CITY OF NEWPORT
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COUNCIL WORKSHOP AGENDA
December 1, 2022- Immediately following the Regular City Council Meeting

1. CALL TO ORDER
2. ROLL CALL
3. SANITARY SEWER CAPACITY
4. FUTURE MEETING AGENDA ITEMS
5. ADJOURNMENT

Technical Memo

To:	Travis Brierley, Interim City Administrator
	Matt Yokiel, Supt. of Public Works
From:	Jon Herdegen, P.E. – City Engineer
Prepared By:	Amber Converse, Samantha Swartz, and Eric Thompson, P.E.
Subject:	Sanitary Utility Extension for Bailey Farm Area Development and Future Developments
Date:	October 28, 2022

Purpose

The purpose of this memo is to summarize the findings of a capacity assessment of a portion of the City's trunk sanitary sewer system in order to help guide decisions regarding approval of a sewer extension to serve the Bailey Development and other future development sites within the City.

Background

The City of Newport owns and operates a sanitary system which serves the majority of residents within its municipal boundary. A main trunkline system conveys the sanitary flows north to south, ultimately connecting to the Metropolitan Council Environmental Services (MCES) lift station (see **Figure 1**). The City's system has several city-owned lift stations pumping sanitary flows to the trunkline in locations where the topography does not allow for gravity flow. One of these lift stations, LS #1 located on 15th Street, is on-line with the main trunk line.

The City of Newport continues to grow, and it is necessary to ascertain the existing trunk line capacity to determine if the system can handle additional wastewater flows. It is important to understand that sanitary sewer systems are not perfectly sealed. During, and subsequent to, wet weather conditions, additional flows can 'leak' into the sanitary sewer such that the sewer is conveying more than just wastewater generated by human activity. This leakage is commonly defined as infiltration and inflow (I&I). Infiltration describes leakage attributable to water within the soil, either as high groundwater or as saturated soils from rainfall events. Inflow typically describes leakage attributable to a direct-runoff contribution, such as an open manhole lid or a directly connected roof downspout or foundation drain. Newport has historically experienced high I&I, and efforts are underway to seal older pipe segments by lining them. However, since this is an on-going endeavor, it will take many years to determine the level of improvement associated with lining projects.

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For this study, MSA conducted a steady-state analysis of the sanitary sewer pipes by comparing the full-flow-capacity with the design flow rates within the area of interest. The design flow rates were obtained by measuring dry-weather inflows in select pump stations and multiplying the inflows with a wet-weather peaking factor, which represented I&I under specific rainfall and groundwater conditions. It is acknowledged that this approach is relatively simplistic when compared to a complete dynamic hydraulic model. A full hydraulic model would be capable of evaluating groundwater influences, wet weather inputs that are event-based (i.e. 10-yr or 25-yr), hydrograph timing and attenuation, as well as comparisons between calculated hydraulic grade lines against system failure points like basement elevations. However, these types of assessments are much more expensive, take longer to prepare, and typically require a substantial amount of flow metering to complete.

Even though the spreadsheet tool completed for this study is less complex, it provides the City with an affordable way to understand the existing trunk sewer capacity and to identify 'pinch points', or locations where the system's capacity is restricted. This will guide decision making efforts on future growth and development within the City.

Methods

Identification of Trunkline and Creation of Sewersheds

The City maintains a map of their utility networks in a Geographic Information System (GIS). The main trunkline of the sanitary system was identified (see **Figure 1**), and data was extracted as necessary to calculate the pipe capacity. Currently, the City's GIS data does not have pipe inverts encoded; therefore, MSA reviewed all plan sets and as-built documents in order to obtain pipe elevations in the main trunkline. Side branches within the system were not reviewed for elevations.

Manholes were identified along the trunkline where a branch connects and brings flows from a developed area. Once each branch connection point was established, an associated sewershed was created. The sewershed boundaries were created within GIS. The GIS sanitary system map does not contain a complete set of lateral connection pipes; therefore sewershed boundaries were assumed based on likely connection point (typically assuming that sanitary laterals extended from the front of buildings/structures). It was assumed that all of the sanitary flows originating within the sewershed would connect to the main trunkline at the specified connection point (see **Figure 2**).

Land Use Classification and Scaled Sanitary Design Flows

A land use dataset was created to cover all of the sewershed boundaries (see **Figure 3**). Land uses were based on GIS parcel data, aerial photography and Google Street View. Land uses classifications were used to estimate sanitary sewer loads originating from each parcel. It was not within this project's scope or budget to measure actual sanitary loads, except at select pump stations which typically collect flows from multiple lots of various sizes. It was assumed that sanitary loads would be proportional to the design flows provided within the Minnesota Administrative Rules Part 7081.0130. The design flows estimates are based on land use combined with another metric (e.g. building square footage, number of employees, number of customers, etc). Number of dwelling units was assigned by parcel address point information or Google Street View. Number of employees was not available for most of the non-residential land use classifications; therefore building square footage was used, based on measured GIS building footprint information collected by Microsoft (2018), and employee numbers were estimated according to building information.

Since the design flow estimates are generalized (and not specific to Newport), three separate measurements of the inflows at LS #1 were recorded during dry weather conditions (ie. no rain in the prior 3 days) to be used as a sum total for purposes of extrapolating parcel-based wastewater flow generation rates. All of the parcels within sewersheds upstream of LS #1 were combined using the design flows listed in **Table 1**. Then, a single scaling factor was applied across all of the different land use types, so that the estimated flows matched what was observed at LS #1. **Table 1** below shows the land use classifications, and their estimated sanitary load contribution before and after scaling to match the dry weather flow inflow rates at LS #1.

