CITY of HARRISONBURG

Sanitary Sewer

Management Plan (SSMP)

FY2024

April 25, 2025

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I. INTRODUCTION

Harrisonburg's Sanitary Sewer Collection System (SSCS) assets are managed by either the Harrisonburg Public Utilities Department (HPU) or the Harrisonburg Rockingham Regional Sewer Authority (HRRSA). As shown in the caption below, the Current Asset Replacement Value (CARV) directly managed by HPU approached $324.3M in FY2024 and comprised mostly of interceptor and collection pipe networks. HPU manages all customer accounts. HRRSA, in contrast, managed $300M+ in CARV assets that were comprised of interceptor pipe networks and a 22.0 MGD Enhanced Biological Nutrient Removal (ENR) treatment facility. HRRSA publishes an Annual Report of Operations that is a companion document.

Sanitary Sewer Management Plan Update

SANITARY SEWER SYSTEM ASSETS

C/O HPU	**$324.3M CARV** **210 miles pipe; 5,004 manholes, 6 pump stations** ***Sanitary Sewer Management Plan*** ***City Code of Ordinances Title 7, Chapter 3***
C/O HRRSA	**$300M+ CARV;** **53% Treatment / 7% to 93% interceptors** ***HRRSA Annual Report of Operations*** **4 of 8 person HRRSA Board - *Members Service Contract***

II. MISSION AND CUSTOMER VALUE

HPU is guided by a mission to meet mandates and expectations while delivering customer value in service, stewardship, and finances. As shown in Figure 1, HPU's biggest challenge is raising capital for the commitment to environmental and economic stewardship in the more specific agenda to replace aging assets and to abate infiltration & inflow (I&I).

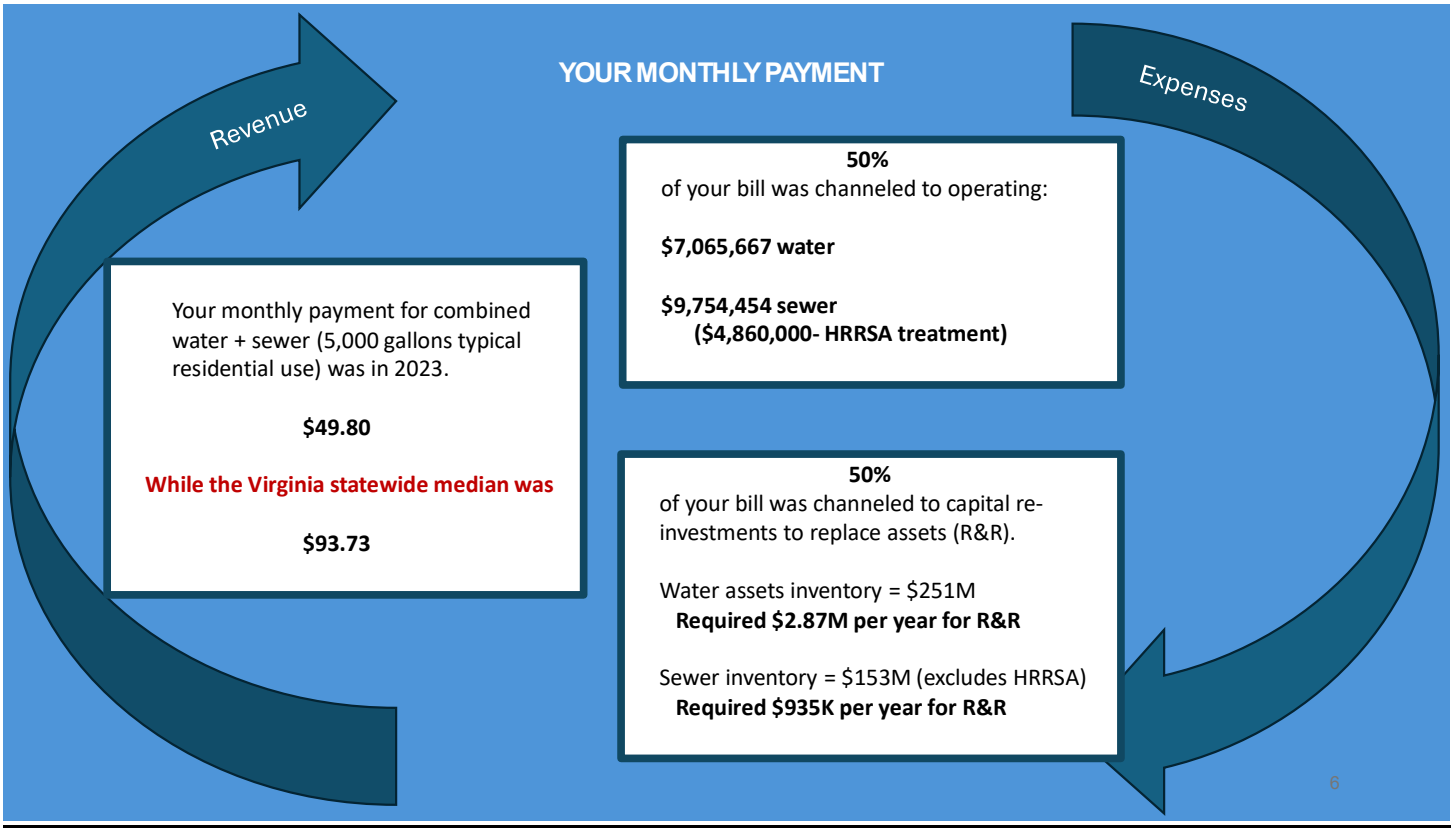


Figure 1

III. SERVICE, STEWARDSHIP AND FINANCES

The strategic roadmap underlying the SSMP is a decision process that balances customer service, environmental and economic stewardship, and financial management in making decisions and in undertaking actions, see Figure 2.

Four failure modes can give foundation to benchmarking service, stewardship, and financial management. The modes of failure are capacity, performance, mortality, and obsolescence.

1) Capacity: Capacity is a failure mode that benchmarks hydraulic induced sewer overflows that are evaluated in terms of probable frequency of occurrence. The goal for any location of overflow in the Harrisonburg SSCS is less than one event every ten years.
2) Performance: The functionality performance failure mode is termed as "System Integrity"; it provides a benchmark for uninterrupted service to the customer. The nationwide average fluctuates significantly so HPU strives for continuous improvement. The MTBF goal for each pipe asset in the Harrisonburg Sewer System is one backup at no more than once every ten years.

3) Mortality: Developing a comprehensive rehab and replacement (R&R) schedule is an analysis in determining RUL for the collection of system assets. Current practices at HPU have used the MASL to forecast long term financial funding requirements through the Capital Improvement Program (CIP). HPU is continuously moving deeper into RISK management (condition assessment and criticality analysis) to applying asset management principles to routine decisions for rehabbing or replacing an asset.
4) Obsolescence: Obsolescence is a failure mode that identifies materials that do not support goals of the SSMP.

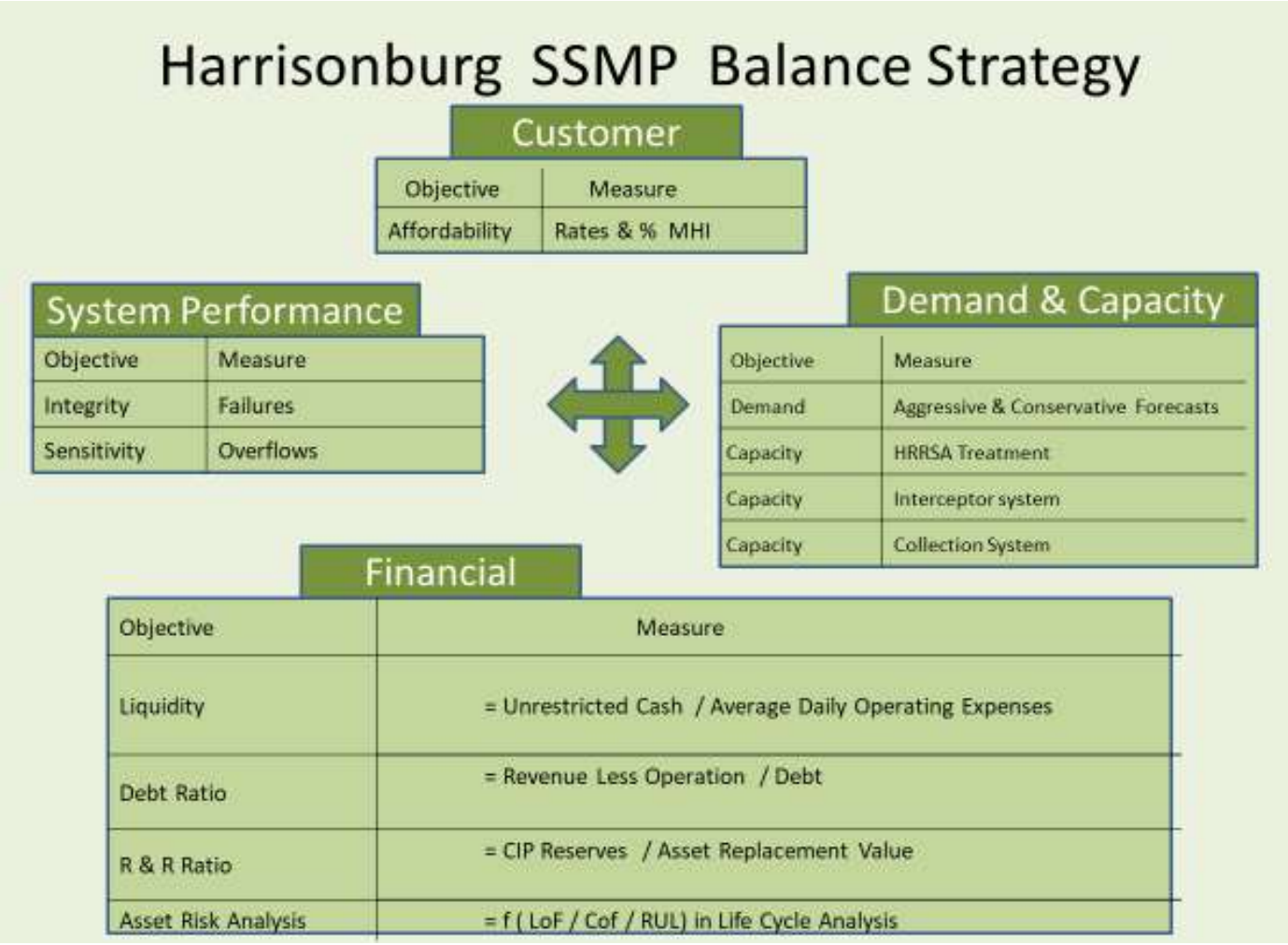


Figure 2

IV. EXECUTIVE SUMMARY SCORECARD:

The following is an executive scorecard summary. The summary provides high level explanation of each objective and provides a similar explanation of HPU status for each

objective as applicable at the end of FY2024. Eleven (11) key objectives of the SSMP are summarized below. Sections of the SSMP which follow provide deeper detail to these objectives.

Annual Update

SSMP Objective #1	Status - FY 2024
Objective #1 requires HPU to monitor and update the SSMP annually.	**Objective #1 has been met for FY2024 with publication of April 2025, edition of the SSMP.**

Capacity Mode: Sales and Treatment Volumes

SSMP Objective #2	Status - FY 2024
Objective #2 requires HPU to monitor and forecast sales of sewer commodity in terms of AAD flows.	**Objective #2 analysis: At 12.8 MGD capacity at HRRSA, Harrisonburg has ample allocation to accommodate its current and future sewer sales.**

Capacity Mode: HRRSA Treatment Capacity

SSMP Objective #3	Status - FY 2024
Objective #3 requires HPU to monitor and forecast the M3CM in terms of AAD flows versus allocated treatment capacity at HRRSA.	**Objective #3 analysis: Considering the effect of I&I upon forecasted future sales, treatment requirements would exceed allocated treatment capacity in 3 of the 11 annual periods that were studied. Prior to FY2024, Harrisonburg did not exceed hydraulic capacity, however; we have undesirably leveraged available unused hydraulic capacity to accommodate I&I. Therefore, I&I reduction is an SSMP goal that must keep pace with sales growth such to make available the leveraged capacity.**

Capacity Mode: HRRSA Interceptor Capacities

SSMP Objective #4	Status - FY 2024
Objective #4 requires HPU to be consistent with the HRRSA planning agenda for its interceptor capacities.	**Objective #4 Analysis: Maintaining compatibility with the future ILOS for the HRRSA interceptors will engage Harrisonburg into shared capital funding and into coordinating demand through planned land development and/or through I&I abatement.**

Capacity Mode: City Interceptor Capacities

SSMP Objective #5	Status - FY 2024
Objective #5 of this SSMP requires an update to the 1989 Black's Run Interceptor Study in ILOS format and to then replace the original CIP strategy to match the recommendations from the updated study.	**Objective #5 Analysis: In 2021 HPU adopted the 10-year storm ILOS which showed one that current flows caused (1) manhole overflow in the North Interceptor and seven (7) manhole overflows in the East Interceptor; remediation by $1.5M in CIP improvements are now included in the HPU Sewer CIP Program. The study will be repeated (in progress) adding forecasted future sales. Results from the analysis of future conditions will guide future CIP and I&I agenda.**

Performance Mode: Collection Integrity

SSMP Objective #6	Status - FY 2024
Objective #6 requires continuous monitoring of system integrity and MTBF sensitivity and to use these benchmarks as drivers for asset management.	**Objective #6 Analysis: HPU benchmark average is 11 public interruptions per 100 miles of pipe; the nationwide average fluctuates significantly thus making comparison irrelevant so we strive for continuous improvement.**

Mortality Mode: RUL by MASL and RISK

SSMP Objective #7	Status - FY 2024
Objective #7 of this SSMP requires HPU to forecast the retirement date and value of its asset inventory.	Objective #7 Annual cost of sustainable operation (ACSO): HPU sewer rates must generate $1.7M annually for asset retirement each year over the next twenty-five years.

