Water Environmental Services

Sanitary and Stormwater Rules and Standards Workshop #2

August 21| 2018

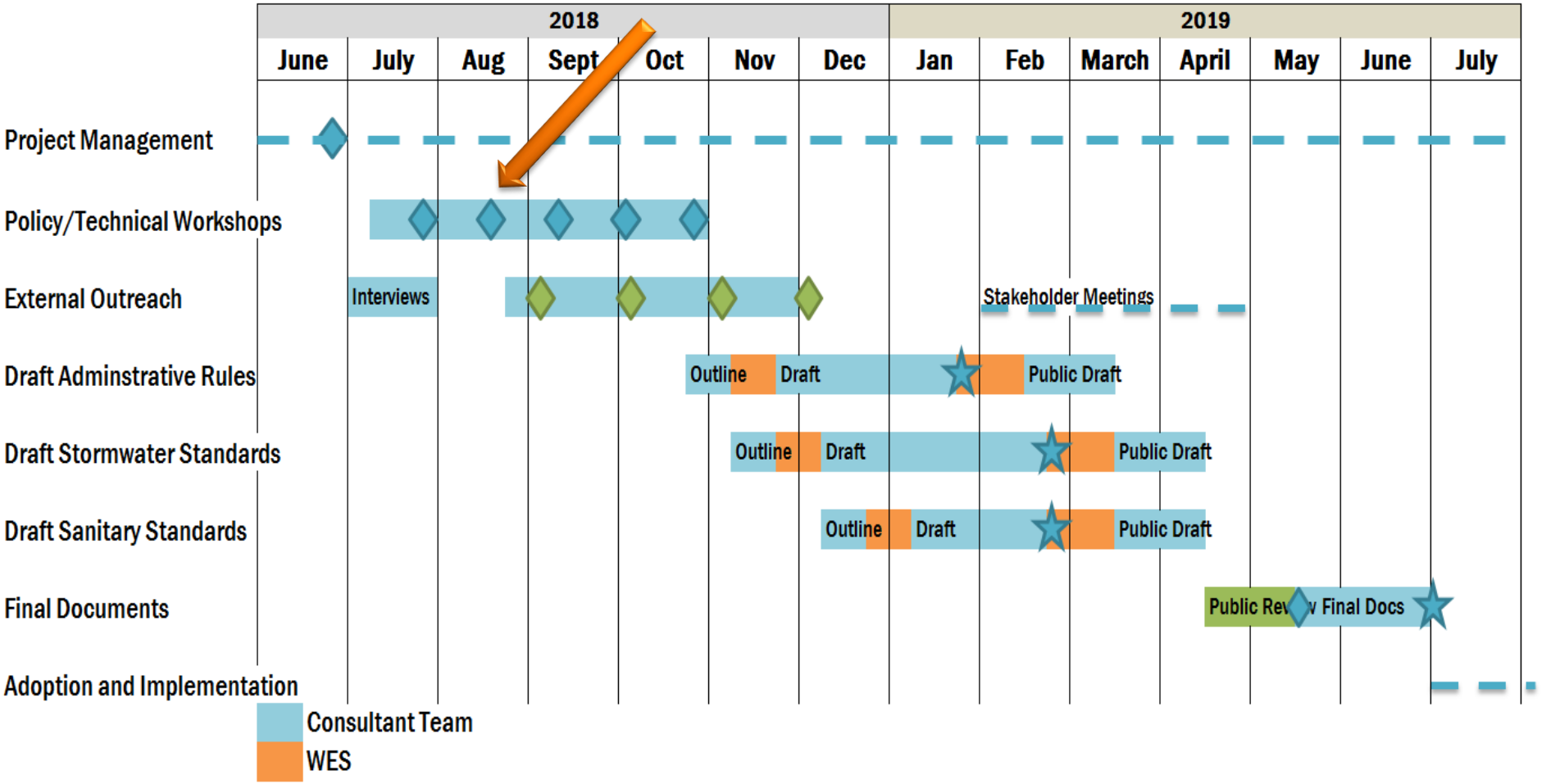
Today's Plan

- Project Update
- Workshop #1 Recap
- Policy and Technical Questions
  - LID/Green Infrastructure Approach
    - Site Planning
    - Facility Design
  - Stormwater Facility Selection and Use Guidelines
- Wrap-Up

Project Update

Brown AND Caldwell

Process Overview



Public Outreach Update

- Stakeholder Interviews
  - All developers, engineers, others contacted multiple times
  - About half scheduled or completed interviews
- Task Force Meetings
  - Will schedule kick-off for mid September
  - WES participant list

Workshop Plan

#1	Thresholds and Stormwater Management Strategy
Key Question	*What is the overall management approach in designing stormwater controls?*
Topics	• Stormwater management thresholds • Flow control standard – infiltration, peak flows, flow durations, retention • Definitions – pre-development, redevelopment, retrofit • Exemptions • Allowable sizing tools (present options)
#2	**Stormwater Facility Selection and Design Criteria**
Key Question	*What facilities will be used for stormwater management?*
Topics	• Allowable sizing t… • Al…
#3	**Stormwater Fa…**
Key Questions	*What credits and incentives are ava…* *review and approve stormwater design?*
Topics	• Credits or incentives for using green infrastructure strategies • Downspout disconnection – requirements, criteria, credits • "Fee in Lieu" program for system development charge vs. onsite facility? • Site Planning Process and Development Guidelines – rural SWM Plan? • Submittal, review, and approval process • Downstream analysis requirements

#4	Sanitary Sewer Regulations and Fiscal Policies
Key Question	*What is the overall management approach for sanitary sewer? What changes need to be made to the sanitary sewer fiscal policies?*
Topics	• Sanitary Connections • Pretreatment Requirements • SDC Calculations and Credits • Shared Laterals • Sanitary bonds and acceptance requirements • Reimbursements
#5	**Ownership/Maintenance and Miscellaneous Topics**
	…ted? Who will be responsible?
	…atios
	…topics or spillover from 4 previous work-
	• Document Layout – division of content between Rules and Standards documents
Other	**Additional Discussion Items – Internal or Individual Meetings**
	• Stormwater conveyance standards • Stormwater facility typical sections • Stormwater Facility Design Requirements – detail items • Standard details for sanitary and storm • Other - TBD

Today:
What is the LID/GI Strategy?
What facilities will be used for stormwater management?

Policy and Technical Issues

Workshop #1 Recap

Brown AND Caldwell

Workshop #1 Recap

- Decisions Reached
  - Impervious threshold at 5,000 SF for new and redevelopment
    - Threshold to cover phased developments
    - Identify exempt project types
  - Flow Control Strategy
    - Exemption for direct discharge
    - Require use of infiltration when feasible
    - Use a flow duration matching standard
    - Consider fee-in-lieu options
- Further follow-up needed for
  - Definition of pre-development
  - Exempt Project Types
  - Flow Control Exemptions
  - Definitions

Proposed Language
Impervious Surface

- No change from existing standards.

That surface area which prevents or retards the entry of water into the soil mantle and/or causes water to run off the surface in greater quantities or at an increased rate. Impervious surfaces may include, but are not limited to, rooftops, concrete or asphalt paving, walkways, patios, driveways, parking lots, oiled macadam, gravel, or other surfaces which similarly resist infiltration or absorption of moisture.

Proposed Language
Replaced Impervious Surface

- Excludes maintenance practices.

The removal of an impervious surface that exposes soil followed by the placement of an impervious surface. Replacement does not include repair or maintenance activities on structures or facilities taken to prevent decline, lapse or cessation in the use of the existing impervious surface as long as no additional hydrologic impact results from the repair or maintenance activity.

Proposed Language
Exempt Project Types

- Projects in the following categories are generally exempt from the requirements of these standards:
  - Residential structures being re-built following fire damage, flooding, earthquake, or other natural disaster, as long as the structure is re-built at the same scale and discharging to the same disposal point. Expansions to the original footprint, such as an addition or alteration to the original structure, trigger stormwater management requirements for the new impervious area.
  - Interior remodeling projects and tenant improvements.
  - Stream enhancement or restoration projects approved by the County
  - Farming practices as defined by Oregon Revised Statutes (ORS) 30.930 and farm use as defined in ORS 214.200, except that buildings associated with farm practices and farm use are subject to the requirements of these standards
  - Actions by a public utility or any other governmental agency to remove or alleviate an emergency condition
  - Road and parking area preservation/maintenance projects such as pothole and square cut patching, surface sealing, replacing or overlaying of existing asphalt or concrete pavement, provided the preservation/maintenance activity does not expand the existing area of impervious coverage above the thresholds listed in Section XXX.
  - Pedestrian and bicycle improvements (sidewalks, trails, pathways, and bicycle paths/lanes) where no other impervious surfaces are created or replaced, built to direct stormwater runoff to adjacent vegetated areas
  - Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics
  - Maintenance or repair of existing utilities

Proposed Language
Flow Control Exemption

- Flow control is not required for projects that discharge directly to the Willamette River, the Tualatin River, or the Clackamas River, provided that the following conditions are met:
  - The project site is drained by a conveyance system that is comprised entirely of man-made conveyance elements (e.g., pipes, culverts, outfall protection, etc.) and extends to the ordinary high water line of the exempt water body; and
  - The flow path distance from the project site to the exempt water body is less than one half mile; and
  - The conveyance system between the project site and the exempt receiving water shall have sufficient hydraulic capacity to convey discharge from the proposed development of the site, and the existing development condition from the remaining drainage area contributing to the conveyance system, based on the conveyance standards outlined in Chapter 5; and
  - Any erodible elements of the man-made conveyance system must be adequately stabilized to prevent erosion under the conditions noted above.

Low Impact Development/ Green Infrastructure Strategy

LID/GI Requirements
NPDES Permit

"3) Prioritize and include implementation of Low-Impact Development (LID), Green Infrastructure (GI) or equivalent design and construction approaches."

