



Comprehensive Sanitary Sewer Plan Update

City of Blaine, Minnesota

BLAIN 141686 | January 25, 2018



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January 25, 2018

RE: Comprehensive Sanitary Sewer Plan
Update
City of Blaine, Minnesota
SEH No. BLAIN 141686 4.00

Ms. Jean Keely, PE
City Engineer
10801 Town Square Dr.
Blaine, MN 55449-8100

Dear Ms. Keely:

In accordance with your authorization, we have prepared the attached Comprehensive Sanitary Sewer Plan for the City of Blaine. The plan was prepared in accordance with our proposal dated December 19, 2003.

We greatly appreciate the assistance provided by the City staff in completion of the plan. The staff's experience and knowledge of the system and cooperative spirit proved very helpful.

We would be pleased to review this report with you in detail at your convenience.

Sincerely,

A handwritten signature in black ink, appearing to read "Greg Anderson", written in a cursive style.

Greg Anderson, PE
Project Manager

ah

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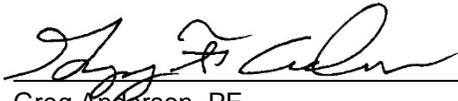
Comprehensive Sanitary Sewer Plan Update

City of Blaine, Minnesota

SEH No. BLAIN 141686

January 25, 2018

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.



Greg Anderson, PE

Date: January 25, 2018

License No.: 26859

Reviewed By: Justin Bergerson

Date: January 25, 2018

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Comprehensive Sanitary Sewer Plan Update

Prepared for City of Blaine

1 Executive Summary

On March 2, 2017, the City Council of the City of Blaine authorized the preparation of this Comprehensive Sanitary Sewer Plan (CSSP) Update. The authorization was based on the City's Request for Qualifications and Proposal, received on January 10, 2017, and SEH's proposal, dated February 10, 2017. The CSSP Update focuses on ultimate development of the trunk sanitary sewer system by examining the existing sanitary sewer facilities and providing guidance for the expansion of the City's sewer system.

The current municipal limits serve as the study area for this plan. This plan does not take the place of detailed studies which are typically prepared prior to the design and construction of improvements. Due to the global nature of this study, it is intentionally general and less specific than detailed feasibility studies. Recommended improvements are considered approximate and detailed feasibility studies must be completed to confirm sizes, locations, costs, and staging for improvements.

Information from previous sanitary sewer studies are used in this plan, and the Future Land Use Plan serves as a foundation for the analysis. The emphasis of this Plan is the trunk sewer system. The trunk sewer system includes lift stations, force mains, and all gravity mains 10 inches in diameter or larger. Analysis of mains smaller than 10 inches in diameter is outside the scope of this study.

Future flows were determined on a sewer district basis using the anticipated unit and area wastewater flow rates for various types of land use. Anticipated land uses at full development were used to determine future flows. Peak flows for residential and commercial/industrial land uses were used as a basis for sizing future facilities. In developed areas, peak flows were compared with system capacities to identify those facilities that might be undersized at ultimate development. All electronic files associated with this study have been forwarded to the City for Staff's ongoing use in analyzing the impacts of future development and redevelopment.

In general, the existing system was found to be adequate to accommodate existing and future flows. However, when anticipated flows resulting from ultimate development are routed through the existing system, one area of the trunk system has a future capacity restriction that will require the construction of a relief sewer pipe.

Of the 27 existing lift stations which are operated within the City, there is a regular maintenance/improvement plan in place. Some lift stations will require only minor modifications, such as increased impeller sizes, but other lift stations will require major expansions. Ultimately, 3 additional lift stations will need to be added to the system to serve future development.

Costs for trunk facility improvements, including trunk main extensions, new lift station construction, existing lift station upgrades and relief sewer construction, total approximately \$2,690,000. The cost estimates include contingencies and overhead costs, but do not include surface restoration, removal of existing facilities, easements, and other extraordinary costs. Accordingly, the cost estimates do not represent the full extent of costs that will be incurred. Preparation of full cost estimates for the future trunk facility improvements are difficult to complete at this point in time since the exact locations of trunk facilities are unknown. Costs are presented

in 2017 dollars and provided only for the purpose of relative comparison. Detailed feasibility reports and cost estimates should be prepared prior to design and construction of any improvements.

1.1 Conclusions

The study and analysis performed during the preparation of this report resulted in the following conclusions:

1. The City has six areas of intercommunity flow around its perimeter. Flow is accepted from 3 neighboring communities while flow is discharged into 4 communities. Various means and methods are used to account and pay for the intercommunity flows.
2. Although an in-depth inflow and infiltration analysis was outside the scope of this study, minimal amounts of clear water inflow and infiltration appear to be present in the collection system. The City sewer lining program has completed lining all VCP and RCP main 12-inches in diameter and smaller, a potential significant source of I/I. the lining program next step is a VCP and RCP main larger than 12-inch in diameter.
3. The collection system has received timely maintenance work at appropriate intervals. The overall condition of the collection system is good and no significant problems are known to exist. Maintenance and repair of the gravity collection system should be considered on-going in order to minimize clear water inflow and infiltration, reduce associated costs of clear water treatment, and provide an acceptable level of service to users.
4. The City uses a unique flow variation curve for design and analysis of its sewer system. The flow variation curve was created during the preparation of the City's 1980 Comprehensive Sanitary Sewer Plan. The 2005 CSP reviewed 2000-2004 metering data recorded by the Metropolitan Council and found that the 1980 flow variation curve was still valid for use in that study. The flow data used and flow model results from areas developed since the 2005 CSSP, indicates this curve is still valid for use today.
5. The existing collection system consists of 7 sanitary sewer districts and 66 subdistricts. The districts and subdistricts were used to generate the hydraulic model that was completed as part of this study. The results of the hydraulic modeling indicate that the system is adequately sized to accommodate ultimate development with relatively minor improvements required, and excess capacity is available in certain areas. The hydraulic model can be used for ongoing analysis of the system to determine potential impacts of future development and redevelopment of the collection system.
6. The collection system contains 27 lift stations which have been built between 1966 and 2016. The lift stations have received timely maintenance at appropriate intervals. The overall condition of the lift stations is good and no significant problems are known to exist.
7. The estimated costs of improvements to the collection system to accommodate ultimate future development, including trunk main extensions, lift station construction, and relief sewer construction is approximately \$1,100,000. It is expected that these improvements will either be financed by a developer in conjunction with new development, assessed to benefiting properties, paid for by the City, or a combination thereof.

1.2 Recommendations

Based on this study, the following recommendations can be made:

1. Continue timely maintenance of the gravity collection system. Clean, televise and inspect pipes and manholes every 2-3 years to determine if rehabilitation or replacement is required.
2. Continue timely maintenance of lift station and force main facilities. Conduct lift station pumping tests a minimum of every 2 years to evaluate pump efficiencies and determine when repairs and/or upgrades are required.

3. Implement a detailed capital improvement program to inventory the condition of the collection system, schedule the appropriate maintenance/ rehabilitation activities, and determine the costs for long range maintenance and rehabilitation operations.
4. If flows from District 5 increase beyond 100,000 gallons per day due to new development, it is recommended that the City make a request to MCES to install a permanent flow meter at this discharge point near the intersection of Lexington Avenue and 85th Avenue.
5. Review and update as needed the existing intercommunity agreement(s) for sanitary sewer service between the City of Blaine and the Cities of Spring Lake Park, Coon Rapids, Mounds View, Circle Pines, and Lexington.
6. Continue to monitor the volume of flow in the sanitary sewer system to detect the presence of I/I and institute appropriate maintenance and rehabilitation techniques to reduce I/I if significant levels are detected.
7. Continue the City's lining program of lining all VCP and RCP sanitary sewer mains. All VCP pipes have been lined. Only large diameter RCP mains remain to be lined.
8. Utilize the proposed sanitary sewer design criteria, as shown in Table 6 for future planning, design and analysis.
9. Adequate system capacity currently exists in District 6 to accommodate future development in accordance with the Northeast Area Land Use Plan. Additional capacity can also be created in District 6 by constructing an optional relief sewer between Manhole E-509 and Manhole B-1113 (see Appendix D, Subdistrict 1B2). If additional capacity is needed in the northern half of District 6 in the future which may be the case if the North Oaks area were to be served in the future, it is recommended that the City consider the construction of this optional relief sewer.
10. Conduct a sanitary sewer rate study to determine if adequate capital will be available in the Sanitary Sewer Fund to complete required system improvements. As significant development is expected to occur in the future, the City may wish to implement either a City SAC or a Trunk Area Charge for maintenance to help offset the larger demand that the new development will place on the City's in-place facilities.

2 Population Projections

Table 1 summarizes the population projections for the City of Blaine. The projections were based on Metropolitan Council's "Population, Household and Employment Forecasts by Community" for the years 2020, 2030 and 2040. The projections for 2018-2021 were developed by assuming 408 new households per year from 2018-2021.

The number of households in 2017 was estimated by subtracting 408 households per year from the Met Council's 2020 household estimate. The result was an estimate of 23,876 households for 2017. This was multiplied by the projected 2017 density in people/household, as estimated by interpolation between 2010 and 2020, to determine the estimated 2017 population. The process was repeated for years 2018-2021 using the estimated number of households and multiplying by the prorated density in people/household to determine the estimated population for each year. Complete buildout is assumed to occur by 2030.

The employment projections were estimated by interpolating between the Metropolitan Council's 2020, 2030 and 2040 employment projections.

Table 1 – Population Projections

Year	Estimated Population	Estimated Households	Estimated Employees	Estimated People / Household
2010	57,186	21,077	19,688	2.71
2016	64,188	23,586	23,986	2.72
2017	64,704	23,876	24,231	2.71
2018	65,810	24,284	24,476	2.71
2019	66,175	24,692	24,721	2.68
2020	66,300	25,100	24,800	2.64
2021	67,341	25,508	25,045	2.64
2030	76,700	29,200	27,300	2.63
2040	87,300	33,300	31,000	2.62

* Source: Thrive MSP 2040 - Forecasts as of January 1, 2017.
Met Council

3 Land Use

3.1 Future Land Use Plan

The City’s Land Use Plan was last updated in June of 2017 and a copy of it presented in Figure 1.

The Land Use Plan along with the 2005 CSSP served as the basis for this CSSP update. The Land Use Plan was divided into sanitary sewer subdistricts, and further divided into developable and undevelopable areas. Undevelopable areas were determined based on the National Wetland Inventory and other water features as identified by the City’s GIS system. A summary of the land use acreages by sanitary sewer subdistrict is presented in Appendix A.

4 Existing Sanitary Sewer Facilities

4.1 Existing Collection System Description

The City’s collection system contains several major trunk sewers which convey flow to the Metropolitan Council Environmental Services (MCES) sanitary sewer interceptor system. The wastewater from Blaine flows through the MCES system to the Metropolitan Wastewater Treatment Plant where the influent is treated and discharged into the Mississippi River.

Construction of the City’s sanitary sewer system began in 1965, progressed steadily through the 1980’s and has significantly expanded since the mid-1990’s. The years of construction for the existing system are shown in Figure 2. The collection system currently includes 27 lift stations which are operated and maintained by the City. Force main piping ranges in size from 4 inches to 20 inches. Gravity sewer pipes within the existing service area range in size from 8 inches to 42 inches in diameter. The total length of sewer pipe in the City’s sanitary sewer system totals more than 367 miles. Sanitary sewer pipes of 10-inch diameter and greater are shown along with lift stations and MCES interceptors in Appendix D.

4.1.1 Maintenance and Repair of System

Conversations with the City’s maintenance staff indicate that the sanitary sewer collection system is in good overall condition and no significant problems exist. The chief maintenance issue identified in discussions is tree root intrusion. In the 2005 CSSP, areas in Districts 1 and 2 were noted to be experiencing significant tree root intrusion. Recent lining of the 12-inch and smaller

diameter mains has helped reduce the root issues. Other maintenance/rehabilitation issues identified were localized sand deposits in pipes and cracked or leaking manholes.

Maintenance and repair of the system should be considered an ongoing process. Pipes should be cleaned, televised and inspected on a regular basis (every 2-3 years). Lift stations should be test pumped every other year to check for condition and efficiency. Lift station pumps should be serviced on a regular basis in accordance with the manufacturer's recommendation. Electrical equipment, SCADA equipment, alarms and controls should also be inspected as recommended by the manufacturer.

As shown in Figure 2, the age of the system varies with the oldest areas being approximately 50 years old. Typical construction practices at the time included the installation of vitrified clay pipe (VCP) sewers. VCP generally has an average life expectancy of at least 60 years. Routine maintenance and rehabilitation techniques can further prolong the life of pipe materials such as VCP.

Since the 2005 CSSP, the City has undertaken an extensive sanitary sewer lining program. The lining program targeted small diameter, 12-inch and smaller mains, made of vitrified clay pipe (VCP). The City has successfully slip-lined all the VCP in the City. This effort has significantly extended the life of these mains while also virtually eliminating root intrusion and infiltration of ground water into these mains.

The City is now planning and budgeting to line all RCP mains greater than 12-inches in diameter in the system (see Figure 3).

It is recommended that the City continue its capital improvement program of routine maintenance/rehabilitation activities and determine the costs for long-range maintenance and rehabilitation operations.

4.1.2 Connection to MCES System

The City of Blaine, along with other metropolitan communities that are connected to the MCES system, pays a fee to the MCES for treating the City's wastewater. First MCES determines the City's total wastewater flow for the year based on metered and unmetered flow (see Table 2). The City's percentage of the regional flow is then determined. MCES then multiplies the City's percentage of the regional flow by the Municipal Wastewater Charge (MWC) for the region to arrive at the City's annual wastewater charge. Table 2 shows the City's flow MCES determined for its 2018 Cost Allocation Year.

Table 2 – 2018 Municipal Wastewater Charge (MWC) Determination

Meter Flow	1,464.20	Million Gallons (MG)
Unmetered Flow (see below)	81.69	MG
2018 Flow Allocation	1,545.89	MG
Percentage of Regional Flow	1.70	Percent (5)

The City of Blaine discharges flow into three MCES interceptors at four separate points along the City's western and southern borders (see Appendix D). The flow at three of the discharge points is metered (MCES Meter Nos. M207, M216, and M217 in Districts 3, 1, and 6) while flow at the remaining point (E-68) is estimated. Metered flow provides the most accurate volumes for billing and analysis purposes. Meters are generally installed at locations that discharge a minimum of 100,000 gallons per day. The discharge point from District 5 at 85th Avenue and Lexington Avenue (E-68) discharges less than 100,000 gallons per day. The flows from District 5 are generally stable and not likely to increase significantly. However, if future flows from District 5

increase beyond 100,000 gallons per day due to new development, it is recommended that the City request a meter be installed at this discharge point also.

Upon review of the City’s 2030 Comprehensive Plan, the MCES identified a future flow restriction on the interceptor that serves the east side of the City (4-NS-523). The MCES has discussed various options for addressing the restrictions, ranging from peak attenuation/storage to reconstruction of the interceptor.

4.2 Inter-Community Flows

The following intercommunity sewage flows exist between the City of Blaine and adjacent communities, as shown in Figure 4. Economy

Table 3 – Summary of Intercommunity Flows

Area	From	To	Land Use	Estimated Average Flow (GPD)
A	Blaine	Coon Rapids	3 Commercial Services	15,000
B	Blaine	Spring Lake Park	Northtown: 26 Commercial Services	46,740
C	Spring Lake Park	Blaine	7 Residential Units, 10 Commercial Services	28,600
D	Spring Lake Park	Blaine	5 Commercial Services	4,525
E	Mounds View	Blaine	3 Residential Services	675
F	Blaine	Lexington	841 Mobile Home Units	126,137
G, H, I	Blaine	Circle Pines	101 Residential Units	22,725

4.2.1 City of Coon Rapids

The City of Coon Rapids neighbors the City of Blaine along the entire west side of Blaine. A small area in the southwest corner of Blaine sends unmetered sanitary flows to the City of Coon Rapids’ system. The area is bounded by University Avenue (Trunk Highway 47) on the north and east, 85th Avenue (CSAH 32) on the south, and University Avenue Service Road West on the west (see Area A – Figure 4). This area, within the City of Blaine, contributes 3 unmetered commercial sewer services to the Coon Rapids system. It is recommended that an intercommunity service agreement be developed between the Cities of Blaine and Coon Rapids for these services.

4.2.2 City of Spring Lake Park

The City of Spring Lake Park borders the southwest corner of the City of Blaine from approximately University Avenue (Trunk Highway 47) to approximately Eldorado Street. The communities exchange unmetered sanitary sewer flows across boundaries in 3 locations.

First, the City of Blaine discharges wastewater from the area commonly known as Northtown Shopping Center (see Area B- Figure 4) into the Spring Lake Park sanitary sewer system. The Northtown area contains 26 unmetered commercial sanitary services that discharge into the Spring Lake Park system.

Second, the City of Spring Lake Park discharges wastewater into the City of Blaine system from a commercial/residential area bordered by 85th Avenue (CSAH 32) on the north, Laddie Lake on the east, and CSAH 10 on the south (see Area C- Figure 4). This area consists of 7 residential

and 10 commercial sanitary services that discharge into the Blaine system. All connections to Blaine in Area C, are unmetered.

Finally, the City of Spring Lake Park discharges wastewater into the City of Blaine system from a commercial area bordered by 85th Avenue (CSAH 32) on the north, Laddie Lake to the west, and Central Avenue (Trunk Highway 65) on the east and south (see Area D- Figure 4). The area contributes 5 unmetered commercial services to the Blaine system.

An agreement exists between the City of Blaine and City of Spring Lake Park for providing sanitary sewer and water service. The agreement was last amended in November 1990. It is recommended that this agreement be reviewed and updated.

4.2.3 City of Mounds View

The City of Mounds View borders the south side of Blaine from approximately Eldorado Street to Lexington Avenue (CSAH 17). A small portion of the northwest corner of Mounds View, along 85th Avenue (CSAH 32), sends sanitary flows to the City of Blaine (see Area E- Figure 4). This area contains 5 residential properties. Two of the properties send their wastewater to the City of Spring Lake Park's system. The three easternmost properties are unmetered residential sanitary services and discharge into the City of Blaine system. It is recommended that an intercommunity service agreement be developed between the Cities of Blaine and Mounds View for these services.

4.2.4 City of Lexington

The City of Lexington is tucked into the southeast corner of the City of Blaine. Lexington provides sanitary service to 841 unmetered residential units and 1 unmetered commercial property (see Area F – Figure 4). All of the services in District 4 flow through an interceptor line located in, and installed by, the City of Lexington. Blaine pays the City of Lexington a monthly fee for the use of this interceptor line and then pays the Metropolitan Council Environmental Services for the treatment of the sewage. An updated agreement between Blaine and Lexington for sanitary service to these properties was recently executed.

4.2.5 City of Circle Pines

The City of Circle Pines lies directly east of Blaine and Lexington on the east side of Lexington Avenue in the southeast corner of Blaine. The neighborhoods of Aspen Gardens, Ellies Cove and Weston Woods, approximately 101 residential units, flows from Blaine into Circle Pines. Blaine pays the City of Circle Pines a monthly fee for the use of their sewer main and then pays the Metropolitan Council Environmental Services for the treatment of the sewage.

4.3 Sanitary Sewer Districts

The 2005 CSSP created 7 sanitary sewer districts within the study area, each defining the limits of service for a trunk system. In some cases, the trunk system from one sanitary sewer district discharges into the trunk system for another district. Most of the district boundaries were originally defined in previous studies, and have been revised to reflect anticipated development patterns. Subdistricts have been added to the larger districts in the 2005 CSSP to assist with calculating ultimate flows in the system. The districts and subdistricts were kept as part of this update for consistency. The district and Subdistricts boundaries are shown in Appendix D.

4.4 Existing and Future Service Area Boundaries

The existing service area of the sanitary sewer system is defined by the Metropolitan Urban Service Area (MUSA) boundary. The MUSA is that area of the city eligible for service by the

City's sanitary sewer utilities. This area is designated by agreement with the Metropolitan Council. The current MUSA boundary is shown in Figure 1.

The ultimate service area for the sanitary system is the City limits. The MUSA boundary will be extended in accordance with the staging plan identified in the City's Comprehensive Plan. However, there is one area within the City limits that is not scheduled to be included in the MUSA boundary at any time in the future. This area is the Blaine-Anoka County Airport as identified in Appendix D.

The Blaine-Anoka County Airport is the largest reliever airport in the Metropolitan Airports Commission system. The airport is located on more than 1,800 acres in the south-central portion of the City (see Figure 1). This area is currently served by City's sewer system, but produces very little flow. Future plans for the airport include runway and navigation improvements with no plans for conversion to residential or commercial land uses. Change to the land use and/or flows generated by the airport would require further study of the available capacity in the system to accommodate additional flows.

A couple of areas of specific concern to the City for this study were in Districts 6 and 7. Those are:

- Could a portion of sanitary sewer district 7J be sent to district 6; and
- How could future flow from currently unserved North Oaks West/North Oaks Ponds be best routed thru the system? Through district 6 or 7 or both?

The North Oaks West, North Oaks Ponds, North Oaks Ponds East and South Oaks neighborhoods are located in the east-central part of the city. These single family residential neighborhoods are classified as R-Rural Residential in the City's Future Land Use Plan as shown in Figure 1. They total approximately 930 acres, of which approximately 695 acres are non-buildable, wetland and right-of-way areas.

The North Oaks West/South Oaks neighborhoods are within the MUSA boundary thru the 2040 projection and are served by individual on-site sewage disposal systems. These neighborhoods are planned to remain serviced by on-site sewage disposal systems indefinitely and are not currently included in the ultimate service area for the City's sewer system.

If the North Oaks West/South Oaks neighborhoods were to convert to low density residential land uses at some point in the distant future, the density of the neighborhoods would likely be limited to 2 units per acre due to natural environmental features. The resulting average daily sanitary sewer flow produced by this area would be 105,300 gallons per day. Connecting the neighborhoods to City sewer would likely require construction of a lift station and forcemain to convey the sewage to an available connection point.

