Fort Lee Sewer System Characterization Report

Submitted on behalf of the following participating Permittee by the

Borough of Fort Lee

NJPDES Number NJ0034517 (Borough of Fort Lee)

NJPDES 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."

Permittee: ____________________________
Alfred R. Restaino, Borough Administrator

Date: 6-28-18
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Executive Summary

The Borough of Fort Lee along with the City of Hackensack and the Village of Ridgefield Park own and operate combined sewer systems that are tributary to the Bergen County Utilities Authority (BCUA) Water Pollution Control Facility (WPCF) located in Little Ferry. The BCUA WPCP also receives wastewater from 44 other communities that have separate sewer systems.

The New Jersey Department of Environmental Protection issued New Jersey Pollutant Discharge Elimination Permits (NJPDES) to all municipalities/authorities in 2015 that own and/or operate combined sewer systems and authorities that provide wastewater transport and/or treatment services to municipalities with combined sewer systems. The Borough of Fort Lee owns and operates the sewer system that transports combined flows to the BCUA interceptor. The combined portion of the sewer system is composed of three pump stations:

- Palisade Terrace Pumping Station;
- Lower Main Pump Station; and
- Bluff Road Pump Station.

During wet weather flows in excess of the pump stations capacity overflow to two netting systems located at Bluff Road serving the Bluff Road overflow and Palisade Terrace serving the Palisade Terrace and Lower Main overflows under NJPDES Permit No. 0034517 which was issued on July 1, 2015. The permit sets certain requirement and ultimately requires that a Long Term Control Plan be developed by June 1, 2020.

Fort Lee belongs to two cooperative CSO groups, the BCUA CSO Group made up of BCUA, Fort Lee, Hackensack and Ridgefield Park, and the NJ CSO Group organized by the Passaic Valley Sewerage Commission (PVSC) and made up of 18 CSO permittees. CSO permit requirements are being complied with by Fort Lee individually and with these cooperative groups through work share agreements.

One of the permit requirements for Fort Lee is the preparation and submission of a Sewer System Characterization Report by July 1, 2018 which this report transmits. The permit also requires development and submission of the LTCP and several other supporting documents. To date these documents have been prepared and submitted a by Fort Lee, the BCUA CSO Group and the NJ CSO Group.

While the members of the BCUA CSO Group have agreed to complete a Regional Sewer System Characterization Study and CSO LTCP, most of the work will be completed separately and then coordinated and integrated through group meetings into a regional submission through the BCUA.

Three different consultants were engaged in the development of Regional Report. The Borough of Fort Lee retained HDR to complete its individual report, the City of Hackensack retained Arcadis to complete its individual Report, while the Village of Ridgefield Park and BCUA both retained Mott MacDonald to complete their Reports.

The Borough of Fort Lee, the City of Hackensack, and the Village of Ridgefield Park had all completed and reported upon their Sewer System Characterization Studies under the General CSO NJPDES Permit in April 2007. The 2015 Individual permit requires municipalities with CSO outfalls to again update their
previous work and reports to the extent necessary and incorporate changes that would affect the combined sewer system including land use and population changes, sewer system changes, expansion or consolidation of the combined sewer system and any other changes that would affect CSOs. The changes to the Fort Lee model include the following:

1. Population and landuse updates.
2. Increased capacity of the Lower Main Station.
3. Redirection of the Lower Main Pump Station discharge from the Palisade Pump Station directly to the BCUA Interceptor.
4. Incorporation the Hudson Lights 16 acre redevelopment project.
5. Addition of seasonal variability to infiltration and inflow flows.

After these changes were made the model was recalibrated to flow data collected during October to December 2017 and validated to BCUA flow metering data from March 1, 2017 to August 27, 2017. Once the model was calibrated and validated a one year simulation was performed using the rainfall design year of 2004. The simulation was performed before and after the redirection of the Lower Main Pump Station discharge to the BCUA Interceptor to see the effect of this change. Overflows for both conditions are summarized below. Before the interceptor was redirected the simulation resulted in 38 overflows totaling 11.73 MGD at the Palisade netting facility. By redirecting the discharge directly to the interceptor overflows were reduced to 22 and total volume was reduced to 4.17 MGD. This is a 42% reduction in overflows and a 64.5% reduction in overflow volume.

