

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

for:

Grazing Yak Solar Project

Located at:

31275 Washington Road, Calhan, CO 80808

Prepared for:

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

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Stormwater Management Facility Operation and Maintenance (O&M) Manual

I. Compliance with Stormwater Facility Maintenance Requirements

All property owners are responsible for ensuring that stormwater facilities installed on their property are properly maintained and that they function as designed. In some cases, this maintenance responsibility may be assigned to others through special agreements. The maintenance responsibility for a stormwater facility may be designated on the subdivision plat, the site development plan, and/or within a maintenance agreement for the property. Property owners should be aware of their responsibilities regarding stormwater facility maintenance. Maintenance agreement(s) associated with this property are provided in Appendix A.

II. Inspection & Maintenance – Annual Reporting

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

Copies of the Inspection and Maintenance forms for each of the stormwater facilities are located in Appendix D and E. A standard annual reporting form is provided in Appendix F.

III. Preventative Measures to Reduce Maintenance Costs

The most effective way to maintain your water quality facility is to prevent the pollutants from entering the facility in the first place. Common pollutants include sediment, trash & debris, chemicals, dog wastes, runoff from stored materials, illicit discharges into the storm drainage system and many others. 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 disposal of hazardous wastes and chemicals.
- Plan lawn care to minimize the use of 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.
- Re-vegetate disturbed and bare areas to maintain vegetative stabilization.
- Clean out the upstream components of the storm drainage system, including inlets, storm sewers and outfalls.
- Do not store materials outdoors (including landscaping materials) unless properly protected from runoff.

IV. Access

The stormwater management facility located on site has a designated access location. Refer to the Stormwater Facilities Map located in Appendix G for access location.

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 or equipment. A confined space should never be entered without at least one additional person present.

If a toxic or flammable substance is discovered, leave the immediate area and contact the local Sheriff at 911.

Potentially dangerous (e.g., fuel, chemicals, hazardous materials) substances found in the areas must be referred to the local Sheriff's Office immediately for response by the Hazardous Materials Unit. The emergency contact number is 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 identified within the pond that is greater than 48" in height, make the appropriate note/comment on the maintenance inspection form.

If any hazard is found within the facility area that poses an immediate threat to public safety, contact the local Sheriff's Office 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 Management Facilities:

- Protective clothing and boots.
- Safety equipment (vest, hard hat, confined space entry equipment).
- Communication equipment.
- Operation and Maintenance Manual for the site including stormwater management facility location maps.
- Clipboard.
- Stormwater Facility Maintenance Inspection Forms (See Appendix D).
- Manhole Lid Remover
- Shovel.

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

VII. Inspecting Stormwater Management Facilities

The quality of stormwater entering the waters of the state relies heavily on the proper operation and maintenance of permanent best management practices. Stormwater management facilities 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

All stormwater management facilities are required to be inspected by a qualified individual at a minimum of once per year. Inspections should follow the inspection guidance found in the SOP for the specific type of facility. (Appendix C of this manual).

B. Inspection Report

The person(s) conducting the inspection activities shall complete the appropriate inspection report for the specific facility. Inspection reports are located in Appendix D.

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

General Information

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

The reason for the inspection is also identified on the form depending on the nature of the inspection. All facilities should 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 (See SOP in appendix A). This can include items like vegetation management or debris/trash removal.
 - 3 = Immediate Repair Necessary – This item needs immediate attention because failure is imminent or has already occurred. This could include items such as structural failure of a feature (outlet works, forebay, etc), significant erosion, or significant sediment accumulation. This score should be given to an item that can significantly affect the function of the facility.
- N/A This is checked by an item that may not exist in a facility. Not all facilities have all of the features identified on the form (forebay, micro-pool, etc.).

Inspection Summary/Additional Comments

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

Overall Facility Rating

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

C. Verification of Inspection and Form Submittal

The Stormwater Management Facility Inspection Form provides a record of inspection of the facility. Inspection Forms for each facility type are provided in Appendix D. The verification and the inspection form(s) shall be reviewed and submitted by the property owner or property manager.

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

VIII. Maintaining Stormwater Management Facilities

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

Routine Work

The majority of this work consists of scheduled mowings and trash and debris pickups for stormwater management facilities during the growing season. This includes items such as the removal of debris/material that may be clogging the outlet structure well screens and trash racks. It also includes activities such as weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year.

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.

Rehabilitation Work

This work consists of large-scale maintenance and major improvements needed to address failures within the stormwater management facilities. This work requires consultation with El Paso County Department of Public Works and may require an engineering design with construction plans to be prepared for review and approval. This work may also require more specialized maintenance equipment, surveying, construction permits or assistance through private contractors and consultants. These items require prior correspondence with El Paso County Department of Public Works and require that completed maintenance forms be submitted to El Paso County Department of Public Works for each maintenance activity.

B. Maintenance Personnel

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

C. Maintenance Forms

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

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

Appendix A - Maintenance Agreement(s)

STORMWATER FACILITY MAINTENANCE AGREEMENT

This Stormwater Maintenance Agreement is entered into this _____ day of _____, 2019, by and between the Board of County Commissioners of El Paso County, a political subdivision of the State of Colorado (the “County”), and Grazing Yak Solar, LLC (the “Owner”), and collectively referred to as the “Parties.”

