Statewide LID Training Program

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Statewide LID
DEPARTMENT OF **ECOLOGY** State of Washington

ADVANCED LID DESIGN 1

Statewide LID Training Program

INSTRUCTORS

Curtis Hinman

Senior Scientist

Key project experience: Research specialist in the performance and design of LID practices.

Dylan Ahearn PhD

Associate Scientist

Key project experience: Stormwater monitoring and proprietary treatment verification and certification specialist.

Statewide LID Training Program

6.2 BIORETENTION MEDIA

Statewide LID Training Program

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ADVANCED TOPICS IN LID DESIGN:
BIORETENTION MEDIA AND COMPOST AMENDED SOILS

6.2

1 introduction

2 media primer

3 water quality treatment strategies

4 performance

5 wrap-up

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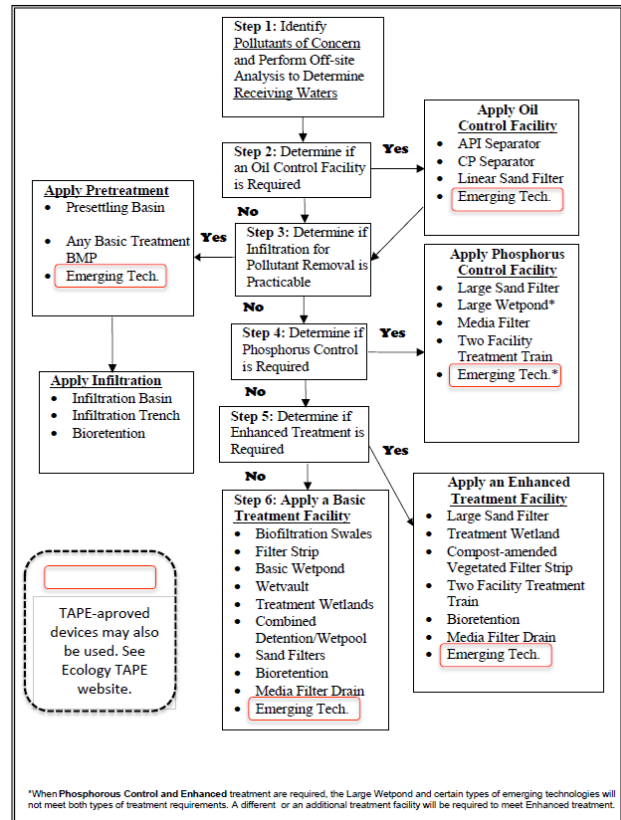
6.2 **BIORETENTION MEDIA**
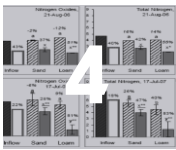
PROPRIETARY MEDIA FILTERS

BMP Selection

- Ecology sets guidance for which BMPs can be used

- Specific BMPs are required for specific pollutants
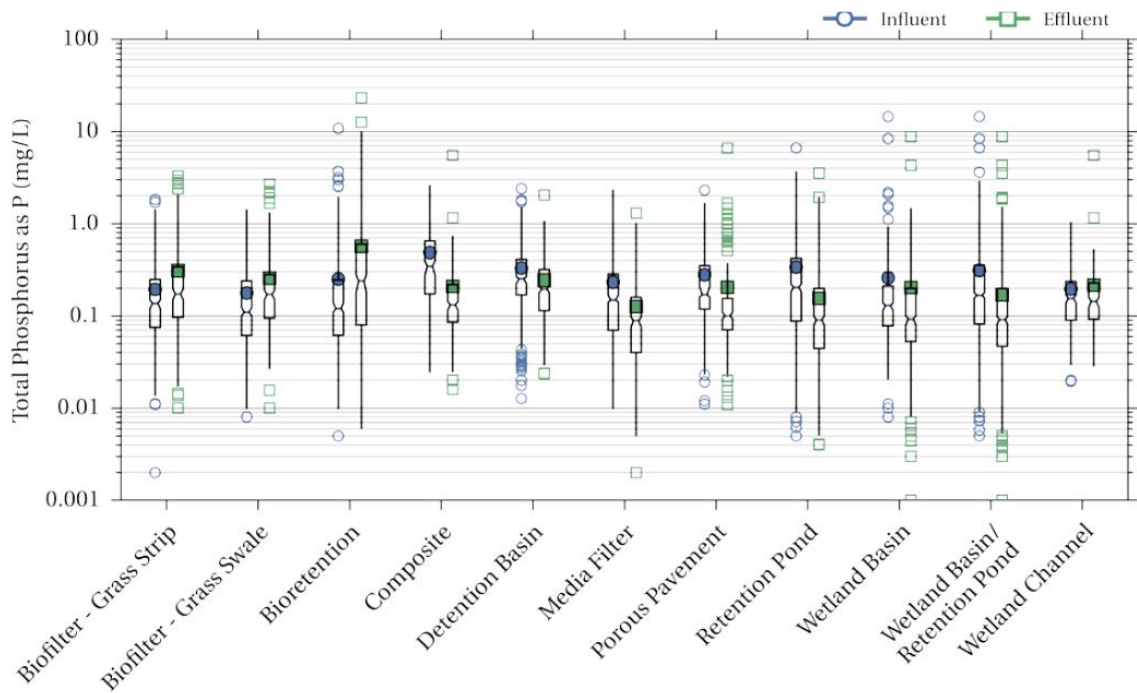
- Most BMPs are grandfathered in

Table 3.3.1
Treatment Trains for Phosphorus Removal

First Basic Treatment Facility	Second Treatment Facility
Biofiltration Swale	Basic Sand Filter or Sand Filter Vault
Filter Strip	Linear Sand Filter (no presettling needed)
Linear Sand Filter	Filter Strip
Basic Wetpond	Basic Sand Filter or Sand Filter Vault
Wetvault	Basic Sand Filter or Sand Filter Vault
Stormwater Treatment Wetland	Basic Sand Filter or Sand Filter Vault
Basic Combined Detention and Wetpool	Basic Sand Filter or Sand Filter Vault

Step 1: Identify Pollutants of Concern and Perform Off-site Analysis to Determine Receiving Waters

Step 2: Determine if an Oil Control Facility is Required — Yes → **Apply Oil Control Facility**
- API Separator
- CP Separator
- Linear Sand Filter
- Emerging Tech.

No ↓

Apply Pretreatment
- Presettling Basin
- Any Basic Treatment BMP — Yes
- Emerging Tech.

Step 3: Determine if Infiltration for Pollutant Removal is Practicable

No ↓

Apply Infiltration
- Infiltration Basin
- Infiltration Trench
- Bioretention

Step 4: Determine if Phosphorus Control is Required — Yes → **Apply Phosphorus Control Facility**
- Large Sand Filter
- Large Wetpond*
- Media Filter
- Two Facility Treatment Train
- Emerging Tech.*

No ↓

Step 5: Determine if Enhanced Treatment is Required — Yes → **Apply an Enhanced Treatment Facility**
- Large Sand Filter
- Treatment Wetland
- Compost-amended Vegetated Filter Strip
- Two Facility Treatment Train
- Bioretention
- Media Filter Drain
- Emerging Tech.

No ↓

Step 6: Apply a Basic Treatment Facility
- Biofiltration Swales
- Filter Strip
- Basic Wetpond
- Wetvault
- Treatment Wetlands
- Combined Detention/Wetpool
- Sand Filters
- Bioretention
- Media Filter Drain
- Emerging Tech.

TAPE-aproved devices may also be used. See Ecology TAPE website.

*When **Phosphorous Control and Enhanced** treatment are required, the Large Wetpond and certain types of emerging technologies will not meet both types of treatment requirements. A different or an additional treatment facility will be required to meet Enhanced treatment.

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN 5

PROPRIETARY MEDIA FILTERS
BMP Selection

PROPRIETARY MEDIA FILTERS
BMP Selection

Something Doesn't Quite Look Right...

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN 7

7

PROPRIETARY MEDIA FILTERS
BMP Selection

Ecology attempts to verify BMP effectiveness with 2007 permit required monitoring

Phase I Municipal Stormwater Permit Monitoring: *Stormwater Treatment and Hydrologic Management Best Management Practice (BMP) Evaluation Monitoring* **(S8.F)**

S8.F requires Phase I Municipal Stormwater Permittees to measure the effectiveness of stormwater treatment and hydrologic management BMPs. Permittees are required to collect influent and effluent water quality and flow data from each BMP in accordance with Ecology's Guidance for Evaluating Emerging Stormwater Treatment, Technology Assessment Protocol-Ecology (TAPE). This monitoring component also includes a requirement for Phase I Permittees (with the exception of Ports) to monitor the effectiveness of one flow reduction strategy that is in use or planned for installation. This monitoring includes continuous rainfall and runoff monitoring.

Ecology required Phase I Permittees to develop Quality Assurance Project Plans (QAPPs). The following describes each Phase I permittee's effectiveness study with links to each QAPP.

King County

King County is monitoring two, large sand filters and two, pre-settling basins. These stormwater facilities are located at a multi-family development on the East-Lake Sammamish Plateau.

S8.F.7: Flow Reduction Strategy
King County is monitoring organic compost added as a soil amendment in an urban planned housing development (part of the Redmond Ridge project). Amending soil is an attempt to mitigate the traditional clearing and grading of land for building that leaves little organic soil in place after construction has been completed. The study hypothesis is that adding organic compost to native soils will absorb more stormwater than un-composted soil and enhance the growth of the planted landscape that will additionally prevent more runoff. Flow will be monitored from a basin with compost-amended soils and from a basin in a similar development without compost-amended soils (control). The paired data will be compared to determine differences between the basins.

King County's QAPP for S8.F and S8.F.7

Snohomish County

Snohomish County is monitoring four modified wet ponds to determine which design is most effective at removing pollutants from stormwater. These wet ponds are located northeast of Mill Creek, southeast of Mill Creek and two ponds located south of Everett.

S8.F.7 Flow Reduction Strategy
For flow reduction, the County is monitoring a modified drainage structure in a subdivision southeast of Mill Creek to determine if a reduction of stormwater volume is occurring from retrofits designed to encourage infiltration.

