Final Project Report

DMACC Lake Watershed

#8023-013

Summary

The DMACC Lake Watershed Improvement project focused on reducing the quantity and improving the quality of stormwater runoff, as well as stream corridor stabilization. Roadway, parking lot, and roof drainage from the west and northwest portions of the campus have added significant amounts of pollutants and silt to the lake in the past. Another major source of sediment was severe channel erosion along the northern creek channel with exposed cut banks ranging from 2-10 feet in height and devoid of vegetation. Heavy lake sedimentation and algae blooms were a result of accumulated sediment being conveyed to the lake.

The project was completed as planned and described in the application. Multiple practices were implemented on the DMACC campus to reduce the delivery of pollutants, control channel erosion, and reduce sediment delivery to the lake. The resulting benefits include both improved quality and reduced quantity of runoff, a stabilized stream channel with a more natural appearance and reduced scour velocities.

The only thing remaining to achieve a high water quality lake at DMACC is the dredging of the years of accumulated sediment from the 14 acre lake itself. Lake surveys show an accumulation of 51,840 cubic yards of sediment. The shallow water causes excessive plant and algae growth which is unsightly and leads to low dissolved oxygen and fish kills. The shallow nature of the lake impedes angling opportunities, especially for youth during fishing clinics and events.

Financial Accountability

Watershed Improvement Funds

Grant Agreement Budget Line Item	WIRB Funds Approved	Actual Funds Expended	Phase I WIRB	Phase II WIRB	Funds Remaining at Completion
Creek Stabilization	$231,763.00	$230,725.75	$229,094.20	$ 1,631.55	$1,037.25
Surface Restoration	$ 53,912.00	$ 56,696.40	$ 35,168.40	$21,528.00	--($2,784.40)
Water Quality	$ 82,656.00	$ 76,590.00	$ 17,250.00	$59,340.00	$6,066.00
Forebay	$ 57,781.00	$ 61,317.40	$ 61,317.40	$ 0.00	--($3,536.40)
Vortech	$ 58,219.00	$ 59,150.74	$ 5,750.00	$53,400.74	--($ 931.74)
Filter Strip	$ 9,919.00	$ 9,919.00	$ 4,750.00	$ 5,169.00	$ 0.00
Signs	$ 5,750.00	$ 5,600.71	$ 2,500.00	$ 3,100.71	$ 101.05
Totals:	**$500,000**	**$500,000**	**$355,830.00**	**$144,170.00**	**--($ 0.00)**

Other Project Funding

Grant Agreement Budget Line Item	DMACC Cash Spent	In-Kind Total	Total Non-WIRB	Total Costs For Project	Percent WIRB Contribution
Creek Stabilization	$ 64,272.14	$614,913.00	$679,185.14	$909,910.89	25%
Surface Restoration	$ 13,790.98	$ 71,963.00	$ 85,753.98	$142,450.38	40%
Water Quality	$ 14,325.25	$ 91,080.00	$105,405.25	$181,995.25	42%
Forebay	$155,561.90	$100,739.41	$256,301.31	$317,618.71	19%
Vortech	$ 703.79	$ 67,380.00	$ 68,083.79	$127,234.53	46%
Filter Strip	$ 6,081.00	$ 12,500.00	$ 18,581.00	$ 28,500.00	35%
Signs	$ 48.24	$ 8,000.00	$ 8,048.24	$ 13,648.95	41%
Totals:	**$254,783.30**	**$966,575.41**	**$1,221,358.71**	**$1,721,358.71**	**29%**

The practices outlined in the grant were installed in two phases. The creek stabilization and sediment forebay were completed in the fall 2009 construction season. The vortech unit, filter strip, and the items called *Water Quality* in the application (wetlands, bioswale and inlet modifications) were completed in the late summer and fall of 2010. The remaining signs were designed, completed and installed in the spring of 2011.

The project was completed using the entire $500,000 WIRB allocation. The project was estimated to be completed for $1,453,400 and the project came in at $1,721,358.71. The overall cost was $267,959 more than anticipated. The sediment forebay was the main practice that came in well over the budgeted cost. The percent of contributions from WIRB are listed above. The initial project contribution from WIRB was anticipated to be 34%. However, the increased project costs shrank the WIRB contribution to just 29% of the total project costs. Additional financial accounting information can be found in the appendix.

The non-WIRB portion of the project was entirely paid for by DMACC. The only exception was the generous assistance from Polk County. They provided heavy equipment and operators to help with the excavation of the forebay and grading of the north creek improvements.

Environmental Accountability

Water Quality Monitoring

Water quality monitoring was initiated post watershed work to provide baseline data and to assess the effects of the watershed treatments. Samples were taken from 4 sites from April through August, 2010. The two tributary sites were taken from above and below the recently installed forebay. The two lake sites were taken from the north (shallow) arm of the lake and the south (deep) arm of the lake. The lake had normal phosphorus, nitrogen and total suspended solid levels when compared to other Iowa lakes. A reduction in total suspended solids (TSS) indicated that the forebay is effective at further reducing sediment delivery to the lake. High levels of ammonia were observed in the lake from April to June, which was likely caused by mixing of anoxic water from the bottom to the surface by wind action (pers. communication, Lisa Fascher IDNR). More quality monitoring at the two main lake sites is being recommended as part of the next project: dredging the lake. The committee hopes to document the impact of dredging to the main lake water quality.

Summary of Practices & Activities

This project completed all of the practices that were outlined in the proposal and the budget. They were all successful and are now working to reduce pollutant loadings, treat stormwater runoff and protect water quality. The table below summarizes the projects completed.

Accumulated sediment is visible during forebay construction when the lake elevation was lowered.

Practices Installed	***Approved Goal***	***Percent Completed***
Creek Stabilization	1,800 feet	100%
Surface Restoration	All	100%
Wetlands (WQ Improvement)	1	100%
Bioswales (WQ Improvement)	1	100%
Inlet Modification (WQ Improvement)	5	100%
Forebay	1	100%
Vortech Unit	1	100%
Filter Strip	2 acres	100%
Educational Signs	2	300%

Load Reduction Benefits

Environmental Benefits

Practice	Area acres	Gallons Treated	TSS t/yr	N lb/yr	P lb/yr	Soil Loss Before	Soil Loss After
Creek Stabilization	1.3	-----	7	---	9	350	7
Wetlands (WQ)	43.5	17.7 Million	26	165	24	---	---
Vortech	18	7.3 Million	5.6	34	15.7	---	---
Forebay	419	2 Million	147	---	217	3	3
Filter Strip	47.5	5.3 Million	7.8	33	4.7	---	---
Totals:	**529.3**	**32.2 Million**	**193.4**	**232**	**270.4**	**353**	**10**

Percent Pollutant Load Reductions Calculated per Practice

Practice	TSS t/yr	% TSS Reduction	N lb/yr	% N Reduction	P lb/yr	% P Reduction
Wetlands (WQ)	26	83%	165	48%	24	30%
Vortech	5.6	48%	34	15%	15.7	48%
Filter Strip	7.8	83%	49	30%	7	30%
Totals:	**193.4**	**---**	**248**	**---**	**272.4**	**---**

Overall Total Load Reduction

Source	Amount	Units
Sediment	193.4	Tons/year
Nitrogen	248	Lbs/year
Phosphorus	272.4	Lbs/year
Stormwater	32,242,983	Gallons treated/year

Pollutant load reduction calculations and assumptions can be found in the appendix. The reductions are based upon the typical concentrations of pollutants in stormwater as determined by the EPA and the Nationwide Urban Runoff Program (NURP) studies of stormwater runoff. Load estimates were chosen from the mid-range of the NURP tables. Load reductions were calculated using the following formula:

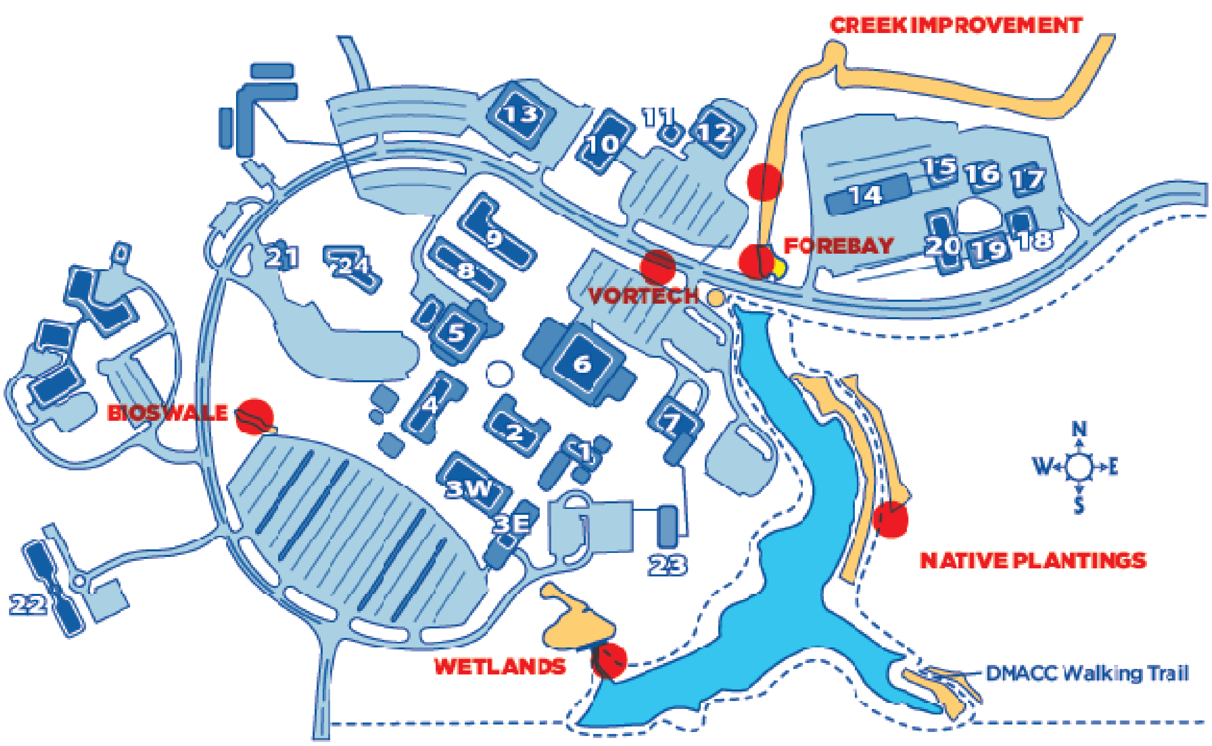
drainage area * total lbs pollutant/ac/yr @ 100% runoff * % actually running off *% reduced by BMP = lbs/yr captured

The goal of the DMACC Lake Watershed project was to retrofit the watershed on campus to protect water quality in the lake. This goal was accomplished with the installation of all the practices set forth in the grant application. Information and pictures follow that highlight the benefits that these practices have made to the watershed on the DMACC campus.