(Schedule A.4.f.i)

"…the co-permittee must develop or reference an enforceable post-construction stormwater quality manual or equivalent document… [that] includes the following:

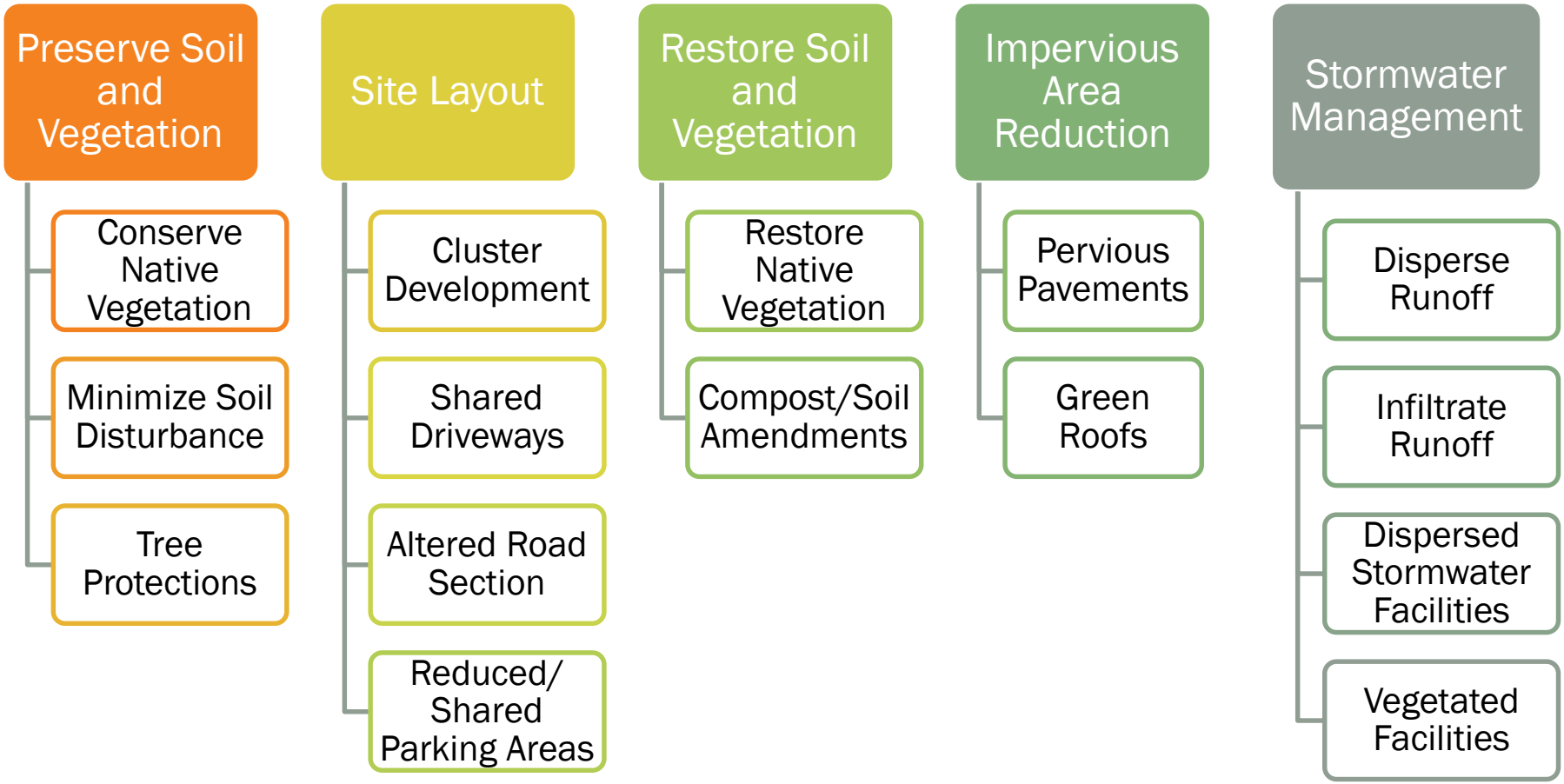
> *"3) Applicable LID, GI, or similar stormwater runoff reduction approaches, including the practical use of these approaches.*
>
> *"4) Conditions where the implementation of LID, GI, or equivalent approaches may be impracticable."*

(Schedule A.4.f.iii)

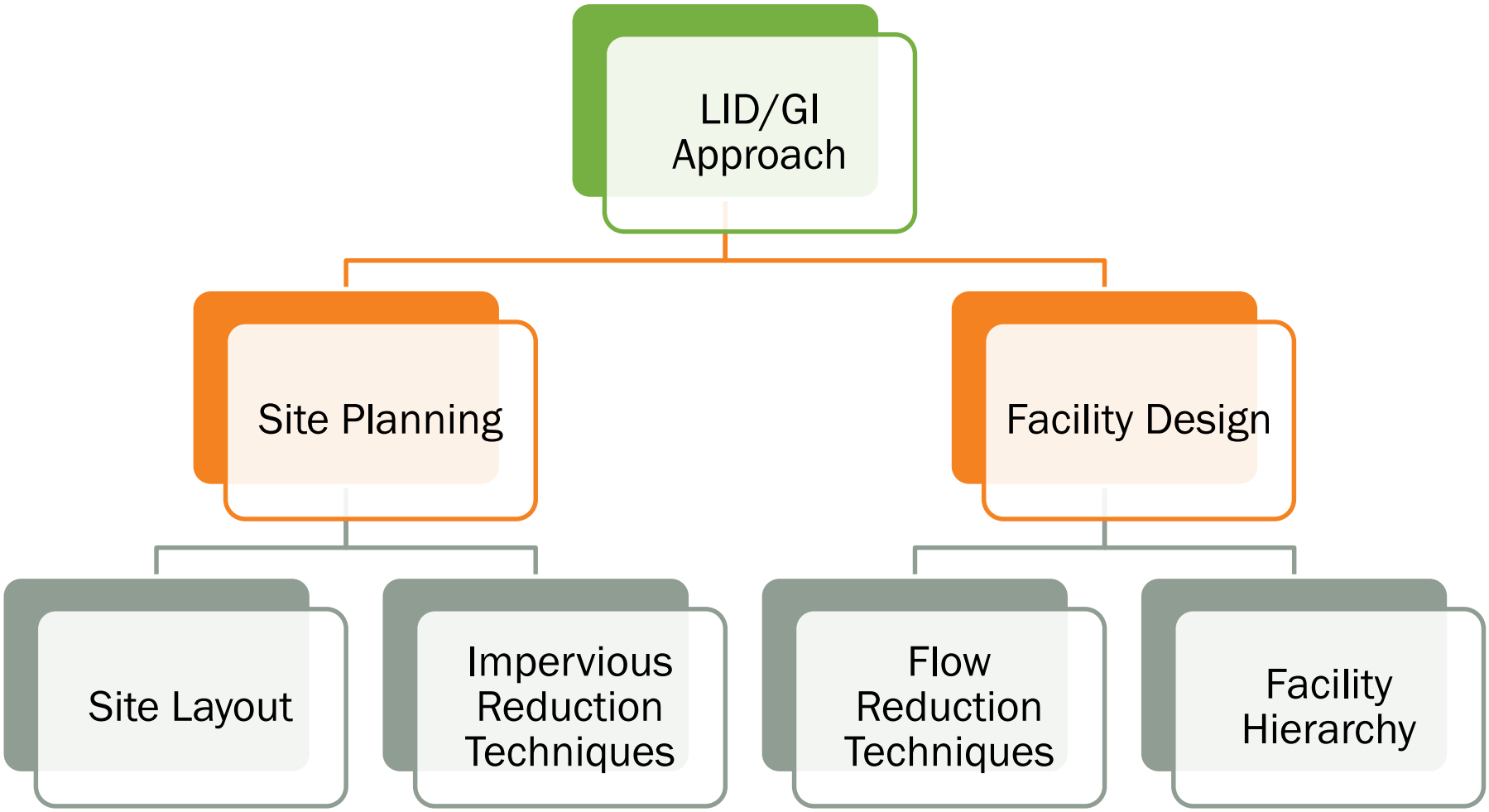
"Identify, and where practicable, minimize or eliminate ordinance, code and development standard barriers that inhibit design and implementation techniques intended to minimize impervious surfaces and reduce stormwater runoff (e.g. Low Impact Development, Green Infrastructure)."

(Schedule A.4.f.ii)

LID Approaches



Site Planning vs. Facility Design



LID/GI Requirements Comparison Jurisdictions

	Site Design Requirements	GI Facilities Included	Facility Selection Hierarchy
Portland		X	X
CWS	X	X	
Salem	X	X	X
Oregon City	X	X	X
Lake Oswego	X	X	X
Clark County	X	X	X

LID Strategy
City of Portland

- Site Planning
  - Site Planning Guidelines covers multi-step process to locate stormwater facilities.
  - Infiltration testing is required.
- Facility Design
  - “Infiltration and discharge” requirements hierarchy for soils that infiltrate >2 in/hr
    - Category 1: Total onsite infiltration with vegetated facilities.
    - Category 2: Total onsite infiltration of 10-year event with vegetated facilities that overflow to subsurface infiltration facilities.
    - Category 3: Onsite detention with vegetated facilities that overflow to a drainage way, river, or storm-only pipe.
    - Category 4: Onsite detention with vegetated facilities that overflow to the combined sewer system.

LID Strategy
City of Salem

- Site Planning
  - Site assessment must cover 10 required elements
  - Site planning recommendations focus on LID principles (through LID is not specifically mentioned).
- Facility Design
  - All projects must apply GSI to the MEF
    - GSI to the MEF = as a facility equal to 10% of the new and replaced impervious surface –OR-
    - A facility that mitigates runoff from 80% of the new and replaced impervious surface.
  - Facilities that manage less than 80% of the impervious surface must document limiting factors (site constraints or financial impacts).

LID Strategy
Oregon City

- Site Planning:
  - Site Planning Checklist required for submittal with land use application
  - 4 minimum requirements

1. *Preserve existing resources*
2. *Minimize site disturbance*
3. *Minimize soil compaction*
4. *Minimize imperviousness*

- Facility Design
  - Flow chart requires surface infiltration to the MEP
  - MEP defined as full infiltration of the 10-year storm OR facility surface area equal to 10% of contributing imperious area
  - Few sites have adequate infiltration
  - Result: most developments can choose from any approved BMP types

LID Strategy
Lake Oswego

- Site Planning
  - Site Assessment and Feasibility Analysis required for all projects.
  - Extensive documentation of site planning recommendations
  - No minimum performance measures
- Facility Design
  - All projects must provide Onsite Stormwater Management
  - Defined as infiltrating the 10-year storm to the MEP or using sheet flow dispersion
  - No facility selection hierarchy

LID Strategy
2010 Draft Manual

- Site Planning Checklist with five minimum principles
  - Required Elements
  - Optional Elements
- Infiltration requirement:
  - Attempt to retain and infiltrate the 10-year storm event.
  - MEP defined as having 6% of the impervious area dedicated to infiltration with a minimum storage depth of 2 feet.
  - For soils where infiltration is not adequate, the design will be required to include an underdrain.
  - Roof runoff for residential lots must be infiltrated and is not counted towards the site's impervious area.
- Exceptions for slopes, high groundwater, well head protection areas, and contaminated soils

Site Planning Requirements

Questions to Consider

- Should the rules and standards include LID/GI site planning elements?
- Will site planning elements be required or encouraged?
- How will applicants document site planning elements?

Site Design Requirements
NPDES Permit

Site Development Guidelines: "If a project site is characterized by factors limiting on-site stormwater management methods (such as high water table, shallow bedrock, poorly-drained or low permeable soils, contaminated soils, steep slopes, or other constraints), the standards must require equivalent pollutant reduction measures."

(Schedule A.4.f.v)

Submittal Guidelines: "The co-permittee must review, approve and verify proper implementation of post-construction site plans for new development and re-development projects applicable to this section.

