DRAFT

SYSTEM CHARACTERIZATION REPORT

Camden County Municipal Utilities Authority
City of Camden
City of Gloucester

NJPDES Permit Nos.

NJ0026182

NJ0108812

NJ0108847

Draft June 2018

cdmsmith.com

DRAFT

Intermunicipal Agreements

DRAFT

Andy Kricun

Resolution of

THE CAMDEN COUNTY MUNICIPAL UTILITIES AUTHORITY

Authorizing an Intermunicipal Agreement With the Cities of Camden and Gloucester for Preparation of a NJDEP-Required Combined Sewer Overflow System Management Plan

#R-13:7-103

Whereas, the New Jersey Department of Environmental Protection has promulgated new regulations for combined sewer overflow systems that require the CCMUA, Camden City and Gloucester City to develop a new Combined Sewer Overflow System Management Plan for the overall system that comprises the CCMUA's wastewater treatment plant, Camden City's combined sewer overflow system and Gloucester City's combined sewer overflow system; and

Whereas, the interconnectedness of these three systems dictates that one plan addresses all three systems; and

Whereas, accordingly, the CCMUA, Camden City and Gloucester City have negotiated an intermunicipal agreement which calls for the CCMUA to prepare the NJDEP-required plan for the three systems, while reaffirming the Cities' ongoing responsibility to own, operate and maintain their own systems.

Now, Therefore Be It Resolved by the CCMUA Board of Commissioners that it authorizes execution of an intermunicipal agreement with the Cities of Camden and Gloucester for preparation of a NJDEP-required Combined Sewer Overflow System Management Plan

ADOPTED: July 15, 2013

Kim Michelini

Kim Michelini, Authority Secretary

I hereby certify that the foregoing is a true copy of the Resolution adopted by the members of the Camden County Municipal Utilities Authority at a meeting held on July 15, 2013.

Kim Michelini

DRAFT

Intermunicipal Agreement Among Camden County Municipal Utilities Authority, Camden City and Gloucester City For Completion of NJDEP-Required Planning For Combined Sewer Systems

Whereas, the New Jersey Department of Environmental Protection has promulgated new requirements for combined sewer overflow systems which include the requirement that owners of combined sewer systems must develop new planning documents to demonstrate best management practices and minimization of combined sewer overflows; and

Whereas, accordingly the Camden County MUA, Camden City and Gloucester City agree as follows:

1) The Camden County MUA will complete the planning requirements for the Cities of Camden and Gloucester at its own cost. Camden City and Gloucester City will provide as much of the required background information as possible in order to assist the CCMUA in completing the required planning documents.

2) Although the CCMUA is undertaking this planning study on behalf of Camden City and Gloucester City at its own cost, all parties agree that this does not, in any way, alleviate Camden City and Gloucester City's ongoing responsibilities to own, operate and maintain their combined sewer systems, or to undertake any improvements that may be required as a result of the aforementioned planning study or any other NJDEP requirements.

IN WITNESS WHEREOF, the parties hereto have made and executed this Agreement and affixed their corporate seals as of the day and year first above written.

CAMDEN COUNTY MUNICIPAL UTILITIES AUTHORITY
OWNER

BY: Michael Brennan 8/19/13
Michael G Brennan, Chairman Date

ATTEST:

CAMDEN CITY

BY: Dana L. Redd 7/29/13
Name/Title: Dana L. Redd Mayor Date

ATTEST:

GLOUCESTER CITY

BY:
Name/Title: Date

ATTEST: Kathleen Jentsch

THE CAMDEN COUNTY MUNICIPAL UTILITIES AUTHORITY

DRAFT

RESOLUTION OF THE CITY OF GLOUCESTER CITY

#R 159-2013

RESOLUTION AUTHORIZING INTERLOCAL AGREEMENT BETWEEN CAMDEN COUNTY MUNICIPAL UTILITIES AUTHORITY, CAMDEN CITY AND GLOUCESTER CITY FOR COMPLETION OF NJDEP-REQUIRED PLANNING FOR COMBINED SEWER SYSTEMS

WHEREAS, the New Jersey Department of Environmental Protection has promulgated new requirements for combined sewer overflow systems which include the requirement that owners of combined sewer systems must develop new planning documents to demonstrate best management practices and minimization of combined sewer overflow; and

WHEREAS, accordingly the Camden County MUA, Camden City and Gloucester City agree as follows:

1) The Camden County MUA will complete the planning requirements for the Cities of Camden and Gloucester at its own cost. Camden City and Gloucester City will provide as much of the required background information as possible in order to assist the CCMUA in completing the required planning documents.
2) Although the CCMUA is undertaking this planning study on behalf of Camden City and Gloucester City at its own cost, all parties agree that this does not, in any way, alleviate Camden City and Gloucester City's ongoing responsibilities to own, operate and maintain their combined sewer systems, or to undertake any improvements that may be required as a result of the aforementioned planning study or any other NJDEP requirements.
3) Gloucester City will review, approve all plans and deliverables prior to any submittal.

William P. James, Mayor

Passed by the Mayor and Common Council of Gloucester City this 27th day of June, 2013.

It is hereby certified that the foregoing is a true and correct copy of a resolution duly adopted by the City of Gloucester City, in the County of Camden, at a meeting held on 6-27-13

Kathleen M. Jentsch, RMC

Kathleen M. Jentsch, City Clerk

DRAFT

RESOLUTION MC-13: *3188*
On Motion Of: Dana M. Burley
APPROVED: June 11th, 2013

R-64

MAR:dh
06-11-13

RESOLUTION AUTHORIZING A SHARED SERVICES AGREEMENT BETWEEN THE CITY OF CAMDEN, THE CITY OF GLOUCESTER AND THE CAMDEN COUNTY MUNICIPAL UTILITIES AUTHORITY FOR THE PLANNING OF THE NEW PERMIT REQUIREMENTS FOR THE COMBINED SEWAGE OVERFLOW SYSTEM

WHEREAS, the New Jersey Department of Environmental Protection has promulgated new requirements for combined sewer overflow systems which include the requirement that owners of combined sewer systems must develop new planning documents to demonstrate best management practices and minimization of combined sewer overflows; and

WHEREAS, accordingly the Camden County MUA, Camden City and Gloucester City agree as follows:

SECTION 1. The Camden County MUA will complete the planning requirements for the Cities of Camden and Gloucester at its own cost. Camden City and Gloucester City will provide as much of the required background information as possible in order to assist the CCMUA in completing the required planning documents.

SECTION 2. Although the CCMUA is undertaking this planning study on behalf of Camden City and Gloucester City at its own cost, all parties agree that this does not, in any way, alleviate Camden City and Gloucester City's ongoing responsibilities to own, operate and maintain their combined sewer systems, or to undertake any improvements that may be required as a result of the aforementioned planning study or any other NJDEP requirements.

NOW THEREFORE, BE IT RESOLVED by the City Council of the City of Camden that a Shared Services Agreement is hereby authorized between the City of Camden and the City of Gloucester and the Camden County Municipal Utilities Authority for the Planning of the new permit requirements for the Combined Sewage Overflow System.

BE IT FURTHER RESOLVED, that pursuant to N.J.S.A. 52:27BBB-23, a true copy of this Resolution shall be forwarded to the State Commissioner of Community Affairs, who shall have ten (10) days from the receipt thereof to veto this Resolution. All notices of veto shall be filed in the Office of the Municipal Clerk.

Date of Introduction June 11, 2013

The above has been reviewed
and approved as to form.

For MARC A. RIONDINO
City Attorney

FRANCISCO MORAN
President, City Council

ATTEST:

LUIS PASTORIZA
Municipal Clerk

I, LUIS PASTORIZA, MUNICIPAL CLERK OF THE CITY OF CAMDEN, DO HEREBY CERTIFY, that the foregoing is a true copy of a resolution entitled "**Resolution authorizing a shared services agreement between the City of Camden, The City of Gloucester and the Camden County Municipal Utilities Authority for the planning of the new permit requirements for the combined sewage overflow system** "**ADOPTED** by the Council of the City of Camden, New Jersey, the **11th** day of **June 2013** as taken from and compared with the original now on file in my office.

IN TESTIMONY WHEREOF, I have thereunto set my hand and affixed seal of the City of Camden, at this **31st** day of **July, 2013.**

Luis Pastoriza, Municipal Clerk

N.J.A.C. 7:14A-4.9 Certifications

DRAFT

Camden County Municipal Utilities Authority
NJPDES Permit NJ0026182 Submittal
N.J.A.C 7:14A-4.9 Certification Form

Pursuant to the requirements under NJPDES Permit NJ0026182, the Camden County Municipal Utilities Authority (CCMUA) is submitting the following document(s)

<u>System Characterization Report</u>
(Title of Document)

As required under Part IV - Combined Sewer Management Paragraph D.1(c) (Submittals), the Authority is providing the following certification:

> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information".

Andrew Kricun, P.E., BCEE
Executive Director/Chief Engineer
Camden County Municipal Utilities Authority

____

Signature

____

Date

DRAFT

DRAFT

Camden County Municipal Utilities Authority
NJPDES Permit NJ0108812 Submittal
N.J.A.C 7:14A-4.9 Certification Form

Pursuant to the requirements under NJPDES Permit NJ0026182, the City of Camden, New Jersey is submitting the following document(s):

System Characterization Report
(Title of Document)

As required under Part IV - Combined Sewer Management Paragraph D.1(c) (Submittals), the Authority is providing the following certification:

> "I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted; or (b) as part of a cooperative effort by members of a hydraulically connected system, as is required under the NJPDES Permit, to provide the information requested. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information".

Name:____, Title: _____________________________
City of Camden

____
Signature

____
Date

Camden County Municipal Utilities Authority
NJPDES Permit NJ0026182 Submittal
N.J.A.C 7:14A-4.9 Certification Form

Pursuant to the requirements under NJPDES Permit NJ0108847, Gloucester City, New Jersey is submitting the following document(s):

System Characterization Report
(Title of Document)

As required under Part IV - Combined Sewer Management Paragraph D.1(c) (Submittals), the Authority is providing the following certification:

> "I certify under penalty of law that this document and all attachments were prepared either: (a) under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted; or (b) as part of a cooperative effort by members of a hydraulically connected system, as is required under the NJPDES Permit, to provide the information requested. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information".

Name:____ Title: ____________________________

Gloucester City

____
Signature

____
Date

DRAFT

SYSTEM CHARACTERIZATION REPORT

Camden County Municipal Utilities Authority
City of Camden
City of Gloucester

NJPDES Permit Nos.

NJ0026182

NJ0108812

NJ0108847

Draft June 2018

CDM Smith

cdmsmith.com

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APPENDICES

DRAFT

Executive Summary

DRAFT

Executive Summary Revised 06/27/18

E.1 Baseline & Next Steps: *Clean, Green, Optimize*

Baseline, the combined sewer system in Camden and Gloucester captures 68% of wet weather flow, and the remaining 32% either overflows to area waterways (as CSO) or to the surface as flooding. This Systems Characterization Report points towards the reduction of flooding and the control of CSOs through the following:

1. ***It is absolutely essential that the City of Camden's sewer and outfall pipes be cleaned to restore their hydraulic capacities, and then maintained on an ongoing basis thereafter. If the Camden system's hydraulic capacity is not maintained by the City on an ongoing basis, the result will be a corresponding increase in combined sewer flooding and overflows. To this end,*** the City of Camden has entered into an operations agreement with American Water which requires that the entire system be cleaned every three years;
2. Using green stormwater infrastructure to reduce the burden on the combined system to the maximum extent feasible;
3. ***Expanding CCMUA's Water Pollution Control Facility*** to maximize wet weather flows to the treatment plant ***will be a crucial component in any long term control plan.*** CCMUA has completed designs that will increase wet weather capacity from 150 to 185 million gallons per day (mgd) and is exploring options with NJDEP to further increase the capacity to 220 mgd;
4. Optimizing key elements of the existing system such as regulator structures and pump stations to allow more combined sewer flow to reach the expanded treatment plant; and
5. CCMUA and the City of Camden working together to target and implement additional phased upgrades to the combined sewer system to further reduce flooding and CSOs.

These control strategies will be refined and evaluated in the forthcoming Development and Evaluation of Alternatives Report, the next element in the development of a Long Term Control Plan (LTCP) for the City of Camden, Gloucester City and the Camden County Municipal Utilities Authority.

E.2 Introduction

This document constitutes Camden County Municipal Utilities Authority's (CCMUA) *Sewer System Characterization Report* (SCR) developed by CCMUA on behalf of CCMUA, the City of Camden and Gloucester City (the Cities). The SCR documents the physical nature and hydraulic performance of the combined sewer system. It is organized into eight sections:

1. ***Introduction*** – Provides the regulatory context, a brief overview of the combined sewer system and service area covered in the SCR and outlines the organization of the SCR in the context of specific NJPDES permit requirements;
2. ***Combined Sewer System Characterization*** – Describes the physical nature, operation and maintenance (O&M) practices of the Cities' combined sewer systems and CCMUA's Water Pollution Control Facilities No. 1. Included are near term capital improvements, areas associated with street flooding and significant industrial users;
3. ***Hydrologic Characterization*** – Summarizes the underlying hydrology of the combined sewer system which controls the stormwater runoff characteristics;
4. ***Receiving Waterbodies*** – Characterizes the receiving streams into which the combined sewer overflows discharge and provides a baseline water quality assessment, and identifies sensitive areas as defined in the USEPA CSO Control Policy;
5. ***Combined Sewer System Monitoring and Modeling*** – Documents the hydrologic and hydraulic model used to characterize the performance of the combined sewer system and in the forthcoming development and evaluation of CSO control strategies;
6. ***Rainfall Analysis and Typical Hydrologic Record*** – Documents the selection of a meteorological "typical year" that best represents the average rainfall statistics for the service area;
7. ***Combined Sewer System Performance*** – Defines the baseline performance of the combined sewer system during the typical year; and
8. ***Institutional Context*** – Provides an overview of roles, responsibilities and legal framework for wastewater and stormwater management in the service area.

E.3 Key Findings

Key findings concerning characterization and performance of the combined sewer system under baseline (2015) conditions and insights relevant to the development of combined sewer overflow (CSO) controls moving forward can be summarized as follows:

System Characterization

- The contributing area to the combined sewer system within the Cities of Camden and Gloucester is 8.2 square miles and the system itself is complex, consisting of more than 210 miles of pipe, 30 regulator structures, 17 pump stations, 37 solids and floatable control (netting) facilities and CCMUA's Water Pollution Control Facility No. 1 (WPCF No. 1). (Section 2)
- CCMUA is proactively expanding the treatment capacity of WPCF No. 1 to 185 million gallons per day (mgd). CCMUA is also evaluating the availability of excess primary treatment capacity (in excess of secondary treatment capacity) that could be used during wet weather to further improve pollutant removal at the facility. (Section 2)

Receiving Waterbody Characteristics

- As is true for other New Jersey combined sewer system permittees and those nationally, the primary water quality driver for CSO control is pathogens. (Section 4)
- A designated use for the Delaware River is secondary contact recreation. This use was determined as being fully supported in terms of water quality standards for pathogens.[E-1] Based on the baseline receiving water quality assessment, there does not appear to be a meaningful change in pathogen levels in the Delaware River upstream and downstream of the Camden and Gloucester CSOs. (Section 4)
- The pathogen standards for the primary contact recreation designated use were not met in the Cooper river upstream or downstream of the Camden CSOs. This was also the case for Newton Creek. (Section 4)
- There is the potential that parts of the Delaware and Cooper Rivers receiving CSO discharges could be suitable habitats for the Short-Nose Sturgeon and for several threatened or endangered species of mussels. If these areas are suitable habitats and these species of aquatic wildlife are present there, these areas would be considered as sensitive areas as defined in the U.S.EPA CSO Control Policy and will require special attention in the development of long term CSO control strategies. (Section 4)

System Performance and Implications for CSO Control Alternative Development

- Around 75% of the land use in Camden and Gloucester is classified as urban and around 54% of the land surface is impervious, providing both challenges and opportunities for further wet weather flow reduction through green stormwater infrastructure. (Section 3)
- CCMUA has developed a robust hydrologic and hydraulic model using U.S. EPA SWMM 5 software that has been used to evaluate the baseline performance of the combined sewer system for this system characterization report and will be used to evaluate CSO control alternatives moving forward. (Section 5)
- CCMUA has identified 2014 as the "typical year" best representing the long term precipitation statistics in Camden and Gloucester for use in the baseline characterization and in future CSO control option modeling. (Section 6)
- Under baseline conditions, around 68% of wet weather flow generated within the combined sewer system is captured for treatment during the typical year. Flows not captured, i.e. combined sewer overflows, discharge to the waterbodies at the CSO outfalls (overflows) and to the surface in the combined sewer communities (flooding). About 830 million gallons of combined sewage overflows annually and around 90 million gallons of surface flooding occurs within the modeled sewers (flow from the entire system is modeled but not routed through all pipes in the system; additional surface flooding is assumed to occur in the smaller non-modeled pipes). (Section 7)
- Under baseline conditions the Camden sewer pipes are heavily impacted by accumulated debris and sedimentation. With the hydraulic impediments to the Camden sewer pipes removed by cleaning, the modeled flooding volume decreases to 50 million gallons in the

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[E-1] Source: NJDEP 2012 New Jersey Integrated Report, Appendix A (Assessment Unit Summary List), July 2014 typical year. Overflow volume would increase to 855 million gallons, reflecting that the cleaned pipes are relieving surface flooding by transporting the stormwater and combined sewage to the outfalls. (Section 7)

- With the expansion of the WPCF No. 1 capacity to 185 mgd, in the typical year the percentage of wet weather flow captured would increase from 68% to 76%; the overflow volume would decrease to 627 million gallons, and the modeled flooding volume would decrease to 44 million gallons. Further improvements to wet weather system performance may be possible with additional expansion of the WPCF No.1 as is currently being evaluated by CCMUA. (Section 7)
- The proper operation and maintenance of the municipal sewer systems to maintain their design capacities will be a foundational assumption in the development and evaluation of CSO control alternatives and in the parallel evaluation of combined sewer surface flooding reduction efforts. The full implementation of Camden's 2014 Best Management Practices Plan and Gloucester's Standard Operating Procedures, Preventive Maintenance and Emergency Response manual are incorporated by reference to this System Characterization Report. (Section 8)

E.4 Section Synopses

E.4.1 Section 1 – SCR Introduction

Regulatory Context

Under their respective NJPDES permits CCMUA, Camden and Gloucester are required to develop a long term CSO control plan (LTCP) in a series of reports to be submitted to NJDEP on the following schedule:

- System Characterization Report (this report) – July 1, 2018;
- Development & Evaluation of Alternatives Report – July 1, 2019; and
- Selection and Implementation of Alternatives Report – June 1, 2020.

Combined Sewer System and Service Area Overview

CCMUA is the regional wastewater treatment authority of Camden County, New Jersey, providing wastewater treatment to a service area of 226 square miles and a population of roughly 500,000. The Authority serves 37 municipalities in Camden County. CCMUA provides regional wastewater conveyance and treatment services through 135 miles of interceptor sewers, 27 pump stations and the 80 million gallon per day (mgd) Delaware No. 1 Water Pollution Control Facility (WPCF). CCMUA's regional service area and facilities are shown on Figure E-1. The Camden and Gloucester sewer systems are shown on Figure E-2.

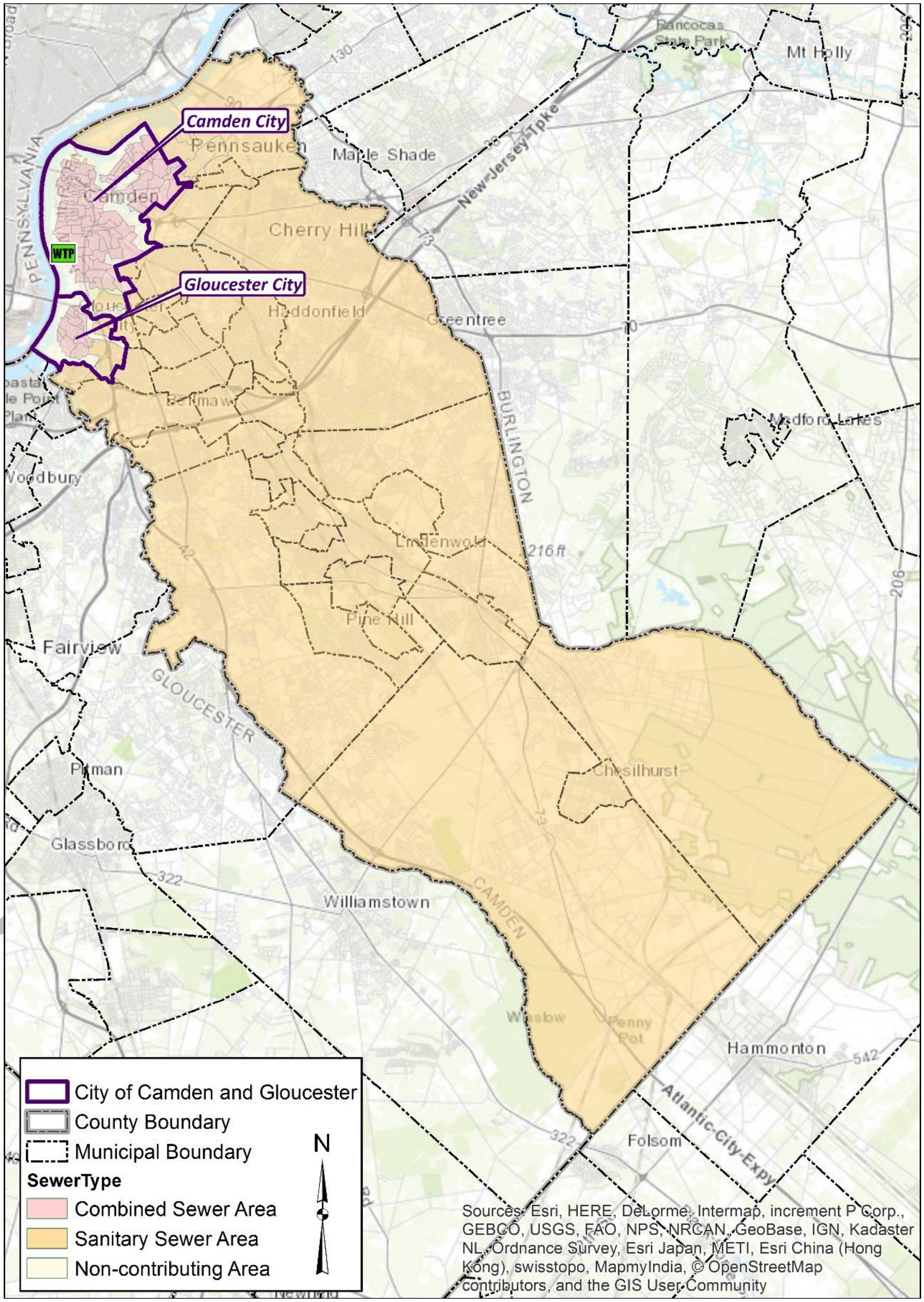

Figure E-1
CCMUA Service Area

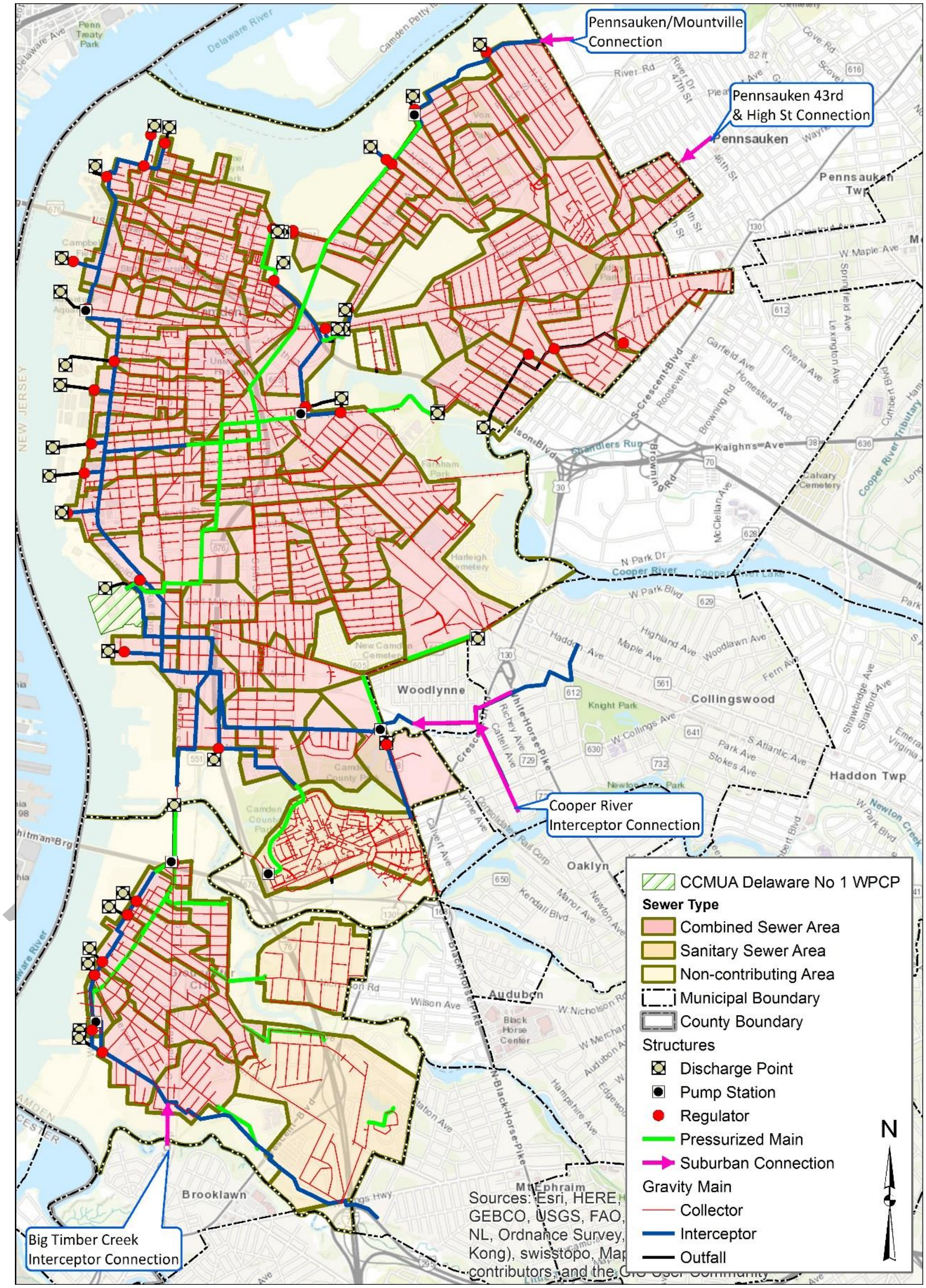

Figure E-2
Camden and Gloucester Sewer Systems Base Map

E.4.2 Section 2 – Combined Sewer System Characterization

System Overview

The Combined Sewer System consists of the respective collection systems owned and operated by the Cities of Camden and Gloucester and the portion of the CCMUA's regional conveyance interceptor system that is located within the Cities of Camden and Gloucester. The general characteristics of the combined sewer system are summarized on Table E-1.

Table E-1 – Collection System Overview

Jurisdiction	# Sewer-sheds	Collection System Pipe in Miles[E-2]	Appurtenances				Contributing Area (square miles)
			Active Regulators	Active Outfalls	Pump Stations	Solids & Floatables Control Facilities	
Camden	29[E-3]	173	22	22	8	22	6.6
Gloucester	7	39	7	7	7	7	1.6
CCMUA			1	1	2	1	
Totals	36	212	30	30	17	30	8.2

The City of Camden has a total area of approximately ten square miles and a population of about 77,344 (2010 Census). The average daily wastewater flow generated within the City is estimated to be approximately 20 mgd. The wastewater collection system consists primarily of combined sewers. There are approximately 170 miles of combined sewers capturing runoff from nearly 4,000 storm inlets, about 60 percent of which were constructed before 1920. The Gloucester City collection system serves an area of approximately 1.6 square miles. The bulk is in combined sewered areas of the City however there are some areas within newer sanitary sewered neighborhoods that are east of the older riverfront portions of the City. There are about 40 miles of combined and sanitary sewers within Gloucester City.

There are a total of 36 sewersheds[E-4] within the Camden and Gloucester combined sewer systems. These include thirty within the City of Camden and seven in Gloucester City. Each of these sewersheds drain to a regulator structure controlling the amount of wet weather flow that enters into the interceptor sewers from the Camden and Gloucester trunk sewers. As of 2018, there are a total of 30 active CSO outfalls located within the two cities. Overflows from CSO outfalls discharge into three receiving streams: the Delaware and Cooper Rivers and Newton Creek.

Flows into the interceptor sewers are controlled by regulator structures which admit the dry weather flows plus a portion of the stormwater runoff during wet weather. When the rate of wet weather flows exceed the flow rates that can be admitted to the interceptor, the remaining wet

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E-2 Source: Table 2-2 from the Sewer System Inventory and Assessment / Facilities Inventory and Assessment Analysis Final Report prepared by CH2MHill, November 1999

E-3 Includes Camden sewersheds flowing to the C-32 regulator for which CCMUA is the permittee.

E-4 A sewershed is analogous to a watershed. It is a geographically delineated area typically defined by topography and represents the area drained by the street sewers (collection system) which converge on a downstream outfall or connection to an interceptor sewer.

weather flows are shunted to an outfall pipe to the receiving stream. The Camden outfalls were inspected in 2016. Based on these inspections, a cleaning and dredging program has been undertaken by CCMUA and Camden. As many of the outfalls are submerged and in tidal waters, dredging is required to regain full hydraulic capacities. CCMUA has contracted for the dredging of nine outfalls. The City of Camden has undertaken the cleaning of twelve of the twenty-two outfalls within its combined sewer system.

CCMUA treats approximately 60 million gallons per day (mgd) of sewage on average at its Delaware No. 1 Water Pollution Control Facility (WPCF). The plant was expanded in the late 1980s to a secondary treatment facility with a dry weather capacity of 80 mgd and a wet weather capacity of 150 mgd.

Current Capital Improvement

CCMUA is currently implementing a number of major capital improvements that will directly improve the control of CSO discharges and/or reduce street and basement flooding within the City of Camden:

- The treatment capacity of WPCF No. 1 is being expanded to 185 mgd through the reconfiguration of the influent chamber, upgraded raw sewage pumps and the optimization of the existing plant tankage and equipment. CCMUA is also evaluating the availability of primary treatment capacity that exceeds secondary treatment capacity to further expand wet weather treatment capability.
- CCMUA is installing a 100 mgd stormwater pump station near the foot of Elm Street and the Delaware River to address street flooding along and in the vicinity of Delaware Avenue south of the Ben Franklin Bridge for wet weather events up to the ten-year return period storm.
- CCMUA and Camden are also undertaking a related project involving the rehabilitation and reconfiguration of the 84" Cooper Street sewer.
- Finally, CCMUA and Camden are upgrading the capacity of the Arch Street Lift Station.

Camden Street Flooding

Street and basement flooding during wet weather has been a major public health, environmental and economic problem for the City of Camden for many years. Areas of Camden with reported street flooding are mapped on Figure E-3.

E.4.3 Section 3 – Hydrologic Characterization

The Cities of Camden and Gloucester cover approximately 4,235 acres (6.6 square miles) and, 1,000 acres (1.6 square miles) respectively. The dominant land use type in both the City of Camden and City of Gloucester is urban. This includes different density residential, industrial, commercial, roads and highways, and other urban or built-up land uses. Land use by category is shown on Table E-2.

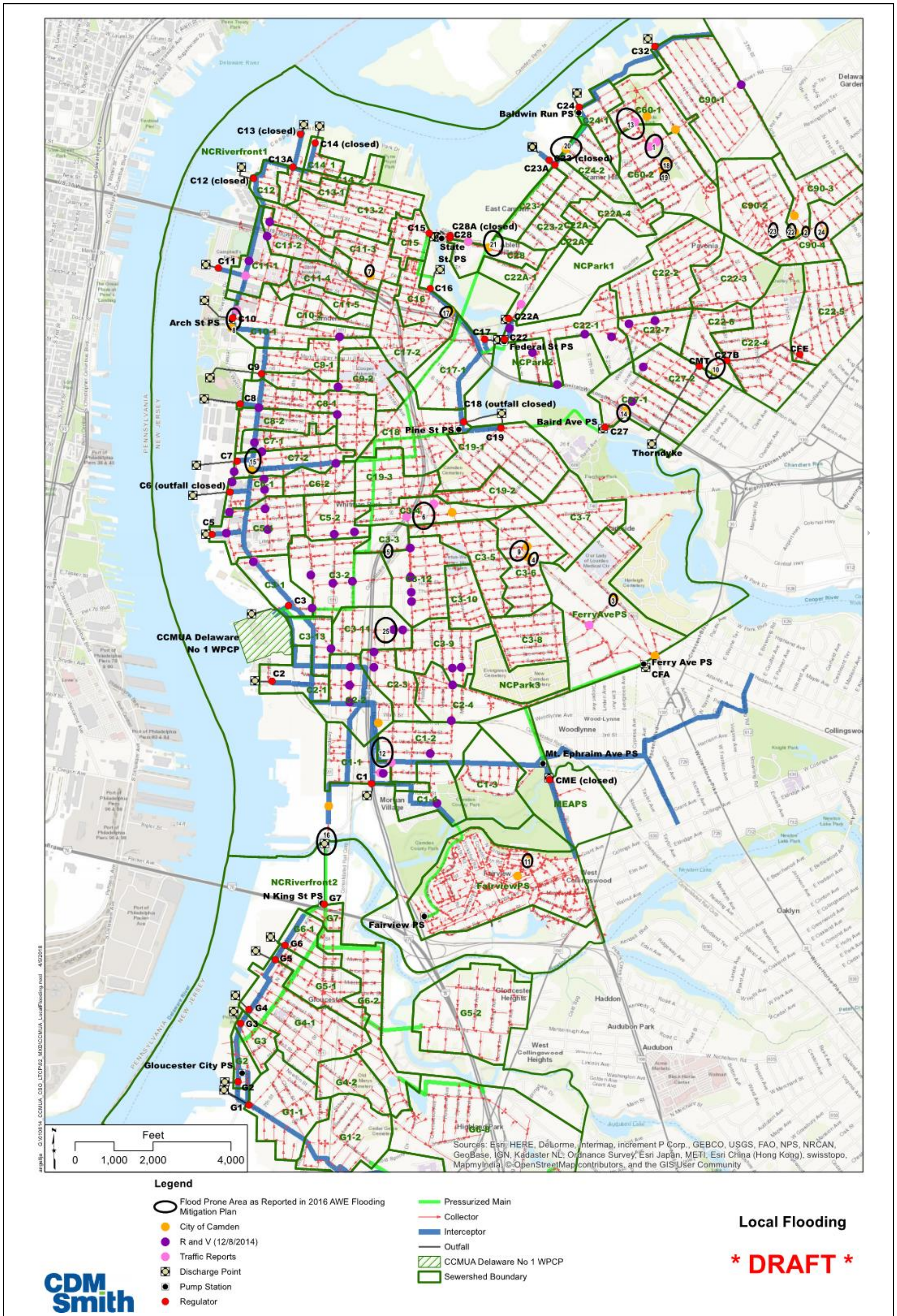

Figure E-3 – Locations Associated with Street Flooding

Table

Table E-2 – Land Use Types by Municipality[E-5]

Municipality	Type	Land Use by Acreage	
Camden City	AGRICULTURE	2	0.1%
	BARREN LAND	109	2.6%
	FOREST	163	3.9%
	URBAN	3,201	75.6%
	WATER	622	14.7%
	WETLANDS	138	3.3%
	Totals	4,235	100.0%
Gloucester City	AGRICULTURE	0	0.0%
	BARREN LAND	13	1.3%
	FOREST	41	4.1%
	URBAN	708	70.8%
	WATER	175	17.5%
	WETLANDS	63	6.3%
	Totals	1,000	100.00%

Approximately 56% of the area in Camden is impervious cover based on the 2012 NJDEP data and approximately 42% of the area in Gloucester is impervious cover as shown on Table E-3.

E-3 – Imperviousness Characteristics for the Cities of Camden and Gloucester

Community	Total area	Pervious		Impervious	
	Acres	Acres	%	Acres	%
City of Camden	4,235	1,859	43.9%	2,376	56.1%
City of Gloucester	1,000	579	57.9%	421	42.1%
Grand Total	**5,235**	**2,438**		**2,797**	

E.4.4 Section 4 – Receiving Waterbodies

Receiving Stream Baseline Water Quality

The 30 active CSO outfalls operated by the Cities of Camden and Gloucester and one by CCMUA discharge into the Cooper River and into the main stem and the back channel of the Delaware River and into Newton Creek. CCMUA conducted a baseline water quality assessment to ascertain the role of CSOs in violations of the applicable receiving stream water quality standards. This assessment focused on the water quality standards for pathogens shown on Table E-4 and examined the differences in receiving stream pathogen levels upstream and downstream of the CSO outfalls.

[E-5] Source: NJ Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS)

Table E-4 Water Quality Standards for Different Pathogen Species[E-6]

Pathogen/receiving water	***E. Coli***	***Fecal Coliform***	***Enterococcus***
Delaware River Zone 3	N/A	geometric mean < 770 cfu/100ml	geometric mean < 88 cfu/100ml
Cooper River	Single value < 235cfu/100ml geometric mean < 126 cfu/100ml	N/A	N/A
Newton Creek	Single value < 235cfu/100ml geometric mean < 126 cfu/100ml	N/A	N/A

Based on the review of the existing ambient water quality data, the following findings and recommendations were suggested:

- ***Delaware*** River – There does not appear to be a meaningful change in sampled bacteria levels between upstream samples taken near the Betsy Ross Bridge and downstream samples taken in the vicinity of the Navy Yard. The Delaware River designated use of secondary recreation contact is fully supported. This leads to an inference that the CSO discharges from Camden and Gloucester do not result in a demonstrable impact on the Delaware River water quality for pathogen concentrations;
- ***Cooper River*** – the E. Coli standards for the primary contact designated use were not met upstream or downstream of the CSO outfalls in the Cooper River; downstream geomean concentrations of E. Coli were in general higher than those in upstream samples. This suggests that while CSO discharges do impact instream pathogen levels, background water quality conditions preclude attainment; and
- ***Newton*** Creek – The pathogenic water quality standards for the primary contact recreation designated uses were not met upstream or downstream of the CSO outfalls in Newton Creek; however the E. Coli geomean concentrations were lower in the downstream samples. This suggests that CSO discharges do not impact instream pathogen levels, but background water quality conditions preclude attainment.

Potential Sensitive Areas

In accordance with the National CSO Control Policy,[E-7] CCMUA and the Cities of Camden and Gloucester are required to give highest priority to controlling overflows to receiving waters considered to be sensitive areas. As a part of this system characterization, CCMUA and the Cities performed an analysis to identify any sensitive areas and the CSO outfalls that discharge to them. The results of this analysis are summarized on Table E-5.

[E-6] Source: Delaware River Basin Commission

[E-7] 59 FR 75-18692

Table E-5 – Potential Sensitive Areas Summary

Category		Applicable to Receiving Streams Impacted by CSOs			Notes
		Delaware River	Cooper River	Newton Creek	
1	Outstanding National Resource Waters	No	No	No	Source: NJ Antidegradation Standards, NJDEP
2	National Marine Sanctuaries	No	No	No	Source: National Oceanographic and Atmospheric Administration (NOAA)
3	Waters with Threatened or Endangered Species or Designated Critical Habitat	Potential Habitat for Fresh-water Mussel, Short-nose Sturgeon	Potential Habitat for Fresh-water Mussel	No	Delaware River – Tidewater Mucket Cooper River: – Yellow Lampmussel – Eastern Pondmussel – Tidewater Mucket
4	Waters used for Primary Contact Recreation	No	No	No	No authorized bathing beaches or other primary contact recreation areas were identified.
5	Public Drinking Water Intakes	No	No	No	• Camden & Gloucester water supplies are from wells.[E-8] • Philadelphia Delaware intake is upstream of applicable CSOs.
6	Shellfish Beds	No	No	No	No shellfish beds as defined in the NJ Costal Management Program have been identified.

As shown on Table E-5 there is the potential that parts of the Delaware and Cooper Rivers receiving CSO discharges could be suitable habitats for the Short-Nose Sturgeon and for several threatened or endangered species of mussels. If these areas are suitable habitats and these species of aquatic wildlife are present there, these areas would be considered as sensitive areas as defined in the U.S.EPA CSO Control Policy and will require special attention in the development of long term CSO control strategies.

E.4.5 Section 5 – Monitoring and Baseline Condition Modeling

The CCMUA / Camden /Gloucester system characterization is based on a hydrologic and hydraulic (H&H) model of the combined sewer system (CSS) developed in the widely used U.S.EPA SWMM 5 software. The CSS model was built reflecting the collection and interceptor system as it existed in 2015, which is the Baseline Condition used for system characterization and for purposes of benchmarking system improvements in the LTCP. This Preliminary Baseline Condition Model was re-calibrated using new data from temporary and permanent flow meters and precipitation gauges detailed in Section 5 of this SCR.

[E-8] Sources: Camden 2016 Annual Water Quality Report – PWS NJ0408001, Gloucester City 2016 Consumer Confidence Report.

The Baseline Condition Model has been used to establish the system performance baseline (detailed in Section 7 of this SCR), and will be used to support the development and evaluation of CSO control alternatives for the CSO LTCP.

E.4.6 Section 6 – Typical Hydrologic Record

CCMUA and the Cities evaluated precipitation data to determine the appropriate typical year to be used in characterizing the performance of the combined sewer system and for the analysis of CSO control alternatives. This evaluation identified calendar year 2014 with some storm event modifications to be the appropriate typical year, as detailed in Section 6.

E.4.7 Section 7 – Combined Sewer System Performance

Two ongoing efforts, (1) cleaning of the Camden sewer system and outfalls to restore design hydraulic capacities and (2) expansion of the wet weather treatment capacity at CCMUA's WPCF No. 1 to 185 mgd are considered in the baseline system performance evaluations. The Baseline Combined Sewer System performance is therefore reported under the following three scenarios:

- The Baseline Condition (prior to sewer cleaning and WPCF No. 1 expansion)
- Post-cleaning (after Camden sewers and outfalls with sedimentation restored to their design capacities)
- Post-cleaning with WPCF upgrade (WPCF upgrade to accept 185 mgd peak flow)

The baseline system performance under these scenarios are summarized on Table E-6.

Table E-6 – System Wide Performance for the Typical Year

System Wide Performance Metrics		Baseline Condition	Projected	
			Post-Cleaning	Post-Cleaning + WPCF Capacity @ 185 mgd
1	% Capture	68%	68%	76%
2	Overflow Volume (million gallons)	829	855	627
3	Range of Overflow Frequencies (events)	10-69	23-69	5-70
4	Modeled Surface Flooding (million gallons)	90	50	44

System-Wide Performance Findings

- Baseline condition system-wide percentage capture is 68% with 829 MG in total annual overflow volume.
- Sewer cleaning increased the conveyance and storage capacity of the system which resulted in significant reduction in flooding along with moderate increase in annual overflow volume. Overflow volumes increase due to increased conveyance capacity in the clean overflow pipes and outfalls.
- The ongoing capacity expansion at WPCF No. 1 improved percentage capture (from 68% to 76%), decreased annual CSO volume significantly (by more than 25%) and decreased flooding by 12% compared to the "clean pipe" scenario. Further improvements to the wet weather performance of the system could be achieved with additional expansion of wet weather treatment capacity at WPFC No. 1 as described in Section 2.5.3.

- Overflow frequency in general increased after cleaning and decreased after WPCF headworks expansion, for reasons consistent with those described above for overflow volume.
- Sewer cleaning and WPCF expansion together are projected to reduce predicted surface flooding in the modeled system by more than 50%, from around 90 million gallons to 44 million gallons, during the typical year.

E.4.8 Section 8 – Institutional Context

Roles and Responsibilities

The Camden County Municipal Utilities Authority (CCMUA) provides wastewater conveyance and treatment services for Camden and Gloucester along with thirty-five suburban municipalities within Gloucester County. The two combined sewered municipalities are responsible for the operation and maintenance of their respective systems.

Operation and maintenance for the City of Camden is provided under contract by the American Water Contract Services division of the American Water Company under a ten year contract extending through 2025 and utilizing the City's 2014 Best Management Practices Plan (BMPP).[E-9] The full implementation of Camden's BMPP will be assumed as a baseline condition for purposes of the development of CSO controls in the joint LTCP, including the restoration and maintenance of the hydraulic capacities of the Camden sewers, regulators, outfalls and other appurtenances. Included in the BMPP is the requirement that the entire Camden sewer system including outfalls be cleaned within the first five years of the operating contract with priority being given to areas of flooding, basement backups and pipes that currently contain debris and then cleaned on an ongoing basis on a three year cycle thereafter.

The Gloucester collection system is operated and maintained by the City's Department of Environmental Utilities. The Department operates and maintains its combined sewer system pursuant to its NJPDES permit[E-10] which imposes requirements paralleling those applicable to the City of Camden. Gloucester City's procedures for compliance with these requirements are documented in its Standard Operating Procedures, Preventive Maintenance and Emergency Response manual.

