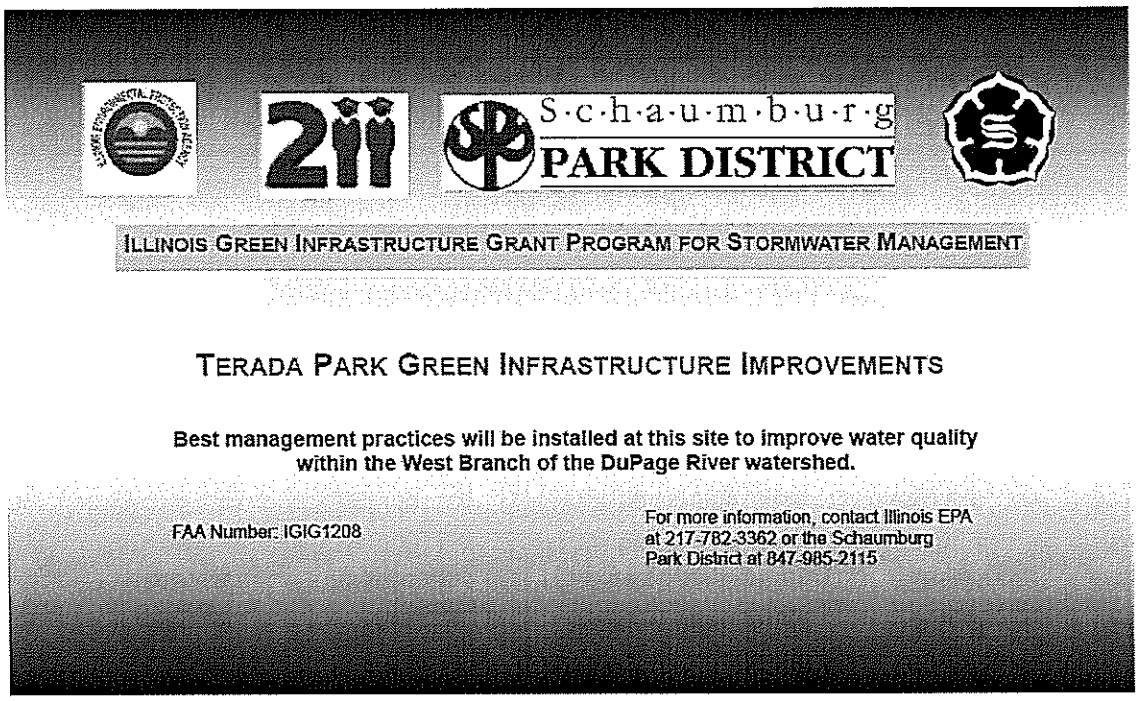
Terada Park Green Infrastructure Improvements

IEPA IGIG Grant

Project Evaluation Report

Agreement Number IGIG1208



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Terada Park Pre-Construction Conditions

Terada Park, located at the southwest corner of Schaumburg Road and Salem Drive in Schaumburg, Illinois
42°01' 32.63" N, 88°06' 7.16 W, Elevation 806

Overview

The Terada Park Infrastructure Improvements Project is a testimony of how the use of Green Infrastructure technology will work in situations where old tried and true technologies could not be considered or were cost prohibited to be considered. With the development of green infrastructure technologies, which utilize natural processes, there are now means to improve degraded and stressed open spaces and improve the quality of storm water runoff.

A project team, consisting of the Village of Schaumburg, the Schaumburg Park District, Schaumburg High School and the U.S. Fish and Wildlife have worked together to create a project which utilized several green infrastructure elements to improve the quality of the park and to provide a laboratory for high school science classes to study the positive impacts of green infrastructure improvements for generations to come.

Pre-Construction Conditions

The project consists of a public park consisting of 14 acres with a 5.7 acre shallow pond. The project is located at the headwaters of the West Branch of the DuPage River within the Village of Schaumburg, Cook County. The 300 acres of tributary area to the park consist of single family residential properties, developed in the 1960's and 1970's. Drainage from a five-lane Cook County highway also discharges into this park. Most of the soils within the limits of the park consist of peat. Early records of this land suggest this area was once a natural low area. The passive park was developed in the early 1970's to include a pond with turf shoreline and grass open spaces. However, the unsuitable soils have contributed to excessive bank erosion and sedimentation of the pond. The park is rarely used by people; however, it is frequented by hordes of geese.

