

## APPENDIX D DENSITY SEPARATION FACILITIES

### 1.0 Introduction

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This appendix provides information for the design of density separation facilities such as the extended detention dry pond.

### 2.0 Extended Detention Dry Pond

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An extended detention dry pond (Figure 1) is a basin that has been designed to detain stormwater for a sufficient time to allow particles and attached pollutants to settle. Infiltration is incidental, and is not taken into account in the pond's design. Extended detention dry ponds do not have a large permanent pool of water; the entire amount of water that enters the pond is released over a period of time.

Extended detention dry ponds effectively remove sediment and sediment bound pollutants, but not dissolved pollutants. They should not be used as stand-alone BMPs in urban areas or on highways with more than very low traffic volumes. Dry ponds are useful as pre-treatment for biofiltration and media filter BMPs.

A typical extended detention dry pond has the following facility features and components:

- **Storage** –The provided pond volume necessary to temporarily store the water quality volume.
- **Outlet control structure** – The outlet designed for a controlled release rate so the water quality design storm volume is detained for a specific time to allow for settling of pollutants, and to bypass high flows. The recommended primary outlet structure for these types of ponds is shown in Figures 2 and 3.
- **Auxiliary Outlet** – It is provided as a safety factor in the event the primary outlet control structure can not safely pass extreme high flows.



**Figure 1 Extended detention dry pond**

Figure 2 and 3 are general configurations of an extended detention dry pond. The actual configuration could vary depending on site constraints and applicable design criteria.

Extended detention dry ponds can be placed along:

- medians,
- interchanges,
- adjacent to ramps,
- and adjacent to roadways
- Away from the highway

## 2.1 Design Criteria

This section describes the features of extended detention dry ponds and the design criteria that apply specifically to these installations. Also apply the general requirements discussed in Section 14.10.

### 2.1.1 Site Selection

#### Area Requirements

1. The site must be of sufficient size to accommodate the pond and also to provide adequate setback distances, include. The proper setback distances are important to ensure slope stability, and maintenance access. General siting requirements are discussed in Section 14.9.

### Groundwater

1. Maintain a minimum distance of 3 feet from the bottom or invert of a facility to bedrock or seasonally high water table.

### Soil Suitability

1. Extended detention dry ponds are applicable in NRCS hydrologic soil groups B, C, and D.

### Pretreatment

1. A pretreatment facility component is required to be installed upstream of the proposed pond. Design a pretreatment facility component according to guidance provided in Appendix E.

### Pond Geometry

1. The **pond bottom area** must be sloped toward the outlet to prevent standing water conditions. A minimum bottom grade of 1 percent is recommended.
2. The pond must have adequate **depth** to provide the needed storage. Other considerations when setting depths include public safety, land availability, land value, present and future land use, water table fluctuations, soil characteristics, shading, maintenance requirements, and freeboard. Aesthetically pleasing features are also important in urbanized areas.
3. The **minimum bottom width** is 10 feet to provide the needed storage and allow for maintenance.
4. The **flow path** between the pond inlet and outlet must be maximized to ensure sufficient time to allow for sedimentation of pollutants. A pond length-to-width ratio of 3:1 or greater is recommended.
5. The pond **storage volume** is designed to temporarily store the water quality volume. This is the volume between the bottom of the pond up to the start of the freeboard volume. Freeboard volume is in addition to the storage volume needed for treatment.

The water quality volume is the predicted volume of runoff for the proposed conditions using the appropriate water quality design storm.

6. **Interior side slopes** should not be steeper than 1V:4H.
7. **Pond walls** may be retaining walls designed in accordance with the ODOT Geotechnical Design Manual. A fence is typically provided along the top of the wall.

8. The **freeboard** criteria of 1 foot minimum is required between the water quality design storm water elevation to the top of embankment. Freeboard is the vertical distance between the design water surface and the top of embankment, as shown in Figures 4.

