infraSGA

RAFT Urban Bioretention System

Runoff+**A**ttenuation+**F**iltration **T**echnology

Project Name:

Project Location:

Catalog Code:

Schedule Type:

Introduction

RAFT is an urban bioretention stormwater solution that achieves practical and regulatory performance requirements through a simplified, flexible, cost-effective, and easily maintained system. RAFT provides stormwater treatment and storage capacity, even in the most constrained environments.

Urban Bioretention functions the same as other bioretention applications, but is constrained to a "container" within the urban environment. RAFT is that "container" and is designed to be more cost-effective and rapidly assembled.

The key feature behind this is the patent pending post and panel assembly. Precast concrete panels slide into preassembled FRP frames to create a contiguous, self-supporting unit. These panels nest together without any additional fasteners and can be assembled by a two-man crew & small equipment operator in as little as 30 linear feet per hour.

Features

Easy Field Repairs

removable panels allow fast replacements or access to buried utilities

Fast Installation

field-assembly in hours rather than days or weeks

Dimensional Flexibility

extend or reduce the footprint with repeating component parts

NO Specialized Equipment

components are sized for easy handling using common small equipment

Adaptable

optimize water quality and quantity for new construction or retrofit projects

Applications

Where to Specify Urban Bioretention

Cities and towns are in need of retrofit stormwater management (SWM) solutions that work with the existing constraints of limited space, underground utilities, and cost. RAFT is a solution that can be implemented in parking islands and streetscapes, as well as larger projects such as campuses, plazas, multifamily developments, and more. Refer to Fig 1.1 to get a better understanding of how RAFT could be applied to your next project.

Fig 1.1: Typical Urban Bioretention Composition

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Australian Patent: No. 2020206670
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Catalog Configurator

Example Catalog Code: *RAFT-3-20-48-2-24*

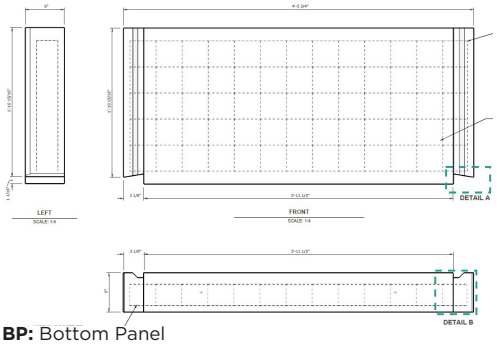
Container	Total Width	Total Length	Depth	Curb Inlets	Dist. to Curb Face
RAFT	3′	5′ : 18′	36″	1	19″
	4′	8′ : 20′	42″	2	xx″
	5′	10′ : 23′	48″	3	
	6′	13′ : 25′		4	
	8′	15′ : 30′			

Specifying RAFT

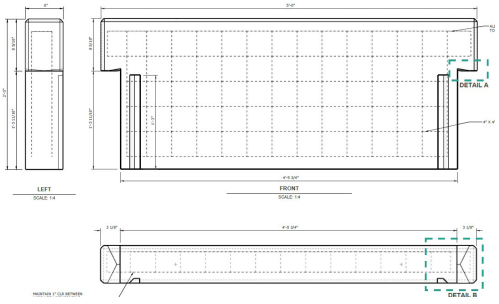
Use the catalog configurator to specify RAFT for your unique project or to request pricing estimates. For multiple RAFT units of varying sizes, provide one code for each unique set.

Fig 2.1 provides an example catalog code and the resulting RAFT unit.

