1. What do you use prioritization for - retrofits, new development and/or redevelopment?
   Redmond uses the prioritization to focus stormwater retrofits, in stream projects, and buffer improvements into watersheds where the moderately degraded stream will see the most ecological lift with investments. Development/redevelopment can buy in to retrofits in “highest restoration” watersheds, allowing for consolidation of stormwater controls in watersheds where they will have the most immediate benefit.

2. How did you develop your prioritization criteria?
   Redmond initially used data (discussed below) to characterize individual fish barring water bodies and their watersheds. Redmond worked with Ecology to rerun the Puget Sound watershed characterization model locally, to prioritize watersheds based on hydrologic metrics (output bottom right). Output from the characterization was adjusted based on local data compilation.

3. What are the criteria?
   Puget Sound Flow metrics included: storage, delivery, recharge, and discharge. Local data included: land cover (forest/impervious/landscape), land use (residential/commercial), fish use, habitat (LWD, buffer canopy), water quality (BIBI, DO, temp), stormwater characteristics (High AADT, area without flow/treatment, culverts, outfalls).

4. How do you apply the criteria – weighting, etc.?
   No weighting was used; the data did not lend itself to weighting. Puget Sound watershed characterization was the basis, then adjusted based on local data.

5. Have you implemented policy or prioritized budget based on the prioritization (have you used the prioritization)?
   Yes. Used to prioritize capital budget, allocating millions to restoring streams. Used prioritization in Ecology grant applications. Used to focus programs in prioritized watersheds.

6. Who were the stakeholders when you set out to prioritize?
   Washington Department of Ecology, Internal departments, Muckleshoot Tribe, Washington Department of Fish and Wildlife,

7. What data sources did you use, and how readily available is the data?
   We used local data, Puget Sound wide data, statewide data, and national data.
Targeting Stormwater Retrofits Investments
Washington Department of Transportation’s Experience

Larry E. Schaffner
NPDES Compliance & Planning Coordinator

BCiTR Working Group
September 23, 2014
Presentation Overview

 ✓ Our Stormwater Investment Challenge
 ✓ WSDOT’s Initial Approach
 ✓ Lessons Learned
 ✓ “Retrofitting” the Approach to Prioritizing Retrofits
 ✓ The 3-Stage Assessment Process
 ✓ Reflections
Our Stormwater Investment Challenge

How do we optimize our stormwater investments to achieve maximum environmental benefit?
Apply a random utility model to assign economic benefits to environmental quality changes for each stormwater outfall.
Lessons Learned

The initial approach was:

- Very data intensive
- Depended on assigning scores to outfalls, many of which had yet to be inventoried
- Expensive
“Retrofitting” the Approach to Prioritizing Retrofits

✔ Focus data collection on areas with the greatest stormwater retrofit needs;
✔ Target urban fringe areas before costs escalate;
✔ Reduce costs by identifying opportunities to combine stormwater retrofits with programmed construction projects; and
✔ Maximize immediate benefits by first targeting areas with highest benefits relative to cost.
3-Stage Assessment Process

1. GIS Screen
   - Applied to the entire highway system

2. Reconnaissance
   - For the top scoring Stage 1 sites

3. Detailed Site Assessment
   - For the top scoring Stage 2 sites

Results of GIS Criteria Screen
Stage 1: GIS Screen

Prioritization Factors*

- Large, frequently traveled highways (1)
- Drinking water supply source (2)
- Fish bearing streams (2)
- Summer spawning areas (2)
- Small streams (3)
- High quality surface receiving waters (3)
- Urban fringe (3)

*Prioritization factor point weightings in parenthesis
Stage 2: Reconnaissance

Prioritization Factors*

- Untreated closed, curbed, and/or impervious-lined conveyance system (2)
- WSDOT observed erosion, pollution, or flooding problems (2)
- Discharges to 303(d) listed water bodies for certain pollutants of concern (2)
- Locally identified erosion, pollution, or flooding problems (3)
- Habitat suitability and value (3)

*Prioritization factor point weightings in parenthesis
Key Aspect of Stage 2
Gleaning Local Knowledge

Questionnaires utilized to target the following audiences:

✓ WSDOT region staff
✓ Local jurisdictions
✓ Biologist
Stage 3: Detail Site Assessment

Prioritization Factors*

✓ *Stage 2 synthesis* – highway segment receiving score of 8 or greater (1)

✓ *Large drainage area* – drains greater than 5 acres of impervious surface (1)

*Prioritization factor point weightings in parenthesis
Stage 3 Results

Used to evaluate:

✓ Whether to package nearby retrofit priorities (and gaps in between) into a single retrofit project package

✓ If the potential exist to bundle retrofit priorities with programmed improvement projects
Reflections
Similarities Between Original & New Approach

Both approaches:
✓ Utilized weighted criteria (however, now there are fewer of them)
✓ Set criteria to reflect priorities and values from an interagency team
Reflections
Difference Between Original & New Approach

New approach:

✓ Factors in local knowledge
✓ Targets areas with highest environmental value rather than degraded areas
✓ Targets intensive data collection to a prescreened subset of candidate locations rather than gathering it everywhere
✓ Evaluates and assigns scores to highway segments rather than individual stormwater outfalls
Reflections
The End Result Produced

An approach:

✓ More transparent & cost-effective
✓ Embraced by resource agencies & stakeholders
✓ Agile enough to incorporate new information & changing conditions
Thank You Very Much for Your Attention!

I love a finished speaker, I really, truly do. I don’t mean one who’s polished. I just mean one who’s through.

- Richard Armour, American Poet

Larry Schaffner
Thurston County Water Resources Division
Olympia, Washington
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TARGETING STORMWATER RETROFITS INVESTMENTS
WITHOUT BREAKING THE BANK

Larry Schaffner
Thurston County Water Resources Division
(Previously with Washington State Department of Transportation)
Olympia, Washington

Overview

Our challenge: How do we optimize investments for stormwater retrofit to achieve maximum environmental benefit? Especially considering most development predates stormwater regulations and was built without any consideration for runoff treatment and flow attenuation.

Washington State Department of Transportation’s (WSDOT) approach to prioritizing areas for stormwater retrofits embraces a conservation biology approach by focusing investments to protect the remaining relatively healthy receiving waters and their habitats. The approach emphasizes preventing degradation to high value aquatic resource areas rather than attempting to correct damage after it occurs. While WSDOT uses this approach for prioritizing stormwater retrofits for its highway system, the methodology could be adapted for use in other settings and customized to reflect alternative values. Our current approach reflects lessons learned from our previous endeavors and thus represents an evolution in our thinking on how to more cost-effectively evaluate and establish stormwater retrofit priorities.