Table 1
Estimated sanitary flows by land use classification

Land Use	Unit	Design Flow (gallons/day/unit)*	Scaling Factor	Scaled Designed Flow (gallons/day/unit)**
Single Family Residential	dwelling unit	220	65%	143
Duplex	dwelling unit	220	65%	143
1/2 Duplex	dwelling unit	220	65%	143
Multi-family Residential	dwelling unit	220	65%	143
Residential, No Unit	*na*	*0*	*65%*	*0*
Vacant Residential	*na*	*0*	*65%*	*0*
Strip Commercial	square foot	0.13	65%	0.08
Industrial	square foot	0.13	65%	0.08
Restaurant	square foot	0.5	65%	0.33
Office Building	square foot	0.18	65%	0.12
Motel	square foot	0.33	65%	0.21
Church	square foot	0.13	65%	0.08
Dentist	square foot	1.1	65%	0.72
Municipal Parcel	employee	18	65%	11.70
School	student	18	65%	11.70
Undeveloped	*na*	*0*	*65%*	*0*
Parking Lot	*na*	*0*	*65%*	*0*
Storage Building	*na*	*0*	*65%*	*0*
Park	*na*	*0*	*65%*	*0*
RR	*na*	*0*	*65%*	*0*

**Design flows based on Minnesota Administrative Rules Part 7081.0130. Industrial flows assumed to be similar to a retail store. Municipal building assumed to be similar to an office building. Church assumed to be similar to a retail store.*

***Three (3) measurements of dry weather inflows were taken at LS#1. All of the land use specific design flows were reduced to match the observed inflows at this location.*

Lift Station Refill Rates, Draw down Rates and Pumping Rates
Newport has eight lift stations pumping wastewater flows from low to high elevations through a pressurized system. Flows in the sanitary sewers downstream of the lift station are controlled to a degree by the pumping capacity at the lift station. A conservative approach for estimating the piped system capacity is to assume that **all** of the pump stations would be operating at their maximum pumping capacity at the same time.

This could be expected to happen if there was high I&I condition, as might be expected under design conditions. To understand how these lift stations are currently operating during dry weather conditions, measurements were taken at all of the lift stations shown in **Table 2** below. LS #1 had three tests completed, and **Table 2** shows the average value from each test for that location.

Table 2

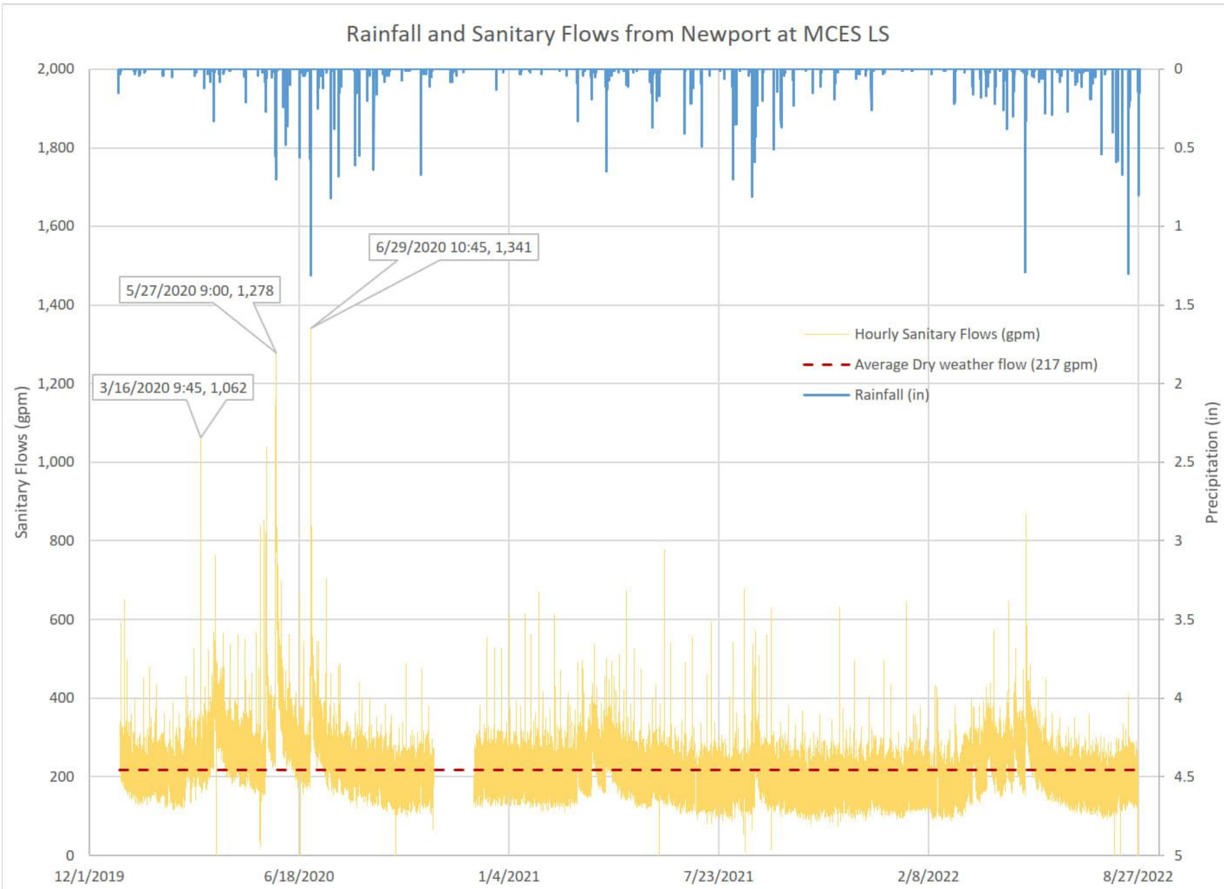
Summer 2022 Lift Station Dry Weather Draw Down Test Results

