Sanitary Sewer Master Plan

Delaware County Regional Sewer District

Delaware County, Ohio

February 1, 2017

Contents

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Glossary of Terms

ADF	Average Daily Flow.
AC/H	Air changes per hour.
ACWRF	Alum Creek Water Reclamation Facility.
Areas of existing need	Neighborhoods in need of centralized sewer, due to failing or a high potential of failing on-lot or off-lot discharging sewage systems.
BOH	Board of Health; Delaware General Health District.
CBOD5	5-Day Carbonaceous Biochemical Oxygen Demand; parameter identifying the quantity of organic material in wastewater.
Comprehensive Plan	Master plans that map out future proposed land uses and densities.
CCTV	Closed Circuit TV.
CIP	Capital Improvement Project.
DCRPC	Delaware County Regional Planning Commission.
DCRSD	Delaware County Regional Sewer District (or District).
DO	Dissolved Oxygen.
Drainage area	A prescribed boundary for natural surface water drainage.
EPA	Environmental Protection Agency.
ERU	Equivalent Residential Units.
Floodplain	The areas subject to being inundated by a 100 year flood event.
FPS/fps	Feet per Second.
GIS	Geographic Information System; A computer-based information system that enables capture, modeling, manipulation, retrieval, analysis, and presentation of geographically reference data.
GIS Layer	Geographically reference data relating to a specific attribute or data type, such as bedrock.

GPD/gpd	Gallons per day.
HSTS	Home Sewage Treatment Systems.
HVAC	Heating, Ventilation, and Air Conditioning.
I/I	Inflow and Infiltration; storm or groundwater that enters a sewer system.
Institutional Knowledge	The aggregate data and knowledge contained, or retrievable by the major partners compiling this study related to the topics addressed herein.
LAMP	Land Application Management Plan.
LF	Linear Feet.
LOS	Level of Service.
LSWRF	Lower Scioto Water Reclamation Facility.
MCC	Motor Control Center.
MGD	Million gallons per day.
MLSS	Mixed Liquor Suspended Solids.
MORPC	Mid-Ohio Regional Planning Commission.
NEC	National Electrical Code.
NFPA	National Fire Protection Association.
NOAA	National Oceanic and Atmospheric Administration.
NPDES Permit	National Pollutant Discharge Elimination System; the primary permit governing the allowable discharge of pollutants from a treatment facility.
ODOT	Ohio Department of Transportation.
OECC	Olentangy Environmental Control Center.
OEPA	Ohio Environmental Protection Agency.
Off-lot system	A wastewater treatment system such as aeration with either collector tile or local stream discharged off the lot being served.

On-lot system	A wastewater treatment system such as septic tank, leach field, or mound located on the lot being served.
Package plant	Small wastewater treatment plant, generally less than 100,000 gallons per day treatment capacity.
PC	Personal Computer.
POTW	Publicly Owned Treatment Works.
PS	Pump Station.
RAS	Return Activated Sludge.
RDII	Rainfall-derived inflow and infiltration; storm water that enters the sanitary collection system during rain events and contributes to the overall sanitary flow.
SCADA	Supervisory Control and Data Acquisition.
Service areas	Existing and proposed areas designated for central sewer service.
SLR	Solids Loading Rate.
SOR	Surface Overflow Rate.
SSO	Sanitary Sewer Overflow.
SRWRF	Scioto Reserve Water Reclamation Facility.
SSES	Sanitary Sewer Evaluation Study.
TDH	Total Dynamic Head.
TIF	Tax-Increment Financing.
TMDL	Total Maximum Daily Load; a calculation of the maximum level of pollutants a waterbody can receive and still meet the water quality standard.
Topology	Arrangement or layout of connectivity in an ethernet network.
TSS	Total Suspended Solids; a pollutant of concern listed in wastewater treatment plant permits to be primarily removed.
UPS	Uninterruptible Power Supply.

UV	Ultraviolet Light.
VFD	Variable Frequency Drive.
WAS	Waste Activated Sludge.
Watershed	The area drained by a stream, river, or river system.
WIB	Water in Basement; an event where sewage backs up into basements from the main sewer line.
WLR	Weir Loading Rate.
WRF	Water Reclamation Facility.
WTP	Water Treatment Plant.
WQM(P)	Water Quality Management (Plan).
WWTP	Wastewater Treatment Plant.
Zero-discharge	A wastewater system that discharges treated wastewater effluent as irrigation water.

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1.0 Executive Summary

With a 58% growth rate in the past decade, and as the 22nd fastest growing County in the United States, Delaware County has and continues to manage rapid development. Despite a significant multi-year lull with the economic downturn of the mid-2000s, all local development indicators have now returned to positive trends. Signs are everywhere: low unemployment, impressive job growth, high per capita incomes, new housing starts, and permit applications. But rapid growth can cause strain on infrastructure and provision of affordable community services. Utilities, roadway networks, schools, police, fire, and general government planning efforts must be scalable and adaptable to a variety of as-yet-unknown and wholly dynamic development scenarios, which is no easy task.

Delaware County Commissioners and the Delaware County Regional Sewer District (DCRSD) have, by undertaking an update to their Sanitary Sewer Master Plan, signaled that they remain vigilant in their commitment to fiscal responsibility, insightful planning, collaboration, and community involvement, which are essential to future success.

Having withstood the impacts of revenue declines (from development lull in the mid-2000s) in the face of increasing operational cost, Delaware County has emerged post-recession with a future view that is informed of the risks of being a development-driven system. While many neighboring communities have adjusted their future plans to adopt more controlled and conservative approaches to avoid financial risk altogether, Delaware County has recognized its opportunity to creatively and affordably shape its future, to sustain its legacy of service, and to ensure that it provides for all it will become, through adaptive management.

In light of development pressures and aging infrastructure drivers, the Delaware County Sanitary Sewer Master Plan provides a prioritized yet flexible capital improvement plan that will deliver regulatory-compliant, reliable, and affordable wastewater utility service, with emphasis on innovation.

1.1 Master Plan Outcomes

The Sanitary Sewer Master Plan update has benefitted Delaware County by delivering these tangible outcomes:

- Realistic **sewer flow and population projections** which accurately reflect County stakeholders' current land use plans, and are endorsed by planning agencies.
- Thorough understanding of the current condition and remaining capacity of existing infrastructure.
- Wastewater **treatment and biosolids needs assessment** that addresses future regulations and permit requirements.
- Progressive yet practical **rate and fee structure recommendations** to support the future program.

This key planning effort included over 40 public, individual stakeholder, and staff collaboration meetings to review needs and options; provided 2 robust, essential tools for system management (full system hydraulic model, and comprehensive financial model of revenue, expense, and rate and fee options); and resulted in a ten-year Capital Improvement Plan that identified over $130 Million (2016 dollars) in projects ($35.8M in system operation and maintenance projects to maintain existing assets, and $94.7M in projects that support service to new areas).

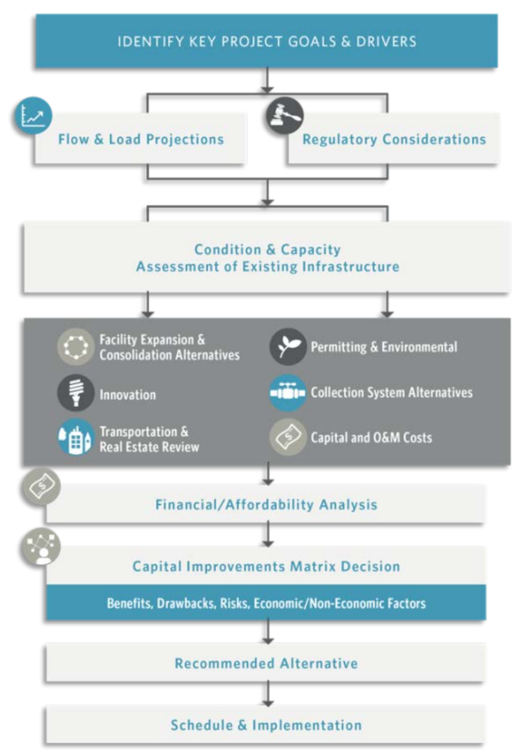
1.2 Financial Impact

In total, the Master Plan recommendations are planned to be supported by a variety of funding mechanisms, such as cash reserves, user rate revenues, State Revolving Fund (SRF) loans, capacity fees, revenue bonds, and Tax-Increment Financing (TIF) proceeds. Following the preparation of a cash-flow analysis, the Master Plan effort concluded with a proposed, phased user rate and fee charge increases phased from 2018 to 2024, bringing user rates to a $39.00 per user per month by the end of this period. A four-year increase in capacity fees to a level of $8,100 per connection is proposed by 2020. Capacity Surcharges in the OECC and ACWRF basins are scheduled to be phased out during this four (4) year period. In general, the CIP projects were clearly organized and coded, and rate and fee proposals were structured to ensure that user rates would support system operation and maintenance, and capacity fees would support new development. During this analysis, DCRSD determined that it would eliminate capacity fee surcharges, in order to reduce reliance on revenue from development, and thereby mitigating an element of financial risk.

1.3 Core Planning Strategy: Project Drivers

Critical to the Master Plan development effort and its future efficacy was the articulation of a strategy, comprised of guiding principles, or project drivers. As the Master Plan took shape, these principles ensured that its foundation was well-communicated and would provide consistency as the County's near-term vision unfolded over time. Key components of the County's strategy included:

1. Progressive, sustainable infrastructure planning
2. Asset operation and maintenance for long-term viability
3. Technological innovation to aid decision making and improve system ease of use
4. Energy efficiency and treatment optimization
5. Financial risk mitigation
6. Promoting a culture of safety



Beyond these foundational plan elements, DCRSD management conveyed their **commitment to follow a 'plan, evaluate, design and construct' process**, with checkpoints at each step.

Lastly, DCRSD has demonstrated its **pledge to continue stakeholder outreach with the development community** to more fully understand the growth trends, establish a defined infrastructure extension policy, and work collaboratively to recognize mutually beneficial opportunities such as the creation of Community Authorities that support significant financial investments from both perspectives.

1.4 The Planning Process

The Master Plan culminates an 18-month effort, during which time the project team compiled thousands of unique data files and supporting documents, reviewed County GIS geodatabases, identified growth pockets and corridors, and conducted numerous stakeholder outreach meetings.

At the outset of the planning process, DCRSD and the project team discussed the establishment of an appropriate planning boundary, a planning horizon year, and a target level of service to more fully communicate the parameters that would define the plan. In brief, the planning boundary is the area within the County which DCRSD desires to consider providing sewer service. The Master Plan horizon year is a future date (or duration) within which customer projections, growth trends, and system operation costs are considered predictable in present day, and to which a capital improvements plan can be reasonably and practically foreseen. A target level of service is a volume of sewer flow (taking into consideration the impacts of system infiltration and peak flows created by rainfall events) that the system owner feels it can reliably receive and process within regulatory standards.

For the Delaware County Sanitary Sewer Master Plan, its **planning boundary coincides generally with County boundaries**, with exceptions being municipalities and other areas within which the County has previously established a sewer service agreement. The **horizon year for planning purposes was 10 years**, although a 25-year and an 'ultimate' buildout of the County were reviewed to aid in conveyance pipe and treatment unit sizing. The **target level of service for the Master Plan recommendations was 25 years**—this factor directly controls the size (and therefore, cost) of infrastructure, and is commonly used as an industry planning standard.

Following the establishment of project goals and drivers, data collection, and planning criteria decisions, the project team simultaneously conducted physical inspections and condition assessment of two treatment plants and nine system pump stations, and created a hydraulic model of the collection system. The model was calibrated for accuracy, then used to simulate both 'existing' and 'future' conditions during dry and wet weather. This exercise, coupled with desktop capacity analyses of the County's treatment facilities, allowed the project team to identify segments of the collection system where flow exceeds pipe capacity, both now and in the future. Further, it allowed the project team to envision and model sewer conveyance routes (new pipes) needed to provide service to development areas, and quantify treatment and pump station needs.

As project recommendations were conceived, construction phasing scenarios were prepared, along with estimates of probable construction cost. This information comprised the DCRSD ten-year Capital Improvements Plan, and was imported to the Master Plan Financial Model. Various financial scenarios and a cash flow analysis were compiled, in concert with input from Delaware County.

1.5 Recommendations

As a whole, the DCRSD system analysis and stakeholder collaboration helped bring into focus the need for 'just in time' infrastructure planning, and improved lines of communication between parties. County stakeholders were able to convey their vision for future land use and density of development, and within that envelope, Developers were able to express the magnitude, location, and timing of their utility needs. With this information in hand, the County was able to form its planning, design, and financial model to be proactive and progressive, fulfilling its role and demonstrating its philosophy as utility service provider with a truly **sustainable infrastructure plan** and community partnership process. As the plan is executed and refined with time, Master Plan tools will help to ensure all customers—present and future---that their utility service is affordable.

Significant CIP recommendations from this effort include a major upgrade to the Olentangy Environmental Control Center (OECC) and an upgrade to Alum Creek Water Reclamation Facility (ACWRF), which present opportunities for **energy efficiency** updates, **treatment optimization**, and chemical cost savings while at the same time positioning for future nutrient (and other) regulations. Master Plan analysis also highlighted the need for the construction of a future (fourth) treatment plant, Central Alum Creek Water Reclamation Facility (CACWRF), which would serve the dual purpose of cost-effective treatment and flow rerouting/capacity relief of infrastructure in the northwest quadrant of the DCRSD system and the trunk sewer to ACWRF.

Beyond these treatment projects, **asset operation and maintenance** pump station improvements were identified at four sites: Peachblow, Cheshire, Lower Alum Creek, and Leatherlips. Collection system hydraulic bottlenecks (or consolidation opportunities) were also highlighted in Golf Village, Olentangy Crossing, Woodland Hall, Sherbourne Mews, and other isolated areas. Creation and manipulation of the hydraulic model to validate observed conditions—and resolve them through alternatives modeled---proved a strong example of how DCRSD's commitment to **technological innovation** would aid in decision-making and system management.

As project recommendations were made, the CIP resulted in 36 separate projects. Reviewing the subset of necessary improvements driven by operation and maintenance, and development, DCRSD took note that all projects would need to include considerations for system ease of use and promotion of equipment and training that further enhanced the County's **culture of safety** for its employees and customers.

At its completion, the conclusions of the Delaware County Sanitary Sewer Master Plan provide for the County's bright future, positioning DCRSD as an active partner and community resource, with the tools to effectively and affordably navigate its changing landscape.

2.0 Introduction

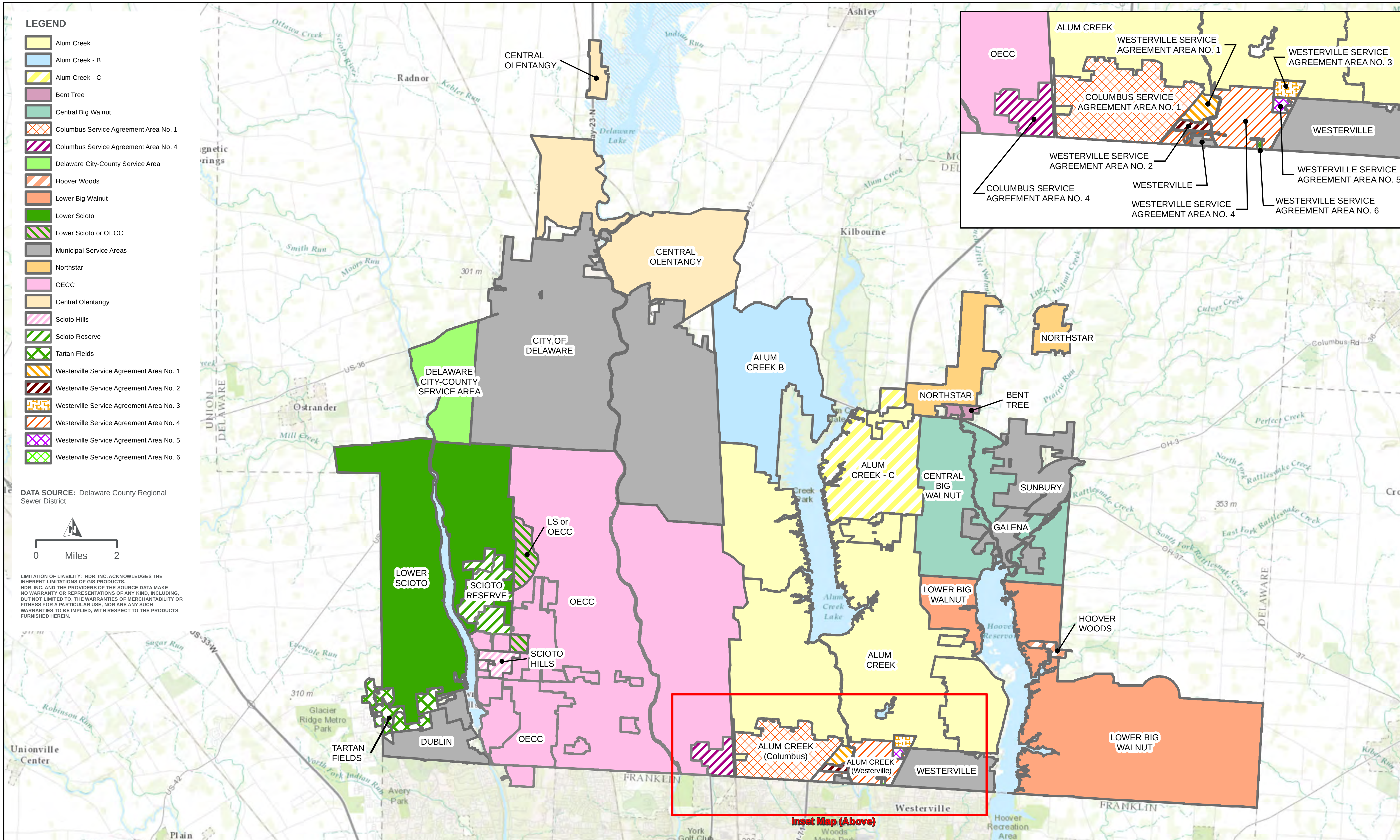
The Delaware County Regional Sewer District (DCRSD) commissioned a project team led by HDR that consisted of AECOM and Raftelis to develop a Sanitary Sewer Master Plan. The Master Plan identified the sanitary infrastructure, financial strategies, and land use planning needed to accommodate future development within Delaware County, Ohio, served by DCRSD. Refer to Figure 1 for a map illustrating DCRSD service areas delineated by treatment facility or service agreement. This effort built upon the District's foundation of sound development planning, robust geospatial data management and forward-looking infrastructure investments. It also incorporated planning by Townships, Cities and other key stakeholders within Delaware County. The Master Plan is accompanied by a sanitary collection system hydraulic model and a financial analysis model that the District may use for future decision making.

The objectives accomplished during development of the Master Plan are summarized as follows:

- **Gather and evaluate relevant information.** Reviewed data to determine what information was available and useable for the subsequent technical phases of the development of the Master Plan.
- **Determine Required System Improvements and Accommodate Future Conditions.** Based on growth trends identified by DCRSD, future conditions were projected including service areas, population, and wastewater flows.
- **Analyze existing infrastructure.** Condition, capacity, and operational aspects of the District's existing infrastructure were assessed to identify remaining capacity and recommended improvements. Furthermore, the existing service areas and their fully built-out population and wastewater flows were evaluated to determine if changes to service area boundaries as a function of existing capacity were warranted.
- **Financial/affordability analysis.** Analyzed funding requirements for recommended capital improvement projects to determine optimal financing alternatives to minimize impact on user rates over time.

This Master Plan is based upon findings from five interrelated technical memoranda (TM). TM1 documented relevant planning information provided by the District and other stakeholders. TM2 identified key technical assumptions, planning, and hydraulic modeling criteria and improvements needed to support planned growth. TM3 presented findings from an assessment of sanitary infrastructure that was performed to identify needs for improvement based on condition and capacity. TM4 focused on the improvements needed to provide sanitary sewer service under future build out conditions within Delaware County served by the District. TM5 included a comprehensive financial analysis of the short- and long-term financial impacts resulting from the implementation of recommendations contained within the Master Plan.

It should be noted that this Master Plan represents a snapshot of growth in the DCRSD based on what is currently anticipated. The District should revisit and update this Master Plan on a periodic basis to review population estimates, growth trends, and changes in other assumptions used in its development.



WRF SERVICE AREAS

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN FIGURE 1

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3.0 Data Research and Collection

Comprehensive mapping, planning, and zoning documentation was collected from the District, public and private stakeholders, and other public entities and were used to develop the Master Plan. The resources collected for this effort reflect the varying applications and planning methodologies of the respective groups that developed them. A list of reviewed documents is provided in Appendix A – Data and Document Collection Summary.

3.1 Population Trends

A summary of the population growth and projections from the Delaware County Regional Planning Commission (DCRPC) is shown in Figure 2. The population forecast within the District shows that the 2035 population will increase by 54% over the 2010 census, representing an average of 7% annual growth. This growth rate represents a departure from higher growth rates experienced by the County in the 1990's and early 2000's, but one that is higher than that seen in the last half decade prior to 2010.

Figure 2. 25-Year Population Forecast

Source: Delaware County Regional Planning Commission (DCRPC)

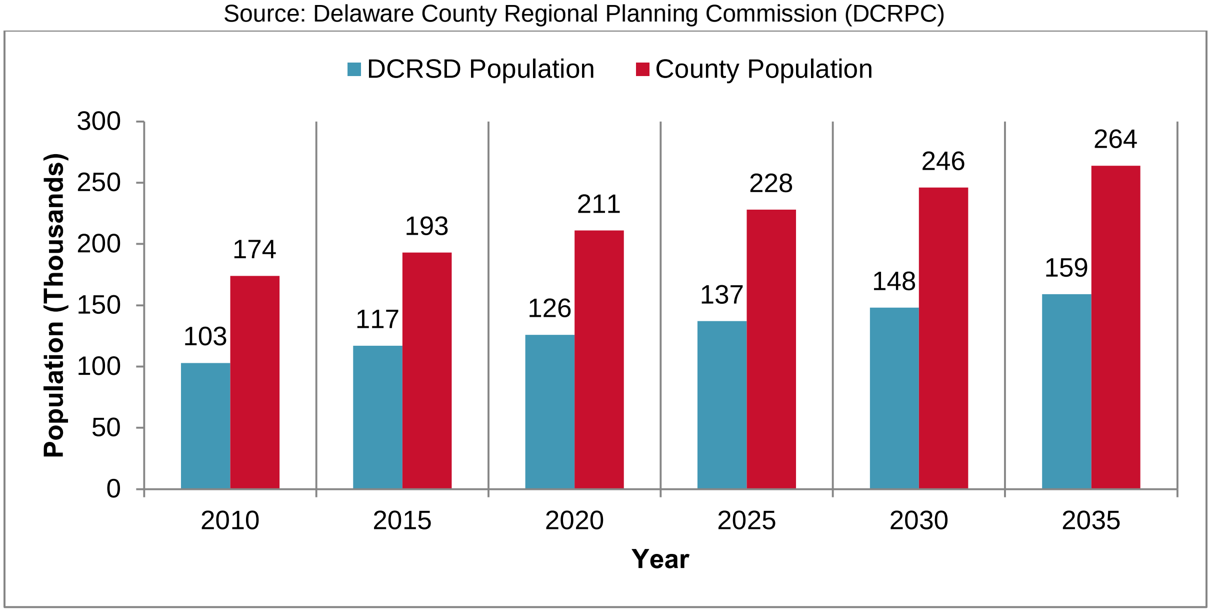
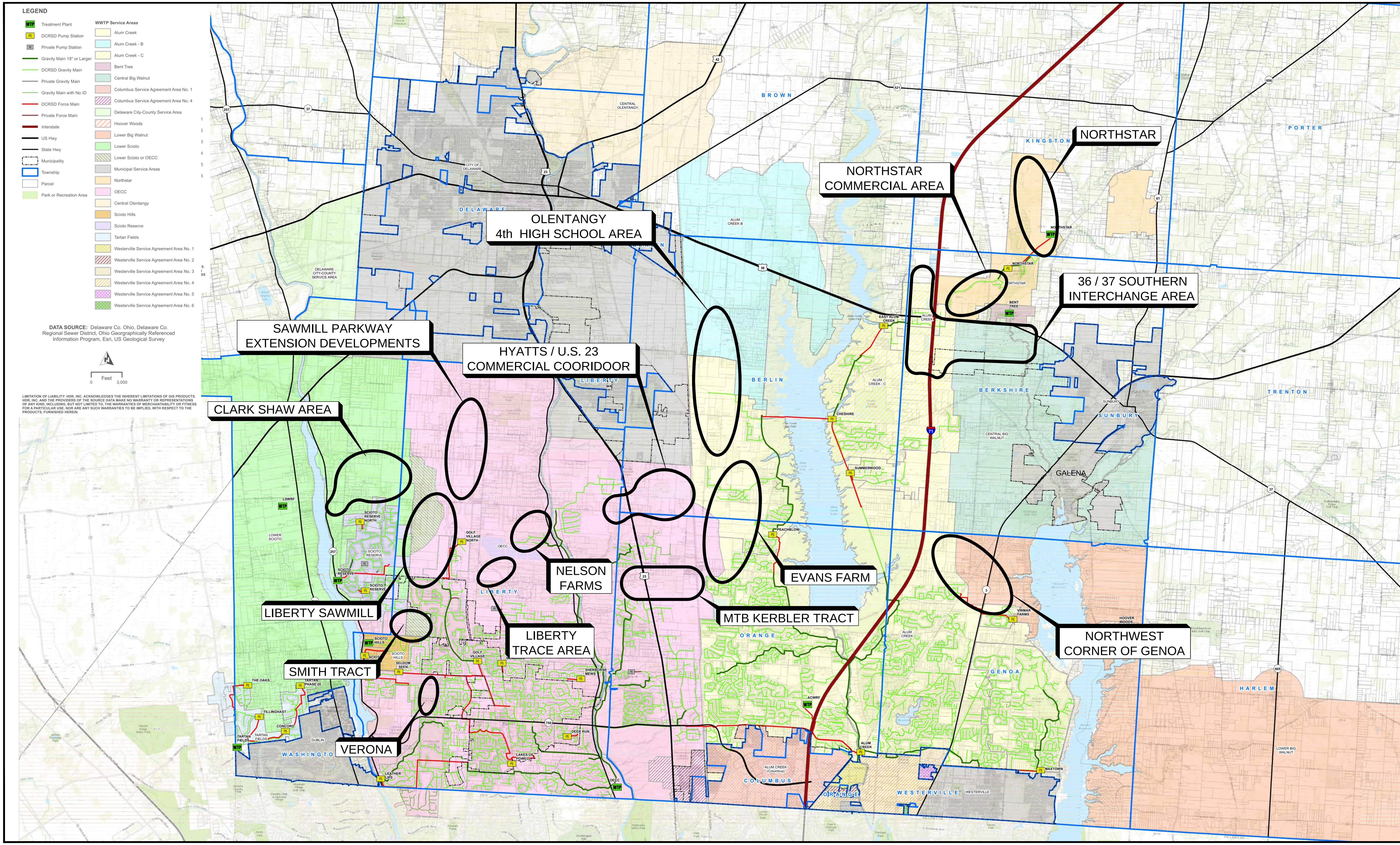


Figure 2 illustrates that more than 60% of the County population is currently served by the District. While specific projections of future growth are largely speculative and are subject to change with time, the DCRSD has provided its view of key growth corridors for this Master Plan effort. Based on current trends, development inquiries, and current and historical trends for new tap connections, key growth areas that are critical to infrastructure decision-making include the townships bordering Franklin County (Liberty, Orange, Concord, and Genoa) and major transportation thoroughfares (US23, I-71, US36/SR37, SR3, SR315, and Sawmill Parkway). Refer to Figure 3 for a map illustrating these key growth areas.



DELAWARE COUNTY GROWTH AREAS

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN

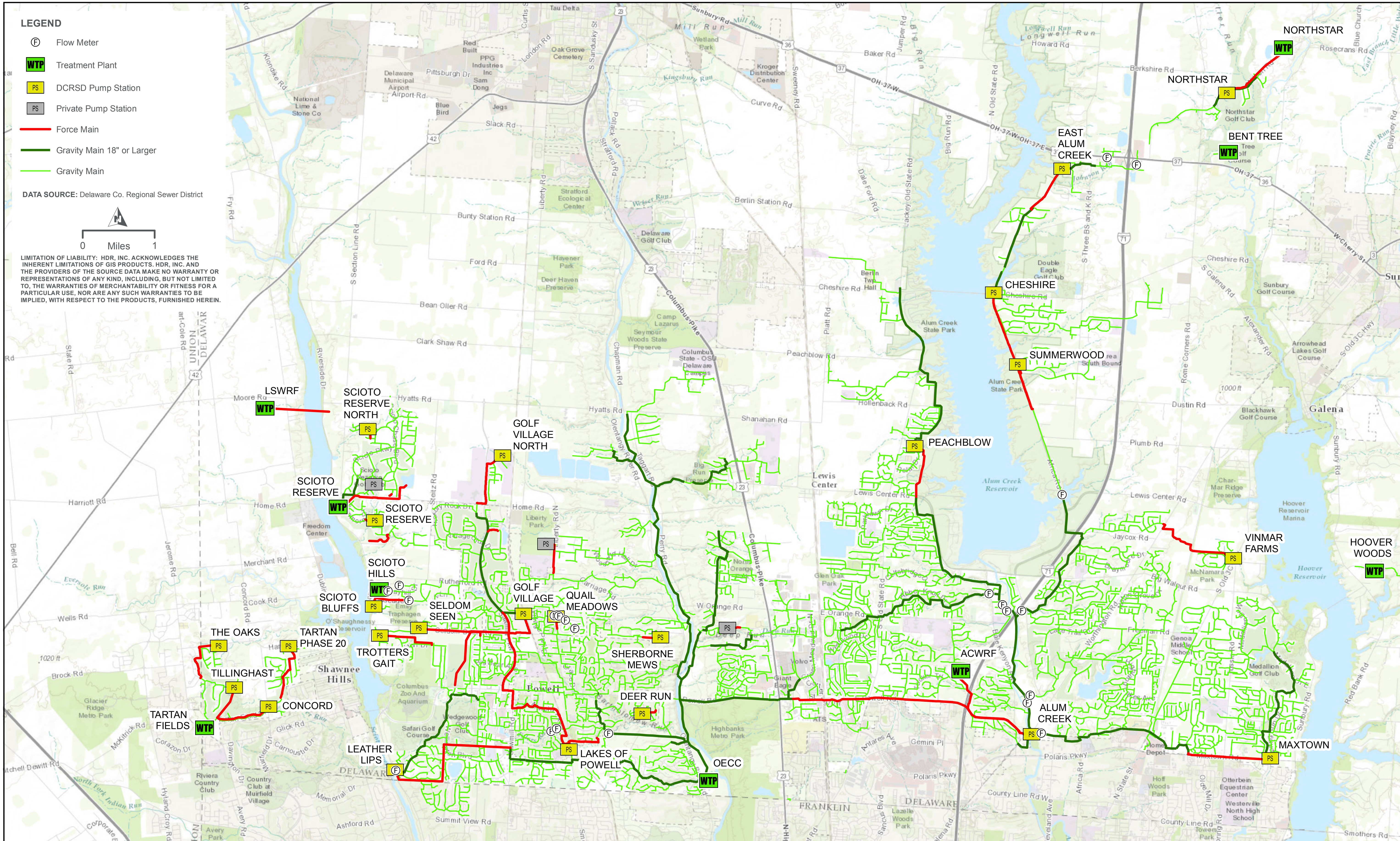
FIGURE 3

3.2 Sewer Flows

Future average dry weather flows were estimated using the projected population to be served by the District, in terms of residential units, and an assumed wastewater generation flow rate of 290 gpd per residential unit. This sewage flow rate includes 290 gpd in base sanitary flow plus 80 gpd per person to account for groundwater infiltration. This flow rate was based on a typical residential unit, consisting of 3 persons, and is the current planning value used by the District to describe the contribution from new residential units. Based on the flow assumptions and growth projections, up to 36% more dry weather flow is expected in 2035 (13.5 MGD) compared to 2014 (9.93 MGD).

For planning and design of sewer systems, the wet weather peaking factor (multiple of dry weather flow) is a critical number which largely determines infrastructure sizing. This factor, which varies from sewershed to sewershed, averaged approximately 2.2 and was determined from metered flows in the collection system. This observed value was within the expected range for a separate (not combined with stormwater) sanitary system. During planning phases, peaking factors are assumed to be greater than observed values to introduce a level of conservatism in infrastructure sizing. Peaking factors used for planning are discussed in Section 4.3 of this report.

Dry and wet weather flow within DCRSD is treated at one of the District's three main water reclamation facilities (WRF) or at one of its six package treatment plants. The three WRFs are the Lower Scioto Water Reclamation Facility (LSWRF), Olentangy Environmental Control Center (OECC), and Alum Creek Water Reclamation Facility (ACWRF). The package treatment plants are Tartan Fields, Scioto Reserve, Scioto Hills, Northstar, Bent Tree, and Hoover Woods. Refer to Figure 4 for a map illustrating the locations of these treatment facilities. A summary of flow and water quality data at the two active main treatment facilities, OECC and ACWRF is shown in Tables 1 and 2.