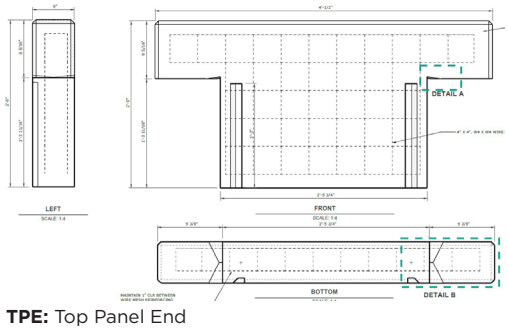
Container Components



BP: Bottom Panel



TP: Top Panel



TPE: Top Panel End

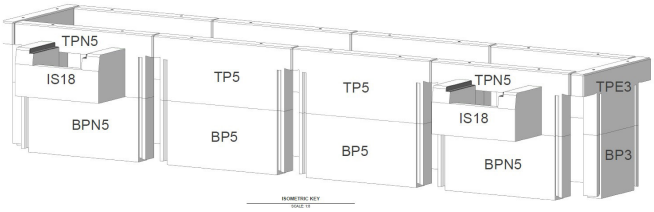
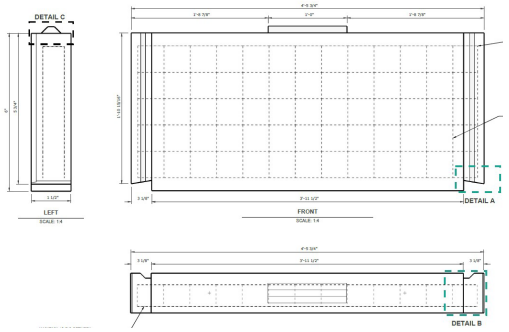
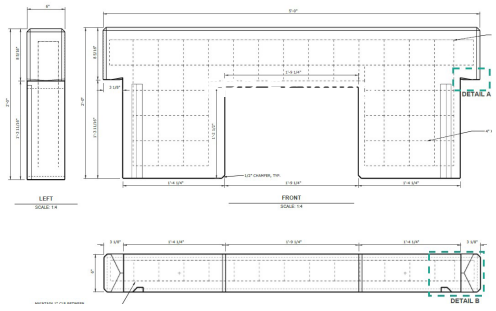


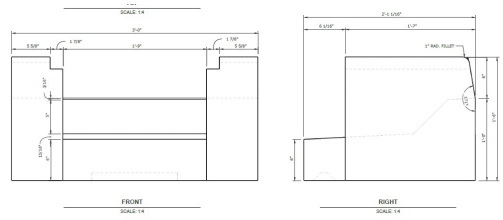
Fig 2.1: *RAFT-3-20-48-2-24* = (3′W x 20′L x 48″D) RAFT unit



BPN: Bottom Panel Inlet



TPN: Top Panel Inlet



IS: Inlet Structure

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Australian Patent: No. 2020206670

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Example Site Design

Fig 3.1: Example Streetscape Application for RAFT

Typical Streetscape Application

Fig 3.1 shows a typical urban streetscape where a series of RAFT units are deployed to support existing storm sewer infrastructure and improve the health of nearby streams and rivers. This is an example of how RAFT can be used to retrofit existing cities and towns and create a viable *Best Management Practice* (**BMP**).

During a rain event, the RAFT units intercept runoff and filter pollutants before entering the storm sewer. This also serves as temporary storage that regulates the rate of runoff and helps prevent the existing infrastructure from being overwhelmed in a cloudburst event.

The Typical Stormwater Management Design Considerations outlines the major design feasibility items when considering a BMP solution. For additional information, refer to succeeding pages for Specifications, Feasibility & Design Constraints, and FAQ.

Typical Stormwater Management Design Considerations

- Determine the desired treatment area
- Of that area, determine what percentage is impervious
- Determine the designed storm and duration the BMP will be treating
- If a high watertable is present, determine whether the groundwater elevation conflicts with the BMP
- Check whether the BMP longitudinal slope will be matching a manageable adjacent grade and whether check dams or weirs are necessary
- Check for underground or overhead utilities that would prevent a BMP solution and whether protective measures are needed
- Determine the CFS PRE-development rates and then what POST-development rates are necessary for the design

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Specifications

The RAFT system follows the design guidelines outlined in the 2019 Washington State Department of Ecology Stormwater Management Manual (SWMMWW) for Western and Eastern Washington, for BMP T7.30 & BMP T5.31. The RAFT system is only intended as a modular precast host for bioretention and is intended to be functionally equivalent to the open bottomed WA DOE V-5.15 Bioretention Planter. The following are critical compliance areas for designing your *Best Management Practice* (**BMP**) RAFT system. Designs should be reviewed and approved by InfraSGA staff for proper compliance.

