LOWHILL TOWNSHIP

LEHIGH COUNTY AUTHORITY

Sewer Capacity Assurance and Rehabilitation Program (SCARP) Implementation Outline

Western Lehigh Sewerage Partnership

August 1, 2018

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Acronym List

10YR24Hr	10-year 24-hour
AO	Administrative Order
ARV	Air Vacuum Release Valve
BEM	Broadband Electromagnetic
CCTV	Closed Circuit Television
CMOM	Capacity, Management, Operations, and Maintenance
CIPLL	Cured in Place Lateral Lining
CIPPL	Cured in Place Pipe Lining
COA	City of Allentown
FEB	Flow Equalization Basin
I/I	Inflow/Infiltration
JCI	Jordan Creek Interceptor
KCE	Keystone Consulting Engineers
KISS	Kline's Island Sewer System
KIWWTP	Kline's Island Wastewater Treatment Plant
LCA	Lehigh County Authority
LF	Linear Feet
LMT	Lower Macungie Township
LLI	Little Lehigh Interceptor
LLRI	Little Lehigh Relief Interceptor
LOP	Level of Protection
LOS	Level of Service
MGD	Million Gallons per Day
O&M	Operations and Maintenance

PADEP	Pennsylvania Department of Environmental Protection
PTP	Pre-Treatment Plant
RDII	Rainfall Derived Inflow and Infiltration
SCARP	Sewer Capacity Assurance and Rehabilitation Program
SCPS	Spring Creek Pump Station
SRP	Source Reduction Program
SSES	Sanitary Sewer Evaluation Study
SSO	Sanitary Sewer Overflow
TTI	Trexlertown Interceptor
UMiT	Upper Milford Township
UMT	Upper Macungie Township
USEPA	United States Environmental Protection Agency
WLI	Western Lehigh Interceptor
WLSP	Western Lehigh Sewerage Partnership

1. Introduction

Between 2000 and 2008, the Kline's Island Sewer System (KISS) experienced sanitary sewer overflows (SSOs) approximately twice per year, typically during significant rainfall, following snow melt, or during the second of back to back moderate (e.g., two 2" rain events separated by only a few days) rain events. Typically, SSOs were documented at several locations during these events, primarily in the Lehigh County Authority's (LCA) Western Lehigh Interceptor (WLI) and the City of Allentown's (COA) Little Lehigh Interceptor (LLI) and Jordan Creek Interceptor (JCI). The Kline's Island Wastewater Treatment Plant (KIWWTP) Outfall 003 bypass also activated at about the same frequency.

In Fall 2010, LCA constructed a 3MG Flow Equalization Basin (FEB) at the LCA Pretreatment Plant (PTP) to intercept peak flow from the top 1/3rd of the LCA system, including most of the industrial flows in the LCA system. The LCA FEB significantly improved wet weather performance throughout the entire KISS, decreasing SSOs in the LCA and COA interceptors and use of Outfall 003 to frequency of about once every 18 months, or a three-fold increase in level of protection (LOP).

In 2009, peak flow issues in LCA and COA interceptors arising from the collection systems connected to them caused the Pennsylvania Department of Environmental Protection (PADEP) to begin reviewing sewer system extensions in each of the KISS communities. LCA sewer conveyance systems and the collections systems connected to it (namely Upper Milford Township, Weisenberg Township, Lower Macungie Township (LMT), Upper Macungie Township (UMT), Lowhill Township, Alburtis, and Macungie) formed the Western Lehigh Sewerage Partnership (WLSP) in 2009 to jointly complete these efforts within the LCA portion of the KISS. Pursuant to communications with PADEP and in accordance with Chapter 94 requirements, in 2009 LCA and the above municipalities prepared and subsequently implemented an investigation plan to locate sources of leakage, identify capacity-limited conveyance components, and evaluate long-term solutions. Subsequent to that, LCA and the WLSP prepared and began implementing corrective action plans to collectively address the problems in the LCA and COA interceptors and within each of the LCA-connected sanitary sewer systems. These investigation findings have been previously presented to both PADEP and the United States Environmental Protection Agency (USEPA) in multiple reports and presentations.

This SCARP Implementation Outline (SIO) presents the WLSP's plan to address PADEP 2009 Chapter 94 concerns, USEPA Administrative Order concerns, and other related

long-term wastewater needs for the Partners. It satisfies the requirements for the Capital Improvements Plan, Long-term Asset Management Plan, and Program Management Plan aspects of the original October 2009 SCARP Program Approach Outline. The WLSP expects the existing Connection Management Plan to remain in place while this plan is being implemented, subject to additional discussion with PADEP.

This SIO is also being submitted to USEPA in response to a Compliance Order (Administrative Order) issued in 2009 to COA and all municipal dischargers (Signatories) to Allentown's KIWWTP. On April 3, 2018, USEPA requested a common Regional Flow Management Strategy be prepared jointly by all KISS Signatories to address wet weather overflow issues; this Implementation Outline serves as the WLSP's submission of I/I Source Reduction Programs required to be included in the Regional Flow Management Strategy submittal.

Several components of the KISS are used by multiple Signatories. COA's LLI and JCI convey flows from all Signatories. Planned growth from all the Signatories will add additional flows to these interceptors. LCA manages both dry-day and wet-weather flows in COA's LLI and JCI to the extent possible using LCA's Spring Creek Pump Station, Park Pump Station, and Flow Equalization Basin, allowing all other Signatories to flow via gravity to KIWWTP. However, because other Signatories also discharge into the COA interceptors, it is not possible for LCA alone to control all dry-day and wet-weather hydraulic restrictions in the KISS, and future overflows are likely on both a dry-day and wet-weather basis if regional infrastructure is not added beyond the works described in the various Signatory plans. In light of this, LCA requests PADEP review the Regional Flow Management Strategy along with our Implementation Outline and the other Signatory plans to determine how additional regional corrective action plans or connection management plans should be implemented.

1.1. System Overview

There are 290 miles of sewer mains in the above municipalities and LCA's system that discharge through the Western Lehigh Interceptor. Approximately 18,000 wastewater connections are served by these systems.

1.1.1. Lehigh County Authority

In 1972, Lehigh County and Lehigh County Authority placed into service a sanitary sewer interceptor system in western Lehigh County to convey wastewater from the Boroughs of Alburtis and Macungie and the Townships of Upper and Lower Macungie to Allentown's Allentown/Emmaus Interceptor. Today, the system additionally serves portions of the Townships of Weisenberg, Upper Milford, and Lowhill, and portions of the Borough of Emmaus. The interceptor system, known as the Western Lehigh Interceptor (WLI) System, consists of 18 miles of gravity sewers ranging in size from 8 inch to 36 inch diameter pipe, one relief pumping station and force main (Spring Creek Road Pump Station), and five meter stations. Wastewater from the WLI discharges into the Allentown/Emmaus Interceptor at Keck's Bridge. The Allentown/Emmaus Interceptor flows from Keck's Bridge to its downstream confluence with the Cedar Creek Interceptor and Little Lehigh Interceptor. The Little Lehigh Interceptor begins at this confluence and serves as the final conveyance step in the transport of wastewater to Allentown Wastewater Treatment Plant at Kline's Island. The Allentown/Emmaus Interceptor, Cedar Creek Interceptor, and Little Lehigh Interceptor are owned by Allentown.

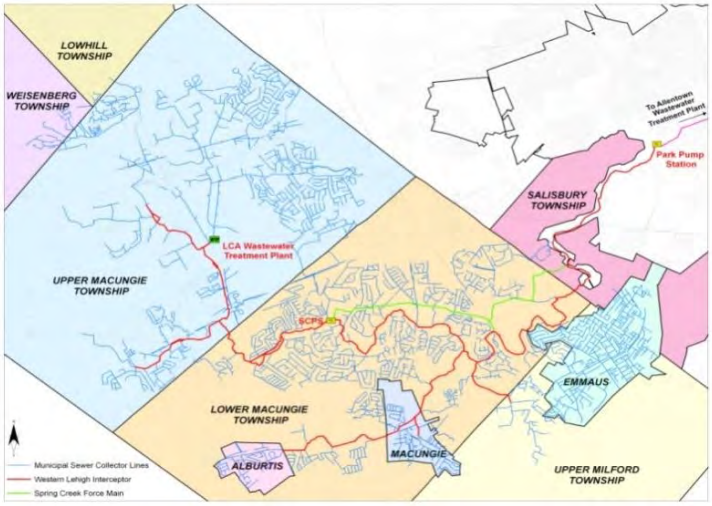


Figure 1-1 - Western Lehigh Interceptor System

In 1981, Allentown compelled LCA to remove a portion of LCA's peak wet weather flows from Allentown's Little Lehigh Interceptor. LCA built and now operates and maintains relief facilities along the Little Lehigh Creek to address intermittent hydraulic overloading of the Little Lehigh Interceptor: Park Pumping Station and Force Main, and the Keck's Bridge Relief Interceptor between Keck's Bridge and Park Pumping Station. The Park Pumping Station and Force Main were placed in operation in the fall of 1983 to supplement capacity in the Little Lehigh Interceptor and pump it through a force main to a location approximately 1000 lf upstream of the KIWWTP. In August 1986, LCA completed construction of the Keck's Bridge Relief Interceptor to relieve overflows during storm events in existing interceptors in the Keck's Bridge area and to allow for

future development in LCA service areas. The capacity of Park Pumping Station was increased in 1986 to accommodate additional flows from the Keck's Bridge Relief Interceptor.

In 1998, the Spring Creek Pump Station (SCPS) began operation. This relief pumping system includes 2,500 feet of 20-inch diameter force main and 11,900 feet of 24-inch diameter force main which bypass approximately 24,000 linear feet of the WLI in Lower Macungie Township. The pump station is designed to pump up to 7 MGD during peak flow periods typically associated with severe rain events.

In 2005, the 10,250 LF 24-inch SCPS force main extension from Millrace Road to the 42-inch Little Lehigh Relief Interceptor near the interception of Devonshire Road and Keystone Avenue (approximately 2,000 feet downstream of Kecks Bridge) was completed. This extension relieved hydraulic loading on that section of the WLI between manholes L-66 and L-1.

LCA also owns and operates a pretreatment plant (PTP) in Upper Macungie Township that treats the industrial wastewaters from the Fogelsville industrial corridor in the upper quarter of the LCA service area as well as the residential wastewaters from the areas upstream of the pretreatment plant.

In 2009, LCA built a 3 MG Flow Equalization Basin (FEB) immediately upstream of the PTP to capture and hold increased flows during significant rain events. This concrete above ground tank has been responsible for most of the improvement in wet weather performance in LCA's WLI, in Allentown's Little Lehigh and Jordan Creek Interceptors, and the reduction in use of the KIWWTP Outfall 003 bypass.

1.1.2. Upper Milford Township

Upper Milford Township (UMiT) is located in southern Lehigh County, adjoining Emmaus Borough, Lower Macungie Township and the Borough of Macungie. The sanitary sewer system in UMiT is owned and operated by the Lehigh County Authority pursuant to a sewer service agreement dated January 1, 1982. UMiT designates the areas of the UMiT where sewer service will be provided and approves the allocation granted.

Currently, there are over 800 customers being served in the UMiT sewer system consisting of over 70,000 feet of pipe, including 29,000 lf of low pressure pipe installed to serve the Vera Cruz area of the Township. Over 55% of the system is 8-inch pipe, 45% is either 2-inch force main, low pressure force main, or 10-inch. The system is 95% PVC and the remainder is DIP. The majority of the system was constructed in the 1980s with the low pressure system constructed in 2012 and 2013. The system consists of

collection systems discharging into the Emmaus Borough system, into the Lower Macungie Township system and into the LCA WLI Interceptor system.

1.1.3. Weisenberg Township

Weisenberg Township is located in the northwestern section of Lehigh County, adjoining Lowhill and Upper Macungie Township. The sanitary sewer system in Weisenberg Township is owned and operated by the Lehigh County Authority. In an agreement dated April 19, 1990, Weisenberg Township designated LCA as the operating agent for the Pointe West and Pennsylvania State University wastewater systems in the Township. Also in an agreement with Upper Macungie Township dated April 19, 1990, Upper Macungie Township agreed to accept the wastewater from the Pointe West Development. The agreement provided for repair and/or elimination of I/I by Weisenberg Township.

In an agreement dated April 22, 2002, the Township conveyed ownership of the wastewater systems to the LCA.

There are 149 customers being served in Weisenberg Township with a system consisting of almost 21,000 feet of pipeline which discharge flows through Upper Macungie Township and the WLI Interceptor system. Over 97% of the system is 8-inch pipe and 3% is 2-inch force main. The system is 99% PVC and 1% DIP. No new connections are expected within Weisenberg Township.

1.1.4. Upper Macungie Township and Upper Macungie Township Authority

Upper Macungie Township (UMT) is a second class Township governed by a three member Board of Supervisors. UMT covers 26.24 square miles and is located in the southwestern portion of Lehigh County. The population, based on current information available, is approximately 23,884. A general breakdown of the land use within UMT shows that residential development accounts for about 23% of its land use while commercial and industrial development make up about 31% with the remaining 46% of the land divided among agriculture and public uses or is undeveloped.

The UMT sanitary sewer system is owned and operated by Upper Macungie Township. Note that the former Upper Macungie Township Authority was an operating authority which owned and operated the UMT sewer system at the time of issuance of the Administrative Order, but was subsequently dissolved in 2016. The collector system comprises approximately 157 miles of sewer pipe and includes six wastewater pumping stations. The sanitary sewer system based on the Act 537 boundary serves approximately 64% of UMT and contains approximately 829,000 linear feet of sewer pipe, 3,200 manholes, and six pumping stations and appurtenances. The original sanitary sewer

system was installed in 1968 and was completed in 1972. Extensions to the public sewer system were added over the years by various UMT projects as well as through development growth in UMT which accounts for its present size. Currently the UMT system customer base consists of 6,498 residential, 373 commercial and 8 industrial customers.

Most of the UMT sewer system drains, through two connection points, into the Lehigh County Authority conveyance system, which in turn flows through the City of Allentown sewer system to the City wastewater treatment facility.

1.1.5. Lower Macungie Township

Lower Macungie Township (LMT) is a first class township governed by a five member Board of Commissioners. LMT covers 22.46 square miles and is located in the southwestern portion of Lehigh County. The population, based on current information available, is 31,964. LMT is characterized as a residential suburban community. A general breakdown of LMT land use based on zoning districts indicates residential development accounts for about 34% of the land use while commercial and industrial development makes up about 19%. The remaining 48% is divided among agriculture and public uses or is undeveloped.

