APPENDIX G

Operations and Maintenance Activities

City of New Berlin Stormwater Management Plan: Operations and Maintenance Guidelines for Open Channels, Culverts, and Detention Facilities

The project team has drafted an operations and maintenance (O&M) plan which will provide the City with a means of addressing both the short and long term maintenance needs of it's open channels, culverts, and detention facilities. Specifically, the program will identify needed maintenance activities and procedures, establish a priority and schedule for maintaining individual system components, and define program management needs including costs, staffing, and equipment.

The prioritization of O&M activities for this project are divided into three levels of service based upon corrective, preventative, and aesthetic maintenance. A brief description of the O&M for each of these types of prioritizations are as follows:

Corrective Maintenance

Corrective Maintenance is performed on an emergency or as-needed basis when the integrity of a stormwater drainage system is compromised. The focus of this type of maintenance is to protect the public health by repairing damages which threaten existing infrastructure or damage species and habitat.

Preventative Maintenance

Preventative maintenance is performed on a routine basis in order to ensure the proper operation of the stormwater drainage system. The intent of this type of maintenance is to continually retain the flow carrying capability of the stormwater drainage system.

Aesthetic Maintenance

Aesthetic maintenance is performed on a routine basis to enhance the appearance and appeal of the stormwater drainage system. The goal of this type of maintenance is to provide the public with stormwater facilities and components that enhance the community atmosphere.

Further information concerning the prioritization of the O&M levels of service are found in "Operation, Maintenance, and Management of Stormwater Management Systems" on page 7-11;7-12; and 7-13. Additional information can be found in 7-20; and in the yellow manilla folder.

Monitoring and Training Program

The adoption of a monitoring program is vital for insuring that the existing stormwater drainage system operates efficiently. As part of the monitoring program, the project team has compiled a series of inspection forms which can be used to identify areas within the drainage system to be monitored during each site visit. The benefit of utilizing such forms allows the City to compile a historical record of the stormwater drainage system, ensure a consistent means of gathering needed information, provide verification that the inspection was done routinely and proficiently, and identify areas where maintenance activities are needed and establish a schedule for their completion.

The frequency for performing the inspections is dependant upon the local climate and rainfall conditions of the study area. The initial estimates concerning frequency range between 1-2 times per year, and after the occurrence of major storm events.

To reduce the potential for improper inspection and maintenance, a mandatory inspector training and certification program must be implemented along with the monitoring program. By initializing such programs, the City benefits in two ways. First, by sending inspectors through the program, they become aware of the components, functions, and safety issues concerning each type of stormwater drainage system. Second, by educating the inspectors about what to look for, they are able to identify potential problems before they escalate into more serious issues.

The suggested components of the inspector training program in addition to further information are laid out in "Operation, Maintenance, and Management of Stormwater Management Systems" on page 7-16.

OPEN CHANNELS

Corrective Maintenance

Removal of debris and sediment

If conditions arise in which heavy deposits of debris and sediment are discovered and cause impediments to the flow of water, steps should be taken to restore the original flow characteristics of the channel.

Structural and erosion repairs

Typical problems encountered pertaining to structural repair work include: erosion damage in and around drop and grade control structures; random bank failures and bottom degradation of soft-lined low flow channels; local undermining of hard-lined low flow channels; stormsewer and bridge repair; and channel bank destabilization due to loss of vegetation, and undermining of riprap and other erosion protectors by scouring and general degradation.

Elimination of mosquito breeding areas

Local mosquito control experts should be consulted in order to find solutions to eliminate breeding areas.

Preventative Maintenance

Inspections

The condition of the open channels should be inspected at least annually but suggested to be between 2 and 3 times per year and after significant storm events.

Grass mowing

Waterways should be mowed regularly to maintain a healthy stand of vegetation, control weeds, and stimulate other grasses which will improve the stand. One suggested schedule is to mow on a yearly basis after the first of August. Accomplishing this task during late summer allows for nesting fowl to have ample time to hatch their eggs. When mowing, the stand should be cut to a height between 4 to 8 inches in order to provide protection for wildlife during winter months. If using a sickle style mower, the clippings should also be raked and removed so that they do not harm the grass stand. Another suggested schedule is to mow between 3 and 6 times per year in order to control weeds and promote community responsibility.

Grass maintenance

A grass fertilization plan should be implemented in order to retain the effectiveness and health of the vegetated cover. A suggested program would call for a yearly rate of 30 ponds of nitrogen per acre and variable rates of potassium and phosphorous to be applied. These variable loadings are dependant upon surrounding land use and agricultural crops being planted.