Sizing Methods & Design Criteria

The hydraulic design for a BMP RAFT system shall comply with the 2019 SWMMWW procedures outlined by their "Runoff Model Representation."

RAFT shall have the following minimum requirements: minimum interior width of 3'-0" , minimum of 18" approved soil mix, minimum 12" wide roadway shoulder separation.

General care should be taken to consider local regulations for urban bioretention and drawings should be reviewed by a licensed industry professional. Regulations to pay special attention to are: the handling of underground & overhead utilities, building and roadway setback conflicts, positive underdrain slope with proper connections to infrastructure inverts, overflow solutions with diverters or inlets, appropriately sized drainage areas, maintenance ease and accessibility, and pedestrian access over or around the installation.

Flow Entrance and Pretreatment

RAFT shall be specifically designed to limit flow velocities entering the system to less than 1.0 ft./sec. Each curb inlet entrance shall be 18" minimum width and include an energy dissipation element (such as river rock) to slow water infall.

RAFT inlets incorporate a drop from the gutter line before passing through an easily accessible and maintained pretreatment cell for sediment capture and debris removal.

Bottom Area and Side Slopes

Flow depths and velocities shall be carefully considered and check dams shall be used to prevent erosion where necessary.

A 12" minimum shoulder width shall be provided between a roadway and any RAFT™ installations. The shoulder shall be backfilled and properly compacted to avoid settlement.

Ponding Area

RAFT shall not be designed with a ponding depth greater than 12" and systems shall draw down any surface ponding within 24 hours.

Soil Depth

RAFT shall have a bioretention soil mix with a depth of 18" minimum.

Filter Fabric

RAFT shall not have filter fabrics used between the drainage and the bioretention soil mix layers.

Underdrain

Underdrains shall be provided when subsurface soils do not meet prescribed conditions for infiltration outlined within the 2019 SWMMWW and shall be designed and installed per the manual.

Check Dams and Weirs

RAFT shall match the longitudinal slope of any adjacent roadway and shall deploy check dams or weirs to slow stormwater flow per 2019 SWMMWW.

Bioretention Soil Mixes

The 2019 SWMMWW default Bioretention Soil Mix (BSM) for BMP T7.30 or Technology Assessment Protocol Ecology (TAPE) approved stormwater treatment technologies shall be the basis of design for BMP RAFT systems. Local state approved bioretention soil mixes (or approved equal) may be used in a BMP RAFT system for projects found outside of Washington State.

Installation Criteria

RAFT was designed for ease of construction, but the assembly instructions should be followed closely. These may be found on the InfraSGA website www.infraSGA.com. Additionally, BMPs within RAFT systems should follow the installation criteria found in the 2019 SWMMWW and/or other applicable local guidelines.

Operations & Maintenance Requirements

All bioretention systems require periodic maintenance to remove trash, debris, and sediment buildup. The RAFT pretreatment cell was designed for easy access and to collect this material. Inspection for plant health, erosion, weeding, mulch cover, and soil integrity are a few items that should be maintained per the 2019 SWMMWW best practices and procedures.

Product Materials

RAFT consists of high quality component materials. Wall panels and inlets are 5,000psi precast concrete with steel wire mesh or rebar reinforcement. The frames are structural FRP (fiber reinforced plastic) consisting of fiberglass reinforcement and thermo-setting isophthalic polyester resin resulting in strong, durable, structural supports with superior corrosion & UV resistance. The FRP frames use high performance 316 SS fasteners for longevity and superior corrosion resistance. Milled aluminum caps are 6061-T6 grade milled aluminum with a durable anodized finish. RAFT is compliant with Buy American Act Requirements through 2029 with a minimum 75% domestic components sourced.

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Feasibility & Design Constraints

Available Space Needed

Urban bioretention is designed to occupy a small surface area in relative to the contributing drainage area. As a general guideline, urban bioretention will occupy a surface area of 3-6% of the contributing drainage area. Ex: 1,500 sf drainage area will need approx. 45-90 sf of urban bioretention.