Sewershed	Name	Refill Rate (gpd)	Drawdown Rate (gpd)	Pumping Rate (gpd)
LS #1	15th St LS Pump 1	302,400	370,656	673,022
	15th St LS Pump 2	299,856	367,200	667,080
LS #2	12 St LS Pump 1	4,752	253,728	258,365
	12 St LS Pump 2	4,752	257,760	262,397
LS #3	5th St LS Pump 1	5,472	153,216	158,674
	5th St LS Pump 2	5,472	157,680	163,123
LS #4	17th St LS Pump 1	9,360	338,256	347,544
	17th St LS Pump 2	9,360	386,496	395,870
LS #5	12 St and 10th Ave Pump 1	7,344	148,896	156,197
	12 St and 10th Ave Pump 2	7,344	113,616	120,989
LS #6	Maxwell Ave Pump 1	5,616	310,896	316,454
	Maxwell Ave Pump 2	5,616	304,416	309,974
LS #7	Maxwell Ave Pump 1	13,824	408,816	422,755
	Maxwell Ave Pump 2	13,824	355,824	369,662

Peaking Factor during Wet Weather Events
Newport is known to have concerns with infiltration. The entire sanitary system flows to the MCES lift station, so there are historical records showing wastewater flows increase substantially during wet weather conditions. MCES provided historical data for this study, down to the 15 minute increments. This data, coupled with rainfall data collected across the river at the municipal airport (NOAA, South Saint Paul Municipal Richard E Fleming Field Airport, WBAN: 72660304974) was used to determine a 'peaking factor' for wet weather events.

Graph 1 displays the historical data from January 2020 through August 2022. Newport plans to implement a sanitary sewer lateral lining project in the spring/summer of 2023. A trunkline lining project was completed in 2012.

Graph 1



Three large peak flow events are called out in **Graph 1**. The largest was on June 29th, 2020 with a peak measured flow of 1,341 gpm (flows are recorded at 15-minute intervals).

The Minnesota Pollution Control Agency (MPCA) states that for an existing collection system, analysis for the capacity should be based on the "*the peak instantaneous flow during the day at a time when the ground water is high and a twenty-five year one-hour storm event is occurring.*" For the City of Newport (using NOAA Atlas 14) the 25-yr 1-hr storm event is 2.64 inches of precipitation.

This study used the 6/28 – 6/29/20 rainfall event as a proxy for the 25-year one-hour storm event. The event duration was longer than on hour (beginning at 6pm on 6/28 and ending at 12pm on 6/29) but approximately 4.5 inches of rain fell within the first 12-hours of the storm. This is close, albeit less, than the 25-yr 12-hr event, which is 4.98 inches according to NOAA Atlas 14. Therefore, it is a reasonable proxy for this analysis.

The MCES lift station measurements show a sharp increase in sanitary flows beginning at 3am on 6/29/20. The 15-minute incremental measurements were averaged to the hour, and the peak hourly measurement during this storm was 1,134 gpm. The average dry weather flow for Newport (determined using only those measurements recorded without any precipitation in the prior 3 days) was 217 gpm. Therefore, a peaking factor of 5.2 was selected for Newport (1134/217 = 5.2), based on this relatively short historical dataset. Dry weather flows (estimated from land use) were therefore increased by a factor of 5.2 to simulate design wet weather conditions.

Note that while this was the largest rainfall event to occur within the time range of data provided (Jan 2020 – August 2022), there were several other large events, even within the same year (2020). Therefore, although this rain event does constituent a large storm, it is anticipated that storms of a similar or greater intensity are likely to occur in Newport and will potentially put more strain on the sanitary infrastructure.

It bears repeating that this study estimated system design flows based on measured dry-weather flows multiplied by a peaking factor of 5.2 which was obtained from measured wet weather flows. The event from which the 5.2 peaking factor was derived was close-to, but less than, a 25-yr event which is MPCA's recommended design standard. Further, the flow data from which the 5.2 value was calculated was originally collected at 15-minute increments and averaged over a 1-hour period. It is possible the true instantaneous peak of this event was not recorded, and even if it was, the aggregation of the 15-minute data to a one hour average further damped the actual measured peak. As a result, the effective peaking factor for Newport is most likely higher than 5.2.

