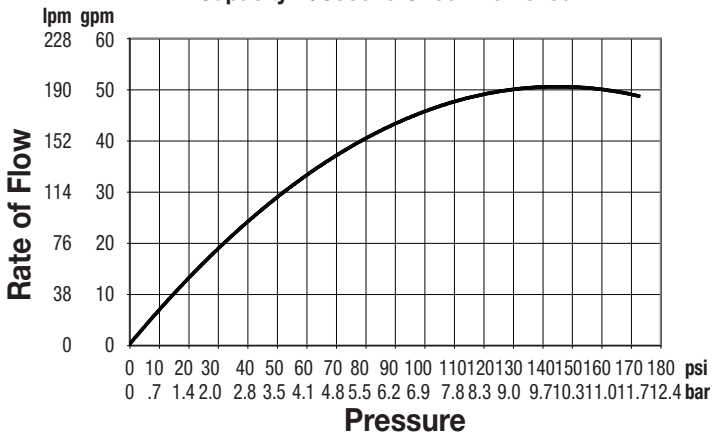


4", 6", 8", 10" 909

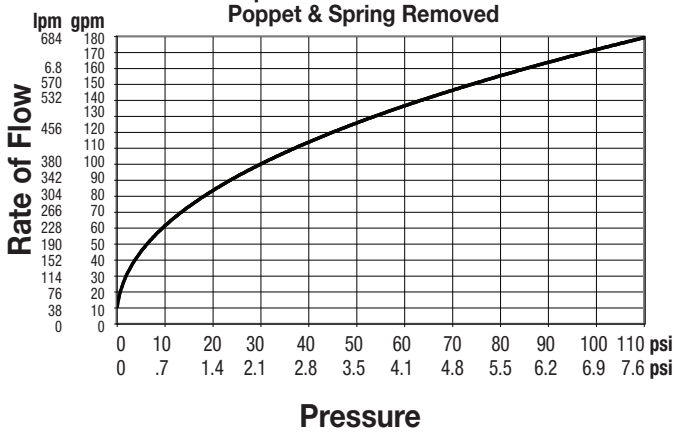


Note: These curves represent catastrophic or worst case discharge rates. These curves were developed by pressurizing the outlet of the backflow preventer with the second check valve's internals removed from the body.

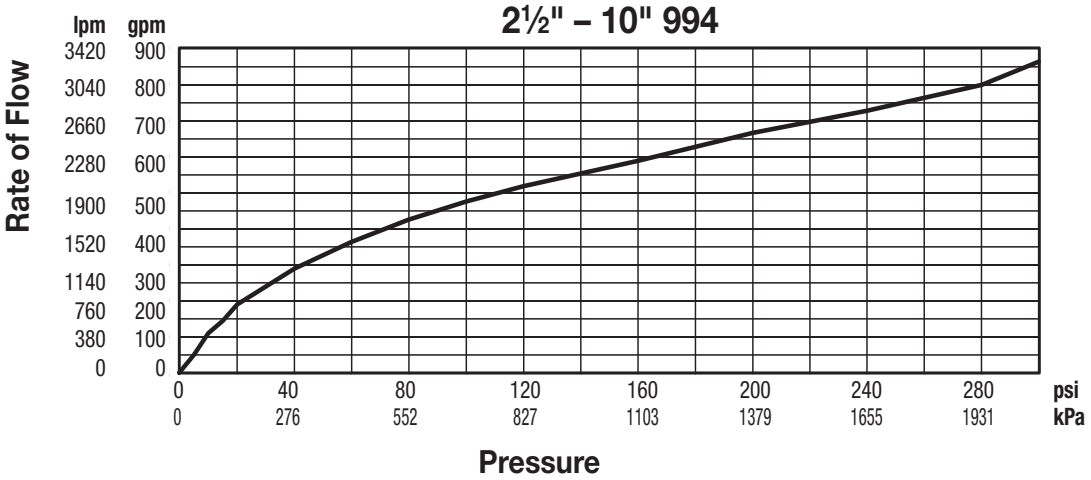
1" 919 RV
Capacity w/Second Check Removed



2" 919 QT
Backpressure w/Second Check Poppet & Spring Removed

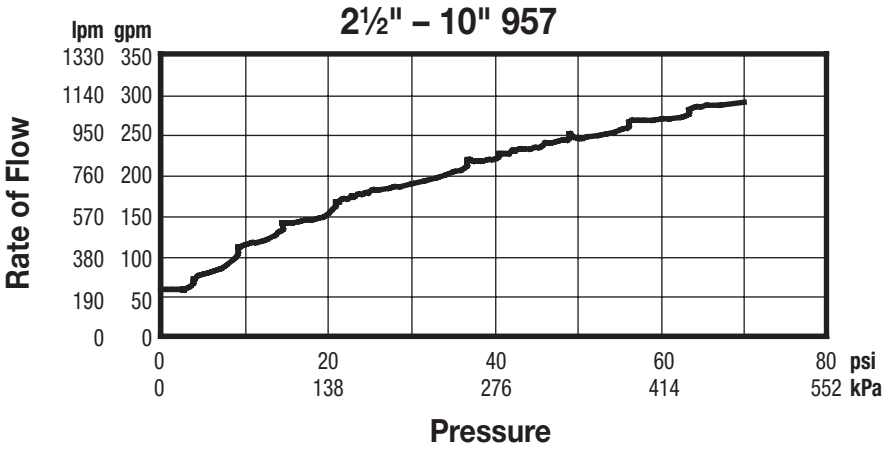


2½" – 10" 994



Note: These curves represent catastrophic or worst case discharge rates. These curves were developed by pressurizing the outlet of the backflow preventer with the second check valve's internals removed from the body.

2½" – 10" 957



Typical Flow Rates as sized by floor drain manufacturers		Drain Size
gpm	lpm	
55	209	2
112	426	3
170	646	4
350	1330	5

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Water Safety & Flow Control Products

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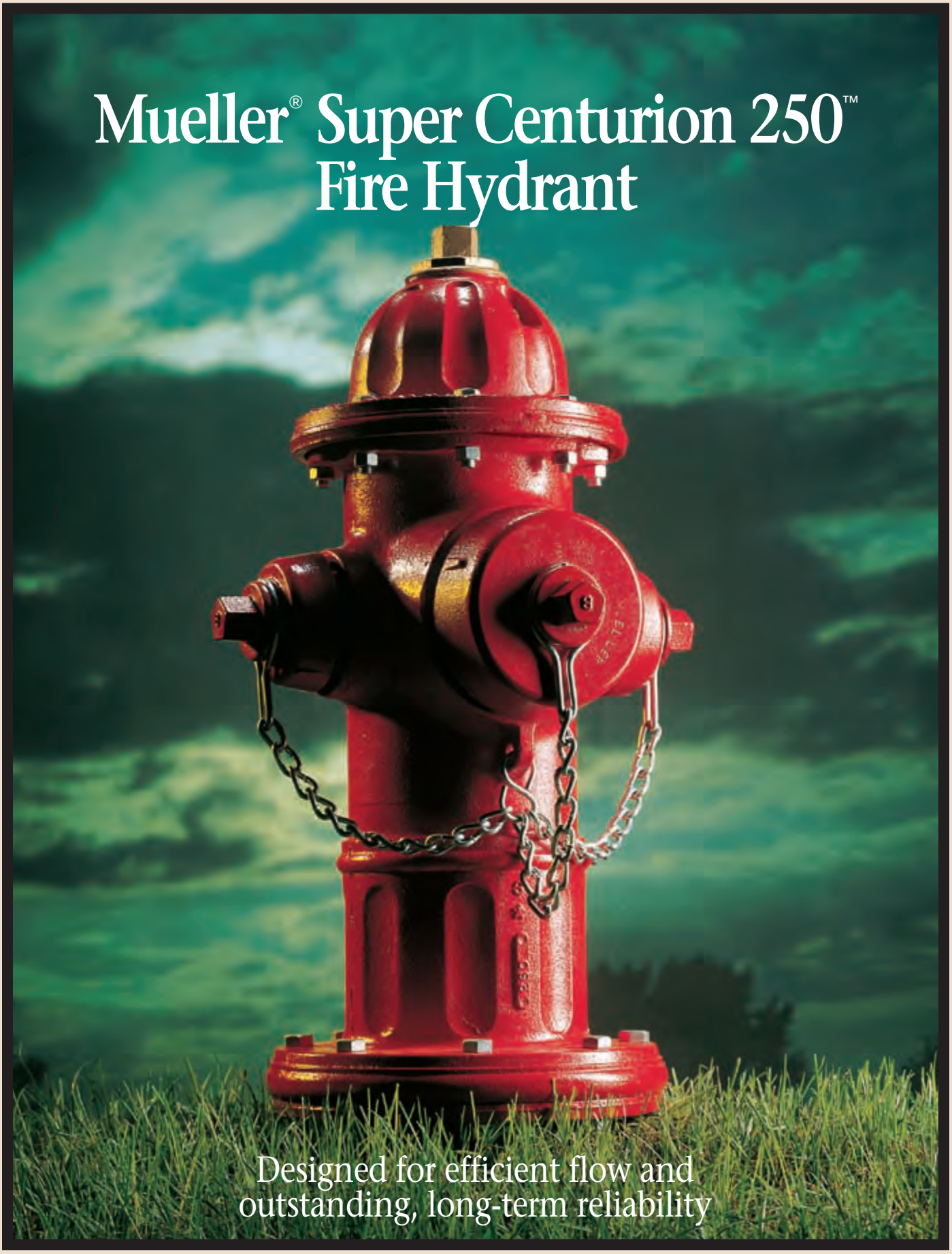
Mueller® Super Centurion 250™ Fire Hydrant



Designed for efficient flow and outstanding, long-term reliability

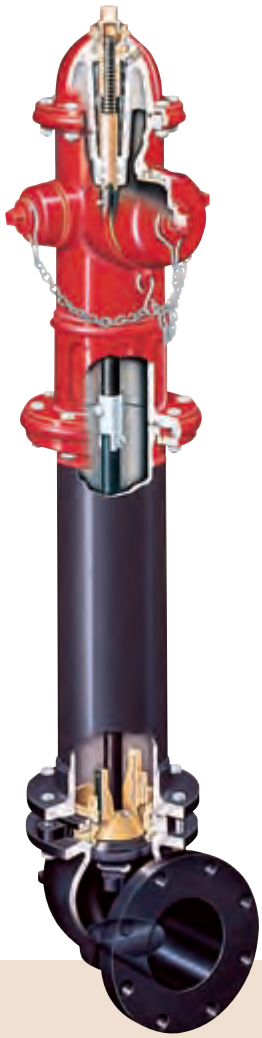
Mueller Co.

Mueller® Super Centurion 250™ Fire Hydrant...250 psig rating, high flow, dependable performance, 10-year limited warranty...and convenient, reversible main valve

Performance is the real test of a fire hydrant. Proven flow characteristics, 250 psig rating, and easy operation and maintenance are among the features of the Mueller® Super Centurion 250™ 3-Way Fire Hydrant. Plus, the hydrant is backed by a 10-year limited warranty on materials and workmanship, and our plant is ISO 9001 certified, the highest level available.

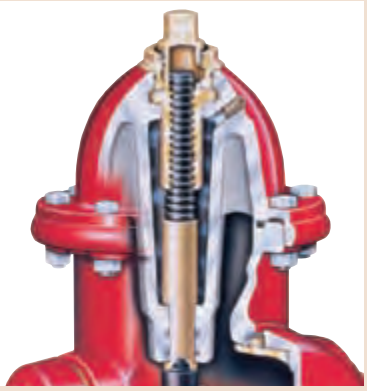
- 250 psig working pressure; 500 psig test pressure.
- Convenient, reversible main valve doubles service life.
- Advanced safety coupling and flange design reduce traffic damage to hydrant. Convenient replacement kit available.
- Stainless steel safety stem coupling resists corrosion and assures a tight connection between stem sections.
- Efficient hydraulic design provides maximum flow.
- Hose and pumper nozzles are threaded in and field-replaceable.
- Forced lubrication system and anti-friction washer ease operation.
- Main valve is easily removed from either the bonnet flange or ground line flange.

- *Fully conforms to AWWA Standard C502*
- *Underwriters Laboratories Listed*
- *Factory Mutual Approved*



From bonnet to shoe, performance is built in

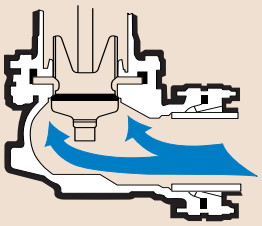
Dry-top design, with unique, self-oiling system, provides automatic, positive lubrication for easy operation, even after years of service. Lubricant is forced over all stem threads and bearing surfaces in the operating mechanism each time the hydrant is operated. Dual O-ring seals prevent lubricant loss during shipping, storage or installation and keep water away from stem threads and bearing surfaces when the hydrant is in use. An anti-friction washer and automatic lubrication of the thrust collar add to easy operation.



Hose and pumper nozzles are threaded-in for easy field replacement if damaged, or for changeover to different thread style. A special locking method makes installation simple and secure. The nozzles can be faced in any direction by loosening the safety flange bolts and rotating the upper barrel assembly.

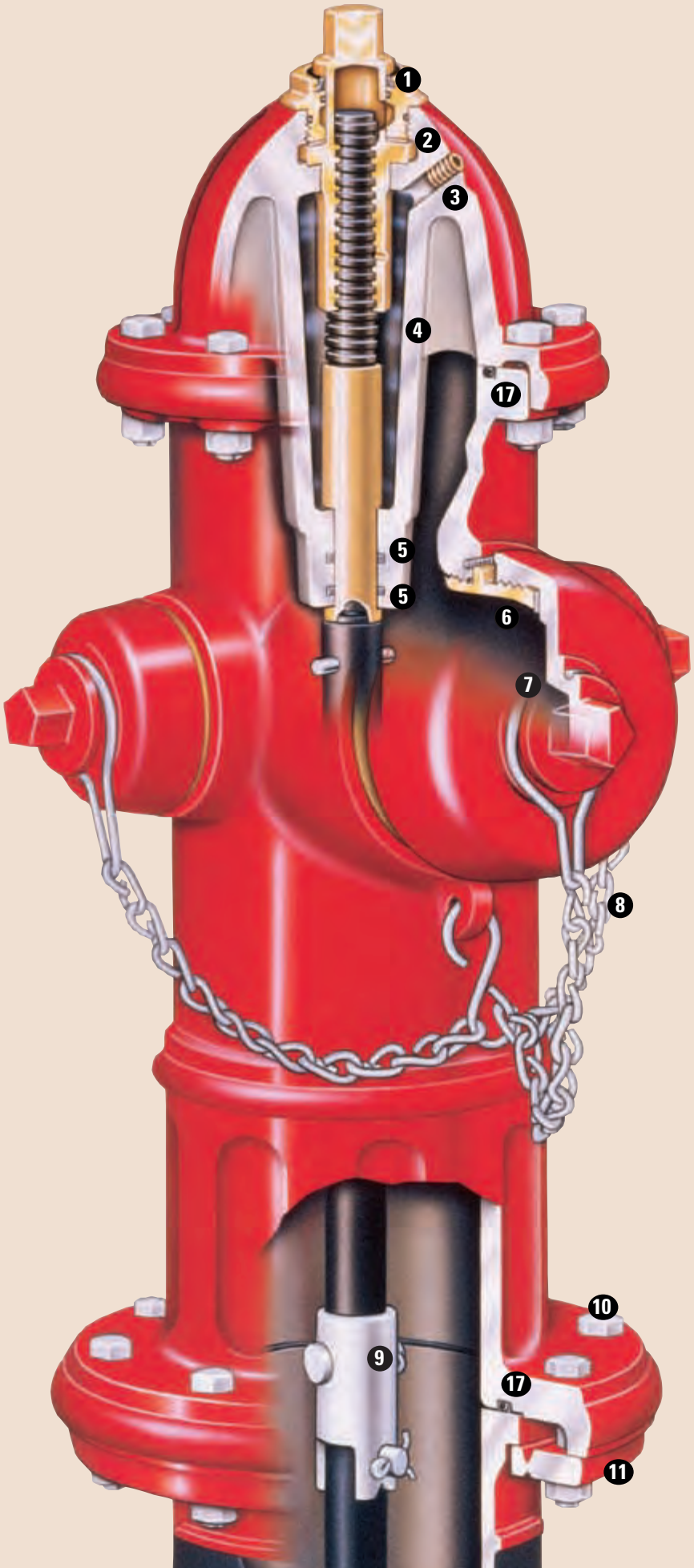
Improved safety flange and stainless steel stem coupling perform more predictably to protect the main connection from traffic induced damage and minimize damage to the hydrant. If struck by a vehicle, the safety flange breaks away below the ground flange area and the safety stem coupling *pulls apart*. No loose pieces can fall into the lower barrel where they could affect main valve or drain operation. The high strength stainless steel safety coupling resists corrosion and assures a tight connection between the stem sections during normal hydrant operation. Upon traffic impact, the coupling tears away, leaving the lower stem below ground level where it cannot be depressed by a vehicle tire, and the main valve remains closed. Service is restored quickly and easily without excavation by replacing the safety flange and coupling using a convenient repair kit.

Reversible, compression-type main valve closes with water pressure for positive sealing. Double drain valves are force flushed each time the hydrant is operated and provide drainage of the barrel. A special wrench allows removal of the main valve and seat ring from either bonnet or ground level flange. The main valve is made of durable rubber which provides a long service life, yet is reversible, providing a convenient spare in place.



Shoe is designed for maximum flow and easy connection with its smooth transitional contours, extended neck and integral anti-rotation pads, allowing use of standard tee-head bolts. The shoe also has large blocking pads for easier setting and two lugs for strapping. (Strapping lugs are not provided on flanged connections.) The inside of the shoe is covered with Mueller HP® Epoxy Coating. The drain ring housing, lower main valve plate and its retaining nut are also covered with epoxy. This thermosetting epoxy forms a tough, corrosion-resistant barrier to chemicals, physical impact and electrical currents.

O-ring sealed flanges at the bonnet, ground line and shoe simplify maintenance by eliminating gasket adhesion at these points, making disassembly easier. The O-rings are easier than flat gaskets to position during reassembly, and provide superior pressure handling.



1 **Hold-down nut** — features integral weather seal. Prevents unauthorized removal of hold-down nut or bronze operating nut. Resilient wiper seal prevents water entry and protects from freezing; material resistant to sunlight deterioration. O-ring provides second level seal.

2 **Anti-friction washer** — helps assure easy operation over life of hydrant.

3 **Oil filler plug** — permits visual check of oil level. Allows addition of oil without removing bonnet.

4 **Sealed oil reservoir** — O-ring sealed to prevent leakage. Lubricant is forced over stem threads and bearing surfaces each time hydrant is operated.

5 **Dual O-ring seals** — seal in lubricant; seal out water.

6 **Field-replaceable hose and pumper nozzles** — O-ring sealed; threaded in place and retained by stainless steel locks.

7 **Full flow openings** — large, smooth radius hose and pumper openings reduce friction loss.

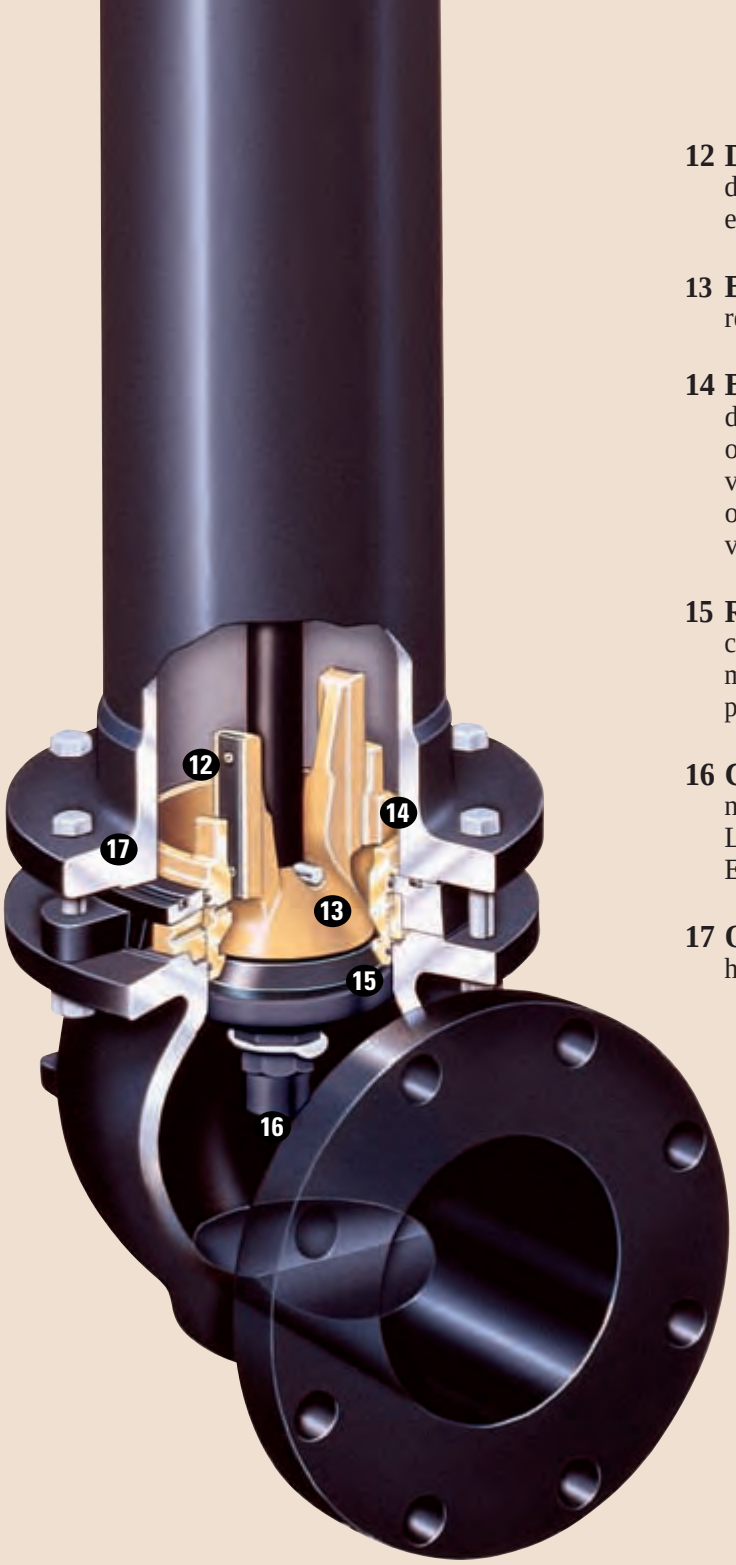
8 **Heavy-duty, non-kinking chains** — special chain loop permits free turning of cap.

9 **Stainless steel safety stem coupling** — provides a tight, corrosion resistant connection during normal operation. If vehicle hits hydrant, coupling pulls free without breaking into pieces, preventing stem or main valve damage. Designed so a tire cannot depress stem and open main valve.

10 **Zinc-plated bolts and nuts** — protect against corrosion.

11 **Safety flange** — breaks cleanly to help prevent barrel damage, but strong enough to withstand normal handling. Allows economical repair, adding of extension section, rotation or changing of upper barrel without excavation.

250 psig working pressure rating — compatible with today's trend toward higher pressure system components.



12 Drain valve facings — specially designed, long-life plastic facings provide effective sealing.

13 Bronze upper valve plate — conical design reduces turbulence.

14 Bronze seat ring — threaded into bronze drain ring and O-ring sealed. Can be removed or installed from above ground. Double drain valves force-flush drain openings to keep them open for effective barrel drainage. Bronze drain valves are integral parts of main valve assembly.

15 Reversible, compression-type main valve — closes with pressure for positive seal. Rubber material has long service life, yet is reversible, providing a convenient spare in place.

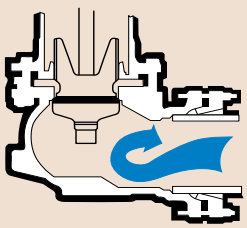
16 Cap nut — retains main valve. Sealed by cap nut gasket to prevent corrosion of stem threads. Locked in place by a stainless steel lock washer. Epoxy coated to resist corrosion.

17 O-ring flange seals — superior pressure handling, easier disassembly and maintenance.

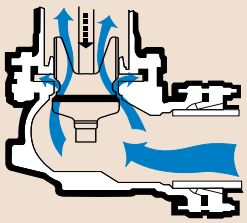
Contoured shoe — designed for maximum flow. Extended neck and anti-rotation pads allow use of standard tee-head bolts.

Mueller HP® Epoxy Coating— covers shoe interior, main valve lower plate and its retaining cap nut. Drain ring housing is also covered to resist corrosion and deposits, and ease main valve removal.

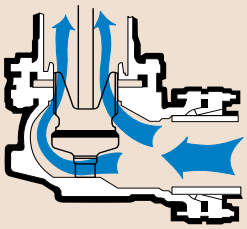
Main valve operation



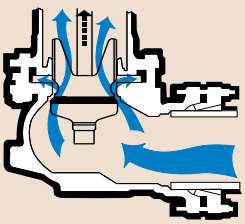
Closed — main valve held closed by operating nut and water pressure; barrel is dry.



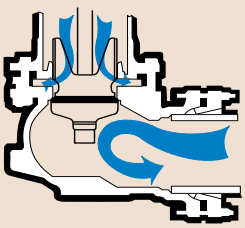
Opening — water pressure force-flushes double drain valves and drain openings; establishes drainage field around hydrant.



Fully open — main valve guides seal drain valves closed.



Closing — water pressure again force-flushes drain valves.



Fully closed — drain valves are open to allow drainage of barrel.

Mueller® Centurion® Fire Hydrant

250 psig working pressure — 500 psig test pressure

A-421	4-1/2"	three-way	2 hose nozzles and 1 pumper nozzle
A-423	5-1/4"	three-way	2 hose nozzles and 1 pumper nozzle

200 psig working pressure — 400 psig test pressure

(Many of the same features as the Centurion 250™ hydrant)

A-420	4-1/2"	two-way	2 hose nozzles
A-422	5-1/4"	two-way	2 hose nozzles
A-424	4-1/2"	one-way	1 pumper nozzle
A-425	5-1/4"	two-way	2 pumper nozzles

Storz pumper nozzle option —

- Available for 5" pumper nozzles, an integral storz connection allows the fire department to connect its pumper hose to the hydrant with a quick, quarter-turn action.
- No thread alignment, cross threading or leakage problems.

4-way with monitor elbow —

- Monitor style eliminates a possible leak path with separate monitor nozzle attachment.
- All parts interchangeable with Mueller Super Centurion 250 hydrant.
- 250 psi working pressure; 500 psi test pressure.
- Full flow 4-way openings: 4" monitor elbow, one 4-1/2" pumper nozzle, two 2-1/2" hose nozzles.

Sizes and types of inlet connections

Size of Hydrant	Aqua-Grip™ System IPS/DIPS	Flanged*	Mech. Joint	D-150 Mech. Joint	Slip-On
4-1/2"	6"**	4", 6"	4", 6", 8"	4", 6"	6"
5-1/4"	6"**	4", 6"	4", 6", 8"	4", 6"	6"

(Auxiliary gate valves with flanged outlet and choice of inlet can be attached to hydrant with flanged inlet.)

*Available with vertical or horizontal inlet.
**Two styles available: IPS (PVC, PE, steel) or DIPS (DI, PVC, PE).

Mueller accessories

A-359-00 seat wrench — universal fit; used to remove main valve and seat ring from bonnet level or ground line. Wrench self-centers on barrel flanges.

A-367 brass sleeve — protects O-rings from damage when the bonnet is removed from the upper stem.

A-311 operating wrench — operates nozzle caps, pin- and lug-type hose couplings, hydrant operating and hold-down nuts.

A-51 hydrant lubricating oil — 10.5 oz. can of all-weather oil exactly fills oil reservoir.

Ordering hydrants, accessories, or repair kits
For complete ordering information refer to the Mueller Water Distribution Products Catalog (available on-line).

Hydrant repair kits

Having everything you need in a convenient kit helps make routine maintenance easier and periodic hydrant upgrading simpler. Kits are available for five different hydrant sections. Specific kits include:

1 Bonnet repair kit

Weather seal.
Bonnet O-ring.
Stem O-rings.
Hold-down nut O-ring.
Anti-friction washer.
Bonnet flange O-ring and gasket.†
Hydrant lubricating oil.

2 Safety flange repair kit

Stem coupling.
Flange gasket.
Safety flange.
Hydrant lubricating oil.
Replacement bolts and nuts.
Bonnet flange O-ring and gasket.†

3 Extension kit

Extension barrel.
Flange.
Extension stem.
8 bolts and nuts.
Flange O-ring and gasket.†
Hydrant lubricating oil.
Stem coupling and hardware.
Bonnet flange O-ring and gasket.†

4 Main valve kit

Top seat O-rings.
Bottom seat O-rings.
Main valve.††
Bronze seat ring.
Lower valve plate.††
Cap nut seal.
Lock washer.

5 Shoe repair kit

Drain valve facings.
Top seat O-ring.
Lower valve plate.††
Bottom seat O-ring.
Cap nut seal.
Main valve.††
Lock washer.
Shoe nuts and bolts.
Drain valve facing screws.
Drain ring housing O-ring and gasket.
Hydrant lubricating oil.

†Kit includes both O-ring and gasket to accommodate either 250 psig or 200 psig style hydrants.
††Reversible style main valve and lower valve plate — must be used together when replacing non-reversible style parts.

Manufactured under one or more of the following:
U.S. Patent No. 4,717,178; 4,842,246.

Mueller Co.

Main Office — Decatur, IL
Water Division: 1-800-423-1323
Canada — Mueller Canada Inc., Milton, Ontario 1-905-878-0541
www.muellercompany.com
e-mail: moreinfo@muellercompany.com

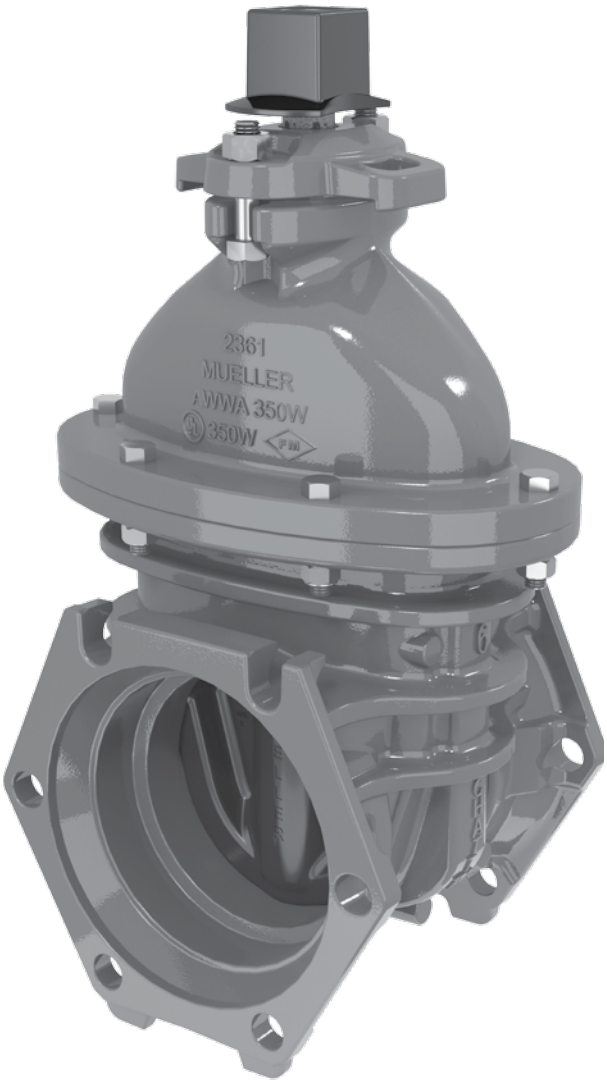
All products must be installed and maintained in accordance with applicable instructions and/or standards.

Copyright 1995 Mueller Co.

MUELLER 2300 Series Resilient Wedge Gate Valves

Mueller Resilient Wedge Gate Valves have features to make them easier to operate, preserve sealing capability, and interior coating integrity for many years of reliable service. In addition to popular end connection options, Mueller brand RW valves can be ordered with Mueller's exclusive AquaGrip® System that incorporates an o-ring sealed compression connection and integral pipe restraint in one "ready to use" easy and quick to install package.

Mueller 4" – 12" 2361 Series Resilient Wedge Gate Valve Features



- 350 PSIG MAXIMUM WORKING PRESSURE – Hydrostatically tested at 700 psig.
- DUAL-PURPOSE LIFTING LUGS – new dual-purpose lifting lugs provide stability for the valve box. Accomodates strap or hooks; provides valve box alignment, eliminating need for valve box adapter.
- "PRESSURE ASSIST" WEDGE GEOMETRY – unique "pressure assst" wedge geometry needs equal or less torque to seal at 350 psig than current valves require at 250 psi.
- AMERICAN MADE QUALITY – factory in Chattanooga, TN with ISO 9001 certification. Certified to ANSI/NSF 61. Manufactured and tested in compliance with ANSI/AWWA Standard C515. UL 262 Listed and FM 1120/1130 Approved.
- Valve body, bonnet, disc, stuffing box, and op nut - Ductile iron
- T-HEAD BOLT RETENTION – improved T-head bolt retention feature eliminates need for anti-rotation bolts
- TRIPLE O-RING SEALS – two above thrust collar and one below, retain lubricant in this critical area. Top two are replaceable with valve fully open and under pressure. Fourth 0-ring serves as dirt seal.
- TWO ANTI-FRICTION WASHERS WITH LUBRICATION – made of polymer, one above and one below the thrust collar, reduce operating torque to open or close valve.
- STEM – forged manganese bronze bar stock is upset, then machined to form a thrust collar for superior strength in this critical area.
- GUIDE CAP BEARINGS – made of polymer and snapped over rubber covered wedge guides, provide bearing surfaces that protect both wedge and interior body coating from wear and aid in easy operation – even the largest valves installed horizontally. Rollers, tracks or scrapers are not needed.
- SMOOTH, OVERSIZED FLOW WAY – full, round, unobstructed flow way accommodates full size cutters, provides superior flow characteristics and reduces pumping costs.**
- MUELLER PRO-GARD™ FUSION EPOXY COATING – 10 mils* thick protects all inside and outside iron surfaces, and complies with AWWA C550.
- INTEGRAL LEGS – stands upright for easier handling and storage.
- 10-YEAR LIMITED WARRANTY – assured reliability (see separate Mueller Warranty document for terms).
- MUELLER VALVES ARE DESIGNED FOR POTABLE WATER APPLICATIONS.

**Nominal*
***16" valve requires 1/2" undersized cutter, 54" valve requires 48" cutter*

Mueller 14" – 54" 2361 Series Resilient Wedge Gate Valve Features

In addition to all the features of the smaller 2361 series valves, large size Mueller 2361 series RW valves offer these features:

- STEM – 18"-54" manganese bronze casting with integral thrust collar.

SIZE	AWWA C515 WORKING PRESSURE	UL WORKING PRESSURE	FM WORKING PRESSURE
14"-16"	250	250	250
18"-24"	250	175*	-
30"-48"	250	-	-
54"	250†	-	-

† AWWA C515 does not recognise valves larger than 48"
** UL Listed without gearing*

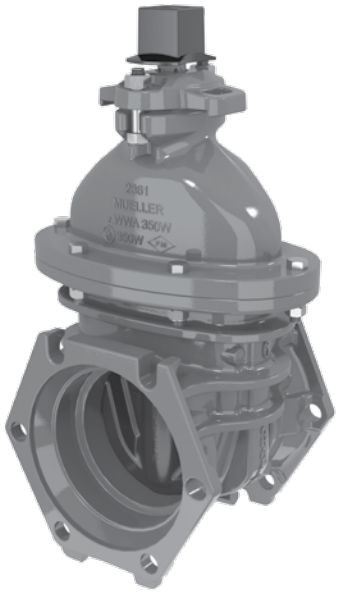
Double-Disc Style gate valves follow the RW valve pages.

Mueller Co.

4"- 12" A-2361 RESILIENT WEDGE GATE VALVES - M.J. x M.J.

Rev. 4-14

- Catalog number–
  A-2361-20 Mechanical joint ends (with accessories unassembled)
  A-2361-23 Mechanical joint ends (less accessories)
  A-2361-25 Mechanical joint ends (with transition gaskets accessories unassembled)
- Sizes – 4", 6", 8", 10", 12"
- Meets or exceeds all applicable requirements of ANSI/AWWA C515 Standard, UL Listed, FM Approved, and certified to ANSI/NSF 61.
- Standard mechanical joint ends comply with ANSI/AWWA C111
- Iron body with nominal 10 mils MUELLER® Pro-Gard® Fusion Epoxy Coated interior and exterior surfaces
- Epoxy coating meets or exceeds all applicable requirements of ANSI/AWWA C550 Standard.
- Iron wedge, symmetrical & fully encapsulated with molded rubber; no exposed iron
- Non-rising stem (NRS)
- Triple O-ring seal stuffing box (2 upper & 1 lower O-rings) with fourth o-ring serving as dirt seal
- 2" square wrench nut (optional handwheel available)–-open left or open right
- 350 psig (2400 kPa/24 barg) maximum working pressure, 700 psig (4800 kPa/48 barg) static test pressure
- UL Listed, FM Approved: 350 psig (2400 kPa/24 barg)
- Mueller valves are designed for potable water application



A-2361-20

Options

See page 10.46 for more information on Resilient Wedge Gate Valve options

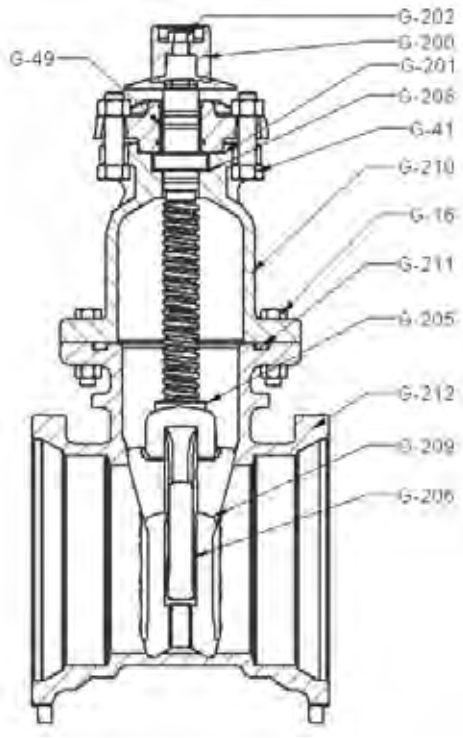
- Position indicators
- Stainless steel fasteners: Type 316
- Stainless steel stem: Type 304, Type 316
- ASTM B98-C66100/H02 stem
- Handwheel
- EPDM Disc and o-rings

Resilient wedge gate valve parts

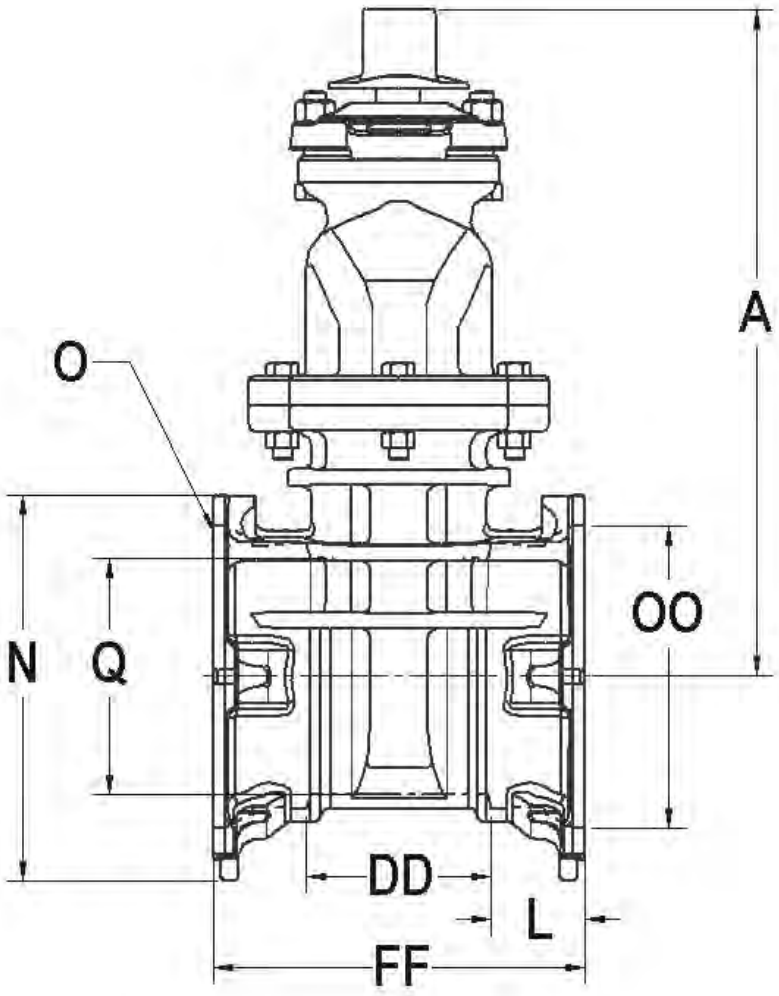
Catalog Part No.	Description	Material	Material Standard
G-16	Bonnet Bolts & Nuts	304 Stainless Steel	ASTM F593 (bolt) ASTM F594 (nut)
G-41	Stuffing Box Bolts & Nuts	304 Stainless Steel	ASTM F593 (bolt) ASTM F594 (nut)
G-49	Stem O-rings (3)	Nitrile	ASTM D2000
G-200	Wrench Nut Cap Screw	304 Stainless Steel	ASTM F593
G-201	Stuffing Box O-ring	Nitrile	ASTM D2000
G-202	Wrench Nut	Ductile Iron	ASTM A536 ▼
G-203	Stem	Bronze	ASTM B138
G-204	Hand Wheel (not shown)	Cast Iron	ASTM A126 CL.B
G-205	Stem Nut	Bronze	ASTM B584
G-206	Guide Cap Bearings	Acetal	-
G-207	Stuffing Box with dirt seal	Ductile Iron Nitrile	ASTM A536 ▼ ASTM D200
G-208	Anti-friction Washers (2)	Acetal	-
G-209	Wedge, Rubber Encapsulation	Ductile Iron* SBR	ASTM A536 ▼ ASTM D2000
G-210**	Bonnet	Ductile Iron	ASTM A536 ▼
G-211**	Bonnet gasket	Nitrile	ASTM D2000
G-212**	Body	Ductile Iron	ASTM A536 ▼

**Fully encapsulated in molded rubber with no iron exposed*

▼ Material strength ASTM A536 65-45-12 minimum



SEE PAGE 10.53 FOR ORDERING INSTRUCTIONS



Dimensions

Dimension	Nominal Size				
	4"	6"	8"	10"	12"
A	14.19	18.00	21.50	25.50	28.62
FF	9.50	10.00	10.50	11.50	12.00
L	2.50	2.50	2.50	2.50	2.50
N	8.40	10.41	12.68	15.24	18.024
O (number and size of holes)	4--.88	6--.88	6--.88	8--.88	8--.88
DD	4.50	5.00	5.50	6.50	7.00
Q	4.30	6.30	8.30	10.30	12.30
OO (bolt circle diameter)	7.50	9.50	11.75	14.00	16.25
Turns to open	14	20.5	26.5	33.0	38.5
Weight*	75	124	181	270	345

**All dimensions are in inches. All weights include accessories are in pounds and are approximate.*

EXHIBIT I

Sanitary Sewer System and Pump Station Engineer's Report

for

Project Olive
2780 Long Road
Town of Grand Island, New York

Prepared For:

TC Buffalo Development Associates, LLC
600 Grant Street, Suite 4800
Pittsburgh, PA 15219

Prepared By:

Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.
One North Broadway, Suite 910
White Plains, New York 10601

Michael Finan, PE, LEED-AP
Professional Engineer, NY License No. 081473

February 21, 2020

Project No.: 100785901

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Appendices

Appendix A: 2012 Engineer's Report prepared by C&S Engineers, Inc.
Appendix B: 2017 Engineer's Report prepared by C&S Engineers, Inc.
Appendix C: Pump Station Calculations
Appendix D: Sanitary Sewer Specifications

1 Executive Summary

This Sanitary Sewer System and Pump Station Engineer's Report has been prepared for the Applicant, TC Buffalo Development Associates, LLC, who is proposing to develop ±145.4 acres of land located at 2780 Long Road ("Site"), in the Town of Grand Island ("Town"), New York for use as an e-commerce storage and distribution facility for consumer products ("Facility") by a single prospective entity ("Project") The project, also known as Project Olive, is a commercial development that consists of a 5-story building with a ±823,400 square foot warehouse building footprint (±3,783,124 square feet total) with associated car and trailer parking (see Figure 1). The site is currently owned by Grand Island Commerce Center Joint Venture ("Owner"). The Owner also owns ± 62.1 acres of land adjacent to the western boundary of the Site ("West Parcel"). No development is proposed in the West Parcel, and the West Parcel was not analyzed as part of this Report.

The sanitary sewer portion of the project involves:

- Removal of ±4,195 linear feet of existing 6-inch diameter PVC force main.
- Removal of three existing manholes.
- Installation of ±4,478 linear feet of 6-inch diameter PVC force main.
- Installation of nine two-way cleanouts.
- Installation of two air release valves.

2 Project History

2012 Engineer's Report

The Site was previously part of a development called the Grand Island Gateway Center. According to the 2012 "Engineer's Report for Stormwater Management, Sanitary Sewer and Water Systems, Grand Island Gateway Center" prepared by C&S Engineers, Inc., due to the lack of capacity and condition of the existing sewer on Long Road, the Town of Grand Island Engineering Department required that the sanitary sewage from the Grand Island Gateway Center development be discharged to the 30-inch diameter interceptor sewer located west of Baseline Road which would require a pump station.

The design flow was estimated to be 140,862 gallons per day (gpd) based on the hydraulic loading rates from the New York State Department of Environmental Conservation (NYSDEC) "Design Standards for Wastewater Treatment Works", 1988 for general office, industrial, and future residential. The breakdown of projected wastewater flow was as follows:

General Office	= 15 gpd/employee x 8,690 employees x 0.8	=	104,283 gpd
Industrial	= 25 gpd/employee x 112 employees x 0.8	=	2,240 gpd
Future Residential	= 438 gpd/unit x 98 units x 0.8	=	34,339 gpd
	Design Flow	**=**	**140,862 gpd**

An 8-inch diameter SDR-18 PVC force main and a duplex Smith & Loveless suction lift pump station were proposed. According to the February 2009 "Site Development Plans for Grand Island Gateway Center" prepared by C&S Engineers, Inc., the pump station pumps are model 4B2B 10 horsepower motors, 1760 RPM, 230 volt, 3 phase. The pump station wet well was a

6-foot internal diameter wet well with an internal depth of 15'-3". See Appendix A for additional information.

2017 Engineer's Report

According to the August 2017 "Engineer's Report for the Town of Grand Island Sanitary Sewer System & Forcemain" prepared by C&S Engineers, Inc., the design flows were revised to include a hotel use on the former Dunlop site. The design flow was estimated to be 97,770 gpd based on the hydraulic loading rates from the "NYSDEC Design Standards for Intermediate Sized Wastewater Treatment Systems", 2014 for general office, light industrial, future residential, and hotel. The breakdown of projected wastewater flow was as follows:

General Office	=	548,856 sf x 0.1 gpd/sf x 0.8	=	43,900 gpd
Light Industrial	=	50 employees x 15 gpd/employee x 0.8	=	600 gpd
Future Residential	=	100 lots x 3.5 beds x 110 gpd/bed x 0.8	=	30,800 gpd
Hotel	=	110 gpd/unit x 205 units x 0.8	=	18,000 gpd
	=	50 seats x 35 gpd/seat x 2 rooms x 0.8	=	2,800 gpd
	=	205 pool guests x 10 gpd/guest x 0.8	=	1,600 gpd
		Design Flow	**=**	**97,770 gpd**

A 6-inch diameter DR-21 HDPE force main and a duplex Smith & Loveless suction lift pump station were proposed. According to the May 2017 pump station plans prepared by C&S Engineers, Inc., the pump station pumps are model 4B2D 10 horsepower motors, 1760 RPM, 230 volt, 3 phase. The pump station wet well was a 5-foot internal diameter wet well with an internal depth of 16'-1". See Appendix B for additional information.

3 Existing Conditions

3.1 Soils

The United States Department of Agriculture (USDA) Soil Conservation Service Soil Survey for Erie County has been reviewed. The surficial soil conditions are shown in Figure 2 and are summarized in the table below.

Table 3-1: USDA Soil Data

Map Symbol	Description	Depth to Groundwater (ft)	Depth to Bedrock (in)
CoA	Churchville silt loam, 0 to 3 percent slopes	0.5 – 1.5 (Dec – May)	>60
La	Lakemont silt loam, 0 to 3 percent slopes	0 – 0.5 (Nov – June)	>60
Od	Odessa silt loam, 0 to 3 percent slopes	0.5 – 1.5 (Dec – May)	>60
Oe	Odessa-Lakemont complex, 0 to 3 percent slopes	0.5 – 1.5 (Dec – May)	>60
Pt	Pits, borrow	>6.0	>60
RkA	Rhinebeck gravelly loam, 0 to 3 percent slopes	0.5 – 1.5 (Jan – May)	>60

Map Symbol	Description	Depth to Groundwater (ft)	Depth to Bedrock (in)
SaA	Schoharie silt loam, 0 to 3 percent slopes	1.5 – 3.0 (Mar – May)	>60
SaB	Schoharie silt loam, 3 to 8 percent slopes	1.5 – 3.0 (Mar – May)	>60

A geotechnical field investigation was performed by Langan from November 12, 2019 to November 25, 2019 to determine the subsurface soil conditions in various locations throughout the property. A total of eight borings, fourteen test pits and four percolation tests were performed.

- Boring depths ranged from 26 to 50 feet below existing grade. Groundwater and bedrock were not encountered in any of the borings.
- Test pit depths ranged from 6 to 1.5 feet below existing grade. Groundwater and bedrock were not encountered in any of the test pits.
- Percolation test depths were 5 feet below existing grade. Percolation rates were less than 0.1 inches per hour.

Refer to the Preliminary Geotechnical Engineering Study Report prepared by Langan for additional information.

3.2 Existing Conditions

The Site is bounded by Long Road and residential and commercial properties to the north; Interstate I-190 to the east; Bedell Road and residential and commercial properties to the south; and the West Parcel, which is predominantly wooded areas, to the west. The site is currently vacant. The majority of the site is wooded; however, there are areas that have been previously cleared. Several wetlands were identified within the project site during the previously performed wetland and waterbody delineations in October 1990 and 2019. Four wetlands are United States Army Corps of Engineers (USACE) jurisdictional wetlands and are identified on the plans as wetlands J, L, N, and P. Five wetlands are New York State Department of Environmental Conservation (NYSDEC) regulated wetlands and are identified on the plans as wetlands M, R, S, T, and U. The remaining wetlands are non-jurisdictional and are identified on the plans as wetlands A, B, C, D, E, F, G, H, I, K, O, and Q. In addition to the wetlands, three waterbodies were identified on the Site. One ditch flows through the central part of the site, one ditch flows along Long Road, and the last ditch flows through the southern part of the site near Bedell Road. The ditches ultimately join together and flow north along Long Road to the Niagara River.

A pump station, located approximately 130 feet south of Long Road and within the Site, has been installed. The pump station is a duplex Smith & Loveless suction lift pump station (Model 4B2D) which has a 6-inch diameter DR-21 HDPE force main with cleanouts and air relief valves within the project development. The force main runs from the pump station through the project development area to Bedell Road (see Figure 3). The force main continues along Bedell Road where it ultimately connects into the Town 30-inch diameter interceptor sewer. The pump station currently provides sanitary sewer conveyance for the hotel located on the former

Dunlop site. We understand that the pump station and forcemain are in the process of being dedicate to the Town.

4 Sanitary Sewer System

4.1 Projected Wastewater Flow

As discussed in the August 2017 "Engineer's Report for the Town of Grand Island Sanitary Sewer System & Forcemain", the constructed hotel on the former Dunlop site has a design average daily flow of approximately 22,400 gpd.

At maximum, there will be up to 1,500 employees in the Facility per shift during peak season, and will have two shifts. The wastewater generation for the Project, based on peak season is:

1,500 employees/shift x 2 shifts x 15 gpd/employee = 45,000 gpd.

The total projected wastewater generation for the Project is:

Hotel	=	22,400 gpd
Warehouse Facility	=	45,000 gpd
Total	**=**	**67,400 gpd**

In addition, the West Parcel is zoned R-1A Low Density Single Family Residential and has the potential to be developed in the future. Based on the current zoning, the minimum lot area required for the West Parcel is 3 acres. Based the lot acreage and minimum lot area required in the R-1A zoning, there is a potential to develop the West Parcel by adding approximately 20 residential lots. It is our understanding that there are potential NYSDEC regulated wetlands on the West Parcel. Taking the wetlands and 100 foot regulated adjacent area into consideration, it is more likely that only 5 lots would be feasible; however, for this analysis the projected wastewater generation is based on the 20 lots as a conservative approach. The projected wastewater generation for the West Parcel is:

20 lots x 3.5 bedrooms/lot x 110 gpd/bedroom = 7,700 gpd.

The pump station has a capacity of 97,770 gpd. The total projected wastewater generation is 67,400 gpd for the Project and the hotel, which leaves approximately 30,370 gpd remaining capacity. Accordingly, the pump station has adequate capacity to handle the Project and the hotel, along with potential future development of the West Parcel.

4.2 Proposed Collection System

The sanitary sewer system is designed to collect the wastewater generated from the proposed development and convey it by gravity to the existing on-Site pump station. The pump station will pump the wastewater south to Bedell Road and ultimately into the 30-inch diameter interceptor sewer. All sanitary flows will be domestic in nature and void of any industrial solid, hazardous, or toxic waste contamination.

The proposed sanitary sewer collection system will consist of ±761 linear feet of 4-inch diameter SDR 35 PVC gravity sewer pipes, ±4,325 linear feet of 8-inch diameter SDR 35 PVC

gravity sewer pipes, 17 manholes, ±615 linear feet of 1½-inch SDR 21 PVC force main, ±4,478 linear feet of 6-inch diameter SDR 21 PVC force main, 9 cleanout structures, and 2 air release valves. The sanitary sewer system has been designed in accordance with the requirements of the New York State Department of Environmental Conservation (NYSDEC) and the *Ten States Recommended Standards for Wastewater Facilities*, latest edition.

Approximately 4,195 linear feet of the existing 6-inch diameter PVC force main will be removed as a result of the proposed development. Approximately 4,478 linear feet of 6-inch diameter SDR 21 PVC force main will be installed. The new force main section will follow the access driveway. Cleanout will be spaced every 500 feet and air release valves will be placed on high points.

Where the proposed sanitary sewer line or force main will be parallel to the water main, minimum horizontal separation distance of 10 feet (wall-to-wall) was maintained. Where the proposed sanitary sewer line or force main crosses the water line, a minimum vertical separation distance of 18-inches (wall-to-wall) was maintained.

The sanitary manholes will be precast concrete and have a minimum inside diameter of 48-inches. Sanitary manholes will be provided at all changes of direction, both vertical and horizontal, at the terminus of all lines, and spaces not more than 400 feet apart. The sanitary manholes will be waterproofed on the exterior surface with two layers of bituminous paint.

4.3 Inflow and Infiltration (I&I)

The Grand Island Wastewater Treatment Facility is located in the southeast corner of Buckhorn State Park on approximately 17.5 acres of land and is designed to handle a domestic sewage flow of 3.5 million gallons of sewage per day. After undergoing advanced secondary treatment and disinfection, effluent is discharged to the Niagara River at the northern terminus of Grand Island. The Applicant understands that the plant currently receives approximately 2.9 million gallons per day.

Through our discussions with the Town Engineering Department an inflow and infiltration offset of 4:1 of the peak flow in gallons per minute (gpm) [16x average daily flow (in gpm)] will be requested by the New York State Department of Environmental Conservation (NYSDEC)/ Erie County Department of Health (ECDOH) during their review/approval of the project and will likely be a condition of the permit. The offset fee is $100/gpm. The Applicant understands that the fees for I&I would be due upon petitioning for building permits.

Based on the above, the projects projected average daily sanitary sewer demand is 45,000 gallons per day (31.25 gpm). The Applicant is willing to participate in the Town I&I contribution program, which equates to $50,000 (31.25 x 16 x $100/gpm).

4.4 Pump Station

The pump station was designed based upon a flow of 275 gallons per minute (gpm) at a total dynamic head of 68 feet. Approximately 283 linear feet of force main will be added to the overall length as a result of the force main relocation. The engineering calculations provided in the August 2017 Engineer's Report were evaluated based upon this additional length. Based on our analysis, at a flow rate of 275 gpm, the new total dynamic head would be 70 feet.

Plotting this information against the design curve demonstrates there is no significant change in the pump curve as a result of the additional force main length. Detailed design calculations are provided in Appendix C.

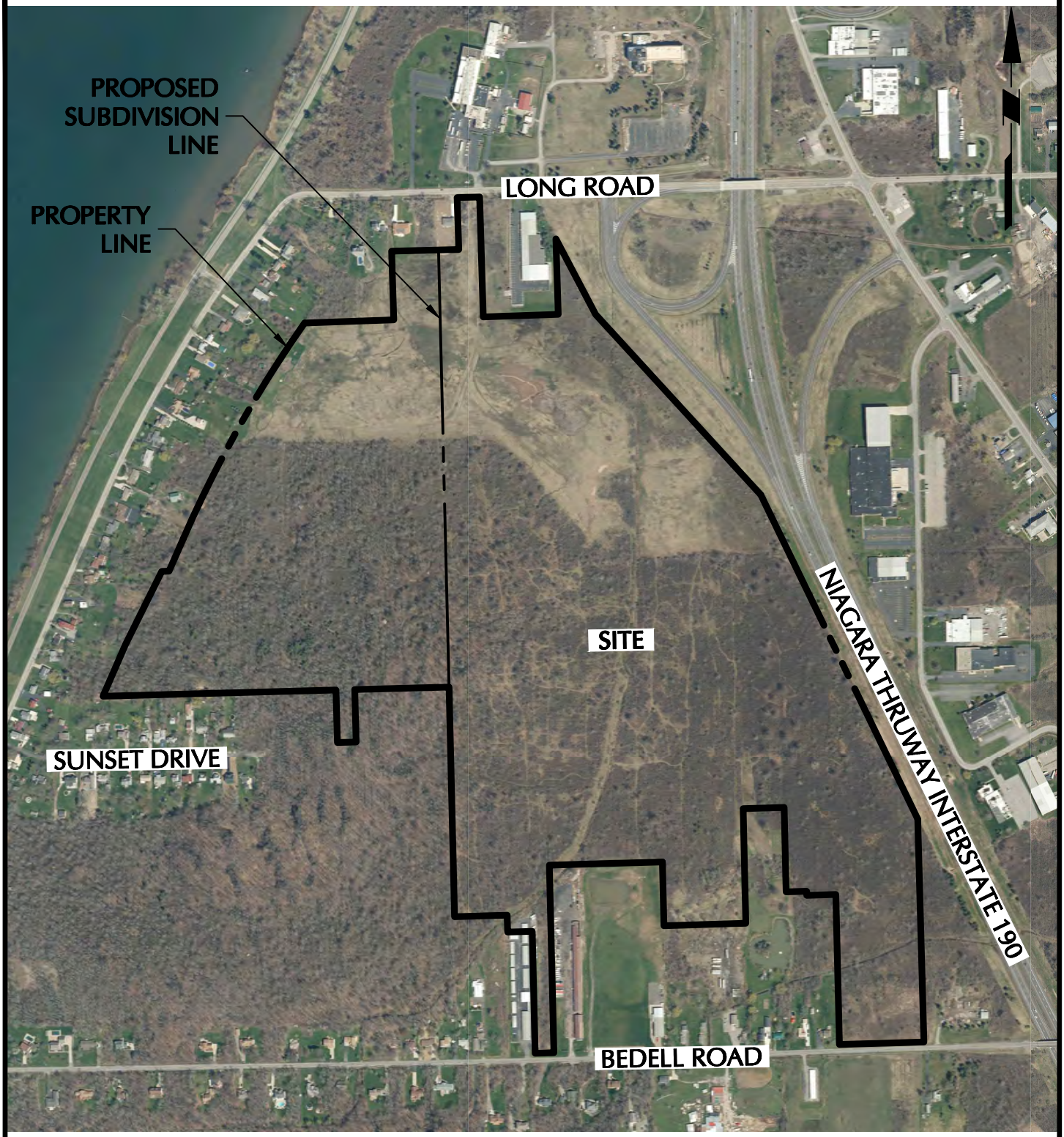
5 Construction Specifications

The proposed sanitary sewer system, force main and appurtenance shall be installed in accordance with the construction specifications provided in Appendix D.

6 Testing

Prior to being placed into service, the sanitary sewer system shall be tested in accordance with the testing procedures outlined on the project plans. A certification letter shall be provided to the Town and NYSDEC once testing has been completed.

Figures



WARNING: IT IS A VIOLATION OF THE NYS EDUCATION LAW ARTICLE 145 FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER, TO ALTER THIS ITEM IN ANY WAY.

750 0 375 750

SCALE: 1 INCH = 750 FEET

LANGAN
Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C.
One North Broadway, Suite 910
White Plains, NY 10601
T: 914.323.7400 F: 914.323.7401 www.langan.com

Project
PROJECT OLIVE
BLOCK No. 1, LOT No.50 & 26.1
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title
SITE LOCATION MAP

Project No. 100785901
Date 02-21-2020
Drawn By LM
Checked By CZ

Drawing No.
FG01
Sheet 1 of 1

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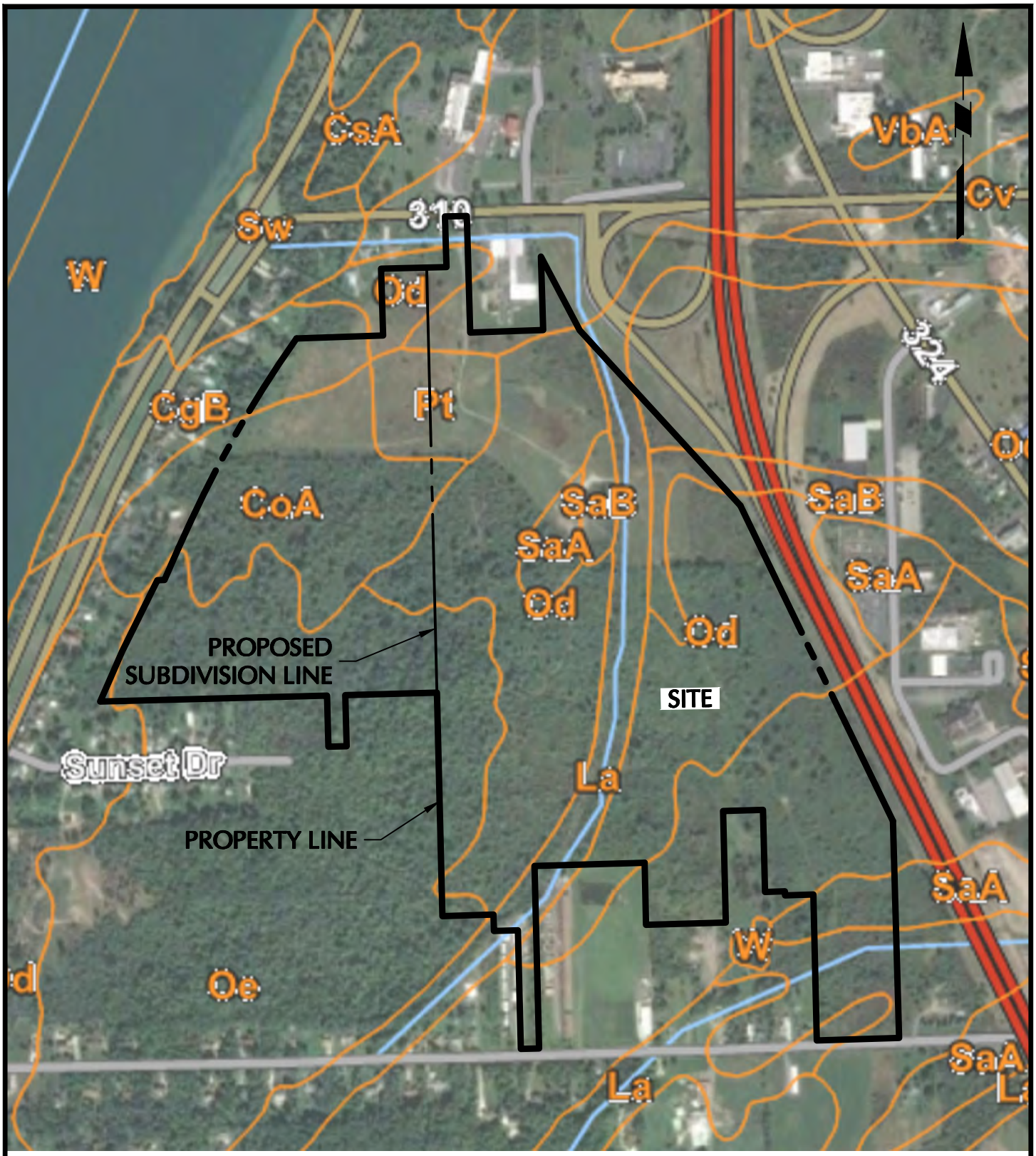

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Project	Drawing Title	Project No.	Drawing No.
PROJECT OLIVE BLOCK No. 1, LOT No.50 & 26.1 TOWN OF GRAND ISLAND ERIE COUNTY NEW YORK	SOILS MAP	100785901	FG02
		Date 02-21-2020	
		Drawn By LM	
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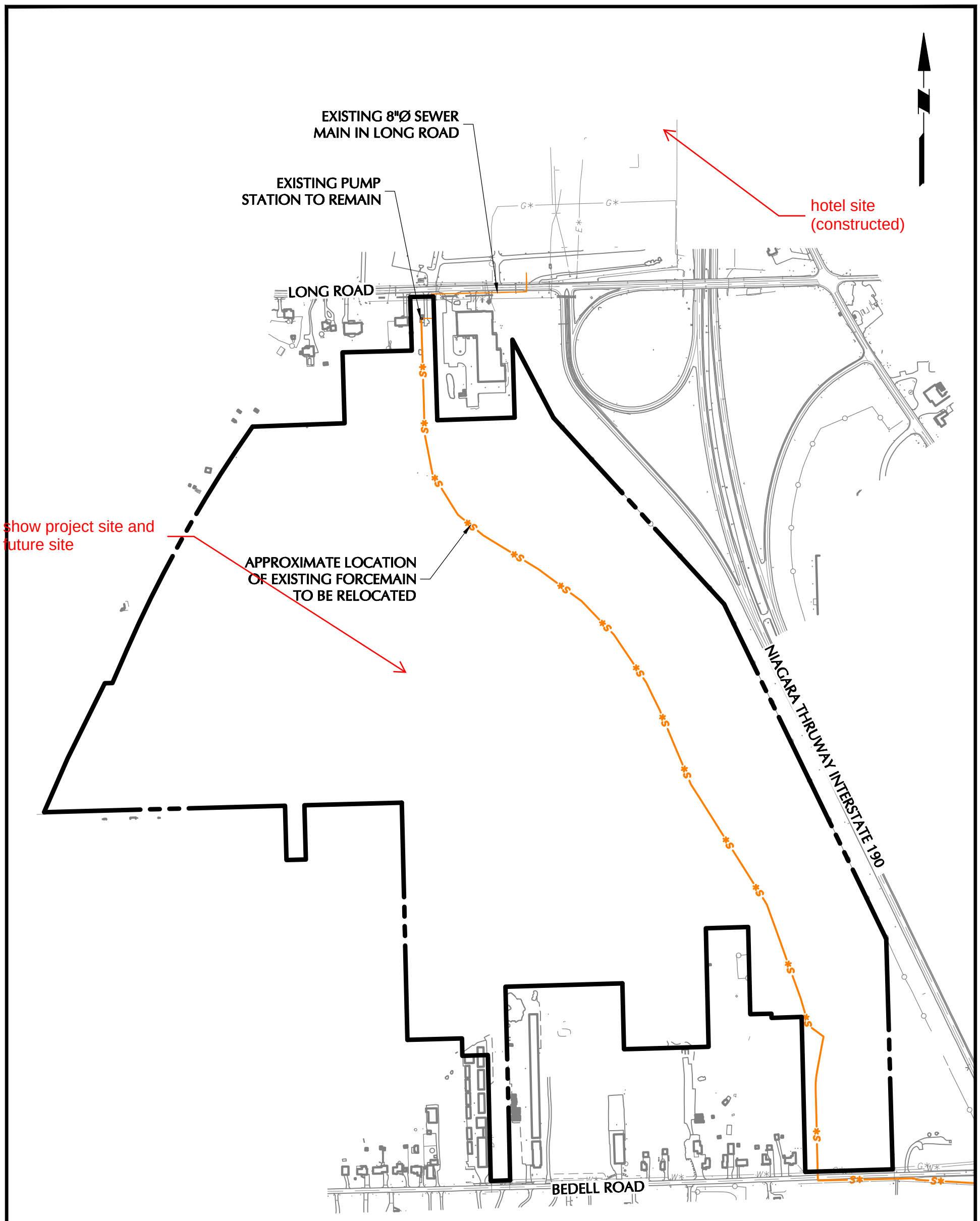

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Project
PROJECT OLIVE
BLOCK No. 1, LOT No.50 & 26.1
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title
EXISTING SEWER SYSTEM

Project No. 100785901
Date 02-21-2020
Drawn By LM
Checked By CZ

Drawing No. FG03
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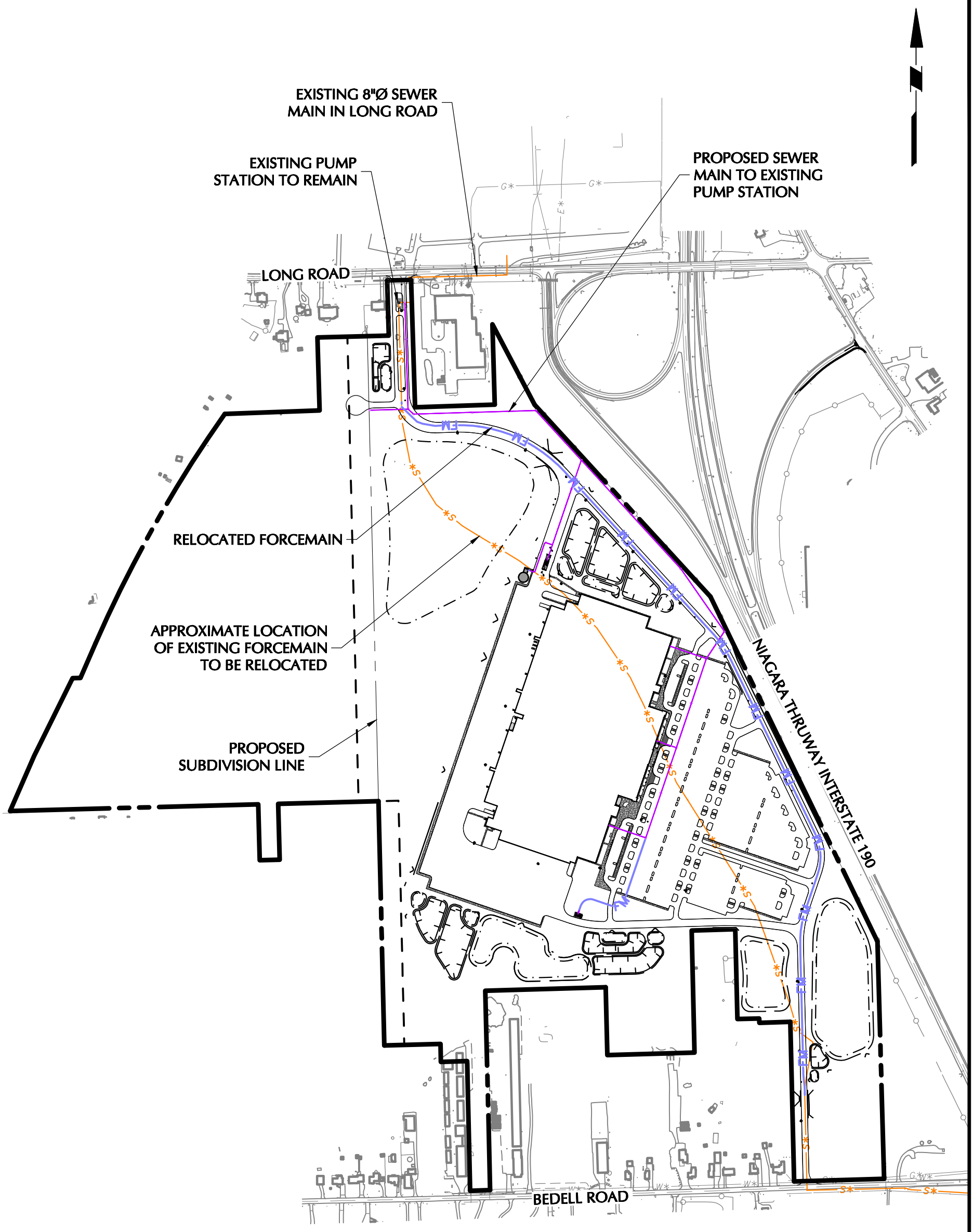

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Project
PROJECT OLIVE
BLOCK No. 1, LOT No.50 & 26.1
TOWN OF GRAND ISLAND
ERIE COUNTY NEW YORK

Drawing Title
PROPOSED SEWER SYSTEM

Project No.	100785901
Date	02–21–2020
Drawn By	LM
Checked By	CZ

Drawing No.
FG04
Sheet 1 of 1

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Appendix A

2012 Engineer's Report prepared by C&S Engineers, Inc.

135A.001.001

105 + 100±

Engineer's Report
for
Stormwater Management, Sanitary Sewer and Water Systems

Grand Island Gateway Center
Grand Island, New York

General

This project consists of constructing the infrastructure for a 144+/-commercial and light industrial development in the Town of Grand Island, Erie County, New York. The project site is located between Bedell and Long Roads, and is bounded to the east by I-190 and to the west by residentially zoned undeveloped land. The existing site conditions consist of a combination of woods and brush. The northern section of the site was previously used as clay borrow area and is now an overgrown meadow.

