



# **Stormwater Management Facility Operation and Maintenance (O&M) Plan**

**for:**

*Tamlin Road RV Storage*

**Located at:**

*Northeast Corner of the intersection of  
Marksheffel Road and Tamlin Road*

**Prepared for:**

*Edward McDonald  
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Colorado Springs, CO  
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**Prepared by:**

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*01/20/2020*

**PCD FILE NO.: PPR1945**

## **Reference:**

**This plan is adapted from Southeast Metro Stormwater Authority, *OPERATION AND MAINTENANCE (O & M) MANUAL*, and Town of Parker, Colorado, *STORMWATER PERMANENT BEST MANAGEMENT PRACTICES (PBMP) LONG-TERM OPERATION AND MAINTENANCE MANUAL*, October 2004**

**Stormwater Management Facility  
Operation and Maintenance (O&M) Plan**

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## **Stormwater Management Facility Operation and Maintenance (O&M) Plan**

### **I. Compliance with Stormwater Facility Maintenance Requirements**

All property owners are responsible for ensuring stormwater facilities installed on their property are properly maintained and function as designed. Edward McDonald may elect to assign many of the management and maintenance functions described in this plan to a third party. Edward McDonald is aware of their responsibilities regarding stormwater facility maintenance. Maintenance agreement(s) associated with this property are provided in Appendix A.

### **II. Inspection & Maintenance – Annual Reporting**

Requirements for the inspection and maintenance of stormwater facilities, as well as reporting requirements are included in this Stormwater Management Facility Inspection and Maintenance (I&M) Plan.

**Verification that the Stormwater facilities have been properly inspected and maintained; submittal of the required Inspection and Maintenance Forms and Inspector qualifications shall be provided to the El Paso County on an annual basis. The annual reporting form shall be provided to the El Paso County prior to May 31st of each year.**

Copies of the Inspection and Maintenance forms for each of the stormwater facilities are located in Appendix D and E. A standard annual reporting form is provided in Appendix F. Each form shall be reviewed and submitted by the property owner or property manager to:

El Paso County  
Department of Public Work  
El Paso County Stormwater  
3275 Akers Drive  
Colorado Springs, Colorado 80922

### **III. Preventative Measures to Reduce Maintenance Costs**

The most effective way to maintain your water quality facility is to prevent the pollutants from entering the facility in the first place. Common pollutants include sediment, trash & debris, chemicals, dog wastes, runoff from stored materials, illicit discharges into the storm drainage system and many others. Edward McDonald's maintenance program includes measures to address these potential contaminants. Depending on the storm water quality facilities installed on the site the maintenance program includes:

- Educate property owners/residents to be aware of how their actions affect water quality, and how they can help reduce maintenance costs.
- Keep properties, streets and gutters, and parking lots free of trash, debris, and lawn clippings.
- Ensure the proper disposal of hazardous wastes and chemicals.

- Plan lawn care to minimize the use of chemicals and pesticides.
- Sweep paved surfaces regularly and dispose the sweepings properly.
- Be aware of automobiles leaking fluids. Use absorbents such as cat litter to soak up drippings – dispose of properly.
- Re-vegetate disturbed and bare areas to maintain vegetative stabilization.
- Clean out the upstream components of the storm drainage system, including inlets, storm sewers and outfalls.
- Do not store materials outdoors (including landscaping materials) unless properly protected from runoff.

#### **IV. Access and Easements**

Edward McDonald shall prepare a drawing showing all stormwater management facilities located on the site including designated access locations as well as a required easements. Refer to the Stormwater Facilities Map located in Appendix G for access and easement locations.

#### **V. Safety**

Keep safety considerations at the forefront of inspection procedures at all times. Likely hazards should be anticipated and avoided. Edward McDonald personnel should never enter a confined space (outlet structure, manhole, etc) without proper training or equipment. A confined space should never be entered without at least one additional person present and without using appropriate personal protection equipment.

If a toxic or flammable substance is discovered, leave the immediate area and call 911.

Vertical drops and fall hazards may be encountered in areas located within and around the facility. Edward McDonald shall avoid walking on top of retaining walls or other structures that have a significant vertical drop. If a vertical drop is identified that is greater than 48" in height, make the appropriate note/comment on the maintenance inspection form.

**If any hazard is found within the facility area that poses an immediate threat to public safety, call 911.**

#### **VI. Field Inspection Equipment**

Edward McDonald's inspectors shall have the appropriate equipment to take to the field. This is to ensure the safety of the inspector and allow the inspections to be performed as efficiently as possible. Below is a list of the equipment that may be necessary to perform the inspections of all Stormwater Management Facilities:

- Protective clothing and boots.
- Safety equipment (vest, hard hat, confined space entry equipment).

- Communication equipment.
- Inspection and Maintenance Plan for the site including stormwater management facility location maps.
- Clipboard.
- Stormwater Facility Maintenance Inspection Forms (See Appendix D).
- Manhole Lid Remover
- Shovel.

Some of the items identified above need not be carried by the inspector (manhole lid remover, shovel, and confined space entry equipment). However, this equipment should be available in the vehicle driven to the site.

## **VII. Inspecting Stormwater Management Facilities**

The quality of stormwater entering the waters of the state relies heavily on the proper operation and maintenance of permanent best management practices. Stormwater management facilities shall be periodically inspected to ensure they function as designed. The inspection will determine the appropriate maintenance required for the facility.

### **A. Inspection Procedures**

All stormwater management facilities shall be inspected by a qualified individual at a minimum of once per year. See the El Paso County *Storm Drainage Design & Technical Criteria* Manual for general guidelines for an inspector. Inspections will follow the inspection guidance found in the SOP for the specific type of facility. (Appendix C of this plan).

### **B. Inspection Report**

Edward McDonald's personnel or inspector conducting the inspection activities shall complete the appropriate inspection report for the specific facility. Inspection reports are located in Appendix D.

The following information explains how to fill out the Inspection Forms:

#### **General Information**

This section identifies the facility location, person conducting the inspection, the date and time the facility was inspected, and approximate days since the last rainfall. Property classification is identified as single-family residential, multi-family residential, commercial, or other.

The reason for the inspection is also identified on the form depending on the nature of the inspection. All facilities shall be inspected on an annual basis at a minimum. In addition, all facilities shall be inspected after a significant precipitation event to ensure the facility is draining appropriately and to identify any damage that occurred as a result of the

increased runoff.

### Inspection Scoring

For each inspection item, a score must be given to identify the urgency of required maintenance. The scoring is as follows:

- 0 = No deficiencies identified.
- 1 = Monitor – Although maintenance may not be required at this time, a potential problem exists that will most likely need to be addressed in the future. This can include items like minor erosion, concrete cracks/spalling, or minor sediment accumulation. This item should be revisited at the next inspection.
- 2 = Routine Maintenance Required – Some inspection items can be addressed through the routine maintenance program (See SOP in appendix C). This can include items like vegetation management or debris/trash removal.
- 3 = Immediate Repair Necessary – This item needs immediate attention because failure is imminent or has already occurred. This could include items such as structural failure of a feature (outlet works, forebay, etc), significant erosion, or significant sediment accumulation. This score should be given to an item that can significantly affect the function of the facility.
- N/A This is checked by an item that may not exist in a facility. Not all facilities have all of the features identified on the form (forebay, micro-pool, etc.).

### Inspection Summary/Additional Comments

Additional explanations to inspection items, and observations about the facility not covered by the form, are recorded in this section.

### Overall Facility Rating

An overall rating must be given for each facility inspected. The overall facility rating should correspond with the highest score (0, 1, 2, 3) given to any feature on the inspection form.

### C. Verification of Inspection and Form Submittal

The Stormwater Management Facility Inspection Form provides a record of inspection of the facility. Inspection Forms for each facility type are provided in Appendix D. Verification of the inspection of the stormwater facilities, the facility inspection form(s), and Inspector Qualifications shall be provided to the El Paso County on an annual basis. The verification and the inspection form(s) shall be reviewed and submitted by Edward McDonald or his property

manager.

Refer to Section II of this Plan regarding the annual reporting of inspections.

## **VIII. Maintaining Stormwater Management Facilities**

Stormwater management facilities shall be properly maintained to ensure they operate correctly and provide the water quality treatment for which they were designed. Routine maintenance performed on a frequently scheduled basis, can help avoid more costly rehabilitative maintenance that results when facilities are not adequately maintained.

### **A. Maintenance Categories**

Stormwater management facility maintenance programs are separated into three broad categories of work. These categories are based largely on the Urban Drainage and Flood Control District's Maintenance Program for regional drainage facilities. The categories are separated based upon the magnitude and type of the maintenance activities performed. A description of each category follows:

#### **Routine Work**

The majority of this work consists of scheduled mowings and trash and debris pickups for stormwater management facilities during the growing season. This includes items such as the removal of debris/material that may be clogging the outlet structure well screens and trash racks. It also includes activities such as weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year. These items can be completed without any prior correspondence with the El Paso County; however, completed inspection and maintenance forms shall be submitted to the El Paso County for each inspection and maintenance activity with the annual report.

#### **Restoration Work**

This work consists of a variety of isolated or small-scale maintenance and work needed to address operational problems. Most of this work can be completed by a small crew, with minor tools, and small equipment. The Edward McDonald shall correspond with the El Paso County and submit completed maintenance forms to the El Paso County for each maintenance activity.

#### **Rehabilitation Work**

This work consists of large-scale maintenance and major improvements needed to address failures within the stormwater management facilities. This work requires consultation with the El Paso County and may require an engineering design with construction plans to be prepared for review

and approval. This work may also require more specialized maintenance equipment, surveying, construction permits or assistance through private contractors and consultants. If these items are needed the Edward McDonald shall correspond with the El Paso County and submit completed maintenance forms to the El Paso County for each maintenance activity.

#### B. Maintenance Personnel

Edward McDonald's maintenance personnel shall be qualified to properly maintain stormwater management facilities. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

#### C. Maintenance Forms

The Stormwater Management Facility Maintenance Form provides a record of maintenance activities. Maintenance Forms for each facility type are provided in Appendix E. Maintenance Forms shall be completed by the Edward McDonald's contractor completing the required maintenance items. The form shall then be reviewed by the Edward McDonald or an authorized agent of the property owner and submitted on an annual basis to the El Paso County.

Refer to Section II of this Plan regarding the annual reporting of inspections and maintenance activities performed.



# **A P P E N D I X   A**

## **Stormwater Maintenance Agreement Template**

STORMWATER MAINTENANCE AGREEMENT  
BETWEEN

THE EL PASO COUNTY, acting by and through its  
Utility Enterprise  
and  
\_\_\_\_\_

THIS STORMWATER MAINTENANCE AGREEMENT, dated for reference this \_\_\_\_ day of \_\_\_\_\_, 20\_\_ is made by and between the El Paso County, a Colorado home rule city and

\_\_\_\_\_ (hereinafter, the "Owner") and the El Paso County, (hereinafter, the "City"), agree as follows:

Paragraph 1. The Owner owns the parcel of land known as Lot \_\_\_\_\_, Block \_\_\_\_\_, \_\_\_\_\_ Subdivision Filing No. \_\_\_\_\_, County of \_\_\_\_\_, State of Colorado (hereinafter, the "Property"). The Owner has installed, or caused to be installed, upon the Property the permanent stormwater best management practices (BMPs). Certain inspections and maintenance of those BMPs are required under the Owner's Inspection and Maintenance Plan, also referred to as the Operations and Maintenance Manual dated \_\_\_\_\_, 20\_\_ and approved by the El Paso County (hereinafter, the "IM Plan") which is attached to and made a part of this Stormwater Maintenance Agreement as Exhibit "A". The Owner agrees, at the Owner's sole expense, to inspect, maintain, and to ensure proper functioning of the BMPs, in accord with and as set out in the IM Plan, as set forth herein below. If the Owner conveys the Property, Owner shall provide a copy of the IM Plan along with a copy of this Agreement to the Grantee. Upon conveyance, Owner shall thereafter be relieved of its obligations under this Agreement. However, such obligations shall run with the Property and become the obligation of Grantee.

Paragraph 2. In accordance with the El Paso County Municipal Code 138-442.5, the Owner has submitted an IM Plan (Exhibit A). That IM Plan was approved by the City on \_\_\_\_\_, 20\_\_. The Owner has also submitted the Drainage Plan. That Drainage Plan was approved by the City on \_\_\_\_\_, 20\_\_.

Paragraph 3. The Owner shall inspect the BMPs at least once every calendar year, and shall submit written inspection reports to El Paso County Water prior to May 31st of that calendar year. The City is under no obligation whatsoever pursuant to this Agreement to notify the Owner of any failure to submit inspection reports.

Paragraph 4. The Owner shall promptly perform all maintenance and shall report maintenance activities to El Paso County Water in accordance with the requirements set forth in the IM Plan.

Paragraph 5. Subject to the notice and Owner's right to cure requirements of El Paso County Municipal Code Section 138-442.5, in the event that the Owner fails to inspect, maintain, or repair any BMP, Owner agrees that the City, at the City's sole discretion, shall have the right to enter upon the Property without warrant or further process of law and may make whatever inspection. Following the City's compliance with the notice requirements of 138-442.5 and Owner's right to cure any deficiencies noted, if the Owner fails to timely cure such deficiencies, the City shall have the right to enter upon the Property without warrant or further process of law and may complete whatever maintenance or repair may be needed, all at the Owner's sole cost. The City shall bill the Owner by invoice for any costs incurred by the City, including but not limited to personnel, contracting, labor, or materials, and the Owner shall pay those costs within thirty (30) City business days of the invoice date.

Paragraph 6. This Agreement shall be binding upon the Owner and the Owner's heirs, successors, and assigns. This Agreement shall be recorded at the Clerk and Recorder's Office. The benefits and burdens of this Agreement shall run with the land.

Paragraph 7. Governing Law. This Agreement is subject to and shall be interpreted under the law of the State of Colorado, and the Charter, City Code, ordinances, rules and regulations of the El Paso County, Colorado, a Colorado home rule city. The Parties agree that this Agreement shall be deemed to have been made in, and the place of performance is deemed to be in the El Paso County, Colorado.

Paragraph 8. Appropriation and availability of funds. In accord with the Colorado Constitution, Article X, Section 20, and the City Charter, performance of the City's obligations under this Agreement is expressly subject to appropriation of funds by the City Council and the availability of those funds for expenditure.

Paragraph 9. No Third Party Beneficiary. It is expressly understood and agreed that enforcement of the terms and conditions of this Agreement, and all rights of action relating to such enforcement, shall be strictly reserved to the Parties hereto, and nothing contained in this Agreement shall give or allow any such claim or right of action by any other or third person or entity on this Agreement. It is the express intention of the Parties hereto that any person or entity, other than the Parties to this Agreement, receiving services or benefits under this Agreement shall be deemed to be incidental beneficiaries only.

Paragraph 10. Amendments. This Agreement may be amended only by prior writing executed by duly authorized representatives of the Property Owner and the City, and recorded in the records of the Clerk and Recorder's Office.

Paragraph 11. Headings. The headings of the several paragraphs of this Agreement are inserted only as a matter of convenience and for reference and do not define or limit the scope or intent of any provisions of this Agreement and shall not be construed to affect in any manner the terms and provisions hereof or the interpretation or construction thereof.

Paragraph 12. Entire Agreement. This Agreement, together with all exhibits attached hereto, constitutes the entire agreement between the Parties hereto, and all other representations or statements heretofore made, verbal or written, are merged herein, and this Agreement may be amended only in writing, and executed by duly authorized representatives of the Parties hereto.

Paragraph 13. Nonwaiver Of Rights. No waiver of default by the City of any of the terms, covenants, and conditions hereof to be performed, kept, and observed by the Owner shall be construed, or shall operate, as a waiver of any subsequent default of any of the terms, covenants, or conditions herein contained to be performed, kept, and observed by the Owner.

Paragraph 14. Waiver. This Agreement is for the benefit of the Owner. The Owner does hereby waive, remise, and release any claim, right, or cause of action the Owner may have or which may accrue in the future, whether under theories of contract or any other cause of action whatsoever, against the City arising in whole or in part from this Agreement.

FOR THE EL PASO COUNTY:

By: \_\_\_\_\_ this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

Approved as to Form:

\_\_\_\_\_

FOR THE OWNER:

By: \_\_\_\_\_ this \_\_\_\_\_ day of \_\_\_\_\_,  
20\_\_\_\_.

\_\_\_\_\_  
(printed name)

By: \_\_\_\_\_ this \_\_\_\_\_ day of \_\_\_\_\_,  
20\_\_\_\_.

\_\_\_\_\_  
(printed name)

By: \_\_\_\_\_ this \_\_\_\_\_ day of \_\_\_\_\_,  
20\_\_\_\_.

\_\_\_\_\_  
(printed name)

(The Acknowledgement (notarization) will vary for Owner depending on if Owner is an individual, corporation or partnership. Also, where there is mortgage on the property, the mortgage holder must sign the Subordination section of this Agreement.)

**ACKNOWLEDGEMENT**  
(For an individual acting in his or her own right)

State of \_\_\_\_\_ )  
\_\_\_\_\_ )

County of \_\_\_\_\_ )

The foregoing instrument was subscribed and affirmed before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by \_\_\_\_\_.

---

Notary Public

My Commission Expires: \_\_\_\_\_

## ACKNOWLEDGEMENT

(For a Corporation)

State of \_\_\_\_\_ )  
\_\_\_\_\_ )

County of \_\_\_\_\_ )

The foregoing instrument was subscribed and affirmed before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by \_\_\_\_\_ of \_\_\_\_\_

\_\_\_\_\_, a

\_\_\_\_\_ corporation, on  
behalf of the corporation.

---

Notary Public

My Commission Expires: \_\_\_\_\_

## ACKNOWLEDGEMENT

(For a Partnership)

State of \_\_\_\_\_ )  
\_\_\_\_\_ )

County of \_\_\_\_\_ )

The foregoing instrument was subscribed and affirmed before me this \_\_\_\_\_day of \_\_\_\_\_, 20\_\_\_\_, by \_\_\_\_\_, as \_\_\_\_\_, on behalf of \_\_\_\_\_, a partnership.

