EROSION AND SEDIMENT POLLUTION CONTROL NARRATIVE
FOR THE REPLACEMENT OF THE
SR 2002 SECTION 01S BRIDGE
OVER
OTTER CREEK
BRISTOL BOROUGH AND BRISTOL TOWNSHIP
BUCKS COUNTY

General Description of Project

The project involves the replacement of the existing bridge carrying SR 2002 (Otter Street) over Otter Creek in Bristol Borough and Bristol Township, Bucks County. The project is scoped for a bridge replacement closely following the existing alignment with improvements to meet PENNDOT standards. The purpose of the project is to provide a safe and reliable crossing of SR 2002 (Otter Street) over Otter Creek. The existing structure is on a tangent horizontal alignment with a 0.05% vertical grade. The roadway curves sharply on the west approach just beyond the bridge. The existing structure is a two-span concrete encased steel I-beam bridge with each span having a length of 20± feet for a total bridge length of 50± feet. The bridge carries two (2) traffic lanes on a 35’-9½”± wide roadway, with flanking 10’-0”± wide concrete sidewalks. The beams support a reinforced deck with a crowned bituminous wearing surface and flanking sidewalks and concrete railings. The structure is supported on a solid stem concrete pier and concrete gravity abutments with U-shaped wingwalls. The bridge was built in 1912.

There will be 476 feet of roadway reconstruction associated with the bridge replacement project. The vertical alignment will be raised 0.68’ in the vicinity of the bridge to maintain the existing bridge opening area. The roadway widths will be increased to meet current criteria and design standards.

The replacement structure will be a single span, prestressed concrete adjacent box beam structure with a clear span length of 56 feet founded on new, reinforced concrete abutments with spread footings. The proposed 58’-10” wide structure would accommodate one 12-foot wide eastbound travel lane and one varying width (15-foot minimum) westbound travel lane, two 8-foot wide shoulders, two varying width (5-foot minimum) sidewalks, and two 1’-2” wide barriers. The bridge width (curb to curb) will vary from 43 foot to 46’-2” across the structure. The replacement bridge will be constructed under a complete detour.

In addition to the obvious cost savings associated with not having to construct a pier, this span arrangement will improve stream hydraulics by providing a slightly greater waterway opening than the existing bridge and will eliminate a debris and scour point in the creek. The superstructure would support a reinforced concrete deck with flanking sidewalks and concrete barriers. The new Abutment No. 1 would be constructed with the centerline of bearing 90° to the tangent of the roadway centerline. Abutment No. 2 will be constructed parallel to Abutment No. 1, therefore, Abutment No. 2 will be skewed to the roadway centerline. The abutments would have wingwalls...
flared to Otter Creek. The existing pier would be removed to the existing streambed elevation to minimize stream impacts.

The proposed structure alignment will be slightly shifted to the northeast to better align with Otter Creek than the existing and to provide an improved horizontal roadway alignment. Minor right-of-way acquisitions from 5 parcels will be required to build the proposed structure.

The existing land use within the project area is urban and commercial in nature. A large percentage of the ground is covered with impervious materials such as buildings, parking lots and roadways. Erosion and sediment pollution control items have been staged due to the surrounding properties and the close proximity of the existing retaining and gabion walls. The contractor is expected to coordinate the construction and the erosion and sediment pollution control measures with the surrounding property owners and any potential construction. The proposed project will not change the land use or significantly increase the amount of impervious cover.

Roadway drainage is sheet flow across paving to curbed inlets. Inlets will be relocated along the proposed curb line, tying into the existing SR 2002 (Otter Street) stormwater sewer system draining to Otter Creek.

**Chapter 93 Classification**

<table>
<thead>
<tr>
<th>Stream</th>
<th>Zone</th>
<th>County</th>
<th>Water Uses Protected</th>
<th>Exceptions to Specific Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1—Delaware Estuary</td>
<td>Tidal portion of Basin, Head of Tide to Burlington-Bristol Bridge</td>
<td>Bucks</td>
<td>WWF, MF</td>
<td>Delete Alk$_1$, Bac$_1$, DO$_2$, pH$_1$, Temp$_2$, TDS$_1$ and Am</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Add Alk$_3$, Bac$_5$, Enterococcus-maximum geometric average 33 per 100 ml, Ch$_4$, DO$_3$, Hd$_2$, MBAS$_1$, pH$_2$, Rad, TDS$_3$, Temp$_5$, Temp$_7$, TON and Tur$_1$</td>
</tr>
</tbody>
</table>

**Soil Survey Information**

The soil underlying the project area at Otter Creek is Urban Land (UfuB). According to the *Soil Survey of Bucks and Philadelphia Counties*, this area is highly urbanized where urban structures and works cover much of this land type, that identification of the soils is not practical. Slopes are 0-8 percent. This land type is found on the uplands, on terraces on the coastal plain, and on the flood plain. Most areas have been smoothed and the original soil material has been disturbed, filled over, or otherwise destroyed prior to construction. Depth to the rock is variable.
According to the geological map of Pennsylvania, the structure is underlain by the Trenton Gravel Formation (Qt), formerly the Cape May Formation, from the Quaternary Period. The Trenton Gravel Formation (Qt) is described in the *Engineering Characteristics of the Rocks of Pennsylvania* as consisting of gray to pale-reddish brown, very gravelly sand with interbedded crossbedded sand and clay-silt layers. The Trenton Gravel is deeply weathered and composed of outwash and alluvium that consists of weathered gravel of granite, sandstone, gneiss, siltstone, and quartzite. The Trenton Gravel is approximately 30 feet thick. Ease of excavation is easy while the foundation stability and cut-slope stability are both poor.

