

# Stormwater Management Ponds

## Township of Uxbridge

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# Overview

- Introduction to stormwater management
- Function of stormwater management ponds
- Maintenance requirements



# Stormwater Management

Mitigate effects of urbanization on surface water:

- Provide water quality and quantity control
- Protect water quality and aquatic habitat
- Prevent increased flooding and erosion





# Stormwater Management

Why?

- Protect water resources for human use
- Maintain diversity of aquatic life
- Avoid potential loss of property and human life



# Types of Stormwater Management Practices:

- Lot Level Controls
- Conveyance Controls
- End of Pipe Controls



# Stormwater Management Examples:

## Lot Level Controls:

- Street sweeping and catch basin cleaning
- Rainwater harvesting
- Public education

## Conveyance Controls:

- Perforated stormsewers
- Permeable pavement
- Infiltration trenches
- Bioretention facilities
- Vegetated swales



# Stormwater Management Examples:

## End of Pipe Controls:

- Infiltration basins
- Disinfection/grit chambers
- **Wet ponds**
- Dry ponds
- Constructed Wetlands
- Oil/grit separators





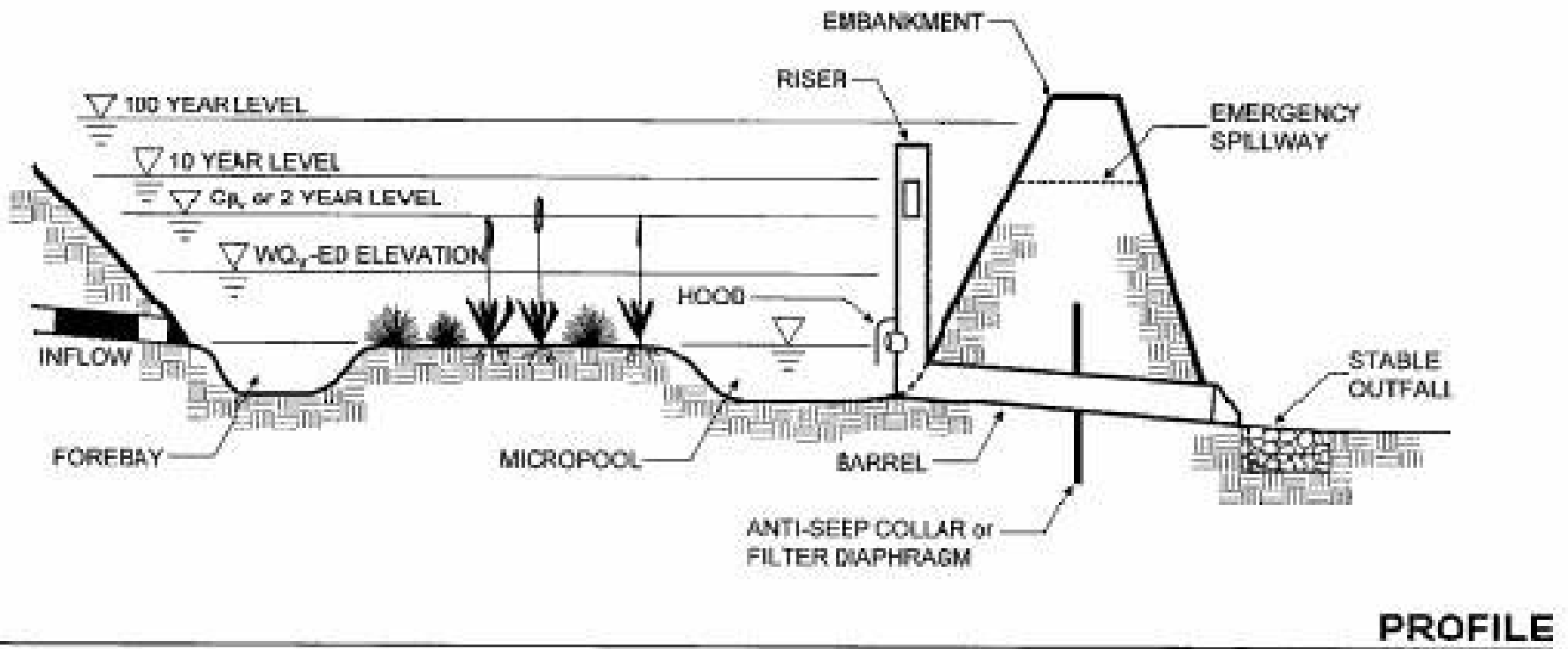
# Stormwater Management: Wet Ponds

- Water quality / quantity and erosion control
- Most type of common end of pipe stormwater management facility in Ontario
- Allows for settling of particles and uptake of nutrients by aquatic vegetation