---

Notary Public

My Commission Expires: \_\_\_\_\_



(For an individual acting as principal by an attorney in fact)

County of \_\_\_\_\_ )

---

Notary Public

01/2020

(By any public officer, trustee, or personal representative)

County of \_\_\_\_\_ )

---

My Commission Expires: \_\_\_\_\_

SUBORDINATION

\_\_\_\_\_, as holder of a mortgage or other  
lien or interest described as

\_\_\_\_\_ upon the parcel of land  
known as Lot \_\_\_\_\_, block \_\_\_\_\_, \_\_\_\_\_ Subdivision,  
Parcel Number \_\_\_\_\_, hereby intentionally and unconditionally  
subordinates that mortgage or other lien or interest in favor of this Stormwater  
Maintenance Agreement.

By: \_\_\_\_\_ this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

State of \_\_\_\_\_ )

)

County of \_\_\_\_\_ )

The foregoing Subordination was acknowledged before me this \_\_\_\_\_ day of  
\_\_\_\_\_, 20\_\_ by \_\_\_\_\_ as the Authorized Agent of

\_\_\_\_\_

\_\_\_\_\_ on behalf of

\_\_\_\_\_

\_\_\_\_\_.

\_\_\_\_\_

Notary Public

My Commission Expires: \_\_\_\_\_

EXHIBIT A  
Operation and Maintenance Plan

# **A P P E N D I X   B**

## **General Location and Description of Stormwater Management Facilities Example**

## **Appendix B**

### **General Location and Description of Stormwater Management Facilities Example**

#### **A. General Site Description**

The site is approximately 16.5 acres and is covered with sparse trees and native vegetation, of the 16.5 acres, a total of 10.9 acres will be disturbed. The site is located at the Northeast corner of the Tamlin Road and Marksheffel Road intersection. The site is currently vacant land located in a portion of Section 20, Township 13 South Range 65 West of the Sixth Principal Meridian in unincorporated El Paso County, Colorado.

#### **B. General Stormwater Management Description**

All developed stormwater is conveyed to and will be collected in a full spectrum water quality and detention pond.

#### **C. Stormwater Facilities Site Plan**

Inspection or maintenance personnel may utilize the Stormwater Facilities Map located in Appendix G for locating the stormwater facilities within this development.

#### **D. On-Site Stormwater Management Facilities**

*List all facilities for each of the types (see examples provided below)*

##### **Volume Reduction Facilities**

Residential Site utilizes Level I MDCIA – All impervious surfaces are routed through grass landscaped areas.

##### **Storage Facilities (Detention)**

Detention for the site is provided in a full spectrum water quality and detention pond. See the Facilities Map located in Appendix G for location of pond.

##### **Water Quality Facilities**

Water quality is provided in the full spectrum water quality and detention pond.

##### **Source Control Best Management Practices**

Residential Site does not include any nonstructural BMPs.

# **A P P E N D I X   C**

## **Standard Operating Procedures**

**For:**

**Extended Detention Basins (EDBs)**

**Grass Buffers and Grass Swales (GB-GS)**

# **A P P E N D I X   C – 1**

## **Extended Detention Basins**



# Standard Operation Procedures for Inspection and Maintenance

## Extended Detention Basins (EDBs)



September 2010

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## **EDB-1 BACKGROUND**

Extended Detention Basins (EDBs) are one of the most common types of Stormwater Management Facilities utilized within the Front Range of Colorado. An EDB is a sedimentation basin designed to “extend” the runoff detention time, but to drain completely dry sometime after stormwater runoff ends. The EDB’s drain time for the water quality portion of the facility is typically 40 hours. The basins are considered to be “dry” because the majority of the basin is designed not to have a significant permanent pool of water remaining between runoff events.

EDBs are an adaptation of a detention basin used for flood control, with the primary difference is the addition of forebays, micro-pools and a slow release outlet design. Forebays are shallow concrete “pans” located at the inflow point to the basin and are provided to facilitate sediment removal within a contained area prior to releasing into the pond. These forebays collect and briefly hold stormwater runoff resulting in a process called sedimentation, dropping sediment out of the stormwater. The stormwater is then routed from the forebay into the concrete trickle channel and upper basin, the large grassy portion of the basin. The EDB uses a much smaller outlet that extends the emptying time of the more frequently occurring runoff events to facilitate pollutant removal. An EDB should have a small micro-pool just upstream of the outlet. This micro-pool is designed to hold a small amount of water to keep sediment and floatables from blocking the outlet orifices.

## **EDB-2 INSPECTING EXTENDED DETENTION BASINS (EDBs)**

### **EDB-2.1 Access and Easements**

Inspection or maintenance personnel may utilize the stormwater facility map located in Appendix G containing the location(s) of the access points and maintenance easements of the EDB(s) within this development.

### **EDB-2.2 Stormwater Management Facilities Locations**

Inspection or maintenance personnel may utilize the stormwater facility map located in Appendix G containing the location(s) of the EDB(s) within this development.

### **EDB-2.3 Extended Detention Basin (EDB) Features**

EDBs have a number of features that are designed to serve a particular function. Many times the proper function of one feature depends on another. For example, if a forebay is not properly maintained, it could negatively affect the performance of a feature downstream (trickle channel, micro-pool, etc.). Therefore, it is critical that each feature of the EDB is properly inspected and maintained to ensure the overall facility functions as it was intended. Below is a list and description of the most common features within an EDB and the corresponding maintenance inspection items that can be anticipated:

**Table EDB-1**  
**Typical Inspection & Maintenance Requirements Matrix**

EDB Features	Sediment Removal	Mowing/ Weed control	Trash & Debris Removal	Erosion	Overgrown Vegetation Removal	Standing Water (mosquito/ algae control)	Structure Repair
Inflow Points (outfalls)	X		X				X
Forebay	X		X				X
Low-flow channel	X		X	X	X		X
Bottom Stage	X	X	X	X	X	X	
Micro-pool	X		X		X	X	X
Outlet Works	X		X				X
Emergency Spillway			X	X	X		X
Upper Stage			X	X			
Embankment		X		X	X		

#### EDB-2.3.1 Inflow Points

Inflow Points or Outfalls into EDBs are the point source of the stormwater discharge into the facility. An inflow point is commonly a storm sewer pipe with a flared end section that discharges into the EDB. In some instances, an inflow point could be a drainage channel or ditch that flows into the facility.

An energy dissipater (riprap or hard armor protection) is typically immediately downstream of the discharge point into the EDB to protect from erosion. In some cases, the storm sewer outfall can have a toe-wall or cut-off wall immediately below the structure to prevent undercutting of the outfall from erosion.

*The typical maintenance items found with inflow points are as follows:*

*a. Riprap Displaced* – Many times, because the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap apron appears to have settled, soil is present between the riprap, or the riprap has shifted, maintenance may be required to ensure future erosion is prevented. Depending on the nature of the maintenance the use of heavy equipment and proper bedding material may be required to repair the riprap. See Section EDB-3.5 – EDB-3.8.

*b. Erosion Present/Outfall Undercut* – In some situations, the energy dissipater may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility. If there is any

question to whether the original design is inadequate, a qualified engineer should review the situation to avoid chronic maintenance repairs if it is a design issue.

*c. Sediment Accumulation* – Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in hydraulic performance of the upstream infrastructure, sediment that accumulates in this area must be removed in a timely manner.

*d. Structural Damage* – Structural damage can occur at anytime during the life of the facility. Typically, for an inflow, the structural damage occurs to the pipe flared end section (concrete or steel). Structural damage can lead to additional operating problems with the facility, including loss of hydraulic performance.

*e. Woody Growth/Weeds Present* – Undesirable vegetation can grow in and around the inflow area to an EDB that can significantly affect the performance of the drainage facilities discharging into the facility. This type of vegetation includes trees (typically cottonwoods) and dense areas of shrubs (willows). If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate, resulting in blockage of the discharge. Also, tree roots can cause damage to the structural components of the inflow. Routine maintenance is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree). In addition, noxious weeds growing in the facility can result in the loss of desirable native vegetation and impact adjacent open spaces/land.

#### EDB-2.3.2 Forebay

A forebay is a solid surface (pad), typically constructed of concrete, immediately downstream of the inflow point. The forebay is designed to capture larger particles and trash to prevent them from entering the main portion of the EDB. The solid surface is designed to facilitate mechanical sediment removal (skid steer). The forebay typically includes a small diameter discharge pipe or v-notch weir on the downstream end and designed to drain the forebay in a specified period of time to promote sedimentation. The forebays vary in size and depth depending on the design and site constraints.

*The typical maintenance items found with forebays are as follows:*

*a. Sediment/Debris Accumulation* – Because this feature of the EDB is designed to provide the initial sedimentation, debris and sediment frequently accumulate in this area. If the sediment and debris is not removed from the forebay on a regular basis, it can significantly affect the

function of other features within the EDB. Routine sediment removal from the forebay can **significantly** reduce the need for dredging of the main portion of the EDB using specialized equipment (long reach excavators). Routine removal of sediment from the forebay can **substantially** decrease the long-term sediment removal costs of an EDB.

*b. Concrete Cracking/Failing* – The forebay is primarily constructed of concrete, which cracks, spalls, and settles. Damage to the forebay can result in decreased performance and impact maintenance efforts.

*c. Drain Pipe/Weir Clogged* – Many times the drainpipe or weir can be clogged with debris, and prevent the forebay from draining properly. If standing water is present in the forebay (and there is not a base flow), the forebay is most likely not draining properly. This can result in a decrease in performance and create potential nuisances with stagnant water (mosquitoes).

*d. Weir/Drain Pipe Damaged* – Routine maintenance activities, vandalism, or age may cause the weir or drain pipe in the forebay to become damaged. Weirs are typically constructed of concrete, which cracks and spalls. The drainpipe is typically smaller in diameter and constructed with plastic, which can fracture.

#### EDB-2.3.3 Trickle Channel (Low-Flow)

The trickle channel conveys stormwater from the forebay to the micro-pool of the EDB. The trickle channel is typically made of concrete. However, grass lined (riprap sides protected) is also common and can provide for an additional means of water quality within the EDB. The trickle channel is typically 6-9 inches in depth and can vary in width.

*The typical maintenance items found with trickle channels are as follows:*

*a. Sediment/Debris Accumulation* – Trickle channels are typically designed with a relatively flat slope that can promote sedimentation and the collection of debris. Also, if a trickle channel is grass lined it can accumulate sediment and debris at a much quicker rate. Routine removal of accumulated sediment and debris is essential in preventing flows from circumventing the trickle channel and affecting the dry storage portion of the pond.

*b. Concrete/Riprap Damage* – Concrete can crack, spall, and settle and must be repaired to ensure proper function of the trickle channel. Riprap can also shift over time and must be replaced/repared as necessary.

*c. Woody Growth/Weeds Present* – Because of the constant moisture in the area surrounding the trickle channel, woody growth (cottonwoods/willows) can become a problem. Trees and dense shrub type vegetation can affect the capacity of the trickle channel and can allow flows to circumvent the feature.

*d. Erosion Outside of Channel* – In larger precipitation events, the trickle channel capacity will likely be exceeded. This can result in erosion immediately adjacent to the trickle channel and must be repaired to prevent further damage to the structural components of the EDB.

#### EDB-2.3.4 Bottom Stage

The bottom stage is at least 1.0 to 2.0 feet deeper than the upper stage and is located in front of the outlet works structure. The bottom stage is designed to store the smaller runoff events, assists in keeping the majority of the basin bottom dry resulting in easier maintenance operations, and enhances the facilities pollutant removal capabilities. This area of the EDB may develop wetland vegetation.

*The typical maintenance items found with the bottom stage are as follows:*

*a. Sediment/Debris Accumulation* – The bottom stage can frequently accumulate sediment and debris. This material must be removed to maintain pond volume and proper function of the outlet structure.

*b. Woody Growth/Weeds Present* - Because of the constant moisture in the soil surrounding the micro-pool, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micro-pool (see EDB 2.3.5), which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree).

*c. Bank Erosion* – The bottom stage is usually a couple feet deeper than the other areas of the ponds. Erosion can be caused by water dropping into the bottom stage if adequate protection/armor is not present. Erosion in this area must be mitigated to prevent sediment transport and other EDB feature damage.

*d. Mosquitoes/Algae Treatment* – Nuisance created by stagnant water can result from improper maintenance/treatment of the bottom stage. Mosquito larvae can be laid by adult mosquitoes within the permanent pool. Also, aquatic vegetation that grows in shallow pools of water can decompose causing foul odors. Chemical/mechanical treatment of the

bottom stage may be necessary to reduce these impacts to adjacent homeowners.

*e. Petroleum/Chemical Sheen* – Many indicators of illicit discharges into the storm sewer systems will be present in the bottom stage area of the EDB. These indicators can include sheens, odors, discolored soil, and dead vegetation. If it is suspected that an illicit discharge has occurred, contact the supervisor immediately. Proper removal/mitigation of contaminated soils and water in the EDB is necessary to minimize any environmental impacts downstream.

#### EDB-2.3.5 Micro-pool

The micro-pool is a concrete or grouted boulder walled structure directly in front of the outlet works. At a minimum, the micro-pool is 2.5 feet deep and is designed to hold water. The micro-pool is critical in the proper function of the EDB; it allows suspended sediment to be deposited at the bottom of the micro-pool and prevents these sediments from being deposited in front of the outlet works causing clogging of the outlet structure, which results in marshy areas within the top and bottom stages.

*The typical maintenance items found with micro-pools are as follows:*

*a. Sediment/Debris Accumulation* – The micro-pool can frequently accumulate sediment and debris. This material must be removed to maintain the micro pool volume, depth, and proper function of the outlet structure.

*b. Woody Growth/Weeds Present* - Because of the constant moisture in the soil surrounding the micro-pool, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micro-pool, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree).

*c. Mosquitoes/Algae Treatment* – Nuisance created by stagnant water can result from improper maintenance/treatment of the micro-pool. Mosquito larvae can be laid by adult mosquitoes within the permanent pool. If mosquitoes are breeding within the micro-pool this may also be an indication there is significant sediment build-up that is reducing the depth of the micro-pool. Also, aquatic vegetation that grows in shallow pools of water can decompose causing foul odors. Chemical/mechanical treatment of the micro-pool may be necessary to reduce these impacts to adjacent homeowners.



*d. Petroleum/Chemical Sheen* – Many indicators of illicit discharges into the storm sewer systems will be present in the micro-pool area of the EDB. These indicators can include sheens, odors, discolored soil, and dead vegetation. If it is suspected that an illicit discharge has occurred, contact the supervisor immediately. Proper removal/mitigation of contaminated soils and water in the EDB is necessary to minimize any environmental impacts downstream.

#### EDB-2.3.6 Outlet Works

The outlet works is the feature that drains the EDB in specified quantities and periods of time. The outlet works is typically constructed of reinforced concrete into the embankment of the EDB. The concrete structure typically has steel orifice plates anchored/embedded into it to control stormwater release rates. The larger openings (flood control) on the outlet structure typically have trash racks over them to prevent clogging. The water quality orifice plate (smaller diameter holes) will typically have a well screen covering it to prevent smaller materials from clogging it. The outlet structure is the single most important feature in the EDB operation. Proper inspection and maintenance of the outlet works is essential in ensuring the long-term operation of the EDB.

*The typical maintenance items found with the outlet works are as follows:*

*a. Trash Rack/Well Screen Clogged* – Floatable material entering the EDB will most likely make its way to the outlet structure. This material is trapped against the trash racks and well screens on the outlet structure (which is why they are there). This material must be removed on a routine basis to ensure the outlet structure drains in the specified design period.

*b. Structural Damage* - The outlet structure is primarily constructed of concrete, which can crack, spall, and settle. The steel trash racks and well screens are also susceptible to damage.

*c. Orifice Plate Missing/Not Secure* – Many times residents, property owners, or maintenance personnel will remove or loosen orifice plates if they believe the pond is not draining properly. Any modification to the orifice plate(s) will significantly affect the designed discharge rates for water quality and/or flood control. Modification of the orifice plates is not allowed without approval from the El Paso County Public Works Department, Engineering Control Division.

*d. Manhole Access* – Access to the outlet structure is necessary to properly inspect and maintain the facility. If access is difficult or not available to inspect the structure, chances are it will be difficult to maintain as well.

e. *Woody Growth/Weeds Present* - Because of the constant moisture in the soil surrounding the outlet works, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate around the outlet works, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree).

#### EDB-2.3.7 Emergency Spillway

An emergency spillway is typical of all EDBs and designed to serve as the overflow in the event the volume of the pond is exceeded. The emergency spillway is typically armored with riprap (or other hard armor) and is sometimes buried with soil. The emergency spillway is typically a weir (notch) in the pond embankment. Proper function of the emergency spillway is essential to ensure flooding does not affect adjacent properties.

*The typical maintenance items found with emergency spillways are as follows:*

a. *Riprap Displaced* – As mentioned before, the emergency spillway is typically armored with riprap to provide erosion protection. Over the life of an EDB, the riprap may shift or dislodge due to flow. Depending on the nature of the maintenance the use of heavy equipment and proper bedding material may be required to repair the riprap. See Section EDB-3.5 – EDB-3.8.

b. *Erosion Present* – Although the spillway is typically armored, stormwater flowing through the spillway can cause erosion damage. Erosion must be repaired to ensure the integrity of the basin embankment, and proper function of the spillway.

c. *Woody Growth/Weeds Present* – Management of woody vegetation is essential in the proper long-term function of the spillway. Larger trees or dense shrubs can capture larger debris entering the EDB and reduce the capacity of the spillway.

d. *Obstruction Debris* – The spillway must be cleared of any obstruction (man-made or natural) to ensure the proper design capacity.

#### EDB-2.3.8 Upper Stage (Dry Storage)

The upper stage of the EDB provides the majority of the water quality flood detention volume. This area of the EDB is higher than the bottom stage and

typically stays dry, except during storm events. The upper stage is the largest feature/area of the basin. Sometimes, the upper stage can be utilized for park space and other uses in larger EDBs. With proper maintenance of the bottom stage, micro-pool, and forebay(s), the upper stage should not experience much sedimentation; however, bottom elevations should be monitored to ensure adequate volume.

*The typical maintenance items found with upper stages are as follows:*

*a. Vegetation Sparse* – The upper basin is the most visible part of the EDB, and therefore aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance and acceptance of the EDB by the public. In addition, vegetation can reduce the potential for erosion and subsequent sediment transport to the other areas of the pond.

*b. Woody Growth/Undesirable Vegetation* – Although some trees and woody vegetation may be acceptable in the upper basin, some thinning of cottonwoods and willows may be necessary. Remember, the basin will have to be dredged to ensure volume, and large trees and shrubs will be difficult to protect during that operation.