The Soils Map and Geological Map for the project location are included in attachment C of this report.

The overburden soils, taken from soil borings at the four corners of the proposed structure consist of fill material underlain by silty sand soil. Table 1 details the characteristics of the soils.

### Table 1. Soil Characteristics

<table>
<thead>
<tr>
<th>Name/Classification</th>
<th>Average Layer Thickness (ft)</th>
<th>Soil Description</th>
<th>Color</th>
<th>Moisture Content</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill</td>
<td>10</td>
<td>Silt, sand, gravel and concrete and brick fragments</td>
<td>Brown, gray, or black</td>
<td>Moist to wet</td>
<td>Loose to medium dense</td>
</tr>
<tr>
<td>Subsoil (SM/A-1-b, ML/A-4, SP-SM/A-2-4, SM/A-4 or GM/A-1-a)</td>
<td>50</td>
<td>Fine to coarse silty sand, with some gravel</td>
<td>Gray, white, brown, or red</td>
<td>Wet</td>
<td>Dense to very dense</td>
</tr>
</tbody>
</table>

Boring B-2 indicated that decomposed schist is present below the subsoil.

**Schedule of Work**

The bridge will be built in one stage with SR 2002 through traffic detoured. While the proposed bridge is being constructed, all vehicular traffic will be diverted onto Old Bristol Pike (Old route 13). The detour is approximately 1.1 miles long. Both bridge approaches will be staged to allow for access to businesses and driveways. The bridge construction will be from Sta. 99+50± to 100+50±. The remainder of the project will consist of the construction of pavement, curb and sidewalk on both approach roadways. The total disturbed area is 0.992 acres.
Significant events in the SR 2002 (Otter Street) over Otter Creek bridge construction schedule are:

1. Install traffic control devices on SR 2002 and Old Bristol Pike, closing a portion of SR 2002 to traffic (from Sta. 96+50 to 102+50), while maintaining access to driveways from SR 2002. Install silt fence at limits of disturbance. Install filter bag inlet protection. Install rock construction entrances at both ends of the project prior to permitting construction vehicles to travel on disturbed areas.

2. Clear and grub embankment, and strip and stockpile topsoil. Provide a 6" layer of stone and silt fence as necessary along temporary roadway to maintain stability in traffic areas. Install Temporary Protective Fence for Existing Plant Material and temporary causeway for existing structure demolition. Construct temporary access road from north side of roadway to temporary causeway location. Stabilize any disturbed areas.

3. Establish area for sediment filter bags. Install debris screen under existing structure and cofferdams at pier and abutments. Demolish existing structure including pier and abutments. No equipment will be operated from the stream, and no debris will be left in the stream.

4. Remove temporary causeway and access road. Construct new abutments and superstructure. Construct embankment for northeast wingwall and establish final grade. Stabilize with seed mixture as indicated on plans. Remove erosion and sediment control devices tributary to the disturbed area only after permanent stabilization is established in affected area. Remove temporary diversion and restore area.

5. Divert flow from existing pipes within limit of disturbance to allow for inlets and pipes to be constructed under dry conditions. Contractor has the option of diverting flow using siphon, flume, or 24-hour continuous pumping.

6. Construct new inlets left and right of the centerline at Sta. 99+50 and Sta. 100+92. Construct new inlet right of the centerline at Sta. 100+60. Construct new storm drains between new inlets and at outlet locations as shown on plan. Stabilize the storm drains and inlets prior to diverting flow to new pipe.

7. Construct roadway on the west and east approaches. To maintain stability in traffic areas, provide 6" layer of stone as necessary along the roadway. Stabilize construction immediately upon completion.

**General Description of Erosion & Sediment Pollution Control Program**

Resulting sediment from bridge demolition and construction, roadway grading and associated earthwork will be controlled and maintained by the following methods:

1. Prior to the establishment of cofferdams, an area for sediment filter bags shall be constructed to filter silts and sediments from water before discharging into the creek. A
volume of 100 C.F. for every 100 g.p.m. pumped water discharge shall be provided. The sediment filter bag shall conform to Special Provision for Item 9858-0001.

2. A temporary causeway shall be constructed to provide access to the existing bridge pier for demolition. Causeway shall be directed to center of existing east span, as indicated on the plan. Rock for the temporary causeway shall be Rock, Class R-5 in accordance with PENNDOT Publication 408, 2003 Specifications Section 850. Geotextile, Class 4, Type A shall comply with Section 212.

