Centralized Stormwater Treatment Facilities

Guidelines and Checklists

(September 2025 version)

Introduction

*A **centralized stormwater treatment facilit**y is a large-scale, regional facility designed to manage stormwater runoff from a wide area. The facility often integrates engineered and natural systems to collect, distribute, and treat stormwater. A centralized facility can collect public right-of way runoff, parcel runoff, or both public and parcel runoff.*

This document provides detailed guidance and required design information for successful Stormwater Control Plan (SCP) preparation when choosing a Centralized Stormwater Treatment Facility (centralized facility) to comply with the City of San Francisco's Stormwater Management Ordinance (SMO). The San Francisco Public Utilities Commission's (SFPUC's) Stormwater Management Requirements (SMR) and current Green Infrastructure Typical Details (GITD) should be thoroughly reviewed and understood prior to proceeding with the design of a centralized facility. A Centralized Stormwater Treatment Facility is designed using bioretention as the primary mechanism of treatment to meet state MS4 requirements for development projects within one of San Francisco's separate storm drain areas. Centralized facilities have successfully been constructed within several redevelopment areas and are often seen as a beneficial approach in large urban redevelopment projects as they can be more efficient and cost-effective than individual, decentralized solutions.

Key Considerations

It is critical to understand that SFPUC considers centralized facilities that are proposed to collect and manage <u>public ROW</u> stormwater runoff as components of the public storm drain utility infrastructure (e.g., an SFPUC asset when managing only ROW runoff). **Therefore, these facilities must be planned and designed to be completed and operational within same phase as the associated ROW improvement.**

Also note that:

- Centralized facilities that manage public ROW stormwater must be constructed and operational prior to the associated public ROW acceptance.
- Centralized facilities that manage parcel stormwater must be constructed and operational prior to the issuance of DBI CFC.
- Centralized facilities that are located in parks or open space and manage public ROW stormwater are considered part of the public utility infrastructure.

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COMMON ACRONYMS:

BMP	Best Management Practice
CSS	Combined Sewer System
GITD	Green Infrastructure Typical Details
HGL	Hydraulic Gradeline
MS4	Municipal Separate Stormwater Sewer System
SCP	Stormwater Control Plan
SFPUC	San Francisco Public Utilities Commission
SMO	Stormwater Management Ordinance
SMR	Stormwater Management Requirements and Design Guidelines

Part I –SCP Submittal Additional Items Checklist

When a centralized facility is proposed in a redevelopment project, the **SCP Submittal Additional Items Checklist** below shall be used to provide additional Stormwater Control Plan (SCP) submittal requirements (drawings and documentation) that are beyond the general items listed in the Multi-Phase SCP Instructions (see Stormwater Management Requirements page under 'SCP Materials and Resources').

Section 2: Project Narrative

- ☐ Summary of Development Area phasing schedule, if applicable.
- ☐ Summary of Stormwater Management Ordinance (SMO) compliance approach per phase, if applicable.
- ☐ Proposed configuration and function of the centralized facility including descriptions of: collection, flow diversion, pretreatment device, pumping (as needed), conveyance and flow distribution (i.e. splitting and spreading), and discharge.
- ☐ *[Non-SMO Requirement]* Description of State Trash Capture requirements, if included
- ☐ Description of how the infiltrative subgrade and centralized facility are protected during construction phasing.
- ☐ Summary of ownership and maintenance obligations, from storm drain sewer diversion to discharge (i.e., outfall).

Section 3: Calculation Summary and Table

- ☐ Summary of the modeling approach and design, including: modeling software used, model parameters, key assumptions, and results. [Any changes to the model's default parameters must be noted and justified.]
- ☐ System component design criteria / calculations:
  - ☐ Pretreatment system sizing for debris/sediment removal
  - ☐ Flow diversion hydraulics (e.g., diversion pipes, weirs, diversion pumps, etc.)
  - ☐ Basin sizing (i.e., individual and collective, if applicable)
  - ☐ Flow distribution hydraulics (e.g., distribution pipes/channels, weirs, etc.)
  - ☐ *[Non-SMO Requirement]* State Trash Capture device sizing, if included
- ☐ Calculation Summary Table presenting calculation performance results and/or model outputs, per MS4 or CSS requirements:
  - ☐ Sub-total by phase (if applicable)
  - ☐ Overall Development Area totals

Section 4: Stormwater Management Plan(s)

- ☐ **Plan(s)**: Proposed specialized components (as applicable; will vary based on gravity versus pumped diversion)
  - ☐ Diversion structures (e.g., diversion manhole, etc.)
  - ☐ Pretreatment (e.g., tank, debris separator, etc.)
  - ☐ *[for Pumped Diversion]* Stormwater treatment lift structure and vault
  - ☐ Forebay / energy dissipation
  - ☐ In-facility flow distribution (e.g., flow splitter / weirs, channel / flow spreader, etc.)
  - ☐ Overflow structure(s)

- ☐ *[for SFPUC Assets]* Green Infrastructure (GI) Asset IDs. Coordinate with SFPUC.
- ☐ *[Non-SMO Requirement]* Trash capture device (see State Trash Capture requirements)
- ☐ Monitoring ports, as needed

☐ **Detail Sheet:** Centralized Facility Schematic Line Diagram
☐ **Detail Sheet(s)**: As-needed details (customized per Designer Checklist section below)
☐ **Detail Sheet(s)**: Enhanced Bioretention detailing (when approved by SFPUC)
☐ **Detail Sheet(s)**: Best Management Practice (BMP) section or figure showing seasonal/tidal high groundwater (HGW) elevation and clearance to bottom of facility
☐ **Detail Sheet(s)**: Green Infrastructure (GI) Asset ID Plan. Coordinate with SFPUC.

Appendix A: Phasing Map(s) and Tracking Table

☐ Redevelopment Phasing Map with phasing schedule and construction sequencing
☐ Stormwater Management Phasing Plan (if different from development phasing)

Appendix B: Design Calculations and Modeling Output

☐ Stormwater Modeling Report with hydrologic and hydraulic information to demonstrate SMO compliance for each project phase and at overall development completion. Report shall document proper design for water quality (WQ) design storm diversion to the centralized facility, and flow distribution within the centralized facility. This report typically includes:
- ☐ Hydrologic modeling: inputs (e.g., rainfall data, catchment properties, flow routing, etc.), results (e.g., bioretention performance such as captured flows vs. bypass flows, facility outflows such as peak flow, total volume, infiltration loss, etc.), and/or supporting calculations.
- ☐ Hydraulic modeling: inputs (e.g. piping, pump, and system design parameters), results (e.g., headloss(es), hydraulic grade lines (HGLs), velocities, peak flow rates, etc.), and/or supporting calculations.

☐ List of all modeling parameters that differ from the model default settings, and/or GITD guidance. [Provide justification for any proposed changes.]
☐ Hydraulic design calculations for critical components of the centralized facility, including: distribution pipe network, overflow structures, underdrain network sizing, collection network / laterals, etc.
☐ Additional specialized component design as needed, such as:
- ☐ Pumping head and pump selection for required WQ flow rate
- ☐ HGL for each system component, and as related to freeboard calculations
- ☐ For pretreatment settling tanks only: Hydraulic residency time calculations

Appendix C: Supporting Documentation (as applicable)

☐ Infiltration tests (required with Preliminary SCP submittal for master planned redevelopment areas)
☐ Sea Level Rise documentation and requirements, as applicable
☐ Seasonal/tidal HGW level documentation
- ☐ Technical letters and reports (w/ test procedure and location map)
- ☐ Seasonally influenced HGW documentation
- ☐ Tidal influenced HGW documentation, as applicable to waterfront projects

- ☐ *[for Pumped Diversion]* Pump Selection Alternative Matrix (required for City-owned assets, recommended for all others)
- ☐ *[for Pumped Diversion]* Selected pump model with operating curves
- ☐ Specialized BMP product cut sheets (e.g., inlet grates, pumps, globe valves, rain gauges, etc.)
- ☐ Specialized BMP product submittals (e.g., draft O&M Manuals, Electronic Data Sheets as required and coordinated by WWE Engineering)
- ☐ Specialized BMP specifications (e.g., Stormwater Treatment Lift Structure specifications with testing and reporting procedures, etc.) **[NOTE: For SFPUC Assets, coordinate: submittal, testing requirements, reporting, or O&M manual requirements with SFPUC Wastewater (WWE) Engineering.]**
    - ☐ Flow Testing procedures and reporting requirements
- ☐ Pump Validation procedures and reporting requirements

Appendix D : Construction Document Drawing Excerpts

- ☐ Specialized plans, profiles, and sections
- ☐ Specialized component details, as applicable:
    - ☐ Diversion structures (e.g., manhole, vault, etc.)
    - ☐ Pretreatment (e.g., tank, debris separator, etc.)
    - ☐ *[for Pumped Diversion]* Stormwater treatment lift structures and vaults
    - ☐ Forebay / energy dissipation
    - ☐ In-facility flow distribution (e.g., flow splitter / weirs, channel / flow spreader, etc.)
    - ☐ Overflow structures
    - ☐ *[Non-SMO Requirement]* Trash capture detail (see State Trash Capture requirements)
    - ☐ Monitoring ports, if needed
- ☐ Enhanced Bioretention detailing (as approved by SFPUC), as applicable

Part II – Designer Checklists & Examples

The intent of the **Designer Checklists & Examples** is to provide detailed guidance regarding the level of design information necessary for successful Stormwater Control Plan (SCP) preparation and approval when choosing a centralized facility to comply with the City of San Francisco's Stormwater Management Ordinance (SMO). The San Francisco Public Utilities Commission's (SFPUC's) Stormwater Management Requirements (SMR) and most recent update for the Green Infrastructure Typical Details (GITD) should be thoroughly reviewed and understood prior to proceeding with the design of a centralized facility.

Part II is separated into two sections:

- **SECTION A** – **Design Documentation:** Enhanced documentation for stormwater approach and construction clarity, and alternatives analysis required for efficient pump selection.
- **SECTION B – Construction Document (CD) Details and Diagrams:** Specific CD details and diagrams required for construction.

A **'Designer Checklist'**, **'Designer Notes & Guidelines'**, and **'Example(s)'** are provided for each required design documentation, detail, or diagram to ensure that the construction documents submitted with the SCP include all information required for SCP approvals and Improvement Plan permitting.

DESIGNER CHECKLISTS

A Designer Checklist is provided for each required detail, diagram, or documentation to help streamline the review and approval process. Prior to submittal, the project team should review the checklists and confirm that each item has been provided in the SCP package. Additional information may be needed within the details and diagrams for design review by other city agencies.

