February 28, 2023

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Sanitary Sewer Asset Management Plan

EGLE Project No.1681-01

VILLAGE OF PINCKNEY

220 S HOWELL STREET
PINCKNEY, MI 48169

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1. Executive Summary

This sanitary sewer asset management plan (AMP) is intended to provide an assessment of routine maintenance staffing requirements, and to provide an opinion of asset conditions and future needs. Operating, maintenance, and replacement costs are reviewed for all system assets, to provide a defined level of service for the utility.

The goal of an asset management plan is to use system wide information to determine the lowest life cycle cost for maintenance, repair, and replacements to maintain that level of service. By performing pre-emptive maintenance on the system, and timing repairs before they become emergencies, the Village of Pinckney can make the most of their limited funds over the long term. Maps of the Village of Pinckney's sanitary sewer system are found in Appendix A.

A. Wastewater Asset Inventory

The Village of Pinckney uses its existing Geographic Information System (GIS) geodatabase as the primary means to inventory and map the assets in the system. However, the geodatabase did not include key attributes associated with each asset, such as installation date (age), size, material, along with other information as needed for a given asset type. Undertaking this AMP allowed the Village to collect the missing data and populate its GIS system for use moving forward. Condition assessment tools and protocols were used to assess sanitary sewer assets with a NASSCO-compliant software program storing data collected during sewer televising.

As part of the grant for the Village of Pinckney sanitary sewer system, the GIS geodatabase inventory was reviewed for completeness and to ensure critical attributes were populated. Approximately 55,736 lineal feet of sewer and 223 manholes underwent condition assessment via cleaning and televising. Vertical assets, including pump stations, force mains, and treatment facilities, were inventoried using record drawings and visual observations.

B. Criticality of Assets

Probability of Failure (PoF) for gravity sewer and manholes was calculated using equations applied to the Overall Quick Rating of each asset. Consequence of Failure (CoF) factors were developed by DPW Staff and its engineering consultants considering social, environmental, and economic cost impacts, and were used to estimate the overall risk of the horizontal assets (sewers and associated structures.) For pump stations, force mains, and treatment facilities, individual assets were reviewed by staff and PoF and CoF factors manually assigned.

Both the PoF and CoF were scored on a scale of 1 to 5, with 1 being the lowest probability or consequence of failure, and 5 corresponding to the highest probability or consequence of failure. The Business Risk Evaluation (BR or Risk) score is the product of the PoF score and the CoF score (PoF times CoF equals Business Risk,) and has a scale of 1 to 25. Higher BR scores identify the assets with the greatest overall risk.

The PoF and CoF for horizontal assets are determined using scoring values developed uniquely for each asset type, such as gravity main, non-gravity main, manholes, etc. The attribute for determining the PoF of gravity mains and manholes was the PACP Overall Quick Rating. Where PACP scores were not available, the POF score was based on the age-based assumed condition.

For force mains, the PoF was based on age, normal operating pressure, and history of repairs. For other access structures other than gravity manholes, the PoF is based primarily on visual observation of the frame condition, chimney condition, cone condition, wall condition, along with age.

The PoF and CoF of vertical assets were calculated using a scoring matrix. The PoF for vertical assets was calculated using a combination of age and physical condition collected from visual observation. O&M protocol and performance factors were also scored and used in the calculation. In the absence of any other data, age was used to estimate PoF. The CoF for vertical assets was scored using a matrix of factors including: safety of public and employees, financial impact, public confidence, regulatory compliance, and firm capacity.

C. Level of Service Determination

At the strategic level, the Level of Service (LOS) identifies the long-term goals and strategies of the organization. An overall LOS guiding matrix was developed to document the goals and strategies of the Village. The Village of Pinckney overall and Sanitary Sewer Mission Statements form additional elements of the LOS.

The goal of the Village of Pinckney sanitary sewer system is to accept and process sanitary sewage safely and efficiently by providing services that meet or exceed customer expectations and to comply with federal regulations. This section describes the Village's Level of Service goals and the key performance targets for each of the level of service goal for present and future performance. The level of service describes the characteristics of utility's performance such as "how much", "of what nature", and "how frequently" about the service and the performance target define how each level of service will be measured. The Village's progress toward meeting those goals will be reported annually.

The mission statement defines the goals of the Village of Pinckney and is the guide for the level of service goals.

The Village of Pinckney Mission Statement *The mission of the Village of Pinckney Council and Offices is to serve the residents of the Village with integrity and respect; practice responsible management of our common funds and resources; conduct business with transparency and accountability; maintain the quality of life through public safety and security; preserve the historic nature of the Village and welcome progress with vision; ensure that all issues are addressed with honesty and fairness.*

The Village of Pinckney Sewer System mission statement *We commit to improving and maintaining the public health protection and performance of our sanitary sewer collection, conveyance, and treatment system assets, while minimizing the long-term cost of operating those assets. We strive to make the most cost-effective renewal and replacement investments and provide the highest-quality customer service possible.*

Table 1.1: Level of Service Criteria, Performance Indicator, and Level

Key Service Criteria	Performance Indicator	Target Level of Service
Treatment Capacity	Active Monitoring of the Treatment process	Continue to be consistently below the EGLE discharge permit limits
O&M Optimization	Regular Cleaning and maintenance of the Collection System	Clean and maintain 33% of the collection system per year
Service Delivery and Customer Communication	Continue to ArcGIS Software to Aide in Utility Management	Respond to Customer complaints and requests within one (1) business day
Staff Training	Continue to Hold Regular Training for O&M Staff	Offer five (5) or more different training sessions each year

D. Revenue Structure

The Village operates both a full-service sewer and wastewater treatment system. The Village has recently undertaken major upgrades to the system, financed by USDA loans. The additional debt service required an increase in rates to cover this cost. Additionally, the Village's was generating insufficient revenue for both operations and capital needs. This gap was too large to bridge in a single year.

Therefore, the Village Council has adopted a seven-year plan whereby rates increased each year resulting in full annual cost recovery by year end 2030. The current sewer revenue structure proportionately allocates costs across the Village's user base by a combination of usage, capacity, and debt service charges, equity buy-in fees and special services revenue to fund annual expenses and capital improvements while driving toward a solid fund balance. These rates fluctuate annually with the system's requirements and increase the cost recovery percentage each fiscal year to reach full cost recovery in 2030.

The current rate setting methodology for operations uses a combination of usage fees and flat fees allocated proportionately by meter equivalent user, taking into account operating, maintenance and wear-and-tear (depreciation) to properly account for the degradation of assets as the infrastructure ages.

Funding for capital improvement projects is a combination of fund balance reserves, connection fees as well as any recovered depreciation expenses.

The rate methodology approved by the Council includes specific and appropriate coverage for any debt service requirements needed to finance capital repairs. A separate debt service charge allocated by meter equivalent user is now a component of the bill and covers the required annual debt service for the sanitary sewer system.

The Village's efficient and equitable allocation of expenses and a solid plan for the future creates a self-sustaining funding structure for the Village's utility infrastructure and maintains a fair cost model to all users of the system.

To ensure the current funding structure will continue to meet the future needs to operate and improve the system, the Village's Council has committed to a seven-year rate plan to add additional funds to provide for needed capital improvements. **Please Note: The Village Council has committed to a rate methodology and seven-year plan to achieve full system cost recovery, including depreciation. If fully implemented, by year five of the plan the village will achieve 80% recovery of depreciation expenses. Combined with available projected fund balances, the village believes it meets the requirements of EGLE's five-year rate plan.** The Village's Utility Committee meets regularly to discuss system capital plan requirements, annual rate changes, and implements any needed adjustments to the capital plan or rates through resolution adopted by the Village Council.

Based on the comprehensive asset review, rate study, adopted rate methodology, rate adjustments, and long-term plan for funding critical system needs, the Sewer Utility Fund has a solid financial outlook and will continue to serve the needs of the Village's customers.

E. Capital Improvement Plan

The Asset Management Plan forecasts and prioritizes assets that require replacement in the planning period. The individual replacements were combined into projects and scheduled with budget amounts established. A list of capital projects was developed, using recommendations from this plan, and consideration of other system needs.

The recommended projects are summarized below. Projects listed for implementation in the 0 to 10 year range include cost estimates prepared on data available at the study/feasibility level. Projects in the 10 to 20 year range are based on broad concepts only and costs are based on estimated replacement year cost. All projects are listed for financial and resource planning purposes only. Changes to project inclusion, scope, cost and/or timing are expected as resources are allocated, and changes occur in prioritization, regulations, technology, cost and other data becomes available.

Total Cost for 5 year CIP (A1-3 and B1 below): **Approximately $545,607**

Total Cost for 6-10 year CIP (B2-3 and C1 below): **Approximately $370,072**

Total Cost for 11-20 year CIP: See **Appendix D**

Capital Projects scheduled to be constructed in 2023:

1. N Howell Street Reconstruction

This project includes complete reconstruction (funded in part by a grant from MDOT) of one block of N Howell Street in the Central Business District of the Village. Sanitary sewer pipe and manholes in an easement within the influence of the street will also be replaced. The approximate cost for the sanitary sewer component of this project is **<u>$273,442</u>**.

2. Northwest Quadrant Infrastructure Improvements

This project includes complete reconstruction (funded in part by a private developer) of approximately 2,300 feet of Pond Street and W Hamburg Street in the northwest quadrant of the Village. A 25-foot section of 8-inch clay sanitary sewer in Pond Street with a major sag will be replaced along with an extension of sanitary sewer to service two homes on W Hamburg Street that are currently on septic and drainfields. The approximate cost for the sanitary sewer component of this project is **<u>$72,756</u>**.

3. WWTP Roof Replacement

This project includes replacement of the WWTP Lab Building roof which was originally installed in 2006. The approximate cost for this project is **<u>$15,000</u>**.

MACP and PACP Rehabilitation Program:

As part of the SAW Grant, 223 manholes and nearly 11 miles of pipe were inspected. Based on the reported defects, rehabilitation and restoration recommendations were made. This CIP project proposes to rehabilitate all sanitary sewers within the first ten years of this CIP that have been tagged with discrete defect ratings of 4 and 5 and/or have a Business Risk 16 or greater. All manholes and sewers that fall within the Business Risk range of 8-16 should be inspected regularly as described in the O&M Strategies. The costs below represent the estimated cost of the recommended rehabilitations made for the first 10 years of this CIP.

1. Brentwood Drive PSR 107 and 108

This project includes replacement of two segments of sanitary sewer that have discrete defect ratings of 4 and 5 and are the only two pipe segments in the entire system that have a Business Risk of 16 or greater

(17.08 for PSR 107 and 17.33 for PSR 108). This work is scheduled to be completed in 2028 and the approximate cost for this project is **$184,409**.

2. No Sags PSR 62, 132, 138, 146, 147, 164, 185, 195, 202, 251, 262

This project includes spot repair (Cured-In-Place Lining or open cut) of segments of sanitary sewer that have discrete defect ratings of 4 and 5 that are not sags in the pipe. This work is scheduled to be completed in 2030 and the approximate cost for this project is **$23,600**.

3. Sags PSR 3, 44, 82, 187, 188, 197, 201, 238

This project includes open cut repair of segments of sanitary sewer that have discrete defect ratings of 4 and 5 that are sags in the pipe. This work is scheduled to be completed in 2033 and the approximate cost for this project is **$242,088**.

Capital Projects scheduled to be constructed within ten years

1. Unadilla Reconstruction PSR 134, 200, 201 (955 feet R&R)

This project includes removal and replacement of segments of sanitary sewer that are within the limits of Unadilla Street reconstruction. This work is scheduled to be completed in 2033 and the approximate cost for this project is **$104,384**.

F. List of Major Assets

A summary of sanitary sewer system assets is listed in Table 1.2 below:

Table 1.2 - System Asset Summary		
Total Gravity Sewer	58,487	Feet
Total Force-Main Sewer	5,892	Feet
Total Manholes	245	Each
Pump/Lift Stations	4	Each
WWTP	1	Each

The breakdown of sizing for the piping for the system is shown in Table 1.3:

Table 1.3 - Sanitary Sewer Pipe Sizing Breakdown		
Pipe Diameter	**Gravity Sewer Length (feet)**	**Force-Main Sewer Length (feet)**
4 inch		1,175
6 inch	438	
8 inch	52,170	

Table 1.3 - Sanitary Sewer Pipe Sizing Breakdown		
10 inch	1,874	
12 inch	3,799	4,717
15 inch	65	
18 inch	141	
Totals	**58,487**	**5,892**

The Village of Pinckney has two runs of undersized gravity sewer main (Lee Street and Knollwood Drive), equating to approximately 0.75% of their system measuring 6-inch. Typically, new mains are not placed with smaller than 8-inch pipe due to the propensity for plugging issues and regulatory rules and regulations require sewer mains to be at least 8-inch in diameter. The makeup of the gravity sanitary sewer sizing is reflected in Figure 1.1 below:

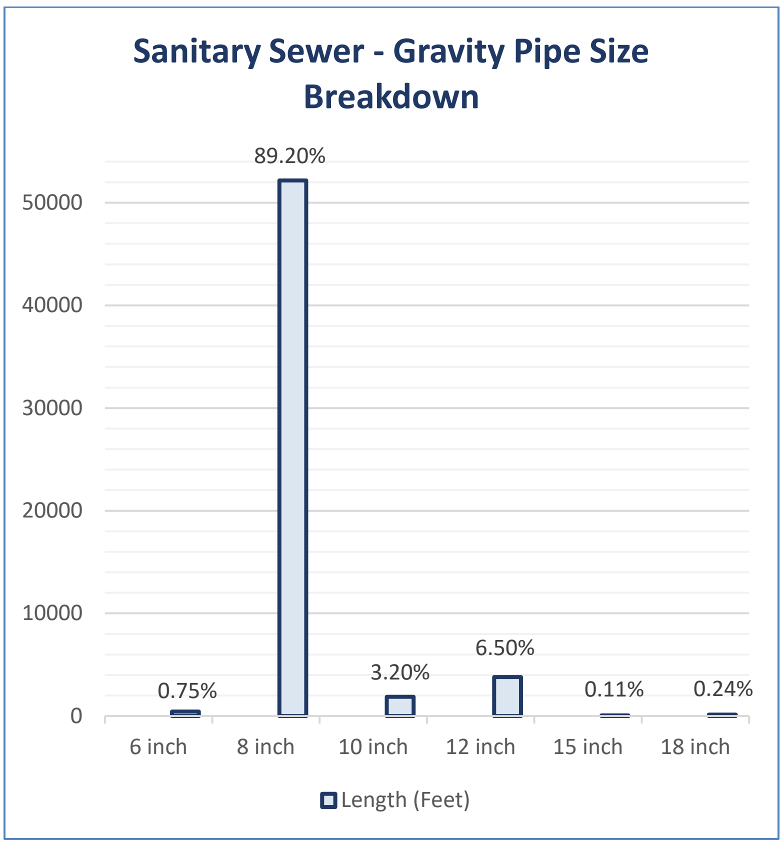


Figure 1.1: Sanitary Sewer Pipe Size

Table 1.4 indicates the quantity of each material making up the Village of Pinckney's sanitary sewer system:

Table 1.4 - Sanitary Sewer Pipe Material Breakdown		
Pipe Material	**Gravity Sewer Length (feet)**	**Force Main Length (feet)**
Polyvinyl Chloride Pipe (PVC)	24,443	

Table 1.4 - Sanitary Sewer Pipe Material Breakdown		
Vitrified Clay Pipe (VCP)	31,806	
Asbestos Cement (AC)	192	
Truss Pipe (TRUSS)	2,046	
Fusible PVC (FPVC)		4,717
High Density Polyethylene Pipe (HDPE)		915
Ductile Iron		260
Totals	**58,487**	**5,892**

Nearly half of the Village of Pinckney's system (42%) has been constructed using plastic products. The newer plastic piping has a lower possibility of catastrophic failure from collapse or breakage, which also typically means a newer pipe and longer service life remaining. The remaining portion of the Village of Pinckney's gravity sanitary system consists of vitrified clay installed primarily in 1970, a small amount of reinforced plastic material (truss pipe), and a very small amount of asbestos cement pipe of unknown age. Figure 1.2 provides a visual breakdown of the gravity materials within the system.