Failure Mode: Obsolescence

SSMP Objective #8	Status - FY 2024
Objective #8 requires HPU to maintain a pipe inventory for material types with a concern for obsolescent pipe types.	Objective #8 Analysis: HPU maintains a pipe inventory for material types with inventory divided equally among clay, concrete, and PVC materials.

Long Term Financial Model – Rates & Revenue

SSMP Objective #9	Status - FY 2024
Objective #9 requires HPU to manage a Long-Term Financial Model (LTFM) to identify funding and expenses that are necessary to meet sanitary sewer asset management goals.	Objective #9 Analysis: The HPU-Econics Long Term Financial Model for FY2024 Sewer Budget suggested a rate increase of 1.00% per year through 2023-2024, 2.75% per year 2025-2029 and then 1.70% per year 2030-2038. (More recent updates may have been completed and posted on the City web site)

Asset Management Implementation at HPU

SSMP Objective #10	Status - FY 2024
Objective #10 requires the development and implementation of an individual Asset Management Plan (AMP) for sewer pipes and manholes to guide the use of all identified drivers in making asset management decisions.	**Objective #10 Analysis: In FY2024 the following asset management activities were completed in coordination with defined asset management plans for sewer pipes and manholes: <u>See section XII for HPU activities.</u>**

Financial Overview

SSMP Objective #11	Status - FY 2024
Objective #11 requires monitoring selected sewer enterprise fund financial benchmarks.	**Objective #11 Analysis FY2024:** • **In Fy2022 HPU's sewer cash revenue collections approached nearly 119% of budgeted revenue.** • **HPU's sewer cash expenses were managed at 89% of budgeted allocations.** • **HPU's customer residential monthly bills for water plus sewer at $48.80 per month was at 56% of the statewide survey benchmark for 5,000 gallons.**

V. <u>Stewardship-Capacity Mode: AAD Sales and Treatment Capacity</u>

Objective #2 requires HPU to monitor and forecast sales of sewer commodity in terms of AAD flows.

Historic Analysis of Sales

Shown in **Figure 3** are sewer sales by the Harrisonburg Department of Billing. Average annual growth rates for the most recent periods of 20-years, 10-years, 5-years, and 1-year were +26.0%, +21.0%, +15.0% and +5.0%, respectively.

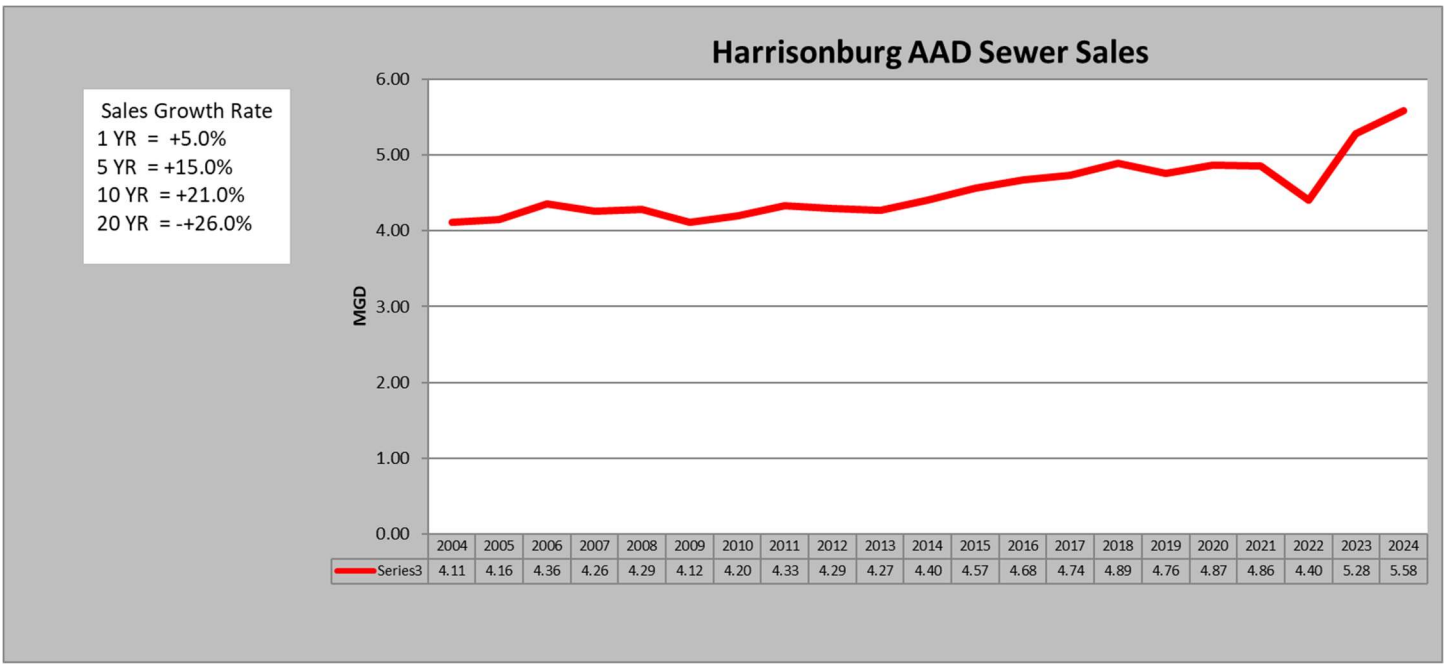


Figure 3

Forecast Analysis of Sales

A team of Harrisonburg City Departments have optimized the methodology and enhanced the use of GIS capabilities to better evaluate existing city water demands. (Note that water sales were analyzed and are presumed to have generated 10%-20% higher estimates as compared to sewer sales. This is an acceptable level of safety for this analysis.) Using most recent sales and land use data from FY2020, the City departments of Economic Development, Community Development, IT & GIS, City Manager and Public Utilities have determined the existing consumption per acre rates for all zoning types in the City.

The team then applied the consumption per acre rates to respective vacant lands to forecast future internal City water sales. The forecast suggested an additional 3.119 MGD in growth for desired future land uses as shown below:

Developed Lands, Existing Land Use *includes lawn and irrigation meter use*	Consumption per acre	Consumption per unit (million gal/day)	Total Consumption
COMMERCIAL - LODGING	0.001975	0.002580	0.126
COMMERCIAL - OFFICE	0.000286	0.000183	0.060
COMMERCIAL - RETAIL SERVICE	0.000400	0.000430	0.406
GOLF COURSES	0.000014	0.000521	0.005
INDUSTRIAL	0.002184	0.006506	1.243
INSTITUTIONAL	0.000462	0.000213	0.116
MIXED USE	0.003207	0.000116	0.052
PARKS AND RECREATION	0.000036	0.000543	0.015
PUBLIC FACILITIES	0.000066	0.000227	0.019
RESIDENTIAL - MULTI-FAMILY	0.001259	0.000116	0.786
RESIDENTIAL - SINGLE FAMILY ATTACHED	0.000577	0.000099	0.257
RESIDENTIAL - SINGLE FAMILY DETACHED	0.000224	0.000111	0.415
RESIDENTIAL SINGLE FAMILY GREATER THAN 2 ACRES	0.000013	0.000119	0.002
ROW	0.000000	#DIV/0!	0.000
SCHOOLS, COLLEGES, AND UNIVERSITIES	0.000855	0.004086	0.874
VACANT	0.000030	0.000096	0.001
BASELINE TOTAL			**4.377**

Vacant Lands, Land Use Guide	*gal/day per unit*	*Number of units per ac*	*Multiplier value (mgd/ac)*	*Apply to ac from LUG*	*Growth Factor*	*Projected Use (mgd)*
Conservation, Recreation, Open Space	-	-	0.000041	15.9	-	0.001
Low density residential	-	-	0.000350	143.7	-	0.050
Low density mixed residential	104	10	0.000001	618.2	-	0.643
Neighborhood residential	-	-	0.000420	60.6	-	0.025
Medium Density Residential	114	15	0.000001	77.0	-	0.132
Medium Density Mixed residential	114	20	0.000001	151.4	-	0.345
High density Residential	118	24	0.000001	5.7	-	0.016
Mixed Use	-	-	0.001418	317.0	-	0.449
Limited Commercial	-	-	0.000513	42.9	-	0.022
Commercial	-	-	0.000513	208.1	-	0.107
General Industrial	-	-	0.002102	567.6	-	1.193
Governmental/Quasi-Governmental	-	-	0.000798	140.3	1.2	0.134
Institutional	-	-	0.000546	2.0	1.2	0.001
USE BY FUTURE LAND USE GUIDE MULTIPLIERS TOTAL						**3.119**

Sales Versus Treatment

Harrisonburg treats its sewer as a member at HRRSA. The contract service agreement between HRRSA and its five members (Bridgewater, Dayton, Harrisonburg, Mount Crawford, and Rockingham County) directly defines member allocation by hydraulic capacity in million gallons per day (MGD). The HRRSA facility is rated at 22.0 MGD with Harrisonburg's allocation at 12.8 MGD (58%).

An initial analysis was to compare current and future sewer sales against allocated capacity at HRRSA. Preliminary discussions suggested a future expansion at HRRSA may increase its total capacity to 28.0 MGD; Harrisonburg would have opportunity to purchase additional capacity to 16.2 MGD (58%).

	FLOW	CAPACITY MGD
Existing Sewer Sales	5.6 MGD	
Future Sewer Sales	3.1 MGD	
Max Sewer Sales	8.7 MGD	12.8 MGD
		16.2 MGD

Objective #2 analysis: At 12.8 MGD capacity at HRRSA, Harrisonburg has ample allocation to accommodate its current 5.6 MGD sales plus its forecasted future sewer sales at 8.7 MGD.

VI. Maximum Three Consecutive Months (M3CM) in terms of AAD, Sales and Treatment

Objective #3 requires HPU to monitor and forecast the M3CM sewer demand in terms of AAD flows versus allocated treatment capacity at HRRSA.

The definition of allocated capacity for each member jurisdiction at HRRSA is set forth under the HRRSA service agreement and refers to the M3CM flow. The use of allocated flow is the sales of sewer as shown in Figure 4 plus infiltration and I&I which is an undesirable component that must be included as part of the flow.

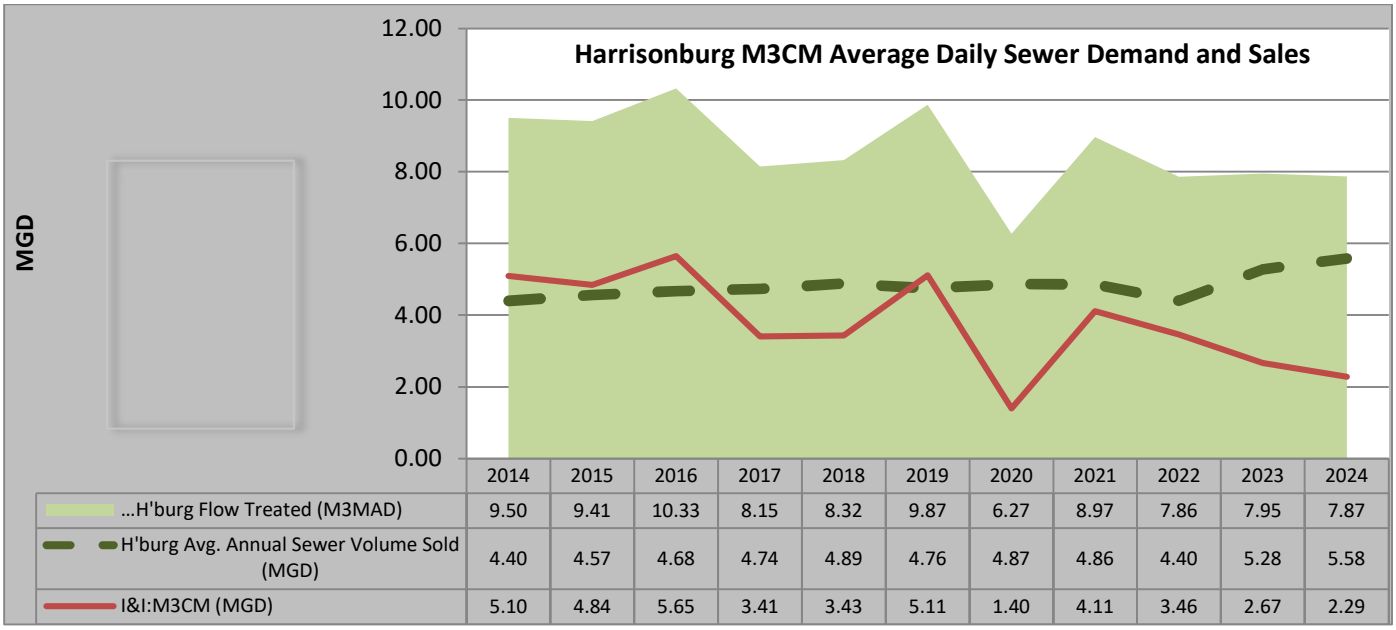
Rainfall-derived "infiltration" refers to rainfall runoff that filters through the soil before entering a sanitary sewer system through damaged pipe sections, leaky joints, or poor manhole connections; duration is generally longer than experienced with inflow.

Rainfall-derived "Inflow" is the water that enters a sanitary sewer system directly by way of depressed manhole lids and frames, downspouts, sump pumps, foundation drains, areaway drains, and cross connections with storm sewers. Inflow occurs and peaks shortly after rainfall and then tapers quickly.

Historic Analysis of Demand

Demand is equal to sales plus I&I. Shown in Figure 4 below for the period of 2014 through 2024 is a historic comparison of sewer sales by the Harrisonburg Department of Billing versus Harrisonburg's demand at the HRRSA sewer treatment plant. Whereas the latter has been consistently larger; the difference is largely caused by I&I. This extraneous source of water is driven by unfavorable sewer system configuration and asset conditions as

well as incurred weather conditions. The maximum recorded M3CM I&I was 6.34 MGD in 2011 and the current 10-year average is 3.77 MGD.