Legal Context

The Camden and Gloucester combined sewer systems are owned and operated by the cities pursuant to Title 40A of New Jersey Statutes (Municipalities and Counties). The financial management of the cities' combined sewer systems are regulated under Chapter 4 of Title 40A. The annual budgets for municipal sewerage systems are controlled through the Local Budget Law, codified at N.J.A.40A:4-1 et seq. Annual operating, debt service, revenue and five-year capital improvement budgets are developed using forms and excel templates specified by the New Jersey Department of Community Affairs. The draft budgets are reviewed and approved by the Department prior to final adoption of the budget by the municipalities prior to the start of the fiscal year.

[E-9] Best Management Practices Plan for the Operation and Maintenance of the Combined Sewer, Separate Sanitary Sewer and Separate Stormwater Systems prepared for the City of Camden in December of 2014 by Greeley and Hansen.

[E-10] NJ0108847 effective October, 2015

CCMUA operates under the New Jersey Municipal and County Utilities Authorities Law[E-11] and under the terms of the Service Agreement of January 1987 with its participant municipalities. Under the terms of the Service Agreement the participant municipalities are individually responsible for the operation, maintenance, expansion and replacement of their local collection systems.[E-12]

Implementation of the Nine Minimum Controls

The USEPA's Combined Sewer Overflow Control Policy establishes nine broad operation and maintenance and minor construction best practices intended to ensure that a municipal permittee's combined sewer system is being optimized.[8-13] The requirement to fully implement the nine minimum controls is incorporated into Section F of their respective NJPDES Combined Sewer Management permits. CCMUA, Camden and Gloucester understand that restoring and optimizing the current combined sewer system's design hydraulic capacity is a critical and integral component of any suite of CSO control strategies that will be evaluated during the forthcoming development of the joint LTCP. CCMUA's commitment to this foundational concept is evidenced by its current wet weather treatment capacity expansion projects at its Water Pollution Control Facilities No. 1, which is occurring well before the completion of the joint LTCP. This expansion will significantly enhance Camden and Gloucester abilities to maximize wet weather flow to the POTW (NMC 4). It must be noted that the scale and costs of the expansion of the wet weather capacity at the treatment facility significantly exceed the vision of minimum controls as involving "minor construction activities".[E-14]

E-11 N.J.S.40:14B-1 et seq.

E-12 Section 502 – Operation and Maintenance of the Local Sewerage System

E-13 59 FR 18691

E-14 59 FR 18691: "Permittees with CSOs should submit appropriate documentation demonstrating implementation of the nine minimum controls, including any proposed schedules for completing ***minor*** (emphasis added) construction activities."

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Section 1 Revised 06/26/18

Introduction

This document constitutes Camden County Municipal Utilities Authority's (CCMUA) *Sewer System Characterization Report* (SCR) developed by CCMUA on behalf of CCMUA, the City of Camden and Gloucester City (the Cities) for the required "Characterization Monitoring and Modeling of the Combined Sewer System" under Part IV Section G.1 of CCMUA's New Jersey Pollutant Discharge Elimination System (NJPEDS) permit action (Permit number NJ0026182). The scope of this includes the Cities of Camden (Permit NJ0108812) and Gloucester (Permit NJ0108847). The SCR was prepared pursuant to the July 2016 *System Characterization Workplan* and NJDEP's August 2016 workplan approval letter. Copies of these documents are provided as Appendix A.

This report documents that CCMUA and the Cities have developed a thorough understanding of their respective sewerage systems, the systems' responses to precipitation events of varying duration and intensity, the characteristics of system overflows, and water quality issues associated with combined sewer overflows (CSOs) emanating from the systems. The objective of the SCR is to provide CCMUA and the Cities with a comprehensive and empirical understanding of the physical nature and hydraulic performance of their respective sewerage systems for use in optimizing the performance of the current systems and in the development of CSO control alternatives.

1.1 Regulatory Context and Objectives

USEPA Combined Sewer Overflow Control Policy

USEPA's CSO Control Policy (Policy) was issued in April of 1994[1-1] to elaborate on the 1989 National CSO Control Strategy and to expedite compliance with the requirements of the Clean Water Act (CWA). The Policy provided guidance to municipal permittees with CSOs, to the state agencies issuing National Pollution Discharge Elimination permits (e.g. NJDEP and NJPDES permits) and to state and interstate water quality standards authorities (e.g. the Delaware River Basin Commission). The Policy establishes a framework for the coordination, planning, selection and implementation of CSO controls required for permittee compliance with the Clean Water Act (CWA).

The Policy includes three major activities required of municipalities with CSO related permits:

- ***System Characterization*** – The identification of current combined sewer system assets and current performance characteristics;
- ***Implementation of the Nine Minimum Controls***[1-2] – identified in the Policy to ensure that the current combined sewer system is being optimized and property maintained; and

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1-1 59 FR 18688 et seq.

1-2 The nine minimum controls include: 1) proper operation and regular maintenance; 2) maximizing the use of the collection system for storage where feasible; 3) review and modification of the Industrial Pretreatment Program to minimize CSO impacts; 4) maximization

- ***Development of a Long-Term Control Plan (LTCP)*** – The analysis and selection of long term capital and institutional improvements to the combined sewer system that once fully implemented will result in compliance with the CWA.

The Policy includes provisions for public and stakeholder involvement (e.g. the CSO Supplemental Committees), the assessment of affordability (rate-payer impacts) and financial capability (permittee ability to finance the long-term controls) as a driver of implementation schedules and two CSO control alternatives. The "presumption" approach is premised on the presumption that the achievement of certain performance standards, e.g. the capture of at least 85% of wet weather flows during a typical year would result in CWA compliance subject to post-implementation verification. Under the "demonstration" approach, permittees demonstrate that their proposed controls do not cause or contribute to a violation of receiving stream water quality standards.

New Jersey Pollution Discharge Elimination System (NJPDES) Permit Requirements

Under Section 1311 of the CWA, all point source discharges to the waters of the United States must be permitted. USEPA Region II has delegated permitting authority in New Jersey to the New Jersey Department of Environmental Protection (NJDEP). The combined sewer system discharges permitted in CCMUA's and the Cities' respective NJ Pollution Discharge Elimination System (NJPDES) permits are listed on Table 1-1 below

The permits are reissued on a nominal five-year cycle. All twenty-one New Jersey municipalities and municipal authorities with combined sewer systems were issued new permits in 2015 that set forth requirements for the completion of the system characterization and the development of LTCPs on the following schedule:

- Submittal of the System Characterization Report to NJDEP – July 1, 2018;
- (LTCP Report 1) Development & Evaluation of CSO Control Alternatives – July 1, 2019; and
- (LTCP Report 2) Selection and Implementation of Alternatives – June 1, 2020.

The System Characterization Reports are to be updates to and to utilize where applicable, previous system inventories and evaluations such as the *Sewage Infrastructure Improvement Act Planning Studies* conducted in the late 1990s. The municipalities documented their implementation of the nine minimum controls under an earlier NJPDES permit cycle.

With minor exceptions such as lists of applicable previous studies, the 2015 permits are standardized. The 2015 information to be included in the System Characterization Report is specified in Part IV (Specific Requirement: Narrative) paragraph G-1 of the permits. These requirements are reproduced on Table 1-2 along with the section of this System Characterization Report in which the requirements are addressed and a list of the principal sources of data used for each requirement.

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of flow to the wastewater treatment plant; 5) the prohibition of CSOs during dry weather; 6) control of solids and floatables (addressed by NJDEP's requirement of screening or other facilities in the late 2000s); 7) pollution prevention; 8) public notification; and 9) monitoring CSO impacts and controls. 59 FR 18691.

Table 1-1 – CCMUA, Camden and Gloucester Permitted Combined Sewer Overflow Outfalls

Sewershed / Regulator			Outfall								
			NJPDES Number	NJPDES Narrative Location	Latitude North			Longitude West			Outfall Status
					D	M	S	D	M	S	
City of Camden											***NJPDES No: NJ0108812***
1	C1	Active	007A	Morgan Blvd.	39	54	44	75	6	59	Open
2	C2	Active	008A	2nd St. & Jefferson	39	55	14	75	7	30	Open
3	C3	Active	009A	Jackson St.	39	55	28	75	7	38	Open
4	C5	Active	010A	Kaighn Ave.	39	55	45	75	7	48	Open
5	C6	Active	011A	NA - discharges via C-7 outfall							Closed
6	C7	Active	012A	Division & Front Streets	39	56	3	75	7	52	Open
7	C8	Active	013A	Clinton & Front Streets	39	56	13	75	7	51	Open
8	C9	Active	014A	2nd & Benson Streets	39	56	30	75	7	49	Open
9	C10	Active	015A	Arch St.	39	56	51	75	7	53	Open
10	C11	Active	016A	Cooper St.	39	56	57	75	7	59	Open
11	C12	Inactive	017A	NA							Closed
12	C13	Inactive	018A	Front & Erie Streets							Closed
	C13A	Active			39	57	5	75	7	25	Open
13	C14	Inactive	019A								Closed
14	C15	Active	020A	10th & State Streets	39	57	3	75	6	40	Open
15	C16	Active	023A	11th & Linden	39	56	18	75	6	33	Open
16	C17	Active	022A	Federal St. East	39	56	35	75	6	18	Open
17	C18	Active	024A	NA - discharges via C-19 outfall							Closed
18	C19	Active	024A	Pine & Magnolia Streets	39	56	19	75	6	18	Open
19	C22	Active	030A	Federal St. West	39	56	38	75	6	15	Open
		Active	033A	Thorndyke Avenue	39	56	13	75	5	57	Open
20	C22A	Active	034A	River Rd.	39	56	44	75	6	18	Open
21	C23	Inactive	035A	NA							Closed
22	C23A	Active	025A	24th & Harrison Streets	39	57	31	75	6	14	Open
23	C24	Active	026A	27th & Van Buren	39	57	41	75	5	52	Open
24	C27	Active	028A	Baird Blvd.	39	56	16	75	5	42	Open
25	C28	Active	029A	E. State St.	39	57	7	75	6	36	Open
26	C28A	Inactive	CC-036A	NA							Closed
27	CFA	Active	005A	Ferry Ave. Pump St.	39	55	15	75	5	28	Open
28	CME	Inactive	006A	NA							Closed
Camden County MUA											***NJPDES No: NJ0026182***
	C32	Active	040A	32nd & Farragut Streets	39	57	54	75	5	28	Open
City of Gloucester City											***NJPDES No: NJ0108847***
1	G1	Active	001A	End of Charles St.	39	53	28	75	7	47	Open
2	G2	Active	002A	End of 6th St.	39	53	28	75	7	50	Open
3	G3	Active	003A	End of Jersey Ave.	39	53	28	75	7	48	Open

Sewershed / Regulator			Outfall								
			NJPDES Number	NJPDES Narrative Location	Latitude North			Longitude West			Outfall Status
					D	M	S	D	M	S	
4	G4	Active	004A	End of Market St.	39	53	50	75	7	44	Open
5	G5	Active	005A	End of Hudson St.	39	53	7	75	7	39	Open
6	G6	Active	006A	End of Mercer St.	39	53	12	75	7	3	Open
7	G7	Active	007A	Broadway @ Newton Creek	39	53	27	75	7	5	Open

1.2 Combined Sewer System and Service Area Overview

CCMUA is the regional wastewater treatment authority of Camden County, New Jersey, providing wastewater treatment to a service area of 226 square miles and a population of roughly 500,000. The Authority serves 37 municipalities in Camden County. CCMUA provides regional wastewater conveyance and treatment services through 135 miles of interceptor sewers, 27 pump stations and the 80 million gallon per day (MGD)[1] Delaware No. 1 Water Pollution Control Facility (WPCF). CCMUA's regional service area and facilities are shown on Figure 1-1. There is one permitted combined sewer overflow discharge within the CCMUA regional conveyance system, the C-32 outfall on the Cooper River at the northeast corner of the City of Camden.

The municipal collection sewer systems are owned and operated by their respective municipalities or municipal authorities. Of the thirty-seven municipalities within the service area only the Cities of Camden and Gloucester have combined sewer systems. Pursuant to the respective NJPDES permits for CCMUA, Camden and Gloucester the scope of this SCR is limited to the two combined sewered municipalities and CCMUA. The Camden and Gloucester sewer systems are shown on Figure 1-2. Consideration of the thirty-five sanitary sewered municipalities is limited in this SCR to their hydraulic impacts on the Camden, Gloucester and CCMUA combined sewer systems.

1.3 SCR Data Sources

Principal sources of data and information used in this SCR include the following:

- The characterizations of the CCMUA system developed by CCMUA and the municipalities in the circa 1999 *Sewage Infrastructure Improvement Act Planning Study* (SIIAPS) as referenced in the sub-paragraph G(-1(c) of the Combined Sewer Management portion of the NJPDES permits;
- Updates and expansion of the CCMUA, Camden and Gloucester geographic information system databases;
- City of Camden Wastewater System Flood Mitigation Plan 2016;
- CCMUA, Camden and Gloucester as-built drawings;
- CCMUA Asset Management System databases;
- CCMUA and Camden pump station data;

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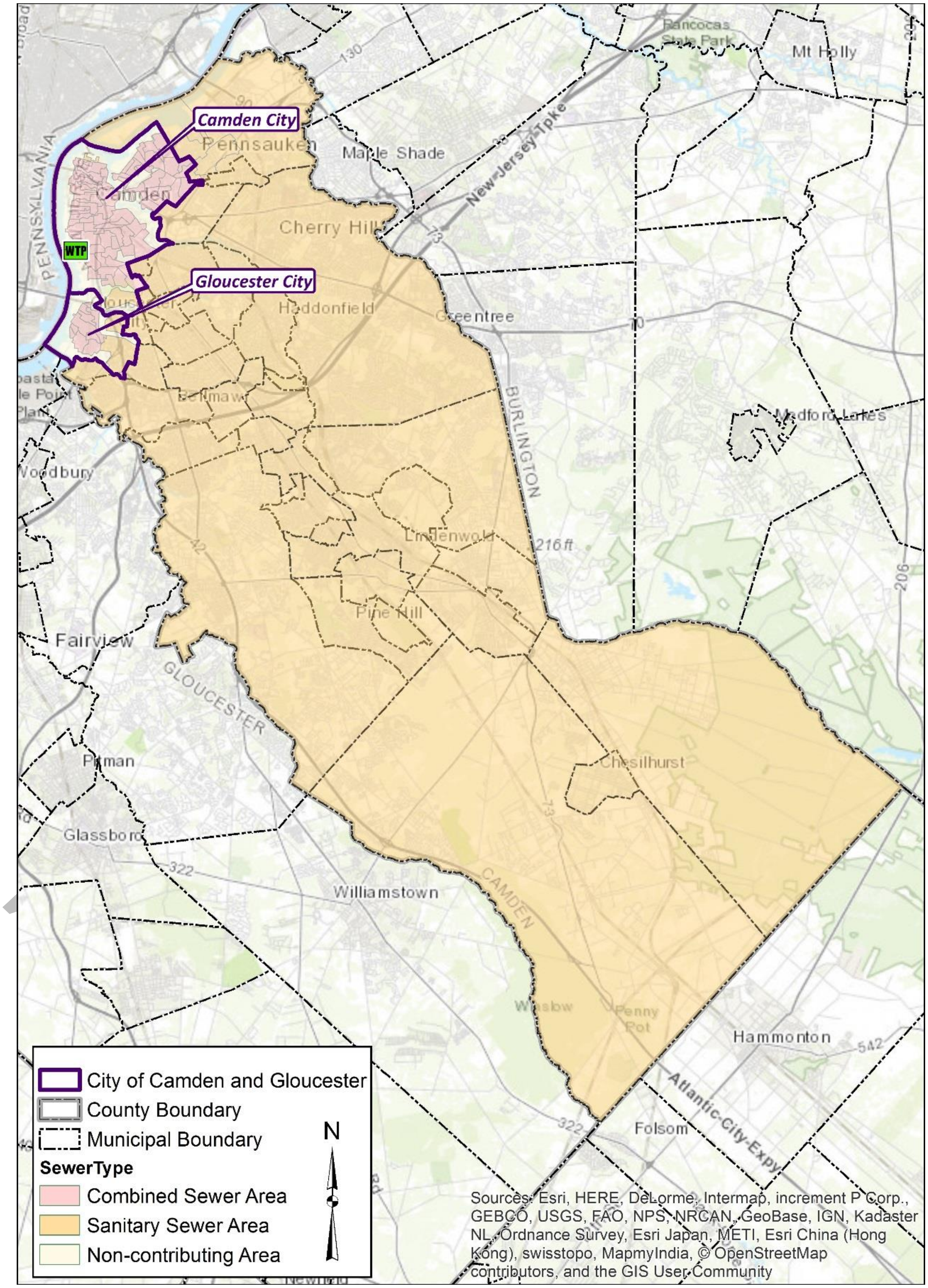

Figure 1-1
CCMUA Service Area

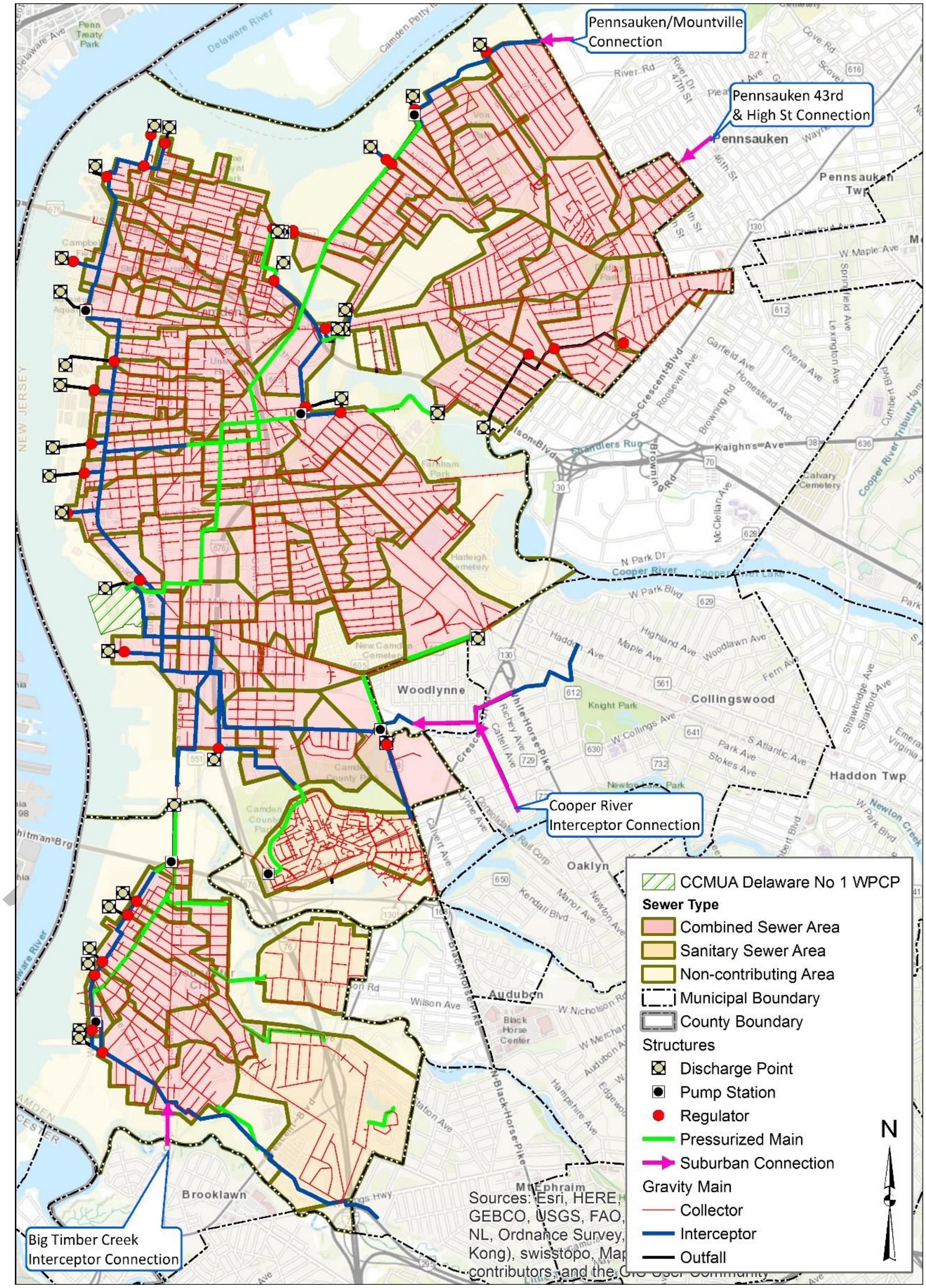

Figure 1-2
Camden and Gloucester Sewer Systems Base Map

- WPCF influent flow rates and plant performance data;
- CCMUA, municipal and National Weather Service permanent precipitation;
- Temporary flow monitoring and precipitation gauging during 2017;
- CCMUA and Camden stormwater management facilities planning and design documents relating to the redevelopment of the Camden waterfront;
- City of Camden and Gloucester City best management plans and standard operating procedures;
- CCMUA 2003 Wet Weather Operating Manual; and
- CCMUA 2017 wet weather upgrades conceptual study information.

The sources of data presented in this SCR are annotated in the various sections.

1.4 Organization of Report

Table 1-2 provides a summary of the system characterization elements along with the applicable section of the System Characterization Report, and principal data sources that be used to develop the report. The technical approaches for addressing the major elements of the System Characterization Report are detailed for each anticipated section of the report. For the purposes of creating a comprehensive overview of the CCMUA, Camden and Gloucester combined sewer system, there are additional details included within this SCR beyond the elements required in the permit.

Table 1-2
Review of Major Elements of the SCR

Permit Section	Permit Requirement	SCR Section	Principal Data Sources
Part IV G.1.A	"The permittee, as per D.3.a and G.10, shall submit an updated characterization study that will result in a comprehensive characterization of the CSS developed through records review, monitoring, modeling and other means as appropriate to establish the existing baseline conditions, evaluate the efficacy of the CSO technology based controls, and determine the baseline conditions upon which the LTCP will be based. The permittee shall work in coordination with the combined sewer communities for appropriate Characterization, Monitoring and Modeling of the Sewer System."	Entire SCR	See following rows

Permit Section	Permit Requirement	SCR Section	Principal Data Sources
Part IV G.1.b	"The characterization shall include a thorough review of the entire collection system that conveys flows to the treatment works including areas of sewage overflows, including to basements, streets and other public and private areas, to adequately address the response of the CSS to various precipitation events"	Section 2	• *Sewer System Inventory and Assessment Analysis*, prepared by CH2MHill, dated November 1999 • *Sewage Infrastructure Improvement Act Planning Study (SIIAPS) prepared by CH2MHill in 1999 (Project No. CSO-91-018)* • System reconfiguration and improvement data since 1999 provided by CCMUA, Camden and Gloucester • GIS data bases provided by CCMUA, Camden and Gloucester • Areas of identified sewage overflow/flooding data provided by CCMUA, Camden and Gloucester. • *BMP Plan for the Operation & Maintenance of the Combined Sewer System…* prepared for the City of Camden by Greeley-Hansen, 2014 • Gloucester City Department of Utilities – *Standard Operating Procedures, Preventive Maintenance and Emergency Response Procedures* • Solids & floatables control facilities design documents provided by the City of Camden and Gloucester City. • *Wet Weather Upgrades at the Delaware WPCF #1 Concept Study of Alternatives* Greeley Hansen May 2017 • *Wet Weather Operating Manual for CCMUA* prepared by WRc/D&B LLC, July 2003. • *City of Camden Wastewater System Flood Mitigation Plan* American Water Contract Services 2016 • Sewer system records, filed inspections data provided by CCMUA, Camden and Gloucester • GIS and other system inventory data bases provided by the Cities of Camden and Gloucester and CCMUA • Field evaluations performed pursuant to Part IV F.1 (NMC-1)
Part IV G.1.b	"The characterization shall identify the number, location, frequency and characteristics of CSOs"	Section 7	• Analysis utilizing updated hydrologic and hydraulic (H&H) modeling.
	"The characterization shall identify water quality impacts that result from CSOs"	Section 4	• CSO discharge event mean concentration (EMC) analysis from CH2MHILL report (1997 SIIAPS Study) • Compiled pathogen data collected from the Cooper and Delaware Rivers and Newton Creek. • Current significant industrial users.

Permit Section	Permit Requirement	SCR Section	Principal Data Sources
Part IV G.1.c	"The permittee may use previous studies to the extent that they are accurate and representative of a properly operated and maintained sewer system and of the currently required information, such as: CSO Modeling Study Sewage Infrastructure Improvement Act Planning Study, Project no. CSO-91-018, prepared by CH2MHILL, dated July 1999;	These sources were used extensively as applicable as starting points for the current system characterization data base(s). As detailed throughout the SCR, the foundational data concerning the physical characteristics of the combined sewer system (e.g. regulator structure locations) have been augmented and updated to reflect current conditions, changes and improvements made since 1999.	
Part IV G.1.d.i	Rainfall Records Analysis	Section 6	• The National Weather Service's (NWS) Philadelphia International Airport station (USW00013739): One minute data (since 2002 to the present), 51-year hourly dataset from 1965–2015. • CDM Smith Technical Memorandum Dec 2017: Typical Year Evaluation for Joint CSO Long Term Control Plan (LTCP) of CCMUA, City of Camden and City of Gloucester • *Rainfall Monitoring Study*, prepared by CH2MHill, dated October 1999.
Part IV G.1.d.ii	Combined Sewer System Characterization	Section 2 Section 8 (Institutiona l)	• *Sewer System Inventory and Assessment Analysis*, prepared by CH2MHill, dated November 1999 • *Sewage Infrastructure Improvement Act Planning Study (SIIAPS) prepared by CH2MHill in 1999 (Project No. CSO-91-018)* • *BMP Plan for the Operation & Maintenance of the Combined Sewer System…* prepared for the City of Camden by Greeley-Hansen, 2014 • Gloucester City Department of Utilities – *Standard Operating Procedures, Preventive Maintenance and Emergency Response Procedures* • Solids & floatables control facilities design documents provided by the City of Camden and Gloucester City. • *Wet Weather Upgrades at the Delaware WPCF #1 Concept Study of Alternatives* Greeley Hansen May 2017 • *Wet Weather Operating Manual for CCMUA* prepared by WRc/D&B LLC, July 2003. • *City of Camden Wastewater System Flood Mitigation Plan* American Water Contract Services 2016 • Sewer system records, filed inspections data provided by CCMUA, Camden and Gloucester • GIS and other system inventory data bases provided by the Cities of Camden and Gloucester and CCMUA • Field evaluations performed pursuant to Part IV F.1 (NMC-1) • N.J.S.A. 40A et seq. and N.J.S.A 40B et seq.

Permit Section	Permit Requirement	SCR Section	Principal Data Sources
Part IV G.1.d.iii	CSO Monitoring	Section 5	• *Combined Sewer System Supplemental Flow and Precipitation Monitoring QAPP*, August 2016 • Memorandum: *Conformance of the Temporary Flow Monitoring and Rain Gauging with the Approved Flow Monitoring Workplan* Sept. 2017
Part IV G.1.d.iv	System Hydrologic & Hydraulic Modeling	Section 5 Section 3	• NJDEP land use data • Sewer system records, filed inspections data provided by CCMUA, Camden and Gloucester • GIS and other system inventory data bases provided by the Cities of Camden and Gloucester and CCMUA System improvement data provided by CCMUA, Camden, and Gloucester • 2012 and previous Land use GIS data downloaded from NJDEP's GIS portal • *Combined Sewer Overflow Service Area and Land Use Report*, prepared by CH2MHill, dated October 1999.

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Section 2 revised 06/27/18

Combined Sewer System Characterization

2.1 Combined Sewer System General Description

2.1.1 Overview

Within the context of this system characterization report (SCR), the Combined Sewer System consists of the respective collection systems owned and operated by the Cities of Camden and Gloucester and the portion of the CCMUA's regional conveyance interceptor system that is located within the Cities of Camden and Gloucester. As noted in Section 1 of this document, CCMUA has one permitted CSO, associated with the C-32 regulator structure. Captured flows from the C-32 regulator flow by gravity to CCMUA's Baldwins Run pump station and are then conveyed via force-main to the Delaware No. 1 Water Pollution Control Facility #1 (WPCF). The general characteristics of the combined sewer system as herein defined are summarized on Table 2-1.

Table 2-1 – Collection System Overview

Jurisdiction	# Sewer-sheds	Collection System Pipe in Miles[2-1]	Appurtenances				Contributing Area (square miles)
			Active Regulators	Active Outfalls	Pump Stations	Solids & Floatables Control Facilities	
Camden	29[2-2]	173	22	22	8	21	6.6
Gloucester	7	39	7	7	7	7	1.6
CCMUA			1	1	2	1	
Totals	36	212	30	30	17	30	8.2

As shown on Table 2-1, there is a total of approximately 212 miles of collection sewers within Camden and Gloucester. A relatively small portion of Camden, the Fairview neighborhood on the south-eastern portion of the city is served by sanitary sewers. Likewise, there are two areas in the eastern portions of the City of Gloucester that are served by sanitary collection sewers. The combined sewer system which is the scope of this SCR is mapped as Figure 2-1. A large format version of this map is provided in the end pocket of the printed version of this document. A large-scale version is also provided digitally as in PDF format to accompany digital versions of this document.

[2-1] Source: Table 2-2 from the Sewer System Inventory and Assessment / Facilities Inventory and Assessment Analysis Final Report prepared by CH2MHill, November 1999

[2-2] Includes Camden sewersheds flowing to the C-32 regulator for which CCMUA is the permitee.

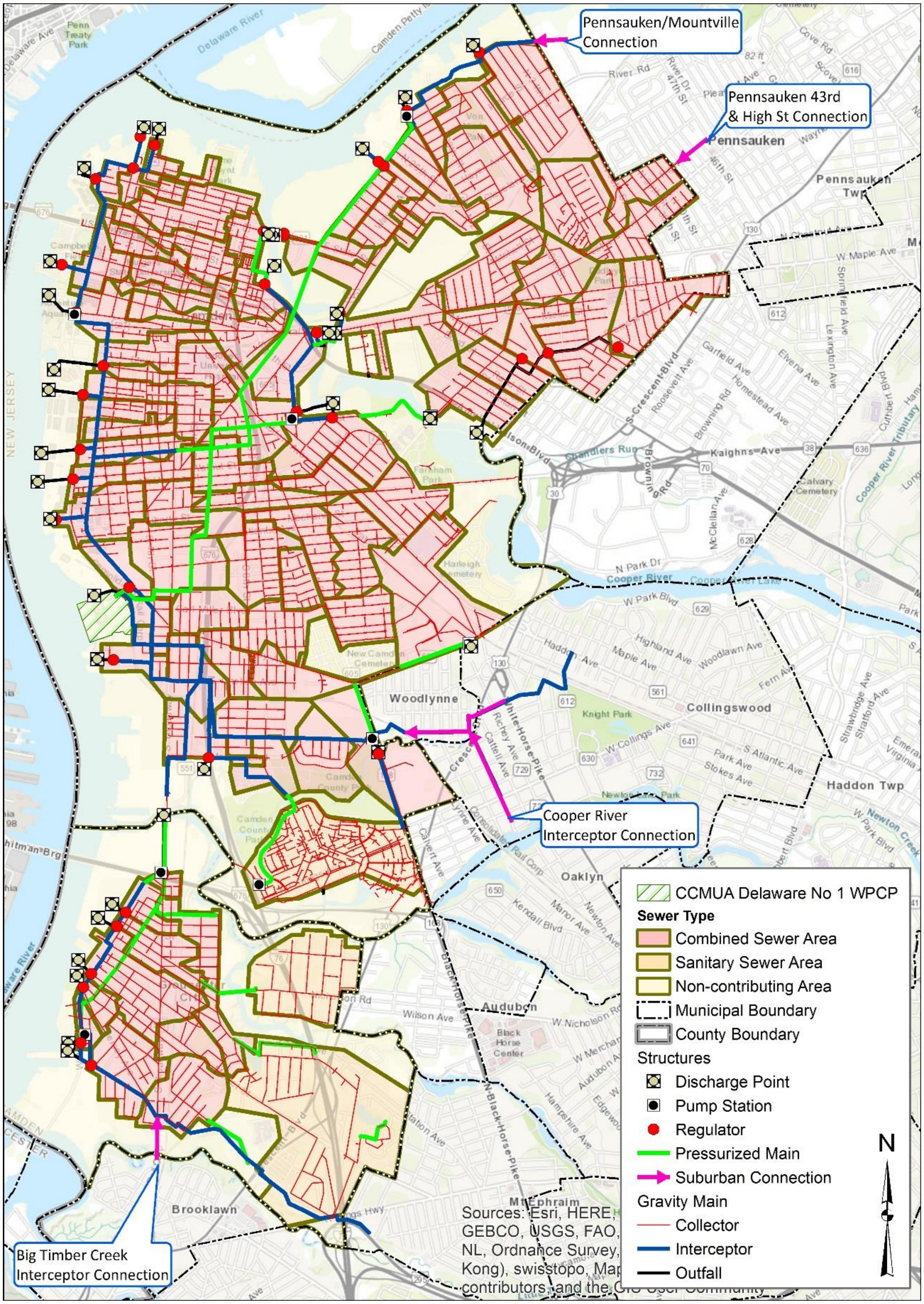

Figure 2-1
Camden, Gloucester & CCMUA Combined Sewer System

2.1.2 City of Camden Collection System[2-3]

The City of Camden has a total area of approximately ten square miles. In addition to a City population of about 77,344 (2010 Census), the City's wastewater collection area also includes approximately 250 customers located in Pennsauken Township and stormwater flow from a larger part of Pennsauken Township. The average daily wastewater flow generated within the City is estimated to be approximately 20 MGD.

The wastewater collection system of the City of Camden Department of Utilities consists primarily of combined sewers. According to City records, there presently exists approximately 170 miles of combined sewers containing nearly 4,000 storm inlets, about 60 percent of which were constructed before 1920. When initially constructed, these pre-1920 sewers served to convey both sanitary sewage and storm drainage directly to the nearest river without treatment.

The newest section of the City, Fairview, was originally served by its own treatment plant and has separate sanitary sewer and stormwater collection and conveyance systems. Fairview has an area of about 0.7 square miles and contains approximately 20 miles of sanitary sewers and approximately five miles of storm sewers.

During the 1950s, the City undertook a major project to construct interceptor systems that would convey all sewage and combined flow to the City-owned treatment plants. Interceptor sewers with regulator chambers were constructed to convey both sewage and combined flows from the wastewater collection system to the Baldwins Run and the City's Main Sewage Treatment Plants. The project included modifications to the existing Baldwins Run Sewage Treatment Plant, construction of the Camden Main Sewage Treatment Plant and construction of the following intercepting sewer systems:

- Delaware River System
- Cooper River System
- Baldwins Run System

The two treatment plants were conveyed by the City to the Camden County Municipal Utilities Authority (CCMUA) in 1975, but the City has retained ownership of the interceptor systems and pumping stations. In the late 1980s the CCMUA closed the Baldwins Run treatment plant and constructed the Baldwin Run pump station which discharges via force main directly to Camden's WPCF #1.

There are 28 sewersheds (catchment areas) within the City of Camden combined sewer system. These are detailed in the following sub-section of this report. These sewersheds flow into one of the three large drainage basins.

2.1.3 City of Gloucester Collection System

The City of Gloucester is located south of Newton Creek, which delineates the municipal boundary with the City of Camden to the north. There are seven sewersheds within

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[2-3] This sub-section was excerpted from the report: Best Management Practices Plan for the Operation and Maintenance of the Combined Sewer, Separate Sanitary Sewer and Separate Stormwater Systems prepared for the City of Camden in 2014 by Greeley & Hansen.

Gloucester which discharge into an interceptor sewer which is roughly aligned along King Street within Gloucester.

The Gloucester City collection system serves an area of approximately 1.6 square miles, of which 1.0 square miles is served by combined sewers. There are some within newer sanitary sewered neighborhoods that are east of the older riverfront portions of the City. There are about 40 miles of collection sewers within Gloucester City.

The Gloucester combined sewer system flows into the Gloucester pump station, which is owned and operated by CCMUA. The Gloucester Pump Station conveys flows from the Big Timber Creek Interceptor and the flows from Gloucester to the WPCF.

2.1.4 Camden County MUA Regional Interceptor System

CCMUA does not own or operate collection sewers. Its regional conveyance interceptor system consists of 135 miles of regional interceptors that convey sewage flows from 30 municipalities in Camden County in addition to the Cities of Camden and Gloucester. The southwestern area of Camden County, containing five municipalities, is included in the Atlantic Basin, draining into the Atlantic Ocean by the Mullica River and the Great Egg Harbor River. This section is much more rural than the Delaware Basin.

The entire CCMUA service area is shown on Figure 1-1 of this document. As noted above, there is only one CSO within CCMUA's regional interceptor system located near the Baldwins Run pump station. A system schematic is provided as Figure 2-2.

2.2 Sewersheds

2.2.1 Sewershed Locations and General Characteristics

There are a total of 36 sewersheds within the Camden and Gloucester combined sewer collection systems. These include thirty within the City of Camden and seven in Gloucester City. Each of these sewersheds drain to a regulator structure controlling the amount of wet weather flow that enters into the CCMUA interceptors from the Camden and Gloucester trunk sewers. As of 2018, there are a total of 30 active CSO outfalls located within the two cities. Overflows from CSO outfalls discharge into three receiving streams: the Delaware and Cooper Rivers and Newton Creek. Key characteristics of the sewersheds are summarized on Table 2-2.

DRAFT

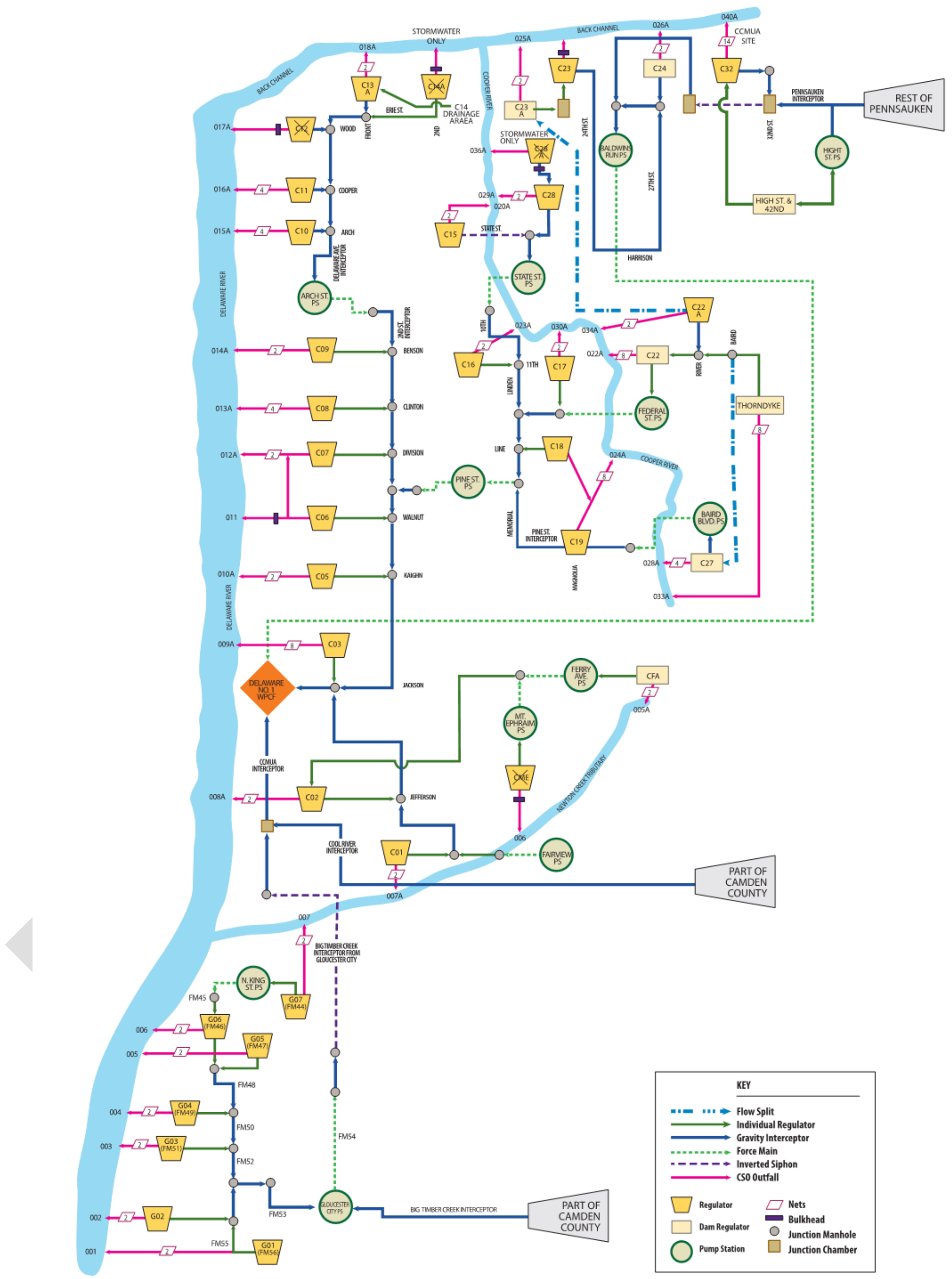

Figure 2-2 – System Schematic

Table 2-2 – Sewershed Location and General Characteristics

<table>
<tr><th colspan="4">Sewershed / Regulator</th><th rowspan="2">Municipality</th><th rowspan="2">Receiving Stream</th><th rowspan="2">Contributing Area (acres)</th></tr>
<tr><th>Count</th><th colspan="2">Name</th><th>Status</th></tr>
<tr><td>1</td><td colspan="2">C1</td><td>Active</td><td>Camden</td><td>Newton Cr.</td><td>422</td></tr>
<tr><td>2</td><td colspan="2">C2</td><td>Active</td><td>Camden</td><td>Delaware R.</td><td>193</td></tr>
<tr><td>3</td><td colspan="2">C3</td><td>Active</td><td>Camden</td><td>Delaware R.</td><td>686</td></tr>
<tr><td>4</td><td colspan="2">C5</td><td>Active</td><td>Camden</td><td>Delaware R.</td><td>104</td></tr>
<tr><td>5</td><td colspan="2">C6</td><td>Active</td><td>Camden</td><td>Delaware R.</td><td>52</td></tr>
<tr><td>6</td><td colspan="2">C7</td><td>Active</td><td>Camden</td><td>Delaware R.</td><td>66</td></tr>
<tr><td>7</td><td colspan="2">C8</td><td>Active</td><td>Camden</td><td>Delaware R.</td><td>100</td></tr>
<tr><td>8</td><td colspan="2">C9</td><td>Active</td><td>Camden</td><td>Delaware R.</td><td>103</td></tr>
<tr><td>9</td><td colspan="2">C10</td><td>Active</td><td>Camden</td><td>Delaware R.</td><td>86</td></tr>
<tr><td>10</td><td colspan="2">C11</td><td>Active</td><td>Camden</td><td>Delaware R.</td><td>175</td></tr>
<tr><td>11</td><td colspan="2">C12</td><td>Inactive</td><td>Camden</td><td>Delaware R.</td><td>15</td></tr>
<tr><td rowspan="2">12</td><td rowspan="2">C13</td><td>C13</td><td>Inactive</td><td rowspan="2">Camden</td><td rowspan="2">Delaware R. back Channel</td><td rowspan="2">94</td></tr>
<tr><td>C13A</td><td>Active</td></tr>
<tr><td>13</td><td colspan="2">C14</td><td>Inactive</td><td>Camden</td><td>Delaware R. back Channel</td><td>27</td></tr>
<tr><td>14</td><td colspan="2">C15</td><td>Active</td><td>Camden</td><td>Cooper R.</td><td>25</td></tr>
<tr><td>15</td><td colspan="2">C16</td><td>Active</td><td>Camden</td><td>Cooper R.</td><td>33</td></tr>
<tr><td>16</td><td colspan="2">C17</td><td>Active</td><td>Camden</td><td>Cooper R.</td><td>129</td></tr>
<tr><td>17</td><td colspan="2">C18</td><td>Active</td><td>Camden</td><td>Cooper R.</td><td>79</td></tr>
<tr><td>18</td><td colspan="2">C19</td><td>Active</td><td>Camden</td><td>Cooper R.</td><td>179</td></tr>
<tr><td>19</td><td colspan="2">C22</td><td>Active</td><td>Camden</td><td>Cooper R.</td><td>518</td></tr>
<tr><td>20</td><td colspan="2">C22A</td><td>Active</td><td>Camden</td><td>Cooper R.</td><td>81</td></tr>
<tr><td>21</td><td colspan="2">C23</td><td>Inactive</td><td>Camden</td><td>Delaware R. back Ch.</td><td rowspan="2">67</td></tr>
<tr><td>22</td><td colspan="2">C23A</td><td>Active</td><td>Camden</td><td>Delaware R. back Ch.</td></tr>
<tr><td>23</td><td colspan="2">C24</td><td>Active</td><td>Camden</td><td>Delaware R. back Ch.</td><td>66</td></tr>
<tr><td>24</td><td colspan="2">C27</td><td>Active</td><td>Camden</td><td>Cooper R.</td><td>120</td></tr>
<tr><td>25</td><td colspan="2">C28</td><td>Active</td><td>Camden</td><td>Cooper R.</td><td>33</td></tr>
<tr><td>26</td><td colspan="2">C28A</td><td>Inactive</td><td>Camden</td><td>Cooper R.</td><td></td></tr>
<tr><td>27</td><td colspan="2">C32</td><td>Active</td><td>Camden</td><td>Delaware R. back Ch.</td><td>491</td></tr>
<tr><td>28</td><td colspan="2">CFA</td><td>Active</td><td>Camden</td><td>Newton Cr.</td><td>170</td></tr>
<tr><td>29</td><td colspan="2">CME</td><td>Inactive</td><td>Camden</td><td>Newton Cr.</td><td>122</td></tr>
<tr><td>30</td><td colspan="2">G1</td><td>Active</td><td>Gloucester</td><td>Delaware R.</td><td>160</td></tr>
<tr><td>31</td><td colspan="2">G2</td><td>Active</td><td>Gloucester</td><td>Delaware R.</td><td>16</td></tr>
<tr><td>32</td><td colspan="2">G3</td><td>Active</td><td>Gloucester</td><td>Delaware R.</td><td>20</td></tr>
<tr><td>33</td><td colspan="2">G4</td><td>Active</td><td>Gloucester</td><td>Delaware R.</td><td>144</td></tr>
<tr><td>34</td><td colspan="2">G5</td><td>Active</td><td>Gloucester</td><td>Delaware R.</td><td>182</td></tr>
<tr><td>35</td><td colspan="2">G6</td><td>Active</td><td>Gloucester</td><td>Delaware R.</td><td>468</td></tr>
<tr><td>36</td><td colspan="2">G7</td><td>Active</td><td>Gloucester</td><td>Newton Cr.</td><td>10</td></tr>
<tr><td>Totals</td><td colspan="2"></td><td></td><td></td><td></td><td>5,235</td></tr>
</table>

2.2.2 Regulator Structures and Outfalls

As was typical in older cities, the original municipal collection sewers were built to discharge directly into the receiving streams. The City of Camden constructed a primary wastewater treatment plant in the late 1940s which was the forerunner of CCMUA's current WPCF #1. The Cities installed municipal interceptor sewers to intercept sewage flows from the pre-existing collection sewers for conveyance to the original treatment facility. Flows into the municipal interceptors are controlled by regulator structures which admit the dry weather flows plus a portion of the increased flow during wet weather. When the rate of wet weather flows exceed the flow rates to be admitted to the interceptor, the remaining wet weather flows are shunted to an outfall pipe to the receiving stream. The types, ages, and status of the Camden and Gloucester regulator structures are summarized on Table 2-3. The City of Camden has undertaken a regulator structure rehabilitation project to restore their full functionality.