<table>
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<th>Condition</th>
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<th>Outfall 002 (Palisade Terrace)</th>
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<td></td>
<td>Overflows</td>
<td>Volume</td>
</tr>
<tr>
<td>2004 before redirection of Lower Main</td>
<td>60</td>
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</tr>
<tr>
<td>2004 after redirection of Lower Main</td>
<td>60</td>
<td>77.20</td>
</tr>
</tbody>
</table>

This model will be used to simulate various CSO controls and determine the effect of these controls on the reduction of CSO frequency and volume.
1 Introduction

The Borough of Fort Lee owns and operates the Combined Sewer System (CSS) and all of its regulator structures. The total area of the Borough is approximately 1,600 acres (2.5 sq. mi.), of which 640 acres (1 sq. mi.) is serviced by the combined sewers. All wastewater flows within the Borough are ultimately transferred to the Bergen County Utility Authority (BCUA) Water Pollution Control Facility (WPCF) located along the Hackensack River in the Town of Little Ferry. The provides wastewater treatment services to residential, commercial, and industrial users located within 46 municipalities in Bergen County with a total population of about one million people.

In 2007, a previous Combined Sewer Overflow (CSO) Characterization study was conducted pursuant to permitting requirements of its NJPDES permit NJ0105023, Part V.B., Condition 4a, 4d, 4e, and 4f and through partial funding from a New Jersey Sewage Infrastructure Improvement Act (SIIA) grant. A computer model of the Fort Lee CSS and tributary collection systems was constructed, calibrated, and verified using InfoWorks, a commercial urban watershed modelling software by Innovyze. The purpose of constructing this model was to develop a suitable tool for evaluating current sewer system flow and solids transport capacity, while also enabling the Borough to estimate the CSO pollutant loadings from the Fort Lee CSS area to the Hudson River. Quantification and qualification of these loadings were subsequently used in water quality improvement projects for this waterbody.

Fort Lee has undertaken a new CSO Characterization Study pursuant to its revised NJPDES permit NJ0034517. The InfoWorks model used in the 2007 study has been updated and recalibrated to account changes to the CSO system. These changes include rerouting the underflow from Lower Main pump station directly to BCUA. To aid in the model calibration process, new flow monitoring data was collected at the underflow and overflow of all of the regulators of which there are three (3).

The following sections of this report provide information on the update of the computer model of the Fort Lee CSS. Section 2 describes the goals of the project. Section 3 characterizes the project area represented in the model. Section 4 summarizes sewer system updates, precipitation and hydraulic data collection efforts. A description of the model and its various components are provided in Section 5, which is followed by descriptions of the model calibration and verification in Section 6. Section 7 discusses the characterization of CSOs from outfalls as well as the results for the extended period simulation using the typical year of 2004 as established by PVSC.

1.1 Receiving Water Quality

Fort Lee CSS overflows the excess flow during rainfall events to the Hudson River. NJDEP has designated the Hudson River as a Primary Contact, Saline Estuary with a SE2 Class. The water quality standards for such receiving water bodies are set with monthly mean and single sample maximums set at the level of the protected use. For the Hudson River the Fecal Coliform standard for is 770 colony forming unit per 100 mL (CFU/100mL) for Monthly Mean.

As described in the BCUA Sewer Characterization Report, monitoring of the receiving waters was done jointly with numerous permittees through the NJ CSO Group. These results will be presented in a separate report. Location 32 was located immediately adjacent to Fort Lee’s discharge and results are shown on the Figure 1. Currently, the water is not impaired compared to the standards.
Figure 1. Water Quality Observed Data near Fort Lee Outfalls, Hudson River
2 Project Description

2.1 Project Goals

A hydraulic and hydraulic collection system model is a mathematical representation of the combined collection system flows. The model is developed with the goal of realistically representing the physical system flows. The model calculations are compared with measured data under known conditions to calibrate the model parameters and to determine if a good match is made. Then the model can be used to evaluate the system under proposed conditions such as new developments or the typical year conditions. By developing a suitable collection system model Fort Lee can evaluate system changes to meet operating and regulatory goals.

The Fort Lee Sewer System Characterization Report was undertaken with the following goals in order of importance:

1) Accurately predict if an overflow occurred in response to various rain events.
   a. If an overflow occurred, predict the volume of the overflow;
   b. If an overflow occurred, predict the peak flow rate of the overflow.
2) Identify locations where system improvements can be made such as:
   a. Reduce Inflow and Infiltration (I/I);
   b. Sewer Separation;
   c. Retention storage alternatives;
   d. Green Infrastructure.
3) Predict flows to the BCUA Interceptor.
3 Sewer System Characterization

Fort Lee’s wastewater services spreads to over 1,600 acres of which 640 acres are serviced by a combined system. The service area extends along the Palisade Ridge adjacent to the Hudson River. The Fort Lee CSS includes three (3) pump stations, their regulators, and two (2) discharge points. The three (3) pump stations are Palisade Terrace Pumping Station (PTPS), Lower Main Pumping Station (LMPS), and Bluff Road Pumping Station (BRPM). During the 2017 flow metering, flows at these pump stations were metered. The tributaries to these pumping stations are described in the following sections.

