

**Stormwater Best Management Practices  
Operations and Maintenance Manual (O&M Manual)  
Sand Filter Basins (SFBs) & Grass Buffers (GBs)**

for:

***Table Rock Homesteads***

***(EPC Project SF-25\_\_\_)***

Located at:

***SE Quarter of Section 6, Township 11S, Range 65W of the 6<sup>th</sup> P.M.***

Date:

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Reference:

**This plan is adapted from various maintenance manuals developed in the  
Colorado Front Range**

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**Table of Contents**

- I. Compliance with Stormwater Best Management Practices Maintenance Requirements**
- II. Inspection & Maintenance**
- III. Preventative Measures to Reduce Maintenance Costs**
- IV. Access and Easements**
- V. Safety**
- VI. Field Inspection Equipment**
- VII. Inspecting Stormwater Best Management Practices**
  - A. Inspection Procedures
  - B. Inspection Report
  - C. Verification of Inspection and Form Submittal
- VIII. Maintaining Stormwater Best Management Practices**
  - A. Maintenance Categories
  - B. Maintenance Personnel
  - C. Maintenance Forms

**Appendices**

- Appendix A** - Description of Stormwater Best Management Practices
- Appendix B1** – SFB Standard Operation Procedures (SOP)
- Appendix B2** – GB Standard Operation Procedures (SOP)
- Appendix C1** – SFB Inspection Form(s)
- Appendix C2** – GB Inspection Form(s)
- Appendix D1** – SFB Maintenance Form(s)
- Appendix D2** – GB Maintenance Form(s)
- Appendix E** – Stormwater Facility Maps

**Stormwater Best Management Practices  
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Sand Filter Basins (SFBs) and Grass Buffers (GBs)**

**I. Compliance with Stormwater Best Management Practices  
Maintenance Requirements**

All property owners are responsible for ensuring that stormwater best management practices (BMPs) or facilities installed on their property are properly maintained and that they function as designed. The property owner at the time of subdivision platting or development plan approval has executed a legally binding “Private Detention Basin/ Stormwater Quality Best Management Practice Maintenance Agreement and Easement” document which runs with the land/ BMP Maintenance Agreement. Property owners should be aware of their responsibilities regarding stormwater facility maintenance and need to be familiar with the contents of this Operations and Maintenance Manual (O&M Manual).

**II. Inspection & Maintenance**

The aforementioned BMP Maintenance Agreement requires the landowner or other responsible parties to conduct regular and routine inspections, cleanings, and maintenance.

Requirements for the inspection and maintenance of stormwater facilities are included in this Stormwater Best Management Practices O&M Manual.

Copies of the Inspection and Maintenance forms for each of the stormwater BMPs are located in Appendix C and D. These are provided for the convenience of the property owner or property manager and may be useful in demonstrating regular inspection and maintenance of the facility.

**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. Common pollutants include sediment, trash & debris, chemicals, pet wastes, runoff from stored materials, illicit discharges into the storm drainage system and many others. A thoughtful maintenance program will include measures to address these potential contaminants and will save money and time in the long run. Key points to consider in your maintenance program include:

- 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 use, storage, and disposal of hazardous wastes and chemicals. Promptly clean up and spilled materials and dispose of properly.
- Plan lawn care to minimize and properly use chemicals and pesticides.
- Sweep paved surfaces and put the sweepings back on the lawn.
- Be aware of automobiles leaking fluids. Use absorbents such as cat litter to soak up drippings – dispose of properly.
- Encourage pet owners to clean up pet waste.
- Re-vegetate disturbed and bare areas to maintain vegetative stabilization.
- Clean any private storm drainage system components, including inlets, storm sewers, and outfalls.
- Do not store materials outdoors (including landscaping materials) unless properly protected from runoff.

#### **IV. Access and Right to Enter**

All stormwater management facilities located on the site should have both a designated access location and El Paso County has the right to enter for the purpose of inspecting and for maintaining BMPs where the owner has failed to do so, in accordance with the BMP Maintenance Agreement.

#### **V. Safety**

Keep safety considerations at the forefront of inspection procedures at all times. Likely hazards should be anticipated and avoided. Never enter a confined space (outlet structure, manhole, etc) without proper training, number of personal, and equipment.

Potentially dangerous (e.g., fuel, chemicals, hazardous materials) substances found in the areas must be referred to emergency services at 911 (non-emergency number is 444-7000). If a toxic or flammable substance is discovered, leave the immediate area and contact the local emergency services at 911.

Vertical drops may be encountered in areas located within and around the facility. Avoid walking on top of retaining walls or other structures that have a significant vertical drop. If a vertical drop 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, contact emergency services at 911 immediately.**

## **VI. Field Inspection Equipment**

It is imperative that the appropriate equipment is taken to the field with the inspector(s). 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 BMPs:

- Protective clothing and boots.
- Safety equipment (vest, hard hat, confined space entry equipment [if certified to perform confined space entry]).
- Communication equipment.
- O&M Manual for the site.
- Clipboard.
- Stormwater BMP Inspection Forms (See Appendix C).
- 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), but should be available in the vehicle driven to the site. Specialized equipment may require specific training related to that equipment and should only be used by trained individuals.

## **VII. Inspecting Stormwater BMPs**

The quality of stormwater entering the waters of the state relies heavily on the proper operation and maintenance of permanent BMPs. Stormwater BMPs must be periodically inspected to ensure that they function as designed. The inspection will determine the appropriate maintenance that is required for the facility.

### **A. Inspection Procedures**

It is recommended that all Stormwater BMPs be inspected a minimum of once per year. Inspections should follow the inspection guidance found in the Standard Operation Procedures (SOP) for the specific type of facility. (Appendix B of this manual).

### **B. Inspection Report**

It is recommended that the person(s) conducting the inspection activities complete the appropriate inspection report for the specific facility. Inspection reports are located in Appendix C. It is recommended that a copy of each inspection form be kept by the owner for a minimum of 5 years.

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. It is recommended that all facilities must be inspected on an annual basis at a minimum. In addition, all facilities should 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. 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 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.

## **VIII. Maintaining Stormwater BMPs**

Stormwater BMPs must be properly maintained to ensure that 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 BMP maintenance programs are separated into three broad categories of work. The categories are separated based upon the magnitude and type of 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 El Paso County; however, it is recommended that inspection and maintenance forms be completed with the information.

#### 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. These items do not require prior correspondence with El Paso County. However, it is recommended that maintenance forms be completed and entered into the owner's maintenance records.

#### Rehabilitation Work

This work consists of large-scale maintenance and major improvements needed to address failures within the stormwater BMP. Consultation with El Paso County is recommended, which may result in a need for engineering design with construction plans to be prepared for review and approval by the County. This work may also require more specialized

maintenance equipment, surveying, construction permits or assistance from private contractors and consultants.

#### B. Maintenance Personnel

Maintenance personnel should be qualified to properly maintain stormwater BMPs, especially for restoration or rehabilitation work. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

#### C. Maintenance Forms

The Stormwater BMP Maintenance Form provides a record of maintenance activities. Maintenance Forms for each facility type are provided in Appendix D. It is recommended that maintenance Forms shall be completed by the property owner, management company, or contractor completing the required maintenance items.



## Appendix A

### General Location and Description of Stormwater Best Management Practices Sand Filter Basins (SFBs) and Grass Buffers (GBs)

#### A. General Site Description

The Table Rock Homesteads site consists of 106.364 acres located north of Walker Road, south of Palmer Divide Avenue, west of Black Forest Road, and east of Thunder Road. The site is accessed from Gambler Place extended east from Thunder Road. The property contains 10 single family rural residential lots and public roadways of Gambler Place and Suset Prairie Lane. All lots range in size from 5 to 20 acres.

#### B. General Stormwater Management Description

Stormwater from the impervious areas of the public roadway is either dispersed by sheet flow to Grass Buffers (GBs) providing water quality treatment by Runoff Reduction or conveyed via roadside ditches and storm drain culverts to one of three Sand Filter Basins (SFBs). In general, storm runoff flows west to east through the site. Much of the runoff enters and is contained within the natural streams. The three significant streams in the site are contained within established Drainage Easements. Storm runoff leaves the site in the natural drainages to the southern and eastern directions or by sheet flow to the south and east. All these flows entering the adjacent properties and continue to the south and east.

#### C. Stormwater Facilities Map

Inspection or maintenance personnel may utilize the map in Appendix E for locating the stormwater facilities within this development.

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

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

Some of the impervious public roadway areas of Table Rock Homesteads drain to impervious Grass Buffers located along the roadway provide Runoff Reduction and Minimized Directly Connected Impervious Areas (MDCIA).

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

Storm Detention is not provided for Table Rock Homesteads. Due to the large rural residential lots, runoff quantities for the Developed and Pre-Developed conditions of the site are virtually identical with only negligible increases in peak flows. Therefore, storm detention is not needed. The SFB's provide a minor degree of storm detention as they capture and release the Water Quality Capture Volume from each storm event.

### **Water Quality Facilities**

The Table Rock Homesteads site utilizes three Sand Filter Basins. One is located adjacent to the south side of Gambler Place on the north edge of Lot 9, west of Sunset Prairie Lane. The second SFB is located adjacent to the south edge of Sunset Prairie Lane on the north edge of Lot 7. The third SFB is located adjacent to the east edge of Gambler Place on the west edge of Lot 6 to the north of Sunset Prairie Lane. All SFB's are located within the private lots and within the platted Drainage Easements.

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

The Table Rock Homesteads site does not include any nonstructural BMPs.

# Appendix B1

## Standard Operation Procedures for Inspection and Maintenance

### Sand Filter Basins (SFBs)

# TABLE OF CONTENTS

<b>SFB-1</b>	<b>BACKGROUND</b> .....	<b>2</b>
<b>SFB-2</b>	<b>INSPECTING SAND FILTER BASINS (SFBS)</b> .....	<b>2</b>
<b>SFB-2.1</b>	<b>ACCESS AND EASEMENTS</b> .....	<b>2</b>
<b>SFB-2.2</b>	<b>STORMWATER BEST MANAGEMENT PRACTICE (BMP) LOCATIONS</b> .....	<b>2</b>
<b>SFB-2.3</b>	<b>SAND FILTER BASINS (SFBS) FEATURES</b> .....	<b>2</b>
	SFB-2.3.1 Inflow Points/Splttter Box .....	3
	SFB-2.3.2 Sedimentation Chamber .....	4
	SFB-2.3.3 Filter Media .....	5
	SFB-2.3.4 Underdrain System.....	6
	SFB-2.3.5 Overflow Outlet Works .....	6
	SFB-2.3.6 Embankments .....	7
	SFB-2.3.7 Emergency Overflow .....	7
	SFB-2.3.8 Miscellaneous .....	<b>Error! Bookmark not defined.</b>
<b>SFB-2.4</b>	<b>INSPECTION FORMS</b> .....	<b>9</b>
<b>SFB-3</b>	<b>MAINTAINING SAND FILTERS BASINS (SFBS)</b> .....	<b>9</b>
<b>SFB-3.1</b>	<b>MAINTENANCE PERSONNEL</b> .....	<b>9</b>
<b>SFB-3.2</b>	<b>EQUIPMENT</b> .....	<b>9</b>
<b>SFB-3.3</b>	<b>SAFETY</b> .....	<b>10</b>
<b>SFB-3.4</b>	<b>MAINTENANCE FORMS</b> .....	<b>10</b>
<b>SFB-3.5</b>	<b>MAINTENANCE CATEGORIES AND ACTIVITIES</b> .....	<b>10</b>
<b>SFB-3.6</b>	<b>ROUTINE MAINTENANCE ACTIVITIES</b> .....	<b>11</b>
	SFB-3.6.1 Mowing .....	11
	SFB-3.6.2 Trash/Debris Removal .....	12
	SFB-3.6.3 Splitter Box/Overflow Outlet Works Cleaning.....	12
	SFB-3.6.4 Woody Growth Control/Weed Removal.....	12
<b>SFB- 3.7</b>	<b>RESTORATION MAINTENANCE ACTIVITIES</b> .....	<b>12</b>
	SFB-3.7.1 Sediment Removal/Pollutant Removal .....	14
	SFB-3.7.2 Erosion Repair .....	15
	SFB-3.7.3 Jet-Vac/Clearing Drains.....	15
<b>SFB-3.8</b>	<b>REHABILITATION MAINTENANCE ACTIVITIES</b> .....	<b>15</b>
	SFB-3.8.1 Major Sediment/Pollutant Removal .....	16
	SFB-3.8.2 Major Erosion Repair .....	17
	SFB-3.8.3 Structural Repair.....	17
	SFB-3.8.4 SFB Rebuild .....	17

## SFB-1 BACKGROUND

Sand Filter Basins (SFBs) are a common type of stormwater best management practice (BMP) utilized within the Front Range of Colorado. A SFB consists of a sedimentation chamber, a flat surfaced area of sand (sometimes covered with grass or sod), a filtration chamber, and a flat sand filter bed with an underdrain system. A surcharge zone exists within the sedimentation and filtration chambers for temporary storage of the Water Quality Capture Volume (WQCV). During a storm, runoff enters the sedimentation chamber, where the majority of sediments are deposited. The runoff then enters the filtration chamber where it ponds above the sand bed and gradually infiltrates into the underlying sand filter, filling the void spaces of the sand. The underdrain gradually infiltrates into the underlying sand filter, filling the void spaces of the sand. The underdrain gradually dewateres the sand bed and discharges the runoff to a nearby channel, swale, or storm sewer. SFBs provide for filtering and absorption of pollutants in the stormwater <sup>1</sup>. The popularity of SFBs has grown because they allow WQCV to be provided on a site that has little open area available for stormwater management. However, there are limitations on their use due to potential clogging from large amounts of sediment.

## SFB-2 INSPECTING SAND FILTER BASINS (SFBs)

### SFB-2.1 Access and Easements

Inspection and maintenance personnel may utilize the figures located in Appendix E containing the location(s) of the access points and potential maintenance easements of the SFB(s) within this development.

### SFB-2.2 Stormwater Best Management Practice (BMP) Locations

Inspection or maintenance personnel may utilize the figures located in Appendix E containing the location(s) of the SFB(s) within this development.

### SFB-2.3 Extended Detention Basin (SFB) Features

SFBs have a number of features that are designed to serve a particular function. Many times the proper function of one feature depends on another. It is important for maintenance personnel to understand the function of each of these features to prevent damage to any feature during maintenance operations. Below is a list and description of the most common features within a SFB and the corresponding maintenance inspection items that can be anticipated:

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<sup>1</sup> Design of Stormwater Filtering Systems, Centers for Watershed Protection, December 1996

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

SFB Features	Sediment Removal	Mowing/ Weed control	Trash & Debris Removal	Erosion	Overgrown Vegetation Removal	Removal/ Replacement	Structure Repair
Inflow Points/ Splitter Box	X		X				X
Sedimentation Chamber	X	X	X	X	X		
Filter Media	X	X	X	X	X	X	
Underdrain System	X					X	
Overflow Outlet Works	X		X				X
Embankment		X	X	X	X		

**SFB-2.3.1 Inflow Points/Splitter Box**

Inflow Points or Outfalls into SFBs are the point source of the stormwater discharge into the facility. An inflow point is commonly a curb cut with a concrete or riprap rundown or a storm sewer pipe outfall with a flared end section.