The Camden outfalls were inspected in 2016. Based on these inspections, a cleaning and dredging program has been undertaken by CCMUA and Camden. Only one of the outfalls is operating normally. CCMUA has undertaken the dredging of nine of the outfalls and the City of Camden is addressing the remaining outfalls within its combined sewer system.

Table 2-3 – Regulator and Outfall Structure Characteristics

<table>
<tr><th colspan="3">Sewershed / Regulator</th><th rowspan="2">Regulator Type*</th><th colspan="3">Outfall</th></tr>
<tr><th>Count</th><th>Name</th><th>Status</th><th>Operational</th><th>Dredging / Cleaning Needed per 2016 Inspection?</th><th>Notes</th></tr>
<tr><td>1</td><td>C1</td><td>Active</td><td>M</td><td>Open</td><td>Yes</td><td></td></tr>
<tr><td>2</td><td>C2</td><td>Active</td><td>M</td><td>Open</td><td>Yes</td><td></td></tr>
<tr><td>3</td><td>C3</td><td>Active</td><td>M</td><td>Open</td><td>Yes</td><td></td></tr>
<tr><td>4</td><td>C5</td><td>Active</td><td>M</td><td>Open</td><td>No</td><td></td></tr>
<tr><td>5</td><td>C6</td><td>Active</td><td>M</td><td>Closed</td><td></td><td>C6 regulator discharges through C7 outfall pipe.</td></tr>
<tr><td>6</td><td>C7</td><td>Active</td><td>M</td><td>Open</td><td>Could not access</td><td></td></tr>
<tr><td>7</td><td>C8</td><td>Active</td><td>M</td><td>Open</td><td>No</td><td></td></tr>
<tr><td>8</td><td>C9</td><td>Active</td><td>M</td><td>Open</td><td>No</td><td></td></tr>
<tr><td>9</td><td>C10</td><td>Active</td><td>M</td><td>Open</td><td>Yes</td><td></td></tr>
<tr><td>10</td><td>C11</td><td>Active</td><td>M</td><td>Open</td><td>Yes</td><td></td></tr>
<tr><td>11</td><td>C12</td><td>Inactive</td><td>M</td><td>Closed</td><td></td><td rowspan="2">C13 regulator was superseded by C13A regulator, Sewershed C13 remained unchanged.</td></tr>
<tr><td rowspan="2">12</td><td>C13</td><td>Inactive</td><td>M</td><td>Closed</td><td></td></tr>
<tr><td>C13A</td><td>Active</td><td>M</td><td>Open</td><td>Yes</td><td></td></tr>
<tr><td>13</td><td>C14</td><td>Inactive</td><td>M</td><td>Closed</td><td></td><td></td></tr>
</table>

Sewershed / Regulator			Regulator Type*	Outfall		
Count	Name	Status		Operational	Dredging / Cleaning Needed per 2016 Inspection?	Notes
14	C15	Active	M	Open	No	
15	C16	Active	M	Open	Yes	
16	C17	Active	M	Open	No	
17	C18	Active	M	Closed		C18 regulator discharges through C19 outfall.
18	C19	Active	M	Open	No	
19	C22	Active	M	Open	No	
			W	Open	No	Thorndyke outfall structure receives flow from regulators C22 and C27.
20	C22A	Active	M	Open	Could not access	
21	C23	Inactive	M	Closed		
22	C23A	Active	W	Open	Yes	
23	C24	Active	A	Open	Yes	
24	C27	Active	M	Open	No	
25	C28	Active	M	Open	No	
26	C28A	Inactive	W	Closed		
27	C32	Active	A	Open	No	
28	CFA	Active	W	Open	No	
29	CME	Inactive	W	Closed		
30	G1	Active	M	Open		
31	G2	Active	M	Open		
32	G3	Active	M	Open		
33	G4	Active	M	Open		
34	G5	Active	M	Open		
35	G6	Active	M	Open		
36	G7	Active	M	Open		

* Regulator type designations are as follows: A = automatic, M = mechanical, W = static well.

In addition to the regulator structues listed above, there is an overflow chamber on the Camden City interceptor located just upstream of CCMUA's Water Pollution Control Facility No. 1 which was in existence prior to the current plant. Its overflow is discharged into the C-3 regulator overflow pipe upstream of the C-3 netting facility.

2.3 Pump Stations

There are seventeen pump stations (PS) within the combined sewer system. The locations of the pump stations areas are shown on Figure 2-3. A summary characterization of the pump stations is provided on Table 2-4.

2.3.1 CCMUA Pump Stations

Two of the pump stations within the combined sewer system as defined above are owned and operated by CCMUA. The Baldwin's Run Pump Station receives flows from three sewersheds within Camden and from one sewershed which includes portions of Camden and Pennsauken Township. CCMUA's Gloucester City conveys flows from the City of Gloucester and from the Big Timber Creek regional interceptor which are conveyed under Newton Creek and to the WPCF.

The CCMUA pump stations are monitored by an Emerson Supervisory Control and Data Acquisition System (SCADA) which was updated and upgraded in 2017. Both pump stations have stand-by diesel power generation capabilities.

2.3.2 City of Camden Pump Stations

The nine Camden pump stations range in size (firm capacity) from 60,000 gallons per day (MGD) to 34 mgd (firm capacity with one pump out of service). In 2016 and 2017 the City of Camden undertook the installation of variable frequency drives and the replacement of its pump station monitoring and control system from its legacy Mission system to a contemporary SCADA system.

2.3.3 Gloucester Pump Stations

There are seven pump stations within the Gloucester City collection sewerage. These range in size from 640 gallons per minute (0.92 mgd) day to gallons per minute (2.38 mgd). Three of the pump stations are located within the combined sewered portions of Gloucester. The remaining four pump stations serve various newer suburban sanitary sewered neighborhoods within Gloucester City. None of the pump stations have (non-emergency) hydraulic relief overflows.

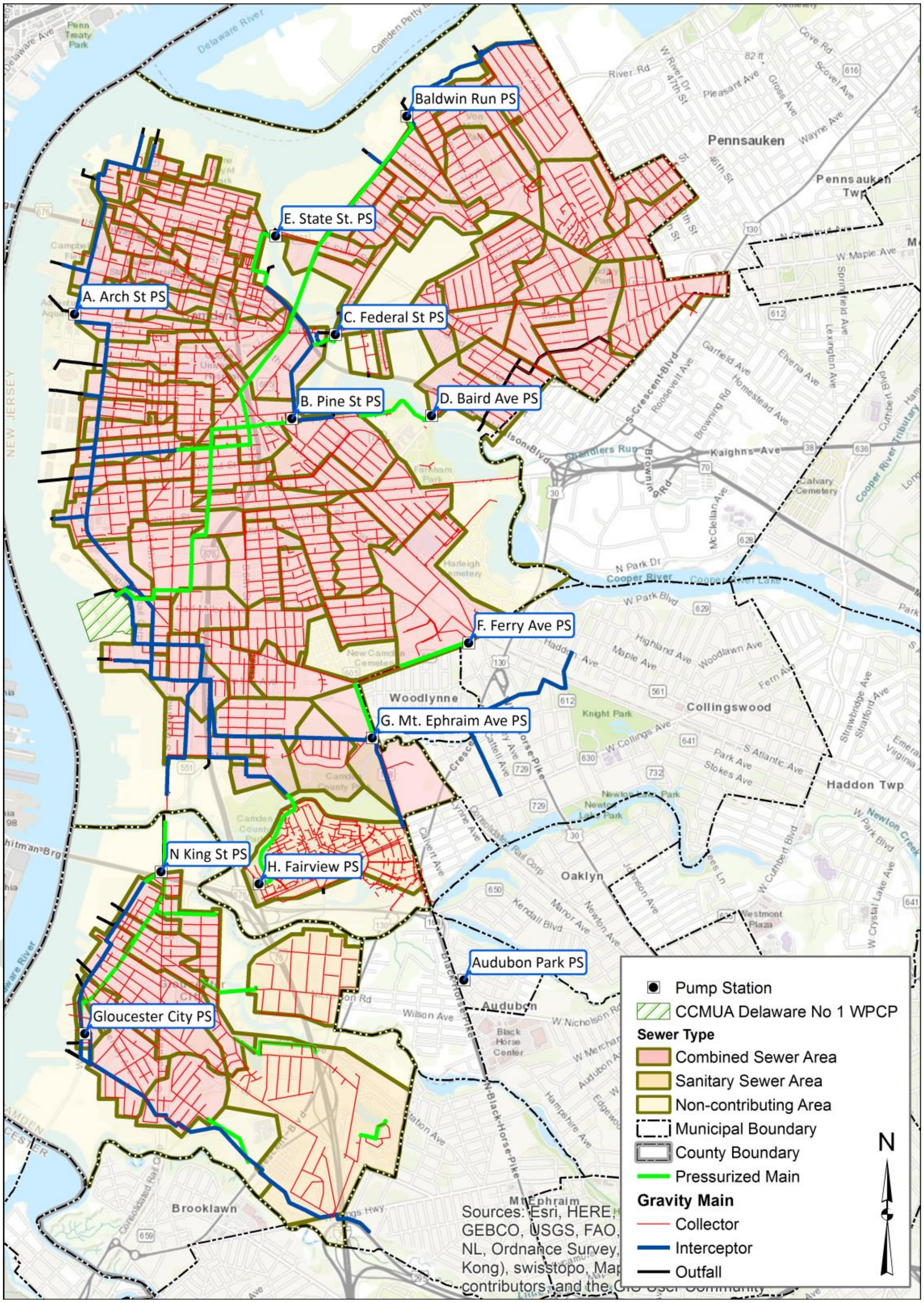

Figure 2-3 – Pump Station Locations

Table 2-4 – Pump Station Characteristics

	PS Name	Sewer Sheds Served	Collection System Type	Pump Data: Number of Pumps	Pump Data: Firm Capacity (mgd)*	Discharge To
CCMUA						
1	Baldwin Run	Pennsauken Interceptor	Mixed	3	25.00	WPCF #1
		C-23 / C-23A	Combined			
		C-24	Combined			
		C-32	Combined			
2	Gloucester City	Big Timber Creed Interceptor	Sanitary	3	53.3	WPCF #1
		G-1	Combined			
		G-2	Combined			
		G-3	Combined			
		G-4	Combined			
		G-5	Mixed			
		G-6	Mixed			
		G-7	Combined			
City of Camden[2-4]						
1	Arch Street	C-14	Combined	3	34.00	Camden Second Avenue Interceptor
		C-13	Combined			
		C-12	Combined			
		C-11	Combined			
		C-10	Combined			
2	Baird Blvd.	C-27	Combined	2	0.85	C-19 Regulator
		C-22 (wet weather)	Combined			
3	City Line / Ferry Street	CFA	Combined	3	3.17	C-02 Regulator
		CME	Combined			
4	Fairview	Fairview neighborhood	Sanitary	2	2.16	Camden Interceptor conveying flows from C-1 and C-2
5	Federal Street	C-22	Combined	3	7.33	Camden interceptor (upstream of Pine St. PS)
		C-22A	Combined			
		C-22B	Combined			
6	Mt. Ephraim	CME	Combined	2	0.49	
7	Pine Street	C-28A	Combined	3	20.17	Camden Second Avenue Interceptor
		C-28	Combined			
		C-27	Combined			
		C-22	Combined			
		C-22A	Combined			
		C-22B	Combined			
		C-19	Combined			
		C-18	Combined			
		C-17	Combined			
		C-16	Combined			
		C-15	Combined			

2-4 Source: City of Camden – American Water Contract Services.

	PS Name	Sewer Sheds Served	Collection System Type	Pump Data		Discharge To
				Number of Pumps	Firm Capacity (mgd)*	
8	State Street	C-28A	Combined	3	1.03	Camden interceptor (to Pine Street PS)
		C-28	Combined			
		C-15	Combined			
City of Gloucester[2-5]						
1	Chestnut Avenue	G-6-8	Sanitary			G-06 Regulator
2	Essex Street	G-2	Combined	3	2.38	G-02 Regulator
3	Gloucester High Station			2	0.92	
4	Goldy Drive	G-6-8	Sanitary	2	0.92	G-06 Regulator
5	King Street	G-7	Combined	2	0.92	G-06 Regulator
6	Klemm Avenue	G-6-8	Sanitary	2	0.92	G-06 Regulator
7	Nicholson Road	G-5-2	Sanitary	2	0.92	G-05 Regulator

* Capacity with one pump out of service.

2.4 Solids & Floatable Control Facilities

Pursuant to their respective NJPDES permits, CCMUA and the Cities of Camden and Gloucester prepared CSO Solids and Floatables Plans. Active CSO outfalls were required to provide netting or bar screens at the point of discharge that prevent the passage of any item through an opening smaller than ½ inch. In Camden City, all 22 active outfalls have solids/floatables control facilities installed.[2-6] Gloucester City has solids/floatables controls currently in operation at all 7 of its CSOs[2-7]; and CCMUA has a facility at C-32, its one combined sewer overflow outfall.

The netting facilities are inspected after each CSO event and the nets are cleaned or replaced as necessary to prevent significant flow-through restrictions. The facilities incorporate tidal control structures to prevent backflows into the combined sewer system. A plan view and cut-away views of a typical netting facility are provided as Figure 2-4. The locations and basic design characteristics of the netting facilities are summarized on Table 2-5.

2-5 Source: Gloucester City Department of Utilities – Standard Operating Procedures, Preventive Maintenance and Emergency Response Procedures – Combined Sewer System Pumping Stations

2-6 Sources: Design data and calculations relating to the Camden City trash capture systems prepared by DRM Consulting Engineers, July 2010, including plan views and cut-away diagrams of the TrashTrap® in-line netting systems of Fresh Creek Technologies. Also, July 2010 Technical design memorandum prepared for CCMUA by D&B/Guarino Engineers, LLC reviewing the plans and specifications for the City of Camden CSO Systems B – Netting facilities. Additional information was from Hazen & Sawyer relative to Camden Phase A netting facilities design.

2-7 Source: Design Calculations for Netting System and Screens at Gloucester City CSO Improvements Prepared for Seprotech Systems Incorporated by August C. Lozano, P.E. Inc. June 2008.

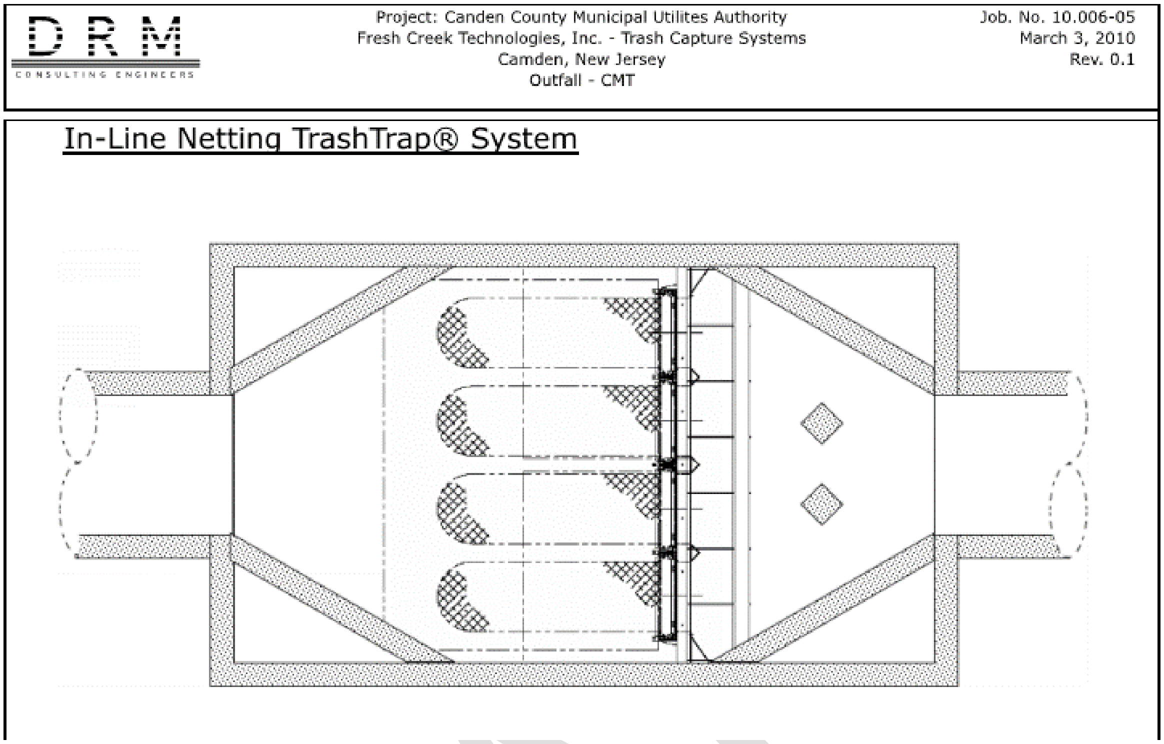

Figure 2-4(a) - Typical Netting Facility – Plan View

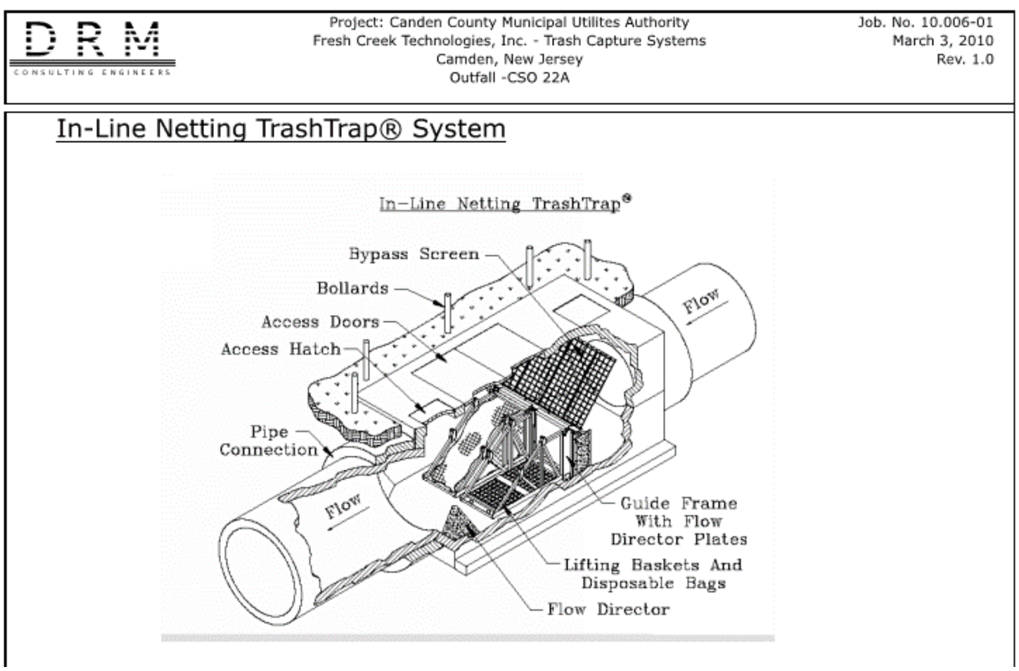

Figure 2-4(b) - Typical Netting Facility – Cut Away View

Table 2-5 – Solids & Floatables Control Facilities

Associated Outfall Structure		Municipality	Receiving Stream	Solids & Floatables Control	
Count	Name			Type	Number of Nets
1	C1	Camden	Newton Cr.	Netting	2
2	C2	Camden	Delaware R.	Netting	2
3	C3	Camden	Delaware R.	Netting	8
4	C5	Camden	Delaware R.	Netting	2
5	C7	Camden	Delaware R.	Netting	2
6	C8	Camden	Delaware R.	Netting	4
7	C9	Camden	Delaware R.	Netting	2
8	C10	Camden	Delaware R.	Netting	4
9	C11	Camden	Delaware R.	Netting	4
10	C13A	Camden	Delaware R. back Channel	Netting	2
11	C15	Camden	Cooper R.	Netting	2
12	C16	Camden	Cooper R.	Netting	2
13	C17	Camden	Cooper R.	Netting	2
14	C19	Camden	Cooper R.	Netting	8
15	C22	Camden	Cooper R.	Netting	8
16	Thorndyke	Camden	Cooper R.	Netting	8
17	C22A	Camden	Cooper R.	Netting	
18	C23A	Camden	Delaware R. back Ch.	Netting	2
19	C24	Camden	Delaware R. back Ch.	Netting	2
20	C27	Camden	Cooper R.	Netting	4
21	C28	Camden	Cooper R.	Netting	2
22	C32	CCMUA	Delaware R. back Ch.	Netting	14
23	CFA	Camden	Newton Cr.	Manual Bar Rack	
24	G1	Gloucester	Delaware R.	Netting	2
25	G2	Gloucester	Delaware R.	Netting	1
26	G3	Gloucester	Delaware R.	Netting	3
27	G4	Gloucester	Delaware R.	Netting	3
28	G5	Gloucester	Delaware R.	Netting	2
29	G6	Gloucester	Delaware R.	Netting	1
30	G7	Gloucester	Newton Cr.	Netting	1

2.5 Delaware Water Pollution Control Facility # 1

2.5.1 Overview

CCMUA treats approximately 60 million gallons of sewage per day at its wastewater treatment plant, which is referred to as the Delaware No. 1 Water Pollution Control Facility (WPCF), or simply "the plant." The plant was expanded in the late 1980s to a secondary treatment facility with a dry weather capacity of 80 mg and a wet weather capacity of 150 mgd. The WPCF operates under NJPDES Permit No. NJ 0026182, with primary year-round permit limits shown below in Table 2-6. The average influent CBOD and TSS concentrations are approximately 187 and 208 mg/L respectively, which is representative of a medium strength wastewater.

Table 2-6 – Delaware WPCF #1 Effluent Limits

Parameter	Monthly Average	Weekly Average
Total Suspended Solids	30 mg/l 85% removal	45 mg/l
Carbonaceous Biochemical Oxygen Demand	25 mg/l 85% removal	40 mg/l
Ammonia	35 mg/l	
Fecal Coliform	200 geometric mean #/100 mL	400 geometric mean #/100 mL

2.5.2 Current Process Train[2-8]

In 2016, the Delaware No. 1 WPCF treated an average flow rate of approximately 52.6 MGD and the plant is rated to treat 80 MGD. The four (4) existing raw sewage pumps together can provide a firm capacity (largest pump out of service) of 150 MGD, which is the maximum wet weather capacity at the plant. The treatment plant processes include preliminary treatment, primary sedimentation, aeration, final sedimentation, and disinfection. The process train flow is diagramed on Figure 2-5 and a plan view of the WPCF # 1 is provided as Figure 2-6.

2-8 Excerpted from: Wet Weather Upgrades at the Delaware No. 1 WPCF – Concept Study of Alternatives Draft May 2017 prepared by Greeley & Hansen for CCMUA.

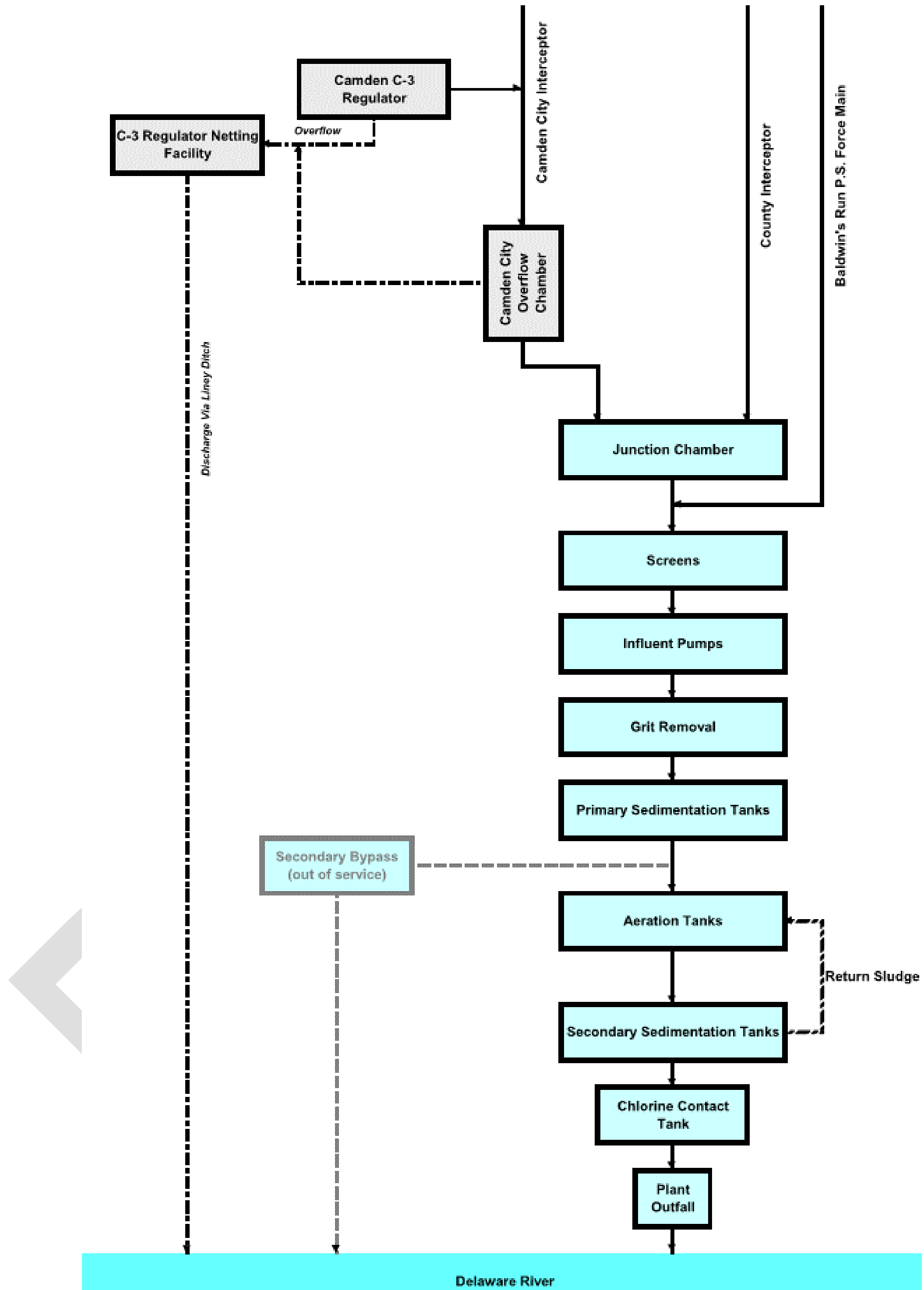

Figure 2-5 – Delaware No. 1 WPCF Treatment Process Flow Diagram

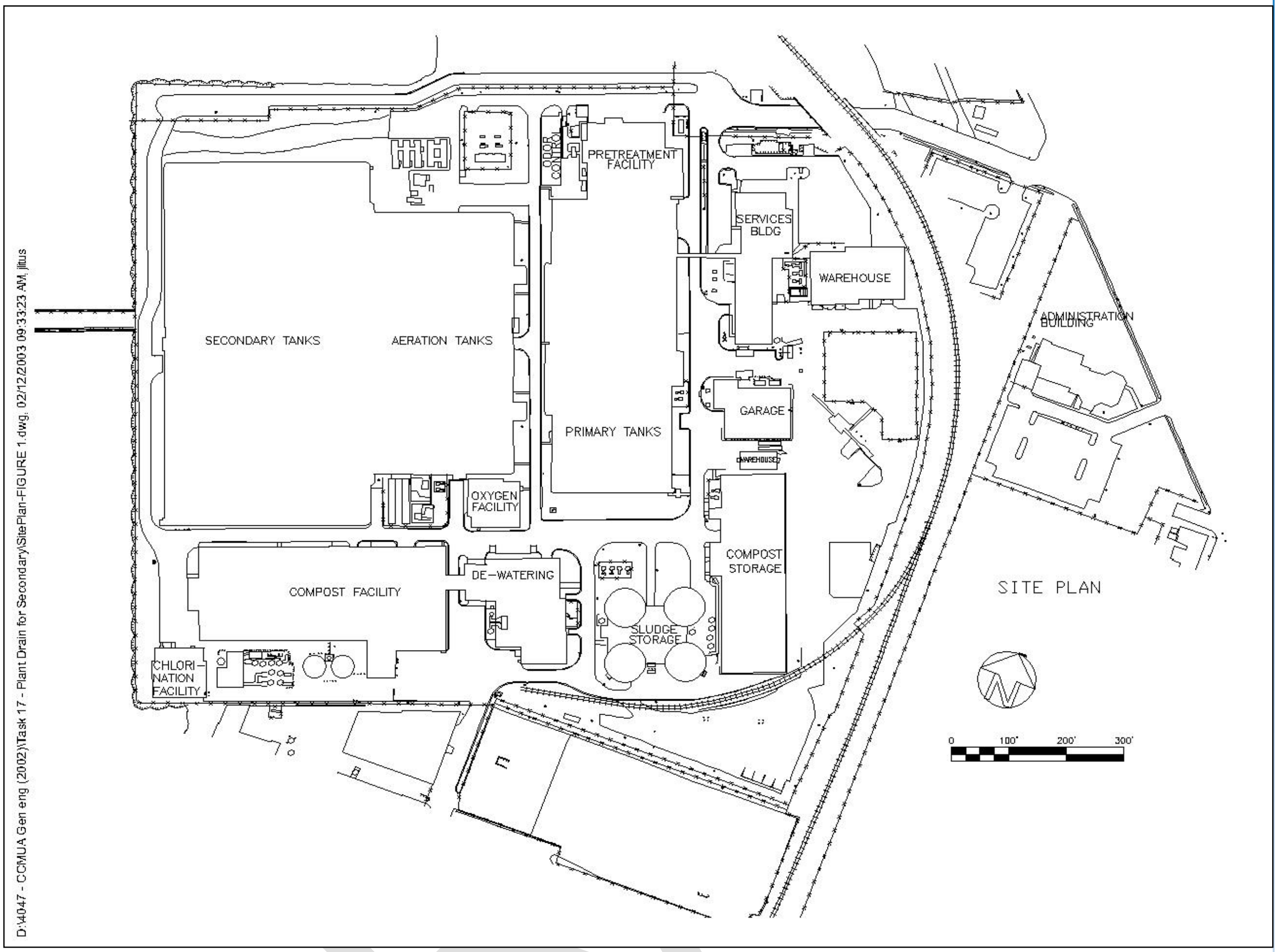

Figure 2-6 – Plan View of CCMUA Delaware Water Pollution Control Facility #1
Source Wet Weather Operating Manual for CCMUA Delaware No. 1 WPCF 2003 WRc/D&B, LLC.

The preliminary treatment facility contains three (3) Detritus Grit Tanks with a combined tank area of 4,357 ft2. Once the wastewater flows through the grit tanks it then enters an effluent channel where it flows to the primary sedimentation facility. The primary sedimentation facility includes 10 PSTs with a combined surface area of 89,280 ft2. The PSTs receive grit tank effluent through the West PST influent channel and East PST influent channel. Flow exits the PSTs into an effluent channel that directs the flow into two (2) flow splitters which split the flow into north and south sides. The aeration facility includes eight (8) aeration tanks with a combined tank volume of 14.79 million gallons. Flow then exits the aeration tanks into effluent channels which direct the flow to the final sedimentation tanks (FSTs).

The final sedimentation facilities include eight (8) tanks with a combined tank surface area of 158,656 ft2. Flow from the FSTs enter into effluent channels that direct the flow into the chlorine contact tanks. The disinfection facilities include two (2) tanks with a combined volume of 2.76 million gallons. Outfall from the CCTs is discharged into the Delaware River through a series of pipes ranging from 60inches in diameter to 72-inches. The current wastewater process train components are summarized below in Table 2-7.

Table 2-7 – WPCF #1 Process Train Unit Summary

Unit Process	Type	Number of Units	Maximum Capacity per Unit	Peak Process Capacity (mgd)	Description
Influent Junction Chamber	Concrete structure	1		150 mgd	Below-grade junction box into which the 72" Camden Delaware interceptor and the 96" CCMUA interceptor discharge. The two sources are not hydraulically isolated.
Influent Wastewater Metering	Magnetic Metering	3			The influent junction chamber is equipped with two 48-inch diameter magnetic flow meters that measure the instantaneous flow from the City of Camden and Camden County {Cooper River & Big Timber Creek combined) interceptors, respectively. The capacity of the meters is limited by the hydraulic capacity of the gravity interceptor lines. The Baldwin Run PS flow is measured by a magnetic flow meter at the Baldwin Run PS on the force main discharge piping. The Baldwin Run force main discharges directly into the Delaware #1 WPCF wet well.
Raw Wastewater Screening	Mechanical Bar Screens	3			Three mechanically cleaned bar screens remove large solids and debris from the plant influent. Accumulated material is removed periodically onto a conveyor which discharges into a dumpster for ultimate disposal in a landfill. The original rated capacity for each unit was 46.7 mgd; however, this was based on the rated capacity of the raw sewage pump station.
Influent Pumping	Non-Clog Vertical Centrifuge	4	2 @ 46.7 mgd 2 @ 60.0 mgd	153.4 mgd	Two of the raw sewage pumps were retrofitted with 600 hp drives and motors Two pumps are equipped with 450 hp motors. Each pump discharge line Is equipped with a 42-inch diameter magnetic flow meter. The influent pump control logic is designed to try to maintain a constant wet well level. Thus, pumping capacity is increased automatically or decreased in response to a rise or fall in the wet well level. During high flows, the pump controls are adjusted to allow flows of 150 mgd or greater into the facility.

Unit Process	Type	Number of Units	Maximum Capacity per Unit	Peak Process Capacity (mgd)	Description
Grit Removal	Grit Chambers	3			Screened wastewater passes through three round grit chambers. Each tank is equipped with a circular raking mechanism that conveys grit to an internal hopper. The grit is pumped to cyclone grit separators and classifiers and subsequently discharged to a dumpster for disposal in a landfill. Each grit chamber is nominally 43 feet long by 43 feet wide with a 6-foot average SWD.
Primary Clarification	Rectangular	10	15	150	The clarifiers are equipped with longitudinal chain-and-flight sludge collectors that convey sludge towards chain-and-flight cross collectors located at the inlet end of the PCs. Floating oils and grease that accumulate on top of the primary clarifiers are conveyed to scum troughs (by the returning sludge flights). Each PC is divided into three longitudinal bays and is nominally 186 feet long by 46.5 feet wide with a 10-foot average SWD.
Secondary Biological Treatment	4-Stage Pure Oxygen Aeration	8	14.5 mgd	114mgd	The Delaware No. 1 WPCF utilizes the pure-oxygen activated sludge process for secondary biological treatment. Each aeration tank is equipped with one mechanical mixer per stage to oxygenate the mixed liquor. The mixer motors decrease in size from 75 hp in the first stage, to 50 HP in the 2nd, to 30 hp in the last two stages. Each aeration tank is nominally 220 feet long by 55 feet wide with an average SWD of approximately 15 feet. The pure oxygen is provided using a 60 ton per day (TPD) Vacuum Swing Adsorption Plant and if necessary, a 60 TPD cryogenic oxygen generation plant.
Final Clarification	Rectangular Tanks	8	14.5 mgd	114 mgd	Eight rectangular final settling tanks (FSTs) are used for removing secondary solids after biological treatment. The FSTs are equipped with longitudinal chain-and-flight sludge collectors that convey sludge towards chain-and-flight cross collectors located in the middle of the FSTs. Floating oils and grease that accumulate on top of the primary FSTs are conveyed to scum troughs (by the returning sludge flights). Each FST is divided into four longitudinal bays and is nominally 190 feet long by 79 feet wide with a 12-foot average SWD.

Unit Process	Type	Number of Units	Maximum Capacity per Unit	Peak Process Capacity (mgd)	Description
Disinfection	Chorine Contact Chamber	2	75 mgd (peak)	150 mgd	The chlorine contact chambers were designed to provide 40 minutes of contact time at the design average plant flow rate of ~~75~~ *80* mgd. The plant doses sodium hypochlorite from one of the 4, 10,000-gallon storage tanks located in the former chlorine rail car shed. The hypochlorite is dosed using flow paced metering pumps located in the gallery adjacent to the contact tanks.
Biosolids Handling and Treatment l	Gravity Belt Thickener	3			Biosolids removed from the primary and secondary clarifications processes are pumped to on-site sludge storage tanks. The waste activated Sludge (WAS) is thickened by one of three gravity belt thickeners (GBT). The thickened WAS is then combined with Primary Sludge and dewatered on belt filter presses (BFP). After the BFP's the cake is either heat dried in a Komline-Sanderson sludge dryer and slated for beneficial reuse. If the cake is not dried it is sent to storage and then land fill.
	Belt Filter Press Dewatering	7			

a Where applicable, maximum capacity per unit is based on maximum day, unless otherwise noted.
b Where applicable, peak process capacity is based on peak hydraulic flow rate with the largest unit out-of-service, unless otherwise noted.

2.5.3 Wet Weather Treatment Capacity Capital Improvements

CCMUA is currently implementing three major capital improvements that will expand the wet-weather treatment capacity of the WPCF:

Influent Chamber Reconfiguration –

The CCMUA WPCF receives wastewater influent from three (3) sources, the City's 72" Combined Sewage system main, the County's 96" Sanitary Sewer main, and the 36" Baldwin Run force main. These pipes merge together at an existing junction structure near the northeasterly side of the plant as shown schematically in Figure 2-7.

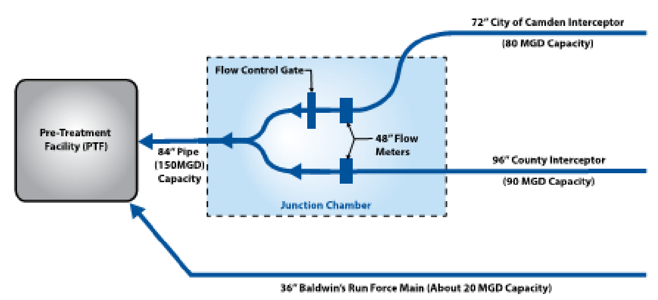

Figure 2-7 – WPCF Influent Chamber Current Configuration.

The 2016 annual average flow rate of wastewater through the plant was approximately 52.6 million gallons per day (MGD), and the plant is rated to treat up to 80 MGD. The existing raw sewage pumps can pump a maximum flow of 150 MGD, which is the rated wet weather capacity of the treatment plant.

The actual range of flows to the plant depend on how the wastewater collection system is operated. CCMUA is currently implementing a Junction Structure Bypass project which will allow approximately 190 MGD of wastewater flow to enter into the plant. Table 2-8 lists the peak flow from each of the identified sources under the current configuration of the combined sewer system. Under the current configuration of the influent chamber, a flow control gate in the City of Camden's interceptor system is used to limit the flow into the junction chamber in response to wet weather events. This results in the need to throttle back the Camden Arch Street Pump Station to reduce flows to the WPCF during wet weather.

Table 2-8 – Peak Flows Deliverable to CCMUA Delaware No. 1 WPCF Under Current CSS Configuration

WPCF # 1 Influent Lines	Diameter (inches)	Flow Rate (MGD)
County Interceptor	96	90
Delaware River Interceptor (Camden)	72	80
Baldwin Run Force Main	36	20
Total Maximum Flow		190

In conjunction with the expansion of wet weather treatment capacities at WPCF #1 described below; CCMUA and the City of Camden anticipate that the need to throttle back pumping at the Arch Street pump station during wet weather will be significantly reduced or eliminated. Moreover, the baseline monitoring and modeling analyses (detailed in section 5) has indicated that the City Interceptor has the hydraulic capacity available to convey additional flows during wet weather events. However additional expansion of wet weather treatment capacities at WPCF No. 1 and modifications to the Camden and Gloucester regulators will be required to utilize this interceptor capacity. These potential improvements will be evaluated during the development and evaluation of alternatives phase of the LTCP process.

Influent Pump Upgrades – A related project is currently underway to increase the firm capacity (largest pump out of service) of the raw sewage pumps to 180 MGD to provide for operating efficiencies and to better match the hydraulic capacity of the reconfigured influent chamber and expanded primary treatment capacity described below. Under the scope of the pump upgrade project. Raw sewage pump upgrades include new premium efficiency motors, variable speed drives, a new resilient power distribution system and related HVAC work. In addition, two of the existing four pumps will be upgraded from 45 MGD to 60 MGD each. The other two existing pumps will remain at 60 MGD each. The existing piping and valves will remain in place.

Primary Treatment Capacity Optimization – USEPA's 1994 CSO Control Policy encourages the optimal use of primary treatment capacities which exceed a treatment plant's secondary treatment capacities:

> "In some communities, POTW treatment plants may have primary treatment capacity in excess of their secondary treatment capacity. One effective strategy to abate pollution resulting from CSOs is to maximize the delivery of flows during wet weather to the POTW treatment plant for treatment. Delivering these flows can have two significant water quality benefits: First, increased flows during wet weather to the POTW treatment plant may enable the permittee to eliminate or minimize overflows to sensitive areas; second. This would maximize the use of available POTW facilities

for wet weather flows and would ensure that combined sewer flows receive at least primary treatment prior to discharge."[2-9]

CCMUA has determined that addressing the hydraulic bottlenecks identified within the treatment plant could increase the plant's capacity to treat flows up to 185 MGD during significant wet weather events with river storm tide elevations of 10.0-feet and 11.5-feet. CCMUA has undertaken to optimize the hydraulics within the WPCF process train enable the maximization of wet weather flows. These hydraulic improvements focus on the primary sedimentation tankage influent and effluent piping and channels and on wet weather plant outfall configuration.

CCMUA also is evaluating the availability of excess primary treatment capacity (i.e. primary treatment capacity that exceeds secondary treatment capacity) as is encouraged in the CSO Control Policy as a means to maximize the treatment of wet weather combined sewer flows. During peak wet weather events additional wet weather flows could be bypassed around the secondary treatment processes. The feasibility and optimal utilization such additional treatment capacity will be documented in the Development & Evaluation of Alternatives Report.

2.6 Camden Stormwater Management Improvement Projects

CCMUA and the City of Camden have undertaken several capital improvement projects intended to improve stormwater management and to reduce localized street flooding in the downtown riverfront redevelopment area. CCMUA is installing a stormwater pump station near the foot of Elm Street and the Delaware River. The pump station will have a peak firm capacity of 100 MGD and is intended to address street flooding along and in the vicinity of Delaware Avenue south of the Ben Franklin Bridge for the ten-year storm. The proposed general configuration is shown on Figure 2-8.

A new diversion chamber will be installed in the vicinity of the intersection of Elm Street and North Front Street to divert flow from the existing 72" Front Street gravity sewer to a new regulator structure. The new regulator will shunt base flows into the existing 36" Camden Delaware Avenue interceptor sewer. Wet weather flows will flow into the new pump station and be discharged into a new outfall on the Delaware River.[2-10] The intent of the pump station is to divert sufficient flow from reaching the existing C10 and C11 Camden regulator structures from the Camden collection system from the north and the east of the redevelopment area to allow the C10 and C11 outfalls to discharge the ten year storm flow at a mean high tide elevation of +3.0 feet.