Lessons Learned

Originally our retrofit prioritization methodology involved developing a stormwater outfall ranking index. This required assigning values for 16 independent variables for each stormwater outfall. Five of these variables required the additional step of selecting and applying a multiplier to the assigned value. The process essentially represented a cost/benefit tool. In applying this tool, we found ourselves expending more resources to score and rank stormwater retrofit priorities than we actually had budgeted for construction of the retrofit projects themselves. The high expenditures incurred resulted from the data intensive approach employed to determine retrofit priorities. Implementation was further complicated since the approach depended upon assigning scores to individual stormwater outfalls, many of which had yet to be inventoried and documented.

Applying the Learnings – Refining WSDOT’s Prioritization Approach

WSDOT’s current stormwater retrofit prioritization scheme (scheme) involves a three-stage assessment process for assigning a retrofit priority score to specific highway segment locations. The scheme (Table 1) includes criteria and rationale for each prioritization factor encompassed in this approach. This scheme emerged through collaborative engagement with Washington State Department of Ecology, U.S. Fish and Wildlife Service, and NOAA Fisheries staff. As a result, the criteria and their associated weightings reflect the priorities and values of these resource agencies. The criterion’s point weighting represents their “significance” relative to other criteria falling within each stage.
<table>
<thead>
<tr>
<th>Prioritization Factor</th>
<th>Criteria</th>
<th>Rationale</th>
<th>Point Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage 1: GIS Screen</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large, frequently traveled highways</td>
<td>Traffic level &gt;30,000 annual average daily traffic (AADT).</td>
<td>For a variety of reasons, larger, frequently traveled highways are associated with greater pollutant generating potential.</td>
<td>1</td>
</tr>
<tr>
<td>Drinking water supply source</td>
<td>Mapped wellhead protection zones, sole source aquifers, and drinking water source-protected watersheds.</td>
<td>Protect drinking water supplies.</td>
<td>2</td>
</tr>
<tr>
<td>Fish bearing streams</td>
<td>Waters identified by the Department of Fish and Wildlife as <em>fish bearing</em>.</td>
<td>Protect fish resources.</td>
<td>2</td>
</tr>
<tr>
<td>Summer spawning areas</td>
<td>Waters identified in state water quality standards as summer spawning areas.</td>
<td>Spawning areas and summer holding and migration areas provide critically important habitat for summer chum and summer steelhead.</td>
<td>2</td>
</tr>
<tr>
<td>Small streams</td>
<td>Waters with mean annual flows less than 20 cubic feet per second (i.e., waters that are not shorelines of the state).</td>
<td>Small streams are less able to assimilate runoff and more vulnerable to changes in flow.</td>
<td>3</td>
</tr>
<tr>
<td>High quality surface receiving waters</td>
<td>Waters identified in State water quality standards as <em>Char and Core salmon spawning and rearing</em>.</td>
<td>High quality streams provide important habitat.</td>
<td>3</td>
</tr>
<tr>
<td>Urban fringe</td>
<td>Urban fringe areas within designated Urban Growth Areas.</td>
<td>More economical to retrofit prior to development which significantly reduces stormwater management options and increases capital and operational costs.</td>
<td>3</td>
</tr>
<tr>
<td><strong>Stage 2: Reconnaissance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Untreated closed, curbed, and/or impervious-lined conveyance systems</td>
<td>Untreated runoff primarily conveyed by curbs, culverts, impervious-lined conveyances, and/or pipes to a receiving water body.</td>
<td>Closed, curbed, and impervious-lined conveyance systems have greater pollutant discharge potential than open drainage systems which have treatment and flow attenuation properties.</td>
<td>2</td>
</tr>
<tr>
<td>WSDOT observed erosion, pollution, or flooding problems</td>
<td>Eroded channels, embankments, excess sediment buildup/loading in stormwater infrastructure, visual observation of water pollution, or flood prone areas.</td>
<td>Gives consideration for known problems.</td>
<td>2</td>
</tr>
<tr>
<td>Discharges to 303(d) listed water bodies for certain pollutants of concern</td>
<td>303(d) listed water bodies for: PAH, metals (zinc and copper), turbidity, and herbicides used by WSDOT.</td>
<td>Gives consideration to known receiving water problems that could be exacerbated by discharges of untreated highway runoff.</td>
<td>2</td>
</tr>
<tr>
<td>Locally identified erosion, pollution, or flooding problems</td>
<td>Consult local basin plans, recovery plans, and associated TMDL implementation documents for identified stormwater runoff-related problems and/or retrofit priorities.</td>
<td>Factors in well informed local knowledge.</td>
<td>3</td>
</tr>
<tr>
<td>Habitat suitability and value</td>
<td>Waters identified by the Washington Department of Fish &amp; Wildlife (WDFW) area habitat and Tribal biologist as important small stream habitat as well as highway segments with fish passages identified by WSDOT as high retrofit priorities.</td>
<td>Factors in well informed local knowledge.</td>
<td>3</td>
</tr>
<tr>
<td><strong>Stage 3: Detail Site Assessment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 2 synthesis</td>
<td>Highway segments receiving a Stage 2 <em>Reconnaissance</em> score of 8 to 12.</td>
<td>Gives higher priority to factors evaluated in Stage 2.</td>
<td>1</td>
</tr>
<tr>
<td>Large highway drainage area</td>
<td>Draining area &gt; 5 acres of impervious surface.</td>
<td>Larger drainage areas generate more runoff.</td>
<td>1</td>
</tr>
</tbody>
</table>
The prioritization process:

1. Focuses data collection on areas with the greatest stormwater retrofit needs;
2. Targets urban fringe areas before retrofit costs escalate;
3. Reduces costs by identifying opportunities to combine stormwater retrofits with programmed highway construction projects; and
4. Maximizes immediate environmental benefits by first targeting areas with highest environmental benefits relative to cost.

The first stage in the prioritization process involves screening the entire state using Geographic Information Systems (GIS) map analysis tools. This screening identifies highway segments having predefined conditions known to present greater than average risks for highway stormwater impacts (Figure 1). This stage takes advantage of existing GIS datasets to rapidly narrow the field of candidate areas that undergo further evaluation in Stage 2 of the prioritization process.

