Appendix A
Nine Minimum Controls

DRAFT REPORT

Nine Minimum Controls: Requirements and Compliance Measures

Prepared for

Greater New Haven Water Pollution Control Authority

November 2016

CH2M HILL Engineers, Inc.
100 Great Meadow Road
Suite 707
Wethersfield, CT, 06109

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Acronyms and Abbreviations

AGRU	automatic grease recovery unit
BMP	best management practice
CCTV	closed-circuit television
CM	corrective maintenance
CMMS	computerized maintenance management system
CMOM	capacity, management, operations, and maintenance
CSO	combined sewer overflow
CSFM	collections system facility maintainer
CSS	combined sewer system
CT DEEP	Department of Energy and Environmental Protection
DWO	dry weather overflow
EPA	U.S. Environmental Protection Agency
FOG	fat, oil, and grease
GNHWPCA	Greater New Haven Water Pollution Control Authority
hp	horsepower
I/I	infiltration and inflow
IPP	Industrial Pretreatment Department
kW	kilowatt(s)
LACP	Lateral Assessment & Certification Program
LTCP	long-term control plan
MACP	Manhole Assessment & Certification Program
MSDS	material safety data sheet
NMCs	nine minimum controls
O&M	operations and maintenance
PACP	Pipeline Assessment & Certification Program
PM	preventive maintenance
POTW	publicly owned treatment works
SOP	standard operating procedure
SSES	sewer system evaluation survey
SSO	sanitary sewer overflow
SWMM	stormwater management model
WPAF	water pollution abatement facility

SECTION 1

Introduction

Combined sewer systems (CSSs) carry a mixture of sanitary sewage and stormwater to a treatment facility via a single pipe. During wet weather, wastewater flows can exceed the capacity of the CSS and/or treatment facilities. In such an event, sewers are designed to overflow directly to surface water bodies, such as lakes, rivers, estuaries, or coastal waters. These overflows, called combined sewer overflows (CSOs), can be a source of water pollution.

As an effort to combat CSOs, the Environmental Protection Agency (EPA) issued the CSO Control Policy on April 11, 1994. One aspect of the policy is the Nine Minimum Controls (NMCs), which are CSO-reducing measures that do not require significant engineering studies or major construction.

The NMCs are:

1) Proper operation and regular maintenance programs for the sewer system and CSO outfalls.
2) Maximum use of the collection system for storage.
3) Review and modification of pretreatment requirements to ensure that CSO impacts are minimized.
4) Maximization of flow to the publicly owned treatment works (POTW) for treatment.
5) Elimination of CSOs during dry weather.
6) Control of solid and floatable materials in CSOs.
7) Pollution prevention programs to reduce contaminants in CSOs.
8) Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts.
9) Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.

CH2M Hill has completed an update to the NMC Implementation Assessment originally included in the City of New Haven's 2001 CSO Long-Term Control Plan (LTCP). This updated assessment of the Greater New Haven Water Pollution Control Authorities (GNHWPCA's) implementation of the NMC measures follows EPA's May 1995 Guidance Document for Nine Minimum Controls.

For each of the NMCs, we have summarized the status of the control measures implemented and looked to identify any deficiencies that would require future corrective action by the GNHWPCA. Based on our assessment, we find that the GNHWPCA is in full compliance with the implementation of the NMCs and that no corrective action is required at this time.

The GNHWPCA should continue to assess and update their programs that support implementation of the NMCs, many of which are listed below:

- CSO Flow Monitoring Program
- Monthly CSO Regulators, CSO Outfalls and Duckbill Inspection Program
- Hydraulic Modeling Program/Updates
- Emergency Response Plan
- Regulator Improvement Program
- Capacity, Management, Operating and Maintenance (CMOM) Plan
- Large Diameter Sewer Cleaning Program

- Wet Weather Operational Plan (East Shore Water Pollution Abatement Facility (WPAF))
- CSO Reporting Using Connecticut Department of Energy and Environmental Protection (CT DEEP) Website.

The GNHWPCA should also continue to work closely with the City of New Haven regarding pollution prevention measures such as catch basin cleaning and street sweeping.

NMC 1 – Proper Operation and Regular Maintenance Programs

The objective of NMC 1 is to create a program that establishes operation, maintenance, and inspection procedures to ensure that a CSS and treatment facility will maximize combined sewage treatment. The following section summarizes the requirements of NMC 1 and GNHWPCA's ongoing implementation of these requirements.

1.1 Organizations and Individuals Responsible for Operations and Maintenance (O&M)

The first requirement of NMC 1 is a delineation and description of the organizations and individuals responsible for operations and maintenance (O&M).

The GNHWPCA owns, operates, and maintains their collection and treatment system; and coordinates CSO activities with the City of New Haven. The City of New Haven owns, operates, and maintains the separated storm sewer system in the City of New Haven including the catch basins that feed into the GNHWPCA's CSS. The GNHWPCA and City of New Haven coordinate activities on a regular basis.

GNHWPCA maintains an up-to-date organizational chart that is published annually as part of their Cost of Service Study (COSS). A copy of the COSS is provided to the City of New Haven to assist in coordinating CSO activities. A copy of the GNHWPCA's fiscal year (FY) 2016 organization chart identifying GNHWPCA staff roles and reporting responsibility is shown on the following page in Figure 1.

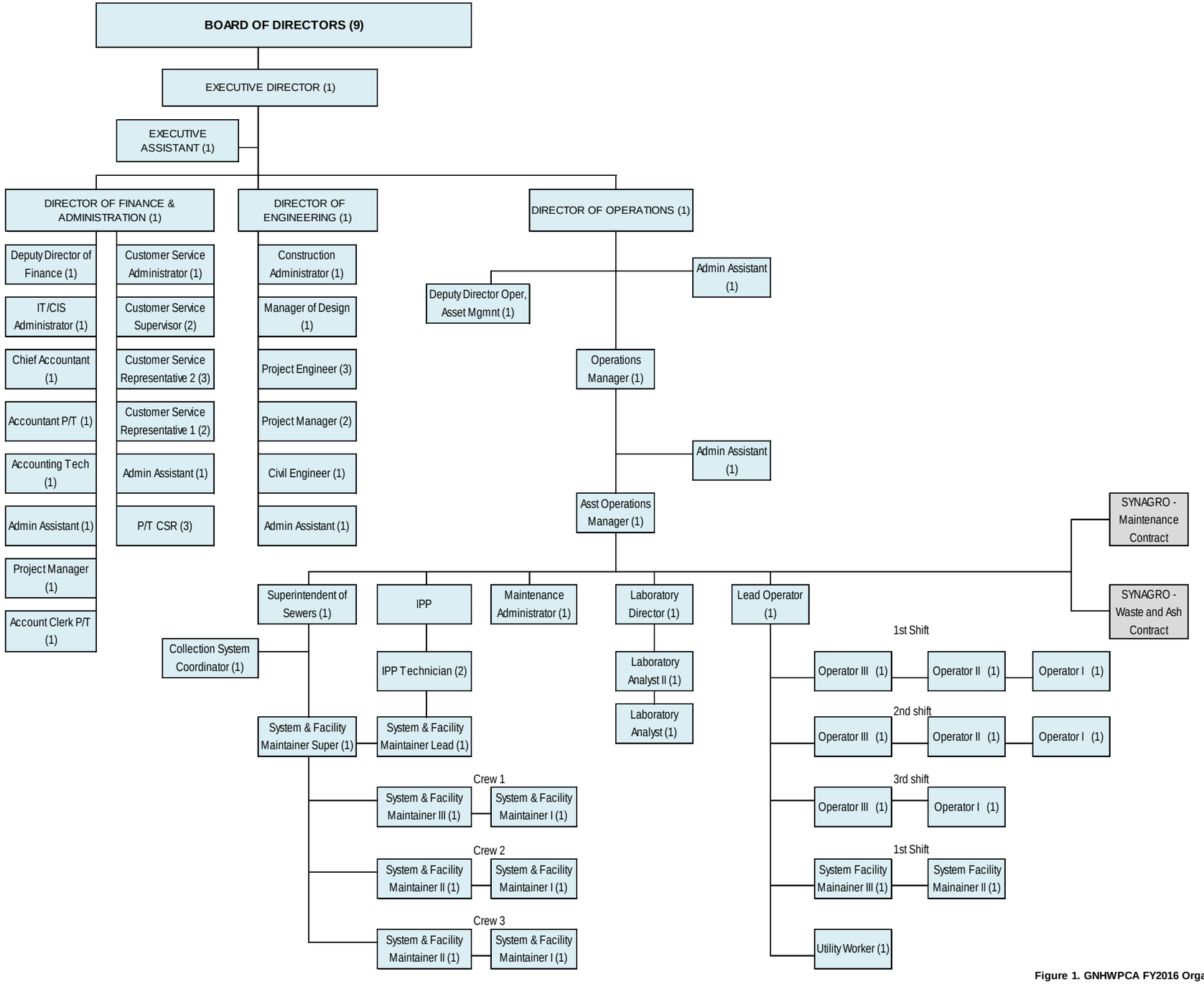

Figure 1. GNHWPCA FY2016 Organization Chart

Figure 1. GNHWPCA Organization Chart

Table 1 contains the names and positions of GNHWPCA's Directors.

Table 1. GNHWPCA Directors

Name	Position	Contact Number
Sidney J. Holbrook	Executive Director	(203) 446 – 5280
Gabriel Varca	Director of Finance and Administration	(203) 466 – 5280
Thomas Sgroi	Director of Engineering	(203) 466 – 5185
Gary Zrelak	Director of Operations	(203) 466 – 5285

Table 2 contains the names and positions of key individuals at the City of New Haven that are responsible for the day-to-day management and operation of the City's separated storm system.

Table 2. City of New Haven

Name	Position	Contact Number
Giovanni Zinn	City Engineer	(203) 946-6417
Jeff Pescosolido	Director of Public Works	(203) 946-7700

1.2 Planning and Budgeting Procedures

NMC 1 requires planning and budgeting procedures for CSS and treatment facility O&M. This should include making resources available for O&M and the procedures for preparing and approving the annual budget. The EPA also recommends that the individuals responsible for day-to-day O&M should be encouraged to participate in budgeting. This is beneficial because these individuals can provide current field-based accounts of what is needed and not needed to carry out their daily responsibilities.

GNHWPCA's sewer collection system O&M budgeting is based on historical expense levels, review of capital requirements, and projection of future requirements to meet the level of service goals of the GNHWPCA. Budget preparation workshops that include the Directors and department supervisors are used to develop the draft annual O&M and capital budgets as the two go hand in hand. In addition, the City of New Haven is consulted as they share in 40% of the cost of the CSO capital program.

Rate studies are performed regularly to confirm the adequacy of rates developed and include the commissioning of the annual COSS. The COSS includes a projection of the cost of service for the next four years and presents the recommended schedule of user rates and charges for the upcoming fiscal year. The budgeting process starts months before the final budget is approved by the GNHWPCA Board of Directors. Through this process, the GNHWPCA continues to successfully deliver required services while maintaining sound cost control. The GNHWPCA also strives to maintain an operating reserve equal to 6 months of annual O&M expense in case of emergencies.

Table 3 summarizes the historic and projected annual O&M and total annual budgeted costs for the GNHWPCA.

Table 3. Summary of Historical Revenue and Expenses

Description	FY2014	FY2015	FY2016 (Approved)
Revenues			
Billing Revenues[1]	$34,176,430	$34,965,518	$36,236,798
Other Revenue[2]	5,220,563	4,204,000	4,176,000
Total Revenue	$39,396,993	$39,169,518	$40,412,798
Expenses			
Operation & Maintenance	27,454,762	27,454,762	28,051,441
Debt Service [3]	10,823,816	11,164,277	10,715,614
Total Expenses	$38,278,578	$38,619,039	$38,767,055

(1) Represents actual billing revenues received (i.e. net of receivables management costs)

(2) Includes City of New Haven CSO cost share

(3) Excludes depreciation expense.

1.2.1 Cost of Service Study (COSS)

The Executive Director, in accordance with the GNHWPCA sewer ordinance, will ensure that a COSS is performed at least annually. The objective of the COSS is to produce a schedule of recommended user rates and charges for the customers of the GNHWPCA's system, which will be sufficient to meet the anticipated costs of operating the sanitary sewer system for the upcoming fiscal year. The COSS shall include:

- A review and evaluation of the proposed expense budget for the upcoming fiscal year, and preparation of cost estimates for the succeeding four fiscal years based on the Executive Director's cost estimates.
- A review and evaluation of the proposed revenue budget for the upcoming fiscal year, and preparation of cost estimates for the succeeding four fiscal years based on the Executive Director's revenue estimates.
- Determination of the projected revenue requirement from user rates for the upcoming fiscal year and the succeeding four fiscal years.
- Development of a schedule of recommended rates and charges sufficient to support the estimated annual revenue requirements from user rates for the upcoming fiscal year and the succeeding four fiscal years.
- Analyzing the GNHWPCA's historical collection rate, including the current fiscal year and the Executive Director's estimate of the collection rate for the upcoming fiscal year.
- Preparation of a report documenting recommendations, assumptions, and methodology.
- Such other information as required by the Executive Director from time to time.
- The Executive Director shall review the results and submit the Cost of Service Study to the GNWHPCA Board of Directors on or before the third Monday in April.

- The Executive Director shall submit one copy of the adopted "Annual Budget" of the GNHWPCA to the State of Connecticut Office of Policy and Management by July 1st of each year or within 30 calendar days after the adoption of the budget, whichever is later pursuant to the act.

1.3 List of Critical GNHWPCA Facilities

The following facilities, including collection system piping and related structures, are critical to CSS performance:

Critical Facilities:

- East Shore Water Pollution Abatement Facility (WPAF) to Treat Dry and Wet Weather Flows
- Pump Stations. GNHWPCA owns and operates 30 pump stations, 3 of which are critical to CSS performance including the East Street, Union, and Boulevard Pump Stations.

Critical Combined Sewers and Related Structures:

- Gravity Sewers
- Force Mains
- Regulator Structures (see Table 4)
- Diversion Structures
- 5 million gallon (MG)Truman CSO Storage Tank
- Large Diameter Combined Sewers Prone to Sedimentation
- CSO Outfalls (see Table 4)
- Duck Bills on CSO Outfalls
- Siphons. GNHWPCA owns and operates 8 siphons, with the James Street Siphon located in the CSS area being the most critical to CSS performance.

The GNHWPCA's Computerized Maintenance and Management System (CMMS) maintains and monitors performance of the critical facilities. The GNHWPCA's Geographic Information System (GIS) maintains information on the sewer collection system piping and related CSS control structures. GNHWPCA staff have remote global position systems (GPS) access to the GIS information to readily facilitate O&M or emergency response when in the field.

The GNHWPCA's CSO flow monitoring program (initiated in 2012) measures, on a continuous basis, the flows to the CSO regulators and at the CSO outfalls. This flow monitoring program provides GNHWPCA with data to measure and further evaluate performance of these critical facilities.

GNHWPCA's CMMS, GIS and flow monitoring program have proven highly effective at monitoring and maintaining the GNHWPCA's critical facilities as well as assisting in managing customer service requests, incorporating work crew observations into collection system conditions reports and bypass reports, timely performance, and documentation of all required bypass notifications, conduct of preventative maintenance and coordination of rehabilitation and replacement projects.

Table 4. List of CSO Outfalls and Regulators

		RECEIVING WATER LOCATION					
NPDES #	NPDES REGULATOR LOCATION	NPDES CSO RECEIVING WATER	Latitude	Longitude	CSO #	REG #	CSO STATUS
#003	E.T. Grasso Boulevard @ Orange Avenue	West River	41°17'50" N	72°57'02" W	#003	#003	Active
#004	E.T. Grasso Boulevard @ Legion Avenue	West River	41°18'20" N	72°57'14" W	#004	#004	Active
#005	E.T. Grasso Boulevard @ Derby Avenue	West River	41°18'37" N	72°57'22" W	#005	#005	Active
#006	Whalley Avenue @ Fitch Street	West River	41°19'30" N	72°57'26" W	#006	#006	Active
#009	Grand Avenue @ James Street	Mill River	41°18'31" N	72°54'21" W	#009	#009	Active
#010 (A)	East Street @ I-91	Mill River	41°18'48" N	72°54'26" W	#011	#010 (A)	Active
#011	Humphrey Street @ I-91	Mill River	41°18'48" N	72°54'26" W	#011	#011	Active
#012	Mitchell Drive @ Nicoll Street	Mill River	41°19'23" N	72°54'20" W	#012	#012	Active
#015	James Street Siphon	Quinnipiac River	41°18'03" N	72°54'08" W	#015	#015	Active
#016	Poplar Street @ River Street	Quinnipiac River	41°18'06" N	72°53'46" W	#016	#016	Active
#019	Pine Street @ North Front Street	Quinnipiac River	41°18'48" N	72°53'14" W	#019	#019	Active
#020	Quinnipiac Avenue @ Clifton Street	Quinnipiac River	41°18'36" N	72°53'08" W	#020	#020	Active
#021	East Street Pump Station	New Haven Harbor	41°17'49" N	72°54'39" W	#021	#021	Active
#024	Boulevard Pump Station (Sea Street)	New Haven Harbor	41°16'58" N	72°55'31" W	#024	#024	Active
#025	Union Pump Station (Union Avenue @ State Street)	New Haven Harbor	41°17'45" N	72°54'58" W	#025	#025	Active
#026	Humphrey Strret Pump Station	Mill River	41°18'48" N	72°54'26" W	#011	#026	Active
#028	Mitchell Drive Pump Station	Mill River	41°19'23" N	72°54'20" W	#012	#028	Active
#034	George Street @ Temple Street	New Haven Harbor	41°17'45" N	72°54'58" W	#025	#034	Active

1.4 Written Procedures and Schedules for Routine, Periodic Maintenance of Major Equipment, and CSO Diversion Facilities

NMC 1 also requires written procedures and schedules for routine, periodic maintenance of major equipment and CSO diversion facilities, with a focus on preventive maintenance (PM). The GNHWPCA's CMMS documents procedures, schedules, and status of performed and required maintenance with a focus on PM for all the GNHWPCA's facilities. In addition, the GNHWPCA's 2011 *Capacity, Management, Operations, and Maintenance (CMOM) Plan* provides goals and programs for collection system inspections and maintenance.

The GNHWPCA's CMOM Plan is being updated to reflect the findings of the GNHWPCA's comprehensive CMOM Program Assessment (completed in February 2016) as documented in its CMOM Corrective Action Plan (completed in April 2016). The updated CMOM Program Manual is scheduled to be submitted to the EPA and the CT DEEP in April 2017. These enhancements include implementing a more proactive hydrogen sulfide monitoring and control program, FOG education program targeted toward residential establishments, siphon and pressure sewer cleaning and inspection program, and force-main performance monitoring.

1.4.1 Preventive Maintenance

The Authority's Collections Lead will create a CMMS work orders for Sub Sewer Sheds and provide identifying mapping for Stick Camera Assessment work to be performed as part of our Preventative Maintenance Program.

- The Collections Facility Maintainers Crew are assigned CMMS work orders from their Collections System Leads accompanied by mapping of sub sewer sheds to Performs Stick Camera Inspections.
- The Collections Crew will identify these Stick Camera Inspections by Asset ID and load this information into one of the Authority's field computers.
- The Collections Crew records information identifying issues based on NASSCO MACP/LACP ratings along with data required within the Field Identification Form.
- This information is uploaded and integrated in the field to the Authority's GIS program which contains the age, condition, materials, and the last date of inspection of each element of the collection system.
- The Facility Maintainer performing the Stick Camera inspection may identify issues that may need immediate attention and are required to notify the Collections Lead who will use the CMMS work order system to create a follow up work order to address these issues (i.e. Blockages, Surcharged System, Compromised Pipe, or Structures).
- Stick Camera Assignments will also determine areas where the Authority's manhole structures are buried, or damaged and in need of repair or replacement.
- The ongoing Manhole Raising Program identifies 175 manhole structures per year which need raising or replacement.
- Manholes to be raised or replaced are assigned to the Authority's contractor through the CMMS work order system and accompanied by a map identifying the asset id.

- The Manhole Structures identified during the Stick Camera Inspections as buried and failed will automatically generate a new follow up work order. These follow up work orders are accessed once the Authority's contractor has raised the structure and access is available.
- The Facility Maintainer upon completion of the requested stick camera work order will close out this work order and turn over the information to the Authority's Engineering Department for evaluation.
- The Engineering Department will determine which Stick Camera information may require follow-up CMMS work orders (i.e. Manhole raising, CCTV Inspections, Map Errors, Cleaning, Repair, or Replacement).

The following sections summarize GNHWPCA's maintenance procedures for specific components of the overall system.

1.4.2 Collection System Maintenance

The Collections Crew or an Authority's Consultant identifies areas within the Collections System which may require a follow up CMMS work order for rehabilitating or replacing sewers to address operational problems, such as blockages, or structural problems and reports back to the Collections Department Leads. Sewers experiencing operational or structural problems can be identified through Hot Spot Evaluations, Stick Camera Inspections, I/I Studies, SSESs, Root Intrusion Treatments, Heavy Grease Removal, CCTV Inspection, Follow up Cleaning and Visual Inspections.

The Collections Leads create a follow up CMMS work order which defines deficiencies within our system. The Collections Leads and the Collections Crew meet with the Collections System Superintendent to identify sewers which may need rehabilitation and or replacement. The Collections System Superintendent or the Collections System Leads identify these deficiencies and submit a report within the CMMS based off the NASSCO PACP/MACP/LACP ratings and turn over these reports to the Authority's Engineering Department. The Collections System Superintendent reviews the CMMS rehabilitation work orders and identifies the emergency replacement CMMS work orders. The Collections System Superintendent addresses emergency replacement CMMS work orders by creating a failure of that asset which will create a new work order in the CMMS system which will be assigned to the Authority's Engineering Construction Manager. The Engineering Department then procures a Contractor to rehabilitate or replace the sewers experiencing operational or structural problems. This program has proven effective at identifying, rehabilitating, and replacing sewers with operational or structural problems.

1.4.3 Pump Stations

The Authority uses a Computerized Maintenance Management System (CMMS) to ensure routine inspections and maintenance is performed consistently. Preventative Maintenance Schedules (PMs) have been systematically developed for each of the Pump Stations. These PMs automatically generate work orders on pre-determined schedules to be completed by the Authority's personnel and Maintenance Contractor. The Work Orders include checklists for the maintenance staff and operators to complete. A record of all results is maintained in the CMMS. A corrective maintenance (CM) work order is generated for any items that required follow-up or repair.

Comprehensive Condition Assessments are generally performed on 5-year intervals by an Independent Outside Engineering Firm. The most recent Comprehensive Condition Assessment was performed on December 2011. Condition Assessments are used to assist in preparation of the 5-year Capital Plan. Weekly and monthly inspections help us to identify capital projects to maintain reliability. Major Maintenance Repairs and Capital Replacement are executed through our on-site maintenance contractor with approval by the Authority.

All pumps Stations are inspected on a minimum of weekly basis by a staff dedicated to pump station operation and inspections. Larger pump Stations are inspected are inspected more frequently (up to 3 times a week). Checklists and PM Work Orders are completed and work order requests are promptly submitted for any items requiring attention.

The Authority has Emergency Generators available at all its large and mid-sized pump stations (above 10 HP) except for the State and Union Pump station. Emergency power can be supplied to the State and Union Pump Station via two of the Authority's 150 KW trailer mounted portable generators. There are 11 small pump station (10 HP or less) which do not have permanently installed generators. These Stations may be maintained during a power outage by the Authority's 35KW portable generator, Vac-truck, or Authority owned portable diesel pumps (3) or vactor contractors.

The Authority has a well-defined hierarchy of incident command and control during emergencies. There are positions which are defined to dispatch resources to suit the conditions of the emergency. There is no formal plan to dispatch mobile resources to the pump Stations during a system-wide power failure.

All the Authority's Pump Stations contain at least one installed redundant pump and can maintain Station pump capacity with one pump out of service. The Truman CSO tank does not have an installed redundant pump but has a spare pump which can be readily swapped with the installed pump if it fails.

Any issues are addressed by assigning a corrective work order. Management monthly reviews the Equipment Status of all pump Stations to ensure issues are being addressed on a timely basis and the proper resources are assigned. The Grit Collectors located at the East Street and Boulevard Pump Stations have proven to be unmanageable to maintain reliability. The Authority currently has a project to replace the current failure current failure prone bucket and chain system with a Screw Conveyor type system. It should be noted that the current Long Term Control Plan eliminates grit collection at the pump stations and provides for consolidated grit collection at the East Shore Water Pollution Abatement Facility.

1.4.4 Siphons

Cleaning and CCTV inspection of over 7,000 feet of large diameter sewers (between 44 and 60 inches' nominal diameter) along Front and River Streets from Pine Street (closed Regulator 019) to the James Street Siphon began in May 2016 and was completed in November 2016. Over 800 cubic yards of debris were removed from the sewer. Cleaning and CCTV inspection of the James Street Siphon is currently underway and is expected to be completed in December 2016.

The Greater New Haven WPCA Collections Department completed cleaning the other seven of the Authority's siphons in 2016 to establish a starting point for the Siphon Preventative Maintenance Program in 2017.

The Siphon Preventive Maintenance Program includes;

- Self-generating work orders within our CMMS system to clean the Short Beach Road siphon in East Haven every six months.
- Self-generating work orders within our CMMS system to clean the Whitneyville siphon in Hamden every year.
- Self-generating work orders within our CMMS system for semi-annual stick camera inspections for the other five siphons (followed by cleaning if required).
- Self-generating work orders within our CMMS system for annual siphon cleaning for the other five siphons.

1.4.5 Force Mains

FORCE MAIN PERFORMANCE ASSESSMENT

The Authority utilizes pump station flow monitoring data from our SCADA system and amp readings recorded during our routine pump station inspections to assess the performance of our thirty force mains. A reduction in pump station pumping capacity or an amp reading which is out of range will trigger a Work Order in our CMMS to investigate and correct the cause of the problem.

AIR RELEASE VALVES

The Authority has developed procedures to inspect and maintain our eight air release valves on an annual basis. These PMs will reside and be tracked in our CMMS system.

INLINE VALVES

The Authority has a program to inspect and maintain our five in-line valves that are over 24 inches in diameter on an annual basis. These activities are tracked in our CMMS system.

FORCE MAIN STRUCTURAL CONDITION ASSESSMENT

As a first step toward development of a proactive program to assess the structural condition of our 9.41 miles of force mains, the Authority has hired CH2MHill to prepare a matrix of alternative technologies available to perform these structural condition assessments. This work was completed on June 30, 2016.

Based on the alternative technologies available to perform these structural condition assessments, the Authority will develop and implement a proactive force main structural condition assessment program for our 9.41 miles of force mains beginning in 2017, as required.

CATHODIC PROTECTION

The three-mile-long ductile iron force main from the Boulevard and East Street Pumping Stations to the ESWPAF is equipped with a cathodic protection (CP) system. CP is the application of direct current to polarize or shift the electrochemical voltage of a metallic surface to a point where the driving force for the corrosion reaction is eliminated. The 36-inch diameter ductile iron force main from the Boulevard Pump Station to East Street Pump Station is 6,806 feet long and was constructed in 1985. The 42 and 48-inch diameter ductile iron force mains from the East Street Pump Station to the Harbor Crossing are 3,536 feet long and were constructed in 1983. The twin barrel 42-inch diameter ductile iron and HDPE force mains under New Haven Harbor were replaced in 2008. The ductile iron portion of each barrel under New Haven Harbor is approximately 340 feet long and is protected by the CP system. The HDPE portion of each barrel is approximately 1785 feet long and is not protected by the CP system. The 48-inch diameter ductile iron force main from the Harbor Crossing to the ESWPAF is 5,497 feet long and was constructed in 1983.

The CP system consists of five impressed current cathodic protection system rectifiers located at Boulevard Pump Station, East Street Pump Station, one at each end of the Harbor Crossing and at the ESWPAF. There are test stations which allow for monitoring the effectiveness of the CP system. In 2012, the Authority hired Corrosion Probe, Inc. to conduct an inspection of the condition of the CP system and make recommendations for improvements to the CP system. Implementation of those improvements is currently underway as part of the ESWPAF upgrade project. The construction is scheduled to be complete in May 2017.

The installation of additional test stations, after completing improvements to the CP system, was also recommended. The Authority intends to hire an outside contractor to conduct annual monitoring of the CP system once these additional test stations are installed.

1.4.6 Regulators and Tide Gates

The Authority owns and maintains five duckbills on four of our CSO Outfalls. The duckbills were installed between 2010 and 2014 to replace aging tide gates. The duckbills are located at CSO Outfalls 015, 016, 021 and 024. There are two duckbills on CSO Outfall 024.

Each of the five duckbills is inspected on monthly basis. Any deficiencies noted will trigger a Work Order in our CMMS to investigate and correct the cause of the problem.

1.5 Written Procedures for Emergency Response

The Emergency Response Plan (ERP) was developed by the Greater New Haven WPCA to strengthen the Authority's ability to effectively respond to and rapidly recover from a range of emergencies. The ERP expands upon emergency response material previously developed for the GNHWPCA, incorporating significant new elements specifically tailored for the GNHWPCA. The ERP is intended to be a consolidated response reference for the full range of potential emergency conditions the GNHWPCA faces. It also is meant to be a living document, regularly updated as new incidents generate "lessons learned" that should inform changes.

1.5.1 Purpose of this Plan

The purpose of this plan is to provide a set of guidelines to GNHWPCA staff to aid in executing a rapid, effective response to and rapid recovery from emergency conditions. Toward that objective, this ERP provides specific guidance in three core aspects of emergency response tailored to the GNHWPCA system:

1. Identifies the GNHWPCA person responsible for coordinating the emergency
2. Provides response procedures for various asset types
3. Describes an internal and external communications process

The Plan is premised on the well-established principle that effective emergency response requires a commitment to preparation. Accordingly, the plan provides recommendations for measures to be implemented prior to an emergency to better facilitate the GNHWPCA response when emergency conditions arise. These recommendations are provided for both long range planning and training purposes.

No ERP can be a substitute for sound judgment and the need to often improvise during times of crisis. At its best, it should serve as a highly-regarded resource, consulted during each step of an emergency to reduce the risk that key aspects of the response have been overlooked.

1.6 Policies and Procedures for Training O&M Personnel

An O&M program includes policies and procedures for training new O&M personnel. GNHWPCA provides technical training to the O&M staff on an annual basis. Collection system certifications are documented and reported annually. Contractors are required to provide to, maintain and track appropriate training for their employees for any contracted work and to comply with GNHWPCA's health and safety and training policies. GNHWPCA's training and safety program has proven effective at providing proper training and safety equipment for all the GNHWPCA staff involved with CSS operation and maintenance. The following provides an overview of the GNHWPCA's training and safety program.

1.6.1 Training and Safety Programs

GNHWPCA uses outside contractors and online certification programs to implement the following training and safety programs:

- Water Environment Association Certification
- Fork Lift Operators Permit
- Confined Space Entry
- OSHA 10 Hour Certification
- NASSCO PACP/MACP/LACP
- Flagger Training
- Smith Driving Course, Forward, Backup, and Distracted
- SSO Estimating & Reporting Training
- Weekly Tailgates
- Hazard Communications Material Safety Data Sheet (MSDS)
- Lockout / Tag-out
- Excavation / Trenching
- Bloodborne Pathogens
- CPR & First Aid

1.6.2 Safety Equipment

GNHWPCA's Safety Committee reviews all standard operating procedures (SOPs) and field procedures and provides recommendations for improvement through an after-action analysis. This program has proven effective at providing proper training and safety equipment for all GNHWPCA's staff involved in collection system O&M. The following equipment is required and used in daily operations of GNHWPCA's collections crew:

- Personal PPE
  - gloves
  - boots
  - hard hats
  - safety glasses
- Safety cones
- Road signs
- Strobe lights
- Retrieval Tripod and Harness
- Fall protection equipment
- Hazardous atmosphere gas meters
- Manhole ventilator and tubing
- Flashlights
- Two-way radios
- CDL vehicle backup cameras

1.7 O&M Program Review and Revision

The GNHWPCA's CMMS documents procedures, schedules, and status of performed and required maintenance with a focus on PM for all the GNHWPCA's facilities. In addition, the GNHWPCA's 2011 *Capacity, Management, Operations, and Maintenance (CMOM) Plan* provides goals and programs for collection system inspections and maintenance.

The GNHWPCA's CMOM Plan is being updated to reflect the findings of the GNHWPCA's comprehensive CMOM Program Assessment (completed in February 2016) as documented in its CMOM Corrective Action Plan (completed in April 2016). The updated CMOM Program Manual is scheduled to be submitted to the EPA and the CT DEEP in April 2017. These enhancements include implementing a more proactive hydrogen sulfide monitoring and control program, FOG education program targeted toward

residential establishments, siphon and pressure sewer cleaning and inspection program, and force-main performance monitoring.

The GNHWPCA's Computerized Maintenance and Management System (CMMS) maintains and monitors performance of the critical facilities. The GNHWPCA's Geographic Information System (GIS) maintains information on the sewer collection system piping and related CSS control structures. GNHWPCA staff have remote global position systems (GPS) access to the GIS information to readily facilitate O&M or emergency response when in the field.

The GNHWPCA's CSO flow monitoring program (initiated in 2012) measures, on a continuous basis, the flows to the CSO regulators and at the CSO outfalls. This flow monitoring program provides GNHWPCA with data to measure and further evaluate performance of these critical facilities.

GNHWPCA's CMMS, GIS and flow monitoring program have proven highly effective at monitoring and maintaining the GNHWPCA's critical facilities as well as assisting in managing customer service requests, incorporating work crew observations into collection system conditions reports and bypass reports, timely performance, and documentation of all required bypass notifications, conduct of preventative maintenance and coordination of rehabilitation and replacement projects. These tools are updated continuously to reflect the most current information.

SECTION 2

NMC 2 – Maximization of Storage in the Collection System

The objective of NMC 2 is to enact simple CSS modifications to improve wet weather flow storage such that excess flow is retained in the system until downstream sewers and treatment facilities are ready to convey and treat the flows. Implementing this NMC involves identifying possible locations where minor modifications can be made and subsequently analyzing each potential modification to ensure that it will not cause problems and only benefit the collection system. Possible modifications include removing accumulations of debris or sediment; replacing undersized sections of pipe; identifying and repairing malfunctioning regulators or broken weirs; inspecting, maintaining, and repairing duckbills; adjusting regulator settings; upgrading and adjusting pump operations at interceptor lift stations; and removing other flow obstructions.

The GNHWPCA uses data from the CSO flow monitoring program, CSO regulator, outfall, and duckbill inspection program; collection system hydraulic model (updated in 2015); large diameter sewer cleaning program, and sanitary sewer overflow (SSO) bypass reports to evaluate and maximize the capacity of the collection system and cost effectively implement its LTCP. This program has proven effective at reducing CSO volumes by more than 66 percent (from 125.93 million gallons (MG) in 1997 to 43.3 MG in 2015 during the Typical Year (as defined in the 2001 LTCP)). Furthermore, the proposed Intermediate-Term Control Plan (ITCP) projects (as defined in the 2016 LTCP Update) are expect to reduce CSO volumes by an additional 30.5 MG to 12.8 MG.

GNHWPCA also has an ongoing program to fund and implement infiltration and inflow studies, sewer system evaluation survey's and sewer rehabilitation projects. The purpose of these projects is to reduce extraneous flows into the sanitary sewer collection system and ultimately to the East Shore WPAF to further maximize conveyance and treatment capacity at the East Shore WPAF.

2.1 Minor CSS Modifications

The initial inception of CSOs (more than a century ago) was to eliminate basement and street flooding during high intensity rainfall events while degradation of receiving water quality was not a concern. For this reason, modern day operation parameters inherited from original design is still reminiscent of the original design concept even after alteration of the sewer system in recent day. Coupled with modern analytic techniques (modeling, investigation, sensing, etc.), evaluation of sewer system performances can be extended to an unprecedented level of details to aid the decision maker in achieving the cost-effective abatement objects for CSO reduction. Primarily, regulators designed in the Late 1800s and early 1900s can now be modified/closed to achieve the maximum potential in-system storage while not putting basements or streets at risk. The Authority utilizes data from our CSO Flow Monitoring Program and our 2014 hydraulic model of our CSS to make decisions about minor CSS modifications.

GNHWPCA has successfully closed seven CSO outfalls, closed eleven regulators and raised weir elevations at another six regulators since 2005. The CSO outfall closures and regulator improvements are listed below.

- Closed CSO 002
- Raised the weir at REG 004 by 8 inches
- Raised the weir at REG 005 by 1.45 feet
- Closed REGs 005A and 005B
- Closed CSO 008

- Raised the weir at REG 009 by 8 inches
- Closed CSO 010
- Raised the weir at REG 012 by 6 inches
- Closed CSO 013
- Closed REG 013A
- Closed REG 014
- Closed CSO 019
- Closed REG 021A
- Raised the weir at REG 024 by 1.56 feet
- Closed REGs 025A and 025B
- Closed CSO 027
- Closed REG 031
- Closed REG 032
- Closed REG 033
- Raised the weir at REG 034 by 2 feet
- Closed CSO Greene
- Closed REG Middletown/Front

2.2 Wet Weather Pumping Capacity Upgrades

Increasing the wet weather pumping capacity at the East Street, Union, and Boulevard pump stations and increasing the wet weather treatment capacity at the East Shore WPAF are integral components of the approved CSO LTCP. The $60M Construction of Phase 1 improvements at the East Shore WPAF are underway and are scheduled to be completed in 2017. The 2016 CSO LTCP Update includes a detailed evaluation of improvements required to increase the wet weather pumping capacity at East Street from 30 mgd to 65 mgd, Union from 15 mgd to 35 mgd, and Boulevard from 30mgd to 45 mgd. These Intermediate-Term improvements are scheduled to begin in 2018 and be completed by 2028. However, these pump stations will be held at their current capacities until the Phase II Wet Weather Capacity Upgrades at the East Shore WPAF have been completed.

2.3 Storm Drain System Capacity Upgrades

Also as part of the LTCP, the City of New Haven has hired a consultant to develop a long-term plan to increase the capacity of the storm drain system around Regulator 025, which will eliminate stormwater inflow at REG 025 and 034 and provide CSO capacity for storms between a 2 year and 10-year return frequency.

GNHWPCA has also developed a Short-Term improvements project to close REG 034 and raise REG 025 by 9.15 feet to eliminate stormwater inflow into the CSS. This project is expected to be completed by 2018.

The City of New Haven has also began introducing green infrastructure projects throughout the City in both separated and combined sewershed to further decrease the stormwater inflow to both systems.

GNHWPCA will construct75 bioswales along City streets during the Short-Term Control Plan in the West River sewershed by 2018.

GNHWPCA, in conjunction with the City of New Haven, has an aggressive green redevelopment program that requires all new development (commercial, institutional, multi housing etc.) in a combined sewer area to be able to capture and retain the 2-year, 6-hour storm on their property. This reduces the stormwater entering the CSS. Technologies employed to detain the 2-year, 6-hour design storm includes infiltrators and drywells, rain water storage tanks, bioswales and tree wells, and water features. Since

2008, the GNHWPCA has approved 30 green redevelopment projects which have effectively separated 50 acres of combined sewer area. These green redevelopment projects have reduced CSO events by 7 per year and CSO volume by 3.3 MG per year. The green redevelopment program is being implemented at no cost to GNHWPCA rate payers.

2.4 Large Diameter Sewer Cleaning and Television Inspection

To increase conveyance and storage in the interceptors and trunk sewers, as well as reduce CSOs, GNHWPCA entered a 4-year contract in 2014 with an outside contractor to perform cleaning and television inspection of 100,000 feet of large diameter sewers with nominal diameters between 25 and 82 inches. Between 2014 and 2016, the contractor completed cleaning and CCTV of over 14,000 feet of the Boulevard Trunk Sewer and 7,000 feet of the Front Street and River Street sewers in Fair Haven. Over 1,500 cubic yards of sediment and debris have been removed from these large diameter sewers to date. Work is expected to continue in 2017.

SECTION 3

NMC 3 – Review and Modification of Pretreatment Requirements

The objective of NMC 3 is to locate and minimize the contributions of nondomestic (industrial and commercial) discharges to CSOs by modifying inspection, reporting, and oversight procedures within the approved pretreatment program. Implementing NMC 3 involves the following three steps:

1) Inventory the flow volume, pollutant types, and discharge concentrations of nondomestic discharges to the CSS.
2) Assess the impact of each nondomestic discharge on CSOs.
3) Evaluate feasible modifications for eliminating the nondomestic discharge.

To implement this NMC, GNHWPCA has implemented a two-phased approach to inspecting and regulating industrial and commercial discharges as follows:

1) Inventory and permitting of all Food Service Establishments
2) Permitting and Inspection of all Commercial and Industrial discharges to the East Shore WPAF.

The GNHWPCA has three full-time Industrial Pretreatment Program (IPP) employees dedicated to enforcing the FOG and Industrial Discharge Permit program. All Class 3 and 4 restaurants are required to be in compliance with the CT DEEP General Permit for the Discharge of Wastewater Associated with Food Service Establishments, and must receive a sign-off by the Industrial Pretreatment Department (IPP) Coordinator indicating compliance, prior to the applicable health department granting a food service license. All restaurants are inspected three to four times a year to enforce best management practices (BMPs) and to ensure proper maintenance of grease interceptors and automatic grease recovery units (AGRUs). To ensure these regulations are reinforced, after an inspection, posters are hung in all kitchens reminding employees not to pour fat, oil, or grease down the drain. Currently, over 96 percent of the restaurants in the region are compliant.

New Haven requires that all producers of industrial discharges apply for a permit from the GNHWPCA, excluding commercial businesses such as restaurants, automobile dealers, etc. The pretreatment program staff visits each permitted facility at least four times per year to inspect the facility, discuss problems or initiatives to ensure that program requirements are being followed, and to take samples, as appropriate. In 2016, the GNHWPCA had approximately 110 industrial accounts, of which approximately 70 are located within the City of New Haven.
Commercial and industrial dischargers are required to monitor and sample discharges on a predetermined frequency and report those analytical results to both CT DEEP and GNHWPCA.

3.1 Food Service Establishments

Discharges from food service establishments have historically caused sanitary sewer disruptions and contributed to CSOs due to the discharges of FOG from normal daily operations. These establishments must comply with the CT DEEP's General Permit for the Discharge of Wastewater Associated with Food Preparation Establishments that became effective September 30, 2005. This regulation requires either the installation of outdoor, in-ground grease traps/interceptors, or the use of an AGRU. This program has proven effective relative to controlling FOG from restaurants in our service area. GHNWPCA requirements for FOG control and discharge are described in subsequent sections.

3.1.1 Pre-installation Requirements for Grease Traps

GNHWPCA requires that engineering drawings (site plans and/or utility plans showing the connection to the sewer and the location of the grease trap/interceptor) prepared and signed by the food preparation establishment's CT licensed professional engineer be submitted to the GNHWPCA Engineering Department for review and approval. The Owner, or his designated Engineer, is also required to submit sizing calculations demonstrating that the unit chosen is adequate for the food service establishments use based on facility size.

A GNHWPCA permit is required for the installation of an in-ground grease trap/interceptor.

The GNHWPCA also requires the installation of a backwater valve and a cleanout downstream from the grease/trap interceptor. The grease trap/interceptor shall be installed on 8 inches of bedding material, Item 305, per GNHWPCA Sewer Standards.

3.1.2 Automatic Grease Recovery Units (AGRUs)

The food service establishment is required to submit sizing calculations for review by the GNHWPCA's IPP Coordinator. The sizing calculations must be consistent with the Fixture-Based Method found in the Connecticut Department of Environmental Protection's Sizing Criteria, and may be prepared by the AGRU's distributor. The IPP Coordinator may require additional documentation such as a floor plan or other facility details as may be appropriate to ascertain the suitability of the installation.

The installation must include a sampling port located after the AGRU so that a GNHWPCA IPP inspector can take representative samples of the wastewater flow from the AGRU. It is recommended that arrangements be made for the plumber who will install the AGRU to meet with one of the GNHWPCA IPP Inspectors to discuss the requirements before the work starts.

3.2 Residential FOG Program

While it is easier to monitor, and control the grease coming from restaurants, residential neighborhoods pose different challenges. Education is more effective than inspection. To address problem areas and blockages in residential neighborhoods, GNHWPCA has developed a residential FOG education program that includes:

- Identifying target areas through Hot Spot Evaluations.
- Distributing door hangers on all home upstream of identified hot spots. The GNHWPCA has developed an informational door hanger and has purchased can lid tops that are hung in tandem with the door hangers as a tool to aid in proper grease disposal (see Appendix 2).
- Notifying and educating residents via issuance of an information letter from the GNHWPCA's IPP Coordinator to all customers upstream of any grease blockage which may have caused a SSO.
- Including, on a periodic basis, FOG education materials as inserts with billing statements or within newsletters.

3.3 FOG Disposal

FOG cannot be discharged into the GNHWPCA's collection system, however, FOG collected from grease traps and AGRUs can be disposed of at the GNHWPCA's FOG receiving area located at the East Shore WPAF, where it is separately processed and then used to offset fuel costs at the GNHWPCA's Multiple Hearth combustor located at the East Shore WPAF.

The GNHWPCA currently processes approximately 4 million gallons a year in FOG from within our service area and other area sources. The FOG replaces about 200,000 hundred cubic feet (CCF) of Natural Gas consumption for the Multiple Hearth combustor.

3.4 Commercial and Industrial Discharges

Discharges from commercial and industrial facilities must obtain a permit from CT DEEP with appropriate approval from GNHWPCA to be authorized to discharge industrial waste to the sanitary sewer. Each permit issued requires the following activities and components:

1. File a discharge report, which must include, but not be limited to, nature of process, volume, rates of flow, production quantities, or any other information that is deemed relevant by the Executive Director to the generation of waste, including substances and concentrations in the wastewater discharge.
2. Submit a plan showing location and size of onsite sewers, sampling point, pretreatment facilities, public sewers and any other information required by the Executive Director.
3. Describe activities, facilities, and plant processes on the premises discharging or proposing to discharge industrial wastewater including all materials, processes, and types of materials that are or proposed to be discharged.
4. List each product produced by type, amount, and rate of production.
5. Provide the chemical components and quantity of liquid or gaseous material bulk stored onsite, even though they may not normally be discharged into the sanitary sewer system.
6. Provide additional information or reports as may be required by the Executive Director.

An annual report shall be submitted by each permittee certifying that there have been no changes in operational procedures, or if there have been such changes, furnishing information thereon in such detail as may be required by the GNHWPCA. Failure to submit such a report shall constitute cause for the suspension or revocation of the industrial waste discharge permit. In the event a permit is canceled for any reason under the provisions hereof, a fee, as revised from time to time, shall be charged for a subsequent initial permit issued to such applicant on completion by the applicant on forms provided by the GNHWPCA, and approval of such application by the Executive Director.

Pretreatment at the discharger's facility may be required when GNHWPCA determines that discharge of the waste will cause an upset at the East Shore WPAF resulting in loss of treatment capacity or exceedance of the East Shore WPAF permit for discharge. Pretreatment via the permitting process may also be required of industrial dischargers when modifications occur within the GNHWPCA's discharge permit where the individual discharger's constituents reasonably could cause an exceedance of the GNHWPCA's discharge permit.

SECTION 4

NMC 4 – Maximization of Flow to the Publicly-Owned Treatment Works (POTW) for Treatment

The objective of NMC 4 is to implement simple modifications to the CSS and treatment plant to enable as much wet weather flow as possible to reach the treatment plant.

The Authority uses data from the CSO flow monitoring program; CSO regulator, outfall, and duckbill inspection program; collection system hydraulic model (updated in 2014); and SSO bypass reports to evaluate the capacity of critical elements of our collection system. This program has proven effective at confirming that the Authority has no unauthorized bypasses from our collection system during wet weather events.

As part of maximizing the wet weather storage and treatment, GNHWPCA is in the process of implementing the New Haven LTCP, which is being updated every five-years. The 2011 LTCP Update detailed the East Shore WPAF expansion to maximize wet weather treatment. The 2016 LTCP update includes plans for CSO regulator modifications and upgrades at the East, Union, and Boulevard pump stations to maximize wet weather capture, conveyance, and treatment.