(Schedule A.4.f.iv)

Encouraging LID Standards Include Examples

- LID Handbook Example (WSU, Pierce County, AHBL)
  - Compares Conventional and LID Site Plan using an actual site
  - Shows significant reduction in infrastructure costs & increase in marketability

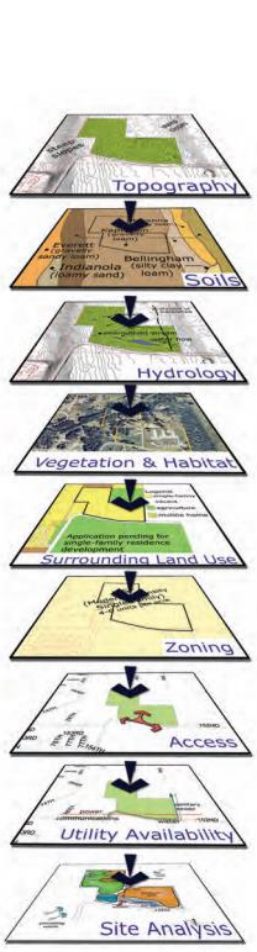
	Detention storage reduced (ft^3)	Detention storage required (ft^3)
Conventional development		270,000
Low impact development		
• reduce development envelope	-149,019	
• use bioretention	-40,061	
• use minimal excavation foundation	-7,432	
• use 20’ wide permeable road	-29,988	43,500

Encouraging LID
Imperious Area Reduction Credits

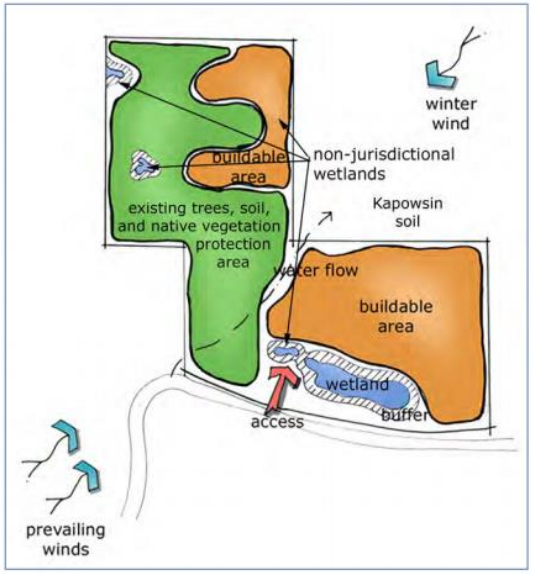
Type	Oregon City	Lake Oswego	2010 WES	Portland	Salem
Porous Pavement	1:1	1:1	1:1	1:1	1:1
Green Roof	1:1	1:1	1:1	1:1	1:1 for treatment ½ credit for flow control
Preserve Trees	N/a	In process of removing	1:1 at drip line Non SFR only	N/A	50 sf/tree Drip line w/in 10 ft pavement
New Trees	N/A	In process of removing	100 sf/tree Non SFR only	100 sf/deciduous 200 sf/evergreen Public streets only Plant w/in 25 ft of pavement	20 sf/tree Trunk w/in 10 ft of pavement
Rainwater Harvesting	N/A	1:1	N/A	As shown through analysis	1:1

Requiring LID
Clean Water Services LIDA Handbook

- Site Analysis
  - Topography, Soils, Hydrology, Vegetation/Habitat, Water Quality Sensitive Areas, Land Use/Zoning, Access, Utilities
- Site Planning
  - Conserve Existing Resources
  - Minimize Disturbance
  - Minimize Soil Compaction
  - Minimize Imperviousness
  - Direct Runoff from Impervious Areas to Pervious Areas



Chapter 2: Site Planning for LIDAs



CWS LIDA Handbook

Table 1: LIDA Selection for Site Conditions

	Green Roof	Porous Pavement	Flow-through Planter	Infiltration Planter/ Rain Garden	Vegetated Filter Strip	LIDA Swale	Street Side LIDA Planter
Reduce imperviousness	✓	✓					
Infiltrate		✓		✓	✓	✓	✓
Detention/ flow control		✓		✓			✓
Provide Habitat			✓	✓	✓	✓	✓
Near Vegetated Corridor			✓	✓	✓	✓	✓
Private property	✓	✓	✓	✓	✓	✓	✓
Private street		✓	✓	✓	✓	✓	✓
Public Street/ROW*			✓	✓	✓	✓	✓
On or next to building	✓		✓				
Parking lot		✓	✓	✓	✓	✓	✓
Landscaped area			✓	✓	✓	✓	
Steep slope	✓		✓				✓
Soils with low infiltration rate	✓	✓	✓		✓	✓	✓
High GW table	✓		✓		✓	✓	
Contaminated soils	✓		✓				

* Check with local juristiction about use in ROW

Requiring LID
2010 WES Draft Manual

Site Assessment and Planning Checklist

✓	Information Needed	Fill in blanks as required, and attach materials as needed
2.2.1 Site Information		
	Applicant Contact Information	
	Project Location	
	Project Type	
	Size of site (acres) and number of existing/ proposed tax lots	
2.2.2 Site Assessment (Attach engineered scal		
	Topography Evaluate site and map slopes: Flat (0-10%), Moderate (10-20%), Steep (20%+)	Attach aerial intervals for s based mappi attach geolog Slope inform
	Soils and Groundwater Research and map site soil hydrologic group, depth to groundwater	NRCS Hydrol Attach seaso floodplain an District.
	Infiltration Assessment Determine soil capacity for onsite infiltration	If an infiltrati (Basic/Profes testing meth Test Type:__
	Hydrology - Conditions and Natural Features Map site floodplains, wetlands, streams, and location of outfalls	Clearly label ((Sensitive Are (pipes, ditche Sensitive Are Floodplain __

✓	Information Needed	Fill in blanks as required, and attach materials as needed
	Downstream Conveyance	Prepare and attach Preliminary Drainage Report with analysis of upstream drainage area and downstream conveyance capacity, as required by **Chapter 5**. Check here if analysis indicates adequate downstream capacity is NOT available: ____
	Existing Vegetation Map trees and vegetation	Using aerial photos or survey, map all trees and vegetation. Note all existing trees 6-inch caliper and greater (DBH) on map. Delineate and identify other areas and types of existing vegetation. The local planning authority may require a formal tree survey.
	Required Vegetated Buffers Assess and map buffers	Identify require Sensitive Area A buffers. (Refer t Good: _____
	Land Use and Zoning	Existing Land U
	Access and Parking	Delineate propo and area of req
	Utilities to Site and Surrounding Area	Map existing ut electricity, phor
2.2.3 Site Planning Design Objectives (Attach er		
	1. Preserve Existing Resources	**Required:** Show enhancement p associated buff **Optional:** Deli protection meth
	2. Minimize Site Disturbance	**Optional:** Deli during construc
	3. Minimize Soil Compaction	**Required:** Delin facilities, other under trees to b

✓	Information Needed	Fill in blanks as required, and attach materials as needed
	4. Minimize Imperviousness	**Required:** Complete and attach *Impervious Reduction Form*. Delineate impervious reduction methods on site plan. Check impervious reduction methods proposed: ___ Porous Paving ___ Green Roof ___ Tree Credit **Optional:** List additional site planning methods to reduce impervious area, footprints for buildings, parking, etc. May qualify for local benefits and/or LEED or other certification credits
	5. Infiltration, Water Quality and Flow Control Requirements (Impervious Area)	**Required:** I Total Propo Total Impe Impervious
2.2.4 Proposed Infiltration Strategy (identify		
	Proposed Onsite Infiltration Strategy (See Chapter 4 for additional information)	___ All on ___ Maxir ___ No inf the M applic
	Minimum Facility Size Required for Infiltration	Calculate n impervious

✓	Information Needed	Fill in blanks as required, and attach materials as needed
2.2.5	**Preliminary Facility Selection/Sizing** (check all that apply, attach output from *District BMP Sizing Tool*, and show facilities on Preliminary Site Plan)	
	Proposed Facility Type(s)	Vegetated Stormwater BMP's: ___ Infiltration Stormwater Planter ___ Filtration Stormwater Planter ___ Infiltration Rain Garden ___ Filtration Rain Garden ___ Vegetated Filter Strip ___ Vegetated Swale ___ Constructed Wet Pond Other Stormwater Facilities as approved: ___ Drywell ___ Infiltration Trench ___ Manufactured Treatment Technology ___ Detention Pond ___ Underground Detention Tank
	Infiltration Requirement Check	Calculate total surface area of infiltration BMP's proposed: _____ SF

Requiring LID
2010 WES Draft Manual

1. Preserve Existing Resources
   - Required: Show sensitive areas and buffers on site plan; Denote buffer areas requiring enhancement; Show areas of buffer encroachment and mitigation areas
   - Optional: Delineate additional areas for permanent preservation
2. Minimize Site Disturbance
   - Optional: Delineate protection areas on site plan for areas to remain undisturbed during construction
3. Minimize Soil Compaction
   - Required: Delineate and note temporary fencing for infiltration areas, vegetated BMPs, revegetation areas, and drip line under preserved trees.
4. Minimize Imperviousness
   - Required: Complete Impervious Area Threshold Determination Form, documenting use of pervious pavement, green roof, and/or tree credits
   - Optional: Adjust site layout to minimize total impervious area allowed by local planning and zoning codes
5. Infiltration, Water Quality, and Flow Control for Impervious Areas
   - Required: Document amount of impervious area requiring treatment

Discussion

- Should the rules and standards include LID/GI site planning elements?
- Will site planning elements be required or encouraged?
- How will applicants document site planning elements?

BREAK?

Facility Design

Flow Reduction Techniques

Facility Selection Hierarchy

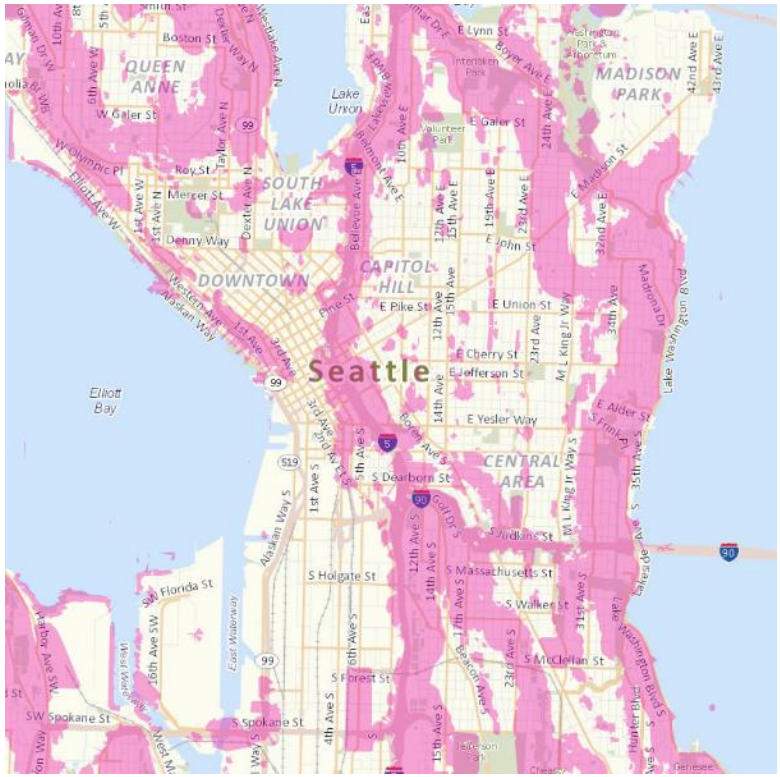
Brown AND Caldwell

Questions to Consider

- Should there be a hierarchy of flow reduction strategies and stormwater BMPs?
- Will there be a defined MEP?
- Will applicants be required to prove infeasibility?
- Are there specific conditions that would warrant a different facility type?

