

CITY OF DETROIT
Water and Sewerage Department



**Sewer Rehabilitation
Project**

**DRAFT
Streamlined Project Plan**

April 2019

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Mayor**

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Item 1 - Project Definition and Overview

A task being performed by AECOM under the Detroit Water and Sewerage Department (DWSD) contract CS-1812, Capital Improvement Program Management Organization (CIPMO), is the assessment and evaluation of existing sewer collection mains and manholes in targeted locations within the City of Detroit. The primary criterion being used to determine if sewer collection mains and manholes will be scheduled for either rehabilitation or replacement is the structural integrity of the assets based upon National Association of Sewer Service Companies (NASSCO) PACP CCTV and MACP ratings respectively.

Work planned for FY2020 (07/01/2019 – 06/30/2020) through FY 2023 capital expenditure is derived from the assessments/evaluations performed in the five City of Detroit neighborhoods known as the Five High Priority Neighborhoods of Brewster Homes, Brewster-Douglass, New Center Commons, Virginia Park and Piety Hills (Project A) and the Four Westside Neighborhoods of Riverdale, Miller Grove, Minock Park and South Rosedale Park (Project B). It is anticipated that construction will commence in May 2020 and be completed by October 2022.

Project A – Five High Priority Neighborhoods

Project Status

All CCTV and manhole inspections have been completed in the project area and preliminary intervention recommendations have been provided to DWSD. It is expected that minor changes will be made to the proposed interventions as project design begins.

Full Project

From the assessments/evaluations in these neighborhoods, AECOM has recommended to DWSD the rehabilitation or replacement of approximately 51,281 feet of sewer collection mains ranging in size from 10-inch through 54-inch in diameter in addition to 82 manhole repairs. This work includes interventions such as cured-in-place lining (CIPP), trenchless point repairs, external point repairs, full section replacements, pointing of brick sewers, cementitious lining of manholes and specialized cleaning. The total estimated cost of these repairs is approximately \$7,750,000.

Loan-Eligible Portion of the Project

As only repairs to address defects that had a NASSCO structural rating of either Significant (Grade 4) or Most Significant (Grade 5) are eligible for loan funding, 23,125 feet of sewer collection mains ranging in size from 10-inch through 54-inch in diameter and 23 manhole repairs appear to meet these criteria. This work includes interventions such as cured-in-place lining (CIPP), trenchless point repairs, external point repairs, full section replacements, cementitious lining of manholes but does not include any type of specialized cleaning or pointing of brick sewers. The total estimated cost of these repairs is approximately \$5,000,000.

Project B – Four Westside Neighborhoods

Project Status

CCTV inspection and manhole surveys are currently being performed by an inspection company through an existing contract with DWSD. 53% of CCTV inspections and no manhole inspections in the project area have been provided to AECOM. As a result, no preliminary intervention recommendations have been provided to DWSD. The available CCTV data collected to-date in the last 18 months for the Pilot Project

areas of North Rosedale Park and Cornerstone Village, the Five High Priority Neighborhoods (Project A), and the Westside Four (Project B) Neighborhoods indicates an average percentage of CCTV with Grade 4 or 5 Defects of 30%. As the total footage is 250,000 LF in Project B and the cost per inch per foot was available based upon the analyzed data in Project A, it was possible to extrapolate estimated repairs and costs from the available data.

Full Project

From the assessments/evaluations in these neighborhoods, AECOM expects to recommend to DWSD the rehabilitation or replacement of approximately 150,000 feet of sewer collection mains ranging in size from 8-inch through 180-inch in diameter in addition to 330 manhole repairs. This work includes interventions such as cured-in-place lining (CIPP), trenchless point repairs, external point repairs, full section replacements, pointing of brick sewers, cementitious lining of manholes, and specialized cleaning. The total estimated cost of these repairs is approximately \$32,000,000.

Loan-Eligible Portion of the Project

As only repairs to address defects that have a NASSCO structural rating of either Significant (Grade 4) or Most Significant (Grade 5) are eligible for loan funding, approximately 59,000 feet of sewer collection mains ranging in size from 8-inch through 180-inch in diameter in addition to over 100 manhole repairs are expected to meet these criteria. This work includes interventions such as cured-in-place lining (CIPP), trenchless point repairs, external point repairs, full section replacements, cementitious lining of manholes but does not include any type of specialized cleaning or pointing of brick sewers. The total estimated cost of these repairs is approximately \$21,000,000.

Item 2 - Study Area and Project Zone

The locations of the proposed projects are provided in the general map below (Figure 1).

Location

Project A – Five High Priority Neighborhoods

These neighborhoods comprise:

1. Piety Hill
2. New Center Commons
3. Virginia Park
4. Brewster Douglass
5. Brewster Homes

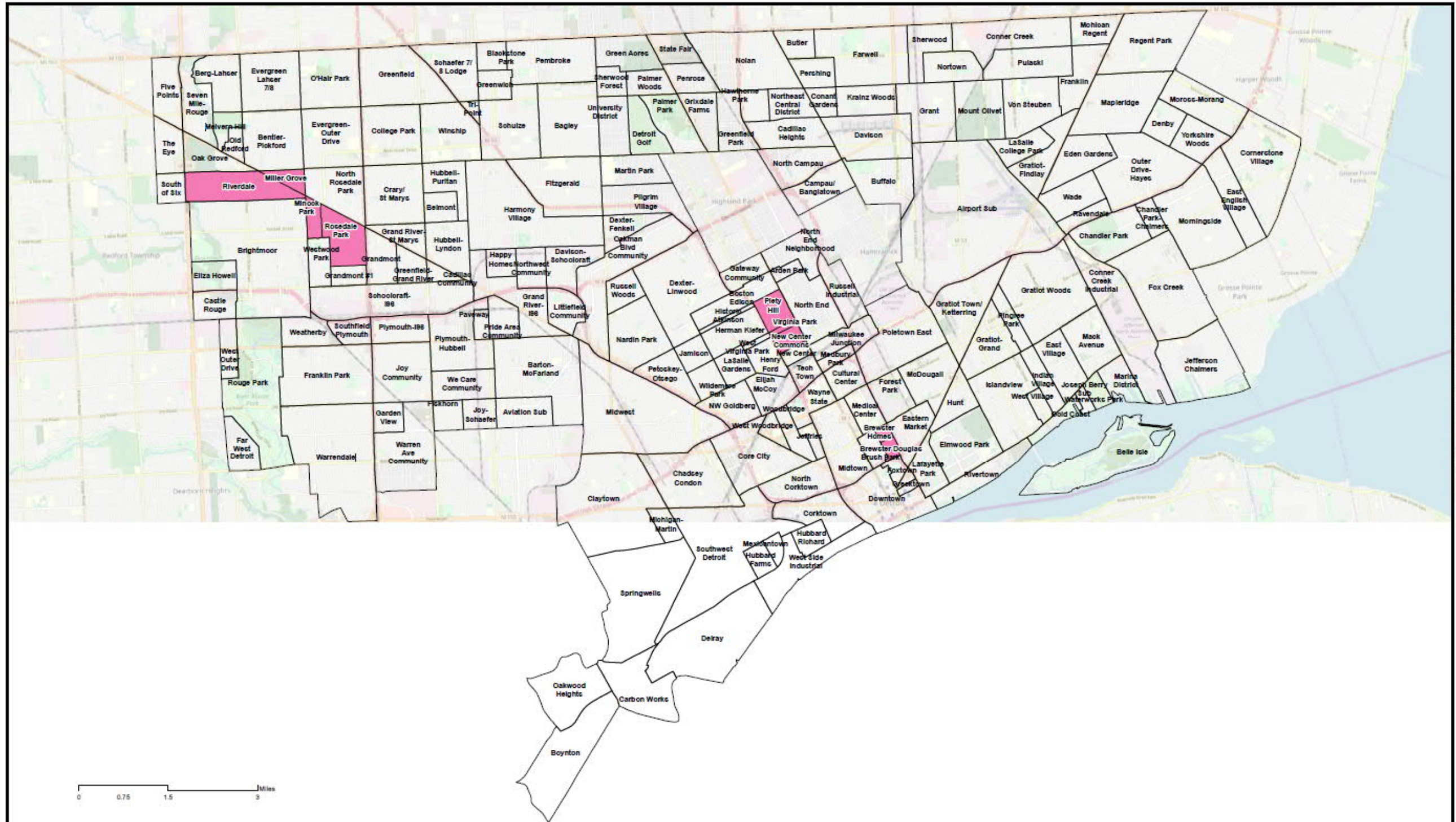
Project B – Four Westside Neighborhoods

These neighborhoods comprise:

1. Riverdale
2. Miller Grove
3. Minock Park
4. South Rosedale Park

Population

The population projections presented in the 2015 Water Master Plan Update report prepared by CDM/Smith for DWSD indicate a forecasted decline in population for the City of Detroit. The City of Detroit population is expected to decrease from 713,777 (2010 Census) to 613,709 by the year 2035. The July 1, 2017 estimated population on the U.S. Census website is 673,104. The estimated 2018 population is not available on this website. The report also indicates a forecasted decline in the overall population in the DWSD service area in the suburban communities.



SHEET SIZE: 11" x 17"	Legend		DETROIT WATER AND SEWERAGE DEPARTMENT CAPITAL IMPROVEMENT PROGRAM		AECOM
	<p> FY 2020 SRF CIP Neighborhoods</p> <p> All Other Neighborhoods</p>		FY 2020 SRF CIP		<p>SCALE: 1:53,000</p> <p>FIGURE: OVERVIEW</p>
					PROJECT NUMBER: CS-1912

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Figure 1 – CIP Neighborhoods

3 - Existing Facilities

General

The gravity and force main system managed by DWSD comprises approximately 2,819 miles of pipe, of which nearly 15 percent has been rehabilitated or reconstructed by lining. 2,424 miles of Detroit’s sewers were constructed prior to the 1940s. This infrastructure has an average age of 95 years. Cementitious material represents the largest portion of inventory. The number of reports for sinkholes and cave-ins associated with defects in the sewer infrastructure has averaged about 200 per year over the last 5 years. The structural condition of this infrastructure requires significant rehabilitation to prevent even more costly repairs and claims due to possible collapses.

Project A – Five High Priority Neighborhoods

There are approximately 21 miles of pipe in Project A neighborhoods in total ranging in size from 10-inch to 54-inch. The pipe material includes brick, concrete, crock, PVC, reinforced concrete, vitrified clay, unknown and CIPP lined. Figure 2 identifies pipe mileage by material type in Project A neighborhoods. Figure 3 is a map of the sewer assets in the northern three neighborhoods of Project A. Figure 4 is a map of the sewer assets in the southern two neighborhoods of Project A.