The proposed land use for the development is estimated to be as follows:

Type	Land Use	Site Area (Acres)
General Office	30%	43.5
Light Industrial	70%	100.5

Drainage

The existing topography generally slopes from south to north, with a high point approximately 1,400' north of Bedell Road. There are two main drainage swales crossing the site. One is located south of the high point and generally flows to the east. This swale collects site runoff south of the high point and runoff from the existing frontage lots on Bedell Road as well as a significant area of undeveloped land south of Bedell. The other swale on the site flows north, bisecting the site, to Long Road. It collects runoff from the project site and off-site areas to the west and south.

The existing and proposed conditions drainage analyses were completed using HydroCAD, Version 8, a TR-20 based software. The calculations are based on SCS 24-hour rainfall, type-II

distribution. Refer to the attached drainage exhibits for a visual description of the drainage sub-catchments and flow/Tc paths used in the HydroCAD analysis.

The project will involve more than one acre of ground disturbance. Therefore, coverage under the SPDES General Permit for Stormwater Discharges from Construction Activities is required. This requires the development of a full Stormwater Pollution Prevention Plan (SWPPP) including erosion and sediment control during construction and permanent, post-construction, water quality and quantity controls and the submission of a Notice of Intent (NOI) to the New York State DEC.

The proposed stormwater management facilities for the project will consist of three wet ponds for each of the respective sub-areas they serve and will be designed to the requirements in the DEC Stormwater Management Design manual. The ponds will be sized to limit the peak rate of discharge to the pre-developed conditions for the 10 and 100-year storm events. In addition, the ponds will provide the necessary channel protection volume (CPv), consisting of extended detention of the 1-year, 24-hour storm. The required water quality volumes will be provided in the forebays and wet pools of the ponds. The discharge rates from the ponds will be controlled through a combination of reverse slope pipes and orifices for the CPv and 10-year events. During the 100-year event, some discharge will also occur over the spillways.

The south pond, denoted 4P in the analysis, will collect runoff from the site south of the high point and discharge to the south ditch.

Two ponds, denoted 2P and 3P in the analysis, are needed for the north half of the site due to the ditch bisecting it. Both of these ponds, in addition to upstream/offsite drainage areas from sub-areas 1A, 1B and 2A all eventually discharge to the ditch on the south side of Long Road. Therefore Long Road was chosen as the design point in the analysis. Area 1B is an off-site area that will be collected by the proposed drainage system and routed through pond 2P.

The following is a summary of the site discharges for the ponds:

Storm Event	**Pre-Developed Runoff to Long (1P) (cfs)**	**Post-Development Runoff to Long (1P) (cfs)**	**Pre-Developed Runoff to South Ditch (4P) (cfs)**	**Post-Developed Runoff to South Ditch (4P) (cfs)**
10	99.88	91.82	5.71	5.38
100	177.39	160.84	10.60	7.77

The following is a summary of the water quality requirements:

Pond	**Required WQv (CF)**	**Required Pretreatment (25% WQv) (CF)**	**Forebay Volume Provided (CF)**	**Total Volume Provided (CF)**
2P	159,403	39,851	134,044	481,021
3P	121,087	30,272	69,925	259,361
4P	32,837	8,209	24,038	31,175

The proposed road system will require culverts in three locations where it crosses the existing swales on the site. One location is at the south swale which we will denote Culvert 1; the second location is at the north flowing swale near the south end of the project, denoted Culvert 2 and the third is adjacent to pond 3P, also crossing the north flowing swale, denoted Culvert 3. The runoff/hydrology calculations for the culvert design were completed as part of the overall project drainage analysis using HydroCAD. Sub-area 3B drains to Culvert 1 and sub-area 2A to Culvert 2. Sub area 2A drains to Culvert 3. The culvert hydraulic calculations were completed using HY-8 software. All culverts as designed are able to pass a 100-year storm with out overtopping of the roadway.

Sanitary Sewer

The proposed sanitary sewer system will consist of an 8" SDR-35 PVC gravity sewer, which will convey flows south toward Long Road, consistent with site's natural topography. However, because of the lack of capacity and current condition of the sewer on Long Road, the Town of Grand Island Engineering Department required that the sewage from the development be discharged to the interceptor sewer located west of Baseline Road, requiring a pumping station.

The pump station will be constructed approximately 750'south of Long Road. Sewage from the development will be pumped through an 8" forcemain north to Bedell Road and then east to the 30" interceptor sewer. The forcemain will be constructed of SDR-18 PVC. Cleanouts and air relief valves will be provided as necessary.

A 24" steel casing pipe was pushed under I-190on the south side of Bedell Road in the early 1990's to facilitate development of the site, which will be used for the proposed forcemain.

Provisions have also been made in the design of the sewage collection and pumping systems to include sewage from the future development of the 27 acre former Dunlop site on the north side of Long Road and the 65 acres of residential property adjacent to the project site. Refer to calculations in Appendix C for additional information.

Design Parameters

General Office.....	15 gpd x 8,690 employees = 134,400gal/day
Industrial*	25 gpd x 112 employees = 2,800 gal/day
Future Residential.....	438 gpd x 98 units = 42,924 gal/day
Reduction for water saving fixtures.....	0.80
Design Flow.....	**140,862 gal/day**

The hydraulic loading rates per "Design Standard for Wastewater Treatment Works", 1988 NYSDEC.

**Assumes a single work shift and no major water consuming industry (process water).*

Water System

The proposed water main will consist of 10" DR-18 PVC Pipe (conforming to AWWA C900 Specifications) tapped to the existing 8" water main on the north side of Bedell Road and the 12" water main on the south side of Long Road. Valves will be provided at intersections and at a maximum interval of 1,000 feet. Hydrants will be provided at a maximum spacing of 500 feet. Water services will include curb stops or valves as required to suite the proposed development.

Victor O'Brien, P.E. and Ron Slazak of C&S Engineers, Inc. performed hydrant flow tests with the assistance of the Town of Grand Island Water Department Personnel on March 26, 2008 between 8:00 and 9:00 AM. The results are indicated below.

Design Parameters

Static Pressure at Exist. 8" main @ Bedell Road	58 psi
Residual Pressure at Exist. 8" Main @ Bedell Road	45 psi
Hydrant Flow = 965 gpm	
Static Pressure at Exist. 12" Main @ Long Road	64 psi
Residual Pressure at Exist. 10" Main @ Long Road	54 psi
Hydrant Flow = 1,090 gpm	
Peak Hourly Demand (Domestic Use)	350 gpm
Head Loss @ Peak Hourly Demand	1 psi
Minimum Available Fire Flow @ 20 psi (at center of development)	1,517 gpm

Refer to attached for further calculations on water services.

Disinfection of the water service following installation will be continuous feed, according to AWWA C-651, latest revision.

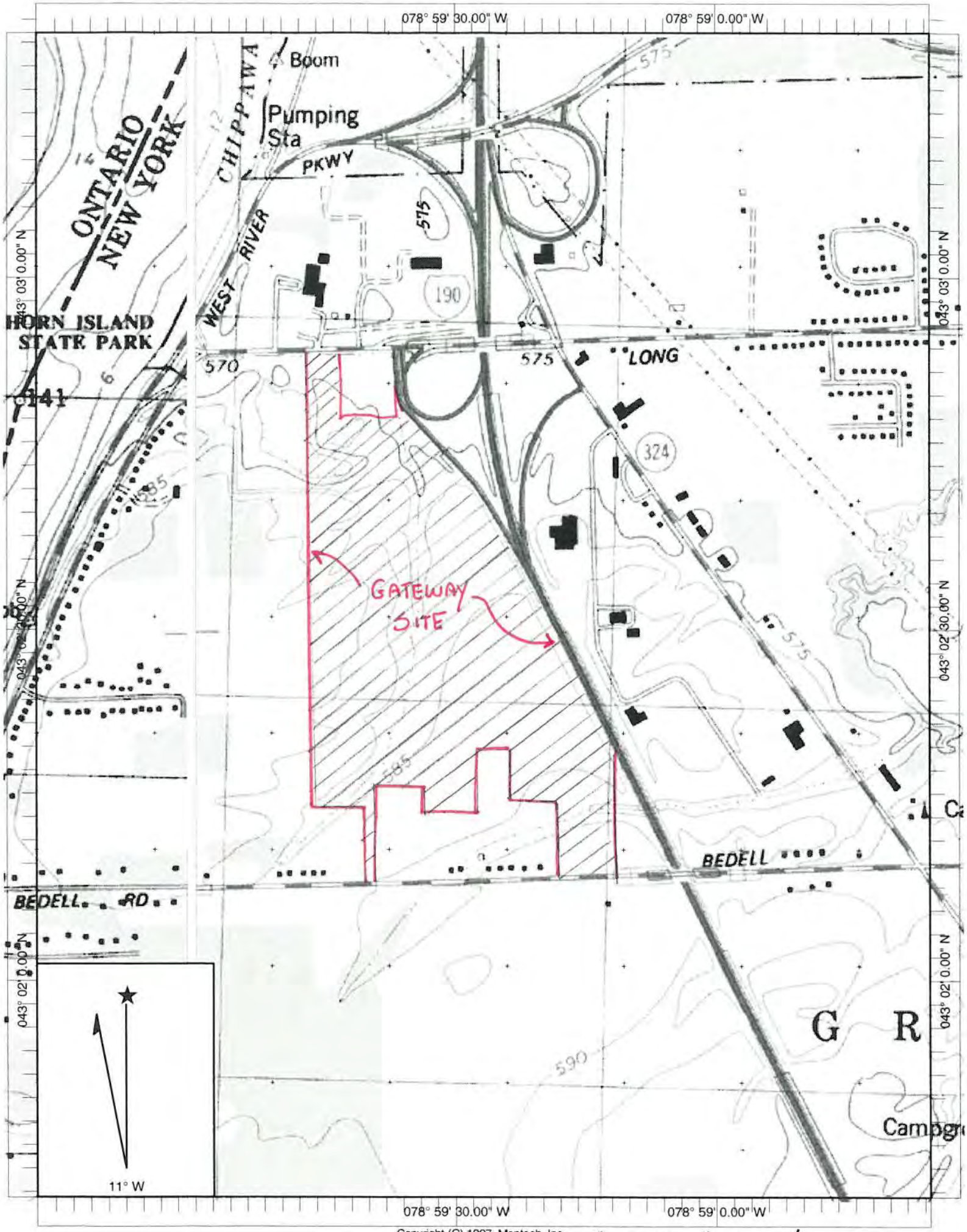
Respectfully submitted,

C&S ENGINEERS, INC.

Victor O'Brien, P.E.
Senior Project Engineer

Appendix A

Site Location / USGS Map


078° 59' 30.00" W
078° 59' 0.00" W
043° 03' 0.00" N
043° 02' 30.00" N
043° 02' 0.00" N
Boom
Pumping Sta
CHIPPAWA
PKWY
WEST RIVER
ONTARIO
NEW YORK
HORN ISLAND STATE PARK
575
190
570
LONG
324
GATEWAY SITE
585
590
BEDELL
BEDELL RD
11° W
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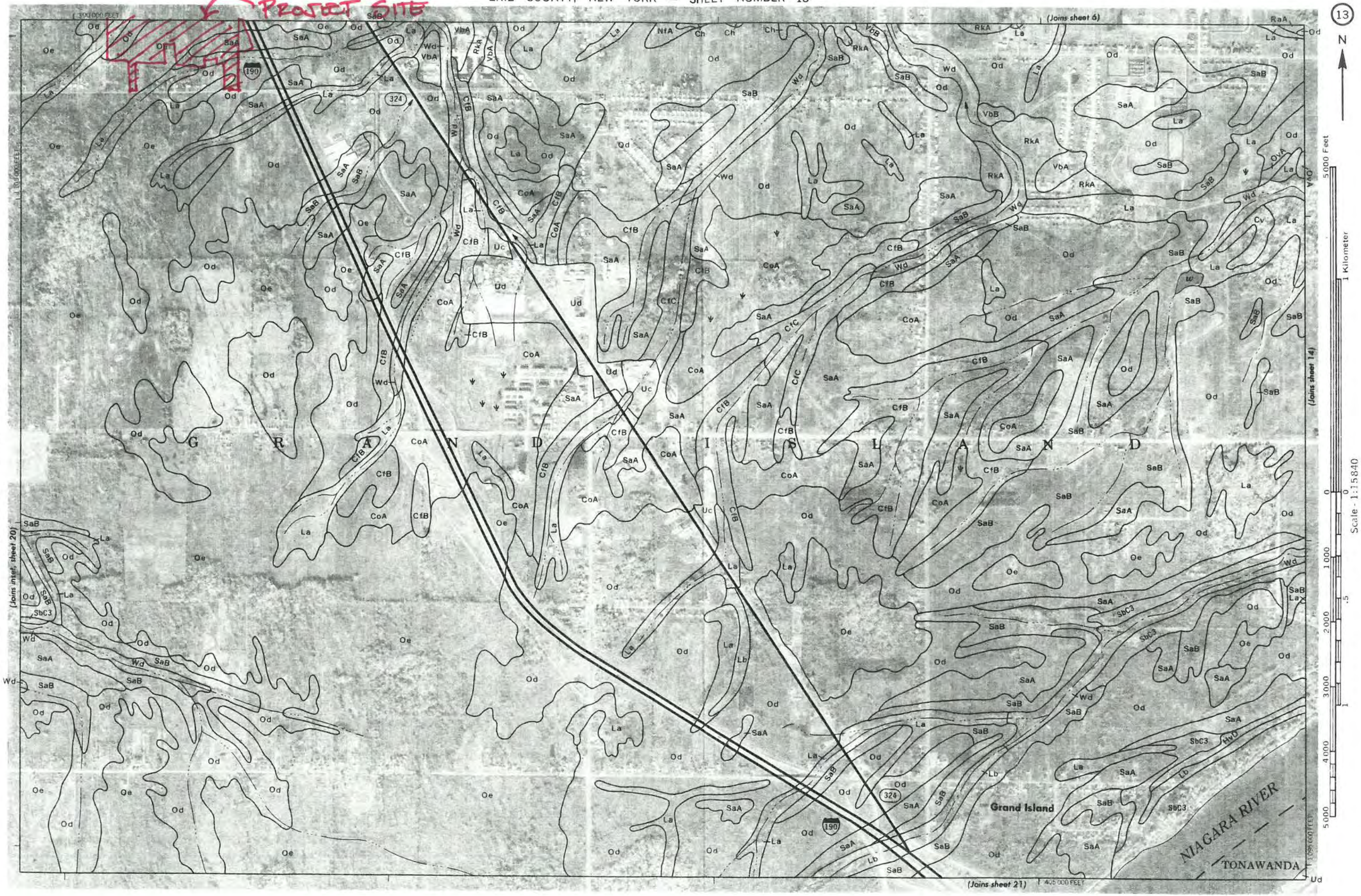
SCALE: 1" = 1,000'

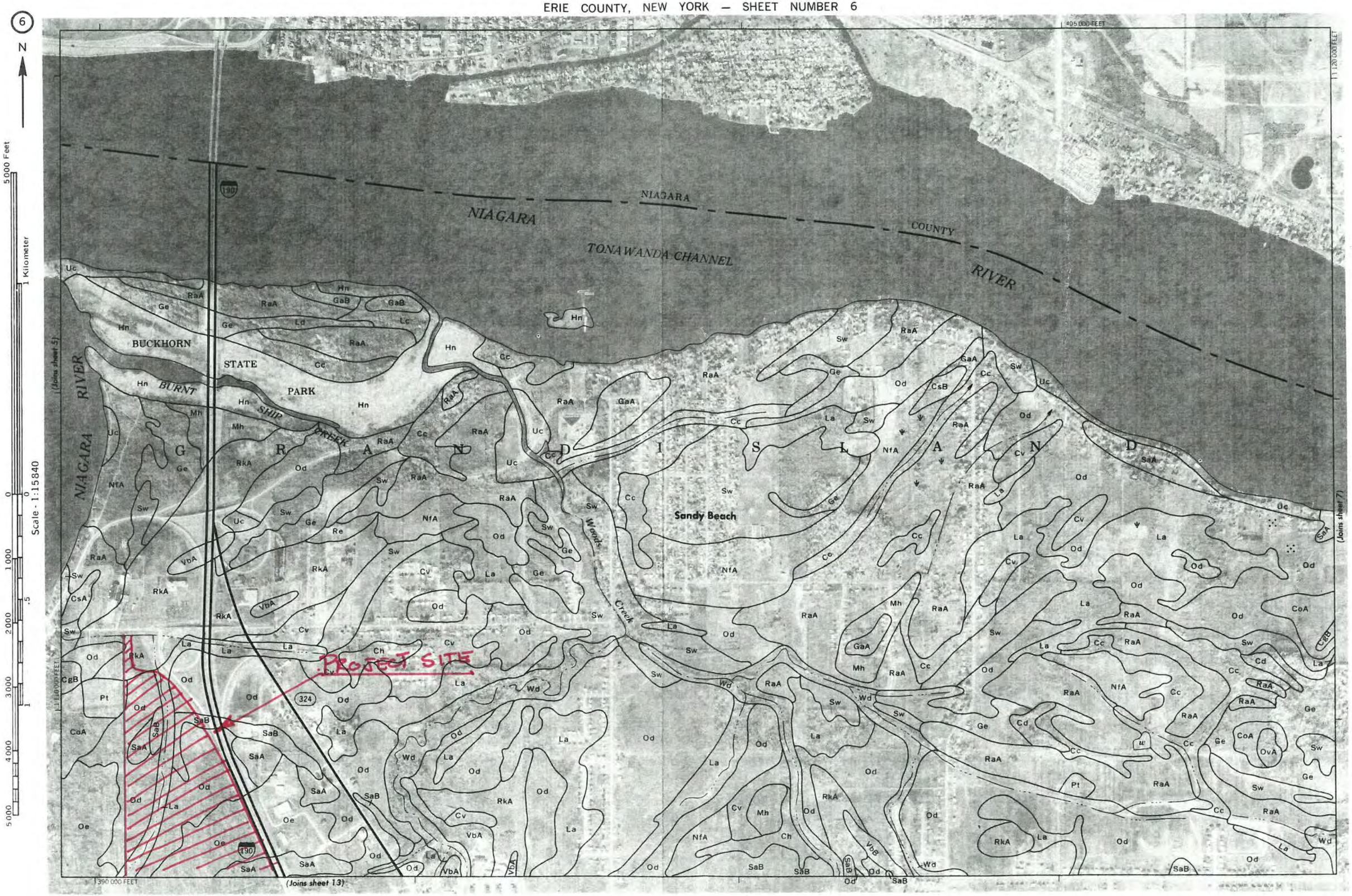
Appendix B

Drainage Calculations



ERIE COUNTY, NEW YORK NO. 13

This soil survey map was compiled by the U. S. Department of Agriculture, Soil Conservation Service, and cooperating agencies. Base maps are prepared from 1978 aerial photography. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This soil survey map was compiled by the U. S. Department of Agriculture, Soil Conservation Service, and cooperating agencies. Base maps are prepared from 1978 aerial photography. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

C&S Engineers, Inc.

PROJECT GIGC SHEET 1 OF

FILE NO.

PREPARED BY V.O. DATE CHECKED BY DATE

EXIST DRAINAGE:

SOIL TYPES
Od - ODESSA SILT LOAM "D"
Oe - ODESSA / LAKEMONT "D"
La - LAKEMONT SILT LOAM "D"
RKA - RHINEBECK SILTY CL LOAM "D"
Sa - SCHOHARIE SILT LOAM "C" (VERY SMALL AMOUNTS)

USE TYPE D

AREA #1 - PORTION OF SITE/OFFSITE ON WEST DRAINING TO LONG RD.

A = 106.35 AC

1A = 29.86 AC
1B = 76.49

1A Tc

100' SHEET FLOW OVER WOODS @ 0.75%
700' SHALLOW CONC OVER WOODS 0.75%
} $\frac{594-588}{800'}$

150' SHALLOW CONC OVER FIELD @ 6.6% $\frac{588-578}{150} = 6.6\%$

450' SHALLOW CONC FLOW / FIELD @ 0.7%
700' SWALE FLOW @ @ 0.7%
} $\frac{578-573}{700} = 0.7\%$

1B Tc

100' SHEET FLOW OVER WOODS @ 0.25% $\frac{3'}{1600} = 0.25$

1,500' SHALLOW CONC. FLOW OVER WOODS @ 0.25%

1,100' SWALE @ 0.9% $\frac{10'}{1,100'} = 0.9\%$ (AVE)

1200' SWALE @ 0.75% $\frac{9'}{1200} = 0.75\%$

700' SWALE @ 0.70%

C&S Engineers, Inc.

PROJECT GIGC SHEET 2 OF

FILE NO.

PREPARED BY VO DATE CHECKED BY DATE

EXIST DRAINAGE Cont-

AREA #2 - AREA DRAINING TO NORTH FLOWING DITCH ON SITE

A = 193.34 AC

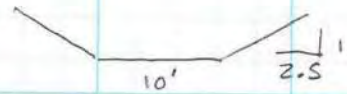
2A = 97.48 (OFFSITE)
2B = 95.86 AC (ON SITE ONLY)

TC (TOTAL AREA #2)

100' SHEET FLOW OVER WOODS @ 0.5%
1,100' SHALLOW CONC. FLOW/WOODS @ 0.5%

$\frac{593 - 586}{1200} = 0.5\%$

5,000' SWALE FLOW @ 0.275%



AREA #3 - 505.3 AC

3A = 18.66 AC
3B = 486.64

TC (TOTAL AREA #3)

100' SHEET FLOW OVER WOODS @ 1.0%

4,700' SHALLOW CONC FLOW OVER WOODS @ 0.3%

$\frac{15'}{4,700}$

2,900' SWALE FLOW @ 0.25%

C&S Engineers, Inc.

PROJECT GATEWAY CENTER
PROPOSED DRAINAGE

SHEET ____ OF ____
FILE NO. ____

PREPARED BY V.O. DATE ____ CHECKED BY ____ DATE ____

1A - SAME T_c, NEW AREA = 23.64 AC

1B - 49.53 AC, 5 ACRES 1± AC RES
44.53 WOODS

1C - 69.80 AC - 85% IMP. COMMERCIAL

2A - 100.69 AC

C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY SHEET ____ OF ____

FILE NO. ____

PREPARED BY V.O. DATE ____ CHECKED BY ____ DATE ____

POND 2P - NORTH POND

CpVol = 1-YR DEVELOPED STORM = 9.79 AC-FT (426,452 CF)

DISCHARGE OVER 24 hours = $\frac{426,452}{24 \times 60 \times 60}$ = 4.94 CFS

REQ'D ORIFICE AREA:

$Q = 0.6(A)\sqrt{2gH}$

FOR H, 9.79 AC-FT STORAGE ≈ ELEV 568.7±

Normal Pool = 566 , $H = \frac{568.7 - 566}{2} = 1.35$

$A = \frac{4.94}{(0.6)(\sqrt{2g(1.35)})} = 0.88$

TRY 3.5'W x 0.25'H orifice = 0.88 FT²

WQv

AREA = 114 AC, 47.4 AC IMPERVIOUS ∴ Rv = 0.05 + 0.009(42) = 0.428 (42%)

$WQv = \frac{PR_vA}{12} = \frac{0.9(0.428)114}{12} = 3.66$ AC-FT

WQv = 3.66 AC-FT OR 159,403 CF TOTAL

25% REQ'D AS PRETREATMENT IN FOREBAY = 39,851 CF

WQ PROVIDED:

	FOREBAY	MAIN POOL	
560	0	0	0
561	16,547	4,918	59,208
562	18,387	5,812	63,863
563	20,354	6,778	68,493
564	22,378	7,816	73,301
565	24,490	8,926	78,231
566	31,888	11,807	+ 91,868
	134,044 CF	(46,057 CF + 434,964 CF)	

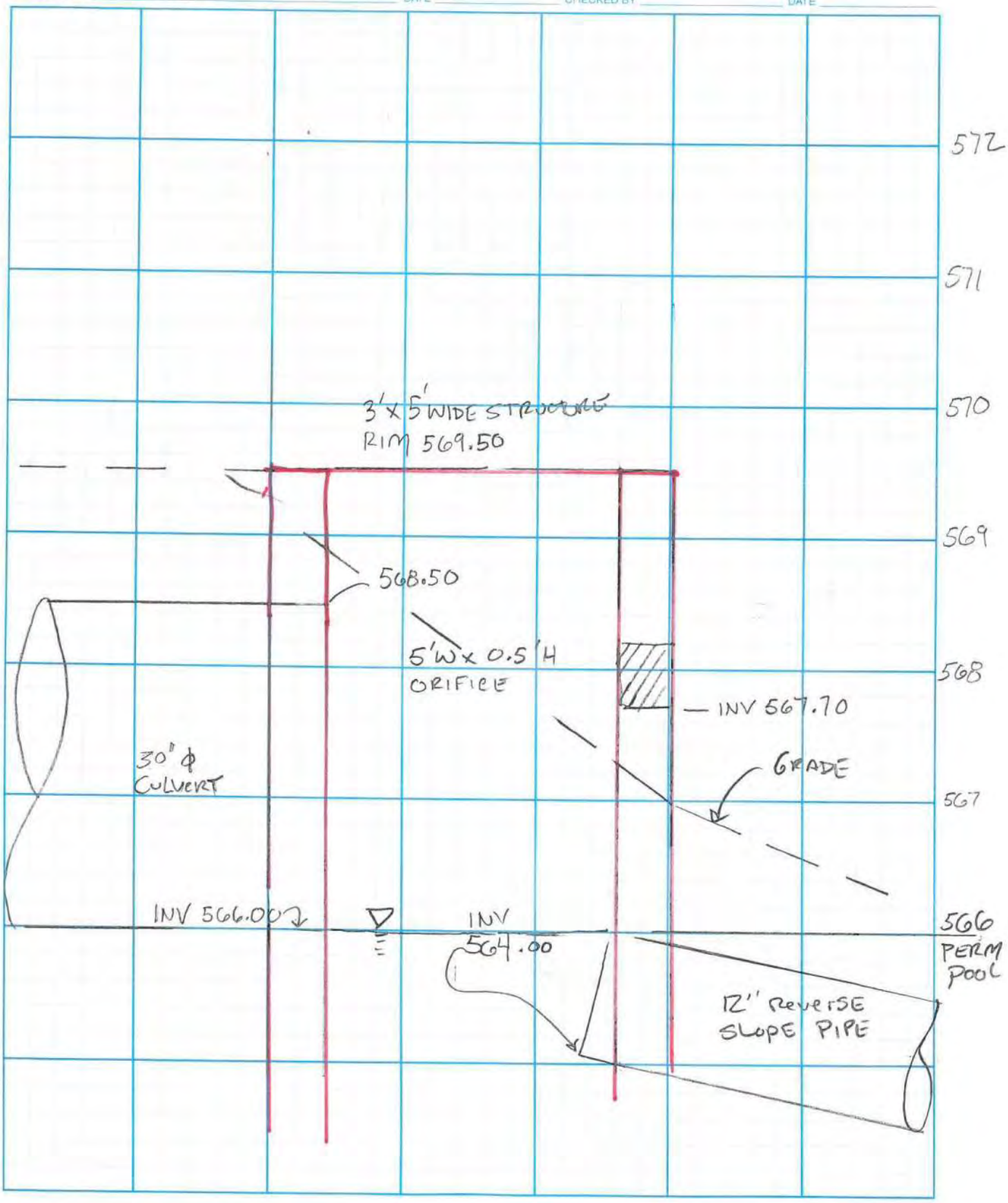
481,021

C&S Engineers, Inc.

PROJECT GATEWAY SHEET ____ OF ____

POND 2P OUTLET STRUCTURE FILE NO. ____

PREPARED BY UO. DATE ____ CHECKED BY ____ DATE ____



C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY SHEET OF

FILE NO.

PREPARED BY J.O. DATE CHECKED BY DATE

POND 3P - CENTER POND

CP VOL: 1-YR DEVELOPED STORM = 6.22 AC-FT (270,943 CF)

DISCHARGE OVER 24 hrs $= \frac{270,943}{24 \times 60 \times 60} = 3.14$ CFS

REQ'D ORIFICE AREA:

$Q = 0.6(A)\sqrt{2gH}$

ELEVATION @ 6.22 AC-FT STORAGE ≈ 577.7

AVE $H = \frac{577.7 - 574.0}{2} = 1.85$

$A = \frac{Q}{(.6)(\sqrt{2g(1.85)})} = 0.48$ SF

USE 10" Reverse SLOPE PIPE

WQV

AREA = 53.1 AC — 38 AC IMPERVIOUS OR 72%

$R_V = 0.05 + 0.009(72) = 0.698$

$WQ_V = \frac{0.9(0.698)\,53.1}{12} = 2.78$ AC-FT or 121,087 CF

25% PRETREATMENT = 30,272 CF

WQV PROV.:

	FOREBAY	MAIN POOL
568	0	0
569	7,893	24,686
570	9,208	26,795
571	10,604	28,987
572	12,080	31,260
573	13,636	33,615
574	16,504	44,093
	69,925 CF	189,436 CF

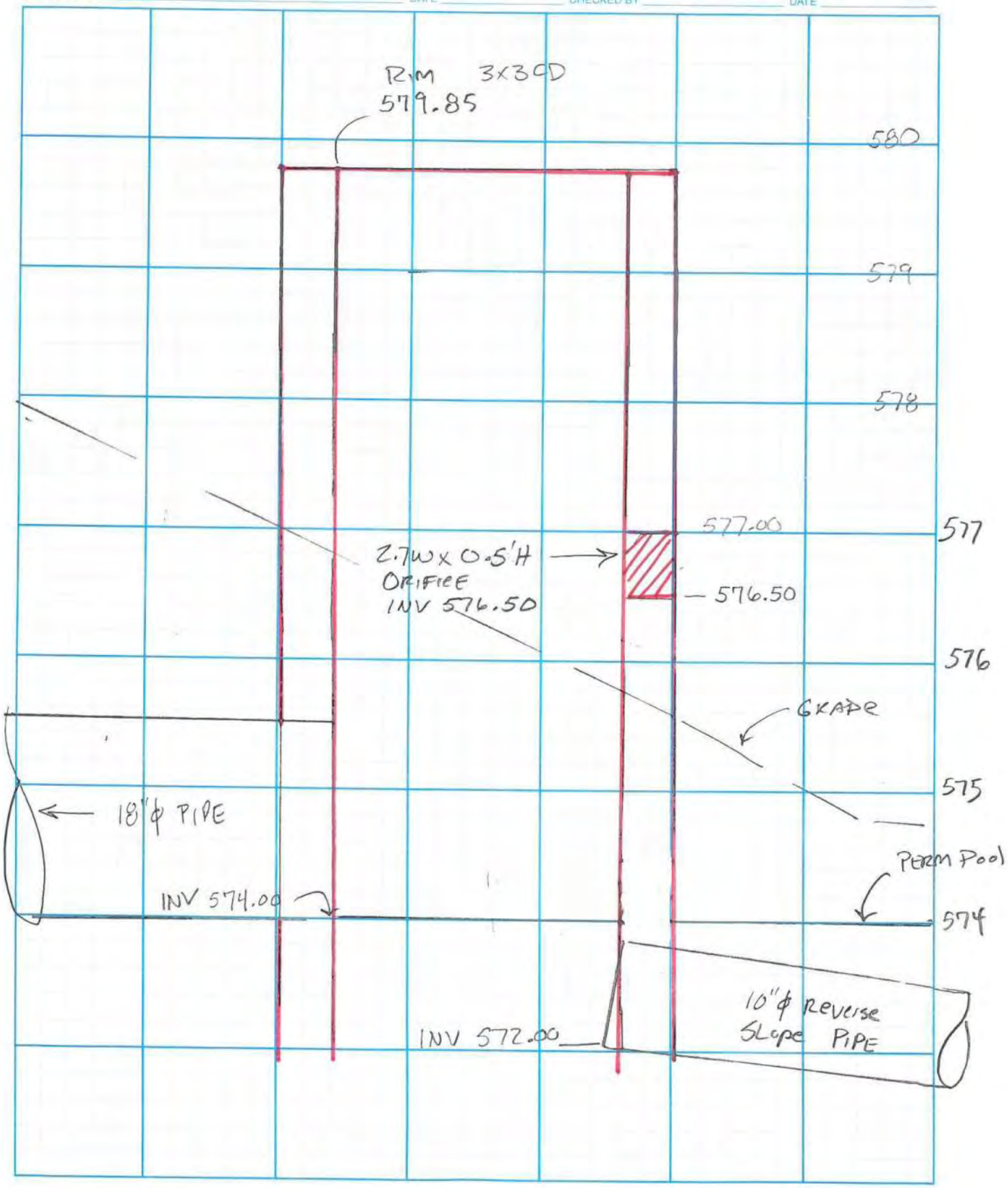
259,361 CF TOTAL ∴ OK

C&S Engineers, Inc.

PROJECT GATEWAY SHEET OF

POND 3P OUTLET STRUCTURE FILE NO

PREPARED BY UO. DATE CHECKED BY DATE



C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY SHEET ____ OF ____

FILE NO. ____

PREPARED BY V.O DATE ____ CHECKED BY ____ DATE ____

POND 4P - SOUTH POND

CP VOL: 1-YR DEVELOPED STORM = 1.68 AC-FT (73,181 CF)

DISCHARGE OVER 24 HRS = $\frac{1.68 \times 43{,}560}{24 \times 60 \times 60} = 0.85$ CFS

REQD ORIFICE DIAMETER:

$Q = 0.6(A)\sqrt{2gh}$

MAX DEPTH = 3', AVE DEPTH = 1.5'

$A = \frac{Q}{(0.6)\sqrt{2gh}} = \frac{0.85}{(0.6)\sqrt{2g(1.5)}} = 0.14\ FT^2$

$A = \pi D^2/4 \quad D = \sqrt{\frac{4A}{\pi}} = 0.42' = 5''\phi$ -

OR USE 0.7'W × 0.2'H RECT. ORIFICE

WQUALITY VOLUME

AREA = 14.4 AC, 72% IMPERVIOUS ∴ $R_V = 0.05 + 0.009(72) = 0.698$

$WQ_V = \frac{P R_V A}{12} = \frac{0.9\,(0.698)\,14.4}{12}$

$WQ_{V_{Req.}} = 0.75$ AC-FT OR 32,837 CF TOTAL

25% REQ IN FOREBAY = 8,209 CF

WQ PROVIDED:

	FOREBAY	MAIN POOL
577	0	3,265
578	2,997	4,201
579	3,825	5,252
580	4,731	6,419
581	5,714	7,702
582	6,771	10,298
	24,038 +	37,137 = 61,175 CF

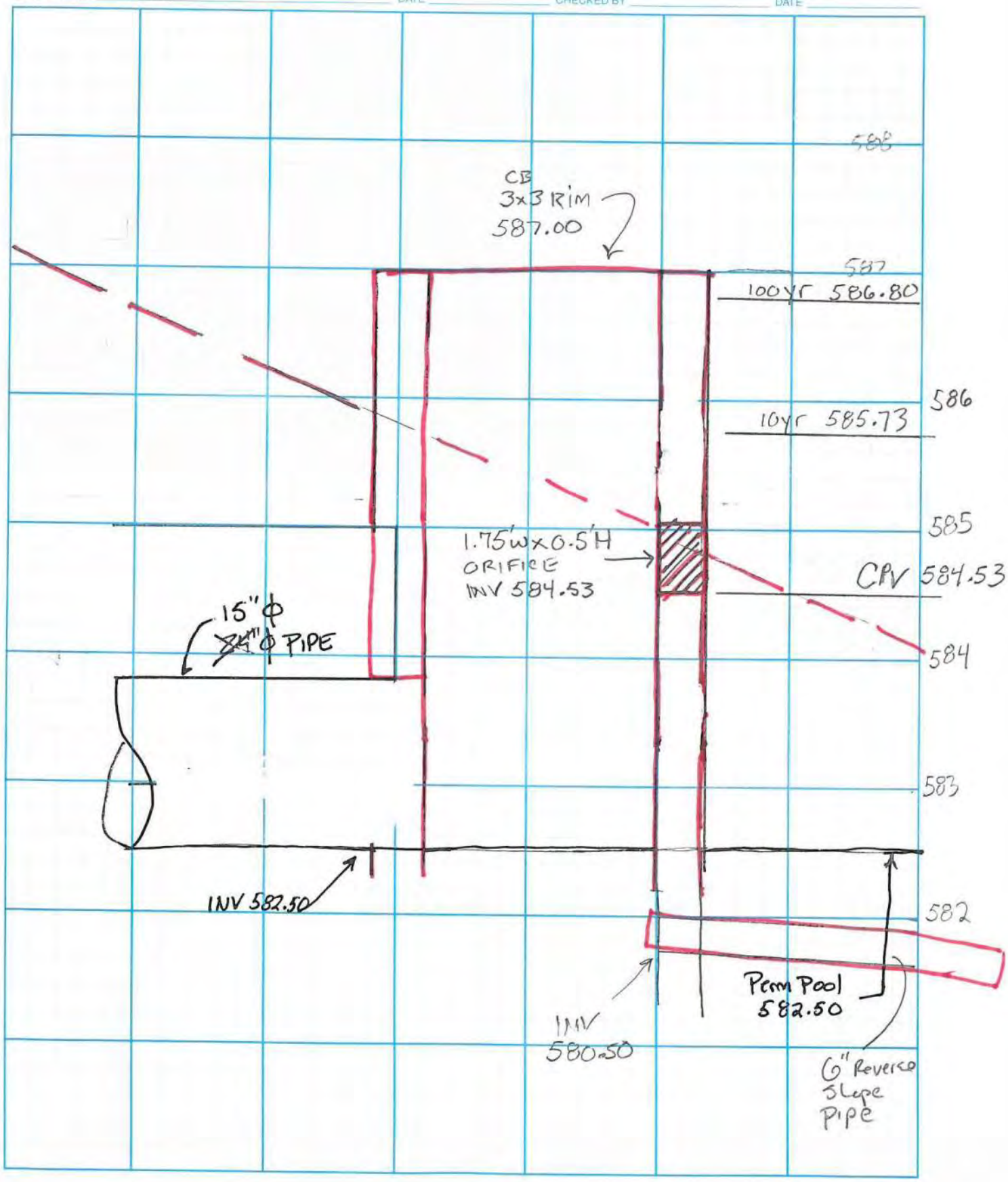
∴ OK

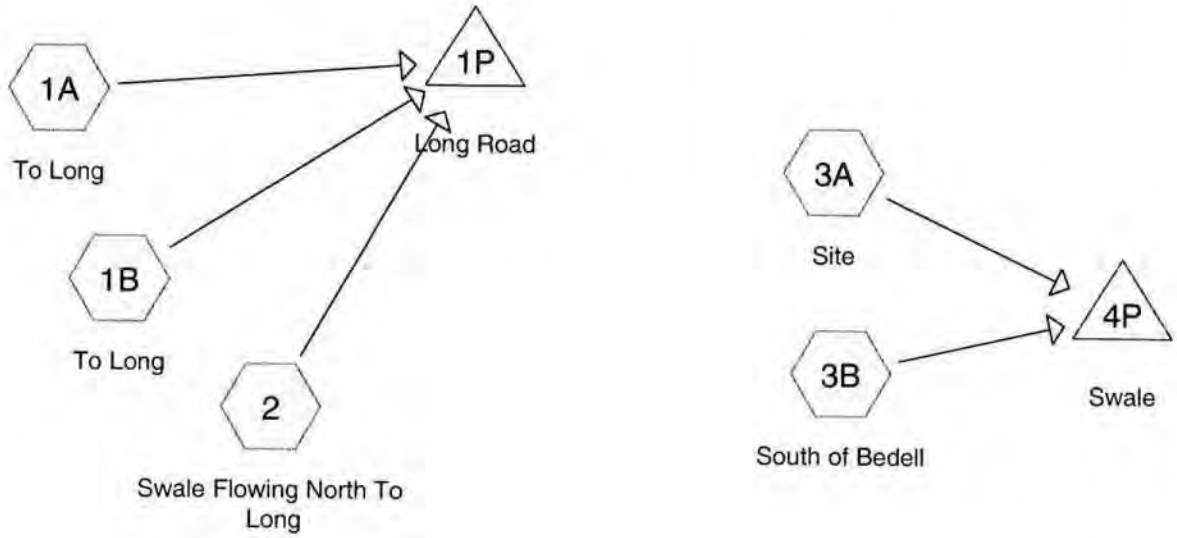
C&S Engineers, Inc.

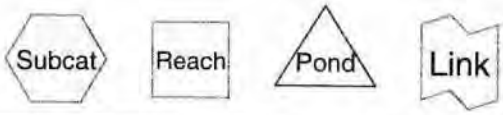
PROJECT GATEWAY SHEET ____ OF ____

POND 4P OUTLET STRUCTURE FILE NO. ____

PREPARED BY V.O. DATE ____ CHECKED BY ____ DATE ____







Drainage Diagram for existing

Prepared by {enter your company name here} 1/11/2008

HydroCAD® 8.00 s/n 002837 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
169.240	73	Brush, Good, HSG D (1A,1B,2,3A)
266.890	77	Woods, Good, HSG D (1A,1B,2,3B)
43.000	84	1 acre lots, 20% imp, HSG D (1B,2,3B)
479.130		

Subcatchment 1A: To Long

Open field & woods draining directly to long ditch

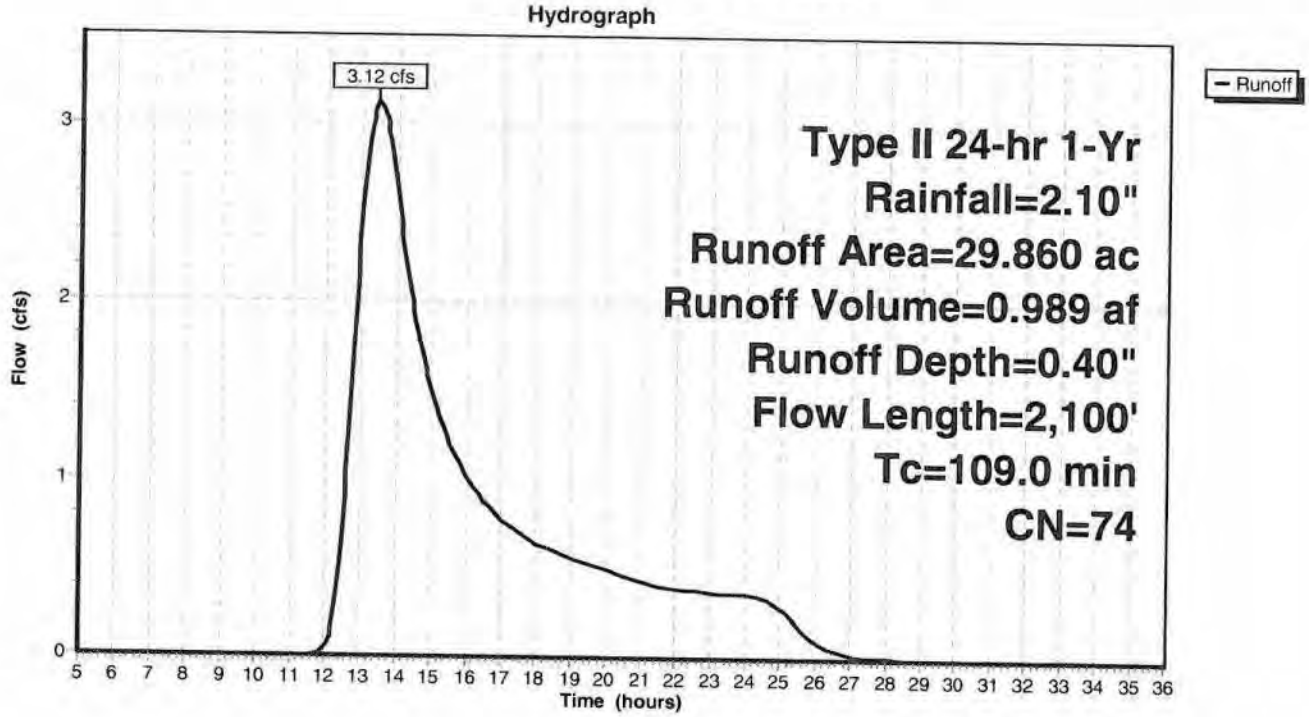
Runoff = 3.12 cfs @ 13.46 hrs, Volume= 0.989 af, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
7.650	77	Woods, Good, HSG D
22.210	73	Brush, Good, HSG D
29.860	74	Weighted Average
29.860		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods**
					Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field**
					Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope**
					Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field**
					Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale**
					Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: To Long



Subcatchment 1B: To Long

Open field & woods draining to 8" culverts on access road

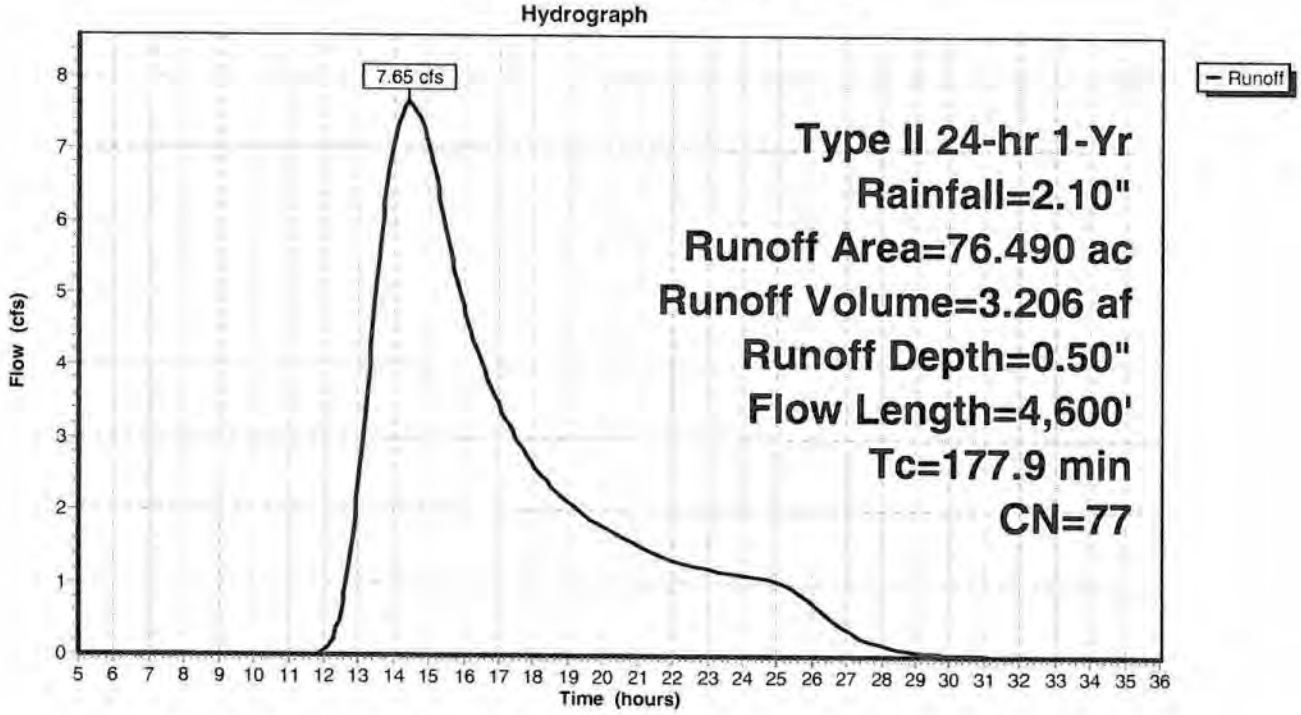
Runoff = 7.65 cfs @ 14.44 hrs, Volume= 3.206 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
56.420	77	Woods, Good, HSG D
15.070	73	Brush, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
76.490	77	Weighted Average
75.490		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
70.7	1,500	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
33.6	3,000	0.0080	1.49	4.47	**Channel Flow, Swale** Area= 3.0 sf Perim= 10.0' r= 0.30' n= 0.040
177.9	4,600	Total			

Subcatchment 1B: To Long



Subcatchment 2: Swale Flowing North To Long

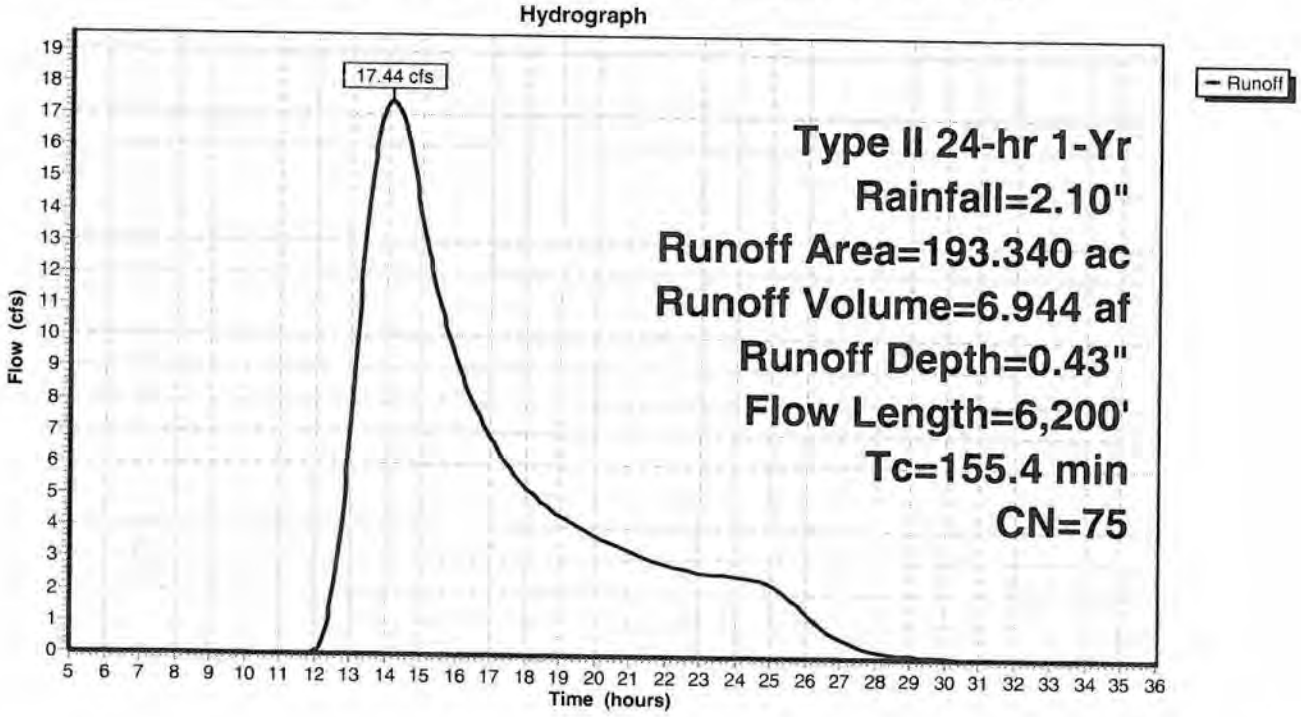
Runoff = 17.44 cfs @ 14.14 hrs, Volume= 6.944 af, Depth= 0.43"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
119.340	73	Brush, Good, HSG D
61.000	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
193.340	75	Weighted Average
190.740		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2: Swale Flowing North To Long



Subcatchment 3A: Site

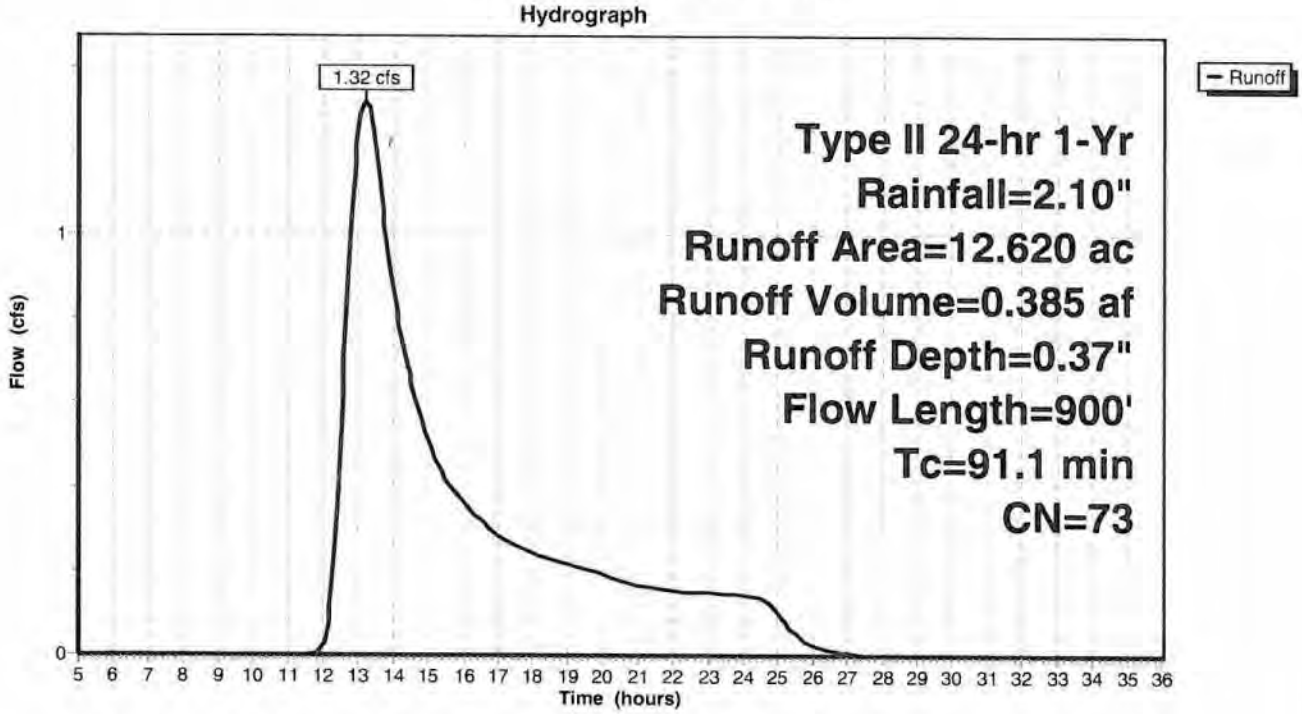
Runoff = 1.32 cfs @ 13.23 hrs, Volume= 0.385 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
12.620	73	Brush, Good, HSG D
12.620		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
64.4	100	0.0070	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.7	800	0.0100	0.50		**Shallow Concentrated Flow, Brush** Woodland Kv= 5.0 fps
91.1	900	Total			

Subcatchment 3A: Site



Subcatchment 3B: South of Bedell

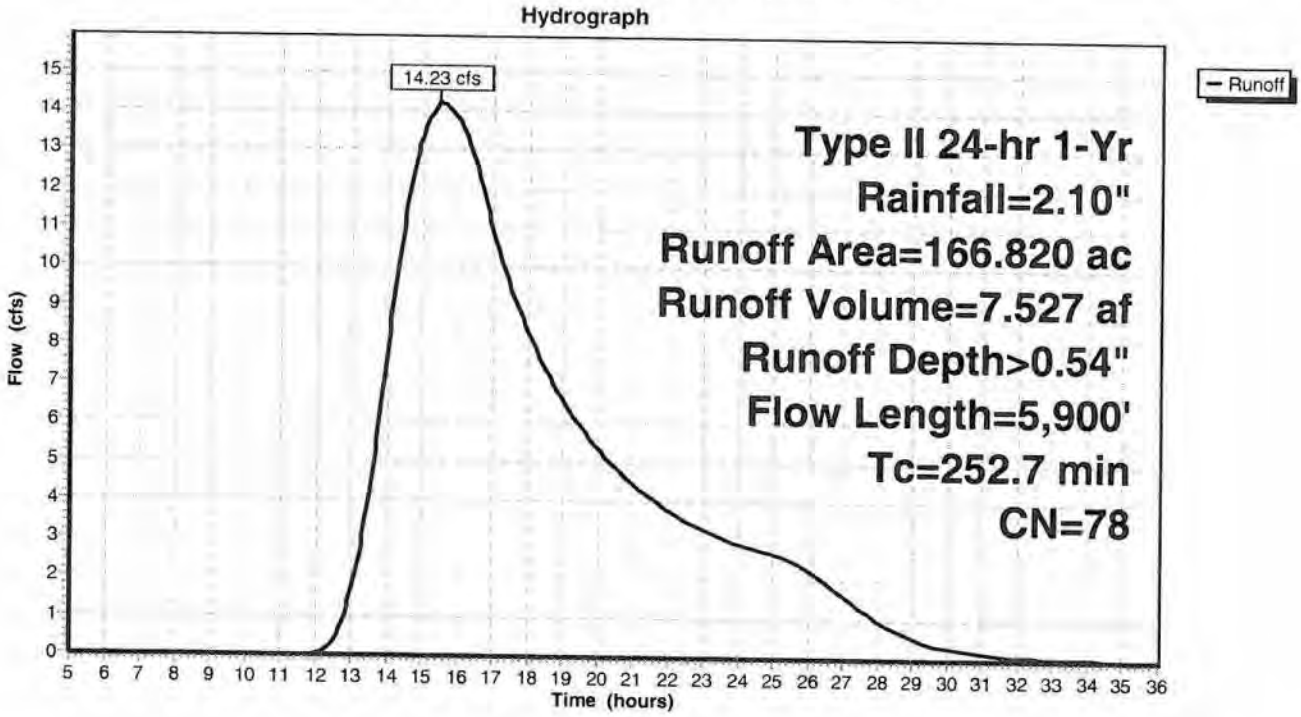
Runoff = 14.23 cfs @ 15.46 hrs, Volume= 7.527 af, Depth> 0.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B: South of Bedell

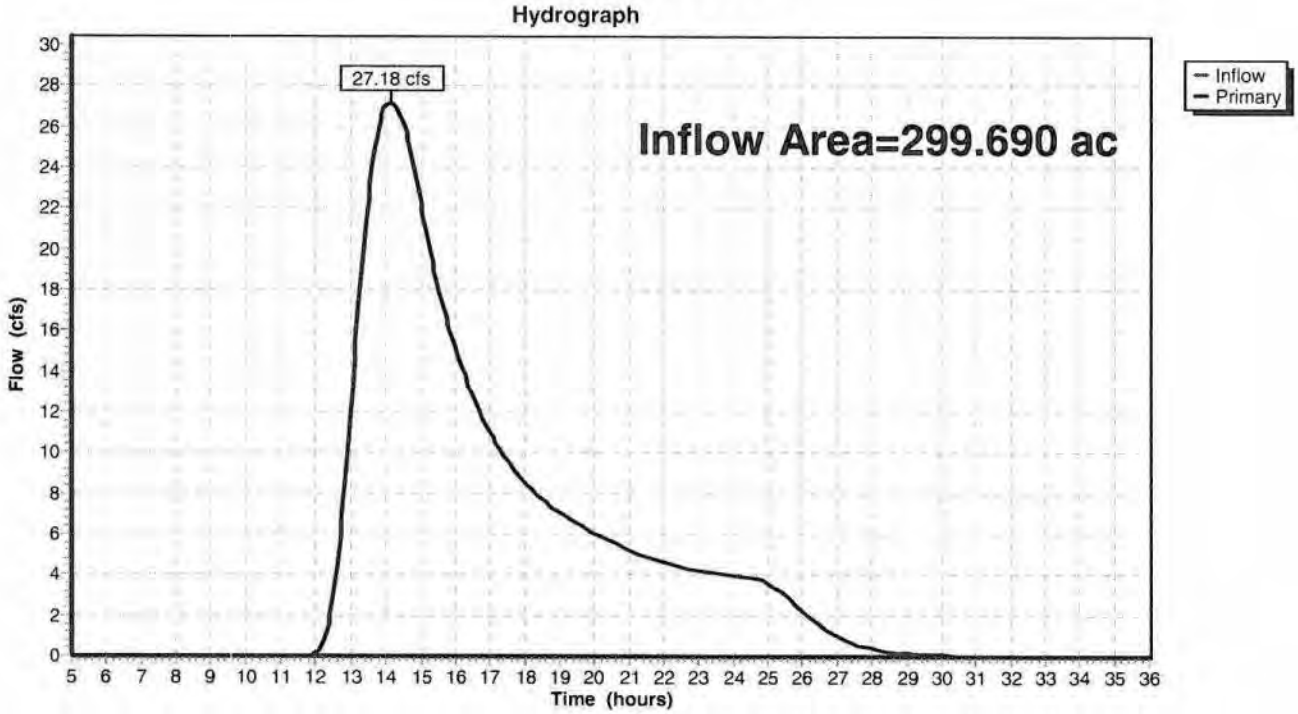


Pond 1P: Long Road

Inflow Area = 299.690 ac, Inflow Depth = 0.45" for 1-Yr event
Inflow = 27.18 cfs @ 14.13 hrs, Volume= 11.139 af
Primary = 27.18 cfs @ 14.13 hrs, Volume= 11.139 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road

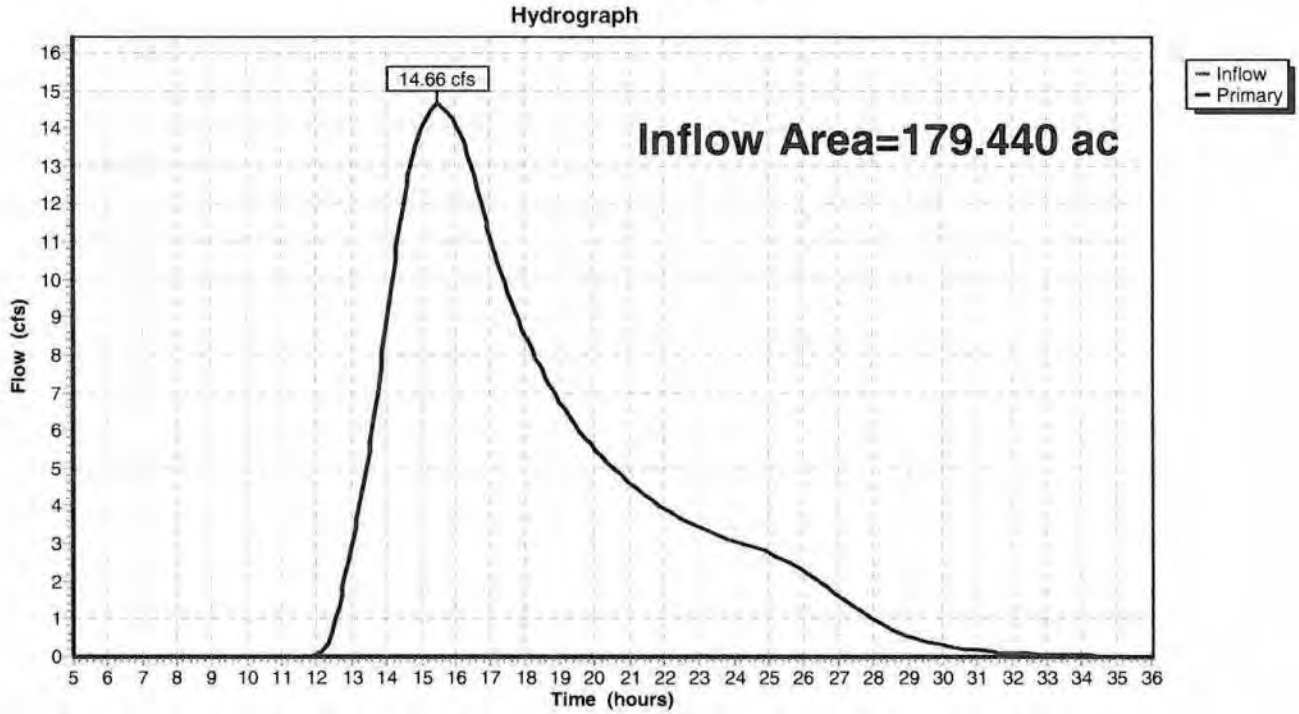


Pond 4P: Swale

Inflow Area = 179.440 ac, Inflow Depth > 0.53" for 1-Yr event
Inflow = 14.66 cfs @ 15.46 hrs, Volume= 7.912 af
Primary = 14.66 cfs @ 15.46 hrs, Volume= 7.912 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 4P: Swale



Subcatchment 1A: To Long

Open field & woods draining directly to long ditch

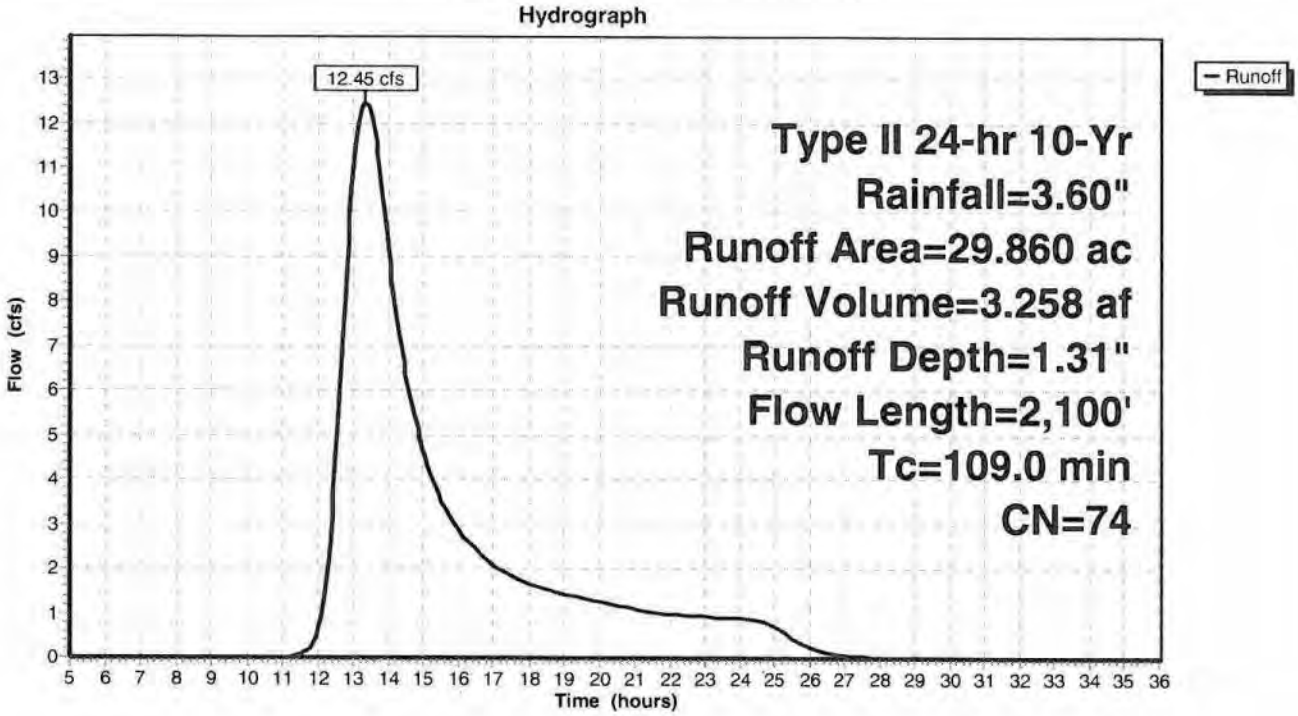
Runoff = 12.45 cfs @ 13.36 hrs, Volume= 3.258 af, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
7.650	77	Woods, Good, HSG D
22.210	73	Brush, Good, HSG D
29.860	74	Weighted Average
29.860		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods**
					Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field**
					Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope**
					Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field**
					Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale**
					Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: To Long



Subcatchment 1B: To Long

Open field & woods draining to 8" culverts on access road

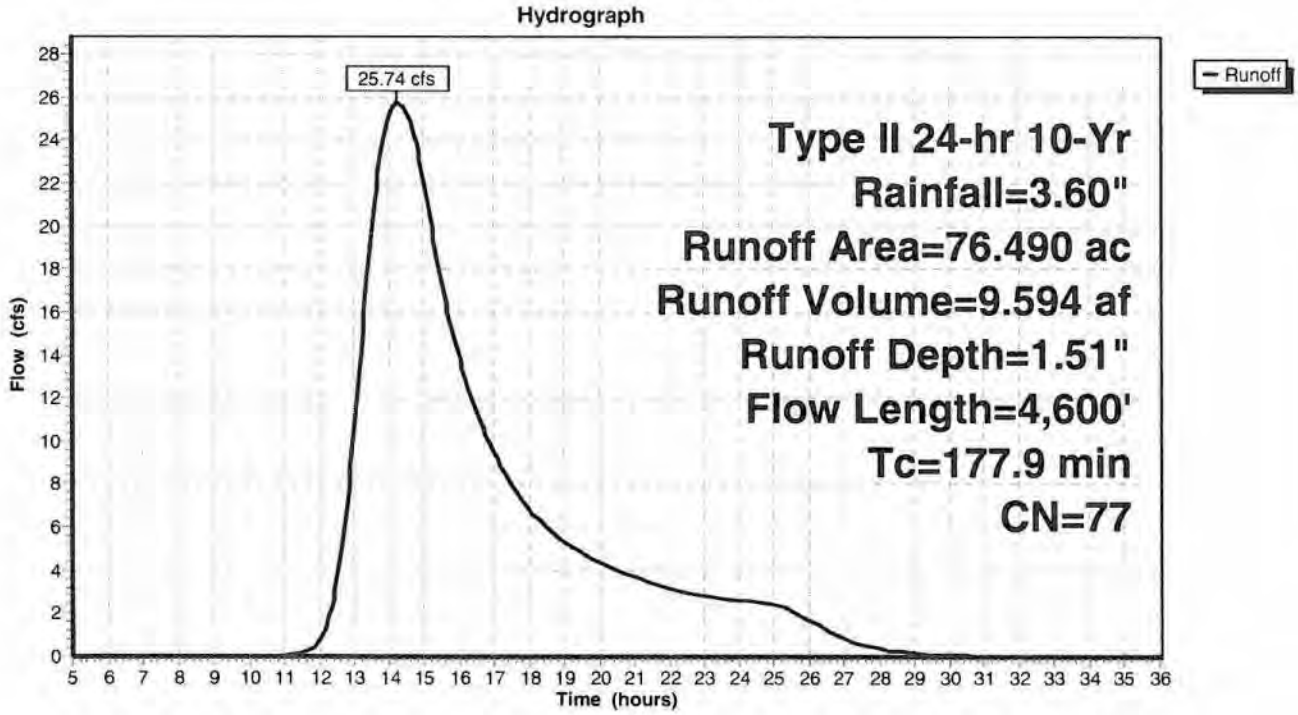
Runoff = 25.74 cfs @ 14.27 hrs, Volume= 9.594 af, Depth= 1.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
56.420	77	Woods, Good, HSG D
15.070	73	Brush, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
76.490	77	Weighted Average
75.490		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
70.7	1,500	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
33.6	3,000	0.0080	1.49	4.47	**Channel Flow, Swale** Area= 3.0 sf Perim= 10.0' r= 0.30' n= 0.040
177.9	4,600	Total			

