Overview

- Permit overview
- Permit requirements
  - SWPPP design
  - BMP selection
- Recent MoDOT erosion control changes
- What does the future hold
Why? Environmental Regulations
Clean Water Act – Effective October 1972
  ◦ Amendments in ‘77 and ‘87
Created a National Pollution Discharge Elimination System (NPDES)
  ◦ 1972 – point sources
  ◦ 1987 – nonpoint sources
EPA has authority over the permitting process
In Missouri, Department of Natural Resources (MDNR) administers permit
How Important to EPA/DNR?

director's comment

“Essentially, all life depends upon the soil ... There can be no life without soil and no soil without life; they have evolved together,” said Dr. Charles E. Kellogg, soil scientist and former chief of the U.S. Department of Agriculture’s Bureau of Chemistry and Soils. Dr. Kellogg’s legacy of bringing awareness to the importance of soil data was built around his belief that soil is the foundation of life.

Healthy soil provides us with clean air and water, productive crops and grazing fields, diverse wildlife and beautiful rural sceneries. It’s a quality of life we all cherish and one we have come to expect. However, our soil quality has not always been healthy. In fact, Missouri once held the second highest rate of erosion in the nation. Soil once used as productive agriculture land has polluted our waterways.

In order to reduce soil erosion, improve water quality as well as support Missouri state parks, Missouri voters passed a one-tenth-of-one-percent sales tax in 1984, now called the Parks, Soils and Water Sales Tax. Missourians have continued to show their support for these efforts by renewing the tax in 1988, 1996 and 2006. The tax is set to expire in 2016 unless renewed.

The Department of Natural Resources has administered funds generated from the tax through county soil and water districts to Missouri landowners to implement voluntary practices that have kept more than 177 million tons of soil from eroding into our waterways. The department through local, state and federal partnerships promotes good farming techniques that keep soil on our fields and our waters clean while conserving the productivity of Missouri’s 97,000 farms.

While these efforts have drastically improved our soil and water quality, it’s no longer enough due to increased population and food production demands. With help from our partners, the department will increase the amount of soil data collected through the state’s premier Soil Health Assessment Center at the University of Missouri-Columbia. Agricultural landowners will submit soil samples for analysis that will provide the state with a new baseline for soil health and help determine which voluntary practices are improving the quality and productivity of our soil the most. I believe Dr. Kellogg would be proud of Missouri’s efforts. Learn more at dnr.mo.gov.

Sara Parker Pauley
Missouri Department of Natural Resources
Why is erosion control important?

From EPA:
- Increases flooding
- Kills aquatic organisms due to inability to see food
- Prevents natural vegetation from growing
- Disrupts natural food chain
- Increases cost for treating drinking water
- Results in odor and taste issue for drinking water
- Activates blue-green algae causing swimmers illness
- Alters navigation depths = making transportation difficult
- Causes $16 billion in damage annually
When is a permit required?

- Greater than 1 acre of disturbance per project
- Less than 1 acre and part of a greater common plan (e.g., subdivision development)
Disclaimer: Projects < 1.0 Acre

- No Permit Required
- No SWPPP Required
- No Reporting Required
- Still need best management practices (BMPs) installed
- Still need to monitor site
National Pollutant Discharge Elimination System
General Permit for Discharges from
Construction Activities

In compliance with the provisions of the Clean Water Act, 33 U.S.C. §1251 et. seq., (hereafter CWA or the Act), as amended by the Water Quality Act of 1987, P.L. 100-4, “operators” of construction activities (defined in Part 1.1.a and Appendix A) that meet the requirements of Part 1.1 of this National Pollutant Discharge Elimination System (NPDES) general permit, are authorized to discharge pollutants in accordance with the effluent limitations and conditions set forth herein. Permit coverage is required from the “commencement of earth-disturbing activities” (see Appendix A) until “final stabilization” (see Part 2.2).