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
…H'burg Flow Treated (M3MAD)	9.50	9.41	10.33	8.15	8.32	9.87	6.27	8.97	7.86	7.95	7.87
H'burg Avg. Annual Sewer Volume Sold (MGD)	4.40	4.57	4.68	4.74	4.89	4.76	4.87	4.86	4.40	5.28	5.58
I&I:M3CM (MGD)	5.10	4.84	5.65	3.41	3.43	5.11	1.40	4.11	3.46	2.67	2.29

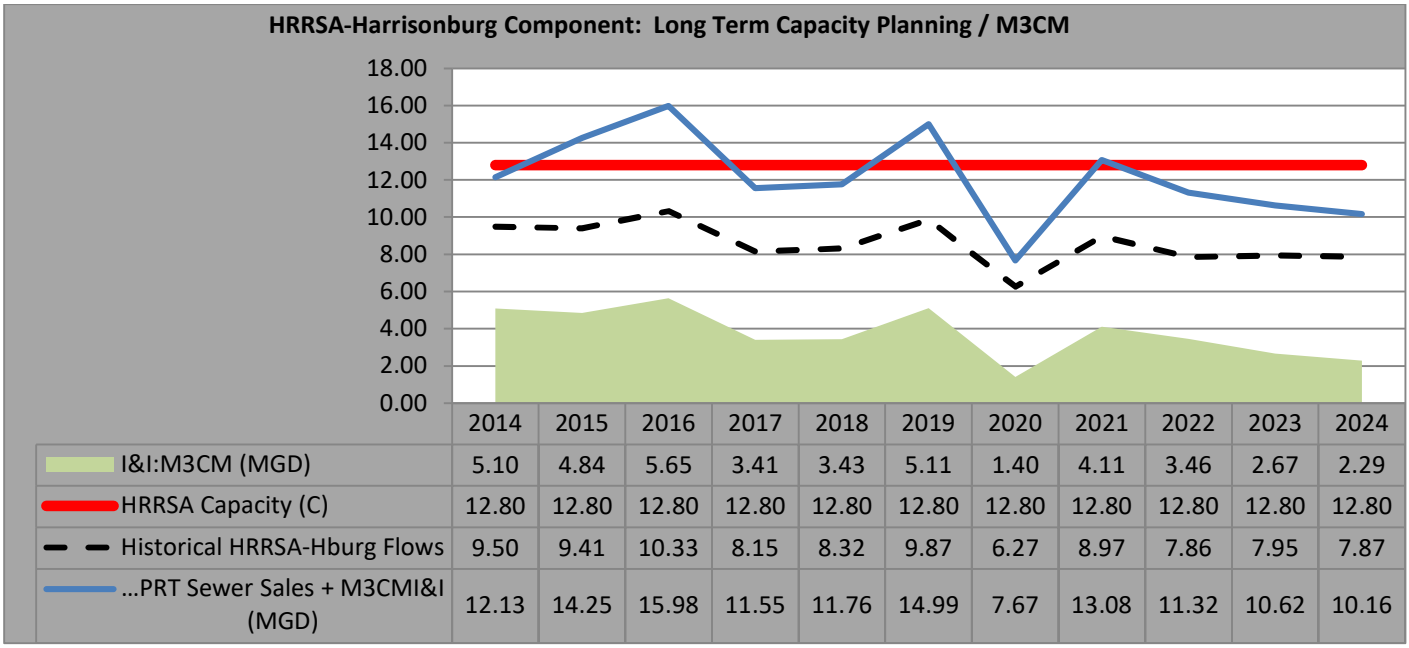
Figure 4

Forecast Analysis of Demand

Forecasting future demand is somewhat difficult because the I&I component is not a constant (as compared to sales) but more related to incurred weather. Therefore, the future demand and needed treatment capacity can be estimated by displaying future demands added upon previous trends. The following are components of future demands:

- Future growth in City sales: 3.1 MGD as determined in the previous section
- Reserved sales for Michael and Daly CONTRACTED COMMITMENTS
  Michael TM 93-B-4 (871 Stone Spring Road)= 93,200 GPD
  Daly = TM 97-A-7 (2460 Ramblewood Road)=168,100 GPD
- Future I&I effect: The analysis assumed zero reduction in existing system and zero addition with future growth. Other allowances can provide opportunities for additional sensitivity analysis.

The results shown in Figure 5 indicate that the available capacity of 12.8 MGD will not always support the future treatment requirement.



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
I&I:M3CM (MGD)	5.10	4.84	5.65	3.41	3.43	5.11	1.40	4.11	3.46	2.67	2.29
HRRSA Capacity (C)	12.80	12.80	12.80	12.80	12.80	12.80	12.80	12.80	12.80	12.80	12.80
Historical HRRSA-Hburg Flows	9.50	9.41	10.33	8.15	8.32	9.87	6.27	8.97	7.86	7.95	7.87
…PRT Sewer Sales + M3CMI&I (MGD)	12.13	14.25	15.98	11.55	11.76	14.99	7.67	13.08	11.32	10.62	10.16

Figure 5

Objective #3 analysis: Considering the effect of I&I upon forecasted future sales, treatment requirements would exceed allocated treatment capacity in 4 of the 11 annual periods that were studied. Prior to FY2024, Harrisonburg did not exceed hydraulic capacity, however; it has undesirably leveraged available unused hydraulic capacity to accommodate I&I. Therefore, I&I reduction is an SSMP goal that must keep pace with sales growth such to make available the leveraged capacity.

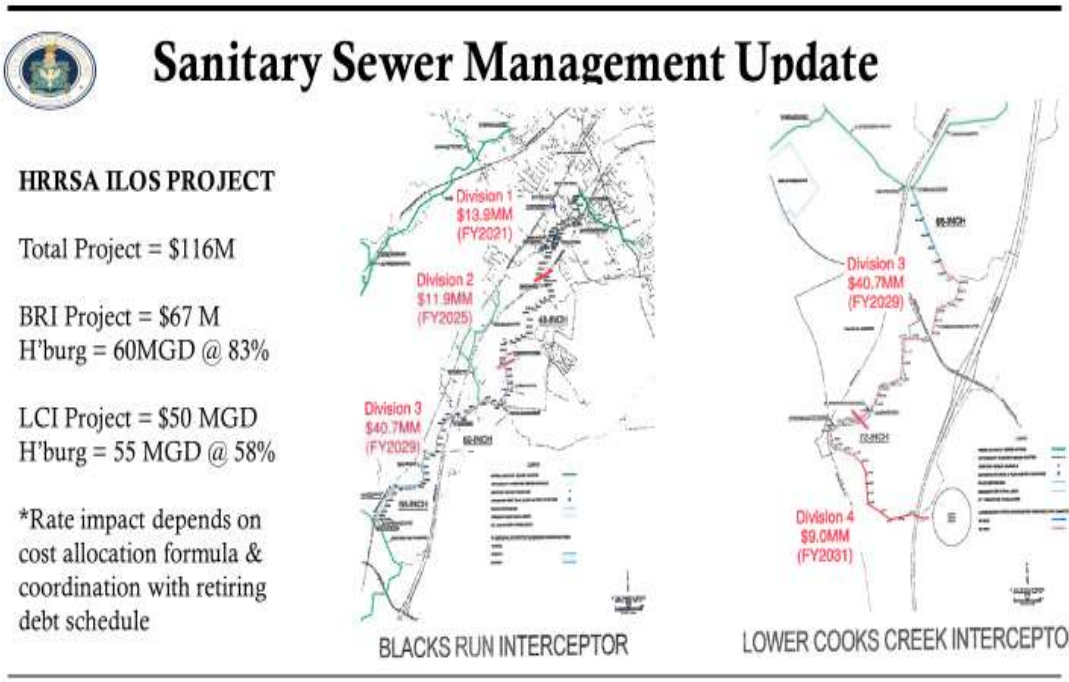
VII. Interceptor Level of Service (ILOS): Harrisonburg Rockingham Regional Sewer Authority (HRRSA)

Objective #4 requires HPU to be consistent with the HRRSA planning agenda for its interceptor capacities.

HRRSA owns and operates interceptor sewer pipes that extend through certain sections of the City and then southward beyond the City limits to the treatment facility in Mount Crawford. HRRSA has defined and named its interceptor system into three divisions. Two divisions are geographically located in the upper system, and they are named Upper Cooks Creek Interceptor (UCCI) and Blacks Run Interceptor (BRI). The lower section has been named Lower Cooks Creek Interceptor (LCCI); it receives flow from UCCI plus BRI and then conveys the combined flow to the HRRSA treatment plant.

Using unvalidated assumptions for future needs, HRRSA completed a study for forecasted future flows and corresponding needed sewer capacities if the treatment facility is expanded from 23 MGD to 28 MGD. A summary of the capital improvement master plan for BRI and LCCI is shown below in Figure 6; UCCI pipe capacities will not be expanded in this project.

Figure 6 (2017 dollars)



Objective #4 Analysis: Maintaining compatibility with the future ILOS for the HRRSA interceptors will engage Harrisonburg into shared capital funding and into coordinating demand through planned land development and / or I&I abatement.

Below is the annual debt schedule provided in the HRRSA ILOS study in 2017 dollars.

- 2023-2042 Div. 1 Bond $ 847,519 per year
- 2027 -2046: Div. 2 Bond $ 718,516 per year
- 2031-2050: Div. 3 Bond $2,471,766 per year
- 2033-2052: Div. 4 Bond $ 544,836 per year

Division 1 improvements are complete. The post improvement capacity as recommended for Upper Blacks Run Interceptor (UBRI) and the Harrisonburg East Interceptor was 75 MGD

with 60 MGD allocated to Harrisonburg. After further evaluation, upper sections of UBRI (Stone Springs Road to Purcell Park) have been retained in capacity at 17 MGD but with structural restoration by slip lining existing pipe. Division 1A project is in the amount of $750k from Prism Contractors & Engineers, Inc. of Williamsburg, Virginia. Division 1B project is in the amount of $4.8M from Garney Companies, Inc. of Chantilly, Virginia. These projects were completed in 2021.

The revised future demand and capacity relationship in the UBRI section is summarized:

- 17 MGD pipe capacity
- 14 MGD allocated to Harrisonburg.

These capacities are based on the interceptors existing capacity and usage only.

VIII. Interceptor Level of Service (ILOS) : City

Objective #5 requires an update to the 1989 Black's Run Interceptor Study in ILOS format and to then to replace the original CIP strategy to match the recommendations from the updated study.

HPU ILOS Program History

Harrisonburg owns and operates its own interceptor sewer pipes that generally run from north to south in the City, see Figure 7. The City interceptors deliver flow to the HRRSA interceptors that have been referenced in the previous section of this document. Over the years, the City and HRRSA interceptors have undergone evaluations as shown in the table below.

As shown in the table below, a study conducted by Wiley & Wilson in 1989 has guided HPU CIP investments into the Blacks Run Interceptor Program. The study provided a 22-year plan to upgrade interceptor capacities to meet future growth forecasts. Most recommendations have been completed; refer to Appendix D for a status update. The study is outdated and was not framed in the format of ILOS that was performed under the HRRSA capacity studies.

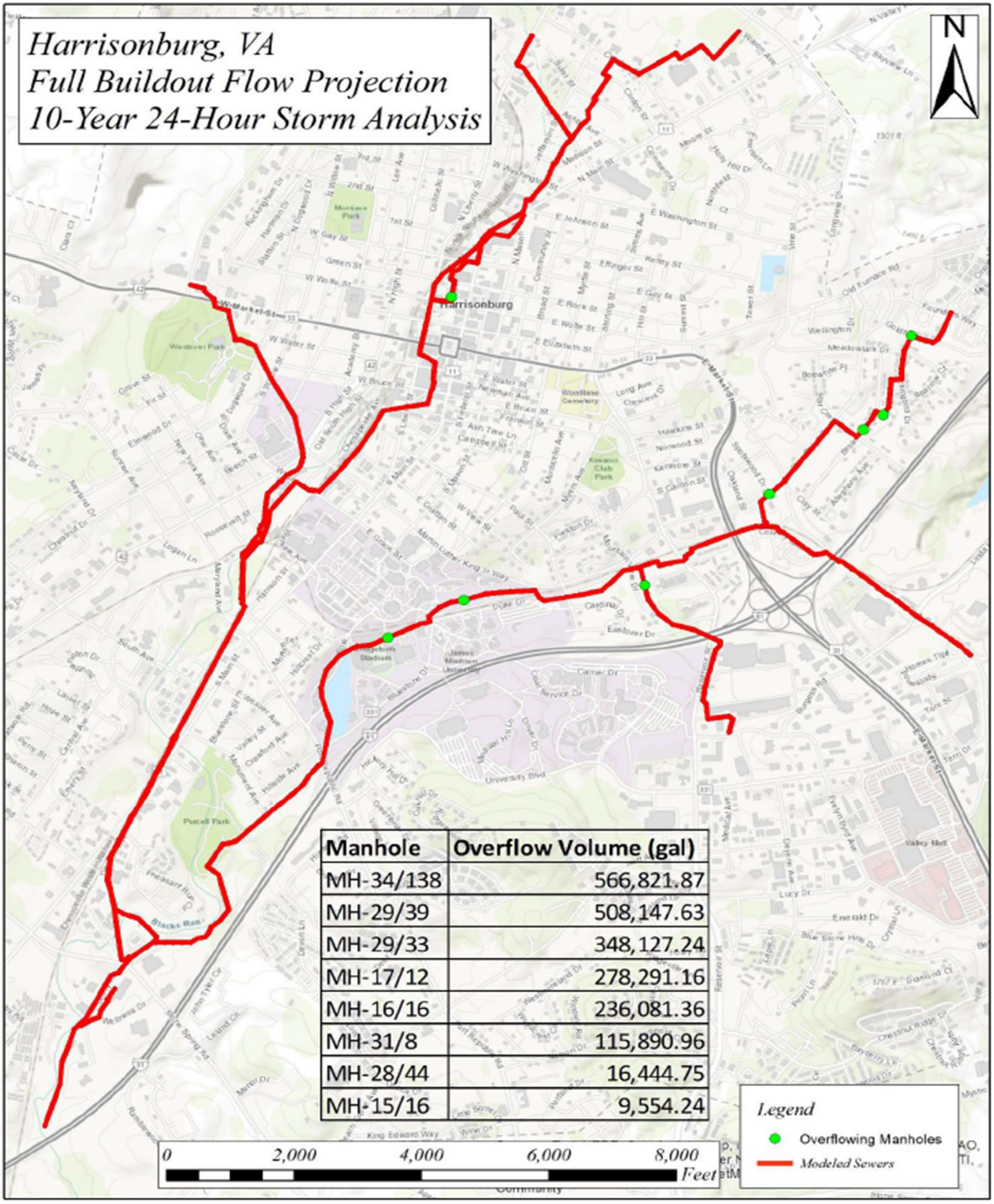

Harrisonburg, VA
Full Buildout Flow Projection
10-Year 24-Hour Storm Analysis
N
Harrisonburg
W Market St
E Market St
Manhole | Overflow Volume (gal)
MH-34/138 | 566,821.87
MH-29/39 | 508,147.63
MH-29/33 | 348,127.24
MH-17/12 | 278,291.16
MH-16/16 | 236,081.36
MH-31/8 | 115,890.96
MH-28/44 | 16,444.75
MH-15/16 | 9,554.24
Legend
Overflowing Manholes
Modeled Sewers
0
2,000
4,000
6,000
8,000
Feet