The model was updated and ran for two scenarios for serving North Oaks West/North Oaks Ponds, send all flow through District 3-7 through a connection in 114th Lane NE to Node E-468. The other scenario split the North Oaks flow between District 6 and 7. We split the North Oaks area into east and west areas by extending the west line of district 7 G & 7E south, through North Oak Ponds (see Appendix C)

It is recommended to route the west portion of North Oaks (North Oaks west) into District 6 at Node E-754 (see Appendix D). The downstream pipe from node E-754 to its discharge in a MCES interceptor has sufficient capacity for all this flow.

In 2017 the Fox Ridge cul-de-sac off of Radisson Road installed a pressurized sanitary sewer collection system to collect and convey the flow from these four homes into sub district 6-5A in District 6. The MUSA line was adjusted to represent this change.

4.4.1 Lift Station Analysis

The City's 27 lift stations have been constructed over a period of nearly 50 years. The City's first lift station was constructed in 1966. The most recent lift station was constructed in 2016. Eight (8) lift stations have been constructed since completion of the 2005 CSSP. A review of records provided by the City indicates that routine maintenance and upgrades have been performed on the lift stations as necessary and no significant problems exist. Tests are periodically performed by City staff to determine the capacities of the existing lift station pumps. The results of the pumping tests are prepared by City staff it is suggested that pump tests be repeated bi-annually to check pump efficiencies and determine when repairs and/or upgrades are required.

4.4.2 Inflow and Infiltration

Sanitary sewers, although designed primarily to carry only wastewater, can also receive clear water. The two components of rainwater or clear water entering a sanitary sewer system are called inflow and infiltration (I/I). Direct inflow enters a sewer system from a point source or single location and is characterized by an abrupt increase in the flow rate during a significant rainfall followed by an abrupt decrease in the flow rate after the rainfall. Infiltration generally enters a sewer system through small cracks and loose joints and is characterized by a gradual increase in the flow rate during wet weather. Flow responses to infiltration continue for several hours or days following each rainfall. Infiltration may also occur during periods of dry weather due to a high groundwater table.

The clear water travels through the sewer system and is ultimately treated with the wastewater. Excess water in the sanitary sewer system has several negative consequences. Clear water increases the City's treatment costs to MCES due to higher volumes discharged to the interceptor system. The City may also incur increased costs for operation and maintenance of lift stations due to I/I. Finally, the presence of clear water in a sanitary sewer system reduces the system capacity and can limit the number of connections to the system. Therefore, it is important for I/I to be monitored and removed from the collection system when encountered.

The Metropolitan Council adopted an Inflow/Infiltration (I/I) Surcharge Program in 2015 to reduce the impact of clear water or I/I entering their interceptor collection system and to insure waste water capacity of the system for future development. The purpose of the I/I program is to insure the capacity of their interceptors. MCES adopted the surcharge program to make sure all communities were properly maintaining their sanitary sewer collection systems and managing peak discharges caused by I/I in their sanitary sewer collection systems. As part of the 2005 CSSP a cursory I/I review was completed. That review found the presence of I/I in the City's sanitary sewer system is relatively minor. This is confirmed by the fact the City has not been identified by MCES as a contributor of excessive I/I. City staff estimates the volume of I/I to be well below the MCES targeted level.

As the City's collection system ages, it is recommended that the City continue to monitor the volume of flow in the system to detect the presence of I/I and institute appropriate maintenance and rehabilitation measures to reduce I/I. The City's lining program to address the older pipes in the system (ie. VCP and RCP) will help keep I/I below the MCES targeted threshold. The City has lined all VCP in their system. Other steps the City could develop a private property inspection program to identify and assist residents in reducing I/I from private connections such as aged service lines and/or direct sump pump connections to the system.

4.5 Subsurface Sewage Treatment

The City of Blaine has enacted ordinances which regulate subsurface sewage treatment systems. The ordinances are designed to protect and promote the health, safety and general welfare of the people of Blaine by regulating seepage discharges and the location, installation, alternation, operation and maintenance and monitoring of all subsurface sewage treatment systems (SSTS). Subsurface sewage treatment systems must be installed in accordance to Chapter 7080 or 7081 of the Minnesota Rules. The SSTS shall be designed to receive all sewage from the dwelling(s), building(s), or other establishment(s), served by the system, including laundry waste and basement floor drainage. Surface, roof and foundation drainage and other storm water shall not be allowed to enter any part of the system. Not more than one dwelling, commercial, business, institutional, or industrial unit shall be connected to the same SSTS, unless such multiple connections was specified in the application submitted and in the permit issued for the system. No SSTS shall be installed or renovated on lands to which public sewer service is currently available, without a system permit.

There are currently 509 SSTS in operation within the City as of November 30, 2017. They City ordinance provides for an inspection of all SSTS by a professional to take place every three years or with transfer of property ownership. The inspections are done by an outside, licensed consultant. The property owner hires an outside consultant to perform this service. Computer records are maintained as to which property owners have SSTS. At the time of the inspection the inspector will make sure that the SSTS is in proper working condition. The inspector will provide maintenance tips to the property owner to keep the system in proper working condition. If the SSTS is found to be in need of repair, the inspector will review the repair or replacement needs with the property owner. The inspector will also notify the City for tracking and inspection of the repairs or replacement whichever is required. All SSTS records are kept at the City.

The City of Blaine has instituted an inspection program for SSTS. The initial inspection is to determine if installation or renovation has been accomplished in compliance with Chapter 7080 or 7081 of the Minnesota Rule and with the Blaine Subsurface Sewage Treatment System Ordinance. The City's inspector shall inspect any individual SSTS at other times with a receipt of a compliant or other notice of system malfunction.

It is the responsibility of the owner of any premises using an SSTS, for which a permit has been issued, to provide for the periodic maintenance by a qualified septic system company. Reports of the maintenance should be submitted to the Department.

It is the duty of the Department to create, update and maintain an accurate inventory of each SSTS for which permits have been issued within the city of Blaine. The inventory should include location, system description, renovation description and maintenance reports. The City may inspect any system it deems necessary as a result of the reporting program. The entire septic systems are inspected upon transfer of property. The holding tanks are inspected when pumped by the company that is providing the pumping service, this occurs every three years. Any system which fails the inspection must be renovated or replaced.

4.6 Current Design Criteria

The City's current design criteria is presented in Table 4.

Table 4 – Current Design Criteria Used by the City of Blaine

Land Use Type	Units / Acre*	Persons / Unit	Gal/Person / Day	Gal/Acre / Day*
Developed Residential	3	3	75	675
Undeveloped Residential	2.2 – 2.5	3	75	495 – 563
Developed Commercial/Industrial	N/A	N/A	N/A	250**
Undeveloped Commercial/Industrial	N/A	N/A	N/A	2,000
Peaking Factor	Flow variation curve from 1980 CSSP			
Manning's "n"	n = 0.011			

* Gross Acre

** 750 GAD in some subdistricts.

The City has restricted commercial/industrial flows to 250 gallons per acre per day in certain areas with potential downstream capacity restrictions. This restricted flow rate is closer to the actual measured flow rate associated with light commercial/industrial development in the City.

The City has historically utilized a flow variation curve which was specifically developed for the City of Blaine in 1980 from sanitary sewer metering data. The curve is shown in Table 5. The City calculates pipe capacity using the Manning's Equation and a Manning's "n" roughness coefficient of 0.011.

Table 5 – City Peaking Factor Lookup Table

AVE. FLOW (MGD)	FLOW VARIATION FACTOR
0	3.25
0.1	3.15
0.2	3.05
0.3	2.95
0.4	2.85
0.5	2.75
0.6	2.72
0.7	2.6
0.8	2.55
0.9	2.5
1	2.45
1.1	2.39
1.2	2.35
1.3	2.3
1.4	2.28
1.5	2.25
1.6	2.22
1.7	2.2

AVE. FLOW (MGD)	FLOW VARIATION FACTOR
1.8	2.15
1.9	2.1
2	2.05
2.5	2.05
3.5	2.02
5	1.95
7.5	1.88
10	1.82
15	1.75
20	1.7
30	1.6

5 Sewer Districts and Facilities

5.1 Recommended Future Design Criteria

Part of the scope of this study was to review and either confirm or update the design criteria that has been used to design improvements to the sanitary sewer system. This design criteria includes items such as housing densities, population densities, discharge rates, the peak flow variation curve and the Manning's roughness coefficient.

We saw in the previous section that the current design criteria produces calculated flows that correlate well to recent measured flows. However, as the community grows and changes in the future, there may be a need to revise the design criteria to better fit the growth that is expected.

5.1.1 Housing Densities

The current City of Blaine design criteria for housing density per land use shown in Table 5 was applied using the current land use shown in Figure 1 to determine housing density.

The Northeast Area Plan Amendment made use of four residential density classifications. Two single-family residential (low density family residential) densities, 2.5 units per acre and 4 units per acre, were used to provide for lot sizes that are smaller than currently allowed by City ordinances. The majority of the single-family residential areas in the Northeast Area Plan Amendment are at the 2.5 unit per acre density. Therefore, use of 3 units per acre for single-family residential is considered an average for purposes of this study and future design criteria. A townhome (medium density residential) category, with an estimated density of 10 units per acre, and a condominium and apartment (high density residential) category, with an estimated density of 20 units per acre, were also used.

Sizing pipes for future growth calls for a conservative approach. Therefore, it is recommended to utilize the household densities proposed in the Northeast Area Plan Amendment for future sanitary sewer planning purposes, as shown in Table 7.

5.1.2 Population Density

The population density of 3 people per household is widely used in other Twin Cities Metro communities for projecting sewage flows. The information can be corroborated with population and household information collected from the 2010 Census. As shown in Section 2.0 of this plan, the Metropolitan Council projects that the average density of people per household in Blaine will

decrease to approximately 2.46 by 2020, so the continued use of 3 people per household is comfortably conservative.

5.1.3 Discharge Rates

In the 2005 CSSP, a design discharge rate of 75 gallons per capita per day was used. This design discharge rate was developed as part of the 1980 CSSP and with City metering records. Although many communities use 100 gallons per capita per day (which includes normal I/I), and MCES noted that regional data indicated that 85 gallons per capita per day is an actual average flow, 75 gallons per capita per day is a defensible figure given the research cited above and the City's minimal I/I. Continued efforts to control I/I in the City will be important for the City to continue using this rate of 75 gallons per capita per day.

The City's planning figure of 2,000 gallons per acre per day for commercial land is consistent with what other Metro communities use in their comprehensive plans. Research shows that communities use rates ranging from 1,000 to 3,000 gallons per acre per day, with an average of 1,500 to 2,000 gallons per acre per day.

Commercial/industrial flow rates can vary widely depending upon the type of use. Metro-wide, the MCES has determined that the average non-residential flow rate for developed commercial/industrial property is approximately 800 gallons per acre per day as part of the 2005 report. The City of Blaine has reviewed water usage records from various commercial/industrial users in Subdistricts 3-6 and 3-7, and has found that actual flow rates in these subdistricts range from 100 gallons per acre per day to 850 gallons per acre per day. The City has also found that, in general, a low flow generator generally produces approximately 250 gallons per acre per day whereas a high flow generator produces approximately 2,000 gallons per acre per day. An example of a low flow generator is one of the office/warehouse facilities that can be found in the City's industrial parks.

It is recommended that the City continue to use 2,000 gallons per acre in commercial/industrial areas for planning purposes. Additionally, since 250 gallons per acre per day is a typical flow rate in an office/warehouse/ industrial park area, it seems reasonable that flows from commercial/ industrial areas which are currently vacant could be limited in the future to 250 gallons per acre per day, if the City deemed it necessary to avoid downstream capacity problems.

5.1.4 Peak Flow Curve

The peak flow curve developed by the City in the 1980 Plan was based on actual metering records in Blaine, and is shown in Table 5. From the data that was collected in 1980, it is evident that extreme peak flows normally associated with some sanitary sewer collection systems did not occur to the same extent in the Blaine system at that time. Blaine's peak flow curve is lower than the curve used by MCES. It is also lower than the curve referenced in the "Recommended Standards for Wastewater Facilities" (10 States Standards). However, the Blaine curve was based on actual metering data from the City of Blaine. It is therefore considered to be more accurate than the general criteria for the City of Blaine. Furthermore, MCES and the MPCA will allow communities to use their own peak flow curves if they are developed from local flow data.

As part of the 2005 CSSP, the Blaine peaking curve was verified using MCES flow data. The resulting peak flow curve from the MCES Flow data resulted in a lower peaking curve than the 1980 City of Blaine Peaking Curve over the entire data range. This suggests that the City's current peaking curve, as developed in the 1980 plan, still represents the City's flow characteristics in a comfortably conservative way. It is recommended that the current peaking curve continue to be used for design.

5.1.5 Manning's Roughness Coefficient

For concrete pipe, the use of 0.012 for the Manning's "n" Roughness coefficient is consistent with the range of suggested "n" values as found in design literature. According to the Concrete Pipe Design Manual, published by the American Concrete Pipe Association, engineers have typically used 0.012 or 0.013 for design purposes. Both values are considered conservative, since actual laboratory test values have ranged between 0.009 and 0.010. This "design factor" of 20 to 30 percent takes into account the difference between laboratory testing and actual installed conditions.

The model used for this CSSP update used a Manning's Roughness Coefficient of 0.011. The City may want to consider reviewing this in the future as they continue to slip line existing trunk mains. The interior pipe surface of the lined trunk mains will have a lower Manning's Roughness Coefficient, between 0.009 and 0.012 based on 0.01. The use of 0.011 as part of this CSSP update was felt to result in an appropriate model as the City continues their lining program and improves the flow capacity of they system.

Figure 3 shows the lined and unlined VCP and RCP pipe in the system. Based on data from the City approximately 40% of the RCP sanitary sewer mains have been lined while over 90% of the VCP sanitary sewer mains have been lined. Continuing the lining program to line the remaining VCP and RCP sanitary sewer mains will eliminate those mains from being a potential infiltration issue while also reducing the friction coefficient of the pipe, which could provide more capacity in the existing mains.

5.1.6 Summary of Future Design Criteria

The recommended future design criteria for planning and design purposes is summarized in Table 6.

Table 6 – Recommended Future Design Criteria For the City of Blaine

Land Use Type	Units / Acre*	People / Unit	Gal/Person / Day	Gal/Acre / Day*
Low Density Residential (LDR)	3	3	75	675
Medium Density Residential (MDR)	10	3	75	2,250
High Density Residential (HDR)	20	3	75	4,500
Commercial/Industrial	N/A	N/A	N/A	2,000**
Peaking Factor	Flow variation curve from 1980 CSSP			
Manning's "n"	n = 0.011			

*Net buildable acres.

**Restrict Commercial/Industrial flows to 250 gallons per acre per day in areas with downstream restrictions.

5.2 Hydraulic Analysis

As part of this CSSP Update, a hydraulic analysis of the city's sanitary sewer system was performed. Goals of the hydraulic analysis included: 1) identify areas where system capacity may be exceeded in the future; 2) determine the appropriate pipe diameters for future trunk main extensions; 3) determine the extent to which excess capacity may be present in the system; 4) update the existing Microsoft Excel spreadsheet model developed as part of the 2005 CSSP with current flow, population and land use data.; and, 5) provide City staff with the updated system model capable of being amended, allowing staff to monitor the available capacity of the system as development progresses. The results of the hydraulic analysis are presented in Appendix B and Appendix C.

In order to estimate the anticipated wastewater flow rates for future development, the Future Land Use Plan and the City's GIS system were used to classify the area of each sanitary sewer district into different land use types. Districts remain unchanged from 2005 CSSP. Population projections were not directly used to estimate future flows. Instead, flows were calculated by multiplying the acres of land by the associated flow rate per buildable acre. Net buildable acreage was defined as the gross acreage of a similar land use type less existing road rights of way, wetlands and lakes. Wetland areas, based on the City's National Wetland Inventory (NWI), were subtracted from the acreages prior to calculating flows. Unit flow rates were used in residential areas, while area flow rates were used in proposed commercial/industrial areas.

Adjustments were made to the number of residential units to more accurately represent existing development in select areas. Sanitary Sewer District 4 (Centennial Square) and Sanitary Sewer Subdistricts 6-4A and 6-5A (TPC) contain unique/specific land uses which noticeably deviate from the estimated housing densities used for analysis purposes. The actual number of residential units is less than the calculated number of units in these areas, which produces lower sewer flows. The actual number of existing residential units in District 4 and Subdistricts 6-4A and 6-5A were entered into the hydraulic model to more accurately calculate flows from these areas. Densities of currently developed areas used in the hydraulic analysis were provided by the City. The developed densities used in this analysis were: LD= 2.5 units per acres; MD= 10 units per acre; HD= 20 units per acre; and, Mobile Home= 10 units per acre.

Several other methods were utilized to calibrate the accuracy and results of the hydraulic model. First, the total acres included in the hydraulic model, as summarized in Appendix A, was compared to other sources of data relative to the overall size of the City. It was determined that the total area included in the model was 99.9% of the total area of the City based on the Future Land Use Map. Although the calculated number of units and volumes of flow from the hydraulic model appear to be greater than other data sources might indicate, the magnitude of the differences are within comfortable levels for a study of this macroscopic nature.

The detailed results of this study are contained in Appendices B, C, and D. Land use types and acreages are shown in Appendix A. Ultimate design flows, and existing and proposed trunk sewer diameters are presented in Appendices B and C.

The results of the hydraulic model were further analyzed to determine the amount of additional flow, beyond anticipated flows at ultimate development, available in the system. Full pipe (peak) flows in each pipe segment were used to determine the appropriate peaking factor from Blaine's Peak Flow Curve. The "full-flow" was divided by the "full-flow" peaking factor to determine the available average flow for the specific pipe segment. The resulting available average flow was divided by 3 people per unit and 75 gallons per capita per day to determine the number of equivalent residential units available in the pipe segment. This process was repeated for every pipe segment in the model. The results were then examined to determine whether critical downstream pipe segments would limit the amount of available excess capacity in upstream pipe segments.

6 Required System Improvements

6.1 Improvements to Existing Trunk Mains

Generally, the existing system is adequately sized to accommodate the City's planned growth. One area of the existing system has been identified as requiring improvements in order to provide the required pipe capacity for the current densities identified in the Future Land Use Plan. A relief sewer was recommended to be constructed in the 2005 study in District 3 between Manhole E-352 and Manhole E-222 as shown in Appendix D. This study found these pipe sections to be 100-104% of capacity. Given the contingencies built into the model, this section is likely fine as is unless additional flow (beyond what is included in this study) is added. Since the

most restrictive downstream pipes have an excess capacity at full buildout construction of this relief sewer could be oversized to provide additional capacity in District 7 based on excess capacity of the limiting downstream pipe. The potential future addition of the North Oaks/South Oaks neighborhoods into the MUSA boundary and resulting increase in sewage flow should be considered when determining the size of the bypass pipe. The timing for the construction of this relief sewer would be entirely dependent on the density and timing of development in District 7.

An optional relief sewer could be constructed in District 6 to divert a portion of the flow from Lift Station 16 to Subdistrict 1B2, between nodes E-509 and E-1113 as shown in Appendix D. Construction of this segment of relief sewer could be undertaken if the City would like to increase future densities in District 6 beyond those identified in the Future Land Use plan and/or serve North Oaks West. Since the most restrictive downstream pipes have an excess capacity at full buildout construction of this relief sewer could be oversized to provide additional capacity in District 6 based on the excess capacity of the limiting downstream pipe. If constructed, the relief sewer could provide sewer capacity for additional residential units in Subdistricts 6-5B, 6-5C and 6-5D.

The City has proactively lined all existing VCP sanitary sewer for I/I purposes. Lining the VCP and also RCP existing sewers will increase their flow capacity with the new pipe surface. We have included the estimated costs to lining the larger RCP sewers in Table 8

Actual sewer flows near the locations of the proposed future improvements should be monitored to determine the appropriate timing for and sizing of the proposed improvements.

The estimated cost for improvements to the existing trunk system is shown in Table 8. Note that these costs do not include contingencies, overhead, surface restoration, boring costs, and other miscellaneous costs.

Table 7 – Estimated Costs for Improvements to Existing Trunk System

Improvement	Estimated Cost
Construct Relief Sewer between MH-E-509 and MH E-1113**	\$390,000.00
Lining of 18" RCP from MH E-352 to MH E-151	\$261,000.00
Lining of 21" RCP from MH E-151 to MH E-36	\$420,000.00
Lining of 21" RCP from MH E-36 to MH E-222	\$23,625.00
Total	\$1,100,000.00

** Optional improvement to provide excess capacity beyond Future Land Plan requirements and to accommodate flow from North Oaks West/ North Oaks Ponds.

6.2 Improvements to Existing Lift Stations

Upgrades to several existing lift stations will also be required to adequately address future growth. The recommended lift station upgrades are based on the “Recommended Standards for Wastewater Facilities,” as published by the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (“10 States Standards”). The 10 State Standards require a minimum of two (2) pumps in each lift station and the “firm lift station capacity” to meet or exceed the peak hourly flow at the lift station. The “firm lift station capacity” is defined as the pumping capacity of a lift station with the highest volume pump out of service.

Actual sewer flows and pump run times should be monitored at the lift stations to determine the appropriate timing for and sizing of the proposed lift station improvements.

All of the City’s lift stations contain a minimum of two (2) pumps which provide for a back-up if one pump is out of service. In addition to redundancy in pumps, the lift stations contain wet wells which allow for the storage of wastewater while the pumps are not running. Depending on the

station, the wet wells can store approximately 3-24 hours of wastewater flow before sewer back-ups occur, which allows additional response time for City maintenance crews in the event of complete lift station malfunction.

6.3 Future Trunk Main Extensions

New trunk sanitary sewer extensions in Districts 6 and 7 are required to provide sanitary sewer service to the undeveloped areas of the City. Appendix D shows the approximate trunk system improvements required to accommodate future growth. The exact diameter and location of each trunk sewer extension should be reviewed on a development by development basis in order to best address the City's needs and ongoing development patterns.

A summary of the estimated trunk sanitary sewer facility costs is shown in Table 8. Partial costs for trunk facility improvements are included in this report. The cost estimates include contingencies and estimated overhead costs, but do not include surface restoration, subsurface crossings, removal of existing facilities, easements, and other extraordinary costs. Costs are provided only for the purpose of relative comparison, and detailed feasibility reports and cost estimates should be prepared prior to design and construction of any improvements.