The LMT sanitary sewer system is owned and operated by Lower Macungie. The collector system comprises approximately 126 miles of sanitary sewer pipe. The sanitary sewer system based on the current Act 537 boundary serves approximately 78% of LMT and contains approximately 666,800 linear feet of 8-inch through 16-inch sewer main and 3,500 manholes. There are no pumping stations in the LMT sewer system. The original sanitary sewer system was constructed in 1968 and completed in 1972. Extensions to the public sewer system were added over the years by various LMT sponsored projects as well as through development growth which accounts for its present size. Currently the LMT system customer base consists of 8,971 residential and 24 commercial/industrial customers.

Most of the LMT sewer system drains, through a number of connection points, into the Lehigh County Authority conveyance system which in turn flows through the City of Allentown sewer system to the City wastewater treatment facility. There are several connection points in the LMT system that drain to either the South Whitehall Township or Salisbury Township sanitary sewer systems.

1.1.6. Borough of Alburtis

The Borough of Alburtis is governed by a seven member Borough Council. The Borough covers approximately 0.7 square mile and is located in the southwestern portion of

Lehigh County. It is surrounded by Lower Macungie Township. The population is approximately 2,300 based on current census data. The Borough is characterized generally as a residential community although it does support retail commercial business and industrial districts. A general breakdown of land use based on zoning districts indicates residential development accounts for about 75% of the land use while commercial and industrial accounts for about 20% of the land use. The remaining 5% is used for community facilities and parks.

The Borough of Alburtis sanitary sewer system is owned by the Borough of Alburtis. The collector system comprises approximately 8.04 miles of sanitary sewer pipe. The sewer system serves approximately 60% of the Borough and contains 42,480 linear feet of 8-inch through 12-inch sewer main and 220 manholes and one wastewater pumping station. The initial sanitary sewer system was constructed between 1968 and 1972. Extensions to the public sewer system were added primarily by development growth over the years accounting for its present size. Currently the Borough system customer base consists of 929 residential, 26 commercial and 1 Industrial customer.

The Borough's sewer system drains directly to the Lehigh County Authority conveyance system which in turn flows through Allentown sewer system to Allentown wastewater treatment facility.

1.1.7. Borough of Macungie

The Borough of Macungie is governed by a seven member Borough Council. The Borough covers approximately 1.0 square mile and is located in the southwestern portion of Lehigh County. It is primarily surrounded by Lower Macungie Township except on the south side where it borders Upper Milford Township. The population of the Borough is 3,039 based on the 2000 census. The Borough is characterized generally as a residential community although it does support retail commercial business and industrial districts. A general breakdown of the Borough land use based on zoning districts indicates residential development accounts for about 75% of the land use while commercial and industrial accounts for about 18% of the land use. The remaining 7% is used for community facilities and parks.

The Borough of Macungie sanitary sewer system is owned and operated by the Borough. The collector system comprises approximately 11.4 miles of sanitary sewer pipe. The sewer system contains 60,330 linear feet of 8-inch through 12-inch sewer main and 315 manholes. The initial sanitary sewer system construction began in 1968 and was completed in 1972. Extensions to the public sewer system were added primarily by development growth over the years accounting for its present size. Currently the Borough system customer base consists of 1654 residential, 83 commercial and 3 Industrial customers.

The Borough sewer system drains directly to the Lehigh County Authority conveyance system which flows through Allentown sewer system to Allentown wastewater treatment facility.

1.1.8. Lowhill Township

Lowhill Township is located the northwestern section of Lehigh County, adjoining Weisenberg and Upper Macungie Townships. In June of 2016, the sanitary sewer system in Lowhill Township was acquired by LCA which now owns and operates the system. A service agreement has been executed with Upper Macungie Township Authority to allow the flow of wastewater through their system to the WLI. The Lowhill Township system consists of 3,052 feet of 8-inch PVC gravity pipeline and 587 feet of 2-inch PVC force main through which 43 connections discharge into the Upper Macungie Township collector system and ultimately into the LCA WLI system.

2. Alternative Analysis Summary

2.1. Objectives

WLSP identified solutions that would address both current and future flow conditions. The current system is at or near capacity, anticipated development will add additional flows, and much of the collection system has aged significantly without its first round of life restoration or rehabilitation. A planning horizon of 30 years was chosen to balance the need to build infrastructure that would not prove too small in the future with the uncertainty about the future.

WLSP recognized that the likely solution would require combining the three basis approaches to sewer capacity assurance: leakage reduction, peak storage, and capacity improvement. A systemic approach to evaluating the effectiveness and cost of these approaches was completed using the flow monitoring and SSES data collected 2009-2011, the WLSP model, experience-based predictions of various source reduction efforts, and cost estimates based on consistent if conservative capital costs, soft costs, and life cycle costs related to operation (energy, labor, cleaning) and maintenance (replacement of wear and tear parts).

2.1.1. Dry Weather Operating Depth Goals

WLSP and LCA established a single level of service goal for dry weather operating conditions: maintain the peak dry weather flow depth within the pipe (i.e. d/D <1). This provides the operators the ability to access the sewers during normal dry weather conditions for inspection and maintenance, recognizes that the pipes were not designed nor constructed to operate under pressure, and that routine pressurization of pipes tends to destroy the pipe bedding over time.

2.1.2. Wet Weather Operating Depth Goals

While the overarching goal is to ensure systems operate so they do not overflow under conditions less than they are designed to handle, WLSP and LCA recognized that the KISS model might under-predict depth of flow, so a safety factor of 3' from rim was selected as the primary maximum operating depth during large storms. Where interceptors have homes and businesses connected at elevations within the maximum operating hydraulic grade line of the interceptors, a second maximum interceptor depth was determined to prevent basement backups.

2.2. Preliminary Screening of Alternatives

An initial screening of potential alternatives was evaluated to assess how effective pure leakage reduction, pure storage, or pure conveyance might be, then what combinations of conveyance, storage, and source removal might be effective. Effectiveness was evaluated for 2040 dry day conditions and for 2040 wet day design conditions.

In addition to options to continue to send all flow to KIWWTP, an evaluation of diverting flow from KIWWTP by converting the PTP into a direct discharge WWTP discharging to either stream or spray irrigation was evaluated.

For source reduction, sewer sub-basins were prioritized based on leakage, then evaluated for effect of source reduction on overall dry and wet weather flows. The 185 sub-basins of the WLSP were ranked based on flow meter data and SSES results. It was assumed that the pipes, taps, laterals, and manholes of those sub-basins with the most leakage (59 miles of pipe – Priority 1 through 3 of the RDII ranking analysis conducted in 2012) would be either rehabilitated or shown not to have excessive I/I. Based on experience conducting holistic source reduction via sewer rehabilitation work, a 65% reduction in leakage was estimated for any pipe segment scheduled to be rehabilitated. Modeling revealed that 27% of the RDII might be eliminated from the system. This would significantly reduce flows, cut SSOs in half, and cut SSO volume in half, but alone would not provide the capacity needed to meet the LOP and LOS goals.

For conveyance via gravity alone, pipe upsizing of the trunklines and interceptors upstream of Allentown's Little Lehigh Interceptor (LLI) were evaluated. This approach would work but requires the entire interceptor and trunkline system downstream of just north of Hamilton Boulevard to be paralleled.

The preliminary screening of alternatives indicated that source removal alone (i.e. I/I removal) will not achieve goals, and that some level of conveyance improvements would additionally be needed. The results of the preliminary screening of alternatives were used to select the alternatives evaluated during the final screening of alternatives described in the following section.

2.3. Final Screening of Alternatives

The KISS model was used to evaluate the impact of three different intensity 24-hour storm events (2-year, 5-year, and 10-year events), respectively, for the KISS area, and the alternatives described in this section. These three events were chosen as statistically representative from a 30-year rain data set. As shown by the model run results and by dry day inspections, some sections of LCA's WLI and Alburtis-Macungie Trunk Line and almost the entirety of Allentown's LLI and JCI operate in surcharged conditions during dry days. Additional dry day capacity will be needed as new development, as indicated in the 2017 future flows planning forecasts developed by each Signatory, is added by all the Signatories. As most of the regional interceptors and/or pump stations will need to be expanded to handle dry day flow, the cost differential between 5 year and 10 year storm wet weather design basis is minimal. Therefore, for the purposes of comparison, the cost and sizing of the components required for each alternative were based on the10Y24H storm.

The alternatives evaluated under the final screening of alternatives included various options of conveyance improvements plus storage and/or source removal work. The option to send the Industrial Pretreatment Plant to a direct discharge was removed from further consideration because the cost and permitting issues were so much more significant than continuing to send flow to KIWWTP. The final alternatives analysis considered 12 alternatives. Half of these had no source removal work, and half had all pipes, taps, laterals, and manholes from the prioritized catchments being rehabilitated. Components were added to each alternative as needed to achieve LOS and LOP goals.

Table 2-1 describes each of the evaluated alternatives; figures for each model run are included in Appendix A.

For conveyance via gravity (FAA1 and FAA2), pipe upsizing of the trunklines and interceptors to KIWWTP were evaluated. Anywhere a need for a parallel line was found, the pragmatic decision to at a minimum match the existing pipe diameter was made. This approach will work but requires the entire interceptor and trunkline system downstream of just north of Hamilton Boulevard to be paralleled. Additionally, existing regional dry weather flows through Allentown's 36" Little Lehigh and Jordan Creek Interceptors cause daily surcharging of these pipes, and daily overflows are only avoided through the dry weather operation of LCA's wet weather relief pump station. To address current dry and wet weather loads as well as future loads from all Signatories, the LLI and JCI would

need to be paralleled with a new 72" Regional Relief Interceptor from Emmaus-Salisbury-South Whitehall to KIWWTP or the construction of a new 27 MGD Regional Pump Station/forcemain in Allentown near the confluence of the Little Lehigh River and Cedar Creek.

For conveyance via pumping (FAA3), pump station and force main discharge locations that would facilitate meeting the wet weather LOP and the dry weather LOS goals were identified and their impact evaluated. This approach will work but requires five new pump stations and forcemains (Breinigsville-1 MGD, Upper Macungie – 2 MGD, Alburtis-2.5 MGD, Upper Milford – 3.5 MGD, and Trexlertown – 6 MGD), plus an expansion from 11 MGD to 24 MGD for Spring Creek Pump Station/forcemain. Additionally, existing regional dry weather flows through Allentown's 36" Little Lehigh and Jordan Creek Interceptors cause daily surcharging of these pipes, and daily overflows are only avoided through the dry weather operation of LCA's wet weather relief pump station. To address current dry and wet weather loads as well as future loads from all Signatories, construction of a new 25 MGD Regional Pump Station/forcemain in Allentown near the confluence of the Little Lehigh River and Cedar Creek would also be needed.

For storage (FAA 5 and 6), tank locations that would facilitate meeting the wet weather LOP goals were identified and their impact evaluated. Storage tanks are not a viable dry weather solution for WLSP because the transit time is so long from end to end (~8 hours) and the industrial flows from the top quarter of the system that discharge during the second and third shifts eliminate much of the diurnal midnight-dawn low flow period typically experiences in smaller or less industrialized systems. Modeling revealed that storage tanks could work with three new tank locations (1.5 MG Breinigsville, 4.0 MG UMT, and 2.5 MG Alburtis) and the existing 3.0 MG PTP FEB upsized to 13 MG would meet wet weather LOP goals, but dry weather flows would still exceed LOS goals, the tanks would go weeks before they could be emptied of their wet weather flows, and 7 miles of new parallel interceptors would still need to be constructed. Additionally, existing regional dry weather flows through Allentown's 36" Little Lehigh and Jordan Creek Interceptors cause daily surcharging of these pipes, and daily overflows are only avoided through the dry weather operation of LCA's wet weather relief pump station. To address current dry and wet weather loads as well as future loads from all Signatories, regional pump station or interceptors through Allentown would also be required.

A combination of new storage tanks, pump stations, and parallel interceptors (FAA 7) that would facilitate meeting the wet weather LOP and the dry weather LOS goals were identified and their impact evaluated. This approach will work but requires a new pump station and forcemain (Trexlertown – 6 MGD), plus four new storage tanks (1.5 MG Breinigsville, 4.0 MG UMT, 0.8 MG UMiT, and 2.5 MG Alburtis). Additionally,

existing regional dry weather flows through Allentown's 36" Little Lehigh and Jordan Creek Interceptors cause daily surcharging of these pipes, and daily overflows are only avoided through the dry weather operation of LCA's wet weather relief pump station. To address current dry and wet weather loads as well as future loads from all Signatories, construction of a new 23 MGD Regional Pump Station/forcemain in Allentown near the confluence of the Little Lehigh River and Cedar Creek would also be needed.

WLSP also considered these same approaches following aggressive I/I reductions gained via public sewer rehabilitation coupled with private-side source reductions (e.g., completion of the clearwater disconnections started in 2012, ongoing real estate transfer sewer inspection/correction programs). Building on the preliminary screening of alternatives conclusion that rehabilitation of the leakiest 20% of the collection system would reduce I/I by 27%, the need for and size of additional interceptors, pump stations, and/or tanks was reduced significantly. When the net present cost of the long term need to rehabilitate these sewers, the smaller regional pump stations/interceptors needed, the smaller KIWWTP treatment facilities needed, and the reduced O&M cost associated with fewer and smaller conveyance infrastructure is considered, the cost of these alternatives (FAA 9 -15) are markedly lower.

Cost estimates were prepared for each alternative, including construction costs, engineering and administration costs, estimated costs of operation and maintenance of pump stations and storage tanks. For alternatives that did not include I/I removal, the cost of an ongoing sewer rehabilitation program was included in the total alternative cost since WLSP members agreed that even if they did not implement a sewer rehabilitation program for I/I removal, they would eventually incur costs for sewer rehabilitation in the future to address aging infrastructure deterioration. Finally, the WLSP cost share of regional facilities needed to address dry day and wet day flows in Allentown's LLI, JCI, and KIWWTP were also estimated. Costs were estimated conservatively but consistently across all alternatives.