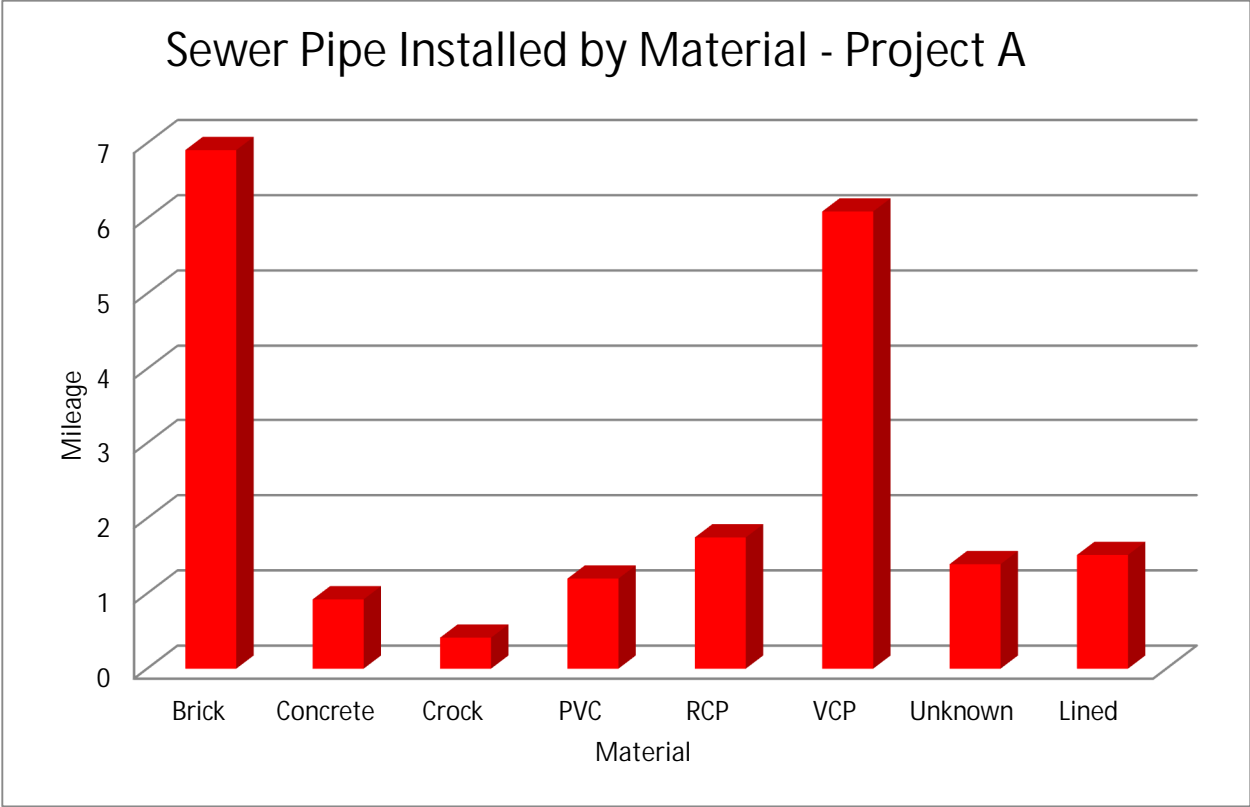


Figure 2 – Pipe Mileage by Material – Project A Neighborhoods

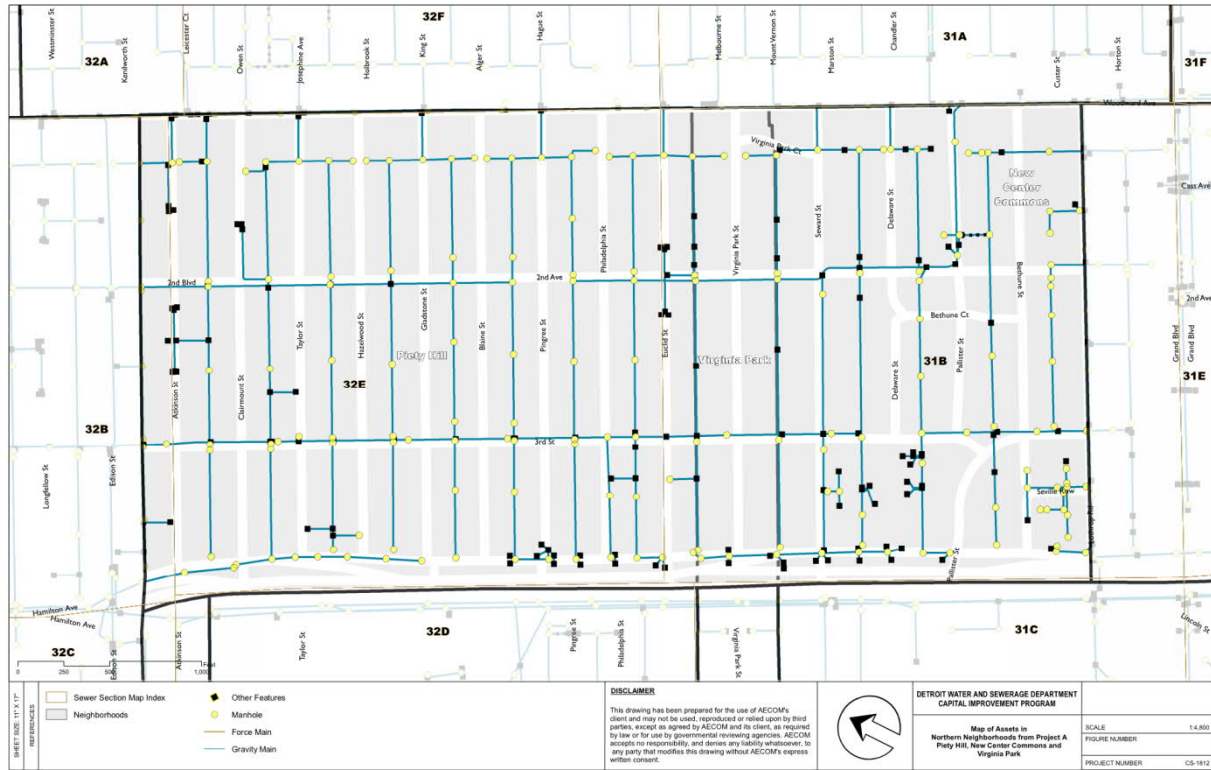


Figure 3 – Map of Assets in Northern Neighborhoods from Project A – Piety Hill, New Center Commons and Virginia Park

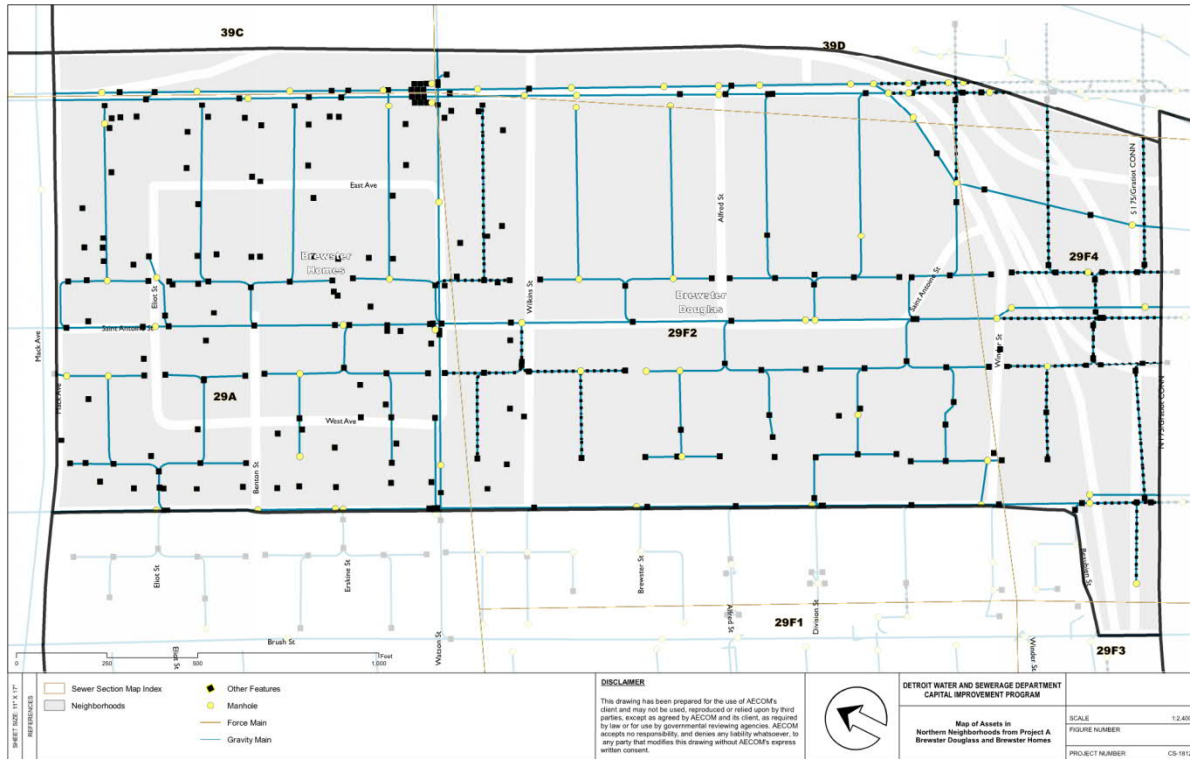


Figure 4 – Map of Assets in Southern Neighborhoods from Project A – Brewster Douglass and Brewster Homes

Project B – Four Westside Neighborhoods

There are approximately 47 miles of pipe in Project B neighborhoods in total ranging in size from 8-inch to 180-inch. The pipe material includes brick, concrete, crock, PVC, vitrified clay, unknown and CIPP lined. Figure 5 identifies pipe mileage by material type in Project B neighborhoods. Not all of the pipe in Project B has been televised, so it is expected that the unknown quantity identified in Figure 5 will reduce once inspection is complete. Figure 6 is a map of the sewer assets in the neighborhoods of Project B.