DESIGNER NOTES AND GUIDELINES

The project team should review the design guidance provided in the Designer Notes & Guidelines. The design professional is solely responsible for ensuring that the system functions properly and meets all local codes and regulations.

EXAMPLES

Detail and diagram examples are provided for reference. The examples do not represent standard details and are for guidance only. The purpose of the examples is to illustratively convey the intended information and level of detail required. The design professional shall ensure that all diagrams are customized to the unique facility function and site conditions while meeting all local codes and regulations. The design professional shall use industry standard terminology, abbreviations, symbols, and line types in all details and diagrams. **[NOTE: Information shown in Examples is not to be used in place of review of checklist and guidelines.]**

A. Design Documentation

The following centralized facility design documentation submittals **are required** during preparation of the construction documents or Improvement Plans.

1. **Centralized Facility Schematic Line Diagram:** Required in the Stormwater Management Plan (SMP). Recommended in Construction Documents / Improvement Plans for contractor reference; required if a City-owned asset.
2. **Pump Selection Alternatives Matrix:** Include in Supporting Documentation appendix; required for City-owned assets, recommended for all others (may be requested by SFPUC).

1. Centralized Facility Schematic Line Diagram

DESIGNER CHECKLIST

Provide a **Centralized Facility Schematic Line Diagram** that shows the structures (nodes) and flow path (routing) of stormwater runoff from 'collection' to 'discharge' including the items below, as applicable:

- ☐ Routing flow paths to and within facilities/basins. If flow splitting is proposed, include:
  - ☐ Pumped flow rate range
  - ☐ Distribution flow rate range(s)
- ☐ Collection storm drains (SDs) and catch basins (CBs); label as public or private
- ☐ Pretreatment and/or State Trash Capture devices
- ☐ Flow diversion structure to centralized facility
  - ☐ Invert elevations
  - ☐ Pipe materials and dimensions
  - ☐ Diversion flow rate (i.e., Water Quality [WQ] flow rate)
  - ☐ High-flow bypass to City collection system, as applicable
- ☐ Pump configuration, as applicable
  - ☐ Pump ID
  - ☐ Pump HP
- ☐ Valve symbols, as applicable
- ☐ Forebay, as applicable
- ☐ Channels, pipes, flow splitters, and other flow distribution infrastructure within the facility
- ☐ Bioretention cells
- ☐ Overflows structures
- ☐ Discharge laterals to the City collection system or outfall

DESIGNER NOTES AND GUIDELINES

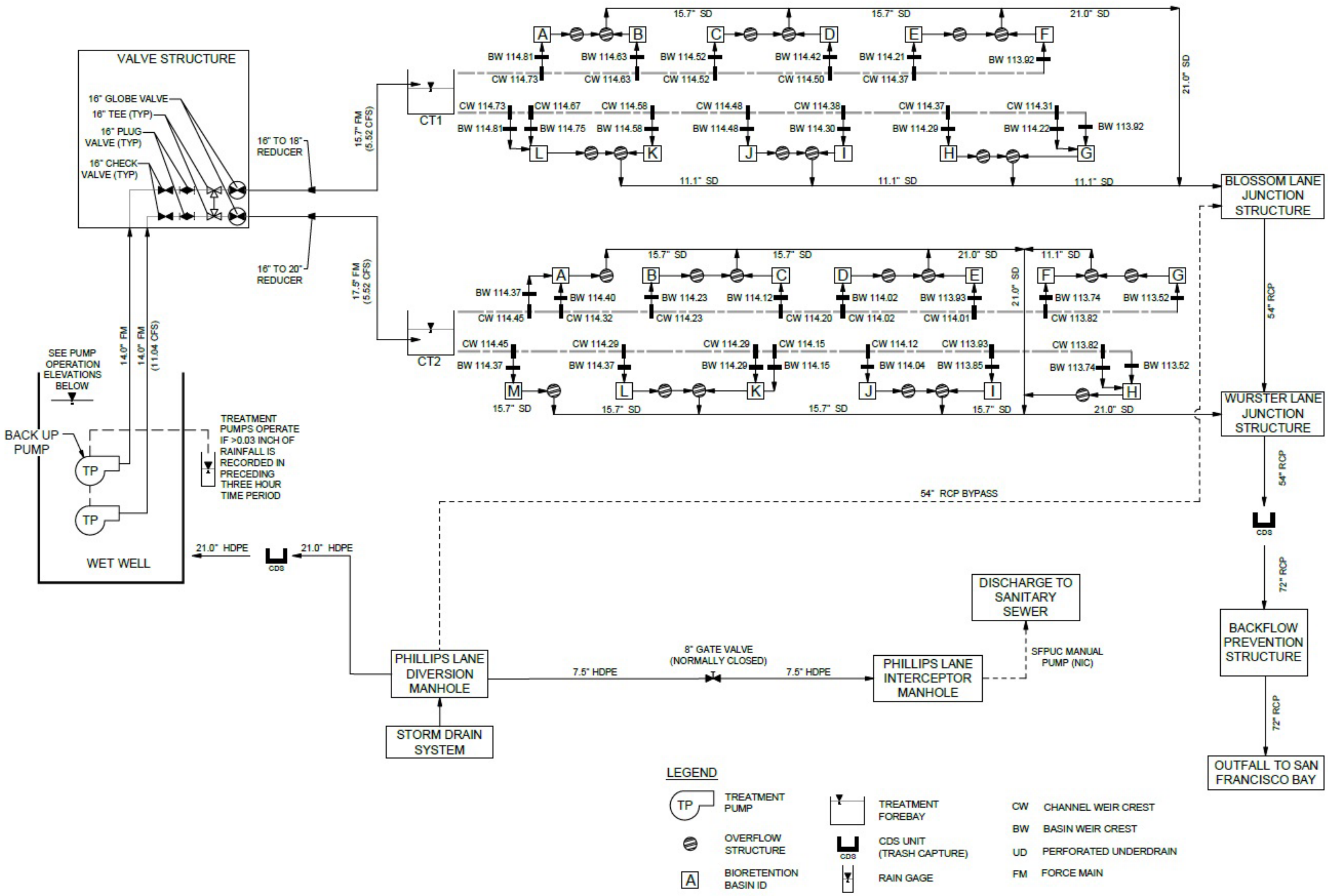
- The Centralized Facility Schematic Line Diagram shall illustrate how the stormwater runoff routes through the facility and shall clearly and concisely communicate system function and routing connectivity. [NOTE: The diagram is intended to be schematic in nature and does not need to be accurately oriented in space or to scale.]
- Use industry-standard symbols for system components.

EXAMPLE:

Example 1 represents the level of detail and typical design information necessary for a Centralized Facility Schematic Line Diagram. This example represents a centralized facility with gravity diversion from the public SD and pumped distribution to multiple bioretention treatment cells.

Example 1: Centralized Facility Schematic Line Diagram

(CREDIT: Figure provided by BKF Engineering for illustrative purposes.)



2. Pump Selection Alternatives Matrix

DESIGNER CHECKLIST

Provide a Pump Selection Alternatives Matrix that compiles and analyzes the viable pump system alternatives, including information listed below. The matrix should summarize the pump alternatives analysis and justify the selection of the most efficient pump models and operating ranges to meet the target water quality flow rate. This analysis is required for City-owned assets and recommended for all others.

- ☐ Pump model alternatives
- ☐ 2 Pump Configurations: Alternating vs. Parallel
- ☐ Regulated Water Quality (WQ) flow rate and total head
- ☐ Achieved pump operating flow rate
- ☐ Pump efficiency at operating flow rate
- ☐ Proposed Alternative: Justified selection of pump model and configuration

DESIGNER NOTES & GUIDELINES:

- Provide Pump Selection Alternatives Matrix as documentation and justification for the selected pump system, including:
    - Evaluate the appropriateness and feasibility of the pump configurations below:
        - 1-Pump 'Alternating', and/or
        - 2-Pump 'Parallel'
    - Include the following pump design information within Supporting Documentation:
        - Pump make and model
        - Horsepower and voltage
        - Efficiency curve
        - Pumped flow at WQ target design point

EXAMPLE:

Example 2 represents the level of information necessary to demonstrate appropriate analysis of pump selection and sizing for a centralized facility. The alternatives matrix in this example is for a centralized facility where analysis was conducted to determine the best pump curve and configuration to most efficiently meet the regulated WQ flow rate, without oversizing the maximum peak flow to the facility.

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Example 2: Pump Selection Alternatives Matrix
(CREDIT: Table provided by Freyer and Laureta Engineering for illustrative purposes.)

Stage 2/3 Treatment Pump Selection Matrix										
Lift Station	Alternative Name	Pump Model Name	Pump Outlet Diameter in	Length in	Width in	Horsepower hp	Efficiency %	Voltage V	Pumped Flow @ Design Point gpm	Factor of Safety
Clipper (Interim)	Current	NP 3202 LT 3~ 619	12	74.0	31.5	35	73.9	230	3,390	13.2%
Clipper (Final)	Current	NP 3202 LT 3~ 619	12	74.0	31.5	35	73.9	230	3,175	6.0%
	Alt 1	NP 3171 LT 3~ 614	10	60.0	26.5	25	77.5	230	3,083	2.9%
	Alt 2	NP 3171 LT 3~ 613	8	60.0	26.5	25	79.4	220	3,032	1.2%
	Alt 3	NP 3202 MT 3~ 643	8	55.5	25.0	35	61.4	230	3,098	3.4%
Macky	Current	NP 3202 LT 3~ 615	14	72.0	31.5	60	79.9	480	5,093	2.8%
	Alt 1	NP 3202 LT 3~ 617	12	72.0	31.5	45	72.0	480	5,146	3.9%
	Alt 2	NP 3301 MT 3~ 639	10	65.5	30.0	70	55.1	380	5,135	3.6%
	Alt 3	NP 3306/605 3~ 870	12	74.5	30.0	70	63.6	380	5,690	14.8%

Water Quality Flow	
Clipper	**2,995 gpm**
	6.67 cfs
Macky	**4,955 gpm**
	11.04 cfs

B. Construction Document Details and Diagrams

The following specialized construction details and diagrams **are required as part of the Improvement Plan and Construction Documents.** They shall also be included within the SCP's Stormwater Management Plan (SMP).