The second stage of the prioritization process involves a site-specific reconnaissance of the candidate sites emerging from Stage 1 to identify those with closed conveyance systems; known high habitat value; and known or observable erosion, pollution, or flooding problems. In defining candidate sites to move to Stage 2 of the process, the interagency team intentionally set the “point bar” low (i.e., Stage 1 highway segments receiving scores of 8 to 16) to avoid narrowing the eligibility pool prematurely during the initial stage of the assessment process.

![Figure 1: Results of Stage 1 GIS query identifying candidate segments for Stage 2 analysis](image-url)
A key aspect of this second stage involves utilizing two questionnaires to glean local knowledge of the candidate sites. The first questionnaire’s target audience includes WSDOT region staff and as well as local jurisdictions. This tool (Table 2), developed by region staff and simple in its approach, significantly improved our ability to gather information from maintenance field staff. WSDOT uses the second questionnaire (Table 3), developed with assistance from a consultant, to query biologists. These questionnaires aid in standardizing data collection and Stage 2 evaluation scoring.

The third and final stage in the prioritization process involves collecting detailed site information to determine drainage areas and estimate retrofit costs. WSDOT uses the results of Stage 3 to evaluate:

1) Whether it makes sense to package nearby highway segments targeted for retrofit (and the gaps between those segments) into a single stand-alone retrofit project; and
2) If the potential exists to bundle any of the retrofit priorities with programmed highway improvement projects rather than advancing them as a set of individual stand-alone retrofit projects.

Retrofit priorities not falling within a programmed highway project boundary get queued by geographic region for completion as stand-alone retrofit projects in order of their priority ranking score. The three geographic regions of the state include: the Puget Sound basin, western Washington sans the Puget Sound basin, and eastern Washington.

WSDOT updates stormwater retrofit prioritization scores to reflect new information and changing conditions brought to our attention.

### Table 2: Questionnaire Use for Querying WSDOT Region Staff and Local Area Jurisdictions

<table>
<thead>
<tr>
<th>State Route</th>
<th>Beginning Milepost</th>
<th>Ending Milepost</th>
<th>Length (mi)</th>
<th>Catch Basins with High Sediment Loading</th>
<th>Stormwater Culverts with High Sediment Loading</th>
<th>Roadways with Excessive Sediment Build-up</th>
<th>Areas with Frequent Slides</th>
<th>Areas with Eroding Soils</th>
<th>Noticeable Pollutants*</th>
<th>Other Stormwater Issues or Concerns</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>113</td>
<td>9.52</td>
<td>9.59</td>
<td>0.07</td>
<td>☒</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>south side</td>
</tr>
</tbody>
</table>

**Total Length:**  **0.07**

| 116         | 0.06             | 0.15           | 0.09        | ☒                                    |                                                |                                          |                          |                       |                     |                               |          |
| 116         | 0.17             | 0.26           | 0.09        |                                      |                                                |                                          |                          |                       |                     |                               | OK       |
| 116         | 1.64             | 1.82           | 0.18        |                                      |                                                |                                          |                          |                       |                     |                               | OK       |
| 116         | 2.28             | 2.39           | 0.11        |                                      |                                                |                                          |                          |                       |                     |                               | OK       |
| 116         | 5.69             | 5.79           | 0.10        |                                      |                                                |                                          |                          |                       |                     |                               | OK       |
| 116         | 6.56             | 7.06           | 0.50        |                                      |                                                |                                          |                          |                       |                     |                               | OK       |
| 116         | 7.86             | 7.96           | 0.10        |                                      |                                                |                                          |                          |                       |                     |                               | OK       |

**Total Length:**  **1.17**

* Other Pollutants - Visible Oil-Sheen, Sewage Concerns, etc.
### Table 3: Questionnaire Use for Querying State Fish & Wildlife and Tribal Biologist

<table>
<thead>
<tr>
<th>Date:</th>
<th>Interviewer:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biologist Interviewee:</td>
<td>Stream Name:</td>
</tr>
<tr>
<td>Highway Segment:</td>
<td></td>
</tr>
</tbody>
</table>

#### C-1 Physical Spawning & Rearing Habitat Quality

Appropriate substrate and cover that promotes spawning and high survival rate for eggs and cover for early life stages of fishes (alevins and fingerlings) in upper channel reaches and provides adequate cover and substrate for rearing in lower channel reaches. Details of high-quality habitat include the following:

<table>
<thead>
<tr>
<th>Riparian Zone</th>
<th>Spawning Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish Cover</td>
<td>Habitat diversity</td>
</tr>
<tr>
<td>Bank stability</td>
<td>Lack of stream channel impairments</td>
</tr>
</tbody>
</table>

High-quality physical spawning & rearing habitat:  □ Yes  □ No
Comments:

#### C-2 Water Quality

Water quality includes the small stream meeting or exceeding chemical and physical characteristics (e.g., low water temperature, high dissolved oxygen concentrations, and moderate pH) of surface water per the Washington State water quality standards (WAC-173-201A) that are intended to protect aquatic life and promote survivability of all life stages.

Water quality conditions meet or exceed water quality standards:  □ Yes  □ No
Comments:

#### C-3 Lack of Stream Impairments

Impairments include the physical alteration of the natural riparian corridor and/or the stream channel that reduces the availability of fish habitat necessary for completing each of the life stages and diminishes survivability, resulting from altered habitat. Examples of impairments include dams, channelization, effects from urbanization, hardened streambank protection, forest harvesting, mining activities, and water diversions.

Lacks stream impairments:  □ Yes  □ No (i.e., stream impairments exist)
Comments:

#### C-4 Lack of Fish Passage Barriers

Lack of presence of fish passage barriers, including dams, culverts, water diversions, and natural passage barrier features (e.g., waterfalls, low dissolved oxygen, and high temperature barriers). The habitat suitability and value criteria is met if the regional WDFW or tribal biologist provides information that supports there is a lack of stream fish passage barriers for the small receiving stream.

Lacks fish passage barriers:  □ Yes  □ No (i.e., fish passage barriers exist)
Comments:
Reflections

In many respects WSDOT’s current prioritization approach resembles aspects of our original methodology. For example, it still includes weighted criteria. However, there are fewer of them, particularly when one considers the elimination of multipliers which previously applied to five of the 16 criteria contained in the original methodology. Similarly, the criteria in the original and existing approaches reflect priorities and values from an interagency team.

However, the similarities diverge with regards to the evolution of thought in establishing priorities. Most notably, now we factor in local knowledge and the target areas with highest environmental value rather than focusing on restoring significantly degraded areas. Another notable difference involves targeting the more intensive data gathering efforts to a prescreened subset of “candidate locations” rather than requiring intensive data gathering efforts everywhere. Additionally, moving away from scoring individual stormwater outfalls to evaluating highway segments reduced our dependency on closing existing knowledge gaps (i.e., outfall locations) which had significantly encumbered our original evaluation process.