Sewer Pipe Installed by Material - 4 Westside

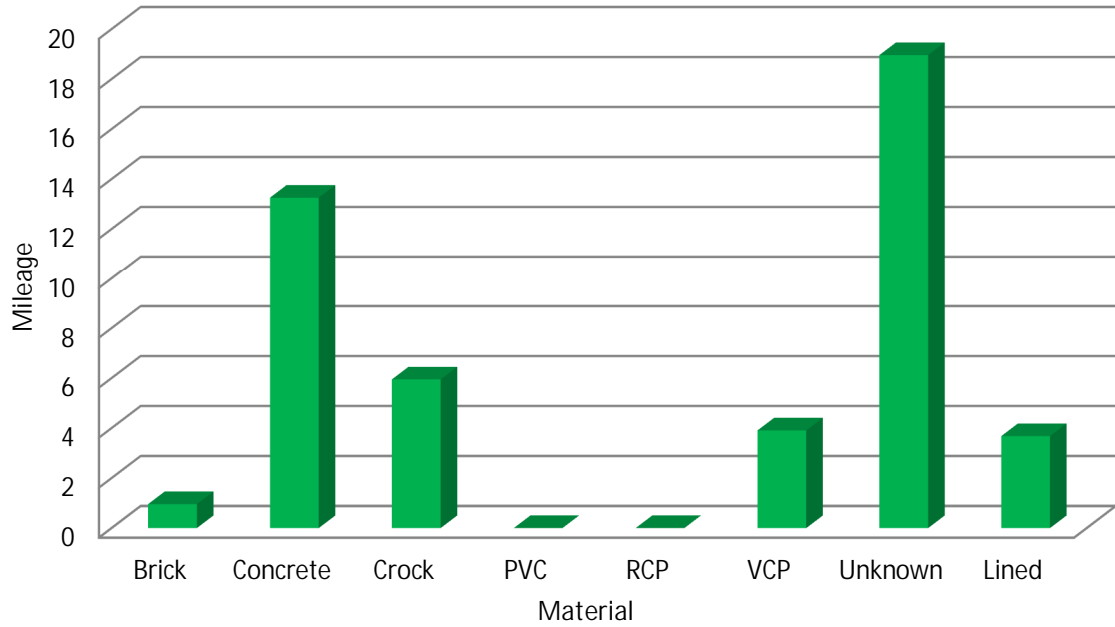


Figure 5 – Pipe Mileage by Material – Four Westside Neighborhoods

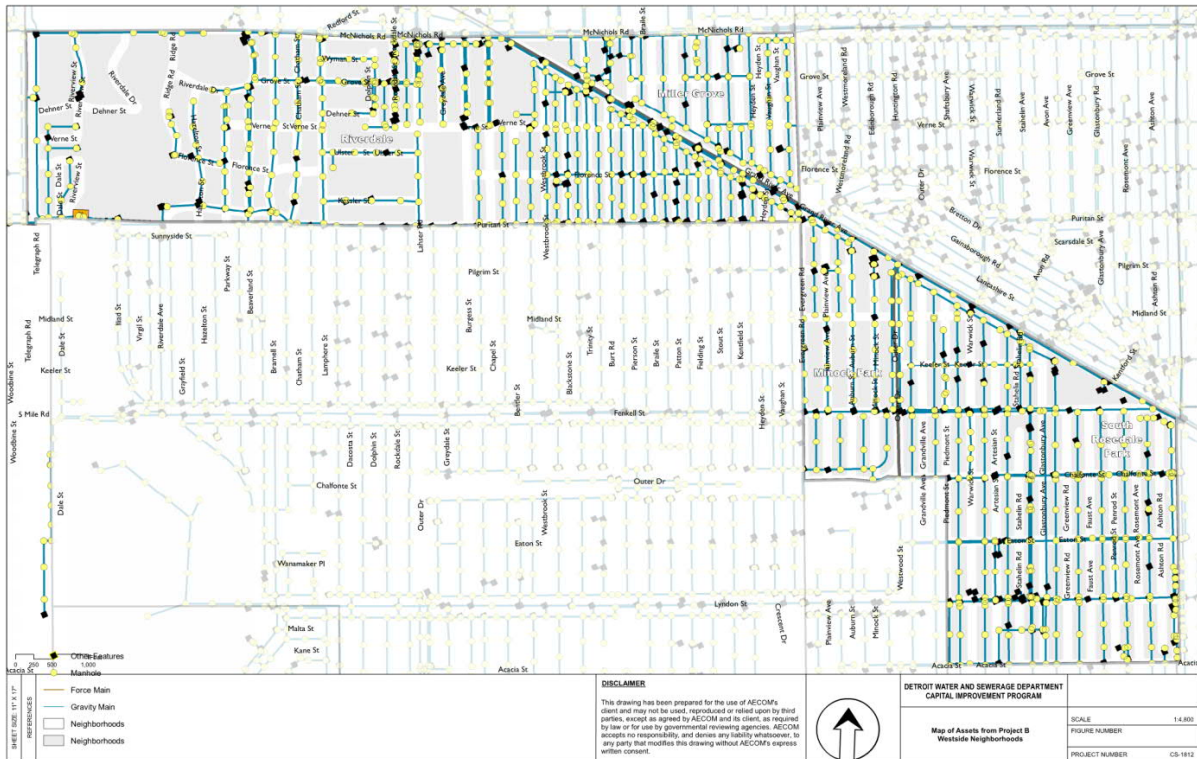


Figure 6 – Map of Assets from Project B - Four Westside Neighborhoods

Item 4 – Project Need

General

As a result of the CCTV and manhole inspection performed to-date, multiple defects requiring intervention have been identified. The primary structural defects encountered are fractures (spiral, hinge, longitudinal and circumferential), holes, continuous cracks, voids outside the pipe and deformation. Some of the defects have a NASSCO structural rating of either Significant (Grade 4) or Most Significant (Grade 5). To avoid sinkholes, back-ups in buildings and disruption to customers, it is recommended that interventions be made to prevent asset failure. Furthermore, based on the average age of the infrastructure at 95 years, the observed condition and the risk to public health, it is felt that the selected pipes and manholes are defensible candidates for intervention.

Project A – Five High Priority Neighborhoods

53% of the pipes televised have defects requiring interventions with 24% of these having a NASSCO structural rating of either Significant (Grade 4) or Most Significant (Grade 5). An example of one of these (a deformation with a Grade 5 structural rating) is shown in Figure 7. A significant crack in a manhole is shown in Figure 8.

The screenshot shows a software window titled "CCTV survey : WWMH0000033216A_U_20181010_1351". It features a "Defects" tab and an "Internal View" sub-tab. A table lists various defects with columns for Distance (ft), PACP Code, Continuous, Value %, Value 1st Dim, Value 2nd Dim, Clock At/From, Clock to, Band, Material, Joint, Remarks, O and M Grade, Structural Grade, Video file, and Counter. A video player is embedded below the table, showing a live feed of a pipe with a defect. The video player includes a play button, a progress bar, and a timestamp of 15:31. The interface also has "Add Defect", "OK", "Cancel", and "Help" buttons.

Distance (ft)	PACP Code	Continuous	Value %	Value 1st Dim	Value 2nd Dim	Clock At/From	Clock to	Band	Material	Joint	Remarks	O and M Grade	Structural Grade	Video file	Counter
82.40	DAE		5			7				<input checked="" type="checkbox"/>		2.00	0.00		565.1
86.30	DAE		5			7	5			<input checked="" type="checkbox"/>		2.00	0.00		576.1
89.00	CL						12			<input checked="" type="checkbox"/>	AECOM	0.00	2.00		587.1
90.60	DAE		5			12	5			<input checked="" type="checkbox"/>		2.00	0.00		598.1
102.30	DAE		5			7	10			<input checked="" type="checkbox"/>		2.00	0.00		623.1
108.80	DAE		5			7	12			<input checked="" type="checkbox"/>		2.00	0.00		637.1
113.20	DAE		5			7	5			<input checked="" type="checkbox"/>		2.00	0.00		656.1
113.90	TFA			6		2				<input type="checkbox"/>		0.00	0.00		667.1
120.00	DR		20							<input type="checkbox"/>		0.00	5.00		849.1
121.20	B					12	12			<input type="checkbox"/>		0.00	4.00		710.1

Figure 7. Sample CCTV Data from a Pipe in the Five High Priority Neighborhoods



Figure 8. Sample Manhole Defect from a Manhole in the Five High Priority Neighborhoods

Project B – Four Westside Neighborhoods

While the CCTV inspections for the Project B area is approximately 50% completed, this data along with the 100% completed CCTV data for the Pilot Project areas of North Rosedale Park, Cornerstone Village and the Project A - Five High Priority neighborhoods indicates an average percentage of CCTV with Grade 4 or 5 Defects of 30% as shown in Table 1.

Table 1 - Cost Summary - Wastewater Interventions by Type for 4 Westside Neighborhoods

Area	Total Televised Footage (LF)	Footage with Grade 4 or 5 Structural Defects (LF)	Percentage with Grade 4 or 5 Structural Defects	Actual Repair Footage of Just Structural Interventions (LF)
North Rosedale	125,669	42,813	34%	31,379
Cornerstone Village	163,154	68,815	42%	54,530
Project A - Five High Priority	108,053	26,399	24%	23,125
Westside Four (As of 03/28/2019)	133,070	20,771	16%	16,855
Total/Average	529,946	158,798	30%	125,443
Westside Four (When inspections completed)	249,979	74,906	30%	59,172

While only 53% of pipes in the Four Westside Neighborhoods have been televised thus far with 16% having a NASSCO structural rating of either Significant (Grade 4) or Most Significant (Grade 5), it has been assumed based on the completed inspections of all surveyed neighborhoods that the average percentage of footage with Grade 4 or 5 defects of 30% will be allocated to the Four Westside Neighborhoods. An external point repair (EPR) or trenchless point repair (TPR) will be shorter than the entire length of pipe where Grade 4 or 5 defects were observed hence the actual repair length of interventions is estimated to be 59,172 LF.

Item 5 - Alternatives Analysis

General

There are three options for addressing the problems associated with aged sewer mains. DWSD can either continue to repair the old pipes (Alternative 1), selected replace or rehabilitate the old pipes (Alternative 2), or replace the pipes using standard open-cut replacement (Alternative 3). As a part of Alternative 2, rehabilitation through CIPP lining of a majority of sewer main will be incorporated.

A. Alternative 1 – Repair of Existing Sewer Mains

Sewer main repair is conducted throughout the system, particularly in those areas where problems have not escalated to the point which would warrant replacement. Nevertheless, sewer main repairs are time consuming, costly, constitute a drain on DWSD resources needed to carry out the repairs, and pose a potential increase in public health risk. Sewer main repairs can require shutting off sewer service to multiple customers while the defect is repaired and returned to service. Repair activities cannot be pre-scheduled, and field crews must respond on an “as needed” basis at any time of year. As typically only point repairs are performed during emergency repairs, other locations along the same pipe may also be at risk of failure but are not repaired. Hence this alternative should not be considered as a viable alternative.

B. Alternative 2 – Sewer Main Selected Replacement/Rehabilitation

Sewer main replacement/rehabilitation of aged sewer main pipes is based on the criteria described under Item 4 - Project Need. The replacement pipe is sized to meet the service area needs, which may in some cases result in an increase of pipe size, depending on the changes in flow, customer base, including commercial, business and residential demographics. Rehabilitation of aged sewer mains also provides for the use of CIPP lining, which is considered superior because it has an expected useful life greater than that of damaged vitrified clay pipe and deteriorated concrete pipe and can be installed by trenchless means.

In addition to full replacement and full rehabilitation through CIPP lining, both external and trenchless point repairs are recommended as appropriate if the defects are localized and the remainder of the pipe is in generally good condition.

C. Alternative 3 – Sewer Main Replacement Only

Full sewer main replacement of aged sewer main pipes is based on the criteria described under Project Need. The replacement pipe is sized to meet the service area needs, which may in some cases result in an increase of pipe size, depending on the changes in flow, customer base, including commercial, business and residential demographics. This methodology suggests standard open-cut replacement of mains and not rehabilitation of the mains through the use of trenchless methodologies such as CIPP lining. Alternative 3 may be considered extreme but represents a viable alternative.

Based upon the alternative that can be most easily implemented with the least disruption to the utility and the rate payers, and the cost analysis that will be discussed below, Alternative 2, selected replacement and rehabilitation is the recommended alternative.

Item 6 - Proposed Project

Project A – Five High Priority Neighborhoods

Full Project – Alternative 2

From the assessments/evaluations in these neighborhoods, AECOM has recommended to DWSD, the rehabilitation or replacement of approximately 51,281 feet of sewer collection mains ranging in size from 10-inch through 54-inch in diameter in addition to 82 manhole repairs. This work includes interventions such as cured-in-place lining (CIPP), trenchless point repairs, external point repairs, full section replacements, pointing of brick sewers, cementitious lining of manholes and specialized cleaning. The total estimated cost of these repairs is approximately \$7,750,000. Maps of the proposed improvements for Project A are shown in Figures 9 to 20, and are separated by neighborhoods, and by intervention type (O&M and structural). It should be noted that the Virginia Park neighborhood is a narrow strip of land included in the New Center Commons and Piety Hill neighborhood maps. As design is commencing on these projects and hydraulic modeling results are being reviewed, it is possible that some upsizing of pipes may be recommended that would increase these costs.

Cost Summary – Full Project – Alternative 2

Rehabilitation and replacement cost estimates have been developed, based on previous work completed to date. The pre-design total capital cost estimates and costs with contingencies for pipes and manholes in all Five High Priority Neighborhoods areas are shown in Table 2.

Table 2 - Cost Summary – Full Project A Interventions for Alternative 2

Intervention	Type	Asset	Count	Length	Estimated Cost
External Point Repair	Structural	Pipe	15	122	\$134,735
CIPP Lining	Structural	Pipe	170	31,462	\$4,842,987
Full Segment Replacement	Structural	Pipe	3	241	\$197,457
TPR-Liner	Structural	Pipe	21	103	\$139,362
TPR-Pointing	Structural	Pipe	12	28	\$70,780
TPR-Tyger	Structural	Pipe	7	23	\$43,855
Clean	O&M	Pipe	93	19,263	\$366,003
Cutting/grinding of Taps	O&M	Pipe	18	39	\$17,334
Replace Adjusters	Structural	Manhole	2		\$1,522
Replace Chimney Only	Structural	Manhole	4		\$12,120
Manhole Cleaning	O&M	Manhole	40		\$15,200
General and/or Spot Repairs	Structural	Manhole	32		\$16,800
Benching and Channel Reconstruction	Structural	Manhole	2		\$3,276
Structural Spray Lining	Structural	Manhole	2		\$4,992
Total Intervention Cost					\$5,866,423
10% Contingency					\$586,642
Sub-total					\$6,453,065
20% Design Contingency					\$1,290,613
Total					\$7,743,678

Loan-Eligible Portion of the Project – Alternative 2

As only repairs to address defects that had a NASSCO structural rating of either Significant (Grade 4) or Most Significant (Grade 5) are eligible for loan funding, 23,125 feet of sewer collection mains ranging in size from 10-inch through 42-inch in diameter in addition to 23 manhole repairs appear to meet these criteria. This work includes interventions such as cured-in-place lining (CIPP), trenchless point repairs, external point repairs, full section replacements, cementitious lining of manholes but does not include any type of specialized cleaning or pointing of brick sewers. The total estimated cost of these repairs is approximately \$5,000,000. Again, maps of the proposed improvements for Project A are shown in Figures 9 to 20, and are separated by neighborhoods, and by intervention type. It should be noted that the Virginia Park neighborhood is a narrow strip of land included in the New Center Commons and Piety Hill neighborhood maps. As design is commencing on these projects and hydraulic modeling results are being reviewed, it is possible that some upsizing of pipes may be recommended that would raise these costs.

Cost Summary – Loan Eligible Portion – Alternative 2

Rehabilitation and replacement cost estimates have been developed, based on previous work completed to date. The pre-design total capital cost estimates and costs with contingencies for pipes and manholes in Project A Five High Priority Neighborhoods areas are shown in Table 3.