Table 8 – Estimated Costs Future Trunk Sewer Extension

From	To	Size (in.)	Length (ft.)	Cost per Foot	Estimated Cost
District 6					
F-306	F-306A	8	1,000	\$83	\$90,000
Subtotal District 6					\$90,000
District 7					
1	PLS#2	10	1,350	\$88	\$118,800
PLS#2 (520 GPM) and FM					\$332,950
PLS#2	3	10	1,350	\$88	\$118,800
3	2	12	1,350	\$101	\$136,350
2	4	12	1,000	\$101	\$101,000
6	PLS#1	8	2,700	\$83	\$224,100
PLS#1 (40 GPM) and FM					\$99,180
PLS#1	4	8	1,000	\$83	\$83,000
9	10	8	2,000	\$83	\$166,000
10	PLS#3	10	2,700	\$88	\$237,600
PLS#3 (400 GPM) and FM					\$269,190
PLS#3	12	15	4,700	\$108	\$507,600
12	EXISTING	15	1,300	\$108	\$140,400
Subtotal District 7					\$2,535,200
GRAND TOTAL					\$2,625,200

¹ Does not include costs for other utilities, streets, easements, surface restoration, administration, financing, etc.

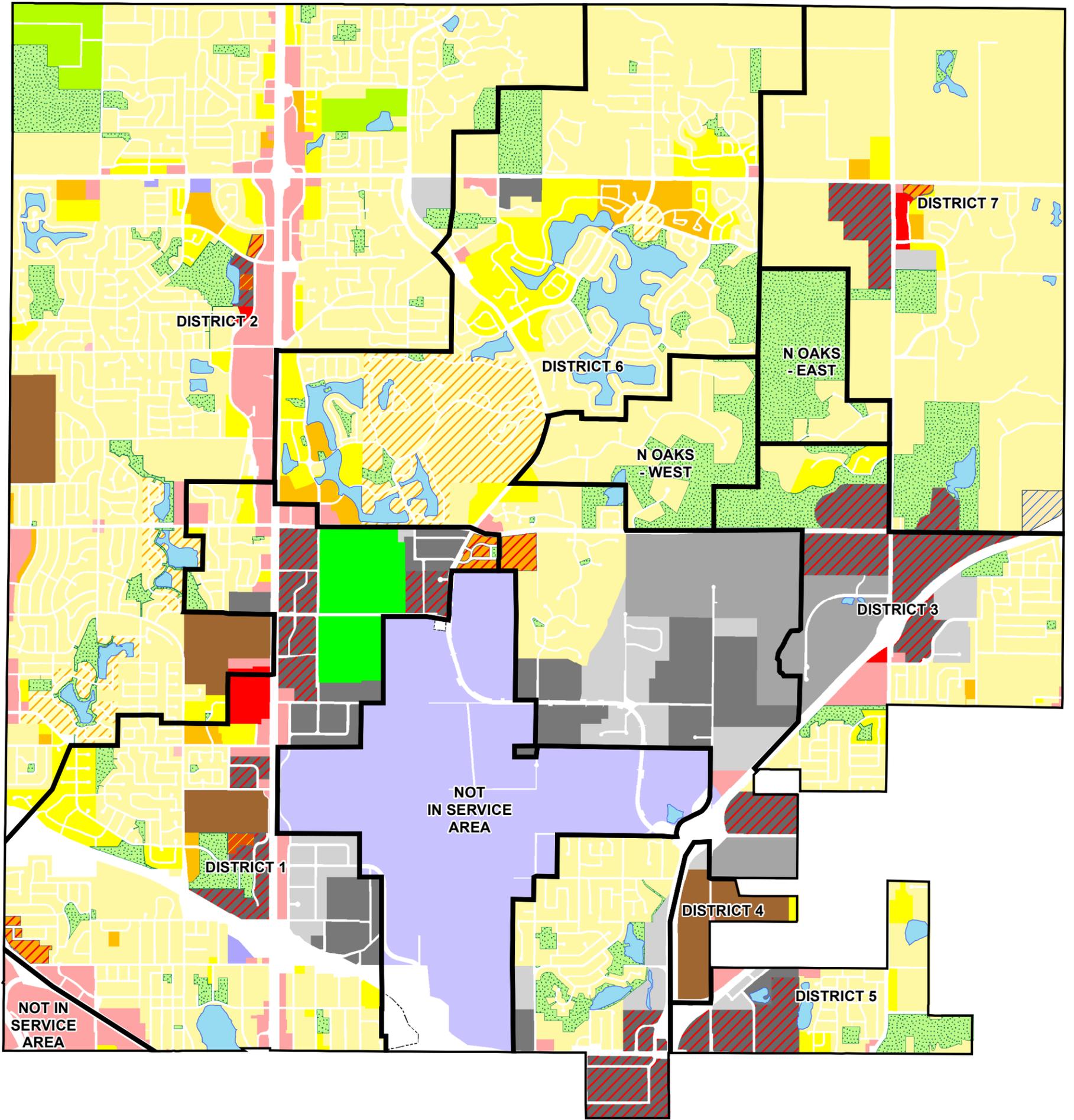
Figures

Figure 1 – Future Land Use Plan

Figure 2 – Collection System Age

Figure 3 – Lined and Unlined Sewer Mains

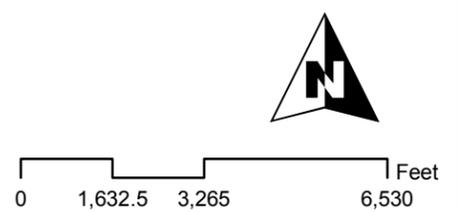
Figure 4 – Intercommunity Flows



LEGEND

- | | | |
|----------------------------------|--|---------------------------------------|
| Sanitary Sewer Districts | R - Rural Residential | HDR/PI/PC |
| Water Features | ABD - Abandoned | HDR/PI |
| LDR - Low Density Residential | L-MDR - Low Density/Medium Density Residential | LI - Light Industrial |
| MDR - Medium Density Residential | HDR - High Density Residential | HI - Heavy Industrial |
| MHR - Mobile Home Residential | NC - Neighborhood Commercial | PI - Planned Industrial |
| CC - Community Commercial | PC - Planned Commercial | O - Office |
| HDR/PC | P/OS - Park/Open Space | PI/PC - Planned Industrial/Commercial |
| | AP - Airport | P/OS - Park/Open Space |
| | ROW - Right-of-Way | AP - Airport |
| | RR - Regional Recreation | RR - Regional Recreation |

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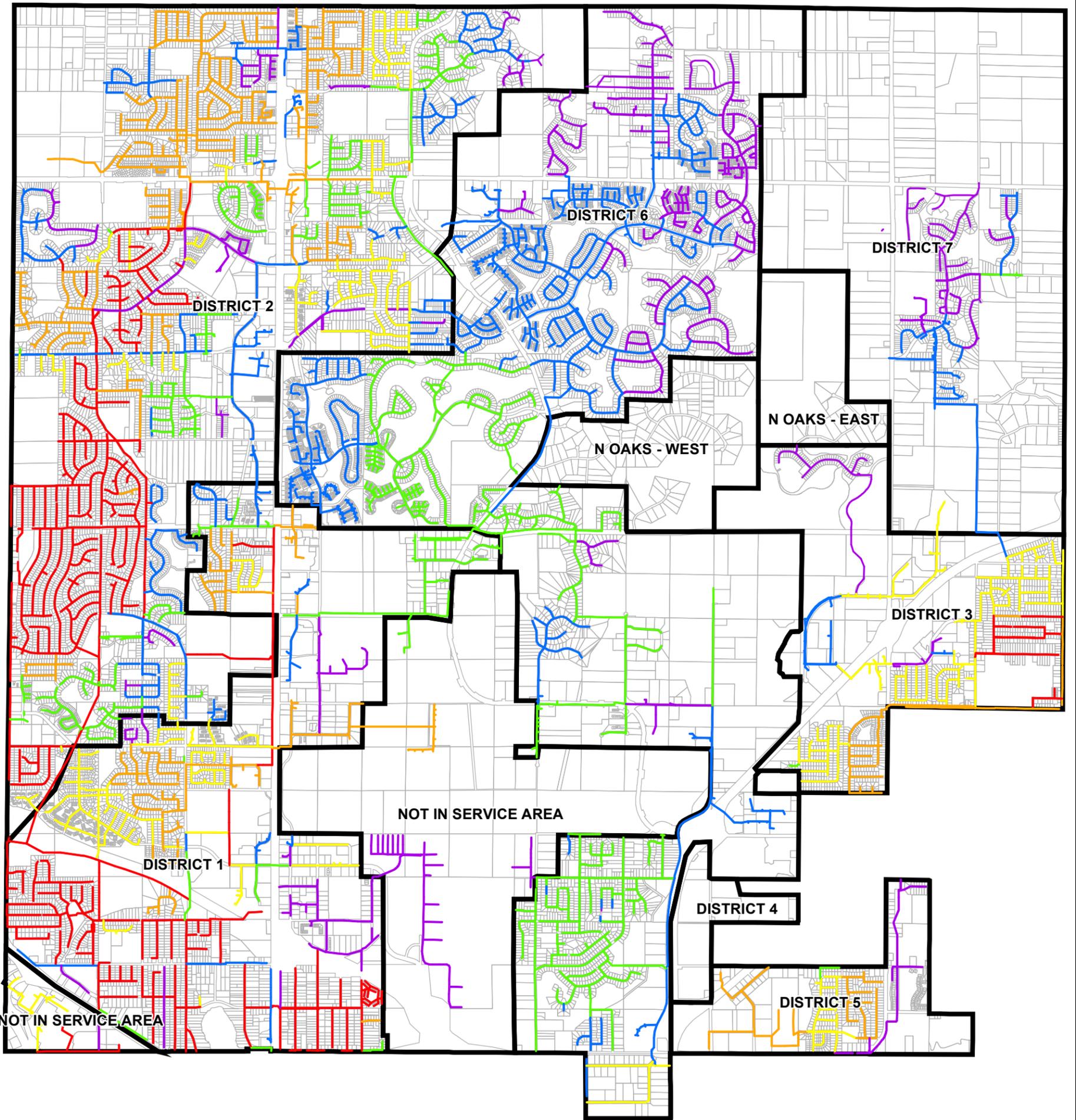
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**CITY OF BLAINE
LANDUSE AND
SEWER SUBDISTRICTS**

**Figure
1**

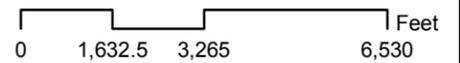


LEGEND

- Pipe Year Built
- 1964 to 1969
 - 1970 to 1979
 - 1980 to 1989
 - 1990 to 1999
 - 2000 to 2009
 - 2010 to Current
 - Sanitary Sewer Districts
 - Parcels

Pipe install dates were generated from the year built of the road using pavement management data and have not been checked against as-built drawings.

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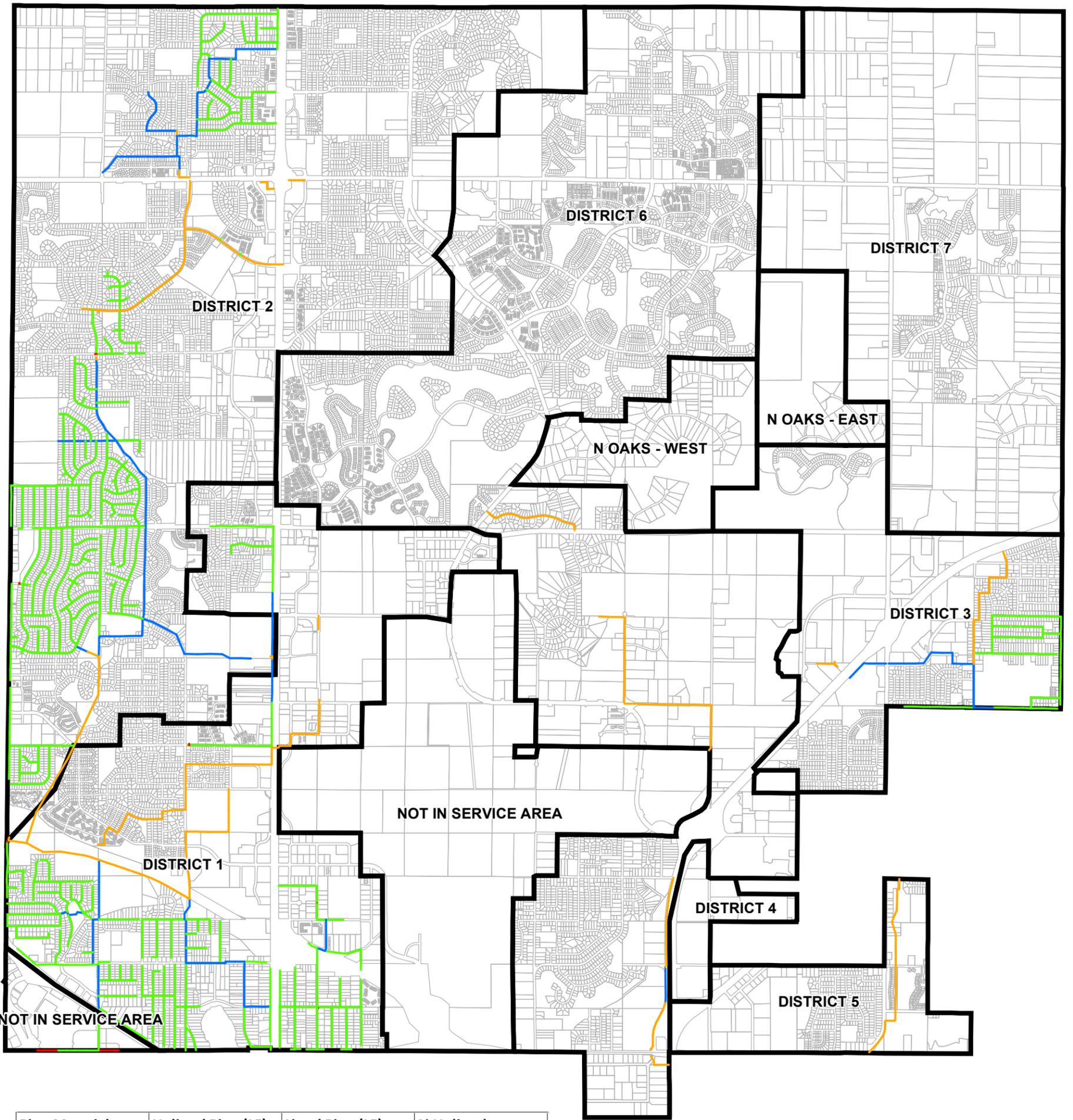
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**CITY OF BLAINE
SANITARY SEWER SYSTEM**

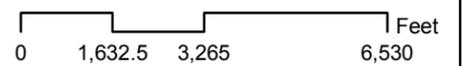
**Figure
2**



Pipe Material	Unlined Pipe (LF)	Lined Pipe (LF)	% Unlined
Clay Sewer Pipe	2,671	227,658	1%
RCP Sewer Pipe	67,020	51,474	57%

LEGEND

- Unlined Clay Pipe
- Lined Clay Pipe
- Unlined RCP
- Lined RCP
- Sanitary Sewer Districts
- Parcels



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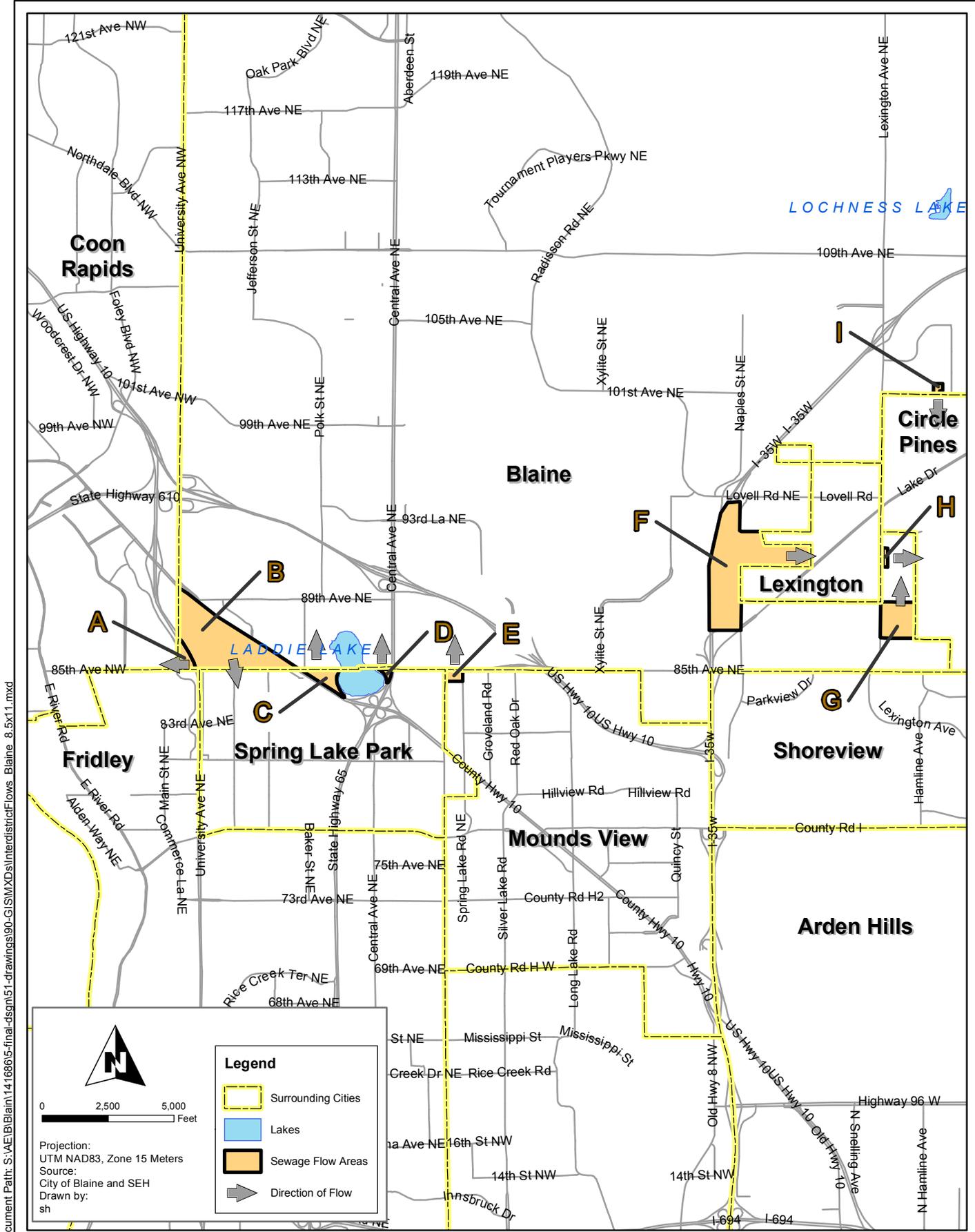
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**CITY OF BLAINE
SANITARY SEWER SYSTEM**

**Figure
3**



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INTERCOMMUNITY FLOWS
 City of Blaine, Minnesota

Figure
 4

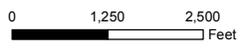
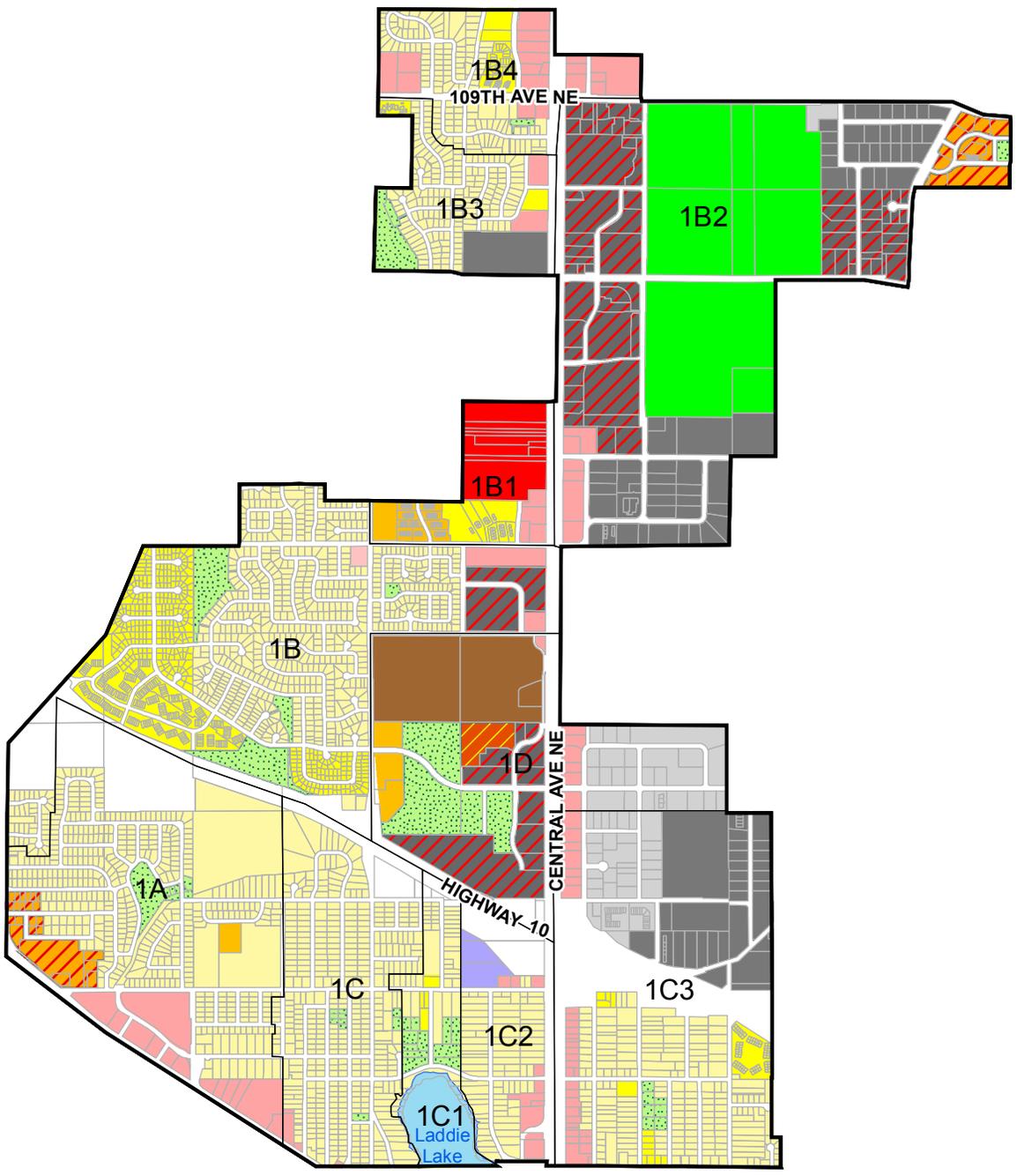
Appendix A