CCMUA is also undertaking a related project involving the rehabilitation and reconfiguration of the 84" Cooper Street sewer. Approximately 190 linear feet of new 84"

2-9 59 FR 18693

2-10 Source: Site Plan for Elm Street Pump Station prepared by Johnson, Mirmiran & Thompson (JMT) March 2017

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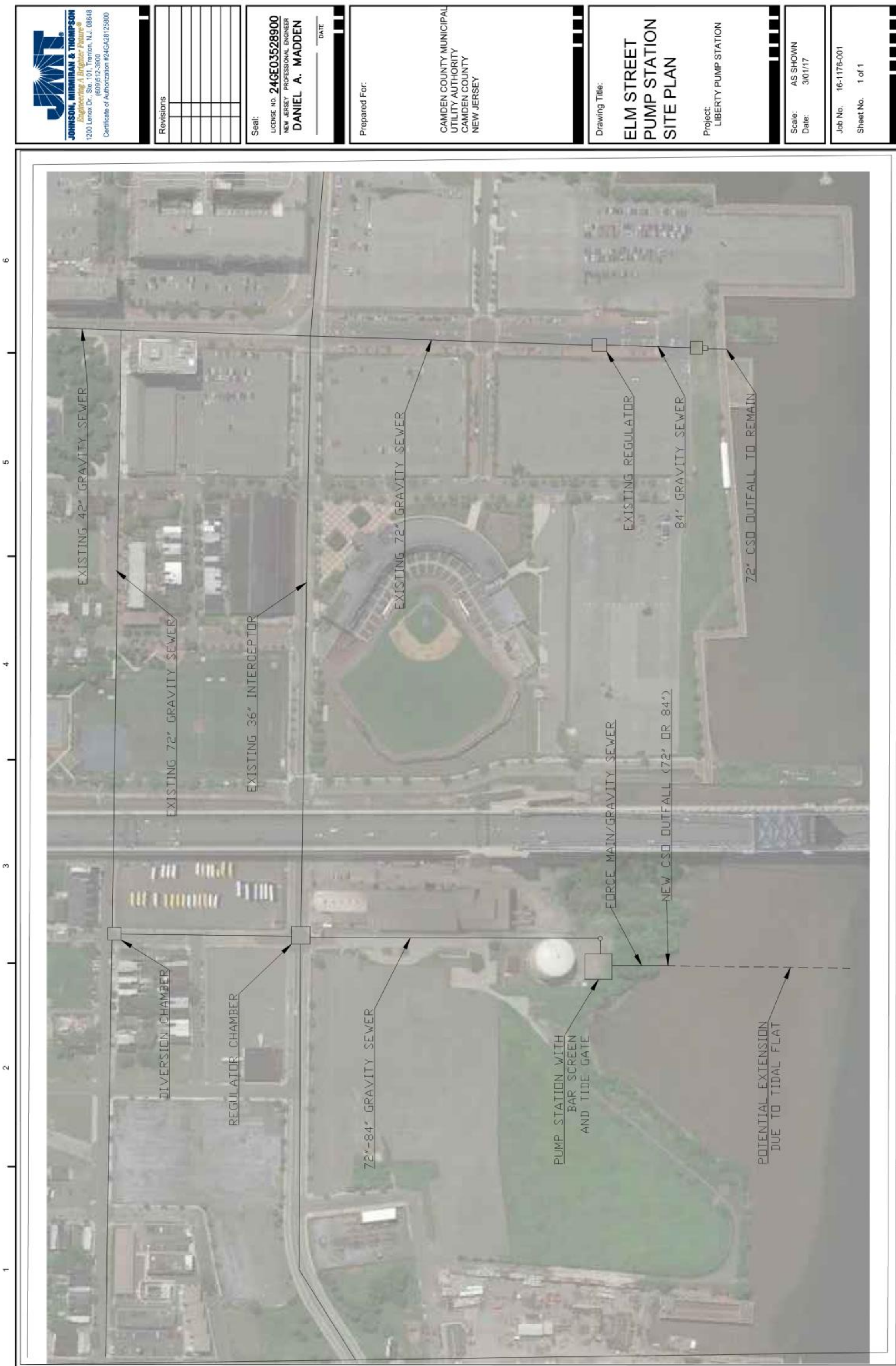

Figure 2-8 – Elm Street Stormwater Pump Station Site Plan diameter Class V reinforced concrete pipe with cured in place liner will be installed from a new relocated netting facility on the Delaware River along Cooper Street towards Riverside Drive. East of Riverside Drive the existing Cooper Street sewer will be lined to Delaware Avenue.[2-11] Finally, CCMUA and Camden are upgrading the capacity of the Arch Street Lift Station by replacing the three existing 75 horsepower motors with new 100 horsepower motors and replacing the three existing 22.25" impellers with 24.25" impellers.[2-12]

2.7 Wet Weather Operating Strategies

2.7.1 Overview

The hydraulic capacities of the Camden and Gloucester combined collection sewer systems are greater than the capacity of the interceptor sewers and of CCMUA's WPCF #1. As detailed in Section 2.2.2 of this report, the CSS have regulator devices located in the CSO chambers that allow the sanitary sewage and a percentage of the stormwater flow to be diverted to the plant for treatment. When the preset combined sewage/stormwater volume is reached the balance overflows directly to surface water bodies through an outfall pipe. This section of the SCR summarizes the baseline wet weather operating procedures used to control flows into the interceptor sewers and wastewater treatment plant. Overall, the combined sewer system that is the subject of the SCR has thirty-eight (38) CSO control points. Thirty (30) CSO control points are located within the collection system serving the City of Camden, seven (7) are located within Gloucester City, and one is operated by CCMUA.

2.7.2 CCMUA Wet Weather Operating Strategy[2-13]

Three interceptor sewers enter the Delaware No. 1 WPCF. One of the interceptors is a force main: 36-inch diameter pipeline from Baldwins Run pumping station carrying wastewater from East Camden and Pennsauken. The other two are: 96inch diameter gravity sewer carrying wastewater from a major suburban portion of Camden County and 72-inch diameter gravity sewer carrying wastewater from the rest of the City of Camden. CCMUA has four control points on the combined sewer part of the collection system:

- 32nd Street Metering Chamber - Gate G-1;
- 27th Street / Baldwins Run Pump Station - Gate G-2;
- Gloucester City Pump Station – Gate G-3
- WPCF # 1 Influent Junction Chamber – Gate G-4.

These control points protect pump stations from being flooded when the upstream CSO regulators fail to limit the amount of combined sewage/ stormwater sent to the pump station. The locations of these control points are shown on Figure 2-9.

2-11 Source: Plan and profile drawings for the Cooper Street Combined Sewer Rehabilitation Project prepared by Remington & Vernick Engineers, November 2017.

2-12 Source: Design drawings for the Arch Street Pump Station Upgrades Project prepared by Remington & Vernick Engineers, November 2017.

2-13 Information on CCMUA's wet weather operating protocols was excerpted from the July 2003 Wet Weather Operating Manual for CCMUA Delaware No 1 WPCF prepared by WRc/D&B, LLC. A copy of this report is provided as Appendix B to this System Characterization Report.

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Figure 2-9 – CCMUA Hydraulic Control Points

Source: Wet Weather Operating Manual for CCMUA Delaware No. 1 WPCF 2003 WRc/D&B, LLC.

CCMUA has established a set of performance goals for protection of the County receiving waters. The performance goals are:

1. Maximize the flows to the plant as early as possible to avoid overflows of the sanitary sewers of the county and reduce CSO.
2. Maximize flows while meeting requirements of the NJPDES Permit.
3. Maximize flows in an orderly fashion to prevent solids loss from the final sedimentation tanks.

CCMUA's wet weather operating protocols for achieving its performance goals are summarized on Table 2-9. Details are available in CCUMA's Wet Weather Operating Manual.

2.7.3 Camden and Gloucester Wet Weather Operating Strategies

The wet weather operating strategies for the Cities of Camden and Gloucester are also summarized on Table 2-9.

Table 2-9 –Wet Weather Operating Protocol

CCMUA		
	Regional Conveyance Interceptor System	**WPCF # 1**
Before Wet Weather	• Preset CCMU Hydraulic Control Gates G-1 through G-3 • Preset Hydraulic Control Gate G-4 (City of Camden) to 25% open	• Lower wet well elevation to negative 10.0 feet elevation. • Verify availability of all eight primary sedimentation tanks for service as needed, reduce sludge blanket. • Verify availability of all eight aeration tanks for service as necessary. • Verify availability of reduce sludge blanket in final sedimentation tanks
During Wet Weather	• Maintain flows at hydraulic control gates G-1, G-2, and G-3 at 3.0 mgd, 1.5 mgd and 4.0 mgd respectively • If Baldwin Run or Gloucester pump stations alarm, lower gates to allow 150% of average dry weather flows. • Maintain flows at hydraulic control gate G-4 at 20 mgd (150% of average daily dry weather flow)	• Operate influent pumps to maintain wet well elevation below negative one foot. • Utilize all primary tanks. • Utilize all eight aeration tanks for sustained plant flows above 80 mgd or at plant flows of 110 mgd or more. • Place all final sedimentation tanks into service if not already on-line.

City of Camden

Before Wet Weather

- Check that netting facilities are clean to ensure solids / floatables will be removed during any CSO discharge.
- Check that inlet / catch basins in known areas susceptible to flooding are clean to ensure that stormwater flow to the sewer is not obstructed.
- Check that the regulators and tide gates are clean to prevent inflow from the outfall from flooding the collection system due to high tides.
- Check that emergency generators for al Lift Stations are fully fueled and test run units.
- Check that emergency contact list is updated for internal and external personnel ant entities:
  - Provide "on-call" personnel with portable cell phone chargers
  - Have "on-call" personnel ensure that their cell phones are fully charged.
- Place operating / emergency response personnel "on-call" and available for the duration of the storm event.

During Wet Weather

- Call in staff to clean MH / catch basins as necessary.
- Staff the Arch Street Lift Station.
- Take Arch Street Lift Station out of automatic, and operate a single pump in manual mode.
- Manually operate the station with one pump as long as possible:
  - Monitor the manholes along the "River Line"
  - Maintain contact with CCMUA regarding the position of the WWTP influent controls
- If any of the following conditions occur, shut down the lift station:
  - High level alarm from MH at 2nd Street & Clinton Avenue
  - MH at Arch Street Lift Station is "dancing" (venting air)
  - CCMUA reports that the "City Gage" is approaching 21% open.
- Make notification to the NJDEP that the station has been shut down at (877)-927-6337, non-emergency option 2:
  - Report as "NJPDES 0108812 permitted wet weather discharge through netting facility to Delaware River from the Arch Street Lift Station, Delaware Avenue & Arch Street, Camden NJ.
  - Write the NJDEP Incent Number, and the NJDEP Operator Number for your report.

Gloucester City

Before Wet Weather

- As part of our ongoing daily maintenance of the Combined Sewer System, each of the 7 Regulator Structures, Tide Gates and Netting Chambers are inspected and maintained as needed.
- In the event a significant precipitation event is forecasted, the Department of Utilities will pre-position a bypass pump at Regulator G-2 in order to pump around the tide gate during periods of High Tide.

During Wet Weather	If, despite these precautions, flooding still occurs on Water St., the Director of the Department of Utilities will contact CCMUA Operations to request opening of the gate at the Water Street Pump station to a fixed 7% (it currently modulates between 4 and 7%).

2.8 Sewersheds Associated With Camden Street Flooding

Street and basement flooding during wet weather has been a major public health, environmental and economic problem for the City of Camden for many years. Areas of Camden with reported street flooding are mapped on Figure 2-9. In 2016 the City of Camden through its contract service operator identified flooding "hot spots" which are also shown on Figure 2-10.[2-14] There are twenty sewersheds that have been associated with the reported street flooding or hot spots which are also listed on Table 2-10.

Table 2-10 – Camden Sewersheds Associated with Street Flooding

Sewershed / Regulator		# of Anecdotal Flooding Locations	Flood Mitigation Plan Hot Spots
Count	Name		
1	C1	5	3, 11, 12
2	C3	21	5, 25
3	C5	5	6
4	C6	5	4, 9
5	C7	4	15, 16
6	C8	2	
7	C9	1	
8	C10	2	8
9	C11	5	7
10	C13 / 13A	0	8, 14, 16, 20, 21
11	C16	1	17
12	C17	0	17
13	C22	8	10
14	C22A	1	
15	C23	0	20, 21
16	C24	1	20
17	C27	4	10, 14
18	C28	1	21
19	CFA	2	
20	C32	12	1, 2, 13,18, 19, 22, 23, 24,

[2-14] Source: American Water Contract Services – City of Camden Wastewater System Flood Mitigation Plan 2016. A copy of this document is provided as Appendix C.

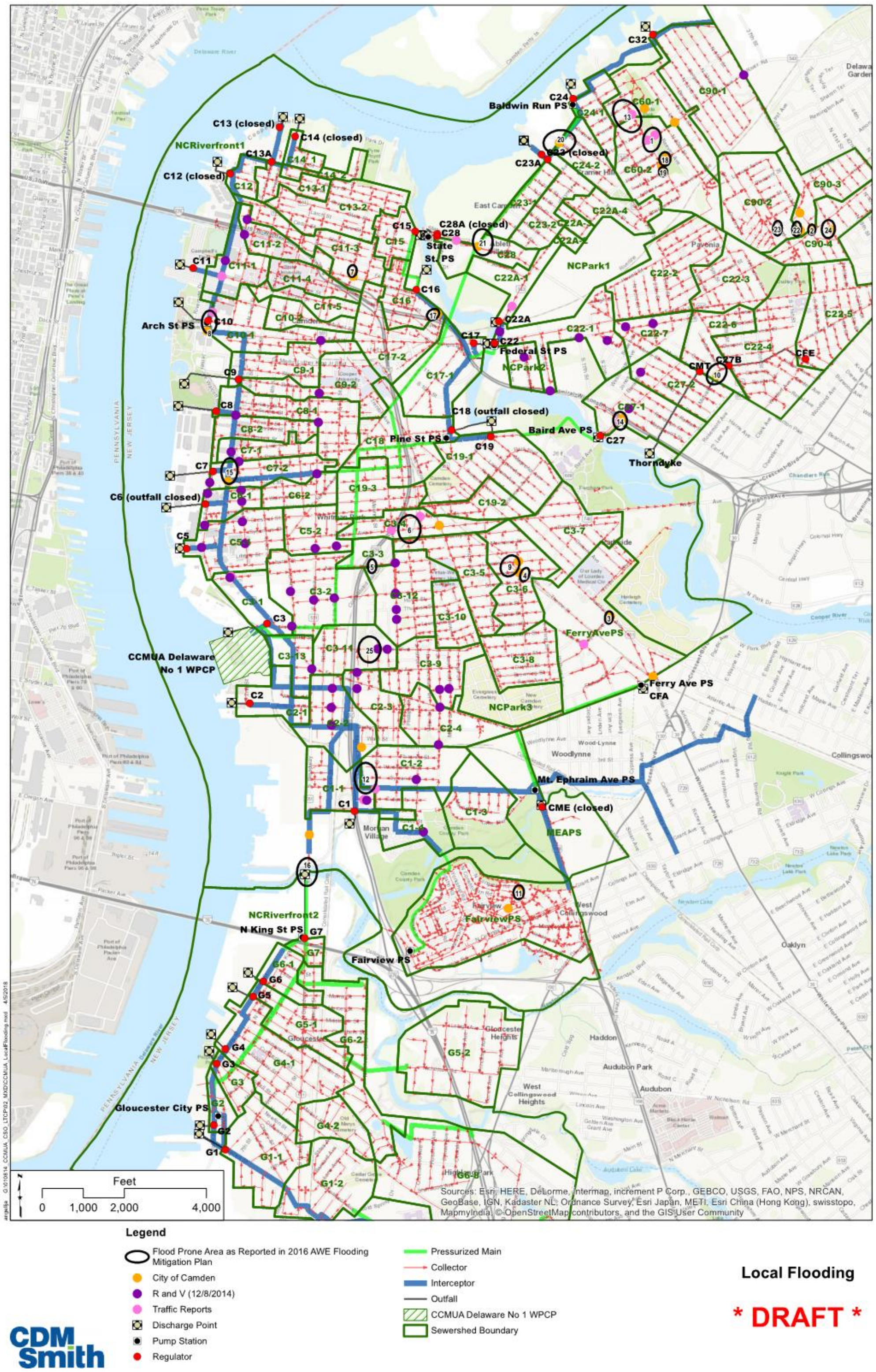

Figure 2-10 – Locations Associated with Street Flooding

2.9 Camden & Gloucester System Usage Characterization

2.9.1 Service Population

The combined service populations in Camden and Gloucester are approximately 88,900 based on the 2010 U.S. Census. No significant unsewered areas are thought to exist in either city. CCMUA's Water Pollution Control Facility #1 has a total service population of around 474,200 including Camden and Gloucester. A summary breakout of the WPCF service population is provided on Table 2-11.

Table 2-11 – Service Populations

Contributing Area	2010 Population	%
Camden City	77,350	16.3%
Gloucester City	11,500	2.4%
Subtotal	88,850	18.7%
CCMUA Regional Interceptors		
Pennsauken	39,700	8.4%
Cooper River	217,950	46.0%
Big Timber Creek*	127,700	26.9%
Subtotal	385,350	81.3%
Total	474,200	100.0%

* Includes Winslow Township

2.9.2 Significant Industrial Users

There are 15 wastewater dischargers within the combined sewered area that are subject to CCMUA's Industrial Pretreatment Program (IPP). Fourteen of these are located within the City of Camden and one is in Gloucester City. Four of the IPP user are categorical users under the Clean Water Act. Seven are Significant Industrial Users due to their respective discharge volumes averaging 25,000 or more gallons per day. The remaining four dischargers are subject to the IPP due to the characteristics of their non-categorical discharges, e.g. high concentrations of compatible wastes such as biochemical oxygen demand.

Total contributions from the users subject to the IPP are around six hundred thousand gallons per day. The users are listed on Table 2-12, along with a descriptions of their respective business activities and their average daily flows.

Count	Facility Name	City	Sewershed	Business Activity	Type	SIC Code	Average Daily Flows (gallons)
1	Adventure Aquarium	Camden	C10	Botanical and zoological gardens	SIU	8422	37,669
2	Art Metalcraft Plating Company		C8-2	Plating and polishing	CIU	3471	728
3	Camden County Correctional Facility		C10	Correctional institutions	SIU	9223	183,578
4	Camden County Energy Recovery Associates, L.P.		C1	Refuse Systems	SIU	4953	104,078
5	Camden Plant Holding, L.L.C.		C2-2	Electric Services	CIU	4911	54,585
6	Campbell Soup Company		C17-1	Food preparations	SIU	2099	33,590
7	Comarco Products		C3-2	Sausages and other prepared meats	NSU	2013	2,785
8	Consolidated Rail Corp-Pavonia Diesel Tenninal		C22A-1	Switching and terminal services	NSU	4013	17,067
9	Cooper Hospital/University Medical Center		C9-2	General medical & surgical hospitals	SIU	8062	38,891
10	Duro Plating		C5-1	Plating and polishing	NSU	3471	191
11	Mafco Worldwide Corporation		C2-1	Flavoring extracts and syrups	SIU	2087	97,118
12	NJ TRANSIT - The RIVER Line Yard & Shop Maintenance		C90-2	Railroad equipment	NSU	3743	246
13	Our Lady of Lourdes Medical Center		Ferry Ave PS	General medical & surgical hospitals	SIU	8062	25,172
14	RF Products		Ferry Ave PS	Communications equipment	CIU	3669	1,414
	Subtotal Camden						**597,112**
		Gloucester	G4-1				
1	Quik-Flex Circuit, Inc.		G5-2	Electronic components	CIU	3679	1,030
	Subtotal Gloucester						**1,030**
	Grand Total						**598,142**

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Section 3 Revised 04/12/18

Hydrologic Characterization

3.1 Introduction

This section focuses on the hydrological elements of the sewersheds which affect runoff into the combined sewer system including land use, impervious cover, and soil type. This section also identifies non-contributing areas, and defines land use in the sanitary sewered areas contributing to the CCMUA regional interceptor system upstream of the combined sewer systems.

3.2 Land Use

The Cities of Camden and Gloucester cover approximately 4,235 acres (6.6 square miles) and , 1,000 acres (1.6 square miles) respectively. The dominant land use type in both the City of Camden and City of Gloucester is urban. This includes different density residential, industrial, commercial, roads and highways, and other urban or built-up land uses. Land use by category is shown on Table 3-1.

Table 3-1 – Land Use Types by Municipality[3-1]

Municipality	Type	Land Use by Acreage	
Camden City	AGRICULTURE	2	0.1%
	BARREN LAND	109	2.6%
	FOREST	163	3.9%
	URBAN	3,201	75.6%
	WATER	622	14.7%
	WETLANDS	138	3.3%
	Totals	4,235	100.0%
Gloucester City	AGRICULTURE	0	0.0%
	BARREN LAND	13	1.3%
	FOREST	41	4.1%
	URBAN	708	70.8%
	WATER	175	17.5%
	WETLANDS	63	6.3%
	Totals	1,000	100.00%

The land use layers from 1995, 2007 and 2012 were downloaded from NJDEP's GIS portal and used for this analysis. The 2012 data were published in early 2015 and is the most up-to-date

[3-1] Source: NJ Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS)

land use information and has been incorporated into the combined sewer system hydrologic and hydraulic (H&H) model. Land use is used to derive impervious area estimates. This analysis is also relevant in the context of baseline receiving stream characterization (Section 4.0) and CSO monitoring and modeling (Section 5.0). Land usage by sewershed is shown on Table 3-2. A map of the land uses within Camden and Gloucester is provided as Figure 3-1 (end of section).

Table 3-2 – Land Use by Sewershed

Sewershed / Regulator		Land Uses by Acre										
Count	Name	Agriculture	Altered Lands	Commercial	Forest	Industrial	Recreation	Residential	Transportation	Water	Wetlands	Grand Total
	Camden											
1	C1	2.3	5.5	79.4	3.5	20.2	15.4	236.6	40.9	1.9	16.1	421.8
2	C10			79.6				3.2	2.9			85.7
3	C11			101.4		2.7	10.5	40.7	20.0			175.3
4	C12 (closed)			9.1			1.3	1.8	2.7			14.9
5	C13/C13A		0.1	36.2	2.1	0.2	4.8	64.5			0.5	108.4
6	C14 (closed)		0.2		1.7	6.0		4.1			0.7	12.7
7	C15			6.0	0.0	1.3		17.8				25.1
8	C16			15.2	3.6	0.1	1.3	8.0	4.9			33.0
9	C17		7.0	49.2	5.3	26.0		0.6	41.0			129.0
10	C18		0.8	23.1		9.0	1.0	29.9	15.0			78.8
11	C19		12.3	43.0	0.7	18.7	0.1	97.9	6.7			179.3
12	C2		10.3	71.7	14.0	81.2	11.6	68.7	46.6	1.5	8.8	314.5
13	C22/Thorn	1.0	9.0	145.8	2.7	19.6	32.0	298.7	9.6	0.1		518.5
14	C22A		1.1	17.1	4.5	14.8	0.9	33.4	2.7		6.2	80.8
15	C23		1.0	12.9	0.5	7.0	5.1	40.7				67.3
16	C24		1.4	13.2	1.4	2.9	1.8	44.7	0.6			66.1
17	C27		2.5	18.5	3.9	4.2	2.0	73.9	14.7			119.8
18	C28			5.1	2.0	6.3		17.3			2.3	33.0
19	C3		13.4	194.2	17.3	60.6	30.2	336.1	33.7			685.6
20	C5		4.1	39.8	0.8	37.4	1.0	20.0	1.1			104.3
21	C6		1.9	16.8		12.2		14.7	6.5			52.0
22	C7			16.6		8.9		19.1	21.3			65.9
23	C8		6.4	20.6		13.3	2.1	53.6	3.7			99.7
24	C9		2.1	51.6		0.5	0.0	34.0	14.5			102.8
25	CFA		21.1	53.3	1.9	24.4	9.6	36.4	22.9			169.6
26	C32	0.0	1.1	78.1	13.4	15.3	39.2	321.6	16.9		5.9	491.4

Sewershed / Regulator		Land Uses by Acre										
Count	**Name**	**Agriculture**	**Altered Lands**	**Commercial**	**Forest**	**Industrial**	**Recreation**	**Residential**	**Transportation**	**Water**	**Wetlands**	**Grand Total**
	Subtotal	3.3	101.5	1,197.7	79.1	392.8	170.0	1,917.9	328.8	3.4	40.4	4,235.0
	Gloucester	0.0										0.0
27	G1		8.1	46.9	0.1	40.4		59.7	2.9		1.6	159.7
28	G2			2.0		7.9	0.0	0.8	4.9			15.7
29	G3			6.4		1.8	0.9	11.1				20.3
30	G4		8.0	51.1			0.2	80.0	4.9			144.3
31	G5		1.7	22.0	3.2	0.7	1.4	131.1	13.3	0.0	8.3	181.7
32	G6		17.1	52.9	24.4	4.4	9.5	279.7	53.7	10.8	15.6	468.2
33	G7	0.0	0.0	3.8		0.4		2.5	3.5			10.2
	Subtotal	0.0	34.9	185.2	27.7	55.6	12.1	565.0	83.1	10.8	25.6	999.9
	Total	**3.3**	**136.4**	**1,382.9**	**106.8**	**448.4**	**182.1**	**2,482.9**	**411.9**	**14.2**	**66.0**	**5,234.9**

3.3 Impervious Area Characteristics

As shown on Table 3-3, approximately 56% of the area in Camden is impervious cover based on the 2012 NJDEP data and approximately 42% of the area in Gloucester is impervious cover. A map showing impervious and pervious areas is provided as Figure 3-2 (end of section). For the state of NJ, impervious is derived from aerial photography, verified and linked to the land use layer described in the metadata in the footnote below.[3-2]

Table 3-3 – Imperviousness Characteristics for the Cities of Camden and Gloucester

Community	**Total area**	**Pervious**		**Impervious**	
	Acres	**Acres**	**%**	**Acres**	**%**
City of Camden	4,235	1,859	43.9%	2,376	56.1%
City of Gloucester	1,000	579	57.9%	421	42.1%
Grand Total	**5,235**	**2,438**		**2,797**	

A breakdown of imperviousness by sewershed is provided on Table 3-4.

[3-2] "…land use conditions interpreted from the 2012 imagery were added directly to the 2007 layer through interactive editing. Photo-interpretation, interactive editing, field surveys and initial QA/QC done by Aerial Information Systems, Redlands, CA, under the direction of the NJDEP/BGIS…….In addition to the lu/lc codes, an impervious surface estimate was made for every polygon. This was a visual estimate and not a measured value."

Table 3-4 – Pervious and Imperviousness Areas by Sewershed

Sewershed / Regulator		Total Area (Acres)	Pervious		Impervious	
Count	Name		Acreage	%	Acreage	%
1	C1	421.8	213.7	51%	208.1	49%
2	C2	192.9	92.0	48%	100.9	52%
3	C3	685.6	310.1	45%	375.5	55%
4	C5	104.3	53.0	51%	51.2	49%
5	C6	52.0	21.4	41%	30.6	59%
6	C7	65.9	17.4	26%	48.6	74%
7	C8	99.7	34.0	34%	65.7	66%
8	C9	102.8	29.9	29%	72.9	71%
9	C10	85.7	5.9	7%	79.7	93%
10	C11	175.3	38.7	22%	136.6	78%
11	C12	14.9	7.6	51%	7.4	49%
12	C13	94.2	28.5	30%	65.7	70%
13	C13A					
14	C14	26.9	14.3	53%	12.5	47%
15	C15	25.1	9.2	37%	15.9	63%
16	C16	33.0	17.9	54%	15.1	46%
17	C17	129.0	47.8	37%	81.2	63%
18	C18	78.8	25.0	32%	53.7	68%
19	C19	179.3	78.8	44%	100.5	56%
20	C22	518.5	233.9	45%	284.5	55%
21	Thorndyke					
22	C22A	80.8	40.0	50%	40.8	50%
23	C23	67.3	42.8	64%	24.5	36%
24	C23A		0.0			
25	C24	66.1	35.3	53%	30.8	47%
26	C27	119.8	52.9	44%	66.9	56%
27	C28	33.0	16.2	49%	16.8	51%
28	C28A					
29	CFA	169.6	65.0	38%	104.6	62%
30	CME	121.6	43.3	36%	78.2	64%
31	C32	491.4	284.0	58%	207.5	42%
32	G1	159.7	79.4	50%	80.2	50%
33	G2	15.6	6.7	43%	9.0	57%
34	G3	20.3	10.4	51%	9.9	49%
35	G4	144.2	70.2	49%	74.0	51%
36	G5	181.6	107.0	59%	74.7	41%
37	G6	468.2	297.9	64%	170.3	36%
38	G7	10.2	5.6	55%	4.6	45%
Totals		5,235	2,436	47%	2,799	53%

3.4 Soil Type

As shown on Figure 3-3 (end of section), virtually the entire combined sewered areas in the Cities of Camden and Gloucester are characterized as "Urban Land" by the NRCS (Natural Resources Conservation Service). The H&H model used in this SCR utilizes the soil characteristics of NRCS Urban Land. For H&H modeling, the soil parameters are initially populated with consistent values throughout the modeled area based on the closest native soil. During model calibration, the infiltration rate was adjusted by matching the observed runoff responses from a series of storms with differing size, durations and antecedent conditions.

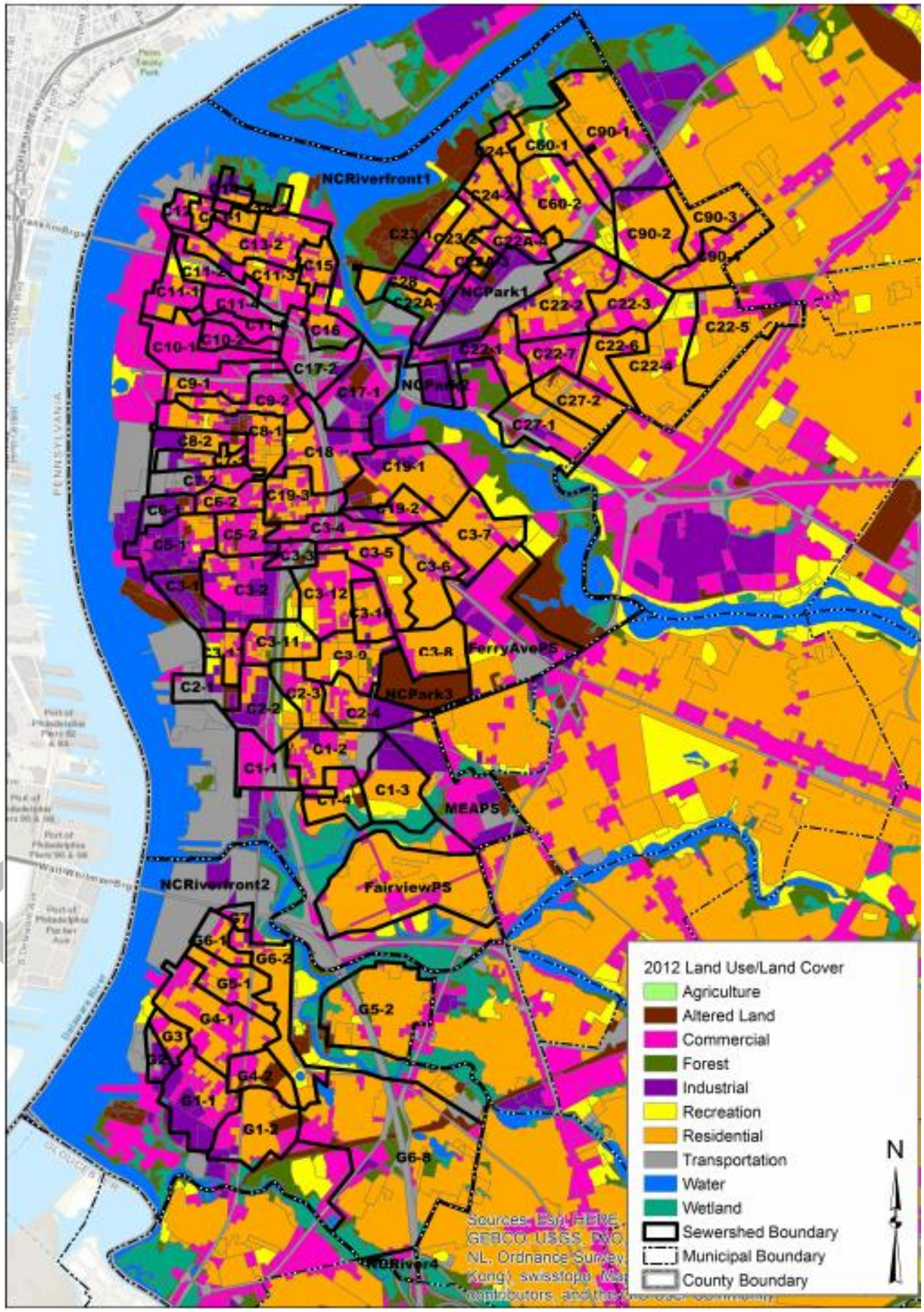


Figure 3-1
Camden City and Gloucester City Land Uses

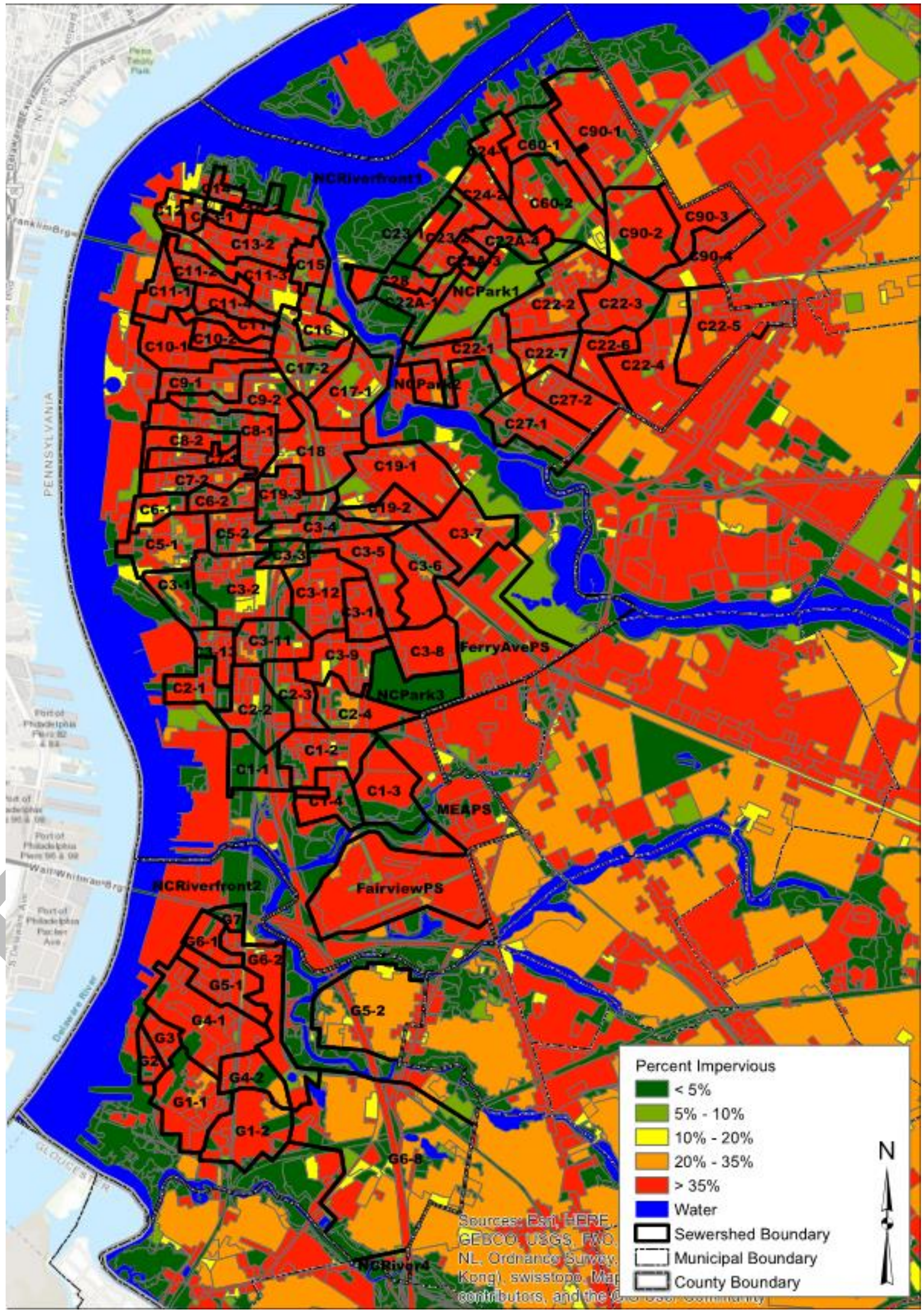


Figure 3-2
Camden City and Gloucester City Impervious and Pervious Areas

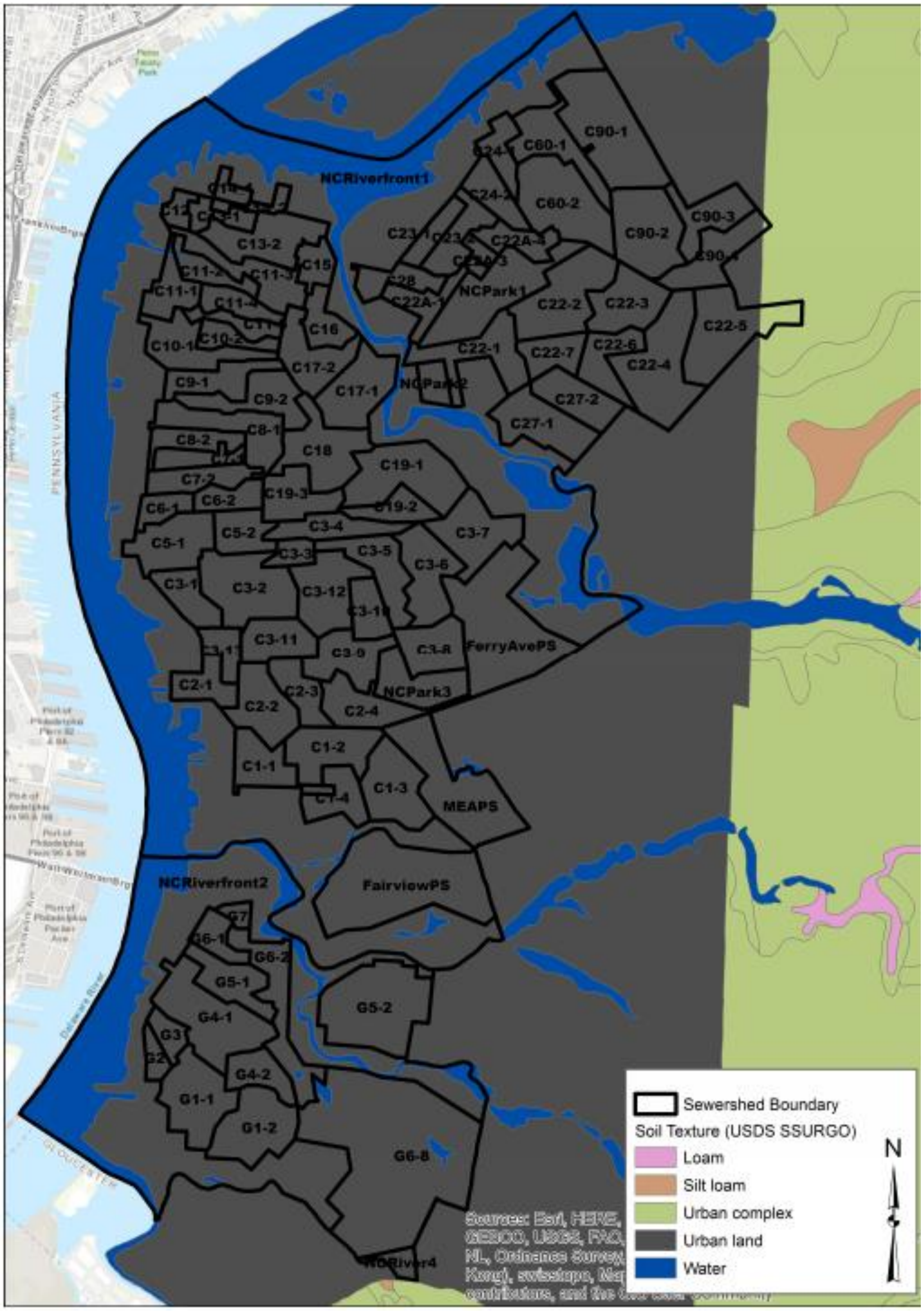


Figure 3-3
Camden City and Gloucester City Soil Texture Map

4

Section 4 Revised 06/07/18

Receiving Waterbodies

Section 4 describes the receiving streams into which the subject CSOs discharge and provides the baseline water quality assessment. The information contained in this section concerning baseline receiving water quality compliance (Sub-Section 4-2) and receiving stream sensitive areas (Sub-Section 4.3) is based upon the Cities' and CCMUA's ***Baseline Compliance Monitoring Report*** and the ***Baseline Consideration of Sensitive Areas*** which are being submitted as separate documents pursuant to paragraph G.1.(d)(iv) of the respective NJPDES permits.

4.1 Description of Receiving Water Bodies

The 30 active CSO outfalls operated by the Cities of Camden and Gloucester and by CCMUA that discharge into the Cooper River and into the main stem and the back channel of the Delaware River and into Newton Creek. The receiving streams for these outfalls are listed on Table 4-1. The three receiving streams are described in turn.

Table 4-1 – CSO Outfall Receiving Streams

Sewershed / Regulator		Outfall		Receiving Stream
Count	Name	NJPDES Number	Status	
Located Within Camden				
1	C1	007A	Open	Newton Cr.
2	C2	008A	Open	Delaware River
3	C3	009A	Open	Delaware River
4	C5	010A	Open	Delaware River
5	C7	012A	Open	Delaware River
6	C8	013A	Open	Delaware River
7	C9	014A	Open	Delaware River
8	C10	015A	Open	Delaware River
9	C11	016A	Open	Delaware River
10	C13A	018A	Open	Delaware River
11	C15	020A	Open	Cooper River
12	C16	023A	Open	Cooper River
13	C17	022A	Open	Cooper River
14	C19	024A	Open	Cooper River

Sewershed / Regulator		Outfall		Receiving Stream
Count	Name	NJPDES Number	Status	
Located Within Camden				
15	C22	030A	Open	Cooper River
16	Thorndyke	033A	Open	Cooper River
17	C22A	034A	Open	Cooper River
18	C23A	025A	Open	Delaware R
19	C24	026A	Open	Delaware.
20	C27	028A	Open	Cooper River
21	C28	029A	Open	Cooper River
22	CFA	005A	Open	Newton Cr.
23	C32	040A	Open	Delaware River
Located Within Gloucester				
24	G1	001A	Open	Delaware River
25	G2	002A	Open	Delaware River
26	G3	003A	Open	Delaware River
27	G4	004A	Open	Delaware River
28	G5	005A	Open	Delaware River
29	G6	006A	Open	Delaware River
30	G7	007A	Open	Newton Creek

4.1.1 Cooper River

The Cooper River flows through seventeen municipalities to its mouth at the Delaware River across from Petty Island. The headwaters for the main stem are in Gibbsboro Borough and for the north branch are in Voorhees Township. The length of the Cooper River is approximately 16 miles, and the drainage area is approximately 40 square miles. There are seven impoundments along its course, with the Cooper Lake in Camden County's Cooper River Park being the most downstream. The river is tidal from its mouth to the dam forming Cooper River Lake. The New Jersey stream classification is Fresh Water 2 (FW-2) non-trout.[4-1] The designated uses and associated water quality standards are provided in Section 4.2 of this SCR.

[4-1] Source: N.J.A.C. 7:9B et seq.

4.1.2 Delaware River

The Delaware is the longest un-dammed river in the United States east of the Mississippi, extending 330 miles from the confluence of its East and West branches at Hancock, N.Y. to the mouth of the Delaware Bay where it meets the Atlantic Ocean. The river is fed by 216 tributaries, the largest being the Schuylkill and Lehigh Rivers in Pennsylvania. In all, the basin contains 13,539 square miles, draining 2,969 square miles of New Jersey.[4-2]

The Cities of Camden and Gloucester lay along the eastern shore of what the Delaware River Basin Commission (DRBC) has designated as Zone 3. This zone is tidally influenced freshwater. The Delaware River is approximately 2,600 feet wide at Camden (Ben Franklin Bridge).

4.1.3 Newton Creek

Newton Creek flows for approximately six miles from source streams in Haddon Township through the Boroughs of Audubon, Audubon Park, Collingswood, and Woodlynne to its mouth on the Delaware River where it forms the municipal boundary between the Cities of Camden and Gloucester. The Creek is tidal estuary up to Audubon Lake which is impounded behind a dam incorporating the N.J. Route 168 crossing.[4-3] The New Jersey stream classification for Newton Creek also is Fresh Water 2 (FW-2) non-trout.[4-4]

4.2 Baseline Water Quality Assessment Sampling

This sub-section documents the baseline CSO discharge quality and baseline receiving stream water quality assessments and comprises the CCMUA/Cities Baseline CMP Report and data. This section is based on CCMUA/Cities' understanding that NJDEP has determined that the existing pathogen data collected from the Delaware River and from the Cooper River and Newton Creek are sufficient to provide an assessment of the baseline receiving stream water quality conditions.

4.2.1 Receiving Stream Designated Uses and Status

The combined sewer system of the City of Camden, City of Gloucester, and the CCMUA discharges overflow into three receiving waters, the Zone 3 of the Delaware River, Cooper River, and Newton Creek. The designated uses and attainment status, as defined by NJDEP, are shown in Table 4-2.