Snohomish County's QAPP for S8.F and S8.F.7

Clark County

Clark County is monitoring two treatment wetlands located in the City of Vancouver, WA and a two-facility treatment train located near the Klineline Bridge over Salmon Creek on Highway 99. The first treatment facility is a bio-filtration swale followed by a StormFilter® media filter vault system equipped with 28 media filter cartridges with zeolite-perlite-granular activated carbon filtration media.

Clark County's QAPP for S8.F

S8.F.7 Flow Reduction Strategy
The County is also monitoring the flow reduction capability of permeable pavers as a low impact development (LID) practice at the Vancouver Toyota car dealership.

Clark County's QAPP for S8.F.7

TAPE Guidance

Stormwater Monitoring Report Guidance-Phase I

EAP Quality Assurance

Phase I Permit

Phase I S8.D Monitoring

Phase I S8.E Monitoring

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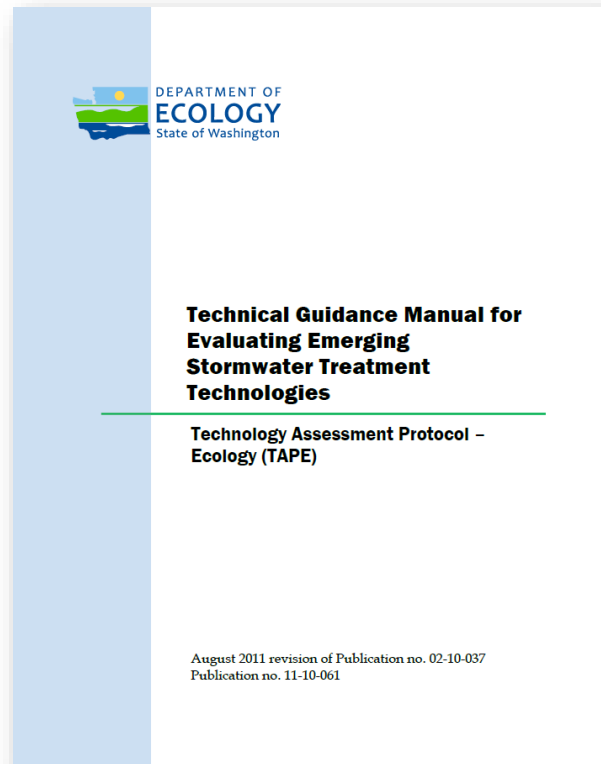
6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 8

PROPRIETARY MEDIA FILTERS

BMP Testing -TAPE

Emerging Technology

- Testing program first established in 2002

- Most recent revision in 2011, next due this year

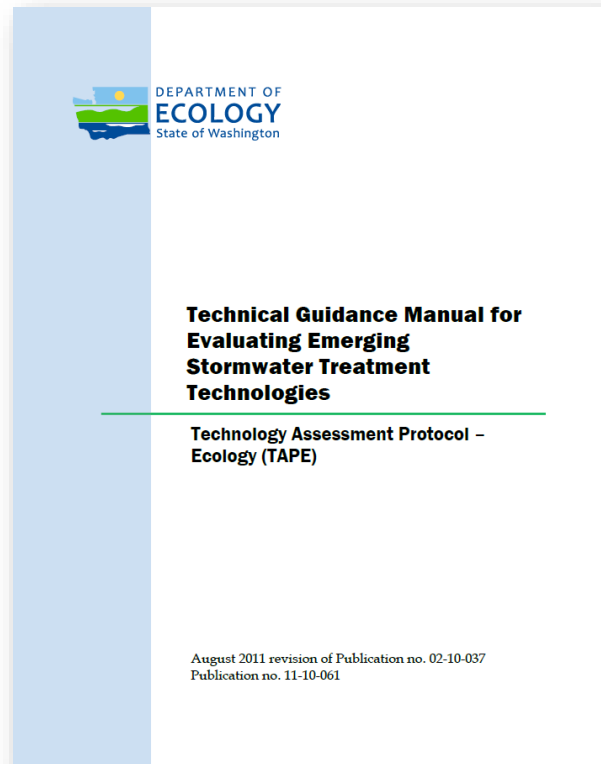- Most rigorous and active testing protocol in the nation

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Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies

Technology Assessment Protocol – Ecology (TAPE)

August 2011 revision of Publication no. 02-10-037
Publication no. 11-10-061

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 9

PROPRIETARY MEDIA FILTERS

BMP Testing -TAPE

Jurisdictions that recognize TAPE

1. Washington
2. Oregon
3. New York
4. Virginia
5. New Hampshire
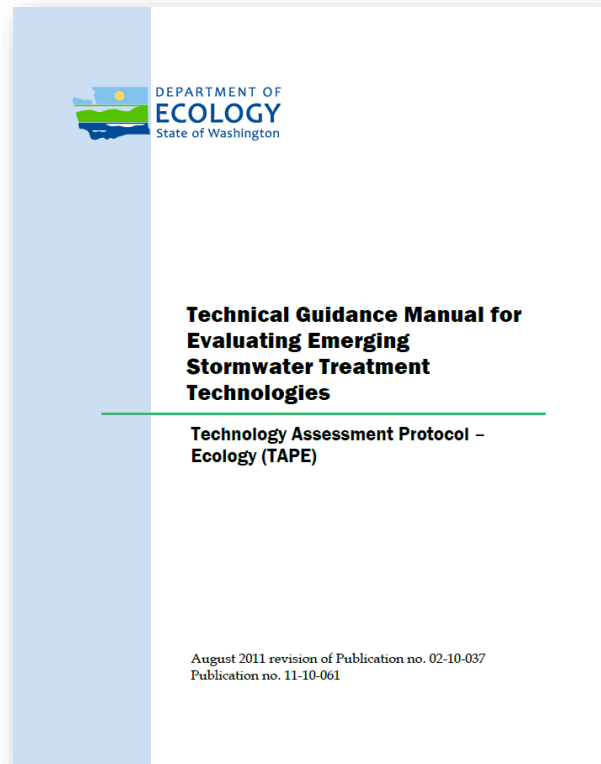6. Rhode Island
7. Many smaller jurisdictions

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Technology Assessment Protocol – Ecology (TAPE)

August 2011 revision of Publication no. 02-10-037
Publication no. 11-10-061

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 10

PROPRIETARY MEDIA FILTERS
BMP Testing -TAPE

Certifications

- General Use – GULD
    - use at will
- Conditional Use – CULD
    - install up to 10, monitor 1
- Pilot Use – PULD
    -install up to 5, monitor all

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Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies

Technology Assessment Protocol – Ecology (TAPE)

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 11

11

PROPRIETARY MEDIA FILTERS

BMP Testing -TAPE

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Table 2. Basic, dissolved metals, phosphorus, and oil treatment and pretreatment performance goals and required water quality parameters for TAPE monitoring.

Performance Goal	Influent Range	Criteria	Required Water Quality Parameters
Basic Treatment	20-100 mg/L TSS	Effluent goal ≤ 20 mg/L TSS [a]	TSS
	100-200 mg/L TSS	≥ 80% TSS removal [b]	
	> 200 mg/L TSS	> 80% TSS removal [b]	
Dissolved Metals Treatment [c]	Dissolved copper 0.005 – 0.02 mg/L	Must meet basic treatment goal and better than basic treatment currently defined as > 30% dissolved copper removal [b,d]	TSS, hardness, total and dissolved Cu and Zn
	Dissolved zinc 0.02 – 0.3 mg/L	Must meet basic treatment goal and better than basic treatment currently defined as > 60% dissolved zinc removal [b,d]	
Phosphorus Treatment	Total phosphorus (TP) 0.1 to 0.5 mg/L	Must meet basic treatment goal and exhibit ≥ 50% TP removal [b]	TSS, TP, orthophosphate
Oil Treatment	Total petroleum hydrocarbons (TPH) > 10 mg/L [e]	1) No ongoing or recurring visible sheen in effluent 2) Daily average effluent TPH concentration < 10 mg/L [a,e] 3) Maximum effluent TPH concentration of 15 mg/L [a,e] for a discrete (grab) sample	NWTPH-Dx, visible sheen
Pretreatment [f]	50-100 mg/L TSS	Effluent goal ≤ 50 mg/L TSS [a]	TSS
	≥ 100 mg/L TSS	> 50% TSS removal [b]	

Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies

Technology Assessment Protocol – Ecology (TAPE)

August 2011 revision of Publication no. 02-10-037
Publication no. 11-10-061

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6.2 BIORETENTION MEDIA
ADVANCED LID DESIGN 12

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PROPRIETARY MEDIA FILTERS

BMP Testing -TAPE

What Does TAPE Monitoring Look Like?

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN **13**

13

PROPRIETARY MEDIA FILTERS

BMP Testing -TAPE

- Continuous Flow Monitoring

- Collect flow-weighted composite samples

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6.2 **BIORETENTION MEDIA**

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ADVANCED LID DESIGN 14

4/21/2015

PROPRIETARY MEDIA FILTERS

BMP Testing -TAPE

Rigorous Acceptance Criteria

Table 5.   Storm event guidelines for TAPE monitoring.

Parameter	Definition	Guideline [a]
Minimum storm depth	Total rainfall amount during the storm event	0.15 inches
Storm start (antecedent dry-period)	Defines the storm event's beginning as designated by minimum time interval without significant rainfall	6 hours minimum with less than 0.04 inches of rain
Storm end (post storm dry period)	Defines the storm event's end as designated by minimum time interval without significant rainfall	6 hours minimum with less than 0.04 inches of rain
Minimum storm duration	Shortest acceptable rainfall duration	1 hour
Average storm intensity	Total rainfall amount divided by total rainfall duration (e.g., inches per hour)	Range of rainfall intensities [b]

[a]   Provide justification in the Technical Evaluation Report (TER) for storm event data that does not meet the storm event guidelines, but is included in the data analysis.
[b]   To assess performance on an annual average basis and performance at the system's peak design rate, proponents should collect samples over a range of rainfall intensities.