SFBs are designed to treat only the WQCV. The WQCV is a volume of water of water that runs off a site during an 80<sup>th</sup> percentile event. Any amount over the WQCV is allowed to go to the storm sewer system without water quality treatment. The splitter box is generally constructed of reinforced concrete. The splitter box typically has a lower wall that has a height that will trap the required WQCV. Volumes over the WQCV are allowed to spill over the wall and enter a storm sewer system that often conveys the runoff to a regional detention facility. Proper inspection and maintenance of the splitter box is essential in ensuring the long-term operation of the SFB.

An energy dissipater is typically immediately downstream of the splitter box, at the discharge point into the SFB, to protect the sedimentation and filtration chambers from erosion. In some cases, the splitter box 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 that are 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.

*b. 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.

*c. Structural Damage* – Structural damage can occur at any time during the life of the facility. Typically, for an inflow, 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.

#### SFB-2.3.2 Sedimentation Chamber

The sedimentation chamber is located adjacent to the splitter box and generally consists of a flat irrigated turf grass area followed by a water trapping device that allows water to be briefly held in the sedimentation chamber before being released into the filtration chamber. This slowing of the runoff allows sediments to be deposited in the sedimentation chamber and not the filtration where they can cause clogging of the filter media.

*The typical maintenance items that are required within the sedimentation chamber are as follows:*

*a. Mowing/woody growth/weeds present* – Routine mowing of the turf grass within the sediment chamber is necessary to improve the overall appearance and to ensure proper function of the SFB. Turf grass should be mowed at a height of 2 to 4-inches and shall be bagged to prevent contamination of the filter media. If undesirable vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate, resulting in the blockage of the filter media. Also, shrubs, grass and weed roots can cause damage to the filter media and underdrain system. Routine maintenance is essential to prevent more extensive and costly future maintenance.

### SFB-2.3.3 Filter Media

The filter media is the main pollutant removal component of the SFB. The filter media consists of 18-inches of washed sand. The filter media removes pollutants through several different processes, including sedimentation, filtration, infiltration and microbial uptake.

Sedimentation is accomplished by the slow release of stormwater runoff through the filter media. This slow release allows for sediment particles that were not deposited in the sedimentation chamber to be deposited on the top layer of the filter media where they are easily removed through routine maintenance. Other pollutants are also removed through this process because they are attached to sediment.

Filtration is the main pollutant removal mechanism of SFBs. When the stormwater runoff migrates down through the filter media, many of the particulate pollutants are physically strained out as they pass through the filter bed of sand and are trapped on the surface or among the pores of the filter media.

SFBs that are not lined with an impervious liner allow for infiltration into the native soils. This process also allows for additional pollutant removal.

Microbes that naturally occur in the filter media can assist with pollutant removal by breaking down organic pollutants.

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

*a. Mowing/woody growth control/weeds present* – Noxious weeds and other unwanted vegetation must be treated as needed throughout the SFB. 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.

*b. Sediment/Pollutant Removal* – Although SFBs should not be utilized in areas where large concentrations of sediment and other pollutants will enter the SFB, it is inevitable that some sediment and other pollutants will enter the SFB. Most sediment will be deposited in the sedimentation chamber; however finer suspended particles will migrate to the filter media. These sediments need to be removed to ensure proper infiltration rates of the stormwater runoff.



*c. Filter Replacement* – The top layers of the filter media are the most susceptible to pollutant loading and therefore may need to be removed and disposed of properly on a semi regular basis when infiltration rates slow.

*d. Infiltration Rate Test* – An infiltration test may be necessary to ensure proper functioning of the filter media. The infiltration test can be conducted by filling the sand filter with water to the elevation of the overflow wall in the splitter box. The sand filter needs to drain completely within 40-hours of the filling. If the drain time for the basin is longer than 40-hours, the filter is in need of maintenance.

#### SFB-2.3.4 Underdrain System

The underdrain system consists of a layer of geotextile fabric, gravel storage area and perforated PVC pipes. The geotextile fabric is utilized to prevent the filter media 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 items that are required for the underdrain system are as follows:*

With proper maintenance of the filter media and sediment chamber, 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.

#### SFB-2.3.5 Overflow Outlet Works

Some SFBs include an overflow outlet that works in place of the splitter box. The overflow outlet works allows runoff amounts that exceed the WQCV to exit the SFB to the detention facility. The outlet works is typically constructed of reinforced concrete into the embankment of the SFB. 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. Proper inspection and maintenance of the outlet works is essential in ensuring the long-term operation of the SFB.

*The typical maintenance activities that are required for the overflow outlet works are as follows:*

*a. Structural Damage* – The overflow outlet structure is primarily constructed of concrete, which can crack, spall, and settle. The steel grate on the overflow outlet structure is also susceptible to damage.

*b. Mowing/woody growth control/weeds present* – The presence of plant material not part of the original landscaping, such as wetland plants or other woody growth, can clog the overflow outlet works during a larger storm event, causing flooding damage to adjacent areas. This plant material may indicate a clogging of the filter media and may require additional investigation.

#### SFB-2.3.6 Embankments

Some SFBs utilize irrigated turf grass embankments to store WQCV.

*The typical maintenance activities that are required for the embankment areas are as follows:*

*a. Vegetation Sparse* – The embankments are one of the most visible parts of the SFB and, therefore, aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance of the SFB. Also, vegetation can reduce the potential for erosion and subsequent sediment transport to the filter media, thereby reducing the need for more costly maintenance.

*b. Erosion* – Inadequate vegetative cover may result in erosion of the embankments. Erosion that occurs on the embankments can cause clogging of the filter media.

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

*d. Mowing/Woody Growth Control/Weeds Present* – The presence of plant material not part of the original landscaping, such as wetland plants or other woody growth, can result in difficulty in performing maintenance activities. These trees and shrubs may also damage the underdrain system of the SFB. This plant material may indicate a clogging of the filter media and may require additional investigation.

#### SFB-2.3.7 Emergency Overflow

An emergency overflow is typical of all SFBs 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 or may be a concrete wall or other structure. The emergency spillway is typically a weir (notch) in the basin

embankment. The proper function of the emergency spillway is essential to ensure flooding does not affect adjacent properties.

*The typical maintenance items that are 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 SFB, the riprap may shift or become dislodged due to flow.

*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. Mowing/Weed/Woody Growth Control* – 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 SFB and reduce the capacity of the spillway. These trees and shrubs may also damage the underdrain system of the SFB.

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

#### SFB-2.3.8 Miscellaneous

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

*a. Access* – Access needs to be maintained.

*b. Graffiti/Vandalism* – Vandals can cause damage to the SFB infrastructure. If criminal mischief is evident, the inspector should forward this information to the local enforcement agency.

*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, contact the local emergency services at 911 immediately!**

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

## **SFB-2.4 Inspection Forms**

SFB Inspection forms are located in Appendix C. 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 El Paso County per the requirements of the Inspection and Maintenance Plan. It is recommended that these inspection forms be kept a minimum of 5 years. A continuing record of inspection and maintenance forms will demonstrate proper maintenance over time in compliance with the BMP Maintenance Agreement.

## **SFB-3 MAINTAINING EXTENDED DETENTION BASINS (SFBS)**

### **SFB-3.1 Maintenance Personnel**

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

### **SFB-3.2 Equipment**

It is imperative that 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 list of tools, equipment, and material(s) that may be necessary to perform maintenance on an SFB:

- 1.) Mowing Tractors
- 2.) Trimmers (extra string)
- 3.) Shovels
- 4.) Rakes
- 5.) All Surface Vehicle (ASVs)
- 6.) Skid Steer
- 7.) Back Hoe
- 8.) Track Hoe/Long Reach Excavator
- 9.) Dump Truck
- 10.) Jet-Vac Machine
- 11.) Engineers Level (laser)
- 12.) Riprap (Minimum - Type M)
- 13.) Geotextile Fabric
- 14.) Erosion Control Blanket(s)

- 15.) Sod
- 16.) Illicit Discharge Cleanup Kits
- 17.) Trash Bags
- 18.) Tools (wrenches, screw drivers, hammers, etc)
- 19.) Confined Space Entry Equipment
- 20.) Approved Inspection and Maintenance Plan
- 21.) ASTM C-33 Sand

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.

### **SFB-3.3 Safety**

Vertical drops may be encountered in areas located within and around the SFB. 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.

### **SFB-3.4 Maintenance Forms**

The SFB Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. It is recommended that the SFB Maintenance Form be filled out in the field after the completion of the maintenance operation. It is recommended that each form be retained by the property owner or property manager for a minimum of five years. The SFB Maintenance form is located in Appendix D.

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

A typical SFB Maintenance Program will consist of three broad categories of work: Routine, Restoration (minor), and Rehabilitation (major). Within each category of work, a variety of maintenance activities can be performed on a SFB. A maintenance activity can be specific to each feature within the SFB, 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 SFB.

A variety of maintenance activities are typical of SFBs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of the SFB filter media or underdrain system. Below is a description of each maintenance activity, the objectives, and frequency of actions:

### SFB-3.6 Routine Maintenance Activities

The majority of this work consists of regularly scheduled mowing, trash and debris pickups for the SFB 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 can be completed without any prior correspondence with El Paso County; however, it is recommended that completed inspection and maintenance forms shall be retained by the owner for a minimum of five years.

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

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

Maintenance Activity	Minimum Frequency	Look for:	Maintenance Action
Mowing	Twice annually	Excessive grass height/aesthetics	Mow grass to a height of 2” to 4”
Trash/Debris Removal	Twice annually	Trash & debris in SFB	Remove and dispose of trash and debris
Splitter Box/Overflow Outlet Works Cleaning	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
Woody growth control/Weed removal	Minimum twice annually	Noxious weeds; Unwanted vegetation	Treat w/ herbicide or hand pull; Consult the local weed specialist

#### SFB-3.6.1 Mowing

Routine mowing of the turf grass embankments and turf grass located in the sedimentation chamber is necessary to improve the overall appearance of the SFB and ensure proper performance of the sediment chamber. Turf grass should be mowed to a height of 2 to 4-inches and shall be bagged to prevent potential contamination of the filter media.

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

### SFB-3.6.2 Trash/Debris Removal

Trash and debris must be removed from the entire SFB 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.

### SFB-3.6.3 Splitter Box/ Overflow Outlet Works Cleaning

Debris and other materials can clog the outlet work's grate. 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.

### SFB-3.6.4 Woody Growth Control/Weed Removal

Noxious weeds and other unwanted vegetation must be treated as needed throughout the SFB. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with a local County Weed Inspector is highly recommended prior to the use of herbicide.

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

## **SFB- 3.7 Restoration 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 do not require prior correspondence with El Paso County. However, it is recommended that completed inspection and maintenance forms be retained for each inspection and maintenance activity for a minimum of five years by the owner.

**Table – SFB-3**  
**Summary of Restoration Maintenance Activities**

<b>Maintenance Activity</b>	<b>Minimum Frequency</b>	<b>Look for:</b>	<b>Maintenance Action</b>
<b>Sediment/Pollutant Removal</b>	As needed; typically, every 1 –2 years	Sediment build-up in sedimentation chamber and filter media; decrease in infiltration rate	Remove and dispose of sediment
<b>Erosion Repair</b>	As needed, based upon inspection	Rills/gullies on embankments or sedimentation in the forebay	Repair eroded areas & revegetate; address cause
<b>Jet Vac/Cleaning Underdrains</b>	As needed, based upon inspection	Sediment build-up /non draining system	Clean drains; Jet Vac if needed



### SFB-3.7.1 Sediment/Pollutant Removal

Sediment removal is necessary to ensure proper function of the filter media. The infiltration rate of the SFB needs to be checked in order to ensure proper functioning of the SFB. A SFB should drain completely within 12-hours of a storm event. If drain times exceed the 12-hour drain time then maintenance of the filter media shall be required.

At a minimum, the top 3-inches of filter media should be removed at each removal period. Additional amounts of filter media may need to be removed if deeper sections of the filter media are contaminated. New filter media will need to be placed back in the SFB when the total amount of sand removed reaches 9-inches. This may take multiple maintenance events to accomplish. It is critical that only sand that meets the American Society for Testing and Material (ASTM) C-33 standard be utilized in the replacement of the filter media.

#### **ASTM C-33 Sand Standard**

<b>US Standard Sieve Size (Number)</b>	<b>Total Percent Passing (%)</b>
<b>9.5mm (3/8 inch)</b>	100
<b>4.75mm (No. 4)</b>	95-100
<b>2.36mm (no. 8)</b>	80-100
<b>1.18mm (No. 16)</b>	50-85
<b>600nm (no. 30)</b>	25-60
<b>300nm (no. 50)</b>	10-30
<b>150nm (no. 100)</b>	2-10

Other types of sand and soil material may lead to clogging of the SFB. The minor sediment removal activities can typically be addressed with shovels, rakes and smaller equipment. Major sediment removal activities will require larger and more specialized equipment. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. The major sediment removal activities may also require surveying with an engineer's level, and consultation with the County's Engineering staff to ensure design volumes/grades are achieved.

Stormwater sediments removed from SFBs 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 to ensure 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.

*Frequency* – Nonroutine – As necessary based upon inspections. Sediment removal in the sedimentation chamber may be necessary as frequently as every 1-2 years.

#### SFB-3.7.2 Erosion Repair

The repair of eroded areas is necessary to ensure the proper function of the SFB, to minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to filter media and embankments, rills, and gullies in the embankments and inflow points. The repair of eroded areas may require the use of excavators, earthmoving equipment, riprap, concrete, and sod. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. Major erosion repairs to the pond embankments, spillways, and adjacent to structures involve consultation with the County's Engineering staff.

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

#### SFB-3.7.3 Jet-Vac/Clearing Drains

A SFB contains an underdrain system that allows treated stormwater runoff to exit the facility. These underdrain systems can develop blockages that can result in a decrease of hydraulic capacity and also create standing water. 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.

### **SFB-3.8 Rehabilitation Maintenance Activities**

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. Consultation with County's Engineering staff is recommended to ensure the proper maintenance is performed, which may result in the need for engineering staff review of the original design and construction drawings to assess the situation and assign the necessary maintenance. This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants. In the event that the basin needs to be dewatered, care should be given to ensure sediment, filter

material and other pollutants are not discharged. Proper permitting is required prior to any dewatering activity.

**Table – SFB-4  
Summary of Rehabilitation Maintenance Activities**

Maintenance Activity	Minimum Frequency	Look for:	Maintenance Action
Major Sediment/Pollutant Removal	As needed – based upon scheduled inspections	Large quantities of sediment in the sedimentation chamber and/or filter media; reduced infiltration rate/capacity	Remove and dispose of sediment. Repair vegetation as needed
Major Erosion Repair	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
Structural Repair	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
SFB Rebuild	As needed- due to complete failure of SFB	Removal of filter media and underdrain system	Contact City Engineering

**SFB-3.8.1 Major Sediment/Pollutant Removal**

In very rare cases the filter media of the SFB may be contaminated so badly that the entire 18-inches of the filter media may need to be removed.

Major sediment/pollutant removal consists of removal of large quantities of sediment/filter media. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. The sediment/filter media needs to be carefully removed, transported and properly disposed of. Vegetated areas need special care to ensure design volumes and grades are preserved or may need to be replaced due to the removal activities. Stormwater sediments removed from SFBs 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.