4-2 Source: Excerpted from DRBC: Basin Information http://www.state.nj.us/drbc/basin

4-3 Sources: Kevin Riordan, Philadelphia Inquirer, September 16, 2012; Matt Skoufalos, NJ Pen February 11, 2018.

4-4 Source: N.J.A.C. 7:9B et seq.

Table 4-2 Receiving Stream Designated Uses[4-5]

Waterbody	Use	Attainment Status	Threatened?	Cause	Source
Delaware River Zone 3	Agricultural Water Supply	Fully Supporting	No	N/A	• Atmosphere Deposition –Toxics • Source Unknown • CSOs • Industrial Point Source Discharge • Urban Runoff/Storm Sewers
	Aquatic Life	Fully Supporting	No	N/A	
	Fish Consumption	Not Supporting	No	Chlordane, DDT, PCB in fish tissue, Dieldrin	
	Industrial Water Supply	Fully Supporting	No	N/A	
	Secondary Contact Recreation	Fully Supporting	No	N/A	
	Public Water Supply	Fully Supporting	No	N/A	
Cooper River (Below Rt. 130)	Agricultural Water Supply	Fully Supporting	No	N/A	• CSOs • Industrial Point Source Discharge • Urban Runoff/Storm Sewers • Atmosphere Deposition –Toxics • Source Unknown • Natural Sources
	Aquatic Life	Not Supporting	No	Phosphorus (total)	
	Fish Consumption	Not Supporting	No	DDT, PCB in fish tissue	
	Industrial Water Supply	Fully Supporting	No	N/A	
	Primary Contact Recreation	Not Supporting	No	Escherichia Coli	
	Public Water Supply	Not Supporting	No	Arsenic, tetrachloro-ethylene and trichloro-ethylene [Comment 13]	
Newton Creek (LDVR – Kaighn Ave to LT Creek)	Agricultural Water Supply	Fully Supporting	No	N/A	• CSOs • Industrial Point Source Discharge • Urban Runoff/Storm Sewers
	Aquatic Life	Not Supporting	No	Phosphorus (total)	
	Fish Consumption	Not Supporting	No	Chlordane, DDT, PCB in fish tissue	
	Industrial Water Supply	Fully Supporting	No	N/A	
	Primary Contact Recreation	Not Supporting	No	Escherichia Coli	
	Public Water Supply	Not Supporting	No	Arsenic	

4-5 Source: **NJDEP 2012 New Jersey Integrated Report,** Appendix A (Assessment Unit Summary List), July 2014

The water quality standards for pathogens in these three receiving waters are listed in Table 4-3. Presently there is no water quality standard for E. Coli on the Delaware River.

Table 4-3 Water Quality Standards for Different Pathogen Species[4-6]

Pathogen/receiving water	*E. Coli*	*Fecal Coliform*	*Enterococcus*
Delaware River Zone 3	N/A	geometric mean < 770 cfu/100ml	geometric mean < 88 cfu/100ml
Cooper River	Single value < 235cfu/100ml geometric mean < 126 cfu/100ml	N/A	N/A
Newton Creek	Single value < 235cfu/100ml geometric mean < 126 cfu/100ml	N/A	N/A

4.2.2 Receiving Stream Water Quality Sampling

As part of the baseline system characterization requirement, baseline receiving water quality assessment is used to determine the baseline conditions upon which the LTCP will be developed and against which subsequent receiving water quality analysis will be compared for purposes of evaluating the efficacy of CSO controls during and after the implementation of the LTCP. NJDEP technical guidance[4-7] encouraged permittees to use any existing data to establish baseline condition before implementation of the LTCP.

4.2.2.1 Receiving Stream Water Quality Data

Comprehensive searches were conducted in EPA's STORET database to identify sampling stations in the vicinity of the Cities of Camden and Gloucester where microbiological data were collected. Nine sampling stations were identified with 3 sites located on each receiving water as shown in Figure 4-1. Listed on Table 4-4 are the stations on each receiving water from the most upstream to the most downstream. For Cooper River, the Cooper River Parkway Dam is located between the Cuthbert Blvd station and the next downstream station (BFBM000049).

Table 4-4 Receiving Water Sampling Locations

Receiving Water	Origin ID	Station ID	Station Name	State	County	Latitude	Longitude
Delaware River	31DELRBC_WQX	892070	Betsy Ross Bridge (RM 104.75)	PA	PHILADELPHIA	39.984444	-75.0675
Delaware River	31DELRBC_WQX	892071	Benjamin Franklin Bridge (RM 100.2)	PA	PHILADELPHIA	39.952778	-75.137222
Delaware River	31DELRBC_WQX	892065	Navy Yard (RM 93.2)	PA	PHILADELPHIA	39.881667	-75.178889

4-6 Source: Delaware River Basin Commission

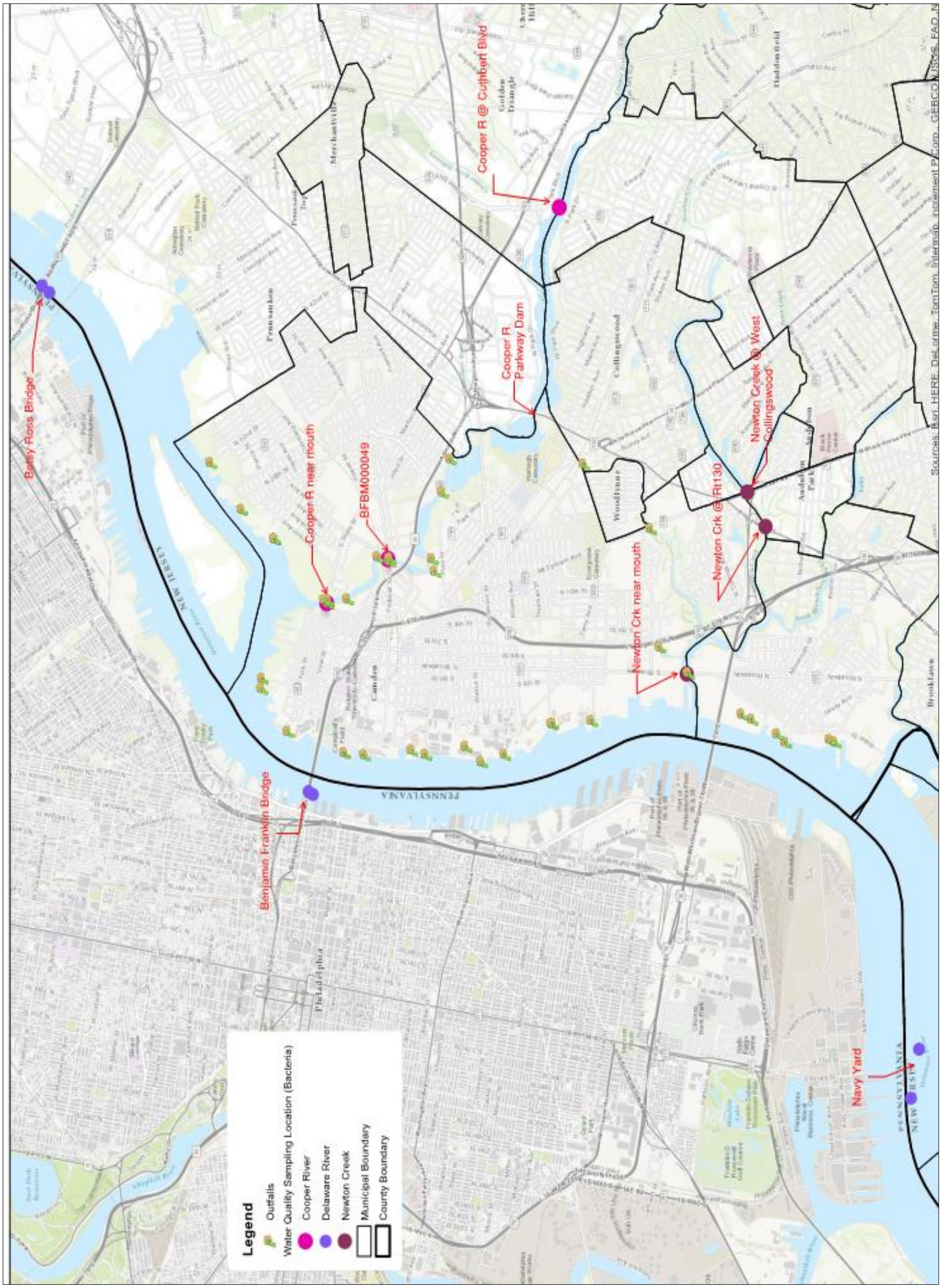
4-7 March 2015 Receiving Waters Monitoring Workplan Guidance (Guidance Document)

Receiving Water	Origin ID	Station ID	Station Name	State	County	Latitude	Longitude
Cooper River	31DELRBC_WQX	Cooper River at Cuthbert Blvd	Cooper River at Cuthbert Blvd	NJ	CAMDEN	39.924013	-75.055116
Cooper River	NJDEP_BFBM	BFBM000049		NJ	CAMDEN	39.944075	-75.104338
Cooper River	31DELRBC_WQX	Cooper River near mouth	Cooper River near mouth	NJ	CAMDEN	39.951315	-75.110541
Newton Creek	21NJDEP1	1467312	NEWTON C AT WEST COLLINGSWOOD NJ	NJ	CAMDEN	39.901502	-75.094618
Newton Creek	31DELRBC_WQX	Newton Creek at Route 130	Newton Creek at Route 130	NJ	CAMDEN	39.899313	-75.099418
Newton Creek	31DELRBC_WQX	Newton Creek near mouth	Newton Creek near mouth	NJ	CAMDEN	39.908551	-75.120036

CCMUA searched and extracted all relevant historical water quality data from the USEPA's STORET database. Extensive analysis on these data was carried out to determine the sampling locations; precipitation, tidal, and CSO conditions at the time of sampling; the total numbers of samples at each location under dry and wet weather conditions; and the measured concentration of each regulated (and potentially regulated) pathogen species. The extracted data, the analysis and its results had been shared and discussed with NJDEP through multiple conference calls, emails, and meetings. NJDEP approved the use of existing water quality data as sufficient to establish the baseline condition of the three receiving streams, and no additional baseline receiving water sampling is necessary. (See appendix D)

DRBC has been sampling the main stem of the Delaware River between Trenton and the Delaware Bay since 1967. Samples are collected monthly from April through October. The pathogen species tested include Fecal Coliform, Enterococcus, and E. Coli,. Although regulatory limits on Zone 3 of the Delaware River only exist for Fecal Coliform and Enterococcus, E. Coli may be adopted in the near future. Thus for purposes of this LTCP, Fecal Coliform, Enterococcus, and E. Coli data at the three identified locations were extracted for the period of 2010 to 2014 (the most recent 5 years when the analysis was completed in 2015). Based on the modeling work conducted by DRBC, the Delaware River in the vicinity of the studies area is vertically and horizontally well mixed.[4-8] Thus the existing data collected are appropriate to use in this assessment.

[4-8] DRBC Administrative Manual –Part III, WATER QUALITY REGULATIONS WITH AMENDMENTS THROUGH DECEMBER 4, 2013, 18 CFR PART 410, Article 4, Section 4.20.5A.4, http://www.state.nj.us/drbc/library/documents/WQregs.pdf



Fiture 4-1 Receiving Stream Pathogen Sampling Locations 2008 - 2014

The two tributaries to this reach of the Delaware River, Cooper River and Newton Creek, were not sampled on a regular basis. All available data in the STORET database for the Cooper River and Newton Creek at the identified locations were extracted for this analysis. These data cover a period from 2004 to 2011 for Cooper River and 2003 to 2009 for Newton Creek. For the tributaries, E. Coli is the only regulated pathogen species. Thus only E. Coli data was extracted.

Table 4-5 listed the years with available data and the total number of samples analyzed in each year.

Table 4-5 Number of Samples for Each Receiving Water

Receiving Water	Sample Locations	Year	Total Number of Samples
Zone 3 of the Delaware River	Navy Yard (RM 93.2)	2010	24
		2011	24
		2012	20
		2013	21
		2014	17
	Betsy Ross Bridge (RM 104.75)	2010	23
		2011	23
		2012	19
		2013	21
		2014	17
	Benjamin Franklin Bridge (RM 100.2)	2010	22
		2011	20
		2012	23
		2013	17
		2014	17
Cooper River	at Cuthbert Blvd	2009	9
	BFBM000049	2010	5
		2011	4
	near mouth	2004	2
		2005	2
		2006	2
		2007	3
		2008	3
		2009	8
Newton Creek	1467312 (at West Collingswood NJ)	2003	5
		2004	5
	at Route 130	2009	8
	near mouth	2007	3
		2008	3
		2009	10

4.2.2.2 Sampling Condition Requirements

The NJDEP Guidance Document specifies pathogen data to be collected on 5 dry days, 5 wet days with CSO discharge, and 5 wet days without CSO discharge. Weather condition and CSO discharge condition at the time of the sampling were identified for the events listed in Table 3-4. Since the study area is in the tidal section of the Delaware River, tidal condition during the sampling events was also identified (detailed in 3.3.2.1). The conformance of the available receiving stream data with the NJDEP *Receiving Waters Monitoring Work Plan Guidance for the CSO Program* (NJDEP Guidance) was then summarized in Tables 4-6 and 4-7.

4.2.2.3 Sampling Conditions

Precipitation Conditions

According to the NJDEP Guidance, dry weather events are characterized as being preceded by a 72-hour period with less than 0.1 inch rainfall. Due to the fact that some of the CSOs in Camden can activate at very low rainfall intensity (< 0.1 inch/hour), a 0.01 inch rainfall depth threshold was used to ensure that dry weather events do not include overflow discharges. Hourly precipitation data at the Philadelphia International Airport gage were downloaded from the National Weather Service. It is then disaggregated into 15 minutes and used for this analysis.

A list of unique sampling times was found from the extracted data. The total rainfall within the 72 hours prior to each sampling time was calculated and dry or wet day sample was subsequently identified according to the above definition.

Overflow Conditions

CCMUA/Cities' H&H System Model was used to analyze the overflow condition at the time of sampling as the latest and best source of data. Model simulations were conducted for the different sampling periods. The simulated overflows were grouped by receiving water to identify the overflow conditions on each one of them. The same 15 minute rainfall was used for these simulations.

Tidal Conditions

Low tide is preferred for tidal receiving water sampling. The tidal condition can be somewhat controlled for dry weather sampling but generally not for wet weather sampling. High and low tide records of the Delaware River at Philadelphia were downloaded from NOAA. The time between the sampling time and the time of its closest low tide was calculated. Although the tidal condition can help understanding data outliers, it was not used to exclude data from this analysis.

4.2.2.4 Inventory of Data

Zone 3 of the Delaware River

With the precipitation and overflow conditions identified, the conformance of the available receiving stream data with the NJDEP guidance is summarized in Table 4-6 for the Delaware River.

Table 4-6 Aggregate Ambient Water Quality Samples – Delaware River (2010 – 2014)

Pathogen	Sampling Location	Total # Samples	Dry Weather	Wet Weather	
				Simulated [Comment 20] CSO	Simulated No CSO
Fecal Coliform	Upstream - Betsy Ross Bridge	31	12	19	0
	Midstream - Ben Franklin Bridge	30	12	18	0
	Downstream - Navy Yard	33	12	21	0
Enterococcus	Upstream - Betsy Ross Bridge	36	12	24	0
	Midstream - Ben Franklin Bridge	36	12	24	0
	Downstream - Navy Yard	36	12	24	0
E. Coli	Upstream - Betsy Ross Bridge	31	10	21	0
	Midstream - Ben Franklin Bridge	30	10	20	0
	Downstream - Navy Yard	32	10	22	0

Enterococcus - There were 36 total samples at each Delaware River location, including 12 dry weather samples and 24 wet weather samples during which, based on the CCMUA sewer system model, CSO discharges were occurring.

Fecal Coliform There were at least 31 total samples for Fecal Coliform at the upstream and downstream Delaware River locations, including 12 dry weather samples along with 19 and 21 wet weather samples during which, based on the CCMUA sewer system model, CSO discharges were occurring.

E. Coli - There were at least 30 total samples for E. Coli at each Delaware River location, including 10 dry weather samples and 20-22 wet weather samples during which, based on the CCMUA sewer system model, CSO discharges were occurring. All sample sets on Zone 3 of the Delaware River meet the requirement of 5 dry day samples and 5 wet day samples with CSO discharge. All wet day samples occurred with simulated CSO discharges.

Cooper River and Newton Creek

Summarized on Table 4-7 is the conformance of the available receiving stream data with the guidance for Newton Creek and the Cooper River. Due to the proximity of the sampling locations, the data collected from the two downstream sampling locations on the Cooper River were grouped together for this analysis. Same applied to the data collected at the two upstream locations on the Newton Creek.

Table 4-7 Aggregate Ambient Water Quality Samples – Newton Creek and Cooper River

Receiving Stream	Sampling Location	Total # Samples	Dry Weather	Wet Weather	
				Simulated CSO	Simulated No CSO
Cooper River (2004 – 2011)	Upstream - at Cuthbert Blvd.	8	2	5	1
	Downstream - Near Mouth & BFBM000049	29	11	14	4
Newton Creek (2003 – 2009)	Upstream – Rt. 130 & West Collingswood	18	5	11	2
	Downstream - Near Mouth	14	5	8	1

Cooper River E. Coli - There were 8 upstream samples for Cooper River, including 2 during dry weather and 6 during wet weather. Of these, 5 coincided with modeled CSO events. There were a total of 29 downstream samples from the Cooper River, including 11 taken during dry weather and eighteen (18) taken during wet weather. All but four of these occurred during modelled CSO events.

Newton Creek E. Coli - The minimum of 15 samples was met for the upstream sampling location along Newton Creek. The 18 upstream samples for Newton Creek included 5 dry weather sampling events, and 11 wet weather events with CSOs. Two wet weather samples were taken when CSOs were not occurring. With 14 samples, the downstream Newton Creek sampling is one short of the target total of 15. Five of these occurred during dry weather. There were 8 samples occurring during which CSOs were occurring. Only one wet weather sample occurred without CSO discharges.

Based on simulation using CCMUA's 2014 sewer system model, 0.05-0.1 inch/hour rainfall intensity can be sufficient to trigger overflow to all three receiving waters. Obtaining wet weather samples when CSOs were not occurring is not realistic due to this characteristic of the combined sewer system.

4.3 Baseline Water Quality Assessment

The extracted data were analyzed in two ways. One is to look at individual sampling results in dry and wet weather, the other way is to calculate geomean of multiple sampling results and compare to the regulatory limits.

4.3.1 Analysis on Individual Sample Results

Since E. Coli is the only pathogen species with a regulatory limit (<235cfu/100ml) on single sample, this analysis is limited to E. Coli data only. Tidal condition was not used to discriminate data since no correlation was found between pathogen concentration and how much time the sampling event was from the nearest low tide.

4.3.1.1 Delaware River

Dry day samples at all three locations on the Zone 3 of the Delaware River met the E. Coli single sample standard. Wet day samples at Navy Yard (downstream of Gloucester City CSO discharges; RM93.2) did not exceed the standard while at the two upstream sampling locations, Benjamin Franklin Bridge (RM100.2) and Betsy Ross Bridge (RM104.75), 9 out of the 63 samples exceeded the standard. The sampling results are shown graphically on Figures 4-2 and 4-3.

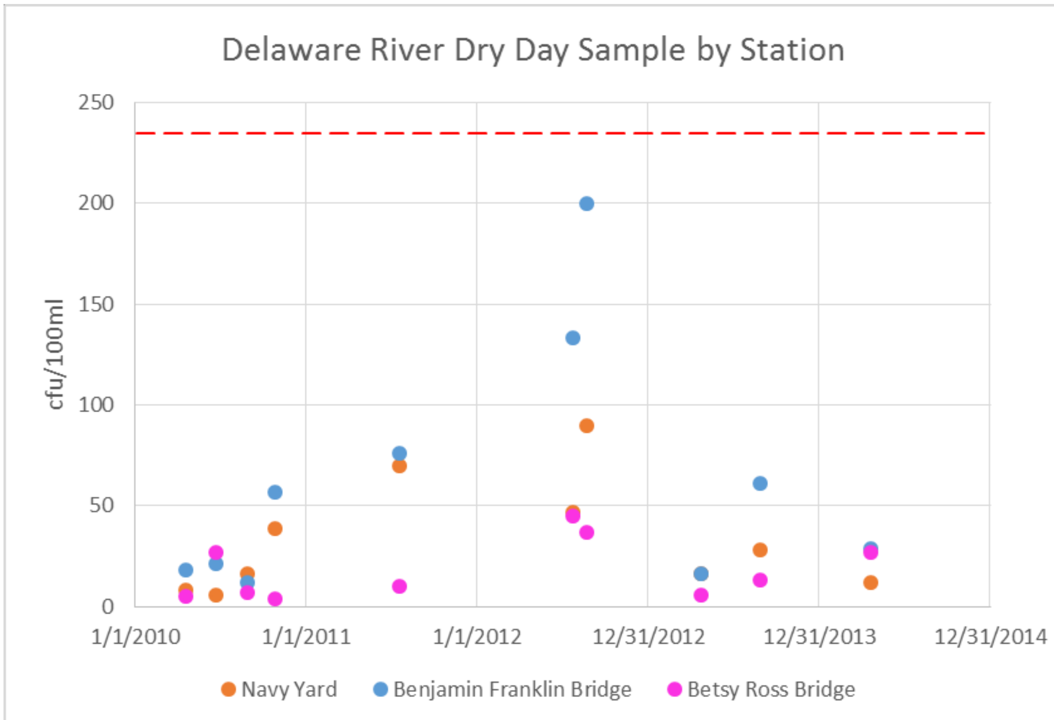


Figure 4-2 Delaware River Zone 3 E. Coli Concentration by Station in Dry Days

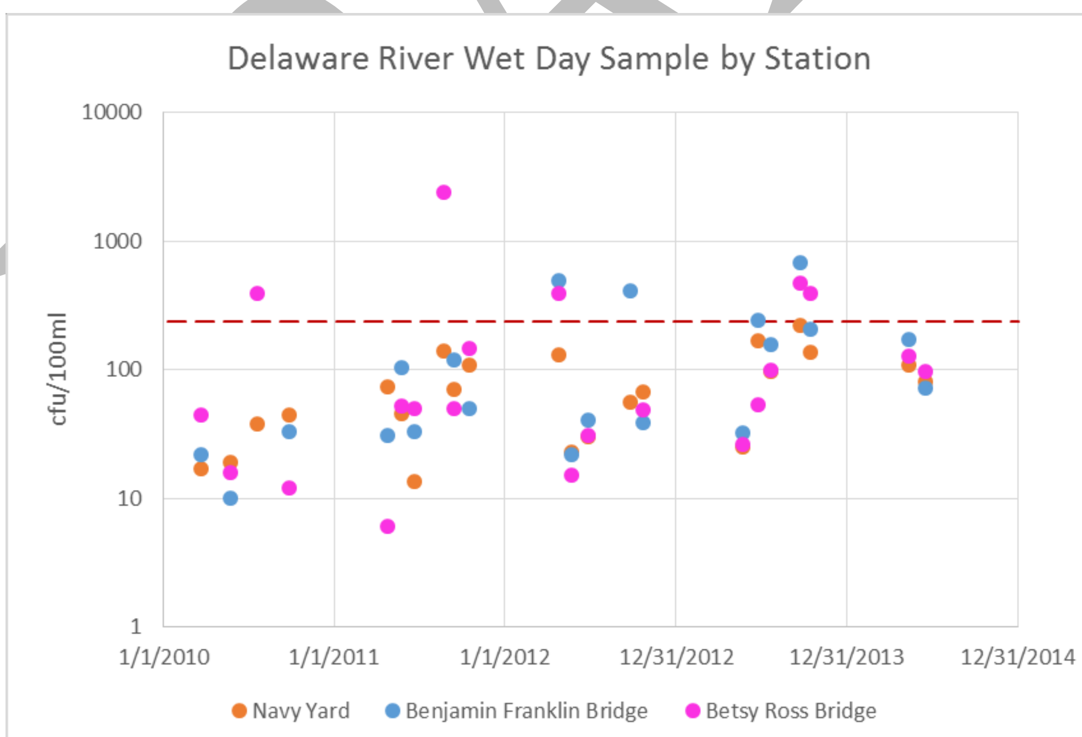


Figure 4-3 Delaware River Zone 3 E. Coli Concentration by Station in Wet Days

4.3.1.2 Cooper River

Among the three sampling stations identified for this analysis on Cooper River, BFBM000049 and Cooper River near Mouth are both located within the CSO discharge zone towards the downstream end of Cooper River. The pathogen data collected from these two stations were combined during data analysis.

As shown in Figure 4-4, 11 out of the13 dry day samples exceeded the limit upstream and downstream of the CSO discharge zone. As shown on Figure 4-5,17 of the 24 wet day samples exceeded the limit upstream and downstream of the CSO discharge zone. Two out of the seven wet day samples that were below the standard were collected without CSO discharge from the sewer system that CCMUA serves.

4.3.1.3 Newton Creek

Of the three sampling stations on Newton Creek that were identified for this analysis, Newton Creek at Route 130 and at West Collingswood are both upstream from CSO discharge area and are in close proximity to each other. Therefore, the pathogen data collected from these two stations were combined during data analysis.

As shown in Figure 4-6, 8 of the 10 dry day samples exceeded the limit upstream and downstream of the CSO discharge zone. As shown on Figure 4-7, 16 of the 22 wet day samples exceeded the limit upstream and downstream of the CSO discharge zone. Two out of the six wet day samples that were below the standard were collected without CSO discharge from the sewer system that CCMUA serves. It may be noted that the E. Coli concentrations seemed to be lower in the downstream samples during both dry and wet days.

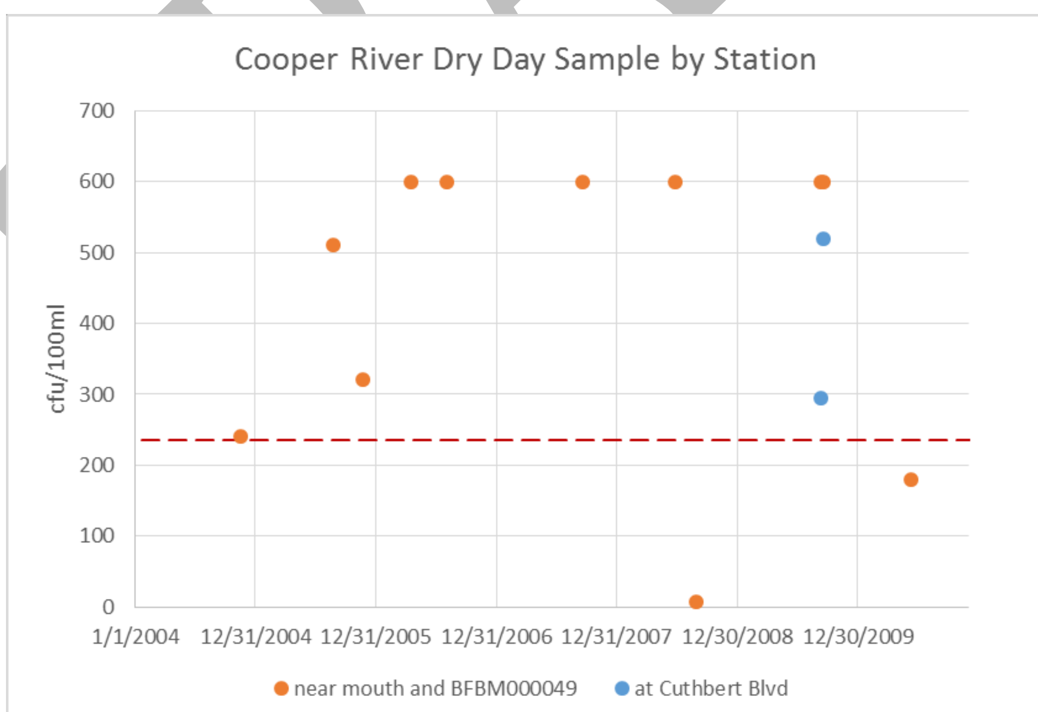


Figure 4-4 Cooper River E. Coli Concentration by Station in Dry Days

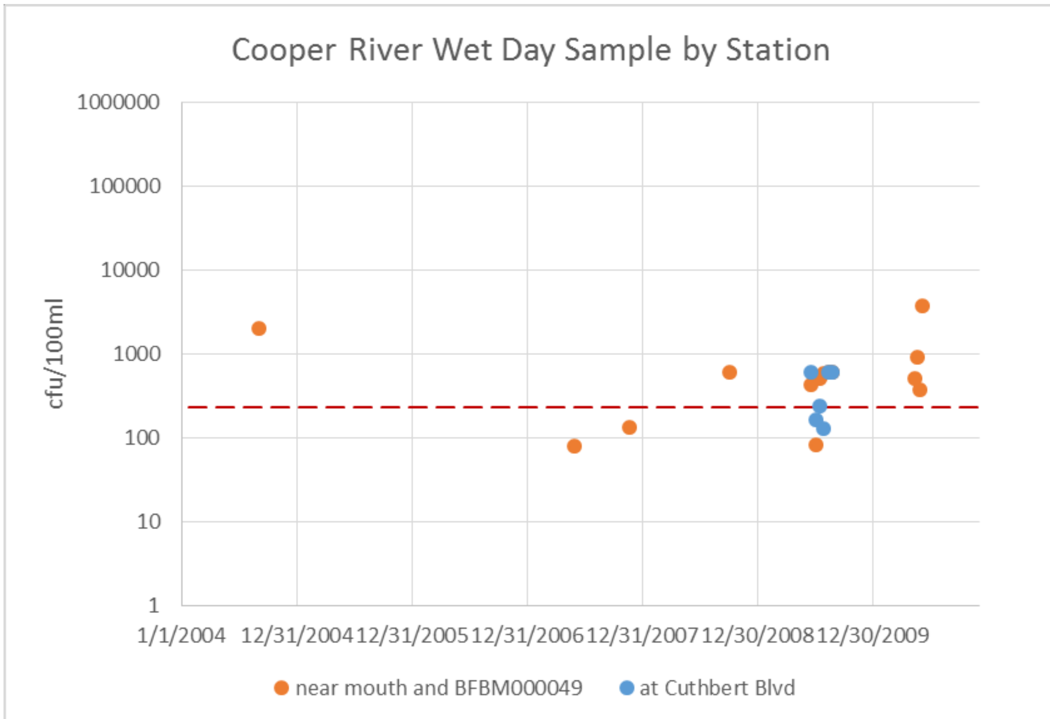


Figure 4-5 Copper River E. Coli Concentration by Station in Wet Days

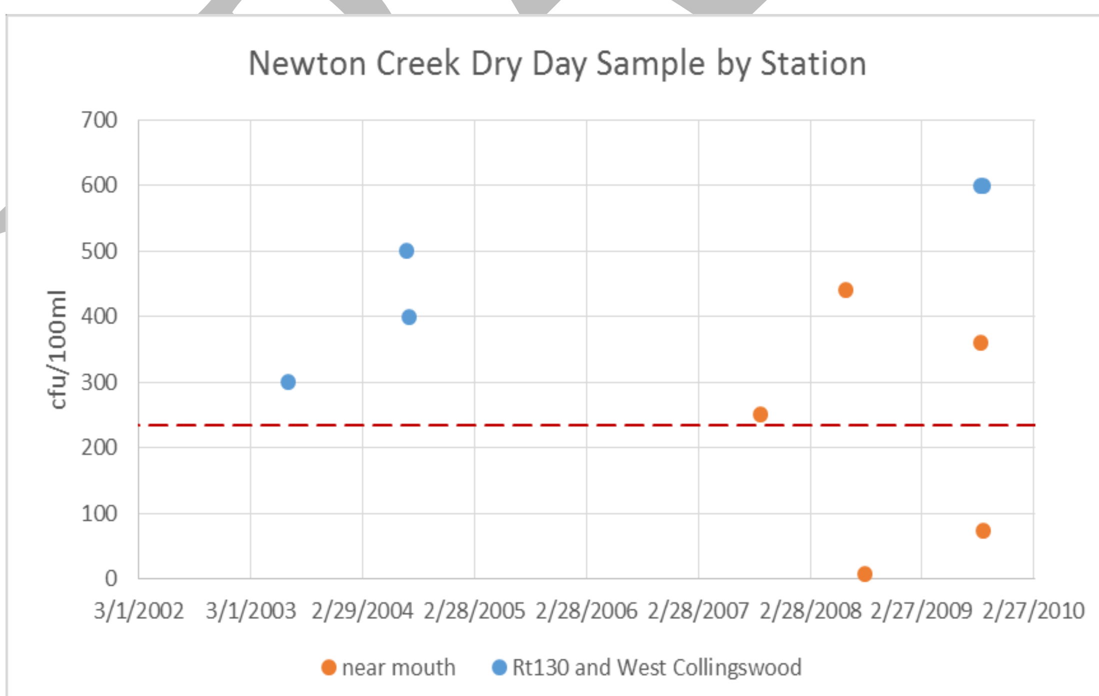


Figure 4-6 Newton Creek E. Coli Concentration by Station in Dry Days

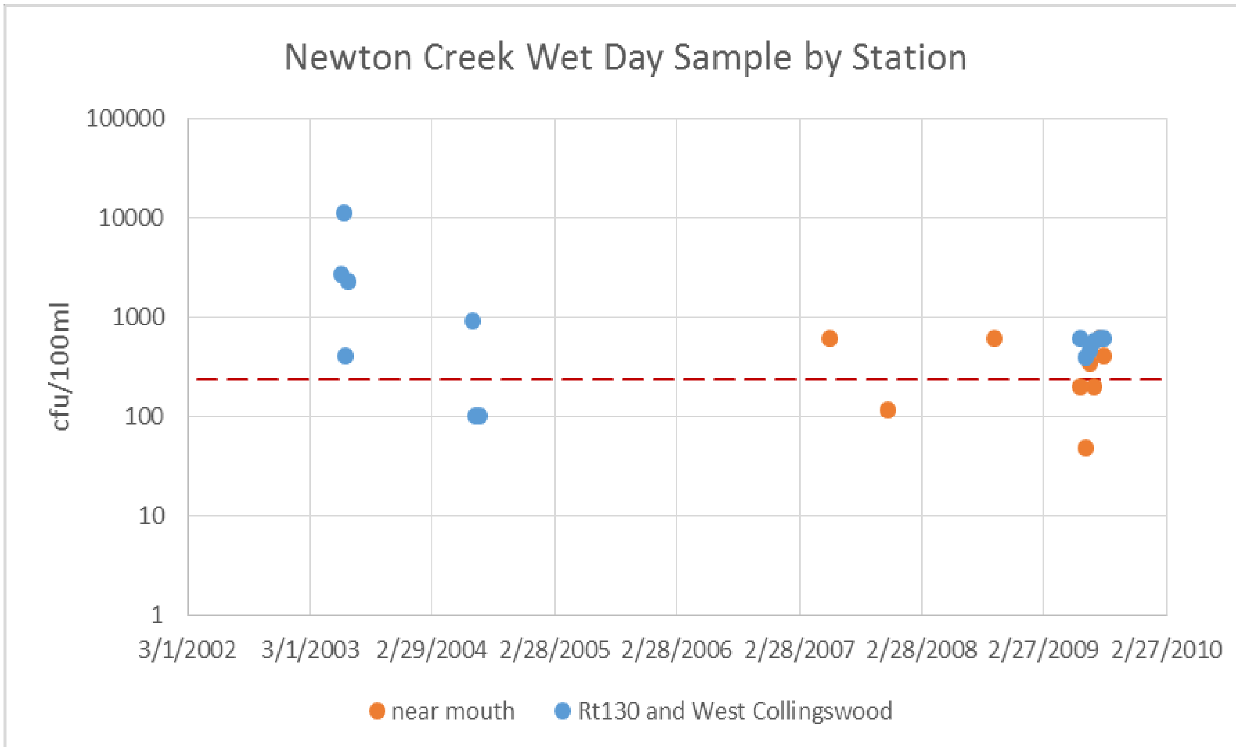


Figure 4-7 Newton Creek E. Coli Concentration by Station in Wet Days

4.3.2 Geometric Mean Analysis

Thirty-day geometric mean for at least 5 samples is generally required for bacteria in recreational water. However, due to the scarcity of the data available for this analysis, seasonal geometric mean was used. The majority of the data were collected between April and October with a few exceptions in late March and early November. This coincided reasonably well with the recreational season of the receiving waters. According to NJDEP, although there is no standard for E. Coli on the Zone 3 of the Delaware River, this may change in the next few years.

Based on a statistically significant number of samples, the geometric mean standard for the three receiving waters are listed in Table 4-8.

Table 4-8 – Geometric Mean Standard for Different Pathogen Species

Pathogen/receiving water	E. Coli	Fecal Coliform	Enterococcus
Delaware River Zone 3	126 cfu/100ml (in near future)	770 cfu/100ml	88 cfu/100ml
Cooper River	126 cfu/100ml	N/A	N/A
Newton Creek	126 cfu/100ml	N/A	N/A

4.3.2.1 Delaware River

The seasonal geomean of each pathogen species at each station were calculated and listed in Table 4-9. All geomean values of all three pathogen species met their respective standard.

Table 4-9 – Seasonal geometric mean for Zone 3 of the Delaware River

Bacteria	Station name	Station ID	Year	No of samples	Seasonal geomean, cfu/100ml	Geomean Standard, cfu/100ml
Enterococcus	Betsy Rose Bridge (RM104.75)	892070	2010	8	8	88
		892070	2011	7	24	88
		892070	2012	7	26	88
		892070	2013	7	18	88
		892070	2014	7	21	88
	Benjamin Franklin Bridge (RM100.2)	892071	2010	8	6	88
		892071	2011	7	23	88
		892071	2012	7	29	88
		892071	2013	7	17	88
		892071	2014	7	18	88
	Navy Yard (RM93.2)	892065	2010	8	9	88
		892065	2011	7	15	88
		892065	2012	7	17	88
		892065	2013	7	13	88
		892065	2014	7	24	88
Fecal Coliform	Betsy Rose Bridge (RM104.75)	892070	2010	7	49	770
		892070	2011	6	105	770
		892070	2012	6	188	770
		892070	2013	5	151	770
		892070	2014	7	222	770
	Benjamin Franklin Bridge (RM100.2)	892071	2010	7	58	770
		892071	2011	7	202	770
		892071	2012	6	336	770
		892071	2013	3	138	770
		892071	2014	7	223	770
	Navy Yard (RM93.2)	892065	2010	8	40	770
		892065	2011	7	163	770
		892065	2012	6	211	770
		892065	2013	5	171	770
		892065	2014	7	130	770
E. Coli	Betsy Rose Bridge (RM104.75)	892070	2010	8	18	126 (potential)
		892070	2011	7	60	126 (potential)
		892070	2012	6	50	126 (potential)
		892070	2013	7	57	126 (potential)
		892070	2014	3	69	126 (potential)
	Benjamin Franklin	892071	2010	7	21	126 (potential)
		892071	2011	6	60	126 (potential)

Bacteria	Station name	Station ID	Year	No of samples	Seasonal geomean, cfu/100ml	Geomean Standard, cfu/100ml
	Bridge (RM100.2)	892071	2012	7	109	126 (potential)
		892071	2013	7	107	126 (potential)
		892071	2014	3	71	126 (potential)
	Navy Yard (RM93.2)	892065	2010	8	19	126 (potential)
		892065	2011	7	62	126 (potential)
		892065	2012	7	54	126 (potential)
		892065	2013	7	66	126 (potential)
		892065	2014	3	47	126 (potential)

4.3.2.2 Cooper River and Newton Creek

All calculated E. Coli seasonal geomean value exceeded the geomean standard on both Cooper River and Newton Creek. See Table 4-10 and 4-11.

Table 4-10 – E. Coli Seasonal Geometric Mean for Cooper River

Sample Location	Year	No. samples	Seasonal geomean, cfu/100ml	Geomean Standard, cfu/100ml
at Cuthbert Blvd	2009	8	338	126
near mouth & BFBM000049	2004	2	693	126
near mouth & BFBM000049	2005	2	404	126
near mouth & BFBM000049	2006	2	600	126
near mouth & BFBM000049	2007	3	186	126
near mouth & BFBM000049	2008	3	142	126
near mouth & BFBM000049	2009	8	439	126
near mouth & BFBM000049	2010	5	647	126
near mouth & BFBM000049	2011	4	1590	126

Table 4-11 – E. Coli Seasonal Geometric Mean for Newton Creek

Sample Location	Year	No. samples	Seasonal geomean, cfu/100ml	Geomean Standard, cfu/100ml
Rt130 & W Collingswood	2003	5	1523	126
Rt130 & W Collingswood	2004	5	283	126
Rt130 & W Collingswood	2009	8	545	126
near mouth	2007	3	260	126
near mouth	2008	3	128	126
near mouth	2009	8	211	126

The data analysis were shared with the NJDEP in a memorandum from CCMUA dated August 17, 2015 (copy provided in appendix D) and during the August 19th meeting as well as follow up discussions. For the Zone 3 of the Delaware River, NJDEP indicated that additional baseline water quality sampling is not needed based on the existing data as well as DRBC's continuing sampling effort on the Delaware River in the coming years. For the tributaries, NJDEP concurred that based on the understanding that CCMUA will be using the Presumption Approach for the LTCP and hence the existing pathogen data collected at several locations in the Cooper River, and Newton Creek are sufficient to provide a baseline assessment of the baseline condition.

4.3.3 Baseline Receiving Stream Water Quality Assessment Summary Findings

Based on the review of the existing ambient water quality data, the following findings and recommendations are suggested:

- ***Delaware*** River – There does not appear to be a meaningful change in sampled bacteria levels between upstream samples taken near the Betsy Ross Bridge and downstream samples taken in the vicinity of the Navy Yard. This leads to an inference that the CSO discharges from Camden and Gloucester do not result in a demonstrable impact on the Delaware River water quality for pathogen concentrations;
- ***Cooper River*** – the E. Coli standards were not met upstream or downstream in the Cooper River; downstream geomean concentrations of E. Coli were in general higher than those in upstream samples; and
- ***Newton*** Creek – with The pathogenic water quality standards were not met upstream or downstream in Newton Creek; however the E. Coli geomean concentrations were lower in the downstream samples.

4.4 CSO Effluent Characterization

During the Sewage Infrastructure Improvement Act Planning Study (SIIAPS), samples of combined sewage were collected from 4 locations in the sewer system in summer of 1997. These locations were:

- the influent to CCMUA's WWTP upstream of the confluence with flow from Baldwin Pump Station, City of Gloucester, and the Cooper River Interceptor
- upstream of Camden regulator C3
- upstream of CCMUA 32nd Street regulator
- upstream of Gloucester regulator G1

The locations are shown geographically on Figure 4-8. These sample locations covered 76% of the combined sewer area in the two Cities. Samples were collected upstream of the sluice gates at each regulator to avoid the influence of the Delaware River. For each sample location, 5 grab samples and 2 QA/QC samples were collected during each of 2 monitoring events. Flow-weighted composite samples were processed and analyzed in laboratory for total recoverable and dissolved copper, lead and zinc. Grab samples were collected and analyzed for the following parameters:

- BOD and COD
- TSS and TDS
- Fecal Coliform
- Nitrogen and ammonia compounds (NH_3-N, NO_3/NO_2-N, TKN)
- Phosphorus (Orthophosphate, Total Phosphorus)

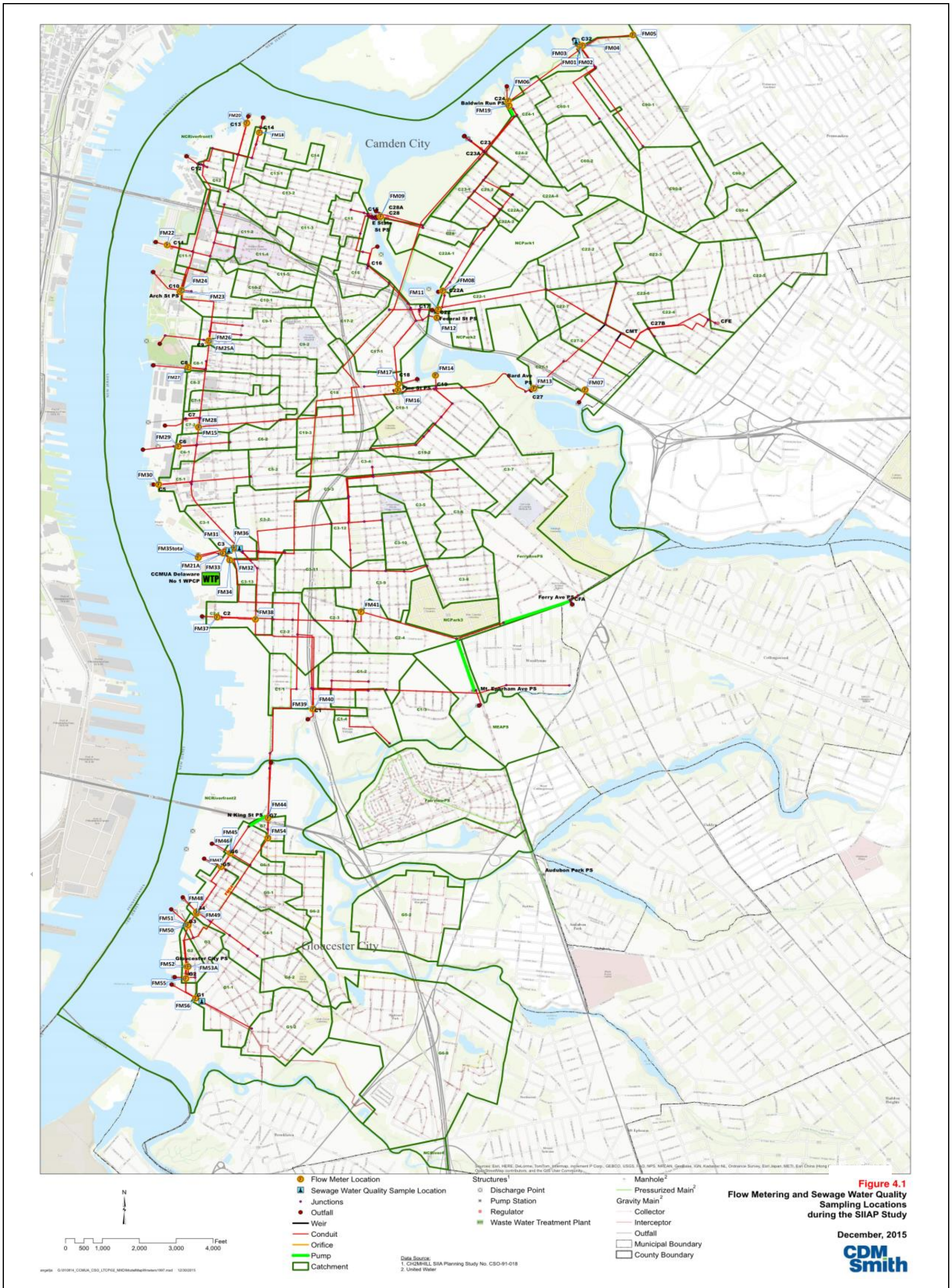


Figure 4-8 – CSO Discharge Sampling Map

The flow at these four sampling locations were either metered or calculated through flow balance of the monitored flows (as described in Section 4.1). These flows and the measured concentration of the pollutants were used to calculate Event Mean Concentrations (EMC) for each storm. Table 4.1 listed the EMC of each pollutant parameter averaging from all 4 locations for August 4 and August 17, 1997 storm events. The overall EMCs were also summarized in Table 4-12.