Subcatchment 1B: To Long



Subcatchment 2: Swale Flowing North To Long

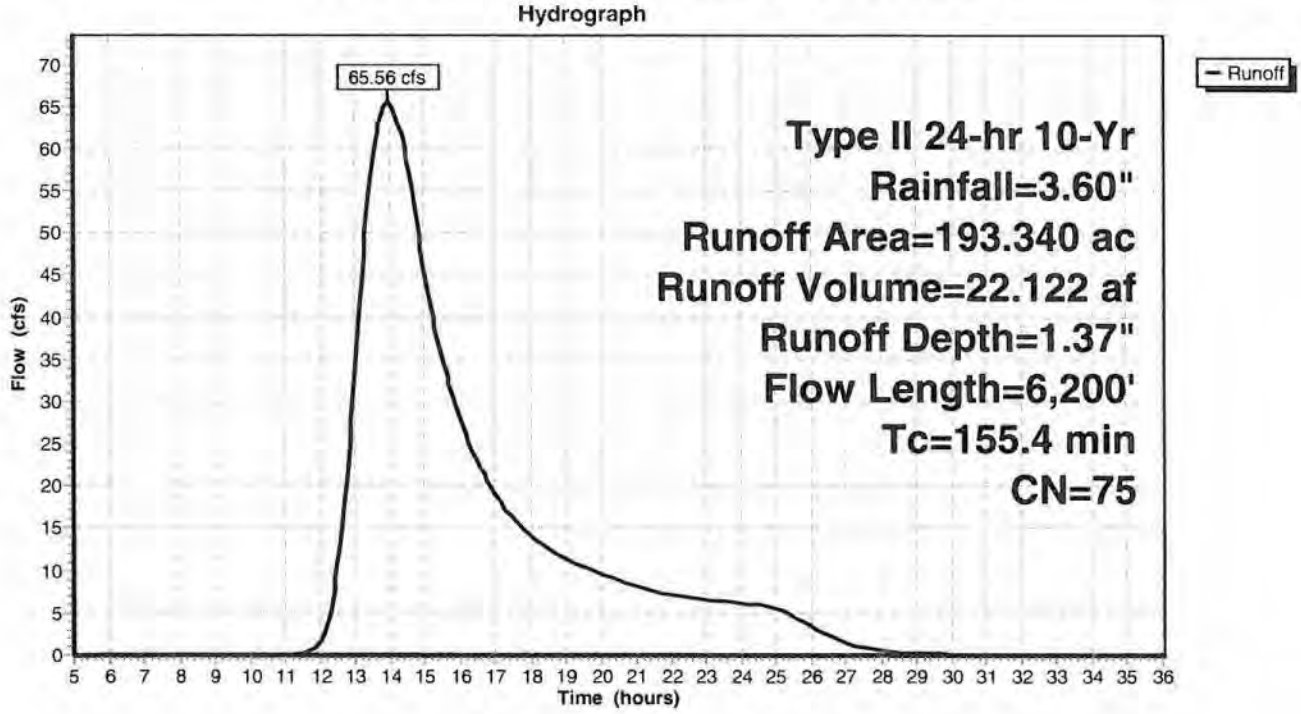
Runoff = 65.56 cfs @ 13.99 hrs, Volume= 22.122 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
119.340	73	Brush, Good, HSG D
61.000	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
193.340	75	Weighted Average
190.740		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2: Swale Flowing North To Long



Subcatchment 3A: Site

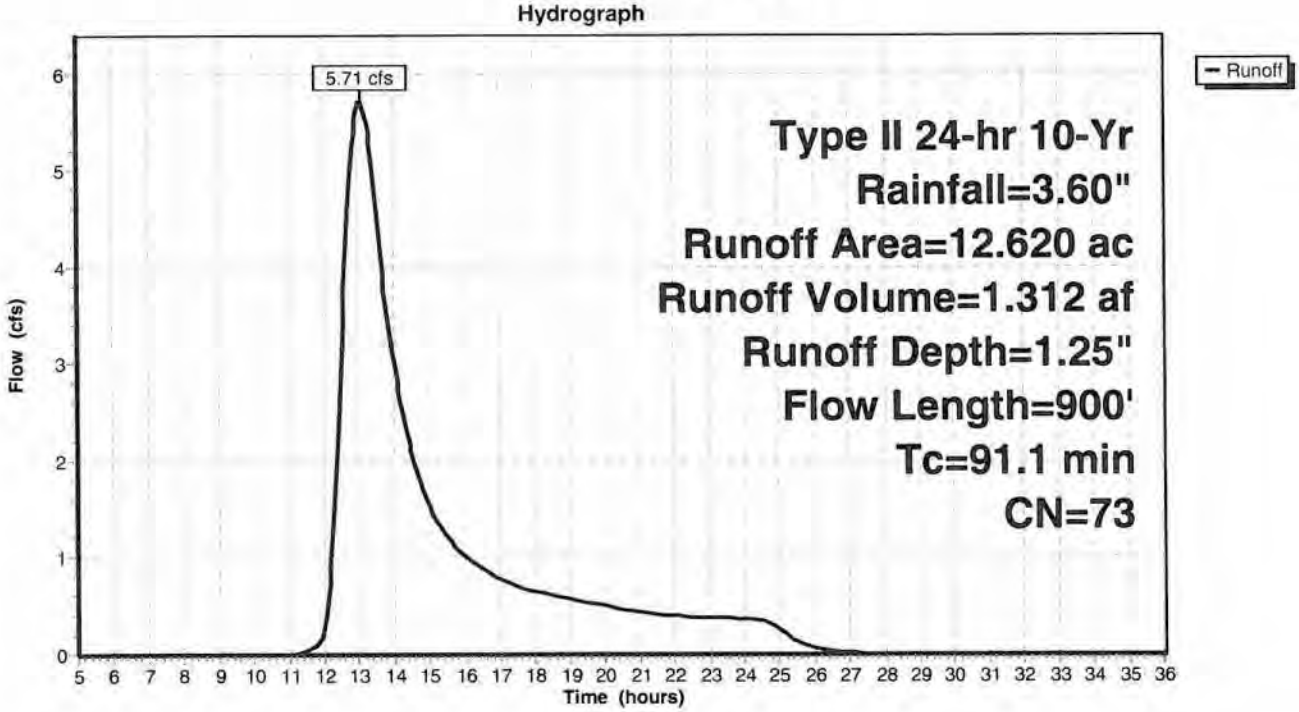
Runoff = 5.71 cfs @ 13.07 hrs, Volume= 1.312 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
12.620	73	Brush, Good, HSG D
12.620		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
64.4	100	0.0070	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.7	800	0.0100	0.50		**Shallow Concentrated Flow, Brush** Woodland Kv= 5.0 fps
91.1	900	Total			

Subcatchment 3A: Site



Subcatchment 3B: South of Bedell

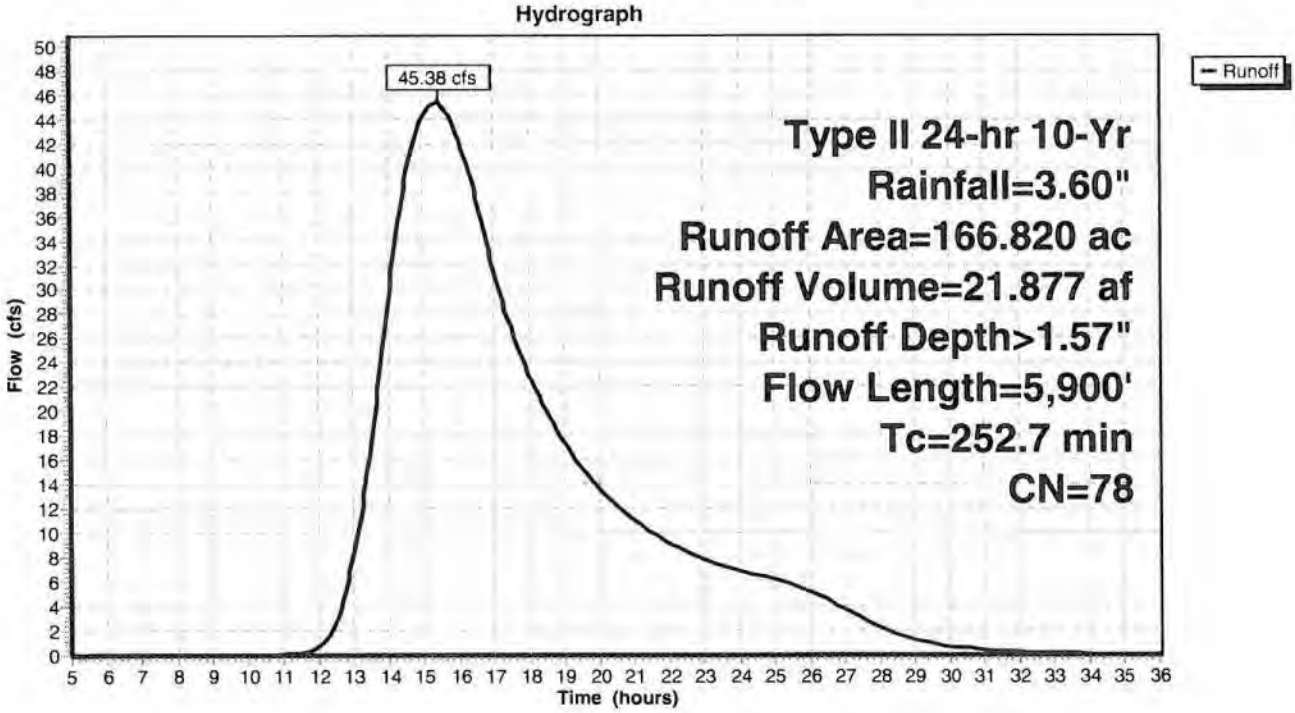
Runoff = 45.38 cfs @ 15.43 hrs, Volume= 21.877 af, Depth> 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B: South of Bedell

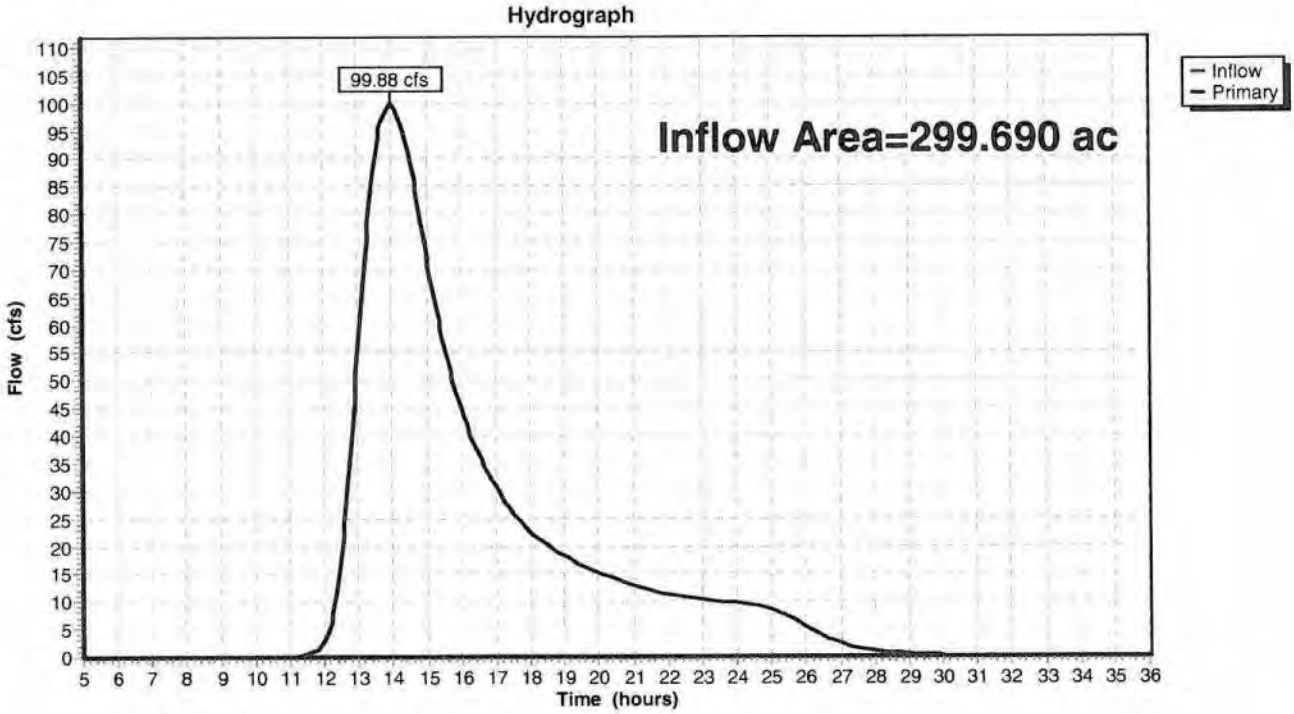


Pond 1P: Long Road

Inflow Area =	299.690 ac,	Inflow Depth =	1.40"	for	10-Yr event
Inflow =	99.88 cfs @	13.99 hrs,	Volume=	34.975 af	
Primary =	99.88 cfs @	13.99 hrs,	Volume=	34.975 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road

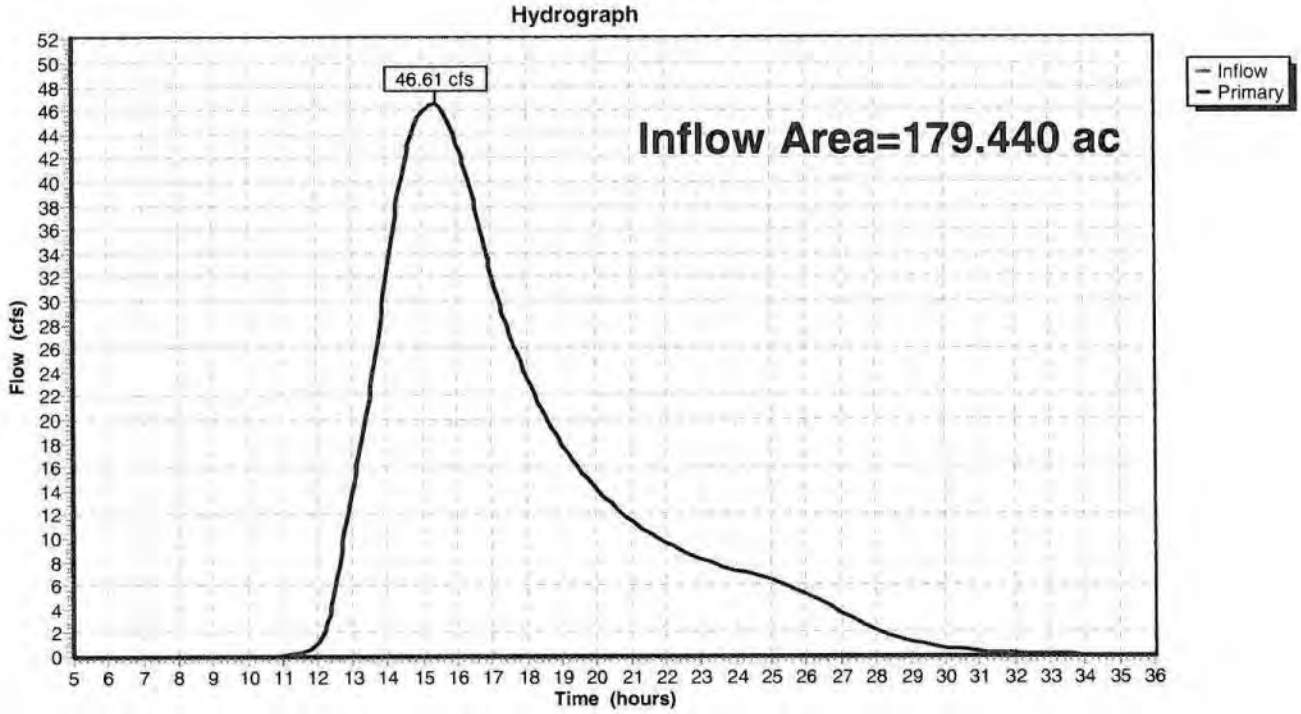


Pond 4P: Swale

Inflow Area = 179.440 ac, Inflow Depth > 1.55" for 10-Yr event
Inflow = 46.61 cfs @ 15.42 hrs, Volume= 23.189 af
Primary = 46.61 cfs @ 15.42 hrs, Volume= 23.189 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 4P: Swale



Subcatchment 1A: To Long

Open field & woods draining directly to long ditch

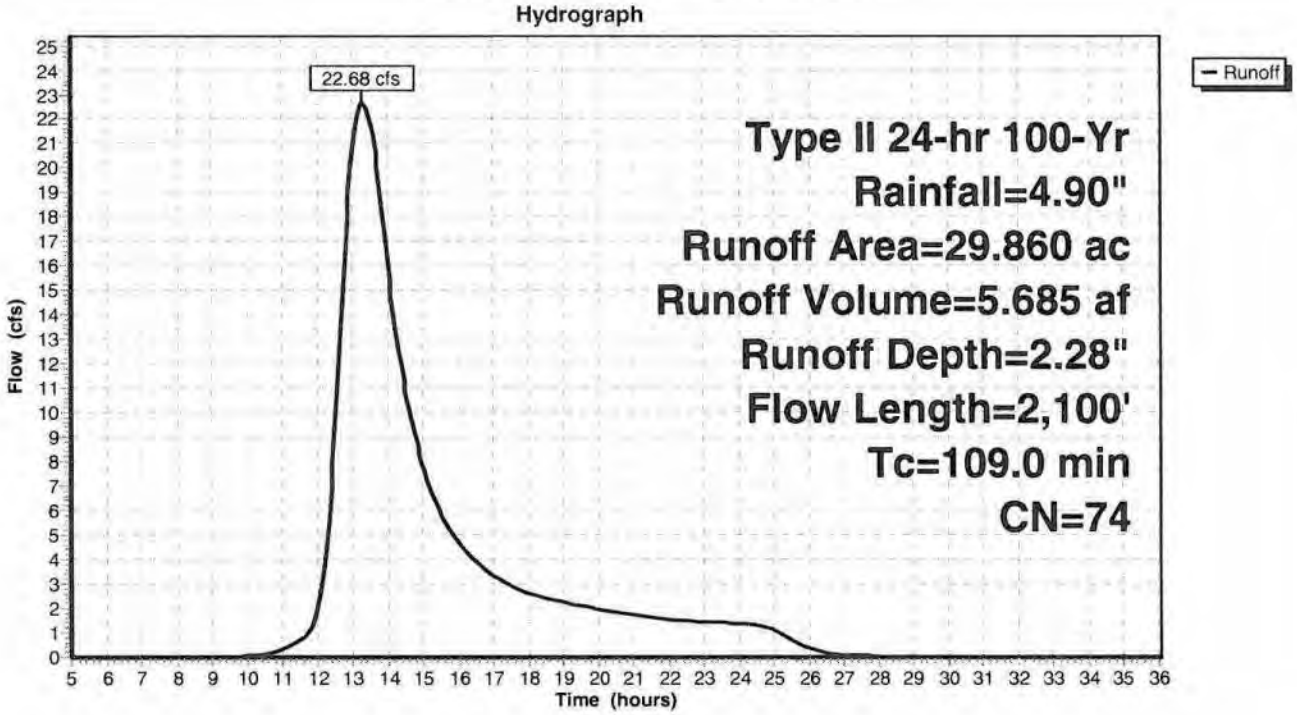
Runoff = 22.68 cfs @ 13.30 hrs, Volume= 5.685 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
7.650	77	Woods, Good, HSG D
22.210	73	Brush, Good, HSG D
29.860	74	Weighted Average
29.860		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope** Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field** Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: To Long



Subcatchment 1B: To Long

Open field & woods draining to 8" culverts on access road

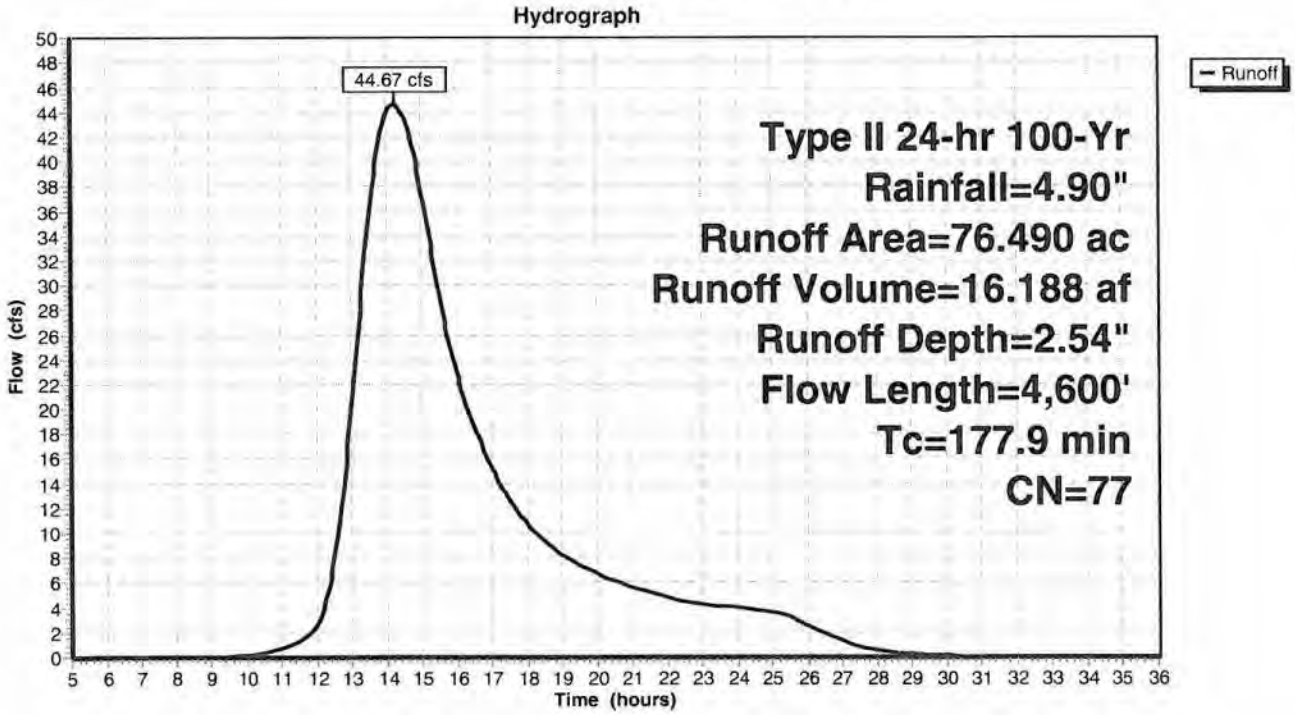
Runoff = 44.67 cfs @ 14.23 hrs, Volume= 16.188 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
56.420	77	Woods, Good, HSG D
15.070	73	Brush, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
76.490	77	Weighted Average
75.490		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
70.7	1,500	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
33.6	3,000	0.0080	1.49	4.47	**Channel Flow, Swale** Area= 3.0 sf Perim= 10.0' r= 0.30' n= 0.040
177.9	4,600	Total			

Subcatchment 1B: To Long



Subcatchment 2: Swale Flowing North To Long

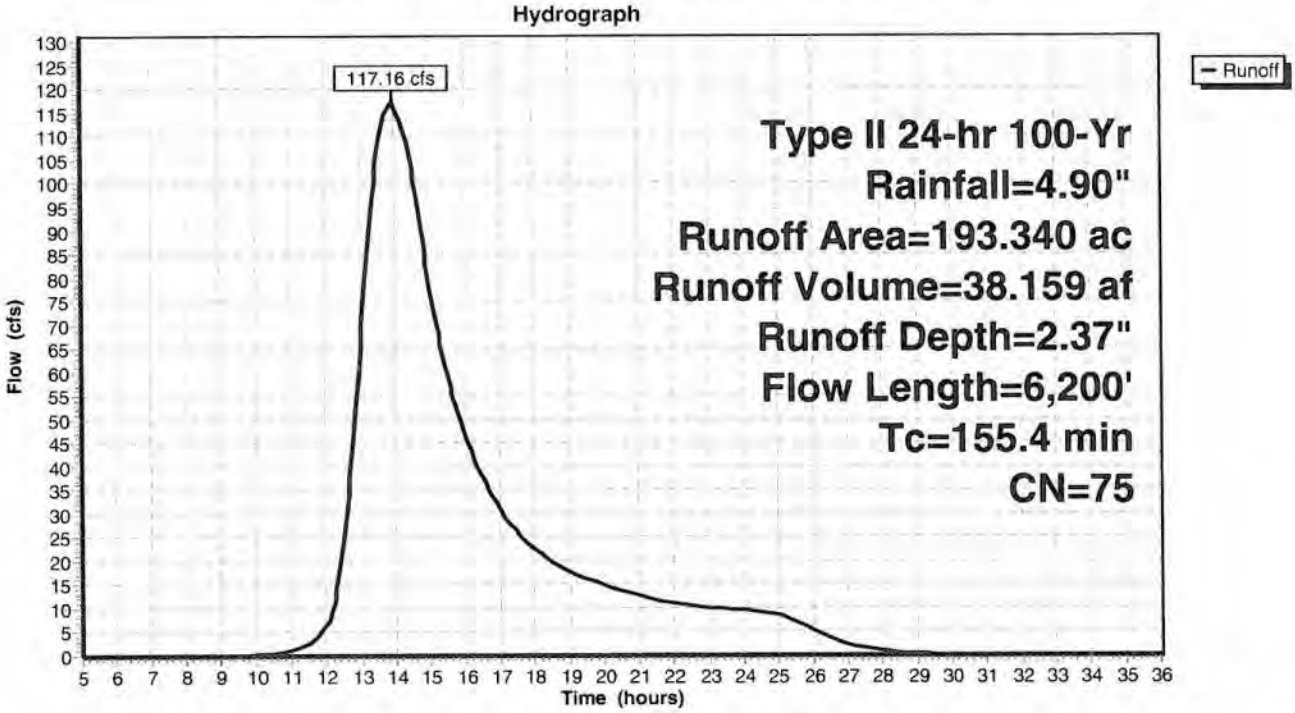
Runoff = 117.16 cfs @ 13.97 hrs, Volume= 38.159 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
119.340	73	Brush, Good, HSG D
61.000	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
193.340	75	Weighted Average
190.740		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2: Swale Flowing North To Long



Subcatchment 3A: Site

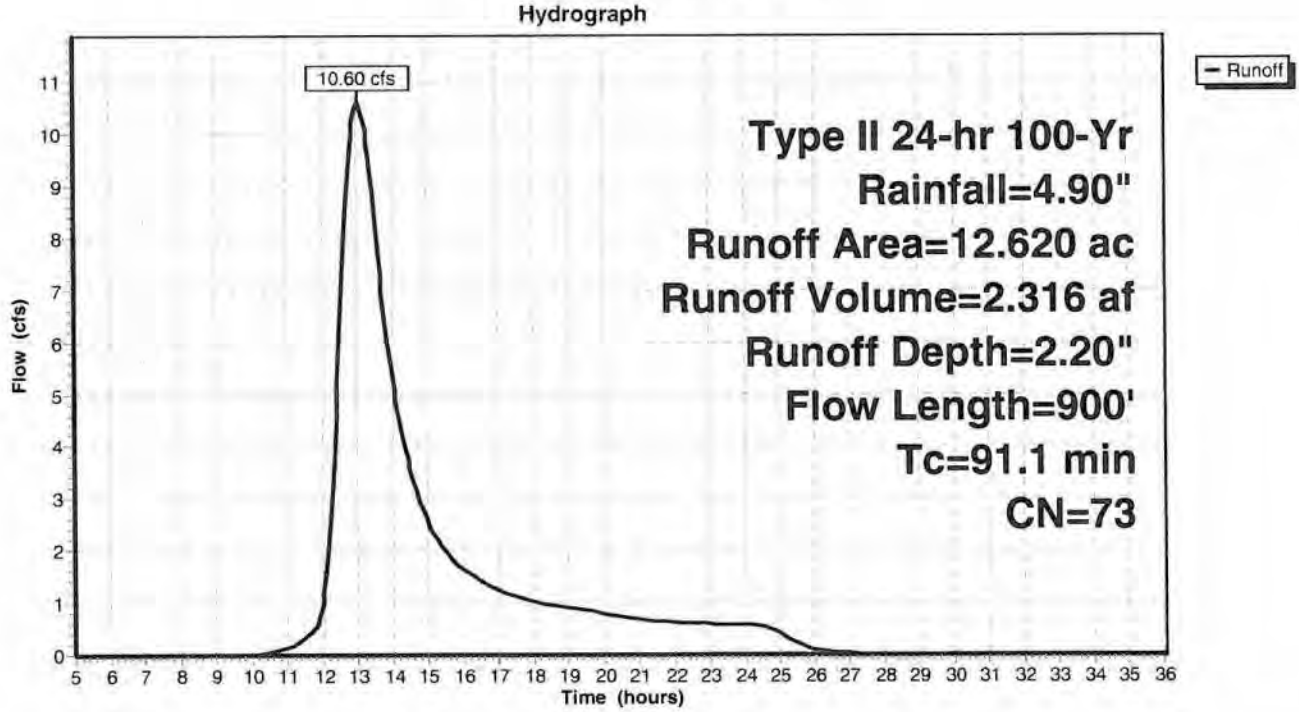
Runoff = 10.60 cfs @ 13.05 hrs, Volume= 2.316 af, Depth= 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
12.620	73	Brush, Good, HSG D
12.620		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
64.4	100	0.0070	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.7	800	0.0100	0.50		**Shallow Concentrated Flow, Brush** Woodland Kv= 5.0 fps
91.1	900	Total			

Subcatchment 3A: Site



Subcatchment 3B: South of Bedell

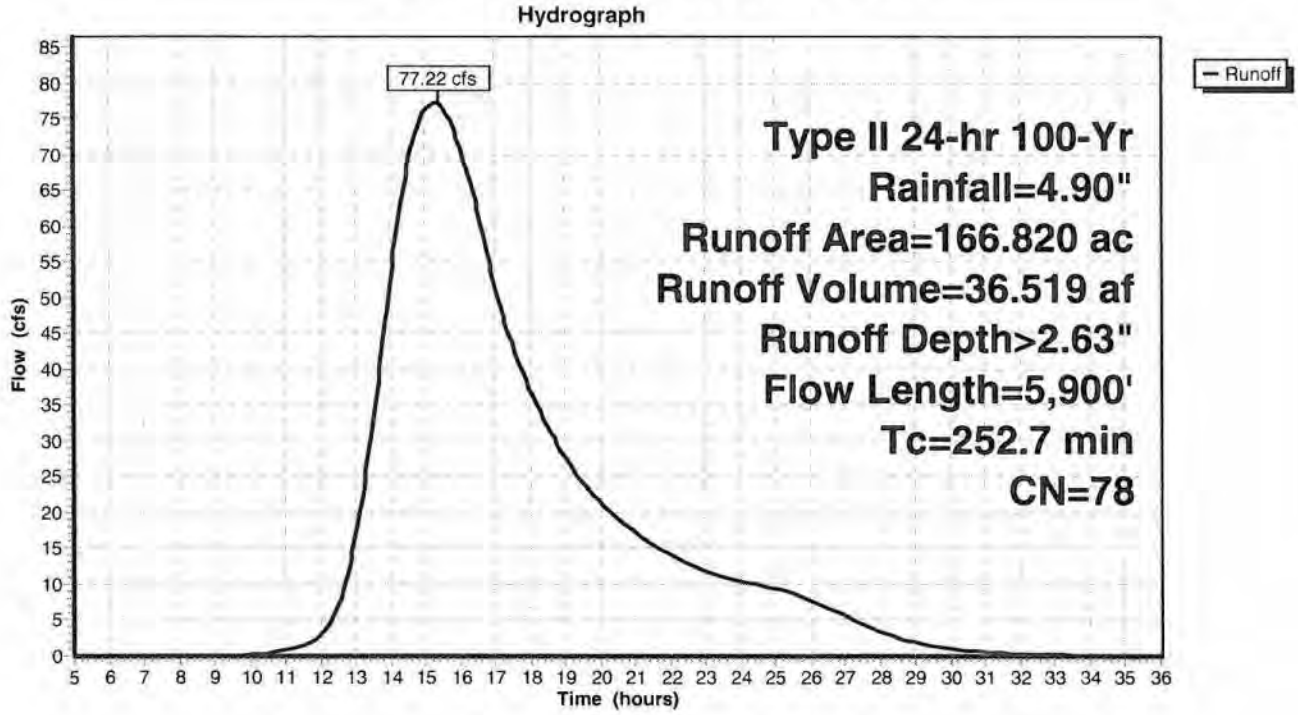
Runoff = 77.22 cfs @ 15.39 hrs, Volume= 36.519 af, Depth> 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B: South of Bedell

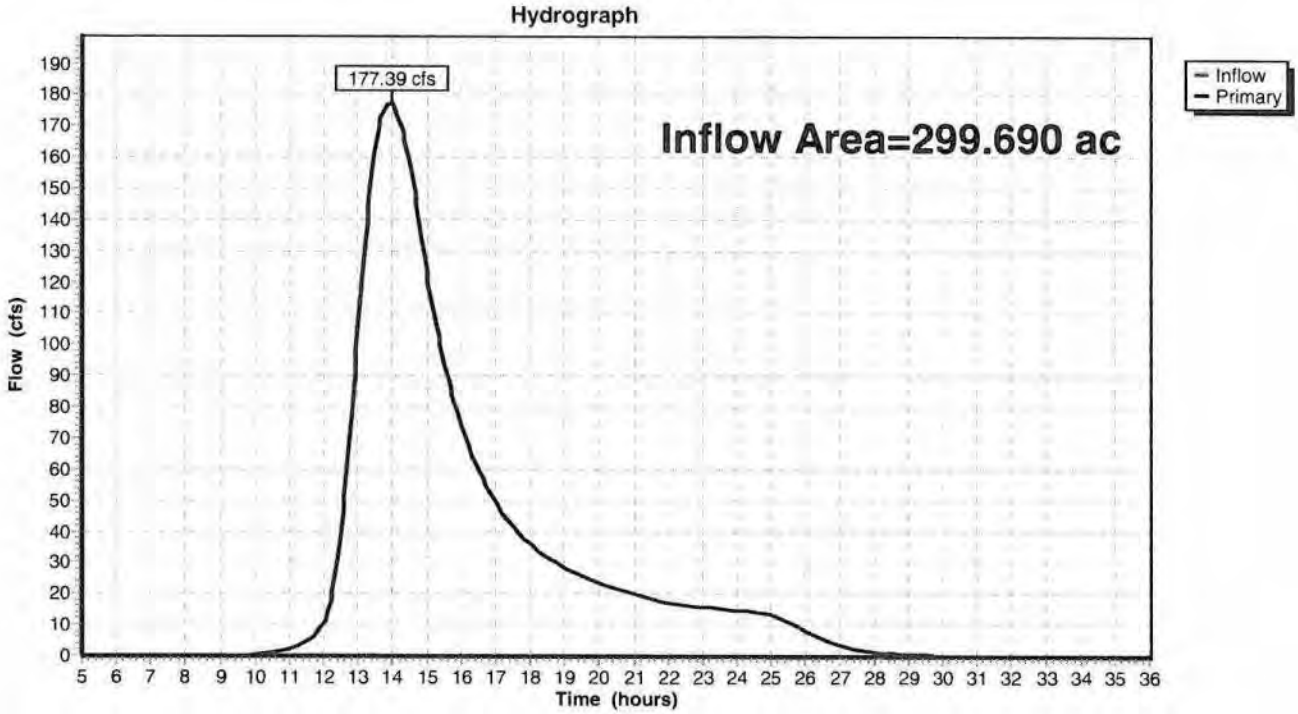


Pond 1P: Long Road

Inflow Area = 299.690 ac, Inflow Depth = 2.40" for 100-Yr event
Inflow = 177.39 cfs @ 13.95 hrs, Volume= 60.032 af
Primary = 177.39 cfs @ 13.95 hrs, Volume= 60.032 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road

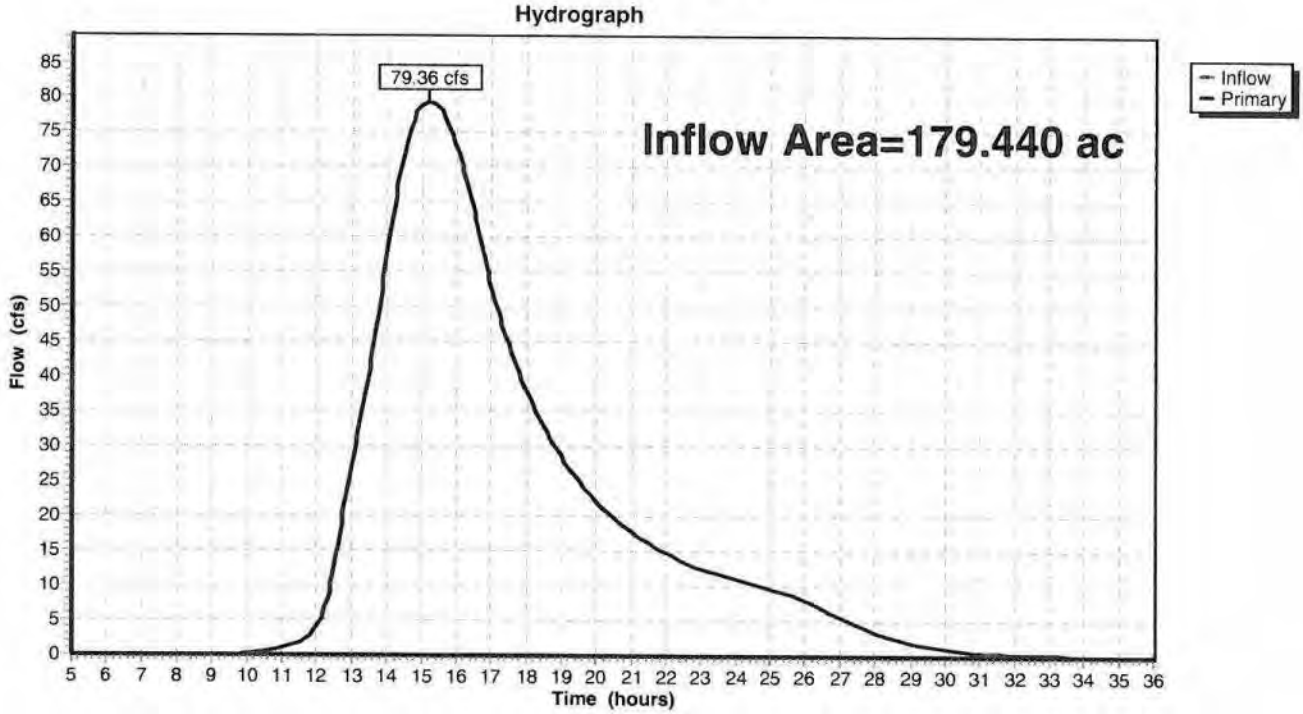


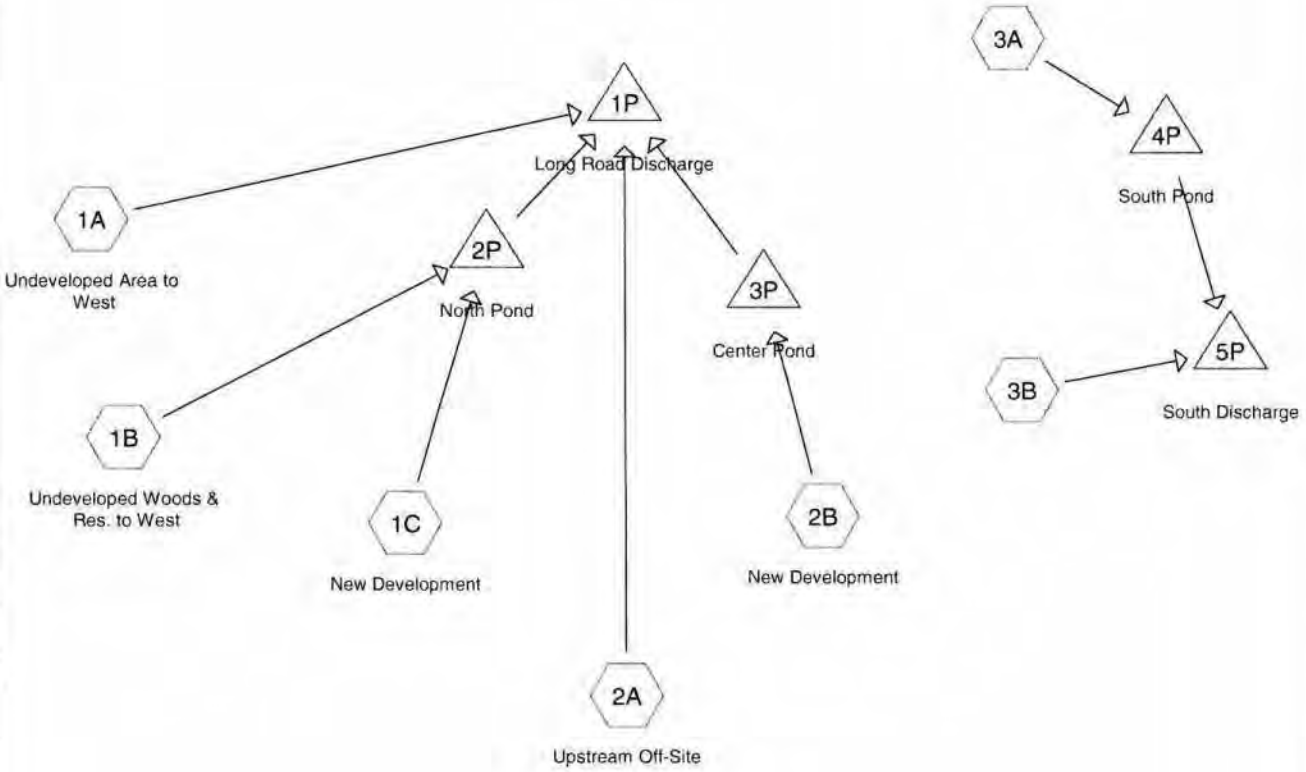
Pond 4P: Swale

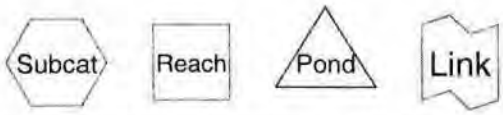
Inflow Area = 179.440 ac, Inflow Depth > 2.60" for 100-Yr event
Inflow = 79.36 cfs @ 15.21 hrs, Volume= 38.835 af
Primary = 79.36 cfs @ 15.21 hrs, Volume= 38.835 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Pond 4P: Swale







Drainage Diagram for proposed
Prepared by {enter your company name here} 5/1/2008
HydroCAD® 8.00 s/n 002837 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
15.990	73	Brush, Good, HSG D (1A)
288.540	77	Woods, Good, HSG D (1A,1B,2A,3B)
43.000	84	1 acre lots, 20% imp, HSG D (1B,2A,3B)
131.840	93	Urban industrial, 72% imp, HSG D (1C,2B,3A)
479.370		

Subcatchment 1A: Undeveloped Area to West

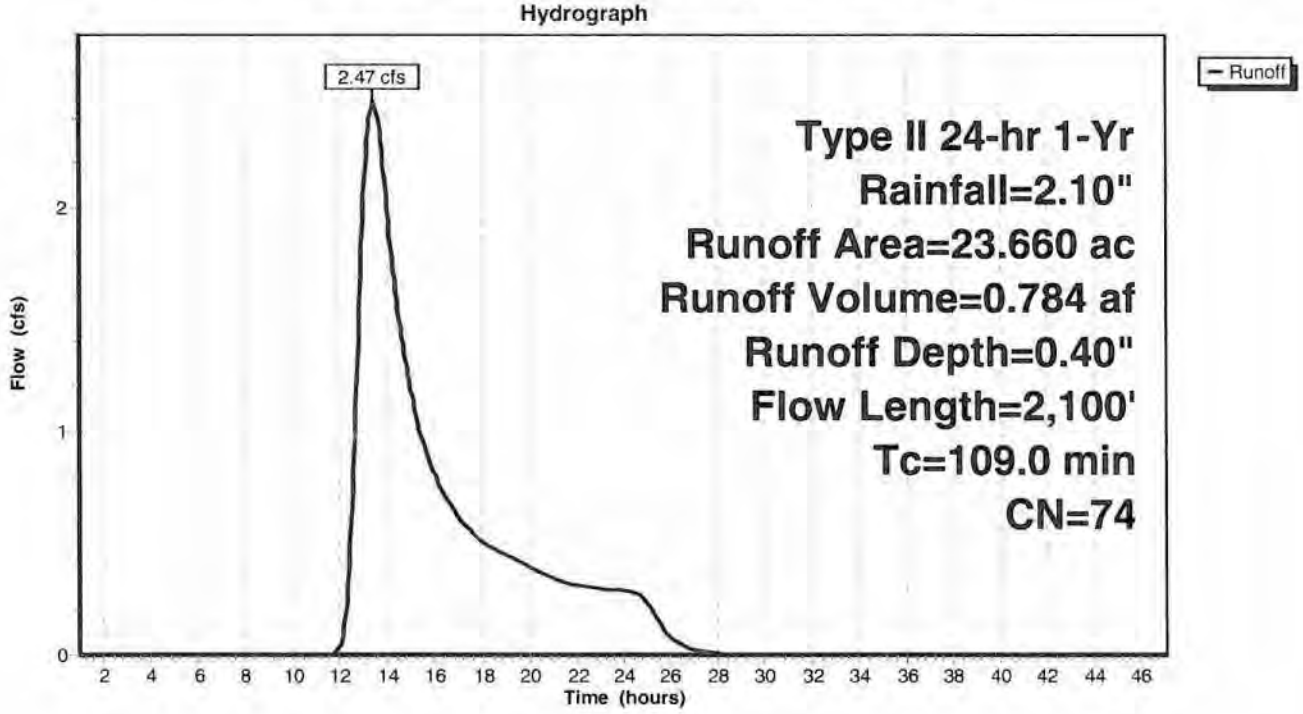
Runoff = 2.47 cfs @ 13.46 hrs, Volume= 0.784 af, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
7.670	77	Woods, Good, HSG D
15.990	73	Brush, Good, HSG D
23.660	74	Weighted Average
23.660		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope** Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field** Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: Undeveloped Area to West



Subcatchment 1B: Undeveloped Woods & Res. to West

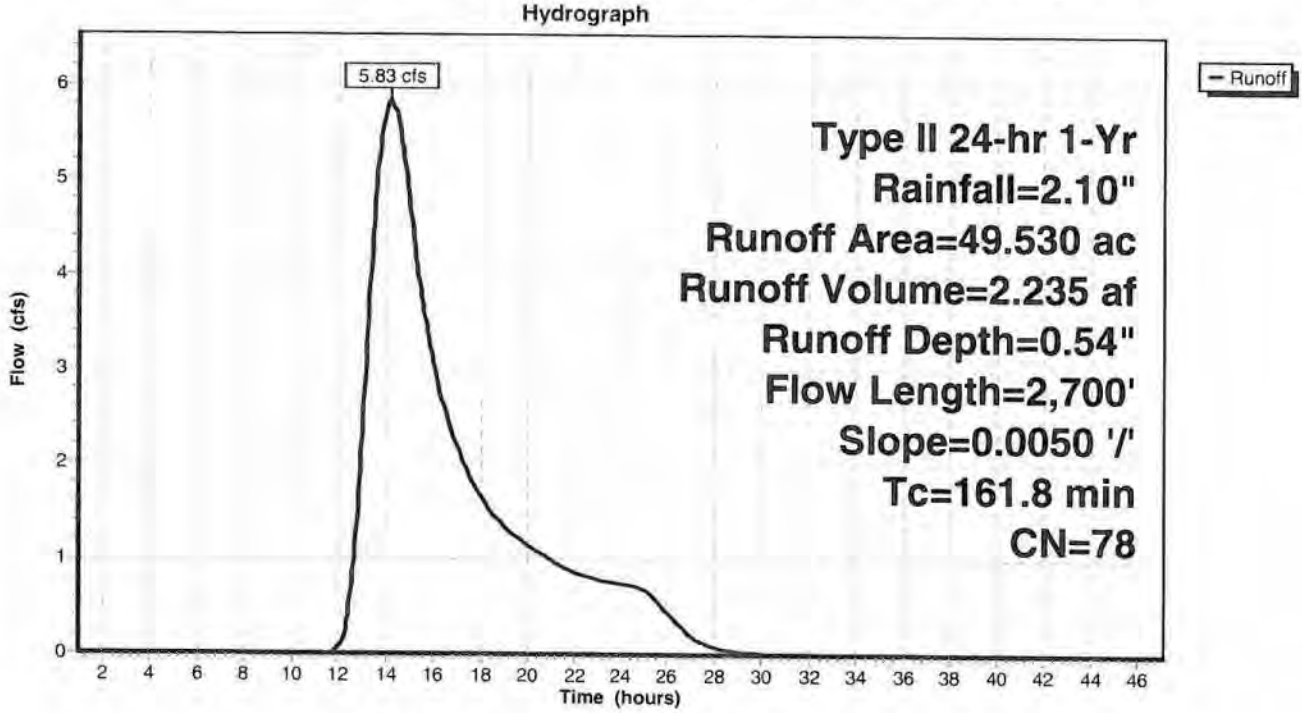
Runoff = 5.83 cfs @ 14.20 hrs, Volume= 2.235 af, Depth= 0.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
44.530	77	Woods, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
49.530	78	Weighted Average
48.530		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
84.9	1,800	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
3.3	800		4.00		**Direct Entry, Pipe Flow**
161.8	2,700	Total			

Subcatchment 1B: Undeveloped Woods & Res. to West



Subcatchment 1C: New Development

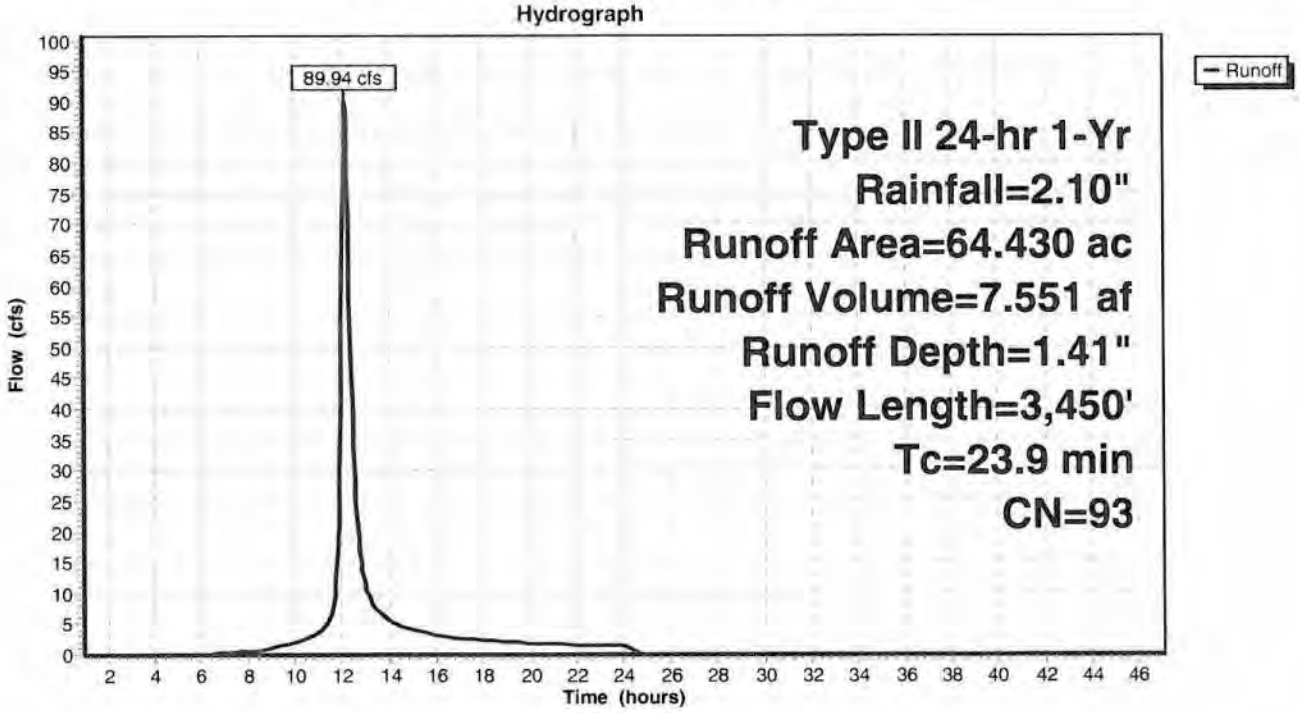
Runoff = 89.94 cfs @ 12.17 hrs, Volume= 7.551 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
64.430	93	Urban industrial, 72% imp, HSG D
18.040		Pervious Area
46.390		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
13.8	3,300		4.00		**Direct Entry, Pipe Flow**
23.9	3,450	Total			

Subcatchment 1C: New Development



Subcatchment 2A: Upstream Off-Site

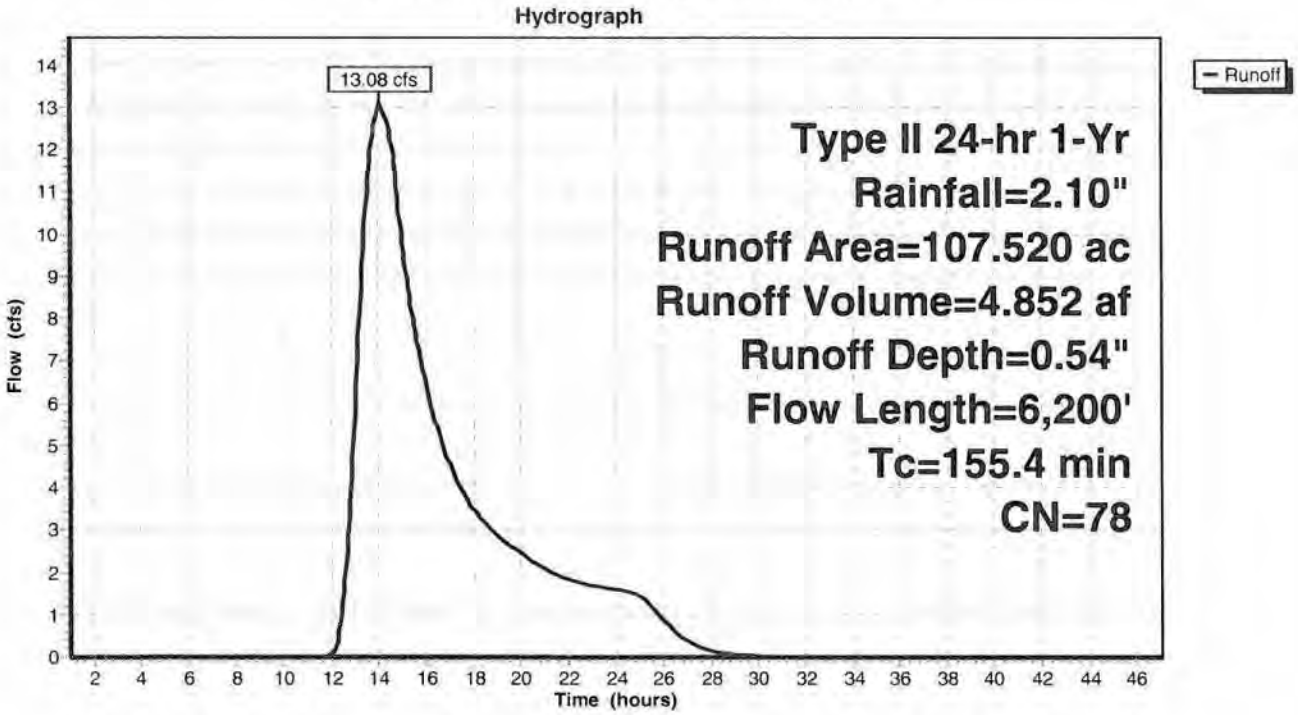
Runoff = 13.08 cfs @ 14.02 hrs, Volume= 4.852 af, Depth= 0.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
94.520	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
107.520	78	Weighted Average
104.920		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2A: Upstream Off-Site



Subcatchment 2B: New Development

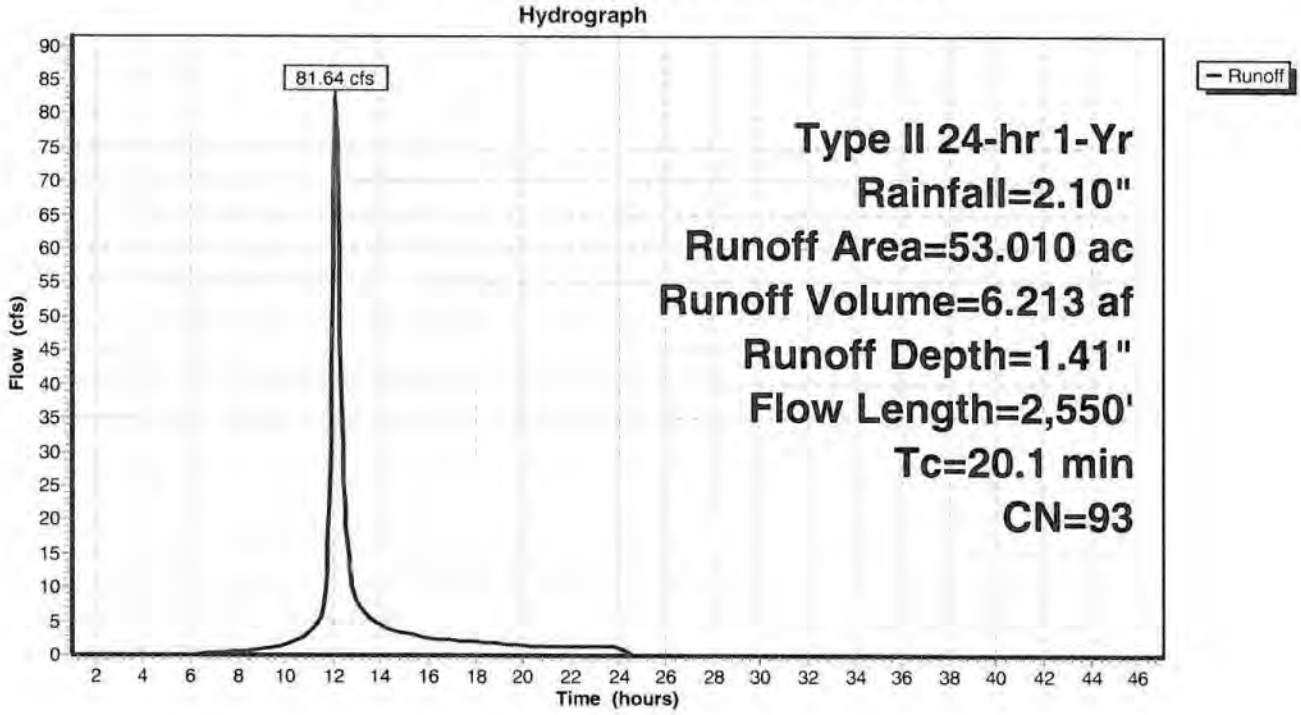
Runoff = 81.64 cfs @ 12.12 hrs, Volume= 6.213 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
53.010	93	Urban industrial, 72% imp, HSG D
14.843		Pervious Area
38.167		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass**
					Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement**
					Paved Kv= 20.3 fps
10.0	2,400		4.00		**Direct Entry, Pipe Flow**
20.1	2,550	Total			

Subcatchment 2B: New Development



Subcatchment 3A:

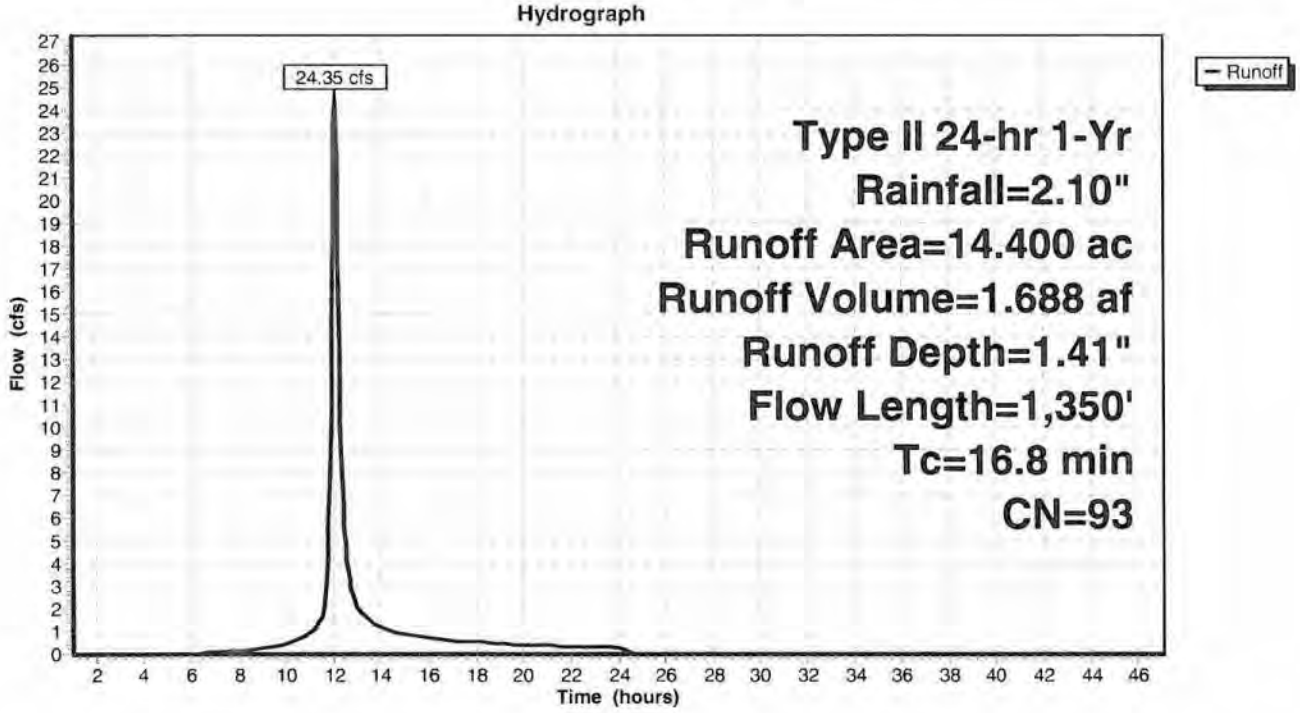
Runoff = 24.35 cfs @ 12.09 hrs, Volume= 1.688 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
14.400	93	Urban industrial, 72% imp, HSG D
4.032		Pervious Area
10.368		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Woods** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
6.7	1,200		3.00		**Direct Entry, Pipe Flow**
16.8	1,350	Total			

Subcatchment 3A:



Subcatchment 3B:

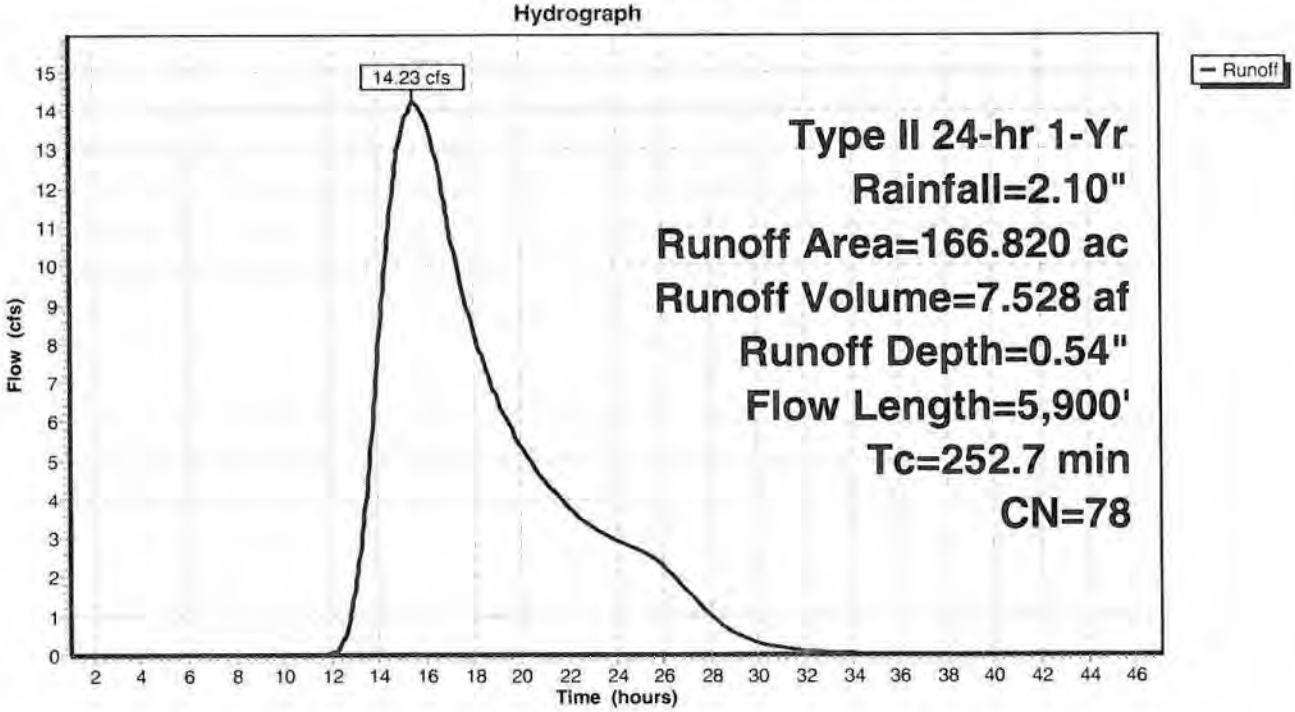
Runoff = 14.23 cfs @ 15.46 hrs, Volume= 7.528 af, Depth= 0.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 1-Yr Rainfall=2.10"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B:

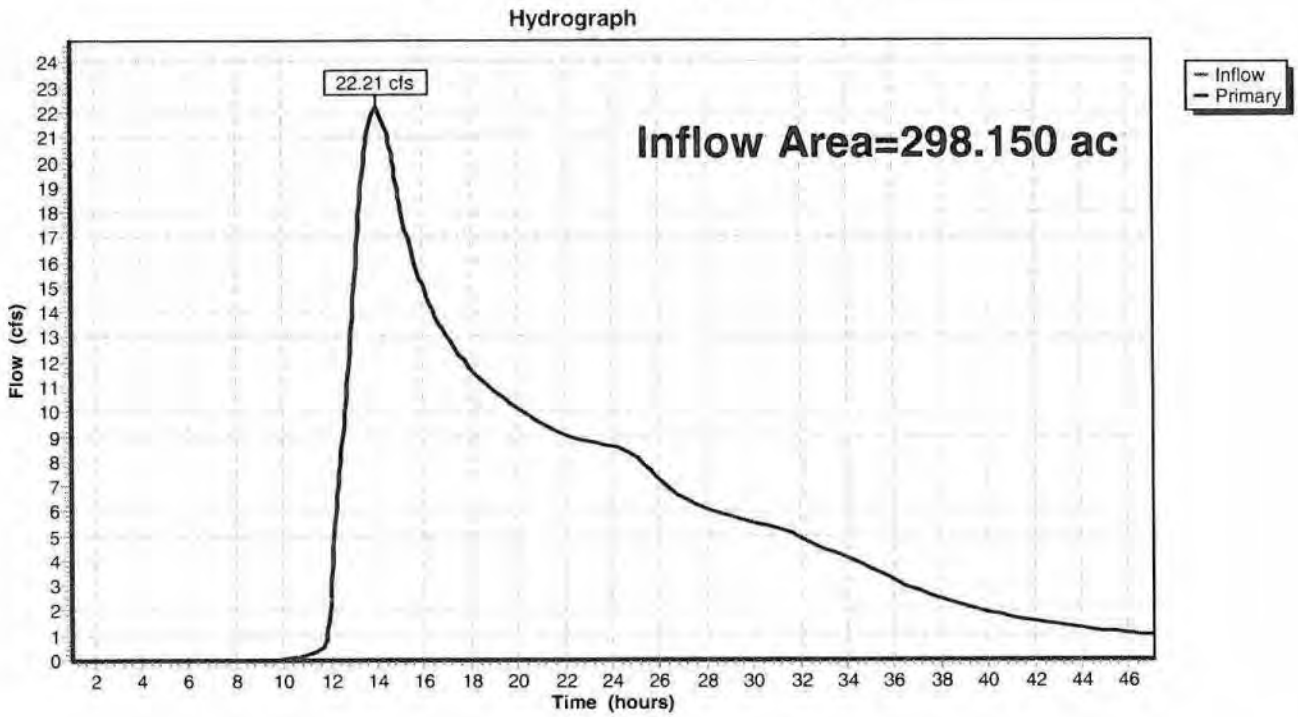


Pond 1P: Long Road Discharge

Inflow Area = 298.150 ac, Inflow Depth > 0.79" for 1-Yr event
Inflow = 22.21 cfs @ 13.99 hrs, Volume= 19.629 af
Primary = 22.21 cfs @ 13.99 hrs, Volume= 19.629 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road Discharge



Pond 2P: North Pond

Inflow Area =	113.960 ac,	Inflow Depth =	1.03"	for	1-Yr event
Inflow =	90.07 cfs @	12.17 hrs,	Volume=	9.786 af	
Outflow =	4.56 cfs @	17.29 hrs,	Volume=	8.343 af,	Atten= 95%, Lag= 307.2 min
Primary =	4.56 cfs @	17.29 hrs,	Volume=	8.343 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 567.81' @ 17.29 hrs Surf.Area= 162,847 sf Storage= 273,687 cf

Plug-Flow detention time= 742.6 min calculated for 8.343 af (85% of inflow)
Center-of-Mass det. time= 669.7 min (1,536.2 - 866.5)

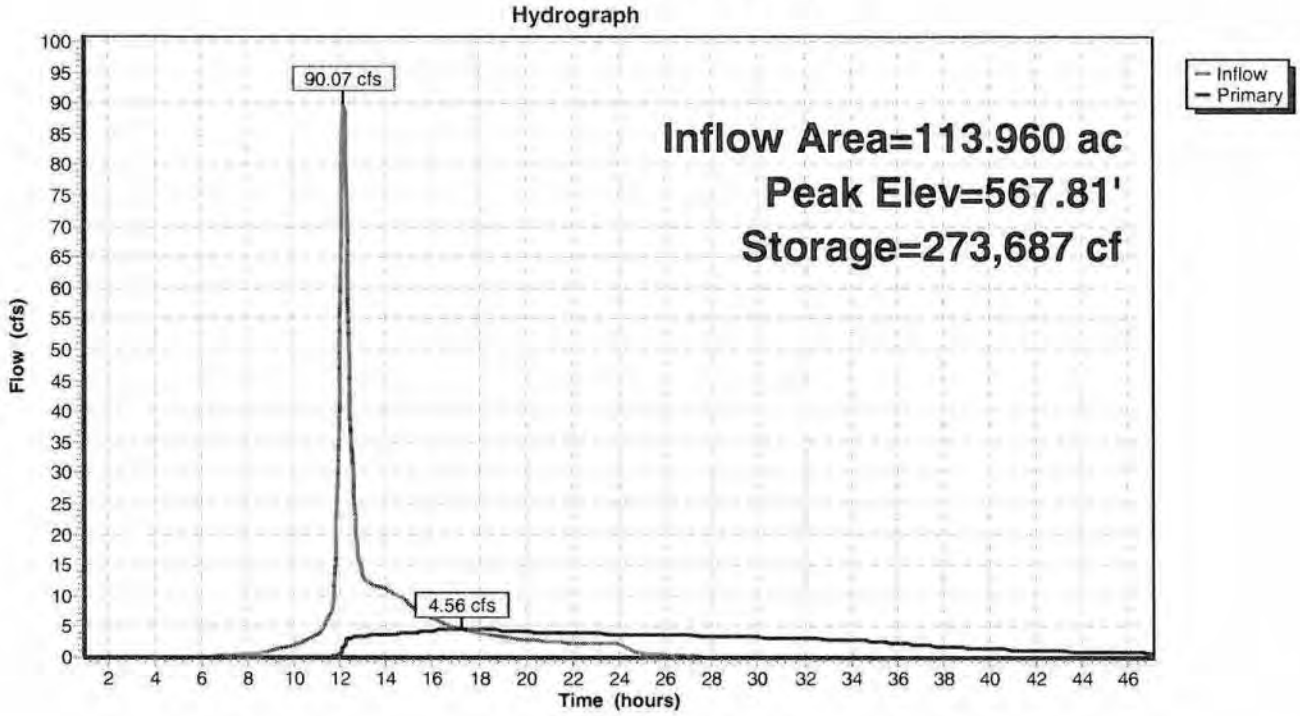
Volume	Invert	Avail.Storage	Storage Description
#1	566.00'	651,210 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
566.00	142,189	0	0
567.00	151,813	147,001	147,001
568.00	165,516	158,665	305,666
569.00	171,536	168,526	474,192
570.00	182,500	177,018	651,210

Device	Routing	Invert	Outlet Devices
#1	Primary	566.00'	**30.0" x 285.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 565.50' S= 0.0018 '/' Cc= 0.900 n= 0.012
#2	Device 1	561.00'	**12.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 564.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	567.70'	**5.00' W x 0.75' H Vert. Orifice/Grate** C= 0.600
#4	Primary	568.30'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.56 cfs @ 17.29 hrs HW=567.81' (Free Discharge)
- **1=Culvert** (Passes 4.56 cfs of 11.19 cfs potential flow)
  - **2=Culvert** (Inlet Controls 4.01 cfs @ 5.11 fps)
  - **3=Orifice/Grate** (Orifice Controls 0.55 cfs @ 1.04 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: North Pond



Pond 3P: Center Pond

Inflow Area =	53.010 ac,	Inflow Depth =	1.41"	for 1-Yr event	
Inflow =	81.64 cfs @	12.12 hrs,	Volume=	6.213 af	
Outflow =	3.38 cfs @	14.80 hrs,	Volume=	5.651 af,	Atten= 96%, Lag= 160.9 min
Primary =	3.38 cfs @	14.80 hrs,	Volume=	5.651 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 576.54' @ 14.80 hrs Surf.Area= 76,654 sf Storage= 177,282 cf