Site Topography

Urban bioretention can be negatively impacted by steep grades unless designed to reduce incoming stormwater flow. As a general guideline, keep the grade between 1-5%.

Drainage Area

Urban bioretention is capable of treating small drainage areas up to 0.1 acres as a single unit but should be implemented in a series for best effect. As a general guideline, use a series of urban bioretention cells that treat between 1,500 sf - 2,500 sf each. Ex: a typical two lane city block would need approx. 4-8 urban bioretention cells.

Underdrain Connection Inverts

Urban bioretention is limited by the invert elevation of existing SW infrastructure. As a general guideline, 4-5 feet of elevation is needed to allow stormwater to pass through a bioretention filter bed and connect to nearby infrastructure via an underdrain.

Water Table

Urban bioretention should not intersect with the groundwater table to avoid mixing contamination. A gravel wetland is a feasible alternative when high groundwater tables are present. As a general guideline, keep a 24 inch separation (12 inch for coastal plain) between the bottom of bioretention and seasonal high groundwater table elevation.

Utilities

Always refer to local utility design guidelines when placing urban bioretention and determine the horizontal & vertical clearances necessary. As a general rule, urban bioretention should not overlap wet utilities such as water and sewer lines. However, dry utilities may overlap if precautions are taken to inspect, repair, and protect damage. If utility crossings are unavoidable, RAFT's removable panel design allows for easier maintenance access than typical bioretention configurations.

Existing Soils

Sites containing poor draining soils such as those in Hydrologic Soil Group C or D should always have an underdrain. Always check the soil permeability when designing urban bioretention.

Land Use (Hotspots & Floodplains)

Sites with contaminated soils (hotspots) should only have sealed urban bioretention that does not allow infiltration. Urban bioretention should also not be constructed inside any 100-year floodplain.

Setbacks

Always refer to local guidelines when considering setbacks. (utilities, buildings, roads, wells, septic, etc) Urban bioretention should not be hydraulically connected to structural foundations or pavement.

Maintenance

Urban bioretention, like any infrastructure, is not intended to be maintenance free and should be considered when implementing. Routine maintenance should be done to remove debris, clean pretreatment cells, inspect and weed plantings, and inspect drains.

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Frequently Asked Questions

What is the product specifically?

RAFT is the open-source "container" for urban bioretention and other (BMPs) Best Management Practices and technologies to be held within. It consists of wall panels, frame, inlet boxes, inlet grates, and a pretreatment cell for sediment/debris capture.

If RAFT is just the container, then what defines the BMP within?

The BMP within RAFT should be defined by a licensed professional in accordance with local guidelines. RAFT is designed to comply with the 2019 Washington State Department of Ecology Stormwater Management Manual, but a range of complimentary products may be used.

What are the benefits of using urban bioretention?

Urban bioretention is an excellent way to supplement existing stormwater infrastructure to reduce flooding, create habitat, and soften the built environment. It can be very cost effective and implemented gradually to accommodate a range of budgets.

How much time does it take to install?

RAFT can be assembled as quickly as 30 linear feet per hour. The site prep and BMP portions require additional time and vary widely on the crew and site conditions.

How long are lead times?

InfraSGA is a young company and limited by manufacturing supply logistics. A general estimate of 12-14 weeks should be considered.

Why is the post and panel assembly so important?

The largest cost for urban bioretention is the container holding the BMP. This is due to material, equipment, and labor costs. The post and panel system is the key to simplifying component parts (lower material cost), reducing weight for small equipment use (lower equipment cost), and slashing installation time (lower labor costs). The system does not require mechanical fasteners or special equipment to assemble. Using the preassembled FRP frames allows panels to slide into place and interlock. Think of building blocks linking together to create a strong end unit.

What are the materials and why do they matter?

The materials used in urban bioretention are exposed to constant moisture, corrosive materials, freeze/thaw cycles, and general urban abuse. RAFT accounts for these conditions in the material choices to offer superior resistance to all of these conditions. Refer to page 4 for Product Materials specifics.