Vegetation management

Vegetation management should be done to help alleviate debris and obstruction problems within and around the open channels and drainage ditches. This activity includes the trimming and thinning of trees that encroach upon the channel; the clearing of excessive weeds and reeds; the adoption of a herbicidal treatment program; replacement of dead or dying plant life; and the continued use of mechanical equipment such as drag lines, bulldozers, backhoes, and excavators.

Trash, debris removal and control

On a yearly basis, America outdoors, the USDA Forest Service, The Bureau of Land

Management, and an assortment of other agencies sponsor National River Cleanup Week. During this week, cleanup kits, support materials, safety guidelines, and trash bags are provided for local cleanups. Registration for the event is free of charge, and local community organizations are placed in charge of organizing and executing the local events. This activity can also be accounted for by incorporating it into the adopted mowing operations or by implementing trash racks and debris traps.

Aesthetic Maintenance

Graffiti removal

Removal of graffiti will improve the appearance of the stormwater facility as well as act as a tool to discourage further acts of vandalism.

Trail repair

On a yearly basis, repairs to trail sections should be performed to guarantee accessible maintenance and promote an increase in pedestrian usage. A suggested schedule for accomplishing this is to formulate a yearly repair schedule with repairs to be performed following the winter season.

Further information concerning these activities as well as frequency and the time of year in which they should be performed are found in “Operation, Maintenance, and Management of Stormwater Management Systems” on page 7-11 to 7-16; “Design and Construction of Urban Stormwater Management Systems” on page 535; and “The Design, Construction, and Maintenance of Grass Waterways in Wisconsin” on page 7 and 47-49.

CULVERTS

Corrective Maintenance

Removal of debris and sediment

Debris and sediment should be cleaned from culvert inlets and outlets between 1 and 2 times per year. It is recommended that the cleaning be done twice, but if only one cleaning is possible, it should be done prior to the rainy season.

Structural repairs

Structural repairs to the culverts should be performed when needed. Typical problem areas which may require repair include: inlet and outlet structures; settlement and subsidence; corrosion, spalling, and cracking repair; leaking; pipe deformation; and trash rack blockage.

Erosion repair around culverts

Erosion repair should be performed to alleviate the scouring of the transition areas due to high water velocities. If evidence of this occurs, erosion control measures must be repaired or constructed (including riprap aprons, concrete headwalls and wingwalls, and energy dissipation structures).

Preventative Maintenance

Inspections

Inspections of culverts should be performed in accordance with open channel maintenance operations. They should also be inspected after major storm events to determine if excessive sedimentation or blockage has occurred.

Trash, debris removal and control

Where applicable, trash racks should be used and regularly cleaned to prevent blockages and clogging. If trash and debris is evident within the structure, it should be removed when it begins to impede flow.

Aesthetic Maintenance

Graffiti removal

Removal of graffiti will improve the appearance of the stormwater facility as well as act as a tool to discourage further acts of vandalism.

Grass trimming

Trimming of grass around the inlet and outlet structures should be done to provide the public with a more attractive stormwater facility.

Further information concerning these activities as well as frequency and the time of year in which they should be performed are found in “Operation, Maintenance, and Management of Stormwater Management Systems” on page 7-11 to 7-16; “The Design and Construction of Urban Stormwater Management Systems” on pages 536-537; and the article entitled “City Fast-Tracks Culvert Replacement” on page 32.

DETENTION FACILITIES (WET PONDS)

Corrective Maintenance

Removal of debris and sediment

Accumulated sediment can reduce both the appearance and pollutant removal efficiency of the pond. Every year it has been estimated that around 1% of the storage capacity is lost annually. A ten to twenty year clean-out cycle is recommended.

Structural repairs

In the event of a structural failure, equipment, staffing, and materials should be readily available on short notice. The repairs should only be performed by qualified personnel.

Erosion, dam, embankment, and slope repairs

Typical problems include settlement, scouring, cracking, sloughing, seepage, and rutting. Repairs need to be made quickly to ensure that the problems do not escalatate into larger problems.

Elimination of mosquito breeding areas

Local mosquito control experts should be consulted in order to find solutions to eliminate breeding areas.

Snow and ice removal

This activity should be accomplished to protect inlets, outlets, and overflow emergency spillways from damage.

Preventative Maintenance

Inspections

Inspections should be performed annually during wet weather events whenever possible. Inspectors should check embankments for subsidence, erosion, cracking, and tree growth; the condition of the emergency spillway and drain; the accumulation of sediment; clogging of the barrel and outlet; the adequacy of upstream and downstream channel erosion protection measures; any modifications which have occurred to the contributing watershed and the pond structure; and the stability of the side-slopes.