*c. Standing Water/Boggy Areas* – Standing water or boggy areas in the upper stage is typically a sign that some other feature in the pond is not functioning properly. Routine maintenance (mowing, trash removal, etc) can be extremely difficult for the upper stage if the ground is saturated. If this inspection item is checked, make sure you have identified the root cause of the problem.

*d. Sediment Accumulation* – Although other features within the EDB are designed to capture sediment, the upper storage area will collect sediment over time. Excessive amounts of sedimentation will result in a loss of storage volume. It may be more difficult to determine if this area has accumulated sediment without conducting a field survey.

Below is a list of indicators:

1. Ground adjacent to the trickle channel appears to be several inches higher than the concrete/riprap trickle channel.
2. Standing water or boggy areas in upper stage
3. Uneven grades or mounds
4. Bottom Stage, Micro-pool, or Forebay has excessive amounts of sediment

*e. Erosion (banks and bottom)* – The bottom grades of the dry storage area are typically flat enough that erosion should not occur. However, inadequate vegetative cover may result in erosion of the upper stage. Erosion that occurs in the upper stage can result in increased

dredging/maintenance of the bottom stage/micro-pool.

*f. Trash/Debris* – Trash and debris can accumulate in the upper area after large events, or from illegal dumping. Over time, this material can accumulate and clog the EDB outlet works.

*g. Maintenance Access* – Most EDBs typically have a gravel/concrete maintenance access path to either the upper stage or forebay. This access path should be inspected to ensure the surface is still drivable. Some of the smaller EDBs may not have maintenance access paths; however, the inspector should verify that access is available from adjacent properties.

#### EDB-2.3.9 Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the EDB. This category on the inspection form is for maintenance items that are commonly found in the EDB, but may not be attributed to an individual feature.

*a. Encroachment in Easement Area* – Private lots/property can sometimes be located very close to the EDBs, even though they are required to be located in tracts with drainage easements. Property owners may not place landscaping, trash, fencing, or other items within the easement area that may adversely affect maintenance or the operation of the facility.

*b. Graffiti/Vandalism* – Damage to the EDB infrastructure can be caused by vandals. If criminal mischief is evident, the inspector should forward this information to the El Paso County Police Department.

*c. Public Hazards* – Public hazards include items such as vertical drops of greater than 4-feet, containers of unknown/suspicious substances, exposed metal/jagged concrete on structures. **If any hazard is found within the facility area that poses an immediate threat to public safety, call 911 immediately!**

*d. Burrowing Animals/Pests* – Prairie dogs and other burrowing rodents may cause damage to the EDB features and negatively affect the vegetation within the EDB.

*e. Other* – Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

#### EDB-2.4 Inspection Forms

EDB Inspection forms are located in Appendix D. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and submitted by the property owner or property manager to the El Paso County per the requirements of the Inspection and Maintenance Plan. These inspection forms shall be kept indefinitely and made available to the El Paso County upon request.

## **EDB-3 MAINTAINING EXTENDED DETENTION BASINS (EDBS)**

### **EDB-3.1 Maintenance Personnel**

Maintenance personnel must be qualified to properly maintain EDBs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

### **EDB-3.2 Equipment**

It is imperative the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a basic list of tools, equipment, and material(s) that may be necessary to perform maintenance on an EDB:

- 1.) Loppers/Tree Trimming Tools
- 2.) Mowing Tractors
- 3.) Trimmers (extra string)
- 4.) Shovels
- 5.) Rakes
- 6.) All Surface Vehicle (ASVs)
- 7.) Skid Steer
- 8.) Back Hoe
- 9.) Track Hoe/Long Reach Excavator
- 10.) Dump Truck
- 11.) Jet-Vac Machine
- 12.) Engineers Level (laser)
- 13.) Riprap (Minimum - Type M, or as shown on the approved civil plans)
- 14.) Filter Fabric
- 15.) Erosion Control Blanket(s)

- 16.) Seed Mix (See seed mix in the *Rules and Regulations Regarding Stormwater (Quality) Discharge for Construction Activities*, Std Det. SM, Seeding & Mulching)
- 17.) Illicit Discharge Cleanup Kits
- 18.) Trash Bags
- 19.) Tools (wrenches, screw drivers, hammers, etc)
- 20.) Chain Saw
- 21.) Confined Space Entry Equipment
- 22.) Approved Stormwater Facility Inspection and Maintenance Plan

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

### **EDB-3.3 Safety**

Vertical drops may be encountered in areas located within and around the facility. Avoid walking on top of retaining walls or other structures having a significant vertical drop. If a vertical drop within the EDB is identified as greater than 48" in height, make the appropriate note/comment on the maintenance inspection form.

### **EDB-3.4 Maintenance Forms**

The EDB Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The EDB Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the El Paso County per the requirements of the Inspection and Maintenance Plan. The EDB Maintenance form is located in Appendix E.

### **EDB-3.5 Maintenance Categories and Activities**

A typical EDB Maintenance Program will consist of three broad categories of work. Within each category of work, a variety of maintenance activities can be performed on an EDB. A maintenance activity can be specific to each feature within the EDB, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for an EDB.

A variety of maintenance activities are typical of EDBs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of drainage infrastructure. Below is a description of each maintenance activity, the objectives, and frequency of actions:

### EDB-3.6 Routine Maintenance Activities

The majority of this work consists of regularly scheduled mowing and trash and debris pickups for stormwater management facilities during the growing season. This includes items such as the removal of debris/material that may be clogging the outlet structure well screens and trash racks. It also includes activities such as weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year. These items can be completed without any prior correspondence with the El Paso County; however, completed inspection and maintenance forms shall be submitted to the El Paso County for each inspection and maintenance activity in accordance with the Inspection and Maintenance Plan.

The Maintenance Activities are summarized below, and further described in the following sections.

**TABLE – EDB-2**  
**Summary of Routine Maintenance Activities**

Maintenance Activity	Minimum Frequency	Look for:	Maintenance Action
<b>Mowing</b>	Twice annually	Excessive grass height/aesthetics	Mow grass to a height of 4" to 6"
<b>Trash/Debris Removal</b>	Twice annually	Trash & debris in EDB	Remove and dispose of trash and debris
<b>Outlet Works Cleaning</b>	As needed - after significant rain events – twice annually min.	Clogged outlet structure; ponding water	Remove and dispose of debris/trash/sediment to allow outlet to function properly
<b>Weed control</b>	Minimum twice annually	Noxious weeds; Unwanted vegetation	Treat w/ herbicide or hand pull; Consult the local weed specialist
<b>Mosquito Treatment</b>	As needed	Standing water/mosquito habitat	Treat w/ EPA approved chemicals
<b>Algae Treatment</b>	As needed	Standing water/ Algal growth/green color	Treat w/ EPA approved chemicals

#### EDB-3.6.1 Mowing

Occasional mowing is necessary to limit unwanted vegetation and to improve the overall appearance of the EDB. Native vegetation should be mowed to a height of 4-to-6 inches tall. Grass clippings should be collected and disposed of properly.

*Frequency* – Routine - Minimum of twice annually or depending on aesthetics.

#### EDB-3.6.2 Trash/Debris Removal

Trash and debris must be removed from the entire EDB area to minimize outlet clogging and to improve aesthetics. This activity must be performed prior to mowing operations.

*Frequency* – Routine – Prior to mowing operations and minimum of twice annually and should be done after significant storm events.

#### EDB-3.6.3 Outlet Works Cleaning

Debris and other materials can clog the outlet work's well screen, orifice plate(s) and trash rack. This activity must be performed anytime other maintenance activities are conducted to ensure proper operation.

*Frequency* - Routine – After significant rainfall event or concurrently with other maintenance activities.

#### EDB-3.6.4 Weed Control

Noxious weeds and other unwanted vegetation must be treated as needed throughout the EDB. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with the local Weed Inspector is highly recommended prior to the use of an herbicide. All herbicide applications should be applied in accordance with the manufacturer's recommendations.

*Frequency* – Routine – As needed based on inspections.

#### EDB-3.6.5 Mosquito/Algae Treatment

Treatment of permanent pools is necessary to control mosquitoes and undesirable aquatic vegetation that can create nuisances. Only EPA approved chemicals/materials can be used in areas that are warranted.

*Frequency* – As needed.

### **EDB- 3.7 Minor Maintenance Activities**

This work consists of a variety of isolated or small-scale maintenance or operational problems. Most of this work can be completed by a small crew, tools, and small equipment. These items require prior correspondence with the El Paso County Water Staff and require completed inspection and maintenance forms to be submitted to the El Paso County Water Staff for each inspection and maintenance activity.



**Table – EDB-3**  
**Summary of Minor Maintenance Activities**

Maintenance Activity	Minimum Frequency	Look for:	Maintenance Action
<b><u>Sediment Removal*</u></b>	As needed; typically every 1 –2 years	Sediment build-up; decrease in pond volume	Remove and dispose of sediment
<b>Erosion Repair</b>	As needed, based upon inspection	Rills/gullies forming on side slopes, trickle channel, other areas	Repair eroded areas Revegetate; address source of erosion
<b>Vegetation Removal/Tree Thinning</b>	As needed, based upon inspection	Large trees/wood vegetation in lower chamber of pond	Remove vegetation; restore grade and surface
<b>Drain Cleaning/Jet Vac</b>	As needed, based upon inspection	Sediment build-up /non draining system	Clean drains; Jet Vac if needed

\*Usually from the forebay, trickle channel, and/or micro-pool

#### EDB-3.7.1 Sediment Removal

Sediment removal is necessary to maintain the original design volume of the EDB and to ensure proper function of the infrastructure. Regular sediment removal (minor) from the forebay, inflow(s), and trickle channel can significantly reduce the frequency of major sediment removal activities (dredging) in the upper and lower stages. The minor sediment removal activities can typically be addressed with shovels and smaller equipment.

Stormwater sediments removed from EDBs do not meet the criteria of “hazardous waste”. However, these sediments are contaminated with a wide array of organic and inorganic pollutants and handling must be done with care. Sediments from permanent pools must be carefully removed to minimize turbidity, further sedimentation, or other adverse water quality impacts. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a landfill for proper disposal. Prompt and thorough cleanup is important should a spill occur during transportation.

*Frequency* – Nonroutine – As necessary based upon inspections. Sediment removal in the forebay, trickle channel, and micro-pool may be necessary as frequently as every 1-2 years.

#### EDB-3.7.2 Erosion Repair

The repair of eroded areas is necessary to ensure the proper function of the EDB, minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to trickle channels, energy dissipaters, and rilling to major gullies in the embankments

and spillways. The repair of eroded areas may require the use of excavators, earthmoving equipment, riprap, concrete, erosion control blankets, and turf reinforcement mats. Major erosion repair to the pond embankments, spillways, and adjacent to structures will require consultation with the El Paso County Water and Engineering Staff.

*Frequency* – Nonroutine – As necessary based upon inspections.

#### EDB-3.7.3 Vegetation Removal/Tree Thinning

Dense stands of woody vegetation (willows, shrubs, etc) or trees can create maintenance problems for the infrastructure within an EDB. Tree roots can damage structures and invade pipes/channels thereby blocking flows. Also, trees growing in the upper and lower stages of the EDB will most likely have to be removed when sediment/dredging operations occur. A small tree is easier to remove than a large tree, therefore, regular removal/thinning is imperative. All trees and woody vegetation that is growing in the bottom of the EDB or near structures (inflows, trickle channels, outlet works, emergency spillways, etc) should be removed. Any trees or woody vegetation in the EDB should be limited to the upper portions of the pond banks.

*Frequency* – Nonroutine – As necessary based upon inspections.

#### EDB-3.7.4 Clearing Drains/Jet-Vac

An EDB contains many structures, openings, and pipes that can be frequently clogged with debris. These blockages can result in a decrease of hydraulic capacity and create standing water in areas outside of the micro-pool. Many times the blockage to this infrastructure can be difficult to access and/or clean. Specialized equipment (jet-vac machines) may be necessary to clear debris from these difficult areas.

*Frequency* – Nonroutine – As necessary based upon inspections.

### **EDB-3.8 Major Maintenance Activities**

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires consultation with the El Paso County to ensure the proper maintenance is performed. This work requires the El Paso County Water Staff review the original design before approval of the proposed maintenance. **A public improvements permit shall be required for all major maintenance activities.** This work may also require more specialized maintenance equipment, design/details, submittal of plans to the El Paso County for review and approval, surveying, or assistance through private contractors and consultants.

**Table – EDB-4  
Summary of Major Maintenance Activities**

<b>Maintenance Activity</b>	<b>Minimum Frequency</b>	<b>Look for:</b>	<b>Maintenance Action</b>
<b>Major Sediment Removal</b>	As needed – based upon scheduled inspections	Large quantities of sediment; reduced pond capacity	Remove and dispose of sediment. Repair vegetation as needed
<b>Major Erosion Repair</b>	As needed – based upon scheduled inspections	Severe erosion including gullies, excessive soil displacement, areas of settlement, holes	Repair erosion – find cause of problem and address to avoid future erosion
<b>Structural Repair</b>	As needed – based upon scheduled inspections	Deterioration and/or damage to structural components – broken concrete, damaged pipes, outlet works	Structural repair to restore the structure to its original design

#### **EDB-3.8.1 Major Sediment Removal**

Major sediment removal consists of removal of large quantities of sediment or removal of sediment from vegetated areas. Care shall be given when removing large quantities of sediment and sediment deposited in vegetated areas. Large quantities of sediment need to be carefully removed, transported and disposed of. Vegetated areas need special care to ensure design volumes and grades are preserved.

Major sediment removal activities will require larger and more specialized equipment. The major sediment activities will also require surveying with an engineer's level, and consultation with the El Paso County Water and Engineering Staff to ensure design volumes/grades are achieved. Pond volume recertification will be required in accordance with the El Paso County's drainage criteria manual.

*Frequency* – Nonroutine – Repair as needed based upon inspections.

#### **EDB-3.8.2 Major Erosion Repair**

Major erosion repair consists of filling and revegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved. Any condition/repair affecting design grades or pond volumes requires consultation with the El Paso County Water and Engineering Staff.

*Frequency – Nonroutine – Repair as needed based upon inspections.*  
EDB-3.8.3 Structural Repair

An EDB includes a variety of structures that can deteriorate or be damaged during the course of use and routine maintenance. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time. These structures include items like outlet works, trickle channels, forebays, inflows and other features. In-house operations staff can perform some of the minor structural repairs. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with the El Paso County and Engineering Staff shall take place prior to all structural repairs.

*Frequency – Nonroutine – Repair as needed based upon inspections.*

**Reference:**

**This plan is adapted from Southeast Metro Stormwater Authority, OPERATION AND MAINTENANCE (O & M) MANUAL, and Town of Parker, Colorado, STORMWATER PERMANENT BEST MANAGEMENT PRACTICES (PBMP) LONG-TERM OPERATION AND MAINTENANCE MANUAL, October 2004**

## **A P P E N D I X   C – 2**

### **Grass Buffers and Grass Swales**

# Standard Operation Procedures for Inspection and Maintenance

## Grass Buffers and Grass Swales (GB-GS)



September 2010

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## **GB-GS-1 BACKGROUND**

Grass Buffers and Grass Swales are common types of Stormwater Management Facilities utilized within the Front Range of Colorado. Grass Buffers and Grass Swales promote filtration, infiltration, and settling to reduce runoff volume.

Grass Buffers are uniformly graded and densely vegetated areas of turf grass. They are designed to accommodate sheet flow rather than concentrated or channelized flow. They are typically located adjacent to impervious areas such as parking lots or along roads. Grass Buffers are designed to evenly distribute runoff across the width of the buffer to achieve uniform sheet-flow conditions. A flow spreader may be incorporated for this purpose. In some cases, grass buffers may have underdrain systems.

Grass Swales are densely vegetated drainage ways with low-pitched side slopes that collect and convey runoff. Design of their longitudinal slope and cross section forces the flow to be slow and shallow, thereby facilitating sedimentation while limiting erosion. Berms or check dams may be installed perpendicular to the flow to decrease the slope and slow down the flow. Grass swales are used in open space and landscaped areas to collect and convey overland flows, and can be used as an alternative to curb and gutter (when approved by the City Engineer) to collect and convey street flows. Some grass swales are designed with underdrain systems.

## **GB-GS-2 INSPECTING GRASS BUFFERS AND SWALES (GB-GS)**

### **GB-GS-2.1 Access and Easements**

Inspection and maintenance personnel may utilize the stormwater facility map located in Appendix G containing the locations of the access points and maintenance easements of the GB-GSs within this development.

### **GB-GS-2.2 Stormwater Management Facilities Locations**

Inspection and maintenance personnel may utilize the stormwater facility map located in Appendix G containing the locations of the GB-GSs within this development.

### **GB-GS-2.3 Grass Buffer - Grass Swale (GB-GS) Features**

GB-GSs are unique stormwater quality facilities, in that they are typically viewed as landscaping or ground cover, and are often overlooked as water quality treatment facilities. GB-GSs have a number of features designed to serve a particular function. It is important for maintenance personnel to understand the function of each of these features. Below is a list of the common features of a Grass Swale or Grass Buffer and the corresponding maintenance inspection items anticipated:



**Table GB-GS-1**  
**Typical Inspection & Maintenance Requirements Matrix**

	<b>Sediment Removal</b>	<b>Mowing Weed control</b>	<b>Trash &amp; Debris Removal</b>	<b>Erosion</b>	<b>Removal/ Replacement</b>	<b>Structural Repair</b>
<b>Swale Bottom</b>	X	X	X	X		
<b>Side Slope</b>		X	X	X		
<b>Buffer Strip</b>	X	X	X	X		
<b>Inflows</b>	X	X	X	X	X	X
<b>Underdrain System*</b>					X	
<b>Grade Control/Level Spreader</b>				X		X
<b>Irrigation System</b>					X	

\*If the design and inspection allows, flushing of the system may be all that is needed.

#### **GB-GS-2.3.1     Grass Swale Bottom and Side Slopes; Grass Buffer Strips**

Grass Swales and Grass Buffers require general maintenance of the turf grass and repair of any rill or gully development. The bottom and side slopes of grass swales and the area of grass buffer strips should be maintained with dense vegetative cover, and should not be eroded or bare. Inspection over the first few years will help to determine if any problems are developing.