Land Use

A-1 – Land Use by Sewer District, Maps of Districts 1-7

A-2 – Land Use by Sewer District Table

A-1 – Land Use by Sewer District, Maps of Districts 1-7



Projection:
Anoka County Coordinates
Source:
City of Blaine, Met Council, SEH
Drawn by:
lo

Legend

- | | | |
|----------------------------|--|---------------------------------------|
| MUSA Boundary | ABD - Abandoned | HDR/PI/PC |
| Sanitary Sewer Districts | LDR - Low Density Residential | LI - Light Industrial |
| Sanitary Sewer Subdistrict | MDR - Medium Density Residential | HI - Heavy Industrial |
| Parcels | L-MDR - Low Density/Medium Density Residential | O - Office |
| | HDR - High Density Residential | PI/PC - Planned Industrial/Commercial |
| | MHR - Mobile Home Residential | P/OS - Park/Open Space |
| | NC - Neighborhood Commercial | AP - Airport |
| | CC - Community Commercial | ROW - Right-of-Way |
| | PC - Planned Commercial | RR - Regional Recreation |
| | HDR/PC | Water Features |



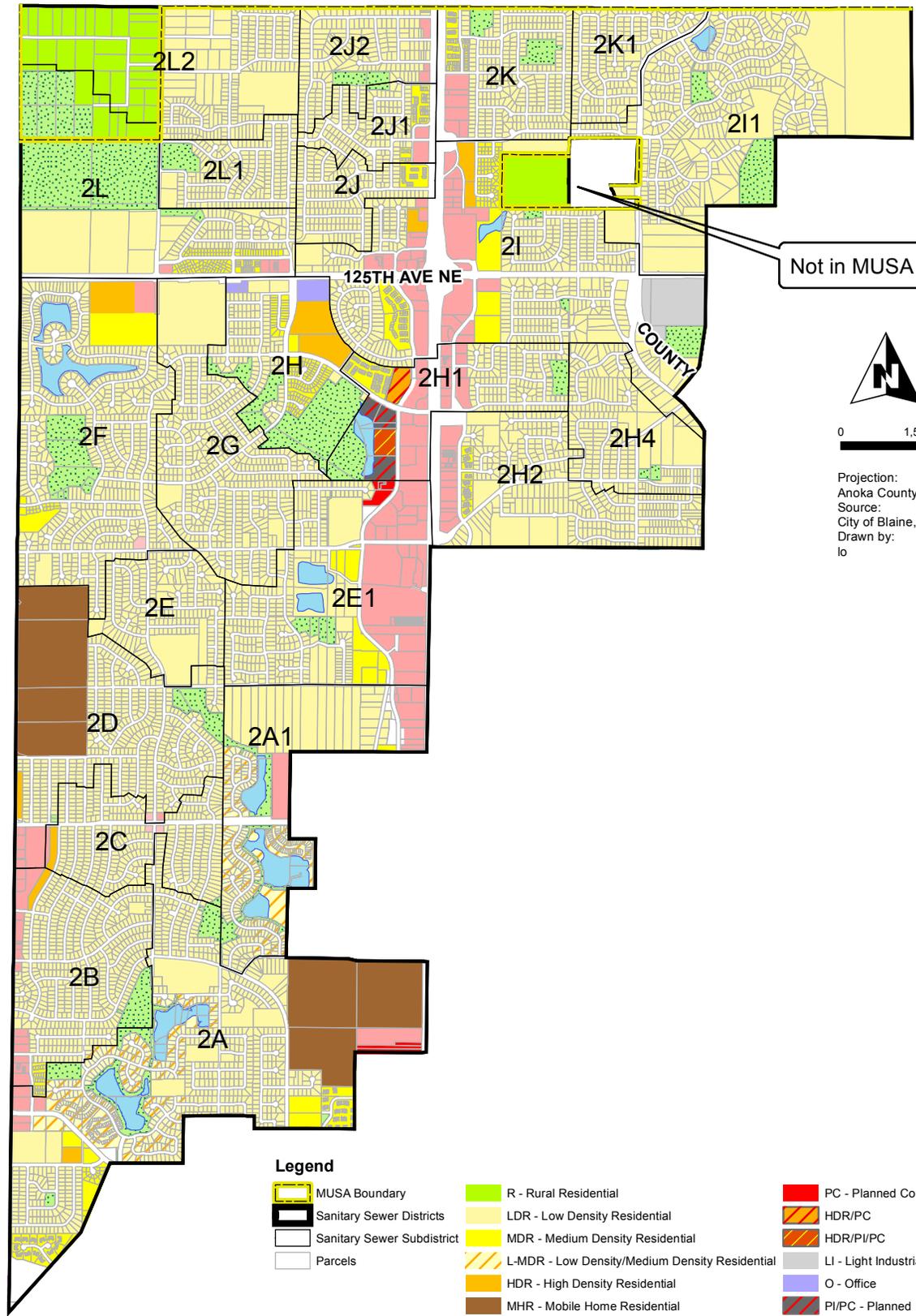
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Date: 9/28/2017

**SANITARY SEWER
DISTRICT NO. 1
City of Blaine, Minnesota**

Appendix
A

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Not in MUSA



0 1,500 3,000 Feet

Projection:
Anoka County Coordinates
Source:
City of Blaine, Met Council, SEH
Drawn by:
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Legend

- MUSA Boundary
- Sanitary Sewer Districts
- Sanitary Sewer Subdistrict
- Parcels
- R - Rural Residential
- LDR - Low Density Residential
- MDR - Medium Density Residential
- L-MDR - Low Density/Medium Density Residential
- HDR - High Density Residential
- MHR - Mobile Home Residential
- NC - Neighborhood Commercial
- CC - Community Commercial
- PC - Planned Commercial
- HDR/PC
- HDR/PI/PC
- LI - Light Industrial
- O - Office
- PI/PC - Planned Industrial/Commercial
- P/OS - Park/Open Space
- ROW - Right-of-Way
- Water Features



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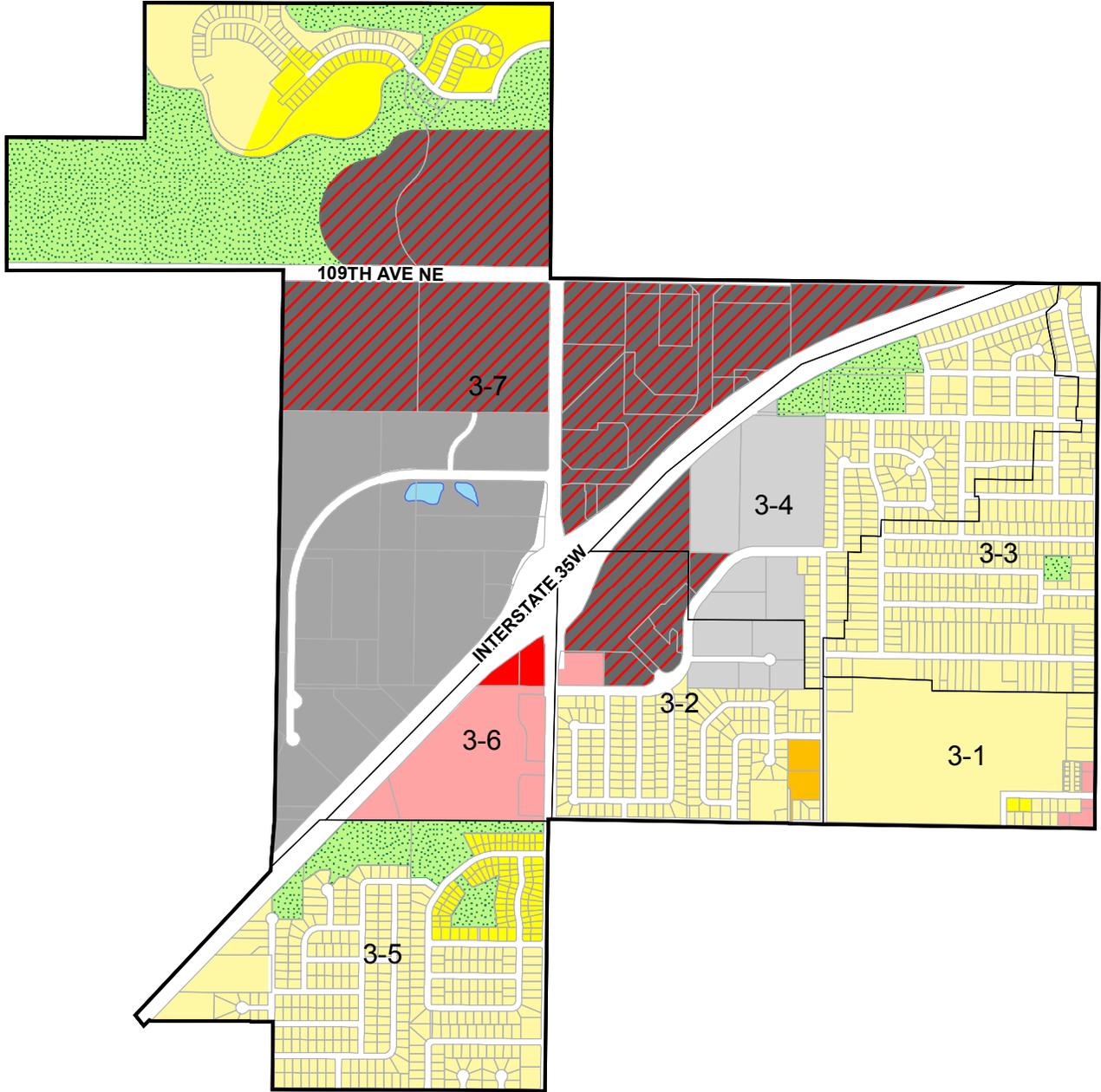
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Date: 1/25/2018

**SANITARY SEWER
DISTRICT NO. 2
City of Blaine, Minnesota**

Appendix
A

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0 800 1,600 Feet

Projection:
Anoka County Coordinates
Source:
City of Blaine, Met Council, SEH
Drawn by:
lo

Legend

- MUSA Boundary
- LDR - Low Density Residential
- HI - Heavy Industrial
- Sanitary Sewer Districts
- MDR - Medium Density Residential
- PI - Planned Industrial
- Sanitary Sewer Subdistrict
- HDR - High Density Residential
- PI/PC - Planned Industrial/Commercial
- Parcels
- CC - Community Commercial
- P/OS - Park/Open Space
- PC - Planned Commercial
- ROW - Right-of-Way
- LI - Light Industrial
- Water Features



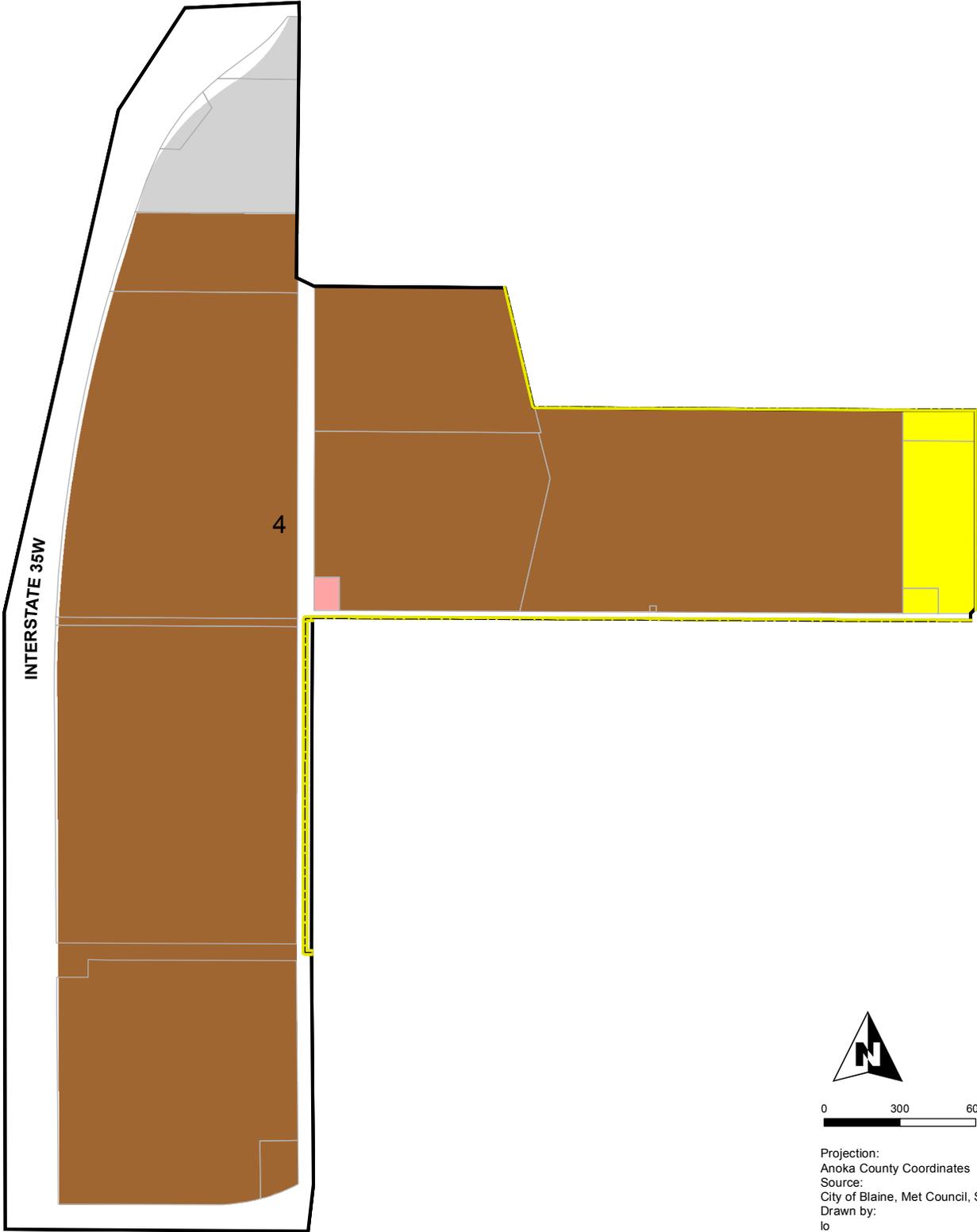
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Date: 1/25/2018

**SANITARY SEWER
DISTRICT NO. 3**
City of Blaine, Minnesota

Appendix
A



Legend

- MUSA Boundary
- Sanitary Sewer Districts
- Sanitary Sewer Subdistrict
- Parcels
- MDR - Medium Density Residential
- MHR - Mobile Home Residential
- CC - Community Commercial
- LI - Light Industrial
- ROW - Right-of-Way
- Water Features



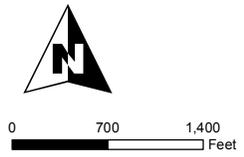
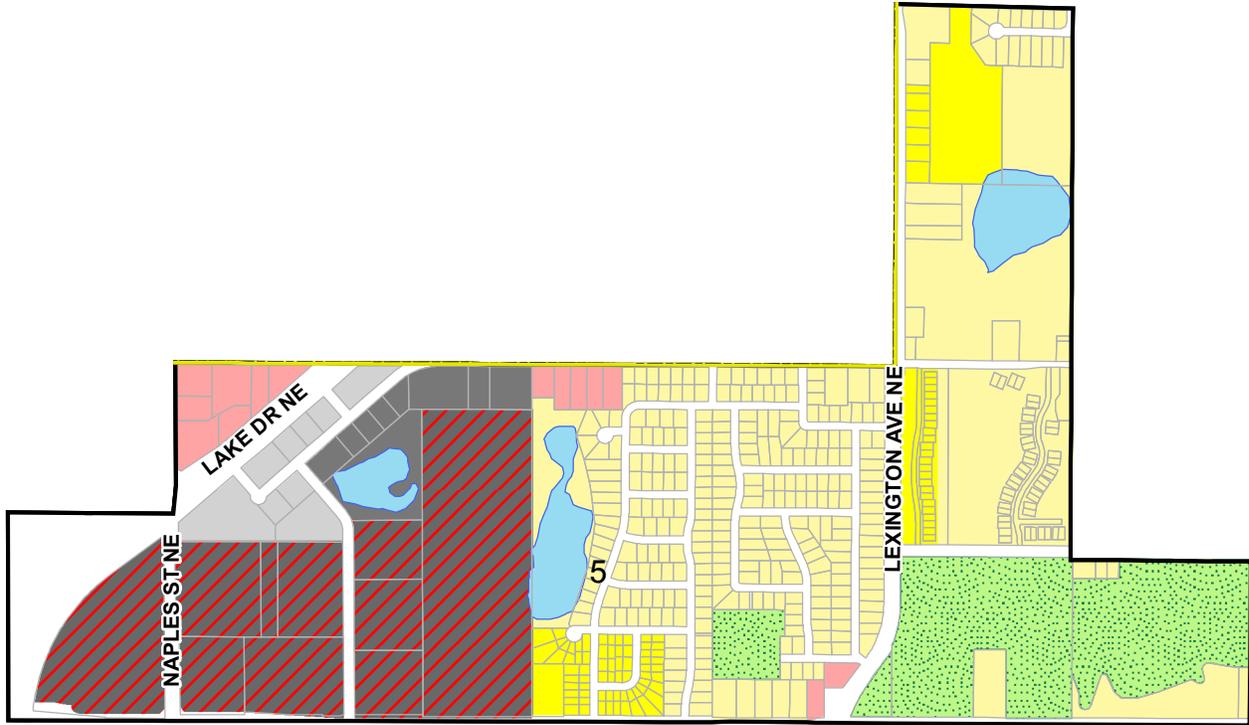
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Date: 9/28/2017

**SANITARY SEWER
DISTRICT NO. 4**
City of Blaine, Minnesota

Appendix
A



Projection:
Anoka County Coordinates
Source:
City of Blaine, Met Council, SEH
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Legend

- MUSA Boundary
- LDR - Low Density Residential
- HI - Heavy Industrial
- Sanitary Sewer Districts
- MDR - Medium Density Residential
- PI/PC - Planned Industrial/Commercial
- Sanitary Sewer Subdistrict
- CC - Community Commercial
- P/OS - Park/Open Space
- LI - Light Industrial
- ROW - Right-of-Way
- Water Features
- Parcels



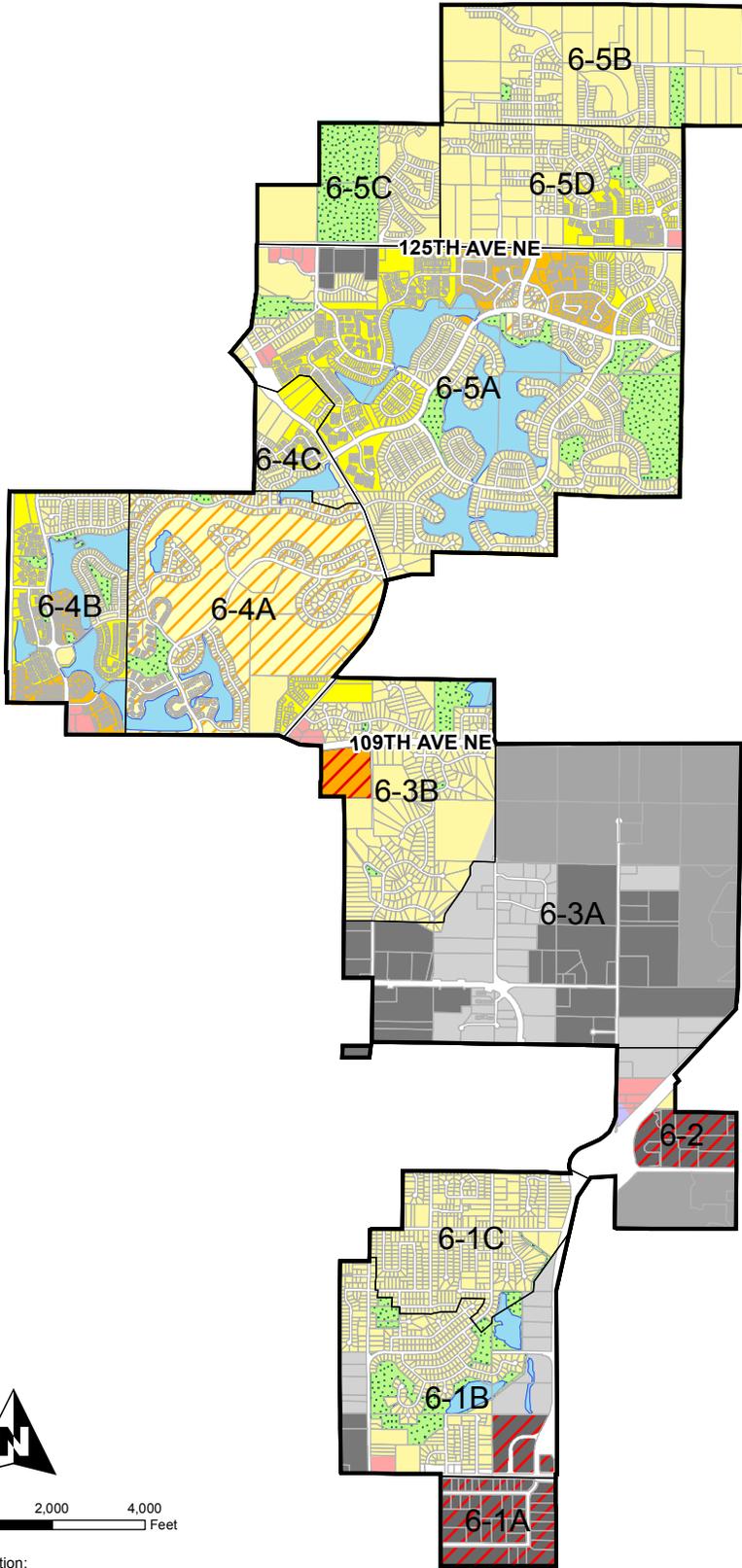
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Date: 9/28/2017

