San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

Rainwater Harvesting for SMO Compliance: Guidance and Checklists

CONTENTS

This document has been prepared by the San Francisco Public Utilities Commission's (SFPUC) Urban Watershed Planning Division (UWPD) to provide Project Teams with detailed guidance regarding the level of design information necessary for successful review of a rainwater harvesting (RWH) system for compliance with the City of San Francisco's Stormwater Management Ordinance (SMO).

- **PART I** provides a checklist for all RWH system documentation and drawings to be provided with the project's Stormwater Control Plan (SCP).
- **PART II** provides checklists and examples of specific required Plumbing Plan details and diagrams.

RWH SYSTEM CLASSIFICATIONS:

For the purposes of SCP review, RWH systems have been classified into two categories – those that DO NOT require (i.e., are exempt from) San Francisco Department of Public Health (SFDPH) Operational Permits, and those that DO require Operational Permits under SFDPH Article 12C. Generally:

- **NON-PERMITTED SYSTEMS** reuse rainwater for subsurface or surface irrigation only (not spray irrigation);
- **PERMITTED SYSTEMS** reuse rainwater for indoor use or spray irrigation.
  - Note: Residential properties of 2 units or less may be exempt from Article 12C.

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

PART I – SCP Submittal Checklist for RWH Systems

A. Provide the information below per *SCP Instructions* (under 'SCP Materials and Resources').

Documents marked:
- **[FSCP]** must be provided with Final SCP submittal; provide with Preliminary SCP if available.
- **[OP]** must be provided for systems that require an SFDPH Operational Permit (OP); provide excerpts from Operational Permit application materials.

Stormwater Management Plan (SMP)

- ☐ **Plan:** RWH cistern footprint
- ☐ **Plan:** DMA(s) draining to cistern
- ☐ **Plan:** Landscape zone(s) to be irrigated by RWH system, as needed
- ☐ **Area Summary Table:** Area(s) draining to the cistern
- ☐ **Area Summary Table:** Landscape areas irrigated by RWH system, as needed
- ☐ **Detail Sheet:** Copy of 'Cistern Detail' (plan & section)
- ☐ **Detail Sheet:** Copy of 'RWH System Process Flow Diagram'
- ☐ **Detail Sheet:** Copy of 'RWH System Schematic Diagram'

Appendix A (Calculation Spreadsheets)

- ☐ CSS BMP Sizing Calculator (print pages 1-2)
- ☐ RWH Calculator (print pages 1-4)

Appendix B (Supporting Documentation)

- ☐ Manufacturer cut sheets for proprietary products (i.e., pre-filter, 3-way 'failsafe' bypass valve, etc.)
- ☐ Copy of 'Non-Potable Water Budget Application' (submit to the SFPUC Water Reuse Program prior to Preliminary SCP submittal)
- ☐ **[OP]** Owner Letter of Understanding[1] (stand-alone[2] permitted systems only)
- ☐ **[FSCP] [OP]** Copy of San Francisco Department of Public Health (SFDPH) Engineering Report (submit SFDPH-approved report)
- ☐ **[FSCP] [OP]** Copy of SFDPH RWH Engineering Report system design approval letter

Appendix C (Construction Documents)

Provide all information listed below unless it is not applicable. If not applicable, provide explanation.

- ☐ **Architectural Plans** showing cistern location/footprint and maintenance access, treatment & control system location/footprint.

[1] Signed letter from the owner stating: (1) Owner is aware of in-perpetuity maintenance and operator requirements, and (2) Owner will adhere to SFDPH Art 12C Application Packet.

[2] Onsite water reuse systems where the only source is RWH (i.e., no graywater or other onsite sources). These systems may operate seasonally unless a potable water make-up supply is proposed.

- ☐ **[FSCP] Landscape Irrigation Plans** showing landscape zones served by RWH System, and irrigation type (subsurface, drip, spray, etc.), as needed.
- ☐ **Plumbing Plans:** (Refer to Part II 'Plumbing Plan Details & Diagrams' below, as available)
  - ☐ 'Construction-level Cistern Detail'
  - ☐ 'Stormwater Riser Diagram'
  - ☐ 'RWH System Process Flow Diagram'
  - ☐ 'RWH System Schematic Diagram'
  - ☐ **[FSCP]** Horizontal Floor Plans (cistern level(s) and roof-level(s))
  - ☐ **[FSCP]** 'Program Logic Control' Narrative (description of operational logic that coordinates with 'Schematic Diagram')

B. Confirm the following Quality Assurance actions:

- ☐ All required RWH information listed above are coordinated with the design in the attached CD Plans.
- ☐ All Calculator inputs are coordinated with the SMP and CD Plans.
- ☐ Irrigation and indoor non-potable demand results from Sizing Calculator are coordinated with the 'Non-Potable Water Budget Application.'

PART II – RWH Plumbing Plan Details and Diagrams:

The following RWH Plumbing Plan details and diagrams are **required for SCP review and approva**l.

1. RWH Cistern Detail
2. Stormwater Riser Diagram
3. RWH System Process Flow Diagram
4. RWH System Schematic Diagram
    4a. Non-Permitted Systems
    4b. Permitted Systems

A. User Guide:

'Designer Checklists', 'Designer Notes & Guidelines', and embedded 'Examples' of the required details and diagrams are provided to ensure that all Plumbing construction documents submitted with the SCP include all information required for review.

DESIGNER CHECKLISTS:
Designer Checklists are provided for each required diagram to assist the Project Team streamline review and approval by SFPUC. Project Team shall confirm each item has been provided. Note: Additional information may be required within diagrams as required for review by SFDPH or other agencies.

DESIGNER NOTES & GUIDELINES:
The Design Professional should review the design guidance provided under the Designer Notes & Guidelines section; however, he/she is solely responsible for ensuring that the system meets all local Code.

EXAMPLES:
Detail and diagram examples are for guidance only, to convey the required information and level of effort. The Design Professional shall ensure that all diagrams are customized to site conditions and meet all local Code. The Design Professional shall use standard terminology, abbreviations, symbols, and linetypes in all diagrams.