This permit becomes effective on **February 16, 2012**. For the State of Idaho (except for Indian country), this permit becomes effective on **April 9, 2012**. For areas in the State of Washington (except for Indian country) subject to construction activity by a Federal Operator, this permit becomes effective on **April 13, 2012**. For projects located in the following areas, this permit becomes effective on **May 9, 2012**: Fond du Lac Band and Grand Portage Band of Lake Superior Chippewa in Minnesota; and the Bad River Band and Lac du Flambeau Band of Lake Superior Chippewa in Wisconsin.

This permit and the authorization to discharge expire at midnight, **February 16, 2017**.
Missouri DNR – General Land Disturbance Permit

- Date issued: 5/31/2012
- Expiration date: 5/30/2017
- Six General Statewide Permits
  - MoDOT
  - MDC
  - OA
  - MoDNR
  - Keystone Pipeline
  - NGMO
Proposed Missouri Changes

- Add Water Quality Standards from CSR
- Remove exemption for linear, strip or ribbon construction
- Sediment Basins designed to 2 year, 24 hour
- List of who was provided the project SWPPP
- NTU sampling?
How to obtain a permit?

Table 6 - General Permit or Permit-By-Rule 10 CSR 20-6.011(2)(F)

<table>
<thead>
<tr>
<th>Permit Description</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>General permits for discharge of process water and stormwater, potentially contaminated, annual fee</td>
<td>$ 200</td>
</tr>
<tr>
<td>Stormwater, land disturbance; 1.0 acre but &lt; 5.0 acres</td>
<td>$ 500</td>
</tr>
<tr>
<td>Stormwater, land disturbance; 5.0 acres but &lt; 10.0 acres</td>
<td>$ 600</td>
</tr>
<tr>
<td>Stormwater, land disturbance; 10.0 acres but &lt; 25.0 acres</td>
<td>$ 750</td>
</tr>
<tr>
<td>Stormwater, land disturbance; 25.0 acres but &lt; 100.0 acres</td>
<td>$ 1,000</td>
</tr>
<tr>
<td>Stormwater, land disturbance; 100.0 acres but</td>
<td>$ 3,000</td>
</tr>
<tr>
<td>Stormwater, land disturbance; 500.0 acres or greater</td>
<td>$ 5,000</td>
</tr>
<tr>
<td>Stormwater, land disturbance, single fee for multiple sites; total &lt; 100.0 acres</td>
<td>$ 1,500</td>
</tr>
<tr>
<td>Stormwater, land disturbance, single fee for multiple sites; total 100.0 acres to &lt;500.0 acres</td>
<td>$ 3,000</td>
</tr>
<tr>
<td>Stormwater, land disturbance, single fee for multiple sites; total ≥ 500.0 acres</td>
<td>$ 5,000</td>
</tr>
</tbody>
</table>
MoDOT Land Disturbance Approach

- General Permit for any project
- MoDOT assumes risk for non-compliance
- Saves the department time and money

- For higher risk projects MoDOT will require an Individual Permit
Additional Project Permits?

- 401 – Water Quality Certification
- 404 – Discharge of Material into WOTUS
- 408 – USACE Levees/Dams/Flood Walls
- MS4 – Municipal Separate Stormwater Sewer Systems
- And many more!!
So what requirements are in Permit?

- Develop SWPPP
- Updated Site Map
- Site Inspection Reports
- Permit Termination
- BMP Selection
So what requirements are in Permit?

- Develop SWPPP
- Updated Site Map
- Site Inspection Reports
- Permit Termination
- BMP Selection
SWPPP

- SWPPP – Stormwater Pollution Prevention Plan
- Kept on site
- Shall include:
  - List or describe all outfalls or primary receiving waters
  - Incorporate erosion control practices specific to site conditions
  - Provide for maintenance and adherence to the plan
  - Discuss whether or not a 401/404 Permit required
  - Name persons responsible for inspection and maintenance of BMPs

www.modot.gov/ld
So what requirements are in Permit?