*The typical maintenance items required at the side slopes and bottoms of grass swales and within grass buffer areas are as follows:*

- a. Sediment Accumulation* – The purpose of the grass swale or buffer is to slow down flow and allow sedimentation to occur. To prevent a loss in performance of the swale or buffer, sediment that accumulates must be removed on a timely basis.
- b. Vegetation Sparse* – Grass Swales and Buffers rely on a healthy, dense cover of grass to decrease the flow velocities and promote sedimentation and infiltration. Grasses that are diseased, dying or otherwise damaged should be replaced. All bare areas should be reseeded or patched. Causes which contribute to the damaged grass cover, including lack of adequate irrigation, traces of pedestrian or vehicular traffic, uncontrolled weeds, excessive sedimentation accumulation, etc., should be identified and remedied.
- c. Erosion Present* – Lack of adequate vegetative cover or excessive flow velocities may result in rill or gully development, and erosion of the swale or buffer strip. Erosion will require maintenance to prevent further damage to the area and to prevent sediment transport.

d. *Standing Water/Boggy Areas* – Grass swales and buffers are generally intended to drain and be dry in between rain events. If areas of standing water are present, the swale or buffer may need to be evaluated for proper grade to ensure drainage or the addition of underdrains. In some cases, where underdrains are used, the underdrains should be inspected to ensure that they are not clogged.

#### GB-GS-2.3.2 Inflow Points

Inflow points are the points of stormwater discharge into the swale or buffer. Inflow points are typically pipe outfalls, other grass swales or buffers, or curb cuts from upstream impervious areas, such as parking lots. Some form of energy dissipation is typically provided immediately downstream of the inflow point into the grass swale or buffer. Energy dissipation devices may include riprap aprons, or flow spreader devices.

*The typical maintenance items required at inflow points are as follows:*

- a. *Riprap Displaced/Rundown Damaged* – Often, because of the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap rundown or apron appears to have settled, if soil is present between the riprap, or if the riprap has shifted, maintenance may be required to ensure future erosion is prevented.
- b. *Erosion Present/Outfall Undercut* – In some situations, an energy dissipater may have not been provided, or may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility.
- c. *Sediment Accumulation* – Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in performance, sediment that accumulates in this area must be removed on a timely basis.

#### GB-GS-2.3.3 Underdrain System

Some grass swales and buffers that have a flatter slope or soils which do not allow adequate percolation or are in areas with a continuous base flow may have been installed with an underdrain system. Underdrains typically consist of a layer of geotextile fabric, gravel storage area and perforated PVC pipe. The geotextile fabric is utilized to prevent the filter material from entering the underdrain system. The gravel storage area allows for storage of treated stormwater runoff prior to the discharge of the runoff through the perforated PVC pipe.

*The typical maintenance activities required for the underdrain system are as follows:*

With proper maintenance of the grassed areas, there should be a minimum amount of maintenance required on the underdrain system. Generally the only maintenance performed on the underdrain system is jet-vac cleaning in the event it becomes clogged.

#### GB-GS-2.3.4 Grade Control Level Spreader

Grass swales installed in areas with steep longitudinal slopes often necessitate the use of grade control checks or drop structures. Grade control structures are typically either concrete walls or rip rap structures that serve to provide a reinforced drop at specific locations in the channel, reducing the longitudinal slope between the control structures.

Level Spreaders are installed on the upstream of grass buffers to evenly distribute flows along the design length. Level spreaders may consist of slotted curbing, modular block porous pavement, level walls or other spreader devices.

*The typical maintenance activities required for grade control structures and level spreaders are as follows:*

*a. Erosion present* – Grade control structures and level spreaders are provided to reduce the potential for erosion of the grassed swale or buffer areas. Erosion within the vicinity of the control structure or level spreader indicates the structure is not functioning as intended and requires maintenance to prevent future erosion and damage. Or, review the original design if erosion becomes chronic.

*b. Structural damage* – Structural damage can occur at anytime along the life of the facility. Typically, structural damage occurs with the deterioration of concrete, including cracking, spalling or settling and the erosion and deterioration of the riprap structures. Level spreaders may settle unevenly creating low areas, which concentrate the flows. Partial or full replacement may be required depending on the extent of the damage.

#### GB-GS-2.3.5 Irrigation

Grass Buffers and Grass Swales depend on healthy, dense turf grass to function, and therefore require an irrigation system, to provide a consistent water supply. Typically, the condition of the grass cover will provide evidence of the effectiveness and maintenance needs of the irrigation system.

*The typical maintenance activities required for irrigation systems are as follows:*  
Irrigation systems will generally require routine periodic maintenance and

adjustment to ensure proper amounts of water are being applied given the weather conditions, and that they are providing coverage to all areas of the grass to eliminate bare spots.

#### GB-GS-2.3.6 Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the GB-GS. This category on the inspection form is for maintenance items commonly found in the GB-GS, but may not be attributed to an individual feature.

*a. Encroachment in Easement Area* – The El Paso County requires GB-GS be located in tracts or drainage easements. Property owners may not place landscaping, trash, fencing, or other items within the easement area that may adversely affect maintenance or the operation of the facility.

*b. Public Hazards* – Public hazards include items such as containers of unknown/suspicious substances, and exposed metal/jagged concrete on structures. **If any unknown/suspicious hazard is found within the facility area that poses an immediate threat to public safety, call 911 immediately.**

*c. Burrowing Animals/Pests*– Prairie dogs and other burrowing rodents may cause damage to the GB-GS features and negatively affect the vegetation within the GB-GS.

*d. Other* – Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

#### **GB-GS-2.4 Inspection Forms**

GB-GS Inspection forms are located in Appendix D. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and submitted by the property owner or property manager to the El Paso County per the requirements of the Inspection and Maintenance Plan. These inspection forms shall be kept indefinitely and made available to the El Paso County upon request

### **GB-GS-3 MAINTAINING GRASS BUFFERS & GRASS SWALES (GB-GS)**

#### **GB-GS-3.1 Maintenance Personnel**

Maintenance personnel must be experienced to properly maintain GB-GSs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

### **GB-GS-3.2      *Equipment***

It is imperative the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a basic list of tools, equipment, and material(s) that may be necessary to perform maintenance on a GB-GS:

- 1.) Mowing Tractors
- 2.) Trimmers (extra string)
- 3.) Shovels
- 4.) Rakes
- 5.) All Surface Vehicle (ASVs)
- 6.) Engineers Level (laser)
- 7.) Erosion Control Blanket(s)
- 8.) Mulch
- 9.) Sod or Seed (See seed mix in the *Rules and Regulations Regarding Stormwater (Quality) Discharge for Construction Activities*, Std Det. SM, Seeding & Mulching)
- 10.) Illicit Discharge Cleanup Kits
- 11.) Trash Bags
- 12.) Jet-Vac Equipment
- 13.) Stormwater Facility Inspection and Maintenance Plan

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

### **GB-GS-3.3      *Maintenance Forms***

The GB-GS Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The GB-GS Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the El Paso County per the requirements of the Inspection and Maintenance Plan. The GB-GS Maintenance form is located in Appendix E.

### **GB-GS-3.4      *Maintenance Categories and Activities***

A typical GB-GS Maintenance Program will consist of three broad categories of work: Routine, Minor and Major. Within each category of work, a variety of maintenance activities can be performed on a GB-GS. A maintenance activity can be specific to each feature within the GB-GS, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for a GB-GS.

A variety of maintenance activities are typical of GB-GSs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of the GB-GS or underdrain system. Below is a description of each maintenance activity, the objectives, and frequency of actions.

### **GB-GS-3.5 Routine Maintenance Activities**

The majority of this work consists of scheduled mowing, trash and debris pickups and landscape care for the GB-GS during the growing season. It also includes activities such as weed control. These activities normally will be performed numerous times during the year. These items do not require any prior approval by the El Paso County, however, completed inspection and maintenance forms shall be submitted to the El Paso County for each inspection and maintenance activity in accordance with the Inspection and Maintenance plan.

The Routine Maintenance Activities are summarized below, and further described in the following sections.

**Table GB-GS-2  
Summary of Routine Maintenance Activities**

<b>Maintenance Activity</b>	<b>Minimum Frequency</b>	<b>Indication Action is Needed:</b>	<b>Maintenance Action</b>
<b>Trash/Debris Removal</b>	Twice annual and before mowing	Trash & debris in GB-GS	Remove and properly dispose of trash and debris
<b>Mowing</b>	Routine – as necessary to maintain 2" – 4" grass height	Excessive grass height/aesthetics	2"-4" grass height for turf grass; 4" to 6" for native grass
<b>Irrigation (Automatic)</b>	Three times annually	Areas of insufficient or excess watering; broken or missing parts	SPRING: start up system; test for even coverage and correct timer settings SUMMER: test for even coverage and correct timer settings FALL: drain and winterized system (follow watering regulations)
<b>Irrigation (Not Automatic)</b>	As needed to maintain healthy grass	Areas of insufficient or excess watering	Water as needed to maintain healthy grass; (follow watering regulations)
<b>Weed Control</b>	Minimum twice annually	Noxious weeds; Unwanted vegetation	Treat w/herbicide or hand pull; consult a local Weed Inspector
<b>Mosquito Treatment</b>	As needed, based upon inspections	Standing water/ mosquito habitat	Perform maintenance to eliminate standing water*; Treat w/ EPA approved chemicals
<b>Level Spreader (Grass Buffer only)</b>	As needed, based upon inspections	Evidence of uneven flow/localized erosion	Look for cause; repair, fill or revegetate areas of erosion
<b>Rodent Damage</b>	As needed, based upon inspections	Holes, small piles of dirt, raised burrows	Evaluate damage; contact Parks Dept. or Division of Wildlife for guidance

\*See Section GB-GS-2.3.1d for further discussion

#### GB-GS-3.5.1 Trash/Debris Removal

Trash and debris must be removed from the GB-GS area to allow for proper functioning and to improve aesthetics. This activity must be performed prior to mowing operations.

*Frequency* – Routine – Prior to mowing operations and a minimum of twice annually.

#### GB-GS-3.5.2 Mowing

Routine mowing of the turf grass embankments is necessary to maintain an appropriate grass height and to improve the overall appearance of the GB-GS. Turf grass should be mowed to a height of 2 to 4- inches (4 – 6- inches for native grass) and shall be bagged to prevent potential contamination of the filter media, especially if there is an underdrain system.

*Frequency* – Routine – as necessary to maintain grass height.

#### GB-GS-3.5.3 Irrigation

Irrigation systems should be maintained in proper working order to provide an adequate water supply to support the grass cover. When automatic irrigation systems are not available, alternate methods for providing a water supply during times of drought must be provided.

Automatic irrigation systems should be maintained routinely throughout the growing season to ensure that they are providing the appropriate amounts of water, and are providing complete coverage of the area. Sprinkler heads should be adjusted as necessary, and checked for broken or missing parts.

*Frequency* - Routine as needed throughout the growing season, plus the following:

SPRING: Start up the system and test for even coverage and correct timer settings.

SUMMER: Test for even coverage and correct timer settings.

FALL: Drain and winterize the system.

#### GB-GS-3.5.4 Weed Control

Noxious weeds and other unwanted vegetation must be treated as needed throughout the GB-GS. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with a local Weed Inspector is highly recommended prior to the use of herbicide. Herbicides should be utilized sparingly and as a last resort. All herbicide applications should be in

accordance with the manufacturer's recommendations.

*Frequency* – Routine – As needed based upon inspections.

#### **GB-GS-3.5.5 Mosquito Treatment**

GB-GS facilities are intended to drain, and should not have areas of standing water which creates mosquito habitat. Causes of the standing water or boggy conditions should be investigated and remediated as necessary to eliminate the standing water. Only EPA approved chemicals should be applied in accordance with the recommendations of the manufacturer. See Section GB-GS-2.3.1d.

*Frequency* – As needed based upon inspections.

#### **GB-GS-3.5.6 Level Spreader (Grass Buffer only)**

Evidence of uneven flow and localized erosion downstream of the level spreader indicates the flow is not evenly distributed along the length of the spreader. Areas of erosion should be repaired, filled and revegetated. Causes for the erosion should be investigated and repaired.

*Frequency* – As needed based upon inspections.

#### **GB-GS-3.5.7 Rodent Damage**

Small holes, piles of dirt, and raised burrows are evidence of rodent damage. Damaged areas should be repaired and revegetated. Consultation with an animal control specialist or the Division of Wildlife may be required for persistent problems.

*Frequency* – As needed based on inspections.

### **GB-GS-3.6 Minor Maintenance Activities**

This work consists of a variety of isolated or small-scale maintenance/operational problems. Most of this work can be completed by a small crew, hand tools, and small equipment. These items require approval by the El Paso County. Completed inspection and maintenance forms shall be submitted to the El Paso County for each inspection and maintenance activity.



**Table GB-GS-3**  
**Summary of Minor Maintenance Activities**

<b>Maintenance Activity</b>	<b>Minimum Frequency</b>	<b>Indication Action is Needed:</b>	<b>Maintenance Action</b>
<b>Sediment Removal</b>	As needed.	Sediment build-up.	Remove and properly dispose of sediment
<b>Erosion Repair</b>	As needed, based upon inspection	Rills and gullies forming on slopes and other areas	Repair eroded areas & revegetate; address cause
<b>Vegetation Removal</b>	As needed, based upon inspection	Trees, willows, shrubs impeding flow	Remove vegetation; restore correct grade and surface
<b>Revegetation</b>	As needed, based upon inspection	Areas without grass	Replace grass by sodding or seeding
<b>Irrigation (Automatic)</b>	As needed, based upon inspection.	Evidence of broken or missing parts	Replace parts and test system
<b>Level Spreader (Grass Buffer Only)</b>	As needed, based upon inspection.	Evidence of uneven flow; erosion; or rills/gullies	Repair sections of level spreader and address cause
<b>Fertilization or Soil Amendment</b>	As needed, minimize fertilization	Grass with pale color; areas with poor grass growth not due to irrigation problems	Consult with turf specialist; Test soil
<b>Vehicle Tracks (Along Roadways)</b>	As needed, based upon inspection	Depressions from vehicle tracks; vegetation damage	Repair and fill depressions; sod or seed damaged areas

#### GB-GS-3.6.1 Sediment Removal

Sediment removal is necessary to ensure proper function of the grass swale or buffer. Care should be taken when removing sediment to prevent damage to the turf grass and surrounding areas. Excessive amounts of sediment are an indication of upstream erosion or lack of adequate BMPs during construction activities. Causes for contributions of excess sediment should be investigated and addressed.

*Frequency* – As needed based upon inspections.

#### GB-GS-3.6.2 Erosion Repair

The repair of eroded areas is necessary to ensure the proper functioning of the GB-GS, to minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to vegetation and embankments, to rills and gullies in the embankments and inflow points. The repair of eroded areas may require the use of excavators, riprap, new poured-in-

place concrete, and sod. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system, if present, does not occur. Major erosion in a GS-GB is generally the result of excessive velocities caused by steep slopes. It may be necessary to make design improvements to the swale or buffer when erosion becomes a major maintenance item.

*Frequency* – As necessary, based upon inspections.

#### GB-GS-3.6.3 Vegetation Removal

Weeds, Shrubs, Willows and other unwanted vegetation that develops in the grass swale or buffer area may impede the flow and cause standing water or back flow problems. It is necessary to remove unwanted vegetation as soon as it appears. Remove the unwanted vegetation, and restore the correct grade. Revegetate with seed or sod. Supplement irrigation as needed until new vegetation is sufficiently established.

*Frequency* – As necessary, based upon inspections.

#### GB-GS -3.6.4 Revegetation

Bare areas should be repaired as soon as possible. Repair bare areas with appropriate grass seed or sod. Supplement irrigation as needed until new vegetation is sufficiently established. Causes of the problem, such as inadequate water supply or diseased grasses, should be investigated and resolved.

*Frequency* – As necessary, based upon inspections.

#### GB-GS-3.6.5 Irrigation (Automatic)

Irrigation systems require routine maintenance in accordance with the manufacturer's recommendations (valves, timer, etc.), and maintenance of the pipe and heads to ensure even coverage is being applied, and there are no missing or broken parts. Timing systems should be checked to verify the correct amount of water is being applied to the grassed areas for the seasonal conditions.

*Frequency* – As necessary, based upon inspections.

#### GB-GS-3.6.6 Level Spreader

Level Spreaders that are no longer level, or have developed damaged areas of cracking or spalling, allow flows to concentrate in these depressed areas instead of being distributed over the length of the structure. Also, build up of grasses

along the edge of the spreader may create an uneven flow distribution. Rills, gullies and other erosion that develop downstream of level spreaders should be repaired and reseeded or sodded. Causes of the erosion should be investigated and addressed.

*Frequency* – As necessary, based upon inspections.

#### GB-GS-3.6.7 Fertilization/Soil Amendment

Grass Buffers and Swales rely on healthy, dense turf in order to function properly. Grasses that appear to be diseased, dying or unhealthy may require amendments. Fertilizers should be applied in the minimum amounts recommended by the manufacturer. Check for insect infestation also.

*Frequency* – As necessary, based upon inspections.

#### GB-GS-3.6.8 Vehicle Tracks

GB-GSs adjacent to roadway sections or drive aisles in parking lots may be damaged by vehicle tracks. Rutted areas should be filled in and revegetated as soon as possible. Frequent problems associated with vehicle traffic (such as around corners) may require a barrier or sign to avoid vehicular traffic within the grassed areas.

*Frequency* – As necessary, based upon inspections.

### **GB-GB-3.7 Major Maintenance Activities**

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires consultation with the El Paso County Water Staff to ensure the proper maintenance is performed. This work requires the El Paso County Water and Engineering Staff review the original design and construction drawings to assess the situation before approval of the proposed maintenance. This work may also require more specialized maintenance equipment, design/details, submittal of plans to the El Paso County for review and approval, surveying, or assistance through private contractors and consultants.

