INSPECTING AND MAINTAINING OUTLET STRUCTURES

TECHNICAL GUIDANCE DOCUMENT

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INTRODUCTION

The routine inspection and maintenance of wetland outlet structures is an important long-term need for most wetland restoration and creation projects. Inspections that are done on a regular basis can help keep structures functioning to their intended purpose and can identify actual or potential problems before they become more serious and costly to correct.

APPLICATION

Structural items such as wetland outlets, ditch plugs, and embankments are often integral components of wetland restoration and creation projects. Routine inspection and maintenance of these items is often essential to their function. The inspection and maintenance needs of these items vary depending on scope of project and purpose of the constructed component. Some maintenance activities may be critically important for some structures but may be less important for other similar structures. Minor maintenance needs can quickly become major and costly maintenance problems if they are left untreated. Over time some of these components may also require repair or replacement.

For most projects, the identification of inspection and maintenance needs will be an important final step in the implementation process. An inspection and maintenance plan should have been prepared that is tailored to fit the site and its specific structural components. The plan should have included enough detail to identify all of the maintenance activities that are likely to be needed and should specify how and when to accomplish them. The plan should have been prepared and reviewed with the owner of the property to ensure a full understanding of the inspection and maintenance needs. Additional discussion of inspection and maintenance plans occurs in Section 6-3, Site Management and Monitoring, Monitoring – Routine Site Inspections.

Inspection Schedule

The schedule for which wetland restoration or creation structural components need to be inspected can vary and will dependent on the type of structure, time of year, or frequency and magnitude of runoff events. Generally, inspections of structural components should be scheduled and performed in early spring, late spring, late summer, and late fall. For many projects, additional inspections will be needed after a significant rainfall or runoff event to ensure all outlets are functioning properly and are not plugged or blocked.

Any problems that are identified should be reported to the project manager or other appropriate person responsible for oversight of the project. Refer to Section 6-3, Site Management and Monitoring, Monitoring – Routine Site Inspections for additional information on inspection schedules.

Embankments and Other Earthen Structures

The purpose of most earthen structures will be to retain wetland hydrology or to protect an adjoining property or infrastructure from negative hydrologic impacts. There are many items that can compromise the integrity and function of earthen structures for which routine inspections will be needed and remedial actions taken, when necessary. These items include but may not be limited to:

- Failed planting or poor vegetation establishment on the embankment structure
- The growth or presence of trees or other woody vegetation growing on the embankment structure t
- Erosion of the embankment slope due to excessive wave action
- Tunnels, burrows an dens in embankments caused by muskrats, beaver, and other animals
- Cracking or sloughing of embankment fills
- Embankment seepage
- Wheel ruts or other damage to the embankment surface from excessive or untimely vehicle or animal use

The establishment of a good stand of dense grass will be important for most embankments. This will help protect them from erosion due to rainfall and wave action and will help maintain soil structure and limit the extent of surface cracking that might occur during dry periods. Reseeding may be necessary if the initial vegetation establishment failed in whole or just in certain areas. Sparse areas of vegetation should be inter-seeded or re-seeded to reestablish the proper cover. Nitrogen only fertilizer can be applied periodically to encourage healthy vegetative cover.

Over time, trees and other woody vegetation often appear on earthen embankments. The root system of trees and other woody plants will often penetrate the full breadth of the embankment. These root systems can provide for a network of small tunnels for which water can travel potentially causing issues with undesired embankment seepage and potential failure. This is especially true when trees that are left to grow on an embankment either die or are removed as their root systems will eventually decay leaving even larger opening and tunnels in the embankment fill. It is therefore important to regularly remove all trees and woody vegetation from embankments before they and their root systems can become established. Pulling, cutting, clipping and herbicide can all be used to control undesirable vegetation growing on the embankment. Chemical treatment of stumps may be needed to control sprouting.

Where embankments are associated with larger, deeper wetland systems, the potential for damage due to wave action does exist. Generally, through a well thought out design and construction process a broad embankment with fairly flat front slopes will have been constructed and a good stand of embankment vegetation will have been allowed to be established both on the embankment and in the wetland before wetland hydrology was fully restored or introduced. While this scenario is ideal and will usually limit the extent of potential erosion due to wave action, it is often not achievable. Usually, wetland hydrology is restored well before the vegetation on the site becomes fully established and erosion of unprotected embankment slopes from wave action often occurs. Fortunately, wave damage is usually only a temporary issue and will not compromise the integrity of the embankment as long as vegetation is adequately established in a reasonable timeframe. In some situations however, excessive erosion from wave action will

occur and remedial actions for protection will be needed. These can include the use of rock riprap or other engineered product along the face of the embankment or the construction of a wave berm or flatter embankment front slope. Where excessive damage has already occurred, wetland water levels may need to be lowered to allow repair and reseeding. Additional discuss on strategies to address wave action occurs in Section 4-5, Design and Construction, Earthen Embankments – Other Design Considerations.