Existing Conditions Wet Weather Flow Analysis

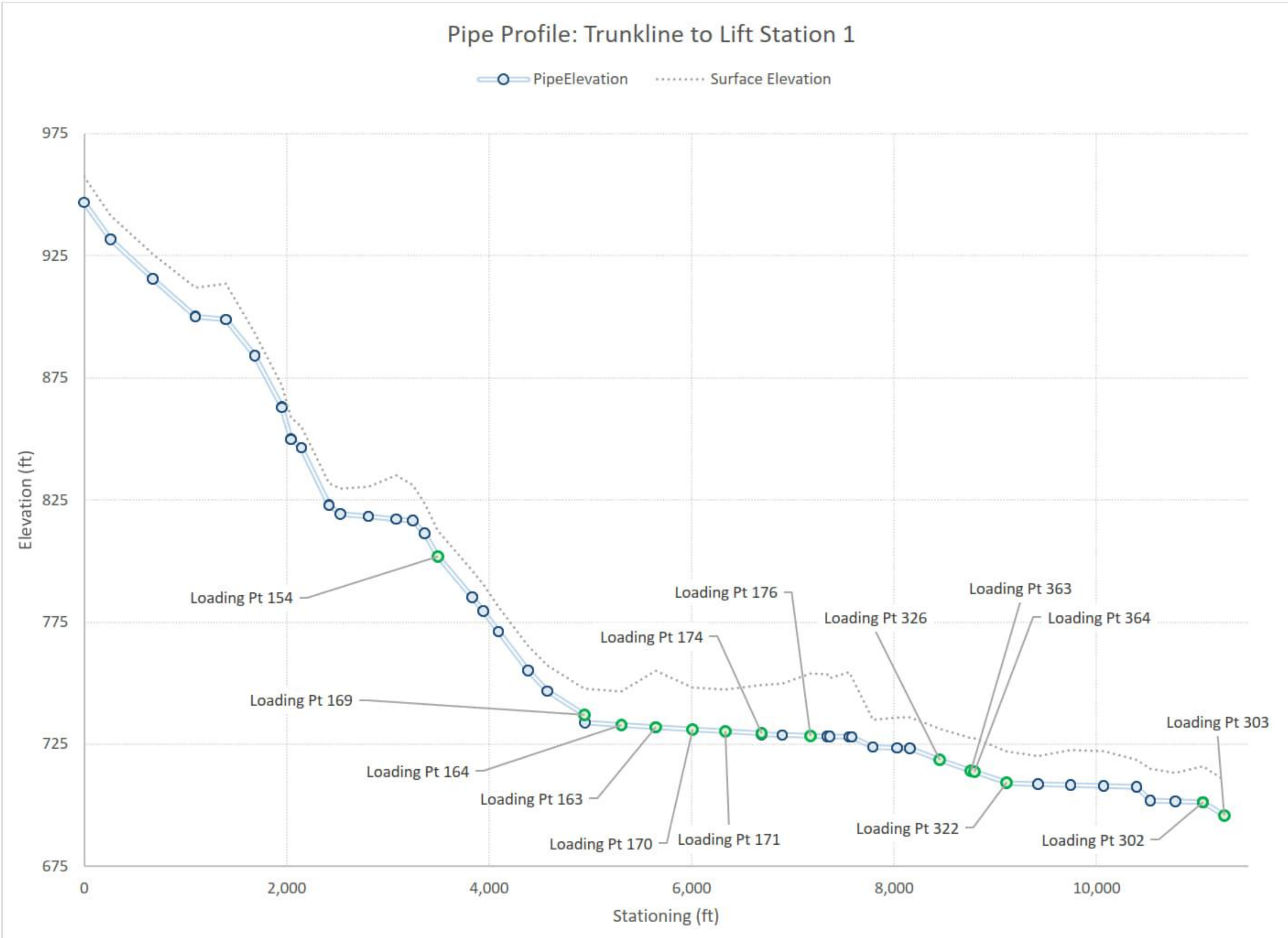
The dry weather flows (estimated by land use) and the wet weather flows (estimated using the peaking factor) were combined and applied to each sanitary sewershed at the appropriate connection point, and cumulative flows were calculated from the sanitary sewer trunk line. Pipe capacity was calculated using Manning's Equation based on the pipe diameter and slope, and then compared to cumulative the potential wet weather flows.

The goal of this exercise is to determine if the system has capacity during a large storm event. It does not account for the timing of loads to each location, and cannot predict the location of potential sanitary sewer backups. However, it does provide insight into "pinch points" within the sanitary system trunkline that might be at/near capacity and adding in additional development would be ill advised.

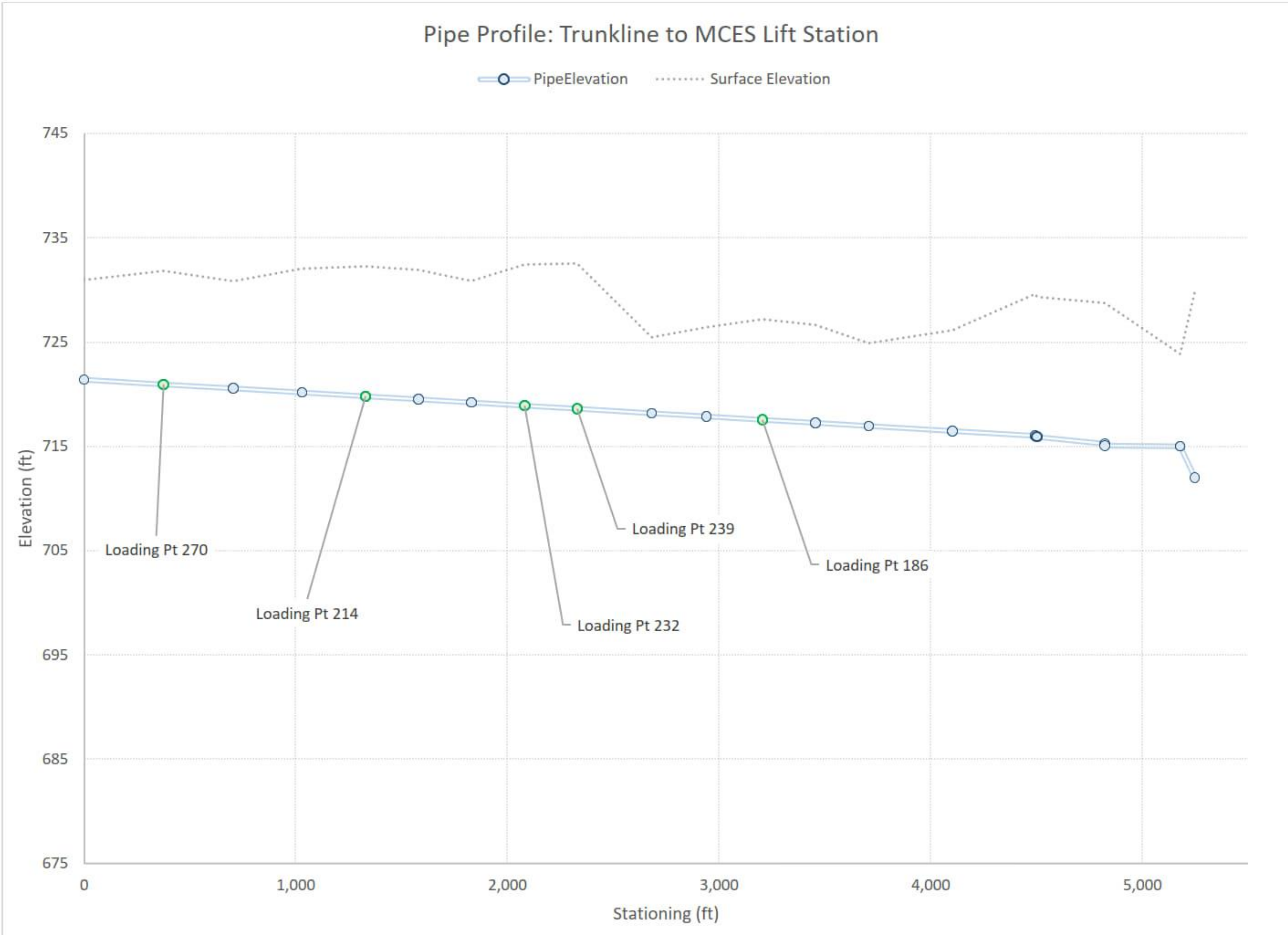
Figure 4 shows the results of the existing trunkline capacity analysis during wet weather conditions, as described above. Note that the system is nearing capacity along the main trunkline of the system along 2nd Ave, immediately upstream of LS #1 (between 17th and 15th Streets). Using this approach, this segment of sewer is already past capacity during wet weather conditions.