Furthermore, collaborative engagement in developing the new approach, as well as “connecting the dots” between the criterion and their rationale, contributed greatly to building buy-in from resource agencies and other stakeholders. The end result produced a transparent and more cost-effective assessment tool. It also produced a method agile enough to revise priority rankings to reflect new information and changing conditions.

Biography

Larry recently joined the Thurston County Water Resources Division in July 2014 where he coordinates compliance with the County’s NPDES municipal stormwater permit as well as provides technical and policy support on water resource and stormwater management issues. Prior to joining the County, Larry worked 12 years for the Washington State Department of Transportation where he oversaw compliance-related activities associated with the department's NPDES municipal stormwater permit. These activities included developing, implementing, and evaluating the department's stormwater management program plan and stormwater design guidance manual.

Earlier in his career, Larry spent eight years as a planner in Oregon for Lane Council of Governments. There he managed projects that involved creating forums for agencies and stakeholders to collaboratively resolve natural resource, land use, and transportation issues. Before becoming a planner, Larry spent nearly ten years in parks operations and management.

Larry holds a master’s degree in Urban and Regional Planning from the University of Oregon and a bachelor’s degree in Outdoor Recreational Planning and Management from the University of Illinois at Urbana-Champaign.
Small Basin Program
Retrofit Prioritization

Presented by
Claire Jonson, Project Manager and
Dale Nelson, Project Engineer

King County
Water and Land Resources Division
1. What do you use prioritization for - retrofits, new development and/or redevelopment?
2. How did you develop your prioritization criteria?
3. What are the criteria?
4. How do you apply the criteria – weighting, etc.?
5. Have you implemented policy or prioritized budget based on the stream prioritization (have you used the prioritization)?
6. Who were the stakeholders when you set out to prioritize?
7. What data sources did you use, and how readily available is the data?
67 Small Basin Retrofits
Basin Selection – B-IBI

- Benthic Index of Biotic Integrity (B-IBI) scoring system is a quantitative method for determining and comparing the biological condition of streams.

- [http://www.pugetsoundstreambenthos.org/](http://www.pugetsoundstreambenthos.org/)

<table>
<thead>
<tr>
<th>Condition</th>
<th>General Description</th>
<th>BIBI Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>Comparable to least disturbed reference condition; overall high taxa diversity, particularly of mayflies, stoneflies, caddis flies, long-lived, clinger, and intolerant taxa. Relative abundance of predators high.</td>
<td>46-50</td>
</tr>
<tr>
<td>Good</td>
<td>Slightly divergent from least disturbed condition; absence of some long-lived and intolerant taxa; slight decline in richness of mayflies, stoneflies, and caddis flies; proportion of tolerant taxa increases.</td>
<td>38-44</td>
</tr>
<tr>
<td>Fair</td>
<td>Total taxa richness reduced – particularly intolerant, long-lived, stonefly, and clinger taxa; relative abundance of predators declines; proportion of tolerant taxa continues to increase.</td>
<td>28-36</td>
</tr>
<tr>
<td>Poor</td>
<td>Overall taxa diversity depressed; proportion of predators greatly reduced as is long-lived taxa richness; few stoneflies or intolerant taxa present; dominance by three most abundant taxa often very high.</td>
<td>18-26</td>
</tr>
<tr>
<td>Very Poor</td>
<td>Overall taxa diversity very low and dominated by a few highly tolerant taxa; mayfly, stonefly, caddis fly, clinger, long-lived, and intolerant taxa largely absent; relative abundance of predators very low.</td>
<td>10-16</td>
</tr>
</tbody>
</table>
Basin Selection

- Benthic Index of Biotic Integrity
  - Tributary Basin
    - Poor → 4
    - Fair/Poor → 3.5
    - Fair → 3
    - No Rating → 0
  - Downstream B-IBI station
    - Very poor → 4
    - Poor → 3
    - Fair → 2
    - Good or better → 0
    - No rating → 0
Basin Selection – Ecology 303d listing

- Category 2 is defined by DOE to be likely impaired
- Category 4 is impaired with a cleanup plan
- Category 5 is impaired without a cleanup plan
Basin Selection

- **Tributary DOE 303(d) Water Quality Listing**
  - Category 5 & 4 → 4
  - Category 2 → 3
  - No Category (NC) → 0
  - NC, Downstream BIBI >0 → 2

- **Downstream DOE 303(d) Water Quality Listing**
  - Category 5 & 4 → 3
  - Category 2 → 2
  - NC, Downstream BIBI >0 → 1
  - No Category (NC) → 0
Basin Selection

- Stream Channel Stability Indices
  - Ratio of 2-year developed to 10-year forested flow
    - No flow controls
    - Peak-matching flow controls – 1990 or later

- Ratio > 1 indicates likely unstable stream channel

- Weighted 5x for scale comparable to impact score
Basin Selection

- Percent of Basin Developed
  - Area > 60% → 4
  - Area > 50% and ≤ 60% → 3
  - Area > 40% and ≤ 50% → 2
  - Area > 30% and ≤ 40% → 1
  - Area ≤ 30% → 0

- Weighted 2.5x
Basin Selection

- **Catchment Size**
  - Area < 1.5 sq. mi. → 4
  - Area ≥ 1.5 and < 3 sq. mi. → 3
  - Area ≥ 3 and < 6 sq. mi. → 2
  - Area ≥ 6 and < 12 sq. mi. → 1
  - Area ≥ 12 sq. mi. → 0

- Weighted 2.5x
Department of Ecology
Stormwater Target Watersheds
# Small Basin Selection

