Section 5.2: Wet Vegetated Treatment Systems

Shallow WVTS: Design Notes

- Min flowpath of 2:1 (length to width)
- High surface area to volume ratio
  - Pretreatment (10% of WQv)
  - Deepwater zones (25% of WQv)
  - Remaining 65% WQv combination of shallow pool and ED
- Shallow depths over most of surface area
  - 35% 6 inches or less
  - 65% 18 inches or less
- Complex internal microtopography, including aquatic benches
- Plant with emergent vegetation
- Consumes most land of any BMP
  - 1.5% of DA
**Gravel WVTS: Design Notes**

- Min. length-to-width ratio 1:1, min. flowpath (L) of 15 ft
- Pretreatment: 10% WQv
- Remaining 90%, a combination of one or more basins/chambers filled with gravel and open ED
- Outlet invert just below gravel surface
- Surface area must be minimum 0.35% of DA
- May use organic soil
- Plant with emergent vegetation

**WVTS Materials List**

1. Earthwork
   - Embankment/berm soils
2. Outlet Control Structures
   - Concrete / PVC
   - Trash racks/hoods
3. Pipe
   - HDPE/PVC/Concrete
4. Storage
   - Clean washed stone
   - PVC chambers
5. Geomembrane liner
6. Plantings
   - Organic soils
   - Trees, shrubs & herbaceous materials
7. Other
   - ESC measures
   - Level spreaders
   - Loam and seed
   - Rip rap

**Approved WQ BMPs**

- Dams of ≥6' or capacity of ≥ 15 ac-ft should consult DEM Office of Compliance and Inspection Dam Safety regulations.
1. Embankments

- Fill material shall be free of roots, stones > 6 inches, other debris, placed in 8-inch layers.
- AASHTO Method T-99 (Standard Proctor) for compaction - 95% of maximum dry density with moisture content within 2% of the optimum.
- Embankment core and cut-off trench shall conform to USC GC, SC, CH, or CL and have at least 30% passing the #200 sieve.
- Cut-off trench min. width and depth of 4’. Side slopes 1:1 or flatter.
- Embankment core shall have top width of 4’ or less, height shall extend up to at least 100-yr water elevation or as shown on plans. 1:1 or flatter.

2. Outlet Control Structures

- Fiberglass Nyloplast (ADS, Inc.) catch basin structures - With frame and grate
- Typically 24” Diameter with main outlet and 1 to 2 underdrain inlets

Other Outlets

Concrete:
- 5000 psi concrete

Joint Sealant:
- 1) Mortar
- 2) Rubber Gasket
- 3) Butyl Joint Sealant
Air content: 6 % by volume

Trash Racks:
- Glass reinforced HDPE.
  - Load Rating: 2030 lbs./sq.ft.
  - Ultimate yield Strength: 1855 lbs./sq.ft.
- Maximum Deflection (@ 90 degrees F): < 2.00 inches
- UV protection must meet or exceed ASTM D2565-99.
- Grid material is 1 ½” thick with 5/8” webbing on center.
2. Outlet Control Structures

- Anti-seep collars, joints and valves shall be watertight.

3. Pipes - Inlet Structures

- HDPE Pipe with flared end section
- RCP with flared end section or wingwalls
- Riprap or landscape stone apron

Underdrain Pipe Cleanout

- Rigid schedule 40 PVC pipe with 5/8" perforations @ 6" O.C. meeting ASTM D 1785 (burr removed)
- Filter Fabric or not?
- PVC elbow, cap and all associated fittings
Bare Hill Pond, Harvard MA

321 acre freshwater lake
Town Swimming Beach
Eutrophication problems
Phosphorous/Noxious Plant TMDL
Gravel WVTS

Bypass to Existing Outlet
Diversion Manhole
Sediment Forebay
Gravel Wetland
Dry Swale

Forebay Dry Swale
Gravel Wetland
Diversion Manhole
Sediment Forebay
Bypass to Existing Outlet
4. Storage - Gravel

- AASHTO M-43 standard
- Washed, clean and open graded
- Size Varies;
  - ASTM # 2 or 3 Stone (<2 to 2 1/2")
  - ASTM #57 Stone (<1 1/2")
  - ASTM #8 (1-2")
**Storage Chambers**

- Injection molded from virgin polypropylene resin;
- Chambers shall be open-bottomed

**Minimum separation of 15’**

**Filter Fabric**

- Non-woven geotextile fabric with a flow rate of > 110 gal./min./sf.
- For use along the side walls, elsewhere?
5. Impermeable Liners

- When a WVTS is located in medium to coarse sands and above the average groundwater table, a liner shall be used to sustain a permanent pool of water. Typically needed when infiltration rate is 0.05 in/hr or greater.
- Acceptable options: a) 6-12 inches of clay (minimum 15% passing the #200 sieve and min. permeability of $1 \times 10^{-5}$ cm/sec), b) a 20 mil poly-liner, c) bentonite, or d) use of chemical additives.
- Use sand under liners for good base.

Liners (cont’d)

30MIL PVC impermeable liner:
- Specific Gravity (ASTM D 792): 120 (min.)
- Tensile (ASTM D 882): 73 (lb/in-width, min)
- Elongation at Break (ASTM D 882): 380 (% min.)
- Modulus (ASTM D 882): 30 (lb/in-width, min)
- Tear Resistance (ASTM D 1004): 30 (lb/in-min.)