Figure 7

ILOS MASTER PLANS
1989 HPU - Wiley & Wilson Interceptor Study & Master Plan
2004 HPU - PHR&A Interceptor Update
2017 HRRSA - Wiley & Wilson Interceptor Study & Master Plan
2020 HPU - RJN Interceptor Level of Service (LOS) Determination
2024 HPU - RJN Hydraulic Model Updates For Future City Growth Projections
2024-25 HPU - RJN Flow Monitoring and I&I Analysis
2025 HPU - RJN Hydraulic Model/Master Plan Updates With New Flow Data

ILOS Updates by RJN

HPU currently has RJN contracted to update the W&W study in the ILOS format; the tasks involved in this process are shown in the tables below. The RJN study began with data from the 1989 WW study; integrated the substantial improvements made by HPU since 1989, integrated flow data that was collected between 2018 through 2020 and then has identified existing ILOS status.

501 & 509 PROJECT TRACKING (RJN COMPLETED TASKS)

DATE	FEE	T.O. #	SCOPE OF WORK	CIP
2015-10-09	$ 1,570	33	(Wiley-Wilson) In support of a collaborative effort between HRRSA and the City of Harrisonburg, CONSULTANT shall provide engineering services that will help identify strategic locations to install future flow monitoring devices along the City's Black's Run Interceptor. These flow devices shall serve to identify Base Wastewater Flow (BWF) as currently exist	501
2017-01-01	$ 6,771	1	RJN Engineering Consultation Services	509
2017-04-27	$ 55,500	2	West Spur Interceptor Flow Monitoring & Report	509
2017-09-01	$ 28,813	3	Meter Data Collection and Review Data Processing and Analysis Kick-Off Meeting	501
2018-03-14	$ 89,625	3.1	Interceptor Flow Monitoring for Model Development	501
2018-08-23	$ 109,645	3.2	Flow and Rainfall Data Analysis Model Calibration Evaluation of Existing Hydraulic Capacity Change Order 3.2.3. Update model with field verified survey at nine locations (2023-02-14)	501
2019-04-30	$ 87,625	3.3	Additional Interceptor Flow Monitoring in Lower Blacks Run for Model Development	501

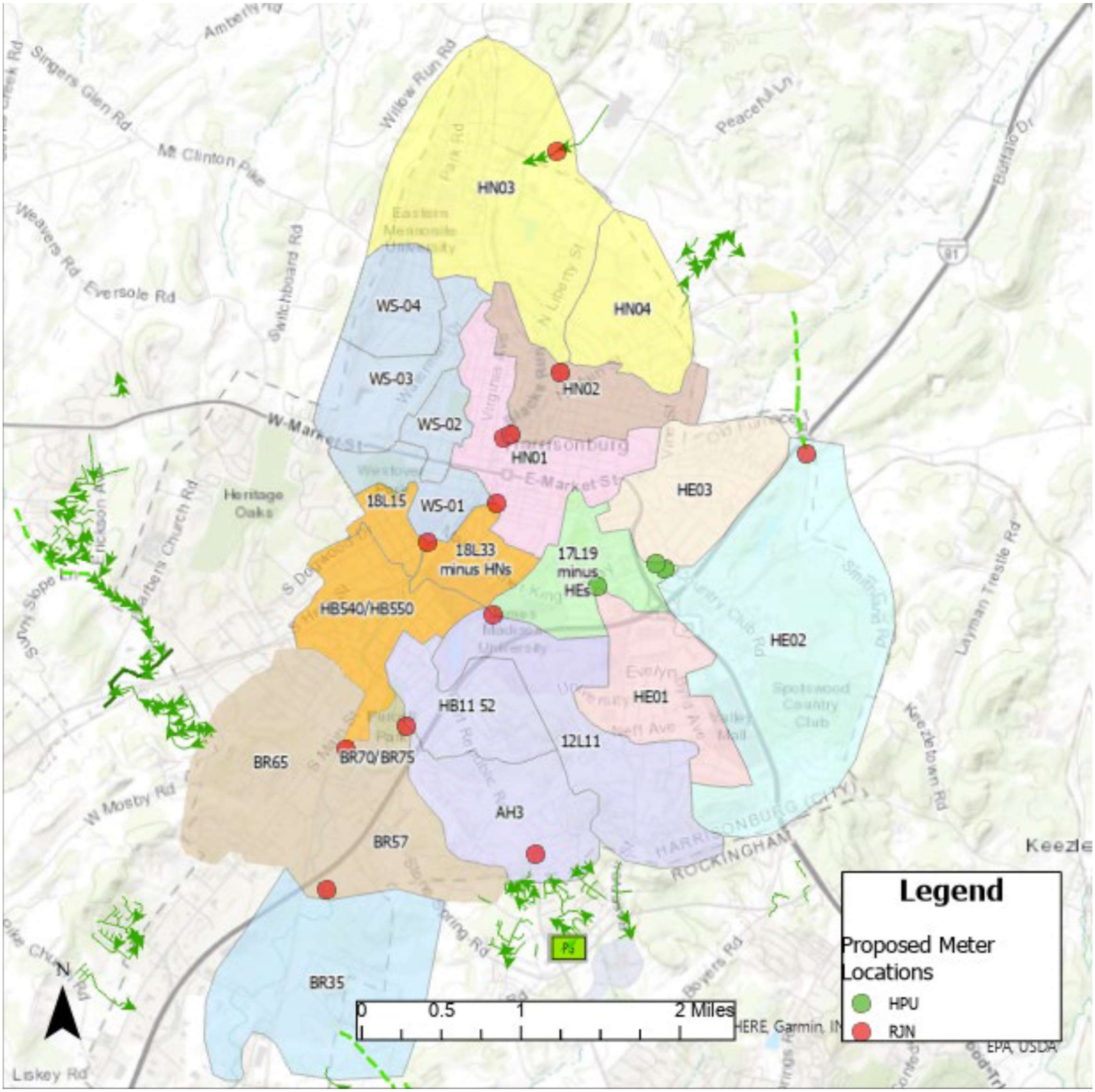
501 PROJECT TRACKING (ACTIVE TASKS)				
2021-02-01	$ 94,450	3.4	**Hydraulic Model - Future City Growth Projections** 1100 - Task 1 - Project Administration & Project Meetings (99.95% complete) 5100 - Task 2 - Hydraulic Model Physical Data & Flow Loading Updates (100% complete) 5300 - Task 3 - Hydraulic Simulations (100% complete) 9110 - Task 4 - Preliminary Result Reporting (100% complete) 5330 - Task 5 - Overflow Elimination (99.73% complete) 9200 - Task 6 - Final Results Reporting (100% complete)	501
2025-01-25	$ 169,680	3.5	Flow Monitoring 1100 - Task 1 - Project Administration & Project Meetings (0% complete) 5100 - Task 2 - Hydraulic Model Physical Data & Flow Loading Updates (0% complete) 5300 - Task 3 - Hydraulic Simulations (0% complete) 9110 - Task 4 - Preliminary Result Reporting (0% complete) 5330 - Task 5 - Overflow Elimination (0% complete) 9200 - Task 6 - Final Results Reporting (0% complete)	501

RJN selected flow monitoring sites based on analysis of GIS data only. The eight primary metered basins were selected based on a review of background information with additional consideration given to hydraulic balance or size of the basins. Locations were also selected based on the need to have contemporaneous data at key locations for hydraulically loading and calibrating a future model update. A detailed map of the eight primary meter locations which show the tributary area to each is shown in Figure 8.

The conclusions for City ILOS existing conditions were provided by RJN in July 2020 with reference to wet weather capacity analysis performed under three design storm conditions: 2 years- 24-hour storm, 5 years- 24-hour storm, 10 years - 24-hour storm. The study referenced capacity conditions as pertaining to the City's East, North, and Western, Blacks Run Interceptors.

- Western Blacks Run Interceptor (WBRI) is comprised of subsystems that include the "Lower West Interceptor (LWI)", "Upper West Interceptor (UWI)", "North Interceptor (NI)" and the "West Spur Interceptor (WSI)".
- Eastern Blacks Run Interceptor (EBRI) is an extension of the HRRSA UBRI and includes the "Blue Ridge Drive Interceptor (BDI).

Figure 8


HN03
HN04
HN02
HN01
WS-04
WS-03
WS-02
WS-01
18L15
18L33 minus HNs
17L19 minus HEs
HE03
HE02
HE01
HB540/HB550
HB11 52
12L11
BR65
BR70/BR75
BR57
AH3
BR35
Harrisonburg
Eastern Mennonite University
James Madison University
Heritage Oaks
Spotswood Country Club
Valley Mall
Willow Run Rd
Singers Glen Rd
Mt Clinton Pike
Weavers Rd
Eversole Rd
Switchboard Rd
Park Rd
N Liberty St
Peacefull Ln
Buffalo Dr
W-Market St
E-Market St
Old Furnace
Country Club Rd
Smithland Rd
Layman Trestle Rd
Keezletown Rd
Erickson Ave
Garbers Church Rd
Sunny Slope Ln
S Dogwood Dr
Evelyn Byrd Ave
Neff Ave
University
S Main St
W Mosby Rd
Stone Spring Rd
Boyers Rd
Liskey Rd
Keezle
HARRISONBURG (CITY)
ROCKINGHAM
Legend
Proposed Meter Locations
HPU
RJN
0
0.5
1
2 Miles
HERE, Garmin, IN
EPA, USDA
N

The table below shows the results of the flow monitoring exercise.

Meter Basin	Base Infiltration Unit Rate (gpd/idm)	1-yr, 60-min Peak Inflow @ 0.95 in/hr Peak Inflow Rate (gpd/idm)	Discrete Peaking Factor
HE01	2,259	11,490	3.0
HE02	1,198	14,740	5.7
HE03	2,203	8,528	2.8
HN01	6,224	21,465	3.1
HN02/HN05	4,341	20,618	2.6
HN03	1,878	7,860	2.6
HN04	464	7,296	6.2

Capacity Analysis Results Summary			
		10-Year Storm Condition	
Simulation Date	Scenario	Sewer Surcharged	Manhole Surcharged
6/16/2023	Dry Weather Full Build-Out	0	0
6/16/2023	Wet Weather Full Build-Out	175	142

Modeling Results by RJN

The table below shows the results of the SewerGEMS modeling results.

Capacity Analysis Results Summary				
		10-Year Storm Condition		
Simulation Date	Scenario	Sewer Surcharged	Manhole Surcharged	Manhole Overflow
6/16/2023	Dry Weather Full Build-Out	0	0	0
6/16/2023	Wet Weather Full Build-Out	175	142	8

Remediation

Remediation will consist of one or more of the following processes: collection system R&R, public I&I reduction and private I&I reduction. Results for determining SSO elimination processes are incomplete at this time. Figure 9 shows estimates for removal of SSO's. The HPU ILOS adopted the 10-year storm Level of Service which showed one (1) manhole overflow in the North Interceptor and seven (7) manhole overflows in the East Interceptor.