Grass mowing

Grass mowing of side-slopes, embankment, and emergency spillway should be performed when grass exceeds 18" in height, and should be mowed to 2" in height. This approximately amounts to between 2-14 mowings per year to prevent woody growth, control weeds, prevent allergies, and retain neighborhood appearance (applicable to residential areas). Contacting local soil conservation districts may also provide maintenance requirements for various types of vegetation. According to a draft memorandum for the Charlotte-Mecklenburg Stormwater Services, dam embankments should be mowed monthly, while leaving the shoreline alone.

Grass maintenance

Activities needed in the maintenance of grassy areas include fertilization, dethatching, soil conditioning, and in some instances reseeding.

Vegetation management

Vegetation management should be done to help alleviate debris and obstruction problems in and around the detention facility. This activity includes the trimming and thinning of trees that encroach upon the channel; fertilization; the clearing of excessive weeds and reeds; the adoption of a herbicidal treatment program; and pest control.

Erosion control

The side-slopes, emergency spillway, and embankment should all be annually or periodically checked for signs of erosion. If found, regrading or revegetation should be implemented to alleviate the problems. Riprap connecting the pilot channel between the upper and lower stages should also be periodically checked for need of regrouting or repair.

Mechanical components

Any valves, pumps, sluice gates, locks, fence gates, and access hatches should be maintained in accordance with the manufacturers recommendations. During each inspection, these components should be operated to assure continual performance.

Trash and debris control and removal

Debris and litter removal should be done in accordance with mowing operations. Particular attention should be addressed to floatable debris around the riser and outlet. Special attention should also be paid to areas where debris exceeds 1 cubic foot per 1000 square feet (~amount to fill office trash can)

Aesthetic Maintenance

Grass trimming

Trimming of grass around outlet structures, fences, and public trails should be done to provide the public with a more attractive stormwater facility.

Graffiti removal

Removal of graffiti will improve the appearance of the stormwater facility as well as act as a tool to discourage further acts of vandalism.

Odor Control

Algae and insect control

The control of insects and algal blooms can be remediated through the use of chemical applications, or biological applications such as the use of flathead minnows and other fish.

Further information concerning these activities as well as frequency and the time of year in which they should be performed are found in “Operation, Maintenance, and Management of Stormwater Management Systems” on page 7-11 to 7-16; “Controlling Urban Runoff” chapters 3 and 4; and King County, Washington’s Surface Water Design Manual” chapter 1 and appendix.

DETENTION FACILITIES (DRY PONDS)

Corrective Maintenance

Removal of debris and sediment

Accumulated sediment can reduce both the appearance and pollutant removal efficiency of the pond. Every year it has been estimated that around 1% of the storage capacity is lost annually. A five to ten year clean-out cycle is recommended. For dry detention ponds, frequent spot clean-outs may be needed to clean sediment from the detention control device.

Structural repairs

In the event of a structural failure, equipment, staffing, and materials should be readily available on short notice. The repairs should only be performed by qualified personnel.

Dam, embankment, and slope repairs

Typical problems include settlement, scouring, cracking, sloughing, seepage, and rutting. Repairs need to be made quickly to ensure that the problems do not grow.

Elimination of mosquito breeding areas

Local mosquito control experts should be consulted in order to find solutions to eliminate breeding areas.

Erosion Repair

The side-slopes, emergency spillway, and embankment should all be annually or periodically checked for signs of erosion. If found, regrading or revegetation should be implemented to alleviate the problems. Riprap connecting the pilot channel between the upper and lower stages should also be periodically checked for need of regrouting or repair.

Snow and ice removal

This activity should be accomplished to protect inlets, outlets, and overflow emergency spillways from damage.

Preventative Maintenance

Inspections

Inspections should be performed annually during wet weather events whenever possible. Inspectors should check the extended detention control device for evidence of clogging, or too rapid a release; the upper stage pilot channel and flow path for evidence of erosion; subsidence, erosion, cracking, and tree growth on the embankment; the condition of the emergency spillway; the accumulation of sediment around the riser; the adequacy of upstream and downstream channel control measures; erosion of the pond's bed and banks; and modifications to the pond or its contributing watershed that may influence pond performance.

Grass mowing

Grass mowing of side-slopes, embankment, and emergency spillway should be performed when grass exceeds 18" in height, and should be mowed to 2" in height. This approximately amounts to between 2-14 mowings per year to prevent woody growth, control weeds, prevent allergies, and retain neighborhood appearance (applicable to residential areas).