### **Bottom Marker**

1. A **bottom marker** made of porous pavers must be installed along the pond bottom to indicate the bottom elevation. Select a porous paver from the Qualified Products List. The porous paver must provide a minimum 80 percent bottom area opening for grass growth. Spaced solid paver blocks are not allowed. Pavers can also function as the access grid to support maintenance equipment. See maintenance access section below.
2. Note the following in the facility's operation and maintenance manual:
  - the use of porous pavers to mark the bottom elevation of the pond
  - use sediment removal techniques that will not damage porous pavers

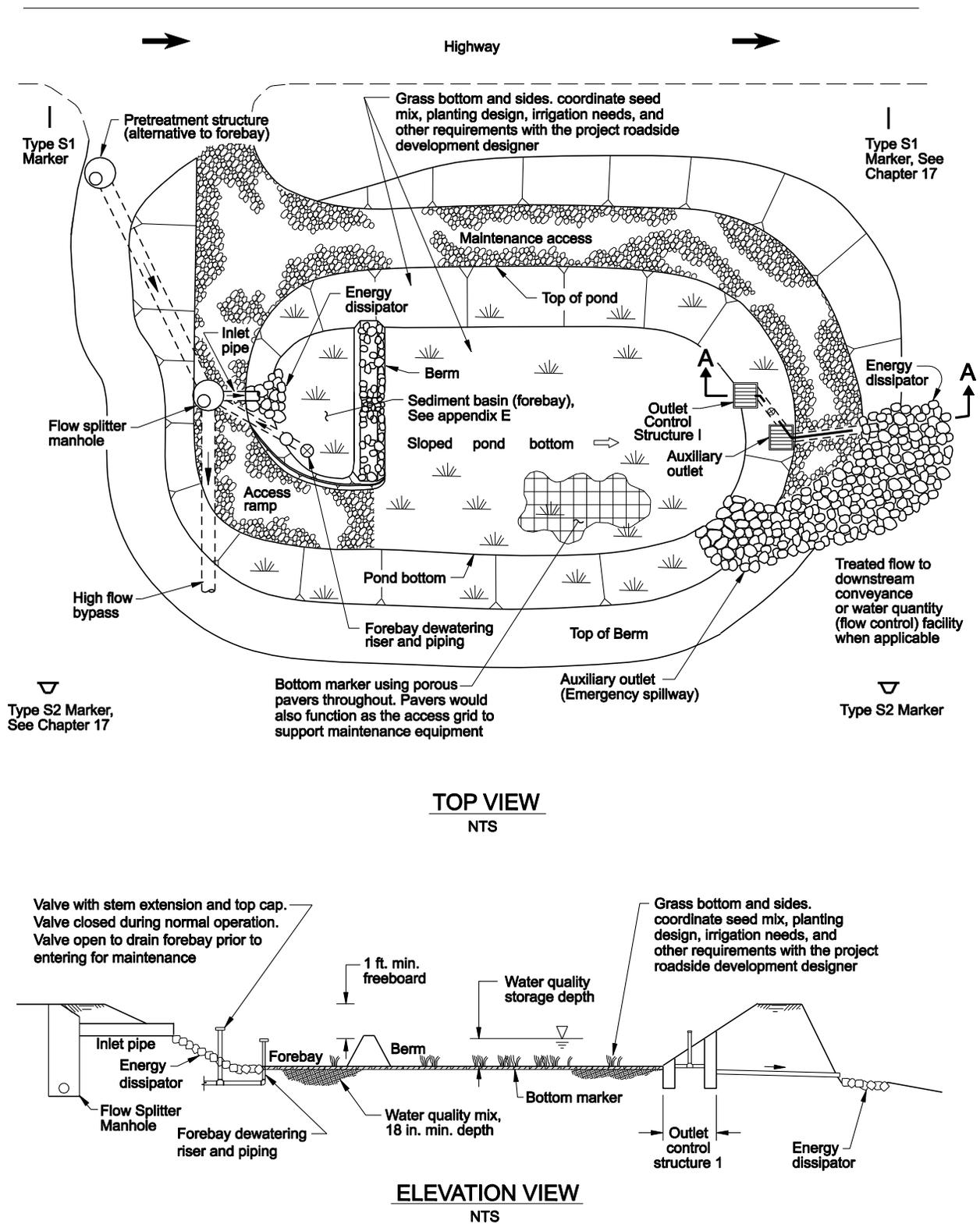