Facility Selection Hierarchy
City of Seattle 2016 Stormwater Manual

- Requires infiltrating BMPs when feasible
- City provides baseline map to show where GSI is not required
- Establishes infeasibility process for applicants to demonstrate where LID is not feasible on a specific site



Facility Selection Hierarchy
City of Seattle 2016 Stormwater Manual

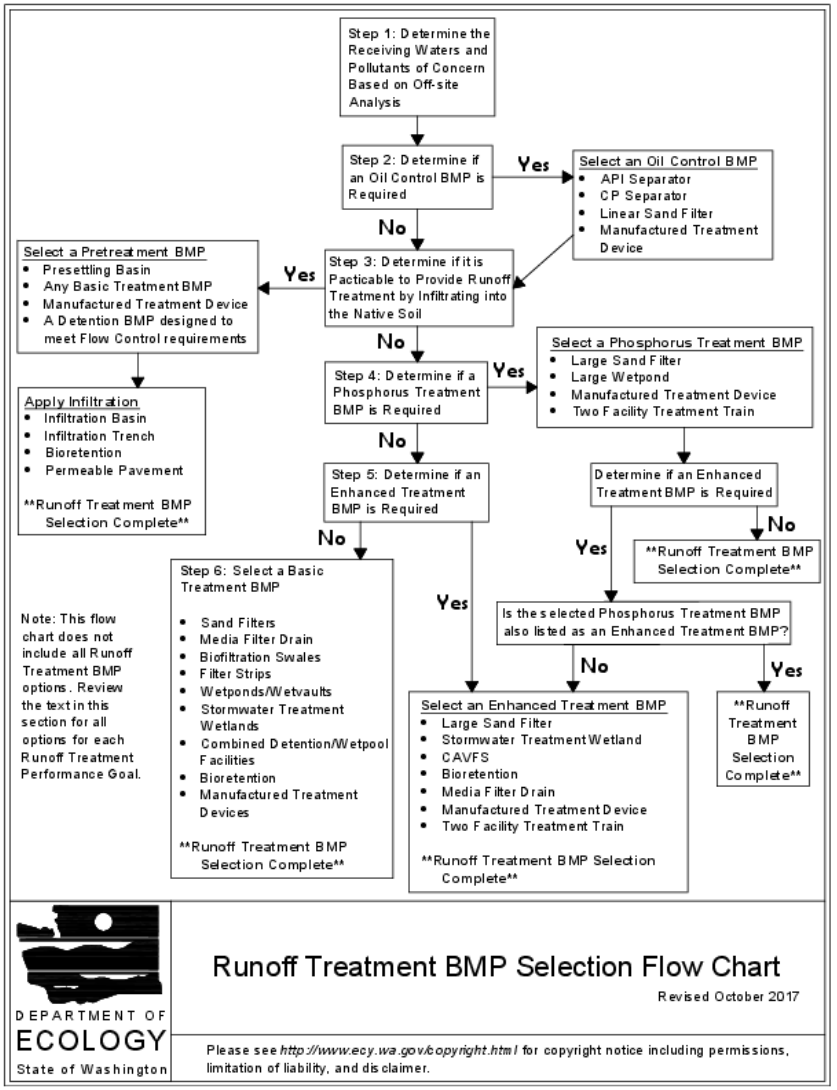
- Design and selection process
  - Infiltration testing (if feasible)
  - Calculation of Areas by Surface Type
  - Lists of BMPS (On-site Management)
    - Category 1: Full dispersion, Infiltration Trench, Drywell
    - Category 2: Rain Garden, Infiltrating Bioretention, Rainwater Harvesting, Permeable Paving
    - Category 3: Sheet Flow Dispersion, Concentrated Flow Dispersion, Splashblock Downspout Dispersion, Trench Downspout Dispersion, Non-Infiltrating Bioretention, Vegetated Roofs, Cisterns (SFR)
    - Category 4: Perforated Stub-out Connections, New Trees

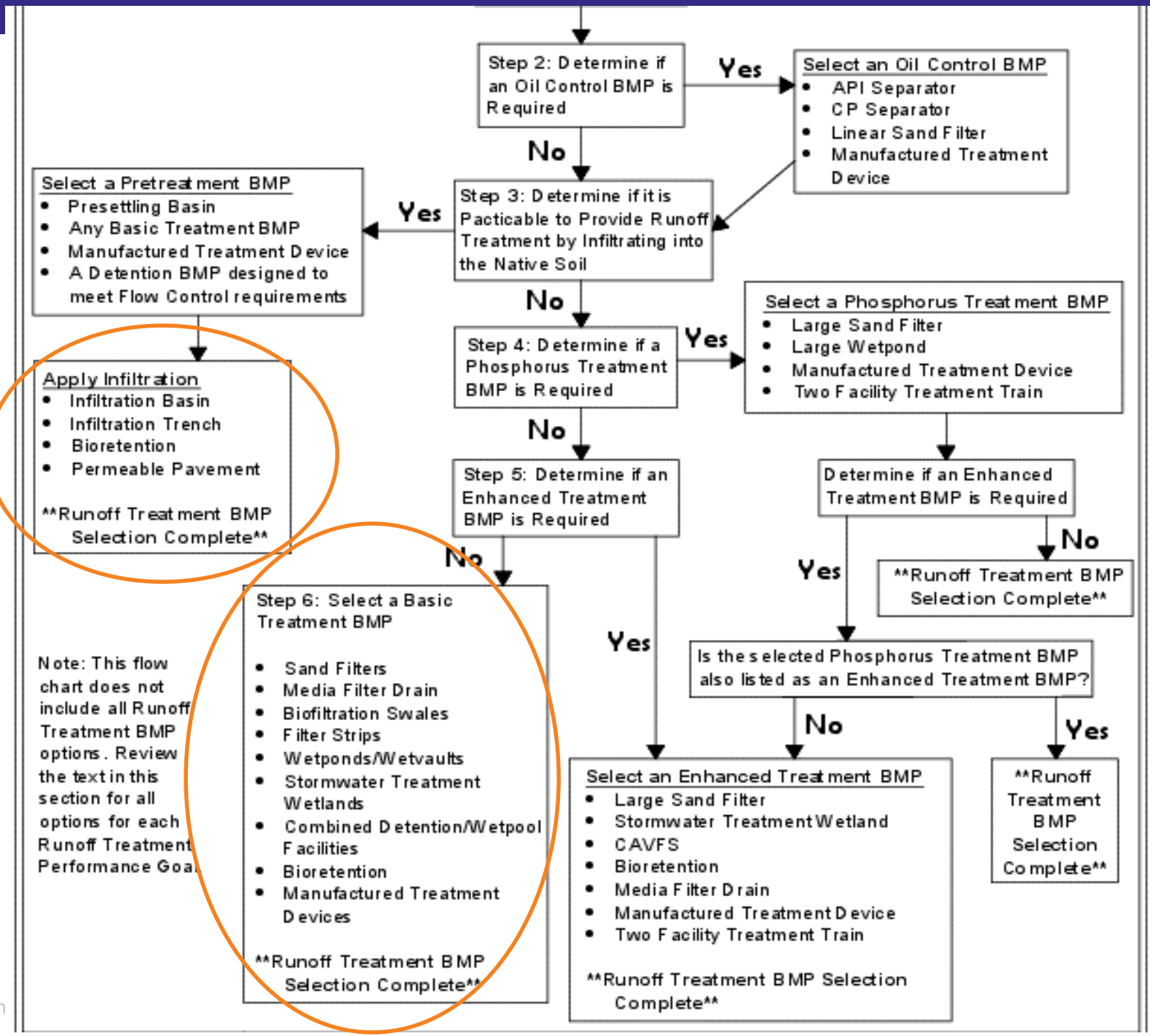
Facility Selection Hierarchy City of Seattle…

- Infeasibility Process
  - Environmentally Critical Area
  - Slope instability
  - Would require tree removal
  - Lack of Infiltration/Low perc rates
  - Setbacks
  - Contaminated Soils/Groundwater
  - Others issues like historic preservation, health & safety standards, lack of available room (too small for min. facility size)

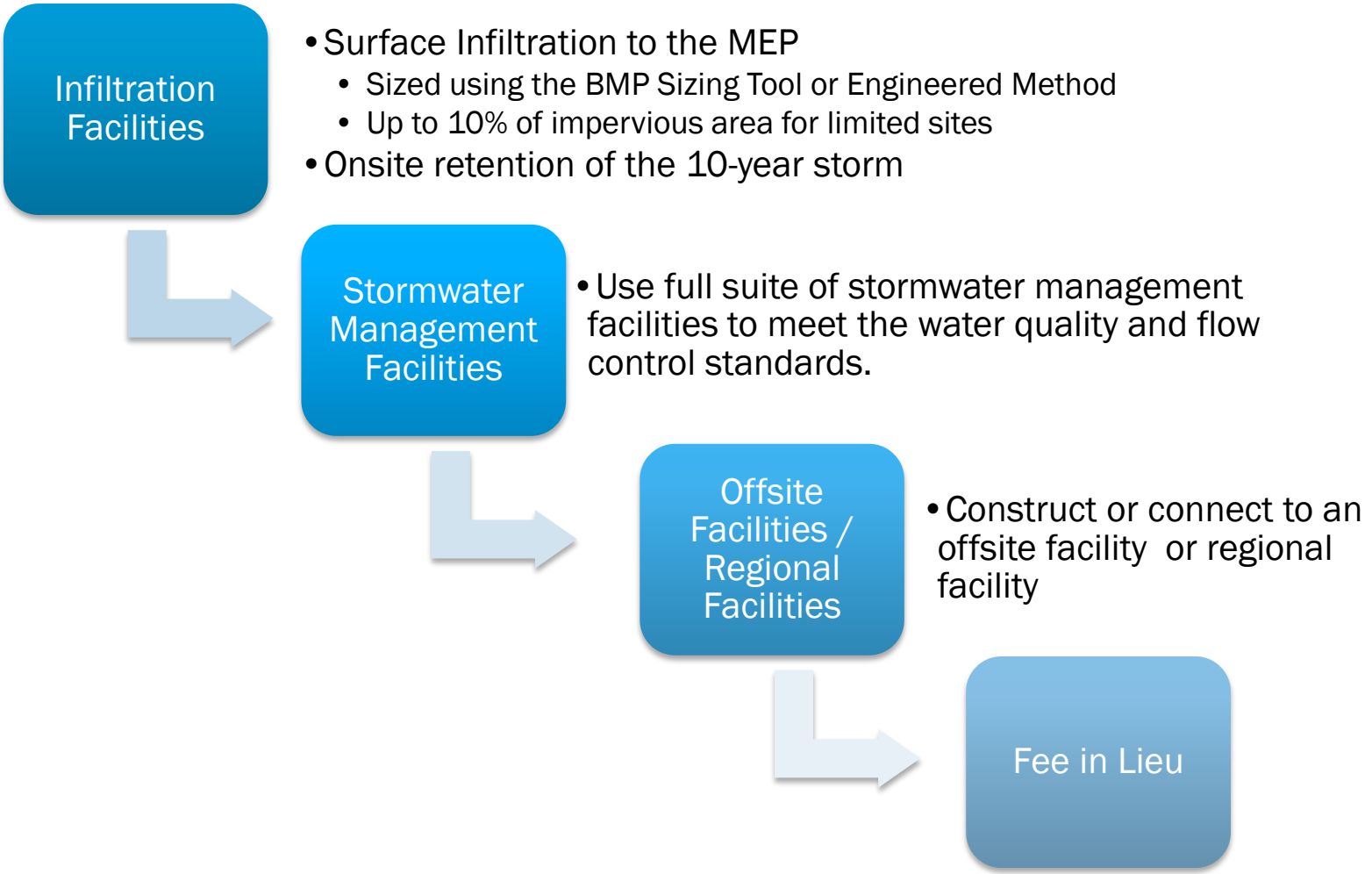
Facility Selection Hierarchy
Western Washington 2019 SWMM (Draft)