1. Pretreatment Details
2. Flow Diversion Details
    a. Gravity Diversion (Passive)
    b. Pumped Diversion (Active)
3. In-Facility Flow Distribution Details
    a. Gravity Distribution (Passive)
    b. Pressurized Distribution (Active)
4. Enhanced / Non-Standard Bioretention Design Details (with SFPUC Approval ONLY)

1. Pretreatment Details

Pretreatment is required prior to a centralized facility to remove large sediment and debris, with the goals to: increase facility resilience and maximize operational life, increase facility efficiency, reduce routine and restorative maintenance, and protect pumps (when proposed).

NOTES:

- Pretreatment may occur before or after the WQ flow diversion. The operational order will affect the size of the pretreatment device. However, it is common to locate the pretreatment device after the flow diversion structure to minimize the pretreatment device size.
- For the purposes of this guidance document, centralized facility pretreatment is not intended to achieve MS4 water quality targets (e.g., a specific particle size removal or 80% total suspended solids [TSS] removal).
- *[Non-SMO Requirement]* For projects in MS4 areas that are subject to the California State Water Resources Control Board's Trash Implementation Program, pretreatment devices may be combined with storm drain system requirements to also meet State Trash Capture Requirements, where applicable. More information is available at: https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html

DESIGNER CHECKLIST

Provide a construction-level detail of the pretreatment device with the information below. Common pretreatment device types are provided below with Designer Checklists.

Proprietary units (hydrodynamic separators or equivalent)

- ☐ Manufacturer, model, capacity, and material
- ☐ Rated design storm (e.g., 2-year 24-hour, 1-year 1-hour, etc.) flow rate and peak flow capacity
- ☐ Plan view with:
  - ☐ Interior and exterior dimensions
  - ☐ Internal components
  - ☐ Pipe penetrations
  - ☐ Maintenance access
- ☐ Section view with:
  - ☐ Interior and exterior dimensions
  - ☐ Internal components
  - ☐ Pipe penetrations and pipe materials
  - ☐ Inlet invert and size
  - ☐ Outlet invert and size
  - ☐ Top and bottom elevations
  - ☐ Permanent pool elevation
  - ☐ HGL at design flow rate and high-flow bypass flow rate, if applicable

Settling tanks

- ☐ Manufacturer, model, capacity, and material
- ☐ Active volume, hydraulic residence time, design particle size, and design particle settling velocity
- ☐ Plan view with:
  - ☐ Interior and exterior dimensions
  - ☐ Internal components
  - ☐ Pipe penetrations
  - ☐ Maintenance access
- ☐ Section view with:
  - ☐ Interior and exterior dimensions
  - ☐ Internal components
  - ☐ Pipe penetrations and pipe materials
  - ☐ Inlet invert
  - ☐ Outlet invert
  - ☐ Top and bottom elevations
  - ☐ Dimensions of sediment collection sump
  - ☐ Permanent pool elevation
  - ☐ HGL at design flow rate and high-flow bypass flow rate, if applicable

DESIGNER NOTES & GUIDELINES:

- Pretreatment device performance and design layout may vary greatly. SFPUC does not promote any pretreatment technology or product over others.
- The project team must submit customized design documents and details showing locations, dimensions, materials, and configurations.
- Maintenance access for subsurface pretreatment infrastructure must have a minimum 24-inch diameter opening per CA Plumbing Code Chapter 16. The minimum number of access/egress points to subsurface structures shall be provided per code.
- The designer shall allow for equipment access for maintenance when locating pretreatment facilities, access ways, and/or maintenance ports.

EXAMPLE:

Example not provided due to the wide range of system manufacturers, configurations, and unique system conditions.

2. Flow Diversion Details

The following section describes the required construction details needed for the successful review of flow diversion structures.

In this document, the term 'flow diversion' is used to describe physical structures and piping that route a defined and controlled rate or volume of stormwater for Water Quality (WQ) treatment purposes in MS4 areas. In general, the centralized facility shall be designed 'off-line' from the storm drain network such that flows higher than the WQ storm bypass the facility and continue to the storm drain system. Flow diversion structures may use gravity diversion, pumped diversion, or both, as applicable.

The flow diversion approach, components, and layout order will vary based on the proposed design function and configuration of each centralized facility as related to the separate storm sewer. Due to the interconnection with the public storm sewer, coordination with SFPUC is recommended.

a. Gravity Diversion (Passive Diversion)

When redevelopments are located in areas with adequate grade, gravity-based flow diversion is the preferred approach to convey the regulated Water Quality (WQ) design storm to the centralized facility.

A typical gravity-based flow diversion structure is a manhole or vault located in-line with the storm drain network. The structure is typically designed with a lower outlet pipe sized to convey the WQ storm flow to the centralized facility, and a higher outlet(s) to bypass peak flows larger than the WQ storm to the collection system. The diversion structure bypass elevation is typically set by the downstream pipe inverts, or by a weir within the diversion structure.

DESIGNER CHECKLIST

Provide a construction-level detail and functional description of the proposed gravity (passive) diversion structure(s) with the information and details below.

- ☐ Diversion structure: manufacturer, model, material, size
- ☐ Regulated WQ design storm flow rate, and/or volume
- ☐ Pipe size, orifice size, or weir elevation to achieve target WQ design flow rate
- ☐ Plan view:
    - ☐ Interior and exterior dimensions
    - ☐ Internal components
    - ☐ Inlet, diversion outlet(s), and bypass locations
    - ☐ Maintenance access
- ☐ Section view:
    - ☐ Interior and exterior dimensions
    - ☐ Internal components
    - ☐ Pipe materials
    - ☐ Inlet, diversion outlet(s), and bypass inverts
    - ☐ Design water surface elevation(s)
    - ☐ Maintenance access

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DESIGNER NOTES & GUIDELINES:

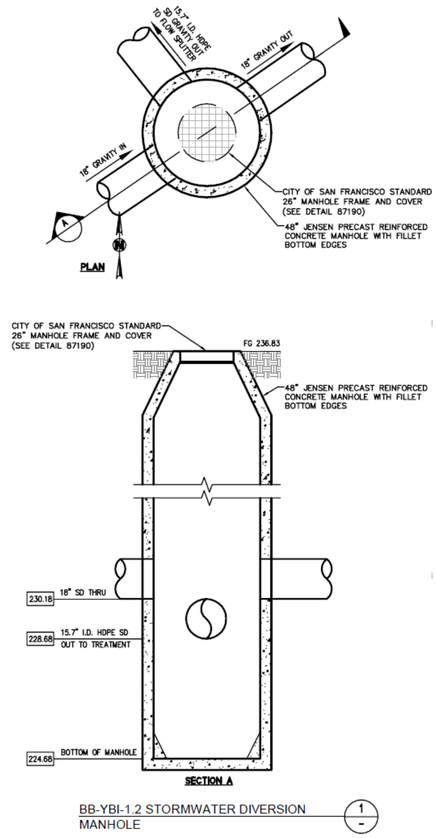
- Gravity flow diversion can be approached in multiple ways. However, when connected to the public storm sewer, SFPUC will review alternates.
- Design documents and customized details shall show project-specific pipe or weir sizing given the water HGL in the diversion structure and required WQ treatment volume and flow rates.
- WQ flow rate is based on orifice and/or lateral sizing.
    - Diversion lateral must be sized to pass the water quality storm or 8” minimum. Smaller flows may need an orifice plate or other flow diversion/splitter structure.
    - Orifice(s) and/or lateral sizing shall match the target WQ flow rate <u>when the height of water in the diversion structure equals the bypass SD invert</u>
- Details must include all relevant invert elevations
- Details must label all inlet and outlet pipes (e.g., ‘laterals to centralized facility’, ‘storm drain system’, or ‘SD to outfall’, etc.).
- A passive diversion structure must be easily accessible per the local Plumbing Code and maintainable per the jurisdiction that maintains it (i.e., SFPUC, Port, or private, etc.).
- Subgrade preparation, backfill requirements, surface treatments, and other related elements are not covered in this detail.

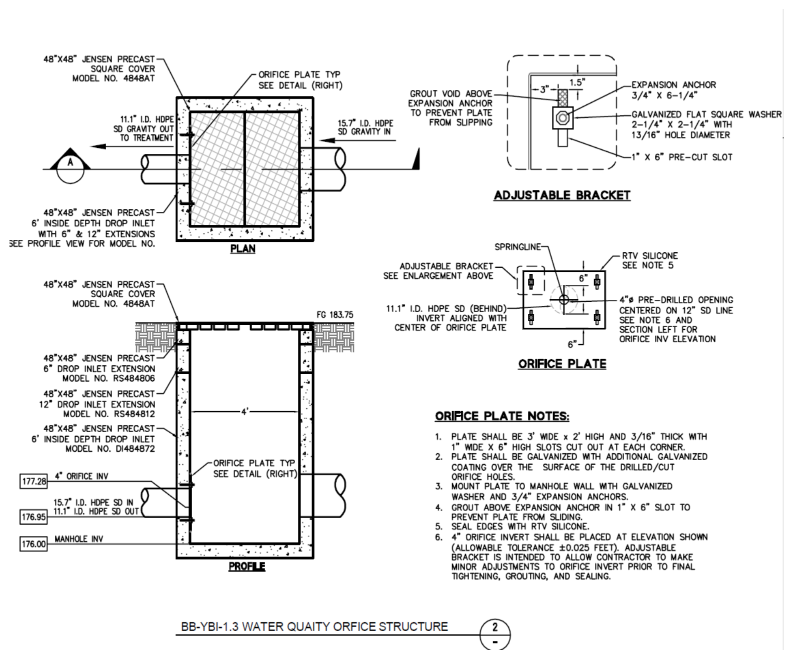
EXAMPLE:

Example 3 represents the general level of detail design information necessary for the review of a gravity-based diversion structure. The example illustrates a two-stage flow diversion configuration in-line with a public storm sewer with downstream WQ flow control. The left detail illustrates an ‘uncontrolled’ diversion structure; where the right detail illustrates a downstream orifice control structure to manage the WQ flow rate to the centralized facility. The orifice control includes an adjustable orifice plate.

Example 3: Gravity Diversion Structure Detail & WQ Orifice Structure

(CREDIT: Figure provided by BKF Engineers for illustrative purposes.)





b. Pumped Diversion (Active Diversion)

Due to generally flat grades along most waterfront development areas, a 'Stormwater Treatment Lift Structure' (i.e., a pump designed for lifting stormwater to a centralized facility to comply with the SMO) is often required to divert the regulated Water Quality (WQ) design storm to a centralized facility (i.e., located within an adjacent open space at a higher elevation than the separate storm drain system hydraulic grade line (HGL)).