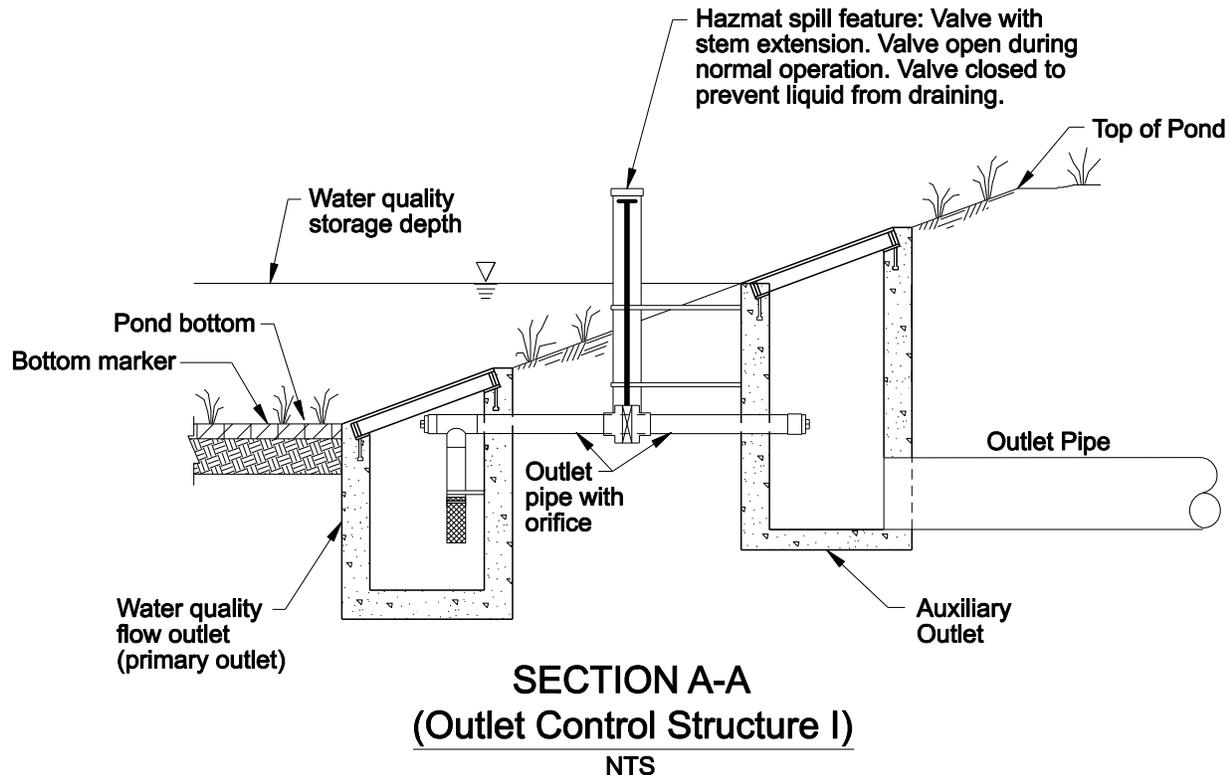


Figure 2 Extended Detention Dry Pond



**Figure 3 Extended Detention Dry Pond Outlet Control Structure**

### Embankments

Pond berm embankments are often needed for dry ponds to obtain sufficient storage volume. Pond berm embankments must meet the following criteria:

1. Vegetated pond berm embankments must be less than 20 feet in height and have exterior side slopes no steeper than 1V:3H and interior side slopes no steeper than 1V:4H.
2. Pond berm embankments higher than 6 feet shall be **designed by a geotechnical engineer**.
3. The **minimum top width** shall be 6 feet for pond berms 6 feet or less, or as recommended by a geotechnical engineer for higher berms.