RECITALS

WHEREAS, the above-named property owner is the owner of a certain parcel of land being the west half of section 29, Township 12 South, Range 61 West of the 6th Principal Meridian, and the North 820 feet of the West 2,450 feet of the West half of said section 29, County of El Paso, State of Colorado, a/k/a 31275 Washington Road, Calhan, Colorado 80808, (hereinafter referred to as the “Property”); and

WHEREAS, a Phase III Drainage Report and Plan (“Plan”) for the Property have been approved by the County; and

WHEREAS, said Plan provides for stormwater management facilities including such facilities intended to reduce, detain, convey, and manage stormwater runoff and also water quality facilities (collectively referred to as “Facilities”); and

WHEREAS, the Facilities shown on the Plan shall be constructed and adequately maintained by the Owner; and

WHEREAS, the County requires that the Owner submit an Operation and Maintenance Manual (“O&M Manual”) as specified by El Paso County; and

NOW, THEREFORE, in consideration of mutual benefits and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Parties agree as follows:

AGREEMENT

1. The Owner shall maintain the Facilities as described in the Plan to ensure that such Facilities are and will remain in proper working condition in accordance with the El Paso County Engineering Criteria Manual and other applicable legal requirements. Maintenance shall include, but not be limited to, routine landscaping, sediment removal, repair, reconstruction, or replacement of the Facilities as necessary to meet the requirements of this Agreement.
2. The maintenance of the Facilities shall be performed in accordance with the approved O&M Manual for the Facilities.
3. The Owner shall cause inspections of the Facilities to be conducted as follows:
 - a) The Owner agrees to cause inspection of the Facilities, at the Owner’s expense, by a person experienced in the inspection of stormwater facilities. Inspections shall occur at least once every calendar year.

- b) An inspection report for the Facilities shall be submitted in writing to County, or its designated representative, for each calendar year by no later than May 31st of the following year. The inspection report shall be in accordance with the requirements set forth in the O&M Manual.
 - c) The Owner agrees to perform promptly all needed maintenance and repairs and report such activities to the County, or its designated representative, pursuant to the O&M Manual.
4. The Owner, hereby, grants, bargains and conveys to the County, officers, agents, and employees an easement over the Property for access from public rights-of-way, abutting private roadways, and/or private driveways, to the Facilities for the purpose of inspecting, operating, installing, constructing, reconstructing, maintaining, repairing or replacing the Facilities to the extent that Owner fails to do so and as necessary to ensure their proper working condition as provided in paragraphs one and two above.
 5. In the event the Owner fails to inspect, report, or properly maintain the Facilities within thirty (30) days after written notice by the County of such deficiencies to the owner, the County, or its designated representative, may enter upon the Property and take whatever steps it deems necessary to maintain or repair the Facilities and bill the owner for such expense. However, if the Owner's failure to properly maintain the Facilities could cause damage to property, loss of life or a violation of a NPDES MS4 Permit, the County, or its designated representative, may take immediate action, without notice to the Owner, to maintain or repair the Facilities. It is expressly understood and agreed that the County, or its designated representative, is under no obligation to maintain or repair the Facilities, and in no event shall this Agreement be considered to impose any such obligation on the County.
 6. The Owner agrees that it will not at any time dedicate the Facilities to the public, to public use or to the County without the County's written consent, nor will it subdivide or convey the Property without a covenant providing that a proportionate share of the cost of maintenance and other costs associated with other of the obligations and duties contained herein runs with each subdivided part of the original tract or parcel of land.
 7. In an event of emergency involving Facilities, the County, its officers, agents, and employees may enter immediately upon the Property and take whatever reasonable steps it deems necessary to meet the emergency. The County shall notify the Owner of such emergency and entry as soon as possible but in no event later than twenty-four (24) hours after such entry. Alternatively, the County may notify the Owner by phone to take whatever reasonable action is necessary within a specified period of time. Should the Owner fail to respond, or should the Owner inform the County that it intends to not respond within the specified period of time, the County, its officers, agents, and employees may enter immediately upon emergency.
 8. The County shall not pay any compensation at any time for its use of the Property in any way necessary for the inspections and maintenance of the Facilities, including access to the Facilities.