Grass maintenance

Activities needed in the maintenance of grassy areas include fertilization, dethatching, soil conditioning, and in some instances reseeding.

Vegetation management

Vegetation management should be done to help alleviate debris and obstruction problems in and around the detention facility. This activity includes the trimming and thinning of trees that encroach upon the channel; fertilization; the clearing of excessive weeds and reeds; the adoption of a herbicidal treatment program; and pest control.

Erosion control

The side-slopes, emergency spillway, and embankment should all be periodically checked for signs of erosion. If found, regrading or revegetation should be implemented to alleviate the problems. Riprap connecting the pilot channel between the upper and lower stages should also be periodically checked for need of regrouting or repair.

Trash and debris control and removal

Debris and litter removal should be done in accordance with mowing operations. Particular attention should be addressed to floatable debris around the riser and outlet. Special attention should also be paid to areas where debris exceeds 1 cubic foot per 1000 square feet (~amount to fill office trash can).

Aesthetic Maintenance

Grass trimming

Trimming of grass around outlet structures, fences, and public trails should be done to provide the public with a more attractive stormwater facility.

Graffiti removal

Removal of graffiti will improve the appearance of the stormwater facility as well as act as a tool to discourage further acts of vandalism.

Weed control

Odor Control

Algae and insect control

The control of insects and algal blooms can be remediated through the use of chemical applications, or biological applications such as the use of flathead minnows and other fish.

Further information concerning these activities as well as frequency and the time of year in which they should be performed are found in “Operation, Maintenance, and Management of Stormwater Management Systems” on page 7-11 to 7-16; “Controlling Urban Runoff” chapter 3.

COSTS

Overall Maintenance Costs

For wet and dry detention ponds, the estimate of the annual maintenance costs (estimated at 3x the surface area of the pond) range between $300-$500 per maintained acre which includes the pond and surrounding buffer (1987 dollars). Several ways to reduce costs include the management of the buffer zone as a meadow rather than a lawn, provide (if possible) on-site disposal, and provide a maintained access way to the facility at a minimum width of 10 feet.

In 1986, a review of several wet pond dredging operations in Northern Virginia estimated a range in cost between $6.25 to $22.40 per cubic yard and an average dredging cost of $14 per cubic yard. This cost is based upon factors including size, accessibility, proximity to disposal site, and the method used to remove and transport the sediment. Costs associated for smaller ponds (<100,000 cf) range between $5 and $10 per cubic yard. If hauling or landfilling is required the costs climb even higher by $5 to $10 per cubic yard and $15 to $20 per cubic yard respectively.

For dry detention ponds, the removal cost for cleaning will be lower than that of wet ponds. Actual costs for dry detention ponds range between $5 and $10 per cubic yard (1987 dollars). This is due to the elimination of dewatering, drag-line, and hydraulic dredging techniques needed for wet pond clean up. If hauling or landfilling is needed, the same unit costs apply as those found from wet detention ponds.

For grass waterways, tables 6 and 7 of the article entitled “The Design, Construction, and Maintenance of Grass Waterways in Wisconsin” provide unit costs (in 1990 dollars) and life spans for a range of activities including seeding, mulching, grade stabilization structures, fertilizers, seed inputs, and herbicides.

For open channels, the Lincoln Creek Phase I Plan has established raw costs associated with operations and maintenance. Labor rates were estimated at $17 per hour; equipment costs at $200 per day; overhead and administrative costs at 3x raw labor; streambank repair and erosion control at $75 per linear foot; and plant replacement at $15 per plant (in 1998 dollars).

For detention basins, the Lincoln Creek Phase I Plan has utilized the same unit costs as seen above for open channels with the addition of slope repair which was estimated at a lump sum of between $1,000 and $3,000 per year (in 1998 dollars).

Further information concerning cost estimates are found in “The Design, Construction, and Maintenance of Grass Waterways in Wisconsin” on pages 52-53; a memo concentrating on the operations and maintenance of the improved Lincoln Creek Phase I Project; and “Controlling Urban Runoff” chapters 3 and 4.

Staffing

For the monitoring and inspection program, the Lincoln Creek Phase I Plan called for a 2-person crew to inspect all open channels.

For mowing of native grass, the Lincoln Creek Phase I Plan called for a 1-person crew.

For vegetative management and weed control, the Lincoln Creek Phase I Plan called for a 2-person crew.

