Stormwater Management Operation and Maintenance Manual

The purpose of this manual is to provide guidance and direction in the operations of outfall control structures and maintenance of stormwater management facilities located at the Georgia Ports Authority Garden City Terminal. This includes retention basins and natural vegetated areas, which provide temporary storage for and some treatment of stormwater runoff. This manual is intended to be in use of the facilities maintenance team for scheduling and performing inspections and non-routine maintenance. The manual features pictures, checklists, and forms from what is expected in the maintaining of efficient and healthy wetlands to lower the pollution entering the Savannah River. Monthly inspections with copies of the forms provided are expected to be filled out and turned into the Manager of Contracts & Facilities.
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General Information

The purpose for having wetlands on the terminal is to help pick up pollutants, such as heavy metals, gas, oil, nutrients, and sediment, along with controlling stormwater runoff. Uncontrolled storm water erodes stream banks, causes flooding, and carries nutrients and sediment downstream. An excess of nutrients contributes to the expansion of oxygen-depleted “dead zones” in the Savannah River, leading to dead fish and odor. Stormwater runoff is temporarily stored in these retention basins and is released at a controlled rate regulated by structures known as Outfall Control Structures (OCS). These outfall control structures have adjustable riser boards or riser gates that adjust the water elevation for vegetation support and heavy rainfall control. There are 8 control structures categorized by 3 sections shown in the map below with specific instructions of maintaining by location.
Maintenance Inspection Forms

The maintaining of the vegetation, water level, and control structures are essential to efficient and healthy wetlands. A qualified Individual on a monthly basis shall inspect all Storm Water management facilities and fill out the monthly inspection form in Appendix A. The form identifies the facility location, inspection criteria, person conducting the inspection, and the date and time the facility was inspected. Each form shall be reviewed and submitted to the Manager of Contracts & Facilities with a copy of each inspection form to be kept and provided to the Director of Engineering and Facilities Maintenance upon request.

The monthly inspection form consists of minor maintenance, the adjustments of water elevation listed in the section of Water Level Adjustments are to be followed and kept up with the use of Form 2 Routine Water Level Adjustments. 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.

The stormwater management facility specific inspection forms are located in Appendix A. There are 3 main stormwater facilities located by section A2 Ponds, CB-7 wetlands, and Gate 6 retention basin. Three separate inspection forms shall be written up on a monthly basis. If a stormwater management facility cannot be inspected, the inspector shall record an explanation of the circumstances on the form. A description of each part of the form follows:

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, significant erosion, or significant sediment accumulation. This score should be given to an item that can significantly impact the function of the facility.

Additional Comments:

Attached behind the inspection form is a form with room for recording the condition of vegetation, slopes, structures, obstructions, pipes, and recommended Maintenance. Comments on each section is not required if the score for the given criteria is a 0.
Maintenance Procedures

Storm water Management Facility Maintenance Programs are separated into three categories of work. 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 regularly scheduled mowing, riser board adjustments, and trash pickup. This includes items such as the removal of debris/material that may be clogging the outlet structures. It also includes activities such as weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year. Completed inspection and maintenance forms shall be submitted to the Manager of Contracts & Facilities for each inspection and maintenance period.

**Minor Work**

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 and include sediment/vegetation removal. These items require prior correspondence with the Manager of Contracts & Facilities and require completed inspection and maintenance forms which will be submitted to the Manager of Contracts & Facilities for each inspection and maintenance period.