Graph 3 shows the trunkline profile of the gravity sewer downstream of LS #1 to the MCES LS. The trunkline system had capacity during the wet weather conditions. The last pipe segment (connecting to the MCES LS) did not have an invert however; therefore the capacity of that pipe could not be determined.

Graph 2


Pipe Profile: Trunkline to Lift Station 1
PipeElevation
Surface Elevation
Elevation (ft)
975
925
875
825
775
725
675
0
2,000
4,000
6,000
8,000
10,000
Stationing (ft)
Loading Pt 154
Loading Pt 169
Loading Pt 164
Loading Pt 163
Loading Pt 170
Loading Pt 171
Loading Pt 174
Loading Pt 176
Loading Pt 326
Loading Pt 322
Loading Pt 363
Loading Pt 364
Loading Pt 302
Loading Pt 303

Graph 3


Pipe Profile: Trunkline to MCES Lift Station
PipeElevation
Surface Elevation
745
735
725
715
705
695
685
675
Elevation (ft)
0
1,000
2,000
3,000
4,000
5,000
Stationing (ft)
Loading Pt 270
Loading Pt 214
Loading Pt 232
Loading Pt 239
Loading Pt 186

Development Projects

Several new development projects are planned for Newport. To the northeast, the Bailey development would straddle three municipalities (Newport, Maplewood and Woodbury). The developer has requested that the City of Newport evaluate the feasibility of supplying municipal utilities to the portion of the development within both Newport and Maplewood (Woodbury would supply utilities to their portion of the development). The plan is still preliminary at this time, and therefore the developer has not finalized land uses. However, they are anticipating 130,000 sq ft of Mixed Use (in Newport), 144,000 sq ft of Industrial (in Newport), 600,000 sq ft of Industrial (in Maplewood) and 267,000 sq ft of Mini Storage (in Maplewood).

In the south east, a separate development is planned for residential improvements, extending sanitary sewer service to approximately 6 existing single family homes, 26 new single family homes and 108 single/multi-family units.

Table 3 below is an initial estimate of the sanitary loads these new developments might contribute to the system. Note that these loads are simply an estimate at this time, as the developer did not have more specifics on the development design. Since this is new development, a 2.5 multiplier was used to estimate the Peak instantaneous wet weather flow, as per the Minnesota Pollution Control Agency Guidance *("Design flow and loading determination guidelines for wastewater treatment plants", MPCA, January 2019).*

Figure 5 shows the relative location of these developments relative to the existing sanitary system.

Table 3

Proposed Development and Estimated Sanitary Flows (dry and wet weather)

Development Area	Portion of Development	Estimated sq. ft.	Estimated # of dwellings or employees	Unit	Design Flow (gallons/day/unit)	Estimated Design Flow (gpd)	Estimated Average Daily Flow for Development Area (gpd)	Peaking Factor	Estimated Peak Hourly Flow for Development Area (gpd)
Bailey Development*	*Mixed Use (Newport)*	130,000	100	dwelling units	203	20,300	21,200	2.5	53,000
	Industrial (Newport)	144,000	20	employees	20	400			
	Industrial (Maplewood)	600,000	20	employees	20	400			
	Mini Storage (Maplewood)	267,000	5	employees	20	100			
Southeast Development	*Existing Single Family Homes*		6		203	1,218	28,420	2.5	71,050
	New Single Family Homes		26		203	5,278			
	New Single/Multi-Family units		108		203	21,924			