- Develop SWPPP
- Updated Site Map
- Site Inspection Reports
- Permit Termination
- BMP Selection
Site Map

 Shall Include

• Direction of flow and slopes after grading activities
• Areas where soil will not be disturbed
• Location of BMPs identified in the SWPPP
• Locations where stabilization practices are expected to occur
• Locations of off-site material, waste, borrow or equipment storage areas
• Location of all waters of the US
• Locations where water discharges to surface water
• Area where final stabilization has been accomplished
Typical Site Map Example
Maintenance Site Map Example

Project Description: Reshape Inslope & Backslope & Clean/Reshape Drivn

- Install S.F. prior to reshaping
- Limits of Disturbance
- Slope Break
- Install DCS prior to reshaping work
- Install post-grading

Turkey Creek

Hwy W
Next Generation Site Maps
So what requirements are in Permit?

- Develop SWPPP
- Updated Site Map
- **Site Inspection Reports**
- Permit Termination
- BMP Selection
### MISSOURI DEPARTMENT OF TRANSPORTATION
#### LAND DISTURBANCE INSPECTION RECORD

**Inspection Date:** ____________  
**Inspection Record No.:** ____________  
**Project Number:** ____________  
**County:** ____________  
**Route:** ____________

**Inspection Type:**  
Weekely ____  
Post-Runoff (Total Precip (in.) ____/Precip Duration (hrs) ____  
Final ____  
Other ____

**Total Disturbed Acreage on the Project:** ____________  
**Total Authorized Acreage on the Project:** ____________

Are there BMP deficiencies/other matters requiring corrective action, modification or installation within this report?  
☐ Yes  
☐ No

### Land Disturbance Inspection Checklist

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Current and updated SWPPP/site map on site when the erosion &amp; sediment control inspector is on site and a copy given to the contractor?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Permit public notification sign(s) posted and visible to the public?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Are all erosion and sediment control BMPs properly installed, maintained, functioning as intended according to the SWPPP and depicted on the site map? If “No”, explain deficiencies below (use add, pages if needed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Are BMPs in place to protect streams, wetlands and other environmentally sensitive areas from pollutants?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Is trackout controlled at project entrance/exit points?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Are active stormwater inlets susceptible to receiving sediment properly protected?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Does the project have a dewatering plan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Are dewatering operations effectively removing pollutants from the water?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Are litter, construction debris, fuels, lubricants and other construction chemicals controlled?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Have all temporary BMPs that are no longer necessary been removed and removal depicted on the site map?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Have all deficiencies from the last report been corrected in 7 days? If not, provide an explanation of adverse site conditions and attach photo evidence.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Other:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Explanation of checklist items identified above (use additional pages if needed):**

________________________________________________________________________________________

________________________________________________________________________________________

Describe areas where land disturbance activities have temporarily or permanently ceased. (Excluding weather shutdowns) Describe how these areas have been or will be stabilized.

________________________________________________________________________________________

________________________________________________________________________________________

Provide a brief description of the current project status with regard to erosion and sediment control and the effectiveness of BMPs (use additional pages if needed):

________________________________________________________________________________________

________________________________________________________________________________________

Has the job reached final stabilization in accordance with the permit?  
☐ Yes  
☐ No

**Inspector Name:** ____________  
**Inspector Signature:** ____________  
**Date:** ____________

**RE Name:** ____________  
**RE Signature:** ____________  
**Date:** ____________

**Distribution:** Contractor (Hard Copy ☐ or Electronic ☐)  
Save to V:\Contract Information Archive & keep hard copy with inspector
# Next Generation Inspections

**Stormwater Compliance Notifications**

Contract: 150220-F09 Project Number: J6P2348 Project ID: 8---Deficiency needing correction: Deficiency id: 2015 --- Date Correction Expected: 3/2/2016
[https://www.modot.mo.gov/StormWaterCompliance/Inspection/DisplayInspection/2220](https://www.modot.mo.gov/StormWaterCompliance/Inspection/DisplayInspection/2220)