Table 2-1: Comparison Costs of Final Alternatives

FAA No.	Description	Notes	Effects	Cost ($M)	Rank
1	Pure Gravity System. Parallel existing pipes for wet day conveyance LOS>3' from rim and dry day conveyance of d/D<1. SCRPS and FEB do not operate during dry weather. PPS and SCRPS abandoned entirely. KI FEB to maintain KI current max wet day flow. No Blending.	Gravity Mains direct from PPS to KIWWTP upsized to 72" for simplified boundary conditions.	122,448 LF Gravity Main	$ 277M	**8**
2	Parallel existing pipes for wet day conveyance LOS>3' from rim and dry day conveyance of d/D<1. SCRPS and FEB do not operate during dry weather. PPS expanded to pump 100% of AEI and LLRI dry and wet flow to KI. For modeling purposes, disconnect AEI DS of PPS. KI FEB to maintain KI current max wet day flow. No Blending.	Gravity Mains downstream of PPS disconnected	122,276 LF Gravity Main 10,625 LF Force Main 47 MGD Regional PS	$ 319M	**11**
3	Pump Stations and force mains for wet day conveyance LOS>3' from rim and dry day conveyance of d/D<1. FEB does not operate during dry weather. Minimal parallel pipe additions. Add Pump Stations and Force Mains as necessary. Regional PS to pump 100% of AEI and LLRI dry and wet flow to	Gravity Mains downstream of PPS disconnected	9,137 LF Gravity Main 97,470 LF Force Main 45 MGD Regional PS Expanded SCRPS to 24 MGD	$ 342M	**12**

FAA No.	Description	Notes	Effects	Cost ($M)	Rank
	KI.KI FEB to maintain KI current max wet day flow. No Blending.		Added 2, 6, 1, 2.5, and 3.5 MGD pump stations at select locations.		
5	Parallel existing pipes for dry day conveyance of d/D<1. Tanks for wet weather LOS>3' from rim. KI FEB to maintain KI current max wet day flow. No Blending. Use tank locations from PSOA. Increase capacity of SCRPS (within the capacity of the existing force main) to operate during wet and dry weather. PPS operates at current 2015 capacity. Boundary condition at PPS/Allentown connection is rough upsizing of Allentown pipes downstream.	Gravity Mains direct from PPS to KIWWTP upsized to 72" for simplified boundary conditions.	38,746 LF Gravity Main FEB increased to 13 MG Added 4, 2.5, and 1.5 MG storage tanks in select locations	$ 318M	**10**
6	Parallel existing pipes for dry day conveyance of d/D<1. Tanks for wet weather LOS>3' from rim. Use tank locations from PSOA. Increase capacity of SCRPS (within the capacity of the existing force main) to		38,746 LF Gravity Main FEB increased to 13 MG	$ 278M	**9**

FAA No.	Description	Notes	Effects	Cost ($M)	Rank
	operate during wet and dry weather. Regional PS to pump 100% of AEI and LLRI dry and wet flow to KI. KI FEB to maintain KI current max wet day flow. No Blending.		Added 4, 2.5, and 1.5 MG storage tanks in select locations 24 MGD Regional PS		
7	Pump Stations and force mains for dry day conveyance of d/D<1. Tanks for wet weather LOS>3' from rim. Tanks and pump stations will be placed according to findings from alternative 3. PS locations from Alt 3 used during WWF and DWF will have both tanks and PS in Alt 7. PS locations from Alt 3 used only during WWF will only have tanks in Alt 7. Regional PS to pump 100% of AEI and LLRI dry and wet flow to KI. Disconnect from the Allentown pipes below PPS. KI FEB to maintain KI current max wet day flow. No Blending.	Gravity Mains downstream of PPS disconnected	6,796 LF Gravity Main 41,201 LF Force Main 43 MGD Regional PS Added TPS at 6 MGD Added 4, 2.5, 1.5, and 0.8 MG tanks at select locations	$ 224M	**1**
9	27% I/I removal through holistic rehab of priority 1-3 sub-basins. Parallel existing pipes for wet day conveyance LOS>3' from rim and dry day conveyance of d/D<1. FEB does not operate during dry weather. PPS and SCRPS abandoned entirely. KI FEB to maintain KI current max wet day flow. No Blending.	SCRPS Weir set to 362.7ft. Gravity Mains direct from PPS to KIWWTP upsized to 72" for simplified boundary conditions.	89,429 LF Gravity Main	$ 266M	**7**

FAA No.	Description	Notes	Effects	Cost ($M)	Rank
10	27% I/I removal through holistic rehab of priority 1-3 sub-basins. Parallel existing pipes for wet day conveyance LOS>3' from rim and dry day conveyance of d/D<1. SCRPS and FEB operate during wet weather, but not dry weather. Regional PS to pump 100% of AEI and LLRI dry and wet flow to KI. KI FEB to maintain KI current max wet day flow. No Blending.	Gravity Mains downstream of PPS disconnected	38,587 LF Gravity Main 10,625 LF Force Main 43 MGD Regional PS	$ 230M	**2**
11	27% I/I removal through holistic rehab of priority 1-3 sub-basins. Pump Stations and force mains for wet day conveyance LOS>3' from rim and dry day conveyance of d/D<1. Regional PS to pump 100% of AEI and LLRI dry and wet flow to KI. KI FEB to maintain KI current max wet day flow. No Blending.	Gravity Mains downstream of PPS disconnected	6,796 LF Gravity Main 60,335 LF Force Main 43 MGD Regional PS Added 1, 2, and 4 MGD pump stations at select locations.	$ 239M	**4**
13	27% I/I removal through holistic rehab of priority 1-3 sub-basins. Parallel existing pipes for dry day conveyance of d/D<1. FEB does not operate during dry weather. Tanks for wet weather LOS>3' from rim. PPS and SCRPS abandoned entirely KI FEB to maintain KI current max wet day flow. No Blending.	Gravity Mains direct from PPS to KIWWTP upsized to 72" for simplified boundary conditions.	74,236 LF Gravity Main Added ABST at 2 MG	$ 256M	**6**

FAA No.	Description	Notes	Effects	Cost ($M)	Rank
14	27% I/I removal through holistic rehab of priority 1-3 sub-basins. Parallel existing pipes for dry day conveyance of d/D<1. Tanks for wet weather LOS>3' from rim. SCRPS and FEB do not operate during dry weather. Regional PS to pump 100% of AEI and LLRI dry and wet flow to KI. KI FEB to maintain KI current max wet day flow. No Blending.	Gravity Mains downstream of PPS disconnected	37,751 LF Gravity Main 10,625 LF Force Main 42 MGD Regional PS Added ABST at 2 MG	$ 235M	**3**
15	27% I/I removal through holistic rehab of priority 1-3 sub-basins. Pump Stations and force mains for dry day conveyance of d/D<1. Tanks for wet weather LOS>3' from rim. Regional PS to pump 100% of AEI and LLRI dry and wet flow to KI. KI FEB to maintain KI current max wet day flow. No Blending.	Gravity Mains downstream of PPS disconnected	6,796 LF Gravity Main 46,782 LF Force Main 43 MGD Regional PS Added TPS at 4 MGD Added UMPS at 2 MGD Added ABST at 2 MG	$ 239M	**4**

2.4. Selected Approach

FAA 10 was selected as the preferred alternative. This approach starts with aggressive I/I source reduction, then sizing and construction of new conveyance as needed after the benefits of source removal are realized. This decision was based on:

- Recognition that collections sewers would need to be rehabilitated at some point, so do it now to reduce operating costs and to reduce the amount, size, and cost of new infrastructure.
- Preference for reinvestment in existing infrastructure over investment into new capacity
- Lower capital and operating cost
- Ease of operation over storage tank option
- Better addresses dry weather LOS goals
- Reduction in size and cost of regional facilities that might be needed to convey WLSP and other Signatory flows to the KIWWTP
- Reduction in size and cost of any storage or treatment that might be needed once the peak flows reach KIWWTP.

Alternative 10 assumes the regional solution to the overcapacity problem in COA's LLI and JCI will be addressed by constructing the Regional Pump Station and forcemain near the existing Park Pump Station to more than double the relief capacity for these two Allentown interceptors. If a regional solution is not implemented, a smaller station/force main that handles only the LCA/WLSP flows would be constructed at a lower cost, but additional (non-LCA) capacity improvements would be needed to reduce flows from South Whitehall, Salisbury, Emmaus, and Coplay-Whitehall in the LLI and JCI.

Only work through 2026 is described in this document. Future capacity improvements, including the potential construction of a Regional Pump Station, would be determined following additional flow characterization update is completed in 2025 as described in Section 6.2.

3. Improvements Plan Overview

3.1. Capital Work

Building on the significant I/I source reductions we have made over the past decade and as has been indicated over the course of several meetings with PADEP and USEPA since 2015, the WLSP's intent is to focus primarily on I/I source reductions through sewer rehabilitation and clearwater disconnections. Predictions of reductions likely to be achieved are based on extensive flow monitoring and SSES work conducted 2010-2012 and subsequent hydrologic modeling efforts conducted in 2013-2014. This engineering evaluation indicated that up to 27% of the peak wet weather storm volume could potentially be removed from the WLSP system by focusing on the leakiest areas identified during the hydraulic condition assessment work (54 miles, or 20% of the 272 miles of collection sewer mains).

Accordingly, source reduction work was begun in 2009 within the Partners' collection systems. As has been reported in the annual and semiannual reports to USEPA and PADEP, by the end of 2017, more than half the 54 miles of sewer mains and many of the manholes targeted will have been rehabilitated. The Source Reduction Programs (SRP) work continues today, and will continue through the end of 2025, when the pipes, laterals, and manholes within the prioritized (i.e., leaking) catchments are either rehabilitated or proven not to have excessive I/I. Additionally, several of the Partners are aggressively extending their rehabilitation efforts outside the priority catchments to include all clay pipe and/or any other pipe found via routine CCTV inspections to have significant defects, as well as many of the manholes.

Additionally, LCA has committed to evaluating and rehabilitating as necessary their entire 18 miles of trunk line and interceptor system. All of the trunk lines of the LCA conveyance system (Breinigsville Trunkline, Alburtis-Macungie Trunkline, Upper Iron Run Trunkline, and Upper Milford Trunkline) were rehabilitated in 2017. The LCA interceptor systems (Western Lehigh Interceptor and Little Lehigh Relief Interceptor) will be rehabilitated or shown not to have excessive I/I in 2018 and 2019.

At the completion of these efforts, 100% of the LCA interceptors and trunk lines will have been rehabilitated or shown not to have excessive I/I, and all of the leakiest collection sewers (i.e., those found to be contributing significant amounts of inflow and infiltration during the 2009-2012 hydraulic condition assessment work) will have been rehabilitated.

Additionally, each of the Partners initiated comprehensive investigations of clearwater connections to their sanitary sewers as part of the hydraulic condition assessment work detailed in Section 2. Many of these connections have already been removed from the sanitary system, and the Partners intend to continue this work through 2025 to eliminate located clearwater connections to the extent practical.

Halfway through the completion of the Source Reduction Programs, a comprehensive recalibration of the WLSP model may be conducted. This work is intended to inform the Partners of the progress they've made as of that date and help shape the remaining source reduction rehabilitation work, especially with regard to public and private lateral connections, which will be very expensive and administratively difficult to address. This work is currently targeted for 2019-2020.

There are also several capacity assurance and capacity improvement projects underway or to be completed. The most significant of these is the complete refurbishment of the Park Pump Station and the potential rehabilitation, if found to be required, of its force main. The Spring Creek Pump Station operating valves are planned for refurbishment and a revised operating logic. A condition assessment of the Spring Creek Pump Station Force Main and the refurbishment of its air vacuum release valves is also planned.

Finally, capacity improvements will be made to relieve the level of service-impacted sections of the Trexlertown portion of the Western Lehigh Interceptor either by constructing a parallel Trexlertown Interceptor or by constructing a new Iron Run Pump Station and force main (unless the Source Reduction Program's greatly exceed expectations). The selection of one of these two options and the sizing of them will be completed as part of the SCARP effort. Additional capacity improvements will be evaluated within the context of normal Chapter 94 reports and Act 537 planning efforts.

Additionally, the WLSP will participate in regional capacity improvements to eliminate the dry weather operational issues in Allentown's LLI and JCI caused by flows from multiple Signatories as well as improvements needed at the KIWWTP to manage peak wet weather flows to the treatment plant.

3.2. Operation and Maintenance Plans

Each of the Partners has developed an Operation and Maintenance (O&M) Plan for its individual sewer system. LCA has prepared theirs to cover their trunklines, interceptors, pump stations, forcemains, and storage tanks as well as the Weissenberg, Lowhill, and Upper Milford collection sewers that they own and operate. These O&M Plans are complementary to the SCARP's source reduction programs and the capacity improvement projects. These O&M Plans ensure that the SCARP improvements are integrated with supporting operation and maintenance strategies to maximize the life

cycle of critical assets and to minimize maintenance-related overflows. The goal of these O&M Plans is to:

- Achieve and maintain the intended hydraulic level of protection and level of service in the sewers
- Mitigate the impact of sanitary sewer overflows when they do occur
- Achieve these goals in the most economically efficient and sustainable manner possible.

The O&M Plans components vary slightly between Partners because of differences in sewer inventory. Where applicable, the sections cover:

- Pump station and force mains
- Gravity sewers
- Laterals
- Lower pressure sewers

Within each section, the following topics are covered:

- Purpose
- Overview
- Goals and Performance Measures
- Preventative Maintenance
- Reactive Maintenance
- SOPs
- Equipment and Spare Parts
- Staffing
- Information Management

The individual Partner O&M Plans were included in the Regional Flow Management Strategy submittal.