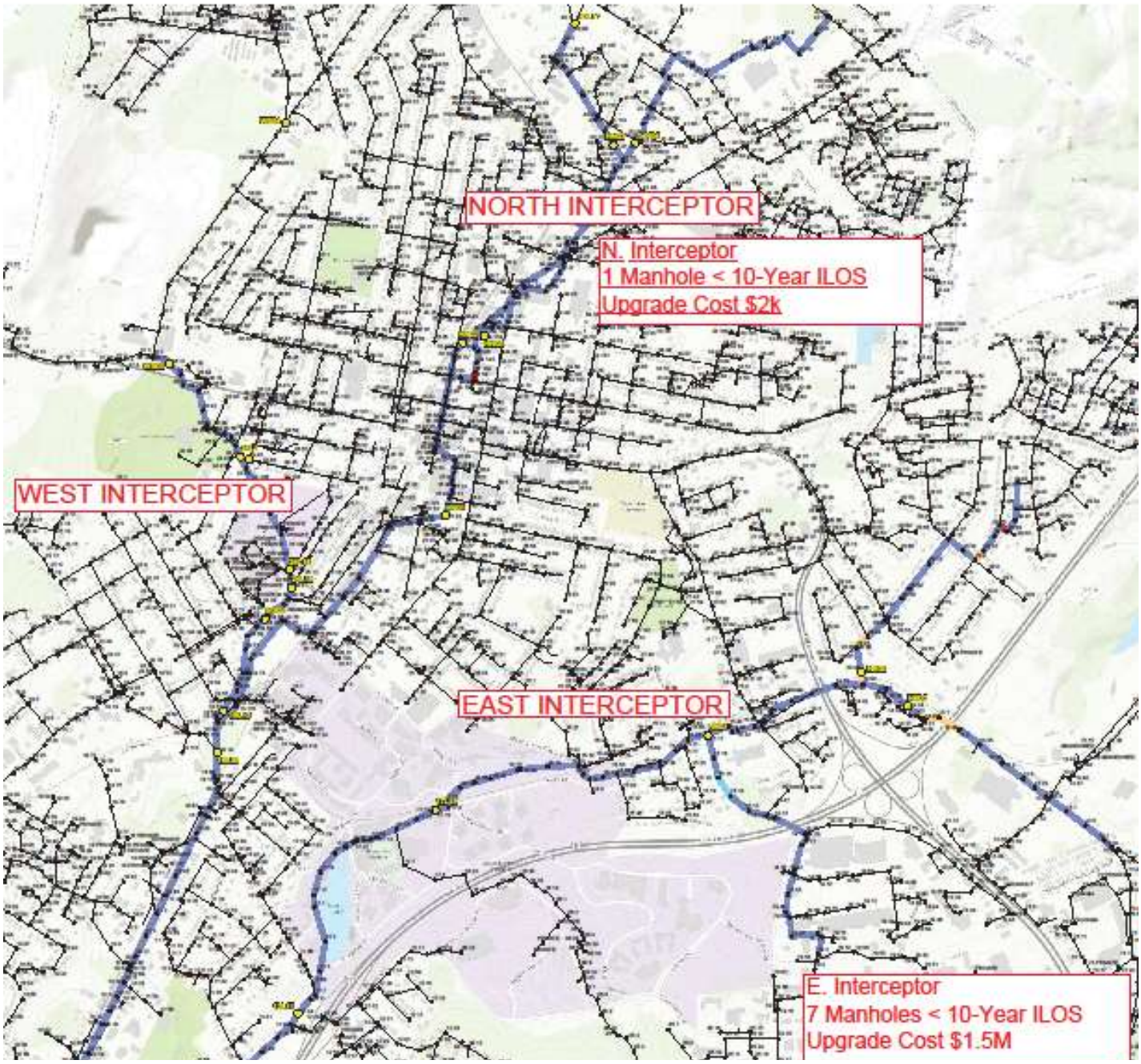


Figure 9

IX. Reliable Service - Performance Mode; Integrity and MTBF

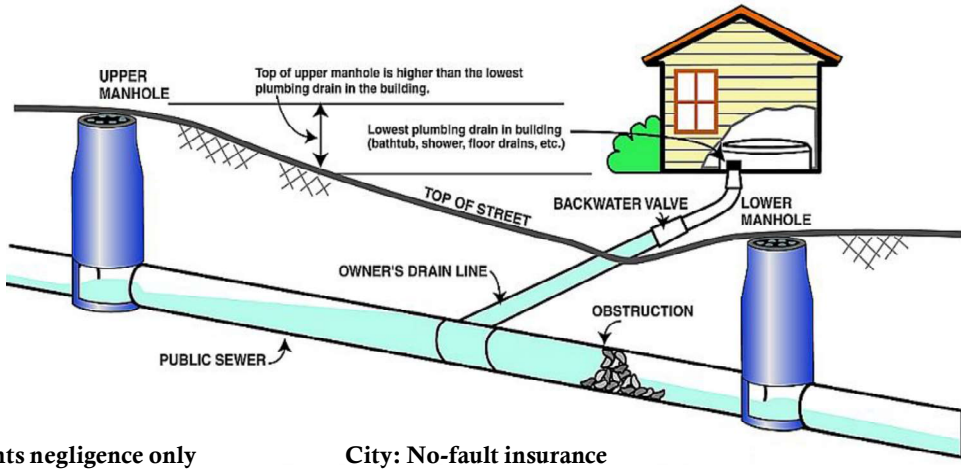
Objective #6 requires continuous monitoring of system integrity and MTBF sensitivity and to use these benchmarks as drivers for asset management.

System Integrity

Failure means a loss of capacity resulting from a flow restriction in gravity or pressurized wastewater systems. Examples include blockages from debris inappropriately deposited by users or blockages caused by substandard pipe structural condition. Integrity analysis is a driver for maintenance decisions.

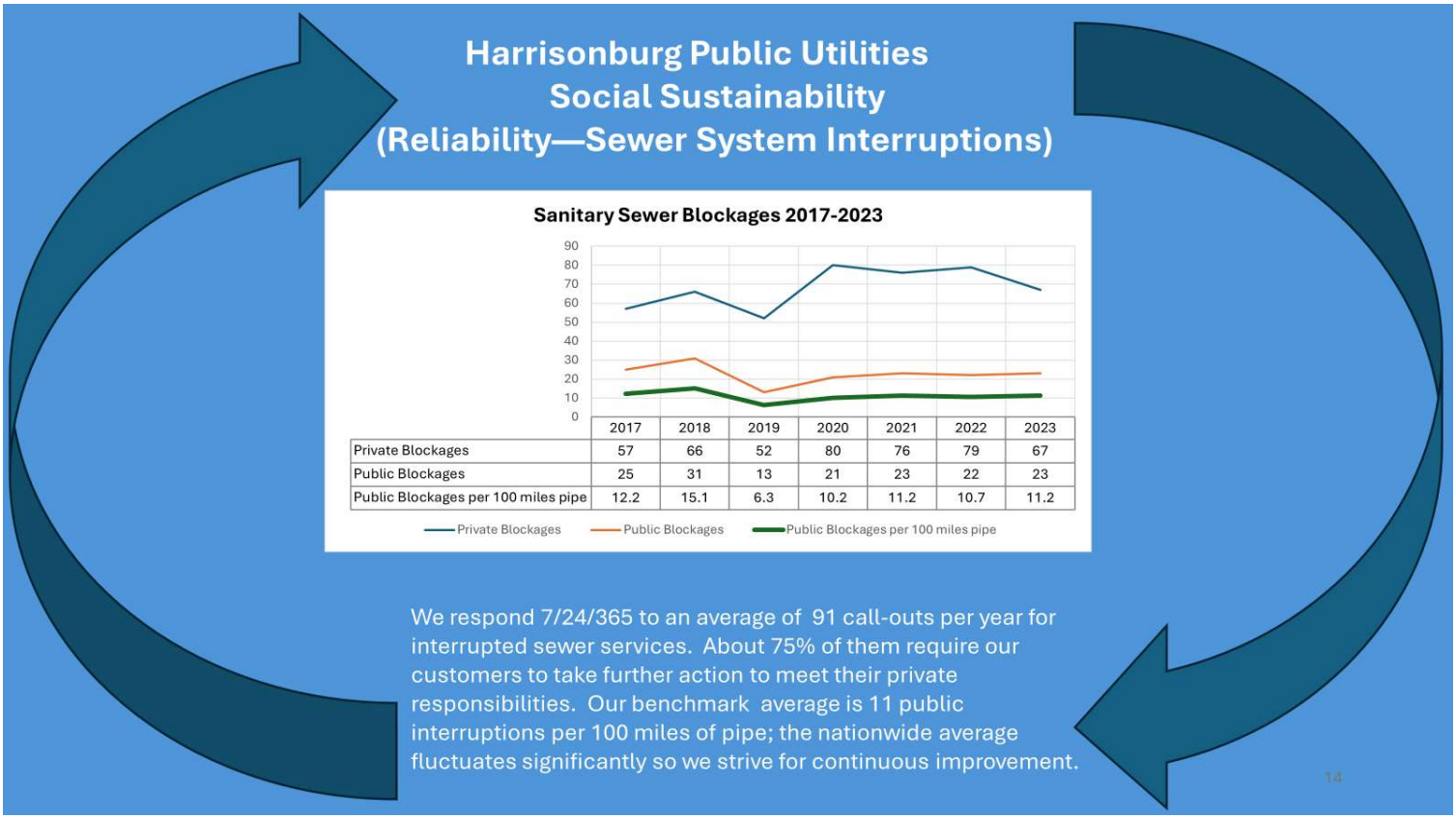
Sanitary Sewer Management Plan Update

Interruption Mode 1



Virginia law- fault by 4 points negligence only **City: No-fault insurance**

RELIABLE SERVICE & LEVEL OF SERVICE



Customer Sensitivity for Integrity:

HPU desires to deliver a LOS of ten years to its customers; it expects to have a backup failure occurring to a customer building no more than once per ten years. For FY2024, 25 pipes were found to be below the 10 years LOS benchmark for MTBF.

X. Mortality Mode: RUL by MASL and RISK

Objective #7 of this SSMP requires HPU to forecast the retirement date and value of its asset inventory.

Asset management is the practice of managing infrastructure capital assets to minimize the total cost of owning and operating these assets while delivering the desired service levels through the following formal tools. The first key decision process in asset management is to determine when the individual assets may need rehabilitation or replacement. Replacement funding requirements are forecasted using the Manufacturer's Anticipated Service Life (MASL) for each asset type (sewer pipes, manholes, etc.). As HPU moves forward in maturing asset management, RISK principles will replace MASL principles.

As shown in the table below the HPU sewer enterprise fund will need to retire $42.4M of its $324.3M asset inventory between 2024 and 2049. The 2024 cost of replacement on a uniform ACSO25 is $1.7M per year. An additional cost for I&I remediation is estimated at $220k per year.

2024 Sanitary Sewer Asset Inventory		CARV	Net Book Value	Net Book Value YR+N	Annual Depreciation	FARC25	ACSO25
Interceptors 911161-48641	Pipes	$22,809,818	$12,658,223	$11,629,033	$205,838	$1,150,338	$46,014
	Manholes	$782,340	$497,025	$473,446	$4,716	$74,974	$2,999
	Pipes	$26,738,151	$15,959,206	$14,780,332	$235,775	$1,287,493	$51,500
	Manholes	$550,898	$343,838	$327,431	$3,281	$58,676	$2,347
	Land		$0	$0	$0		
	Subtotal	**$50,881,206**	**$29,458,292**	**$27,210,242**	**$449,610**	**$2,571,480**	**$102,859**
Collection & Transmission 911161-48735	Pipes	$252,082,573	$142,153,698	$131,826,924	$2,065,355	$35,035,531	$1,401,421
	Manholes	$16,311,789	$10,117,786	$9,647,730	$94,011	$2,215,326	$88,613
	Land		$0	$0	$0		
		$0	$0	$0	$0		
	Subtotal	**$268,394,362**	**$152,271,484**	**$141,474,654**	**$2,159,366**	**$37,250,857**	**$1,490,034**
Pumps & Storage 911161-48736	Equipment	$1,124,933	$528,678	$415,232	$27,633	$748,995	$29,960
	Building	$593,426	$352,408	$312,846	$7,912	$146,559	$5,862
	SCADA	$146,265	$75,232	$45,979	$5,851	$142,615	$5,705
	Land		$0	$0	$0		
	Subtotal	**$1,864,624**	**$956,317**	**$774,056**	**$41,396**	**$1,038,170**	**$41,527**
Metering 910161-48734	Small Meters	$2,221,125	$811,648	$671,467	$28,036	$988,265	$39,531
	Large Meters	$958,553	$245,846	$139,390	$47,928	$574,527	$22,981
	Land	$0	$0	$0	$0	$0	$0
	Subtotal	**$3,179,679**	**$1,057,494**	**$810,857**	**$75,964**	**$1,562,792**	**$62,512**
TOTALS		**$324,319,871**	**$183,743,586**	**$170,269,809**	**$2,726,336**	**$42,423,299**	**$1,696,932**
Current Asset Replacement Cost (CARV)							
Future Asset Replacement Cost 25 Year (FARC25)							
Annual Cost of Sustainable Service 25 Year (ACSO25)							

XI. Obsolescence Mode

Objective #8 requires HPU to maintain a pipe and manhole inventory for material types with a concern for obsolescent pipe types.

Cohort Groups	Inventory (feet)	% of System
Cast Iron	478	0%
Clay Tile	280,066	26%
Terracotta (clay)	8,366	1%
Concrete	344,286	32%
Ductile Iron	20,732	1%
HDPE	829	0%
PVC	429,736	39%

Cohort Groups	Inventory Totals	% of System
Brick Manholes	248	5%
Concrete Manholes	4,748	95%

Objective #8 Analysis: HPU maintains a pipe inventory for material types with inventory divided equally among clay, concrete, and PVC materials.

XII. Asset Management at HPU

Long Term Financial Model (LTFM):

Objective #9 requires HPU to manage a Long-Term Financial Model (LTFM) to identify funding and expenses that are necessary to meet sewer asset management goals. The table below summarizes the 2024 recommendations for rate increases.

Escalation Rates	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Muniworth growth rates from population data Population Growth	0.00%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Rate Increase	1.00%	2.75%	2.75%	2.75%	2.75%	2.75%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%
Escalation Rates	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**	**2049**
Muniworth growth rates from population data Population Growth	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Rate Increase	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%	1.70%

Objective #9 Analysis: The HPU-Water Worth Sewer Long Term Financial Model for FY2024 Budget suggested rate increases of 1.00% per year through 2024, 2.75% per year 2025-2029 and then 1.70% per year 2030-2049.

Asset Management Plans (AMPS):

Objective #10 requires the development and implementation of individual Asset Management Plans (AMPS) for sewer pipes and manholes to guide the use of all identified drivers in making asset management decisions.

Integrated Asset Management

Decision Strategy

Shown below is the decision tree that is conveyed in the HPU Sewer Pipe AMP. Identification of various activities (predictive, preventive, and R&R) used by HPU under both scheduled and unscheduled agendas. Further detail and outputs from these activities are provided later in this section.

