Green Infrastructure Sessions:

**Session1: Quantifying Volume Reduction in Grass Buffers and Swales**
Andrew Earles (Wright Water Engineers), Derek Rapp (Peak Stormwater), Jim Wulliman and Sara Johnson (Muller Engineering), Holly Piza (UDFCD)

**Session2: Navigating the New Jersey & Washington State Stormwater Programs as Models for Approving Manufactured Treatment Devices**
Mark B. Miller (AquaShield, Inc.)

**Permaculture and Low Impact Development (LID)**
Patrick Padden (Padden Permaculture)

**Comprehensive Watershed Planning: Prioritize, Target and Implement Multipurpose Projects**
Darren Beck (HR Green, Inc.)

**Developing a Comprehensive Stormwater Infrastructure Master Plan**
Drew Beck (Matrix Design Group)

**Strategic Planning for Green Infrastructure in Boulder**
Candice Owen (City of Boulder)
QUANTIFYING VOLUME REDUCTION IN GRASS BUFFERS AND SWALES

Andrew Earles, Wright Water Engineers
Derek Rapp, Peak Stormwater
Jim Wulliman and Sara Johnson, Muller Engineering
Holly Piza, UDFCD

CASFM 2018
4-Step Process

1. Reduce Runoff LID/MDCIA
2. Treat & Slowly Release WQCV
3. Stabilize Stream Channel
4. Source Controls

Protected Receiving Water
New MS4 Design Standard

(C) Runoff Reduction Standard

- Directly Connected Impervious Area (DCIA)
- Unconnected Impervious Area (UIA)
- Receiving Pervious Area (RPA)
- Separate Pervious Area (SPA)

Total Runoff Volume ≤ 40% WQCV

Runoff Volume

DCIA

UIA

RPA

SPA
Infiltration

- Infiltration Research
  - Pitt and Lantrip, 2000
  - Colorado Field Studies
- Soil
- Vegetation
Infiltration Rates
(Pitt and Lantrip, 2000)

**Sandy Soils Infiltration (iph)**
- Observed non-compacted: Initial 39, Final 15
- Observed compacted: Initial 15, Final 1.8

**Clayey Soils Infiltration (iph)**
- Observed dry non-compacted: Initial 18, Final 6.6
- Observed dry compacted and saturated: Initial 3.4, Final 1.4

**Published**
- 1
- 0.05
Central Colorado Field Studies

- Douglas County/SEMSWA
- 4 Sites (2012-2015)
  - Residential
  - Park
  - Commercial
  - SEMSWA Office Swale
- Soil types
  - Sandy Loam
  - Clay Loam
- Sheet flow infiltration
Central Colorado Field Studies

Sheet flow infiltrated vs time

Assumed minimum infiltration capacity
# Two Ends of the Soil Spectrum

<table>
<thead>
<tr>
<th>Property</th>
<th>Sandy</th>
<th>Clayey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage rate</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Aeration</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Water holding capacity</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Organic content</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Ability to store plant nutrients</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Adsorption of pollutants</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
Topsoil: “Searching for the Sweet Spot”

“SWEET SPOT”
Vegetation Studies

Infiltration Rate (in/hr)

Test Number

First Plant Growth

Vegetation

Infiltration

Time
SWMM

Variables Considered

Total Area

Hydrologic Soil Group/ Horton Infiltration Parameters

Ratio of UIA to RPA

Overland Slope

Depression Storage

Figure 2 – Simplified SWMM Layouts for Varying UIA:RPA Ratios

NOTE: For modeling practices, the depression storage does not leave the site and assumed to be evaporated or evaporated or transpired.
Rainfall

- Water Quality Capture Volume (WQCV) for Denver = 0.6 inches of rainfall
- 0.6 inches depth distributed over 2 hours using CUHP temporal distribution
- Analyzed range from 0.25 to 0.95 inches
Largest impacts

- Soil Type
- UIA:RPA ratio (imperviousness)
Runoff vs. Subarea Imperviousness (C/D Soils)
for Varying Rainfall Depths

\[ y = 7E-05x^2 + 0.0015x \]
\[ Q = C_0 + C_1(0.95 - P_2) + C_2(Area) + C_3(L:W) + C_4(Slope) + C_5(Imp) + C_6(Imp)^2 \]  

*Equation 1*

Where:

- \( Q \) = Runoff (inches)
- \( P_2 \) = 2-hour WQCV Rainfall Depth (inches)
- \( Area \) = total subarea, sum of UIA and RPA (acres)
- \( L:W \) = Ratio of total flow length to catchment width
- \( Slope \) = average overland slope (%)
- \( Imp \) = subarea imperviousness (%) calculated as \( (\text{UIA} / (\text{UIA} + \text{RPA})) \times 100 \)
- \( C_x \) = coefficients determined through regression analysis

**Table 3: Empirical Runoff Equation Coefficients.**

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Constant ( C_0 )</th>
<th>Rainfall (in) ( C_1 )</th>
<th>Area (ac) ( C_2 )</th>
<th>L:W ( C_3 )</th>
<th>Slope (%) ( C_4 )</th>
<th>%Imp ( C_5 )</th>
<th>%Imp(^2 ) ( C_6 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5.81E-01</td>
<td>-7.79E-01</td>
<td>-1.45E-02</td>
<td>-1.93E-03</td>
<td>7.03E-04</td>
<td>-2.49E-02</td>
<td>2.64E-04</td>
</tr>
<tr>
<td>B</td>
<td>-7.77E-02</td>
<td>-9.25E-01</td>
<td>-1.07E-02</td>
<td>-1.45E-03</td>
<td>5.02E-04</td>
<td>-1.36E-04</td>
<td>9.24E-05</td>
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<tr>
<td>C/D</td>
<td>-1.13E-02</td>
<td>-8.99E-01</td>
<td>-1.17E-02</td>
<td>-1.57E-03</td>
<td>5.45E-04</td>
<td>3.55E-03</td>
<td>4.64E-05</td>
</tr>
</tbody>
</table>
Equation vs. SWMM Runoff
Recommended Constraints

- 0.25 inches < Precipitation < 0.95 inches
- 0.025 acres < Area < 2.0 acres
- 0.0625 < L:W ratio < 16.0
- 0.5% < Slope < 33%
Quantifying Runoff Reduction

- Intro to UD-BMP – Runoff Reduction
- Examples

---

### Design Procedure Form: Runoff Reduction

| Date | BMP Details | UD-BMP
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Site Information
- [Value based on Site 1]
- [Detailed information for Site 1]

### Calculated BMP Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMP Type</td>
<td></td>
</tr>
<tr>
<td>Flow Rate</td>
<td></td>
</tr>
</tbody>
</table>

### Calculated Water Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Rate</td>
<td></td>
</tr>
<tr>
<td>BMP Type</td>
<td></td>
</tr>
</tbody>
</table>

### Calculated Water Quality Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>BMP Type</td>
<td></td>
</tr>
<tr>
<td>Flow Rate</td>
<td></td>
</tr>
</tbody>
</table>

### Calculated Sediment Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMP Type</td>
<td></td>
</tr>
<tr>
<td>Flow Rate</td>
<td></td>
</tr>
</tbody>
</table>

---
Quantifying Runoff Reduction
Intro to UD BMP – Runoff Reduction

- Inputs
  - **Site Information**
    - Area Type and how much of each
      - UIA/RPA
      - DCIA
      - SPA
  - Soils
  - HSG A, B, C/D (%)
  - Average Slope of RPA
  - Interface width (Area Type UIA:RPA only)
Quantifying Runoff Reduction
Intro to UD BMP – Runoff Reduction

- Runoff Output/Results
  - Total Area
  - L/W Ratio
  - UIA/Area
  - Runoff (from UIA:RPA pair)
    - Depth
    - Volume
    - Reduction (Infiltration into RPA+ Depression Storage)
Quantifying Runoff Reduction
Intro to UD BMP – Runoff Reduction

- WQCV Output/Results
  - Calculated WQCV based on impervious area only
  - WQCV Reduction (as volume and as %)
  - Untreated WQCV
Quantifying Runoff Reduction

- Regional Trail 10 ft wide x 100 ft long
  - B Soils

**CALCULATED RUNOFF RESULTS**

<table>
<thead>
<tr>
<th>Area ID</th>
<th>Trail 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIA:RPA Area (ft²)</td>
<td>1,500</td>
</tr>
<tr>
<td>L/W Ratio</td>
<td>0.15</td>
</tr>
<tr>
<td>UIA/Area</td>
<td>0.6667</td>
</tr>
<tr>
<td>Runoff (in)</td>
<td>0.00</td>
</tr>
<tr>
<td>Runoff (ft³)</td>
<td>0</td>
</tr>
<tr>
<td>Runoff Reduction (ft³)</td>
<td>42</td>
</tr>
</tbody>
</table>

**CALCULATED WQCV RESULTS**

<table>
<thead>
<tr>
<th>Area ID</th>
<th>Trail 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>WQCV (ft³)</td>
<td>42</td>
</tr>
<tr>
<td>WQCV Reduction (ft³)</td>
<td>42</td>
</tr>
<tr>
<td>WQCV Reduction (%)</td>
<td>100%</td>
</tr>
<tr>
<td>Untreated WQCV (ft³)</td>
<td>0</td>
</tr>
</tbody>
</table>
Quantifying Runoff Reduction

- Regional Trail 10 ft wide x 100 ft long
  - C\D Soils – 852 ft²
Quantifying Runoff Reduction