DCRSD SANITARY SEWER MAP

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN FIGURE 4

HDR

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Table 1. OECC Operating Data Summary

Parameter	Influent		Effluent		Units
	Design Criteria	Current Conditions	NPDES Limit (Monthly)	Current Conditions	
Average Flow	1.5 (NP)	-	-	-	MGD
	4.5 (SP)	3.4	-	-	
Peak Flow	4.5 (NP)	-	-	-	MGD
	13.5 (SP)	14.4[1]	-	-	
Dissolved Oxygen	-	-	5.0 (winter and summer)	7.38 avg 4.2 min	mg/L
Total Suspended Solids	200 (NP)	140.4 avg 760.0 peak	12	1.46 avg 76.0 peak	mg/L
Ammonia-Nitrogen	15 (NP)	-	1.28 (winter) 0.78 (summer)	0.28 avg 4.08 peak	mg/L
Nitrite + Nitrate	-	-	4.58	4.09 avg 15.2 peak	mg/L
Phosphorus	20 (NP)	-	1.0	0.76 avg 3.32 peak	mg/L
E. Coli	-	-	126	23.9 avg 510 peak	#/100 mL
5-day Carbonaceous Biochemical Oxygen Demand	200 (NP)	-	-	-	mg/L
	167(SP)	84.3 avg 267.0 peak	8.5	1.81 avg 6.56 peak	

[1] June 23, 2016 wet weather event (estimated between a 25- and 50-year storm).
SP = South Plant.
NP = North Plant (not in service).
"-" =Not monitored/available.

Table 2. ACWRF Operating Data Summary

Description	Influent		Effluent		Units
	Design Criteria	Current Conditions	NPDES Limit (Monthly)	Current Conditions	
Average Flow	10	5.3[1]	10	4.8	MGD
Peak Flow	30	26[2]	-	10.8	MGD
Dissolved Oxygen	-	-	7.0 (summer) 6.0 (winter)	9.58 avg 7.6 min	mg/L
Total Suspended Solids	-	224 avg 552 peak	12	4.33 avg 209 peak	mg/L
Nitrogen-Ammonia	-	-	3.0 (winter) 1.0 (summer)	0.23 avg 1.67 peak	mg/L
Nitrate + Nitrite	-	-	-	14.3 avg 19.8 peak	mg/L
Phosphorus	-	-	-	3.2 avg 5.6 peak	mg/L
5-day Carbonaceous Biochemical Oxygen Demand	167 avg 232 peak	208 avg 368 peak	10	2.39 avg 69.8 peak	mg/L
E. Coli	-	-	126	18.9 avg 1,299 peak	#/100mL

[1] Assumes 10% recycle for non-potable uses.
[2] June 23, 2016 wet weather event (estimated between a 25- and 50-year storm).
"-" = not monitored/available.

Lower Scioto Water Reclamation Facility (LSWRF)

The LSWRF was built in 2007 to accept wastewater flows from Concord Township and western Liberty Township. LSWRF was designed for an average daily flow (ADF) of 1.4 MGD with provisions to expand to an ADF of 2.8 MGD. However, due to a dramatic downturn in area development in the mid-2000's, the LSWRF has remained idle since its construction. DCRSD is currently evaluating LSWRF and collection system projects required to safely startup this asset. As such, DCRSD did not include an evaluation of the LSWRF in the Master Plan.

Package Plants

The District owns and operates six package treatment plants: Northstar, Scioto Hills, Scioto Reserve, Tartan Fields, Bent Tree, and Hoover Woods. Similar to LSWRF, DCRSD is currently conducting independent condition assessments of these facilities, which (combined) receive an ADF of approximately 0.57 MGD, primarily from residential sources throughout the District. In general, the District has expressed desire to transition away from multiple satellite facilities towards larger regional treatment plants, which is a consideration of the conveyance section of this Master Plan. Until such time as the elimination of these facilities makes financial sense however, the District will continue to evaluate their needs to ensure that they are maintained in good working order. DCRSD has provided information for inclusion in the Master Plan on the package plants which will be presented in Section 6.0 – Future Conditions and Recommendations.

3.3 District GIS

Collection system GIS data was provided by the District and used to create a hydraulic model of the collection system. The GIS data, which was provided in a geodatabase, reflects the District's infrastructure as of May 29, 2015. The geodatabase contained data layers for the following features: manholes, gravity mains, forcemains, sewer network junctions, air releases, and pump stations. The Master Plan project team worked with the DCRSD during hydraulic model development to fill data gaps in GIS data layers. Results of the hydraulic model will be discussed in greater detail in Sections 5.1.3 and 5.2.3.

3.4 Planning Documents

Beyond pure population projections, the nature (residential, commercial, etc.) and geographic location of planned future development is key to any infrastructure Master Plan. In order to accurately reflect this information, Delaware County sought relevant planning documents from its stakeholder group, particularly those whose planning methodology or vision had changed in recent years.

Various County, township, and state level entities have updated their planning documents since completion of the District's previous Master Plan in 2008. These changes have had a direct impact on this Master Plan. Entities with updated or otherwise clarified plans (since the prior DCRSD Master Plan in 2008) include the Ohio Department of Transportation (ODOT), the Delaware County Engineer, and Liberty, Berlin, Genoa, and Berkshire Townships. Future development trends obtained from these planning documents will be discussed in greater detail in Section 4.1.

3.5 Stakeholder Feedback

To ensure that the DCRSD Master Plan could accommodate stakeholder needs, meetings and workshops were conducted to gather information and perspectives from various stakeholders. The range of stakeholders consulted included residents and customers, County and District representatives, Township trustees and zoning officials, property owners and developers, and planning organizations. Generally, the characterization of the feedback received is as follows:

- Developers desired an early understanding of District policies during Master Plan development, particularly those regarding change in rate structure and capital improvement plan funding.
- Many constituent groups desired an understanding of how potential rate increase would be allocated between existing infrastructure maintenance and proposed new construction.

- Developers and homeowners expressed concerns over the way funding for future improvements related to overcoming capacity limitations would be handled.
- Residents were concerned about the changes that increased sewer availability would bring increased traffic and reduced availability of public services.

Feedback obtained from these workshops was taken into consideration during development of this Master Plan. These workshops confirmed the underlying development trends found in researched planning reports. To accommodate this development, capital improvement projects (CIPs) were identified and sequenced (Sections 6.4, 6.7, 6.10 and 7.0). CIPs were categorized based on the District's operations and maintenance (O&M) needs and its development-related needs. Funding for these projects is dependent upon the CIP type and is achieved through an optimum combination of user rate increases, capacity fees, loans, bonds, and TIF proceeds as discussed in Section 8.0 – Financial Analysis.

Because development within the County is ongoing, the District assisted the Master Plan project team by relaying development-related updates as they occurred. This ensured that the Master Plan incorporated the latest development trends at the time of writing. The District continues to communicate with developers and County residents as the development landscape evolves.

4.0 Master Plan Methodology

Following the Master Plan data collection effort, but prior to the evaluation of the DCRSD system and development of alternatives, a number of fundamental technical assumptions and modeling criteria were identified as a foundation of the planning process. These criterion were used to evaluate the capacity of the current system and identify improvements needed to support planned growth. The planning benchmarks were established based on industry best planning practices and the specific requirements of the DCRSD. Generally, these planning criteria include: Level of Service (LOS), assumed future wet and dry weather flow values, and growth potential.

4.1 Land Use & Density

Having received updated planning (future land use) information from various stakeholders at the beginning of the Master Plan effort, an evaluation of the future land use and density of development was conducted to determine the approximate number and location of future connections. Factors considered include:

- The existing density of recent development within Delaware County,
- Development trends and Township Comprehensive Plans,
- Zoning Requirements for the jurisdiction where growth is occurring,
- Undeveloped, but developable land.

For the purposes of this Master Plan, developable land within Delaware County is characterized as privately held land outside of floodplains, easements, and other construction restrictions and is not already utilized at a density typical for the more sub-urbanized areas of Delaware County (1.5-2 units per acre). This would primarily include vacant land or land that is currently utilized for either agriculture or low density residential/commercial space. Though the actual development of this land and the densities seen therein will be determined by the owners and townships themselves, this Master Plan considers the higher densities reflected in nearby development and the existing Comprehensive Plans to be the long term outcome as a means of conservatively sizing the proposed assets. Lower than estimated densities will allow for increased flexibility in nearby development.

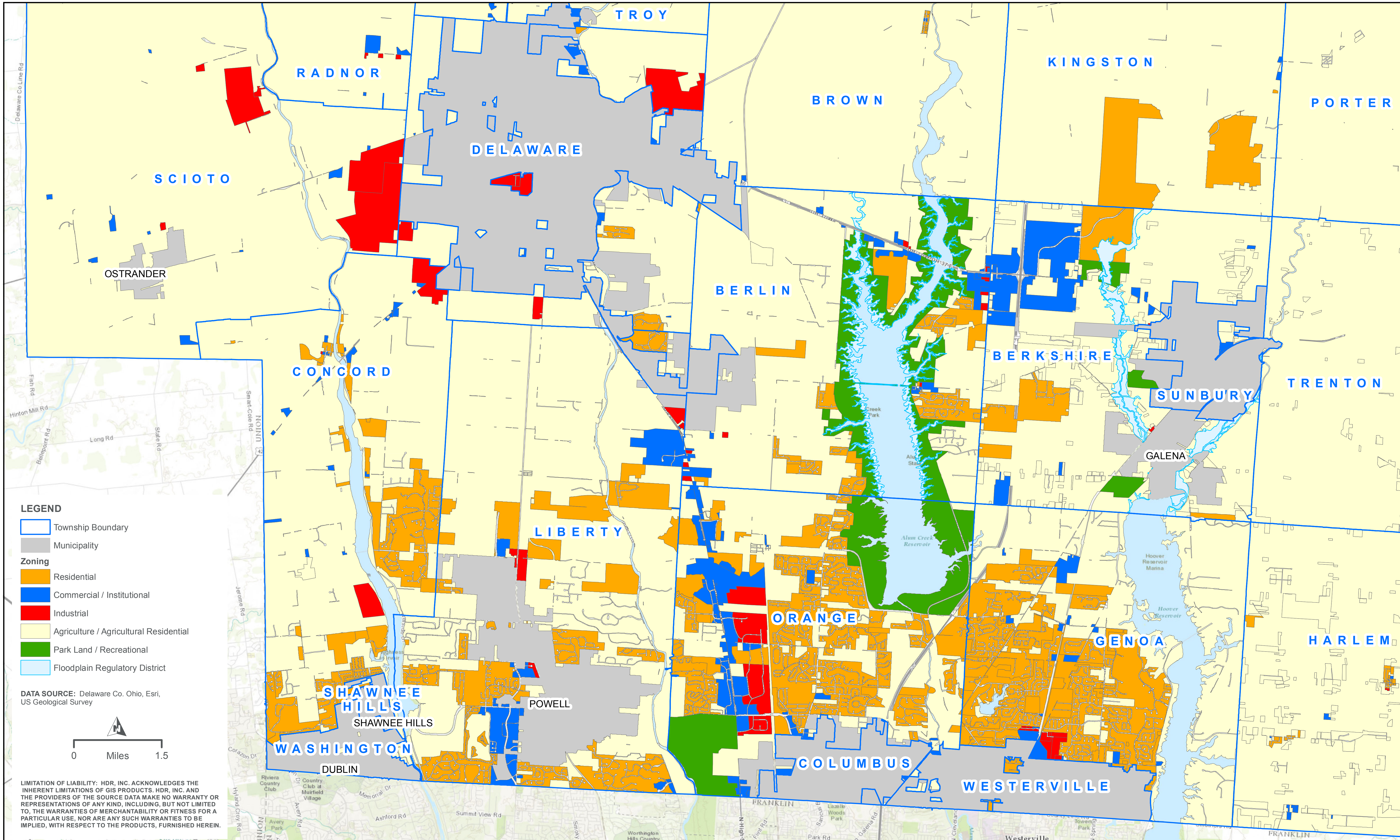
Table 3 shows the existing land remaining for development in Delaware County, at the time of this report. The zoning requirements for minimum lot size, together with the quantity of remaining undeveloped land are based on the Zoning Codes and Comprehensive Plans (specific to each Township), and historical information compiled by the DCRPC. These documents provide the foundation for future planning assumptions regarding the density of development and the ultimate number of additional sewer connections that may be required.

Table 3. Land Use Density (Maximum Permitted in Current Zoning)[1]

Township	Acres Zoned as Farm Residential or Similar[2]	Agricultural and Farm Residential Districts[2]	Light Residential (R-2) Districts	Medium Residential (R-3 and R-4) Districts
Berkshire	8,656 Ac	0.2 Units/Acre	0.5 Units/Acre	1.5 Units/Acre
Berlin	9,042 Ac	1 Unit/Acre	1.5 Units/Acre	2.2 Units/Acre
Concord	10,766 Ac	0.66 Units/Acre	1.5 Units/Acre	1.5 Units/Acre
Genoa	5,763 Ac	0.5 Units/Acre	N/A	1.8 Units/Acre
Harlem	16,816 Ac	0.5 Units/Acre	N/A	N/A
Kingston	13,733 Ac	0.5 Units/Acre	N/A	N/A
Liberty (including Powell)	4,325 Ac	1 Unit/Acre	2.2 Units/Acre	2 Units/Acre Single Family 6 Units/Acre Multifamily
Orange	-	0.5 Units/Acre	3 Units/Acre	2 Units/Acre Single Family 8 Units/ Acre Multifamily (4 Units/Acre average across multifamily development)

[1] Based on the approximate minimum lot size for the zoning district in each township per DCRPC.
[2] Areas with the potential to be developed new or re-zoned to a higher density.

Estimates for residential units serve as the basis for the allocation of sanitary flow, which were used to determine the requirements for conveyance, pumping and treatment. The residential density assumed in the Master Plan for new development varies between 1.5 and 4.2 units per acre across the County. Zoning within the Delaware County study area is shown in Figure 5.



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DELAWARE COUNTY ZONING MAP

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN FIGURE 5

PATH: J:\OH\DELAWARECO\DELAWARECO_WWMP\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\ZONING_MAP_161201_ABO.MXD - USER: AOVERBAY - DATE: 12/2/2016

Beyond residential development, DCRSD expects new commercial construction along the major thoroughfares in Delaware County. As has been a historical trend, commercial development is likely to continue to represent between 2 and 5 percent of developable land in order to serve the growing residential population. DCRSD and DCRPC expect future commercial development will generally be distributed across the County but will most likely follow major arterial roads. Within the DCRSD service area, those routes include Sawmill Parkway, Liberty, Home, and Orange Roads as well as US-23 and US36/SR37. Refer to Figure 3 in Section 3.1 for a map of growth areas within the tributary areas for each DCRSD facility.

4.2 Sewersheds/Basins

The Delaware County sanitary sewer system is made up of 3 major tributary basins corresponding to each of the major water reclamation facilities (ACWRF, OECC, LSWRF) as well as a number of smaller package or zero discharge facilities sewersheds. Refer to Figure 1 for a map showing these facilities. These smaller facilities include Northstar, Bent Tree, Scioto Reserve, Tartan Fields, and Scioto Hills – each with their own tributary area. The extents of all of these basins were determined prior to the initiation of the Master Plan and will be left intact with the exception of any new WRFs, at the direction of DCRSD. New developments will contribute to these basins via gravity sewer or forcemain from a pump station for eventual treatment at the basin WRF per the individual facility NPDES or Land Application Management Plan (LAMP) permits.

4.3 Wastewater Flow

With information compiled regarding the type and location of future development, future wastewater flows were calculated within identified sewersheds, and distributed within the hydraulic model that also estimate flows at treatment facilities and pump stations. The total wastewater flow that is used for master planning purposes was based on three distinct components:

- Sanitary base flow (either existing or estimated from density and acreage)
- Dry weather infiltration
- Rainfall-derived inflow/infiltration (RDII)

The sanitary base flow component is the flow generated by all approved sanitary connections on a daily basis, tributary to the collection system. Dry weather infiltration includes water that infiltrates from the ground into the sanitary collection system through pipe and joint breaks. While the magnitude of this value may vary depending on the age and condition of infrastructure, time of year, and the level of the groundwater, it is present on a continuous basis. On a typical dry day with no rainfall, the flow to DCRSD wastewater plants is made up of the sanitary base flow and the dry weather infiltration.

During rain events, additional water may enter the sanitary system through both direct (improper connections such as downspouts) and indirect (cracks in joints) methods. This additional flow is considered rainfall-derived inflow/infiltration (RDII) and is present only following rainfall events. This RDII will peak during (and immediately following) rainfall events and will gradually subside until the sources are no longer contributing. When planning for potential collection system improvements, all of these sources must be considered.

Table 4 lists the key criteria that have been developed for use within the Delaware County Sewer Model based on an evaluation of the flow monitoring data provided by DCRSD.

Table 4. Sewer Model Contribution Design Criteria

Criteria	Value	Description
Total dry weather flow	290	Gallons per day (gpd)/unit – 210 gpd sanitary base flow, 80 gpd dry weather ground infiltration).
Dry weather peaking factor	1.8	Ratio of peak dry weather flow to average dry weather flow.
Wet weather peaking factor	4.0-5.0	Ratio of peak wet weather flow to average dry weather flow in 25-year design storm event; range is based on size of new development.
RDII volume factor	2.0% of rainfall as RDII	Flow data from recent development.

A more detailed description of each item is included below:

Total dry weather flow: This value is based on a typical residential unit and is the current planning number in use to describe the contribution from new units in the district. The value of 290 gpd/unit includes both sanitary flow (aggregated for all land types) and dry weather infiltration.

Dry weather peaking factor: A value of 1.8 was used as the peak dry weather flow on a typical dry weather day from a unit. This accounts for the diurnal or other variation in daily usage, with peak rates of usage occurring in the morning and in the evening, with lower rates during daytime working hours and overnight.

Wet weather peaking factor: A range of approximately 4.0 to 5.0 was used for the peak wet weather flow observed during rainfall events relative to the average dry weather flow. This allows for the inclusion of RDII in the planning process. The range of 4.0 to 5.0 is based on the 25-year, 24-hour design storm event (4.4 inches in 24-hours), which was found to produce responses for new development similar to existing Delaware County design standards.

Different size storm events generate varying degrees of RDII and subsequently, varying magnitudes of peaking factors. A 0.5-inch rainfall event is significantly different than a 5.0-inch rainfall event and will generate a different response. Also, for developable areas of varying sizes (e.g. 100 acres to 1,000 acres), the peaking factor is adjusted based on the size of the proposed tributary area, creating the range of potential values. For purposes of planning, the peaking factor range of 4.0 to 5.0 will be assumed to occur during a 25-year, 24-hour recurrence event, which is approximately 4.4 inches in a 24-hour period. This peaking factor was validated by flow monitoring conducted during the Master Plan and through comparisons to existing design standards.

RDII volume factor: Wet weather response due to inflow/infiltration is defined not only by a peaking factor, but also by the total volume of water expected to enter the collection system as a result of the rainfall. Previous studies of other similar utilities have indicated that recent developments (those occurring in the past 20 years) have shown a range of contributions from 0.0% to 2.0%. Depending on the time of year, new developments may not produce any RDII, while during the winter and spring wet seasons, new developments may generate RDII values closer to 2.0%. In addition, the observed rate varies from developments that were recently built compared to those that were built 20-25 years ago. For this study, 2.0% was used because it allows for some aging of sewers and sewer laterals, and accounts for RDII from new development moving forward.

Each of the above factors were used in the newly created DCRSD collection system hydraulic model, to fully and accurately estimate total wastewater flow.

4.4 Collection System Capacity Evaluation

Hydraulic Software models (PCSWMM) were utilized in the master planning process to determine the remaining hydraulic capacity of the existing infrastructure, and forecast the sewer capacity needed to accommodate future flow increases. Hydraulic model scenarios were created and analyzed as “Existing Infrastructure” (Dry and Wet Weather Conditions), and “Future Conditions” (Dry and Wet Weather Conditions). Within the sewer model representing future conditions, dry weather flow was based on projections of future population and land use, and verified by historical flow records. Wet weather sewer flow responses (the indication of how quickly rain or groundwater results in a sewer rate increase) were applied to the entire modeled area based on actual field-measured flow monitoring data. Table 5 summarizes the capacity evaluation factors that were used either as inputs or indicators of potential performance issues in the sewer model. A full overview of the system capacity under various conditions can be found in Appendix B.

Table 5. Collection System Capacity Evaluation Factors

Category	Value	Notes
Design Storm	25-year, 24-hour events per NOAA - Bulletin 71 distributions and Atlas 14 volumes	Range of design storms to evaluate potential scenarios for new facilities and infrastructure
Pipe Roughness	n = 0.013	Coefficient of friction for all sewers; this value varies by material type and age but the value of 0.013 reflects the average of the DCRSD system.
Minimum Velocity	2.0 feet per second (fps)	2.0 fps is the EPA recommended minimum for sewer cleaning velocity. Only those low-velocity sewers that correlate to maintenance issues regarding sediment will likely be recommended for any improvements.
Design Capacity (as % of full)	50% full at peak dry weather flow; 100% full during peak wet weather	Set prior to modeling effort. Sewers that are 50% full during peak dry weather flow will be flagged to evaluate the possibility of potential capacity issues; in addition, any sewers flowing 100% full during wet weather will be flagged for further investigation to determine if action is needed.

4.5 Target Level of Service

One of the key elements of Master Planning is the articulation of performance benchmarks that sanitary sewer infrastructure must achieve, or Level of Service. The target Level of Service is developed and recommended by the project team based on experience and knowledge of the local community and ultimately approved by the system owner (DCRSD). The LOS represents the system condition and maximum fullness of pipes and manholes deemed acceptable during storm conditions. Criteria for LOS include items listed in Table 6 as well as the unique circumstances and condition of the Delaware County sewer system. It is applied to the model output during the capacity evaluation (as a hydraulic benchmark) to determine if a sewer pipe's performance is either acceptable or not.

Beyond Level of Service targets for sewer pipes, other hydraulic benchmarks were set for the Master Plan. Each of these helps to establish the threshold for capacity of infrastructure, and indicates that action is required (when Level of Service is not met). Generally, the Level of Service is determined by system owners (as the performance goals for their infrastructure) will drive pipe, pump station, and treatment plant sizes, and therefore cost.

Table 6. DCRSD Selected Infrastructure Level of Service

Category	Criteria	Condition
Sanitary Sewer Capacity	Sewer surcharge within 6' (Typical Basement Depth) of ground surface during selected storm wet weather event	A range of design events was used to help identify a reasonable storm to use that provides significant benefit while maintaining a reasonable cost. A comparison between DCRSD design standards and the design storm approach suggests that the **current Level of Service is 25 Years**.
Collection System Pump Station Capacity	Velocity range: 2.0 – 8.0 fps is recommended in 10 States Standards. Pump Cycles: max 10 starts per hour for ideal pump conditions. Operating Conditions: Pump operating point falls within the actual operating range (AOR) defined by Hydraulic Institute Standards. Motor Load: Non-overloading.	Velocity Range: Maintains appropriate minimum and maximum velocity to reduce sewer blockages and scour. Pump cycle evaluations are performed based on standard industry practice and are dependent upon individual motor size and pump type. Operating Conditions: Range of pumping output is evaluated against the pumps Preferred Operating Range (POR) and Actual Operating Range (AOR) to verify efficient operation. Pumps Motors operate in non-overloading conditions at all points in POR.
Pump and Equipment Redundancy	Peak hourly flow rate able to be conveyed with the single largest component out of service.	These criteria may be adjusted for specific pump stations, depending on age and criticality.
Water Reclamation Facility Hydraulic Capacity	Freeboard: for aeration tanks, the minimum is 18 inches. For other channels and tanks, the minimum is 12 inches. For hydraulic controls, an unsubmerged condition is the minimum. Loading rates: 5 gpm/sf (tertiary filtration), 900 gpd/sf (final clarification), 30,000 gpd/LF (weir loading rate, final clarification).	Check that hydraulic elevations maintain appropriate freeboard and hydraulic control. Check that hydraulic loading rates fall within regulatory stipulated values for wet stream process.
Water Reclamation Facility Treatment Capacity	Process Efficiency: evaluated treatment data to check for NPDES permit compliance. Treatment Capacity: based on calculated air flow requirements (activated sludge aeration, and effluent post-aeration), and solids loading rate (final clarification).	Evaluate organic loading and process efficiency at current and future (anticipated) loads. Check performance to verify regulatory compliance of conditions.

The project team has attempted to balance the competing objectives of Level of Service and planning flexibility when evaluating the system hydraulic model and making project recommendations.

5.0 Existing Conditions

To begin the assessment phase of the Master Plan, a condition and capacity assessment of District owned conveyance and treatment infrastructure was conducted. The condition assessment was performed by visual observation of District-owned assets, and identified needs (for replacement or rehabilitation) based on their estimated remaining useful life, physical condition, maintenance records, and feedback from District staff. The capacity assessment included treatment and hydraulic capacity calculations performed through a desktop evaluation of available data for OECC and ACWRF. Assessed capacity of the collection system, including pump stations, was determined through use of the collection system hydraulic model.

The sanitary collection system assessment is presented below by WRF tributary basin. This assessment included 9 of the 24 District-owned pump stations. Information about the condition and capacity of the LSWRF and the six package treatment plants was provided by the District for inclusion in the Master Plan.

5.1 OECC Basin

The OECC Basin is located generally on the Western half of the DCRSD service area, and consists of 8,840 acres and contains over 56,000 linear feet (LF) of forcemains and over 963,000 LF of gravity sewers. These sewers range in size from 6 to 42 inches. The OECC Basin also includes 9 pump stations, 2 of which were evaluated under the Master Plan. Refer to Figure 1 in Section 2.0 and Figure 4 in Section 3.0 for maps of the OECC Basin.

5.1.1 Olentangy Environmental Control Center (OECC)

OECC consists of two treatment trains called OECC North and OECC South. OECC North was commissioned circa 1979 and was subsequently removed from service with the commissioning of OECC South around 1994. OECC North was not demolished and still remains connected even though flow is not sent through it. Treatment processes employed at OECC include raw sewage grinding and pumping, activated sludge aeration, final clarification, tertiary filtration, ultraviolet (UV) light disinfection, post-aeration, aerobic digestion, and sludge thickening and dewatering. The tertiary filtration, UV light disinfection, post-aeration, aerobic digestion, sludge thickening and dewatering processes are shared between OECC North and South. Refer to Figure 6 for a site plan of OECC. Liquid and solid stream process flow diagrams are shown in Figure 7 and Figure 8, respectively. OECC South is currently the only treatment train in service; however, both plants were evaluated as part of this Master Plan. Key findings obtained from the condition and capacity assessment of OECC North and South are summarized as follows:

- OECC has insufficient hydraulic capacity to receive the peak flows predicted from a modeled 25-year design storm. Plant inflows of approximately 26 MGD are predicted, which is significantly greater than OECC South's rated peak wet weather capacity of 13.5 MGD. This is a function of insufficient raw sewage pumping capacity, OECC North being offline, and piping bottlenecks.
- OECC South may have insufficient treatment capacity to treat peak flows (modeled 25-year design storm) at observed peak pollutant concentrations. This was determined through a desktop evaluation and will require further analysis for verification.
- OECC does not employ a screening or grit removal process. Grit and debris accumulate in downstream process tanks and equipment, reducing reliability and increasing maintenance burdens. This was observed in the OECC South aeration mixers and the sludge dewatering centrifuge.
- OECC North is offline and limits the overall capacity of OECC. Because OECC North has been out of service for over 20 years, it cannot be returned to service without significant renovation. Due to the general condition and age of equipment installed in OECC North, substantial repair or replacement of equipment is recommended.
- The tertiary filters have operational problems. High filter headloss and recycle flows from excessive backwashing are major issues.
- Dewatered sludge load out capacity is lower than desired.
- Motor soft starters and variable frequency drives (VFD) are reaching the end of their useful lives and will require replacement.
- The existing arc flash study is outdated. Arc flash studies are needed every 5 years per NFPA 70E.
- Instrumentation and control system needs are summarized as follows:
  - The existing programmable controllers manufactured by Allen Bradley are obsolete and are being phased out. This equipment will eventually need to be replaced with a manufacturer-supported system.
  - District staff reuse replacement parts from existing panels to keep the existing aeration tank mixer control panels running. Eventual panel replacement will be necessary.
  - Desktop PC's, their operating systems, and SCADA software have relatively short life cycles and will require a near-term upgrade.
  - There exists no documentation or labeling of the control system network configuration or topology. This poses a risk during troubleshooting or when the District wishes to implement changes. A network configuration audit should be performed that includes the development of drawings representing the network architecture and include the application of labeling for all network cabling and receptacles. The audit should also look for potential security

risks and provide recommendations for minimizing risk from either intentional cyber attack or internal accidents.

- The age of the UPS batteries is unknown. If original to the equipment, they are very likely in need of replacement.
- The District does not have an agreement established with an additional control system support provider. An additional support provider should be identified in case the primary provider becomes unavailable. The District could circumvent this by employing a systems integrator.
- As-built documentation of the control system networks was not available. Development and maintenance of this documentation will assist the District's troubleshooting, maintenance, and integration of future facility upgrades.
- The District does not have a formal disaster recovery plan in place. This plan typically involves identifying disaster risks, assembling important system documentation and original program files (PLC, SCADA), identifying key personnel and their roles, and procedures that may be called upon to restore the process control system in the event of a disaster.

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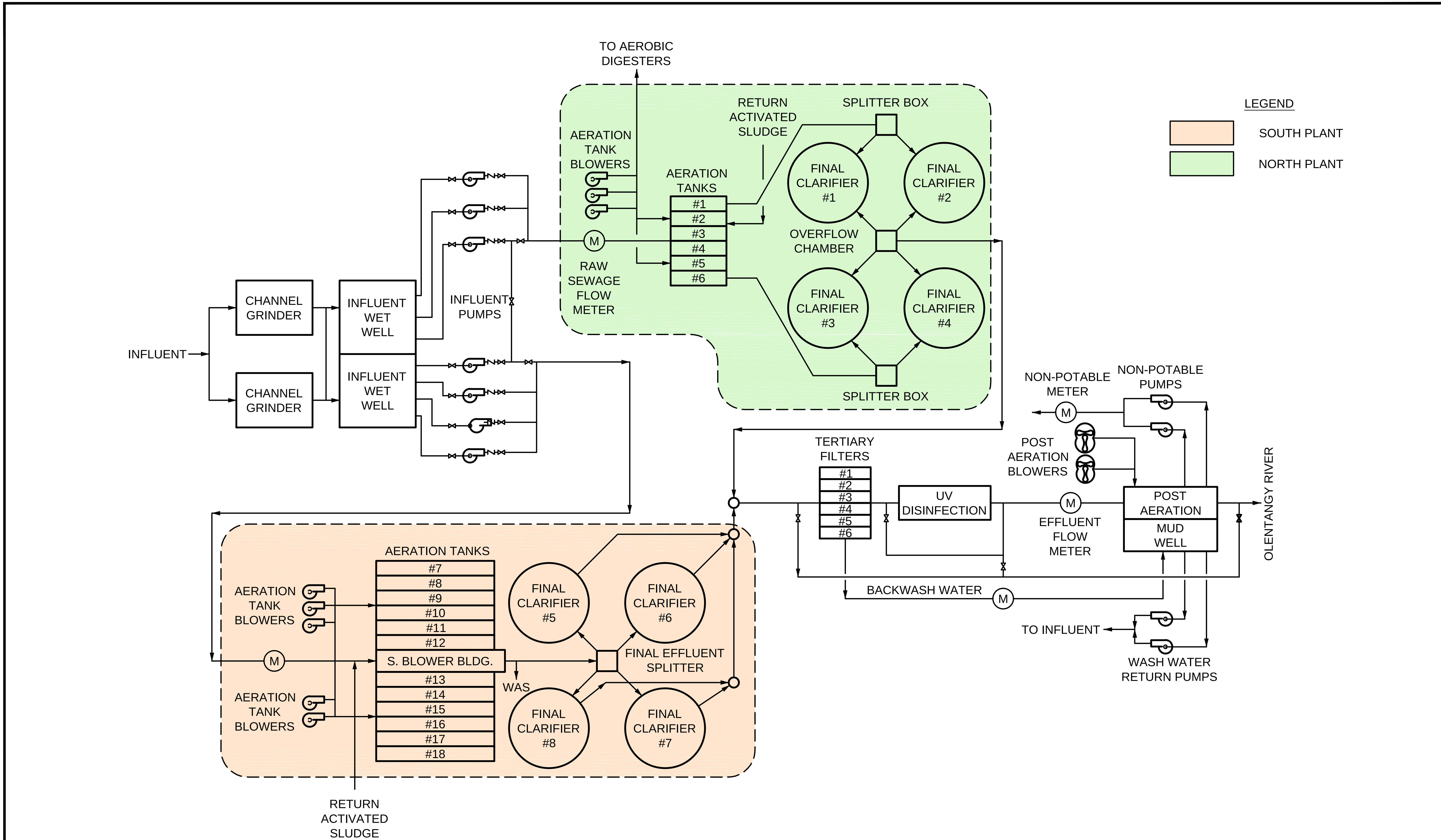
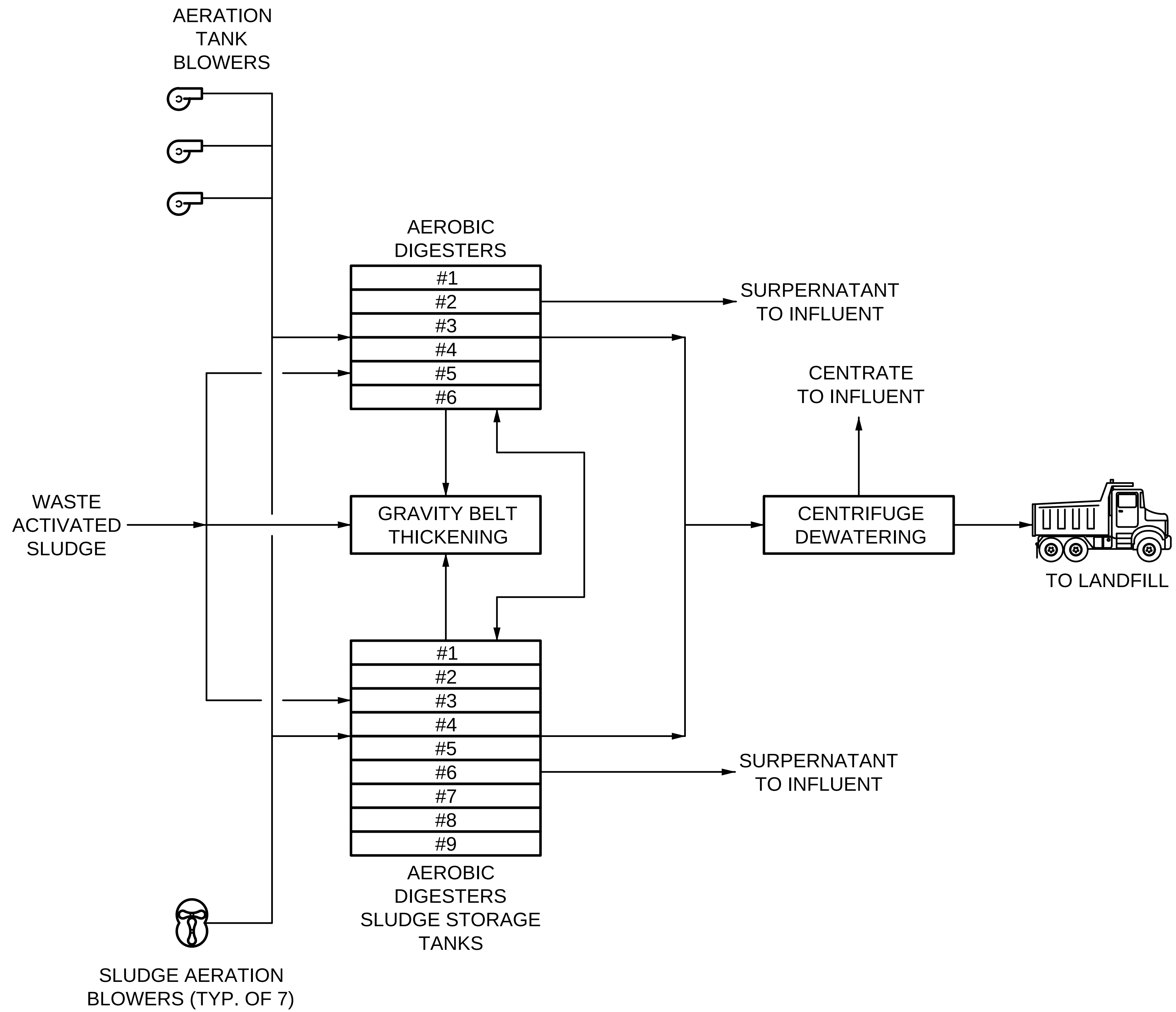
OLENTANGY ENVIRONMENTAL CONTROL CENTER
DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN
FIGURE 6



OECC LIQUID STREAM PROCESS FLOW DIAGRAM

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN

FIGURE 7



OECC SOLIDS STREAM PROCESS FLOW DIAGRAM

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN

FIGURE 8

5.1.2 Pump Stations

Two District pump stations were evaluated in the OECC Basin: Leather Lips and Golf Village. There exists a Golf Village North pump station but it was not included in the assessment. Features of these pump stations are summarized in Table 7. Refer to Figure 4 in Section 3.2 for a map showing the locations of Leather Lips and Golf Village.