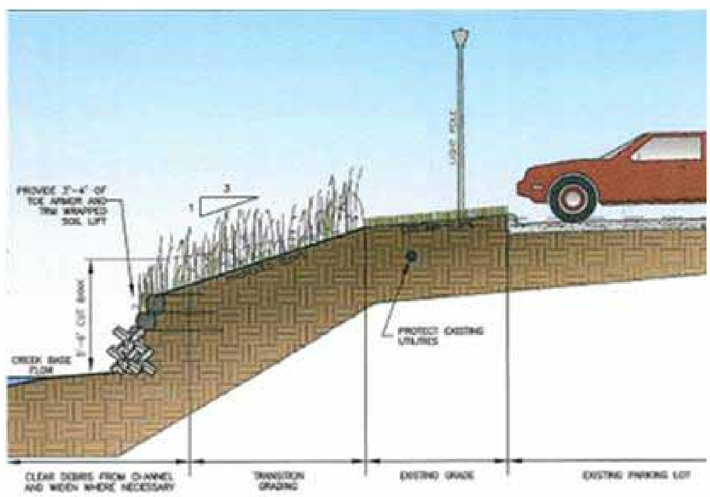
The innovative forebay outlet structure (top right) features a three staged weir that retains and slowly releases small rain events to allow sediment deposition. The hole (visible in the concrete wall at water line) passes normal stream flow. When small runoff events occur water is retained (see discoloration on structure) and is slowly released through the holes. In larger rain events, the water level rises and flows over the three additional release levels in the structure. The outlet structure manages the frequent small rains which account for the majority of annual precipitation.

These culverts, replaced by the forebay, allowed unrestricted flow of sediment to the lake.

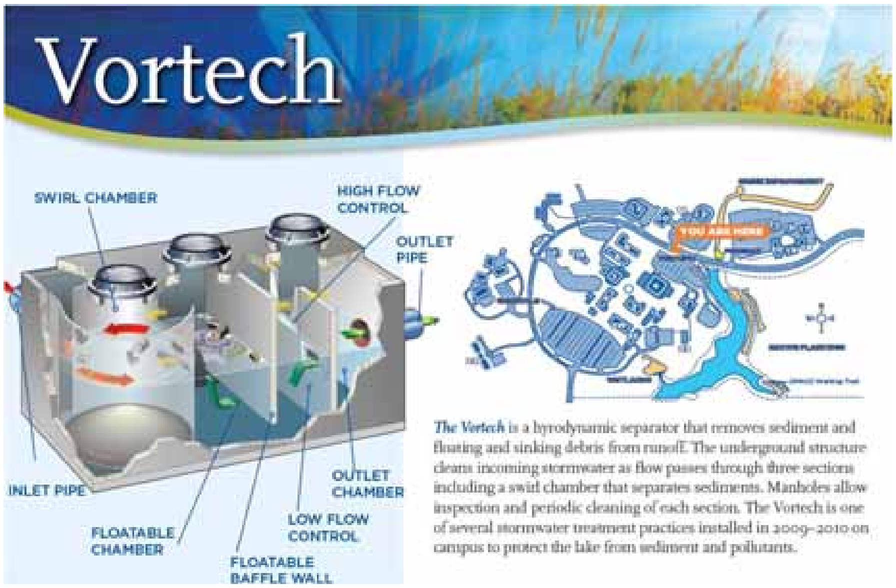
Locations of improvements (and signs) protecting water quality on DMACC campus in Ankeny.



Creek Stabilization: The 1,800 feet of creek was stabilized with 12,000 cubic yards of grading to pull back the steep slopes of the creek, 1,330 lineal feet of slope toe armor to stabilize the creek bank, 4 riffle dam structures. These structures create riffles and pools that prevent down cutting of the stream bed, control flow velocities and improve aquatic habitat in the stream. Grading slopes back to stable and more manageable angles has allowed deep rooting native vegetation to establish and protect the slopes from erosion. The toe armor around outside bends has stopped the undercutting of the banks. The riffle dams provide a more natural means of reducing stream velocity. It is estimated that the stabilization of this channel will lessen the amount of sediment from reaching the lake by 343 tons/year.



Before and after photos of creek at DMACC.

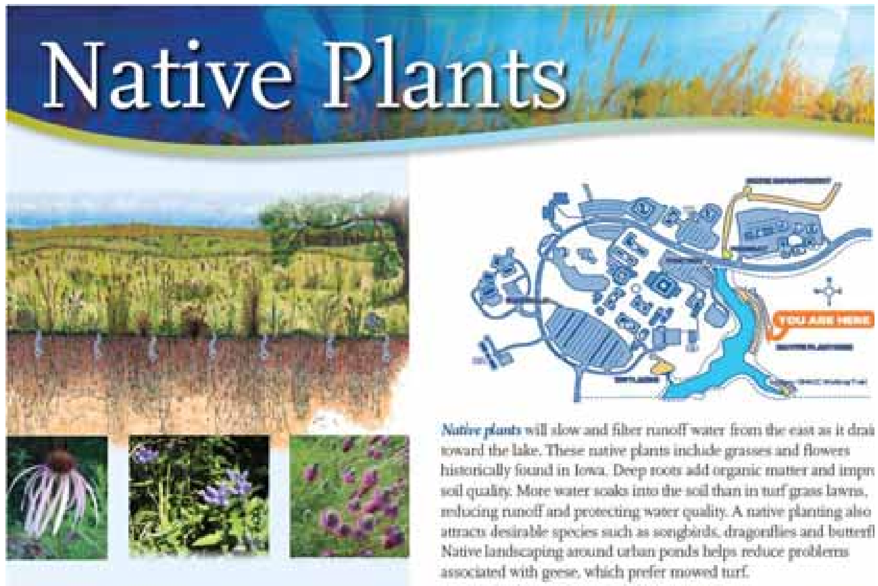


Vortech Unit: A hydrodynamic separator device called a Vortech unit was installed and is being used to treat the parking lot, road runoff, and roof drainage by settling out the heavier sediment particles and debris. Space was limited, making this the best practice to treat stormwater runoff. The device will collect the sediment and debris before it reaches the lake. It will be periodically cleaned and the amount of material that was stopped from reaching the lake can be measured. Information on this technology and its load reduction capacity can be found in the appendix.

Installation of the Vortech. July 2010.

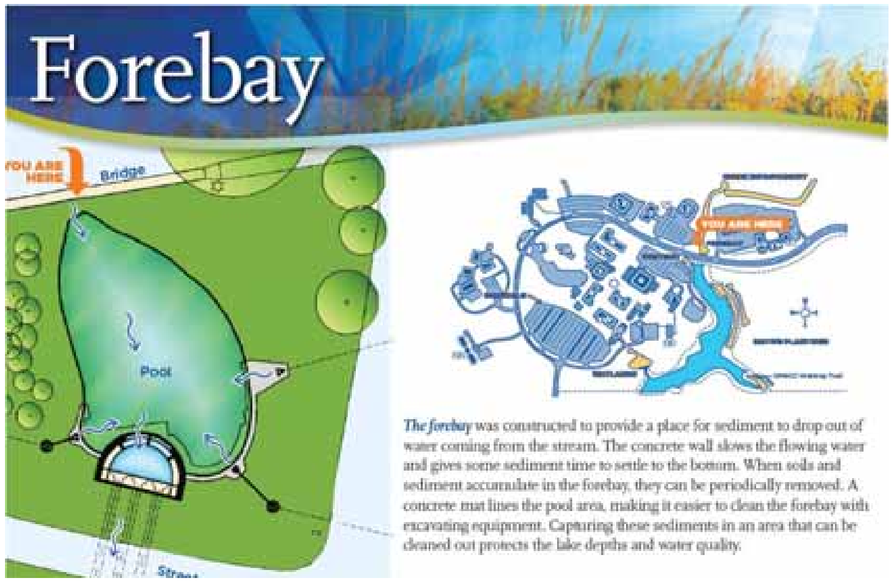
This sign is the only indication of the water quality practice that lies just below the surface. In the background the parking lot that contributes stormwater runoff is visible.

Native Filter Strip Planting: Two acres of native plants were planted as filter strip plantings to create a buffer. The buffer is filtering sediment and other pollutants from stormwater runoff before it reaches the lake. The planting area buffers the lake from 47.5 acres of overland flow on campus. It is also a beautiful addition to the landscaping around the lake and provides trail users with a colorful display of wildflowers, butterflies, and dragonflies.



Trail users take advantage of beauty many of these watershed improvements provide. Signage provides information about the recently installed water quality improvement practices.

Forebay: The sediment forebay is a basin designed to dissipate the energy of incoming runoff and detain the runoff for initial settling of coarse particulates. This sediment forebay constructed with a control weir and armor mat bottom is capturing silt before it enters the lake and giving DMACC maintenance personnel a place to monitor and remove trapped sediment.