3.1 Service Area Land Use Data

The sanitary flow in Fort Lee is primarily residential with some commercial flow. Figure 2 displays the various land use types in Fort Lee. There are no planned changes to land use type in the future.

Figure 2. Land Use Type in Fort Lee

3.1.1 Palisade Terrace Pumping Station (PTPS)

The PTPS collects dry weather flows from the north-western portion of the Borough that has an area of about 340 acres. The land use in the drainage area is mostly residential. The PTPS drainage area has the
population of approximately 9,100 people who contribute on average of 1.23 million gallons per day of dry weather flow.

Most of this area is separately sewered with the exception of McCloud Drive. Additional Inflow and Infiltration (I&I) sources (e.g., sump pumps, groundwater infiltration, etc.) contribute flows to the PS during wet weather periods. The PTPS pumped flows discharge to the BCUA interceptor starting at the intersection of Route 4 and Edwin Avenue.

3.1.2 Lower Main Pumping Station (LMPS)

The LMPS collects flows from the north-eastern portion of the Borough and has a drainage area of about 167 acres. The drainage area is primarily residential. The LMPS has approximately 2,500 people who contribute on average 0.64 million gallons per day of dry weather flow. This drainage area is separately sewered with the exception of English and Cedar Street. I&I is also prevalent in this drainage area. Before 2016 the LMPS sent pumped flow to a 12 inch pipe on Parking Avenue, from which the flow traveled by gravity to the PTPS. After 2016, the flow from the pump station was rerouted to a 12 inch pipe that discharges to the BCUA interceptor. In addition to the rerouting the flow, the pump station capacity was upgraded from 2 MGD to 5 MGD.

3.1.3 Bluff Road Pumping Station (BRPS)

The BRPS collects dry weather flow from about 493 acres from the southern portion of the Borough. This drainage area is primarily residential. The BRPS has approximately 12,100 people who contribute on average 1.83 dry weather flow.

Unlike the other drainage areas, this area is serviced mostly by combined sewers with the exception of Anderson Avenue and the areas north of the street. The pump station can pump 6 MGD of flow.

3.1.4 Direct drainage to BCUA Interceptor

Within the Borough of Fort Lee there are two drainage areas that drain directly to the BCUA interceptor Sewer. BCUA-1 combines with the Bluff Road Pumping Station and drains downstream of the Overpeck Valley Sewer. BCUA-1 has an approximate population of 3,500 with an average flow of 0.5 MGD. BCUA-2 directs to the Fort Lee East Interceptor Sewer and combines with both Lower Main and Palisades Pumping Station upstream of the Overpeck Valley Trunk Sewer. BCUA-2 drainage area contains approximately 7,800 people with an average flow of 2 MGD. Both areas are separated and primarily residential.

3.2 Monitoring of Background Conditions

An overflow water quality sampling program was completed in 2006. The objective of the monitoring program included development of dry and wet weather quantity and quality data to be used for development of loadings to the Hudson River.
3.2.1 Previous Dry Weather Monitoring

An overflow water quality sampling program was completed in 2006. The objective of the monitoring program included collection of dry and wet weather quantity and quality data to be used for the estimation of loadings to the Hudson River.

3.2.2 Previous Wet Weather Monitoring

Monitoring Wet Weather monitoring occurred during three (3) rainfall events in 2016 which occurred on October 28th, November 16th, and December 1st. The December 1st event produced a minimal overflow volume and was not used for characterization purposes.

3.2.3 Need for Additional Data

A stormwater sampling program will be performed for the purpose of confirming that the pathogen concentrations of runoff from various land uses is consistent with published literature values. Availability of mapping of separate storm sewer systems is limited. While stormwater outfalls for separate sewer systems can be identified, the lack of mapping prevents us from delineating the tributary drainage area and identifying the respective land use characteristics.

A total of one (1) sampling station is proposed with sampling to be performed for three (3) wet weather events. Two (2) samples will be collected per for the High Density Residential area as noted in Table 1.

<table>
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<th>Designated Land Use</th>
<th>Location</th>
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<td>High Density Residential</td>
<td>Intersection of Myrtle and Short</td>
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</table>

The pathogen data from will be used for comparison with literature values and adjusted accordingly for use in the landside model for the characterization of CSO and stormwater discharges. Literature values for pathogen concentrations will be used for open space.
4 Combined Sewer System Characteristics

The combined sewer area is served by 3 regulators, whose correlation is shown in Figure 3. The flow from Lower Main Pump Station is pumped to the Palisades Pump Station from which is then pumped to the BCUA Interceptor. The flow from Bluff Road is pumped to the BCUA Interceptor.