When preparing the CDs and SCP, the Design Team should be advised that:

- An AutoCAD DWG file containing standard RWH system plumbing symbols ('RWH Plumbing Symbol Legend') to assist designers in the preparation of the detail and diagrams is available at http://sfpuc.org/smr under 'SCP Materials and Resources' (see also Attachment A).

- The 'Example' detail and diagrams are not provided in AutoCAD format as they illustrate one typical RWH system configuration, while documents submitted must be customized to the site approach and design.
- For more complex systems (e.g., those that also reuse graywater, those that meet indoor non-potable demands, etc.), additional system components should be included as appropriate to illustrate the complete water reuse system.

As a reminder, the SMO review focuses on RWH system approach, sizing, and routing only (see SCP Statement of Certification Note 7). Other information (e.g., Treatment & Control System information in the Schematic Diagram, etc.) is provided to show the level of design information needed to build system. Items noted with an * are "Review by others."

B. RWH Details and Diagrams

The following RWH Details and Diagrams are required as part of the construction documents and SCP.

1. RWH Cistern Detail

DESIGNER CHECKLIST:

Provide a construction-level Cistern Detail with the information below. The cistern detail shall be focused on sizing and routing information. Structural support, seismic anchoring, backfill requirements and related information shall not be covered in this detail.

- ☐ Cistern material and manufacturer and make/model, as applicable
- ☐ Cistern liner or coatings if used
- ☐ Cistern access and ladder or other cistern access components, per applicable code
- ☐ Plan view with interior dimensions and pipe penetration locations
- ☐ Section A-A view with:
    - ☐ Water level elevations:
        - ☐ Low water level (i.e., 'pump off' level, 'makeup on' level, etc.)
        - ☐ High water level (i.e., overflow invert, float switch level, etc.)
        - ☐ 'Active depth' (i.e., low water level to high water level)
        - ☐ Other levels, as needed (e.g., alarm levels, 'makeup off' level, etc.)
    - ☐ Volumes
        - ☐ 'Active volume' (i.e., volume from low water level to high water level)
        - ☐ Maximum volume (i.e., total air space/freeboard inside of cistern)
    - ☐ Cistern components:
        - ☐ Water level controls (e.g., level sensors, float switches, etc.)
        - ☐ Calming inlet, if included
        - ☐ Floating filter, if included
        - ☐ Pump, if inside cistern
        - ☐ Air vent
        - ☐ Drain valve, if applicable
        - ☐ Other components, as applicable
    - ☐ Pipe and access penetrations through cistern (e.g., inlets, outlets, overflow, vent, etc.):
        - ☐ Elevations/inverts of all piping
        - ☐ Pipe sizes and materials
        - ☐ Cistern vent details, including screen.
- ☐ Section B-B view as needed to show features that cannot be seen on Section A-A view due to irregular shape or configuration of cistern.

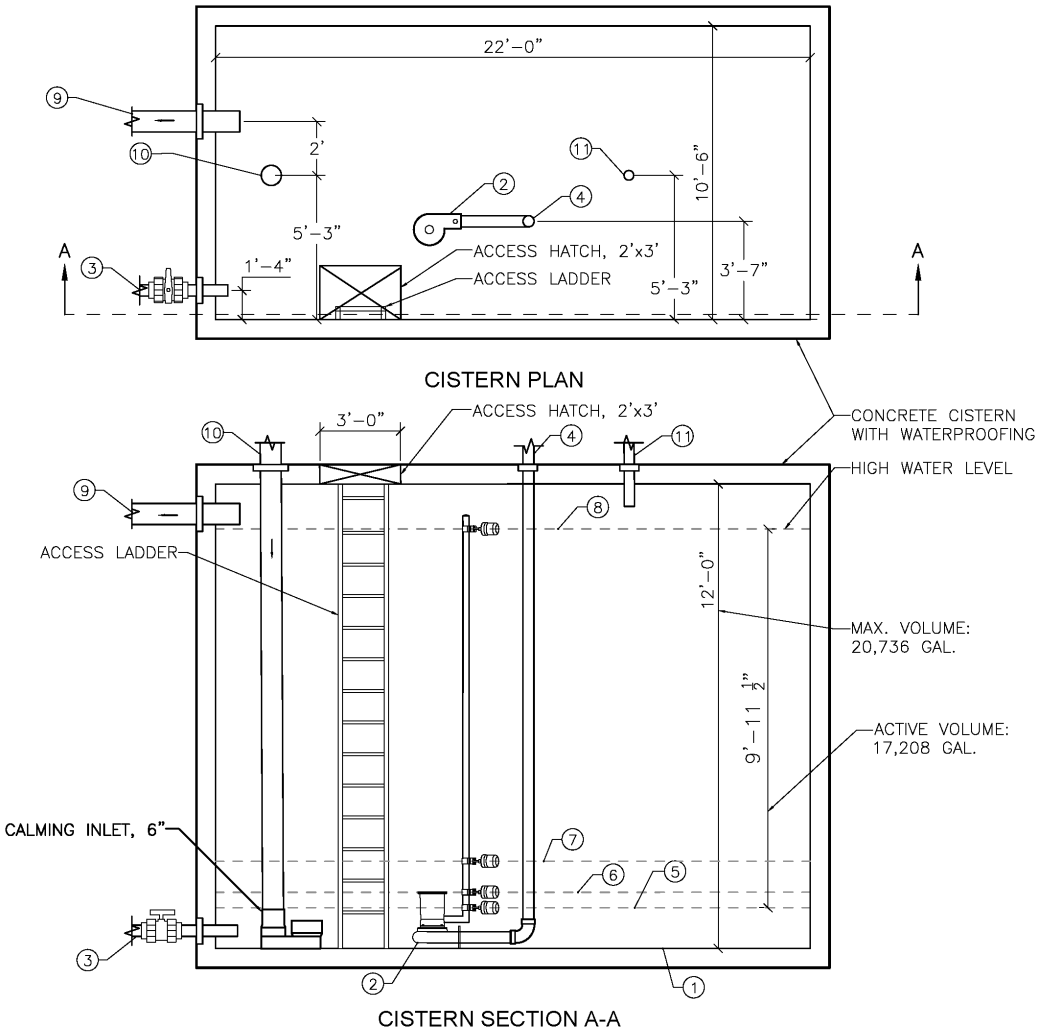
DESIGNER NOTES & GUIDELINES:

- Maintenance access must have minimum 24" diameter opening per CA Plumbing Code Chapter 16. Designer shall consider maintenance and access for equipment from the side and above as applicable.
- Cistern shall be designed and specified to meet all applicable building, structural, seismic, plumbing, and other requirements.
- The cistern dimensions as well as required maintenance access shall be considered in the siting of the cistern.