3. Prior to demolition of superstructure, debris screens shall be installed to prevent stream pollution. Debris screens shall not be removed until the superstructure has been completely removed.

4. Prior to all earthwork activities, a silt barrier fence shall be installed as shown on the Erosion & Sediment Pollution Control Plan, in accordance with PENNDOT Publication 408, 2003 Specifications, Section 865. The silt barrier fence is to be installed prior to constructing the causeway and temporary road. It can be removed when the area is stabilized.

5. Temporary rock construction entrances shall be provided and maintained (or reinstalled if necessary) during earthwork activities. Entrances are shown and detailed on the Plan. All materials used for these entrances shall comply with PENNDOT Publication 408, 2003 Specifications, Sections 212 & 703.

6. A temporary protective fence for existing plant material shall be installed prior to clearing and grubbing for each stage of construction. The protective fence shall conform to PENNDOT Publication 408, 2003 Specifications, Section 811.

7. Filter bag inlet protection for storm inlets shall be installed to prevent sediment from entering storm drainage system. The filter bag inlet protection shall conform to Special Provision for Item 9006-0122.

8. All drainage structures, utilities, and existing features shall be stabilized prior to establishing embankments. Construction of embankments over pipes will not continue until all pipes and inlets tributary to the pipes are confirmed operational.

9. Area disturbed by construction shall be temporarily or permanently stabilized immediately upon disturbance completion. Areas employing vegetative stabilization must be seeded or planted in adequate time to germinate by October 15th of each year. Hydroseeding techniques or conventional seeding and mulching, at the rate of 3.0 tons/acre, shall be utilized.

10. Formula B seeding shall be used for all lawn areas. All other areas shall be stabilized with Formula L seeding. Temporary seeding will be Formula E. Seeding and mulching shall be in accordance with PENNDOT Publication 408, 2003 Specifications, Sections 804 and 805.
11. Mulch anchoring systems, comprised of mulch control netting, shall be constructed on slopes 3:1 or steeper, and will be installed in accordance with PENNDOT Publication 408, 2003 Specifications, Section 806.

12. Sediment deposited in erosion and sediment pollution control structures and devices shall be removed and disposed of in compliance with PENNDOT Publication 408, 2003 Specifications, Section 861. (According to specifications, removal is required when sediment accumulation has reached one-third of the depth of the device.)

13. Comply with all DEP regulations relating to solid waste disposal/recycling.

14. Stockpile heights must not exceed 35 feet. Stockpile slopes must be 2:1 or flatter.

15. Properly maintain all erosion and sediment Best Management Practices (BMPs) until the site is stabilized. Inspect all erosion and sediment BMPs after each runoff event and on a weekly basis. Perform immediately all preventative and remedial maintenance work, including clean out, repair, replacement, regrading, reseeding, remulching and renetting. If erosion and sediment control BMPs fail to perform as expected, replace BMPs, or modify those installed.

16. For any additional disturbances including spoil or borrow areas not covered by this plan, obtain the necessary approvals from Bucks County Conservation District.

**Maintenance & Removal of Temporary Erosion & Sediment Pollution Control Devices**

Devices for erosion and sediment pollution control shall be satisfactorily maintained for the duration of the project. The devices shall be periodically cleaned to remove sediment and/or debris deposited when the amount of sediment reaches one-third the depth of the device, in accordance with PENNDOT Publication 408, 2003 Specifications, Section 861. (The Inspector-in-Charge may require cleaning and removal of sediment at anytime during construction.)

After the project is completed and the site is properly stabilized, temporary devices shall be removed and disturbed areas shall be cleaned and restored to the Inspector-in-Charge’s satisfaction.

**Unforeseen Project Water Pollution Control**

A special pay item will be included (at a pre-determined price) in the construction specifications which will be implemented as required to cover all recommended measures that must be taken should any unforeseen erosion or sediment pollution problems occur. The Inspector-in-Charge shall direct the contractor to correct any such problems.

**Special Provision**

The entire narrative shall be incorporated as a Special Provision within the project construction documents. Copies of the Special Provisions for items not included in PENNDOT Publication 408, 2003 Specifications are included in Appendix F.
EROSION & SEDIMENT POLLUTION CONTROL PLAN

ATTACHMENT A

Resume
EROSION AND SEDIMENT POLLUTION CONTROL NARRATIVE
FOR THE REPLACEMENT OF THE
SR 2002 SECTION 01S BRIDGE
OVER
OTTER CREEK
BRISTOL BOROUGH AND BRISTOL TOWNSHIP
BUCKS COUNTY

PREPARER: Candace A. Funston, P.E.
Project Engineer - Highway

COMPANY: Lichtenstein Consulting Engineers, Inc.
One Oxford Valley, Suite 818
Langhorne, PA 19047
(215) 752-2206
cfunston@lce.us