- Regional Trail 10 ft wide x 100 ft long
  - B Soils – RPA 5 feet wide along the 100 ft trail
  - C/D Soils – RPA 8.5 feet wide along the 100 ft trail
Quantifying Runoff Reduction

- Parking Lot 7,000 ft²
  - B Soils – RPA = 3,500 ft²
  - C/D Soils – RPA = 5,910 ft²
Verifying Soil Type
Run-on ratio
When you need a level spreader (?)
Defining the RPA
Slotted Curb

SECTION A

SLOTTED CURB

PLAN
Sediment Pad at Swale Entry

**SECTION A**
- **FLOWLINE/CURB OPENING BEYOND**
- **CURB TRANSITION**
- **TOP OF CURB**
- **2'-6" CONCRETE SEDIMENT COLLECTION PAD**
- **1" CHAMFER**
- **TURF GRASS**
- **6" MIN. TOPSOIL**

**SECTION B**
- **CURB OUTFALL TO GRASS SWALE**

**PLAN**
- **FLOWLINE**
- **4" VERTICAL DROP**
- **2'-0" GUTTER**

**SPECIFICATIONS**
- **2'-6" CONCRETE**
- **6" CURB**
- **6" MIN. TOPSOIL**
- **3'-0" CURB OPENING**
- **3'-0" CURB TRANSITION**
- **STD. CURB AND GUTTER**
- **5'-0" CURB TRANSITION**

**NOTES**
- **8.33%**

More Information Available

www.UDFCD.org

- Technical Memorandum, Determination of Runoff Reduction Method Equations (UIA to RPA) based on Multivariable SWMM Analysis, Piza and Rapp 2018
- Criteria Manual, Volume 3, Fact Sheet T-0
- UD-BMP (Excel Based Tool for calculating runoff)
- Flood Control District Youtube video for using UD-BMP
Coming soon

Topsoil Management Guidance
Thank You
Navigating the New Jersey & Washington State Stormwater Programs as Models for Approving Manufactured Treatment Devices

Mark B. Miller, P.G.
Research Scientist
mmiller@aquashieldinc.com
Chattanooga, Tennessee
(888) 344-9044

Colorado Association of Stormwater & Floodplain Managers
September 25-28, 2018
Snowmass Village, CO
A bunch of stormwater Quality programs

Distribution of state/regional stormwater testing/evaluation programs

- UDFCD
- NJCAT 2013, Recognizes NJCAT
- Recognizes TARE; WA TARE
- 2003 TARP Tier II, Recognize TARP Tier II
- CALTRANS, GTAP, WI Stormwater Post-Construction Technical Standard 1006;
PEP (Preliminary Evaluation Period Program); VTAP (Withdrawn)

Select Cities/Counties/Regions

Modified from www.werf.org, Executive Summary, Document #INFR2R14
## Underground BMPs

To evaluate performance of an underground proprietary BMP, data should be provided to the local jurisdiction to demonstrate that anticipated BMP performance will be comparable to that of surface-based BMPs such as extended detention basins, constructed wetland basins, sand filter basins, or retention ponds. Underground BMPs approved for stand-alone treatment should be capable, on an annual basis, of producing effluent quality with a median TSS concentration of no more than 30 mg/L. This level of treatment is comparable to the long-term effluent median concentrations from the International Stormwater BMP Database for surface-based BMPs.

Data collected to substantiate performance of proprietary BMPs should meet the following criteria:

1. Testing must consist of field data (not laboratory data) collected in compliance with the criteria in Table UG-1. Laboratory studies and/or vendor-supplied studies without third party involvement or verification should not be considered. The Technology Acceptance Reciprocity Partnership (TARP) Protocol for Stormwater Best Management Practice Demonstrations may provide additional useful information on development of a monitoring program for evaluation of underground BMPs. Information on the TARP program can be found in several locations on the internet, including http://www.dep.state.pa.us/dep/deputate/polpre/techservices/tarp/. Forthcoming field testing guidelines from the American Society of Civil Engineers Urban Water Resources Research Council (ASCE UWRRC) Task Committee developing Guidelines for Certification of Manufactured Stormwater BMPs (Sansalone et al. 2009) may also be applicable in the future.

2. Data collected in environments similar to the Colorado Front Range (i.e., semi-arid with freezing and thawing in the winter) are preferable. This is particularly important for flow-based devices where differences in rainfall intensity and duration may affect performance.

3. Data should be collected and analyzed in accordance with the guidance provided in Urban Stormwater BMP Performance Monitoring (Geosyntec and WWE 2009; available online at www.bmpdatabase.org). When reviewing performance data, it is important to recognize that the use of percent removal may be more reflective of how "dirty" the influent water is rather than how well the BMP is actually performing (Jones et. al. 2008). Instead, look at effluent concentrations for a range of influent concentrations. The device should have performance data that demonstrates the ability to meet a median TSS effluent concentration of approximately 30 mg/L or lower on an annual basis.

4. Data should be collected or verified by independent third parties in accordance with good Quality Assurance/Quality Control (QA/QC) procedures.

Many studies have been conducted over the past decade to document the performance of underground BMPs. Sources of data that may be used to support using a proprietary BMP include the following:

- International Stormwater BMP Database (www.bmpdatabase.org).
- University of Massachusetts Amherst Stormwater Technologies Clearinghouse (www.masten.net).
Then in mid-2016...

- Proposes a National program to evaluate products and practices.
- Draws upon New Jersey & Washington State stormwater programs for MTD evaluations.
Let's look at 2 stormwater programs as models for approving (evaluating) Manufactured Treatment Devices (MTDs)...

Lab testing protocol

Field testing protocol
Lab testing provides repeatable and defensible results under controlled conditions to allow for side by side comparisons of MTD performance testing.

Field testing is a logical progression from lab testing and provides long term, real world results under random storm conditions under which an MTD would be expected to encounter.
Two Step Process for NJDEP “Certification”

**Step 1:** NJCAT “Verification”

[www.njcat.org](http://www.njcat.org)

**Step 2:** NJDEP “Certification” (if eligible)

[www.njstormwater.org/treatment.html](http://www.njstormwater.org/treatment.html)
NJCAT Verification vs. NJDEP Certification

- **NJCAT Verification** provides independent documentation of a protocol-based performance claim for an MTD in either a lab and/or field test setting.

- **NJDEP Certification** allows an eligible MTD to be specified within New Jersey under conditions specific to state stormwater rules.

We’ll talk about eligibility later.....
NJDEP Lists MTD Certifications @ www.njstormwater.org/treatment.html

Link to NJCAT Verification Database

Links to NJDEP Certifications

Stormwater Manufactured Treatment Devices

As MTDs are required to be NJCAT verified and NJDEP certified when the MTD is used to satisfy the requirements of the Stormwater Management Rule (N.J.A.C. 7:8), as a result of triggering the requirements for major development.

For projects requiring New Jersey Environmental Infrastructure Financing Program (NJEIFP) funding, an MTO must be either: 1) NJCAT verified and NJDEP certified or 2) installed using the NJDEP MTO Funding Policy.

As MTOs which are not NJCAT verified or NJDEP certified may be used as long as the MTO is not intended to satisfy the requirements of the Stormwater Management Rule and is not subject to NJDEP MTO Funding Policy.

Please note that any MTO installed shall be listed on the MSW’s permittee’s inventory of stormwater management measures and must be properly maintained by the responsible party. Other state, federal and local requirements may apply.

NOTICE (January 13, 2017)

NJDEP Field Test Certifications for MTDs expired December 1, 2016. As such, MTDs that failed the Field Test Certification can no longer be used in new installations to satisfy the requirements of the Stormwater Management Rule. However, projects that have been deemed administratively complete by the Division of Land Use Regulation for a permit renewal, after the stormwater review as of December 1, 2016 may continue to utilize the design as specified in the prior certification letter. If no permit is required from the Division of Land Use Regulation, projects that have received preliminary or final site plan approval from the municipality as of December 1, 2016 may continue to utilize the design as specified in the prior certification letter.

NOTICE (January 31, 2013)

Guidance for obtaining verification and certification can be found at the NJDEP website at http://www.njdep.nj.gov/mtf/mtf_guidance.htm.

The list of MTDs with expired Field Test Certifications can only be found at the NJstormwater MTD GC page located at: http://www.njstormwater.org/njstormwater.mtd_GC.htm.

The table below includes the listing of MTDs that are NJCAT verified and NJDEP certified under the updated procedures and protocols and have valid dates.

Click here to link to NJCAT Verification Database.
Technology Verification

The Energy and Environmental Technology Verification (EE TV) Act at N.J.S.A. 13D: 134 et seq., establishes the guidelines for a verification and certification process to approve the use of innovative energy and environmental technologies that benefit the environment and economy of New Jersey. The New Jersey Legislature found that, in establishing the technology verification and certification program, it is in the public's interest to encourage the commercial development and use of new technology-based environmental and energy-related products, services and systems that abate and prevent environmental pollution and promote energy conservation in the most cost-effective and environmentally efficient manner in the State.

Highlights

Although innovative environmental and energy technologies often consume fewer natural resources than traditional methods, they encounter numerous technical, financial, and regulatory impediments. Over the years, NJCAT has broken down many of the barriers, but there are still daunting challenges facing innovative technologies.

Stormwater Treatment Systems

Stormwater Management Technologies in particular are difficult to evaluate. Pollutant removal performance depends upon many factors, e.g., influent particulate size distribution, influent pollutant concentration (loading), stormwater flow rate, sump design and capacity, and maintenance. NJCAT involvement and activities over the past decade in identifying and evaluating a number of pre-manufactured stormwater treatment devices has created the knowledge and experience base necessary to effectively and confidently assess anticipated sediment removal performance.