9. In the event the County, pursuant to this Agreement, performs work or expends any funds reasonably necessary for the maintenance or repair of the Facilities, including labor, equipment, supplies and materials, the Owner agrees to reimburse the County, or its designated representative, within thirty (30) days after the County gives the Owner written notice of such expense. If the Owner or its successors or assigns fails to make timely payment as required herein, interest on such payment shall accrue at the rate of 1½ % per month until paid in full.
10. Any amount owed to County and not paid within thirty (30) days of the date of notification shall be the joint and several obligation of any owner of record of the Property or any portion thereof served by the Facilities and any successors in interest to such owner on the date such maintenance or repair was performed.
11. The Owner, its successors, and assigns shall indemnify and hold harmless County, its officers, agents, and employees for any and all damages, accidents, casualties, occurrences or claims which might arise or be asserted against the County arising out of or resulting from the construction, presence, existence maintenance or use of the Facilities.
12. The Owner shall notify the County when the Owner transfers its interest in the Property or any portion thereof. The Owner shall provide the County with a copy of any such deed.
13. The responsibilities and obligations of the Owner shall constitute a covenant running with the land, and shall be binding upon all present and subsequent owners, their administrators, executors, assigns, heirs, and any other successors in interest so long as they own an interest in the Property of any portion thereof served by the Facilities.
14. The Owner acknowledges that any approved Final Development Plan, Administrative Site Plan, Location and Extent, Use by Special Review, Engineering Case, or other case process determined by El Paso County to be a final plan, shall include the following language: “The property owner, its successors, and assigns shall be responsible for maintenance of the Facilities pursuant to the Operations and Maintenance (O&M) Manual and all permanent Best Management Practices (BMP’S). Requirements include, but are not limited to, performing the specified BMP’s contained in the O&M Manual recorded on _____ in the El Paso County Clerk and Recorder’s Office at reception number _____, and maintaining the Facilities shown on the approved Phase III Drainage Report and the approved Construction Plans.” If the Facilities are not properly maintained, the County may provide necessary maintenance and assess the maintenance cost to the owner of the property. Failure to abide by the above note shall constitute a Zoning Violation, as defined in the El Paso County Land Development Code.
15. This Agreement shall be recorded in the El Paso County Clerk and Recorder’s Office.
16. In the event either of the Parties hereto files a law suit to enforce the terms of this Agreement, the prevailing party shall be entitled to its reasonable costs and attorney fees.

IN WITNESS WHEREOF, the County and Owner have executed this Agreement on the date set forth above.

For the Board of County Commissioners:

By: Scot Cuthbertson.
Executive Director, Department of Public Works

OWNER:

By:

Name:

Title:

STATE OF FLORIDA)
)SS.
COUNTY OF PALM BEACH)

The foregoing instrument was acknowledged before me this _____ day of _____, 20____, by _____, as _____ of _____.

My commission expires _____. Witness my hand and official seal.

Signature

Name of Notary

Address of Notary

(SEAL)

EXHIBIT A: GRAZING YAK, LLC SOLAR ARRAY LEGAL DESCRIPTION

PARCEL CONTAINING THE SOLAR ARRAY:

TAX ASSESSOR SCHEDULE NO. 1200000040

A PARCEL OF LAND BEING THE WEST HALF OF SECTION 29, TOWNSHIP 12 SOUTH, RANGE 61 WEST OF THE 6TH PRINCIPAL MERIDIAN, EL PASO COUNTY, COLORADO, LESS AND EXCEPT ANY EXISTING RIGHTS OF WAY AND ALSO EXCLUDING THE FOLLOWING PARCEL OF LAND:

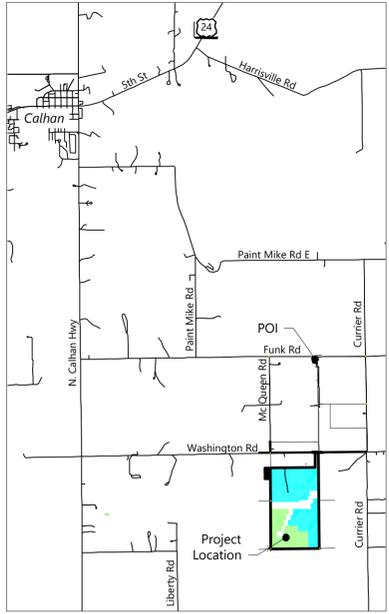
THE NORTH 820 FEET OF THE WEST 2450 FEET OF THE WEST HALF OF SAID SECTION 29.

CONTAINING 271.850 ACRES, MORE OR LESS



LEGEND & ABBREVIATIONS

- EX. PROJECT BOUNDARY LINE
- INVERTER BLOCK BOUNDARY
- PROPOSED UNDERGROUND CIRCUIT 1
- PROPOSED UNDERGROUND CIRCUIT 2
- x- EX. FENCE LINE
- PROPOSED SOLAR TRACKER
- BOUNDARY SET BACK LINE 10M
- BOUNDARY SET BACK LINE 15M
- PROPOSED PERMANENT ACCESS ROAD
- PROPOSED CAB
- PROPOSED SECONDARY CAB
- PROPOSED LAYDOWN AREA
- PROPOSED PROTECTED CROSSING
- GL --- PROPOSED GRADING LIMITS
- 340- --- PROPOSED INDEX CONTOUR LINE
- 340- --- PROPOSED INTERVAL CONTOUR LINE
- 340- --- EX. INDEX CONTOUR LINE
- EX. INTERVAL CONTOUR LINE
- EX. SECTION LINE
- EX. EASEMENT LINE
- x- EX. FENCE LINE
- POH --- EX. OVERHEAD POWERLINE
- FO --- EX. FIBER OPTIC LINE
- OIL --- EX. OIL LINE
- EX. GRAVEL ROAD
- EX. ASPHALT PAVEMENT ROAD
- 395W MODULES
- 400W MODULES