4. Source Reduction Programs

4.1. Lehigh County Authority

4.1.1. Alburtis-Macungie-Breinigsville Trunk Lines Rehabilitation

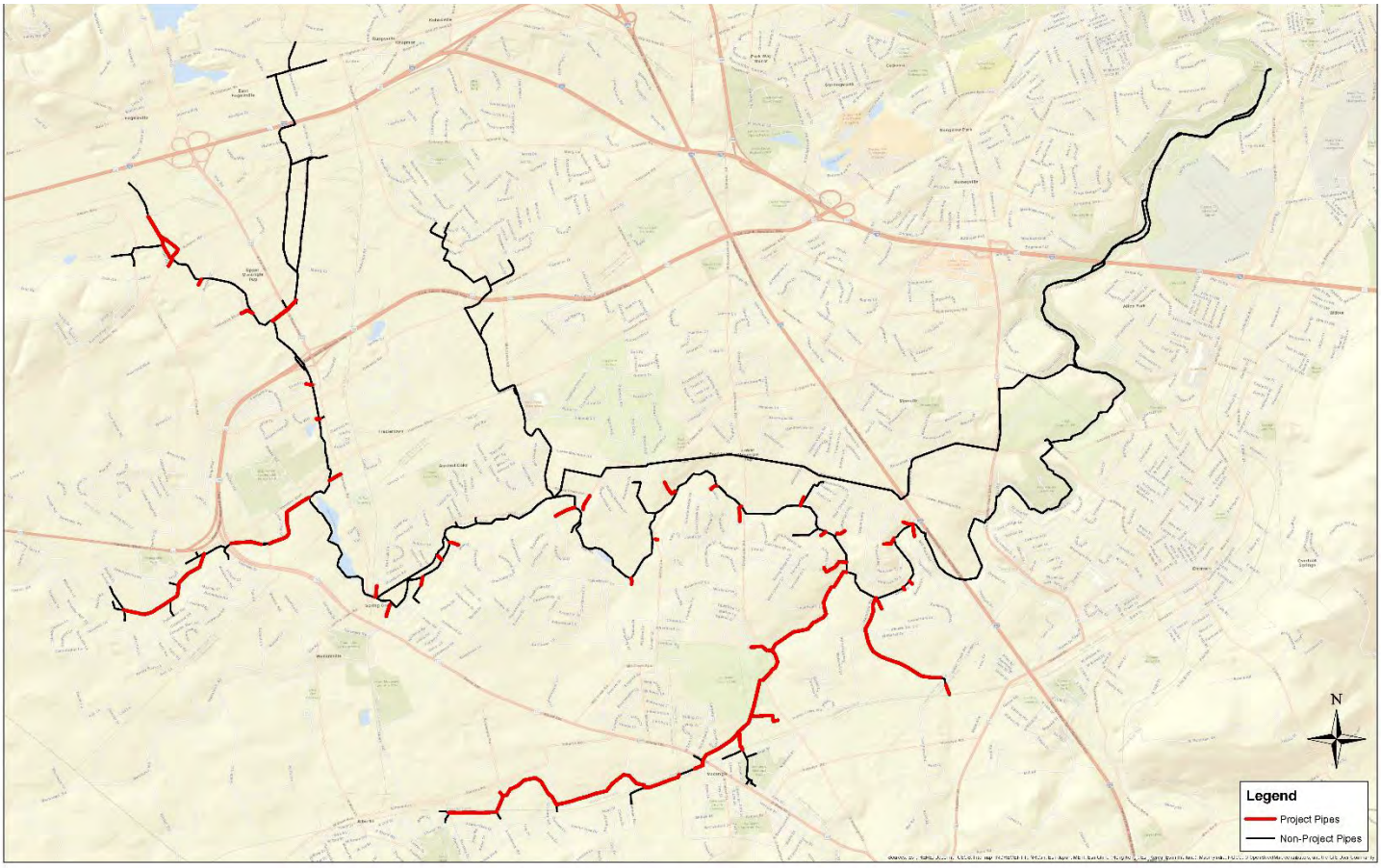
4.1.1.1. Purpose

The Alburtis-Macungie-Breinigsville Trunk Lines (AMB Trunklines) are several tributary trunklines to the Western Lehigh Interceptor (WLI). These pipelines, along with several dozen collection system segments immediately adjacent to the AMB Trunklines and the WLI, are in low-lying bottom lands, often running parallel to or under streams. These pipes had been televised in 2007-2008 and were shown to be structurally sound, though some evidence of joint leakage was identified. However, due to their being interceptors/trunklines or in difficult to access areas, the leakage characteristics of these pipes were not determined during the SSES work of 2010-2012. In April 2013, LCA had ElectroScan'd evaluate section U32-U33 of the Breinigsville Trunkline; they reported that most of the joints had minor leak potential (i.e., will leak under elevated groundwater or percolating rainwater conditions), and 25% of the joints suffered medium to large leakage potential. Given their location and that structurally sound pipe can have leaking joints, the goal of this project was to seal any leaking joints to render these pipes as watertight as possible.

4.1.1.2. Scope

The pipes shown in Figure 4-1 underwent test and seal rehabilitation. During this work, 39,482 lf (7.5 miles) of 12" to 36" trunklines and interceptors and 15,775 lf (3.0 miles) of 8" and 10" collector sewers were cleaned, inspected, tested, and where necessary, grouted. In total, 3,817 pipe joints 12" to 36" were tested; only 19 (0.5%)of these joints failed the air test and required grouting. In total, 1,296 pipe joints 8" to 10" were tested; only 56 (4.3%) of these joints failed the air test and required grouting.

Figure 4-1 - AMB Trunklines Rehabilitation Scope



LCA T&S SAPR PROJECT PIPES

4.1.1.3. Cost

The cost for engineering, construction, and construction oversight for this project was $1.1.

4.1.1.4. Schedule

This work was completed in 2016 and 2017.

4.1.1.5. Effectiveness

This project confirmed that the joints of these pipes were largely leak free. The few leaking joints in these 10.5 miles of pipe were rehabilitated and made watertight.

4.1.2. Western Lehigh Interceptor and Manhole Rehabilitation

4.1.2.1. Purpose

The WLI is the primary conveyance interceptor for the WLSP. CCTV inspections in 2004-2008 showed the pipe to be in good physical condition and to have little evidence of leakage. A pilot investigation to determine if the pipe joints leak during high groundwater conditions by air testing several segments of the WLI. If the pipe joints are found to have sufficient leakage to warrant, a test and seal approach will be used to grout leaking joints.

The manholes of the WLI were inspected in 2014, and a list of recommended rehabilitation to 260 specific manholes was developed.

4.1.2.2. Scope

If determined necessary, the scope of work could include up to all pipes from the PTP to Park Pump Station. All manholes identified for rehabilitation will be repaired; several of the manholes have already been rehabilitated.

4.1.2.3. Cost

The anticipated cost of this project, including design engineering, construction oversight, easement clearing, and rehabilitation, is up to $4.8M.

4.1.2.4. Schedule

This work is anticipated to be conducted in 2018-2019.

4.1.2.5. Anticipated Effectiveness

The manhole rehabilitation work will eliminate inflow into manhole covers and significantly reduce groundwater and river-water driven infiltration into manholes. The pipe joint grouting work will significantly reduce any groundwater and river-water driven infiltration into the WLI pipes.

4.2. Upper Milford Township

Flow metering and SSES investigations indicated there are no areas of excessive I/I in the LCA operated portions of Upper Milford Township. Therefore, no SRP works are planned.

4.3. Weisenberg Township

Flow metering and SSES investigations indicated there are no areas of excessive I/I in the LCA operated portions of Weisenberg Township. Therefore, no SRP works are planned.

4.4. Upper Macungie Township

4.4.1. Completed Projects

Over the past several years, LMT has undertaken a number of source removal projects within UMT's sanitary sewer system specifically targeting the designated infiltration/inflow priority areas in the system. The completed projects included private property illegal discharge sump pumps and other clearwater sources, main line cured-in-place pipe lining of the clay pipe mains and manhole rehabilitation.

4.4.1.1. Purpose

Most of the completed source removal projects fall within the Priority 1, 2 and 3 I/I areas identified by flow meter evaluation and SSES analysis. Selected projects were identified within each designated priority area as a result of systematic SSES field tasks and data assessment. Subsequently, specific sewer system rehabilitation efforts and tasks began in these areas or catchments with the expectations that the initial rehabilitation work will have an immediate and significant impact on RDII removal.

4.4.1.2. Scope

The scope of the completed source removal programs or rehabilitation efforts is shown in Table 4-1 and includes the following:

- Private property sump pump removal: 90 sump pumps illegally discharging to the sanitary sewer system were removed.
- Cured-in-Place pipe lining of the VCP mains within the sewer system: Approximately 70,000 linear feet of VCP main sewer pipe has now been lined. This represents about 96% of all the existing VCP pipe in the entire UMT sewer system.
- Manhole rehabilitation: 1,260 manholes have gone through some form of rehabilitation including full depth epoxy lining, epoxy chimney lining, base section lining, slipline annular space repair, chimney grouting, drill and grouting active leaks, manhole inserts, reset offset castings, replace manhole cover gaskets

as well as replacement of existing manhole castings with composite watertight castings.

Table 4-1 - UMT Completed Source Reduction Work

Year	Epoxy Line MH Chimney	Caulk & Seal MH Chimney Base & Frame	Remove/Reseat Offset MH Frame	Drill, Grout, & Parge Leaking MH section Joints	Replace MH Lid or Repair Gasket	Parge MH Chimney	Full Depth Epoxy MH Lining	Repair/Replace Leaking MH Frame Adjustment Rings	General MH Repair	Epoxy Line Base Sections	Repair Slipline Annular Space	Replace Existing Manhole Castings with Composite Watertight Frame & Covers	Sewer Main Line Replacement	Cured-In-Place Pipe Lining (VCP) (LF)	Lateral Rehabilitation	Sump Pumps Removed
2009														10,458'		
2010																6
2011														7,337'		74
2012														8,680'		4
2013	39	217	18	102	100									11,105'		2
2014	9	95	3	6	3	186	6	14	50					10,402'	4	1
2015	233	48	2	1	27	379	4	2	98				430'	5,590'		3
2016	184			6			4		4					7,196'		
2017	164	37	7	12	10	4	2	19	38	64	91	17		8,826'		
Total	**629**	**397**	**30**	**127**	**140**	**569**	**16**	**35**	**190**	**64**	**91**	**17**	**430'**	**69,594'**	**4**	**90**

Note: A number of manholes rehabilitated may have received one or more than one, type of rehabilitation repairs.

4.4.1.3. Cost

The cost for engineering, construction, and construction oversight for this project was $2,805,000.

4.4.1.4. Effectiveness

There has been no flow meter effectiveness monitoring or analysis completed to date to measure or quantify the effects of the infiltration/inflow reduction rate as a result of the ongoing source removal projects. Interim flow meter effectiveness monitoring is anticipated to be done in 2019 with the analysis report available in 2020.

4.4.2. Anticipated Projects

4.4.2.1. Purpose

Between 2018 and 2025, UMT plans to continue source removal projects in an effort to improve the RDII reductions as well as to maintain a reasonably effective Infiltration/Inflow reduction program.

4.4.2.2. Scope

UMT's Source Reduction Program or I/I rehabilitation efforts will be conducted in the areas shown in Figure 4-2, and will include the following projects:

- Continue private property sump pump and clearwater source investigations and removal as necessary.
- Continue the cured-in-place pipe lining of the VCP sewers until all VCP within the Township sanitary sewer system is lined. Anticipated to be completed in 2018.
- Continue with the scheduled 5-year cycle of individual manhole inspections (~600 manholes per year) program and determine the type of repairs and/or rehabilitation methods as may be necessary.
- Starting in 2018, conduct lateral investigation and rehabilitation program of ~450 laterals annually through 2025.

4.4.2.3. Cost

The anticipated cost for engineering, construction, and construction oversight for these works is estimated at $6.5M.

4.4.2.4. Schedule

The above projects are scheduled to be developed, designed, and constructed between 2018 and 2025.

4.4.2.5. Anticipated Effectiveness

UMT anticipates all source reduction work, when completed in 2025, will result in an infiltration/inflow reduction of 15% to 20%.

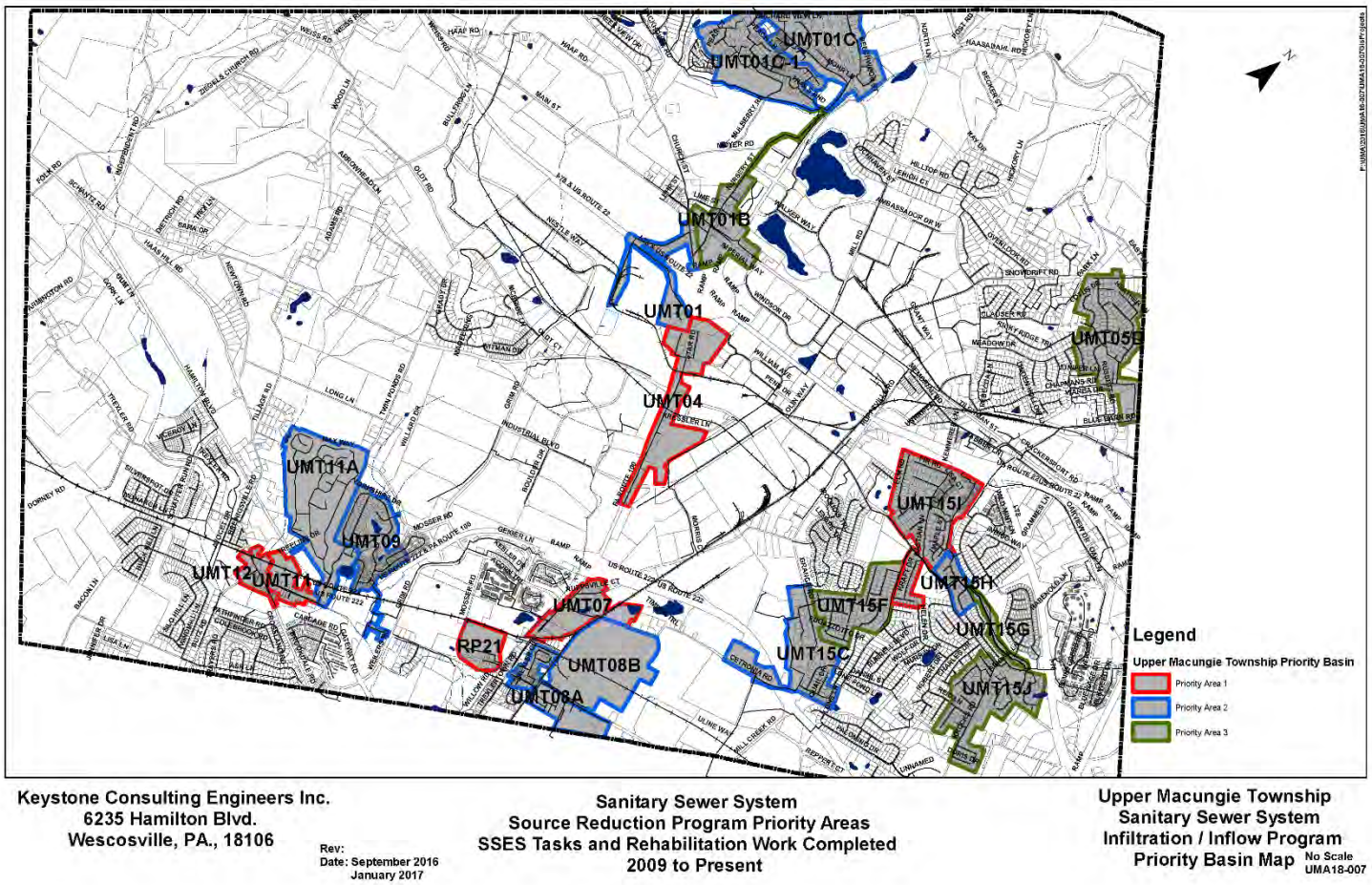


Figure 4-2 - UMT SRP Project Areas

4.5. Lower Macungie Township

4.5.1. Completed Projects

Over the past several years, LMT has undertaken a number of source removal projects within the Township's sanitary sewer system specifically targeting the designated infiltration/inflow priority areas in the system. The completed projects included private property illegal discharge sump pumps and other clearwater sources, main line cured-in-place pipe lining of the clay pipe mains and manhole rehabilitation.