Table 7. OECC Basin Pump Station Features

Name	Pumping Capacity (MGD)[1]	Forcemain Size and Capacity (MGD)[2]	Modeled Pump Station Capacity (MGD)[3]	Modeled Peak Inflows (MGD)[4]	Notes
Leather Lips	1.73	16" – 7.22	2.99	5.19	Code and pump capacity upgrades needed
Golf Village	1.56	14" – 5.53	1.80	2.20	Maintenance and pump capacity upgrades needed

[1] Pump station capacity may differ significantly based on operating conditions.
[2] Based on a maximum velocity of 8 FPS.
[3] Based on peak hourly flow.
[4] 25-year design storm.

Observed and recorded average daily pump run times suggest that inflows at Leather Lips currently outpace the pump station's capacity. This condition was not observed at Golf Village. The hydraulic model predicted peak inflows resulting from a 25-year design storm that were greater than the modeled capacities of Leather Lips and Golf Village pump stations. Beyond capacity improvements, these pump stations require upgrades to meet code and maintenance best practices: Leather Lips does not meet the ventilation requirements of 6 air changes per hour (ac/h) for hazardous locations per NFPA 820 (code) and Golf Village needs the protective coating on pump discharge piping to be reapplied (maintenance).

5.1.3 Collection System

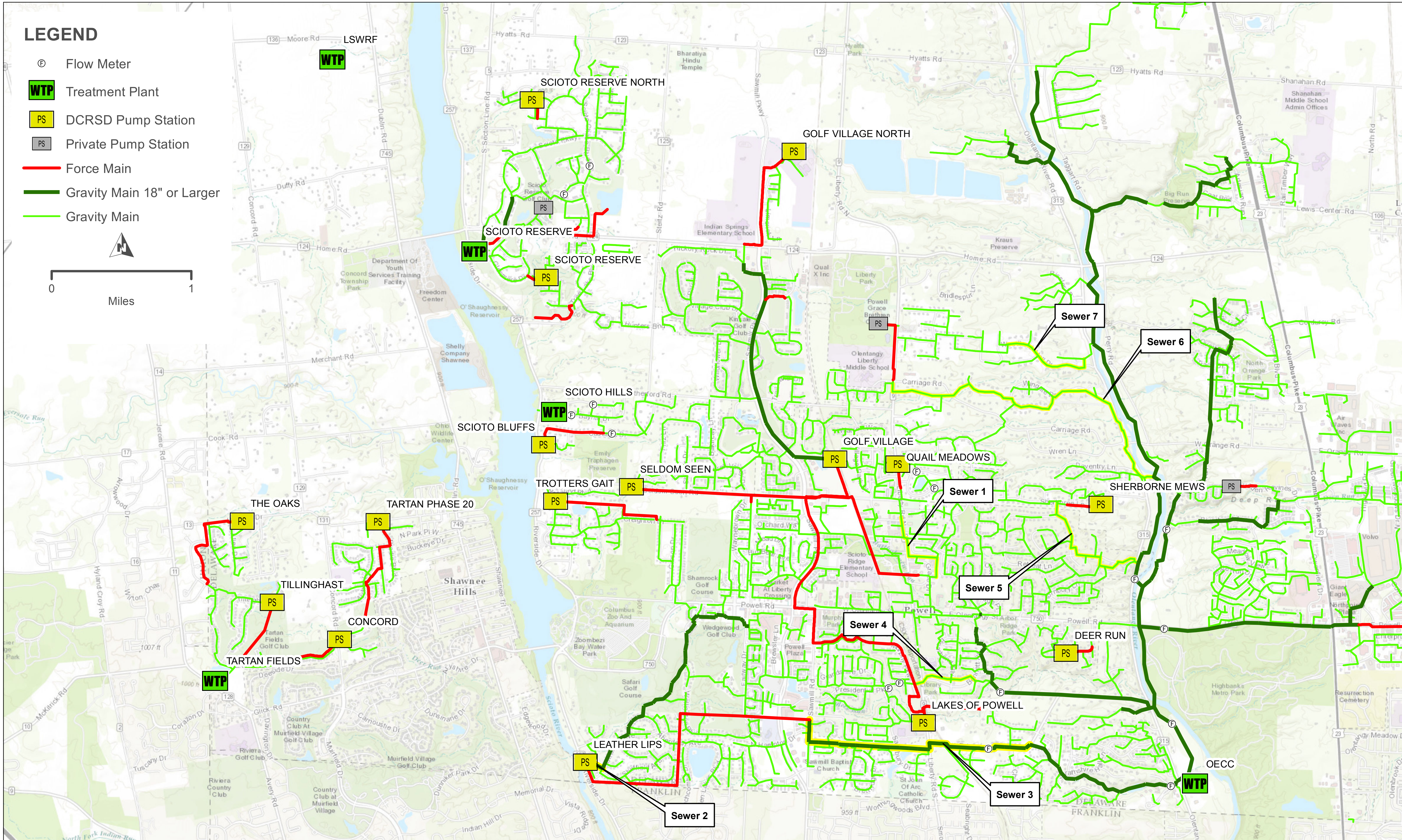
CCTV inspection data (performed and provided by DCRSD) for the OECC Basin includes 1,955 total observations. Among these, the number of observed O&M issues and structural defects were 29 and 8, respectively. The total number of O&M issues and structural defects do not include multiple observations of the same code for the same sewer line. The locations of observed O&M issues and structural defects are illustrated in Figure 9.

Generally, for the age of the collection system, the number and type of O&M issues and structural defects is considered normal. Observations made by DCRSD staff indicate that O&M issues in the OECC collection system are described as settled deposits, infiltration, and root intrusion whereas structural defects are described as pipe cracking or broken pipe.

Having reviewed in detail the output of the “Existing Infrastructure” hydraulic model at the target level of service, the following sewers have capacity limitations (less than 6 feet of freeboard in connected manholes and/or operating at 75% capacity) at the 25-year design storm:

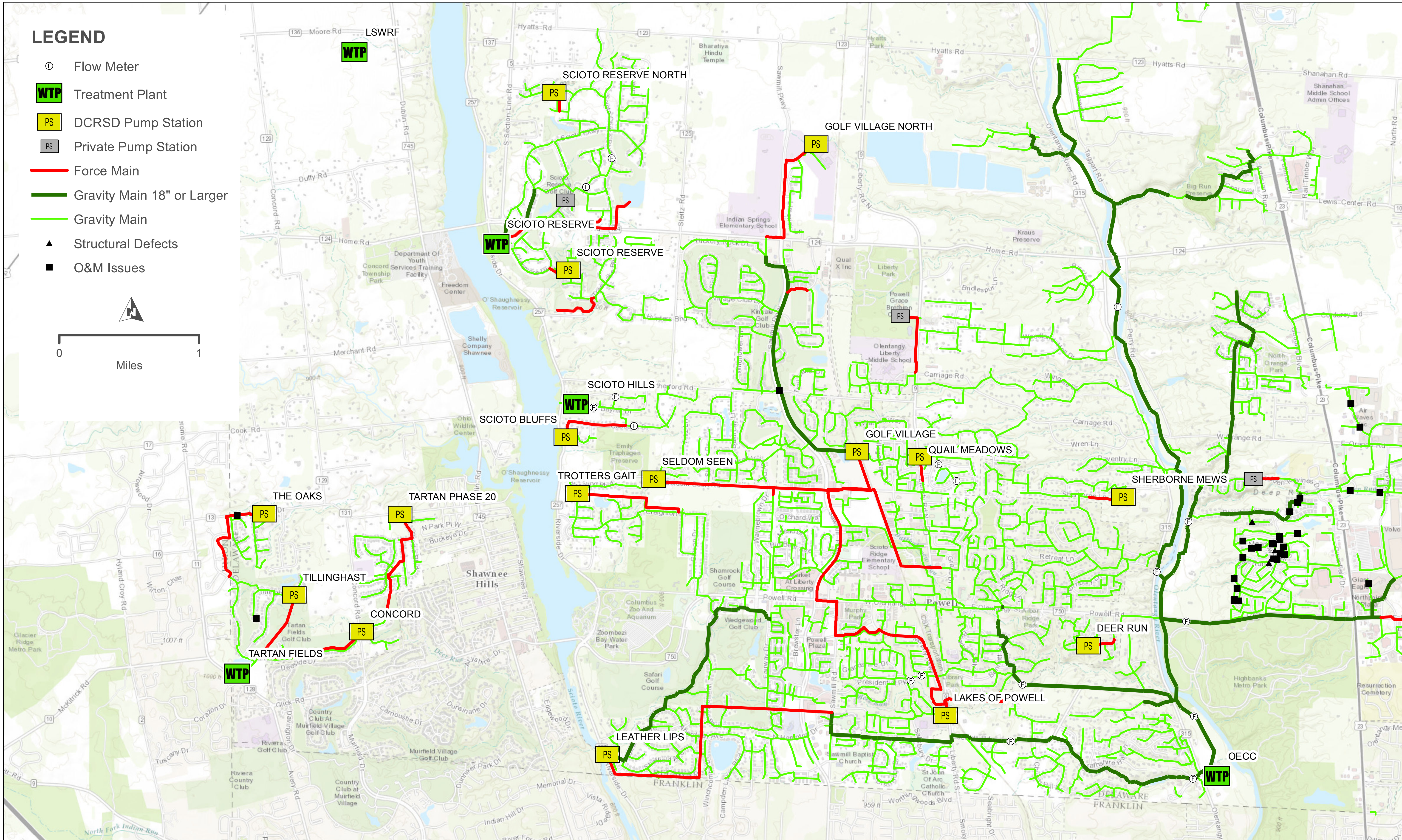
- Sewer 1: 10 inch sewer downstream of the Quail Meadows Pump Station forcemain.
- Sewer 2: 18 to 24 inch sewer upstream of the Leather Lips Pump Station.
- Sewer 3: 18 inch sewer at the Leather Lips forcemain outlet to the downstream end of Jewett Road.
- Sewer 4: Portions of the 10 inch sewer on Oakham Court and Wallsend Court.
- Sewer 5: 8 to 15 inch sewer downstream of the Sherborne Mews Pump Station forcemain.
- Sewer 6: Upstream of the 10 to 15 inch sewer on U.S. 315 where the 15 inch line downsizes to a 8-inch line upstream to Liberty Road.
- Sewer 7: 8 to 10 inch local sewer that runs along Woodland Hall Drive.

These addressed localized sewer capacity issues are illustrated on Figure 10 for reference. Specific capacity restrictions under varying scenarios can be found in the maps in Appendix B



OECC BASIN SANITARY SEWER 25-YEAR EVENT CAPACITY LIMITATIONS (EXISTING CONDITIONS)
DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN
FIGURE 10

HDR



OECC BASIN SANITARY SEWER CCTV OBSERVATIONS

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN

FIGURE 9

5.2 ACWRF Basin

The ACWRF Basin is located generally on the eastern half of the DCRSD service area and consists of 10,568 acres and contains over 43,000 LF of forcemains and over 1.2 million LF of gravity sewers. These sewers range in size from 8 to 48 inches. The ACWRF Basin currently includes 7 pump stations, all of which were evaluated in this Master Plan. Refer to Figure 1 in Section 2.0 and Figure 4 in Section 3.0 for maps of the ACWRF Basin.

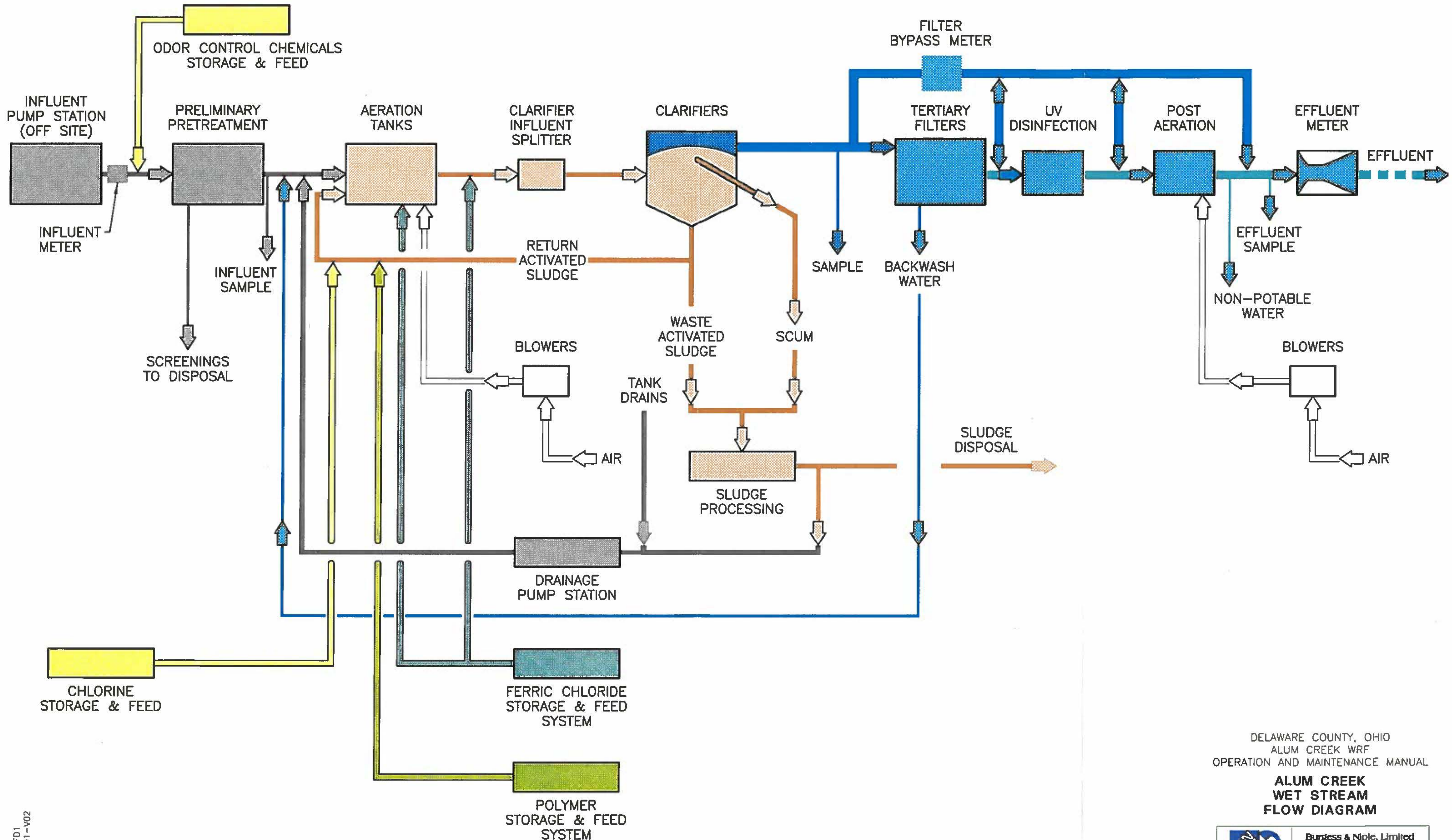
5.2.1 Alum Creek Water Reclamation Facility (ACWRF)

ACWRF was commissioned in 2002 and features the following treatment processes: raw sewage pumping, mechanical bar screening, activated sludge aeration, final clarification, tertiary filtration, UV light disinfection, post-aeration, aerobic digestion, and sludge dewatering. ACWRF utilizes a remote raw sewage pumping process located over 1 mile to the southeast. Refer to Figure 11 for a site plan of ACWRF. Liquid and solid stream process flow diagrams from the plant Operations and Maintenance Manual are shown in Figure 12 and Figure 13, respectively.

ALUM CREEK WATER RECLAMATION FACILITY

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN

FIGURE 11



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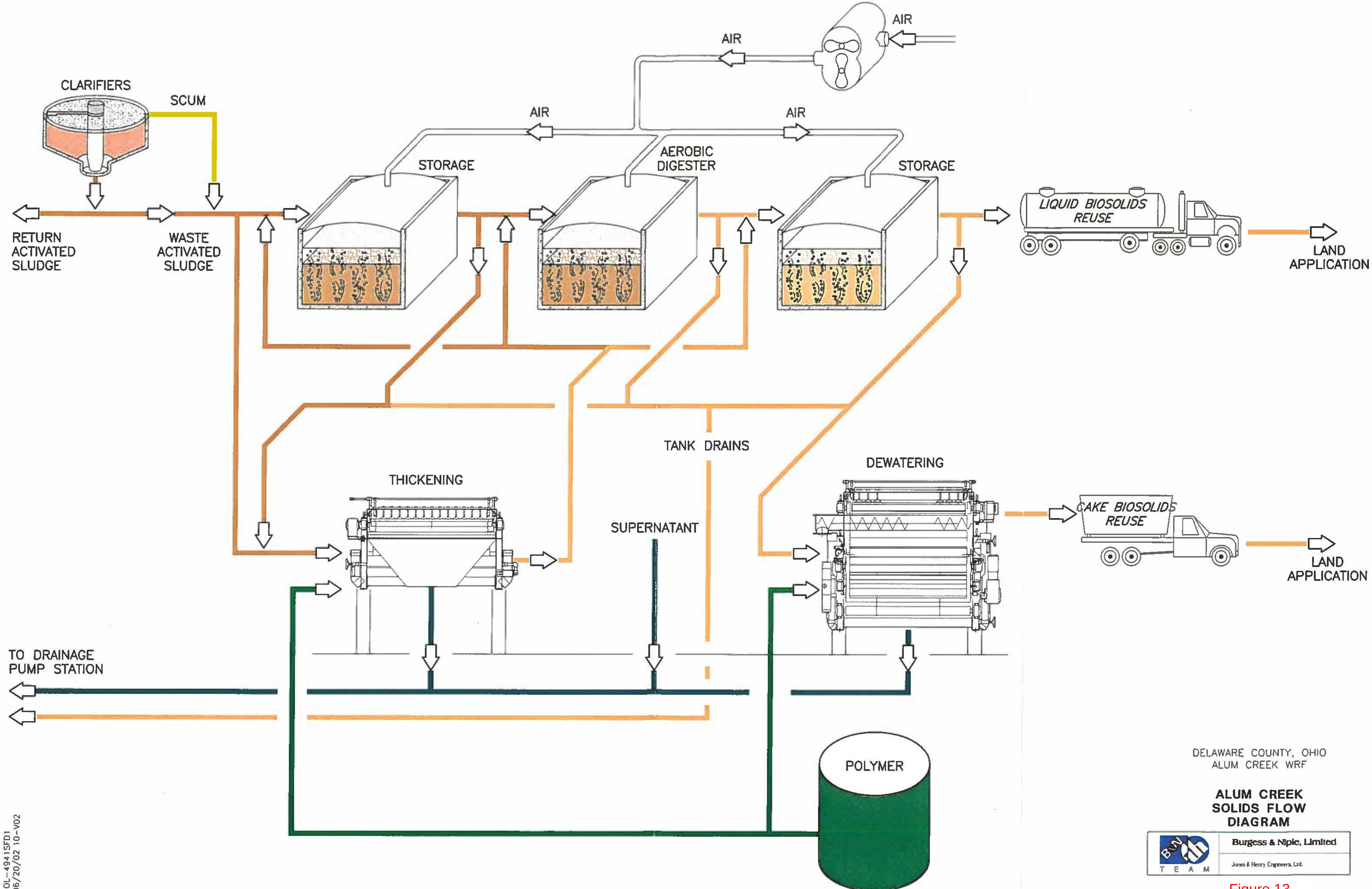
04/01/02 01-V02

DELAWARE COUNTY, OHIO
ALUM CREEK WRF
OPERATION AND MAINTENANCE MANUAL

ALUM CREEK WET STREAM FLOW DIAGRAM

Burgess & Niple, Limited
Jones & Henry Engineers, Ltd.
TEAM

Figure 12



DELAWARE COUNTY, OHIO
ALUM CREEK WRF

ALUM CREEK SOLIDS FLOW DIAGRAM

Burgess & Niple, Limited
Jones & Henry Engineers, Ltd.
B&N TEAM

Figure 13

TOL-4941SFD1
06/20/02 10-V02

Key findings obtained from the condition and capacity assessment of ACWRF are summarized as follows:

- ACWRF has sufficient hydraulic capacity to receive peak flows resulting from a modeled 25-year design storm. ACWRF is rated for a peak flow of 30 MGD and has approximately 13% peak hydraulic capacity remaining during a 25-year design storm.
- ACWRF may have insufficient treatment capacity to treat peak flows (modeled 25-year design storm) at observed peak pollutant concentrations. This was determined through a desktop evaluation and will require further analysis for verification.
- Duct heater DH1-PR violates NFPA 820. Duct heater DH1-PR, which had a visible open flame, was located within a 3 foot buffer area surrounding the odor control scrubber in the Pre-Treatment Building.
- Grit accumulation in channels and tanks has been troublesome. The District believes that filter media is washing out from the tertiary filters and is being recycled to the head of the plant.
- The tertiary filters have operational problems. High filter headloss and recycle flows from excessive backwashing are major issues. The District believes that the source of the grit deposits in upstream channels and tanks is from the tertiary filters but it has not been confirmed through testing.
- The District does not operate the aerobic digesters. ACWRF's proximity to residential development has resulted in numerous odor complaints from operation of the aerobic digesters.
- Motor soft starters and VFD's have reached the end of their useful lives.
- The existing arc flash study is outdated. Arc flash studies are needed every 5 years per NFPA 70E.
- Instrumentation and control system needs are summarized as follows:
  - The existing programmable controllers manufactured by Allen Bradley are obsolete and are being phased out. This equipment will eventually need to be replaced with a manufacturer-supported system.
  - Desktop PC's, their operating systems, and SCADA software have relatively short life cycles and will require a near-term upgrade.
  - There exists no documentation or labeling of the control system network configuration or topology. This poses a risk during troubleshooting or when the District wishes to implement changes. A network configuration audit should be performed that includes the development of drawings representing the network architecture and include the application of labeling for all network cabling and receptacles. The audit should also look for potential security risks and provide recommendations for minimizing risk from either intentional cyber attack or internal accidents.

- The age of the UPS batteries is unknown. If original to the equipment, they are very likely in need of replacement.
- The District does not have an agreement established with an additional control system support provider. An additional support provider should be identified in case the primary provider becomes unavailable. The District could circumvent this by employing a systems integrator.
- As-built documentation of the control system networks was not available. Development and maintenance of this documentation will assist the District's troubleshooting, maintenance, and integration of future facility upgrades.
- The District does not have a formal disaster recovery plan in place. This plan typically involves identifying disaster risks, assembling important system documentation and original program files (PLC, SCADA), identifying key personnel and their roles, and procedures that may be called upon to restore the process control system in the event of a disaster.

5.2.2 Pump Stations

Six pump stations were evaluated in the ACWRF Basin: Alum Creek, Maxtown, Cheshire, Vinmar, East Alum Creek, and Peachblow. Features of these pump stations are summarized in Table 8.

Table 8. ACWRF Basin Pump Station Features

Name	Pumping Capacity (MGD)[1]	Forcemain Size and Capacity (MGD)[2]	Modeled Pump Station Capacity (MGD)[3]	Modeled Peak Inflows (MGD)[4]	Notes
Alum Creek	30.0 / 22.5	20" – 11.3 36" – 36.6	-	25.8	Code and pump capacity upgrades needed
Maxtown	2.71	16” – 7.22	2.38	2.78	Code and pump capacity upgrades needed
Cheshire	0.86	10" – 2.82	1.12	1.19	Code and pump capacity upgrades needed
Vinmar	0.37	6" – 1.02	0.43	0.19	Pump capacity upgrade needed
East Alum Creek	0.37	12" – 4.06	0.55	0.48	Code and maintenance upgrades needed
Peachblow	0.72	8" – 1.80	0.86	1.04	Code and pump capacity upgrades needed

[1]Pump station capacity may differ significantly based on operating conditions.
[2]Based on a maximum velocity of 8 FPS.
[3]Based on peak hourly flow.
[4]25-year design storm.
“-“: not available.

Observed and recorded average daily pump run time data suggests that Maxtown, Cheshire, and Peachblow are currently receiving inflows greater than their maximum capacities. The hydraulic model predicted peak inflows resulting from a 25-year design storm that were greater than the modeled capacities of Maxtown, Cheshire, and Peachblow. This condition was not observed for Vinmar, and East Alum Creek. Because the Alum Creek pump station discharges directly to ACWRF and not to the collection system, its capacity was not estimated in the collection system hydraulic model. It is not typical to model the hydraulics of a treatment facility in these types of models. However, peak inflows from a 25-year design storm were modeled and shown to exceed the pump station’s capacity. Other improvement needs identified for the pump stations is listed as follows:

- Does not meet the ventilation requirements of 6 ac/h for hazardous locations per NFPA 820 (code) – Alum Creek, Maxtown.
- No fall protection installed at wet well access hatches (code) - Cheshire, East Alum Creek, and Peachblow.
- Defective unit heaters (maintenance) - East Alum Creek, Peachblow, and Cheshire.
- Failure of protective coatings on pump discharge piping (maintenance) – Cheshire.

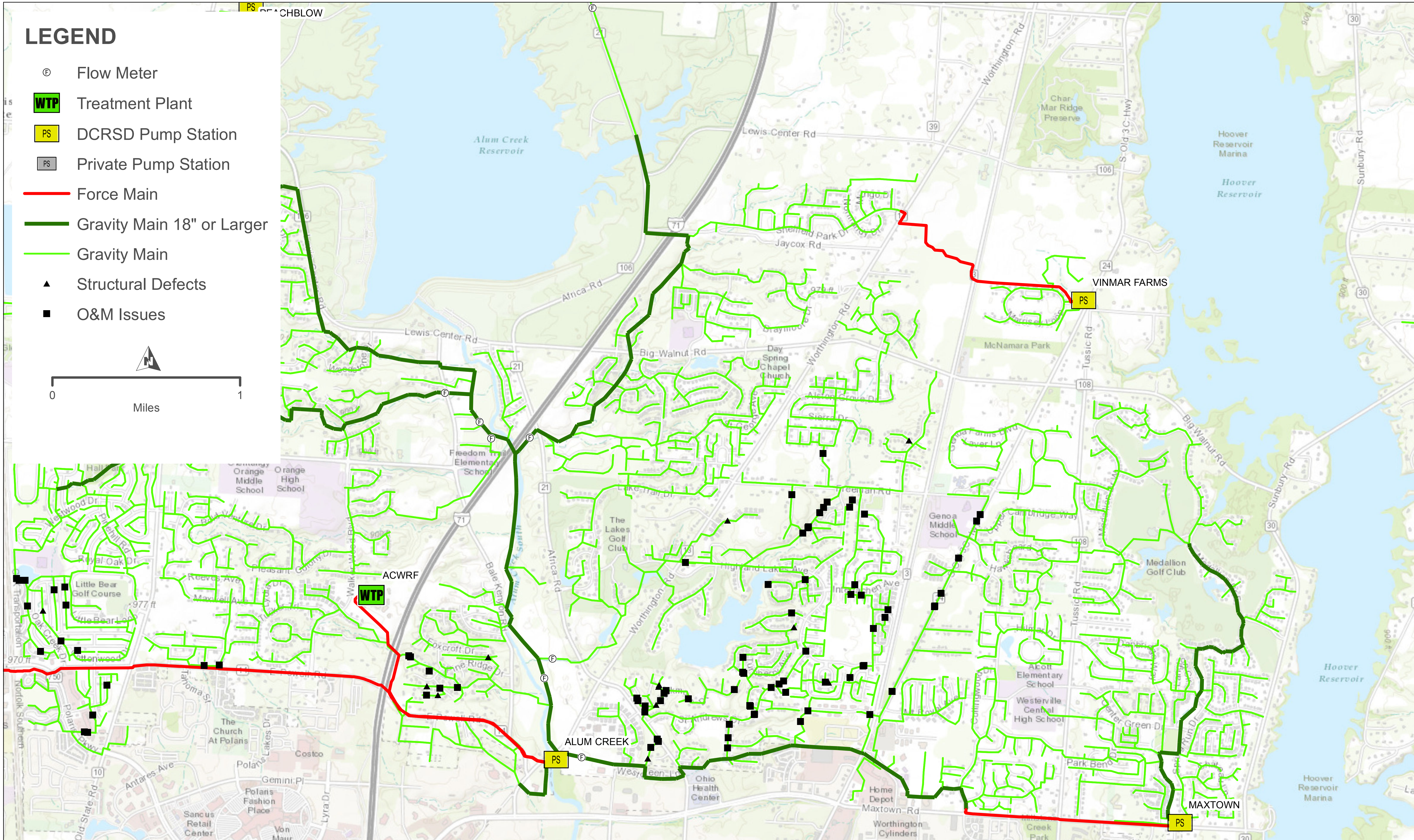
5.2.3 Collection System

CCTV inspection data for the ACWRF Basin (also performed and provided by DCRSD) includes 6,621 total observations. Among these, the number of observed O&M issues and structural defects were 99 and 13, respectively, which is considered normal for the age and condition of the sewers. In the ACWRF Basin, much of the recorded O&M issues are attributable to settled deposits, infiltration, and root intrusion and the structural defects are attributable to pipe cracking and joint offsets. The total number of O&M issues and structural defects do not include multiple observations of the same code for the same sewer line. The locations of observed O&M issues and structural defects are illustrated in Figure 14.

Following analysis of the "Existing Infrastructure" hydraulic model of the ACWRF Basin at the target level of service, the following sewers with capacity limitations (less than 6 feet of freeboard in connected manholes and/or operating at 75% capacity) were identified using a 25-year design storm:

- Sewer 1: Portions of the 8 inch sewer on Old 3C Highway.
- Sewer 2: 12 inch sewer that runs along Pinewild Drive.
- Sewer 3: 24 to 30 inch sewer along the Main Interceptor.
- Sewer 4: Along portions of the 18 inch sewer north of Orange Road, upstream of the Main Interceptor.