<table>
<thead>
<tr>
<th>Map Ref No.</th>
<th>Stream Name</th>
<th>Small Stream or Lake Name</th>
<th>Downstream Receiving Water</th>
<th>Impact Scores + Trib Area Scores</th>
<th>DOE Flow Integrity Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Evans Creek Trib 0108</td>
<td>No Name</td>
<td>Evans Creek</td>
<td>43.5</td>
<td>9.0</td>
</tr>
<tr>
<td>9</td>
<td>Bear Creek Trib 0114</td>
<td>No Name</td>
<td>Bear Creek</td>
<td>42.5</td>
<td>9.0</td>
</tr>
<tr>
<td>19C</td>
<td>May Creek Trib 291A</td>
<td>No Name</td>
<td>May Creek</td>
<td>42.0</td>
<td>9.0</td>
</tr>
<tr>
<td>19B</td>
<td>Honey Creek</td>
<td>Honey Creek</td>
<td>May Creek</td>
<td>42.0</td>
<td>9.0</td>
</tr>
<tr>
<td>8</td>
<td>Mackey Creek Trib 0129</td>
<td>Mackey Creek</td>
<td>Bear Creek</td>
<td>39.5</td>
<td>9.0</td>
</tr>
<tr>
<td>48</td>
<td>Mill Creek Trib 0051</td>
<td>Mill Creek</td>
<td>Mill Creek</td>
<td>39.0</td>
<td>9.0</td>
</tr>
<tr>
<td>1</td>
<td>Gold Creek Trib 0088</td>
<td>Gold Creek</td>
<td>Sammamish Riv</td>
<td>39.0</td>
<td>8.0</td>
</tr>
<tr>
<td>3</td>
<td>Sammamish Riv Trib 0095B</td>
<td>No Name</td>
<td>Sammamish Riv</td>
<td>38.5</td>
<td>8.0</td>
</tr>
<tr>
<td>2</td>
<td>Sammamish Riv Trib 0090</td>
<td>No Name</td>
<td>Sammamish Riv</td>
<td>38.0</td>
<td>8.0</td>
</tr>
<tr>
<td>10</td>
<td>Evans Creek Trib 0107</td>
<td>No Name</td>
<td>Evans Creek</td>
<td>36.0</td>
<td>9.0</td>
</tr>
<tr>
<td>23</td>
<td>Lower Cedar Riv Trib 0307</td>
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<td>12</td>
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<td>Hylebos Creek Trib 49</td>
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<td>5</td>
<td>Bear Creek Trib 0134A</td>
<td>No Name</td>
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<td>6</td>
<td>Struve Creek Trib 0131</td>
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<td>32.5</td>
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<td>50</td>
<td>Trout Lake Trib 0033</td>
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<td>Lower White Riv</td>
<td>32.5</td>
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<td>19</td>
<td>May Creek Valley Reach</td>
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<td>8.7</td>
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</table>
Project Selection

- North Kitsap County, LID Retrofit Project Implementation Plan, 2013
## Project Selection – Level 1

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
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</thead>
<tbody>
<tr>
<td><strong>Site Slopes</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Site slopes $(X) &gt; 10%$</td>
</tr>
<tr>
<td>2</td>
<td>$5% &gt; X \leq 10%$</td>
</tr>
<tr>
<td>3</td>
<td>$X \leq 5%$</td>
</tr>
<tr>
<td><strong>Available Area</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Available area in the existing drainage facilities</td>
</tr>
<tr>
<td>2</td>
<td>Available area in the right-of-way (0 to half width)</td>
</tr>
<tr>
<td>3</td>
<td>Available area in the right-of-way (full width)</td>
</tr>
<tr>
<td><strong>Effective Impervious Area (EIA) Managed</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Low</td>
</tr>
<tr>
<td>2</td>
<td>Medium</td>
</tr>
<tr>
<td>3</td>
<td>High</td>
</tr>
<tr>
<td><strong>Meets Multiple Objectives</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Meeting one of the following: water quality improvement, peak flow reduction, or local drainage improvement</td>
</tr>
<tr>
<td>2</td>
<td>Meeting two of the following: water quality improvement, peak flow reduction, or local drainage improvement</td>
</tr>
<tr>
<td>3</td>
<td>Meeting all of the following: water quality improvement, peak flow reduction, and local drainage improvement</td>
</tr>
<tr>
<td><strong>Risk to the Environment</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Sites located within required setback zones for existing wells, steep slopes, critical areas, or pose a risk to existing structure or features</td>
</tr>
<tr>
<td>2</td>
<td>Sites located near the same features, but considered minor risk</td>
</tr>
<tr>
<td>3</td>
<td>Site located outside of the same features</td>
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</table>
## Project Selection – Level 2 Part 1

<table>
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<tr>
<th>Score</th>
<th>Criteria</th>
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<tbody>
<tr>
<td><strong>Water Quality</strong></td>
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<tr>
<td>0</td>
<td>The Water Quality scoring was derived from the Benefit Calculation from Department of Ecology Phase I Municipal Stormwater Permit, Appendix 11, Pages 3 and 4. The Water Quality Benefit Calculation can be found at the following web address:</td>
</tr>
<tr>
<td><strong>Drainage &amp; Local Flooding</strong></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Project expected to provide no effect on existing drainage or local flooding problems</td>
</tr>
<tr>
<td>1</td>
<td>Project expected to provide some drainage improvement</td>
</tr>
<tr>
<td>2</td>
<td>Project expected to improve local drainage and reduce local flooding</td>
</tr>
<tr>
<td>3</td>
<td>Project helps address specific drainage or local flooding issues based on record of historical</td>
</tr>
<tr>
<td><strong>Utility Coordination</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Numerous potential utility conflicts</td>
</tr>
<tr>
<td>2</td>
<td>Moderate potential utility conflicts</td>
</tr>
<tr>
<td>3</td>
<td>Limited potential utility conflicts and/or good opportunity to coordinate retrofit with planned utility or roadway improvement projects.</td>
</tr>
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</table>
## Project Selection – Level 2 Part 2

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<th>Score</th>
<th>Criteria</th>
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</thead>
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<td><strong>Constructability</strong></td>
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<tr>
<td>0</td>
<td>Construction costs expected to exceed the project value; Potentially significant impacts to residents during construction</td>
</tr>
<tr>
<td>1</td>
<td>No major impacts to residents expected; Some utility conflicts may increase construction time/costs</td>
</tr>
<tr>
<td>2</td>
<td>No major impacts to residents expected; Construction not expected to be complicated by utility or other types of conflicts</td>
</tr>
<tr>
<td>3</td>
<td>No major impacts to residents expected; County crews can construct the project in approximately 2 weeks or less</td>
</tr>
<tr>
<td></td>
<td><strong>Operation and Maintenance</strong></td>
</tr>
<tr>
<td>0</td>
<td>Long-term operation and maintenance of project is not feasible or cost effective</td>
</tr>
<tr>
<td>1</td>
<td>Project located outside of County-owned right-of-way and will require external O&amp;M</td>
</tr>
<tr>
<td>2</td>
<td>Project may require purchase of new equipment, training staff, and/or allocation of additional budget to properly maintain the proposed retrofits</td>
</tr>
<tr>
<td>3</td>
<td>County has necessary equipment, staff experience, and budget allocated to maintain the proposed retrofits</td>
</tr>
<tr>
<td></td>
<td><strong>Ease of Funding</strong></td>
</tr>
<tr>
<td>0</td>
<td>Expected cost of project exceeds value and/or funding is not available</td>
</tr>
<tr>
<td>1</td>
<td>Project funding depends on collaboration with tribes or other public agencies</td>
</tr>
<tr>
<td>2</td>
<td>Project not expected to be eligible for grant funding through Ecology's Stormwater LID Retrofit grant program</td>
</tr>
<tr>
<td>3</td>
<td>Project expected to be eligible and compete successfully for grant funding through Ecology's Stormwater LID Retrofit grant program</td>
</tr>
</tbody>
</table>
Contact Information