Contract: 150220-F09 Project Number: J6P2348 Project ID: 8---Deficiency needing correction: Deficiency id: 2016 --- Date Correction Expected: 3/2/2016
[https://www.modot.mo.gov/StormWaterCompliance/Inspection/DisplayInspection/2220](https://www.modot.mo.gov/StormWaterCompliance/Inspection/DisplayInspection/2220)

Contract: 150220-F09 Project Number: J6P2348 Project ID: 8---Deficiency needing correction: Deficiency id: 2017 --- Date Correction Expected: 3/2/2016
[https://www.modot.mo.gov/StormWaterCompliance/Inspection/DisplayInspection/2220](https://www.modot.mo.gov/StormWaterCompliance/Inspection/DisplayInspection/2220)

Contract: 150220-F09 Project Number: J6P2348 Project ID: 8---Deficiency needing correction: Deficiency id: 2019 --- Date Correction Expected: 3/2/2016
[https://www.modot.mo.gov/StormWaterCompliance/Inspection/DisplayInspection/2220](https://www.modot.mo.gov/StormWaterCompliance/Inspection/DisplayInspection/2220)

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<thead>
<tr>
<th>Select</th>
<th>Weekly</th>
<th>Date</th>
<th>Name</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select</td>
<td>Weekly</td>
<td>2/16/2016</td>
<td>HEATHER COPELAND</td>
<td>2/16/2016</td>
</tr>
<tr>
<td>Select</td>
<td>Weekly</td>
<td>2/2/2016</td>
<td>HEATHER COPELAND</td>
<td>2/2/2016</td>
</tr>
<tr>
<td>Select</td>
<td>Weekly</td>
<td>1/20/2016</td>
<td>HEATHER COPELAND</td>
<td>1/20/2016</td>
</tr>
<tr>
<td>Select</td>
<td>Weekly</td>
<td>1/19/2016</td>
<td>HEATHER COPELAND</td>
<td>1/19/2016</td>
</tr>
<tr>
<td>Select</td>
<td>Weekly</td>
<td>1/12/2016</td>
<td>HEATHER COPELAND</td>
<td>1/12/2016</td>
</tr>
<tr>
<td>Select</td>
<td>Weekly</td>
<td>1/5/2016</td>
<td>HEATHER COPELAND</td>
<td>1/5/2016</td>
</tr>
<tr>
<td>Select</td>
<td>Weekly</td>
<td>12/29/2015</td>
<td>HEATHER COPELAND</td>
<td>12/29/2015</td>
</tr>
<tr>
<td>Select</td>
<td>Post-Runoff</td>
<td>12/23/2015</td>
<td>HEATHER COPELAND</td>
<td>12/23/2015</td>
</tr>
</tbody>
</table>

Provide a brief description of the current project status with regards to erosion and sediment control and BMPs. Deficiency was corrected today. All project BMPs currently functioning well.
So what requirements are in Permit?

- Develop SWPPP
- Updated Site Map
- Site Inspection Reports
- Permit Termination
- BMP Selection
Permit Termination

- All temporary BMPs shall be removed
- “Final Stabilization” – 70% plant density over 100% of the site
- Permanent materials cover areas of disturbance
  - Pavement
  - Building
  - Rock
So what requirements are in Permit?

- Develop SWPPP
- Updated Site Map
- Site Inspection Reports
- Permit Termination
- BMP Selection
BMP Review

Erosion Control Vs. Sediment Control
Erosion Control is the act of protecting the soil surface to prevent displacement of soil by water or wind.