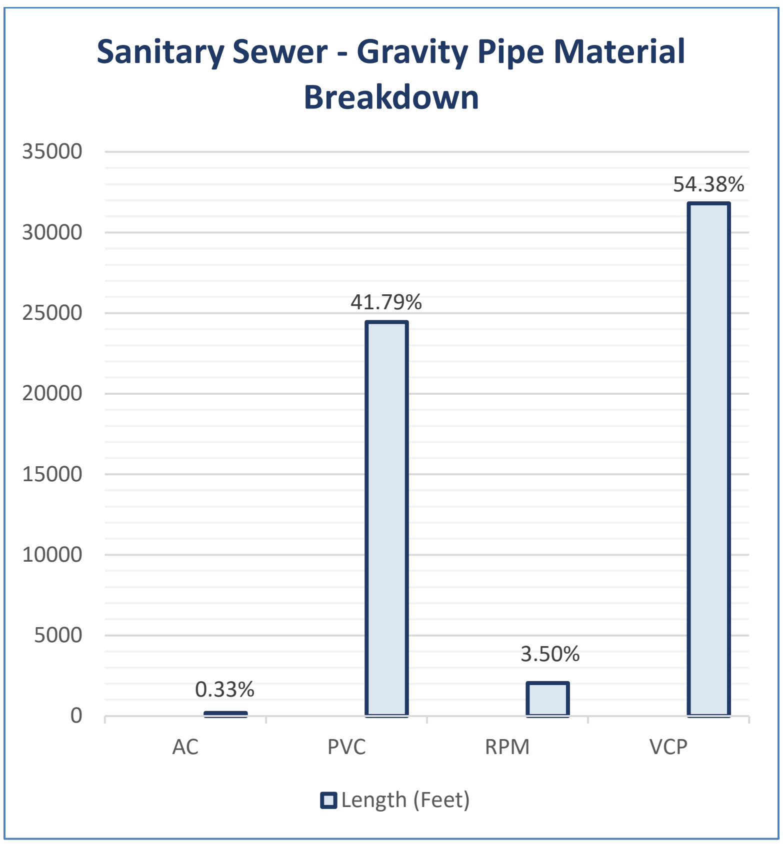


Figure 1.2: Sanitary Sewer Material

As part of the sanitary sewer system study, a risk assessment was performed for each of the system assets. This risk assessment was completed using a combination of the asset's condition, probability of failure, and consequence of failure. The probability of failure multiplied by the consequence of failure or criticality results in the business risk. This number will vary between 0 and 25 with 0-8 being not critical, 8-16 being important but not critical, and 16-25 being critical. The resulting business risk rating allows the Village to prioritize those items where condition, probability, and consequence make it expedient to perform proactive maintenance of the asset. Condition assessments were performed by cleaning and televising inspections on nearly all assets and ratings were assigned by NASSCO certified inspectors. For those assets which were not televised or not reachable from the surface, assessments of probable condition were made based on material, age, and history of the asset, or assigned the same ratings as adjacent assets that could be assessed. Table 1.4 summarizes the business risk range of system assets.

Table 1.4 - Risk Assessment

Asset Type	Business Risk			
	0-8	8-16	16-25	Totals
Sanitary Sewer (Feet)	52,753	5,119	615	**58,487**
Manholes (Each)	234	11	0	**245**

2. Introduction and Background

In 2013 the Michigan Department of Environmental Quality (MDEQ), now the Michigan Department of Environment, Great Lakes, and Energy (EGLE), announced a new grant program called the Stormwater Asset Management and Wastewater (SAW) Program for development of Asset Management Plans for stormwater and wastewater systems in Michigan. Grant funds could be used for evaluation of the systems at little to no cost to the communities. In 2020 the Village of Pinckney was awarded a $300,946 grant for completing a Sanitary Sewer System Asset Management Plan (AMP) and given three (3) years to complete the work. Work associated with the grant was broken out into the following categories and the results of the investigations are presented in this report.

A. Inventory

Perform Site Data Collection on each of the system components to create an inventory to determine/confirm size, material, age, and condition.

B. Condition Assessment

Perform condition assessments on each of the systems' assets and assign condition ratings based on the evaluations completed.

C. Metering/Modeling

Identify any unique flow characteristics within the Village and use anticipated flows to identify inflow and infiltration and the resulting need for maintenance and/or capital improvements.

D. Cleaning & Televising

Perform system cleaning as necessary and televising on sewer piping older than 20 years in order to assign condition ratings to all sewer mains. (The Village elected to also proactively clean and televise nearly all of its system less than 20 years old outside of the grant to develop a baseline business risk for future tracking and planning purposes).

E. Level of Service

Define what the Village's level of service is for the sewer system and determine the service life remaining for each of the Village's assets.

F. Rate Structure Development Costs

Review the Village's revenue structure to develop budgets and proposed capital and operational & maintenance costs that will be necessary to maintain the proposed level of service necessary to keep the Village's Sewer fund self-sufficient.

This AMP is a long-range planning document used to provide an understanding of the Village's existing system and to document the sewer system assets the Village owns and operates as well as the service levels it provides, risks it faces, and financial investments it requires.

The plan has the following purposes:

1. To demonstrate responsible management of the sanitary sewer system assets
2. To communicate and justify funding requirements indicated by the plan
3. To provide a management roadmap for the utility
4. To serve as a link between the Village of Pinckney Sewer System and its customers

The Asset Management Plan contains an overview of the utility, mission statement, level of service agreement, critical asset list, operation and maintenance strategy, capital investment program, and financial strategies.

G. Asset Management Team

The Village of Pinckney Sewer System has the equivalent of one full-time employee who performs day-to-day functions to keep the utility functioning properly. Together, the director and superintendent have volunteered as members of the asset management team. The team is responsible for preparing, implementing, and updating this plan. To the extent that other staff are involved with this or other projects, the asset management team is responsible for coordinating such involvement in the developing and implementing this plan. More specific roles and responsibilities are listed in Table 2.1.

2.1 – Asset Management Team			
Company/Organization	**Name**	**Title**	**Role**
Village of Pinckney	Linda Lavey	Village President	Sewer/Water Committee Rep
Village of Pinckney	Jeffrey Buerman	Council Trustee	Sewer/Water Committee Rep
Village of Pinckney	Jeffrey Spencer	Council Trustee	Sewer/Water Committee Rep
Village of Pinckney	Beverly Harris	Accountant/Treasurer	Budget/Financial
Village of Pinckney	Dustin Moma	DPW Director	Facility Manager
Village of Pinckney	Mike Hughes	DPW Superintendent	Head Operator
Woodhill Group	Michael Lesich	Program Manager	Budget and Rate Setting
Wolverine Engineers & Surveyors	Joseph White	Village Engineer	Project Engineer

3. Sewer System Description

A. History

The Village of Pinckney is located in the southeast portion of Michigan's Lower Peninsula. The Village can be generally described as moderately populated with a limited number of commercial and industrial customers. According to the latest Census in 2020, the population was 2,415. The projected population growth over the next 20 years is expected to be a maximum of 1.0% per year based on a recent analysis of the projected population growth in the latest Water Reliability Study (WRS).

Prior to 1970, sewer within the Village was comprised of individual onsite septic and drain field systems. In 1970, the Village installed a public sewage collection system and two (2) pump stations to collect and convey sewage to a treatment lagoon system. The original 1970 system serviced an estimated 70 percent of the residents and most of the businesses within the village corporate boundary. Additions and expansions have been made to the system since the early 1970's to include an estimated additional 20 percent of the village. In addition, the Village has maintained and made improvements to the wastewater treatment lagoon system over the years. Improvements have included major lagoon reconfiguration and treatment additions in 1991, a ferric chloride Chemical Feed Building in 2006, a Blower Building and aeration system in 2013 and, most recently, a Headworks Building with a fine screen in 2020. Other improvements made in 2020 include the replacement of the two (2) original main pump stations with one (1) new master pump station and replacement of nearly 5,000 feet of 1970 8-inch cast iron force main with a new 12-inch FPVC force main from the new pump station to the WWTP. The components that make up the current system are described in detail in the following sections and graphically represented on the system maps provided in Appendix A. Ultimately, treated effluent is discharged to the ground water through two (2) sand filter and infiltration beds. The Village maintains a ground water discharge permit with the State of Michigan, Environment Great Lakes, and Energy (EGLE). To our knowledge, the Village has not reported any sanitary sewer overflows (SSO's) or infiltration/inflow (I/I's) issues throughout the 50+ years of operating their sanitary wastewater collection, conveyance, and treatment systems.

B. Collection System

The Village's existing collection system consists of approximately 54% older Vitrified Clay Pipe (VCP) and 42% of newer Polyvinyl Chloride (PVC) pipe. Expansions to the system have been installed to service new development of both residential and commercial type. These expansions have primarily been PVC. A very small percentage of other pipe material is estimated to exist in the system. The Village has not reported any sanitary sewer overflows (SSO's) or infiltration/inflow (I/I's) issues throughout the +50 years of operating their sanitary wastewater collection and treatment system.

Table 3.1 below summarizes the type and approximate amount of sewer collection piping currently in the Village's sanitary collection system. Appendix A Maps show the layout of the Village's Sanitary Sewer Collection System and its major components.

Table 3.1 Existing Gravity Sewer Collection Piping					
	Material (feet)				
4 inch	AC	PVC	RPM	VCP	**Totals**
6 inch				438	**438**

Table 3.1 Existing Gravity Sewer Collection Piping					
8 inch	192	20,504	821	30,653	**52,170**
10 inch		584	575	715	**1,874**
12 inch		3,149	650		**3,799**
15 inch		65			**65**
18 inch		141			**141**
Totals	**192**	**24,443**	**2,046**	**31,806**	**58,487**

C. Pump/Lift Stations and Force Main

The Village currently operates and maintains one (1) pump station and three (3) lift stations located throughout the service area. The stations and pumping equipment are in good condition due to the recent nature of their construction and the diligent monitoring and maintenance program. The following is an evaluation of each of the lift stations located in the study area. See Appendix A for the location of the stations.

Pump Station No.1 (Main) is a duplex self-priming pump station constructed in 2020 replacing the original two (2) main stations which conveyed sewage to the treatment plant. It is located just north of Mower Road on the east side of S Howell Street. There are two (2) Gorman-Rupp self-priming pumps each having a design capacity of 705 GPM at 110 feet total Dynamic Head (TDH) and capable of passing 3" solids. The pumps are equipped with 75 horsepower motors. This station pumps into a 12-inch FPVC force main, also installed in 2020, that is 4,717-feet in length and discharges into the inlet channel of the Screening Building at the treatment plant. There is an on-site natural gas-powered generator rated at 80KW manufactured by Kohler with an automatic transfer switch to provide back-up power to the station. The pumps are controlled by a programmable PLC and submersible pressure transducer with float backups. The station is tied into the Village's SCADA system which allows operators to view pump status, runtimes, pump faults, magnetic flow meter data, and other conditions from the Village Public Works Department and remotely.

Lift Station No.3 is a duplex submersible lift station constructed in 1999 in conjunction with the construction of the Village Edge #2 subdivision. This lift station is located east of the intersection of Turtle Trace and Blue Bird Lane. There are two (2) submersible wastewater pumps each having a design capacity of 55 GPM at 26 feet total Dynamic Head (TDH) and capable of passing 3" solids. The pumps are equipped with 2.4 horsepower, 1780 rpm motors. The Village is currently testing a new Barnes Sythe demo unit for one of the pumps. The remaining existing pump is an ABS AFP1 pump. This lift station pumps into a 4-inch Ductile Iron force main that is 260-feet in length which discharges into MHR 70. There is an on-site natural gas-powered generator to provide back-up power to the site which is rated at 30KW to provide back-up power to the station. The pumps are controlled by a programmable PLC and submersible pressure transducer with float backups. The lift station is tied into the Village's SCADA system which allows operators to view pump status, runtimes, pump faults, and other conditions from the Village Public Works Department and remotely.

Lift Station No. 4 is a duplex submersible lift station constructed in the 2008. This lift station is located on E M-36. There are two (2) newer submersible PX Pumps PX-1-80-4 wastewater pumps each having a design capacity of 95 GPM at 23.2 feet total Dynamic Head (TDH) and capable of passing 3" solids. The pumps are equipped with 4.69 horsepower, 1750 rpm motors. This lift station pumps into a 4-inch HDPE force main that is 485-feet in length which discharges into MHR 1. There is an on-site natural gas-powered generator to provide back-up power to the site which is rated as 25KW to provide back-up power to the station. The pumps are controlled by a programmable PLC and submersible pressure transducer with float backups. The lift station currently uses a Raco CB4 Chatterbox for alarm callouts.

Lift Station No. 5 is a duplex submersible lift station constructed in 2003. This lift station is located midway on the east side of Pumpkin Lane. There are two (2) submersible Barnes 4SHVB30N4 wastewater pumps installed in 2021 each having a design capacity of 100 GPM at 23.5 feet total Dynamic Head (TDH) and capable of passing 3" solids. The pumps are equipped with 3 horsepower, 1700 rpm motors. This lift station pumps into a 4-inch HDPE force main that is 430-feet in length which discharges into MHR 271. There is an on-site natural gas-powered generator to provide back-up power to the site which is rated at 20KW manufactured by Kohler with an automatic transfer switch to provide back-up power to the station. The pumps are controlled by a programmable PLC and submersible pressure transducer with float backups. The lift station currently uses a Raco CB4 Chatterbox for alarm callouts.

D. Wastewater Treatment Plant

Nearly all the Village's wastewater is treated at the Village WWTP. There are, however, small pockets of the Village that remain connected to on-site septic and drain field systems. The Village WWTP was constructed as part of the original public system in 1970. This treatment plant, in its current configuration, is a lagoon facility with four (4) lagoons operated in series with treated effluent directed to two (2) sand filter beds and ultimately to ground water infiltration beds. The rated capacity of the treatment plant is 0.26 MGD. The Village maintains a ground water discharge permit with the State of Michigan Department of EGLE. The facility is in overall good condition and has hydraulic capacity to support the current service area and well as some additional development within the Village. However, Chloride has been an issue in the past and in 2005 the Village updated its water ordinance to require all customers to install a dry well for water softener backwash. Further investigation into Chloride sources is recommended.

The Village is continually making improvements and performing proper operation and maintenance to the facility. Most recently, an aeration piping system and Blower Building was added in 2013. A Headworks Building with a fine screen was added in 2020 as part of the Pump Station No. 1 project.

E. SCADA System

The Village's existing Pump and Lift Station Control System (SCADA) consists of a radio-controlled system that was integrated with the Village's wastewater system SCADA in 2020. Pump Station No. 1 and Lift Station No. 3 each have a control panel with a Human Machine Interface (HMI) where status of systems can be viewed, and settings can be changed. The Sewer System Main Control Panel is located at the DPW Building where all the pump/lift station statuses can be viewed, and some settings changed as well. The Main Control Panel has detailed information screens for the stations which logs pump run times, wet well level, alarm settings and current operation status of systems. Station operation reports are generated daily and automatically printed out at the Main Control Panel location for the Village to review and determine issues that exist requiring attention. These reports are reviewed by Village staff daily and filed for future reference if needed. There is a single alarm dialer at the Department of Public Works Garage on Patterson Lake Road which will call a user specified list when an alarm fault is tripped. Typical alarm faults include communication fail, pump fail, high and low wet well levels, power fail, and pump overload.

4. Service Areas

A. Existing Service Area

The existing Service Area of the Village's Sanitary Sewer System is shown on the System Map provided in Appendix A. The overall service area is roughly 1.0 square miles which is approximately 60% of the total area within the Village limits. The current service area includes 793 Residential Customers and 37 Other Users consisting of Commercial, Industrial, Government, School, and Church Users for a total of 830 customers.

B. Population Growth

The Village of Pinckney's Sanitary Sewer System Service Area can be characterized as developed older residential and commercial areas. Review of census data for the Village of Pinckney provided in Table 4.1 indicates that the population has steadily increased from 1970 to 2010. However, the 2020 Census data shows a slight decrease from the previous Census in 2010. Regardless, the overall trend line of the Census data shows continued growth over the next 20 years, but at a decreasing rate. According to data prepared by the Southeast Michigan Council of Governments (SEMCOG), also provided in Table 4.1, the population a continues to decline, about 15% over the next ten years with a significant jump at the 20-year mark to more resemble the Census data.

Table 4.1 - Population Projection Data

Year	1970	1980	1990	2000	2010	2020	5 yr Projection	20 yr Projection
Census	921	1,390	1,603	2,141	2,427	2,415	2,750	2,950
SEMCOG						2,415	2,030	2,840
Used						2,415	2,538	2,948
Number Increase	189	469	213	538	286	-12	123	410
Percent Increase (Per Year)	4.20	1.44	2.94	1.26	-0.05	-0.50	1.00	1.00

The Census population trend and projection can be considered conservative as it is derived from past periods of economic prosperity and when the Village had ample land for development. Whereas the SEMCOG population projection can be considered extreme and representing a seemingly temporary economic low. Therefore, this report utilizes a median population projection line which results in a 5 year and 20-year population of 2,538 and 2,948, respectively. This results in an approximate growth rate of 1.0% per year from the current population, through the 20-year study period. Moreover, the Village is limited in future growth due to available lands within the corporate boundaries and the median growth used better represents the actual growth capability of the Village. Figure 4.1 provides a graphical representation of the data in Table 4.1.