EXAMPLE:

Figure 1 represents the level of design information necessary for successful review and construction of a RWH cistern. RWH cistern designs vary greatly, and SFPUC does not promote any product, technology, or design alternative over others. The Designer shall submit customized detail showing site-specific materials, dimensions, and configurations including pump location, level controls, access hatch location, etc. Plan and section views showing all information from the above Designer Checklist are required; the Design Summary Table is optional, but can be a clear way to organize information. Structural supports, anti-buoyancy footings, subgrade preparation, backfill requirements and other related elements are not covered in this detail but will need to be addressed by the Designer in the Construction Drawings and Specifications.

Figure 1. RWH Cistern Detail Example



DESIGN SUMMARY TABLE

	DESCRIPTION	ELEVATION ABOVE CISTERN FLOOR
①	CISTERN FLOOR	0'–0"
②	SUBMERSIBLE PUMP WITH FLOAT SWITCH ASSEMBLY	0'–0"
③	CISTERN DRAIN PIPE, 2"ø PVC	INVERT: 1 ½"
④	PIPE TO TREATMENT SKID, 2"ø PVC	––
⑤	LOW WATER LEVEL: PUMP OFF/MAKEUP ON	4 ½"
⑥	PUMP ON	6 ½"
⑦	MAKEUP WATER OFF	10 ½"
⑧	HIGH WATER LEVEL: DIVERT TO BUILDING STORM DRAIN	10'–4"
⑨	INCIDENTAL OVERFLOW PIPE, 6"ø PVC	INVERT: 10'–6"
⑩	CISTERN INLET PIPE, 6"ø PVC	––
⑪	CISTERN VENT PIPE, 3"ø PVC	––

NOTE: LAYOUT, MATERIALS, AND DIMENSIONS FOR ILLUSTRATIVE PURPOSES ONLY

2. Stormwater Riser Diagram

DESIGNER CHECKLIST:

Provide a Stormwater Riser Diagram with the information below.

- ☐ Roof drains with unique 'IDs' and 'Catchment Surface Areas' (sf) to RWH cistern
- ☐ Rainwater leader routing from roof to cistern including in-line RWH system components (e.g., pre-filter, bypass valves, etc.).
- ☐ Cistern section with floor level and callout to 'Cistern Detail'
- ☐ Passive overflow routing directed to the City collection system via either:
  - ☐ Gravity overflow piping from cistern
  - ☐ 3-way 'failsafe' bypass valve prior to cistern with gravity bypass piping (before pre-filter recommended) AND incidental overflow piping from cistern to point of discharge
- ☐ Rainwater reuse routing with demand labels (e.g., "To irrigation", "To toilets", etc.)
- ☐ If applicable, connection to graywater / other non-potable reuse system (e.g., "To graywater reuse system," etc.)

DESIGNER NOTES & GUIDELINES:

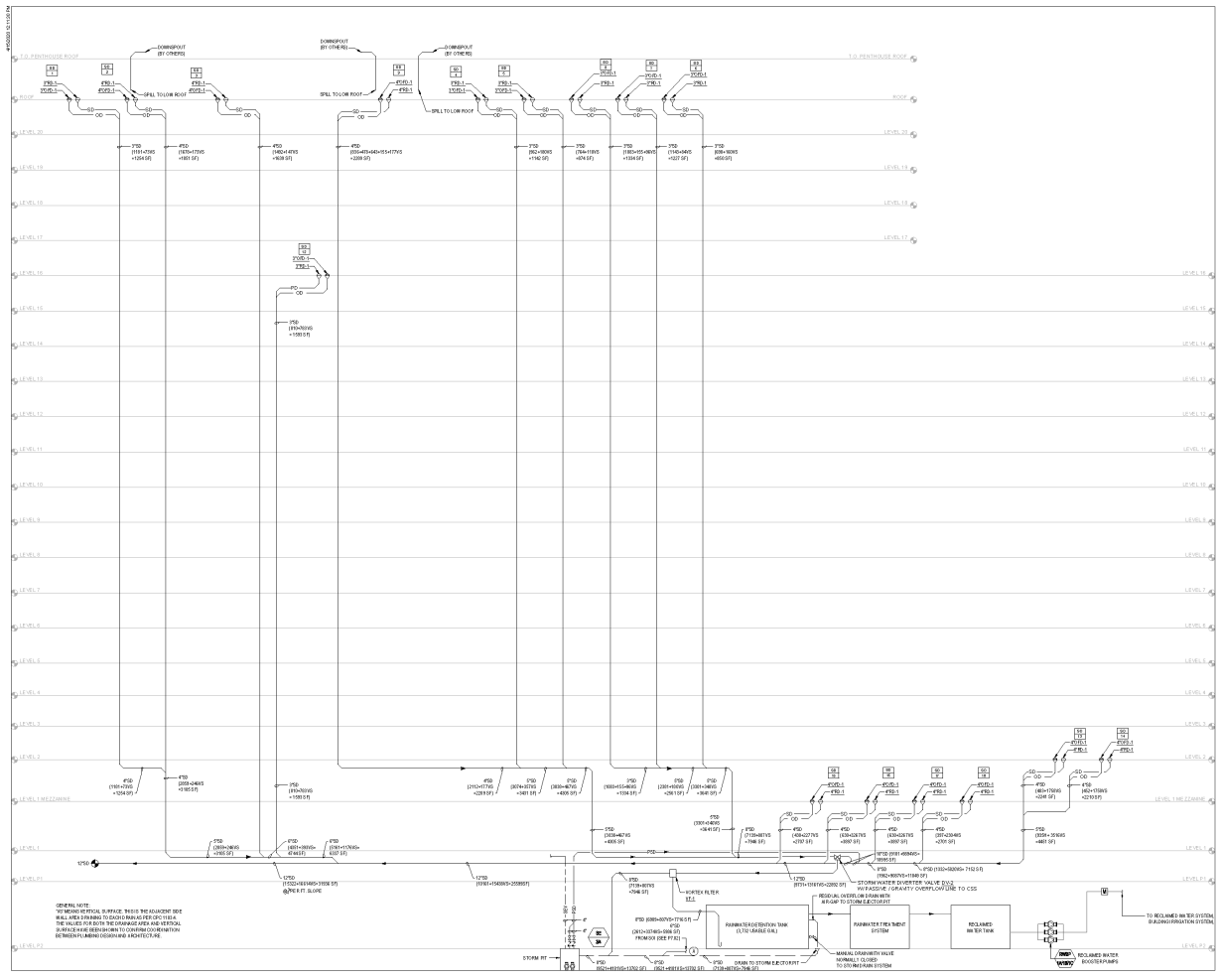
- Overflow from the RWH system must be passive gravity flow to the CSS connection with no pumping, either from the cistern tank or using a three-way 'failsafe' bypass diverter valve installed at an elevation that allows gravity flow to the CSS connection in case of water high levels and power outage.