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

#### SFB-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. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur.

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

#### SFB-3.8.3 Structural Repair

A SFB generally includes a splitter box or concrete overflow outlet 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 County's Engineering staff shall take place prior to all structural repairs.

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

#### SFB-3.8.4 SFB Rebuild

In very rare cases a SFB 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, or extensive contamination of the SFB. Consultation with the County's Engineering staff shall take place prior to any rebuild project.

*Frequency* – Nonroutine – As needed, based upon inspections.

#### **Reference:**

This Manual is adapted from City of Colorado Springs Best Management Practices IM Plan, SEMSWA (2007) and from the Town of Parker, Colorado (2004), STORMWATER PERMANENT BEST MANAGEMENT PRACTICES (PBMP) LONG-TERM OPERATION AND MAINTENANCE MANUAL

# Appendix B2

## Standard Operation Procedures for Inspection and Maintenance

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

# TABLE OF CONTENTS

<b>GB-GS-1 BACKGROUND</b>	<b>3</b>
<b>GB-GS-2 INSPECTING GRASS BUFFERS AND SWALES (GB-GS)</b>	<b>3</b>
<b>GB-GS-2.1 ACCESS AND EASEMENTS</b>	<b>3</b>
<b>GB-GS-2.2 STORMWATER BEST MANAGEMENT PRACTICE (BMP) LOCATIONS</b>	<b>3</b>
<b>GB-GS-2.3 GRASS BUFFER - GRASS SWALE (GB-GS) FEATURES</b>	<b>3</b>
GB-GS-2.3.1 Grass Swale Bottom and Side Slopes; Grass Buffer Strips	4
GB-GS-2.3.2 Inflow Points	5
GB-GS-2.3.3 Underdrain System	5
GB-GS-2.3.4 Grade Control Level Spreader	6
GB-GS-2.3.5 Irrigation	6
GB-GS-2.3.6 Miscellaneous	7
<b>GB-GS-2.4 INSPECTION FORMS</b>	<b>7</b>
<b>GB-GS-3 MAINTAINING GRASS BUFFERS &amp; GRASS SWALES (GB-GS)</b>	<b>7</b>
<b>GB-GS-3.1 MAINTENANCE PERSONNEL</b>	<b>7</b>
GB-GS-3.2 EQUIPMENT.....	7
<b>GB-GS-3.3 MAINTENANCE FORMS</b>	<b>8</b>
<b>GB-GS-3.4 MAINTENANCE CATEGORIES AND ACTIVITIES</b>	<b>8</b>
<b>GB-GS-3.5 ROUTINE MAINTENANCE ACTIVITIES</b>	<b>8</b>
GB-GS-3.5.1 Trash/Debris Removal	9
GB-GS-3.5.2 Mowing	10
GB-GS-3.5.3 Irrigation	10
GB-GS-3.5.4 Weed Control	10
GB-GS-3.5.5 Mosquito Treatment	10
GB-GS-3.5.6 Level Spreader (Grass Buffer only)	11
GB-GS-3.5.7 Rodent Damage	11
<b>GB-GS-3.6 RESTORATION MAINTENANCE ACTIVITIES</b>	<b>11</b>
GB-GS-3.6.1 Sediment Removal	12
GB-GS-3.6.2 Erosion Repair	12
GB-GS-3.6.3 Vegetation Removal	12
GB-GS-3.6.4 Revegetation	12
GB-GS-3.6.5 Irrigation (Automatic)	13
GB-GS-3.6.6 Level Spreader	13
GB-GS-3.6.7 Fertilization/Soil Amendment	13
GB-GS-3.6.8 Vehicle Tracks	13
<b>GB-GS-3.7 REHABILITATION MAINTENANCE ACTIVITIES</b>	<b>13</b>
GB-GS-3.7.1 Major Sediment/Pollutant Removal	14
GB-GS-3.7.2 Major Erosion Repair	15
GB-GS-3.7.3 Structural Repair	15
GB-GS-3.7.4 GB-GS Rebuild	15

## GB-GS-1 BACKGROUND

Grass Buffers and Grass Swales are common types of Stormwater BMPs 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 highways and 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 drainageways with low-pitched side slopes that collect and convey runoff. The 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 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 figures located in Appendix E containing the locations of the access points and potential maintenance easements of the GB-GSs within this development.

**GB-GS-2.2 Stormwater Best Management Practice (BMP) Locations** Inspection and maintenance personnel may utilize the figures located in Appendix E 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 that are 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 that can be anticipated:

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

	Sediment Removal	Mowing Weed control	Trash & Debris Removal	Erosion	Removal/ Replacement	Structural Repair
Swale Bottom	X	X	X	X		
Side Slope		X	X	X		
Buffer Strip	X	X	X	X		
Inflows	X	X	X	X	X	X

<b>Underdrain System</b>	X				X	
<b>Grade Control/Level Spreader</b>				X		X
<b>Irrigation System</b>					X	

### 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 that are 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 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. 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 that are 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 that are 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 that it becomes clogged.

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

Grass swales that are 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 that are 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 that the structure is not functioning as intended and requires maintenance to prevent future erosion and damage.

*b. Structural damage* – Structural damage can occur at any time throughout 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.

#### 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 that are required for irrigation systems are as follows:*

Irrigation systems will generally require routine periodic maintenance and adjustment to ensure that 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 that are commonly found in the GB-GS but may not be attributed to an individual feature.

*a. Access* – Access needs to be maintained.

*b. Public Hazards* – Public hazards include items such as containers of unknown/suspicious substances, and exposed metal/jagged concrete on structures. **If any hazard is found within the facility area that poses an immediate threat to public safety, contact the local emergency services at 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 C. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and approved by the property owner or property manager. These inspection forms shall be kept a minimum of 5 years and made available to El Paso County Stormwater Planning upon request. The GB-GS Inspection form is located in Appendix C.

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

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

Maintenance personnel should 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 that 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 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
- 10.) Illicit Discharge Cleanup Kits
- 11.) Trash Bags
- 12.) Approved 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 approved by the property owner or property manager. These maintenance forms shall be kept for a minimum of 5 years and made available to El Paso County Stormwater Planning upon request. The GB-GS Maintenance form is located in Appendix D.

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

A typical GB-GS Maintenance Program will consist of three broad categories of work: Routine, Restoration (minor), and Rehabilitation (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 El Paso County Stormwater Planning, however, completed inspection and maintenance forms shall be retained and supplied to El Paso County Stormwater Planning upon request.

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

#### 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.

*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, alternative 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.

*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 that 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 Restoration 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 do not require approval by El Paso County Stormwater Planning. Completed inspection and maintenance forms shall be retained and provided to El Paso County Stormwater Planning for each inspection and maintenance activity upon request.

**Table GB-GS-3  
Summary of Restoration 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</b>	As needed,	Grass with pale color;	Consult with turf

<b>Amendment</b>	minimize fertilization	areas with poor grass growth not due to irrigation problems	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, concrete, and sod. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system 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 develop 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.

*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 grass or sod. 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 that even coverage is being applied, and that there are no missing or broken parts. Timing systems should be checked to verify that 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, buildup of grasses along the edge of the spreader may create an uneven flow distribution. Rills, gullies and other erosion that develops 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.

*Frequency* – As necessary, based upon inspections. GB-GS-3.6.8 Vehicle Tracks

GB-GSs that are adjacent to roadway sections 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 Rehabilitation 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 Stormwater Planning staff to ensure the proper maintenance is performed. This work requires that El Paso County Stormwater Planning staff review the original design and construction drawings to assess the situation and assign the necessary maintenance. This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants.

### **Table GB-GS-4 Summary of Rehabilitation Maintenance Activities**

Maintenance Activity	Minimum Frequency	Look for:	Maintenance Action
<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 PLD	Removal of filter media and underdrain system	Contact El Paso County Stormwater Planning

#### 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 El Paso County Stormwater Planning 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, or extensive contamination of the GB-GS. Consultation with El Paso County Stormwater Planning staff shall take place prior to any rebuild project.

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

**Reference:**

This Manual is adapted from City of Colorado Springs Best Management Practices IM Plan, SEMSWA (2007) and from the Town of Parker, Colorado (2004), STORMWATER PERMANENT BEST MANAGEMENT PRACTICES (PBMP) LONG-TERM OPERATION AND MAINTENANCE MANUAL

**APPENDIX C1**

**INSPECTION FORMS**

**SFB**

**EXTENDED DETENTION BASIN (SFB)  
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.)

**2.) Forebay**

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

**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

It is recommended that this inspection form be retained for a minimum of 5 years by owner.

**APPENDIX C2**

**INSPECTION FORM**

**GB**

# 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/Rundown 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 a minimum of 5 years and made available to El Paso County upon request.

**APPENDIX D1**

**MAINTENANCE FORM**

**SFB**



## EXTENDED DETENTION BASIN (SFB) 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

#### REHABILITATION WORK

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li><input type="checkbox"/> SEDIMENT REMOVAL               <ul style="list-style-type: none"> <li><input type="checkbox"/> FOREBAY</li> <li><input type="checkbox"/> TRICKLE CHANNEL</li> <li><input type="checkbox"/> INFLOW</li> </ul> </li> <li><input type="checkbox"/> EROSION REPAIR               <ul style="list-style-type: none"> <li><input type="checkbox"/> INFLOW POINT</li> <li><input type="checkbox"/> TRICKLE CHANNEL</li> </ul> </li> <li><input type="checkbox"/> VEGETATION REMOVAL/TREE THINNING               <ul style="list-style-type: none"> <li><input type="checkbox"/> INFLOW(S)</li> <li><input type="checkbox"/> TRICKLE CHANNEL</li> <li><input type="checkbox"/> UPPER STAGE</li> <li><input type="checkbox"/> BOTTOM STAGE</li> </ul> </li> <li><input type="checkbox"/> REVEGETATION</li> <li><input type="checkbox"/> JET-VAC/CLEARING DRAINS               <ul style="list-style-type: none"> <li><input type="checkbox"/> FOREBAY</li> <li><input type="checkbox"/> OUTLET WORKS</li> <li><input type="checkbox"/> INFLOWS</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li><input type="checkbox"/> SEDIMENT REMOVAL (DREDGING)               <ul style="list-style-type: none"> <li><input type="checkbox"/> BOTTOM STAGE</li> <li><input type="checkbox"/> UPPER STAGE</li> </ul> </li> <li><input type="checkbox"/> EROSION REPAIR               <ul style="list-style-type: none"> <li><input type="checkbox"/> OUTLET WORKS</li> <li><input type="checkbox"/> UPPER STAGE</li> <li><input type="checkbox"/> BOTTOM STAGE</li> <li><input type="checkbox"/> SPILLWAY</li> </ul> </li> <li><input type="checkbox"/> STRUCTURAL REPAIR               <ul style="list-style-type: none"> <li><input type="checkbox"/> INFLOW</li> <li><input type="checkbox"/> OUTLET WORKS</li> <li><input type="checkbox"/> FOREBAY</li> <li><input type="checkbox"/> TRICKLE CHANNEL</li> </ul> </li> </ul> <p>OTHER _____</p> <p>_____</p> <p>_____</p> |
|--|--|

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

COSTS INCURRED (include description of costs):

EQUIPMENT/MATERIAL USED (include hours of equipment usage and quantity of material used):

COMMENTS/ADDITIONAL INFO:

It is recommended that this Maintenance Activity Form be retained for a minimum of 5 years by owner.

## **APPENDIX D2**

### **MAINTENANCE FORM**

**GB**

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

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

COSTS INCURRED (include description of costs): \_\_\_\_\_

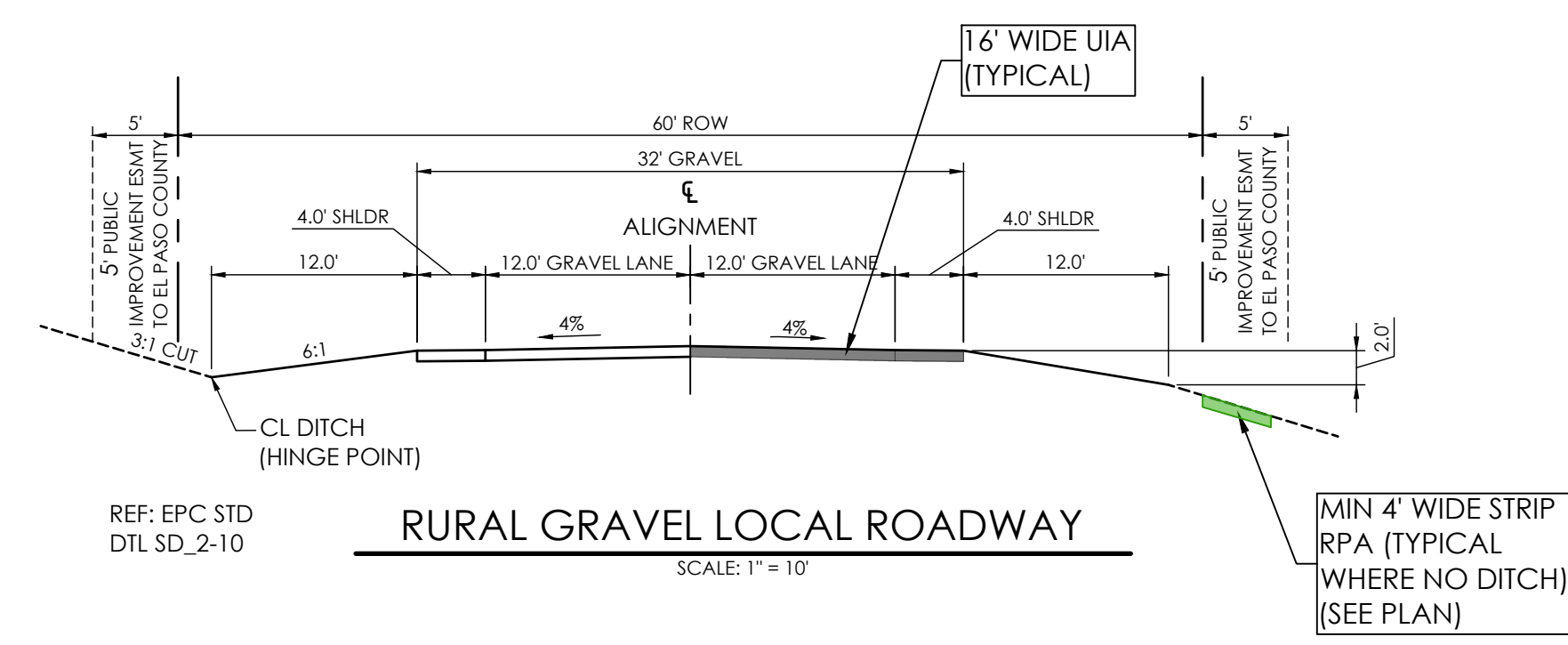
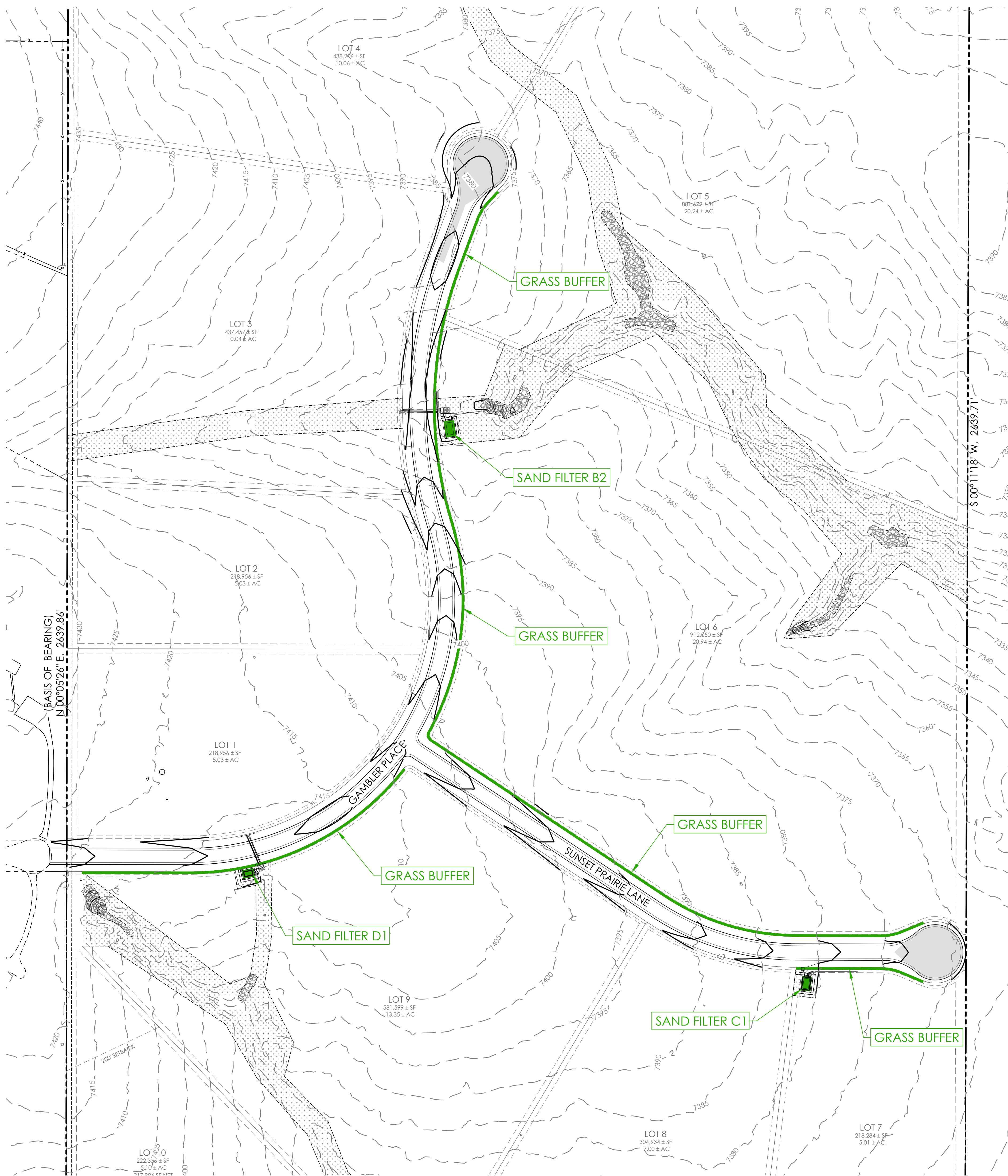
EQUIPMENT/MATERIAL USED (include hours of equipment usage and quantity of material used):  
\_\_\_\_\_  
\_\_\_\_\_