4.1 Sewer System Updates or Modifications

In 2016 the Lower Main Pump Station was upsized and a new 10” line was installed connecting it to the BCUA Interceptor. The overflow from the Lower Main Pump Station still combined with the overflow from the Palisades Pump Station and discharges to Outfall 2. The new pumps at Lower Main was built to handle additional flows from new housing developments in the Lower Main area.
4.2 CSO Regulators and Control Facilities

Netting system utilized by Fort Lee to remove floatables from the CSOs and meet USEPA “Nine Minimum Controls” and the Long Term Control Plan requirements. The netting systems were installed in 1995. The netting systems are inspected on a regular basis by DPW personnel. Inspections are undertaken prior to anticipated storm events, and after significant storm events.

The netting systems are in-line TrashTrap systems manufactured by Fresh Creek Technologies, Inc. who is currently owned by Storm Trap. Each netting facility contains two nets. The netting units are installed in in-line chambers and are installed in line with the combined sewer system pipe. A fixed hydraulic relief screen located upstream of the nets assures screening of the flow under all conditions and provides additional system capacity. The screen is inclined in the direction of flow so that any debris caught on this screen falls into the nets as the water level in the chamber recedes. The screen will also work as a weighted relief valve, if required, to reduce back pressure. Grating under the nets allows them to drain dry. Debris
is captures and contained in disposable nets. The disposable nets and support frame are housed in a rack assembly installed in the chamber.

Net maintenance and change outs are scheduled based on periodic visual inspection. The system is maintained through ground-level lockable access doors on the top of the netting chamber. There is no confined-space entry required during routine service because the disposable nets are held net frames which are lifted from the chamber to perform the net change-out above ground. A hoist truck for changing the nets and a container for holding the full nets are used for maintenance. A crew of two typically accomplishes the net change-out. The full nets are disposed of approved facility.

4.3 Recent Reports or Plans

The 2004 NJPDES permit for Fort Lee required the Borough to develop a Long Term Control Plan (LTCP) in accordance with the National CSO Control Policy. This phase of the CSO program requires development and evaluation of the feasibility of a range of control alternatives to reduce CSO frequency and pollutant loadings pursuant to the Federal Clean Water Act (CWA) goals. It resulted in the following reports:

- Interim Service Area and Land Use Report for Fort Lee, March 2007;
- Rainfall Monitoring Study Report for Borough of Fort Lee, March 2007;
- Interim System Inventory and Assessment Report for Borough of Fort Lee, March 2007;
- Interim Combined Sewer System Modeling Report for Borough of Fort Lee, March 2007;
- Combined Sewer Overflow Interim Monitoring Report for Fort Lee, March 2007; and

Their reports presented the development of the Long Term Control Plan in 2007.

Two reports were used to define the reconfiguration for the combined sewer system:

- Engineer’s Design Report For Lower Main Pumping Station and Force Main, March 2013; and
- Calculations Report for Flow Reduction to Lower Main Pump Station Due to Sewer-Storm Separation at Fort Lee Redevelopment Projects, April 2013.

The 2015 NJPDES permit for Fort Lee required a System Characterization and Landside Modeling Program Quality Assurance Project Plan. This was submitted in December 2015. This document provided guidance for the preparation of this report.

4.4 Rainfall Monitoring Study

4.4.1 Precipitation Data Collection

During the 2017 monitoring period, rainfall data from Teterboro (TET) airport rain gauge was used for model calibration purposes. Data at this rain gauge is collected at hourly intervals. Storm events that occurred during flow monitoring period are shown in the Table 2. Event 11, 15, 25 were used for model calibration. These events are plotted with the typical year storms in Figure 5.
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<td>12/9/2017 22:00</td>
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<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
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<td>12/14/2017 8:00</td>
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<td>0.07</td>
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<td>12/15/2017 19:00</td>
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<td>0.03</td>
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<tr>
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<td>12/18/2017 3:00</td>
<td>12/18/2017 4:00</td>
<td>56</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
</tbody>
</table>
4.4.2 Typical Year Analysis

Historical precipitation data is available at the Newark International Airport (EWR) located 20 miles southwest of Fort Lee. The average annual precipitation at EWR is around 43 inches. Measurable precipitation occurs approximately 120 days during the year, or about once every three days. Rainfall totals during the typical year and displayed in Figure 5.