**Major Work**

This work consists of larger maintenance/operational problems and failures within the storm water management facilities. Most of this work requires consultation with Director of Engineering and Facilities Maintenance to ensure the proper maintenance is performed. Some of this work requires that the engineering staff review the original design and construction drawings to access 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.
### Summary of Routine Maintenance Activities

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mowing</td>
<td>Monthly</td>
<td>Excessive grass height</td>
<td>Mow excessive grass</td>
</tr>
<tr>
<td>Weed Control</td>
<td></td>
<td>Noxious weeds, and unwanted vegetation</td>
<td>Hand pull weeds out</td>
</tr>
<tr>
<td>Mosquito Treatment</td>
<td>As needed</td>
<td>Standing water/Mosquito habitat</td>
<td>Treat w/ EPA approved chemicals</td>
</tr>
<tr>
<td>Algae Treatment</td>
<td>As needed</td>
<td>Standing Water/ Algal growth/ green color</td>
<td>Remove algae</td>
</tr>
<tr>
<td>Control Structure Cleaning</td>
<td>As needed – after significant rain events</td>
<td>Clogged outlet structure, ponding water</td>
<td>Remove and dispose of debris/trash/sediment to allow proper flow</td>
</tr>
</tbody>
</table>

### Summary of Major Maintenance Activities

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Erosion Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Large quantities of sediment; reduced pond capacity</td>
<td>Remove and dispose of sediment. Repair vegetation as needed</td>
</tr>
<tr>
<td>Structural Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Deterioration or damage to structural components</td>
<td>Structural repair to restore the structure to its original design</td>
</tr>
</tbody>
</table>
### Summary of Minor Maintenance Activities

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment Removal</td>
<td>Every 1-2 years</td>
<td>Sediment build-up; decrease in pond volume</td>
<td>Remove and dispose of sediment</td>
</tr>
<tr>
<td>Erosion Repair</td>
<td>As needed, based upon inspection</td>
<td>Rilling/gullying of side slopes, trickle channel, other areas</td>
<td>Repair eroded areas</td>
</tr>
<tr>
<td>Vegetation Removal</td>
<td>As needed based upon inspection</td>
<td>Large trees/wood vegetation in lower chamber pond</td>
<td>Remove vegetation; restore grade and surface</td>
</tr>
</tbody>
</table>
Area A2 Ponds:

The water surface elevations in Ponds 1-3 can be adjusted at OCS-1 by the addition to or removal of boards from the channels mounted on each structure. During periods in which the elevation is to be raised, planks shall be added until the top of the uppermost plank is at the desired water surface elevation. To affect an elevation increase, it will be necessary to install planks across all three openings at both control structures. Water surface decreases can be accomplished by removing planks from only one opening at one structure.

The minimum pool elevation is 1.0 Mean Sea Level (MSL) which is the elevation when all the boards are removed. This is the primary wet weather static water elevation, which maximizes the storage potential of the ponds for runoff attenuation and runoff treatment. This elevation should be in place from June to November along with times of predicted heavy rainfall. If the static pool is elevated at the time an event like this happens, then all of the riser boards should be removed as soon as possible. During the months of November – May, the water elevation should be raised to 2.0 (MSL), which is established with one 2x6 board placed on all sides.

On a quarterly basis, the wetland shelves should be inundated to water surface elevation 2.0 for a 48-hour period, provided that the water surface is not already elevated. Form 3 Non-Routine Water elevations in the appendix shall be completed by the maintenance and provided to the Manager of Contracts & Facilities.
The CB-7 wetlands are controlled by the three control structures, OCS-3, OCS-4, and OCS-5. OCS-3 is an above ground concrete vault with fixed weirs on four sides of the structure. The weirs are set at elevation 11.50 and diverts a portion of stormwater runoff from CB-8 into the CB-7 wetlands via the CB-7 Diversion channel. The slide gate of OCS-3 (as shown in picture to the side) is to be kept closed under normal operating conditions. When a rainfall event of 4 inches or more is anticipated, the slide gate should be opened to a 3-4 inch gap. The gate should be closed after the storm to keep the water level of the wetlands at the required elevation.