VICINITY MAP
Scale: 1" = 5000'



PREPARED FOR:



REVISIONS:

#	DATE	COMMENT
A	02/27/19	Issued for Review (30%)
B	03/28/19	Issued for Review (60%)
C	04/22/19	Permit Submittal Revisions



Grazing Yak Solar

El Paso County, Colorado

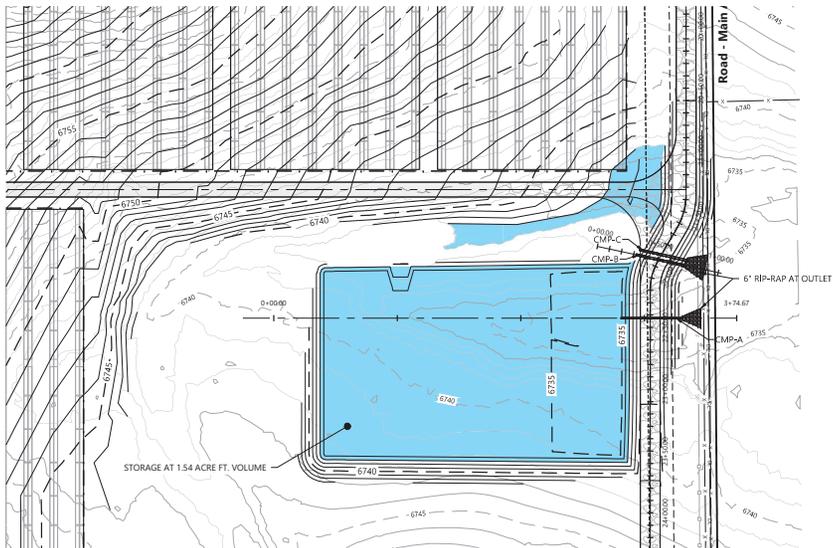
Preliminary Module Grouping

Not For Construction

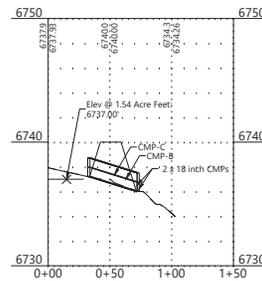
DATE: 04/22/2019

SHEET: EX.102

P:\0323281\000\dwg\Grazing Yak\0210101.dwg 2/24/2019 2:58 PM Paul C...r

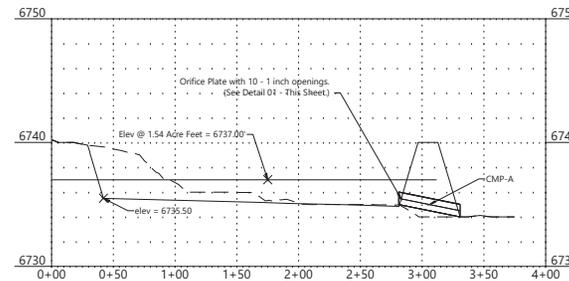


1 Permanent Setention Basin - Plan View
1" = 50'

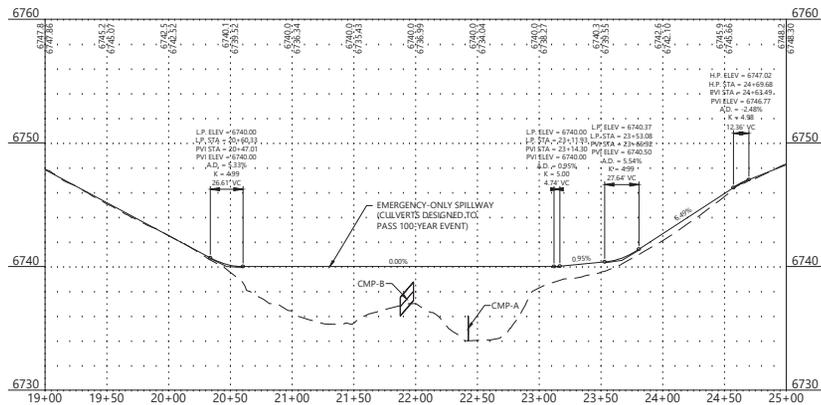


Pipe Table					
Pipe Name	Size	Length	Slope	Inv Up	Inv Down
CMP-A	12"	50'	2.01%	6735.00'	6734.00'
CMP-B	18"	40'	3.13%	6737.25'	6736.00'
CMP-C	18"	40'	3.12%	6737.25'	6736.00'

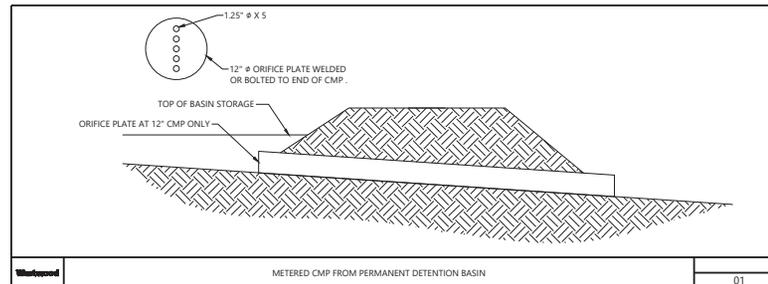
3 2 - 18" CMP - Main Access Rd.
1" = 50'