Sediment Control is the act of trying to stop the displaced soil that resulted from erosion.
BMP – Best Erosion Control = Grass
BMP – Vegetative Buffer

- Required by permit, “when possible”
BMP – Soil Roughening
BMP – Interception or Diversion
BMP – Seeding
Hydromulch
Sediment Control BMPs
BMP – Silt Fence
BMP – Dirt/Earth Berm
BMP – Rock Berm
BMP – Mulch Berms
BMP – Outfall Protection
Ditch Check
BMP – Ditch Checks – Lessons Learned
### Ditch Checks – Rock

*Most commonly used check*

*High volume and high velocities*

*Slopes > 10% might require ECB or TRMs*

*Size between 4" and 12”*

*Desire a good mix of rock size*

*Last two checks in a run shall be rock*

*Filter fabric might be needed for clay soils*

*18" in effective height*

### Example

**Ditch Check Spacing for Standard Heights**

<table>
<thead>
<tr>
<th>Ditch % Slope</th>
<th>9” Eff. Height</th>
<th>18” Eff. Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>150</td>
<td>300</td>
</tr>
<tr>
<td>1.0</td>
<td>75</td>
<td>150</td>
</tr>
<tr>
<td>1.5</td>
<td>50</td>
<td>100</td>
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<tr>
<td>2.0</td>
<td>37</td>
<td>75</td>
</tr>
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<td>2.5</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>3.0</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>3.5</td>
<td>21</td>
<td>43</td>
</tr>
<tr>
<td>4.0</td>
<td>19</td>
<td>38</td>
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<tr>
<td>4.5</td>
<td>16</td>
<td>33</td>
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<td>5.0</td>
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<td>30</td>
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<td>5.5</td>
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<td>27</td>
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<td>6.0</td>
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<td>23</td>
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<td>7.0</td>
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<td>7.5</td>
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<td>20</td>
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<td>8.0</td>
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<td>17</td>
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<tr>
<td>9.5</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>10.0</td>
<td>7</td>
<td>15</td>
</tr>
</tbody>
</table>

**Minimum Ditch Check Spacing**

---

*Toe Elevation of toe must be same or less than elevation of top.*

*Spacing of ditch check measured center to center.*
Alternate Ditch Checks

- Triangular Silt Dike
- EnviroBerm (with ECB or TRM)
- GeoRidge (with ECB or TRM)
- Compost Filter Berm (with ECB or TRM)
- Fiber Rolls, Sediment Logs, Compost Filter Socks (with ECB or TRM)
Alternate Ditch Checks
## Ditch Check Specification Change

<table>
<thead>
<tr>
<th>Old Method</th>
<th>New Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Type I Checks: &lt; 3 Acres</td>
<td>- Rock Check: 18” tall</td>
</tr>
<tr>
<td>Examples: Silt Fence and straw bales</td>
<td>Location: High velocities or Q</td>
</tr>
<tr>
<td>- Type II Checks: &gt; 3 Acres</td>
<td>- Alternate Checks: 9” tall</td>
</tr>
<tr>
<td>Examples: Rock and Tri Dikes</td>
<td>Location: Clear Zone concerns (&lt;4% grade)</td>
</tr>
</tbody>
</table>

*New* Alternate Check Standard

*New* Rock Check Standard
BMP – Inlet Protection
BMP – Sediment Basins
BMP – Sediment Traps
What do I do now?
Settable Solids

- Imhoff Cone Test
  - Collect Sample
  - Add water sample into cone
  - After 45 min gently stir sample
  - After 15 more min record results

*Imhoff cones are used to measure the settleable solids (biofloc), which indicate the quantity of biofloc in the tank.*
Turbidity vs. SSC

Turbidity (NTU)

Water Samples:

- 250
- 100
- 50
- 25
- 10

SSC (mg/L)
Flocculent
Dewatering
Dewatering BMPs
IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF MISSOURI

UNITED STATES OF AMERICA,

Plaintiff,

v.

MISSOURI HIGHWAYS AND
TRANSPORTATION COMMISSION,

Defendant.