The New Jersey Stormwater rules (35 N.J.R. 154) clearly establish that manufactured stormwater...
### NJCAT MTD Verifications

Visit the NJCAT website for information on MTD verifications: [www.njcat.org/verification-process/technology-verification-verification-database.html](http://www.njcat.org/verification-process/technology-verification-verification-database.html)

#### Field Verifications per TARP or NJDEP 2009

- **AquaShield Inc.**
  - Product: Aquafilter
  - Verification Date: November 2009
- **AquaShield Inc.**
  - Product: Aquafilter
  - Verification Date: November 2009
- **BaySaver Technologies, LLC**
  - Product: BaySaver Filter Enhance Media Cartridge
  - Verification Date: November 2018
- **DoClean Environmental Services**
  - Product: Krieran Membrane Filtration System
  - Verification Date: April 2018

#### Lab Verifications open for Public Comment

- **Aquashield Inc.**
  - Product: Aquafilter
  - Verification Date: November 2009
- **BaySaver Technologies, LLC**
  - Product: BaySaver Enhanced Media Cartridge
  - Verification Date: November 2018

#### Stormwater Technologies: Laboratory Verified

<table>
<thead>
<tr>
<th>Company</th>
<th>Product</th>
<th>Verification Date</th>
<th>Link to Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>AquaShield Inc.</td>
<td>Aquafilter</td>
<td>November 2009</td>
<td>Download</td>
</tr>
<tr>
<td>AquaShield Inc.</td>
<td>Aquafilter</td>
<td>November 2009</td>
<td>Download</td>
</tr>
<tr>
<td>AquaShield Inc.</td>
<td>Aquafilter Stormwater Filtration System with Pellet Media</td>
<td>March 2017</td>
<td>Download</td>
</tr>
<tr>
<td>BaySaver Technologies, LLC</td>
<td>BaySaver Filter Enhance Media Cartridge</td>
<td>November 2018</td>
<td>Download</td>
</tr>
<tr>
<td>DoClean Environmental Services</td>
<td>Krieran Membrane Filtration System</td>
<td>April 2018</td>
<td>Download</td>
</tr>
</tbody>
</table>
Ever heard of TARP? Well, it is no longer applicable to NJDEP.

The Technology Acceptance Reciprocity Partnership

Protocol for

Stormwater Best Management Practice Demonstrations

Endorsed by California, Massachusetts, Maryland, New Jersey, Pennsylvania, and Virginia

Final Protocol 8/01
Updated: 7/03

Original NJDEP Certification Process

- NJCAT Lab Verification, no standard protocol
- NJDEP Issued “Conditional Interim Certification”
- TARP Tier II Field Test
- NJCAT Field Verification Report
- NJDEP Final Certification

There was no TARP Tier I
New Jersey Lab Testing Protocols for HDSs and Filters

New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device

January 25, 2013

http://www.njstormwater.org/treatment.html
Stormwater Manufactured Treatment Device Protocols and Guidance Documents

- NJDEP MTD Process - January 25, 2013, pdf, 70kb
- NJCAT MTD Process - January 25, 2013, pdf, 182 kb
- HDS Protocol - January 25, 2013, pdf 350 kb
- Filter Protocol - January 25, 2013, pdf, 290kb
- Funding of MTDs by the New Jersey Environmental Infrastructure Financing Program, pdf 112kb
- Transition for Manufactured Treatment Devices July 15, 2011, pdf, 25kb
- Interim Process for Certification of Manufactured Treatment Devices - Posted 4/23/09, pdf 72kb

http://www.njstormwater.org/mtd_guidance.htm
Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology

For use in accordance with the Stormwater Management Rules, N.J.A.C. 7:8

January 25, 2013
Vendor Submits Application to NJCAT Exec. Dir.

NJCAT Exec. Dir. Approves Application

Vendor Prepares QAPP

NJCAT Exec. Dir. Approves QAPP

1. 30 Day Public Comment Period for Verification if seeking NJDEP Certification. Posted on NJCAT Website

Laboratory Testing

Vendor + NJCAT Exec. Dir. prepares Verification Report

Resolve Any Public Comments

2. NJCAT Verification + NJDEP Certification Process

Final Verification Report Posted on NJCAT Website

Submit Verification Report + Maintenance Manual to NJDEP

Verifications ineligible for NJDEP Certification posted on NJCAT website, no Public Comment Period

NJDEP Certification Letter Posted

3. All Comments Resolved

NJCAT Board
NJDEP Limits:  
HDSs to 50% annual TSS  
Filters to 80% annual TSS  
Regardless of whether the NJCAT Verification is for a greater annual TSS removal efficiency percentage.
If following NJDEP as a model for local approval...

Require only NJCAT Verification?

Then which Verification?
- 2013 Lab + MTDs Ineligible for Certification
- CIC Lab (Certifications expired)
- NJDEP 2009 Field (Certifications expired)
- TARP Tier II Field (Certifications expired)

OR...

Require NJDEP Certification per 2013 Protocol?

“Level Playing Field”, all hold Final Certification
Consider 4 fundamental aspects of the NJDEP/NJCAT MTD Process

1. NJDEP Certification is specific to New Jersey stormwater rules. An MTD must hold NJDEP Certification in order to be specified in New Jersey.

2. NJDEP Certification does not necessarily carry a higher level of technical scrutiny beyond that of an NJCAT Verification. However, NJDEP reviews maintenance manuals, NJCAT does not. NJDEP Certifications includes Maintenance Manual as part of Cert. Letter.

3. Not all NJCAT Verifications for an MTD are eligible for NJDEP Certification when there is a deviation from the protocol. This has significant ramifications for MTD sizing outside of NJ.

4. An NJCAT Verification can be issued for an MTD technology that is not recognized by NJDEP to be eligible for Certification. This has significant ramifications for MTD technology approval outside of NJ.
Let's look closer at NJCAT/NJDEP Aspects #3 & #4

**#3: Deviation from Protocol - Sizing**: An MTD test follows the protocol but uses a coarser PSD. An NJCAT Verification could still be obtained but that test would **not be eligible** for NJDEP Certification since the test purposefully deviated from the protocol to obtain a more favorable performance result. If an agency outside of NJ accepts NJCAT verifications only, then this test would allow for MTD sizing to be more favorable (smaller MTD) compared to those MTDs that tested to the protocol using the finer specified PSD (larger MTD). **Could this lead to undersizing?**

**#4: Ineligible Technology for Certification**: The NJCAT Application will identify whether an MTD technology is accepted by NJDEP, and whether the proposed MTD test will be eligible for NJDEP Certification. For example, NJDEP considers underground infiltration structures (inclusive of fabric) not to be filtration MTDs and not eligible for Certification. However, NJCAT can issue a Verification for that technology as a pretreatment device but not NJDEP eligible. Agencies outside of New Jersey can then make their determination whether (a) that technology is an MTD, or (b) to allow the Verification (and sizing) for pretreatment and/or filtration.
“TAPE” is Ecology’s process for approving emerging & proprietary technologies (MTDs)

Current TAPE is August 2011, Revised Version in progress

How hard could it be to get some field samples?
Well, 73 pages worth.
Select WDOE/TAPE slides taken from presentation at Washington State Municipal Stormwater Conference, May 17, 2017, Carla Milesi, WSC
Emerging stormwater treatment technologies (TAPE)

Stormwater treatment technologies are reviewed and certified by the Washington state Technology Assessment Protocol - Ecology — better known as the TAPE program.

Submitting treatment technologies for review

Vendors, designers, and manufacturers who wish to have their treatment technologies reviewed should follow these three steps:

1. Follow the TAPE process

Refer to the TAPE process overview for everything you need to know about how we evaluate your technology.

2. Prepare your technology
2. Prepare your technology

Refer to the [2011 TAPE guidance manual](#) as you prepare your technology for review and certification.

3. Send in your application

The [application form](#) and fee must be submitted both as a hard copy and digitally to:

TAPE Program  
Washington State Department of Ecology  
Cashiering  
PO Box 47611  
Olympia, WA 98504-7696

Email: [douglas.howie@ecy.wa.gov](mailto:douglas.howie@ecy.wa.gov)

We also review chemical technologies

We also accept applications to the Chemical Technology Assessment Protocol – Ecology (C-TAPE) program. See the [construction site chemical technology guidance](#) for more information.
Approved technologies

The following table lists the devices that have received a designation through the TAPE process.

In addition to our certification, local jurisdiction approval is required (and not guaranteed) for installation of treatment technologies we have evaluated and given a use designation.