Bentonite Clay
- Bentonite shall be a free flowing, high swelling, granular sodium bentonite.

6. Plants

- Native plants referred, non-invasive mandatory;
- Tolerant to wet/inundation
- Mix of shrubs and perennials - Shallow WVTS
- Rushes and sedges - Gravel WVTS
- Smaller plant sizes to keep costs down?
Plants

- All plant material shall conform to the guidelines of the “American Standard for Nursery Stock” latest edition

![American National Standards Institute (ANSI) logo](image)

Gravel WVTS Plantings

- Three-square bullrush (Scirpus pungens)
- Soft rush (Juncus effusus)
- Tussock sedge (Carex stricta)

Watering

- Soaker hose to water plants
- Both plants and grass will need watering during the initial establishment period.
- A watering schedule should be determined based upon plant species and the time of year
- If the plants are chosen properly watering should not be necessary after the plants are established
Gravel WVTS Organic Soil

- Uniform mix, free of stones, stumps, roots or other similar objects larger than 2 inches, and free of noxious weeds.
- 70 - 80 Sand
- 5 - 10% Soil Fines (<5% Clay)
- 15 - 20% Organic Matter
- Organic matter shall be well aged (6-12 months), well aerated, leaf compost or approved equivalent.
- Should have min. thickness of 8”

Pea Gravel

- 3/8” Washed stone
- Should be used between the organic soil layer and gravel
7. Other: Stone Forebay Structures
- Stone size in accordance with DA
- Concave shape
- Filter Fabric below subbase
- Height below overflow spillway

Other Options for Forebays
- 6" x 6" Pressure treated timbers
- Sediment Forebay Weir Wall
- Pre-cast curbing
- Armor downgradient edge of weir?

Side Slopes: Loam/ESC Blanket
- pH range of 5.5 to 7
- A minimum of 6% and a maximum of 20% organic material content
- Free of stones 1" or larger in any dimension
- Woven 100% biodegradable jute fiber
- Bionet S150BN
- To be used on >3:1 side slopes for stabilization
Grass Seed/Sod

- New England Conservation/Wildlife mix or approved equivalent: http://www.newp.com
- To be used on side slopes
- Sod can be used for faster results, but will increase the cost.

Landscape Stone/Rip Rap

- Rounded landscape river stone
- Min 4” diameter
- Greater aesthetic value but is more expensive
- Provide durable stone meeting RIDOT requirements
- D50 varies
- Less aesthetic value but is less expensive
**BMP Pretreatment Requirements**

<table>
<thead>
<tr>
<th>BMP Group</th>
<th>Required %WQ</th>
<th>Notes</th>
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<tbody>
<tr>
<td><strong>WVTS</strong></td>
<td>10%</td>
<td>Provided at each inlet, unless inlet provides &lt;10% of flow.</td>
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| **Infiltration** | 25%          | - Grass channel, filter strip, sediment forebay, proprietary device  
                 - Deep sump catch basin combined with one of the following:  
                   - Upper sand layer; or  
                   - Washed pea gravel (1/8" to 3/8")  
                 - Not required for permeable pavements (unless there is "run-on") or drywells |
| **Filtration Practices** | 25%          | - Deep sump catch basins may not be used as sole pretreatment. |
| **Green Roofs** | Not Applicable | No pretreatment required for direct rainfall. |
| **Open Channels** | 10%          | - forebays/checkdams at pipe inlets and/or driveway crossings  
                 - filter strip |

**Green Wetland Material Specifications**

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<tr>
<td>Holesides</td>
<td>1.5%</td>
<td>1.5% of the total project area.</td>
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Elements of Proper Installation

- Good Design Plans;
- Construction administration by the design engineer or a qualified resident engineer;
- Contractor skills and experience;
- Time of year construction;
- Surface water diversions and dewatering;
- Temporary and permanent stability;
- Construction stake-out;
- Routine construction inspections and progress meetings;
- Construction record documents.
**Mandatory Inspection**

- **Liners in WVTS**
  - Confirm sub grade dimensions
  - Prior to the installation of the underdrain
  - Watertight and coordinated with grading
- **Control Devices**
  - Confirm orifice/weir dimensions/elevations
  - Outlet pipe
  - Overflow spillways
WVTS - Maintenance

- Clean-out trash racks and access gates;
- Remove sediment from forebay every 5 yrs or after 50% loss in capacity - whichever occurs first;
- If 50% vegetative coverage is not achieved after 2nd growing season, reinforcement planting is required.
- Remove sediment and organic build-up from gravel WVTS ~2 yrs
- For discharges >200 ft from cold-water fisheries, inspect gravel trench outlet after every storm in first 3 months of operation. After that - once annually.
**WVTS - Maintenance Guidance**

- Replace dead/damaged vegetation
- Vegetation management around perimeter of WVTS
- Repair minor gullying.
- Repair embankment structural integrity (borrowing animals, seepage, slope sloughing);
- Repair structural elements (spillways, orifice, weir, etc.);
- Major erosion (inflow/exit channels)

Questions?