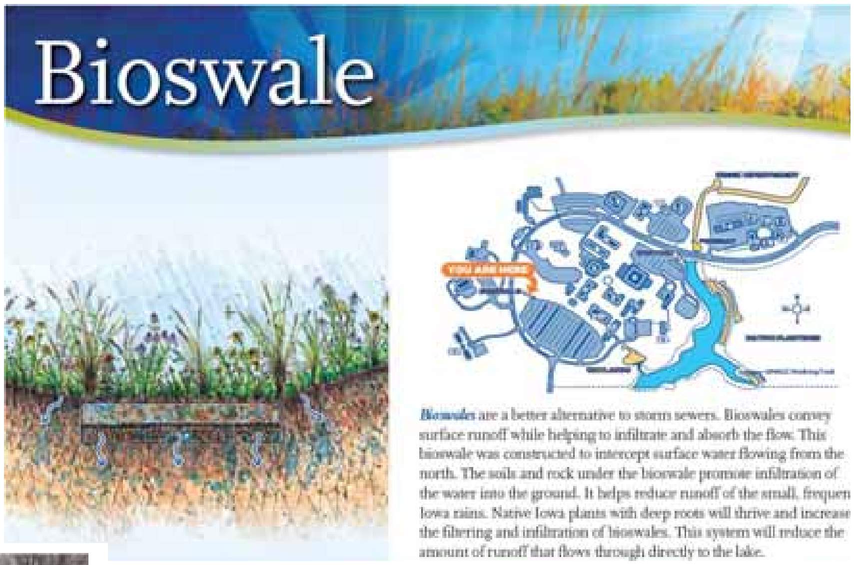


Pictures illustrate the construction of the forebay, including the hard surface that will allow for clean-out of the stored sediment.

Constructed Wetlands (Category-Water Quality Improvement) : The constructed wetland intercepts and treats runoff from 43.5 acres including the west DMACC parking lot, before being discharged into the lake. A variety of native grasses and forbs (wildflowers) will attract and support numerous insects and their predators. The wetland slows incoming flows and temporarily detains minor storm events allowing sediments to settle. A wide variety of aquatic and edge plants provides wildlife habitat while removing many pollutants from the water.

Stormwater wetland under construction.

Long stormwater flow path, treatment forebay and micropool wetland area after construction.



Bioswale (Category-Water Quality Improvement): A bioswale was constructed on the west side of campus to intercept flow and treat it prior to its release into the treatment train that flowed into the new constructed wetland practice. This practice will reduce the volume of runoff and increase water quality. It was also seeded to native plants.

Bioswale after construction prior to establishment of vegetation.

Inlet Modifications (Category-Water Quality Improvement): Five storm drain inlets around campus were modified to cleanse and infiltrate water prior to their release to either the constructed wetland or the north creek channel. These modifications treat runoff from sidewalks and pavement. The areas were reshaped and water has a chance to infiltrate for before discharging to surface water, either in north creek or the stormwater wetland.

Surface Restoration: This funding was used to stabilize the areas disturbed in the construction of the retrofits on the DMACC campus. All the areas were seeded back to turf or a mixture of native vegetation.

Educational Signage: The grant called for two signs. However, the lake committee decided to install six signs to highlight the practices as people use the walking trails around campus. The signs highlight these main practices installed through the grant process.

SIGNS:
Stream Stabilization
Forebay
Vortech Unit
Native Plants (filter strip)
Wetland
Bioswale

Program Accountability

Public Outreach

Informational talks and tours have been given to many groups in the last three years. Powerpoint presentations and campus tours were given to five DMACC environmental and biology classes on campus. A presentation of accomplishments at DMACC Lake was also given to the Central Iowa Greenways Committee at their meeting on March 23, 2011. A variety of slides and information about practices on the DMACC campus are also given in many of the frequent presentations given to groups around central Iowa by the Polk SWCD Urban Conservationist. An article was also put into place in the DMACC newspaper Campus Chronicle in March, 2011 that highlighted the practices and their impacts to water quality and the lake. A busload of approximately 45 people on the State Soil Conservation Committee and Conservation Districts of Iowa toured the DMACC campus as part of their 2011 summer tour. A tour guide document that highlighted the practices with photos and their benefits is included in the appendix of this report.

The six educational signs (as seen above) explain the water quality improvements and provide information to visitors and trail users around the campus. The signs illustrate the practices, how they work, and their importance for protecting water quality.

Many people utilizing the trail system and at events on campus will learn about the improvements to the watershed and what it can mean to water quality in the local resource.

DMACC Lake has been utilized as a location for fishing events that are close to the urban population. The lake has hosted a number of fishing events and has been stocked with trout to provide fun sport fish to catch.

Total DMACC LAKE Project Funding

Practice	WIRB Cash Budget	Actual	WIRB Phase I	WIRB Phase II	Phase I DMACC Cash	Phase II DMACC Cash	DMACC Cash Total	Phase I In Kind	Phase II In Kind	In-kind Total	TOTAL NON WIRB	TOTAL TOTAL	Actual % WIRB	Allowed % WIRB
Creek	$231,763.00	$230,725.75	$229,094.20	$1,631.55		$64,272.14	$64,272.14	$587,413.00	$27,500.00	$614,913.00	$679,185.14	$909,910.89	25%	28
Surface	$53,912.00	$56,696.40	$35,168.40	$21,528.00		$13,790.98	$13,790.98	$71,963.00	$0.00	$71,963.00	$85,753.98	$142,450.38	40%	43
Water Q	$82,656.00	$76,590.00	$17,250.00	$59,340.00	$1,000.00	$13,325.25	$14,325.25		$91,080.00	$91,080.00	$105,405.25	$181,995.25	42%	42
Forbay	$57,781.00	$61,317.40	$61,317.40	$0.00	$123,247.29	$32,314.61	$155,561.90	$100,739.41	$0.00	$100,739.41	$256,301.31	$317,618.71	19%	40
Vortech	$58,219.00	$59,150.74	$5,750.00	$53,400.74		$703.79	$703.79		$67,380.00	$67,380.00	$68,083.79	$127,234.53	46%	46
Filter Strip	$9,919.00	$9,919.00	$4,750.00	$5,169.00		$6,081.00	$6,081.00		$12,500.00	$12,500.00	$18,581.00	$28,500.00	35%	35
Signs	$5,750.00	$5,600.71	$2,500.00	$3,100.71		$48.24	$48.24		$8,000.00	$8,000.00	$8,048.24	$13,648.95	41%	41
	$500,000.00	**$500,000.00**	$355,830.00	$144,170.00	$124,247.29	$130,536.01	$254,783.30	$760,115.41	$206,460.00	$966,575.41	$1,221,358.71	**$1,721,358.71**		
			Total:	**$500,000.00**								% WIRB Contr	29%	

Pollutant Load Reduction Calculations
DMACC Lake
July 2011

Typical concentration of pollutants in stormwater from the EPA
and the Nationwide Urban Runoff Program (NURP).
The mid-range of the NURP recommendations for load estimates was calculated).

Total Suspended Solids

1 in/ac = 27,152 gallons x 32 in/yr = 868,864 gals/ac/yr

Typical TSS in stormwater = 364 mg/l

364 mg = 0.000801 lbs (from cell phone "Unit Converter")

1 liter = 0.264172 gals (from cell phone "Unit Converter")

$$\frac{0.000801 \text{ lbs/gal} \times 868{,}864 \text{ gals/ac/yr}}{0.264172 \text{ gals}}$$ = **2,634 lbs/ac/yr TSS with 100% runoff**

Total P

1 in/ac = 27,152 gallons x 32 in/yr = 868,864 gals/ac/yr

Typical Total P in stormwater = 0.65 mg/l

0.65 mg = 0.000001 lbs (from cell phone "Unit Converter")

1 liter = 0.264172 gals (from cell phone "Unit Converter")

$$\frac{0.000001 \text{ lbs/gal} \times 868{,}864 \text{ gals treated / yr}}{0.264172 \text{ gals}}$$ = **3.3 lbs/ac/yr total P with 100% runoff**

Total Kjeldahl Nitrogen

1 in/ac = 27,152 gallons x 32 in/yr = 868,864 gals/ac/yr

Typical Total Kjeldahl N in stormwater = 3.04 mg/l

3.04 mg = 0.000007 lbs (from cell phone "Unit Converter")

1 liter = 0.264172 gals (from cell phone "Unit Converter")

$$\frac{0.000007 \text{ lbs/gal} \times 868{,}864 \text{ gals treated / yr}}{0.264172 \text{ gals}}$$ = **23 lbs/ac/yr Total Kjeldahl N with 100% runoff.**

DA x total lbs pollutant/ac/yr w/100% runoff x % that runs off x % reduced by BMP = lbs/yr captured

Stormwater Wetland: 75% to 100% imperviousness*

TSS: Assume high or 83% removal rate with wetlands**

43.5 ac x 2,634 lbs/ac/yr TSS x 55% runoff x .83% removal = **26 tons/yr TSS** captured
2,000 lbs/ton

Total P: Assume low to medium or 30% removal rate with wetlands**

43.5 ac x 3.3 lbs/ac/yr P x 55% runoff x .30% removal = **24 lbs /yr P** captured

Total Kjeldahl N: Assume medium or 48% removal rate with wetlands**

43.5 ac x 23 lbs/ac/yr N x 55% runoff x 48% removal = **165 lbs / yr N** captured

Filter Strip: Non-natural green space – 15% runoff*

TSS: Assume high or 83% removal rate**

47.5 ac x 2,634 lbs/ac/yr x 15% runoff x 83% removal = **7.8 tons/yr TSS** captured
2,000 lbs/ton

Total P: Assume low or 30% removal rate**

47.5 ac x 3.3 lbs/ac/yr x 15% x 30 removal % = **7 lbs/yr P** captured

Total Kjeldahl N: Assume low to medium or 30% removal rate**

47.5 ac x 23 lbs/ac/yr x 15% x 30% removal = **49 lbs/yr N** captured.

Hydrodynamic device (Vortech): 75% to 100% imperviousness*

Low trap efficiency:

TSS: Assume low or 15% removal rate with hydrodynamic device**

18 ac x 2,364 lbs/ac/yr x 55% x 15% = **1.8 tons/yr TSS** captured
2,000 lbs/ton

Total P: Assume low or 15% removal rate with hydrodynamic device**

18 ac x 3.3 lbs/ac/yr x 55% x 15% = **5 lbs/yr P** captured

Total Kjeldahl N: Assume low or 15% removal rate with hydrodynamic device**

18 ac x 23 lbs/ac/yr x 55% x 15% = **34 lbs/yr N** captured

High Trap Efficiency:

TSS: Assume high or 80 % removal rate***

$$\frac{\text{18 ac x 2,364 lbs/ac/yr x 55\% x 80\%}}{\text{2,000}}$$ = **9.4 tons/yr TSS** captured

Total P: Assume high or 80% removal rate with hydrodynamic device***

18 ac x 3.3 lbs/ac/yr x 55% x 80% = **26 lbs/yr P** captured

Total Kjeldahl N:

Use the low capture range from above

Mid-range Trap Efficiency:

TSS: (15% + 80% = 95% / 2 = 48%)

$$\frac{\text{18 ac x 2,364 lbs/ac/yr x 55\% runoff x 48\% removal}}{\text{2,000 lbs/ton}}$$ = **5.6 tons/yr TSS** captured

Total P:

18 ac x 3.3 lbs/ac/yr x 55% runoff x 48% removal = **15.7 tons/yr P** captured

Total Kjeldahl N:

Use the low capture range from above

*Percent of runoff according to land use was taken from the Iowa Stormwater Management Manual Chapter 2A-1, Figure 1, page 2.