Plug-Flow detention time= 648.0 min calculated for 5.651 af (91% of inflow)
Center-of-Mass det. time= 600.8 min (1,418.9 - 818.1)

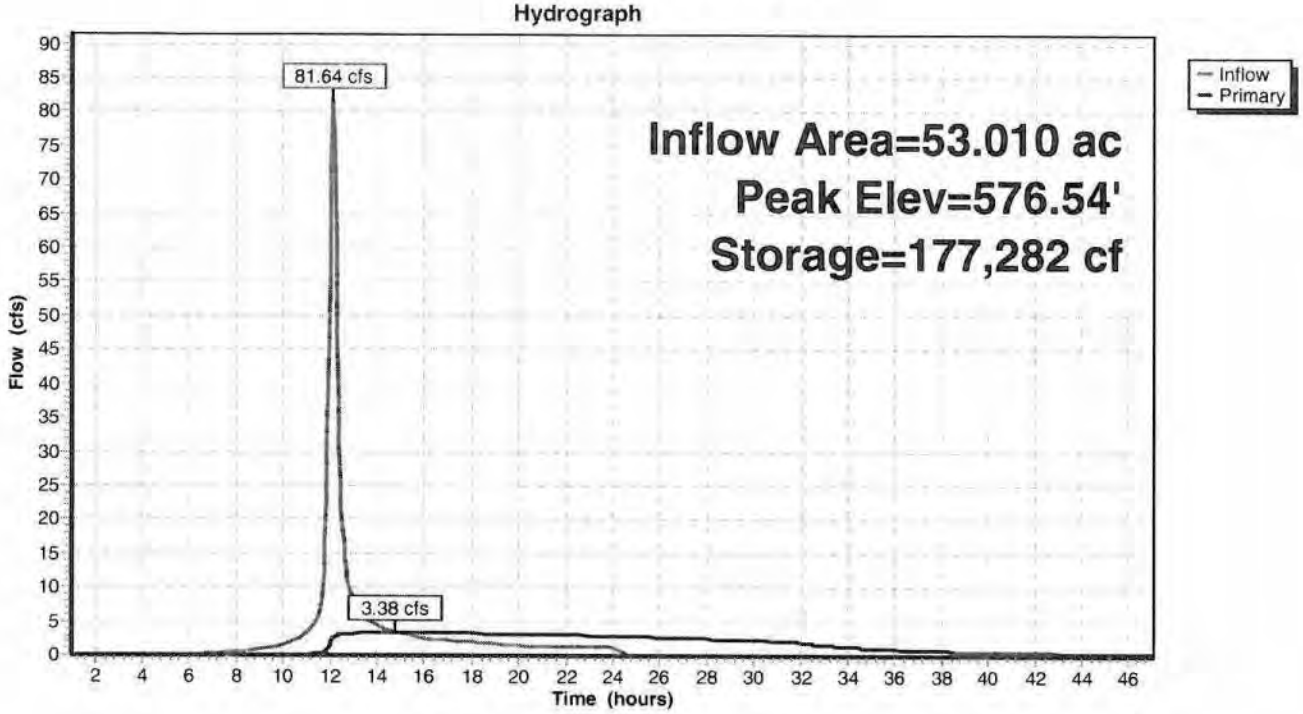
Volume	Invert	Avail.Storage	Storage Description
#1	574.00'	577,210 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
574.00	62,610	0	0
575.00	68,020	65,315	65,315
576.00	73,586	70,803	136,118
577.00	79,282	76,434	212,552
578.00	85,109	82,196	294,748
579.00	91,066	88,088	382,835
580.00	97,155	94,111	476,946
581.00	103,374	100,265	577,210

Device	Routing	Invert	Outlet Devices
#1	Primary	574.00'	**18.0" x 70.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 574.00' S= 0.0000 '/' Cc= 0.900 n= 0.012
#2	Device 1	569.00'	**10.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 572.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	576.50'	**2.70' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	579.00'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=3.37 cfs @ 14.80 hrs HW=576.54' (Free Discharge)
- **1=Culvert** (Passes 3.37 cfs of 8.36 cfs potential flow)
  - **2=Culvert** (Inlet Controls 3.30 cfs @ 6.06 fps)
  - **3=Orifice/Grate** (Orifice Controls 0.07 cfs @ 0.63 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Center Pond



Pond 4P: South Pond

Inflow Area =	14.400 ac,	Inflow Depth =	1.41"	for	1-Yr event
Inflow =	24.35 cfs @	12.09 hrs,	Volume=	1.688 af	
Outflow =	1.06 cfs @	14.18 hrs,	Volume=	1.624 af,	Atten= 96%, Lag= 125.3 min
Primary =	1.06 cfs @	14.18 hrs,	Volume=	1.624 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 584.52' @ 14.18 hrs Surf.Area= 28,340 sf Storage= 46,026 cf

Plug-Flow detention time= 538.2 min calculated for 1.624 af (96% of inflow)
Center-of-Mass det. time= 515.9 min (1,330.9 - 815.1)

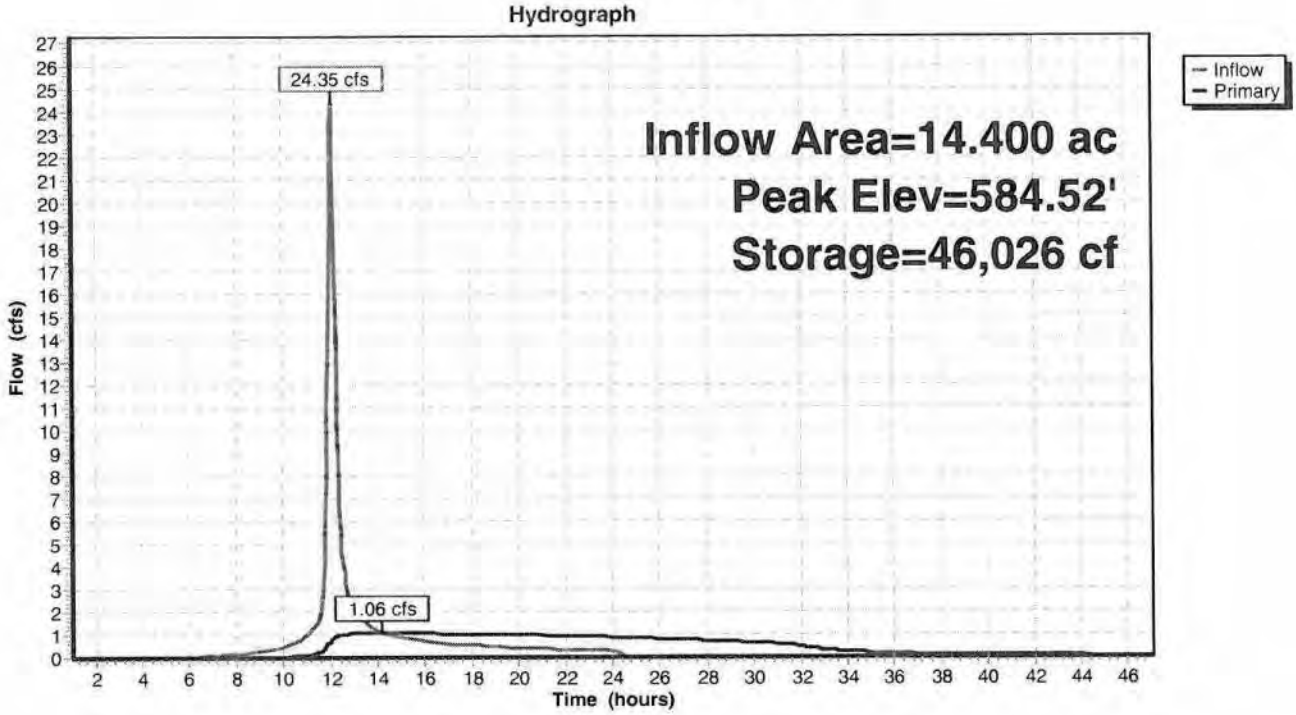
Volume	Invert	Avail.Storage	Storage Description
#1	582.50'	167,557 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
582.50	18,000	0	0
583.30	20,000	15,200	15,200
584.00	26,452	16,258	31,458
585.00	30,118	28,285	59,743
586.00	33,922	32,020	91,763
587.00	37,863	35,893	127,656
588.00	41,939	39,901	167,557

Device	Routing	Invert	Outlet Devices
#1	Primary	582.50'	**15.0" x 52.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 582.50' S= 0.0000 '/' Cc= 0.900 n= 0.011
#2	Device 1	579.00'	**6.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 580.50' S= -0.0750 '/' Cc= 0.900 n= 0.012
#3	Device 1	584.53'	**1.75' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	586.75'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=1.06 cfs @ 14.18 hrs HW=584.52' (Free Discharge)
- **1=Culvert** (Passes 1.06 cfs of 5.60 cfs potential flow)
  - **2=Culvert** (Inlet Controls 1.06 cfs @ 5.40 fps)
  - **3=Orifice/Grate** (Controls 0.00 cfs)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: South Pond

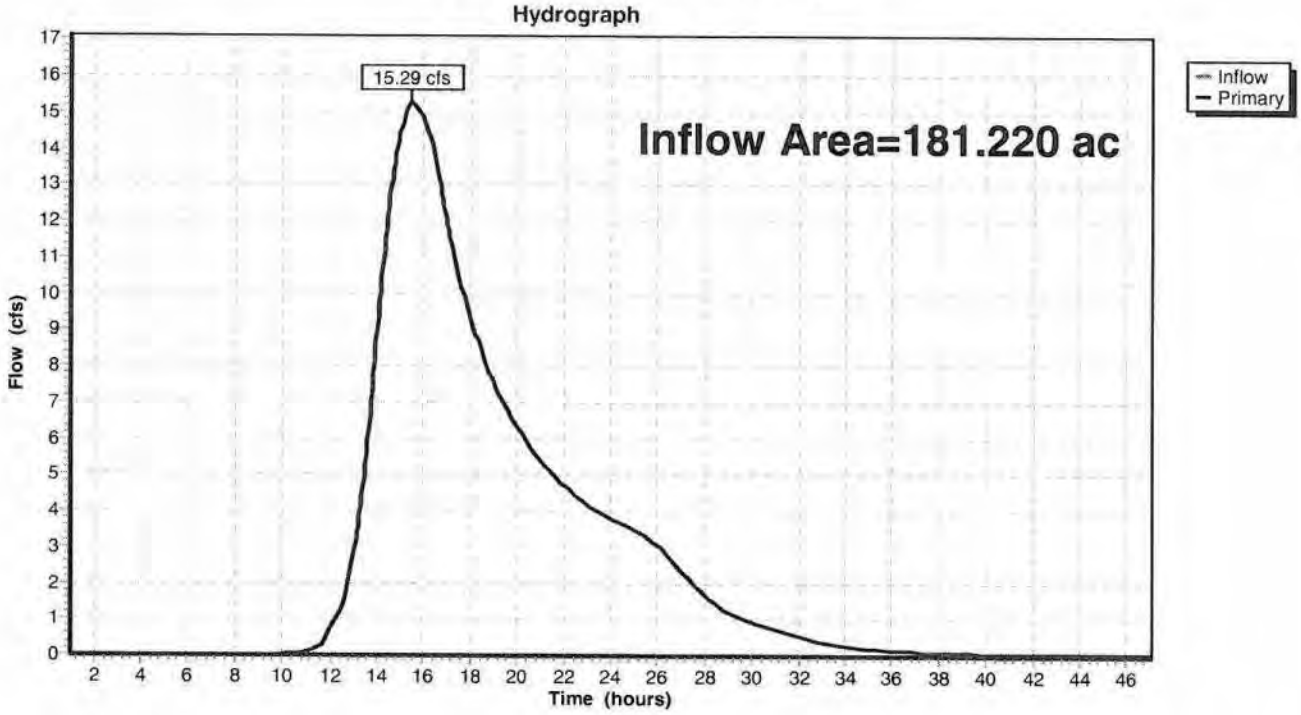


Pond 5P: South Discharge

Inflow Area = 181.220 ac, Inflow Depth > 0.61" for 1-Yr event
Inflow = 15.29 cfs @ 15.46 hrs, Volume= 9.152 af
Primary = 15.29 cfs @ 15.46 hrs, Volume= 9.152 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 5P: South Discharge



Subcatchment 1A: Undeveloped Area to West

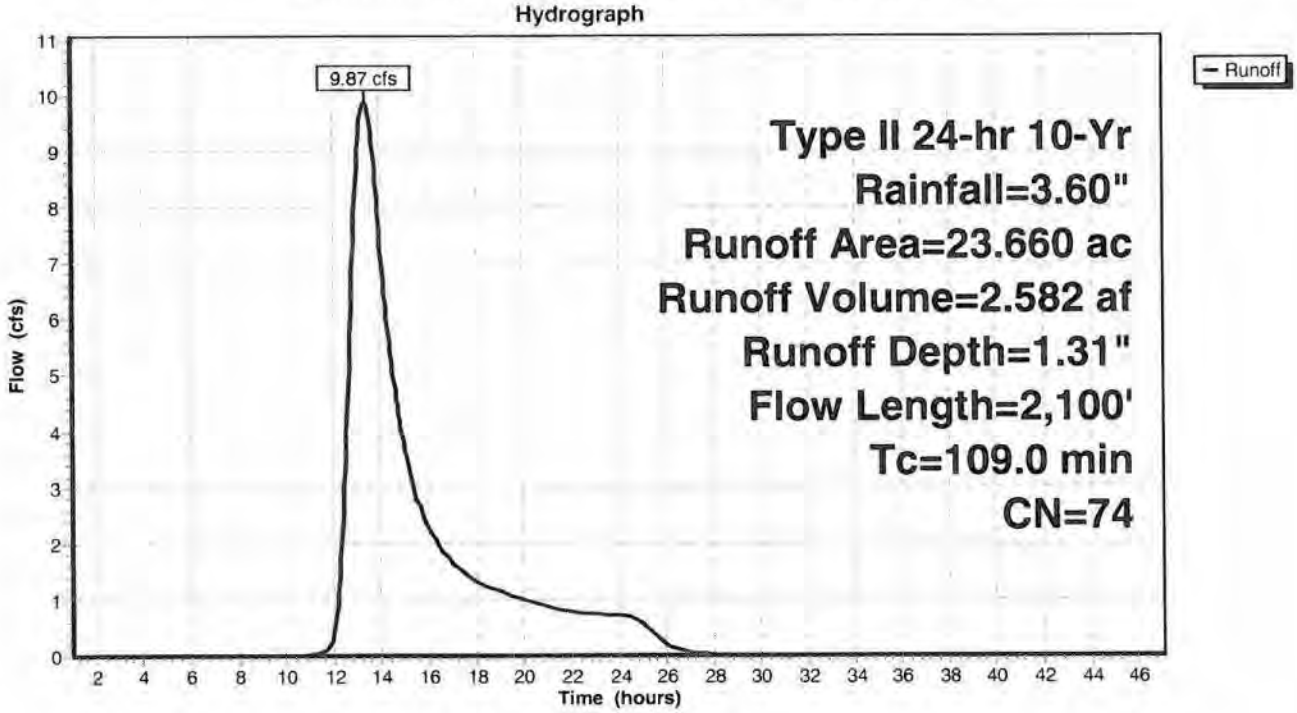
Runoff = 9.87 cfs @ 13.36 hrs, Volume= 2.582 af, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
7.670	77	Woods, Good, HSG D
15.990	73	Brush, Good, HSG D
23.660	74	Weighted Average
23.660		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope** Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field** Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: Undeveloped Area to West



Subcatchment 1B: Undeveloped Woods & Res. to West

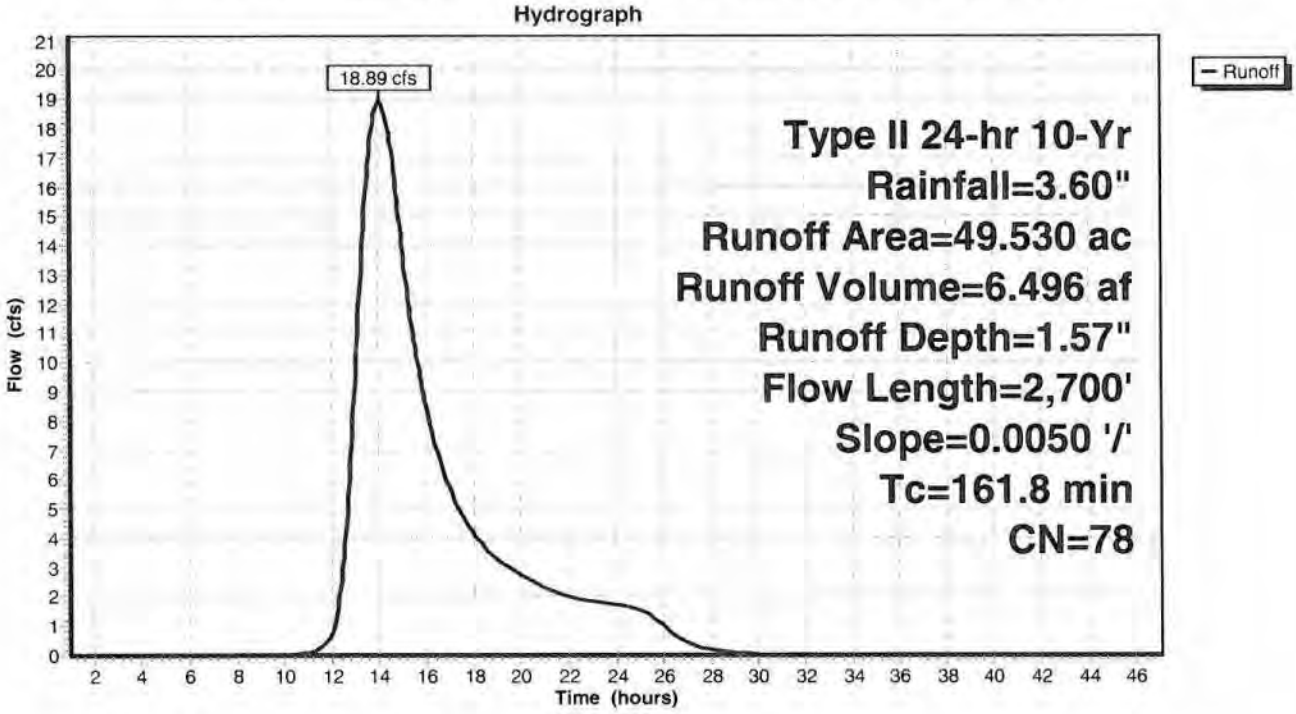
Runoff = 18.89 cfs @ 14.04 hrs, Volume= 6.496 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
44.530	77	Woods, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
49.530	78	Weighted Average
48.530		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
84.9	1,800	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
3.3	800		4.00		**Direct Entry, Pipe Flow**
161.8	2,700	Total			

Subcatchment 1B: Undeveloped Woods & Res. to West



Subcatchment 1C: New Development

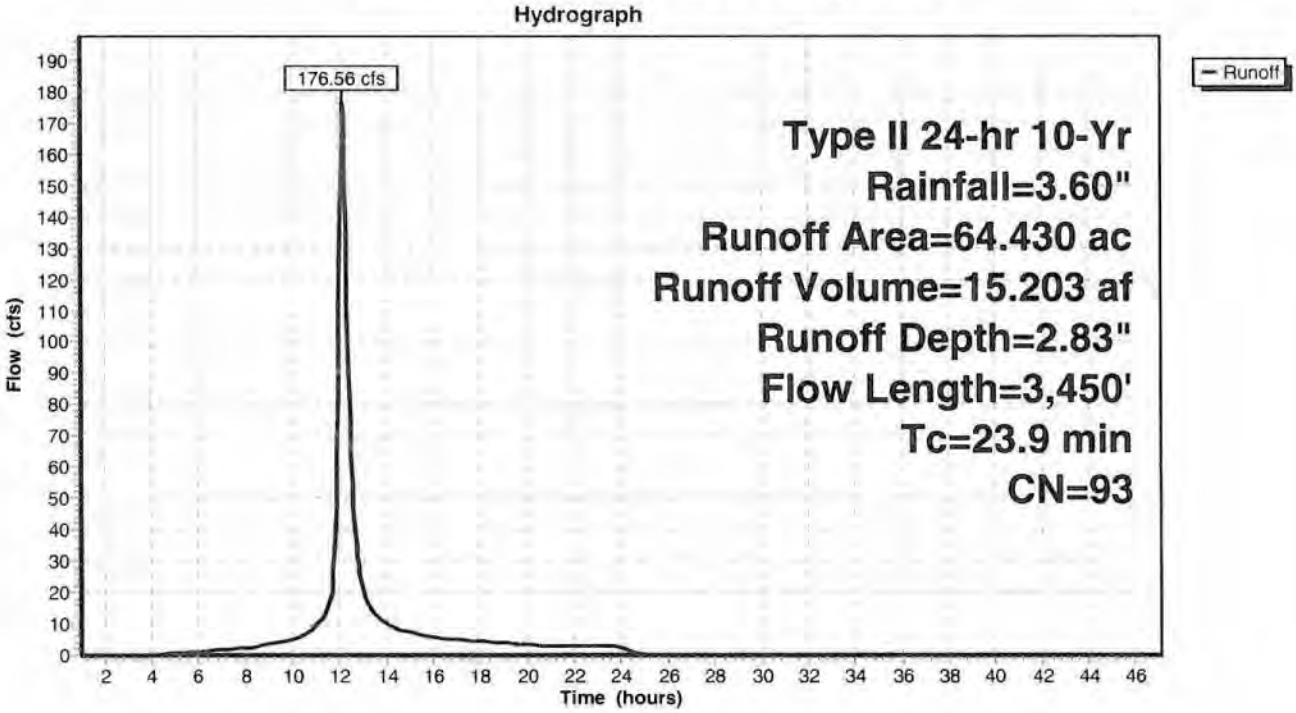
Runoff = 176.56 cfs @ 12.16 hrs, Volume= 15.203 af, Depth= 2.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
64.430	93	Urban industrial, 72% imp, HSG D
18.040		Pervious Area
46.390		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
13.8	3,300		4.00		**Direct Entry, Pipe Flow**
23.9	3,450	Total			

Subcatchment 1C: New Development



Subcatchment 2A: Upstream Off-Site

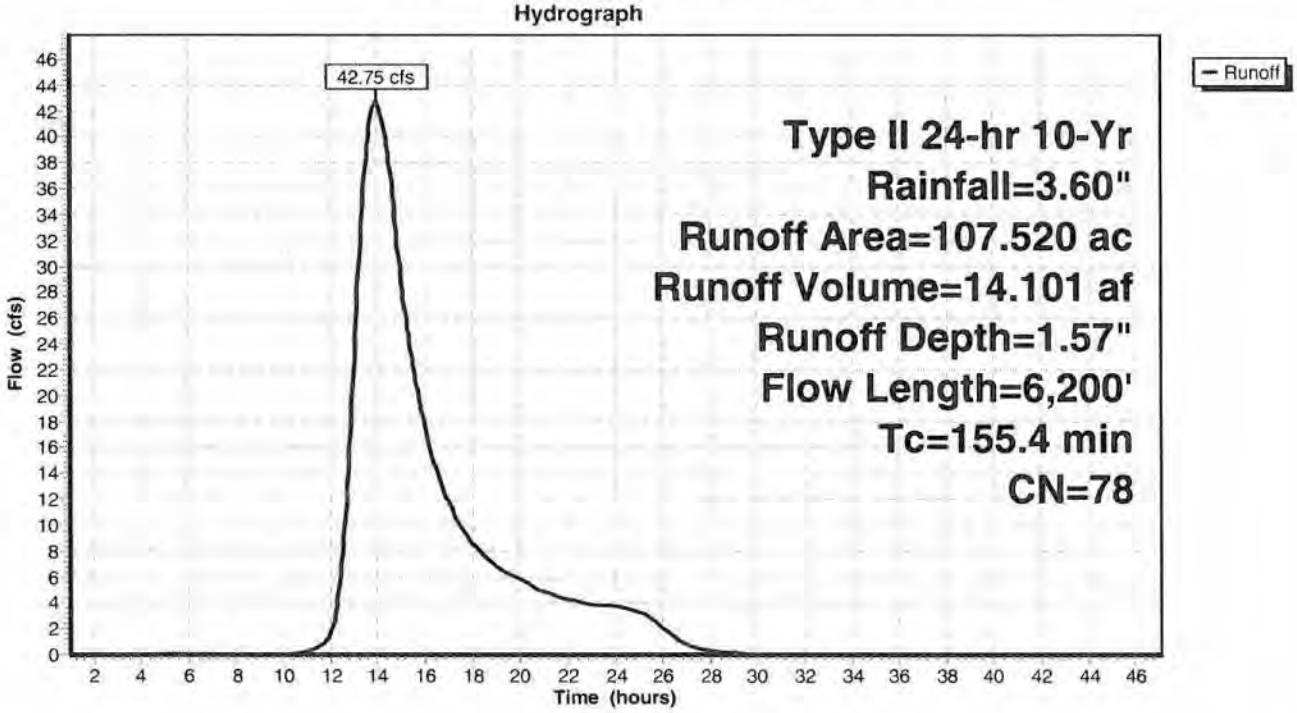
Runoff = 42.75 cfs @ 13.98 hrs, Volume= 14.101 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
94.520	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
107.520	78	Weighted Average
104.920		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2A: Upstream Off-Site



Subcatchment 2B: New Development

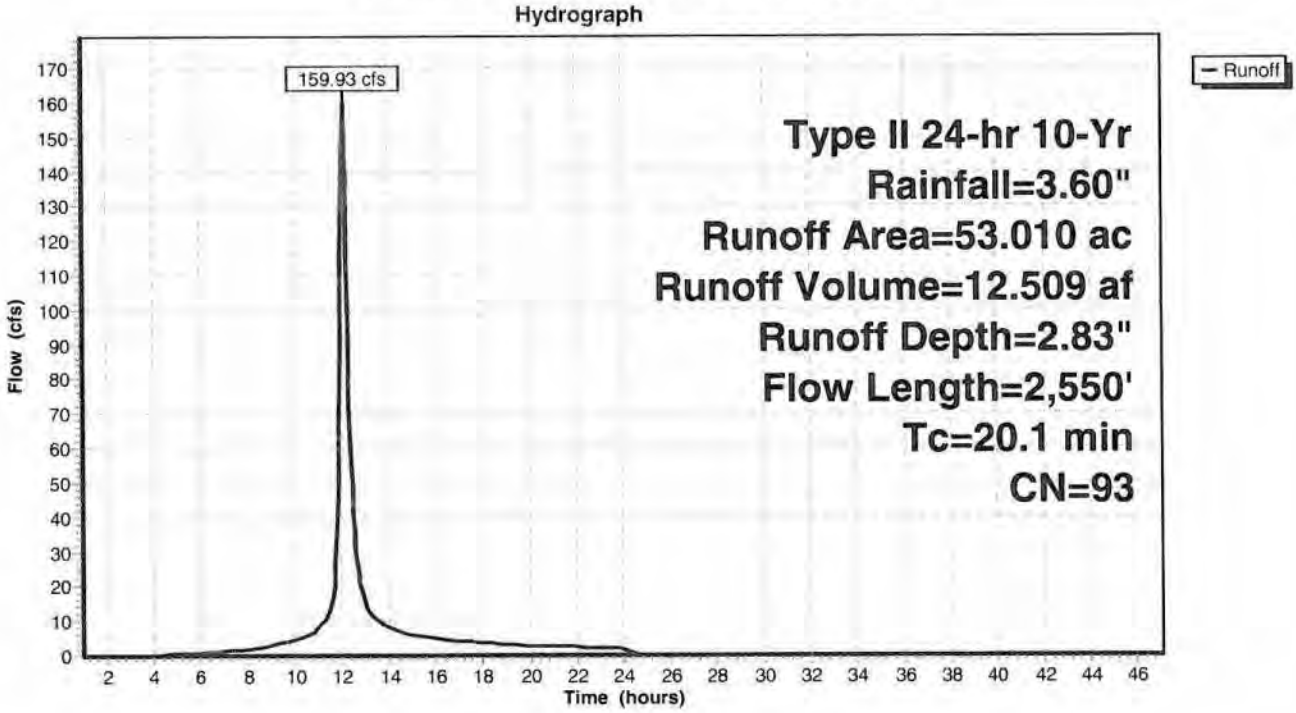
Runoff = 159.93 cfs @ 12.12 hrs, Volume= 12.509 af, Depth= 2.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
53.010	93	Urban industrial, 72% imp, HSG D
14.843		Pervious Area
38.167		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
10.0	2,400		4.00		**Direct Entry, Pipe Flow**
20.1	2,550	Total			

Subcatchment 2B: New Development



Subcatchment 3A:

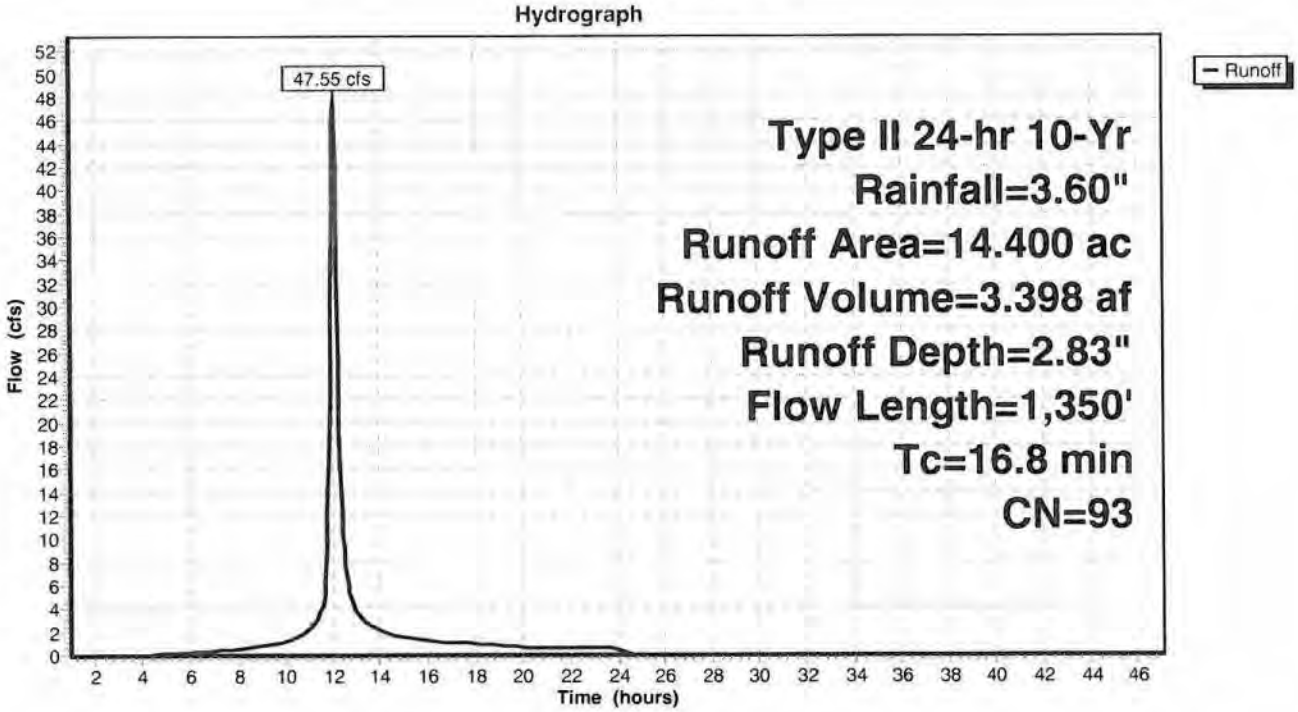
Runoff = 47.55 cfs @ 12.08 hrs, Volume= 3.398 af, Depth= 2.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
14.400	93	Urban industrial, 72% imp, HSG D
4.032		Pervious Area
10.368		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Woods** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
6.7	1,200		3.00		**Direct Entry, Pipe Flow**
16.8	1,350	Total			

Subcatchment 3A:



Subcatchment 3B:

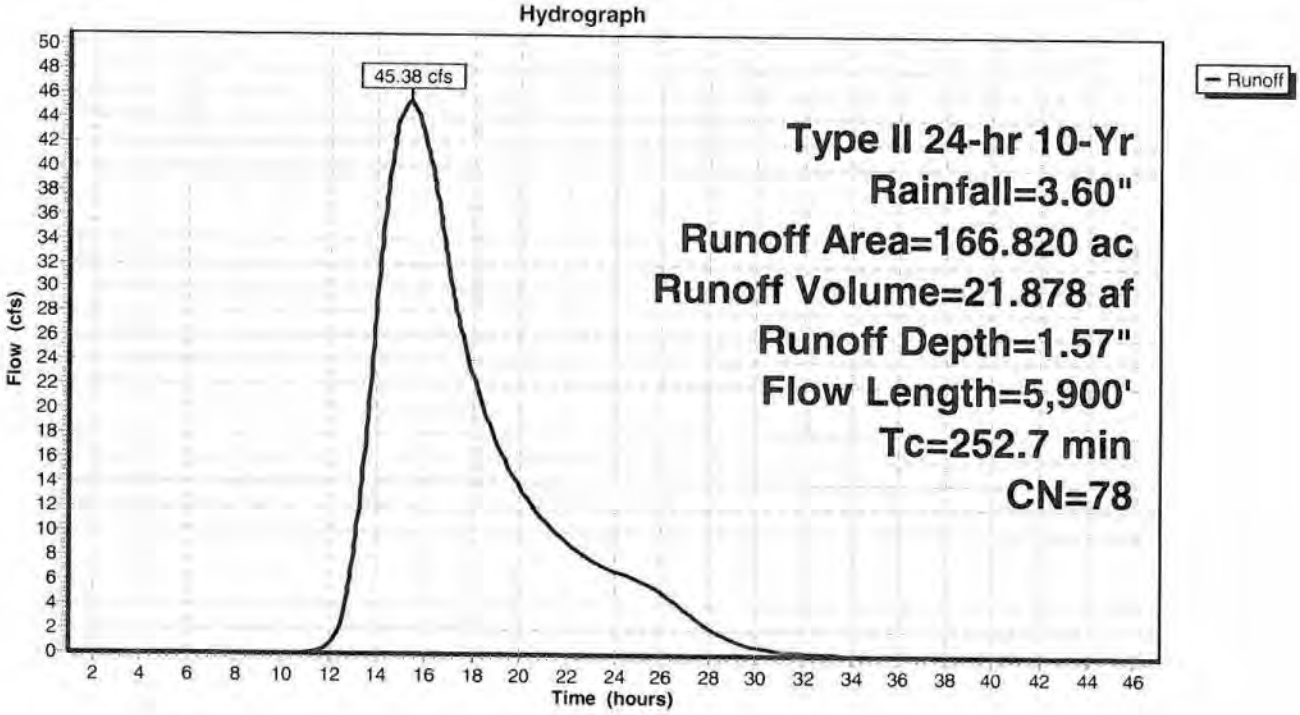
Runoff = 45.38 cfs @ 15.43 hrs, Volume= 21.878 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Yr Rainfall=3.60"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B:

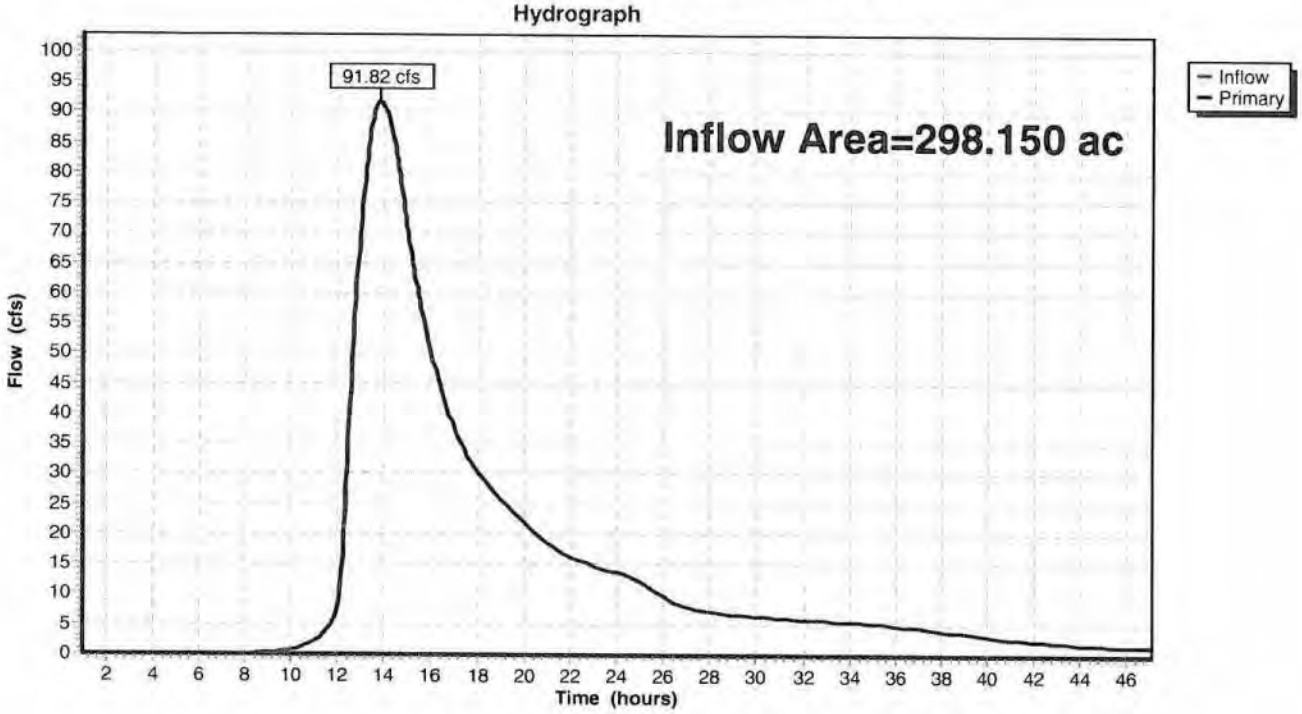


Pond 1P: Long Road Discharge

Inflow Area =	298.150 ac,	Inflow Depth >	1.95"	for	10-Yr event	
Inflow =	91.82 cfs @	13.82 hrs,	Volume=		48.540 af	
Primary =	91.82 cfs @	13.82 hrs,	Volume=		48.540 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road Discharge



Pond 2P: North Pond

Inflow Area =	113.960 ac,	Inflow Depth =	2.28"	for	10-Yr event
Inflow =	177.79 cfs @	12.16 hrs,	Volume=	21.699 af	
Outflow =	28.84 cfs @	14.00 hrs,	Volume=	20.018 af,	Atten= 84%, Lag= 110.1 min
Primary =	28.84 cfs @	14.00 hrs,	Volume=	20.018 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 568.61' @ 14.00 hrs Surf.Area= 169,204 sf Storage= 408,207 cf

Plug-Flow detention time= 440.7 min calculated for 19.996 af (92% of inflow)
Center-of-Mass det. time= 398.0 min (1,254.7 - 856.7)

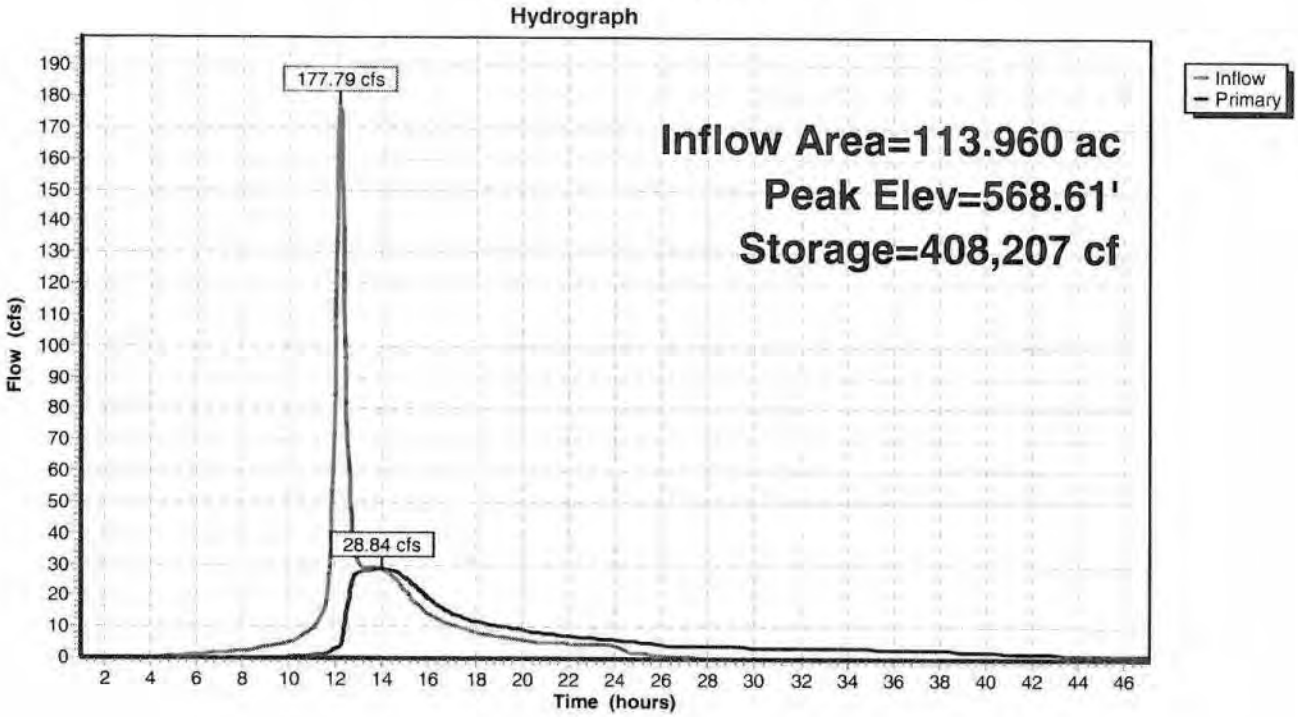
Volume	Invert	Avail.Storage	Storage Description
#1	566.00'	651,210 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
566.00	142,189	0	0
567.00	151,813	147,001	147,001
568.00	165,516	158,665	305,666
569.00	171,536	168,526	474,192
570.00	182,500	177,018	651,210

Device	Routing	Invert	Outlet Devices
#1	Primary	566.00'	**30.0" x 285.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 565.50' S= 0.0018 '/' Cc= 0.900 n= 0.012
#2	Device 1	561.00'	**12.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 564.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	567.70'	**5.00' W x 0.75' H Vert. Orifice/Grate** C= 0.600
#4	Primary	568.30'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=28.82 cfs @ 14.00 hrs HW=568.61' (Free Discharge)
- **1=Culvert** (Passes 17.77 cfs of 19.78 cfs potential flow)
  - **2=Culvert** (Inlet Controls 4.83 cfs @ 6.14 fps)
  - **3=Orifice/Grate** (Orifice Controls 12.94 cfs @ 3.45 fps)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 11.06 cfs @ 1.41 fps)

Pond 2P: North Pond



Pond 3P: Center Pond

Inflow Area =	53.010 ac,	Inflow Depth =	2.83"	for	10-Yr event
Inflow =	159.93 cfs @	12.12 hrs,	Volume=	12.509 af	
Outflow =	12.70 cfs @	13.16 hrs,	Volume=	11.839 af,	Atten= 92%, Lag= 62.6 min
Primary =	12.70 cfs @	13.16 hrs,	Volume=	11.839 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 578.40' @ 13.16 hrs Surf.Area= 87,509 sf Storage= 330,241 cf

Plug-Flow detention time= 495.7 min calculated for 11.839 af (95% of inflow)
Center-of-Mass det. time= 464.8 min (1,263.3 - 798.5)

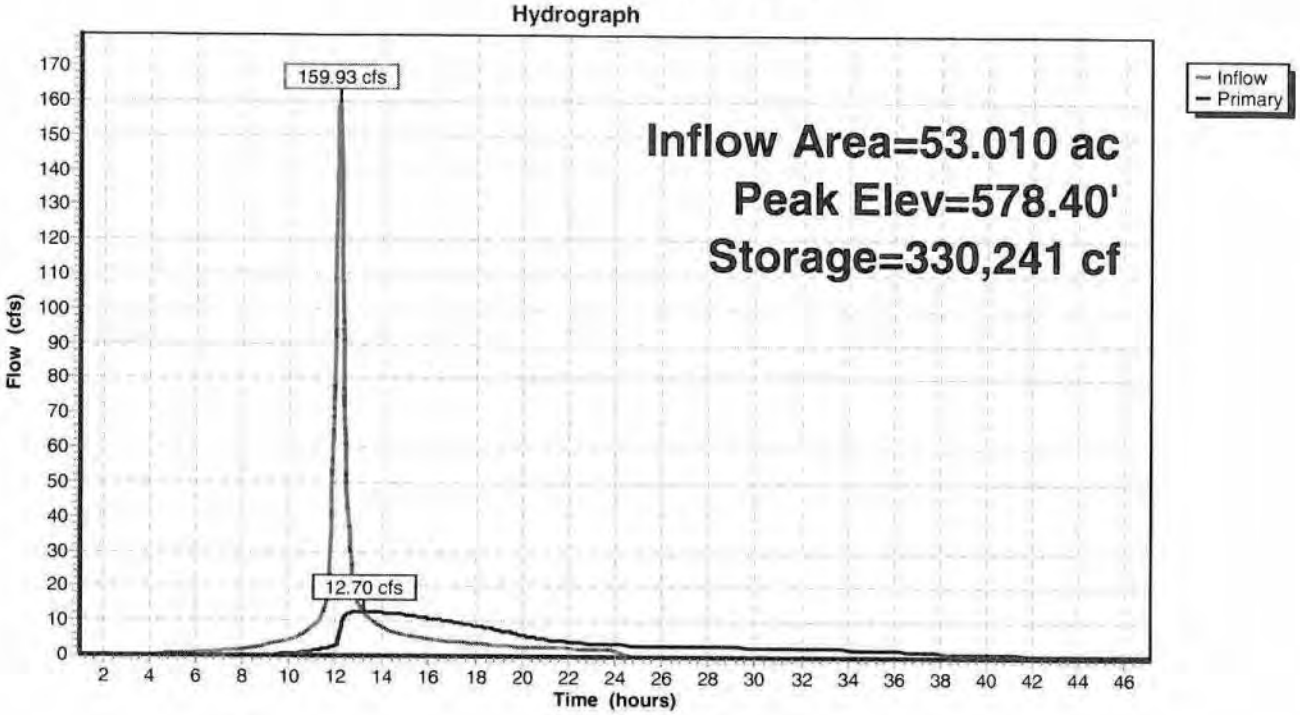
Volume	Invert	Avail.Storage	Storage Description
#1	574.00'	577,210 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
574.00	62,610	0	0
575.00	68,020	65,315	65,315
576.00	73,586	70,803	136,118
577.00	79,282	76,434	212,552
578.00	85,109	82,196	294,748
579.00	91,066	88,088	382,835
580.00	97,155	94,111	476,946
581.00	103,374	100,265	577,210

Device	Routing	Invert	Outlet Devices
#1	Primary	574.00'	**18.0" x 70.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 574.00' S= 0.0000 '/' Cc= 0.900 n= 0.012
#2	Device 1	569.00'	**10.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 572.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	576.50'	**2.70' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	579.00'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=12.70 cfs @ 13.16 hrs HW=578.40' (Free Discharge)
- **1=Culvert** (Passes 12.70 cfs of 12.84 cfs potential flow)
  - **2=Culvert** (Inlet Controls 4.35 cfs @ 7.98 fps)
  - **3=Orifice/Grate** (Orifice Controls 8.35 cfs @ 6.18 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Center Pond



Pond 4P: South Pond

Inflow Area =	14.400 ac,	Inflow Depth =	2.83"	for	10-Yr event
Inflow =	47.55 cfs @	12.08 hrs,	Volume=	3.398 af	
Outflow =	5.38 cfs @	12.71 hrs,	Volume=	3.323 af,	Atten= 89%, Lag= 37.4 min
Primary =	5.38 cfs @	12.71 hrs,	Volume=	3.323 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 585.71' @ 12.71 hrs Surf.Area= 32,815 sf Storage= 82,445 cf

Plug-Flow detention time= 402.6 min calculated for 3.323 af (98% of inflow)
Center-of-Mass det. time= 388.9 min (1,184.3 - 795.4)

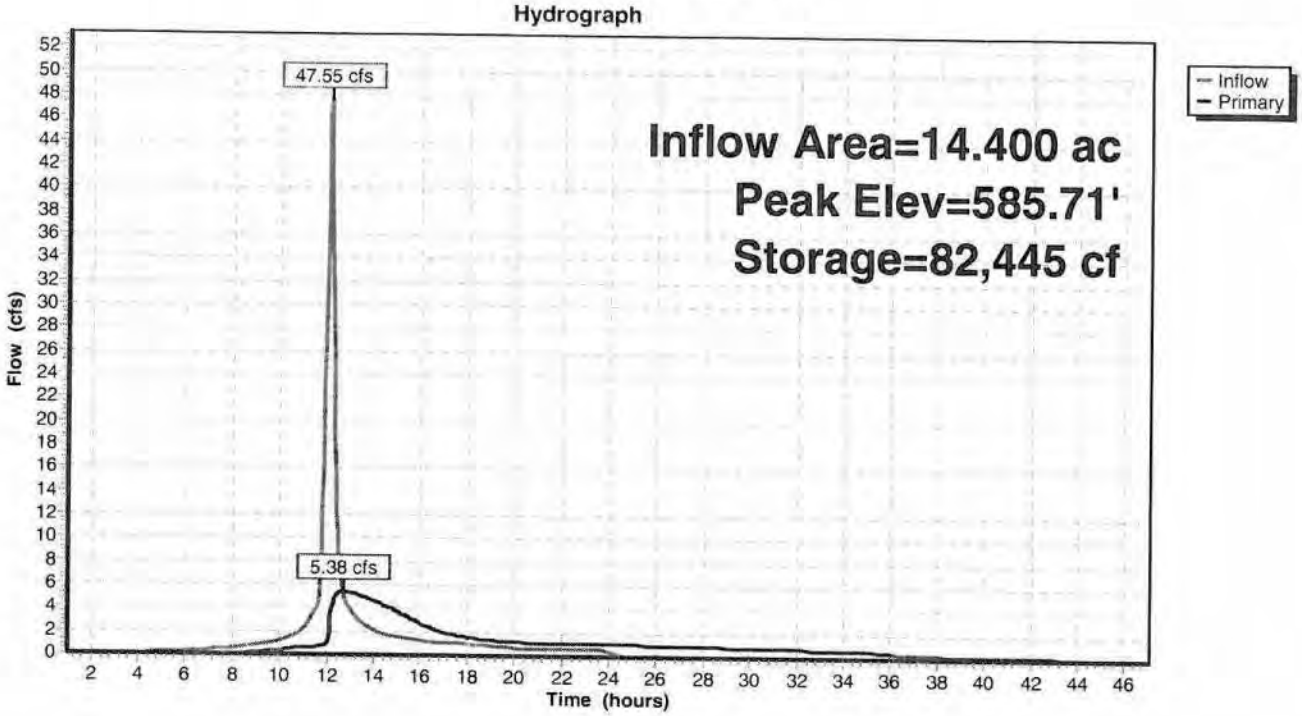
Volume	Invert	Avail.Storage	Storage Description
#1	582.50'	167,557 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
582.50	18,000	0	0
583.30	20,000	15,200	15,200
584.00	26,452	16,258	31,458
585.00	30,118	28,285	59,743
586.00	33,922	32,020	91,763
587.00	37,863	35,893	127,656
588.00	41,939	39,901	167,557

Device	Routing	Invert	Outlet Devices
#1	Primary	582.50'	**15.0" x 52.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 582.50' S= 0.0000 '/' Cc= 0.900 n= 0.011
#2	Device 1	579.00'	**6.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 580.50' S= -0.0750 '/' Cc= 0.900 n= 0.012
#3	Device 1	584.53'	**1.75' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	586.75'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=5.38 cfs @ 12.71 hrs HW=585.71' (Free Discharge)
- **1=Culvert** (Passes 5.38 cfs of 8.96 cfs potential flow)
  - **2=Culvert** (Inlet Controls 1.34 cfs @ 6.81 fps)
  - **3=Orifice/Grate** (Orifice Controls 4.05 cfs @ 4.63 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: South Pond

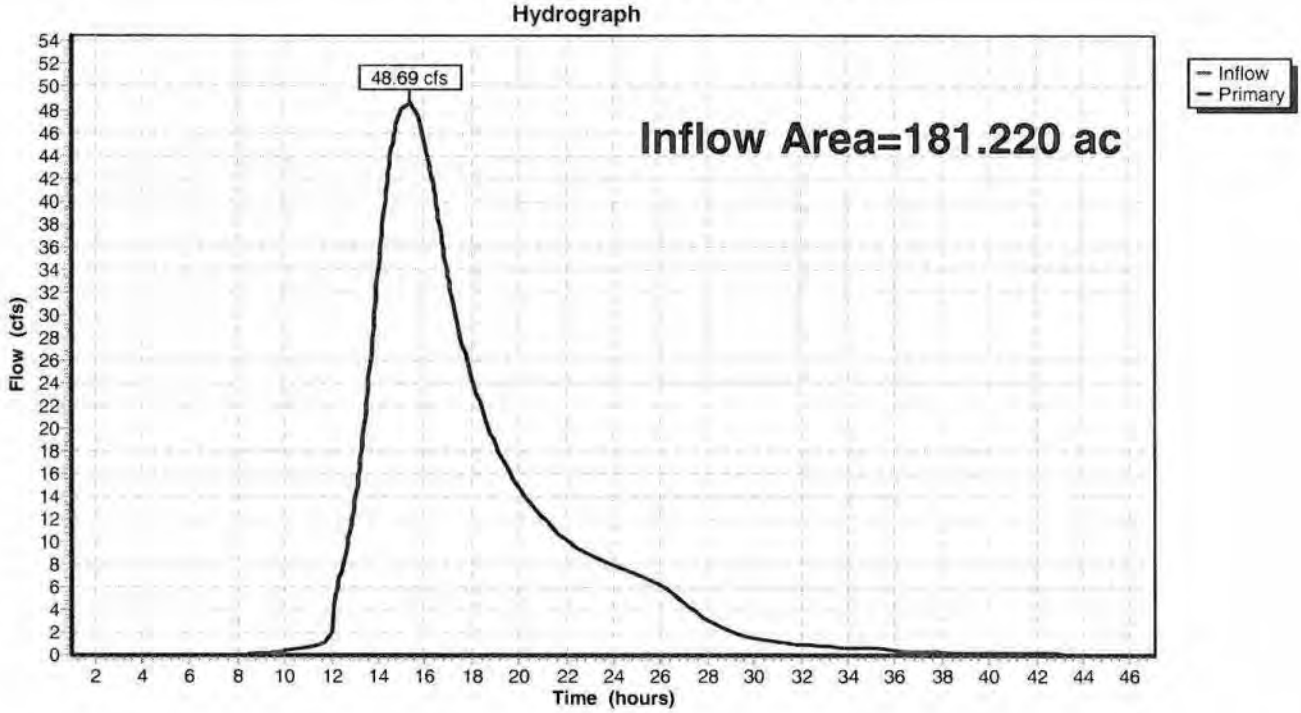


Pond 5P: South Discharge

Inflow Area =	181.220 ac,	Inflow Depth >	1.67"	for	10-Yr event
Inflow =	48.69 cfs @	15.40 hrs,	Volume=	25.201 af	
Primary =	48.69 cfs @	15.40 hrs,	Volume=	25.201 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 5P: South Discharge



Subcatchment 1A: Undeveloped Area to West

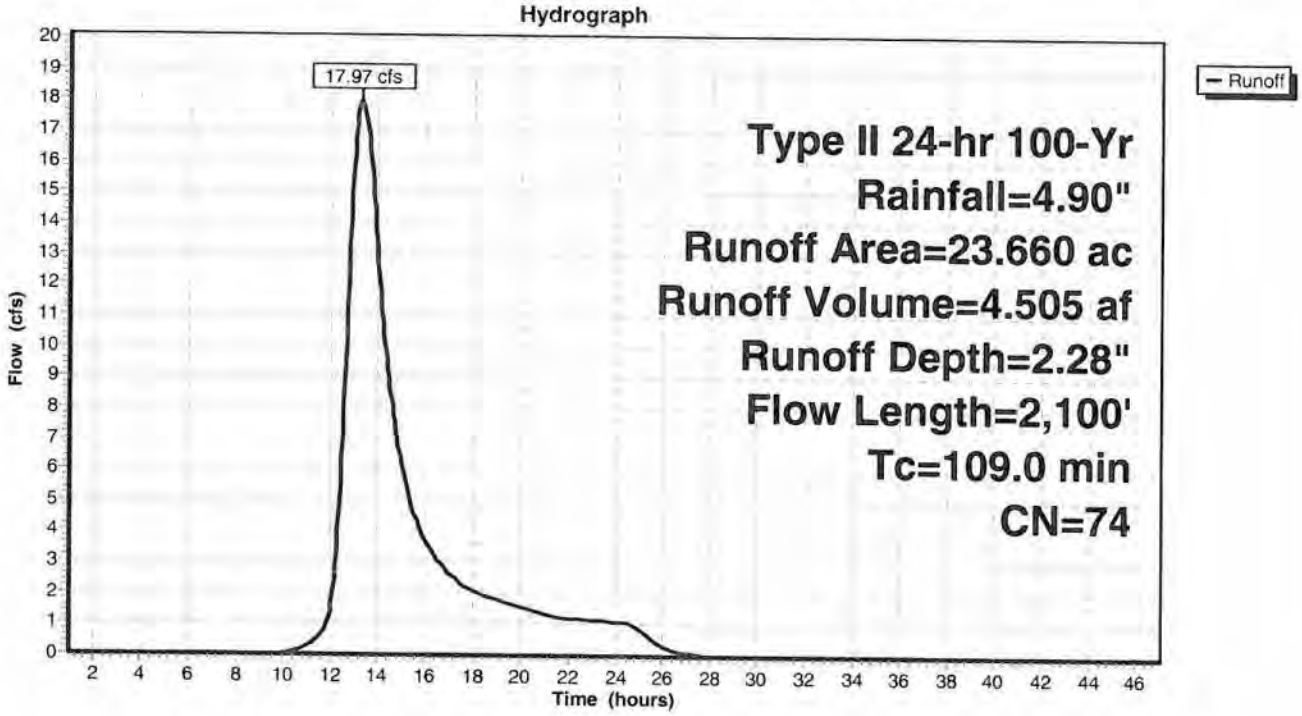
Runoff = 17.97 cfs @ 13.30 hrs, Volume= 4.505 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
7.670	77	Woods, Good, HSG D
15.990	73	Brush, Good, HSG D
23.660	74	Weighted Average
23.660		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.6	100	0.0075	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
26.9	700	0.0075	0.43		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
1.4	150	0.0660	1.80		**Shallow Concentrated Flow, Slope** Short Grass Pasture Kv= 7.0 fps
12.8	450	0.0070	0.59		**Shallow Concentrated Flow, Field** Short Grass Pasture Kv= 7.0 fps
5.3	700	0.0070	2.21	13.27	**Channel Flow, Swale** Area= 6.0 sf Perim= 10.0' r= 0.60' n= 0.040
109.0	2,100	Total			

Subcatchment 1A: Undeveloped Area to West



Subcatchment 1B: Undeveloped Woods & Res. to West

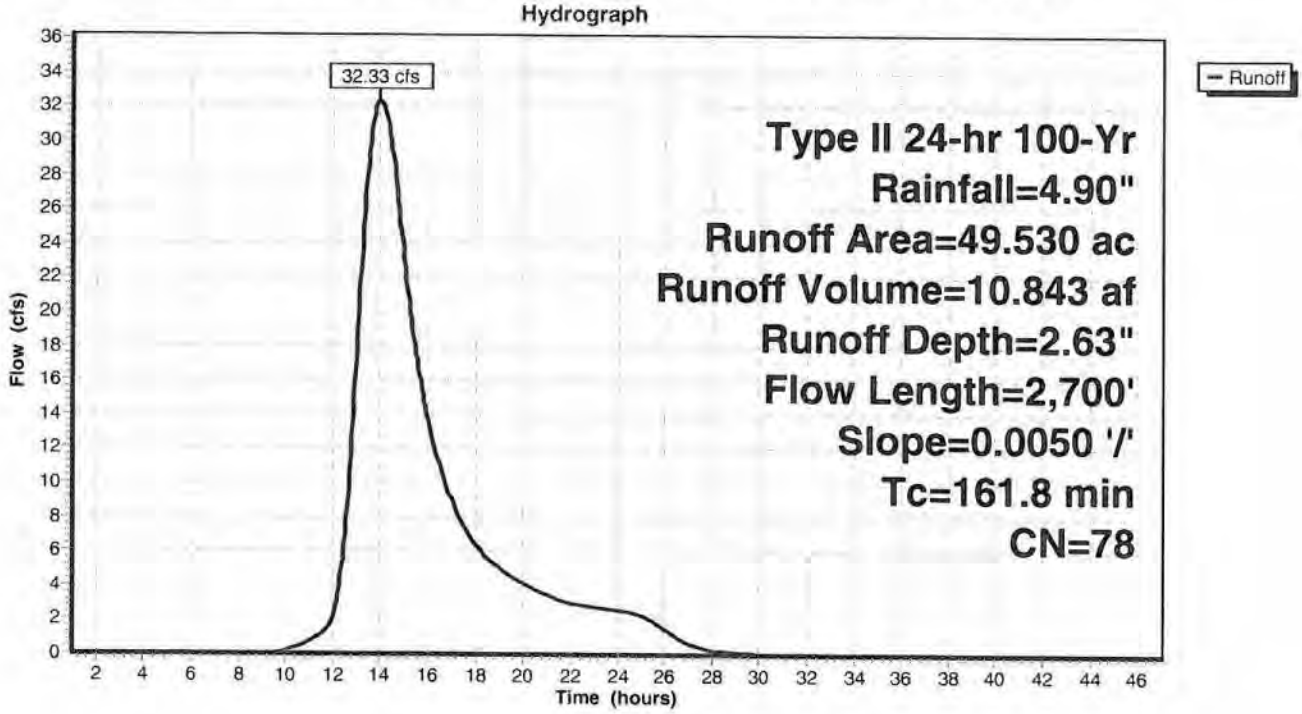
Runoff = 32.33 cfs @ 14.00 hrs, Volume= 10.843 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
44.530	77	Woods, Good, HSG D
5.000	84	1 acre lots, 20% imp, HSG D
49.530	78	Weighted Average
48.530		Pervious Area
1.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
84.9	1,800	0.0050	0.35		**Shallow Concentrated Flow, Woods & Field** Woodland Kv= 5.0 fps
3.3	800		4.00		**Direct Entry, Pipe Flow**
161.8	2,700	Total			

Subcatchment 1B: Undeveloped Woods & Res. to West



Subcatchment 1C: New Development

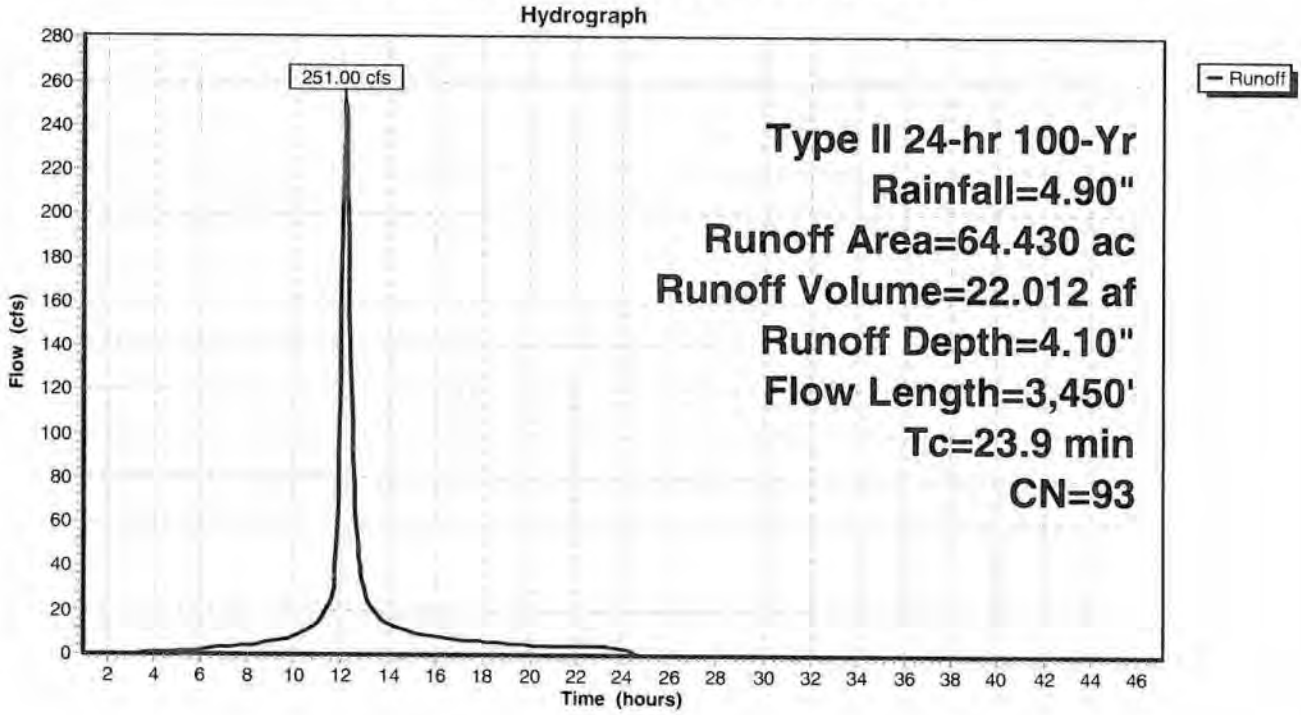
Runoff = 251.00 cfs @ 12.16 hrs, Volume= 22.012 af, Depth= 4.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
64.430	93	Urban industrial, 72% imp, HSG D
18.040		Pervious Area
46.390		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass**
					Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement**
					Paved Kv= 20.3 fps
13.8	3,300		4.00		**Direct Entry, Pipe Flow**
23.9	3,450	Total			

Subcatchment 1C: New Development



Subcatchment 2A: Upstream Off-Site

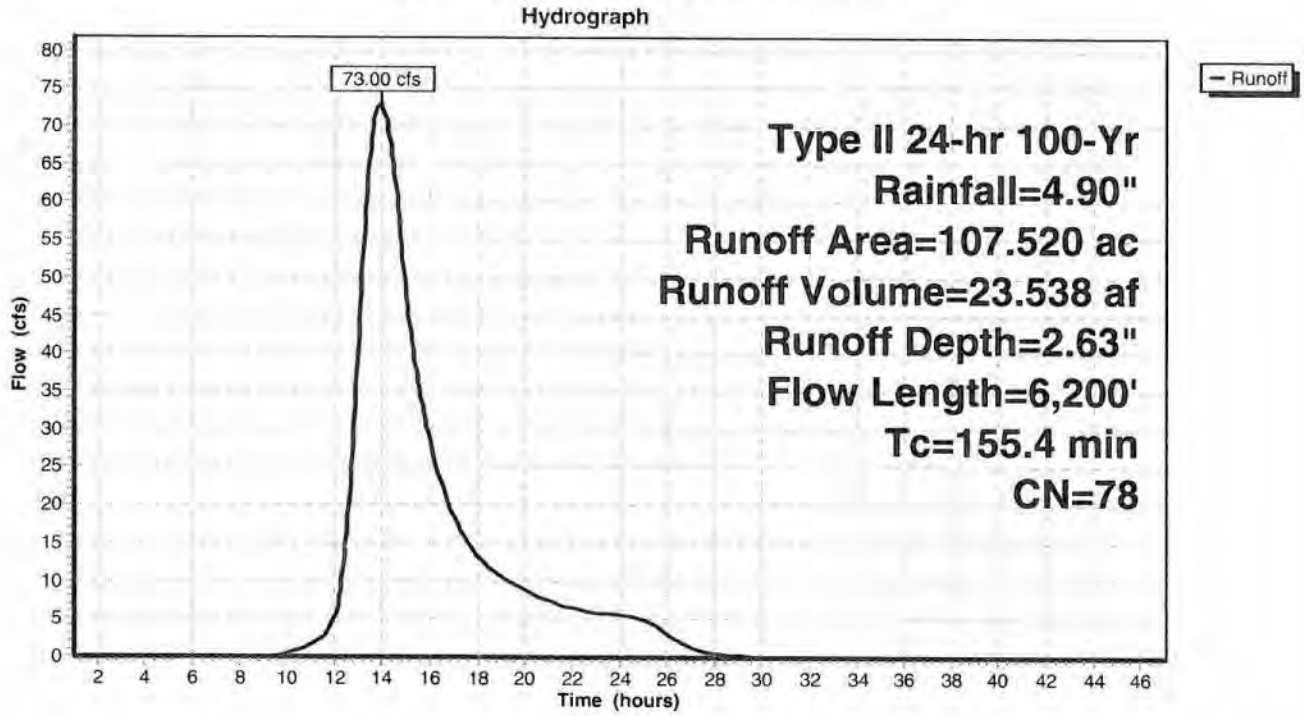
Runoff = 73.00 cfs @ 13.96 hrs, Volume= 23.538 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
94.520	77	Woods, Good, HSG D
13.000	84	1 acre lots, 20% imp, HSG D
107.520	78	Weighted Average
104.920		Pervious Area
2.600		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.6	100	0.0050	0.02		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
51.9	1,100	0.0050	0.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
29.9	5,000	0.0027	2.78	113.08	**Trap/Vee/Rect Channel Flow, Ditch** Bot.W=10.00' D=2.50' Z= 2.5 '/' Top.W=22.50' n= 0.040 Earth, dense weeds
155.4	6,200	Total			

Subcatchment 2A: Upstream Off-Site



Subcatchment 2B: New Development

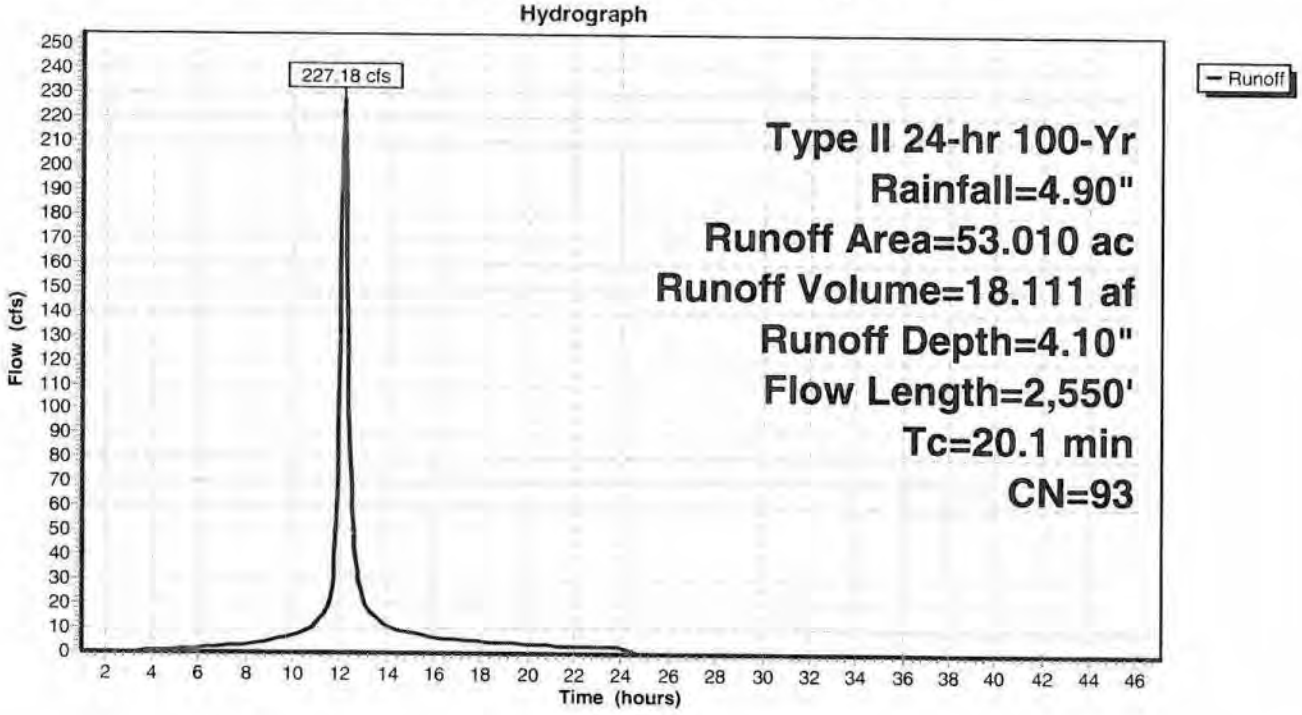
Runoff = 227.18 cfs @ 12.12 hrs, Volume= 18.111 af, Depth= 4.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
53.010	93	Urban industrial, 72% imp, HSG D
14.843		Pervious Area
38.167		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Grass**
					Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement**
					Paved Kv= 20.3 fps
10.0	2,400		4.00		**Direct Entry, Pipe Flow**
20.1	2,550	Total			