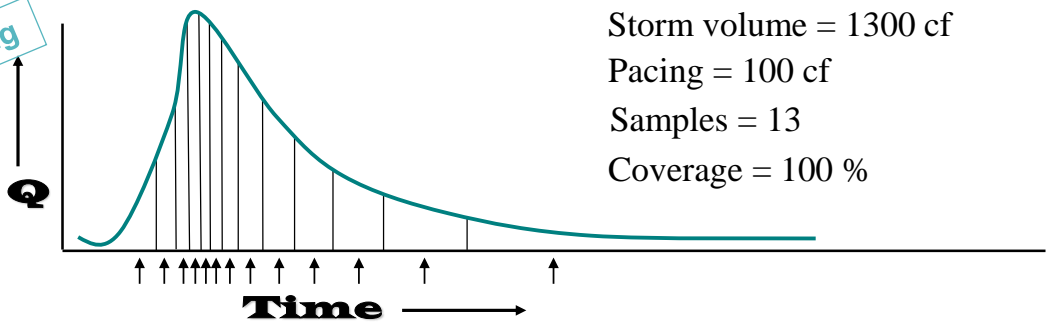Table 6.   Sample collection requirements for automated, flow-proportional composite sampling.

Parameter	Definition	Requirement
Minimum aliquot number	The number of equal-volume samples collected during a storm event that are combined to create a composite sample	10 aliquots [a]
Storm event coverage	The percentage of the total storm volume that the collected aliquots represent	For storm events lasting less than 24 hours, samples shall be collected for at least 75% of the storm event hydrograph (by volume). For storm events lasting longer than 24 hours, samples shall be collected for at least 75% of the hydrograph (by volume) of the first 24 hours of the storm.
Maximum sampling duration	Time in hours between the collection of the first and last aliquots	36 hours
Minimum number of samples	Number of storm events with successfully collected flow-proportional composite samples that meet the influent concentration ranges and the storm event guidelines	12 samples [b]

[a]   Ecology may accept as few as 7 aliquots. Proponents must include rationale in the TER why less than 10 aliquots were collected, but the sample accepted.
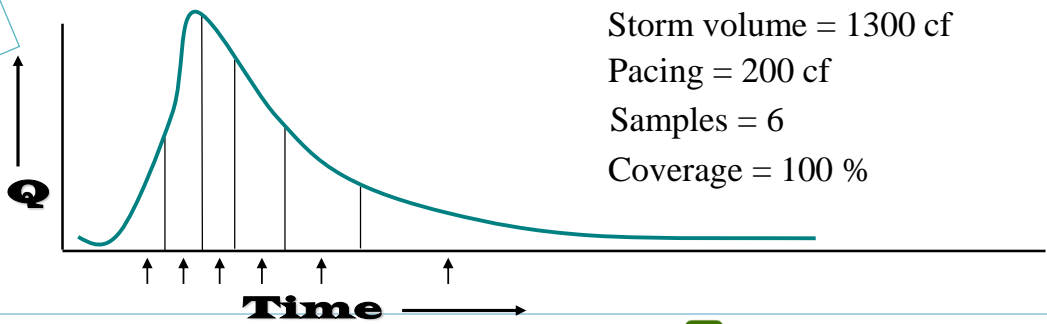[b]   Paired influent and effluent data from more than one site can be combined (pooled) to meet the minimum number of samples.

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN **15**

15

PROPRIETARY MEDIA FILTERS
BMP Testing -TAPE

Good Pacing

Q

Time →

Storm volume = 1300 cf

Pacing = 100 cf

Samples = 13

Coverage = 100 %

Too High

Q

Time →

Storm volume = 1300 cf

Pacing = 200 cf

Samples = 6

Coverage = 100 %

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 16

PROPRIETARY MEDIA FILTERS

BMP Testing -TAPE

Storm volume = 1300 cf

Pacing = 20 cf

Samples = 30 (Max. that autosampler can hold)

Coverage = 46%

Too Low

Q
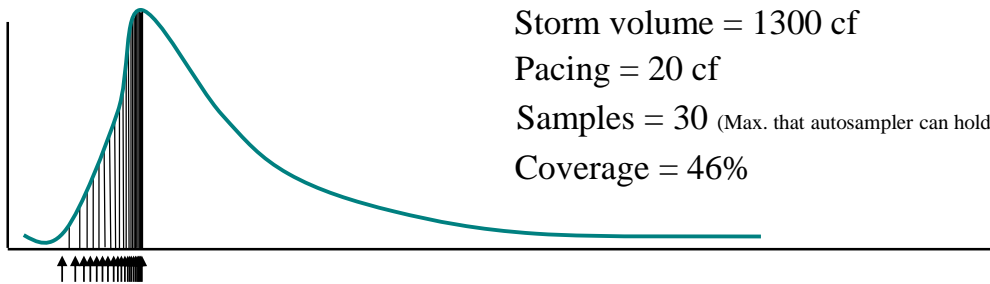
Use Regression to Estimate

MP8 IN

$y = 3E\text{-}05x - 0.0223$
$R^2 = 0.7929$

Storm Depth (in)

Influent volume (cf)

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 17

17
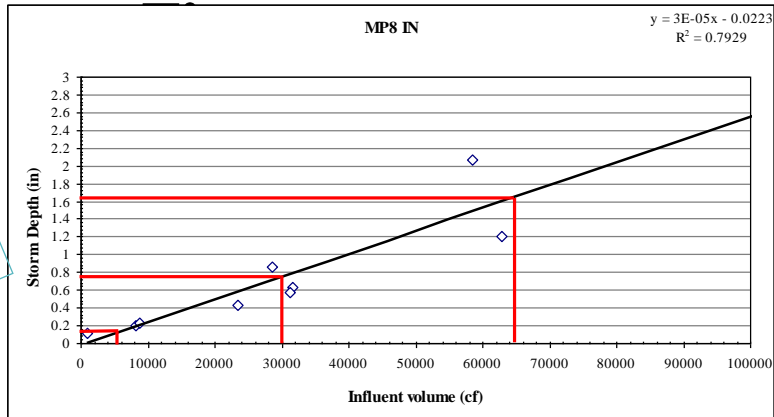
PROPRIETARY MEDIA FILTERS

BMP Testing -TAPE

Basic Treatment

- 80% removal of TSS (influent = 100 to 200 mg/L)
- 20 mg/L TSS effluent goal (influent <100 mg/L)

Enhanced Treatment

- Influent dissolved copper range = 0.003 to 0.02 mg/L
- Influent dissolved zinc range = 0.02 to 0.3 mg/L
- Significantly higher removal rates than basic treatment

Oil Treatment

- No ongoing or recurring visible sheen
- Daily average TPH <10 mg/L
- Maximum TPH discrete (grab) sample = 15 mg/L

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 18

PROPRIETARY MEDIA FILTERS
BMP Testing -TAPE
Murphys' Law and Field Work

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 19

PROPRIETARY MEDIA FILTERS

BMP Testing -TAPE
Labor and Tech Intensive

- $15,000 equipment
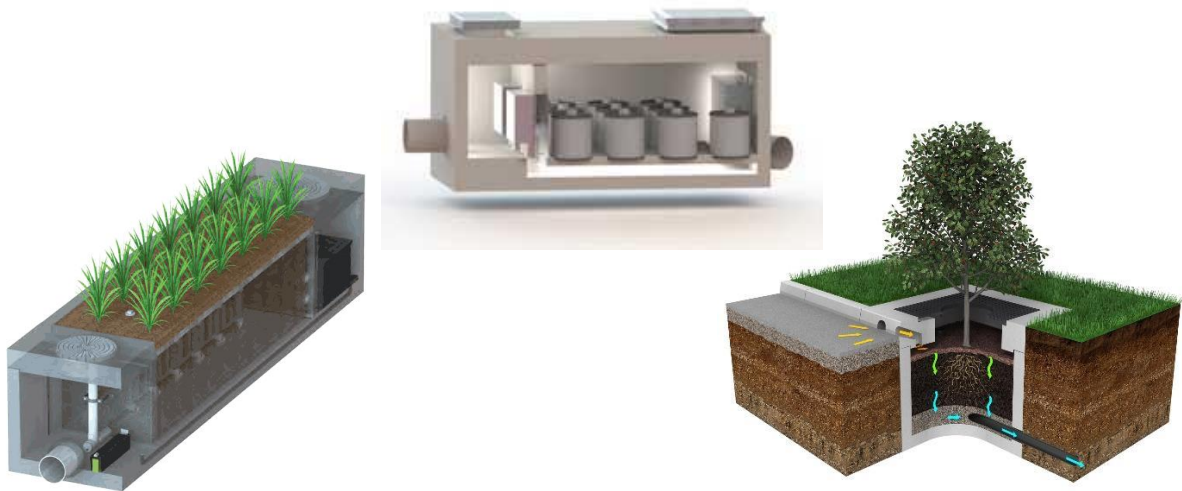- $200,000 total cost

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN 20

20

BMP Selection

TAPE Testing of Three Proprietary Media Filters

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 21

PROPRIETARY MEDIA FILTERS
BMP Selection

TAPE Testing of Three Proprietary Media Filters

Filterra

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 22

PROPRIETARY MEDIA FILTERS
Filterra - Tacoma

- Inlet
- Concrete container
- Surface storage
- Mulch layer
- Filter media
- Vegetation
- Underdrain
- Bypass

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN 23

23
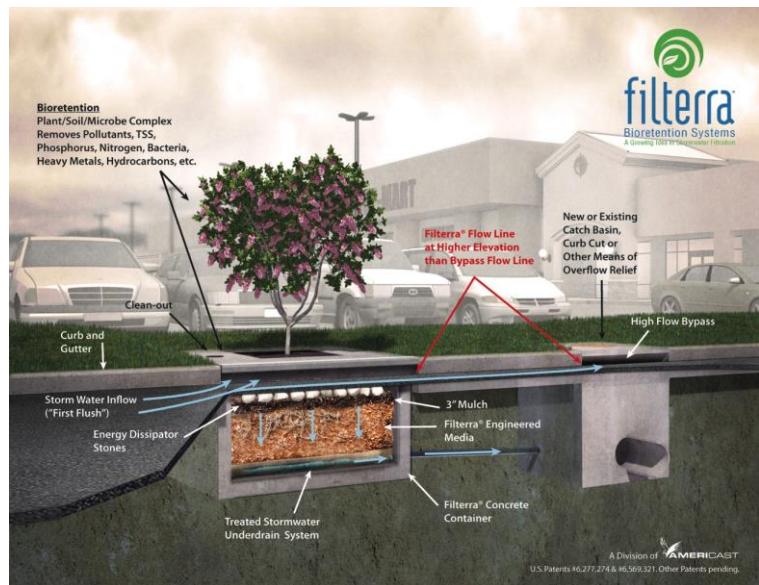
PROPRIETARY MEDIA FILTERS
Filterra - Tacoma