Experience: Ms. Funston has fifteen years of erosion and sediment pollution control experience. Recent projects include:
- S.R. 2021 Section 01B Bridge (Lindbergh Viaduct) rehabilitation in City of Reading, Berks County
- S.R. 0013 Section 01B bridge replacement in Delaware County
- S.R. 2006 Section 002 bridge replacement in Carbon County
- Strawberry Mansion Bridge rehabilitation project in the City of Philadelphia

Courses: “NPDES Stormwater Management Permit Seminar”
October 27, 2004
Berks, Carbon, Lehigh, Northampton & Monroe County Conservation Districts

“E&S Review, Design, and Innovations Seminar”
October 13, 2004
Berks County Conservation District

“Stream Stability and Scour at Railroad Bridges”
January 29 & 30, 2003
by AREMA

“New Chapter 102 Manual, Erosion and Sediment Control”
October 13, 2000
Berks, Carbon, Lehigh, Northampton & Monroe County Conservation Districts.

“Erosion and Sedimentation Control Seminar”
December 1, 1995
Southeastern PA Association of Conservation Districts
EROSION & SEDIMENT
POLLUTION CONTROL PLAN

ATTACHMENT B

Location Map
Aerial Map
Topographic Map
S.R. 2002 (OTTER STREET) OVER MILL CREEK
INTERSECTING PA ROUTE 413 AND OLD ROUTE 13
LOCATION MAP
BRISTOL TOWNSHIP AND BRISTOL BORO
BUCKS COUNTY, PA
PREPARED BY: PINTO ENGINEERING, INC.

LEGEND

- STREAMS
- RAILROADS
--- LOCAL ROADS
- STATE ROADS

PROJECT LOCATION
MUNI. BOUNDARY

1" = 2000'
S.R. 2002 (OTTER STREET) OVER MILL CREEK INTERSECTING PA ROUTE 413 AND OLD ROUTE 13
AERIAL MAP
BRISTOL TOWNSHIP AND BRISTOL BORO
BUCKS COUNTY, PA
PREPARED BY: PINTO ENGINEERING, INC.

LEGEND
STREAMS
MUNI. BOUNDARY
RAILROADS

1" = 2000'
EROSION & SEDIMENT
POLLUTION CONTROL PLAN

ATTACHMENT C

Soils Map
Geological Map
EROSION & SEDIMENT POLLUTION CONTROL PLAN

ATTACHMENT D

Drainage Calculations
DRAINAGE NOTES:

1) INLET 2 accepts drainage from unknown area (18" RCP pipe w/o inlet)
4) Assume no drainage

2) INLET 2 discharges to pipe with slopes upstream (+0.4%)

3) Assume INLET 2 discharges to Proposed INLET 3 through 18" RCP (shown as broken pipe with no starting INLET on existing TPOD)
Fig. 6. Rainfall intensity-duration-frequency curves for Region 5.

1. 12
### Existing Drainage Calculations

**Line: Inlet 1**

Design Storm - 10 year
\( T_c = 5 \text{ min.} \)

Pipe Flow:
\[
Q = \text{flow(cfs)} = Va \\
V = \text{velocity(ft/s)} = (1.486/n) \times R^{2/3} \times S^{1/2} \\
R = a/WP \\
S = \text{slope(ft/ft)} \\
n = \text{roughness coefficient}
\]

Runoff (Sheet Flow):
\[
Q = \text{flow (cfs)} = CIA \\
C = \text{runoff coefficient} \\
I = \text{rainfall intensity (in/hr)} \\
A = \text{drainage area (acres)} \\
\]

<table>
<thead>
<tr>
<th>Inlet 1</th>
<th>Inlet 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runoff:</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.95</td>
</tr>
<tr>
<td>I</td>
<td>6.2</td>
</tr>
<tr>
<td>A</td>
<td>0.232</td>
</tr>
<tr>
<td>Q (req'd)</td>
<td>1.366</td>
</tr>
</tbody>
</table>

**I1 to I2**

Pipe:
\[
\text{Type} \quad \text{RCP} \quad \text{RCP} \\
\text{Size} \quad 15 \quad 18 \text{ in} \\
n \quad 0.012 \quad 0.012 \\
a \quad 1.227 \quad 1.767 \text{ sq ft} \\
WP \quad 3.927 \quad 4.712 \text{ ft} \\
R \quad 0.313 \quad 0.375 \\
\text{Length} \quad 63 \quad 250 \\
\text{Inv}_{\text{in}} \quad 13.79 \quad 10.54 \\
\text{Inv}_{\text{out}} \quad 11.26 \quad 7.40 \\
S \quad 0.0402 \quad 0.0125 \text{ ft/ft} \\
\text{Velocity} \quad 11.428 \quad 7.200 \text{ ft/s} \\
Q (\text{max}) \quad 14.024 \quad 12.723 \text{ cfs} \\
\]

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<td>V</td>
<td>7.2</td>
<td>5.0 fps *</td>
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**Line: Inlet 2**

Runoff:
\[
C \quad 0.95 \\
I \quad 6.2 \quad 6.2 \text{ in/hr} \\
A \quad 0.063 \quad 1.800 \text{ acres} \\
Q (req'd) \quad 0.371 \quad 10.973 \text{ cfs} \\
\]