4.5.1.1. Purpose

Most of the completed source removal projects fall within the Priority 1, 2 and 3 I/I areas identified by flow meter evaluation and SSES analysis. Selected projects were identified within each designated priority area as a result of systematic SSES field tasks and data assessment. Subsequently, specific sewer system rehabilitation efforts and tasks began in these areas or catchments with the expectations that the initial rehabilitation work will have an immediate and significant impact on RDII removal.

4.5.1.2. Scope

The scope of the completed source removal programs or rehabilitation efforts is shown in Table 4-2 and includes the following:

Year	Offset MH Casting and/or Cone Repairs	Manhole Rehabilitation (Inserts, Seal casting, etc)	Full Depth Manhole Epixy Lining	Sewer Main Replacement (LF)	Main Line Spot Repairs	Main Line CIPP Lining (VCP)	Lateral Rehab	Removed Sump Pumps Remove
2009				221'		4,880'	64	
2010				1,051'		204'		
2011	1						28	46
2012		73	16			11,190'		
2013					1	6,959'		
2014		40	2			5,355'	10	
2015		17	3			4,361'	18	
2016	2	31	8		1	5,716'	7	
2017		36	11	380	1	19,176'	23	
Totals	**3**	**197**	**40**	**1,652**	**3**	**57,841'**	150	46

Note: A number of manholes rehabilitated may have received one, or more than one, type of rehabilitation repairs.

Table 4-2 - LMT Completed Source Reduction Work

- Private property sump pump removal: 46 sump pumps illegally discharging to the sanitary sewer system were removed.

- Cured-in-Place pipe lining of the VCP mains within the sewer system: Approximately 57,500 linear feet of VCP main sewer pipe has now been lined. This represents about 72% of all the existing VCP pipe in the entire LMT sewer system.

- Manhole rehabilitation: 250 manholes have gone through some form of rehabilitation including full depth epoxy lining, epoxy chimney lining, base section lining, slipline annular space repair, chimney grouting, drill and grouting active leaks, manhole inserts, reset offset castings, replace manhole cover gaskets

as well as replacement of existing manhole castings with composite watertight castings.

4.5.1.3. Cost

The cost for engineering, construction, and construction oversight for this project was $2,108,520.

4.5.1.4. Effectiveness

There has been no flow meter effectiveness monitoring or analysis completed to date to measure or quantify the effects of the infiltration/inflow reduction rate as a result of the ongoing source removal projects. Interim flow meter effectiveness monitoring is anticipated to be done in 2019 with the analysis report available in 2020.

4.5.2. Anticipated Projects

4.5.2.1. Purpose

Between 2018 and 2025, LMT plans to continue source removal projects in an effort to improve the RDII reductions as well as to maintain a reasonably effective Infiltration/Inflow reduction program.

4.5.2.2. Scope

LMT's Source Reduction Program or I/I rehabilitation efforts will be conducted in the areas shown in Figure 4-3, and will include the following projects:

- Continue private property sump pump and clearwater source investigations and removal as necessary.
- Continue the cured-in-place pipe lining of the VCP sewers until all VCP within the Township sanitary sewer system is lined. Anticipated to be completed in 2018.
- Continue with the scheduled 5-year cycle of individual manhole inspections (~250 manholes per year) program and determine the type of repairs and/or rehabilitation methods as may be necessary.
- Starting in 2018, conduct lateral investigation and rehabilitation program of 1200 laterals through 2025.

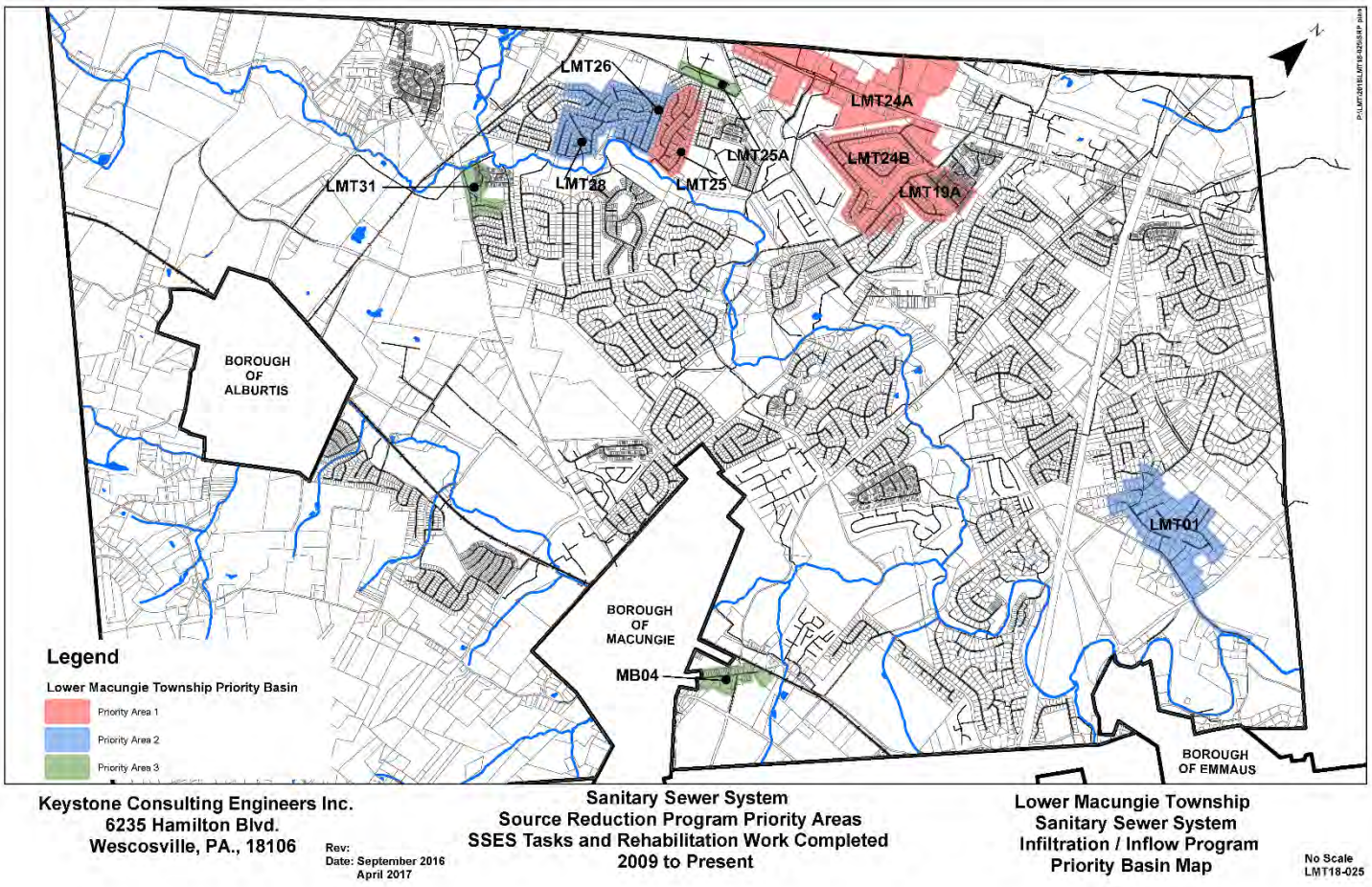


Figure 4-3 - LMT SRP Project Areas

4.5.2.3. Cost

The anticipated cost for engineering, construction, and construction oversight for these works is estimated at $5.2M.

4.5.2.4. Schedule

The above projects are scheduled to be developed, designed, and constructed between 2018 and 2025.

4.5.2.5. Anticipated Effectiveness

LMT anticipates all source reduction work, when completed in 2025, will result in an infiltration/inflow reduction of 15% to 20%.

4.6. Borough of Alburtis

4.6.1. Completed Projects

4.6.1.1. Purpose

The purpose of these works were to address structural and leakage issues within the collection system.

4.6.1.2. Scope

At various locations throughout the Borough, where needed, CIPPL mainline lining, manhole rehabilitation and repair, and cleanout cap installations were conducted.

4.6.1.3. Cost

The cost for engineering, construction, and construction oversight for this project has been approximately $600,000 since 2010.

4.6.1.4. Schedule

Projects were conducted between 2010 – 2016.

4.6.1.5. Effectiveness

The effectiveness of these projects was not monitored.

4.6.2. 2018 SRP Project

4.6.2.1. Purpose

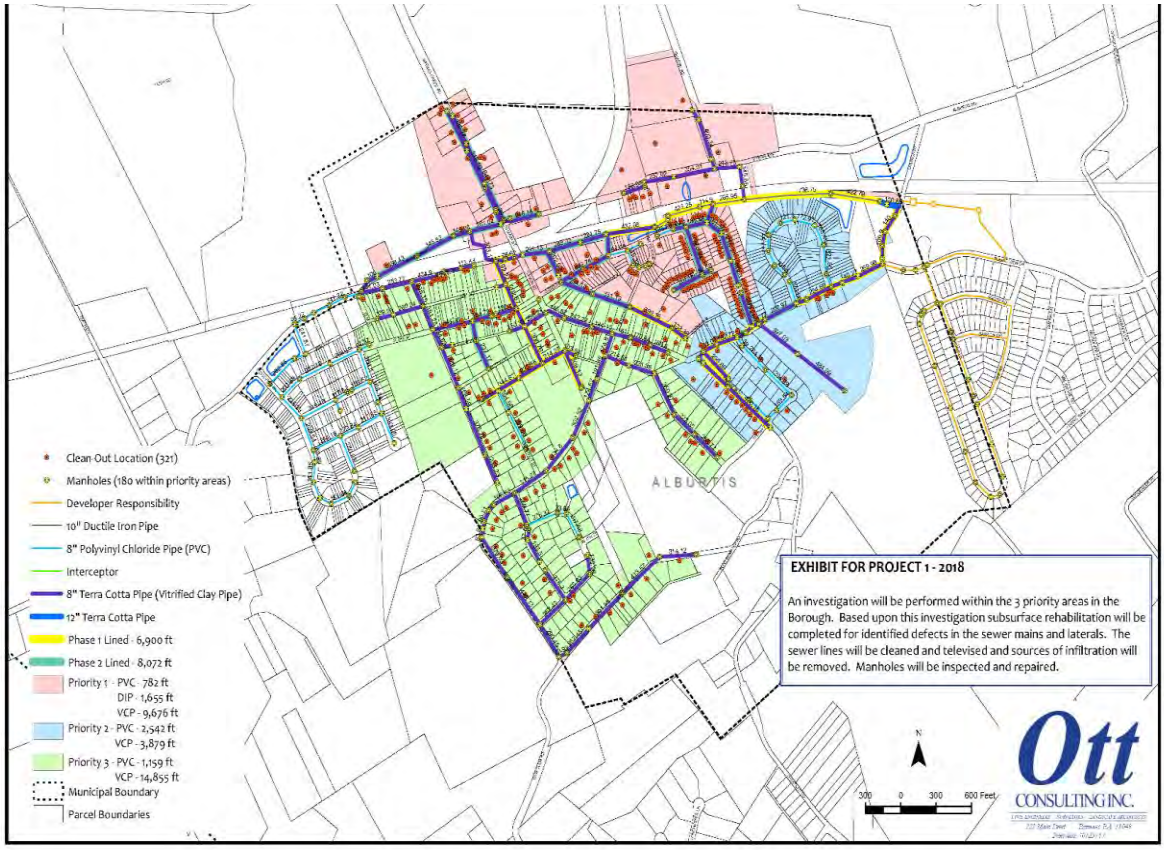
The purpose of this project is to reduce inflow and infiltration from all areas prioritized based on leakage during the SSES investigations.

4.6.2.2. Scope

Additional investigations of the sanitary sewer system within the priority areas (Figure 4-4) will be conducted to establish rehabilitation technique. Based upon this investigation, rehabilitation will be completed for identified defects within the sewer

mains and laterals. Manhole rehabilitation will be completed on manholes with leakage or structural defects.

Figure 4-4 – Alburtis 2018 SRP Project



4.6.2.3. Cost

This work is estimated to cost $500,000.

4.6.2.4. Schedule

This work is scheduled to be completed in 2018.

4.6.2.5. Anticipated Effectiveness

Alburtis anticipates all source reduction work, when completed in 2025, will result in an infiltration/inflow reduction of at least 25%.

4.6.3. 2019 SRP Project

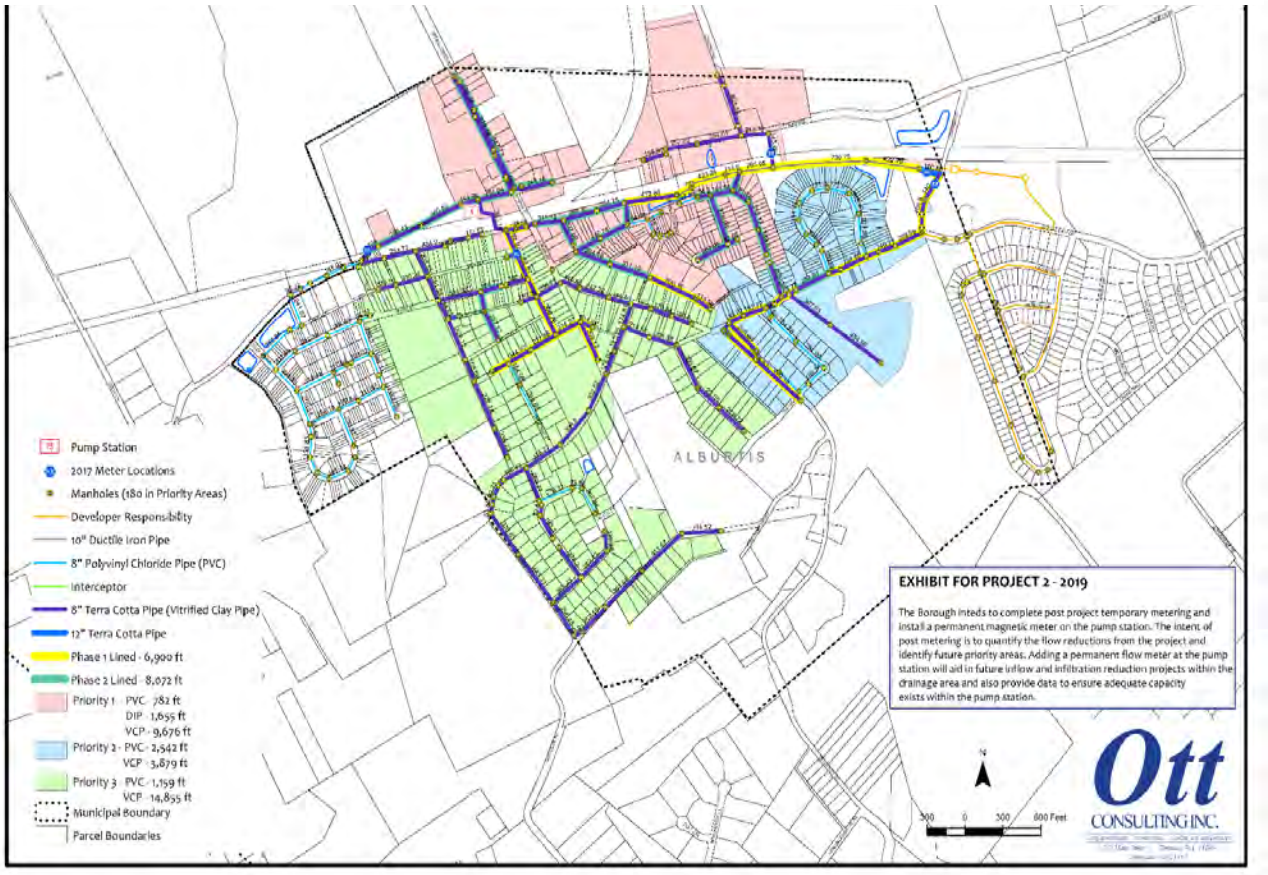
4.6.3.1. Purpose

The purpose of this project is to reduce inflow and infiltration entering through manholes within the priority areas.