<table>
<thead>
<tr>
<th>Manufacturers</th>
<th>Device Name</th>
<th>Treatment Type</th>
<th>Use Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AquaShield, Inc.</td>
<td>Aqua-Filter System, Aqua-Blend C Filter Media</td>
<td>Basic Treatment</td>
<td>Pilot Level</td>
</tr>
<tr>
<td>AquaShield, Inc.</td>
<td>Aqua-Filter System, Coarse Perlite Filter Media</td>
<td>Basic Treatment</td>
<td>Cond Level</td>
</tr>
<tr>
<td>BaySaver Technologies, Inc.</td>
<td>BayFilter w/ BFC Media</td>
<td>Basic Treatment</td>
<td>Gene Level</td>
</tr>
<tr>
<td>BaySaver Technologies, Inc.</td>
<td>BayFilter w/EMC Media</td>
<td>Basic Treatment</td>
<td>Gene Level</td>
</tr>
<tr>
<td>BaySaver Technologies, Inc.</td>
<td>BayFilter w/GAC Media</td>
<td>Basic Treatment</td>
<td>Pilot Level</td>
</tr>
</tbody>
</table>
April 2017

GENERAL USE LEVEL DESIGNATION FOR PRETREATMENT

For
Aquashield™, Inc.’s Aqua-Swirl® Stormwater Treatment System

Ecology’s Decision:

Based on Aquashield™, Inc. application submissions, Ecology hereby issues the following use level designations:

1. General Use Level Designation (GULD) for the Aqua-Swirl® for pretreatment use (a) ahead of infiltration treatment, or (b) to protect and extend the maintenance cycle of a Basic or Enhanced Treatment device (e.g., sand or media filter)

2. The following table shows flow rates associated with various Aqua-Swirl models

<table>
<thead>
<tr>
<th>Model</th>
<th>Diameter (ft)</th>
<th>WQF (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS-2</td>
<td>2.5</td>
<td>0.25</td>
</tr>
<tr>
<td>AS-3</td>
<td>3.5</td>
<td>0.64</td>
</tr>
<tr>
<td>AS-4</td>
<td>4.5</td>
<td>1.31</td>
</tr>
<tr>
<td>AS-5</td>
<td>5</td>
<td>1.78</td>
</tr>
<tr>
<td>AS-6</td>
<td>6</td>
<td>2.98</td>
</tr>
<tr>
<td>AS-7</td>
<td>7</td>
<td>4.63</td>
</tr>
<tr>
<td>AS-8</td>
<td>8</td>
<td>6.78</td>
</tr>
<tr>
<td>AS-9</td>
<td>9</td>
<td>9.48</td>
</tr>
<tr>
<td>AS-10</td>
<td>10</td>
<td>12.80</td>
</tr>
<tr>
<td>AS-11</td>
<td>11</td>
<td>16.79</td>
</tr>
<tr>
<td>AS-12</td>
<td>12</td>
<td>21.52</td>
</tr>
<tr>
<td>AS-13</td>
<td>13</td>
<td>27.03</td>
</tr>
</tbody>
</table>
# TAPE Use Level Designations

<table>
<thead>
<tr>
<th>Use Level Designation</th>
<th>Minimum Data</th>
<th>Months (justified extensions allowed)</th>
<th>Max. # of Installations in WA</th>
<th>Field Testing Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot (PULD)</td>
<td>Lab data</td>
<td>30</td>
<td>5, Unlimited for Retrofits</td>
<td>All installation sites to be monitored. At least 1 indicative of or in Pacific NW</td>
</tr>
<tr>
<td>Conditional (CULD)</td>
<td>Field data, lab data may supplement</td>
<td>30</td>
<td>10, Unlimited for Retrofits</td>
<td>1 site indicative of or in Pacific NW</td>
</tr>
<tr>
<td>General (GULD)</td>
<td>Field data, lab data may supplement</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>None</td>
</tr>
</tbody>
</table>
Requirements for New/Redevelopment

- Treatment Facilities
  - Pretreatment (Total Suspended Solids)
  - Basic (Total Suspended Solids)
  - Enhanced (Dissolved Copper and Zinc)
  - Phosphorus (Total Phosphorus)
  - Oil (motor oil fraction of Total Petroleum Hydrocarbons)
TAPE Approval Timeline

~ 3 years, $250K

2. Receive P/CULD
3. Find Potential Field Site
   - Pick Site
   - Evaluate Site
4. Prepare QAPP
5. QAPP Approved
6. Field Evaluation
7. Prepare TER
8. Receive GULD
# TAPE Performance Goals (per event)

<table>
<thead>
<tr>
<th>Performance Goal</th>
<th>Influent Range</th>
<th>Criteria</th>
<th>Required Water Quality Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic Treatment</strong></td>
<td>20-100 mg/L TSS</td>
<td>Effluent goal ≤ 20 mg/L TSS a</td>
<td>TSS</td>
</tr>
<tr>
<td></td>
<td>100-200 mg/L TSS</td>
<td>≥ 80% TSS removal b</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 200 mg/L TSS</td>
<td>&gt; 80% TSS removal b</td>
<td></td>
</tr>
<tr>
<td><strong>Dissolved Metals Treatment</strong></td>
<td>Dissolved copper 0.005 – 0.02 mg/L</td>
<td>Must meet basic treatment goal and better than basic treatment currently defined as &gt; 30% dissolved copper removal b,d</td>
<td>TSS, hardness, total and dissolved Cu and Zn</td>
</tr>
<tr>
<td></td>
<td>Dissolved zinc 0.02 – 0.3 mg/L</td>
<td>Must meet basic treatment goal and better than basic treatment currently defined as &gt; 60% dissolved zinc removal b,d</td>
<td></td>
</tr>
<tr>
<td><strong>Phosphorus Treatment</strong></td>
<td>Total phosphorus (TP) 0.1 to 0.5 mg/L</td>
<td>Must meet basic treatment goal and exhibit ≥ 50% TP removal b</td>
<td>TSS, TP, orthophosphate</td>
</tr>
<tr>
<td><strong>Oil Treatment</strong></td>
<td>Total petroleum hydrocarbons (TPH) &gt; 10 mg/L e</td>
<td>1) No ongoing or recurring visible sheen in effluent</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) Daily average effluent TPH concentration &lt; 10 mg/L a,e</td>
<td>NWTPH-Dx, visible sheen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) Maximum effluent TPH concentration of 15 mg/L a,e for a discrete (grab) sample</td>
<td></td>
</tr>
<tr>
<td><strong>Pretreatment</strong></td>
<td>50-100 mg/L TSS</td>
<td>Effluent goal ≤ 50 mg/L TSS a</td>
<td>TSS</td>
</tr>
<tr>
<td></td>
<td>≥ 100 mg/L TSS</td>
<td>&gt; 50% TSS removal b</td>
<td></td>
</tr>
</tbody>
</table>
Both the NJDEP/NJCAT & Ecology MTD approval processes provide robust performance testing programs to serve as models to assist other state/local regulators to evaluate MTD performance claims with greater confidence.

MTD testing presents many challenges in the field and lab. Understanding the limitations of both is critical for any performance evaluation.

The NJDEP/NJCAT lab-based approach allows for side-by-side comparison of MTD performance claims.

Ecology’s field-based approach provides long term, real-world performance and functionality to support MTD performance claims based on initial laboratory testing.

NJDEP MTD certifications are specific to New Jersey to allow for MTD sales in New Jersey. Just because an MTD may hold NJCAT Verification, that verification may not be eligible for NJDEP Certification. Has significant marketplace implications outside of NJ.
It’s all about good clean water...

Tennessee River, Chattanooga
Thank you.

Mark Miller      mmiller@aquashieldinc.com
2733 Kanasita Drive, Suite 111
Chattanooga, Tennessee 37343
888-344-9044
www.AquaShieldInc.com
Permaculture and Low Impact Development (LID)

By Patrick Padden
CASFM Annual Conference
September 27, 2018

PADDEN PERMACULTURE
Ecological Landscape Design and Build
970-999-4306
Permaculture is a combination of sustainable site design, energy smart technology, edible landscaping, and innovative water management practices.
PERMACULTURE

Bill Mollison’s Permaculture One
A landscape on the wasteful path to scarcity. Rain, runoff, and topsoil are quickly drained off the landscape to the street where the sediment-laden water contributes to downstream flooding and contamination. The landscape is dependent upon municipal/well water irrigation and imported fertilizer.
A landscape on the stewardship path to abundance. Rain, runoff, leaf drop, and topsoil are harvested and utilized with the landscape contributing to flood control and enhanced water quality. The system is self-irrigating with rain and self-fertilizing with harvested organic matter.
Xeriscape Projects

Xeriscape is not one particular style or look – it's the creation of a healthy, attractive landscape that conserves water.

Xeriscape
• Provides a diversity of seasonal colors and textures
• Lowers outdoor water use 30-50 percent
• Reduces yard maintenance
Patio Projects

Perennial Polycultures
I group plants together in a way that mimics natural ecosystems, but I select species that are especially productive for humans.

Plant List
-Toka Plum
-Stanley Plum
-Golden Raspberry
-Blackberry
-Strawberry
-Lead Plant (Nitrogen Fixer)
-Comfrey (Dynamic Accumulator for soil fertility)
-Goji Berry
-Western Sand Cherry
-Black and Red Currant
-Culinary Herbs
-Alliums and Citronella for Insect repellent

Rainwater Harvesting Patios
I always design an infiltration basin around the perimeter of my patios. This feature allows runoff to passively irrigate useful plants.