**SANITARY SEWER
DISTRICT NO. 5**
City of Blaine, Minnesota

Appendix
A



Legend

- MUSA Boundary
- Sanitary Sewer Districts
- Sanitary Sewer Subdistrict
- Parcels
- LDR - Low Density Residential
- MDR - Medium Density Residential
- L-MDR - Low Density/Medium Density Residential
- HDR - High Density Residential
- MHR - Mobile Home Residential
- CC - Community Commercial
- HDR/PC
- LI - Light Industrial
- HI - Heavy Industrial
- PI - Planned Industrial
- PI/PC - Planned Industrial/Commercial
- P/OS -Park/Open Space
- AP - Airport
- ROW - Right-of-Way
- Water Features



0 2,000 4,000
Feet

Projection:
Anoka County Coordinates
Source:
City of Blaine, Met Council, SEH
Drawn by:
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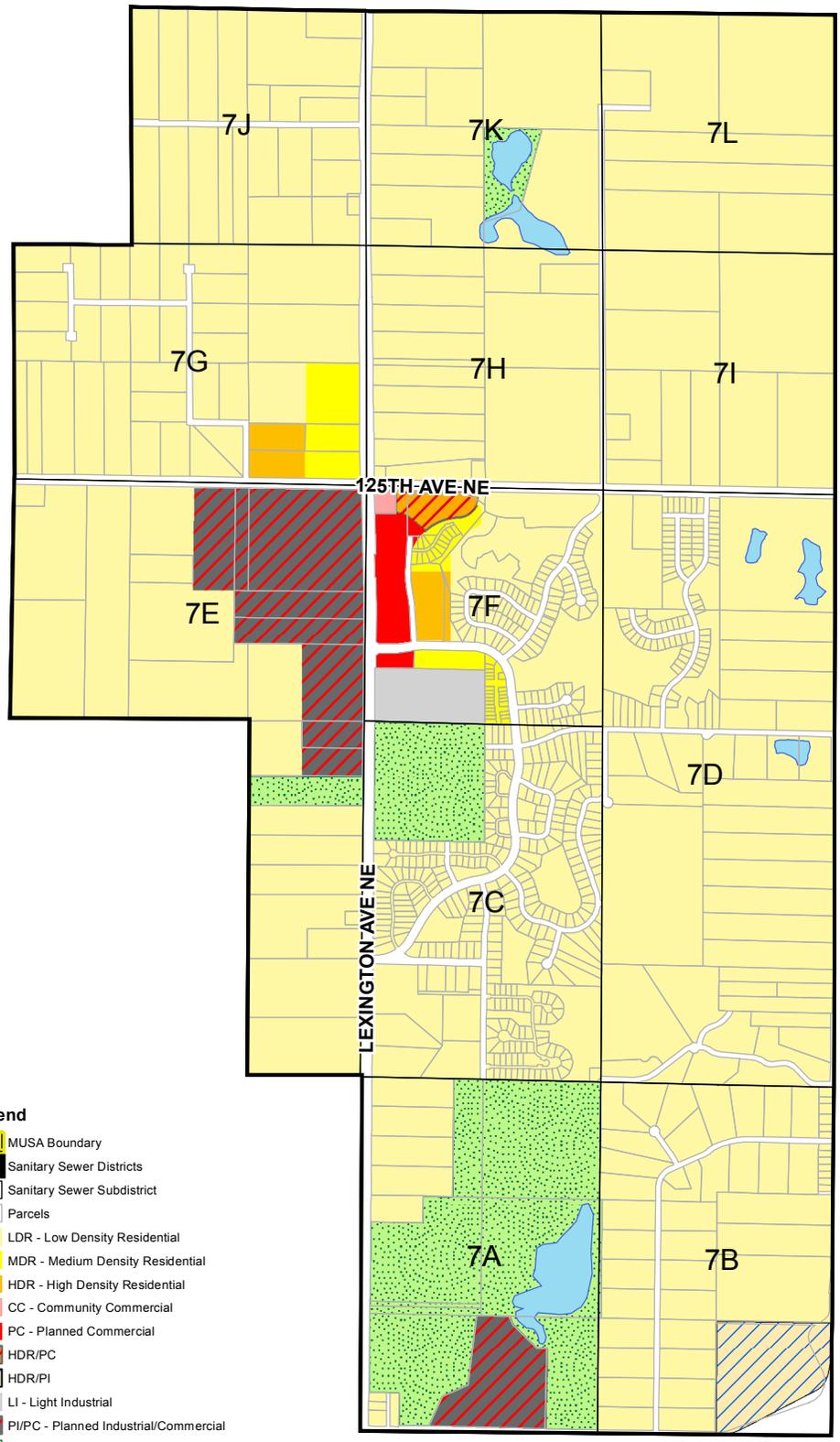
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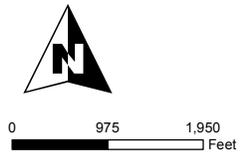
Date: 1/25/2018

**SANITARY SEWER
DISTRICT NO. 6
City of Blaine, Minnesota**

**Appendix
A**



- Legend**
- MUSA Boundary
 - Sanitary Sewer Districts
 - Sanitary Sewer Subdistrict
 - Parcels
 - LDR - Low Density Residential
 - MDR - Medium Density Residential
 - HDR - High Density Residential
 - CC - Community Commercial
 - PC - Planned Commercial
 - HDR/PC
 - LI - Light Industrial
 - PI/PC - Planned Industrial/Commercial
 - P/O/S - Park/Open Space
 - ROW - Right-of-Way
 - Water Features



Projection:
Anoka County Coordinates
Source:
City of Blaine, Met Council, SEH
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BLAIN 141686
Date: 1/25/2018

**SANITARY SEWER
DISTRICT NO. 7**
City of Blaine, Minnesota

Appendix
A

A-2 – Land Use by Sewer District Table

Appendix A- Land Use by Sewer District (From Future Land Use Plan)

Sum of ACRES SUB_DIST	LANDUSE Commercial Developed	Developed Undeveloped	High Density Developed	Undeveloped	Low Density Developed	Undeveloped	Medium Density	Mobile Home Developed	NWI/Water Developed	Undeveloped	Park/Open Space Undeveloped	ROW/AP Developed	Undeveloped	Rural Developed	Undeveloped	Grand Total
4	7.1						5.5	132.7				33.5				178.7
5	46.3	179.4			180.8		35.1		21.6			98.6				561.8
1A	57.4		8.1		208.6						8.9		119.4			402.4
1B	21.2	11.7			187.2		93.4				28.9		136.4			478.8
1B1	6.2	42.4	14.6				14.9	0.0					11.0			89.1
1B2	390.9	13.1									150.2		96.2			650.4
1B3	26.3				51.2		5.5	0.0			12.2		21.0			116.3
1B4	40.1				52.4		12.4				1.0		30.4			136.3
1C	2.5				153.9					0.2	3.5		60.0			220.1
1C1					25.3		2.9			29.7	11.9		11.1			80.9
1C2	17.6	2.6			51.3					0.5	0.0		40.3			112.2
1C3	115.5	38.1			107.8		16.0				5.2		115.9			398.5
1D	125.5		12.1					73.5			44.8		63.8			319.8
2A	6.1	16.0	2.8		205.1		123.7	109.0		21.8	28.1		101.2			613.7
2A1		26.2			101.8		58.4			24.7	15.9		28.1			255.2
2B	17.6		2.8		132.7		4.4				11.8		45.0			214.4
2C	2.3		2.9		101.1						0.7		29.7			136.6
2D	11.3		2.5		131.3			103.1			11.6		47.1			307.0
2E					95.2			0.0					18.8			114.0
2E1	87.8	4.3			126.2		20.1			9.1	8.3		51.3			307.1
2F	1.2	6.0		12.4	215.2		27.3	0.1		18.3	28.5		67.3			376.3
2G	0.0				196.0						0.3		46.2			242.5
2H	7.8		21.1		38.1		19.6			0.1	53.8		28.0			168.5
2H1	44.7	6.7		5.7	40.7		10.5			6.5	18.7		33.0			166.6
2H2	16.0				158.6		6.7				0.0		50.1			231.3
2H4					80.3	24.4					2.5		20.3			127.6
2I	62.7	28.2	13.2		192.4	8.7	46.8			2.7	13.8		119.8		31.1	519.4
2I1					345.2	12.6				9.9	25.9		52.2		27.4	473.1
2J	0.0				54.5		5.7						17.2			77.5
2J1	4.3				40.1		7.8				1.2		19.1			72.4
2J2	2.9				79.0						6.6		20.4			108.9
2K	12.3				82.4		9.2				12.9		39.4			156.2
2K1					65.0								21.5			86.5
2L	4.3				114.1		15.4				124.1		29.4		22.6	309.9
2L1					61.2						8.3		18.9			88.3
2L2					129.2								29.2	61.6	35.1	255.0
3-1	2.2				74.2		0.7						5.7			82.9
3-2	44.9		4.2		55.0								28.6			132.7
3-3					93.4						1.5		24.6			119.5
3-4	57.2				69.7						14.6		38.7			180.2
3-5					98.0		15.3				24.8		44.6			182.8
3-6	42.5										0.1		14.8			57.4
3-7	248.8	135.7				39.2	37.6			2.0	127.3		80.4			671.0
6-1A	100.1												14.9			115.0
6-1B	91.4	25.8			150.7					21.4	60.2		79.9			429.3
6-1C		0.4			193.9	6.7				1.6	5.8		52.4			260.7
6-2	91.6	72.7				2.8		0.0					55.5			222.5
6-3A	555.9	389.3			2.0								54.2			1,001.4
6-3B	39.5				285.9		12.1			6.7	22.1		48.8			415.1
6-4A			0.0		458.0	0.7	16.9			36.0	14.6		67.5			593.8
6-4B	6.1		47.7		56.6		72.7			53.6	11.9		51.9			300.5
6-4C					38.0		31.4			7.9			18.5			95.7
6-5A	31.0		68.6		432.0		192.0			151.0	112.7		190.0			1,177.2
6-5B					218.4						1.8		19.6			239.8
6-5C					108.6						79.4		15.0			203.0
6-5D	3.0				213.0		50.2				4.3		50.7			321.3
7A	24.9				34.0					15.1	152.8		16.0			242.8
7B		29.8			185.0						0.9		20.6			236.3
7C	0.0				172.8						37.5		33.1			243.3
7D					275.9	89.0							25.2			396.0
7E		92.0			89.4	161.0				5.9			7.0			359.3
7F	18.3	14.3		14.0		76.1	14.4				0.0		22.8			160.0
7G				8.7		195.9	17.9						18.6			241.1
7H					151.1					0.3			10.9			162.3
7I					154.4								6.0			160.4
7J					300.5						10.1		10.7			321.2
7K					138.7					9.5	6.9		5.3			160.3
7L					159.5								1.7			161.2
Not in Service Area	112.9				414.3		7.1			9.9	493.8		1,952.1			2,990.2
Grand Total	2,607.9	1,134.5	200.6	40.9	7,523.2	1,521.1	1,009.5	418.4	21.6	444.4	1,832.4	132.1	4,725.0	61.6	116.1	21,789.3

Appendix B

Future Flows

**APPENDIX B - Table 1
FLOWS FROM DISTRICT 1 AND 2**

1/22/2018

From Node	To Node	Districts / SubDistricts	Residential				Avg. Flow (MGD)	Comm/Ind Avg. Flow (MGD)	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Existing Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)
			LD	MD	HD	MH											
			Units	Units	Units	Units											
LS #5	D-122	1/4 2L2	142	0	0	0	0.032	0	0.0320	0.0320	3.25	0.104	0.16	8" FM	FM	0.67	24%
D-122	D-73	1/4 2L2, 1/2 2J2	781	0	0	0	0.1757	0.0004	0.1761	0.2081	3.05	0.6347	0.98	10	0.28	1.38	71%
D-417	D-434	2K1	163	0	0	0	0.0367	0	0.0367	0.0367	3.25	0.1193	0.18	10	0.28	1.38	13%
D-434	D-90	1/2 2K	104	28	0	0	0.0297	0.0015	0.0312	0.0679	3.25	0.2207	0.34	10	0.28	1.38	25%
D-90	D-73	1/2 2K, 1/2 2J2	202	28	0	0	0.0518	0.0019	0.0537	0.1216	3.15	0.383	0.59	12	0.24	2.08	28%
D-73	D-65	2J1, 1/4 2L2	604	47	0	0	0.1465	0.0011	0.1476	0.4773	2.85	1.3603	2.1	15	0.24	3.77	56%
D-65	D-20	1/2 2J	69	18	0	0	0.0196	0	0.0196	0.4969	2.85	1.4162	2.19	21	0.10	5.97	37%
D-20	D-17	1/2 2J	69	18	0	0	0.0196	0	0.0196	0.5165	2.75	1.4204	2.2	24	0.09	8.09	27%
LS #23	D-184	1/4 2L2	142	0	0	0	0.032	0	0.0320	0.032	3.25	0.104	0.16	6" FM	FM	0.41	39%
D-184	D-175	1/4 2L2	142	0	0	0	0.032	0	0.0320	0.0640	3.25	0.208	0.32	12	0.40	2.69	12%
D-175	D-17	1/2 2L, 1/2 2L1	658	47	0	0	0.1586	0.0005	0.1591	0.2231	3.05	0.6805	1.05	15	0.28	4.07	26%
D-17	C-50	1/2 2L1, 1/2 2L (R)	686	47	0	0	0.1649	0.0005	0.1654	0.9050	2.50	2.2625	3.5	24	0.09	8.09	43%
LS #19	C-638	1/3 2I1	320	0	0	0	0.072	0	0.0720	0.0720	3.25	0.234	0.36	4" FM	FM	0.55	65%
C-638	C-561	--								0.0720	3.25	0.234	0.36	10	0.28	1.38	26%
C-561	C-553	1/3 2I1	320	0	0	0	0.072	0	0.0720	0.1440	3.15	0.4536	0.7	10	0.28	1.38	51%
C-553	C-397	1/3 2I1	320	0	0	0	0.072	0	0.0720	0.2160	3.05	0.6588	1.02	15	0.15	2.98	34%
C-397	C-274	1/2 2I	293	141	99	0	0.1199	0.0361	0.1560	0.3720	2.95	1.0974	1.7	15	0.15	2.98	57%
C-274	C-267	1/4 2I	147	71	50	0	0.0603	0.018	0.0783	0.4503	2.85	1.2834	1.99	15	0.15	2.98	67%
C-267	C-50	1/4 2I	147	71	50	0	0.0603	0.018	0.0783	0.5286	2.75	1.4537	2.25	16	0.14	3.42	66%
C-50	C-45	1/2 2H	48	59	159	0	0.0599	0.001	0.0609	1.4945	2.28	3.4075	5.27	24	0.08	7.63	69%
C-383	C-423	2H4	274	0	0	0	0.0617	0	0.0617	0.0617	3.25	0.2005	0.31	12	0.18	1.80	17%
LS #11	C-373	1/3 2H2	131	14	0	0	0.0326	0.0013	0.0339	0.0339	3.25	0.1102	0.17	6" FM	FM	0.67	25%
C-373	C-369	--								0.0339	3.25	0.1102	0.17	15	0.32	4.35	4%
C-369	C-423	1/3 2H2	131	14	0	0	0.0326	0.0013	0.0339	0.0678	3.25	0.2204	0.34	15	0.21	3.53	10%
C-423	C-45	1/3 2H2, 2H1	233	77	115	0	0.0956	0.0259	0.1215	0.2510	3.05	0.7656	1.18	15	0.18	3.27	36%

**APPENDIX B - Table 1
FLOWS FROM DISTRICT 1 AND 2**

1/22/2018

From Node	To Node	Districts / SubDistricts	Residential				Avg. Flow (MGD)	Comm/Ind Avg. Flow (MGD)	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Existing Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)
			LD	MD	HD	MH											
			Units	Units	Units	Units											
C-45	C-12	1/2 2H	48	59	159	0	0.0599	0.001	0.0609	1.8064	2.15	3.8838	6.01	27	0.08	10.44	58%
LS #17	C-309	1/2 2-E1	158	61	0	0	0.0493	0.0152	0.0645	0.0645	3.25	0.2096	0.32	4" FM	FM	0.40	80%
C-309	C-12	1/4 2G	123	0	0	0	0.0277	0	0.0277	0.0922	3.25	0.2997	0.46	8	0.40	0.91	51%
C-12	LS#4	1/2 2G	245	0	0	0	0.0551	0	0.0551	1.9537	2.10	4.1028	6.35	27	0.08	10.44	61%
C-237	LS #4	1/2 2F	269	121	125	1	0.1162	0.0061	0.1223	0.1223	3.15	0.3852	0.6	12	0.20	1.90	32%
C-193	LS #4	1/2 2F	269	121	125	1	0.1162	0.0061	0.1223	0.1223	3.15	0.3852	0.6	10	0.25	1.31	46%
LS #4	B-492	--					0		0.0000	2.1983	2.05	4.5065	6.97	2-16" FM	FM	7.73	90%
B-492	B-487	1/4 2G	123	0	0	0	0.0277	0	0.0277	2.2260	2.05	4.5633	7.06	30	0.07	12.93	55%
LS #15	B-611	1/2 2-E1	158	61	0	0	0.0493	0.0152	0.0645	0.0645	3.25	0.2096	0.32	6" FM	FM	0.77	42%
B-611	B-487	1/4 2E	60	0	0	1	0.0138	0	0.0138	0.0783	3.25	0.2545	0.39	10	0.28	1.38	28%
B-487	B-302	3/4 2E	179	0	0	1	0.0406	0	0.0406	2.3449	2.05	4.807	7.44	30	0.08	13.83	54%
B-468	B-307	1/2 2D	165	0	19	516	0.1962	0.0014	0.1976	0.1976	3.15	0.6224	0.96	12	0.22	1.99	48%
B-314	B-307	1/2 2D	165	0	19	516	0.1962	0.0014	0.1976	0.1976	3.15	0.6224	0.96	10	0.28	1.38	69%
B-307	B-302	--								0.3952	2.95	1.1658	1.8	15	0.15	2.98	60%
B-302	B-292	1/2 2A1	128	176	0	0	0.0684	0.0262	0.0946	2.8347	2.05	5.8111	8.99	30	0.08	13.83	65%
B-352	B-292	2C	253	0	43	0	0.0666	0.0006	0.0672	0.0672	3.25	0.2184	0.34	10	0.28	1.38	25%

**APPENDIX B - Table 1
FLOWS FROM DISTRICT 1 AND 2**

1/22/2018

From Node	To Node	Districts / SubDistricts	Residential				Comm/Ind	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Existing Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)	
			LD	MD	HD	MH											
			Units	Units	Units	Units	Avg. Flow (MGD)	Avg. Flow (MGD)									
B-292	B-81	1/4 2A1	64	88	0	0	0.0342	0.0131	0.0473	2.9492	2.05	6.0459	9.35	30	0.08	13.83	68%
LS #22	B-1521	1/8 2A1	32	44	0	0	0.0171	0.0065	0.0236	0.0236	3.25	0.0767	0.12	4" FM	FM	0.30	40%
B-1521	B-499	1/8 2A1	32	44	0	0	0.0171	0.0065	0.0236	0.0472	3.25	0.1534	0.24	8	0.25	0.72	33%
LS #18	B-1761	1/4 1B4	33	19	0	0	0.0117	0.0025	0.0142	0.0142	3.25	0.0462	0.07	4" FM	FM	0.25	28%
B-1761	B-499	1/4 1B4	33	19	0	0	0.0117	0.0025	0.0142	0.0756	3.25	0.2457	0.38	8	0.25	0.72	53%
B-499	B-514	1/4 1B4	33	19	0	0	0.0117	0.0025	0.0142	0.0898	3.25	0.2919	0.45	10	0.28	1.38	33%
B-514	LS #3	1/4 1B4, 1B3	161	52	0	1	0.0482	0.0091	0.0573	0.1471	3.15	0.4634	0.72	12	0.22	1.99	36%
B-540	LS #3	1/2 1B1	0	45	110	1	0.0352	0.0432	0.0784	0.0784	3.25	0.2548	0.39	10	0.28	1.38	28%
LS #3	B-531	1/2 1B1	0	45	110	1	0.0352	0.0432	0.0784	0.3039	2.95	0.8965	1.39	12" FM	FM	1.50	93%
B-531	B525	--								0.3039	2.95	0.8965	1.39	15	1.00	7.70	18%
B-525	B-81	1/4 2A	129	186	11	273	0.1553	0.0084	0.1637	0.4676	2.85	1.3327	2.06	21	0.30	10.34	20%
B-81	B-75	--								3.4168	2.05	7.0044	10.84	30	0.11	16.21	67%
B-75	B-66	1/4 2A	129	186	11	273	0.1553	0.0084	0.1637	3.5805	2.02	7.2326	11.19	30	0.11	16.21	69%
B-66	B-68	2B	332	27	43	0	0.0905	0.0044	0.0949	3.6754	2.02	7.4243	11.49	36	0.05	17.77	65%
B-68	B-09	1/4 2A	129	186	11	273	0.1553	0.0084	0.1637	3.8391	2.02	7.755	12	36	0.05	17.77	68%
B-09	B-03	---								3.8391	2.02	7.755	12	36	0.05	17.77	68%
B-03	A-483	1/4 2A	129	186	11	273	0.1553	0.0084	0.1637	4.0028	2.02	8.0857	12.51	36	0.05	17.77	70%
E-1113	B-1099	1/4 1B2	0	0	0	0	0	0.031	0.0310	0.0310	3.25	0.1008	0.16	12	0.22	1.99	8%
B-1099	LS #10	1/4 1B2	0	0	0	0	0	0.031	0.0310	0.0620	3.25	0.2015	0.31	18	0.22	5.87	5%
LS #10	B-1077	--								0.0620	3.25	0.2015	0.31	10" FM	FM	1.35	23%
B-1077	B-779	1/4 1B2	0	0	0	0	0	0.031	0.0310	0.0930	3.25	0.3023	0.47	18	0.12	4.34	11%
B-779	B-764	1/4 1B2	0	0	0	0	0	0.031	0.0310	0.1240	3.15	0.3906	0.6	18	0.12	4.34	14%
B-764	B-756	1/4 1B	118	141	0	0	0.0583	0.0072	0.0655	0.1895	3.15	0.5969	0.92	21	0.07	5.00	18%
B-756	B-743	1/4 1B	118	141	0	0	0.0583	0.0072	0.0655	0.2550	3.05	0.7778	1.2	21	0.07	5.00	24%
B-743	B-660	1/4 1B	118	141	0	0	0.0583	0.0072	0.0655	0.3205	2.95	0.9455	1.46	21	0.07	5.00	29%
B-660	B-658	1/4 1B	118	141	0	0	0.0583	0.0072	0.0655	0.3860	2.95	1.1387	1.76	24	0.08	7.63	23%
B-553	B-557	1D	0	0	182	736	0.2618	0.0314	0.2932	0.2932	3.05	0.8943	1.38	18	0.16	5.01	28%
B-557	A-496						0		0.0000	0.2932	3.05	0.8943	1.38	12	0.20	1.90	73%