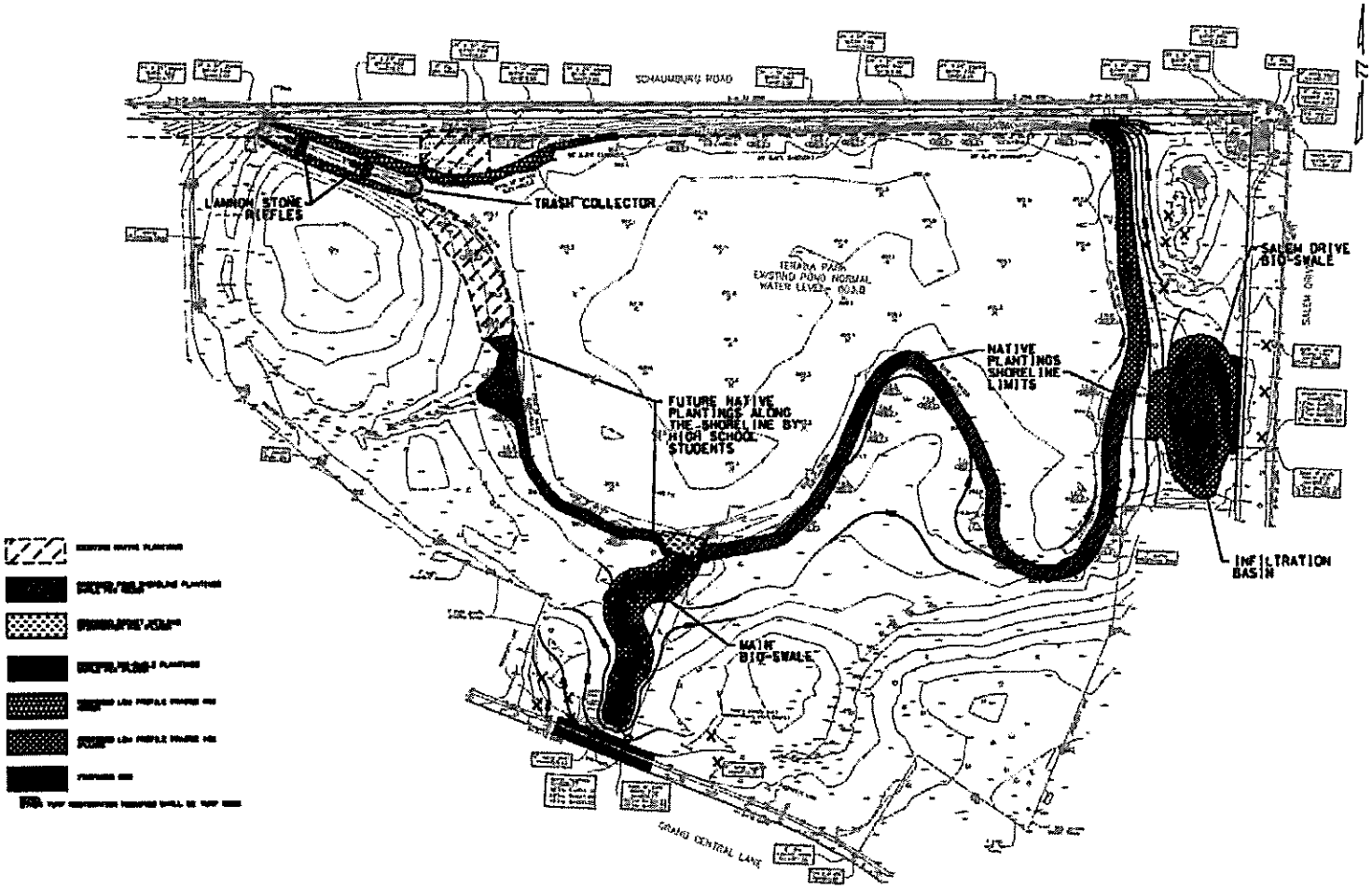
The park is tributary to the West Branch of the DuPage River, which is included on the 303(d) list of impaired state waters. Identified impairments include chloride, dissolved oxygen, manganese, phosphorous, total suspended solids and fecal coliform, (DuPage River/Salt Creek Watershed TMDL Stage 1 Report, IEPA, 2009).