Table 3 - Cost Summary – Loan Eligible - Project A Interventions for Alternative 2

Intervention	Type	Asset	Count	Length	Estimated Cost
External Point Repair	Structural	Pipe	15	122	\$134,735
CIPP Lining	Structural	Pipe	100	22,729	\$3,391,361
Full Segment Replacement	Structural	Pipe	3	241	\$197,457
TPR-Liner	Structural	Pipe	5	23	\$33,855
TPR-Tyger	Structural	Pipe	3	10	\$18,850
General and/or Spot Repairs	Structural	Manhole	20		\$10,500
Benching and Channel Reconstruction	Structural	Manhole	1		\$1,638
Structural Spray Lining	Structural	Manhole	2		\$4,992
Total Intervention Cost					\$3,793,388
10% Contingency					\$379,339
Sub-total					\$4,172,727
20% Design Contingency					\$834,545
Total					\$5,007,273

Cost Summaries – Alternative 3 – Full Replacement

To illustrate the expected increase in cost if full replacement (Alternative 3) is assumed instead of rehabilitation (Alternative 2) of pipes using trenchless methodologies, Tables 4 and 5 were developed. The CIPP and TPR lining items have been removed and full replacement and EPR quantities have been increased accordingly. As shown, the costs for Alternative 3 are significantly higher than those for Alternative 2.

Table 4 - Cost Summary – Full Project – Project A for Alternative 3

Intervention	Type	Asset	Count	Length	Estimated Cost
External Point Repair	Structural	Pipe	43	248	\$387,014
Full Segment Replacement	Structural	Pipe	173	31,702	\$14,374,646
TPR-Pointing	Structural	Pipe	12	28	\$70,780
Clean	O&M	Pipe	93	19,263	\$366,003
Cutting/grinding of Taps	O&M	Pipe	18	39	\$17,334
Replace Adjusters	Structural	Manhole	2		\$1,522
Replace Chimney Only	Structural	Manhole	4		\$12,120
Manhole Cleaning	O&M	Manhole	40		\$15,200
General and/or Spot Repairs	Structural	Manhole	32		\$16,800
Benching and Channel Reconstruction	Structural	Manhole	2		\$3,276
Structural Spray Lining	Structural	Manhole	2		\$4,992
Total Intervention Cost					\$15,269,687
10% Contingency					\$1,526,969
Sub-total					\$16,796,656
20% Design Contingency					\$3,359,331
Total					\$20,155,987

Table 5 - Cost Summary – Loan Eligible – Project A for Alternative 3

Intervention	Type	Asset	Count	Length	Estimated Cost
External Point Repair	Structural	Pipe	23	155	\$192,207
Full Segment Replacement	Structural	Pipe	103	22,970	\$10,224,569
General and/or Spot Repairs	Structural	Manhole	20		\$10,500
Benching and Channel Reconstruction	Structural	Manhole	1		\$1,638
Structural Spray Lining	Structural	Manhole	2		\$4,992
Total Intervention Cost					\$10,433,906
10% Contingency					\$1,043,391
Sub-total					\$11,477,297
20% Design Contingency					\$2,295,459
Total					\$13,772,756

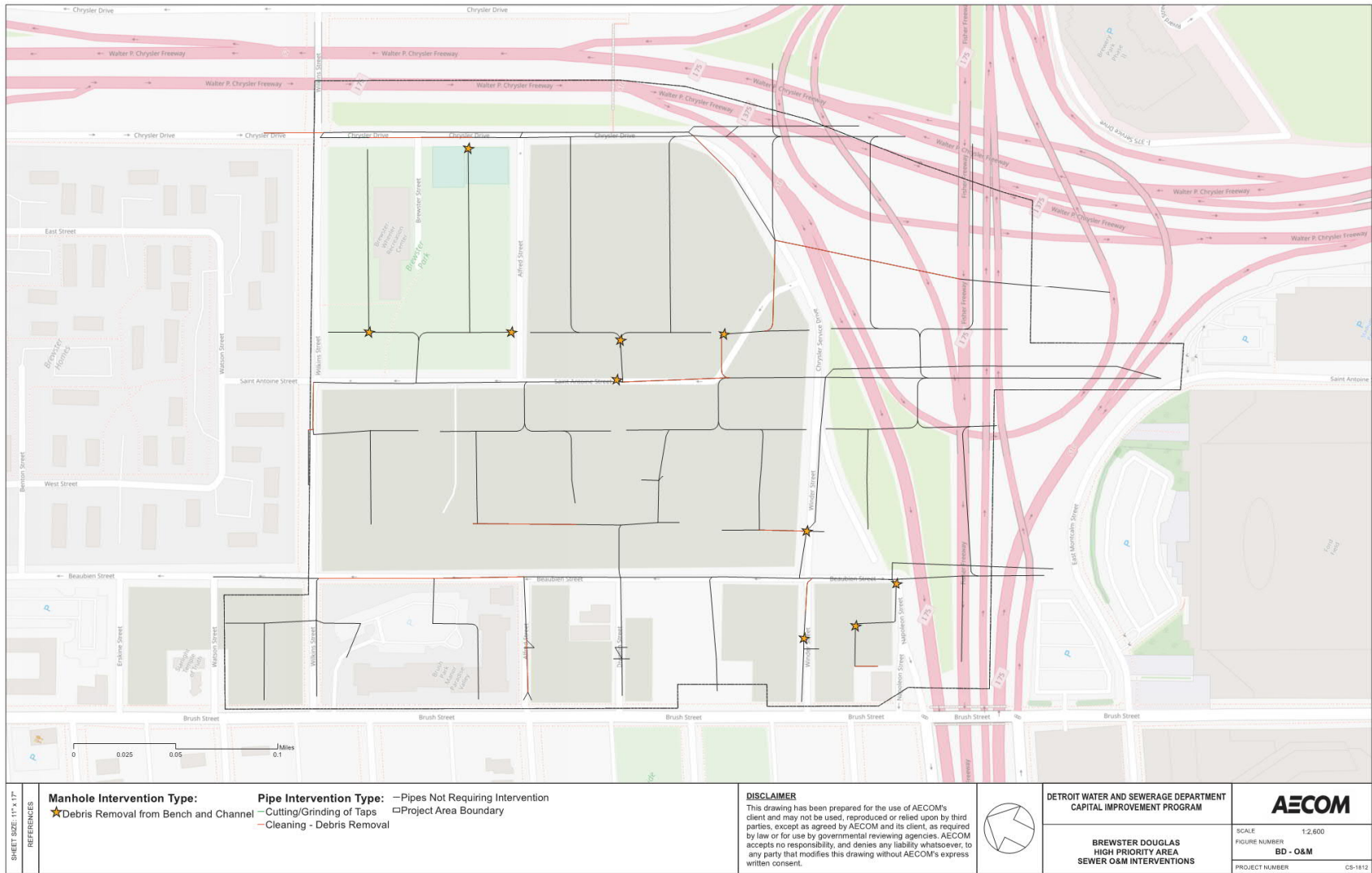


Figure 9 – Brewster – Douglas Sewer O&M Repairs

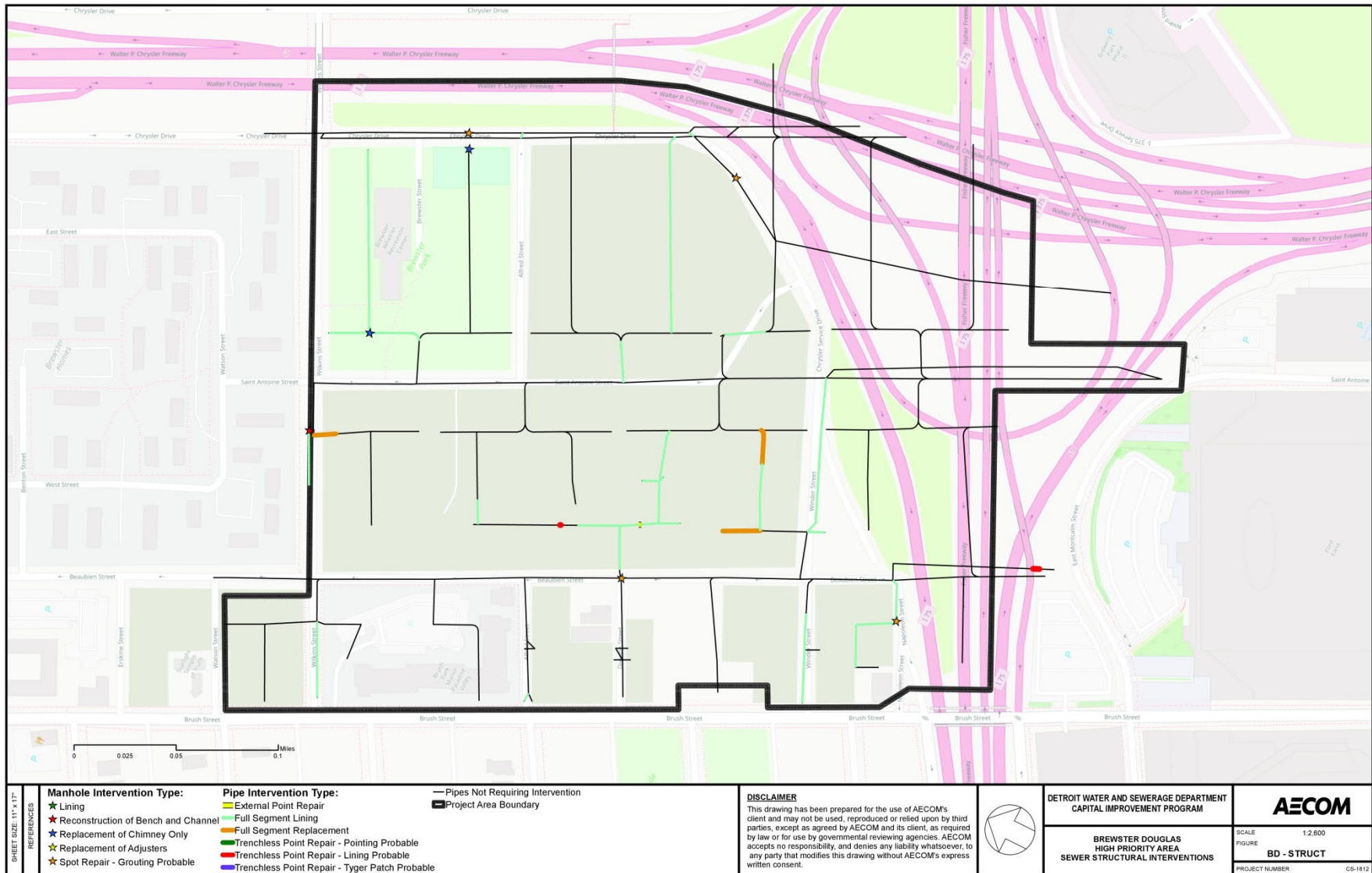
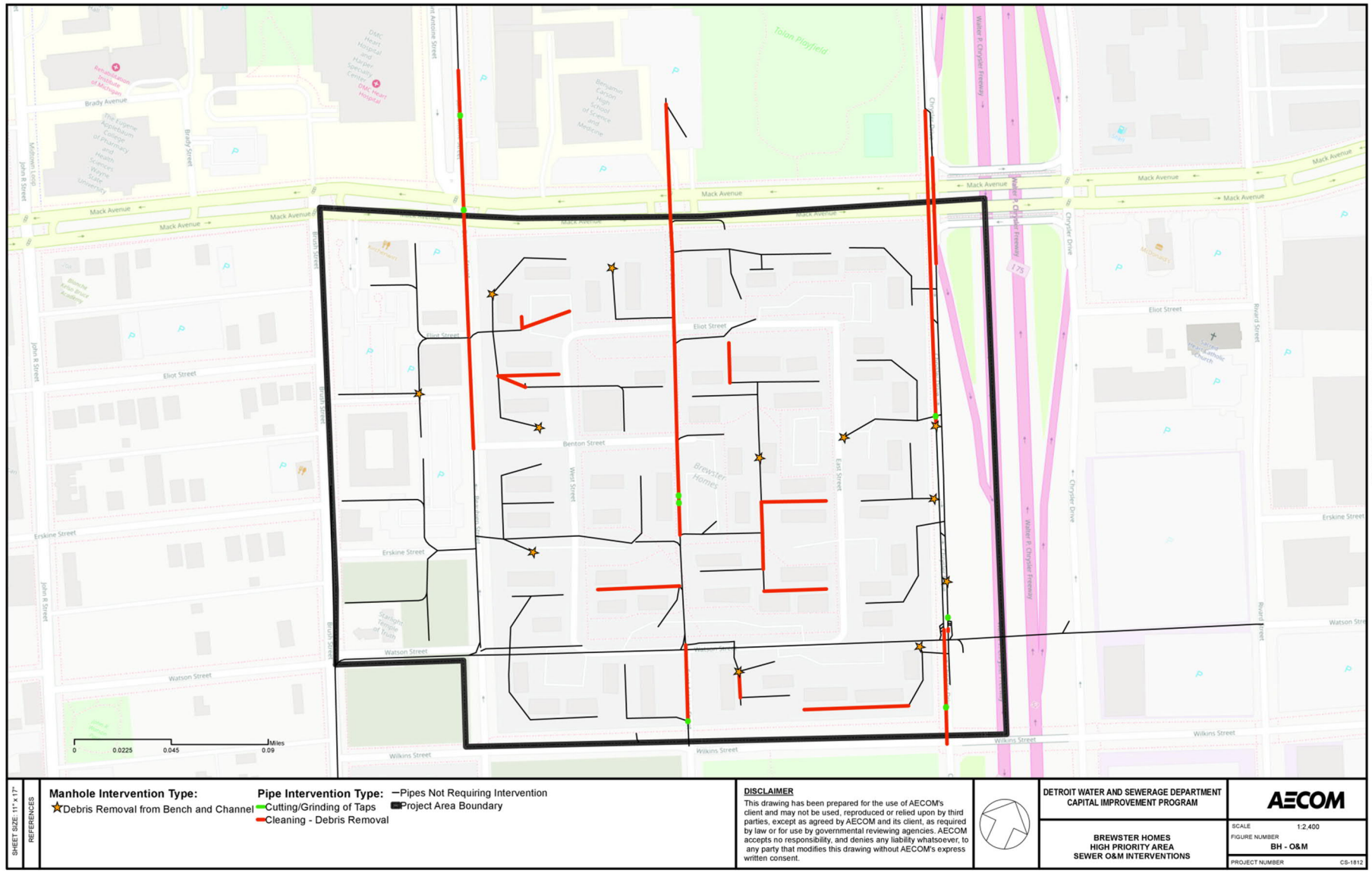