HPU SEWER MAIN ASSET MANAGEMENT DECISION TREE								
	FAILURE MODE	UNSCHEDULED				SCHEDULED		
	EVENTS	Progression →				Progression →		
	Performance							
1	Sewer Main Backup	Flushing	CCTV	Repair			(1) CCTV	Repair
2	Staff Recommendations						CCTV	Repair
3	MTBF:							
4	Infiltration & Inflow					Flow Monitor	(2) CCTV Smoke Test	(3) Repair, R&R
	Mortality							
5	Age/RUL-MASL						(2) CCTV	(3) Repair, R&R
6	Paving Schedule:						(2) CCTV	(3) Repair, R&R
7	CIP Project Integration						(2) CCTV	(3) Repair, R&R
	Capacity							
8	Sewer Main Surcharge or Overflow					Flow Monitor	(2) CCTV	(3) Repair, R&R
	Obsolescence							
9	See Age/RUL-MASL						(2) CCTV	(3) Repair, R&R

(1) CCTV	Three backups in the sewer main trigger a CCTV inspection.
(2) CCTV	HPU targets 100% CCTV inspection of its sewer main inventory over ten years. Failure mode events are used to prioritize the schedule of CCTV work.
(3) CCTV	Risk based selection is a tool of asset management that is preferred for selection and for prioritizing repair and replacement.

HPU utilizes Cityworks a computer maintenance management system (CMMS) to better schedule activities and to formulate data into useful information in the asset management decision processes.

Maintenance Planning

HPU invests considerable City employed resources into sewer system management. We highly value a strong planned agenda versus a more reactionary mode of operation. The next table is the HPU Field Utilities Division "Maintenance Baseline Schedule" which defines the goals as were set forth for FY2024:

Field Utilities - Preventative Maintenance Baseline Schedule

	Total	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24
Construction - Baseline	**10,032.00**	960.00	1104.00	960.00	1056.00	0.00	0.00	1008.00	960.00	1008.00	1008.00	1056.00	912.00
Gravity Main - Easement Inspection - PM	**55.00**	0.00	55.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravity Main - Easement Maintenance - PM	**240.00**	0.00	0.00	0.00	0.00	0.00	0.00	240.00	0.00	0.00	0.00	0.00	0.00
Gravity Main - Flushing - PM	**182.00**	0.00	0.00	0.00	176.00	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gravity Main - Grease Run - PM	**300.00**	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00	50.00	0.00
Gravity Main - Root Run - PM	**33.00**	17.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00	0.00	0.00
Gravity Main - Smoke Testing - PM	**167.00**	0.00	0.00	152.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Air Valve - Inspect/Exercise - PM	**360.00**	0.00	0.00	0.00	90.00	90.00	90.00	90.00	0.00	0.00	0.00	0.00	0.00
Water Main - Leak Detection - PM	**195.00**	0.00	0.00	0.00	65.00	65.00	65.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Valve - Inspect/Exercise - PM	**721.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	240.00	240.00	241.00	0.00
Total	**12,285.00**	**1027**	**1159**	**1166**	**1402**	**215**	**155**	**1392**	**960**	**1302**	**1248**	**1347**	**912**

R&R Planning

Figure 10 below is the HPU R&R component of the decision tree above. Item 3 in the decision tree references condition assessment or Likelihood of failure (LOF), and criticality or Consequence of Failure (COF), and their product of Risk (= LOF * COF); these parameters are inscribed in green in the process below.

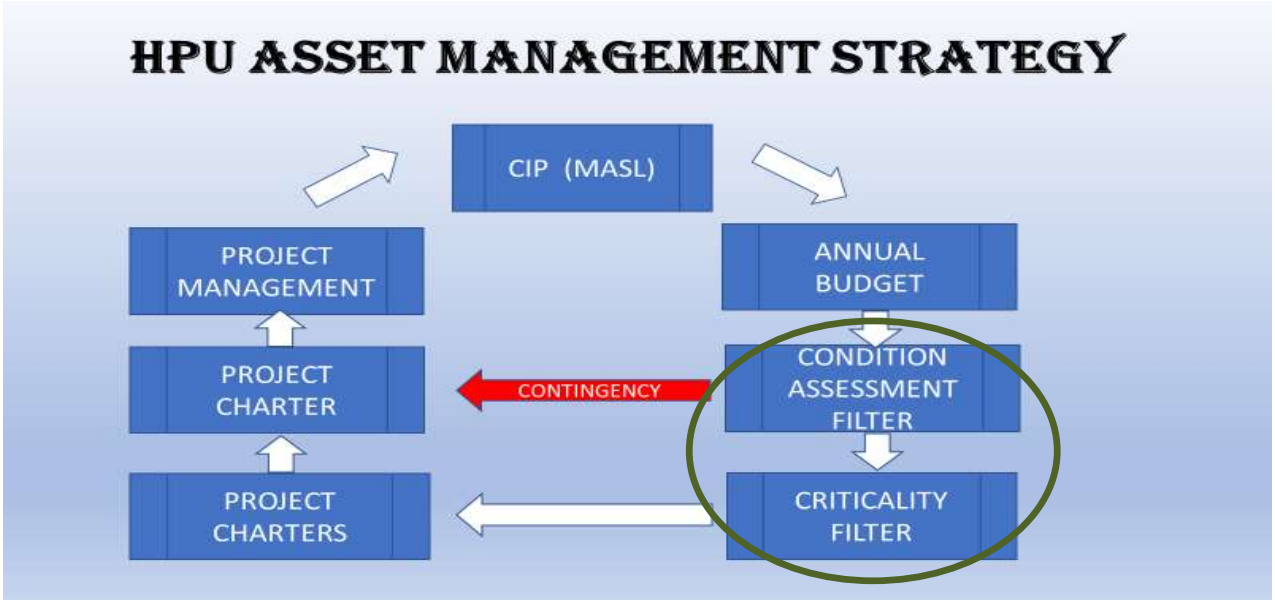
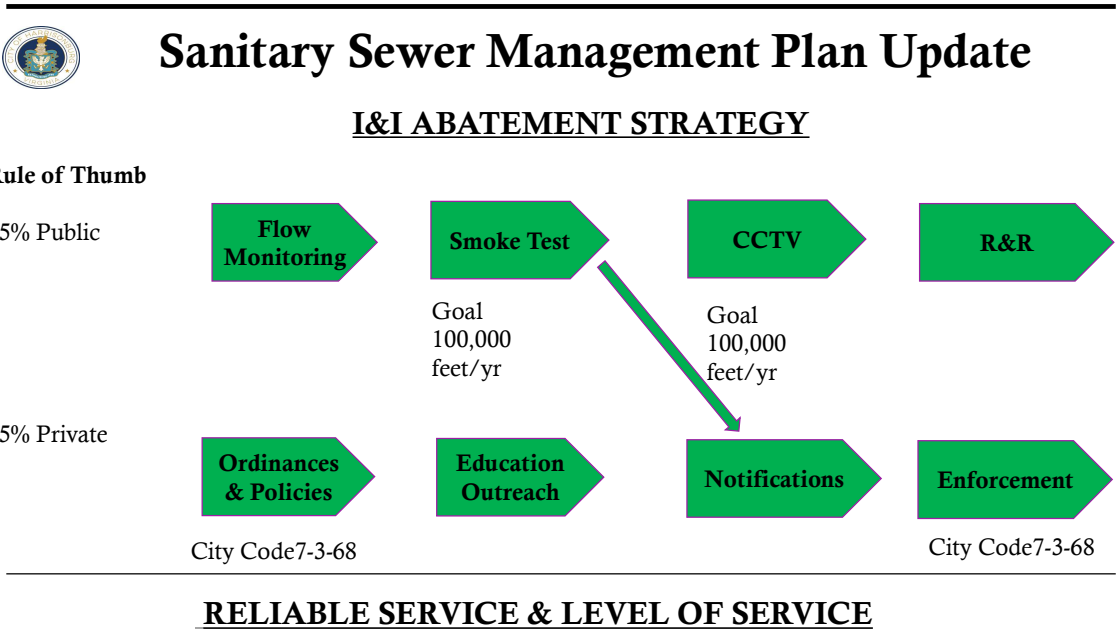


Figure 10

Infiltration & Inflow Abatement

The HPU I&I program is designed to address both public and private sources of I&I. Publications have generalized that fifty five percent (55%) of all I&I comes from the private sector stating that without I&I abatement in the private sector little more than 5-10% I&I reduction will be achieved. Shown below is the HPU Public-Private I&I abatement strategy. The HPU approach toward private I&I abatement and integration of Ordinances includes education outreach AND ENFORCEMENT of the public system activities described previously.



The HPU Public Sewer System management strategy for I&I abatement has integrated flow monitoring, smoke testing, CCTV inspection, repair, and R&R. HPU has the following database of information to prioritize asset management.

- RJN ILOS study 2018 through 2023
- CCTV structural score database 2013 through present
- CCTV I&I score database: 2013 through present
- EMU Part 1 I&I Study - 1997
- PHR&G SSES - 1983 & 1989
- Blue Ridge Drive I&I Study - 1996
- Hillandale I&I Data Summary - 1995
- Park View FPS Sewer Study – 1994
- Pleasant Hill Sewer Study – 1997
- South Hampton Sewer Study – 1998

The reduction of I&I is somewhat difficult to measure, however, visual observation of Figure 11 suggests that HPU may have achieved a seventeen percent (17%) reduction since 2011.

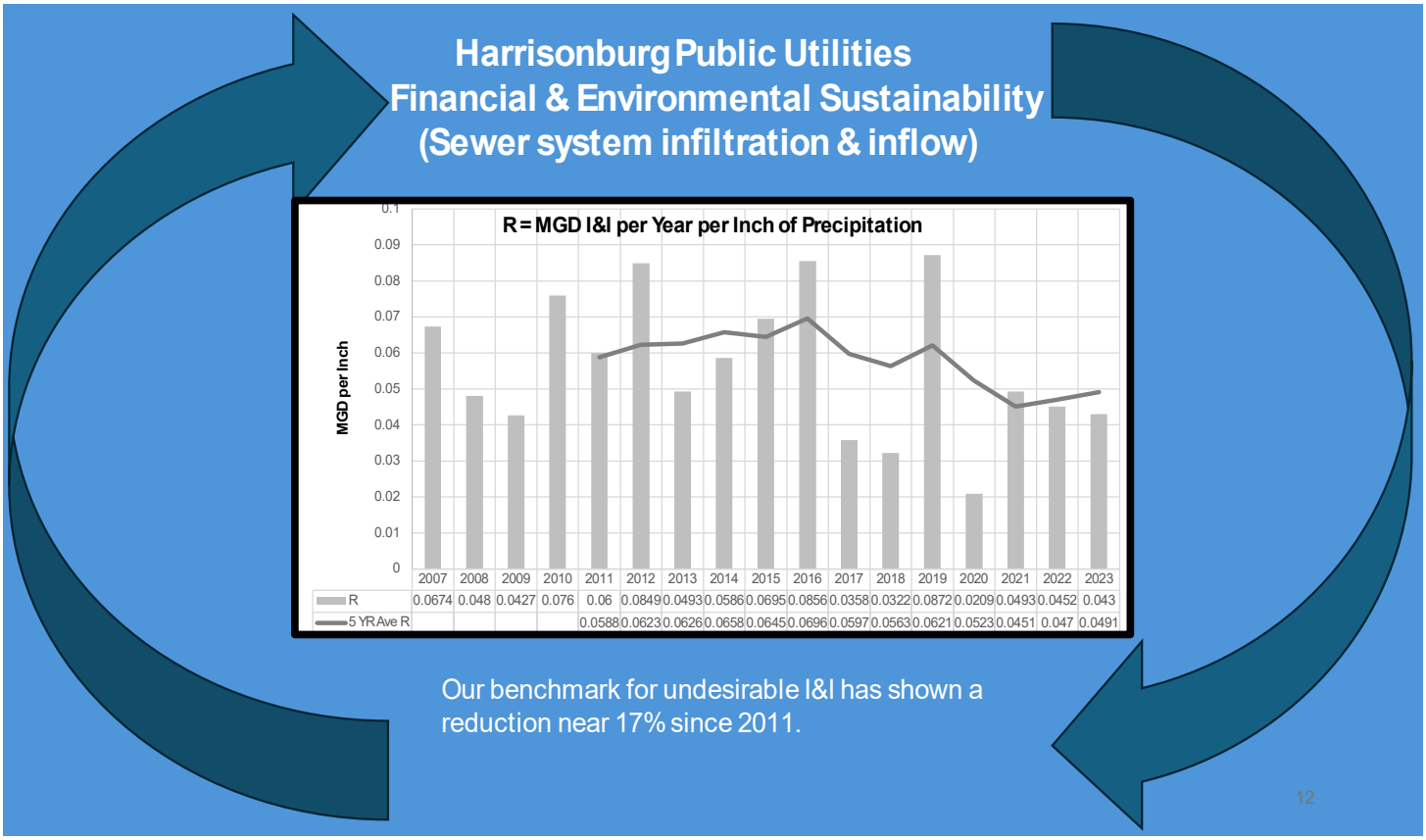


Figure 11

HPU has its next priority in I&I reduction in HN02/05 sub-basin for the purpose of providing a 10-year Level of Service (LOS) within the north interceptor where the City is fully developed. Events 4 and 8 of the Asset Management Decision Tree will direct the R&R Planning within this sub-basin. Unless significant defects are found elsewhere, HPU intends to focus most R&R efforts within the HN02/05 sub-basin. Reference the Preliminary Engineering Report for the HN02/05 Sub-Basin Infiltration & Inflow (I&I) Reduction Project for an in depth commentary on the means and methodology of how this project will select assets for R&R. Figurers 11A and 11B below show the areas that encompass HN02/05 sub-basin.