Project Goals and Outcomes

The project includes several water quality enhancements; including riffles, trash filters, bio-swales, infiltration, ponds, and shoreline native vegetation intended to improve water quality, reduce runoff, eliminate erosion and discourage geese. Many of these enhancements will treat the observed pollutants found in this watershed.

The anticipated outcomes include an improved quality of storm water entering the West Branch of the DuPage River. The green infrastructure technologies selected target identified pollutants entering this watershed. The planned riffles will improve the oxygen levels in the water. A similar outcome is anticipated for the reduction in fecal coliform due the substantial reduction in geese frequenting this park. The table below summarizes the proposed and completed green infrastructure elements constructed with the Terada Park Green Infrastructure Improvements Project:

Terada Park Green Infrastructure Improvements Summary of Project BMPs					
		Original		Constructed	
BMP	Location	Quantity	Unit	Quantity	Unit
Bio-swale	Outfall	10,000	SF	9,250	SF
Bio-swale	Salem Dr.	3,000	SF	1,400	SF
Infiltration Basin	Salem Dr.	5,000	SF	7,700	SF
Native Vegetation	Pond Shore	15,000	SF	15,252	SF
Pocket wetland	Bio-Swale Ent	1,000	SF	600	SF
Riffles/Filter	Sch Rd Outfall	2	Each	2	Each
Trash Collector	Outfall	1	Each	1	Each



Summary of Project BMPs

⇒ Bio-Swale - Outfall

Reason for Selecting BMP

The bio-swale on the pond outfall was selected due to the ability for the bio-swale to filter and remove pollutants on a variety of storm events. Since the pond is collecting water from several locations, a single large outfall bio-swale is most effective. The existing pond outfall consisted of a 48" Corrugated Metal Storm Sewer that had settled several feet and was considered obsolete. The selection of a bio-swale eliminated the need to install a new storm sewer on structural support piles.