Why aren't you on the DEQ BMP Clearinghouse website?

RAFT is the "container" for urban bioretention and other Best Management Practices to be held within. RAFT by itself is not a BMP product that can be approved for the DEQ BMP Clearinghouse.

It is, however, capable of holding a range of DEQ BMP Clearinghouse approved soil mixes and was designed to be functionally equivalent to a BMP "bioretention planter" or "planter box" when used for treating stormwater.

Do you have proof the product functions?

RAFT has been successfully implemented on several pilot projects as of Fall 2023. A prototype has been functional since Spring 2022 as seen on www.infraSGA.com in the time-lapse video.

What if something goes wrong?

We are committed to making RAFT the best solution for stormwater Best Management Practices. If something goes wrong, we want to hear about the concern and help solve it. InfraSGA wants to make a positive impact for our customers and our environment and successful projects are the backbone of our mission.

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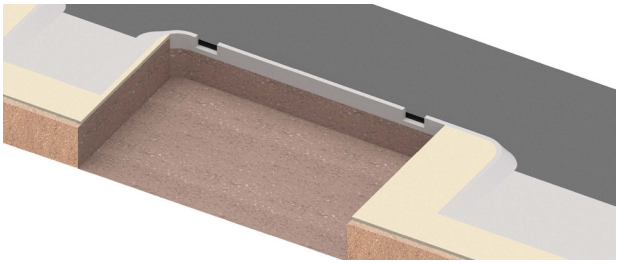

Fig 7.1: Excavate area per the design drawings

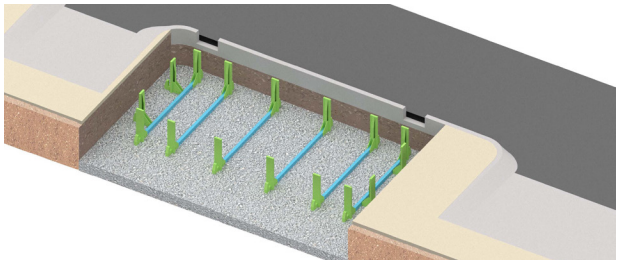

Fig 7.2: Spread base layer aggregate and set the FRP assembly frames in place

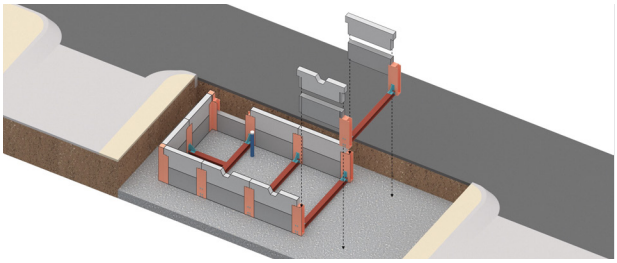

Fig 7.3: Starting at one end, begin sliding the panels into the frames until complete

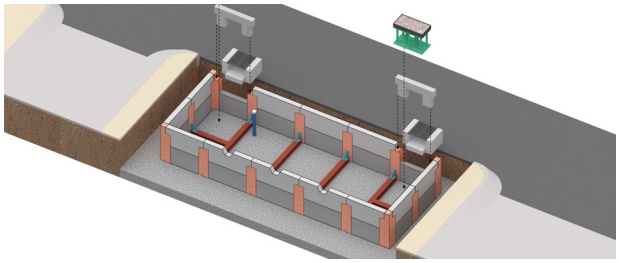

Fig 7.4: Set the inlets and pretreatment devices into place

Fig 7.5: Layer the bioretention soil in specified lift depths

Fig 7.6: Install the specified vegetation and top dressing mulch cover

Typical Installation Overview

Figures 7.1 - 7.6 demonstrate the main steps for installing a RAFT urban bioretention system. Refer to the RAFT Assembly Drawing for detailed RAFT installation instructions. The process would require a min. of two general laborers and one small equipment operator (mini-excavator or skid steer). For additional questions, please contact InfraSGA for support.

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