In general, a treatment lift structure uses submersible pumps to lift the WQ design storm into the centralized facility. A typical system configuration includes the following infrastructure:

1. A diversion structure (passive diversion) is located in-line with the storm sewer main or outfall.
    a. The diversion structure is typically designed using a modified manhole (MH) to divert the WQ design storm to the treatment lift structure via a storm drain diversion pipe set at a low elevation within the MH sump. The invert of the downstream sewer main (higher elevation than the diversion pipe invert) sets the 'design bypass level' in the MH.
    b. During larger storms, the stormwater elevation in the MH rises and activates the downstream storm sewer main to 'bypass' storm flow onward to the outfall. Thus, storm flows greater than the pumped WQ flow rate will raise the HGL in the diversion structure and initiate the bypass of the lift structure (and centralized facility) once the 'design bypass level' is reached.
2. A pretreatment device is typically located upstream of the stormwater treatment lift structure to protect pump intakes by capturing debris and sediment.
3. A treatment lift structure is located downstream of the diversion structure (and pretreatment device). The pumps, valves and force main are selected and sized to discharge the WQ flow rate to the centralized facility for the duration of the storm event. NOTE: During storm flows that are lower than the maximum operating flow rate of the pump, the HGL in the diversion structure remains lower than the downstream 'design bypass level' (i.e. downstream SD outfall INV).
4. A forebay or appropriate energy dissipation structure to dissipate energy is located at the discharge point into the centralized facility.

NOTE: The actual process order of required infrastructure, such as diversion structure, pretreatment device, treatment lift structure (e.g., pumps), pipe routing, and valving configurations, will be project-dependent and may be required to be shifted.

Key Design Considerations:

Skillful pump selection and design of the Pump Operation Curves are necessary to achieve active diversion via a treatment lift structure to 'mimic' the variable flow rates that typically occur within a passive diversion structure during natural rainfall intensity fluctuations. Treatment lift structures should be designed and sized to have a maximum peak discharge rate that can achieve the required WQ flow rate yet will discharge at a lower rate during periods of lower rainfall intensity. Pumps selected for treatment lift structures should be inherently 'self-regulating' within the anticipated range of total dynamic head such that they discharge at a lower flow rate during the small storm events when the water level in the wet well is generally low, and conversely, discharge at a higher flow rate during larger storm events when the water level in the wet well is generally high. Variable Frequency Drives may be proposed, only when determined necessary.

The careful selection of the pump, design of the Pump Operation Curves, and resulting system operation design is critical in ensuring the pumps will operate at appropriate System Operating Points and Range (refer to Figure 5 and Figure 7). A few key design considerations include:

- The WQ flow rate shall be fully diverted by the treatment lift structure prior to any stormwater bypass to the downstream storm drain or outfall.
- The maximum operating flow rate is controlled by the point on the pump operation curves (i.e. pump operating point) at the lowest operating static head (i.e. highest water level in the wet well occurring with no ponding depth in the centralized treatment facility). NOTE: The maximum operating flow rate of the selected pump(s) shall be designed to be slightly higher than the regulated WQ flow rate to minimize excessive flow rates and scouring.
- The lowest operating static head, or highest wet well water level, is generally regulated by the 'design bypass level' in the diversion structure. This occurs when the storm drain system HGL at the MH reaches the bypass level (i.e. downstream SD INV) in the diversion structure.
- For large centralized facilities, flow splitters may be required. Flow splitters should be designed to provide either proportional flow, or generally equal flow, to multiple basins (as applicable). Flow splitters may be achieved using multiple sized force mains and flow control valving, subject to review and approval by SFPUC.

DESIGNER CHECKLIST

Provide construction-level lift structure details, pump station curves, and pump operation diagrams with the information below.

NOTES:

- Lift structure and force main valve vault detailing may be combined for overall system construction clarity. They are presented separately, herein, to distinguish 'flow diversion' versus 'flow distribution'.
- Valve vaults have been intentionally separated from lift structures and discussed in Section III.B.3.b 'Pressurized Distribution'. See Designer Checklist for 'Valve Vault with Globe Valves' (page 36).
- **Lift structures will be required to be reviewed by SFPUC's Wastewater Engineer Division (WWE Engineering).** Project must coordinate with WWE Engineering and request the "WWE Pump Station Design Guidelines and Standards".

Lift Structure Plan and Section Views: (see Example 4)

- ☐ Manufacturer, model, and material for all lift structure components
- ☐ Lift Structure Plan View(s) with:
  - ☐ Lift structure design with pump and wet well layout
  - ☐ *[See Section III.B.3.b]* Valve vault layout and location
  - ☐ Interior and exterior dimensions
  - ☐ Inlet, diversion outlet(s), and bypass locations
  - ☐ Maintenance access
- ☐ Lift Structure Section View with:
  - ☐ Lift structure and pump and wet well section
  - ☐ *[See Section III.B.3.b]* Valve vault section
  - ☐ Interior and exterior dimensions
  - ☐ Bottom of floor elevations
  - ☐ Pipe penetrations and pipe materials
  - ☐ Inlet and outlet invert(s)
  - ☐ Pump intake elevations
  - ☐ Pump On and Pump Off elevations
  - ☐ Minimum, maximum, and HGL bypass water surface elevations
- ☐ Material List w/ key note IDs and component description

Pump Operation Curves: Pump Curves vs. System Curves (see Example 5 and Example 7)

- ☐ System Curve(s) with labels & elevations:
  - ☐ High static head
  - ☐ Pump On elevation
  - ☐ Diversion structure HGL bypass elevation
  - ☐ Low static head (maximum operating flow rate)
- ☐ Pump Curve(s) with VFD Pump Curves, as applicable
- ☐ System Operation Points and Range: Specified system design operational range and key operational points, with labels & design flow rates

- ☐ WQ flow rate, with label
- ☐ Maximum operating flow rate (maximum wet well elevation / lowest static head), with label

Pump Operational Diagram and Design Parameters (see Example 6a & 6b and Example 8)

- ☐ Pump Operational Diagram
  - ☐ Low Water Level / High Water Level alarm elevations
  - ☐ Pump Off / Pump On elevations
  - ☐ Rain Gauge operation (if applicable)
- ☐ Pump design parameters
  - ☐ WQ flow rate
  - ☐ Maximum operating flow rate
  - ☐ Total dynamic head
  - ☐ Pump design point
  - ☐ Minimum and maximum velocity in force main
  - ☐ Net positive suction head, required and available
  - ☐ Wet well characteristics

As-Needed Lift Structure Documentation (no Examples provided)

- ☐ Lift structure Program Logic Control description
- ☐ Variable Frequency Drive (VFD) pump control
- ☐ Rain gauge location plan
- ☐ Rain gauge design

DESIGNER NOTES & GUIDELINES:

- Pump flow rate shall be designed and sized at, or slightly above, the required WQ flow rate along the system curves at the point of gravity-bypass discharge to outfalls. The pump may operate with a lower flow rate as long as the pump discharge rate equivalent to the required WQ flow rate is fully achieved before the passive gravity-bypass is activated.
- The lift structure operational elevation range (i.e., wet well water elevation range) cannot be above the invert of hydraulically connected critical infrastructure (e.g., valve vault components and valves) unless infrastructure is designed with appropriate NEMA equipment rating with owner/operator approval.
- There are a multitude of system configurations for pumped diversion and SFPUC does not promote any technology or product over others. However, if owned and maintained by the City, SFPUC may request one design alternative over another.
- The project team must submit customized design documents and details showing project-specific pump sizing given the required head, treatment volume, and flow rates.
- Subgrade preparation, backfill requirements, surface treatments, pumping housing or other above-ground structures, electrical supply, and other related elements are not covered in this detail.

EXAMPLES:

Example 4 through **Example 8** represent the general level of detail and anticipated design information necessary for review of Pumped Diversion to a centralized facility. Selected figures represent varied projects to illustrate varied configurations.

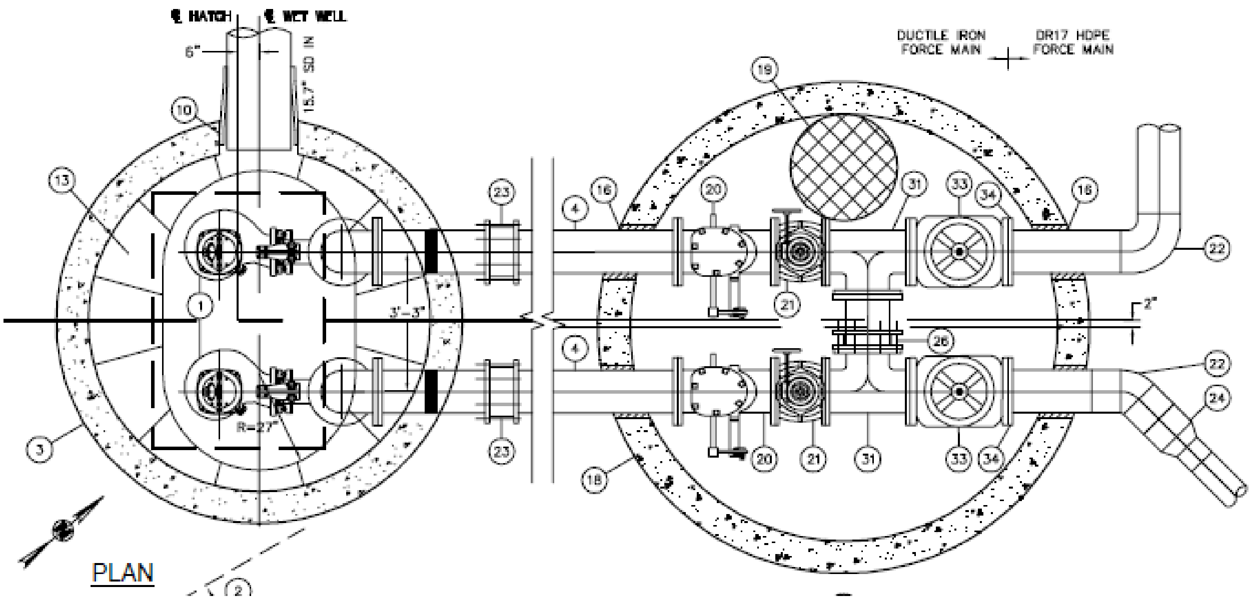
- Example details may not include all information listed in above Designer Checklist.