Advantages/Disadvantages

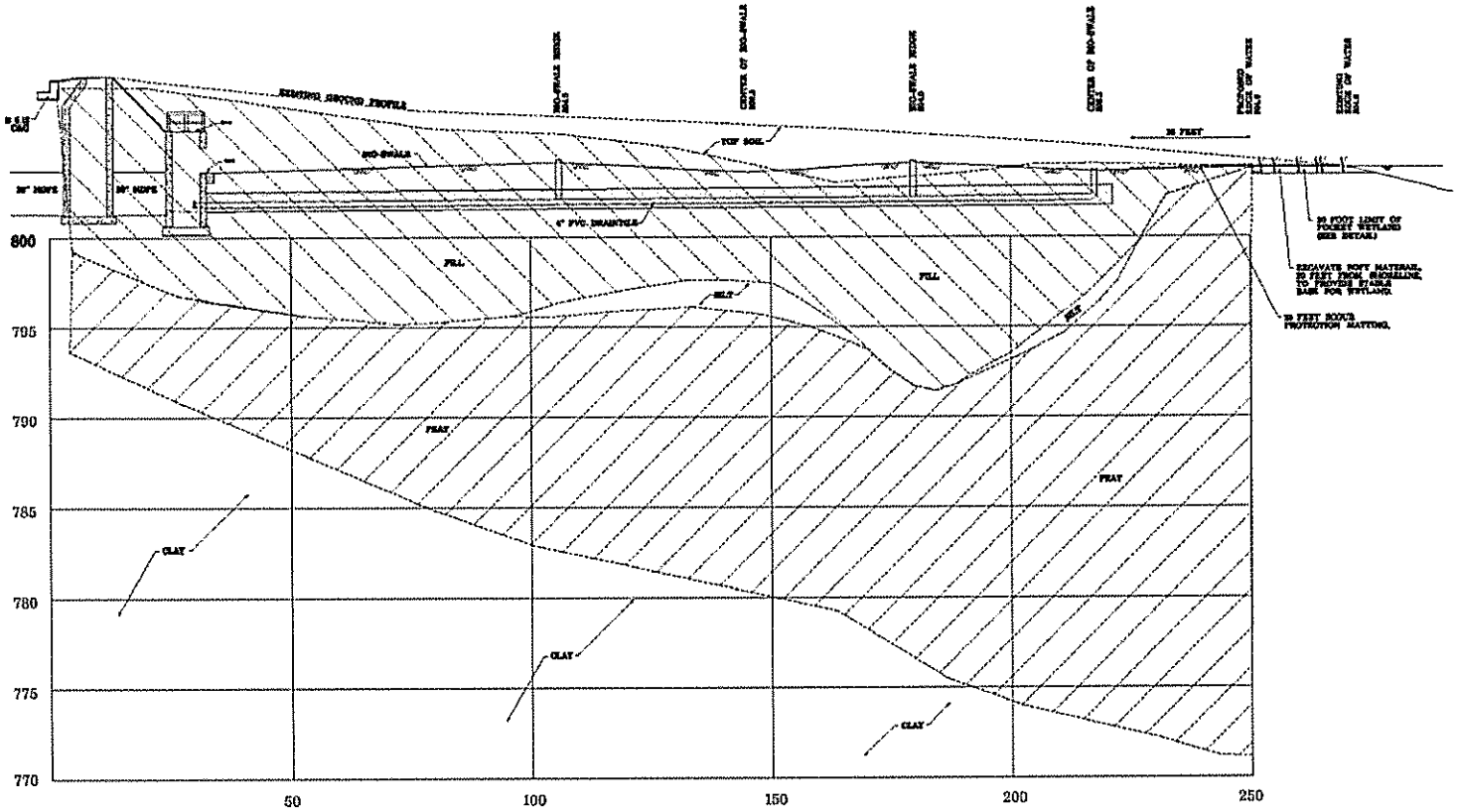
The advantage of a bio-swale in this location is the ability to construct it in locations where poor soil exists. Alternatives, such as a storm pipe outfall, are a very costly alternatives due to the need to support the pipe on structural piles, and do not provide any water quality benefits. The disadvantage of this bio-swale is that it is not common to use a bio-swale as a discharge route from a large pond. The outfall bio-swale must be designed to convey an extreme range of flows due to the size of the upstream tributary area. The critical part of this bio-swale is the interface of the bio-swale at the pond edge where the normal water level and the bio-swale meet, establishing the pond normal water level. This interface will tend to keep the pond/bio-swale edge saturated weakening its ability to withstand wave action and high flow velocities that will occur. To help protect this interface, heavy rubber structural matting has been installed with deep rooted native planting plugs to anchor this end of the bio-swale in place. This is the location chosen for the pocket wetland. Also included in the project is a small drain pipe intended to lower the normal water level one to two inches below the bio-swale edge during dry periods to minimize wave action on this pond edge and allow this section of the bio-swale to dry and promote growth of the vegetation, which in turn will further stabilize the shoreline.

Design Considerations

The bio-swale is rather large and contains a sizeable area to provide filtering for a range of storm events. The bio-swale is generally flat but is designed with intermediate low points every 100 feet to help the bio-swale dry out after a storm event. The area at the pond edge is protected with permanent rubber matting with plugs to anchor the critical area of the bio-swale. The calculated storm water volumes during heavy storm events will create depth of flows over two feet in depth. In these cases, the entire bio-swale, over 35 feet wide, will need to safely convey the storm water.

Installation & Construction

The installation for the bio-swale involved cutting a trapezoidal channel into the thin layer of clay fill existing over the top of the underlying peat material. The clay fill thickness varied from 15 feet to less than a foot near the pond and it was important for the stability of the bio-swale to stay within the clay filled area. A drain tile with a granular stone trench wrapped in ground stabilization fabric helps maintain the stability of the bio-swale over a wide range of moisture conditions. The project team is confident that with pro-active maintenance operations, this bio-swale will serve its intended purposes very well.



Profile of Pond Outfall Bio-swale Top area of cross-hatching indicates layer of clay fill. Middle area of cross-hatching (positive sloped lines) indicate underlying layer of peat.

Post Construction Comments

The picture above depicts the finished bio-swale from the pond edge with the new seeding, plugs and bio-degradable erosion control fabric. Even though the planned vegetation has yet to mature, the bio-swale safely conveys the storm water from the pond into the new outfall structure.

Estimated Cost of BMP				
Description	Quantity	Unit	Unit/Cost	Total
Outfall Bio-Swale	9,250	SF	$6.80/SF	$62,900

⇒ Bio-Swale – Salem Drive

Reason for Selecting BMP

The bio-swale along the east side of the pond is intended to provide a filter for the initial storm water runoff entering the Infiltration Basin. This bio-swale also allows the High School Science Classes to compare the benefits of a bio-swale in removing pollutants from an urban area. The other main bio-swale is downstream of the main pond and other BMPs and the storm water has already passed through a train of BMPs as it flows over the main bio-swale.