**APPENDIX B - Table 1
FLOWS FROM DISTRICT 1 AND 2**

1/22/2018

From Node	To Node	Districts / SubDistricts	Residential				Comm/Ind	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Existing Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)	
			LD	MD	HD	MH											
			Units	Units	Units	Units	Avg. Flow (MGD)	Avg. Flow (MGD)									
A-358	A-355	1/4 1C3	68	25	0	0	0.0209	0.0263	0.0472	0.0472	3.25	0.1534	0.24	15	0.09	2.31	10%
A-355	LS #1	1/4 1C3	68	25	0	0	0.0209	0.0263	0.0472	0.0944	3.25	0.3068	0.47	15	0.22	3.61	13%
LS #1	A-257	1/2 1C3	135	49	0	0	0.0414	0.0525	0.0939	0.1883	3.15	0.5931	0.92	10" FM	FM	1.93	48%
A-257	A-244	1/4 1C2	33	0	0	0	0.0074	0.0024	0.0098	0.1981	3.15	0.624	0.97	15	0.28	4.07	24%
A-244	A-208	3/4 1C2, 1/4 1C1	112	5	0	0	0.0263	0.0071	0.0334	0.2315	3.05	0.7061	1.09	15	0.24	3.77	29%
A-208	A-168	3/4 1C1, 1/2 1C	240	14	0	0	0.0572	0.0003	0.0575	0.2890	3.05	0.8815	1.36	21	0.30	10.34	13%
A-168	A-496	1/2 1C	193	0	0	0	0.0434	0.0003	0.0437	0.3327	2.95	0.9815	1.52	21	0.30	10.34	15%
A-496	A-161	--								0.6259	2.72	1.7024	2.63	24	0.30	14.77	18%
A-161	A-11	--								0.6259	2.72	1.7024	2.63	24	0.08	7.63	34%
A-26	A-18	1/6 1A	88	0	21	0	0.0245	0.0024	0.0269	0.0269	3.25	0.0874	0.14	15	0.15	2.98	5%
A-18	A-17	1/2 1A	261	0	61	0	0.0725	0.0072	0.0797	0.1066	3.15	0.3358	0.52	15	0.15	2.98	17%
A-17	A-11	1/3 1A	173	0	41	0	0.0482	0.0047	0.0529	0.1595	3.15	0.5024	0.78	15	0.15	2.98	26%
A-11	B-658	--								0.7854	2.60	2.042	3.16	30	0.10	15.46	20%
B-658	A-483	--								1.1714	2.39	2.7996	4.33	30	0.10	15.46	28%
A-483	MCES INT. M216	--								5.1742	1.95	10.0897	15.61	42	0.05	26.81	58%
TOTAL UNITS			11,548	3,107	1,575	2,867		0.6615									

**APPENDIX B - Table 2
FLOWS FROM DISTRICT 3, 4, 5, AND 7**

1/22/2018

From Node	To Node	Districts / SubDistricts	Residential				Comm/Ind Avg. Flow (MGD)	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Proposed Pipe Size (in)	Existing & Proposed Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)	
			LD	MD	HD	MH												Avg. Flow (MGD)
			Units	Units	Units	Units												
1	2	1/2 7L,1/2 7K	448	0	0	0	0.1008	0	0.1008	0.1008	3.15	0.3175	0.49	8	0.40	0.91	54%	
2	3	1/2 7L,1/2 7K	448	0	0	0	0.1008	0	0.1008	0.2016	3.05	0.6149	0.95	12	0.28	2.25	42%	
3	PLS #2	1/2 7I, 1/4 7H	345	0	0	0	0.0776	0	0.0776	0.2792	3.05	0.8516	1.32	14	0.22	3.00	44%	
PLS #2	4	1/2 7I, 1/4 7H	345	0	0	0	0.0776	0	0.0776	0.3568	2.95	1.0526	1.63	14	0.22	3.00	54%	
6	PLS #1	1/4 7H	114	0	0	0	0.0257	0	0.0257	0.0257	3.25	0.0835	0.13	8	0.40	0.91	14%	
PLS #1	4	1/4 7H	114	0	0	0	0.0257	0	0.0257	0.0514	3.25	0.1671	0.26	8	0.40	0.91	29%	
4	G-152								0.4082	2.85	1.1634	1.8		16	0.22	4.29	42%	
G-152	G-34	7F, 1/2 7D, 2/3 7C	992	145	281	0	0.3191	0.0332	0.3523	0.7605	2.6	1.9773	3.06	18	0.15	4.85	63%	
	PLS #3	1/2 7J,1/4 7G	598	45	44	0	0.1546	0	0.1546	0.1546	3.15	0.487	0.75	10	0.28	1.38	54%	
PLS #3	12	3/4 7G, 1/3 7E	674	135	131	0	0.2115	0.0607	0.2722	0.4268	2.85	1.2164	1.88	15	0.15	2.98	63%	
12	G-34	2/3 7E	474	0	0	0	0.1067	0.1233	0.2300	0.6568	2.72	1.7865	2.76	18	0.15	4.85	57%	
LS #2	E-36	3-3	234	0	0	0	0.0527	0	0.0527	0.0527	3.25	0.1713	0.27	8" FM	FM	0.57	47%	
G-70	G-34	1/2 7D, 1/3 7A, 1/3 7C	650	0	0	0	0.1463	0.0021	0.1484	0.1484	3.15	0.4675	0.72	21	0.28	9.99	7%	
G-34	LS #25									1.5657	2.25	3.5228	5.45	18	0.28	6.62	82%	
LS #25	E-352	1/3 7B	153	0	0	0	0.0344	0.0196	0.0540	1.6197	2.22	3.5957	5.56	16" FM	FM	6.98	80%	
E-352	E-151	2/3 7B, 1/4 3-4	354	0	0	0	0.0797	0.0434	0.1231	1.7428	2.2	3.8342	5.93	18	0.23	6.00	99%	
E-151	E-36	3/4 3-4	131	0	0	0	0.0295	0.0107	0.0402	1.7830	2.2	3.9226	6.07	21	0.22	8.86	69%	
E-36	E-222						0		0.0000	1.8357	2.15	3.9468	6.11	21	0.11	6.26	98%	
LS #9 (Not In Use)	E-475	3/4 3-7, CWMP	505	170	0	0	0.1519	0.3435	0.4954	0.4954	2.85	1.4119	2.18	18	0.12	4.34	50%	
E-475	LS #8	2/3 7A	57	0	0	0	0.0128	0.0042	0.0170	0.5124	2.75	1.4091	2.18	18	0.12	4.34	50%	
LS #8	E-474	1/4 3-7	30	57	0	0	0.0196	0.1145	0.1341	0.6295	2.72	1.7122	2.65	10" FM	FM	3.10	85%	
E-474	E-248									0.6295	2.72	1.7122	2.65	18	0.12	4.34	61%	
E-248	E-222	3-6	0	0	0	0	0	0.0106	0.0106	0.6401	2.72	1.7411	2.69	18	0.12	4.34	62%	
E-222	E-08	3-2	138	0	64	0	0.0455	0.0112	0.0567	2.5325	2.05	5.1916	8.03	27	0.13	13.31	60%	

**APPENDIX B - Table 2
FLOWS FROM DISTRICT 3, 4, 5, AND 7**

1/22/2018

From Node	To Node	Districts / SubDistricts	Residential				Comm/Ind	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Proposed Pipe Size (in)	Existing & Proposed Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)	
			LD	MD	HD	MH												Avg. Flow (MGD)
			Units	Units	Units	Units												
LS #6	E-08	3-5	246	92	0	0	0.0761	0	0.0761	0.0761	3.25	0.2473	0.38	6" FM		FM	0.58	66%
E-08	E-10						0		0.0000	2.6086	2.05	5.3476	8.27	27		0.13	13.31	62%
E-10	E-1425	3-1	186	5	0	0	0.043	0.0005	0.0435	2.6521	2.05	5.4368	8.41	36		0.13	28.66	29%
E-182	E-113						0		0.0000	0.0000	3.25	0	0	10		0.34	1.52	0%
E-113	E-104	5 CI					0	0.3704	0.3704	0.3704	2.95	1.0927	1.69	12		0.19	1.85	91%
E-104	E-71	5 1/2LD, MD	227	211			0.0986		0.0986	0.4690	2.85	1.3367	2.07	14		0.16	2.56	81%
E-71	E-1425	5 1/2 LD	227				0.0511		0.0511	0.5201	2.75	1.4303	2.21	16		0.12	3.17	70%
E-1425	E-1426	5 R	0				0		0.0000	0.5201	2.75	1.4303	2.21	16		0.12	3.17	70%
E-1426	MCES INT. M203								0.0000	3.1722	2.05	6.503	10.06	36		0.10	25.14	40%
TOTAL UNITS			7,690	860	520	0		1.1479										

= Flow generation rate of 750 gpd for developed, commercial land in Subdistrict 3-7 used to more accurately represent existing flows from The Village and Pheasant Ridge Industrial Park.

**APPENDIX B - Table 3
FLOWS FROM DISTRICT 6**

1/22/2018

From Node	To Node	Districts / SubDistricts	Residential				Avg. Flow (MGD)	Comm/Ind Avg. Flow (MGD)	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Proposed Pipe Size (in)	Existing & Proposed Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)
			LD	MD	HD	MH												
			Units	Units	Units	Units												
F-961	LS #29	1/4 6-5B	137	0	0	0.00	0.0308	0	0.0308	0.0308	3.25	0.1001	0.15	8		0.40	0.91	16%
LS #29	F-951	--								0.0308	3.25	0.1001	0.15	4" FM		FM	0.50	30%
F-951	F-938	--								0.0308	3.25	0.1001	0.15	8		0.40	0.91	16%
F-938	F-537	1/4 6-5B	137	0	0	0.00	0.0308	0	0.0308	0.0616	3.25	0.2002	0.31	8		0.40	0.91	34%
F-902	LS #7	1/2 6-5B	550	0	0	0.00	0.1238	0	0.1238	0.1238	3.15	0.3900	0.6	8		0.40	0.91	66%
F-537	F-531	1/2 6-5D	267	151	0	0.00	0.0941	0.0004	0.0945	0.1561	3.15	0.4917	0.76	10		0.28	1.38	55%
F-531	F-19	--								0.1561	3.15	0.4917	0.76	12		0.28	2.25	34%
LS #7	F-922	--								0.1238	3.15	0.39	0.6	4" FM		FM	1.44	42%
F-922	F-807	1/8 6-5D	67	38	0	0.00	0.003	0.0001	0.0031	0.1269	3.15	0.3997	0.62	8		0.28	0.76	81%
F-807	F-491	3/8 6-5D	200	113	0	0.00	0.0264	0.0003	0.0267	0.1536	3.15	0.4838	0.75	12		0.28	2.25	33%
F-491	F-25	1/8 6-5A	136	144	129	0.00	0.092	0.001	0.0930	0.2466	3.05	0.7521	1.16	12		0.28	2.25	52%
F-25	F-19	--								0.2466	3.05	0.7521	1.16	12		0.28	2.25	52%
F-19	F-17	--								0.4027	2.85	1.1477	1.78	15		0.28	4.07	44%
F-306	F-298	1/16 6-5A	68	72	65	0.00	0.0461	0.0005	0.0466	0.0466	3.25	0.1515	0.23	8		0.50	1.02	23%
F-298	F-10	1/16 6-5A	68	72	65	0.00	0.0461	0.0005	0.0466	0.0932	3.25	0.3029	0.47	10		0.40	1.65	28%
F-874	F-774	6-5C	272	0	0	0.00	0.0612	0	0.0612	0.0612	3.25	0.1989	0.31	8		0.40	0.91	34%
F-774	F-17	1/8 6-5A	136	144	129	0.00	0.092	0.001	0.0930	0.1542	3.15	0.4857	0.75	10		0.28	1.38	54%
F-53	F-43	1/8 6-5A	136	144	129	0.00	0.092	0.001	0.0930	0.0930	3.25	0.3023	0.47	8		0.40	0.91	52%
F-43	LS #21	1/8 6-5A	136	144	129	0.00	0.092	0.001	0.0930	0.1860	3.15	0.5859	0.91	10		0.28	1.38	66%
F-17	F-10	--								0.5569	2.75	1.5315	2.37	18		0.22	5.87	40%
F-10	F-07	--								0.6501	2.72	1.7683	2.74	18		0.22	5.87	47%
F-07	LS #21	3/8 6-5A	406	432	386	0.00	0.2754	0.0029	0.2783	1.1144	2.39	2.6634	4.12	16" FM		FM	6.70	61%
F-268	LS #20	3/4 6-4C	72	142	0	0.00	0.0482	0	0.0482	0.0482	3.25	0.1567	0.24	4" FM		FM	0.27	89%
LS #20	E-1855	1/4 6-4C	24	48	0	0.00	0.0162	0	0.0162	0.0644	3.25	0.2093	0.32	8		0.40	0.91	35%
E-1855	E-1402	--								0.0644	3.25	0.2093	0.32	8		0.40	0.91	35%

**APPENDIX B - Table 3
FLOWS FROM DISTRICT 6**

1/22/2018

From Node	To Node	Districts / SubDistricts	Residential				Comm/Ind	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Proposed Pipe Size (in)	Existing & Proposed Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)	
			LD	MD	HD	MH												
			Units	Units	Units	Units	Avg. Flow (MGD)	Avg. Flow (MGD)										
F-196	E-1400	1/8 6-4A	144	13	1	0.00	0.0356	0	0.0356	0.0356	3.25	0.1157	0.18	12		0.22	1.99	9%
E-1400	E-1273	--							0.0000	0.0356	3.25	0.1157	0.18	12		0.22	1.99	9%
E-1273	LS #16	1/8 6-4A	144	13	1	0.00	0.0356	0	0.0356	0.0712	3.25	0.2314	0.36	12		0.22	1.99	18%
F-1684	E-1677	1/2 6-4B	71	219	358	0.00	0.1458	0.0008	0.1466	0.1466	3.15	0.4618	0.71	12		0.22	1.99	36%
E-1677	E-1232	1/2 6-4B	71	219	358	0.00	0.1458	0.0008	0.1466	0.2932	3.05	0.8943	1.38	16		0.22	4.29	32%
E-1232	E-1228	3/8 6-4A	431	38	1	0.00	0.1058	0	0.1058	0.3990	2.95	1.1771	1.82	16		0.22	4.29	42%
E-1228	LS #16	3/8 6-4A	431	38	1	0.00	0.1058	0	0.1058	0.5048	2.75	1.3882	2.15	16		0.22	4.29	50%
LS #16	E-509	--								0.5760	2.75	1.584	2.45	10" FM		FM	4.50	54%
E-509	E-754	1/2 6-3B	358	37	0	0.00	0.0889	0.0049	0.0938	1.7842	2.20	3.9252	6.07	21		0.10	5.97	102%
E-754	E-566	1/3 6-3A, 1/2 6-3B	360	37	0	0.00	0.0893	0.3108	0.4001	2.1843	2.05	4.4778	6.93	24		0.08	7.63	91%
E-611	E-566	1/6 6-3A	1	0	0	0.00	0.0002	0.1529	0.1531	0.1531	3.15	0.4823	0.75	10		0.24	1.28	59%
E-566	LS # 13	1/2 6-3A	3	0	0	0.00	0.0007	0.4588	0.4595	2.7969	2.05	5.7336	8.87	27		0.076	10.18	87%
LS # 13	E-1507	1/3 6-2	3	0	0	1.00	0.001	0.0555	0.0565	2.8534	2.05	5.8495	9.05	20" FM		FM	10.91	83%
E-1507	LS # 12	6-1C, 2/3 6-2	511	0	0	1.00	0.1153	0.1136	0.2289	3.0823	2.05	6.3187	9.78	27		0.090	11.07	88%
E-704	E-670	1/2 6-1B	189	0	0	0.00	0.0425	0.0372	0.0797	0.0797	3.25	0.259	0.4	10		0.28	1.38	29%
E-670	LS#12	1/2 6-1B	189	0	0	0.00	0.0425	0.0372	0.0797	0.1594	3.15	0.5021	0.78	10		0.28	1.38	56%
LS#12	E-530									3.2417	2.05	6.6455	10.28	2 - 16" FM		FM	9.48	108%
E-197	E-530	6-1A	0	0	0	0.00	0	0.025	0.0250	0.0250	3.25	0.0813	0.13	8		0.40	0.91	14%
E-530	MCES INT. M217						0		0.0000	3.2667	2.05	6.6967	10.36	30		0.08	13.83	75%
TOTAL UNITS			5,718	2,258	1,752	2.00		1.2062										

Appendix C

Future Flows – North Oaks

**APPENDIX C - Table 1
FLOWS FROM DISTRICT 1 AND 2**

1/24/2018

From Node	To Node	Districts / SubDistricts	Residential				Avg. Flow (MGD)	Comm/Ind Avg. Flow (MGD)	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Existing Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)
			LD	MD	HD	MH											
			Units	Units	Units	Units											
LS #5	D-122	1/4 2L2	142	0	0	0	0.032	0	0.0320	0.0320	3.25	0.104	0.16	8" FM	FM	0.67	24%
D-122	D-73	1/4 2L2, 1/2 2J2	781	0	0	0	0.1757	0.0004	0.1761	0.2081	3.05	0.6347	0.98	10	0.28	1.38	71%
D-417	D-434	2K1	163	0	0	0	0.0367	0	0.0367	0.0367	3.25	0.1193	0.18	10	0.28	1.38	13%
D-434	D-90	1/2 2K	104	28	0	0	0.0297	0.0015	0.0312	0.0679	3.25	0.2207	0.34	10	0.28	1.38	25%
D-90	D-73	1/2 2K, 1/2 2J2	202	28	0	0	0.0518	0.0019	0.0537	0.1216	3.15	0.383	0.59	12	0.24	2.08	28%
D-73	D-65	2J1, 1/4 2L2	604	47	0	0	0.1465	0.0011	0.1476	0.4773	2.85	1.3603	2.1	15	0.24	3.77	56%
D-65	D-20	1/2 2J	69	18	0	0	0.0196	0	0.0196	0.4969	2.85	1.4162	2.19	21	0.10	5.97	37%
D-20	D-17	1/2 2J	69	18	0	0	0.0196	0	0.0196	0.5165	2.75	1.4204	2.2	24	0.09	8.09	27%
LS #23	D-184	1/4 2L2	142	0	0	0	0.032	0	0.0320	0.032	3.25	0.104	0.16	6" FM	FM	0.41	39%
D-184	D-175	1/4 2L2	142	0	0	0	0.032	0	0.0320	0.0640	3.25	0.208	0.32	12	0.40	2.69	12%
D-175	D-17	1/2 2L, 1/2 2L1	658	47	0	0	0.1586	0.0005	0.1591	0.2231	3.05	0.6805	1.05	15	0.28	4.07	26%
D-17	C-50	1/2 2L1, 1/2 2L (R)	686	47	0	0	0.1649	0.0005	0.1654	0.9050	2.50	2.2625	3.5	24	0.09	8.09	43%
LS #19	C-638	1/3 2I1	320	0	0	0	0.072	0	0.0720	0.0720	3.25	0.234	0.36	4" FM	FM	0.55	65%
C-638	C-561	--								0.0720	3.25	0.234	0.36	10	0.28	1.38	26%
C-561	C-553	1/3 2I1	320	0	0	0	0.072	0	0.0720	0.1440	3.15	0.4536	0.7	10	0.28	1.38	51%
C-553	C-397	1/3 2I1	320	0	0	0	0.072	0	0.0720	0.2160	3.05	0.6588	1.02	15	0.15	2.98	34%
C-397	C-274	1/2 2I	293	141	99	0	0.1199	0.0361	0.1560	0.3720	2.95	1.0974	1.7	15	0.15	2.98	57%
C-274	C-267	1/4 2I	147	71	50	0	0.0603	0.018	0.0783	0.4503	2.85	1.2834	1.99	15	0.15	2.98	67%
C-267	C-50	1/4 2I	147	71	50	0	0.0603	0.018	0.0783	0.5286	2.75	1.4537	2.25	16	0.14	3.42	66%
C-50	C-45	1/2 2H	48	59	159	0	0.0599	0.001	0.0609	1.4945	2.28	3.4075	5.27	24	0.08	7.63	69%
C-383	C-423	2H4	274	0	0	0	0.0617	0	0.0617	0.0617	3.25	0.2005	0.31	12	0.18	1.80	17%
LS #11	C-373	1/3 2H2	131	14	0	0	0.0326	0.0013	0.0339	0.0339	3.25	0.1102	0.17	6" FM	FM	0.67	25%
C-373	C-369	--								0.0339	3.25	0.1102	0.17	15	0.32	4.35	4%
C-369	C-423	1/3 2H2	131	14	0	0	0.0326	0.0013	0.0339	0.0678	3.25	0.2204	0.34	15	0.21	3.53	10%