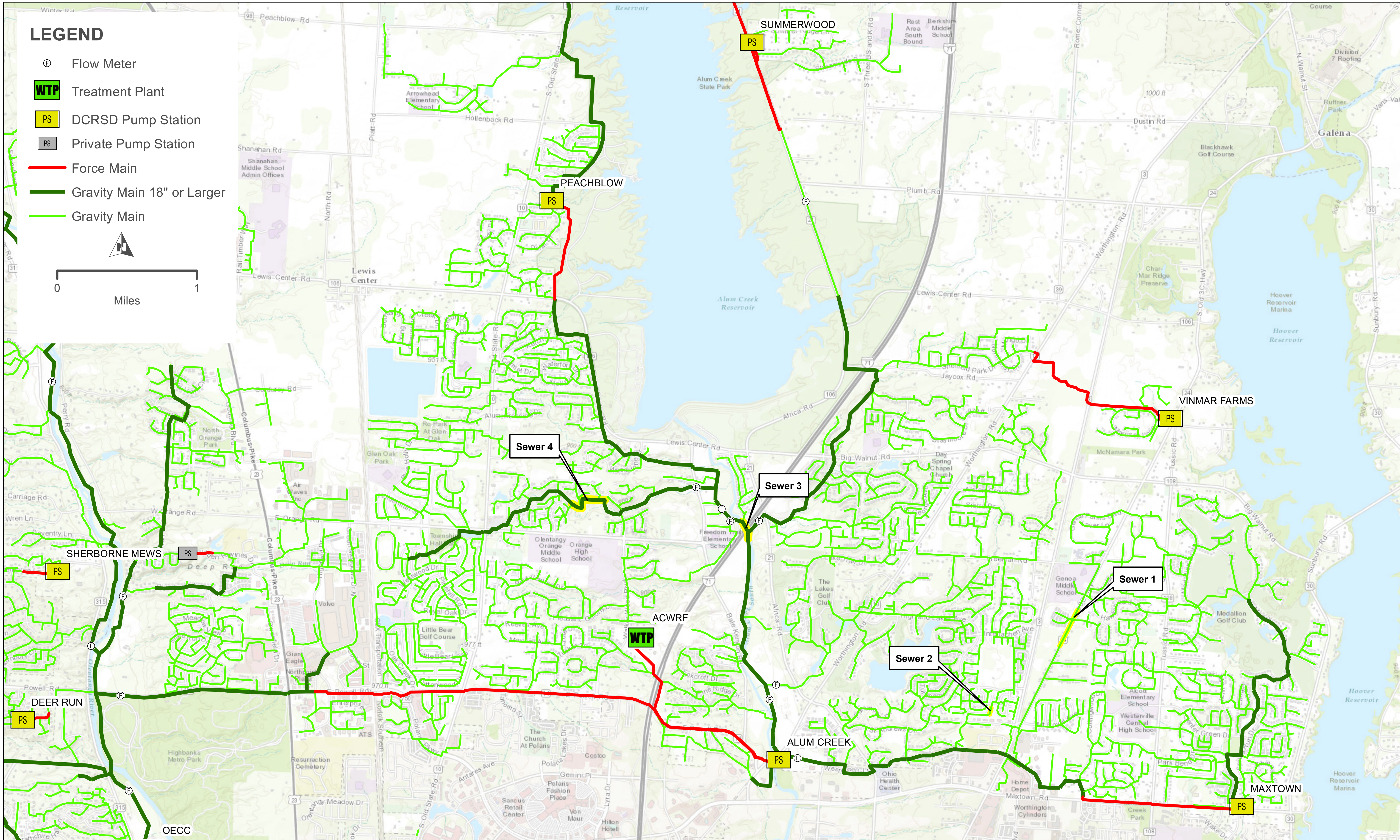
These addressed localized sewer capacity issues are illustrated on Figure 15 for reference. Specific capacity restrictions under varying scenarios can be found in the maps in Appendix B.



ACWRF BASIN SANITARY SEWER CCTV OBSERVATIONS

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN

FIGURE 14



ACWRF BASIN SANITARY SEWER 25-YEAR EVENT CAPACITY LIMITATIONS (EXISTING CONDITIONS)

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN

FIGURE 15

5.3 Other WRFs

The following seven WRFs make up the balance of the District's sanitary conveyance and treatment infrastructure. Information noted on condition and capacity of the facilities that serve these basins was provided by DCRSD, unless otherwise noted.

5.3.1 LSWRF WRF

LSWRF has been offline since construction was completed around 2008. Plant startup is expected in early 2018, during which all equipment will be assessed.

5.3.2 Northstar WRF

The facility is currently undergoing repairs for structural issues associated with the aeration and sludge holding tanks. During startup, all equipment will need to be assessed. A consultant has been hired to assist in the structural repairs and to assist with startup.

5.3.3 Scioto Hills WRF

Recent work at the facility includes upgrades to the motor control center (MCC), a new generator, and a new aeration blower. Pending safety and/or compliance reviews, updates, and issuances, the facility is not anticipated to require significant upgrades. The District believes the Scioto Hills collection system, which was installed in the 1970's, has significant sources of I/I.

5.3.4 Scioto Reserve WRF

A review and recommendations analysis of this facility is being performed by DCRSD. Anticipated process upgrades resulting from this analysis include new screens influent/effluent pumping, and aeration basin upgrades. The facility drive is not appropriately sized to accommodate tanker trucks for sludge disposal needs. The effluent filters are currently offline as they are not required to meet current effluent permit limits. The filters may need to be retrofitted or overhauled if effluent permit limits dictate.

The Scioto Reserve and Scioto Reserve North pump stations are located in the Scioto Reserve basin but only Scioto Reserve pump station was evaluated by the Master Plan project team. Features of this pump station are shown in Table 9. Observed and recorded average daily pump run time data suggests that the Scioto Reserve pump station is currently receiving inflows below its maximum capacity. The only major improvement that was identified for the pump station is the installation of fall protection (code) at the wet well access hatches. Pumping capacity and peak inflows resulting from a 25-year design storm were not modeled because this pump station is located outside the OECC and ACWRF basins.

Table 9. Scioto Reserve Basin Pump Station Features

Name	Total / Firm Pumping Capacity (MGD)[1]	Forcemain Size and Capacity in (MGD)	Notes
Scioto Reserve	0.73 / 0.32	4" – 0.45	Code upgrade needed

[1] Pump station capacity may differ significantly based on operating conditions.

5.3.5 Tartan Fields WRF

New tertiary filters and a new standby generator were recently installed. Equalization of the influent waste stream is an issue at the facility. It is noted that hydraulic problems occur throughout the entire process train and the facility cannot treat the current average design flow of 250,000 gpd. Another consultant is currently preparing an evaluation of this facility.

5.3.6 Bent Tree WRF

Elimination of this plant from service is being considered as part of the Berkshire Pump Station and Forcemain project. If the plant continues to stay in service, upgrades would be necessary for the MCC and generator.

5.3.7 Hoover Woods WRF

A determination of the long term service life of this facility will be needed to evaluate the potential for taking it offline. If the plant continues to stay in service, upgrades to the MCC would be necessary.

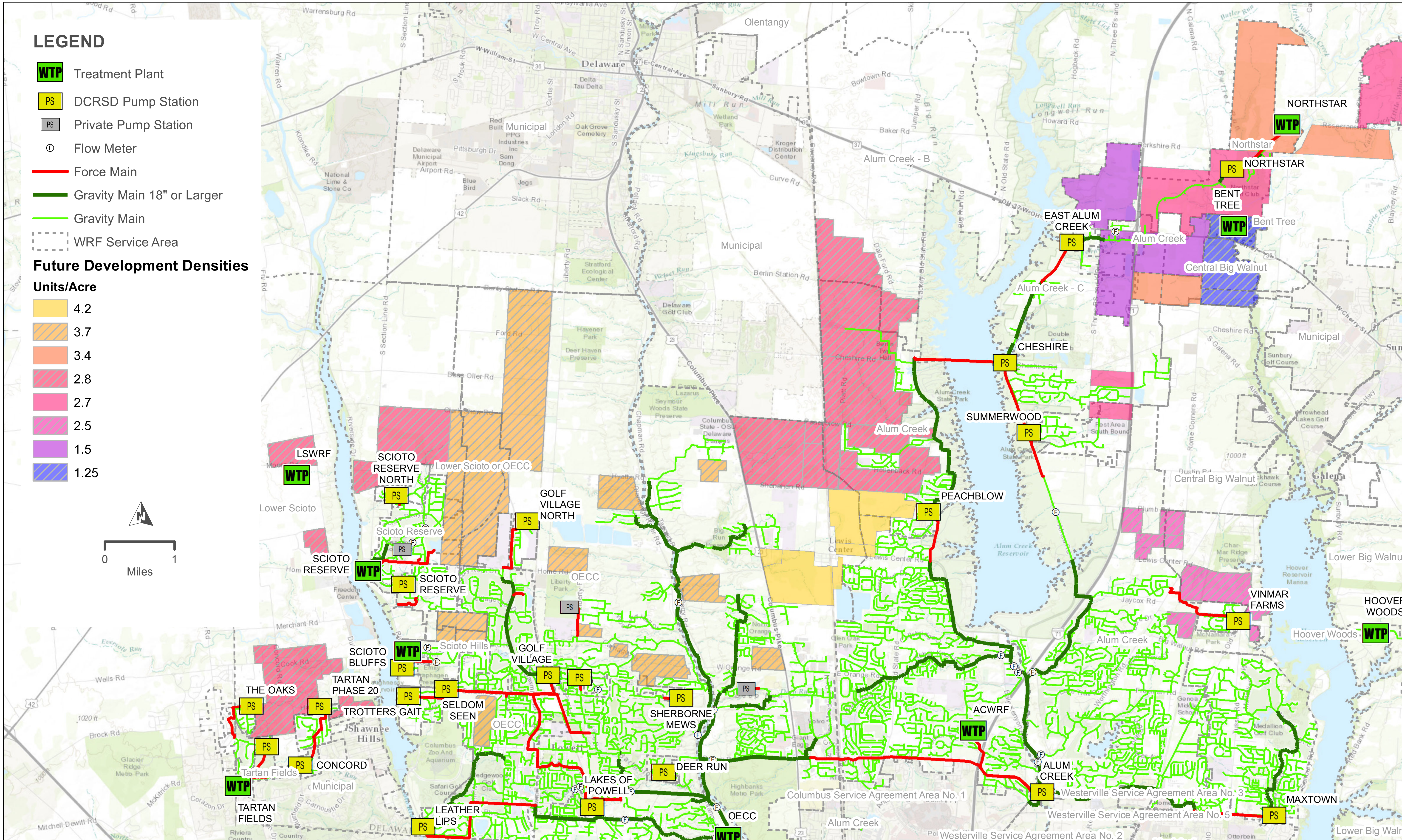
6.0 Future Conditions and Recommendations

This Master Plan evaluates the capacity of the existing DCRSD infrastructure based on current and projected future sanitary flow under the defined 25 Year level of service. Areas of projected growth were developed from stakeholder discussions or review of documents provided.

Generally, the DCRSD staff concluded that due to the rapid pace of development, it would be infeasible and impractical to accurately anticipate future infrastructure phasing beyond a planning horizon window of ten years. For the purpose of infrastructure sizing only (not for conveyance routing), ultimate build out was considered to better understand its long term impact to the DCRSD system and subsequent updates.

As a part of the evaluation, DCRSD determined that the existing treatment facility tributary basins would remain intact with the exception of potential new water reclamation facilities, if they enabled more cost-effective conveyance by gravity flow. The growth areas identified in the master plan do not represent all potential growth in the County, but rather serve to identify the most likely locations of development in areas that will impact the DCRSD system at this time. Going forward, conditions are likely to change which will require a review of the hydraulic model.

Projected flows were determined based on the anticipated density of the areas predicted to develop and wet weather peaking factors determined by the review of flow monitoring data. Future growth areas and assumed densities used in this evaluation are shown in Figure 16. The combination of the base dry weather flow and calculated peaking factors allowed for the identification of current and future capacity constraints detailed below. This section will briefly define the development areas, DCRSD projects currently in design or construction, and the flow contributions of each area. A summary table of the costs for each of these projects as well as the project numbers and necessary precursors can be found in Figure 27 and Tables 15 and 16.



FUTURE DEVELOPMENT DENSITY
DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN
FIGURE 16

6.1 OECC Basin Future Growth Areas

Future development was determined for the OECC service area based on discussions with the County and incorporation of input from Townships, planning documents and discussions with developers. Figure 16 in Section 6.0 shows the future development and densities that were assumed, in the OECC basin, and incorporated in the future conditions hydraulic model.

The OECC tributary area was evaluated for capacity needs based on future flow. It is notable that the following improvements (under design) were considered part of the future DCRSD collection system and modeled as existing infrastructure:

- The Liberty Sawmill Extension Phases 1 and 2 – This project will result in the elimination of the Golf Village North PS.
- Verona PS – PS is online and accepting flow from Trotters Gait area as well as the Verona subdivision. This project results in the transfer of the Trotters Gait tributary area from the Leather Lips PS to the Golf Village PS.
- Liberty Park PS – The pump station is online and contributing flow to the Woodland Hall area sewers.

The overall evaluation of the OECC was completed based on the specific basins and pump stations that showed current and future hydraulic limitation given the planned future development. Figure 27 shows the location of each of the proposed OECC basin projects.

6.2 OECC Basin Future Infrastructure Needs – Collection System

The model was simulated using the 25 year design event and assuming the above conditions to examine locations that were identified as problem areas. The results of the model simulation are discussed in greater detail in Technical Memorandum #3. The following sections discuss two specific locations that were identified as part of the hydraulic evaluation. Leatherlips Pump Station flow redirection and I/I reduction, and Golf Village Pump Station Relief Sewer.

6.2.1 Leatherlips Pump Station Service Area I/I Reduction (Project 7) and Seldom Seen Forcemain Redirection (Project 8)

Leatherlips PS (under existing conditions) was found to overflow within the 25-year design storm event. Although there is limited growth projected to occur within the tributary area, the current observed wet weather responses have indicated that the station is unable to handle wet weather flows during large events.

Construction of the Verona PS and redirection of flows from the Leatherlips basin to the Golf Village basin will reduce wet and dry weather flows to Leatherlips pump station. Additional flow from this pump station tributary area could be moved to the Verona PS tributary area with the construction of the Seldom Seen Forcemain Redirection project. The District should continue to mitigate the likelihood of flooding (due to hydraulic limitations) in wet weather by performing a Sanitary Sewer Evaluation Study (SSES). It is notable that a 50% I/I reduction would greatly reduce the projected overflow at Leatherlips PS (and eliminate it completely if Seldom Seen can be redirected to Golf Village at some point in the future). It is recommended that Closed Circuit TV (CCTV) and some additional field investigation are performed to identify if remedial action can be taken in these areas to address the high wet weather response observed at the pump station.

Upon completion of the Verona Pump Station and I/I evaluation, additional flow monitoring should be performed in this sub basin to determine the efficacy of the work done, as well as the magnitude of any remaining capacity problem. If the results of this study do not yield enough reduction in peak flows, additional options such as the redirection of the Seldom Seen PS to the Golf Village system or a Leatherlips PS or forcemain upgrade may be necessary.

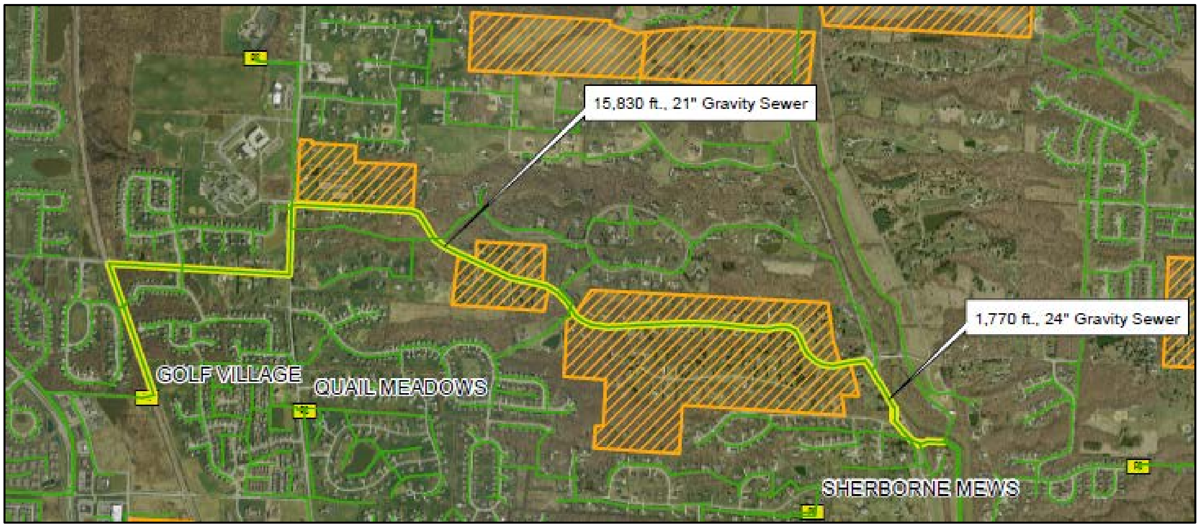
6.2.2 Golf Village Pump Station Relief Sewer (Project 30)

Under existing conditions, the peak flow to the Golf Village pump station exceeds the maximum capacity, causing the influent line to surcharge. Under proposed future conditions, the Golf Village North pump station (which currently pumps to the Golf Village PS) will be redirected to the Liberty Sawmill sewer while the Verona PS will be directed to the Golf Village PS. This results in a slight increase in peak flows, exacerbating the current surcharge condition and pushing the maximum HGL within a few feet of the ground surface along Sawmill Road, requiring improvements at Golf Village PS. The 18-inch main gravity line upstream of Golf Village PS surcharges nearly to the surface under the proposed 25-year conditions and there is some flooding along some of the tributary sewers at low-lying manholes.

To alleviate this flooding and reduce long term costs, it is recommended to eliminate the Golf Village Pump Station with a gravity sewer (which ultimately conveys flow to the OECC). The following are elements of the Golf Village relief gravity sewer shown in Figure 17:

- Remove Existing Pump Station and abandon forcemain.
- Install 15,830 LF of new 21-inch new sewer from Golf Village PS north to Rutherford Rd and then along Carriage Road to SR315 where it would connect to the Olentangy Trunk Sewer.
- Upsize 1,700 LF of 15-inch sewer to 24-inch sewer downstream of the connection to just south of Daventry Lane.
- Upsize 370 LF of 8-inch sewer to 24-inch sewer between SR315 and the 42-inch north/south sewer along the Olentangy River.

Figure 17. Golf Village PS Relief Sewer



The Golf Village Pump Station elimination will have the following impacts:

- The proposed gravity sewer offers **opportunities to redirect flow** from Seldom Seen PS to the Golf Village basin and potential development that is currently planned to be treated at Scioto Reserve WRF.
- Elimination of the Golf Village pump station (and therefore its forcemain discharge from the current outlet) would **enable additional flow to be received from the Powell area**. This would eliminate a restriction of the flows in the existing trunk sewer serving the downtown Powell area, enabling increased densities in the Powell area for redevelopment.
- **Sewer service to pockets of homes that are currently served by septic systems** (along Carriage Road and Wren Lane) could potentially be sewered with the installation of this gravity sewer.

Downstream of the Golf Village connection, there is some capacity available in the existing Olentangy River trunk sewer (prior to the addition of any future flows from the north). The 42-inch sewer is currently (assuming no growth) operating at 40% depth capacity, this will increase to 50% depth capacity with the Golf Village PS Elimination. The 36-inch sewer is currently (no growth) operating at 70% depth capacity, this will increase to 90% depth capacity. The most downstream sections of 42-inch sewer are currently (no growth) operating at 70-90% depth capacity, this will increase to 90-100% depth capacity.

This proposed elimination sewer in and of itself does not cause the Olentangy trunk sewer to require an upgrade, but it does utilize some of the remaining capacity, indicating that a parallel trunk sewer or replacement sewer will be necessary with the continued growth projected in the northern portions of the OECC basin.

6.2.3 US 23 Sewers (Project 33)

This project is intended to provide sewer service to an area bounded by US 23, Shanahan Road, Peachblow Road, and railroad tracks to the east. The project includes a new pump station of approximately 1.75 MGD at buildout with a new forcemain running west along the south side of Hyatts Road. This is an area of likely near term development as significant roadway improvements have been made recently, though full buildout of the new service area will be subject to the pace of development.

6.3 Additional OECC Basin Hydraulic Bottlenecks – Collection System

Across the OECC basin, there are some additional locations that hydraulic modeling revealed to have capacity limitations following the addition of the baseline improvements (Verona PS, Liberty Sawmill Extension), anticipated future growth, and the 25-year design storm event. These locations were analyzed and evaluated to determine any potential improvements that may be necessary in the near term. Additional flow monitoring on each of these sub areas is recommended prior to any improvements, however, if areas are likely to require improvements due to growth, the anticipated improvements have been identified.

Figure 18 Trotters Gait Surcharge Area

6.3.1 Olentangy Crossing Trunk Sewer

A section of the Olentangy Crossing Trunk Sewer is a 10-inch diameter sewer between sections of 15-inch and 21-inch diameter sewer. With future growth projected to occur upstream, the 10-inch section of sewer is shown to be undersized (in future conditions) and causes a backup to occur during the 25-year design storm. Though this location does not have any current issues, upsizing is recommended along this length of pipe to eliminate the bottleneck and accommodate the anticipated long-term growth. It is recommended that this improvement install approximately 360-ft of 21-inch diameter sewer in the place of the existing 10 and 15-inch segments when additional upstream development occurs. No improvements are recommended without additional flow monitoring in this area.

6.3.2 Trotters Gait Pump Station

In the 25-year design storm, the Trotters Gait Pump Station shows an upstream surcharge that could cause potential basement backup issues as the hydraulic grade line is within the range where basements are typically located. Figure 18 shows the plan view of the sewer upstream of the pump station illustrating the backup in the event. Prior to any improvements at this location, it is recommended that DCRSD monitor the flows at the pump station to confirm the precise magnitude of the capacity limitations prior to recommending any projects.

6.3.3 Woodland Hall Sewer (Project 18)

The sewer along Woodland Hall Drive shows significant surcharge in both the 10-inch and 8-inch diameter sections during the modeled 25-year design storm. It is recommended that this area be flow monitored in more detail moving forward to ensure that it is appropriately represented in the model, particularly as the Liberty Park PS upstream adds flow to the area. Upon completion of the more targeted flow monitoring, there may be expansions suggested by the model, however no immediate improvements are recommended in the short term. If faster than anticipated development occurs in the Liberty Park area, these improvements could be accelerated. This project is identified as a Long Term improvement. This can be seen in Figure 27.

6.3.4 Olentangy/Wingate/White Oak Sewer (Project 15)

In the 25-year design storm, the sewer along Wingate Dr. is shown to surcharge along its entire length. This area had no local flow monitoring conducted and there is not likely to be much development tributary to this sewer. It is recommended that this area be monitored going forward to ensure that it is appropriately represented in the model. Upon completion of the additional monitoring and verification of the results, the project listed in as a short term project may be necessary as shown in Figure 27. No improvements are recommended without additional investigation.

6.3.5 Sherborne Mews Pump Station

In the 25-year design storm, the Sherborne Mews Pump Station shows an upstream surcharge that could cause potential basement backup issues. This area is not projected to have substantial future growth and it nearly meets the 25 Year LOS as currently modeled. Prior to any action at this location, it would be recommended to monitor the pump station and update the model with more localized data to confirm the potential for capacity limitations. No improvements are recommended at this time.

6.3.6 The Retreat Sewer

In the 25-year design storm, a portion of the Retreat Sewer is shown to surcharge along the length. Figure 19 shows the plan view of this sewer with the red areas indicating the segments with modeled surcharging. This area did not have any local flow monitoring conducted and there is not likely to be much development tributary to this line. This area should be included in future flow monitoring to ensure that it is appropriately represented in the model. No improvements are recommended at this time.

Figure 19. Retreat Sewer Surcharge Area

6.3.7 Olentangy River Trunk Sewer Parallel Relief Sewer (Project 31)

Flows in the Olentangy Trunk sewer were reviewed to determine the potential need for any increased trunk sewer conveyance. It was determined that under existing conditions and with the addition of the Liberty Sawmill extension, available capacity remains. Under the future growth scenario that was modeled, it is likely improvements will eventually be required to the trunk sewer; however, those may have to be evaluated under full build out conditions to ensure that any relief sewer is appropriately sized. It is recommended that the County monitor the flows in the main trunk sewer as new connections come online to identify the need and timing of potential upgrades. The preliminary investigation into the need to upsize this sewer or provide a parallel relief sewer is identified as a Short Term project.

6.3.8 Liberty Sawmill Sewer, Phases 1 and 2 (Projects 23 and 24)

The Liberty Sawmill Sewers, Phases 1 and 2 are two phases of a relief sewer intended to eliminate Golf Village North PS and provide additional gravity sewer capacity in the area between Liberty and Sawmill Roads, north of Home Road. The first phase of this sewer is already in design and will convey flow east, connecting to existing gravity sewers in the Nelson Farms subdivision. Phase 2 of this sewer will continue west from the proposed terminus of the Phase 1 sewer and include additional areas along Sawmill Road.

6.4 OECC Basin – Future Infrastructure Needs – WRF

Capacity constraints are most clearly identified within OECC at the headworks. While large flows are regularly handled at OECC, the influent wet well frequently surcharges to varying degrees indicating that the influent pumping cannot keep up with the incoming flow. By allowing the additional flow to be stored in the influent gravity sewer upstream of the pump station, the existing system configuration acts as a damper on high – but infrequent – peak flows. Unfortunately in the more extreme cases, the disparity between incoming sewage flows and pumping capacity can lead to surcharging in the wet well more than what would be considered acceptable. Once influent flows have backed up in the wet well to the extent that they are able bypass the raw sewage grinders (which allows larger debris to reach the pumps and other downstream unit processes), it is no longer operating at an acceptable level.

6.4.1 OECC Facilities Study (Project 1)

The OECC Facilities Study is proposed in recognition of the fact that the facility is recommended to have a number of significant projects developed to modernize or expand capacity at the plant. In order to ensure that all future improvements are appropriately sized and using the same set of assumptions, a total Facility Plan for the OECC is recommended prior to the initiation of any other significant design work at the OECC.

6.4.2 OECC Headworks (Project 12)

In order to handle the flow generated by a 25-year design storm of approximately 26 MGD, the existing influent pump station is proposed to be upsized. Due to the age and size of the existing pump station as well as the desire to remove more debris than can currently be captured prior to the influent pumps, a new influent pump station, sized at a firm capacity of 26 MGD is proposed. It will require new pumps capable of matching the existing dry weather and wet weather flows and should be expandable to accept increased flows as Liberty Township continues to develop along the new Sawmill Parkway. The new headworks will also replace the raw sewage grinders with grit removal and screening. This will lead to significantly less ragging in the pumps, downstream mixers, and solids handling equipment as well as reduce the wear from grit and its associated accumulation in the aeration tanks and channels. The type and specific sizing of the equipment will be determined upon the completion of the OECC Facility Study (Project 1). The sanitary flows projected in the Master Plan and 25 Year Level of Service indicate that this project will be required within the 1-5 year Early Action window.

6.4.3 OECC South Aeration Upgrades (Project 16)

Aeration Upgrades for OECC South are proposed to maximize the ability of plant staff to utilize their existing tankage while also providing the capability to provide better control of their blower usage. This will also provide the ability to better react to changes in NPDES nutrient removal requirements moving forward as the over aeration can hamper Biological Nutrient Removal. Nutrient removal efficiencies will also be improved with the added control of sidestream flows originating from the solids handling processes. Proposed improvements include new turbo blowers, fine bubble diffusers, piping, and valving for more precise and efficient transfer of oxygen to the wastewater. This project will include new baffles and mixers for the tanks as well as VFDs on the RAS pumps, which will allow for better flow control to respond to varying conditions. As there have not yet been changes to NPDES permit requiring additional nutrient control, and because the existing system is currently capable of meeting the permit, this project is designated as a long-term project. Significant changes to the discharge permit during the next renewal cycle however may cause this project to be brought forward.

6.4.4 OECC North Plant Rehabilitation (Project 25)

The OECC North Plant Rehabilitation project will include a thorough evaluation and the rehabilitation or renovation of the “original” northern train of OECC. This part of the facility was originally designed to treat an average flow of 1.5 MGD but has been offline for over 20 years and will require restoration to the concrete tankage as well as new valves, pipes, air diffusers and piping, RAS pumps, mixers, and baffles. In addition, the clarifier equipment will also need to be replaced as well as various gates and sludge collection equipment. The new equipment will need to be connected to the existing SCADA system and will require integration of new equipment into recently updated MCCs and PLCs and replacement of wiring that has not yet been upgraded as part of recent electrical improvements. Due to the anticipated increases in flow to the OECC facility and the current utilization of the facility, this project is designated as a short-term project.

6.4.5 OECC Filter Upgrades (Project 17)

At the OECC, the OEPA is currently allowing for partial filter bypass as long as effluent limits are still being met, sampling results demonstrate this, and the bypass is done to ensure efficient operation. During “automatic” bypass (v-notch weir inside the filter building) events, sampling at the outfall is required to ensure effluent limits are being met. Absent the current OEPA allowance, OECC can only route flow around the filter building, through a bypass pipe, during filter and UV maintenance and the bypass must be agreed upon in advance by the OEPA. Increases in flow, solids loading, or changes to the facility NPDES permit would require the Filter Upgrade project to be undertaken sooner than anticipated. At this time no specific replacement technology has been selected, as the filters would not need to be utilized if replaced in the short term (due to the current OEPA bypass allowance). This is subject to change in the future however, particularly as flow or loading increases. This has been designated as a long-term project.

6.4.6 OECC Dewatering Improvements (Project 10)

Dewatering at the OECC currently entails thickening and dewatering via a single centrifuge prior to removal and disposal via truck. This operation has some challenges based on the grit and rag content of the sludge as well as operational issues involving the amount of time necessary to fill a single load. The County desires a more efficient operation of this unit process and an additional centrifuge is therefore recommended. It is also recommended that sludge screens be installed if the proposed plant headworks project cannot be constructed within a suitable timeframe to otherwise protect the centrifuges. The addition of the new headworks with grit removal and screening should make the solids flow moving to the centrifuge more consistent with less deleterious effects on the solids handling operation.

6.4.7 OECC Cake Storage Improvements (Project 11)

Additional sludge cake storage is necessary at the OECC in order to meet the preferred operating conditions of the plant staff under existing flows and equipment. A sludge cake holding building and associated appurtenances and odor control via a bio filter will allow for sludge cake to be stored on site reducing the frequency it must be hauled to a landfill offsite for disposal.

6.4.8 System Arc Flash Study (Project 2)

An arc flash hazard exists whenever qualified personnel are servicing electrical equipment while it's still in its energized state. While it is preferred to de-energize equipment prior to servicing, occasionally it is necessary for qualified personnel to work within energized equipment. The arc flash study will provide the calculated arc flash hazard of the particular equipment and will provide labels for the use of qualified maintenance personnel in determining the proper protective equipment to wear.

6.4.9 WRF Electrical and I&C Improvements (Project 13)

Numerous electrical and instrumentation and control equipment has reached the end of their useful lives. Affected electrical equipment include motors, transformers, VFDs, and MCCs. Affected I&C components include programmable logic controllers, and SCADA system hardware and software. In addition to equipment replacement, several improvements to the District's I&C system were also identified including cyber security, disaster recovery, control system documentation.

6.5 OECC Basin Project Prioritization and Implementation

Table 10 indicates the projects recommended for the OECC basin as well as their proposed categorization and justification.

Table 10. Proposed Early Action and Short Term OECC Basin Improvements

Project Number[1]	Project Description	Justification	Timeline
7	Leatherlips Pump Station Service Area I/I Reduction	The existing pump station shows a capacity limitation but the tributary area is shown to have significant I/I, making this a candidate for upstream rehabilitation and I/I mitigation activities.	Early Action (1-5 Years)
1	OECC Facility Study	The project is necessary to ensure that all upgrades at the OECC are coordinated and are sized appropriately.	Early Action (1-5 Years)
10	OECC Dewatering Improvements	This project will reduce the overall volume of sludge that must be disposed of, reducing costs.	Early Action (1-5 Years)
11	OECC Cake Storage Improvements	This improvement will allow for increased storage of dewatered sludge allowing for lower shipping costs and better operational flexibility.	Early Action (1-5 Years)
12	OECC Headworks	Existing headworks is undersized for larger storms under current conditions. Under future conditions, the wetwell and pumping will be even more undersized.	Early Action (1-5 Years)

30	Golf Village Pump Station Relief Sewer	The existing Golf Village PS is undersized in the 25-year event and is projected to get worse in the future.	Short-Term (5-10 Years)
31	Olentangy River Trunk Sewer Parallel Relief Sewer	Given the long-term future growth, the Olentangy Trunk Sewer is required to have a capacity increase for significant portions of the sewer.	Short-Term (5-10 Years)
25	OECC North Plant Rehabilitation	Renovating and restarting the North Train at OECC will provide additional hydraulic and biological capacity for future flow.	Short-Term (5-10 Years)

[1]Project number refers to project cost schedule on page 78.

Long Term Projects in this basin but not contained within in the above table include Aeration and Filter Upgrades at OECC (#3), the Olentangy/Wingate/White Oak Sanitary Sewer (#15), and the Woodland Hall Sewer Upsizing (#18).

6.6 ACWRF Basin Future Growth Areas

Future development was determined for the Alum Creek Water Reclamation Facility service area based on discussions with the County and incorporation of input from townships, planning documents and discussions with developers.

Figure 16 in Section 6.0 shows the future development that is anticipated to occur in the ACWRF basin, and incorporated into the "future conditions" hydraulic model of the ACWRF Basin.

The Alum Creek Water Reclamation Facility and its tributary collection system was evaluated to identify the location of potential capacity deficiencies expected in the basin based on the planned future development. Based on discussions with the County, the Maxtown PS upgrade project will be considered part of existing infrastructure for the purpose of modeling, although they are still under construction at the time of model development. Figure 27 shows the location of each of the proposed ACWRF basin projects.

6.7 ACWRF Basin – Future Infrastructure Needs – Collection System

Recommendations in this basin, the most dynamic DCRSD development area, hinge on the central premise that construction of a new treatment plant will alleviate certain significant hydraulic, construction, and cost challenges. Therefore, all recommendations were modeled and presented with the inclusion of this project, the Central Alum Creek WRF. A brief discussion is presented in Section 6.7.1 followed by a more detailed one in Section 6.9.