Advantages/Disadvantages

The main advantages of this bio-swale include pollutant removal and erosion protection at the outfall of the Infiltration Basin Control Structure. This bio-swale is also an excellent example to study the effectiveness of bio-swales in urban areas. The main disadvantages are the flat grades and small area to place this bio-swale.

Design Considerations

This bio-swale was designed to convey storm water runoff around the outside of the eastern portion of the Infiltration Basin. This routing increased the time and routing of the water through the bio-swale and also through the basin. The adjacent public sidewalk was raised to increase the effective size of the bio-swale, which runs parallel to the sidewalk.

Installation & Construction

The bio-swale installation could not begin until the adjacent grading, underground improvements and elevating of the adjacent public sidewalk was completed. The planting of the bio-swale material was delayed from the fall of 2013 to the fall of 2014 due to the early winter experienced in the fall of 2013. The final length of this bio-swale is less than originally planned due to the minimal fall and grading of the adjacent infiltration basin. This bio-swale is still large enough, 90 feet in length, for the anticipated controlled inflow from the upstream area.

Post Construction Comments

The bio-swale will not reach its maximum effectiveness until the native plant material has matured to be able to properly filter the storm water runoff. The continued effectiveness of this bio-swale is dependent on proper long-term maintenance need to keep the pollutant reduction capabilities high.

Estimated Cost of BMP

Description	Quantity	Unit	Unit/Cost	Total
Salem Dr. Bio-Swale	1,400	SF	$6.16/SF	$8,624

⇒Infiltration Basin

The infiltration basin was completed in the fall of 2013 since it is located near the right-of-way and far enough away from the pond where the weak soils have become a challenge for this project. The infiltration basin intercepts a portion of the flows from the upstream developed area and discharges into a settling basin. This improvement has functioned well and the Schaumburg High School Science Department will be performing experiments to compare the runoff from the off-stream area to the runoff that is collected through the drain tile system from the infiltration basin.

Reason for Selecting BMP

The infiltration basin serves three BMPs. First this basin will reduce initial runoff from a storm event and capture this runoff in the basin. Secondly, the design of infiltration basins will allow storm water runoff to soak into the ground, reducing runoff from the park. The third BMP involves filtering and cleaning the storm water as it passes through the vegetation and through the soil, removing pollutants.

Advantages/Disadvantages

The advantage of this basin at this location is the ability to control the flow of storm water entering this basin. This basin was a challenge due to the flat grades, high water table, and poor soils present. To make this area work, the adjacent sidewalk was elevated and the initial bio-swale was routed around the outside of the basin, maximizing the effective length of the bio-swale and maximizing the area of the infiltration basin.

Design Considerations

The key design elements included balancing the size and depth of the proposed infiltration basin with the quantity of calculated storm water flow in order to divert sufficient initial runoff into the basin and allow the balance of the storm runoff to flow directly into the main pond. A diversion structure was utilized with two outfall inverts, one lower directing the initial flow into the infiltration basin and the second invert higher to convey the balance of the flow into the main pond.

Installation & Construction

Through several storms, this basin has functioned as intended. The basin fills during the initial part of the storm event and slowly soaks into the ground. During heavy events, the basin will fill and overflow into the main pond.

Post Construction Comments

As one can see from the photo below, that the basin area has been mowed several times this summer even though the vegetation selected is not to be mowed, but allowed to grow in its native state to be most effective. This is an example of the need for a solid Operational and Management plan. It is important to the long term success of this project and installed BMPs.

Estimated Cost of BMP

Description	Quantity	Unit	Unit/Cost	Total
Infiltration Basin	7,700	SF	$6.33/SF	$48,741

⇒ Native Vegetation - Shoreline

Reason for Selecting BMP

The shoreline treatments were selected for two primary reasons and one secondary reason. First the use of staked Coir Logs impregnated with plugs and select native planting seeds with biodegradable erosion control matting will stabilize the existing pond edge and minimize the significant bank erosion experienced on the pond banks. The pictures below show the extent of the bank erosion before construction. This is the east bank which experiences the wave pounding from the westerly prevailing winds. The new shoreline is designed to withstand the wave action and once the native planting mature, the shoreline will have long rooted plants helping to anchor the pond edge.