![Figure 5. Rainfall Total Comparison during Typical Year](image_url)
5 Model Development

The model was originally developed in 2006 for the previous LTCP. The model was constructed using sewer system data compiled in a GIS database by Boswell McClave. The information included manhole inverts, ground elevations and pipe dimensions. The model extents included all significant combined sewers over 8 inches within each regulator drainage area. Conduits in the system were primarily modeled from manhole to manhole where changes in pipe characteristics occur. The regulator structures were simulated by modeling conduits upstream of a regulator, the weir/orifice controlling flow within a regulator chamber included float controls if any, its overflow discharge conduit, and its connection to the pump station. The model included the drainage areas for the three (3) pump stations.

The model was updated to include any system changes not represented in the previous model, such as the new Hudson Yards Development and rerouting of the pump station. Flow metering at the all three (3) regulators was done for three months, from 9/14/2017 to 12/18/2017, to provide data for model recalibration. The flow through the overflow pipe was monitored at all three (3) locations and for PTPS and LMPS the incoming pipe flow was also metered. Because of hydraulic conditions the underflow pipe flow was metered for BRPS.

5.1 Modeling Framework

During the 2006 LTCP, a mathematical model was developed using Infoworks. Infoworks is a dynamic rainfall-runoff hydraulic model primarily used for collection system modeling in urban areas. It is capable of simulating the response to single and long term rainfall events. The model can characterize the entire urban water cycle, from rainfall to runoff to flow routing through the sewer system. It is a time-variable model capable of calculating the flow and hydraulic grade lines (HGL). Infoworks provides friendly graphical user interfaces, database management tools, post-processing utilities, GIS integration, and other enhancements.

Infoworks solves the complete St. Venant (dynamic flow) equations for hydraulic calculations. It can characterize the backwater effects, flow reversal, surcharging, looped connections, pressure flow, tidal outfalls, and real time control operations within a sewer network. The model post processing tools can generate summary tables and graphs for review and analysis of model results.

Surface characteristics of each subcatchment are required to calculate and route runoff flows. These characteristics include infiltration, evaporation, depression storage, and percent impervious. Characteristic parameters such as drainage area, land slope, width of overland flow, and Manning’s surface roughness coefficients are used to calculate the movement of overland runoff flow.

5.2 Dry Weather Flows

Dry Weather flow or sanitary flow was calculated on a subcatchment basis. Dry weather flow was modeled as time-variable flow, simulating the typical diurnal nature of sanitary flow. Diurnal variations in sanitary flow were estimated using the monitoring data. For each monitored Pump Station drainage area, a diurnal curve was established by averaging the hourly flows of all recorded dry weather weekdays and dividing by the total average daily dry weather flows. Dry weather days were defined as 2 days (48 hours) after rainfall ended. Because one of the calibrated storm events occurred on a weekend, a weekend curve was also calculated. Daily patterns can be found in Appendix A.
Each monitored drainage area was assigned a per capita wastewater flow based on the population. Each person was assigned 100 gallons per day. The remaining flow was dry weather ground water infiltration (GWI). Population data was downloaded from NJ Census data and population was added to account for the new Hudson Lights development.

Even during dry weather the Fort Lee collect system collects GWI from the influent sewer system. On average, less than half of total flow is GWI.

### Table 3. Regulator Drainage Area Properties

<table>
<thead>
<tr>
<th>Regulator</th>
<th>Population</th>
<th>Average Dry Weather Flow (MGD)</th>
<th>Assumed Sanitary Flow (MGD)</th>
<th>Average GWI (MGD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Main</td>
<td>2,532</td>
<td>0.64</td>
<td>0.25</td>
<td>0.39</td>
</tr>
<tr>
<td>Palisades</td>
<td>9,101</td>
<td>1.23</td>
<td>0.91</td>
<td>0.32</td>
</tr>
<tr>
<td>Bluff Rd</td>
<td>12,094</td>
<td>1.83</td>
<td>1.21</td>
<td>0.62</td>
</tr>
<tr>
<td>BCUA-1</td>
<td>3,471</td>
<td>0.52</td>
<td>0.35</td>
<td>0.18</td>
</tr>
<tr>
<td>BCUA-2</td>
<td>7,757</td>
<td>2.01</td>
<td>0.78</td>
<td>1.23</td>
</tr>
<tr>
<td>Total</td>
<td>34,955</td>
<td>6.23</td>
<td>3.5</td>
<td>2.73</td>
</tr>
</tbody>
</table>

Average dry weather patterns were developed for both weekday and weekend. BCUA-1 was assigned the same pattern as Bluff Road and BCUA-2 was assigned the average pattern as Palisades and Lower Main.