4.6.3.2. Scope

Manhole rehabilitation will be completed on manholes identified with extraneous flow or structural defects within the priority areas as shown in Figure 4-5.

Figure 4-5 – Alburtis 2019 SRP Project



4.6.3.3. Cost

This work is estimated to cost $100,000.

4.6.3.4. Schedule

This work is scheduled to be completed in 2019.

4.6.3.5. Anticipated Effectiveness

Alburtis anticipates all source reduction work, when completed in 2025, will result in an infiltration/inflow reduction of 25%.

4.6.4. 2020 SRP Project

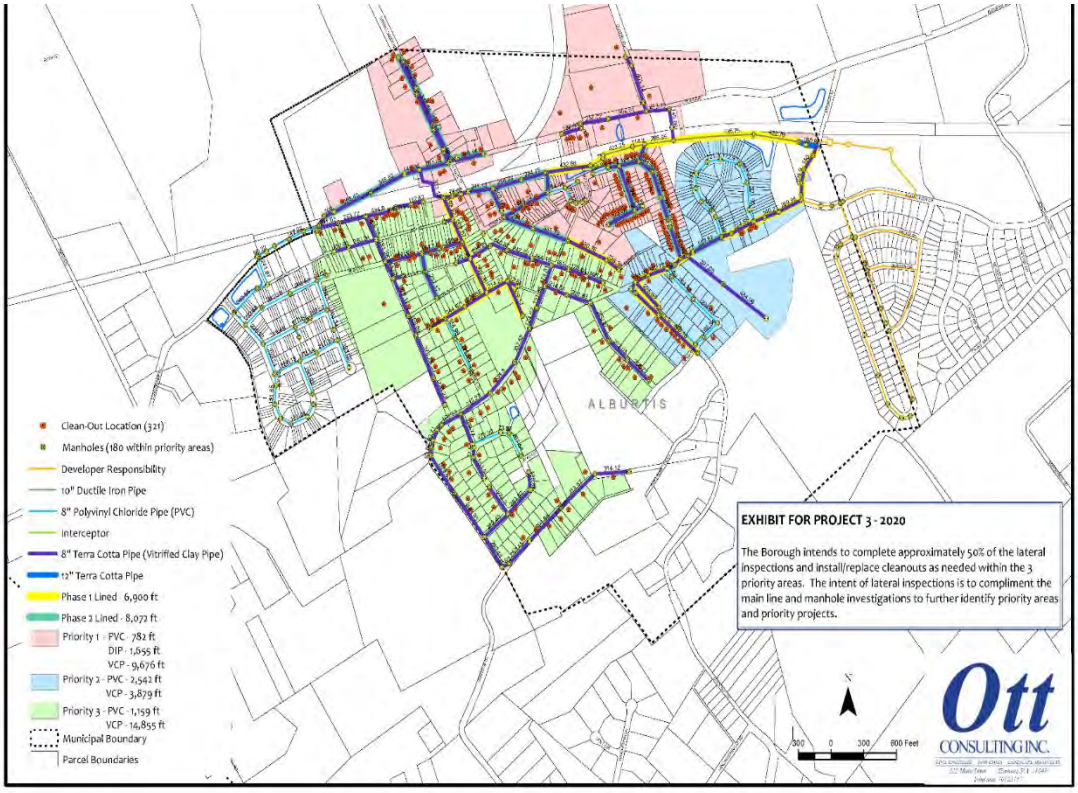
4.6.4.1. Purpose

The purpose of this project is to reduce inflow and infiltration entering through cleanouts and laterals within the priority areas.

4.6.4.2. Scope

Cleanout cap replacement and lateral rehabilitation will be completed in yet-to-be-determined locations within the priority areas as shown in Figure 4-6.

Figure 4-6 – Alburtis 2020 SRP Project



4.6.4.3. Cost

This work is estimated to cost $200,000.

4.6.4.4. Schedule

This work is scheduled to be completed in 2020.

4.6.4.5. Anticipated Effectiveness

This project is anticipated to reduce rainfall derived infiltration volume by 35-70% from the project area.

4.6.5. 2021 SRP Project

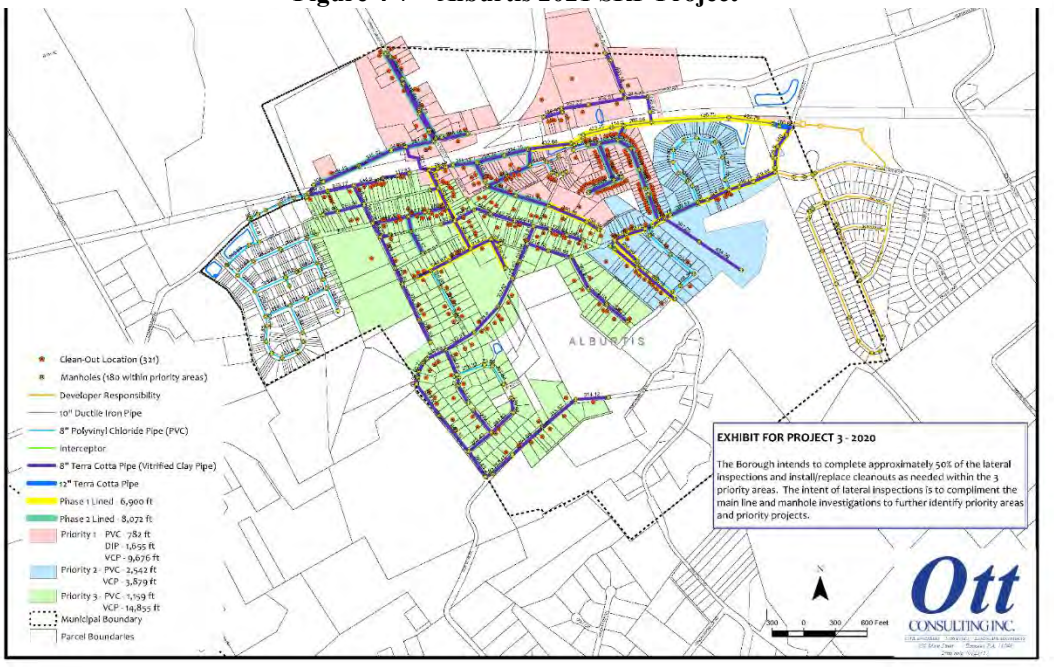
4.6.5.1. Purpose

The purpose of this project is to reduce inflow and infiltration entering through cleanouts and laterals within the priority areas.

4.6.5.2. Scope

Cleanout cap replacement and lateral rehabilitation will be completed in yet-to-be-determined locations within the priority areas as shown in Figure 4-7.

Figure 4-7 – Alburtis 2021 SRP Project



4.6.5.3. Cost

This work is estimated to cost $200,000.

4.6.5.4. Schedule

This work is scheduled to be completed in 2021.

4.6.5.5. Anticipated Effectiveness

This project is anticipated to reduce rainfall derived infiltration volume by 35-70% from the project area.

4.6.6. 2022 SRP Project

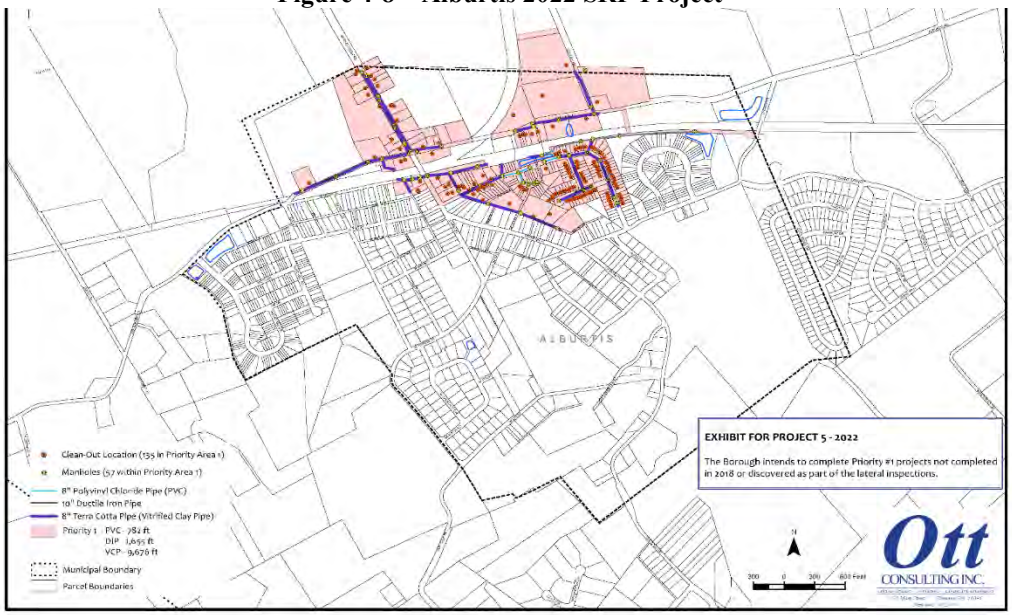
4.6.6.1. Purpose

The purpose of this project is to reduce inflow and infiltration entering through sewer mains, lateral, and manholes within the priority areas.

4.6.6.2. Scope

Sewer mains, lateral, and manhole rehabilitation will be completed in yet-to-be-determined locations within the priority areas as shown in Figure 4-8.

Figure 4-8 – Alburtis 2022 SRP Project



4.6.6.3. Cost

This work is estimated to cost $200,000.

4.6.6.4. Schedule

This work is scheduled to be completed in 2022.

4.6.6.5. Anticipated Effectiveness

This project is anticipated to reduce rainfall derived infiltration volume by 35-70% from the project area.

4.6.7. 2023 SRP Project

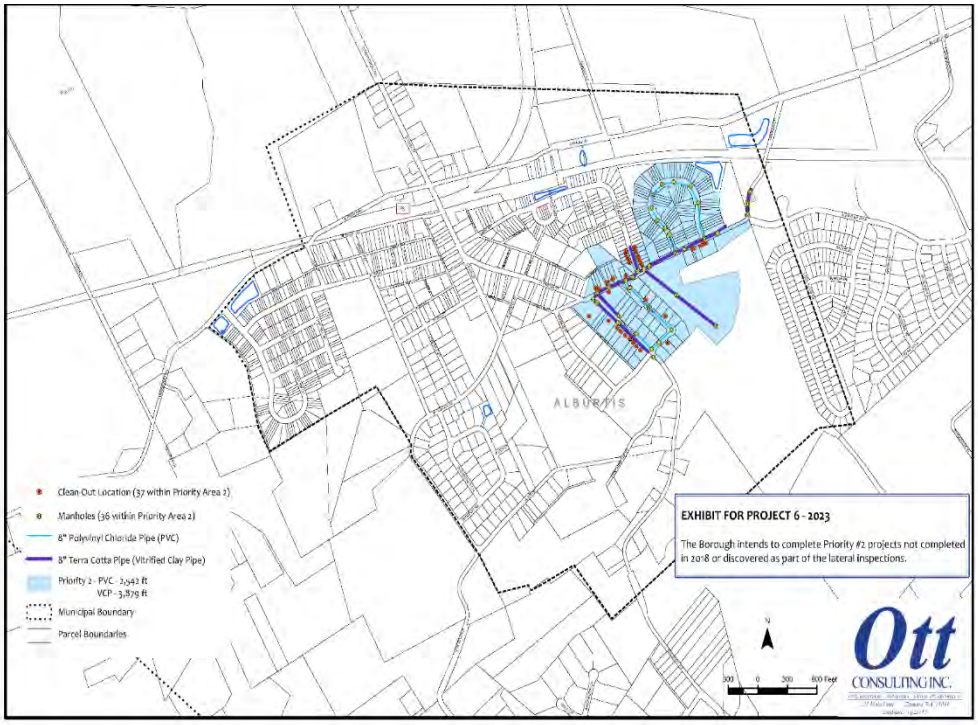
4.6.7.1. Purpose

The purpose of this project is to reduce inflow and infiltration entering through sewer mains, lateral, and manholes within the priority areas.

4.6.7.2. Scope

Sewer mains, lateral, and manhole rehabilitation will be completed in yet-to-be-determined locations within the priority areas shown in Figure 4-9.

Figure 4-9 – Alburtis 2023 SRP Project



4.6.7.3. Cost

This work is estimated to cost $200,000.

4.6.7.4. Schedule

This work is scheduled to be completed in 2023.

4.6.7.5. Anticipated Effectiveness

This project is anticipated to reduce rainfall derived infiltration volume by 20-50% in mainlines and 35-70% in laterals from the project area.