4 Section View of 12" CMP - Main Access Rd. & Basin
1" = 50'



2 Proposed Main access Rd at Permanent Detention Basin - Profile
1" = 50'



PREPARED FOR:



REVISIONS:

#	DATE	COMMENT
A	04/22/19	Permit Submittal Revisions



Grazing Yak Solar
El Paso County, Colorado

Detention Basin
Drainage Plan

Not For Construction

DATE: 04/22/2019

SHEET: DR.01

Appendix B - Description of Stormwater Management Facilities

Appendix B

General Location and Description of Stormwater Management Facilities.

A. General Site Description

Grazing Yak Solar Project (Project) is located approximately five (5) miles southeast of the town of Calhan on land situated east and south of the intersection of McQueen Road and Washington Road. The site is within Sections 20, 29, and 30, Township 12 South, Range 61 West of the Sixth Principal Meridian. The Project will generate up to 35-megawatts (MW) of energy and will consist of solar panels, underground collection lines, DC to AC inverters, medium voltage transformers, circuit breakers and disconnect switches, upgrades within the existing Golden West Wind Energy Project (“Golden West”) substation, two temporary laydown areas for use during construction, and the use of the existing Golden West Operations & Maintenance (O&M) building. The solar arrays will be located on a 272-acre parcel (1200000390) owned in fee simple by the Applicant. The collection lines will transport energy from the inverters and will converge at the northeast corner of the solar array area and run approximately one-mile north along a 300-foot wide collection line corridor to interconnect to the existing Golden West substation, owned and operated by the Applicant.

B. General Stormwater Management Description

The solar facility will be constructed as to not significantly alter existing drainage patterns. Stormwater runoff within the solar array currently drains to an unnamed drainage to Horse Creek which is a tributary to the Arkansas River.

The Project will require gravel access paths to a small portion of the site, which will increase runoff. The Project will employ runoff reductions practices such as allowing sheet flow across grass buffers and minimize the increased imperviousness to 2% total for the site post construction. Natural flow patterns will convey stormwater runoff to the Extended Detention Basin (EDB). The EDB mitigates the increase of runoff generated by the access roads and small electrical equipment pads throughout the site. Runoff generated by the access roads will flow into the EDB through a combination of sheet flow from the south and flows entering from the adjacent channelized bypass to the north. The EDB will have an approximate volume of 1.54 acre-feet and release below historic runoff rates.

C. Stormwater Facilities Site Plan

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

D. On-Site Stormwater Maintenance Facilities

Storage Facilities (Detention)

Detention for the Grazing Yak Solar project is provided in the on-site extended detention basin, located within the east-central portion of the Project, in line with the unnamed drainage to Horse Creek.

Appendix C - Standard Operation Procedures (SOP) for each facility type

Standard Operation Procedures for Inspection and Maintenance

Extended Detention Basins (EDBs)

November 2007

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EDB-1 BACKGROUND

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

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

EDB-2 INSPECTING EXTENDED DETENTION BASINS (EDBs)

EDB-2.1 Access and Easements

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

EDB-2.2 Stormwater Management Facilities Locations

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

EDB-2.3 Extended Detention Basin (EDB) Features

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

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

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

EDB-2.3.1 Inflow Points

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

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

The typical maintenance items 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. Erosion Present/Outfall Undercut – In some situations, the energy dissipater may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of

the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility.

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

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

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

EDB-2.3.2 Forebay

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

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

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

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

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

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

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

EDB-2.3.3 Trickle Channel (Low-Flow)

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

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

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

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

c. Woody Growth/Weeds Present – Because of the constant moisture in the area surrounding the trickle channel, woody growth (cottonwoods/willows)

can become a problem. Trees and dense shrub type vegetation can affect the capacity of the trickle channel and can allow flows to circumvent the feature.

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

EDB-2.3.4 Bottom Stage

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

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

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

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

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

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

be necessary to reduce these impacts to adjacent homeowners. (*El Paso County uses a bacterial larvacide for mosquito control, Vectobac-G, or approved equal)

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

EDB-2.3.5 Micro-pool

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

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

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

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

*c. Mosquitoes/Algae Treatment** – Nuisance created by stagnant water can result from improper maintenance/treatment of the micro-pool. Mosquito larvae can be laid by adult mosquitoes within the permanent pool. Also, aquatic vegetation that grows in shallow pools of water can decompose causing foul odors. Chemical/mechanical treatment* of the micro-pool may be necessary to reduce these impacts to adjacent homeowners. (*El Paso

County uses a bacterial larvacide for mosquito control, Vectobac-G, or approved equal)

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

EDB-2.3.6 Outlet Works

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

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

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

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

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

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

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

EDB-2.3.7 Emergency Spillway

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

The typical maintenance items 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 EDB, the riprap may shift or dislodge 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. Woody Growth/Weeds Present – Management of woody vegetation is essential in the proper long-term function of the spillway. Larger trees or dense shrubs can capture larger debris entering the EDB and reduce the capacity of the spillway.