The second reason for the selected design is to create a barrier that would discourage geese from visiting this park. Once the native plantings block the view of the pond, geese tend to seek other locations where they feel more secure.

The third reason for the pond edge design is to create a native planting buffer wide enough and dense enough to filter storm water runoff before the storm water reaches the pond.

Advantages/Disadvantages

The advantages of native vegetation along a shoreline include the stability of the deep rooted plants to firm the soils along the shoreline to protect from the erosive nature of wave action and saturated soils. Also, the native plantings will become a natural filter for runoff from the park turf areas before the runoff enters the pond. The tall grasses will discourage geese from visiting this area. The only disadvantage noted on this project is complaints from residents who prefer a turf edge of the pond. However, these complaints have been decreasing as residents get used to and have begun to appreciate the use of native plants in park like settings.

Design Considerations

The most important design consideration is the placement and anchoring of the coir logs. The coir logs must be installed with the center-line of the coir logs at the normal water level. This placement maximizes the protection of the shoreline while maintaining a favorable environment for the native plants to thrive in and adjacent to the coir log.

Installation & Construction

The installation was carefully inspected to insure proper placement at the correct elevation of the coir logs. The contractor tended to take two "short cuts" if not watched closely. They usually did not place the wooden stakes at the correct location, angle, depth or number. Also, the contractor had to be told more than once to place the erosion control matting under the coir log and not over it or up to the log.

Post Construction Comments

The coir logs have exceeded expectations. During a wide range of conditions, the logs have remained stable and protecting the exposed shoreline. The range of conditions include extended periods of flooding high water, extended periods of draught, inter freezing and ice action.

Coir logs not only provide the shoreline protection but also provide an ideal medium for the nature plant material

Estimated Cost of BMP

Description		Quantity	Unit	Unit/Cost	Total
Shoreline Vegetation	**Native**	15,252	SF	$3.55/SF	$54,145

⇒ Pocket Wetland

Reason for Selecting BMP

The primary reason for selecting a pocket wetland as a BMP is the stability wetlands can provide in poor soil conditions. They also provide important filtering of the initial storm water discharge from the large pond.

Advantages/Disadvantages

The advantage of a pocket wetland is the pollutant removal properties and the ability to stabilize areas of poor soil. A disadvantage of a pocket wetland is the maintenance required to keep the wetland healthy or to keep a healthy wetland from becoming too invasive into adjacent areas.

Design Considerations

The pocket wetland design included the use of permanent rubber matting to help secure the wetland plants and to minimize scouring due to the expected high velocities. The specific depth of normal water of 6 inches was also important for the types of plants selected. This water depth also maximizes the ability to enhance the desired plant species and minimizes the intrusion of undesirable evasive species.

Installation & Construction

The installation of the pocket park was one of the last BMPs to be installed. Wet weather conditions and weak soils prohibited this installation of this wetland until the fall of 2014. Since this location is also the pond outfall, the contractor had to maintain the flow route throughout the entire installation fo the pocket wetland. The floating silt curtain, anchored just off shore of the pocket wetland location, did allow work to take place with proper erosion control adjacent to the pond.

Post Construction Comments

The installation near the existing pond edge limited the area of the pocket wetland to the reach on the equipment available. The actual size of the wetland was less than originally planned, 600 SF versus the planned 1,000 SF. However, the smaller size maintains sufficient access to the entire wetland for the needed long term maintenance of this wetland. The smaller size also allowed for use of a heavy scour protection mat over the entire wetland, which is located on the pond outfall and subject to high flows and extreme velocities of storm water runoff.

One of the keys to the installation of the pocket wetland was the attention to detail in the installation of the erosion control matting material. Since the location of the pocket wetland is at the interface of the pond and the pond outfall bio-swale, there is a very high potential for severe erosion on this location. The project team engaged an expert involved in the use and installation of erosion control matting that spent considerable amount of time coaching the contractor in the proper way to install the matting in this location. The installation of the matting needed different installation details on the pond edge, the bio-swale edge, and the two sides with coir logs installed along the shore line. In most cases, the heavy rubber matting needed to be installed under the coir logs and the bio-swale matting.

The wetland plugs will require several seasons to mature and to establish the needed soil stabilization and water quality filtering qualities. This BMP provides water quality benefits, but the most important quality of this BMP to this project is protecting the interface between the pond and the bio-swale.