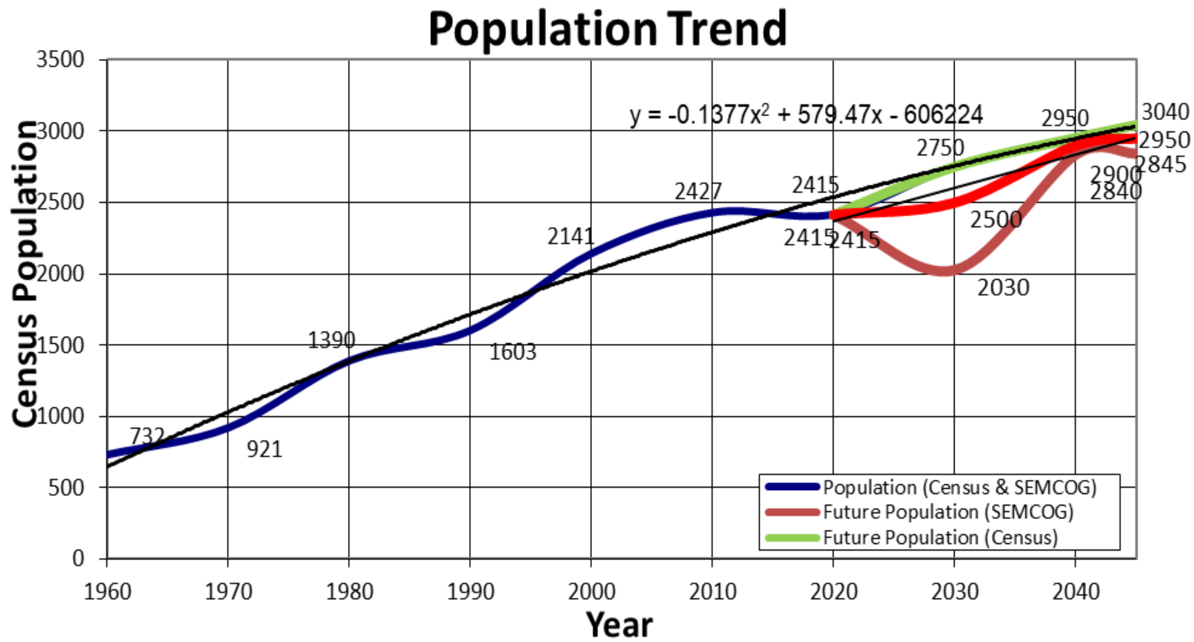


Figure 4.1: Population Trend

C. Future Service Areas

The Village of Pinckney's Sanitary Sewer System currently serves about 60% of the total land area with the Village's Corporate Limits. There is limited potential for system expansion within the Village as most of the remaining areas are limited in development due to undesirable topography and wetlands. However, a few select areas have been identified. With the nature of subdivision construction, the cost for collection system extensions would not be provided by the Village and therefore are not included as capital improvement projects. However, considerations were given to the possible extensions through the 20-year projection period.

Future growth/sanitary sewer service areas were identified based on the possibility to service existing areas that are not currently serviced and conversations with developers regarding recent inquiries about new development along with consideration of the Village's current zoning map and future land use map. A subdivision being proposed in a portion of the northwestern quadrant of the Village is in the design stage and has the real potential to begin construction in the 5-year planning period. This planned development encompasses the currently undeveloped 56 acres directly west of the Water Storage Tank. This new subdivision will have the potential for 121 households. However, with subdivision construction uncertainties and considering the population trend, the development may take years to reach its maximum potential density. Therefore, this extension was considered to fall within the calculated projected population increase.

There is also an existing developed portion on the west side of the village north of Mower Road that is currently not served by the Village's sanitary system. This area includes 28 households.

Additionally, a new marijuana grow and distribution facility is currently under construction at the westerly Village limits on M-36. At a projected 5,000 gpd discharge, this facility will add the equivalent of approximately 70 people to the system.

5. Sanitary Sewer System Maintenance

A. Staff

The Village employs four (4) full time staff members in addition a Department of Public Works Director who also performs operation and maintenance, as well as one to two seasonal staff members during the summer. This staff is responsible for maintenance of the Village's sewer, water, streets, and parks. Currently, maintenance time for the sewer system includes the following:

1. Jetting/Cleaning clogged lines.
2. Monitoring pump/lift station activity.
3. Reactive maintenance to pump/lift stations.
4. Routine inspection and cleaning of the collection, conveyance, and treatment systems.
5. Emergency repairs as required.

B. Equipment

The Village's Department of Public Works (DPW) is responsible for the operation and maintenance of the Sanitary Sewer System. To effectively maintain the system, the Village has various equipment that is used in system maintenance. Since the DPW also maintains the Village's water system, streets, parks, and other areas of the Village day-to-day operations, many of these pieces of equipment are used for maintenance of other Village operations.

General Contractors				
Company	**Name**	**Phone**	**Email**	**Work**
Howell Excavation	Wendy Lybrink	517.861.7664		Excavation
Howell Sanitary	Jim Wellman	517.323.4931		Septic Pumping
Bailey Construction LLC	Jay Bailey	734.323.8889		Concrete

Inspection				
Company	**Name**	**Phone**	**Email**	**Work**
Plummers Environmental	Dave Van Dyken	616.877.3930	davidv@plummersenv.com	Cleaning, Televising, Pipe Lining
Vanmar Services	Randy Robertson	734.891.1632		Cleaning, Televising
Total Energy Systems	Bob Thackeray	248.840.6428		Generators

Pump/Lift Stations				
Company	**Name**	**Phone**	**Email**	**Work**
Dubois Copper	Joe Moore	313.920.4064	jmoore@duboiscooper.com	Self-Priming Pumps
Jett Pump	Joe Skowyra	248.378.5006	jskowyra@jettpump.com	Submersible Pumps

Controls and Electrical				
Company	**Name**	**Phone**	**Email**	**Work**
UIS SCADA, Inc.	Ken Wesley	734.787.6410	ken.wesley@teamuis.com	SCADA

Suppliers				
Company	**Name**	**Phone**	**Email**	**Work**
ETNA		616.245.4373		Sanitary Pipe Materials
Core & Main	Chris Climie	734.787.0026		Sanitary Pipe Materials
Michigan Pipe & Valve	Kyle Richmond	517.764.9151	krichmond@mpvj.com	Sanitary Pipe Materials
Northern Concrete Pipe	John Washabaugh	517.645.2777	johnw@ncp-inc.com	Manholes

6. Inventory and Assessment of Fixed Assets

A. Summary and Inventory

A system wide inventory and condition assessment of most the components of the Village's Sanitary Sewer System was conducted to gather information on the assets of the system. These assets are broken down into four categories: manholes, pipes, pump/lift stations and force mains, and treatment plant components. The inventory and condition assessments were performed through multiple methods. Records research was performed on existing drawings to get a general idea of system layout and asset locations, and manual surveys were performed on each of the visible assets as feasible.

A Level 2 Manhole Assessment and Certification Program (MACP) inspection was performed on nearly all of the manholes in the Village's sewer system (manholes newer than 20 years were paid for outside of the SAW grant). Reports and videos for each of the televised manholes were prepared by the MACP certified televising contractor. Some manholes were private including manholes on private mains and leads and metering manholes at commercial/industrial properties. These manholes were not inspected. Data was logged using a custom tool allowing for generation of a final inspection report for each manhole. GPS equipment was used to collect the location of each manhole for mapping. Measurements and observations were made within each manhole to establish invert elevations, material type, and sizes of connecting pipes.

Sewer main evaluations were performed using the Pipe Assessment and Certification Program (PACP) methods for televising pipes on nearly all of the pipes (pipes newer than 20 years were paid for outside of the SAW grant). Reports and videos for each of the televised sections of pipe were prepared by the PACP certified televising contractor. Some pipes were private including private mains and leads servicing residential, commercial, and industrial properties. These pipes were not inspected. Information gathered from televising along with information from record drawings, as-built plans, and other historical records were used to determine the condition and material of each section of pipe.

Pump/lift stations were evaluated through various methods. Records research was performed to collect and determine existing information for each of the pump/lift stations and force mains. Visual inspection of each station was made.

WWTP evaluations included record drawing review, treatment capacity report review, and in-depth discussions with the DPW Department to determine the location, condition, and materials of the existing assets.

7. Condition Assessment

A number of assessment ratings were assigned to system components as part of the sewer system evaluation. These ratings were used to help determine overall system condition and were used to prioritize areas that may need additional maintenance, repairs, or total replacement. The tables below summarize the ratings for the Condition Assessment, Probability of Failure, Consequence of Failure, and Business Risk of the Asset.

A. Condition Assessment

The National Association of Sewer Service Companies (NASSCO) is a not-for-profit organization setting the industry standard for the rehabilitation of underground utilities. NASSCO's MACP and PACP standardize identification of the type and severity of defects found in manholes and pipelines. The MACP and PACP processes rate the overall, structural, and operations and maintenance (O&M) condition of the assets using a well-established and universal defect coding system. MACP and PACP use the same process with some minor adjustments to length-dependent defects since manholes are usually not as deep as sewer pipes are long. The results are in the industry standard format used by most municipalities and infrastructure assessment professionals.

Individual defects were assigned a grade from 1 through 5, with five being the most serious, based on the type and severity of the defect. These grades are predefined by NASSCO in their defect coding system. Because there were often multiple defects per asset, their associated grades were totaled and combined to generate several metrics that are representative of the condition of each pipe segment. An explanation of the metrics are included in Figure 7.1. The metrics are categorized as: Structural, O&M, and Overall. Structural condition is affected by defects such as cracks, fractures, and surface or lining damage. O&M condition is affected by defects such as soil/dirt/rock deposits, roots, infiltration, and obstructions. Continuous defects in pipes are calculated by dividing the defect length by five (5). Overall condition metrics combine both Structural and O&M defects. Appendix C contains tables to illustrate the condition of the assets inspected as part of this AMP.

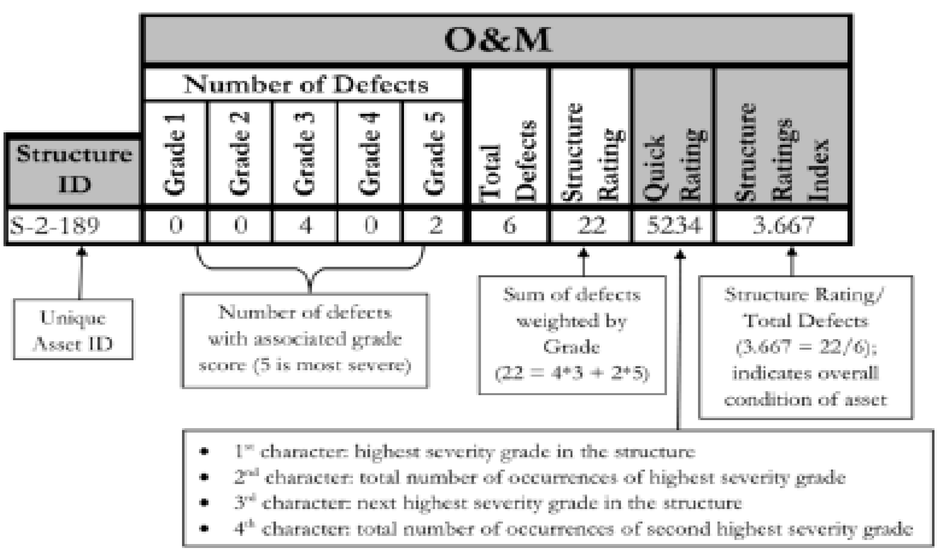


Figure 7.1: NASSCO Metrics, shown for O&M (same idea for structural and combined metrics)

The Ratings Index indicates the general condition of each inspected asset. The Ratings Indices range from 1 through 5 as shown in Table 7.1. (Note: Assets with continuous defects do not fit with this 1 through 5 scale)

Table 7.1 - Condition Assessment	
Ratings Index	**Description**
5	Asset Unserviceable - Over 50% of asset requires replacement
4	Significant deterioration - significant renewal/upgrade required (20 -40%)
3	Moderate deterioration - Significant maintenance required (10 -20%)
2	Minor Deterioration - Minor maintenance required (5%)
1	New or Excellent Condition - Only normal maintenance required

B. Probability of Failure

The Quick Rating provides a brief summary of the severity of the worst defects in each asset. For the analysis of the manholes and gravity sewer mains, the Overall Quick Rating as demonstrated in Figure 7.2 was used to calculate a probability of failure (PoF) score. The PoF is a 1 through 5 rating with a score of 5 indicating worst condition as shown in Table 7.2. This metric is used over the ratings index because the ratings index is an average of the scores where the PoF uses the highest defect score. As an example, the ratings index score could be a 2 even though there are defects noted as 4's and 5's. This example indicates that the defect 2's are dominating the score even though there are more significant problems in the structure. Overall Quick Rating (QR) equations are shown on the following page and a Grading System and Ratings Example can be found in Appendix B.

Table 7.2 - Probability of Failure	
Performance Rating	**Description**
5	Imminent - Likely to occur in the life of the item
4	Probable - Will occur several times in the life of an item
3	Occasional - Likely to occur some- time in the life of an item
2	Remote - Unlikely but possible to occur in the life of an item
1	Improbable - So unlikely, it can be assumed occurrence may not be experienced

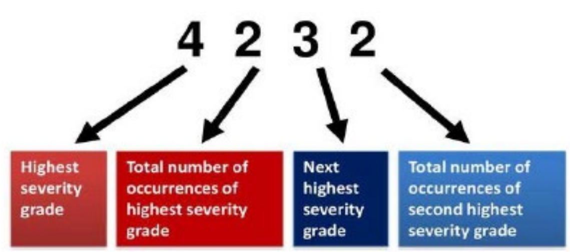


Figure 7.2: NASSCO Quick Rating

Calculating the Probability of Failure (PoF) using Manhole and Pipe Overall Quick Ratings (QR)

- Probability of Failure is derived from the first 2 numbers of the Quick Rating
- Scale is 1 to 5, with 1 being the least likely, 5 the most likely

PoF = (First 2 numbers of QR) / (10) / (1.2)

PoF = 42/10/1.2 = 3.5

- If no defects recorded for feature segment, then add 1.0

PoF = (first 2 numbers of QR) / 12) +1.0

PoF = [0/12] + 1.0 = 1.0

- If second character in Quick Rating is a letter, use zero (0) in place of the letter and divide by 10 rather than 12, then add 1.0 as well and divide the result by 1.2

PoF = [(first 2 numbers of QR) / 10) +1.0] / (1.2)

Example: QR is 5B21 (meaning 15-19 occurrences of a Grade 5 defect); therefore:

PoF = [(50/10)+1.0] / 1.2 = 5.0

C. Consequence of Failure

Consequence of Failure (CoF) encourages a focus on social, environmental, and economic cost impacts. The economic CoF encompasses the impacts of direct and indirect economic losses to the affected organization and third parties due to asset failure. The social consequence represents the impact of society due to asset failure and the environmental consequence of failure considers the impact to ecological conditions occurring as a result of asset failure.

The factors were rated on a 1 through 5 scale for each asset. The CoF values for Pinckney's system are based on pipe diameter and number of people served. Additionally, the CoF for sewers in the immediate vicinity of water bodies and critical infrastructure were bumped up. The CoF is described in Table 7.3.

Table 7.3 - Consequence of Failure

Performance Rating	Description
5	Catastrophic disruption
4	Major disruption
3	Moderate disruption
2	Minor disruption
1	Insignificant disruption

In addition to the above ratings a Business Risk Factor rating was calculated for each asset. This rating is determined by multiplying the probability of failure by the consequence of failure described above to give a business risk factor, which scales from 0 (least risk) to 25 (highest risk). A Business Risk Factor of 0 is an asset that has a low probability of failure and has a low consequence of failure that poses an insignificant disruption to the System. While a Business Risk Factor of 25 is an asset that has a significant chance of failure and would cause a significant disruption in the system if it did fail. The Village has identified any items with a business risk factor of greater than 16 to be of sufficient risk to require repair or replacement.

D. Manhole Condition Assessment

Plummers Environmental Services televised 223 of the 245 manholes in the Village's Sewer System. As previously mentioned in Section 6(A), a Level 2 Manhole Assessment and Certification Program (MACP) inspection was performed on all manholes that were inspected. Some manholes were private and therefore not inspected. Data was logged using a custom tool allowing for generation of a final inspection report for each manhole. GPS equipment was used to collect the location of each manhole for mapping. Measurements were made within each manhole to establish invert elevations, material type, and sizes of connecting pipes.

When a manhole inspection is performed, based on the inspector's overall evaluation of the manhole, a probability of failure can be calculated. Table 7.4 below summarizes the categories of risk for the system assets and also provides a system breakdown of the manhole business risk. This risk assessment was completed using a combination of the asset's probability of failure, and consequence of failure. The probability of failure multiplied by the consequence of failure results in the business risk. This number will vary between 0 and 25 with 0-8 being not critical, 8-16 being important but not critical, and 16-25 being critical.

Table 7.4 - Risk Assessment

Asset Type	Business Risk			
	0-8	8-16	16-25	Totals
Manholes (Each)	234	11	0	245

A full list of manhole names and manhole specific information such as diameter, material, approximate installation year, condition rating, Probability of Failure, Consequence of Failure, and Business Risk factor can be found in Appendix C. The manhole inspection reports can be viewed using the Village's GIS system and are attached as a hyperlink for each manhole inspected.

E. Pipe Condition Assessment

Plummers Environmental Services Inc. also televised approximately 55,736 linear feet of sanitary sewer main. These televising reports and the associated videos were used in the evaluation of the sanitary sewer gravity mains. The televising reports can be viewed using the Village's GIS system and are attached as a hyperlink for each pipe televised.