Downspout Incorporation
The runoff from downspouts is often an under valued resource in conventional landscape designs, but is always integrated in a Padden Permaculture Design.
Greywater Harvesting Laundry Machine
Brad Lancaster Design
Tucson, Arizona
Edible Landscaping

Landscapes designed with permaculture in mind will often incorporate groupings of fruits and veggies, usually perennial varieties to make the most efficient use of space.
Nanking Cherry
White Mulberry
Concord Grape
Siberian Pea Shrub
Sea Berry
Storm Water Overflow Apron
Desert Four o'Clocks
Nanking Cherry
Sweet Pea
Strawberry
Collection Basin
Lavender
Fruit Tree Guild
Grow more ~ Work less

Dynamic Accumulator Herbaceous layer

Pest Deterrent

Food

Mulch/Groundcover

Nitrogen Fixer Shrub layer

Nitrogen Fixer Herbaceous layer

Pollinator/Insectary

Food

Fruit Tree

theresiliencyinstitute.net
Harvesting Street Runoff
People’s Food Co-op
Portland, Oregon
Permaculture is a global movement that is providing solutions to many of the world’s social and ecological challenges.
Permaculture Design Certificate (PDC)

July 20—Aug. 1, 2019
Sunrise Ranch, Colorado

11 day permaculture course

- permaculture design process

- rainwater harvesting and earthworks

- natural building and appropriate technology

- regenerative tools and techniques

- permaculture gardening and food forestry

- animals, soils, compost
grow food, 
not lawns.
Comprehensive Watershed Planning: Prioritize, Target and Implement Multipurpose Projects
Introduction

- **PART 1**
  - What is 1W1P?
  - How it came to be
  - Planning funding
  - Operation of plan
  - Implementation funding

- **PART 2**
  - Case study
PART ONE – 1W1P OVERVIEW
What is 1W1P?

- Aligns local water planning towards watershed-based implementation
- 63 HUC8 (~700 mi²)
- Comprehensive
- Formal agreements
- No new governing agency
CASFM | One Watershed, One Plan

Actions

Targeted

Strategies

Issues

Values

- Assemblage of all locally-relevant plans, programs and studies
- Statement of existing watershed status
- Unified agreement on priority values
- Vision of long-term management goals by value
- Selection of 10-year management targets
- Identification of implementation actions
- Prioritization of actions based on ability to meet multiple goals
- Prioritized, targeted and measurable goals
What is 1W1P?

Part of MN’s 10-yr management cycle

1. Monitoring
2. Issues and stressors
3. WRAPS
4. 1W1P
5. Voluntary implementation
How it came to be

LGWR 2011

Pilot Watersheds 2014

Statewide 2025

Legislation 2012

Program Adoption 2016
Planning funding

Nov 2008 voters approved CWF to:

- Protect drinking water sources
- Protect, enhance, and restore lakes, rivers, streams, and groundwater
- Protect, enhance, and restore wetlands, prairies, forests, and fish, game, and wildlife habitat
- Support parks and trails
- Preserve arts and cultural heritage
## Operation of plan development

<table>
<thead>
<tr>
<th>Planning Groups</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy Committee</strong></td>
<td>Local plan authorities purposed with making final decisions about plan content and regarding expenditure of planning funds. Final owner and operator.</td>
</tr>
<tr>
<td><strong>Advisory Committee</strong></td>
<td>Various local, State, Federal, Tribal and NGO technical members. Makes recommendations on plan content and implementation to the Policy Committee.</td>
</tr>
<tr>
<td><strong>Work Planning Group / Steering Committee</strong></td>
<td>A small group of local staff, BWSR Board Conservationist, and consultants for the purposes of logistical and process decision-making in the plan development process.</td>
</tr>
</tbody>
</table>
Plan partners

- Municipalities/Townships
- Counties
- Soil and Waters Conservation Districts
- Watershed Districts
- Flood Management Authorities
- State BWSR, DNR, DOT, DOH, etc.
- USFS, USACE, USFWS
- Tribal Government
- NGOs and Public

Required
Voluntary
Planning process

1. Formal agreements, initiation
2. Assemble/review existing plans and studies
3. Establish planning zones (=/< 3)
4. Prioritize issues
5. Assemble implementation programs and procedures
6. Develop implementation plan
7. Establish measurable goals
8. Prioritize resources
9. Internal review
10. External review
11. Approval
12. Adopt plan
13. Implement, evaluate, update
Plan content

- Executive summary
- Land and Water narrative
- Priority resources and issues
- Measurable goals
- Targeted implementation schedule
- Plan implementation programs
- Plan administration and coordination
## Operation of plan implementation

<table>
<thead>
<tr>
<th>Type of Governance Agreement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memorandum of Agreement (MOA)</td>
<td>An agreement between multiple parties; method of formally recognizing a partnership; specifies mutually-accepted expectations and guidelines</td>
</tr>
<tr>
<td>Joint Powers Agreement (JPA)</td>
<td>Agreement to jointly deliver a service or a product</td>
</tr>
<tr>
<td>Joint Powers Board (JPB)</td>
<td>Type of JPA that specifically establishes a new entity or board that operates autonomously from the members. Risk is transferred to this entity.</td>
</tr>
<tr>
<td>Watershed District (WD)</td>
<td>Formal local unit of government, defined by hydrologic boundary and formed by a local petition process</td>
</tr>
</tbody>
</table>
Implementation funding

- Watershed-based funding
  - $4,875,000 Y1
  - $4,875,000 Y2
  - 10% non-State match (cash or in-kind)
- Eligible activities
PART TWO – CASE STUDY
Case study – Leech Lake River 1W1P

- 1,335 mi²
- 3 counties
- Leech Lake Bank of Ojibwe
- 277 river miles
- 750 lakes (166,374 acres)
- Northern Lakes and Forest Ecoregion
- Largely forested
- 46% privately held land
- Some of most pristine lands in MN
## Case study – Leech lake River 1W1P

<table>
<thead>
<tr>
<th>Planning Groups</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy Committee</td>
<td>Cass Environmental Services Dept, Cass SWCD, Hubbard County, Hubbard SWCD</td>
</tr>
<tr>
<td>Advisory Committee</td>
<td>Cities, Chamber of Commerce, Counties, The Nature Conservancy, USACE, MNDNR, USFS</td>
</tr>
<tr>
<td>Work Planning Group / Steering Committee</td>
<td>Cass and Hubbard SWCD Administrators, BWSR BC, Leech Lake Band of Ojibwe, Leech Lake Area Watershed Foundation, Consultants</td>
</tr>
</tbody>
</table>
Case study – Leech Lake River 1W1P

Natural Resources
Case study – Leech Lake River 1W1P

Climate and Risk

Climate-change
Case study – Leech Lake River 1W1P

Leadership

counties-townships-Tribe-associations

Local

Laws-regulations

Care-concern

Prioritize

Monitor-Assess

state-federal

People-Age

Leadership

Volunteers

Irrigation

Investive-species

Education

Progress

Sustainability

BMP

Wetland

Broaden

Water

Pipeline

Groundwater

Plan Commitment

Funding

Buffers

Preserve/Protect

Enforced

Improving

Knowledge

Irrigation

Involvement

CASFM | One Watershed, One Plan
Case study – Leech Lake River 1W1P

Quality of Life
Case study – Leech Lake River 1W1P

1. High Quality Lakes
2. Recreational Lakes
3. Impoundments
4. Impaired Lakes
5. High Value/Priority Rivers and Streams
6. Declining, Impaired and Channelized Rivers and Streams
7. Wetlands
8. Groundwater
9. Upland Resources – Forests
10. Upland Resources – Habitat
11. Upland Resources - Working lands
12. Upland Resources - Cities and towns
Case study – Leech Lake River 1W1P

PRIORITY NATURAL WORLD VALUES AND THE 10-YEAR PLAN GOAL ATTAINMENT LEVEL

Goal Attainment Level

<table>
<thead>
<tr>
<th>Category</th>
<th>Maintain</th>
<th>Improve</th>
<th>Enhance</th>
<th>Protect</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Quality Lakes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreational Lakes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impoundments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impaired lakes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Value Rivers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impaired/Declining Rivers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetlands</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forests</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habitat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working lands</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cities and towns</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Case study – Leech Lake River 1W1P

Level 1
- Metric scoring

Level 2
- Natural Values Ranking

Level 3
- Aggregate Ranking
# Case study – Leech Lake River 1W1P

<table>
<thead>
<tr>
<th>HIGH QUALITY LAKES METRICS</th>
<th>SCORING</th>
<th>DATA SETS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coldwater Habitat Presence</td>
<td>Yes = 1, No = 0.01</td>
<td>WRAPS</td>
</tr>
<tr>
<td>P-Sensitivity Lake Presence</td>
<td>0.33, 0.66 and 1.0; high, higher highest</td>
<td>State 2108 data</td>
</tr>
<tr>
<td>WQ Trend</td>
<td>Close to threshold = 1</td>
<td>State 2017 data</td>
</tr>
<tr>
<td></td>
<td>Declining trend = 0.66</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No data = 0.33; rising = 0.01</td>
<td></td>
</tr>
<tr>
<td>Forest</td>
<td>Composite score above mean = 1 (X=99.08; range = 15 – 175)</td>
<td>Forests of the Future data</td>
</tr>
<tr>
<td>Terrestrial Biodiversity</td>
<td>Yes = 1, No = 0.01</td>
<td>State MCBS Biodiversity data</td>
</tr>
<tr>
<td>WRAPS Priority Lake</td>
<td>Yes = 1, No = 0.01</td>
<td>WRAPS</td>
</tr>
<tr>
<td>Lakes of Biological Significance</td>
<td>Outstanding =1 High = 0.66 Moderate = 0.33</td>
<td>WRAPS</td>
</tr>
<tr>
<td>Wild Rice Lake</td>
<td>High = 1 (local = high and/or DNR List = high) High = 0.66 Moderate = 0.33 No data or zero value = 0.01</td>
<td>State Top 350 lakes and Local Preference data</td>
</tr>
</tbody>
</table>
Case study – Leech Lake River 1W1P
Case study – Leech Lake River 1W1P
Case study – Leech Lake River 1W1P
Case study – Leech Lake River 1W1P