Claire Jonson, Project Manager
claire.jonson@kingcounty.gov
206-477-4720

Dale Nelson, Project Engineer
dale.nelson@kingcounty.gov
206-477-4785
Kitsap County Stormwater Retrofit Program

Chris May
Kitsap County Public Works
Stormwater Division

Managing Stormwater in the Built Environment
Kitsap County Washington
Overview

- Stormwater regulations typically only apply to NEW development (1980)
- Much of our developed (impervious) landscape is OLD and often has little or no stormwater treatment
- If we really want to improve WQ and protect Puget Sound, we need to do stormwater RETROFIT projects
How development harms the Sound

One house has little impact on stormwater. But grouped together they add up, blocking rainwater from soaking into the ground, polluting stormwater and damaging streams. Every year around Puget Sound, we level as much as 10,000 acres of forest as we gradually make way for the 4 million people who could move here this century.

UNDEVELOPED LAND
STORMWATER ABSORBED
Only about 3 percent of rain reaches streams and the Sound as surface runoff; the rest is absorbed by soil and vegetation.

THE EFFECT OF DEVELOPMENT
IMPERVIOUS SURFACES
- Streets, roofs, sidewalks and driveways prevent water from being absorbed, creating stormwater runoff.

RUNOFF
- Surface runoff flows into streams and streams, causing flooding and erosion. Streams are more prone to drying up during a drought. Higher water temperatures harm salmon.

CHEMICALS AND WASTE
- Runoff picks up chemicals, including oil and gas from cars, copper from brakes, household chemicals including fertilizer, refrigerants, pesticides and weed killers; animal waste; and sewage.

Source: Environmental Protection Agency
Amanda Raymond / THE SEATTLE TIMES
Kitsap County Stormwater Problems

Same problems throughout the Puget Sound

- Hydrologic Modification due to Stormwater Runoff Volume
- Water Quality Degradation due to Stormwater Pollution
- Fecal Pollution in Local Inlets, Embayments, and Shorelines
- Stream Habitat Degradation due to Frequent & Elevated Stormflows
- Localized Flooding of Urban Areas
Actions to Reduce Pollution Sources

- Septic & Sewer Repairs
- Stormwater System O&M
- Business Inspections
- IDDE & Source Control
- Mutt Mitt Program
- CB Cleaning
- New Stormwater Standards
- HE Street Sweeping
- Stormwater Retrofits
  - Green (LID) Solutions
Kitsap Stormwater Retrofit Program Goals

- Enhance GW Recharge
- Reduce Local Flooding
- Stabilize Stream Channels
- Reduce Pollutant Loading and Improve WQ
- Improve Habitat and Ecological Integrity
Kitsap Stormwater Retrofit Program Targets

• Replace or upgrade failing or damaged drainage infrastructure
• Add WQ enhancements in areas where there is little or no stormwater treatment
• Upgrade stormwater flood/flow-control in areas where runoff controls are inadequate
The Challenge of Stormwater Retrofit

- Often difficult to find opportunities and space
- Especially difficult in highly urbanized areas with lots of utility conflicts

- Many more problems than retrofit options
- Flood and Flow Control and/or WQ Treatment
- Public Acceptance
Green Stormater Retrofit Solutions

Small-Scale Practices That:

- Manage rain where it falls
- Closely mimic natural hydrologic processes

Make this... Function more like this...
Crafting a Retrofit Strategy

- Need to be systematic in identifying and prioritizing projects
- Need to have a multi-tiered implementation approach
  - Roads and ROW
  - Ponds
- Integrate with other watershed-based initiatives
- How do we pay for retrofits?
1. Retrofit Scoping/Goals
2. Desktop (GIS) Analysis
3. Reconnaissance
4. Retrofit Inventory
5. Evaluation/Ranking
6. Design
7. Construction
8. Monitoring
9. O&M
Types of Green (LID) Stormwater Solutions (GSS)

- Bioretention (Rain Gardens) and Street-Tree Box Filters
- Permeable Pavement
- Green (Eco) Roofs
- Constructed Wetlands
- Infiltration Systems

Utilize Natural Hydrologic Functions

- Infiltration
- Filtration
- Storage
- Evaporation
- Transpiration

- Soils
- Vegetation
- Fungi
- Micro-Organisms
Bioretention (Rain Garden Systems)
Permeable Pavement
Constructed Wetlands
Green Roofs and Green Walls
Benefits of Green Stormwater Solutions

- Remove Pollutants
- Reduce Runoff Flows and Volume
- Replenish Groundwater
- Control Local Flooding
- Aesthetically Pleasing
Brookwood Green Street Retrofit Project
Identify Constraints

- Criteria:
  - Proximity to Steep Slopes/Landslide Prone Areas
  - High Groundwater
  - Low Permeability Soils
- Delineate Areas Suitable for:
  - Shallow Infiltration
  - Deep Infiltration
Evaluate Constraints

Infiltration Assessment

Infiltration Feasibility
- Good
- Moderate
- Likely Poor
- Poor

Shallow

Deep
Impervious and Forest Cover

Existing Drainage System
Soils and Infiltration

Steep Slopes
Opportunities and Constraints

Mapping Evaluation

- Delineate Drainage Areas
- Space for Green Stormwater Solutions
  - ROW Areas with Wide Medians or Planting Strips
  - Public or Private Sites with Nearby Open Space
- Large Pollution-Generating Area not Currently Treated
Evaluate Opportunity Area

Windshield Survey

• Benefit
  ✓ Pollutant Loads
    (e.g., parking lot use)
  ✓ Visibility/ Education opportunities

• Feasibility
  ✓ Available Space
  ✓ Topography
  ✓ Existing Drainage Patterns
Evaluate Opportunity Area
Quantitative Ranking of Sites