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

This Maintenance Activity Form shall be kept a minimum of 5 years and made available to El Paso County upon request.

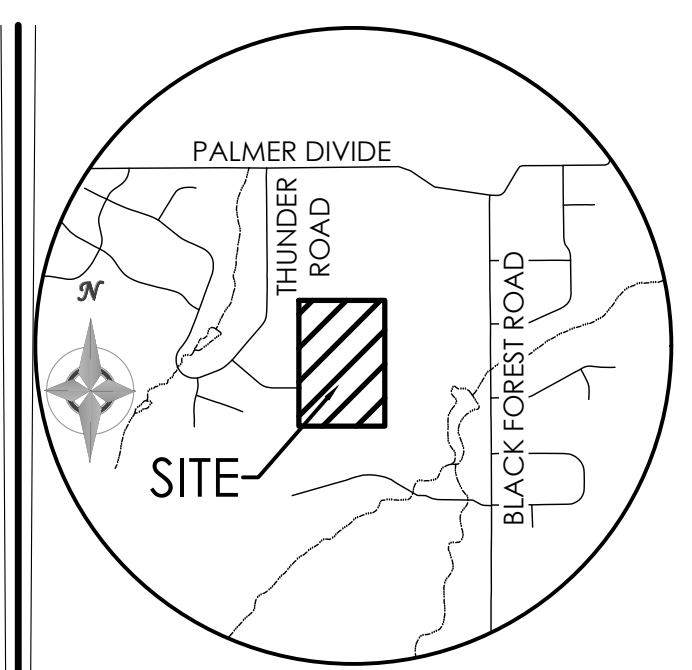
## **APPENDIX E**

### **STORMWATER FACILITY MAPS**



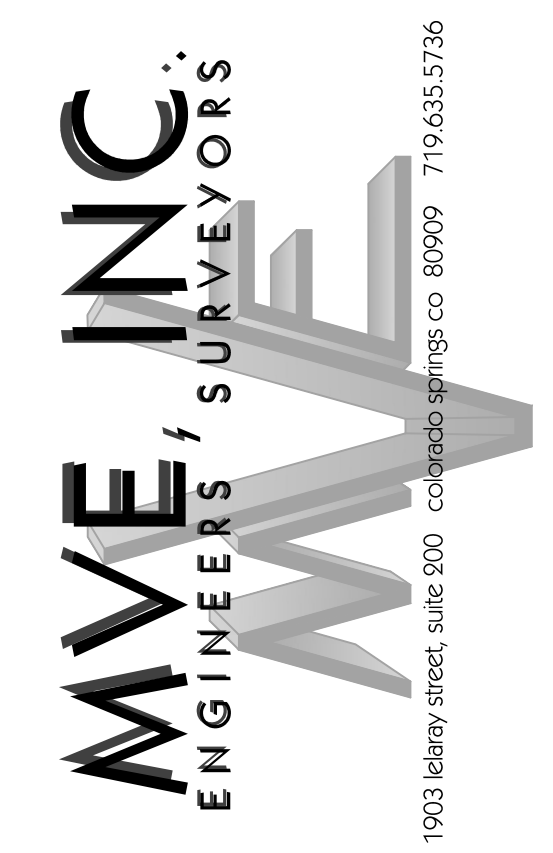
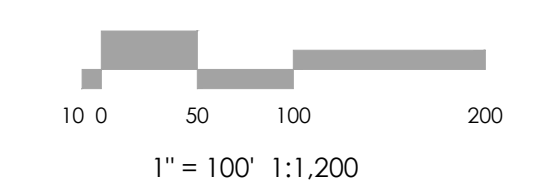
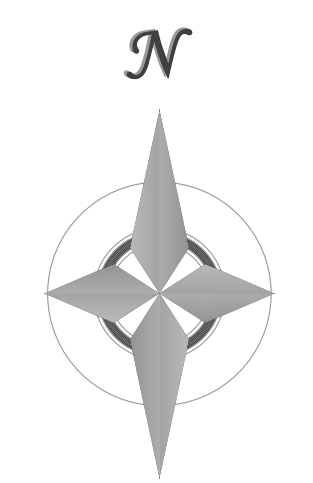
**RPA REQUIREMENTS:**

- 4' OF RPA MINIMUM ALONGSIDE RIGHT-OF-WAY, INSIDE INDIVIDUAL LOTS, WHERE ROADSIDE SHEET FLOWS INTO LOTS.
- SEE PLAN FOR LOCATIONS OF RPAs
- NO DROP AT THE UIA / RPA INTERFACE FOR SAFETY.
- RPAs SHALL BE VEGETATED AND HAVE A UNIFORM DENSITY OF AT LEAST 80%.
- RPAs SHALL BE MAINTAINED PER THE APPROVED O&M MANUAL AND ADMINISTERED PER THE PCM MAINTENANCE AGREEMENT.



**VICINITY MAP**  
NOT TO SCALE

BENCHMARK



REVISIONS

DESIGNED BY \_\_\_\_\_  
 DRAWN BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_  
 AS-BUILT BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_

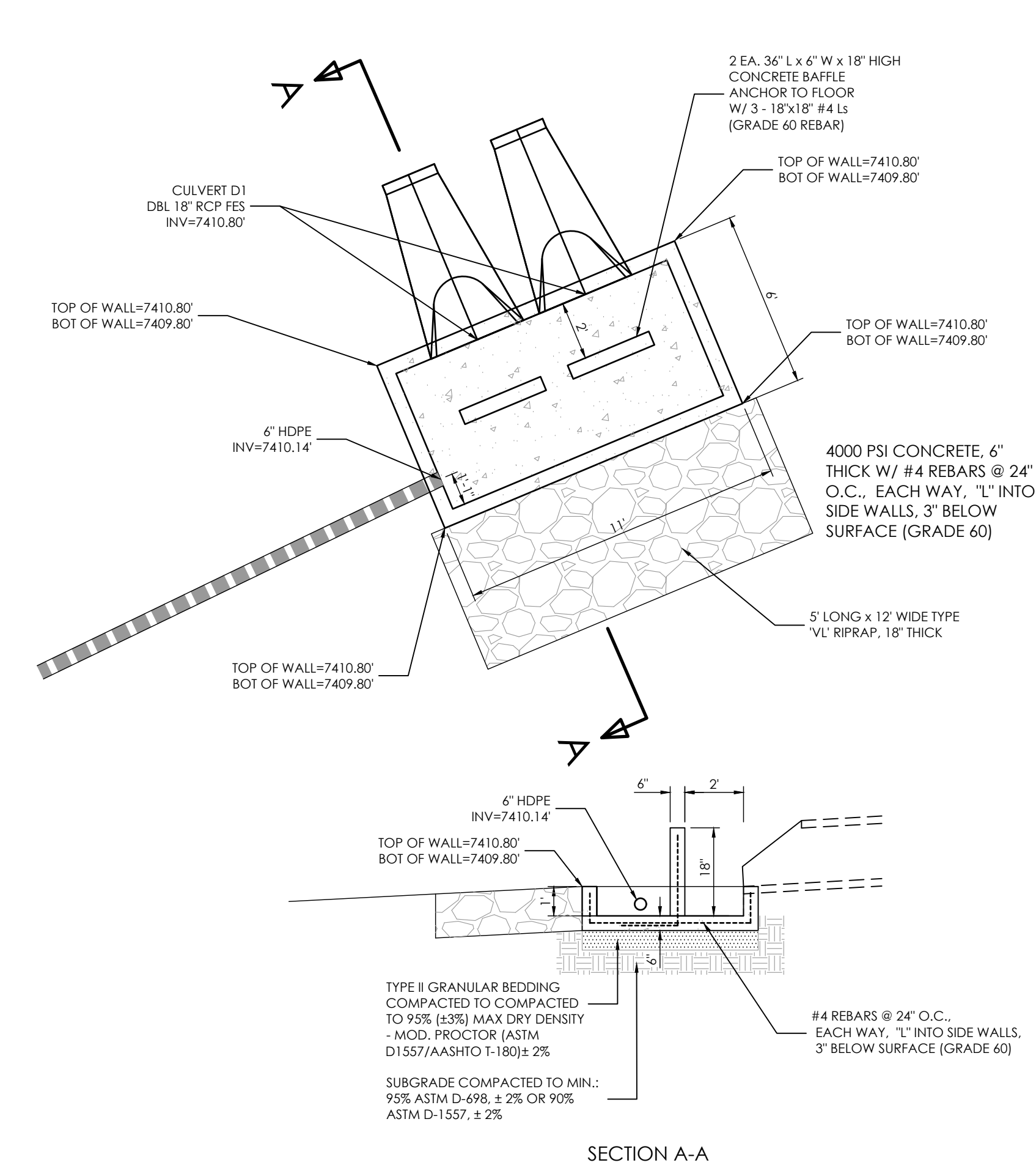
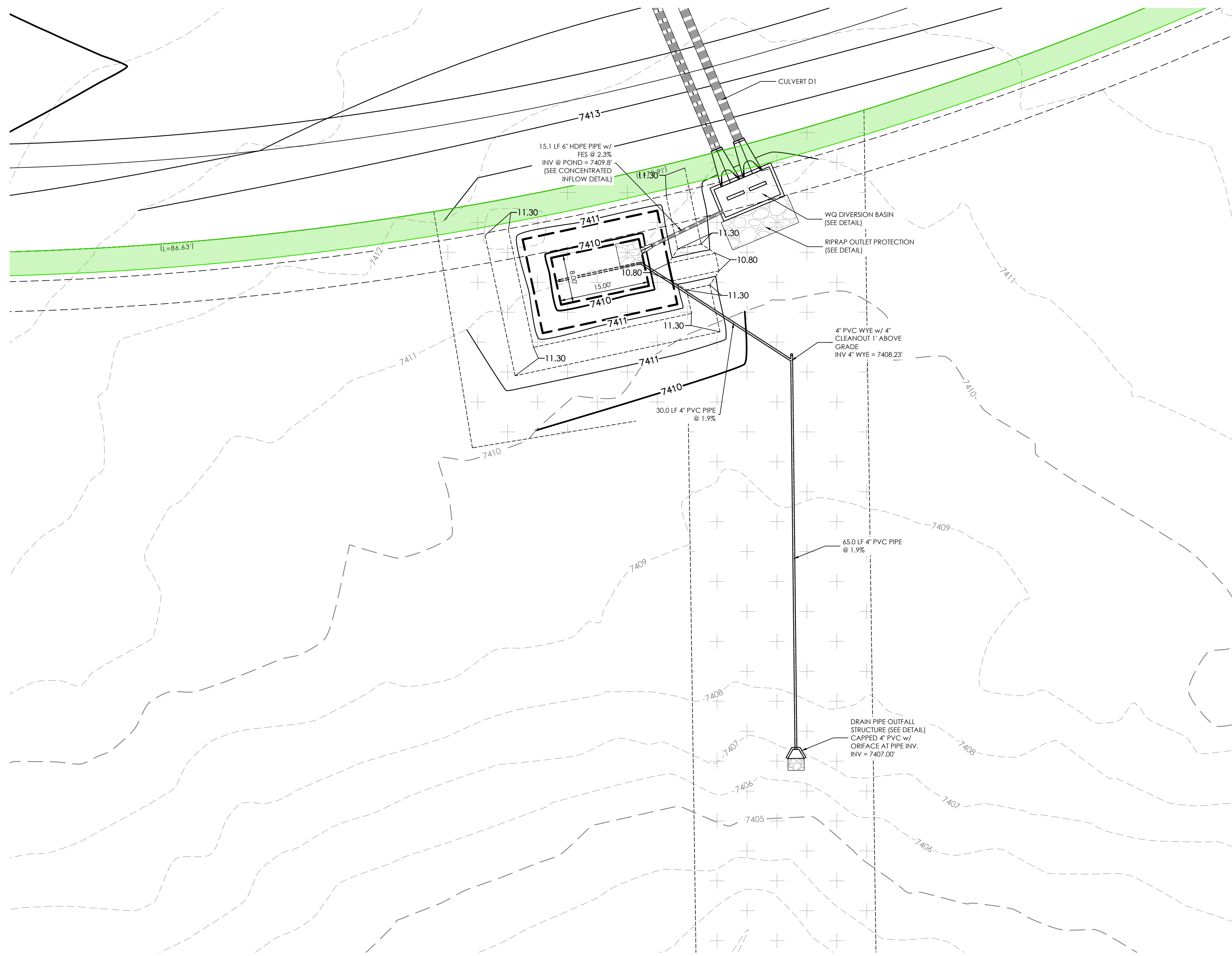
**TABLE ROCK**  
HOMESTEADS