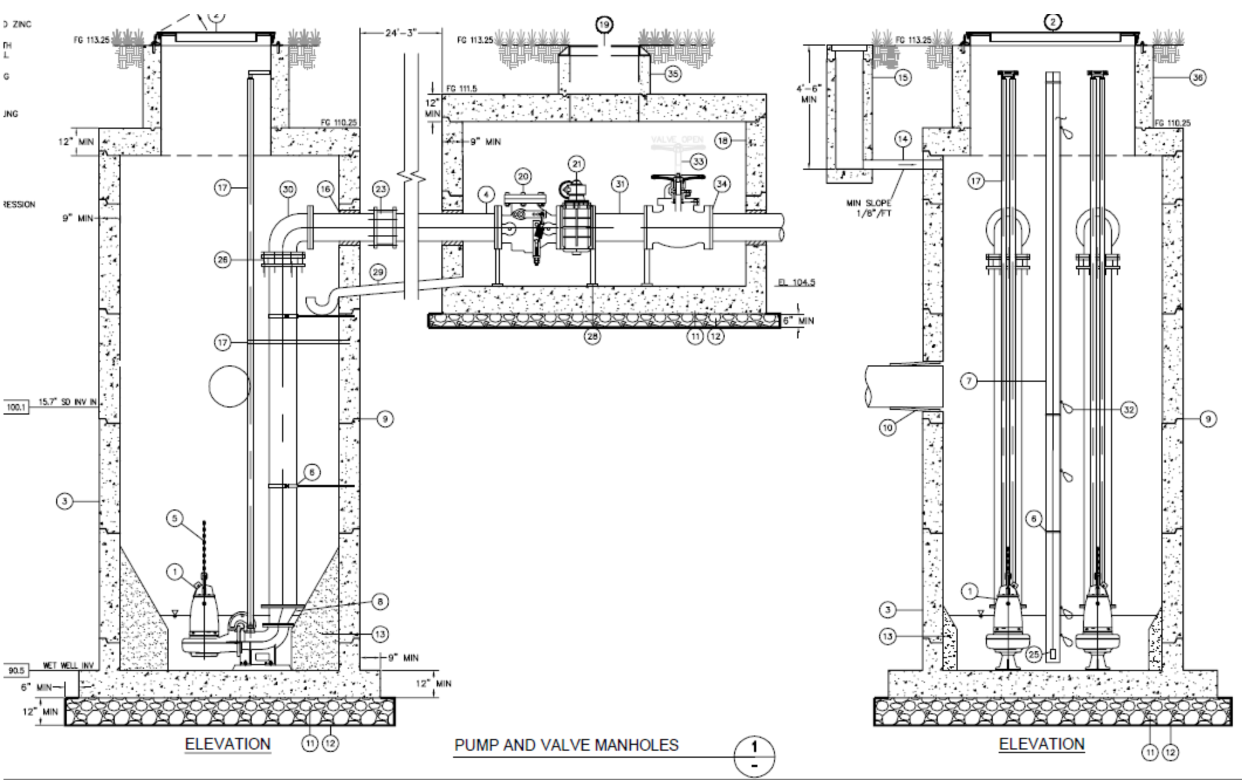
Example 4 represents a typical stormwater treatment lift structure with a two-pump in parallel configuration directed to an external valve vault.

Examples 5 and 6a&6b represent typical pump operation curves (pump curves and system curves) and corresponding pump operational diagram and design parameters based on a one-pump alternating configuration, with no VFD.

Examples 7 and 8 represent typical pump operation curves (pump curves and system curves) and corresponding pump operational diagram based on a two-pump in parallel configuration, with VFD.

Example 4: Pumped Diversion via Treatment Lift Structure, Plan and Section View
(see Material List, cont.) *(CREDIT: Figures provided by BKF Engineering for illustrative purposes.)*





Example 4: Cont.

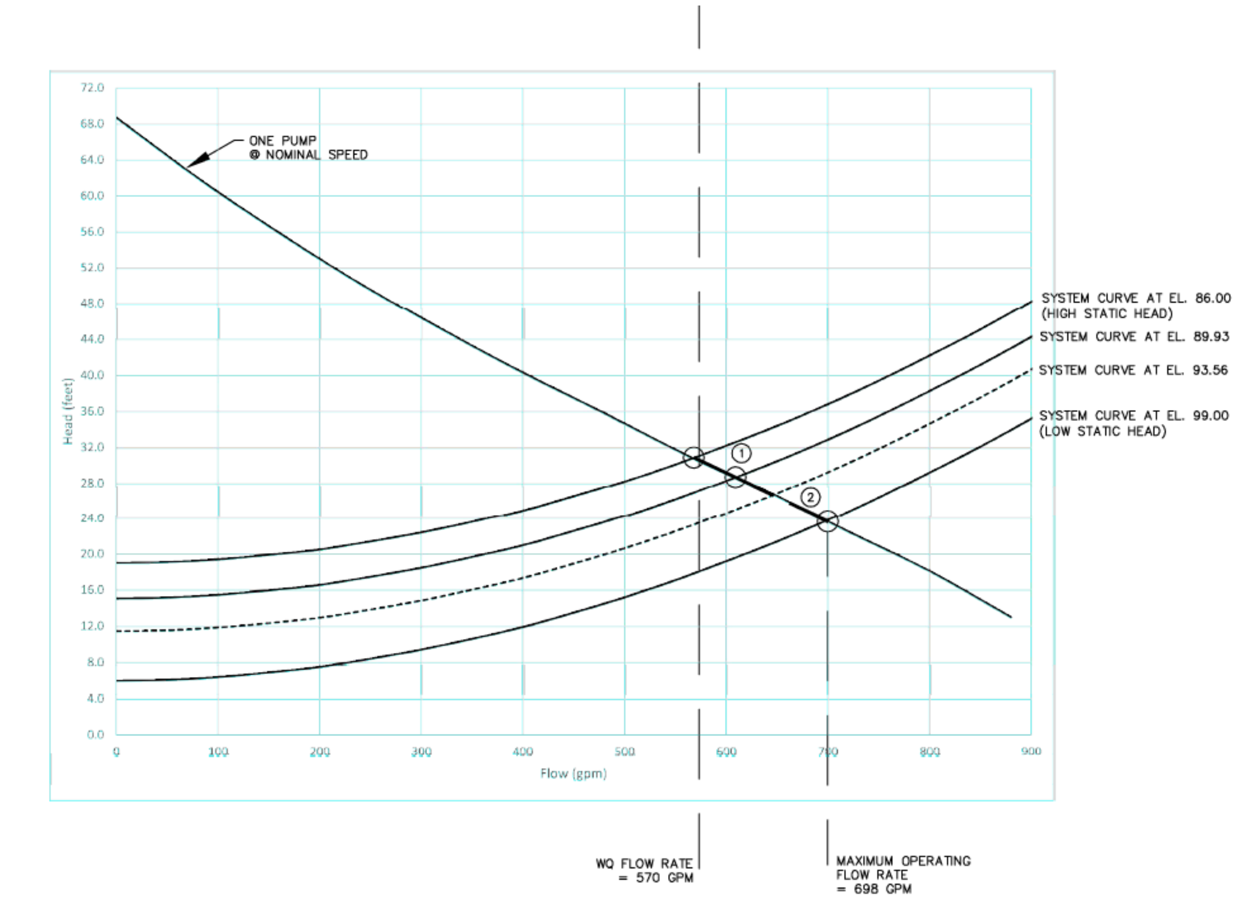
MATERIAL LIST:

1. FLYGT 15-HP SUBMERSIBLE PUMP NP 3153 LT 3~ 416 W/ ELBOW (EPOXY COATED) AND ZINC ANODES
2. SURFACE MOUNTED ALUMINUM HATCH, 48"x72" CLEAR OPENING, PEDESTRIAN RATED, WITH SAFETY GRATE SYSTEM AND 316 SST LOCK, FASTENERS, AND LIFT ASSIST. HATCH SHALL LOCK. HALLIDAY SERIES F1R OR APPROVAL EQUAL
3. 96" PRECAST REINFORCED CONCRETE MANHOLE WITH 144" BASE FOR FLOTATION FOOTING
4. 12" DUCTILE IRON FORCE MAIN
5. FLYGT PUMP LIFT SYSTEM, W/ GRADE 316 STAINLESS STEEL GUIDE ROPE AND CHAIN SLING
6. VERTICAL PIPE SUPPORT. SEE DETAIL 4 ON SHEET SW.19-1T
7. 6" SCHEDULE 80 PVC STILLING WELL
8. 12" x 8" FLANGED DI ECCENTRIC REDUCER
9. JOINT W/ RAM-NECK, TYP.
10. FLEXIBLE RUBBER BOOT TYPE PIPE CONNECTOR W/ GRADE 316 STAINLESS STEEL COMPRESSION RING AND TAKE-UP CLAMP, TYP.
11. 3/4" CRUSHED DRAIN ROCK
12. MIRAFI 140 GEOTEXTILE OR APPROVED EQUAL
13. CONCRETE FILL
14. 4" SCH40 PVC AIR VENT
15. 12"x12" PRECAST CONCRETE DROP INLET W/ H20-RATED, CAST-IN FRAME AND GRATE
16. LINK SEAL PIPE TO MANHOLE CONNECTOR
17. 2" GRADE 316 STAINLESS STEEL GUIDE RAIL W/ INTERMEDIATE BRACKET
18. 120" PRECAST REINFORCED CONCRETE MANHOLE
19. 30" CAST IRON MANHOLE FRAME AND COVER, W/ LOCKING MECHANISM
20. 12" APCO FLANGED SWING CHECK VALVE W/ LEVER AND SPRING
21. 12" DEZURIK FLANGED PLUG VALVE W/ MANUAL ACTUATOR & HANDWHEEL
22. DR17 HDPE 90° BEND
23. 12" KRAUSZ HYMAX GRIP COUPLING
24. DR17 HDPE 12" X 8" REDUCER
25. GLOBAL WATER WL430 WATER LEVEL SENSOR (TRANSDUCER)
26. 12" RESTRAINED FLANGE ADAPTER, EBAA SERIES 2100 OR EQUAL
27. DR17 HDPE 45° BEND
28. PIPE SUPPORT. SEE DETAIL 1 ON SHEET SW.19-1T
29. 3" DRAIN LINE W/ P-TRAP
30. 12" FLANGED DUCTILE IRON 90° BEND
31. 12"x12"x12" FLANGED DUCTILE IRON TEE
32. INTERNALLY WEIGHTED NON MERCURY MECHANICAL FLOATS
33. 12" FNW FLANGED CAST IRON GLOBE VALVE, FIGURE 661 (THROTTLING VALVE)
34. 12" HDPE FLANGE W/ DI BACKUP RING
35. 30" PRECAST CONCRETE MANHOLE RINGS
36. 48"x72" PRECAST CONCRETE MANHOLE RISERS

Example 5: Pump Operation Curves (1 Pump)

Curves provide system operation points and range

(CREDIT: Figures provided by BKF Engineering, for illustrative purposes only.)