- **Benefit**
  - ✓ Pollutant Loads
    (e.g., parking lot use)
  - ✓ Visibility/ Education opportunities
- **Feasibility**
  - ✓ Available Space
  - ✓ Topography
  - ✓ Existing Drainage Patterns
Feasibility Evaluation of Potential Sites
Field Evaluation to Confirm Feasibility

- Sufficient Space Given Setbacks
  Existing Grading and Drainage Patterns
  Allow Gravity Flow
- Limited Impact to Site Uses
- Property Operations do Not Preclude Retrofit
- Drainage Infrastructure can be Reasonably Modified
- Confirm Stormwater is Not Treated
Evaluate of Potential Sites
Effectiveness Evaluation and Ranking

- Net Treatment Benefit
  *(Current Treatment Level vs. Retrofit Treatment Level)*
- Removal of Priority Pollutants
  *(e.g., Fecal Coliform)*
- Removal of Other Pollutants
- Flow Control Benefits *(if drainage problem exists)*
- Public Visibility and Education Benefits
- Project Risks
- Grant Funding?

Top Potential Retrofit Sites
Develop Concepts for Top Sites

Design and Cost
Kitsap County Stormwater Retrofit Plans

- Manchester
- Silverdale
- Kingston
- Indianola
- Suquamish
- Keyport

<table>
<thead>
<tr>
<th>Typology</th>
<th>Kitsap LID Manual Design Standards</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROW Flat Streets - Commercial, Residential</td>
<td>DS Previous Pavement - Asphalt, Concrete, Reinforced Grass &amp; Gravel Systems, Previous Paving, Dispersion, Amendment of Disturbed Soils, Bioretention, Trees, DG Street Edge Treatments, Right of Way Sections, Bioretention Facilities, Alternative Bioretention Strategies, Appendices - Bioretention Plant List, Street Tree List, Missing a DG to cover integrating platform with steep cascades (where cascades may go under sidewalk)</td>
<td></td>
</tr>
<tr>
<td>ROW Cascades - Commercial, Residential</td>
<td>DS Pervious Pavement - Asphalt, Concrete, Reinforced Grass &amp; Gravel Systems, Previous Paving, Dispersion, Amendment of Disturbed Soils, Bioretention, Trees, DG Street Edge Treatments, Right of Way Sections, Bioretention Facilities, Alternative Bioretention Strategies, Appendices - Bioretention Plant List, Street Tree List, Missing a DG to cover steep connected planters/storage, Missing a DG to cover integrating platform with steep cascades (where cascades may go under sidewalk)</td>
<td></td>
</tr>
<tr>
<td>Detention Pond Pocket Park</td>
<td>DS Dispersion, Amendment of Disturbed Soils, Bioretention, Trees, DG Bioretention Facilities, Alternative Bioretention Strategies, Appendices - Bioretention Plant List, Street Tree List, Missing a DG to cover a larger site where detention and park are combined</td>
<td></td>
</tr>
<tr>
<td>Commercial Parking Lot</td>
<td>DS Previous Pavement - Asphalt, Concrete, Reinforced Grass &amp; Gravel Systems, Previous Paving, Dispersion, Amendment of Disturbed Soils, Bioretention, Trees, DG Street Edge Treatments, Right of Way Sections, Bioretention Facilities, Alternative Bioretention Strategies, Appendices - Bioretention Plant List, Street Tree List</td>
<td></td>
</tr>
<tr>
<td>Residential GCI Options</td>
<td>DS Undispersion, Amendment of Disturbed Soils, Bioretention, Trees, DG Bioretention Facilities, Alternative Bioretention Strategies, Appendices - Bioretention Plant List, Street Tree List, DS Pervious Pavement - Asphalt, Concrete, Reinforced Grass &amp; Gravel Systems, Previous Paving, DG Alley &amp; Driveway Treatments</td>
<td></td>
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</tbody>
</table>

NOTES: The intent of the typologies is to provide guidance on the best management practices most suitable for incorporation into the designs for the study sites.
SITE 5 - MANCHESTER BUSINESS DISTRICT - COLCHESTER DRIVE E

Site Description
The site is located along the northernmost block of Colchester Drive E, which is relatively flat, coming into Manchester from the south and terminating at E Main Street and the village center. It is a main arterial connecting areas to the north and south of Manchester.

Context & Analysis
There is no formal parking along this block of Colchester, which is lined by several small businesses and commercial buildings, a few houses, and the Post Office. Parking is provided in private lots along the right-of-way, with continuous access off the sidewalk. No formal sidewalks or crosswalks are provided (pedestrians use the street shoulders) and there is a bus stop with shelter on the northbound lane midway along the block. Vacant parcels at the southeast corner of Colchester and Main could be purchased by the County and developed as public open space (see Site 3). The intersection with Main St. has a stop sign and striped pedestrian crosswalk. This site is at the bottom of the Main Street drainage basin, which has a significant area upstream including numerous other project sites in this study.

Description of Retrofit
Street improvements along a main downtown street to facilitate complete street concepts and integrate bioretention facilities and permeable pavement. Streetscape improvements require a partnership with adjacent property owners to the west to allow for public walkway and amenities zone within the existing parking area that lies outside the right-of-way. Permeable pavement to reduce runoff and bioretention to provide water quality treatment prior to discharge to the downstream system. Water quality treatment is to be provided for surrounding pavement areas and upstream parcels surface draining through the site. Site improvements will improve collection of runoff from E Spruce St and convey to the downstream water quality facility proposed at Site 9. Street trees may not be a viable addition due to overhead power and Manchester’s View Protection Overlay Zone.

Stormwater Benefits: Estimate of Treatment Potential
<table>
<thead>
<tr>
<th>PGIS Site Area (acres)</th>
<th>On-site Treatment Facility Area (sf)</th>
<th>Percent of Site Mitigated (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>2,200</td>
<td>100%</td>
</tr>
</tbody>
</table>

Benefits shown are based on improvements shown in conceptual design and GIS site data. See Stormwater Runoff Treatment Notes on page 1 for additional explanation of benefits.