Figure 10 – Brewster – Douglas Sewer Structural Repairs



AECOM MAP NAME: Brewster_Homes_Sewer_O&M_Intervention111117

SHEET SIZE: 11" x 17" REFERENCES	Manhole Intervention Type: ★ Debris Removal from Bench and Channel	Pipe Intervention Type: — Pipes Not Requiring Intervention — Cutting/Grinding of Taps — Cleaning - Debris Removal	Project Area Boundary ■	DISCLAIMER This drawing has been prepared for the use of AECOM's client and may not be used, reproduced or relied upon by third parties, except as agreed by AECOM and its client, as required by law or for use by governmental reviewing agencies. AECOM accepts no responsibility, and denies any liability whatsoever, to any party that modifies this drawing without AECOM's express written consent.		DETROIT WATER AND SEWERAGE DEPARTMENT CAPITAL IMPROVEMENT PROGRAM	AECOM
					BREWSTER HOMES HIGH PRIORITY AREA SEWER O&M INTERVENTIONS		SCALE: 1:2,400 FIGURE NUMBER: BH - O&M
							PROJECT NUMBER: CS-1812

Figure 11 – Brewster Homes Sewer O&M Repairs



Figure 12 – Brewster Homes Sewer Structural Repairs

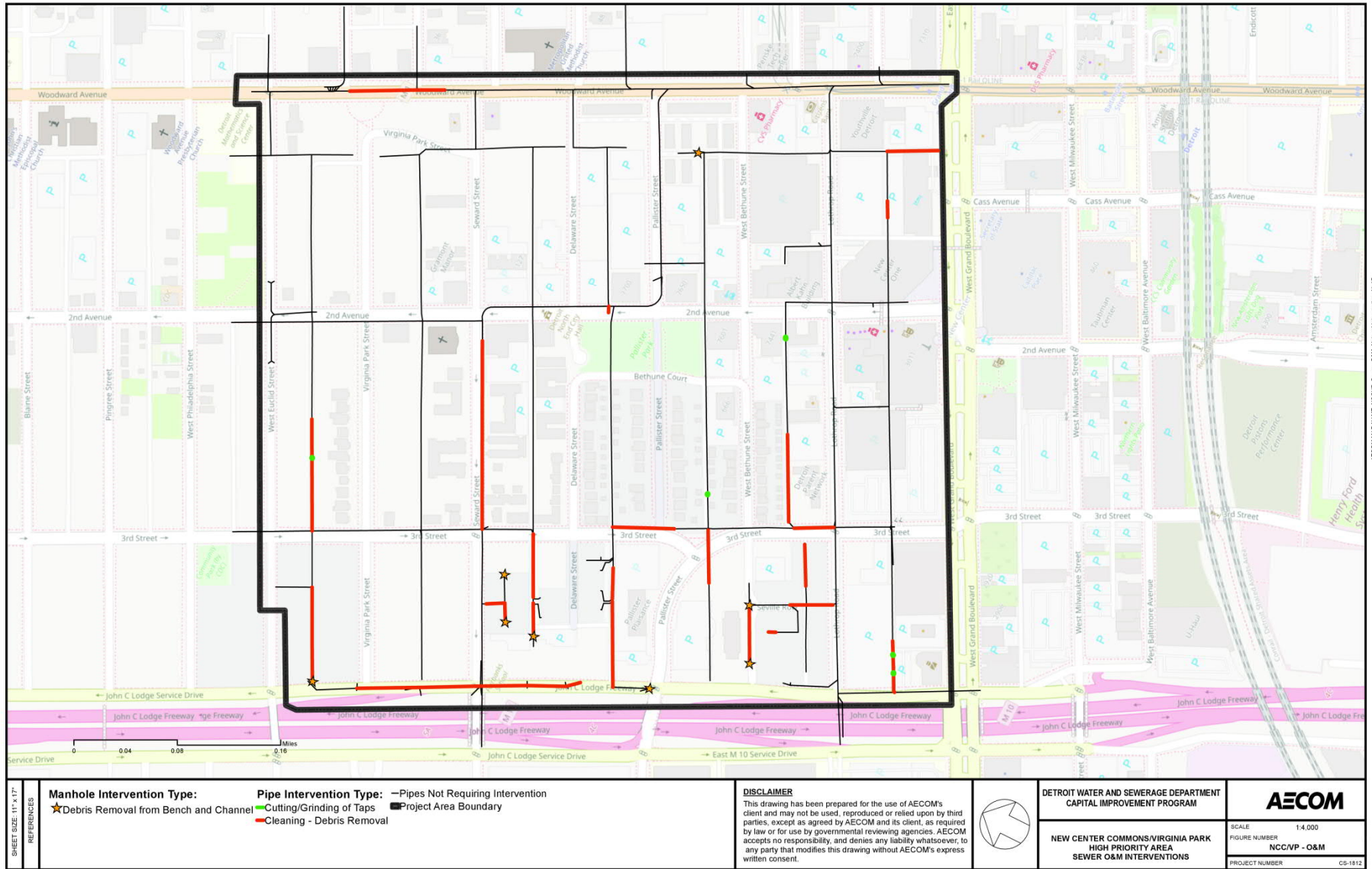


Figure 13 – New Common Center/Virginia Park Sewer O&M Repairs

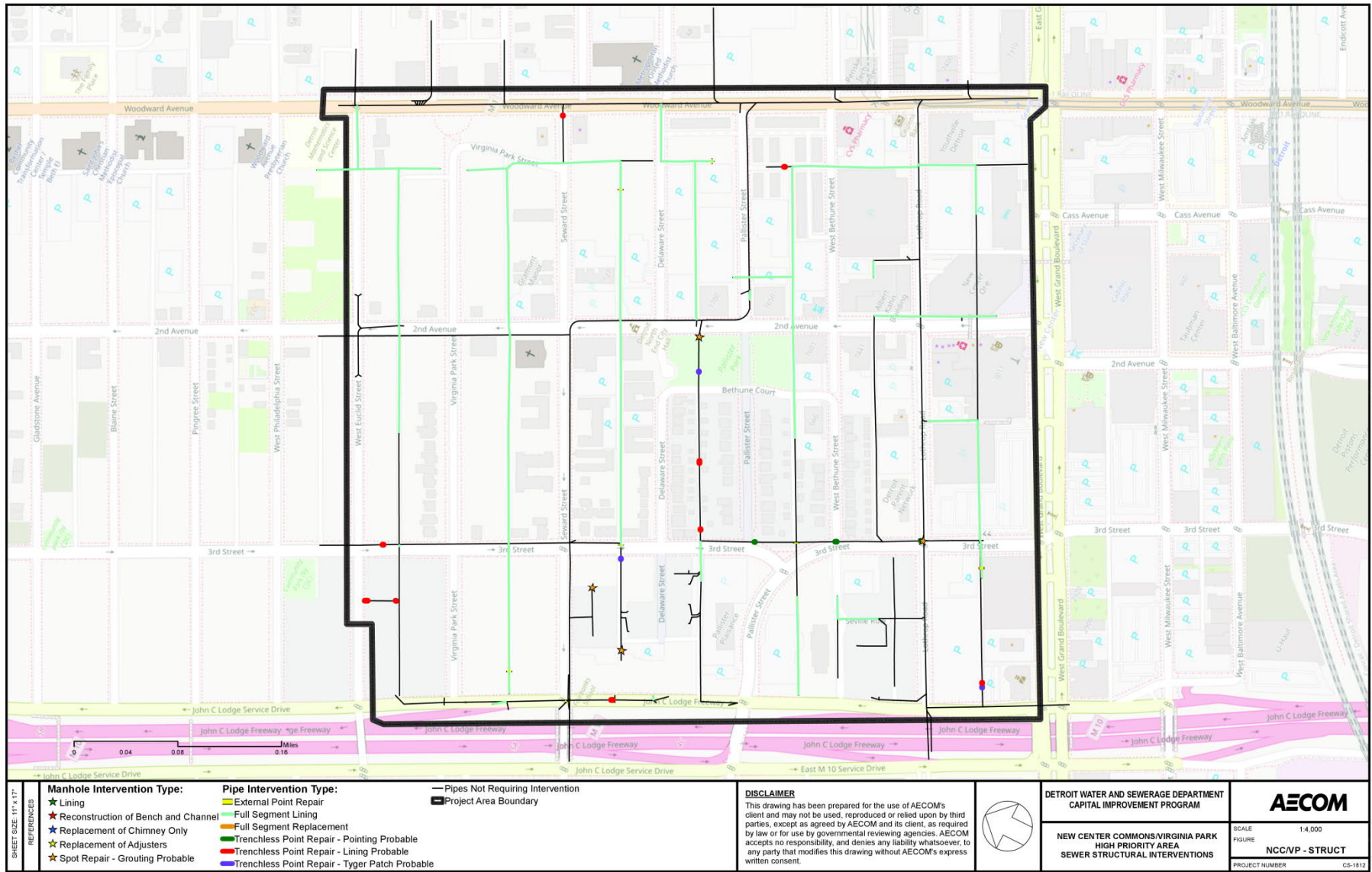


Figure 14 – New Common Center/Virginia Park Sewer Structural Repairs

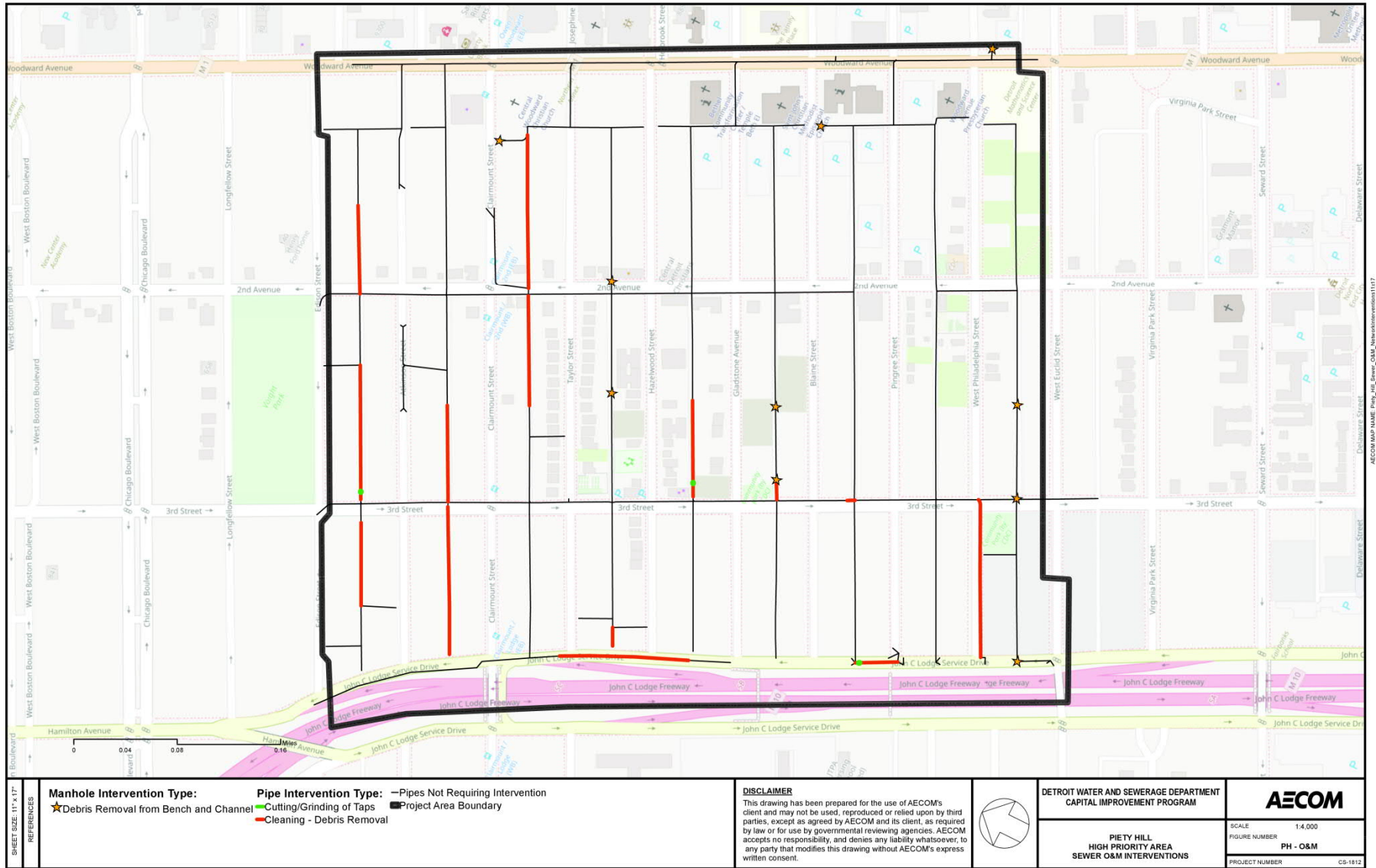


Figure 15 – Piety Hill Sewer O&M Repairs

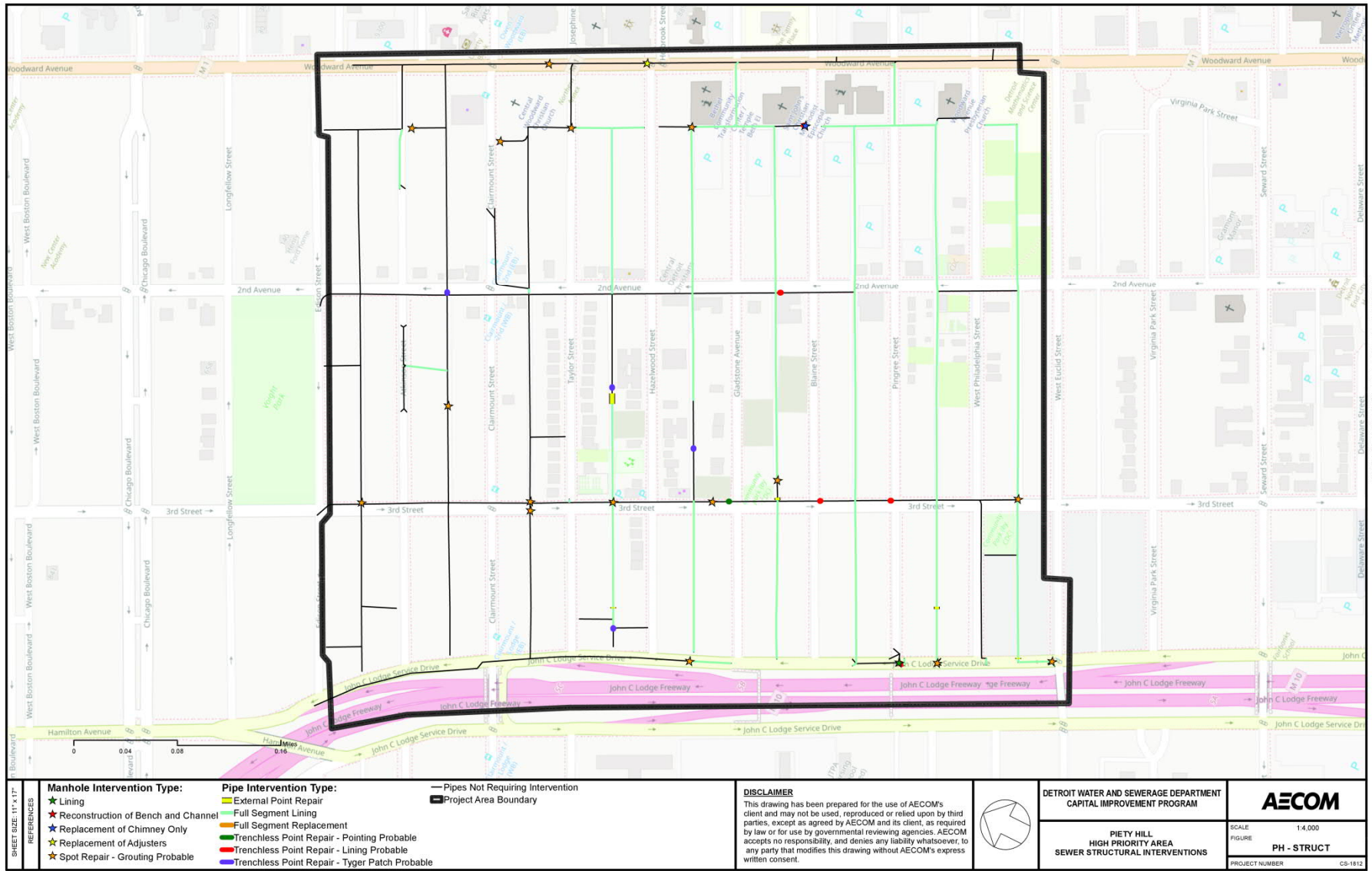


Figure 16 – Piety Hill Sewer Structural Repairs

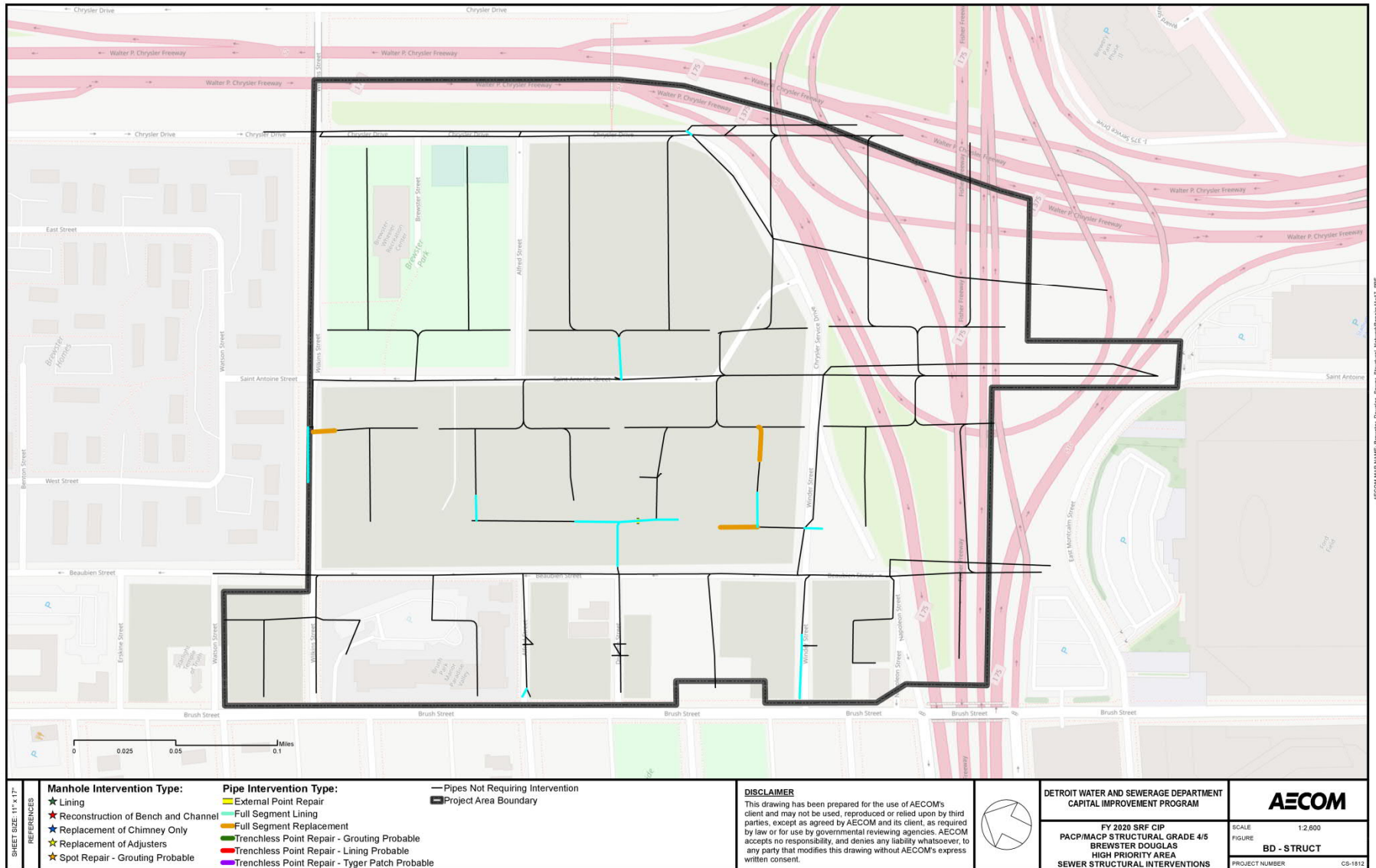


Figure 17 – Brewster – Douglas Sewer Structural Network Repairs



Figure 18 – Brewster Homes Sewer Structural Network Repairs

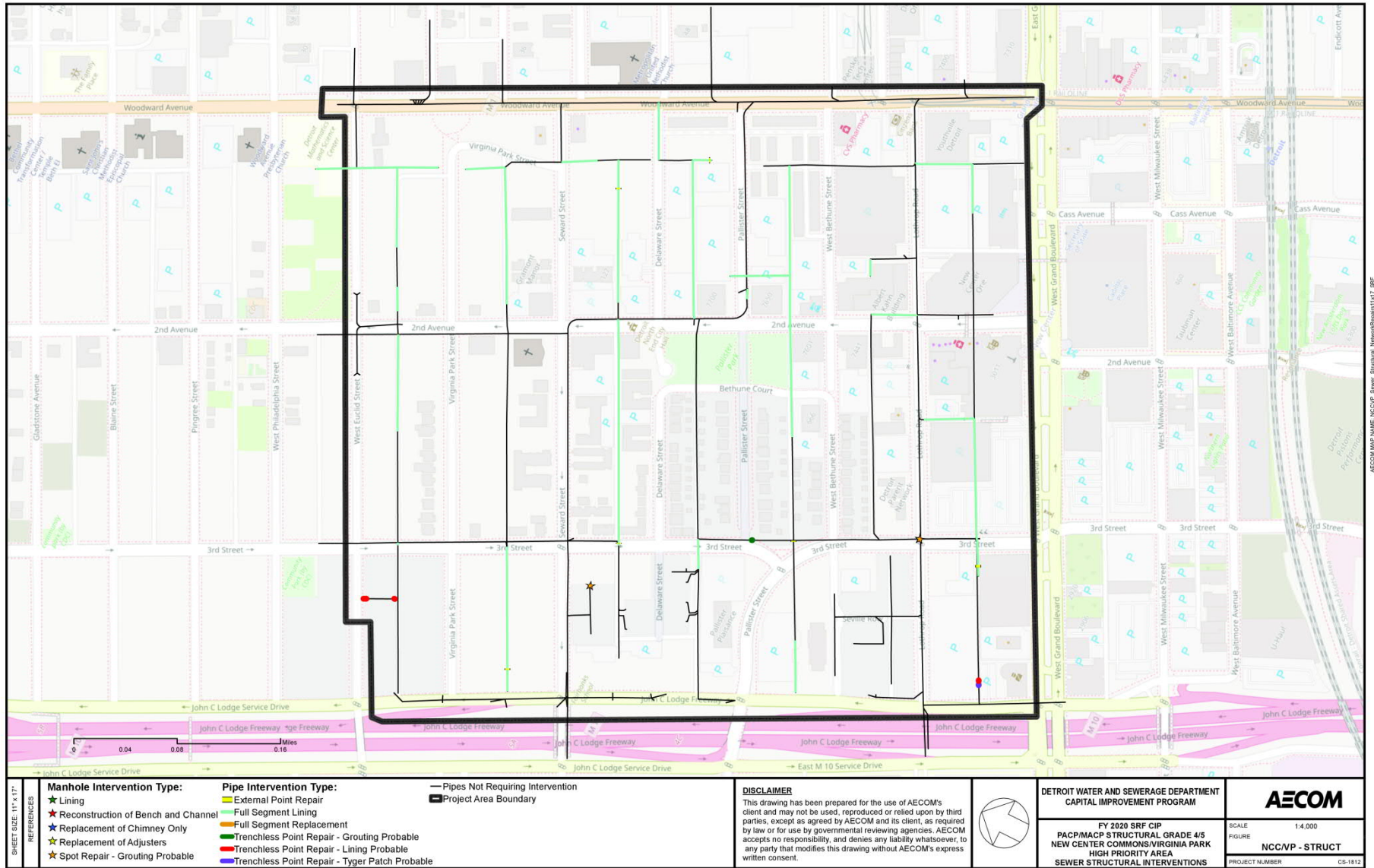


Figure 19 – New Center Commons/Virginia Park Sewer Structural Network Repairs 11x17

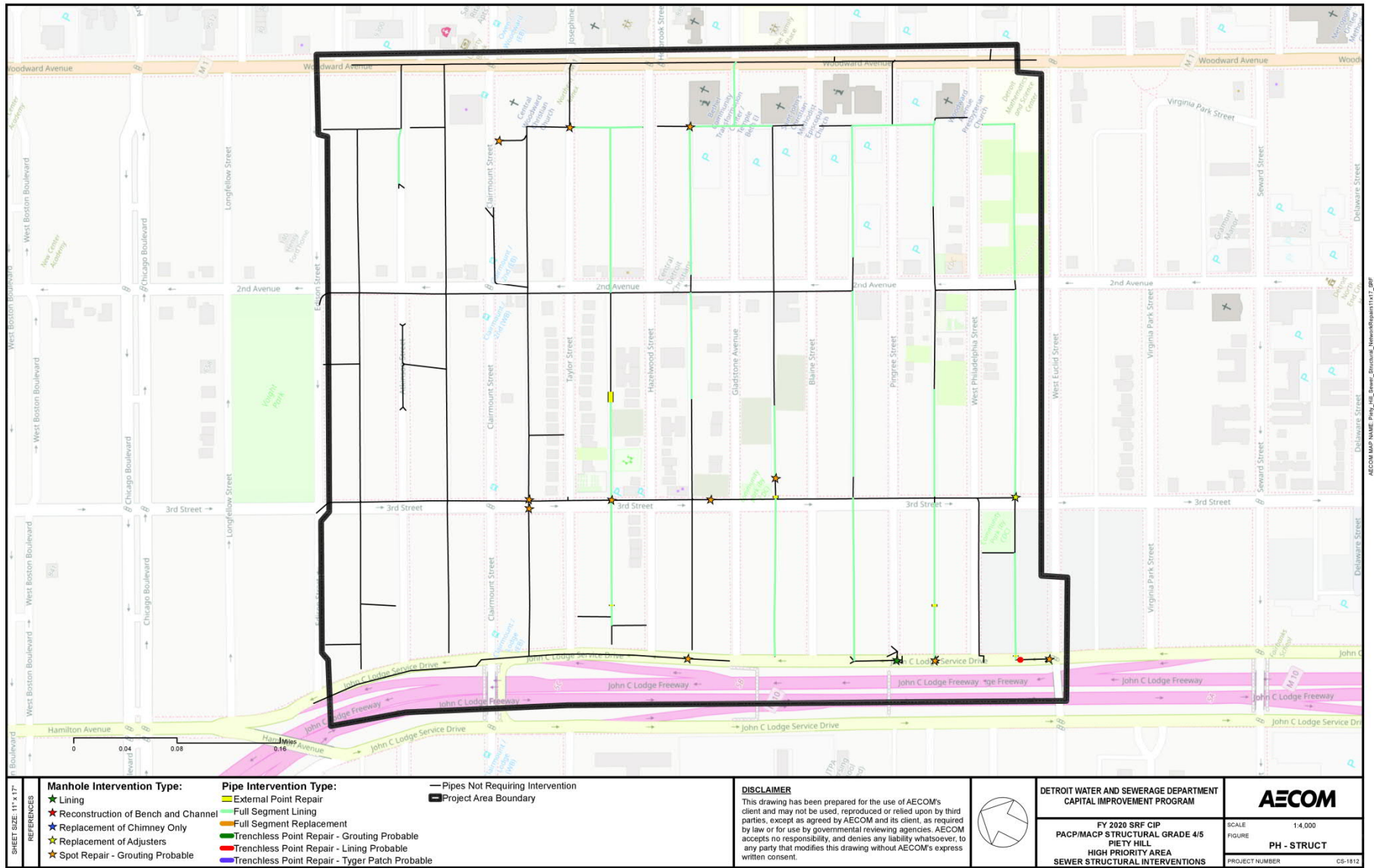


Figure 20 – Piety Hill Sewer Structural Network Repairs

Project B – Four Westside Neighborhoods

Data Interpolation – Alternative 2

The available CCTV data for the Pilot Project areas of North Rosedale Park, Cornerstone Village in addition to the Project A - Five High Priority and the Project B - Westside Four Neighborhoods indicates an average percentage of CCTV with grade 4 or 5 defects of 30%. Table 1 indicated that the actual repair length of interventions is estimated to be 59,172 LF for the Westside Four Neighborhoods.

As Table 6 below indicates, the available data also indicates that the cost per inch per foot to repair the grade 4 or 5 defects for Project A is estimated to be approximately \$10.80. This includes manhole repair costs. The average diameter of repairs was 15-inches for Project A, while for Project B based on the defects identified thus far it is 24-inches.