Civil Action No. 15-4069

CONSENT DECREE
MoDOT Land Disturbance Changes

- Increased Training
- New Electronic Reporting Database
- Reduction in Projects > 1 Acre
- New Specifications, JSPs and Payment Direction
MoDOT Land Disturbance Changes

- Increased Training
- New Electronic Reporting Database
- Reduction in Projects > 1 Acre
- New Specifications, JSPs and Payment Direction
MoDOT Seeding Team

- Goal: projects “Final Stabilized” quicker
- Members from every district
- Background in design, construction and maintenance
Seeding Team – MoDOT “Standard Mix“

- We need quicker grass growth
- Continue to strive for long-term growth
- Historically works well in “most” areas

- Average price per acre of seeding continues to increase at a higher rate than other bid items
Seeding Team

- What are other states doing?
- Time of the year?
- Reconsider regional approach?

- Start trying different concepts to see what works and what doesn’t!
Liquid Lime

**FIGURE 1.** The change in soil pH with rate and time.
Slope Tracking
Seeding Mobilization

- Fix Price for every mobilization of hydroseeder
- Allow for quick response for permit compliance
- Goal remains finish slopes and germinate seed
Top Soil Preservation
Erosion Control Blankets
## Erosion Control Blankets or TRM?

<table>
<thead>
<tr>
<th>ECB Type</th>
<th>Netting Type</th>
<th>Service Life</th>
<th>Slope (ft/ft)</th>
<th>Soil Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>Single, quickly degradable</td>
<td>45–60 days</td>
<td>3:1 or flatter</td>
<td>Clay</td>
</tr>
<tr>
<td>Type 2</td>
<td>Single photodegradable</td>
<td>12 months</td>
<td>3:1 or flatter</td>
<td>Sandy</td>
</tr>
<tr>
<td>Type 3</td>
<td>Double photodegradable</td>
<td>12–18 months</td>
<td>2:1 or flatter</td>
<td>Clay</td>
</tr>
<tr>
<td>Type 4</td>
<td>Double photodegradable</td>
<td>24 months</td>
<td>2:1 or flatter</td>
<td>Sandy</td>
</tr>
<tr>
<td>Type 5</td>
<td>Double photodegradable</td>
<td>36 months</td>
<td>1:1 or flatter</td>
<td>Any</td>
</tr>
</tbody>
</table>
Bonded Fiber Matrix
Ditch Checks – Payment

- Paid by LF
- Either as Rock or Alternate
- Install entire width of the ditch
- Last two BMPs should be rock ditch checks
Ditch Checks Payment—New Contractor Guidance

- Clean Out – Paid as sediment removal

- MoDOT is not paying for poor erosion control

- Rock checks pay for failure or re-install
  - Engineer’s judgment if full replacement or partial
  - Price not to exceed original bid item cost

- Alternate checks is Engineer’s judgment for replacement payment (2 year, 24 hour or 2”)

- Quick payment will help with compliance for the Consent Decree. Everyone is at risk!
Ditch Treatment

- Flexamat
- Geoweb
Ditch Treatment – ScourStop

Before
Diamond Grinding – Changes?
Construction Entrances – Changes?
New Consent Decree JSP’s

- Stormwater Compliance Requirements
  - > 1 acre: JSP-15-04A
  - < 1 acre: NJSP 15–38

- Bid Item: Water Pollution Control Manager (WPCM)
  - Method of Measurement: Per Week
  - Item Code: 806–99.28
  - Bid Prices anywhere from $0.01 to $1200
What does the future hold?
## Future – Design Advances