- BMP Selection Flowchart
  - Infiltration options first
  - Basic and Enhanced BMP options for non-infiltrating sites
  - Alternative facility requirements for Oil Control, Phosphorous Removal, other special conditions




Step 2: Determine if an Oil Control BMP is Required
Yes
Select an Oil Control BMP
API Separator
CP Separator
Linear Sand Filter
Manufactured Treatment Device
No
Select a Pretreatment BMP
Presettling Basin
Any Basic Treatment BMP
Manufactured Treatment Device
A Detention BMP designed to meet Flow Control requirements
Yes
Step 3: Determine if it is Pacticable to Provide Runoff Treatment by Infiltrating into the Native Soil
No
Apply Infiltration
Infiltration Basin
Infiltration Trench
Bioretention
Permeable Pavement
Runoff Treatment BMP Selection Complete
Step 4: Determine if a Phosphorus Treatment BMP is Required
Yes
Select a Phosphorus Treatment BMP
Large Sand Filter
Large Wetpond
Manufactured Treatment Device
Two Facility Treatment Train
No
Step 5: Determine if an Enhanced Treatment BMP is Required
Determine if an Enhanced Treatment BMP is Required
No
Runoff Treatment BMP Selection Complete
Yes
No
Step 6: Select a Basic Treatment BMP
Sand Filters
Media Filter Drain
Biofiltration Swales
Filter Strips
Wetponds/Wetvaults
Stormwater Treatment Wetlands
Combined Detention/Wetpool Facilities
Bioretention
Manufactured Treatment Devices
Runoff Treatment BMP Selection Complete
Yes
Is the selected Phosphorus Treatment BMP also listed as an Enhanced Treatment BMP?
No
Yes
Select an Enhanced Treatment BMP
Large Sand Filter
Stormwater Treatment Wetland
CAVFS
Bioretention
Media Filter Drain
Manufactured Treatment Device
Two Facility Treatment Train
Runoff Treatment BMP Selection Complete
Runoff Treatment BMP Selection Complete
Note: This flow chart does not include all Runoff Treatment BMP options. Review the text in this section for all options for each Runoff Treatment Performance Goa

Facility Selection Hierarchy
Oregon City



Discussion

- Should there be a hierarchy of flow reduction strategies and stormwater BMPs?
- Will there be a defined MEP?
- Will applicants be required to prove infeasibility?
- Are there specific conditions that would warrant a different facility type?

BREAK?

Stormwater Facility Types and Use Guidelines

Allowable Facilities

Design Guidelines

Brown AND Caldwell

Questions to Consider

- Which BMPs will be included as “standard” use?
- Should certain facilities only be allowed as part of a modification or variance request?
- Which facilities should be used for
  - Impervious Area Reduction
  - Infiltration
  - Water Quality Treatment
  - Flow Control
- What site conditions would limit the use of each facility?

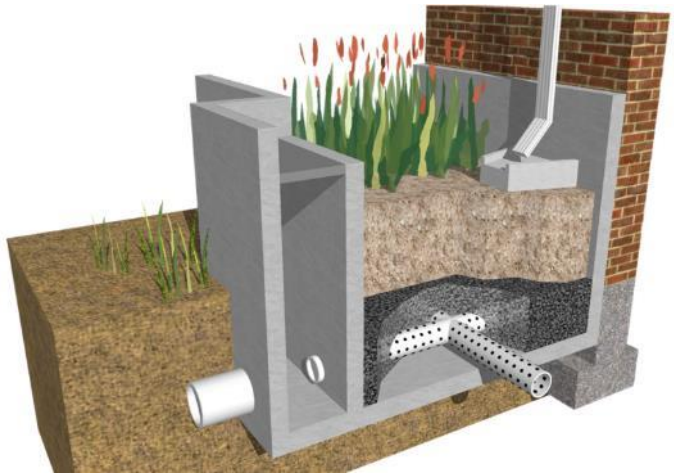
Allowable Facilities

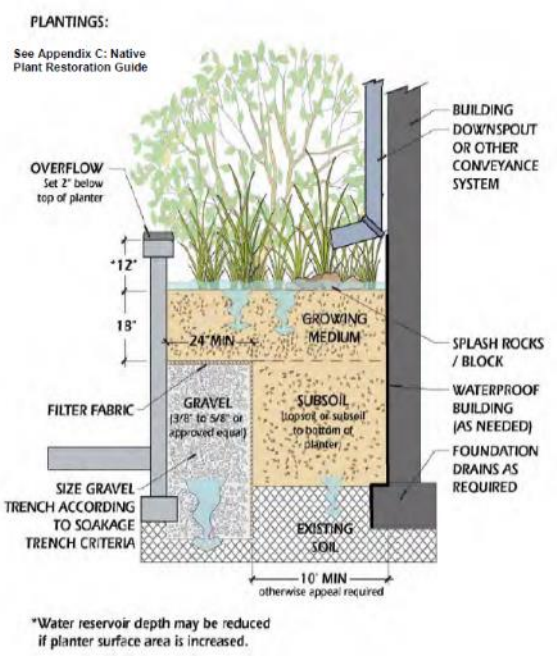
	Portland	Salem	Oregon City	Lake Oswego	WES Draft
Stormwater Planter	X	X	X	X	X
Rain Garden	Basin	X	X	X	X
Vegetated Swale	X	X	X	X	X
Filter Strip	X	X	X	X	X
Drywell	X	Private Only	X	X	
Infiltration Trench	Soakage Trench	Private Only	X	X	SFR Roofs
Sand Filter	X			X	
Constructed Wetland		X		X	
Ponds		Parking Lot only	X	X	X
Structural Detention	X	X		X	
Manufactured Treatment	X	X	Private Only	Private Only	X
Sheet Flow Dispersion		X		X	
Pervious Pavement	X	X	X	X	X
Green Roof	X	X	X	X	X
Rainwater Harvesting				X	

Facility Selection and Use Guidelines

- Impervious Area Reduction
- Infiltration
- Water Quality Treatment
- Flow Control
- Public Street/ROW
- Private Property
- Steep Slopes
- Design Notes
- Maintenance Notes
- Other