As the total footage is 250,000 LF in Project B and the cost per inch per foot is available based upon the analyzed data in Project A, it is possible to extrapolate estimated repairs and costs from the available data. As some upsizing of pipes is possible due to hydraulic capacity issues in the Project B area, the cost per inch per foot was rounded to \$11. Hence, for an estimated 59,172 LF of repairs with an average diameter of 24-inches, the expected repair cost is estimated to be \$15.6 MM as shown in Table 6. Adding a general 10% contingency and 20% for design/administration, the expected cost for the grade 4/5 defects is approximately \$21 MM as shown in Table 7.

Table 6 - Cost Interpolation – Loan Eligible – Project B for Alternative 2

Area	Total Televised Footage (LF)	Actual Repair Footage of Just Structural Interventions (LF)	Average Diameter of Repaired Pipes (Inches)	Cost per Inch per Foot	Cost per Foot	Estimated Repair Cost
Project A Estimate	108,053	23,125	15	\$10.8	\$164	\$3,793,388
Project B Interpolated	249,979	59,172	24	\$11.0	\$264	\$15,621,447

Table 7 - Cost Summary – Loan Eligible – Project B for Alternative 2

Intervention	Estimated Cost
Total Estimated Intervention Cost	\$15,621,447
10% Contingency	\$1,562,145
Sub-total	\$17,183,592
20% Design Contingency	\$3,436,718
Total	\$20,620,310

Loan-Eligible Portion of the Project Summary – Alternative 2

As only repairs to address defects that have a NASSCO structural rating of either Significant (Grade 4) or Most Significant (Grade 5) are eligible for loan funding, 59,172 feet of sewer collection mains ranging in size from 8-inch through 180-inch in diameter in addition to over 100 manhole repairs are expected to meet these criteria. This work includes interventions such as cured-in-place lining (CIPP), trenchless point repairs, external point repairs, full section replacements, cementitious lining of manholes but does not include any type of specialized cleaning or pointing of brick sewers. The total estimated cost of these repairs is approximately \$21,000,000 from Table 7 above. As full analysis of the infrastructure has not begun yet, maps of the proposed interventions for Project B cannot be provided in this Project Plan.

Full Project Summary – Alternative 2

As shown in Table 8, the ratio of grade 4/5 repair costs to the total cost of the project is 1.55. Applying the same ratio to the Westside Four yields a total repair cost of \$24 MM for the Westside Four. Applying the same contingency figures as before, the total expected cost of the full project is estimated to be just under \$32 MM.

From the assessments/evaluations in these neighborhoods and the ratio of grade 4/5 defects to full interventions for Project A, AECOM expects to recommend to DWSD, the rehabilitation or replacement of approximately 150,000 feet of sewer collection mains ranging in size from 8-inch through 180-inch in diameter in addition to 330 manhole repairs. This work includes interventions such as cured-in-place lining (CIPP), trenchless point repairs, external point repairs, full section replacements, pointing of brick sewers, cementitious lining of manholes and specialized cleaning. The total estimated cost of these repairs is approximately \$32,000,000 as detailed in Table 9. As full analysis of the infrastructure has not begun yet, maps of the proposed interventions cannot be provided.