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

EDB-2.3.8 Upper Stage (Dry Storage)

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

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

- a. Vegetation Sparse* – The upper basin is the most visible part of the EDB, and therefore aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance and acceptance of the EDB by the public. In addition, vegetation can reduce the potential for erosion and subsequent sediment transport to the other areas of the pond.
- b. Woody Growth/Undesirable Vegetation* – Although some trees and woody vegetation may be acceptable in the upper basin, some thinning of cottonwoods and willows may be necessary. Remember, the basin will have to be dredged to ensure volume, and large trees and shrubs will be difficult to protect during that operation.
- c. Standing Water/Boggy Areas* – Standing water or boggy areas in the upper stage is typically a sign that some other feature in the pond is not functioning properly. Routine maintenance (mowing, trash removal, etc) can be extremely difficult for the upper stage if the ground is saturated. If this inspection item is checked, make sure you have identified the root cause of the problem.
- d. Sediment Accumulation* – Although other features within the EDB are designed to capture sediment, the upper storage area will collect sediment over time. Excessive amounts of sedimentation will result in a loss of storage volume. It may be more difficult to determine if this area has accumulated sediment without conducting a field survey.

Below is a list of indicators:

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

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

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

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

EDB-2.3.9 Miscellaneous

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

a. Encroachment in Easement Area – Private lots/property can sometimes be located very close to the EDBs, even though they are required to be located in tracts with drainage easements. Property owners may place landscaping, trash, fencing, or other items within the easement area that may affect maintenance or the operation of the facility.

b. Graffiti/Vandalism – Damage to the EDB infrastructure can be caused by vandals. If criminal mischief is evident, the inspector should forward this information to the local Sheriff's Office.

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 Sheriff at 911 immediately!**

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

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

EDB-2.4 Inspection Forms

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

EDB-3 MAINTAINING EXTENDED DETENTION BASINS (EDBS)

EDB-3.1 Maintenance Personnel

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

EDB-3.2 Equipment

It is imperative 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 EDB:

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

- 17.) Illicit Discharge Cleanup Kits
- 18.) Trash Bags
- 19.) Tools (wrenches, screw drivers, hammers, etc)
- 20.) Chain Saw
- 21.) Confined Space Entry Equipment
- 22.) Approved Stormwater Facility Operation and Maintenance Manual

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

EDB-3.3 Safety

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

EDB-3.4 Maintenance Forms

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

EDB-3.5 Maintenance Categories and Activities

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

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

EDB-3.6 Routine Maintenance Activities

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

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

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

MAINTENANCE ACTIVITY	MINIMUM FREQUENCY	LOOK FOR:	MAINTENANCE ACTION
Mowing	Twice annually	Excessive grass height/aesthetics	Mow grass to a height of 4" to 6"
Trash/Debris Removal	Twice annually	Trash & debris in EDB	Remove and dispose of trash and debris
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
Weed control	Minimum twice annually	Noxious weeds; Unwanted vegetation	Treat w/ herbicide or hand pull; Consult the local weed specialist
Mosquito Treatment*	As needed	Standing water/mosquito habitat	Treat w/ EPA approved chemicals *
Algae Treatment	As needed	Standing water/ Algal growth/green color	Treat w/ EPA approved chemicals

(*El Paso County uses a bacterial larvacide for mosquito control, Vectobac-G, or approved equal)

EDB-3.6.1 Mowing

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

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

EDB-3.6.2 Trash/Debris Removal

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

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

EDB-3.6.3 Outlet Works Cleaning

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

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

EDB-3.6.4 Weed Control

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

Frequency – Routine – As needed based on inspections.

EDB-3.6.5 Mosquito/Algae Treatment

Treatment of permanent pools is necessary to control mosquitoes and undesirable aquatic vegetation that can create nuisances. Only EPA approved chemicals/materials can be used in areas that are warranted.* (*El Paso County uses a bacterial larvacide for mosquito control, Vectobac-G, or approved equal)

Frequency – As needed.

EDB- 3.7 Minor Maintenance Activities

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

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

MAINTENANCE ACTIVITY	MINIMUM FREQUENCY	LOOK FOR:	MAINTENANCE ACTION
Sediment Removal	As needed; typically every 1 –2 years	Sediment build-up; decrease in pond volume	Remove and dispose of sediment
Erosion Repair	As needed, based upon inspection	Rills/gullies forming on side slopes, trickle channel, other areas	Repair eroded areas Revegetate; address source of erosion
Vegetation Removal/Tree Thinning	As needed, based upon inspection	Large trees/wood vegetation in lower chamber of pond	Remove vegetation; restore grade and surface
Drain Cleaning/Jet Vac	As needed, based upon inspection	Sediment build-up /non draining system	Clean drains; Jet Vac if needed

EDB-3.7.1 Sediment Removal

Sediment removal is necessary to maintain the original design volume of the EDB and to ensure proper function of the infrastructure. Regular sediment removal (minor) from the forebay, inflow(s), and trickle channel can significantly reduce the frequency of major sediment removal activities (dredging) in the upper and lower stages. The minor sediment removal activities can typically be addressed with shovels and smaller equipment. Major sediment removal activities will require larger and more specialized equipment. The major sediment activities will also require surveying with an engineer’s level, and consultation with El Paso County Engineering Staff to ensure design volumes/grades are achieved.