**WATER QUALITY**

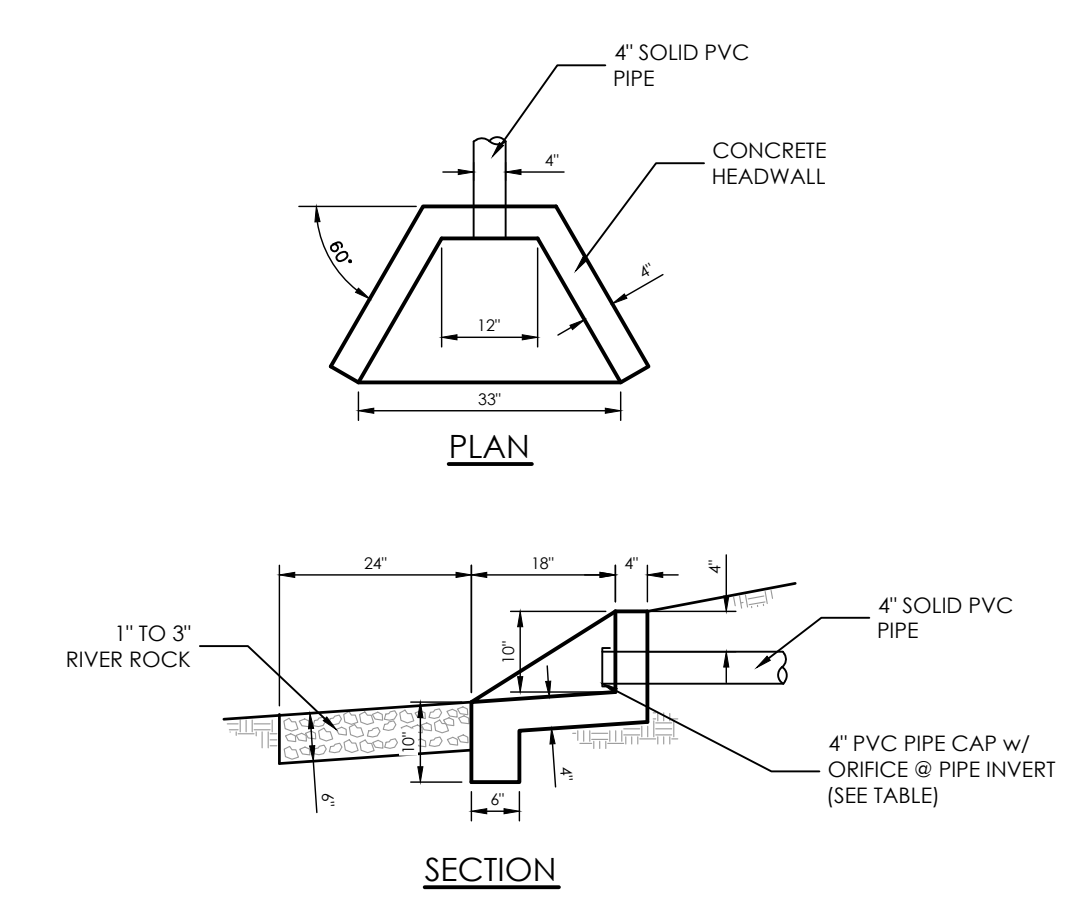
**BMP AREAS**

MVE PROJECT **61223**  
 MVE DRAWING **O&M EXHIBIT**

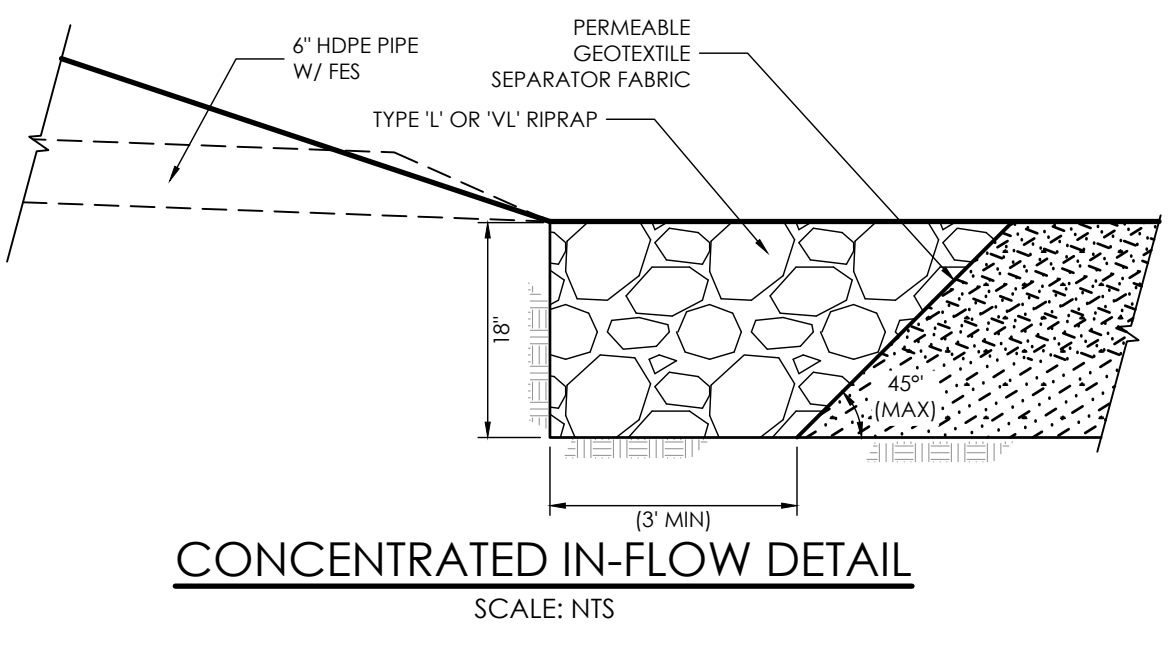
**JANUARY 24, 2025**  
**SHEET 1 OF 1**



WQ DIVERSION BASIN DETAIL SCALE: 1" = 4'



DRAIN PIPE OUTFALL DETAIL SCALE: 1" = 2'



CONCENTRATED IN-FLOW DETAIL SCALE: NTS

SOIL MATERIAL GRADATION TABLE (SOURCE: UDFCD BENCHMARK (BQ) TABLE B-1 & SAND FILTER BASIN (SF) TABLE SF-1)

STANDARD SIEVE SIZE	GROWING MEDIA <sup>(1)(2)</sup>	% PASSING	
		CLASS B	CLASS C
1-1/2"		100	100
3/4"		100	100
NO. 4	100	20-60	60-100
NO. 10	85-100	10-30	10-30
NO. 50		0-3	0-10
NO. 100		0-3	0-3
NO. 200	80-90		
NO. 250	3-17		

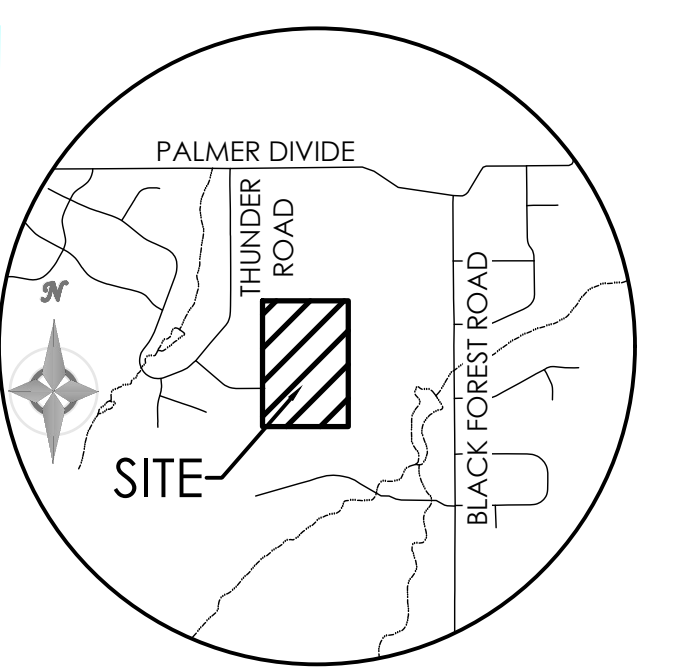
<sup>(1)</sup>RAIN GARDEN ONLY  
<sup>(2)</sup>LESS THAN 1.5% ORGANIC MATERIAL  
<sup>(3)</sup>APPLIES TO BOTH SAND FILTER BASIN AND RAIN GARDEN

TABLE SF-2 (SLOTTED PIPE DIMENSIONS)

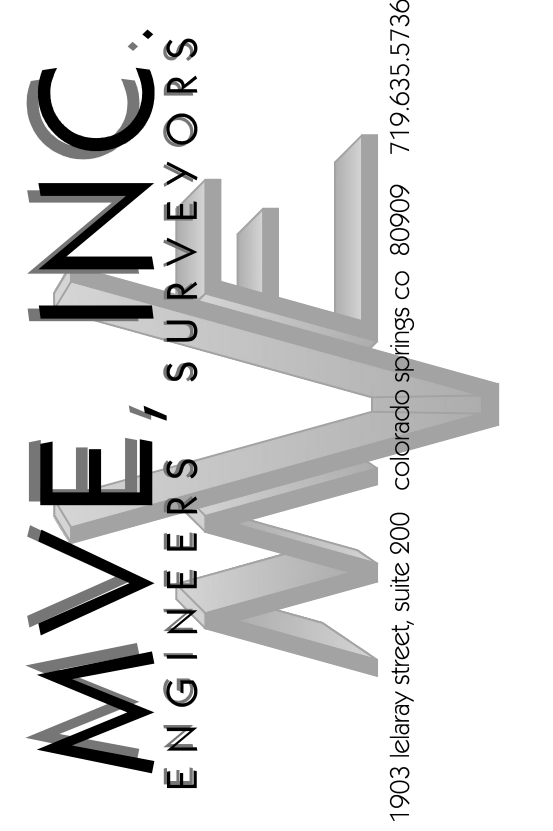
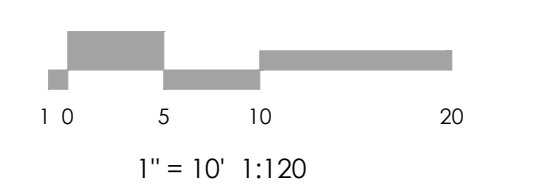
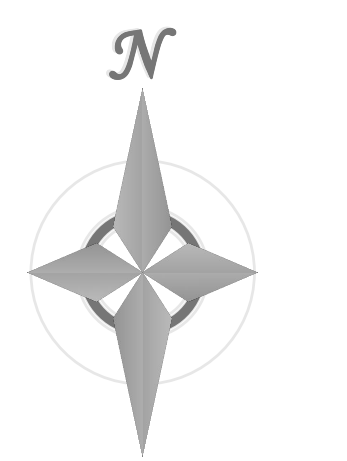
PIPE Ø	SLOT LENGTH	SLOT WIDTH	SLOT CENTERS	OPEN AREA
				(PER SF)
4"	1-1/16"	0.032"	0.413"	1.90 SQ. IN.

SAND FILTER WATER QUALITY POND DATA TABLE

SAND FILTER	BASE AREA (SQ. FEET)	SAND FILTER VOLUME (FT <sup>3</sup> )	SAND FILTER BASE ELEV	POND DEPTH (FT)	EMERGENCY OVERFLOW ELEVATION	SLOTTED PIPE INVERT ELEVATIONS		OUTLET ORIFICE INV ELEV	OUTLET ORIFICE DIAMETER (IN)
						HIGH END	LOW END		
D1	120	244	7409.80'	1.0	7410.80'	7408.87'	7408.80'	7407.00'	3/8"



BENCHMARK THE BENCHMARK FOR THESE PLANS IS THE SOUTHWEST PROPERTY CORNER, A REBAR & CAP, ALESSI, PLS 30130. ELEVATION = 7395.63' (NAVD88).



DESIGNED BY \_\_\_\_\_  
 DRAWN BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_  
 AS-BUILT BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_