6.7.1 Central Alum Creek WRF (Project 27)

A new Water Reclamation Facility, located on the north side of the Alum Creek Lake, south of Rt. 36/37 and referred to as the Central Alum Creek Water Reclamation Facility, is considered an integral component of future planning. This is due to the significant growth anticipated on the north side of Alum Creek Lake as well as significant capacity constraints of the existing conveyance assets all the way down to the ACWRF. Due to the anticipated need for additional conveyance or treatment capacity for both near and long-term growth in the ACWRF basin as well as additional growth along the Rt. 36/37 corridor, the location of a new regional WRF on the north side of the Alum Creek Lake is seen as a logical location for an additional regional water reclamation facility to service the growth. This was seen as more viable over the long term than providing significant upgrades to nearly every segment of the collection system between the location of the new growth and the existing ACWRF located in central Orange Township. This facility is discussed further in Section 6.9.

The long-term discharge of the existing East Alum Creek PS could be relocated to the new Central Alum Creek WRF. A new forcemain from an upsized East Alum Creek PS will be required to handle anticipated future growth regardless of the outlet location.

A new pump station, referred to as West Alum Creek Pump Station, is planned for the west side of Alum Creek Lake, near the intersection of Cheshire Rd. and Old State Road. This pump station is intended to convey sewage generated from new and existing development north of Cheshire Road and west of the Alum Creek Lake to the new Central Alum Creek WRF.

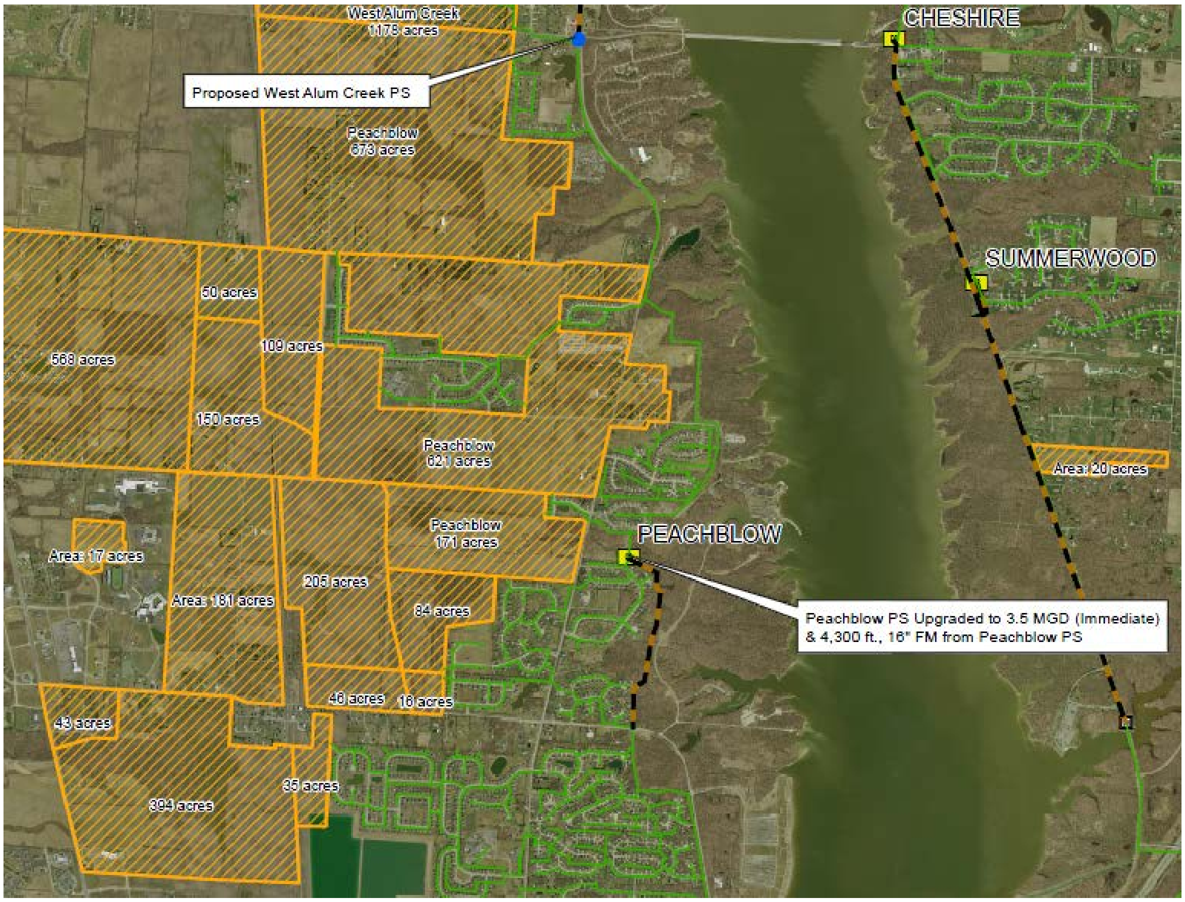
6.7.2 Berkshire Township Pump Station (Project 32)

A new pump station (Berkshire PS) located south of the Bent Tree Golf Course and within Berkshire Township is proposed to address local flows, allow for the removal of the Bent Tree treatment facility, and redirect flows into the East Alum Creek system. This facility would serve a large area south of the Rt.36/37 corridor, east of I-71, and west of Sunbury. This facility and the collection system tributary to it will need to be coordinated with plans developed by the villages of Sunbury and Galena to ensure there is no unnecessary duplication of service.

6.7.3 Peachblow Pump Station Early Action Upgrade (Project 19) and West Alum Creek Pump Station (Project 26)

The current peak inflow to the Peachblow Pump Station is approximately 3.0 MGD, but the station is only capable of pumping a maximum flow of 0.9 MGD, which is causing a backup upstream of the pump station under wet weather conditions. This backup results in the influent sewer experiencing significant surcharge, though it is not currently projected to overflow (due to its depth and the length of upstream surcharge). In addition to the current capacity issues, there is a substantial area anticipated to be tributary to Peachblow Pump Station that is likely to grow in the near term. The current tributary acreage for Peachblow Pump Station (see Figure 20) is approximately 500 acres with approximately 3,250 acres planned for possible future development. Long-term future flows are likely to create significant additional problems at Peachblow, with peaks in excess of both the proposed pump station as well as a number of downstream sewers. To address all of the projected future flows, some sanitary flows will need to be directed away from Peachblow while also upsizing the existing Peachblow PS to send part of the additional flows downstream. This plan will maximize the capacity of the Peachblow Pump Station and existing sewers in the near term, while also maintaining flexibility for longer-term growth.

Figure 20. Peachblow PS Upgrade



As part of a long-term plan for the area west of Alum Creek Lake, it is recommended to split the existing area tributary to Peachblow Pump Station and redirect flow from an area north of the Peachblow Pump Station to the proposed Central Alum Creek WRF. This will be done through the construction of a new West Alum Creek Pump Station, located near the intersection of Cheshire and Old State Roads. Given the potential long-term build out of this area, the recommended maximum capacity of this new pump station would be approximately 3.9 MGD, which would handle the current and 25-year future growth flows in this area. The area that would be available for future growth tributary to this new pump station is approximately 1,240 acres.

The proposed West Alum Creek PS project relieves the Peachblow Pump Station of these acres of tributary area preserving its capacity for anticipated development closer to the southern end of the lake. To direct flow from the new West Alum Creek Pump Station to the new Central Alum Creek WRF, a new forcemain would be required. The approximate length and size of the new forcemain is 12,200 L.F. and 16 inches, respectively which allows for a range of future capacity increases to the Peachblow PS up to 6.6 MGD. The size of the forcemain is based on the velocity in the forcemain being approximately 5 feet per second (fps) at the maximum planned flow. Some additional local sewer improvements in the vicinity of the new pump station may be required as well, but will be dependent on specific development locations.

Prior to the completion of the West Alum Creek Pump Station, an interim solution to increase the local capacity of Peachblow PS while limiting the potential for downstream flooding in the 21-inch trunk sewer is proposed to upgrade the pump station to a larger maximum capacity that would not overload the downstream sewer. The maximum capacity for Peachblow PS (without causing an issue in the 21-inch trunk sewer) is approximately 3.5 MGD capacity. At this capacity, the Peachblow pump station can meet current peak flows (approximately 3.0 MGD) and would allow for some additional connections upstream of Peachblow PS until the West Alum Creek PS and Central Alum Creek WRF were constructed. In the 21-inch sewer downstream of the forcemain discharge, there would be no flooding or surcharging due to local hydraulic restrictions.

6.7.4 Peachblow PS Long-Term Upgrade (Project 35)

Predicted station inflows, with construction of the West Alum Creek PS completed, are estimated at 6.6 MGD (25-year design storm under future growth conditions). This exceeds Peachblow's capacity. To handle this higher wet weather flow, both the pump station and forcemain will need to be upsized.

6.7.5 Peachblow Gravity Sewer Upsizing (Project 34)

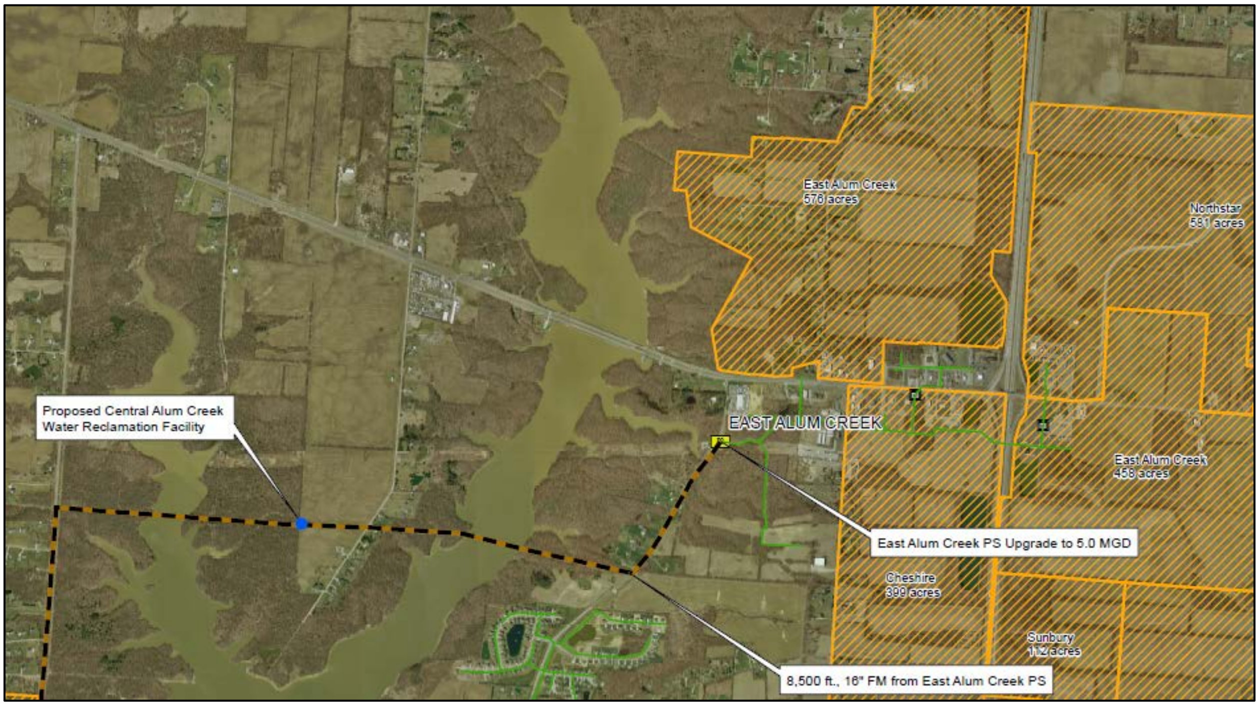
To convey the increased flow resulting from the Peachblow PS Long-Term Upgrade project, the downstream gravity sewer in which the pump station discharges will need to be upgraded. This includes upsizing approximately 11,500 feet of 21-inch pipe to 30-inch sewer from the forcemain discharge to the start of the existing 30-inch sewer.

6.7.6 East Alum Creek Pump Station Upgrade (Project 29)

Under existing conditions, the peak flow to the East Alum Creek pump station is approximately 0.5 MGD in the 25-year, 24-hour design event. The existing pump station has the capacity to handle current flows without significant upstream surcharging. Without considering the downstream limitations of Cheshire PS (which accepts all flow from the East Alum Creek tributary area via the East Alum Creek PS and forcemain), East Alum Creek would have the ability to accept approximately 600 more single family housing units before it would need to be upsized.

Downstream capacity constraints of the Cheshire PS however, reduce the overall availability for near term development in the Cheshire/East Alum Creek tributary area to essentially zero. There is a substantial amount of future development that is projected to occur within the East Alum Creek PS tributary area. The future growth upstream of the East Alum Creek will eventually increase the maximum flow in the 25-year design event from 0.5 MGD to 5 MGD as the area builds out. Therefore, it is recommended to redirect the flow from its current discharge point (in the trunk sewer tributary to the Cheshire PS) to the proposed Central Alum Creek WRF, and upsize the pump station capacity to 5 MGD as flow increases in the system demand. To serve a 5 MGD pump station, a new forcemain would be constructed that would convey flow from the upgraded pump station to the Central Alum Creek WRF; the approximate length and size of forcemain from East Alum Creek to Central Alum WRF would be 8,500 L.F. and 16-inch diameter, respectively. Figure 21 shows the recommended changes to the East Alum Creek PS and forcemain.

Figure 21. East Alum Creek PS Upgrade



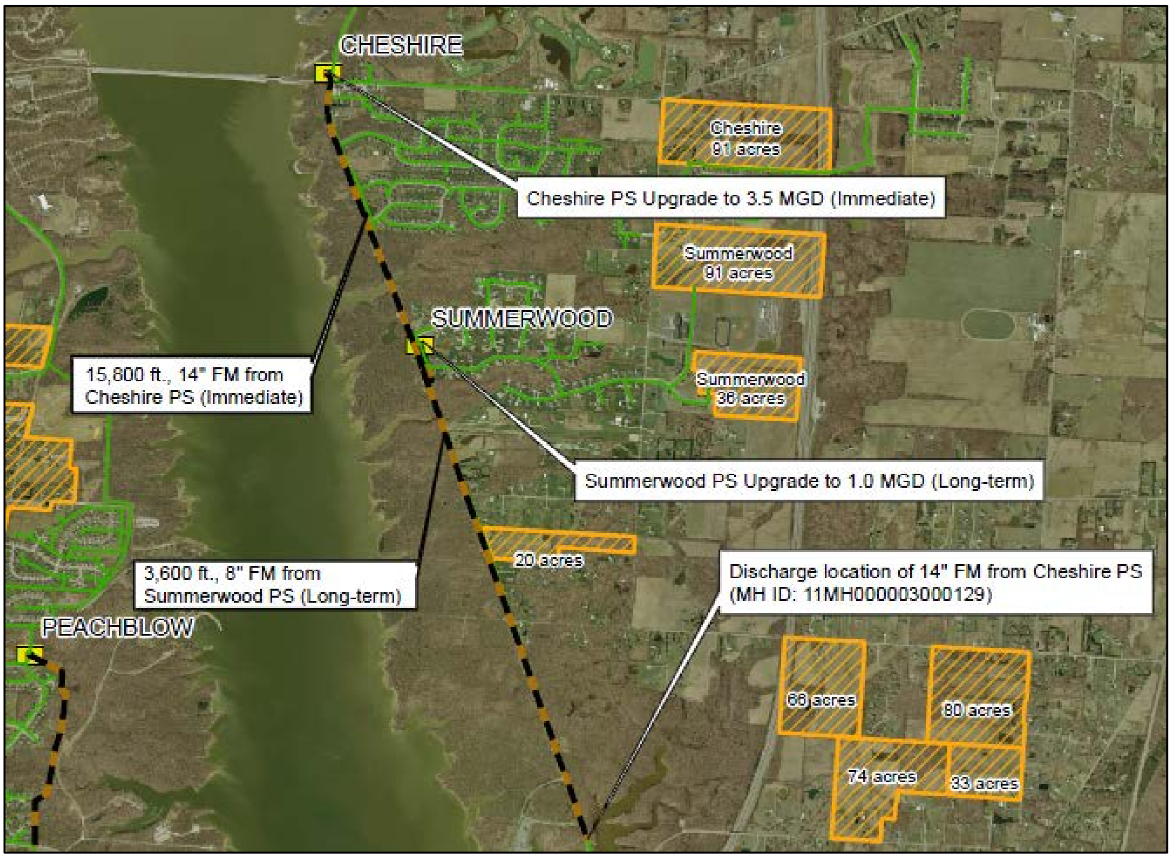
6.7.7 Cheshire (Project 21) and Summerwood (Project 28) Pump Station Upgrades

After considering the existing and anticipated future flows for the areas upstream of both the Cheshire and Summerwood pump stations, it was determined that both pump stations need to be upgraded to meet existing and future flows. Figure 22 shows the recommended upgrades to the Cheshire and Summerwood pump station and forcemain.

The peak flow for Cheshire PS under existing conditions and the 24-hour 25 year design storm is 2.0 MGD, which is above the 1.1 MGD the pump station is currently able to pump. This currently causes a backup upstream of the pump station and surcharge along the influent sewers during large rainfall events. This matches what is observed by DCRSD staff when they set up additional pumping at this station during more extreme events. To help address anticipated flows associated with significant growth upstream of Cheshire PS, the proposed redirection of the East Alum Creek PS to the Central Alum Creek WRF is recommended. This would remove some existing upstream tributary area from the Cheshire basin while also eliminating a large area of future growth from Cheshire PS.

If the redirection of the East Alum Creek PS is completed, the peak flow in the 25-year design event under future conditions for the remaining area is 3.5 MGD. Therefore, it is recommended to upgrade the existing Cheshire pump station to 3.5 MGD capacity to meet capacity of both current and future flows. In order for the downstream forcemain to handle this additional flow from a 3.5 MGD Pump Station, it will need to be upsized to 14-inches up from the existing 10-inch. It is also recommended that the forcemain outlet be changed from its current location at the 15-inch sewer to MH 11MH000003000129, which is the start of the 21-inch sewer. This would require that the new 14-inch forcemain extend approximately 15,800 feet south from the upgraded Cheshire Pump Station.

Figure 22. Cheshire PS Area Projects



In addition to upgrading and upsizing the Cheshire pump station and forcemain, respectively, it is also recommended to upgrade and upsize the Summerwood pump station and forcemain to handle future growth within the Summerwood tributary area. Currently, the pump station is pumping 0.6 MGD. The anticipated future growth flow contributions increase the peak flow in the 25-year design event to 1.0 MGD, which causes flooding to be modeled upstream of the pump station. It is recommended to increase the pump station capacity to 1.0 MGD and upsize the existing forcemain from 6 inches to 8 inches in diameter. This project is dependent on local connections upstream of Summerwood PS and could be coordinated with the timing of specific development with any upgrades to the station being contingent upon new units being added in the upstream tributary area. Based on current estimates, approximately 150 additional single family units could be constructed within the Summerwood basin prior to the upgrade being necessary.

6.7.8 Lower Alum Creek Relief Pump Station (Project 22)

One of the major hydraulic bottlenecks identified in the existing system is located along the Alum Creek Trunk Sewer, at the location where the Oak Creek trunk sewer meets the Alum Creek Trunk Sewer. Both the hydraulic model and DCRSD staff have identified this site as a current bottleneck. This can be seen in the ACWRF hydraulic model outputs in Appendix B. Both the 24-inch sewer and the 30-inch sewer in this area are shown to be out of capacity in major storm events when any upsizing of the Peachblow PS is included. Any upstream improvements or future growth, including the upsizing of Peachblow PS (even without additional growth to go with it), would exacerbate the capacity issue in the Alum Creek Trunk Sewer and may result in local flooding or potential basement backups due to the short vertical distance between the sewer and basements south of the Alum Creek dam. Figure 17 summarizes the recommended improvements for the Lower Alum Creek Relief PS and potential forcemain alignment.

To address the capacity issue, two possible options were identified:

- Increase conveyance to the Alum Creek Pump Station through the construction of a parallel relief sewer or upsizing of the current trunk sewer. This would result in approximately 9000' of 30-inch to 36-inch new trunk sewer or upsizing the existing trunk sewer for approximately the same length.
- Construct a Relief Pump Station near the intersection of the 18-inch Oak Creek Trunk Sewer and the 24-inch Alum Creek Trunk Sewer that would direct flow directly to the Alum Creek WRF through a new forcemain.

The Relief Pump Station was selected due to the flexibility it provides for additional growth as well as the easier construction versus a considerable length of gravity sewer though a developed area. This new pump station would enable sewage flows from the east side of Alum Creek Lake to continue to increase from additional development without causing further capacity issues on the trunk sewer.

Three locations for the new relief pump station were evaluated: north of the Oak Creek trunk sewer along the main Alum Creek Trunk Sewer, along the Oak Creek trunk sewer west of the Alum Creek Trunk Sewer, and south of the confluence of the Oak Creek trunk sewer and Alum Creek Trunk Sewer. Under wet weather conditions (25 year design storm) and future growth flows on both sides of the lake (including the upsized Peachblow PS, forcemain, and gravity sewer), the location south of the Oak Creek trunk sewer is recommended so as not to cause flooding along the Alum Creek trunk line. The recommended capacity of the new relief pump station is 11 MGD. The recommended forcemain length to reach the Alum Creek WRF is approximately 9,500 L.F. which would keep the forcemain within existing Right of Way. The recommended diameter given the projected forcemain flow and velocities is 24-inch however this sizing would need to be confirmed during the design of the pump station and force main.

6.8 ACWRF Basin – Future Infrastructure Needs – WRF

The Alum Creek Water Reclamation Facility (ACWRF) generally requires fewer improvements and upgrades compared to the OECC, which is in line with what should be expected from a newer facility. However, the facility is overloaded biologically (compared to the design conditions). Because the facility still has hydraulic capacity available, the biological overload has not become a significant issue (current peaks are around 14 MGD with 26 MGD capacity), but as the flows to the plant increase toward the anticipated buildout conditions, it is anticipated that BOD and TSS removal will become a concern before the hydraulic limits are reached. The two projects recommended are both related to existing reliability and flexibility of existing systems.

The first project is proposed to assist in maximizing the capabilities of the activated sludge system as indicated by a recent evaluation commissioned by DCRSD. The recommended improvements include new blowers, fine bubble diffusers, air piping, valves, and mixers.

The second major project is for the installation of a new grit removal system which the facility does not currently have. Grit accumulation was discussed in staff interviews and noted upon inspection in the aeration tanks and various channels within the plant. The grit removal improvements will bring the facility in line with most other major treatment works, will help maximize tank space, protect the diffusers, and prolong the life of mechanical equipment in the wet stream including pumps and mixers. This project has been identified as a short-term project. Prior to the design of this project, an evaluation of the sources of grit should be performed to ensure that filter backwashing is not causing filter media to recycle to the head of the plant.

6.8.1 System Arc Flash Study (Project 2)

Refer to Section 6.4.8 for a discussion related to the System Arc Flash Study project. This project applies to both ACWRF and OECC.

6.8.2 WRF Electrical and I&C Improvements (Project 13)

Refer to Section 6.4.9 for a discussion related to the WRF Electrical and I&C Improvements project. This project applies to both ACWRF and OECC.

6.8.3 ACWRF Dewatering Improvements (Project 9)

Dewatering improvements at ACWRF will allow for more efficient operation of the facility and solids handling system. The improvements include construction of a new sludge centrifuge at ACWRF that will allow for fewer dry tons of solids to be disposed at the landfill.

6.8.4 ACWRF Mixer and Aeration Study (Project 3)

This project will add new mixers, blowers, air diffusers, and air piping per the recommendations of an evaluation completed by another consultant. The purpose of this upgrade project is to optimize the biological system to ensure that energy use is minimized while pollutant removal is maximized.

6.8.5 ACWRF Grit Removal Improvements (Project 14)

This project will add a new facility that includes vortex grit removal chambers, grit washer/classifiers, and grit handling pumps. A grit characterization study will need to be performed prior to implementing this project to determine if the source of the grit is from the tertiary filtration process. Reducing the amount of grit that enters ACWRF should decrease the amount of maintenance performed by District staff by prolonging equipment life and decreasing the frequency of cleaning operations to remove accumulated grit.

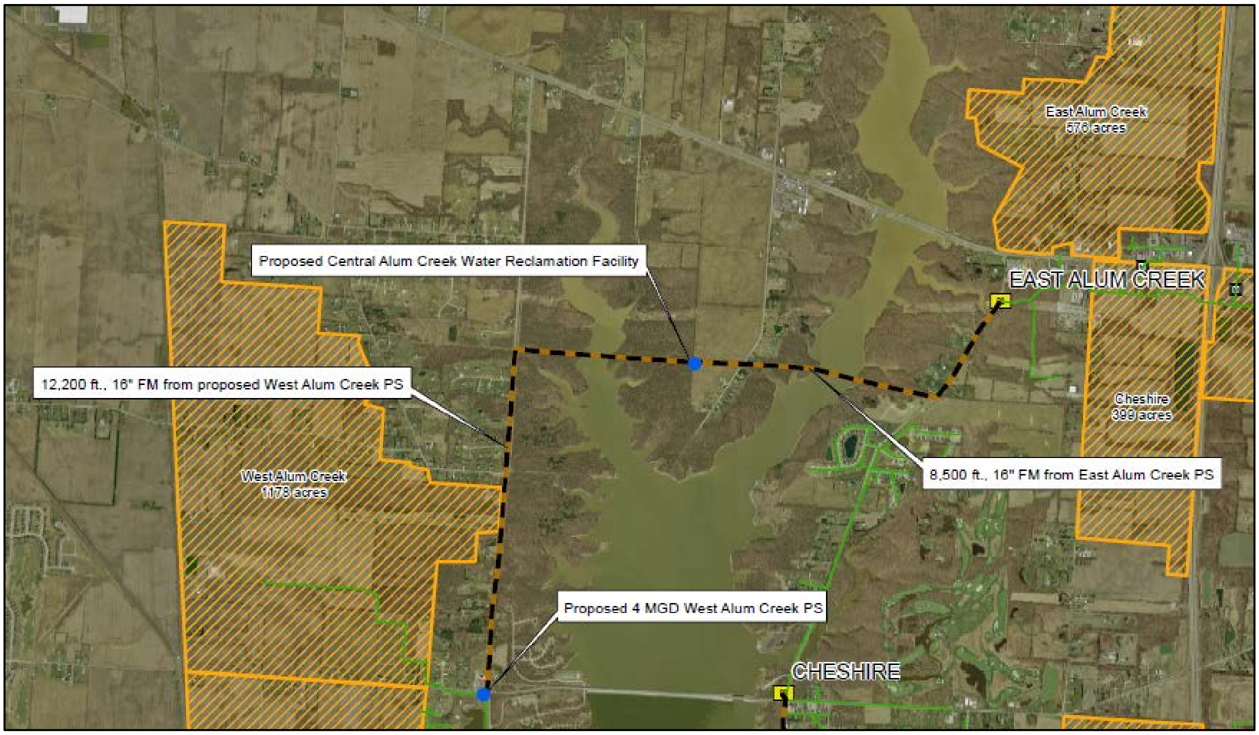
6.9 Central Alum Creek Water Reclamation Facility (Project 27)

The Central Alum Creek Water Reclamation Facility (CACWRF) is a proposed new treatment plant to be constructed on the Alum Creek peninsula on the north side of Alum Creek Lake, south of 36/37 (See Figure 23). The purpose of this facility is to accommodate the increased growth which is anticipated to occur in the areas designated as Delaware County Service Areas “Alum Creek B” and the northeastern sections of “Alum Creek C” – see Figure 1. These areas are projected to develop in the near future due to their proximity to the Tanger Outlet Mall and other development recently constructed at the I-71/36/37 interchange; the possible interchange expansion; and the siting of a new high school on the northwest side of Alum Creek Lake. Nearly 2,250 acres have been identified as likely to see some type of improvement over time.

6.9.1 Central Alum Creek WRF Influent Gravity Sewer (Project 36)

The Central Alum Creek WRF will accept flow from both east of the Alum Creek Lake via the renovated East Alum Creek PS and from the west side of the Lake via the proposed new West Alum Creek PS. Areas developed north of the facility along the US36/SR37 corridor are proposed to flow to the new facility by gravity along a new trunk sewer. This sewer is nominally sized at 24” however no long term growth study for areas north of 36/37 has been conducted and as such, the ultimate sizing of this sewer and anticipated buildout conditions of its tributary area should be studied prior to installation. Construction of this sewer will eliminate the need for additional pump stations to pump flow from the area between branches of the Alum Creek Lake to either the East or West Alum Creek PS.

Figure 23. Proposed Central Alum Creek WRF



While the timing of new development is difficult to determine, it has become apparent that some type of development will occur in the 5-10 year time period which will stress the existing collection system both east and west of Alum Creek Lake as described in Section 4.0 – Master Plan Methodology. Due to the defined Level of Service and the size of the existing gravity sewer currently conveying flow to the ACWRF, it was difficult to identify a cost effective alternative for sending significant quantities of additional sewage through the existing collection system for treatment. Furthermore, it was determined that possible future infill development in the northern sections of Genoa and Orange Townships as well as the southern segments of Berlin Township and the sanitary flow generated therein would be better situated to be conveyed to – and treated at – the existing ACWRF in a more cost effective manner.

The proposed CACWRF was sited to be easily accessible to the areas in the northern parts of Berlin and Berkshire Townships (which have already been identified as a source of near term development). The location will require the purchase of property by the District for the construction of the new facility, which would discharge highly treated effluent to the Alum Creek Lake. Preliminary agreement with the City of Columbus allows for this facility to be sized at approximately 800,000 GPD which should serve the near term needs of the DCRSD.

As previously discussed, in order to convey flow from the east and west sides of the lake, one new pump station is proposed on the west side of the lake as well as the upgrade and rerouting of an existing one on the east side. A new gravity sewer is also proposed to accept flow from developments directly to the north along US36/SR37 and into southern Kilbourne Township. All three proposed conveyance lines (and two pump stations) will be sized to accept flow from the proposed development area utilizing a 25-

year Level of Service. Based on current projections of development, there could be upwards of 4,000 new residential units in the CACWRF tributary area developed over the next decade along with a number of commercial and possibly even industrial sites. The proposed West Alum Creek Pump Station is initially sized for a peak flow of 3.9 MGD while the existing East Alum Creek Pump Station will be rerouted and expanded to be capable of handling a peak flow of 5 MGD. The proposed CACWRF is expected to be sized for approximately 800,000 GPD in its initial phase but is likely to be expandable as agreement allows and development requires.

The CACWRF will need to be timed to fit with existing development needs as Peachblow, Cheshire, and East Alum Creek pump stations all are anticipated to reach their capacity over the next ten years. Both Peachblow and Cheshire pump stations are slated for near term upgrades to ensure capacity is available within both tributary areas but as growth continues, both of those facilities will approach their upgraded capacity as well as the capacity of the much longer downstream gravity sewers. East Alum Creek pump station has some remaining capacity as well (as long as Cheshire PS is upgraded) but in the next 5 to 10 years, even that facility is likely to be pushed to its limits. It is at that time (prior to any significant upgrade to East Alum Creek pump station, or the gravity sewers downstream of Peachblow or Cheshire pump stations) that the CACWRF should be brought online. This timing will allow DCRSD to utilize existing assets for as long as possible prior to additional interim upgrades that will ultimately route sanitary flow away from its long term terminus, the CACWRF. The precise timing of these steps will be determined by carefully monitoring the flows at East Alum Creek, Cheshire, and Peachblow pump stations during wet weather events as well as the number of new sanitary sewer connections approved in the areas tributary to those pump stations. Ideally, this will provide enough time to complete the CACWRF in conjunction with the upgrade or construction of the asset (East or West Alum Creek PS) that triggered the requirement for treatment capacity in the area.

6.10 Project Prioritization and Implementation

For purposes of developing Capital Improvement Project recommendations, the proposed projects identified across the Basins have been grouped into three categories: Early Action projects (0-5 years), Short-term projects (5-10 years) and Long-term projects (>10 years). The prioritization takes into account the likely timeframe of net development within a subbasin; however there can be significant deviations from the assumptions over the short term. Due to the pace of development in Delaware County and the degree to which that development will influence the need for specific improvements, the model should be reevaluated on a continuous basis.

Table 11 indicates the identified projects for the Alum Creek WRF basin as well as their proposed categorization.

Table 11. Proposed Early Action and Short Term Alum Creek Basin Improvements

Project Number	Project Description	Justification	Timeline
22	New 11 MGD Lower Alum Creek Relief PS and 9,500 ft. of 24-inch diameter forcemain to ACWRF	Existing 24-inch and 30-inch sewers show surcharge in the 25-year design event; additional growth upstream would cause local flooding.	Early Action (1-5 Years)
19	Peachblow PS Early Action Upgrade to 3.5 MGD and 4,300 ft. of 16-inch forcemain	Existing station is undersized and receives 3.0 MGD under current conditions.	Early Action (1-5 Years)
21	Cheshire PS Upgrade to 3.5 MGD and 15,800 ft. of 14-inch forcemain	Existing station is undersized and upstream flooding occurs in the 25-year design event.	Early Action (1-5 Years)
2	System Arc Flash Study	Required to ensure safe maintenance can be completed and meet code requirements.	Early Action (1-5 Years)
3	ACWRF Mixer and Aeration Upgrades	Optimization of the Aeration system will allow for better pollutant removal and lower energy use.	Early Action (1-5 Years)
9	ACWRF Dewatering Improvements	This project will reduce the overall volume of sludge that must be disposed of, reducing costs.	Early Action (1-5 Years)
27	Central Alum Creek WRF	Prior to upgrades to the East Alum Creek PS or a construction of a new West Alum Creek PS, the WRF would have to be available to handle wastewater flows.	Short-Term (5-10 Years)
26	New 4 MGD West Alum Creek PS and 12,200 ft. of 16-inch diameter forcemain to CACWRF	This station is based on full –build-out of the upstream tributary area and is heavily reliant on future growth. The timing and sizing of this facility will depend on the local growth patterns.	Short-Term (5-10 Years)
29	East Alum Creek PS Upgrade to 5.0 MGD and 8,500 ft. of 16-inch forcemain to CACWRF	This station is based on the full build out of this area along Rt 36-37 and is heavily reliant on future growth. The timing and sizing of this facility will depend on the local growth patterns.	Short-Term (5-10 Years)
14	ACWRF Grit Removal Improvements	Grit removal improvements at ACWRF which currently has no grit handling equipment will reduce maintenance costs as well as wear and tear on downstream pumps and mechanical equipment.	Short-Term (5-10 Years)
13	WRF Electrical and I&C Improvements	Overall Electrical and Control System integration is needed at both facilities to ensure smooth operation.	Short-Term (5-10 Years)

[1]**Project number refers to project cost schedule on page 78.**

Long Term Projects in this basin but not contained in the table above include the Peachblow PS Long Term Upgrade (#35) and corresponding upsizing for the downstream gravity sewer (#34).