Stormwater sediments removed from EDBs do not meet the criteria of “hazardous waste”. However, these sediments are contaminated with a wide array of organic and inorganic pollutants and handling must be done with care. Sediments from permanent pools must be carefully removed to minimize turbidity, further sedimentation, or other adverse water quality impacts. Sediments should be transported by motor vehicle only after they

are dewatered. All sediments must be taken to a landfill for proper disposal. Prompt and thorough cleanup is important should a spill occur during transportation.

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

EDB-3.7.2 Erosion Repair

The repair of eroded areas is necessary to ensure the proper function of the EDB, minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to trickle channels, energy dissipaters, and rilling to major gullies in the embankments and spillways. The repair of eroded areas may require the use of excavators, earthmoving equipment, riprap, concrete, erosion control blankets, and turf reinforcement mats. Major erosion repair to the pond embankments, spillways, and adjacent to structures will require consultation with El Paso County engineering staff.

Frequency – Nonroutine – As necessary based upon inspections.

EDB-3.7.3 Vegetation Removal/Tree Thinning

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

Frequency – Nonroutine – As necessary based upon inspections.

EDB-3.7.4 Clearing Drains/Jet-Vac

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

Frequency – Nonroutine – As necessary based upon inspections.

EDB-3.8 Major Maintenance Activities

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires consultation with El Paso County to ensure the proper maintenance is performed. This work requires that the engineering staff review the original design and construction drawings to assess the situation and assign the necessary maintenance. **A public improvements permit shall be required for all major maintenance activities.** This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants.

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

MAINTENANCE ACTIVITY	MINIMUM FREQUENCY	LOOK FOR:	MAINTENANCE ACTION
Major Sediment Removal	As needed – based upon scheduled inspections	Large quantities of sediment; reduced pond 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

EDB-3.8.1 Major Sediment Removal

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

Frequency – Nonroutine – Repair as needed based upon inspections.

EDB-3.8.2 Major Erosion Repair

Major erosion repair consist 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 – Nonroutine – Repair as needed based upon inspections.

EDB-3.8.3 Structural Repair

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

Frequency – Nonroutine – Repair as needed based upon inspections.

Appendix D - Inspection Form(s)

**EXTENDED DETENTION BASIN (EDB)
INSPECTION FORM**

Date: _____

Subdivision/Business Name: _____ Inspector: _____

Subdivision/Business Address: _____

Weather: _____

Date of Last Rainfall: _____ Amount: _____ Inches

Property Classification: Residential Multi Family Commercial Other: _____
(Circle One)

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

INSPECTION SCORING - For each facility inspection item, insert one of the following scores:
0 = No deficiencies identified 2 = Routine maintenance required
1 = Monitor (potential for future problem) 3 = Immediate repair necessary
N/A = Not applicable

FEATURES

1.) Inflow Points

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

2.) Forebay

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

3.) Trickle Channel (Low-flow)

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

4.) Bottom Stage (Micro-Pool)

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

5.) Outlet Works

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

6.) Emergency Spillway

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

7.) Upper Stage (Dry Storage)

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

8.) Miscellaneous

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

Inspection Summary / Additional Comments: _____

OVERALL FACILITY RATING (Circle One)

0 = No Deficiencies Identified 2 = Routine Maintenance Required
1 = Monitor (potential for future problem exists) 3 = Immediate Repair Necessary

This inspection form shall be kept indefinitely and made available to Arapahoe County upon request.

Appendix E - Maintenance Form(s)

**EXTENDED DETENTION BASIN (EDB)
MAINTENANCE FORM**

Subdivision/Business Name: Grazing Yak Solar Project Completion Date: _____
Subdivision/Business Address: 31275 Washington Road, Calhan, CO 80808 Contact Name: _____

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

MAINTENANCE ACTIVITIES PERFORMED

ROUTINE WORK

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

RESTORATION WORK

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

REHABILITATION WORK

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

ESTIMATED TOTAL MANHOURS: _____

EQUIPMENT/MATERIAL USED: _____

COMMENTS/ADDITIONAL INFO: _____

Appendix F - Annual Inspection and Maintenance Submittal form

Annual Inspection and Maintenance Reporting Form
for
Stormwater Facilities

(This form to be submitted to El Paso County prior to May 31 of each year)