The reports completed as part of this Asset Management Plan were prepared in accordance with the Pipeline Assessment & Certification Program (PACP). The PACP grading system only considers the internal pipe conditions obtained from televising. Defects are calculated based on two categories: structural (ST), and operation and maintenance (O&M).

The structural index only includes structural defects. Examples of structural defects includes cracks, fractures, or joint offsets.

O&M index only includes O&M defects such as infiltration, roots, deposits or obstructions. The index number is based on the number of occurrences in each pipe multiplied by the severity of the defect found in the pipe, divided by the number of defects found in the pipe.

Per PACP guidelines, five infiltration codes are used when groundwater from outside the pipe leaks in through defects in the pipe. These defects are coded as an infiltration stain, an infiltration weeper, an infiltration dripper, an infiltration runner, and an infiltration gusher, listed from minor to major respectively. An infiltration stain is a dark area on the pipe, commonly left by past wet weather events. It is said to be a stain because clear water flow is not visible at the time the code is given; but a sign of groundwater entering the system through the pipe at this area is evident. An infiltration weeper is the slow ingress of water through a defective or faulty joint or pipe wall, no drips are visible. An infiltration dripper is defined as water dripping through a defect or faulty joint or pipe wall, not a continuous flow. An infiltration runner is water running into the sewer through a faulty joint or pipe wall, a continuous flow is visible. An infiltration gusher is defined as water entering the pipe "under pressure" through a defect or faulty joint.

PACP specifies that four codes be used to describe roots intruding in through defects in the pipe. These roots are coded as fine root, tap root, medium root, and a root ball listed from minor to major respectively. Fine roots are defined as the occasional intrusion of small roots. These roots are insufficient to cause a reduction to overall pipe cross-sectional area. These fine roots are evidence that roots have found their way into the sewer pipe and may eventually cause damage or obstruction. Tap roots are individual roots that are over ½ inch thick; that is of sufficient size to cause damage to the pipe material by expanding defects or creating new defects. Medium roots are roots that have formed a mass and are restricting the flow and reducing the cross- sectional area by up to 50%. A root ball is defined as a mass of roots that have formed causing a severe restriction in flow and a reduction of more than 50% of the cross-sectional area.

Three joint codes are used to describe a defect at or near a joint. These defects are coded as a joint offset, joint separated, and joint angular, listed from minor to major respectively. Joint offset is defined when the spigot end of the pipe is not concentric with the socket or bell of the next pipe. Joint separated is when a gap exists between two adjacent pipes. Joint angular refers to the pipe joints where the alignment of adjacent pipes is not straight. Modifiers may be added to the three joint codes described above. Modifiers used are medium and large. A medium offset joint is defined as greater than 1.0 times the pipe wall thickness but less than 1.5 times the pipe wall thickness. A large offset joint is anything larger than 1.5 times the pipe wall thickness. A medium separated joint is anything up to 1.0 times the pipe wall thickness. A large separated joint is anything larger than 1.0 times the pipe wall thickness.

A crack is defined as a crack that is visible but is not open, meaning there is no gap between the edges of the crack. Five crack codes are used to describe defects in the pipe. These defects are coded as a longitudinal crack, a circumferential crack, multiple cracks, spiral cracks, and hinge cracks. A longitudinal crack runs lengthwise down the pipe. A circumferential crack runs in a circular pattern around the pipe, encompassing most or all of the pipe and may appear like a joint. Multiple cracks are defined as one or more cracks that occur, similar to spider web cracking. Spiral cracks are cracks that change from longitudinal to circumferential. They often change position and usually don't leave the pipe segment or cross joints. Hinge cracks are when more than one longitudinal crack occurs at the same footage in the pipe.

A fracture is a crack that is visibly open and has a gap between the edges of the fracture. Five fracture codes are used to describe defects in the pipe. These defects are coded as a longitudinal fracture, a circumferential fracture, multiple fractures, spiral fractures, and hinge fractures.

A longitudinal fracture runs lengthwise down the pipe. Circumferential fractures run in a circular pattern around the pipe. It encompasses most or all of the pipe and may appear like a joint. Multiple fractures are one or more fractures that occur, similar to spider web cracking. Spiral fractures are individual fractures that change positions down the pipe, meaning it should go from a longitudinal fracture to a circumferential fracture. Typically, they do not leave a segment of pipe or cross any joints. Hinge fractures are when more than one longitudinal fracture occurs at the same footage in the pipe.

When a pipe inspection is performed, based on the inspector's evaluation of the pipe segment, a condition report is generated. The resulting condition rating allows the Village to prioritize those items where both condition and consequence make it expedient to perform proactive maintenance of the asset. Table 7.5 below summarizes the categories of risk for the system assets and also provides a system breakdown of the pipe business risk. Again, this risk assessment was completed using a combination of the asset's condition, probability of failure, and consequence of failure. The probability of failure multiplied by the consequence of failure results in the business risk. This number will vary between 0 and 25 with 0-8 being not critical, 8-16 being important but not critical, and 16-25 being critical.

Table 7.5 - Risk Assessment

Asset Type	Business Risk			
	0-8	8-16	16-25	Totals
Sanitary Sewer (Feet)	52,753	5,119	615	58,487

Additionally, condition ratings of 0 to 5 for individual discrete defects were tabulated. Defects with a condition rating of 4 or 5 were singled out for repair under the Village's Capital Improvement program. A condition rating at or lower three (3) is considered moderate, minor, or insignificant. Eighty-nine percent (89%) or 52,015 feet of the Village's pipes have a maximum discrete defect of less than 4. Only nine percent (9%) have a discrete defect of 4 and only two percent (2%) have a discrete defect of 5. A rating of 4 will need attention and possible reconstruction within the next 10 years and a rating of 5 will need attention within the next 5 years.

F. Pump/Lift Station Condition Assessment

The Village's four (4) pump/lift stations were evaluated by various methods to identify the major components of each lift station and to determine the condition of each lift station. Evaluations consisted of a review of operation and maintenance information and records, visual inspection of the physical condition, and other onsite testing or observations. A full list of lift station assets including capacities, size, make and model information, condition rating, probability of failure, consequence of failure, business risk factor, and installation year can be found in Appendix C.

Each of the Village's pump/lift stations has force main piping to transmit the sewage from the pump/lift station wet well to the discharge point. The following table is an inventory of the Village's pump/lift station force mains and following that is a graph indicating the condition ratings for each of the Village's force mains.

Table 7.6 Risk Assessment				
Pump/Lift Station	**Force Main Diameter (inch)**	**Force Main Material**	**Force Main Length (feet)**	**Rating**
No. 1	12	FPVC	4,717	1
No. 3	4	Ductile Iron	260	2
No. 4	4	HDPE	485	2
No. 5	4	HDPE	430	2

A full list of pipe names and pipe specific information such as size, material, length, approximate installation year, condition rating, probability of failure, consequence of failure, and business risk can be found in Appendix C.

G. WWTP Condition Assessment

The Village owns and operates a Lagoon Treatment Plant which was evaluated by various methods to identify the major components to determine the condition of each. Evaluations consisted of a review of operation and maintenance information and records, as-built plan drawings and visual inspection of the physical condition. As stated in Section 3(A) the Plant was originally constructed in 1970 and has been well maintained over the years. In addition, there have been several upgrades to the facility and the treatment processes. The work done on these treatment systems are described in detail in Section 3(A). A full list of the treatment system assets including types, capacity, size, material, condition rating, probability of failure, consequence of failure, business risk factor, and installation year can be found in Appendix C.

8. Metering and Modeling

A. Flow Data

The Village of Pinckney does not experience the significant flow increases during periods of rainfall that are typically found in gravity sewer collection systems with Inflow and Infiltration (I&I) problems. We believe that this is the result of a well built and well maintained system. Additionally, the sandy nature of the native soils within the Village along with the depth to groundwater help to minimize potential I&I problems.

Figure 8.1 plots daily sewer flow recorded at the WWTP, metered flow from a flow meter installed in the collection system, and precipitation vs. time for the months of February through June of 2022. It is noteworthy to point out that the highest flows in systems experiencing I&I issues are recorded during the spring of each year when there is an abundance of water from snow melt and spring rains and water tables are highest.

In reviewing climatological data from the National Oceanic and Atmospheric Administration (NOAA) Chelsea Michigan site just a few miles from the study area and Monthly Operating Reports (MOR's) from the WWTP, it is evident that the daily flows depicted as the red line in Figure 8.1 have almost no correlation with the amount of precipitation as depicted by the blue line, indicating that I&I is not prevalent in the Village's system.

1. Pump Station Flow Data:

The Village currently monitors lift station flows at Lift Stations 3, 4, and 5 daily by recording pump run times and electric use at each station. Currently, all wastewater treated by the Village is first pumped through Pump Station 1 to the treatment plant. Pump Station 1 includes a permanent 8 inch flow meter. It is understood that pump run times are not an adequate basis for I&I determination alone or for defining the scopes of work, although excessive run times can identify areas where further analysis is needed. The Village has completed further analysis of the entire system; however, the monitored flow was very helpful in supporting findings from the cleaning and televising efforts.

2. Gravity Manhole Meter Flow Data:

A Hach FL900 flow logger was installed in MHR 132 to capture flow data originating from the section of the Village serviced by Lift Stations 3, 4, and 5. Meter data in depicted as the orange line in figure 8.1.

Due, in part, to the relatively low typical flows experienced in this manhole, the flow logger struggled to function correctly, and reliable data was not collected. Therefore, the data has proven not useful and was disregarded in this report.

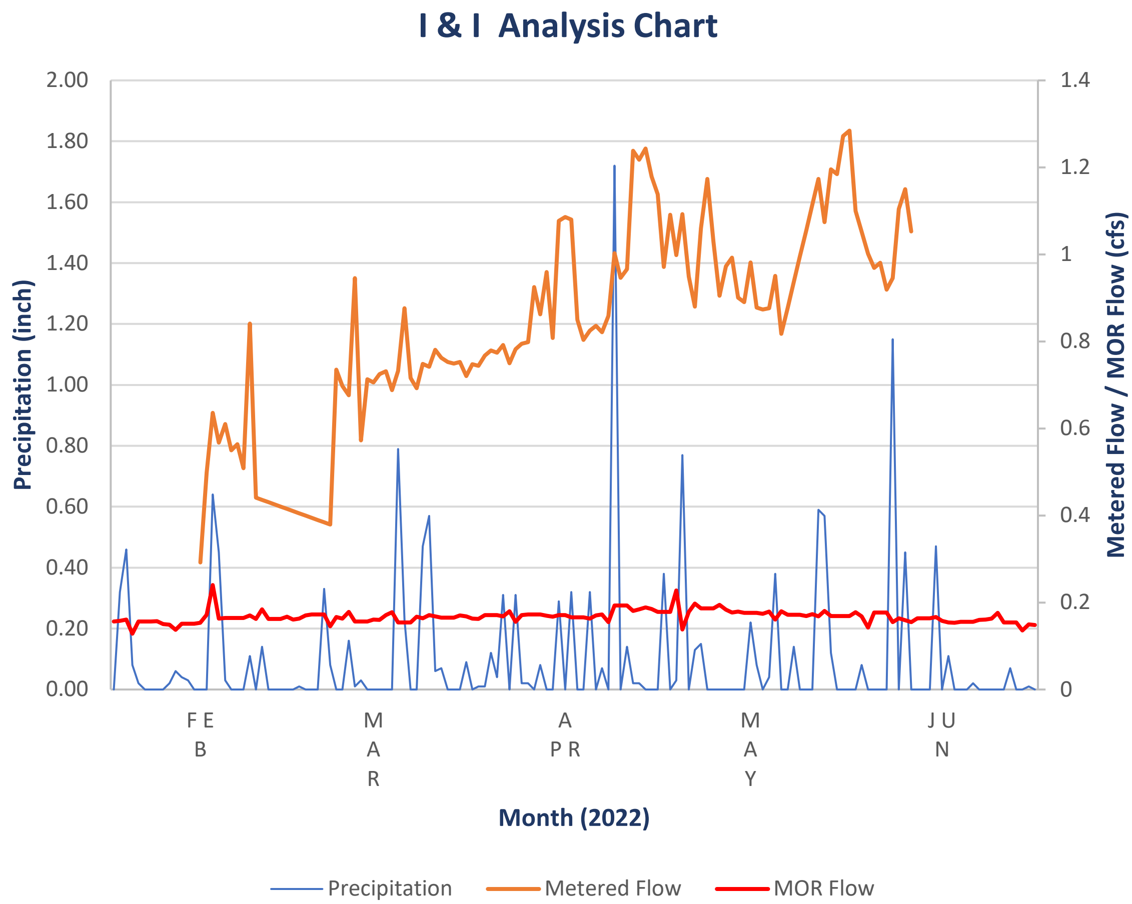


Figure 8.1: I&I Analysis Chart

B. Identified Problem Areas

Run time data was compiled from pump run time readings for Lift Stations 3, 4, and 5. Each station's pump run times were compared to average flows based on the number of equivalent single family homes being served by the lift station.

Run times and resulting discharge for Lift Stations 3 and 4 closely matched what would be expected for the service area. However, Lift Station 5 pump run times were approximately double that of what would be expected. In discussing this finding with Village DPW it was revealed that the impellers in the pumps at Lift Station 5 are worn and are planned to be replaced this year.

Other than this one minor discovery, the Village's collection and conveyance systems are remarkably sound with no signs of significant inflow or infiltration.

9. Level of Service

A. Goals and Target Levels

The goal of the Village of Pinckney sanitary sewer system is to accept and process sanitary sewage safely and efficiently by providing services that meet or exceed customer expectations and to comply with federal regulations. This section describes the Village's Level of Service goals and the key performance targets for each of the level of service goal for present and future performance. The level of service describes the characteristics of utility's performance such as "how much", "of what nature", and "how frequently" about the service and the performance target define how each level of service will be measured. *The Village's progress toward meeting those goals will be reported annually.*

The target levels of service that the utility has chosen to meet are presented in Table 9.1. This table lists the Level of Service goals and measures the success of each goal.

The minimum level of service for the Village's sanitary sewer system has been set at being able to provide functional wastewater collection, conveyance, and treatment for flows from the Village's residents without disruption, overflow, discharge events, or violations of standard wastewater practices and/or permit requirements.

Potential violations of the collection system include sewer backups that cause wastewater to either come to surface or to back up into individual service lines and basements. In order to prevent sewer backups, the Village must maintain its lines in a minimum condition by repairing collapsed pipes, jetting and cleaning lines that pose additional risk due to sizing, slope, or condition concerns.

Pump/lift stations must be kept operational and be capable of pumping the necessary flows to avoid backups. Proper provisions for backup power or bypass pumping must be maintained to avoid backups during extensive power outages.

The WWTP components must be actively maintained including proper and routine maintenance of process equipment, regular inspection and upkeep of the aeration and storage lagoon berms and control structures, and proactive investigation and monitoring of the sand filters and infiltration beds.

Table 9.1 – Level of Service Criteria, Performance Indicator, and Level

Key Service Criteria	Performance Indicator	Target Level of Service
Treatment Capacity	Active Monitoring of the Treatment process	Continue to be consistently below the EGLE discharge permit limits
O&M Optimization	Regular Cleaning and maintenance of the Collection System	Clean and maintain 33% of the collection system per year
Service Delivery and Customer Communication	Continue to ArcGIS Software to Aide in Utility Management	Respond to Customer complaints and requests within one (1) business day
Staff Training	Continue to Hold Regular Training for O&M Staff	Offer five (5) or more different training sessions each year

10. Capital Improvement Plan (CIP)

A CIP is a core component of an AMP and an essential planning tool that allows a community to properly plan for high cost, non-recurring projects. A CIP should detail capital needs related to future/upcoming regulations, major asset replacements, system expansions, system consolidation or regionalization, and improved technology. Capital improvement projects generally create or purchase a new asset that previously did not exist, or they upgrade and improve an asset's existing capacity. Additionally, rehabilitation expenditures do not increase the asset's design capacity but restores an existing asset to its original capacity.

The Village of Pinckney's CIP for the wastewater collection system is detailed in Appendix D and annual replacement reserve for the various components are detailed in Appendix E. The following sections outline the proposed short term (0-10 years) capital improvement projects that the Village has identified to maintain the minimum level of service for the next 20 years.

A. Capital Projects scheduled to be constructed in 2023:

1. N Howell Street Reconstruction

This project includes complete reconstruction (funded in part by a grant from MDOT) of one block of N Howell Street in the Central Business District of the Village. Sanitary sewer pipe and manholes in an easement within the influence of the street will also be replaced. The approximate cost for the sanitary sewer component of this project is **$273,442**.

2. Northwest Quadrant Infrastructure Improvements

This project includes complete reconstruction (funded in part by a private developer) of approximately 2,300 feet of Pond Street and W Hamburg Street in the northwest quadrant of the Village. A 25-foot section of 8-inch clay sanitary sewer in Pond Street with a major sag will be replaced along with an extension of sanitary sewer to service two homes on W Hamburg Street that are currently on septic and drain fields. The approximate cost for the sanitary sewer component of this project is **$72,756**.