- <u>November 2006</u>
  - Conditional Short-Term Use Level Designation (CULD) for basic and phosphorus treatment
  - Pilot Use Level Designation (PULD) for enhanced and oil treatment

- Monitoring design developed based on the Technology Assessment Protocol – Ecology (TAPE) (Ecology 2008)

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN **24**

24

Filterra - Tacoma

- Two Filterra test systems installed at the Port of Tacoma (POT) in Tacoma, WA

- Hydrologic and water quality monitoring from May 2008 through May 2009

- 27 storm events sampled
  - 29 grab samples
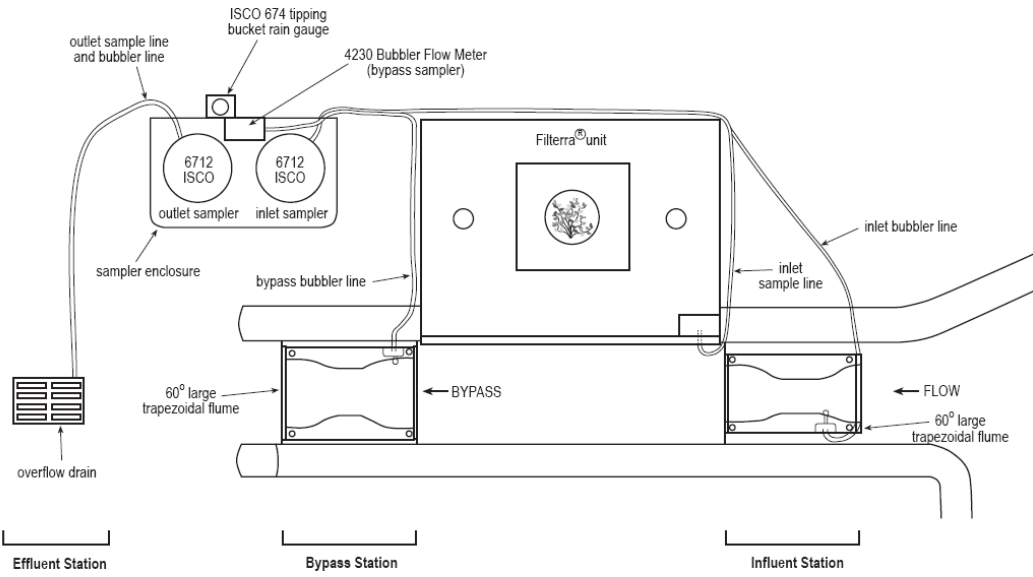 - 35 composite samples

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN **25**

PROPRIETARY MEDIA FILTERS
Filterra - Tacoma

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 26

26

PROPRIETARY MEDIA FILTERS
Filterra - Tacoma

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 27

Filterra - Tacoma

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN   **28**

Filterra - Tacoma

Basic Treatment (TSS) Results

Test System	Storm Events	Influent TSS (mg/L)	Effluent TSS (mg/L)	TSS Removal Efficiency (%)
POT1	22	11 – 40	1.7 – 7.8	65 – 90
POT2	13	0.83 – 8.0	0.5 U – 5.0	-79 – 91
Meets TAPE	10	20 – 40 (median = 28)	2.0 – 7.8 (median = 4.2)	79 – 90 (median = 86)

PROPRIETARY MEDIA FILTERS

Filterra - Tacoma

- Irreducible = 20-40 mg/L using conventional stormwater treatment technologies (Schueler 1996)

- Based on the POT data, influent TSS concentrations as low as 5.0 mg/L resulted in TSS removal efficiencies that met or exceeded the 80% goal

- Effluent concentrations were consistently reduced to less than 8.0 mg/L regardless of influent concentration

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN 30

PROPRIETARY MEDIA FILTERS

Filterra - Tacoma

Enhanced Treatment Results (Diss. Copper)

Test System	Storm Events	Influent Dissolved Cu (mg/L)	Effluent Dissolved Cu (mg/L)	Dissolved Cu Removal Efficiency (%)
POT1	18	0.0029 – 0.017	0.0015 – 0.10	24 – 74
POT2	11	0.001 U – 0.0056	0.001 U – 0.0033	27 – 62
Meets TAPE	23	0.0029 – 0.017 (median = 0.0056)	0.0015 – 0.0099 (median = 0.0033)	24 – 74 (median = 44)

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 31

Filterra - Tacoma

Enhanced Treatment Results (Diss. Copper)

BMP Type	n	Median Dissolved Cu Removal (%)	Comparison
Filterra	23	44	NA
Biofilter – Grass Strip	151	20	Filterra > Basic
Biofilter – Grass Swale	86	7	Filterra > Basic
Filter – Peat Mixed with Sand	9	15	Filterra > Basic
Filter – Sand	78	14	Filterra > Basic
Wet Pond	56	33	Filterra > Basic
Wet Vault	29	19	Filterra > Basic
Ecology Embankment	10	39.2	Filterra > EE

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN **32**

PROPRIETARY MEDIA FILTERS
Filterra - Tacoma

General Use Level Designation

- GULD for basic, enhanced, and oil treatment received in December 2009

- May be installed anywhere in the state of Washington (subject to Ecology's conditions)

- CULD extended for phosphorus monitoring until December 2011

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 33

Filterra - Bellingham

The Search for Phos Treatment

PROPRIETARY MEDIA FILTERS

Filterra - Tacoma

- Filterra test system installed at Hayward Dr., Bellingham, WA

- Hydrologic and water quality monitoring from Jan 2013 through July 2013

- 22 storm events sampled

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN **35**

PROPRIETARY MEDIA FILTERS
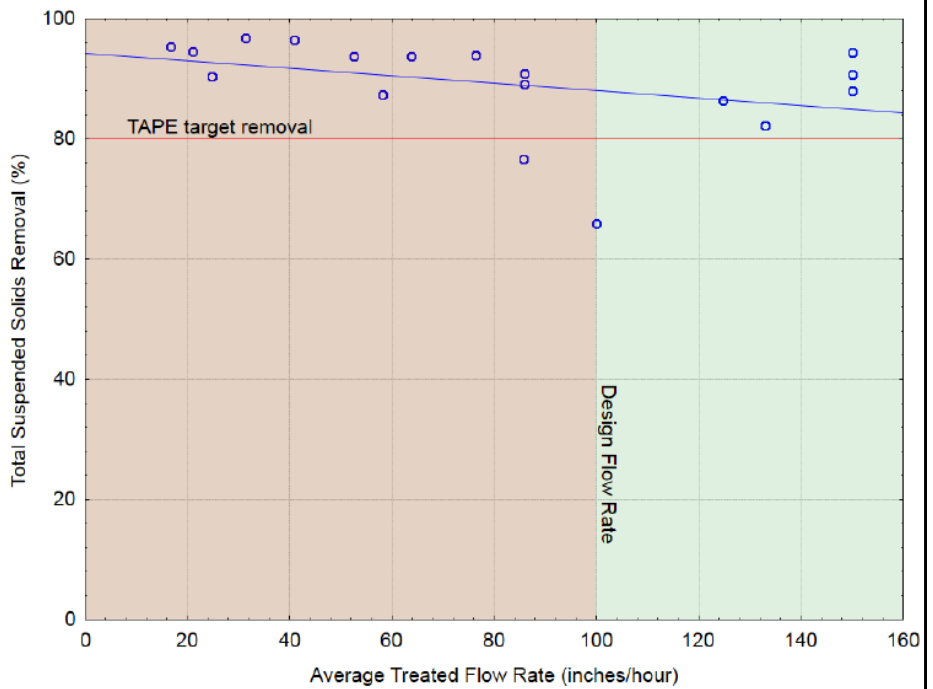# Filterra - Bellingham

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN **36**

36

PROPRIETARY MEDIA FILTERS
Filterra - Bellingham

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 37

PROPRIETARY MEDIA FILTERS

Filterra - Bellingham

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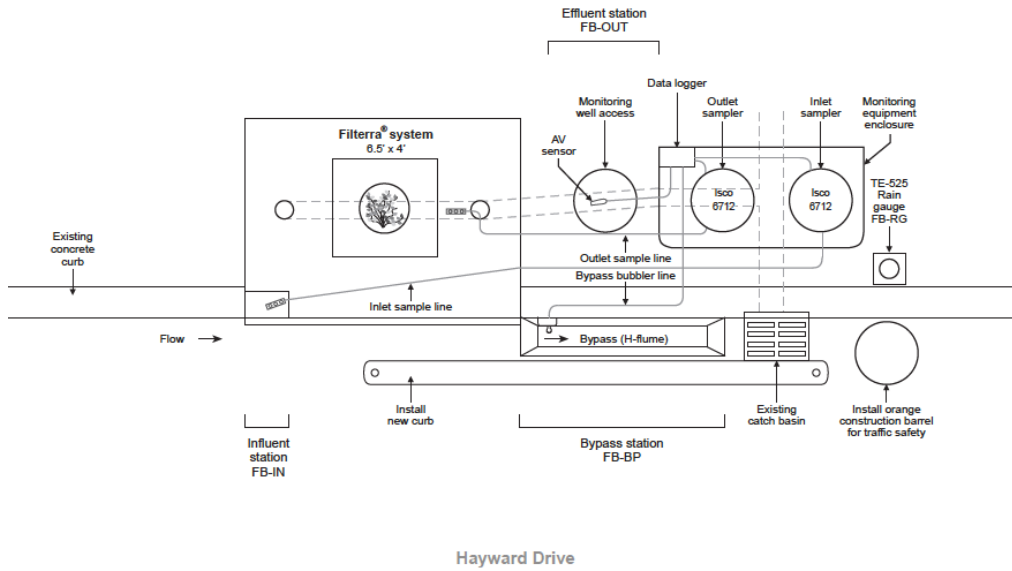
6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN 38

38

PROPRIETARY MEDIA FILTERS

Filterra - Bellingham

- Only 3 samples with influent > 100

- NC LCL95 TSS Removal

- 85% mean removal

- UCL95 effluent = 5.2 mg/L

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 39

39

PROPRIETARY MEDIA FILTERS

Filterra - Bellingham

- 66% LCL95 TP Removal
- 73% mean removal
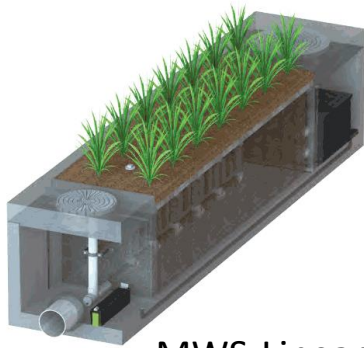