4.6.8. 2024 SRP Project

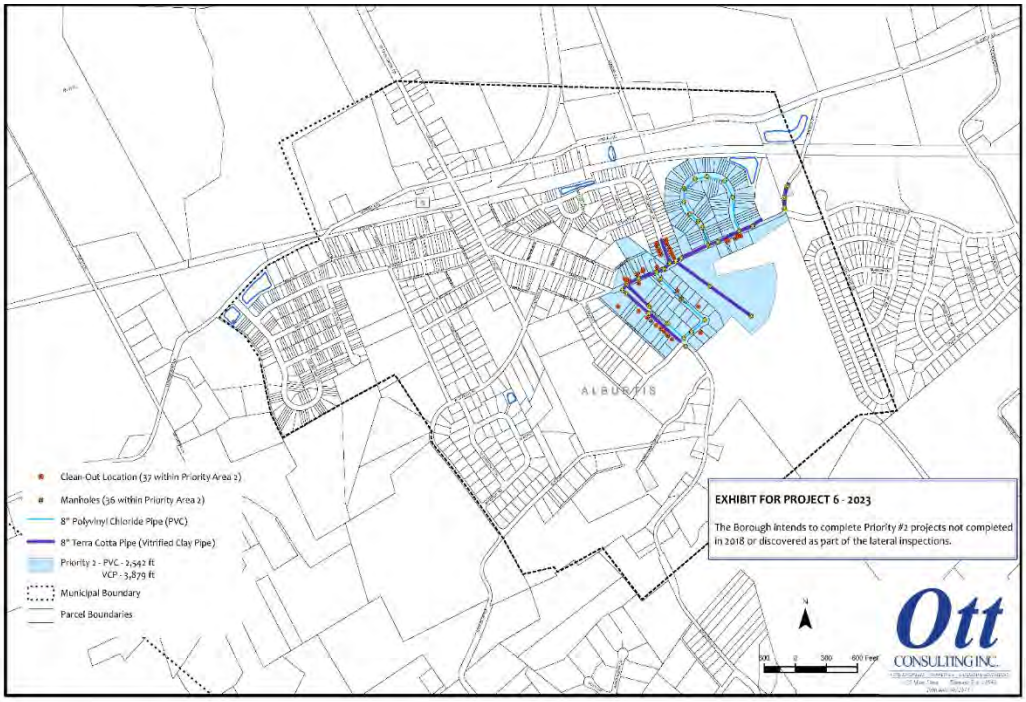
4.6.8.1. Purpose

The purpose of this project is to reduce inflow and infiltration entering through sewer mains, lateral, and manholes within the priority areas.

4.6.8.2. Scope

Sewer mains, lateral, and manhole rehabilitation will be completed in yet-to-be-determined locations within the priority areas shown in Figure 4-10.

Figure 4-10 – Alburtis 2024 SRP Project



4.6.8.3. Cost

This work is estimated to cost $200,000.

4.6.8.4. Schedule

This work is scheduled to be completed in 2024.

4.6.8.5. Anticipated Effectiveness

This project is anticipated to reduce rainfall derived infiltration volume by 20-50% in mainlines and 35-70% in laterals from the project area.

4.6.9. 2025 SRP Project

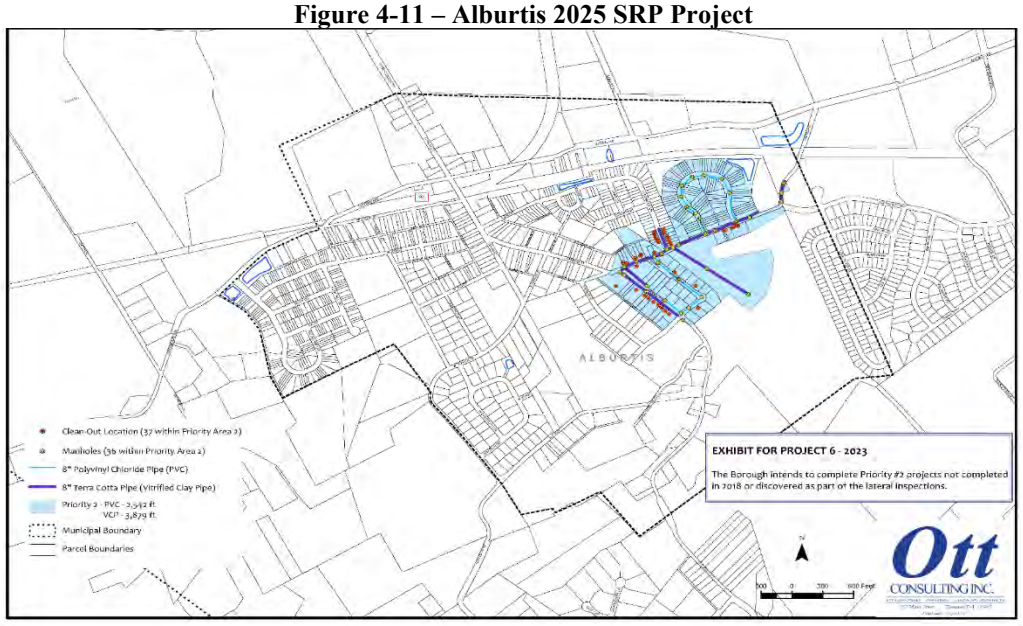
4.6.9.1. Purpose

The purpose of this project is to reduce inflow and infiltration entering through sewer mains, lateral, and manholes within the priority areas.

4.6.9.2. Scope

Sewer mains, lateral, and manhole rehabilitation will be completed in yet-to-be-determined locations within the priority areas shown in Figure 4-11.

Figure 4-11 – Alburtis 2025 SRP Project



4.6.9.3. Cost

This work is estimated to cost $200,000.

4.6.9.4. Schedule

This work is scheduled to be completed in 2025.

4.6.9.5. Anticipated Effectiveness

This project is anticipated to reduce rainfall derived infiltration volume by 20-50% in mainlines and 35-70% in laterals from the project area.

4.7. Borough of Macungie

4.7.1. 2013 Cured in Place Pipe Lining (CIPPL) Project

4.7.1.1. Purpose

The purpose of this project was to rehabilitate sanitary sewer mains within the Borough where I/I had been found to be excessively high during the SSES investigations.

4.7.1.2. Scope

This project consisted of CIPPL lining of 5,510 feet of 8" sanitary sewer mains.

4.7.1.3. Cost

The cost for engineering, construction, and construction oversight for this project was $200K.

4.7.1.4. Schedule

This work was completed in 2013.

4.7.1.5. Effectiveness

Flow meters were placed at strategic points in the Macungie sewer system in 2017, and an analysis of the flow monitoring results to determine the effectiveness of this work is currently underway.

4.7.2. Race Street Sanitary Sewer Replacement

4.7.2.1. Purpose

The purpose of this project was to replace two VCP sanitary sewer sections in the lower section of Race Street with DIP. (Due to the groundwater table being above the pipe, groundwater was pouring into the sewer pipe at numerous locations and it was determined that it was unlikely that a suitable cure of a CIPP lining could be achieved.

4.7.2.2. Scope

The project consisted of replacing 751 feet of VCP with DIP.

4.7.2.3. Cost

The anticipated cost for engineering, construction, and construction oversight for this project was $211K.

4.7.2.4. Schedule

The project was completed in 2015.

4.7.2.5. Effectiveness

The project successfully eliminated the groundwater that was pouring into this pipe, although the exact extent was not measured.

4.7.3. Spring Street Sanitary Sewer Replacement

4.7.3.1. Purpose

The purpose of this project was to replace the VCP sewer in Spruce Street with PVC pipe.

4.7.3.2. Scope

The project consisted of replacing 178 feet of VCP with PVC.

4.7.3.3. Cost

The anticipated cost for engineering, construction, and construction oversight for this project was $35K.

4.7.3.4. Schedule

The project was completed in 2015.

4.7.3.5. Effectiveness

The project successfully eliminated the groundwater that was entering into this pipe, although the exact extent was not measured.

4.7.4. 2016 Sanitary Sewer Rehabilitation Project

4.7.4.1. Purpose

The purpose of this project was to rehabilitate sanitary sewer mains within the Borough where I/I had been found to be excessively high during the SSES investigations.

4.7.4.2. Scope

This project consisted CIPP lining of 3,893 feet of 8" VCP sanitary sewer mains.

4.7.4.3. Cost

The cost for engineering, construction, and construction oversight for this project was $131K.

4.7.4.4. Schedule

This work was completed in 2016.

4.7.4.5. Effectiveness

Flow meters were placed at strategic points in the Macungie sewer system in 2017, and an analysis of the flow monitoring results to determine the effectiveness of this work is currently underway.

4.7.5. 2017 Sanitary Sewer Rehabilitation Project

4.7.5.1. Purpose

The purpose of this project was to rehabilitate sanitary sewer mains within the Borough where I/I had been found to be excessively high during the SSES investigations.

4.7.5.2. Scope

This project consisted CIPP lining of 12,524 feet of 8" and 466 feet of 10" VCP sanitary sewer mains.

4.7.5.3. Cost

The cost for engineering, construction, and construction oversight for this project was approximately $500K.

4.7.5.4. Schedule

This work was completed in 2017.

4.7.5.5. Effectiveness

Flow meters were placed at strategic points in the Macungie sewer system in 2017, and an analysis of the flow monitoring results to determine the effectiveness of this work is currently underway.

4.7.6. 2018 Sanitary Sewer Rehabilitation Project

4.7.6.1. Purpose

The purpose of this project is to rehabilitate sanitary sewer mains within the Borough where I/I had been found to be excessively high during the SSES investigations.

4.7.6.2. Scope

This project consists of CIPP lining of 8,735 feet of 8" VCP sanitary sewer mains.

4.7.6.3. Cost

The cost for engineering, construction, and construction oversight for this project is estimated to be $304K.

4.7.6.4. Schedule

This work is scheduled to be completed in 2018.

4.7.6.5. Anticipated Effectiveness

Macungie anticipates all source reduction work, when completed in 2025, will result in an infiltration/inflow reduction of 25%.

4.7.7. Lateral Cleanout Installations

4.7.7.1. Purpose

The purpose of this project is to identify where cleanouts need to be installed to facilitate lateral inspection and rehabilitation.

4.7.7.2. Scope

Approximately 150 new lateral cleanouts will be required.

4.7.7.3. Cost

The cost for engineering, construction, and construction oversight for this project was $280K.

4.7.7.4. Schedule

The locations of where lateral cleanouts are needed is anticipated to be completed in 2018, and the installation of the cleanouts is anticipated to be done in 2019.

4.7.7.5. Anticipated Effectiveness

Not applicable.

4.7.8. Lateral Tap Connection Sealing

4.7.8.1. Purpose

The purpose of this project is to seal lateral penetrations where laterals were reinstated during prior CIPPL projects. Reinstated laterals will be done by installations of top hats, shorties, or full length lateral lining.

4.7.8.2. Scope

Approximately 600 reinstated laterals need to be addressed. It is estimated that 200 will be sealed with a top hat, 200 will be lined with a shortie liner, and 200 will be lined with a full length CIPLL liner to the right-of-way line.

4.7.8.3. Cost

The cost for engineering, construction, and construction oversight for this project was $2.2M.

4.7.8.4. Schedule

This work is anticipated to be completed in in 2019.

4.7.8.5. Anticipated Effectiveness

Macungie anticipates all source reduction work, when completed in 2025, will result in an infiltration/inflow reduction of 25%.

4.7.9. Manhole Rehabilitation

4.7.9.1. Purpose

The purpose of this project is to inspect all sanitary sewer manholes in priority areas and rehabilitate those manholes in need of repair.

4.7.9.2. Scope

Approximately 200 manholes are anticipated to require rehabilitation.

4.7.9.3. Cost

The cost for engineering, construction, and construction oversight for this project was $500K.

4.7.9.4. Schedule

The manhole inspections are anticipated to be completed in 2018, and manhole rehabilitation are anticipated to be completed in 2019.

4.7.9.5. Anticipated Effectiveness

Macungie anticipates all source reduction work, when completed in 2025, will result in an infiltration/inflow reduction of 25%.

4.8. Lowhill Township

Flow metering and SSES investigations indicated there are no areas of excessive I/I in the LCA operated portions of Lowhill Township. Therefore, no SRP works are planned.

5. Capacity Improvements

There are several capacity related projects that will need to be conducted contemporaneously with the WLSP Source Reduction Programs and completed before the planned 2025 KISS model update. These are primarily refurbishment and rehabilitation projects designed to extend the life of existing components without increasing capacity. The exceptions to this are the Park Force Main Extension, which provides needed partial capacity relief in the JCI, and the Trexlertown Interceptor, which provide needed additional dry day and wet weather conveyance capacity in the upper section of the WLI.

5.1. Park Pump Station Refurbishment

5.1.1.1. Purpose

The Park Pump Station was constructed in the early 1980s and was originally intended to serve as a wet weather flow relief facility for the Western Lehigh and Little Lehigh Interceptors during wet weather events. The station conveys wastewater from ten municipalities (Upper Milford Township, Weisenberg Township, Lower Macungie Township, Upper Macungie Township , Lowhill Township, Alburtis, Macungie, Borough of Emmaus, Salisbury Township, and South Whitehall Township) to the Jordan Creek Interceptor just upstream of KIWWTP. Since 2012, dry day flows from these municipalities and Allentown have increased to the point that daily overflows would occur in Allentown's Little Lehigh Interceptor and Jordan Creek Interceptor if LCA's Park Pump Station were not daily operated as a dry day pump station. Age, increased operation, and wet well characteristics have resulted in significant wear and tear on equipment, with many components at or beyond their service life. The increasing frequency of pump related repairs and declining pump performance has necessitated an upgrade of this essential asset in order to restore the station to its design capacity and avoid sanitary sewer surcharging and overflows in the interceptors. The purpose of this project is to restore the station to its design capacity (level of service), extend the service life, and enhance station reliability

5.1.1.2. Scope

The scope of work includes the replacement of extended shaft type pumps with dry pit submersible type pumps, replacement of the electrical controls and rheostat drives with modern controls and variable frequency drives, upgrade of HVAC system, replacement of roof system, replacement of (inoperable) force main drain valve, replacement of wet

well level control system, replacement of influent slide gate, installation of new hoist system and related structural members, construction of new floor opening and hatch to access dry well, electrical service upgrade, SCADA system upgrade and associated new instrumentation, and replacement of internal process piping, valves and fittings in order to complete a comprehensive structural/mechanical/electrical upgrade to the station.Cost

5.1.1.3. Cost

The cost for engineering, construction, and construction oversight for this project is $4.5M.

5.1.1.4. Schedule

Engineering for this project was completed in 2017. The DEP Part 2 Water Quality Management Permit was approved (dated 9/27/17permit) and design was completed by the end of November 2017. The project was advertised for bid (via PennBid) on 12/13/17, the pre-bid meeting was held on 1/4/18, and bids were opened on 2/1/18. Construction has begun and is anticipated to be completed by Summer 2019.