Subcatchment 2B: New Development



Subcatchment 3A:

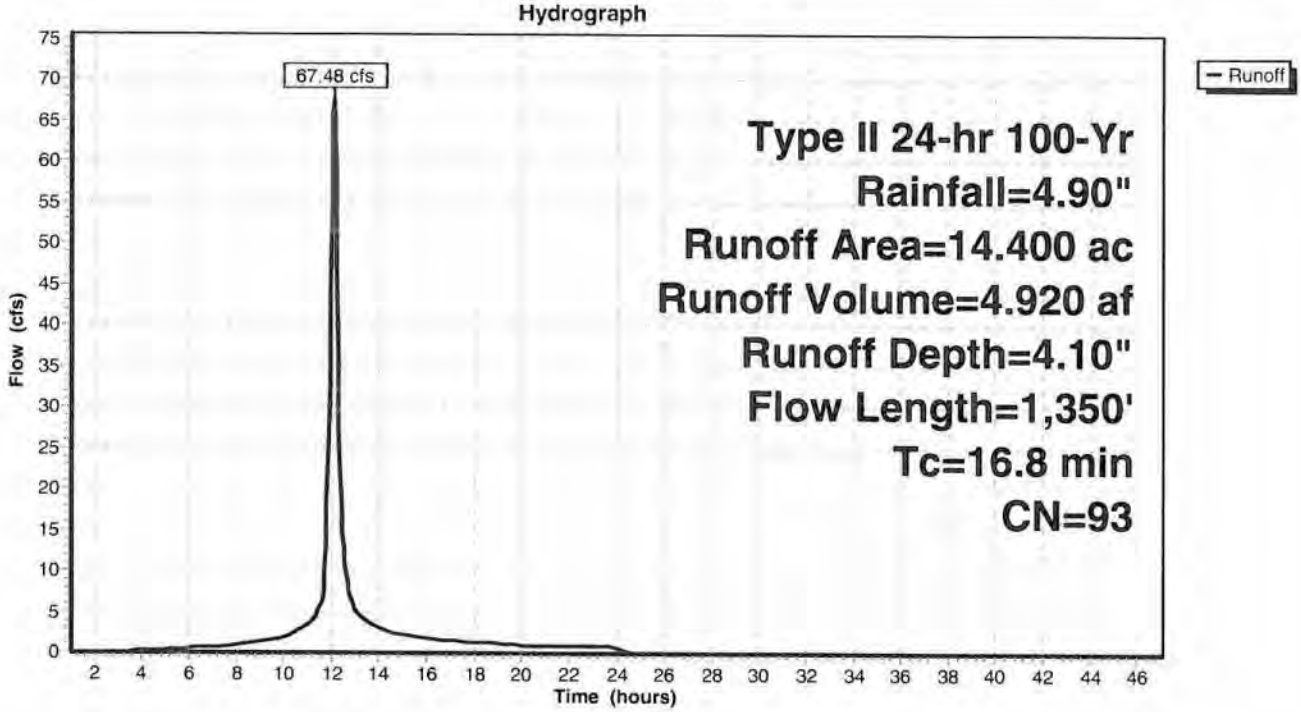
Runoff = 67.48 cfs @ 12.08 hrs, Volume= 4.920 af, Depth= 4.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
14.400	93	Urban industrial, 72% imp, HSG D
4.032		Pervious Area
10.368		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0200	0.09		**Sheet Flow, Woods** Grass: Dense n= 0.240 P2= 2.50"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
6.7	1,200		3.00		**Direct Entry, Pipe Flow**
16.8	1,350	Total			

Subcatchment 3A:



Subcatchment 3B:

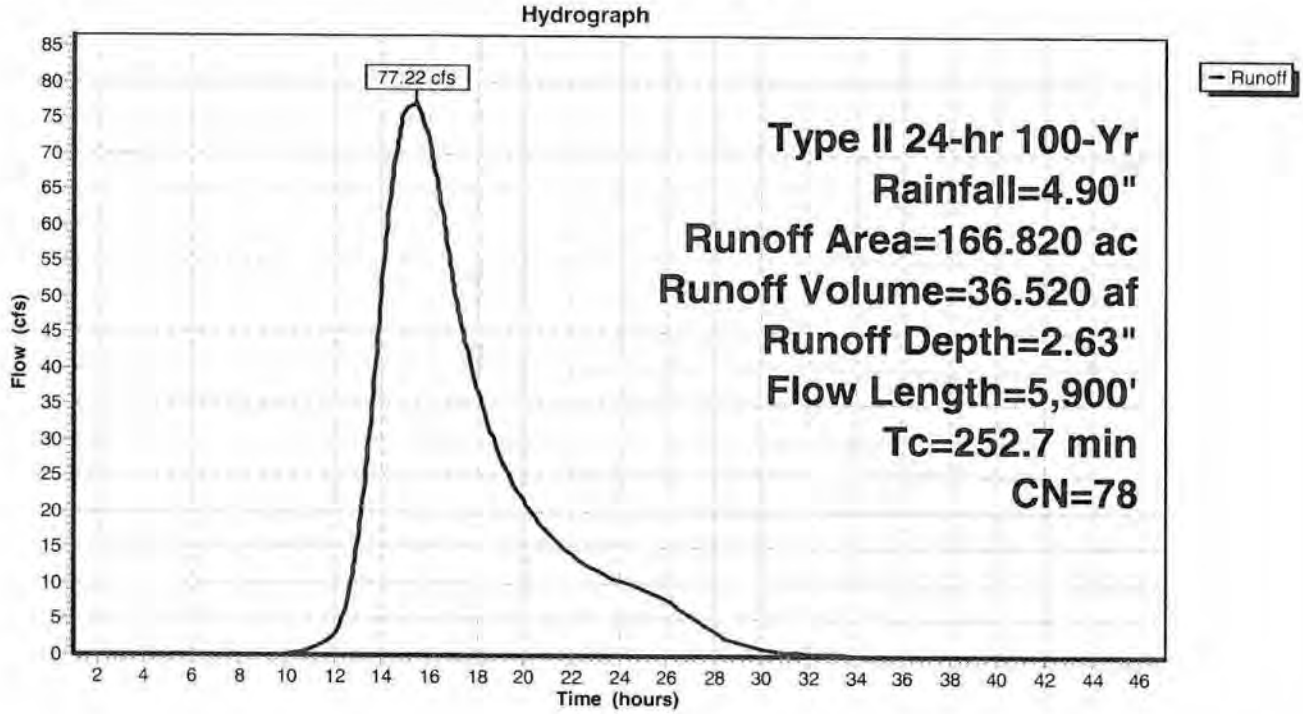
Runoff = 77.22 cfs @ 15.39 hrs, Volume= 36.520 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Yr Rainfall=4.90"

Area (ac)	CN	Description
141.820	77	Woods, Good, HSG D
25.000	84	1 acre lots, 20% imp, HSG D
166.820	78	Weighted Average
161.820		Pervious Area
5.000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	100	0.0100	0.03		**Sheet Flow, Woods** Woods: Dense underbrush n= 0.800 P2= 2.50"
176.5	2,900	0.0030	0.27		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
20.4	2,900	0.0025	2.37	71.20	**Trap/Vee/Rect Channel Flow, Swale** Bot.W=10.00' D=2.00' Z= 2.5 '/' Top.W=20.00' n= 0.040 Earth, dense weeds
252.7	5,900	Total			

Subcatchment 3B:

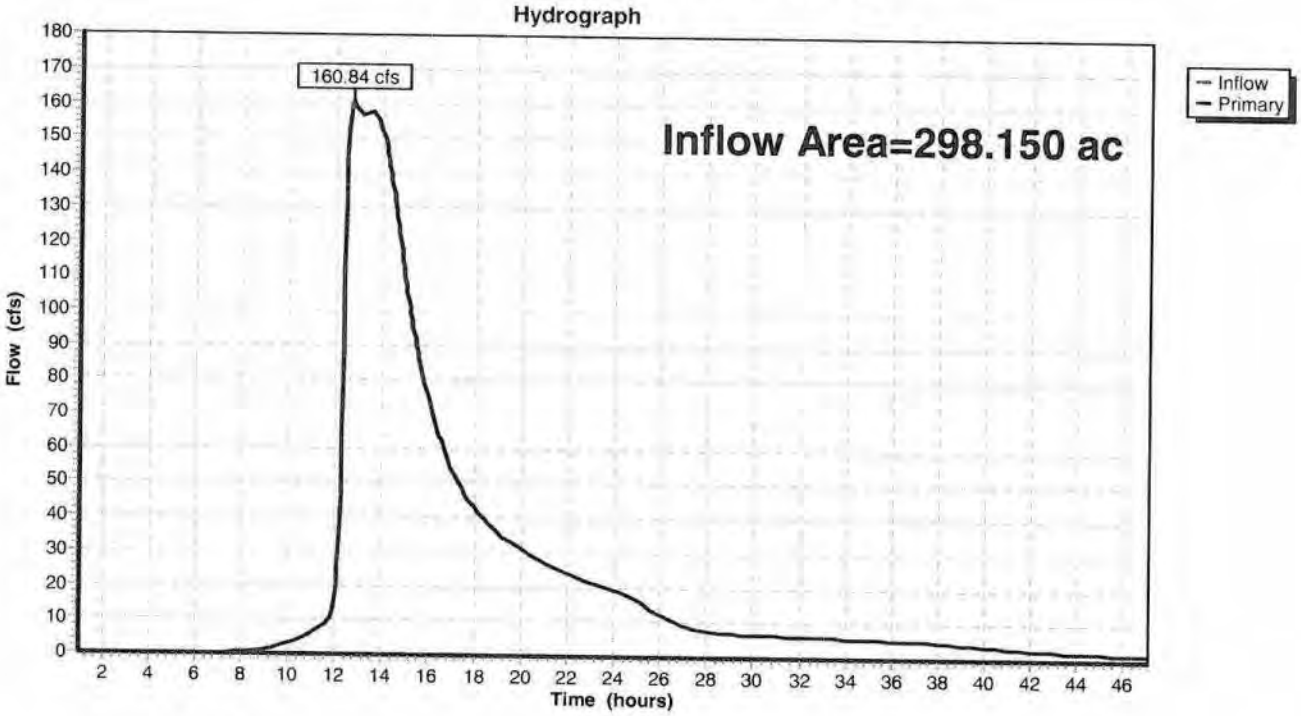


Pond 1P: Long Road Discharge

Inflow Area = 298.150 ac, Inflow Depth > 3.08" for 100-Yr event
Inflow = 160.84 cfs @ 12.66 hrs, Volume= 76.525 af
Primary = 160.84 cfs @ 12.66 hrs, Volume= 76.525 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 1P: Long Road Discharge



Pond 2P: North Pond

Inflow Area = 113.960 ac, Inflow Depth = 3.46" for 100-Yr event
Inflow = 254.21 cfs @ 12.16 hrs, Volume= 32.855 af
Outflow = 81.70 cfs @ 12.57 hrs, Volume= 31.085 af, Atten= 68%, Lag= 24.3 min
Primary = 81.70 cfs @ 12.57 hrs, Volume= 31.085 af

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 569.20' @ 12.57 hrs Surf.Area= 173,772 sf Storage= 509,400 cf

Plug-Flow detention time= 319.7 min calculated for 31.085 af (95% of inflow)
Center-of-Mass det. time= 287.2 min (1,138.0 - 850.7)

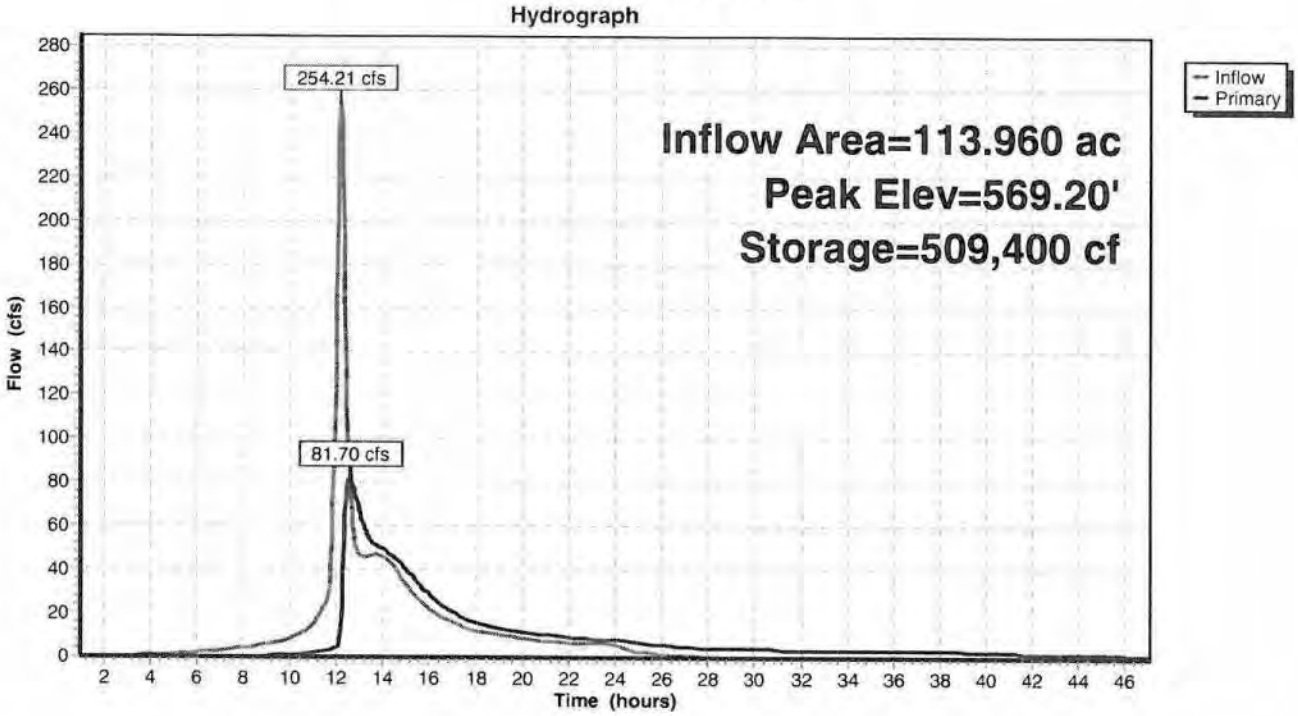
Volume	Invert	Avail.Storage	Storage Description
#1	566.00'	651,210 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
566.00	142,189	0	0
567.00	151,813	147,001	147,001
568.00	165,516	158,665	305,666
569.00	171,536	168,526	474,192
570.00	182,500	177,018	651,210

Device	Routing	Invert	Outlet Devices
#1	Primary	566.00'	**30.0" x 285.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 565.50' S= 0.0018 '/' Cc= 0.900 n= 0.012
#2	Device 1	561.00'	**12.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 564.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	567.70'	**5.00' W x 0.75' H Vert. Orifice/Grate** C= 0.600
#4	Primary	568.30'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=81.58 cfs @ 12.57 hrs HW=569.20' (Free Discharge)
- **1=Culvert** (Barrel Controls 24.02 cfs @ 4.96 fps)
  - **2=Culvert** (Passes < 5.34 cfs potential flow)
  - **3=Orifice/Grate** (Passes < 19.08 cfs potential flow)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 57.56 cfs @ 2.55 fps)

Pond 2P: North Pond



Pond 3P: Center Pond

Inflow Area =	53.010 ac,	Inflow Depth =	4.10"	for	100-Yr event
Inflow =	227.18 cfs @	12.12 hrs,	Volume=	18.111 af	
Outflow =	49.74 cfs @	12.55 hrs,	Volume=	17.397 af,	Atten= 78%, Lag= 26.2 min
Primary =	49.74 cfs @	12.55 hrs,	Volume=	17.397 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 579.57' @ 12.55 hrs Surf.Area= 94,556 sf Storage= 436,781 cf

Plug-Flow detention time= 416.1 min calculated for 17.397 af (96% of inflow)
Center-of-Mass det. time= 392.3 min (1,180.9 - 788.6)

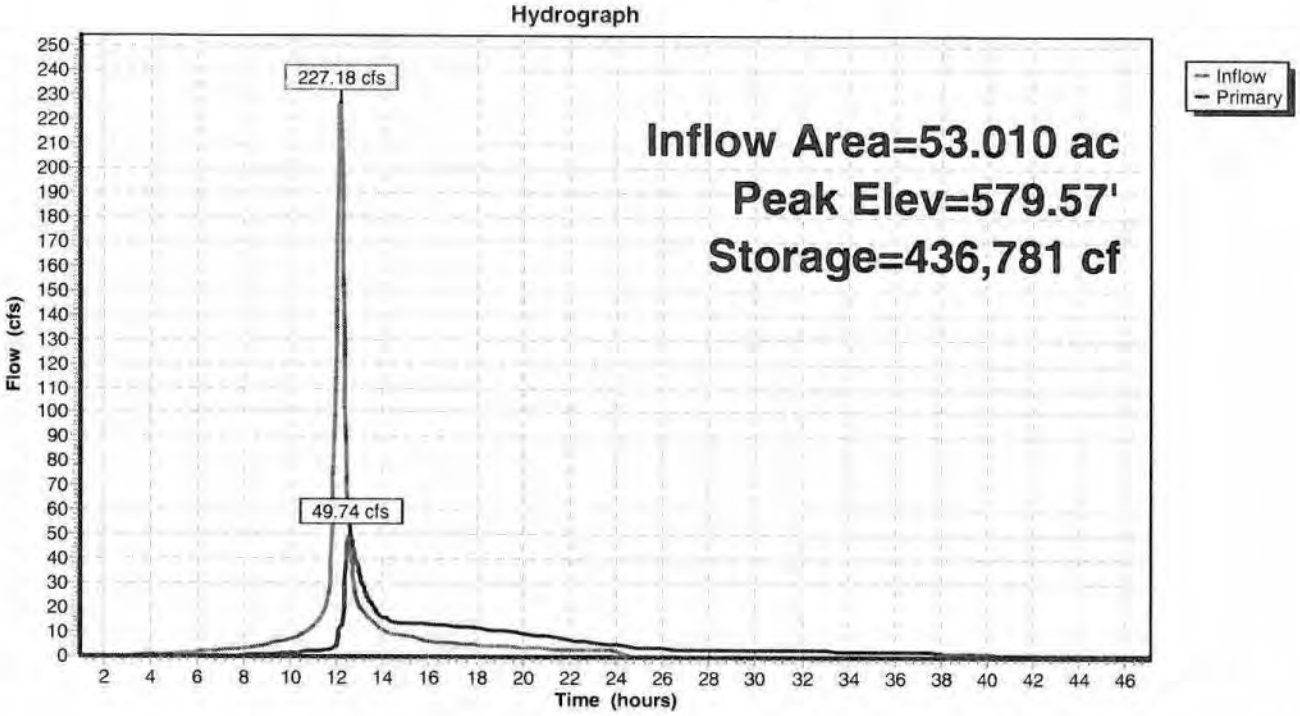
Volume	Invert	Avail.Storage	Storage Description
#1	574.00'	577,210 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
574.00	62,610	0	0
575.00	68,020	65,315	65,315
576.00	73,586	70,803	136,118
577.00	79,282	76,434	212,552
578.00	85,109	82,196	294,748
579.00	91,066	88,088	382,835
580.00	97,155	94,111	476,946
581.00	103,374	100,265	577,210

Device	Routing	Invert	Outlet Devices
#1	Primary	574.00'	**18.0" x 70.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 574.00' S= 0.0000 '/' Cc= 0.900 n= 0.012
#2	Device 1	569.00'	**10.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 572.00' S= -0.1500 '/' Cc= 0.900 n= 0.012
#3	Device 1	576.50'	**2.70' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	579.00'	**30.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=49.60 cfs @ 12.55 hrs HW=579.57' (Free Discharge)
- **1=Culvert** (Inlet Controls 14.75 cfs @ 8.35 fps)
  - **2=Culvert** (Passes < 4.89 cfs potential flow)
  - **3=Orifice/Grate** (Passes < 10.92 cfs potential flow)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 34.85 cfs @ 2.03 fps)

Pond 3P: Center Pond



Pond 4P: South Pond

Inflow Area =	14.400 ac,	Inflow Depth =	4.10"	for	100-Yr event
Inflow =	67.48 cfs @	12.08 hrs,	Volume=	4.920 af	
Outflow =	7.77 cfs @	12.69 hrs,	Volume=	4.839 af,	Atten= 88%, Lag= 36.5 min
Primary =	7.77 cfs @	12.69 hrs,	Volume=	4.839 af	

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs
Peak Elev= 586.77' @ 12.69 hrs Surf.Area= 36,967 sf Storage= 119,493 cf

Plug-Flow detention time= 349.8 min calculated for 4.834 af (98% of inflow)
Center-of-Mass det. time= 340.5 min (1,126.0 - 785.5)

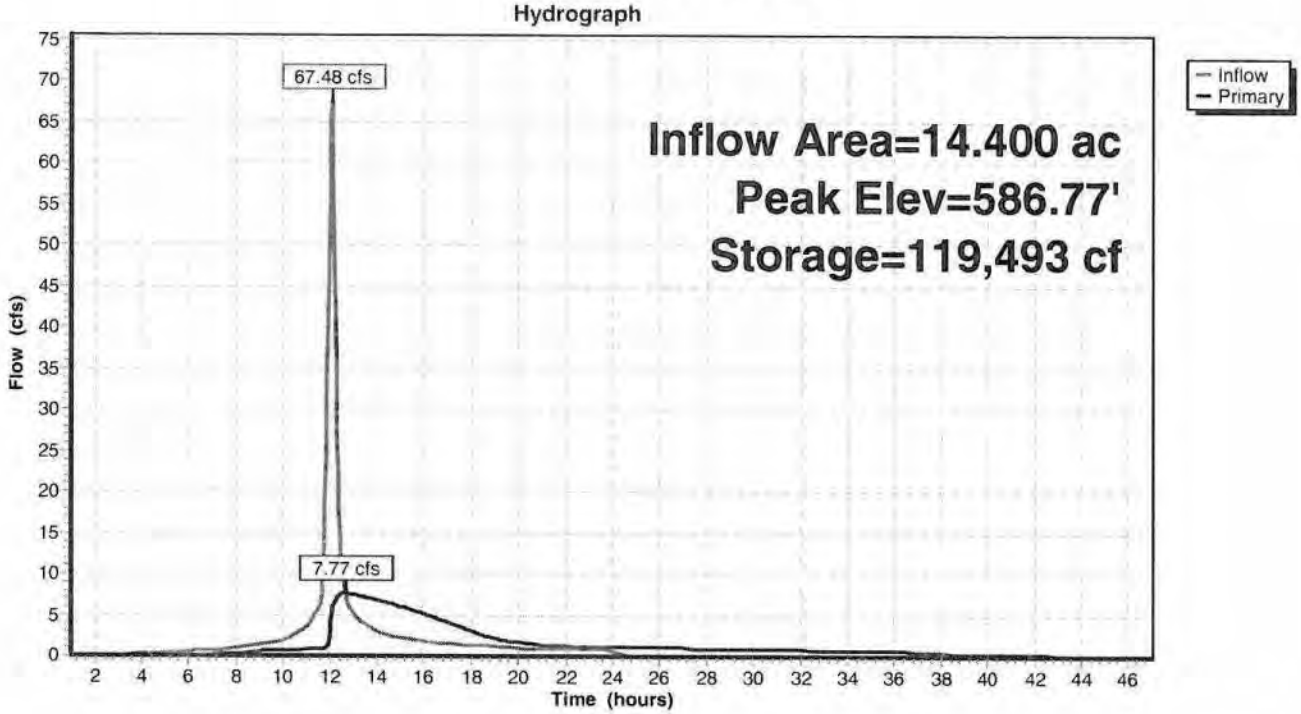
Volume	Invert	Avail.Storage	Storage Description
#1	582.50'	167,557 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
582.50	18,000	0	0
583.30	20,000	15,200	15,200
584.00	26,452	16,258	31,458
585.00	30,118	28,285	59,743
586.00	33,922	32,020	91,763
587.00	37,863	35,893	127,656
588.00	41,939	39,901	167,557

Device	Routing	Invert	Outlet Devices
#1	Primary	582.50'	**15.0" x 52.0' long Culvert** CPP, square edge headwall, Ke= 0.500 Outlet Invert= 582.50' S= 0.0000 '/' Cc= 0.900 n= 0.011
#2	Device 1	579.00'	**6.0" x 20.0' long Culvert** CPP, projecting, no headwall, Ke= 0.900 Outlet Invert= 580.50' S= -0.0750 '/' Cc= 0.900 n= 0.012
#3	Device 1	584.53'	**1.75' W x 0.50' H Vert. Orifice/Grate** C= 0.600
#4	Primary	586.75'	**25.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=7.69 cfs @ 12.69 hrs HW=586.77' (Free Discharge)
- **1=Culvert** (Passes 7.49 cfs of 11.13 cfs potential flow)
  - **2=Culvert** (Inlet Controls 1.54 cfs @ 7.86 fps)
  - **3=Orifice/Grate** (Orifice Controls 5.94 cfs @ 6.79 fps)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 0.21 cfs @ 0.37 fps)

Pond 4P: South Pond

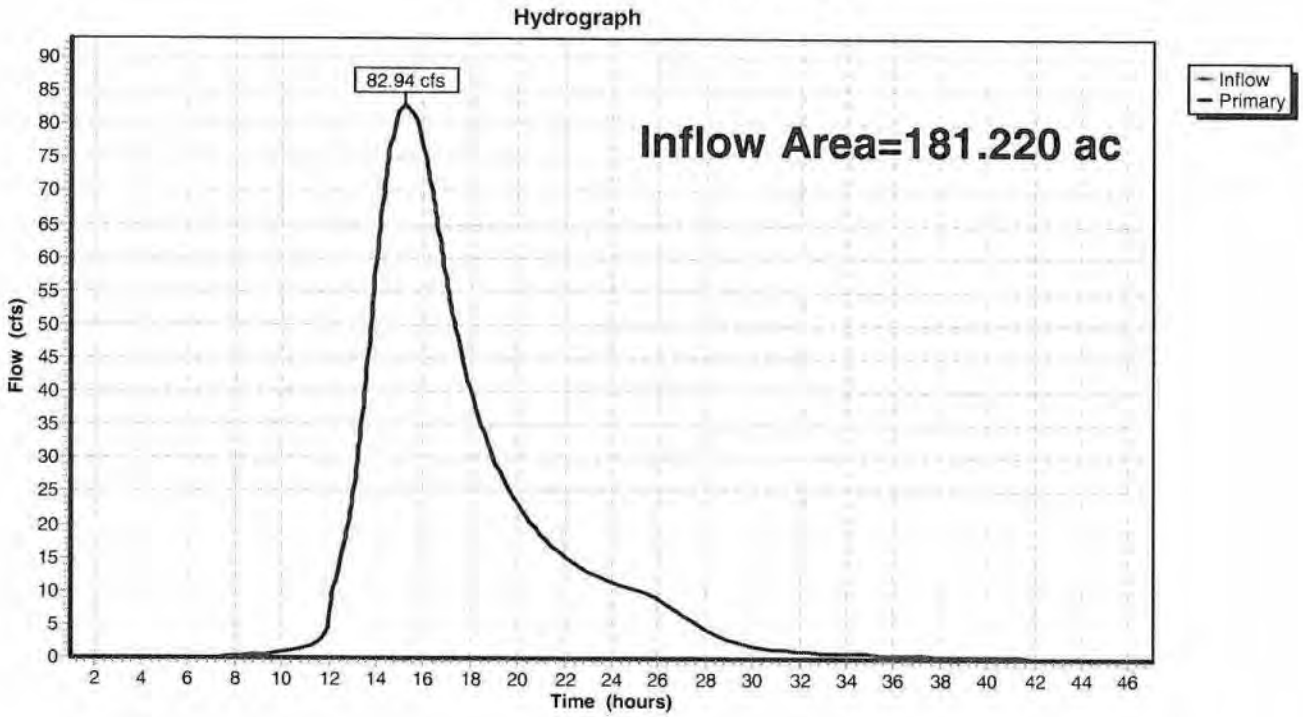


Pond 5P: South Discharge

Inflow Area =	181.220 ac,	Inflow Depth >	2.74"	for	100-Yr event
Inflow =	82.94 cfs @	15.22 hrs,	Volume=	41.359 af	
Primary =	82.94 cfs @	15.22 hrs,	Volume=	41.359 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-47.00 hrs, dt= 0.05 hrs

Pond 5P: South Discharge



HYDRAULIC SLOPE (%) 0.70

ROUGHNESS COEFF (N) 0.012

DIAMETER (IN)	AREA	WETTET PERM.	HYD. RADIUS	VELOCITY	FLOW
4	0.09	1.05	0.083	1.98	0.17
6	0.20	1.57	0.125	2.60	0.51
8	0.35	2.09	0.167	3.14	1.10
10	0.55	2.62	0.208	3.65	1.99
12	0.79	3.14	0.250	4.12	3.24
15	1.23	3.93	0.313	4.78	5.87
18	1.77	4.71	0.375	5.40	9.54
* 24	3.14	6.28	0.500	6.54	20.55
30	4.91	7.85	0.625	7.59	37.27
36	7.07	9.42	0.750	8.57	60.61
42	9.62	11.00	0.875	9.50	91.43
48	12.57	12.57	1.000	10.39	130.55
60	19.63	15.71	1.250	12.06	236.71

10YR RUNOFF FROM AREA 1B = 18.89 CFS

CULVERT1

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:08:45

FILE DATE: 12-31-2007
FILE NAME: SOUTHCUL

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	582.50	582.45	72.00	2 RCP	2.50	2.50	.015	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: SOUTHCUL DATE: 12-31-2007

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
582.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
583.57	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
584.04	15.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
584.42	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
584.76	30.8	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
585.10	38.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
585.43	46.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
585.92	53.9	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
585.48	61.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
585.80	69.3	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
586.17	77.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: SOUTHCUL DATE: 12-31-2007

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
582.50	0.000	0.00	0.00	0.00
583.57	0.000	7.70	0.00	0.00
584.04	0.000	15.40	0.00	0.00
584.42	0.000	23.10	0.00	0.00
584.76	0.000	30.80	0.00	0.00
585.10	0.000	38.50	0.00	0.00
585.43	0.000	46.00	0.00	0.00
585.92	0.000	53.90	0.00	0.00
585.48	0.000	61.60	0.00	0.00
585.80	0.000	69.30	0.00	0.00
586.17	0.000	77.00	0.00	0.00

CULVERT1

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:08:45

FILE DATE: 12-31-2007
FILE NAME: SOUTHCUL

PERFORMANCE CURVE FOR CULVERT 1 - 2(2.50 (ft) BY 2.50 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	582.50	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
7.70	583.57	0.84	1.07	3-M2t	1.11	0.63	0.95	0.95	2.25	1.03
15.40	584.04	1.27	1.54	3-M2t	1.72	0.92	1.35	1.35	2.84	1.25
23.10	584.42	1.61	1.92	3-M2t	2.50	1.13	1.65	1.65	3.35	1.40
30.80	584.76	1.90	2.26	3-M2t	2.50	1.32	1.90	1.90	3.85	1.51
38.50	585.10	2.16	2.60	3-M2t	2.50	1.49	2.11	2.11	4.36	1.60
46.00	585.43	2.41	2.93	3-M2t	2.50	1.63	2.30	2.30	4.85	1.68
53.90	585.92	2.68	3.42	3-M2t	2.50	1.77	2.48	2.48	5.52	1.75
61.60	585.48	2.98	2.58	3-M2t	2.50	1.88	2.48	2.63	6.31	1.81
69.30	585.80	3.30	2.73	3-M2t	2.50	2.00	2.48	2.78	7.09	1.87
77.00	586.17	3.67	2.87	3-M2t	2.50	2.08	2.48	2.92	7.88	1.92

El. inlet face invert 582.50 ft El. outlet invert 582.45 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	100.00 ft
INLET ELEVATION	582.50 ft
OUTLET STATION	172.00 ft
OUTLET ELEVATION	582.45 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0007
CULVERT LENGTH ALONG SLOPE	72.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.50 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.015
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

CULVERT 1

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:08:45

FILE DATE: 12-31-2007
FILE NAME: SOUTHCUL

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	5.00 ft
SIDE SLOPE H/V (X:1)	3.0
CHANNEL SLOPE V/H (ft/ft)	0.001
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	582.45 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	582.45 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	582.45	0.000	0.00	0.00	0.00
7.70	583.40	0.187	0.95	1.03	0.06
15.40	583.80	0.190	1.35	1.25	0.08
23.10	584.10	0.192	1.65	1.40	0.10
30.80	584.35	0.193	1.90	1.51	0.12
38.50	584.57	0.194	2.11	1.60	0.13
46.00	584.75	0.195	2.30	1.68	0.14
53.90	584.93	0.196	2.48	1.75	0.16
61.60	585.08	0.197	2.63	1.81	0.16
69.30	585.23	0.198	2.78	1.87	0.17
77.00	585.37	0.198	2.92	1.92	0.18

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	0.00 ft
CREST LENGTH	586.00 ft
OVERTOPPING CREST ELEVATION	100.00 ft

CULVERT 2

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:28:42

FILE DATE: 12-31-2007
FILE NAME: N-SDITCH

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	579.90	579.70	91.00	2 RCP	2.50	2.50	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: N-SDITCH DATE: 12-31-2007

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
579.90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
580.80	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
581.19	14.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
581.52	21.9	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
581.82	29.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
582.09	36.5	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
582.33	43.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
582.63	51.1	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
582.90	58.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
583.13	65.7	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
583.58	73.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: N-SDITCH DATE: 12-31-2007

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
579.90	0.000	0.00	0.00	0.00
580.80	0.000	7.30	0.00	0.00
581.19	0.000	14.60	0.00	0.00
581.52	0.000	21.90	0.00	0.00
581.82	0.000	29.20	0.00	0.00
582.09	0.000	36.50	0.00	0.00
582.33	0.000	43.00	0.00	0.00
582.63	0.000	51.10	0.00	0.00
582.90	0.000	58.40	0.00	0.00
583.13	0.000	65.70	0.00	0.00
583.58	0.000	73.00	0.00	0.00

CULVERT 2

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:28:42

FILE DATE: 12-31-2007
FILE NAME: N-SDITCH

PERFORMANCE CURVE FOR CULVERT 1 - 2(2.50 (ft) BY 2.50 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	579.90	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
7.30	580.80	0.81	0.90	2-M2c	0.70	0.62	0.62	0.55	3.85	1.15
14.60	581.19	1.23	1.29	2-M2c	1.02	0.89	0.89	0.81	4.65	1.45
21.90	581.52	1.56	1.62	2-M2c	1.29	1.10	1.10	1.02	5.25	1.65
29.20	581.82	1.84	1.92	2-M2c	1.54	1.28	1.28	1.19	5.75	1.80
36.50	582.09	2.10	2.19	2-M2c	1.82	1.44	1.44	1.35	6.22	1.93
43.00	582.33	2.31	2.43	2-M2c	2.15	1.57	1.57	1.47	6.62	2.02
51.10	582.63	2.58	2.73	2-M2c	2.50	1.72	1.72	1.62	7.10	2.13
58.40	582.90	2.85	3.00	2-M2c	2.50	1.84	1.84	1.73	7.57	2.21
65.70	583.13	3.14	3.23	2-M2c	2.50	1.95	1.95	1.85	8.03	2.29
73.00	583.58	3.47	3.68	2-M2c	2.50	2.04	2.04	1.95	8.50	2.36

El. inlet face invert 579.90 ft El. outlet invert 579.70 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	100.00 ft
INLET ELEVATION	579.90 ft
OUTLET STATION	191.00 ft
OUTLET ELEVATION	579.70 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0022
CULVERT LENGTH ALONG SLOPE	91.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	2.50 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

CULVERT 2

CURRENT DATE: 12-31-2007
CURRENT TIME: 13:28:42

FILE DATE: 12-31-2007
FILE NAME: N-SDITCH

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	10.00 ft
SIDE SLOPE H/V (X:1)	3.0
CHANNEL SLOPE V/H (ft/ft)	0.002
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	579.70 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	579.70 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	579.70	0.000	0.00	0.00	0.00
7.30	580.25	0.274	0.55	1.15	0.07
14.60	580.51	0.283	0.81	1.45	0.10
21.90	580.72	0.288	1.02	1.65	0.13
29.20	580.89	0.290	1.19	1.80	0.15
36.50	581.05	0.292	1.35	1.93	0.17
43.00	581.17	0.294	1.47	2.02	0.18
51.10	581.32	0.295	1.62	2.13	0.20
58.40	581.43	0.296	1.73	2.21	0.22
65.70	581.55	0.297	1.85	2.29	0.23
73.00	581.65	0.298	1.95	2.36	0.24

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	28.00 ft
CREST LENGTH	588.00 ft
OVERTOPPING CREST ELEVATION	100.00 ft

CULVERT 3

CURRENT DATE: 04-01-2008
CURRENT TIME: 11:25:18

FILE DATE: 04-01-2008
FILE NAME: NORTHCUL

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	576.40	576.20	135.00	2 RCP	3.00	3.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: NORTHCUL DATE: 04-01-2008

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
576.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
577.45	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
577.91	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
578.29	31.8	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
578.63	42.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
578.91	53.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
579.20	62.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
579.55	74.2	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
579.86	84.8	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
580.10	95.4	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
580.57	106.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0
0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: NORTHCUL DATE: 04-01-2008

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
576.40	0.000	0.00	0.00	0.00
577.45	0.000	10.60	0.00	0.00
577.91	0.000	21.20	0.00	0.00
578.29	0.000	31.80	0.00	0.00
578.63	0.000	42.40	0.00	0.00
578.91	0.000	53.00	0.00	0.00
579.20	0.000	62.00	0.00	0.00
579.55	0.000	74.20	0.00	0.00
579.86	0.000	84.80	0.00	0.00
580.10	0.000	95.40	0.00	0.00
580.57	0.000	106.00	0.00	0.00

CULVERT 3

CURRENT DATE: 04-01-2008
CURRENT TIME: 11:25:18

FILE DATE: 04-01-2008
FILE NAME: NORTHCUL

PERFORMANCE CURVE FOR CULVERT 1 - 2(3.00 (ft) BY 3.00 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	576.40	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
10.60	577.45	0.93	1.05	2-M2c	0.88	0.71	0.71	0.68	4.12	1.30
21.20	577.91	1.40	1.51	2-M2c	1.28	1.02	1.02	1.00	4.98	1.63
31.80	578.29	1.79	1.89	2-M2c	1.62	1.27	1.27	1.25	5.60	1.85
42.40	578.63	2.11	2.23	2-M2c	1.95	1.48	1.48	1.46	6.11	2.02
53.00	578.91	2.40	2.51	2-M2c	2.33	1.66	1.66	1.65	6.62	2.15
62.00	579.20	2.63	2.80	2-M2c	3.00	1.80	1.80	1.79	6.98	2.25
74.20	579.55	2.93	3.15	2-M2c	3.00	1.97	1.97	1.97	7.53	2.37
84.80	579.86	3.21	3.46	2-M2c	3.00	2.12	2.12	2.11	7.94	2.46
95.40	580.10	3.52	3.70	3-M2t	3.00	2.24	2.24	2.24	8.44	2.54
106.00	580.57	3.85	4.17	3-M2t	3.00	2.36	2.37	2.37	8.87	2.62

El. inlet face invert 576.40 ft El. outlet invert 576.20 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	100.00 ft
INLET ELEVATION	576.40 ft
OUTLET STATION	235.00 ft
OUTLET ELEVATION	576.20 ft
NUMBER OF BARRELS	2
SLOPE (V/H)	0.0015
CULVERT LENGTH ALONG SLOPE	135.00 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	3.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

CULVERT 3

CURRENT DATE: 04-01-2008
CURRENT TIME: 11:25:18

FILE DATE: 04-01-2008
FILE NAME: NORTHCUL

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	10.00 ft
SIDE SLOPE H/V (X:1)	3.0
CHANNEL SLOPE V/H (ft/ft)	0.002
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	576.20 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	576.20 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	576.20	0.000	0.00	0.00	0.00
10.60	576.88	0.280	0.68	1.30	0.08
21.20	577.20	0.287	1.00	1.63	0.13
31.80	577.45	0.291	1.25	1.85	0.16
42.40	577.66	0.294	1.46	2.02	0.18
53.00	577.85	0.295	1.65	2.15	0.21
62.00	577.99	0.296	1.79	2.25	0.22
74.20	578.17	0.298	1.97	2.37	0.25
84.80	578.31	0.299	2.11	2.46	0.26
95.40	578.44	0.299	2.24	2.54	0.28
106.00	578.57	0.300	2.37	2.62	0.29

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	28.00 ft
CREST LENGTH	588.00 ft
OVERTOPPING CREST ELEVATION	100.00 ft

C&S Engineers, Inc.

PROJECT GATEWAY CENTER SHEET ____ OF ____

STORM DRAINAGE FILE NO. ____

PREPARED BY V.O. DATE ____ CHECKED BY ____ DATE ____

RATIONAL METHOD Q = CIA 10-YR STORM

DETERMINE C:

COMMERCIAL / LT INDUSTRIAL 85% IMPERVIOUS
HYDROLOGICAL SOIL TYPE "D"

C = 0.80 ASPHALT
C = 0.20 GRASS

C_W INDUSTRIAL SITES = 0.85(.80) + 0.15(.20) = 0.71

C_{ROW} (55% IMP) = 0.55(.80) + 0.45(.20) = 0.53

DETERMINE INITIAL Tc to FIRST INLETS

FOR COMMERCIAL/INDUSTRIAL SITE:

ASSUME: 20' GRASS @ 2% OVERLAND FLOW = 6 MIN
100' PAVEMENT @ 1% OVERLAND FLOW = 1 MIN
750' PIPE FLOW = 4 MIN

USE 10 MINUTES Tc

FOR R.O.W:

ASSUME: 20' GRASS @ 2% OVERLAND FLOW = 6 MIN
150' PAVEMENT FLOW = 2 MIN

USE 8 MINUTES Tc

Appendix C

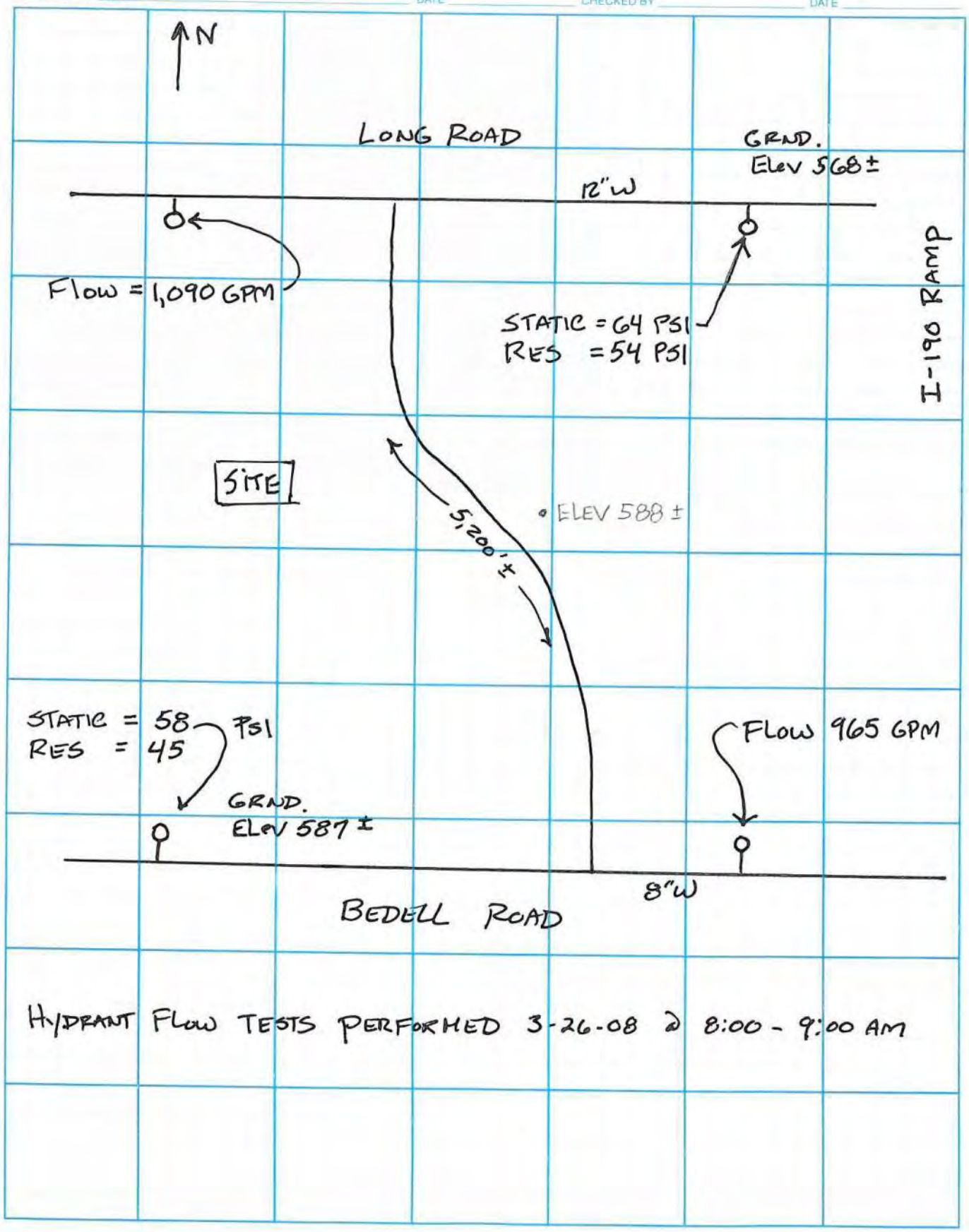
Water & Sanitary Sewer Calculations

C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY CENTER SHEET 1 OF

WATER CALCS FILE NO.

PREPARED BY J.O. DATE CHECKED BY DATE



HYDRANT FLOW TESTS PERFORMED 3-26-08 @ 8:00 - 9:00 AM

C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY CENTER SHEET 2 OF

WATER CALCS. FILE NO.

PREPARED BY U.O. DATE CHECKED BY DATE

- FLOW @ LONG = 1,090 GPM @ 54 PSI FROM HYD. FLOW TESTS.
- CENTER OF DEVELOPMENT IS APPROX $\frac{5,200'}{2}$ NORTH OF LONG = 2,600'
- DETERMINE AVAIL. FLOW @ 20 PSI
- HL THROUGH NEW MAIN (10"), PVC C = 130

L = 2600 + MINOR LOSSES SAY 10% L, ∴ L = 2,860 FT - EQUIV.

$HL = 12'/1000 \times 2,860 \times (0.62) = 21'$ OR 9 PSI (SEE NOMOGRAPH)

ELEVATION LOSS = 20' ± OR 9 PSI

∴ RESIDUAL PRESSURE @ CENTER OF SITE @ 1,090 GPM = 54 - 9 - 9 = 36 PSI

EQUIV FLOW @ 20 PSI = $1,090 \frac{(55\text{ PSI} - 20)^{0.54}}{(55\text{ PSI} - 36)^{0.54}}$ = 1,517 GPM (64-9)

∴ THE MINIMUM FLOW EXPECTED @ 20 PSI IS 1,517 GPM. THIS CONSERVATIVELY ASSUMES THAT THE FLOW FROM BEDELL ROAD MAIN IS Ø BECAUSE OF THE PRESSURE DROP IN THE SYSTEM.

C&S Engineers, Inc.

PROJECT GRAND ISLAND GATEWAY CENTER SHEET 3 OF

WATER CALCS. FILE NO.

PREPARED BY J.O DATE CHECKED BY DATE

DOMESTIC FLOW -

MAXIMUM DAILY DEMAND = 1.5 x AVE DAILY DEMAND

DAILY FLOW = 140,862 GPD

∴ MAXIMUM DAILY DEMAND = 140,862 x 1.5 = 211,293 GPD

PEAK HOURLY FLOW = 352 GPM (FROM SEWER CALCS)
(506,880 GPD)

HLD PEAK FLOW = 1.4'/1000 x 2,860(.62) = 2.5' = 1 PSI

WATER DISTRIBUTION—FLOW IN PIPES*—2

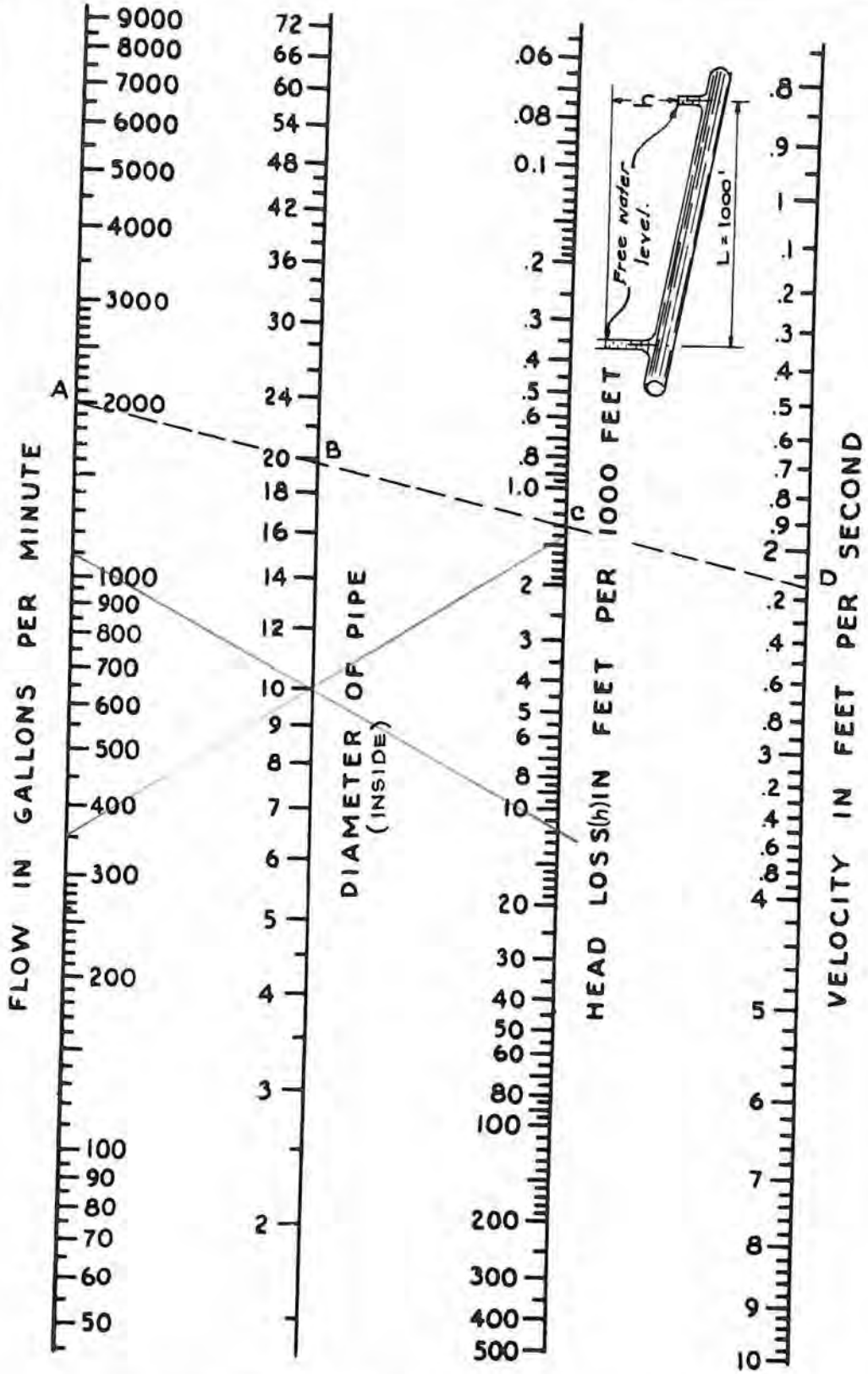


FIG. A - FLOW CHART "C" = 100*
(BASED ON HAZEN AND WILLIAMS FORMULA)

USE OF FIG. A *

Knowing any two o the following: FLO DIAMETER, HEAD LO. VELOCITY, the oth two values can b found by placing straight-edge on the factors knowr and reading desire factors (Known A & B desired C & D.)

TABLE B - CONVERSION OF FLOV

Gals/Min.	Cu.ft./Sec.	Gallons/Day
10	0.022	14,4
20	0.045	28,8
30	0.067	43,2
40	0.089	57,6
50	0.111	72,0
60	0.134	86,4
70	0.156	100,80
80	0.178	115,20
90	0.201	129,60
100	0.223	144,00
120	0.27	172,80
140	0.31	201,60
160	0.36	230,40
180	0.40	259,20
200	0.45	288,00
220	0.49	316,80
240	0.54	345,60
260	0.58	374,40
280	0.63	403,20
300	0.67	432,00
350	0.78	504,00
400	0.89	576,00
450	1.00	648,00
500	1.11	720,00
550	1.23	792,00
600	1.34	864,00
700	1.56	1,008,00
800	1.78	1,152,00
900	2.01	1,296,00
1000	2.23	1,440,00
1100	2.45	1,584,00
1200	2.67	1,728,00
1300	2.90	1,872,00
1400	3.12	2,016,00
1500	3.34	2,160,00
1600	3.57	2,304,00
1700	3.79	2,448,00
1800	4.01	2,592,00
1900	4.23	2,736,00
2000	4.46	2,880,00
3000	6.68	4,320,00
4000	8.92	5,760,00
5000	11.14	7,200,00
6000	13.36	8,640,00

*See Table B, Page 22-03, for use of Fig. A with values of "C" other than 100.

WATER DISTRIBUTION—FLOW IN PIPES—I

HAZEN & WILLIAMS FORMULA

$$V = 1.318\, C r^{0.63} S^{0.54}$$

Where V=mean Velocity in feet per second, r = hydraulic radius in feet, S=hy-aulic Slope in feet per foot of length, C=Hazen & Williams Coefficient of roughness.

QUANTITY OF FLOW FORMULA

$$Q = AV$$

Where Q = flow in cubic feet per second, A=cross-sectional Area of pipe in quare feet, V=mean Velocity in feet per second.

TABLE A – VALUES OF "C" IN HAZEN AND WILLIAMS FORMULA FOR VARIOUS KINDS OF PIPE.

KIND OF PIPE	"C"
CAST IRON	
lew well laid	130
to 6 years old	120
0 to 12 years old	110
3 to 20 years old	100
6 to 35 years old (4" to 10" sizes)	80
7 to 47 years old (12" to 60" sizes)	80
ASBESTOS-CEMENT	140
CEMENT-LINED PIPE	
pplied by hand	125
entrifugally applied	140
RIVETED STEEL PIPE	
ew (66" to 144" sizes)	110
years old (66" to 144" sizes)	100
ver 10 years old	95
, 2½" & 3" PIPE	
ry smooth & straight Brass, Tin	140
rdinary straight Brass, Tin, etc.	130
mooth New Iron	120
rdinary Iron	100

KIND OF PIPE	"C"
Old Iron	80
Very rough	60
Badly tuberculated	40
WROUGHT IRON (⅛" to 1½" Sizes)	
Very smooth and straight	140
Smooth New Iron	120
Ordinary Iron	100
Old Iron	80
Very rough	60
BRASS PIPE (0.03 to 1.2 Sizes) (May also be used for straight Lead, Tin & drawn Copper Pipes)	130
TILE (Good condition)	110
WOOD STAVE OR SMOOTH WOODEN PIPE	120
BRICK	100
CONCRETE	120
FIRE HOSE	
Extremely smooth	143
Rubber lined	125-140
Mill Hose	100-120
Unlined Linen Hose	85-95

TABLE B – RELATIVE CARRYING CAPACITY AND HEAD LOSS FOR VARIOUS VALUES OF "C" FOR USE WITH FLOW CHART, FIG. A-Pg.6-63.

"C"	"K_1"	"K_2"
40	5.46	0.40
60	2.58	0.60
80	1.51	0.80
90	1.22	0.90
00	1.00	1.00
110	0.84	1.10
120	0.71	1.20
130	0.62	1.30
40	0.54	1.40

Explanation:

1. To determine loss of head with value of "C" other than 100, multiply the loss of head found in Fig. A - Pg.22-04 by the "K_1" value given in table at left.

2. To determine quantity of flow with value of "C" other than 100, multiply the quantity of flow found in Figure A - Pg.22-04 by the "K_2" value given in table at left.

C&S Engineers, Inc.

PROJECT GATEWAY CENTER SAN SEWERS — SHEET 1 OF — FILE NO.

PREPARED BY V.O. — DATE — CHECKED BY — DATE

DETERMINE LOADING

REF: NYSDEC "DESIGN STANDARDS FOR WASTEWATER TREATMENT WORKS", 1988

DESIGN FACILITIES FOR ULTIMATE BUILDOUT OF THE FOLLOWING:

- 144 ACRE GATEWAY SITE (COMMERCIAL/LT. INDUSTRIAL)
- 27 ACRE FORMER DUNLOP SITE (COMMERCIAL/LT. INDUSTRIAL)
- 65 ACRE RESIDENTIAL PARCEL TO WEST

- ASSUME 171 ACRES (144+27) IS 70% COMMERCIAL/OFFICE
  30% LT. INDUSTRIAL (WAREHOUSE/MANF.)
- ASSUME SITE BUILDING COVERAGE = 25%

- ASSUME 50% OF COMMERCIAL/OFFICE IS 2 STORY

- COMMERCIAL/OFFICE – ASSUME 225 SF/EMPLOYEE

171 ACRES × 70% × 25% × 1.5 = 1,955,300 SF

1,955,300 SF ÷ 225 SF/EMPLOYEE × 15 GPD/EMP × 0.8 = 104,283 GPD

- LT. INDUSTRIAL/WAREHOUSE/MANUF

171 ACRES × 30% × 25% = 558,657 SF

ASSUME 1 EMPLOYEE PER 5,000 SF = $\frac{558,657}{5,000}$ = 112 EMPLOYEES

112 EMPLOYEES × 25 GPD × 0.8 = 2,240 GPD

- RESIDENTIAL

65 ACRES × 1.5 LOTS/ACRE = 98 LOTS

ASSUME 50% 3 BDRM & 50% 4 BDRM = 438 GPD AVE

98 × 438 × 0.8 = 34,339 GPD

TOTAL DAILY FLOW = 140,862 GPD

C&S Engineers, Inc.

PROJECT GATEWAY CENTER SHEET 2 OF

SAN SEWERS FILE NO.

PREPARED BY V.O. DATE CHECKED BY DATE

DETERMINE PEAK HOURLY FLOW

EQUIVALENT POPULATION = $\frac{140,862}{100}$

PEAK FACTOR = 3.6 (FIGURE 1, pg 10-5, 10 STATES STDS)

$Q_{peak} = \frac{140,862}{24 \times 60} \times 3.6 = \underline{352 \text{ GPM}}$

$Q_{peak} = 352 \text{ GPM} = 352^{GPM} \times \frac{1}{7.48 G/CF} \times \frac{1^{M}}{60 \text{ sec}} = 0.784 \text{ CFS}$

MIN. VELOCITY = 2.0 FPS

$A_{req} = \frac{Q}{V} = \frac{0.784}{2.0} = 0.392 \text{ SF}$

$0.39 = \frac{\pi D^2}{4}$ $D = \sqrt{\frac{4}{\pi}(.39)} = 0.7' = 8.4''$

TRY 6" ϕ FORCEMAIN

$A = \frac{\pi(.5)^2}{4} = 0.196 \text{ FT}^2$

$V = \frac{0.784}{0.196} = 4.0 \text{ FPS} > 2.0 < 10 \therefore \text{OK}$

DEVELOP HEAD DISCHARGE CURVE

- STATIC LIFT

BOTTOM OF PUMP STATION WET WELL 555
DISCHARGE ELEVATION 567
12'

- HL

10,300 LF FORCEMAIN

ADD 10% FOR MINOR LOSSES, TOTAL LENGTH = $\underline{11,330'}$

C&S Engineers, Inc.

PROJECT GATEWAY CENTER SAN SEWER — SHEET 3 OF — FILE NO.

PREPARED BY V.O. — DATE — CHECKED BY — DATE

C = 120, 6" PVC FORCEMAIN (C=120 MAX PER 48.6 10 ST. STDS.)

FLOW (gpm)	VELOCITY (FPS)	FRICTION LOSS FEET/100'	TOTAL H_L (11,330')	TDH (FT)
300	3.4	0.940	106.5	119
325				
350	3.98	1.245	141.1	153
375				
400	4.54	1.589	180.0	192

TRY 8" PVC FORCEMAIN, C = 120

300	1.93	0.23	26.1	38
325				
350	2.24	0.31	35.1	47
375				
400	2.56	0.39	44.2	56

h_L CALCULATIONS BASED HAZEN WILLIAMS

$$h_F = \frac{4.73\,(L)}{C^{1.85}\,D^{4.87}}\,Q^{1.85}$$

L = Length in Feet
C = 120
D = PIPE DIAMETER IN FEET
Q = FLOW IN CFS

GATEWAY CENTER - GRAND ISLAND, NY

DIVISION 11 - EQUIPMENT

SECTION 11502 - RECESSED WET WELL MOUNTED PUMP STATION

1.1 WORK DEFINED

A. Work of this section shall conform with all requirements of the Contract Documents.

B. The contractor shall furnish and install one (1) factory-built, automatic pumping station. The station shall be complete with all needed equipment, factory-installed and tested.

The principal items of equipment shall include station shell and base; hinged fiberglass covers; separate wet well entrance; two (2) vertical, close-coupled, motor driven, vacuum primed, non-clog pumps; valves; internal piping, central control panel with circuit breakers; motor starters and automatic pumping level controls; heater; ventilating blower; priming pumps and appurtenances; and all internal wiring.

C. The pump station for Gateway Center shall be a completely new installation as shown on the contract drawings.

1.2 SUBMITTALS

A. In accordance with the procedures outlined in the specifications, submit seven (7) copies of the following:

1. Manufacturer's catalog cuts, specifications, and recommended methods of installation.
2. Dimensional drawings.
3. Station layout drawings.
4. Catalog data on all accessories included with the pump station.
5. Assembly and foundation drawings.
6. Impeller opening drawing.
7. Wiring diagrams.
8. Operation and Maintenance Manual.
9. Current parts and price list.

1.3 QUALITY ASSURANCE

A. The manufacturer of the recessed wet well-mounted pump stations is Smith & Loveless, Inc. in accordance with the Town of Grand Island standardization resolution.

1.4 DESIGN CONDITIONS

A. Refer to attached "Pump Schedule" for sizes, capacities of pumps, and electrical characteristics. All openings and passages shall be large enough to permit the passage of a sphere 3" in diameter.

B. All drive equipment shall be non-overloading at all points along the performance curve. Minimum efficiencies will be strictly adhered to.

1.5 PUMP WARRANTY

A. The manufacturer shall guarantee the structure and all equipment to be free from defects in materials and workmanship per period of up to one year from the date of start up not to exceed 18 months from date of shipment. In addition to the standard warranty the impeller shall have a 20-year warranty and mechanical seal 3-year warranty. Should either of these components fail within the warranty period the manufacture shall provide replacement parts as well as the necessary labor for removal of the failed component and replacement of the new part without cost to the owner. Should manufacture's published maintenance schedule require replacement of these components within this warranty period they shall be provided as spare parts with the new station. Documentation shall be provided by the manufacture to confirm scheduled replacement.

B. Warranties and guarantees by the suppliers of various components in lieu of a single-source responsibility by the manufacturer will not be accepted. The manufacturer shall be solely responsible for the guarantee of the station and all components. Furnishing warranties and guarantees to the Owner shall be the Contractor's responsibility.

C. In the event the component fails to perform as specified or is proven defective in service during the guaranteed period, the manufacturer shall provide a replacement part without cost to the owner.

D. The manufacturer shall supply the services of a factory-trained technician to inspect the installation, test the equipment for proper performance and instruct maintenance personnel on the operation and care of the stations. This provision shall be the responsibility of the Contractor. The number of days of this service shall be as required by the Town of Grand Island public works department.

PART 2 - PRODUCTS

2.1 GENERAL

A. The factory-built recessed wet well-mounted automatic pumping station shall be complete with all needed equipment; factory installed as shown on the contract drawings or as specified in this section.

B. Precast wet well monobases, riser and top slab sections shall be designed per ASTM C-478 as shown on the drawings. O-ring joint shall meet ASTM C-443.

2.2 PRODUCT

A. Construction

1. Each station shall be constructed in one (1) complete factory-built assembly. It shall be sized to rest on the top of the wet well as detailed in the construction drawings. The supporting floor plate shall be minimum 3/8" thick steel. The shell shall be of 1/4" minimum thickness rolled to an inside diameter of 8'-6".

2. The equipment chamber shall be completely isolated from the wet well in a gas tight configuration. Wet well access shall be completely separate from the equipment chamber and shall be provided with the aluminum, slide away access man-way exposed only to the atmosphere. Access slide door shall be labeled for confined entry requirements of Town of Grand Island.

3. The equipment chamber shall be provided with a split fiberglass cover hinged at the partition wall separating the equipment chamber from the access man-way to the wet well. The fiberglass cover shall be formed with a drip-lip around the edge and a labyrinth at the top. Hinges, bolts, nuts, washers and reinforcing plates shall be stainless steel. Brackets shall be provided to support the cover in the open position and to restrain it under load. An aluminum ladder shall be located in the equipment chamber to provide easy access. Only one segment of the fiberglass cover need be opened for access into the equipment chamber. A Bilco "ladder up" extension shall be provided on the ladder in the equipment chamber.

4. The slide away aluminum wet well man-way shall be an integral part of the station head plate and shall provide access into the wet well.

5. Both equipment chamber and wet well access cover shall be provided with hasp and staple arrangement for padlocking.

6. A stanchion with removable lifting arm shall be provided to support a hoist to facilitate easy removal of the motors, impellers and pumps. The lifting arm shall be provided with a storage tube that shall be mounted behind the pump control panel. The lifting arm shall be stored within reach of a person at grade level

7. The top of the equipment chamber shall have a neoprene lip gasket, a minimum of 1/8" thick.

8. Factory mounting brackets for every piece of equipment to be mounted in the station shall be provided.

B. Welding

1. All steel and the station structure shall be jointed by electric arc welding with fillets of adequate section for the joint involved. Where required to exclude ground water, all welded joints on the exterior of the station shall be continuous throughout their length.

C. Protection Against Corrosion

1. After welding, all inside and outside surfaces of the structures, pumps and piping shall be steel shop blasted to a 2-mil minimum profile commercial blast. Immediately after cleaning, a single 6-mil minimum thickness insert coating shall be factory applied to all inside and outside surfaces. The coating shall be Versapox epoxy resin, formulated for abrasion and corrosion resistance. The dry coating shall contain a minimum of 85% epoxy resin with the balance being pigments and Thixotrobic agents. Four (4) 17-pound magnesium anodes shall also be provided and installed in accordance with manufacturer's recommendations.

D. Sewage Pumps

1. The pumps shall be vertical, non-clog sewage pumps of heavy cast iron construction, especially designed for the use of mechanical seals and vacuum priming. In order to minimize seal wear caused by lineal movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that endplay is limited to the clearance within the bearing. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump, the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter as outlined. The dimensions from lowest bearing to top of impeller shall not exceed 6 inches.

2. The bearing nearest the impeller shall be designed for the combined thrust and radial load. The upper bearing shall be free to move lineally with a thermal expansion of the shaft and shall carry only radial loads.

3. The shaft shall be solid stainless steel through the pump and bottom bearing to eliminate corrosion with the pump or mechanical seal. Stainless steel shaft sleeves will not be acceptable and minimum shaft diameters will be strictly adhered to

4. The pump impeller shall be specifically designed to handle high solids, problematic pumping applications. The impeller shall be of the enclosed type made of close-grained cast iron and shall be balanced. The impeller shall be keyed with a stainless steel key and secured to the motor shaft by a stainless steel cap screw equipped with a Nylock or other suitable self-locking device. The impeller shall not be screwed or pinned to the motor pump shaft and shall be readily removable without the use of special tools. To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter shall be trimmed inside the impeller shroud. The shroud shall remain full diameter so that close minimum clearances from shroud to the volute are maintained. Both the end of the shaft and bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft.

5. The pump shall be constructed so as to permit priming from the low-pressure area behind the impeller. Priming from the high-pressure connections, which allow solids to enter and to clog the priming system will not be acceptable. The priming bowl shall be transparent to enable the operator to monitor the priming level.

6. The pump shall be arranged so that the rotating element can easily be removed from the volute without disconnecting the electrical wiring or disassembling the motor, impeller, back head or seal, so that any foreign object may be removed from the pump or suction line.

7. The pump shaft shall be sealed against leakage by a single mechanical seal constructed so as to be automatically drained and primed each time the pump is drained and primed. Water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime, in order to allow both the pump and the seal to be drained, thereby preventing freezing and breakage of the seal during prolonged power outages in sub-freezing temperatures.

8. The seal shall be of carbon and ceramic materials with the mating surfaces lapped to a flatness tolerance of one light band. The rotating ceramic

shall be held in mating position with the stationary carbon by a stainless steel spring.

E. Motors

1. The motors shall be squirrel-cage induction type and shall have Class F insulation, suitable for temperatures up to 115 degrees C, but the motor shall have Class B temperature limits of 90 degrees C rise by resistance, at 115% of rated load. The motors shall have normal starting torque and low starting current, as specified for NEMA design B characteristics. They shall be open drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame. Leads shall be terminated in a cast connection box and shall be clearly identified.

2. The motors shall have 1.15 service factor. The service factor shall be reserved for the owner's protection. The motors shall not be overloaded beyond their nameplate rating, at the design condition, or at any head in the operating range as specified under operating conditions.

3. The motor-pump shaft shall be centered in relation to the motor base, within .005 inches. The shaft run-out shall not exceed .003 inches.

4. The motor shaft shall equal or exceed the diameter as specified above at all points from immediately below the top bearing to the top of the impeller hub.

5. The bearing cap shall be provided to hold the bottom motor bearing in a fixed position. Bearing housings shall be provided with fittings for lubrication as well as purging old lubricant.

6. The motors shall be fitted with heavy lifting eyes, each capable of supporting entire weight of the pump and motor.

F. Controls

1. The control equipment shall be mounted in a NEMA Type 1 steel enclosure two side hinged doors. The circuit breakers, starter-reset buttons, control switches, and D152 controller shall be operable without opening the doors, for dead front operation. Non-resetable elapsed time meter shall be provided for each pump. Starting and overload equipment shall be manufactured by Westinghouse, Square D or Allen Bradley.

2. A ground fault circuit interrupter duplex type outlet shall be provided on the face of the cabinet for operation of 115V AC devices.

3. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short circuit protection of all motor control and auxiliary circuits.

4. Magnetic across-the-line starters with under-voltage release, phase loss protection and overload coils for each phase shall be provided for each pump motor to give positive protection. Each single-phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker, or shall be impedance protected. All switches shall be labeled and a coded wiring diagram shall be provided.

5. To control the operation of the pumps with variations of sewage level in the wet well, an automatic pump and alarm controller, manufactured by USF/Control Systems Model D152 shall be supplied and installed in the pump station control panel.

   a) The D152 Pump and Alarm Controller shall provide full-range differential control of two pumps plus a High and Low level alarm in response to an electronic, level-proportional signal.

   b) The D152 shall operate on 120 VAC power. It shall incorporate a motor starter pilot circuit control contact for the operation of each of the two pumps. The abnormal level alarms (individually adjustable High and Low settings with a total of four set points) shall be outputted through a fail-safe load relay having a form C contact and an audible alarm driver circuit. A 10-second time delay to prevent a simultaneous after power outage shall be incorporated into the controller.

   c) The D152 Controller shall provide level indication on a 40-segment LED bar graph display. The control adjustments shall be easily changed by means of the plug-in programming pins. Each of the eight adjustments shall have forty possible positions relating to the segments of the level display.

   d) A manual override switch below the level display shall allow the actual output level signal to be overridden to confirm the performance of the controlled equipment. The switch shall be a spring-return-to-center type with raise-auto-lower positions. This shall allow operating personnel to simulate a false High or Low level and to observe the performance of the controlled pumps. The spring return feature shall assure that the station will not be left in a non-automatic state.

   e) An automatic alternator shall be provided that transposes the starting sequence of the two pumps on successive operations. The alternator

has a front panel override switch, allowing placement of the pumps in either fixed manual sequence or allows for automatic alternation.

f) An alarm silence pushbutton on the face of the Controller shall cancel the audible alarm driver output circuit while the failsafe alarm relay remains in the abnormal state until the condition has cleared.

g) Four LEDs across the top of the Controller indicate the On/Off State of each of the pump and alarm control circuits.

h) The submersible transducer shall be as manufactured by USF/Control Systems Model A1000. The transducer shall sense pressure caused by the height of liquid above its bottom face. The sensing area shall be a minimum of 3" in diameter. The lower unit body shall be stainless steel. The bottom shall have a molded reinforced synthetic rubber diaphragm with Teflon face. The stainless steel transducer and pipe shall be supported by a stainless steel cable with stainless steel weight kit and shall have a sealed breather system.