**Percent removal used was the mid-range of Benefits Chart from the Iowa Storwater Management Manual General Information for Individual BMP's.

***More recent research on the Contech Vortechs Model 5000 showed a high TSS removal efficiency rate of 80%. The rmoval rate of TSS and P are re-calculated with high efficiency to show the potential capture of TSS and P. P was recalculated on the assumption that most P movement would be attached to sediment. With high removal efficiency of TSS high removal of P should be achieved. N capture was not recalculated, assuming most N will be moving in solution and a low removal rate would be achieved.

Gallons of Stormwater Treated

Vortech device:
18 ac x 27,152 gals/ac/in = 488,736 gals/inch x 32 in/yr = 15,639,552 gals/yr

15,639,552 gals/yr x 55% runoff = 8,601,753 gallons of runoff

8,601,753 gallons of runoff x 85% treated = **7.3 million gallons treated**

Stormwater Wetland:
43.5 ac x 27,152 gals/ac/in = 1,181,112 gals/inch x 32 in/yr = 37,795,584 gals/yr

37,795,584 gals/yr x 55% runoff = 20,787,571 gallons of runoff

20,787,571 gallons of runoff x 85% treated = **17.7 million gallons treated**

Filter Strip:
47.5 ac x 27,152 gals/ac/in = 1,289,720 gals/inch x 32 in/yr = 41,271,040 gals/yr

41,271,040 gals/yr x 15% runoff = 6,190,656 gallons of runoff

6,190,656 gallons of runoff x 85% treated = **5.3 million gallons treated**

Forebay:

419 ac x 27,152 gals/ac/in = 11,376,688 gals/inch x 32 in/yr = 364,054,010 gals/yr

364,054,010 gals/yr x 55% runoff = 200,229,700 gallons of runoff

200,229,700 gallons of runoff x 1% treated* = **2 million gallons treated**

The actual treatment provided by the forebay is unknown. 1% is a conservative estimate. Post construction monitoring will better define how much treatment the forebay provides.

DMACC Lake Watershed

Legend

Resource Inventory (Polygon)

Table 1.-Quality Characteristics of Runoff From Residential and Commercial Areas

Constituent	Average residential or commercial site concentration	Weighted mean residential or commercial site concentration	NURP recommendations for load estimates
TSS..................	239 mg/l	180 mg/l	180-548 mg/l
BOD...................	12 mg/l	12 mg/l	12-19 mg/l
COD..................	94 mg/l	82 mg/l	82-178 mg/l
Total Phosphorus.....	0.5 mg/l	0.42 mg/l	0.42-0.88 mg/l
Soluble Phosphoru....	0.15 mg/l	0.15 mg/l	0.15-0.28 mg/l
Total Kjeldahl Nitrogen....	2.3 mg/l	1.90 mg/l	1.90-4.18 mg/l
Nitrate-Nitrite......	1.37 mg/l	0.86 mg/l	0.86-2.21 mg/l
Total Copper.........	53 µg/l	43 µg/l	43-118 µg/l
Total Lead...........	238 µg/l	182 µg/l	182-443 µg/l
Total Zinc...........	353 µg/l	202 µg/l	202-633 µg/l
Fecal Coliform:			
Warm Weather.......	50,240 counts/100 gml	27,605 counts/100 ml	
Cold Weather.......	22,918 counts/100 gml	7,075 counts/100 ml	

Source: Developed from Results of the Nationwide Urban Runoff Program, Vol. 1-Final Report, EPA 1983.

ENVIRONMENTAL PROTECTION AGENCY

[FRL-4202-5]

Final NPDES General Permits for Storm Water Discharges Associated
With Industrial Activity

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice of final NPDES general permits.

Modeling Long Term Load Reduction: The Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydrologically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. To estimate efficiencies as accurately as possible, CONTECH Stormwater Solutions Inc. has developed the Rational Rainfall Method™ which combines site-specific information with laboratory generated performance data (see Technical Bulletin 1 for more information), and local historical precipitation records.

Short duration rain gauge records from across the United States and Canada were analyzed by CONTECH Stormwater Solutions to determine the percent of the total annual rainfall that fell at a range of intensities. At U.S. stations, depths were totaled every 15 minutes or hourly and recorded in 0.01-inch increments. Depths were recorded hourly with 1 mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and intense storms contributed relatively little to the total depth.

These intensities along with the total drainage area and runoff coefficient for each specific site are translated into flow rates using the Rational Method. The flow rates are then used to calculate operating rates for a proposed CONTECH Stormwater Solutions system. Finally, operating rates are paired with their corresponding removal efficiencies. See figure 4 for a graphic illustration this relationship between operating rate, removal efficiency and intensity distribution.

The net annual TSS removal efficiency is then calculated by summing the relative efficiencies at each intensity (see Table 4.1 and 4.2).

How the Vortechs® System Removal Efficiencies and Operating Rates Relate to Rainfall Intensity Distribution

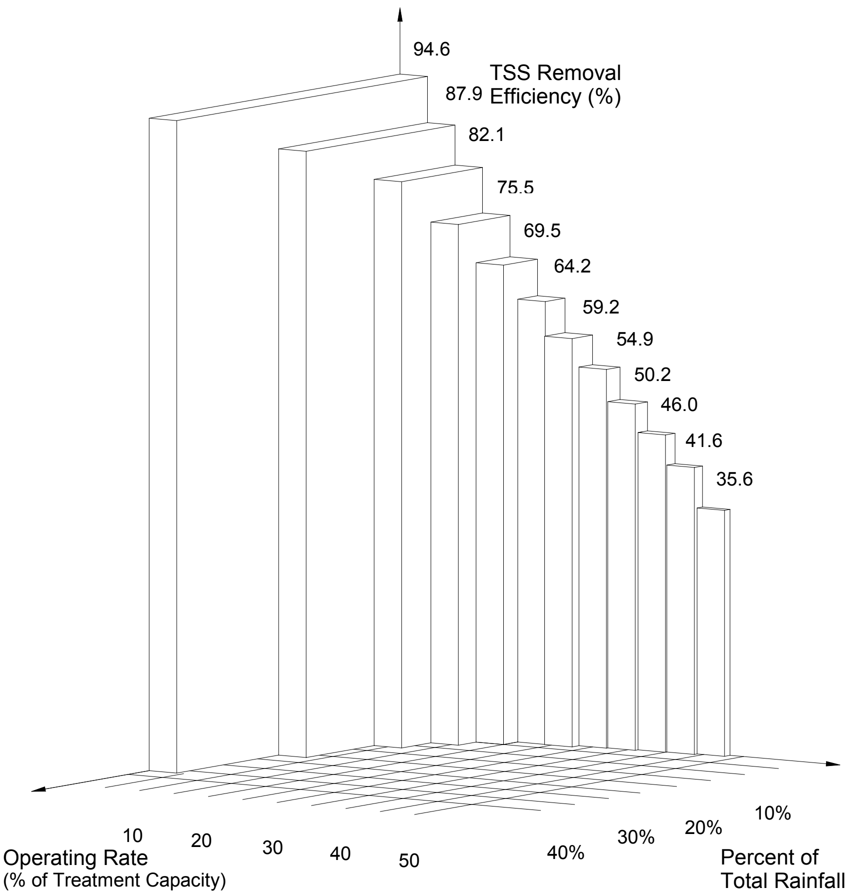


Figure 4

The same process was used to develop the CONTECH Stormwater Solutions sizing methodology described in Technical Bulletin 3. The design ratio was created as a tool to help calculate an operating rate from an intensity. Maximum design ratios for different geographic regions across North America have been determined through analysis of historical precipitation records archived by the National Climatic Data Center. Depending on climatic regime, design ratio thresholds vary, with higher design ratio thresholds in areas like the Gulf Coast where high intensity precipitation is common and lower thresholds in areas like the Pacific Northwest where the vast majority of rain falls at very low

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Table 4.1: Vortechs® Model 5000 Net Annual TSS Removal Efficiency in Portland, ME

$$\text{Design Ratio}^1 = \frac{(4.5\text{ acres}) * (0.95) * 449\text{ gpm/ft}^2)}{38.5\text{ ft}^2} = 50$$

Rainfall Intensity		Operating Rate[2]	% Total Rainfall Volume[3]	Removal Efficiency[4]	Relative Efficiency
in/0.25 hr	in/hr	gpm/ft²			
0.02	0.08	4	36.9%	94%	34.7%
0.04	0.16	8	21.9%	88%	19.3%
0.06	0.24	12	11.9%	82%	9.8%
0.08	0.32	16	7.6%	76%	5.8%
0.10	0.40	20	5.0%	70%	3.5%
0.12	0.48	24	2.9%	64%	1.9%
0.14	0.56	28	3.0%	60%	1.8%
0.16	0.64	32	2.0%	55%	1.1%
0.18	0.72	36	1.8%	51%	0.9%
0.20	0.80	40	1.4%	46%	0.7%
0.22	0.88	44	1.2%	41%	0.5%
0.24	0.96	48	0.8%	36%	0.3%
				subtotal:	**80.2%**
				% rain falling at 0.96 in/hr:	**3.5%**
				assumed removal efficiency of remaining %:	**0.0%**
				net annual TSS removal efficiency:	**80%**

1 - Design Ratio = (Total Drainage Area) * (Runoff Coefficient) * (cfs to gpm conversion) / Grit Chamber Area
- Total Drainage Area and Runoff Coefficient are specified by the site engineer.
- The conversion factor from cfs to gpm is 449.