Estimated Cost of BMP				
Description	Quantity	Unit	Unit/Cost	Total
Pocket Wetland	600	SF	$24,50/SF	$14,700

⇒ Spillway Riffles

The concrete patching and installation of Lannon stones to act as energy attenuator, commonly called "riffles" have been installed. The trash collecting system is located at the end of this portion and is currently collecting debris and other floating that accumulates along a mile section of the County highway.

Reason for Selecting BMP

The purpose of these riffles is to disrupt and lower the velocity of the storm water discharging from the adjacent County highway. Riffles are also effective in adding Oxygen to the water.

Advantages/Disadvantages

The advantage to the use of Lannon stones as riffles is the simplicity of this design. Lannon stone have the size and weight to be effective and are able to withstand the expected storm water flow velocities. The stones are drilled and pinned to the spill way to insure they will not move under any expected situation. A disadvantage is the relative high cost of Lannon stones. This is only a disadvantage if high quantities of Lannon stones are needed for a project.

Design Considerations

A Structural Engineer was hired to design and prepare details for the location, type and anchoring of the Lannon stones on the existing spillway. Two sets of riffles were included in the project. Native vegetation was added along the sides of the spillway to protect the turf areas along the spillway. During extreme storm events, the riffles will disrupt the flow if storm water resulting in increased depths of water, which will spill over the sides of the spillway onto the turf areas. The native planting will help protect the sides of the spillway from the erosive potential of the runoff. The spillway, constructed in the mid-1970, also needed structural patching in areas near the proposed riffles.

Installation & Construction

The riffles were installed in late summer 2014 after the concrete spillway was repaired. There were no noted issues with the installation except that the access to the spillway was difficult and the delivery of the Lannon stones to the spillway was a challenge to the contractor.

Post Construction Comments

The Lannon stone riffles are a cost-effective BMP that provides several project benefits. The riffles are installed on a large 54 inch diameter storm sewer that discharges a large volume of storm water at a high velocity. These riffles will lower the velocity of the flow of storm water and due to the disruptive nature of the stone riffles, will oxygenate the runoff, addressing one of the identified impairments of the West Branch of DuPage River. The riffles, along with the native plantings, will eventually greatly improve the appearance of the large concrete spillway.

Estimated Cost of BMP

Description	Quantity	Unit	Unit/Cost	Total
Lannon Stone Riffles	10	Each	$1.0206/EA	$10,206

⇒ Trash Collector

Reason for Selecting BMP

The trash collector is intended to collect trash, mostly floatables that accumulate along the County Highway. Man-made floatables like bottles and cups pose a threat to wildlife. It is one of the High School Science Classes assignments to collect, identify, and learn about the negative impacts to the community and nature by litter.

Advantages/Disadvantages

The advantage is that the trash collector and its location in this project is the large outfall that conveys most of the storm water runoff into this park from an highly urban environment and will capture the floatable debris. The disadvantage is that trash that does not float will most likely not be captured by this boom.

Design Considerations

The rigid floating boom needed to be strong enough to withstand high velocity runoff and not pose a threat to wildlife. The anchors on both sides of the floating boom needed to be secured to a solid point. In this project, the boom was anchored to the ends of the concrete spillway.

Installation & Construction

There were no known issues with the installation or use of the trash collector system once installed.

Post Construction Comments

The trash collector has collected minimal amounts of trash since it has been installed. It is an encouraging sign that the nearby community of residents and visitors is respectful of the environment and the minimal amount of trash collected to date reflects a green attitude.

Estimated Cost of BMP				
Description	Quantity	Unit	Unit/Cost	Total
Trash Collector	50	LF	$70.00/LF	$3,500

Expected Pollutant Removal Efficiency

Since the project has recently been completed, the full pollutant removal efficiency capability of the BMPs will not be realized until the native plant material is mature and the Operations and Maintenance Program has been proactively maintaining and improving the BMPs.

The following information was submitted with the formal application for this project. Since the project was constructed essentially as proposed, the expected pollutant removal efficiency is still in the ranges originally calculated. However, the high school science classes will be an active participant in testing for several of these identified pollutants and will hopefully show results confirming the water quality benefits of these BMPs.