6. Provisions shall also be made for the pumps to operate in parallel should the level in the wet well continue to rise above the starting level of the low-level pump. Should the level continue to rise to the standby pump level, the standby pump shall start and the high water alarm shall be activated. It shall also activate a remote 110V AC red alarm light. This alarm light shall be provided by the station manufacturer, for mounting as shown on the Contract Drawings.

7. Lightning arrestors shall be provided as required.

8. Pump failure alarms shall be provided for each pump and shall be of the check valve limit switch type.

9. A 3KVA transformer shall be supplied in the station to convert the 230V/3Ø power to 115V/1Ø for control, if supply power is not 208V.

G. Vacuum Priming Systems

1. A separate and independent priming system shall be furnished for each sewage pump, providing complete standby operation. Each priming system shall include a separate vacuum pump. Vacuum pump shall have corrosion resistant internal components. They shall each be capable of priming the sewage pump and suction piping in not greater than 60 seconds, under rated static suction lift conditions of 20 feet at mean sea level.

2. Each priming system shall be complete with vacuum pump, vacuum controls, solenoid valve, prime level sensing probe, and a float operated check valve installed in the system ahead of the vacuum pump to prevent liquid from entering the vacuum pump. The float operated check valve shall have a transparent body for visual inspection of the liquid level and shall be automatically drained when the vacuum pump shuts off.

3. The priming system shall automatically provide positive lubrication of the mechanical seal each time the sewage pump is primed. To prevent excessive stoppage due to grease accumulation, no passageway in the priming system through which sewage must pass shall be smaller than the equivalent of 2-1/2" opening.

H. Ventilating Blower

1. A ventilating blower shall be provided capable of delivering (200 CFM) in the equipment chamber. The blower shall be rigidly mounted and shall discharge to atmosphere as shown on the plans. It shall be controlled by a thermostat and percentage timer.

I. Heater

1. This station shall be provided with a dual wattage forced air ceramic type heater with built-in thermostat to control operation. The heater wattage shall be 1300/1500, 110V. The heater shall have maximum dimensions of 10" high x 8" wide x 8" deep.

J. Lighting

1. A twin 20-watt fluorescent light fixture and guard shall be mounted opposite the control panel to provide adequate illumination for all areas within the equipment chamber. The fluorescent ballast shall be the cold-weather zero-degree Fahrenheit-starting type.

K. Sump Pump

1. A submersible sump pump with close-coupled motor shall be installed in the sump. It shall be rated 1000 GPH at design head. A mechanical seal on the shaft shall exclude water from the motor housing. The sump pump shall be controlled automatically by a float switch. It shall discharge into the entryway to the wet well through a steel pipe as shown on the drawings.

L. Sewage Piping and Valves

1. The pump suction shall be drilled and tapped for a 125 pound American standard flange for ready connection of the suction riser. The discharge line from each pump shall be fitted with a clapper type check valve and plug valve. Size, location, and quantity of check valves and plug valves shall be as shown on the construction drawings. The check valves shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against vacuum leaks. Check valves shall have stainless steel shaft with replaceable bronze shaft bushings and shall be sealed through the bearing with O-Rings, an operating wrench shall be provided for the plug valves. A compound pressure gauge shall be installed on each pump discharge. The gauge shall be rated for (0-30) PSI and vacuum and have bronze hardware with 1/4" NPT taps in corporation style.

2. All protrusions through the floor plate shall be welded gas-tight to effect sealing between the equipment chamber and the wet well. In order to prevent corrosive, noxious fumes from entering the station, the lift station manufacturer shall extend the suction connection below the floor plate at the factory, so that field connections can be made without disturbing the gas-tight seals.

3. The discharge pipe shall exit the station as shown on the drawings.

M. Mounting brackets for the telemetry system as well as a separate 1" conduit entrance and 20 amp circuit breaker shall be provided in the station.

N. The telemetry system as manufactured by Motorola shall be Model F6857 MOSCAD-L and be provided in accordance with the town standards by the station supplier.

O. An above-ground service entrance cabinet shall be provided as shown on the contract drawings. This shall be the 3M 4220 Series with double door. The service entrance cabinet shall include cabinet light, alarm light, GFI receptacle, heater, 200 amp main circuit breaker panel, and meter socket.

2.3 FACTORY TESTS

A. All components of the pump station shall be given an operational test of all equipment at the factory to check for excessive vibration, for leaks in all piping or seals, for correct operation of vacuum priming and control systems and all auxiliary equipment. Pumps shall take suction from a deep well simulating actual service conditions. The control panel shall undergo a dry logic test and a full operational test with all systems operating.

2.4 SPARE PARTS

A. A complete spare parts kit shall be furnished with each station. The kit shall include the following:

- One (1) mechanical seal and seal gasket
- One (1) volute gasket
- One (1) complete electrode assembly with electrical relay, capacitor, resistor and diode
- Touch up paint - One gallon in one quart containers

2.5 EXTENDED SERVICE

A. The manufacturer shall provide the Town of Grand Island a service contract for maintaining the pumping stations for two (2) years.

B. The service contract shall include checking each station twice per year to ensure correct operation, train operation personnel and spare parts review. A written report after each visit shall be provided to the Town of Grand Island.

2.6 BYPASS PIPING

A. Bypass piping shall be provided in accordance with the contract drawings, including suction and discharge lines with discharge plug valve and box. The bypass piping shall be ductile iron pipe, 4" male quick disconnects with chain and cap shall be provided.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of the pump chamber shall be done in accordance with the written instructions provided by the manufacturer.

B. Five (5) copies of Operation and Maintenance manuals shall be furnished which will include parts list of components and complete service procedures and trouble-shooting guide.

3.2 ELECTRICAL INSTALLATION

A. All field wiring and electrical installation shall be performed by licensed electricians and shall be in full accordance with the standards of the national electric code and the national board of fire underwriters.

B. All conduits shall have a minimum of 2' each cover. All wiring shall be suitably grounded. All fittings and electrical boxes shall be made watertight.

C. All station wiring shall be trained and routed in a workmanlike manner.

D. A single line diagram of the power shall be provided.

E. Equipment enclosures shall be identified to their function, to correspond with the single line diagram.

PUMP SCHEDULE

Manufacturer's Model #	Smith & Loveless 4B2B
Quantity	2

Physical Characteristics:

Pump Speed (RPM)	1760
Suction Size	4"
Discharge Size	4"
Solids Size	3"
Seal Type	Mechanical
Seal Material	Carbon/Ceramic
Impeller Size	7-3/4"
SS Shaft (min.)	1-7/8" diameter

Pumping Characteristics:

Condition #1	200 GPM @ 55.00' TDH – 55.0% Eff
Condition #2	350 GPM @ 49.50' TDH – 63.5% Eff
Condition #3	500 GPM @ 45.00' TDH – 67.0% Eff

Electrical Characteristics:

Max. Motor HP	10
Voltage	230
Phase	3
Wire	3

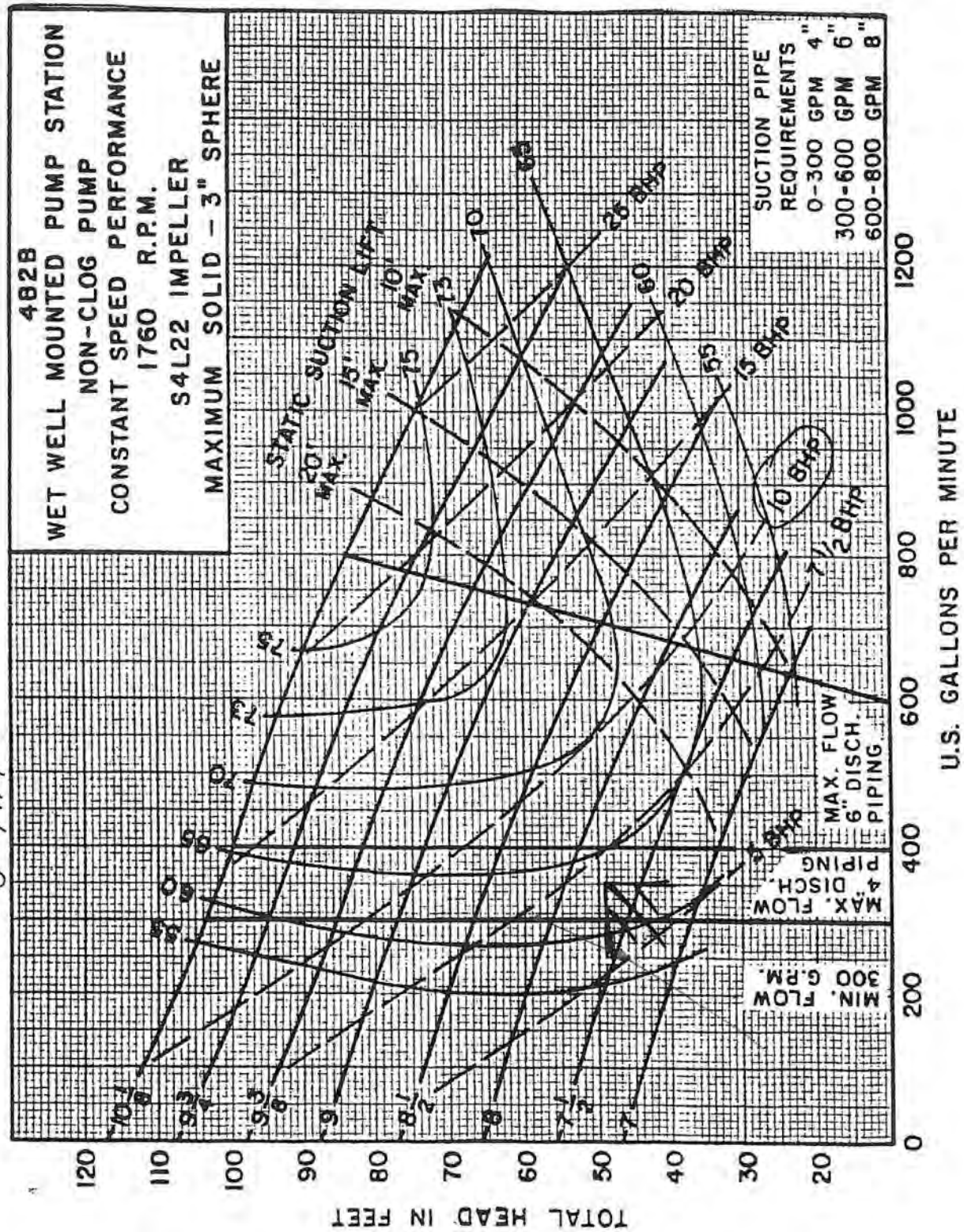
END OF SECTION

ENGINEERING DATA

Smith & Loveless, Inc.

14040 W. Santa Fe Trail Dr.
Lenexa, Kansas 66215

Vacuum Primed
Pump Performance Curves
Constant Speed
4B2B
1760 RPM
Page 3
January, 1988



8" F.M

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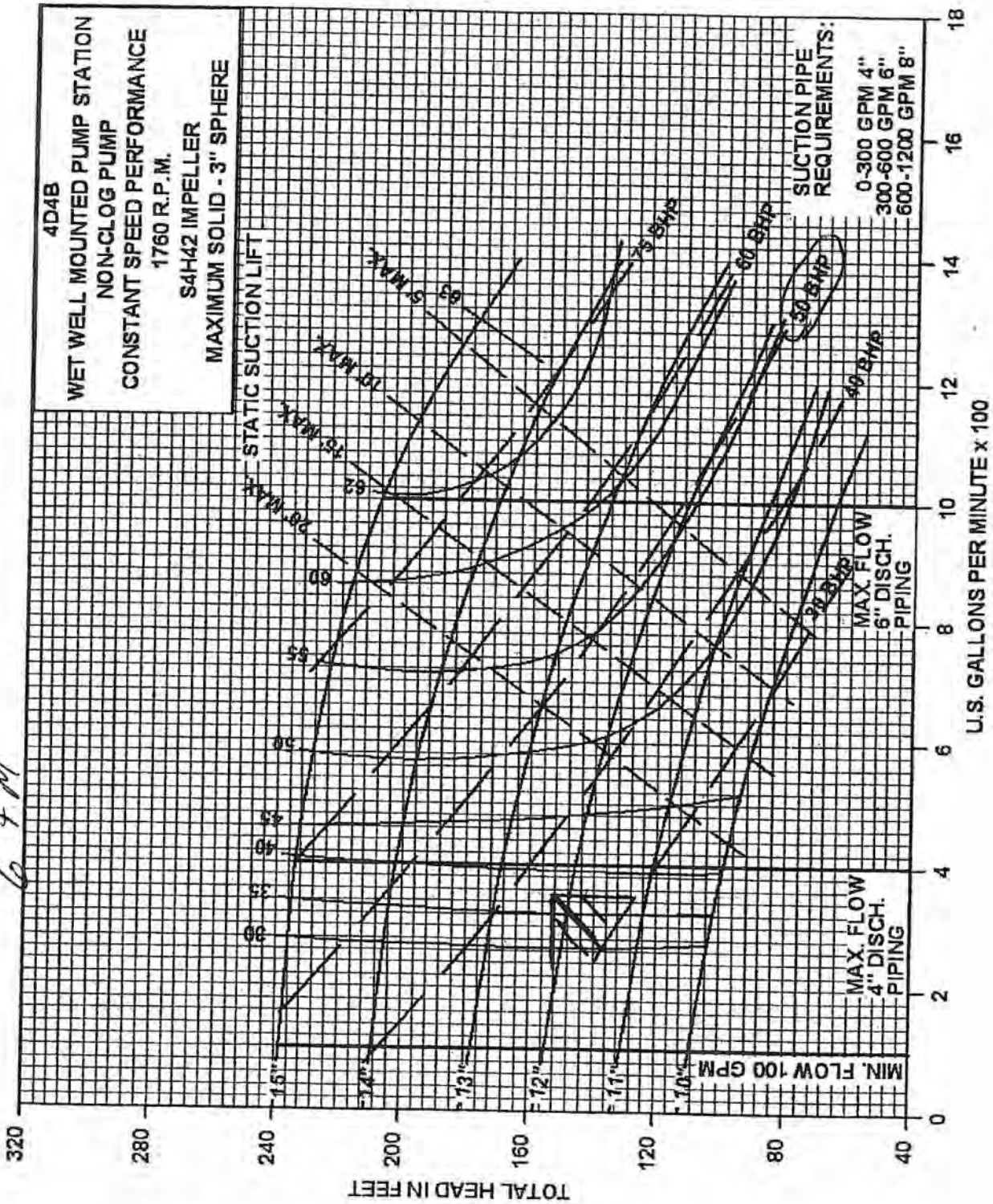
ENGINEERING DATA

Smith & Loveless, Inc.®

14040 West Santa Fe Trail Drive
Lenexa, Kansas 66215-1284

Vacuum Primed Pump
Performance Curves
Constant Speed
4D4B Non-Clog Pump
1760 RPM



6" FM

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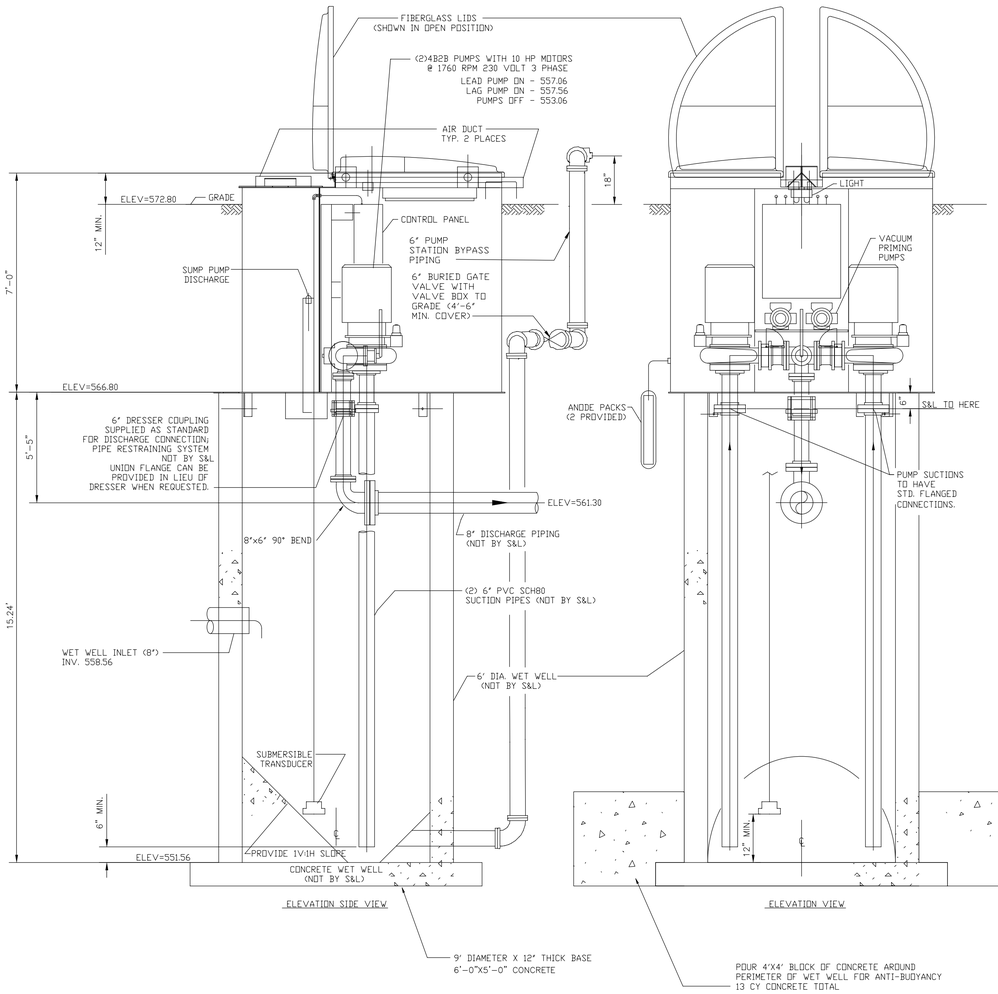
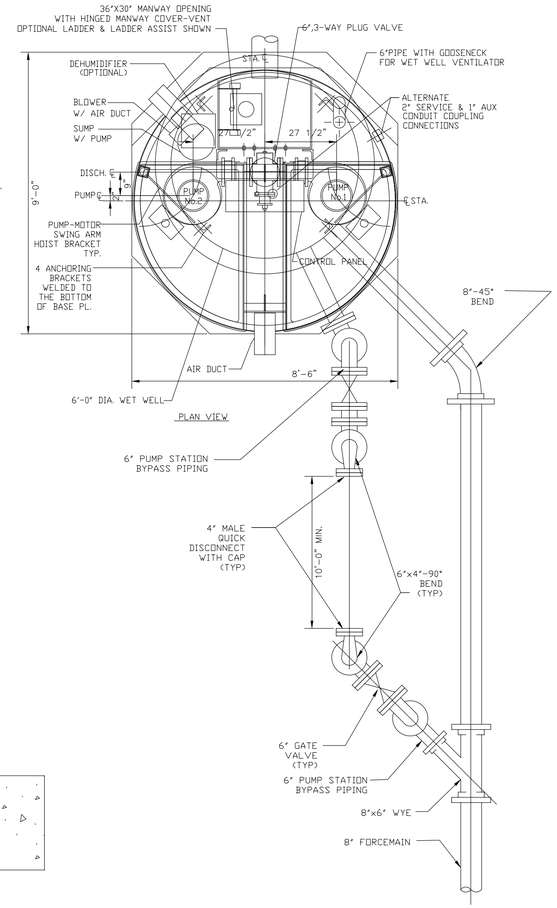
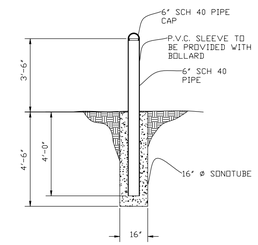




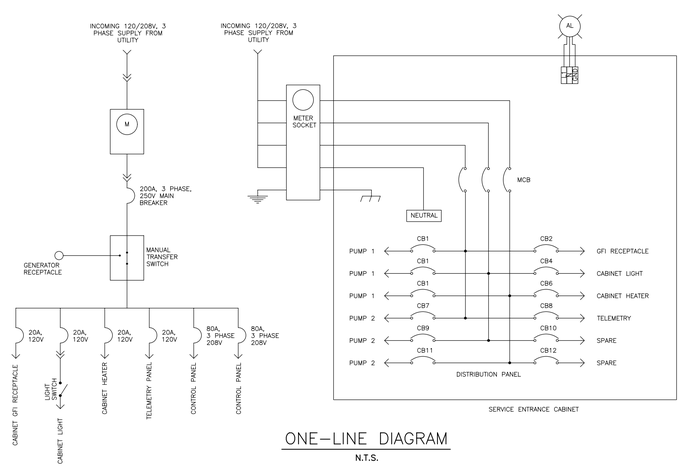
NOTES

1. BASIS OF DESIGN FOR THE PREFABRICATED, PUMPING STATION IS SMITH & LOVELESS
2. SERVICE ENTRANCE CABINET TO BE PRE-ASSEMBLED BEFORE SHIPMENT
3. CONTRACTOR IS RESPONSIBLE FOR COORDINATION OF POWER REQUIREMENTS TO PROVIDE 3ø POWER TO THE PUMPING STATION
4. BYPASS PIPING TO BE DUCTILE IRON
5. SERVICE ENTRANCE CABINET TO BE PROVIDED BY PUMP STATION MANUFACTURER
6. RADIO TELEMETRY PANEL TO BE MOUNTED IN SERVICE ENTRANCE CABINET WIRING BETWEEN RADIO TELEMETRY PANEL AND PUMP STATION TO BE COORDINATED WITH THE TELEMETRY MANUFACTURER
7. SERVICE ENTRANCE CABINET TO HAVE DOUBLE DOORS EACH WITH STAINLESS-STEEL FULL-LENGTH HINGES ON BOTH SIDES OF THE CABINET THE SERVICE ENTRANCE CABINET AS INSTALLED SHALL BE UL APPROVED.



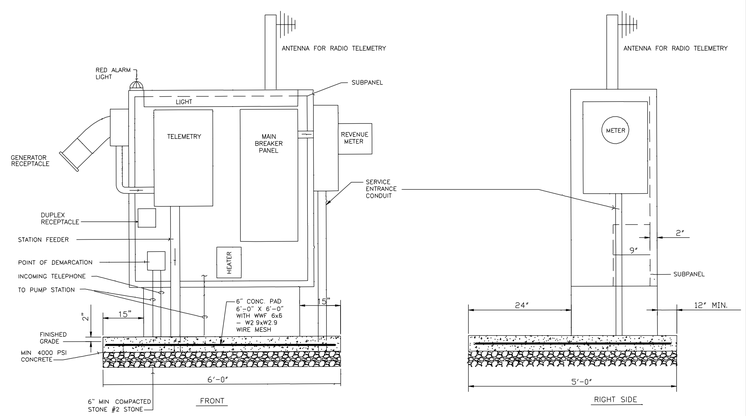
TYPICAL BOLLARD DETAIL

N.T.S.



ONE-LINE DIAGRAM

N.T.S.



SERVICE ENTRANCE CABINET DETAIL

N.T.S.

C&S COMPANIES
C&S Engineers, Inc.
90 Broadway
Buffalo, New York 14203
Phone: 716-847-1630
Fax: 716-847-1454
www.cscos.com

GRAND ISLAND GATEWAY CENTER
TOWN OF GRAND ISLAND, NEW YORK
ERIE COUNTY INDUSTRIAL DEV. AGENCY

MARK	DATE	DESCRIPTION

REVISIONS

PROJECT NO: 135A.001.001
DATE: FEBRUARY 12, 2009
SCALE: AS NOTED
DRAWN BY: S. SCHIENER
DESIGNED BY: E. DANIEL
CHECKED BY: V. O'BRIEN

NO ALTERATION PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK EDUCATION LAW

PUMP STATION & & FORCEMAIN DETAILS

C505

SHEET OF

CADD NO. 2170BD42.DGN

Copyright ©

Appendix B

2017 Engineer's Report prepared by C&S Engineers, Inc.

ENGINEER'S REPORT

For

TOWN OF GRAND ISLAND SANITARY SEWER SYSTEM & FORCEMAIN

Town of Grand Island
Grand Island, New York

Prepared for:
Town of Grand Island

Prepared by:
C&S ENGINEERS, INC.
141 Elm Street, Suite 100
Buffalo, NY 14203

May 15, 2017
Revised June 20, 2017
Revised August 14, 2017

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APPENDIX D 30” INTERCEPTOR AS-BUILT DRAWINGS

APPENDIX E CORRESPONDENCE/MISC.

Engineer's Report
for
Proposed Sanitary Sewer & Forcemain Extension
from
Long Road to 30" Interceptor Sewer

Town of Grand Island, New York

General

This project consists of constructing the sanitary sewer infrastructure to serve approximately 171+/- acres of light industrial zoned property (M-1) located adjacent to Long Road and I-190 in the Town of Grand Island, Erie County, New York. The area to be served by the proposed infrastructure is bisected by Long Road. Approximately 27 acres lies north and 144 acres south, of Long Road. The 144-acre parcel south of Long Road is currently in the sewer district. The project design will also accommodate the adjacent 65-acre residentially zoned (R1-A) property to the west (not currently in the sewer district.)

The 27-acre parcel north of Long Road is the site of the former Dunlop office building, which has been unoccupied for many years. The building is currently being renovated by a private developer and adapted into a 105 room hotel. The site has the potential to accommodate another 100-room hotel or other development in the future. This property is not currently in the sewer district. It will be permitted to connect by the Town as the first adjacent out-of-district user.

The 144-acre service area south of Long Road extends south to Bedell Road and is bounded to the east by I-190 and to the west by residentially zoned undeveloped land. The existing site is undeveloped with conditions consisting of a combination of woods and brush. The northern section of the site was previously used as clay borrow area and is now an overgrown meadow.

Refer to project location sketch in Appendix A.

The proposed land use for the sewer service area is estimated to be as follows:

Type	Land Use	Site Area (Acres)
Light Industrial	26%	44
General Office	58%	100
Hotel	16%	27

Sanitary Sewer

The proposed sanitary sewer system will consist of the following:

- 630 linear feet of 8" SDR-35 PVC gravity sewer, which will convey flows west along Long Road and then south to the proposed pump station location. Additional gravity sewer to serve the future parcels south of long Road will be constructed as development occurs.

- 10,680 linear feet of 6" DR-21 HDPE forcemain, which will convey flows south to Bedell road across the industrial property and then east within the Bedell Road right-of-way to the existing town of Grand Island 30" interceptor sewer. Cleanouts and air relief valves will be provided as necessary. A 24" steel casing pipe was pushed under I-190 on the south side of Bedell Road in the early 1990's to facilitate development of the industrial property, which will be used for the proposed forcemain.

- The pump station will be constructed approximately 140'south of Long Road. It will consist of duplex Smith & Loveless model 4B2D, 10 horsepower suction lift pumps in a pre-engineered enclosure with a pre-cast concrete wet well. A pump by pass line and generator receptacle will be provided in case of power and/or pump failure. Radio telemetry will also be provided compatible with the Town's existing SCADA system.

- The proposed improvements will be constructed under a Public Improvement Permit issued by the Town of Grand Island. The town will provide construction inspection and final construction certification.

<u>Design Parameters</u>

General Office*.....548,856 sf / x 0.1 gpd per day/sf x 0.80 = 43,900 gal/day

Light Industrial* 50 employees x 15 gpd per employee x 0.80 = 600 gal/day

Future Residential .....100 lots x 3.5 beds x110 gpd x 0.80 = 37,730 gal/day

Hotel (proposed & future).....110 gpd per unit x 205 units = 22,550 gal/day + 50 Restaurant Seats @ 35 gpd/seat x 2 banquet rooms +205 pool guest x 10 gpd/guest = 22,400 GPD

Design Flow..... 97,770 gal/day

The hydraulic loading rates per "NYSDEC Design Standards for Intermediate Sized Wastewater Treatment Systems," 1988, (per DEC comments).

**Uses 0.80 (20% reduction) for water saving fixtures*

Refer to appendix B for additional sanitary sewer loading and pump station/forcemain calculations.

Downstream Sanitary Sewer Capacity Analysis

Sanitary sewage from the proposed forcemain will discharge to the town 30" diameter interceptor sewer. The interceptor sewer flows north to the wastewater treatment plant located on the north side of Grand Island.

Flow data for the 30" interceptor sewer was previously obtained during March thru May of 2015 for the Gun Creek Subdivision Study. The flow measurement location was just north of Havenwood Lane and is the furthest downstream point prior to the treatment plan. No other flows enter the system after this point. The Town of Grand Island provided additional flow information (total and peak flow rates) for the 30" interceptor sewer entering the wastewater treatment plant for the same time period as the above study.

No other flow information is currently availbe for the 30" interceptor sewer. However, the flow information contained herein represents the worst case flow in the system. Obtaining additional flow monitoring in this sewer line at an additional location will not provide any additional useful data. Consequently, we hereby request a variance for the three-node standard.

See flow study Summary in Appendix C.

Typical dry weather flows at Node 3 were in the 4" to 5" depth range and the maximum wet weather depth recorded was approximately 14."

The proposed pump station is designed to pump at a rate of 275 gpm or 0.396 MGD.

Sewer Node	Existing Wet Weather Peak Flow (mgd)	Proposed Peak Flow from Project (mgd)	Proposed Peak Flow from Gun Creek Subdivision (mgd)	Total Flow (mgd)	Theoretical Capacity (mgd)	Measured Capacity (mgd)	Available Capacity (Y/N)
30" Interceptor MH @ Havenwood	6.403	0.396	0.340	7.139	7.52*	14.55**	Y
30" Interceptor @ WWTP	6.336	0.396	0.340	7.072	7.52*	N/A	Y

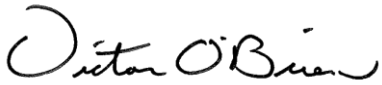
* Estimated capacity of a 30-inch sewer at 0.08% slope based on Manning's equation with n=0.013. Refer to as-built drawings in Appendix D. This is the flattest section of the 30" interceptor sewer between the forcemain discharge and the WWTP per the attached as-built drawings.

**Estimated capacity of a 30-inch sewer based on a measured flow of 6.403 MGD at a depth of 14.07" at Node 3 (manhole where flow meter was installed). Theoretical capacity of 30" sewer at this location with a slope of 0.25% (from as-built) and "n" value of 0.013 is 13.29 MGD.

Based on the above analysis, the existing 30" interceptor sewer has sufficient capacity to accommodate the proposed flows.

Respectfully submitted,

C&S ENGINEERS, INC.



Victor O'Brien, P.E.
Department Manager

Revised June 5, 2017
Revised June 20, 2017
Revised August 14, 2017

APPENDIX A

PROJECT LOCATION MAP

N
LONG ROAD
PROJECT LOCATION
BEDELL ROAD
(INTERSTATE 190)

APPENDIX B

SANITARY SEWER LOADING AND PUMP STATION / FORCEMAIN CALCULATIONS

SANITARY

REFERENCE: "NYSDEC DESIGN STANDARDS FOR INTERMEDIATE SIZED WASTEWATER TREATMENT SYSTEMS," MARCH 5, 2014

DESIGN FACILITIES FOR ULTIMATE BUILDOUT OF THE FOLLOWING:

- 144 ACRE GATEWAY SITE (COMMERCIAL/LIGHT INDUSTRIAL)
- 27 ACRE FORMER DUNLOP SITE (2 HOTELS)
- 65 ACRE RESIDENTIAL PARCEL TO WEST

PER TABLE B-3: TYPICAL PER-UNIT HYDRAULIC LOADING RATES

SINGLE FAMILY RESIDENCE = 110 GPD/BEDROOM
OFFICE/COMMERCIAL = 15 GPD/EMPLOYEE
LT. INDUSTRIAL/MANUFACTURING/WAREHOUSE = 15 GPD/EMPLOYEE/SHIFT
HOTEL = 110 GPD/SLEEPING UNIT (ADD FOR FOOD SERVICE, BANQUET HALL, NIGHTCLUB, POOL/SPA, THEATRE, ETC.)

- ASSUME 144 ACRE GATEWAY SITE IS 70% COMMERCIAL/OFFICE
  30% LT. INDUSTRIAL (WAREHOUSE/MANUF.)
- ASSUME 50% SITE IS DEVELOPABLE
- ASSUME SITE BUILDING COVERAGE = 25%

COMMERCIAL/OFFICE – ASSUME 350 SF/EMPLOYEE

50% × 144 ACRES × 70% × 25% × 43,560 = 548,856 SF

548,856 SF × 0.1 GPD/SF × 0.8 = 43,900 GPD

LT. INDUSTRIAL/WAREHOUSE/MANUF.

50% × 144 ACRES × 30% × 25% = 235,224 SF

ASSUME 1 EMPLOYEE PER 5,000 SF = $\frac{235,224 \text{ SF}}{5,000 \text{ SF/EMP}}$ = 47 EMPLOYEES
SAY 50 EMPLOYEES

50 EMPLOYEES × 15 GPD/EMPLOYEE × 0.80 = 600 GPD

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RESIDENTIAL

65 ACRES × 1.5 LOTS/ACRE = 98 LOTS ⇒ SAY 100 LOTS

ASSUME 3.5 BEDROOMS PER LOT

100 LOTS × 3.5 ROOM/LOT × 110 GPD/ROOM × 0.8 = 30,800 GPD

HOTEL

PROPOSED 105 ROOM HOTEL + FUTURE 100-ROOM HOTEL + POOL + FOOD

205 ROOMS × 110 GPD/ROOM = 22,550 GPD
50 FOOD SEATS × 35 GPD/SEAT × 2 BANQ. ROOMS = 3,500 GPD
205 POOL GUESTS × 10 GPD/GUEST = 2,050 GPD

TOTAL = (22,550 + 3,500 + 2,050) × 0.8 = 22,400 GPD

TOTAL AVG. DAILY FLOW = 43,900 + 600 + 30,800 + 22,400 = 97700 GPD

97,700 GPD = 68 GPM

PER 10 STATE STANDARDS, 2014 EDITION, FIG. 1

$$\frac{Q \text{ PEAK HOURLY}}{Q \text{ DESIGN AVERAGE}} = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

WHERE: P = EQUIV. POPULATION IN THOUSANDS

DETERMINE EQUIVALENT POPULATION:

$$\text{EQUIV. POPULATION} = \frac{97{,}700 \text{ GPD}}{100 \text{ GPC}} = 977 \text{ PEOPLE}$$

P = 977 / 1,000 = 0.977

PEAK FACTOR = 3.25 PER NYSDEC COMMENTS

Q PEAK HOURLY = 97,700 (3.25) = 317,525 GPD

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$Q_{PEAK} = 317{,}525 \frac{GAL}{DAY} \times \frac{1\ DAY}{24\ HR} \times \frac{1\ HR}{60\ MIN} = \underline{\underline{221\ GPM}}$

$Q_{PEAK} = 221 \frac{GAL}{MIN} \times \frac{1\ CF}{7.48\ GAL} \times \frac{1\ MIN}{60\ SEC} = 0.492\ CFS$

MIN. VELOCITY = 2 FT/sec

$AREA = \frac{Q}{V} = \frac{0.492\ CF/sec}{2\ FT/sec} = 0.246\ FT^2$

$0.246\ SF = \frac{\pi D^2}{4} \Rightarrow D = \sqrt{\frac{4(0.246)}{\pi}} = 0.56' \approx 6''$

TRY 6" ϕ FORCEMAIN

$A = \frac{\pi D^2}{4} = \frac{\pi (0.5)^2}{4} = 0.196\ FT^2$

$V = \frac{Q}{A} = \frac{0.492\ CF/S}{0.196\ FT^2} = 2.51\ FT/sec > 2.0 < 8 \therefore OK$

<u>DEVELOP HEAD DISCHARGE CURVE</u>

STATIC LIFT:

PUMP OFF ELEV.	550
DISCHARGE ELEVATION	570
	20 FT

HEADLOSS:

10,680 LF FORCEMAIN

ADD 5% FOR MINOR LOSSES, TOTAL LENGTH = 11,214 FT

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C = 120, 6" PVC FORCEMAIN (C = 120 MAX PER 49.61 10 STATES STDS)

$$h_{L(PSI)} = \frac{10.44(L)(Q)^{1.85}}{C^{1.85} D^{4.87}}$$

WHERE: L = 11,214 FT
Q = FLOW IN GPM
C = 120
D = 6-INCH

$$h_{L(FT)} = 0.433(h_{L(PSI)})$$

FLOW (GPM)	VELOCITY (FT/SEC)	FRICTION LOSS (h_L) IN PIPE (FT)	TDH (FRICTION LOSS + STATIC) (FT)
250	2.84	32	52
275	3.13	38	58
300	3.41	45	65
325	3.69	52	72
350	3.98	60	80

~~TRY AN 8" PVC FORCEMAIN, C=120~~

FLOW (GPM)	VELOCITY (FT/SEC)	FRICTION LOSS (h_L) IN PIPE (FT)	TDH (FRICTION LOSS + STATIC) (FT)
350	2.23	15.8	29
375	2.39	18.0	31
400	2.55	20.3	34
425	2.71	22.7	36
450	2.87	25.2	38

USE 6" FORCEMAIN

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CASE 2 - PUMPING TO HIGH POINT

STATIC LIFT = 586 - 550 = 36 FT

LENGTH OF FORCEMAIN = 3,700 FT × 1.05 = 3,885 FT
↑ MINOR LOSSES

C = 120

$$h_{L(PSI)} = \frac{10.44(L)(Q_{GPM})^{1.85}}{C^{1.85} D^{4.87}}$$

WHERE L = 3,885 FT
Q = 275 GPM
C = 120
D = 6-INCH

= 30.5 PSI

$h_{L(FT)}$ = 0.433(30.5 PSI) = 13.2 FT

TDH = STATIC + h_L = 36 + 13.2 = 49.2 FT

CASE 3 - PUMPING TO HIGH POINT

STATIC LIFT = 583 - 550 = 33 FT

LENGTH OF FORCEMAIN = 9,700 FT × 1.05 = 10,185 FT
↑ MINOR LOSSES

C = 120

$$h_{L(PSI)} = \frac{10.44(L)(Q_{GPM})^{1.85}}{C^{1.85} D^{4.87}}$$

WHERE: L = 10,185 FT
Q = 275 GPM
C = 120
D = 6-INCH

= 80 PSI

$h_{L(FT)}$ = 0.433(80 PSI) = 34.6 FT

TDH = STATIC + h_L = 33 + 34.6 = 67.6 FT

⇒ CASE 3 GOVERNS (275 GPM w/ TDH = 68 FT)
SEE THE FOLLOWING FOR HEAD/DISCHARGE CHART

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CASE 3 SYSTEM HEAD - DISCHARGE

	FLOW (GPM)	VELOCITY (FT/SEC)	FRICTION LOSS (h_L) IN PIPE (FT)	TDH (STATIC + FRICTION LOSS) (FT)	
	250	2.84	29	62	
*	275	3.13	34.6	67.6	*
	300	3.41	40.7	73.7	
	325	3.69	47.2	80.2	
	350	3.98	54.1	87.1	

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WET WELL: USING A 6-FOOT DIAM. LIFT STATION

$$\text{AREA} = \frac{\pi D^2}{4} = \frac{\pi (6')^2}{4} = 28.27 \text{ SF}$$

$$\text{VOLUME} = \frac{28.27 \text{ SF}}{\text{FT DEPTH}} \times \frac{7.48 \text{ GAL}}{1 \text{ CF}} = 211.5 \text{ GAL/FT DEPTH}$$

$8' \Rightarrow 50.3 \text{ CF/FT} \Rightarrow 376 \text{ GAL/FT}$

PER 10 STATES STDS, STORAGE REQ'D IS BASED ON AVG DAILY FLOW

$$\text{MAX STORAGE ALLOW.} = \frac{68 \text{ GPM} \times 30 \text{ MIN}}{211.5 \text{ GAL/FT DEPTH}} = 9.6 \text{ FT} \Rightarrow \text{SAY } 7 \text{ FT}$$

- USE SMALLER STORAGE, SAY 7' IN 6'ϕ MH AND CHECK PUMP CYCLE TIMES @ FULL BUILD AND INITIAL CONDITION

$$\text{VOL} = 211.5 \text{ GAL/FT} \times 7' = \underline{1{,}481} \text{ GALLONS STORAGE}$$

- AT INITIAL COND, $Q_{PEAK} = 105 \text{ RM} \times 110 \text{ GPD/RM} \times 4 = 46{,}200 \text{ GPD}$
  (ONE HOTEL ONLY) $= 32 \text{ GPM}$

$$\text{TIME TO FILL} = \frac{1{,}481 \text{ GALLONS}}{32 \text{ GPM}} = 59.5 \text{ MIN (AT PEAK)}$$

$$\text{CYCLES PER DAY} = \frac{11{,}550 \text{ GPD } (105 \times 110 \text{ GPD/RM})}{1{,}481 \text{ GAL}} = \boxed{7} \text{ CYCLES/DAY}$$

(1 cyle / 4 hrs ±)

- AT FULL BUILD OUT, $Q_{PEAK} = 221 \text{ GPM}$

$$\text{TIME TO FILL} = \frac{1{,}481 \text{ GALLONS}}{221 \text{ GPM}} = 6.7 \text{ MINUTES}$$

$$\text{CYCLES PER DAY} = \frac{97{,}700 \text{ GPD}}{1{,}481 \text{ GAL}} = 66 \text{ CYCLES/DAY TOTAL}$$

2.75 CYCLES/HOUR

- PUMP RUN TIME @ PEAK - FULL BUILD

- $\underset{(\text{FILL})}{221 \text{ GPM}} - \underset{(\text{PUMP})}{275 \text{ GPM}} = -54 \text{ GPM} \quad \frac{1{,}481}{54} = 27.4 \text{ MIN.}$

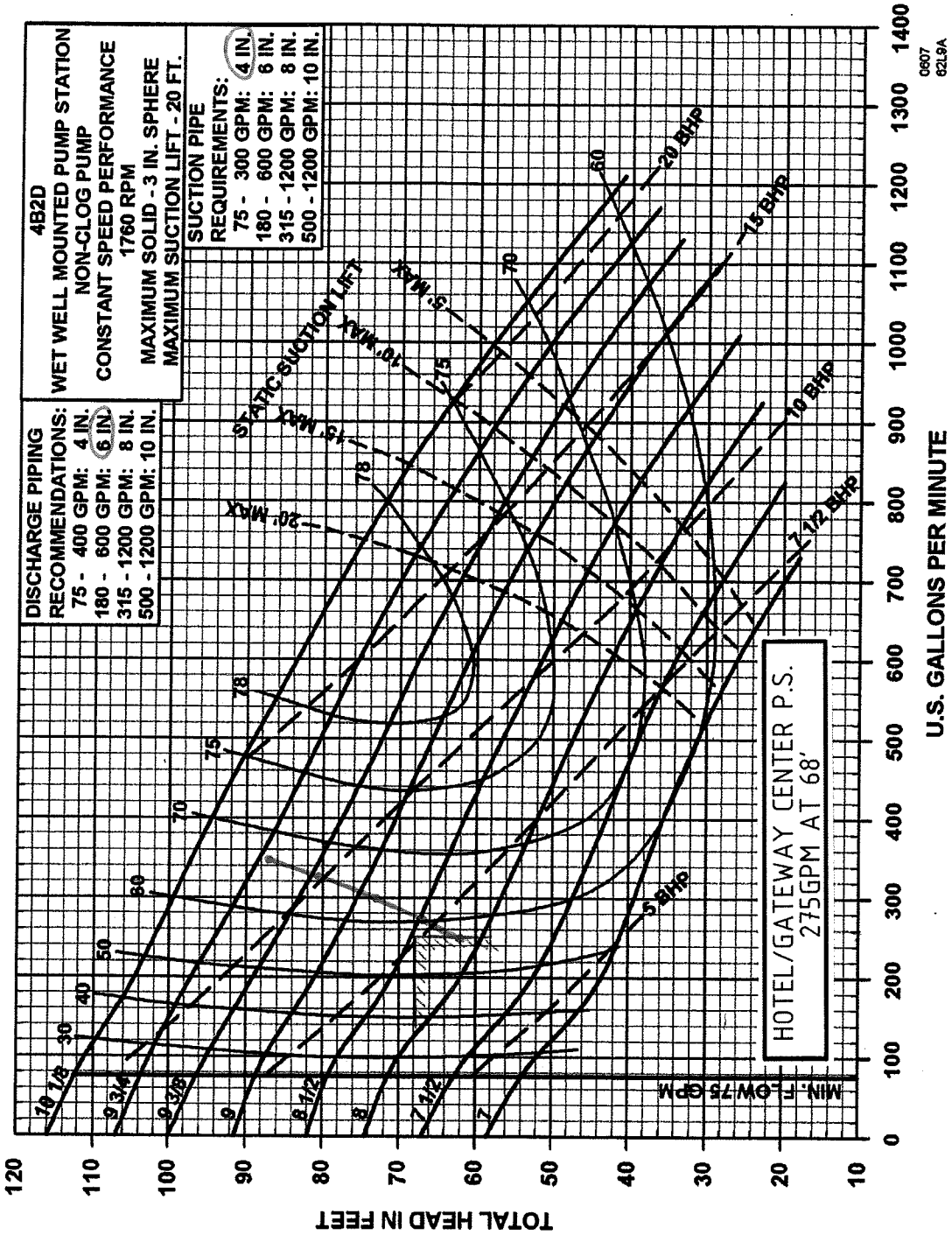
Printed on recycled paper

ENGINEERING DATA

Smith & Loveless, inc.®

14040 West Santa Fe Trail Drive
Lenexa, Kansas 66215-1284

Vacuum Primed Pump
Performance Curve 62L9
Constant Speed
Non-Clog Pump
4B2D – 1760 RPM
July, 2012



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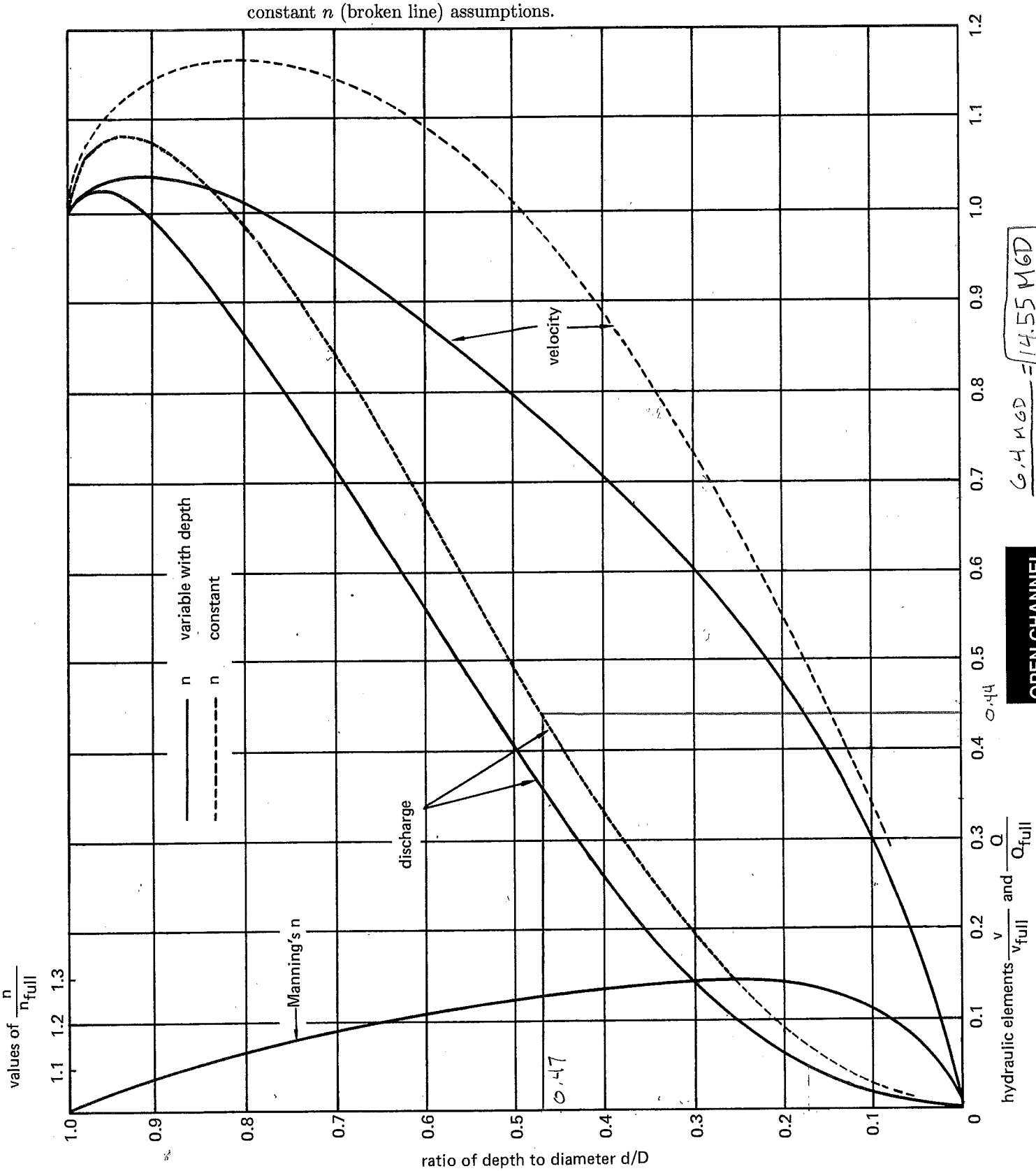
Appendix C: Circular Channel Ratios

Experiments have shown that n varies slightly with depth. This figure gives velocity and flow rate ratios for varying n (solid line) and constant n (broken line) assumptions.



$\frac{6.4 \text{ MGD}}{.44} = \boxed{14.55 \text{ MGD}}$

$\frac{14.07''}{30''}$

OPEN CHANNEL

APPENDIX C

DOWNSTREAM SANITARY SEWER ROUTING AND FLOW MONITORING

2015 Flow Measurement @ Havenwood MH

Date	NODE 1			NODE 2			NODE 3			Rain[2]
	1197 Whitehaven Rd (8")			1563 Whitehaven Rd (24")			239 Havenwood (30")			
	FLOW (GAL x 1000)	PEAK FLOW (MGD)	PEAK LEVEL (IN)	FLOW (GAL x 1000)	PEAK FLOW (MDG)	PEAK LEVEL (IN)	FLOW (GAL x 1000)	PEAK FLOW (MGD)	PEAK LEVEL (IN)	(inches)
03/30/15	0.175	0.016	0.568	248.735	0.696	26.456	1930.073	4.738	11.661	***0.19***
03/31/15	0.042	0.004	0.247	423.417	0.583	24.023	2516.900	4.307	11.262	***0***
04/01/15	0.000	0.000	0.000	440.141	0.721	22.559	2140.855	2.753	8.423	***0***
04/02/15	0.000	0.000	0.000	486.272	0.944	27.246	2490.588	4.900	11.990	***0.28***
04/03/15	0.000	0.000	0.000	642.456	0.944	26.589	3513.664	4.926	12.016	***0.37***
04/04/15	0.000	0.000	0.000	642.973	0.932	26.895	3428.263	4.755	11.717	***0.04***
04/05/15	0.103	0.005	0.372	391.112	0.700	22.193	2036.519	2.612	8.239	***0.03***
04/06/15	0.000	0.000	0.000	357.077	0.578	21.071	1702.195	2.025	7.189	***0***
04/07/15	0.024	0.002	0.262	318.927	0.662	20.342	1476.947	1.837	6.821	***0***
04/08/15	0.033	0.003	0.323	641.415	1.123	27.170	3479.248	4.904	11.786	***0.41***
04/09/15	0.103	0.010	0.522	547.989	0.918	26.211	3524.214	4.528	11.419	***0.22***
04/10/15	0.208	0.018	0.755	744.320	1.182	28.233	4035.376	6.403	14.074	***0.2***
04/11/15	0.000	0.000	0.000	452.547	0.740	22.278	2042.088	2.570	8.042	***0.01***
04/12/15	0.422	0.012	0.932	346.441	0.713	21.483	1584.225	2.005	6.861	***0***
04/13/15	0.000	0.000	0.000	346.152	0.618	22.938	1395.421	2.677	8.201	***0.27***
04/14/15	0.000	0.000	0.000	381.861	0.588	20.876	1463.192	2.055	7.196	***0***
04/15/15	0.000	0.000	0.000	266.109	0.513	20.134	1160.033	1.568	6.097	***0***
04/16/15	0.000	0.000	0.000	271.783	0.505	21.117	1088.621	1.862	6.903	***0.13***
04/17/15	0.000	0.000	0.000	386.769	0.678	22.884	1801.937	2.493	8.069	***0.17***
04/18/15	0.172	0.013	0.536	282.757	0.544	21.025	1270.492	1.649	6.171	***0***
04/19/15	0.034	0.003	0.225	254.863	0.601	20.400	1085.022	1.433	5.702	***0.1***
04/20/15	0.175	0.008	0.379	641.312	1.117	26.781	3563.885	4.495	11.218	***0.39***
04/21/15	0.052	0.005	0.291	517.157	0.807	23.761	2017.278	3.088	8.928	***0***
04/22/15	0.000	0.000	0.000	349.418	0.770	21.111	1322.994	1.753	6.286	***0.05***
04/23/15	0.000	0.000	0.000	284.786	0.527	20.217	1090.591	1.467	5.419	***0***
04/24/15	0.000	0.000	0.000	294.857	0.506	19.882	931.075	1.288	5.058	***0***
04/25/15	0.000	0.000	0.000	242.158	0.513	19.855	938.133	1.306	5.248	***0***
04/26/15	0.000	0.000	0.000	269.358	0.647	19.620	929.086	1.367	5.411	***0***
04/27/15	0.158	0.015	0.658	218.496	0.598	18.960	835.563	1.114	4.841	***0.03***
04/28/15	0.029	0.003	0.254	240.738	0.455	19.378	788.647	1.143	4.858	***0***
04/29/15	0.000	0.000	0.000	38.345	0.521	19.086	792.784	1.113	4.877	***0***
04/30/15	0.000	0.000	0.000	0.000	0.000	19.095	745.751	1.149	4.880	***0***
---	---	---	---	---	---	---	---	---	---	***2.89***

Note: Rain data from: http://www.nws.noaa.gov/climate/index.php?wfo=buf

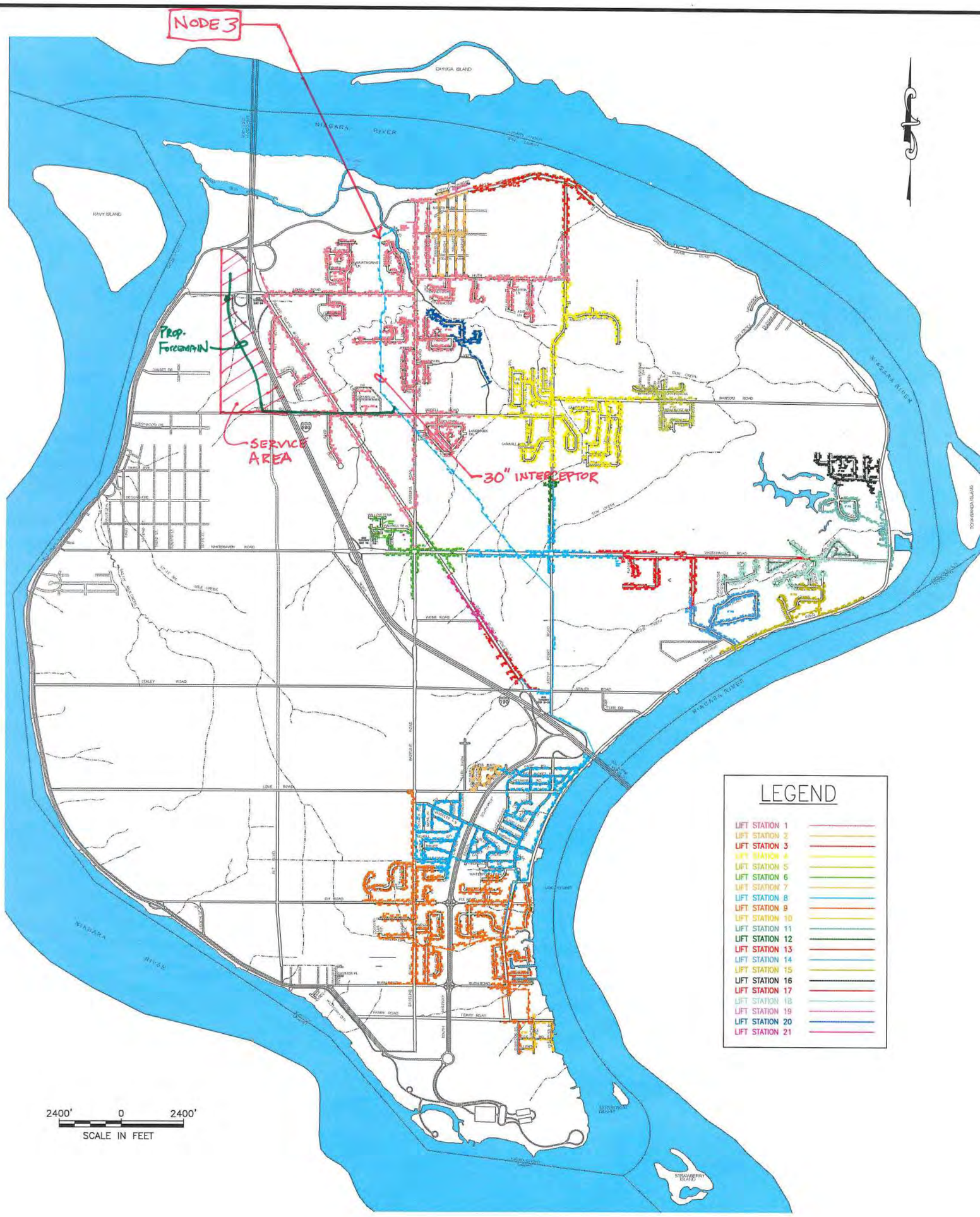
2015 Flow Measurement @ Havenwood MH

Date	NODE 1			NODE 2			NODE 3			Rain[2]
	1197 Whitehaven Rd (8")			1563 Whitehaven Rd (24")			239 Havenwood (30")			
	FLOW (GAL x 1000)	PEAK FLOW (MGD)	PEAK LEVEL (IN)	FLOW (GAL x 1000)	PEAK FLOW (MDG)	PEAK LEVEL (IN)	FLOW (GAL x 1000)	PEAK FLOW (MGD)	PEAK LEVEL (IN)	(inches)
05/01/15	0.000	0.000	0.000	41.890	0.407	19.151	712.947	1.122	4.897	*0*
05/02/15	0.000	0.000	0.000	91.505	0.391	19.522	773.978	1.197	5.019	*0*
05/03/15	0.311	0.030	0.896	80.059	0.088	19.522	754.876	1.189	4.922	*0*
05/04/15	0.057	0.003	0.319	79.128	0.086	18.963	692.294	0.981	4.417	*0*
05/05/15	0.512	0.011	0.511	79.313	0.088	19.354	679.597	1.144	4.899	*0.08*
05/06/15	0.000	0.000	0.000	104.579	0.577	19.184	723.142	1.096	4.721	*0*
05/07/15	0.000	0.000	0.000	79.099	0.088	19.410	666.692	1.028	4.546	*0*
05/08/15	0.007	0.001	0.235	78.460	0.087	19.131	643.092	1.003	4.473	*0*
05/09/15	0.000	0.000	0.000	79.880	0.087	19.075	677.718	1.016	4.666	*0*
05/10/15	0.088	0.008	0.361	265.626	0.514	19.812	740.085	1.250	5.077	*0.1*
05/11/15	0.318	0.031	0.937	81.860	0.102	25.556	812.534	3.666	9.722	*0.49*
05/12/15	0.000	0.000	0.000	89.313	0.102	25.053	1358.412	3.613	9.696	*0*
05/13/15	0.032	0.003	0.239	131.835	0.685	19.913	458.849	1.091	4.697	*0*
										0
---	---	---	---	---	---	---	---	---	---	*0.67*

Note: Rain data from: http://www.nws.noaa.gov/climate/index.php?wfo=buf

30" Gravity Flow @ GI WWTP April 2015

Apr-15	FLOW	PRECIP	Min GPM	Max GPM	Max MGD
1	2,019,365	0.00	1300	2200	3.168
2	2,238,691	0.28	1200	1700	2.448
3	3,680,677	0.16	2600	4400	6.336
4	3,123,179	0.01	1400	2900	4.176
5	1,894,269	0.00	1100	1600	2.304
6	1,571,880	0.00	900	1200	1.728
7	1,364,043	0.00	750	1100	1.584
8	3,111,377	0.50	700	2800	4.032
9	3,899,421	0.12	2400	2600	3.744
10	3,873,316	0.58	2700	3100	4.464
11	3,345,778	0.00	1700	2600	3.744
12	2,110,692	0.00	1100	2000	2.88
13	1,370,950	0.14	750	1600	2.304
14	1,448,482	0.00	600	1100	1.584
15	1,397,085	0.00	600	1300	1.872
16	1,106,379	0.10	450	950	1.368
17	1,831,219	0.08	900	1700	2.448
18	1,360,892	0.00	750	1200	1.728
19	1,190,361	0.03	800	1000	1.44
20	3,521,430	0.75	800	2900	4.176
21	2,911,274	0.00	1500	2400	3.456
22	1,803,452	0.07	700	1200	1.728
23	1,226,562	0.00	700	1100	1.584
24	1,079,756	0.00	650	1000	1.44
25	1,069,448	0.00	550	1000	1.44
26	1,041,156	0.00	600	900	1.296
27	922,196	0.00	450	800	1.152
28	887,122	0.00	400	800	1.152
29	882,506	0.00	350	1000	1.44
30	849,231	0.00	350	800	1.152



JOHN C. WHITNEY, P.E.
TOWN ENGINEER
N.Y.S. LICENSE NO. 66900

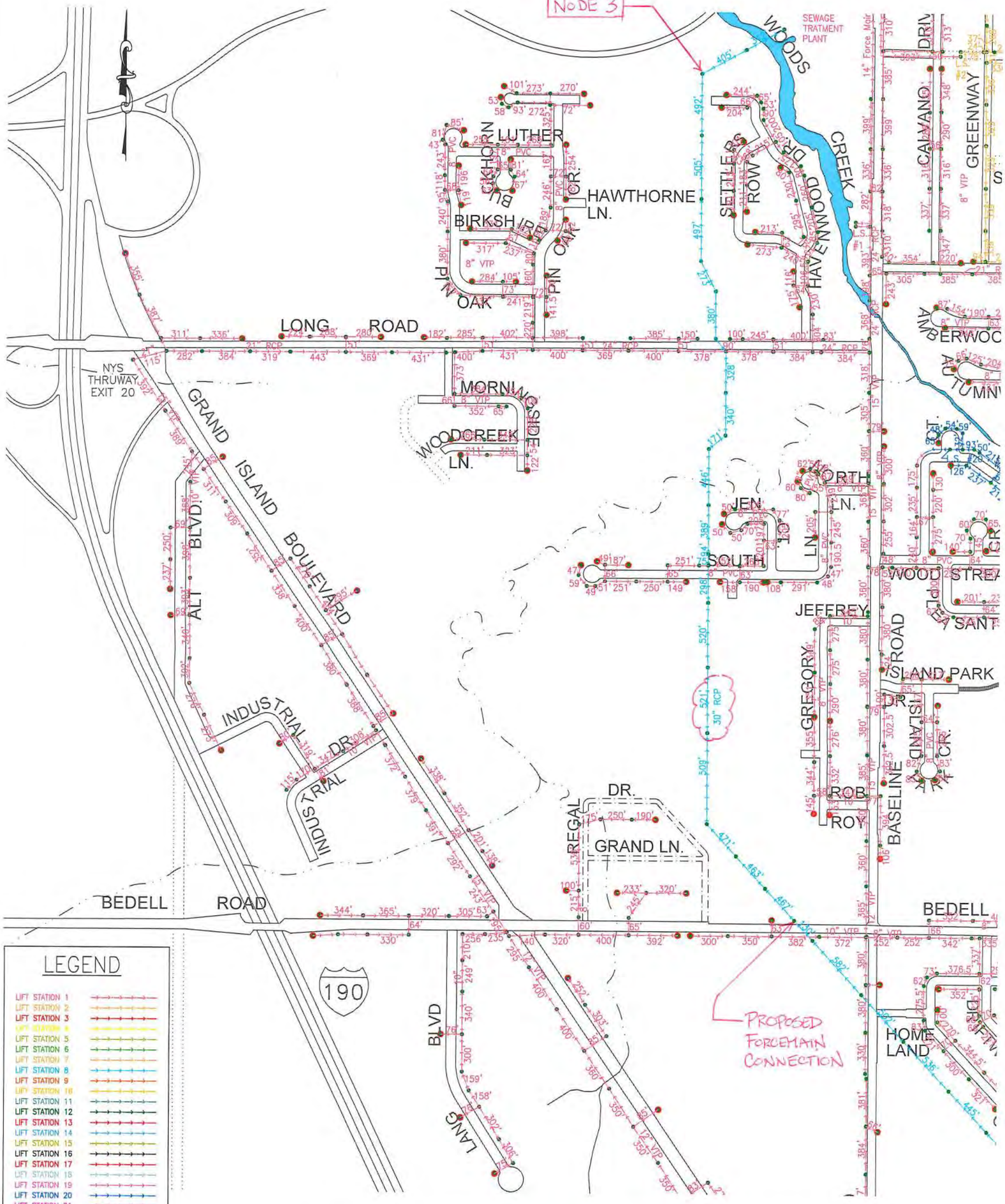
TOWN OF GRAND ISLAND
ENGINEERING DEPT.
2255 BASELINE RD,
GRAND ISLAND, NY 14072

No.	REVISION	DATE

ANY ALTERATION OR ADDITION TO SURVEY DRAWING DESIGN SPECIFICATION PLAN OR REPORT IS IN VIOLATION OF SECTION 720B PROVISION 2 OF THE N.Y.S. EDUCATION LAW.

JOB NAME:	SANITARY FLOW
DRAWING NAME:	GRAND ISLAND SANITARY FLOW DIRECTIONS
DESIGNED:	DATE:
DRAWN: KPL	DATE: 07/23/
CHECKED:	DATE:
APPROVED:	DATE:
JOB No.	SHEET: COVER

S:\Engineering\CAD\Misc Projects\Infrastructure\SANITARY FLOW DIRECTIONS\ACAD-Infrastructure Schematic FLOW DIRECTIONS-2007.dwg



LEGEND

- LIFT STATION 1
- LIFT STATION 2
- LIFT STATION 3
- LIFT STATION 4
- LIFT STATION 5
- LIFT STATION 6
- LIFT STATION 7
- LIFT STATION 8
- LIFT STATION 9
- LIFT STATION 10
- LIFT STATION 11
- LIFT STATION 12
- LIFT STATION 13
- LIFT STATION 14
- LIFT STATION 15
- LIFT STATION 16
- LIFT STATION 17
- LIFT STATION 18
- LIFT STATION 19
- LIFT STATION 20
- LIFT STATION 21

500' 0 500'
SCALE IN FEET

JOHN C. WHITNEY, P.E.
TOWN ENGINEER
N.Y.S. LICENSE NO. 66900

TOWN OF GRAND ISLAND
ENGINEERING DEPT.
2255 BASELINE RD,
GRAND ISLAND, NY 14072

No.	REVISION	DATE

ANY ALTERATION OR ADDITION TO SURVEY DRAWING DESIGN SPECIFICATION PLAN OR REPORT IS IN VIOLATION OF SECTION 720B PROVISION 2 OF THE N.Y.S. EDUCATION LAW.