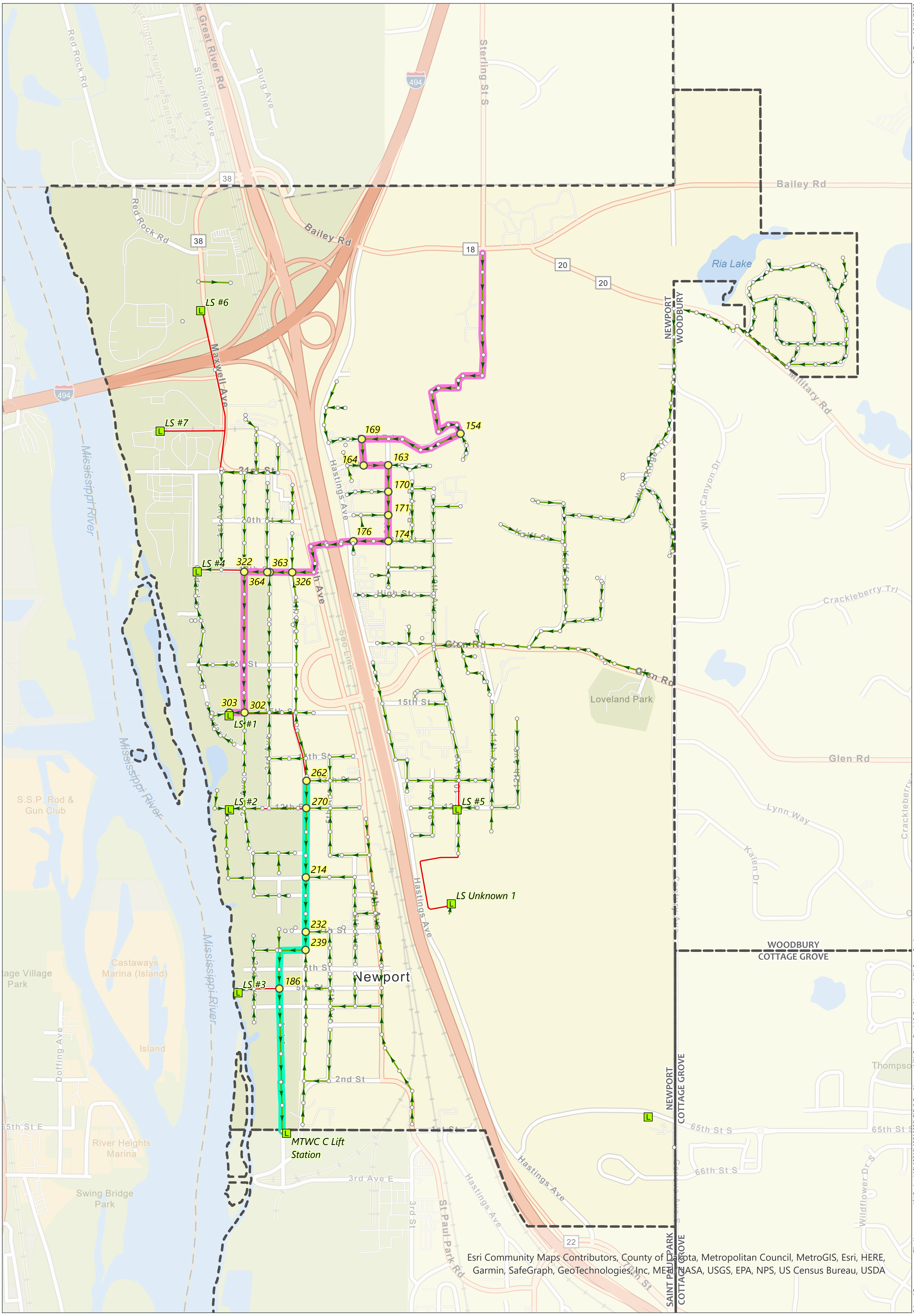
**Note that in general, estimating sanitary loads from non-residential properties is more variable and is highly dependent on how the space is ultimately used. Also, the Mixed Use development did not have a set number of residential units at this point in time, and it was therefore estimated to be ~100 units. This estimate did not account for any additional sanitary flows from any non-residential land uses associated with the mixed use development.*

Proposed Conditions Wet Weather Flow Analysis

The two development areas were added into the analysis along the sanitary system trunkline, to determine if the system would have capacity during wet weather events. **Figure 6** shows the results of the proposed conditions trunkline capacity analysis during wet weather conditions, as described above. The section of trunkline along 2nd Ave is the pinch point in the system, and under capacity.

Summary: This memo is intended to present a planning level evaluation of the feasibility for the City of Newport to extend sanitary utilities to unserved Bailey Development within Newport and the portion within Maplewood, as well as a potential residential development to the south east. It is understood that the sanitary flows from the proposed development are not yet know at this time, but as it stands, the 2nd Ave section of trunkline is nearing capacity during the wet weather events, and therefore it is recommended to increase the pipe capacity between 17th St and 15th St prior to adding in substantial more sanitary flows to the City infrastructure. The current sanitary trunkline in this area is an 18" pipe; increasing the pipe diameter (and keeping the same slope) to a 21" pipe would provide adequate capacity, and increasing it further to a 24" pipe would provide even more security to support future development/growth. Other development opportunities are also on the horizon, and therefore the City should be aware of any potential capacity limitations to ensure that the sanitary system continues to function well.

It is also recommended to complete a study before and after pipes are lined in those areas with known I&I concerns. Reducing both inflow and infiltration within the system will provide more capacity to the system to support development efforts. Knowing the scale/extent of how much lining improves capacity will provide more informed decision making.



MSA

Municipality
Lift Station
Gravity Mains
Northern Trunkline
Connection Point
Pressurized Mains
Southern Trunkline
Manhole