# Stormwater Management: Wet Ponds



Example profile view of a wet pond design

Ref: U.S.EPA - Stormwater Management

# Stormwater Management: Wet Ponds

## Wet Pond Design Guidelines (MOE, 2003)

Table 4.6: Wet Ponds – Summary of Design Guidance

Design Element	Design Objective	Minimum Criteria	Preferred Criteria
Drainage Area	Volumetric turnover	5 hectares	≥ 10 hectares
Treatment Volume	Provision of appropriate Level of protection (see Section 3.3.1.1)	As per Table 3.2	1. Permanent Pool volume increased by expected maximum ice volume  2. Active Storage increased from 40 m <sup>3</sup> /ha to 25% of total volume
Active Storage Detention	Suspended Solids Settling	24 hrs (12 hrs if in conflict with minimum orifice size)	24 hrs
Forebay	Pre-treatment	Minimum Depth: 1 m  Sized to ensure non-erosive velocities leaving forebay  Maximum Area: 33% of total Permanent Pool	Minimum Depth: 1.5 m  Maximum Volume: 20% of total Permanent Pool
Length-to-Width Ratio	Maximize flow path and minimize short-circuiting potential	Overall: minimum 3:1 (may be accomplished by berms, etc.)  Forebay: minimum 2:1	From 4:1 to 5:1
Permanent Pool Depth	Minimize re-suspension, avoid anoxic conditions	Maximum Depth: 3 m  Mean Depth: 1 m - 2 m	Maximum Depth: 2.5 m  Mean Depth: 1 m - 2 m
Active Storage Depth	Storage/Flow Control	Water Quality and Erosion Control: maximum 1.5 m  Total (including quantity control): 2 m	Water Quality and Erosion Control: maximum 1.0 m  Total (including quantity control): 2 m
Side slopes	Safety  Maximize the functionality of the pond	5:1 for 3 m on either side of the permanent pool  Maximum 3:1 elsewhere	7:1 near normal water level plus use of 0.3 m steps  4:1 elsewhere

# Stormwater Management: Wet Ponds

## Wet Pond Design Guidelines (MOE, 2003)

Table 4.6: Wet Ponds – Summary of Design Guidance (cont'd)

Design Element	Design Objective	Minimum Criteria	Preferred Criteria
Inlet	Avoid clogging/ freezing	Minimum: 450 mm  Preferred pipe slope: > 1%  If submerged, obvert 150 mm below expected maximum ice depth	
Outlet	Avoid clogging/ freezing	Minimum: 450 mm outlet pipe  Reverse sloped pipe should have a minimum diameter of 150 mm  Preferred pipe slope: > 1%  If orifice control used, 75 mm diameter minimum	Minimum 100 mm orifice
Maintenance Access	Access for backhoes or dredging equipment	Provided to approval of Municipality	Provision of maintenance drawdown pipe
Sediment Drying Area	Sediment removal	While preferable, should only be incorporated into the design when it imposes no additional land requirement	To be provided above maximum water quality water level  Drainage returned to Pond
Buffer	Safety	Minimum 7.5 m above maximum water quality/erosion control water level  Minimum 3 m above high water level for quantity control	

# Stormwater Management: Wet Ponds

Maintenance Activities are required to avoid SWMP failures and /or poor performance (MOE, 2003)

Table 6.1: Stormwater Management Practices Operation and Maintenance Activities

Item No.	Operation or Maintenance Activity	Type of Stormwater Management Practice											
		Wet Pond	Wetland	Dry Pond	Infiltration Basin	Infiltration Trench	Filter Strip	Superpipe Storage	Filters	Oil/Grit Separator	Soakaway Pit	Pervious Pipe	Grassed Swales
1	Inspection	■	■	■	■	■	■	■	■	■	■	■	■
2	Grass cutting	□	□	■	■	■			■				■
3	Weed Control	■	■	■	■		■		□				■
4	Upland vegetation replanting	□	□	□	□	□	□		□				
5	Shoreline Fringe and Flood Fringe vegetation replanting	□	□										
6	Aquatic vegetation replanting	□	□										
7	Removal of accumulated sediments	■	■	■	■	■	■		■	■		■**	■
8	Outlet valve adjustment	□	□	□									
9	Roof leader filter cleaning/replacement										■		
10	Pervious pipe flushing											■	
11	Oil/Grit separator or Catchbasin cleaning									■		■	
12	Closing of infiltration facility inlet for winter months				■g	■g			■g			■g	
13	Trash removal	■	■	■	■	■	■	■	■	■*	■***	■	■
14	Infiltration basin floor tilling				■								

■ Normally Required

□ May be Required

\* Litter removal part of sediment removal.