For graffiti removal, the Lincoln Creek Phase I Plan called for a 1-person crew.

For storm sewer and bridge repairs, the Lincoln Creek Phase I Plan called for a 3-person crew.

Equipment

Information concerning a broad listing of maintenance equipment and materials is found in “Operation, Maintenance, and Management of Stormwater Management Systems” on page 7-18; and “Turf and Roadside Maintenance” on pages B-96 to B-104.

Operation and Maintenance Report for Stormwater Open Channels

Inspector Name _____ Community _____

Inspection Date _____

Open Channel Reach location _____ Watershed _____

Length _____

Inspection Frequency Key A= Annual M= Monthly S= After major storm event

Items Inspected	Checked		Maintenance Needed		Inspection	Remarks
	Yes	No	Yes	No	Frequency	
I. Open Channels						
A. General channel conditions					A,S	
1 Streambank erosion and scouring						
a Upper bank (mass wasting or slumping)						
b Lower bank (root mat overhangs and sloughing)						
2 Sedimentation						
3 Evidence of obstructions, debris, and trash						
4 Future obstruction potential						
a Small size and volume						
b Medium size and volume						
c Heavy size and volume						
5 Condition of vegetation and ground cover						
along streambank						
6 Encroachment on open channel by trees and shrubs						
7 Other (specify)						
B. Structural conditions					A	
1 Condition of drop or grade control structure						
2 Stormsewer and bridge repair						
3 Undermining of hard-lined channel section						
4 Other (specify)						
C. Other					A	
1 Trail condition						
2 Aesthetics						
a Grass mowing required						
b Graffiti removal required						
c Other (specify)						

II. Summary

1 Inspectors Remarks: _____

Inspection Frequency Key A= Annual M= Monthly S= After major storm event

Items Inspected	Checked		Maintenance Needed		Inspection Frequency	Remarks
	Yes	No	Yes	No		

2 Overall condition of open channel reach (check one)
___ No action necessary. Continue routine inspections.
___ Action required. Need to establish time frame for correction or repair.

3 Photographs taken on-site: _____

(photo number and brief description of problem) _____

_____

4 Dates any maintenance must be completed by: _____

_____

_____

_____

_____

5 Re-inspection accomplished on _____

6 Corrections or repairs were completed
___ Yes
___ No

Operation and Maintenance Report for Stormwater Culverts

Inspector Name _____ Community _____

Inspection Date _____ Address _____

Culvert identification _____

Type of material: _____ Reinforced concrete Watershed _____

_____ Corrugated metal pipe

_____ Other (specify) "As-Built" plans available Y / N

Inspection Frequency Key A= Annual M= Monthly S= After major storm event

Items Inspected	Checked		Maintenance Needed		Inspection	Remarks
	Yes	No	Yes	No	Frequency	
I. Culvert Information						
A. Structural condition					A	
1 Evidence of settlement or subsidence						
2 Evidence of frost action						
3 Downstream invert condition						
4 Upstream invert condition						
5 Trash rack condition (if applicable)						
6 Other (specify)						
B. Non-structural condition					A,S	
1 Sedimentation present						
2 Erosion and scouring						
3 Evidence of obstructions						
4 Potential blockage debris found						
upstream of structure (specify)						
5 Presence of unmarked utility lines						
6 Other (specify)						
C. Concrete/masonry condition					A	
1 Cracking						
a Minor (< 6" in length)						
b Major (> 6" in length)						
2 Spalling						
3 Joint failures						
4 Water tightness / leaking						
5 Spring-line failure						
6 Other (specify)						
C. Corrugated metal pipe condition					A	
1 Corrosion						
2 Vertical deformation						
3 Other (specify)						

II. Summary

1 Inspectors Remarks: _____

_____

_____

_____

Inspection Frequency Key A= Annual M= Monthly S= After major storm event

Items Inspected	Checked		Maintenance Needed		Inspection Frequency	Remarks
	Yes	No	Yes	No		

2 Overall condition of culvert (check one) ___ No action necessary. Continue routine inspections.

___ Action required. Need to establish time frame for correction or repair.

3 Photographs taken on-site: _____

(photo number and brief description of problem) _____

_____

4 Dates any maintenance must be completed by: _____

_____

_____

_____

_____

5 Re-inspection accomplished on _____

6 Corrections or repairs were completed ___ Yes

___ No

Operation and Maintenance Report for Stormwater Management Ponds

(Adapted from "Operation, Maintenance, and Management of Stormwater Management Systems" by Eric Livingston and Florida Department of Environmental Protection)