- Cities and Townships: 100%
- Forests: 50%
- Groundwater: 60%
- Impaired/Channelized Rivers: 5%
- High Value/Priority Rivers: 50%
- Impaired Lakes: 10%
- Recreational Lakes: 20%
- High Quality Lakes: 20%
## Case study – Leech ake River 1W1P

<table>
<thead>
<tr>
<th>Resource</th>
<th>Management Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cities and Townships</strong></td>
<td>1. Urban stormwater management for City of Laporte (particular attention to highway runoff)</td>
</tr>
<tr>
<td></td>
<td>2. Update stormwater management.</td>
</tr>
<tr>
<td></td>
<td>3. Stormwater management plan for future development including land development and Stormwater ordinance updates.</td>
</tr>
<tr>
<td><strong>Groundwater</strong></td>
<td>1. Update ground water plan with Geologic Atlas and shallow well data.</td>
</tr>
<tr>
<td></td>
<td>2. Targeted well-monitoring.</td>
</tr>
<tr>
<td></td>
<td>3. SSTS Management (inventory, functional assessment) for Garfield Lake</td>
</tr>
<tr>
<td><strong>Forests and Working Lands</strong></td>
<td>1. Conservation easements and forestry management incentives on private lands (riparian and non-riparian) in Garfield and Kabekona lakesheds.</td>
</tr>
<tr>
<td><strong>Kabekona River</strong></td>
<td>1. SSTS Management (inventory, functional assessment, regulatory)</td>
</tr>
<tr>
<td></td>
<td>2. River corridor regulation</td>
</tr>
<tr>
<td></td>
<td>3. Wild Rice easements</td>
</tr>
<tr>
<td></td>
<td>4. Riparian easements and acquisitions</td>
</tr>
<tr>
<td></td>
<td>5. Riparian conservation and stewardship</td>
</tr>
<tr>
<td></td>
<td>6. Stormwater water quality and temperature stormwater BMPs</td>
</tr>
<tr>
<td></td>
<td>7. Culvert hydraulic, hydrologic, sediment transport and fish barrier inventory and assessment priority.</td>
</tr>
<tr>
<td></td>
<td>8. Pasture management.</td>
</tr>
</tbody>
</table>
COLORADO WATER PLAN
“Productive economy, vibrant and sustainable cities, productive agriculture, strong environment, robust recreational industry”

Social, Economic and Environmental Values for Vision to shape mission of plan.
MANAGEMENT GROUPS
• Federal Agencies
  • USACE
  • USFS
  • USFWS
  • NRCS
• State of Colorado
  • CO Water Cons. Board
  • CO Watershed Assembly
  • DNR
  • DOT
  • DOA
• Local drainage authorities
  • Urban Drainage and Flood Control District
• Counties
• Conservation Districts
• Municipalities/Townships
• NGO’s
  • The Greenway Foundation
  • Trout Unlimited

EXAMPLE PLANS
• Colorado Water Plan
• Statewide Water Supply Initiative
• Basin Improvement Plans
• Stream Management Plans
• Watershed Protection Plans
• …several others
LOCAL POLICY COMMITTEE & PLAN OWNER/OPERATOR

- Urban Drainage and Flood Control District
- Conservation Districts
- Colorado Watershed Assembly

STEERING COMMITTEE

- The Greenway Foundation
- USACE
- USFS
- USFWS
- NRCS
- DNR
- Co Water Cons. Board.
- DOT
- DOA
- Municipalities/Townships
- Trout Unlimited
Actions

Targeted Strategies

Issues

Values

- Colorado Water Plan
- Basin Improvement Plans
- Stream Management Plans
- Watershed Protection Plans
- Statewide Water Supply Initiative
- Local drainage authorities (e.g., Urban Drainage and Flood Control District, Denver area)
- Federal Agencies
- NGO/Special interest Groups
  - Greenway Foundation
  - Trout Unlimited
Values

- Social
- Economic
- Environment

Quality of life, way of life
- Hunting, fishing, recreation
- Water supply
- Etc.
Values

Social

Economic

Environment

Vibrant sustainable cities

Sustainable agriculture

Conservation development

Flood risk mgmt

Etc.
Values

- Social
- Economic
- Environment

- Water quality
- Habitat
- Etc.
• Synthesis of existing information.
• Based on right project, right location, right costs

Prioritized, targeted and measurable local 10-yr implementation plan
Contact Information

Shawn Tracy, Water Resource Project Manager
651.659.7747
stracy@hrgreen.com

One Watershed, One Plan
http://www.bwsr.state.mn.us/planning/1W1P/index.html
Outline

- Background
- Goals
- Approach
- Database and Web Application
- Takeaways
Problems
Project Goals

- GIS-based web application for CIP planning
- Existing infrastructure gaps
- CIP prioritization and budgeting tool
- Create a Stormwater Channel Assessment Program framework
- BMP tracking system
Colorado Springs Utilities
Operations & Maintenance
Development Review
Fountain Creek Watershed Flood Control & Greenway District
CIP Delivery
Parks & Open Space
GIS and IT
Benchmarking

- City of Aurora
- City & County of Denver
- Urban Drainage & Flood Control District

- Project Definitions
- Sub-Projects
- Prioritization
- Querying
- Cut Sheets
- Work Flow
- Cost Index
- Editability
- Accessibility
Over 258 mi of open channel
- 37 major drainage basins
- 63 mi improved/195 unimproved
- 1,260 grade control structures
- 800+ existing BMPs

GIS data
- Tablet data collection
- Geolocated photos
Parameters collected

- Location - GPS
- Improvement type
- Condition
  - Tier 1
  - Tier 2
- Height
- Vegetation
Tier 1 – Infrastructure Condition
- Health/safety/flooding
- Channel stability
- Utility risks
- Road/bridge/structure risk
- Criteria – headcuts, unstable banks, severe floodplain disconnect, undermined drop structures

Tier 2 – Corridor Function
- Recreation
- Habitat/riparian function
- Aesthetics
- Criteria – geomorphic floodplain connection, vegetation quality and connection, bedrock
Field Assessment

Tier 1 – Infrastructure Condition: Examples

Good (green) – healthy stream corridor; sustainable [35%/67%]

Fair (yellow) – some instability but no adjacent risks; at risk in large flood; maintenance [50%/28%]

Poor (orange) – instability with adjacent risks; could need a CIP [10%/4%]

Critical (red) – needs immediate attention; imminent risk [<5%/<1%]
Tier 2 – Corridor Value: Examples

Good (green) – healthy stream corridor; high aesthetic and habitat value [30%/48%]

Fair (yellow) – some impaired habitat but mostly functioning [45%/35%]

Poor (orange) – disconnected floodplain, sparse vegetation [20%/16%]

Critical (red) – minimal habitat value [<5%/<1%]
Examples

📈 Tier 1 – Good
📈 Tier 2 - Poor
Data Collection - Documents

- Over 400 documents
  - Plans/Reports
  - IGA Projects
  - Needs Assessment
  - Databases
  - Spreadsheets
  - Hand written notes
  - Individual staff knowledge

- GIS data

---

Jimmy Camp Creek
Drainage Basin Planning Study
Development of Alternatives & Design of Selected Plan Report

March 9, 2015
Over 462 Potential Projects

- 326 Channel projects
- 55 Detention projects
- 81 Storm drain projects
## PROJECT ORGANIZATION: INVENTORY SPREADSHEET

<table>
<thead>
<tr>
<th>No.</th>
<th>ID</th>
<th>Improvement Name</th>
<th>Location (Street Names)</th>
<th>Drainageway</th>
<th>Category</th>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Cost Subtotal</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-0</td>
<td>Sand Creek DBPS - Detention Basin Cost Estimate</td>
<td>Sand Creek Basins</td>
<td>-</td>
<td>0 - Project summary</td>
<td>-</td>
<td>-</td>
<td>LS</td>
<td>1</td>
<td>$$$</td>
<td>Constructed</td>
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<tr>
<td>1</td>
<td>1-1</td>
<td>SC-C6 - Sand Creek DBPS</td>
<td>Lower Sand Creek</td>
<td>Sand Creek</td>
<td>X - Channel - Grade Control</td>
<td>Grade control</td>
<td>EA</td>
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<td>$27,000</td>
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<td>SC-C6 - Sand Creek DBPS</td>
<td>Lower Sand Creek</td>
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<td>X - Channel - Lining</td>
<td>Selective riprap lining</td>
<td>LF</td>
<td>350</td>
<td>$127</td>
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<td>EFSC-C8 - Sand Creek DBPS</td>
<td>East Fork Sand Creek Tributaries</td>
<td>East Fork Sand Creek</td>
<td>X - Channel - Lining</td>
<td>Selective riprap lining</td>
<td>LF</td>
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<td>$85</td>
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<td>EFSC-D1 - Sand Creek DBPS</td>
<td>Constitution Ave and East Fork Sand Creek</td>
<td>East Fork Sand Creek</td>
<td>X - Detention</td>
<td>Public regional 100-year detention with water quality (278 AF)</td>
<td>AC-FT</td>
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<td>$10,000</td>
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<tr>
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<td>EFSC-D1 - Sand Creek DBPS</td>
<td>Constitution Ave and East Fork Sand Creek</td>
<td>East Fork Sand Creek</td>
<td>X - Detention</td>
<td>Land acquisition</td>
<td>AC</td>
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<td>$15,900</td>
<td>$427,710</td>
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<tr>
<td>1</td>
<td>1-6</td>
<td>EBSC-B160 - Sand Creek DBPS - Roadway Culvert Crossing Cost Estimate</td>
<td>Bridlespur Road</td>
<td>East Bierstadt Creek</td>
<td>X - Culvert</td>
<td>2.8'Hx10'W CBC</td>
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<td>EBSC-B47A - Sand Creek DBPS - East Fork Sand Creek Bridge Crossing Cost Estimate</td>
<td>Unnamed Roadway</td>
<td>East Bierstadt Creek</td>
<td>X - Bridge / Full span</td>
<td>2.10'Hx14'W CBC</td>
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<td>$312,500</td>
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</tr>
</tbody>
</table>