\*\* Sediment removal part of catchbasin cleaning.

\*\*\* Litter removal by a filter in the rain gutter.

gBased on municipality experience and practices (e.g., may not be required if used on a local road with no salting or sanding).



# Stormwater Management: Wet Ponds

## Typical Maintenance Activities:

- Inspection
- Weed Control
- Vegetation Replanting (Upland, Shoreline & Flood Fringe, and Aquatic)
- Removal of Accumulated Sediments
- Outlet Valve Adjustment
- Trash Removal



# Stormwater Management: Wet Ponds

## Maintenance Activity - Grass Cutting

- Grass cutting is recommended to be very limited or eliminated around SWM facilities
- Allowing grass to grow tends to enhance water quality and provide other benefits for wet facilities
- Allowing grass to grow is an effective means of discouraging nuisance species such as geese
- Grass around wet facilities should not be cut to the edge of the permanent pool



# Stormwater Management: Wet Ponds

## Potential Inspection Routine Questions for SWMPs (MOE, 2003)

Table 6.2: Potential Inspection Routine Questions for SWMPs

SWMP	Inspection Routine
Wet Ponds Wetlands	<ol style="list-style-type: none"> <li>1. Is the <b>pond level higher</b> than the normal permanent pool elevation &gt; 24 hours after a storm (or other design detention time)? (This could indicate blockage of the outlet by trash or sediment. Visually inspect the outlet structure for debris or blockage.)</li> <li>2. Is the <b>pond level lower</b> than the normal permanent pool elevation? (This could indicate a blockage of the inlet. Visually inspect the inlet structure for debris or blockage.)</li> <li>3. Is the <b>vegetation</b> around the pond unhealthy or dying? (This could indicate a poor selection of species. If occurs chronically further analysis should be conducted to identify the cause.) Is the pond all open water (no bulrushes or vegetation in the water)? Are there areas around the pond with easy access to open water? (This will indicate a need for replanting the pond)</li> <li>4. Is there an <b>oily sheen</b> on the water near the inlet or outlet? Is the water frothy? Is there an unusual colouring to the water? (This may indicate the occurrence of an oil or industrial spill and the need for cleanup.)</li> <li>5. Check the <b>sediment depth in pond.</b> (This will indicate the need for sediment removal. The sediment depth can be checked using a graduated pole with a flat plate attached to the bottom. A marker (pole, buoy) should be placed in the pond to indicate the spot(s) where a measurement should be made. A visual inspection on the pond depth can also be made if the pond is shallow and a graduated marker is located in the pond.)</li> </ol>

# Stormwater Management Facility Assessment



Stantec conducted an assessment of twenty two (22) stormwater management (SWM) facilities within the Township of Uxbridge in 2012 to assist the Township in prioritizing maintenance activities.





# Stormwater Management Facility Assessment

## Stormwater Management (SWM) Pond Assessment Checklist



- Maintenance Access Road
- Signage
- Fencing
- Sediment Drying Area
- Inlet Structures
- Overland Flow Route
- Infiltration Basin
- Outlet Structure
- Emergency Spillway
- Permanent Pool Water level
- Forebay/Aftbay
- Permanent Pool Water Depth
- Liner
- Length to Width Ratio
- Water Quality
- Oils/Floatables
- Active Storage Depth
- Side Slopes
- Erosion/Slope Stability
- Vegetation
- Waterfowl Activity
- Miscellaneous Items