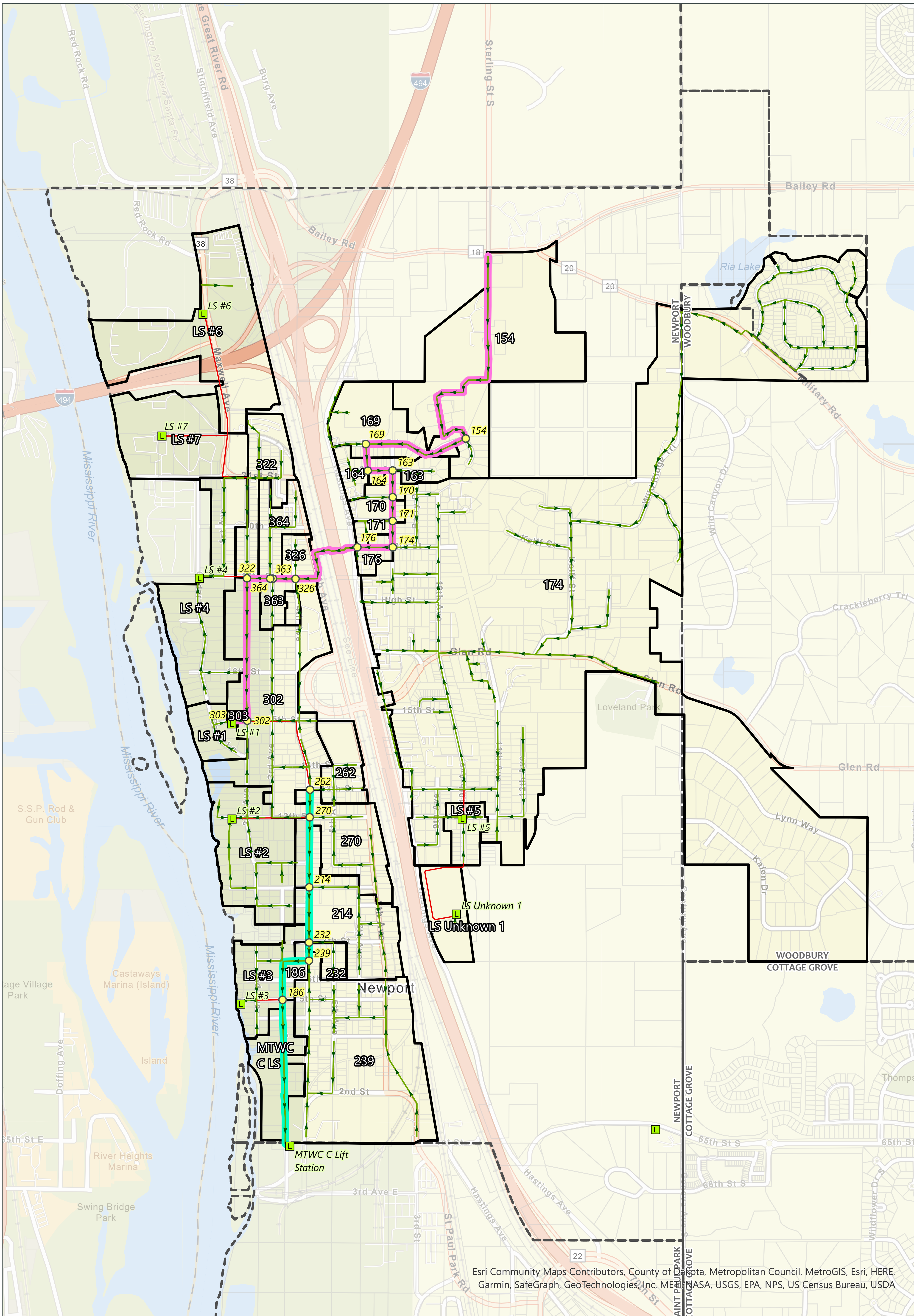
0 600 1,200 Feet

Sanitary System Map

Figure 1

Sewer Capacity Study

City of Newport, Washington County, MN



MSA

Municipality | Lift Station | Gravity Mains | Northern Trunkline
Sewershed | Connection Point | Pressurized Mains | Southern Trunkline

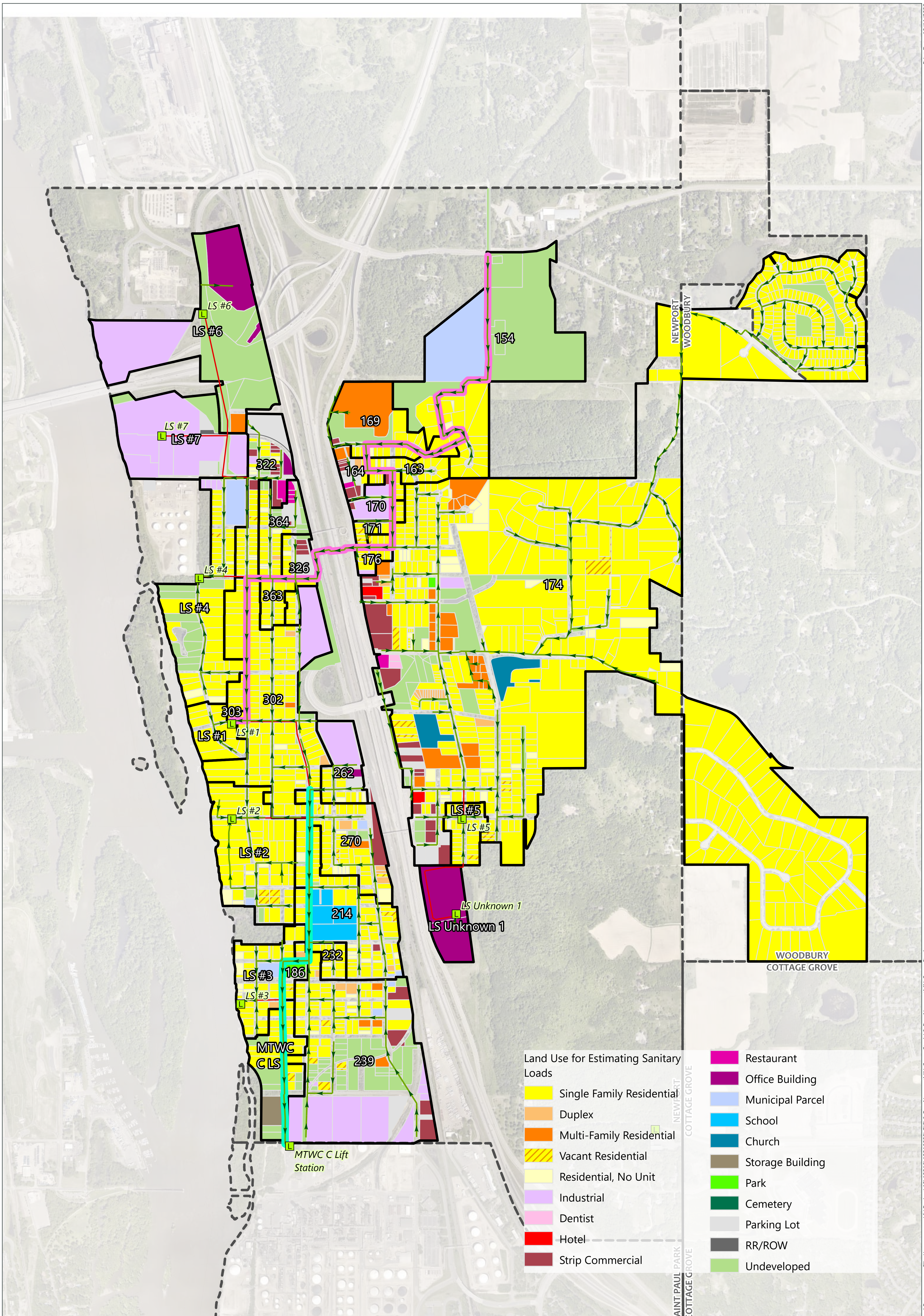
0 600 1,200 Feet

Sewersheds

Figure 2

Sewer Capacity Study

City of Newport, Washington County, MN



Municipality | Lift Station | Gravity Mains | Northern Trunkline
Sewershed | Pressurized Mains | Southern Trunkline