Table 4-12 – SIIA Sampling Event and Overall EMC for CSO Discharge Samples

Sites	WPCF		C3		C32		G1	Overall Event Mean Concentrations
Storm	8/4/1997	8/17/1997	8/4/1997	8/17/1997	8/4/1997	8/17/1997	8/17/1997	
BOD (mg/L)	111	188	276	182	45	101	98	143
TSS (mg/L)	171	226	432	205	140	177	262	230
COD (mg/L)	255	479	622	445	135	389	326	379
TDS (mg/L)	205	313	147	144	39	146	105	157
Fecal Coliform (colonies/ 100ml)	846,252	2,972,067	955,254	2,632,204	229,121	5,137,229	1,727,162	2,071,327
NH_3-N (mg/L)	5.13	12.8	8.03	8.92	2.15	3.83	3.76	6.37
NO_3/NO_2-N (mg/L)	3.34	0.85	2.3	1.06	1.76	1.43	0.93	1.67
NO_2-N (mg/L)	0.061	0.014	0.175	0.013	0.032	0.022	0.037	0.051
Orthophosphate (mg/L)	0.592	1.61	0.690	0.936	0.309	0.653	0.424	0.745
Total Phosphorus as P (mg/L)	0.413	3.17	3.11	3.17	0.511	1.63	1.73	1.96
TKN (mg/L)	16.1	16.4	20.5	14.6	7.86	9.00	7.80	13.18
Total Hardness (mg/L)	102	119	81.8	78.9	59.7	86.1	63.3	84.4
Dissolved Copper (mg/L)	0.017	0.020	0.027	0.018	0.029	0.027	0.017	0.022
Total Recoverable Copper (mg/L)	0.121	0.078	0.093	0.101	0.095	0.122	0.096	0.101
Dissolved Lead (mg/L)	0.046	<0.030	0.035	<0.030	0.043	<0.030	<0.030	<0.0413
Total Recoverable Lead (mg/L)	0.199	0.049	0.175	0.091	0.180	0.088	0.093	0.125
Dissolved Zinc (mg/L)	0.128	0.057	0.181	0.057	0.127	0.086	0.082	0.103
Total Recoverable Zinc (mg/L)	0.474	0.224	0.385	0.351	0.284	0.385	0.412	0.359

Source: Section 3 of CSO Monitoring Study, CH2MHILL, October 1999

During the development and evaluation of control alternatives, CCMUA will continue to evaluate annual influent concentrations at CCMUA's WPCF No. 1 in the context of pollutant characteristics and the pollution load reduction potential of various control strategies.

4.5 Sensitive Areas

In accordance with the National CSO Control Policy,[4-9] CCMUA and the Cities of Camden and Gloucester are required to give highest priority to controlling overflows to receiving waters considered to be sensitive areas. The Policy identifies six categories of sensitive areas:

1. Outstanding National Resource Waters;
2. National Marine Sanctuaries;
3. Waters with threatened or endangered species or their designated critical habitat;
4. Primary contact recreation waters, such as bathing beaches;
5. Public drinking water intakes or their designated protection areas; and
6. Shellfish beds.

4.5.1 Summary Findings

As a part of this system characterization, CCMUA and the Cities performed an analysis to identify any sensitive water bodies and the CSO outfalls that discharge to them. The results of this analysis are summarized on Table 4-13. With the potential exception of freshwater mussels in the Delaware and Cooper Rivers, this analysis has not identified any portions of the CSO receiving waters that meet the definition of sensitive areas as defined in the CSO Control Policy.

Table 4-13 – Sensitive Areas Summary

Category		Applicable to Receiving Streams Impacted by CSOs			Notes
		Delaware River	Cooper River	Newton Creek	
1	Outstanding National Resource Waters	No	No	No	Source: NJ Antidegradation Standards, NJDEP
2	National Marine Sanctuaries	No	No	No	Source: National Oceanographic and Atmospheric Administration (NOAA)
3	Waters with Threatened or Endangered Species or Designated Critical Habitat	Potential Habitat for Fresh-water Mussel, Short-nose Sturgeon	Potential Habitat for Fresh-water Mussel	No	Delaware River – Tidewater Mucket Cooper River: – Yellow Lampmussel – Eastern Pondmussel – Tidewater Mucket

4-9 59 FR 75-18692

Category		Applicable to Receiving Streams Impacted by CSOs			Notes
		Delaware River	Cooper River	Newton Creek	
4	Waters used for Primary Contact Recreation	No	No	No	No authorized bathing beaches or other primary contact recreation areas were identified.
5	Public Drinking Water Intakes	No	No	No	• Camden & Gloucester water supplies are from wells.[4-10] • Philadelphia Delaware intake is upstream of applicable CSO.
6	Shellfish Beds	No	No	No	No shellfish beds as defined in the NJ Costal Management Program have been identified.

As shown on Table 4-14 there is the potential that parts of the Delaware and Cooper Rivers receiving CSO discharges could be suitable habitats for the Short-Nose Sturgeon and for several threatened or endangered species of mussels. If these areas are suitable habitats and these species of aquatic wildlife are present there, these areas would be considered as sensitive areas as defined in the U.S.EPA CSO Control Policy and will require special attention in the development of long term CSO control strategies.

4.5.1 Detailed Analyses

Outstanding National Resource Waters

Outstanding National Resource Waters (ONRW) are categorized in New Jersey's Surface Water Quality Standards[4-11] as one of three categories of waterbodies. ONRWs include FW-1 (freshwater) waters which are also known as non-degradation waters which are set aside for posterity and include PL (Pinelands) waters. Category 1 waters are protected from any measurable change in water quality because of exception ecological, recreational, fisheries or water supply significance. All other waters of New Jersey are designated as Category 2 waters for which existing water quality and designated uses are to be maintained. As shown in Figure 4-9, the Delaware and Cooper Rivers and Newton Creek have not been designated as ONRWs by NJDEP.

4-10 Sources: Camden 2016 Annual Water Quality Report – PWS NJ0408001, Gloucester City 2016 Consumer Confidence Report.

4-11 N.J.A.C. 7:9B et seq.

National Marine Sanctuaries

A review of information from the Office of Marine Sanctuaries of the National Oceanographic and Atmospheric Administration (NOAA) has confirmed that there are no national marine sanctuaries affected by the Camden / Gloucester / CCMUA combined sewer overflows.

Waters with Threatened or Endangered Species or Designated Critical Habitat

Roughly the northwestern half of Camden County, including the Cities of Camden and Gloucester is located in the Southern Piedmont Plains as shown on Figure 4-10. As detailed in the 2008 New Jersey Wildlife Action Plan,[4-12] this zone contains the Delaware River and estuary which is freshwater tidal from Trenton to Camden and the brackish upper Delaware estuary from Camden to the Cohansey River.

The Wildlife Action Plan identified five riverine mussel species and their associated habitats in the Southern Piedmont Plains as being endangered or threatened:

- Dwarf Wedgemussel (Federal Endangered and Threatened Species);
- Eastern Pondmussel (State Threatened Species);
- Tidewater Mucket (State Threatened Species);
- Triangle Floater (State Threatened Species); and
- Yellow Lampmussel (State Threatened Species).

The NJDEP Landscape Project Stream Habitat GIS data base was utilized to identify the habitat areas of the Delaware and Cooper Rivers and Newton Creek that may receive CSO discharges. The NJDEP identified habitat areas are ranked in the Wildlife Action Plan as follows:

1. ***Rank 1*** – is assigned to patches of that meet habitat specific suitability requirements such as minimum size criteria for endangered, threatened or priority wildlife species but that do not intersect with any confirmed occurrences of such species;
2. ***Rank 2*** – is assigned to patches containing one or more occurrences of at least one non-listed State priority species;
3. ***Rank 3*** – is assigned to patches containing one or more occurrences of at least one State threatened species;
4. ***Rank 4*** – is assigned to patches with one or more occurrences of at least one State endangered species; and
5. ***Rank 5*** – is assigned to patches containing one or more occurrences of at least one wildlife species listed as endangered or threatened on the Federal list of endangered and threatened species.

[4-12] New Jersey Wildlife Action Plan – January 23, 2008. NJDEP Division of Fish & Wildlife, Endangered and Non-Game Species Program

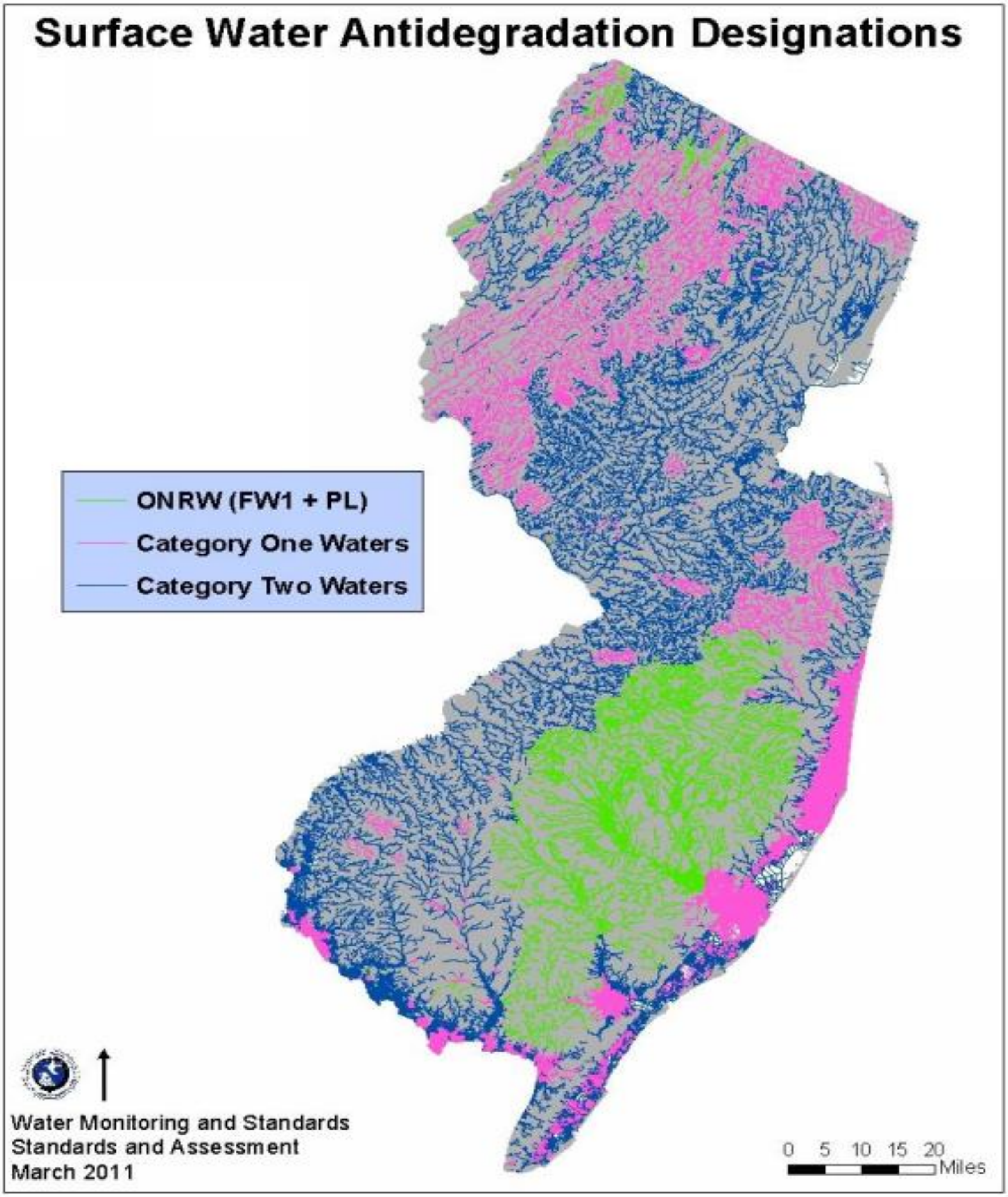


Figure 4-9 – NJ Surface Water Categories

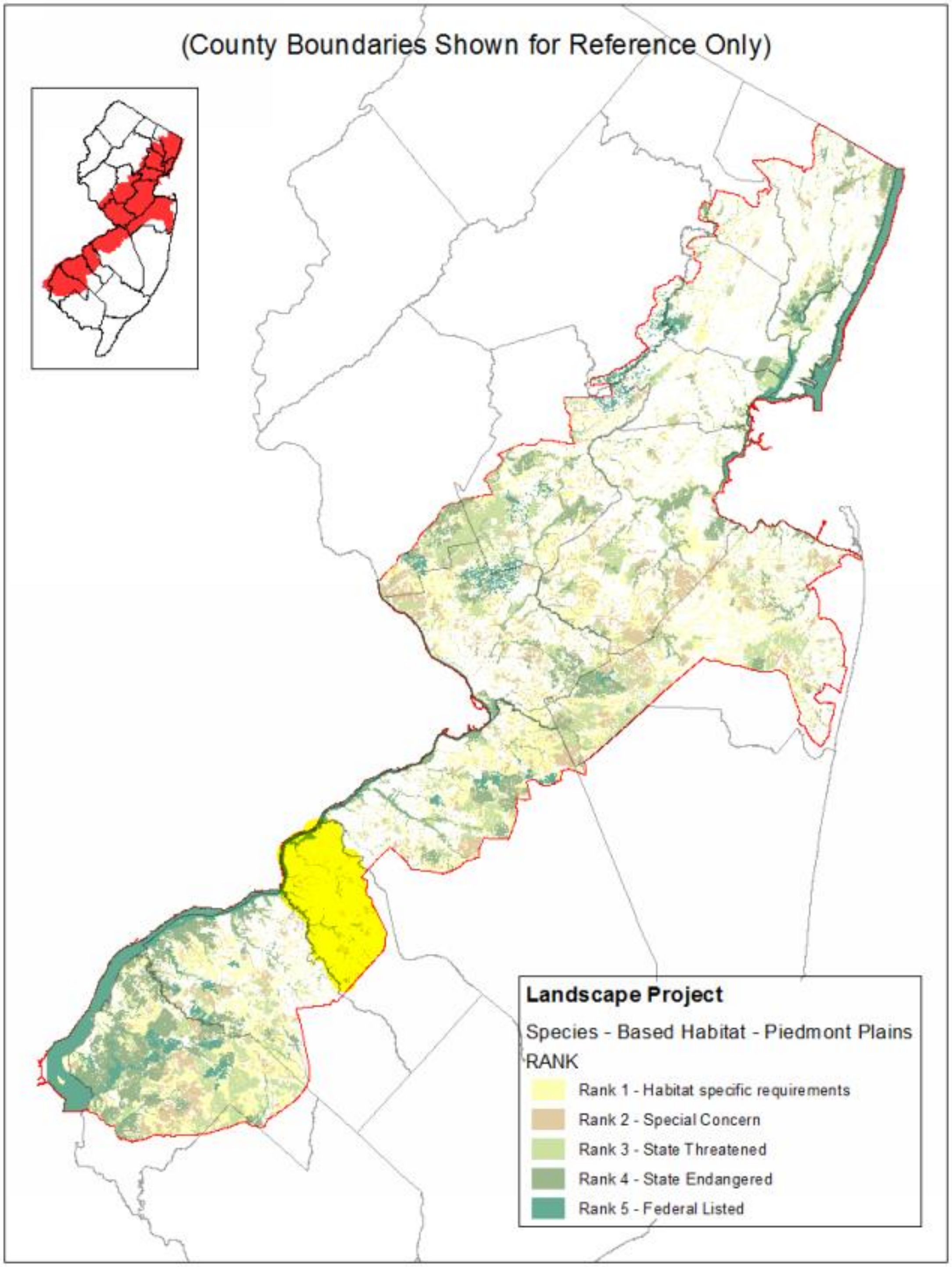


Figure 4-10 – New Jersey Piedmont Plains, Camden County is Highlighted

The species based aquatic habitat map for the CSO receiving streams are shown on Figure 4-11 (following page). Based upon the intersection of the NJDEP data base of confirmed occurrences and the habitat suitability data base, it appears that three mussel species potentially could exist within the CSO receiving streams:

- Eastern Pondmussel (State Threatened Species);
- Tidewater Mucket (State Threatened Species); and
- Yellow Lampmussel (State Threatened Species).

In addition, per the NJDEP data base, there has been one or more occurrences of the short-nose sturgeon which is included on the Federal endangered and threatened species list. It must be noted that the protocol of intersecting one or more confirmed occurrence and species appropriate habitats does not indicate whether these species are present in the Cooper and/or Delaware Rivers.

Bald eagle wintering and habitat suitable for foraging have been identified through the NJDEP Landscape Project Areas v3.3 data base. As shown on Figure 4-12, these areas are along the Cooper River in or about Cooper River Park. The winter habitat area is upstream of the CSO discharge area and above the Cooper River Parkway Dam. The foraging area is along the lower portions of Cooper River Park downstream of the Thorndyke and the C-27 outfalls.

Waters used for Primary Contact Recreation

There are no authorized primary contact recreational areas within the CSO receiving streams. Extensive seasonal secondary contact recreational usage occurs on Cooper Lake, which is the impoundment of the Cooper River in Camden County's Cooper River Park; e.g. usage by the Cooper River Rowing Club. The lake is formed by the Cooper River Parkway Dam which is approximately two miles upstream of the upstream most CSO outfall into the Cooper River (C-27-2 Thorndyke outfall). There are no authorized primary recreational areas along within the CSO receiving portions of the Delaware River or Newton Creek.

Public Drinking Water Intakes

The Cities of Camden and Gloucester both utilize wellfields to draw their potable source-water from the Potomac-Raritan-Magothy Aquifer.

Shellfish Beds

Shellfish beds are defined under the New Jersey Coastal Management Program as:

> "… as estuarine bay or river bottoms (tidelands) that are productive for hard clams (Mercenaria mercenaria), soft clams (Mya arenaria), eastern oysters (Crassostrea virginica), bay scallops (Argopecten irradians), or blue mussels (Mytilus edulis). A productive bed is one which can be shown to have a history of natural recruitment for one or more of these species, or is leased by the State of New Jersey for shellfish culture, or is a State Shellfish Management Area."[4-13]

No shellfish beds have been identified within the area impacted by the CSO discharges.

[4-13] Source: New Jersey Coastal Management Program and Final Environmental Impact Statement, August 1980 prepared by NJDEP and the national Oceanic and Atmospheric Administration. Section 7:7E-3.2, page 81.

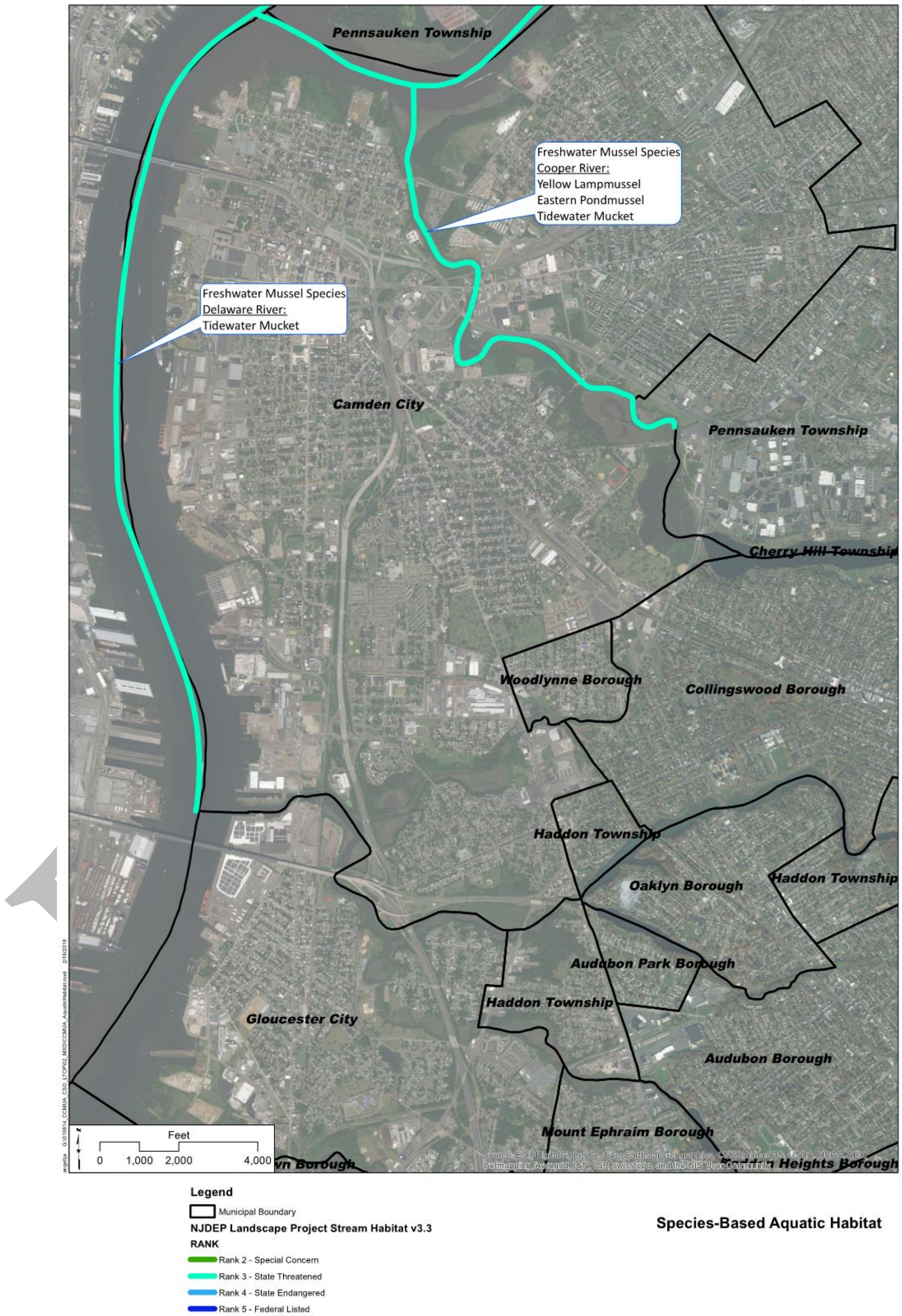


Figure 4-11 – Aquatic Species Based Habitat Map

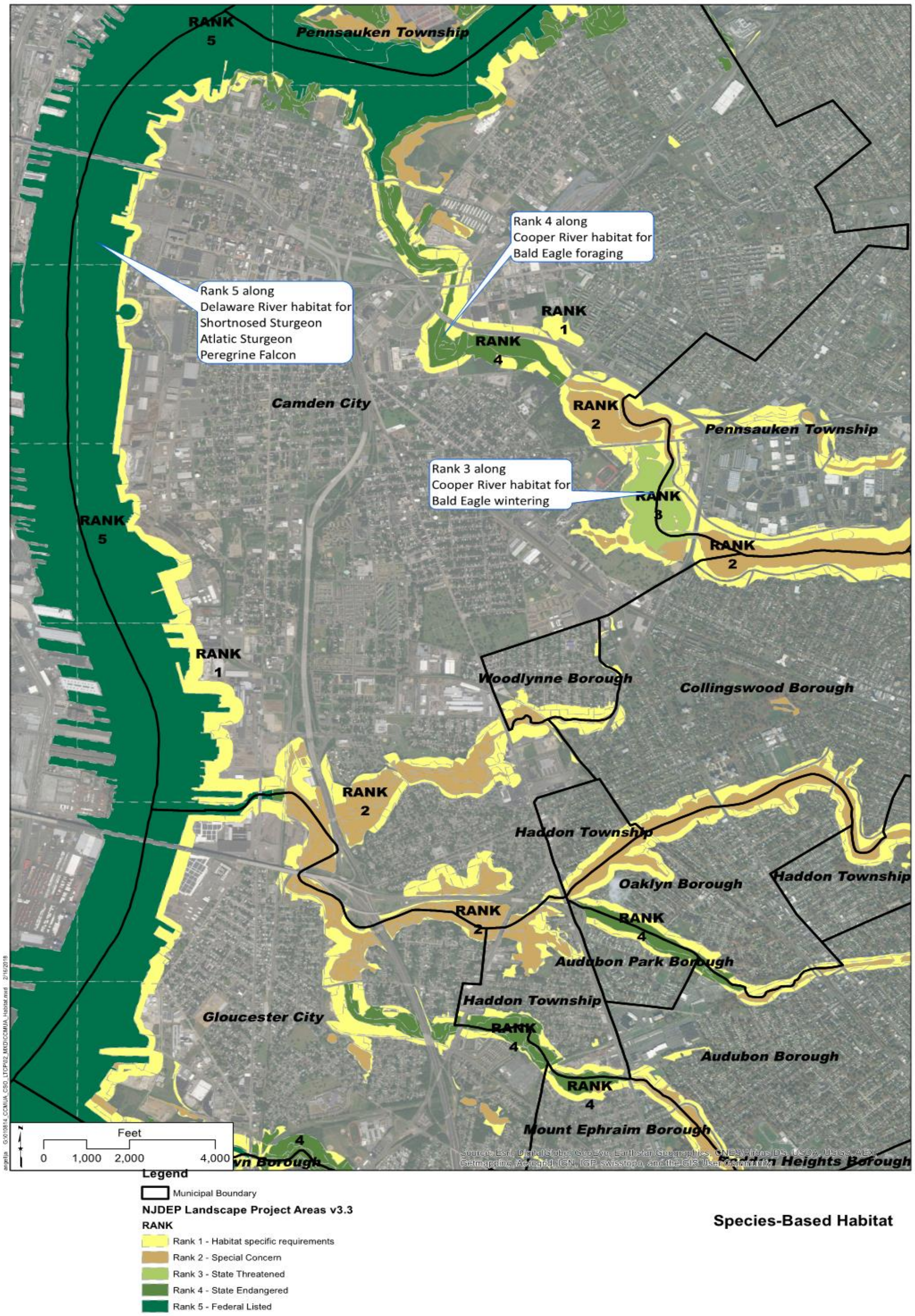


Figure 4-12 - Bald Eagle Foraging and Winter Nesting

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Section 5 Revised 06/27/18

Combined Sewer System Monitoring & Baseline Condition Modeling

5.1 Background and Approach

Pursuant to their respective NJPDES permits, CCMUA and the Cities of Camden and Gloucester submitted a System Characterization Report Work Plan which was approved by NJDEP in August 2016. Supplementing the Work Plan was a Combined Sewer System Supplemental Flow and Precipitation Monitoring QAPP, also approved by NJDEP in August 2016.

The CCMUA / Camden /Gloucester system characterization is based on a hydrologic and hydraulic (H&H) model of the combined sewer system (CSS) developed in the widely used U.S.EPA SWMM 5 software. The CSS model was built reflecting the collection and interceptor system as it existed in 2015, which is the Baseline Condition used for system characterization and for purposes of benchmarking system improvements in the LTCP. This model is referred to as the Baseline Condition Model. This model was first constructed in 2015 using the SIIAPS data and model from 1997. During 2015 this model was preliminarily calibrated using nine permanent CCMUA flow monitors. Two permanent precipitation monitors located at CCMUA's Water Pollution Control Facility and at the Philadelphia International Airport were utilized. This preliminarily calibrated model, referred to as the Preliminary Baseline Condition Model, enabled CCMUA and the Cities to initiate system performance characterization and analyses. In August 2016, CCMUA and the Cities submitted a Quality Assurance Project Plan (QAPP) for additional flow and precipitation monitoring to augment existing data. A copy of the QAPP and NJDEP's subsequent approval are provided as Appendix E to this SCR.

Under the SCR workplan and QAPP, the Preliminary Baseline Condition Model was re-calibrated using new data from temporary and permanent flow meters and precipitation gauges as detailed below. This model is referred to as the Baseline Condition Model.

5.2 Flow and Precipitation Monitoring

5.2.1 Flow Meter Locations

CCMUA installed eight temporary flow meters throughout the system at locations determined with NJDEP at a meeting held on June 16, 2016 and were documented in the QAPP. These locations are:

- Pennsauken connection into Camden upstream of C32 at High St and 43rd St.
- C22 trunk sewer before the confluence from C22
- C11 trunk sewer
- C7 trunk sewer
- C3 trunk sewer

- C1 trunk sewer
- C17 trunk sewer
- G5 trunk sewer

The specific locations are shown on Figure 5-1. The temporary flow meters were installed in late April 2017 and were removed at the end of September 2017 for a total duration of twenty-three weeks. In consultation with NJDEP prior to removal of the meters, CCMUA and the Cities determined that sufficient monitoring and requisite storm events had occurred through September 2017. A memorandum documenting the conformance of the temporary flow and precipitation monitoring efforts with the approved QAPP is provided as Appendix F.

In addition to the eight temporary flow meters, CCMUA is utilizing hourly data from nine permanent flow meters currently in service throughout its sewer system, located at hydraulically important interceptor locations, pump stations, WPCF, as well as at the points of connection with its member communities. A map of the meter locations is provided as Figure 5-2. The locations of the nine permanent flow meters are:

1. WPCF influent
2. Interceptor carrying flow from City of Camden
3. Interceptor with flow from Camden County and City of Gloucester
4. Pennsauken Interceptor as flow entering from Pennsauken to City of Camden
5. Cooper River, Collingswood, and West Collingswood Pump Station effluent on Cooper River Interceptor
6. Baldwins Run Pump Station effluent
7. Gloucester City Pump Station influent on the Gloucester City flow line
8. Gloucester City Pump Station effluent
9. Flow through the 32nd St. regulator into the interceptor

CCMUA is also utilizing data from the eight City of Camden pump stations. In concurrence with NJDEP, CCMUA is using data from the legacy "Mission" data system pending the completion of supervisory control and data acquisition (SCADA) systems which are currently being implemented.

These pump stations include:

1. Arch Street PS
2. Pine Street PS
3. Federal Street PS
4. Baird Blvd. PS
5. State Street PS
6. Ferry Avenue PS
7. Mt. Ephraim PS, and
8. Fairview PS

CCMUA utilized data from these 17 permanent meters in conjunction with the 8 temporary meters (25 meter sites in total) to update the Preliminary Baseline Condition Model during system baseline characterization. It is anticipated that the 17 permanent meters will be used as well during the development of control alternatives and for post LTCP implementation. In addition, after completion of the ongoing sewer cleaning program in the City of Camden system it is expected that additional temporary flow meters (number of sites still to be determined) will be installed, which together with the 17 permanent meters, would be used to update the Baseline Condition Model and evaluate the enhancement to system performance by the improvement projects.

5.2.2 Precipitation Gauge Locations

CCMUA has a permanent rain gauge at Delaware No.1 WPCF that was used for this study. The National Weather Service rain gauge at Philadelphia International Airport was used for quality control purposes. Additional temporary rain gauges were also installed to support the system characterization project.

CCMUA conducted field investigations to identify suitable project rain gauge sites. Siting considerations included: access conditions and site safety, security concerns, potential interferences from surrounding buildings and trees, and local wind conditions. Two temporary precipitation gauges were installed to augment the existing permanent gauges. One was installed in the northeast area of Camden at the Baldwin's Run Pump Station. The second temporary gauge was located near the center of Camden County at the Berlin Borough Pump Station. The two temporary precipitation gauges have provided broad coverage of the combined as well as the suburban sewered areas in conjunction with the permanent gauges.

5.2.3 Installation and Duration of Temporary Meter/Gauge Deployment

With the exceptions of the meters for C-11 and C-22, the temporary meters were installed on or before April 22, 2017 after extensive field reconnaissance by the flow monitoring specialty contractor CSL Services. Alternative locations were used for C-3 and C-7 due to accessibility issues. The installation of the C-11 meter was delayed due to the obstruction of the primary and secondary manholes (on Cooper Street upstream of the C-11 regulator and west of Delaware Avenue) by the commencement of the waterfront development project subsequent to the approval of the flow monitoring plan. A suitable alternative location was subsequently identified on Cooper Street just east of Delaware Avenue and the meter was installed on June

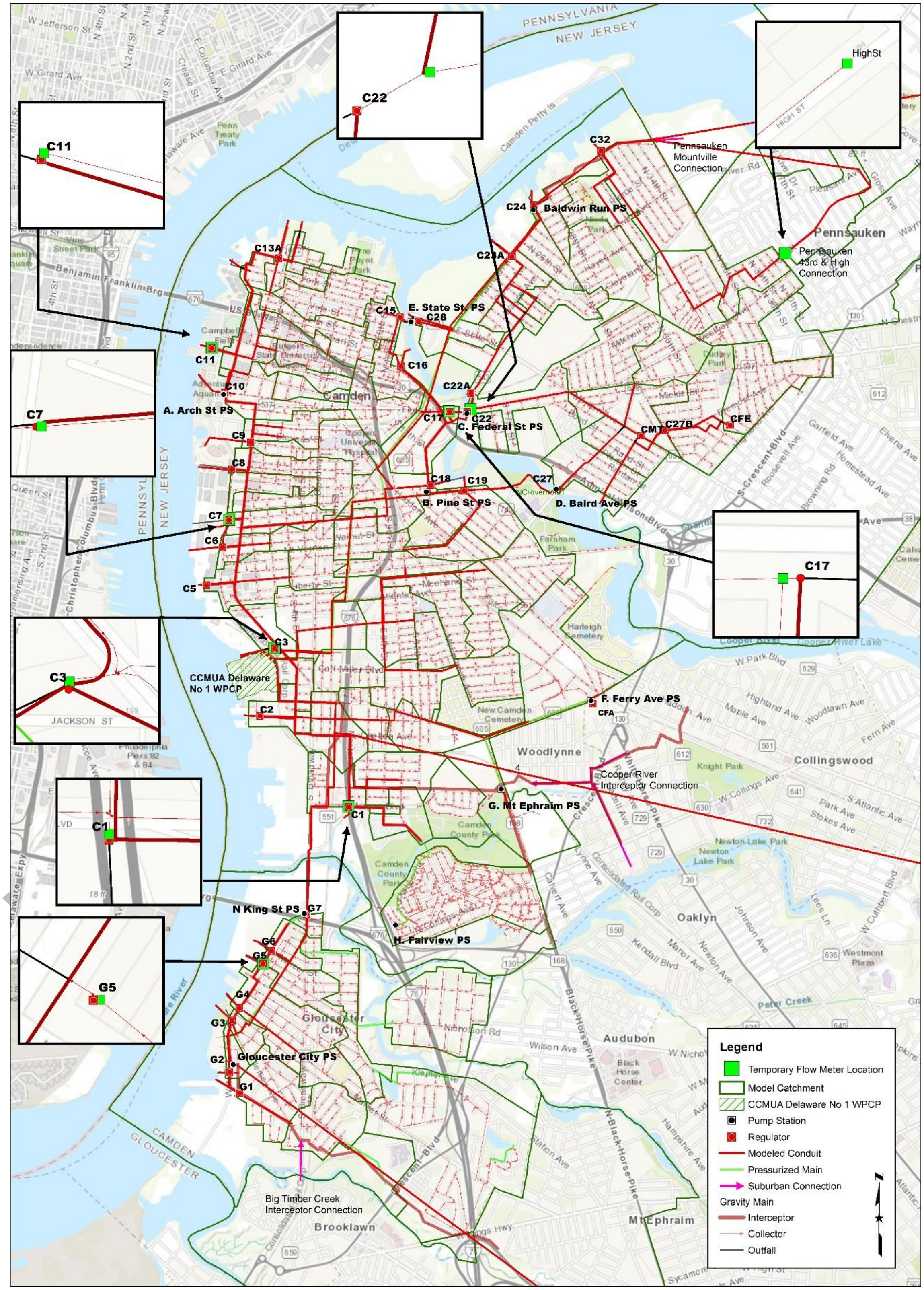

Figure 5-1 - CCMUA Temporary Flow Monitor Locations

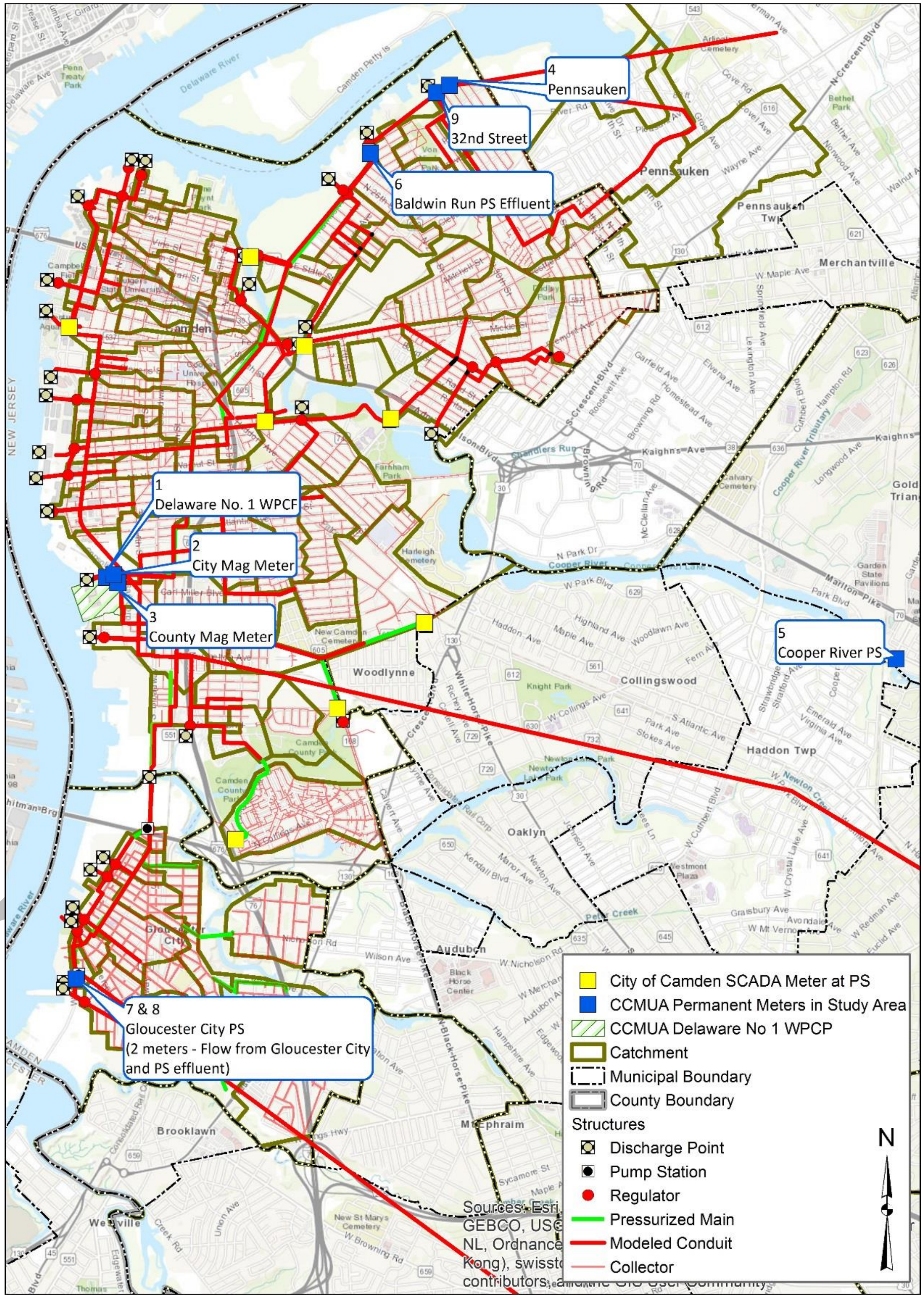

Figure 5-2 – CCMUA and City of Camden Permanent Flow Meter Locations

9, 2017. The C-22 location experienced significant sediment buildup despite several cleanings by the City of Camden's collection system contract operator (American Water). CDM Smith and CSL Services determined that the meter head could be offset above the sediment to obtain useful if not optimal data and the meter was installed successfully on June 16, 2017.

Under the workplan, the temporary flow monitoring period was to extend long enough to capture five representative precipitation events with a rainfall depth of at least 0.5 inches and an observable hydrologic response in the combined sewer system. The workplan specified a minimum duration of twelve weeks for the system-wide monitoring with a two-week "settling in" period for the meters for a total of fourteen weeks.

The precipitation monitoring equipment were programmed to record data in 5-minute intervals. Times were recorded in 24-hour military format with each hour beginning at 00 minutes. The flow monitoring contractor calibrated the equipment and documented the equipment installations and calibration activities. During the flow monitor settling-in period, the equipment for each gauge site were interrogated, checked, and maintained until the equipment was verified to be performing properly.

As of July 29, 2017 the combined sewer system-wide flow monitoring program duration was fourteen weeks. The system experienced six precipitation events during this period with rainfall depths of at least 0.5 inches which produced observable hydrologic responses at the 8 temporary meters. However, a power outage at the Delaware No. 1 WPCF caused loss of data at all the CCMUA permanent meters from mid-May to mid-July. Thus the temporary metering program was extended through September 2017 for a total of 23 weeks of flow monitoring in order to collect enough precipitation events where hydrological responses throughout the entire CCMUA's system were recorded.

5.2.4 Completion of Temporary Meter/Gauge Deployment

The removal of the temporary flow monitors and rain gauges is dependent upon CCMUA demonstrating that:

1. The temporary flow monitors and rain gauges were working properly through the monitoring period;
2. That there were five or more representative precipitation events with a depth of at least 0.5 inches; and
3. That the precipitation events produced observable hydrologic responses in the combined sewer system that were captured by the temporary flow monitors.

CCMUA documented that its flow and precipitation monitoring program complied with the approved QAPP and met the objectives for representative events producing observable hydrologic responses in a memorandum to NJDEP dated September 25, 2017. NJDEP determined that the duration of the flow and precipitation monitoring conducted and the number of precipitation events captured was consistent with these requirements. Copies of the CCMUA memorandum and NJDEP response are provided in Appendix F.

5.3 Baseline Conditions Model

5.3.1 Model Description

The CCMUA/Camden/Gloucester Baseline Condition Model uses the U.S. EPA's Storm Water Management Model (SWMM 5) software Version 5.1.12. The model is in NAVD88 vertical datum and NAD 1983 New Jersey state plane coordinate system.

As the intent of the model is to support the development of CSO control strategies, the primary focus of the model is on the interceptor sewers within the combined sewer system including appurtenances such as regulator structures, outfalls, and pump stations. The modeled hydraulic network covers at least one pipe segment in the trunk sewer upstream of each regulator in the combined sewer service areas of the CCMUA system in Camden and Gloucester City. The network includes about 300 pipes, 38 outfalls, and 11 pump stations. The combined sewer service area and some separated sewer within Camden and Gloucester areas were discretized into 90 sub-catchments. Infiltration and inflow (I/I) from the separated sanitary communities in Camden County outside the Camden/Gloucester City area also contribute flow to the CCMUA treatment plant. They were simplified in the model as a few pipe segments and five aggregated catchments.

5.3.2 Model Updates

The Preliminary Baseline Condition Model was first built in 2015 based on the model documented in the 2001 SIIAPS reports. A series of updates were made in 2015 as listed below to bring the model to the latest industry standards and configure it to fit the needs of the LTCP.

Modifications to the hydraulic elements of the SIIAPS model include:

- Geo-referenced the modeled network to the GIS data from the SIIAPS Study;
- Replaced artificially adjusted pipe lengths with actual lengths based on the geo-referenced model;
- Modified artificially adjusted pipe roughness coefficients to more representative values;
- Verified regulator and outfall dimensions against available information;
- Used observed river stage at Delaware River at Trenton (USGS 01463500) as tidal boundary conditions;
- Updated model node depth from artificially high values required by SWMM4 for representing force mains to depth calculated using DEM and modeled invert; surcharge depth was subsequently used in SWMM 5 to represent the surcharge condition along the force mains;
- Updated all pump curves to the Type 4 pump in the SWMM 5 software;
- Added simplified representation of the Cooper River Interceptor and the Big Timber Interceptor at their respective connection point to the study area.