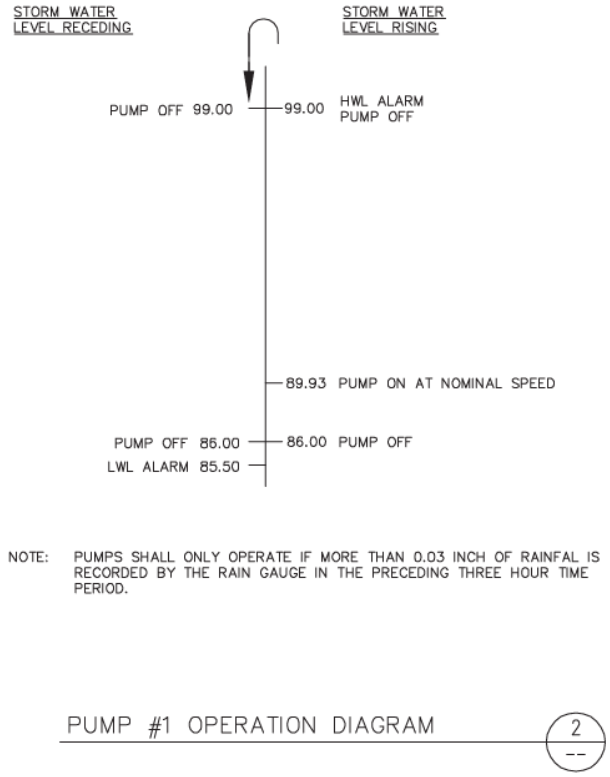
PUMPS OPERATING RANGE:

- ZONE 1: ONE PUMP ON AT 89.93 DOWN TO 86.00 | NOMINAL, FIXED SPEED (60.0 Hz) | 86.00 ≤ WL ≤ 89.93 | 560 ≤ FLOW ≤ 610 GPM
- ZONE 2: ONE PUMP ON AT 89.93 UP TO 99.00 | NOMINAL, FIXED SPEED (60.0 Hz) | 89.93 ≤ WL ≤ 99.00 | 610 ≤ FLOW ≤ 698 GPM

PUMP #1 CURVES VS SYSTEM CURVES DIAGRAM 3 / --

Example 6a: Pump Operational Diagram (1 Pump)

(CREDIT: Figures provided by BKF Engineering, for illustrative purposes only.)



Example 6b: Lift Structure Design Parameters (1 Pump)

(CREDIT: Figures provided by BKF Engineering, for illustrative purposes only.)

WATER QUALITY FLOW RATE:	570 GPM (OR 1.27 CFS)
MAX PUMPS OPERATING FLOW RATE:	698 GPM
TOTAL DYNAMIC HEAD (TDH):	27.1 FT @ 570 GPM
NUMBER OF PUMPS:	2
PUMP DESIGN POINT:	27.1 FT @ 570 GPM
MAX VELOCITY IN FORCE MAIN:	3.5 FT/SEC
WET WELL DIAMETER:	7 FT
PUMP DOWN DISTANCE:	3.9 FT
MAX NUMBER OF STARTS:	9/HR
(ALTERNATING OPERATION OF PUMPS DISREGARDED)	
NPSH REQUIRED:	14.8 FT
NPSH AVAILABLE:	29.2 FT
NPSH SAFETY MARGIN:	5 FT

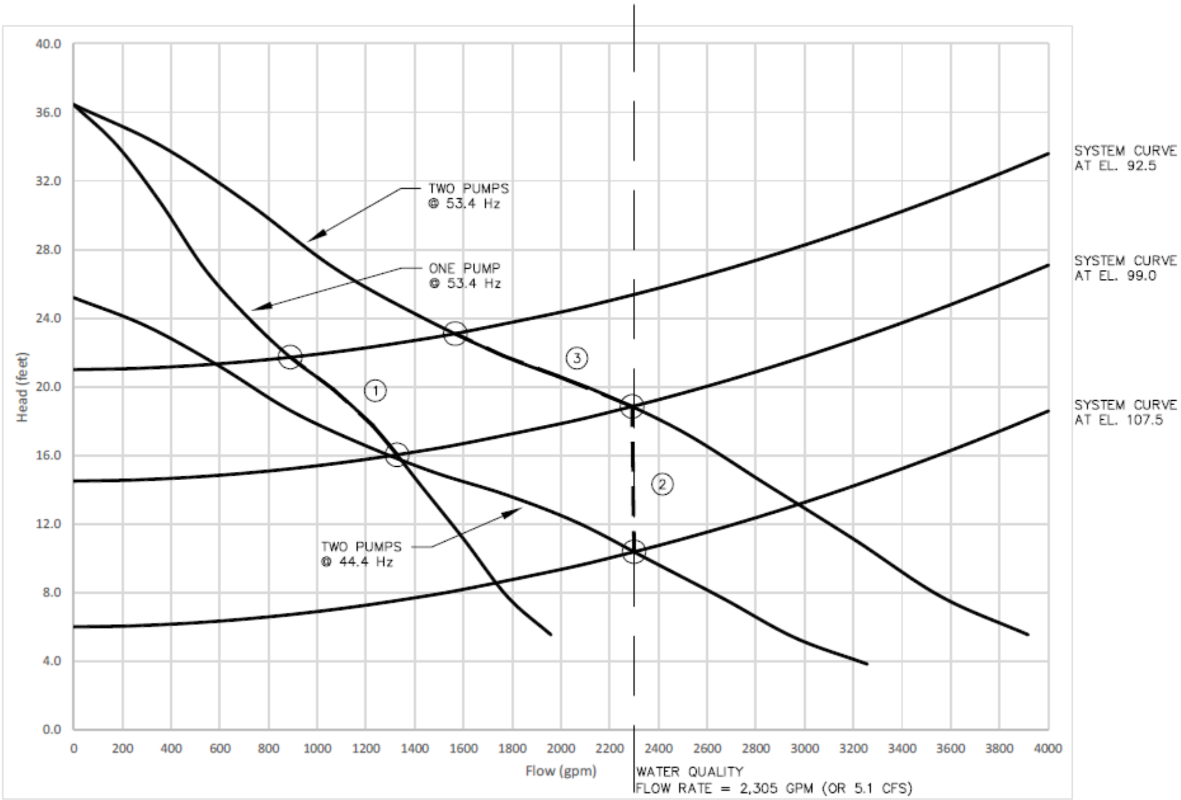
REFER TO PUMP STATION'S BASIS OF DESIGN REPORT FOR MORE INFORMATION.

PUMP STATION #1 MAIN DESIGN PARAMETERS (1 / --)

Example 7: Pump Operation Curves (2 Pumps in Parallel w/ VFD).

Curves provide system operation points and range.

(CREDIT: Figures provided by BKF Engineering, for illustrative purposes only.)

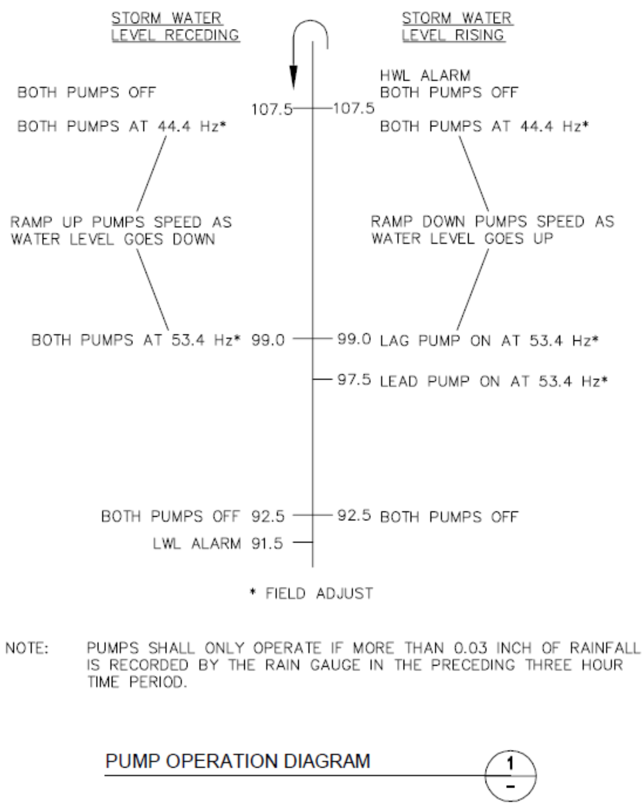


PUMPS OPERATING RANGE:

– ZONE 1: ONE PUMP AT 53.4 Hz	92.5 ≤ WL ≤ 99.0	890 ≤ FLOW ≤ 1,320 GPM
– ZONE 2: TWO PUMPS AT ADJUSTED SPEED (44.4 TO 53.4 Hz)	99.0 ≤ WL ≤ 107.5	FLOW = 2,305 GPM
– ZONE 3: TWO PUMPS AT 53.4 Hz	92.5 ≤ WL ≤ 99.0	1,550 ≤ FLOW ≤ 2,305 GPM

Example 8: Pump Operational Diagram (2 Pumps in Parallel w/ VFD)

(CREDIT: Figures provided by BKF Engineering, for illustrative purposes only.)



3. In-Facility Flow Distribution Details

In this document, the term 'flow distribution' is used to describe flow splitting structures that proportionally 'equalize' the distribution of stormwater throughout a centralized facility, including to various bioretention basins, or cells, within a facility. 'Flow distribution' typically occurs after 'flow diversion' diverts the WQ storm to the facility.

This section describes the required design details needed for the successful design and review of common in-facility flow distribution approaches to route flow to multiple bioretention cells. Flow distribution is an important design element to ensure the flow and volume directed to individual bioretention cells are proportionally split among variously sized cells to ensure equivalent treatment loading and facility activation. The type and quantity of flow distribution structures are dependent on the unique centralized facility layout and configuration.