Inspector Name _____ Community _____

Inspection Date _____ Address _____

Stormwater Pond _____

Wet ____ _____

Dry ____ Watershed _____

"As-Built" plans available Y / N

Inspection Frequency Key A= Annual M= Monthly S= After major storm event

Items Inspected	Checked		Maintenance Needed		Inspection	Remarks
	Yes	No	Yes	No	Frequency	
I. Pond Components						
A. Embankment and emergency spillway					A,S	
1 Vegetation and ground cover adequate						
2 Embankment erosion						
3 Animal burrows						
4 Unauthorized plantings						
5 Cracking, bulging, or sliding of dam						
a Upstream face						
b Downstream face						
c At or beyond toe						
Upstream						
Downstream						
d Emergency spillway						
6 Pond, toe, and chimney drains clear						
and functioning						
7 Seeps / leaks on downstream face						
8 Slope protection or riprap failures						
9 Vertical and horizontal alignment of						
top of dam as "As-Built" plans						
10 Emergency spillway clear of						
obstructions and debris						
11 Rock missing						
12 Other (specify)						
B. Riser and principle spillway					A	
Type: Reinforced concrete _____						
Corrugated pipe _____						
Masonry _____						
1 Low flow orifice obstructed						
2 Low flow trash rack						
a Debris removal necessary						
b Corrosion control						
3 Weir trash rack maintenance						
a Debris removal necessary						
b Corrosion control						
4 Excessive sediment accumulation inside riser						
5 Concrete/masonry condition						
riser and barrels						
a Cracks or displacement						
b minor spalling (<1")						

Inspection Frequency Key A= Annual M= Monthly S= After major storm event

Items Inspected	Checked		Maintenance Needed		Inspection	Remarks
	Yes	No	Yes	No	Frequency	
c major spalling (rebar exposed)						
d Joint failures						
e water tightness						
6 Metal pipe condition						
7 Control valve						
a Operational/exercised						
b Chained and locked						
8 Pond drain valve						
a Operational/exercised						
b Chained and locked						
9 Outfall channels functioning						
10 Other (specify)						
C. Permanent pond (wet ponds)					M	
1 Undesirable vegetative growth						
2 Floating or floatable debris removal required						
3 Visible pollution						
4 Shoreline problems						
5 Other (specify)						
D. Sediment forebays						
1 Sedimentation noted						
2 Sediment cleanest when depth < 50%						
design depth						
E. Dry pond areas					M	
1 Vegetation adequate						
2 Undesired vegetative growth						
3 Undesirable woody growth						
4 Low flow channels clear of obstructions						
5 Standing water or wet spots						
6 Sediment and/or trash accumulation						
7 Other (specify)						
F. Condition of outfalls into pond					A,S	
1 Riprap failures						
2 Slope erosion						
3 Storm drain pipes						
4 Endwalls/headwalls						
5 Other (specify)						
G. Other					M	
1 Encroachments on pond or easement area						
2 Complaints from residents (describe on back)						
3 Aesthetics						
a Grass mowing required						
b Graffiti removal needed						
c Other (specify)						
4 Any public health hazards (specify)						
5 Presence of poisonous vegetation						
6 Presence of excessive insect infestation						
7 Maintenance access						
H. Constructed wetland areas					A	
1 Vegetation healthy and growing						
2 Evidence of invasive species						

Inspection Frequency Key A= Annual M= Monthly S= After major storm event

Items Inspected	Checked		Maintenance Needed		Inspection Frequency	Remarks
	Yes	No	Yes	No		
3 Excessive sedimentation in wetland area						

II. Summary

1 Inspectors Remarks: _____

_____

_____

_____

_____

_____

_____

_____

_____

2 Overall condition of facility (check one) ___ No action necessary. Continue routine inspections.

___ Action required. Need to establish time frame for correction or repair.

3 Photographs taken on-site: _____

(photo number and brief description of problem) _____

_____

4 Dates any maintenance must be completed by: _____

_____

_____

_____

_____

5 Site re-inspection accomplished on _____

6 Facility corrections or repairs were completed ___ Yes

___ No

Operation and Maintenance Report for Stormwater Drainage Swales

Inspector Name _____ Community _____

Inspection Date _____ Watershed _____

Drainage swale Reach location _____

Length _____

Inspection Frequency Key A= Annual M= Monthly S= After major storm event

Items Inspected	Checked		Maintenance Needed		Inspection	Remarks
	Yes	No	Yes	No	Frequency	
I. Drainage Swales						
A. General swale conditions					A,S	
1 Erosion and scouring						
a Bottom						
b Side						
2 Sedimentation						
a Even distribution						
b Uneven distribution						
3 Vegetation type						
a Grass _____						
b Wetland _____						
c Shrubs _____						
d Trees _____						
4 Vegetation abundance						
a None _____						
b Sparse _____						
c Moderate _____						
d Heavy _____						
5 Vegetation condition						
a Healthy _____						
b Dry / brown _____						
c Uprooted _____						
d Toppled _____						
6 Standing water evident						
7 Trash and debris evident						
8 Other (specify)						