# Stormwater Management Facility Assessment

**Stormwater Management Pond Example:**  
SWM Pond 1E, Industrial Park East



# Stormwater Management Facility Assessment

Example:  
Assessment Checklist

Item	Criteria/Maintenance Item	Y/N	Notes
<p><b>SWM Pond Condition Assessment Checklist</b></p> <p><b>SWM Facility Name: Pond 1E - Industrial Park East</b></p> <p>Date: October 16, 2012</p> <p>Location: East of Paisley Lane &amp; Highway 47 Inspectors: Wendy Burke &amp; Lori C6on</p> <p>Current Weather: Partly cloudy, 10°C</p> <p>Rain in previous 72 hrs?: No Amount (mm): N/A</p> <p><b>Background Information</b></p> <p>Contributing Drainage Area (ha): Unknown SWM Facility Type: <u>Wet Pond</u> Wetland Dry Pond Infiltration Other?</p> <p>Level of Imperviousness (%): Unknown</p> <p>Contributing Predominant Land Use: Industrial</p> <p>Within LSRCA <u>TRCA</u> Regulated Area (Y/N): Unknown</p> <p>Classified as a Dam under CDA or MNR Regulations (Y/N): N</p> <p>Approximate Year of Construction: 1991 (Possibly later)</p> <p>Last known Sediment Cleanout Operation: Unknown</p> <p>Water Quality Treatment Level: 1 2 3 <u>Unknown</u></p> <p>Water Quantity Control: Yes</p> <p>Receiving Watercourse: Unknown</p>			
Maintenance Access Road	Has a maintenance access road been provided? What material is the road made up of? Is there clear access from the municipal roadway? Is the road provided around the entire pond? What SWM pond features does the road allow for easy access? Circle all that are accessible. Does the road extend to the bottom of the forebay?	<u>Forebay</u> <u>Inlet HW</u> Afbay Outlet Structure(s) Outlet HW Em. Spwy Other?	A granular maintenance access road is provided off of Anderson Boulevard. It provides access to the east inlet headwall and forebay, as well as the outlet structure. More granular material was recently placed on the access road within the ROW and on the steep sloped section of the road. Within the ROW, the granular covers the curb and gutter, no curb cut was provided. There is significant amount of erosion (holes) at the base of the slope. As the road wraps around the east forebay toward the outlet structure, it 'disappears', became very overgrown with vegetation.
Signage	Has a SWM pond warning sign been installed? Any other signage related to SWM?	No	
Fencing	Has a safety fence been installed around the pond? Is there a locked gate prohibiting access?	No	
Sediment Drying Area	Has an area been provided for sediment de-watering?	No	
Inlet Structures	Structural integrity of headwall/pipes (cracked, broken, separated, grate secure, etc.) Are pipes clear of debris and/or sediment? Is there erosion protection? If so, what is the approx. mean diameter of the stone? (Photo document)	Yes	The pond has three inlets , two storm sewer inlets, east and west headwall, as well as a culvert inlet, central headwall. The east inlet headwall is in good repair, pipe is free of debris, the pedestrian handrail is secure, however, the grate is loose and needs to be tightened. The erosion protection for this headwall consists of rip rap embedded in concrete, a lot of the rip rap has been dislodged and at the waters edge, the ground beneath the concrete has been eroded leaving a gap between the ground and the concrete. The central headwall (box culvert) is in good repair, grate and pedestrian handrail secure.

# Stormwater Management Facility Assessment

Example:

Assessment Checklist (Cont'd)

Item	Criteria/Maintenance Item	Y/N	Notes
Inlet Structures	Con't		There is approximately 0.3 m of accumulated sediment and vegetation growth within the headwall bottom (a tree is actually growing in it), the downstream side of the culvert has accumulated sediment in it (not measured as difficult to access), however the upstream side of the culvert has little sediment accumulated in it. Gabion baskets are located around the wing walls. No erosion protection visible. The west headwall is in good repair, grate and pedestrian handrail secure, there is a slight gap in the handrail which is corroding however as mentioned it is still secure. Inlet pipe is clear of debris, however, some minor sediment accumulation at wingwalls. Some erosion protection visible beneath the water surface.
Overland Flow Route	Is the facility equipped with an overland flow route? If so, is it in good repair? Vegetated or hardened? (Photo document)	No	
Infiltration Basin	Is the facility equipped with an infiltration basin? If so, describe.		
Outlet Structure	Are there any visible control structures (hickenbottom riser pipe, orifice plates/tubes, DICB grates, etc.) If so, what are their condition? Is outlet headwall/pipe clear of debris and/or sediment? Is there erosion protection? If so, what is the approx. mean diameter of the stone? (Photo document)	Yes	The outlet structure is comprised of a 200mm PVC inlet pipe, a DICB MH (grate is sloped and it's dimensions are 0.6 m wide x 1.2 m) and CMP outlet pipe complete with a rip rap plunge pool (located on south side of Highway 47). All of which are in good repair.
Emergency Spillway	Is the facility equipped with an emergency spillway? If so, is it in good repair? Vegetated or hardened? (Photo document)	No	
Permanent Pool Water Level	Is the pond level higher than the normal permanent pool elevation > 24 hrs after a storm? Is the pond level lower than the normal permanent pool elevation? What are possible causes for water level (blocked inlet/outlet)?		Water level is normal.