All the pump stations existing or future capacities are shown in Table 5. GNHWPCA is continuing to provide maximum capacities at these pump stations through routine O&M activities. The Authority uses a Computerized Maintenance Management System (CMMS) to ensure routine inspections and maintenance is performed consistently. Preventative Maintenance Schedules (PMs) have been systematically developed for each of the Pump Stations. These PMs automatically generate work orders on pre-determined schedules to be completed by the Authority's personnel and Maintenance Contractor. The Work Orders include checklists for the maintenance staff and operators to complete. A record of all results is maintained in the CMMS. A corrective maintenance (CM) work order is generated for any items that required follow-up or repair.

Table 5. Active Pump Station Capacities

Pump Station	Address	Pumps	Capacity (MGD)	VFD
East Street	1 East Street Extension	3	65.0	
Boulevard	17 Sea Street	3	45.0	Y
Morris Cove	1217 Dean Street	4	18.0	
Union	1 State Street	4	35.0	
Quinnipiac	1040 Quinnipiac Avenue	4	5.2	Y
Barnes Avenue	345 Middletown Avenue	2	4.0	Y
Long Wharf	17 Sea Street	2	1.7	Y
Old Grand Avenue	441 Grand Avenue	2	1.0	
Mitchell Drive	125 Mitchell Drive	2	1. 2	
Fort Hale	25 Woodward Avenue	2	0.4	
Market Street	135 Market Street	2	0.3	
Stone Street	19 Stone Street	2	0.8	
West Rock	355 West Rock Avenue	2	0.3	

Table 5. Active Pump Station Capacities

Pump Station	Address	Pumps	Capacity (MGD)	VFD
Humphrey Street	145 Humphrey Street	2	0.3	
New Grand Avenue	535 Grand Avenue	2	0.1	
Welton Street	151 Welton St.	1	0.4	
Lighthouse Point	Lighthouse Point	2	1.1	
Truman Dewater	Storage Facility	1	5.0	
East Shore WPAF Influent	East Shore WPAF	1	50.0	Y

GNHWPCA implemented its flow monitoring program in 2012 and has since installed continuous flow monitoring devices at CSO regulators for all active CSO outfalls.. CSO flow metering services are provided under contract with CSL Services, Inc.

GNHWPCA monitors the daily, monthly, and annual CSO volumes at each CSO and reports them to CT DEEP. The East Shore WPAF also has an influent meter and an effluent meter. GNHWPCA reviews and analyzes the flow meter data to update the hydraulic model, develop projected flows at the pump stations and maximize flows to the East Shore WPAF.

SECTION 5

NMC 5 – Elimination of CSOs during Dry Weather

The objective of NMC 5 is to eliminate dry weather overflows (DWOs).

5.1 DWOs in GNHWPCA's Jurisdiction

The Authority initiated the combined sewer overflow (CSO) Flow Monitoring Program. CSL Services collects data from 32 depth and velocity meters and one rain gauge owned by GNHWPCA. The meters are deployed to continuously monitor our 17 active CSO Regulators and 13 active CSO Outfalls. Engineering monitors the data, which is posted on CSL's website, in real time. If a CSO DWO did occur, the Authority would be able to respond to the situation immediately.

Each month, CSL submits a report to Engineering which details rainfall events and CSO volumes and durations at each CSO Outfall. Engineering reviews the monthly report to provide quality assurance and quality control. Engineering then prepares a summary report for the month which is submitted to the Connecticut Department of Energy and Environmental Protection (DEEP) each June 30th as a part of our Annual Report which is required under our Consent Decree.

A summary of the current meter locations is included below.

0F-003 SEWER AND OVERFLOW

- Meter OF-003 Sewer was installed in the 72 inch wide by 67 inch high sewer downstream of REG 003 on 6/5/12 at an invert elevation of 1.34 (overflow depth is 46 inches)
- Meter OF-003 Overflow was installed in the 54 inch overflow pipe on 6/5/12 at an invert elevation of 1.70
- The regulator consists of a 5 foot long transverse weir
- CSO start and stop times are based on a depth greater than 46 inches at Meter OF-003 Sewer and positive velocities at Meter OF-003 Overflow
- CSO volumes are calculated based on depths and velocities at Meter OF-003 Overflow, the hydraulic elements chart and the Continuity Equation
- There is significant tidal influence at Meter OF-003 Overflow

0F-004 SEWER AND OVERFLOW

- Meter OF-004 Sewer was installed in the 72 inch wide by 64 inch high sewer downstream of REG 004 on 6/6/12 at an invert elevation of 3.00 (overflow depth is 43 inches)
- Meters OF-004 Overflow was installed in the 5 foot wide by 3 foot high box culvert overflow on 6/6/12 at an invert elevation of 3.01
- The regulator consists of three weirs, each two feet wide. The weirs were raised 8 inches on 7/25/14 to elevation 6.59
- CSO start and stop times are based on a depth greater than 43 inches at Meter OF-004 Sewer and positive velocities at Meter OF-004 Overflow
- CSO volumes are calculated based on depths and velocities at Meter OF-004 Overflow, the hydraulic elements chart and the Continuity Equation

0F-005 SEWER AND OVERFLOW

- Meter OF-005 Sewer was installed in the 60 inch wide by 57 inch high sewer at REG 005 on 6/7/12 at an elevation of 4.27 (5 inches above the invert due to sediment) (overflow depth is 72 inches)
- Meter OF-005 Overflow was installed in the 48 inch overflow pipe on 6/7/12 at an invert elevation of 7.35 downstream of the 36 inch drain connection
- Meter OF-005 Overflow was reinstalled in the 48 inch overflow pipe on 11/17/13 at an invert elevation of 7.35 upstream of the 36 inch drain connection
- A new overflow weir was constructed on 7/25/14 at an elevation of 10.25
- CSO start and stop times are based on a depth greater than 72 inches at Meter OF-005 Sewer and positive velocities at Meter OF-005 Overflow
- CSO volumes are calculated based on depths and velocities at Meter OF-005 Overflow, the hydraulic elements chart and the Continuity Equation

0F-006 SEWER, OVERFLOW AA AND OVERFLOW BB

- Meter OF-006 Sewer was installed in the 36 inch sewer upstream of the two overflow pipes on 6/4/12 at an invert elevation of 7.20 (overflow depth is 27 inches)
- Meters OF-006 Overflows AA and BB were installed in the twin 24 inch overflow pipes on 7/30/12 at an invert elevation of 9.49
- CSO start and stop times are based on a depth greater than 27 inches at Meter OF-006 Sewer and positive velocities at Meters OF-006 Overflows AA and BB
- CSO volumes are calculated based on depths and velocities at Meters OF-006 Overflows AA and BB, the hydraulic elements chart and the Continuity Equation

OF-009 SEWER AND OVERFLOW

- Meter OF-009 Overflow was installed in the 30 inch wide by 45 inch high overflow pipe on 10/3/12 at an invert elevation of 2.65
- The regulator consists of a 5.5 foot long weir at an elevation of 4.65. The weir was rebuilt on January 27, 2013. The overflow was raised 8 inches to elevation 5.32 on 6/23/15.
- Meter OF-009 Sewer (FM-19) was installed in the 35 inch wide by 52 inch high sewer one manhole upstream of REG-009 on 7/21/15 at an invert elevation of 2.81 (overflow depth is 30 inches)
- CSO start and stop times are based on a depth greater than 30 inches at Meter OF-009 Sewer (FM-19) and positive velocities at Meter OF-009 Overflow
- CSO volumes are calculated based on depths and velocities at Meter OF-009 Overflow, the hydraulic elements chart and the Continuity Equation
- There is significant tidal influence at Meter OF-009 Overflow

REG 010A (CSO 011)

- Meter REG 010A was installed in the 54 inch sewer at REG 010A on 12/20/12 at an invert elevation of 7.42 (overflow depth is 62 inches)
- The regulator is a 114 inch wide weir at elevation 12.62
- CSO start and stop times at REG 010A are based on a depth greater than 62 inches at Meter REG 010A
- CSO volumes at REG 010A are calculated based on depth over the 114 inch weir at REG 010A using the weir formula

REG 011 (METERS 0F-011-997, 609, 631 AND 819) (CSO 011)

- Four meters were installed in December 2012 to estimate CSOs at REG 011
- Meter OF-011-997 was installed in the 30 inch sewer on State Street upstream of the 42 inch discharge pipe**– (THIS METER WAS REMOVED IN SEPTEMBER 2013)** Metered flows were very consistent and relatively small
- Meter OF-011-609 was installed in the 37 inch wide by 25 inch high sewer on Humphrey Street upstream of REG 011**– (THIS METER WAS REMOVED IN SEPTEMBER 2013)** Metered flows were very consistent and relatively small
- Meter OF-011-631 was installed in the 66 inch sewer on State Street upstream of REG 011
- Meter OF-011-819 was installed in the 42 inch discharge pipe downstream of REG 011 and Meter OF-011-631
- CSO start and stop times at REG 011 are estimated by subtracting the flows from the downstream meter (Meter OF-011-819) from the one upstream meter (Meter OF-011-631) (anytime the resultant flow is greater than zero a CSO is occurring)
- CSO volumes from REG 011 are estimated using the resultant flows as calculated above
- Total CSO volumes from CSO 011 are estimated by summing the CSO volumes from REG 010A, REG 011 and REG 026

REG 026 AT HUMPHREY STREET PUMP STATION

- Regulator 026 is a 10 inch overflow pipe from the Humphrey Street PS wetwell to CSO 011
- The SCADA system monitors the depth in the wetwell
- When depths in the wetwell exceed 74 inches an overflow is occurring

OF-012 SEWER

- Meters OF-012 Overflows A and B were installed in the twin 18 inch overflow pipes on 10/15/12 at an invert elevation of 13.05 **(THESE METERS WERE RELOCATED IN SEPTEMER 2014)**
- New 6 inch high weirs were installed in each 18 inch overflow pipes on 5/3/13 at an elevation of 13.65 (raising the overflow depth to 36 inches)
- The new Meter OF-012 Sewer was installed in the 36 inch wide by 55 inch high sewer, three manholes downstream of REG 012, at an invert elevation of 9.89 (overflow depth is 36 inches)
- CSO start and stop times at REG 012 are based on a depth greater than 36 inches at Meter OF-012 Sewer
- CSO volumes at REG 012 are calculated based on depth over the equivalent 1.08 foot long weir at REG 012 using the weir formula

REG 028 AT MITCHELL DRIVE PUMP STATION

- Regulator 028 is a 15 inch overflow pipe from the Mitchell Drive PS wetwell to CSO 012
- The SCADA system monitors the depth in the wetwell
- When depths in the wetwell exceed 102 inches a CSO is occurring

0F-015 US and DS SEWERS

- Meter OF-015 US Sewer was installed in the 45 inch sewer upstream of REG 015 on 10/3/12 at an invert elevation of -1.21
- Meter OF-015 DS Sewer was installed in the 48 inch sewer to the James Street siphon inlet downstream of REG 015 on 10/3/12 at an invert elevation of -2.15 (overflow depth is 40.5 inches)
- The James Street siphon was designed with a capacity of 24 MGD

- The regulator consists of a 7 foot long concrete weir at elevation 1.22
- CSO start and stop times are based on depths greater than 40.5 inches at Meter OF-015 DS Sewer
- CSO volumes are calculated by subtracting the Meter 015 DS Sewer flows from the Meter 015 US Sewer flows

0F-016 OVERFLOW

- Meter OF-016 Overflow was installed in the 48 inch wide by 60 inch high overflow pipe on 8/30/12 at an invert elevation of -0.43
- The regulator consists of a 3.8 foot long weir at an elevation of 2.35
- CSO start and stop times are based on a positive velocity at Meter OF-016 Overflow
- CSO volumes are calculated based on depths and velocities at Meter OF-016 Overflow, the hydraulic elements chart and the Continuity Equation
- There is significant tidal influence at Meter OF-016 Overflow (even though there is a duckbill)

OF-020 SEWER AND OVERFLOW

- Meter OF-020 Overflow (depth sensor) was installed in the 15 inch overflow pipe at REG 020 on 3/25/13 at an invert elevation of 12.90
- Meter OF-020 Sewer was installed in the 24 inch sewer at REG 020 on 3/25/13 at an invert elevation of 10.45 (overflow depth is 30 inches)
- The regulator is a 15 inch pipe
- CSO start and stop times are based on a depth greater than 30 inches at REG-020
- CSO volumes are calculated based on depth over the 30 inches at REG-020 using the hydraulic elements chart and the Continuity Equation

REG 021-OF AND OF-021 US SEWER (E ST PS SEWER)

- Meter OF-021 US Sewer (E St PS) was installed in the 62 inch wide by 67 inch high sewer upstream of REG 021 on 9/13/12 at an invert elevation of -0.95
- Meter OF-021 was installed in REG 021 on 11/15/12 at an invert elevation of -2.21 (overflow depth is 90 inches)
- The regulator is twin 84 inch wide steel plate weirs at elevation 5.29
- There is a duckbill on the overflow pipe
- CSO start and stop times are based on a depth greater than 90 inches at REG 021
- CSO volumes are calculated based on depth over the twin 84 inch weirs at REG 021 using the weir formula

0F-024 US and DS SEWER AND REG 024 WEIR

- Meter OF-024 US Sewer was installed in the 84 inch wide by 69 inch high sewer upstream of REG 024 on 7/30/12 at an invert elevation of -2.22 (overflow depth is 65 inches)
- Meter OF-024 DS Sewer was installed in the 48 inch sewer downstream of REG 024 on 7/30/12 at an invert elevation of -3.19 (overflow depth is 81 inches)
- Meter 024 Weir was installed to measure weir depth at REG 024 on 10/31/12 at the weir elevation of 2.99
- The regulator consists of three weirs each 4.5 feet wide

- CSO start and stop times are based on depths greater than 65 inches at Meter OF-024 US Sewer, depths greater than 81 inches at Meter OF-024 DS Sewer (verified by the Meter 024 Weir depths)
- CSO volumes are calculated by subtracting the Meter OF-024 DS flows from the Meter OF-024 US flows

REG 025 (METERS State, Frontage, Columbus, and weir) (CSO 025)

- Four meters were installed in September 2013 to estimate CSOs at REG 025
- Meter State was installed in the 48 inch wide by 60 inch high sewer on State Street upstream of REG 025 at an invert of 3.87
- Meter Frontage was installed in the 30 inch sewer on North Frontage Road upstream of REG 025 at an invert of 1.95
- Meter Columbus was installed in the 30 inch sewer on Columbus Avenue in November 2013 at an invert of -1.78
- Meter REG 025 weir was installed in REG 025 in November 2013. Sensors are metering the depths above the overflow elevation on each side of the overflow weir
- The overflow weir is 45 inches long and is made up of stainless steel plates at an overflow elevation of 5.35
- CSO or stormwater inflow start and stop times are estimated based on the depths at the overflow weir
- CSO or stormwater inflow volumes are estimated using the weir formula

REG 034 (METERS Temple, George, and weir) (CSO 025)

- Three meters were installed in September 2013 to estimate CSOs at REG 034
- Meter Temple was installed in the 25 inch wide by 37 inch high sewer on Temple Street upstream of REG 034
- Meter George was installed in the 36 inch wide by 48 inch high sewer on George Street upstream of REG 034
- Meter REG 034 weir was installed in REG 034 in November 2013. Sensors are metering the depths on each side of the overflow weir above the overflow elevation
- The overflow weir consists of wood stop logs, 6.6 feet long. The overflow elevation was raised two feet by adding stop logs to elevation 13.65 on 8/1/14
- CSO or stormwater inflow start and stop times are estimated based on the depths at the overflow weir
- CSO or stormwater inflow volumes are estimated using the weir formula

GNH1 SEWER AT TRUMAN TANK

- Meter GNH1 Sewer was installed in the 72 inch wide by 64 inch high sewer downstream of the Truman Tank Diversion Chamber on 6/12/12 at an invert elevation of 0.25 (there is 14 inches of hard packed sediment in the Diversion Chamber) (overflow depth is 36 inches)
- The regulator is a 10 foot bending weir at elevation 3.28 feet
- The SCADA system measures depths in each cell of the 5 MG tank
- Truman Tank activation start and stop times are based on a depth greater than 36 inches at Meter GNH1 Sewer and SCADA depths in the Truman Tank
- CSO storage volumes are calculated based on SCADA depths in the Truman Tank

SECTION 6

NMC 6 – Control of Solid and Floatable Materials in CSOs

The objective of NMC 6 is to remove coarse solids and floatables from combined sewage. The City of New Haven's pollution prevention practices as discussed further under NMC 7, coupled with the GNHWPCA's O&M programs have proven effective at keeping solids and floatables from discharging into receiving waters.

6.1 Techniques for Removal and Prevention of Solid and Floatable Materials

GNHWPCA and City of New Haven O&M practices have been proven successful at solids and floatables control. Since 2014, GNHWPCA has used CSL Services, Inc. to monitor each of the 13 active CSO Outfalls every month for the presence of floatables. . These inspections confirm that GNHWPCA does not have a problem with floatables at any of its 13 active CSO outfalls. CSL continues to monitor each of the CSO locations for floatables.

6.2 GNHWPCA's Current Fat, Oil, and Grease (FOG) Control Procedures

As discussed as part of the third minimum control measure (Pretreatment Requirements) GNHWPCA has three full-time IPP employees dedicated to enforcing the FOG program. All Class 3 and 4 restaurants are required to follow the CT DEEP General Permit for the Discharge of Wastewater Associated with Food Service Establishments, and must receive a sign-off by the IPP Coordinator indicating compliance, prior to the applicable health department granting a food service license. All restaurants are inspected three to four times a year.

6.3 New Haven Stormwater Management Plan

The City of New Haven, as part of its stormwater management program and in compliance with its municipal separated storm sewer system (MS4) permit also conducts public education, street cleaning and catch basin cleaning within the CSS service area. GNHWPCA and City of New Haven's practices and coordination of services have been successful at controlling floatables in the service area.

SECTION 7

NMC 7 – Pollution Prevention Programs to Reduce Contaminants in CSOs

The objective of NMC 7 is to prevent contaminants from entering the CSS.

7.1 Pollution Control Measures

Just like with NMC 6, the best way to reduce contaminants in CSOs is to prevent contaminants from entering the CSS in the first place. There are several simple yet effective control measures that the GNHWPCA and the City of New Haven implement to address this issue:

- Street cleaning. The City of New Haven Department of Public Works begins its annual street sweeping program in April. The program is designed to remove the heavy accumulation of salt, sand and litter that has collected over the winter months and to help keep New Haven's 226 miles of streets clean. The City has 15 sweeping routes; 9 Tag and Tow routes; 6 No Tag and No Tow routes.
- Catch basin cleaning. The City of New Haven contracts with a private contractor(s) to clean and maintain catch basins. The City typically cleans more than 3,000 catch basins per year which represents more than a third of the total number of catch basins located in the City.
- Bulk Trash Removal. The City of New Haven provides bulk trash removal to customers on an as-requested basis.
- Leaf Pickup. The City of New Haven seasonally collects leaves placed at the curb during the late fall/early winter.
- Construction Debris Disposal. A privately owned and operated transfer station is in the City of New Haven which accepts construction and demolition debris and other materials which cannot be disposed locally within the State where it is rail-hauled out-side of the State for disposal.
- Household Hazardous Waste. On behalf of the City of New Haven, the South Central Regional Water Authority (RWA) has safe and free disposal of household hazardous waste at their administrative offices located in the City of New Haven.
- Erosion Control. The City of New Haven maintains construction specifications and regulations which require erosion control and which is enforced as part of the permitting process.
- Public education programs and anti-litter campaigns. Education methods include but are not limited to:
  - Public service announcements
  - Advertising
  - Stenciling of street drain inlets
  - Distribution of information with water or sewer bills
- Solid waste collection and recycling. The City of New Haven provides curbside collection of garbage and single stream recyclables to residents and maintains and collects garbage and recyclables from a network of public trash cans along City streets. Collected material is delivered to the City of New Haven Solid Waste Authority (NHSWA) Transfer Station for processing and disposal. This facility also accepts solid waste and recyclables from commercial establishments.

- Water conservation. The GNHWPCA works with the RWA to assist in promoting water conservation measures. These include RWA water metering, RWA provision of water saving kits and as requested assistance, public education programs, and GNHWPCA provision of rain barrels to residents when requested.
- Control illegal dumping into waterways, storm drain inlets, catch basins, or the ground. City of New Haven has public education programs, notices in locations commonly used for dumping, and illegal dumping law enforcement program to mitigate this issue

In addition to the above, the City of New Haven also complies with the requirements of its MS4 permit which it implements City-wide.

SECTION 8

NMC 8 – Public Notification

The objective of NMC 8 is to inform the public of the location of CSO outfalls, the actual occurrences of CSOs, the possible health and environmental effects of CSOs, and the recreational or commercial activities (such as swimming) that CSOs jeopardize.

The Authority initiated the combined sewer overflow (CSO) Flow Monitoring Program in 2012. CSL Services collects data from 32 depth and velocity meters and one rain gauge owned by GNHWPCA. The meters are deployed to continuously monitor our 17 active CSO Regulators and 13 active CSO Outfalls. Engineering monitors the data, which is posted on CSL's website, in real time. If a CSO occurs, the Authority would have the data to estimate the CSO volume and duration.

Each month, CSL submits a report to Engineering which details rainfall events and CSO volumes and durations at each CSO Outfall. Engineering reviews the monthly report to provide quality assurance and quality control. Engineering then prepares a summary report for the month which is submitted to the Connecticut Department of Energy and Environmental Protection (DEEP) each June 30th as a part of our Annual Report which is required under our Consent Decree.

In accordance with Section 9 of GNHWPCA's National Pollutant Discharge Elimination System (NPDES) Permit, GNHWPCA has installed new signs at each of the 13 active CSO Outfalls. The signs contain the number of the CSO outfall and telephone numbers at both the Authority and DEEP where people can call to report a CSO.

The GNHWPCA also reports potential and actual CSO events using CT DEEP's Right-to-Know Online Bypass Reporting System. In July 2012, Public Act No. 12-11, "An Act Concerning the Public's Right to Know of a Sewage Spill", was finalized into law. In accordance with Section 9 of GNHWPCA's NPDES Permit, within two hours of learning of a potential or actual untreated CSO, the Authority must report the event using the DEEP website. Within five days the Authority must file a follow-up report which contains an estimate of CSO volume to each of the four receiving waters in New Haven using the DEEP website.

SECTION 9

NMC 9 – Monitoring to Characterize CSO Impacts and the Efficacy of CSO Controls

The objective of NMC 9 is to use visual inspections and other simple monitoring methods to determine the occurrence and impact of CSOs.

The Authority initiated the combined sewer overflow (CSO) Flow Monitoring Program in 2012. CSL Services collects data from 32 depth and velocity meters and one rain gauge owned by GNHWPCA. The meters are deployed to continuously monitor our 17 active CSO Regulators and 13 active CSO Outfalls. Engineering monitors the data, which is posted on CSL's website, in real time.

Each month, CSL submits a report to Engineering which details rainfall events and CSO volumes and durations at each CSO Outfall. Engineering reviews the monthly report to provide quality assurance and quality control. Engineering then prepares a summary report for the month which is submitted to the Connecticut Department of Energy and Environmental Protection (DEEP) each June 30th as a part of our Annual Report which is required under our Consent Decree.

Since 2014, GNHWPCA has used CSL Services, Inc. to perform a condition assessment of each of the 17 active CSO regulators, 13 active CSO Outfalls and five duckbills every month.

The GNHWPCA uses data from the CSO flow monitoring program, CSO regulator, outfall, and duckbill inspection program; collection system hydraulic model (updated in 2015); large diameter sewer cleaning program, and sanitary sewer overflow (SSO) bypass reports to effectively characterize CSO impacts and the efficacy of CSO controls. These tools also allow the Authority to evaluate and maximize the capacity of the collection system and cost effectively implement its LTCP. This program has proven effective at reducing CSO volumes by more than 66 percent (from 125.93 million gallons (MG) in 1997 to 43.3 MG in 2015 during the Typical Year (as defined in the 2001 LTCP)). Furthermore, the proposed Short- Term Control Plan (STCP) and the Intermediate-Term Control Plan (ITCP) projects (as defined in the 2016 LTCP Update) are expect to reduce annual CSO volumes by an additional 30.5 MG to 12.8 MG.

Appendix 1:
Overflow Emergency Response Plan

Overflow Emergency Response Plan

- Provide collections system personnel with appropriate health and safety training including confined space entry training
- Train collections system personnel to estimate SSO volumes based on a consistent methodology
- Purchase and maintain appropriate collections system equipment and spare parts
- Execute appropriate on-call services Agreements with specialty collections system contractors
- Execute appropriate mutual aid Agreements with local municipal police, fire and publics works departments
- Establish an SSO reporting hotline for customers
- Provide hotline personnel with appropriate training regarding information to obtain from callers including:
    - Time and date of the call
    - Specific location of the overflow
    - Description of problem (what is overflowing, extent of spill, if the cause is obvious)
    - Time overflow was noticed by the caller
    - Caller's name and phone number
    - Observations of the caller (odor, duration, back or front of property)
    - Other relevant information that will enable the SSO Manager to quickly locate, assess and stop the overflow
- Establish and maintain an up to date SSO notification list including:
    - GNHWPCA personnel
    - New Haven, Hamden, East Haven and Woodbridge municipal police and fire personnel
    - State and municipal officials to be notified within 2 hours of an SSO;
    - CT DEEP
    - CT Bureau of Aquaculture (if SSO is south of Interstate 95)
    - CT Department of Health
    - New Haven, Hamden, East Haven and Woodbridge Health Departments, as appropriate
    - Regional Health Districts (Quinnipiac Valley and East Shore Health Districts), as appropriate
    - Health Director of contiguous municipalities (West Haven, Orange, Derby, Ansonia, Seymour, Bethany, Cheshire, Wallingford, North Haven, North Branford and Branford), as appropriate
    - Municipal officials in New Haven, Hamden, East Haven and Woodbridge, as appropriate, including but not limited to:
        - Chief Elected Official
        - Board of Alderman President
        - Chief Administrative Officer
        - Chief of Staff
        - Building Official
        - Community Services Administrator
        - Director of Engineering
        - Director of Public Works
        - EOC Deputy Director
        - Utility companies
        - United Illuminating
        - Regional Water Authority

        - Southern Connecticut Gas
- State and municipal officials to receive a faxed copy of the CT DEEP Bypass Report Form (included in Appendix 8-4) within 5 days of an SSC:
    - CT DEEP
    - CT Bureau of Aquaculture (if SSO is south of Interstate 95)
    - Local health department
- Once an SSO is reported:
    - SSO hotline personnel provide information to the SSO Manager
    - The SSO Manager dispatches collections system personnel with appropriate training and equipment to assess the root cause and severity of the SSO and report back
    - The SSO Manager refers to Appendix 8-1 of the Overflow Emergency Response Plan to determine the appropriate SSO response procedures
    - The SSO Manager dispatches additional collections systems personnel and equipment, contacts on-call specialty collections system contractors, and contacts local municipal police, fire and publics works departments, as required, to contain and stop the SSO
    - The SSO Manager notifies appropriate parties, based on the location, root cause and severity of the SSO, that an SSO is in progress
- After the SSO is stopped:
    - The SSO Manager notifies the same appropriate parties that the SSO has been stopped
    - The SSO Manager consults with the collections system personnel to understand the root cause of the SSO and to review the estimate of the SSO volume
    - Within 5 days of the SSO, the SSO Manager completes the CT DEEP Bypass Report Form and faxes a copy to the appropriate State and municipal officials
    - The SSO Manager enters the CT DEEP Bypass Form into the CMMS
    - The SSO Manager recommends manhole or gravity sewer rehabilitation projects to mitigate Mure SSOs in this location
    - The SSO Manager recommends changes to the preventive maintenance schedules to
    - mitigate future SSOs in this location

GNHWPCA O&M has detailed response procedures for the following SSO situations:

- Basement backups
- Overflowing sewer manholes
- Cavities or depressions in streets or lawns
- Sewer pipe breaks or collapses
- Partially or totally blocked siphons
- Force main breaks
- Air release or vacuum relief valve failures

Appendix 2: Residential FOG Educational Door Hanger

Appendix 3: CSL Inspection Reports and Photographs

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/18/16 (CSO), 10/3/16 (Reg)

INSPECTION CREW: Shelton Holloway / Patrick Cain

REGULATOR 003

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 003

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/18/2016 (CSO), 10/4/16 (Regulator)

INSPECTION CREW: Shelton Holloway / Patrick Cain

REGULATOR 004

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 004

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/18/16

INSPECTION CREW: Shelton Holloway / Patrick Cain

REGULATOR 005

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 005

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/19/16

INSPECTION CREW: Shelton Holloway / Patrick Cain

REGULATOR 006

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 006

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/19/16

INSPECTION CREW: Shelton Holloway / Patrick Cain

REGULATOR 009

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 009

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/3/16

INSPECTION CREW: Shelton Holloway / Joe Beckham

REGULATOR 010A

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/17/16 (CSO), 10/5/16 (Reg)

INSPECTION CREW: Shelton Holloway / Patrick Cain

REGULATOR 011

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 011

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/17/16

INSPECTION CREW: Shelton Holloway / Patrick Cain

REGULATOR 012

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 012

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/4/16

INSPECTION CREW: Shelton Holloway / Joe Beckham

REGULATOR 015

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 015

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

DUCKBILL 015

CONDITION OR DUCKBILL: Good

WORK PERFORMED DURING INSPECTION: _____

_____

ADDITIONAL WORK REQUIRED: _____

_____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/4/16

INSPECTION CREW: Shelton Holloway / Joe Beckham

REGULATOR 016

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 016

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

DUCKBILL 016

CONDITION OR DUCKBILL: Good

WORK PERFORMED DURING INSPECTION: _____

_____

ADDITIONAL WORK REQUIRED: _____

_____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: _____

INSPECTION CREW: _____

_____

REGULATOR 019

CONDITION OR REGULATOR: Overflow pipe from sewer sealed off.

WORK PERFORMED DURING INSPECTION: Meter removed 6/9/15

_____

ADDITIONAL WORK REQUIRED: _____

_____

CSO OUTFALL 019

CONDITION OF CSO OUTFALL: _____

CONDITION OF CSO SIGN: _____

WORK PERFORMED DURING INSPECTION: _____

_____

ADDITIONAL WORK REQUIRED: _____

_____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/4/16

INSPECTION CREW: Shelton Holloway / Joe Beckham

REGULATOR 020

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 020

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/3/16

INSPECTION CREW: Shelton Holloway / Joe Beckham

REGULATOR 021

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 021

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

DUCKBILL 021

CONDITION OR DUCKBILL: Good

WORK PERFORMED DURING INSPECTION: _____

_____

ADDITIONAL WORK REQUIRED: _____

_____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/19/16

INSPECTION CREW: Shelton Holloway / Patrick Cain

REGULATOR 024

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 024

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: _____

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

DUCKBILL 024

CONDITION OR DUCKBILL: Good

WORK PERFORMED DURING INSPECTION: _____

_____

ADDITIONAL WORK REQUIRED: _____

_____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/3/16

INSPECTION CREW: Shelton Holloway / Joe Beckham

REGULATOR 025

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

CSO OUTFALL 025

CONDITION OF CSO OUTFALL: Good

CONDITION OF CSO SIGN: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
REGULATOR, CSO OUTFALL AND DUCKBILL
MONTHLY INSPECTION REPORT

INSPECTION DATE: 10/17/16

INSPECTION CREW: Shelton Holloway / Patrick Cain

REGULATOR 034

CONDITION OR REGULATOR: Good

WORK PERFORMED DURING INSPECTION: _____

ADDITIONAL WORK REQUIRED: _____

Photo Log

Photo Log

003 overflow 400

004 overflow 400

004 overflow regulator 400

005 regulator 400

005 overflow regulator 400

006 aa & bb CSO 400

006 aa & bb overflow regulator CSO 400

006 aa & bb regulator 400

006 aa & bb CSO

006 CSO 400

009 overflow CSO

009 overflow regulator

010 regulator 400

CSO picture for 011-631 -400

11-631 CSO-400

11-631 regulator 400

012 sewer CSO 400

012 sewer CSO 400

015 CSO 400

015 DS regulator

015 duckbill 400

016 CSO 400

016 duckbill 400

016 regulator 400

020 CSO 400

020 regulator 400

021 CSO 400

021 duckbill 400

021 regulator 400

024 DS CSO

024 duckbill 400

024 DS regulator

025 CSO 400

025 weir regulator 400

034 weir regulator 400

Appendix B
Rainfall Analysis

Rainfall Analysis

This section outlines the reevaluation of the two rainfall conditions, the 2-year 6-hour design storm and the Typical Year, used to evaluate system performance. During the 2001 LTCP report, these two rainfall conditions were evaluated and established. Due to climate change and increased extreme weather, these two rainfall conditions change overtime and need to be re-evaluated.

2-year, 6-hour Design Storm

The 2-year 6-hour design storm was established as the level of control required for CSO elimination in the Consent Order. The following sections detail the storm's original development in 2001 and the current analysis conducted to re-evaluate the storm for 2016 conditions.

2001 Condition

In 2001, a storm with a 2-year recurrence interval and duration of 6 hours had a depth of 2.05 inches and a peak 15-minute intensity of 2.15 in/hr based on IDF curves in the area. From these values the storm shape was calculated by determining, on average, the peak of storms occur 60 percent through the duration. The peak intensity from the IDF curve was plotted at its appropriate time through the storm's duration. For each extracted depth in order of increasing duration, the amount of rainfall already plotted was subtracted from each extracted depth. The remaining rainfall in each increment is calculated as an average intensity and plotted as intensity versus time, centered around the peak. Therefore, summing incremental areas from the start of the synthetic storm to its end produces a total storm depth equivalent to the total storm depth obtained from the IDF curve for the recurrence interval and storm duration.

This design storm was used during the 2001 Long-Term Combined Sewer Overflow Control Plan, the 2007 Hydraulic Model Update and the 2014 Hydraulic Model Update. This storm was re-evaluated for current conditions during the 2016 LTCP update.

2016 Condition

Based on IDF curves generated by Cornell University and the Northeast Regional Climate Center (NRCC), the 2-year 6-hour storm has since increased to 2.13 inches. Based on the storm template developed in 2001, the design storm was adjusted to the increased volume. The peak 15-minute intensity has now increased from 2.15 in/hr to 2.23 in/hr. The 2001/2016 storm comparison is shown below in **Figure 1**. This increase in rainfall depth has increased CSO volume by 11% in the 2014 Conditions model from 14.0 MG to 15.5 MG.

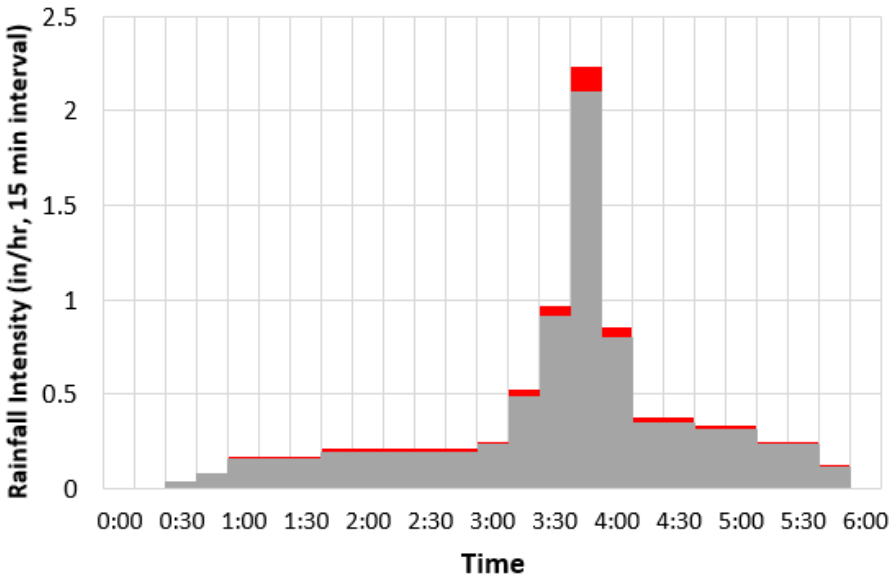

Figure 1. 2-year, 6-hour Design Storm
Comparison between the 2001 and 2016 2-year 6-hour design storm

Typical Year

Another important hydraulic characterization includes an assessment of the sewer system and CSO performance for a 12-month period under average rainfall conditions. Simulation of individual storm events, which is performed to meet different goals, does not include the cumulative impacts from multiple storm events upon the sewer system and receiving water as well as the wide variety of storms that occur throughout any given year. This average year, or Typical Year, also produces quantities that are more relatable to the general public. The following sections detail the original methodology during the Typical Year selection and the current analysis to evaluate if 1967 is still considered a Typical Year.

2001 Condition

In 2001, available precipitation data was obtained, reviewed and statically examined to find a representative typical year. The following statics were examined:

- Annual precipitation
- Monthly precipitation
- Number of storm events
- Maximum event volume
- Maximum event intensity

Five rainfall data sets were obtained including New Haven (Tweed Airport), Hartford (Bradley Airport), Bridgeport (Airport), Providence (Green Airport) and New Haven (Lake Whitney). Of these data sets, New Haven (Tweed Airport) was ultimately selected due to the period of record, completeness of the data, proximity and resolution of the data. This data set included 22 years of rainfall from 1948-1969. Following the statistical analysis, 1967 was selected as a typical year of rainfall in New Haven. This year had a total of 40.63 inches of rainfall compared to the 22-year average of 41.27 inches, reasonable monthly precipitation values, 114 storm events compared to the average 108 storms, a maximum event volume of 3.32 inches compared to the average 3.22 inches and maximum event intensity of 0.92 in/hr compared to 0.96 in/hr.

2016 Condition

The objective of this analysis was to validate if 1967 is still considered a Typical Year, and if not, find a better representative year. Recent rainfall data from the Tweed New Haven Airport was obtained from NOAA and similar statics were performed for validation. This data set has now been expanded from 1948-1969 to 1948-1977 and 2002-2015. Two separate owners have measured data at this location, explaining the gap between 1977 and 2002. To fill the gap, rainfall data was collected at the nearest location of the Bridgeport Sikorsky Memorial Airport. This was the similar process conducted by the NRCC under the extreme precipitation analysis in New England.

Annual Precipitation

The first statistic examined was the amount of annual rainfall. This is the foundation of rainfall statistics, without having a similar amount of rain volume, it is unlikely the remaining statistics will be considered typical. During the original analysis, the average annual precipitation was 41.27 inches. This value has only slightly changed to 41.77 inches over the 68-year period of record. This updated annual precipitation does not invalidate 1967 which had 40.63 inches of total rainfall. Of the newly updated data set, 19 years fall within a reasonable range of annual precipitation. 13 years were omitted either for missing/inaccurate data, multiple outliers or previous analysis in the 2001 report. The other 6 years, 1967, 1980, 1991, 1999, 2007 and 2010, were evaluated throughout the remaining statistics to determine if any of these years would better represent a Typical Year. **Figures 2** and **3** display the distributions of annual precipitation.

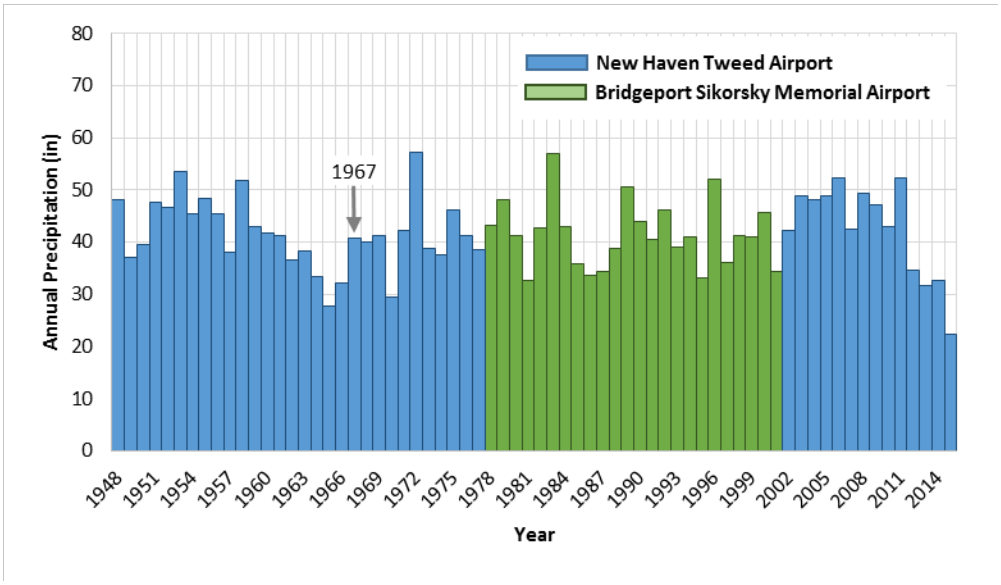

Figure 2. Annual Precipitation

Annual precipitation at the Tweed New Haven Airport and the Bridgeport Sikorsky Memorial Airport

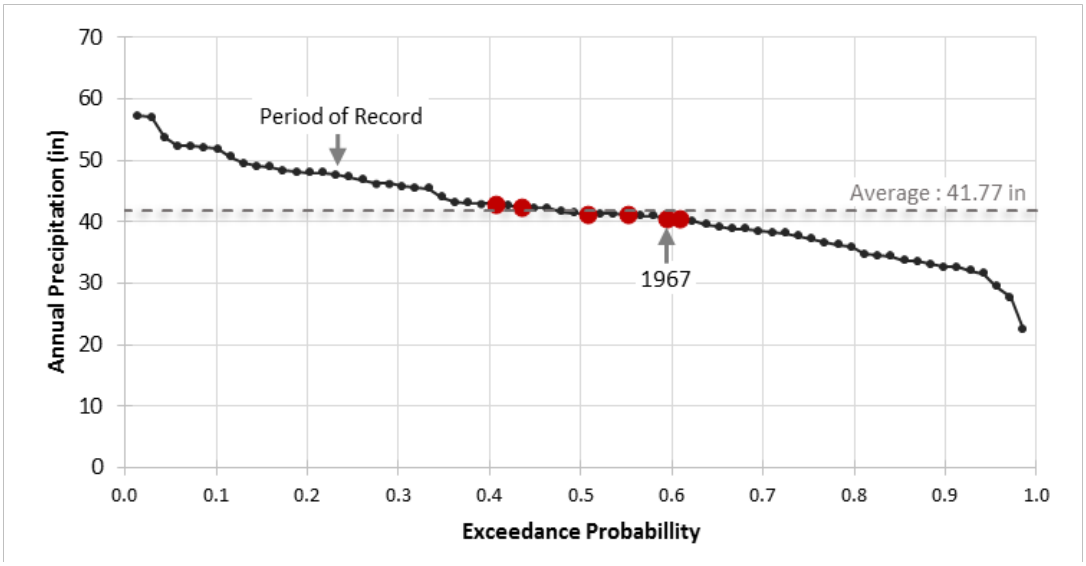

Figure 3. Annual Precipitation Exceedance Probability

Annual precipitation versus Exceedance Probability for the Analysis Period at the Tweed New Haven Airport and the Bridgeport Sikorsky Memorial Airport

Monthly Precipitation

Similar to annual precipitation, the monthly precipitation can be equally as import. Seasonal trends in groundwater levels and sanitary dry weather flows can be the difference between a rainfall event causing a CSO event or not. For this reason, the monthly precipitation was examined as well. This can be one of the hardest statistics for any given year to match, and it is best to find a year that does not contain any outliers opposed to a year with a few perfect matches. Upon examination of the average, the monthly averages have only changed slightly, and still show 1967 as a Typical Year. The remaining years contain large outliers and would not better represent a Typical Year than 1967 under this statistic. **Table 1** shows updated monthly averages and the six candidate years.

Table 1. Average Monthly Precipitation

Comparison of average monthly precipitation to 1967, 1980, 1991, 1999, 2007 and 2010

Month	Precipitation (in)						
	Average	**1967**	**1980**	**1991**	**1999**	**2007**	**2010**
January	3.23	1.40	1.02	2.82	6.42	4.32	1.57
February	2.80	2.87	1.07	1.83	3.88	1.54	5.17
March	3.87	5.35	7.05	4.07	3.40	5.68	10.52
April	3.88	3.26	7.03	3.19	1.81	9.03	1.94
May	3.64	5.75	2.69	3.83	3.78	1.09	2.85
June	3.38	2.23	2.52	2.29	0.82	3.44	3.19
July	3.15	4.17	5.97	2.17	0.93	2.89	3.12
August	3.74	3.25	2.38	7.84	4.36	3.04	3.45
September	3.54	1.09	2.39	3.47	6.88	1.92	1.68
October	3.48	2.45	4.12	1.88	3.23	2.51	3.19
November	3.43	3.50	3.95	2.82	3.08	2.40	2.57
December	3.64	5.31	0.95	4.27	2.39	4.60	3.63
Total	**41.77**	**40.63**	**41.14**	**40.48**	**40.98**	**42.45**	**42.87**

Number of Storm Events

Even if the annual precipitation depth in a given year is roughly typical, the number of storm events may not be typical, as the individual events might tend to be either small or large. Having few very large events or many very small events is likely to skew CSO volumes and frequencies and affect the evaluation of alternatives. Therefore, the number of events was determined for each of the six candidate years and compared against the average value. In the 68-year record, the values for this statistic ranged from 55 to 139 events, with an average of 101 events. **Table 2** shows the values for the six candidate years. The number of events per year has decreased from 108 events to 101 events, and 2007 is the best candidate for a typical year under this statistic.

Table 2. Number of Storm Events per Year

Comparison of number of storm events per year

Year	Number of Storm Events
1967	114
1980	71
1991	91
1999	129
2007	95
2010	62
Average	**101**

Maximum Event Volume and Intensity

It is important when selecting a year that represents typical conditions that there were no extreme events during the year. The maximum event volume and 1-hour intensity was determined and compared to the average. Maximum event volumes for the record ranged from 1.48 to 6.40 inches, with an average of 3.39 inches. Maximum event intensity for the record ranged from 0.44 in/hr to 2.33 in/hr with an average of 1.00 in/hr. **Table 3** shows the values for the six candidate years. 1967 proves to best represent a Typical Year for maximum event volume and 1991 proves the best for maximum event intensity.

Table 3. Maximum Events

Comparison of maximum event volume and intensity

Year	Maximum Event Volume (in)	Maximum Event Intensity (in/hr)[1]
1967	3.32	0.92
1980	3.88	1.32
1991	4.71	0.95
1999	4.20	1.06
2007	4.22	0.73
2010	4.17	0.73
Average	**3.39**	**1.00**

[1] 1-hour intensity

The Typical Year: 1967

After the new rainfall data was incorporated and all the statistical analysis was completed, 1967 still seems to have all the qualities of a Typical Year. **Table 4** shows the six candidate years' performance under each of the 5 criteria. The average annual rainfall has increased leaving 1967 on the low side, but

the monthly precipitation is about as typical as any given year could be, and the maximum event values are almost identical to the averages in New Haven. 1967 from the Tweed New Haven Airport will continue to be used as a Typical Year during the Long Term Control Plan Update in 2016.