6.11 Other Basins

Figure 27 shows the location of each of the proposed projects in all other tributary basins.

6.11.1 LSWRF: Growth Areas within the LSWRF Service Area

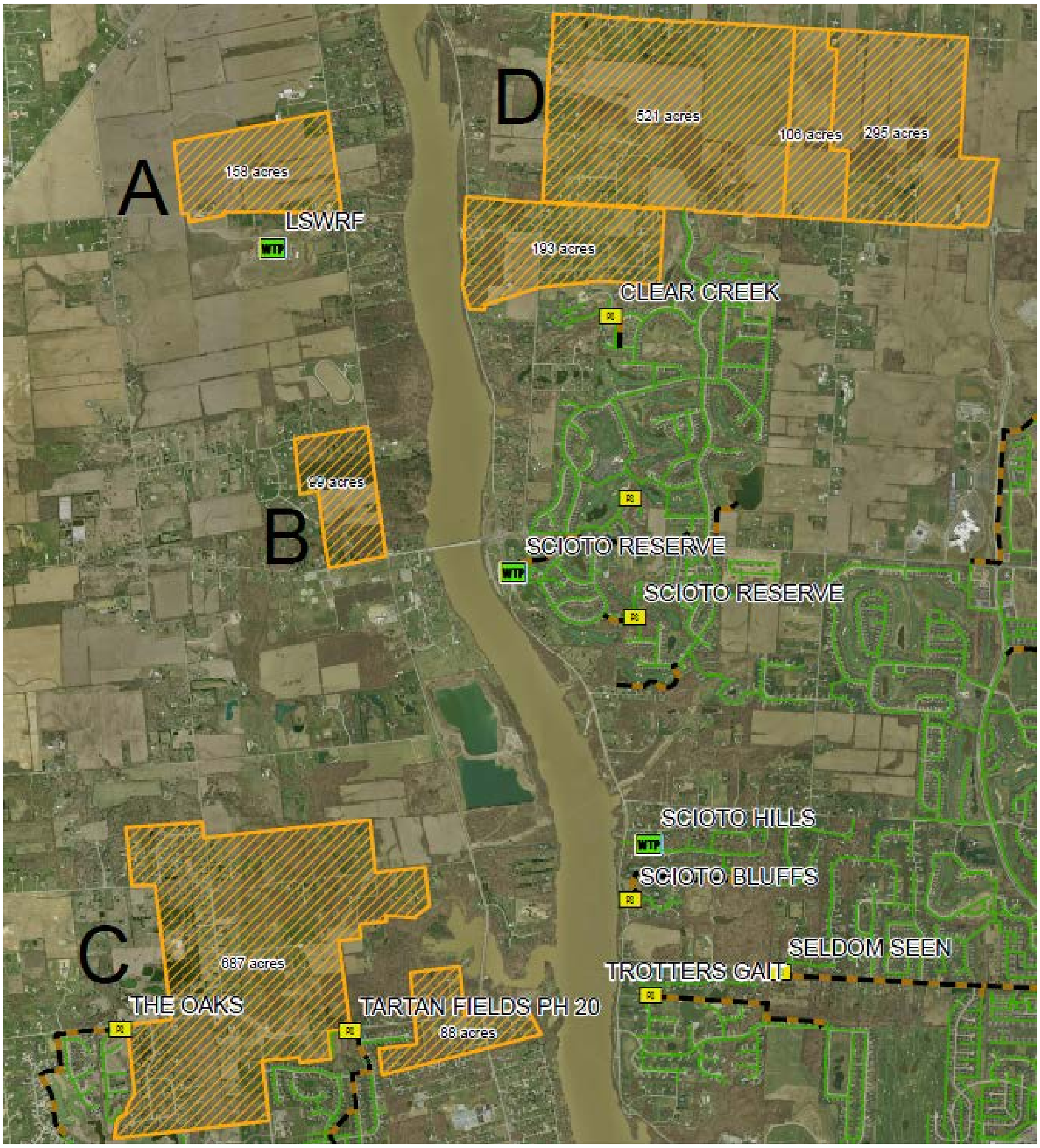
The LSWRF is located within Concord Township and was built to provide service to future development in southwestern Delaware County. The design capacity of the plant is 1.4 MGD (expandable to 2.8 MGD). Table 12 identifies four future development areas that are proposed to discharge flow to the LSWRF over time. These four development areas, shown in Figure 24, total 2,160 acres (6,371 units). Based on the model assumptions, the proposed future development will generate an average DWF of 1.85 MGD and a peak wet weather flow (25-year, 24-hour design storm) of 8.25 MGD.

Table 12. Lower Scioto Water Reclamation Facility Future Development

WRF	Sub-Basin	Units	Area (ac)	Avg Dry Weather Flow (MGD)	Peak Wet Weather Flow (MGD)
LSWRF	A	442	158	0.13	0.59
	B	276	99	0.08	0.37
	C	2170	785	0.63	2.90
	D	3483	1118	1.01	4.38
Total		6371	2160	1.85	8.25

Although the average dry weather flow from these development areas is larger than the current design capacity, minimal growth in the plant's tributary area has occurred and as such, it is not currently in danger of being under capacity in the near term. As growth occurs within the tributary area, flows should be tracked at the Water Reclamation Facility and should be monitored against the current design capacity.

Figure 24. LSWRF Tributary Area



To serve the future development areas, significant new infrastructure will be required including additional influent Pump Stations or gravity sewers. The exact location of these facilities will be determined as necessary as the development occurs. At this time, it is anticipated that any new infrastructure directing flow to LSWRF will be a part of, or in conjunction with, a significant new development in the vicinity of the treatment facility. No other improvements are recommended at this time. Once the LSWRF is placed into service, planning in the area should be completed to guide development of the system tributary to the facility.

Clark Shaw Sewer (Project 20)

This project will allow for additional growth in the LSWRF basin on the east side of the O'Shaughnessy Reservoir.

Lower Scioto WRF (Project 6)

These improvements are necessary for the LSWRF to begin accepting and treating sanitary flow.

6.11.2 Growth Areas within the Scioto Reserve, Scioto Hills, Tartan Fields, Northstar, and Bent Tree Service Areas

Scioto Reserve Upgrades (Project 5)

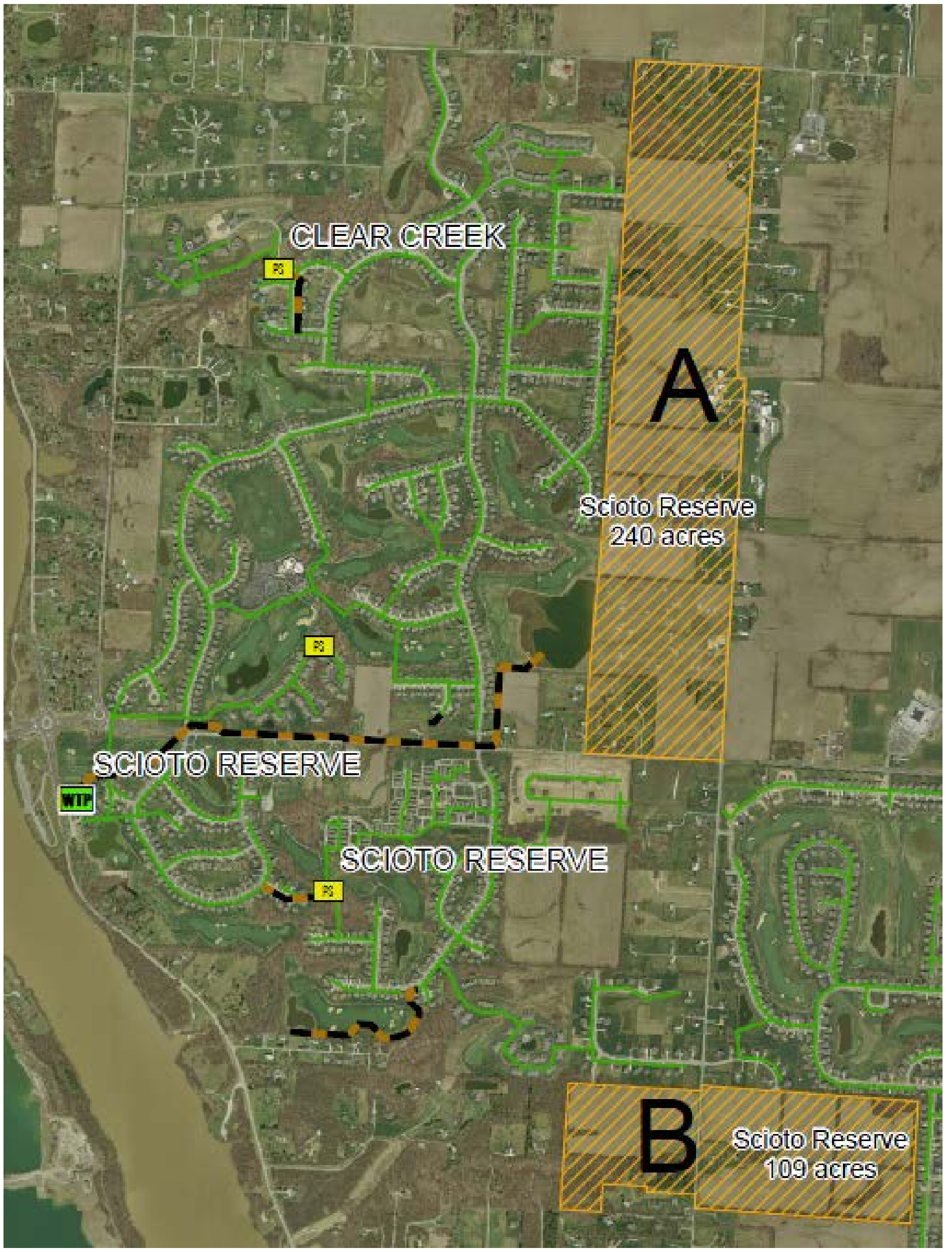
The Scioto Reserve Water Reclamation Facility has a design capacity of 0.4 MGD. Table 13 shows future development areas that are proposed to discharge to Scioto Reserve. These development areas total 349 acres (approximately 1,292 units). Based on the model assumptions detailed in Section 4.0, the proposed future development tributary to SRWRF will generate an average DWF of 0.38 MGD and a peak wet weather flow (25-year, 24-hour design storm) of 1.48 MGD. This additional flow may be somewhat offset over time if part of the current Scioto Reserve tributary area is rerouted to the LSWRF via the O'Shaughnessy Pump Station and the Butts Road Trunk Sewer, though this will not likely be enough to offset the flow from the proposed future areas.

Table 13. Scioto Reserve Water Reclamation Facility Future Development

WRF	Sub-Basin	Units	Area (ac)	Avg. Dry Weather Flow (MGD)	Peak Wet Weather Flow (MGD)
Scioto Reserve	A	887	240	0.26	1.02
	B	405	109	0.12	0.46
Total		1292	349	0.38	1.48

The average dry weather flow from these new development areas in addition to the current flow (estimated at about 0.3 MGD) is larger than the current design capacity; as growth occurs in these areas, flows should be tracked at the Water Reclamation Facility and should be monitored against the existing design capacity. The outcome of the ongoing study at SRWRF should also be considered upon its completion to determine the impact on both existing and future flows. This facility is a zero discharge facility which requires that the facility both treat the wastewater flow up to permit levels and provides treated effluent for use at the golf course associated with the facility. Discharged flow must be accommodated in the existing golf course impoundment ponds prior to land application.

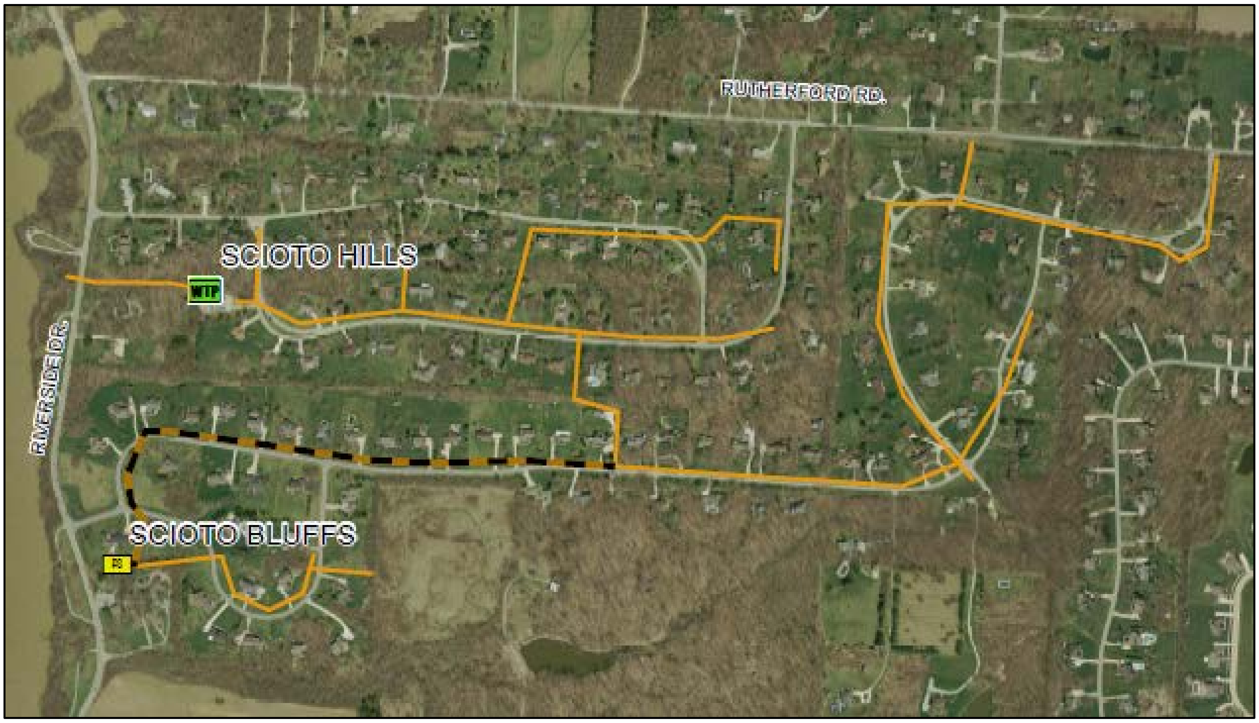
Figure 25. Scioto Reserve Tributary Area



Scioto Hills

The current design capacity of Scioto Hills Water Reclamation Facility is 0.084 MGD. The system is currently operating at capacity, however there are currently no future development plans proposed to be tributary to this facility.

Figure 26. Scioto Hills Tributary Area



Tartan Fields Upgrades (Project 4)

The current design capacity of Tartan Fields Water Reclamation Facility is 0.25 MGD although in practice, the facility has been unable to achieve this throughput. This is related to outlet pipes from the aeration tanks and transfer pipes between the tanks. Hydraulic issues related to this facility are being evaluated by a study separate from the Master Planning process. There is a considerable amount of nearby agricultural land as well as areas of consolidated numbers of Home Sewage Treatment Systems nearby that have the potential for development. This facility is a zero discharge facility which requires that the facility both treat the wastewater flow up to permit levels and provides treated effluent for use at the golf course associated with the facility. Both of these criteria must be met in order for changes in the volume of flow accepted by the Tartan Fields WRF.

Northstar

The Northstar Water Reclamation Facility is a zero discharge facility, with treated wastewater held on site and used as irrigation on the Northstar Golf Course and other common property. The design capacity is 0.4 MGD. The facility was recently put online as homes in the tributary area are beginning to be built. Figure 27 shows two future development areas that are proposed to discharge flow to the Northstar WRF. These two development areas total 2,441 acres (approximately 7,185 residential unit equivalents at anticipated density, however due to the location near the 36/37 interchange with I-71, this could end up developing at higher than anticipated densities if accepted by the Township). Based on the model assumptions detailed in Section 4.0, the proposed future development will generate an average DWF of 2.09 MGD and a peak wet weather flow (25-year, 24-hour design storm) of 9.5 MGD.

Figure 27. Northstar Development Area

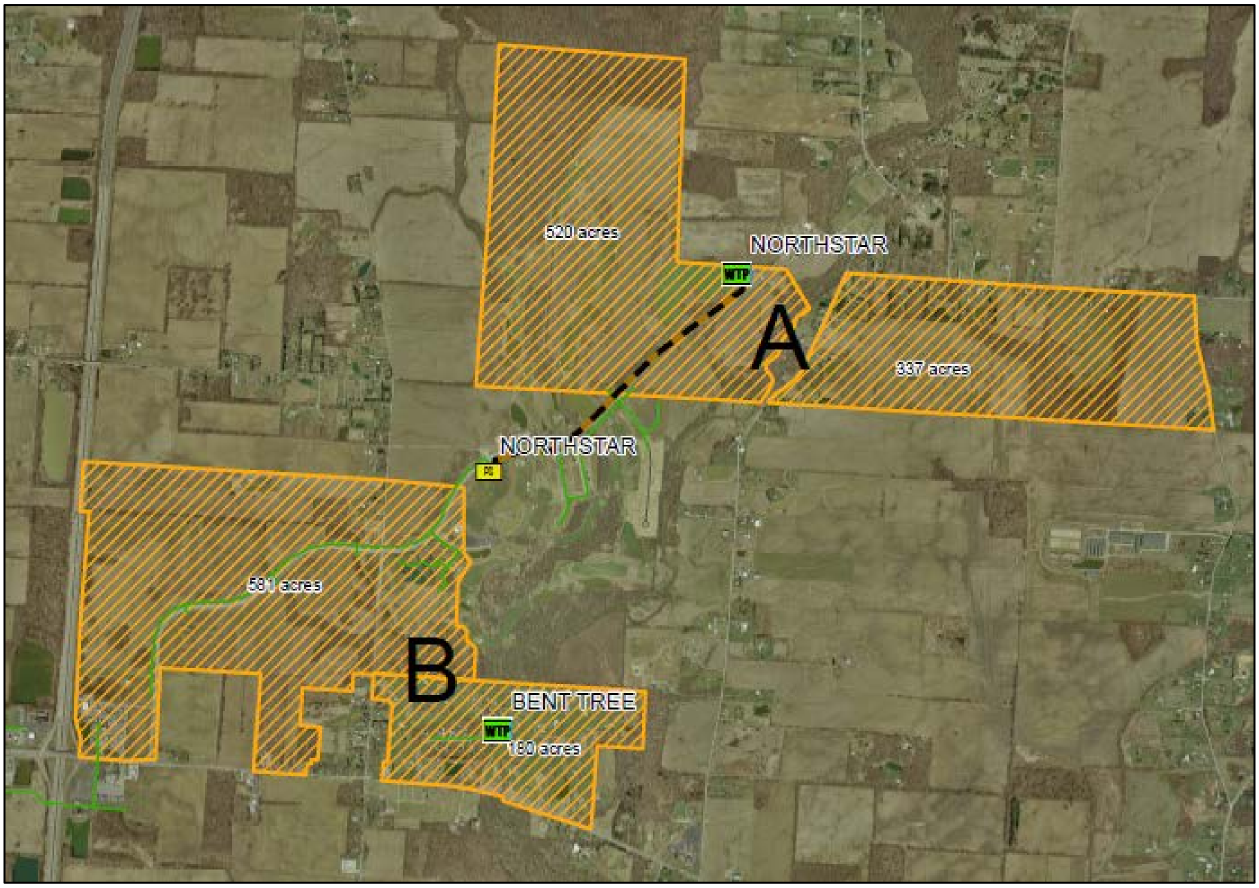


Table 14 includes a summary of the future growth for Northstar Water Reclamation Facility.

Table 14. Northstar Water Reclamation Facility Future Development

WRF	Sub-Basin	Units	Area (ac)	Avg Dry Weather Flow (MGD)	Peak Wet Weather Flow (MGD)
Northstar	A	1611	597	0.47	2.25
	B	5574	1844	1.62	7.25
Total		7185	2441	2.09	9.5

The average dry weather flow from these development areas in addition to the current flow (estimated at about 0.05 MGD) is larger than the current design capacity; as growth occurs in these areas, flows should be tracked at the Water Reclamation Facility and should be monitored against the existing design capacity. Growth in these areas could be redirected to the Alum Creek Central Basin at some point in the future if needed as well.

To serve these future development areas within the Northstar sub basin, new infrastructure will be required; however it is anticipated to be provided by the developer as growth within the Northstar development occurs.

Bent Tree

The current design capacity of Bent Tree Water Reclamation Facility is 0.01 MGD. There are currently no future development plans proposed to be tributary to this facility. The proposed Berkshire Pump Station is intended to serve much of the surrounding area and could include the possible elimination of the Bent Tree WRF and conveyance of the flow to the Central Alum Creek Basin.

Sunbury

Portions of the current DCRSD service area are planned to be tributary to the Sunbury collection system while other areas annexed by Sunbury are proposed to be served by DCRSD. This includes a total of 381 acres (1029 units) and future design flows of 0.3 MGD average DWF and 1.43 MGD. As the potential for future annexations by Sunbury are uncertain, development and sewage flows generated east of I-71 in the vicinity of the 36/37 interchange should be closely monitored to ensure that new development does not negatively impact either the East Alum Creek or Cheshire Pump Stations prior to completion of the Early Action projects.

HDR

PROJECT MAP

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN

FIGURE 28

PATH: J:\OH\DELAWARECO\DELAWARECO_WWMP\7.2_WORK_IN_PROGRESS\MAP_DOCS\DRAFT\DELAWARE_EXHIBIT_PRESENTATION_161004_ABO.MXD - USER: AOVERBAY - DATE: 10/6/2016

7.0 Project Schedule and Cost Estimate

As part of this Master Plan, estimates of probable cost for recommended projects and potential project schedule and sequencing have been developed. This information has been incorporated into the proposed Ten-Year DCRSD Project Cost Schedule. The timing of these projects was determined in order to develop a defensible, revised rate structure. It is notable that project timing is driven in large part by the pace and location of specific development. It is therefore highly recommended to recheck the hydraulic model prior to the installation of any major conveyance or treatment facility improvements to ensure that the model matches observed and recorded actual field conditions.

The conveyance projects listed in the table below were identified as a result of hydraulic capacity or condition issues, or in anticipation of future growth (for safe and reliable service). As such, they are coded as “O&M” project types. Other projects which will extend or provide service to new areas of the County are termed “Development Projects.” These labels are directly noted in the rate analysis. Precursor projects are identified to ensure that downstream capacity is available before expansions of upstream infrastructure can be undertaken.

Table 15. Proposed Conveyance Project Summary

Project Number	Project Name	Project Type	Timeframe	Project Precursors
19	Peachblow PS Early Action Upgrade	Development	Early Action (0-5 Years)	22
21	Cheshire PS Upgrades	Development	Early Action (0-5 Years)	-
22	Lower Alum Creek Relief PS (LACR PS)	Development	Early Action (0-5 Years)	-
7	Leatherlips PS Service Area I&I Reduction	O&M	Early Action (0-5 Years)	-
26	West Alum Creek PS (WACPS)	Development	Short Term (5-10 Years)	27
27	Central Alum Creek WRF (CACWRF)	Development	Short Term (5-10 Years)	26 or 29
29	East Alum Creek PS (EAC PS) Upgrade	Development	Short Term (5-10 Years)	27
8	Seldom Seen Forcemain Redirection	O&M	Short Term (5-10 Years)	7
30	Golf Village PS Relief Sewer	Development	Short Term (5-10 Years)	15
31	Olentangy River Trunk Sewer Parallel Relief Sewer	Development	Short Term (5-10 Years)	OECC Headworks
28	Summerwood PS Upgrade	Development	Long Term (10+ Years)	150 service connections
15	Olentangy/Wingate/White Oak Road Sewer Upsizing	O&M	Long Term (10+ Years)	30
34	Peachblow Gravity Sewer Upsizing	Development	Long Term (10+ Years)	22, 35
35	Peachblow PS Long Term Upgrade	Development	Long Term (10+ Years)	19, 22, 34
18	Woodland Hall Road Sewer Upsizing	O&M	Long Term (10+ Years)	-
36	Central Alum Creek WRF (CACWRF) Influent Gravity Sewer	Development	Long Term (10+ Years)	27

The proposed treatment projects are primarily necessary for efficiency gains, to provide a reduction on persistent maintenance issues, or ensure long term permit compliance. Over the next ten years, the OECC is anticipated to have capacity improvements required to handle increasing flows but the specific timing of this will need to be closely monitored. The table below details the various projects needed at the OECC and ACWRF.

Table 16. Proposed Treatment Project Summary

Project Number	Project	Project Type	Timeframe	Project Precursors
1	OECC Facility Plan	O&M	Early Action (1-5 Years)	-
2	System Arc Flash Study	O&M	Early Action (1-5 Years)	-
3	ACWRF Mixer and Aeration Upgrades	O&M	Early Action (1-5 Years)	-
9	ACWRF Dewatering Improvements	O&M	Early Action (0-5 Years)	-
10	OECC Dewatering Improvements	O&M	Early Action (0-5 Years)	1
11	OECC Cake Storage Improvements	O&M	Early Action (0-5 Years)	1
12	OECC Headworks	O&M	Early Action (0-5 Years)	1
14	ACWRF Grit Removal Improvements	O&M	Short-Term (5-10 Years)	-
25	OECC North Plant Rehabilitation	Development	Short-Term (5-10 Years)	1, 12
13	WRF Electrical and I&C Improvements	O&M	Short-Term (5-10 Years)	1
27	Central Alum Creek Water Reclamation Facility	Development	Short-Term (5-10 Years)	See project #27, Table 15
16	OECC South Aeration Upgrades	O&M	Long-Term (10+ Years)	1, 12
17	OECC Filter Upgrades	O&M	Long-Term (10+ Years)	1

The overall distribution of both the improvements identified by the project team as well as additional work determined by DCRSD can be seen on the table in Section 7.1. These projects have been broken down to indicate the anticipated spending outlays by year and by need, O&M versus Development.

7.1 Cost Estimates

The cost estimates for the projects discussed in this document were developed based on the approximate sizing and siting requirements as defined in Technical Memoranda 3 and 4. While the basic size and location requirements of various improvements are known, additional work will be necessary to verify this prior to any construction. This is particularly critical with regard to improvements proposed to handle future growth as the timing and distribution of the growth is highly variable. The purpose of the cost estimates was to ensure that the needed improvements were given a viable and conservative estimate for budgeting purposes. These estimates include Administrative costs, Engineering, and a 30% design contingency on top of the mobilization, contractor overhead and profit, and estimated cost of the work to be performed. Assumptions for each estimate as well as the cost breakdowns can be found in Technical Memorandum #4, Appendix A. All costs are estimated in 2016 dollars.

DELAWARE COUNTY SANITARY SEWER MASTER PLAN - PROJECT COST SCHEDULE

Project Number	Project Type	Project Name	Cost (2016 Dollars)	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12+
				CY 2017	**CY 2018**	**CY 2019**	**CY 2020**	**CY 2021**	**CY 2022**	**CY 2023**	**CY 2024**	**CY 2025**	**CY 2026**	**CY 2027**	**CY 2027+**
1	O&M	OECC Facilities Study	$500,000	$ 250,000	$ 250,000										
2	O&M	System Arc Flash Study	$300,000	$ 300,000											
3	O&M	ACWRF Mixer and Aeration Upgrades	$2,500,000	$ 1,000,000	$ 1,500,000										
4	O&M	Tartan Fields Upgrades	$1,000,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000								
5	O&M	Scioto Reserve Upgrades	$1,500,000	$ 250,000	$ 500,000	$ 500,000	$ 250,000								
6	O&M	Lower Scioto WRF (LSWRF) Service Upgrades	$1,500,000	$ 500,000	$ 500,000	$ 500,000									
7	O&M	Leatherlips PS Service Area I&I Reduction	$300,000	$ 100,000	$ 100,000	$ 100,000									
8	O&M	Seldom Seen Forcemain Redirection	$268,800		$ 268,800										
9	O&M	ACWRF Dewatering Improvements	$1,710,000			$ 1,710,000									
10	O&M	OECC Dewatering Improvements	$1,570,000			$ 1,570,000									
11	O&M	OECC Cake Storage Improvements	$1,650,000				$ 1,650,000								
12	O&M	OECC Headworks	$15,009,800			$ 1,500,000	$ 3,000,000	$ 5,250,000	$ 5,259,800						
13	O&M	WRF Electrical and I&C Improvements	$3,000,000	$ 200,000		$ 500,000	$ 1,000,000	$ 1,300,000							
14	O&M	ACWRF Grit Removal Improvements	$4,995,800			$ 495,800	$ 2,000,000	$ 2,000,000	$ 500,000						
15	O&M	Olentangy/Wingate/White Oak Road Sewer Upsizing	$5,901,300												$ 5,901,300
16	O&M	OECC South Aeration Upgrades	$8,009,000												$ 8,009,000
17	O&M	OECC Filter Upgrades	$3,002,100												$ 3,002,100
18	O&M	Woodland Hall Road Sewer Upsizing	$3,001,100												$ 3,001,100
		O&M Subtotal:	$55,717,900	$2,850,000	$3,368,800	$7,125,800	$8,150,000	$8,550,000	$5,759,800	$0	$0	$0	$0	$0	$19,913,500
19	Development	Peachblow PS Early Action Upgrade	$1,440,200	$ 200,000	$ 620,100	$ 620,100									
20	Development	Clark-Shaw Sewer	$4,000,000	$ 4,000,000											
21	Development	Cheshire PS Upgrade	$2,733,200	$ 233,200	$ 1,250,000	$ 1,250,000									
22	Development	Lower Alum Creek Relief PS (LACR PS)	$7,609,400	$ 609,400	$ 3,500,000	$ 3,500,000									
23	Development	Liberty Sawmill Sewer Phase 1	$5,000,000	$ 2,500,000	$ 2,500,000										
24	Development	Liberty Sawmill Sewer Phase 2	$5,000,000				$ 500,000	$ 2,250,000	$ 2,250,000						
25	Development	OECC North Plant Rehab	$9,300,900					$ 500,000	$ 500,000	$ 1,750,000	$ 4,250,000	$ 2,300,900			
26	Development	West Alum Creek PS (WACPS)	$3,725,500						$ 1,500,000	$ 2,225,500					
27	Development	Central Alum Creek WRF (CACWRF)	$22,000,000	$ 500,000	$ 500,000	$ 1,000,000	$ 2,000,000	$ 3,000,000	$ 7,500,000	$ 7,500,000					
28	Development	Summerwood PS Upgrade	$1,023,100										$ 1,023,100		
29	Development	East Alum Creek PS (EAC PS) Upgrade	$3,422,200						$ 1,422,200	$ 2,000,000					
30	Development	Golf Village Relief Sewer	$9,390,500		$ 140,500	$ 250,000	$ 1,000,000	$ 1,100,000	$ 2,300,000	$ 2,300,000	$ 2,300,000				
31	Development	Olentangy River Trunk Sewer Parallel Relief Sewer	$8,755,800					$ 2,000,000	$ 3,377,900	$ 3,377,900					
32	Development	Berkshire Township PS	$2,500,000	$ 250,000	$ 250,000	$ 1,000,000	$ 1,000,000								
33	Development	US 23 Sewers	$3,866,000		$ 1,933,000	$ 1,933,000									
34	Development	Peachblow Gravity Sewer Upsizing	$3,929,900												$ 3,929,900
35	Development	Peachblow PS Long Term Upgrade	$2,987,000												$ 2,987,000
36	Development	Central Alum Creek WRF (CACWRF) Influent Gravity Sewer	$5,000,000						$ 2,000,000	$ 2,000,000	$ 1,000,000				
		Development Subtotal:	$101,683,700	$8,292,600	$10,693,600	$9,553,100	$4,500,000	$8,850,000	$20,850,100	$21,153,400	$7,550,000	$2,300,900	$1,023,100	$0	$6,916,900
		Total:	**$157,401,600**	**$11,142,600**	**$14,062,400**	**$16,678,900**	**$12,650,000**	**$17,400,000**	**$26,609,900**	**$21,153,400**	**$7,550,000**	**$2,300,900**	**$1,023,100**	**$0**	**$26,830,400**

All cost opinions and estimates provided by HDR are on the basis of experience and judgment; however since HDR has no control over market conditions or bidding procedures, HDR does not warrant that bids, ultimate construction cost, or project economics will not vary from such opinions or estimates

8.0 Financial Analysis

The financial plan and model is based on DCRSD's current financial data, including customer account information, annual operating budgets and actual expenses, and existing debt service requirements. The forecasted "annual needs" incorporate the identified capital investment recommendations relative to the existing system (called the "O&M" capital projects) and projected future growth (called the "development" capital projects). The overall operating and capital requirements have been projected over a long-term planning horizon to determine any future revenue shortfalls and the rates and charges that would be needed to meet DCRSD financial policies and goals. This section of the Master Plan addresses revenue and expenses projections, CIP funding requirements, and debt service requirements in making rate recommendations for DCRSD.