Table 8 – Ratio between Grade 4/5 Costs and Full Project Costs

Area	Grade 4/5 Defect Cost	Estimated Full Project Total Cost	Ratio
Project A	\$3,793,388	\$5,866,423	1.55
Project B	\$15,621,447	\$24,158,356	1.55

Table 9 - Cost Summary – Full Project – Project B for Alternative 2

Intervention	Estimated Cost
Total Intervention Cost	\$24,158,356
10% Contingency	\$2,415,836
Sub-total	\$26,574,191
20% Design Contingency	\$5,314,838
Total	\$31,889,030

Cost Summaries – Alternative 3 – Full Replacement

As tables 4 and 5 showed earlier for Project A - Five High Priority Neighborhoods, the costs for Alternative 3 are significantly higher than those for Alternative 2. As minimal data is available for the Project B - Westside Four Neighborhoods, it can be assumed that Alternative 3 - full replacement would also be significantly higher for Project B than would Alternative 2, which utilizes trenchless methodologies for much of the recommended pipe interventions.

Monetary Evaluation of Alternative 2 and 3

A monetary evaluation of the feasible alternatives, Alternatives 2 and 3 was prepared using MDEQ guidelines for SRF Project Plans, including the present worth formulas and discount interest rate of 0.200%. Under this analysis, the useful life is assumed to be 50 years for pipelines. The salvage value of pipes at the end of the 20 or 30-year planning period was computed on the basis of a straight-line depreciation over the useful life of the item. Therefore, the salvage value of the pipes at the end of the 20 or 30-year planning period is estimated to be 60% or 40%, respectively, of the initial cost.

The present worth of salvage value was then computed by multiplying the salvage at the end of the 20 or 30 years by the conversion factor 0.9608 or 0.9418, respectively, based on the following formula:

$PW = F \times 1/(1 + i)^n$, Where:

PW = Present Worth (Salvage)

F = Future Value (Salvage)

i = Discount Interest Rate (0.200%)

n = Number of Years (20 or 30)

$1/(1 + i)^n$ = Conversion Factor

Interest during the construction period was computed using the formula:

$I = i \times 0.5 \times P \times C$

Where:

I = Interest Value

i = Discount Interest Rate (0.200%)

P = Period of Construction in Years (assumed to be two and a half years)

C = Capital Cost of the Project

For each of Alternatives 2 and 3, the total Present Worth was computed from the estimated cost (including construction, engineering, and administrative costs), salvage value, and interest during construction. This equates to the amount which would be needed at the start of the project to cover design and construction costs over the 20 or 30-year planning period if interest were to accrue at the discount rate 0.200% annually.