Muskrats and beavers are burrowing animals and they will tunnel and create dens within constructed embankments or other shoreline areas if given the opportunity. Earthen embankments are particularly attractive for den habitat due to their heights and relatively steep front slopes in comparison to other shoreline areas. For new projects, constructed earthen embankments may provide the only opportunity for den habitat as emergent vegetation to construct houses or lodges with is yet to establish. Tunnels and dens that are dug within embankments can cause surface collapse, possible piping and eventually can lead to embankment failure. Burrows and dens that are observed must be filled in and compacted as soon as they are noticed. Additional discuss on strategies to address embankment damage from muskrats, beaver and other burrowing animals occurs in Section 4-5, Design and Construction, Earthen Embankments – Other Design Considerations

Embankment seepage primarily occurs when soil permeabilities are high or when poor construction practices and methods and have left void spaces, cracks, poorly compacted soils, or stratified horizontal layers in the fill section. Seepage also occurs under embankments when foundation soils are improperly stripped or treated as part of construction. Excessive seepage can affect the wetland's ability to retain adequate hydrology and usually results in the development of wet areas along the downstream toe of the embankment. In more extreme situations, seepage can physically remove and internally erode soil particles from the embankment, create problems with slope stability, reduce soil shear strengths. Embankments constructed with organic soils and peats will be subject to much higher seepage rates than with other more suitable embankment materials, especially if tension cracks within the embankment fill have developed. These tension cracks can become deep and interconnected, increasing the risk and problems associated with embankment seepage. Uncontrolled seepage can, over time, erode the embankment materials, leading to embankment failure. Keeping embankments well vegetated will help with moisture retention in the soil material. Problems can develop, however, during prolonged dry spells or drawdown of wetland water levels. The methods or strategies to address issues with embankment seepage are limited and difficult to determine. Should issues with embankment seepage be observed, it is recommended that a professional engineer or other qualified individual be consulted for advice. Additional discussion on this topic occurs in Section 4-5, Design and Construction, Earthen Embankments – Other Design Considerations.

Outlet Structures

Outlet structures are an important part of many wetland restoration and creation projects. It is important that outlet structures be kept clear of debris, ensuring that they function as intended. There are several items that can compromise the integrity and function of an outlet structure for which routine inspections will be needed and remedial actions taken, when necessary. These items include but may not be limited to:

- Sediment, vegetation, and other debris blocking the entrance or outlet of the structure
- Blockage due to animal activity
- Cracks or other performance issues
- Displacement of rock riprap and other materials
- Damage due to vandalism

All structures, especially pipes and tile outlets will be subject to blockage from floating vegetation, debris, and sediment. These materials should be removed to allow the structure to function as intended. Skimmer fences and trash guards that were installed to protect the structure from these blockages should be routinely inspected, cleaned, and maintained as needed. Where no such devices exist, they should be considered if the structure continually gets blocked or plugged and needs frequent cleaning.

Structure blockages may also be caused animals such as beaver and muskrat. Preventing animals from plugging or blocking outlets can be difficult although certain types of outlets are more effective than others at deterring animal activity than others. Regardless of the type of outlet, regular inspection and maintenance will be necessary where beaver are present Pipes that are blocked are the most difficult to be cleaned. If the pipe is of large enough diameter that allows access and work inside the pipe, it can be completely plugged and very challenging to clear of debris. The key to keeping animals from doing any damaging work is to deny their access to the outlet or to design an outlet that prevents an animal's detection of the outlflows. Additional discuss on strategies to address plugging and blocking of outlets by nuisance animals occurs in Section 4-4, Design and Construction, Spillways and Outlet Structures – Other Design Considerations

All outlet structures should occasional be inspected for physical damage. Metal structures will be susceptible to deterioration from corrosion or damaged finished surfaces. Polyethylene plastic or fiberglass material could be susceptible from the sun's ultraviolet rays or fire if not properly protected. Structures made from plastic, fiberglass or concrete can crack and break and pipes joints can separate. When issues are identified, depending on the type of structure or magnitude of the problem, repairs or replacement will likely be needed.

In addition, soils around the inlets and outlets of pipes and other types of structure need to be inspected for holes, water movement, settlement and erosion. Water seepage along structures, especially pipes is a serious problem that needs immediate attention when found. It can occur from improper design, poor construction, deteriorating material or animal borrowing activity. Experience personnel should be consulted for advice on remedial action when seepage along a pipe or other structure is identified. Immediate action can help minimize the extent of the repair work that may be needed.

In some designs, rock rip rap or other manufactured products are used to control soil erosion and take the place of traditional vegetative cover. Undesirable vegetation such as trees should be prevented from establishing in the rock areas. Displacement of rock can occur, especially during high flows and over time normal wear on the rock does occur. If weathered or displaced rock riprap is identified it should be replaced to its original construction grade.

OTHER CONSIDERATIONS

The inspection and maintenance needs for each structure varies depending on scope of project and purpose of the constructed component. It will be important for each structural component, to have a full understanding of its scope and the importance for the inspection and maintenance activities. It will also be important to have a sense of understanding of potential problems and issues that may be observed and which of those are more critical for addressing. It will also be important to understand which issues may require the services of other resource professionals to help determine the best means of correction.

COSTS

The cost for performing maintenance and repair work can vary depending on the issue. Most items will likely be relatively minor in cost however, if left uncorrected can lead to more expensive repair costs later.

ADDITIONAL REFERENCES

Section 4-4, Design and Construction, Spillways and Outlet Structures – Other Design Considerations

Section 4-5, Design and Construction, Earthen Embankments – Other Design Considerations.

Section 6-3, Site Management and Monitoring, Monitoring – Routine Site Inspections