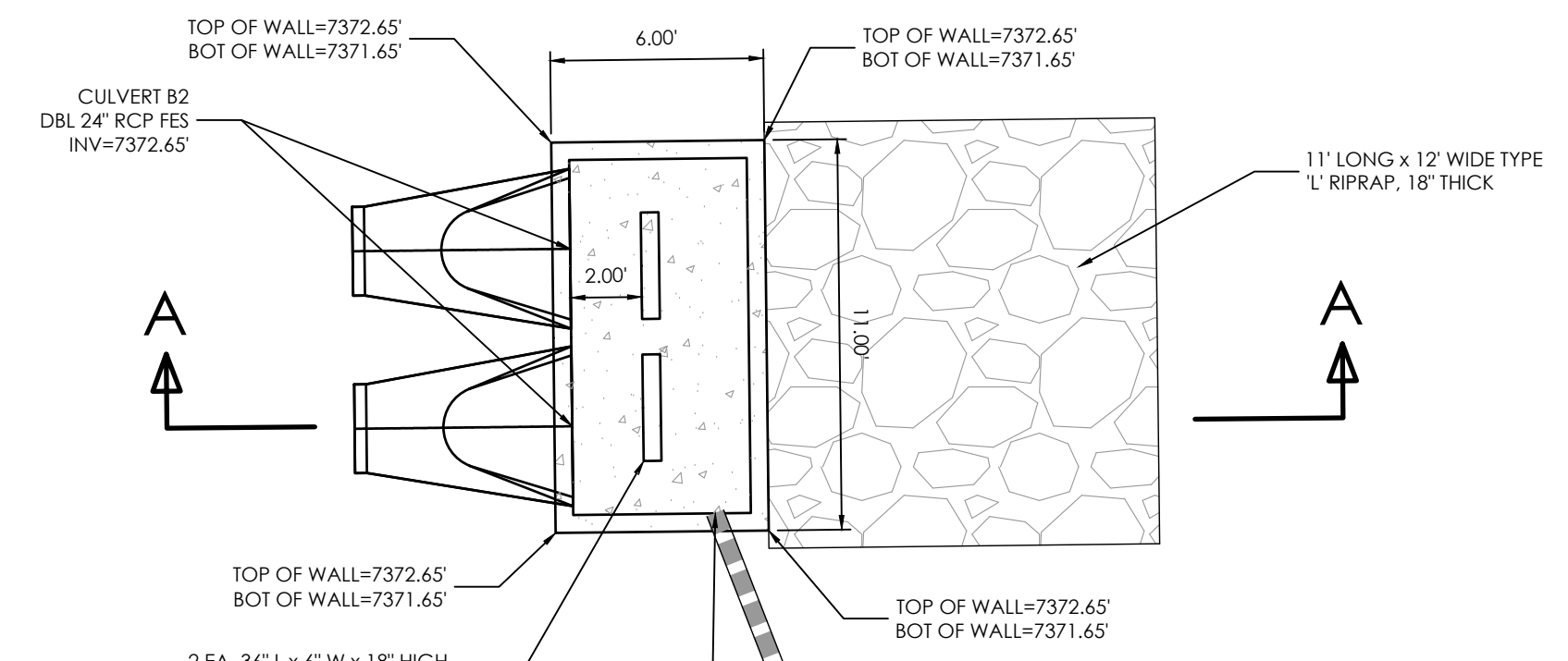
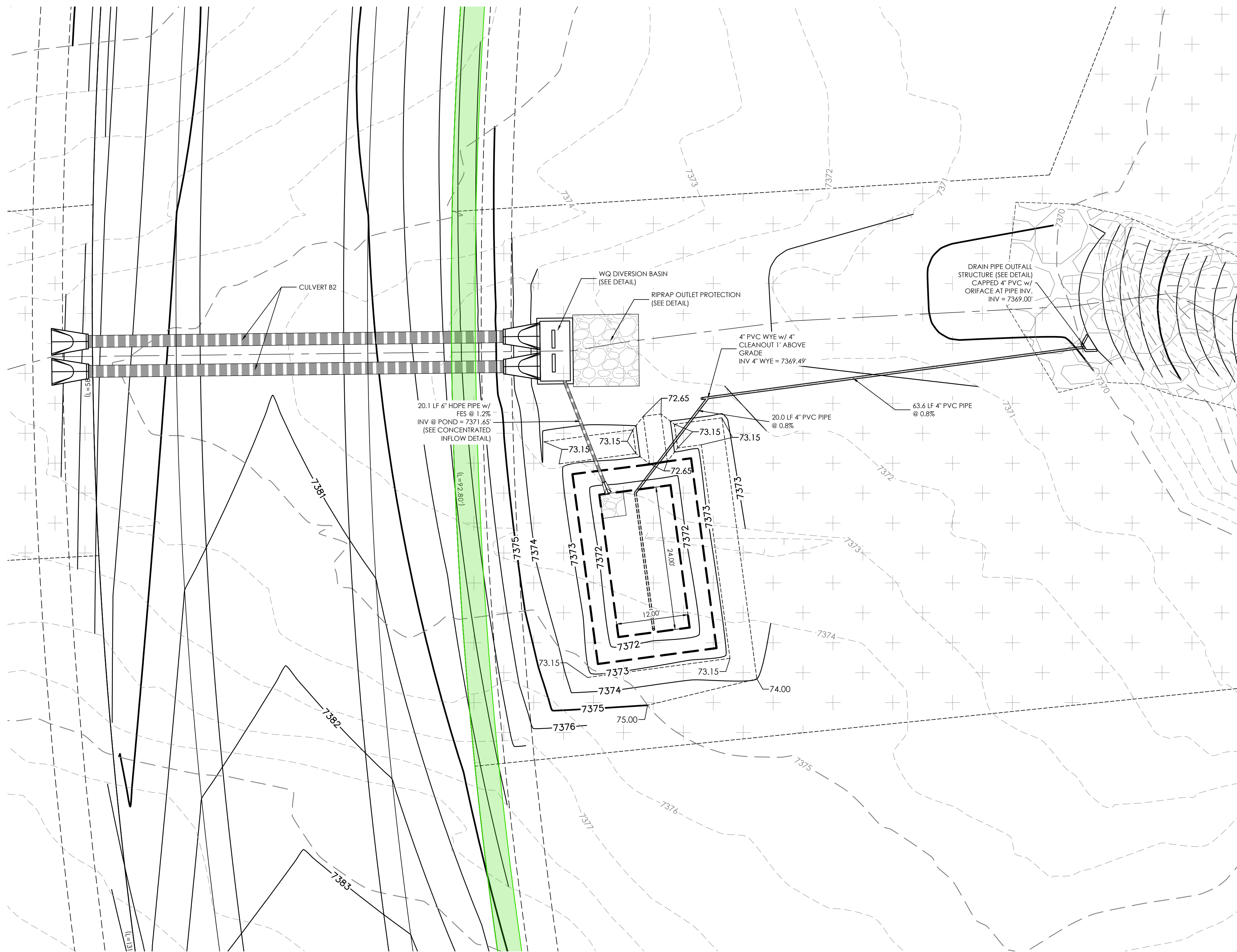
REVISIONS

TABLE ROCK HOMESTEADS

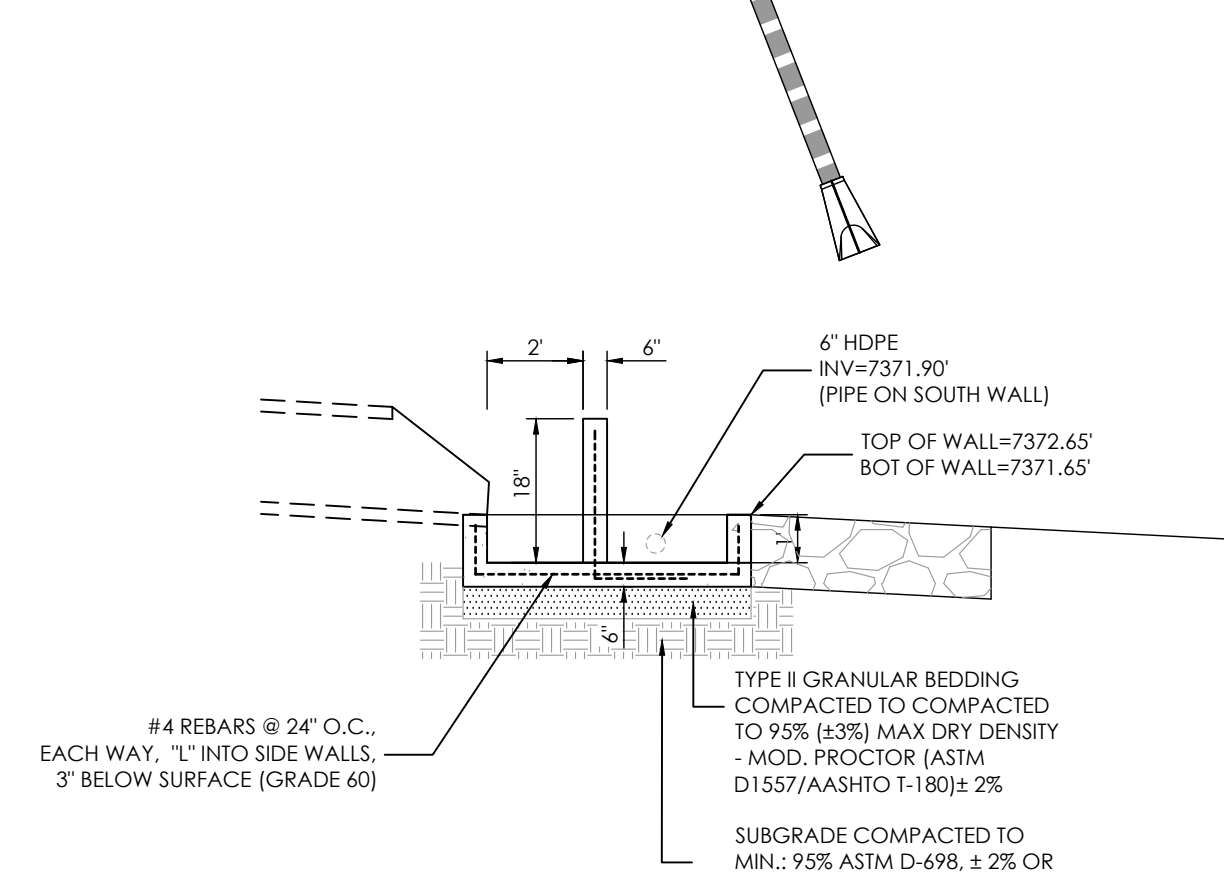
GRADING & EROSION CONTROL PLANS  
 WQ SAND FILTER D1

C2.3 MVE PROJECT 61223  
 MVE DRAWING GEC-PP

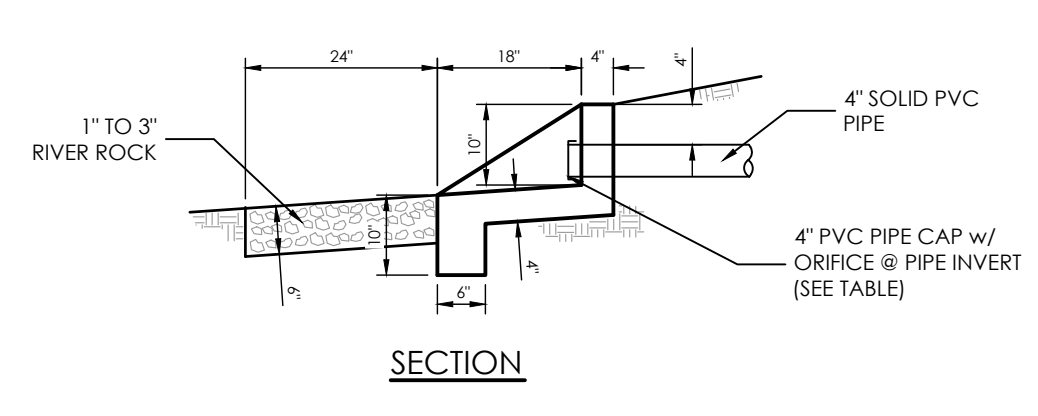
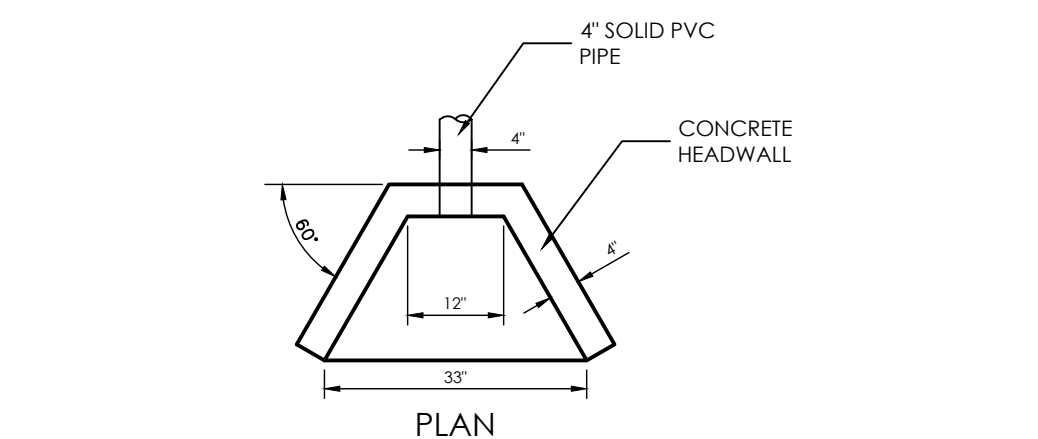
NOVEMBER 5, 2024  
 SHEET 3 OF 7



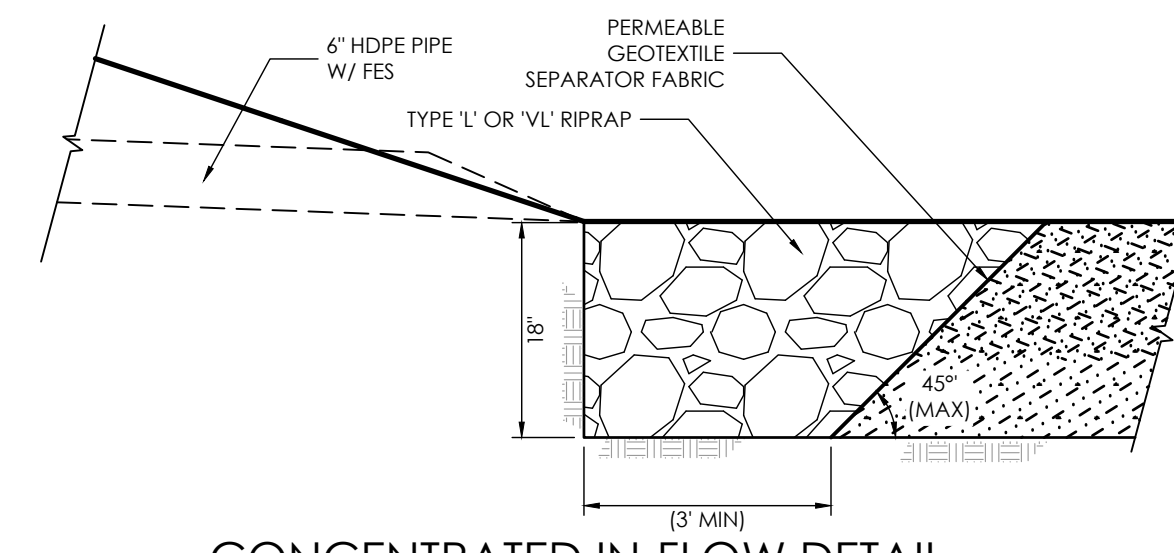
4000 PSI CONCRETE, 6" THICK W/ #4 REBARS @ 24" O.C., EACH WAY, "L" INTO SIDE WALLS, 3" BELOW SURFACE (GRADE 60)



SECTION A-A  
WQ DIVERSION BASIN  
DETAIL  
SCALE: 1" = 4'