JOB NAME: SANITARY FLOW

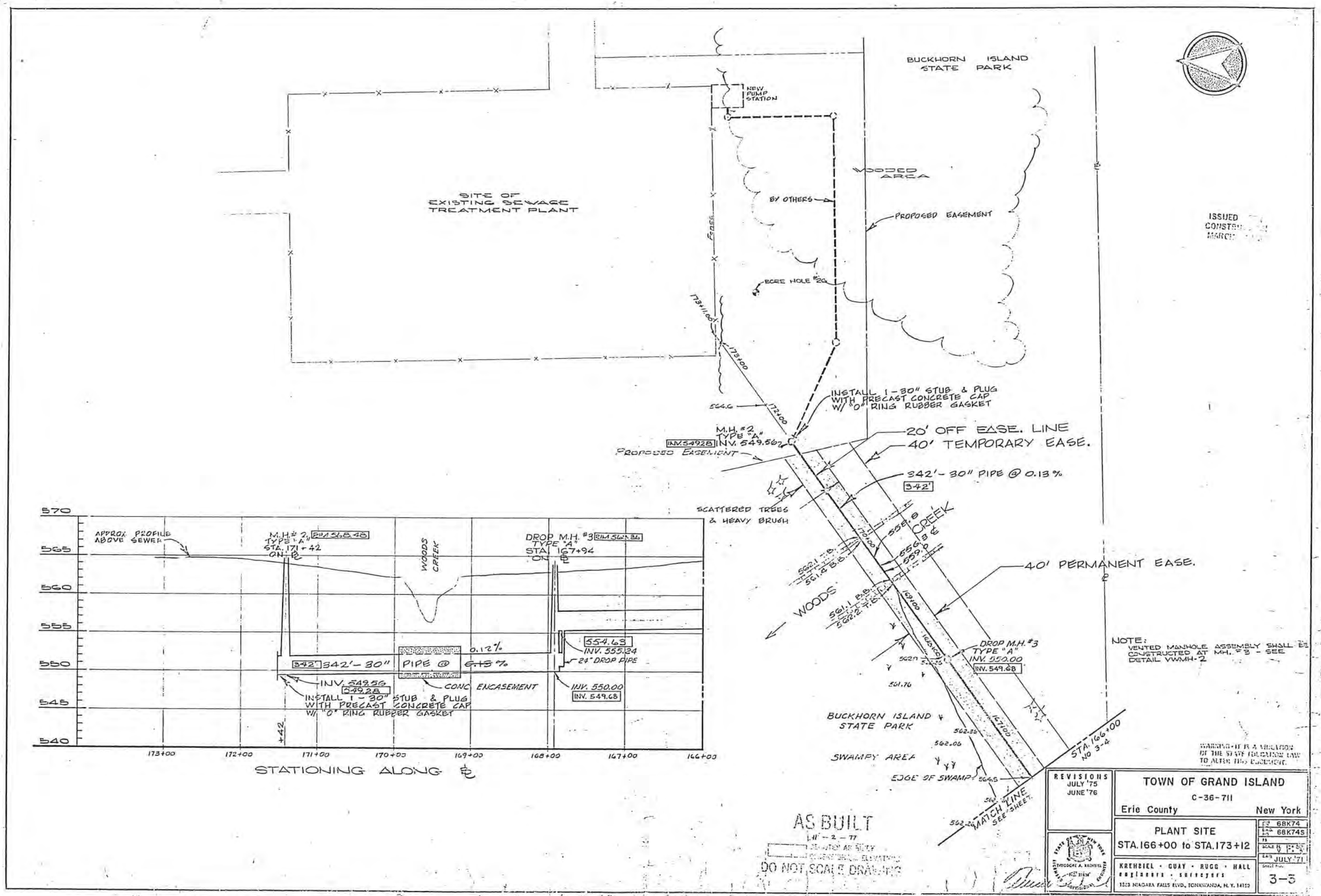
DRAWING NAME: GRAND ISLAND SANITARY FLOW DIRECTIONS

DESIGNED:		DATE:	
DRAWN:	KPL	DATE:	07/23/10
CHECKED:		DATE:	
APPROVED:		DATE:	
JOB No.		SHEET:	1 OF 8

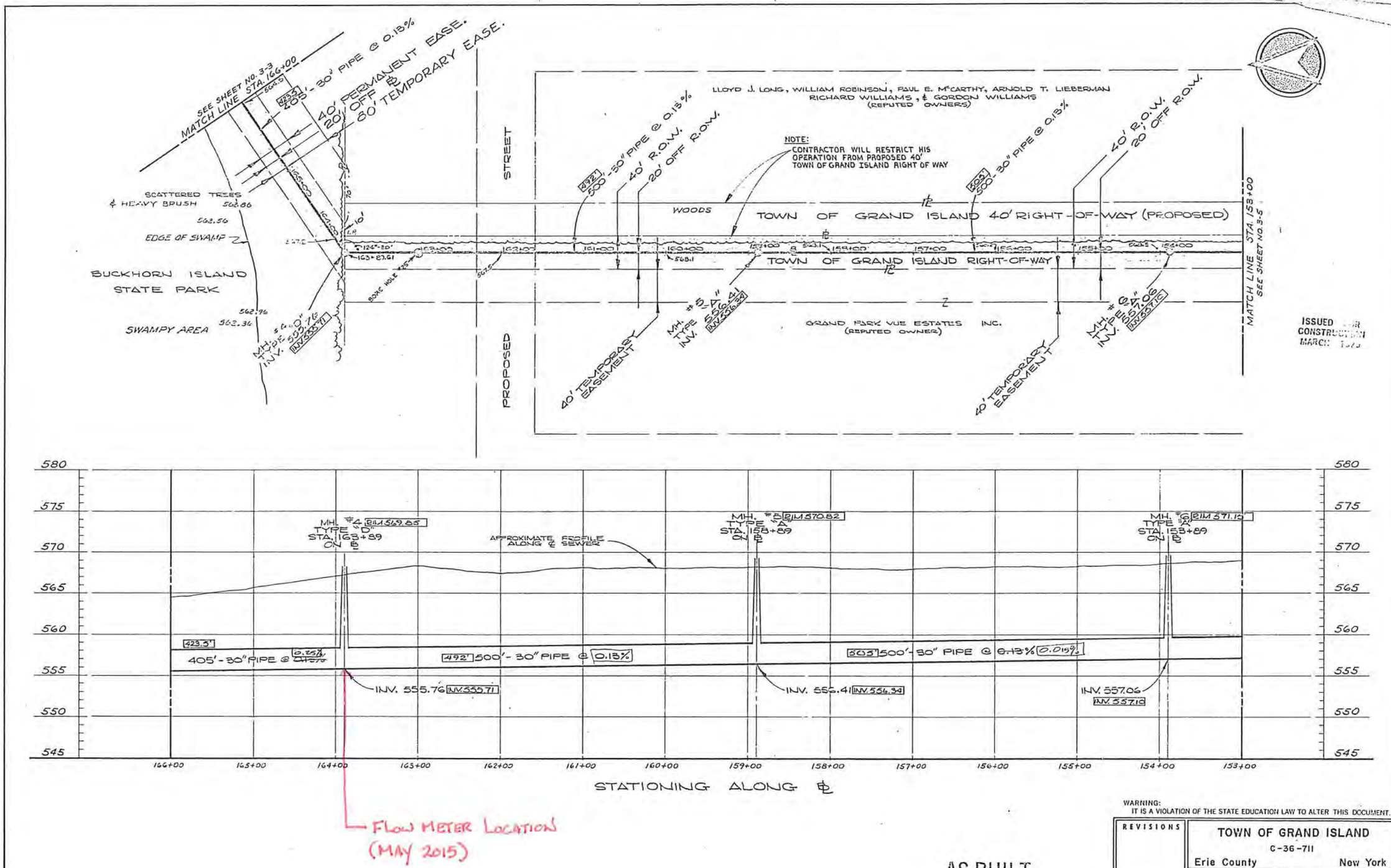
S:\Engineering\CAD\Misc Projects\Infrastructure\SANITARY FLOW DIRECTIONS\ACAD-Infrastructure Schematic FLOW DIRECTIONS-2007.dwg

APPENDIX D

30” INTERCEPTOR SEWER
AS-BUIT DRAWINGS



BUCKHORN ISLAND STATE PARK
NEW PUMP STATION
WOODED AREA
SITE OF EXISTING SEWAGE TREATMENT PLANT
BY OTHERS
PROPOSED EASEMENT
ECRE HOLE #26
INSTALL 1-30" STUB & PLUG WITH PRECAST CONCRETE CAP W/ "O" RING RUBBER GASKET
M.H. #2 TYPE "A" INV. 549.56
INV. 549.28
PROPOSED EASEMENT
20' OFF EASE. LINE
40' TEMPORARY EASE.
342'-30" PIPE @ 0.13%
342'
SCATTERED TREES & HEAVY BRUSH
CREEK
40' PERMANENT EASE.
WOODS
DROP M.H. #3 TYPE "A" INV. 550.00
INV. 549.68
BUCKHORN ISLAND STATE PARK
SWAMPY AREA
EDGE OF SWAMP
MATCH LINE SEE SHEET
STA. 166+00 NO 3-4
NOTE: VENTED MANHOLE ASSEMBLY SHALL BE CONSTRUCTED AT MH. #3 - SEE DETAIL VWMH-2
APPROX PROFILE ABOVE SEWER
M.H. #2 TYPE "A" STA. 171+42 ON ℄
RIM 568.48
WOODS CREEK
DROP M.H. #3 TYPE "A" STA. 167+94 ON ℄
RIM 563.36
554.63
INV. 555.24
24" DROP PIPE
342' 342'-30" PIPE @ 0.13%
0.12%
INV. 549.56
549.28
CONC ENCASEMENT
INV. 550.00
INV. 549.68
INSTALL 1-30" STUB & PLUG WITH PRECAST CONCRETE CAP W/ "O" RING RUBBER GASKET
570
565
560
555
550
545
540
173+00
172+00
171+00
170+00
169+00
168+00
167+00
166+00
STATIONING ALONG ℄
AS BUILT
DO NOT SCALE DRAWING
REVISIONS JULY '75 JUNE '76
TOWN OF GRAND ISLAND
C-36-711
Erie County
New York
PLANT SITE
STA. 166+00 to STA. 173+12
68K74
68K74S
JULY '71
KREHBIEL · GUAY · RUGG · HALL
engineers · surveyors
1503 NIAGARA FALLS BLVD., TONAWANDA, N.Y. 14150
3-3
9-2-41

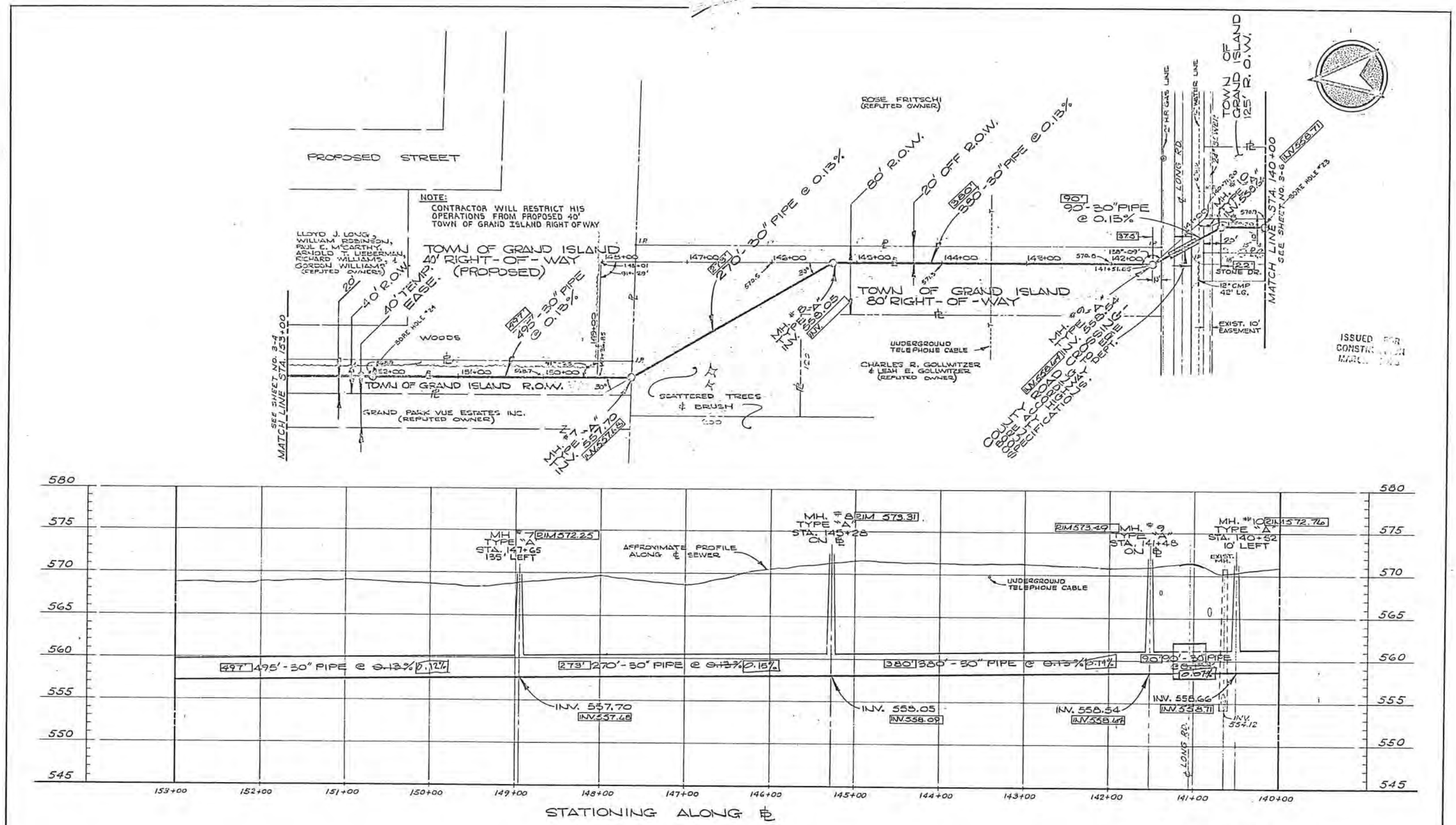


AS BUILT
11-2-77
DENOTES AS BUILT DIMENSIONS & ELEVATIONS
DO NOT SCALE DRAWING

WARNING:
IT IS A VIOLATION OF THE STATE EDUCATION LAW TO ALTER THIS DOCUMENT.

REVISIONS	TOWN OF GRAND ISLAND C-36-711 Erie County New York	
	GRAND ISLAND R.O.W. STA. 153+00 to STA. 166+00	68K74 68K74S JULY '75
	KRENBIEL · GUAY · RUGG · HALL engineers · surveyors 1853 NIAGARA FALLS BLVD., TONAWANDA, N.Y. 14150	3-4

9-2-40



WARNING:
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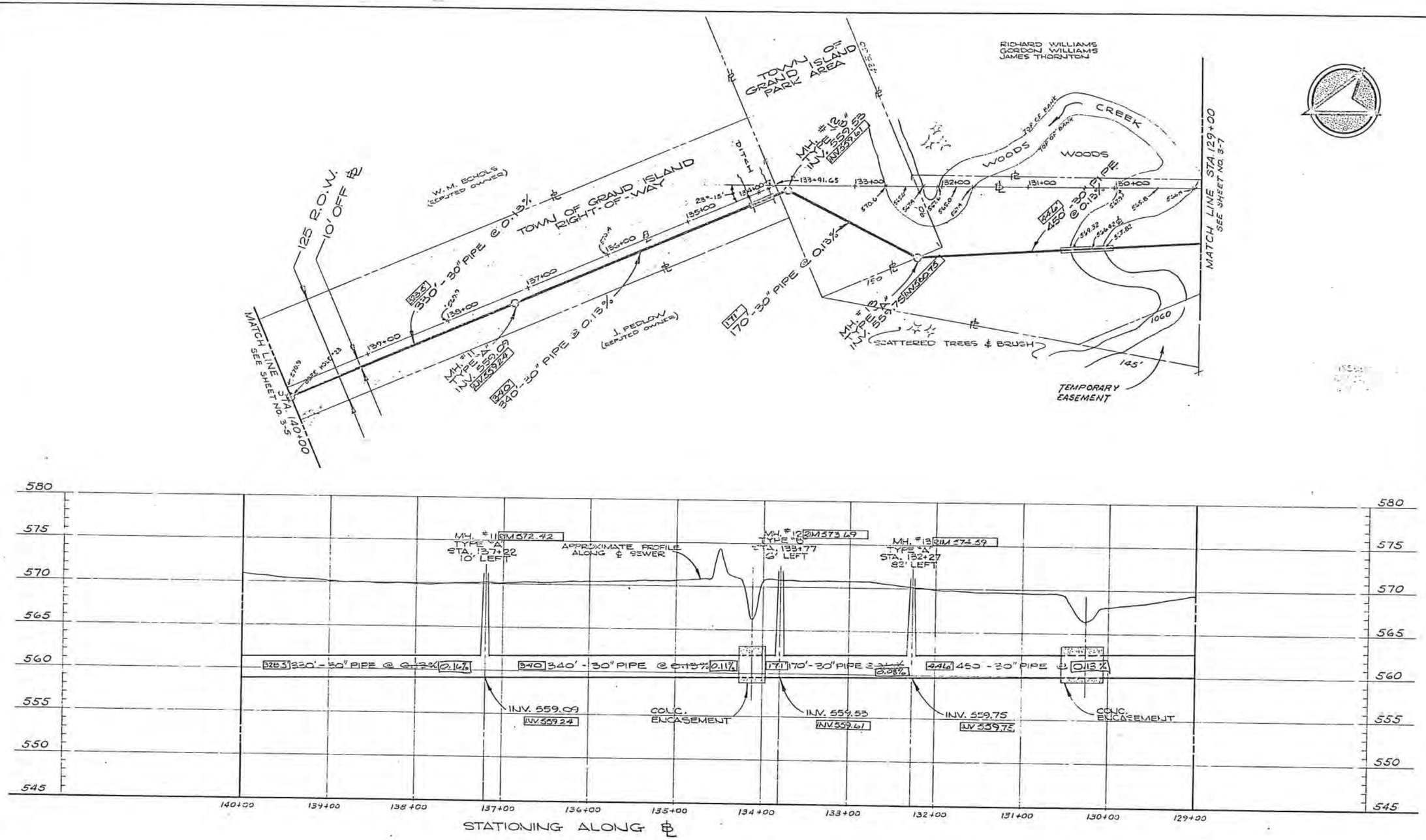
AS BUILT
11-2-77
DENOTES AS BUILT DIMENSIONS & ELEVATIONS
DO NOT SCALE DRAWING

REVISIONS	TOWN OF GRAND ISLAND C-36-711 Erie County New York	
	GRAND ISLAND R.O.W. STA. 140+00 to STA. 153+00	JOB NO. 68K74 DWG. NO. 68K74S SCALE H. 1" = 50' V. 1" = 5' DATE JULY '75
	KREHBIEL · GUAY · RUGG · HALL engineers · surveyors 1663 NIAGARA FALLS BLVD., TONAWANDA, N.Y. 14150	SHEET NO. 3-5

9-2-39



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11-2-77
DENOTES AS BUILT DIMENSIONS & ELEVATIONS
DO NOT SCALE DRAWING

REVISIONS

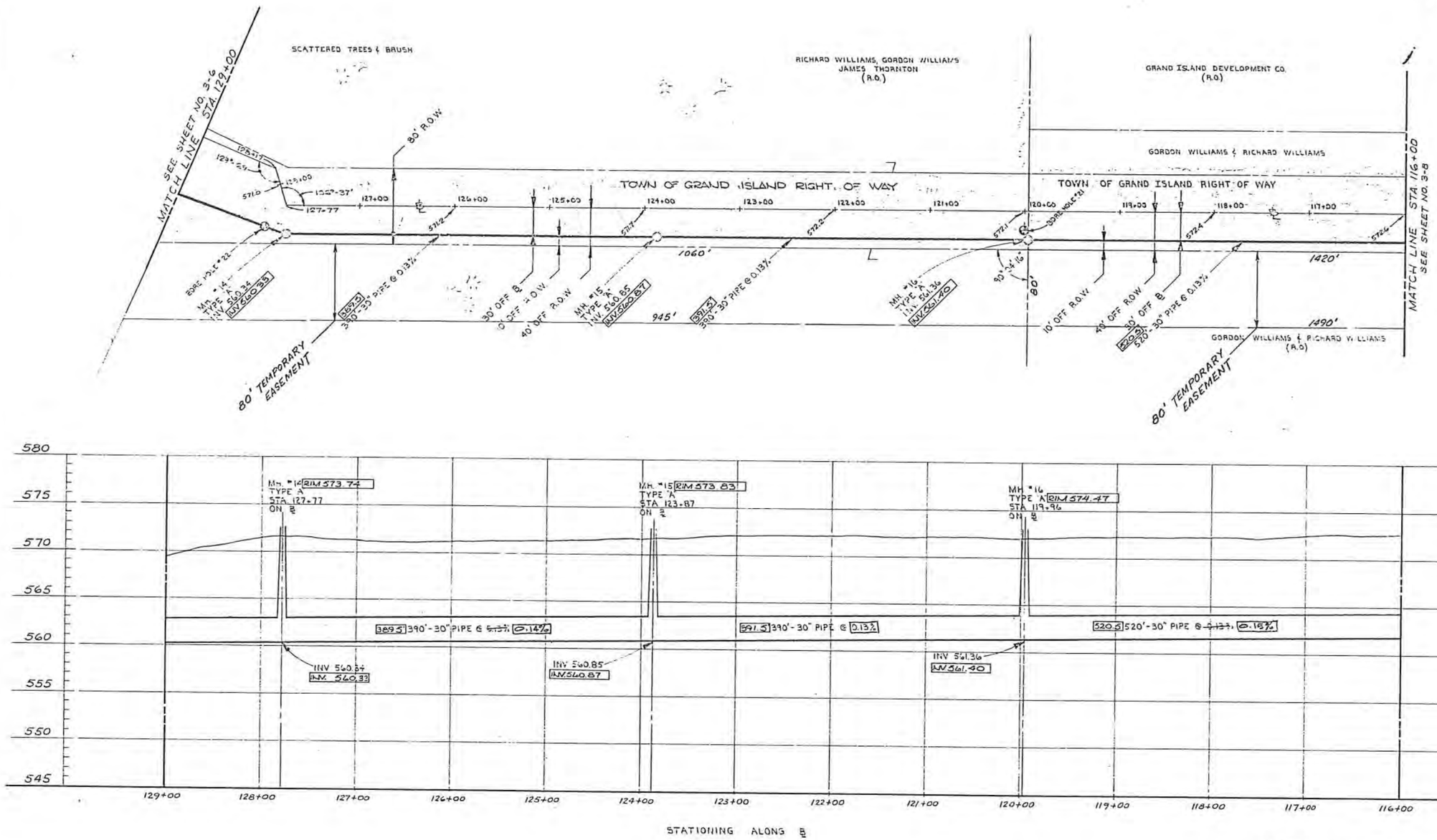
TOWN OF GRAND ISLAND
C-36-711
Erie County New York

GRAND ISLAND R.O.W.
STA. 129+00 to STA. 140+00

KREHBIEL · GUAY · RUGG · HALL
engineers · surveyors
1868 NIAGARA FALLS BLVD., TONAWANDA, N.Y. 14150

68K74
68K74S
SCALE H. 1"=50' V. 1"=5'
DATE JULY '75
SHEET NO. 3-6

9-2-38



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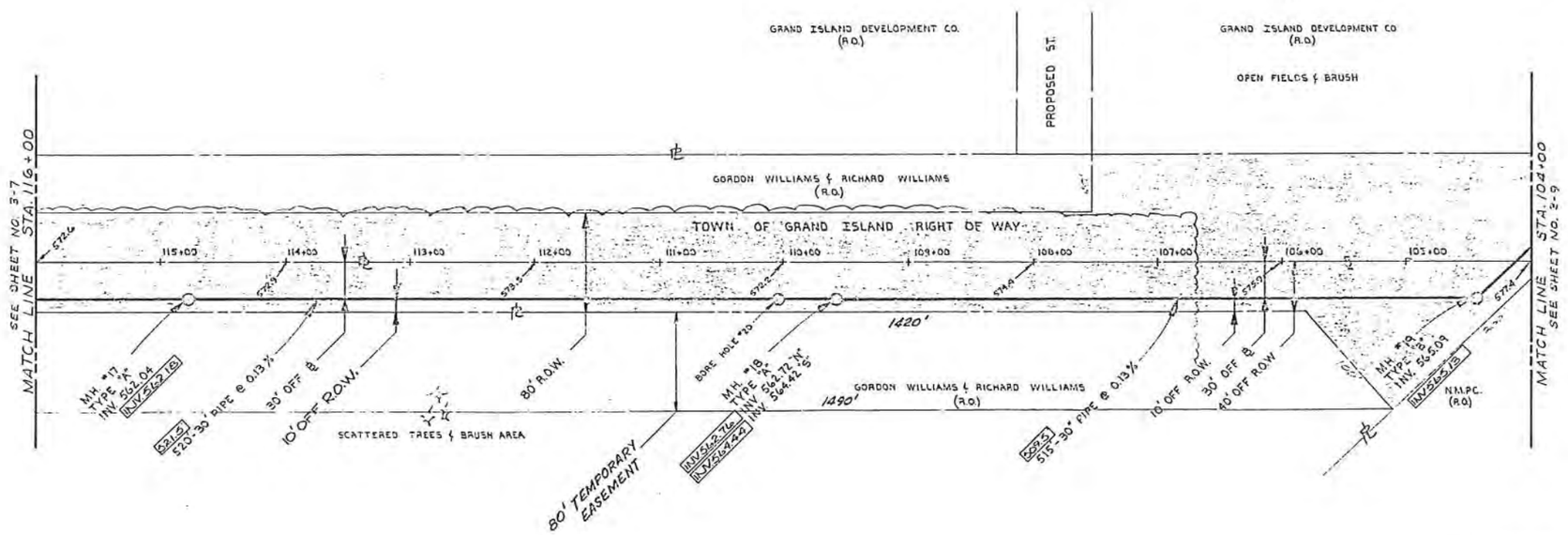
AS BUILT
11-2-77
DEPICTES AS BUILT DIMENSIONS & ELEVATIONS
DO NOT SCALE DRAWING

REVISIONS	TOWN OF GRAND ISLAND C-36-711 Erie County New York	
	GRAND ISLAND R.O.W. STA. 116+00 to STA. 129+00	JOB NO. 68K74 DWG. NO. 68K74S SCALE H. 1"=60' V. 1"=8' DATE JULY '75
	KREHBIEL · GUAY · RUGG · HALL engineers · surveyors 1868 NIAGARA FALLS BLVD., TONAWANDA, N.Y. 14153	SHEET NO. 3-7

9-2-37

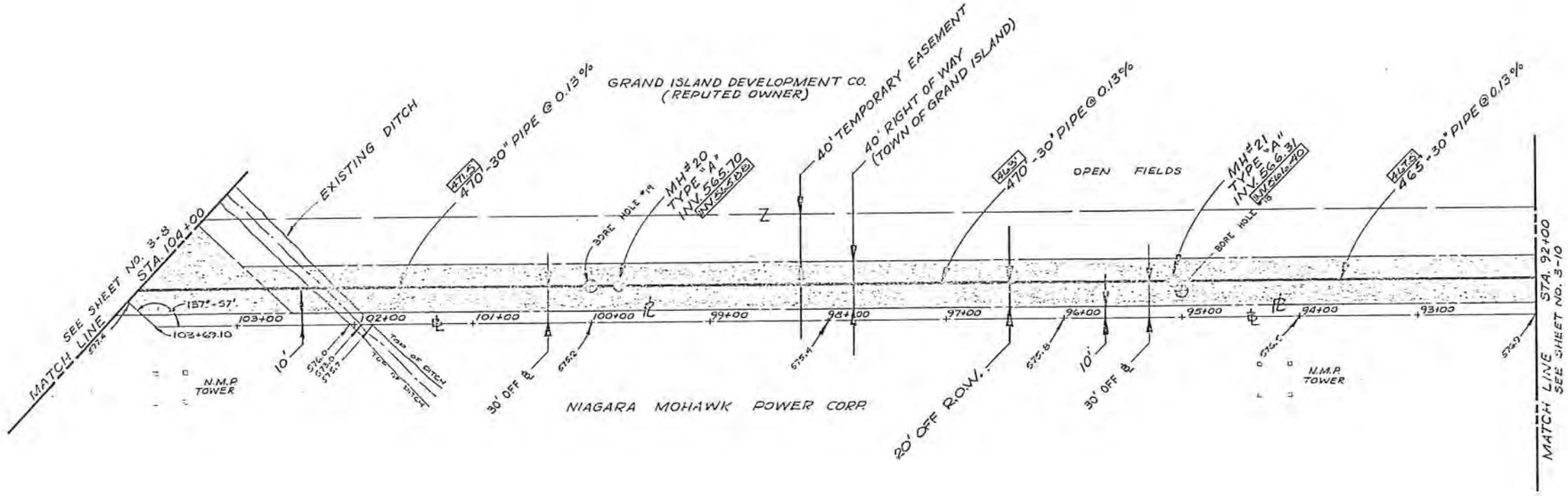


WARNING:
IT IS A VIOLATION OF THE STATE EDUCATION LAW TO ALTER THIS DOCUMENT.

AS BUILT
11-2-77
DENOTES AS BUILT
DIMENSIONS & ELEVATIONS
DO NOT SCALE DRAWING

REVISIONS	TOWN OF GRAND ISLAND C-36-711 Erie County New York	
	GRAND ISLAND R.O.W. STA. 104+00 to STA. 116+00	C.S. 68K74 DWG. NO. 68K74S SCALE H. 1"=50' V. 1"=5' DATE JULY '75
	KREHBIEL · GUAY · RUGG · HALL engineers · surveyors 1868 NIAGARA FALLS BLVD., TONAWANDA, N.Y. 14150	SHEET NO. 3-8

19-2-36



WARNING:
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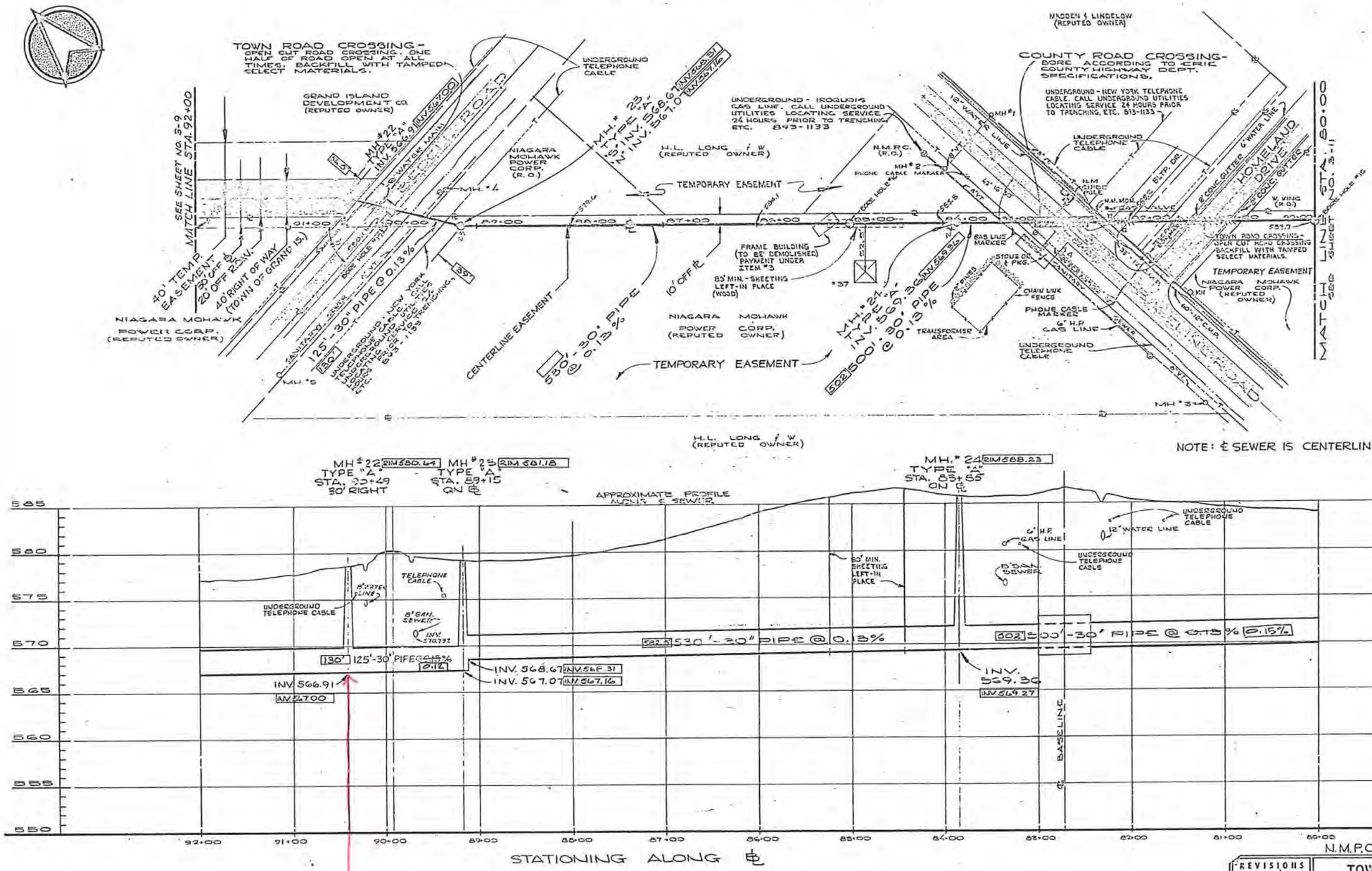
AS BUILT
11-2-77
DENOTES AS BUILT DIMENSIONS & ELEVATIONS
DO NOT SCALE DRAWING

REVISIONS	TOWN OF GRAND ISLAND C-36-711 Erie County New York	
	GRAND ISLAND R.O.W. STA. 92+00 to STA. 104+00	68K74 68K74S SCALE H. 1"=50' DATE JULY '75
	KREHBIEL · GUAY · RUGG · HALL engineers · surveyors 1868 NIAGARA FALLS BLVD., TONAWANDA, N.Y. 14150	SHEET NO. 3-9

19-2-35

NIAGARA MOHAWK EASEMENT

ISSUED FOR CONSTRUCTION MARCH 1976



N.M.P.C. EASEMENT MAP (SAVE)

AS BUILT
11-2-77
DENOTES AS BUILT DIMENSIONS & ELEVATIONS
DO NOT SCALE DRAWING

WARNING - IT IS A VIOLATION OF THE STATE EDUCATION LAW TO ALTER THIS DOCUMENT.

REVISIONS JULY '75 JAN. 14, 1976 (EASEMENT)	TOWN OF GRAND ISLAND C-36-711 Erie County New York
	NIAGARA MOHAWK EASEMENT STA. 80+00 to STA. 92+00
	KREHBIEL · QUAY · RUGG · HALL engineers · surveyors 1223 NIAGARA FALLS BLVD., TONAWANDA, N.Y. 14150
	DWG. 68K74 SUB. 68K74S SCALE 1" = 100' DATE JULY '71 SHEET NO. 3-10

9-2-34

APPENDIX E

CORRESPONDENCE/MISC.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
APPLICATION FOR APPROVAL OF PLANS FOR A WASTEWATER DISPOSAL SYSTEM

1. NAME OF APPLICANT	2. LOCATION OF WORKS (City, Village, Town)	3. COUNTY
TOWN OF GRAND ISLAND	GRAND ISLAND	ERIE

4. ENTITY OR AREA SERVED

5. TYPE OF OWNERSHIP
- ☒ Municipal
- ☐ Industrial
- ☐ Commercial
- ☐ Sewage Works Corp
- ☐ Private - Home
- ☐ Private – Other
- ☐ Private – Institutional
- ☐ Board of Education
- ☐ Authority
- ☐ Federal
- ☐ State
- ☐ Interstate
- ☐ International
- ☐ Indian Reservation

6. TYPE AND NATURE OF CONSTRUCTION

Collection System
- ☒ New
- ☐ Additions or Alterations

Treatment and/or Disposal
- ☐ New
- ☐ Additions or Alterations

7. ESTIMATED COST OF CONSTRUCTION

Collection System: $ 750,000

Treatment and/or Disposal: $ N/A

8. TYPE OF WASTE
- ☒ Sewage
- ☐ Industrial (Specify)
- ☐ Other (Specify)

9. NAME OF RECEIVING TREATMENT WORKS
GRAND ISLAND WASTE WATER TREATMENT PLANT

10. POINT OF DISCHARGE
Surface Water: (Name of Watercourse) NIAGARA RIVER — Class IA-SPECIAL

Ground Water: (Name of Watercourse to which ground water is tributary) — Class

11. IS STATE OR FEDERAL AID APPLIED FOR?
- ☐ Yes
- ☒ No

LOCATION (City, Village, Town)	TYPE OF PERMIT	PERMIT NO.	DATE ISSUED
TOWN OF GRAND ISLAND	☐ NYDES ☒ SPDES	27693	8/1/2011

12. NAME OF DESIGN ENGINEER VICTOR O'BRIEN / C&S ENGINEERS, INC.

NEW YORK STATE LICENSE NO. 075818

ADDRESS 141 ELM ST. SUITE 100, BUFFALO, NY 14203

TELEPHONE NO. 716-847-1630

13. WATER CONSUMPTION (GPD)
Present 11,550 — Future 79,662 — Design Year 2017

14. POPULATION SERVED
Present 116 — Future 797 — Design Year 2017

15. AVERAGE DAILY FLOW FOR NEW OR EXISTING TREATMENT WORKS (GPD)
Present 2.91 (2015) — Future 3.5 — Design Year 1979

16. SOURCE OF WATER SUPPLY (if private well; give location, type, depth and character of soil)
MUNICIPAL

17. DESIGN EQUIVALENT POPULATION (BOD Basis)
Design Flow GPD — Design Plant Efficiency %

18. GIVE NUMBER, CHARACTER AND DISTANCE OF ANY BUILDINGS WHICH MAY BE AFFECTED BY THE PROPOSED TREATMENT WORKS
N/A

19. DESCRIBE PROPOSED OR EXISTING STORM WATER DISPOSAL
N/A

ADDITIONAL INFORMATION MUST BE SUBMITTED FOR PRIVATE AND INSTITUTIONAL SYSTEMS.

20. INDICATE OF U.S.G.S. TOPOGRAPHIC MAP EXACT LOCATION OF SEWAGE TREATMENT WORKS AND ADJACENT BUILDINGS. SHOW LOCATION OF ALL WELLS OR OTHER SOURCES OF WATER SUPPLY WITHIN 200' OF THE PROPOSED WORKS. GIVE DESCRIPTION OF THESE SOURCES AND CHARACTER OF SOIL

21. STATE DEPTH BELOW EXISTING GROUND SURFACE AT WHICH GROUND WATER IS ENCOUNTERED

22. DESCRIBE SOIL AT SITE OF PROPOSED WORKS. GIVE DESIGN BASIS AND OBSERVED SOIL PERCOLATION RATE DATA (Use additional sheet, if necessary)

DATE:

RECEIVED
MAY 16 2017
TOWN OF GRAND ISLAND
ENGINEERING DEPT.

BSP-5 (3/75)

NOTE: All applications must be accompanied by plans, specifications and completed Form BSP-65 (appropriate portions). The submission must conform to a previously approved engineering report describing the system in detail. The plans must be stamped with the designing engineer's seal and must be of sufficient clarity and eligibility to permit satisfactory microfilming. Only white prints will be accepted because of the difficulty of microfilming blue prints. There must be a blank area, at least 4" X 7", in the lower right corner of each sheet so that the approval stamp may be placed on the face of the plans.

Any deviation from the Department's standards for wastewater collection and treatment facilities must be explained in detail.

Approved plans are to be returned to: ☒ Applicant ☐ Engineer

If the application is signed by a person other than the applicant shown in Item 1, the application must be accompanied by a letter of authorization. Failure to comply with this provision may be grounds for the rejection of any submission.

I hereby affirm under penalty of perjury that information provided on this form is true to the best of my knowledge and belief. False statements made herein are punishable as a Class A misdemeanor pursuant to Section 210.45 of the Penal Law.

Signatures and Official Titles: John C. Whitney

JOHN C. WHITNEY, P.E.; TOWN ENGINEER

Mailing Address: 2255 BASELINE ROAD, GRAND ISLAND, NY 14072

Date of Application: 5/22/2017

REMARKS:

TECHNICAL REVIEW OF PLANS AND SPECIFICATIONS
FOR SEWAGE AND WASTE TREATMENT SYSTEMS

PROJECT DATA

1. Type of Facility COLLECTOR SEWER & PUMP STATION
(Treatment plant, interceptor, pumping station, additions, etc.)

2. Location LONG ROAD TO EXISTING 30" INTERCEPTOR SEWER

3. Type of sewer system SEPARATE
(separate or combined)

4. Population to be immediately served 116

Design Population 797

5. Design Period 50 YEAR

6. Hydraulic Loading

	Present flow (mgd)	Design flow (mgd)
Sanitary sewage	0	0.0797
Institutional sewage	N/A	N/A
Industrial waste	N/A	N/A
Infiltration	0	INCLUDED ABOVE
Total	0	0.0797
Minimum flow	0	0
Maximum flow	0	0.3076 (PEAK HOUR)

Engineer's Signature and Seal:

STATE OF NEW YORK
VICTOR J. O'BRIEN
075818
LICENSED PROFESSIONAL ENGINEER

92-15-8(5/77)
Formerly
BMW-65(11/73)

ENGINEERING REPORT - SEWER SYSTEM

Ref.	Point Under Review	Standard	This Project	Remarks
11.	Does the engineering report include a tabular form giving depths and velocities of flow at minimum, average, and maximum daily sewage flows for all sewers proposed?	yes	NO	SEE BMW 65
	If the project is for sewer extensions only, is the engineering report prepared in accordance with section 11.1 and 11.2? The report should state:	yes	YES	
	(1) Name and exact location of the treatment plant to which the proposed sewer extensions will be tributary.	-		
	(2) Present average daily sewage flow received by the plant.	-		
	(3) Design flow and the design year for the plant.	-		
	(4) The date when the permit for the plant was issued.	-		

OUTFALL SEWERS

Ref.	Point Under Review	Standard	This Project	Remarks
55.	Is the outfall sewer submerged?	yes	N/A	
	Is the discharge end of the outfall sewer extended into the middle of the receiving stream?	yes	N/A	
	Are diffusion facilities provided?	yes	N/A	

Remarks including explanation of departures from standard practice:

SEWER SYSTEM

Ref.*	Point Under Review	Standard	This Project	Remarks
31.	Is the proposed sewer system separate or combined?	separate	SEPARATE	
	Does sewage overflow from proposed intercepting sewers?	no	NO	
32.	Is sewer system designed for estimated ultimate tributary population?	yes	YES	
33.	Are sewers sized to meet requirements of sections 32, 33.1, 33.2 and 33.3?	yes	YES	
11.24	What average unit sewage flow (gpcd) is proposed for design?	100 gpcd	100 GPD	
33.1	What is maximum diameter of sewers?	8"	8" GRAVITY 6" FORCEMAIN	
33.2	Are sewers designed deep enough to drain all basements and to prevent freezing?	yes	YES	
33.4	Will all sewers be constructed at or greater than the specified minimum gradient?	yes	YES	
	Does the design comply with requirements stated in subsections 33.4, 33.5, 33.6, 33.7, and 33.8?	yes	YES	
34.	Are manholes designed and specified according to Section 34?	yes	YES	
34.3	What is minimum manhole diameter?	48"	48"	
35.	Are inverted siphons, if any, designed in accordance with Section 35?	yes	N/A	
38.	Where water lines are close to proposed sewers, does design protect water supplies according to Section 38?	yes	YES	

Remarks including explanation of departures from standard practice:

HYDRAULIC LOADING RATES ARE PER "NYS DESIGN STANDARDS FOR ITERMEDIATE SIZED WASTEWATER TREATMENT SYSTEMS" DATED MARCH 5, 2014.

* Reference numbers refer to numbers of Sections and Paragraphs of Great Lakes - Upper Mississippi River Board of State Sanitary Engineers 1990 Edition, Recommended Standards for Sewage Works.

SEWER SYSTEM

Location of Sewer (name of street)	Total Length (feet)	Dia. (in.) and Material	Min. & Max. slope (%)	Min. & Max. Depth (feet)	Max. Manhole Interval (feet)	Remarks
LONG ROAD	630	8" PVC	0.4%	7.2'/ 13.0'	225	GRAVITY
LONG RD. → BEDELL RD.	10,680	6" DR-21 HDPE	N/A	4' MIN. COVER	N/A	FORCEMAIN

STATE OF NEW YORK)
TOWN OF GRAND ISLAND) ss.
COUNTY OF ERIE)

To Whom It May Concern:

I, HEREBY CERTIFY, *That at a meeting of the Town Board of the Town of Grand Island, held on the* ***Seventeen of June, 2013*** *a Resolution was adopted, of which the following is a true copy:*

A RESOLUTION SUBMITTED BY:
SUPERVISOR: MARY S. COOKE
COUNCILMEMBERS:
RICHARD W. CRAWFORD,
RAYMOND A. BILLICA, CHRISTOPHER K. ARONICA

SEQR – Grand Island Gateway Center, Long/Bedell Roads, West of the I-190 – Site Plan Approval – Right-of-Way Reservation

Supervisor Cooke presented the resolution for the Grand Island Gateway Center, Long/Bedell Roads, West of the I-190 – Site Plan Approval – Right-of-Way Reservation:

WHEREAS, Acquest Development has proposed the Grand Island Gateway Center Project (herein the "Project") in the Town of Grand Island, which Project has been reviewed by the Town Board of Grand Island Town Board; and

WHEREAS previously the Town Board had conducted a review of the Project under the State Environmental Quality Review Act (SEQRA) in which it identified the relevant environmental issues, took a hard look at them, and issued a reasoned elaboration for its decision; and

WHEREAS, as part of its review the Town Board has reviewed updated studies in order to determine whether a Supplemental Environmental Impact Statement pursuant to 6 N.Y.C.R.R § 617(a)(7) is required.

NOW THEREFORE BE IT RESOLVED by the Town Board of the Town of Grand Island as follows:

1. The Board hereby affirms its prior findings and determines that no Supplemental Environmental Impact statement or further review pursuant to SEQRA is required.

2. This Resolution is effective immediately.

A motion was made by Councilman Roesch, seconded by Councilman Billica to adopt the resolution for Grand Island Gateway Center, Long/Bedell Roads, West of the I-190 – Site Plan Approval – Right-of-Way Reservation.

APPROVED Ayes 5 Crawford, Roesch, Billica, Aronica, Cooke
Noes 0

IN WITNESS WHEREOF, I have hereunto set my hand and the Seal of the Town of Grand Island, Erie County, New York the ***Fifteenth of May, 2017.***

ATTEST

Patricia A. Frentzel

PATRICIA A. FRENTZEL
TOWN CLERK

(SEAL)

C&S Companies
141 Elm Street, Suite 100
Buffalo NY 14203
p: (716) 847-1630
f: (716) 847-1454
www.cscos.com

August 14, 2017

Richard Rink, P.E.
NYSDEC
270 Michigan Avenue
Buffalo, New York 14203

Re: Long Road Sewer & Forcemain
Grand Island, New York

File: S25.003.001

Dear Mr. Rink:

We are in receipt of your comments dated July 6, 2017 regarding the above referenced project. Following are the comments in italics followed by our response:

Engineering Plans

Comment:
It is recommended that clean-outs be placed at all bends with significant horizontal or vertical change. In addition to the bends, clean-outs shall be installed at 1,000-foot spacing.

Response: Comment acknowledged. The plans have been revised to include cleanouts at significant horizontal and vertical bends as well as 1,000-foot spacing.

Comment:
Is the forcemain at the top of the bend between station 22+50 and 23+00 supposed to read 579.45 feet instead of 575.45 feet on sheet CU105.

Response: Yes. The elevation has been corrected.

Comment:
Please ensure all electrical equipment complies with National Electric Code requirements for Class 1, Division 1, Group D locations.

Response: All electrical equipment shall comply with National Electric Code requirements for Class 1, Division 1, Group D locations.

Engineering Report

The Engineering Report [ER] must present a complete Downstream Sewer Capacity Analysis containing the following:

Comment:
Flow monitoring at a ***minimum of three nodes*** *along the sewer route; this can be new data obtained from three months of flow monitoring or an event of at least 0.5 inches of rain or this data can be from previous monitoring up to three years old.*

Response: We are aware of the three node rule, but as we have previously stated, the existing flow measurements used in the Downstream Sewer Capacity Analysis represents the maximum flows in the system before entering the treatment plant as no other connections are made after the point of measurement upstream of the WWTP.

Comment:
An evaluation at each of the three nodes showing pipe capacity, peak flow rates and the addition of peak flow from the sewer extension.

Response: As mentioned below, an additional node has been added. The flow at each node is presented in the engineer's report. The additional flow data were provided by the Town of Grand Island. To be conservative, the flow in each node is compared to the minimum slope identified on the 30" sewer rather than at the node itself. The flows evaluated include the existing flows and other known future flows (previously approved projects) plus the proposed flows.

Comment:
An evaluation of one node has been presented. The information in the ER shows that this pipe to be a 30" and/or 36 "pipe. What is correct.

Response: The sewer is a 30" pipe. The reference to the 36" pipe has been removed.

Comment:
Please present information on two additional nodes. We recommend that you seek information from the Town regarding peak flow at the WWTP influent for a second node and additional flow information the Town may have regarding the 30"/36" sewer for a third node. If no additional data exists for the 30"/36" sewer, a variance from the requirements may be requested.

Response: The town has provided flows from the WWTP. There is no additional avaible flow information for the 30" sewer. The flow measurements used in the Downstream Sewer Capacity Analysis represent the maximum flows in the system before entering the treatment plant as no other connections are made after this point of measurement to the WWTP. To be conservative, this flow was checked at the flattest section of sewer between the point of connection and the

treatment plant, indicating avaible capacity and we herby request a variance for the third node flow measurement requirements.

Comment:
Please provide additional supporting information that the SEQRA was initially properly complied with in June, 2013.

Response: This project initially went through SEQRA in the late 1980's early 1990's at which times a DEIS was completed. When this project was restarted in 2007, updated study and wetland delineations were completed and the original DEIS was sent to DEC for review (by Mark Passuite). The town reviewed the revised studies and documents and issued the new SEQR resolution based on the fact that the project had not significantly changed from the original design/SEQR.

General

Comment:
The NYSDEC agrees in concept with the proposed sewer extension as shown in this report. The proposed project shall comply with Ten States Standards Chapter 30 Design of Sewers.

Response: Acknowledged.

Comment:
Please incorporate into a revised Engineering Report [ER]: the application for Approval of Plans; the BMW-65 Form; the additional SEQRA information; the Response to NYSDEC Comments Letter of June 19, 2017; the Response to ECHD Comments Letter of June 26, 2017; and the Response to Comment Letter addressing the above comments.

Response:
The above items have been incorporated into the Engineer's Report.

Comment*:*
If all comments can be properly satisfied, please submit 4 copies of the revised ER and Plans for approval.

Response:

The revised materials are enclosed for your review/approval.

I trust the above responses with the attached revised drawings and engineer's report adequately address your comments and we respectfully request design approval from your department.

Thank you for your continued attention and cooperation in this matter. Please feel free to call me if you have any questions or need any additional information.

Sincerely,

C&S ENGINEERS, INC.

Victor O'Brien, P.E.
Department Manager

Enc.

cc: Rebecca Wightman, ECDOH W/ enclosures
John Whitney, Town of Grand Island
Jim Sharpe, Town of Grand Island
Jayesh Patel, Rudra Management
Tim Weber, Acquest Development

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June 19, 2017

Richard Rink, P.E.
NYSDEC
270 Michigan Avenue
Buffalo, New York 14203

Re: Long Road Sewer & Forcemain
Grand Island, New York

File: S25.003.001

Dear Mr. Rink:

We are in receipt of your comments dated June 9, 2017 regarding the above referenced project. Following are the comments in italics followed by our response:

Comment:
The main infrastructure [PS and forcemain] approval for the undeveloped area of the Consolidated Sewer District will be done by this Office [NYSDEC]. The ECHD will also review this initial submittal. All subsequent subdivision and sewer extension approvals tributary to this project will be done by the ECHD. The required I/I mitigation/offset work will also be evaluated/required at the time of each individual sewer extension approval.

Response: Comment acknowledged. We are also currently submitting to the DOH for the sewer extension (private) for the proposed hotel.

Comment:
A BMW-65 Project Data Form must be filled out and submitted with the pump station [PS] and forcemain [FM] Engineering Report and Plans.

Response: The BMW-65 Project Data form was originally submitted to ECDOH. A copy is attached for your review/approval. A separate BMW-65 will be submitted to the DOH for the private sewer lateral/extension.

Comment:
An Application for Approval of Plans Form must be filled out and signed by the Town of Grand Island, and shall be submitted with the Engineer's Report and Plans.

Response: The Application for Approval of Plans form was originally submitted to ECDOH. A copy is attached for your review/approval. A separate Application for Approval of Plans will be submitted to the DOH for the private sewer lateral/extension.

Comment:
The SEQR process must be completed. Documentation of such must be provided.

Response: A copy of the Town Board SEQR resolution was originally submitted to ECDOH. A copy is attached for your review/records.

Comment:
A statement shall be included in the Engineering Report regarding the Professional Engineer or Architect that is responsible for overseeing construction activities and testing, and providing project completion certification.

Response: The town engineering department will inspect and certify the proposed sewer under a Public Improvement Permit. The required statement has been added to the engineer's report**.**

Comment:
An Out-of-District Agreement will be needed for the new Hotel[s] to tie into the Sewer District. If a second out of district property in that area ties into the sewer line, the Sewer District will need to be expanded or a Sewage Works Corporation will need to be formed.

Response: Comment acknowledged. The Town and property owner/developer are aware of this and will comply.

Comment:
Please evaluate, if not already done, a more centrally located pump station in the new 144 acre parcel. The depth of the new pump station should be sufficient to sewer all planned development areas by gravity.

Response: The pump station is located at the lowest practical elevation on the site to permit the future gravity sewers for the 144-acre parcel and other potential development to flow by gravity. Placing the pump station more centrally on the site would require the gravity sewers and pump station to buck grade and be much deeper than necessary.

Comment:
Detailed plan and profile sheets should be included with the next submittal.

Response: Detailed plan and profile sheets have been previously submitted to the ECDOH. A set of drawings was delivered to you on June 9, 2017. Attached are the latest plan and profile sheets that incorporate the current comments/responses.

Comment:
We recommend the following design flows:
- Commercial/Office: 144 acres x .7 x .5 x .25 = 12.6 acres or 548,860 sf x 0.1 gals/sf [1988 NYSDEC Std.] = 54,890 gpd x .8 = 43,900 gpd.
- Light Industrial: 50 employees x 15 gpd x .8 = 600 gpd.
- Residential: 100 lots x 3.5 per/lot x 110 gpd = 38,500 gpd x .8 = 30,800 gpd.
- Hotels: 205 rms x 110 gpd = 22,550 gpd; Food: 50 seats x 35 gpd x 2 [included banq.]= 3,500 gpd; Pool: 205 x 10 = 2050 gpd; Total: 28,100 gpd x .8= 22,400 gpd

Total: ***97,700 gpd Design ADF*** *x 3.25 PF =* ***317,500 gpd PHF***

Response: We have revised the design flows as suggested. The net changes in flow were minimal. Note that this will not affect the pump or forcemain sizing.

Comment:
Please evaluate the possibility of the Isle-Chem Plant on Long Rd tying into the new sewerage facilities.

Response: The proposed sewerage facilities have been designed and located such that it is possible for Isle-Chem to connect in the future.

Comment:
The Engineer's Report must present a complete Downstream Sewer Capacity Analysis containing the following:
- a sewer map showing the project location and the sewer route the wastewater will travel from project location to the WWTP, the map should show pipe sizes and carrying capacities;
- flow monitoring at a minimum of three nodes along the sewer route should be provided, this can be new data obtained from 3 months of flow monitoring or an event of at least 0.5 inches rain, or existing data from a maximum of 3 years ago;
- an evaluation at each of the three nodes should show pipe capacity, peak flow data and the addition of the peak flow from the sewer extension[s];
- I/I Offset-mitigation will be required of each future sewer extension.

Response: The engineer's report has been revised to include a map that shows the sewer routing from the proposed project to the existing WWTP. Note that the downstream routing consists of only one sewer - a 30" diameter pipe from the point of the proposed forcemain discharge to the WWTP, at a minimum slope of 0.08 %. The as-built drawings for this sewer are included in the revised engineer's report for your information

Flow monitoring was obtained in May of 2015 in the 30" sewer north of Havenwood Drive. No other flow enters the sewer downstream of this point. Therefore, this represents the worst case flow in the interceptor sewer. Obtaining additional flow monitoring in this line at two additional locations will not provide any additional useful data.

We (C&S and the Town) acknowledge the need for I&I mitigation for subsequent development.

Comment:
The forcemain [FM] is very long and initially the flow through it will be low. To ensure that blockages do not occur from settling sewage, please place cleanouts at regular intervals along the FM.

Response: Although the total flow through the forcemain will initially be low, the pumping rate and forcemain velocity will not change through buildout. Ten States Standards requires a minimum velocity of two feet per second in force mains, the generally accepted velocity to keep solids from settling. We have designed this project to pump at a minimum velocity of three feet per second. This is the generally accepted standard for the re-suspension of solids in order to address the intermittent flow associated with the initial system operation.

Cleanouts are typically not needed if velocities are kept at three feet per second or more. Other sewer authorities/districts, including Erie County, do not permit cleanouts and require the higher velocity. However, we have added cleanouts at low points in the system as directed. Access is also provided at the high points within the air release valve manholes.

Comment:
The NYSDEC agrees in concept with the proposed sewer extension[s] as discussed in the report. The project[s] must also comply with the "Ten State Standards" Chapter 30 and 40 for the design of the PS, FM and sewers. There should be several pump [impeller] designs to accommodate the low initial flows and the increase in flow that will occur to full build out.

Response: As stated above, the pump and forcemain are designed to pump the peak hourly design flow at three feet per second for the initial condition and at full build out. Therefore, additional pump and impeller sizes are not needed. What will vary is the pump cycle times. Using Ten States Standard maximum allowable fill times, the wet well filling and pump down times were determined for both the initial and full build-out conditions to determine the pump cycle times, which are within the pump manufacture recommendations.

If different flow characteristics are required in the future, the pump impellers and motors are able to be modified if needed.

I trust the above responses with the attached revised drawings and engineer's report adequately address your comments and we respectfully request design approval from your department.

Thank you for your continued attention and cooperation in this matter. Please feel free to call me if you have any questions or need any additional information.

Sincerely,

C&S ENGINEERS, INC.

Victor O'Brien, P.E.
Department Manager

Enc.

cc: Rebecca Wightman, ECDOH W/ enclosures
John Whitney, Town of Grand Island
Jim Sharpe, Town of Grand Island
Jayesh Patel, Rudra Management
Tim Weber, Acquest Development

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f: (716) 847-1454
www.cscos.com

June 26, 2017

Ms. Rebecca Wightman, P.E.
Assistant Public Health Engineer
Erie County Department of Health
503 Kensington Avenue, BB 173
Buffalo, New York 14214

Re: Long Road Sewer & Forcemain
Grand Island, New York

File: S25.003.001

Dear Ms. Wightman:

Below are comments received from you via email on June 13, 2017, followed by our responses in italics:

1. NYSDEC will have the authority as the lead reviewer to approve this project. Therefore, the $300 review fee paid to ECDOH will be applied to the sewer connection review fee (also $300) for the hotel project.
    a. For the sewer connection review, we will need an engineering report and a plan review application (BSP-5 form) signed by the hotel owner.

Response: Comment acknowledged. Separate BSP-5 and BWM-65 forms for the proposed hotel private sewer connection are attached.

2. The scope of ECDOH review for this project is limited to the sanitary sewer and force main; the pump station was not reviewed.

Response: Comment acknowledged.

3. Note that the future public waterline extension will need to be reviewed by ECDOH.

Response: Comment acknowledged.

4. Plans shall be stamped and signed by a licensed professional prior to approval of the project.

Response: Comment acknowledged. The latest sealed and signed plans are attached.

5. Per Ten States Standards for wastewater, a sewer force main shall be constructed of material equal to pressure pipe for waterlines. It does not appear that DR-21 HDPE will perform equal to waterline pressure pipe.

Response: The DR-21 HDPE pipe specified is rated for 100 psi working pressure and an occasional surge pressure of 200 psi. The maximum pressure that the proposed pump can develop at shut-off head is 82 ft or36 psi. The standard operating pressure for this system will be approximately 67 feet or 29 psi at the lowest point in the system. This is one third of the allowable working pressure.

After further consideration we have decided to increase the pipe stiffness to DR-17, which has an allowable working pressure of 125 psi and an occasional surge pressure rating of 250 psi to provide an additional factor of safety. This heavier wall pipe will allow the contractor greater flexibility with respect to directional drilling pullback lengths, soil types, entry and exit angles, etc.

Requiring a heavier wall pipe beyond DR-17 has several negative impacts that cannot be justified. There is not only the additional material and labor cost of the pipe itself but the heavier pipe has a smaller inside diameter, which will create addional friction head and will lower the efficiency of the system, consuming more electricity increasing operating costs (increasing the pipe size isn't an option because the flow velocity would then be too small).

6. It appears that the areas for General Office and Light Industrial on the first page of the Engineer's Report were transposed.

Response: The figures were in fact transposed and have been corrected in the revised engineer's report.

We trust that above responses along with the requested material and revised drawings adequately address your concerns and therefore request approval of the proposed sewer extension/connection.

Please feel free to call if you have any questions.

Sincerely,

C&S ENGINEERS, INC.

Victor O'Brien, P.E.
Managing Engineer

cc: Richard Rink, NYSDEC
John Whitney, Town of Grad Island
Jim Sharpe, Town of Grand Island
Jay Patel, Rudra Management
Tim Webber, Acquest Development

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
APPLICATION FOR APPROVAL OF PLANS FOR A WASTEWATER DISPOSAL SYSTEM

1. NAME OF APPLICANT	2. LOCATION OF WORKS (City, Village, Town)	3. COUNTY
JAYESH PATEL	GRAND ISLAND	ERIE

4. ENTITY OR AREA SERVED
GRAND ISLAND HOTEL
@ 2760 LONG ROAD

5. TYPE OF OWNERSHIP
- ☐ Municipal
- ☐ Industrial
- ☒ Commercial
- ☐ Sewage Works Corp
- ☐ Private - Home
- ☐ Private – Other
- ☐ Private – Institutional
- ☐ Board of Education
- ☐ Authority
- ☐ Federal
- ☐ State
- ☐ Interstate
- ☐ International
- ☐ Indian Reservation

6. TYPE AND NATURE OF CONSTRUCTION

Collection System	Treatment and/or Disposal
☒ New	☐ New
☐ Additions or Alterations	☐ Additions or Alterations

7. ESTIMATED COST OF CONSTRUCTION

Collection System	Treatment and/or Disposal
$	$ N/A

8. TYPE OF WASTE
☒ Sewage ☐ Industrial (Specify) ☐ Other (Specify)

9. NAME OF RECEIVING TREATMENT WORKS
GRAND ISLAND WASTE WATER TREATMENT PLANT

10. POINT OF DISCHARGE
Surface Water: (Name of Watercourse) NIAGARA RIVER — Class IA-SPECIAL
Ground Water: (Name of Watercourse to which ground water is tributary) — Class

11. IS STATE OR FEDERAL AID APPLIED FOR?	LOCATION (City, Village, Town)	TYPE OF PERMIT	PERMIT NO.	DATE ISSUED
☐ Yes ☒ No	TOWN OF GRAND ISLAND	☐ NYDES ☒ SPDES	27693	8/1/2011

12. NAME OF DESIGN ENGINEER VICTOR O'BRIEN / C&S ENGINEERS, INC. — NEW YORK STATE LICENSE NO. 075818
ADDRESS 141 ELM STREET, SUITE 100, BUFFALO, NY 14203 — TELEPHONE NO. 716-847-1630

13. WATER CONSUMPTION (GPD)		
Present 11,550	Future 22,550	Design Year 2017

14. POPULATION SERVED		
Present 116	Future 226	Design Year 2017

15. AVERAGE DAILY FLOW FOR NEW OR EXISTING TREATMENT WORKS (GPD		
Present 2.91 (2015)	Future 3.5	Design Year 1979

16. SOURCE OF WATER SUPPLY (if private well; give location, type, depth and character of soil)
MUNICIPAL

17. DESIGN EQUIVALENT POPULATION (BOD Basis)
Design Flow GPD — Design Plant Efficiency %

18. GIVE NUMBER, CHARACTER AND DISTANCE OF ANY BUILDINGS WHICH MAY BE AFFECTED BY THE PROPOSED TREATMENT WORKS
NONE

19. DESCRIBE PROPOSED OR EXISTING STORM WATER DISPOSAL
N/A

ADDITIONAL INFORMATION MUST BE SUBMITTED FOR PRIVATE AND INSTITUTIONAL SYSTEMS.

20. INDICATE OF U.S.G.S. TOPOGRAPHIC MAP EXACT LOCATION OF SEWAGE TREATMENT WORKS AND ADJACENT BUILDINGS. SHOW LOCATION OF ALL WELLS OR OTHER SOURCES OF WATER SUPPLY WITHIN 200' OF THE PROPOSED WORKS. GIVE DESCRIPTION OF THESE SOURCES AND CHARACTER OF SOIL

21. STATE DEPTH BELOW EXISTING GROUND SURFACE AT WHICH GROUND WATER IS ENCOUNTERED

DATE:

22. DESCRIBE SOIL AT SITE OF PROPOSED WORKS. GIVE DESIGN BASIS AND OBSERVED SOIL PERCOLATION RATE DATA (Use additional sheet, if necessary)

NOTE: All applications must be accompanied by plans, specifications and completed Form BSP-65 (appropriate portions). The submission must conform to a previously approved engineering report describing the system in detail. The plans must be stamped with the designing engineer's seal and must be of sufficient clarity and eligibility to permit satisfactory microfilming. Only white prints will be accepted because of the difficulty of microfilming blue prints. There must be a blank area, at least 4" X 7", in the lower right corner of each sheet so that the approval stamp may be placed on the face of the plans.

Any deviation from the Department's standards for wastewater collection and treatment facilities must be explained in detail.

Approved plans are to be returned to: ☐ Applicant ☒ Engineer

If the application is signed by a person other than the applicant shown in Item 1, the application must be accompanied by a letter of authorization. Failure to comply with this provision may be grounds for the rejection of any submission.

I hereby affirm under penalty of perjury that information provided on this form is true to the best of my knowledge and belief. False statements made herein are punishable as a Class A misdemeanor pursuant to Section 210.45 of the Penal Law.

Signatures and Official Titles: Anil Dholakia - Member
GRAND ISLAND HOTEL LLC

Grand Island Hotel LLC

Mailing Address: 51 Anderson Road, Cheektowaga, NY 14225

Date of Application: 06/15/2017.

REMARKS:

TECHNICAL REVIEW OF PLANS AND SPECIFICATIONS
FOR SEWAGE AND WASTE TREATMENT SYSTEMS

PROJECT DATA

1. Type of Facility NEW PRIVATE GRAVITY SEWER
(Treatment plant, interceptor, pumping station, additions, etc.)

2. Location N.W. OF LONG ROAD AND I-190 CROSSING

3. Type of sewer system SEPARATE
(separate or combined)

4. Population to be immediately served 116

Design Population 226

5. Design Period 50 YEAR

6. Hydraulic Loading

	Present flow (mgd)	Design flow (mgd)
Sanitary sewage	0	0.0226
Institutional sewage	N/A	N/A
Industrial waste	N/A	N/A
Infiltration	0	INCLUDED ABOVE
Total	0	0.0226
Minimum flow	0	0
Maximum flow	0	0.0392

Engineer's Signature and Seal:

STATE OF NEW YORK
VICTOR J. O'BRIEN
075818
LICENSED PROFESSIONAL ENGINEER

92-15-8(5/77)
Formerly
BMW-65(11/73)

ENGINEERING REPORT - SEWER SYSTEM

Ref.	Point Under Review	Standard	This Project	Remarks
11.	Does the engineering report include a tabular form giving depths and velocities of flow at minimum, average, and maximum daily sewage flows for all sewers proposed?	yes	NO	SEE BMW 65
	If the project is for sewer extensions only, is the engineering report prepared in accordance with section 11.1 and 11.2? The report should state:	yes	YES	
	(1) Name and exact location of the treatment plant to which the proposed sewer extensions will be tributary.	-		
	(2) Present average daily sewage flow received by the plant.	-		
	(3) Design flow and the design year for the plant.	-		
	(4) The date when the permit for the plant was issued.	-		

OUTFALL SEWERS

Ref.	Point Under Review	Standard	This Project	Remarks
55.	Is the outfall sewer submerged?	yes	N/A	
	Is the discharge end of the outfall sewer extended into the middle of the receiving stream?	yes	N/A	
	Are diffusion facilities provided?	yes	N/A	

Remarks including explanation of departures from standard practice:

SEWER SYSTEM

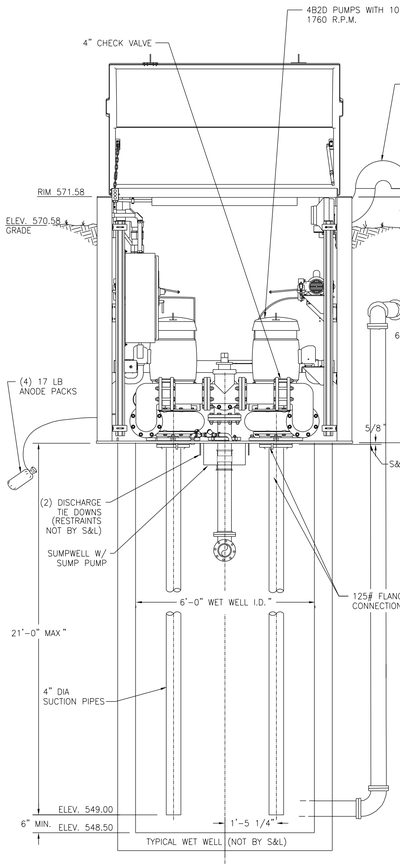
Ref.*	Point Under Review	Standard	This Project	Remarks
31.	Is the proposed sewer system separate or combined?	separate	SEPARATE	
	Does sewage overflow from proposed intercepting sewers?	no	NO	
32.	Is sewer system designed for estimated ultimate tributary population?	yes	YES	
33.	Are sewers sized to meet requirements of sections 32, 33.1, 33.2 and 33.3?	yes	YES	
11.24	What average unit sewage flow (gpcd) is proposed for design?	100 gpcd	100 GPCD	
33.1	What is maximum diameter of sewers?	8"	8"	
33.2	Are sewers designed deep enough to drain all basements and to prevent freezing?	yes	YES	
33.4	Will all sewers be constructed at or greater than the specified minimum gradient?	yes	YES	
	Does the design comply with requirements stated in subsections 33.4, 33.5, 33.6, 33.7, and 33.8?	yes	YES	
34.	Are manholes designed and specified according to Section 34?	yes	YES	
34.3	What is minimum manhole diameter?	48"	48"	
35.	Are inverted siphons, if any, designed in accordance with Section 35?	yes	N/A	
38.	Where water lines are close to proposed sewers, does design protect water supplies according to Section 38?	yes	YES	

Remarks including explanation of departures from standard practice:

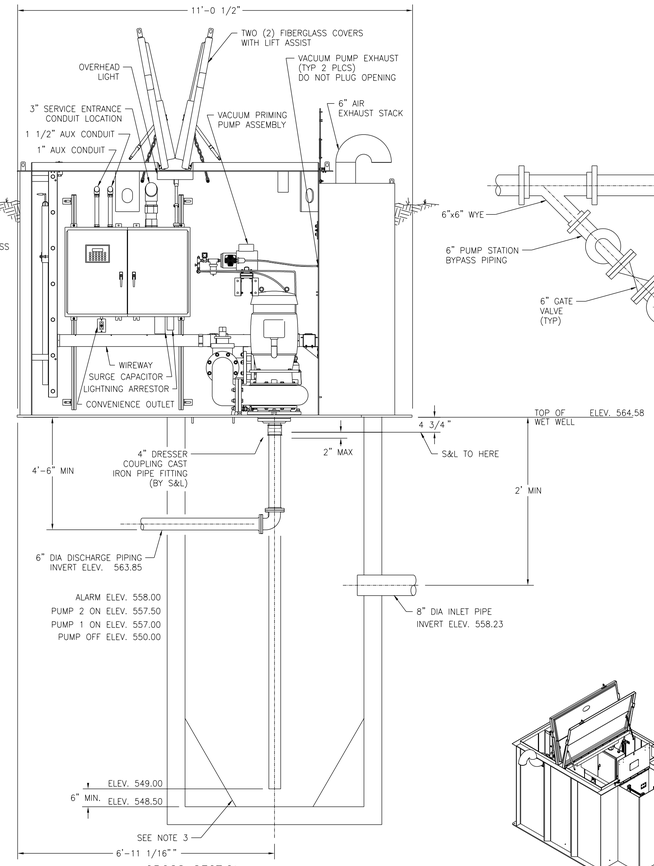
* Reference numbers refer to numbers of Sections and Paragraphs of Great Lakes - Upper Mississippi River Board of State Sanitary Engineers 1990 Edition, Recommended Standards for Sewage Works.

SEWER SYSTEM

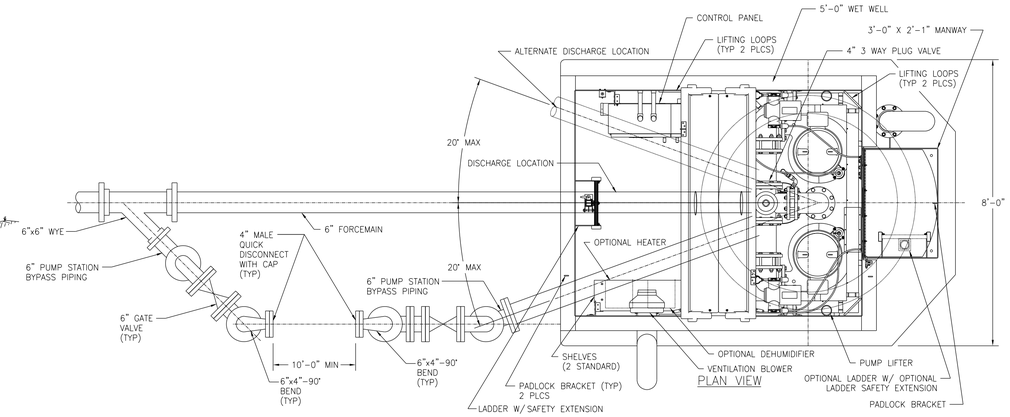
Location of Sewer (name of street)	Total Length (feet)	Dia. (in.) and Material	Min. & Max. slope (%)	Min. & Max. Depth (feet)	Max. Manhole Interval (feet)	Remarks
LONG ROAD	742	8" PVC	0.4%	7.2'/10.4'	326	GRAVITY



SECTIONAL ELEVATION



CROSS SECTION

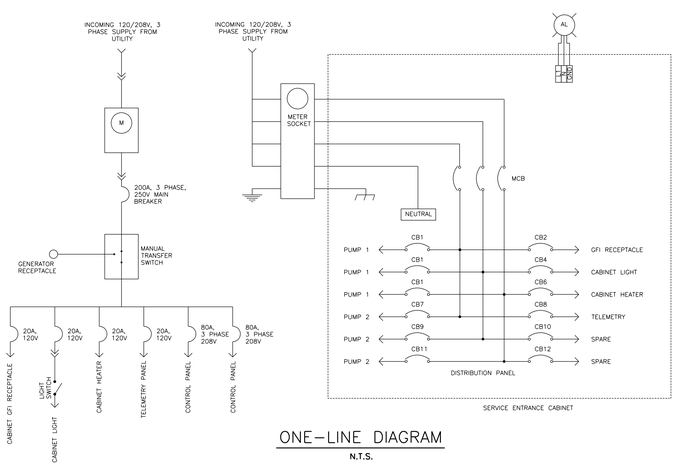


NOTES:

1. BASIS OF DESIGN FOR THE PREFABRICATED, PUMPING STATION IS SMITH & LOVELESS
2. SERVICE ENTRANCE CABINET TO BE PRE-ASSEMBLED BEFORE SHIPMENT
3. CONTRACTOR IS RESPONSIBLE FOR COORDINATION OF POWER REQUIREMENTS TO PROVIDE 3ø POWER TO THE PUMPING STATION
4. BYPASS PIPING TO BE DUCTILE IRON
5. SERVICE ENTRANCE CABINET TO BE PROVIDED BY PUMP STATION MANUFACTURER
6. RADIO TELEMETRY PANEL TO BE MOUNTED IN SERVICE ENTRANCE CABINET. WIRING BETWEEN RADIO TELEMETRY PANEL AND PUMP STATION TO BE COORDINATED WITH THE TELEMETRY MANUFACTURER
7. SERVICE ENTRANCE CABINET TO HAVE DOUBLE DOORS EACH WITH STAINLESS-STEEL FULL-LENGTH HINGES ON BOTH SIDES OF THE CABINET. THE SERVICE ENTRANCE CABINET AS INSTALLED SHALL BE UL APPROVED

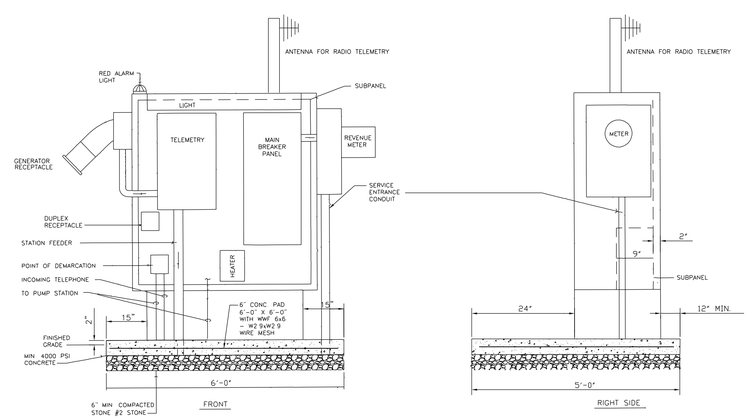
NOTES:

1. PROVIDE 60" SLOPE IN WET WELL, AS REQUIRED.
2. VOLUME IN GALLONS BETWEEN L.L. ON AND PUMPS OFF SHOULD BE EQUAL TO OR GREATER THAN THE PUMPING RATE IN G.P.M.
3. PUMP MOTORS – 50HP MAXIMUM.
4. MAXIMUM CAPACITY – 1200 GPM.
5. INTERIOR HEAD CLEARANCE 6'-7".
6. SUBGRADE UNDER STATION BASE PLATE SHALL BE COMPACTED AND PROVIDE UNIFORM SUPPORT UNDER ENTIRE BASE PLATE.
7. COPYRIGHT (C) 2005 SMITH & LOVELESS, INC.