**I2 to outlet**

Pipe:
\[
\text{Type} \quad \text{RCP} \quad \text{RCP} \\
\text{Size} \quad 24 \quad 24 \text{ in} \\
n \quad 0.012 \quad 0.012 \\
a \quad 3.142 \quad 3.142 \text{ sq ft} \\
WP \quad 6.283 \quad 6.283 \text{ ft} \\
R \quad 0.500 \quad 0.500 \\
\text{Length} \quad 63 \quad 250 \\
\text{Inv}_{\text{in}} \quad 13.79 \quad 10.54 \\
\text{Inv}_{\text{out}} \quad 11.26 \quad 7.40 \\
S \quad 0.005 \quad \text{upstream ft/ft} \\
\text{Velocity} \quad 5.516 \quad 0.000 \text{ ft/s} \\
Q (\text{max}) \quad 17.329 \quad 0.000 \text{ cfs} \\
\]

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<tr>
<td>V</td>
<td>2.3</td>
<td>0.0 fps *</td>
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</table>

* From pipe nomograph.
** Due to upstream flow of existing pipe between I5 & I8, pipe is adjusted for positive flow.
Water will collect in pipe but will still discharge to stream.
PIPE FLOW CHART
18-INCH DIAMETER
C FROM TABLE 2 p. 8

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
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<tr>
<td>1</td>
<td>Industrial</td>
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</tr>
<tr>
<td>2</td>
<td>Pavement</td>
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</tr>
<tr>
<td>3</td>
<td>Pavement</td>
<td>0.95</td>
</tr>
<tr>
<td>4</td>
<td>50% Pave (0.95) + 50% Lawn (0.20)</td>
<td>0.575</td>
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<tr>
<td>5</td>
<td>20% Residential + 80% Pave (0.95)</td>
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<td>6</td>
<td>20% Lawn (0.20) + 80% Pave (0.95)</td>
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<td>7</td>
<td>80% Veg/Lawn (0.40) + 20% Pave (0.95)</td>
<td>0.51</td>
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<tr>
<td>8</td>
<td>50% Veg/Lawn (0.25) + 50% Pave (0.95)</td>
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REF. DEP. EROSION & SEDIMENT POLLUTION CONTROL MANUAL, 2000
**Consulting Engineers**

**Lichtenstein**

**Project:** S.R. 0013  
**Job:** 2242  
**Sheet No:** 4 of 5  
**Calc. By:** E. Brush  
**Date:** 02/05/06  
**Scale:** N.T.S.

### Proposed Drainage Calculations

**Line: Inlet 1**  
Design Storm- 10 year  
Tc = 5 min.  
*(DM2, p.10-12)*

**Pipe Flow:**  
\[ Q = \text{flow(cfs)} = Va \]  
\[ V = \text{velocity(ft/s)} = \frac{(1.486/n) \times R^{2/3} \times S^{1/2}}{} \]

**Runoff (Sheet Flow):**  
\[ R = \frac{a}{WP} \]  
\[ Q = \text{flow (cfs)} = CIA \]  
\[ C = \text{runoff coefficient} \]  
\[ a = \text{area(sq ft)} = \pi \times (\text{Dia}/2)^2 \]  
\[ WP = \text{wetted perimeter(ft)} = \pi \times \text{Dia} \]  
\[ I = \text{rainfall intensity (in/hr)} \]  
\[ S = \text{slope(ft/ft)} \]

**A = drainage area (acres)**  
\[ n = \text{roughness coefficient} \]

<table>
<thead>
<tr>
<th>Inlet</th>
<th>Inlet 2</th>
<th>Inlet 3</th>
<th>Inlet 4</th>
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</thead>
<tbody>
<tr>
<td>C</td>
<td>0.95</td>
<td>0.95</td>
<td>0.95</td>
</tr>
<tr>
<td>I</td>
<td>6.2</td>
<td>6.2</td>
<td>6.2</td>
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<tr>
<td>A</td>
<td>0.232</td>
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<tr>
<td>Q (req’d)</td>
<td>1.366</td>
<td>1.814</td>
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**I1 to I2  I2 to I3  I3 to I4  I4 to outlet**

**Pipe:**

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<th>Type</th>
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<th>RCP</th>
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<th>RCP</th>
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<td>18</td>
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<td>18 in</td>
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<td>0.012</td>
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<td>a</td>
<td>1.227</td>
<td>1.767</td>
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<td>WP</td>
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<td>4.712</td>
<td>4.712 ft</td>
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<td>8.047 cfs</td>
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<th>OK</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>0.26</td>
<td>0.38</td>
<td>0.90</td>
</tr>
<tr>
<td>V</td>
<td>7.2</td>
<td>5.2</td>
<td>4.8</td>
</tr>
</tbody>
</table>

* From pipe nomograph.
PIECE FLOW CHART
15-INCH DIAMETER
PIPE FLOW CHART
18-INCH DIAMETER
### Consulting Engineers