## Maintenance Access

1. An **access road** shall be provided to the primary and auxiliary outlet control structures. The proposed access road must be able to support heavy equipment such as a vactor truck, dump truck, track how, or large mower.
2. Access road must be 16 feet in **width**.
3. The access road **maximum longitudinal slope** must be:
  - a) 2 percent (edge of pavement to a longitudinal distance of 20 feet)
  - b) 10 percent (20 feet from edge of pavement to end of access road)
3. An **access grid** made of porous pavers must be installed along the pond bottom for maintenance vehicle and mowing equipment access. Select a porous paver from the Qualified Products List. The porous paver must provide a minimum 80 percent bottom area opening for grass growth. Spaced solid paver blocks are not allowed. Pavers would also function as the bottom marker.
4. The access road **maximum cross slope** is 4 percent.
5. An access ramp is required for mowing, repairs, and sediment removal. The ramp must extend to the pond bottom.
6. **Maximum grade** of an access road or ramp shall be 10 percent
7. **Manhole lids** located in non-traffic areas such as grassed areas or behind guardrail must be set 1 foot above finish ground so that manhole location is visible for locating and for maintenance. This should be coordinated with the maintenance districts, lids may be placed flush with the finished grade at the request of the serving maintenance district. Lid elevations must match proposed finish grade in traffic areas.

## Treatment Detention Time

1. The **minimum required treatment detention time** is 48 hours. The detention time is the time duration to release the entire water quality volume.

## Safety Features

1. Exclusionary measures may be required to prevent entry to facilities that present a hazard to children and, to a lesser extent, all persons. Fences are recommended for detention areas where one or more of the following conditions exist:
  - areas where small children are present, particularly in residential areas and close to schools and playgrounds.

- areas where rapid water level increases would make escape practically impossible,
  - side slopes steeper than 1V:3H and have water depths greater than 3 feet for more than 24 hours or are permanently wet and have side slopes steeper than 1V:3H, or
2. Guardrail may be needed if the extended dry detention pond is placed next to a highway

### **Water Quality Mix**

There are three design options to establish a “Water Quality Mix” that meets criteria for organic content, long term hydraulic conductivity and other soil characteristics. See Appendix E.