Additional Benefits
- Mobility - Complete Street street elements provide formalized and controlled access to downtown businesses
- Community - Wide walkways would allow opportunity to integrate street furnishings to promote pedestrian activity and create a vibrant downtown center
- Community - Improvements maintain existing driveway access for adjacent parcels
- Safety - provides traffic calming and access control
MANCHESTER LID STORMWATER RETROFIT
Manchester, Washington
Conceptual Designs - January 2012

SITE 5 - COLCHESTER BUSINESS DISTRICT
Location - Colchester Dr., Main to Spruce
Type - Commercial ROW Flat Street

Construction Cost Range (does not include soft costs)
- $555,000 - $655,000
- Costs include:
  - pavement demolition, excavation and haul
  - roadway and walkways
  - permeable pavement for parking areas
  - storm drain infrastructure
  - bioretention soil and plantings
  - construction contingency

Conceptual Design Plan

Conceptual Design Section

Bioretention facility Water Street, Pt. Townsend, WA

Bioretention facility Fort Townsend, WA

Bioretention facility Winslow Way, City of Bainbridge Island, WA
Manchester Stormwater Park

Your input, our design.

On schedule for Construction
Fall 2014
SILVERDALE LID RETROFIT
SILVERDALE WAY/NW BUCKLIN HILL RD (LAND USE TYPE: COUNTY RIGHT OF WAY)

POTENTIAL LID STRATEGIES:

1. Trees contribute to the control of stormwater runoff in the following ways: reducing and building interstitial/pervious plant in the foliage, drawing water in the soil through the roots into the subsurface (transpiration), and building soil structure through root growth (biostimulation), increasing interception of water in the root zone. Trees provide many additional benefits beyond their aesthetic appearance. Conceptual design-level provided green infrastructure efforts reduce stormwater runoff, construct wetlands, and add on wind barriers. Trees provide privacy and habitat functions that are useful in wildlife and urban environments alike.

Kitsap County: Low Impact Development 2020 Guidance Manual p. 143

2. Curbs to allow sheet drainage into rain gutters. "Curbs should include such as other erosion protection methods in the thorough service to distribute energy."

Low Impact Development Technical Guidance Manual for Puget Sound p. 11

3. Providing stormwater solutions, "integrate appropriately, technical retreats, and biological catchments, and properly integrate them with surface or groundwater applications to promote a resilient infrastructure. Sources can be used in the infrastructure systems where they do not interfere or disrupt natural waterways."


KITSAP COUNTY
CLEAN STORMWATER
Our Community, Our Waterways

www.kitsapgov.com/sswm
SILVERDALE LID RETROFIT
RIDGETOP BLVD  LAND USE TYPE: COUNTY RIGHT OF WAY

KITSAP COUNTY
CLEAN STORMWATER
Our Community. Our Waterways

www.kitsapgov.com/sswm
Stormwater Ponds
Retrofit Selection

- Wetland conversion
- Bioretention
- Pond expansion
- Pond outlet modification
- Configuration change
- Vegetation improvement
- Infiltration
- Multiple uses
- Subsurface gravel wetland
<table>
<thead>
<tr>
<th>Criteria for Assessing Feasibility</th>
<th>Wetland Conversion</th>
<th>Bioretention</th>
<th>Pond Expansion</th>
<th>Pond Outlet Modification</th>
<th>Configuration Change</th>
<th>Vegetation Improvement</th>
<th>Infiltration</th>
<th>Multiple Uses</th>
<th>Subsurface Gravel Wetland</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit Treatment Processes</strong></td>
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<tr>
<td>Class A/B soils</td>
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<tr>
<td>Evidence of good infiltration</td>
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<tr>
<td>Loam, sandy loam, or sand</td>
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<td></td>
<td></td>
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<tr>
<td><strong>Minimal amount of standing water</strong></td>
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<td></td>
<td></td>
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<td>Significant amount of standing water</td>
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<td>Outlet located near inlet</td>
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<tr>
<td><strong>Vegetation and Aesthetic Assessment</strong></td>
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<td></td>
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<tr>
<td>Functioning similarly to a wetland</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Invasive species dominant</td>
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<td></td>
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</tr>
<tr>
<td>Low species diversity (non-native plants)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>High visibility</td>
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<tr>
<td>Potential for community amenity</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Shallow with minimal side slopes</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Retrofit Feasibility Assessment</strong></td>
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<tr>
<td>Evidence of groundwater seepage into pond</td>
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<td>Long linear pond</td>
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<td>Single-cell pond</td>
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<td>Deepen pond to increase the storage volume</td>
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<td>Space on parcel not fully utilized</td>
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<td>Add a new outlet structure</td>
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<td>Modify existing outlet structure</td>
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<td>Raise or lower existing outlet structure</td>
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</tbody>
</table>
Wetland Conversion Example
### Rationale for Retrofit Prioritization and Selection

<table>
<thead>
<tr>
<th>Receiving Water</th>
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</thead>
<tbody>
<tr>
<td>Drains to Sinclair Inlet – 303(d) listings for dissolved oxygen and fecal coliform bacteria</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Design Deficiencies</th>
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</thead>
<tbody>
<tr>
<td>Pond originally designed as a two-celled system, two separate cells were not observed during field visit</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit Treatment Processes</th>
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<tbody>
<tr>
<td>Class C soils, standing water near outlet and in bottom of pond</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Retrofit Feasibility</th>
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<tbody>
<tr>
<td>Some room for expansion, good access</td>
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</tbody>
</table>

### Selected Retrofit Options

| - Restore to two-celled pond |
| - Deepen and re-contour pond bottom and side slopes |
| - Improve vegetation |
| - Wetland conversion |

**Wetland Conversion Example**
ROADSIDE DITCH AND SHOULDER WATER QUALITY ENHANCEMENT PLAN
GOAL:

To provide some guidelines for better roadside ditch and shoulder design and maintenance which will accomplish:

- Reduce your work load and your costs.
- Keep your stakeholders happy.
- Prevent erosion, protect water, and maintain a healthy environment.
ROADSIDE DITCHES:
An unrecognized factor in stormwater runoff management
Ditches increase the volume and velocity of runoff entering streams.

Ditches are a source of sediment and associated contaminants to downstream waters, especially when scraped.
Create and maintain a shallow, gentle sloping ditch.

- Easier to maintain
- Safer for traffic
- Less likely to erode
AVOID THE V-SHAPED DITCH:
The bottom is easily incised and starts the erosion process.
Prevent erosive flows by using:

- Check Dams
- Rock Lined
REINFORCE SIDE SLOPES:

- Reinforced Soil Slope
- Rock Side Slope
- Reinforced Gabion
PLANTING

- Seed Mixes
- Plant List

HYDROSEED

- Immediately after ditching
- Early in the season; not before rain
Use treatment structures in areas with curb / gutter / sidewalks
Thank You

Clean Water Kitsap
Partners in Stormwater Solutions

Questions?