Date: _____

**To: El Paso County Department of Public Works
3275 Akers Drive
Colorado Springs, CO 80922**

Re: Certification of Inspection and Maintenance; Submittal of forms

Property/Subdivision Name: _____

Property Address: _____

Contact Name: _____

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

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

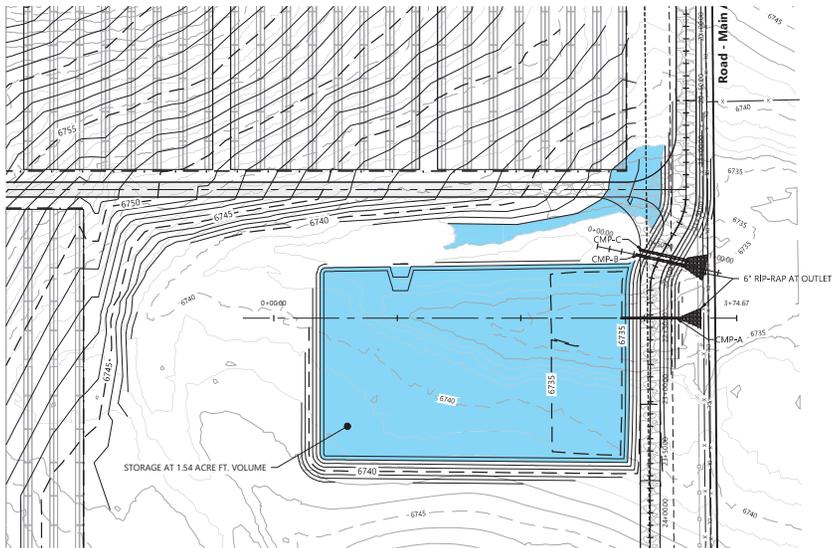
Name of Party Responsible for Inspection
& Maintenance

Property Owner

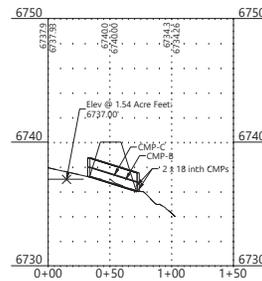
Authorized Signature

Signature

Appendix G - Stormwater Facilities Map; Facility plan and detail sheets

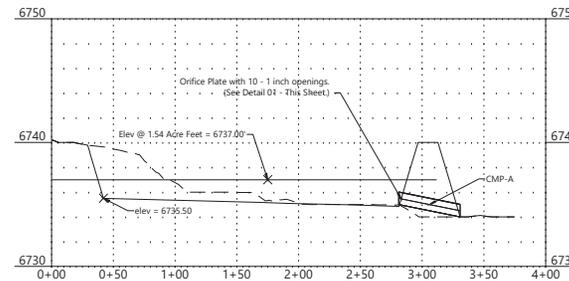


1 Permanent Setention Basin - Plan View
1" = 50'

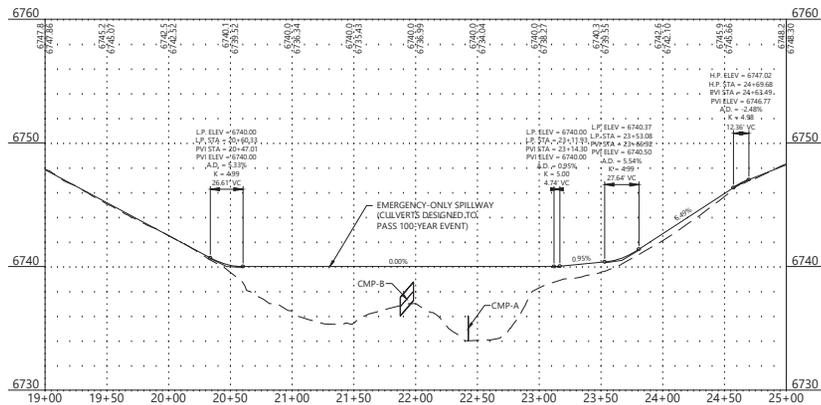


Pipe Table					
Pipe Name	Size	Length	Slope	Inv Up	Inv Down
CMP-A	12"	50'	2.01%	6735.00'	6734.00'
CMP-B	18"	40'	3.13%	6737.25'	6736.00'
CMP-C	18"	40'	3.12%	6737.25'	6736.00'

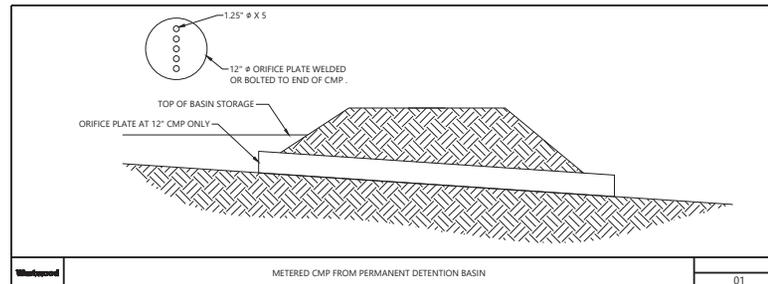
3 2 - 18" CMP - Main Access Rd.
1" = 50'



4 Section View of 12" CMP - Main Access Rd. & Basin
1" = 50'



2 Proposed Main access Rd at Permanent Detention Basin - Profile
1" = 50'



PREPARED FOR:



REVISION #	DATE	COMMENT
A	04/22/19	Permit Submittal Revisions



Grazing Yak Solar
El Paso County, Colorado

Detention Basin
Drainage Plan

Not For Construction

DATE: 04/22/2019

SHEET: DR.01