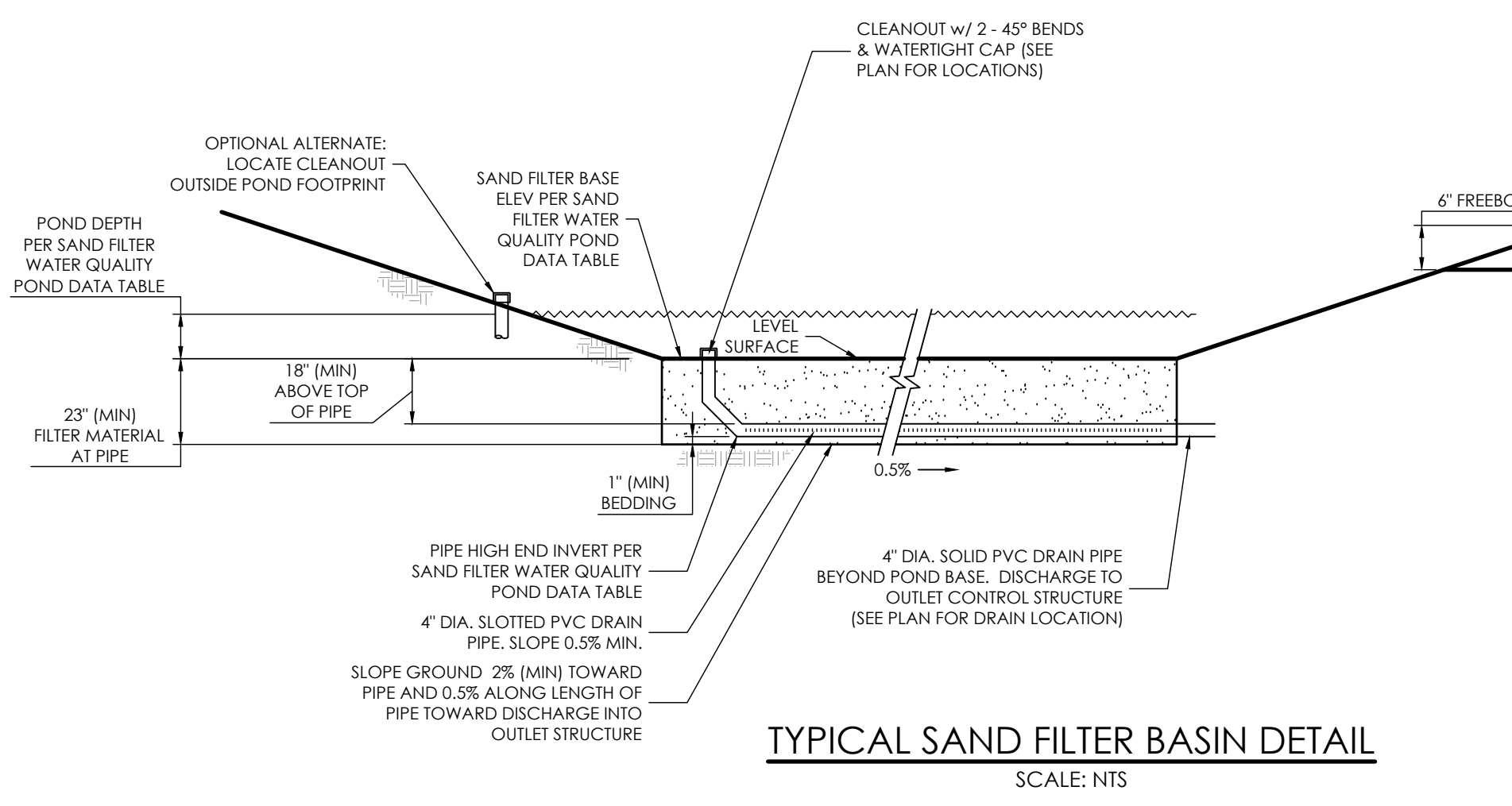
SECTION  
DRAIN PIPE OUTFALL DETAIL  
SCALE: 1" = 2'



CONCENTRATED IN-FLOW DETAIL  
SCALE: NTS

**SAND FILTER SPECIFICATIONS, NOTES & REFERENCES:**  
 REFERENCE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT (UDFCD), URBAN STORM DRAINAGE CRITERIA MANUAL VOLUME 3, SECTION 1-6, FOR FULL SET OF SAND FILTER DETAILS AND SPECIFICATIONS AS IDENTIFIED.  
 - FILTER MATERIAL - CLASS C FILTER MATERIAL, PER SOIL MATERIAL GRADATION TABLE.  
 - PERMEABLE GEOTEXTILE SEPARATOR FABRIC - TENCATE MIRAFI 170N, OR EQUAL, PER UDFCD TABLE SF-3.  
 - CONCENTRATED INFLOW - PER CONCENTRATED INFLOW DETAIL.  
 - SLOTTED PIPE - CONTECH A-2000, OR EQUAL, PER PIPE SPECIFICATION TABLE.

**CONTRACTOR NOTE:**  
 EMERGENCY OVERFLOW ELEVATION OF POND TO BE SET AT SAME ELEVATION AS THE CONCRETE STILLING BASIN TOP.  
 CONTRACTOR TO ADJUST ELEVATIONS OF POND OVERFLOW, BOTTOM AND BERM AS NECESSARY TO ENSURE ELEVATIONS MATCH.



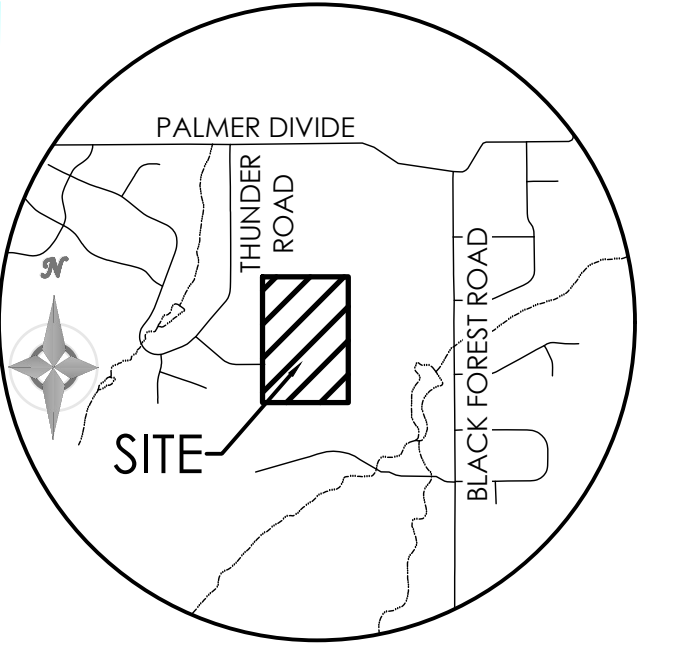
TYPICAL SAND FILTER BASIN DETAIL  
SCALE: NTS

STANDARD SIEVE SIZE	% PASSING	
	GROWING MEDIA <sup>(1)</sup>	FILTER MATERIAL <sup>(2)</sup>
1-1/2"	100	100
3/4"	100	100
NO. 4	85-100	20-60
NO. 10		10-30
NO. 50		10-30
NO. 100		10-30
NO. 200	80-90	0-3
NO. 250	3-17	0-3

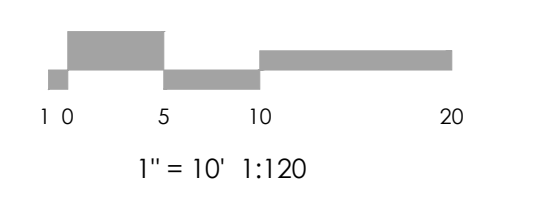
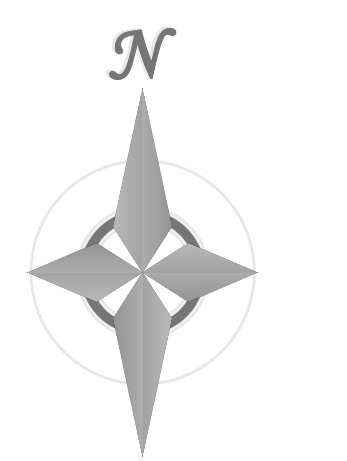
<sup>(1)</sup>RAIN GARDEN ONLY  
<sup>(2)</sup>LESS THAN 1.5% ORGANIC MATERIAL  
<sup>(3)</sup>APPLIES TO BOTH SAND FILTER BASIN AND RAIN GARDEN

TABLE SF-2 (SLOTTED PIPE DIMENSIONS)				
PIPE Ø	SLOT LENGTH	SLOT WIDTH	SLOT CENTERS	OPEN AREA (PER SF)
4"	1-1/16"	0.032"	0.413"	1.90 SQ. IN.

SAND FILTER WATER QUALITY POND DATA TABLE									
SAND FILTER	BASE AREA (SQ. FEET)	SAND FILTER VOLUME (FT <sup>3</sup> )	SAND FILTER BASE ELEV.	POND DEPTH (FT)	EMERGENCY OVERFLOW ELEVATION	SLOTTED PIPE INVERT ELEVATIONS		OUTLET ORIFICE INV. ELEV.	OUTLET ORIFICE DIAMETER (IN)
						HIGH END	LOW END		
B2	288	464	7371.65'	1.0	7372.65'	7369.77'	7369.65'	7369.00'	7/16"



**VICINITY MAP**  
NOT TO SCALE  
 BENCHMARK: THE BENCHMARK FOR THESE PLANS IS THE SOUTHWEST PROPERTY CORNER, A REBAR & CAP, ALESSI, PLS 30130. ELEVATION = 7395.63' (NAVD88).



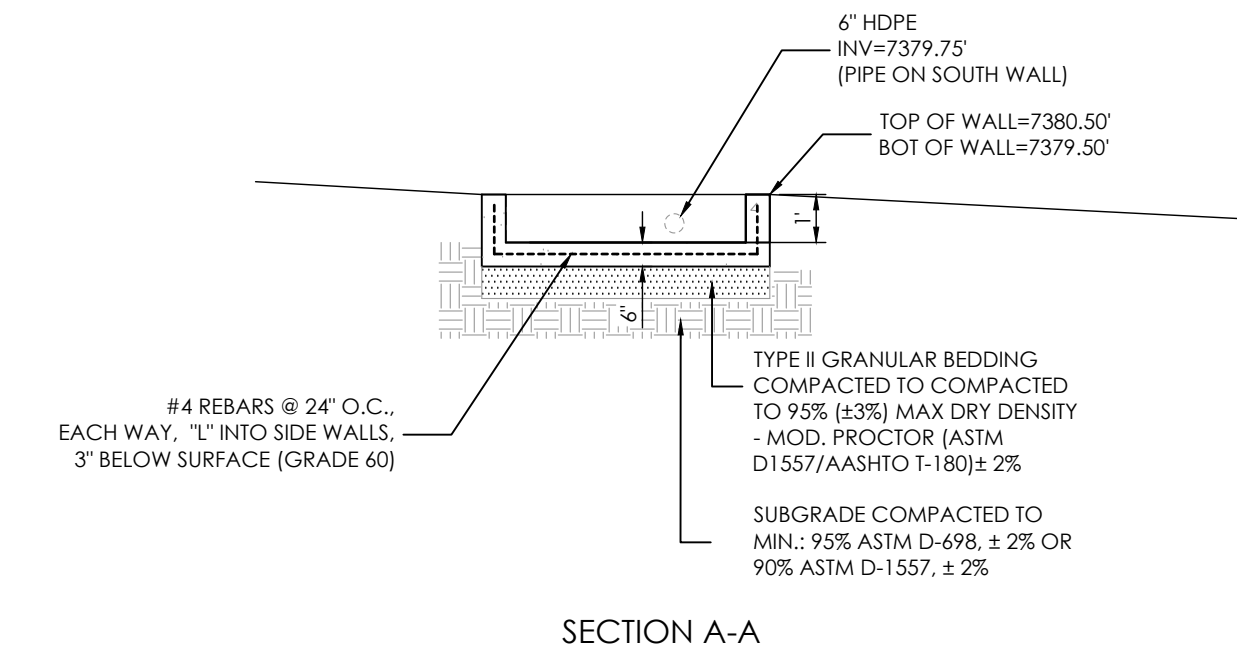
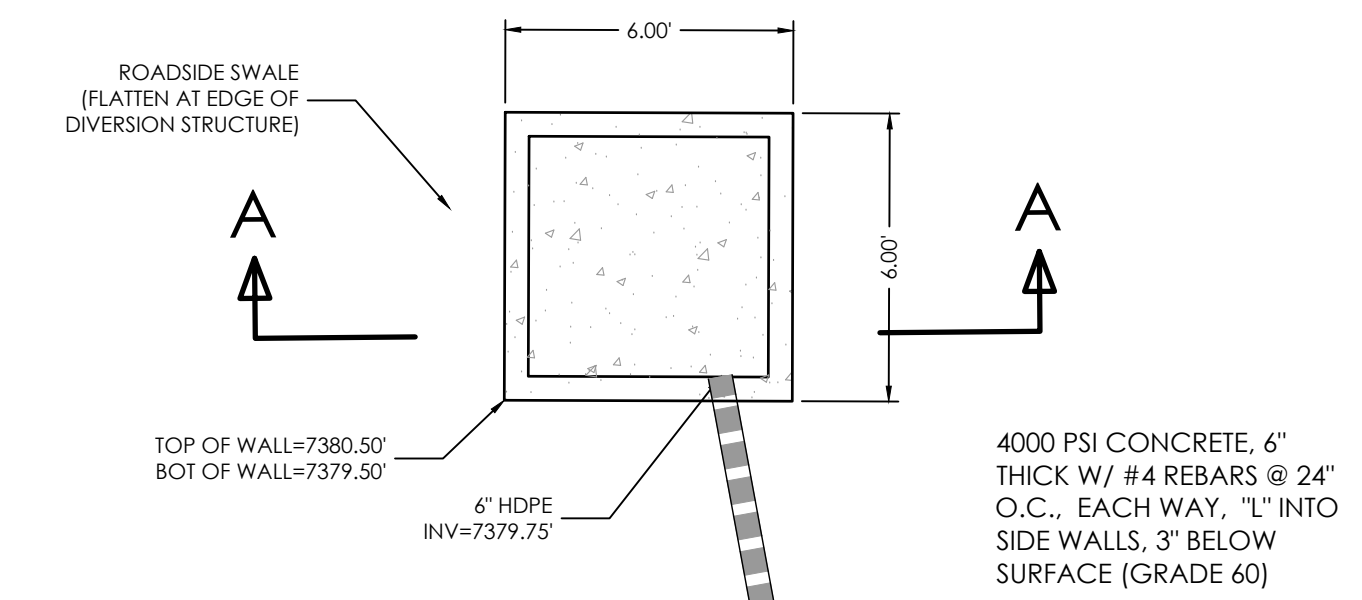
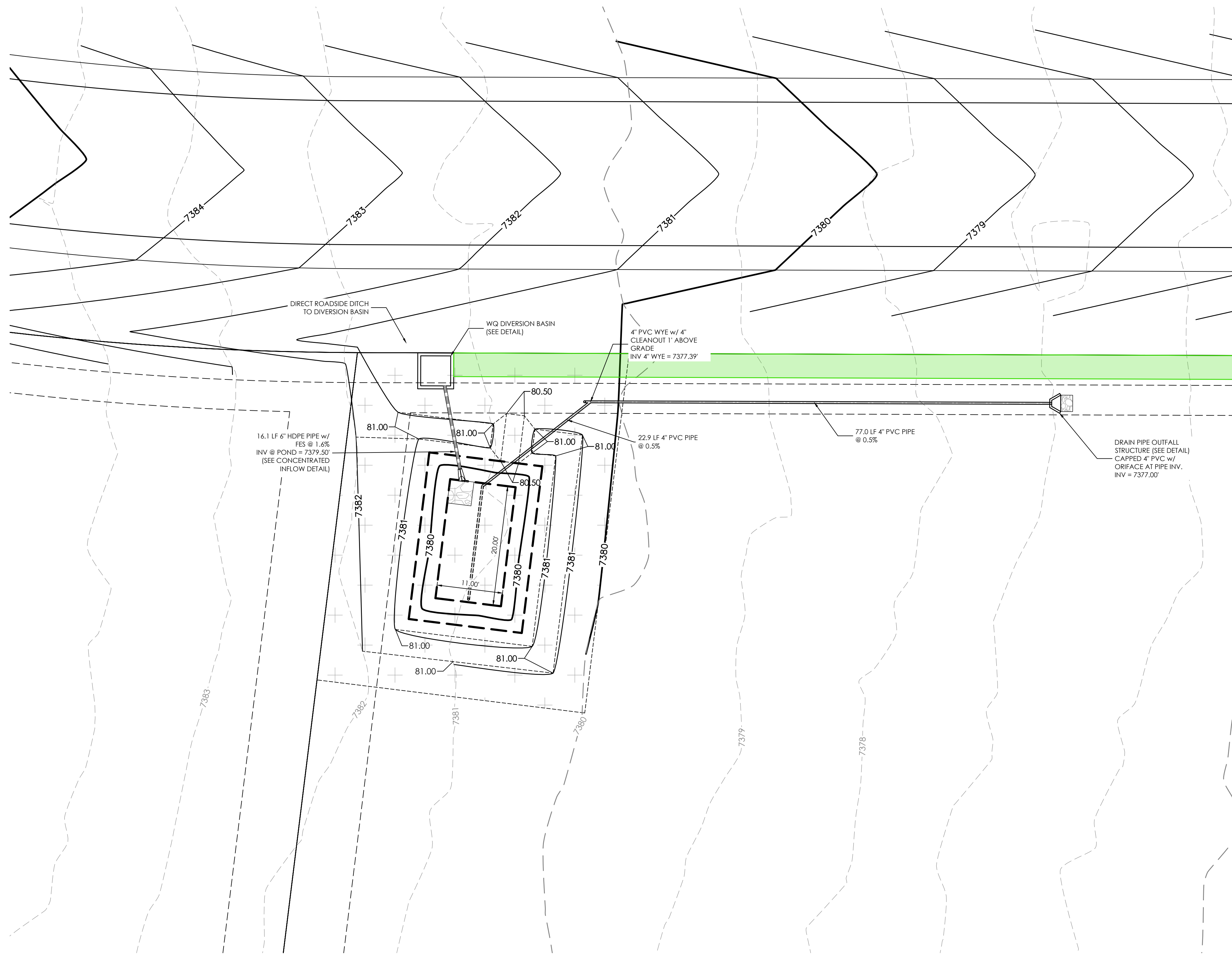
**MVE, INC.**  
 ENGINEERS, SURVEYORS  
 1903 Leary Street, Suite 200 Colorado Springs, CO 80909 719.635.5736