Land Uses

Figure 3
Sewer Capacity Study
City of Newport, Washington County, MN

0 600 1,200 Feet

MSA

- Municipality
- Lift Station
- Pressurized Mains
- No Extra Capacity
- More than 0.5 cfs Capacity
- Non-trunkline Gravity Mains

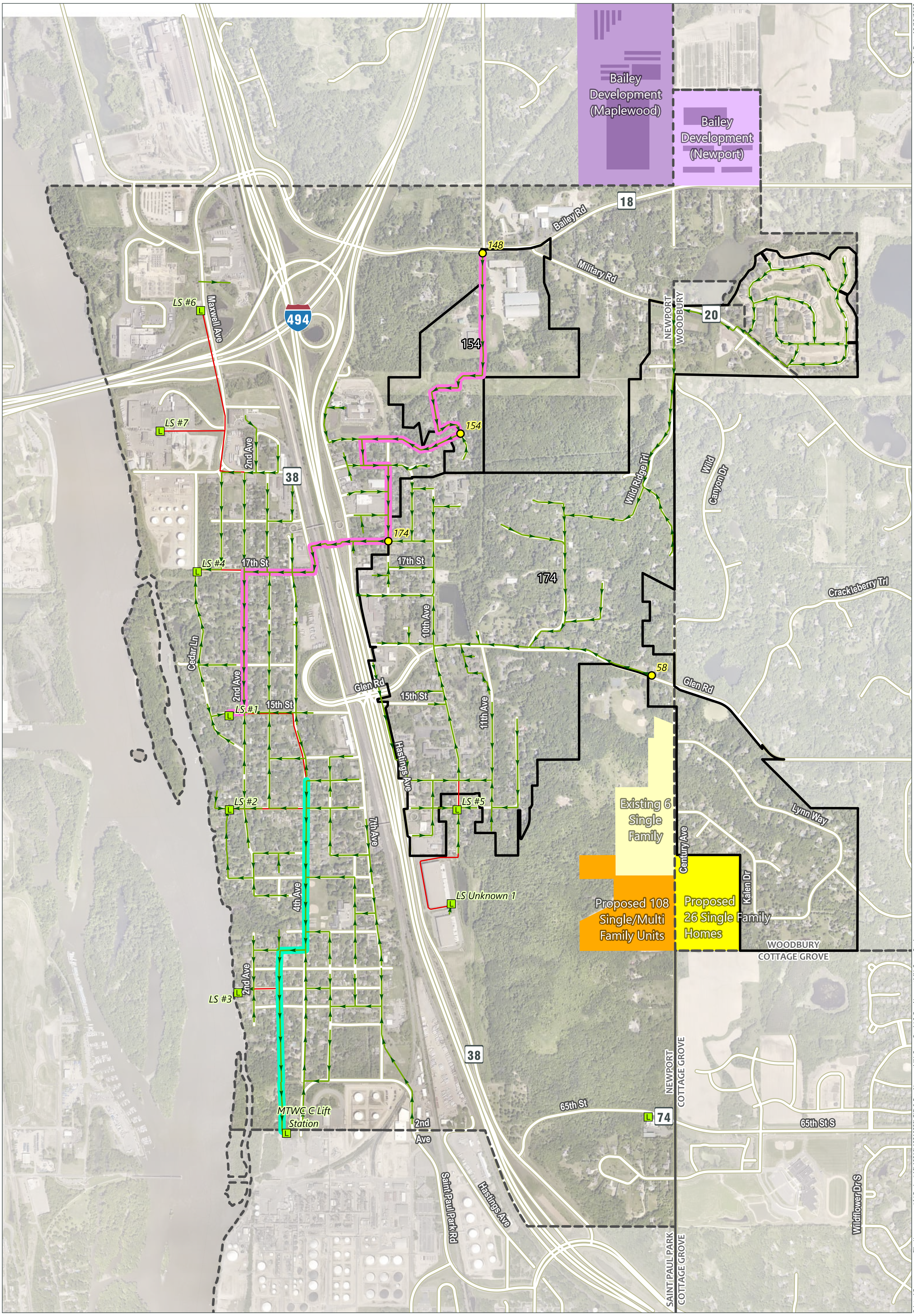
0 600 1,200 Feet

N

Existing Conditions Pipe Capacity, Wet Weather Event

Figure 4: Sewer Capacity Study

City of Newport, Washington County, MN



MSA

- Municipality
- Select Sewersheds
- Proposed Connection Point
- Lift Station
- Northern Trunkline
- Southern Trunkline
- Gravity Mains
- Pressurized Mains
- Bailey Development (Maplewood)
- Bailey Development (Newport)
- Existing 6 Single Family
- Proposed 108 Single/Multi Family Units
- Proposed 26 Single Family Homes

0 600 1,200 Feet

Proposed Development Areas

Figure 5: Sewer Capacity Study

City of Newport, Washington County, MN

MSA

Municipality	Municipality
Lift Station	Lift Station
Pressurized Mains	Pressurized Mains
No Extra Capacity	No Extra Capacity
More than 0.5 cfs Capacity	More than 0.5 cfs Capacity
Non-trunkline Gravity Mains	Non-trunkline Gravity Mains

- Bailey Development (Maplewood)
- Bailey Development (Newport)
- Existing 6 Single Family
- Proposed 108 Single/Multi Family Units
- Proposed 26 Single Family Homes

0 600 1,200 Feet

Proposed Conditions Pipe Capacity, Wet Weather Event

Figure 6: Sewer Capacity Study

City of Newport, Washington County, MN