EXAMPLE:

Figure 2 is an excerpt of a stormwater riser diagram from an approved SCP and is best viewed onscreen; it is not an example diagram created by SFPUC. This example represents the typical level of design information necessary for successful review of a Stormwater Riser Diagram. The Designer shall submit a customized stormwater riser diagram showing project-specific catchment areas, stormwater routing to the cistern through all building floor levels, stormwater routing that bypasses the cistern and connects directly to the site drainage system, and include all information from the above Designer Checklist.

Figure 2. Stormwater Riser Diagram Example

(Zoom image for added legibility)



3. RWH System Process Flow Diagram

The Designer Checklist and Example below apply to RWH-only systems. Please include additional components as needed for water reuse systems that include other onsite sources (e.g., graywater, etc.).

DESIGNER CHECKLIST:

Provide a Process Flow Diagram with the information below.

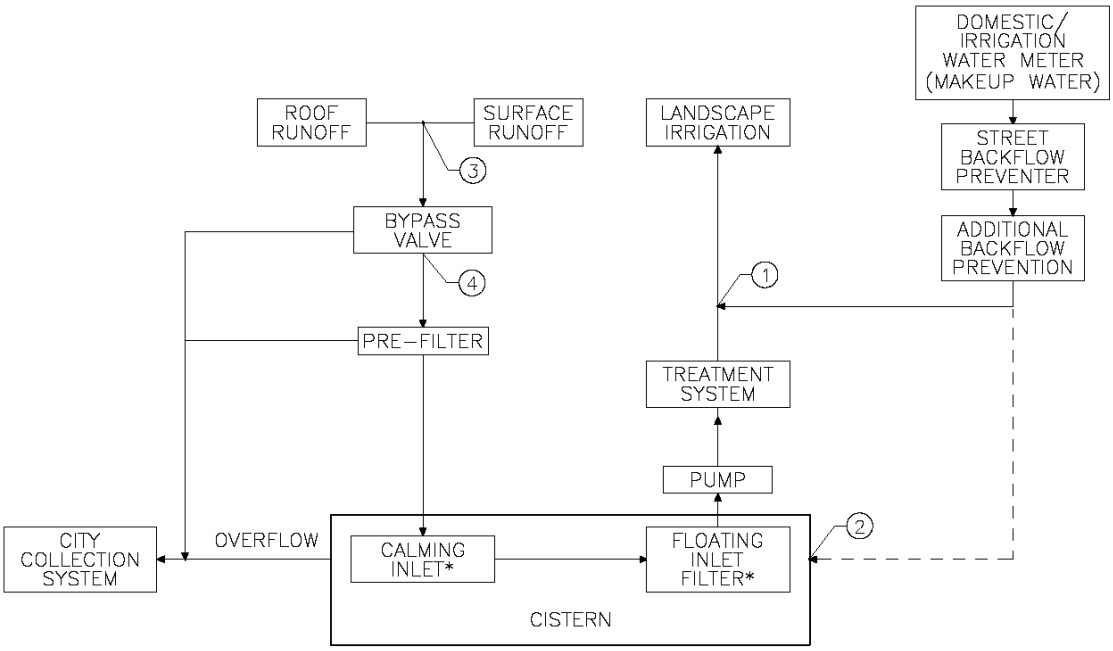
- ☐ Catchment surfaces draining to cistern
- ☐ Pre-filter
- ☐ Passive overflow routing to City collection system (i.e., gravity overflow from cistern and/or 3-way 'failsafe' bypass valve)
- ☐ Cistern
- ☐ Other in-line system components, as applicable
- ☐ Pumps, as applicable (e.g., booster, ejector, etc.)*
- ☐ Treatment system*
- ☐ Rainwater demands (e.g., irrigation, toilets, etc.)
- ☐ Rainwater outflows (e.g., cistern overflow to City collection system, etc.)
- ☐ Makeup water supply connections and backflow prevention, as required*

* Review by others

EXAMPLE:

Figure 3 represents the level of design information necessary for successful review of a RWH System Process Flow Diagram. The system represented in this diagram is for a rainwater to irrigation system. RWH system designs vary greatly and can include additional alternative water sources (e.g., graywater), pre-filters, pump types, etc. The Designer shall submit a customized process flow diagram showing project-specific elements and routing, and include all information from the above Designer Checklist.