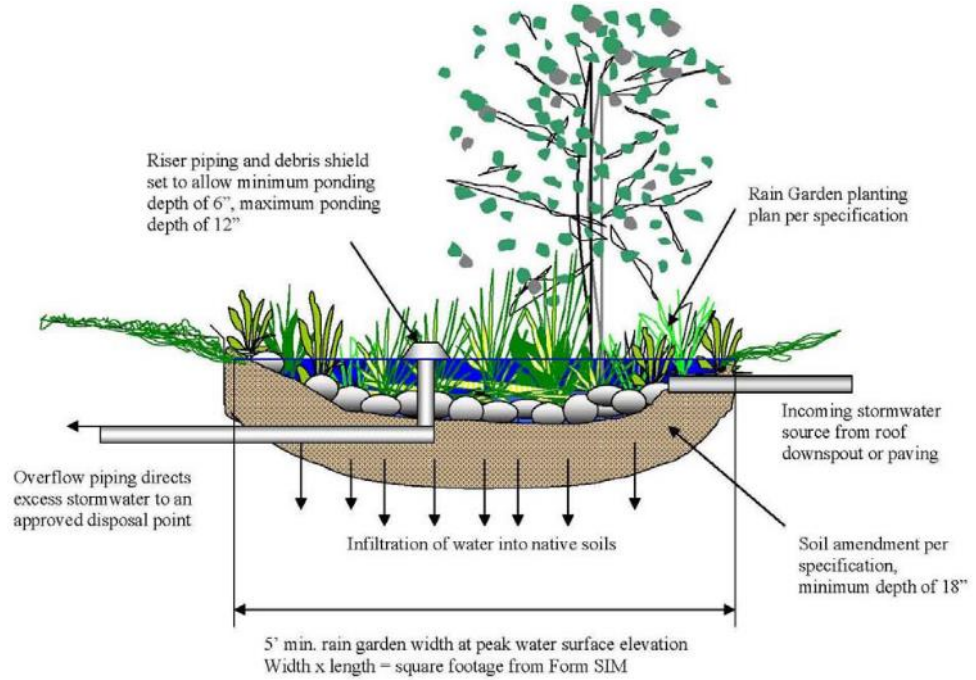
Stormwater Planter

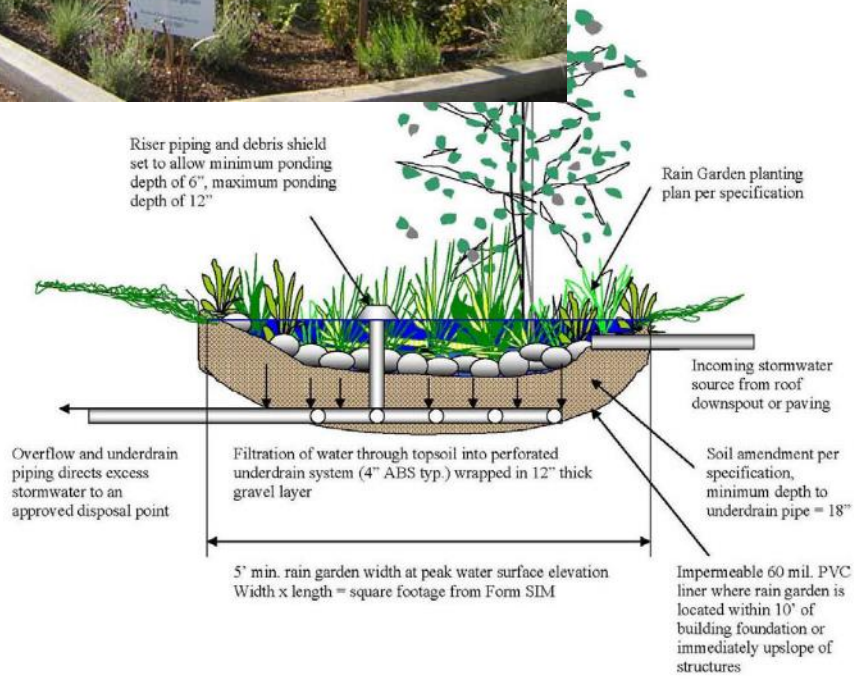




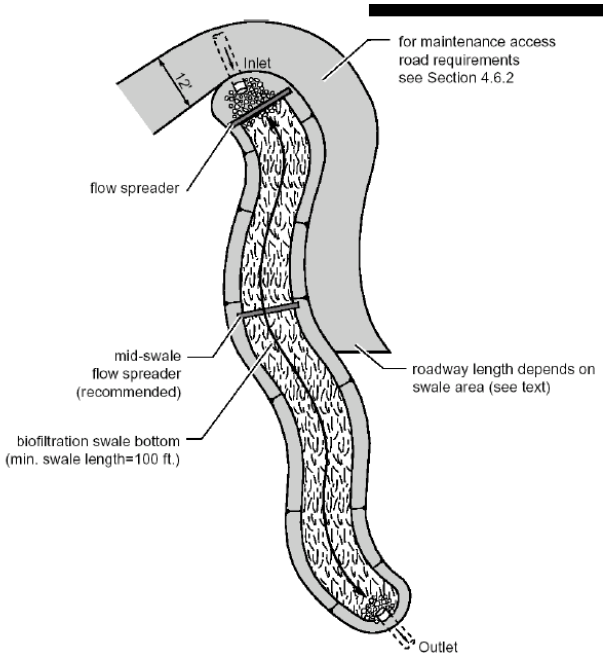
Rain Garden

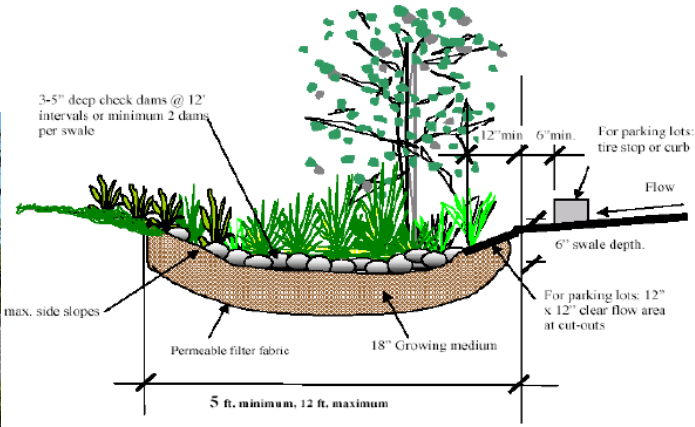

Welcome to the
Glencoe
Rain Garden


Riser piping and debris shield set to allow minimum ponding depth of 6", maximum ponding depth of 12"
Rain Garden planting plan per specification
Incoming stormwater source from roof downspout or paving
Overflow piping directs excess stormwater to an approved disposal point
Infiltration of water into native soils
Soil amendment per specification, minimum depth of 18"
5' min. rain garden width at peak water surface elevation
Width x length = square footage from Form SIM

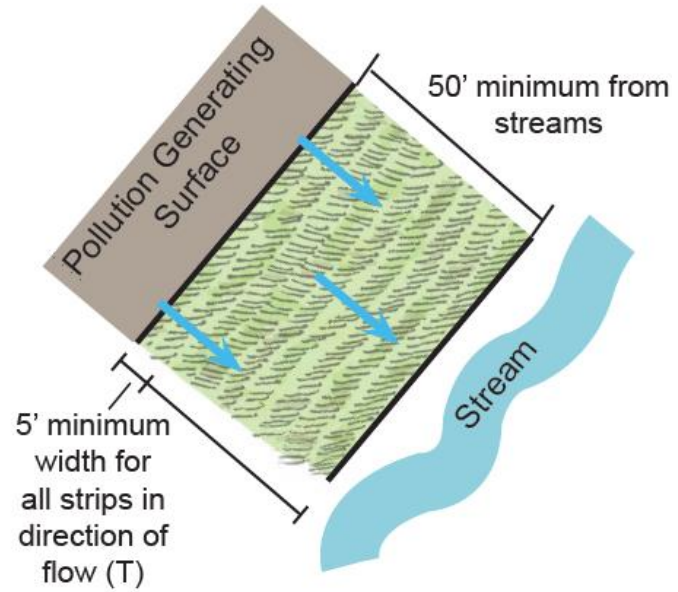

Riser piping and debris shield set to allow minimum ponding depth of 6", maximum ponding depth of 12"
Rain Garden planting plan per specification
Incoming stormwater source from roof downspout or paving
Overflow and underdrain piping directs excess stormwater to an approved disposal point
Filtration of water through topsoil into perforated underdrain system (4" ABS typ.) wrapped in 12" thick gravel layer
Soil amendment per specification, minimum depth to underdrain pipe = 18"
5' min. rain garden width at peak water surface elevation
Width x length = square footage from Form SIM
Impermeable 60 mil. PVC liner where rain garden is located within 10' of building foundation or immediately upslope of structures

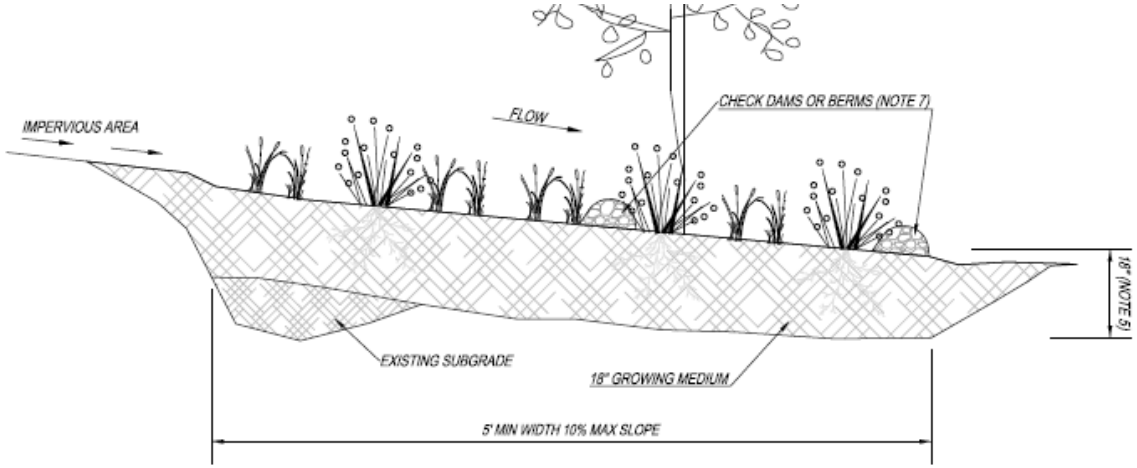
Vegetated Swale





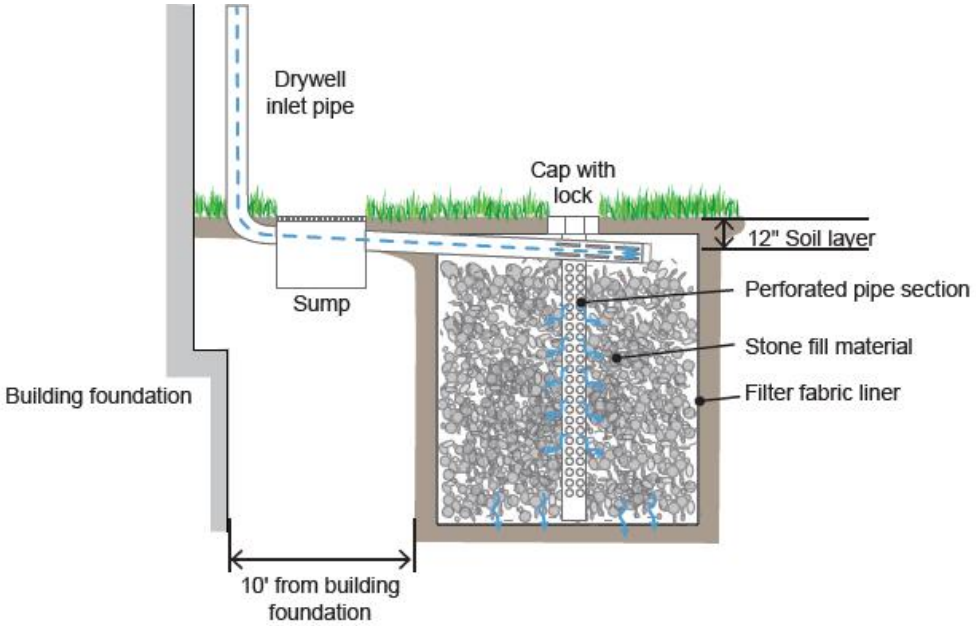
Filter Strip





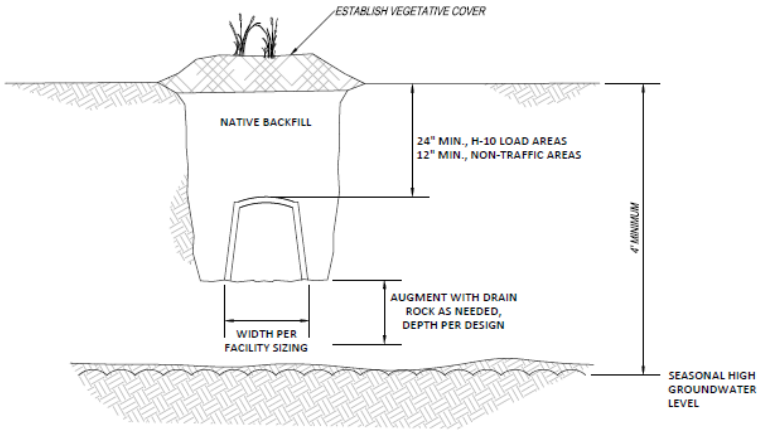
SLOPE OF FILTER STRIP	LENGTH OF IMPERVIOUS AREA FLOW PATH (30' MAX)			
	5'	10'	20'	30'
2%	5'	5'	5'	5'
5%	5'	5'	7'	9'
10%	5'	7'	10'	14'
15%	5'	9'	13'	16'