# Stormwater Management Facility Assessment

Example:

Assessment Checklist (Cont'd)

Item	Criteria/Maintenance Item	Y/N	Notes
Forebay/Aftbay	Is there a defined forebay and aftbay? Is there a forebay berm? If so, is it submerged? (Photo document)		There are two defined forebays and one aftbay between the two. The forebay berms are raised, lined with rip rap on the downstream side (adjacent to the aftbay). Vegetation is growing within the rip rap and some erosion matting is exposed on the east berm. Each berm is equipped with two PVC pipes, on the upstream side of the berm the pipes are fully submerged and on the downstream side the pipe inverts are set at the normal water level. All the pipes are in good condition.
Permanent Pool Water Depth	Approximate permanent pool depth? Is there significant sediment accumulation in the forebay? Aftbay? Estimated depth of sediment in the forebay? Is a sediment cleanout likely necessary?		The permanent pool is deep. At the east inlet headwall, a lot of sediment has accumulated (up to normal water level). There is some accumulation at the west inlet headwall but not as much.
Liner	Is the pond lined? If so, describe.		No evidence of a liner.
Length to Width Ratio	Is pond geometry 3 L to 1 W OR has internal berming been used to increase effective flow length?		The pond geometry is at least 3:1. Both forebays have an internal submerged berm used to increase the forebay flow length (only slightly visible on the day of the inspections).
Water Quality	How clear is the water (turbidity level)? Is there any algae growth? Are there any noxious odours? Is there an aerator in pond?		The water was very brown in colour, ie. very sediment laden, however, no algae growth.
Oils/Floatables	Is there an oily sheen on the water near the inlet or outlet? Is the water frothy? Any unusual colouring of the water? If so then document - review the contributing drainage area for potential contamination and provide recommendation. (Photo documentation)	No	

# Stormwater Management Facility Assessment

Example:

Assessment Checklist (Cont'd)

Item	Criteria/Maintenance Item	Y/N	Notes
Active Storage Depth	Approximate Active Storage depth? (Refer to engineering drawings)		There is a lot of active storage within the pond.
Side Slopes	What are the approximate side slopes within the SWM pond? Upstream embankment? Downstream embankment? Is there a safety bench graded at the normal water level?		Side slopes are approximately 3:1. a safety bench has been provided around the normal water level.
Erosion / Slope Stability	Are there any signs of erosion? Are there any signs of obvious slope instability (slumping, undercutting, rill/gully development)? (Photo document).	Yes	There is some minor gully development along the north side slope, adjacent to Anderson Blvd, however, the area is currently heavily vegetated which suggests that the erosion occurred prior to vegetation taking hold.
Vegetation	Is the vegetation established around the pond? Has it been maintained (cut, landscaped or is it overgrown)? Describe the vegetation around the permanent pool perimeter and the upland areas within the SWM pond block. (Photo document)		The pond is heavily vegetated, a lot of weeds present. There is a maintained path off an adjacent industrial parking lot to the normal water level but otherwise the pond block is very 'natural'.
Waterfowl Activity	Any evidence of waterfowl activity?	No	
Miscellaneous Items	Any other comments/ observations?	Yes	The drawings provided do not seem to reflect what was constructed. A large rip rap area exists within the aftbay along the north limit water's edge, not sure of it's purpose. As well, a lot of animal holes were located within the pond block.