5.1.1.5. Anticipated Effectiveness

This project will provide 20 MGD of firm capacity from the Park Pump Station, allow for higher levels of operating efficiencies during dry day (lower flow demand) operations than the older motors/pumps, and provide an additional 25 years of life to pump station.

5.2. Park Forcemain and ARV Rehabilitation

5.2.1.1. Purpose

The Park Pump Station was intermittently operated during storm events only from start of operations in 1981 through mid-2000s. Beginning around 2005, the Park Pump Station began intermittent dry day operations to relieve City of Allentown's hydraulically overloaded Little Lehigh Interceptor; during this period, the pump station would operate for up to 4 hours per day several days per week. Beginning around 2013, the Park Pump Station began daily operations to relieve City of Allentown's hydraulically overloaded Little Lehigh Interceptor; during this period, the pump station would operate for one or two 4-hour cycles each day. During this entire 38-year period, the air release vacuum valves (ARV) would allow air to enter the Park Forcemain each time the pump station shutoff, allowing the pipeline to partially drain. Between periods of operation, the sewage in the line would turn completely septic, to the point where when the pumps turned on the grass around the ARVs would be killed by the hydrogen sulfide gases.

These same gases supported sulfide reducing bacteria inside the pipe that produce sulfuric acid that attacks the interior cement mortar and steel cylinder of the prestressed concrete cylinder pipe forcemain. This may have compromised the structural integrity of the forcemain. Inspections are planned to assess the condition and possible need for rehabilitation or replacement of the forcemain.

5.2.1.2. Scope

The scope of Park Forcemain rehabilitation is not determined.

5.2.1.3. Cost

The cost of Park Forcemain rehabilitation is not determined.

5.2.1.4. Schedule

The schedule for corrective action for the Park Forcemain depends on the extent and nature of the work needed. If spot repairs are needed, the work will be conducted in 2019-2020. If rehabilitation is required, the work will be conducted in 2019-2021. If replacement is required, the work will be conducted 2019-2023, depending on the difficulty of identifying and procuring easements for a new pipeline.

5.2.1.5. Anticipated Effectiveness

The intention is to extend the life of the Park Forcemain so it is commensurate with that of the newly refurbished Park Pump Station.

5.3. Spring Creek Pump Station Force Main and ARV Rehabilitation

5.3.1.1. Purpose

The SCPS was intermittently operated during storm events only from start of operations in 1994 through mid-2000s. Beginning around 2013, the SCPS began irregular but increasingly routine daily operations to relieve high flow levels in the WLI between SCPS and Kecks Bridge. In 2016, the influent gate to the SCPS failed open, and the SCPS has operated regularly since that time. During most of this entire 24-year period, the air release vacuum valves (ARV) were shut off (and in some cases removed entirely) to prevent odors from leaving the pipeline when the pumps turned on. Between periods of operation, the sewage in the line would turn completely septic, allowing air/sulfide

gases inside the pipe to develop into pockets that move as the pumps turn on and off. This may have compromised the structural integrity of the ductile iron forcemain. Inspections are planned to assess the condition and possible need for rehabilitation or replacement of the forcemain as well as replace the ARVs.

5.3.1.2. Scope

A PURE SmartBall investigation will be attempted to identify the location of gas pockets. A broadband electromagnetic (BEM) tests will be conducted at locations were gas pockets are found to determine remaining wall thickness and assess the remaining useful life of the forcemain before repair, rehabilitation, or replacement is needed.

An evaluation of the impact of vacuum on the pipeline from inoperable vacuum release valves will be conducted to determine if vacuum release valves are warranted. An evaluation of the need for and location required to remove gas pockets will be conducted to determine if air release valves are warranted. Pipeline rehabilitation and ARV replacement or relocation will be completed as needed.

5.3.1.3. Cost

As the scope of work is undefined, no costs for this work have been as yet determined.

5.3.1.4. Schedule

Inspections and testing will be conducted in 2020. Pipeline rehabilitation and ARV replacement or relocation, if needed, will be completed as dictated by the findings.

5.3.1.5. Anticipated Effectiveness

The intention is to extend the life of the Spring Creek Forcemain so it is commensurate with that of the remaining useful life of the SCPS.

5.4. Trexlertown Interceptor Paralleling

5.4.1.1. Purpose

The KISS modeling of SCARP alternatives identified the 2-mile section of the WLI from just north of Hamilton Boulevard (starting around the Sportmen's Association) through to Spring Creek Road as being currently within 0.5 MGD of its dry weather capacity and within a decade being well over its wet weather LOP goals. This section will be paralleled with a new Trexlertown Interceptor (TTI).

5.4.1.2. Scope

The TTI will consist of approximately 2 miles of 24-inch and 27-inch centrifugally cast fiberglass reinforced polymer mortar pipe. The alignment of this new interceptor is not yet determined.

5.4.1.3. Cost

The cost for easements, engineering, construction, and construction oversight for this project is $13M.

5.4.1.4. Schedule

Alignment evaluation and easement acquisition are anticipated to start in 2019 and take up to two years to complete. Once complete, engineering will be completed, with an anticipated start of construction in 2022 and completion of construction in 2023.

5.4.1.5. Anticipated Effectiveness

This work will achieve all 2040 capacity goals within this reach of the WLI.

5.5. Post-2026 Capacity Improvements

As previously reported in the semiannual reports, existing regional dry weather flows cause daily surcharging of LCA's WLI and COA's LLI and JCI. Dry-day overflows are avoided through the daily operation of LCA's wet weather relief pump stations. Source reduction efforts by all Signatories will reduce the impact of wet weather flows, and some measures may also incrementally reduce base flow infiltration entering these interceptors, but previously conducted modeling efforts indicate a probability these interceptors will remain hydraulically overloaded. The additional flows projected by the Signatories to enter these lines will exacerbate the overload.

It is anticipated that additional conveyance improvements may be required, and this will be further studied during the 2026 flow characterization discussed in Section 6.2.2, or earlier if needed. The options studied on a preliminary basis via the alternatives analysis described in Section 2 suggest LCA capacity improvements may include construction of additional parallel sections of the WLI while other Signatory capacity improvements may include construction of a new regional pump station, transfer of the existing Park Pump Station from an LCA facility to a regional facility, paralleling of COA's LLI and JCI interceptors, paralleling of other Signatory interceptors, and peak flow treatment and hydraulics improvements at KIWWTP to address all KISS Signatory flows.

6. Flow Characterization

6.1. Past Flow Characterizations

Flow and rainfall data were collected in Allentown in 2008 and used to calibrate a hydraulic planning model of the City of Allentown sewer system. Figure 6-1 displays the locations of the WLSP gravity flow monitors and rain gauges, as well as the pump stations and municipalities' boundaries.

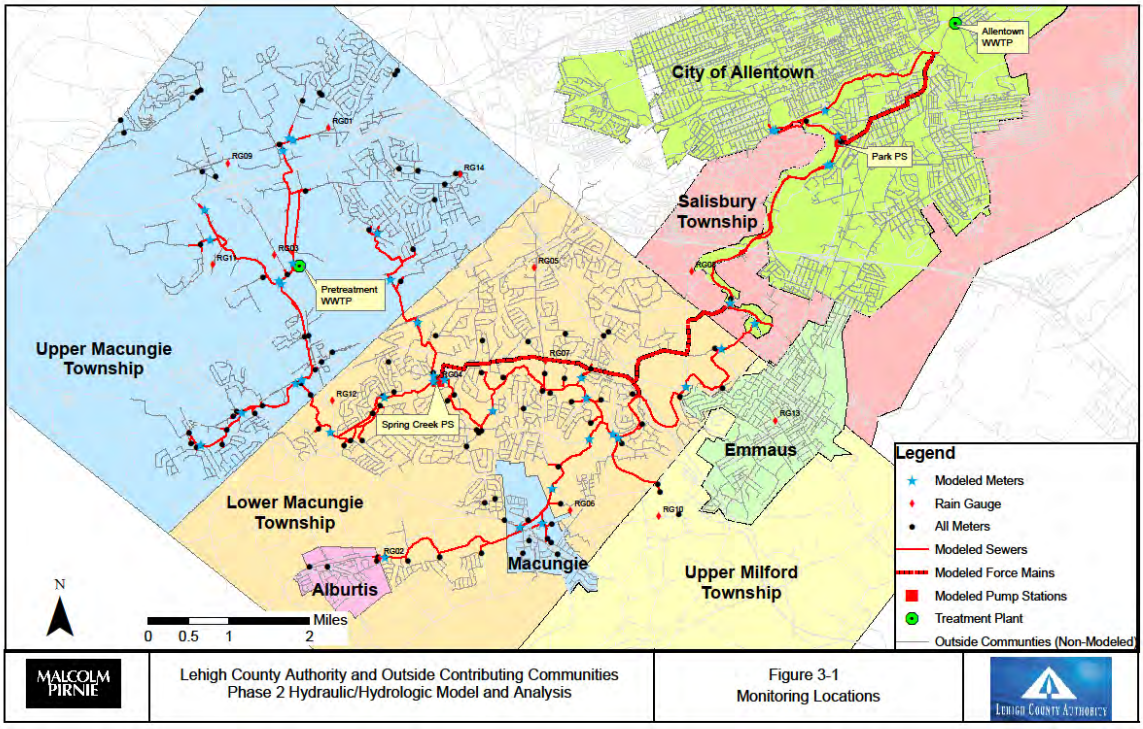


Figure 6-1 - Monitoring Locations for the WLSP's Sanitary Sewer System

In 2014, the WLSP planning-level model was combined with the Allentown hydraulic model to create a single hydraulic model called the Kline's Island Sewer System (KISS) Model. The KISS model is the primary planning and hydraulic basis of design tool for the KISS. This model confirmed that portions of the primary conveyance components, namely the WLI , LLI, and JCI, were experiencing high hydraulic grade lines in conveying dry-day flows and, accordingly, had limited ability to convey significant peak wet-weather flows.

6.2. Flow Characterization Updates

The source reduction and capacity improvements will improve levels of protection and reduce the frequency of SSOs in the WLSP sewer systems, especially within the Western Lehigh Interceptor, in the downstream COA Little Lehigh and Jordan Creek Interceptors, and at KIWWTP. However, additional development flows will add flow to the system. To evaluate the impact of these on WLSP Level of Protection and Level of Service Goals, the KISS model will be periodically recalibrated and dry day and wet day hydraulic grade lines evaluated against goals.

To accomplish this, a program of flow monitoring, rainfall monitoring, future flow projections, and dynamic hydraulic modeling will be conducted at key planning stages.

6.2.1. 2019 WLSP Flow Characterization Update

Additional development flows have been added to the WLI since the last system flow characterization in 2009. More broadly, the same is true of the remaining 75% of the flow in the KISS that originate with other Signatories as that portion of the KISS was last modeled in 2008. Additionally, source reduction and capacity improvements that improve levels of protection and reduce the frequency of SSOs have also been undertaken. An updated WLSP flow characterization of the primary conveyance components is necessary to understand the current average dry day and peak wet weather flow demands on the sewer system and to size needed capacity improvements. This work should be done simultaneously with a broader recalibration of the rest of the KISS system for identical reasons.

This flow characterization work will:

- Quantify the dry and wet day impacts of new development flows added since 2009
- Quantify the dry and wet day effectiveness of the I/I reduction work conducted since 2009
- Quantify the dry and wet day effectiveness of capacity improvements made since 2009

To accomplish this, a program of flow monitoring, rainfall monitoring, future flow projections, and dynamic hydraulic modeling will be conducted. Approximately 30 meters and 4 rain gauges will be installed throughout the WLSP in February 2019 or 2020 to capture the flows entering the Western Lehigh Interceptor from WLSP municipalities. (Additional meters would be needed to recalibrate the remaining 75% of

the KISS system). Meters will remain in place for 9-10 months. Model recalibration will be complete in the first half of 2020 or 2021.

6.2.2. 2026 Conveyance Upgrade Flow Characterization

The WLSP Source Reduction Programs are expected to be completed by the end of 2025. These are intended to reduce I/I for both dry day (infiltration) and wet day (rainfall derived inflow and infiltration) flows though it is not possible to positively and accurately predict their impact on peak flow at this time. Additional I/I reduction programs are proposed by COA and the other Signatories during this same time period.

Conversely, new development flows will have been added to the KISS by *all* Signatories between the now and then. An updated flow characterization of both the WLSP sewer system as well as the primary KISS components are expected to be performed in 2026 to understand the average dry day and peak wet weather flow demands on the primary regional conveyance components of the KISS and to assess the need for capacity improvements in the primary components of the KISS or at KIWWTP if there are significant and chronic SSOs and/or activations of Outfall 003 after completion of the SRP work.

This flow characterization work will:

- Quantify the dry and wet day impacts of new development flows added since the last model update
- Quantify the dry and wet day effectiveness of the I/I reduction work conducted since the last model update
- Quantify the dry and wet day effectiveness of capacity improvements made since the last model update

This work is proposed to be conducted after 2025. These hydraulic modeling results will form the hydraulic basis of design for any future projects needed to address system performance and future growth.

6.3. Anticipated Growth and Impact on Dry and Wet Weather Flows

Flow projections will be added to KISS models to evaluate depth of dry and wet weather flows within the various primary conveyance components of KISS. Concurrent with the flow metering and modeling work, sewage growth forecasts for all areas served by LCA will be conducted by each of the Partners in conjunction with modeling efforts. These sewage growth forecasts will be completed on a parcel basis and will consider zoning, likely density usage, and modern low flow plumbing and watertight sewerage impacts on

flow projections. Forecasts will evaluate future flows 25-30 years into the future to ensure long term capacity is cost effectively secured.

6.4. Rehabilitation Effectiveness Monitoring to Inform Connection Management Program

Flow data will be collected to complete the rehabilitation effectiveness analysis using the control basin methodology to quantify flow development credits under the SCARP's Connection Management Program that was approved as part of the 2010 SCARP Program Approach Outline and has been managed by PADEP since 2010. As part of this analysis, some basins will be selected and/or set-aside to be compared to the basins in which rehabilitation has been performed. This study will largely mimic the 2017 rehabilitation effectiveness study conducted by the WLSP. The pre-rehabilitation data sets will be drawn from the 2009 and 2017 data sets. The post-rehabilitation data set will be drawn from the subsequent monitoring periods.

7. Progress Reporting

7.1. Annual Reports

WLSP will report its activities and progress to PADEP as part of the annual Chapter 94 Report. Development flow credit reporting under the existing Connection Management Plan will continue to be reported with the Chapter 94 Report.

Appendix A : Final Alternatives Analysis Figures

AVAILABLE UPON REQUEST:

www.lehighcountyauthority.org/contact-us/