**Legend:**

- **Summary of costs by document.**
- **Project Improvements identified in the reviewed document.**
- **Steps in inventory spreadsheet to define project organization.**
Prioritization

Planning

- Drainage Basin Planning Studies
- Existing Infrastructure Needs Assessment

Condition

Capacity
## Planning Prioritization

<table>
<thead>
<tr>
<th>Drainage Basin</th>
<th>DBPS Published Date</th>
<th>Age of DBPS</th>
<th>Design Standard</th>
<th>Degree of Future Development</th>
<th>Existing Regional Detention</th>
<th>Future Regional Detention</th>
<th>Potential Natural Stream Preservation/Restoration Opportunities</th>
<th>Closed Basin</th>
<th>City-Input</th>
<th>Weighted Score</th>
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</thead>
<tbody>
<tr>
<td>Black Canyon</td>
<td>2/1/1980</td>
<td>1</td>
<td>3</td>
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<td>3</td>
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<tr>
<td>Black Squirrel Creek</td>
<td>1/1/1989</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
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<tr>
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<td>3/1/1981</td>
<td>1</td>
<td>4</td>
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<td>3</td>
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<tr>
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<td>4</td>
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<td>3</td>
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<td>Mesa</td>
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<td>57</td>
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<tr>
<td>Sand Creek (including Upper Sand Creek)</td>
<td>3/1/1996</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>0</td>
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<td>1</td>
<td>57</td>
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<tr>
<td>Camp Creek</td>
<td>10/1/1964</td>
<td>0</td>
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<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>56</td>
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<tr>
<td>Westside</td>
<td>10/1/1975</td>
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<td>4</td>
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<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>55</td>
</tr>
<tr>
<td>Peterson Field (Sand Creek)</td>
<td>8/1/1984</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>55</td>
</tr>
</tbody>
</table>

| Score Range          | -                   | 0-3         | 0-4             | 0-3                         | 0-3                         | 0-3                       | 0-1                           | 0-1          | 0-5         | 0-100          |
| Scaling Multiplier   | -                   | 5           | 5               | 12                          | 1                           | 1                         | 10                            | 6            | 5           | 0-100          |

<table>
<thead>
<tr>
<th>Basin</th>
<th>DBPS Date</th>
<th>Age</th>
<th>Design</th>
<th>Degree Future</th>
<th>Existing Regional</th>
<th>Future Regional</th>
<th>Potential Natural Stream Preservation/Restoration Opportunities</th>
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<td>1</td>
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<td>1</td>
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<tr>
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<td>3/1/1981</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>57</td>
</tr>
<tr>
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<td>3/1/1986</td>
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<td>1</td>
<td>1</td>
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</tr>
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<td>1</td>
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<td>3</td>
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<td>1</td>
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<td>1</td>
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<td>1</td>
<td>1</td>
<td>55</td>
</tr>
</tbody>
</table>
Project Prioritization

**DCM Principles**
- Regional implications
- Infrastructure integration
- Land allocation
- Runoff mitigation
- Multi-purpose
- Natural systems
- Downstream impacts
- Maintenance
- Flood hazard
- Legal/permit obligations

**Technical criteria**
- Channels
- Detention
- Storm drains

**Decision Matrix**
## Technical Criteria - Channels

<table>
<thead>
<tr>
<th>Channel Technical Criteria</th>
<th>DCM Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1 Score (Infrastructure condition)</td>
<td>Downstream Impacts</td>
</tr>
<tr>
<td></td>
<td>Maintenance</td>
</tr>
<tr>
<td></td>
<td>Flood Hazard</td>
</tr>
<tr>
<td>Tier 2 Score (Corridor function)</td>
<td>Multi-Purpose</td>
</tr>
<tr>
<td></td>
<td>Preservation</td>
</tr>
<tr>
<td>Bank Risk</td>
<td>Infrastructure Integration</td>
</tr>
<tr>
<td></td>
<td>Downstream Impacts</td>
</tr>
<tr>
<td></td>
<td>Maintenance</td>
</tr>
<tr>
<td>Bank Height</td>
<td></td>
</tr>
<tr>
<td>Improvement type (if any)</td>
<td></td>
</tr>
<tr>
<td>K-Factor score (susceptibility to erosion)</td>
<td></td>
</tr>
<tr>
<td>303(d) impairments</td>
<td>Downstream Impacts</td>
</tr>
<tr>
<td></td>
<td>Legal/Permit</td>
</tr>
<tr>
<td>Adjacent utilities, institutions, and facilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Infrastructure Integration</td>
</tr>
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</table>
## Technical Criteria - Detention

<table>
<thead>
<tr>
<th>Detention Technical Criteria</th>
<th>DCM Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location in watershed</td>
<td>Runoff Mitigation</td>
</tr>
<tr>
<td></td>
<td>Downstream Impacts</td>
</tr>
<tr>
<td></td>
<td>Flood Hazard</td>
</tr>
<tr>
<td>Closed basins &amp; Parcel ownership</td>
<td>Land Allocation</td>
</tr>
<tr>
<td>Proposed detention pond volume</td>
<td>Runoff Mitigation</td>
</tr>
<tr>
<td></td>
<td>Downstream Impacts</td>
</tr>
<tr>
<td></td>
<td>Flood Hazard</td>
</tr>
<tr>
<td>Underlying Hydrologic Soil Group</td>
<td>Preservation</td>
</tr>
<tr>
<td></td>
<td>Natural Systems</td>
</tr>
<tr>
<td>Maximizing BMP treatment area within the City</td>
<td>Preservation</td>
</tr>
<tr>
<td></td>
<td>Multi-Purpose</td>
</tr>
<tr>
<td></td>
<td>Downstream Impacts</td>
</tr>
<tr>
<td>Provide protection for people as permanent and recreational users?</td>
<td>Protect or improve habitat, water quality, and geomorphology?</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Infrastructure Integration, Flood Mitigation, Flood Hazard, Downstream Impacts, Multi-Purpose</td>
<td>Preservation</td>
</tr>
<tr>
<td>Permanent user protection? Applicable justifications: Neighborhood access Heavily traveled road Other (specify)</td>
<td>Recreational user protection? Applicable justifications: Trail users Golf course users Other (specify)</td>
</tr>
</tbody>
</table>
### Decision Matrix

<table>
<thead>
<tr>
<th>Create infrastructure investments that are high value and reasonable to construct?</th>
<th>Improve downstream conditions?</th>
<th>Serve a large population?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrastructure Integration, Land Allocation, Maintenance</strong></td>
<td><strong>Downstream Impacts, Flood Hazard</strong></td>
<td><strong>Regional Implications</strong></td>
</tr>
</tbody>
</table>
| Applicable justifications:  
  Low maintenance needs  
  Low cost, high return  
  Moderate to high cost, but foundational  
  Closed basin  
  Land acquisition  
  Other (specify) | Applicable justifications:  
  Improves downstream channel  
  Reduces downstream flooding  
  Other (specify) | Applicable justifications:  
  Improves downstream channel  
  Reduces downstream flooding  
  Other (specify) |

**Technical Score**

**Decision Score**

Priority Rank
Web Application

Colorado Springs Stormwater Infrastructure Master Plan
Evolution is painful
Deferred maintenance is not the sum of its parts
Leverage existing data
Listen to users
Communicate
Special Thanks

City Project Manager – Tim Biolchini
Engineering Stormwater Division Manager – Richard Mulledy
Stormwater Capital Programs Manager – Brian Kelley
Strategic Planning for Green Infrastructure in Boulder

Candice Owen, P.E.

September 27, 2018
Overview

• Background
• Project Components
  – Stakeholder Group
  – Process and Policy
  – Prioritization and Pilots
• Next Steps
Shifting Paradigms.. The GI Way of Thinking

Gray infrastructure:
- Use basins, pipes & ditches to remove pollutants from stormwater where it collects

Green infrastructure:
- Use soil and vegetation to manage rainwater close to where it falls

Source: Tompkins County NY (Bioswale)
Shifting Paradigms..
The GI Way of Thinking

Soil & Vegetation are now Infrastructure

At the pre-design stage: LID Opportunities

During design & construction: BMP Design Elements

After construction: BMP Maintenance Elements
Background: Stormwater in Boulder

- Boulder is mostly infill on marginally draining urban soils
- Many sites are dense and space is very valuable
- Approval process for changing criteria is challenging
- New MS4 permit requirements posed challenges
How do we do this in Boulder?

• What are we required to do?
  – *MS4 permit requirements*

• What can we do?
  – *Understand ability to infiltrate*

• What should we do?
  – *Set by stakeholder group*
Project Goals

• MS4 Permit Compliance
• Build a Green Infrastructure Program that promotes GI on both Private and Public Projects
Project Design

Internal Stakeholder Process
Support decisions made throughout the project and provide critical feedback through 5 meetings

GI Process & Policy
MS4 Permit Compliance and inclusion of GI in city development requirements

Prioritization & Pilots
5 conceptual designs for GI projects and tools to repeat prioritization and GI installation types
STAKEHOLDER GROUP PROCESS
VISION
What do YOU envision for the final outcome of this project?