3. WWTP Roof Replacement

This project includes replacement of the WWTP Lab Building roof which was originally installed in 2006. The approximate cost for this project is **$15,000**.

B. MACP and PACP Rehabilitation Program:

As part of the SAW Grant, 223 manholes and nearly 11 miles of pipe were inspected. Based on the reported defects, rehabilitation and restoration recommendations were made. This CIP project proposes to rehabilitate all sanitary sewers within the first ten years of this CIP that have been tagged with discrete defect ratings of 4 and 5 and/or have a Business Risk 16 or greater. All manholes and sewers that fall within the Business Risk range of 8-16 should be inspected regularly as described in the O&M Strategies. The costs below represent the estimated cost of the recommended rehabilitations made for the first 10 years of this CIP.

1. Brentwood Drive PSR 107 and 108

This project includes replacement of two segments of sanitary sewer that have discrete defect ratings of 4 and 5 and are the only two pipe segments in the entire system that have a Business Risk of 16 or greater (17.08 for PSR 107 and 17.33 for PSR 108). This work is scheduled to be completed in 2028 and the approximate cost for this project is **$184,409**.

2. No Sags PSR 62, 132, 138, 146, 147, 164, 185, 195, 202, 251, 262

This project includes spot repair (Cured-In-Place Lining or open cut) of segments of sanitary sewer that have discrete defect ratings of 4 and 5 that are not sags in the pipe. This work is scheduled to be completed in 2030 and the approximate cost for this project is **$23,600**.

3. Sags PSR 3, 44, 82, 187, 188, 197, 201, 238

This project includes open cut repair of segments of sanitary sewer that have discrete defect ratings of 4 and 5 that are sags in the pipe. This work is scheduled to be completed in 2033 and the approximate cost for this project is **$242,088**.

C. Capital Projects scheduled to be constructed within ten years

1. Unadilla Reconstruction PSR 134, 200, 201 (955 feet R&R)

This project includes removal and replacement of segments of sanitary sewer that are within the limits of Unadilla Street reconstruction. This work is scheduled to be completed in 2033 and the approximate cost for this project is **$104,384**.

11. OM&R Budget and Rate Sufficiency

A. Revenue Structure Information

The Village recently contracted The Woodhill Group (WHG) to perform a rate study. The rate review report for both the Water System and Sanitary System is included in Appendix F. The Executive Summary from the report is included in this section below:

Executive Summary

The Village of Pinckney's water and sewer system has been operating at a deficit for the past three years. Recent major improvements to the village's wastewater treatment plant and sewer system have been financed by debt that is now due. Projected capital improvement plans will require significant investments that cannot be paid for through the current rate structure. The Village will likely not be able to reach full cost recovery all at once as the increase would be dramatic on its customers.

The Village has three distinct cash flow needs:

- *Annual operational expenses*
- *Existing debt service*
- *Creating a recurring source of funding for capital improvement project*

WoodHill recommends prioritizing the rate adjustments, customer billing practices and accounting changes as follows:

1. *Calculate the Base/Ready To Serve charges based on a consistent application of a Meter Equivalent Unit (MEU) factor based on equivalent meter size.*
2. *Eliminate number of bedroom schema for flat rate sewer customers. Apply standard MEU factor of 1 for single family residential home, 2.5 for multi-family (formerly SEWER10). Use this factor as a multiplier for calculating charges.*
3. *Based on the established MEU factors, add a separate debt service charge equal to the customer's portion of the actual debt service obligations for upgrades to the wastewater treatment plant and other sewer improvements.*
4. *Each year transfer funds equal to a proportion of the system depreciation expense to the Capital Fund.*
5. *Based on the established MEU factors, utilize the same rate methodology for both the water and sewer systems which includes a combination of:*
    a. *A fixed charge for each customer, based on the determined rate multiplied by their MEU factor, to recover a portion of the operational expenses.*
    b. *A commodity charge to recover a portion of the operational expenses.*
6. *Redesign the billing program setup so the various billing components are tracked separately on the financial statements and billing registers.*
7. *Identify residential "second meters" as irrigation or sprinkler meters, and track that usage separate from the primary residential water usage for analysis purposes.*

The Village is in the planning stages for multiple upcoming capital improvement projects. Current reserves can cover near term improvements, but water and sewer funds are not sufficient to pay for all planned improvements. While reserves will cover some costs, the available funds will be depleted quickly and projects will be delayed, cancelled, or require some other financing method to complete.

To finance capital improvements, the village should incorporate into the rate structure revenues to fund these future capital improvements, with the goal of using cash reserves (pay-as-you-go), rather than long-term financing where possible.

Conclusions and Recommendations

- *Review and adjust rates each year to ensure that expenses of the system are covered by the revenues generated from rates. It also keeps increases to more manageable levels.*
- *Incorporate debt service costs into the rates being set to provide the cash flow necessary to retire debt principal and interest.*
- *Incorporate depreciation expense as a factor in setting rates and, at the end of the year, set that amount aside, each year, in a Water and Sewer Capital Fund to help fund future Water and Sewer CIP projects (reduce need for debt to finance projects).*
- *Set aside Net tap fee revenue for Capital Improvements and transfer that money to the Capital Fund.*
- *Review the Utility Ordinance so that management has the flexibility to do what it needs to do each year to ensure that costs are being covered by their corresponding revenue source.*

12. GIS Mapping

As a result of all the work done to develop this Asset Management Plan there was a large amount of data collected, developed, and analyzed. In order to organize this data and make it useful for the Village, a Geographic Information System (GIS) Map was developed. This GIS MAP is a single database containing all the pertinent information on the Village's Sanitary Sewer System.

It is presented in a geographic or spatial representation similar to online mapping programs with various map layers that are used to integrate, store, edit, analyze, share, and display geographic information such as the location, condition, type, size, or other unique characteristics.

Pinckney's Sanitary Sewer GIS Maps were developed by Wolverine Engineers & Surveyors, Inc. using the ESRI product ArcMap. This GIS database and map was then uploaded to the ESRI's online ArcGIS mapping software. ArcGIS is an online mapping and GIS tool that allows access to the GIS database over the internet or through ESRI's Web AppBuilder app for mobile devices. Since the Village maintains an annual subscription to ArcMap, the online ArcGIS is available to the Village at no additional fee. See Appendix A for screen shot of the Village's GIS ArcGIS system.

The current version of the Village's online mapping is available to Village DPW staff through a web link that is username and password protected. The online map can provide location information as well as information on the objects age, physical characteristics, and condition.

There are also links available for each pipe or manhole that will open the Pipe Segment or Manhole Inspection Report if they are available for that asset. Additionally, pdf copies of sanitary sewer; lead sheets, record drawings, easements, and deeds have been attached to shape files within the map for permanent storage and ready access when needed.

There are options available that would allow the Village to publish the GIS map to the public, however, there are no plans to make that available at this time.

In addition to the ability to view and edit existing information, the system built for the Village will provide for standard maintenance item forms for use by the Village to maintain records of their system maintenance, repairs, and other issues that may arise.

This will allow the Village to catalog events so that in the future, assets can be replaced based on their condition and other known factors. Most communities of the size of Pinckney are heavily dependent upon the memories of staff that have been around for many years, and retirements can cause a large loss of that knowledge. This system allows the Village a simpler way to keep records so that the knowledge is not lost with employee turnover.

13. Ongoing Data Management

A fully utilized AMP will improve the Village's wastewater system for future generations. Figure 13.1 shows that a healthy data management process is an ongoing cycle. The Village's new asset management plan has essentially completed one cycle of the data management process. Even though that initial cycle is complete, it is essential that the Village continue to collect data. Appendix C explains the lay out of the first cycle conducted by Wolverine Engineers & Surveyors, Inc. This data management process will aid in the tracking and use of data to cost-effectively manage the Village's wastewater system.

A. Inventory

The Village should continue to populate and complete missing or incorrect data in each asset's attributes. When assets are repaired or replaced and new assets are added, the Business Risk value can be updated. The Village should assign new unique Facility IDs to new assets in accordance with its current naming convention.

Figure 12.1: Data Management Process Diagram

B. Inspection Plan

Nearly all of the system was condition-assessed in the creation of this AMP, but it will be important to perform ongoing condition assessments of the remaining assets of the system. Eventually the cycle will come back to assess assets again. The Village should develop a plan to inspect assets at a maximum of every 20 years. Whether the Village performs the inspections internally or utilizes the help of a contractor, the Village should specify a data format that will integrate with their existing GIS.

C. Quality Assurance

Data from the condition assessments will need to be checked for quality, either by the Village or its engineering consultants' staff. The Quality Assurance process should occur throughout the Inventory and Inspection Plan steps, especially while condition assessment is taking place to ensure that the data is of satisfactory quality and in the correct format.

D. Data Integration

After data is checked for quality, it will need to be integrated into the Village's existing system (e.g. ArcGIS). Significant data rectification and preparation work may need to be performed so that the collected information will transfer into the Village's systems seamlessly. The amount of effort required will depend on the accuracy and format of the inspection data, as well as the status of the existing system database.

E. Data Mining

Now that the data is in the Village's system, the Village's engineering consultant can perform data mining, or train Village staff, and can analyze the data to draw valuable insight. These insights include trends in pipes of certain material, size, age, and location.

F. Immediate Needs Assessment

Use the inspection results to repair/replace assets that are failing and are in need of immediate attention, such as collapsing pipes or other imminent concerns.

G. Long Term Planning

As time goes on and a new batch of data is added, the Village should check to see if the long term plan still aligns with the results of the updated system deterioration forecasting and O&M and budget optimizations. Long term budgeting and O&M planning should be updated as needed.

If these steps for a data management program are followed and continuously repeated and improved, the Village will be well on its way to leveraging their asset management plan into a truly sustainable and cost-effective infrastructure management program.

14. Summary and Recommendations

In general, the Village's Sanitary Sewer System is in remarkably good condition with nearly 99% of the gravity sewer and all of the manholes, lift stations, force main piping, and WWTP components having a business risk of less than 16. The system components that are older than 20 years generally appear to be in good condition, with some minor exceptions noted and repair/replacement noted in the Capital Improvements Plan.

Additionally, the Village's new rate structure will provide sufficient funds for proper operation and maintenance of the system and future rate increases as the Village deems necessary based on their annual analysis of their sewer fund should keep sufficient monies in the sewer fund. It is recommended the Village continue to review past and future expenses when examining future rate increases to determine if they are sufficient to meet the expected future expenditures.

This Asset Management Plan should be considered a working plan and updated annually to reflect changes in the Village's sanitary sewer system, rate structures, budgets, or other facets of the plan.

Appendix A – GIS Maps

1. Sanitary Sewer System Map
2. Gravity Sewer Pipe Segment Reference Number Map
3. Gravity Manhole Reference Number Map
4. Gravity Sewer Probability of Failure Map
5. Gravity Sewer Consequence of Failure Map
6. Gravity Sewer Business Risk Map
7. Gravity Manhole Business Risk Map
8. Force Main Probability of Failure Map
9. Force Main Consequence of Failure Map
10. Force Main Business Risk Map
11. WWTP Enlargement Map
12. Sanitary Sewer Easement Map
13. Sanitary Sewer Deeds Map
14. Gravity Sewer Parcels with Lead Sheets Map
15. Sanitary Sewer Record Drawing Map

Map 1
Sanitary Sewer System Map

Sanitary Manholes

Sanitary Manholes

Pump Stations

Pump Station

Force Mains

Force Main

Sanitary Sewer

Pipe Diameter

- 6" or Less
- 8"
- 10"
- 12"
- 15"
- Private

Village Boundary

Village Limits

0 0.05 0.1 0.2 0.3 0.4 Miles

Map 2
Gravity Sewer Pipe Reference Number

N

Sanitary Manholes

o Sanitary Manholes

Force Mains

Force Main

Sanitary Sewer

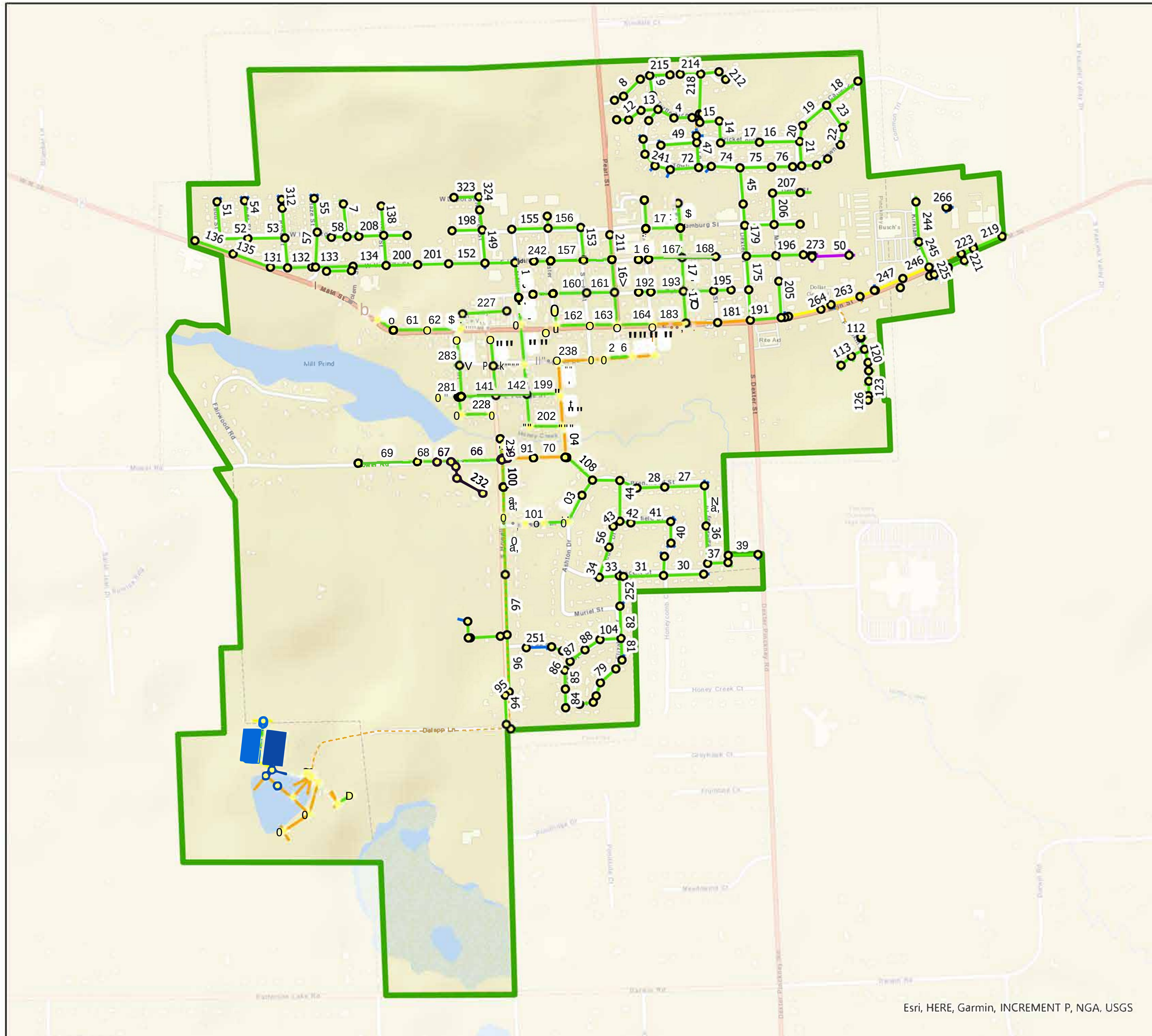
Pipe Diameter

- 6" or less
- 8"
- 10"
- 12"
- 15"
- Private

Village Boundary

Village Limits

0 0.05 0.1 0.2 0.3 0.4 Miles



Map 3
Gravity Manhole
Reference Number

N

Sanitary Manholes

Sanitary Manholes

Force Mains

Force Main

Sanitary Sewer

Pipe Diameter

6" or Less

8"

10"

12"

15"

Private

Village Boundary

Village Limits

0 0.05 0.1 0.2 0.3 0.4
Miles

[redacted]