OCS-4 is an above ground concrete vault with two adjustable weirs on three sides of the structure. This structure is shown in the two pictures below. The weir height is adjustable by timber planks. The minimum weir elevation is 9.5 with all boards removed, and a maximum elevation of 11.0 when 3 boards per weir section are placed. This structure should be kept at elevation at 11.0 at all times with markings on the structure as noted in the picture below. This elevation detains approximately 1.5 feet of water within the CB-7 wetland while allowing a 6-inch deep flow over the weirs.
Gate 6 Retention Basin

Outside of Gate 6, there are two outfall structures that help discharge water into the Pipermaker’s canal. OCS-6 and OCS-7 are above ground concrete vault with fixed weirs on two sides of the structure and an adjustable weir on a third side. The fixed weirs are set at Elevation 9.84 MSL. The adjustable weir is one foot wide and has a bottom Elevation of 7.84 MSL and maximum elevation of 9.84 MSL. A half circle oil and trash guard is mounted to the wall of the adjustable weir.

The slide gates of the OCS-6 and OCS-7 are to be kept nearly closed (3-4 inch gap) under normal conditions as marked in picture to the side. The purpose of the partially opened slide gate is to drain off water from the basin once the storm event has passed. It can accommodate a rainfall event of about 9 inches, but with rainfall anticipated to be greater than this, the slide gate should be fully opened.
Water Level Adjustments

Storm water management basins help prevent overflow with heavy rainfall, and also support vegetation that help filter out the water. In the diagram below lists the different elevations. The minimum pool is the elevation when all the riser boards are removed. The toe elevation is the elevation required for support of the submerged plants and the top elevation being the level where water is needed to support emergent plants. The elevation of all the boards in is the maximum elevation reached when all the boards are placed that the structure is meant to support. The pond extends higher for emergency overflow during a heavy rainfall in case all the boards are accidently left in.
Riser Board Adjustments

On a quarterly basis, the adjusting of water depth will follow the schedule below. Changes are necessary because of heavier rain seasons in summer, while keeping the vegetation correctly watered. Having the boards too low won’t supply enough water to the emergent plants, but if the water level is too high, there will be overflow during a heavy rainstorm.

<table>
<thead>
<tr>
<th>Drainage Structure no.</th>
<th>Location</th>
<th>Type of adjuster</th>
<th>Frequency of adjustment</th>
<th>Normal Operating Condition</th>
<th>During Storms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OCS-1</td>
<td>Board</td>
<td>Twice a year</td>
<td>0-1 boards</td>
<td>Boards removed</td>
</tr>
<tr>
<td>2</td>
<td>OCS-2</td>
<td>Board</td>
<td>Never</td>
<td>Not needed</td>
<td>Not needed</td>
</tr>
<tr>
<td>3</td>
<td>OCS-3</td>
<td>Gate</td>
<td>Storms</td>
<td>Closed</td>
<td>3-4 inch gap</td>
</tr>
<tr>
<td>4</td>
<td>OCS-4</td>
<td>Board</td>
<td>Never</td>
<td>3 boards</td>
<td>3 boards</td>
</tr>
<tr>
<td>6</td>
<td>OCS-6</td>
<td>Gate</td>
<td>Storms</td>
<td>3-4 Inch gap</td>
<td>Open</td>
</tr>
<tr>
<td>7</td>
<td>OCS-7</td>
<td>Gate</td>
<td>Storms</td>
<td>3-4 Inch gap</td>
<td>Open</td>
</tr>
</tbody>
</table>
### Monthly Inspection Form

<table>
<thead>
<tr>
<th>Location:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reason for Inspection:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Signature:</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Circle one of the following options</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
<th>Type</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the facility show signs of settling, cracking, bulging, misalignment, or other structural deterioration?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Major</td>
<td></td>
</tr>
<tr>
<td>Do inlet/outlet structures show signs of excessive erosion or slumping?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Major</td>
<td></td>
</tr>
<tr>
<td>Is the outlet pipe damaged or otherwise not functioning properly?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Major</td>
<td></td>
</tr>
<tr>
<td>Are there discolorations, cracks, or displacement of concrete in structures?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Major</td>
<td></td>
</tr>
<tr>
<td>Are the adjustable riser boards warped, skewed, or missing?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Are the adjustable boards in the right location for given month?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Routine</td>
<td></td>
</tr>
<tr>
<td>Do grassed areas require mowing?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Routine</td>
<td></td>
</tr>
<tr>
<td>Is there an accumulation of floating debris and/or trash?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Routine</td>
<td></td>
</tr>
<tr>
<td>Is there evidence of oil, grease, or other automotive fluids entering and clogging the facility?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Is there dead vegetation that needs to be removed?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Routine</td>
<td></td>
</tr>
<tr>
<td>Any non-routine Maintenance that is required?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Is sediment removal required?</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>Minor</td>
<td></td>
</tr>
</tbody>
</table>
Monthly Inspection Form Comments