Figure11A

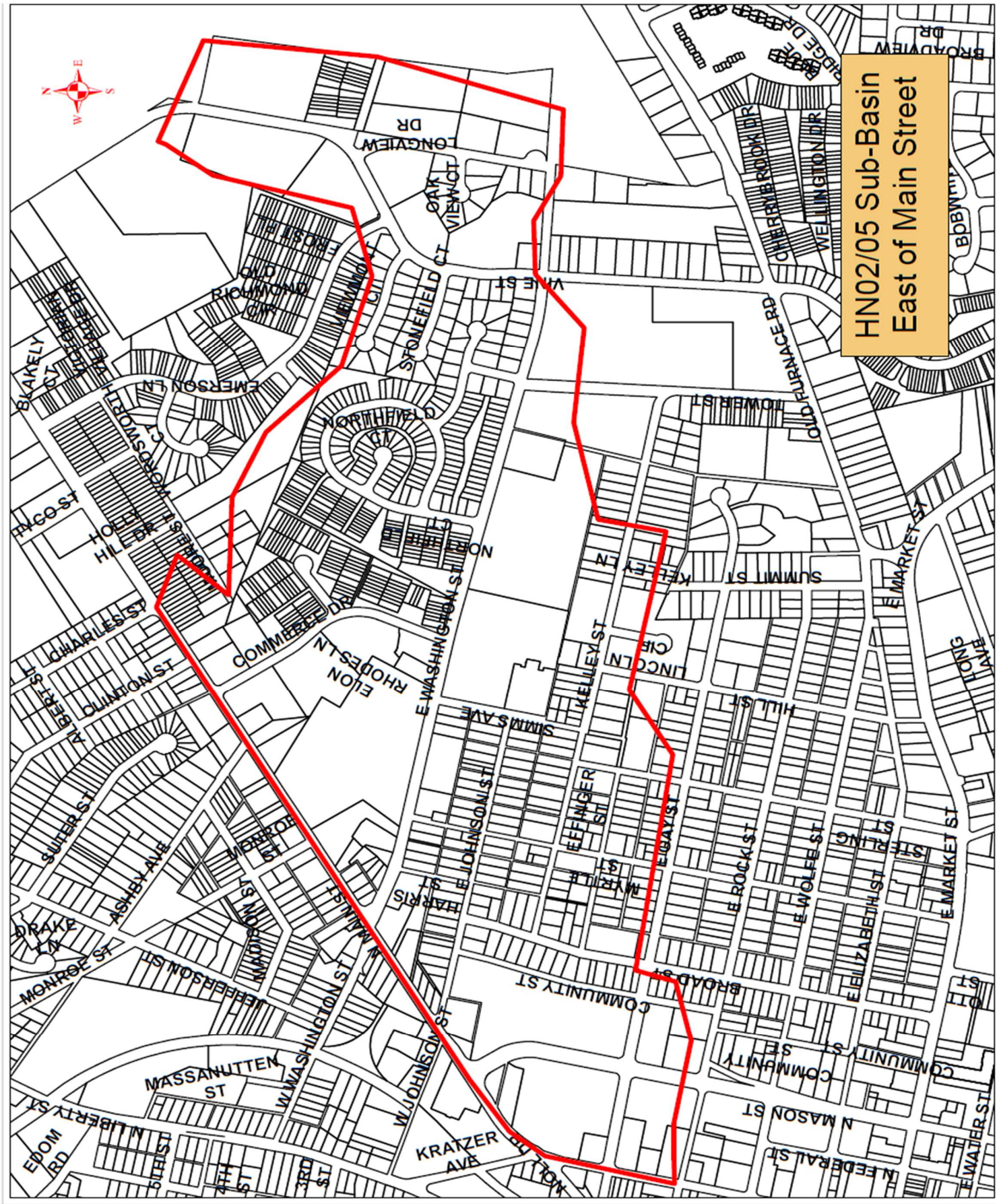


Figure11B


N
W
E
S
MT CLINTON PIKE
HOT ROD ALY
TALIAFERRO DR
SUMTER CT
4TH ST
6TH ST
EDOM RD
SOPHIE DR
CHLOE LN
KATES LN
VIRGINIA AVE
LEE AVE
5TH ST
4TH ST
3RD ST
2ND ST
1ST ST
COLLICELLO ST
JACKSON ST
ALTAFER CT
ALTAFER DR
LIBERTY ST
MASSANUTTEN ST
ASHBY AVE
MONROE ST
ROBERTS CT
DRAKE LN
JEFFERSON ST
SUTER ST
CHARLES ST
CLINTON ST
ALBERT ST
MADISON ST
MONROE ST
W WASHINGTON ST
E WASHINGTON ST
N MAIN ST
W JOHNSON ST
E JOHNSON ST
HARRIS ST
KRATZER AVE
N MASON ST
COMMUNITY ST
BROAD ST
MOLL DR
W GAY ST
E GAY ST
HN02/05 Sub-Basin
West of Main Street

A summary of inputs and outputs for this program in FY2024 is shown below:

Activity Asset Inventory:

Asset Register / Inventory: FY2024 sewer asset inventory for collection and transmission was $268.4M. The breakout among assets is shown below:

CARV	Net Book Value	Annual Depreciation
$268.4M	$152.3M	$2.2M

210 Miles of Pipes
5,004 Manholes

Assets are field located by GPS coordinates and retained in GIS asset registers.

Activity Predictive Maintenance:

As defined in the AMPS, sewer pipe CCTV inspection has been the single most important predictive maintenance activity in HPU's Linear Asset Management. **FY2024 CCTV completed 19,157 feet of condition assessments for sewer pipe.** HPU is actively pursuing Artificial Intelligence (AI) CCTV scoring services with outside sources. CCTV inspections will be conducted via contracted services with outside vendors for subsequent years. For this reason, CCTV for 2024 was limited to paving reconnaissance and emergency operations only.

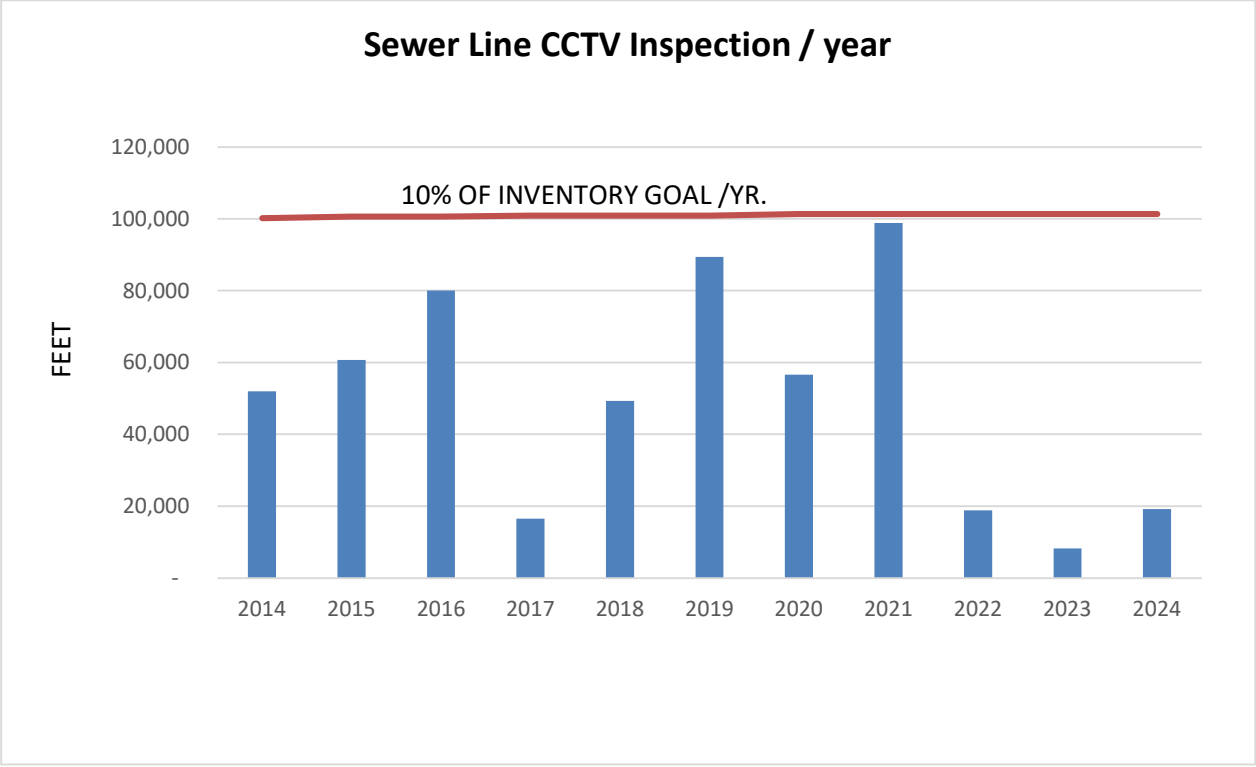


Figure 12

Activity Preventive Maintenance:

Strategies for scheduling preventive maintenance and for using retrieved data are being summarized in AMPS as discussed earlier. FY2024 sewer flushing provided service to 10% of the sewer asset inventory. Sewer pipe flushing has been the single most important preventive maintenance activity in HPU's Linear Asset Management. HPU progress for preventive cleaning is shown below. HPU attempts to preventive flush 10% of its asset inventory annually to improve system integrity. HPU will continue to perform flushing preventive maintenance and focus upon troubled areas that our CMMS system has identified as high probability for blockage.

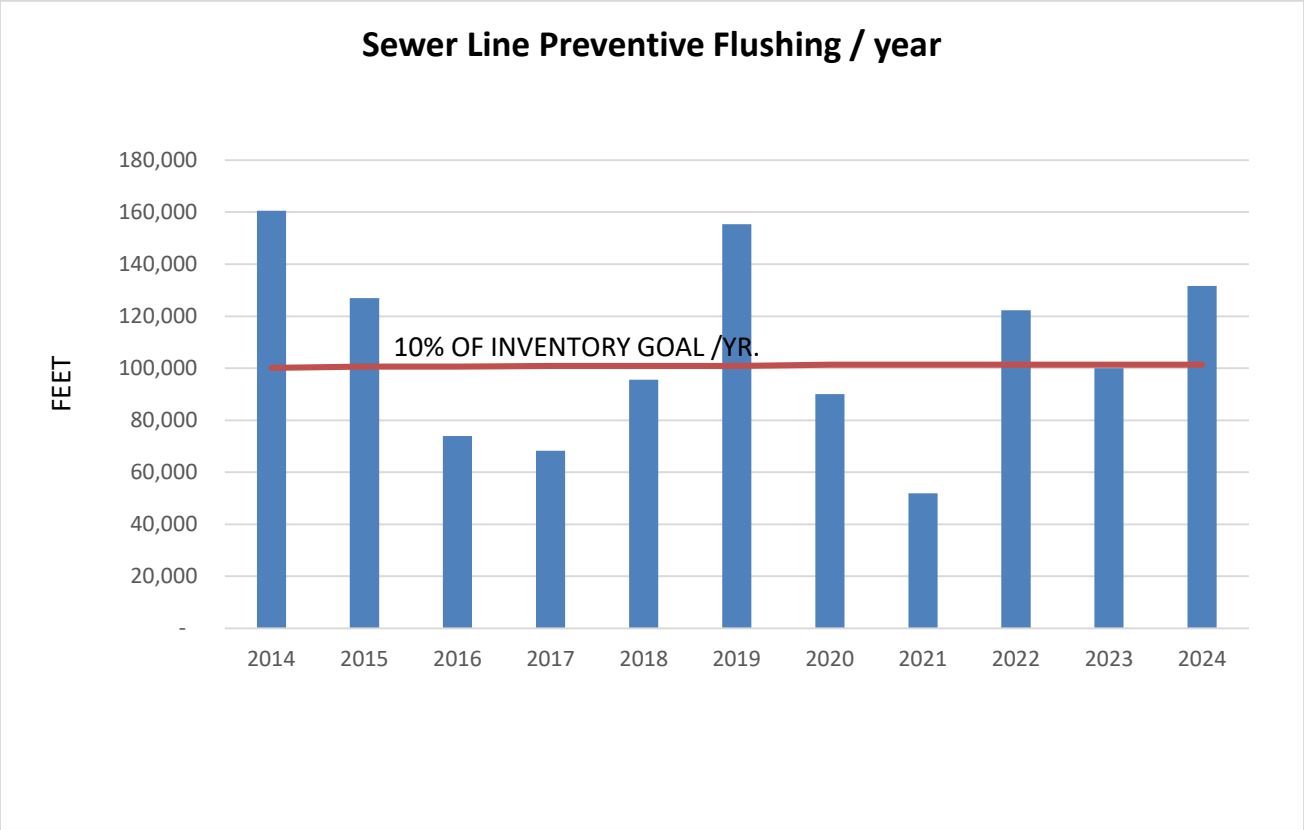


Figure 13

Activity Repair Maintenance:

American Water Works Association (AWWA) Utility Benchmarking 2022 edition defines the following terms:

- Corrective maintenance – All maintenance undertaken after asset failure. Corrective maintenance is always responsive but may not necessarily result in service disruption. Total time for corrective maintenance should include overtime attributed to these activities, including contractors' time. Separate maintenance time as allocated to linear resources (distribution and collection systems) and vertical resources (plants and pump stations).

- Planned maintenance – All regular maintenance activities undertaken in advance of asset failure during the reporting period. Planned maintenance may be predictive or preventive and may not necessarily result in service disruption. Preventive maintenance is performed according to a predetermined schedule rather than in response to failure. Predictive maintenance is initiated when condition monitoring signals from activities such as vibration and oil analysis indicate that maintenance is due. The total time for planned maintenance includes overtime attributed to these activities including contractors' time. Utilities have an opportunity to separate maintenance time allocated to linear resources (distribution and collection systems) and vertical resources (plants and pump stations).
- Combined utilities – Provide both water (W) AND wastewater (WW) services (and/or stormwater services).

Corrective maintenance is disruptive and is accompanied with high ancillary costs in fiscal, social, and environmental terms. AMPS are drafted to provide continuous improvement by enhancing the presence of planned maintenance and to minimize corrective maintenance.