# Stormwater Management Facility Assessment

Example:

Assessment Checklist  
(Cont'd)

Maintenance Recommendations		
<p><b>Required</b></p> <p>The pond appears to require a full sediment cleanout. Obtain a sediment survey to confirm the quantity of sediment to be removed. Repair undermined erosion protection at east inlet headwall. Place more rip rap at east forebay berm to cover exposed erosion matting.</p>		
<p><b>Recommended</b></p>		
Major Maintenance Activities Completed		
Item	Date Completed	Comments
Sediment Cleanout		Volume Removed (Forebay/Aftbay): Cleanout Method: Disposal Location: Cost \$/m3: Other Comments:
Vegetation/ Landscape		
Structural Improvements		
Other		

# Stormwater Management Facility Assessment



East inlet headwall, Erosion protection



Central headwall culvert



Outlet Structure, Quality Control Pipe



Outlet structure, DICB

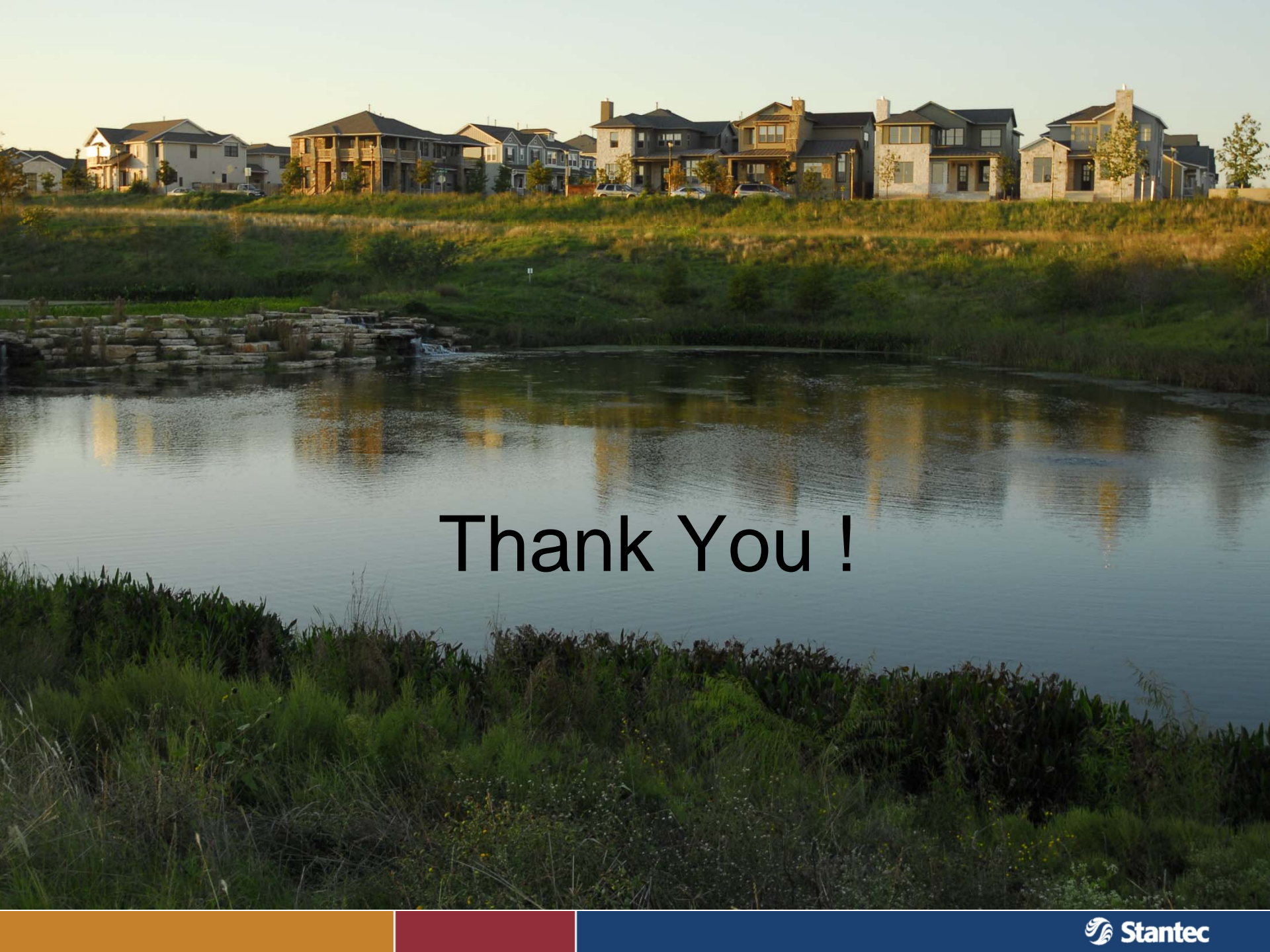


Forebay berm



**Questions?**





Thank You !