Map 4
Gravity Sewer Probability of Failure

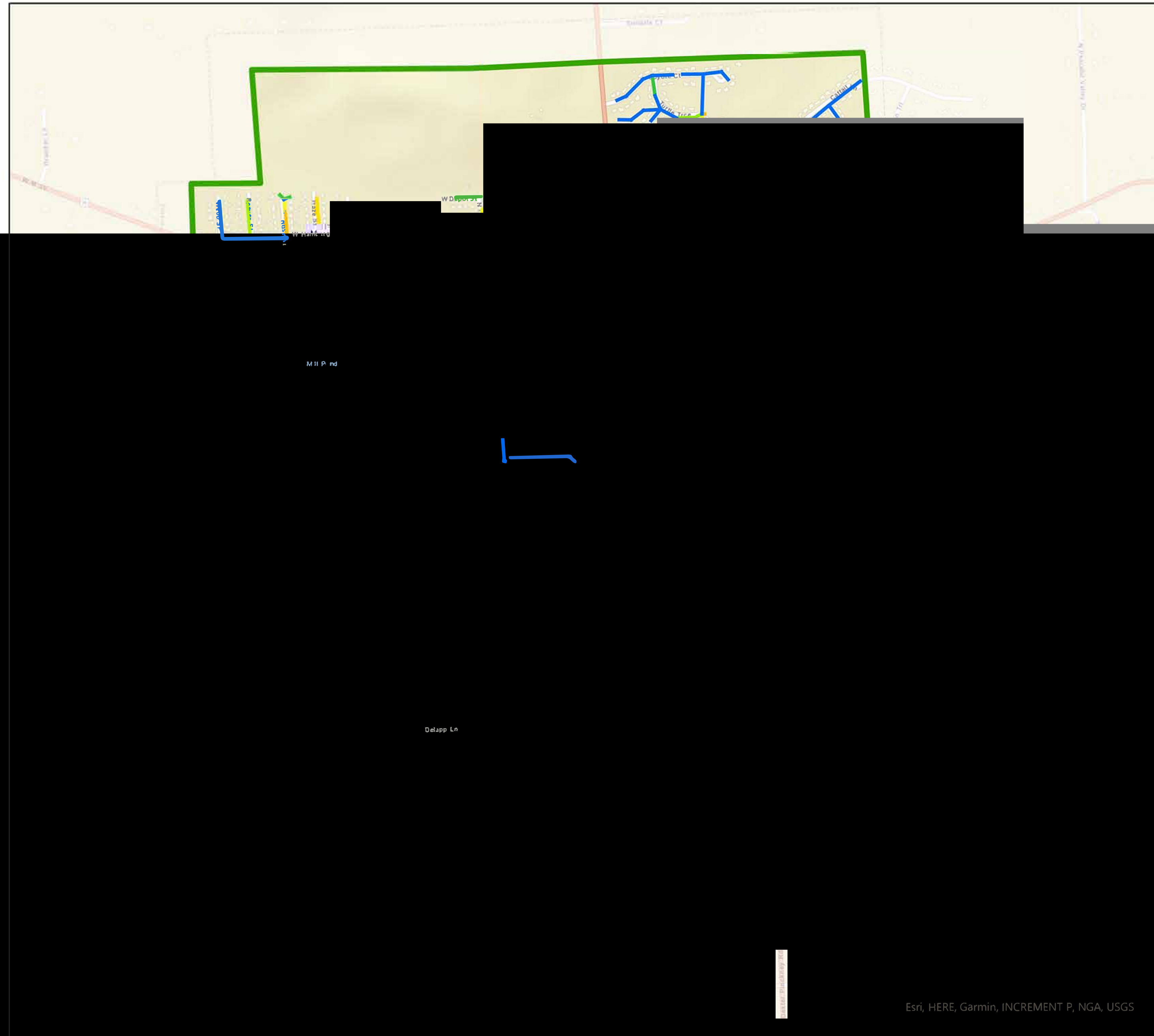
0.0

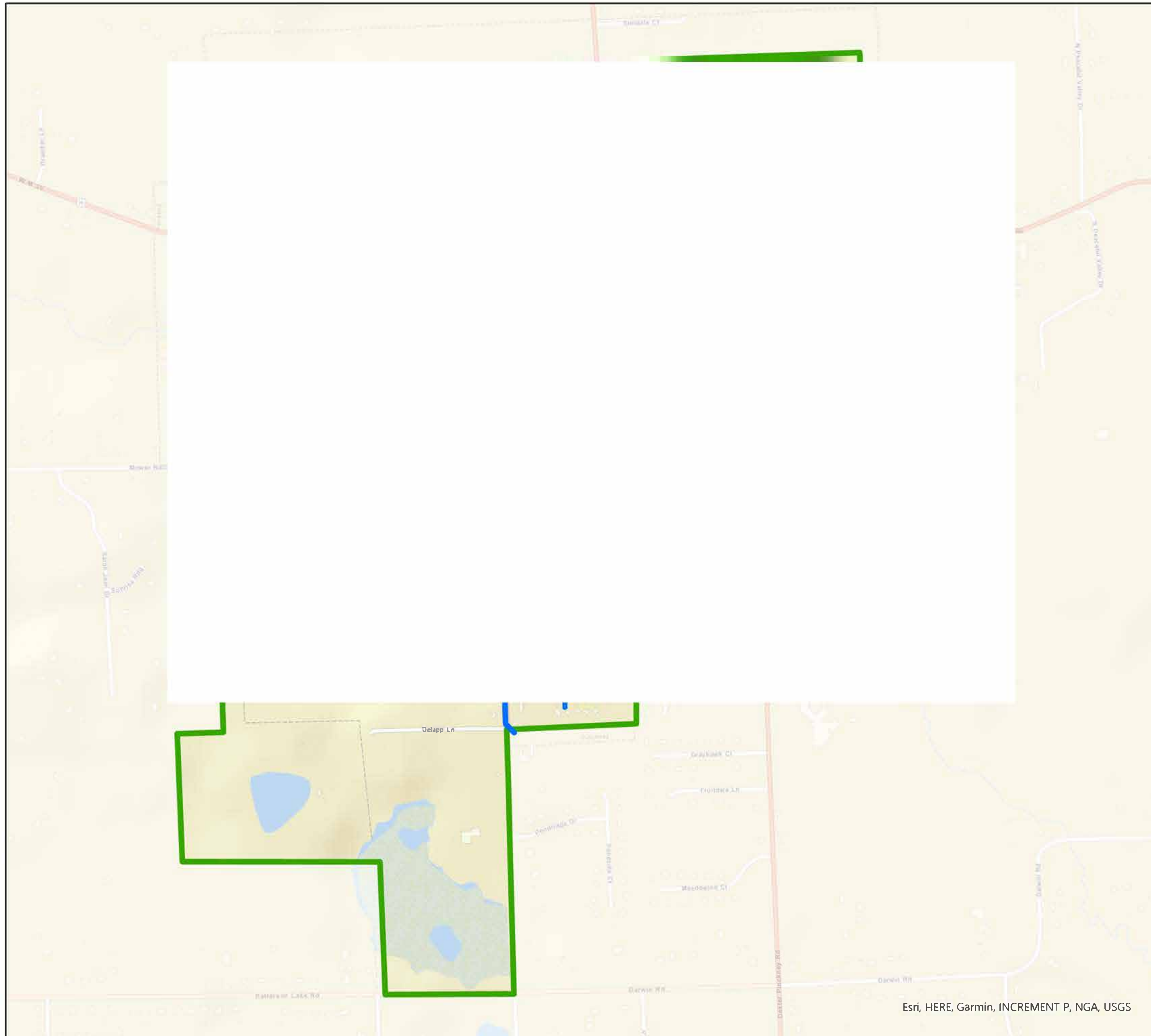
5.0

Village Limits

0 0.05 0.1 0.2 0.3 0.4

Miles





N

Consequence of Failure

Consequence Rating

- Slight
- Minor
- Moderate
- Major
- Massive

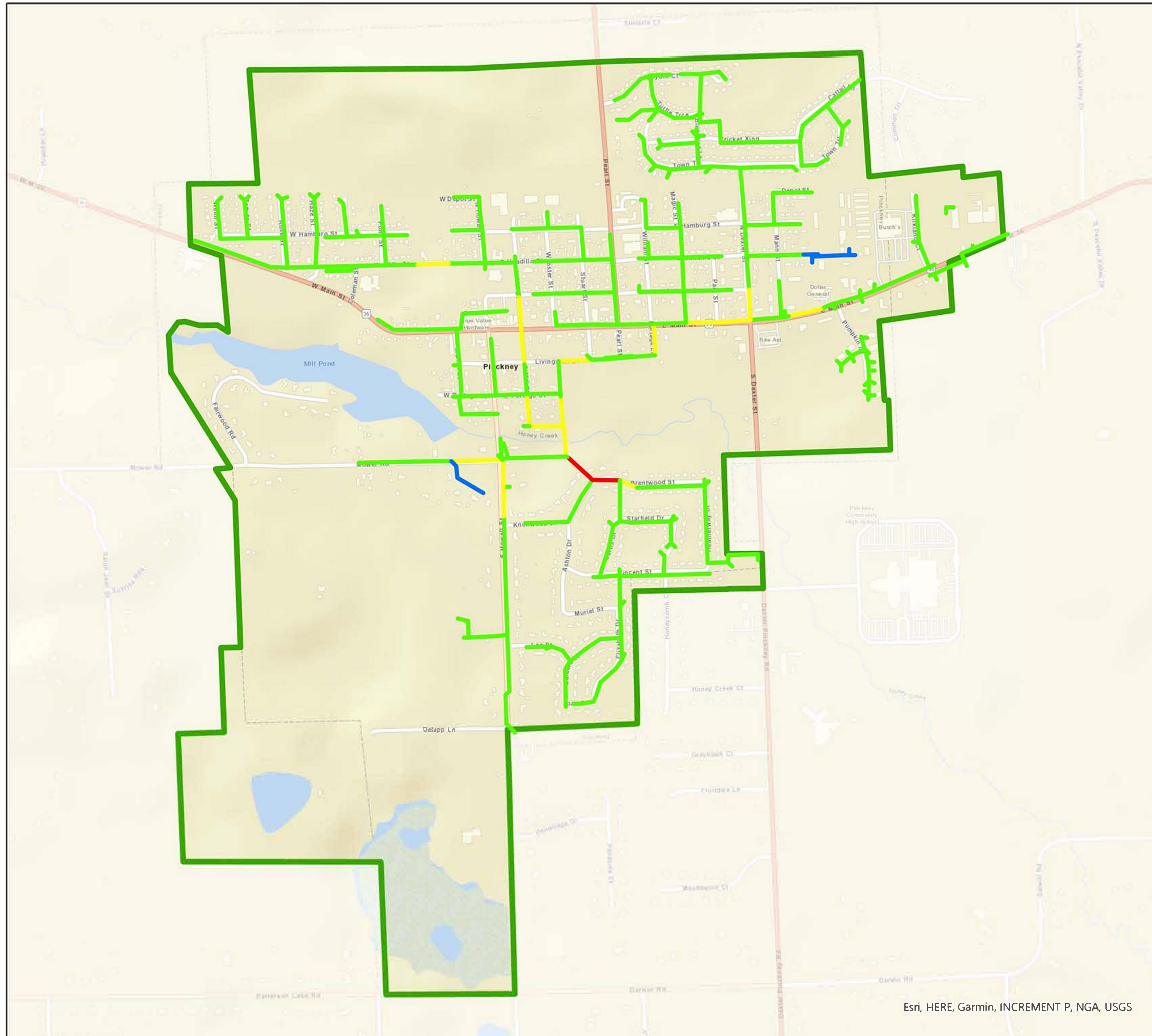
Village Boundary

- Village Limits

0 0.05 0.1 0.2 0.3 0.4 Miles

Map 6
Gravity Sewer Business Risk

N



Sanitary Sewer Business Risk

Business Risk

- High
- Moderate
- Low
- Private

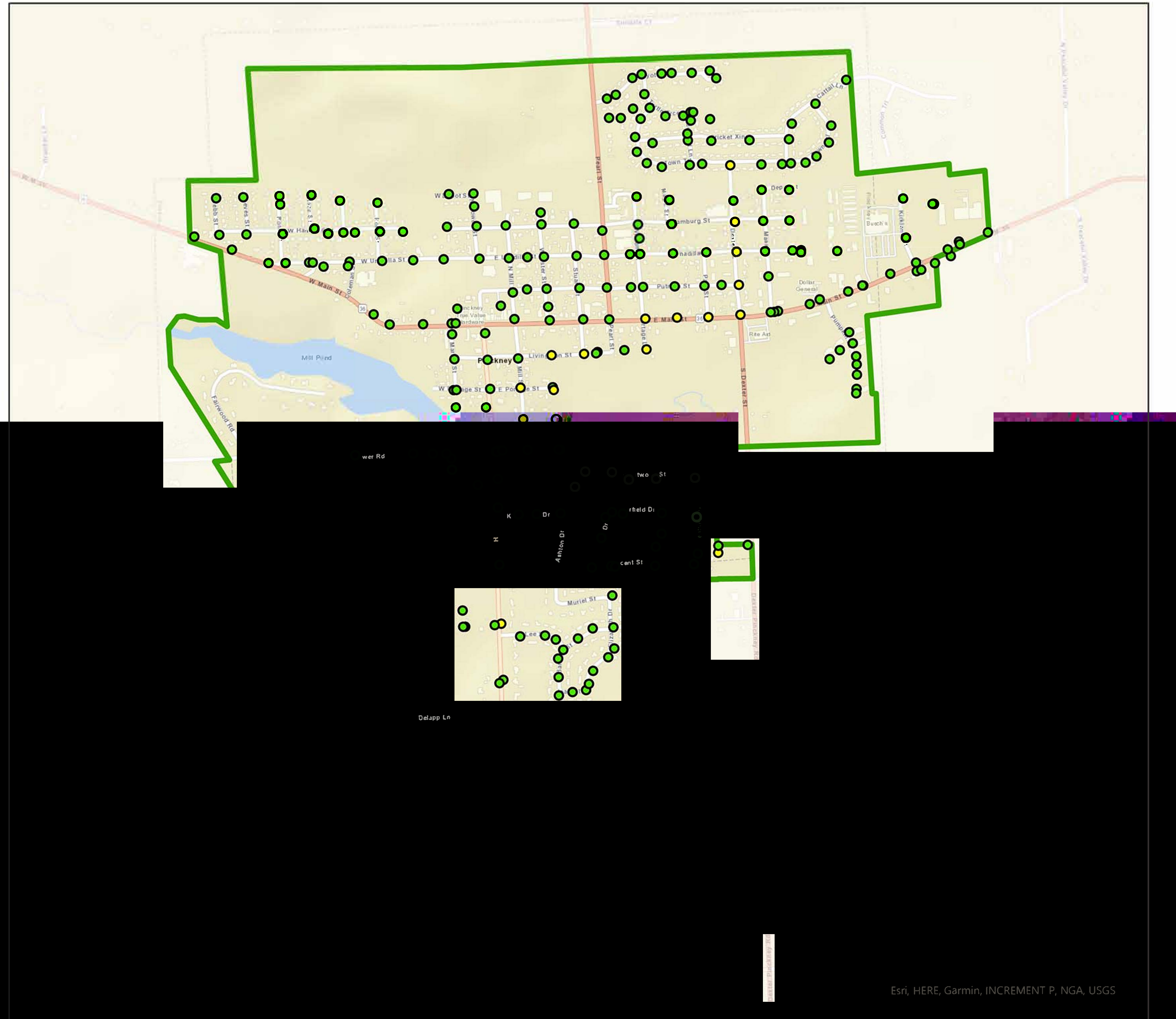
Village Boundary

- Village Limits

0 0.05 0.1 0.2 0.3 0.4 Miles

Map 7
Gravity Manhole Business Risk

N



Business Risk

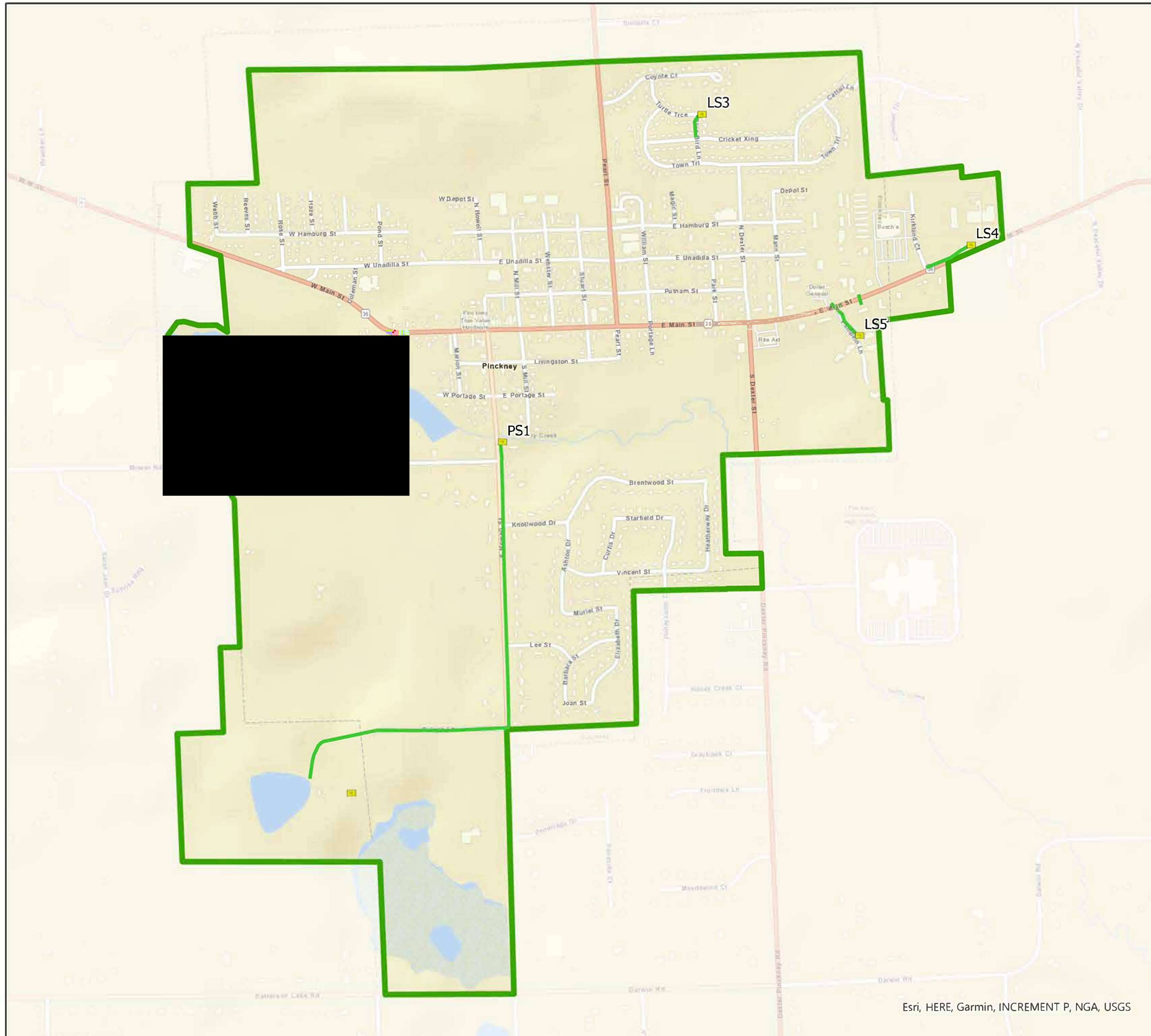
- Low
- Moderate
- High

Village Limits

0 0.05 0.1 0.2 0.3 0.4 Miles

Map 8
Force Main Probability of Failure

N



Pump Stations

Pump Station