Table 4. Scoring of the Six Candidate Years

Years earned checks for acceptable values in the specified statistic

Year	Annual Volume	Monthly Volumes	# of Events	Max. Event Volume	Max. Event Intensity	Total Score
1967	✓	✓		✓	✓	4
1980	✓			✓		2
1991	✓		✓		✓	3
1999	✓				✓	2
2007	✓		✓	✓		2
2010	✓					1

Appendix C
East Street Pump Station Preliminary Design Report

DRAFT REPORT

Long-Term Control Plan Update

East Street Pump Station – Preliminary Design Report

Prepared for

Greater New Haven Water Pollution Control Authority

November 2016

CH2M HILL Engineers, Inc.
100 Great Meadow Road
Suite 707
Wethersfield, CT 06109

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Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ACGIH	American Conference of Governmental Industrial Hygienists
ACH	air changes per hour
ACI	American Concrete Institute
AFD	adjustable frequency drive
AISC	American Institute of Steel Construction
ANSI	American National Standard Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
ATC	automatic temperature control
Authority	Greater New Haven Water Pollution Control Authority
AWWA	American Water Works Association
BEP	best efficiency point
BFE	base flood elevation
CAIECC	Connecticut Amendments to the International Energy Conservation Code
CFD	computational fluid dynamics
cfm	cubic feet per minute
cfph	cubic feet per hour
CISPI	Cast Iron Soil Pipe Institute
CMU	concrete masonry unit
CSBC	Connecticut State Building Code
CSO	combined sewer overflow
DC	direct current
DDC	direct digital control
DFE	design flood elevation
DLR	device level ring
DWF	dry weather flow
DX	direct expansion
fps	feet per second
FRP	fiberglass reinforced plastic
ft^2	square feet
ft^3	cubic feet
GNHWPCA	Greater New Haven Water Pollution Control Authority
gpm	gallon(s) per minute
H_2S	hydrogen sulfide
HI	Hydraulic Institute
HMI	human-machine interface
hp	horsepower
HSS	hollow structural sections
HVAC	heating, ventilation, and air conditioning
I&C	instrumentation and controls
I/O	input/output

IBC	International Building Code
ICRI	International Concrete Repair Institute, Inc.
IEBC	International Existing Building Code
IECC	International Energy Conservation Code
IMC	International Mechanical Code
IPC	International Plumbing Code
ksi	kilopound(s) per square inch
kVA	kilovolt-ampere(s)
LTCP	long-term control plan
MAU	make-up air unit
MCC	motor control center
mgd	million gallon(s) per day
mHz	millihertz
mph	mile(s) per hour
mVA	millivolt ampere(s)
NaOH	sodium hydroxide
NAVD 88	North American Vertical Datum of 1988
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association (NEMA)
NFPA	National Fire Protection Association
NGVD 29	National Geodetic Vertical Datum of 1929
NPV	net present value
O&M	operations and maintenance
OIT	operator interface terminal
pcf	pound(s) per cubic foot
PLC	programmable logic controller
POR	preferred operating range
ppmv	part(s) per million by volume
psf	pound(s) per square foot
psi	pound(s) per square inch
RPM	revolution(s) per minute
SLR	sea level rise
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SSPC	Structural Steel Painting Council
TDH	total dynamic head
UI	United Illuminating
UL	Underwriter's Laboratory
UPS	uninterruptable power supply
VFD	variable-frequency drive
WEF	Water Environment Federation
WPAF	water pollution abatement facility
WSE	water surface elevation
WWF	wet weather flow
WWTP	wastewater treatment plant

SECTION 1

Hydraulics

1.1 Introduction

The *Long-Term Control Plan (LTCP) Update* includes alternatives that control combined sewer overflow (CSO) discharges from all CSO outfalls to meet a 2-year, 6-hour level of CSO control (zero discharges) by 2040. The LTCP Update includes short term, intermediate term, and long term improvements to meet these stated goals. This Preliminary Design Report of the LTCP focuses on long term improvements at the East Street (East Street) Pump Station. Preliminary Design Drawings are shown in Appendix A of the report.

1.2 Basis of Design

1.2.1 Hydraulic Design Objectives

The hydraulic design objective is to upgrade the Union, East Street and Boulevard Pump Stations to convey the maximum flow to the East Shore Water Pollution Abatement Facility (ESWPAF) resulting in CSO mitigation.

Models were developed to calculate how much flow can be conveyed to the wet well of the pump station using the existing infrastructure and to evaluate improvements to the pump station to allow the station to convey the design flows.

1.2.2 Design Flows and Pumping Strategy

The flow scenarios (Table 1-1) analyzed were developed from the 2015 Hydraulic Model. The model identified the design flows necessary for the system to meet the 2 year 6-hour level of service. Three flow scenarios were analyzed during the LTCP Update. They are the short-term, intermediate-term and long-term scenarios.

The short term improvements do not impact the existing flows from the three pump stations. The total flow conveyed to the East Shore WPAF from the pump stations is 60 mgd split between Boulevard and East Street with each pump station pumping 30 mgd. Union currently pumps 15 mgd to East Street.

The intermediate term improvements increase the total flow conveyed to the ESWPAF. Union will be upgraded to pump 35 MGD capacity under the intermediate improvements, but capacity will be limited to between 15 and 25 MGD. East Street will be upgraded to pump up to 65 MGD, but capacity will be limited to 40 MGD. This is an increase of 10 MGD over existing capacity. Boulevard will be increased to pump up to 45 MGD, but capacity will be limited to 30 MGD.

The long term improvements increase the total flow conveyed to the East Shore WPAF by the three pump stations to 110 mgd. The flows from the pump stations are 35 mgd from Union (pumping to East Street), 65 mgd from East Street, and 45 mgd from Boulevard.

Table 1-1. Flow Scenarios

Pump Station	Short-Term Flows (mgd)	Intermediate-Term Flows (mgd)	Long-Term Flows (mgd)
Union (to East)	15	25	0-35
East Street	30	40	65
Boulevard	30	30	45

The design parameters and considerations in selecting pumps for the stations include;

1. Create maximum reliability, efficiency and redundancy for flows in the dry weather range since flows in the dry weather range occur 98 percent of the time during a typical year.
2. Utilize extended shaft centrifugal pumps.
3. Maintain N+1 for dry weather and wet weather pumping conditions.
4. Consider space restrictions in existing station footprints.
5. Avoid cycling of flows at the East Street and Boulevard Pump Stations since these flows go directly to the ESWPAF.
6. Select pumps to operate well within the pump manufacturers' defined allowable operating range (AOR) for both wet and dry weather conditions.
7. For high frequency flow capacities, select pumps to operate within the pump's preferred operating range (POR) as defined by the Hydraulic Institute Standards (HIS) to obtain high wire-to-water pump efficiencies for both wet and dry weather conditions. For less frequent lower flow capacities, size pumps for operation well within the candidate pump manufacturers' defined allowable operating range (AOR).
8. Maintaining impeller tip speed to prevent accumulation of rags within the volute.
9. Maintaining scouring velocities in pump discharges to prevent grit accumulation.

Avoiding high VFD and corresponding pump speed turndown.

1.3 Hydraulic Model

Two models were developed for each pump station to identify what improvements are necessary to meet the design flows.

Improvements necessary to convey the design flows by gravity from the sanitary sewer through the pump stations screening and grit systems to the wet well were identified by computing a hydraulic profile using CH2M's proprietary software, WinHydro. The hydraulic model was prepared using available mechanical, structural, and civil plan-and-profile record drawings, site visits, and photos.

Improvements to the existing pump station pumping capacity and force mains were identified through incompressible pipe flow modeling using AFT Fathom version 8.0. The hydraulic model was prepared using available mechanical, structural, and civil plan-and-profile record drawings and photos.

Record drawings are in the National Geodetic Vertical Datum of 1929 (NGVD 29) and have been converted to the North American Vertical Datum of 1988 (NAVD 88) by subtracting 1.05 feet from NGVD 29. All elevations referenced in this section are in NAVD 88.

1.4 Hydraulic Analyses

1.4.1 Hydraulic Profile

The hydraulic profile from the influent sewer through the station and into the wet well at the East Street Pump Station includes the following:

- Influent Chamber flow split between screening channels
- Screening Channel (three channels)
- Junction Chamber downstream of the screening channels
- Flow Split between grit channels

- Grit channels (four channels)
- Junction Chamber downstream of the grit channels
- 48-inch circular pipe between Junction Chamber and Wet Well
- Wet well influent channel
- Flow split to the divided wet well

The analysis included four alternatives.

- **Alternative 1:** Three screens installed in screening channels and four grit channels.
- **Alternative 2:** Three screens installed in screening channels and two grit channels with the remaining two grit channels serving as high flow bypass channels.
- **Alternative 3:** Three screens installed in screening channels and zero grit channels. This alternative assumes grit removal is moved to the East Shore WPAF.
- **Alternative 4:** Zero screens and zero grit channels are installed. This assumes screening and grit removal is moved to the East Shore WPAF.

The alternatives were run at the proposed long-term flow of 65 mgd. The results of the analysis are as follows:

- **Alternative 1:** The water surface elevation (WSE) coming into the influent chamber is 1.4. The sewer invert coming into the chamber is -2.4. This shows at maximum flows there is 3.8 feet of water depth as the sewer enters the chamber. A model run was performed with a WSE at the influent chamber of 1.4 and the run shows that the upstream infrastructure was able to deliver 65 mgd to the pump station under this alternative.
- **Alternative 2:** The WSE coming into the influent chamber is 0.9. At maximum flow, it is assumed all flow bypasses the grit channels in service and is conveyed through the high flow bypass channels. It was assumed for the bypass that the weir walls at the end of the existing grit channels would be demolished and all grit equipment would be removed. Influent gates would need to be opened during high flows to bypass the grit channels. A model run was performed with a WSE at the influent chamber of 0.9 and the run shows that the upstream infrastructure was able to deliver 65 mgd to the pump station through the bypass channels.
- **Alternative 3:** The WSE coming into the influent chamber is 0.9. It was assumed that the weir walls at the end of the existing grit channels would be demolished and all grit equipment would be removed in all four grit channels. There is a drop in the invert from the screening channels to the grit channels, with the grit equipment removed and weir wall demolished the WSE in the influent chamber is minimally effected by the number of bypass channels at the maximum flow rate of 40 mgd. A model run was performed with a WSE at the influent chamber of 0.9 and the run shows that the upstream infrastructure was able to deliver 65 mgd to the pump station through the channels.
- **Alternative 4:** The WSE coming into the influent chamber is 0.7. It was assumed that the existing screens would be removed, the weir walls at the end of the existing grit channels would be demolished and all grit equipment would be removed in all four grit channels. A model run was performed with a WSE at the influent chamber of 0.7 and the run shows that the upstream infrastructure was able to deliver 65 mgd to the pump station through the channels.

1.4.2 Pipe Flow Modeling

A pipe flow model was created using AFT Fathom to represent the pressurized system. The model included East Street, Union, and Boulevard Pump Stations, their force mains, the harbor crossings, and force main to the East Shore WPAF. The model base was built from existing conditions. Various

alternatives were added to the model to identify the improvements necessary to meet the design flows at the short-term, intermediate-term, and long-term scenarios. All scenarios used an N+1 design to meet the design flow rate with the largest pump out of service.

1.4.2.1 East Street

East Street currently has four pumps installed with space for two additional pumps. The existing pumps are rated at 13 mgd. The stations firm pumping capacity is 39 mgd and total pumping capacity is 52 mgd. Through conversations with pump station operators, the station pumps approximately 30 mgd during peak flows. The station pumps to a 42-inch force main. The force main increases to 48 inches downstream of the connection with the Boulevard force main. The force main splits at the harbor crossing to twin 42-inch pipes. After the harbor crossing the force main combines to a 48-inch pipe to the East Shore WPAF.

The long-term flow scenario for East Street is 65 mgd. The minimum dry weather flow (DWF) is 6.76 mgd, the average dry weather flow is 10.5 mgd, and the maximum dry weather flow is 16.8 mgd.

The existing pumps do not have the capacity to meet the long-term pumping scenario with the largest pump out of service (N+1 redundancy criteria). Several scenarios were investigated to meet the design flows.

- **Scenario 1:** Six identical pumps installed in the existing pump station each rated at 13 mgd. A single pump in service would be used for DWFs and five pumps in service, with one pump in standby, would be used for the maximum wet weather flows (WWFs).
- **Scenario 2:** Three dry weather pumps and four wet weather pumps installed. The dry weather pumps were sized to efficiently pump the minimum flows to avoid cycling and pump the dry weather maximum with one pump out of service. To achieve this the dry weather pumps were sized for 8.4 mgd and would require two pumps in service to meet the maximum dry weather flowrate. The wet weather pumps would be sized to pump the maximum flows with one pump out of service. Each wet weather pump would be rated at 21.67 mgd. In order to fit seven pumps in the existing station, the two dry weather pumps are installed on a single suction header.
- **Scenario 3:** Three dry weather pumps and five wet weather pumps installed. The dry weather pumps are sized similar to scenario 2 but the pumps would be installed in a submersible pump station next to the existing station. The wet weather pumps would be installed in the existing pump station. Each wet weather pump would be rated at 16.25 mgd.

It was determined that Scenario 3 was the best option to meet the design flows. This scenario allows for N+1 redundancy for both dry weather and wet weather pumping and efficiently handles the minimum dry weather flows without cycling and peak wet weather flows.

Table 1-2 shows the proposed pumps operation under several flow regimes for the Intermediate and Long Term Flow Scenarios.

Table 1-2. Pump Operation

Flow Scenario		Total Flow (mgd)	Dry Weather Pumps	Wet Weather Pumps
Intermediate-Term	Min. Dry Weather	5.9	1 pump	0
	Avg. Dry Weather	10.5	2 pumps	0
	Max. Dry Weather	16.8	2 pumps	0
	Max. Wet Weather	40	0	3 pumps
Long-Term	Min. Dry Weather	5.9	1 pump	0
	Avg. Dry Weather	10.5	2 pump	0
	Max. Dry Weather	16.8	2 pumps	0

Max. Wet Weather	65	0	4 pumps

1.4.2.2 Force Mains and Harbor Crossing

The existing force main from East Street is 42 inches before the junction with the 36-inch Boulevard force main. East Street and Boulevard combine upstream of the harbor crossing and the force main increases to 48 inches downstream of this junction.

The existing twin harbor crossings are each 42 inches in diameter. The model assumed both crossings would be open during minimum dry weather flow and maximum wet weather flows.

The twin harbor crossing join together into a 48-inch force main on the east side of the harbor. The force main terminates at the East Shore WPAF.

Standard practice recommends velocities of 3 fps to provide self-cleaning velocities and limits force main velocities to 8 fps. Under the long-term flow scenario, many of the force mains in the system would be below 3 fps during minimum dry weather flows and above 8 fps during maximum wet weather flows.

See Table 1-3 for a summary of force main velocities.

Table 1-3. Force Main Velocities

Force Main Segment	Min Dry Weather Flow Velocity (fps)	Average Dry Weather Flow Velocity (fps)	Max Wet Weather Flow Velocity (fps)	Max Wet Weather Flow Velocity[1] (fps)	Max Wet Weather Flow Velocity[2] (fps)
42-inch FM US of East and Boulevard Junction	1.0	1.6	2.6	6.1	9.8
48-inch FM DS of East and Boulevard Junction	1.6	2.7	4.1	8.2	12.8
48-inch FM DS of Harbor Crossing to ESWPAF	1.6	2.7	4.1	8.2	12.8
42-inch FM US of East and Boulevard Junction	1.0	1.6	2.6	6.1	9.8

[1]Intermediate Flow Scenario

[2]Long Term Flow Scenario

SECTION 2

Process Mechanical

2.1 Introduction

This section describes the basis of the process mechanical design associated with improvements to meet the intermediate- and long-term flow scenarios and improve reliability of the station.

2.2 Pump Station Existing Conditions

2.2.1 Background and Existing Conditions

East Street was originally constructed as a treatment plant and converted to a pump station in 1984. The station is composed of two buildings. The Inlet Works building houses the screens and grit channels and the Pump Station houses the wet well, pumps, generator, odor control, and ancillary equipment.

Flow enters the influent chamber in the inlet works building from a 66-inch gravity sewer. A sluice gate is installed on the incoming sewer. Flow can split between three screen channels. Each channel has a sluice gate on the influent and effluent. As-built drawings show coarse screens followed by fine screens in each channel. Both sets of these screens have been removed. Mechanically cleaned bar screens manufactured by Duperon Corporation have recently been installed in two of the channels. The screens have a ¾-inch opening. Figure 2-1 is a photograph of the newly installed screens.

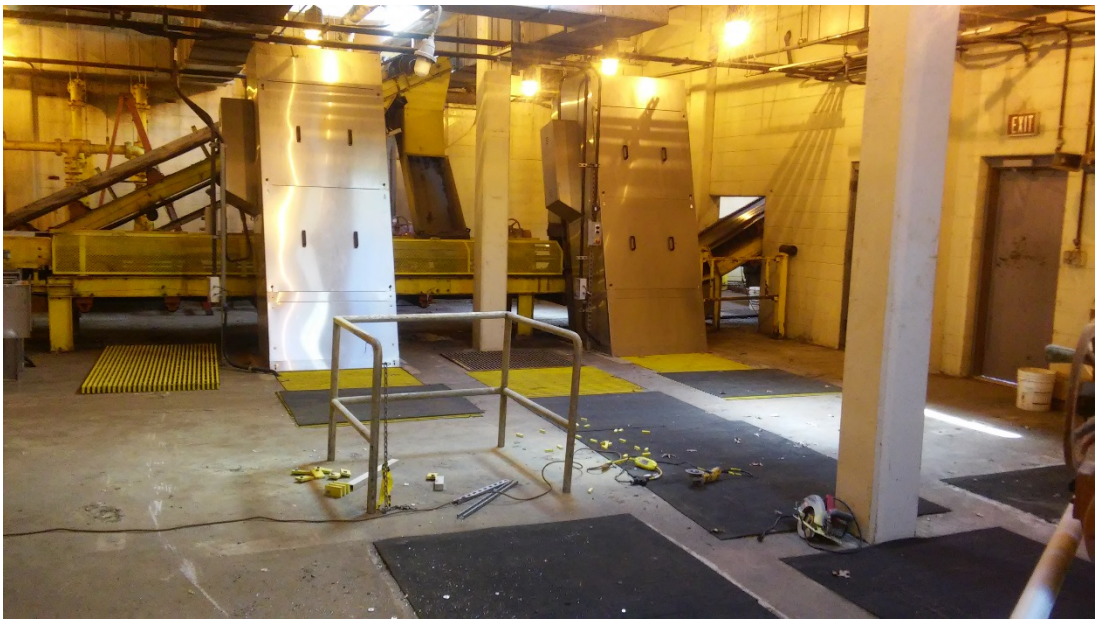


Figure 2-1: Existing Screens

The channels combine in a junction chamber downstream of the screens and splits into four grit channels. Sluice gates are located on each of the grit channels. An adjustable weir allows the operator to control the depth in the channel. The original grit removal mechanisms are in the process of being replaced with shaftless screw bottom collectors and a bucket removal system. The grit channels combine before leaving the Inlet Works building via a 48-inch gravity sewer. The sewer flows into the Pump Station wet well influent channel. A sluice gate is located on the influent to the wet well. There

are sluice gates located on the inlet to each side of the wet well and a sluice gate on the wet well dividing wall.

The screenings and grit combine and are conveyed to a dumpster in the inlet works building by belt conveyors. There is a belt conveyor that conveys grit to the screenings conveyor. The combined grit and screenings are conveyed to a room with a single bin. The room has a roll up door to remove the bin.

Each side of the wet well has three 24-inch suction wall pipes for a total of six. Four pumps are currently installed with space for two additional pumps. All four pumps are identical, as shown in Table 2-1. They are manufactured by Worthington. They are extended shaft vertical centrifugal pumps.

Table 2-1. Existing Pumps

Pump	Make/Model	Rated Capacity	Motor Size	Speed
1	Worthington 16MNZ-25	13 mgd	300 HP	900 rpm
2	Worthington 16MNZ-25	13 mgd	300 HP	900 rpm
3	Worthington 16MNZ-25	13 mgd	300 HP	900 rpm
4	Worthington 16MNZ-25	13 mgd	300 HP	900 rpm

Figure 2-2 is a photograph of the existing pumps at East.

Figure 2-2. Existing Pumps

Each pump has a gate valve on the suction side and a modulating ball valve on the discharge. There is a flow meter located on each pump discharge. A plug valve isolates the pumps from the discharge

manifold downstream of the flow meter. The pumps combine in a 42-inch force main before leaving the station to the west. A surge suppressor is connected to the force main inside the pump station. The surge suppressor drains to the wet well. Figure 2-3 is a photograph of the surge suppressor.

Figure 2-3. Existing Surge Suppressor

2.3 Inlet Works Facilities Design Criteria

2.3.1 Screening

The East Street Pump Station currently has new mechanical screens on two of the screening channels. The pump station cannot pass the 65 mgd through two screens. The third channel needs to be opened up for peak flows. To protect the pumps a mechanical screen can be provided in the channel. A third mechanical screen provides greater redundancy to the system if a screen needs to be taken offline for maintenance. The screen will match the existing screens.

The existing screening conveyors should be replaced with new conveyors and the grit and screenings should be separated. The new screenings system will include a grinder and compactor washer section to augment the existing screens. The grinder will have its own motor as will the compactor section, but the system will be operated by a common control panel that will be interlocked with the screen controls such that it is energized whenever the screen is operating.

The grinder section will precondition the screenings allowing a cleaner, drier, and more compact screenings product reducing odors and screenings volume. Spray washwater will be provided to allow organics to be washed back into the channel. The compactor (screw auger) portion of the grinder compactor will compact and convey clean screening into an adjacent screening bin.

Screenings loading is based on conservative assumptions of 9 cubic feet of screenings per million gallons of wastewater flow. These values were selected based on review of the Water Environment Federation's (WEF's) *Manual of Practice 8* (MOP 8) and design experience from other Connecticut wastewater treatment plants (WWTPs). Screenings are estimated to be 3.3 cubic feet per hour (cfph), on average, with peaks up to 15 cfph. Screening design criteria are listed in Table 2-2.

Table 2-2. Screening Design Criteria

Design Criteria	
Screenings Capacity	71 cubic feet per hour
Spray Washwater Capacity	249 gpm
Dry Solids Content	40%
Grinder Motor	5 hp
Compactor Motor	3 hp
Manufacturer	JWC, Franklin Miller

2.3.2 Grit Removal

The Authority is in the process of replacing the grit removal mechanisms on the four grit channels.

The existing grit conveyor should be replaced and the grit conveyor should be separated from screenings.

Grit loading is based on conservative assumptions of 8 cubic feet of grit for each per million gallons of flow. These values were selected based on review of WEF's MOP 8 and design experience from other Connecticut WWTPs. Grit loading is estimated to be 2.9 cfph, on average, with peaks up to 13.3 cfph.

2.4 Pumping Systems Design

2.4.1 Pump Configuration

As stated in Section 1, the proposed configuration for East is to have separate dry weather and wet weather pumps. This requires a dry weather submersible pump station located next to the existing pump station. The existing pump station would be converted to a wet weather pump station.

Table 2-3 lists preliminary dry weather pump selections.

Table 2-3. Dry Weather Pump Selections

Design Criteria	DWF Avg	DWF Min	DWF Max
Number of pumps	3	3	3
Number of pumps operating	1	1	2
Design flow (each pump) (mgd)	10.5	6.76	8.4
TDH at design flow (ft)	34.3	31.2	42.4
Efficiency at design flow	81%	78%	81%
NPSHA (ft)	47	47	47
NPSH3	16	10	13
Motor (HP)		90	
Impeller (in)		17.31	
Speed		900 RPM	
Type of Pump		Submersible	
Model		NP 3315.180	
Manufacturer		Flygt	

Table 2-4 lists preliminary wet weather pump selections.

Table 2-4. Wet Weather Pump Selections

Design Criteria	DWF Max	WWF
Number of Pumps	5	5
Number of pumps operating	1	4
Design flow each pump (mgd)	16.8	16.25
TDH at design flow (ft)	41	145
Efficiency at design flow	83%	84%
NPSHA (ft)	47	45
NPSH3	16	17
Motor (HP)	500	
Impeller (in)	30.43	
Speed	900 RPM	
Type of Pump	Extended Shaft Vertical Centrifugal	
Model	16MN33C	
Manufacturer	Flowserve	

Figures 2-4 and 2-5 show the system versus system curves containing the design points for dry and wet weather pumps.

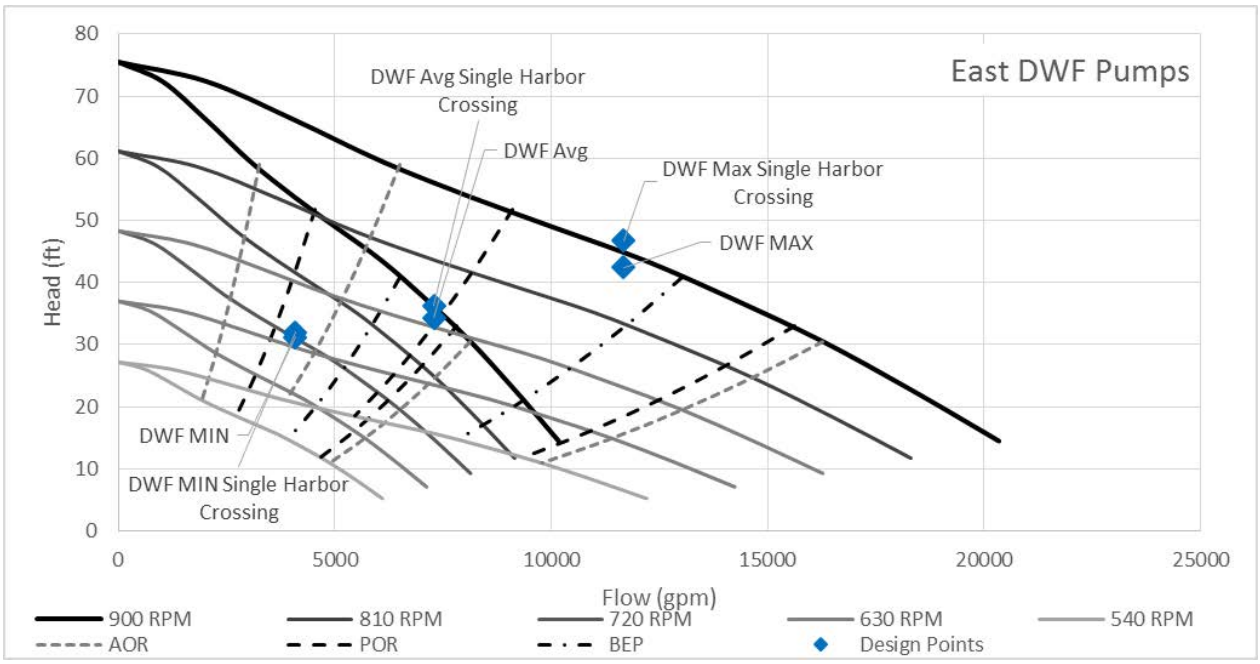


Figure 2-4. Dry Weather Pump and System Curves

Figure 2-4 shows the variable-frequency drive (VFD) curves for two pumps in operation. Under the minimum dry weather flow (DWF), a single pump is operating within the preferred operating range (POR), close to the best efficiency point (BEP). Under average DWF, a single pump is operating within the POR. Two pumps are necessary to meet the maximum DWF flow when both pumps are operating within the POR close to the BEP.

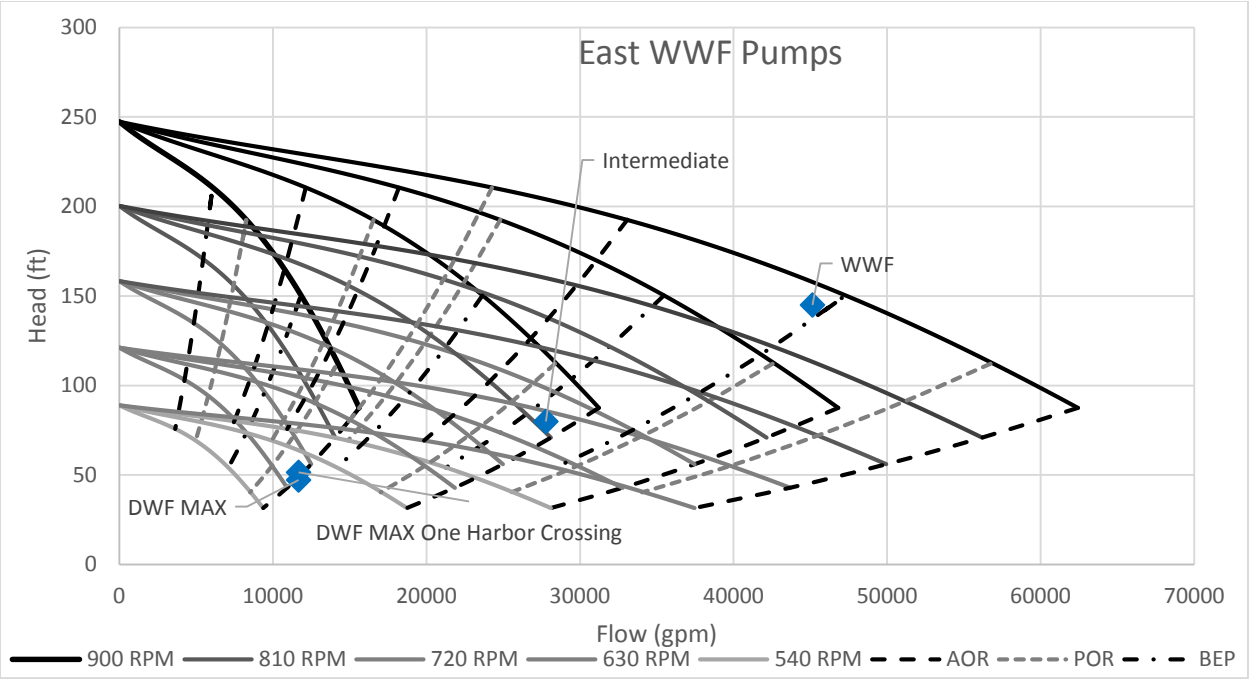


Figure 2-5. Wet weather pump and system curves

Figure 2-5 shows the maximum DWF is within the operating range of a single wet weather pump. The maximum flow from the dry weather pumps is within the operating range of a single wet weather pump within the POR. The WWF is within the POR when four pumps are in operation.

The finished floor elevation of East is 10.70. Our proposed design flood protection elevation accounting for sea level rise is 16.00. The existing motors are located at El -1.95. The finished floor at El 10.70 is open in the middle to provide access to the pumps below. See Figure 2-6 for a view of the finished floor El at 10.70 looking down at the pump motors at El -1.95.

Figure 2-6. Existing Ground Floor Level

A new platform will need to be constructed at El 10.70 to support the pump motors if extended shaft pumps are selected. The distance from the ground floor to the underside of the monorail is approximately 11.5 feet or at El 22.45 (this does not account for the hoist and trolley).

The preliminary selections for the extended shaft motors are 6.8 feet tall. The top of the motors installed at the ground floor would be 17.75.

There is 4.7 feet from the top of the motor to the underside of the monorail. Field measurements would need to confirm if this is sufficient for the existing hoist and trolley.

2.4.2 Pump Operating Criteria

The minimum dry weather flow can be met with a single dry weather pump in operation. The average and maximum dry weather flows can be met with two dry weather pumps in operation or a single wet weather pump in operation.

Wet weather flows can be met with three wet weather pumps during the Intermediate Term and four wet weather pumps in operation during the Long Term.

2.4.3 Wet Well Intake Configuration

The existing wet well configuration does not meet Hydraulic Institute (HI) standards in the following areas:

- Anti-rotational baffles are required for pumps larger than 3,000 gpm (4.3 mgd).
- Pumps suctions should be located in a confined wet well where each suction inlet bell is located in a confined pocket to isolate the pump from any flow disturbances that might be generated by adjacent pumps.

For retrofit designs, meeting the requirements of HI standards is often not feasible. If designs other than those required by HI standards are shown by prototype or model tests performed in accordance with HI standards the alternative designs are considered to comply with HI standards. During detailed design the wet wells will be evaluated using computational fluid dynamics (CFD) modeling verify the hydraulic efficiency and further physical testing may be required to model the existing wet well to identify measures that can be taken to comply with HI standards.

HI also provides recommendations for retrofit designs of rectangular wet wells that would help improve suction conditions. Recommendations are as follows:

- Inclusion of a baffle wall to minimize air entrainment due to falling liquid.
- Setting the baffle wall below the maximum wet well level to allow any floatable material to pass over the wall.
- Inclusion of fillets below the pump intake.
- Inclusion of baffles between the pump intakes.
- Inclusion of fillets along the sides of the wet well to eliminate dead zones.

2.4.4 Effluent Piping

The proposed effluent piping follows the existing discharge piping layout.

2.4.5 Valves and Flow Meters

Gate valves are recommended for isolation upstream and downstream of each pump. American Water Works Association (AWWA) C500 double disk metal seated valves are recommended for this application. Resilient seated gate valves (AWWA C509 or 515) are prone to damage from grit, double disk metal

seated valves are more robust than the resilient seated valves and leak less than a solid metal seated disk.

Check valves are provided for prevention of flow reversal on all pumps.

Flow meters are recommended on the discharge of each wet weather pump. It is not recommended to reduce a pipe size upstream and downstream of the flow meter. This is a standard practice to ensure adequate velocities through the flow meter but can cause turbulence reducing the accuracy of the instrument. At the minimum dry weather flow the velocity through the flow meter would be 2.6 fps. According to published literature for ABB mag meters velocities greater than 1.6 fps result in +/-0.15 percent and the minimum flow through the meter is 33 gpm. The flow meter will have 5 upstream diameters and 2 downstream diameters of straight run.

A single flow meter will be installed on the discharge of the dry weather pump station.

2.4.6 Equipment Access and Removal

A new platform will be required for access to the pump motors if extended shaft pumps are selected. The existing monorail has a 5-ton capacity which is sufficient to remove the new pumps.

The existing hatches are 8 feet by 10 feet. This is sufficient to remove the new larger pumps.

Hatches will be provided above the pumps at the new dry weather submersible pump station for removal of the pumps. A hatch will be provided for access to the valve vault for removal of equipment.

SECTION 3

Structural

3.1 Introduction

This section is intended to assess the building structure components of the East Street Station and identify design criteria for the rehabilitation of the facility. It also defines the design criteria for the new dry weather pump station and structural concrete foundations for odor control systems. It outlines proposed solutions to address structural deterioration, deficiencies and upgrades to incorporate architectural, process mechanical, and MEP findings.

3.2 Codes and Standards

The current governing code utilized by the City of New Haven and the State of Connecticut are based on the 2016 Connecticut State Building Code.

The following standards shall be used in support of the building code requirements:

Standards:

- ACI 318-11 – Building Code Requirements for Structural Concrete
- ACI 530-11 Building Code Requirements for Masonry Structures
- ASCE/SEI 7-10 - (Supp 1)—Minimum Design Loads for Buildings and Other Structures.
- ASCE 24 – 14 – Flood Resistant Design and Construction
- CH2M HILL Water Business Group Design Guide.
- International Concrete Repair Institute Technical Guidelines (ICRI)
- ICC-ES Evaluation Reports for specific products.
- Structural Steel Painting Council (SSPC)

Reinforced Concrete:

- Typical Unless Noted Otherwise: ACI 318-11 Building Code Requirements for Structural Concrete.
- Liquid Containment Structures: ACI 350-06 Code Requirements for Environmental Engineering Concrete Structures.

Concrete Repair:

- ICRI GS03130 Guide Specifications for Structural Concrete Repair
- ICRI Technical Guideline No. 03732 -Selecting and Specifying Concrete Surface Preparation for Coatings, Sealers, and Polymer Overlays

Steel:

- AISC 360-10 Specification for Structural Steel Buildings, including Supplement No. 1 dated 2005.
- Manual of Steel Construction, Thirteenth Edition.

3.3 Structural Condition Assessment

The construction of the East Street Pump Station facility consists of two structures: the Operations Building and the Inlet Works Building. Date of construction for the Operations and Pump Station building was in the early 1960s. The Inlet works building was later constructed in 1983. The structure was designed by CE Maguire, Inc. Engineers of Providence, Rhode Island. Original design drawings available for review are dated March 30, 1983.

The Operations Building structure is primarily composed of conventionally reinforced cast-in-place concrete frame with concrete columns, slabs and below-grade foundation walls. Based on the original as-built drawings, it is assumed the foundation system is a mat foundation supported by undisturbed soils. The above-grade exterior elevations of the pump station structure appear to be non-load-bearing concrete masonry unit (CMU) with an exterior stucco coating. There are three supported levels in the facility: Dry Well/Wet Well Level, the Ground Level and Second Level Control Rooms, and Office.

The Inlet Works Building is a single level conventionally reinforced cast-in-place concrete frame with concrete columns, slabs, beams and foundation walls. The building exterior is composed of a splitface block veneer with CMU backup.

3.3.1 Observations and Recommendations

Observations and recommendations (in italics) are divided between the Operations Building and the Inlet Works Building:

Operations Building:

1. Pump Room: The motor room houses electrical control panels, pump motors and provides access to the dry well area below.
    a. The concrete floor structure in the Pump Room is in good condition and protected by a floor coating system. Some cracking was evident throughout the floor area, but it does not appear to be structural distress cracking. A CH2M report completed in 2007 indicated that the floor has an unreinforced bonded concrete topping slab; a topping slab would be expected to reflect construction joints and shrinkage cracking through the topping and should not be a concern.
    b. The roof structure above the motor room appears to be in good condition with no observed leaks or distress.
    c. A new Bridge Crane system is desired in the pump room. *Existing drawings for the original Operations building must be analyzed for structural capacity prior to the design and installation of a new bridge crane. Confirming the roof framing capacity could allow upsizing of the crane to handle larger pump system.*
    a. There are four floor openings provided for access to the dry well pumps. Each opening has a 6-inch raised curb and a 42-inch high removable aluminum railing to minimize access. One area of grating was damaged/bent indicating a past overloading. *To increase access, the curb and railing could be removed at each opening and replaced with a flush-mount access hatch designed for heavy live loads from equipment.*
2. Dry Well: The dry well is located approximately 22 feet below the Motor Room and houses the pumps for discharge from the adjacent wet well.
    a. The dry well area concrete surfaces were in good condition and painted. No leakage was noted through the foundation walls. The coating on the floor slab was not continuous in some areas. *The floor slab coating should be recoated and new coating placed in uncoated areas to provide a continuous barrier.*
    b. The drains in the floor appear to be corroded with broken grating. *Drains should be planned for replacement*
    c. The stairs leading from the motor room down to the dry well are composed of concrete and are in good condition. Because the stair down to the dry well will be enclosed with CMU for code compliance, significant modification of the railings will be required. *All existing stair and landing railings should be planned for replacement.*

For code compliance a full height CMU wall will be necessary to isolate the stair from the drywell (see Architectural section of this report).

d. A steel platform composed of galvanized framing and grating is provided for access to each of the four pumps. Due to leaks at each of the pumps, the platform supports have been subjected to moisture. *Corroded stair and platform framing areas should be cleaned and protected with a new coating system*.

e. The pump pedestals and steel pipe supports are also subjected to moisture due to leaks around the pump mechanism. *All deteriorated areas of steel and concrete should be cleaned, repaired and recoated with a protective coating system.*

3. Wet Well: The wet well access is located on the south side of the Operations building, a corridor leading to cast-in-place concrete stairs provides access down into the wet well. Review of the wet well was limited to visual inspection at the bottom of the stairs.

   a. The concrete stairs down into the wet well were in good condition.

   b. The concrete framing and walls within the wet well did not appear to exhibit deterioration. *A protective coating shall be applied to all surfaces within the wet well.*

   c. Steel grating platforms and railing are provided for access over wet well spaces. Although these areas were not physically accessed for inspection, they do exhibit visual deterioration. *All platforms and railings within the wet well structure should be replaced.*

4. Exterior Site:

   a. Existing access hatches provided over influent and wet well openings were typically a hinged diamond plate steel and did not lay flush with surfaces. *New heavy duty stainless steel flush-mount access hatches with the ability to seal should be provided over exterior openings.*

Inlet Works Building:

1. Screening Room: The screening room is the largest room in the Inlet Works building and provides access to the influent, bar screen and grit collection channels:

   a. The reinforced concrete floor in the screening room appears to be in good condition. The floor appears to be constantly wet. *The floor should be planned for sealants in joints at perimeter walls and a protective coating system. This will protect the concrete structure and perimeter walls.*

   b. At the time of the site visit, the aluminum gratings over channel openings were being replaced with new composite grating.

2. Influent Channel: One influent channel enters at the northeast corner of the facility and is divided into three channels leading to the bar screen equipment. The flow is further divided into four channels leading into the grit collection equipment.

   a. The concrete channels for the influent and bar screens were reported to be in good condition, although access into the channels was not available during the time of inspection. Some necessary concrete repair was noted around the influent and screen channel slide gates. The Bar Screen channels on the south side of the building were not available for review at the time of the site visit. *The extent of concrete repairs should be defined during design development.*

   b. Influent Channel: One influent channel enters at the northeast corner of the facility and is divided into three channels leading to the bar screen equipment. The flow is further divided into four channels leading into the grit collection equipment.

      A protective coating shall be applied to all concrete surfaces in the channels.

3. Mechanical Room: The mechanical room is located on the south side of the Inlet Works building and houses motor control panels, chemicals and other mechanical equipment.

   a. The concrete slab in the mechanical room exhibits significant deterioration totaling approximately 300 square feet (ft^2). We suspect this is due to the chemicals stored in the room and an unprotected floor surface. *All deteriorated concrete on the floor slab should be repaired, a new chemical resistant protective coating should be provided on all concrete and wall surfaces with in the chemical storage area.*

   b. The chemical storage area within the mechanical room does not have walls or a curb for chemical containment in the case of the spill. *Containment walls should be added to this area. All walls should be protected with a chemical resistant coating.*

3.4 Design Criteria

3.4.1 Loading

Design loading criteria for the Operations building was not available for review. Prior to renovation/rehabilitation in this building, a structural analysis should be completed to confirm expected loads during construction and during service.

Design loading criteria was available for the Inlet Works Drawings as Follows:

Snow Load	40 psf
<u>Live Loads</u>	
Stairs	100 psf
Maintenance and Mech Rooms	150 psf
Heavy Storage Rooms	250 psf or Weight of Equipment
Slab on Grade	150 psf

3.4.2 Resiliency Planning and Design Basis

As part of its recognition of future coastal resiliency impacts, the State of Connecticut has directed that all projects using State funding, such as the Clean Water Fund (CWF), must include features that address potential sea level rise and coastal resiliency issues within its design. Each of these stations are either within or directly adjacent to the 100-year floodplain, as determined by the Federal Emergency Management Agency (FEMA). The current Flood Insurance Rate Maps (FIRMs) for the New Haven area have recently been updated as a result of documented impacts from Hurricane Sandy, and recent regional evaluations of sea level rise trends and future projections. Due to this revision, the regulatory base flood elevations have risen by 1 foot at both East Street and Boulevard Pump Stations, but remain the same for Union Pump Station.

In accordance with the Public Act Nos. 13-15, the CWF is required to consider the necessity and feasibility of implementing measures designed to mitigate the impact of a rise in sea level over the projected life span of such a project. To further the abilities of municipalities to implement this requirement, the New England Interstate Water Pollution Control Commission (NEIWPCC) updated its Technical Release 16, Guides for the Design of Wastewater Treatment Works (TR-16) and provided guidance on selecting an appropriate protection elevation related to the criticality of each process component and the impact on the environment if that process was impacted during a storm event. The guidance document separates facilities into two types: critical and non-critical. Critical facilities are defined as those systems that are required for the conveyance of wastewater to and through a treatment facility. This includes all electrical, mechanical, and control systems within a pump station.

The recommendation in TR-16 is to elevate these critical elements a minimum of 3 feet above the 100-year flood elevation.

As part of the recent Phase 1 Wet Weather Capacity Improvements and Nitrogen Reduction Project at the South Shore WPAF, an evaluation was conducted to establish the resiliency elevation for use during this construction project. This evaluation included consideration of recent regional coastal sea level rise evaluations, along with elevating equipment above the 500-year flood elevation. Combining these two elements resulted in a protection elevation for the East Shore WPAF of 2.95 feet (NAVD 88) above the established 100-year base flood elevation. As part of this Preliminary Design Report, the protection elevation is being set at 3 feet to be consistent with the TR-16 guidance.

The East Street Pump Station was evaluated for the feasibility and necessity of elevating critical equipment to maintain operations during a flooding event. It was deemed not feasible or cost-effective to elevate all equipment due to existing space limitations, or overall station configuration. In addition, due to the interconnectivity of the station with existing outfalls adjacent to the stations, certain areas will be inundated without the ability to protect the interior of the facilities from rising flood waters. For this purpose, GNH has taken the approach of providing dry floodproofing where critical equipment must remain below the resiliency protection elevation, and providing wet floodproofing where appropriate to maintain structural stability and allow the facility to quickly regain full operations once the flood waters recede. In general, floodproofing methods include construction of cast-in-place structural walls around the perimeter of each area to be dry floodproofed, with implementation of removable bulkheads at roll up doors and personnel doors as needed. Wet floodproofing methods include installation of flood vents to allow hydrostatic pressures to equalize on either side of facility walls during the flooding event allowing immediate return to service following cessation of flood waters. Specific floodproofing locations are included in the Preliminary Design Drawings included in Appendix A.

3.4.3 Design Loads

In some cases, minimum loads listed in the American Society of Civil Engineers *Minimum Design Loads for Buildings and other Structures* standards (ASCE 7) may be an equivalent criterion and may be substituted for the following loads. The below minimum criteria shall be used for design.

3.4.3.1 Floor Live Loads

In accordance with codes and standards listed above, and the following minimums:

Process Rooms	300 psf on slabs and beams and 200 psf on girders, columns
Electrical Rooms	300 psf
Storage Areas	150 psf
Mechanical/HVAC Rooms	150 psf or Equipment weight plus 50 psf Allow for rolling equipment
Stairs, Walkways and Platforms	100 psf
Platforms Only for Access	60 psf
Vehicular Traffic	AASHTO HS 20-44

3.4.3.2 Wind Loads

Wind loads will be based on Risk Category III unless otherwise noted, with an ultimate design wind speed (Vult) of 135 mph (3-second gust), Exposure C.

3.4.3.3 Snow Loads

Existing areas requiring analysis and areas of new construction will be analyzed with the following assumptions.

Ground Snow Loads	30 psf
Importance Factor	1.1
Snow Exposure Factor	1.0

3.4.3.4 Flood Loads

Hydrostatic Loading of 63 pounds per cubic foot (pcf) will be assumed up to the proposed Sea Level Rise (SLR) Elevation. Portions of the facility will be dry floodproofed while other areas will receive wet floodproofing. The extent of floodproofing will be finalized during detailed design.

The following assumptions apply to the East Street Pump Station, all elevations are based on NAVD 88.

Base Flood Elevation (BFE):	+13.0 feet
Design Flood Elevation (DFE):	+14.0 feet
Sea Level Rise Elevation:	+16.0 feet

3.4.3.5 Liquid Loads

Load cases that will be considered in design of liquid holding basins are:

- A fluid pressure of 62.4 pcf will be used for hydrostatic loads from ground water and flooding.
- A fluid pressure of 63 pcf will be used for process liquid in channels, unless otherwise noted.

3.4.4 Concrete

Materials and design procedures for concrete are described below.

3.4.4.1 Materials

The following minimum requirements apply (concrete compressive strength at 28 days):

- Typical Concrete, unless otherwise noted 4,500 psi
- Concrete Fill, unless otherwise noted 3,000 psi
- Concrete Fill exposed to liquid 4,500 psi
- Curbs and Sidewalks 3,000 psi
- Conduit Encasements and pipe encasements not integral with foundation 4,500 psi

Reinforcement:

- Conventional Steel: ASTM A615, Grade 60 (f_y = 60 ksi)

3.4.4.2 Design Procedures

Strength design will be used for concrete in accordance with ACI 318 unless noted otherwise. Hydraulic structures will be designed in accordance with ACI 350.

Design of concrete hydraulic structures will include use of environmental durability factor (Sd), for anticipated fluid and earth loads during normal operation only. Available capacity of members will be checked for loads that may occur during extreme design events.

Slab thickness will be checked to provide adequate embedment of post installed anchor bolts for mechanical equipment.

3.4.4.3 Details of Steel Reinforcement

The minimum concrete cover over steel reinforcement will be as follows:

- Surfaces cast against soil 3 inches
- Typical unless otherwise noted 2 inches

3.4.5 Masonry

The materials and design procedures for masonry are described below.

3.4.5.1 Materials

The following requirements apply:

- Hollow CMUs will conform to ASTM C 90 and will be normal- or medium-weight units with a net area compressive strength of 1,900 psi.
- Mortar will conform to ASTM C 270, Type S.
- Grout will conform to ASTM C 476. Minimum 28-day compressive strength will be 2,000 psi.
- Steel reinforcement will conform to ASTM A615, Grade 60.
- Horizontal joint reinforcing steel will conform to ASTM A82.

3.4.5.2 Design Procedures

Allowable stress design will be used for masonry in accordance with ACI 530. Compressive strength of masonry, f'_m, for masonry assembly will be 1,500 psi. For design, calculated tensile/compressive stress, f_s, of steel reinforcement is 24,000 psi for deformed bars and 30,000 psi for wire-in joints.

3.4.5.3 Details of Steel Reinforcement

1. Limit maximum spacing of vertical steel reinforcement in bearing walls and partition walls to 4 feet and 8 feet, respectively.
2. Provide bond beams at top and bottom of walls.
3. Use joint reinforcement at 16-inch maximum vertical spacing.

3.4.6 Structural Steel

Materials and design procedures for structural steel are as follows.

3.4.6.1 Material

The material requirements for structural steel are listed in Table 3-1.