2 - Operating Rate (gpm/ft^2) = Intensity (in/hr) * Design Ratio
3 - Based on 5 years of rainfall data recorded at 15 minute intervals in Portland, ME.
4 - Based on CONTECH Stormwater Solutions laboratory verified removal of 50 micron particles.

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Table 4.2: Vortechs® Model 5000 Net Annual TSS Removal Efficiency in Toronto, ON, Canada

$$\text{Design Ratio}^{1} = \frac{(2.3\ \text{hectare}) * (100\%) * (2.78)}{3.58\ \text{m}^2} = 1.79$$

Rainfall Intensity mm/hr	Operating Rate[2] (L/s)	% Total Rainfall Volume[3]	Removal Efficiency[4]	Relative Efficiency
1	1.8	19.7%	97%	19%
2	3.6	18.4%	93%	17%
3	5.4	10.8%	90%	9.7%
4	7.2	9.3%	86%	8.0%
5	8.9	7.3%	80%	5.9%
6	11	6.0%	77%	4.7%
7	13	5.8%	72%	4.2%
8	14	3.2%	68%	2.2%
9	16	1.9%	65%	1.3%
10	18	4.2%	62%	2.6%
11	20	2.5%	60%	1.5%
12	21	1.9%	56%	1.0%
15	27	3.5%	47%	1.6%
20	36	2.1%	31%	0.7%
25	45	2.4%	16%	1.4%
			subtotal:	**81%**
			% rain falling at > 25 mm/hr:	**1.0%**
			assumed removal efficiency of remaining %:	**0.0%**
			net annual TSS removal efficiency:	**81%**

1 - Design Ratio = (Total Drainage Area) * (Runoff Coefficient) * (2.77) / Grit Chamber Area
- Total Drainage Area and Runoff Coefficient are specified by the site engineer.
2 - Operating Rate (L/s) = Intensity (mm/hr) * Design Ratio
3 - Based on 10 years of rainfall data from Canadian Station 6158350, Toronto, Ontario, Canada.
4 - Based on CONTECH Stormwater Solutions laboratory verified removal of 50 micron particles.

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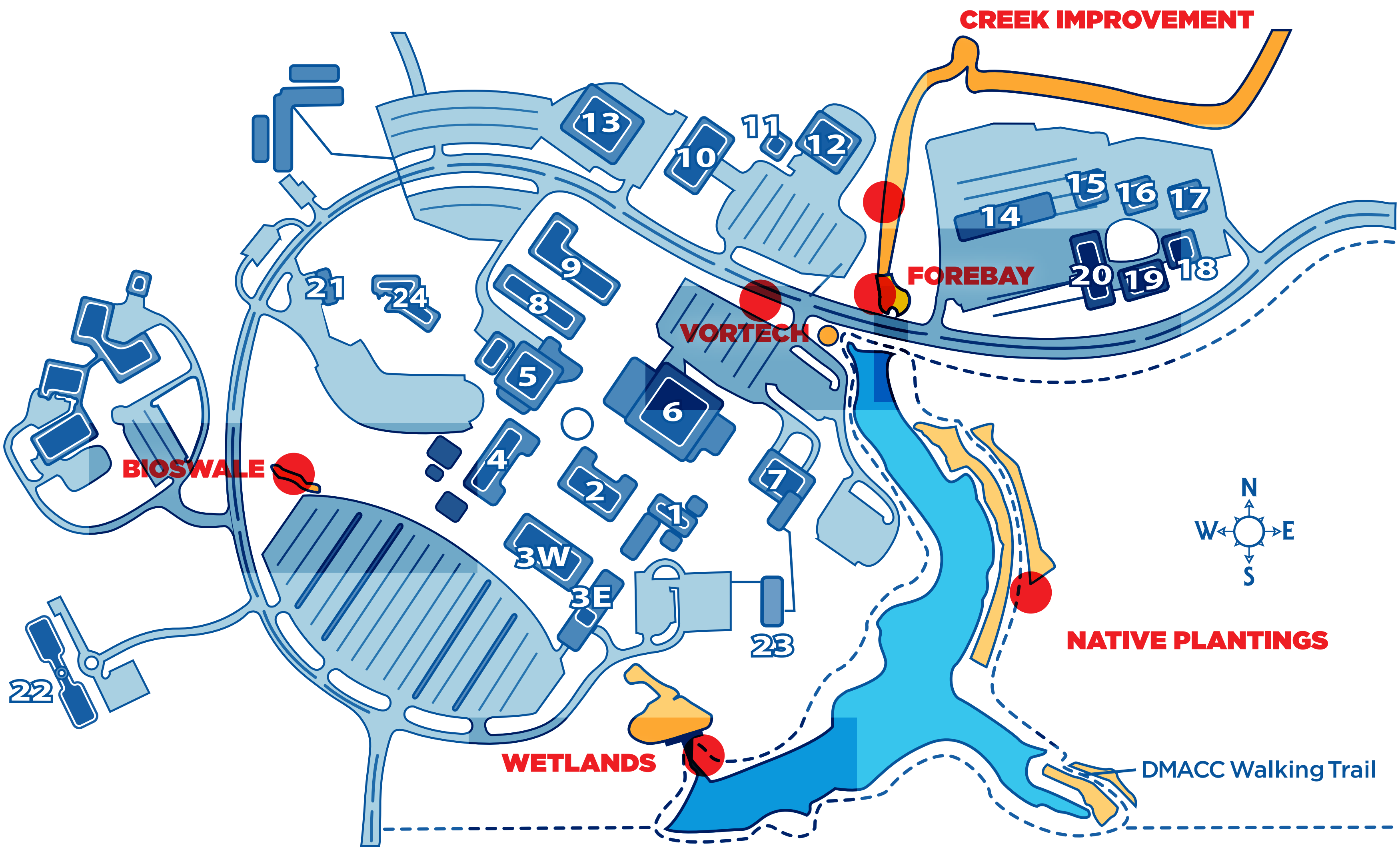

CREEK IMPROVEMENT
13
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FOREBAY
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19
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VORTECH
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BIOSWALE
4
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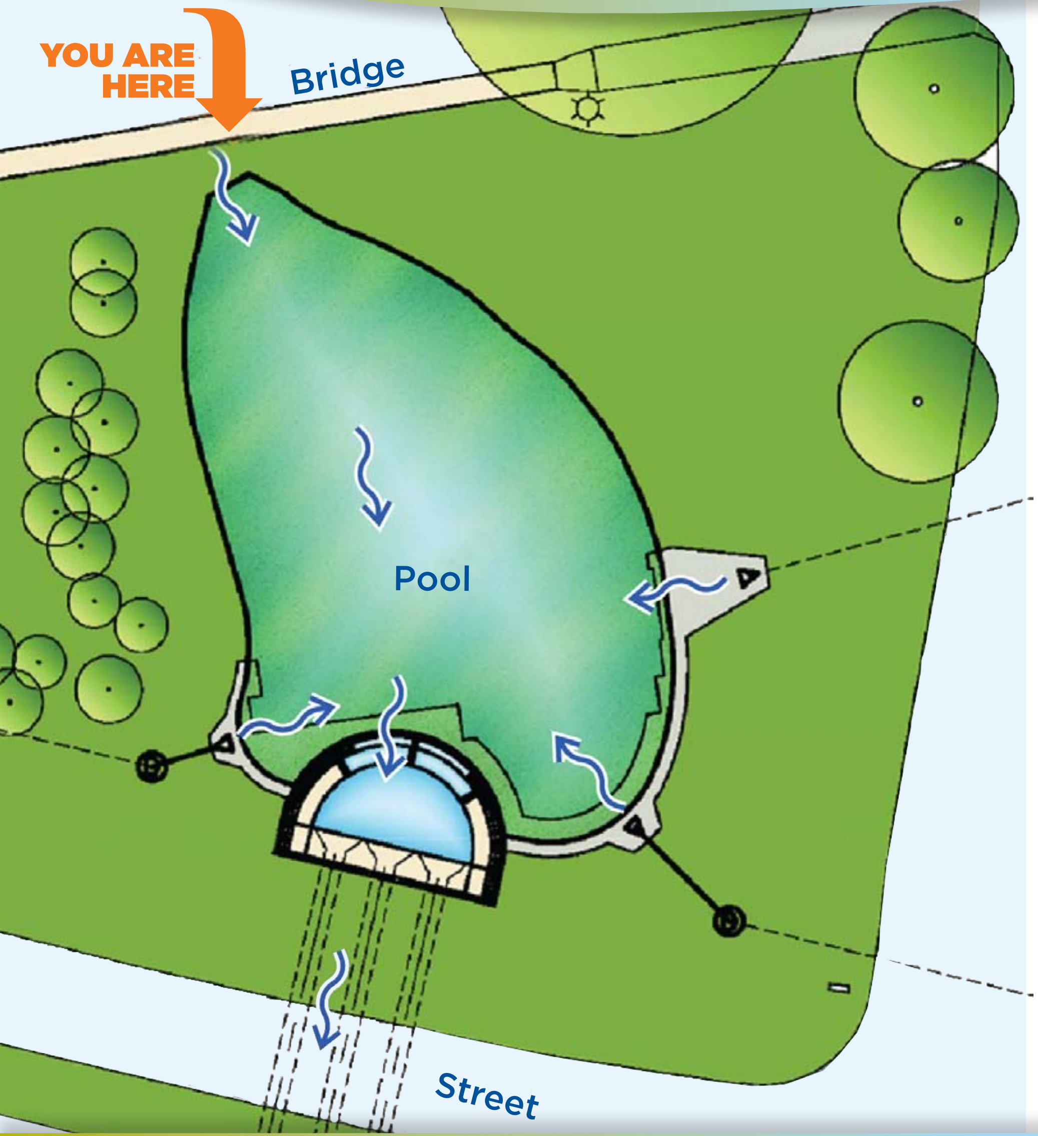
S
NATIVE PLANTINGS
WETLANDS
DMACC Walking Trail

Forebay



The forebay was constructed to provide a place for sediment to drop out of water coming from the stream. The concrete wall slows the flowing water and gives some sediment time to settle to the bottom. When soils and sediment accumulate in the forebay, they can be periodically removed. A concrete mat lines the pool area, making it easier to clean the forebay with excavating equipment. Capturing these sediments in an area that can be cleaned out protects the lake depths and water quality.