**Table GB-GS-4  
Summary of Major Maintenance Activities**

<b>Maintenance Activity</b>	<b>Minimum Frequency</b>	<b>Look for:</b>	<b>Maintenance Action</b>
<b>Major Sediment/Pollutant Removal</b>	As needed – based upon scheduled inspections	Large quantities of sediment	Remove and dispose of sediment. Repair vegetation as needed
<b>Major Erosion Repair</b>	As needed – based upon scheduled inspections	Severe erosion including gullies, excessive soil displacement, areas of settlement, holes	Repair erosion – find cause of problem and address to avoid future erosion
<b>Structural Repair</b>	As needed – based upon scheduled inspections	Deterioration and/or damage to structural components – level spreader, grade control structures, irrigation components, and ponding water.	Structural repair to restore the structure to its original design
<b>GB-GS Rebuild</b>	As needed – due to complete failure of BMP	Removal of filter media and underdrain system	Contact El Paso County Water Staff

#### **GB-GS-3.7.1 Major Sediment/Pollutant Removal**

Major sediment removal consists of removal of large quantities of pollutants/sediment /landscaping material. Stormwater sediments removed from GB-GSs do not meet the regulatory definition of “hazardous waste”. However, these sediments can be contaminated with a wide array of organic and inorganic pollutants and handling must be done with care to insure proper removal and disposal. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a licensed landfill for proper disposal. Should a spill occur during transportation, prompt and thorough cleanup and disposal is imperative. Vegetated areas need special care to ensure design volumes and grades are preserved or may need to be replaced due to the removal activities.

*Frequency* – Non-routine – Repair as needed, based upon inspections.

#### GB-GS-3.7.2 Major Erosion Repair

Major erosion repair consists of filling and revegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved.

*Frequency* – Non-routine – Repair as needed, based upon inspections.

#### GB-GS-3.7.3 Structural Repair

A GB-GS generally includes level spreader and grade control structure that can deteriorate or be damaged during the service life of the facility. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with the El Paso County Water and Engineering Staff shall take place prior to all structural repairs.

*Frequency* – Non-routine – Repair as needed, based upon inspections.

#### GB-GS-3.7.4 GB-GS Rebuild

In very rare cases, a GB-GS may need to be rebuilt. Generally, the need for a complete rebuild is a result of improper construction, improper maintenance resulting in structural damage to the underdrain system, if present, or extensive contamination of the GB-GS. Consultation with the Water and Engineering Staff shall take place prior to any rebuild project.

*Frequency* – Non-routine – As needed based upon inspections.

#### Reference:

**This plan is adapted from Southeast Metro Stormwater Authority, OPERATION AND MAINTENANCE (O & M) MANUAL, and the Douglas County, Colorado, STANDARD OPERATING PROCEDURE FOR EXTENDED DETENTION BASIN (EDB) INSPECTION AND MAINTENANCE, July 2005**

# **A P P E N D I X   D**

## **Inspection Forms**



## EXTENDED DETENTION BASIN (EDB) INSPECTION FORM

Date: \_\_\_\_\_

Subdivision/Business Name: \_\_\_\_\_ Inspector: \_\_\_\_\_

Subdivision/Business Address: \_\_\_\_\_

Weather: \_\_\_\_\_

Date of Last Rainfall: \_\_\_\_\_ Amount: \_\_\_\_\_ Inches

**Property Classification:** Residential Multi Family Commercial Other: \_\_\_\_\_  
(Circle One)

**Reason for Inspection:** Routine Complaint After Significant Rainfall Event  
(Circle One)

**INSPECTION SCORING** - For each facility inspection item, insert one of the following scores:

0 = No deficiencies identified

2 = Routine maintenance required

1 = Monitor (potential for future problem)

3 = Immediate repair necessary

N/A = Not applicable

### FEATURES

#### 1.) Inflow Points

- \_\_\_ Riprap Displaced
- \_\_\_ Erosion Present/Outfall Undercut
- \_\_\_ Sediment Accumulation
- \_\_\_ Structural Damage (pipe, end-section, etc.)
- \_\_\_ Woody Growth/Weeds Present

#### 2.) Forebay

- \_\_\_ Sediment/Debris Accumulation
- \_\_\_ Concrete Cracking/Failing
- \_\_\_ Drain Pipe/Wier Clogged (not draining)
- \_\_\_ Wier/Drain Pipe Damage

#### 3.) Trickle Channel (Low-flow)

- \_\_\_ Sediment/Debris Accumulation
- \_\_\_ Concrete/Riprap Damage
- \_\_\_ Woody Growth/Weeds Present
- \_\_\_ Erosion Outside Channel

#### 4.) Bottom Stage (Micro-Pool)

- \_\_\_ Sediment/Debris Accumulation
- \_\_\_ Woody Growth/Weeds Present
- \_\_\_ Bank Erosion
- \_\_\_ Mosquitoes/Algae Treatment
- \_\_\_ Petroleum/Chemical Sheen

#### 5.) Outlet Works

- \_\_\_ Trash Rack/Well Screen Clogged
- \_\_\_ Structural Damage (concrete, steel, subgrade)
- \_\_\_ Orifice Plate(s) Missing/Not Secure
- \_\_\_ Manhole Access (cover, steps, etc.)
- \_\_\_ Woody Growth/Weeds Present

#### 6.) Emergency Spillway

- \_\_\_ Riprap Displaced
- \_\_\_ Erosion Present
- \_\_\_ Woody Growth/Weeds Present
- \_\_\_ Obstruction/Debris

#### 7.) Upper Stage (Dry Storage)

- \_\_\_ Vegetation Sparse
- \_\_\_ Woody Growth/Undesirable Vegetation
- \_\_\_ Standing Water/Boggy Areas
- \_\_\_ Sediment Accumulation
- \_\_\_ Erosion (banks and bottom)
- \_\_\_ Trash/Debris
- \_\_\_ Maintenance Access

#### 8.) Miscellaneous

- \_\_\_ Encroachment in Easement Area
- \_\_\_ Graffiti/Vandalism
- \_\_\_ Public Hazards
- \_\_\_ Burrowing Animals/Pests
- \_\_\_ Other

Inspection Summary / Additional Comments: \_\_\_\_\_

### OVERALL FACILITY RATING (Circle One)

0 = No Deficiencies Identified

2 = Routine Maintenance Required

1 = Monitor (potential for future problem exists)

3 = Immediate Repair Necessary

This inspection form shall be kept indefinitely and made available to the City of Aurora upon request.



## GRASS BUFFER-GRASS SWALE INSPECTION FORM

Date: \_\_\_\_\_

Subdivision/Business Name: \_\_\_\_\_ Inspector: \_\_\_\_\_

Subdivision/Business Address: \_\_\_\_\_

Weather: \_\_\_\_\_

Date of Last Rainfall: \_\_\_\_\_ Amount: \_\_\_\_\_ Inches

**Property Classification:** Residential Multi Family Commercial Other: \_\_\_\_\_  
(Circle One)

**Reason for Inspection:** Routine Complaint After Significant Rainfall Event  
(Circle One)

**INSPECTION SCORING** - For each facility inspection item, insert one of the following scores:

0 = No deficiencies identified

2 = Routine maintenance required

1 = Monitor (potential for future problem)

3 = Immediate repair necessary

N/A = Not applicable

### FEATURES

#### 1.) Grass Swale Bottom & Side Slopes

\_\_\_ Sediment/Debris Accumulation

\_\_\_ Vegetation Cover

\_\_\_ Erosion Present

\_\_\_ Standing Water/Boggy Areas

#### 2.) Grass Buffer

\_\_\_ Sediment/Debris Accumulation

\_\_\_ Vegetation Cover

\_\_\_ Erosion Present

\_\_\_ Standing Water/Boggy Areas

#### 3.) Inflow Points

\_\_\_ Rip Rap Displaced/Run-down or Pipe Damage

\_\_\_ Erosion Present/Outfall Undercut

\_\_\_ Sediment Accumulation

#### 4.) Underdrain System

\_\_\_ Standing water/Not draining

\_\_\_ Evidence of clogged system

#### 5.) Grade Control

\_\_\_ Erosion Present

\_\_\_ Structural Damage

#### 6.) Level Spreader

\_\_\_ Erosion Present

\_\_\_ Structural Damage

\_\_\_ Unlevel/Uneven Distribution of flow

#### 7.) Irrigation

\_\_\_ General Grass Condition

\_\_\_ Bare Spots

\_\_\_ Broken sprinkler heads

#### 8.) Miscellaneous

\_\_\_ Encroachment in Easement Area

\_\_\_ Public Hazards

\_\_\_ Burrowing Animals/Pests

\_\_\_ Other

Inspection Summary / Additional Comments: \_\_\_\_\_

### OVERALL FACILITY RATING (Circle One)

0 = No Deficiencies Identified

2 = Routine Maintenance Required

1 = Monitor (potential for future problem exists)

3 = Immediate Repair Necessary

This inspection form shall be kept indefinitely and made available to the City of Aurora upon request.



# **A P P E N D I X E**

## **Maintenance Forms**



## EXTENDED DETENTION BASIN (EDB) MAINTENANCE FORM

Subdivision/Business Name: \_\_\_\_\_ Completion Date: \_\_\_\_\_  
Subdivision/Business Address: \_\_\_\_\_ Contact Name: \_\_\_\_\_

**Maintenance Category:**      Routine      Restoration      Rehabilitation  
(Circle All That Apply)

### MAINTENANCE ACTIVITIES PERFORMED

#### ROUTINE WORK

- ☐ MOWING
- ☐ TRASH/DEBRIS REMOVAL
- ☐ OUTLET WORKS CLEANING (TRASH RACK/WELL SCREEN)
- ☐ WEED CONTROL (HERBICIDE APPLICATION)
- ☐ MOSQUITO TREATMENT
- ☐ ALGAE TREATMENT

#### RESTORATION WORK

- ☐ SEDIMENT REMOVAL
  - ☐ FOREBAY
  - ☐ TRICKLE CHANNEL
  - ☐ INFLOW
- ☐ EROSION REPAIR
  - ☐ INFLOW POINT
  - ☐ TRICKLE CHANNEL
- ☐ VEGETATION REMOVAL/TREE THINNING
  - ☐ INFLOW(S)
  - ☐ TRICKLE CHANNEL
  - ☐ UPPER STAGE
  - ☐ BOTTOM STAGE
- ☐ REVEGETATION
- ☐ JET-VAC/CLEARING DRAINS
  - ☐ FOREBAY
  - ☐ OUTLET WORKS
  - ☐ INFLOWS

#### REHABILITATION WORK

- ☐ SEDIMENT REMOVAL (DREDGING)
  - ☐ BOTTOM STAGE
  - ☐ UPPER STAGE
- ☐ EROSION REPAIR
  - ☐ OUTLET WORKS
  - ☐ UPPER STAGE
  - ☐ BOTTOM STAGE
  - ☐ SPILLWAY
- ☐ STRUCTURAL REPAIR
  - ☐ INFLOW
  - ☐ OUTLET WORKS
  - ☐ FOREBAY
  - ☐ TRICKLE CHANNEL

OTHER \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

ESTIMATED TOTAL MANHOURS: \_\_\_\_\_

EQUIPMENT/MATERIAL USED: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COMMENTS/ADDITIONAL INFO: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

This Maintenance Activity Form shall be kept indefinitely and made available to the City of Aurora upon request.



**GRASS BUFFERS AND GRASS SWALES  
(GB-GS)  
MAINTENANCE FORM**

Subdivision/Business Name: \_\_\_\_\_ Completion Date: \_\_\_\_\_

Subdivision/Business Address: \_\_\_\_\_ Contact Name: \_\_\_\_\_

**Maintenance Category:**                      Routine                      Restoration                      Rehabilitation  
(Circle all that apply)

**MAINTENANCE ACTIVITIES PERFORMED**

**ROUTINE WORK**

- \_\_\_ MOWING
- \_\_\_ TRASH/DEBRIS REMOVAL
- \_\_\_ OUTLET WORKS CLEANING (TRASH RACK/WELL SCREEN)
- \_\_\_ WEED CONTROL (HERBICIDE APPLICATION)

**RESTORATION WORK**

- \_\_\_ SEDIMENT REMOVAL
  - \_\_\_ INFLOW POINT
  - \_\_\_ SWALE BOTTOM
  - \_\_\_ SIDE SLOPE
  - \_\_\_ BUFFER STRIP
- \_\_\_ EROSION REPAIR
  - \_\_\_ INFLOW POINT
  - \_\_\_ SWALE BOTTOM
  - \_\_\_ SIDE SLOPE
  - \_\_\_ BUFFER STRIP
  - \_\_\_ GRADE CONTROL/LEVEL SPREADER
- \_\_\_ REVEGETATION
  - \_\_\_ SWALE BOTTOM
  - \_\_\_ SIDE SLOPE
  - \_\_\_ BUFFER STRIP

**REHABILITATION WORK**

- \_\_\_ SEDIMENT REMOVAL (DREDGING)
  - \_\_\_ SWALE BOTTOM
  - \_\_\_ INFLOW POINT
- \_\_\_ EROSION REPAIR
  - \_\_\_ INFLOW POINT
  - \_\_\_ SWALE BOTTOM
  - \_\_\_ SIDE SLOPE
  - \_\_\_ BUFFER STRIP
- \_\_\_ STRUCTURAL REPAIR
  - \_\_\_ INFLOW
  - \_\_\_ UNDERDRAIN
  - \_\_\_ LEVEL SPREADER

OTHER \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

ESTIMATED TOTAL MANHOURS: \_\_\_\_\_

EQUIPMENT/MATERIAL USED: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

COMMENTS/ADDITIONAL INFO: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

This Maintenance Activity Form shall be kept indefinitely and made available to the City of Aurora upon request.

# **A P P E N D I X F**

## **Annual Inspection and Maintenance Reporting Form**



Annual Inspection and Maintenance Reporting Form  
for  
Stormwater Facilities

*(This form shall be submitted to the El Paso County prior to May 31 of each year along  
with the Inspection Forms and Maintenance Forms as required for the  
property/subdivision)*

**Date:** \_\_\_\_\_

**To:** El Paso County  
Water Department  
Attn: El Paso County Stormwater  
3275 Akers Drive  
Colorado Springs, Colorado 80922

**Re:** Certification of Inspection and Maintenance; Submittal of forms

Property/Subdivision Name: \_\_\_\_\_

Property Address: \_\_\_\_\_

Contact Name: \_\_\_\_\_

I verify that the required stormwater facility inspections and required maintenance have been completed in accordance with the Stormwater Facilities Maintenance Agreement and the Inspection and Maintenance Plan associated with the above referenced property.

The required Stormwater Facility Inspection and Maintenance forms are hereby provided.

\_\_\_\_\_  
Name of Party Responsible for Inspection  
& Maintenance







\_\_\_\_\_  
Property Owner

\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Signature

# **INSPECTION AND MAINTENANCE SITE PLANS STORMWATER FACILITIES MAP CHECKLIST FOR REQUIRED ITEMS**

Stormwater facilities map shall include:







-  ☐ Labels for all streets (includes line work for edge of street and street name)
-  ☐ Line work for right-of-way lines, lot lines, and tracts
-  ☐ Line work and labels for all major drainage ways
-  ☐ Label roadways, developments, etc adjacent to project site
-  ☐ Labels for all BMPs being constructed on project site including a summary table when multiple BMPs are present
-  ☐ Legend for identifying features/line types on drawing (optional)

## **Plan and Profile**







# **INSPECTION AND MAINTENANCE SITE PLANS EXTENDED DETENTION BASIN (EDB) CHECKLIST FOR REQUIRED ITEMS**

## **PLAN AND PROFILE SHEET**

Plan view shall include:






-  ☐ Location and labels for all major features of EDB (inflow structure(s), forebay, micro-pool, trickle channel, access road, outlet work(s), spillway, maintenance access ramps, embankment, etc.)
-  ☐ Contours
-  ☐ Other utilities in vicinity of EDB (n/a)
-  ☐ Cross-reference to EDB Operation and Maintenance Details sheet
-  ☐ Line work for right-of-way lines, lot lines, easements, and tracts
-  ☐ Hatch indicating permanent water elevation in micro-pool. (n/a)








Profile view shall include:

-  ☐ Location and labels for all major features of EDB (inflow structure(s), forebay, micro-pool, trickle channel, access road, outlet work(s), spillway, maintenance access ramps, embankment, etc.) . (n/a)
-  ☐ Invert elevations at major features of EDB (inflow structure(s), forebay, micro-pool, outlet work(s)) (n/a)
-  ☐ Permanent pool elevation of micro-pool(n/a)
-  ☐ Water quality water surface elevation
-  ☐ Water surface elevation of all applicable storm events
-  ☐ Label for upper and bottom stages for EDB(n/a)

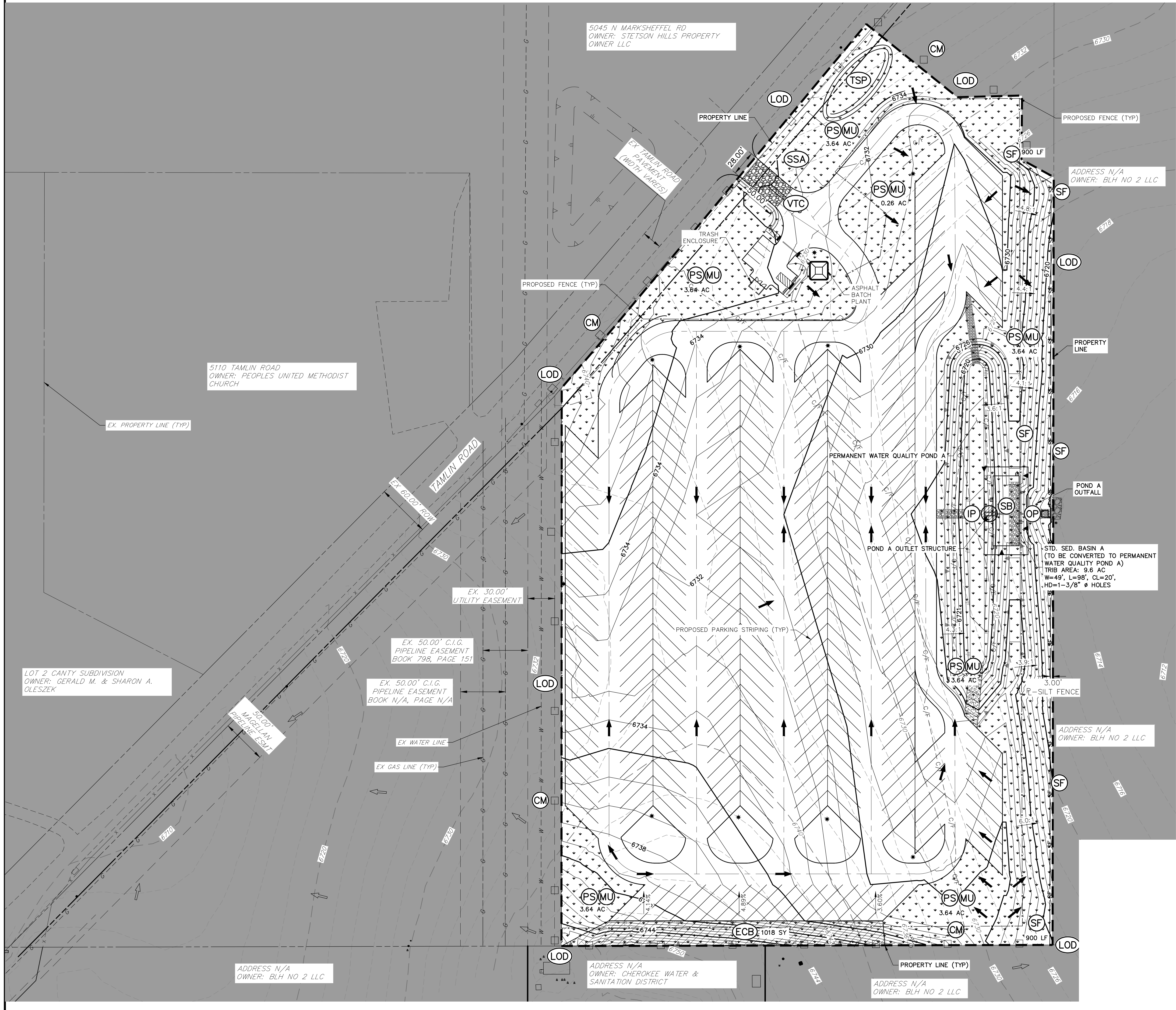
## **DETAIL SHEET**

Detail sheet shall include:

-  ☐ Volume provided by the EDB forebay and micro-pool, including the WQCV n/a)
-  ☐ WQCV drain time
-  ☐ Seed mix n/a)
-  ☐ Total mow area including approximate mow boundaries on each side of EDB
-  ☐ Duplicate the following tables from the "Standard Operation Procedure for Extended Detention Basin Inspection and Maintenance" document:
  - Inspection and Maintenance Requirements at Specific EDB Features

- Summary of Routine Maintenance Activities for an EDB
- Summary of Minor Maintenance Activities for an EDB
- Summary of Major Maintenance Activities for an EDB
-  ☐ Water quality outlet works detail(n/a)
-  ☐ Water quality plate detail(n/a)
-  ☐ Maintenance access road detail(n/a)
-  ☐ Trickle channel typical section
-  ☐ Forebay edge detail (or cross section) which includes maximum allowed sediment depth in forebay(n/a)
-  ☐ Forebay release structure detail(n/a)
-  ☐ Spillway detail(s), including cutoff wall



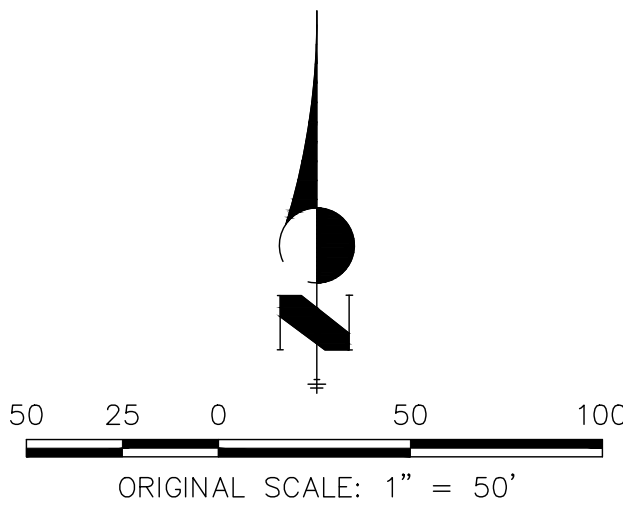


LEGEND

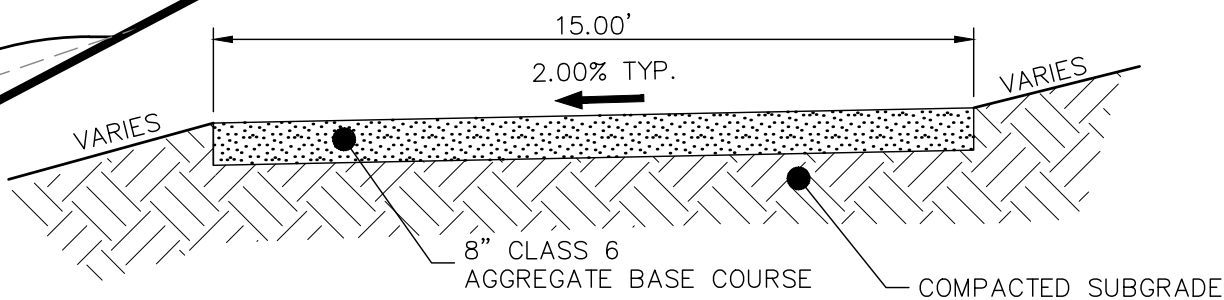
SEDIMENT BASIN	(SB)	
SILT FENCE	(SF)	
STABILIZED STAGING AREA	(SSA)	
CONSTRUCTION MARKER	(CM)	
VEHICLE TRACKING CONTROL	(VTC)	
TEMPORARY STOCK PILE	(TSP)	
EROSION CONTROL BLANKET	(ECB)	
INLET PROTECTION	(IP)	
OUTLET PROTECTION	(OP)	
DIVERSION DITCH AND DIKE, TEMPORARY	(DD)	
CUT AND FILL LINE		
LIMITS OF DISTURBANCE	(LOD)	
ASPHALT BATCH PLANT	(ABP)	
PERMANENT SEEDING/MULCHING	(MU)	

BMP PHASING

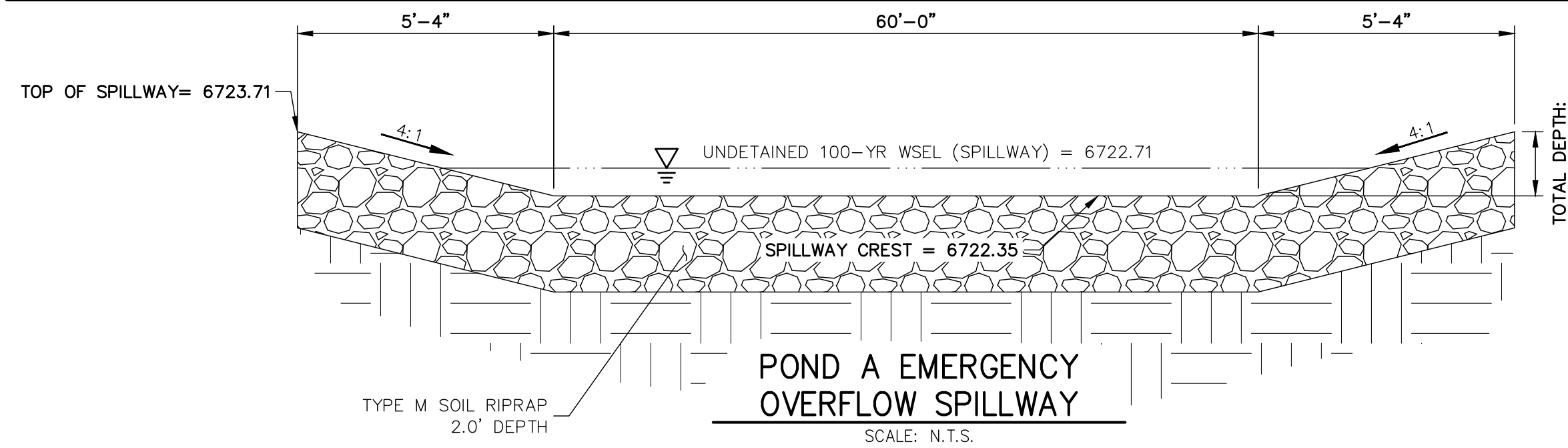
- INITIAL (MARCH 2020):
- 1) INSTALL VTC
  - 2) ESTABLISH SSA
  - 3) INSTALL CONSTRUCTION MARKERS
  - 4) INSTALL SILT FENCE
  - 5) INSTALL SEDIMENT BASINS
  - 6) INSTALL DIVERSION DITCHES
- INTERIM (MAY 2020):
- 1) LOCATE/INSTALL TEMPORARY STOCKPILE
  - 2) MAINTAIN ALL BMPs
  - 3) INSTALL INLET AND OUTLET PROTECTION
  - 4) INSTALL EROSION CONTROL BLANKETS
- FINAL (AUGUST 2020):
- 1) INSTALL MULCH AND PERMANENT SEEDING IN ALL DISTURBED AREAS
  - 2) REMOVE SILT FENCE AFTER STABILIZED
- FINAL STABILIZATION ANTICIPATED NOVEMBER 2020.



TAMLIN ROAD RV STORAGE		O&M MANUAL – FACILITIES MAP		SHEET 3 OF 10		JOB NO. 25134.00	
H-SCALE		V-SCALE		DATE		DESIGNED BY	
1"=50'		N/A		01/17/20		NQJ	
						NQJ	
						NQJ	
						CHECKED BY	

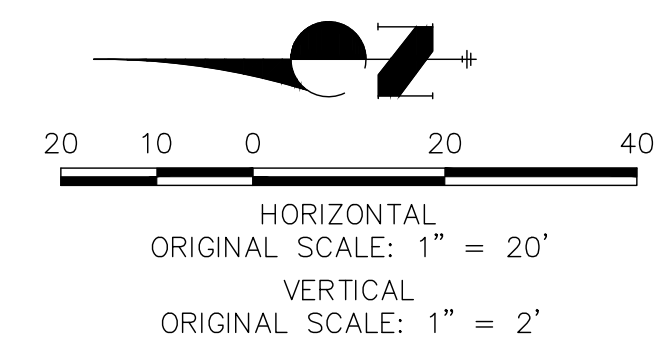


WATER QUALITY POND – LOW FLOW  
SWALE



## POND A EMERGENCY OVERFLOW SPILLWAY

POINT TABULATION				POINT TABULATION				POINT TABULATION			
ID NO.	DESCRIPTION	NORTHING/EASTING	ELEVATION	ID NO.	DESCRIPTION	NORTHING/EASTING	ELEVATION	ID NO.	DESCRIPTION	NORTHING/EASTING	ELEVATION
10	TOE OF SLOPE	N: 9952.98 E: 20516.20	6717.21	34	TOP OF SLOPE	N: 9971.97 E: 20488.14	6724.94	56	DISSIPATOR	N: 9915.51 E: 20592.13	6716.42
11	TOE OF SLOPE	N: 10001.44 E: 20516.02	6717.69	35	TOP OF SLOPE	N: 10077.90 E: 20487.75	6727.06	57	DISSIPATOR	N: 9921.01 E: 20592.11	6716.42
12	TOE OF SLOPE	N: 10078.00 E: 20515.75	6718.46	36	TOP OF SLOPE/RIPRAP	N: 10114.03 E: 20523.84	6727.13	58	DISSIPATOR	N: 9921.05 E: 20602.11	6714.42
13	TOE OF SLOPE	N: 10078.06 E: 20531.75	6718.30	37	TOP OF SLOPE	N: 10078.16 E: 20559.75	6726.07	59	DISSIPATOR	N: 9915.55 E: 20602.13	6714.42
14	TOE OF SLOPE	N: 10086.03 E: 20523.72	6718.51	38	TOP OF SLOPE	N: 10029.60 E: 20559.93	6725.15	60	DISSIPATOR	N: 9915.53 E: 20598.13	6714.42
15	TOE OF SLOPE	N: 10049.63 E: 20531.85	6718.02	39	TOP OF POND/BEGIN SPILLWAY	N: 9953.58 E: 20560.20	6723.71	61	DISSIPATOR	N: 9921.03 E: 20598.11	6714.42
16	TOE OF SLOPE	N: 9966.08 E: 20532.15	6717.18	40	SPILLWAY CREST	N: 9948.14 E: 20560.22	6722.35	62	TOP OF POND	N: 9994.27 E: 20560.05	6724.48
17	MAINT. & ACCESS ROAD	N: 9723.82 E: 20513.63	6722.79	41	TOP OF POND/BEGIN SPILLWAY	N: 9953.63 E: 20572.20	6723.71	63	TOP OF POND	N: 10108.14 E: 20563.79	6726.00
18	MAINT. & ACCESS ROAD	N: 9692.81 E: 20510.67	6726.72	42	SPILLWAY CREST	N: 9948.19 E: 20572.22	6722.35	64	TOP OF POND	N: 10110.05 E: 20540.21	6726.81
19	MAINT. & ACCESS ROAD	N: 9679.96 E: 20524.43	6727.48	43	TOP OF POND/BEGIN SPILLWAY	N: 9882.75 E: 20572.45	6723.71	65	TOP OF POND	N: 9803.90 E: 20572.72	6725.39
20	MAINT. & ACCESS ROAD/TOE OF SLOPE	N: 9753.55 E: 20531.54	6718.35	44	SPILLWAY CREST	N: 9888.19 E: 20572.43	6722.35	66	EDGE OF ROAD/RIPRAP	N: 10150.11 E: 20510.72	6728.18
24	RIPRAP	N: 10102.65 E: 20550.02	6726.58	45	TOP OF SLOPE	N: 9756.61 E: 20572.88	6726.38	67	EDGE OF ROAD/RIPRAP	N: 10166.14 E: 20512.51	6728.52
25	SPILLWAY CREST	N: 9888.14 E: 20560.43	6722.35	46	TOP OF SLOPE	N: 9722.26 E: 20555.94	6726.75	68	EDGE OF ROAD/RIPRAP	N: 10161.45 E: 20517.21	6728.55
26	TOP OF POND/BEGIN SPILLWAY	N: 9882.70 E: 20560.45	6723.71	47	TOP OF SLOPE/RIPRAP	N: 10111.36 E: 20515.89	6727.15	69	TOE OF SLOPE/RIPRAP	N: 10085.01 E: 20519.83	6718.56
27	TOP OF SLOPE	N: 9803.15 E: 20560.74	6725.41	49	TOP OF SLOPE	N: 10078.20 E: 20571.75	6726.07	70	TOE OF SLOPE/RIPRAP	N: 10084.86 E: 20527.93	6718.39
28	TOP OF SLOPE	N: 9756.78 E: 20560.88	6726.40	50	TOP OF SLOPE	N: 10026.47 E: 20571.94	6725.09	71	EDGE OF ROAD/RIPRAP	N: 9923.03 E: 20479.28	6724.25
29	MAINT. & ACCESS ROAD	N: 9722.19 E: 20528.55	6722.19	51	TOP OF SLOPE	N: 9993.97 E: 20572.05	6724.47	72	EDGE OF ROAD/RIPRAP	N: 9913.03 E: 20479.28	6724.21
30	TOP OF SLOPE	N: 9757.88 E: 20488.90	6725.00	52	DISSIPATOR	N: 9923.29 E: 20604.95	6715.42	73	TOE OF SLOPE/RIPRAP	N: 9923.17 E: 20516.30	6716.91
31	TOP OF SLOPE	N: 9807.61 E: 20488.72	6724.65	53	DISSIPATOR	N: 9923.25 E: 20590.10	6716.90	74	TOE OF SLOPE/RIPRAP	N: 9913.17 E: 20516.34	6716.91
32	TOP OF SLOPE	N: 9844.80 E: 20488.59	6724.38	54	TOP OF SLOPE	N: 9913.25 E: 20590.13	6716.89	75	TOP OF SLOPE/RIPRAP	N: 9913.07 E: 20488.34	6723.89
33	TOP OF SLOPE/RIPRAP	N: 9923.07 E: 20488.30	6723.96	55	DISSIPATOR	N: 9913.31 E: 20604.99	6715.39				





EDB Features	Sediment Removal	Mowing/ Weed control	Trash & Debris Removal	Erosion	Overgrown Vegetation Removal	Standing Water (mosquito/ algae control)	Structure Repair
Inflow Points (outfalls)	X		X				X
Forebay	X		X				X
Low-flow channel	X		X	X	X		X
Bottom Stage	X	X	X	X	X	X	
Micro-pool	X		X		X	X	X
Outlet Works	X		X				X
Emergency Spillway			X	X	X		X
Upper Stage			X	X			
Embankment		X		X	X		

Maintenance Activity	Minimum Frequency	Look for:	Maintenance Action
<u>Sediment Removal*</u>	As needed; typically every 1 –2 years	Sediment build-up; decrease in pond volume	Remove and dispose of sediment
Erosion Repair	As needed, based upon inspection	Rills/gullies forming on side slopes, trickle channel, other areas	Repair eroded areas  Revegetate; address source of erosion
Vegetation Removal/Tree Thinning	As needed, based upon inspection	Large trees/wood vegetation in lower chamber of pond	Remove vegetation; restore grade and surface
Drain Cleaning/Jet Vac	As needed, based upon inspection	Sediment build-up /non draining system	Clean drains; Jet Vac if needed

**TABLE EDB-2**  
**SUMMARY OF ROUTINE MAINTENANCE ACTIVITIES**

Maintenance Activity	Minimum Frequency	Look for:	Maintenance Action
<b>Mowing</b>	Twice annually	Excessive grass height/aesthetics	Mow grass to a height of 4" to 6"
<b>Trash/Debris Removal</b>	Twice annually	Trash & debris in EDB	Remove and dispose of trash and debris
<b>Outlet Works Cleaning</b>	As needed - after significant rain events – twice annually min.	Clogged outlet structure; ponding water	Remove and dispose of debris/trash/sediment to allow outlet to function properly
<b>Weed control</b>	Minimum twice annually	Noxious weeds; Unwanted vegetation	Treat w/ herbicide or hand pull; Consult the local weed specialist
<b>Mosquito Treatment</b>	As needed	Standing water/mosquito habitat	Treat w/ EPA approved chemicals
<b>Algae Treatment</b>	As needed	Standing water/ Algal growth/green color	Treat w/ EPA approved chemicals

Maintenance Activity	Minimum Frequency	Look for:	Maintenance Action
<b>Major Sediment Removal</b>	As needed – based upon scheduled inspections	Large quantities of sediment; reduced pond capacity	Remove and dispose of sediment. Repair vegetation as needed
<b>Major Erosion Repair</b>	As needed – based upon scheduled inspections	Severe erosion including gullies, excessive soil displacement, areas of settlement, holes	Repair erosion – find cause of problem and address to avoid future erosion
<b>Structural Repair</b>	As needed – based upon scheduled inspections	Deterioration and/or damage to structural components – broken concrete, damaged pipes, outlet works	Structural repair to restore the structure to its original design