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6.2 BIORETENTION MEDIA

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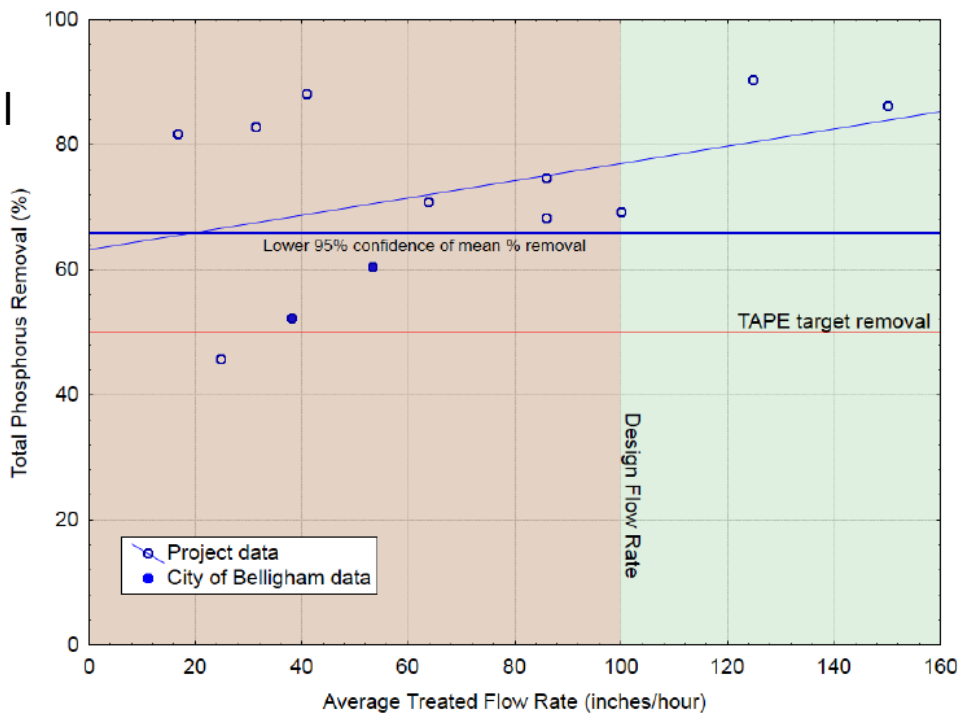
ADVANCED LID DESIGN 40

40

PROPRIETARY MEDIA FILTERS
Filterra Summary

- Certified for Basic, Phosphorus, Enhanced, and Oil treatment

- 3 monitoring installations

- Maintenance is simple

- Dual structure design can be difficult for engineers

- Mulch is an effective prefilter and bioturbation keeping infiltration rate high. A living filter!

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 41

PROPRIETARY MEDIA FILTERS
Modular Wetland System

MWS-Linear

Statewide LID Training Program

6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 42

PROPRIETARY MEDIA FILTERS
Modular Wetland System

Statewide LID Training Program

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State of Washington
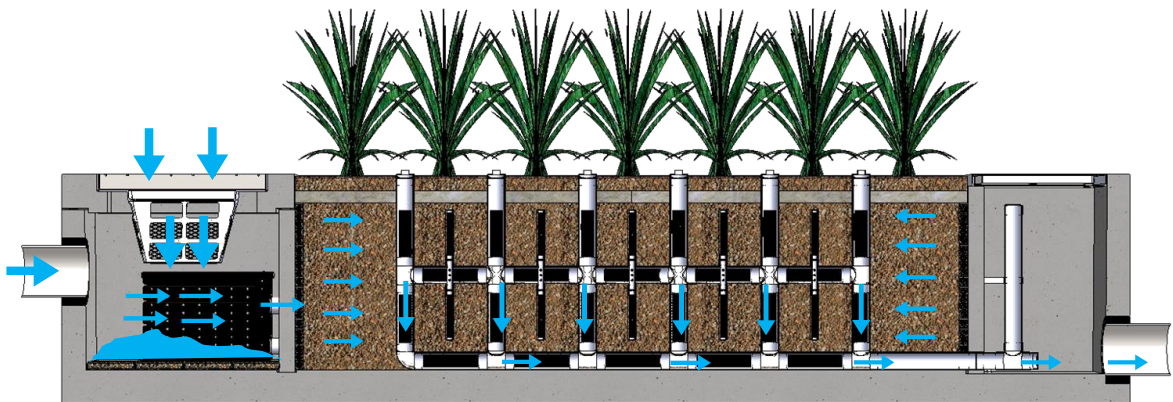
6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 43

43

PROPRIETARY MEDIA FILTERS
Modular Wetland System

Statewide LID Training Program

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 44

44

Modular Wetland System

- One test system installed in Portland, OR in a city maintenance yard
- Hydrologic and water quality monitoring from April 2012 through May 2013
- 28 storm events sampled

Statewide LID Training Program

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State of Washington

6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN 45

PROPRIETARY MEDIA FILTERS
Modular Wetland System

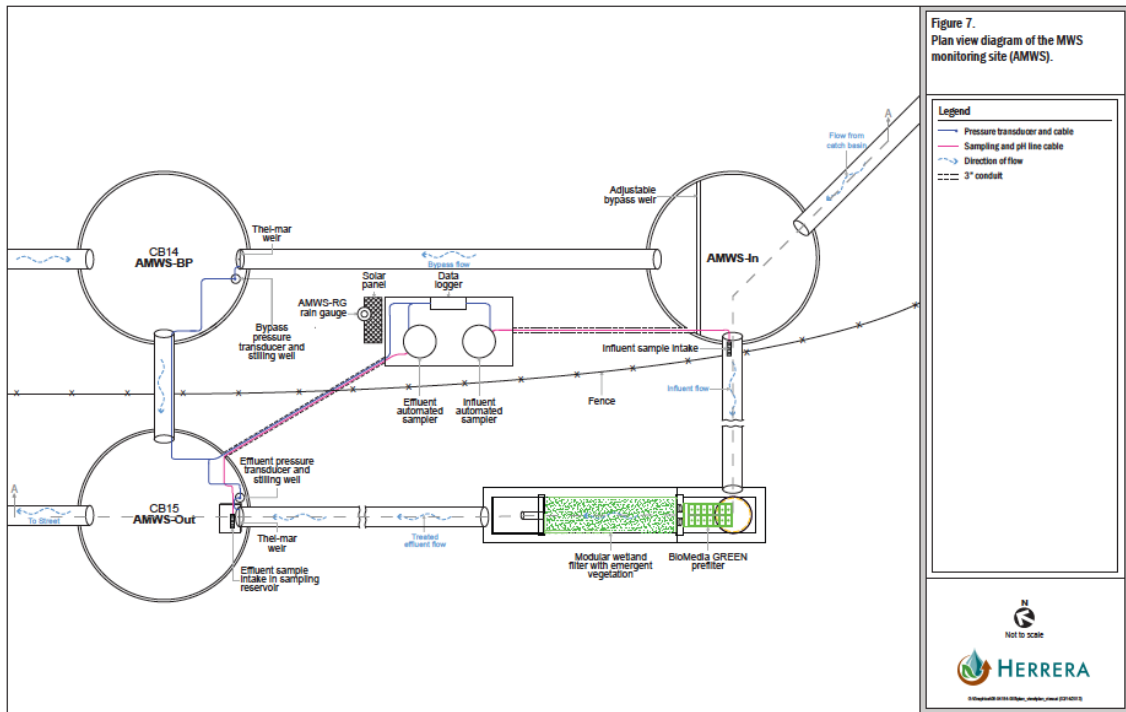**Statewide LID Training Program**

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 46

46

4/21/2015

PROPRIETARY MEDIA FILTERS

Modular Wetland System

Figure 7.
Plan view diagram of the MWS monitoring site (AMWS).

Statewide LID Training Program

6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN **47**

47

PROPRIETARY MEDIA FILTERS
Modular Wetland System

Highly turbid inflow

BioMediaGREEN blocks coated with fines

Ribbed BioMediaGREEN blocks coated with fines

Installation of temporary perlite prefilter with new cartridge design

Cubed BioMediaGREEN ready for installation

High sediment loading in drainage basin

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN **48**

PROPRIETARY MEDIA FILTERS
Modular Wetland System

Statewide LID Training Program
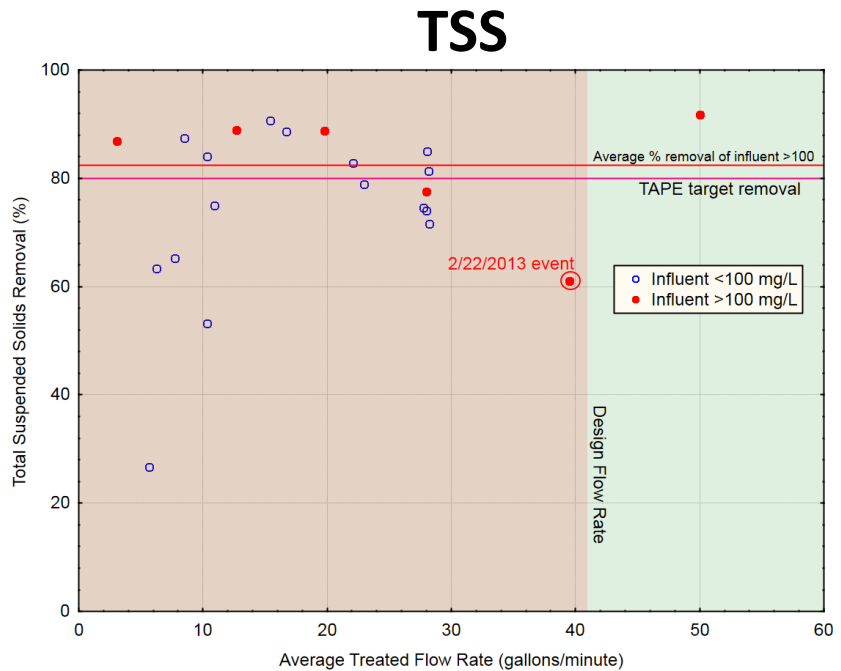
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State of Washington