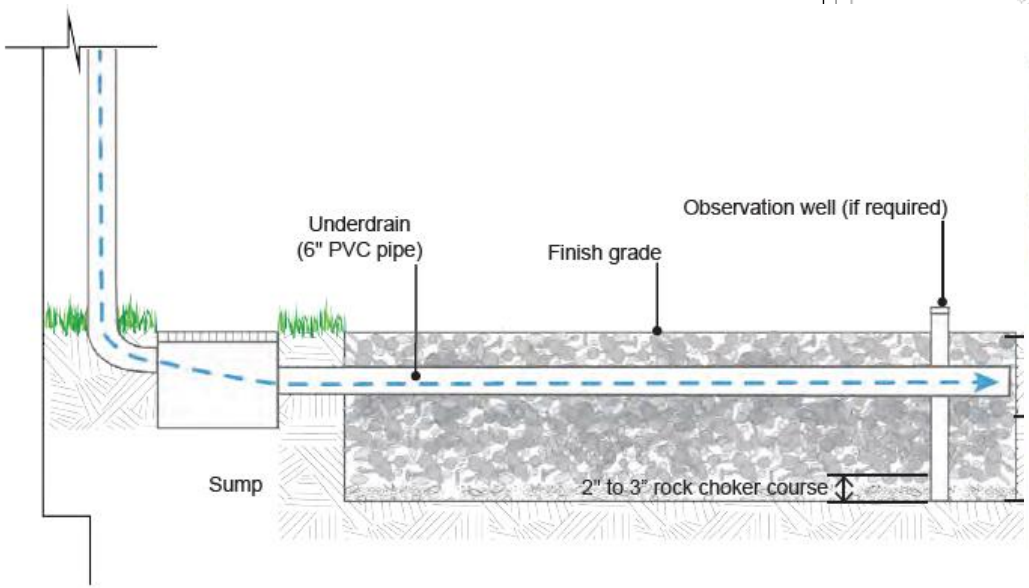
Drywell


Drywell
inlet pipe
Cap with
lock
12" Soil layer
Perforated pipe section
Stone fill material
Filter fabric liner
Sump
Building foundation
10' from building
foundation


PRECAST

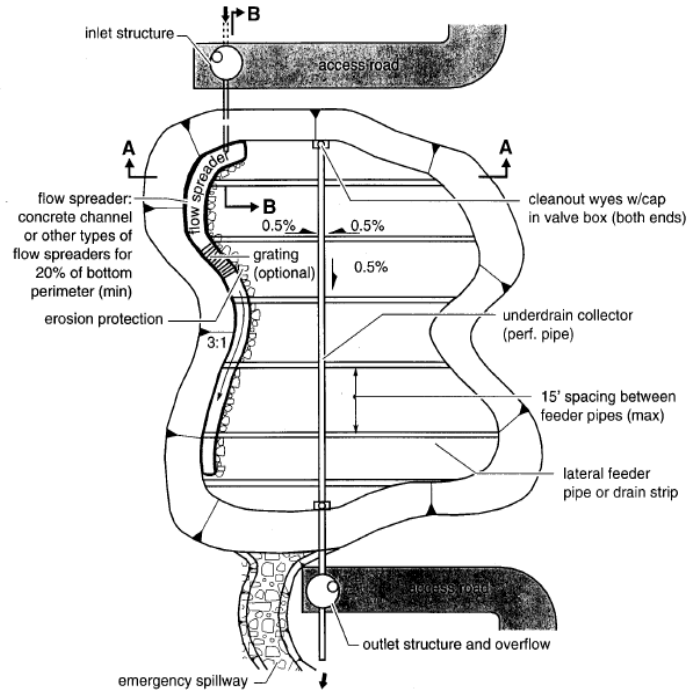
Infiltration Trench

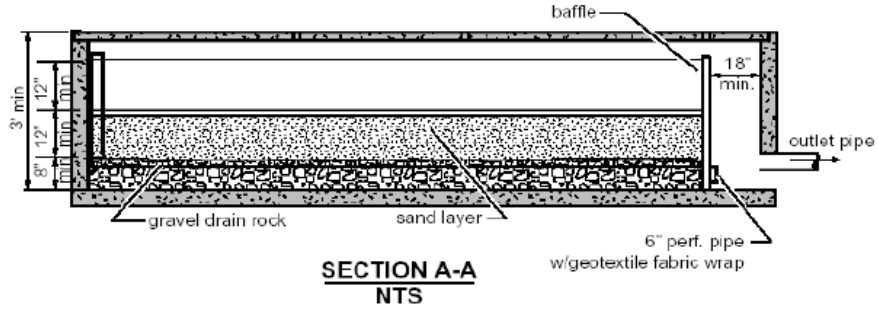


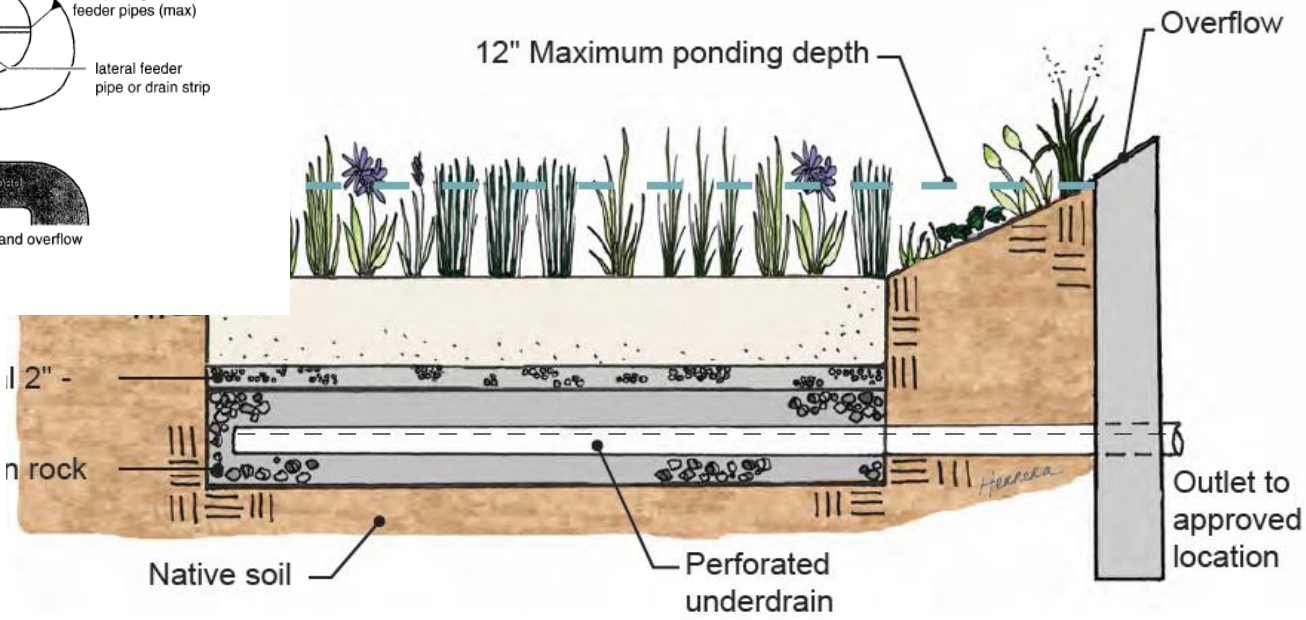


Infiltration trench also serving as an outdoor gathering space.

Sand Filter


inlet structure
access road
B
A
A
flow spreader
flow spreader: concrete channel or other types of flow spreaders for 20% of bottom perimeter (min)
B
0.5%
0.5%
0.5%
grating (optional)
erosion protection
3:1
cleanout wyes w/cap in valve box (both ends)
underdrain collector (perf. pipe)
15' spacing between feeder pipes (max)
lateral feeder pipe or drain strip
access road
outlet structure and overflow
emergency spillway


baffle
3' min
12" min
12" min
8"
18" min.
outlet pipe
gravel drain rock
sand layer
6" perf. pipe w/geotextile fabric wrap
SECTION A-A
NTS


12" Maximum ponding depth
Overflow
2" -
rock
Native soil
Perforated underdrain
Outlet to approved location

Constructed Wetland

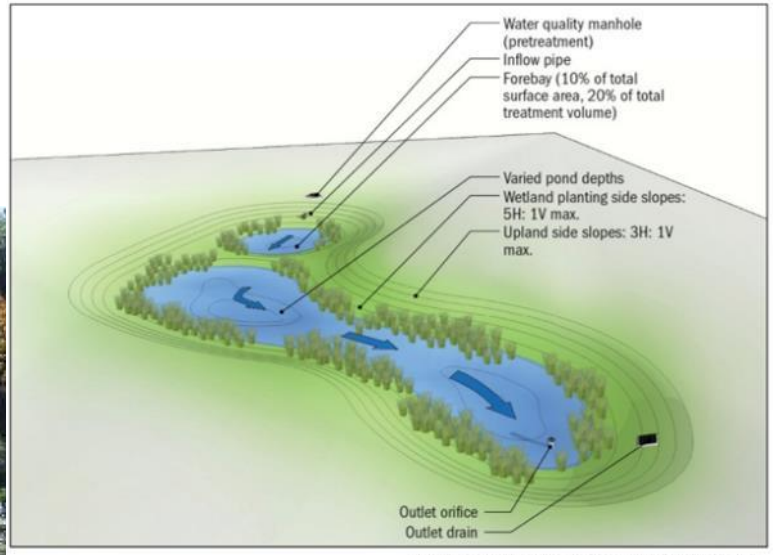
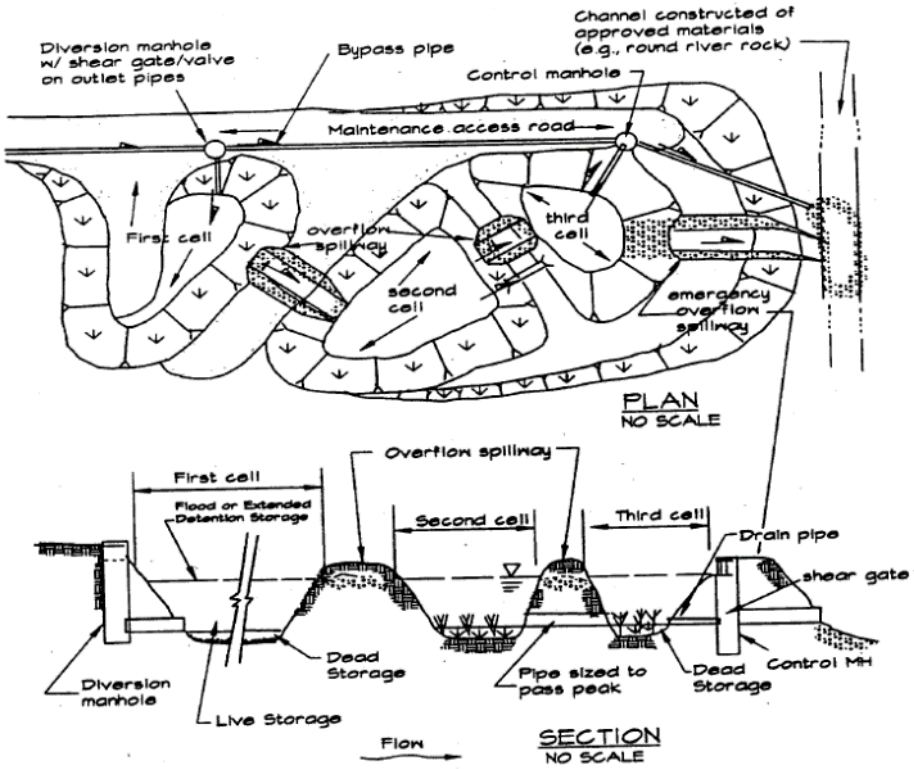