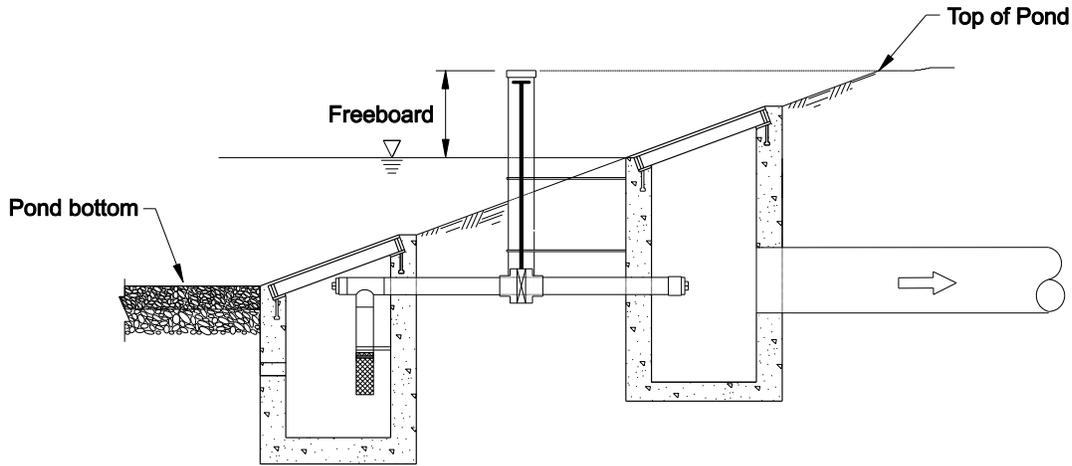
### **Planting Requirements**

1. Grass shall be established along the sides and bottom of pond, unless the local climate is unsuitable. Where grass is not appropriate, side slopes should be protected against erosion by other means. Note that urban jurisdictions may require plants and shrubs instead of grass.
2. Permanent seeding is best performed as follows:
  - West of the Cascades – March 1 through May 15 and September 1 through October 31 if grass areas are watered regularly during the establishment period.
  - East of the Cascades – October 1 through February 1 or March 1 through October 1 if grass areas are water regularly during the establishment period.

### **Field Markers**

1. Field Markers are required to be installed at the start and end of a facility’s maintenance area. Marking guidance is provided in **Chapter 17**.

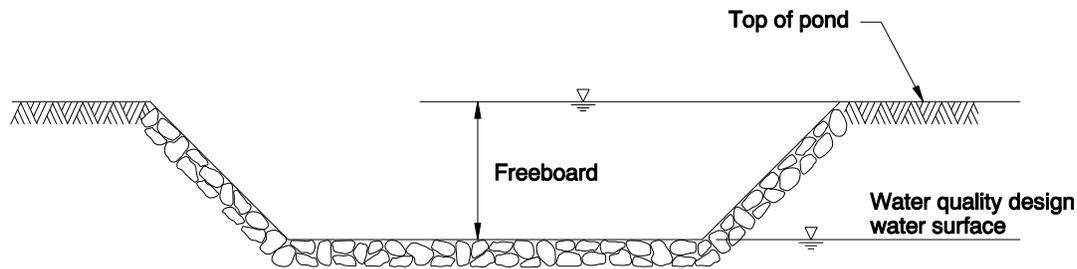
The figure below illustrates freeboard when the two-type D inlet structure is used:



**OUTLET CONTROL STRUCTURE I**

NTS

The figure below illustrates freeboard when an emergency overflow is used:



**EMERGENCY SPILLWAY**

NTS

**Figure 4 Freeboard**

## 2.2 Design Procedure

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The procedure for designing an extended detention dry pond is presented below.

- Step 1** – Determine water quality design storm. Highway runoff from impervious areas needs to address the most stringent standards or reference ODOT's requirements summarized in Section 14.10.2.
- Step 2** - Determine contributing impervious area. See Section 14.10.1
- Step 2** – Determine the water quality volume ( $V_{wq}$ ). Use hydrology guidance in **Chapter 7** and the design recurrence interval from step 1.
- Step 3** – Determine the dimensions of the pond that will contain the required storage. The method of determining the dimensions of a basin is presented in subsection 12.8.2.
- Step 4** – Adjust pond cross-section to include freeboard.
- Step 5** – Design the following facility components using the guidelines included in Appendix E:
- Pretreatment (sediment basin, pollution control manhole, or proprietary structure)
  - Water quality mix
  - Flow splitter manhole
  - Primary outlet structure
  - Auxiliary outlet when applicable
  - Storm drain piping
  - Outfall
  - Energy dissipation
  - Coordinate soil preparation, seed mix, irrigation needs, and other requirements with the project roadside development designer
  - Coordinate temporary and/or permanent erosion control measures with the project erosion control designer
- Step 6**– Prepare the Stormwater Design Report and Operations and Maintenance Manual as discussed in Section 14.10.15 and 14.11.
- Step 7** – Coordinate the installation field markers at the start and end of a facility's maintenance area. Marking guidance is provided in **Chapter 17**.