**Proposed Drainage Calculations**

#### Line: Inlet 5

<table>
<thead>
<tr>
<th>Tc = 5 min. (DM2, p.10-12)</th>
<th>Pipe Flow:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q = flow(cfs) = Va</td>
</tr>
<tr>
<td></td>
<td>V = velocity(ft/s) = (1.486/n) * R^2/3 * S^1/2</td>
</tr>
</tbody>
</table>

#### Runoff (Sheet Flow):

- \( Q = \text{flow (cfs)} = CIA \)
- \( a = \text{area (sq ft)} = \pi \times (\text{Dia}/2)^2 \)
- \( WP = \text{wetted perimeter(ft)} = \pi \times \text{Dia} \)
- \( S = \text{slope(ft/ft)} \)
- \( n = \text{roughness coefficient} \)

#### Runoff:

<table>
<thead>
<tr>
<th>Inlet</th>
<th>C</th>
<th>I</th>
<th>A</th>
<th>Q (req'd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.91</td>
<td>6.2</td>
<td>0.063</td>
<td>0.355</td>
</tr>
<tr>
<td>6</td>
<td>0.86</td>
<td>6.2</td>
<td>0.346</td>
<td>1.845</td>
</tr>
<tr>
<td>7</td>
<td>0.51</td>
<td>6.2</td>
<td>1.071</td>
<td>5.587</td>
</tr>
<tr>
<td>8</td>
<td>0.6</td>
<td>6.2 in/hr</td>
<td>0.008</td>
<td>5.615 cfs</td>
</tr>
</tbody>
</table>

#### Check Capacity:

<table>
<thead>
<tr>
<th>OK</th>
<th>OK</th>
<th>OK</th>
<th>OK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>0.21</td>
<td>0.43</td>
<td>1.25</td>
</tr>
<tr>
<td>V</td>
<td>2.2</td>
<td>5.0</td>
<td>2.7</td>
</tr>
</tbody>
</table>

* From pipe nomograph.
Fig. 1100-204

PIPE FLOW CHART

INLET

Qn (CMS)

DISCHARGE - Q

Qn (CFPS)

VELOCITY (fps)

Vn (fps)

24" (61 cm)

I5 to I7

I6 to I7

(PROP)
PIPE I7 to I8
Slope = 0.001 1/1

Fig. 100-204

PIPE FLOW CHART

Vn = 0.032
V = 2745
Drainage calculation and scupper design (Existing)

\[ Q_{Rx} = CIA + (Q_R(x-1) - Q_i(x-1)) \]
\[ Q_G = \frac{1}{n} \times S_{x}^{1.67} \times S_{x}^{0.5} \times T^{2.67} \]
\[ Q_i = (E)(Q) = Q^*[Rf(Eo)+Rs(1-Eo)] \]
\[ V = \frac{1.12}{n} \times S_{x}^{0.5} \times S_{x}^{0.67} \times T^{0.67} \]
\[ T = (Q_R^*1/((.56/n)S_{x}^{1.67}S_{x}^{0.5}))^{(1/2.67)} \]

Max Spread 1/5 Lane width + shoulder (for shoulders less than 6')

\[ i = 6.2 \text{ in/hr} \]
\[ c = 0.94 \] (20% bridge decks (0.9) + 80% pavement (0.95))
\[ n = 0.016 \]

Shoulder = 0 ft
Lane width = 15 ft
Max spread T = 3 ft

<table>
<thead>
<tr>
<th>Area 1</th>
<th>Area 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>0.602</td>
</tr>
<tr>
<td>X-Slope (Sx)</td>
<td>0.02</td>
</tr>
<tr>
<td>Slope (S)</td>
<td>0.015</td>
</tr>
<tr>
<td>QR</td>
<td>3.51</td>
</tr>
<tr>
<td>QG (capacity)</td>
<td>0.117</td>
</tr>
</tbody>
</table>

\[ V = 3.05 \] 2.60 fps
Grate Length 2 ft
Grate Width 1.33 ft
Rf 1 1
Rs 0.078 0.085
W/T 0.12 0.16
Eo 0.44 0.44
Qi (intercept cap) 1.70 0.90 fps

\[ T = (QR^*1/((.56/n)S_{x}^{1.67}S_{x}^{0.5}))^{(1/2.67)} \]
Figure 3.2.3.7.4-4 - Grate Inlet Frontal Flow Interception Efficiency
**Example:**

Given: $S_x = 0.025$

- $L = 0.61\text{ m} (2\text{ ft})$
- $V = 1.22\text{ m/s} (4\text{ ft/sec})$

Find: $R_s = 0.063$

**Figure 3.2.3.7.4-5** - Grate Inlet Side Flow Interception Efficiency
T = PERMITTED SPREAD WIDTH
W = GRATE WIDTH

Figure 3.2.3.7.4-6 - Ratio of Frontal Flow to Total Gutter Flow
Drainage calculation and scupper design (Proposed)

\[ Q_{Rx} = CIA + (Q_{Rx-1} - Q_{Rx-1}) \]
\[ Q_G = (\frac{.56}{n}) S_x^{1.67} S^{0.5} T^{2.67} \]
\[ Q_i = (E)(Q) = Q[(R_f)(E_o) + R_s(1-E_o)] \]
\[ V = (\frac{1.12}{n}) S_x^{0.5} S^{0.67} T^{0.67} \]
\[ T = \left( Q_R^* \frac{1}{((.56/n)S_x^{1.67} S^{0.5})^{1/2.67}} \right) \]