Table 3-1. Material Requirements for Structural Steel

Shape	ASTM	Grade	Fy (ksi)	Fu (ksi)
Rolled Shapes, Plates and Rods	A36	-	36	58
W-shapes & WT-shapes	A992	-	50	65
Pipes	A53	B	35	60
Round Hollow Structural Sections (HSS)	A500	B	42	58
Square and Rectangular HSS	A500	B	46	58
Bolts for Connections (1/2” to 1” diameter)	A325 or F1582	-	-	120
Anchor Rods – Dry Areas Only	F1554	36	36	58
Anchor Rods – Typical	F593	316, Cond. CW	40	80
Welding Electrode	E70XX			70

3.4.7 Design Procedures

Structural steel design will be in accordance with the American Institute of Steel Construction's (AISC's) *Steel Construction Manual*.

3.4.8 Cranes

Cranes shall meet requirements of the AISC *Steel Construction Manual* and ASCE 7. Unless noted otherwise, vertical impact shall be 25 percent of maximum wheel load. Lateral force on crane runway shall be calculated as 20 percent of sum of rated capacity of crane and weight of hoist and trolley. Lateral force shall be assumed to act horizontally at traction surface of a runway beam, in either direction perpendicular to beam. Longitudinal force on crane runway beams shall be calculated as 10 percent of maximum wheel loads of crane. Longitudinal force shall be assumed to act horizontally at traction surface of a runway beam in either direction parallel to beam.

SECTION 4

Architectural

4.1 Introduction

This section assesses the architectural components of the East Street Pump Station and presents the design criteria for upgrades to the facility. The architectural assessment consisted of three tasks: interviewing staff, visiting facility site, and reviewing available facility documentation. It outlines proposed solutions to deficiencies found from building and code assessment done. These recommendations are intended to serve as preliminary guidance for the design of facility renovations.

The East Street Pump Station consists of the following two buildings:

- Operations Building and Pump Station
- Inlet Works Building

4.2 Building Codes

The 2016 Connecticut State Building Code will be used as a basis of this review.

4.2.1 Authorities Having Jurisdiction

The East Street Pump Station is located in the City of New Haven, Connecticut. The City of New Haven Building Department enforces the Connecticut State Building Code (CSBC).

4.2.2 Current Connecticut Codes

Per the State of Connecticut Department of Construction Services, the following codes have been adopted and are applicable to this project:

Building Code:	2016 Connecticut State Building Code (CSBC 2012 International Building Code (IBC), as modified by CSBS.
Existing Building Code:	2012 International Existing Building Code (IEBC), as modified by CSBS.
Accessibility Code:	ICC/ANSI A117.1-2003 Accessible and Usable Buildings and Facilities, as modified by CSBC.
Fire Code:	Connecticut State Fire Safety Code including all current Amendments to the fire code.
Energy Code:	2012 International Energy Conservation Code (IECC) as modified by CAIECC.
Mechanical Code:	2012 International Mechanical Code International Mechanical Code (IMC) as modified by CSBC.
Plumbing Code:	2012 International Plumbing Code (IPC), as modified by CSBC.
Electrical Code:	2014 National Electrical Code (NEC) as modified by CSBC.

4.3 Operations Building and Pump Station

4.3.1 Building Code Analysis

4.3.1.1 Enclose Stairs

Egress distance from west end of lower level Pump and Motor rooms to egress door is greater than the 75 feet allowed by code. Also, the egress distance from upper level Control Room to egress door is greater than the 75 feet allowed by code. There is also limited headroom under the concrete beam at bottom of the stair. The design will include the following components:

1. Demolish existing stair enclosure and door on upper level.
2. Enclose existing stair with 2-hour fire-rated CMU walls on all 5 levels.
3. Add interior fire-rated FRP doors on all 5 levels for a total of 5 single doors and one double door at the ground floor.
4. Paint concrete beam at bottom of stair safety yellow and add limited headroom warning sign.
5. Modify existing handrails as required to install new CMU walls.
6. Remove east window frame between Upper Motor Room and Unassigned Room, and fill opening in with CMU.

4.3.1.2 Chemical Storage

There is corrosive Sodium Hydroxide and combustible No. 2 Diesel Fuel stored below ground south of the Operations building. There is a corroded 1050-gallon diesel storage tank in the Oil Tank Room that is not to code. There is a 275-gallon Diesel day tank in the Mechanical Room. No. 2 Diesel Fuel is a Class II Combustible Liquid and irritant. The exempt amount of inside storage of diesel fuel is 120 gallons. Rooms with diesel tanks over the exempt amount would be H-3 hazardous occupancies. This requires fire separation from the rest of the building and sprinkler system. There is no containment for the inside diesel tanks and battery storage and no safety shower or eyewashes. The design will include the following components:

1. Remove the existing inside diesel storage tanks and provide a new exterior generator system with integral day tank in a weatherproof enclosure.
2. Abandon interior and exterior chemical storage tanks used for odor control. Odor control systems will be activated carbon systems.
3. Add leak detection in chemical containment areas to remain.
4. Add NFPA 704 Hazardous Material Signal signs at underground diesel storage and doors to chemical storage areas. Add Warning Diesel Fuel sign at outside Diesel storage tank.

4.3.1.3 Stoops

Two south entrances are 12 inches above grade, which is greater than code allowed 7 inches. The following solution will correct this problem:

1. Add a long concrete stoop with 6-inch high step covering both wall openings. No handrail is required for just one step.

4.3.1.4 Sprinkler System

Current code requires floors with limited fire fighter access doors and openings to have a sprinkler system. The Pump Room lower levels has limited fire access, so a sprinkler system is required. The design will include the addition of a sprinkler system to Pump Room lower levels.

4.3.2 Building Condition Assessment

4.3.2.1 Roof

The 33-year-old gravel surfaced built-up roof is in need of replacement. The upper roof was replaced in 2015 and is in good condition. The design will include the following components:

1. Remove existing lower roof down to concrete substrate.
2. Install vapor retarder on concrete deck.
3. Install polyisocyanurate insulation with ¼" per foot slope to drains, R-value of 20 minimum average.
4. Add overflow drains to comply with current plumbing code.
5. Install gravel surface 4-ply built-up roofing.
6. Add treated blocking on top of the parapets and add aluminum coping.
7. Modify existing lightning protection system to allow for new coping.
8. Add walkway pads from roof hatch to equipment.
9. Add stainless steel roof flashings.
10. Provide new curbs for new and existing roof top HVAC.

4.3.2.2 Skylights and Hatch

The 33-year-old plastic domed skylight and roof hatch is in need of replacement. The design will include the following components:

1. Remove five existing domed skylights and protective screens.
2. Install five new translucent panel hip skylights on prefabricated insulated curbs.
3. Replace roof hatch with aluminum roof hatch with safety rails.

4.3.2.3 Windows

The existing windows need replacement. The design will include the following components:

1. Remove ground floor 14-feet-tall narrow windows and one large window above east Motor Room double door, and replace with insulated translucent panels with 8x8-inch grid pattern and aluminum frame. Paint existing steel lintels with a chemical resistant epoxy paint system.
2. Remove the upper floor single tall narrow window and 4 large windows, and replace with insulated translucent panels with 8x8-inch grid pattern, aluminum frame, and bottom 7 feet section above the floor of the large windows with insulated tinted laminated glass with low-e coating. Paint existing steel lintels with a chemical resistant epoxy paint system.
3. Provide insulated translucent panels with 8x8-inch grid pattern and aluminum frame in transom frame above door to Mechanical Room.
4. Seal around windows.

4.3.2.4 Doors, Louvers and Interior Windows

The hollow metal doors and interior windows are deteriorated and need replacement. The existing aluminum louver appears to be in good condition. The design will include the following components:

1. Remove 11 single doors and replace with fiberglass reinforced plastic (FRP) doors and frames with heavy duty stainless steel hardware.
2. Remove four double doors and replace with FRP doors and frames with heavy duty stainless steel hardware. Provide transom frame with insulated translucent panels above door to Mechanical Room, see Windows.
3. Remove west window frame between Upper Motor Room and Unassigned Room and CMU below window, and add FRP door.

4. Remove double monorail door on the west side of the Motor Room and replace with FRP double monorail door with heavy duty stainless steel hardware and monorail seal.
5. Remove two metal window frames and glass windows in the south wall of Unassigned Room and install FRP frames with laminated glass.
6. Provide FRP louvers required for new ventilation.
7. Seal around doors, interior windows, and louvers.
8. Seal around 42-inch pipe penetration in Motor Room west wall.
9. See Stair Enclosure for additional doors.

4.3.2.5 Grating, Floor Hatches, and Handrail

Handrails in wet well are corroded and need to be replaced. Grating and other handrails appear to be in good condition. The floor hatch into the wet well needs to be replaced. There are several tripping hazards on the floor. The design will include the following components:

1. Remove existing metal handrail in wet well and replace with FRP handrail.
2. Replace floor hatch into wet well with Type 316 stainless steel double leaf floor hatch.
3. Fix floor drain in Electrical Room and drain cover in Unassigned Room to be level with floor and plumb to new sump.

4.3.2.6 Painting

The exterior on the building was recently painted and is in good condition. The interior walls, floors, and ceilings are in need of repainting. Equipment and piping is in need of painting. The design will include the following components:

1. Surface prepare and paint walls and ceilings in all the rooms with a chemical resistant epoxy paint system.
2. After surface preparation and before painting walls patch holes in the walls with 100% solid epoxy filler.
3. Surface prepare and paint existing painted floor with chemical resistant epoxy non-skid paint system.
4. Surface prepare and paint piping, equipment, and supports in all the rooms with a chemical resistant epoxy paint system.

4.3.2.7 Toilet and Janitor Closet

The plumbing fixtures and toilet accessories are deteriorated and in need of replacement. The tile floors and walls are also in need of replacement. The design will include the following components:

1. Demolish existing Toilet lockers, benches, partitions, fixtures, wall and floor tile, and accessories.
2. Demolish existing Janitor Closet service sink and wall and floor tile.
3. Install floor and wall tile in Toilet and Janitor closet
4. Add Toilet fixtures and faucets.
5. Add lockers and benches if required.
6. Add Janitor Closet service sink with stainless steel service sink and faucet.
7. Add drinking fountain outside of restroom.

8. Since only one Toilet Room is provided, provide privacy lock on door.
9. Add commercial grade stainless steel partitions and accessories.

4.3.3 New Rooms and Spaces

4.3.3.1 Control Room

Enclose new electrical equipment so it can be climate controlled. The design will include the following components:

1. Make the upper level floor a Control Room and expand the room south to provide for new MCC and switchgear components.

4.4 Inlet Works Building

4.4.1 Building Code Analysis

4.4.1.1 Chemical Storage

There are corrosive chemicals stored in the Mechanical Room and below ground between the buildings. There appears to be more than the code exempt amount of 500 gallons stored inside the building, which would make the room an H-4 hazardous occupancy. This requires fire separation from the rest of the building and a sprinkler system. There is no containment for the large sodium hypochlorite tank. The floors and walls are damaged from what appears to be chemical leaks. There is no safety shower. The design will include the following components:

1. Remove corrosive storage tanks and appurtenances. Odor control systems will be activated carbon systems.
2. Add emergency safety shower and eyewash in Mechanical Room.
3. Seal wall penetrations in Mechanical Room.

4.4.1.2 Stoops

The three south door entrance steps are higher than code allowed 7 inches. Existing door heights above grade are 11, 14, and 16 inches. The following solution will correct this problem:

1. Add concrete 3 concrete stoops with 7-inch high maximum step.
2. Add handrails at stairs greater than 1 step.

4.4.2 Building Condition Assessment

4.4.2.1 Exterior Masonry

Existing exposed concrete and split rib CMU walls are stained and deteriorated. The design will include the following components:

1. Clean existing masonry with sand blasting and mild detergent.
2. Tuck-point mortar joints.
3. Replace joint sealant in masonry joints.
4. Seal split rib CMU with clear breathable sealer.
5. Coat exposed concrete with breathable coating.

4.4.2.2 Roof

The 33-year-old gravel surfaced built-up roof is in need of replacement. The design will include the following components:

1. Remove existing roof down to concrete substrate.
2. Install vapor retarder on concrete deck.
3. Install polyisocyanurate insulation with ¼-inch per foot slope to drains, R-value of 20 minimum average.
4. Add overflow drains to comply with current plumbing code.
5. Install gravel surface 4-ply built-up roofing.
6. Add treated blocking on top of the parapets and add aluminum coping.
7. Modify existing lightning protection system to allow for new coping.
8. Add walkway pads from roof hatch to equipment.
9. Add stainless steel roof flashings.
10. Provide new curbs for new and existing roof top HVAC.

4.4.2.3 Skylights and Hatch

The 33-year-old plastic domed skylight and roof hatch are in need of replacement. The design will include the following components:

1. Remove eight existing domed skylights and protective screens.
2. Install eight new translucent panel hip skylights on prefabricated insulated curbs.
3. Replace roof hatch with Type 316 stainless steel roof hatch with safety rails.

4.4.2.4 Doors and Louvers

The hollow metal doors and interior windows are deteriorated and need replacement. Existing aluminum louver appears to be in good condition. The design will include the following components:

1. Remove 11 single doors and replace with FRP doors and frames with heavy duty stainless steel hardware.
2. Remove four double doors and replace with FRP doors and frames with heavy duty stainless steel hardware. Provide transom frame with insulated translucent panels above door to Mechanical Room, see Windows.
3. Remove west window frame between Upper Motor Room and Unassigned Room and CMU below window, and add FRP door.
4. Remove double monorail door on the west side of the Motor Room and replace with FRP double monorail door with heavy duty stainless steel hardware and monorail seal.
5. Remove two metal window frames and glass windows in the south wall of Unassigned Room and install FRP frames with laminated glass.
6. Provide FRP louvers required for new ventilation.
7. Seal around doors, interior windows, and louvers.
8. Seal around 42-inch pipe penetration in Motor Room west wall.
9. See Stair Enclosure for additional doors.

4.4.2.5 Grating and Handrails

Grating is corroded and needs to be replaced. The existing grating is being replaced with FRP grating. Handrails are corroded and need to be replaced. The design will include the following components:

1. Remove all existing metal grating and replace with FRP grating. Make all grating level with floor.
2. Surface prepare and paint grating supports with a chemical resistant epoxy paint system.
3. Remove all existing metal handrail and replace with FRP handrail.

4.4.2.6 Painting

The walls and ceilings are in need of repainting. Floors in Mechanical Room are cracked and spalling. Bottom of walls are deteriorating. Equipment and piping is in need of painting. The design will include the following components:

1. Surface prepare and paint walls and ceilings in all the rooms with a chemical resistant epoxy paint system.
2. After surface preparation and before painting the walls of the Mechanical Room, patch the base of the walls with 100 percent solid epoxy filler.
3. Remove spalling concrete and patch Mechanical Room floor. Paint floor with chemical resistant non-skid epoxy paint system.
4. Surface prepare and paint piping, equipment, and supports in all the rooms with a chemical resistant epoxy paint system, including exterior vent pipes.
5. Surface prepare and paint ladder to roof with a chemical resistant epoxy paint system.

4.4.2.7 Service Sink

Service sink in the Screening Room is deteriorated and in need of replacement. The design will include the following components:

1. Replace service sink with stainless steel service sink and faucet.

SECTION 5

Heating, Ventilation, and Air Conditioning

5.1 Introduction

Ventilation measures will be established based on the 2012 edition of the National Fire Protection Association (NFPA) 820 standard entitled “Fire Protection in Wastewater Treatment and Collection Facilities”. NFPA 820 establishes outside air ventilation rate criteria as well as ventilation design recommendations for safeguarding against fire and explosion hazards specific to wastewater treatment plants and associated collection systems.

5.2 Design Approach

Air handling units will be located outside on the roof structure or at grade on an elevated platform adjacent to the structure. Air handling units serving electrically classified areas will be designed to supply tempered 100 percent outside air without recirculation, except where NFPA 820 allows dual ventilation rate during cold weather and the space atmosphere is relatively moisture and corrosive vapor free. Combustible gas detectors will override air handling systems operating in dual mode if combustible gases are detected.

Ventilation will be continuous and at rates adequate to reduce area NFPA 820 electrical classifications one category where required to suit the design. Ventilation systems that are required to reduce electrically classified spaces one category shall be monitored and provided with alarm stations located within and at entrances to these spaces. Air handling units in electrically classified areas will be designed in such a way as to isolate the unit supply air stream from the process area in the event the unit is turned off or losses power. An intermediate damper will open to atmosphere to provide a naturally vented air break space between the unit interior and the process space.

Air will be exhausted via exhaust fans mounted where foul air is not present within the space. Areas containing foul air will be exhausted to an Activated Carbon system, as described in Section 9 – Odor Control in this report. Air will be exhausted low within the space to facilitate removal of hydrogen sulfide that collects along the floor.

Supplemental unit heaters will be provided throughout spaces as required to maintain local heating needs during winter.

Louvers/vents/exhaust fans or supply/exhaust fans will be used to supplement ventilation in areas requiring higher summer ventilation rates or intermittent ventilation.

Staff areas and electrical rooms requiring air conditioning will be provided with packaged rooftop direct expansion (DX) equipment, self-contained DX equipment or ductless split system DX equipment as required to suit the space need. Critical electrical and control rooms will be provided with redundant air conditioning systems if necessary to ensure space temperatures can be met if primary units should fail.

Facilities will be provided with an automatic temperature control (ATC) system for global monitoring and control of heating, ventilation, and air conditioning (HVAC) equipment. The control system will be based on an open architecture (Lon or BACnet) direct digital control (DDC) system or programmable logic controller (PLC) based system, the selection of which will be determined during design. ATC panels will be located in “clean spaces” (e.g., electric room, control room) where possible. Control devices such as sensors and thermostats will be provided with suitable enclosures designed for the associated atmosphere in which they are located.

5.2.1 Inlet works Building

The existing heating and ventilation system in the Inlet Works Building will be completely demolished and a new make-up air unit (MAU) will be provided for the Screen/Grit Room, and garage. The MAU may be located on the roof and will provide 12 air changes/hour (ACH) with 100 percent outside air in order to reduce the National Fire Protection Association (NFPA) electrical classification from Class 1, Division 1 to Class 1, Division 2. The supply air will be tempered to minimum 55 degrees F during winter in order to protect plumbing and water piping from freezing and ventilation system will be reduced to 6 ACH, as allowed by NFPA 820 and whenever the outside air temperature is 50 degrees F or below, the space is unoccupied, and the combustible gas detector is 10 percent below the lower explosive limit of methane. The MAU and exhaust fans will be provided with VFDs and a separate exhaust fans will be provided to maintain proper temperature conditions for the pump motors during the summer months.

The 50 percent exhaust air during the summer and 100 percent of exhaust air during the winter (ambient temperature is 50 degrees F or below) from the Inlet Works Building will be treated by the proposed odor control system (See Section 11).

5.2.2 Operations Building

The pump dry well will be heated and ventilated at a rate of 12 ACH with 100 percent outside air in order to reduce the NFPA electrical classification to Unclassified. A new MAU will be provided that can recirculate up to 50 percent of the air when the space is unoccupied, the outside air temperature below 50 degrees F and the combustible gas detector is 10 percent below the lower explosive limit of methane. The makeup unit and exhaust fans will be provided with VFDs such that the ventilation system is capable of maintaining proper temperature conditions for the pump motors during the summer months.

The generator room/odor control room will be ventilated at a rate of 12 ACH (2,800 cubic feet per minute [cfm]). Since the generator and odor control system will be moved outside, this room will be repurposed during detailed design. According to the drawings, a ventilation system that provides heated air does not exist for this room. A new MAU and exhaust fan should be provided to ventilate these spaces. The MAU may be located on the roof.

The Electrical Room with a split system DX air conditioning system is recommended to handle the heat dissipation from the VFDs. Outdoor condensing units are recommended to be located on the roof.

The existing dual fuel boiler (gas-oil) is recommended to be replaced with a new dual-fuel boiler to provide heat in this building. The new boiler will be sized to provide heating hot water in the Inlet Works Building if a hot water MAU is used in that building.

5.3 Equipment

The specific type of equipment used on a particular building will be determined during detailed design based on application. Roof mounted equipment will be used where possible to preserve floor space and to minimize equipment exposure to aggressive environments. The types of HVAC equipment that may be used on this project are described below.

5.3.1 Heating Equipment

- Air handling units incorporating outside air hoods, filters, Natural Gas HX, hot water heating coils, fans, and air break plenums, as required.
- Hot water and electric unit heaters.
- Gas fired hot water boilers and water circulating pumps.

5.3.2 Ventilating Equipment

- Exhaust fans
- Supply fans
- Wall louvers
- Roof vents

5.3.3 Air Conditioning Equipment

- Packaged rooftop air conditioning units
- Split system air conditioning units

5.4 Materials

Table 5-1 provides various material choices that may be used for HVAC systems depending on the type of atmosphere in which equipment is installed. Specific materials will be selected during detailed design to suit the application.

Table 5-1. HVAC Materials of Construction

Area	Atmosphere [1]	Equipment or System	Materials of Construction
Process	Corrosive	Ductwork	SS, FRP
		Equipment	HPCS
Process	Non-corrosive	Ductwork	Al
		Equipment	HPCS
Non-process	Non-corrosive	Ductwork	GS/Al
		Equipment	GS/Al

Table Notes and Abbreviations:

[1] Corrosive areas are areas that have elevated levels of moisture, hydrogen sulfide or chemical vapors.

Al – Aluminum

FRP – Fiberglass Reinforced Plastic

GS – Galvanized Steel

HPCS – High Performance Coated Steel

SS – Stainless Steel (Type 316)

5.5 Design Criteria

5.5.1 Outdoor Design Criteria

Table 5-2. HVAC Outdoor Design Criteria

Location	Elevation (Ft.)	Cooling Criteria (ASHRAE 0.4%) [1]		Heating Criteria (ASHRAE 99.6%)
New Haven, CT	20	DB (°F)	MCWB (°F)	DB (°F)
		90.7	73.2	8.5

Table Notes and Abbreviations:

[1] Cooling criteria for critical spaces such as electrical equipment rooms shall be based on extreme conditions (100° F).

ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers, 2013 Fundamentals

DB – Dry Bulb Temperature

MCWB – Mean Coincident Wet Bulb Temperature

5.5.2 Mechanical System Criteria

Table 5-3. Mechanical System Criteria

Space or Area	Cooling (°F)	Cooling Method	Heating (°F)	Heating Method	Ventilation Basis
Process Areas	5-10 °F above ambient	Outside Air Ventilation	55	HW	100% OA
Control Rooms	75	AC	68	G, E	6 ACH min (5 cfm/person and 0.06 cfm/ft^2 OA)
Electric Room s	75	AC	55	E	6 ACH min (0% OA)
Personnel Areas	75	AC	68	G,E	6 ACH min (5 cfm/person and 0.06 cfm/ft^2 O.A.)

Table Abbreviations:

AC – Air Conditioning
ACH – Air changes/hour
cfm – cubic feet per minute
E – Electric
G – Gas Heating Method
HW – Hot Water
OA – Outside Air

5.5.3 Miscellaneous Design Criteria

Not Used.

5.5.4 Louver Sizing

1. Intake Louvers – 500 ft. per minute
2. Exhaust Louvers – 800 ft. per minute

5.5.5 Ductwork Friction Rate Sizing

1. Low Pressure: 0.1 inches of water column pressure drop per 100 feet of ductwork up to an air velocity of 1,500 to 1,800 ft. per minute.
2. Medium Pressure: 0.2 inches of water column pressure drop per 100 feet of ductwork up to an air velocity of 2,000 to 2,500 feet per minute.
3. Transfer Ducts: 0.03-0.05 inches of water column pressure drop per 100 feet of ductwork.
4. Outside Air Intake Shafts: 0.05-0.10 inches of water column pressure drop per 100 feet of ductwork up to an air velocity of 1,000 feet per minute.
5. Gravity Relief Shafts: 0.03-0.05 inches of water column pressure drop per 100 feet of ductwork up to an air velocity of 1,000 feet per minute.

5.6 References

5.6.1 Codes

The HVAC design will follow shall follow all applicable local, state, and federal codes and criteria. The following codes will be used for the mechanical design of this project:

- 2016 Connecticut State Building Code
- 2012 International Building Code

- 2012 International Mechanical Code
- 2012 International Energy Conservation Code
- 2005 Connecticut State Fire Safety Code

5.6.2 Standards

The following standards and guides will be used for the mechanical design of this project:

1. ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers)
2. SMACNA (Sheet Metal and Air Conditioning Contractors' National Association)
3. ACGIH (American Conference of Governmental Industrial Hygienists) Industrial Ventilation Manual of Recommended Practice
4. NFPA (National Fire Protection Association)

5.6.3 Miscellaneous

5.6.3.1 Calculation Software

- Heating and Cooling Load Analysis: Carrier E20-II Hourly Analysis Program (HAP)

SECTION 6

Plumbing and Fire Protection

6.1 Introduction

Any modification to existing plumbing systems to support the existing or new processes and facilities including potable water piping, service water piping, sanitary drainage piping, and storm drainage piping will be selectively provided for each facility as required by the current building codes or local authority.

6.2 Design Approach

6.2.1 General

Limited existing plumbing system modifications have been considered for this project. A summary of the improvements are as follows:

- The existing potable and non-potable water piping in the Operations and Inlet Works Building will be replaced with new piping as required.
- The existing incoming potable water service line along with the backflow preventer is recommended to be relocated to accommodate the construction of the new Electrical Room in the operation building.
- The existing plumbing fixtures are recommended to be replaced as required.

6.3 Equipment, Materials and Systems

6.3.1 Equipment

The specific type of equipment that will be used on a particular building will be determined during detailed design based on application. Listed below are types of plumbing equipment that may be used for this project.

- Storage type electric or gas-fired water heaters
- Wall-mounted instantaneous electric water heaters
- Backflow preventers
- Emergency eyewash and shower stations
- Sump and sewage ejector pumps
- Plumbing fixtures such as service sink, water closet, lavatory, drinking fountain and kitchen sink
- Hose stations
- Floor, air gap, standpipe and roof drains
- Electric heat trace systems

6.3.2 Materials

Table 6-1. Plumbing and Fire Protection Materials of Construction

Area	Atmosphere [1]	Equipment or System	Materials of Construction
Process	Corrosive	Piping	SS/GS/CU/AL/HCI/CU/CPVC
		Equipment	Coated GS/Al/SS/CU
Process	Non-corrosive	Piping	CU/BS/CI/DI
		Equipment	Coated GS/Al
Administration	Non-corrosive	Piping	GS/BS/CU/DI/PVC
		Equipment	GS/CS
Administration - Toilet Rooms	Non-corrosive	Piping	CU/BS/CI/PVC
		Equipment	CU/DI/CI

Table Notes and Abbreviations:

[1] Corrosive areas are areas that have elevated levels of moisture, hydrogen sulfide or chemical vapors.

PVC – Polyvinyl Chloride

SS – Stainless Steel (Type 316)

GS – Galvanized Steel

Al – Aluminum

CU - Copper

CI – Cast Iron

DI – Ductile Iron

BS – Black Steel

HCI – High Silicon Cast Iron

CS – Carbon Steel

CPVC – Chlorinated Polyvinyl Chloride

6.4 Design Criteria

6.4.1 Potable Water System

- Water Source: City Water
- Minimum Pressure: 30 psi
- Maximum Pressure: 80 psi
- Maximum Velocity: 8 fps
- Hydrostatic Test Pressure: 100 psi minimum

6.4.2 Service Water System

- Water Source: City Water
- Minimum Pressure: 20 psi
- Maximum Pressure: 100 psi
- Maximum Velocity: 8 fps
- Hydrostatic Test Pressure: 150 psi minimum

6.4.3 Sanitary Drainage System

- Type: Gravity
- Minimum Pipe Slope: 1/8-inch per foot
- Minimum Cover: 4 feet
- Minimum Velocity: 4 fps

6.4.4 Storm Drainage System

- Type: Gravity
- Minimum Pipe Slope: 1/8-inch per foot
- Minimum Cover: 4 feet
- Minimum Velocity: 4 fps

6.5 References

6.5.1 Codes

The design of this project will be governed by the 2016 Connecticut State Building Code, Connecticut State Fire Safety Code, and all adopted International Codes including the International Plumbing and International Fire Codes.

6.5.2 Standards

The following standards and guides will be used for the plumbing and fire protection design of this project:

- ANSI (American National Standard Institute)
- ASPE (American Society of Plumbing Engineers)
- ASTM (American Society for Testing and Materials)
- AWWA (American Water Works Association)
- CISPI (Cast Iron Soil Pipe Institute)
- IBC (International Building Code)
- IFC (International Fire Code)
- IPC (International Plumbing Code)
- NFPA (National Fire Protection Association)

SECTION 7

Electrical

7.1 Introduction

The electrical work at East Street station will consist of replacing the incoming 480-volt distribution switchgear, motor control center (MCC), generator, and automatic transfer switch with new 480-volt distribution equipment and generators to accommodate new 500hp wet weather pump motors. The existing switchgear is over 30 years old, and is due to be replaced.

Five new wet weather pump motors will be compatible with and controlled by 480-volt adjustable frequency drives to provide precise control, improve efficiency, and reduce power factor losses. Three 480 volt, 90hp dry weather pumps are also required, and they will be controlled by new 480-volt adjustable frequency drives.

The local electric utility that provides power to this facility is United Illuminating (UI). The existing electrical service to this facility is 480 volt, 3-phase via a single 2000 kVA transformer.

Electrical equipment will be installed in the second floor control room to allow existing equipment to remain in service, and keep the new gear safe from flooding and sea level rise concerns. The second floor control room will be expanded to the south to accommodate the new 480-volt power switchgear, 480-volt generator switchgear, and 480 volt AFDs.

The existing generator is located indoors, and the existing diesel fuel tank is below grade. Two new 1000 kVA generators will be located above grade in an elevated weatherproof enclosure as required to address flooding concerns.

The work required for this station is described in further detail below.

7.2 Codes and Standards

The following codes and standards will apply to the design, and may be referenced in this document:

1. NFPA: 70, National Electrical Code, 2014 Edition.
2. NFPA: 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2016 Edition.
3. National Electrical Manufacturer's Association (NEMA)
4. Underwriter's Laboratory (UL)

7.3 Utility Service

The power provider to the East Street Station is UI, which is based locally in New Haven. The United Illuminating transformer is 2000 kilovolt-amperes (kVA) with a 480-volt secondary service, and located in a grassy area in the southeast side of the pump station. This service should be adequate for the new loads at the pump station, and this will be further evaluated in detailed design. UI has indicated that they will assist in raising the existing transformer, or providing a new transformer at the required height to address SLR concerns.

UI indicated that they could not supply a second service from a separate substation to this station without an extensive engineering study that is started after receipt of payment for engineering services.

7.4 Equipment and Sequence of Equipment Replacement

7.4.1 Existing Equipment

The existing service entrance switchgear and automatic transfer switch is located in the operations building electrical room, in the southeast corner of the building. The room also includes a motor control center, MCC-1, that is dedicated to the operations building. The equipment in this room sits on the floor level on an equipment pad approximately 3 inches tall. This equipment was installed in 1984, and will be near the end of its useful life by the time this project is ready to be executed. Due to flooding and SLR concerns, it is recommended that this equipment be replaced, and the new equipment be placed in the expanded control/electrical room on the top floor of this facility. Due to the size of the new equipment and the increased pumping capacity of the station, the room will have to be expanded south to provide adequate code required clearances for the new equipment.

This service entrance switchgear also feeds MCC-2, which is located in and dedicated to the inlet works. The room is located on the ground level, and is a small rectangular room. The room contains multiple NEC code violations, as the minimum NEC code clearance is not available between the MCC and the wall. However, equipment is mounted on the back wall in the working space, and HVAC equipment descends from the ceiling into the working space. This MCC was also installed in 1984, and is due to be replaced. The MCC will be removed from this room, as it is not a suitable venue for the replacement MCC. The relocation of these feeders will be discussed in depth below.

The existing generator is also over 30 years old, provides 480-volt power, is undersized for the new loads and is due for replacement. The existing generator will need to be replaced with two 1000kVA, 480 volt generators with adequate capacity for the new motors. Since adequate room is available outdoors to the west of the pump station, the new generators will be placed in elevated weatherproof enclosures outdoors in the grass plot to the west of the wall near on the west side of the storage area between the operations building and inlet works. A temporary generator will not be required since the new generators can be installed while the existing generator remains in service.

Two generators will allow greater flexibility and more efficient loading of generators during construction and when operating the plant at reduced load. However, the use of two generators in parallel requires the installation of generator paralleling switchgear.

The existing generator fuel tank is below grade in the driveway just south of the Operations Building. The tank was recently installed in 2015 and will be reused to supply fuel to the emergency generator.

7.4.2 New Electrical Equipment

All new electrical distribution equipment will be installed on the top level of the operations building. The existing rooftop control room will be expanded to the south wall of the operations building in order to accommodate the low voltage switchgear, generator paralleling switchgear, and AFDs. With this building addition, sufficient space is available in this building to also house the low voltage motor control center, low voltage AFDs, PLC, and operator/control interface. The AFDs are currently shown on the plan drawings are the worst case Allen-Bradley AFD dimensions. All other manufacturers can be accommodated. Placing the equipment on the upper level will allow the new equipment to be installed while the existing equipment remains energized and in place. This will assist in providing a smooth transition from using existing equipment to the new equipment while allowing all equipment to run, with only small outages required for pump replacement and switching over of loads.

It is recommended that inlet works equipment, formerly powered by MCC-2 in the inlet works building, also be powered from MCC-1, located in the control room of the operations building. This does require that the station have documented switching procedures per NEC section 225.30(E), as multiple feeders of the same voltage will enter a separate building. Although this does mean some long cable runs, the

alternative is to build an electrical room on the roof of the inlet works with a separate MCC, as there is not a suitable location in this facility for an electrical room.

7.4.2.1 Generator and Associated Equipment

Two new 1000 kVA, 480 volt generators are required to provide full backup power to this pump station. Each generator will be located in a weatherproof enclosure outdoors in the grassy area on the northwest side of the Operations Building. The base of the generator will be located at Elevation 16.00, to meet DFE with SLR requirements. The new generators will be installed while the existing generator is in service, so that a temporary generator is not required. Access stairs and platforms will be provided as required.

Additional generator batteries and controls will be mounted within the weatherproof enclosure. The generator batteries and controls will be mounted 5 feet, 0 inches above the finished floor to meet DFE with SLR requirements. Stairs and platforms will be provided as required.

The existing generator fuel storage tank is located underground, under the driveway on the south side of the Operations Building. The existing fuel tank holds 6000 gallons of diesel fuel. The generators require approximately 7000 gallons combined to run at least 48 hours under fully loaded conditions or 96 hours under normal load. A 1000-gallon auxiliary fuel tank will be added underneath the belly of each generator.

7.4.2.2 480 Volt Generator Paralleling Switchgear

Since two generators are recommended at this site, generator paralleling switchgear is required so that they can both be synchronized to run at the same time. The generator paralleling switchgear will be rated at 480 volts, 2500 amperes. The switchgear will be located in the new electrical /control room.

7.4.2.3 Low Voltage Switchgear

A 2500A low voltage switchgear, designated LVSWGR-1, will distribute power to the five wet weather pump AFDs, and MCC-1. The low voltage switchgear will be of arc resistant construction.

7.4.2.4 480 Volt Motor Control Center

A 600A motor control center, designated MCC-1, will distribute power to small motor and miscellaneous loads in both the operations building and the inlet facility.

7.4.2.5 Low Voltage Adjustable Frequency Drives

The low voltage switchgear will feed five 500 hp AFDs which will control the wet weather pumps. One of the AFD/pump combinations is standby, while the others can run at the same time. AFDs will be eighteen pulse or active front end, to reduce harmonics. The AFDs are currently shown on the plan drawings as Cutler-Hammer AFD dimensions. However, there is also enough room to accommodate Allen-Bradley AFDs.

MCC-1 will feed three 90hp AFDs, which will control three new dry weather pumps. One of the AFDs is standby, while the other two can run at the same time. AFDs will be six pulse, as eighteen pulse is not required to meet IEEE 519 at this low horsepower. There is enough room to accommodate the AFDs of any manufacturer, as 90HP AFDs are only about 12” wide.

7.4.3 Sequence of Equipment Replacement

A detailed sequence of equipment replacement is not required for this facility, as all new electrical equipment will not occupy the same space as existing electrical equipment. Existing electrical equipment can remain in service until new equipment is installed. Wires can be run from new equipment to the load location, and wait for the existing power source and load to be disconnected. Then the new load can be installed and energized.

7.5 Design Criteria

7.5.1 Energy Efficient Design

All pump motors are currently started across the line, and run at full speed. The new design will include AFD controllers for each pump motor. These AFDs will allow the pump to run at an optimum speed and higher efficiencies with lower power factor losses.

Existing pump station lighting will be replaced with more efficient LED type lighting wherever possible.

7.5.2 Area Classification

No changes in area classification are expected for this project. Headworks/screenings areas above ground will be ventilated at 12 ACH so that they are classified as Class I, Division 2. Wet wells are classified as Class I, Division 1. New electrical equipment will be provided per the area classification. Every effort will be made to place electrical equipment outside the classified area.

7.5.3 Design Flood Elevation and Electrical Equipment Elevation

All electrical distribution equipment is going to be relocated to the existing control room on the upper level of the Operations Building. This floor is well above the DFE with SLR criteria, so the equipment will be safe from any flood event.

The new generator will be installed on an equipment outdoors to the west of the operations building, at an elevation of 16.00, to meet DFE with SLR criteria.

7.5.4 Flooding of equipment that cannot be relocated Above DFE.

All power distribution equipment will be located on the upper level of the operations building, and cannot be affected by flood waters. However, motors, actuators, local control panels, and other equipment could be in a position to be flooded, because it is not practical to locate them above the DFE. Where possible, motors, and panelboards should be located above the DFE level. Submersible rated motors are available 200 hp and below, but will be considered for critical functions only.

Portions of the facility will be dry floodproofed while other areas will receive wet floodproofing. The extent of floodproofing will be finalized during detailed design. Where panelboards must be elevated five feet above the floor, a platform will be provided with adequate working clearance behind it.

Submersible rated control panels, motors (under 200 hp) and actuators should be provided for all critical loads that cannot be elevated 5 feet above the finished floor of the ground level.

7.5.5 Single Line Diagrams and Preliminary Equipment Layout

Refer to attached drawings for single line diagram and preliminary equipment layout.

7.5.6 Lighting

Existing lighting will be replaced with state-of-the-art LED type fixtures in all areas, including Class I, Division 1 and Class I, Division 2 areas. LED frog-eye type emergency lighting fixtures will also be provided.

Existing outdoor lighting fixtures will be replaced with metal halide or LED type fixtures. Where existing lighting is insufficient, new lighting will be added.

SECTION 8

Instrumentation and Controls

8.1 Introduction

This section documents the instrumentation and control (I&C) design concepts for the East Street Pump Station. A state-of-the-art I&C system will be provided to ensure continuous and reliable process control and monitoring for the pump station, including remote monitoring and control from the East Shore WPAF.

8.1.1 Existing Instrumentation and Control System

The existing overall control system for the East Street Pump Station consists of several control panels.

- Pump Station and Operations Building
  - A Modicon Momentum PLC based pump control panel is mounted adjacent to the pump drives in the pump motor room. This panel monitors and controls the pumps based on wet well level. The wet well level transmitters are wired to this panel. The pump control panel does not have an Operator Interface Terminal (OIT).
  - The pump control panel communicates with an overall pump station control panel located in the control room. The pump station control panel is also equipped with Modicon Momentum PLC hardware. The pump station control panel monitors and controls the rest of the equipment at the pump station and communicates with the East Shore WPAF over a T1 line. The communication link allows limited remote control from the plant. This panel also has an OIT and several hand switches and analog indicators that are not all functional.
  - The generator system includes a PLC-based control panel. Limited number of signals from this panel are hardwired to the pump station control panel in the control room.
  - The odor control system includes a control panel. This panel does not have any interface with the pump station control system.
- Inlet Works Building
  - Screens in both channels have been recently replaced and provided with new PLC based control panels equipped with OITs. Signals from these panels are hardwired to the pump station control panel in the control room. The bypass channel has a manual rack. The screenings are conveyed to a dumpster via a belt conveyor.
  - The bucket and chain style collector mechanisms in the four grit channels are being replaced by screw mechanism. The grit is conveyed to the same dumpster as the screenings via a belt conveyor.
  - The odor control system includes a control panel. This panel does not have any interface with the pump station control system.

The level in the wet well is monitored by two bubbler systems that transmit signals to the pump control panel. The bubbler systems require frequent maintenance.

Each pump is equipped with an electromagnetic flow meter in the discharge line. The signals from these flow meters are wired to the pump station control panel. The location of the existing electromagnetic flow meters is not ideal for a reliable reading.

The pump station gates and some of the valves are hydraulically actuated. The hydraulic system control panels are not in good condition.

The pump station includes a surge control system. The surge control system valves and panels are in poor condition.

8.2 Design Approach

The existing instrumentation and control system at the East Street Pump Station is out-of-date. It lacks the modern hardware and software, as well as instrumentation required for reliable operation. The overall goal is to remove obsolete control system equipment and to take advantage of the current technology for improved operational reliability and process optimization.

The existing pump control panel in the pump motor room and the pump station control panel in the control room will be demolished. The pump station control will be consolidated in a single new control panel, located in the existing control room. The control room will be updated and expanded as detailed in the Architectural Section. The proposed location and layout of the room are detailed in the Architectural and Electrical Sections.

To bring the pump station to the same platform as the East Shore WPAF, the new control panel will be based on a redundant (hot backup) Allen-Bradley ControlLogix PLC system.

The PLC control panel will be equipped with an Allen-Bradley PanelView Plus 6 1500 OIT to provide means for local monitoring and control (e.g., LEAD/LAG/ALTERNATE selection, PLC AUTO/ PLC MANUAL mode selection, setpoints, etc.). A desktop HMI work station, loaded with Factory Talk View SE Standalone Client software, be also provided in the control room. All features available at the OIT will also be available at the HMI work station.

The AFDs for the new pumps will be installed in the control room.

Power monitors will be provided in the new MCC for monitoring power consumption and quality.

In addition to hardwired signals, device level rings (DLRs) will be used for Pump Station PLC communication with AFDs and power monitors to manage traffic on the control network.

Control system equipment will be powered from a true online double-conversion-type uninterruptable power supply (UPS) unit to maintain reliable operation during power system disturbances and outages. UPS unit will power the PLCs, operator interface terminals, and human-machine interface (HMI) operator workstation. UPS battery backup will have enough capacity to energize the control system for 30 minutes after a power failure. The low-battery alarm will be hardwired to the Plant PLC input/output (I/O) for monitoring. The panel will be designed to automatically switch over to the line power upon UPS failure.

For powering loop powered instruments, redundant 24 V direct current (DC) power supplies will be provided in the PLC panel. The power supply failure alarm will be hardwired to the plant PLC I/O.

Electric or hydraulic actuation will be provided for all valves and gates. In general, electric actuators, rated for the environment, will be used. If the actuator can potentially be submerged, hydraulic actuation will be considered. Base on the field investigations, the wet well gate actuators at the East Street Pump Station can be submerged during wet weather conditions. For these gates, hydraulic actuation along with new hydraulic equipment, control panels and piping will be provided. The main influent gate will be modulating type to prevent flooding of the wet wells.

To complement process redundancy, the monitoring and control signals for redundant equipment (e.g., pumps, screens, etc.) will be split between separate I/O modules and racks, if necessary.

The control systems for the new odor control system, the new bar screen in the bypass channel, and the new generator system will be PLC/OIT based. The package control systems will not be customized to use Allen-Bradley hardware if the system vendor's "standard" operating platform is different. Instead, gateways and/or protocol convertors will be provided for digital connection to the Pump Station PLC System. The system supplier will program the package PLCs. Hardwired I/O will be used for connecting critical monitoring and control signals from the package systems to the Pump Station PLC System. The digital interface will be used for monitoring of additional signals. Digital data interface requirements between the package systems and the Pump Station PLC System will be further developed during design development and coordinated with the package system vendors.

The sump pump control panel will be replaced. If new sump pumps are provided, a new control panel will be specified. The panel will be mounted above the sea level rise protection elevation.

The hydraulic surge control valves will be replaced and a new control panel will be provided.

The existing bubbler systems, along with the associated compressors and receiver tanks will be replaced by non-fouling, hydrostatic pressure type transmitters, designed specifically for wastewater applications. The transmitters will be installed in stilling wells. As a backup to the level transmitters, high and low level switches will be provided to operate the pumps upon failure of a transmitter.

New electromagnetic flow meters will be provided in the discharge line of each pump. The installation will be coordinated with the new piping layout for better locations conforming to the upstream and downstream straight pipe length requirements.

Detailed change-out procedure will be developed so that the new I&C equipment can be installed and tested prior to being put into operation. The design will allow the new Pump Station PLC System and the existing control system to coexist for some time as the new system is brought online and the old system is decommissioned. The pump station will remain operational during switchover.

A security camera system with a DVR will be provided at the pump station. The location and quantity of cameras will be determined during design development.

8.3 Control System Design Philosophy

The control system design philosophy at the East Street Pump Station will be the same as detailed in the Union and Boulevard Pump Station Instrumentation and Control Sections for overall consistency.

8.4 Control System Operating Philosophy

The control system operating philosophy at the East Street Pump Station will be the same as detailed in the Union and Boulevard Pump Station Instrumentation and Control Sections for overall consistency.

8.5 Remote Telemetry System

As a backup to the T1 line, a licensed frequency (900 millihertz [MHz]) Ethernet radio telemetry system will be considered for communication between the pump station and the plant. A path study will be conducted to determine the feasibility of utilizing radios. If radio telemetry is feasible, new Ethernet radio equipment and antennas will be installed at the pump station and at the East Shore WPAF.

If the path study is unfavorable, the use of cellular modems will be considered in lieu of radios. The possibility of buying bandwidth on the City's fiber optic network can also be considered. The system will be configured to automatically fail over to the backup communication path upon primary path failure.

8.6 Codes and Standards

The East Street Pump Station design will follow the same codes and standards as the Union and Boulevard Pump Stations for consistency.

SECTION 9

Odor Control

9.1 Introduction

The East Street Pump Station has two buildings: the Inlet Works building that contains screen and grit removal processes, and the Operations Building that contains two wet wells, pumping systems and controls. Each building contains a 12,000 cfm mist scrubber. The Operations Building odor control system is not operational. Although the Inlet Works Building system is in operation, it is unknown how much foul air is actually being ventilated and only sodium hypochlorite is being added. It is recommended that both of these systems be replaced.

The East Street Pump Station processes that require odor control include an inlet chamber, three parallel channels that include bar screens, four aerated grit chambers and two wet wells. There are belt conveyors that convey grit/screenings to a dumpster for disposal.

9.2 Basis of Design

This section provides information used as the basis for the odor control system design. The proposed odor control system is based on a "contain-convey-treat" design approach and as such includes design information for each component.

9.2.1 Containment

The existing channels contain sections of grating that are covered with mats to contain odors within the channels. The inlet chamber is uncovered and allows for comingling of sewage vapors with the overlying room space that can then result in the release of sewage odors to the ambient atmosphere. It is recommended that all grating be replaced and that the inlet chamber be covered with solid panels to prevent escape of raw sewage vapors into the overlying room space. Covers will be designed using materials of construction resistant to corrosion (e.g., fiberglass reinforced plastic (FRP) or aluminum checker plate). Covers will be constructed using flat removable panels. The cover design will facilitate easy removal of individual panels by two people. Each panel will not weigh more than 100 lbs and will have an integral nonskid surface. Lifting handles shall be provided on each panel. Each panel will have gasketed joints to prevent fugitive air release.

As a result of the containment of foul air within the process channels, protection of concrete against corrosion using either protective coatings or liners is recommended and will be included during detailed design.

Grit and screenings are currently conveyed to the garage where they are discharged into open dumpsters. As a result, the entire volume within the garage requires ventilation and odor control. It is recommended that foul air capture hoods be installed over each dumpster to facilitate focused air capture from the dumpsters thereby allowing for overall reduced foul air extraction rates from the garage.

9.2.2 Conveyance

Foul air will be conveyed from within the contained process channels and wet wells by FRP ductwork. It is anticipated that up to nine foul air pickup locations will be designed, three associated with channels, four associated with the grit chambers and one for each wet well. Each foul air pickup location will include a flow balancing damper to facilitate adjustment of flow for each pickup to design values. The foul air duct will connect to the covers through a flanged connection to allow for easy removal. The duct

will rise vertically straight up and then move horizontally at a distance overhead ensuring clearance (e.g., minimum 7 feet). The exact layout will be determined during detailed design.