Common flow distribution structures include, but are not limited to:

- Gravity distribution (passive):
    - Flow-splitting structure or vault
    - In-line control weirs
    - Side weirs
- Pressurized distribution (active):
    - Valve vaults with globe valves
    - Force main networks with globe valves

a. Gravity Distribution (Passive Distribution)

Flow distribution via gravity-based piped storm networks or open channels is typically achieved by structures that are designed to regulate the distribution of the stormwater flow based on physical controls with set invert elevations or pipe dimensions. One example is a flow-splitting structure where the design storm is equally divided amongst several pipes, or orifices, of the same diameter serving similarly-sized bioretention cells. Alternatively, the design storm could be proportionally divided among pipes of different sizes, or orifice diameters, serving variably-sized bioretention cells. Another example is the use of in-line or side weirs within a channel where the weir invert elevations or the flow-notch cross-sectional area can be used to control the flow into the adjacent bioretention cells.

DESIGNER CHECKLIST

Provide construction-level drawings for each type of flow distribution infrastructure proposed within the centralized facility. Provide plan and section views, details, and accompanying required information, as applicable.

- ☐ Plan view showing the layout and interconnectivity of all distribution components including weirs, channels, swales, pipes, valves, gates, flow spreaders, and any required maintenance access per local code, as applicable. Include the following information for each proposed distribution component:
  - ☐ Pipe, orifice, channel, and swale sizing for distribution of variable flow rates, as applicable
  - ☐ Weir invert elevation and weir notch sizing for distribution of variable flow rates, as applicable
- ☐ Section view that clearly relates all elevations and dimensions of distribution components including weirs, channels, swales, pipes, valves, gates, flow spreaders, and any required maintenance access per local code, as applicable
- ☐ Details of all distribution components that include the manufacturer, model, material, and dimensions, as applicable
- ☐ In-field adjustment and operational plan for flow control valves, as applicable

DESIGNER NOTES & GUIDELINES:

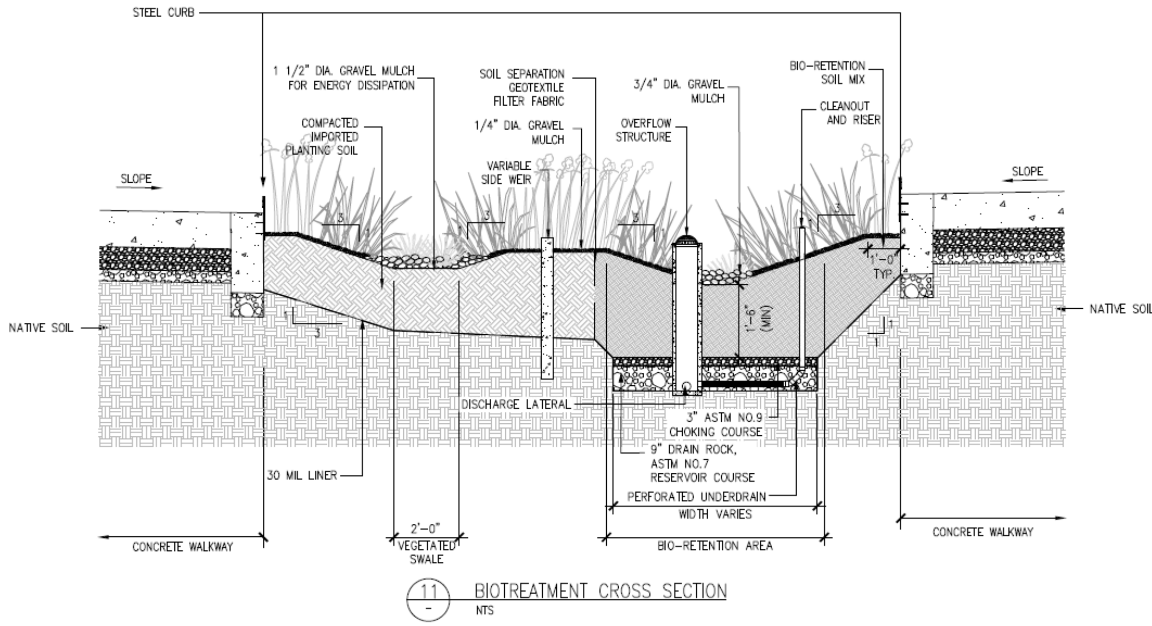
- The use of gravity distribution may require adjustable orifice plates or adjustable weir plates to ensure simultaneous and proportional activation.
- Accurate flow splitting requires precise construction, field testing, and likely post-construction adjustment. Specifications shall adequately incorporate in-field flow testing to verify flow.
- The project team must submit customized design documents and drawings showing project-specific internal flow distribution given variable runoff volumes and flow rates, along with locations, dimensions, materials, and configurations of all components.

EXAMPLES:

Example 9 to **Example 13** represent the level of detail and design information necessary for review of in-facility gravity distribution.

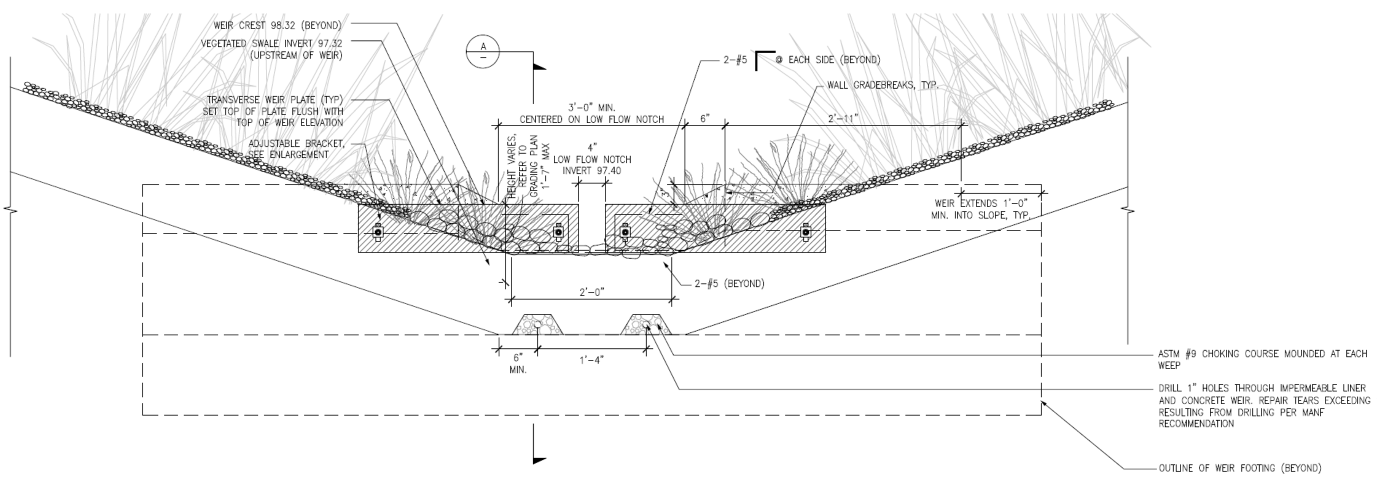
Example 9: Conveyance Channel with Adjustable Side Weirs to Bioretention

(CREDIT: Figures provided by CMG and Freyer & Laureta Engineering for illustrative purposes.)



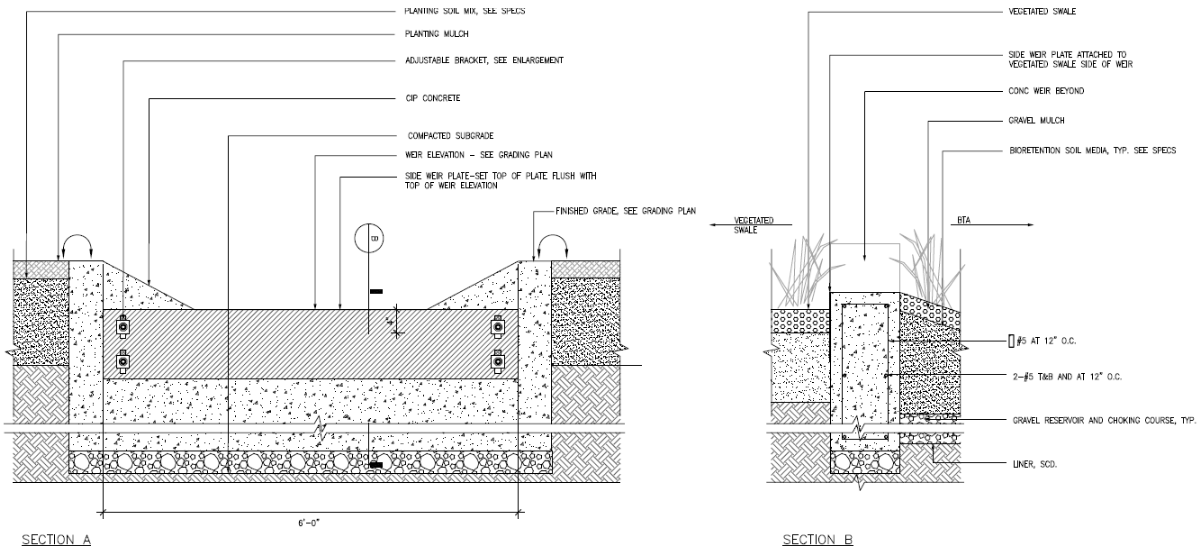
Example 10: Conveyance Swale with Adjustable Control Weir

(CREDIT: Figures provided by CMG and Freyer & Laureta Engineering for illustrative purposes.)



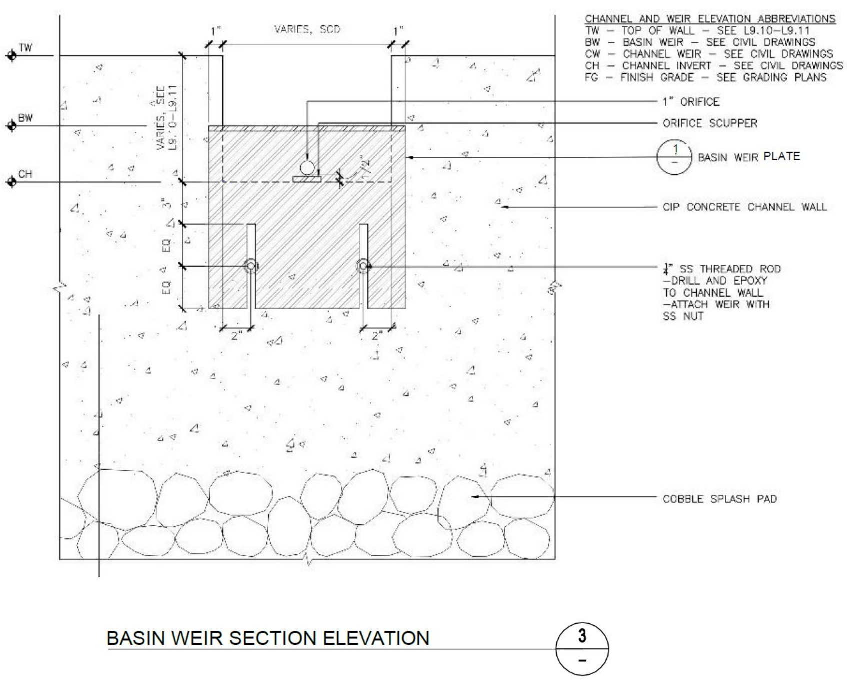
Example 11: Conveyance Swale with Adjustable Side Weir

(CREDIT: Figures provided by CMG and Freyer & Laureta Engineering for illustrative purposes.)