AWWA 2022 TOTAL PLANNED MAINTENACE RATIO (COMBINED UTITLIY)

$$Total\ planned\ mainteance\ ratio\ (TPMR) = \frac{A}{B}$$

$$TPMR = \frac{3605 + 2215}{7834 + 3716}$$

$$TPMR = 0.50 = 50\%$$

A = Total time for planned W and WW maintenance

B = Time for planned W and WW maintenance + time for corrective W and WW maintenance.

AWWA 2022 Aggregate data for total planned maintenance ratio

	75th percentile	Median	25th percentile	Sample size
Combined utilities	68%	56%	47%	61

Shown below is the W and WW Assets Program Summary outputs from the CMMS system.

Water Assets Program Summary

From: 7/1/2023 To: 6/30/2024

	TOTALHOURS	LABORCOST	EQUIPMENTCOST	MATERIALCOST	TOTAL COST
Billable Services	599.50	$ 20,523.30	$ 8,939.65	$ 29,254.31	$ 58,717.26
New Installation	1,816.75	$ 58,407.20	$ 18,004.74	$ 290,409.71	$ 366,821.65
Other	633.25	$ 21,335.72	$ 1,473.90	$ 64,508.49	$ 87,318.11
Preventative Maintenance (PM)	2,045.54	$ 75,042.45	$ 365.00	$ 23.98	$ 75,431.43
Rehab & Replace	794.50	$ 27,266.76	$ 6,422.02	$ 53,598.07	$ 87,286.85
Remove	81.00	$ 2,693.17	$ 300.00	$ 165.01	$ 3,158.18
Repair	4,229.00	$ 156,441.98	$ 23,196.72	$ 52,289.65	$ 231,928.35
Replace	4.00	$ 248,635.56	$ 0.00	$ 0.00	$ 248,635.56
Scheduled Repair	46.50	$ 1,591.68	$ 0.00	$ 225.16	$ 1,816.84
Program Totals:	10,250.04	$ 611,937.83	$ 58,702.03	$ 490,474.38	$ 1,161,114.24

Sewer Assets Program Summary

From: 7/1/2023 To: 6/30/2024

	TOTALHOURS	LABORCOST	EQUIPMENTCOST	MATERIALCOST	TOTAL COST
Billable Services	599.00	$ 20,553.38	$ 8,379.14	$ 14,657.03	$ 43,589.55
New Installation	482.50	$ 73,439.84	$ 5,762.38	$ 47,490.28	$ 126,692.50
Other	304.00	$ 39,123.37	$ 2,737.02	$ 11,996.16	$ 53,856.55
Predictive Maintenance (PdM)	6.00	$ 178.86	$ 0.00	$ 0.00	$ 178.86
Preventative Maintenance (PM)	847.00	$ 27,820.32	$ 8,480.00	$ 2,791.84	$ 39,092.16
Rehab & Replace	847.25	$ 49,341.30	$ 13,805.72	$ 87,831.11	$ 150,978.13
Remove	106.00	$ 3,624.65	$ 948.03	$ 319.95	$ 4,892.63
Repair	1,500.75	$ 56,119.46	$ 8,860.56	$ 8,604.58	$ 73,584.60
Scheduled Repair	104.50	$ 11,150.95	$ 1,056.01	$ 9,478.88	$ 21,685.84
Program Totals:	4,797.00	$ 281,352.13	$ 50,028.86	$ 183,169.83	$ 514,550.82

Activity Rehab & Replacement (R&R) through CIP:

With funding available to rehab and replace assets, the application of project selection and then project management is paramount into effective and efficient results. HPU encourages PMI endorsed project management principles to plan and complete effective and efficient projects. During FY2023 HPU allocated $0.72M to CIP R&R. The distribution of these expenditures can be reported from Cityworks. Most funds were allocated to slip lining of pipes and open cut excavations for manhole and pipe replacements.

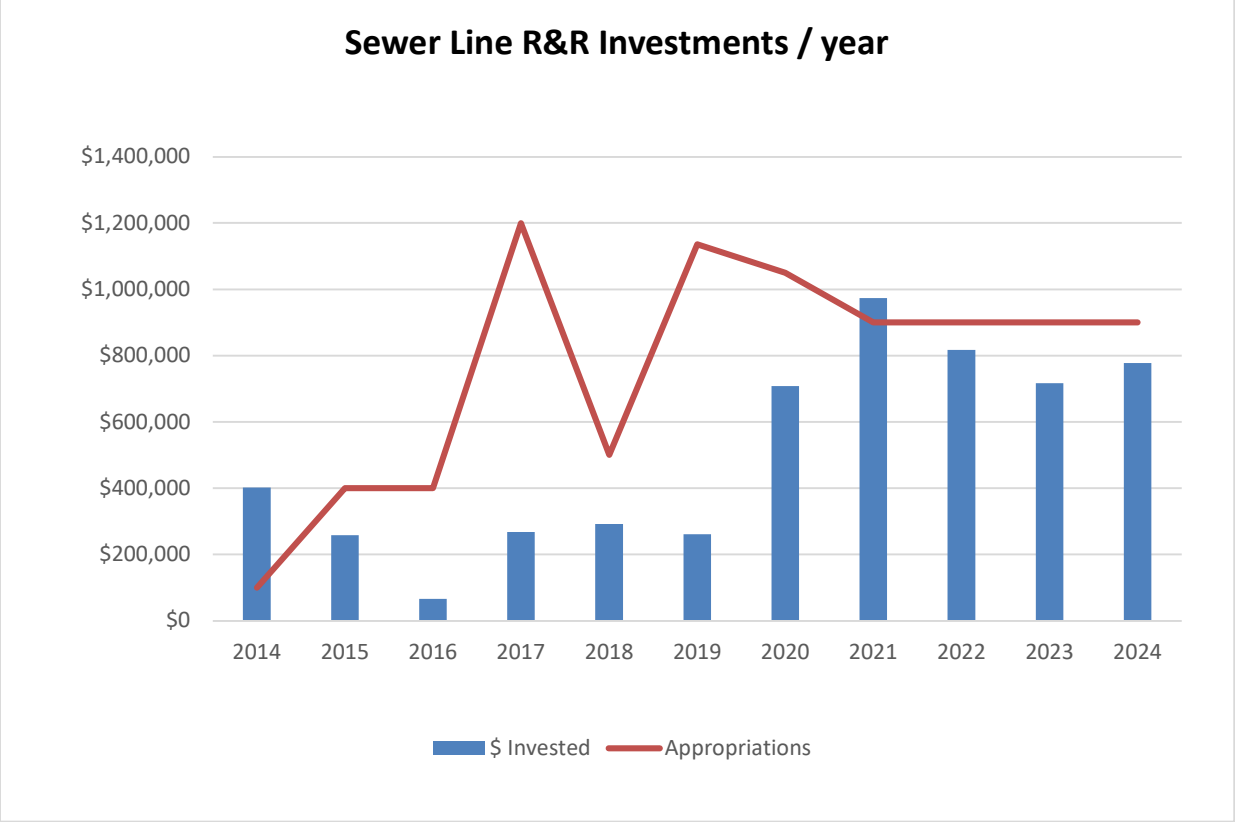


Figure 14

Activity Flow Monitoring:

<u>During FY2020 baseline flow monitoring was completed for ILOS status. The data will provide a baseline for five-year interval comparisons.</u>

The majority of flow monitoring in FY2020, was conducted by RJN under the City Interceptors ILOS study. As noted earlier for the ten years level of service, the study showed one (1) manhole overflow in the North Interceptor and seven (7) manhole overflows in the East Interceptor. The study also divided the City into subsections with identified area of high I&I and thus preferred areas for future flow monitoring.

RJN recommendations for Task Order 3.1 Blacks Run Interceptor Monitoring for Model Development

Full manhole inspections and smoke testing of the HN01 and HN02/HN05 area is recommended to identify sources of infiltration and inflow. Additionally, the HE02 area should be reviewed in order to identify excessive flow sources in the Harrisonburg East system.

Specific recommendations are detailed in Section 5 of the RJN report but summarized below:

- Task 3.2 Model calibration results should be used to determine if any additional flow metering is required.
- Task 3.2 model work should be completed to determine the location of capacity constrained areas. Options to address these findings should be investigated by implementing modeling Phase 2, which involves using the hydraulic model to conduct alternative analysis.
- Based on the results of this report, comprehensive manhole inspections and smoke testing are recommended in the HN02/HN05, HN01, and HE02 areas to investigate excessive inflow.
- Based on the results of this report relative to infiltration, night flow isolation weir measurements are recommended in the HN01 and HN02/HN05 areas.
- Use the flow isolation results to prepare a focused CCTV inspection schedule for the HN01 and HN02/HN05 areas.
- A pilot project for full Sanitary Sewer Evaluation Survey (SSES) in HN01 is recommended to initiate the program, evaluate results, and provide guidance for program continuance. It should include manhole inspections, smoke testing, flow isolations, and CCTV pipe inspection.

RJN recommendations for Task Order 3.3 Lower Blacks Run Interceptor

Monitoring for Model Development

The most downstream basin BR57/BR65 area should have full manhole inspections and smoke testing of this area is recommended to identify sources of infiltration and inflow.

Specific recommendations are detailed in Section 5 of the RJN report but summarized below:

- Based on the results of this report, comprehensive manhole inspections and smoke testing are recommended in the BR57/BR65 area to investigate excessive inflow.
- Based on the results of this report relative to infiltration, night flow isolation weir measurements are also recommended in the BR57/BR65 area.

•Use the flow isolation results to prepare a focused CCTV inspection schedule for the BR57/BR65 area.

RJN has been contracted to update the flow monitoring data across the City during the spring of 2025. The Interceptor ILOS study update will follow shortly after with an anticipated completion date by July 1, 2025.

Activity Smoke Testing:

The second component for I&I abatement is smoke testing. HPU attempts to complete 100,000 feet of smoke testing per year. This amounts to approximately 10% of the collection system, which allows for a 10-year system-wide completion cycle. **HPU completed smoke testing for 99,986 feet of sewer in FY2024.** HPU Field Utilities completed smoke testing during dry weather conditions on the entire HN02/05 sub-basin. HN02/05 shows a much higher Unit Rate for peak inflow as compared to other sub-basins in the City. A detailed project summary of the I&I reduction efforts within this sub-basin is written in the Preliminary Engineering Report for CIP No. 576-24-25. Repeated smoke testing within HN02/05 may be required depending on effectiveness of meeting stated goals. Shown in Figure 15 is the completed activity schedule over a ten year period.

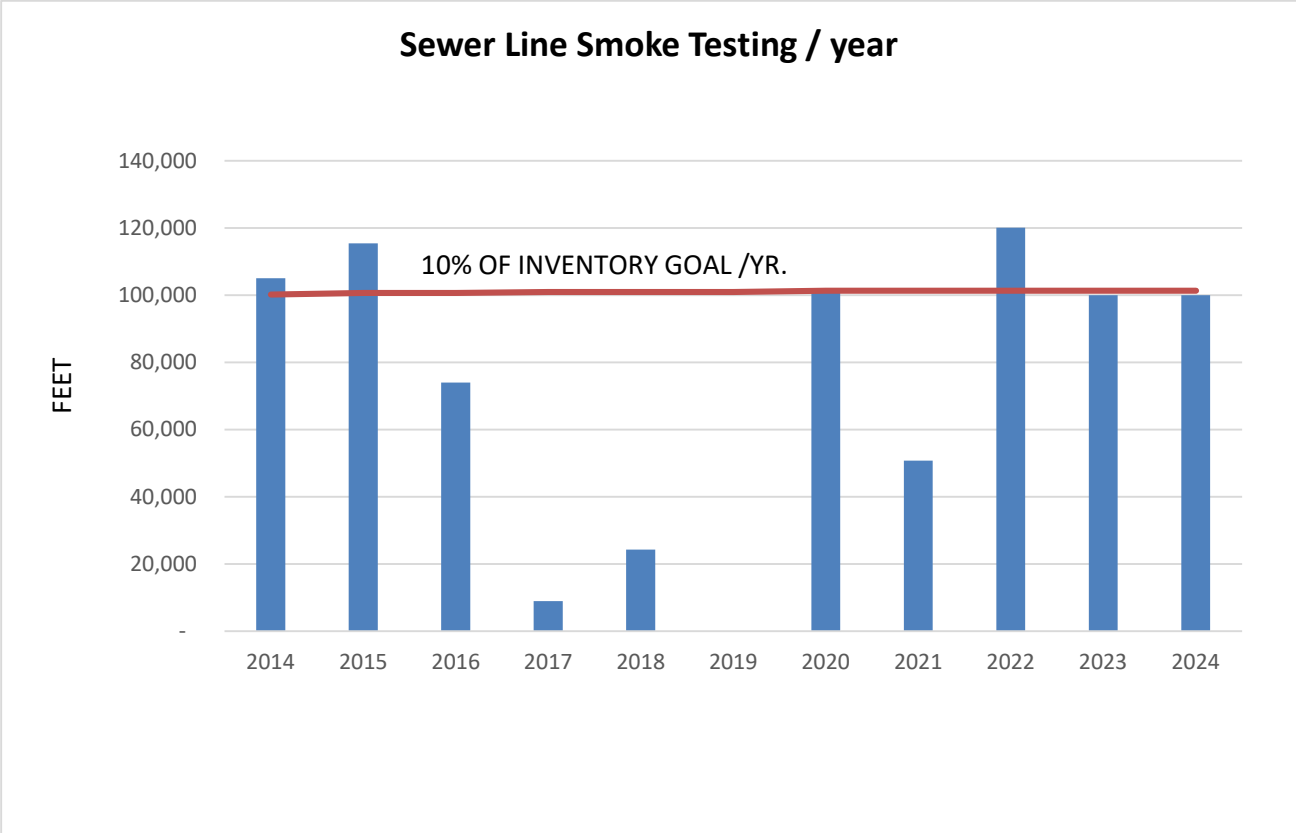


Figure 15