Allowance for air flow into the covered process channels and wet wells will be included in the design. The relative locations of air entry and foul air extraction will be selected to achieve good overall air movement within the enclosed process area and minimize development of "dead zones" or short-circuiting.

The extraction of foul air will be achieved through use of a single exhaust fan constructed of FRP. A flow balancing damper will be located at the fan inlet to allow for adjustment of overall system air flow. The fan will convey captured foul air to an odor control system where the odorous compounds, primarily hydrogen sulfide (H_2S), are removed prior to release to the ambient atmosphere.

9.2.3 Odor Control System Sizing

All process areas will be continuously ventilated at a rate of least 12 air changes per hour (ACH). Table 9-1 summarizes ventilation rates required for the East Street Pump Station. The total system ventilation rate is 17,000 cfm.

Table 9-1. Process Area Ventilation Rates

Source	Volume (ft^3)	Ventilation Rate (ACH)	Ventilation Rate (cfm)	Design Ventilation Rate (cfm)
Inlet Box and screen channels	10,600	12	2,125	2,900
Grit Chambers	24,750	12	5,000	5,600
Wet wells	40,000	12	8,000	8,000
Screenings/Grit dumpster	540	12	108	500
Total				**17,000**

9.2.4 Anticipated Odor Causing Compounds

CH2M recommends that air sampling be completed at the East Street Pump Station in order to definitively establish current H_2S concentrations and the nature of peaks observed during normal diurnal cycles. It is recommended that an instrument capable of measuring and logging H_2S concentrations (e.g., Odalog), be installed for a week. Based on data previously collected at East and Boulevard Pump Stations, and experience from other similar systems, it is anticipated that H_2S concentrations may average on order of 10 parts per million by volume (ppmv) with peaks as high as 100 ppmv. Additionally, it is anticipated that other odorous non- H_2S sulfur bearing compounds will total less than 1 ppmv.

9.3 Odor Control Technology Selection

Three potential odor control technologies have been evaluated; biotowers, carbon, and wet chemical scrubbers. A brief description of each technology is provided below.

9.3.1 Biotowers

In many ways, a biotower looks externally similar to a wet chemical scrubber, except that no hazardous chemical addition is required. Figure 9-1 depicts a simplified schematic diagram of a biotower system.

Systems are pre-engineered, vendor-supplied systems made of FRP or high density polyethylene shells. Biotowers use a biologically active media bed to absorb and oxidize odorous compounds from the foul

air stream. One of the primary technical advances associated with this technology is the development of engineered inert media on which the biomass attaches. As the media is inert, it is not compromised by the acidic environment within the biotower and has lifespans on the order of 20 years. The media receives either constant recycle spray (bioscrubber) or intermittent once-through spray humidification (biotrickling filter), depending on the vendor's approach. The spray is also the source of trace nutrients for the biological system. There are typically two potential sources of water, potable or plant effluent. If potable water is used, then a supplemental nutrient supply containing trace organics, nitrogen, phosphorous, and potassium is required. If plant effluent is available, then supplemental nutrients are usually not required as the plant effluent water will contain sufficient nutrients. For East Street Pump Station, potable water and supplemental nutrients would be required as plant effluent is not available.

Biotowers are usually designed in the form of a cylindrical arrangement, such as those shown in Figure 9-2.

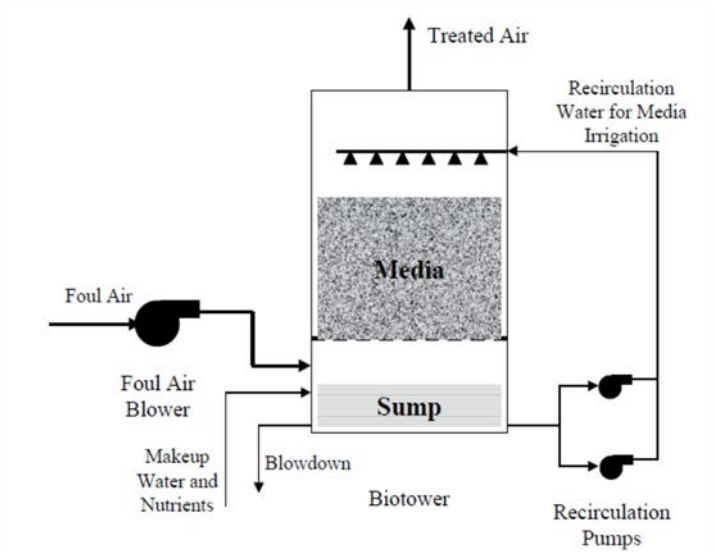


Figure 9-1. Simplified Schematic of a Biotower System

Figure 9-2. Photograph of a Biotower System

9.3.2 Carbon Scrubbers

Carbon scrubbers are the simplest of the vapor phase treatment technologies. They pass the foul air stream through a bed of dry (no irrigation) activated carbon. Odorous constituents diffuse into the media pore spaces and adsorb onto the media, and are thereby removed from the air stream. There are many types of activated carbon media designed for removal of various types of compounds. A single medium or a mixture of different media can be used. Carbon scrubbers have a small footprint compared to other technologies and can be configured with either vertical upward air flow through single, dual or radial flow beds or with horizontal flow configurations in locations where system height is constrained. Figures 9-3 and 9-4 depict a simplified schematic and photograph of a dual carbon bed system, respectively. Carbon scrubbers are effective at removing a range of compounds with excellent removal efficiency. One potential disadvantage is that under high H_2S loads, the media must be replaced frequently resulting in high annualized media replacement costs. However, the East Street Pump Station is anticipated to have relatively low average H_2S concentrations (e.g., $\leq$ 10 ppmv); therefore, the potential use of carbon scrubbers as a treatment technology is recommended for consideration.

Carbon selection is an important part of designing carbon systems, because different types of carbon can be used depending on the nature of the odorant to be removed. For East Street Pump Station, the primary odorant to be designed for is H_2S.

Various types of carbon are available. Virgin activated carbon is the lowest cost but also has the lowest overall capacity for H_2S resulting in relatively high frequency media replacements. Carbon adsorption capacity for H_2S can be increased with media that is impregnated with chemicals, such as sodium hydroxide (NaOH), to enhance contaminant removal. This, however, adds handling complexity because of the potentially hazardous nature of the impregnated carbon and potential for carbon bed fires. The

use of this type of impregnated carbon is not recommended for further consideration. Finally, there are carbons available that have been processed in a manner that results in high selective adsorptive capacity for H_2S (e.g., order of magnitude higher than virgin activated carbon). The use of this type of high capacity carbon is recommended for consideration as it will extend the useful life of the carbon significantly thereby reducing operations and maintenance (O&M) issues and costs associated with frequent media replacement.

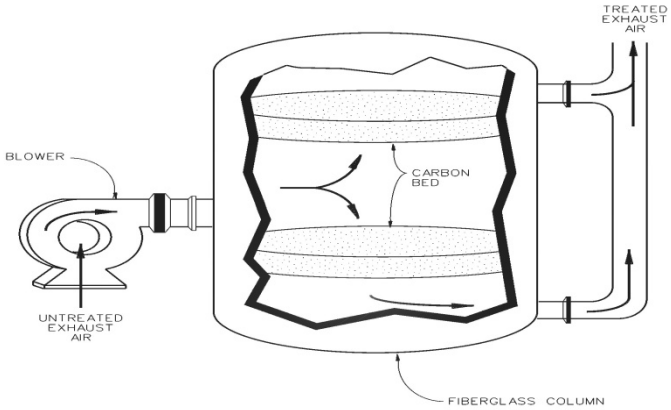


Figure 9-3. Schematic Dual Carbon Bed System

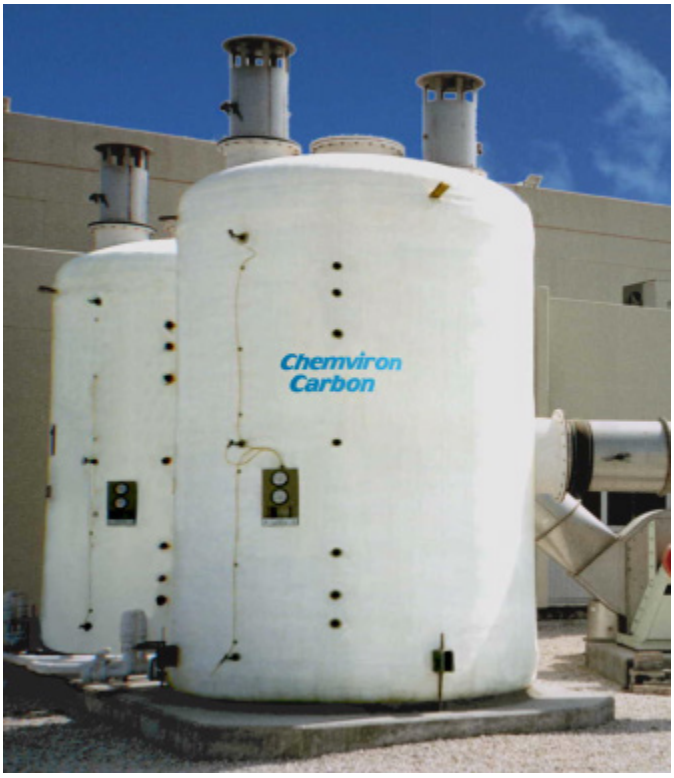


Figure 9-4. Photograph of a Dual Bed Carbon Scrubber

9.3.3 Chemical Scrubbers

Chemical scrubbers are similar to biotowers in that the foul air stream is passed through a bed of inert media that is continuously irrigated. Rather than using microbes to oxidize odorous compounds, chemicals are added to the irrigation water. Chemical scrubbers can be designed using several different

configurations with separate stages using different chemistry. Some include a high pH stage with caustic soda to facilitate dissolution of hydrogen sulfide into solution. Most have a stage with sodium hypochlorite added to oxidize reduced compounds. Other chemistries can be used to remove compounds, such as ammonia, that are less amenable to oxidation. Chemical scrubbers offer flexible configurations with smaller foot prints than are typical of biofilters and biotowers. Figure 9-4 shows an example. However, chemical scrubbers have the disadvantage that the cost to operate is proportional to the hydrogen sulfide loading. Significant hydrogen sulfide loadings, such as would be present at the headworks, can result in large operating costs. Nevertheless, chemical scrubbers are technically viable for this application and are therefore included in the technology cost comparison. For this application, a two stage dual chemistry chemical scrubber is recommended for consideration.

Figure 9-4. Photograph of a Chemical Scrubber

9.4 Economic Evaluation

An economic evaluation has been completed in order to compare capital costs, annual O&M costs and a 20-year net present value (NPV) for the biotower, carbon and chemical scrubber technologies.

Capital construction cost estimates were based on a database of recent vendor quotes for similar technology. O&M costs were estimated and combined with capital costs using a constant discount rate to determine a 20-year net present value. For planning purposes, it was assumed that the vapor phase treatment equipment has a life span of 20 years.

Unit costs and financial factors used in the cost estimate are listed in Table 9-2. As shown in Table 9-2, the inflation rate was assumed to be 6 percent and the discount rate was assumed to be 7 percent. Both the equipment life and planning horizon was 20 years. Factors were applied equally to each technology option.

Table 9-2. Capital, O&M and NPV Assumptions

Unit Costs		
Electricity	0.10	$/kW-hr
Labor	40	$/hr
Potable Water	4.4	$/1000 gal

Table 9-2. Capital, O&M and NPV Assumptions

Unit Costs		
Sodium Hydroxide (50% strength)	1.8	$/gal
Sodium Hypochlorite	0.7	$/gal
Excavation	15	$/CY
Backfill	35	$/CY
Slab on Grade Concrete	525	$/SF
Support Wall Concrete	525	$/SF
Allowance Costs		
Equipment Installation	10	%
Field painting/finishes	1	%
Mechanical	8	%
Electrical	8	%
Instrumentation	5	%
Financial Factors		
Discount Rate	7	%
Annual Escalation Rate	3	%
Time Horizon	20	years
Construction Completion Year	2020	
Contractor Markups:		
General Conditions	7	%
Contractor Overhead & Profit	15	%
Bonds and Insurance	2	%
Contingency	30	%

Results of the economic evaluation are provided in Table 9-3.

As can be seen from the results of this evaluation, carbon has the lowest initial capital cost ($734,000) and overall lowest NPV ($1,434,000) compared to the biotower and chemical scrubber options, and therefore from a financial perspective, is the initial preferred option. However, given the sensitivity of carbon annual O&M costs and resultant NPV to the H_2S inlet concentration, further evaluations were completed to determine impacts of the assumption of an average 10 ppmv H_2S concentration on the economic results. Specifically, the assessment was repeated with increasingly higher concentrations of H_2S inlet to determine at which point the biotower option had the lower NPV. As chemical scrubber annual O&M costs are also directly related to H_2S inlet concentrations, the chemical scrubber option would not be more financially attractive at higher costs and was therefore, not included in this additional analysis.

The biotwer option did not have the lowest NPV until inlet H_2S concentrations were on the order of 25 ppmv. Given the high ventilation rate included in the odor control design (i.e., 12 ACH), it is anticipated that the frequent turnover of air within the enclosed areas will prevent high concentrations of H_2S from accumulating, thus maintaining an inlet concentration of H_2S to the odor control system well below the 25 ppmv threshold. Therefore, carbon is recommended as the odor control technology of choice.

Table 9-3. Capital, Annual O&M, and NPV Evaluation

Technology	Carbon	Biotower	Chemical Scrubber
Capital	$734,000	$1,662,000	$1,048,000
Annual O&M	$66,000	$29,000	$92,000
20-yr NPV	$1,434,000	$1,970,000	$2,023,000

9.5 Odor Control System Design Recommendations and Overview

A dual deep bed carbon scrubber system utilizing carbon with high adsorptive capacity for H_2S is recommended. The use of the high adsorptive carbon will prolong carbon life and thereby increase the time between media replacements. Based on an average inlet concentration of 10 ppmv H_2S, it is anticipated that media replacement will be on the order of every 2 years.

Recommended odor control system process equipment and anticipated design operating conditions are summarized in Table 9-4.

Table 9-4. Major Equipment, Design Criteria and Operating Conditions

Equipment/design criteria	Size/Operating conditions
Carbon Vessel	Two (2) 10 ft diameter dual bed FRP vessels
Carbon type and replacement frequency	High adsorptive capacity carbon (e.g., 0.3 g H_2S/cc carbon); 24 month media replacement frequency
Carbon bed depth	3 ft each
Carbon bed face velocity	55 fpm
Odorous Air Fan	One (1) fan, FRP construction with sound enclosure; continuous operation
Fan design point	17,000 cfm at 9.5 inches w.c. pressure
Electrical requirements	480V/3-ph/60 Hz; 50 hp

Appendix A
Preliminary Design Drawings

INDEX TO DRAWINGS

200 - EAST STREET PUMP STATION

SHEET NO.	DRAWING NO.	TITLE
GENERAL		
	200-G-001	EAST STREET PUMP STATION INDEX OF DRAWINGS
	200-G-002	EAST STREET PUMP STATION ABBREVIATIONS
	200-G-003	EAST STREET PUMP STATION ABBREVIATIONS AND GENERAL LEGEND
	200-G-005	EAST STREET PUMP STATION INSTRUMENTATION AND CONTROL LEGEND - SHEET 1
	200-G-006	EAST STREET PUMP STATION INSTRUMENTATION AND CONTROL LEGEND - SHEET 2
	200-G-007	EAST STREET PUMP STATION ARCHITECTURAL AND STRUCTURAL LEGEND
	200-G-012	EAST STREET PUMP STATION PROCESS MECHANICAL LEGEND
	200-G-015	EAST STREET PUMP STATION ELECTRICAL LEGEND SHEET 1
	200-G-016	EAST STREET PUMP STATION ELECTRICAL LEGEND SHEET 2
	200-G-017	EAST STREET PUMP STATION ELECTRICAL LEGEND SHEET 3
CIVIL		
	200-C-201	EAST STREET PUMP STATION SITE PLAN
STRUCTURAL		
	200-S-201	EAST STREET PUMP STATION OPERATIONS BUILDING GROUND FLOOD PROOFING 65 MGD CAPAICITY
ARCHITECTURAL		
	200-A-201	EAST STREET PUMP STATION OPERATIONS BUILDING SUBLEVEL PLAN 65 MGD CAPACITY
	200-A-202	EAST STREET PUMP STATION OPERATIONS BUILDING LOWER LEVEL PLAN 65 MGD CAPACITY
	200-A-203	EAST STREET PUMP STATION OPERATIONS BUILDING - GROUND FLOOR PLAN 65 MGD CAPACITY
	200-A-204	EAST STREET PUMP STATION OPERATIONS BUILDING - UPPER FLOOR AND ROOF PLAN 65 MGD CAPACITY
	200-A-205	EAST STREET PUMP STATION INLET WORKS BUILDING - GROUND FLOOR PLAN 65 MGD CAPACITY
	200-A-206	EAST STREET PUMP STATION INLET WORKS BUILDING ROOF PLAN 65 MGD CAPACITY
MECHANICAL		
	200-M-201	EAST STREET PUMP STATION 75 MGD CAPACITY PLAN
	200-M-215	EAST STREET PUMP STATION ODOR CONTROL PLAN & SECTIONS
	200-M-301	EAST STREET PUMP STATION 40 MGD CAPACITY SECTIONS
	210-M-201	EAST STREET DRY WEATHER PUMP STATION PLAN AND SECTION

SHEET NO.	DRAWING NO.	TITLE
ELECTRICAL		
	200-E-201	EAST STREET PUMP STATION SINGLE LINE DIAGRAM, MCC-1 AND LVSWGR-1ELEVATIONS (75 MGD)
	200-E-202	EAST STREET PUMP STATION OPERATIONS BUILDING - GROUND FLOOR PLAN 75 MGD CAPACITY
	200-E-203	EAST STREET PUMP STATION UPPER FLOOR AND ROOF PLAN
INSTRUMENTATION AND CONTROL		
	200-N-601	EAST STREET PUMP STATION PROCESS FLOW DIAGRAM
	210-N-601	EAST STREET DRY WEATHER PUMP STATION PROCESS FLOW DIAGRAM

NO.	DATE	DSGN	DR	CHK	APVD	BY	APVD
		J. OSOSKIE	Z BRYAN				

REVISION

OC Review

Sealer

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

GENERAL

EAST STREET PUMP STATION
INDEX OF DRAWINGS

PRELIMINARY – NOT FOR CONSTRUCTION

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-G-001
SHEET	of

ABBREVIATIONS

A	AMMETER, AMPERES, AWNINGS
AB, ABV	ANCHOR BOLT, ABOVE
ABDN	ABANDON
AC	ACOUSTICAL, ACOUSTICAL CEILING
AC	ALTERNATING CURRENT
AC	ASPHALTIC CONCRETE
ACFL	ACCESS FLOORING
ACI	AMERICAN CONCRETE INSTITUTE
ACMU	ACOUSTICAL CONCRETE MASONRY UNIT, ACOUSTICAL CMU
ACP	ACOUSTICAL PANELS
ACST	ACOUSTICAL
ACT	ACOUSTICAL TILE
AD	AREA DRAIN
ADDL	ADDITIONAL
ADJ	ADJACENT
ADW	DRY WEATHER AVERAGE
AFD	ADJUSTABLE FREQUENCY DRIVE
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AG	ACOUSTICAL, ACOUSTICAL GLASS, AIR GAP (FIXED)
AGGR	AGGREGATE
AHR	ANCHOR
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AJ	ADJUSTABLE
AL	ALUMINUM
ALKY	ALKALINITY
ALTN	ALTERNATE
AM	AUTO-MANUAL
AMRD	ACOUSTICAL METAL ROOF DECKING
ANDZ	ANODIZE
APPROX	APPROXIMATE
APVD	APPROVED
ARCH	ARCHITECTURAL
AR	ANALOG RELAY
AS	AS SELECTED
ASSY	ASSEMBLY
ATS	AUTOMATIC TRANSFER SWITCH
AUTO	AUTOMATIC
AUX	AUXILIARY
AVG	AVERAGE
AWW	WET WEATHER AVERAGE
@	AT
B	BELL
BAL	BALANCE
BETW	BETWEEN
BF	BLIND FLANGE, BOTTOM FACE
BFV	BUTTERFLY VALVE
BL	BASELINE
BFP	BACKFLOW PREVENTER
BLDG	BUILDING
BLK	BLOCK
BM	BEAM, BENCHMARK
BO	BOTTOM OF
B.O.B.	BOTTOM OF BEAM
BOD	BOTTOM OF DUCT
BOP	BOTTOM OF PIPE
BOT	BOTTOM
BRG	BEARING
BRK	BRICK
BRKR	BREAKER
BSP	BLACK STEEL PIPE
BV	BALL VALVE, BLOCK VENT
BVC	BEGINNING OF VERTICAL CURVE
C	CONDUIT, CASEMENT
°C	DEGREE CELSIUS
C TO C	CENTER TO CENTER
CAB	CABINET
CB	CATCH BASIN, CIRCUIT BREAKER
CC	CENTER OF CIRCLE
CC	CONTROL CABLE
CCP	CENTRAL CONTROL PANEL
CCS	CENTRAL CONTROL SYSTEM
CDF	CONTROLLED DENSITY FILL
CE	CONSTRUCTION ENTRANCE
CFM	CUBIC FEET PER MINUTE
CFS	CUBIC FEET PER SECOND
CHEM	CHEMICAL
CHKD	CHECKERED
CI	CAST IRON
CIP	CAST IRON PIPE, CAST IN PLACE
CIP	CULVERT INLET PROTECTION
CISP	CAST IRON SOIL PIPE
CJ	CONSTRUCTION JOINT
CKT	CIRCUIT
CL	CENTERLINE
CLDI	CEMENT LINED DUCTILE IRON
CLSF	CONTROLLED LOW STRENGTH FILL
CLG	CEILING
CLR	CLEAR, CLEARANCE
CLSM	CONTROLLED LOW STRENGTH MATERIAL
CMP	CENTRAL MONITORING PANEL
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CNTR	COUNTER
CO	CLEANOUT, CARBON MONOXIDE
COL	COLUMN, COLOR
CONC	CONCRETE
COND	CONDENSATE
CONDTN	CONDITIONED
CONN	CONNECTION
CONSTR	CONSTRUCTION
CONT	CONTINUED, CONTINUOUS, CONTINUATION
CONTR	CONTRACTOR
COORD	COORDINATE
COP	COPPER
CP	CENTER PIVOT
CP-X	CONTROL PANEL NO. X
CPLG	COUPLING
CPRSR	COMPRESSOR
CPT	CONTROL POWER TRANFORMER, CARPET
CPVC	CHLORINATED PVC
CR	CONTROL RELAY
CRS	COLD ROLLED STEEL
CRS	CONSTRUCTION ROAD STABILIZATION
CT	CERAMIC TILE
CT	CURRENT TRANSFORMER
CTC	COMPUTER TERMINAL CABINET
CTR	CENTER
CTRD	CENTERED
CTSK	COUNTERSUNK
CU	CUBIC
CU FT	CUBIC FOOT
CU IN	CUBIC INCH
CUH	COPPER TUBING, HARD DRAWN
CV	CHECK VALVE
CWR	CABINET DOOR MOUNTED WASTE RECEPTACLE
CY, CU YD	CUBIC YARD
CWS	CLEAN WATER SERVICES
D	DEEP, DRAIN
d	PENNY NAIL SIZE
DA	DUAL ACTION
DAS	DATA ACQUISTION SYSTEM
DBA	DEFORMED BAR ANCHOR
DBL	DOUBLE
DC	DIRECT CURRENT
DEG	DEGREE
DET	DETAIL
DF	DOUGLAS FIR, DRINKING FOUNTAIN
DDI	DROP INLET
DH	DOUBLE HUNG
DI	DUCTILE IRON
DIA	DIAMETER
DIAG	DIAGONAL
DIP	DUCTILE IRON PIPE
DIR	DIRECTION
DISCH	DISCHARGE
DN	DOWN
DO	DISSOLVED OXYGEN
DOL	DIRECT-ON-LINE
DP, DPNL	DISTRIBUTION PANEL
DR	DOOR
DS	DOWNSPOUT
DWG	DRAWING
DWL	DOWEL
△	DELTA
E	EAST, EMPTY
EA	EACH, EXHAUST AIR
EB, EBCT	EMPTY BED CONTACT TIME
ECC	ECCENTRIC
EE	EMERGENCY EYEWASH
EDF	EGG-SHAPED DIGESTER FACILITY
EF	EACH FACE, EXHAUST FAN
EFF	EFFICIENCY, EFFICIENT
EFL	EFFLUENT
EIFS	EXTERIOR INSULATION AND FINISH SYSTEM
EL	ELEVATION
ELB	ELBOW
ELC	ELECTRICAL LOAD CENTER
ELEC	ELECTRIC, ELECTRICAL
ENGR	ENGINEER
EOP	EDGE OF PAVEMENT
ESC	EROSION AND SEDIMENT CONTROL
EP	EXPLOSION PROOF, EDGE OF PAVING
EQL	EQUAL
EQL SP	EQUALLY SPACED
EQPT	EQUIPMENT
ESC	EROSION AND SEDIMENT CONTROL
ETM	ELAPSED TIME METER
EVC	END OF VERTICAL CURVE
EW	EACH WAY
EWC	ELECTRIC WATER COOLER
EXH	EXHAUST
EXP	EXPANSION, EXPOSED
EXP AB	EXPANSION ANCHOR BOLT
EXP JT	EXPANSION JOINT
EXST, EXIST	EXISTING
EXT	EXTERIOR
°F	DEGREE FAHRENHEIT
FACP	FIRE ALARM CONTROL PANEL
FB	FLAT BAR
F, FU	FUSE
F, FX	FIXED
FAP	FIRE ALARM PANEL
FC	FLEXIBLE CONDUIT
FCA	FLANGED COUPLING ADAPTER
FCL2	FREE CHLORINE RESIDUAL
FCO	FLOOR CLEANOUT
FCTY	FACTORY
FD	FLOOR DRAIN
FDN	FOUNDATION
FDR	FEEDER
FEXT	FIRE EXTINGUISHER
FF	FINISHED FLOOR
FG	FINISH GRADE, FLOAT GLASS
FH	FLAT HEAD
FHY	FIRE HYDRANT
FIG	FIGURE
FL	FLOW LINE
FLG	FLANGE
FL	FLOOR
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FLUOR	FLUORESCENT
FNSH	FINISH
FOB	FLAT ON BOTTOM
FOT	FLAT ON TOP
FP	FIELD PANEL
FPM	FEET PER MINUTE
FR	FORWARD REVERSE
FRP	FIBERGLASS REINFORCED PLASTIC
FSHS	FOLDING SHOWER SEAT
FT	FOOT OR FEET
FTG	FOOTING
FU	FIXTURE UNIT
FVNR	FULL VOLTAGE NON-REVERSING
FVR	FULL VOLTAGE REVERSING
FWD	FORWARD
G, GND	GROUND
GA	GAUGE
GAL	GALLON
GALV	GALVANIZED
GB	GYPSUM BOARD
GC	GROOVED COUPLING
GCMU	GLAZED CONCRETE MASONRY UNITS
GFA	GROOVED FLANGE ADAPTER
GFI	GROUND FAULT INTERRUPTER
GFR	GROUND FAULT RELAY
GH	GREENHOUSE
GL	GLASS
GPD	GALLONS PER DAY
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GPS	GLOBAL POSITION SYSTEM
GRTG	GRATING
GSB	GYPSUM SOFFIT BOARD
GSP	GALVANIZED STEEL PIPE
GV	GATE VALVE
GVL	GRAVEL
GWB	GYPSUM WALLBOARD
GYP	GYPSUM
H	HIGH, HORN OR HOWLER
H2S	HYDROGEN SULFIDE
H.A.S.	HEADED ANCHOR STUD
HC	HOLLOW CORE WOOD
HCL	HYDROCHLORIC ACID
HDNR	HARDENER
HDNS	HARDNESS
HDR	HEADER
HDW	HARDWARE
HGL	HYDRAULIC GRADE LINE
HK	HOOK
HGT	HEIGHT
HH	HANDHOLE
HID	HIGH INTENSITY DISCHARGE
HK	HOOK
HM	HOLLOW METAL
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
HORIZ	HORIZONTAL
HP	HORSEPOWER
HPT	HIGH POINT
HPU	HYDRAULIC POWER UNIT
HR	HOSE RACK, HANDRAIL
HV	HOSE VALVE
HVAC	HEATING, VENTILATING AND AIR CONDITIONING
HWL	HIGH WATER LEVEL
IC	INTERRUPTING CAPACITY
ID	INDUCED DRAFT, INSIDE DIAMETER
IE	INVERT ELEVATION
I.F.	INSIDE FACE
IG	INSULATING, INSULATING GLASS
IN	INCH
INCAND	INCANDESCENT
INFL	INFLUENT
INJS	INJECTIONS
INST	INSTANTANEOUS
INSTM	INSTRUMENT, INSTRUMENTATION
INSUL	INSULATION
INVT	INVERT
IP	INLET PROTECTION, INSTRUMENTATION PANEL
IRRIG	IRRIGATION
ITG	INSULATED TEMPERED GLASS
ITX	ISOLATION TRANSFORMER
IU	INTAKE UNIT
IW	IRRIGATION WELL
JA	JALOUSIE
JB	JAL-AWNING
JAN	JUNCTION BOX
JCT	JANITOR
JT	JUNCTION
K	JOINT
KIP	KEY GROUP, KEY INTERLOCK
KIT	THOUSAND POUNDS
K-PL	KITCHEN
KSK	KICKPLATE
KV	KITCHEN SINK
KVA	KILOVOLTS
KVAR	KILOVOLT AMPERES
KW	KILOVOLT AMPERES REACTIVE
L	KILOWATT
LA	ANGLE, LENGTH
LAB	LIGHTNING ARRESTER
LAM	LABORATORY
LAT	LAMINATE
LB	LATITUDE
LC	POUND
LD	LIGHTING CONTACTOR
LDG	COMBINATION LOUVER/DAMPER
LEL	LOADING DOCK
LF	LOWER EXPLOSIVE LIMIT
LG	LINEAR FEET
LH	LONG
LHR	LEFT HAND
LLH	LEFT HAND REVERSE
LLV	LONG LEG HORIZONTAL
LNTL	LONG LEG VERTICAL
LONG	LINTEL
LOS	LONGITUDINAL
LP	LOCK-OUT STOP PUSHBUTTON
LPT	LIGHT POLE, LIGHTING PANEL, LOCAL PANEL
LR	LOW POINT
LR	LATCHING RELAY
LR	LOCAL-REMOTE
LS	LONG RADIUS
LT	LABORATORY SINK
LTG, LTS	LEFT
LTX	LIGHTS OR LIGHTING
LWL	LIGHTING TRANSFORMER
	LOW WATER LEVEL
MA	MANUAL-AUTO
MAS	MASONRY
MATL	MATERIAL
MAX	MAXIMUM
MB	MACHINE BOLT
MC	MASONRY CLEARANCE
MC	MODULATE-CLOSE
MCC	MOTOR CONTROL CENTER
MCJ	MASONRY CONTROL JOINT
MDO	MEDIUM DENSITY OVERLAY
MECH	MECHANICAL
MFD	MANUFACTURED
MFR	MANUFACTURER
MGD	MILLION GALLONS PER DAY
MH	MANHOLE, MOUNTING HEIGHT
MIN	MINIMUM
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
MLO	MAIN LUGS ONLY
MMDW	DRY WEATHER MAXIMUM MONTH
MMP	MECHANICAL MOUNTING PANEL
MMWW	WET WEATHER MAXIMUM MONTH
MO	MANUAL OPERABLE, MASONRY OPENING
MP	METAL PANEL
MPU	MULTIPURPOSE UNIT
MS	MANUFACTURER'S STANDARD
MSC	MANUFACTURER SUPPLIED CABLE
MSR	GROUPED MOTOR CONTROL
MT	MOUNT
MTD	MOUNTED
MTG	MOUNTING
MTS	MANUAL TRANSFER SWITCH
MTS	MILL TYPE STEEL PIPE
MU	MULCHING
MV	MERCURY VAPOR
MWS	MAXIMUM WATER SURFACE
N	NORTH, NEUTRAL
NA	NOT APPLICABLE
NA	NON-AUTOMATIC
NC	NORMALLY CLOSED
NEUT	NEUTRAL
NG	NATURAL GAS
NGVD	NATIONAL GEODETIC VERTICAL DATUM
NIC	NOT IN CONTRACT
N.O.	NORMALLY OPEN
NO., #	NUMBER
NOM	NOMINAL
NP	NON-PROTECTED
NPT	NATIONAL PIPE THREADS
NS	NON-SHRINK
NTS	NOT TO SCALE
O2	OXYGEN
O TO O	OUT TO OUT
OA	OVERALL, ODOROUS AIR
OC	ON CENTER
OC	OPEN-CLOSE (O)
OCA	OPEN-CLOSE-AUTO
OCR	OPEN-CLOSE-REMOTE
OD	OUTSIDE DIAMETER, OVERFLOW DRAIN
O.F.	OUTSIDE FACE
OFCI	OWNER FURNISHED, CONTRACTOR INSTALLED
OFOI	OWNER FURNISHED, OWNER INSTALLED
OL	OVERLOAD RELAY
OO	ON-OFF
OOA	ON-OFF-AUTO
OOR	ON-OFF-REMOTE
OP	OPAQUE PANEL, OUTLET PROTECTION
OPER	OPERATOR
OPNG	OPENING
OPP	OPPOSITE
OSA	OUTSIDE AIR
OSC	OPEN-STOP-CLOSE
OSD	OPEN SITE DRAIN
OWSJ	OPEN WEB STEEL JOIST
OZ	OUNCE
P	PROJECTED
P	PILASTER, PIPE
PAVT	PAVER TILE
PB	PUSHBUTTON SWITCH
PC	POINT OF CURVE, PHOTOCELL
PC	PRECAST CONCRETE PANEL
PCCP	PRECAST CONCRETE CYLINDER PIPE
PCV	PRESSURE CONTROL VALVE
PE	PLAIN END
PED	PEDESTAL, PEDESTRIAN
PEP	POLYETHYLENE PIPE
PEN.	PENETRATION
PFC	POUNDS PER CUBIC FOOT
PH	PENTHOUSE
pH	HYDROGEN ION CONCENTRATION
PH	PHASE
PI	POINT OF INTERSECTION
PIT	PILOT TUBE TEST STATION
PJF	PREMOULDED JOINT FILLER
PL	PLATE (STEEL)
PL	PROPERTY LINE
PLAM	PLASTIC LAMINATE
PLAS	PLASTER, PLASTIC
PLC	PROGRAMMABLE LOGIC CONTROLLER
PLYWD	PLYWOOD
PNL	PANEL
PP	POWER POLE
P-P	PUSH-PULL
PPL	POLYPROPYLENE LINED
PR	PAIR
PRC	POINT OF REVERSE CURVE
PRCST	PRECAST
PREFAB	PREFABRICATION
PRES	PRESSURE
PRI	PRIMARY
PRM	PERMANENT REFERENCED MARKER
PROJ	PROJECTION
PROP	PROPERTY
PS	PLASTIC SHEET, POLYCARBONATE SHEET
PS	PAINT SYSTEM
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSIG	POUNDS PER SQUARE INCH, GAUGE
PT	POINT OF TANGENCY
PT	POTENTIAL TRANSFORMER
PT	PRESSURE TREATED
PTD	PAPER TOWEL DISPENSER
PTN	PARTITION
PV	PLUG VALVE
PVC	POLYVINYL CHLORIDE
PVI	POINT OF VERTICAL INTERSECTION
PVMT	PAVEMENT
PVT	POINT OF VERTICAL TANGENCY
QAA	AVERAGE FLOW
QMM	MAXIMUM 30 DAY FLOW
QPI	PEAK INSTANTANEOUS FLOW
QPP	PEAK PUMPING FLOW
QT	QUARRY TILE
R	RISER
R OR RAD	RADIUS
RA	RETURN AIR
RC	REINFORCED CONCRETE
RCP	REINFORCED CONCRETE PIPE
RCPT	RECEPTACLE
RD	ROAD, ROOF DRAIN
RDCR	REDUCER
RDW	REDWOOD
RECIR	RECIRCULATION
REF	REFER OR REFERENCE
REFR	REFRIGERATE, REFRIGERANT
REINF	REINFORCED, REINFORCING, REINFORCE
REQD	REQUIRED
RESIL	RESILIENT
RFS	ROLL-UP FIRE SHUTTER
RH	RIGHT HAND
RH	RODHOLE
RHR	RIGHT HAND REVERSE
RL	RAIN LEADER
RLS	RUBBER LINED STEEL
RM	ROOM
RO	ROUGH OPENING
ROL	RAISE-OFF-LOWER
RPM	REVOLUTIONS PER MINUTE
RR	RIPRAP

GENERAL NOTES:

1. THIS IS A STANDARD LEGEND SHEET. THEREFORE, NOT ALL OF THE INFORMATION SHOWN MAY BE USED ON THIS PROJECT.
2. CONTACT ENGINEER FOR ABBREVIATIONS USED BUT NOT SHOWN ON THIS DRAWING.

NO.	DATE	DSGN
		J. OSOSKIE
		DR
		J. HARGIS
		CHK
		OC Review
		APVD
		BY
		APVD

REVISION

Sealer

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

ch2m

GENERAL
UNION PUMP STATION ABBREVIATIONS

10% SUBMITTAL - NOT FOR CONSTRUCTION

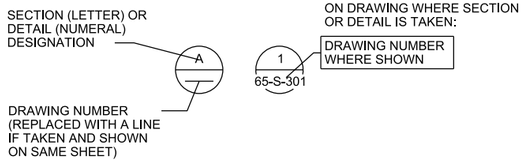
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	100-G-002
SHEET	of

ABBREVIATIONS

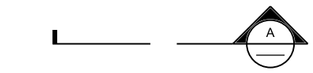
RRUB	RADIAL RUBBER
RS	RIGID STEEL
RST	REINFORCING STEEL
RT	RIGHT
RTN	RETURN
RTO	REGENERATIVE THERMAL OXIDIZER
RUB	RUBBER
RUBC	RUBBER CUSHIONED FLOORING
RUBS	RUBBER ESD CONTROL FLOORING
R/W	RIGHT OF WAY
S	I-BEAM
S	SLOPE, SOUTH, SWITCH
SA	SUPPLY AIR
SATC	SUSPENDED ACCUSTICAL TILE CEILING
SB	SEDIMENT BASIN
SC	SHOWER CURTAIN, SOLID CORE WOOD
SCADA	SUPERVISORY CONTROL AND DATA ACQUISITION
SCC	SOLID CORE
SCFM	STANDARD CUBIC FEED PER MINUTE
SCHED	SCHEDULE
SCU	SPEED CONTROL UNIT
SDP	SUB-DISTRIBUTION PANEL
SDWK	SIDEWALK
SEC	SECONDARY
SECT	SECTION
SED	SEDIMENTATION
SEW	SEWAGE
SG	LAMINATED SAFETY GLASS, SAFETY
SGWB	SUSPENDED GYPSUM WALL BOARD
SH	SHEET
SHA	SURFACE HARDENING AGENT
SHS	SOLIDS HANDLING SYSTEM
SIM	SIMILAR
SK	SINK
SLR	SEALER
SMLS	SEAMLESS EPOXY
SOI	SPRAY- ON INSULATION
SOLN	SOLUTION
SP	SPACE OR SPACES, SPANDREL PANEL, STORMPROOF
SPEC, SPECS	SPECIFICATIONS
SPD	SUMP PUMP DISCHARGE
SPG	SPACING
SPLY	SUPPLY
SQ	SQUARE
SQ FT	SQUARE FOOT, FEET
SQ IN	SQUARE INCH
SR	SHORT RADIUS
SS	START-STOP
SST	STAINLESS STEEL
SSC	SUPERVISORY SET POINT CONTROL
ST	STORM DRAIN
ST	STRAIGHT
STA	STATUS, STATION
STD	STANDARD
STIF	STIFFENER
STIRR	STIRRUP
STL	STEEL
STRL	STRUCTUAL
STRUCT	STRUCTURE
SUBFL	SUBFLOOR
SUSP	SUSPENDED
SV	SOLENOID VALVE
SVIN	SHEET VINYL
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
SYMM	SYMMETRICAL
T	THERMOSTAT, TREAD
T/	TOP OF
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
TA	TRANSFER AIR
TAN	TANGENT
TB	TERMINAL BOARD
TBG	TUBING
TC	TIME TO CLOSE
TC	TURBIDITY CURTAIN
TCAD	TIME CLOSE AFTER DE-ENERGIZATION
TCAE	TIME CLOSE AFTER ENERGIZATION
TDH	TOTAL DYNAMIC HEAD
TDR	TIME DELAY RELAY
TECH	TECHNICAL
TEL	TELEPHONE
TEMP	TEMPORARY, TEMPERATURE
TF	TOP FACE
TFG	TEMPERED FLOAT GLASS
TG	TEMPERED
TH	TOP-HINGED
THD	THREAD
THK	THICKNESS
THRU	THROUGH
TJB	TERMINAL JUNCTION BOX
TL	TEFLON LINED PIPE
T.O.	TIME TO OPEN, TOP OF
TOAE	TIME OPEN AFTER ENERGIZATION
TOC	TOP OF CONCRETE
TOC	TOP OF CURB
TOD	TIME ON DELAY, TOP OF DUCT TOTAL OXYGEN DEMAND
TOF	TOP OF FOOTING
TOG	TOP OF GROUT, TOP OF GRATE
T.O.P.	TOP OF PARAPET
TOS	TOP OF SLAB
TOW	TOP OF WALL
TP	TURNING POINT
TR	TRANSOM, TRUSS
TRANS	TRANSFORMER, TRANSITION
TRANSV	TRANSVERSE
TRD	TREAD
TS	TEMPORARY SEEDING, TUBE STEEL
TSHT	THRESHOLD
TSS	TOTAL SUSPENSION SOLIDS
TST	TOP OF STEEL
TTC	TELEPHONE TERMINAL CABINET
TTD	TOILET TISSUE DISPENSER
TU-X	TREATMENT UNIT NO. X
TURB	TURBIDITY
TWP	TRANSLUCENT WALL PANEL
TX	TRANSFORMER
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED
UNO	UNLESS NOTED OTHERWISE
UPS	UNINTERRUPTIBLE POWER SUPPLY
USB	UNIT SUBSTATION
UVR	UNDER VOLTAGE RELAY
V	VENT, VALVE
V	VOLTMETER, VOLTS
VB	VAPOR BARRIER (RETARDER)
VC	VERTICAL CURVE
VCP	VITRIFIED CLAY PIPE
VCT	VINYL COMPOSITION TILE
VEL	VELOCITY
VERT	VERTICAL
VHC	VOLATILE HYDROCARBONS
VIB	VIBRATION
VIF	VERIFY IN FIELD
VIN	VINYL
VINT, VT	VINYL TILE
VP	VERTICAL PIVOTED
VPS	VENEER PLASTER SYSTEM
VPC	POINT OF VERTICAL CURVATURE
VPI	POINT OF VERTICAL INTERSECTION
VPT	POINT OF VERTICAL TANGENT
VS	VERTICAL SLIDE
VTR	VENT THRU ROOF
VWC	VINYL WALL COVERING
W	WEST
W/	WITH
WC	WATER COLUMN
WEASTRIP	WEATHERSTRIP
WG	WIRE, WIRE GLASS
WH	WATTHOUR METER
WHD	WATTHOUR DEMAND METER
WP	WATERPROOF, WEATHERPROOF, WORKPOINT
WR	WASTE RECEPTACLE
WRB	WATER RESISTANT GWB
WS	WATER SURFACE, WATERSTOP, WELDED STEEL
WWF	WELDED WIRE FABRIC
WWPH	WET WEATHER PEAK HOUR

SECTION / DETAIL DESIGNATIONS

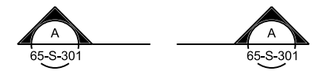


DRAWING TITLE
SCALE

ON DRAWING WHERE ONLY A TITLE IS REQUIRED WITH NO REFERENCE (eg: ELEVATIONS)



SECTION CALLOUT WHERE SECTION IS ON THE SAME SHEET AND CUT EXTENDS TO A FIXED LIMIT



SECTION CALLOUT WHERE SECTION IS ON ANOTHER SHEET AND CUT EXTENDS THROUGHOUT ENTIRE SHEET

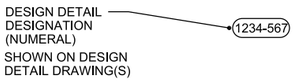
GRID LINE INDICATOR

KEYNOTE NUMBER

REVISION / ADDENDA NUMBER

NORTH ARROW

DESIGN DETAIL DESIGNATION



NOTES:

1. ALL DESIGN DETAILS ARE TYPICAL AND MUST BE USED IF DESIGN DETAIL DESIGNATION IS NOT SHOWN
2. THE TERM STANDARD DETAIL, OR A FORM OF IT, IS SYNONYMOUS WITH DESIGN DETAIL. THE DESIGN DETAILS REPRESENT THE CHARACTER AND NATURE OF THE WORK REQUIRED THROUGHOUT THE PROJECT. ALL ASSOCIATED WORK SHALL BE IN ACCORDANCE WITH THE DESIGN DETAILS SHOWN WHETHER THE DETAILS ARE SPECIFICALLY REFERENCED OR NOT.

DRAWING NUMBER DESIGNATION

DRAWING NUMBER

100-S-201

SEQUENTIAL NUMBER

SHEET TYPE
0 GENERAL, DIAGRAMS, SCHEMATICS
1 DEMOLITION DRAWINGS
2 PLANS
3 SECTIONS AND OR ELEVATIONS
4 LARGE SCALED VIEWS
5 DETAILS
6 SCHEDULES

DISCIPLINE
G GENERAL
C CIVIL
L EROSION CONTROL
S STRUCTURAL
A ARCHITECTURAL
F FIRE PROTECTION
P PLUMBING
D PROCESS
Y PIPING
M MECHANICAL
E ELECTRICAL
N INSTRUMENTATION AND CONTROLS

FACILITY
100 - UNION PUMP STATOIN
200 - EAST STREET PUMP STATION
300 - BOULEVARD PUMP STATION

PROJECT NOTES:

1. PROJECT ELEVATIONS ARE BASED ON NAVD 88. EXISTING ELEVATIONS ARE BASED ON NGVD 29. EXISTING DRAWINGS WERE USED AS BACKGROUNDS FOR EXISTING BUILDINGS/STRUCTURES. EXISTING ELEVATIONS HAVE BEEN CONVERTED TO NAVD 88, UNLESS NOTED OTHERWISE. TO CONVERT BETWEEN NGVD 29 AND NAVD 88 USE THE FOLLOWING CONVERSIONS:

   NGVD 29 TO NAVD 88: SUBTRACT 1.04 FEET
   NAVD 88 TO NGVD 29: ADD 1.04 FEET

2. CONTRACTOR SHALL FIELD VERIFY EXISTING ELEVATIONS AND DIMENSIONS.

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NO.	DSGN	DATE	REVISION	CHK	APVD	BY	APVD
	J. OSOSKIE	J. HARGIS			OC Review		Sealer

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

GENERAL

UNION PUMP STATION
ABBREVIATIONS AND GENERAL LEGEND

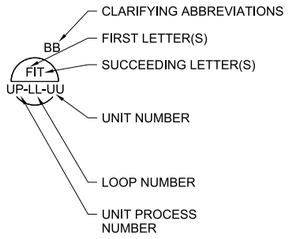
10% SUBMITTAL - NOT FOR CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	100-G-003
SHEET	of

INSTRUMENT IDENTIFICATION

EXAMPLE SYMBOLS



DIGITAL SYSTEM INTERFACES

- ▲ ANALOG INPUT
- ▼ ANALOG OUTPUT
- $\triangle_X$ DISCRETE INPUT
- ∇_X DISCRETE OUTPUT

INSTRUMENT IDENTIFICATION LETTERS TABLE

LETTER	FIRST-LETTER		SUCCEEDING-LETTERS		
	PROCESS OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	READOUT OR PASSIVE FUNCTION	READOUT OR PASSIVE FUNCTION
A	ANALYSIS (+)		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE (*)	USER'S CHOICE (*)	USER'S CHOICE (*)
C	USER'S CHOICE (*)			CONTROL	
D	DENSITY (S.G.)	DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT, SENSOR		
F	FLOW RATE	RATIO (FRACTION)			
G	USER'S CHOICE (*)		GLASS, GAUGE VIEWING DEVICE	GATE	
H	HAND (MANUAL)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOTION	MOMENTARY			MIDDLE, INTERMEDIATE
N	TORQUE		USER'S CHOICE (*)	USER'S CHOICE (*)	USER'S CHOICE (*)
O	USER'S CHOICE (*)		ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD OR PRINT		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTI VARIABLE		MULTI FUNCTION	MULTI FUNCTION	MULTI FUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED (*)	X AXIS	UNCLASSIFIED (*)	UNCLASSIFIED (*)	UNCLASSIFIED (*)
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION	Z AXIS		DRIVE, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

TABLE BASED ON THE INSTRUMENTATION, SYSTEMS, AND AUTOMATION SOCIETY (ISA) STANDARD.