Max Spread 1/5 Lane width + shoulder (if less than 6') or Shoulder Width

\[ i = 6.2 \text{ in/hr (figure 2.10.4.2 (D) 5 min duration, 10 year storm)} \]
\[ c = 0.9 \text{ bridge decks} \]
\[ n = 0.016 \]
Shoulder = 8 ft
Lane width = 12 ft
Max spread T = 8 ft

<table>
<thead>
<tr>
<th>Area 1</th>
<th>Area 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>78</td>
</tr>
<tr>
<td>Width</td>
<td>6</td>
</tr>
<tr>
<td>Area</td>
<td>0.011</td>
</tr>
<tr>
<td>X-Slope (Sx)</td>
<td>0.02</td>
</tr>
<tr>
<td>Slope (S)</td>
<td>0.015</td>
</tr>
<tr>
<td>QR</td>
<td>0.06</td>
</tr>
<tr>
<td>QG (capacity)</td>
<td>1.607</td>
</tr>
<tr>
<td>Qi (intercept cap)</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>1.10</td>
</tr>
<tr>
<td>Grate Length</td>
<td>2.5</td>
</tr>
<tr>
<td>Grate Width</td>
<td>2.3</td>
</tr>
<tr>
<td>Rf (Figure 3.5.2.7.4 (D))</td>
<td>1</td>
</tr>
<tr>
<td>Rs (Figure 3.5.2.7.4 (E))</td>
<td>0.49</td>
</tr>
<tr>
<td>W/T</td>
<td>0.29</td>
</tr>
<tr>
<td>Eo (Figure 3.5.2.7.4 (F))</td>
<td>0.59</td>
</tr>
<tr>
<td>Qi (intercept cap)</td>
<td>0.05</td>
</tr>
<tr>
<td>T actual</td>
<td>2.33</td>
</tr>
</tbody>
</table>

\[ T = \left( Q_R^* \frac{1}{((.56/n)S_x^{1.67} S^{0.5})^{1/2.67}} \right) \]
Figure 3.2.3.7.4-4 - Grate Inlet Frontal Flow Interception Efficiency
EXAMPLE:

GIVEN: \( S_x = 0.025 \)  
\( L = 0.61 \text{m (2 ft)} \)  
\( V = 1.22 \text{m/s (4 ft/sec)} \)  

FIND: \( R_s = 0.063 \)

\( S_x = \text{SHOULDER CROSS SLOPE} \)  
\( L = \text{LENGTH OF THE GRATE} \)  
\( V = \text{VELOCITY OF FLOW IN THE GUTTER} \)

Figure 3.2.3.7.4-5 - Grate Inlet Side Flow Interception Efficiency
$E_0 = \frac{Qw}{Q}$

$W / T = 0.29$

$T = \text{PERMITTED SPREAD WIDTH}$

$W = \text{GRATE WIDTH}$

Figure 3.2.3.7.4-6 - Ratio of Frontal Flow to Total Gutter Flow
EROSION & SEDIMENT
POLLUTION CONTROL PLAN

ATTACHMENT E

Erosion Control Calculations
STANDARD WORKSHEET # 3
Reinforced Filter Fabric Fence

PROJECT NAME: S.R. 2002 Otter Street
LOCATION: Over Otter Creek
PREPARED BY: E. Brush DATE: 01/10/06
CHECKED BY: C. Funston DATE: 04/18/06

CONSTRUCTION DETAIL:

Filter fabric fence must be installed at existing level grade. Both ends of each fence section must be extended at least 8 feet upslope at 45 degrees to the main fence alignment.

Sediment must be removed where accumulations reach 1/2 the above ground height of the fence.

Any fence section which has been undermined or topped must be immediately replaced with a rock filter outlet. See Rock Filter Outlet Detail.
<table>
<thead>
<tr>
<th>BARRIER NO.</th>
<th>LOCATION</th>
<th>SLOPE-PERCENT</th>
<th>SLOPE LENGTH ABOVE BARRIER (FT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>ACROSS LAWN (Sta. 97+85 to 98+67 LT.)</td>
<td>5% and less</td>
<td>10’</td>
</tr>
<tr>
<td>S2</td>
<td>END OF CAUSEWAY (Sta. 100+24 to 100+78 LT.)</td>
<td>33% and less</td>
<td>25’ and less</td>
</tr>
</tbody>
</table>

**CALCULATIONS**

**S1**
- Maximum existing slope = 5%
- Slope Length = 10ft
- For slope of 5%:
  - Maximum slope length = 250 ft  **OK**

**S2**
- Maximum slope = 33%
- Slope Length = 25ft
- For slope of 33%:
  - Maximum slope length = 42ft  **OK**
EROSION & SEDIMENT
POLLUTION CONTROL PLAN

ATTACHMENT F

Special Provisions
ITEM 9006-0122 - FILTER BAG INLET PROTECTION

DESCRIPTION - This work is furnishing, placing, maintaining, and removing sediment pollution control protection at existing and proposed curb inlets, as indicated or directed.