**APPENDIX C - Table 1
FLOWS FROM DISTRICT 1 AND 2**

1/24/2018

From Node	To Node	Districts / SubDistricts	Residential				Avg. Flow (MGD)	Comm/Ind Avg. Flow (MGD)	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Existing Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)
			LD	MD	HD	MH											
			Units	Units	Units	Units											
C-423	C-45	1/3 2H2, 2H1	233	77	115	0	0.0956	0.0259	0.1215	0.2510	3.05	0.7656	1.18	15	0.18	3.27	36%
C-45	C-12	1/2 2H	48	59	159	0	0.0599	0.001	0.0609	1.8064	2.15	3.8838	6.01	27	0.08	10.44	58%
LS #17	C-309	1/2 2-E1	158	61	0	0	0.0493	0.0152	0.0645	0.0645	3.25	0.2096	0.32	4" FM	FM	0.40	80%
C-309	C-12	1/4 2G	123	0	0	0	0.0277	0	0.0277	0.0922	3.25	0.2997	0.46	8	0.40	0.91	51%
C-12	LS#4	1/2 2G	245	0	0	0	0.0551	0	0.0551	1.9537	2.10	4.1028	6.35	27	0.08	10.44	61%
C-237	LS #4	1/2 2F	269	121	125	1	0.1162	0.0061	0.1223	0.1223	3.15	0.3852	0.6	12	0.20	1.90	32%
C-193	LS #4	1/2 2F	269	121	125	1	0.1162	0.0061	0.1223	0.1223	3.15	0.3852	0.6	10	0.25	1.31	46%
LS #4	B-492	--					0		0.0000	2.1983	2.05	4.5065	6.97	2-16" FM	FM	7.73	90%
B-492	B-487	1/4 2G	123	0	0	0	0.0277	0	0.0277	2.2260	2.05	4.5633	7.06	30	0.07	12.93	55%
LS #15	B-611	1/2 2-E1	158	61	0	0	0.0493	0.0152	0.0645	0.0645	3.25	0.2096	0.32	6" FM	FM	0.77	42%
B-611	B-487	1/4 2E	60	0	0	1	0.0138	0	0.0138	0.0783	3.25	0.2545	0.39	10	0.28	1.38	28%
B-487	B-302	3/4 2E	179	0	0	1	0.0406	0	0.0406	2.3449	2.05	4.807	7.44	30	0.08	13.83	54%
B-468	B-307	1/2 2D	165	0	19	516	0.1962	0.0014	0.1976	0.1976	3.15	0.6224	0.96	12	0.22	1.99	48%
B-314	B-307	1/2 2D	165	0	19	516	0.1962	0.0014	0.1976	0.1976	3.15	0.6224	0.96	10	0.28	1.38	69%
B-307	B-302	--								0.3952	2.95	1.1658	1.8	15	0.15	2.98	60%
B-302	B-292	1/2 2A1	128	176	0	0	0.0684	0.0262	0.0946	2.8347	2.05	5.8111	8.99	30	0.08	13.83	65%
B-352	B-292	2C	253	0	43	0	0.0666	0.0006	0.0672	0.0672	3.25	0.2184	0.34	10	0.28	1.38	25%

**APPENDIX C - Table 1
FLOWS FROM DISTRICT 1 AND 2**

1/24/2018

From Node	To Node	Districts / SubDistricts	Residential				Comm/Ind	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Existing Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)	
			LD	MD	HD	MH											Avg. Flow (MGD)
			Units	Units	Units	Units											
B-292	B-81	1/4 2A1	64	88	0	0	0.0342	0.0131	0.0473	2.9492	2.05	6.0459	9.35	30	0.08	13.83	68%
LS #22	B-1521	1/8 2A1	32	44	0	0	0.0171	0.0065	0.0236	0.0236	3.25	0.0767	0.12	4" FM	FM	0.30	40%
B-1521	B-499	1/8 2A1	32	44	0	0	0.0171	0.0065	0.0236	0.0472	3.25	0.1534	0.24	8	0.25	0.72	33%
LS #18	B-1761	1/4 1B4	33	19	0	0	0.0117	0.0025	0.0142	0.0142	3.25	0.0462	0.07	4" FM	FM	0.25	28%
B-1761	B-499	1/4 1B4	33	19	0	0	0.0117	0.0025	0.0142	0.0756	3.25	0.2457	0.38	8	0.25	0.72	53%
B-499	B-514	1/4 1B4	33	19	0	0	0.0117	0.0025	0.0142	0.0898	3.25	0.2919	0.45	10	0.28	1.38	33%
B-514	LS #3	1/4 1B4, 1B3	161	52	0	1	0.0482	0.0091	0.0573	0.1471	3.15	0.4634	0.72	12	0.22	1.99	36%
B-540	LS #3	1/2 1B1	0	45	110	1	0.0352	0.0432	0.0784	0.0784	3.25	0.2548	0.39	10	0.28	1.38	28%
LS #3	B-531	1/2 1B1	0	45	110	1	0.0352	0.0432	0.0784	0.3039	2.95	0.8965	1.39	12" FM	FM	1.50	93%
B-531	B525	--								0.3039	2.95	0.8965	1.39	15	1.00	7.70	18%
B-525	B-81	1/4 2A	129	186	11	273	0.1553	0.0084	0.1637	0.4676	2.85	1.3327	2.06	21	0.30	10.34	20%
B-81	B-75	--								3.4168	2.05	7.0044	10.84	30	0.11	16.21	67%
B-75	B-66	1/4 2A	129	186	11	273	0.1553	0.0084	0.1637	3.5805	2.02	7.2326	11.19	30	0.11	16.21	69%
B-66	B-68	2B	332	27	43	0	0.0905	0.0044	0.0949	3.6754	2.02	7.4243	11.49	36	0.05	17.77	65%
B-68	B-09	1/4 2A	129	186	11	273	0.1553	0.0084	0.1637	3.8391	2.02	7.755	12	36	0.05	17.77	68%
B-09	B-03	---								3.8391	2.02	7.755	12	36	0.05	17.77	68%
B-03	A-483	1/4 2A	129	186	11	273	0.1553	0.0084	0.1637	4.0028	2.02	8.0857	12.51	36	0.05	17.77	70%
B-1099	LS #10	1/2 1B2	0	0	0	0	0	0.0619	0.0619	0.0619	3.25	0.2012	0.31	18	0.22	5.87	5%
LS #10	B-1077	--								0.0619	3.25	0.2012	0.31	10" FM	FM	1.35	23%
B-1077	B-779	1/4 1B2	0	0	0	0	0	0.031	0.0310	0.0929	3.25	0.3019	0.47	18	0.12	4.34	11%
B-779	B-764	1/4 1B2	0	0	0	0	0	0.031	0.0310	0.1239	3.15	0.3903	0.6	18	0.12	4.34	14%
B-764	B-756	1/4 1B	118	141	0	0	0.0583	0.0072	0.0655	0.1894	3.15	0.5966	0.92	21	0.07	5.00	18%
B-756	B-743	1/4 1B	118	141	0	0	0.0583	0.0072	0.0655	0.2549	3.05	0.7774	1.2	21	0.07	5.00	24%
B-743	B-660	1/4 1B	118	141	0	0	0.0583	0.0072	0.0655	0.3204	2.95	0.9452	1.46	21	0.07	5.00	29%
B-660	B-658	1/4 1B	118	141	0	0	0.0583	0.0072	0.0655	0.3859	2.95	1.1384	1.76	24	0.08	7.63	23%
B-553	B-557	1D	0	0	182	736	0.2618	0.0314	0.2932	0.2932	3.05	0.8943	1.38	18	0.16	5.01	28%
B-557	A-496						0		0.0000	0.2932	3.05	0.8943	1.38	12	0.20	1.90	73%

**APPENDIX C - Table 1
FLOWS FROM DISTRICT 1 AND 2**

1/24/2018

From Node	To Node	Districts / SubDistricts	Residential				Comm/Ind	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Existing Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)	
			LD	MD	HD	MH											
			Units	Units	Units	Units	Avg. Flow (MGD)	Avg. Flow (MGD)									
A-358	A-355	1/4 1C3	68	25	0	0	0.0209	0.0263	0.0472	0.0472	3.25	0.1534	0.24	15	0.09	2.31	10%
A-355	LS #1	1/4 1C3	68	25	0	0	0.0209	0.0263	0.0472	0.0944	3.25	0.3068	0.47	15	0.22	3.61	13%
LS #1	A-257	1/2 1C3	135	49	0	0	0.0414	0.0525	0.0939	0.1883	3.15	0.5931	0.92	10" FM	FM	1.93	48%
A-257	A-244	1/4 1C2	33	0	0	0	0.0074	0.0024	0.0098	0.1981	3.15	0.624	0.97	15	0.28	4.07	24%
A-244	A-208	3/4 1C2, 1/4 1C1	112	5	0	0	0.0263	0.0071	0.0334	0.2315	3.05	0.7061	1.09	15	0.24	3.77	29%
A-208	A-168	3/4 1C1, 1/2 1C	240	14	0	0	0.0572	0.0003	0.0575	0.2890	3.05	0.8815	1.36	21	0.30	10.34	13%
A-168	A-496	1/2 1C	193	0	0	0	0.0434	0.0003	0.0437	0.3327	2.95	0.9815	1.52	21	0.30	10.34	15%
A-496	A-161	--								0.6259	2.72	1.7024	2.63	24	0.30	14.77	18%
A-161	A-11	--								0.6259	2.72	1.7024	2.63	24	0.08	7.63	34%
A-26	A-18	1/6 1A	88	0	21	0	0.0245	0.0024	0.0269	0.0269	3.25	0.0874	0.14	15	0.15	2.98	5%
A-18	A-17	1/2 1A	261	0	61	0	0.0725	0.0072	0.0797	0.1066	3.15	0.3358	0.52	15	0.15	2.98	17%
A-17	A-11	1/3 1A	173	0	41	0	0.0482	0.0047	0.0529	0.1595	3.15	0.5024	0.78	15	0.15	2.98	26%
A-11	B-658	--								0.7854	2.60	2.042	3.16	30	0.10	15.46	20%
B-658	A-483	--								1.1713	2.39	2.7994	4.33	30	0.10	15.46	28%
A-483	MCES INT. M216	--								5.1741	1.95	10.0895	15.61	42	0.05	26.81	58%
TOTAL UNITS			11,548	3,107	1,575	2,867		0.6614									

**APPENDIX C - Table 2
FLOWS FROM DISTRICT 3, 4, 5, AND 7**

1/24/2018

From Node	To Node	Districts / SubDistricts	Residential				Comm/Ind Avg. Flow (MGD)	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Proposed Pipe Size (in)	Existing & Proposed Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)	
			LD	MD	HD	MH												Avg. Flow (MGD)
			Units	Units	Units	Units												
1	2	1/2 7L,1/2 7K	448	0	0	0	0.1008	0	0.1008	0.1008	3.15	0.3175	0.49	8	0.40	0.91	54%	
2	3	1/2 7L,1/2 7K	448	0	0	0	0.1008	0	0.1008	0.2016	3.05	0.6149	0.95	12	0.28	2.25	42%	
3	PLS #2	1/2 7I, 1/4 7H	345	0	0	0	0.0776	0	0.0776	0.2792	3.05	0.8516	1.32	14	0.22	3.00	44%	
PLS #2	4	1/2 7I, 1/4 7H	345	0	0	0	0.0776	0	0.0776	0.3568	2.95	1.0526	1.63	14	0.22	3.00	54%	
6	PLS #1	1/4 7H	114	0	0	0	0.0257	0	0.0257	0.0257	3.25	0.0835	0.13	8	0.40	0.91	14%	
PLS #1	4	1/4 7H	114	0	0	0	0.0257	0	0.0257	0.0514	3.25	0.1671	0.26	8	0.40	0.91	29%	
4	G-152								0.4082	2.85	1.1634	1.8	16	0.22	4.29	42%		
G-152	G-34	7F, 1/2 7D, 2/3 7C	992	145	281	0	0.3191	0.0332	0.3523	0.7605	2.6	1.9773	3.06	18	0.15	4.85	63%	
	PLS #3	1/2 7J,1/4 7G	598	45	44	0	0.1546	0	0.1546	0.1546	3.15	0.487	0.75	10	0.28	1.38	54%	
PLS #3	12	3/4 7G, 1/3 7E	674	135	131	0	0.2115	0.0607	0.2722	0.4268	2.85	1.2164	1.88	15	0.15	2.98	63%	
12	G-34	2/3 7E	474	0	0	0	0.1067	0.1233	0.2300	0.6568	2.72	1.7865	2.76	18	0.15	4.85	57%	
LS #2	E-36	3-3	234	0	0	0	0.0527	0	0.0527	0.0527	3.25	0.1713	0.27	8" FM	FM	0.57	47%	
G-70	G-34	1/2 7D, 1/3 7A, 1/3 7C	650	0	0	0	0.1463	0.0021	0.1484	0.1484	3.15	0.4675	0.72	21	0.28	9.99	7%	
G-34	LS #25									1.5657	2.25	3.5228	5.45	18	0.28	6.62	82%	
LS #25	E-352	1/3 7B	153	0	0	0	0.0344	0.0196	0.0540	1.6197	2.22	3.5957	5.56	16" FM	FM	6.98	80%	
E-352	E-151	2/3 7B, 1/4 3-4	354	0	0	0	0.0797	0.0434	0.1231	1.7428	2.2	3.8342	5.93	18	0.23	6.00	99%	
E-151	E-36	3/4 3-4	131	0	0	0	0.0295	0.0107	0.0402	1.7830	2.2	3.9226	6.07	21	0.22	8.86	69%	
E-36	E-222						0		0.0000	1.8357	2.15	3.9468	6.11	21	0.11	6.26	98%	
N OAKS - EAST	E-468	N OAKS - EAST	100	1	0	0.00	0.0227	0	0.0227	0.1773	3.15	0.5585	0.86	12	0.15	1.64	52%	
E-468	E-475	3/4 3-7, CWMP	505	170	0	0	0.1519	0.3435	0.4954	0.6727	2.72	1.8297	2.83	18	0.12	4.34	65%	
E-475	LS #8	2/3 7A	57	0	0	0	0.0128	0.0042	0.0170	0.6897	2.72	1.876	2.9	18	0.12	4.34	67%	
LS #8	E-474	1/4 3-7	30	57	0	0	0.0196	0.1145	0.1341	0.8068	2.55	2.0573	3.18	10" FM	FM	3.10	103%	
E-474	E-248									0.8068	2.55	2.0573	3.18	18	0.12	4.34	73%	
E-248	E-222	3-6	0	0	0	0	0	0.0106	0.0106	0.8174	2.55	2.0844	3.22	18	0.12	4.34	74%	
E-222	E-08	3-2	138	0	64	0	0.0455	0.0112	0.0567	2.7098	2.05	5.5551	8.59	27	0.13	13.31	65%	

**APPENDIX C - Table 2
FLOWS FROM DISTRICT 3, 4, 5, AND 7**

1/24/2018

From Node	To Node	Districts / SubDistricts	Residential				Comm/Ind	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Proposed Pipe Size (in)	Existing & Proposed Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)		
			LD	MD	HD	MH												Avg. Flow (MGD)	Avg. Flow (MGD)
			Units	Units	Units	Units													
LS #6	E-08	3-5	246	92	0	0	0.0761	0	0.0761	0.0761	3.25	0.2473	0.38	6" FM		FM	0.58	66%	
E-08	E-10						0		0.0000	2.7859	2.05	5.7111	8.84	27		0.13	13.31	66%	
E-10	E-1425	3-1	186	5	0	0	0.043	0.0005	0.0435	2.8294	2.05	5.8003	8.97	36		0.13	28.66	31%	
E-182	E-113						0		0.0000	0.0000	3.25	0	0	10		0.34	1.52	0%	
E-113	E-104	5 CI					0	0.3704	0.3704	0.3704	2.95	1.0927	1.69	12		0.19	1.85	91%	
E-104	E-71	5 1/2LD, MD	227	211			0.0986		0.0986	0.4690	2.85	1.3367	2.07	14		0.16	2.56	81%	
E-71	E-1425	5 1/2 LD	227				0.0511		0.0511	0.5201	2.75	1.4303	2.21	16		0.12	3.17	70%	
E-1425	E-1426	5 R	0				0		0.0000	0.5201	2.75	1.4303	2.21	16		0.12	3.17	70%	
E-1426	MCES INT. M203								0.0000	3.3495	2.05	6.8665	10.62	36		0.10	25.14	42%	
TOTAL UNITS			7,790	861	520	0		1.1479											

= Flow generation rate of 750 gpd for developed, commercial land in Subdistrict 3-7 used to more accurately represent existing flows from The Village and Pheasant Ridge Industrial Park.

**APPENDIX C - Table 3
FLOWS FROM DISTRICT 6**

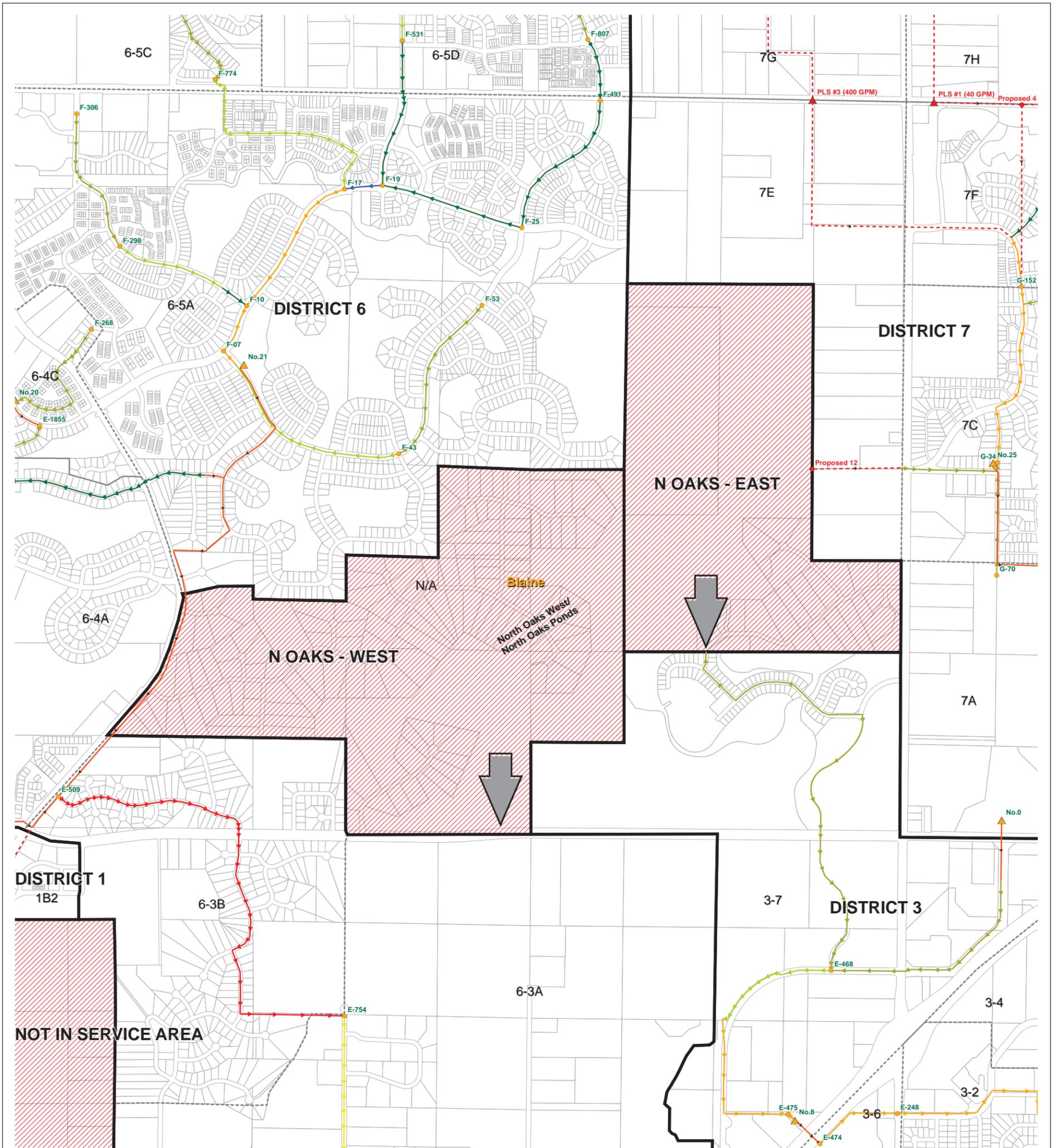
1/24/2018

From Node	To Node	Districts / SubDistricts	Residential				Comm/Ind	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Proposed Pipe Size (in)	Existing & Proposed Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)	
			LD	MD	HD	MH												
			Units	Units	Units	Units	Avg. Flow (MGD)	Avg. Flow (MGD)										
F-961	LS #29	1/4 6-5B	137	0	0	0.00	0.0308	0	0.0308	0.0308	3.25	0.1001	0.15	8		0.40	0.91	16%
LS #29	F-951	--								0.0308	3.25	0.1001	0.15	4" FM		FM	0.50	30%
LS #29	F-938	--								0.0308	3.25	0.1001	0.15	8		0.40	0.91	16%
F-938	F-537	1/4 6-5B	137	0	0	0.00	0.0308	0	0.0308	0.0616	3.25	0.2002	0.31	8		0.40	0.91	34%
F-902	LS #7	1/2 6-5B, 1/2 7J	550	0	0	0.00	0.1238	0	0.1238	0.1238	3.15	0.3900	0.6	8		0.40	0.91	66%
F-537	F-531	1/2 6-5D	267	151	0	0.00	0.0941	0.0004	0.0945	0.1561	3.15	0.4917	0.76	10		0.28	1.38	55%
F-531	F-19	--								0.1561	3.15	0.4917	0.76	12		0.28	2.25	34%
LS #7	F-922	--								0.1238	3.15	0.39	0.6	4" FM		FM	1.44	42%
F-922	F-807	1/8 6-5D	67	38	0	0.00	0.003	0.0001	0.0031	0.1269	3.15	0.3997	0.62	8		0.28	0.76	81%
F-807	F-491	3/8 6-5D	200	113	0	0.00	0.0264	0.0003	0.0267	0.1536	3.15	0.4838	0.75	12		0.28	2.25	33%
F-491	F-25	1/8 6-5A	136	144	129	0.00	0.092	0.001	0.0930	0.2466	3.05	0.7521	1.16	12		0.28	2.25	52%
F-25	F-19	--								0.2466	3.05	0.7521	1.16	12		0.28	2.25	52%
F-19	F-17	--								0.4027	2.85	1.1477	1.78	15		0.28	4.07	44%
F-306	F-298	1/16 6-5A	68	72	65	0.00	0.0461	0.0005	0.0466	0.0466	3.25	0.1515	0.23	8		0.50	1.02	23%
F-298	F-10	1/16 6-5A	68	72	65	0.00	0.0461	0.0005	0.0466	0.0932	3.25	0.3029	0.47	10		0.40	1.65	28%
F-874	F-774	6-5C	272	0	0	0.00	0.0612	0	0.0612	0.0612	3.25	0.1989	0.31	8		0.40	0.91	34%
F-774	F-17	1/8 6-5A	136	144	129	0.00	0.092	0.001	0.0930	0.1542	3.15	0.4857	0.75	10		0.28	1.38	54%
F-53	F-43	1/8 6-5A	136	144	129	0.00	0.092	0.001	0.0930	0.0930	3.25	0.3023	0.47	8		0.40	0.91	52%
F-43	LS #21	1/8 6-5A	136	144	129	0.00	0.092	0.001	0.0930	0.1860	3.15	0.5859	0.91	10		0.28	1.38	66%
F-17	F-10	--								0.5569	2.75	1.5315	2.37	18		0.22	5.87	40%
F-10	F-07	--								0.6501	2.72	1.7683	2.74	18		0.22	5.87	47%
F-07	LS #21	3/8 6-5A	406	432	386	0.00	0.2754	0.0029	0.2783	1.1144	2.39	2.6634	4.12	16" FM		FM	6.70	61%
F-268	LS #20	3/4 6-4C	72	142	0	0.00	0.0482	0	0.0482	0.0482	3.25	0.1567	0.24	4" FM		FM	0.27	89%
LS #20	E-1855	1/4 6-4C	24	48	0	0.00	0.0162	0	0.0162	0.0644	3.25	0.2093	0.32	8		0.40	0.91	35%
E-1855	E-1402	--								0.0644	3.25	0.2093	0.32	8		0.40	0.91	35%