(+) WHEN USED, EXPLANATION IS SHOWN ADJACENT TO INSTRUMENT SYMBOL. SEE ABBREVIATIONS AND LETTER SYMBOLS.
(*) WHEN USED, DEFINE THE MEANING HERE FOR THE PROJECT.

GENERAL INSTRUMENT OR FUNCTIONAL SYMBOLS

- FIELD MOUNTED
- REAR-OF-PANEL MOUNTED (OPERATOR INACCESSIBLE)
- PANEL MOUNTED (OPERATOR ACCESSIBLE)
- MCC MOUNTED

HAND SWITCHES AND INDICATING LIGHTS

ON AND OFF EVENT LIGHTS

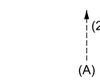
ON-OFF HAND SWITCH, MAINTAINED CONTACT SWITCH (CONTROLLED DEVICE WILL RESTART ON RETURN OF POWER AFTER POWER FAILURE).

STOP-START HAND SWITCH MOMENTARY CONTACT SWITCHES (CONTROLLED DEVICE WILL NOT RESTART ON RETURN OF POWER AFTER POWER FAILURE).

LINE LEGEND

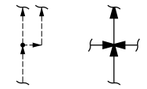
- PRIMARY PROCESS (CLOSED CONDUIT, DASHED LINE INDICATES ALTERNATE FLOW STREAM)
- SECONDARY PROCESS
- BYPASS PROCESS
- PROCESS (OPEN CHANNEL)
- ANALOG SIGNAL (4 TO 20 mAdc, ETC.)
- DISCRETE (ON/OFF, ETC.)
- PNEUMATIC SIGNAL
- FILLED SYSTEM SIGNAL
- HYDRAULIC SYSTEM SIGNAL
- DATA LINK
- BUILDING OR FACILITY BOUNDARY
- PACKAGE SYSTEM EQUIPMENT
- SIMILAR PROCESS

PARALLELING LINES



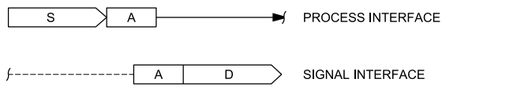
(A) TOTAL OF 2 SIGNALS

CONNECTING LINES



NON-CONNECTING LINES

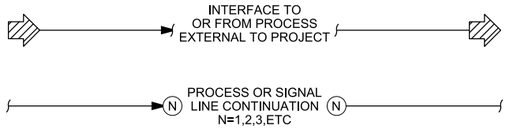
INTERFACE SYMBOLS



A INTERFACE LETTER

D DESTINATION DRAWING NO.

S SOURCE DRAWING NO.



SELF CONTAINED VALVE & EQUIPMENT TAG NUMBERS

D-UP-LL-UU

D	ARV	AIR RELEASE VALVE
	AVRV	AIR AND VACUUM RELEASE VALVE
	E	EJECTOR
	G	GATE
	M	MECHANICAL EQUIPMENT
	P	PUMP
	T	TANK
UP		UNIT PROCESS NUMBER
LL		LOOP NUMBER
UU		UNIT NUMBER

ABBREVIATIONS & LETTER SYMBOLS

AC	ALTERNATING CURRENT
AM	AUTO-MANUAL
CL_2 etc.	CHLORINE (TYPICAL: USE STANDARD CHEMICAL ELEMENT ABBREVIATIONS)
COD	CHEMICAL OXYGEN DEMAND
CP-X	CONTROL PANEL NO. X (X = FACILITY NUMBER)
DC	DIRECT CURRENT
DO	DISSOLVED OXYGEN
FCL_2	FREE CHLORINE RESIDUAL
FOS	FAST-OFF-SLOW
FOSA	FAST-OFF-SLOW-AUTO
FOSR	FAST-OFF-SLOW-REMOTE
FP-W-X	FIELD PANEL NO. WX (W = UNIT PROCESS NUMBER X = PANEL NUMBER)
FR	FORWARD-REVERSE
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
ISR	INTRINSICALLY SAFE RELAY
LEL	LOWER EXPLOSIVE LIMIT
LOS	LOCKOUT STOP
LR	LOCAL-REMOTE
MA	MANUAL-AUTO
MC	MODULATE-CLOSE
MCC-X	MOTOR CONTROL CENTER NO. X
MSC	MANUFACTURER SUPPLIED CABLE
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OC	OPEN-CLOSE(D)
OCA	OPEN-CLOSE-AUTO
OCR	OPEN-CLOSE-REMOTE
OO	ON-OFF
OOA	ON-OFF-AUTO
OOR	ON-OFF-REMOTE
ORP	OXIDATION REDUCTION POTENTIAL
OSC	OPEN-STOP-CLOSE
pH	HYDROGEN ION CONCENTRATION
PLC	PROGRAMMABLE LOGIC CONTROLLER
RIO	REMOTE I/O UNIT
RTU-X	REMOTE TELEMETRY UNIT NO. X
SOF	SLOW-OFF-FAST
SS	START-STOP
TCL_2	TOTAL CHLORINE RESIDUAL
TOC	TOTAL ORGANIC CARBON
TOD	TOTAL OXYGEN DEMAND
TURB	TURBIDITY
VHC	VOLATILE HYDROCARBONS
VIB	VIBRATION

GENERAL NOTES

1. COMPONENTS AND PANELS SHOWN WITH A SINGLE ASTERISK (✳) ARE TO BE PROVIDED AS PART OF A PACKAGE SYSTEM.
2. COMPONENTS AND PANELS SHOWN WITH A DOUBLE ASTERISK (✳✳) ARE TO BE PROVIDED UNDER DIVISION 26, ELECTRICAL.
3. THIS IS A STANDARD LEGEND. THEREFORE, NOT ALL OF THIS INFORMATION MAY BE USED ON THE PROJECT.

NO.	DATE	DSGN	DR	CHK	BY	REVISION	APVD
		J. OSOSKIE	J. HARGIS			OC Review	Sealer

10% SUBMITTAL - NOT FOR CONSTRUCTION

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

GENERAL
UNION PUMP STATION
INSTRUMENTATION AND CONTROL
LEGEND - SHEET 1

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	100-G-005
SHEET	of

VALVE SYMBOLS

- GATE
- KNIFE GATE
- BUTTERFLY
- GLOBE
- BALL
- VEE-BALL
- SEAT PORT ECCENTRIC PLUG
- DIAPHRAGM
- PINCH
- NEEDLE
- SWING CHECK
- BALL CHECK
- BACKFLOW PREVENTER
- ROTARY
- TELESCOPING
- SAMPLE
- MUD
- PRESSURE RELIEF
- AIR AND/OR VACUUM RELEASE
- REGULATED SIDE PRESSURE CONTROL
- PRESSURE REGULATION (CLAY-TYPE)
- MULTI-PORT VALVE (GATE VALVE SHOWN. FOR OTHER VALVE TYPES, APPROPRIATE VALVE SYMBOL SHOWN.) SEAT PORTS ARE IMPLIED BY INDICATED FLOW PATTERN.
- ANGLE GATE

GATE SYMBOLS

- SLUICE
- FABRICATED SLIDE
- STOP LOG
- BUTTERFLY
- FLAP
- SHEAR

ACTUATOR SYMBOLS

- PNEUMATIC DIAPHRAGM SPRING-OPPOSED, SINGLE OR DOUBLE ACTING
- VALVE POSITIONER
- MANUAL
- PNEUMATIC CYLINDER SINGLE OR DOUBLE ACTING ACTUATED BY ONE INPUT
- HYDRAULIC
- ELECTRIC MOTOR
- DIAPHRAGM, DIFFERENTIAL PRESSURE
- SOLENOID
- ELECTROHYDRAULIC

NOTE:
ON LOSS OF PRIMARY POWER (PNEUMATIC, ELECTRICAL, OR HYDRAULIC)

XX: FO FAIL OPEN
FC FAIL CLOSED
FLP FAIL TO LAST POSITION

PRIMARY ELEMENT SYMBOLS

- PARSHALL FLUME
- PROPELLER OR TURBINE METER
- LEVEL (FLOAT)
- WEIR
- THERMAL FLOWMETER
- ROTAMETER
- ORFICE PLATE
- LEVEL (BUBBLER TUBE)
- DENSITY METER
- FLOW TUBE
- GENERIC
- ULTRASONIC FLOWMETER
- LEVEL (ULTRASONIC)
- ELECTROMAGNETIC FLOWMETER

PIPING DESIGNATION

RAS
FLOW STREAM IDENTIFICATION

MISCELLANEOUS SYMBOLS

- VENT TO ATMOSPHERE
- AIR GAP
- DRIP TRAP
- PIG INSERT POINT
- PIG CATCH POINT
- SELF CONTAINED AIR SUPPLY
- AIR PURGE SET
- FLUSHING CONNECTION
- SEAL WATER SET
- WATER PURGE SET
- FLEXIBLE CONNECTION
- AERATOR
- DIAPHRAGM SEAL
- ANNULAR DIAPHRAGM SEAL
- COMPOSITE SAMPLER
- FLAME TRAP
- CALIBRATION COLUMN
- INLINE SILENCER
- BLIND FLANGE
- PIPE CAP
- STRAINER
- BASKET STRAINER
- FILTER
- PULSATION DAMPENER
- EXPANSION CHAMBER
- SLUDGE GRINDER
- FFLCPLLLX — PANEL CONTINUED ON SAME OR OTHER DRAWING; PANEL OUTLINE; PANEL NAME
- 120V — 120 VOLT, 60 HZ POWER
- 480V — 480 VOLT, 60 HZ POWER
- XX — AIR SET XX = SUPPLY PRESSURE IN PSIG.
- PLUG
- RECEPTACLE
- RUPTURE DISK (VACUUM)
- RUPTURE DISK (PRESSURE)
- TV MONITOR
- TV CAMERA
- RADIO ANTENNA
- OR — INTERLOCK, SEE CONTROL DIAGRAMS
- VOICE COMMUNICATION POINT
- SKIMMING MECHANISM
- SCREW CONVEYOR
- SUBMERSIBLE MIXER
- INTRINSIC SAFETY BARRIER/RELAY
- INLINE FAN
- SIGHT INDICATOR

PUMP AND COMPRESSOR SYMBOLS

- CENTRIFUGAL PUMP (DRY PIT)
- CENTRIFUGAL WET PIT PUMP OR TURBINE PUMP
- RECIPROCATING OR METERING PUMP (POSITIVE DISPLACEMENT)
- DIAPHRAGM PUMP
- GEAR PUMP OR BLOWER (POSITIVE DISPLACEMENT)
- PROGESSING CAVITY PUMP
- COMPRESSOR (CENTRIFUGAL)
- COMPRESSOR (PISTON)
- BLOWER OR FAN (CENTRIFUGAL)
- EJECTOR
- PISTON PUMP
- SUBMERSIBLE SUMP PUMP
- PERISTALLIC PUMP

XX: AS ADJUSTABLE SPEED
CS-1 CONSTANT SPEED (SINGLE SPEED)
CS-2 CONSTANT SPEED (TWO SPEED)

FLOW STREAM IDENTIFICATION

ALP	AIR LOW PRESSURE PROCESS	S	SANITARY SEWER (GRAVITY)
ARD	ACID RESISTANT DRAIN	SA	SAMPLE
ARV	ACID RESISTANT VENT	SC	SUPPLEMENTAL CARBON
BD	BLOW DOWN	SCS	SUPPLEMENTAL CARBON SOLUTION
BSD	BLENDED SLUDGE	SHC	SODIUM HYPOCHLORITE
BYP	BYPASS	SMD	SCUM DECANT
CA	SODIUM HYDROXIDE / CAUSTIC	SPD	SUMP PUMP DRAIN / DISCHARGE
CO	CONDENSATE DRAIN	SR	SCRUBBER RECIRCULATION
CSM	COMBINED SCUM	SSM	SECONDARY SCUM
D	DRAIN (PLUMBING)	SU	SULFURIC ACID
DR	DRAIN (PROCESS)	TA	TREATED AIR
FF	FIRE SUPPRESSION FOAM	TPSD	THICKENED PRIMARY SLUDGE
FO	FUEL OIL	TW	TEMPERED WATER (POTABLE)
FS	FIRE SPRINKLER WATER	TWAS	THICKENED WAS
G	NATURAL GAS (PROCESS)	V	VENT
GTO	GRAVITY THICKENER OVERFLOW	VR	VAPOR RECOVERY
HW	HOT WATER (POTABLE)	W1	CITY WATER (POTABLE)
HWR	HEATING WATER RETURN	W2	SEPARATED CITY WATER (NON-POTABLE)
HWS	HEATING WATER SUPPLY	W3	PLANT WATER (PLANT EFFLUENT)
ISD	IMPORTED SLUDGE	WAS	WASTE ACTIVATED SLUDGE
LPR	LOW PRESSURE RETURN (CONDENSATE)		
LPS	LOW PRESSURE STEAM		
NG	NATURAL GAS (PLUMBING)		
NRCY	NITRATE RICH RECYCLE		
OA	ODOROUS AIR		
OD	OVERFLOW ROOF DRAIN		
OF	OVERFLOW		
PE	PRIMARY EFFLUENT		
PSD	PRIMARY SLUDGE		
PSM	PRIMARY SCUM		
RAS	RETURN ACTIVATED SLUDGE		
RBSD	RECYCLE BLENDED SLUDGE		
RD	ROOF DRAIN		
RHG	REFRIGERANT HOT GAS		
RHW	RECIRCULATING HOT WATER		
RL	REFRIGERANT LIQUID		
RS	REFRIGERANT SUCTION		
RTW	RECIRCULATING TEMPERED WATER		

NOTE:
1. FOR EXISTING CIVIL YARD PIPING FLOW STREAM IDENTIFICATION, SEE CIVIL LEGEND.

NO.	DATE	DSGN
	REVISION	
	CHK	Z BRYAN
DR		J. OSOSKIE
APVD	OC Review	
BY	APVD	Sealer

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

GENERAL
EAST STREET PUMP STATION
INSTRUMENTATION AND CONTROL
LEGEND - SHEET 2

PRELIMINARY – NOT FOR CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-G-006
SHEET	of

GENERAL ARCHITECTURAL NOTES

1. UNLESS OTHERWISE INDICATED, PLAN DIMENSIONS ARE TO COLUMN GRID ON CENTERLINES, NOMINAL SURFACE OF MASONRY, FACE OF STUDS AND FACE OF CONCRETE WALLS.
2. "FLOOR LINE" REFERS TO TOP ON CONCRETE SLABS. FINISH FLOORING IS INSTALLED ABOVE THE FLOOR LINE. FOR DEPRESSED FLOORS AND CURBS, SEE STRUCTURAL DRAWINGS.
3. REPETITIVE FEATURES ARE NOT DRAWN IN THEIR ENTIRETY AND SHALL BE COMPLETELY PROVIDED AS IF DRAWN IN FULL.
4. WHERE DOOR IS LOCATED NEAR CORNER OF ROOM AND IS NOT LOCATED BY DIMENSION ON PLAN OR DETAILS, DIMENSION SHALL BE 3-INCHES FROM FACE OF STUD (WALL) TO FACE OF ROUGH OPENING. DIMENSION SHALL BE 6" FROM FACE OF WALL TO EDGE OF ROUGH OPENING AT CONCRETE WALLS, 8" AT CMU WALLS.
5. AT SOUND INSULATED WALLS, FULL HEIGHT PARTITIONS SHALL BE SEALED BOTH SIDES WITH ACOUSTIC SEALANT; TOP, BOTTOM, INTERSECTION, DOOR FRAMES, GLAZED OPENING FRAMES, AND OTHER PENETRATIONS.
6. LINE OF EXISTING GRADES, AS SHOWN ON THE BUILDING ELEVATIONS AND SECTIONS ARE APPROXIMATE. THEY ARE AT THE BUILDING FACE, OR ON THE SECTION END EXCEPT AS NOTED.
7. VERIFY ALL ROUGH-IN DIMENSIONS FOR EQUIPMENT PROVIDED IN THIS CONTRACT, OR BY OTHERS.
8. REFER TO ARCHITECTURAL, STRUCTURAL, MECHANICAL, ELECTRICAL AND OTHER CATEGORIES OR DRAWINGS FOR ADDITIONAL NOTES.
9. VERIFY SIZE AND LOCATION OF, AND PROVIDE: REQUIRED OPENINGS THROUGH FLOORS AND WALLS, ACCESS DOORS, FURRING, CURBS, ANCHORS AND INSERTS. PROVIDE ALL BASES AND BLOCKING REQUIRED FOR ACCESSORIES, MECHANICAL, ELECTRICAL AND OTHER EQUIPMENT.

ARCH/STRUCT MATERIAL SYMBOLS

SYMBOL	LEGEND
	GRATING, SPAN DIRECTION INDICATED
	CHECKERED PLATE
	GROUT
	GRANULAR FILL
	EARTH OR FINISH GRADE
	CONCRETE
	CMU WALL (PLAN)
	CMU WALL (SECTION)
	MASONRY WALL
	METAL STUD WALL (PLAN)
	WOOD STUD WALL (PLAN)
	RIGID INSULATION
	BATT INSULATION
	STEEL
	ALUMINUM
	PLYWOOD
	GYPSUM WALLBOARD
	ACOUSTICAL TILE
	WOOD, ROUGH CONTINUOUS
	WOOD, ROUGH NON-CONTINUOUS
	WOOD, FINISHED

ARCHITECTURAL/STRUCTURAL LEGEND

SYMBOL	LEGEND
A	NEW REFERENCE GRID INDICATOR
A	EXISTING REFERENCE GRID INDICATOR
ROOM NAME XX-101 OR ROOM NAME 101	ROOM IDENTIFIER
"XX" = FACILITY INDICATOR (IF SHOWN); DOOR LETTER; ROOM NUMBER; XX-101A	DOOR IDENTIFIER
XXW-1 OR W-1	WINDOW IDENTIFIER
XXR-1 OR R-1	RELIGHT IDENTIFIER
XXL-1 OR L-1	LOUVER IDENTIFIER
A	WALL TYPE INDICATOR
S-1	SIGNAGE IDENTIFIER
P-1	PRECAST PANEL IDENTIFIER
1 XX-A-301	EXTERIOR ELEVATION INDICATOR
QUANTITY AND DIRECTION OF POINTERS AS REQUIRED; A B C D E; 1 XX-A-301	INTERIOR ELEVATION INDICATOR
1 XX-A-401	DETAIL INDICATOR - SMALL CONDITION
⊗ 110.50	SPOT ELEVATION INDICATOR
	DIRECTION OF SLOPE DOWN
HINGE SIDE	DOOR/HATCH SWING INDICATOR
ACTIVE; INACTIVE; XX-101A	INDICATES PAIR OF DOORS
F.EXT-X	FIRE EXTINGUISHER "X" = NUMBER IN SPECIFICATIONS
	CONTROL JOINT
	EXPANSION JOINT
POST	RAILINGS

NO.	DATE	DSGN	DR	CHK	APVD	BY	REVISION
		J. OSOSKIE	J. HARGIS	OC Review	APVD	Sealer	

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

10% SUBMITTAL - NOT FOR CONSTRUCTION

GENERAL
UNION PUMP STATION
ARCHITECTURAL AND STRUCTURAL LEGEND

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	100-G-007
SHEET	of

PIPE AND FITTING SYMBOLS

DOUBLE LINE	SINGLE LINE	
		EXISTING PIPE
		NEW PIPE
		EXISTING PIPE TO BE ABANDONED
		EXISTING PIPE TO BE REMOVED
		WELDED JOINT
		GROOVED END JOINT
		FLANGED JOINT
		MECHANICAL JOINT & PROPRIETARY RESTRAINED JOINT
		BELL & SPIGOT JOINT (LEADED)
		HUB & SPIGOT JOINT (RUBBER GASKET)
		BALL JOINT
		ADAPTER SIDE GROOVED END ADAPTER FLANGE
		FLANGED COUPLING ADAPTER (RESTRAINING SYSTEM BY MFR)
		RESTRAINED FLANGED COUPLING ADAPTER SEE (4005-545)
		FLEXIBLE COUPLING
		METAL BELLOWS EXP JOINT
		ELASTOMER BELLOWS EXP JOINT
		ELBOW UP
		ELBOW DOWN
		TEE UP
		TEE DOWN
		LATERAL UP
		LATERAL DOWN
		CONCENTRIC REDUCER
		ECCENTRIC REDUCER

DOUBLE LINE	SINGLE LINE	
		REDUCING BUSHING
		UNION
		CAP
		ANCHOR
		ELBOW, 90 DEGREE
		CROSS
		TEE
		ELBOW, 45 DEGREE
		LATERAL

NOTES:

1. ONLY FLANGED END CONNECTIONS ARE SHOWN HERE FOR DOUBLE LINE FITTINGS. FITTINGS WITH OTHER END PATTERNS ARE SHOWN SIMILARLY ON THE CONSTRUCTION DRAWINGS. ALSO SEE PIPING SPECIFICATIONS.
2. SYMBOLS SHOWN HERE FOR SINGLE LINE FITTINGS ARE GENERIC ONLY. REFER TO PIPING SPECIFICATIONS FOR SPECIFIC END CONNECTIONS FOR SINGLE LINE PIPE AND FITTINGS.
3. EXISTING PIPE AND EQUIPMENT IS SHOWN LIGHT-LINED AND/OR SCREENED. NEW PIPING AND EQUIPMENT IS SHOWN HEAVY-LINED.

VALVE SYMBOLS

SINGLE LINE	DOUBLE LINE
GATE	
KNIFE GATE	OR
BUTTERFLY	OR
GLOBE	OR
BALL	OR
SEATING PORT	
ECCENTRIC PLUG	OR
PLUG OR COCK	OR
NEEDLE	OR
DIAPHRAGM	OR
PINCH	OR
SWING CHECK	OR
BALL CHECK	OR

HOSE VALVE (HV- X) OR (V-X)
X = NO. IN SPECS

SAMPLE

MUD

PRESSURE RELIEF

AIR AND/OR VACUUM RELEASE

REGULATED SIDE
PRESSURE CONTROL (INTERNAL PILOT)

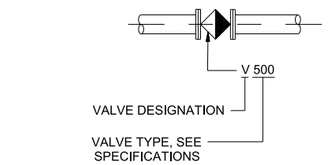
REGULATED SIDE
PRESSURE CONTROL (EXTERNAL PILOT)

MULTI-PORT VALVE,
ARROWS INDICATE FLOW PATTERN.
SEATING PORTS ARE IMPLIED BY
INDICATED FLOW PATTERN.

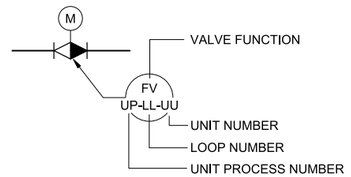
TELESCOPING

VALVE DESIGNATIONS

MANUAL VALVES AND CHECK VALVES

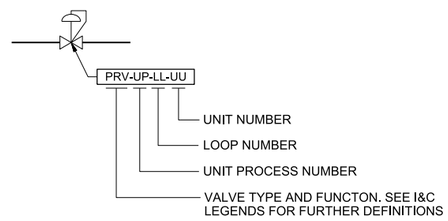


CONTROL VALVES



NOTE:
SEE I&C LEGENDS FOR FURTHER DEFINITIONS AND ACTUATOR TYPES.

SELF-CONTAINED REGULATING VALVES



ACTUATOR SYMBOLS

PNEUMATIC DIAPHRAGM

PNEUMATIC CYLINDER

ELECTRIC MOTOR (M)

HYDRAULIC (H)

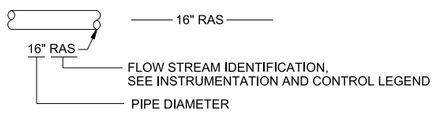
MANUAL

SOLENOID (S)

ELECTRO HYDRAULIC (E/H)

PIPING DESIGNATION

EXAMPLE:



GENERAL PIPING NOTES

1. LAY PIPE TO UNIFORM GRADE BETWEEN INDICATED ELEVATION POINTS.
2. SIZE OF FITTINGS SHOWN ON DRAWINGS SHALL CORRESPOND TO ADJACENT STRAIGHT RUN OF PIPE, UNLESS OTHERWISE INDICATED. TYPE OF JOINT AND FITTING MATERIAL SHALL BE THE SAME AS SHOWN FOR ADJACENT STRAIGHT RUN OF PIPE.
3. LOCATION AND NUMBER OF PIPE HANGERS AND PIPE SUPPORTS SHOWN IS ONLY APPROXIMATE. CONTRACTOR SHALL DESIGN SUPPORTS AS SPECIFIED.
4. ALL JOINTS SHALL BE WATERTIGHT. WALL PIPES SHALL BE USED WHEREVER PIPING PASSES FROM A STRUCTURE TO BACKFILL.
5. ALL FLEXIBLE CONNECTORS AND COUPLING ADAPTERS SHALL BE PROVIDED WITH THRUST PROTECTION AS SPECIFIED, UNLESS OTHERWISE NOTED. THRUST PROTECTION SHALL BE ADEQUATE FOR TEST PRESSURES SPECIFIED.
6. SYMBOLS, LEGENDS, AND PIPE USE IDENTIFICATIONS SHOWN SHALL BE FOLLOWED THROUGHOUT THE DRAWINGS, WHEREVER APPLICABLE. NOT ALL OF THE VARIOUS PIPING COMPONENTS ARE NECESSARILY USED IN THE PROJECT.
7. ALL BURIED PIPING SPECIFIED TO BE PRESSURE TESTED, EXCEPT FLANGED, WELDED, OR SCREWED PIPING, SHALL BE PROVIDED WITH THRUST PROTECTION AS SPECIFIED, UNLESS OTHERWISE NOTED.
8. NUMBER AND LOCATION OF UNIONS SHOWN ON DRAWINGS IS ONLY APPROXIMATE. PROVIDE ALL UNIONS NECESSARY TO FACILITATE CONVENIENT REMOVAL OF VALVES AND MECHANICAL EQUIPMENT.
9. WHERE A GROOVED END COUPLING IS SHOWN, IT SHALL BE THE RIGID JOINT TYPE, UNLESS OTHERWISE SPECIFIED. WHERE A FLANGED COUPLING ADAPTER IS SHOWN, A STANDARD FLANGE SHALL BE JOINED TO THE COUPLING ADAPTER.

NO.	DSGN	DATE	DR	REVISION	CHK	OC Review	APVD	BY	APVD
			S. CLARK		J. HARGIS				Sealer

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL PLAN
CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

10% SUBMITTAL - NOT FOR CONSTRUCTION

ch2m

GENERAL

UNION PUMP STATION
PROCESS MECHANICAL
LEGEND

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	100-G-012
SHEET	of

ONE-LINE DIAGRAM-1

SYMBOL	DESCRIPTION
	DRAWOUT AIR CIRCUIT BREAKER, LOW VOLTAGE
400	CIRCUIT BREAKER, THERMAL MAGNETIC TRIP SHOWN, 3 POLE, UNO
AS/AF or AT/AF	CIRCUIT BREAKER, STATIC TRIP UNIT, SENSOR AMP TRIP AND FRAME RATINGS SHOWN, 3 POLE, UNO
100/M	CIRCUIT BREAKER, MAGNETIC TRIP ONLY, TRIP RATING SHOWN, 3 POLE, UNO
400 400	CIRCUIT BREAKER WITH CURRENT LIMITING FUSES, TRIP AND FUSE RATING INDICATED, 3 POLE, UNO
400 225	FUSED SWITCH, SWITCH AND FUSE CURRENT RATING INDICATED, 3 POLE, UNO
100	SWITCH, CURRENT RATING INDICATED, 3 POLE, UNO
60 (3)	FUSE, CURRENT RATING AND QUANTITY INDICATED
1	MAGNETIC STARTER WITH OVERLOAD, NEMA SIZE INDICATED, FVNR UNO
AFD	ELECTRONIC STARTER/SPEED CONTROL RVSS = REDUCED VOLTAGE SOFT STARTER AFD = AC ADJUSTABLE FREQUENCY DRIVE DC = DC ADJUSTABLE SPEED DRIVE RVAT = REDUCED VOLTAGE AUTO TRANSFORMER TYPE RVRT = REDUCED VOLTAGE REACTOR TYPE
	CABLE OR BUS CONNECTION POINT
K	KEY INTERLOCK
	SURGE ARRESTER (GAP TYPE)
10	CAPACITOR - KVAR INDICATED, 3 PHASE
3	AC MOTOR, SQUIRREL CAGE INDUCTION - HORSEPOWER INDICATED
G 500/625	GENERATOR, KW/KVA RATING SHOWN
VS V 0-600V	ANALOG METER WITH SWITCH - SCALE RANGE SHOWN V = VOLTAGE KW = KILOWATTS A = AMPERAGE KVAR = KILOVARS PF = POWER FACTOR
DPM	DIGITAL POWER METER (MULTIFUNCTION)
	UTILITY REVENUE METER
	GROUND
15 KVA 480-120/240V 1 PH	TRANSFORMER, SIZE, VOLTAGE RATINGS, AND PHASE INDICATED
	SHIELDED ISOLATION TRANSFORMER
480-120V (3)	POTENTIAL TRANSFORMER, VOLTAGE RATING AND QUANTITY INDICATED
100:5 (3)	CURRENT TRANSFORMER, RATIO(100:5) AND QUANTITY INDICATED (3)
	CONNECTION POINT TO EQUIPMENT SPECIFIED IN OTHER DIVISIONS, RACEWAY, CONDUCTOR AND CONNECTION IN THIS DIVISION
SPD	SURGE PROTECTIVE DEVICE

ONE-LINE DIAGRAM-2

SYMBOL	DESCRIPTION
	DRAWOUT POWER CIRCUIT BREAKER, MEDIUM VOLTAGE
	NON DRAWOUT FUSED SWITCH, MEDIUM VOLTAGE
	DRAWOUT FUSED SWITCH AND CONTACTOR, MEDIUM VOLTAGE
	DRAWOUT FUSED SWITCH AND VACUUM CONTACTOR, MEDIUM VOLTAGE
	DRAWOUT VACUUM CONTACTOR, MEDIUM VOLTAGE
	MEDIUM VOLTAGE CABLE STRESS CONE TYPE TERMINATION, OPEN TERMINATOR OR ELBOW
	SWITCH - LOAD BREAK, GROUP OPERATED, MEDIUM VOLTAGE
	SWITCH W/ARCING HORNS, MEDIUM VOLTAGE
	DISCONNECTING FUSE - SOLID MATERIAL, MEDIUM VOLTAGE
	SWITCH - HOOK STICK OPERATED, SINGLE POLE, MEDIUM VOLTAGE
	FUSE - EXPULSION, HOOK STICK OPERATED, SINGLE POLE, MEDIUM VOLTAGE
	GROUND SWITCH, GANG OPERATED
	TERMINAL BLOCK LUG
	DELTA CONNECTION
	WYE GROUNDED CONNECTION, SOLID GROUND
R or Z	WYE NEUTRAL GROUND RESISTOR OR IMPEDANCE CONNECTION
86	RELAY OR DEVICE, FUNCTION NUMBER AS INDICATED
50:5 (1)	CURRENT TRANSFORMER, ZERO SEQUENCE, RATIO AND QUANTITY INDICATED
800/1200:5 (3)	BUSHING CURRENT TRANSFORMER, MULTI-RATIO AND QUANTITY INDICATED
MO	MOTOR OPERATOR, BREAKER OR SWITCH
EUM	ENERGY MONITORING UNIT
MRP	MOTOR PROTECTION RELAY
E N	TRANSFER SWITCH - LOW VOLTAGE
E N	TRANSFER SWITCH - MEDIUM VOLTAGE

NOTES:

1. THESE ARE STANDARD LEGEND SHEETS. SOME SYMBOLS AND ABBREVIATIONS MAY APPEAR ON THE LEGEND AND NOT ON THE DRAWINGS.
2. FOR ADDITIONAL ABBREVIATIONS OF OTHER DIVISIONS (HVAC, MECHANICAL, AND STRUCTURAL/ARCHITECTURAL) SEE OTHER LEGENDS.

CONTROL DIAGRAM-1

SYMBOL	DESCRIPTION
	PUSH-BUTTON SWITCH, MOMENTARY CONTACT, NORMALLY OPEN
	PUSH-BUTTON SWITCH, MOMENTARY CONTACT, NORMALLY CLOSED
	PUSH BUTTON SWITCH, MAINTAINED CONTACTS WITH MECHANICAL INTERLOCK
	3 POSITION SELECTOR SWITCH MAINTAINED CONTACT
HAND OFF REMOTE	SELECTOR SWITCH - MAINTAINED CONTACT - CHART IDENTIFIES OPERATION WHEN NEEDED FOR CLARITY:
	TOGGLE SWITCH, ON-OFF TYPE
ON OFF	SELECTOR SWITCH, ON-OFF TYPE
	MUSHROOM HEAD PUSHBUTTON SWITCH
A	INDICATING LIGHT, PUSH-TO-TEST, LETTER INDICATES COLOR
A	INDICATING LIGHT - LETTER INDICATES COLOR A - AMBER G - GREEN S - STROBE B - BLUE R - RED C - CLEAR W - WHITE
ETM	ELAPSED TIME METER
M	MOTOR STARTER CONTACTOR COIL
CRX	CONTROL RELAY, X INDICATES NUMERICAL ORDER IN CIRCUIT
TDR X	TIME DELAY RELAY, X INDICATES NUMERICAL ORDER IN CIRCUIT
SV X	SOLENOID VALVE, X INDICATES NUMERICAL ORDER IN CIRCUIT
	CONTACT - NORMALLY OPEN
	CONTACT - NORMALLY CLOSED
	REMOTE DEVICE
	TIME DELAY RELAY CONTACT, NORMALLY OPEN, CLOSES WHEN ENERGIZED AND TIMED OUT
	TIME DELAY RELAY CONTACT, NORMALLY CLOSED, OPENS WHEN ENERGIZED AND TIMED OUT
	TIME DELAY RELAY CONTACT, CLOSES WHEN ENERGIZED, OPENS WHEN DE-ENERGIZED AND TIMED OUT
	TIME DELAY RELAY CONTACT, OPENS WHEN ENERGIZED, CLOSES WHEN DE-ENERGIZED AND TIMED OUT
	MOTOR SPACE HEATER
	TERMINAL BLOCK, REMOTE
	TERMINAL BLOCK, INTERNAL
	FUSED TERMINAL BLOCK
	FUSE, RATING INDICATED
CPT 120V	TRANSFORMER, CONTROL POWER
	THERMOCOUPLE

	POSITION		
CKT	HAND	OFF	REMOTE
1	X	O	O
2	O	O	X

X - CLOSED CONTACT
O - OPEN CONTACT

CONTROL DIAGRAM-2

SYMBOL	DESCRIPTION
	CAPACITOR
+ −	BATTERY
	LIMIT SWITCH, NORMALLY OPEN, CLOSES AT END OF TRAVEL
	LIMIT SWITCH, NORMALLY CLOSED, OPENS AT END OF TRAVEL
	TEMPERATURE SWITCH, OPENS ON TEMPERATURE RISE
	TEMPERATURE SWITCH, CLOSES ON TEMPERATURE RISE
	FLOAT SWITCH, NORMALLY OPEN, CLOSES ON DESCENDING LEVEL
	FLOAT SWITCH, NORMALLY OPEN, CLOSES ON RISING LEVEL
	PRESSURE SWITCH, NORMALLY CLOSED, OPENS ON RISING PRESSURE
	PRESSURE SWITCH, NORMALLY OPEN, CLOSES ON RISING PRESSURE
	FLOW SWITCH, CLOSES ON INCREASED FLOW
	FLOW SWITCH, OPENS ON INCREASED FLOW
NGR	NEUTRAL GROUND CURRENT LIMITING RESISTOR
RES	CALIBRATING RESISTOR
T GEN	TACHOMETER GENERATOR
GFS	GROUND FAULT SENSOR
	FLASHER
	SEALED CONTACT
	BUZZER
	POTENTIOMETER
	RESISTOR
	BLOWN FUSE INDICATOR
	COAXIAL CABLE
	MULTICONDUCTOR SHIELDED CABLE
	DUPLEX RECEPTACLE
L U	RELAY, WITH MECHANICAL LATCH
	FULLWAVE DIODE BRIDGE (AC TO DC)

NO.	DATE	DSGN	DR	CHK	REVISION	BY	APVD
	R. WOOD		M. REICHERT	QC Review			Sealer

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

GENERAL

ELECTRICAL LEGEND 1

10% SUBMITTAL - NOT FOR CONSTRUCTION

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	100-G-015
SHEET	of

POWER SYSTEM PLAN-1

SYMBOL	DESCRIPTION
	CONNECTION POINT TO EQUIPMENT SPECIFIED. RACEWAY, CONDUCTOR,TERMINATION AND CONNECTION IN THIS DIVISION.
MCC-A	MAJOR ELECTRICAL COMPONENT OR DEVICE - NAME OR IDENTIFYING SYMBOL AS SHOWN.
	PANELBOARD - SURFACE MOUNTED
LPXXA	PANELBOARD LETTER OR NUMBER FACILITY NUMBER LP - LOW VOLTAGE PANEL DP - DISTRIBUTION PANEL
	PANELBOARD - FLUSH MOUNTED
	TERMINAL JUNCTION BOX
M	MOTOR, SQUIRREL CAGE INDUCTION
G	GENERATOR, VOLTAGE AND SIZE AS INDICATED.
LPXXA	HOME RUN - DESTINATION SHOWN
or G	EXPOSED CONDUIT AND CONDUCTORS*
or G	CONCEALED CONDUIT AND CONDUCTORS*

NOTE:
ALL UNMARKED CONDUIT RUNS CONSIST OF TWO NO. 12, ONE NO. 12 GROUND CONDUCTORS IN 3/4" CONDUIT. RUNS MARKED WITH CROSSHATCHES INDICATE NUMBER OF NO. 12 CONDUCTORS. CROSSHATCH WITH SUBSCRIPT "G" INDICATES GREEN GROUND WIRE.

G	CROSSHATCHES WITH BAR INDICATE NO.10 CONDUCTOR. SIZE CONDUIT ACCORDING TO SPECIFICATIONS AND APPLICABLE CODE.
[A1]	CONDUIT AND CONDUCTOR CALLOUT, SEE LEGEND.
	CONDUIT DOWN
	CONDUIT UP
	CONDUIT, STUBBED AND CAPPED
	CONDUIT TERMINATION AT CABLE TRAY
EX	EXISTING CONDUIT/ DUCT BANK
BD	BUS DUCT - SEE SPECIFICATIONS
CE	CONCRETE ENCASED CONDUIT
DB	DIRECT BURIED CONDUIT
FO	FIBER OPTIC CONDUIT
XXXX	CONCRETE ENCASED DUCT BANK WHERE XXXX IS THE DUCT BANK NAME. SEE CIRCUIT AND RACEWAY CODING DEFINITION
	CONCEALED CONDUIT ROUTING AREA
	CONDUIT ROUTING AREA
	CABLE TRAY
T	TRANSFORMER
J or HH	GENERAL CONTROL OR WIRING DEVICE. LETTER SYMBOLS OR ABBREVIATIONS INDICATE TYPE OF DEVICE
CS	CONTROL STATION, SEE CONTROL DIAGRAMS FOR CONTROL DEVICE(S) REQUIRED.
30	NONFUSED DISCONNECT SWITCH, CURRENT RATING INDICATED, 3 POLE
60/40	FUSED DISCONNECT SWITCH, CURRENT RATING INDICATED (60/40, 60=SWITCH RATING / 40=FUSE RATING) 3 POLE
2	COMBINATION CIRCUIT BREAKER AND MAGNETIC STARTER, NEMA SIZE INDICATED

POWER SYSTEM PLAN-2

SYMBOL	DESCRIPTION
100/40	BREAKER, SEPARATELY MOUNTED, CURRENT RATING INDICATED (100/40, 100 = FRAME SIZE; 40 = TRIP RATING) 3 POLE
C 2	CONTACTOR, MAGNETIC, NEMA SIZE INDICATED
L 30	LIGHTING CONTACTOR, CURRENT RATING INDICATED
2	STARTER, MAGNETIC NEMA SIZE INDICATED
XX 2	CONVENIENCE RECEPTACLE - DUPLEX UNLESS NOTED OTHERWISE WP - WEATHERPROOF C - CLOCK HANGER TL - TWIST LOCK CRE - CORROSION RESISTANT GFCI - GROUND FAULT CIRCUIT INTERRUPTER SUBSCRIPT NUMBER AT RECEPTACLE INDICATES CIRCUIT
	240V RECEPTACLE
	CONVENIENCE RECEPTACLE - QUADRUPLEX
	MULTI OUTLET ASSEMBLY
	DUPLEX CONVENIENCE RECEPTACLE - FLUSH IN FLOOR
	CONVENIENCE RECEPTACLE, PEDESTAL, DUPLEX SINGLE FACE UNLESS INDICATED OTHERWISE
L20R 20	RECEPTACLE, SPECIAL PURPOSE-NEMA CONFIGURATION AND AMPERAGE INDICATED
T	THERMOSTAT
	UTILITY REVENUE METERING FACILITY
EUH	ELECTRIC UNIT HEATER
AC	ELECTRIC AIR CONDITIONER (SELF CONTAINED UNIT)
	UTILITY POLE

LIGHTING SYSTEM PLAN

1 or 1	LUMINAIRE, SEE SCHEDULE
1	LUMINAIRE, SEE SCHEDULE
1 or	LUMINAIRE WITH INTERNAL BATTERY BACKUP, SEE SCHEDULE
1	STRIP LUMINAIRE, SEE SCHEDULE
4 or 4	LUMINAIRE AND POLE, SEE SCHEDULE
5 or 5	WALL MOUNTED LUMINAIRE, SEE SCHEDULE
1	FLOOD LIGHTS - AIM IN THE DIRECTION SHOWN
	STANDBY LIGHTING UNIT, SURFACE MOUNTED, SEE SCHEDULE
XX or	EXIT LIGHTS - FILLED SECTION INDICATES LIGHTED FACE, ARROW INDICATES EGRESS DIRECTIONAL INDICATORS, XX = FIXTURE NUMBER, SEE SCHEDULE
$a or 2a	SMALL LETTER SUBSCRIPT AT SWITCH AND LUMINAIRE INDICATES SWITCHING. SUBSCRIPT NUMBER AT LUMINAIRE INDICATES CIRCUIT
$3	WALL SWITCH: 2- DOUBLE POLE 3- THREE WAY 4- FOUR WAY WP- WEATHERPROOF EX- EXPLOSIONPROOF M- MOTOR RATED P- PILOT LIGHT K- KEY OPERATED D- DIMMER CRE- CORROSION RESISTANT L- MOMENTARY 3-WAY MS- MANUAL STARTER WITH OVERLOADS
OS	OCCUPANCY SENSOR
LC	LIGHTING CONTACTOR
MD	MOTION DETECTOR
PC	PHOTOCELL

FIRE ALARM SYSTEM PLAN AND RISER

SYMBOL	DESCRIPTION
F P	FIRE ALARM STATION, MANUAL
	FIRE ALARM SYSTEM, AUTOMATIC SMOKE DETECTOR
HD	FIRE ALARM SYSTEM, AUTOMATIC, HEAT DETECTOR
F	FIRE ALARM BELL
F	FIRE ALARM HORN
	FIRE ALARM HORN/STROBE LIGHT
	FIRE ALARM STROBE LIGHT
	AIR DUCT DETECTOR
FS	FIRE SPRINKLER FLOW SWITCH
TS	FIRE SPRINKLER TAMPER SWITCH
D	DOOR HOLDER

TELEPHONE SYSTEM PLAN AND RISER

TTC	TELEPHONE TERMINAL CABINET
	TELEPHONE RECEPTACLE FLOOR BOX
	TELEPHONE RECEPTACLE
T	TELEPHONE SYSTEM RACEWAY

COMPUTER SYSTEM (DATA) PLAN AND RISER

CTC	COMPUTER SYSTEM TERMINAL CABINET
	COMPUTER NETWORK CONNECTION
	COMPUTER NETWORK CONNECTION, FLUSH IN FLOOR
D	DATA SYSTEM RACEWAY

COMBINED TELEPHONE/COMPUTER SYSTEM PLAN AND RISER

4	COMBINATION TELEPHONE/DATA RECEPTACLE, WALL MOUNTED, NUMBER OF PORTS INDICATED
4	COMBINATION TELEPHONE/DATA RECEPTACLE, FLOOR BOX, NUMBER OF PORTS INDICATED

CLOSED CIRCUIT/TELEVISION CABLE PLAN AND RISER

	COMBINATION CLOSED CIRCUIT TELEVISION RECEPTACLE (CCTV) AND DUPLEX CONVENIENCE RECEPTACLE IN TWO GANG BOX WITH BARRIER, 12" DOWN FROM CEILING
	COMBINATION TELEVISION CABLE RECEPTACLE (TV) AND DUPLEX CONVENIENCE RECEPTACLE IN TWO GANG BOX WITH BARRIER, 12" DOWN FROM CEILING
	CLOSED CIRCUIT TELEVISION RECEPTACLE, FLOOR BOX
	TELEVISION CABLE RECEPTACLE, FLOOR BOX

SOUND SYSTEM PLAN AND RISER

SYMBOL	DESCRIPTION
S	SPEAKER, CONE TYPE, RECESSED IN CEILING, SEE ARCHITECTURAL DRAWINGS FOR CEILING TYPE
S	SPEAKER, CONE TYPE, WALL MOUNTED
S	SPEAKER, CONE TYPE, SURFACE MOUNTED
V	VOLUME CONTROL, WALL MOUNT 5'-0" AFF
S	INTERIOR PAGING TRUMPET SOUND REPRODUCER WITH REMOTE AMPLIFIER, SURFACE MOUNTED
M	MICROPHONE OUTLET
S	SOUND SYSTEM RACEWAY
S	COMMUNICATION STATION

SECURITY SYSTEM PLAN AND RISER

CR	CARD KEY ACCESS
CS	CONTROL STATION
DS	DOOR SWITCH
EP	EGRESS PUSHBUTTON
	ELECTRONIC LOCK M = MAGENITIC S = STRIKE
	INTERCOM
	MONITOR
	MOTION SENSOR
	VIDEO CAMERA PTZ = PAN/TILT/ZOOM F = FIXED

GROUND SYSTEM PLAN

	GROUND ROD
	GROUND ROD IN TEST WELL
G	GROUNDING CONDUCTOR, SIZE AS INDICATED
	PIGTAIL FOR CONNECTION TO EQUIPMENT CABINET OR FRAME
G	EQUIPMENT GROUND BUS
N	EQUIPMENT NEUTRAL BUS

NO.	DATE	DSGN
	REVISION	
DR	M. REICHERT	CHK
R. WOOD		APVD
	OC Review	
		BY
		APVD

Sealer

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

ch2m

GENERAL

ELECTRICAL LEGEND 2

10% SUBMITTAL - NOT FOR CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	100-G-016
SHEET	of