DESIGNED BY \_\_\_\_\_  
 DRAWN BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_  
 AS-BUILT BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_

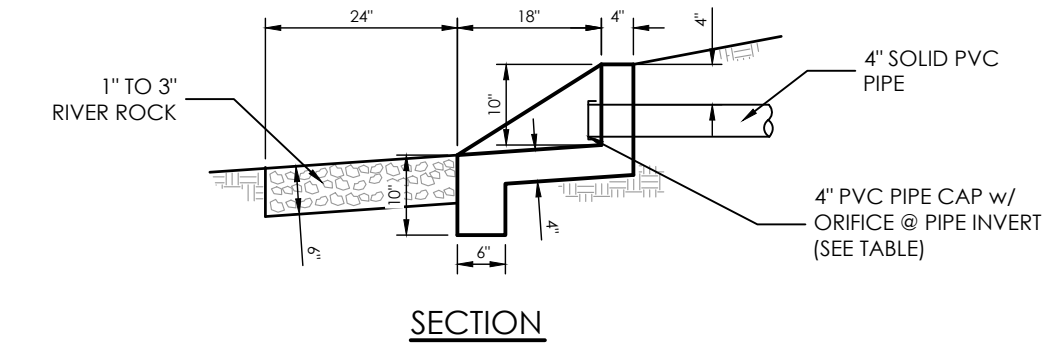
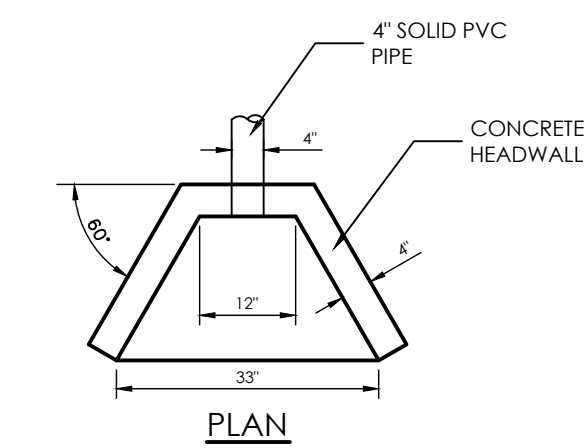
TABLE ROCK  
 HOMESTEADS  
 GRADING & EROSION  
 CONTROL PLANS  
 WQ SAND FILTER B2

**C2.4** MVE PROJECT 61223  
 MVE DRAWING GEC-PP

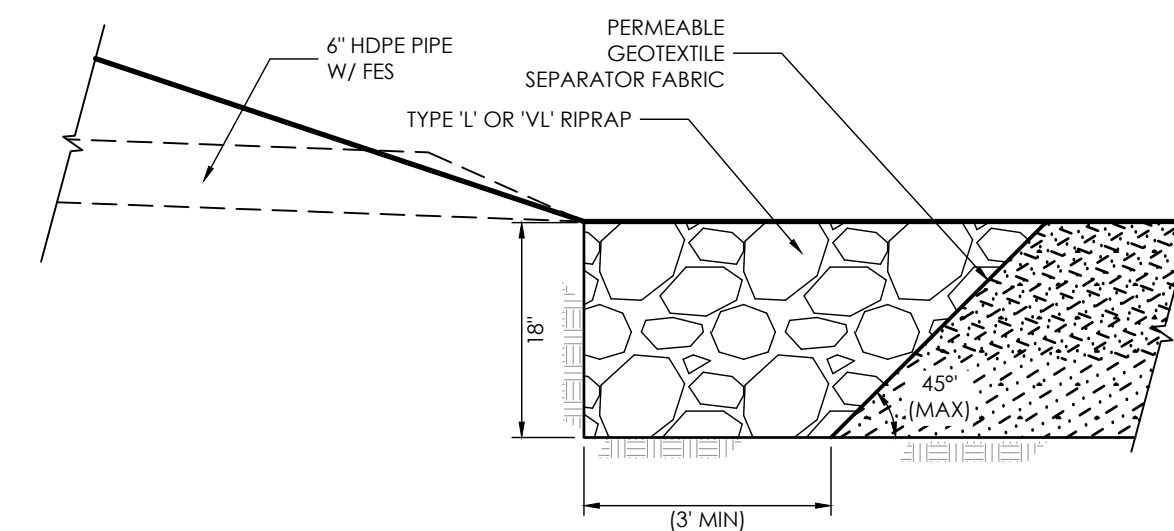
NOVEMBER 5, 2024  
 SHEET 4 OF 7



SECTION A-A  
**WQ DIVERSION BASIN**  
**DETAIL**  
 SCALE: 1" = 4'



**DRAIN PIPE OUTFALL DETAIL**  
 SCALE: 1" = 2'



**CONCENTRATED IN-FLOW DETAIL**  
 SCALE: NTS

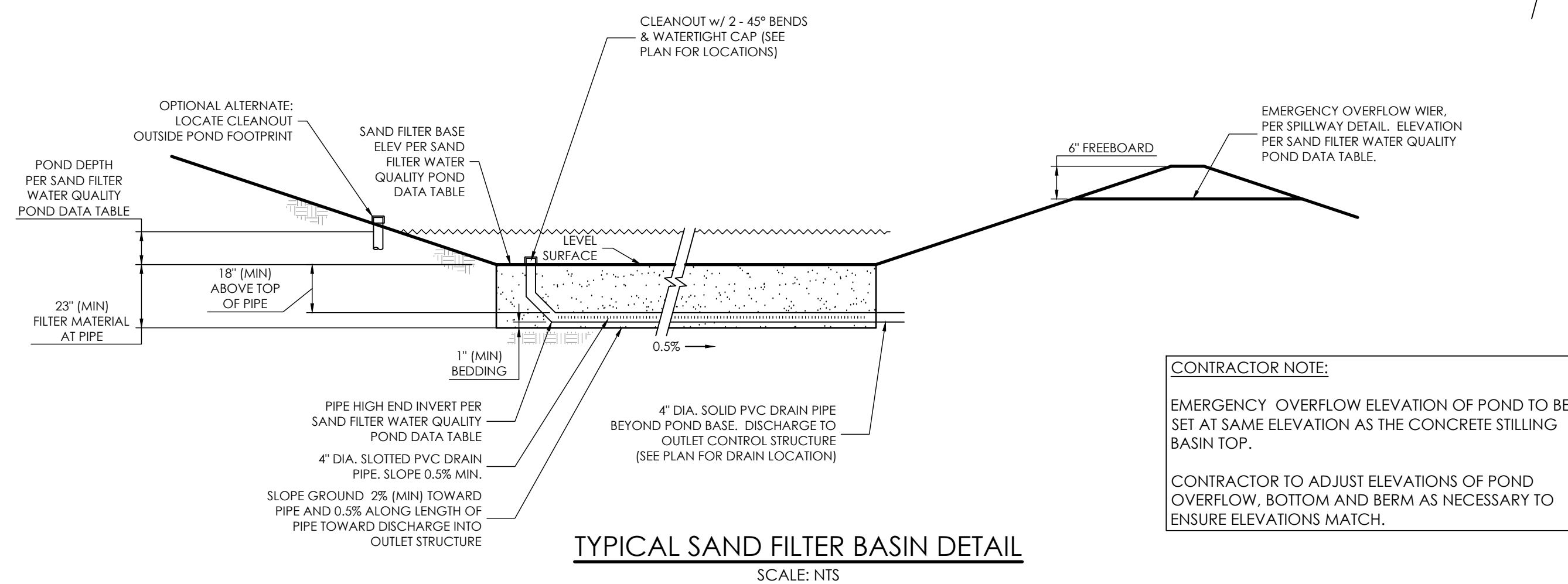
**SAND FILTER SPECIFICATIONS, NOTES & REFERENCES:**  
 REFERENCE URBAN DRAINAGE AND FLOOD CONTROL DISTRICT (UDFCD), URBAN STORM DRAINAGE CRITERIA MANUAL VOLUME 3, SECTION 1-6, FOR FULL SET OF SAND FILTER DETAILS AND SPECIFICATIONS AS IDENTIFIED.  
 - **FILTER MATERIAL** - CLASS B or CLASS C FILTER MATERIAL, PER SOIL MATERIAL GRADATION TABLE.  
 - **PERMEABLE GEOTEXTILE SEPARATOR FABRIC** - TENCAE MIRAFI 170N, OR EQUAL, PER UDFCD TABLE SF-3.  
 - **CONCENTRATED INFLOW** - PER CONCENTRATED INFLOW DETAIL.  
 - **SLOTTED PIPE** - CONTECH A-2000, OR EQUAL, PER PIPE SPECIFICATION TABLE.

SOIL MATERIAL GRADATION TABLE			
(SOURCE: UDFCD BENCHMARK, FIG. TABLE B-1 & SAND FILTER BASIN (SF) TABLE SF-1)			
STANDARD SIEVE SIZE	GROWING MEDIA <sup>(1)</sup>	FILTER MATERIAL <sup>(2)</sup>	
		CLASS B	CLASS C
1-1/2"		100	100
3/4"		100	100
NO. 4	100	20-60	60-100
NO. 10	85-100	10-30	10-30
NO. 50		0-3	0-10
NO. 100		0-3	0-3
NO. 200	80-90		
NO. 250	3-17		

<sup>(1)</sup>RAIN GARDEN ONLY  
<sup>(2)</sup>LESS THAN 1.5% ORGANIC MATERIAL  
<sup>(3)</sup>APPLIES TO BOTH SAND FILTER BASIN AND RAIN GARDEN

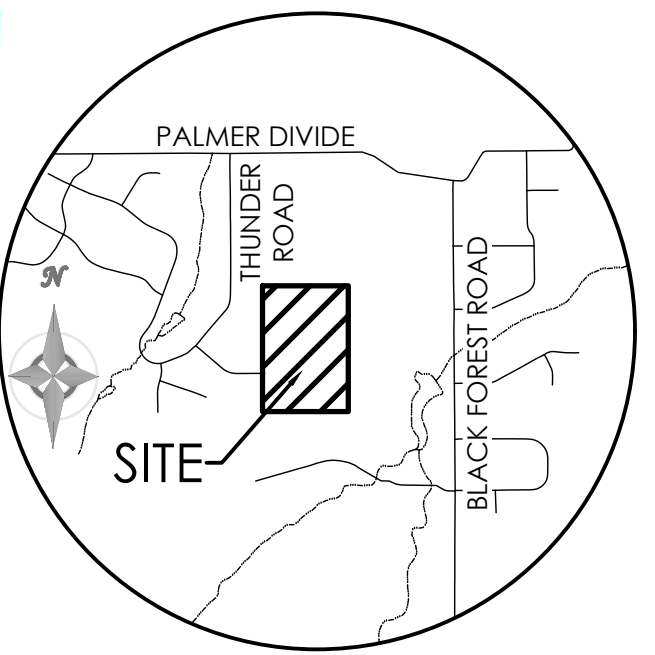
TABLE SF-2 (SLOTTED PIPE DIMENSIONS)				
PIPE Ø	SLOT LENGTH	SLOT WIDTH	SLOT CENTERS	OPEN AREA (PER SF)
4"	1-1/16"	0.032"	0.413"	1.90 SQ. IN.

SAND FILTER WATER QUALITY POND DATA TABLE									
SAND FILTER	BASE AREA (SQ. FEET)	SAND FILTER VOLUME (FT <sup>3</sup> )	SAND FILTER BASE ELEV.	POND DEPTH (FT)	EMERGENCY OVERFLOW ELEVATION	SLOTTED PIPE INVERT ELEVATIONS		OUTLET ORIFICE INV. ELEV.	OUTLET ORIFICE DIAMETER (IN)
						HIGH END	LOW END		
C1	220	376	7379.50	1.0	7380.50	7371.60	7371.50	7371.00	7/16"



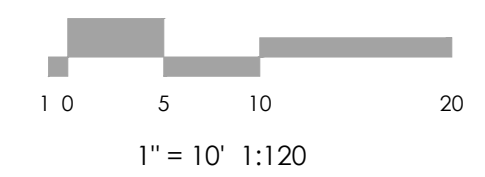
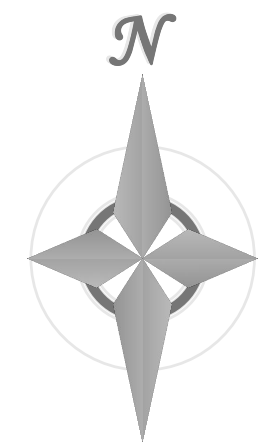
**TYPICAL SAND FILTER BASIN DETAIL**  
 SCALE: NTS

**CONTRACTOR NOTE:**  
 EMERGENCY OVERFLOW ELEVATION OF POND TO BE SET AT SAME ELEVATION AS THE CONCRETE STILLING BASIN TOP.  
 CONTRACTOR TO ADJUST ELEVATIONS OF POND OVERFLOW, BOTTOM AND BERM AS NECESSARY TO ENSURE ELEVATIONS MATCH.



**VICINITY MAP**  
 NOT TO SCALE

BENCHMARK  
 THE BENCHMARK FOR THESE PLANS IS THE SOUTHWEST PROPERTY CORNER, A REBAR & CAP, ALESSI, PLS 30130.  
 ELEVATION = 7385.63' (NAVD88).



REVISIONS

DESIGNED BY \_\_\_\_\_  
 DRAWN BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_  
 AS-BUILTS BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_

**TABLE ROCK HOMESTEADS**

**GRADING & EROSION CONTROL PLANS**  
**WQ SAND FILTER C1**

**C2.5** MVE PROJECT 61223  
 MVE DRAWING GEC-PP

NOVEMBER 5, 2024  
 SHEET 5 OF 7