Improving *Water Quality*

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Creek Improvement

Creek improvements were installed to stabilize slopes and reduce erosion that was causing sedimentation in DMACC lake. These improvements include sloped grading, armoring, riffle dams and native plantings. Previously, stormwater runoff from upstream areas scoured the banks of the creek and washed soil into the water. A more stable stream channel was created by reducing both the grade of the creek and slope of the banks. Native plants help hold soil on the banks while concrete and stone armor the toe of the slope.

Improving *Water Quality*

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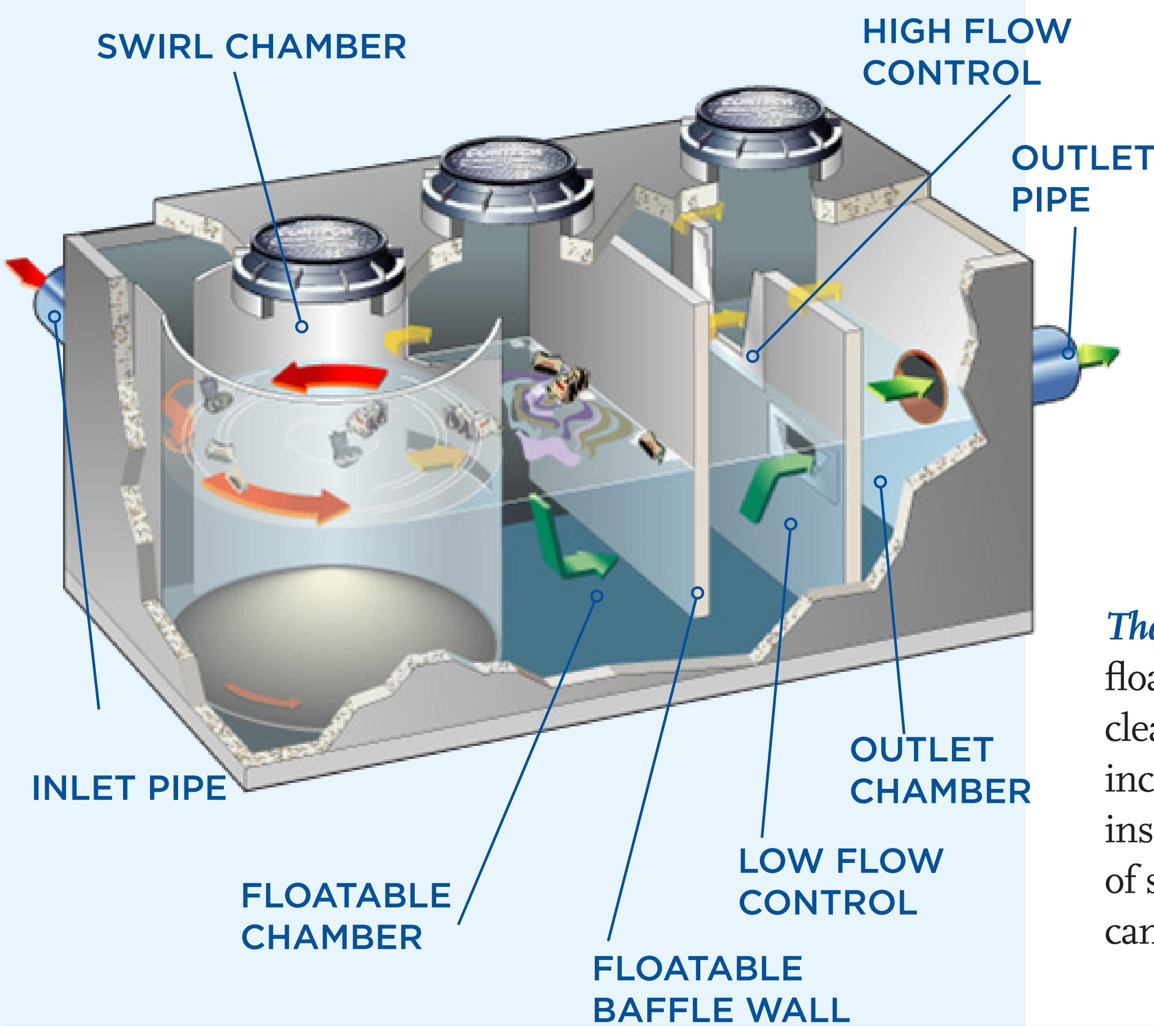
Vortech



The Vortech is a hyrodynamic separator that removes sediment and floating and sinking debris from runoff. The underground structure cleans incoming stormwater as flow passes through three sections including a swirl chamber that separates sediments. Manholes allow inspection and periodic cleaning of each section. The Vortech is one of several stormwater treatment practices installed in 2009–2010 on campus to protect the lake from sediment and pollutants.

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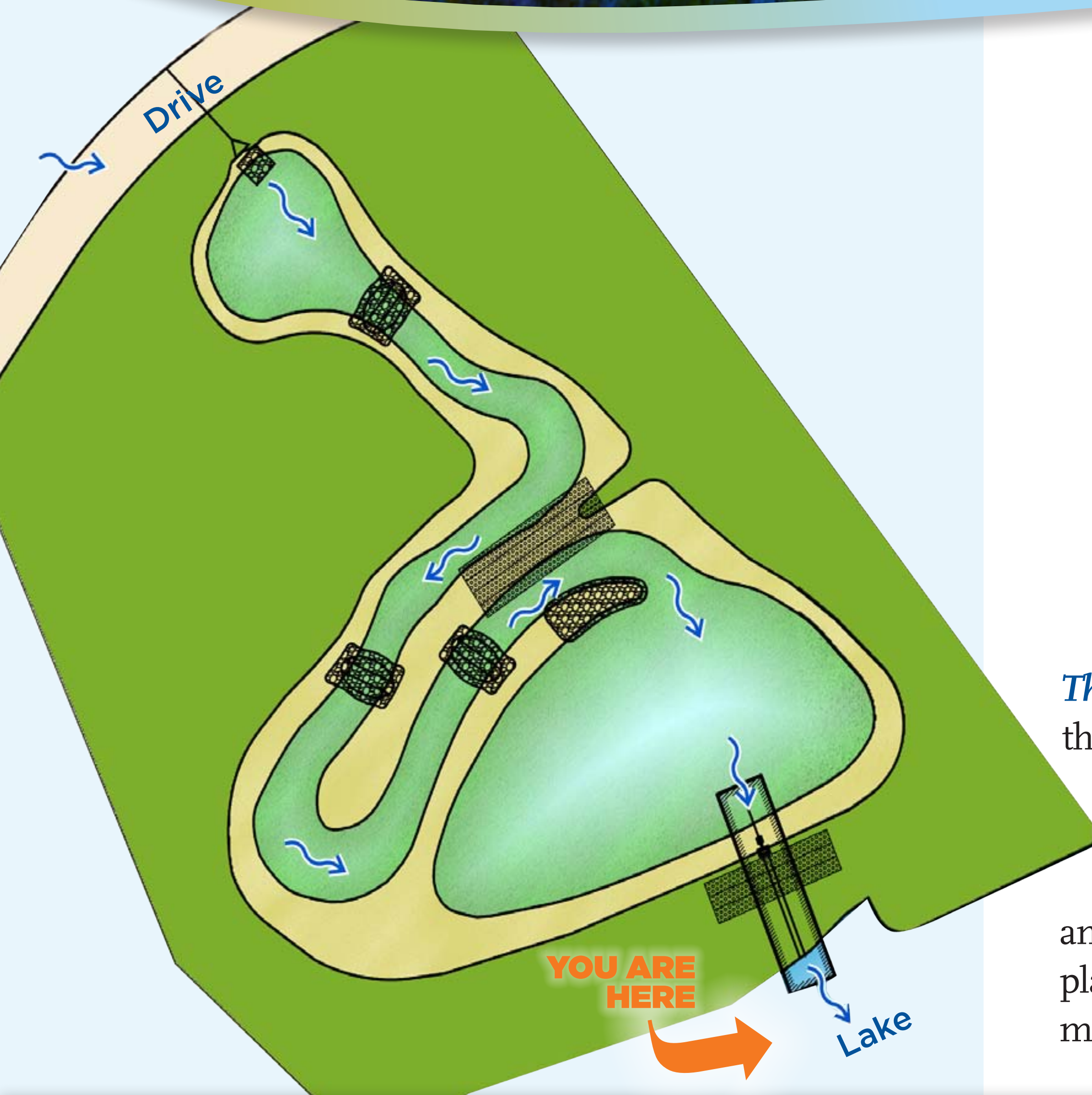
Wetlands



The wetlands intercept surface water runoff from parking areas to the north. The runoff water can contain sand, soil and automobile pollutants picked up from the parking lot. These contaminants can diminish the water quality of the lake and downstream waters.

The swale, meandering through the wetlands, slows runoff water and allows sediments and pollutants to settle out. Native Iowa wetland plants trap and use the nutrients brought into the wetlands while microorganisims in the soil break down many pollutants.