I. Plants:

a. Vegetation
   Give an overall assessment of the vegetation on the banks, berms and shoulders/shelves. This shall include overall health, color, moisture conditions and coverage/invasive vegetation.

____________________________________________________________________________________________________
____________________________________________________________________________________________________
____________________________________________________________________________________________________
____________________________________________________________________________________________________

b. Maintenance Status

   Record maintenance measures, such as mowing, spraying, pruning which have occurred since last inspection. Note maintenance measures, which are needed.

____________________________________________________________________________________________________
____________________________________________________________________________________________________
____________________________________________________________________________________________________
____________________________________________________________________________________________________

   c. Dead Vegetation

   Provide location (ex., Pond 1, west bank, middle) of grass or other plantings which show signs of distress or are dead.

____________________________________________________________________________________________________
____________________________________________________________________________________________________
____________________________________________________________________________________________________
____________________________________________________________________________________________________
____________________________________________________________________________________________________
II. Slopes

a. Discuss general condition of slopes, shoulders and banks. List locations of eroding and/or failing slopes and affix photographs of each location.

____________________________________________________________________________________________________

____________________________________________________________________________________________________

____________________________________________________________________________________________________

III. Storm Drainage Structures

a. Visual Inspection of Outfalls and Headwalls

Note new cracks, discolorations and displacements of concrete or structure. Note erosion behind or around walls.

____________________________________________________________________________________________________

____________________________________________________________________________________________________

____________________________________________________________________________________________________

b. Obstructions

Visually examine each structure and note the presence of any sediment build-up, debris, or other obstructions to flow. Affix photos of obstructions.

____________________________________________________________________________________________________

____________________________________________________________________________________________________

____________________________________________________________________________________________________

____________________________________________________________________________________________________

c. Riser Boards
Visually examine the height of riser boards with seasonal updates listed in form 5. Note any cracked, broken, or missing riser boards, and wrong positioning, which may lead to stagnant water and algal blooms.

____________________________________________________________________________________________________

____________________________________________________________________________________________________

____________________________________________________________________________________________________

IV. Storm Drain Pipes

a. Examine visible portions of pipes. Note any separations, cracks, or displacements. Note any visible sediment buildup in pipes.

____________________________________________________________________________________________________

____________________________________________________________________________________________________

____________________________________________________________________________________________________

V. Recommended Maintenance

a. Provide Notations and recommendations for non-routine maintenance, such as debris removal, or routine maintenance (such as mowing or erosion repair) which needs to be advanced to address noted problems

____________________________________________________________________________________________________

____________________________________________________________________________________________________

____________________________________________________________________________________________________

Completed by                                                                                                           Date
Form 2: Routine Water Surface Adjustments

Quarter:_________ Year:________________________

Stormwater Facility Location: ________________________________

Date weir riser boards installed: ___________________________

Date water surface reached top of boards: ___________________

Date riser boards removed: ________________________________

Date base elevation reestablished: __________________________

______________________________________________________________________

Completed by ________________ Date ________________
Form 3: Non- Routine Water Surface Adjustment

Quarter:_________  Year:________________________

Stormwater Facility Location: ______________________________

Date weir riser boards installed: ___________________________

Date water surface elevation raised to 2.0: ___________________________

Date riser boards removed*: ___________________________

Date water surface elevation returns to 1.0 ___________________________

Date base elevation reestablished: ___________________________

*Maximum of 5 days after 2.0 initially reached

____________________________________________________________________    _____________
Completed by                                                                                          Date
Form 4: Sedimentation Check