CRITICAL SUCCESS FACTORS
What must this project and process accomplish in order for you to think it has been successful?
Making policy & process changes

**Assess**
- Opportunities
- Problems
- Needs

**Gather Input**

**Set Goals**
- Align needs with opportunities
- Build tactics

**Identify Strategies**
- Align needs with opportunities
- Build tactics

**Employ Tactics**
- Educate
- Change policies
- Change processes

**Act**

**Analyze**
- Combine like inputs
- Set priorities

**Project Vision & Critical Success Factors**
Resulting Policies

- Prioritization factors for pilot projects
- MEP of LID for <1 acre development
- Do as much GI as practicable on city projects
POLICY AND PROCESS
Code and Design Standards Revisions

(B) Technical Report
The technical report shall provide a description of and developed runoff conditions, approximate stormwater quality and erosion control measures, stormwater measures, proposed stormwater utility improvements, results of study data sources, methods and findings, and is

(1) Background: Provide a written statement of development that includes the following:
   (a) Site location, including legal descriptions, identifying land use, networks and stormwater systems, and
   (b) Site description, including the total area covered, external and internal

(2) Development Proposal: Provide a description of development, including land use, density, water planning concepts.

(3) Existing Condition Hydrology: Provide:
   (a) Land cover, denoting by type all (e.g., water bodies, 4. Land development, as developed or are
designed; crops or orchards, pastures, buildings, pavement, compacted
   (b) Natural features, including stream
   (c) Floodplains and floodways, known
   (d) Natural soil identified by use, erosion
   (e) Natural areas where infiltration of stormwater
   (f) Areas with soil contamination (known or
   (g) Areas with cultural, historic, or arch.
   (h) Existing Storm Water Basins and Drainage patterns:
   (a) Oftsite drainage patterns and their
   (b) Oftsite drainage patterns, existing
   (c) Previous drainage studies for the

(A) Required
The Director of Public Works may require the inspection of stormwater quality measures after their installation to confirm their conformance with the approved design stormwater report and plan. The survey for the applicable development site, and to evaluate if the stormwater quality measures and the larger stormwater system and facilities of the property are clean, free of sediment and debris, and in full operational condition. The Director of Public Works may order corrective actions before construction cession will be approved.

7.16 Storm Water Quality Measure Maintenance

(A) Required
   (1) The property owner shall be responsible for maintaining permanent stormwater quality measures. Maintenance shall be as recommended by the BMP Inspection and Maintenance Field Guide published by the Environmental Protection Agency. The use of stormwater quality measures for materials, stockpiles, parking, and storage of equipment, construction materials, wastes, or pollutants is prohibited.

   (2) The use of stormwater quality measures for materials, stockpiles, parking, and storage of equipment, construction materials, wastes, or pollutants is prohibited.

   (3) The area that discharges to a storm drainage system shall be fully stabilized with permanent vegetation with no areas of bare soil or erosion to prevent the discharge of sediment to, and clogging of, the practice. The area shall at all times be kept clean to prevent the discharge of sediment and pollutants to the practice. Use of the area for construction or maintenance, storage of stockpiles, or the use of stormwater quality measures for materials stockpiles, parking, and storage of equipment, construction materials, wastes, or pollutants is prohibited.

   (4) Stormwater quality practices should be protected from soil compaction. Controls should be established to prevent encroachment by equipment and vehicles, and foot traffic unrelated to their maintenance.
Code and Design Standards Revisions

- Permit required
- Stakeholder Input
- Necessary Clean-up
Policy & Process Questions

• What does MS4 compliance and GI look like in Boulder?
• What happens <1 acre?
• How can we best integrate with capital projects throughout the city to install GI?
• How do we create better, clearer policy and back that up with assisting documents and guidance?
MS4 Post-Construction Requirements

- Runoff Reduction
- Pollutant Removal
- Water Quality Capture Volume

MS4 Post-Construction Requirements
MOUs for Permit Compliance

City of Boulder, CO

DRAFT POLICIES AND STANDARD OPERATING PROCEDURE

for the Design and Construction of Stormwater Quality BMPs

City departments responsible for the design and construction of BMPs must adhere to the policies and procedures established in this SOP.

2. PROCESS

Figure 1 illustrates the general process for implementing stormwater BMPs. It starts at the time a City project is approved by the City Planning and Development Services Department. Figure 4 provides a flowchart for project construction phases.

3. REQUIRED DOCUMENTATION

Table 5. Construction Stage Documentation

<table>
<thead>
<tr>
<th>Department Responsible</th>
<th>Required Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department responsible for applicable City project</td>
<td>Stormwater BMP as-built plans, prepared in accordance with BRC Title 11, Chapter 5 and the BCS.</td>
</tr>
<tr>
<td>Water Quality and Environmental Services (WQES)</td>
<td>1. Documentation of construction inspections and final inspection, including corrective action reporting to responsible department/contractor.</td>
</tr>
<tr>
<td></td>
<td>2. Create and maintain data for City BMP tracking.</td>
</tr>
</tbody>
</table>

GLOSSARY

Applicable City project -- An applicable City project is subject to water quality improvement requirements in Boulder Revised Code, Title 11, Chapter 5 Storm Water and Flood Management Utility.

BMP -- The Management Practices (BMP) -- BMPs are single, engineered, structural controls that are designed and constructed to address...
Supporting Documents

• Compliance “Packet”
  – Checklists

• Example GI projects

• MEP LID Guidance
PILOT PROJECTS
Project Components

• Unique GI
  – Based on GIS analysis and prioritization

• CIP project opportunities

• Planning for future use of capital funds
**GI Potential Capital Projects - Compiling the List**

### CITY OF BOULDER PREDICTIVE PILOT PROJECT SCORING

<table>
<thead>
<tr>
<th>Overall &quot;Bucket&quot; Category</th>
<th>Policy Regulatory</th>
<th>Public Impact</th>
<th>Engineering Resiliency Effects</th>
<th>Economic</th>
<th>Administrative</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weighting Factor</td>
<td>Z 1</td>
<td>1</td>
<td>1.5</td>
<td>Z 1</td>
<td>1 1 1</td>
<td>1 1 1</td>
</tr>
</tbody>
</table>

1. **Define Projects**
2. **Assign weighting factor importance to site suitability categories**
3. **Assign numerical ranking to detailed evaluation criteria for each project**
4. **Review project raw score and weighted total for project prioritization**
5. **Sort the list by the weighted total to list in order of prioritization**
# Green Infrastructure Potential Projects - Evaluation

<table>
<thead>
<tr>
<th>Overall Priority Ranking</th>
<th>Weighted Total</th>
<th>Project ID</th>
<th>Proposed Project</th>
<th>Proposed CIP Description</th>
<th>CIP Project Cost</th>
<th>GI - Stormwater Est Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>74.5</td>
<td>7</td>
<td>Sumac &amp; 19th Street (Wonderland Creek 2) Neighborhood Drainage Improvements</td>
<td>PavDrain &amp; Hybrid drainage swale w/ bioretention cells &amp; staged stormwater inlets &amp; risers</td>
<td>$748,200</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>74</td>
<td>11</td>
<td>Valmont City Park Development</td>
<td>Integrated SW mgmt w/ hybrid swale in landscape, bioretention, PICP paver &amp; storage in parking, educational signage</td>
<td>$5,000,000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>65.5</td>
<td>18</td>
<td>CU South Planned Open Space</td>
<td>Passive GI and regional storage</td>
<td>TBD</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>62</td>
<td>9</td>
<td>Twomile Canyon Creek 1 Runoff Collection &amp; Conveyance</td>
<td>Kalmia &amp; Jupiter improvements PavDrain Shoulder &amp; Bioswale with sub-surface conveyance and capacity improvements to creek/road crossing</td>
<td>$1,000,000</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>60.5</td>
<td>1</td>
<td>North Boulder Library Site Based GI</td>
<td>Integrated SW mgnt w/ hybrid swale in landscape, PICP paver &amp; storage in parking, educational signage</td>
<td>$5,000,000</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>60.5</td>
<td>2</td>
<td>New Fire Station Site Based GI</td>
<td>Integrated SW mgnt w/ hybrid swale in landscape; PICP paver &amp; storage in parking, educational signage</td>
<td>$12,500,000</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>59</td>
<td>3</td>
<td>Alpine &amp; Balsam Area Plan Streetscape / Landscape</td>
<td>Permeable Pavement, Stormwater Planters, PavDrain Shoulder, Focal Point w/Rank</td>
<td>$1,000,000</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>58</td>
<td>13</td>
<td>30th &amp; Colorado Bike/Ped Underpass</td>
<td>Inform plan with concept roadway corridor GI - PICP parking, FocalPoint, Bioretention planters</td>
<td>$5,900,000</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>56</td>
<td>16</td>
<td>Elmer’s Twomile Creek-2 - New and Replacement Storm Sewer</td>
<td>Integrated stormwater management mix of GI bioretention swale, infiltration trenches w/storm collection system</td>
<td>$3,874,000</td>
<td></td>
</tr>
</tbody>
</table>
Unique GI Projects
Next Steps

• Two more Stakeholder Meetings
• Finalize Pilot Projects – Format
• Path forward with funding for GI projects
• Incorporate Code and policy changes
• Finalize compliance tools
Candice Owen
owenc@bouldercolorado.gov
5 Stakeholder Meetings

• What is our vision for this program?
• What level of stormwater management is enough?
• How do we incorporate these concepts in city projects and on private development?