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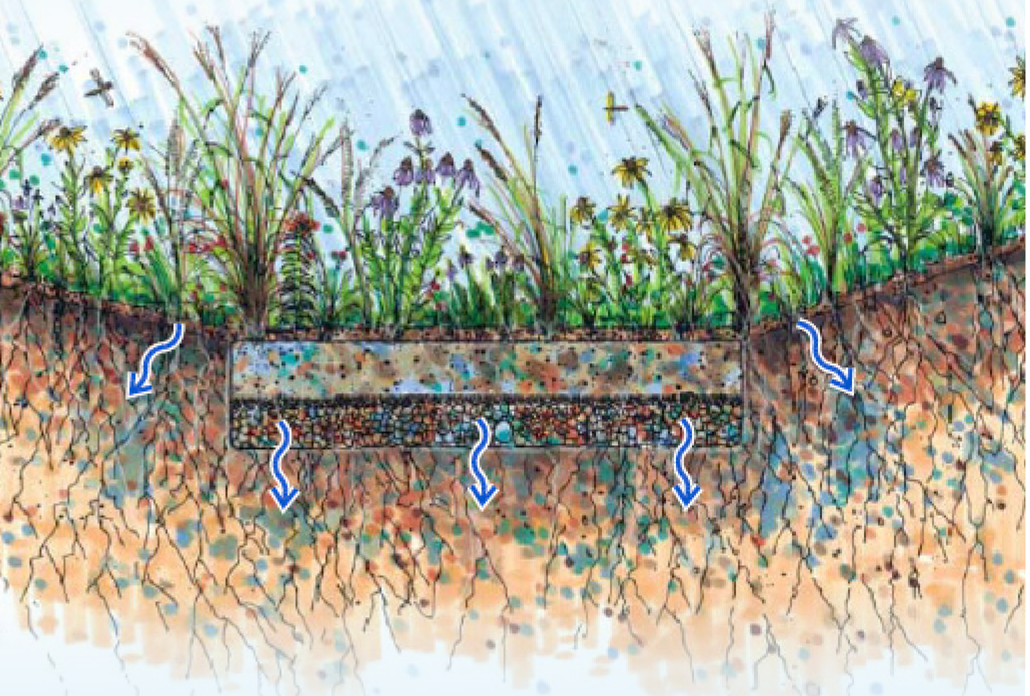
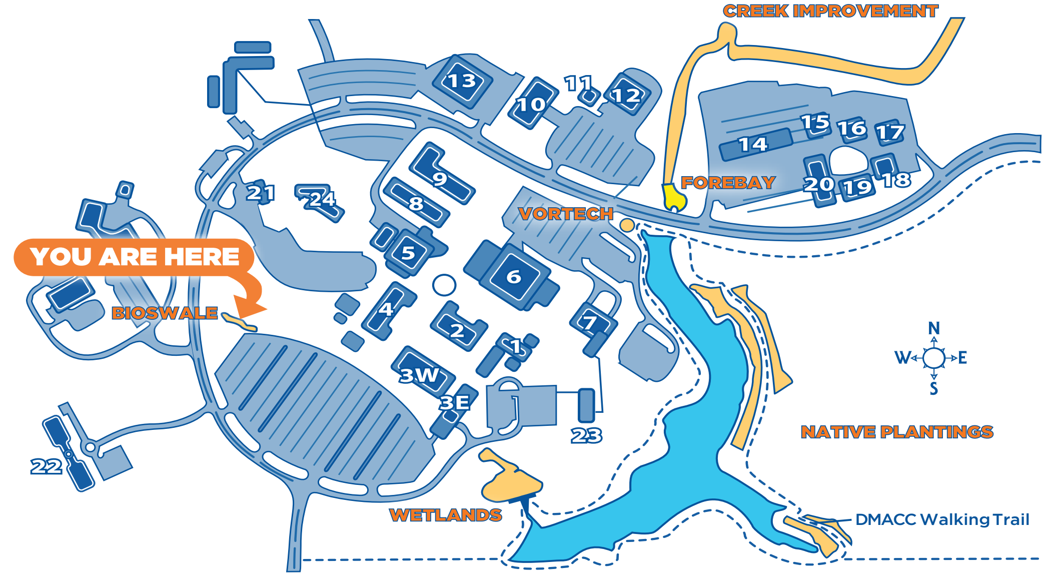
Bioswale





Bioswales are a better alternative to storm sewers. Bioswales convey surface runoff while helping to infiltrate and absorb the flow. This bioswale was constructed to intercept surface water flowing from the north. The soils and rock under the bioswale promote infiltration of the water into the ground. It helps reduce runoff of the small, frequent, Iowa rains. Native Iowa plants with deep roots will thrive and increase the filtering and infiltration of bioswales. This system will reduce the amount of runoff that flows through directly to the lake.

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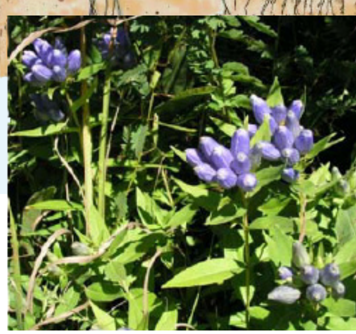
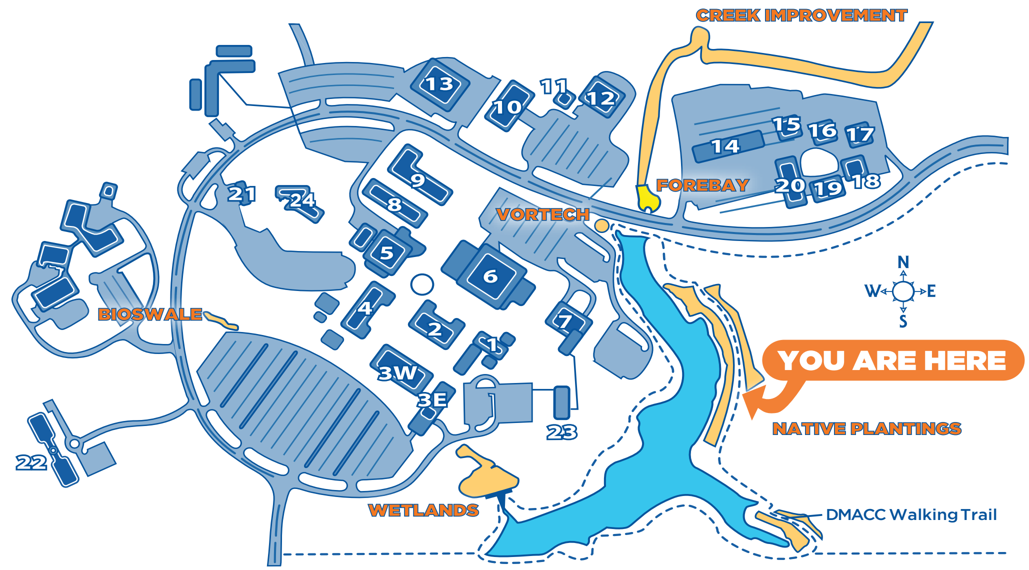
Native Plants

Pale Purple Coneflower



Bottle Gentian

Purple Prairie Clover



Native plants will slow and filter runoff water from the east as it drains toward the lake. These native plants include grasses and flowers historically found in Iowa. Deep roots add organic matter and improve soil quality. More water soaks into the soil than in turf grass lawns, reducing runoff and protecting water quality. A native planting also attracts desirable species such as songbirds, dragonflies and butterflies. Native landscaping around urban ponds helps reduce problems associated with geese, which prefer mowed turf.

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State Soil Conservation Committee and Conservation Districts of Iowa 2011 Summer Tour
Story, Polk and Jasper SWCD
June 13-14-15, 2011

Monday:	**Time:**
Martin Marietta Safety and Hazard Training	3:45 p.m.
Meeting room by the Hotel Lobby	
Martin Marietta Quarry/Underground Mine tour	
Bus will pick the group up at the hotel	4:00
Olde Main Brewing	6:30
316 Main St. 515-232-0053	
Tuesday:	
Charter bus arrival Quality Inn & Stes Starlite	7:30 a.m.
Charter bus leaves hotel	7:45
BECON – Nevada	8:15 – 10:15
A Biomass Energy Conversion Facility	
Snacks by Story SWCD	
CREP site – Colo Matt Lechtenberg, Water Resources CREP Field Coordinator	10:30 – 11
Camp Creek Watershed– Brandon Dittman & Paul Miller	
Neal Smith National Wildlife Center	11:45 - 1
Lunch by Magg Family Restaurant, Mitchellville	
Tour the Center	
Urban Conservation Practices – Ankeny Paul Miller, D.C. Polk SWCD	
Bio Century Research Farm	2:30
Return to Hotel	4:30
Hickory Park	6:30
1404 S. Duff Ave. 515-232-8940	
Wednesday:	
CDI/SSCC Joint Meeting	8:00 – 10:00
Break	10:00 – 10:15
Separate meetings	10:15 – adjournment

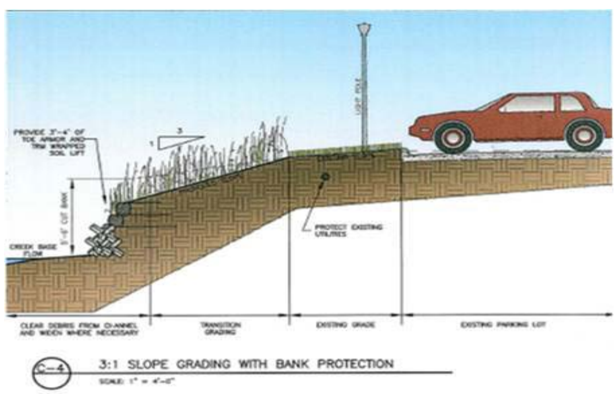
Everyone have a safe trip back home.

Thanks for attending.

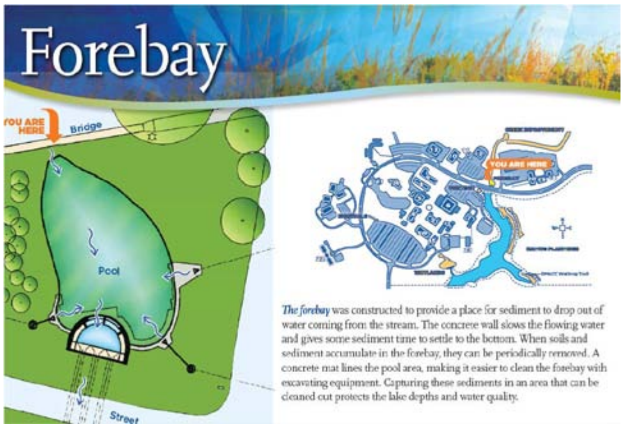
SSCC tour planning committee

Des Moines Area Community College (DMACC) received a WIRB grant in 2009 to install a variety of erosion control and stormwater management practices to improve the water quality of the pond on campus and to Saylor Creek. The pond has lost 1/3 of its capacity and collected 52,000 cubic yards of sediment. The north finger of the 14 ac pond has gone from a maximum depth of 12 feet to its current depth of 2 feet. The stream flowing into the pond had streambank and channel erosion concerns. The pond also experiences algae blooms in the summer months.


Stream Stabilization (right window) A-Jacks and rip-rap was used to stabilize the streambank toes and the banks were pulled back on 3:1 or 5:1 slopes and re-vegetated. The A-Jacks were used along the parking lot area to stabilize the channel and build the bank vertically, due to the limited space between the lot and the stream. Riffle pools were also installed through the channel in several locations to control the channel cutting and grade.