It was noted during the 2017 flow monitoring period that Bluff Roads total average flow decreased by 0.75 MGD from the previous 2006 calibration. The flow assessor who performed the metering stated that:

“The original flows recorded from the Bluff Road Pump Station monitoring site in 2006 were increased 60% to accommodate what was believed to be upstream contributing flows from meters deployed on the same project. It was suspected that the flow recorded was faulty, either by the monitoring location or the recording meter itself. The closed pipe meter used in 2006 is no longer in use with our company.

The flow monitoring performed in 2017 at the Bluff Road Pump Station utilized the same type of meter but different manufacturer of meter to record flows passing through the closed pipe pump discharge line. The original flows recorded in 2006 appear to be close to the same flows recorded in 2017. The flows from 2006 should not have been increased from what was originally recorded.”

Thus the new data is correct and the model was adjusted for the new metering.
5.3 Monthly Variation of Flow

After receiving BCUA data for March to August, it was noted that dry weather flow changed seasonally. The monthly factor used to represent seasonal variation in GWI is shown in Figure 6.

![Figure 6. Monthly Variation in Flow](image)

5.4 Model Calibration Data

The accuracy and performance of a hydraulic model is measured by its ability to reproduce the actual systems response to rainfall performance it is simulating. A calibration and verification process involves a selection of simulation events. Events were selected that were representative of both typical and extreme rainfall events. A long period of dry weather was also verified.

The model calculations of overflow occurrence were compared with the observed overflow data. If an overflow occurred the total volume and peak volume of the overflow was compared.

5.5 Model Verification

The model was compared with BCUA data to verify flow contributed from Fort Lee. This was done after the model was calibrated to the flow data from Fort Lee's short term-meters. One dry weather event and three (3) wet weather events were chosen for model validation. The wet weather events were of different sizes than the events used for the model calibration.
6 Model Calibration and Verification

Model calibration consists of changing model network and subcatchments parameters to achieve acceptable agreement between the models calculated and observed flows and volumes. This involved manually adjusting runoff parameters.

6.1 Calibration Criteria

The model was evaluated through the application of individual storms. The primary criteria was correctly matching the occurrence of overflows. Next, Fort Lee used the standard Wastewater Planning Users Group (WaPUG) Code of Practice for the Hydraulic Modeling of Sewer Systems which was applied for Peak Flow (+25% to -15%) and Volume (+20% to -10%).

6.2 Dry Weather Calibrations

The observed dry weather flow was compared with model calculations. The results are shown in Figure 7.
Figure 7. Dry Weather Flow Comparison
6.3 Wet Weather and Water Quality Calibration

After individual storms were calibrated, the model was run for the entire period. The comparison of total Volume (Figure 8) and Peak Volume (Figure 9) was completed. For smaller sized overflows (less than 1MG) the model could not accurately predict the occurrence of overflows while still predicting the size. Because of the hydraulics at Bluff Road correctly calculating the peak overflow was problematic.
Figure 8a. Model and Observed Total Volume Comparison (Full Extent)

Figure 8b. Model and Observed Total Volume Comparison (Less than 1 MG)
Figure 9a. Model and Observed Peak Flow Rate Comparison (Full Extent)

Figure 9b. Model and Observed Peak Volume Comparison (Less than 10 MG)
6.4 Model Verification

The Fort Lee model was ran for the months of March through August and compared with the BCUA data. Because overflows do not occur in the BCUA interceptor, calculating the peaks of events and total volume was important (Figure 10).

![Figure 10. Model Validation](image1)

![Figure 10. Model Validation](image2)
7 Sensitive Areas Review

The report entitled “Identification of Sensitive Areas” prepared by the Passaic Valley Sewerage Commission on behalf of the New Jersey CSO Group presents the Sensitive Area review for members of that group including Fort Lee. This will serve as a summary of the finding of that report as they relate to Fort Lee.

The USEAP CSO Policy “expects a permittee’s long-term CSO control plan to give the highest priority to controlling overflows to sensitive areas”. The CSO Control Policy states the following six criteria for defining an area as a “Sensitive Area” include:

1. Designated Outstanding National Resource Waters;
2. National Marine Sanctuaries;
3. Waters with threatened or endangered species and their habitat;
4. Waters with primary contact recreation;
5. Public drinking water intakes or their designated protected areas; and

The CSO Control Policy states that if Sensitive Areas are present and impacted, the LTCP should include provisions to:

- Prohibit new or significantly increased overflows;
- Eliminate or relocate overflows wherever physically possible and economically achievable;
- Treat overflows where necessary; and
- Where elimination or treatment is not achievable, reassess impacts each permit cycle.