Village Boundary

Village Limits

Sanitary Force Main Probability of Failure

ProbabilityofFailure

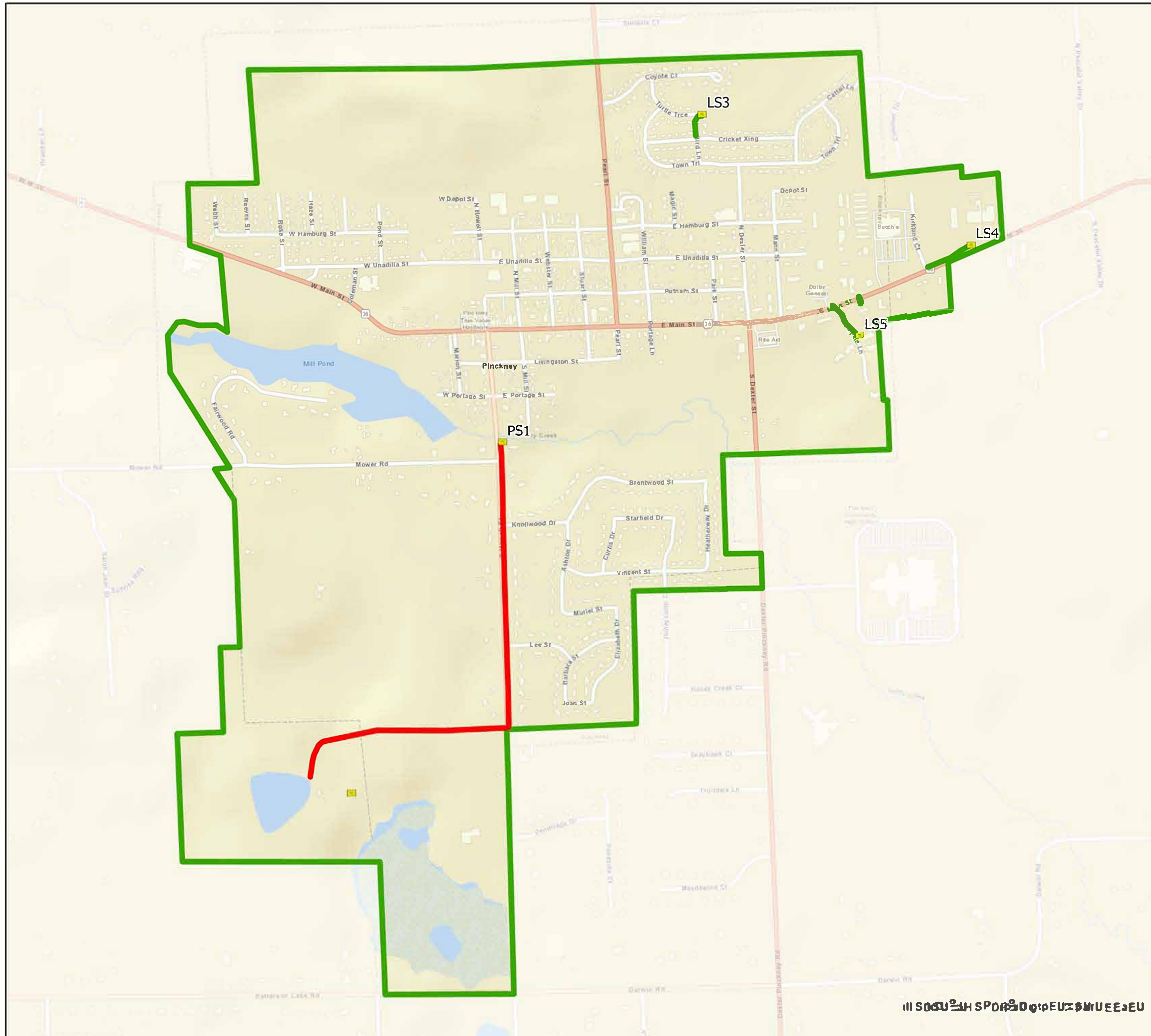
0.0

5.0

0 0.05 0.1 0.2 0.3 0.4 Miles

Map 9
Force Main Consequence of Failure Map

N



Pump Stations

Pump Station

Consequence of Failure

Consequence Rating

- Slight
- Minor
- Moderate
- Major
- Massive

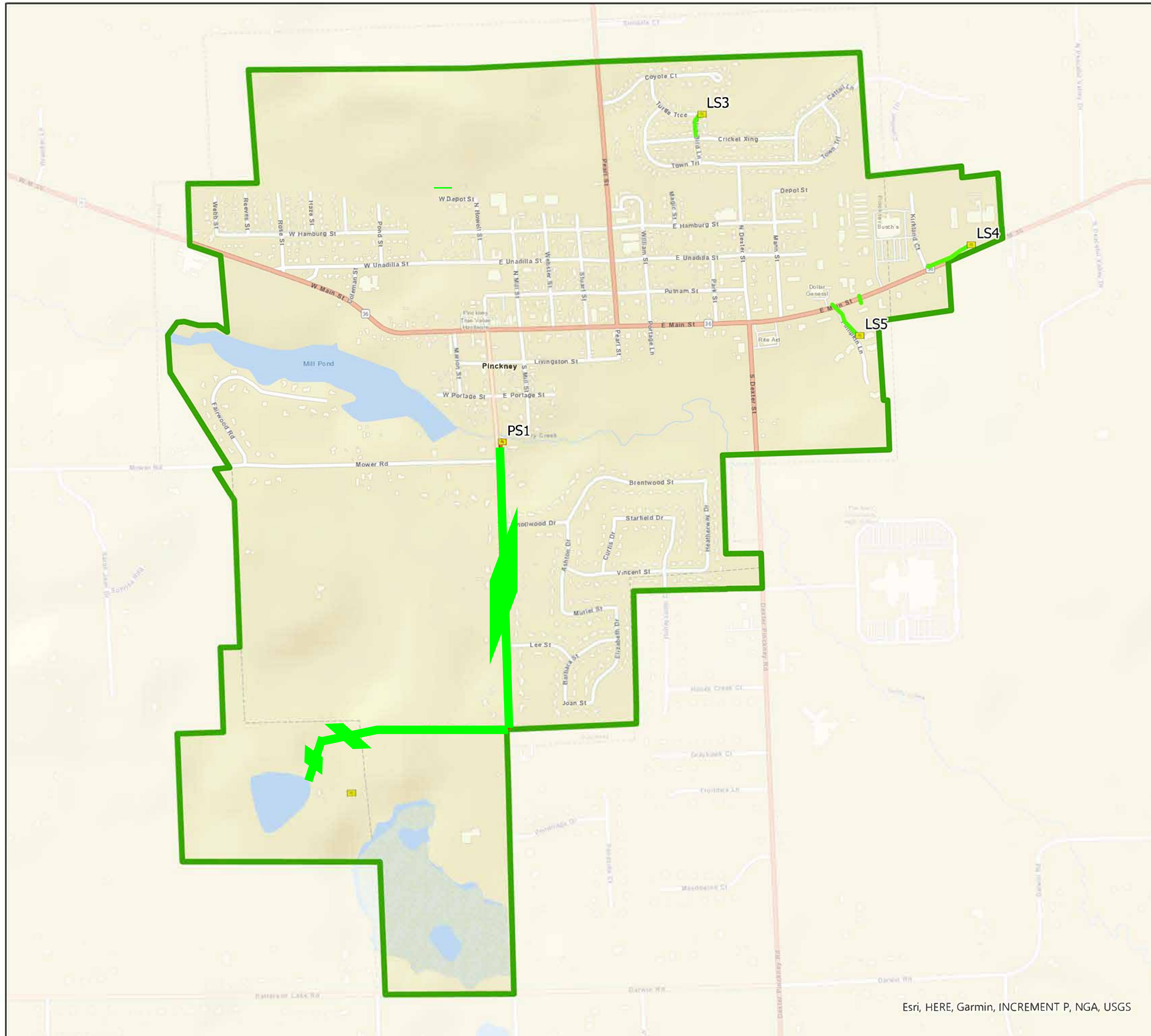
Village Boundary

Village Limits

0 0.05 0.1 0.2 0.3 0.4 Miles

Map 10
Force Main Business Risk Map

N



Pump Stations

Pump Station

Village Boundary

Village Limits

Sanitary Force Main Business Risk

Business Risk

- High
- Moderate
- Low
- Private

0 0.05 0.1 0.2 0.3 0.4 Miles

Map 11
WWTP
Enlargement Map

N

Sanitary Manholes

Sanitary Manholes

Pump Stations

Pump Station

Force Mains

Force Main

Sanitary Sewer

Pipe Diameter

6" or Less

8"

10"

12"

15"