Figure 3. RWH System Process Flow Diagram Example



	NOTES
①	MAKEUP METHOD 1 (PREFERRED): INSTALL ISOLATION REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION (RP) DEVICE AND DIRECT CONNECT MAKEUP WATER TO NON–POTABLE PIPE
②	MAKEUP METHOD 2: IF ISOLATION RP IS NOT USED, MAKEUP WATER SHALL BE ADDED TO CISTERN THROUGH AIR–GAP
③	ROOF GUTTER SCREENS ARE RECOMMENDED TO PREVENT TREE LITTER AND OTHER LARGE DEBRIS FROM CLOGGING SYSTEM.
④	BYPASS VALVE IS OPTIONAL IF THERE IS A GRAVITY OVERFLOW FROM THE CISTERN, BUT REQUIRED IF NOT.
*	OPTIONAL ITEMS THAT ARE REQUIRED FOR SYSTEMS COLLECTING WATER FROM HIGH DEBRIS/SEDIMENT SURFACES

4a. RWH System Schematic Diagram: NON-PERMITTED SYSTEMS

The Designer Checklist, Designer Notes & Guidelines, and Example below apply to RWH systems that supply subsurface or drip irrigation.

DESIGNER CHECKLIST:

Provide a Schematic Diagram with the information below for non-permitted systems. Use standard symbols from SFPUC's AutoCAD 'RWH Plumbing Symbol Legend' available at http://sfpuc.org/smr under 'SCP Materials and Resources' (see also Attachment A).

- ☐ **General**
  - ☐ Schematic legend
- ☐ **Cistern**
  - ☐ Rainwater collection pipe routing
  - ☐ Pre-filter on all inlet connections to cistern, with screen size (µm); pre-filter bypass, if included, routed to City collection system (refer to Attachment B: RWH Pre-filter Selection Guidance)
  - ☐ Optional Cistern Components: First flush diverter, floating filter, calming inlet, etc.
  - ☐ Cistern tank with 'Active Volume' callout (gallons or CF)
  - ☐ Plumbing pipe connections to cistern (e.g., inlets, outlets, vents, etc.) with inverts and diameters
  - ☐ Passive overflow routing directed to the City collection system via either:
    - Gravity overflow piping from cistern
    - 3-way 'failsafe' bypass valve prior to cistern with gravity bypass piping (before pre-filter recommended) AND incidental overflow piping from cistern to point of discharge
  - ☐ Cistern drain valve or other method to drain/pump out low water levels in cistern for maintenance or repair
  - ☐ Cistern pump with design pressure in PSI & flow in GPM*
- ☐ **Treatment & Control System**
  - ☐ Treatment skid or filter with screen size (µm) and associated connections and valves*
  - ☐ Makeup water supply (recommended) with makeup control valve and Reduced Pressure Principle (RP) backflow preventer per code.*
    - Connection Method 1: Makeup water plumbed directly into the non-potable pipe after treatment system with a 2nd RP backflow preventer near the point of connection with the non-potable water piping
    - Connection Method 2: Makeup water added to cistern with air gap backflow preventer near the point of connection with cistern
  - ☐ Control panel*

* Review by others

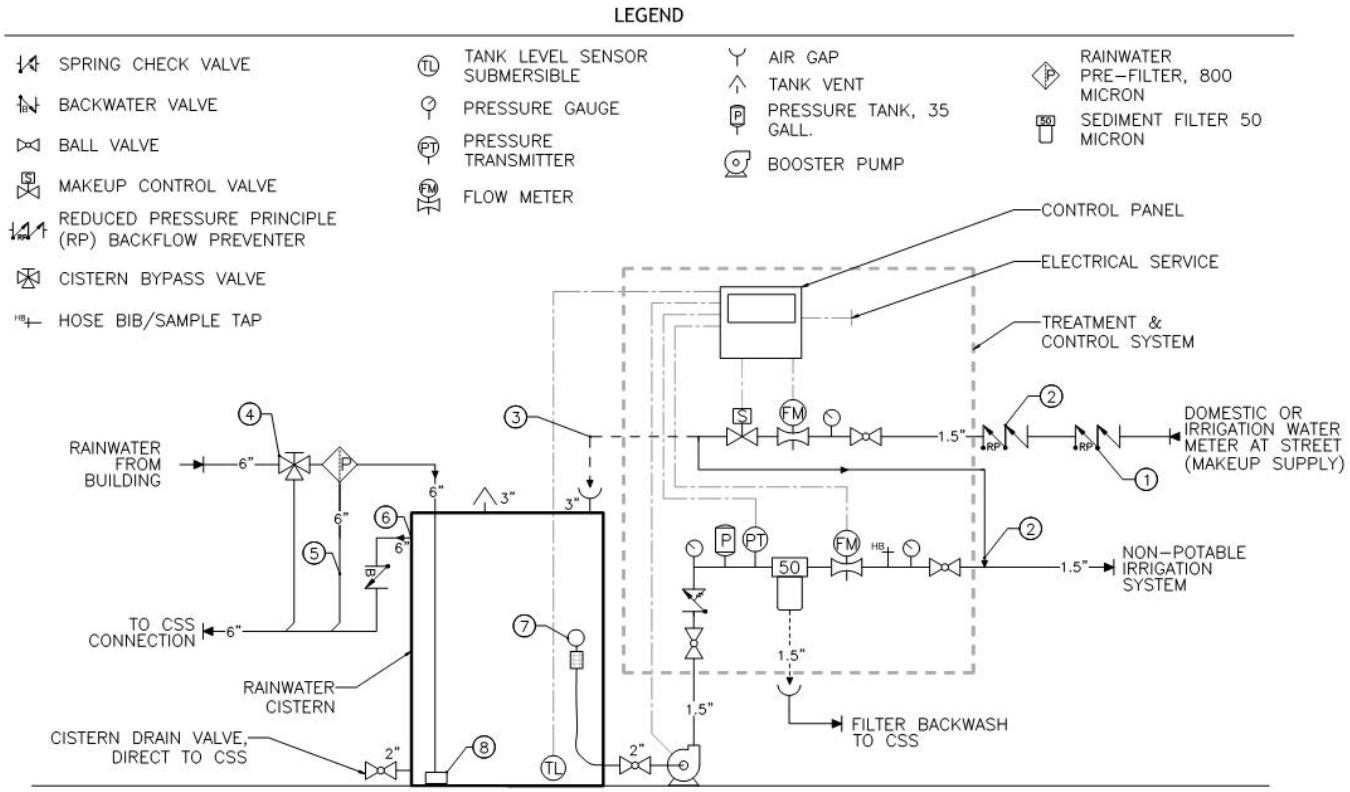
DESIGNER NOTES & GUIDELINES:

- Pre-filter: See Attachment B: RWH Pre-filter Selection Guidance for more information.
- Primary Overflow: To ensure overflow functionality in the case of water high levels and power outage, overflow from the RWH system must be a passive gravity discharge from the cistern tank to the CSS connection with no pumping; or use a three-way 'failsafe' bypass diverter valve installed at a floor elevation that allows gravity flow to the CSS connection.
- Incidental Overflow: Nuisance overflows upon activation of primary overflow may be directed to sump / ejector pump, floor sink, etc.
- Treatment and Control System: Ensure that treatment and control system design include:
    - Appropriate shutoff valves, pressure gauges, and hose bibs/sample taps to facilitate the maintenance, drain-down and repair of treatment system piping or components
    - Check valve to prevent backflow from treatment system to cistern
    - Sediment filter screens that meet irrigation system needs (20 – 50 µm recommended) and code requirements (100 µm per CA Plumbing Code Chapter 16); backwash routed to City collection system, if applicable. Designer to consider the type of irrigation fixtures to determine the level of filtration to avoid clogging of the system components.
    - Control panel connections to all control & monitoring equipment (e.g., pumps, valves, sensors, meters, etc.)
    - Cistern pump sized to provide sufficient pressure and flow to the irrigation system per irrigation designer specification.
    - Gravity overflow backwater valve (per CA Plumbing Code Chapter 16)
- Makeup Water: Locate makeup water RP backflow preventer within 25 feet of irrigation or domestic water meter per SFPUC *Rules and Regulations Governing Water Service to Customer*.

EXAMPLE:

Figure 4 represents the level of design information necessary for successful review of a RWH System Schematic Diagram. The system represented in this diagram is for a rainwater to irrigation system. RWH system designs vary greatly and can include additional alternative water sources (e.g., graywater), demands (e.g., toilet flushing), treatment equipment, controls, etc. The Designer shall submit a customized system schematic diagram showing project-specific equipment, controls and plumbing connections, and include all information from the above Designer Checklist.

Figure 4a. RWH System Schematic Diagram Example



SYSTEM SPECIFICATIONS

PRE-FILTER SCREEN SIZE	800 µm
SEDIMENT FILTER SCREEN SIZE	50 µm
ACTIVE CISTERN VOLUME	14,039 GALLONS (1,403 CUFT.)
DESIGN PRESSURE & FLOW	25 GPM @ 50 PSI
ELECTRICAL SERVICE	120VAC 20A CIRCUIT

SYSTEM NOTES

①	RP INSTALLED WITHIN 25' OF WATER METER
②	MAKEUP METHOD 1 (PREFERRED): DIRECT CONNECT MAKEUP WATER TO NON-POTABLE PIPE AFTER TREATMENT SYSTEM. 2ND RP NEAR CONNECTION TO NON-POTABLE PIPE.
③	MAKEUP METHOD 2: MAKEUP WATER ADDED TO CISTERN VIA AIR-GAP. 2ND RP NOT NEEDED
④	CISTERN FAILSAFE BYPASS VALVE REQUIRED IF GRAVITY CISTERN OVERFLOW TO CSS NOT POSSIBLE
⑤	BYPASS PIPE ON PRE-FILTER
⑥	CISTERN GRAVITY OVERFLOW
⑦	OPTIONAL: FLOATING FILTER FOR HIGH DEBRIS SURFACES
⑧	OPTIONAL: CALMING INLET FOR HIGH DEBRIS SURFACES

4b. RWH System Schematic Diagram: PERMITTED SYSTEMS

DESIGNER CHECKLIST:

Provide a Schematic Diagram that includes all items from the previous 'Non-permitted Systems' Designer Checklist **PLUS** additional items below that are required for permitted systems.

- ☐ **All items from Non-Permitted Systems**

ADDITIONAL ITEMS:

- ☐ **Treatment & Control System:** Makeup water supply (required per SFDPH Article 12C); see *RWH System Schematic Diagram Designer Checklist: Non-Permitted Systems* for requirements and connection methods.
- ☐ **Other system components**

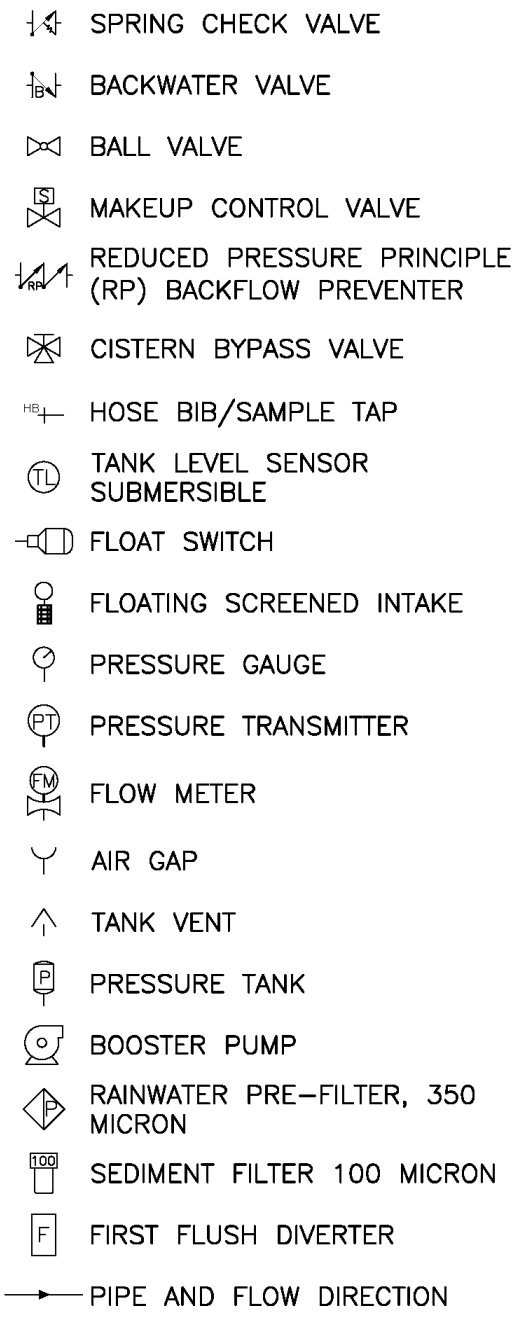
DESIGNER NOTES & GUIDELINES:

- If the catchment area includes any non-roof surfaces (i.e., at or below grade surfaces, parking lots), CA plumbing code requires the RWH system shall comply with water quality standards of NSF 350, see California Plumbing Code Chapter 16 & 15.
- Ensure that treatment and control system design include:
    - Fine sediment filter prior to disinfection system; disinfection method will determine the requirements of the filter.
    - Flowmeter on the RWH treatment system with continuous monitoring (required per SFDPH Article 12C)
    - Turbidimeter with continuous monitoring (required per SFDPH Article 12C)
    - Disinfection system with continuous or weekly monitoring (required per SFDPH Article 12C): chlorine, ozone, ultraviolet radiation or other approved system
    - Water sampling locations on treatment piping with monitoring frequency (as required by disinfection system)

EXAMPLE:

Intentionally not provided due to wide range of system configurations and complexities.

ATTACHMENT A: RWH PLUMBING SYMBOL LEGEND



ATTACHMENT B: RWH PRE-FILTER SELECTION GUIDANCE

This document provides a general overview of Rainwater Harvesting (RWH) system pre-filter types and general guidance to help with the selection of pre-filters based on varied site conditions and system configurations. Choosing an appropriate pre-filter type and size can (i) increase rainwater collected by the cistern, (ii) minimize ongoing operation and maintenance (O&M) efforts, and (iii) reduce the potential for pre-filter clogging, pipe blockage, and even facility-wide damage due to clogging (etc.).

In addition to descriptions of pre-filter types and selection guidance, this document also provides information regarding pre-filter sizing, bypass requirements, and installation location; and first flush diverters.

Pre-filter Types

Pre-filters are located upstream of the RWH cistern. All pre-filters have an inlet port and a filtered outlet port (to the cistern), and many also have a third port for debris and overflows. A mesh screen inside the pre-filter, typically ranging from 350-800 microns, prevents debris from flowing into the cistern.

Pre-filter products fall into two general categories based on how they function and are maintained — 'self-cleaning' or 'manually cleaned'.

- **Self-cleaning:** Self-cleaning pre-filters generally rely upon incoming water to move debris off the filter screen surface and flush debris out through a bypass port. Depending on the specific product, self-cleaning pre-filters can capture nearly 100% of incoming water at low flows, yet may have reduced capture rates at medium to high flows.
- **Manually cleaned:** Manually cleaned pre-filters direct all flow through a screen basket or filter media to capture debris. Debris is retained in the filter until manually serviced and cleaned. These filters are designed to capture 100% of incoming water, yet consideration must be made to prevent system back-up when filters become clogged. Some manually cleaned pre-filters include an integrated bypass that can convey flows if the filter screen becomes clogged; some do not. For those that do not, the pipe network must be configured to provide a bypass overflow for allowance by the City.

Choosing a Pre-filter Type

Selection of a low O&M, low-risk pre-filter type is based on two main criteria: the size of the contributing area and the anticipated debris level of the surface.

- **Contributing Area**: The dividing line between Small and Large contributing areas can generally be considered to be approximately 2,000 square feet. Refer to manufacturer sizing recommendations for drainage area capacity and installation design criteria for specific

products. Some self-cleaning pre-filters have both minimum and maximum contributing area requirements.

- **Surface Debris Level**:
  - *'High debris'* surfaces include, but are not limited to:
    - Sites near large bird populations (i.e., near the Bay, ocean, or lakes) where feathers, feces, nesting material, etc. can accumulate on catchment areas;
    - Areas with large trees adjacent to or overhanging the contributing area;
    - Areas with planter boxes or landscaping that drain to contributing areas; and
    - Areas with vehicular or foot traffic, especially at ground level.
  - *'Low debris'* surfaces are generally elevated roof areas away from large bird populations, with minimal vegetation and foot traffic.

SFPUC supports the following pre-filter types based on the typical site conditions:

- **Self-cleaning pre-filters** for sites with large contributing areas and/or high debris surfaces. A self-cleaning pre-filter will minimize O&M and reliance on manual cleaning, and will minimize the risk of pre-filter clogging.
- **Manually cleaned pre-filters** for sites with small contributing areas AND low debris surfaces. However, the facility ownership representative shall understand that there is an increased risk of pre-filter clogging if pre-filters are not routinely checked and cleaned.

For a planning level summary of pre-filter types and sub-types, refer to Table 1 at the end of this appendix.

Pre-filter Sizing

The designer shall size the pre-filter per manufacturer guidance, ensuring that the contributing area meets manufacturer minimums and maximums, and that maximum flow rates listed by the manufacturer align with the Uniform Plumbing Code's flow rates for rain gutter sizing (1-hour, 100-year storm event) for the project's location. Designer shall also coordinate with City of San Francisco DBI Plumbing Inspection Division, as needed.

Pre-filter Bypass Requirement

Both self-cleaning and manually cleaned pre-filters **must include a bypass** to provide a route for rainwater to reach the building's collection system discharge in the event the pre-filter becomes clogged.

Pre-filter Installation Location

Pre-filters are designed to be installed on either horizontal pipes or vertical pipes, depending on the product and model, and some must be certain distances from pipe bends. Therefore, they must be properly located on the building's pipe network. Coordinate with the manufacturer for required design criteria regarding proper installation.