8.1 Customer Accounts and Revenue Projections

DCRSD generates revenue through two primary customer charges: a flat quarterly user charge and a capacity fee paid by new connections. The user charges are based on the number of equivalent residential units (ERUs) which recognizes the larger potential demands placed on the system by certain customers. At the beginning of calendar year 2016, residential ERUs totaled 28,986 and commercial ERUs were 3,221.

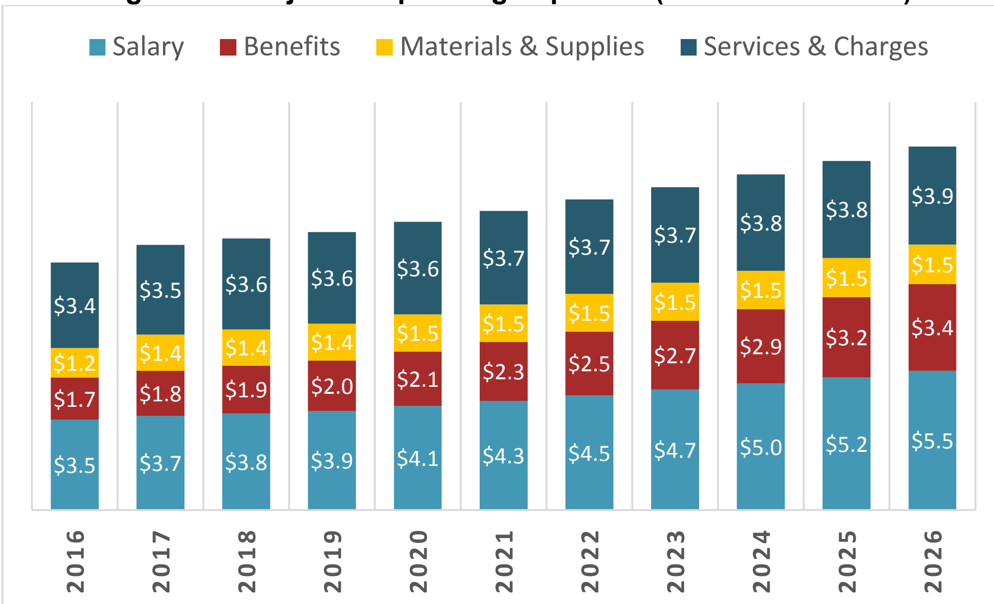
The financial forecast assumes that 750 additional residential ERUs will be added annually in 2017 through 2020, a figure which is consistent with historical trends for new residential connections. Over the same time frame, annual growth of 1.25% is projected for commercial ERUs. The overall projection is an increase of approximately 2.3% per year for 2017 through 2020, which is also consistent with recent trends. Beyond 2020, system ERUs are projected to increase by 2.15% annually.

8.2 Operating and Maintenance Costs

Operating and maintenance expenses fall into four primary categories: **salaries**; **benefits**, such as health insurance and workers' compensation; **materials and supplies**, such as, computer supplies, uniforms, minor tools, equipment, and furniture valued at less than $1,000; and **services and charges**, such as costs associated with external services and purchases, including maintenance and repair services, professional services, communications and postage.

Operating costs are projected to increase based on annual cost escalation rates (which vary by expense type) per DCRSD. Salary costs are projected to increase by 2.5% per year in 2018 and 2019, and by 5% per year thereafter. In keeping with recent historical (industry) trends, benefits are projected to increase by 6% per year in 2018 and 2019, and by 8% per year thereafter. Materials and supplies and services and charges are projected to increase by 1% per year throughout the forecast. The overall projected increase in operating costs is approximately 3.5% per year and the forecasted expenses are presented in Figure 29.

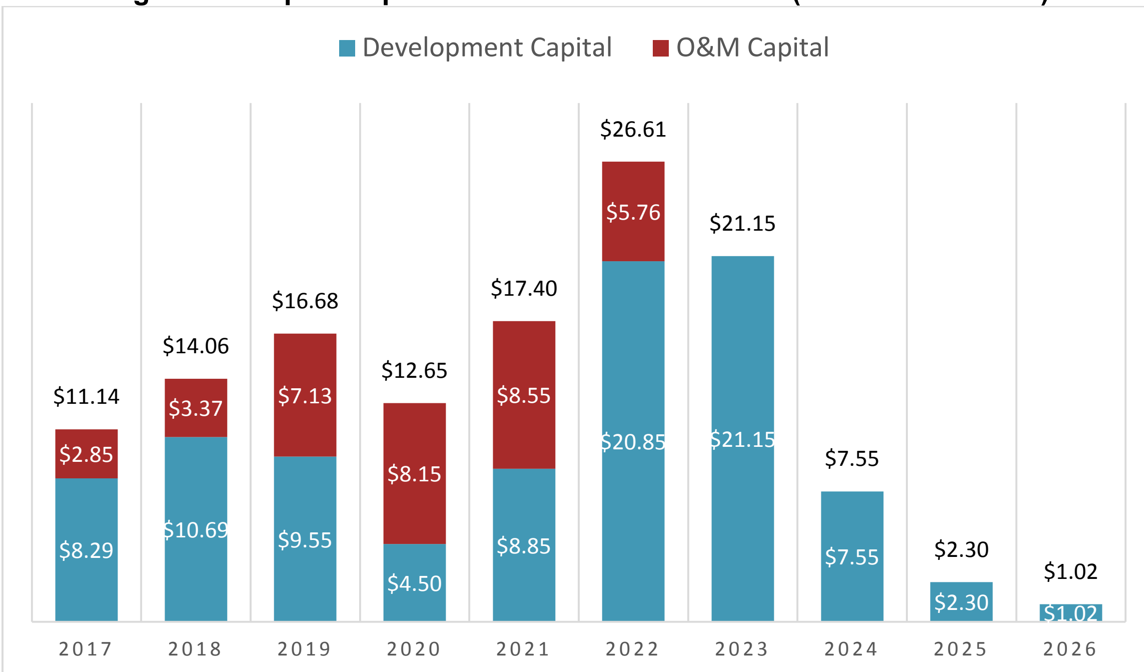
Figure 29. Projected Operating Expenses (Dollars in Millions)



8.3 Capital Projects and Funding Requirements

Capital project recommendations have been separated into two major groups: O&M Capital Projects and Development Capital Projects. O&M Capital Projects seek to ensure safe and reliable future service. Development Capital Projects focus on extending service to new areas of the County. Over the next ten years, an investment of $35.8 million for O&M Capital Projects and $94.7 million for the Development Projects (2016 dollars). O&M capital projects include repair and replacement as well as improvements of the existing system and its assets. The largest improvements as part of the O&M project list are for improvements and upgrades at the Alum Creek Water Reclamation Facility and the Olentangy Environmental Control Center. The projected capital project needs are presented in Figure 30.

Figure 30. Capital Improvement Recommendations (Dollars in Millions)



The financial plan assumes that capital project costs are escalated by 2% per year. It is also important to develop financing projections for each component of the CIP independently to ensure that **user charges are funding the O&M projects while capacity fee revenue is supporting the Development projects.**

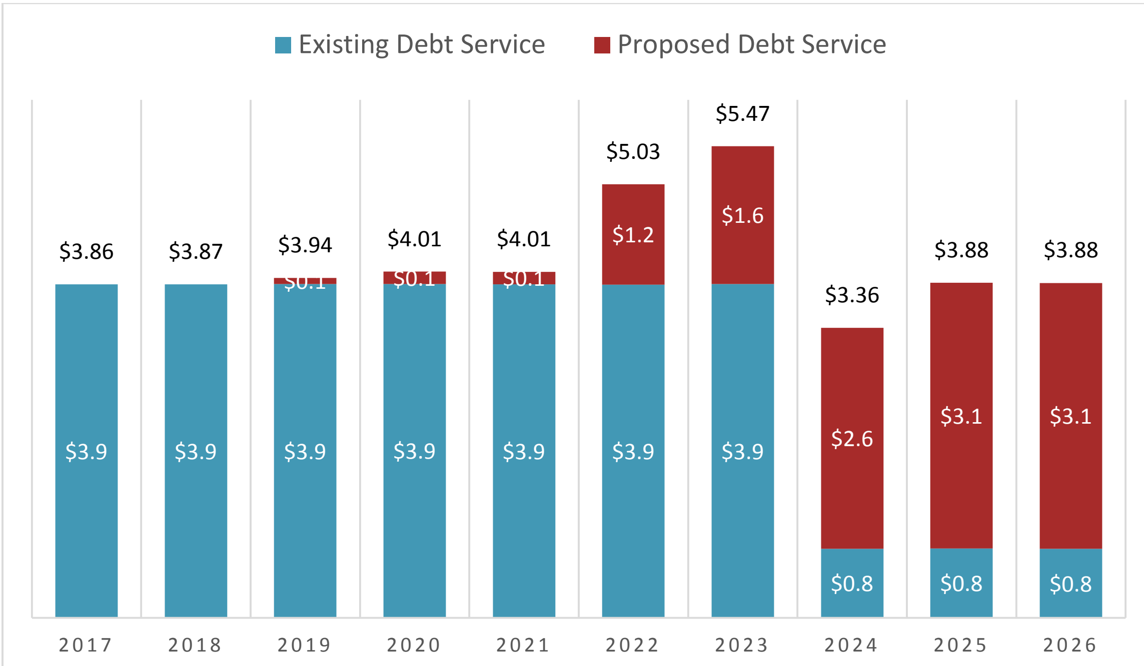
At the request of DCRSD, the O&M projects are funded by a combination of cash reserves, rate revenues, and anticipated State Revolving Fund (SRF) Loans. A $15 million Ohio Water Development Authority (OWDA) loan is projected to be issued in 2020, and the remainder of the O&M capital project needs are projected to be financed through cash reserves and rate revenues. The $15 million OWDA loan is expected to fund the OECC headworks project which begin design in 2019 (construction will take four years to complete). Repayment of the loan is projected to begin in 2022, and is based on a 20-year term at 3.0% interest rate.

Development Capital Projects are primarily funded by capacity fees collected from new customers. Capacity fees are anticipated to fund approximately $65 million of the total Development project needs. Other sources of funding include an annual 3% transfer from the Revenue Fund; revenue bond proceeds of $2.5 million, $15 million, and $18 million in 2018, 2022, and 2023, respectively; and $4 million in tax-increment financing (TIF) proceeds received in 2018 through 2022 for infrastructure needed to support growth in the central and western Alum Creek area.

8.4 Debt Service Requirements

DCRSD has two revenue bond issues outstanding with a total annual payment requirement of approximately $3.8 million. The largest issue is the 1999 Sewer Revenue Bonds; it accounts for $3.0 million in annual debt service costs and will be fully repaid in 2023. The SRF loans and revenue bonds that are needed to fund the capital needs will result in additional debt service requirements. The proposed annual debt service will be approximately $3.0 million by the end of the ten-year forecast period. The existing and proposed debt service requirements are presented in Figure 31.

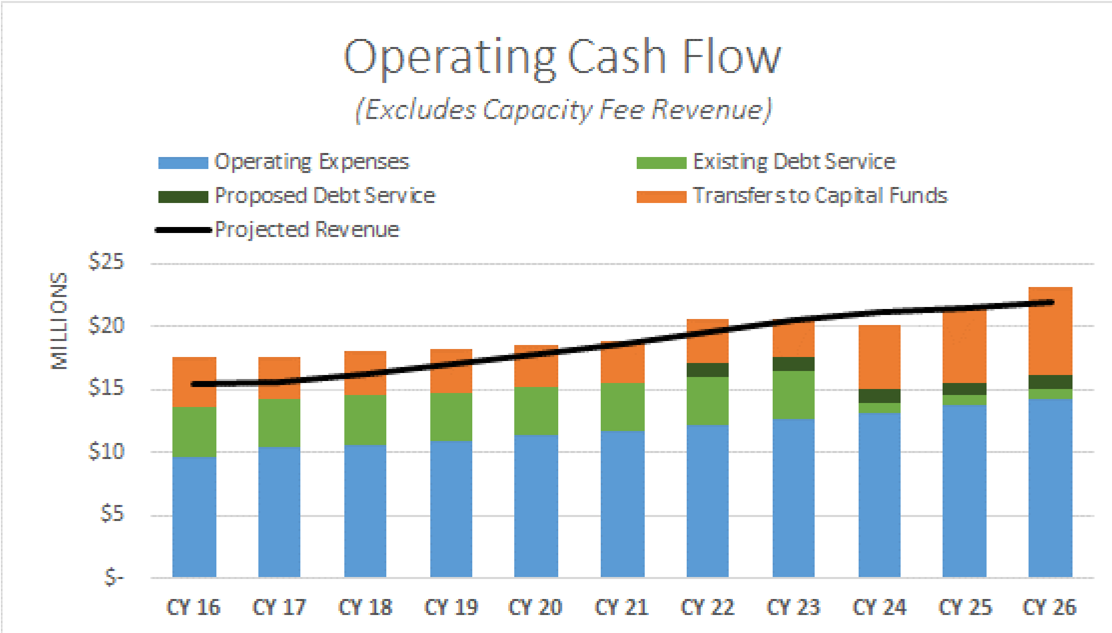
Figure 31. Existing and Proposed Debt Service (Dollars in Millions)



8.5 Financial Plan and Rate Recommendations

The financial plan has been developed with independent cash flow projections for the existing system (which funds the O&M capital projects) and the Development-related funds. The O&M system funds the annual operating costs of the utility, the existing debt service and proposed OWDA loan, as well as annual capital outlays and rate-funded capital. In order to meet these obligations, **the financial plan projects a need for 3% annual user charge increases in 2019 through 2023 and an increase to $39/ERU per month in 2024.** The O&M financial plan is presented in Figure 32.

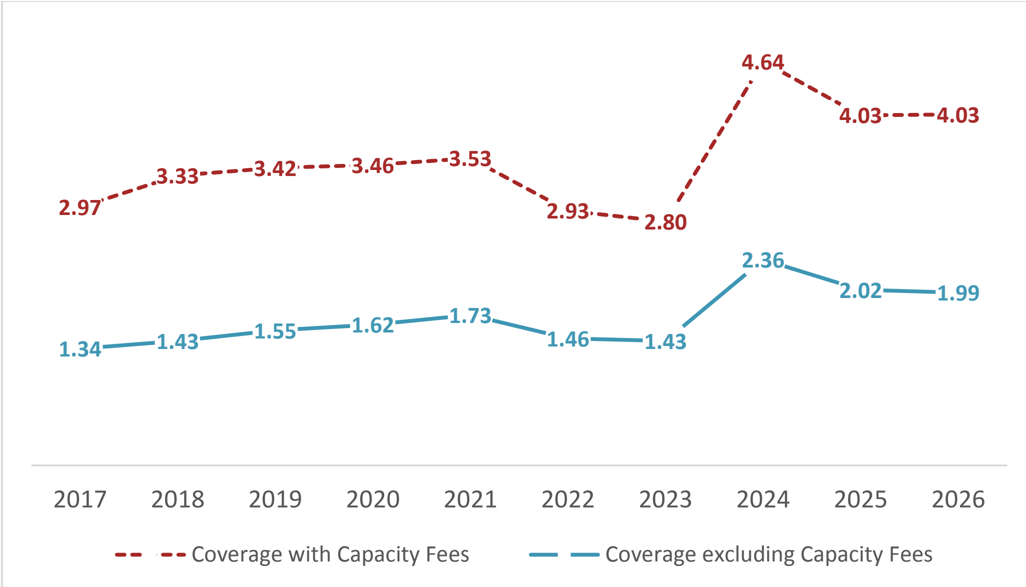
Figure 32. O&M Financial Plan



Under the proposed forecast of customer growth and user charge increases, revenues (excluding capacity fees) are projected to increase from $15.5 million in 2016 to nearly $22 million in 2026. These increased revenues are needed to support the projected future operating expenses, to finance the O&M capital project needs, and to maintain cash reserves and debt service coverage levels.

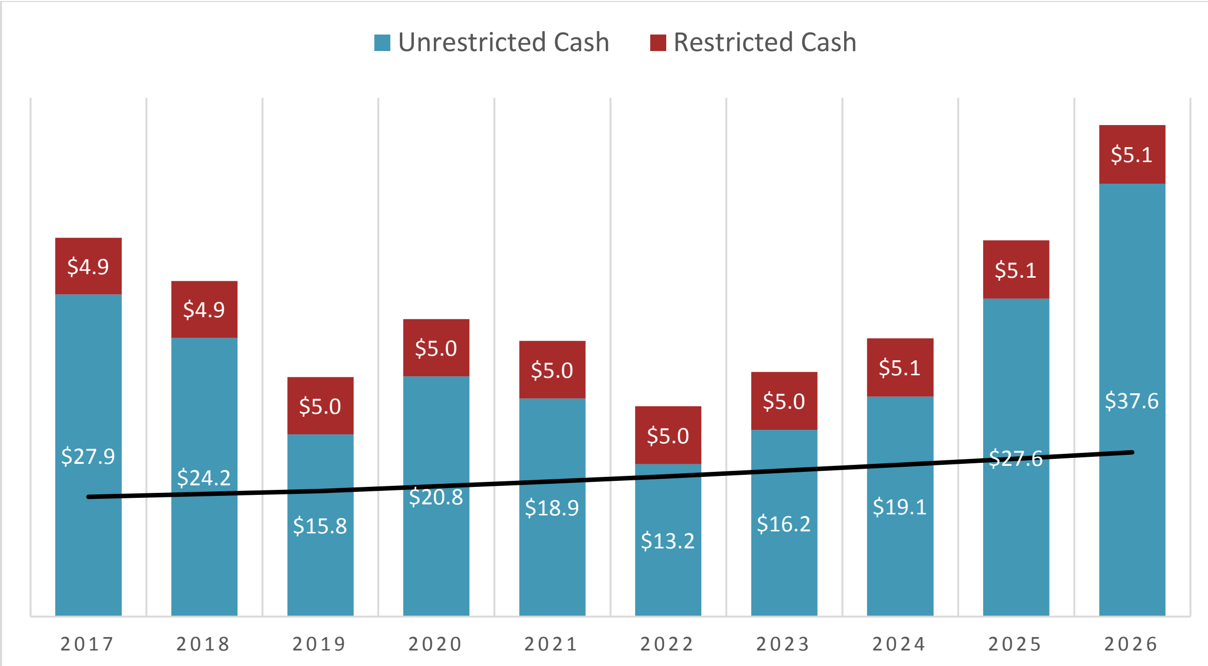
The credit worthiness of a municipality is largely impacted by cash reserves and debt service coverage. When evaluating debt service coverage, the credit agencies (Standard & Poor's, Moody's, and Fitch) will consider the metrics with and without the revenue from capacity fees since this revenue source is subject to volatility based on external factors. Figure 33 presents the total debt service coverage ratios with and without capacity fee revenue.

Figure 33. Total Debt Service Coverage



Cash reserves are another key financial metric that rating agencies will consider when evaluating DCRSD's credit profile. Reserves can be used in the event of unforeseen capital or operating expense, to help smooth projected rate increases, and to finance capital projects. Figure 34 shows the projected cash balances throughout the forecast period. Existing reserves are used to finance capital improvements over the first five years of the plan. The projected increase in reserves beginning in 2024 will likely be used for future O&M capital projects. The restricted cash balance includes funds which are required to be held by the revenue bond Trust Agreement.

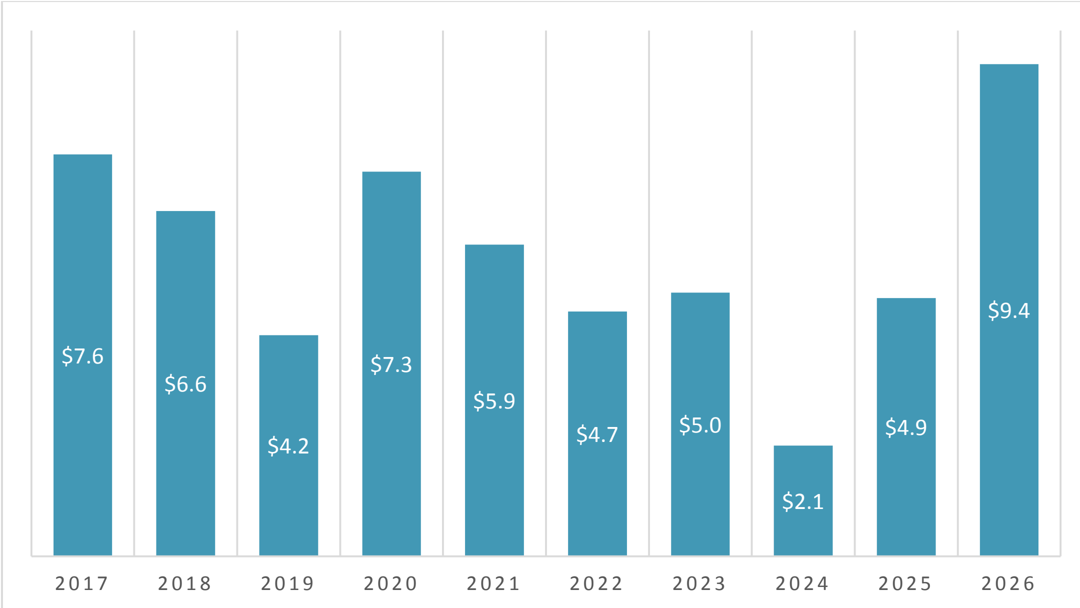
Figure 34. Projected Cash Reserves (Dollars in Millions)



Development capital projects were evaluated as a standalone component of the financial plan to identify the capacity fee revenues which would support the capital financing needs. The Master Plan projects capital spending over the next ten years based on all information known currently and variations in development and growth, which could vary significantly from this projection. However, **if growth does not materialize as projected, DCRSD will have the flexibility to defer projects to meet the meet the new timing without impacting the financing significantly.**

Meeting the Development capital financing needs requires a four-year increase to the capacity fee. The current fee of $5,900/ERU is projected to increase to $6,400/ERU in 2017, to $6,900 in 2018, $7,500 in 2019, and $8,100 by 2020 where it will remain throughout the forecast. In addition to these increases, elimination of the capacity fee surcharges is also recommended. Removal of the surcharges eliminates administrative burden for DCRSD staff and will promote the total system financial health. The projected capacity fee revenue is used to cash finance capital projects directly, to meet the annual debt service obligations related to borrowing for Development projects, and to maintain a targeted cash reserve position. The Development cash reserve projection is shown in Figure 35.

Figure 35. Development Fund Cash Reserves (Dollars in Millions)



The Development fund cash flow includes transfer of approximately 10% of capacity fee revenue to the O&M fund to recognize some continued growth in existing service areas. The O&M fund also transfers 3% of the annual sewer user charge revenue to the Development fund consistent with existing DCRSD ordinances. Development of Evans Farm is projected to be supported by TIF. The TIF earmarks a portion of future property tax revenue for DCRSD based on the idea that installation of the utilities helped to spur growth in the area. This $4.0 million in proceeds is projected to be received over a five-year period from 2018 through 2022.

In total, the stated conveyance and treatment projects will support safe and efficient service and bring new customers to the County, while rates and capacity fees for service can easily remain within industry standard ranges. The rates and fees proposed will set DCRSD on course to sustain their practice of sound fiscal and utility management.

9.0 Recommendations

The following section summarizes the various recommended improvement projects required to meet projected growth within Delaware County over the planning horizon.

9.1 Financial Recommendations

O&M capital funding needs require a 3% annual user charge increase in 2019 through 2023 and an increase to $39/ERU per month in 2024. Meeting the Development capital financing needs requires a four-year increase to the capacity fee. The current fee of $5,900/ERU is projected to increase to $6,400/ERU in 2017, to $6,900 in 2018, $7,500 in 2019, and $8,100 by 2020 where it will remain throughout the forecast. In addition to these increases, elimination of the capacity fee surcharges is also recommended.

9.2 Project Recommendations

The projects listed below are the Early Action and Short-Term recommendations of this Sanitary Sewer Master Plan. The projects described below were the basis of the Financial Recommendations defined in Section 9.1.

9.3 Collection System: Early Action Recommendations

- Peachblow PS Early Action Upgrade – Upgrade of the Peachblow Pump Station will permit near term growth (prior to the construction of the Central Alum Creek WRF) with flow conveyed to the ACWRF. This project, in conjunction with the New Lower Alum Creek Relief Pump Station, forcemain upgrade, and the downstream gravity sewer upgrade will permit flow from both the near and long term upgrade sizing of the Peachblow PS to be conveyed to ACWRF. This project is necessary to enable any growth beyond the Evans Farm development to be served by sewers with available downstream capacity. As there are a number of development tracts west of the Alum Creek Lake in the tributary area for this pump station, the immediate planning for the upgrade of this facility is considered a high priority. The estimated cost of this project is $1,440,200.
- Cheshire PS Upgrade – The upgrade of the Cheshire Pump Station and forcemain is necessary to meet existing requirements under peak wet weather conditions however the proposed size will allow for some growth within the basin. Long term, the proposed forcemain can continue to be used as growth continues however an additional pump station upgrade will likely be necessary in the to accommodate this, depending on the speed of growth in the tributary area. The estimated cost of this project is $2,733,200.
- Lower Alum Creek Relief PS – The Lower Alum Creek Relief Pump Station is a requirement prior to any improvements to the Peachblow PS or other development within the ACWRF tributary area along the west side of Alum Creek Lake. The estimated cost of this project is $7,609,400.

- Leatherlips Service Area I/I Study – This project is already ongoing per DCRSD however additional resources including flow monitors should be brought to bear as available to develop a more robust understanding of the tributary area. This project and the associated flow monitoring will not only yield a more accurate model of the sub basin but may also identify "low hanging fruit" type projects which can quickly address some of the larger sources of inflow and infiltration if they exist. The estimated cost of this project is $300,000.
- Clark Shaw Sewer – This sewer project was developed as a way of adding flow to the LSWRF and to serve new development areas north of Home Road outside of the OECC tributary basin. $4,000,000
- Berkshire Township PS –This new pump station will allow for removal of the Bent Tree package treatment plant. Flows received by this station will be directed towards the East Alum Creek system. The estimated cost for this project is $2,500,000.
- US 23 Sewers – These sewers open up additional sanitary capacity in new growth areas along US 23. $3,866,000.
- Lower Scioto WRF – Additional Service Upgrades needed to allow the facility to accept and treat flow. $1,500,000.
- Scioto Reserve WRF – Additional Service Upgrades needed to allow the facility to continue to operate efficiently. $1,500,000.
- Tartan Fields WRF – Additional Service Upgrades needed to allow the facility to continue to operate efficiently. $1,000,000.

9.4 WRF: Early Action Recommendations

- OECC Facility Plan – A Facility Plan for the OECC is needed to ensure that the large number of proposed improvements at this facility is coordinated. These improvements include a new headworks (pumps, grit removal, screening), aeration improvements, and the North Plant Rehabilitation. The estimated cost of this Facility Plan project is $500,000.
- OECC Headworks – The precise sizing and requirements of the new headworks proposed for the OECC will be determined as part of the facility plan. For the purposes of this evaluation and cost estimating, the pump station was assumed to need to be capable of handling the modeled 25-year storm. This includes the ability to screen and pump up to a firm 26 MGD peak. The estimated cost of this project is $15,009,800.
- Arc Flash Study – The Arc Flash Study is a comprehensive review and mapping of the plant electrical systems in order to develop safety requirements for live maintenance. The outcome of this work is to determine the necessary level of Personal Protection Equipment needed to safely do maintenance. This study is to be performed every five years and is a code requirement. The estimated cost of this project is $300,000.

- ACWRF Mixer and Aeration Upgrades – This project will add new mixers, blowers, air diffusers, and air piping per the recommendations of the Hazen and Sawyer Filter Study. The purpose of this upgrade project is to optimize the biological system to ensure that energy use is minimized while pollutant removal is maximized. The estimated cost of this project is $2,500,000.
- System Wide Electrical and I&C Improvements– As there was no additional capacity component to these improvements, they were discussed at length in Technical Memorandum #3. These improvements are necessary to synchronize electrical and control systems at the water reclamation facilities and to ensure worker safety and code compliance. In addition to equipment replacement, several improvements to the District's current I&C practices will also be implemented. The estimated cost of this project is $3,000,000.
- ACWRF and OECC Dewatering Improvements – The dewatering improvements at each facility were discussed at length in Technical Memorandum #3. The proposed improvements entail the installation of new sludge centrifuges at both ACWRF and OECC and the associated systems and appurtenances. The estimated costs of these projects are $1,710,000 and $1,570,000 respectively.
- OECC Cake Storage Improvements – The cake storage improvements are proposed to ensure that dewatered sludge can be safely stored at the OECC prior to ultimate disposal. This project, in conjunction with additional dewatering improvements at each major facility will increase the flexibility with regard to the removal of solids. The estimated cost of this project is $1,650,000.

9.5 Short Term Recommendations

The recommendations for the short term are not listed as Early Action projects in large part due to the need to complete a precursor project in advance or the need for additional flow monitoring. These projects can not be immediately constructed however the planning and preliminary design of these improvements should begin as soon as possible to ensure that the system is able to accommodate new growth and maintain the desired Level of Service.

- ACWRF Grit Removal Improvements – New grit removal tanks and equipment will need to be added to the existing preliminary treatment works if the source of the grit is found not to be the tertiary filters. This will increase the long term life of downstream mechanical equipment as well as maintain maximum available tank space and reduce a persistent maintenance issue. This equipment will need to be sized to accommodate approximately 12-15 MGD peaks that area anticipated during reasonable recurrence intervals and expandable to the peak rated flow of the ACWRF of 30 MGD. The estimated cost of this project is $4,995,800.
- OECC North Plant Rehabilitation – The evaluation of the existing north plant facilities is the first step to getting the north train of OECC back online. Significant upgrades are needed to all mechanical and electrical equipment as well as to the degraded concrete, coatings, diffusers, and air piping. Existing valves, gates, and other

equipment will need to be thoroughly inspected prior to any possible reuse. The estimated cost of this project is $9,300,900.

- West Alum Creek PS – The West Alum Creek Pump Station will be needed as the area around the proposed new high school develops. This area encompasses the entire northwestern corner of the Alum Creek Lake. The speed with which this growth occurs will be the driver behind this improvement project. This project can not be completed until the CACWRF is online. The estimated cost of this project is $3,725,500.
- Central Alum Creek WRF – Begin preliminary siting, sizing, and possible land acquisition for the development of this new WRF over the next 2 to 3 years. Ultimate timing for the startup of this facility will be at such time as either the Peachblow or Cheshire pump stations or downstream conveyance options no longer have available capacity for new development at the 25 Year Level of Service. The estimated cost of this project is $22,000,000.
- Central Alum Creek WRF Influent Gravity Sewer – Pursuant to completion of the Central Alum Creek WRF, install an influent gravity sewer to ensure additional tributary areas projected near the new facility can be conveyed to it. The pace of surrounding development will impact the timing of this improvement. The estimated cost of this project is $5,000,000.
- East Alum Creek PS – This project is intended to replace the existing East Alum Creek Pump Station with a regional pump station that will supply flow from the northeastern edge of Alum Creek Lake and the 36/37/I71 interchange area to the new CACWRF. This facility will continue to convey flow via Cheshire Pump Station until this upgrade is complete at which point the upsized pump station and forcemain will be one of two major influent pump stations to the CACWRF. This improvement may be needed earlier than anticipated due to rapidly changing development scenarios in its tributary area. If such development occurred, this improvement could be completed earlier than planned in this document. Downstream conditions at Cheshire PS will need to be investigated and shown to be adequate to accept more flow and/or earlier development of the CACWRF may be necessary. The estimated cost of this project is $3,442,200.
- Seldom Seen Forcemain Redirection – The Seldom Seen Forcemain redirection is a project that will either reduce the overall pump station count by consolidating flow at larger regional pump stations, in this case, Trotters Gait or reduce the length of forcemain needed to convey flow to the OECC. This project would remove flow from the Leatherlips tributary area which may impact the wet weather surcharging seen there. The Leatherlips I/I investigation and additional model calibration in that sub basin should be completed prior to the redirection of this forcemain or elimination of the Seldom Seen Pump Station. The estimated cost of this project is $268,800.
- Golf Village Relief Sewer – This project is intended to relieve the wet weather surcharging that already exists upstream of the Golf Village Pump Station while also opening up additional gravity sewer capacity in the Powell area. The construction of this relief sewer will reduce the risk of overflows by replacing a mechanical system

with a gravity line and will allow for additional HSTS to be replaced with sewer if desired. This sewer will convey flow from a large tributary area which has some remaining available land for development. The estimated cost of this project is $9,390,500.

- Olentangy River Trunk Sewer Parallel Relief Sewer – The Olentangy River Trunk Sewer Parallel Relief Sewer is a project that is intended to supplement the gravity sewer capacity of the main trunk sewer which runs north from the OECC along the Olentangy River. Currently this trunk sewer conveys the bulk of the OECC tributary area but as it is extended north, it has begun to encounter capacity constraints. The construction of a parallel relief sewer will provide additional capacity for development in the OECC basin along the Sawmill Parkway Extension at a lower cost than expanding the existing trunk sewer. It is anticipated that this relief sewer could be extended farther north as additional capacity is needed however at this time, only the southern phase is included. The estimated cost of this project is $8,755,800.
- Peachblow Gravity Sewer Upsizing – This project, in conjunction with the new Lower Alum Creek Relief Pump Station, will permit additional flow resulting from the projected upgrades to Peachblow PS to be conveyed to ACWRF. This project is necessary to enable any growth beyond the Evans Farm development to be served by sewers with available downstream capacity. This project is projected to be completed alongside the Peachblow PS Long Term Upgrade. The estimated cost of this project is $3,929,900.
- Peachblow PS Long Term Upgrade – This pump station will need to be upgraded again over the long-term timeframe if development continues to occur upstream as currently projected. The necessity of this improvement will be based upon the speed and location of development on the west side of the Alum Creek Lake. Additional flow modeling should be completed prior to the design and construction of this upgrade to ensure projected flows match what is actually generated. The forcemain from the Peachblow PS Early Action Upgrade project should still be sufficient for the new pump station sizing. The estimated cost of this project is $2,987,000.
- Liberty Sawmill Phases 1 and 2 – These projects will expand the sewer availability to areas north of Home Road and allow for the elimination of the Golf Village North Pump Station. $10,000,000.