- Clean, weed-free and seed-free cereal grain straw should be applied evenly at a rate of 2 tons per acre and must be tacked or fastened by a method suitable for the condition of the site. Straw mulch must be anchored (and not merely placed) on the surface. This can be accomplished mechanically by crimping or with the aid of tackifiers or nets. Anchoring with a crimping implement is preferred, and is the recommended method for areas flatter than 3:1. Mechanical crimpers must be capable of tucking the long mulch fibers into the soil to a depth of 3 inches without cutting them. An agricultural disk, while not an ideal substitute, may work if the disk blades are dull or blunted and set vertically; however, the frame may have to be weighted to afford proper soil penetration.
- Grass hay may be used in place of straw; however, because hay is comprised of the entire plant including seed, mulching with hay may seed the site with non-native grass species which might in turn out-compete the native seed. Alternatively, native species of grass hay may be purchased, but can be difficult to find and are more expensive than straw. Purchasing and utilizing a certified weed-free straw is an easier and less costly mulching method. When using grass hay, follow the same guidelines as for straw (provided above).
- On small areas sheltered from the wind and heavy runoff, spraying a tackifier on the mulch is satisfactory for holding it in place. For steep slopes and special situations where greater control is needed, erosion control blankets anchored with stakes should be used instead of mulch.
- Hydraulic mulching consists of wood cellulose fibers mixed with water and a tackifying agent and should be applied at a rate of no less than 1,500 pounds per acre (1,425 lbs of fibers mixed with at least 75 lbs of tackifier) with a hydraulic mulcher. For steeper slopes, up to 2000 pounds per acre may be required for effective hydros seeding. Hydromulch typically requires up to 24 hours to dry; therefore, it should not be applied immediately prior to inclement weather. Application to roads, waterways and existing vegetation should be avoided.
- Erosion control mats, blankets, or nets are recommended to help stabilize steep slopes (generally 3:1 and steeper) and waterways. Depending on the product, these may be used alone or in conjunction with grass or straw mulch. Normally, use of these products will be restricted to relatively small areas. Biodegradable mats made of straw and jute, straw-coconut, coconut fiber, or excelsior can be used instead of mulch. (See the ECM/TRM BMP for more information.)
- Some tackifiers or binders may be used to anchor mulch. Check with the local jurisdiction for allowed tackifiers. Manufacturer's recommendations should be followed at all times. (See the Soil Binder BMP for more information on general types of tackifiers.)
- Rock can also be used as mulch. It provides protection of exposed soils to wind and water erosion and allows infiltration of precipitation. An aggregate base course can be spread on disturbed areas for temporary or permanent stabilization. The rock mulch layer should be thick enough to provide full coverage of exposed soil on the area it is applied.

Maintenance and Removal

After mulching, the bare ground surface should not be more than 10 percent exposed. Reapply mulch, as needed, to cover bare areas.

Temporary and Permanent Seeding (TS/PS)EC-2

Seeding dates for the highest success probability of perennial species along the Front Range are generally in the spring from April through early May and in the fall after the first of September until the ground freezes. If the area is irrigated, seeding may occur in summer months, as well. See Table TS/PS-3 for appropriate seeding dates.

Table TS/PS-1. Minimum Drill Seeding Rates for Various Temporary Annual Grasses

Species* (Common name)	Growth Season <sup>a</sup>	Pounds of Pure Live Seed (PLS)/acre	Planting Depth (inches)
1. Oats	Cool	35 - 50	1 - 2
2. Spring wheat	Cool	25 - 35	1 - 2
3. Spring barley	Cool	25 - 35	1 - 2
4. Annual ryegrass	Cool	10 - 15	½
5. Millet	Warm	3 - 15	½ - ¾
6. Sudangrass	Warm	5-10	½ - ¾
7. Sorghum	Warm	5-10	½ - ¾
8. Winter wheat	Cool	20-35	1 - 2
9. Winter barley	Cool	20-35	1 - 2
10. Winter rye	Cool	20-35	1 - 2
11. Triticale	Cool	25-40	1 - 2

<sup>a</sup> Successful seeding of annual grass resulting in adequate plant growth will usually produce enough dead-plant residue to provide protection from wind and water erosion for an additional year. This assumes that the cover is not disturbed or moved closer than 8 inches.

Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1 or where access limitations exist. When hydraulic seeding is used, hydraulic mulching should be applied as a separate operation, when practical, to prevent the seeds from being encapsulated in the mulch.

<sup>b</sup> See Table TS/PS-3 for seeding dates. Irrigation, if consistently applied, may extend the use of cool season species during the summer months.

<sup>c</sup> Seeding rates should be doubled if seed is broadcast, or increased by 50 percent if done using a Brillion Drill or by hydraulic seeding.

EC-2Temporary and Permanent Seeding (TS/PS)

Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses

Common <sup>a</sup> Name	Botanical Name	Growth Season <sup>b</sup>	Growth Form	Seeds/ Pound	Pounds of PLS/acre
<b>Alkalali Soil Seed Mix</b>					
Alkali sacaton	<i>Sporobolus airoides</i>	Cool	Bunch	1,750,000	0.25
Basin wildrye	<i>Elymus cinereus</i>	Cool	Bunch	165,000	2.5
Sodar streambank wheatgrass	<i>Agropyron riparium 'Sodar'</i>	Cool	Sod	170,000	2.5
Jose tall wheatgrass	<i>Agropyron elongatum 'Jose'</i>	Cool	Bunch	79,000	7.0
Arriba western wheatgrass	<i>Agropyron smithii 'Arriba'</i>	Cool	Sod	110,000	5.5
<b>Total</b>					<b>17.75</b>
<b>Fertile Loamy Soil Seed Mix</b>					
Ephriam crested wheatgrass	<i>Agropyron cristatum 'Ephriam'</i>	Cool	Sod	175,000	2.0
Dural hard fescue	<i>Festuca ovina 'Iuriuscula'</i>	Cool	Bunch	565,000	1.0
Lincoln smooth brome	<i>Bromus inermis leys</i>	Cool	Sod	130,000	3.0
Sodar streambank wheatgrass	<i>Agropyron riparium 'Sodar'</i>	Cool	Sod	170,000	2.5
Arriba western wheatgrass	<i>Agropyron smithii 'Arriba'</i>	Cool	Sod	110,000	7.0
<b>Total</b>					<b>15.5</b>
<b>High Water Table Soil Seed Mix</b>					
Meadow foxtail	<i>Alopecurus pratensis</i>	Cool	Sod	900,000	0.5
Redtop	<i>Agrostis alba</i>	Warm	Open sod	5,000,000	0.25
Reed canarygrass	<i>Phalaris arundinacea</i>	Cool	Sod	68,000	0.5
Lincoln smooth brome	<i>Bromus inermis leys</i> 'Lincoln'	Cool	Sod	130,000	3.0
Pathfinder switchgrass	<i>Panicum virgatum 'Pathfinder'</i>	Warm	Sod	389,000	1.0
Alkar tall wheatgrass	<i>Agropyron elongatum 'Alkar'</i>	Cool	Bunch	79,000	5.5
<b>Total</b>					<b>10.75</b>
<b>Transition Turf Seed Mix<sup>c</sup></b>					
Ruebens Canadian bluegrass	<i>Poa compressa 'Ruebens'</i>	Cool	Sod	2,500,000	0.5
Dural hard fescue	<i>Festuca ovina 'Iuriuscula'</i>	Cool	Bunch	565,000	1.0
Citation perennial ryegrass	<i>Lolium perenne 'Citation'</i>	Cool	Sod	247,000	3.0
Lincoln smooth brome	<i>Bromus inermis leys</i> 'Lincoln'	Cool	Sod	130,000	3.0
<b>Total</b>					<b>7.5</b>

Temporary and Permanent Seeding (TS/PS)EC-2

Table TS/PS-2. Minimum Drill Seeding Rates for Perennial Grasses (cont.)

Common Name	Botanical Name	Growth Season <sup>a</sup>	Growth Form	Seeds/ Pound	Pounds of PLS/acre
<b>Sandy Soil Seed Mix</b>					
Blue grama	<i>Bouteloua gracilis</i>	Warm	Sod-forming bunchgrass	825,000	0.5
Camper little bluestem	<i>Schizachyrium scoparium 'Camper'</i>	Warm	Bunch	240,000	1.0
Prairie sandreed	<i>Calamovilfa longifolia</i>	Warm	Open sod	274,000	1.0
Sand dropseed	<i>Sporobolus cryptandrus</i>	Cool	Bunch	5,298,000	0.25
Vaughn sidecoats grama	<i>Bouteloua curtipendula 'Vaughn'</i>	Warm	Sod	191,000	2.0
Arriba western wheatgrass	<i>Agropyron smithii 'Arriba'</i>	Cool	Sod	110,000	5.5
<b>Total</b>					<b>10.25</b>
<b>Heavy Clay, Rocky Foothill Seed Mix</b>					
Ephriam crested wheatgrass <sup>d</sup>	<i>Agropyron cristatum 'Ephriam'</i>	Cool	Sod	175,000	1.5
Oahe Intermediate wheatgrass	<i>Agropyron intermedium 'Oahe'</i>	Cool	Sod	115,000	5.5
Vaughn sidecoats grama <sup>e</sup>	<i>Bouteloua curtipendula 'Vaughn'</i>	Warm	Sod	191,000	2.0
Lincoln smooth brome	<i>Bromus inermis leys</i> 'Lincoln'	Cool	Sod	130,000	3.0
Arriba western wheatgrass	<i>Agropyron smithii 'Arriba'</i>	Cool	Sod	110,000	5.5
<b>Total</b>					<b>17.5</b>

<sup>a</sup> All of the above seeding mixes and rates are based on drill seeding followed by crimped straw mulch. These rates should be doubled if seed is broadcast and should be increased by 50 percent if the seeding is done using a Brillion Drill or is applied through hydraulic seeding. Hydraulic seeding may be substituted for drilling only where slopes are steeper than 3:1. If hydraulic seeding is used, hydraulic mulching should be done as a separate operation.

<sup>b</sup> See Table TS/PS-3 for seeding dates.

<sup>c</sup> If site is to be irrigated, the transition turf seed rates should be doubled.

<sup>d</sup> Crested wheatgrass should not be used on slopes steeper than 6H to 1V.

<sup>e</sup> Can substitute 0.5 lbs PLS of blue grama for the 2.0 lbs PLS of Vaughn sidecoats grama.

EC-2Temporary and Permanent Seeding (TS/PS)

Table TS/PS-3. Seeding Dates for Annual and Perennial Grasses

	Annual Grasses (Numbers in table reference species in Table TS/PS-1)		Perennial Grasses	
	Warm	Cool	Warm	Cool
<b>Seeding Dates</b>				
January 1–March 15			✓	✓
March 16–April 30	4	1,2,3	✓	✓
May 1–May 15	4		✓	
May 16–June 30	4,5,6,7			
July 1–July 15	5,6,7			
July 16–August 31				
September 1–September 30		8,9,10,11		
October 1–December 31			✓	✓

Mulch

Cover seeded areas with mulch or an appropriate rolled erosion control product to promote establishment of vegetation. Anchor mulch by crimping, netting or use of a non-toxic tackifier. See the Mulching BMP Fact Sheet for additional guidance.

Maintenance and Removal

Monitor and observe seeded areas to identify areas of poor growth or areas that fail to germinate. Reseed and mulch these areas, as needed.

An area that has been permanently seeded should have a good stand of vegetation within one growing season if irrigated and within three growing seasons without irrigation in Colorado. Reseed portions of the site that fail to germinate or remain bare after the first growing season.

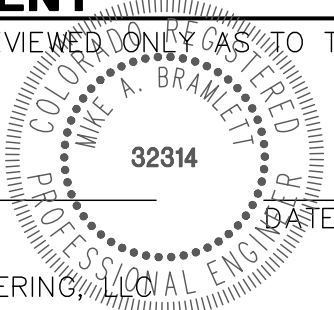
Seeded areas may require irrigation, particularly during extended dry periods. Targeted weed control may also be necessary.

Protect seeded areas from construction equipment and vehicle access.

ENGINEER'S STATEMENT

STANDARD DETAILS SHOWN WERE REVIEWED ONLY AS TO THEIR APPLICATION ON THIS PROJECT

MIKE A. BRAMLETT, P.E.  
COLORADO P.E. 32314  
FOR AND ON BEHALF OF JR ENGINEERING



UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, JR ENGINEERING APPROVES THEIR USE FOR THE PROJECTS DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR  
**C&M PROPERTIES, LLC**  
12748 BAROSSA VALLEY ROAD  
COLORADO SPRINGS, CO 80921  
EDWARD McDONALD  
719-210-9480

**J.R. ENGINEERING**  
A Western Company  
Centennial 303-740-9883 • Colorado Springs 719-588-2583  
Fort Collins 970-491-9888 • [www.jrengineering.com](http://www.jrengineering.com)



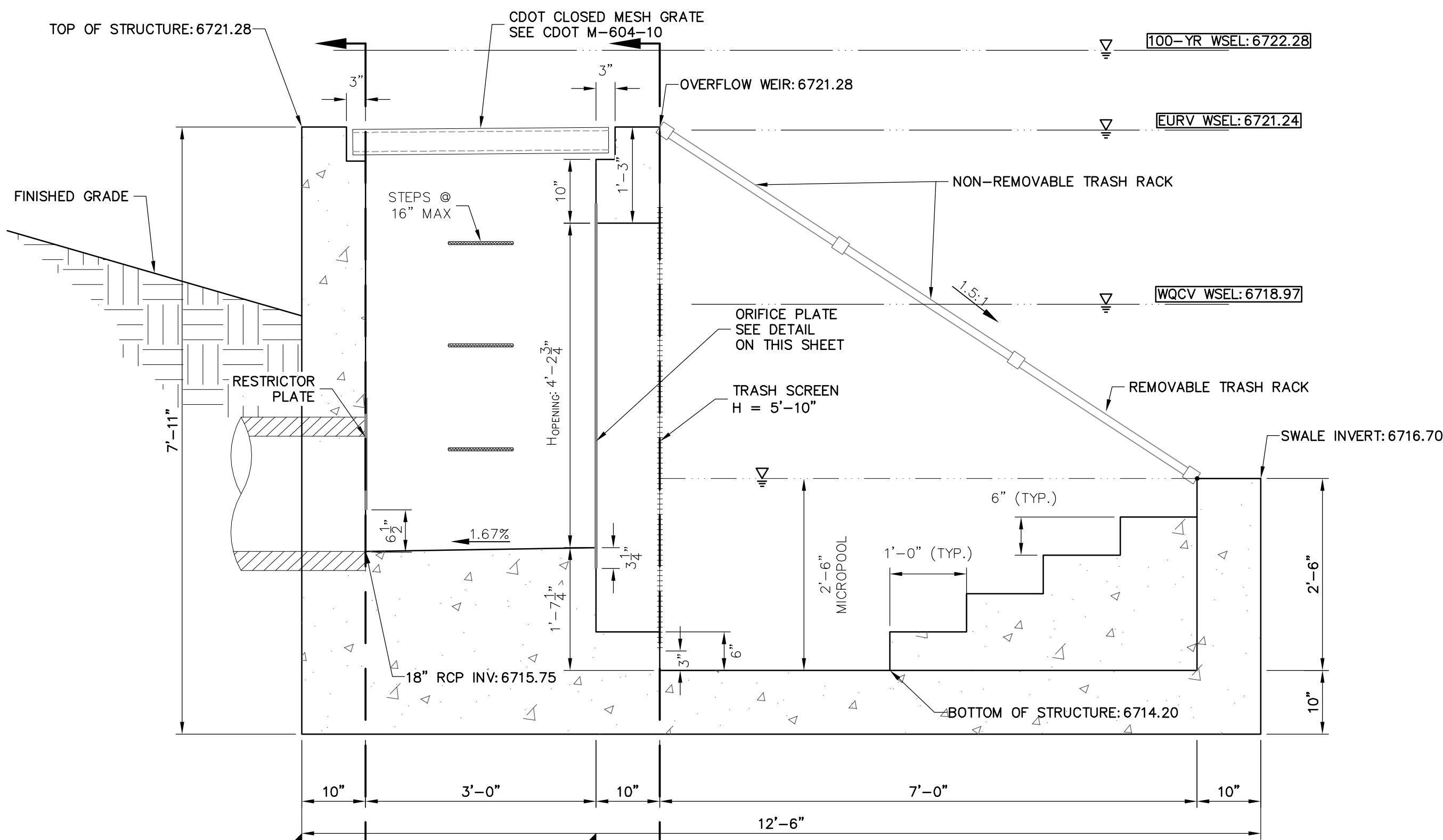
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OPERATION & MAINTENANCE PLAN