First Flush Diverters (Optional)

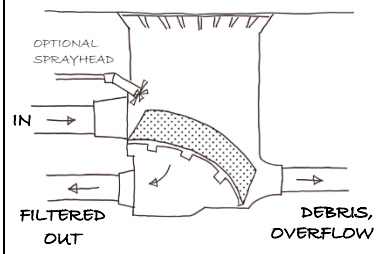
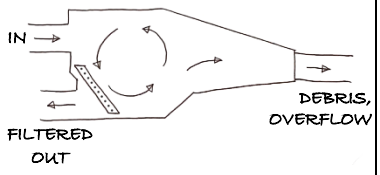
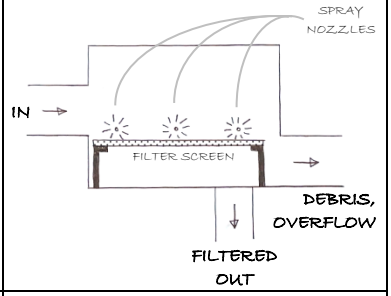
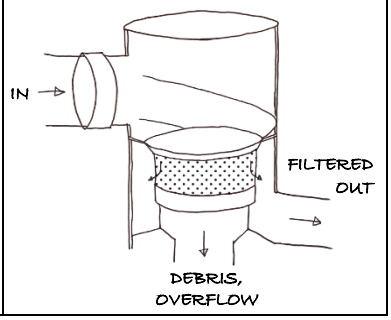
A first flush diverter is a device that diverts a certain volume of collected rainwater following the onset of a rain event. At the beginning of a rain event, the first flush of water off the catchment surface contains a relatively high level of debris and sediment that has accumulated since the last rain event. The first flush diverter directs this "first flush" water to a separate diverter chamber, rather than to the cistern. The diverter chamber is drained either manually or automatically via a small release orifice or through an automated valve via the control panel.

There are differing views on the effectiveness and appropriateness of first flush diverters in RWH systems of the large scale that are commonly proposed for projects subject to San Francisco's Stormwater Management Ordinance. First flush diverters are not required for Stormwater Control Plan approval (unlike pre-filters, which are required). The Design Team should confirm whether a first flush diverter is appropriate and beneficial to their specific project, as well as whether it may be required by other City departments (e.g., SF Department of Public Health).

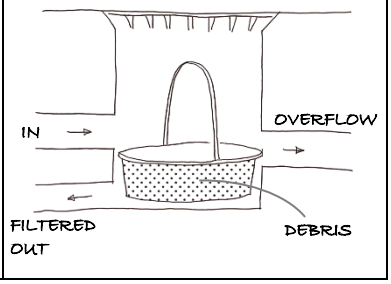
Table 1: Planning Level Summary of Typical Pre-filter Types

Table 1 is a working draft. It not intended to be exhaustive of all pre-filter types. The information below is provided to assist and educate design teams and includes best available information to aid in the selection of an appropriate prefilter type for various project conditions. The designer shall coordinate directly with the manufacturer prior to proposing and specifying a pre-filter.

Self-cleaning pre-filters: Supported for large drainage areas and/or high debris surfaces

Pre-filter Sub-type	How it Works	Example Links [1] (for illustrative purposes only)	Simplified Sketch
Cascade Filter	A cascade pre-filter is installed onto a **horizontal pipe**. It has a curved, angled screen within the filter body. As water flows over the screen, debris and sediment are continuously washed away while filtered water passes through the filter screen to the outlet port to the cistern. Some cascading filters may include internal spray heads that spray the screen to further reduce maintenance requirements.	https://www.graf-water.com/rainwater-harvesting/filter/optimax-filter-external/optimax-filterr-external-suitable-for-pedestrian-loading.html	
Hydraulic Jump Filter	A hydraulic jump pre-filter is installed onto a **horizontal pipe**. Water enters a hydraulic jump filter through an inlet port, collects in a depression at the bottom of the filter body. Filtered water flows through an inclined filter screen to the outlet port while debris flows out the dirty water outlet. During heavy storm events, the drop between the inlet port and the bottom of the depression results in a hydraulic jump. The eddy caused by the hydraulic jump washes debris off the filter screen to the dirty water outlet port.	https://www.ecoviewater.com/products/purain/	
Sprayhead Filter	Water enters a sprayhead filter and flows across a horizontal screen. Filtered water drops through the screen and flows out a vertical outlet below. Debris is sprayed off of the screen by sprayheads and flows out the outlet pipe, along with any overflows. Sprayhead filters are installed onto a **horizontal pipe**.	https://wadedrainscatalog.com/upload/TRIDENT.pdf https://wadedrainscatalog.com/upload/OIM-TRIDENT.pdf	
Vortex Filter	A vortex pre-filter is installed onto a **horizontal pipe**. Within the filter body is a smaller cylindrical filter insert with vertical mesh walls. Water enters through the inlet port, spins around the circumference of the top of the filter body, descends to the inside of the filter, and is drawn outwards through the vertical mesh walls by adhesion forces. Filtered water exits through the outlet port to the cistern, while debris flows down the dirty water outlet.	https://rainwatermanagement.com/products/wisy-vortex-fine-filter-wff-300	

Manually cleaned pre-filters: Supported for small drainage areas with low debris surfaces

Pre-filter Sub-type	How it Works	Example Links [a] (for illustrative purposes only)	Sketch
Basket Filter	A basket filter consists of a removable screened filter basket that fits within the filter body. Water flows in through the inlet port, down through the basket that filters out debris, and out through the outlet port to the storage tank. An overflow port needs to be provided at the top of the filter above the basket as an overflow bypass for when the filter basket is full. Basket filters are installed onto a **horizontal pipe**.	https://www.rainharvest.com/graf-basket-filter-industrial-pedestrian.asp	

NOTES:

1. The SFPUC does not support one manufacturer over another assuming equivalent function. Additional manufacturer links may be included upon request. Please email StormwaterReview@sfpuc.org.