Sensitive Areas should be considered prior to the evaluation of CSO control alternatives. This allows a CSO community to identify and estimate costs for controls that could eliminate or relocate CSOs from Sensitive Areas where pollutant loadings pose a high environmental or public health risk and where control efforts should be focused. The cost of these controls can then be considered, along with the community’s financial capability, to evaluate cost-effective controls for all of the receiving waters.

7.1 Requirements of the NJPDES Permits

The NJPDES permits indicate that the permittee’s LTCP shall give the highest priority to controlling overflows to sensitive areas. The NJPDES Permit further states that “Sensitive areas include designated Outstanding National Resource Waters, National Marine Sanctuaries, waters with threatened or endangered species and their habitat, waters used for primary contact recreation (including but not limited to bathing beaches), public drinking water intakes or their designated protection areas, and shellfish beds.”

The NJPDES Permits indicate that if Sensitive Areas are present and impacted, the following requirements will apply:

- Prohibit new or significantly increased CSOs.
• Eliminate or relocate CSOs that discharge to sensitive areas wherever physically possible and economically achievable, except where elimination or relocation would provide less environmental protection than additional treatment.

• Where elimination or relocation is not physically possible and economically achievable, or would provide less environmental protection than additional treatment, the permittee shall provide the level of treatment for remaining CSOs deemed necessary to meet WQS for full protection of existing and designated uses.

7.2 Assessment of Sensitive Areas

The six criteria for Sensitive Areas identified in the CSO policy were evaluated for the waterbodies affected by Fort Lee’s CSO’s in the Study Area including reaches upstream of the CSOs. Special consideration was given to areas downstream and within the tidal influence of the CSOs, as any potential Sensitive Areas within hydraulic proximity to outfalls may be impacted by their discharge.

7.3 Methodology

In order to develop a comprehensive understanding of the presence of designated Sensitive Areas within the Study Area, multiple strategies were used to complete these investigations including searching online data resources, sending letters to regulatory agencies and environmental organizations, and conducting an observation survey. The outcome of this effort is discussed in PVSC’s report. The goal of this multi-faceted approach was to gain a thorough understanding of the presence of factors that may be considered for the determination of potential Sensitive Areas to support the development of future CSO control alternatives.

7.4 Online Database Searches

An abundance of information is available online regarding the waterbodies in the Study Area. The following entities and on-line databases were searched for information related to Sensitive Areas within the Study Area boundary:

• National Oceanic and Atmospheric Administration (NOAA)
  o NOAA 2017 Environmental Sensitivity Index Maps
• United States Environmental Protection Agency
  o Anti-degradation Policy - Outstanding Natural Resource Water
• United States Fish and Wildlife Service (USFWS)
• New Jersey Department of Environmental Protection (NJDEP)
• Office of National Marine Sanctuaries

7.5 Summary of Sensitive Areas

A comprehensive review of online databases, correspondence with regulatory agencies, direct observations, and local environmental organizations was conducted to identify potential Sensitive Areas impacted by CSO’s within the Study Area. There are no Outstanding Natural Resource Waters, National
Marine Sanctuaries, Drinking Water intake areas or Shellfish Beds in the Fort Lee affected area of the Hudson River. There were also no sensitive areas identified as it is related to waters with threatened or endangered species and their habitats. The Atlantic and Shortnose sturgeon populations in the Hudson River have both been successfully recovering since the species have been listed as endangered, and the coinciding improvements in water quality since the 1970s have had a positive impact. The current level of CSO discharge is not preventing the recovery of a healthy adult sturgeon population for either species.

For the Hudson River the Atlantic and Shortnose Sturgeon critical habitats extend throughout the river including the area of Fort Lee. Both species are susceptible to environmental contamination due to their benthic foraging behavior and long life span. A total of 15 CSO outfalls, including Fort Lee’s two outfalls, discharge to the Hudson River and were further reviewed to determine if there are any impacts on the Sturgeon. Three documents were reviewed to assess the status of the sturgeon on the Hudson River:

- Appendix B in the OVSC report presents a Status Review of Atlantic Sturgeon by NOAA. This study concluded that commercial bycatch and decades of prior environmental degradation are the biggest threats to Atlantic sturgeon recovery in the New York Bight. The water quality in the Hudson River and New York Bight has improved in recent decades, and no longer appears to present a significant threat to Atlantic Sturgeon recovery.

- Appendix D of the PVSC report presents a separate review of the available published scientific articles, reports, and data by GLEC specifically examining the impact of human enteric pathogens to find any specific effects on Atlantic sturgeon. The study concludes that Atlantic sturgeon survival and recovery is likely not affected by exposure to human pathogens.