II. Summary

1 Description of swale _____

(shape, lining, depth, _____

and width) _____

_____

2 Inspectors Remarks: _____

_____

_____

_____

2 Overall condition of drainage swale reach (check one) ___ No action necessary. Continue routine inspections.

___Action required. Need to establish time frame for correction or repair.

3 Photographs taken on-site: _____

(photo number and brief description of problem) _____

_____

_____

4 Dates any maintenance must be completed by: _____

_____

_____

_____

_____

5 Re-inspection accomplished on _____

6 Corrections or repairs were completed ___Yes

___No

Operation and Maintenance Report for Stormwater Infiltration Facilities

(Adapted from "Operation, Maintenance, and Management of Stormwater Management Systems" by Eric Livingston and Florida Department of Environmental Protection)

Inspector Name _____ Community _____

Inspection Date _____ Address _____

Infiltration Facility _____

Basin _____ _____

Trench _____ Watershed _____

"As-Built" plans available Y / N

Inspection Frequency Key A= Annual M= Monthly S= After major storm event

Items Inspected	Checked		Maintenance Needed		Inspection Frequency	Remarks
	Yes	No	Yes	No		
I. Infiltration Basin						
A. Debris cleanest					M	
1 Basin bottom clear of debris						
2 Inlet clear of debris						
3 Outlet clear of debris						
4 Emergency spillway clear of debris						
B. Sediment traps or forebays					A	
1 Obviously trapping sediment						
2 Greater than 50% of storage volume remaining						
C. Vegetation					M	
1 Mowing done when needed						
2 Fertilized per specifications						
3 No evidence of erosion						
D. Dewatering					M	
1 Basin dewaters between storms						
E. Sediment cleanout of basin					A	
1 No evidence of sedimentation in basin						
2 Sediment accumulation does not yet						
require cleanout						
F. Inlets					A	
1 Good condition						
2 No evidence of erosion						
G. Outlets/overflow spillway					A,S	
1 Good condition, no need for repair						
2 No evidence of erosion						
H. Structural repairs					A,S	
1 Embankment in good repair						
2 Side slopes are stable						
3 No evidence of erosion						
I. Fences/access repairs					A	
1 Fences in good condition						
2 No damage which would allow undesired entry						
3 Locks and gate function adequately						
II. Infiltration Trench						
A. Debris cleanout					M	
1 Basin bottom clear of debris						

Inspection Frequency Key A= Annual M= Monthly S= After major storm event

Items Inspected	Checked		Maintenance Needed		Inspection	Remarks
	Yes	No	Yes	No	Frequency	
2 Inlet clear of debris						
3 Outlet clear of debris						
4 Emergency spillway clear of debris						
B. Sediment traps, forebays, or pretreatment swales					A	
1 Obviously trapping sediment						
2 Greater than 50% of storage volume remaining						
C. Vegetation					M	
1 Mowing done when needed						
2 Fertilized per specifications						
3 No evidence of erosion						
D. Dewatering					M	
1 Basin dewaters between storms						
E. Sediment cleanout of basin					A	
1 No evidence of sedimentation in basin						
2 Sediment accumulation does not yet						
require cleanout						
F. Inlets					A	
1 Good condition						
2 No evidence of erosion						
G. Outlets/overflow spillway					A	
1 Good condition, no need for repair						
2 No evidence of erosion						
H. Aggregate repairs					A	
1 Surface of aggregate clean						
2 Top layer of stone does not need replacement						
3 Trench does not need rehabilitation						
I. Vegetated surface					M	
1 No evidence of erosion						
2 Perforated inlet functioning adequately						
3 Water does not stand on vegetated surface						
4 Good vegetative cover exists						

III. Summary

1 Inspectors Remarks: _____

_____

_____

_____

_____

_____

_____

_____

_____

Inspection Frequency Key A= Annual M= Monthly S= After major storm event

Items Inspected	Checked		Maintenance Needed		Inspection Frequency	Remarks
	Yes	No	Yes	No		