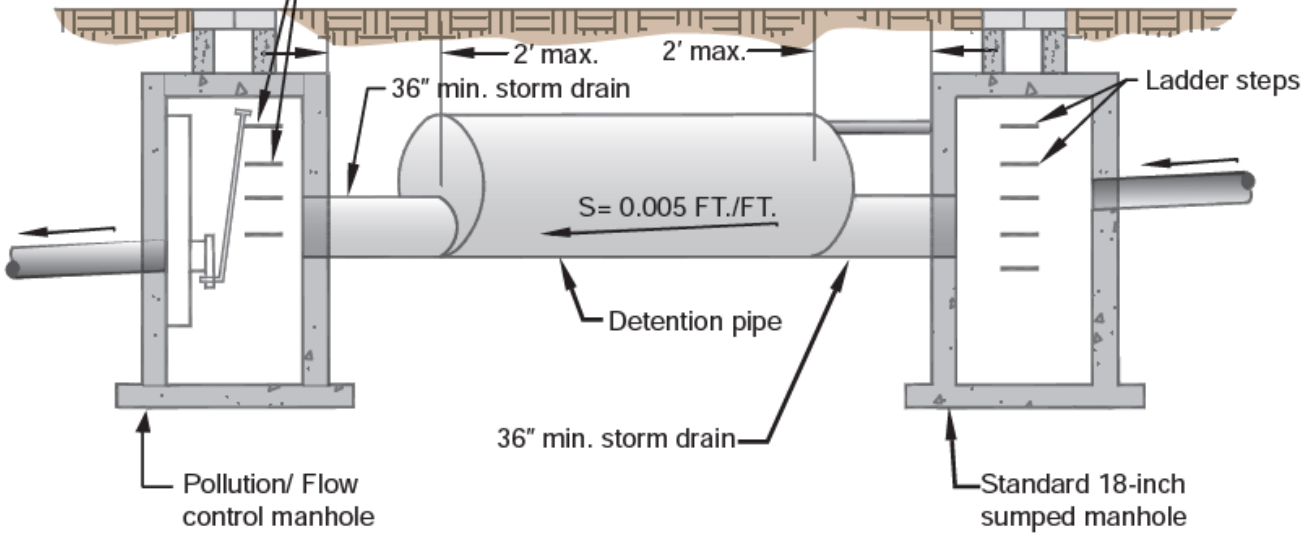
Image from Clean Water Services LIDA Handbook

Washington County

Ponds – Detention, Infiltration, Wet



Structural Detention



Manufactured Treatment Technologies

- Two Options:
  - Identify a specific list of facilities that will be allowed
    - Portland and Gresham developed a list of approved systems in 2005
    - Salem allows 10 different systems, with a table of allowable uses
  - Reference another jurisdiction's approved list (i.e. Department of Ecology, City of Portland)

Manufactured Treatment Systems Example Approval List

Portland
Gresham

Currently Approved List as of April 2005	
Approved for use in Public Right-of-Way (systems maintained by the City)	**Approved for use on Private Property (systems maintained privately)**
1. Stormwater Management Stormfilter (vault-type w/multiple filter cartridges). Approved for stand-alone[1] use at 15 gpm treatment flow per cartridge.	1. Stormwater Management Stormfilter (vault-type w/multiple filter cartridges). Approved for stand-alone[1] use at 15 gpm treatment flow per cartridge.
2. Stormwater Management Stormfilter (precast 48" manhole w/2 filter cartridges). Approved for stand-alone[1] use at 15 gpm treatment flow per cartridge.	2. Stormwater Management Stormfilter (precast 48" or 60" manhole designs). Approved for stand-alone[1] use at 15 gpm treatment flow per cartridge.
3. Stormwater Management Stormfilter (precast 60" manhole w/3 filter cartridges). Approved for stand-alone[1] use at 15 gpm treatment flow per cartridge.	3. Stormwater Management Stormfilter (catch basin model). Approved for stand-alone[1] use at 15 gpm treatment flow per cartridge.
4. CDS Technologies. Approved for pretreatment[2] as a component of a treatment train.	4. CDS Technologies. Approved for pretreatment[2] as a component of a treatment train.
5. Downstream Defender. Approved for pretreatment[2] as a component of a treatment train.	5. Downstream Defender. Approved for pretreatment[2] as a component of a treatment train.
6. Vortechnics Vortechs System. Approved for pretreatment[2] as a component of a treatment train.	6. Vortechnics Vortechs System. Approved for pretreatment[2] as a component of a treatment train.
7. Stormceptor. Approved for pretreatment[2] as a component of a treatment train.	7. Stormceptor. Approved for pretreatment[2] as a component of a treatment train.
	8. Jensen Precast Stormvault. Approved for pretreatment[2] as a component of a treatment train.

Sheet Flow Dispersion

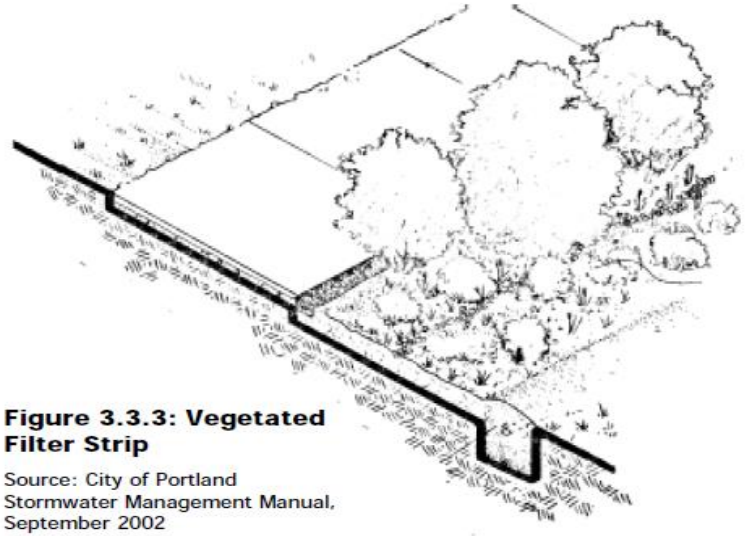
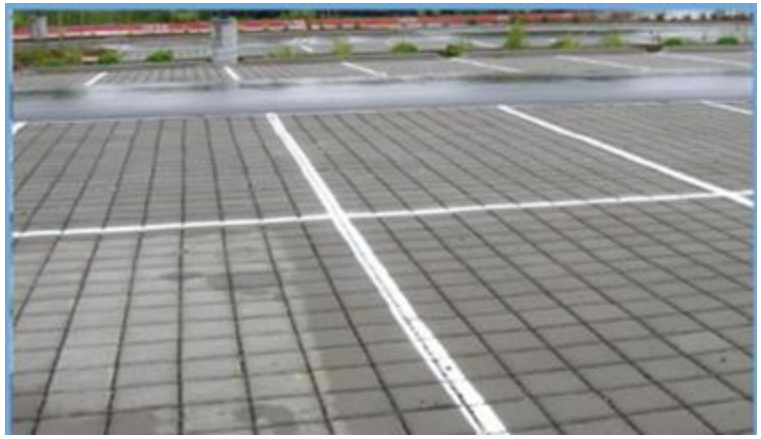


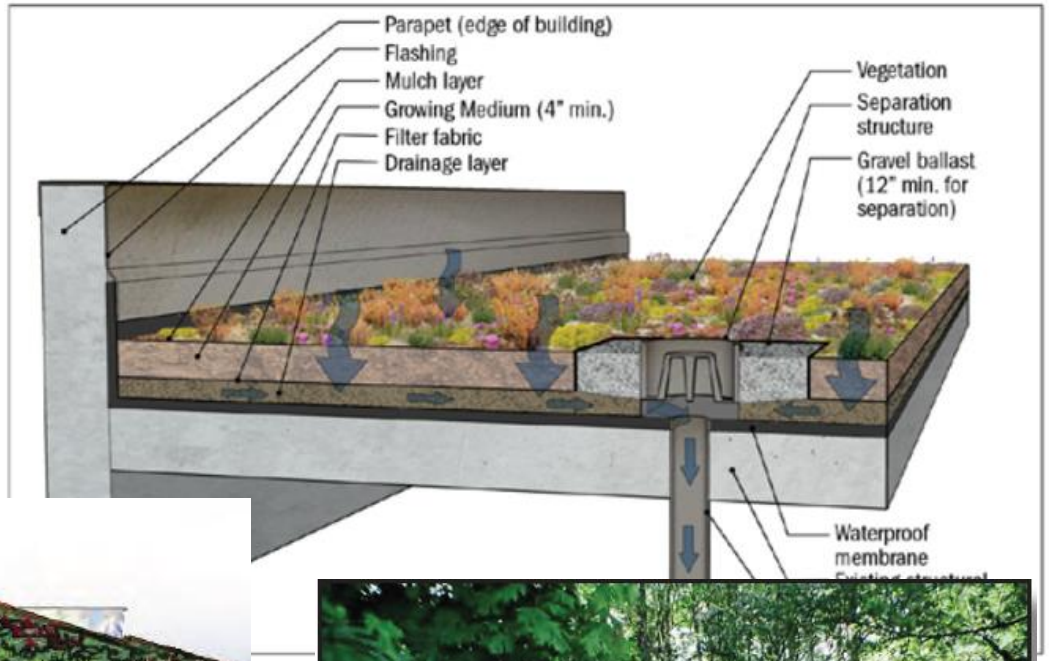
Figure 3.3.3: Vegetated Filter Strip

Source: City of Portland Stormwater Management Manual, September 2002

Pervious Pavement



Green Roof


Parapet (edge of building)
Flashing
Mulch layer
Growing Medium (4" min.)
Filter fabric
Drainage layer
Vegetation
Separation structure
Gravel ballast (12" min. for separation)
Waterproof membrane

Rainwater Harvesting

Wrap Up

Brown AND Caldwell

Summarize Decisions

- LID/Green Infrastructure Approach
  - Site Planning
  - Facility Design
- Facility performance criteria and design requirements
- Follow-up Assignments
- Workshop #3