SYMBOL	DESCRIPTION

ONE LINE PROTECTION RELAYING AND ELEMENTARY DIAGRAMS-1

51 or 52	DEVICE FUNCTION NUMBER INDICATED, SEE DEVICE TABLE
CS T	CONTROL SWITCH TRIP
CS C	CONTROL SWITCH CLOSE
43/CS	43-DEVICE FUNCTION NUMBER, SEE DEVICE TABLE
VS	VOLTMETER SWITCH
AS	AMMETER SWITCH
A	INDICATING LAMP-SWITCHBOARD TYPE INDICATING LAMP LENS COLORS INDICATED AS FOLLOWS: A - AMBER R - RED B - BLUE W - WHITE G - GREEN
V	VOLTMETER
A	AMMETER
W	WATTMETER
F	FREQUENCY METER
PF	POWER FACTOR METER
WH	WATT-HOUR METER
ETM	ELAPSED TIME METER
RPM	TACHOMETER
W XD	WATTS TRANSDUCER
PF XD	POWER FACTOR TRANSDUCER
TD	TIME DELAY
4	RELAY COIL, DEVICE FUNCTION NUMBER PER ANSI 37.2 - AMERICAN STANDARD MANUAL AND AUTOMATIC STATION CONTROL, SUPERVISORY AND ASSOCIATED TELEMETRY EQUIPMENT
7 8	NORMALLY OPEN CONTACT
3 4	NORMALLY CLOSED CONTACT
	REMOTE DEVICE
	TEST SWITCH CURRENT ELEMENT
	TEST SWITCH POTENTIAL ELEMENT
	NEUTRAL CONNECTION
	DIODE
	INSTRUMENTATION CABLE, SHIELDED
NGR	NEUTRAL GROUNDING RESISTOR
PST	PHASE SHIFTING TRANSFORMER

DEVICE TABLE

ONE LINE PROTECTION RELAYING AND ELEMENTARY DIAGRAMS-2

DEVICE FUNCTION NO.	DEVICE DESCRIPTION
21	IMPEDANCE/DISTANCE RELAY
25A	AUTOMATIC SYNCHRONIZER
25C	SYNCH CHECK RELAY
27	UNDERVOLTAGE RELAY
32	REVERSE POWER RELAY
40	GENERATOR LOSS OF EXCITATION RELAY
43CSE	AUTOMATIC POWER TRANSFER AND LOAD CONTROL MODE SEL. SWITCH
43CSX	MODE SEL. SWITCH
46	GENERATOR CURRENT UNBALANCE RELAY
49	THERMAL RELAY
50GS	INSTANTANEOUS OVERCURRENT DEVICE, GROUND SENSOR
50	INSTANTANEOUS OVERCURRENT DEVICE,
51	TIME OVERCURRENT RELAY
51G	TIME OVERCURRENT RELAY, GROUND FAULT
51V	TIME OVERCURRENT, VOLTAGE RESTRAINED
52	POWER CIRCUIT BREAKER
52CSX	POWER CIRCUIT BREAKER CONTROL SWITCH
59	OVERVOLTAGE RELAY
60	VOLTAGE OR CURRENT BALANCE RELAY
65A	ENGINE GOVERNOR, SPEED CONTROL
65A, MOP	ENGINE GOVERNOR, SPEED CONTROL MOTOR OPERATED POTENTIOMETER
65A, RL	ENGINE GOVERNOR, SPEED CONTROL RAISE/LOWER SWITCH
65B	ENGINE GOVERNOR, LOAD CONTROL
65B, MOP	ENGINE GOVERNOR, LOAD CONTROL MOTOR OPERATED POTENTIOMETER
65B, RL	ENGINE GOVERNOR, % LOAD RAISE/LOWER SWITCH
65E	AUTOMATIC POWER TRANSFER AND LOAD CONTROL, WOODWARD APTL
65F	AUTOMATIC GENERATOR LOADING CONTROL, WOODWARD AGLC
67	DIRECTIONAL TIME OVERCURRENT RELAY
74	ALARM RELAY
81O/U	FREQUENCY RELAY, OVER/UNDER
86	LOCKOUT RELAY
87	DIFFERENTIAL PROTECTIVE RELAY
90	VOLTAGE REGULATOR
90, MOP	ENGINE EXCITATION, POWER OPERATED POTENTIOMETER
90PF	ENGINE EXCITATION, POWER FACTOR CONTROL
90RL	ENGINE EXCITATION, RAISE/ LOWER SWITCH

X = DEVICE NUMBER, WHEN THERE ARE MULTIPLE UNITS

CIRCUIT AND RACEWAY

GENERAL CIRCUIT CONDUCTOR AND CONDUIT IDENTIFICATION

POWER CIRCUIT CALLOUTS

[P1]	[1/2"FLEX, 2#12,#12G]	[P24]	[1"C,3#8,3#14,1#10G]
[P2]	[3/4"C,2#12,1#12G]	[P25]	[1"C,3#8,4#14,1#10G]
[P3]	[3/4"C,3#12,1#12G]	[P26]	[1"C,3#8,5#14,1#10G]
[P4]	[3/4"C,4#12,1#12G]	[P27]	[1"C,2#6, 1#10G]
[P5]	[3/4"C,5#12,1#12G]	[P28]	[1"C,3#6, 1#8G]
[P6]	[3/4"C,6#12,1#12G]	[P29]	[1"C,3#6, 2#14,1#8G]
[P7]	[3/4"C,7#12,1#12G]	[P30]	[1"C,3#6, 3#14,1#8G]
[P8]	[3/4"C,8#12,1#12G]	[P31]	[1"C,3#6, 4#14,1#8G]
[P9]	[3/4"C,3#12,2#14,1#12G]	[P32]	[1"C,3#6, 5#14,1#8G]
[P10]	[3/4"C,3#12,3#14,1#12G]	[P33]	[1"C,3#4,1#8G]
[P11]	[3/4"C,3#12,4#14,1#12G]	[P34]	[1 1/4"C,3#4,3#14,1#8G]
[P12]	[3/4"C,3#12,5#14,1#12G]	[P35]	[1 1/4"C,3#4,5#14,1#8G]
[P13]	[3/4"C,3#12,6#14,1#12G]	[P36]	[1 1/4"C,3#3, 1#6G]
[P14]	[3/4"C,3#12,7#14,1#12G]	[P37]	[1 1/4"C,3#3, 3#14,1#6G]
[P15]	[3/4"C,2#10,1#10G]	[P38]	[1 1/4"C,3#2, 1#6G]
[P16]	[3/4"C,3#10,1#10G]	[P39]	[1 1/4"C,3#1, 1#6G]
[P17]	[3/4"C,3#10,2#14,1#10G]	[P40]	[1 1/2"C,3#1, 3#14,1#6G]
[P18]	[3/4"C,3#10,3#14,1#10G]	[P41]	[1 1/2"C,3#2/0, 1#4G]
[P19]	[3/4"C,3#10,4#14,1#10G]	[P42]	[2"C,3#3/0, 1#4G]
[P20]	[3/4"C,3#10,5#14,1#10G]	[P43]	[2"C,3#4/0, 1#3G]
[P21]	[1"C,2#8,1#10G]		
[P22]	[1"C,3#8,1#10G]		
[P23]	[1"C,3#8,2#14,1#10G]		

MULTICONDUCTOR POWER CABLE CIRCUIT CALLOUTS

[PC1]	[3/4"C,1 (3C#12,1#12G) TYPE 2]
[PC2]	[3/4"C,1 (3C#10,1#10G) TYPE 2]
[PC3]	[1"C,1 (3C#8,1#10G) TYPE 2]
[PC4]	[1 1/4"C,2 (3C#12,1#12G) TYPE 2]
[PC5]	[1 1/2"C,2 (3C#10,1#10G) TYPE 2]
[PC1A]	[3/4"C,1 (2C#12,1#12G) TYPE 2]
[PC2A]	[3/4"C,1 (2C#10,1#10G) TYPE 2]

EMPTY CONDUIT

[EC-1]	[3/4"C,WITH PULL STRING]
[EC-2]	[1"C,WITH PULL STRING]
[EC-3]	[1 1/4"C,WITH PULL STRING]
[EC-4]	[1 1/2"C,WITH PULL STRING]
[EC-5]	[2"C,WITH PULL STRING]
[EC-6]	[3"C,WITH PULL STRING]
[EC-7]	[4"C,WITH PULL STRING]
[EC-8]	[5"C,WITH PULL STRING]

ANALOG CIRCUIT CALLOUTS

[A1]	[3/4"C,1 TYPE 3]
[A2]	[1"C,2 TYPE 3]
[A3]	[1"C,3 TYPE 3]
[A4]	[1"C,4 TYPE 3]
[A5]	[1 1/4"C,5 TYPE 3]
[A6]	[1 1/4"C,6 TYPE 3]
[A7]	[1 1/2"C,7 TYPE 3]
[A8]	[1 1/2"C,8 TYPE 3]
[A9]	[1 1/2"C,9 TYPE 3]
[A10]	[2"C,10 TYPE 3]
[A11]	[2"C,11 TYPE 3]
[A12]	[2"C,12 TYPE 3]
[A13]	[2"C,13 TYPE 3]
[A14]	[2"C,14 TYPE 3]
[A15]	[3/4"C,1 TYPE 4]
[A16]	[3/4"C,2 TYPE 4]
[A17]	[1"C,3 TYPE 4]
[A18]	[1 1/4"C,4 TYPE 4]
[A19]	[1 1/4"C,5 TYPE 4]
[A20]	[1 1/4"C,6 TYPE 4]
[A21]	[1 1/2"C,7 TYPE 4]
[A22]	[1 1/2"C,8 TYPE 4]
[A23]	[2"C,9 TYPE 4]
[A24]	[3/4"C,1-4 pr. TYPE 5]
[A25]	[1"C,2-4 pr. TYPE 5]

CONTROL CIRCUIT CALLOUTS

[C1]	[3/4"C,MSC]
[C2]	[3/4"C,2#14,1#14G]
[C3]	[3/4"C,3#14,1#14G]
[C4]	[3/4"C,4#14,1#14G]
[C5]	[3/4"C,5#14,1#14G]
[C6]	[3/4"C,6#14,1#14G]
[C7]	[3/4"C,7#14,1#14G]
[C8]	[3/4"C,8#14,1#14G]
[C9]	[3/4"C,9#14,1#14G]
[C10]	[3/4"C,10#14,1#14G]
[C11]	[3/4"C,11#14,1#14G]
[C12]	[3/4"C,12#14,1#14G]
[C13]	[3/4"C,13#14,1#14G]
[C14]	[3/4"C,14#14,1#14G]
[C15]	[3/4"C,15#14,1#14G]
[C16]	[3/4"C,16#14,1#14G]
[C17]	[3/4"C,17#14,1#14G]
[C18]	[3/4"C,18#14,1#14G]
[C19]	[3/4"C,19#14,1#14G]
[C20]	[1"C,20#14,1#14G]
[C21]	[1"C,21#14,1#14G]
[C22]	[1"C,22#14,1#14G]
[C23]	[1"C,23#14,1#14G]
[C24]	[1"C,24#14,1#14G]
[C25]	[1"C,25#14,1#14G]

MULTICONDUCTOR CONTROL CABLE CIRCUIT CALLOUTS

[CC5]	[3/4"C,1-5C TYPE 1]
[CC7]	[3/4"C,1-7C TYPE 1]
[CC9]	[1"C,1-9C TYPE 1]
[CC12]	[1"C,1-12C TYPE 1]
[CC19]	[1 1/2"C, 1-19C TYPE 1]
[CC25]	[1 1/2"C,1-25C TYPE 1]
[CC37]	[2"C,1-37C TYPE 1]
[CCC1]	[1-7C #12 TYPE 1]

NOTES:
1. FOR CABLE TYPES, SEE SPECIFICATIONS.
2. CONDUIT SIZES ARE BASE ON THE AREA OF THW CONDUCTORS.
3. SIZING OF CONDUCTORS #1AWG AND SMALLER BASED ON AMPACITIES AT 60 DEGREES C, SIZING OF CONDUCTORS #1/0AWG AND LARGER BASED ON AMPACITIES AT 75 DEGREES C.
4. WHERE CIRCUITS ARE UNDERGROUND, DIRECT BURIED OR CONCRETE ENCASED, MINIMUM CONDUIT SIZE SHALL BE 1".
5. FOR METRIC CONDUIT SIZES USE THE FOLLOWING CONVERSION:
   1/2" = 16 mm 1/4" = 35 mm
   3/4" = 21 mm 1 1/2" = 41 mm
   1" = 27 mm 2" = 53 mm

NO.	DATE	DSGN	DR	CHK	APVD	BY	REVISION
		R. WOOD	M. REICHERT	QC Review	APVD	Sealer	

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

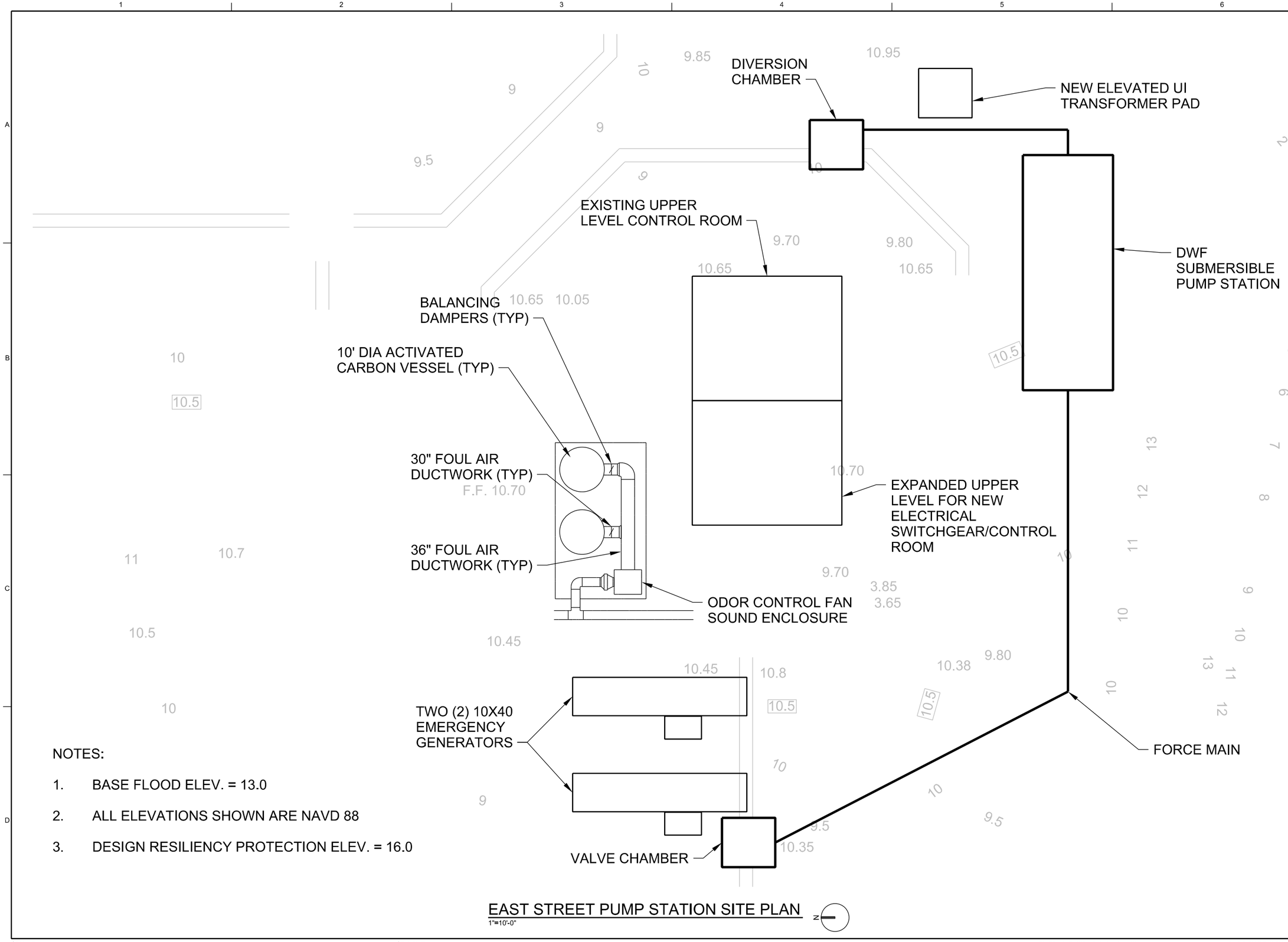
GENERAL

ELECTRICAL LEGEND 3

10% SUBMITTAL - NOT FOR CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	100-G-017
SHEET	of



NOTES:

1. BASE FLOOD ELEV. = 13.0
2. ALL ELEVATIONS SHOWN ARE NAVD 88
3. DESIGN RESILIENCY PROTECTION ELEV. = 16.0

EAST STREET PUMP STATION SITE PLAN

1"=10'-0"

N

NO.	DATE	REVISION	DR	CHK	BY	APVD
DSGN	R. SIEBERS		T. DUFFNEY			

PRELIMINARY – NOT FOR CONSTRUCTION

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

CIVIL

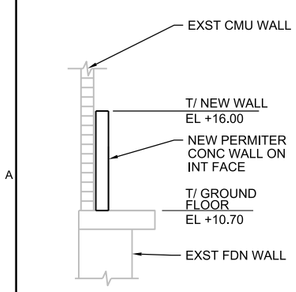
EAST STREET PUMP STATION SITE PLAN

1"=10'

VERIFY SCALE

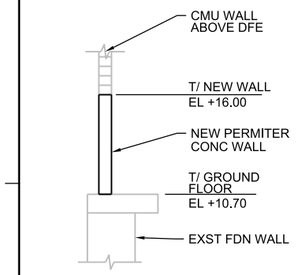
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-C-201
SHEET	of



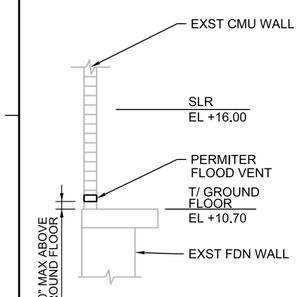
DRY FLOOD PROOFING PERMITER WALL

1 DETAIL
NTS



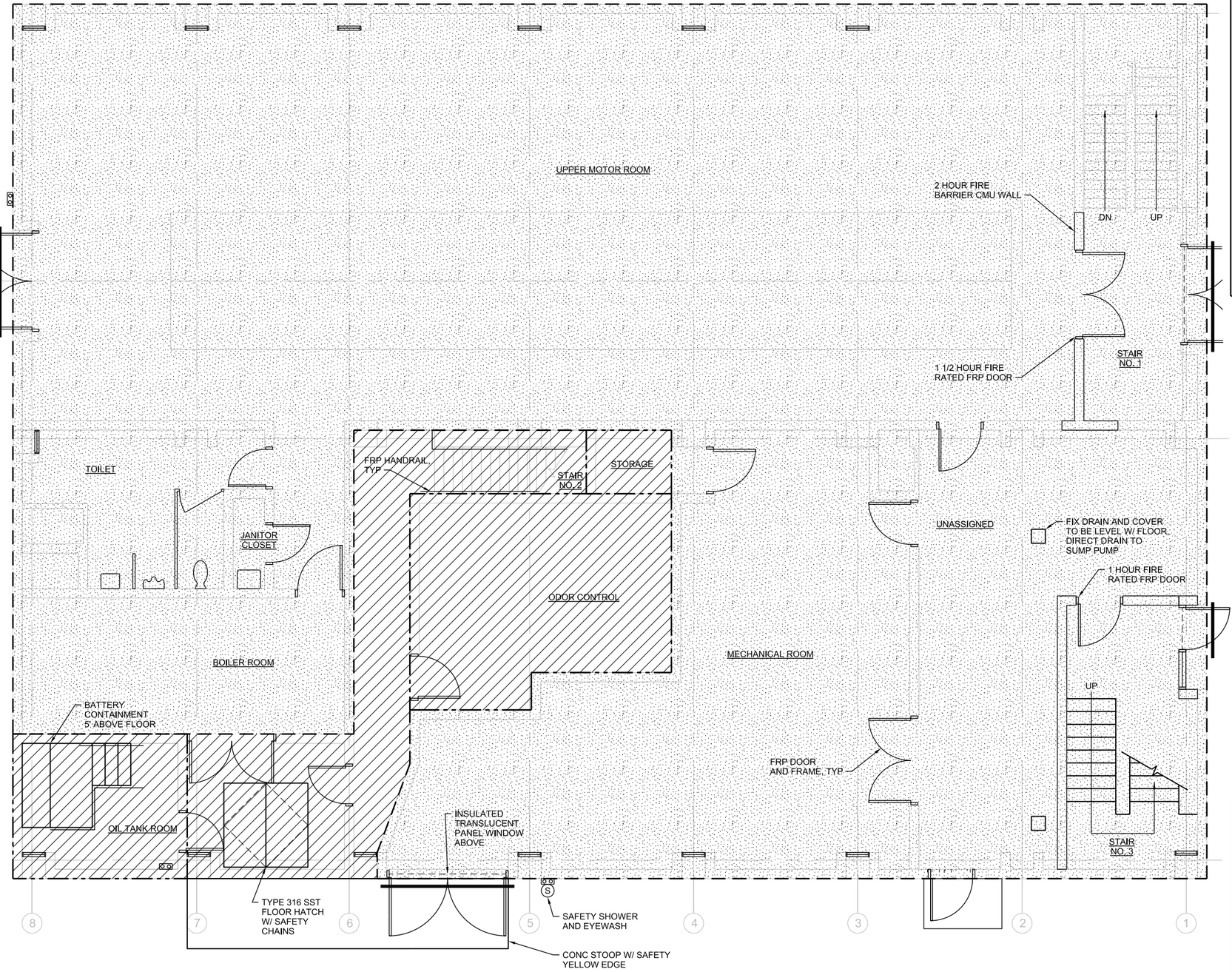
DRY FLOOD PROOFING INTERIOR WALL

1a DETAIL
NTS



WET FLOOD PROOFING PERMITER WALL

2 DETAIL
NTS



GROUND FLOOR PLAN

1/4"=1'-0"

N

FLOOD PROOFING NOTES

1. BASE FLOOD EL (BFE) = 13.00
2. DESIGN FLOOD EL (DFE) = 14.00
3. PROJECTED SEA LEVEL RISE EL (SLR) = 16.00
4. THE GROUND FLOOR EL = 10.70
5. AREAS IDENTIFIED FOR WET FLOOD PROOFING SHALL CONFORM WITH THE FOLLOWING:
   a. AREA OF FLOOD RELIEF OPENINGS (Ao) = 2.5 in^2/1.0 ft^2
6. AREAS IDENTIFIED FOR DRY FLOOD PROOFING SHALL CONFORM WITH THE FOLLOWING:
   a. FLOOD PROOFING PLAN SHALL BE APPROVED BY "AHJ".
   b. A BUILDING CODE COMPLIANT EXIT DOOR FROM EACH ISOLATED ROOM WITHIN THE DRY FLOOD PROOF AREA SHALL BE PROVIDED.
   c. ALL ELECTRICAL, LIFE SAFETY AND ESSENTIAL EQUIPMENT SHALL BE LOCATED ABOVE THE DFE.

LEGEND

- NEW PERMANENT CONCRETE WALL
- PERIMETER FLOOD BARRICADE
- REMOVABLE FLOOD BARRICADE
- DRY FLOOD PROOF AREA WITH FLOOD BARRICADES
- WET FLOOD PROOF AREA WITH FLOOD VENTS

NO.	DATE	REVISION	DR	CHK	APVD
DSGN	J. OSOKIE		M. DEL DUCA		BY APVD

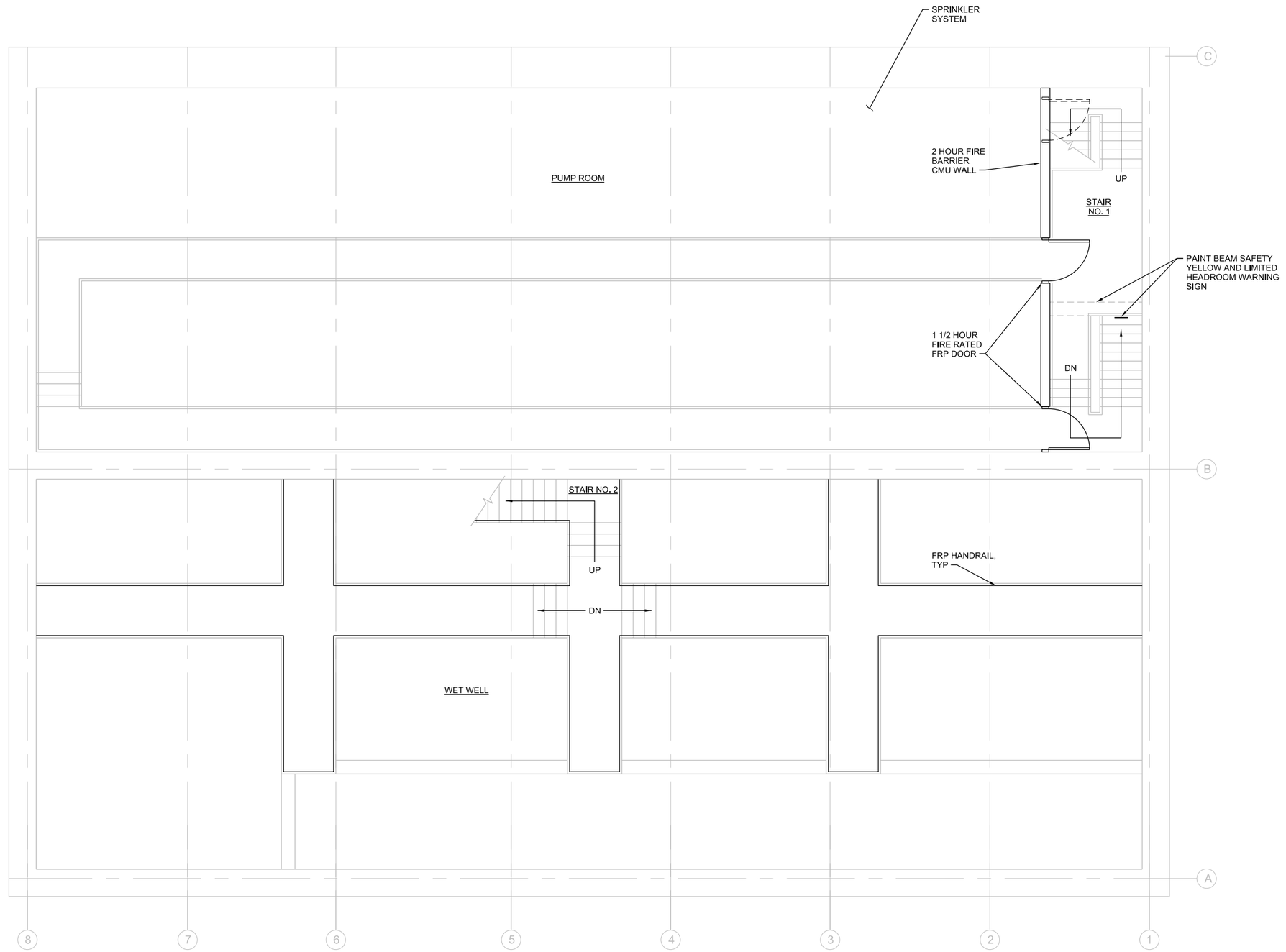
GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

FLOOD RESISTANT DESIGN

EAST STREET PUMP STATION OPERATIONS BUILDING - GROUND FLOOR PROOFING 65 MGD CAPACITY

PRELIMINARY – NOT FOR CONSTRUCTION

	1/4"=1'-0"
	VERIFY SCALE
	BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"
DATE	NOVEMBER 2016
PROJ	664626
DWG	200-C-201
SHEET	of



SUBLEVEL PLAN

1/4"=1'-0"

N

NO.	DATE	REVISION	DR	CHK	APVD	BY	APVD
DSGN	R. SIEBERS		D. MICHALEK				

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

ch2m

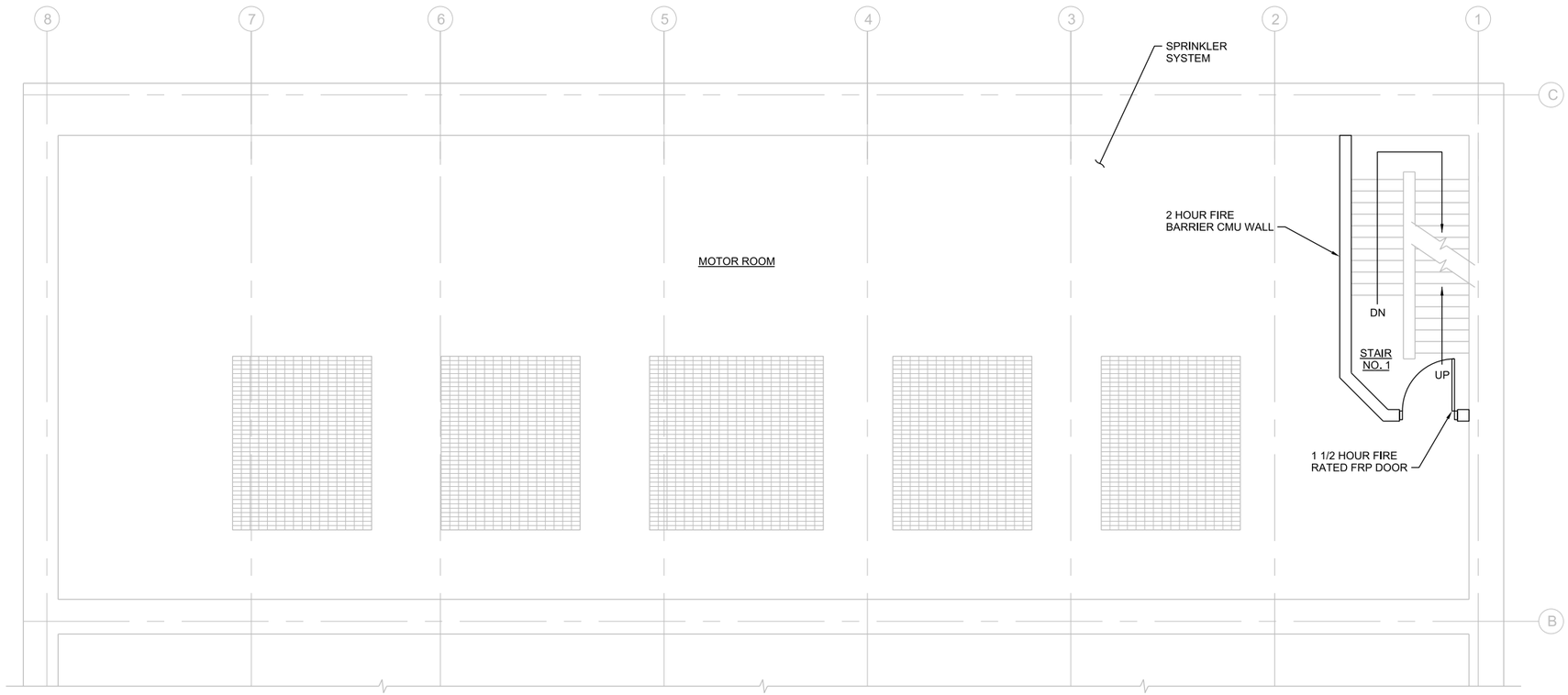
ARCHITECTURAL

EAST STREET PUMP STATION
OPERATIONS BUILDING
SUBLEVEL PLAN 65 MGD CAPACITY

PRELIMINARY – NOT FOR CONSTRUCTION

1/4"=1'-0"
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-A-201
SHEET	of



LOWER LEVEL PLAN

1/4"=1'-0"

N

NO.	DATE	DR	REVISION	CHK	APVD	BY	APVD
DSGN	R. SIEBERS	D. MICHALEK					

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

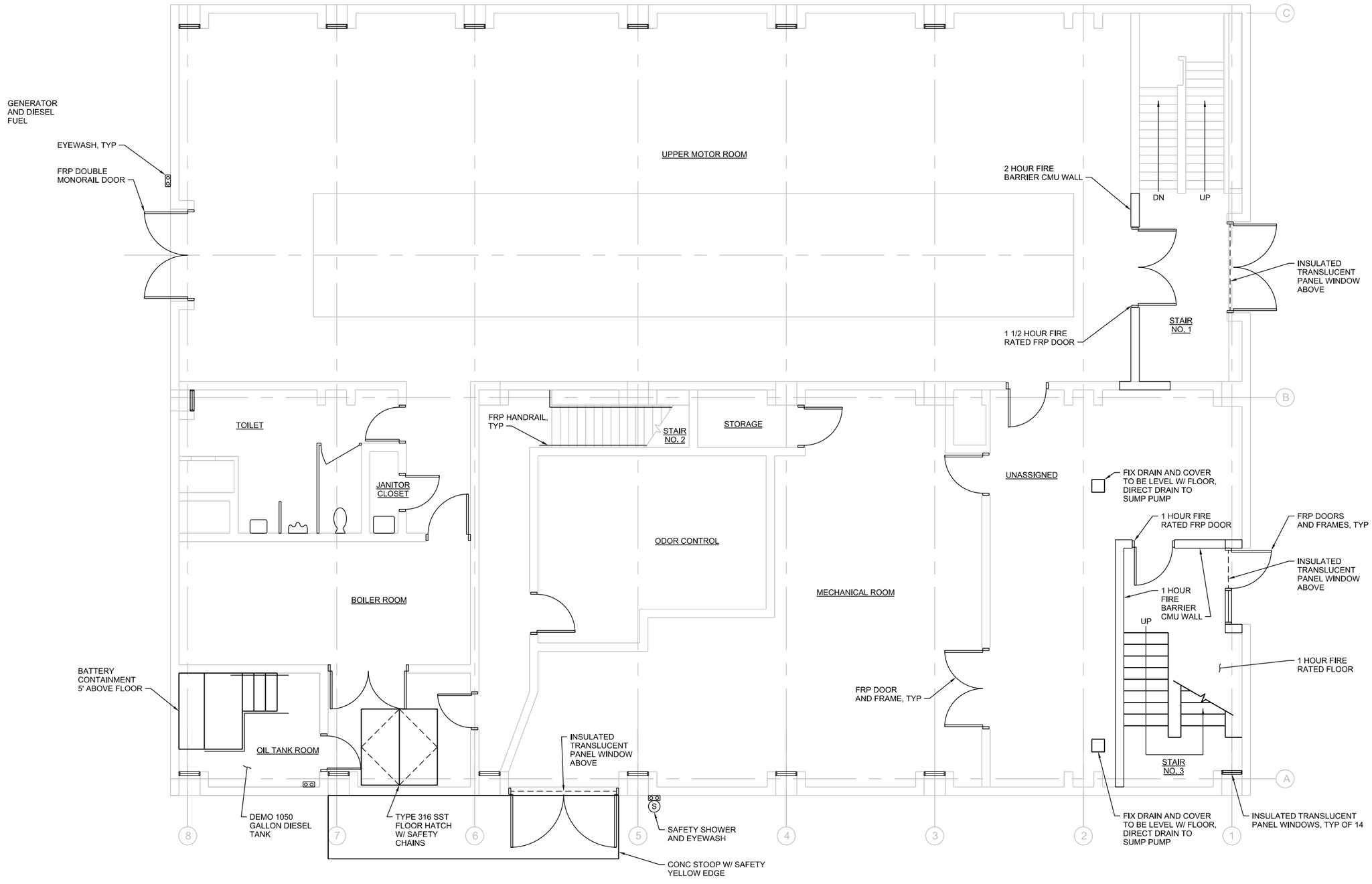
ch2m

ARCHITECTURAL

EAST STREET PUMP STATION
OPERATIONS BUILDING
LOWER LEVEL PLAN 65 MGD CAPACITY

PRELIMINARY – NOT FOR CONSTRUCTION

	1/4"=1'-0"
	VERIFY SCALE
	BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"
DATE	NOVEMBER 2016
PROJ	664626
DWG	200-A-202
SHEET	of



GROUND FLOOR PLAN

1/4"=1'-0"

NO.	DSGN	DATE	REVISION	CHK	APVD	BY
	R. SIEBERS		D. MICHALEK	DR	APVD	

PRELIMINARY – NOT FOR CONSTRUCTION

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

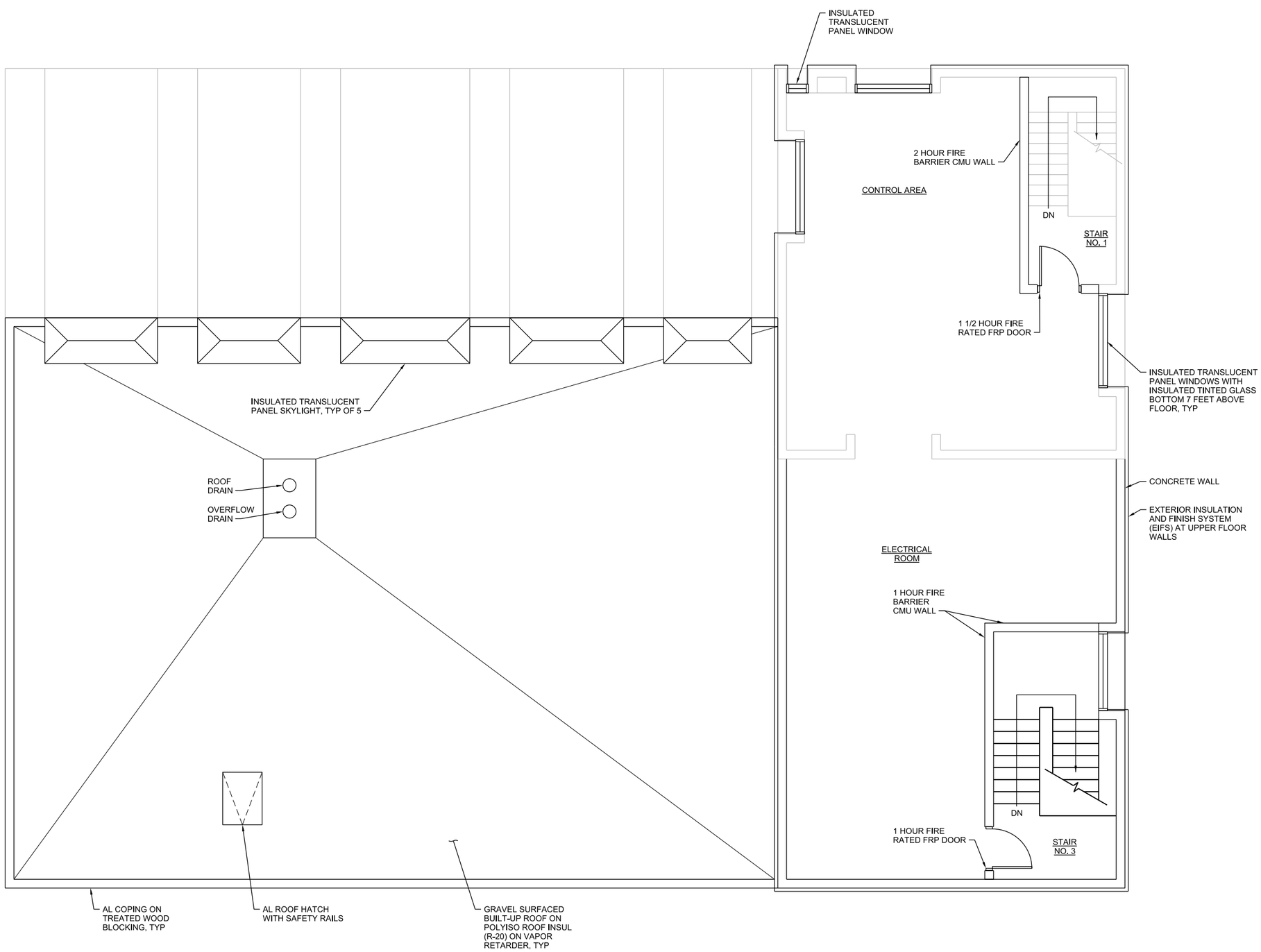
ch2m

ARCHITECTURAL

EAST STREET PUMP STATION
OPERATIONS BUILDING - GROUND FLOOR PLAN 65 MGD CAPACITY

1/4"=1'-0"
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-A-203
SHEET	of



UPPER FLOOR AND ROOF PLAN

1/4"=1'-0"

N

NO.	DSGN	DATE	REVISION	DR	CHK	APVD	BY	APVD
				R. SIEBERS	D. MICHALEK			

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

ch2m

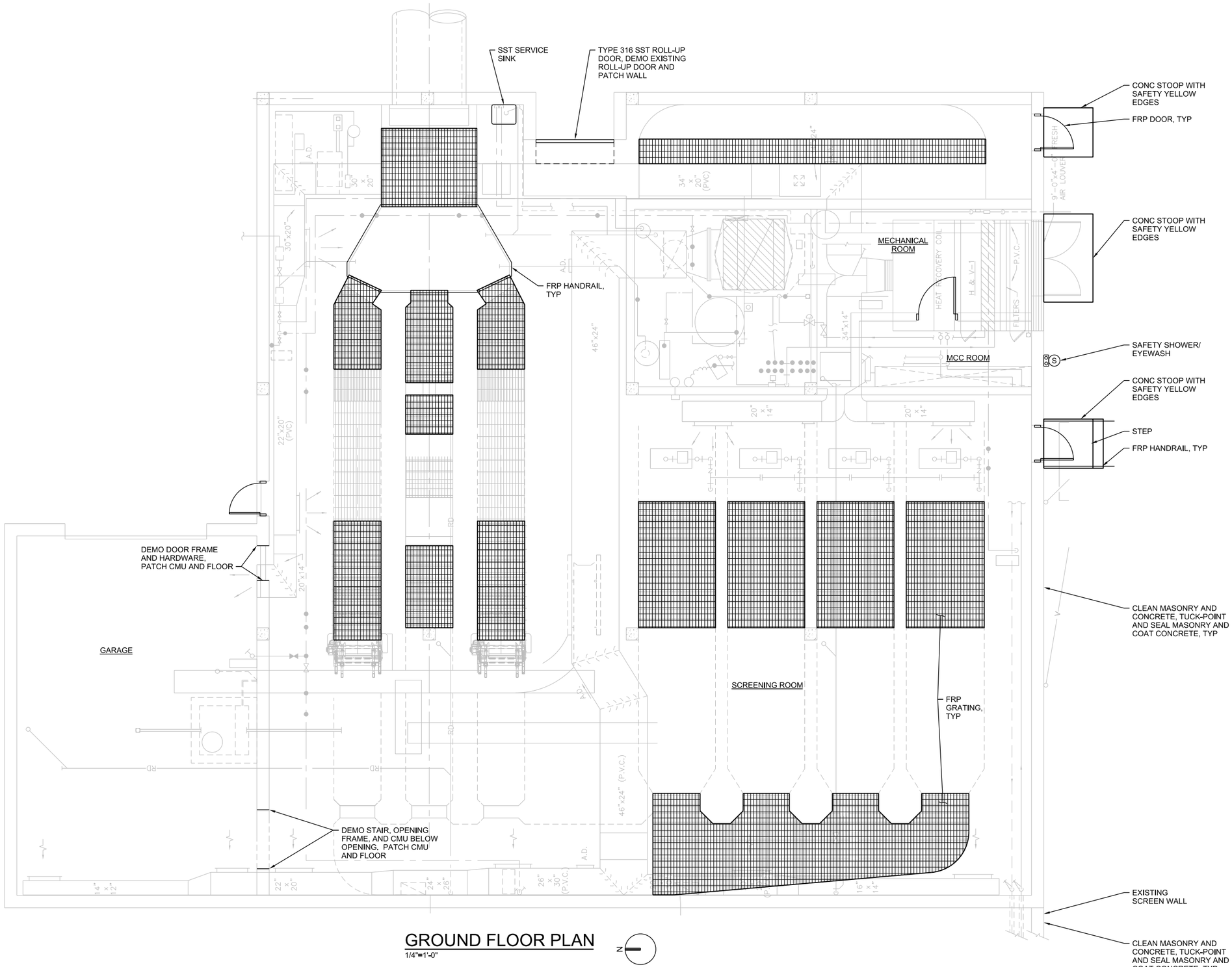
ARCHITECTURAL

EAST STREET PUMP STATION
OPERATIONS BUILDING - UPPER FLOOR AND ROOF PLAN 65 MGD CAPACITY

PRELIMINARY – NOT FOR CONSTRUCTION

1/4"=1'-0"
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-A-204
SHEET	of



GROUND FLOOR PLAN

1/4"=1'-0"

N

NO.	DATE	REVISION	DR	CHK	APVD	BY	APVD
DSGN	R. SIEBERS	D. MICHALEK					

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

ch2m

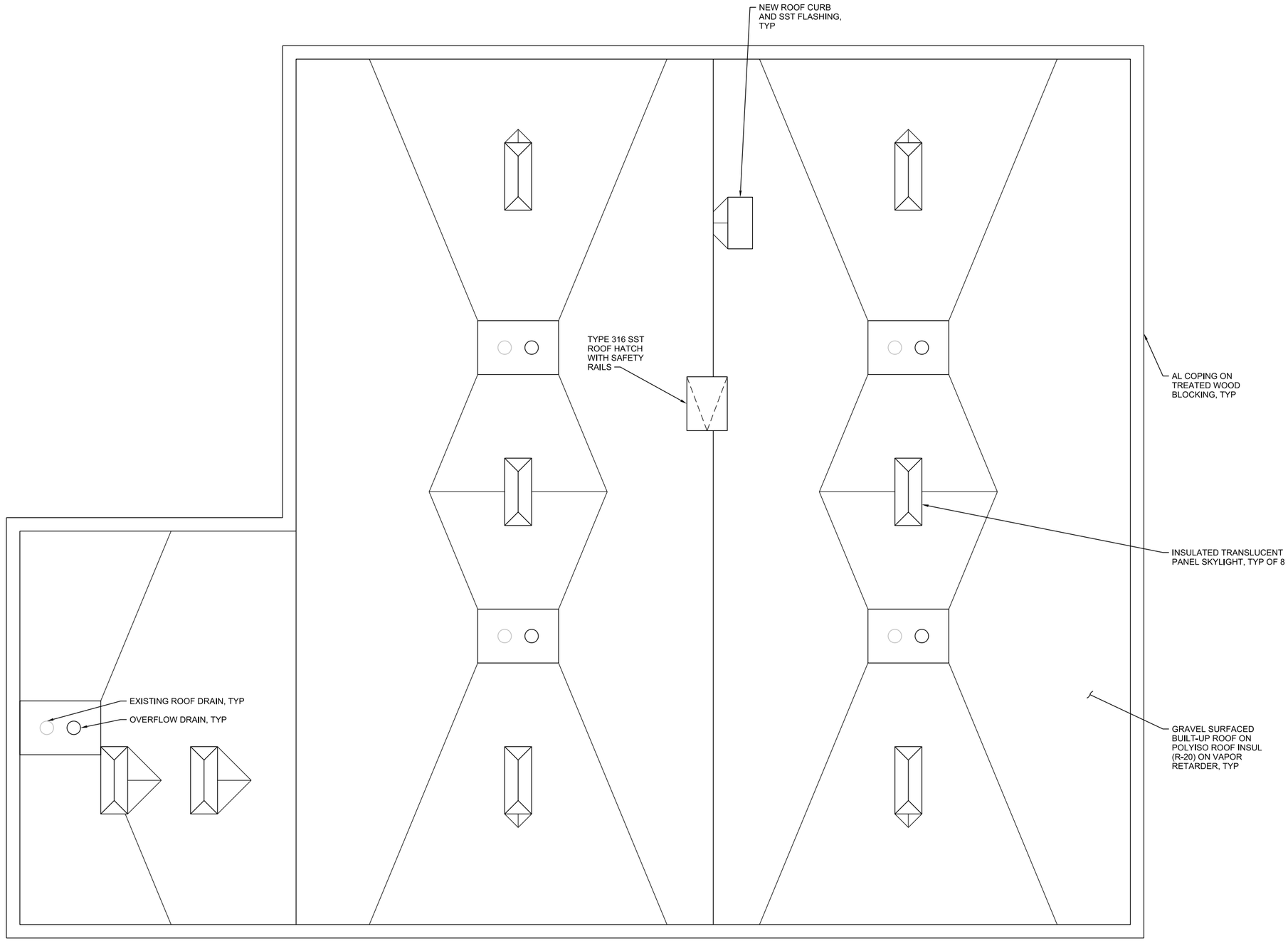
ARCHITECTURAL

EAST STREET PUMP STATION
INLET WORKS BUILDING - GROUND FLOOR PLAN 75 MGD CAPACITY

10% SUBMITTAL - NOT FOR CONSTRUCTION

1/4"=1'-0"
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-A-205
SHEET	of



ROOF PLAN
1/4"=1'-0"