2 Overall condition of facility (check one) ___ No action necessary. Continue routine inspections.

___ Action required. Need to establish time frame for correction or repair.

3 Photographs taken on-site: _____

(photo number and brief description of problem) _____

_____

4 Dates any maintenance must be completed by: _____

_____

_____

_____

_____

5 Site re-inspection accomplished on _____

6 Facility corrections or repairs were completed ___ Yes

___ No

NEW BERLIN STREAM EVALUATION

Stream Name: _____ **Date of Field Inventory:** _____ **Conducted By:** _____

Reach Description: _____

Reach Length: _____

Location	Indicator Item Rated	Classification							
		Excellent		Good		Fair		Poor	
Upper Bank area between normal high water line and extreme high water line	**Landform Slope** steepness of land adjacent to the channel, related to extent and ease of erosion	Slope <30%	2	Slope 30 - 40 %	4	Slope 40-60%	6	Slope >60%	8
	Mass Wasting or Failure detachment of soil and movement downslope, potential for large volumes of material to be introduced into the stream	No evidence of occurrence	3	Infrequent or very small occurrences	6	Moderate frequency and size occurrences	9	Frequent or large occurrences	12
	Debris Jam Potential floatable objects such as branches or logs located along the bank, potential for the development of flow deflection and creation of debris jams	Essentially absent	2	Mostly small twigs and limbs	4	Present - quantity and size of material increasing	6	Moderate to heavy amounts - mostly large size materials	8
	Vegetative Bank Protection density of vegetation on the bank, related to stability of bank soils and reduction in erosion potential	Over 90% plant density	3	70-90% plant density	6	50-70% plant density	9	<50% Plant density	12
Lower Bank area between the waters edge during low flow period to the normal high water line	**Channel Capacity** ability of channel to transmit the volume of water	Ample for present flow and increases	1	Adequate - Overbank flow rare	2	Barely contains present peak flow	3	Inadequate - overbank flow common	4
	Bank Rock Content amount and size of rocks in the bank materials, related to the resistance to flow forces which may cause erosion	65% rock - large boulders >12" diameter	2	40-65% rock – mostly small boulders and cobbles 6-12" diameter	4	20-40% rock - 3-6" diameter	6	<20% rock - 1-3" diameter	8
	Obstructions objects within the stream channel, obstructions may change in flow direction and velocity	Rocks/old logs embedded - flow pattern without cutting or deposition	2	Some present - causing erosive cross currents and minor pool filling	4	Moderately frequent - causing bank cutting and filling of pools	6	Frequent obstructions - causing yearlong bank erosion and channel migration	8
	Cutting loss of vegetation protection on bank or increase in bank steepness	Little or none evident: raw banks infrequent and less than 6" high	4	Some present: raw banks up to 12" high	8	Significant: raw banks 12-24" high	12	Almost continuous cuts: some over 24" high	16
	Deposition deposition of sediment resulting in growth of sediment bars, indication of upstream erosion	Little or no evidence	4	Some new increases	8	Moderate deposition	12	Extensive deposition	16
		Column Total		Column Total		Column Total		Column Total	
		Excellent 23		Good 46		Fair 69		Poor	

DRAINAGE SWALE INVENTORY
City of New Berlin

Inspector:_____
Date:_____

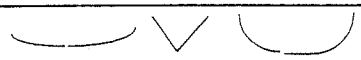
Location

Designation:_____

Street Name: _____ Side: N S E W

From: _____ To:_____

Description:

Shape:  Lining: none concrete asphalt other:_____

Depth: 1' - 2' 2' - 5' 5' - 10' > 10' Width: 0' - 5' 5' - 10' 10' - 20' > 20'

Conditions Observed:

☐ ***Erosion***

Bottom: *Slight* *Moderate* *Severe*

Side: *Slight* *Moderate* *Severe*

☐ ***Sedimentation***

Material: *Silt* *Sand* *Gravel*

Even Distribution: *Slight* *Moderate* *Severe*

Uneven Distribution: *Slight* *Moderate* *Severe*

☐ ***Vegetation***

Abundance: *None* *Sparse* *Moderate* *Heavy*

Type: *Grass* *Wetland Vegetation* *Shrubs* *Trees*

Condition: *Healthy* *Dry/brown* *Uprooted* *Toppled*

☐ ***Trash***

Minor Moderate Heavy

☐ ***Standing Water***

<3" 3" - 6" 6" - 12" >12"

☐ ***Damaged Guard Rail*** Missing Deformed Broken

☐ ***Sign Damage*** Missing Graffiti Sign location:_____