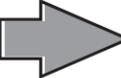
**APPENDIX C - Table 3
FLOWS FROM DISTRICT 6**

1/24/2018

From Node	To Node	Districts / SubDistricts	Residential				Comm/Ind	Total Avg. Flow Resi.+ C/I (MGD)	Cum.Avg. Flow (MGD)	City Peak Factor	Cum. Peak Flow (MGD)	Cum. Peak Flow (CFS)	Existing Pipe Size (in)	Proposed Pipe Size (in)	Existing & Proposed Pipe Slope %	Pipe Capacity n=0.011 (CFS)	Percent Utilized (%)	
			LD	MD	HD	MH												Avg. Flow (MGD)
			Units	Units	Units	Units												
F-196	E-1400	1/8 6-4A	144	13	1	0.00	0.0356	0	0.0356	0.0356	3.25	0.1157	0.18	12		0.22	1.99	9%
E-1400	E-1273	--							0.0000	0.0356	3.25	0.1157	0.18	12		0.22	1.99	9%
E-1273	LS #16	1/8 6-4A	144	13	1	0.00	0.0356	0	0.0356	0.0712	3.25	0.2314	0.36	12		0.22	1.99	18%
F-1684	E-1677	1/2 6-4B	71	219	358	0.00	0.1458	0.0008	0.1466	0.1466	3.15	0.4618	0.71	12		0.22	1.99	36%
E-1677	E-1232	1/2 6-4B	71	219	358	0.00	0.1458	0.0008	0.1466	0.2932	3.05	0.8943	1.38	16		0.22	4.29	32%
E-1232	E-1228	3/8 6-4A	431	38	1	0.00	0.1058	0	0.1058	0.3990	2.95	1.1771	1.82	16		0.22	4.29	42%
E-1228	LS #16	3/8 6-4A	431	38	1	0.00	0.1058	0	0.1058	0.5048	2.75	1.3882	2.15	16		0.22	4.29	50%
LS #16	E-509	--								0.5760	2.75	1.584	2.45	10" FM		FM	4.50	54%
E-509	E-754	1/2 6-3B	358	37	0	0.00	0.0889	0.0049	0.0938	1.7842	2.20	3.9252	6.07	21		0.10	5.97	102%
N OAKS - WEST	E-754	N OAKS - WEST	675	29	0	0	0.1584	0.031	0.1894	0.1894	3.15	0.5966	0.92	12		0.22	1.99	46%
E-754	E-566	1/3 6-3A, 1/2 6-3B	360	37	0	0.00	0.0893	0.3108	0.4001	2.3737	2.05	4.8661	7.53	24		0.08	7.63	99%
E-611	E-566	1/6 6-3A	1	0	0	0.00	0.0002	0.1529	0.1531	0.1531	3.15	0.4823	0.75	10		0.24	1.28	59%
E-566	LS # 13	1/2 6-3A	3	0	0	0.00	0.0007	0.4588	0.4595	2.9863	2.05	6.1219	9.47	27		0.076	10.18	93%
LS # 13	E-1507	1/3 6-2	3	0	0	1.00	0.001	0.0555	0.0565	3.0428	2.05	6.2377	9.65	20" FM		FM	10.91	88%
E-1507	LS # 12	6-1C, 2/3 6-2	511	0	0	1.00	0.1153	0.1136	0.2289	3.2717	2.05	6.707	10.38	27		0.090	11.07	94%
E-704	E-670	1/2 6-1B	189	0	0	0.00	0.0425	0.0372	0.0797	0.0797	3.25	0.259	0.4	10		0.28	1.38	29%
E-670	LS#12	1/2 6-1B	189	0	0	0.00	0.0425	0.0372	0.0797	0.1594	3.15	0.5021	0.78	10		0.28	1.38	56%
LS#12	E-530									3.4311	2.05	7.0338	10.88	2 - 16" FM		FM	9.48	115%
E-197	E-530	6-1A	0	0	0	0.00	0	0.025	0.0250	0.0250	3.25	0.0813	0.13	8		0.40	0.91	14%
E-530	MCES INT. M217						0		0.0000	3.4561	2.05	7.085	10.96	30		0.08	13.83	79%
TOTAL UNITS			6,393	2,287	1,752	2.00		1.2372										



LEGEND

-  Direction of Flow
-  Proposed Sewer Pipe
-  Existing 8" Sewer Pipe
-  Existing 10" Sewer Pipe
-  Existing 12" Sewer Pipe
-  Existing 14" Sewer Pipe
-  Existing 15" Sewer Pipe
-  Existing 16" Sewer Pipe
-  Existing 18" Sewer Pipe
-  Existing 21" Sewer Pipe
-  Existing 24" Sewer Pipe
-  Existing 27" Sewer Pipe
-  Existing 30" Sewer Pipe
-  Existing 36" Sewer Pipe
-  Existing 42" Sewer Pipe
-  Existing Forcemain
-  Proposed Manhole
-  Proposed Lift Station
-  Existing Manhole
-  Existing Lift Station
-  MCES Meter Location
-  Existing MCES Interceptor
-  Sanitary Sewer Districts
-  Sanitary Sewer Subdistrict
-  Not in Service Area Districts
-  Parcels
-  City Boundary

NOTE:
FUTURE SEWER MAIN AND LIFT STATION
LOCATIONS PROVIDED BY CITY OF BLAINE.



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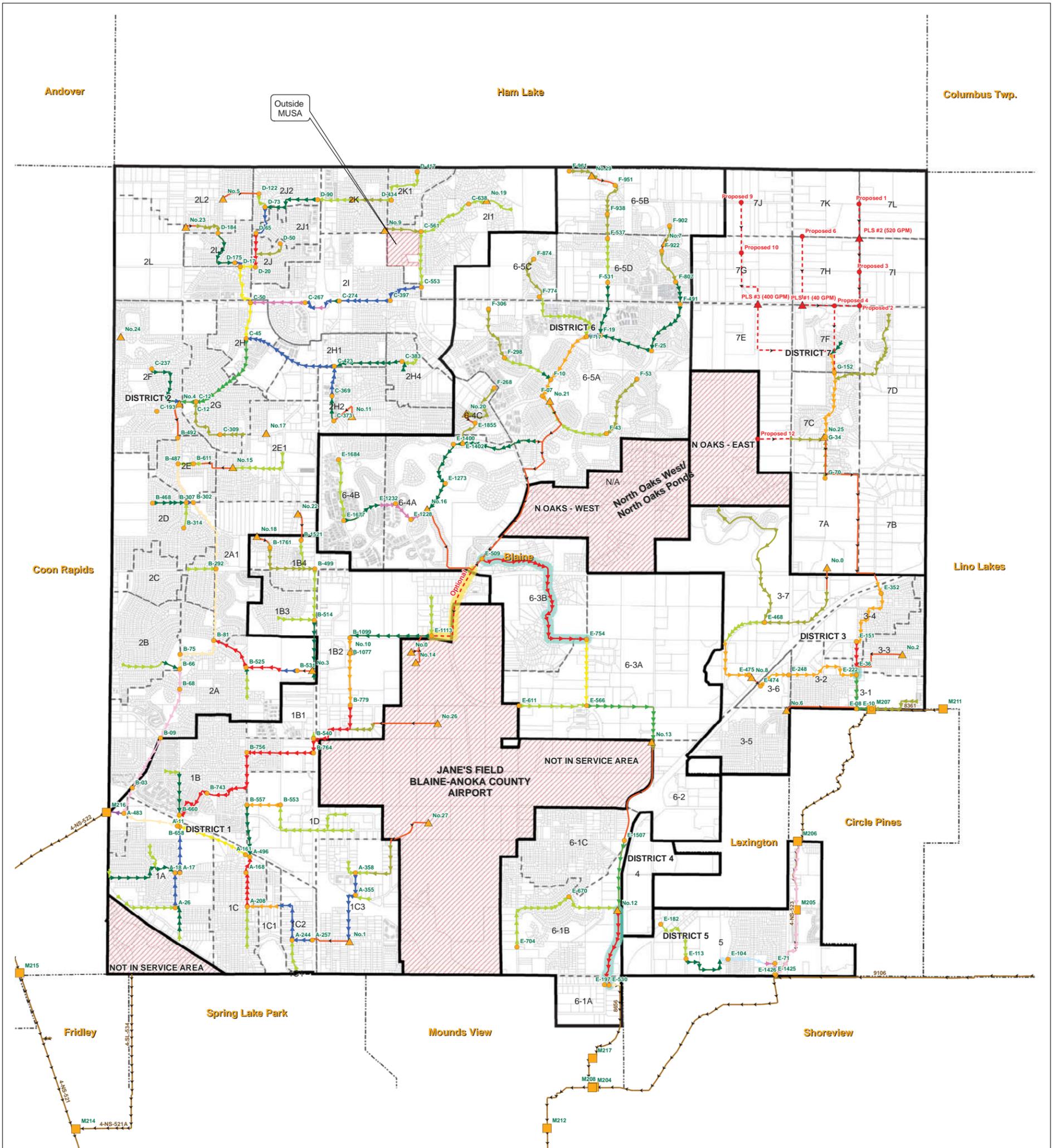
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CITY OF BLAINE
NORTH OAKS POTENTIAL SERVICE AREA

APPENDIX
C

Appendix D

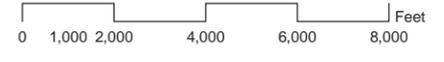
Map of Trunk System Improvement



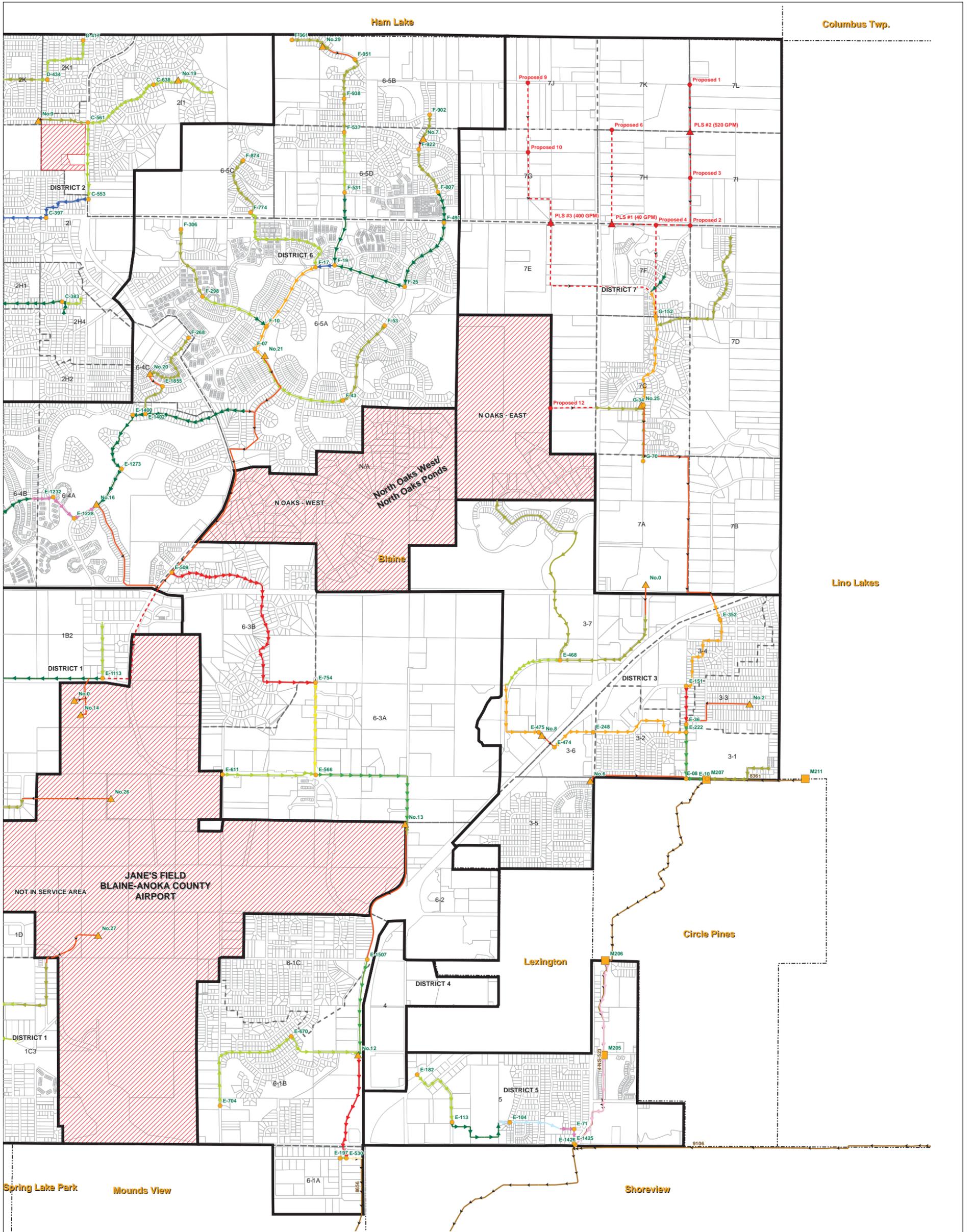
LEGEND

- Proposed Manhole
- ▲ Proposed Lift Station
- Existing Manhole
- ▲ Existing Lift Station
- MCES Meter Location
- ▨ Not in Service Area Districts
- ▭ Sanitary Sewer Districts
- ▭ Parcels
- - - City Boundary
- - - Sanitary Sewer Subdistrict
- color Relief Sewer
- Flow Over 100% 1980 Blaine Peaking Factor
- - - Proposed Sewer Pipe
- Existing MCES Interceptor
- Existing 8" Sewer Pipe
- Existing 10" Sewer Pipe
- Existing 12" Sewer Pipe
- Existing 14" Sewer Pipe
- Existing 15" Sewer Pipe
- Existing 16" Sewer Pipe
- Existing 18" Sewer Pipe
- Existing 21" Sewer Pipe
- Existing 24" Sewer Pipe
- Existing 27" Sewer Pipe
- Existing 30" Sewer Pipe
- Existing 36" Sewer Pipe
- Existing 42" Sewer Pipe
- Existing Forcemain

NOTE:
FUTURE SEWER MAIN AND LIFT STATION
LOCATIONS PROVIDED BY CITY OF BLAINE.



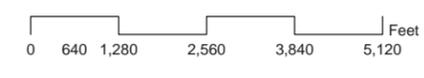
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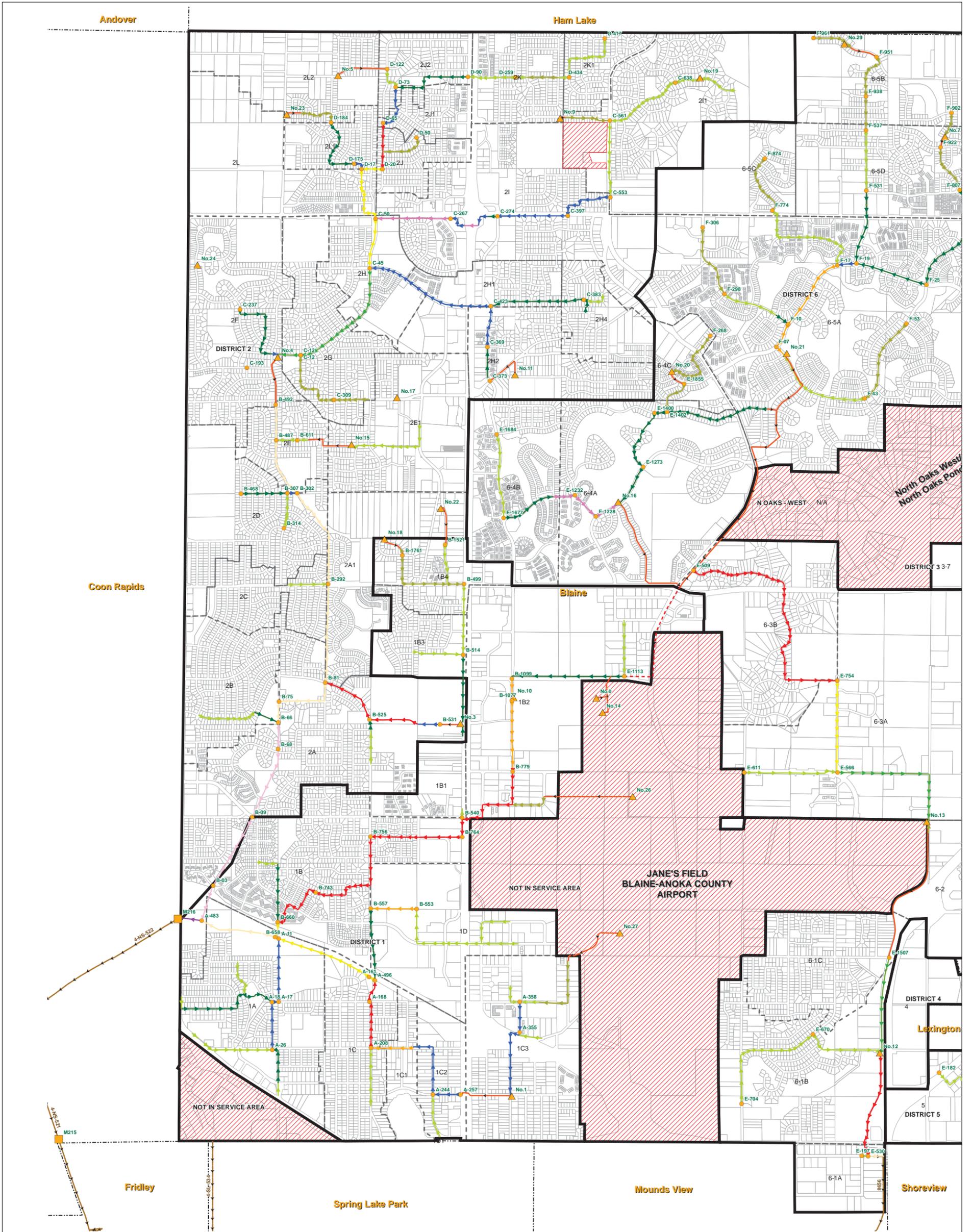
LEGEND

- Proposed Manhole
- ▲ Proposed Lift Station
- Existing Manhole
- ▲ Existing Lift Station
- MCES Meter Location
- ▭ Sanitary Sewer Districts
- ▨ Not in Service Area Districts
- - - Sanitary Sewer Subdistrict
- ▭ Parcels
- - - City Boundary
- - - Proposed Sewer Pipe
- - - Existing MCES Interceptor
- Existing 8" Sewer Pipe
- Existing 10" Sewer Pipe
- Existing 12" Sewer Pipe
- Existing 14" Sewer Pipe
- Existing 15" Sewer Pipe
- Existing 16" Sewer Pipe
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- Existing 24" Sewer Pipe
- Existing 27" Sewer Pipe
- Existing 30" Sewer Pipe
- Existing 36" Sewer Pipe
- Existing 42" Sewer Pipe
- Existing Forcemain

NOTE:
FUTURE SEWER MAIN AND LIFT STATION
LOCATIONS PROVIDED BY CITY OF BLAINE.



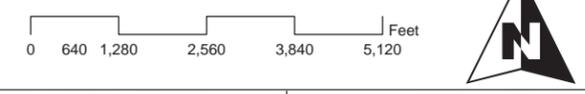
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LEGEND

- Proposed Manhole
- ▲ Proposed Lift Station
- Existing Manhole
- ▲ Existing Lift Station
- MCES Meter Location
- ▭ Sanitary Sewer Districts
- ▨ Not in Service Area Districts
- - - Sanitary Sewer Subdistrict
- ▭ Parcels
- - - City Boundary
- Existing MCES Interceptor
- - - Proposed Sewer Pipe
- Existing 8" Sewer Pipe
- Existing 10" Sewer Pipe
- Existing 12" Sewer Pipe
- Existing 14" Sewer Pipe
- Existing 15" Sewer Pipe
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- Existing 30" Sewer Pipe
- Existing 36" Sewer Pipe
- Existing 42" Sewer Pipe
- Existing Forcemain

NOTE:
FUTURE SEWER MAIN AND LIFT STATION
LOCATIONS PROVIDED BY CITY OF BLAINE.



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Building a Better World for All of Us[®]

Sustainable buildings, sound infrastructure, safe transportation systems, clean water, renewable energy and a balanced environment. Building a Better World for All of Us communicates a companywide commitment to act in the best interests of our clients and the world around us.

We're confident in our ability to balance these requirements.