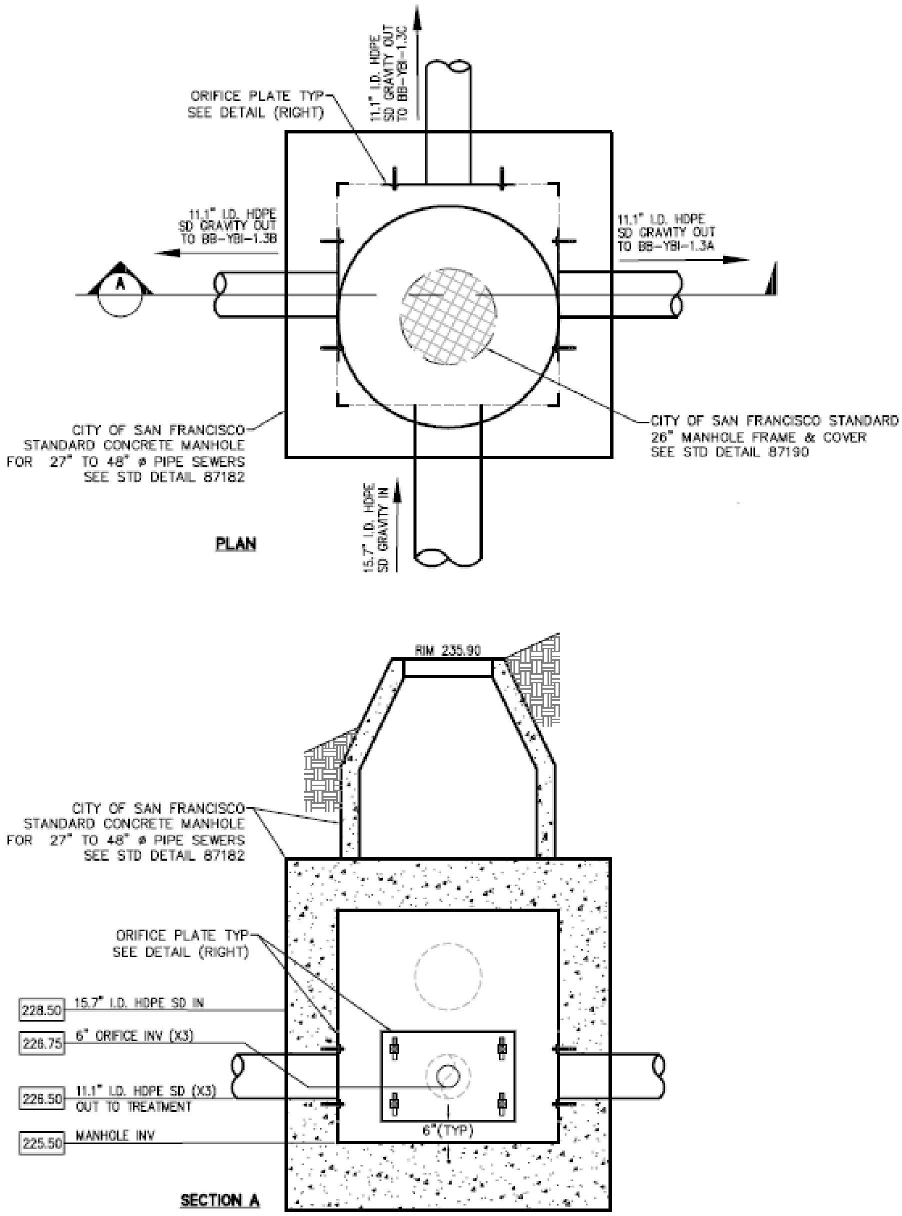
Example 12: Conveyance Channel with Adjustable Side Weir Detail

(CREDIT: Figures provided by CMG and BKF Engineering for illustrative purposes.)



Example 13: Flow Splitter Structure with Adjustable Orifice Plates

(CREDIT: Figures provided by BKF Engineering for illustrative purposes.)



b. Pressurized Distribution (Active Distribution)

Flow distribution within a pressurized system (i.e., force main with flow control valves) is typically achieved by initially sizing the pipes of the distribution network to carry the desired flow to each bioretention cell. Advanced hydraulic modeling is required to calculate proper pipe network sizing and layout design.

To refine the flow from the pipe network to each cell, globe valves can be used to proportionally adjust and control the flow and overall volume discharged into each bioretention cell. They can be incorporated into the valve vault or within the pipe network such that the valve is located adjacent to the bioretention cells. The globe valve is a commonly used and secondary method of fine-tuning the flow splitting during post-construction verification and for possible future adjustment.

NOTE: SFPUC requires the use of globe valves rather than gate valves for flow control in a pressurized force main.

DESIGNER CHECKLIST

Provide construction-level drawings with the information below for each type of flow distribution infrastructure proposed within the centralized facility. Provide plan and section views, details, and required accompanying information, as applicable.

Valve Vault with Globe Valves

- ☐ Plan view showing the layout of vault, check valves, globe valves, and appurtenances, as applicable. Include the following information for each proposed distribution component:
  - ☐ Layout and sizing of pipes, fittings, and valves
  - ☐ Maintenance access per local code
- ☐ Section view showing elevations and dimensions of vault, pipes, check valve, globe valves, and appurtenances, as applicable.
  - ☐ Layout and sizing of pipes, fittings, and valves
  - ☐ Vault drainage connections to lift structure / wet well, as needed
  - ☐ Vault inundation elevation if connected to lift structure / wet well
  - ☐ Maintenance access per local code
- ☐ Specifications of all distribution components that include the manufacturer, model, material, NEMA rating, and dimensions, as applicable
- ☐ Operational Flow Equalization Plan for setting flow control globe valves, as applicable

Force Main Network with Globe Valves

- ☐ Plan view showing the layout and routing of all distribution pipe networks including pipes, globe valves, and air release valves, as applicable. Include the following information for each proposed distribution component:
  - ☐ Pipe network layout and sizing for distribution of design flow rates
  - ☐ Globe valve and valve box details, as applicable
  - ☐ Maintenance access per local code
- ☐ Profile of distribution components including pipes, pipe crossings, globe valves, appurtenances, and required maintenance access per local code (as applicable)

☐ Details of all distribution components that include the manufacturer, model, material, and dimensions (as applicable)
☐ Operational Flow Equalization Plan for setting flow control globe valves (as applicable)

DESIGNER NOTES & GUIDELINES:

The project team must submit customized design documents and drawings showing project-specific internal flow distribution given variable runoff volumes and flow rates, along with locations, dimensions, materials, and configurations of all components.

EXAMPLE:

Example not provided due to wide range of system configurations.

4. Enhanced / Non-Standard Bioretention Design Details

This section provides examples of potential non-standard centralized facility or bioretention design criteria. Non-standard design elements must be closely coordinated with, and approved by, SFPUC early during the master planning process and prior to improvement permitting. Non-standard design elements must be approved prior to submitting the initial Preliminary SCP.

The SFPUC supports the continued evolution of centralized facilities through innovative design that works within the unique context of each site and redevelopment area. SFPUC may allow non-standard or contextually appropriate 'enhanced' bioretention system design criteria that fall outside the focus of typical detailing and design criteria listed in the Green Infrastructure Typical Details (GITDs).

Potential non-standard bioretention design approaches include, but are not limited to:

a. **Performance-Based Design Enhancement:** Context-specific design changes to typical details and guidelines may be allowed by SFPUC which enhance the design-form while also improving the performance of the facility. Potentially allowed enhancements and associated performance goals include:

    - Pretreatment conveyance swale → Reduced bioretention sizing ratio
    - Enhanced grading and landforming → Increased maximum and average ponding depths via varied bottom topography
    - Enhanced grading and landforming → Steepened basin side slopes via durable edge features or hardscapes to increase active bioretention volume

b. **Placemaking and Urban Design Enhancement:** Context-specific design elements incorporated into typical details that add a multi-function benefit separate from SMO compliance are supported. The elements and features incorporate enhanced connection to the adjacent urban programming, provide education of facility function, and create placemaking opportunities that promote better user experience and site programming. NOTE: These elements are typically not necessary components for centralized facility treatment performance or benefit compliance.

    - Decking and boardwalks over bioretention
    - Gathering spaces and seating via functional edge design
    - Integration of art and educational signage
    - Integration of trees in centralized facility

Approval Process for the Allowance of Enhanced / Non-Standard Bioretention Design:

- Infrastructure Plan: Project Team shall schedule a design coordination meeting to discuss any proposal to implement a centralized facility for stormwater management compliance. Coordination required with or without non-standard design elements.

- Non-standard Design Concept(s) Allowance:
    - Provide concept-level drawings and details for any proposed non-standard bioretention facility design to SFPUC for review and feedback.

- Master Plan and Basis of Design (BOD): Allowed non-standard concept shall be advanced during master planning and basis of design with SFPUC oversight. Master Plan and BOD shall incorporate non-standard design element(s).
    - Upon SFPUC determined allowance of an enhanced concept design, SFPUC will coordinate with Project Team regarding specific design criteria for the allowed non-standard design requirements (if no precedent set).

- Improvement Permit and Construction Documents:
    - The project team must submit fully customized drawings, details, and design documentation clearly showing the enhanced non-standard project-specific components along with all items shown on the applicable GITDs for bioretention.
    - Drawings and details must, at a minimum, show the information and level of detail provided in the GITDs. Refer to the GITDs for bioretention basins (BB 1.2 to BB 2.2) and bioretention components (BC 1.1 to BC 7.3) for additional information.

- **NOTE:** SFPUC reserves the right to change a non-standard design allowance at any point of the planning or Improvement Plan process.