9.6 Other Recommendations

Because future development is difficult to predict, it is recommended that the District reevaluate development within the County periodically. The District should revisit and update this Master Plan on a regular basis to reflect accurate population estimates, growth trends and changes in assumptions used as the basis of this Master Plan. If growth does not materialize as projected, DCRSD will have the flexibility to defer projects to meet the new timing without impacting the financing significantly.

Appendices

Appendix A – Data and Document Collection Summary

Data and Document Collection Summary			
Category Type Title	**Date**	**Summary**	**Source**
		Key for Government Planning Reports	
		New/updated information, significant changes or key growth area =	
		New/updated information, minor changes to past or relevant growth area =	
		No new information, similar growth to past projections or less impactful growth area =	
Planning & Development			
Township Comprehensive Plans			
Berkshire Township	8/11/2008 (Update in Progress)	Recommends continued growth contiguous to existing areas. Concerns about the ability of the rest of the Township services to keep up with higher density growth.	DCRPC
Berlin Township	9/8/2014	Details existing and projected future development patterns. Anticipates future residential growth at varying densities. Future build out goals include maintaining 1-2 acre minimum lot size similar to Berkshire and Genoa Townships.	DCRPC
Brown Township	7/10/2001	Anticipated maintaining close to existing level of build out for the near future. Farmland with pockets of low density housing is to be expected. HSTS or Delaware City sewer system will be used.	DCRPC
Concord Township	2/23/2004 (Update in Progress)	The Comprehensive Plan was developed prior to the Lower Scioto WWTP being built. The ability to direct gravity flow to this facility will have had a significant impact on their utility planning. The 2004 plan desired managed low density growth on the magnitude of the existing. HSTS and package plants were the only means of wastewater treatment at the time. A draft version of a 2015 update to this plan has been reviewed and projects increasing growth east of the Scioto as well as in the southern portion of the township adjacent to Dublin and Shawnee Hills.	DCRPC
Delaware Township	N/A	No Plan. Zoning map highlights mainly farmland and low density residential development. Future treatment likely to be handled by Delaware City system.	DCRPC
Genoa Township	12/8/2008 (Update in Progress)	Recommends continued low density development across the Township. HSTS systems and sewer where available are recommended to be used.	DCRPC
Harlem Township	1/23/2008	Recommends continued low density development across the Township with the exception of the southern part of the Township. HSTS systems and sewer where available are recommended to be used. Sewer in the southern part of the Township may be available in the future but would be provided by the City of Columbus. The City of Columbus is currently developing preliminary alignments for a proposed trunk sewer that will provide capacity to the agreement service area with the City in Harlem Township.	DCRPC
Kingston Township	7/2/2008	Township is zoned primarily low density residential or agricultural. There are currently no sanitary sewers available except in the Northstar area. All others are served by HSTS. Future low density development suggests that HSTS will be the primary means of providing sewage service for the foreseeable future.	DCRPC
Liberty Township	3/20/2006	Liberty Township is subject to extensive development along the northern boundaries of existing development. Proposed densities range from 0.75-1.25 units per developable acre for residential development however significant commercial development has occurred in the past along major transportation corridors and would be anticipated to continue. The Perry-Taggart trunk line opened up the northern portion of the Township to additional development prior to the 2008 recession. Future growth is anticipated to follow existing single family densities with the potential for denser development along the major thoroughfares of Sawmill Parkway, US 23, and SR 315. Increased availability of sewer service will likely lead to smaller lot sizes and greater infill development.	DCRPC
Marlboro Township	N/A	No Plan. Zoning map shows almost entirely farmland. No Sewer likely in the near future due to distance from existing WWTPs and low existing densities. All HSTS.	DCRPC
Orange Township	7/19/2010 (Update in Progress	Orange Township has had significant development in the 1990s and 2000s with most of the Township being built out with residential subdivisions, commercial, and light industrial development. The northwest edge of the Township is the main area remaining undeveloped though there is significant pressure along US 23. Sanitary Sewer service is provided both by ACWRF and OECC, with some of the flow pumped (prior to the plant influent stations).	DCRPC

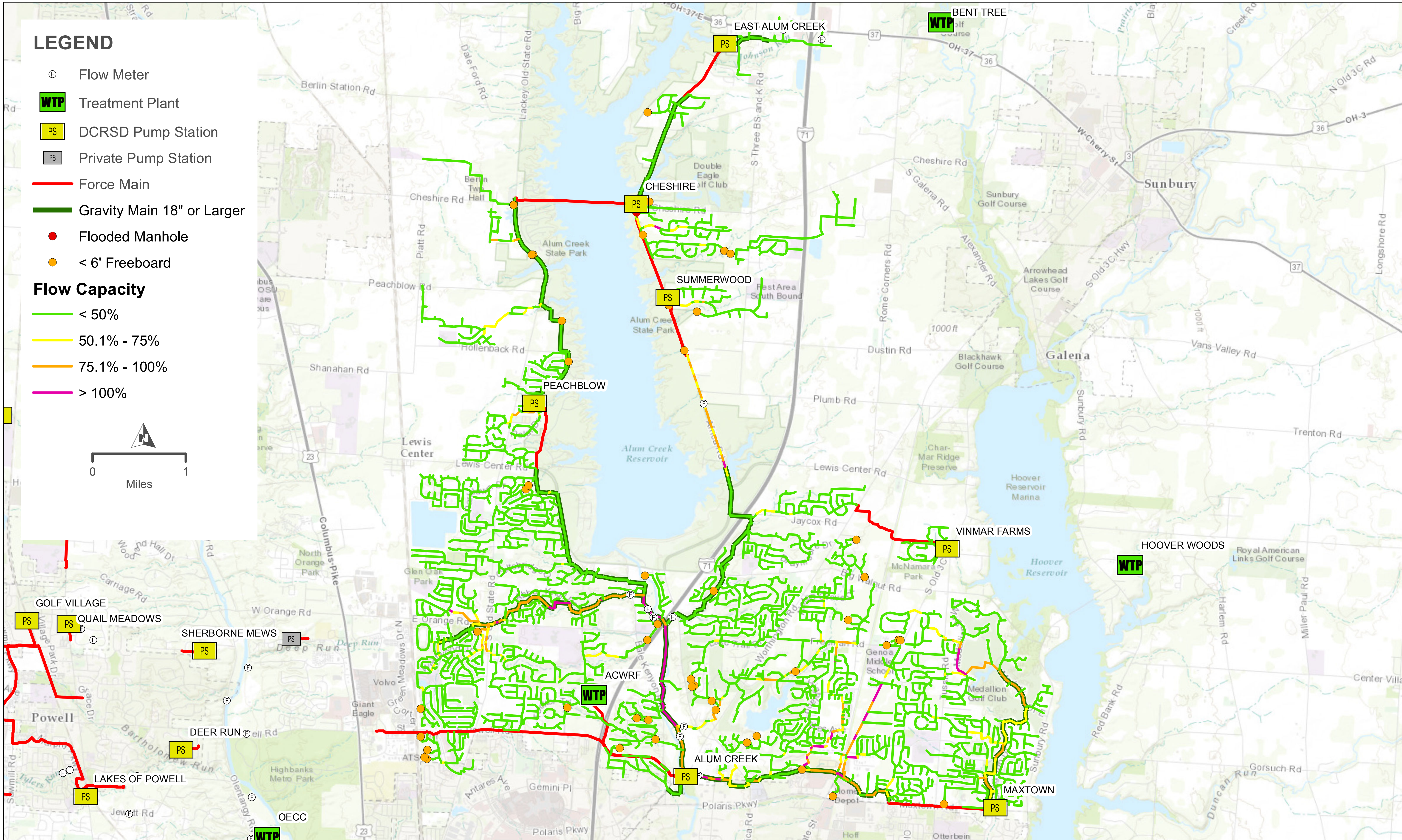
		The Township has sewer service for all areas however local capacity and conveyance is not necessarily available.	
Oxford Township	12/12/2006	Township is zoned primarily low density residential or agricultural with the exception of Ashley. There are currently no sanitary sewers available outside of Ashley. All areas are served by HSTS. Future low density development suggests that HSTS will be the primary means of providing sewage service for the foreseeable future. Oxford Township has stated in their 2000 Comprehensive Plan that they do not desire the increased development density that could come with expansion of sanitary sewers. Any future addition of sewers in this area would likely be related to zero effluent systems or an expansion of the Ashley service area.	DCRPC
Porter Township	2000	Township is zoned primarily low density residential or agricultural. There are currently no sanitary sewers available. All areas are served by HSTS. Future low density development suggests that HSTS will be the primary means of providing sewage service for the foreseeable future.	DCRPC
Radnor Township	N/A	No Plan. Zoning map shows almost entirely farmland. No Sewer likely in the near future due to distance from existing WWTPs and low existing densities. All HSTS.	DCRPC
Scioto Township	8/10/2005	The bulk of Scioto Township is zoned for agriculture or low density residential with all home sewage service provided by on site treatment systems. It is anticipated that this type of densities and growth will continue in the Township. Longer term, the location of the Lower Scioto WWTP will allow for sewers to be installed in the direction of Scioto Township and may facilitate denser development in the future.	DCRPC
Thompson Township	N/A	No Plan. Zoning map shows almost entirely farmland. No Sewer likely in the near future due to distance from existing WWTPs and low existing densities. All HSTS.	DCRPC
Trenton Township	1/7/2004	Trenton Township does not have any sanitary sewers provided by Delaware County. While zero discharge systems are permitted, the existing and proposed density of the Township likely makes sanitary sewers unfeasible in the near term.	DCRPC
Troy Township	4/15/2002	No sewer likely from County in near term. Central Olentangy Service Area includes parts of the south central has been discussed with treatment provided by the City of Delaware. Currently all HSTS or Delaware City Sewers.	DCRPC
Incorporated Area Plans			
Ashley	7/19/2005	Map of areas zoned for development beyond existing built areas.	
Delaware Collection System Master Plan	2004	Plan lays out Design Criteria for existing and future sewers as well as existing and future capacity projections and constraints. Identifies and proposes alternatives for providing sewer service to existing areas and new service for growth areas.	City of Delaware
Dublin	N/A	Dublin maintains a significant sanitary sewer system which contracts with the City of Columbus for treatment for their approximately 6mgd of sewage. There are no plans to have DCRSD handle any sewage flows in the near future.	Dublin Website
Galena		Galena has developed maps for long term zoning and density. These plans have been developed in concert with Columbus and DCRSD.	DCRPC
Ostrander		The Village of Ostrander maintains zoning and density maps with the DCRPC. These maps show existing and proposed future developable areas.	DCRPC
Powell – Draft Comprehensive Plan	8/9/2015	Provides existing land use summary as well as recommendations for future land use and transportation improvements. This includes projections for northward growth along Sawmill Parkway.	DCRPC
Shawnee Hills Comprehensive Plan	12/12/2011	Detailed existing zoning and plans for future growth as well as existing sanitary facilities. Current sewer system flows to the City of Columbus. No sewage is planned to be sent to DCRSD.	Land Use Plan on DCRPC website
Sunbury - Proposed Sewer Extension		Plan outlines proposed sewer and new residential and commercial development areas from Sunbury to I-71 along 36/37.	Sunbury
Westerville	N/A	Discussions with the City of Westerville determined that only small areas of the City are planned or are already served by DCRSD. Areas currently under development or already developed are covered by existing service agreement.	Conversation Record
Zoning Maps			
Maps & Use Plans	Multiple	These maps have been updated at various times over the last 10 years and represent a snapshot of future projected development densities.	DCRPC
Columbus Far North Area Plan	9-15-2014	Long range plan for Columbus north of 270. Focuses on the type of development/density that already exists in the area and highlighting areas for new development and the type and density that is envisioned.	DCRPC
County Departments and Public Entities			
DelCo Water	2014 (For Master Plan)	Provided their shapefiles, master planning documents, and information related to the cost sharing of new assets.	DelCo Water
DCRPC Annual Reports	Updated annually, 2001 through 2014	Includes growth rates, lot approval numbers, acres rezoned, developments approved, highlights of large developments, building permits issued by year, density review.	DCRPC
Delaware Strategic Plan	2014	Compiled in 2014 by Regionomics, this report details population growth and other projections for Delaware County.	DCRPC
Delaware County Building		Total Number of Building Permits issues by Township & Municipalities from 1993 through June 2014. Total Number of Unincorporated Area Building	DCRPC

Permits		Permits for Townships & Municipalities from 2007 through June 2015. Approved lots from 1987 through 2014.	
Delaware County Sewer Permits		Microsoft Access File with county numbers, property addresses, permit numbers, issue date & inspection date.	DCRSD
Delaware County Census Data		Shows general growth on 10 year increments. Last census was taken in 2010.	US Census Bureau, DCRPC and MORPC.
MORPC, Balanced Growth Plans for Big Walnut, Olentangy, and Scioto Watersheds		Provided multiple reports related to the longer term development of southern Delaware County, primarily focused on transportation issues. Sustaining Scioto Report and Balanced Growth Plans both related to Delaware County.	MORPC
Delaware County Health Department		The Health Department reviews soils reports and provides insight on the installation of HSTS. They also maintain a comprehensive list of existing HSTS within the county as well as ensuring that they do not become a nuisance.	Health Department Records
County Engineer		County engineer sources provided detailed plans for new transportation projects at various stages of implementation, primarily over the next 5 years.	Delaware County Engineer
Regulatory			
State Water Quality Management Plan Including Section 208 Areawide Waste Management Plans	2006	Adopted by Delaware County in April 2006, the State 208 Plan allowed the County to provide sanitary sewer service in the unincorporated areas of the County. The Agency's review of water quality conditions and wastewater facility needs found that large scale regional planning is appropriate and necessary.	OEPA DSW Water Quality Management Program
TMDL's			
Olentangy River Watershed TMDL	8/27/07 (Update in Progress)	Identifies impairment and restorative measures on various segments of the Olentangy River in Delaware and Franklin County.	OEPA
Big Walnut Creek TMDL	8/19/05	Identifies impairment restorative measures on various segments and branches of Big Walnut Creek, including Alum Creek in Delaware and Franklin County.	OEPA
NPDES Permits			
Scioto Reserve	Current	LAMP Permit	DCRSD
Scioto Hills	Current	Discharge Permit	DCRSD
OECC	Current	Discharge Permit	DCRSD
Northstar	Current	LAMP Permit	DCRSD
LSWRF	Current	Discharge Permit	DCRSD
Bent Tree	Current	Discharge Permit	DCRSD
ACWRF	Current	Discharge Permit	DCRSD
Tartan Fields	Current	LAMP Permit	DCRSD
Sewer District			
Planning			
Capital Improvement Plan	10/14	District prepared a CIP outlook in late 2014 to reflect budgeting that would projects that would accommodate more aggressive development. Improvements were delineated by category, need, type and schedule.	DCRSD
RSD Central Alum Creek Sewer Study	2010	Report to identify approach for providing sanitary sewer service to Alum Creek WRF tributary area B.	DCRSD
RSD Crownover Farms Study (Exhibits A & B)	2014	Report to identify service to new development along Alum Creek, east of Africa Road.	DCRSD
Flow Monitoring Data - Portable Sewer Meters	2015	Flow data from various monitoring stations and plants. Contains location map, time & date, velocity, flow and graphs.	DCRSD
GIS Shapefiles	2015	Sewer layers maintained by the District.	DCRSD
Sewer Inspection Conditions Assessment	2015	PACP & MACP Classifications completed by District Staff as part of cleaning activity.	DCRSD
CSO & SSO Annual Reports	Varies	2011-2014 Annual Reports to OEPA for each Facility	DCRSD

Collection System - Pump Stations			
Equipment Summary	Varies	Pump description and test data & OEM Pump O&M manuals. Undated test data.	DCRSD
Operations Data	Varies	Pump Runtimes, data files, and operator reports (2010-2014) for all pump stations.	DCRSD
Maintenance Data	2012-2015	Description of problem areas and pipe repairs	DCRSD
Plans and As Builts	Varies	Plans for Vinmar, Scioto Reserve, Peachblow, Cheshire, Maxtown, Leatherlips, Golf Village, East Alum Creek and Alum Creek	DCRSD
Service Agreements			
Sunbury 208 Plan	July, 2004	Identifies area surrounding Sunbury (Delaware Co. Townships) as potential area to be served by Sunbury sewers and WWTP.	DCRSD
City of Columbus	11/12/91	Agreement between City of Columbus and Delaware County	DCRSD
	6/4/09	Memo between City of Columbus and Delaware County for Lower Big Walnut Service Area	DCRSD
	7/12/12	Modification to Agreement between City of Columbus and Delaware County	DCRSD
City of Delaware	1/29/07	Agreement between City of Delaware and Delaware County for Area SW of City of Delaware	DCRSD
	9/22/08	Amendment to service area between City of Delaware and Delaware County for Area S & SW of City of Delaware	DCRSD
	4/1/09	Map detailing Service Area agreements between City of Delaware and Delaware County	DCRSD
City of Dublin	8/22/94	Agreement between City of Dublin and Delaware County	DCRSD
	4/24/00	Agreement between City of Dublin and Village of Shawnee Hills	DCRSD
City of Westerville	4/22/02	Agreements between City of Westerville and Delaware County	DCRSD
	7/17/14		DCRSD
Concord/Scioto Community Authority	9/30/13	Resolution between Concord/Scioto Community Authority and Delaware County regarding a Subdivider's Agreement	DCRSD
	10/3/13	Modification to Agreement between Authority and Delaware County	DCRSD
Delaware County	6/2/69	Creation of DCRSD	DCRSD
Delaware County - Cheshire Elementary School Sub-District	7/13/11	Memo establishing surcharge fee for Cheshire Elementary School Sanitary Sewer Improvements	DCRSD
Delaware County - Cheshire Pump Station Sub-District	7/18/11	Establishing Capacity Fees	DCRSD
Delaware County - Leatherlips Sub-District	9/25/06	Amending capacity fees	DCRSD
Delaware County - Liberty Park Pump Station Sub-District	6/2/14	Establishing Capacity Fees	DCRSD
Delaware County - Liberty Township	10/28/13; 1/9/14; 3/20/14; 6/2/14	Multiple resolutions: Sanitary Sewer Extension & funding formula; Amending user charges; Sanitary Sewer Improvements; Establishing Capacity Fees	DCRSD
Delaware County - Perry Taggart Sub-District	1/8/07	Amending capacity fees	DCRSD
Delaware County - Regional 1A	9/25/06	Service Area Modifications	DCRSD
	7/18/11		DCRSD
	8/20/12		DCRSD
	3/21/13		DCRSD
Delaware County - Subdivider's Agreement	10/01/13	Agreement between Delaware County & Donald Kenney for Scioto Reserve Gold Club Community Subdivision	DCRSD
Union County	1/28/98	Agreement between Union County and Delaware County	DCRSD
Village of Galena	11/24/03	Resolution to separate from DCRSD	DCRSD
	3/7/05	Settlement Agreement and release between Village of Galena and Delaware County	DCRSD
	11/2003	Wastewater Planning Study for planning area, sewer system, and existing treatment evaluation.	DCRSD
Village of Shawnee Hills	12/12/11	Sanitary House Lateral Connection Specifications	DCRSD
Treatment Plants			
Operations & Maintenance Manuals			

OECC Manual	July 1979	For North train only (out of service)	DCRSD
OECC Centrifuge Manual	2008	Equipment Manufacturers Manual	DCRSD
ACWRF Manual	6/27/03	Complete Plant Manual, less figures	DCRSD
OECC Equipment Summary	January 2008	Inventory of large machinery & preventative maintenance; List of model & serial numbers & general preventative maintenance procedures	DCRSD
<u>Operations Data</u>			
OECC Equipment Run Times	2015	Description of general practice on equipment run times	DCRSD
OECC Weekly Plant Reports	1/2006 - 12/2014	Influent, Effluent & Process Control data only from 2006 - 2014	DCRSD
ACWRF Operations Lab Sheets	1/2012 - 6/2015	Process control and biosolids data only from 2012 - Mid 2015. multiple Three samples per day;	DCRSD
OECC - Solids Hauling Costs		Cost and volume of for sludge hauling contractor - excludes cost & volume hauled by County since 2014	DCRSD
OECC & ACWRF - Polymer Costs		Annual expense for polymer 2010-2014	DCRSD
OECC & ACWRF - Solids Hauling	2012-2014	Annual totals for Solids Hauled	DCRSD
OEPA Sewage Sludge Report	2010 - 2014	2010-2014 Annual Reports for Scioto, OECC, Lower Scioto, Hoover Woods, Bent Tree and ACWRF	DCRSD
Monthly Operating Reports (OEPA 4500 Forms)	1/13 - 3/15	MOR's for Scioto Reserve, Scioto Hills, OECC, Northstar, Bent Tree, ACWRF, Tartan Fields and Hoover Woods	DCRSD
<u>Maintenance Data</u>			
DCRSD maintenance records	6/4/13 – 5/21/15	2 years of maintenance tasks for pump stations and treatment facilities	DCRSD
DCRSD maintenance schedule	2016-2017	2 years of preventative maintenance schedule (asset & location, not specific maintenance activity)	DCRSD
Financial			
Asset List		1/13 - 3/15	DCRSD
Bond Trust Agreements		Trust Agreement for outstanding revenue bonds, if applicable. Included 2007 and 2014	DCRSD
Comprehensive Annual Financial Reports		Three years of annual reports from 2012-2014	DCRSD
Budget Reports		Reports by Facility	DCRSD
Sewer Capacity Charge		Surcharge and Capacity Fees for plants	DCRSD
Sewer Customer Quantity		2015-1997 Table of growth of residential users equivalents and income growth	DCRSD
User Charges and Revenue Data		Revenue Summary from 2012 to 2014	DCRSD

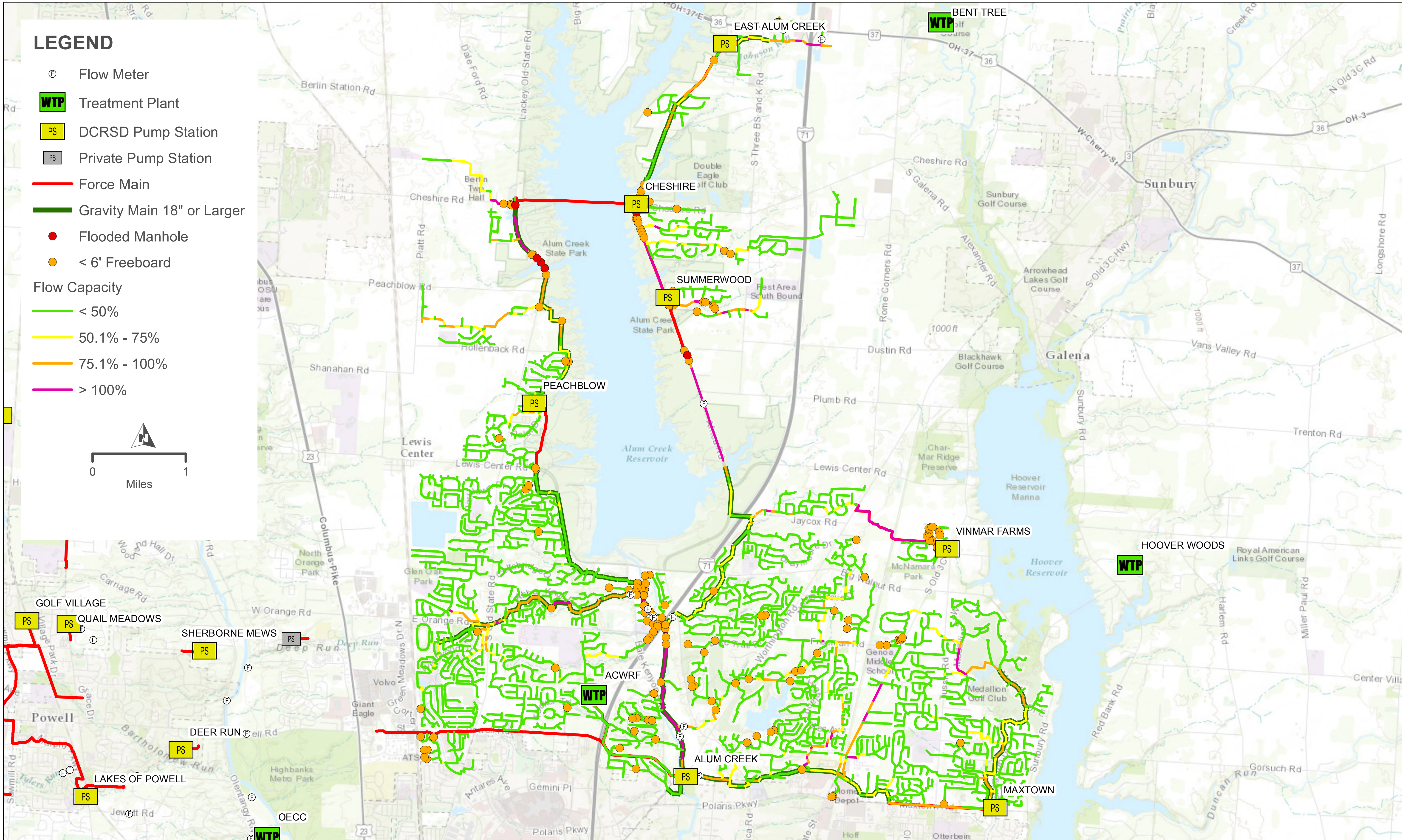
Appendix B – Hydraulic Model Summary Maps



ACWRF BASIN 25-YEAR EVENT MODEL RESULTS (EXISTING CONDITIONS)

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN

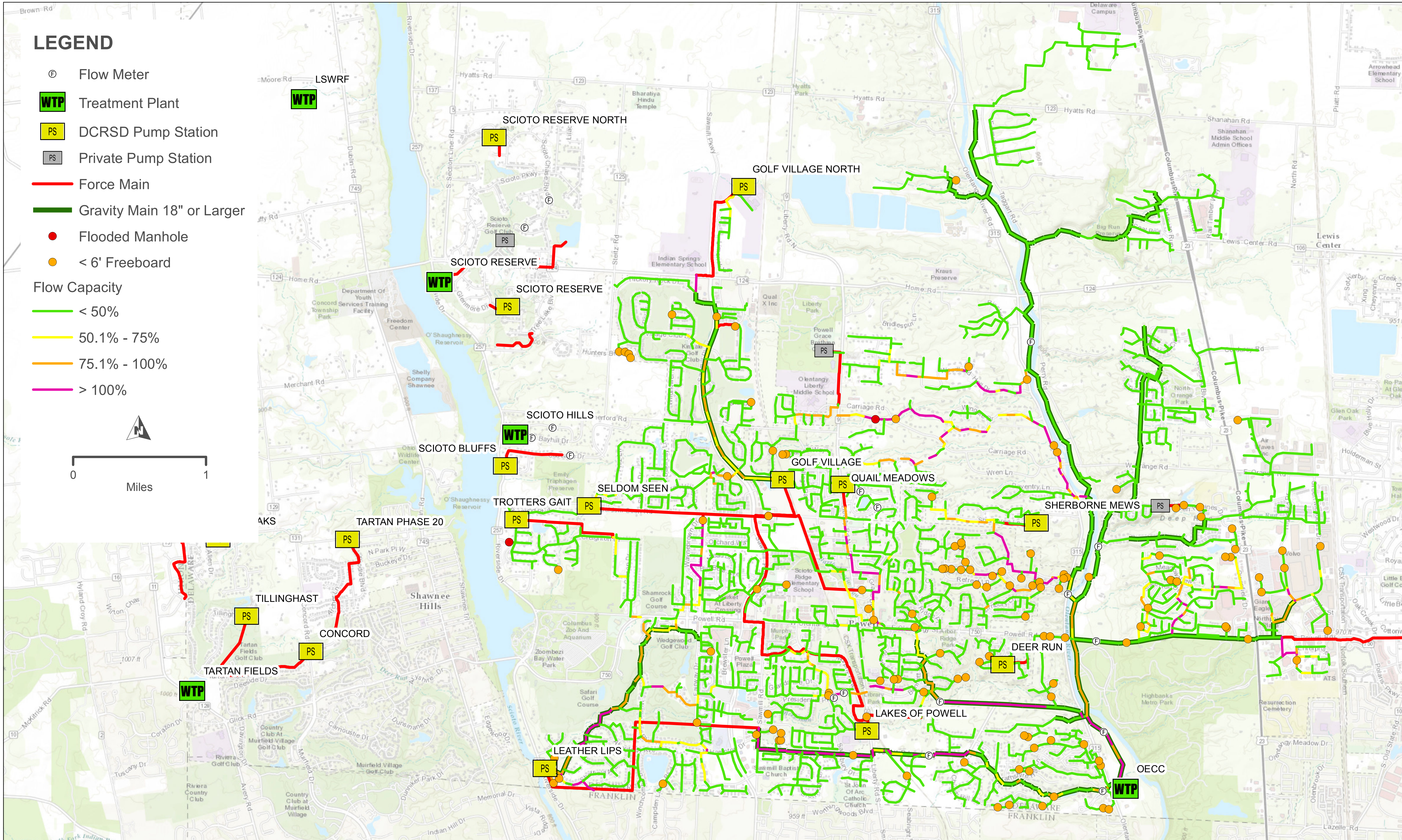
FIGURE 36



ACWRF BASIN 25-YEAR EVENT MODEL RESULTS (FUTURE CONDITIONS)

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN

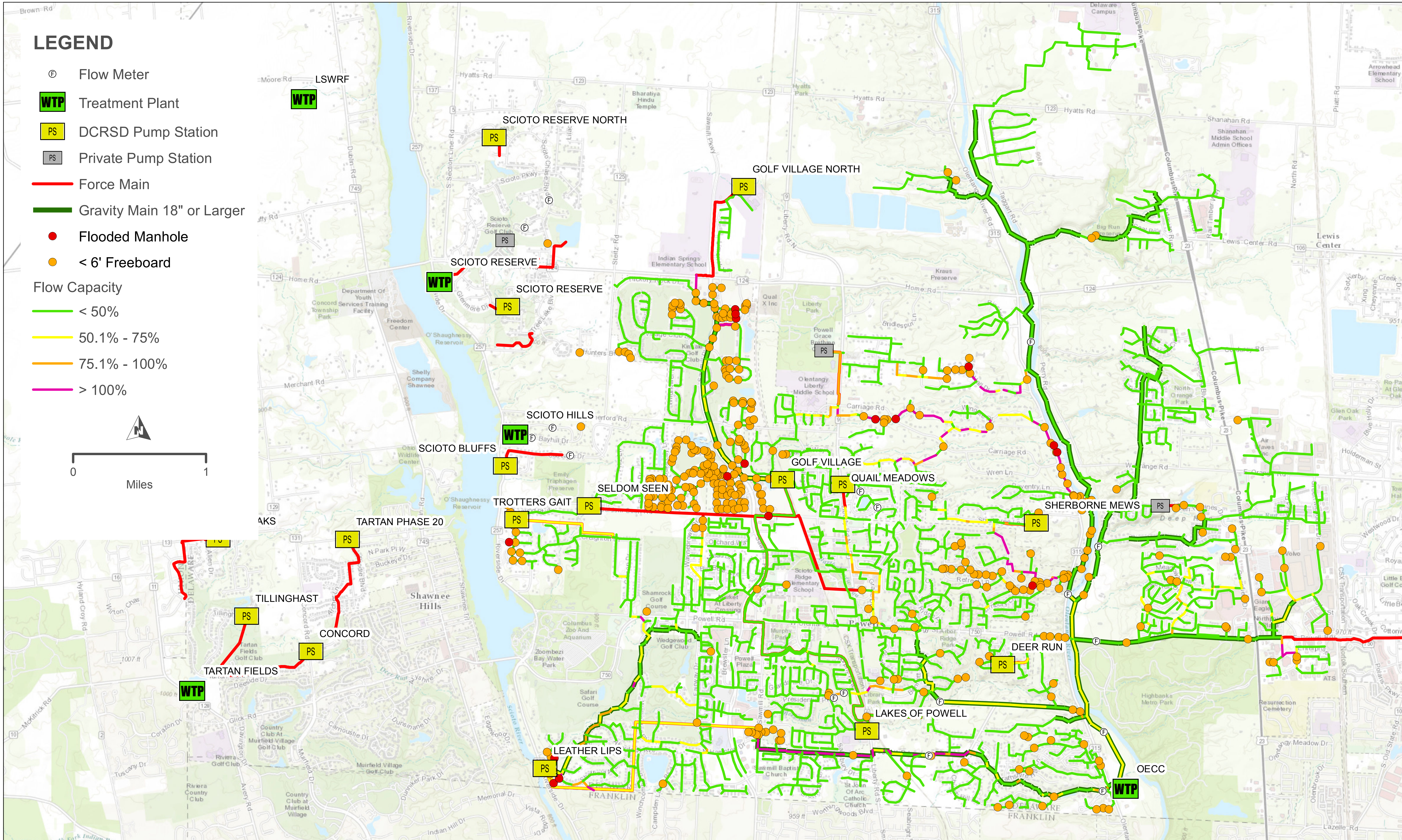
FIGURE 37



OECC BASIN 25-YEAR EVENT MODEL RESULTS (EXISTING CONDITIONS)

DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN

FIGURE 38



OECC BASIN 25-YEAR EVENT MODEL RESULTS (FUTURE CONDITIONS)
DELAWARE CO. REGIONAL SEWER DISTRICT - SANITARY SEWER MASTER PLAN
FIGURE 39

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