The Present Worth of each alternative was then converted to an Equivalent Annual Cost, which is the amount which would be paid uniformly over a 20 or 30-year period based on the Present Worth value. This amount was obtained by the using the following formula and capital recovery factor of 0.0511 or 0.0344, respectively:

$$A = PW \times [(i(1 + i)^n)/((1 + i)^n - 1)]$$

Where:

A = Equivalent Annual Cost PW = Present Worth

i = Discount Interest Rate (0.200%) n = Number of Years (20 or 30)

$[(i(1 + i)^n)/((1 + i)^n - 1)]$ = Capital Recovery Factor

The cost effective analysis and present worth determination for Alternatives 2 and 3 for Project A is presented in Table 10. From the equivalent annual cost below, Alternative 2 minimizes the impact to the users more than does Alternative 3. This analysis has not been performed for Project B as those results would yield a similar outcome with Alternative 2 being more favorable.

Table 10 – Cost Effective Analysis/Present Worth Determination – Project A Loan Eligible

	Project A Alternative 2 Rehabilitation/Limited Section Replacement for Loan Eligible Grade 4/5	Project A Alternative 3 Full Replacement for Loan Eligible Grade 4/5	Comments
Initial Cost	\$5,007,272	\$13,772,756	
O&M Costs	\$0	\$0	
Replacement Costs	\$0	\$0	
Salvage Value 20-year Anal.	\$2,186,876	\$6,015,113	50 year asset
Salvage Value 30-year Anal.	\$1,429,077	\$3,930,748	50 year asset
Interest during Construction	\$10,015	\$27,546	2 year const.
Total Present Worth	\$2,830,411	\$7,785,189	20 year analysis
Total Present Worth	\$3,588,210	\$9,869,553	30 year analysis
Equivalent Annual Cost	\$144,511	\$397,486	20 year analysis
Equivalent Annual Cost	\$123,351	\$339,282	30 year analysis

Total Cost and Loan-Eligible Cost for Project A and B, Alternative 2

From Tables 2 and 9 the combined total cost for the full project for Alternative 2 for Projects A and B is \$39,632,708.

From Tables 3 and 7 above, the combined total loan eligible cost for Alternative 2 for Projects A and B is \$25,627,583.

Alternative 2 is recommended and DWSD anticipates paying for the entire Projects A and B Alternative 2 with SRF loan for the loan eligible portion, and cash and bonds for the non-loan eligible portion.

User Cost

Repayment of the SRF loan through annual debt retirement payments will impact the residential customer rates resulting in increased user costs. The annualized equivalent costs for the loan eligible portions of Projects A and B are:

- Project A = \$144,511 (20-year); \$123,351 (30-year)
- Project B = \$595,108 (20-year); \$507,967 (30-year)
- Total Annualized Equivalent Cost for Projects A and B = \$739,619 (20-year); \$631,317 (30-year)

This impact to customer rates is generally determined by dividing the additional expenses among the users in the service area as summarized in Table 11. The annualized cost of the loan eligible portion of the project was calculated using the capital recovery factor 0.0511(20-year) or 0.0344 (30-year) following formula:

$$A = PW \times [(i(1 + i)^n)/((1 + i)^n - 1)]$$

Where:

A = Equivalent Annual Cost PW = Present Worth

i = Interest Rate through SRF Loan (2.0%)

n = Number of Years (20 or 30)

$[(i(1 + i)^n)/((1 + i)^n - 1)]$ = Capital Recovery Factor

Table 11 – Loan Eligible User Cost Impact for Alternative 2 (Sewer Rehabilitation/Limited Replacement)

Projects A and B

Item	Sewer Rehabilitation/Limited Replacement	
	20-year Analysis	30-year Analysis
Total Cost of Projects A and B	\$25,628,000	\$25,628,000
Annualized Cost of Projects A and B (Assuming SRF interest rate 2.0%)	\$739,619	\$631,317
Number of User Accounts (households) in City of	178,791	178,791
Average Sewage Disposal Based upon Water Consumption per Household (industry average)	7,333 gallons/month (approx. 980 ft ³ /month)	7,333 gallons/month (approx. 980 ft ³ /month)
Current DWSD Sewage Disposal Rate	\$54.84 per 1,000 ft ³	\$54.84 per 1,000 ft ³
Current Estimated Monthly DWSD Sewage	\$53.74	\$53.74
Current Estimated Annual DWSD Sewage Disposal Rate per Household	\$644.92	\$644.92
Estimated Increase in Cost per Household (Year 1)	\$4.14	\$3.53
Proposed Estimated Annual DWSD Sewage Disposal Rate per Household (Year 1)	\$649.06	\$648.45
Proposed Percent Increase in Cost per Household per Year	0.64%	0.55%

Non-Monetary Evaluation of Alternative 2 and 3

The end result of constructing either Alternative 2 or 3 will provide the end user the same level of service. Constructing Alternative 2, rehabilitation/limited replacement, can achieve that level of service more efficiently and with the least disruption to the user, natural or cultural features and the environment by the extensive use of trenchless technologies for a majority of the piping work. Rehabilitating manholes will also be less disruptive as opposed to excavations required for replacement. By use of trenchless technologies, restoration of the visible landscape is also minimized. It is also anticipated that Alternative 2 can be constructed in a shorter time period than Alternative 3.

Disadvantaged Community Status

The SRF program includes provisions for qualifying the applicant community as a disadvantaged community. The benefits for communities with a population of 10,000 or more that qualify for the disadvantaged community status consist of:

- Award of 30 additional priority points.
- Possible extension of the loan term to 30 years or the useful life of the components funded, whichever is earlier. The estimated useful life of the sewer rehabilitation/limited replacement is 50 years. DWSD is aware that the SRF program offers both 20 and 30 year loan terms and will evaluate which term is the most appropriate for DWSD and its customers.

MDEQ requires submittal of a Disadvantaged Community Status Determination Worksheet to determine if the community qualifies for this status. A completed worksheet will be included in the final plan.

Item 7 – Environmental Preview/ Review

The environmental setting for the proposed project is within the city limits and will be done in local urban neighborhoods. There is minimal environmental impact as the majority of work will occur within the public right-of-way, where multiple utilities and infrastructure already exists. This work includes interventions such as cured-in-place lining (CIPP), trenchless point repairs, external point repairs, full section replacements, pointing of brick sewers, and cementitious lining of manholes and specialized cleaning. Trenchless technologies will be used extensively on a majority of this project. The proposed project will not detrimentally affect the water quality of the area, air quality, wetlands, endangered species, wild and scenic rivers or unique agricultural lands.

The anticipated environmental impacts resulting from implementing the recommendations of this Project Plan include beneficial and adverse; short and long-term; and irreversible and irretrievable. The following is a brief discussion of the anticipated environmental impacts of the selected alternative.

Beneficial and Adverse

The proposed improvements will significantly improve DWSD's capability to operate a reliable sewer collection system, reducing sewer backups into homes, avoiding catastrophic sinkholes from sewer collapses and increase efficiency at Detroit WRRF. Implementation of the improvements will also generate construction-related jobs, and local contractors will have an opportunity to bid contract work. The majority of the work to be constructed with this project will be performed by use of trenchless technologies; minimizing disruption to the existing natural and cultural features, and to the end users.

Noise and dust will be generated during construction of the proposed improvements. The contractor will be required to implement efforts to minimize noise, dust and related temporary construction byproducts. Street congestion and disruption of vehicular movement may occur for short periods of time on the roads where work is actively being done. For work resulting in the need to have open trenches, and spoils from open trenches will be subject to erosion; the contractor will thereby be required to implement a Soil Erosion and Sedimentation Control (SESC) Program as described and regulated under Michigan's Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act (NREPA). Underground utility service inside the project area may be interrupted occasionally for short periods of time. The aesthetics of the area will be temporarily affected until restoration is complete.

Short and Long Term

The short-term adverse impacts associated with construction activities will be minimal, and will be mitigated, in comparison to the resulting long-term beneficial impacts. Short-term impacts include traffic disruption, dust, noise and site aesthetics. No adverse long-term impacts are anticipated.

Irreversible and Irretrievable

The impact of the proposed project on irreversible and irretrievable commitment of resources includes materials utilized during construction and fossil fuels utilized to implement project construction.

Item 8 – Other Impacts or Concerns

Direct Impacts

Construction of the proposed project is not expected to have an adverse effect on historical, archaeological, geographic or cultural areas, as the construction activities will occur underground and will require minimal disturbance of the project area soils due to much of the work being performed by use of trenchless technologies. The proposed project will not detrimentally affect the water quality of the area, air quality, wetlands, endangered species, wild and scenic rivers or unique agricultural lands. The construction activities associated with this project will not permanently impact the visible landscape.

User Rates

As discussed in Item 6 above, the impact of financing the Projects A and B, Alternative 2 through the SRF loan program is expected to increase by no more than 0.64% the cost of sewer disposal to a typical City of Detroit customer due to the impact of construction cost. However, the actual rate determination will be based on factors that encompass the delivery of comprehensive services by DWSD to its customers. The increase is based on repayment of the SRF loan over a 20-year period.

Indirect Impacts

It is not anticipated that DWSD's proposed improvements to the sewer collection system will alter the ongoing pattern of growth and development in the study area as these neighborhoods are fully developed. Growth patterns in the service area are subject to local use and zoning plans, thus providing further opportunity to minimize indirect impacts.

Cumulative Impacts

Improved reliability, efficiency and the ability to safely convey storm water and sanitary flows to the WRRF are the primary cumulative beneficial impacts anticipated from the implementation of the proposed project.

Item 9 – Mitigation

Where adverse impacts cannot be avoided, mitigation methods will be implemented. Mitigating measures for the projects such as soil erosion control, if required, will be utilized as necessary and in accordance with applicable laws. Details will be further specified in the construction contract documents used for the project.

Mitigation of Short Term Impacts

Short-term impacts due to construction activities such as noise, dust and minor traffic disruption cannot be avoided. However, efforts will be made to minimize the adverse impacts by use of thorough design and well planned construction sequencing. Noise from equipment cannot be avoided, but hours of work can be controlled. Dust and soil deposits on the streets can be controlled through watering and construction area sweeping. Construction area footprints will be minimized, and traffic control measures can be utilized. Site restoration will minimize the adverse impacts of construction, and adherence to the Soil Erosion and Sedimentation Act will minimize the impacts due to disturbance of the soil structure, if such disturbance is found to be necessary. Specific techniques will be specified in the construction contract documents.

Mitigation of Long Term Impacts

Adverse long term impacts due to the proposed project are not anticipated. The aesthetic impacts of construction within the boundaries of the project area will be mitigated by site restoration.

Mitigation of Indirect Impacts

In general, it is not anticipated that mitigative measures to address indirect impacts will be necessary for the recommended improvements addressed in this Project Plan. The proposed improvements are located within the project area so they do not promote growth in areas not currently served by DWSD. Therefore, indirect impacts are not likely to be a concern for these improvements.

Item 10 – Public Involvement

The project team has pursued contact with the neighborhoods in the Project A and B areas during the initial planning and condition assessment phases leading up to the project plan development. Several of the techniques that have been progressively incorporated include: door-to-door outreach; door hangers; movable lawn signs while condition assessment work was being performed; informational meeting with neighborhood association presidents; information provided to the City's Department of Neighborhoods, Detroit Economic Growth Corporation District Liaisons and Detroit City Council. A key, required component of this public involvement will be a public hearing outlined in the following sections. Notice for the public hearing will be advertised in local publications and will be posted electronically on various websites, social media and through email.

Public Hearing Advertisement and Notice

A notice will be published no less than 30 days in advance to alert parties interested in this Project Plan and request input at a public hearing prior to its adoption. In addition, a direct mail notification of the notice will be sent to the potentially interested local and federal agencies. This direct mail notice includes an invitation to comment.

Public Hearing Transcript

A formal public hearing on the draft Project Plan will be held before the DWSD Board of Water Commissioners at 1:00 PM on June 5, 2019. The hearing will include a presentation on the project, as well as an opportunity for public comment. The hearing transcript will be provided with the submission, along with a list of attendees.

Public Hearing Comments Received and Answered

Comments from the public during the Public Hearing will be addressed and answered by the project team.

Adoption of the Project Plan

Upon approval and certification of resolution by the DWSD Board of Water Commissioners, the GLWA Board of Water Commissioners will certify a resolution at its regular monthly meeting in June 2019, authorizing GLWA to proceed with official filing of the Project Plan for purposes of securing low interest loan assistance under the SRF Program. Executed copies of both Boards of Water Commissioners' Resolutions and certifications for the Project Plan will be provided with the submission.