6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 49

49

4/21/2015

Modular Wetland System

- Only 7 samples with influent > 100

- NC LCL95 TSS Removal

- 85% mean removal

- UCL95 effluent = 12.8 mg/L

TSS

Statewide LID Training Program

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN **50**

50

Modular Wetland System

- 17 qualifying samples
- LCL95 removal = 58%

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6.2 **BIORETENTION MEDIA**
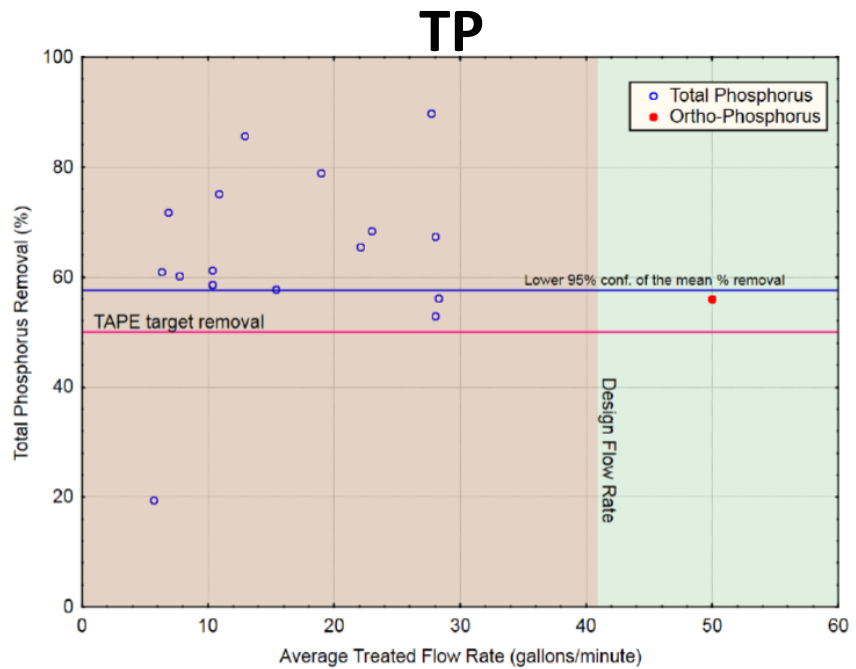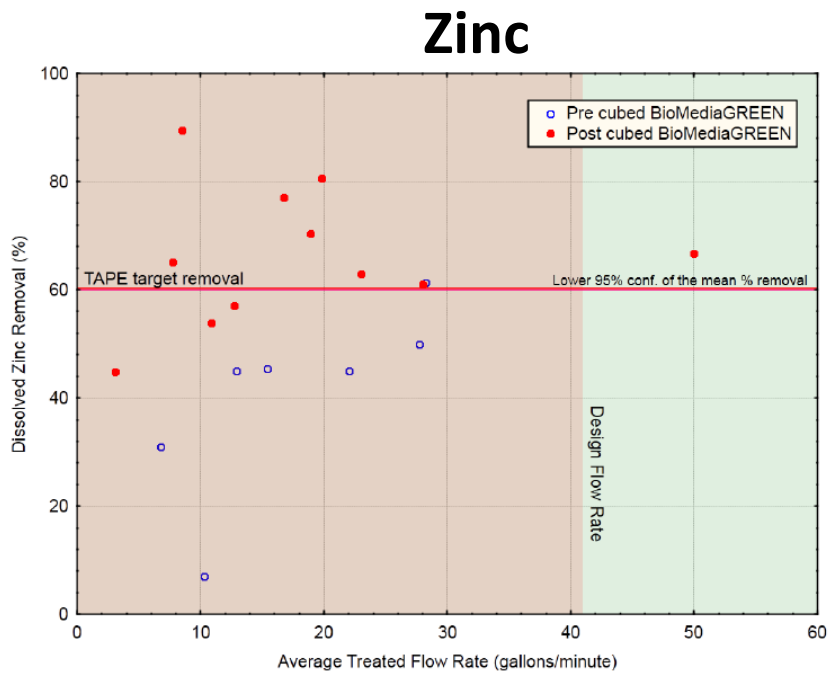
Modular Wetland System

- 11 qualifying samples
- LCL95 removal = 60.5%

Zinc

PROPRIETARY MEDIA FILTERS

Modular Wetland System
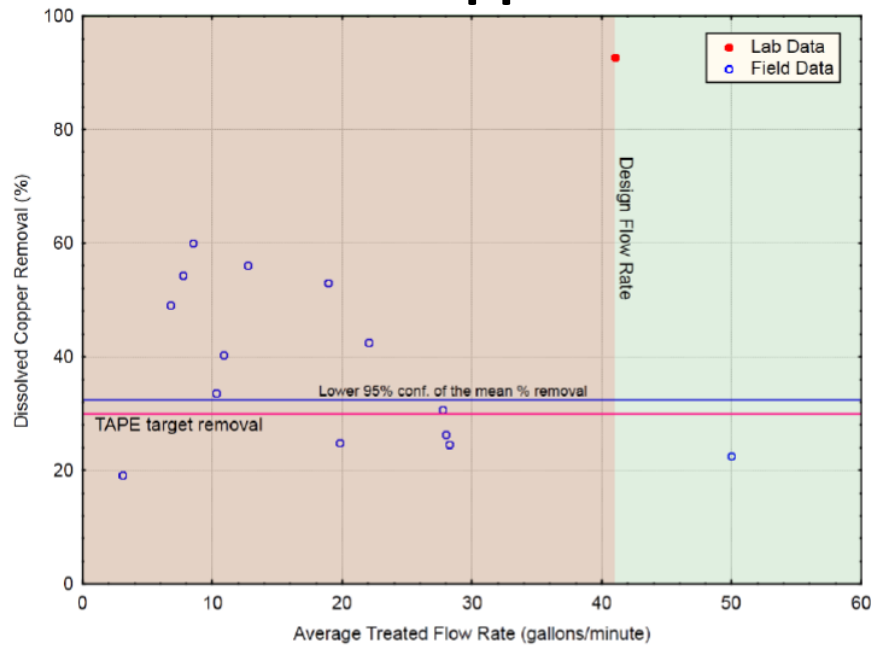
- 14 qualifying samples
- LCL95 removal = 32.5%

Copper

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 53

PROPRIETARY MEDIA FILTERS

MWS Summary

- Certified for Basic, Phosphorus, Enhanced treatment

- Maintenance is relatively simple

- Flexible design options

- Two stage filter and large surface area extend the life of the filter

- Living filter?

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 54

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

Perk Filter

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 55

PROPRIETARY MEDIA FILTERS

Old Castle Perk Filter

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 56

56

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

Statewide LID Training Program

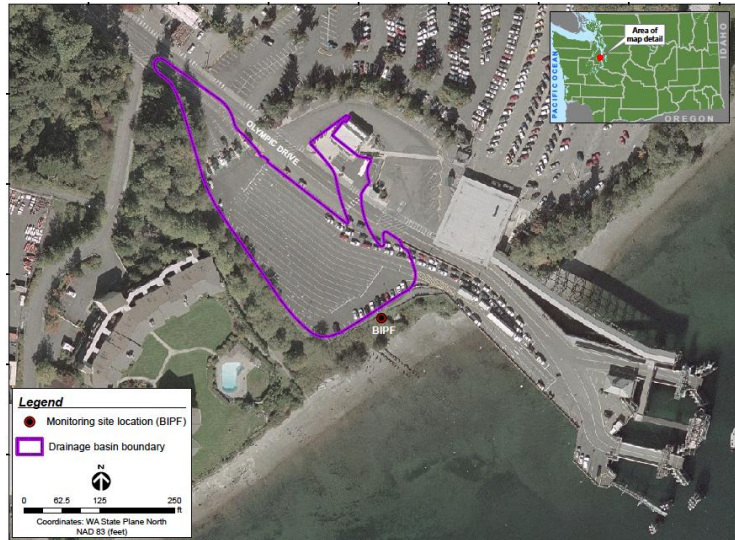6.2 **BIORETENTION MEDIA**

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ADVANCED LID DESIGN 57

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

System installed on Bainbridge Island

Hydrologic and water quality monitoring from May 2009 through Feb 2010

22 storm events sampled

Statewide LID Training Program

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN   **58**

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

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6.2 BIORETENTION MEDIA

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ADVANCED LID DESIGN 59

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN 60

60

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 61

61

PROPRIETARY MEDIA FILTERS
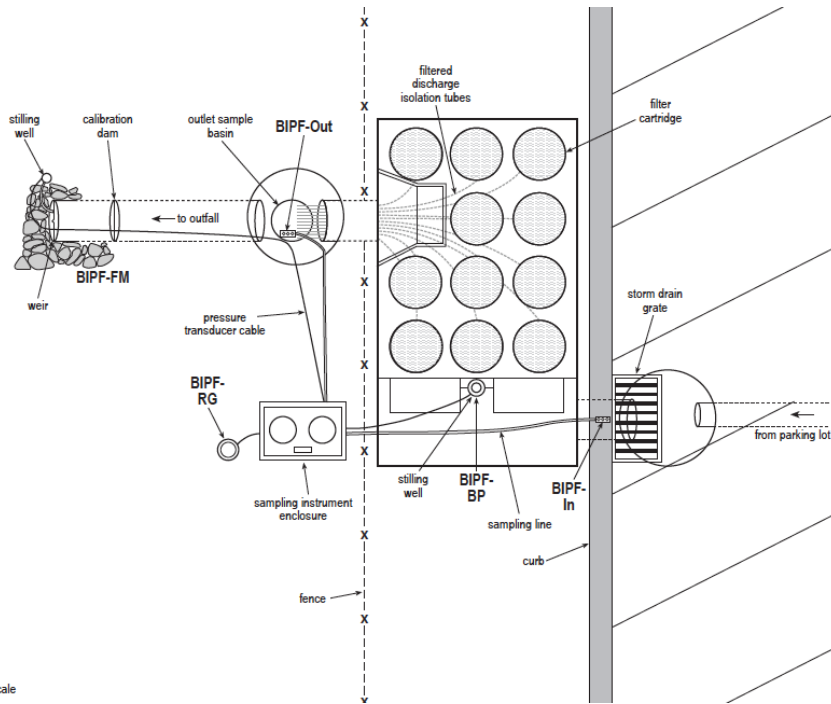
Old Castle Perk Filter