MATERIAL -

Provide Inlet Filter bags that trap all particles larger than 150 Microns.

CONSTRUCTION - As shown on the FILTER BAG INLET PROTECTION detail shown on the Erosion and Sediment Pollution Control plans and as follows:

Install filter bags according to the manufacturer's specifications.

Install sandbags and temporary earth to direct storm flow into inlet.

Inspect inlet protection weekly and after each storm event. Clean and/or replace filter bags when the bag is 1/2 full. Replace damaged filter bags. Initiate required repairs immediately after the inspection.

MEASUREMENT AND PAYMENT - Each

Temporary earth, sandbag or asphalt dikes considered incidental to this item.
ITEM 9858-0001 - SEDIMENT FILTER BAG

DESCRIPTION - This work is furnishing, installing, maintaining and disposing of a Sediment Filter Bag (bag).

MATERIAL –

Sediment Filter Bag. Provide straw as specified in Section 805.2(a)1.b Geotextile, Class 4 (Type A), 340 g/m2 (10 ounces/yard) as listed in Section 735.1. Construct a 4.6 m (15 feet) x 4.6 m (15 feet) (± 80 mm (3 inches)) bag using heat bonded seam or 401 lock chain stitch seam with a 98 kg (216 pounds), minimum breaking strength, tested in accordance with ASTM-D4632. Label each bag indicating maximum flow rate of bag in liters (gallons) per minute.

CONSTRUCTION –

Place bag over straw on a stabilized area. Distribute straw at the rate of 1 bale per 3 m2 (30 square feet). Filter bags may be used on low volume dewatering operations not to exceed 3785 liters (1000 gallons) per minute. Pump flow rate not to exceed 50% of maximum flow rate indicated on bag label. Double clamp bag firmly to pump discharge hose. Monitor and evaluate entire pumping operation to assure that bag continues to function properly. Replace bag when contained silt reduces flow to approximately 50% of rate of initial bag discharge, or when directed by the Inspector-in-Charge. Dispose of sediment in a manner satisfactory to the Engineer. Restore area as specified in Section 105.14.

MEASUREMENT AND PAYMENT - Lump Sum.

Includes straw, replacement, and disposal of filter bag and contained sediment as required.
EROSION & SEDIMENT
POLLUTION CONTROL PLAN

ATTACHMENT G

PENNDOT Standard Drawing RC-70M
Erosion and Sediment Pollution Control
1. FILTER BAGS MAY BE USED ON LOW VOLUME DWELLING OPERATIONS NOT TO EXCEED 100 LITERS (250 GALLONS) PER MINUTE.

2. CLEAR SITE BUT DO NOT DREDGE.

3. INVESTIGATE AREA TO DETERMINE PATH DISCHARGE WATER WILL TAKE. STABILIZE ANY POTENTIALLY ERODIBLE AREAS (STEEP SLOPED).

4. CONSTRUCT COURSE AGGREGATE PLATFORM SURFACE LEVEL. PLACE SEDIMENT FILTER BAG ON STABILIZED AREA.

5. IF THE EXISTING AREA IS STABILIZED, STREAM MAY BE USED INSTEAD OF FILTER BAG OR AGGREGATE. PLACE BAG OVER STREAM DISTRIBUTED AT THE RATE OF 1 BAG PER 400 SQ FT.

6. USE PUMP WITH A RATING IN GALLONS PER MINUTE NOT TO EXCEED SIZE OF THE MAXIMUM FLOW RATE LISTED ON THE BAG LABEL. DOUBLE CLAMP THE PUMP DISCHARGE HOSE TIGHTLY TO THE BAG.

7. MONITOR AND EVALUATE THE ENTIRE PUMPING OPERATION TO ENSURE THAT THE BAG CONTINUES TO FUNCTION PROPERLY. REPLACE THE BAG WHEN THE CONTAINED Silt REDUCES THE PUMP CAPACITY TO 60 PERCENT OR LESS (REPLACEMENT FREQUENCY AND METHOD DETERMINED BY INSPECT OR-IN-CHARGE). DISPOSE OF SEDIMENT IN A MANNER SATISFACTORY TO THE ENGINEER. ASSURE THE AREA AS SPECIFIED IN SECTION 105.14.

8. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED. U.S. CUSTOMARY UNITS ARE IN () PARENTHESES.

NOTE: EITHER ALL METRIC OR ALL ENGLISH VALUES MUST BE USED ON PLANS, METRIC AND ENGLISH VALUES SHOWN MAY NOT BE MIXED.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

SEDIMENT FILTER BAG