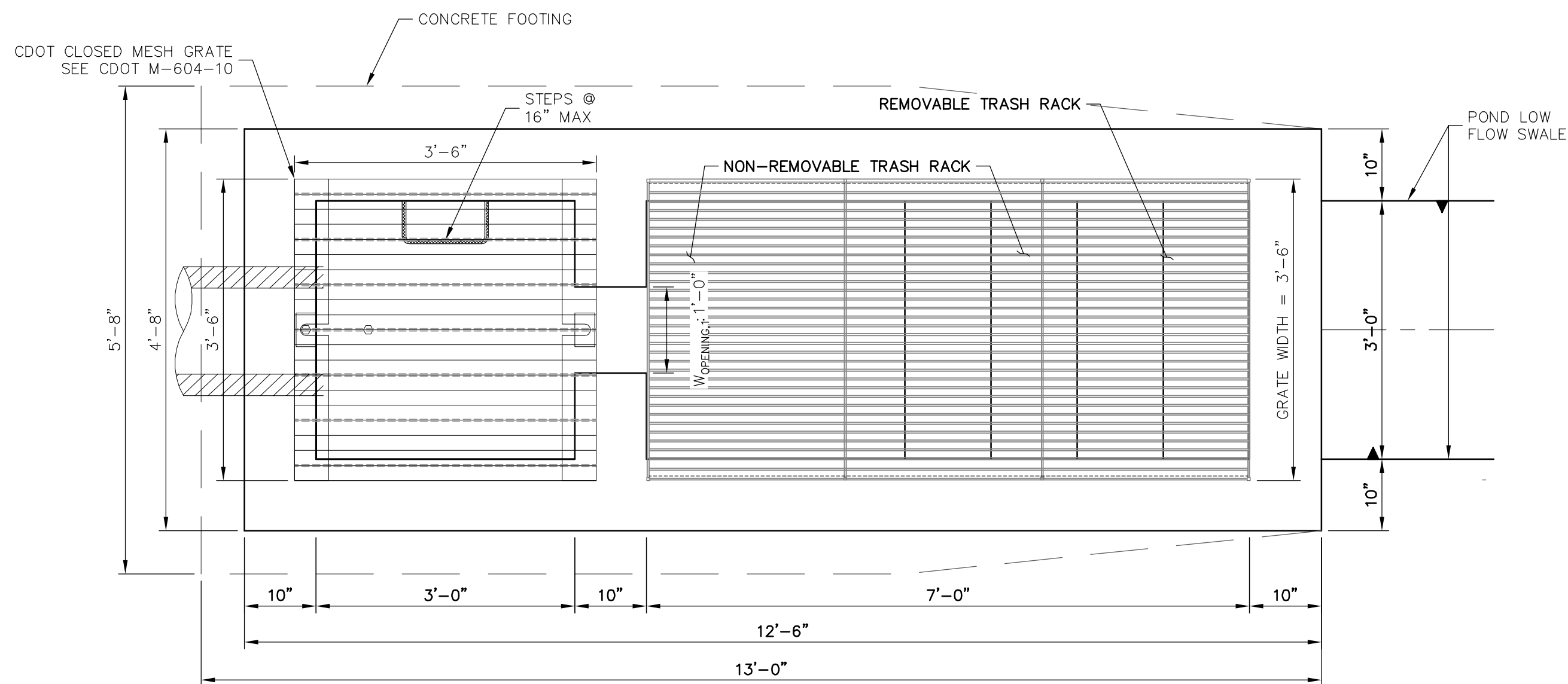
SEED MIX





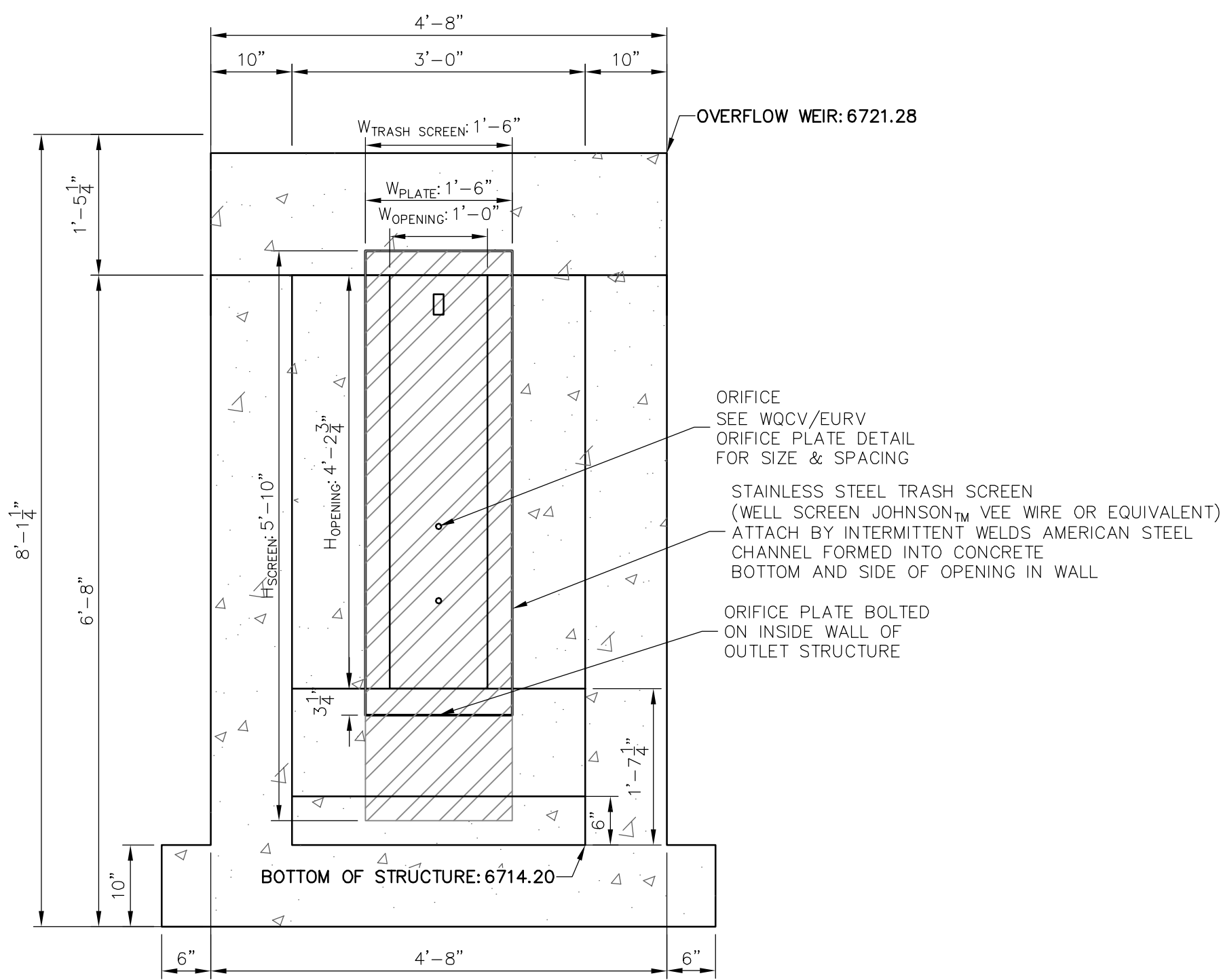
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STRUCTURE - PROFILE

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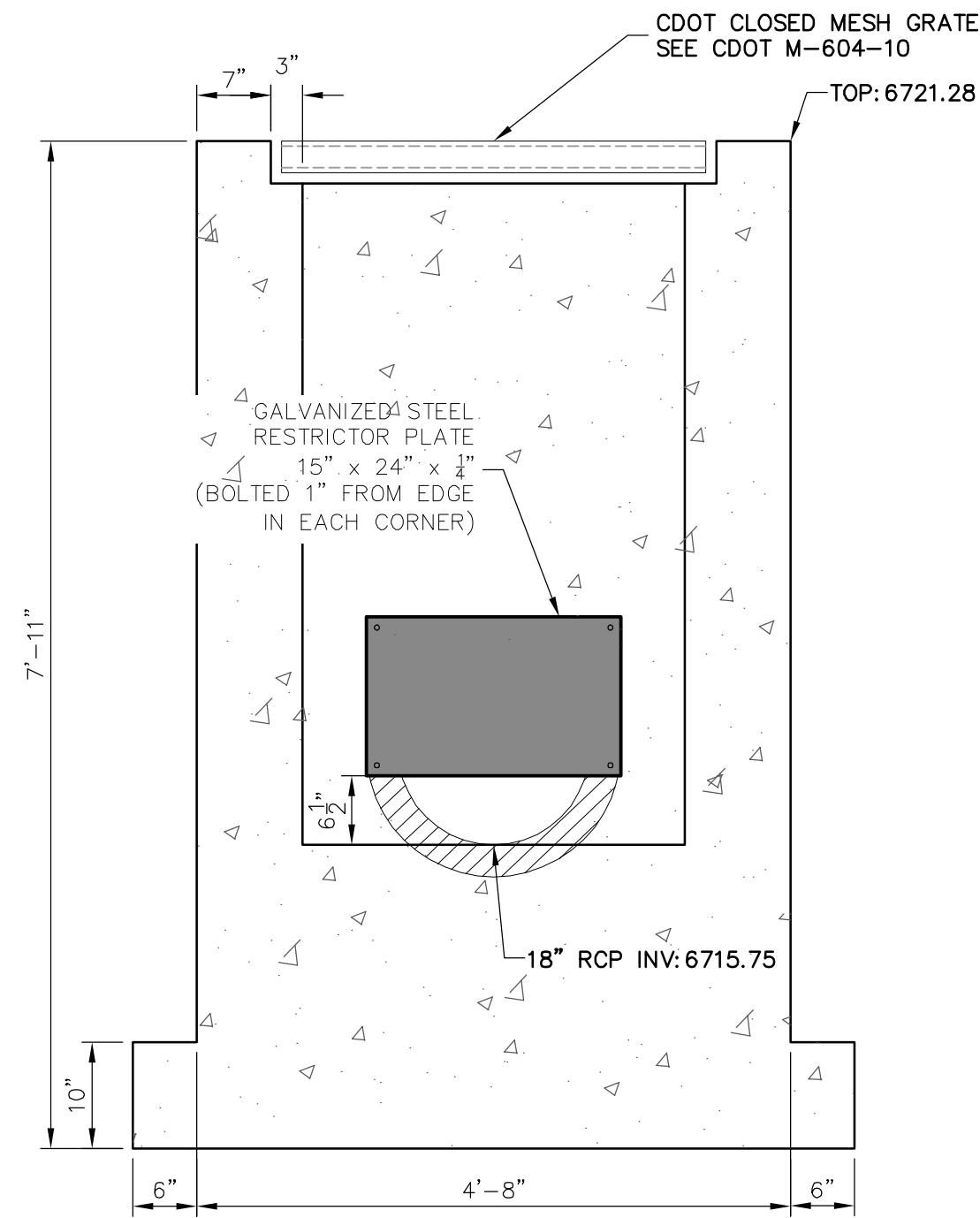
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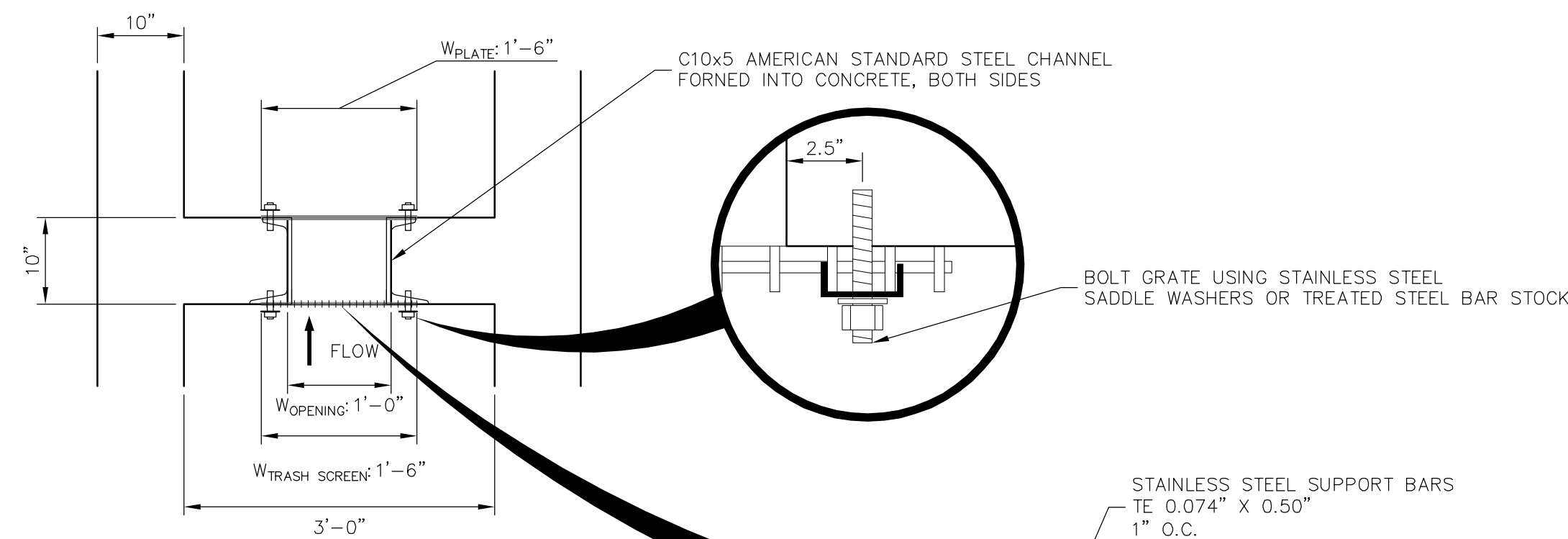
SECTION A AT ORIFICE (FRONT) WALL

SCALE: 3/4\"=1'



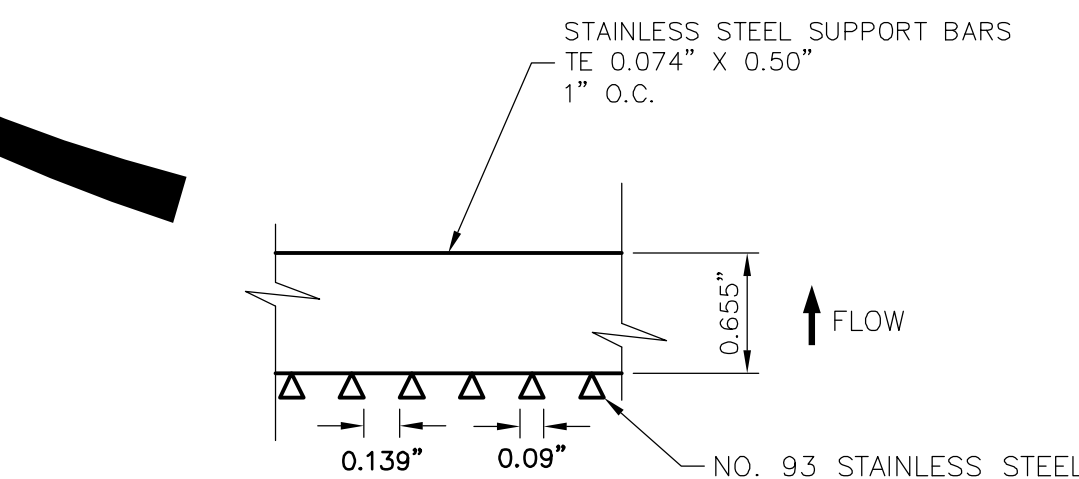
SECTION B AT OUTLET (REAR) WALL

SCALE: 3/4\"=1'



TRASH SCREEN AND WQCV PLATE  
DETAIL (PLAN)

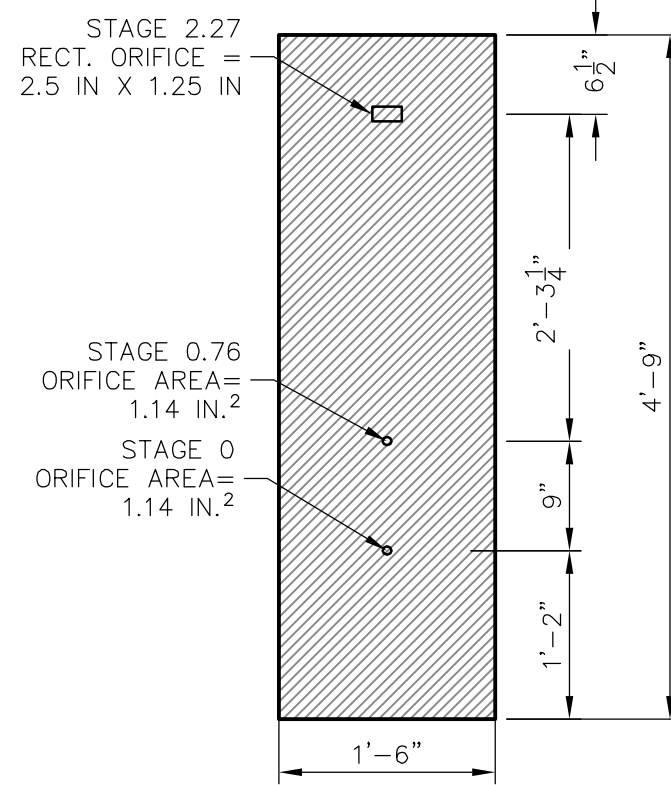
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TRASH SCREEN DETAIL

N.T.S.

EURV/WQCV ORIFICE PLATE:  
4'-9\"/>



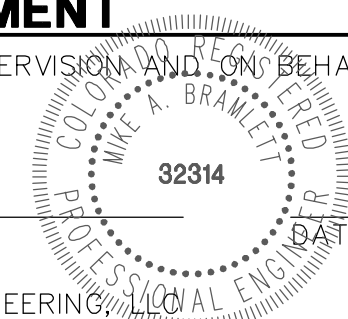
WQCV/EURV ORIFICE  
PLATE DETAIL

SCALE: 3/4\"=1'

ENGINEER'S STATEMENT

PREPARED UNDER MY DIRECT SUPERVISION AND ON BEHALF OF JR ENGINEERING

MIKE A. BRAMLETT, P.E.  
COLORADO P.E. 32314  
FOR AND ON BEHALF OF JR ENGINEERING



TAMLIN ROAD RV STORAGE

POND A OUTLET STRUCTURE

SHEET 6 OF 10

JOB NO. 25134.00

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# **INSPECTION AND MAINTENANCE SITE PLANS GRASS SWALES/GRASS BUFFERS (GS/GB) CHECKLIST FOR REQUIRED ITEMS**




## **PLAN SHEET**

Plan view shall include:

-  ☐ Location of grass swale(s) and/or buffer(s)
-  ☐ Contours
-  ☐ Line work for right-of-way lines, lot lines, easements, and tracts
-  ☐ Labels for streets adjacent to grass swale(s)/buffer(s)
-  ☐ Line work for all storm sewer structures
-  ☐ Cross-reference to Grass Swale/Buffer Operation and Maintenance Details sheet

## **DETAIL SHEET**

Detail sheet shall include:

-  ☐ Duplicate the following tables from the “Standard Operation Procedure for Grass Swales/Grass Buffers Inspection and Maintenance” document:
  - ☐ Typical Inspection and Maintenance Requirements Matrix
  - ☐ Summary of Routine Maintenance Activities
  - ☐ Summary of Minor Maintenance Activities
  - ☐ Summary of Major Maintenance Activities
-  ☐ Typical grass swale and/or buffer section including typical horizontal and vertical dimensions, side slopes, subgrade material, and underdrain (if applicable).
-  ☐ Underdrain details (if applicable) including trench dimensions, perforated PVC dimensions, and trench fill material.