<table>
<thead>
<tr>
<th>Phase I</th>
<th>BMP Plan Ref No.</th>
<th>BMP Description</th>
<th>Remove after Stage</th>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - Prior to Land Disturbance/Sanitary Sewer Installation</td>
<td>1</td>
<td>Construction Entrance and Staging Area - Construction Fencing</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Curb Inlet Protection</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Perimeter Sediment Fence</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Temporary Diversion Dike</td>
<td>E</td>
<td>Remove only when graded areas south of berm have permanent stabilization established.</td>
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<td>Phase II</td>
<td>6</td>
<td>Temp Sediment Basin</td>
<td>E</td>
<td>To be installed prior to disturbing entire site.</td>
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<td>7</td>
<td>Stockpile Topsoil</td>
<td>D</td>
<td>Install sediment fence a minimum of 5’ beyond toe of slope for all stockpile areas.</td>
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<td>8</td>
<td>Sediment Fence</td>
<td>E</td>
<td>Install on contour for intermediate sediment control.</td>
</tr>
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<td></td>
<td>9</td>
<td>Check Dams</td>
<td>D</td>
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<td>10</td>
<td>Concrete Washout</td>
<td>D</td>
<td>To be installed prior to pouring any concrete.</td>
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<td>C - Storm Sewer Installation</td>
<td>11</td>
<td>Phase I Area Inlet Protection</td>
<td>D</td>
<td>Install excavated area and sediment fence around all area inlets and open junction boxes.</td>
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<td>12</td>
<td>Phase I Curb Inlet Protection</td>
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<td>Install excavated area and throat protection on all curb inlets.</td>
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<tr>
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<td>13</td>
<td>Stabilize Borrow Area with Perennial Vegetation</td>
<td>NA</td>
<td>Seed and mulch future development area. Temporarily stabilize with hyrdromulch if out of seeding season.</td>
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<td>Phase III</td>
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<td>Phase II Area Inlet Protection</td>
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<td>At time of final grading, concurrent with stabilization of site, install stabilized buffer and filler bag.</td>
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<td>15</td>
<td>Phase II Curb Inlet Protection</td>
<td>E</td>
<td>Following installation of curb and gutter, install inlet filter bag.</td>
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<td>16</td>
<td>Sediment Log/Wattle</td>
<td>E</td>
<td>Where indicated adjacent to street - place at back of curb. Install per manufacturer's instructions.</td>
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<tr>
<td>E - Final Stabilization</td>
<td>17</td>
<td>Erosion Control Blanket (Curex II)</td>
<td>NA</td>
<td>To be installed in swale per manufacturer's instructions.</td>
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<td>18</td>
<td>Establish Perennial Vegetation</td>
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<td>Redistribute topsoil and seed and mulch all disturbed areas. Sod right-of-way. Stabilization complete when 100% of disturbed area is established with perennial vegetation with a density of 70%.</td>
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</table>
Future – Design Advances

- RUSLE – Advanced design used on west coast
  \[ A = (R) (K) (LS) (C) (P) \]
  - R = Hydrology
  - K = Geology
  - L & S = Geometry of Slope
  - C = Land Coverage Factor
  - P = Land Usage
- SELDM: USGS and FHWA advanced analysis for BMPs effectiveness
- Runoff event analysis
- Construction review of BMPs
Design Example

A = (R) (K) (LxS) (C) (P)

- R = Erosivity Factor = Table Number
- K = Erodibility Factor = Table Number
- LS = Slope Length Factor = Table Number
- C = Cover Management = 1.0
- P = Erosion Conservation = 1.0
A = (R) (K) (LxS) (C) (P)

- **R** = Erosivity Factor = Table Number = 120
- **K** = Erodibility Factor = Table Number =
- **LS** = Slope Length Factor = Table Number =
- **C** = Cover Management = 1.0
- **P** – Erosion Conservation = 1.0

**Design Example**

Map of Missouri with color legend indicating different values for K Value.
### Design Example

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A = \( R \) (\( K \)) (\( L \times S \)) (C) (P)
- \( R \) = Erosivity Factor = Table Number = 120
- \( K \) = Erodibility Factor = Table Number = 0.30
- \( LS \) = Slope Length Factor = Table Number = 50.63
- \( C \) = Cover Management = 1.0
- \( P \) = Erosion Conservation = 1.0

\[ A = (120) (0.30) (50.63) (1.0) (1.0) \]
\[ A = ? \]
Design Example

- \( A = (R) (K) (L \times S) (C) (P) \)
  - \( R = \) Erosivity Factor = Table Number = 120
  - \( K = \) Erodibility Factor = Table Number = 0.30
  - \( LS = \) Slope Length Factor = Table Number = 50.63
  - \( C = \) Cover Management = 1.0
  - \( P = \) Erosion Conservation = 1.0

\[
A = (120) (0.30) (50.63) (1.0) (1.0)
\]

\[
A = 1,823 \text{ T/yr}
\]
Pre-Treatment

\[ A = (120) (0.30) (50.63) (1.0) (1.0) \]

\[ A = 1,823 \text{T/yr} \]