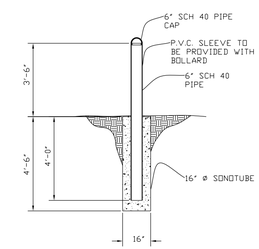
ONE-LINE DIAGRAM

N.T.S.



SERVICE ENTRANCE CABINET DETAIL

N.T.S.



TYPICAL BOLLARD DETAIL

N.T.S.

DOH APPROVAL BLOCK

2170BD42.DGN

C&S COMPANIES®

C&S Engineers, Inc.
141 Elm St. Suite 100
Buffalo, New York 14203
Phone: 716-847-1630
Fax: 716-847-1454
www.cscos.com

PRELIMINARY NOT FOR CONSTRUCTION

PROPOSED SANITARY SEWER & FORCEMAIN EXTENSION FROM LONG ROAD TO 30" INTERCEPTOR SEWER TOWN OF GRAND ISLAND, NEW YORK

MARK	DATE	DESCRIPTION

REVISIONS

PROJECT NO: S25003001
DATE: MAY 12, 2017
SCALE: NTS
DRAWN BY: S. SCHIENER
DESIGNED BY: B. ROGERS
CHECKED BY: V. O'BRIEN

NO ALTERATION PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK EDUCATION LAW

PUMP STATION & & FORCEMAIN DETAILS

CS502

USER
DATE
TIME
SYTIME

Copyright ©

Project Olive
2780 Long Road
Town of Grand Island, New York

Appendix C

Pump Station Calculations

LANGAN

Development Head Discharge Curve

Static Head	20	ft	*(from 05/2017 Engineer's Report)*
Force Main Length	10,963	LF	*(adjusted length based on relocated line)*
Minor Losses	11,511	LF	*(1.05 x force main length)*
C	120		
Pipe Diameter	6	in	
Pipe Area	0.20	sf	

Flow (gpm)	Flow (cfs)	Velocity (fps)	Friction Loss (ft)	TDH (ft)
250	0.56	2.84	32.8	52.8
275	0.61	3.12	39.2	59.2
300	0.67	3.40	46.0	66.0
325	0.72	3.69	53.4	73.4
350	0.78	3.97	61.2	81.2

Case 2 - Pumping to High Point

Static Head	36	ft	*(from 05/2017 Engineer's Report)*
Force Main Length	4,168	LF	*(adjusted length based on relocated line)*
Minor Losses	4,376	LF	*(1.05 x force main length)*
Head Loss ($h_{L\ psi}$)	34.4	psi	*($[10.44 \times L \times Q^{1.85}] \div [C^{1.85} \times D^{4.87}]$)*
Head Loss ($h_{L\ ft}$)	14.9	ft	*($0.433 \times h_{L\ psi}$)*
Total Dynamic Head	50.9	ft	*(Static Head + Friction Head Loss)*

Case 3 - Pumping to High Point

Static Head	33	ft	*(from 05/2017 Engineer's Report)*
Force Main Length	10,468	ft	*(adjusted length based on relocated line)*
Minor Losses	10,991	ft	*(1.05 x force main length)*
Head Loss ($h_{L\ psi}$)	86.4	psi	*($[10.44 \times L \times Q^{1.85}] \div [C^{1.85} \times D^{4.87}]$)*
Head Loss ($h_{L\ ft}$)	37.4	ft	*($0.433 \times h_{L\ psi}$)*
Total Dynamic Head	70.4	ft	*(Static Head + Friction Head Loss)*

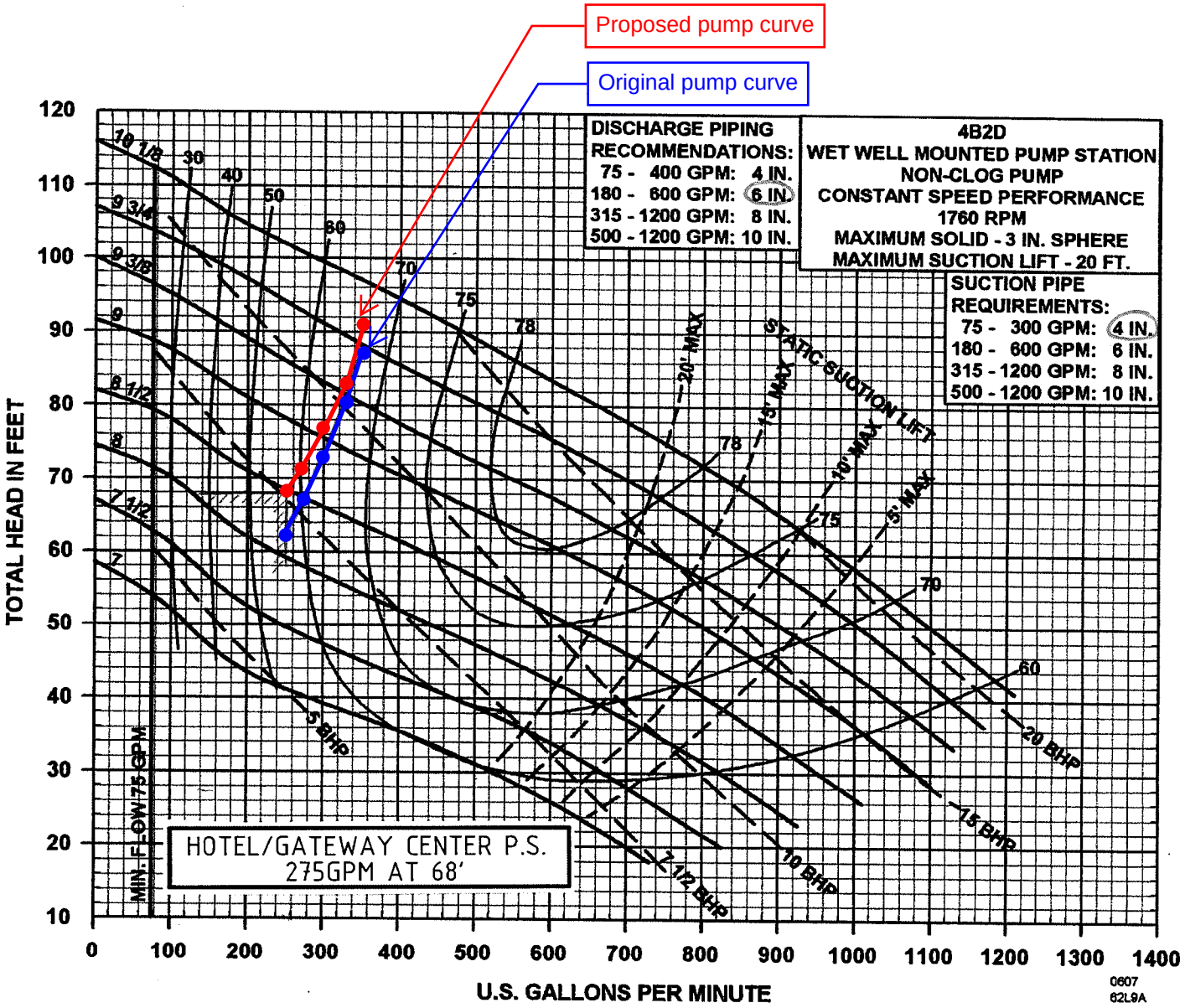
Flow (gpm)	Flow (cfs)	Velocity (fps)	Friction Loss (ft)	TDH (ft)	
250	0.56	2.84	31.4	64.4	
275	0.61	3.12	37.4	70.4	←
300	0.67	3.40	43.9	76.9	
325	0.72	3.69	50.9	83.9	
350	0.78	3.97	58.4	91.4	

ENGINEERING DATA

Smith & Loveless, Inc.®

14040 West Santa Fe Trail Drive
Lenexa, Kansas 66215-1284

Vacuum Primed Pump
Performance Curve 62L9
Constant Speed
Non-Clog Pump
4B2D – 1760 RPM
July, 2012



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Appendix D

Sanitary Sewer System Specifications

SECTION 333104

SANITARY SEWER PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Gravity sewer pipe.

B. Related Sections include the following:
   1. Section 310000 – Earthwork.
   2. Section 331101 – Water Utility Distribution Piping.
   3. Section 333901 – Sanitary Sewer Structures.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.5 SUBMITTALS

A. Product Certification: Pipe, fittings, precast concrete units, metal items, and miscellaneous appurtenances.

B. Product Data: For the following:
   1. Pipe.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with standards of authorities having jurisdiction for sanitary sewer piping, including materials, installation, and testing.
   2. Comply with Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, “Recommended Standards for Wastewater Facilities”, dated 2004, as amended.
   3. Comply with Occupational Safety and Health Administration, OSHA, Standards 29 CFR, Section 1926, Subpart P and its latest revision.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight. Keep plastic items at ambient outdoor temperature.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

D. Inspection: Upon delivery of pipe, inspect pipe.
   1. Straightness Tolerance: Maximum deviation of 1/16 inch per foot from straight line drawn between centers of openings.
   2. Immediately remove lengths of pipe that fail straightness requirement.
   3. Rejection of Manufacturer and Product: Remove all pipe supplied by a manufacturer if more than five percent of shipment is rejected.

1.8 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Civil Engineer not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Civil Engineer's written permission.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. PVC Sewer Pipe and Fittings: According to the following:
   1. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D3034, SDR 35, for gasketed joints.
   2. Gaskets: ASTM F477, elastomeric seals; resistant to common sewage and industrial wastes, including oil.

2.2 IDENTIFICATION

A. Materials and their installation are specified in Section 310000 Earthwork. Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.
   1. Use warning tape or detectable warning tape over ferrous piping.
   2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

2.3 BEDDING AND COVER MATERIALS

A. Pipe Bedding: Mixture of crushed stone and gravel, free of soft, nondurable particles, organic materials and elongated particles. The maximum diameter of the large particles shall not exceed ¾ inches. When in ledge, use AASHTO No. 67 or approved equal processed sand and gravel, free of debris, clay lumps, organic, or other deleterious material.

B. Pipe Backfill: Mixture of crushed stone and gravel, free of soft, nondurable particles, organic materials and elongated particles. The maximum diameter of the large particles shall not exceed ¾ inches.

PART 3 - EXECUTION

3.1 EXCAVATION

A. For Utility Trenches:
   1. Excavate trenches to indicated gradients, lines, depths, and elevations.
   2. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
      a. Clearance: 12 inches each side of pipe or conduit.
   3. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
      a. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course.
   4. Trenches in Tree- and Plant-Protection Zones:
      a. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrowtine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
      b. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.2 INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Check previously made joints as installation progresses. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.

F. Install piping pitched down in direction of flow, at slope indicated.

G. Install piping with minimum cover as shown on the Drawings.

3.3 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. PVC Sewer Pipe and Fittings: As follows:
   1. Join pipe and fittings with gaskets according to ASTM D2321 and manufacturer's written instructions.
   2. If full entry of pipe joint is not achieved, remove pipe and replace with new unit and gasket.

B. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

C. Install pipe, fittings, and accessories in accordance with Drawings.

D. Route piping in straight line.

E. Install bedding at sides and over top of pipe in accordance with Drawings.

F. Do not displace or damage pipe when compacting.

G. Connect to sanitary sewer manholes, pumping stations and existing manhole as shown on Drawings.

H. Install Work in accordance with Quality Assurance standards described above.

3.4 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Install detectable warning tape directly above utilities, 12 inches below finished grade.

3.5 FIELD QUALITY CONTROL

A. Perform test of sanitary sewage system in accordance with the standards of the Town of Thompson, New York State Health Department, and the Ten State Standards.

B. When tests indicate Work does not meet specified requirements, remove work, replace and retest.

END OF SECTION 333104

SECTION 333400

SANITARY SEWER FORCE MAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Force mains.

B. Related Sections include the following:
   1. Section 310000 – Earthwork.
   2. Section 331101 – Water Utility
   3. Section 333901 – Sanitary Sewer Structures.
   4. Section 333201 – Package Pump Station.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

B. DIP: Ductile Iron Pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Force-Main Pressure Ratings: At least equal to system operating pressure, but not less than 150 psig (1035 kPa).

1.5 SUBMITTALS

A. Product Certification: Pipe, fittings, precast concrete units, metal items, and miscellaneous appurtenances.

B. Product Data: For the following:
   1. Pipe.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with standards of authorities having jurisdiction for sanitary sewer piping, including materials, installation, and testing.
   2. Comply with Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, “Recommended Standards for Wastewater Facilities”, latest edition.
   3. Comply with Occupational Safety and Health Administration, OSHA, Standards 29 CFR, Section 1926, Subpart P and its latest revision.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight. Keep plastic items at ambient outdoor temperature.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

D. Inspection: Upon delivery of pipe, assist Civil Engineer in inspecting pipe.
   1. Straightness Tolerance: Maximum deviation of 1/16 inch per foot from straight line drawn between centers of openings.
   2. Immediately remove lengths of pipe that fail straightness requirement.
   3. Rejection of Manufacturer and Product: Remove all pipe supplied by a manufacturer if more than five percent of shipment is rejected.

1.8 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Civil Engineer not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Civil Engineer's written permission.

PART 2 - PRODUCTS

2.1 FORCE MAIN

A. Polyvinyl Chloride (PVC) Pressure Sewer Pipe and Fittings – 1.5 inch Nominal Pipe Size:
   1. ASTM D2241, PVC SDR 21.

B. Polyvinyl Chloride (PVC) Pressure Sewer Pipe and Fittings – 6 inch Nominal Pipe Size:
   1. ASTM D2241, PVC SDR 21.

2.2 IDENTIFICATION

A. Materials and their installation are specified in Section 310000 Earthwork. Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.
   1. Use warning tape or detectable warning tape over ferrous piping.
   2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

2.3 BEDDING AND COVER MATERIALS

A. Pipe Bedding: Mixture of crushed stone and gravel, free of soft, nondurable particles, organic materials and elongated particles. The maximum diameter of the large particles shall not exceed ¾ inches. When in ledge, use AASHTO No. 67 or approved equal processed sand and gravel, free of debris, clay lumps, organic, or other deleterious material.

B. Pipe Backfill: Mixture of crushed stone and gravel, free of soft, nondurable particles, organic materials and elongated particles. The maximum diameter of the large particles shall not exceed ¾ inches.

PART 3 - EXECUTION

3.1 EXCAVATION

A. For Utility Trenches:
   1. Excavate trenches to indicated gradients, lines, depths, and elevations.
   2. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
      a. Clearance: 12 inches each side of pipe or conduit.
   3. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
      a. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course.
   4. Trenches in Tree- and Plant-Protection Zones:
      a. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrowtine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
      b. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.2 INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install cleanouts and air release valves as shown on the Drawings. Bend flexible pipe per manufacturer's guidelines for changes in direction, unless otherwise indicated.

C. Install force main piping and connect to the site pump station. Terminate piping as indicated.
   1. Install piping with minimum cover as shown on the Drawings.

3.3 AIR RELEASE VALVES

A. Install air release valves in vault from force main pipe to grade as indicated. Set air release vault frame and cover flush with grade in pavement.

3.4 CLEANOUTS

A. Install cleanouts in vault from force main to grade as indicated. Set cleanout vault frame and cover flush with grade in pavement.

3.5 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. PVC Sewer Pipe and Fittings: As follows:
   1. Join pipe and fittings with gaskets according to ASTM D2321 and manufacturer's written instructions.
   2. If full entry of pipe joint is not achieved, remove pipe and replace with new unit and gasket.

B. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

C. Install pipe, fittings, and accessories in accordance with Drawings.

D. Route piping in straight line.

E. Install bedding at sides and over top of pipe. Pipe backfill to be installed a minimum of 12 inches overtop of the pipe and compacted in 6 inch loose lifts maximum.

F. Do not displace or damage pipe when compacting.

G. Connect to sanitary sewer manholes, pumping stations and existing manhole as shown on Drawings.

H. Install Work in accordance with Quality Assurance standards described above.

3.6 JOINT RESTRAINT SYSTEM

A. Restraining system shall include Field Lok gaskets as manufactured by Griffon Pipe Products Co., mechanical joints, restraining glands, lugs, clamps, rod couplings, nuts and washers as required or approved equal. All units shall be constructed of corrosion resistant material.

B. The mechanical joint restraint for PVC shall be EBAA Iron Inc., Series 1912 for PVC to PVC connections, Series 19MJ12 for PVC to PVC fittings, Series 2012PV for PVC to DI fittings, or approved equal.

C. Alternate: Concrete thrust block control at abrupt changes in pipeline grade, horizontal alignment, or reduction in pipe size. The pipe manufacturer’s recommendations for thrust control shall be followed.

3.7 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Install detectable warning tape directly above utilities, 12 inches below finished grade.

3.8 FIELD QUALITY CONTROL

A. Perform test of sanitary sewage system in accordance with the standards of the Town of Thompson, New York State Health Department, and the Ten State Standards.

B. When tests indicate Work does not meet specified requirements, remove work, replace and retest.

END OF SECTION 333400

SECTION 333901

SANITARY SEWER STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Sanitary manholes.

B. Related Sections include the following:
   1. Section 310000 – Earthwork.
   2. Section 331101 – Water Utility Distribution Piping.
   3. Section 333100 – Sanitary Sewer Pipe.
   4. Section 333400 – Sanitary Sewer Force Mains.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with standards of authorities having jurisdiction for sanitary sewer piping, including materials, installation, and testing.
   2. Comply with Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, “Recommended Standards for Wastewater Facilities”, latest edition.
   3. Comply with Occupational Safety and Health Administration, OSHA, Standards 29 CFR, Section 1926, Subpart P and its latest revision.

1.4 SUBMITTALS

A. Shop Drawings: Indicate manhole locations, elevations, piping, sizes, and elevations of penetrations.

B. Product Data: Submit cover and frame construction, features, configuration, and dimensions.

C. Design Mix Reports and Calculations: For each class of cast-in-place concrete.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Civil Engineer not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Civil Engineer's written permission.

PART 2 - PRODUCTS

2.1 MANHOLES

A. Precast Concrete Manholes: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
   1. Diameter: 48 inches minimum, unless otherwise indicated on the Drawings.
   2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
   3. Base Section: 6-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
   4. Riser Sections: 4-inch minimum thickness and lengths to provide depth indicated.
   5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
   6. Gaskets: ASTM C443, rubber.
   7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch diameter frame and cover.
   8. Steps: ASTM C478, individual steps or ladder.
   9. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

B. Sanitary Manhole Frames and Covers: 30 inch ID to include indented top design with lettering "SANITARY SEWER" cast into cover.
   1. Campbell Foundry Co. Pattern No. 1206A
   2. Or approved equal.

C. Steps: Copolymer Polypropylene step, ½ inch Grade 60 steel reinforcement, pattern no. 2593-2254 as manufactured by Campbell Foundry or approved equal. Cast steps or anchor ladder into base, riser, and top section sidewalls at 12-inch intervals. Omit steps for catch basins less than 60 inches deep.

D. Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
    a. Invert Slope: 2 percent through manhole.
    b. Benches: concrete, sloped to drain into channel.
    c. Slope: 4 percent.

2.2 FORCE MAIN CLEAN-OUT

A. Precast Concrete Clean-out Structure: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
    1. Internal Dimensions: 10 foot-0 inches by 4 foot-0 inches (min.)
    2. Top Slab: 8 inch minimum thickness
    3. Walls: 6 inch minimum thickness
    4. Bottom Slab: 8 inch minimum thickness
    5. Sump: 18 inches by 18 inches by 3 inches. Pitch floor to sump.

B. Sanitary Manhole Frames and Covers: 30 inch ID to include indented top design with lettering "SANITARY SEWER" cast into cover.
    1. Campbell Foundry Co. Pattern No. 1490
    2. Or approved equal.

C. Pipe Supports: 2 inch minimum diameter.
    1. Tilco
    2. Or approved equal.

2.3 FORCE MAIN AIR RELEASE MANHOLE

A. Precast Concrete Manholes: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
    1. Diameter: 48 inches minimum, unless otherwise indicated on the Drawings.
    2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
    3. Base Section: 6-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
    4. Riser Sections: 4-inch minimum thickness and lengths to provide depth indicated.
    5. Top Section: Flat-slab-top type is indicated.
    6. Gaskets: ASTM C443, rubber.
    7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch diameter frame and cover.
    8. Steps: ASTM C478, individual steps or ladder.
    9. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

B. Sanitary Manhole Frames and Covers: 30 inch ID to include indented top design with lettering "SANITARY SEWER" cast into cover.
    1. Campbell Foundry Co. Pattern No. 1206A
    2. Or approved equal.

C. Steps: Copolymer Polypropylene step, ½ inch Grade 60 steel reinforcement, pattern no. 2593-2254 as manufactured by Campbell Foundry or approved equal.

Cast steps or anchor ladder into base, riser, and top section sidewalls at 12-inch intervals. Omit steps for catch basins less than 60 inches deep.

D. Pipe Supports: 2 inch minimum diameter.
   1. Tilco
   2. Or approved equal.

E. Vent: 4 inch Schedule 80 PVC vent with rodent screen supported by a 4x4 pressure treated wood post embedded 36 inches into the ground with an 8 inch diameter concrete sonotube.

2.4 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
   1. Cement: ASTM C150, Type II.
   2. Fine Aggregate: ASTM C33, sand.
   3. Coarse Aggregate: ASTM C33, crushed gravel.
   4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
   1. Reinforcement Bars: ASTM A615/A615M, Grade 60, deformed steel.

C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio. Include channels and benches in manholes.
   1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
   2. Benches: Concrete, sloped to drain into channel.

2.5 PROTECTIVE COATINGS

A. Description: Two-coat, coal-tar epoxy; 15-mil minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:
   1. Concrete Manholes: On exterior surface.

2.6 CONNECTIONS TO EXISTING STRUCTURES

A. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

PART 3 - EXECUTION

3.1 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated on Drawings.

B. Form continuous concrete channels and benches between inlets and outlet.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated on Drawings.

D. Install precast concrete manhole sections with gaskets according to ASTM C891.

3.2 FORCE MAIN CLEAN-OUT

A. General: Install clean-out, complete with appurtenances and accessories indicated on Drawings.

B. Set tops of frames and covers flush with finished surface in pavements.

3.3 FORCE MAIN AIR RELEASE MANHOLE

A. General: Install air release manholes, complete with appurtenances and accessories indicated on Drawings.

B. Set tops of frames and covers flush with finished surface in pavements.

C. Install precast concrete manhole sections with gaskets according to ASTM C891.

D. Groundwater
   1. Provide a 2 inch PVC line to daylight
   2. If groundwater is present or unable to daylight, provide 12 inch by 12 inch opening in structure floor with 6 inches of ¾ inch gravel to allow for drainage.

3.4 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.5 CONNECTIONS TO EXISTING STRUCTURES

A. Core drill existing structures and boot with flexible pipe connector.

3.6 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.7 FIELD QUALITY CONTROL

A. Test system in accordance with the Drawings.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Schedule tests and inspections by authorities having jurisdiction with at least 48 hour advance notice.
   3. Submit separate reports for each test.

END OF SECTION 333901

EXHIBIT J

EXHIBIT J
Energy Conservation Assessment
Proposed Warehouse Distribution Facility Project
2780 Long Road
Town of Grand Island, Erie County, New York

This Energy Conservation Assessment describes the potential impacts of the Project on energy use. An estimate of the natural gas and electricity demand of the Project is provided, as well as information on how natural gas and electricity will be supplied to the Site and an overview of the energy conservation measures to be implemented is included.

Energy Use

The primary energy source for heating will be natural gas, which will also be used to operate ventilation and HVAC systems. Electricity will be used to provide lighting and energy for warehouse and accessory office operations. Electric and natural gas service would be extended from the utility lines north and south of the Site.

Natural Grid is the electric service provider for the Site. Correspondence from National Grid dated November 7, 2019 indicates there are existing service lines to the north, south and west of the Site, a more comprehensive engineering study is necessary to determine the best means to serve the anticipated demand.

The estimated annual electricity demand during operations is approximately 3,350 Megawatt Hours (MWhrs). It is anticipated it will not be necessary to require a new substation or an upgrade to an existing substation.

The following electric service lines are near the Site:

1. North of Site: 13.2kV service line limiting loads to 2.5 MW.
2. West and south of the Site. Each line has only 4.8kV, limited to 1000 kVA. There is a possibility of converting these lines to 13.2kV

National Fuel is the natural gas service provider for the Site. Correspondence from National Fuel dated October 31, 2019 confirmed there is available natural gas service to the Site. Existing natural gas lines serving the Site are the following:

1. Three inch plastic medium pressure gas main on Long Road adjacent to the north end of the Site.
2. Four inch coated steel medium pressure gas main on Bedell Road adjacent to the south end of the Site.

National Fuel indicated that a summary of all natural gas equipment with Btu requirements specifying process equipment versus heating and cooling equipment, site drawings and specifications, preferred location of outside gas meter at the site and a new service line application will be required together with a review of required permits and rights-of-way to provide a cost for gas service and capacity requirements.

Heating and Cooling

Rooftop HVAC units are proposed to provide heating and cooling for the warehouse and office spaces. Natural gas would be used to provide heating, while electricity would be used to provide cooling. It is projected that the entire warehouse will require heating and cooling with the mechanical, electrical, and equipment rooms requiring heating only. Heating and insulation will prevent freezing temperatures within the building, while cooling during the summer months will be provided with adequate ventilation. The warehouse would experience only minor temperature changes. Materials stored in the warehouse at moderate temperatures would not be damaged or spoiled.

Energy Conservation Measures

All of the mechanical equipment within the building is being designed to New York State Energy Code (the "Code") standards, with high-efficiency motors, transformers, etc. All of the light fixtures, both pole mounted and wall mounted, are LED type, which are up to 80 percent more efficient that traditional lighting. With LED lighting, approximately 95 percent of the energy is converted to light with only five percent wasted as heat. LED lighting reduces overall power demand. The lighting plan (Site Plan Drawing Nos. LL100-LL107 and LL501), provides a photometric survey outlining the lighting limits on the Site and at the lot lines. The lighting layout complies with the Illuminating Engineering Society of North America (IESNA) safety standards for light levels.

The lowest level of the building uses conveyor-type material handling equipment and the upper levels are used for storage with battery powered drive units. There is no anticipation of any more of a per-square-foot power demand than is typical for other warehouse-type facilities.

Other measures would be taken to conserve energy for the operation of mechanical and electrical systems include and are not limited to the following:

1. Motion sensors will be located in around the building near ingress/egress points to avoid lighting areas that are not in use.
2. Mechanical equipment efficiency for energy conservation will be maximized to the extent possible, including and not limited to operation of forklifts inside the Facility.
3. Temperature set points would be reviewed based on specific needs, including and not limited to storage types, comfort of personnel, etc., to maximize energy conservation potential.

It is acknowledged that energy consumption will increase from the Project. New building construction proposed at the Site shall comply with the Code, contained in Title 19 of the New York Codes, Rules and Regulations ("NYCRR"), Part 1240, and in the publications incorporated by reference in 19 NYCRR Part 1240.

Standards apply to the use of energy-efficient building materials (e.g., insulation, windows, weather stripping, door seals, etc.) and mechanical systems (e.g., air conditioners, heating systems, HVAC systems, water heaters, heat pumps, etc.), which minimize the amount of energy required. The New York State Environmental Conservation Law also requires that water saving plumbing fixtures be installed that meet water conservation flow standards. The purpose of installing this equipment is to conserve energy resources required to heat the water and minimize unnecessary water loss.

Based on the nature of the future use of the project site and the energy conservation measures to be implemented, there will not be any significant adverse impact on energy resources and/or use.

\\langan.com\data\PAR\data9\100785901\Project Data_Discipline\Planning\EAF Full Form\EAF Exhibits\Exhibit J - Energy Conservation\Project Olive Exhibit J - Energy Conservation Assessment 02_21_2020.docx

National Fuel

October 31, 2019

Ms. Trista Kuna, P.E., CFM
Project Engineer
Langan Engineering, Environmental, Surveying,
Landscape Architecture and Geology, D.P.C.
300 Kimball Drive
Parsippany, New Jersey 07054

RE: **Gas Service Availability Confirmation Request**
Between Long Road and Bedell Road; West of Interstate 190
Grand Island, NY 14072

Dear Ms. Kuna:

Thank you for your interest in natural gas service for your energy needs. National Fuel Gas Distribution Corporation (NFGDC) has a 3" plastic medium pressure gas main on Long Road adjacent to the North end of the property. There is a 4" coated steel medium pressure gas main on Bedell Road adjacent to the South end of the property. Please consider this confirmation of availability for natural gas service to the site located on Grand Island, New York, between Long Road and Bedell Road and West of Interstate 190. Please note that a summary of all natural gas equipment with Btu requirements specifying process equipment versus heating and cooling equipment, site drawings and specifications, preferred location of outside gas meter at the site and a New Service Line Application (which is available at no cost and no obligation) will be required together with a review of the necessary permits and rights of way, to provide a cost for gas service and capacity requirements at the site.

It is also important to note that National Fuel's Area Development Program (ADP grant program and/or Conservation Incentive Program) could help reduce the cost of the project. If you need further assistance, please feel free to contact me at 716-857-7025. We thank you for this opportunity and look forward to serving you.

Appreciatively,

Rachel L. Gebhart
Associate Energy Consultant
Energy Services Department

RLG/vlz

Sean Moronski

From: Welch, MaryGrace <MaryGrace.Welch@nationalgrid.com>
Sent: Thursday, November 07, 2019 5:00 PM
To: Trista Kuna
Subject: FW: EXT || Will-Serve Request - Grand Island, NY
Attachments: Project Olive 1a.pdf; NY Electric Service Request Form- New Service.pdf; Electric Service Application.doc

Importance: High

Trista,
As we discussed – an estimated load of 7MW is usually served via our 115KV transmission lines. I have attached a map showing all our service lines for better reference. As previously indicated:

There is 13.2kV service line to the north limiting loads to 2.5 MW.

The west and south sides of the property have only 4.8kV, limited to 1000 kVA. There is a possibility of converting these lines to 13.2kV

The east side has the Thruway as a barrier, making an expensive crossing underground below the Thruway. This goes for 13.2kV or 115kV. The Thruway Authority now requires underground crossings, a costly underground boring and cable installation.

There is 115kV & 230kV 1/ 2 – 1-1 /2 miles to the east, depending where on the site the facility will be located. $5M per mile for double circuit 115kV plus the Thruway adder is a high level estimate for the service charge.

As we also discussed, the attached service request forms must be completed in order to start the engineering study necessary in order to determine the best means to serve the 7MW. This particular site poses several variables.

Please contact me if you have any questions.
MG

Mary Grace Welch
Lead Economic Developer

National Grid
144 Kensington Ave
Buffalo, NY 14214-2726

T: 716/831-7752
C: 716/440-0910
F: 716/831-5258
www.shovelready.com

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EVALUATION OF SITE SOUND EMISSIONS

PROPOSED DISTRIBUTION FACILITY
Grand Island, New York

Prepared for:	**Langan**
Prepared by:	**John T Baldassano Jr.**
Reviewed by:	**Benjamin C. Mueller, P.E.**
Date:	**20 February 2020**
OAA File:	**4201A**

OSTERGAARD ACOUSTICAL ASSOCIATES

1460 US Highway 9 North Suite 209
Woodbridge, NJ 07095
Voice 973-731-7002
Fax 973-731-6680
acousticalconsultant.com

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INTRODUCTION

Ostergaard Acoustical Associates (OAA) was retained to analyze projected sound emissions from a proposed e-commerce storage and distribution center in Grand Island, Erie County, New York. The site approximately 145.4 acres of undeveloped land located at 2780 Long Road immediately west of Interstate-190 (Niagara Thruway) adjacent to southbound Exit 20B and zoned M-1 Light Industrial Research District. Low density residential development adjoins the site to the north and south, with commercial uses interspersed among residences nearby Interstate-190. To the west is an approximately 62.1 acre vacant parcel zoned for low-density residential and other undeveloped lands. To the east, beyond Niagara Thruway are primarily non-noise sensitive commercial uses with sporadic residences further from the site. Plans call for the construction of a storage and distribution center with personnel vehicle[1] and trailer parking around the building. Access to the facility will be provided via Long Road to the north and Bedell Road to the south. The site is anticipated to operate 24/7, and this report addresses the on-site noise radiated to nearby potentially noise sensitive receptors.

The purpose of this sound study is to analyze future site sound emissions and consider improvements to the project needed to comply with applicable code limits and/or to minimize the acoustical impact and potential for noise complaints.

There are no New York State or Erie County noise codes that regulates site sound emissions; however, the New York State Department of Environmental Conservation (DEC) has guidelines for assessing and mitigating noise impacts. There are also local noise codes that apply. Hence, potential sound emissions from the facility were evaluated against the applicable Town of Grand Island noise code and the DEC guidelines, along with criteria recommended by OAA based on experience. The site will contribute steady sound from rooftop HVAC equipment. Of most concern is intermittent sound from truck and personnel vehicle movements during the nighttime sleeping hours potentially affecting nearby residential receptors.

Note that all acoustical modelling for this professional acoustical evaluation relied on analyses in octave frequency bands. However, in the interest of providing a concise report of findings, results in this report are provided using the most common metric of environmental sound, the A-weighted sound level. Full acoustical data in octave bands for all measurements and modelling are available upon request.

---

[1] Note that throughout this report, the term "personnel vehicle" collectively refers to any passenger vehicle such as a car, pick-up, or SUV.

Work by OAA was overseen by Benjamin C. Mueller, P.E., with assistance from OAA Staff Consultant John T. Baldassano Jr. The representative at Langan coordinating the project is Michael Finan, P.E.

SITE AND VICINITY

Figure 1 is an aerial image obtained from Google Earth showing the site property line outlined in red. The site is currently undeveloped; the northern portion of the property is grassland while the remainder of the property is wooded. The site is located in the M-1, Light Industrial and Research, district. Our understanding of zoning/land uses in the various directions is as follows:

- North of the site, fronting on Long Road, are five single-family residences in the R1A zone and a pressure sensor manufacturer, GP:50, in the M-1 Zone. Beyond are additional commercial/industrial uses and a hotel in the M-1 zone. The hotel parking lot accommodates heavy trucking and buses.

- Bordering the site to the east is Niagara Thruway with non-noise sensitive commercial/industrial uses in the M-1 zone beyond. Uses are varied and include an antique store, a sign shop, an electronic parts supplier, and a promotional products supplier. In addition, there are a few apartment buildings, a hotel, and a church interspersed among these non-noise sensitive uses.

- To the south are approximately a dozen single-family houses fronting on Bedell Road in the R1A zone with undeveloped wooded land beyond. There are also sporadic commercial properties in this direction, also fronting on Bedell Road in the M1 zone. Of interest are an auto body shop and a storage facility in the M1 and M2 zones, respectively.

- West of the site are undevelopable wetlands and a large wooded circle. Beyond these, approximately ¼ to ½ mile away, are single-family residences in the R1A zone fronting on West River Road and Sunset Drive. Further west is the Niagara River.

Plans call for the construction of an 3,783,124 ft^2 building located in the eastern portion of the property. Site access is provided via two driveways: Long Road to the north and Bedell Road to the south. Personnel vehicles will enter from both driveways; trucks will primarily use the northern driveway and will only utilize the southern driveway to Bedell Road in the event of emergencies. Once on site, trucks will travel south to check in at the guard house before continuing to docks along the west and south sides of the building. Truck activity is concentrated in the dock area and trailer parking areas outboard of the docks. Personnel vehicles utilize the parking area east of the building and are segregated from the trucking areas on the west side of the building. Based on OAA findings and coordination with team members, site plans also call for the construction of a sound barrier along the northern driveway carried to a height of 16 feet above grade. This is accomplished by constructing an earth berm that ranges from 5-to-6 feet above the driveway surface with an 11-to-10 foot high wall on top of the berm.

Since facility operations will be 24/7, the primary concern with sound emissions is minimizing the acoustical impact and meeting appropriate noise goals at night at residences. Site sound will likely be dominated by on-site truck activity. Other activities, such as sound from personnel vehicles, are lower in level, but higher in quantity, and therefore also of concern. This sound study analyzes the sound levels contributed by these intermittent noise sources as well as from steady rooftop HVAC equipment.

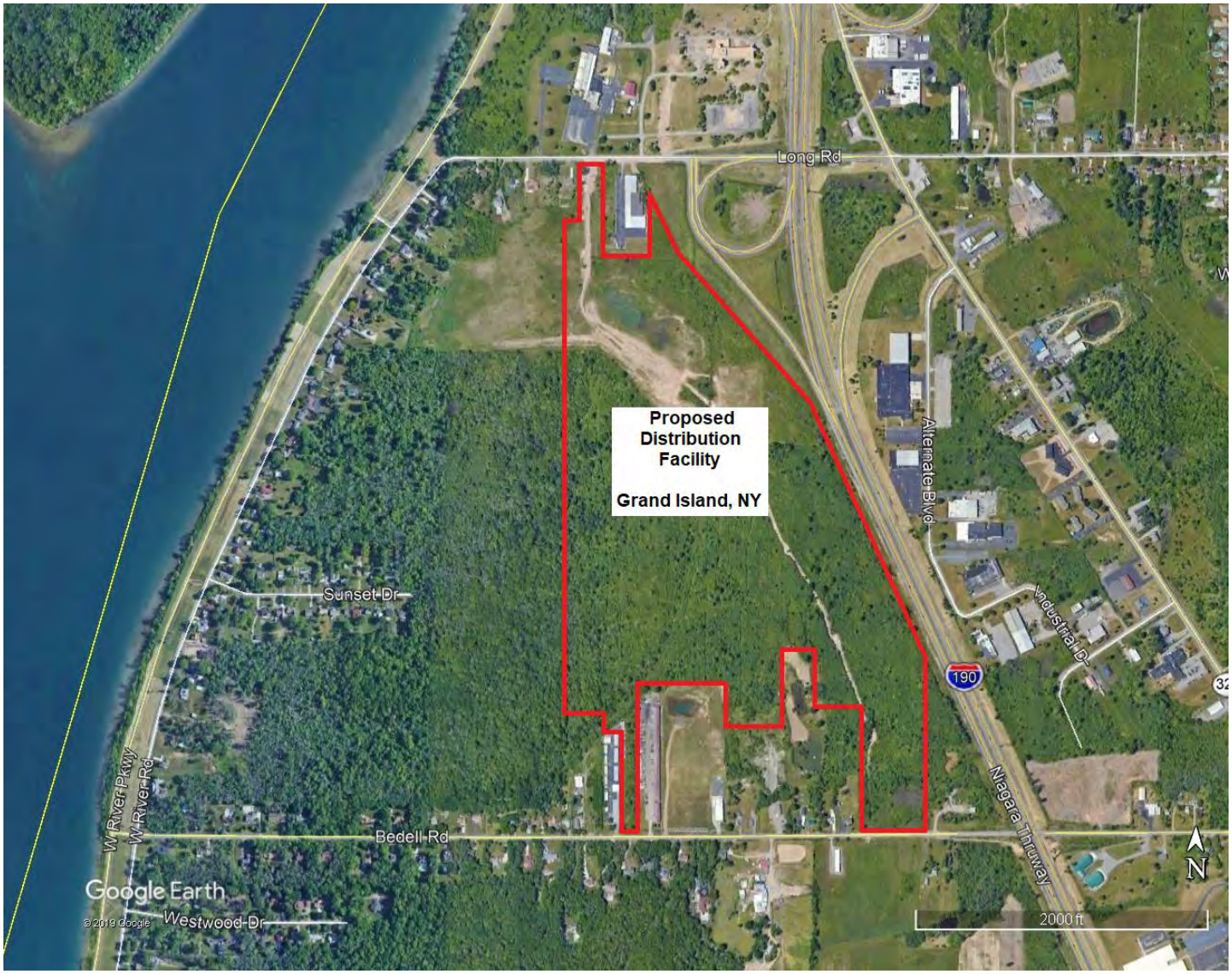

Figure 1 — Google Earth image showing the proposed distribution facility site and vicinity in Grand Island, NY. The approximate site boundary line is outlined in red.

REGULATIONS/GOALS

When developing a site of this type, it is appropriate to consider how sound from the facility will likely be received, especially by noise-sensitive receptors. Sound produced by a typical distribution center includes personnel vehicle and truck parking lot activity such as idling and vehicle movement, as well as HVAC rooftop equipment. These noise sources should be evaluated and compared to applicable noise code regulations.

Site sound emissions from this facility are regulated by local noise codes. The Town of Grand Island regulates noise in Code Chapter 230: Noise Pollution Control. Specific acts in connection with noise are prohibited, but most are not applicable. Applicable to the site is that noise associated with the sounding of a horn or alarm from an automobile, "except as a warning of danger or distress" is prohibited. In addition, quantitative limits for steady noise sources as well as more permissive limits for transient noise sources are provided. Steady noise is defined as "noise caused by any mechanical device that continues in excess of one minute". HVAC sound is nominally steady in nature and would be considered a steady-state noise source. Steady-state site sound emissions are limited to 65 dB(A) during the daytime hours of 0900-to-2300 and 50 dB(A) during the complementary nighttime hours when measured "three feet from the major surface … or residences, buildings or structures used primarily for sleeping purposes by people." Similarly, transient noise is defined as "any noise having a duration of six seconds up to one minute." Vehicle movements and activity are best characterized as transient noise since they are either moving or create sound that is short in duration. Transient site sound emissions are limited to 85 dB(A) at all times when measured at a distance of fifty feet from the source.

The State of New York has no noise codes that relate to site sound emissions. The New York State Vehicle and Traffic (VAT) Law states that all motor vehicles must have a muffler and must be below specific sound limits at a distance of 50 feet. Specifically, vehicles over 10,000 pounds must not exceed 86 dB(A) at speeds of 35 mph or less nor exceed 90 dB(A) at speeds above 35 mph. There are also limits for lighter weight vehicles and motorcycles. Overall, these State limits somewhat mimic the local transient source limits and are generally easy to meet with modern, well-maintained vehicles. The New York State Department of Environmental Conservation (DEC) has a policy "Assessing and Mitigating Noise Impacts" that provides guidance for analyzing and minimizing the acoustical impact applicable to the State Environmental Quality Review Act (SEQRA) review. Guidelines require comparison of the average existing ambient sound to proposed site sound emissions. The DEC states that an increase in ambient sound levels by 0-to-3 dB should have no appreciable effect on receptors and an increase of 3-to-6 dB is tolerable

but may have potential for an adverse noise impact only in cases where the most noise-sensitive of receptors are present. Increases of more than 6 dB require closer scrutiny while increases of 10 dB deserve consideration of avoidance and mitigation measures in most cases.

Project Criteria

At a minimum, the site should strive to meet all applicable code limits. Therefore steady sound emissions from HVAC, which can operate at night, should meet 50 dB(A) when received at noise sensitive receptors. Since Grand Island and New York State vehicle code limits regulate transient vehicle sound in relation to the noise source, and not the receptor, a project goal should be established to minimize the potential for complaints and the acoustical impact of the site. Current transient sound in the area is governed by the nearby Thruway and occasional intermittent local traffic. For receptors remote from the Thruway, to the west and south of the site, on-site transient noise sources at residential receptors should strive to meet the Grand Island steady noise nighttime code limit of 50 dB(A). Residences near the north end of the site are in proximity to on and off ramps of Niagara Thruway, and a generally busier area of the Town, and therefore experience higher vehicle sound levels than residences to the south. An appropriate transient noise goal for these northern receptors is strive to meet 55 dB(A). Note that these northern residences are roughly 150 feet from local roadways and can experience moderate to high maximum sound levels of 50-to-60 dB(A) from vehicle passbys. Hence controlling on-site transient sound levels to meet 55 dB(A) will be similar to other transient sound in the area, and therefore will not have an appreciable effect on receptors per DEC guidelines. These transient project criteria are appropriate only during the night; there is no need for daytime criteria as receptors are not traditionally sensitive during this time.

EXPECTED SOUND EMISSIONS

Acoustical modelling software, specifically CadnaA, was used to create and analyze sound level contours for the site. The model takes into account relevant parameters between the noise source and receptor positions of interest to predict how sound will propagate. In addition to distance attenuation, the model accounts for the effects of terrain, various types of ground cover, shielding by structures, and reflections from buildings. The modelling software provides A-weighted sound emission contours (in 1 dB increments) for an ear-height elevation typical of a standing observer, 5 feet above grade. The model also tabulates sound emissions received at selected nearby receptors, Locations B through G. All Locations represent worst-case sound emissions and typify upper story receptors at the façade, 15 feet above grade, except for Location D which typifies a single story receptor at 5 feet above grade. Location A is reserved for future use. Calculations are carried out in octave frequency bands.

As discussed previously, site noise will comprise HVAC sound and intermittent vehicle traffic on site. The contribution of each type of source was calculated separately and then combined to be compared to code limits and the project criteria.

Rooftop HVAC Equipment Sound

Rooftop HVAC equipment produces noise that is steady in nature, and hence will not vary over time. Based on our experience with other projects, a good approximation for a facility of this size is to assume fifty-six (56) 25-ton HVAC units distributed on the rooftop of the facility. The sound power level for each of these was assumed to be 96 dB(A) re 1 picowatt based on typical manufacturer's sound data.

The noise from the 56 rooftop units was included in the HVAC acoustical model, and were placed 4 feet above the rooftop in a layout based on a similar, completed facility. Sound from the sources was projected to nearby receptors. Figure 2 shows the results graphically and tabulates the summed A-weighted sound levels at the six discrete Locations. Buildings are shown in white, sound barriers are shown in light blue, and HVAC noise sources are shown as blue "+"s. The property line is outlined in red, and the Niagara River to the west is represented by a blue diagonal hatch.

The results show that with all 56 rooftop units operating, HVAC sound levels off site are at or below 37 dB(A). Noise from HVAC meet local code limits by margins of 13 dB(A) or more. As a result, HVAC sound will not have no acoustical impact per DEC guidelines and will likely be inaudible or hard to discern in the presence of traffic flow on the Niagara Thruway.

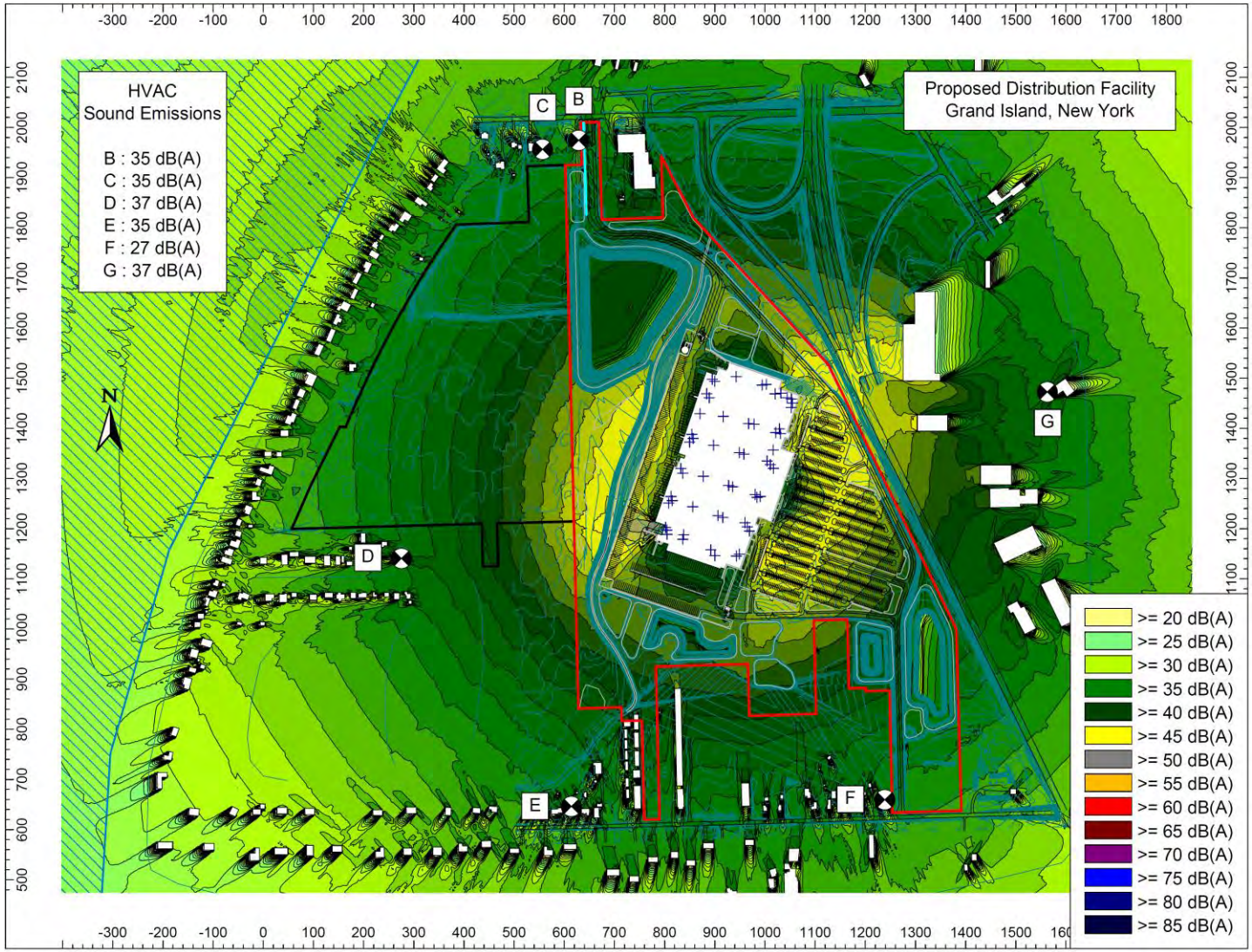

Figure 2 — A-weighted sound emission contours, 5 feet above grade, for sound from rooftop HVAC equipment. Each of the 56 rooftop units shown with a blue + sign. Buildings shown in white, sound barrier shown in light blue, and approximate site boundary outlined in red. Sound emissions tabulated at 5 feet above grade for Location D. All other Locations are 15 feet above grade.

Motor Vehicle Sound

Maximum site sound levels from transient motor vehicles should also be scrutinized for comparison to project criteria. To evaluate these sound emissions, the acoustical model included representative sources modeled at their maximum sound level. Heavy truck activity at dock and trailer areas can routinely contribute maximum sound levels of about 79 dB(A) at 50 feet, at a source height of 8 feet above grade. This includes movements, air brakes, coupling/decoupling, and back-up alarms. A driving truck contributes slightly lower maximum sound levels of about 74 dB(A) at 50 feet. Personnel vehicles traveling at low speeds are better typified by maximum sound levels of 59 dB(A) at 50 feet. Personnel vehicle noise sources were modelled at 3½ feet above grade. Note that all of these maximum sound emissions comply with the local and State motor vehicle noise limit of 85 dB(A) at 50 feet.

The worst-case peak hourly traffic movements for personnel vehicles occur from 0630-to-0730 where on average 643 vehicles are expected. This equates to 107 vehicles over a 10 minute period. Truck movements are less frequent and are expected to have peak activity around 0900 where the site will see about 4 trucks every 10 minutes. By design, worst case peak activity from personnel vehicles and trucks will not overlap and hence were analyzed separately. To be conservative, traffic counts over 10 minute durations were modelled with each personnel vehicle and heavy truck source at maximum sound levels. In reality, multiple maximums events will rarely synchronize in time in this manner. Figure 3 shows the results of 107 personnel vehicles over a 10 minute period combined with the HVAC model to represent worst-case personnel vehicle sound emissions. Similarly, Figure 4 shows the results of five trucks modelled, two heavy truck activity events and three driving truck movements, combined with the HVAC model to represent worst case heavy truck sound emissions. Truck activity events are shown as white "+"s while driving truck movements are shown as pink "+"s. Personnel vehicles are shown as green "+"s. Maximum sound levels from personnel vehicles and HVAC equipment range from 38-to-51 dB(A) at receptors; maximum sound levels from trucks with HVAC equipment operating range from 34-to-57 dB(A) at receptors.

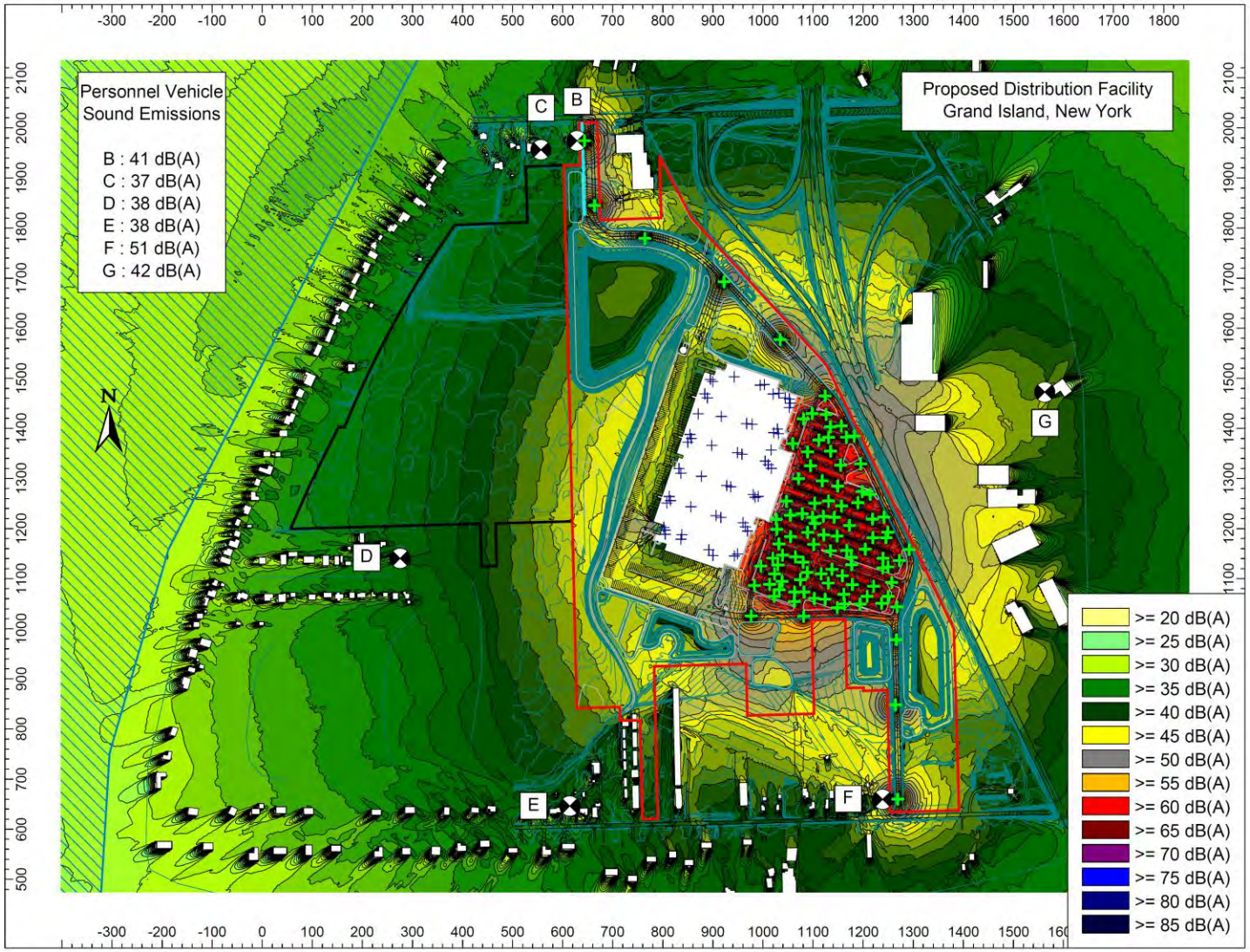

Figure 3 — A-weighted sound level contours expected for worst case personnel vehicle sound emissions: 56 HVAC units (blue +) and 107 vehicles (green +). Buildings shown in white, sound barrier shown in light blue, and the approximate site boundary outlined in red. Sound emissions tabulated at 5 feet above grade for Location D. All other Locations are 15 feet above grade.

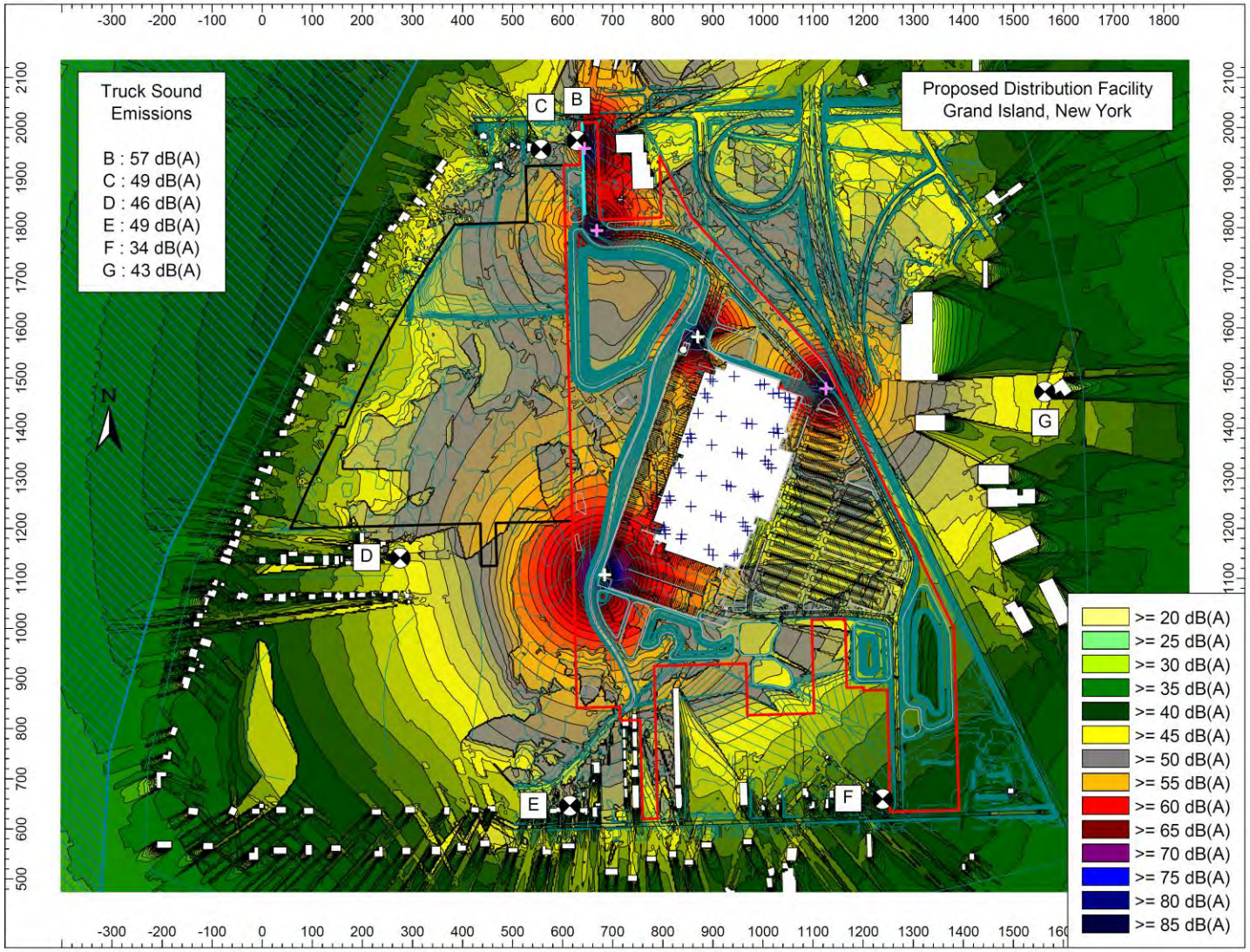

Figure 4 — A-weighted sound level contours expected for worst case truck sound emissions: 56 HVAC units (blue +), two truck activity events (white +), and three truck movements (pink +). Buildings shown in white, sound barrier shown in light blue, and the approximate site boundary outlined in red. Sound emissions tabulated at 5 feet above grade for Location D. All other Locations are 15 feet above grade.

To be conservative, although peak traffic counts occur during the daytime, results were compared to recommended nighttime criteria at residential receptors. Table 1 compares the project criteria with the highest maximum model results for each Location.

Table 1 — Project criteria compared to worst-case maximum site sound emissions at receptors for personnel vehicle and heavy truck sound emissions, A-weighted sound pressure levels in dB re 20μPa.

Location	Project Criteria	Personnel Vehicle Maximum	Heavy Truck Maximum
B	55	41	57
C	55	37	49
D	50	38	46
E	50	38	49
F	50	51	34
G	50	42	43

Results show that anticipated worst-case maximum site sound levels meet the intent of the nighttime project criteria at all Locations. Locations B and F show sound levels slightly above project criteria but differences of 1-to-2 dB(A) are not detectable or expected to result in a negative acoustical impact. As noted above, the DEC, in its impact guidelines, states that an increase in ambient sound levels by 0-to-3 dB should have no appreciable effect on receptors. In addition, at most locations the worst-case intermittent maximum site sound emissions complies with local nighttime code limits for steady noise. All motor vehicle noise fully complies with local and State motor vehicle sound limits.

ADDITIONAL CONSIDERATIONS

This sound study assessed back-up alarms as typical tonal alarms most commonly seen. Results from the study show that despite this inclusion, no negative acoustical impact is anticipated. Regardless, back-up alarm alternatives are recommended for switcher engines or trucks (terminal tractors) directly under control of the site tenant because they are responsible for the majority of backup movements on site. These alternative alarms in the form of smart, ambient sensing, multi-frequency back-up alarms. This type of alarm is commonly called a "shusher" alarm due to the type of noise it produces. These are available from a variety of manufacturers and reduce annoyance generated from constant level, pure tone, "beeping" back-up alarms. The reduction in annoyance is accomplished in two ways:

- A broadband "shushing" sound is less intrusive and annoying than a pure tone "beeping" sound since, at a distance, it can blend in easier with other ambient sounds.

- The smart, ambient-sensing feature allows back-up alarms to operate safely and effectively at far lower sound levels than typical brute-force, constant level devices. The smart alarms sample ambient background noise and adjust the warning signal to be 5-to-10 dB higher than the background sound level, therefore reducing levels nearby and off-site.

Although construction conditions are temporary in nature, it is worth discussing considerations to minimize the acoustical impact of this activity. It should be noted that the Town of Grand Island prohibits the operation of heavy construction equipment outside the hours of 0700-to-1900 Monday to Saturday in its noise ordinance. While the construction of the proposed project will conform with these requirements, earth moving equipment used during the civil construction phase of the project can be close to nearby residential receptors. Construction equipment, such as bulldozers, front end loaders, and dump trucks, can typically produce maximum sound levels of 80 dB(A) at 50 feet. To minimize receptor exposure to construction noise during this phase, the project proposes to implement the following construction noise control strategies:

- Limit all heavy equipment operation to non-noise-sensitive daytime hours and follow allowable town construction hours.

- If possible, limit the number of equipment operating near one receptor at a given time. Avoid exposing any one receptor to high sound levels for an extended period of time.

- Place stationary equipment, such as generators, compressors, and office trailers, away from noise-sensitive receptors.

- Avoid having construction parking or laydown areas near noise-sensitive receptors.

CONCLUSION

The storage and distribution facility site planned for Grand Island, NY is proposed on undeveloped land, industrially zoned, and situated between residential receptors and a major highway. The construction of the storage and distribution facility would bring personnel vehicle and truck activity near noise-sensitive receptors which is a potential acoustical concern. Grand Island limits noise from a facility such as this to 50 dB(A) for steady sources, such as HVAC equipment. The Town and State provide sound limits for transient sources, but do so relative to the noise source, not the receptor. As a result, appropriate project criteria at nearby residential receptors were established for personnel vehicles and heavy trucks during the nighttime hours. At northern noise-sensitive receptors, site sound should not exceed 55 dB(A); site sound should not exceed 50 dB(A) at the western and southern noise-sensitive receptors.

Analyses show that HVAC sound meets the applicable nighttime code limit. Sound from personnel vehicles and heavy trucks will meet the intent of the project goal due to distance, site geometry, and proposed sound barriers. In addition, motor vehicle sound is expected to be similar in level to what currently exists, and hence will have no negative effect on the surroundings.

Using the layout and sound barriers proposed will put the site in the best position to minimize the acoustical impact of the site. Given the results of this analysis, on-site noise is not expected to have a negative acoustical impact per DEC guidelines. HVAC and motor vehicle sound will comply with all local and State noise codes, as well as the intent of recommended project criteria.

EXHIBIT L
Emergency Services Assessment
Proposed Warehouse Distribution Facility Project
2780 Long Road
Town of Grand Island, Erie County, New York

This section reviews the existing capabilities and resources of local, county and/or regional agencies potentially providing police, fire and emergency medical services ("EMS") for the Site. As discussed herein, the Project as proposed does not pose a significant adverse impact to the resources of these important first responder agencies. For your convenience, please find below an overview of the existing conditions at each first responder agency, including the closest facilities to the Project site and estimated response time, as well as a discussion of potential impacts.

POLICE DEPARTMENT

Existing Conditions

The Town is served by five police agencies, as follows:

1. Grand Island Town Police ("Town Police")
2. Erie County Sheriff's Office ("Sheriff")
3. New York State Police ("State Police")
4. New York State Park Police ("Park Police)"
5. U.S. Customs and Border Protection.

The Town Police has approximately 23 part-time officers. The Town Police substation is located at 1856 Whitehaven Road. Although the substation is not staffed on a 24 hour, seven day a week ("24/7") basis, on-duty officers are available to respond to a call for Town Police. In addition to dialing 911 for police service, on-duty officers may be reached via the phone located near the door of the substation. Town property taxes contribute to funding the Town Police. The Site is located less than three miles from the substation with an estimated time of five minutes for police response from the substation to the Site via I-190 or NY-324.

The Sheriff provides road patrol services on Grand Island. The Town is located in Road Patrol District 1, which has its office at 1856 Whitehaven Road. This office has one detective at the office. Typically there are two officers on road patrol The Site is less than three miles from the Road Patrol District 1 Office and the estimated time for police response of approximately from the District 1 Office to the Site via I-190 or NY-324 is approximately five minutes.

During the day, the maximum number of police officers from all agencies is approximately seven or eight officers.

The State Police patrols the Thruway (I-190). Grand Island is located under the jurisdiction of Troop A. The closest Troop A station to the Site is the Zone 2 station located in Grand Island Town Hall at 2255 Baseline Road, approximately three miles from the Site, approximately five minutes travel time. Other police agencies include the Park Police patrolling State Parks and U.S. Customs and Border Protection although it is not anticipated these agencies would respond to the Facility.

Potential Impacts

Security measures shall be implemented at the Project Site, including and not necessarily limited to, gates and guardhouses, video surveillance, alarms, a loss prevention program to minimize theft, and internal training of staff. Security measures specific to visitors and employees include identification badges for employees, guest sign in and escort, and trailer parking area access limited by guardhouses. Such security measures would be fully implemented and function on a 24/7 basis. The Town Police will have the opportunity to review the application, the procedures and provide input on plans to address any concerns.

While there is no anticipated need for additional police manpower at the Project site, it is acknowledged that there may be calls generated by the Facility operations. While there could be the potential increase in the need for police services due to the proposed use at the Project site, it is anticipated that due to the on-Site security measures to be implemented at the Facility and the Site, any such potential impacts will not be significant. Based on the proposed security measures for the Site, there will not be a potential significant adverse impact to the police departments and their ability to provide police services for the Project Site.

FIRE DEPARTMENT AND EMERGENCY MEDICAL SERVICES

Existing Conditions

EMS for the Site is provided by the Grand Island Fire Company ("GIFC"), a volunteer fire department. GIFC contracts with the Town of Grand Island to provide fire protection services. The GIFC has three stations serving its coverage area:

(1) GIFC Headquarters: located at 2275 Baseline Road, approximately 2.6 miles south of the Site;
(2) GIFC Station 2 located at 3293 Stony Point Road, approximately 2.8 miles east of the Site; and
(3) GIFC Station 3: located at 790 Baseline Road, approximately 5.1 miles south of the Site.

GIFC maintains a fleet of 24 response vehicles. Available fire department apparatus types include aerial fire apparatus, pumper, rescue vehicle, marine rescue and fire fighting vehicle, special services fire apparatus utility vehicle and ice rescue apparatus.

Intensive training and regularly scheduled drills assure the highest levels of proficiency in all operational facets of GIFC. Specialized 'Jaws of Life' extrication equipment, basic hazardous material coverage, marine rescue capabilities, and mutual aid participation, also represent the ever expanding role of GIFC. The Company also provides services for public relations and community events. In the event of a fire, all three stations respond. EMS calls are answered by GIFC Headquarters or a closer station. As of now, members respond in their personal vehicle and some will get apparatus from one of the stations.

The GIFC has 82 active volunteer members, including three doctors, 14 paramedics, and 46 emergency medical technicians (EMT). These members provide critical Basic Life Support ("BLS") and Advanced Life Support ("ALS") on a daily basis. Extensive use of state of the art technology, including Automatic External Defibrillators ("AED") and 12 Lead Cardiac Monitors, further enhancing overall effectiveness of the GIFC

in life threatening situations. In addition, the GIFC has its own state of the art NexGen 9-1-1 dispatching center. GIFC handles approximately 1,600 emergency calls per year. Twin City Ambulance provides a paramedic level ambulance to all EMS calls since GIFC does not transport patients.

GIFC operates as a non-transporting advanced Life Support/First Responder ("ALS"/"FR") response agency for the delivery of EMS. All logistical support services exist under the overall logistical services of the GIFC. Personnel with NYS Department of Health certifications are able to provide emergency medical services up to the ALS level. Personnel are dispatched to emergency medical incidents such as medical emergencies, motor vehicle accidents, carbon monoxide calls and hazardous material incidents. All personnel are responsible for inspection of medical equipment during scheduled vehicle checks or after each use of any medical equipment. Supplies are replenished from the general station stock or purchased following department purchasing policy.

Medical control for the GIFC is provided by the receiving hospital or as otherwise dictated by protocols. GIFC additionally has the privilege of having three medical directors. These physicians are volunteer members of the Company much the same as the volunteer firefighters serving the Town.

Potential Impacts

The Utility Plan (Site Plan Drawing Nos. CU100-CU107, bound separately) indicates the location of fire hydrants, fire riser rooms, and .fire pump discharge to tie into the internal fire service loop. The Facility includes the provision of well labeled sprinkler and standpipe connections on the outside of the Facility. As required by the NYS Fire Code, multiple points of access to the building will be provided allowing for alternate routes of entry and exit in the event of an emergency.

To avoid a situation when unnecessary hose lays block other apparatus from setting up at the scene, which could create an adverse impact in fighting a fire, it is also important to confirm where on-site hydrants are located. GIFC will have the opportunity to provide comment on the site plan to address potential issues such as the location of on-site hydrants. Also necessary is 360-degree access to the building so the proper apparatus can reach where they need to be situated. Large paved surfaces around the warehouse building will facilitate safe circulation as these trucks weigh a significant amount and need solid surfaces to set up on. GIFC acknowledges the Facility would be the largest structure in the Town and are trained on scaling up an incident as required with the assistance of mutual aid from the City of Tonawanda, Town of Tonawanda (six fire companies) and beyond if necessary.

The Facility will be equipped with two completely independent and redundant automatic fire water supplies, each of sufficient capacity, reliability, and duration to serve automatic fire sprinkler systems in the facility in accordance with NFPA 13, NFPA 24, and all local requirements. The fire suppression water supply source will need to meet the greater of the sprinkler hose demand and the fire flow demand. All sprinkler systems and fire alarm components such as smoke detectors and pull stations will be properly labeled. This will allow the fire department to quickly locate activated alarms and minimize the facility's evacuation time.

The proposed access driveways will be designed to accommodate fire engines. Emergency vehicle access will be provided around the building and fire lanes will be provided at appropriate locations around the building in accordance with the Town Code.

GIFC will have the opportunity to review plans for the new construction and provide its input, to identify any potential issues. GIFC review can also be useful to determine equipment requirements when needed. Review of plans would help to confirm that GIFC equipment can have access to the Site and the necessary space requirements for the apparatus is available.

Enhanced and state-of-the art fire protection measures shall be implemented at the Site. A review with GIFC regarding the site plans and a determination of equipment requirements for the Project will be completed.

Accordingly, any potential impacts will not be significant and can be appropriately addressed within the existing resources of the GIFC. Based on the foregoing, the Project will not pose a significant adverse impact to the GIFC in carrying out fire protection and EMS duties at the Site.

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