Date of sedimentation check:

<table>
<thead>
<tr>
<th></th>
<th>Pond 1</th>
<th>Pond 2</th>
<th>Pond 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pond water surface elevation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth, surface to bottom, channel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth, surface to bottom, pond</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

List areas where depth is reduced by 6” in channel areas and 12” in pond areas, based on design bottom elevations of (-1) 1 MSL in channel and (-4) MSL in pond

_________________________________________________________________________________________________________

_________________________________________________________________________________________________________

_________________________________________________________________________________________________________

_________________________________________________________________________________________________________

Areas noted above should be planned for sediment removal

____________________________________________________  _____________

Completed by                                                                                                         Date
Plant Maintenance

Algae Removal

Filamentous algae are colonies of microscopic plants that link together to form threads or mesh-like filaments. These plants normally grow on the surface of hard objects or other substrates under the water. Filamentous algae can cause problems such as clogs and stagnancy. It is not uncommon for stormwater ponds to develop large floating mats of algae during the warm months of the year. Ponds that have algae covering more than 20% of the surface are more likely to develop stagnancy, and noxious odors, so it is recommended that filamentous algae be controlled to prevent it from covering more than 20% of the pond surface. Manual harvesting and raking can provide immediate short-term control along with herbicides that are labeled for control of algae in ponds.

Planktonic algae are microscopic plants that live in every drop of pond water. Because stormwater ponds collect water flowing from the terminal and roads, they often grow an abundance of algae. An abundance of planktonic algae is aesthetically non-beneficial, especially with visible ponds in area A2 and can be removed manually.
**Fertilizing**

Grassed areas shall be fertilized twice per year, once in March and once in September, with 10-10-10 fertilizer applied at a rate of 5 pounds per 1,000 square feet. The fertilizer shall be any commercially available mixture providing 10% each of nitrogen, phosphorus and potash. This concentration will be sufficient to ensure plant health while limiting negative impacts should some enter into the pond waters. Higher concentrations of fertilizers or nitrogen shall not be used due to potential impacts on plants and the hydrologic regime. Grassed areas shall also be sprayed every April with a weed killer, which will not harm the established grass. The herbicide shall be a 2, 4-D or an approved equivalent. This product provided very good broadleaf weed coverage while protecting most grasses. The weed killer shall be applied in accord with the manufactures’ instructions. The application by sprayer should occur in dry conditions and when rainfall is not expected with 12 hours. The spray is absorbed into the plants, so there is little opportunity for runoff into water bodies. Spray rates should be set as to not produce runoff. Also the spray should not be applied directly to surface waters.

**Sediment Measurement and Removal**

Some buildup of sediment in the ponds is to be expected, and is acceptable. Sediment build-up which occurs at the entrance to pipes and which is noted by visual inspection should be removed by shovel. Sediment build-up in the open water areas also requires consideration. The design bottom elevation in the open water areas is (-)1.0 MSL in the channel areas (depth 2’ from normal pool) and (-)4.0 MSL in the pond areas (depth 5’ from normal pool). The depth to sediment should be checked in each pond every 6 months by use of a graduated rod to determine the depth from the pool elevation. For planning purposes, the inspections should be expected to occur elevation. The check shall be accomplished by lowering the bottom of the graduated rod until contact with the bottom or built-up sediment is felt, and then reading the amount of separation from the rod.

Whenever the depth is reduced by 6” in the channel areas and 12” in the pond areas, the sediment should be removed by shovel (after dewatering) or by small floating dredge until the design depths are reestablished. All sediment removed shall be captured and disposed of off-site. Form 24 shall be completed for each sedimentation inspection. The form will be completed by the regular maintenance inspector and will be submitted to the Director of Engineering, with a second copy being placed in the project file or record.
**Invasive weeds**

No amount of the vegetation below should be considered acceptable due to the nature of rapid growth and spread which wipes out desirable vegetation.