- Appendix E of the PVSC report says that the adult population of Shortnose sturgeon in the Hudson River has also been increasing at rates higher than those expected by recovery criteria according to the population research study “Recovery of a US Endangered Fish” by Cornell University. Shortnose sturgeon population estimated in the late 1990s had increased more than 400% from the 1970s estimates, and mainly in the adult segment of the population. The estimate’s results suggest the current level of habitat protection is adequate toward growing and maintaining healthy sturgeon population.

From these studies and conclusions, these areas are not considered sensitive areas as they relate to the Sturgeon.
8 CSO Analysis and Extended Period Simulation

Newark rainfall gauge record was used for the Baseline simulation. System improvements will be evaluated based on these results. Table 4 displays the number of overflow events and volume for each outfall. Bluff Road regulator which discharges to Outfall 001 is the main contributor to CSO in Fort Lee with 20 more overflow events and 6 times more CSO discharge. Every event that Outfall 002 discharges, Outfall 001 discharges.

Table 4. 2004 Baseline

<table>
<thead>
<tr>
<th>Month</th>
<th>Outfall 001</th>
<th>Overflow Volume (MG)</th>
<th>Number of Overflows</th>
<th>Overfall Volume (MG)</th>
<th>Number of Overflows</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>3</td>
<td>0.91</td>
<td>1</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>2</td>
<td>4.58</td>
<td>2</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>5</td>
<td>1.24</td>
<td>5</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>7</td>
<td>6.91</td>
<td>7</td>
<td>1.01</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>10</td>
<td>7.14</td>
<td>3</td>
<td>0.69</td>
<td></td>
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<tr>
<td>June</td>
<td>6</td>
<td>3.96</td>
<td>1</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>7</td>
<td>17.10</td>
<td>8</td>
<td>2.88</td>
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<tr>
<td>August</td>
<td>6</td>
<td>5.93</td>
<td>3</td>
<td>0.45</td>
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<tr>
<td>September</td>
<td>6</td>
<td>19.42</td>
<td>4</td>
<td>3.77</td>
<td></td>
</tr>
<tr>
<td>October</td>
<td>1</td>
<td>0.28</td>
<td>2</td>
<td>0.58</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>5</td>
<td>6.03</td>
<td>2</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>4</td>
<td>3.71</td>
<td>0</td>
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</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>77.20</td>
<td>38</td>
<td>11.73</td>
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</tr>
</tbody>
</table>
The 2004 Baseline was run with the re-routing and upgrade of the Lower Main Pump Station. With the new pump station outfall 002 discharges 16 less time and about 7 MG less. Table 5 displays the results of the Baseline results with the system improvements.

**Table 5. 2004 Baseline with System Improvements**

<table>
<thead>
<tr>
<th>Outfall</th>
<th>001</th>
<th>002</th>
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</thead>
<tbody>
<tr>
<td>Month</td>
<td>Number of Overflows</td>
<td>Overflow Volume (MG)</td>
</tr>
<tr>
<td>January</td>
<td>3</td>
<td>0.91</td>
</tr>
<tr>
<td>February</td>
<td>2</td>
<td>4.58</td>
</tr>
<tr>
<td>March</td>
<td>5</td>
<td>1.24</td>
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<tr>
<td>April</td>
<td>5</td>
<td>6.91</td>
</tr>
<tr>
<td>May</td>
<td>10</td>
<td>7.14</td>
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<td>5.93</td>
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<td>September</td>
<td>6</td>
<td>19.42</td>
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<tr>
<td>October</td>
<td>1</td>
<td>0.28</td>
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<tr>
<td>November</td>
<td>5</td>
<td>6.03</td>
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<tr>
<td>December</td>
<td>4</td>
<td>3.71</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>77.20</td>
</tr>
</tbody>
</table>
Appendix A.  Dry Weather Statistical Analysis

Average Diurnal Patterns: Weekday vs Weekend

Fort Lee Weekday DWF

Fort Lee Weekend DWF
Appendix B.  Wet Weather Calibration Results

Event 11 - 2.77 in on 10/29/2017

Bluff Road
Event 11 - 2.77 in on 10/29/2017

Lower Main

[Graph showing inflow and overflow data for Event 11 with observed, modeled, and rainfall data.]
Event 11 - 2.77 in on 10/29/2017

Palisades
Event 11 - 0.58 in on 11/07/2017

Bluff Road
Event 11 - 0.58 in on 11/07/2017

Lower Main
Event 11- 0.58 in on 11/07/2017

Palisades
Event 25- 0.58 in on 12/06/2017

Bluff Road
Event 25- 0.58 in on 12/06/2017

Lower Main
Event 25- 0.58 in on 12/06/2017

Palisades