Post-Treatment

\[ A = (120) (0.30) (50.63) (0.0003) (1.0) \]

\[ A = 0.55 \text{T/yr} \]
Design Example – Phase II

- Cover Factors are becoming the hot topic:
  - Bare Soil = 1.0
  - Temporary Seed (90% Stand) = 0.05
  - Permanent Seeding (90% Stand) = 0.01
  - Erosion Control Blankets = 0.002
  - Fiber Matrix = 0.0001
Future – Design Advances – Water Volume BMPs
Future – Design Advances – Focal Point Biofiltration

- Basin 1: 12,000sf → 240sf
- Basin 2: 3,037sf → 60sf
- Basin 3: 1,626sf → 40sf
- Basin 4: 2,055sf → 52sf
- Total: 18,718sf → 352sf (98%)
Future – Design Advances – Highway Pervious Pavements
Future – Inspection Documentation

- Pre-project inspection
- Pre-rain event documentation
- Rain event video documentation
- Surrounding projects BMPs
- Post-rain event analysis

- Drones?
- Live on-site cameras?
High Risk for Projects
Lakes/Rivers/Ponds?

Site Topography
Future – Regulator Visits
### FY16 CWA Inspections

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<th>NE</th>
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DNR – Future Interaction

[Map of Missouri with counties labeled]
Future Innovation – Seeding
Future Innovation –
Tree Pollutant Reduction

Atmospheric Particulates
Direct deposit and adhesion to leaf and bark surfaces

Atmospheric Organics
Direct partitioning to leaf-surface and waxy cuticles
PAHs, PCBs, PCDDs

High surface area above ground tissues for maximized gas exchange with the atmosphere

Offering above ground sampling points to subsurface contaminants and geochemistry

Organic
Direct Uptake from Vadose or saturated zone: Chlorinated Solvents, Pesticides, Petroleum

Inorganic Metals
Direct Uptake:
V, Cr, Ni, Sr in Petroleum
As, Cd, Cu, B in Leachate
U, Sr, Te in radioactive wastes

Root structure and function evolved for maximized mass transfer from subsurface to translocation pathways

8 Daze until the best ever – 108th
Future Innovation – Sediment Tracking

Tracing and tracking sediment sources in river catchments
Adrian Collins and Yusheng Zhang

The use of particle tracking in sediment transport studies: a review

KEVIN S. BLACK1, SAM ATHEY1, PETER WILSON1 & DARREN EVANS2

1Partrac Ltd, 141 St James Road, Glasgow G4 OLT, UK (e-mail: kblack@partrac.com)
2Department of Geography, Loughborough University, Loughborough, UK

Abstract: New European environmental legislation such as the Shellfish and Habitats Directives, together with the more recent Water Framework Directive, are driving new and established approaches to sediment management. Regional authorities, environment protection agencies and consultants are increasingly being required to adopt a holistic, system-wide approach to the identification of sediment flux in aquatic systems. Increasingly, and necessarily, there is a need to describe sediment (and contaminant) transport pathways on dynamically variable and temporally distributed scales rather than at single point localities. ‘Particle tracking’, or as it is...
Additional Information & Resources

- www.modot.gov/ld

- Exhibitors Booths

- Friday 8am–9am Grand Ballroom A
  - Consent Decrees & MS4
Questions

Eric.Kopinski@modot.mo.gov

Phone (573) 291-0364