Our Unique Challenge

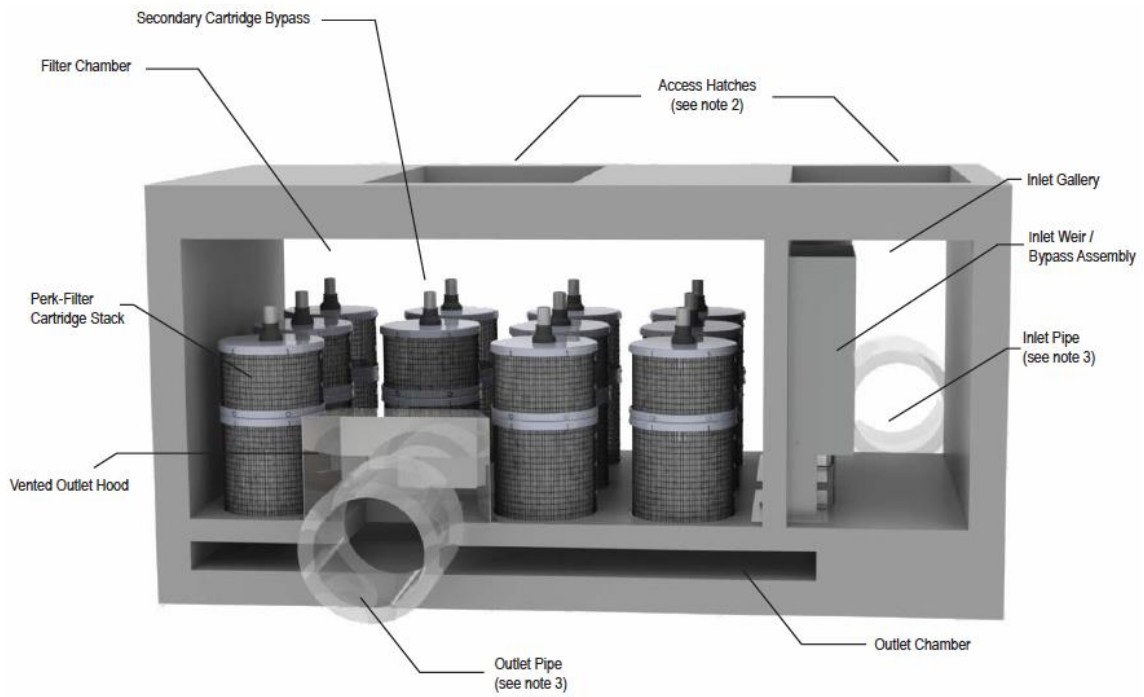**Statewide LID Training Program**

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN 62

62

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

63

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 64

64

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

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6.2 BIORETENTION MEDIA
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ADVANCED LID DESIGN 65

65

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

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State of Washington
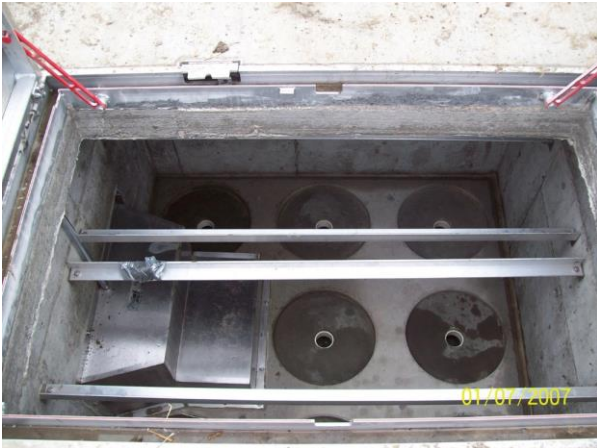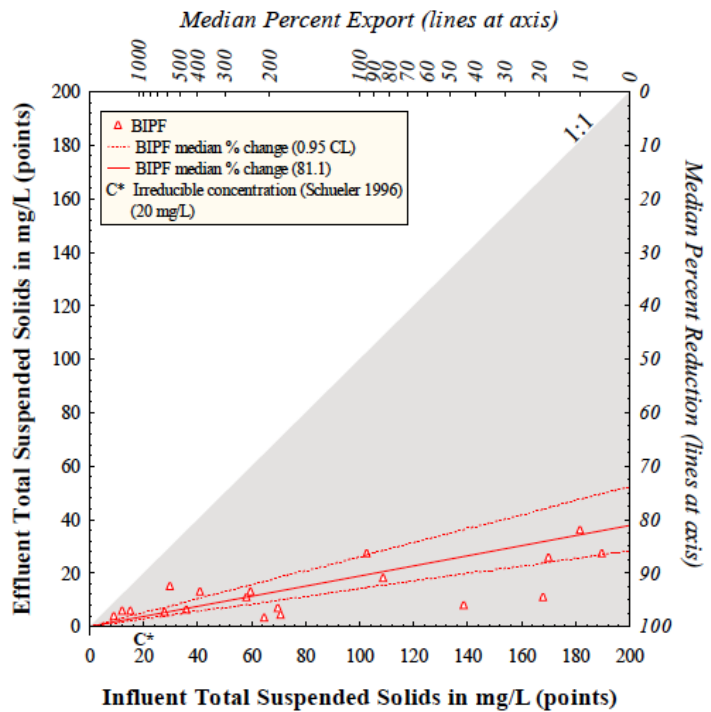
6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 66

66

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

TSS

Only 7 samples with influent > 100

- NC LCL95 TSS Removal

- 81% median removal

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6.2 **BIORETENTION MEDIA**

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ADVANCED LID DESIGN 67

67

Old Castle Perk Filter

Table 19. Total suspended solids summary statistics for 16 sampling events at the BIPF test system with influent total suspended solids concentrations of 20 mg/L or greater.

All Data	Influent (mg/L)	Effluent (mg/L)	Percent Removal
n	16	16	16
Mean	95	14	82
Median	71	12	83
Standard Deviation	57.5	9.8	12
COV	60.5	70	14
Bootstrapped Median Lower CI	53	7	80
Bootstrapped Median	71	12	83
Bootstrapped Median Upper CI	139	19	90
25th Percentile	49.5	6.4	79
75th Percentile	153.5	21.8	92
IQR	104.0	15.4	13
Minimum	28	3	50
Maximum	190	36	95

mg/L: milligrams per liter
n: number of samples
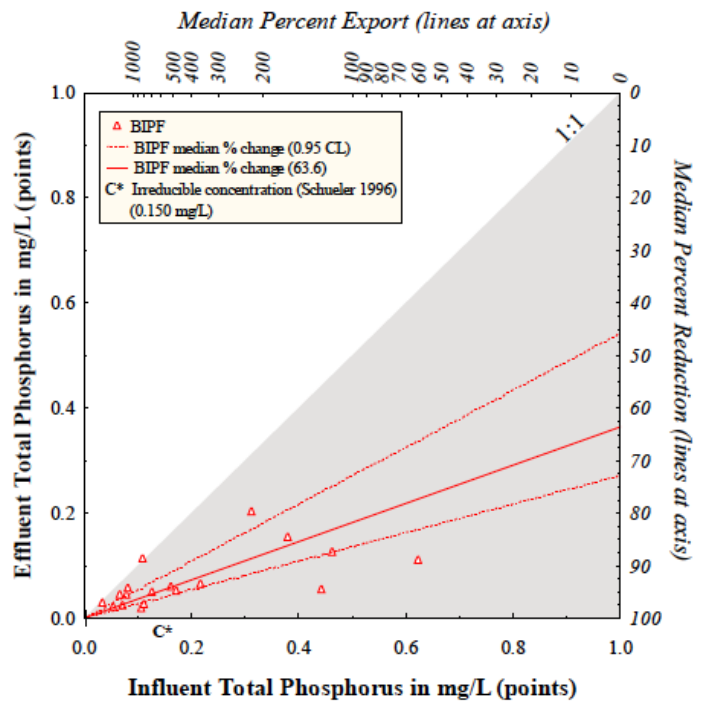COV: coefficient of variance
CI: 95% confidence interval
IQR: interquartile range

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6.2 **BIORETENTION MEDIA**

PROPRIETARY MEDIA FILTERS

Old Castle Perk Filter

TP

- 13 samples with influent > 0.1

- 64% median removal

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 69

PROPRIETARY MEDIA FILTERS
Old Castle Perk Filter

Table 21. Total phosphorus summary statistics for 11 sampling events at the BIPF test system with influent total phosphorus concentrations between 0.100 and 0.500 mg/L.

All Data	Influent (mg/L)	Effluent (mg/L)	Percent Removal
n	11	11	11
Mean	0.237	0.083	62
Median	0.174	0.059	71
Standard Deviation	0.138	0.058	25
COV	58	70	40
Bootstrapped Median Lower CI	0.113	0.048	60
Bootstrapped Median	0.174	0.059	71
Bootstrapped Median Upper CI	0.381	0.126	78
25th Percentile	0.113	0.048	60
75th Percentile	0.381	0.126	78
IQR	0.268	0.078	18
Minimum	0.107	0.017	-1
Maximum	0.464	0.203	88

mg/L: milligrams per liter
n: number of samples
COV: coefficient of variance
CI: 95% confidence interval
IQR: interquartile range

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 70

PROPRIETARY MEDIA FILTERS
Perk Filter Summary

- Certified for Basic and Phosphorus treatment
- Flexible design options
- Fluidized media inhibits occlusion
- Cheaper than StormFilter
- Maintenance relatively involved

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 71

PROPRIETARY MEDIA FILTERS

Filter Longevity

Treatment is all well and good, but what if the thing clogs after 1 month?