Private

WWTP Buildings

WWTP Buildings

Lagoons

Aeration

Storage

Sand Pits

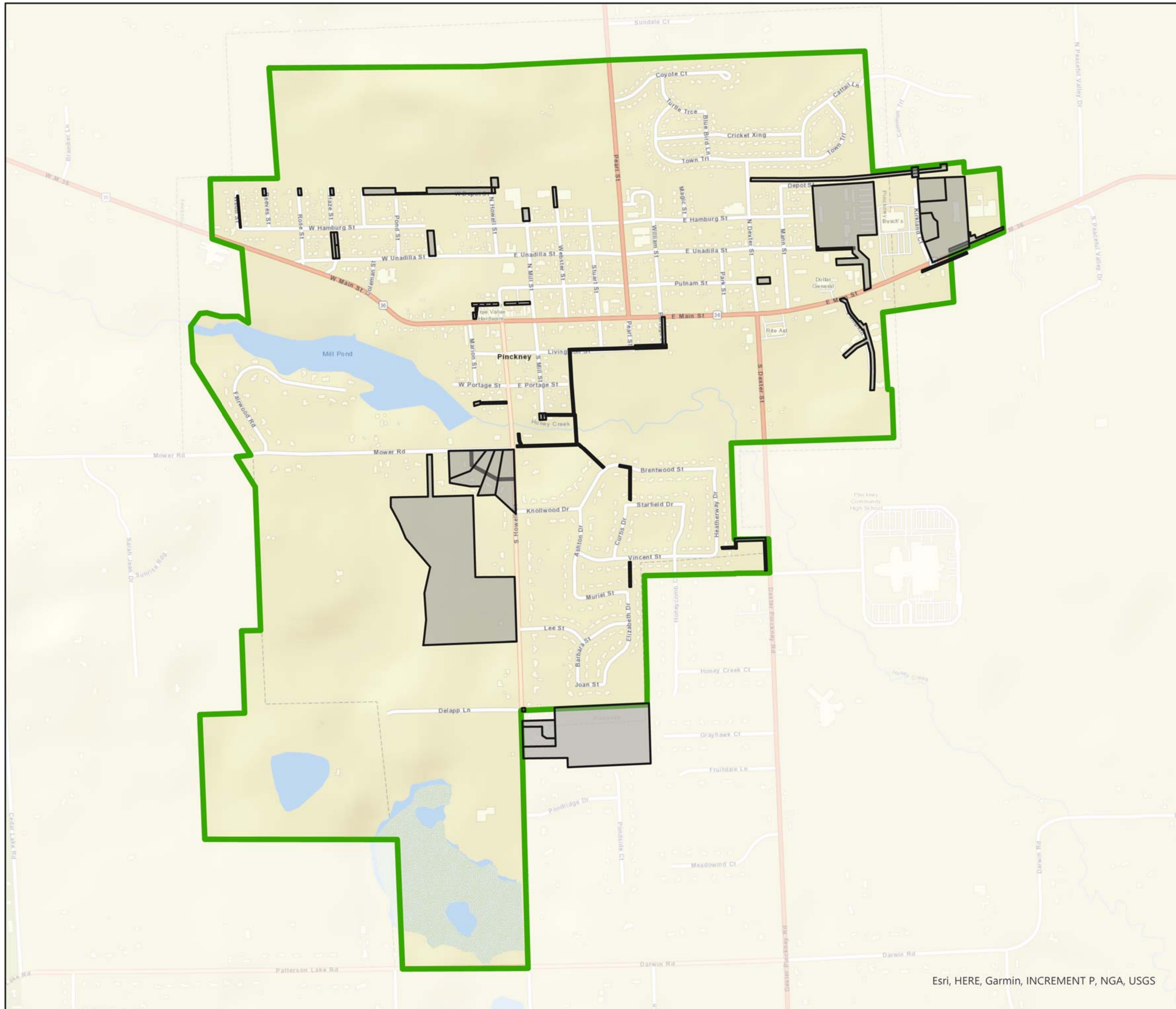
Sand Pits

Village Boundary

Village Limits

0 0.01 0.02 0.04 0.06 0.08 Miles

Map 12
Sanitary Sewer Easement Map



N

Easements

Easements

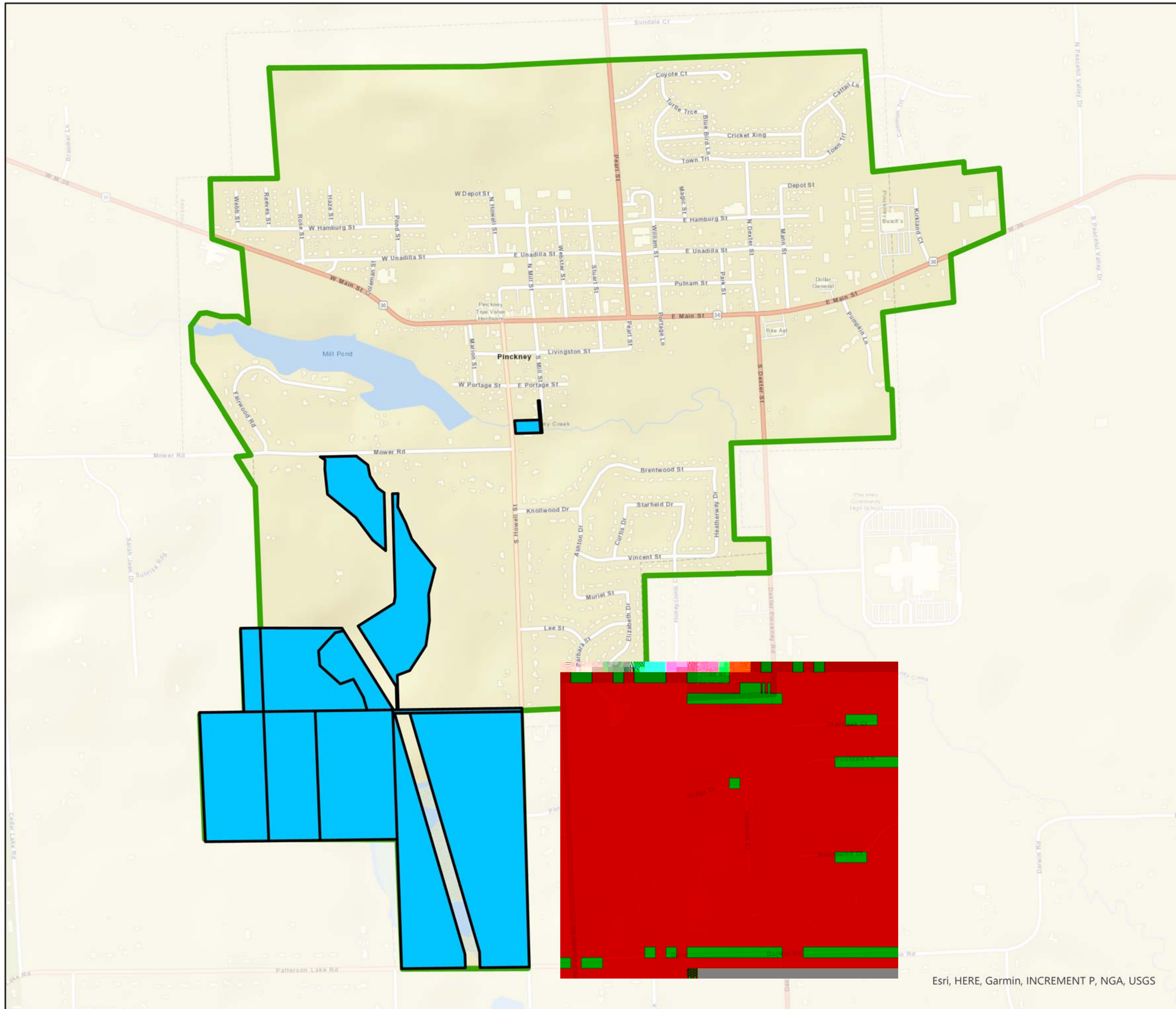
Village Boundary

Village Limits

0 0.05 0.1 0.2 0.3 0.4 Miles

Map 13
Sanitary Sewer Deeds Map

N



Deeds

Deeds

Village Boundary

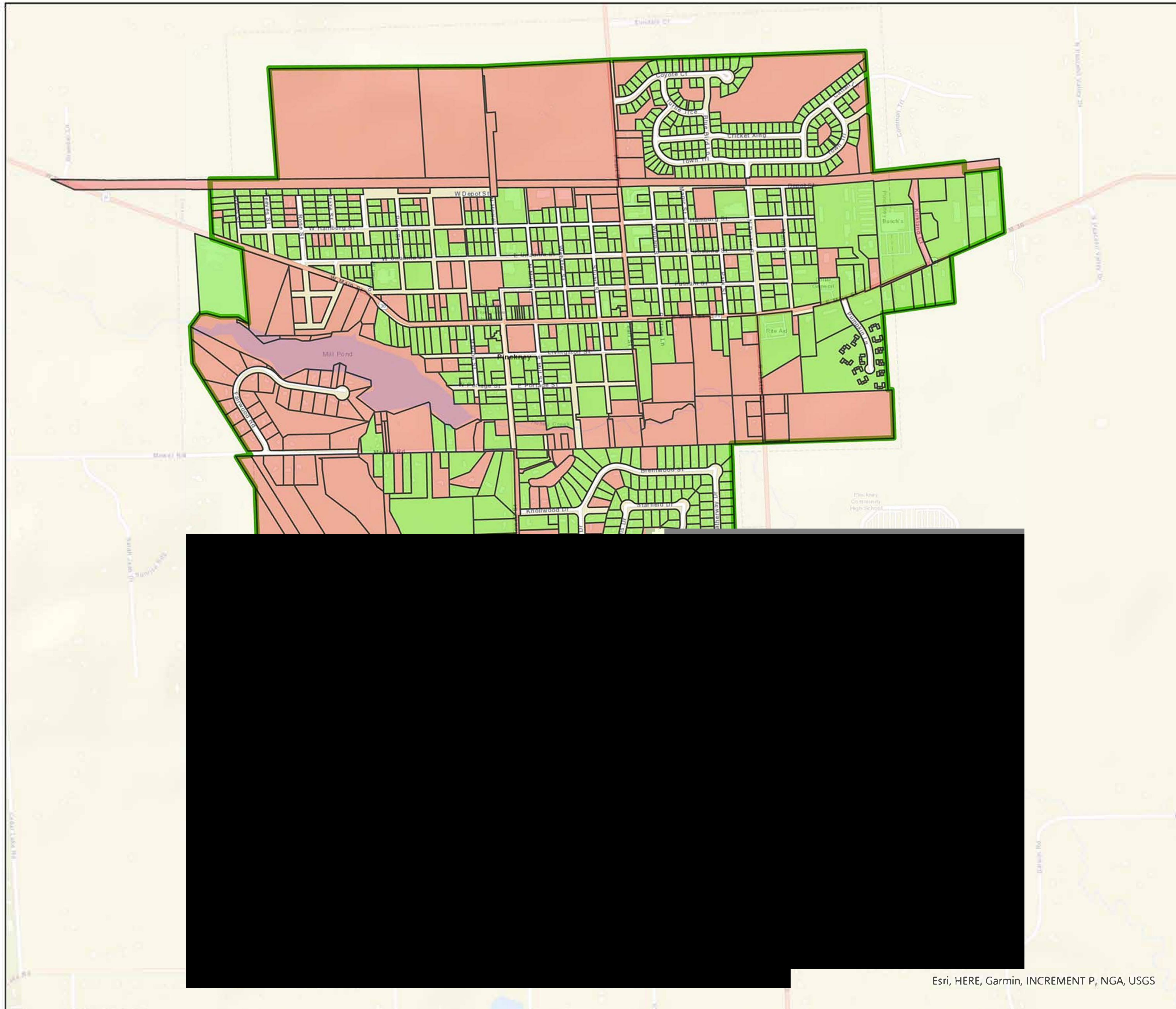
Village Limits

0 0.05 0.1 0.2 0.3 0.4

Miles

Map 14
Gravity Sewer Parcels With Lead Sheets

N



[redacted]

Parcels

- Contains Lead Sheet
- Does Not Contain Lead Sheet

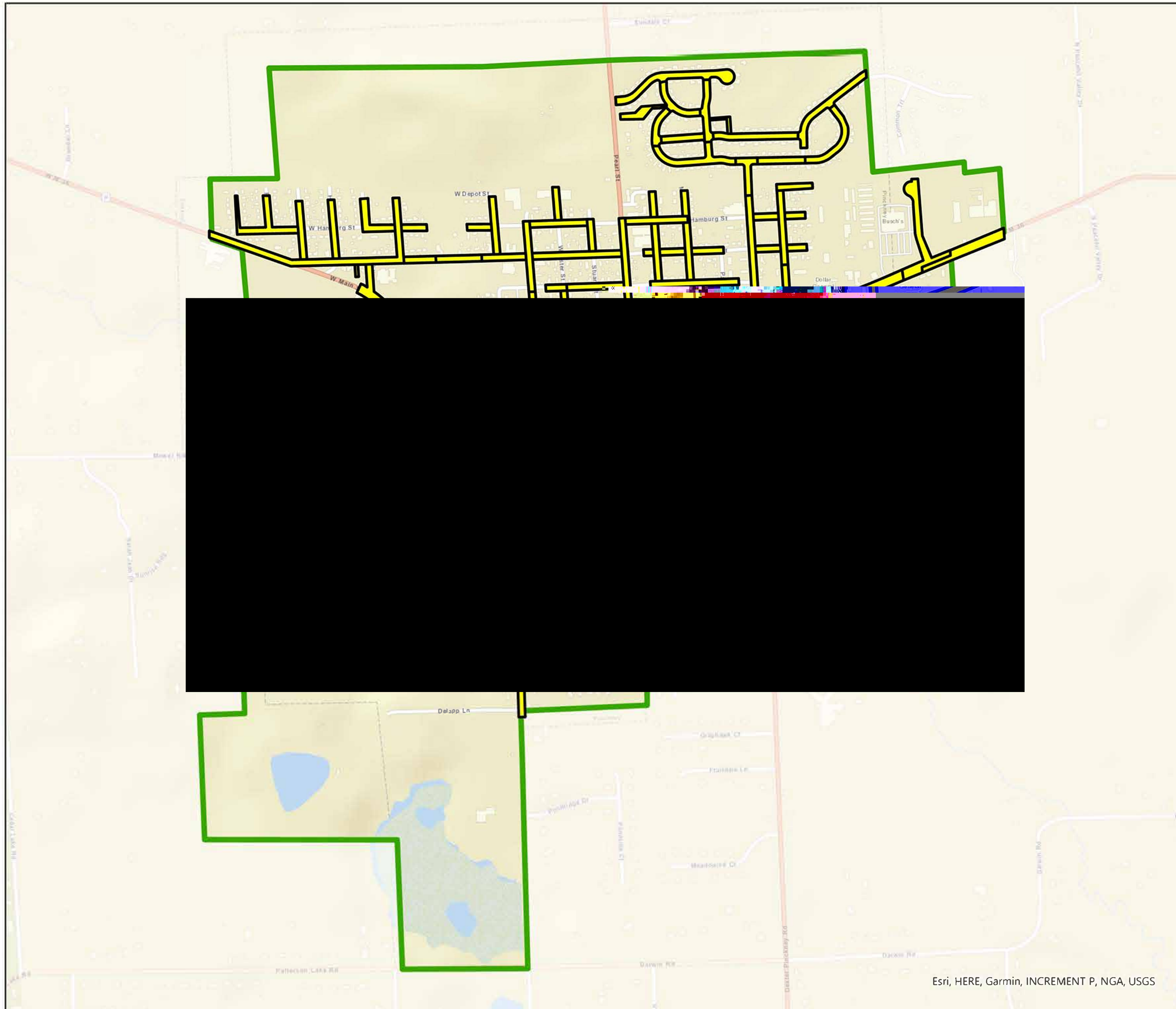
Village Boundary

- Village Limits

0 0.05 0.1 0.2 0.3 0.4 Miles

Map 15
Sanitary Sewer Record Drawing Map

N



Record Drawings

Record Drawings

Village Boundary

Village Limits

0 0.05 0.1 0.2 0.3 0.4 Miles

Appendix B - Grading System and Ratings Example

Grading System and Ratings Example

As observations are added to an inspection, users assign them a defect and the system automatically fills in attribute information about that defect. Based on the PACP/MACP system, the program calculates the grade of the damage (the severity of the damage) and the number of occurrences the damage represents (usually 1, but may be more if it is a continuous defect). The system then uses these grades and occurrences to calculate the pipe or structure's rating.

Below is an example of a Grading System Code Matrix that complies with NAASCO PACP/MACP standards and explanations of how the *Ratings* fields are calculated.

Sample Grading Matrix

This matrix represents the calculations that the system performs automatically based on the PACP/MACP code the user selected in the *Observations* record.

	Occurrences *			**Ratings ***		
Grades *	**Structural**	**O&M**	**Overall**	**Structural**	**O&M**	**Overall**
1	1	3	4	1	3	4
2	3	5	8	6	10	16
3	2	4	6	6	12	18
4	5	0	5	20	0	20
5	3	2	5	15	10	25
Totals	14	14	28	48	35	83

***** The system automatically calculates grades in the *Grade* fields on the *Observation* records.

***** The system automatically calculates occurrences in the *Number* fields on the *Observation* records.

***** The system automatically calculates ratings in the *Ratings* fields on the *Condition Ratings* tab.

Pipe Ratings

Pipes and structures are graded based on the number and severity of defects observed. Ratings are found on the *Condition Ratings* tab.

Structural and O&M Ratings

Structural and *O&M Ratings* are calculated by:

1. Grouping the *Observations* by *Type* and *Grade*.
2. Multiplying the *Grade* by the *# of Occurrences*.
3. Adding the results of Step 2.

▾Example

1. Group observations by *Type* and *Grade*.
   - There is 1 occurrence of a Grade 1 *Structural* defect.
   - There are 3 occurrences of a Grade 2 *Structural* defect.
   - There are 2 occurrences of a Grade 3 *Structural* defect.
   - There are 5 occurrences of a Grade 4 *Structural* defect.
   - There are 3 occurrences of a Grade 5 *Structural* defect.
2. Multiply the grade by the # of occurrences
   - **1 * 1 = Rating of 1**
   - **2 * 3 = Rating of 6**
   - **3 * 2 = Rating of 6**
   - **4 * 5 = Rating of 20**
   - **5 * 3 = Rating of 15**
3. Sum the Results of step 2.
   - **1 + 6 + 6 + 20 + 1 5 = 48**
   - **Pipe Structural Rating = 48**

	Occurrences *			**Ratings ***		
Grades *	**Structural**	**O&M**	**Overall**	**Structural**	**O&M**	**Overall**
1	1	3	4	1	3	4
2	3	5	8	6	10	16
3	2	4	6	6	12	18
4	5	0	5	20	0	20
5	3	2	5	15	10	25
Totals	14	14	28	48	35	83

Note: This same process is used for *O&M Ratings*, as well.

Total Ratings

Total Ratings are calculated by:

- Adding the results of the *Structural* and *O&M Ratings.*

▾Example

Add the *Structural Total* and the *O&M Total.*

- **48 + 35 = 83**

	Occurrences *				Ratings *		
Grades *	**Structural**	**O&M**	**Overall**		**Structural**	**O&M**	**Overall**
1	1	3	4		1	3	4
2	3	5	8		6	10	16
3	2	4	6		6	12	18
4	5	0	5		20	0	20
5	3	2	5		15	10	25
Totals	14	14	28		48	35	83

Rating Indexes

A *Rating Index* is the average grade of a type of defect found in the inspection. These calculations are based on the pipe ratings and on the number of occurrences. The formulas for these indexes are:

- **Rating Index Structural = Total Structural Rating/Total Structural Occurrences**
- **Rating Index O&M = Total O&M Rating/Total O&M Occurrences**
- **Rating Index Total = Total Rating/Total Occurrences**

Example

- Divide the *Total Structural Rating* by the *Total Structural Occurrences.*
  - **48 / 14 = 3.4**
- Divide the *Total O&M Rating* by the *Total O&M Occurrences.*
  - **35 / 14 = 2.5**
- Divide the *Total Rating* by the *Total Occurrences.*
  - **83 / 28 = 3.0**

	Occurrences *				Ratings *		
Grades *	**Structural**	**O&M**	**Overall**		**Structural**	**O&M**	**Overall**
1	1	3	4		1	3	4
2	3	5	8		6	10	16
3	2	4	6		6	12	18
4	5	0	5		20	0	20
5	3	2	5		15	10	25
Totals	14	14	28		48	35	83
			Indexes		3.4	2.5	3.0

Quick Ratings

Quick Ratings are codes that give users an overview of the worst defects observed during the inspection.

Structural and O&M Quick Ratings

These are calculated by:

1. Grouping the observations by *Type* and *Grade*.
2. Identifying the highest grade for a type of defect.
3. Identifying the number of occurrences of that grade.
4. Identifying the second highest grade for a type of defect.
5. Identifying the number of occurrences of that grade.
6. Forming the *Quick Rating* using the following syntax:

[Highest Grade for Type][# of Occurrences][Second Highest Grade for Type][# of Occurrences]

Example

The *O&M Quick Rating* is formed using the following syntax:

[Highest O&M Grade][# of Occurrences][Second Highest O&M Grade][# of Occurrences]

5 2 3 4

	Occurrences *			Ratings *		
Grades *	**Structural**	**O&M**	**Overall**	**Structural**	**O&M**	**Overall**

2. Identifying the highest grade of all defects.
3. Identifying the number of occurrences of that grade.
4. Identifying the second highest grade of all defects.
5. Identifying the number of occurrences of that grade.
6. Forming the *Quick Rating* using the following syntax:

   [Highest Grade][# of Occurrences][Second Highest Grade][# of Occurrences]

▾Example

The Total Quick Rating is formed using the following syntax:

[Highest Grade][# of Occurrences][Second Highest Grade][# of Occurrences]

5 5 4 5

	Occurrences *			**Ratings ***		
Grades *	**Structural**	**O&M**	**Overall**	**Structural**	**O&M**	**Overall**
1	1	3	4	1	3	4
2	3	5	8	6	10	16
3	2	4	6	6	12	18
4	5	0	5	20	0	20
5	3	2	5	15	10	25
Totals	14	14	28	48	35	83
Quick Ratings	5345	5234	5545			

Note: According to PACP/MACP, if the number of occurrences is greater than 9, the letters A-Z are used to represent additional occurrences in the *Quick Ratings.*

Letter	Number of Occurrences
A	10-14
B	15-19
C	20-24
D	25-29
E	30-34
F	35-39
G	40-44
H	45-49
I	50-54

J	55-59
K	60-64
L	65-69
M	70-74
N	75-79
O	80-84
P	85-89
Q	90-94
R	95-99
S	100-104
T	105-109
U	110-114
V	115-119
W	120-124
X	125-129
Y	130-134
Z	135-139

Appendix C – System Inventory and Assessment Tables

1. Pipe Tables
2. Manhole Tables
3. Pump Station 1 Tables
4. Lift Station 3 Tables
5. Lift Station 4 Tables
6. Lift Station 5 Tables
7. Screening Building Tables
8. Blower Building Tables
9. DPW/Lab Building Tables
10. WWTP Tables

Appendix D – 10-Year Discrete Defect (Grade 4-5) Repair Cost Estimates

Appendix E – 20-Year Annual Replacement Reserve Tables

1. Pipe Tables
2. Manhole Tables
3. Pump Station 1 Tables
4. Lift Station 3 Tables
5. Lift Station 4 Tables
6. Lift Station 5 Tables
7. Screening Building Tables
8. Blower Building Tables
9. DPW/Lab Building Tables
10. WWTP Tables

Appendix F – Sanitary Sewer System Rate Methodology

Appendix G – Sanitary Sewer System Fund 10-Year Budget