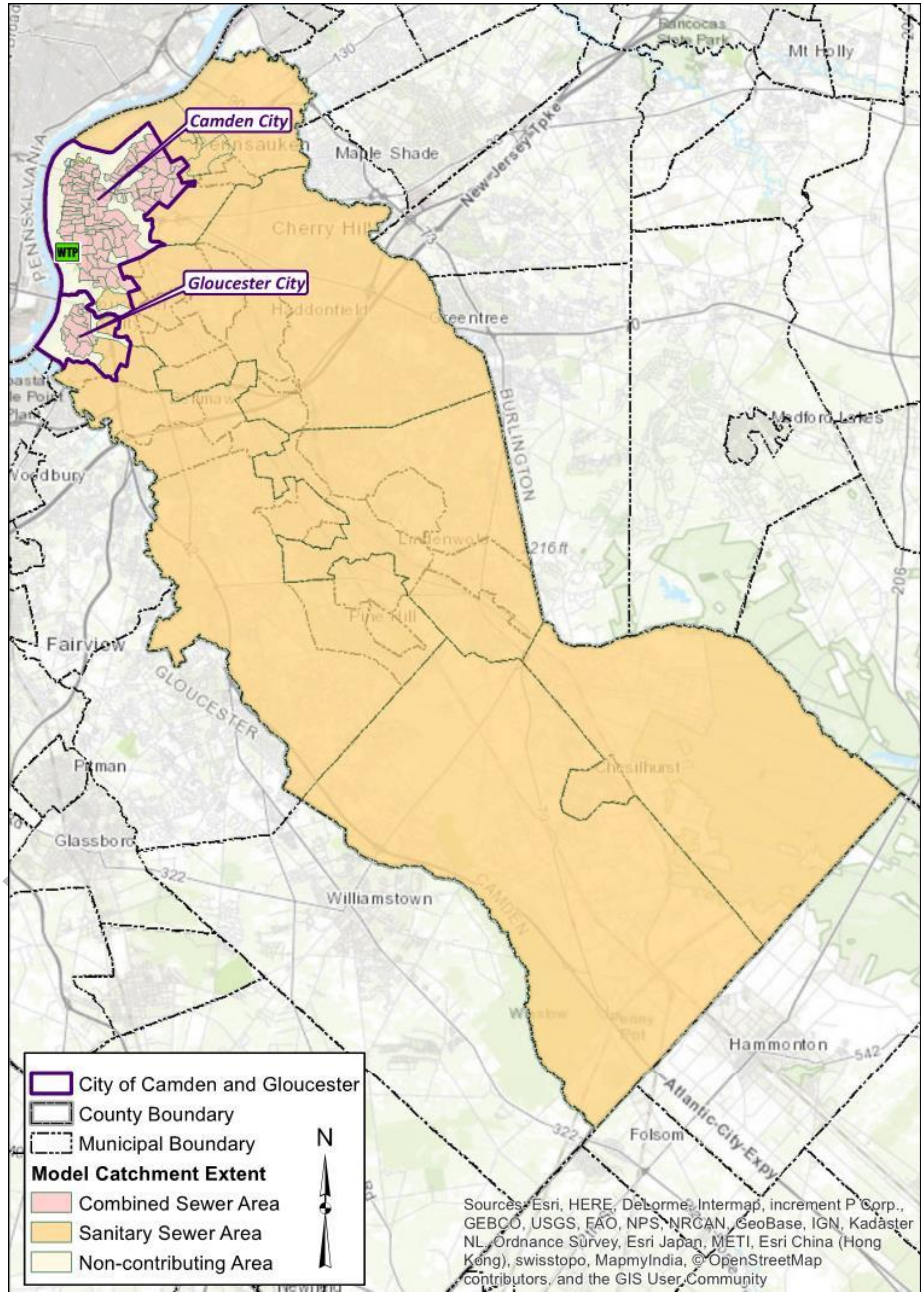

Figure 5-3 – CCMUA / Camden / Gloucester Baseline Condition Model Extents - Hydrology

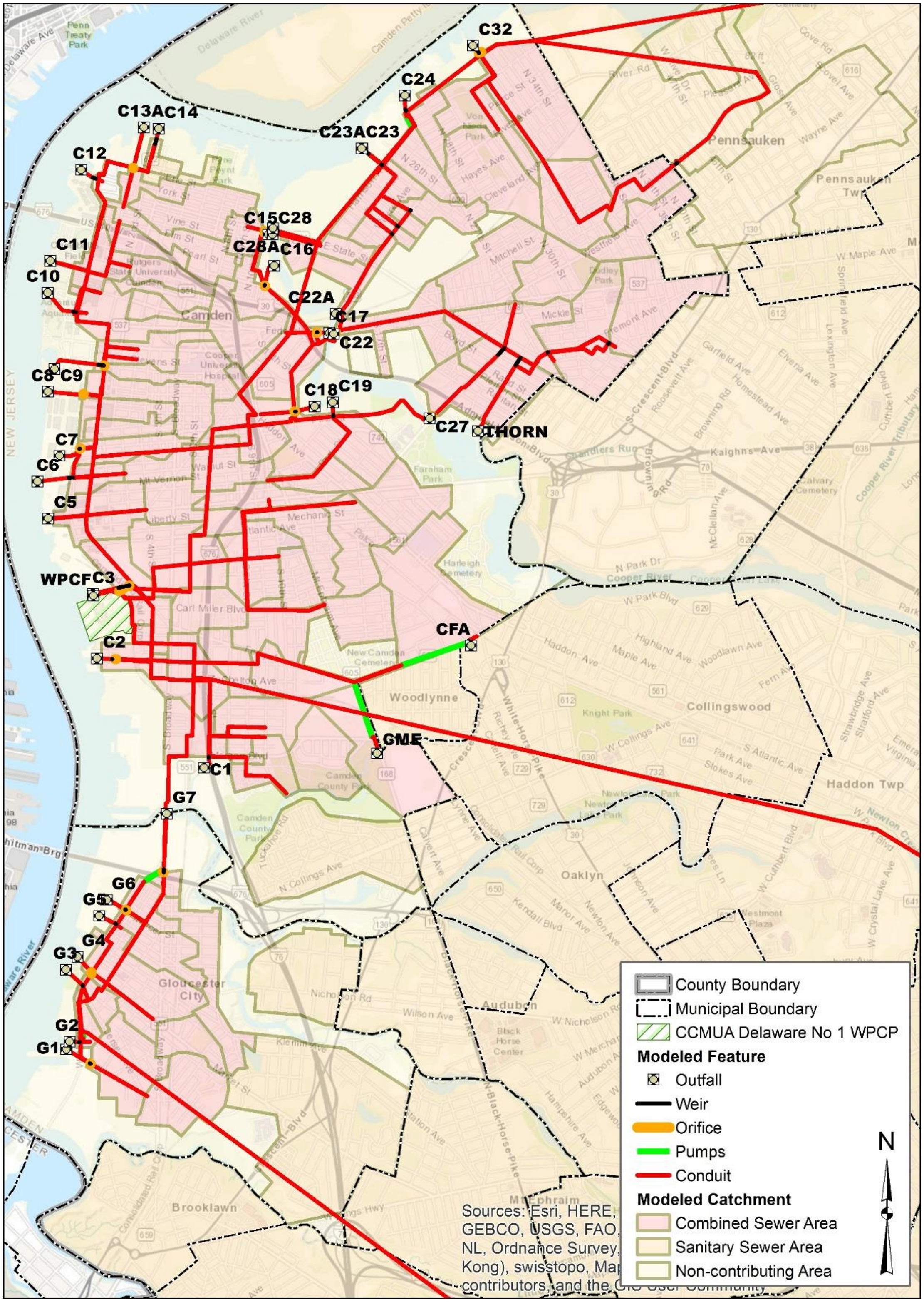

Figure 5-4 – CCMUA / Camden / Gloucester Baseline Condition Model Extents - Hydraulics

Major modifications to the SIIAPS model's hydrology elements include:

- Digitized and geo-referenced sewersheds from maps in the SIIAPS reports;
- Added simplified sewersheds to represent separated communities in Camden County that are outside of the study area;
- Modeled infiltration and inflow from separated sewer communities using the non-linear reservoir routing method;
- Updated imperviousness for each sewershed using the 2007 National Land Cover Database;
- Modified soil infiltration parameters and keep them as consistent as possible throughout the model for the given soil types;
- Partitioned metered flow in days without precipitations into sanitary base flow and base groundwater infiltration components.

Since completion of the SIIAPS Study in 2001, the system had experienced a series of changes including but not limited to installation of netting systems for solids and floatables capture at the outfalls, closure of overflows, and Winslow Township flow connecting into Big Timber Creek Interceptor. The Preliminary Baseline Condition Model was subsequently updated as needed to reflect these evolving conditions.

The following updates were made in 2017 to incorporate the latest available data into the Baseline Condition Model.

- Re-delineated Dry weather flow using 2010 Census population data and 2017 metered flows
- Updated imperviousness values based on 2012 NJDEP imperviousness data
- Added connection from Pennsauken at 43rd and High Street to Camden as well as High Street Pump Station in Pennsauken to the model based on record drawings and field information
- Adjusted the contributing catchments in Pennsauken according to Pennsauken sewer maps
- Changed geometry or size of outfall C1, C2, C3, C10, C11, C13A, C16 and C24 to reflect the heavy sediment condition of outfalls based on Outfall Status Report by American Water (Nov. 2016)
- Updated outfall pipe geometry for C9 and C24 based on regulator drawings

The extent of the Baseline Condition Model network is shown in Figure 5-3 and 5-4.

5.3.3 Model Calibration

The updated (2017) Baseline Condition Model was first calibrated to dry weather conditions at the 25 meter locations described in Section 5.2. Any extended period of time with very little or no runoff response was used to quantify sanitary flow and base groundwater infiltration at each metered location. A method commonly used for desegregating these two components is to assume that a certain percentage of the flow below the lowest diurnal value is part of the sanitary flow and the rest is base groundwater infiltration. This percentage, usually between 85-95%, was adjusted at each meter so that each one of the two components satisfies the mass balance check with the immediate upstream and downstream meters. Weekday and weekend sanitary flow hourly diurnal patterns were also developed from the data during dry days. For base groundwater infiltration, a monthly pattern was developed based on long term data at the Delaware No.1 WPCF.

Calibrating to wet weather response in the system is the next step in the calibration process, and the more important one for a combined sewer system. During the 2017 metering program a wide range of storms were recorded. The precipitation data was analyzed in the memo submitted to NJDEP (September 25, 2017; see Appendix F) in which storms for wet weather calibration and validation were also identified. These storms occurred on July 23rd, Aug 2nd, Aug 5th, Aug 29th, and Sept 6th. Although these storms were the least spatially varied among all the available storms during the metering period, recorded distribution and intensity still exhibited significant differences among different gauges for each storm.

The spatial variation in rainfall is a challenge during calibration, as the rainfall actually occurring across the physical system can be significantly different than the rainfall occurring at the precise location of the rain gauge sites. Increasing the number of rain gauges can improve the representation of spatially varied rainfall, as can the use of sophisticated radar-based approaches to estimate rainfall at higher spatial resolution, but there are practical limits on the number of rain gauges that can be used. In this case three rain gauges were used in the model to calibrate flows at 25 flow meters. As a result, when data collected at the relatively few rain gauge sites are used as the precipitation input in the model, the modeled hydrological responses may not be able to match the recorded responses at the flow meters throughout the system. It should be recognized that this reflects unavoidable model input error (i.e. rainfall measurement error), not poor calibration of the model.

To reproduce the timing and magnitude of metered runoff responses, hydrological parameters were adjusted, notably infiltration rate, percentage routed, and catchment width. For the modeled catchments representing the suburban communities, the same calibration process was followed except that the modeled catchment area was also adjusted slightly to achieve agreement with the observed volume. Manning's friction factors (conduit "n" values) and minor loss coefficients were used to represent head losses through the system and calibrate to metered depth and velocity. Pump curves were modified to reproduce observed pump flows. A control rule was applied to Arch Street Pump Station according to the operating protocol and was optimized to reflect recorded flow.

Calibration was carried out to not have bias in the simulated peak flows, i.e. not consistently over or under predicting. Calibration plots were generated to determine how well the model represented the observed data for current system conditions. The Baseline Condition Model reproduced the duration and magnitude of wet weather flows for multiple metered storms fairly well. Figure 5-5 showed the metered flow vs modeled flow at the Delaware No.1 WPCF.

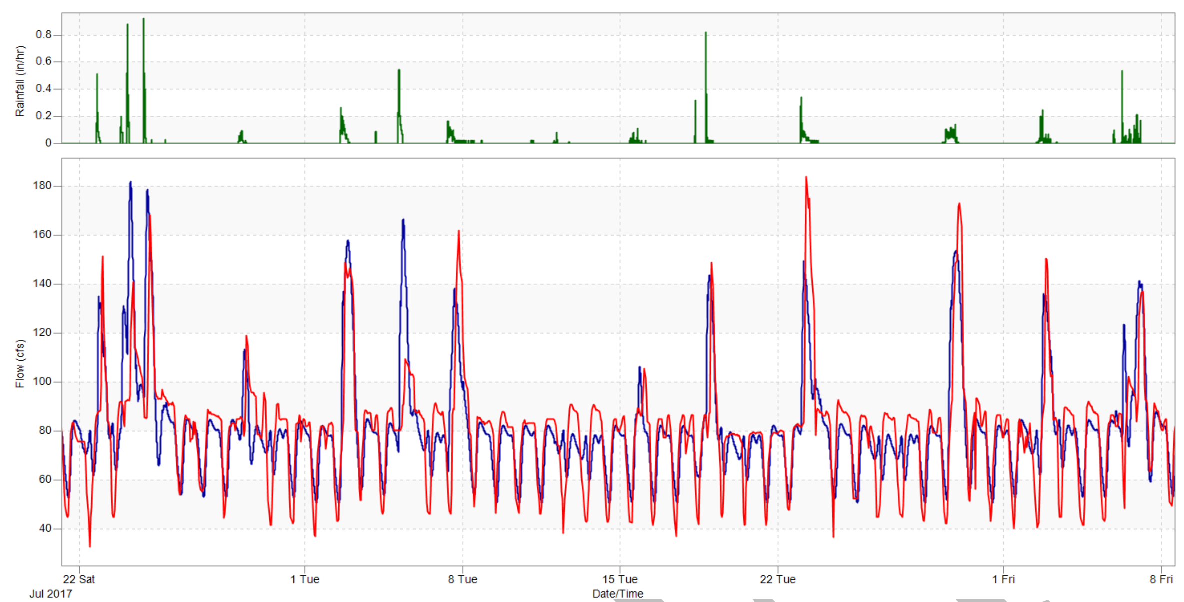

Figure 5-5 Simulated and Metered Flow at Influent of Delaware No.1 WPCF from Jul 22nd – Sept 10th, 2017

Since all the 2017 storms used for calibration were during the summer season when the groundwater was low, CCMUA spring 2014 data was used to calibrate the model to high groundwater conditions. The same 9 locations were used as described in Section 5.2. RDII was applied to March through May to reflect the seasonal rainfall induced inflow and infiltration throughout the system. Figure 5-6 showed the calibration plots for spring of 2014 at the Delaware No.1 WPCF.

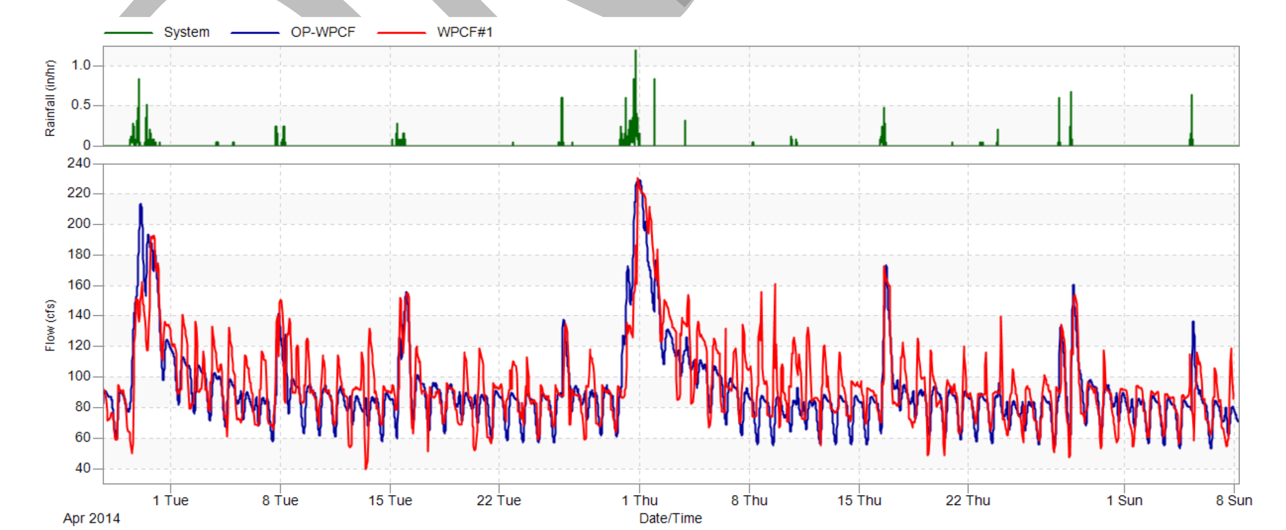

Figure 5-6 – Simulated and Metered Flow at Influent of Delaware No.1 WPCF in Spring 2014

A complete set of calibration plots including time series plots and scatter plots during the five 2017 calibration storms are presented in Appendix J. Where the model results were not in close agreement with the metered data, an explanation was provided along with the plots.

One thing to note when reviewing the calibration time series plots for the CCMUA flow meters is that CCMUA meter data is recorded in Universal Time (UTC), which is four hours ahead of Eastern Daylight Time (EDT) (all other data was recorded in EDT). The time zone for the observed data collected at the CCMU flow meters was adjusted from UTC to EDT for the calibration time series plots. However, after this adjustment the wet weather responses in some storm events appeared to be one hour ahead of the precipitation. This may be simply an artefact of the rain gauge resolution (i.e. rainfall may be occurring in the sewershed before it occurs at the gauge), but there may also be a timestamping issue with these sites. In any case, the observed data collected and used for calibration at these sites did not impact the ability of the model to reliably predict CSO behavior as the model reproduced well the shape and peak of the hydrographs at the CCMUA meters.

5.3.4 Model Applications

The Baseline Condition Model has been used to establish the system performance baseline (detailed in Section 7 of this SCR), and will be used to support the development and evaluation of CSO control alternatives for the CSO LTCP. The model will be run using the typical year for both baseline conditions and to characterize CSO control benefits of various control strategies. Overflow statistics will be compiled to estimate average annual CSO volume, duration, and frequency at each outfall for evaluation and comparison. Design storms may be used for preliminary evaluation of CSO control and flood reduction alternatives.

During the LTCP implementation, the Baseline Condition Model will be updated to reflect interim system changes and improvements such as changes in system operations (e.g. adjustment of regulator settings), and the completion of GSI and other source reduction projects. It must be noted that individual GSI projects cannot generally be effectively evaluated using H&H models at the level of detail of the Baseline Condition Model, as the scale of these projects will generally be too small individually to be representable at the resolution of the Baseline Condition Model. Thus for GSI and other source reduction projects, the model will likely need be updated during LTCP implementation to provide the additional model resolution needed to represent and simulate individual projects.

CCMUA anticipates that additional future flow monitoring of targeted catchment areas (sewersheds) may be appropriate once a sufficient critical mass of GSI and other source reduction has been implemented to materially change flow characteristics at a level that can be represented and simulated with the future updated versions of the Baseline Condition Model. The updated model will be calibrated to the corresponding metering data and subsequently used to evaluate the efficacy of the completed system improvement by ascertaining the system-wide annual wet weather flow capture levels for the typical year. The updated model will also be used to re-evaluate other proposed improvement projects as part of the adaptive management process.

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Section 6 Revised 04/26/18

Rainfall Analysis and Typical Hydrologic Record

6.1 Background

A representative annual precipitation record, or "typical" year is often used in combined sewer overflow (CSO) studies to evaluate system performance under baseline conditions and future improvement alternatives. Under the current (2015) NJPDES permits, NJDEP requires permittees to incorporate recent precipitation data and to re-evaluate the typical year for their system characterizations.

CCMUA and the Cities evaluated precipitation data to determine the appropriate typical year to be used in characterizing the performance of the combined sewer system and for the analysis of CSO control alternatives. A draft technical memorandum was submitted to NJDEP for review and comment in December of 2017 on which NJDEP provided comments via a letter in February 2018. CCMUA and the Cities provided a revised memorandum to NJDEP which was discussed during the quarterly LTCP progress call in March. Copies of these correspondences are provided in Appendix G. Based on the revised memorandum, NJDEP concurred with CCMUA's and the Cities' typical year selection during the progress call.

6.2 Evaluation Criteria

The following criteria were used for the typical year evaluation:

- Annual precipitation;
- Seasonal precipitation;
- Number of storms exceeding selected average recurrence intervals (ARI) at different durations;
- Exclusion of years with extended dry periods; and
- Favor selection of 2002 or later data where 1-minute precipitation data are available.

6.3 Typical Year 2014

The analysis showed that 2014 was the most recent year with precipitation closest to the long-term average. However, storms on April 29th and June 10th with ARIs larger than 1-year are problematic for use of this period as a typical year. These two events were therefore modified to be equal to or smaller than 1-year ARI, to improve the fit of the 2014 precipitation record against long term statistics.

The modified 2014 precipitation record conforms well with average annual precipitation statistics for over the last five decades and can be reliably used as the typical year for system characterization and subsequent alternatives analysis in development of the Long-Term Control Plan. Therefore, the modified 2014 precipitation record was used as the selected typical year for the system characterization report and will be used for subsequent control alternatives evaluations.

6.4 Formulation of 15-minute interval typical year rainfall for system characterization

During the typical year selection process, hourly data at Philadelphia International Airport (PIA) was used since it provided the longest period of historical record and it is quality controlled. When conducting model simulation of the typical year, the hourly interval can be used, although a rainfall file with the same interval as the rain gage used in calibration is preferred. In this case, the rain gauge data is at a 15-minute time interval and it was decided to generate 15-minute interval values for the typical year rainfall record.

There are two ways through which a 15-minute 2014 typical year rainfall can be formulated for the PIA rainfall record; one is to disaggregate the modified hourly dataset for 2014, and the other one is to aggregate any available 2014 rainfall records with intervals smaller than 15-minute. In this case, 1-minute data are available for 2014 at PIA and the latter approach is considered better since the actual rainfall pattern can be preserved through aggregation. For the PIA gauge, 1-minute ASOS (Automated Surface Observing System) data has been collected since the late 1990's. Since it is not quality controlled by the NWS as the hourly data, care should be taken when using this data set, as described below.

In order to test for and correct any data quality issues in the 1-minute dataset, monthly total rainfall depths calculated from ASOS data in 2014 were compared to those from the hourly data and daily total data (the highest quality data). Differences were found in January and February among the three datasets. Closer inspection identified two specific snow storms where the gauge used for hourly and 1-minute data recording differed from the daily total gauge. The ASOS data for these two events were modified accordingly and aggregated from a 1-minute to a 15-minute interval rainfall time series. Subsequently, the two storms that were larger than a 1-year storm were scaled down following the same methodology as described in Section 6.6. Table 6-1 lists the monthly totals from all three original data series (daily, hourly, and 1-minute) as well as the changes throughout the quality control and modification process.

The resulted 2014 typical year rainfall time series with 15-minute interval has an annual total of 44.49 inches, very close to the modified total of 44.88 inches using the hourly data. This typical year rainfall dataset therefore provides consistency with the 15-minute time interval in the calibration dataset, retains the actual rainfall patterns in the measured rainfall, and is quality controlled against the longer interval datasets to closely match the total rainfall depths.

Table 6-1 – Precipitation Data Series (Inches of Precipitation)

Month	Daily record	QCLCD record	ASOS 1-min record	ASOS Quality Controlled – Modified 2014	15-min Modified Typical Year 2014	Modifications
Jan	3.55	2.71	2.75	3.17	3.17	Modified Jan 21st storm using daily data
Feb	5.12	5.11	3.57	5.01	5.01	Modified Feb 5th storm using disaggregated hourly data
Mar	4.23	4.16	4.17	4.17	4.17	
Apr	6.69	6.69	6.7	6.7	4.83	Scaled down Apr 30th storm for typical year
May	2.91	2.91	2.92	2.92	2.92	
Jun	5.46	5.46	5.46	5.46	4.85	Scaled down June 10th storm for typical year
Jul	4.3	4.3	4.3	4.3	4.3	
Aug	3.55	3.46	3.59	3.59	3.59	
Sep	1.69	1.78	1.71	1.71	1.71	
Oct	2.53	2.53	2.55	2.55	2.55	
Nov	4.07	4.07	4.1	4.1	4.1	
Dec	3.27	3.27	3.29	3.29	3.29	
Total	47.37	46.45	45.11	46.97	44.49	

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Section 7 Revised 06-07-18

Combined Sewer System Performance

7.1 Introduction

The Baseline Condition Model was calibrated and validated using the 2017 data and reflects 2015 system conditions including CCMUA service areas, system conditions including regulator settings and sedimentation conditions, and system operation. However it is expected that the system conditions will change in the relatively near future due to the ongoing efforts to improve system performance in two significant ways.

The Camden sewer system is currently undergoing inspection and cleaning to restore the hydraulic capacities of the existing sewers as described in Section 8.1.2. Outfall pipes which are heavily obstructed by sedimentation are also planned for dredging and sediment removal. The other significant performance improvement is at CCMUA's WPCF No. 1. Simultaneous with the Camden sewer cleaning work, CCMUA is in the process of expanding the wet weather treatment capacity at the Delaware No. 1 WPCF to 185 MGD as summarized in Section 2.5.3 of this document. A concept study of plant expansion alternatives developed for CCMUA by Greeley & Hansen is provided as Appendix I. As also noted in Section 2.5.3 CCMUA is evaluating additional expansion of the wet weather treatment capacity at WPCF No. 1 beyond 185 MGD. Due to these anticipated changes in the near term, the Baseline Condition Model was revised to reflect the cleaning of the Camden sewers and outfalls and the expansion of the WPCF No. 1 treatment capacity to 185 MGD.

System performance of the following three scenarios were evaluated and included in this section:

- The baseline condition (prior to pipe cleaning and WPCF No. 1 expansion)
- Post-cleaning (after Camden sewers and outfalls with sedimentation restored to their design capacity)
- Post-cleaning with WPCF upgrade (WPCF upgrade to accept 185 MGD peak flow)

Under each scenario, system performance during the typical year (see Section 6) was simulated. Use of the typical year enables system performance to be characterized on an average annual basis, and performance was defined using the following metrics:

- Annual overflow volume;
- Annual overflow frequency;
- Percentage of wet weather flow captured for treatment on an annual basis[7-1]; and

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[7-1] The CSO Control Policy capture describes wet weather capture in the context of the evaluation of control alternatives. Under the "Presumption Approach", one control option is: "The elimination or the capture for treatment of no less than 85% by volume of the combined sewage collected in the CSS (combined sewer system) during precipitation events on a system-wide annual average basis…" 59 FR 18962 section II-C4(a)(ii).

- Annual surface flooding volume.

The above metrics were applied to both system wide performance as well as performance at the sewershed level (by each regulator or in several cases by regulator groups).

Annual overflow volume is the total volume of all simulated CSO events. Annual overflow frequency is the total number of overflow events, defined as events with modeled flow in the overflow conduit at or above 0.001 cubic feet per second (cfs), with a minimum inter-event time of 24 hours to distinguish individual events. Annual flooding volume is the total volume of water that discharged from the sewer system at a flooded node in the model, i.e. discharge to the surface due to system surcharge reaching the manhole rim elevation. When reviewing these flooding estimates it should be recognized that because the model only includes a relatively small sub-set of the combined sewer pipes, and does not model the smaller upstream pipes and catch basins, modeled flooding is not a comprehensive estimate of current flooding conditions in the combined sewer system.

Percentage capture is a more complex metric than volume and frequency. This is the fraction (as a percentage) of wet weather flow in the combined sewer system that is captured for treatment. On an individual CSO outfall basis, captured flow is the wet weather flow that passes through the underflow pipe from the combined trunk sewer to the interceptor sewer. On a system wide basis, captured flow is the wet weather flow that passes through the headworks of the treatment plant.

To calculate percentage capture, first the wet weather period needs to be defined. In this case, simulated total flow entering the sewer system in wet weather was compared to that in dry weather for every time step. When the former was more than 10% of the latter, this time step would be flagged as a wet weather time step. Wet weather time steps were flagged for the entire typical year. Total flow entering Delaware No.1 WPCF (also defined as Total Captured Flow) was then summed up for all the wet weather days. Finally the system wide percentage capture was calculated using the following formula for fraction captured (which can be converted to a percentage):

$$Percentage\ Capture = 1 - \frac{(Total\ CSO\ Volume + Total\ Flooding\ Volume)}{(Total\ Captured\ Flow + Total\ CSO\ Volume - Total\ Volume\ from\ Separate\ Sanitary\ Communities)}$$

Flow contribution from separate sanitary communities during wet weather was subtracted from the total captured flow as percentage capture only applies to the combined system flow.

Due to the limitation of the model on flooding volume prediction, simulated flooding under Baseline Condition may be somewhat understated, thus based on the formula above percentage capture estimates may be slightly overstated for the Baseline Condition. However since overflow volume is ten times bigger, the effect is limited. This will also not be a significant factor for the other two (near term) scenarios, where sewer system cleaning is assumed to be completed and less flooding is expected. It should be noted that the actual performance of the *Post-Cleaning Condition* and the *Post-Cleaning with WPCF Upgrade* may vary from the performance predicted by the model. The actual performance should be evaluated with the model through post-implementation monitoring to inform updates to the model.

7.2 Modeled System Performance

7.2.1 System Wide Performance

System wide performance is summarized on Table 7-1 for all three scenarios.

Table 7-1 – System Wide Performance for the Typical Year

System Wide Performance Metrics		Baseline Condition	Projected	
			Post Cleaning	Post Cleaning + WPCF Upgrade to 185 MGD
1	% Capture	68%	68%	76%
2	Overflow Volume (million gallons)	829	855	627
3	Range of Overflow Frequencies (events)	10-69	23-69	5-70
4	Modeled Surface Flooding (million gallons)	90	50	44

System – Wide Performance Findings

- Baseline condition system wide percentage capture is 68% with 829 MG in total annual overflow volume. As noted above, this percentage capture estimate may be slightly overstated due to model limitations in the flooding estimates.
- Cleaning increased the conveyance and storage capacity of the system which resulted in significant reduction in flooding along with moderate increase in annual overflow volume. Overflow volumes increase due to increased conveyance capacity in the clean overflow pipes and outfalls. It should be noted that the reduction in flooding exceeds the increase in overflow, thus there is a slight net improvement in capture (less than 1%), in addition to the significant benefits to the service area from reduced flooding of combined sewage.
- The forthcoming capacity expansion at WPCF No. 1 improved percentage capture (from 68% to 76%, a significant improvement), decreased annual CSO volume significantly (by more than 25%) and decreased flooding by 12%.
- Overflow frequency in general increased after cleaning and decreased after WPCF headworks expansion, for reasons consistent with those described above for overflow volume.

7.2.2 System Performance on Sewershed Level

CSO Volume by Outfall

The annual total overflow volume by sewershed is listed in Table 7-2 for all three scenarios although sorted based on *Post Cleaning with WPCF Upgrade* scenario. Percentage of system total CSO annual volume was calculated for each outfall for Baseline Condition and Post Cleaning with WPCF Upgrade. They are illustrated in Figure 7-1 and 7-2 in which the CSO outfalls are ranked from the largest CSO volume to the smallest. Cumulative plots were also included in these two figures to show the rate of increase in total system CSO volume contributed by each individual CSO.

Table 7-2 – Total CSO Volume by Outfall for the Typical Year

Rank	Outfall	NJPDES Number	Annual CSO Volume (MG/Year)			Ownership	Receiving Water
			Baseline Condition	Post Cleaning	Post Cleaning & WPCF Upgrade		
1	C32	040A	114.5	114.7	114.7	CCMUA	Delaware River
2	C3	009A	131.5	146.8	113.2	Camden	Delaware River
3	C27	028A	31.8	34.8	35	Camden	Cooper River
4	C18&C19	024A	33.1	32.4	33	Camden	Cooper River
5	C11	016A	39.8	59.8	27.8	Camden	Delaware River
6	C9	014A	35.4	32.8	26.4	Camden	Delaware River
7	C22	030A	24.8	23	23.3	Camden	Cooper River
8	G5	005A	22.2	22.4	22.4	Gloucester	Delaware River
9	C17	022A	22.4	21.8	21.9	Camden	Cooper River
10	Thorndyke	033A	22.8	21.7	21.7	Camden	Cooper River
11	C22A	034A	22.4	21.1	21.4	Camden	Cooper River
12	C23A	025A	19.7	19.5	19.8	Camden	Delaware River
13	G1	001A	18.3	19.9	19.8	Gloucester	Delaware River
14	G4	004A	19.6	17.1	17.1	Gloucester	Delaware River
15	C6&C7	012A	42.4	34.9	15.8	Camden	Delaware River
16	C10	015A	75.1	50.4	13	Camden	Delaware River
17	CFA	005A	12.4	12.4	12.4	Camden	Newton Creek
18	C1	007A	18.7	33.6	9.5	Camden	Newton Creek
19	C13A	018A	5.8	26.2	8.9	Camden	Delaware River
20	G6	006A	9.3	8.5	8.5	Gloucester	Delaware River
21	C24	026A	5.8	7.6	7.6	Camden	Delaware River
22	C15	020A	7.4	7.4	7.4	Camden	Cooper River
23	C8	013A	15.1	13.1	6	Camden	Delaware River
24	G2	002A	4.4	5	5.1	Gloucester	Delaware River
25	C2	008A	31.6	36.1	4.3	Camden	Delaware River
26	C28	029A	3.8	3.9	4	Camden	Cooper River
27	C16	023A	2.8	3.6	3.6	Camden	Cooper River
28	G3	003A	1.8	1.8	1.9	Gloucester	Delaware River
29	G7	007A	1.1	1.1	1.1	Gloucester	Newton Creek
30	C5	010A	33.2	21.3	0.3	Camden	Delaware River
	System Total		829	855	627		
	CSO Min		1.1	1.1	0.3		
	CSO Max		131.5	146.8	114.7		
	CSO median		20.95	21.5	14.4		

As shown in Figure 7-1, under the Baseline Condition, C3 has the largest annual overflow volume followed by C32. Together they make up 30% of the system total CSO volume. The next three largest CSO volumes were at C10, C6/C7, and C11. Together these five largest CSO outfalls by annual volume were estimated to contribute 403 MG of CSO overflow, which is almost 50% of the total system overflow volume.

As shown in Figure 7-2, after cleaning and WPCF upgrade, C3 and C32 remained the two largest CSO outfalls by volume and together they will make up 35% of the total system CSO volume. C10 and C6/C7, which benefit largely from WPCF upgrade, will no longer be among the largest CSO volume outfalls. Instead C27 and C18/C19 will move up on the ranked list, and together with C3, C32, and C11 they will make up more than 50% of the system total CSO volume (324 MG).

Figures 7-1 and 7-2 demonstrate that CSO volume is not evenly distributed across the system, but rather much of the total system volume is concentrated at a few large outfalls. This suggests that significant CSO control benefits may be achievable by focusing on those key CSO outfall locations. Although there are a number of factors, not just CSO volume, that will be considered in developing the LTCP, this information will be useful and inform the forthcoming evaluation of alternatives under the NJDEP CSO permitting process.

Simulated flooding volumes for all three scenarios are shown on Table 7-3. These are sorted by simulated flooding volume in *Post Cleaning with WPCF Upgrade* scenario. The system wide impacts of sewer cleaning on overflow volumes and flooding are demonstrated in Table 7-1. On a sewershed level, notable increases in CSO volumes at C1, C2, C3, C16, and C24 will be accompanied by significant reduction in flooding volume. Total flooding in the modeled system for these 4 sewersheds will drop from 36 MG to 25 MG for the typical year. Sediment removal from outfall C10, C11, and C13A increase total CSO from 120 MG to 136 MG while reducing total modeled flooding from 24 MG to 5 MG for the typical year. Although the absolute volumes of flooding reported here are limited to the modeled system (as discussed above), the relative changes are still insightful.

The WPCF upgrade will have significant impact on CSO reduction at C1 through C13A along the Second Street and Delaware Avenue Interceptors (reducing typical year CSO volume from 147 MG post-cleaning to 113 MG), while having no impact on any other outfalls. Modeled flooding in these 11 sewersheds will also be further reduced by about 10% from the post-cleaning scenario.

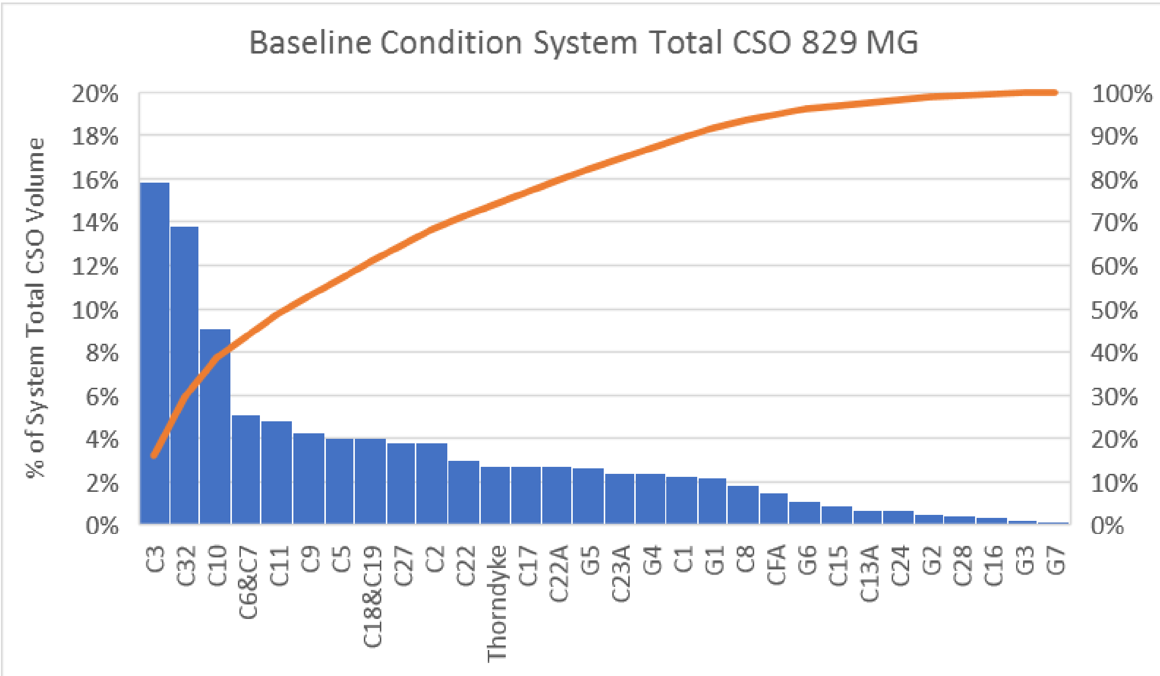

Figure 7-1 Percentage of System Total CSO for Each Outfall and Cumulative Distribution (Baseline Condition)

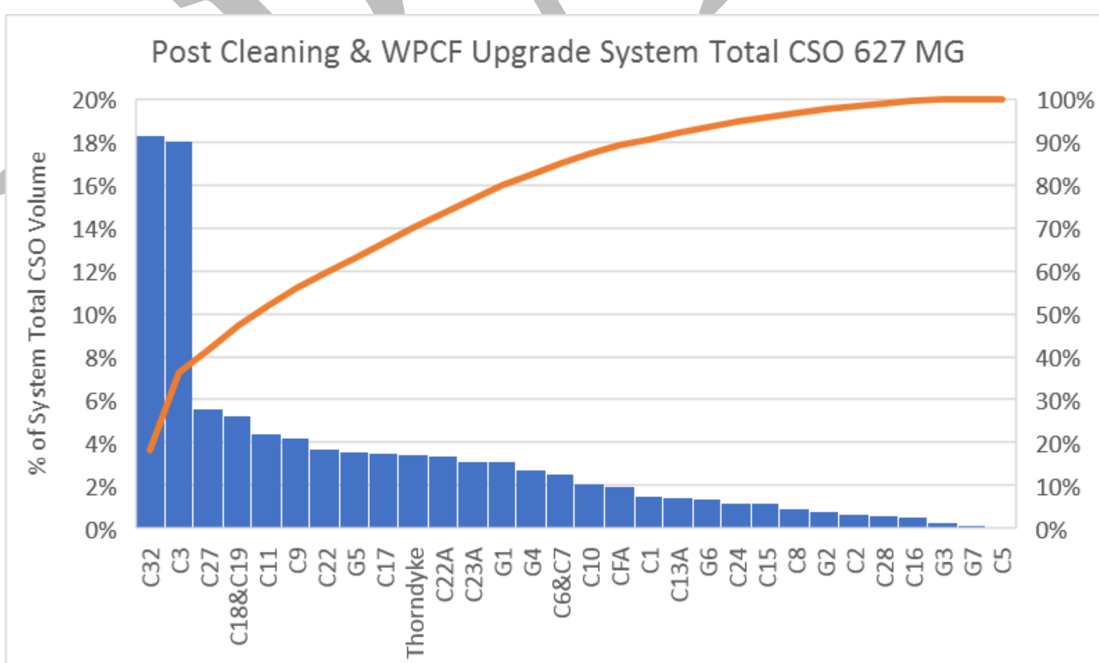

Figure 7-2 Percentage of System Total CSO for Each Outfall and Cumulative Distribution (Post Cleaning with WPCF Upgrade

Table 7-3 – Total Simulated Flooding by Outfall for the Typical Year

Rank	Outfall	Simulated Flooding/Year (MG/Year)[7-2]		
		Baseline Condition	Post Cleaning	Post Cleaning & WPCF Upgrade
1	C3	19.7	16.1	16.0
2	C17	8.1	8.1	7.7
3	C1	12.1	8.0	6.6
4	G1	4.9	4.9	4.9
5	C6&C7	1.8	2.0	1.6
6	C11	12.2	1.7	1.5
7	G4	1.3	1.3	1.3
8	C2	2.2	1.0	1.0
9	C32	0.8	0.8	0.8
10	C22	1.1	0.7	0.7
11	G5	0.5	0	0
12	C10	11.7	3.1	0
13	C24	2.0	0	0
14	G7	0.1	0	0
15	G2	0.02	0	0
16	C28	0.0	0	0
17	CFA	0	0	0
18	Thorndyke	0	0	0
19	C5	0	0	0
20	C8	0	0	0
21	C9	0.6	0	0
22	C13A	0.5	0	0
23	C15	0	0	0
24	C16	0	0	0
25	C18&C19	0	0	0
26	C22A	0	0	0
27	C23A	0	0	0
28	C27	2.2	0	0
29	G3	0	0	0
30	G6	0	0	0
Total		**82**	**48**	**43**
System Total		**90**	**50**	**44**

[7-2] When reviewing these flooding estimates it should be recognized that because the model only includes a relatively small sub-set of the combined sewer pipes, and does not model the smaller upstream pipes and catch basins, modeled flooding is not a comprehensive estimate of current flooding conditions in the combined sewer system.

CSO Frequency by Outfall

Simulated typical year CSO frequencies by outfall under the three scenarios are listed in Table 7-4, listed in ranked order for the Baseline Condition. Under the Baseline Condition, C13A has the least frequent overflows while outfall C6/C7 overflows most frequently. Cleaning the outfall pipes will result in increases in overflow frequencies at C1, C2, C3, C10, C11, C13A, and C16. Based on the sedimented segments in the Baseline Model, cleaning did not show significant impact at other outfalls in the simulations. Although the WPCF upgrade will result in significant reduction in CSO volumes at C1 through C13A, overflow frequencies will only drop for C1, C2, C5, C8, and C13A. C5 will have the fewest overflow events under the *Post-Cleaning with WPCF Upgrade* scenario while C6/C7 will remain the outfall with the most frequent overflows.