Based on studies of reports and collaboration with owners of green infrastructure improvements, the expected outputs are based on the following obtainable efficiencies:

Bio-Swales (minimum 200 feet in length, max velocity 1.5 ft/sec):

Parameter	Removal Rate	Project Removal Targets	Calculated Annual Output 300 Acres
Total Suspended Solids	83 to 92%	80%	445tns*(167tns)
Total Phosphorus	29 to 80%	50%	173lbs
Total Nitrates	39 to 89%	50%	297lbs

(State of Oregon DEQ) *Based on sample collected upstream in park. Adjusted to 30% based on watershed conditions due to adjacent upstream pond.

Infiltration Basin

Pollutant	Removal Rate	Project Removal Targets	Calculated Annual Output 10Acres
Sediment	99%	80%	15tns*(7.5tns)
Total Phosphorous	65-75%	70%	8.4lbs
Total Nitrates	60-70%	65%	12.8lbs

(Wisconsin Storm Water Manual) *Based on sample collected upstream in park. Adjusted to 40% based on watershed conditions .

The anticipated outcomes include a vastly improved quality of storm water entering the West Branch of the DuPage River. The green infrastructure technologies selected target identified pollutants entering this watershed. The reduced solids will also improve the turbidity of the water. The reduction of phosphorus, along with the planned riffles, will improve the oxygen levels in the water. A similar outcome is anticipated for the reduction in fecal coliform due the substantial reduction in geese frequenting this park.

Post-Construction Summary

Since 1980, when the village tried to replace the failed storm water and determined it was too costly to replace, this park and pond has been for the most part, a neglected piece of property. With the advent of Green Technology, it is finally possible to provide a variety of improvements to not only enhance this park but also provides valuable water quality benefits. The various BMPs recently installed on this park will greatly eliminate the severe erosion that has plagued this park for decades. Even though the native plantings have not matured, the appearance of the park has been greatly enhanced due to the new shoreline and elimination of the eroded bare soil pond edges.

As the landscaping matures, the park's appearance will continue to improve. The irony of the use of Green Technology at this location involved a failed attempt of the Park District to add native plantings along the shoreline in the 1990's. At that time, the residents who lived adjacent to the park protested adamantly against the use of this new technology and the Park District subsequently cancelled the project. However, over the past several years, the use of Green Technology is becoming much more common. Also, as the nearby Schaumburg High School Science Classes continued to use the old park as a laboratory, the student would learn of the benefits of Green Technology as well as the challenges of impaired water sheds. Many of these students live in the area adjacent to the park and may have had a profound impact on the residents, many who are parents of students of the High School. Both the Village and Park District now receive favorable comments regarding this park and the use of Green Infrastructure to improve this park.

In regard to the final project costs, the project was awarded at a cost approximately 70% higher than the project application estimate. The costs for earthwork, materials and working in and around poor soils all contributed to the higher than expected costs. The higher costs did not impact the approved IGIG grant amount, which is capped at $75,000 for this Green Infrastructure category. Both agencies involved in funding the local share of this project, the Village of Schaumburg and Schaumburg Park District are very pleased with this project and the benefits associated with the Green Infrastructure enhancements provided with this project. Both agencies appreciate the contributions of not only funds, but input provided by the knowledgeable staff and resources of the Illinois Environmental Protection Agency.

Final Cost of Terada Park Project							
		Original Concept Quantities			Final Project Quantities		
BMP	Location	Quantity	Unit	Total	Quantity	Unit	Total
Bioswale	Outfall	10,000	SF	$50,000	9,250	SF	$62,900
Bioswale	Salem Dr	3,000	SF	$15,000	1,400	SF	$8,624
Infiltration Trench	Salem Dr	5,000	SF	$30,000	7,700	SF	$48,741
Native Vegetation	Pond Shore	15,000	SF	$30,000	15,252	SF	$54,145
Pocket wetland	Bio-Swale Ent	1,000	SF	$6,000	600	SF	$14,700
Riffles/Filter	Sch Rd Outfall	2	Each	$3,000	2	Each	$10,206
Trash Collector	Sch Rd Outfall	50	LF	$1,000	50	LF	$3,500
New Outfall Structure	Outfall	1	Each	$10,000	1	Each	$27,260
Miscellaneous		1	LS	$5,000	1	LS	$25,000
Totals				**$150,000**			**$255,076**
IEPA IGIG 50% $75,000 MAX		**Local 50% $75,000**			**Local 70.6% $180,076**		

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