N

NO.	DATE	DR	REVISION	CHK	APVD	BY	APVD
DSGN	R. SIEBERS	D. MICHALEK					

PRELIMINARY – NOT FOR CONSTRUCTION

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

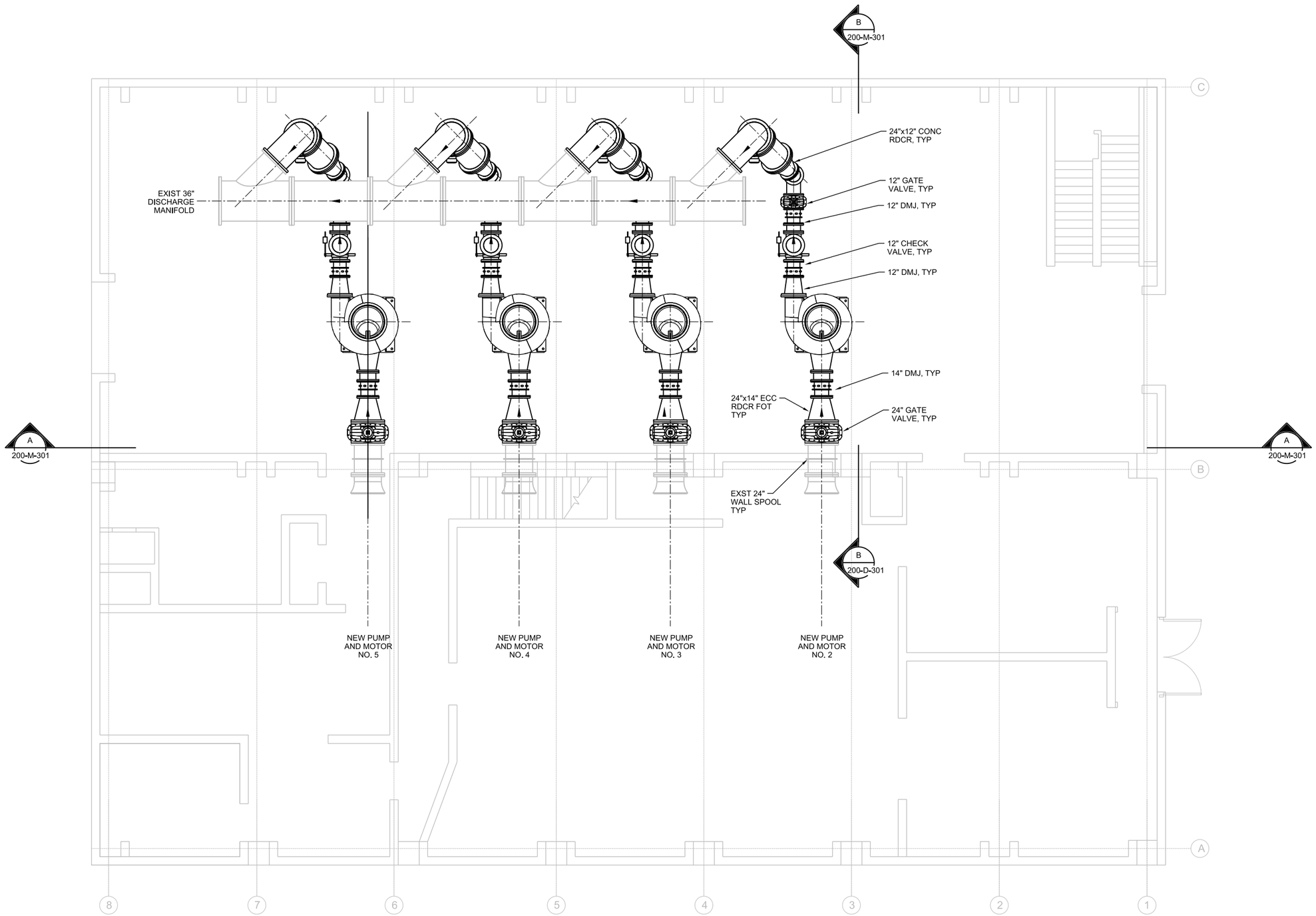
ch2m

ARCHITECTURAL

EAST STREET PUMP STATION
INLET WORKS BUILDING
ROOF PLAN 65 MGD CAPACITY

1/4"=1'-0"
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-A-206
SHEET	of



EAST STREET PUMP STA - OVERALL PLAN

1/4"=1'-0"

NO.	DATE	DSGN	DR	CHK	APVD	BY	REVISION
		S. CLARK	Z. BRYAN	APVD			

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

PROCESS MECHANICAL

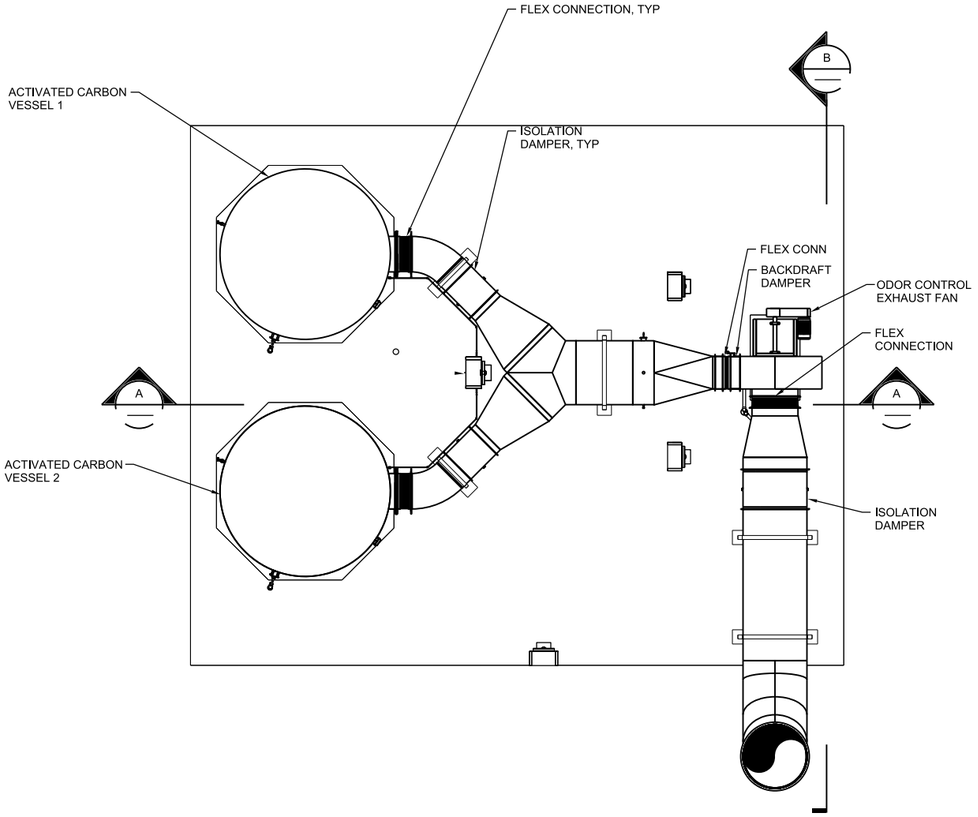
EAST STREET PUMP STATION
65 MGD CAPACITY
PLAN

PRELIMINARY – NOT FOR CONSTRUCTION

VERIFY SCALE

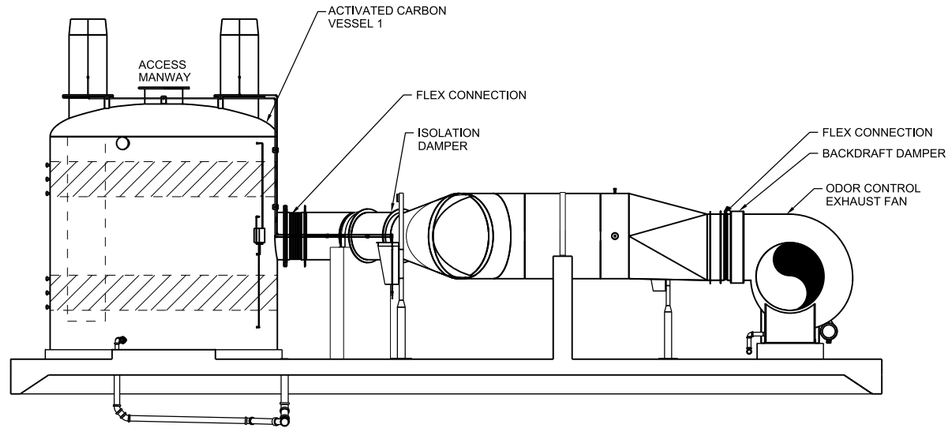
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-M-251
SHEET	of



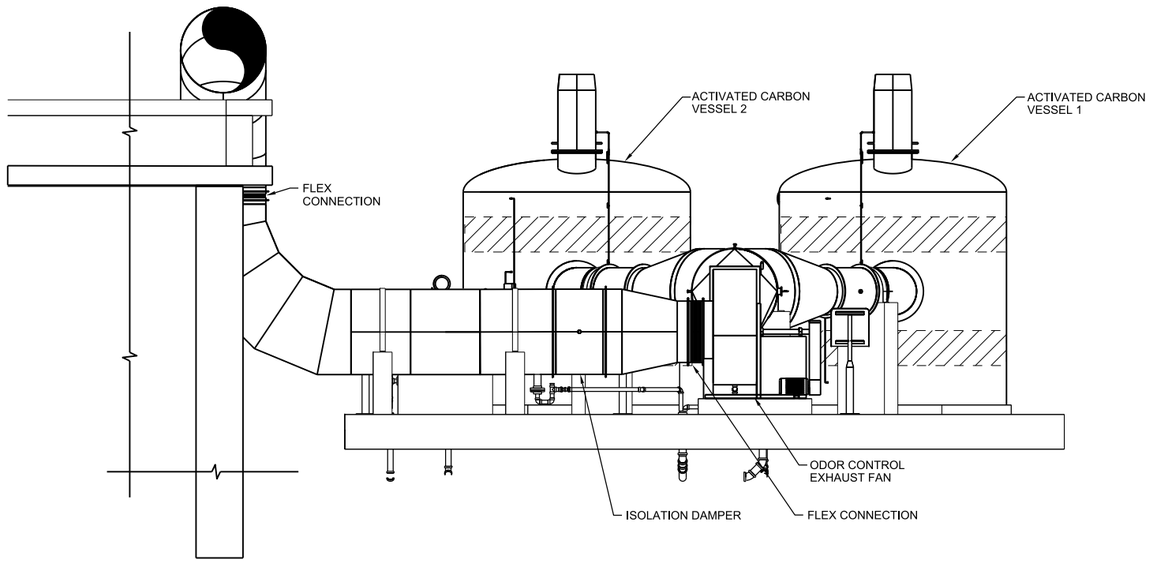
ODOR CONTROL - PLAN

3/16"=1'-0"



A SECTION

1/4"=1'-0"



B SECTION

1/4"=1'-0"

NO.	DSGN	DATE	DR	CHK	APVD	BY
REVISION			Z. BRYAN		APVD	

ch2m

PROCESS MECHANICAL

EAST STREET PUMP STATION
ODOR CONTROL
PLAN & SECTIONS

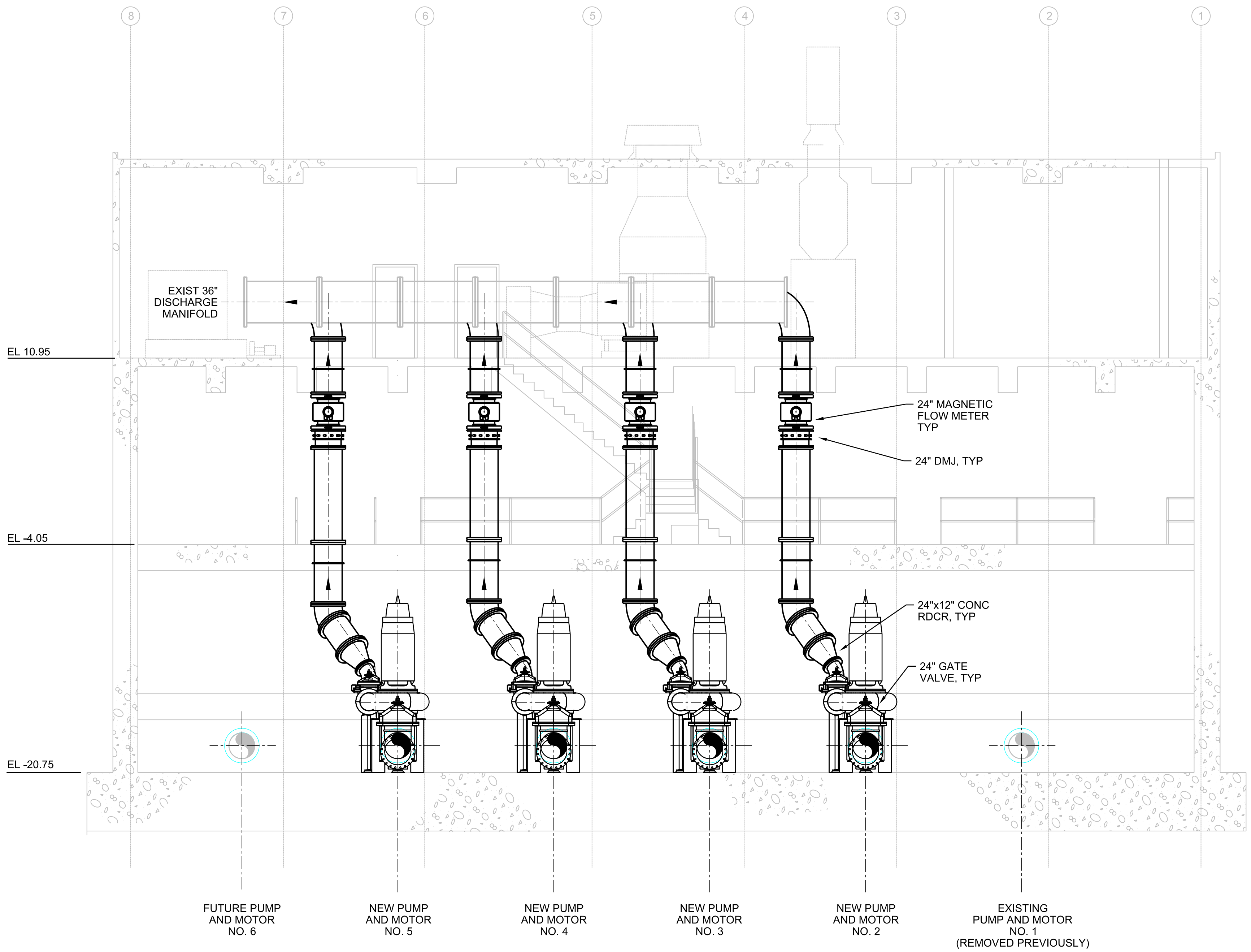
GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

PRELIMINARY – NOT FOR CONSTRUCTION

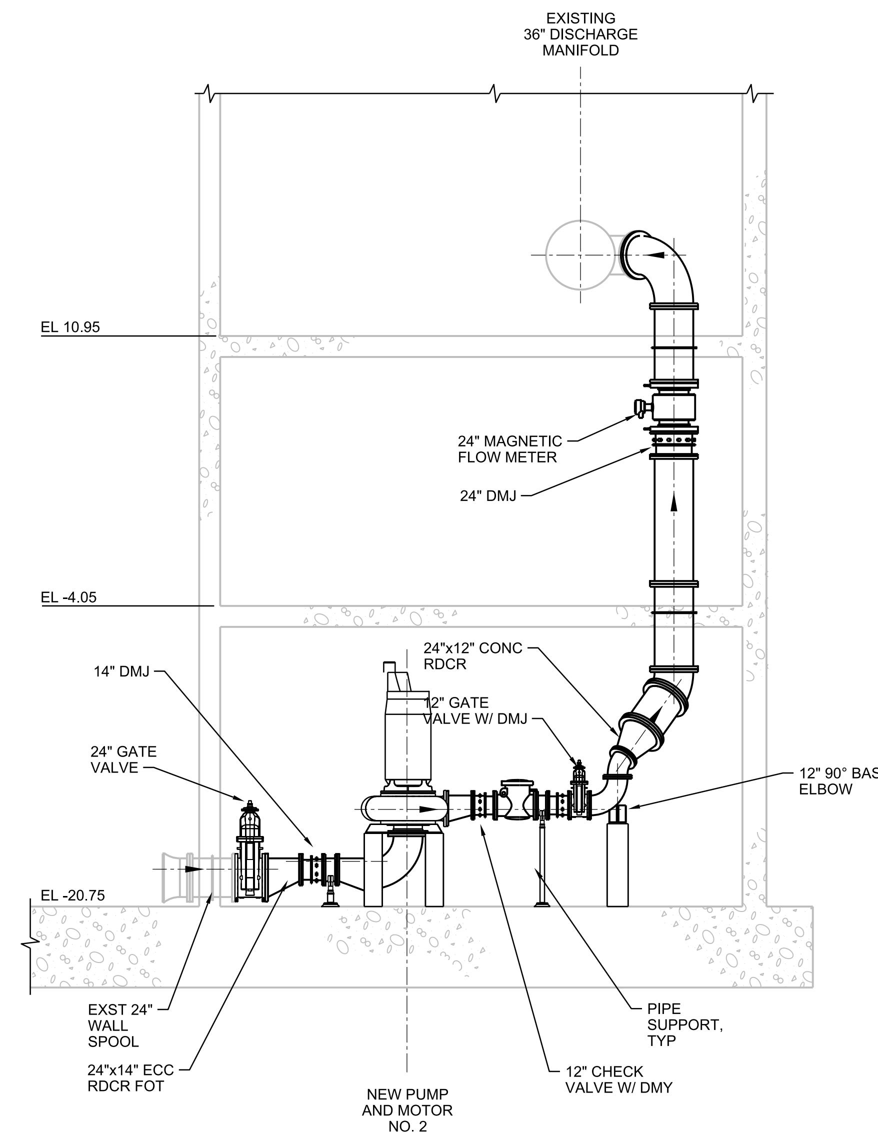
VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	AUGUST 2016
PROJ	664626
DWG	200-D-215
SHEET	of



A SECTION
3/16"=1'-0"
200-M-201



B SECTION
3/16"=1'-0"
200-M-201

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
S. CLARK	Z. BRYAN		

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

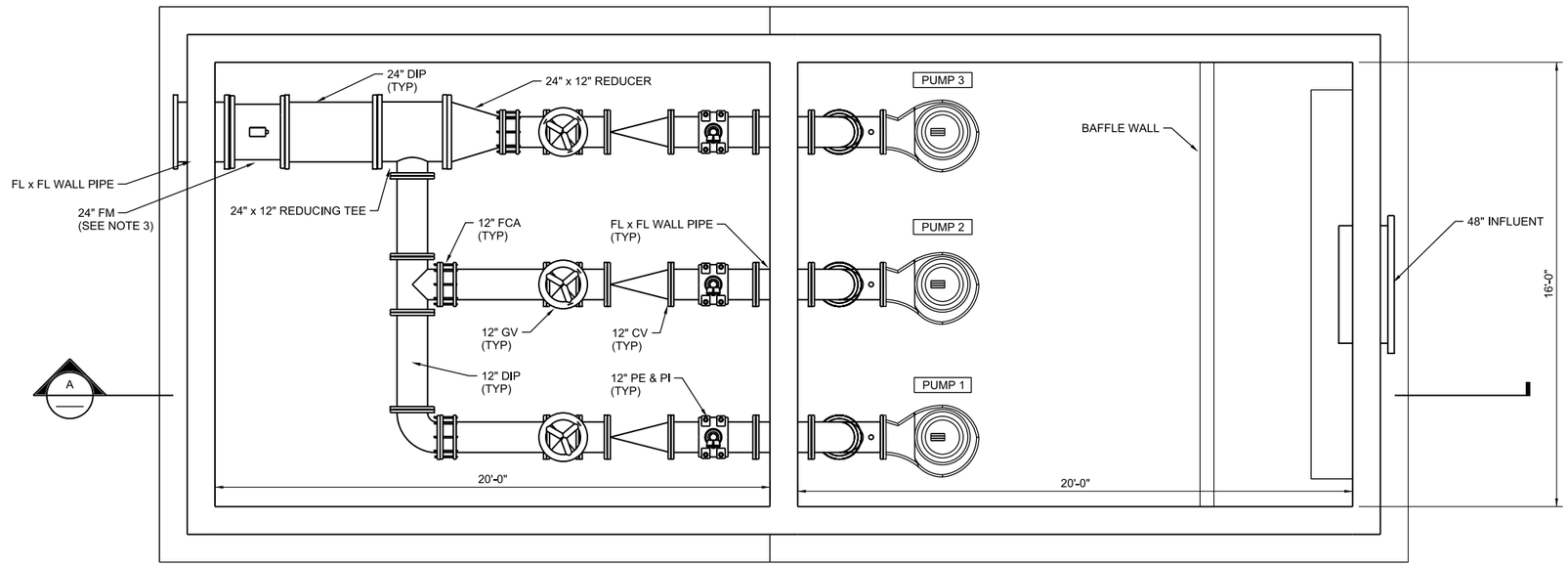
ch2m.

PROCESS MECHANICAL
EAST STREET PUMP STATION 65 MGD CAPACITY SECTIONS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

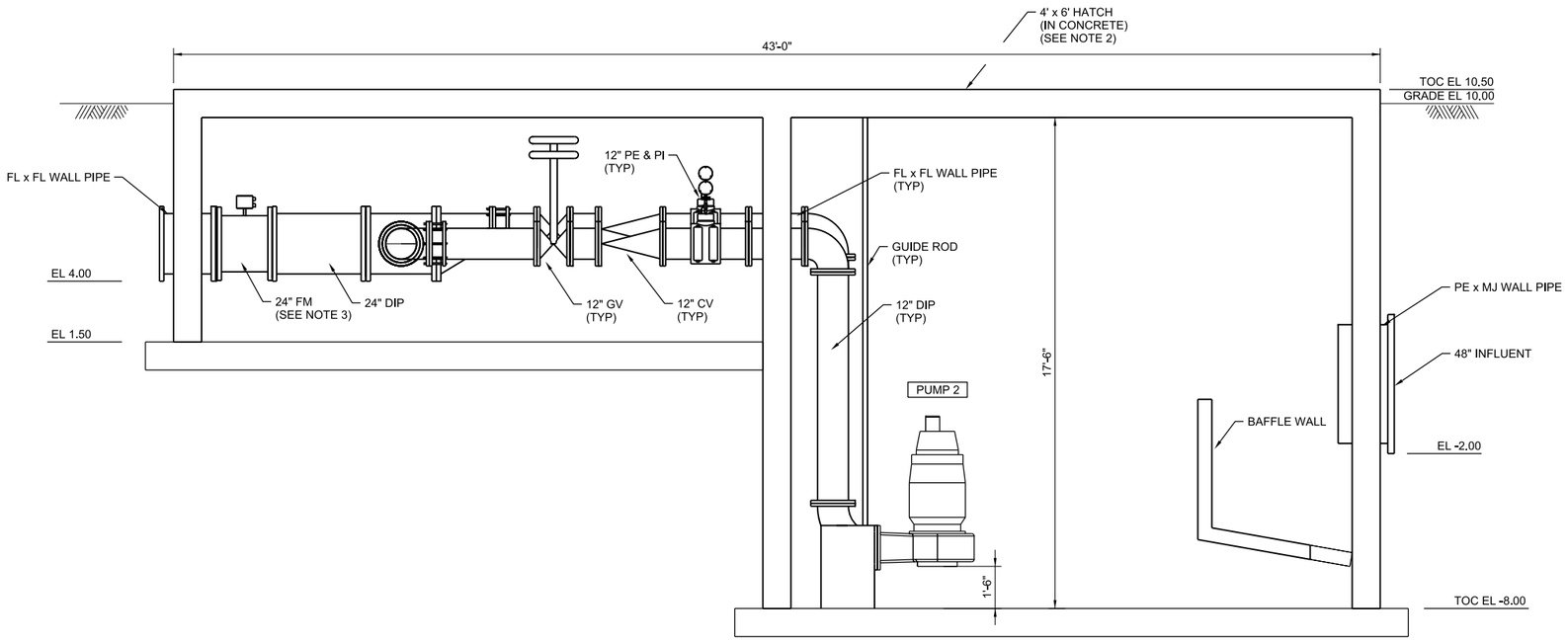
DATE	NOVEMBER 2016
PROJ	664626
DWG	200-M-351
SHEET	of

PRELIMINARY – NOT FOR CONSTRUCTION



DRY WEATHER PUMP STATION

3/8"=1'-0"



A SECTION

3/8"=1'-0"

GENERAL NOTES

1. PROVIDE A CHAIN ON PUMPS FOR REMOVAL IF NEEDED.
2. PROVIDE A 4' x 6' HATCH PER EACH PUMP FOR ACCESS. CENTER ACCESS HATCH OVER PUMPS.
3. PROVIDE A BURIED GATE VALVE DOWN STREAM OF FLOW METER.

NO.	DATE	DSGN	DR	CHK	APVD
		Engineer	ZBRYAN	OC	APVD

REVISION BY APVD

Seal

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

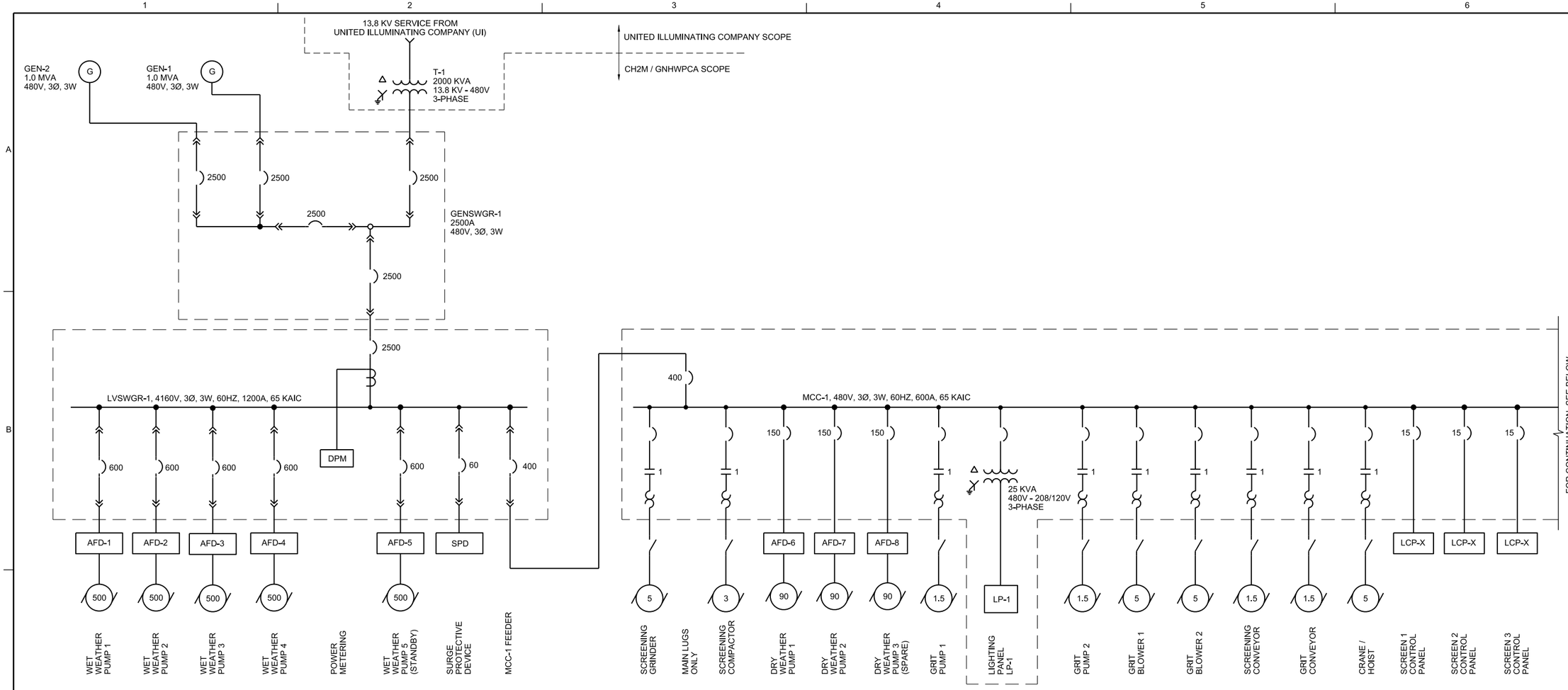
PROCESS MECHANICAL
EAST STREET
DRY WEATHER PUMP STATION
PLAN & SECTION

PRELIMINARY – NOT FOR CONSTRUCTION

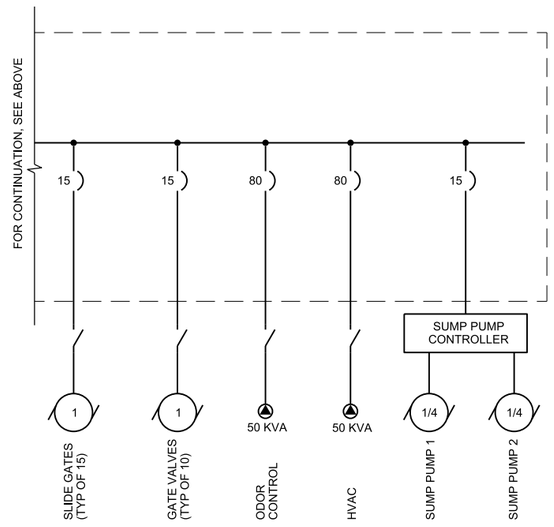
VERIFY SCALE

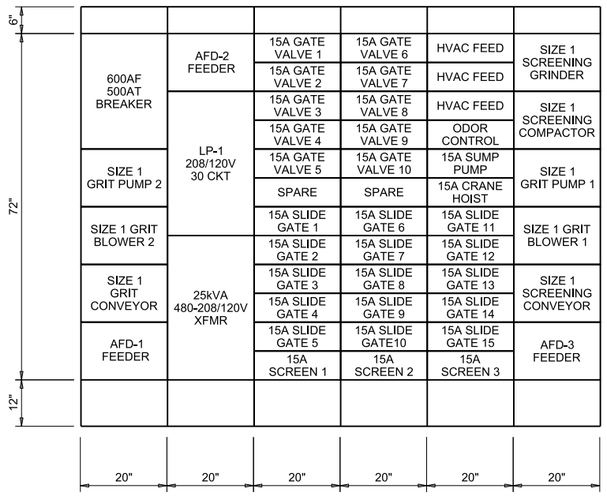
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	210-M-201
SHEET	of

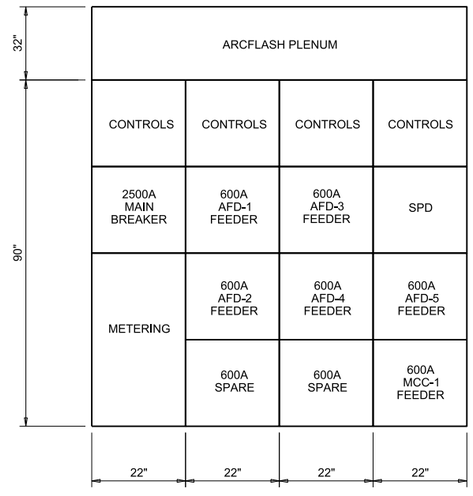


SINGLE LINE DIAGRAM
NTS





MCC-1 ELEVATION
NTS



LVSWGR-1 ELEVATION
NTS

REVISION	
NO.	
DATE	
BY	
DSGN	R. WOOD
DR	M. REICHERT
CHK	APVD
APVD	

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

ELECTRICAL

EAST STREET PUMP STATION
SINGLE LINE DIAGRAM, MCC-1 AND MVSWGR-1 ELEVATIONS (65 MGD)

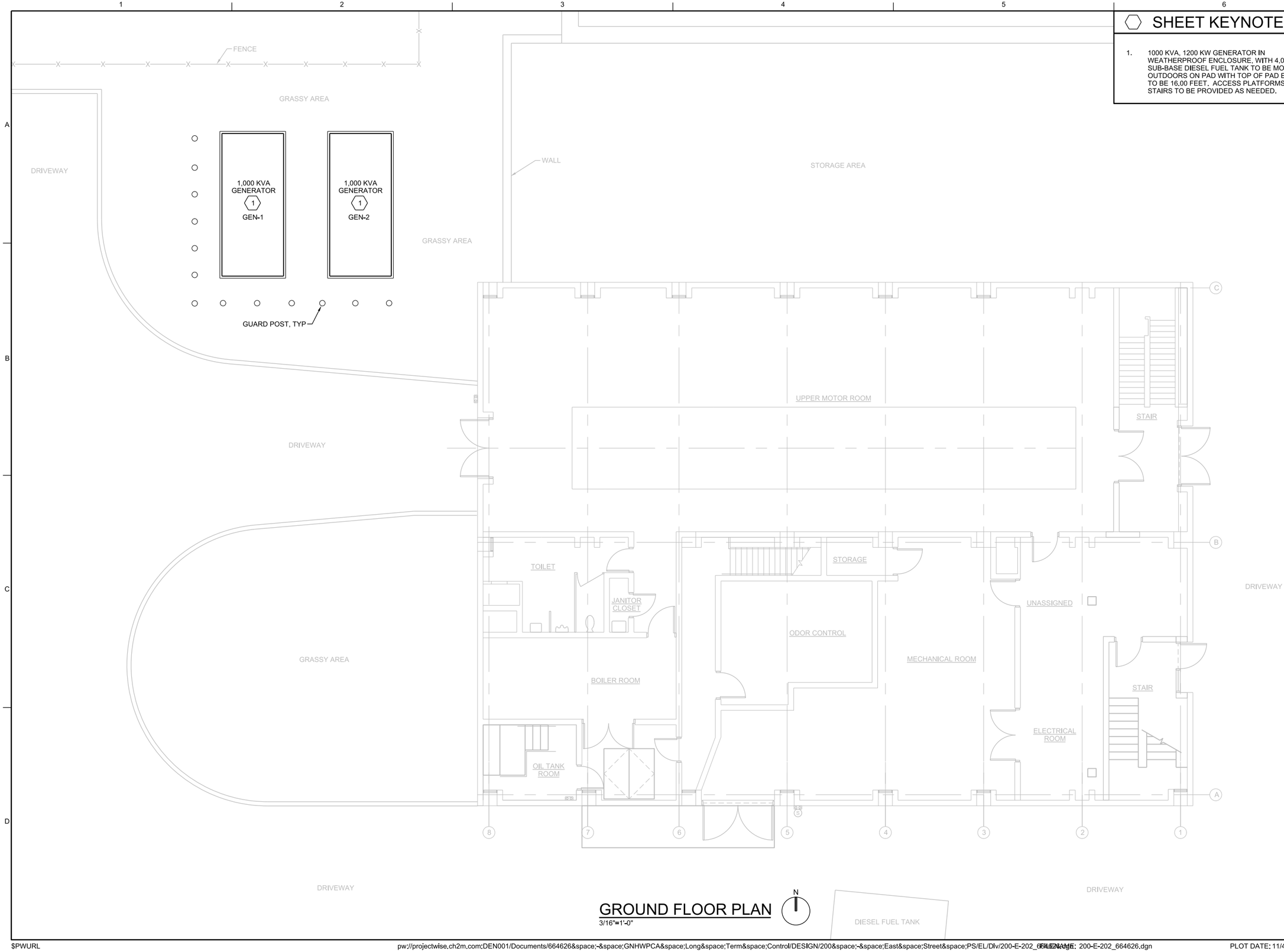
PRELIMINARY – NOT FOR CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT 1" ADJUST SCALE ACCORDINGLY

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-E-201
SHEET	of

SHEET KEYNOTE

1. 1000 KVA, 1200 KW GENERATOR IN WEATHERPROOF ENCLOSURE, WITH 4,000 GALLON SUB-BASE DIESEL FUEL TANK TO BE MOUNTED OUTDOORS ON PAD WITH TOP OF PAD ELEVATION TO BE 16.00 FEET. ACCESS PLATFORMS AND STAIRS TO BE PROVIDED AS NEEDED.



GROUND FLOOR PLAN

3/16"=1'-0"

N

NO.	DSGN	DATE	REVISION	DR	CHK	BY	APVD
	R. WOOD			M. REICHERT			APVD

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

ELECTRICAL

EAST STREET PUMP STATION OPERATIONS BUILDING - GROUND FLOOR PLAN 65 MGD CAPACITY

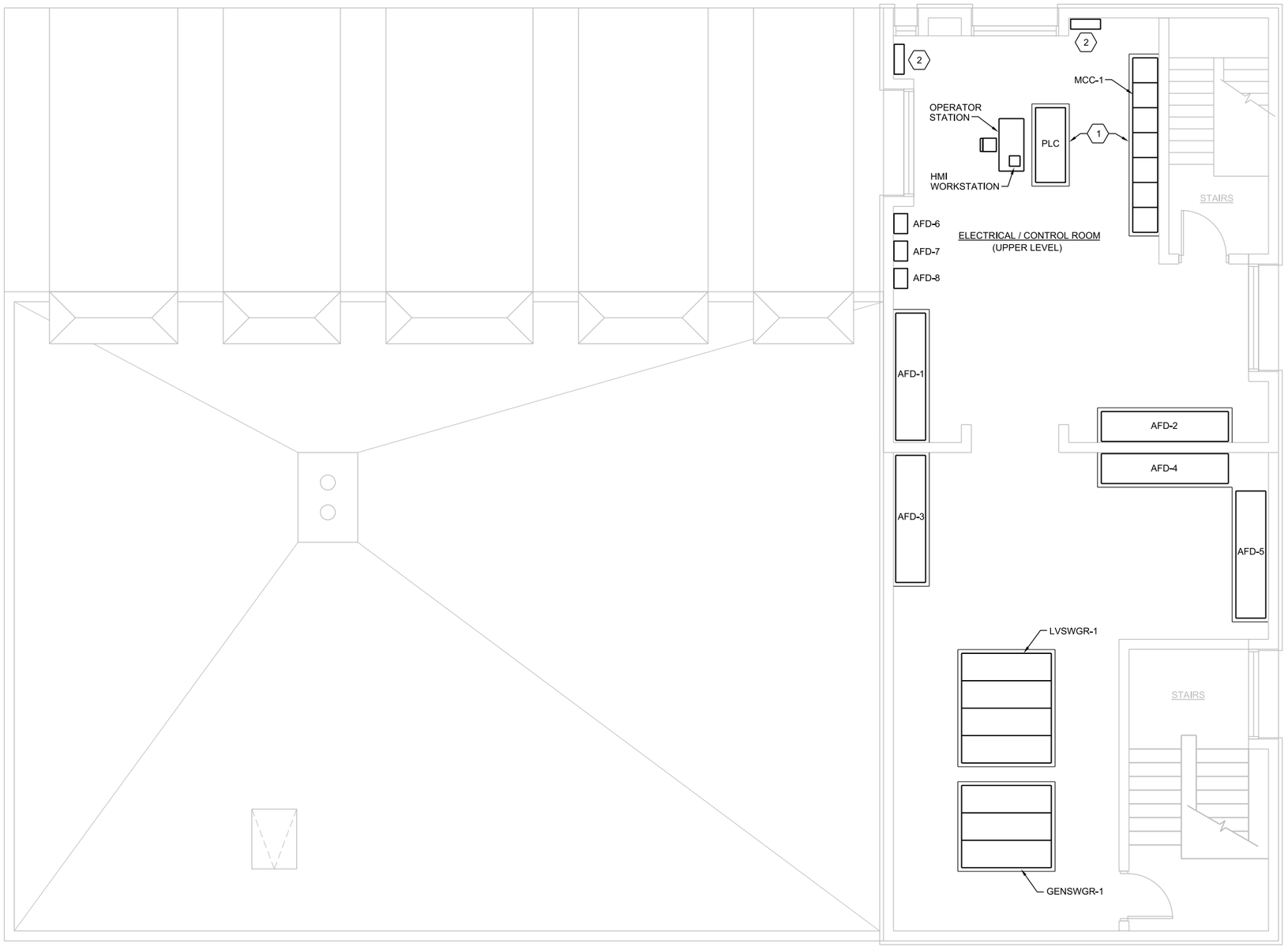
PRELIMINARY – NOT FOR CONSTRUCTION

3/16"=1'-0"
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-E-202
SHEET	of

SHEET KEYNOTES

1. ELECTRICAL EQUIPMENT TO BE MOUNTED ON STANDARD 3-INCH EQUIPMENT PAD.
2. MISCELLANEOUS PANELBOARDS AND GENERATOR CONTROLS AS REQUIRED.



UPPER FLOOR AND ROOF PLAN

1/4"=1'-0"

N

NO.	DSGN	DATE	DR	CHK	APVD	BY	REVISION
		R. WOOD	M. REICHERT	APVD		APVD	

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

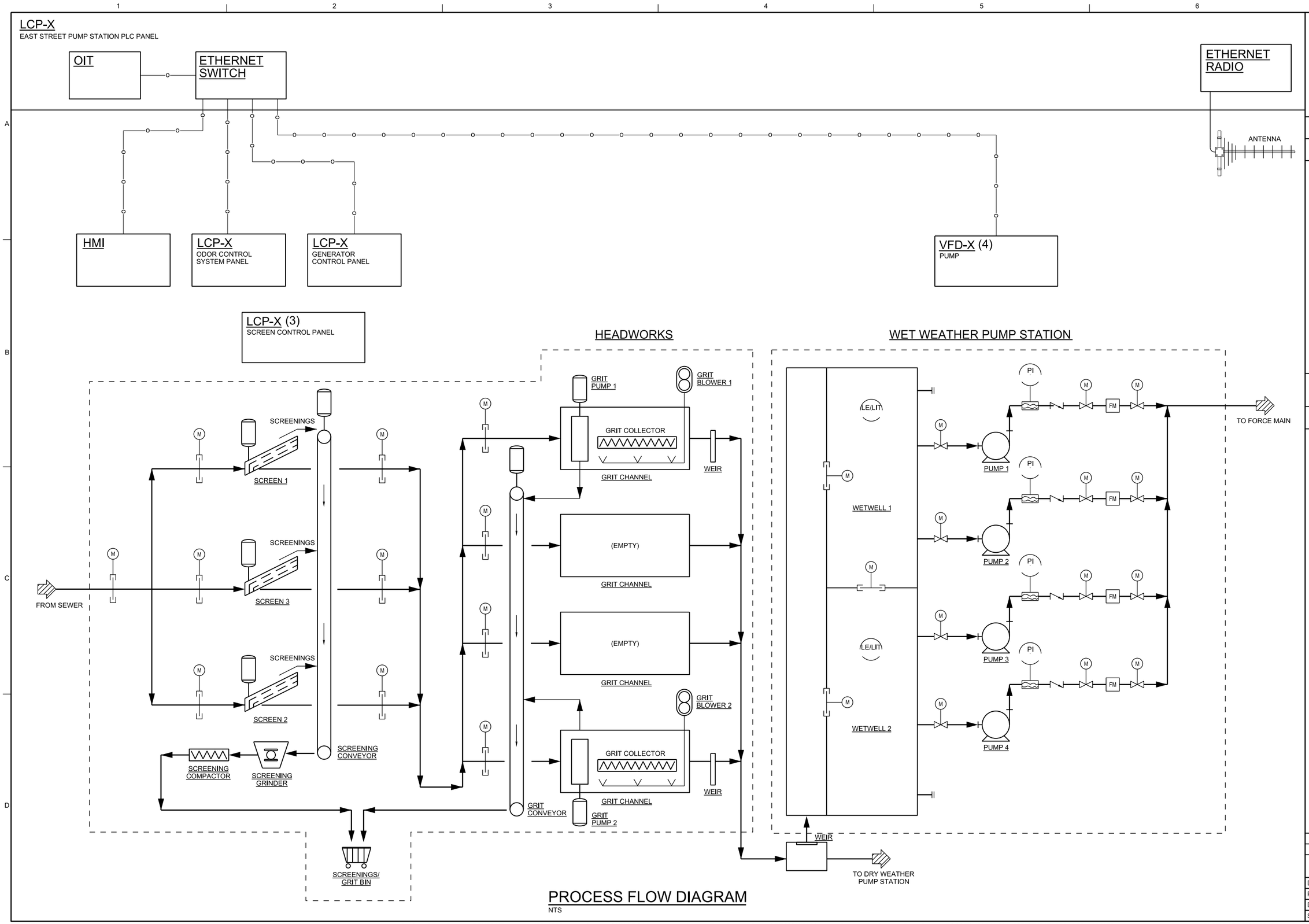
ELECTRICAL

EAST STREET PUMP STATION
UPPER FLOOR AND ROOF PLAN

PRELIMINARY – NOT FOR CONSTRUCTION

1/4"=1'-0"
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-E-203
SHEET	of



PROCESS FLOW DIAGRAM

NTS

NO.	DATE	DSGN	REVISION	CHK	APVD	BY	APVD
DR	R. SRIVASTAVA	M. REICHERT					

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

INSTRUMENTATION AND CONTROL

EAST STREET PUMP STATION
PROCESS FLOW DIAGRAM

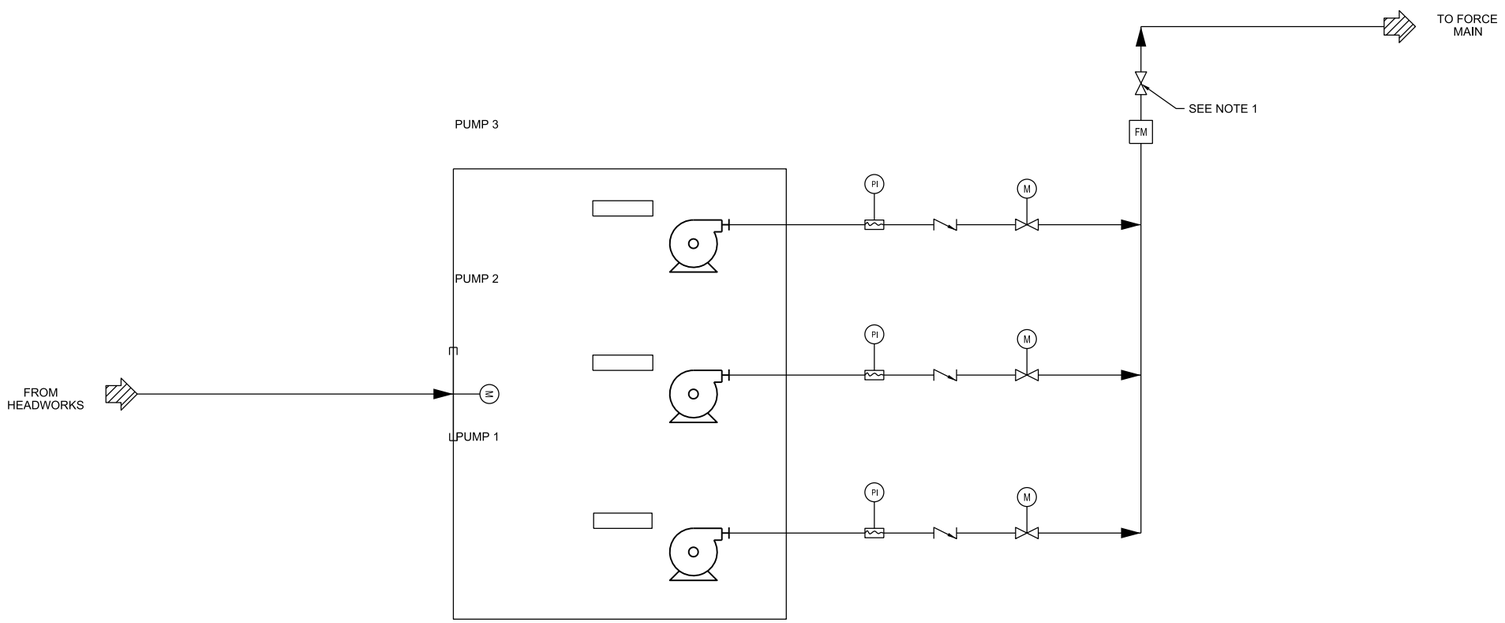
PRELIMINARY – NOT FOR CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	200-N-601
SHEET	of

GENERAL NOTES

1. PROVIDE A BURIED GATE VALVE DOWN STREAM OF THE FLOW METER.



NO.	DSGN	DATE	Engineer	DR	REVISION	CHK	OC	APVD	BY	APVD
			Z BRYAN				APVD			Seal

GNHWPCA LONG TERM CONTROL PLAN
GREATER NEW HAVEN WATER POLLUTION CONTROL AUTHORITY
NEW HAVEN, CONNECTICUT

REUSE OF DOCUMENTS:

INSTRUMENTATION & CONTROL

EAST STREET DRY WEATHER PUMP STATION PROCESS FLOW DIAGRAM

PRELIMINARY – NOT FOR CONSTRUCTION

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	NOVEMBER 2016
PROJ	664626
DWG	210-N-601
SHEET	of