Table 7-4 – Ranked Order of CSO Frequency by Outfall for the Typical Year

Rank	Outfall	NJPDES Number	CSO Frequency/Year			Ownership	Receiving Water
			Baseline Condition	Post Cleaning	Post Cleaning & WPCF Upgrade		
5	C6&C7	012A	69	69	70	Camden	Delaware River
28	G5	005A	64	64	64	Gloucester	Delaware River
19	C27	028A	64	63	63	Camden	Cooper River
25	G2	002A	62	62	62	Gloucester	Delaware River
3	C3	009A	54	61	61	Camden	Delaware River
16	C22A	034A	60	61	61	Camden	Cooper River
11	C15	020A	59	59	59	Camden	Cooper River
24	G1	001A	59	59	59	Gloucester	Delaware River
13	C17	022A	58	58	58	Camden	Cooper River
7	C9	014A	57	57	57	Camden	Delaware River
15	C22	030A	55	54	54	Camden	Cooper River
27	G4	004A	54	54	54	Gloucester	Delaware River
17	C23A	025A	53	53	53	Camden	Delaware River
20	C28	029A	52	52	52	Camden	Cooper River
22	Thorndyke	033A	52	52	52	Camden	Cooper River
23	C32	040A	51	51	51	CCMUA	Delaware River
30	G7	007A	51	50	50	Gloucester	Newton Creek
29	G6	006A	47	47	47	Gloucester	Delaware River
14	C18&C19	024A	43	43	43	Camden	Cooper River
26	G3	003A	43	43	43	Gloucester	Delaware River
12	C16	023A	36	42	42	Camden	Cooper River
8	C10	015A	28	40	39	Camden	Delaware River
9	C11	016A	26	39	38	Camden	Delaware River
1	C1	007A	34	45	35	Camden	Newton Creek

Rank	Outfall	NJPDES Number	CSO Frequency/Year			Ownership	Receiving Water
			Baseline Condition	Post Cleaning	Post Cleaning & WPCF Upgrade		
18	C24	026A	28	28	28	Camden	Delaware River
21	CFA	005A	23	23	23	Camden	Newton Creek
6	C8	013A	44	41	22	Camden	Delaware River
10	C13A	018A	10	28	22	Camden	Delaware River
2	C2	008A	40	43	17	Camden	Delaware River
4	C5	010A	46	45	5	Camden	Delaware River
	Min Frequency		10	23	5		
	Max Frequency		69	69	70		

CSO Volume and Frequency By System Owner and Receiving Water

CSO volume and frequency are summarized by system ownership in Table 7-5. Camden's system, with 22 of the 30 active CSO outfalls, contributes about 75% of the CSO volume system wide. CCMUA's only CSO outfall (C32) makes up about 15% of the total system volume. The 7 CSO outfalls in Gloucester's system contribute the remaining 10%.

Overflow frequencies are not significantly different among the outfalls owned by the three different entities. System cleaning and WPCF upgrade only will impact (reduce) the lower end of the frequency range in the Camden system.

Table 7-5 - Summary of Typical Year CSO Volume and Frequency by System Owner

System Owner	Annual CSO Volume (MG/Yr)			Range of CSO Frequency		
	Baseline Condition	Post Cleaning	Post Cleaning & WPCF Upgrade	Baseline Condition	Post Cleaning	Post Cleaning & WPCF Upgrade
Camden	637.8	664.2	436.3	10 - 69	23 - 69	5 -70
Gloucester	76.7	75.8	75.9	43 - 64	43 - 64	43 - 64
CCMUA	114.5	114.7	114.7	51	51	51
Total	829	855	627			

A similar summary for CSO volume and frequency by receiving water is shown in Table 7-6. The Delaware River receives overflow from 18 outfalls which together account for 73% of the total system CSO volume. These include the two CSO outfalls with the largest annual volumes (C3 and C32). There are 9 outfalls which discharge to the Cooper River and their total annual discharge is about 9% of the system total volume. The largest contributors to the Cooper River are C18/C19 and C27, each with more than 30 MG in the typical year. Only 3 outfalls discharge into Newton Creek, with 3% of the system total annual CSO volume. Among these three outfalls, either C1 or CFA is the largest contributor depending on the scenario.

Table 7-6 - Summary of Typical Year CSO Volume and Frequency by Receiving Water

Receiving Water	Annual CSO Volume (MG/Yr)			Range of CSO Frequency		
	Baseline Condition	Post Cleaning	Post Cleaning & WPCF Upgrade	Baseline Condition	Post Cleaning	Post Cleaning & WPCF Upgrade
Delaware River	625.5	637.9	432.6	10 - 69	28 - 69	5 - 70
Cooper River	171.3	169.7	171.3	36 - 64	42 - 63	42 - 63
Newton Creek	32.2	47.1	23	23 - 51	23 -50	23 - 50
Total	829	855	627			

Percentage Capture by Outfall

The percentage capture for the typical year is listed by outfall in Table 7-7. It should be noted that the percentage capture calculation cannot be applied to outfalls that are located directly on the interceptor, as opposed to those on a trunk sewer, as there is no specific sewershed that can be associated with interceptor outfalls. This applies to C19 and G6, and these two outfalls have therefore been omitted from the table.

The percentage capture calculation needs to be modified where interconnections exist upstream from multiple regulators. There are a number of sewersheds in Camden that are interconnected, and two groups of outfalls drain these sewersheds: (1) C22A and C23A, and (2) C22, C27, and Thorndyke. A composite percentage capture was calculated for each of these two groups of regulators/outfalls.

At the bottom of Table 7-7 the number of outfalls/groups with particularly low capture (less than 50%) and with particularly high capture (greater than 85%) are indicated. Figure 7-3 illustrates the percentage captures at these 26 outfalls/groups by sorting the Baseline capture from the lowest to the highest. Changes in percentage capture between the *Baseline Condition* and the *Post Cleaning with WPCF Upgrade* scenarios are also shown in Figure 7-3.

Table 7-7 – Percentage Capture by Outfall/Outfalls for the Typical Year

Rank	Outfall	NJPDES Number	Percentage Capture		
			Baseline Condition	Post Cleaning	Post Cleaning & WPCF Upgrade
4	C5	010A	27%	53%	99%
2	C2	008A	77%	75%	96%
10	C13A	018A	93%	72%	90%
8	C10	015A	24%	52%	88%
14	C18	024A	87%	87%	87%
17	C24	026A	87%	86%	86%
19	CFA	005A	86%	86%	86%
23	G3	003A	85%	86%	85%
1	C1	007A	68%	57%	83%
6	C8	013A	55%	62%	82%
5	C6 & C7	012A	48%	56%	80%
12	C16	023A	83%	79%	79%
18	C28	029A	79%	78%	78%

Rank	Outfall	NJPDES Number	Percentage Capture		
			Baseline Condition	Post Cleaning	Post Cleaning & WPCF Upgrade
9	C11	016A	59%	51%	77%
15	C22/C27 / Thorndyke	030A/028A/ 033A	73%	73%	73%
24	G4	004A	69%	73%	73%
26	G7	007A	68%	68%	68%
20	C32	040A	63%	63%	63%
3	C3	009A	54%	50%	61%
7	C9	014A	47%	52%	61%
21	G1	001A	63%	60%	60%
11	C15	020A	54%	54%	54%
16	C22A/C23A	034A/025A	53%	55%	54%
25	G5	005A	54%	53%	53%
13	C17	022A	36%	38%	38%
22	G2	002A	27%	18%	17%
	<50%		6	2	2
	>85%		5	4	8

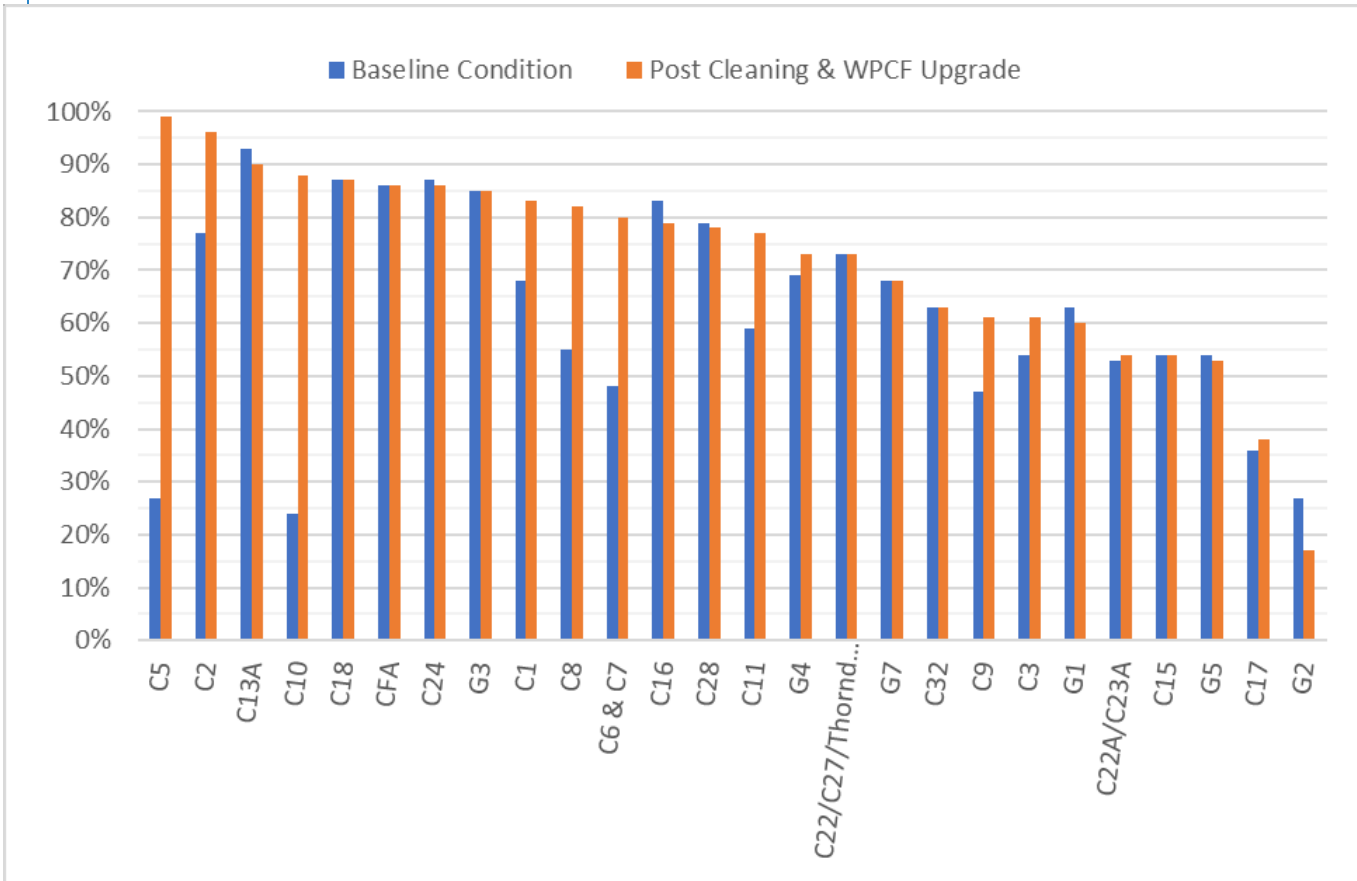

Figure 7-3 Percentage Capture of 26 Outfalls and Outfall Groups

Examination of Table 7-7 and Figure 7-3 reveal the following observations:

- C10 has the lowest baseline percentage capture (24%) and the third largest annual total CSO discharge volume under the Baseline Condition (75 MG; see Table 7-2). These conditions are largely due to two factors: (1) operations at the Arch Street Pump Station, which shut down pumping during storm event peaks; and (2) heavy sedimentation in the vicinity of C11 and C10, both in the outfall pipes and the trunk sewers. After sewer cleaning, and WPCF upgrade which will allow the Arch Street Pump Station to continue pumping during storm peaks, percentage capture at C10 will increase dramatically to 88% with only 13 MG CSO discharge volume for the typical year.
- The WPCF upgrade simulations showed significant increase in percentage capture at C1 through C13A along the Delaware Avenue Interceptor, but showed no significant impact on any other outfalls/groups. The percentage capture at C2, C5, and C10, will exceed 85% with the WPCF upgrade, up from values well below that level in the other two scenarios.

- With the WPCF upgrade, eight of the 26 outfalls/groups listed in Table 7-6 will have percentage capture higher than 85%, and only 2 will have lower than 50% capture.

7.2.3 Sewersheds Associated with Potential Sensitive Areas

As described in Section 4.3 of this document, portions of the Cooper and Delaware Rivers have been identified by NJDEP as locations for one or more occurrences and meeting the habitat requirements of several freshwater mussel species. In addition, Zone 3 of the Delaware River has been identified having one or more occurrences and of meeting the habitat requirements for the Shortnosed and Atlantic Sturgeon, federally listed species. The performance under *Post Cleaning with WPCF Upgrade* for the outfalls discharging upstream of or adjacent to the identified potential sensitive areas are provided on Table 7-8.

Table 7- – Camden CSO Outfalls Associated with Potential Receiving Stream Sensitive Areas

Outfall		Projected Annual CSO Statistics (Post Cleaning with WPCF Upgrade)		
		Volume (MG/yr)	% Capture	Annual Events
1	C10	13.0	88%	39
2	C11	27.8	77%	38
3	C15	7.4	54%	59
4	C16	3.6	79%	42
5	C17	21.9	38%	58
6	C19	25.9	77%	43
7	C22	28.3	88%	54
8	C22A	21.4	52%	61
9	C23A	19.4	56%	53
10	C24	7.6	86%	28
11	C27	35.0	53%	63
12	C28	3.9	78%	52

7.3 Combined Sewer System Flooding Analysis

Overflows from the combined sewer system occur both as discharges at CSO outfalls and as flooding at various locations within the sewer system. The goal of the CCMUA / Camden / Gloucester Long Term Control Plan is to address both sources of overflows and to integrate street flooding mitigation with CSO control in the LTCP. This will require an evolving understanding of the interrelated causes of street flooding. These include physical obstructions to catch basin inlets entering the municipal combined sewer collection systems, hydraulic impediments within the collection systems, e.g. gravel and sediment deposits reducing pipe capacity, inadequate design hydraulic capacities intrinsic to the pipes, e.g. pipe diameter and slope that are inadequate to convey peak stormwater flows, and high tide conditions.

7.3.1 Flooding Locations

Anecdotal street flooding locations in Camden were available from three sources: (1) historical knowledge from City of Camden, (2) investigations by Remington and Vernick, and (3) traffic reports obtained through online search. The cross streets at these locations were incorporated into GIS data, which enables visualization of these locations in a map format as well as enabling comparison with model simulated flooding locations. Although these anecdotal flooding locations are helpful, this information does not include the time, magnitude, and frequency of the flooding nor the cause of it. Therefore the anecdotal flooding information cannot be correlated with specific rainfall events and can only be referenced for the location information when comparing to modeled flooding in Camden. No flooding information is available from Gloucester.

American Water (AM), the operator for Camden's sewer system, provided an overview map of the locations in Camden where recurrent flooding had been reported. In AM's Wastewater System Flood Mitigation Plan (May 2016) an initial assessment of flooding was made and proposed preliminary investigations where necessary.

As detailed in Section 5 of this document, the Baseline Condition Model focuses on the interceptor sewers and related appurtenances such as the regulator structures. Generally, the model does not extend into the local sewers in the upstream portions of the individual sewersheds and thus cannot predict flooding in these portions of the system. Where a flow meter exists (usually at the downstream end of a sewershed), the upstream hydrology and hydraulics in the model are calibrated to reproduce the metered flow, depth, and velocity at the metered location. This will enable the model to properly simulate flooding within the model extent, but the model cannot simulate upstream flooding unless or until those portions of the system are explicitly represented in the model.

A comparison among the anecdotal flooding locations, American Water flooding hot spots and simulated flooding in Camden are shown in Figure 7-4. In general, the modeled flooding occurred near where flooding was reported anecdotally within the model extent. The only area within the model extent without simulated flooding was around sewersheds C90-2, C90-3, and C90-4. Due to the limitations of the anecdotal information, the model extent, and the flow meter locations, only relative location can be inferred from this comparison. The simulated flooding locations were usually consistent among the three scenarios.

Although the simulated flooding volumes have a high degree of uncertainty, the relative change among the three different scenarios reasonably demonstrate the impacts of different system improvements. As was shown in Table 7-1, cleaning will have significant impact on

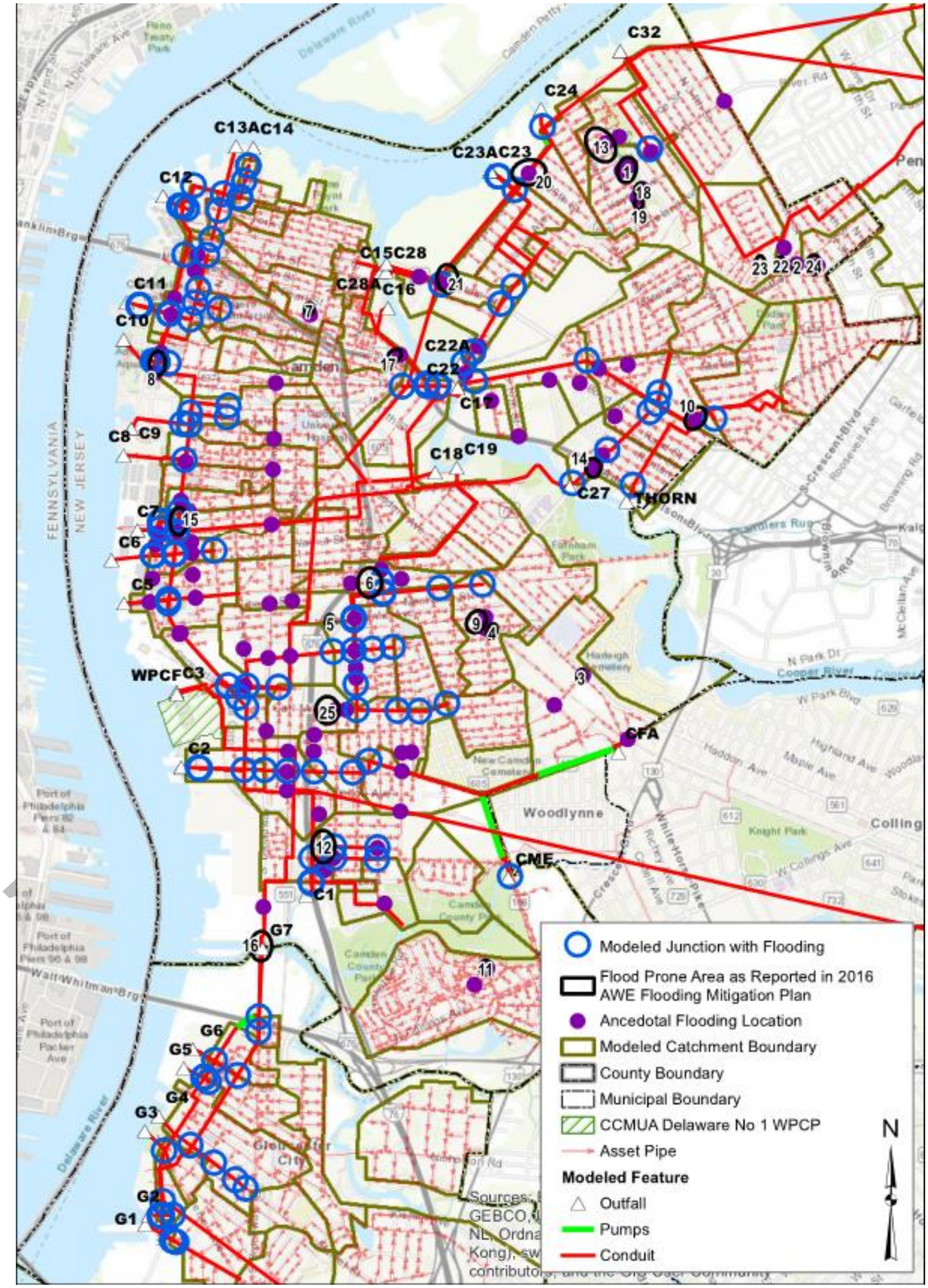

Figure 7-4 – Comparison of Anecdotal and Simulated Flooding Locations flooding reduction. The WPCF upgrade will result in only limited flooding reduction along the Delaware Avenue and Second Street Interceptors.

The impact of tidal conditions on flooding was estimated with the model for the *Post Cleaning with WPCF Upgrade* scenario. Simulated flooding was reduced by 25% when tidal conditions were removed from the model, which would allow the CSO outfalls to freely discharge at all times.

Two flooding information collection efforts were initiated recently by two entities. The Camden Smart Program developed a web application[7-3] which allows citizens to report flooding in real time. Through March 2018, three reports were recorded with date/time and street address. This application will provide important information for correlating flooding with specific storm events, which can be used to validate the model in the future. The other entity, Drexel University, recently developed a similar web application to collect voluntary flood reporting in the Cramer Hill neighborhood.[7-4] Their dependence on voluntary reporting from citizens will limit the completeness of the number of flooding events and comprehensiveness of the information reported for each event, but useful information may still be generated. A more systematic and comprehensive recording process to document flooding incidents could be implemented in the future to support the calibration and validation of simulated flooding, to identify potential future model expansion into upstream areas of the system, and to identify priorities for corrective actions

7.3.2 Interceptor Surcharge

Pipe capacity limitations in both the combined sewer trunks and in the interceptors can lead to flooding, and the latter condition is discussed further in this section. The pipes with simulated flow exceeding the design capacity of the pipe are colored in red on Figure 7-5 to show surcharge in the system. The locations of the surcharged pipe segments correspond to simulated flooding locations. After sewer cleaning and WPCF upgrade, surcharge conditions in the system will be relieved as indicated by the reduced simulated flooding volume from 90 million gallons to 44 million gallons during the typical year as was shown in Table 7-1.

Figure 7-6 demonstrates the changes in hydraulic grade line (HGL) along the Second Street and Delaware Avenue Interceptors. The red line is taken from the *Baseline Condition* simulation and blue is from *Post Cleaning with WPCF Upgrade*. Both sediment removal and WPCF upgrade relieve surcharge in this section of the system. The relief in surcharge was not as significant in other parts of the system. The depth in the WPCF influent wet well will increase during large storms due to the unimpeded flow from Camden (at the Arch Street Pump Station). This may affect the HGL in the Cooper River Interceptor depending on the ultimate design details. This issue will be evaluated in more details during the alternatives analysis.

[7-3] http://camdenreports.com/

[7-4] https://survey123.arcgis.com/share/c1adb7424d8c4e418bf44a77f85e2efc

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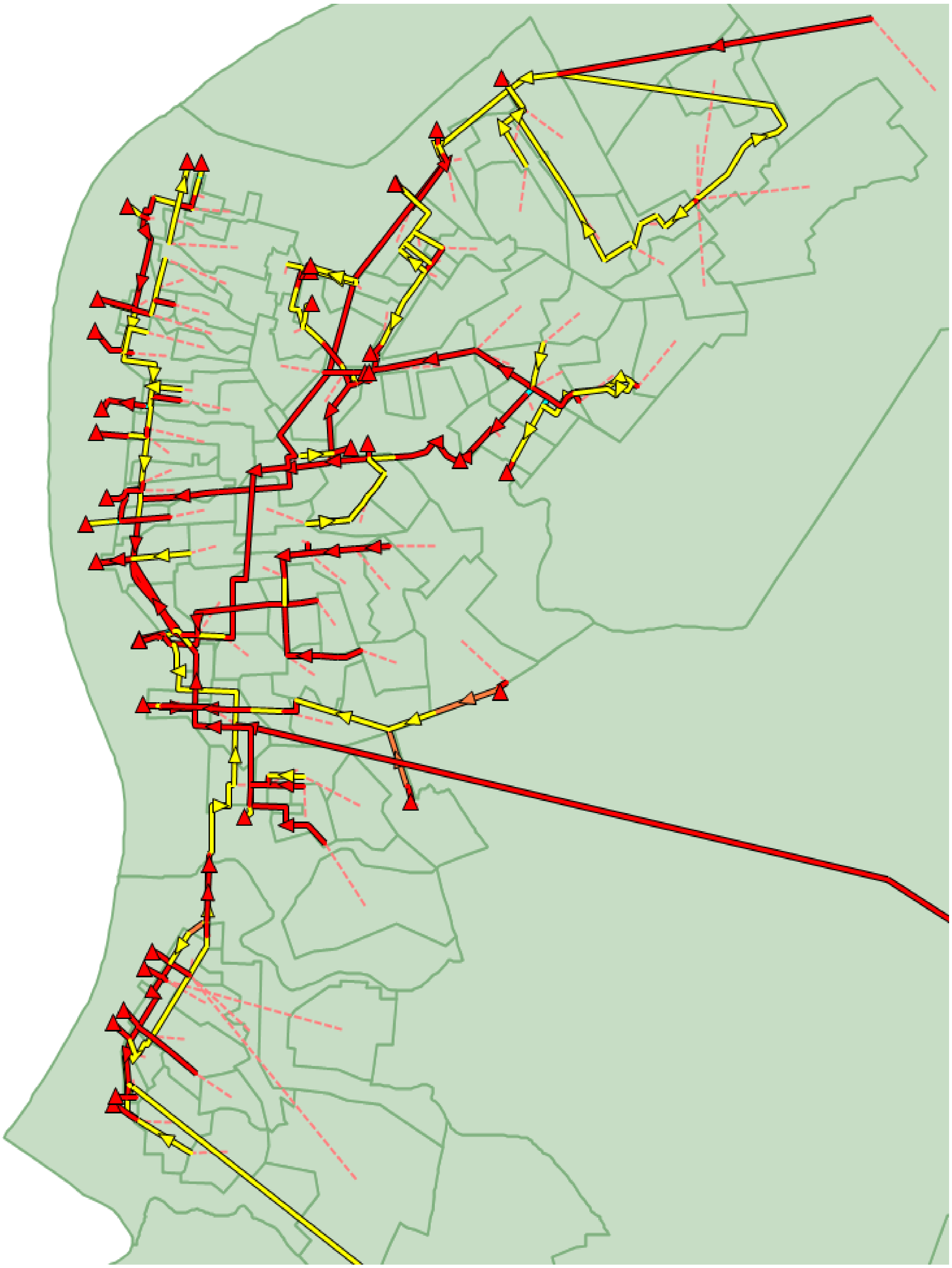

Figure 7-5 System Wide Surcharge under Post Cleaning with WPCF upgrade

CDM Smith

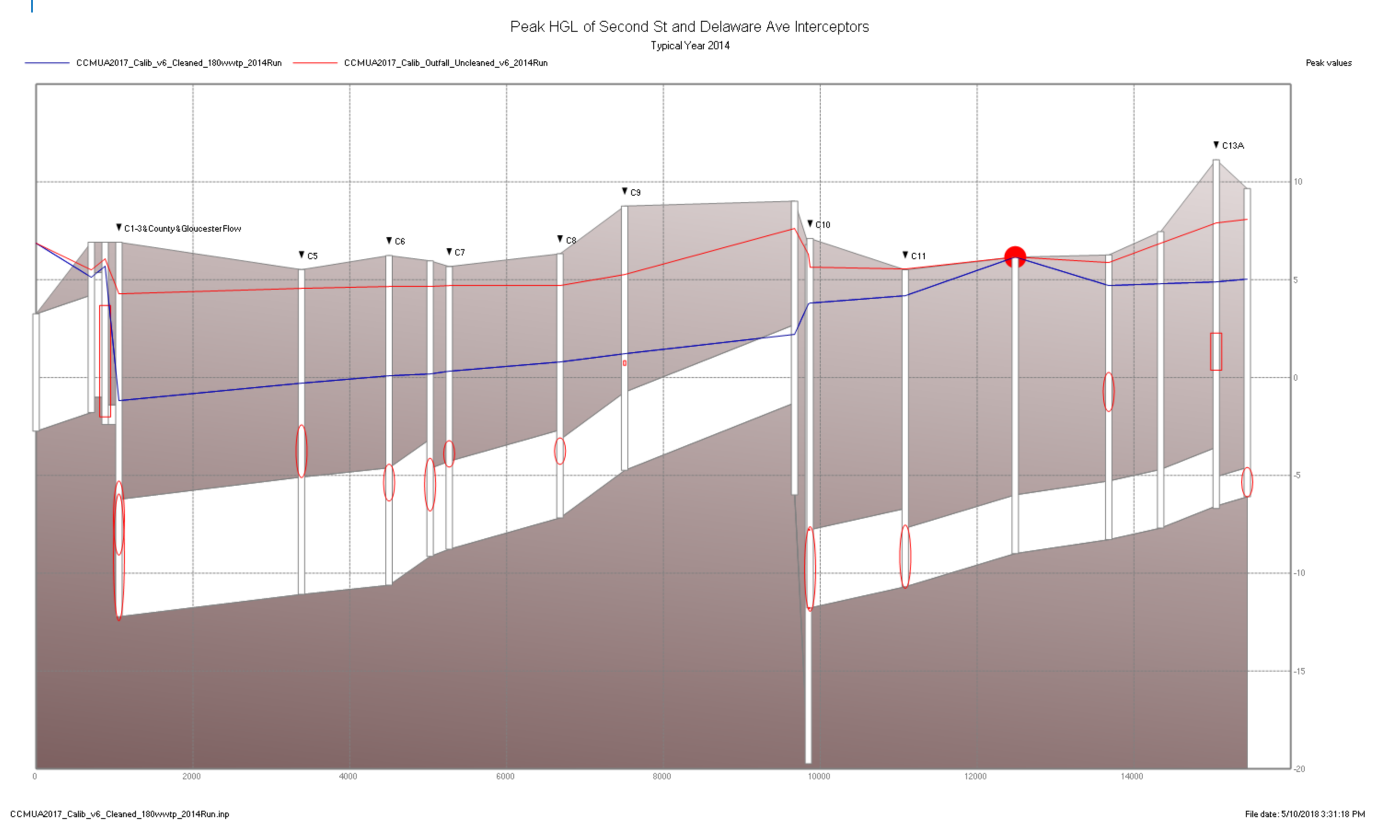

Figure 7-6 Peak HGL during Typical Year 2014. Red Line – Baseline Conditions, Blue Line – post cleaning and WPCF No. 1 Capacity Expansion.

7.4 Combined Sewer System Performance Conclusions

Based on the analyses presented above, the following overall conclusions are offered as to the baseline and projected near term performance of the combined sewer system:

1. The combined sewer system under baseline conditions discharges approximately 829 million gallons at the CSO outfalls during the typical year. This CSO volume corresponds to capture of around 68% of the wet weather flow generated within the combined system during the typical year.
2. Two ongoing efforts, (1) cleaning of the Camden sewer system and outfalls to restore design hydraulic capacities and (2) expansion of the wet weather treatment capacity at CCMUA's WPCF No. 1 to 185 MGD, are projected to result in an increase in system-wide capture to 76% and the corresponding reduction in annual overflow volume of roughly 200 million gallons from 829 million to 627 million gallons. Further improvements to the wet weather performance of the system could be achieved with additional expansion of wet weather treatment capacity at WPCF No. 1 as described in Section 2.5.3.

3. These two efforts are also projected to reduce predicted surface flooding in the modeled system by more than 50%, from around 90 million gallons to 44 million gallons, during the typical year.
4. CSO volume is not evenly distributed throughout the combined sewer system. Two of the 30 outfalls in the system (C-3 and C-32) discharge 30% of the CSO volume during the typical year. These, together with C-6/C-7, C-10 and C-11 discharge around 50% of the total annual overflow volume under the Baseline Condition.
5. Under Baseline Condition, capture rates by sewershed range from 24% (C-10) to more than 90% (C13-A). With the expansion of WPCF No.1 and the elimination of the need for the Arch Street Pump Station to be throttled back during wet weather events, the projected capture rate for C-10 will increase dramatically to 88%.
6. Although it is premature to assume that the presumptive approach target of 85% capture (by volume) will be applied during the evaluation and selection of alternatives, this threshold does serve as useful benchmark for characterizing combined sewer system performance. It is noted that after completion of the ongoing sewer cleaning and WPCF upgrade efforts, current modeling results show this level of capture will be achieved at 8 of the 30 outfalls in the system.
7. The changes in overflow volumes, capture percentages and surface flooding statistics between the *Baseline Condition* and the *Post-Cleaning and WPCF Upgrade* scenarios have been estimated by the model using the best available data. Follow-up flow monitoring and model refinement may to be performed after completion of the ongoing sewer cleaning and WPCF upgrade efforts to provide an updated characterization of system performance in to support of adaptive management during the LTCP implementation process.

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Section 8 Revised 06/27/18

Institutional Context

8.1 Roles & Responsibilities

8.1.1 System Ownership, Operation and Maintenance Responsibilities

The Cities of Camden and Gloucester own their respective municipal sewerage consisting of primarily combined collection systems and sanitary collection systems and stormwater collection and conveyance systems in limited areas of each municipality. The combined sewer portions of their collection systems are operated under permits NJ0108812 (Camden) and NJ0108847 (Gloucester). The Camden County Municipal Utilities Authority (CCMUA) provides wastewater conveyance and treatment services for Camden and Gloucester along with thirty-five suburban municipalities within Gloucester County. CMUA's one CSO associated with the C-32 regulator structure upstream of the Baldwin's Run pump station operates under permit number NJ0026182. The two combined sewered municipalities are responsible for the operation and maintenance of their respective systems.

8.1.2 Camden Operations and Maintenance

Operation and maintenance for the City of Camden is provided under contract by the American Water Contract Services division of the American Water Company under a ten year contract extending through 2025. The contract operator is obliged through the service agreement with the City of Camden to implement the City's 2014 Best Management Practices Plan (BMPP).[8-1] The City's BMPP is provided as Appendix H and is incorporated by reference as a component of this Systems Characterization Report. As such, the full implementation of Camden's BMPP will be assumed as a baseline condition for purposes of the development of CSO controls in the joint LTCP including the restoration and maintenance of the hydraulic capacities of the Camden collection sewers, regulators, outfalls and other appurtenances.

Included in the BMPP is the requirement that the entire combined sewer, separate sewer separate stormwater system, and outfalls be cleaned within the first five years of the operating contract with priority being given to areas of flooding, basement backups and existing pipes that contain debris. Thereafter, the entire system must be cleaned out in three-year cycles.[8-2]

The BMPP includes provisions for preventive maintenance and pollution prevention[8-3] relating to the limitation of grit and sediment deposition in the collection sewers.

8-1 Best Management Practices Plan for the Operation and Maintenance of the Combined Sewer, Separate Sanitary Sewer and Separate Stormwater Systems prepared for the City of Camden in December of 2014 by Greeley and Hansen.

8-2 Op-Cit. Greeley-Hansen Section 3-9.

8-3 Number 7 of the "Nine Minimum Controls" required under the 1994 CSO Control Policy (59 FR 18691)

These include monthly street sweeping.[8-4] The BMPP called for the cleaning of all catch basins within the first year of the operating contract and for quarterly catch basin inspection and the immediate cleaning of any debris, litter or other obstructions that may be blocking the openings or bottoms of the basins or connecting pipes.[8-5]

Also included in the BMPP is a Flood Mitigation Plan[8-6] intended to identify those areas most prone to flooding as well as basement backups. The Flood Mitigation Plan is to develop strategies to prevent flooding and basement backups using standard design storms (10-year storm, 20-year storm, etc.). Flood and basement backup mitigation strategies requiring major improvements to the systems that are developed as part of the plan shall be included in the City's Capital Improvement Program (CIP). Any repairs, maintenance, or cleaning of sewers and/or catch basins that will reduce flooding and/or basement backups are to be completed immediately.

8.1.3 Gloucester Operations and Maintenance

The Gloucester collection system is operated and maintained by the City's Department of Environmental Utilities. The Department operates and maintains its combined sewer system pursuant to its NJPDES permit[8-7] which under Section F imposes requirements paralleling those applicable to the City of Camden. Key permit requirements in the context of collection sewer operation and maintenance include:

- The implementation and annual update of an O&M Program as documented through its O&M manual;
- Visual inspections to provide reasonable assurance that unpermitted discharges, obstructions, damage and dry weather overflows are detected;
- To provide a gravity sewer and catch basin inspection and cleaning schedule;
- To provide a system for tracking and documenting residential complaints concerning blockages, basement and street flooding, etc.;
- Timely removal of obstructions or blockages contributing to overflows due to debris, fats, oils and grease, and sediment buildups; and to
- Minimize the introduction of sediment and obstructions into the collection system.

Additional details as to Gloucester City's compliance with these requirements are documented in its Standard Operating Procedures, Preventive Maintenance and Emergency Response manual.

8-4 Greeley-Hansen BMPP Section 3.2 *Street Sweeping*

8-5 Greeley-Hansen BMPP Section 3.3 *Catch Basin Inspection and Cleaning*

8-6 Greeley-Hansen BMPP Section 2-23.

8-7 NJ0108847 effective October, 2015

8.2 Legal Framework

8.2.1 Cities of Camden and Gloucester

The Camden and Gloucester combined sewer systems are owned and operated by the cities pursuant to Title 40A of New Jersey Statutes (Municipalities and Counties). New Jersey municipalities are authorized and empowered to:

- "…acquire, construct, improve, extend, enlarge or reconstruct and finance sewerage facilities and to operate, manage and control all or part of these facilities and all properties relating thereto…"
- "To issue bonds of the local unit or units to pall all or part of the costs of the purchase, construction, improvement, extension, enlargement or reconstruction of sewerage facilities";
- "To make and enter into all contracts and agreements necessary or incidental to the performance…";
- "To fix and collect rates, fees, rents and other charges…"
- "To prevent toxic pollutants from entering the sewerage system.";
- "To exercise any other powers necessary or incidental to the effectuation of the general purpose of N.J.S.40A:26A-1 et seq."[8-8]

The financial management of the cities' combined sewer systems are regulated under Chapter 4 of Title 40A. Municipalities are required to establish public utility funds to isolate sewer system costs and revenues from the municipal general funds:

> "All moneys derived from the operation of publicly owned or operated utility or enterprise and any other moneys applicable to its support, shall be segregated by the local unit and kept in a separate fund which shall be known as "utility fund" and shall bear a further designation identifying the utility or enterprise and, except as provided in section 40A:4-35, shall be applied only to the payment of the operating and upkeep costs, and the interest and debt redemption charges upon the indebtedness incurred for the creation of such utility or enterprise."[8-9]

The annual budgets for municipal sewerage systems are controlled through the Local Budget Law, codified at N.J.A.40A:4-1 et seq. Annual operating, debt service, revenue and five-year capital improvement budgets are developed using forms and excel templates specified by the New Jersey Department of Community Affairs. The draft budgets are reviewed and approved by the Department prior to final adaption of the budget by the municipalities prior to the start of the fiscal year.

8-8 N.J.S.40A:26A-1 et seq. Municipal and County Sewerage Act.

8-9 N.J.S.40A:4-62

8.2.2 Camden County Municipal Utilities Authority

CCMUA owns and operates its regional conveyance interceptor system and the Water Pollution Control Facility # 1 under the New Jersey Municipal and County Utilities Authorities Law.[8-10] Municipal Utility Authorities are empowered to provide water, wastewater, solid waste and hydroelectric power generation and distribution services in a defined service area (district). These services may be provided directly to end-user properties (retail services) or indirectly through service contracts with the municipalities. CCMUA provides wholesale wastewater conveyance and treatment to Camden, Gloucester and the other municipalities within its service area under the terms of the Service Agreement of December 1986 with its participant municipalities. Under the terms of the Service Agreement the participant municipalities are individually responsible for the operation, maintenance, expansion and replacement of their local collection systems.[8-11] CCMUA has the option at its sole discretion but not the obligation to address inflow and infiltration on a regional basis where cost-effective.[8-12]

Municipal utility authorities have broad powers to acquire, build, own, be the lessor or lessee, operate and maintain wastewater and other public works systems.[8-13] They can finance capital improvements through revenue bonds. With the exception of retail services provided outside of their geographic districts, municipal authorities can set wholesale and retail rates (as applicable) without review by the New Jersey Board of Public Utility Commissioners. The annual budget process for municipal utility authorities is proscribed in the Local Authorities Fiscal Control Law[8-14] and closely parallels that used by municipal governments under the Local Budget Law.

8.3 Implementation of the Nine Minimum Controls

The USEPA's Combined Sewer Overflow Control Policy establishes nine broad operation and maintenance and minor construction best practices intended to ensure that a municipal permittee's combined sewer system is being optimized.[8-15] The requirement to fully implement the nine minimum controls is incorporated into Section F of their respective NJPDES permits. Provided on Table 8-1 is a summary of the implementation status for CCMUA, Camden and Gloucester.

Table 8-1 also lists additional commitments to optimizing the current combined sewer system that the three permittees are making at this time. CCMUA, Camden and Gloucester understand that restoring and optimizing the current combined sewer system's design hydraulic capacity is a critical and integral component of any suite of CSO control strategies that will be evaluated during the remaining development of the joint LTCP. CCMUA's

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8-10 N.J.S.40:14B-1 et seq.

8-11 Section 502 – Operation and Maintenance of the Local Sewerage System

8-12 Section 503 – Authority's Option to Correct Infiltration and Inflow.

8-13 N.J.S.40:14B-20 (Powers)

8-14 N.J.S.40A:5A-1 et seq.

8-15 59 FR 18691

commitment to this foundational concept evidenced by its current wet weather treatment capacity projects at its Water Pollution Control Facilities # 1, which is occurring well before the completion of the joint LTCP. This expansion will significantly enhance Camden and Gloucester abilities to maximize wet weather flow to the POTW (NMC 4). It must be noted that the scale and costs of the expansion of the wet weather capacity at the treatment facility significantly exceed the vision of minimum controls as involving "minor construction activities".[8-16]

Table 8-1 – Summary Status of the Nine Minimum Control Implementation

NMC		CCMUA	City of Camden	City of Gloucester
1	***Proper Operation & Regular Maintenance***			
	Current Practice	• Comprehensive operating procedures • Wet weather operational procedures implemented • Comprehensive parts inventory and preventive maintenance system in place • Daily inspection of pump-stations and other remote facilities. • Remote monitoring through SCADA system.	• Established <u>Best Management Practices</u> for City's sewer systems. • 10 year contract operations & maintenance agreement with American Water Contract Services • Cleaning of the entire collection system within the first five years of the 2016 O&M contract. • Subsequent inspection and cleaning of 33% of collection system sewers annually.	• Collection system operated and maintained by City Environmental Utilities Department • Established standards of practice, preventive maintenance program and emergency response procedures,
	Additional Commitments	• Continue to look for cost-effective regional inflow/infiltration opportunities.	• Catch basin cleaning per the Camden PMPP • Completion of Regulator Rehabilitation Project. • Improved wet weather operation through new SCADA system	• Collection system inspection and cleaning as necessary to maintain hydraulic capacity every three years.
2	***Maximum Use of Collection System for Storage***			
	Current Practice	As documented in the Cities' respective NMC Plans, the physical configurations of the Camden and Gloucester collection sewers and interceptor sewer lines preclude significant wet weather storage.		

[8-16] 59 FR 18691: "Permittees with CSOs should submit appropriate documentation demonstrating implementation of the nine minimum controls, including any proposed schedules for completing ***<u>minor</u>*** (emphasis added) construction activities."

NMC		CCMUA	City of Camden	City of Gloucester
	Additional Commitments	Not Applicable	• Collection system cleaning will restore what limited storage capacity may exist. • New SCADA system may provide opportunities for system optimization	
	Review & Modification of Pretreatment Requirements			
3	Current Practice	• NJDEP approved Industrial Pretreatment Program. • Applies to all categorical and non-categorical Significant Indirect Users. • Monthly or quarterly Industrial Discharge Monitoring Reports • Encourage significant industrial users to reduce discharges to the sewer system during wet weather where feasible.	Support CCMUA's Industrial Pretreatment Program	
	Maximization of Flow to the POTW for Treatment			
	Current Practice	Current wet weather flow to CCMUA's Water Pollution Control Facility #1 is limited due to the hydraulic limitations of the plant influent junction chamber, influent pumping capacities and current configuration of the primary and secondary treatment process train.		
4	Additional Commitments	CCMUA is currently implementing the following capital improvement projects at the WPCF # 1: • Reconfiguration of the plant influent junction chamber to isolate flows from the Camden Delaware River interceptor from the CCMUA Big Timber and Cooper River interceptors. This will reduce the need to throttle back flow rates from Camden's Arch Street pump station during wet weather. • The expansion of plant influent fixed pumping capacity from 150 MGD to 180 MGD (one pump out of service). • The reconfiguring of the primary treatment process train to enable the bypassing of secondary treatment during wet weather, thereby increasing plant wet weather capacity to 185 MGD. • Evaluation of the expansion of the wet weather treatment capacity beyond 185 MGD by utilizing available primary treatment capacity. • The enhancement of backup power capabilities at the treatment plant with the goal of energy self-sufficiency.		

	NMC	CCMUA	City of Camden	City of Gloucester
5	***Prohibitions of CSOs During Dry Weather***			
	Current Practice	• Preventive maintenance program • Inspection of regulators after rain events		
6	***Control of Solids & Floatables***			
	Current Practice	½” Netting facilities installed at CCMUA’s sole CSO outfall (C-32)	Twenty-two ½” netting facilities have been installed.	½” Netting facilities installed at Gloucester’s seven CSO outfalls.
	Additional Commitments	Removal and replacement of nets after each activation event as necessary to maintain design performance.		
7	***Pollution Prevention***			
	Current Practice	CCMUA support of and participation in more than 60 green stormwater infrastructure projects within the combined sewered service area to date.	• Street sweeping program • Leaf collection program • Pollution prevention flyer available from Camden / AWCS web site. • Household hazardous waste collection	• Street sweeping program? • Leaf collection program? • Public information • Household hazardous waste collection
	Additional Commitments	Continued support for GSI projects and initiatives.	Revision to City redevelopment ordinance(s) requiring sewer separation and green stormwater infrastructure or other source reduction for redevelopment projects receiving City, County or State technical, in-kind or financial support.	Revision to City redevelopment ordinance(s) requiring sewer separation and green stormwater infrastructure or other source reduction for redevelopment projects receiving City, County or State technical, in-kind or financial support.
8	***Public Notification***			
	Current Practice	• Signage at C-32 • C-32 overflow status provided on Authority’s web site.	Signage at outfalls	Signage at outfalls
9	***Monitoring to Characterize CSO and Control Efficacy***			
	Current Practice	• Outfall inspection • Overflow durations tracked using storm intensities and durations and reported in monthly discharge monitoring reports.		

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