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN 72

72

PROPRIETARY MEDIA FILTERS

Filter Longevity

- City of Seattle CatchBasin StormFilter Study

- Studies **15** CBSF units across the City

- Conducted quarterly testing

- Tested rate of clogging

StormFilter Hydrologic Performance and Sizing Study

Seattle
Public
Utilities

By: Sotheary Ouk, Kevin Wood, Doug Hutchinson
June 4, 2013

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN 73

PROPRIETARY MEDIA FILTERS
Filter Longevity

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6.2 **BIORETENTION MEDIA**

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ADVANCED LID DESIGN   74

Filter Longevity

- 6-months old loading
- Sized right = 120%
- Undersized = 74%


Figure 5.3a – Hydrologic Performance Compared to Cartridge Deficit – 6 months (with trend lines)
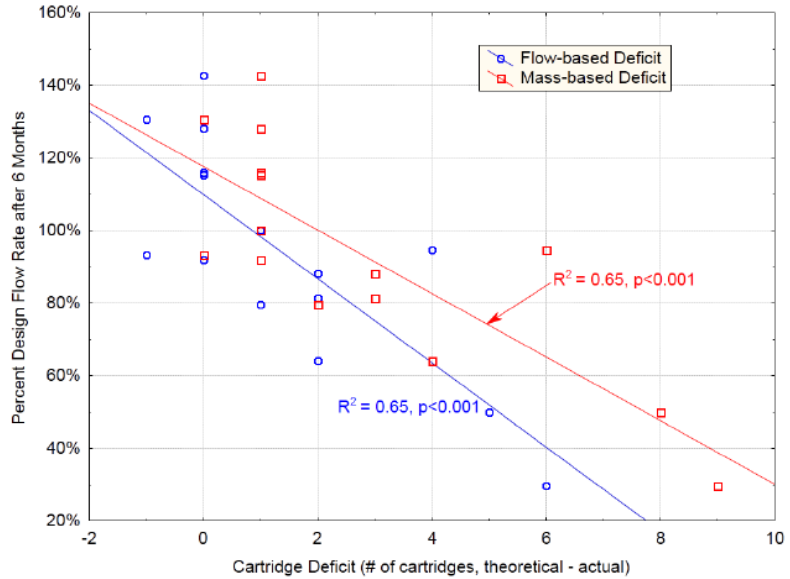
Filter Longevity

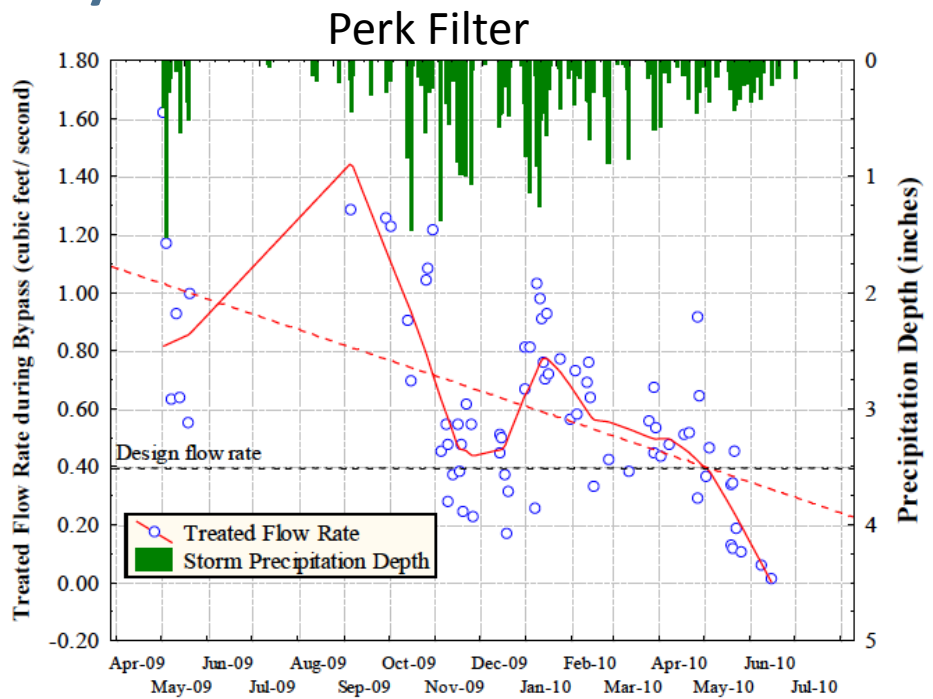- 12.5-months old loading

- Sized right = 68%

- Undersized = 18%

Figure 5.3b – Hydrologic Performance Compared to Cartridge Deficit – 12.5 months

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6.2 **BIORETENTION MEDIA**

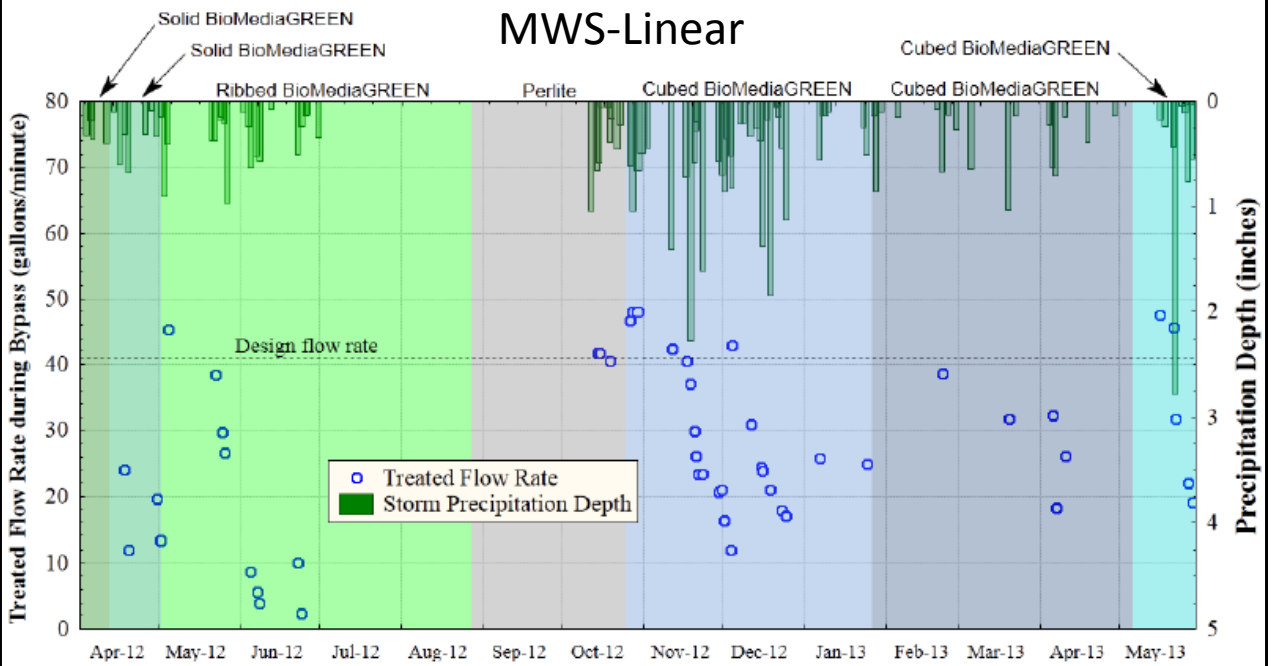ADVANCED LID DESIGN 76

76
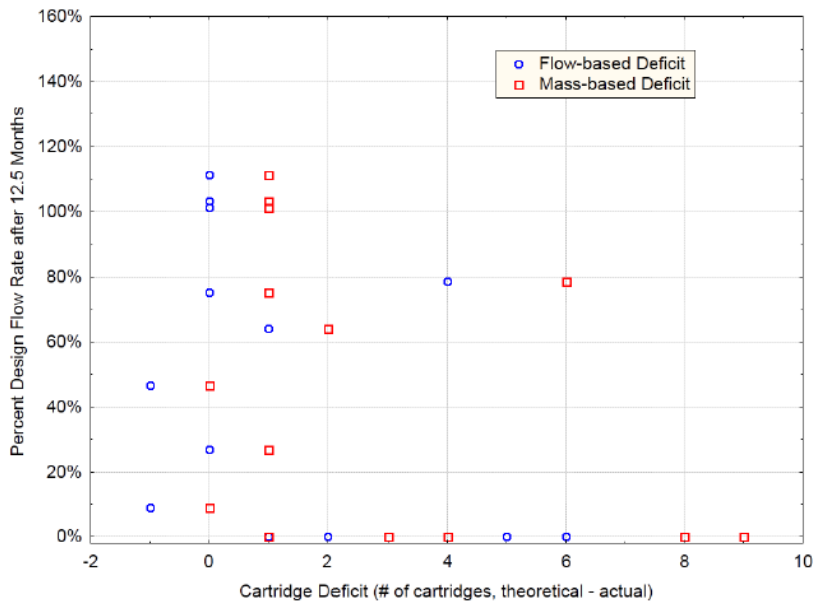
PROPRIETARY MEDIA FILTERS

Filter Longevity

Once
maintained
then back to
full capacity!

Perk Filter

Solid red line = Lowess fit, dashed red line = linear fit

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 77

77

PROPRIETARY MEDIA FILTERS
Filter Longevity

Filterra Tacoma

Only 2% annual
bypass, but occurred
near end

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6.2 **BIORETENTION MEDIA**

Filter Longevity

Filterra Bellingham

Table 9. Summary Statistics for Storms That Produced Bypass Flow at the Filterra Test System from January 1, 2013, through July 23, 2013.

Storm Start Date & Time	Storm Depth (inches)	Peak Storm Intensity (in/hr)	Total Volume (gpm)	Bypass Volume (gallons)	% of Total Volume Bypassed	Peak Treated Flow Rate during Bypass (gpm)	Peak Infiltration Rate during Bypass (in/hr)
New media installed on 12/11/2012							
1/8/2013 7:35	1.42	0.48	14,076	368	2.6	60	222
3/19/2013 17:00	0.5	0.48	3,300	144	4.4	42	155
4/6/2013 17:25	1.38	0.48	14,491	618	4.3	52	192
5/11/2013 22:20	0.7	0.72	5,890	52	0.9	151	559
Mulch replaced and routine maintenance on 8/31/2013							

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6.2 BIORETENTION MEDIA

ADVANCED LID DESIGN   80

PROPRIETARY MEDIA FILTERS
The Take Home

- All certified systems are high performance and use state of the science media

- BMPs are systematically undersized

- Proprietary BMPs are sized to sell

- Sediment loading to polishing systems is their downfall

- "Living" filters may last longer, but when will the main filter clog?

- TAPE style testing should be applied to all BMPs

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6.2 **BIORETENTION MEDIA**

ADVANCED LID DESIGN 81