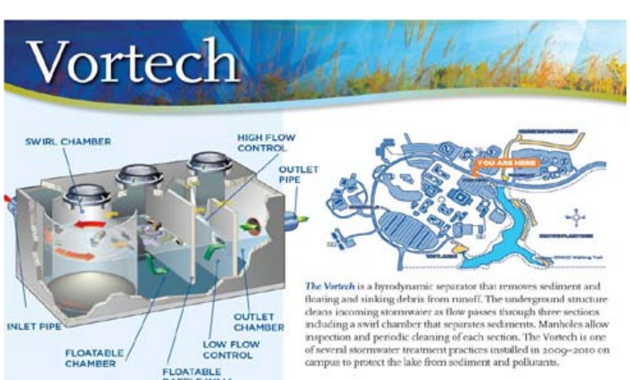



Forebay (right window) A forebay was placed at the end of the stream just above the pond on the north side of the street. A forebay is designed to create a pool to catch sediment before it can go into the pond. The forebay has articulated concrete mats on the bottom to facilitate cleaning out the collected sediment.



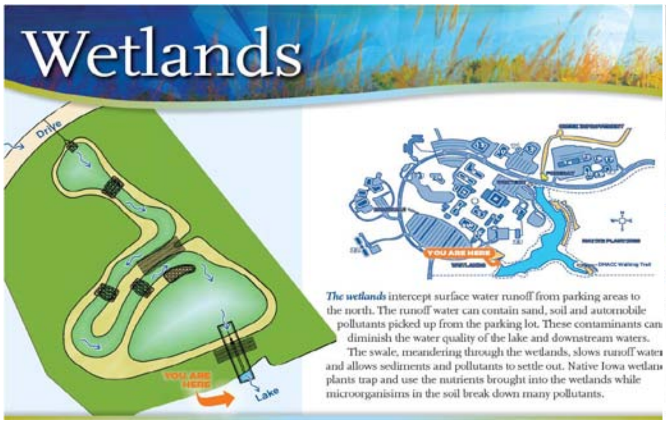


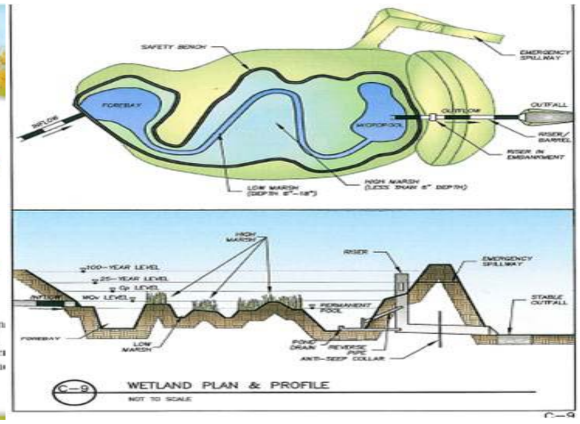
Vortech (left window) On the south side of the street, a vortech unit was placed underground to intercept the flow from a stormwater pipe and collect pollutants before they can enter the pond. The stormwater flows through three sections including a swirl chamber that separates sediments. The vortech has manholes to allow inspection and periodic removal of the trapped sediment and debris.



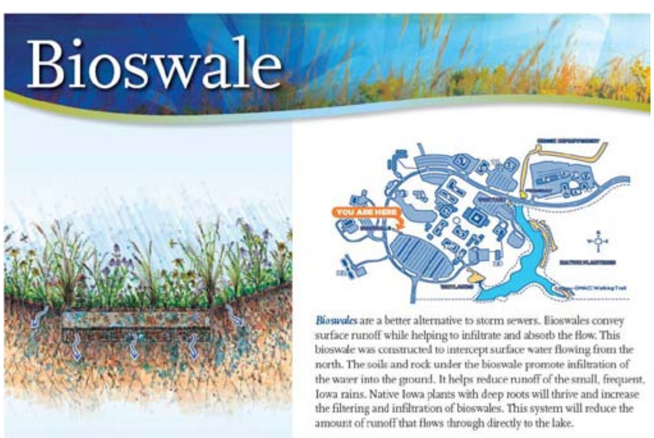
Other practices installed on the DMACC campus include the following:

A **Constructed Wetland** was installed to intercept surface runoff from parking lots to collect soil, sand, and vehicle pollutants before they can reach the pond. The wetland contains a forebay and meandering swale to slow the water flow and allow sediment and pollutants to settle out.

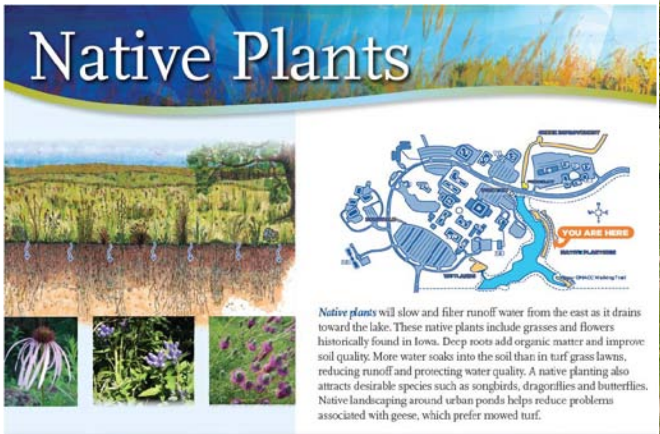




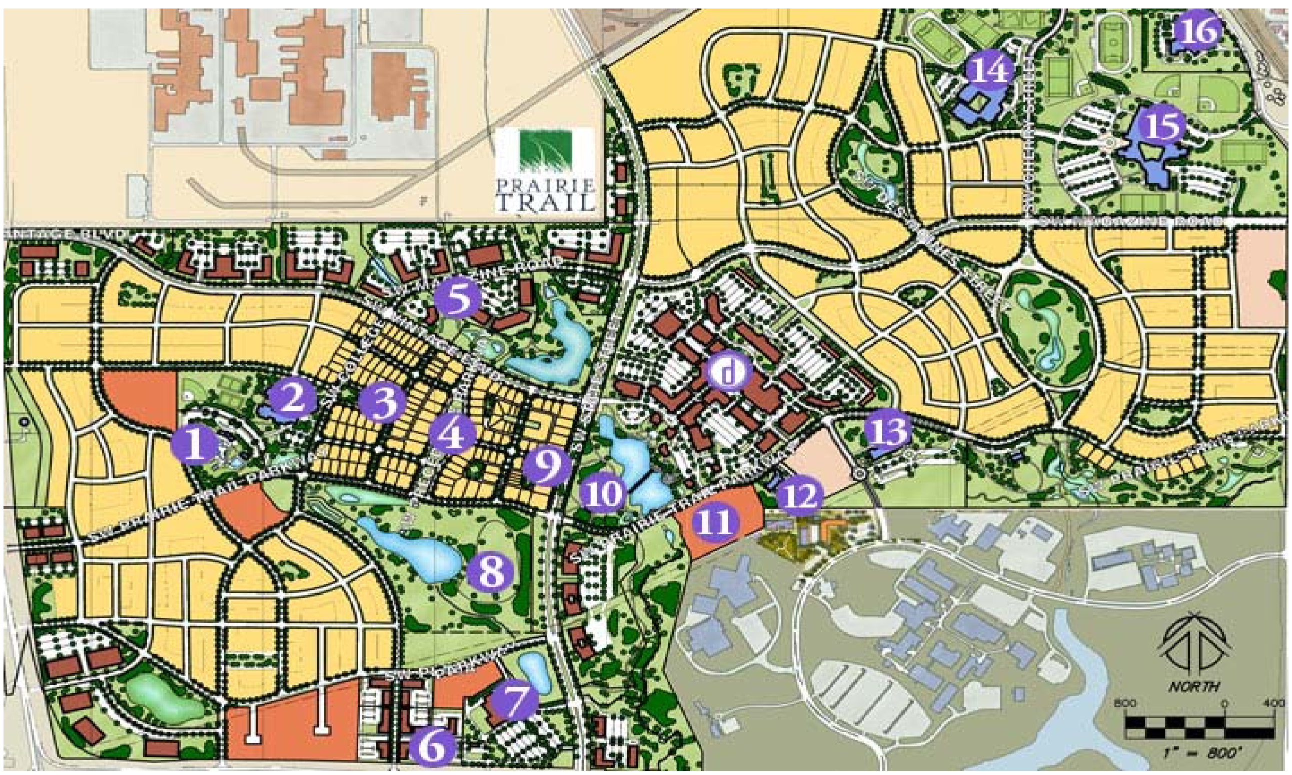
A **Bioswale** was installed to convey surface runoff while helping to infiltrate and absorb water into the soil. The soil and rock under the bioswale promotes infiltration of strormwater into the ground and helps to reduce runoff to storm drains.



Native Plants were used in various practices such as the bioswale, streambanks, the wetland, and along the pond banks. The native plants have deep root systems to increase organic matter and infiltration of water into the soil.



Prairie Trail is a development site on 1,030 acres adjacent to DMACC and lays in the upper reaches of Saylor Creek watershed. In 2007 the Iowa Heartland RC&D received a WIRB grant to implement phase I of the Saylor Creek Improvement Project in partnership with the City of Ankeny. In 2008 the city received a WIRB grant to implement Phase II. All of the stormwater created by Prairie Trial development will flow to Saylor Creek. This project was designed for the stormwater to follow a “treatment train” on its way to Saylor Creek. The “treatment train” incorporates stormwater management practices such as bioswales and rain gardens throughout the development to slow the flow of runoff and allow treatment in wetlands and retention ponds before the water is released to restored banks in Saylor Creek.



Sign showing the treatment train.

Saylor Creek Streambank Stabilization (left window) A-Jacks and rip-rap were used to stabilize the streambank toes and riffle pools were used to stabilize the channels. Multiple erosion and sediment control measures were used to protect the streambanks including a native buffer planting along Saylor Creek. Practices include: compost socks, rolled erosion control blankets, straw wattles, straw mulch, and silt fence.

Constructed Wetlands (left window) were installed to treat stormwater from the residential development. The wetland includes a forebay and rock checks in the swales to slow the water flow and allow sediment and pollutants to settle out before flowing to Saylor Creek.

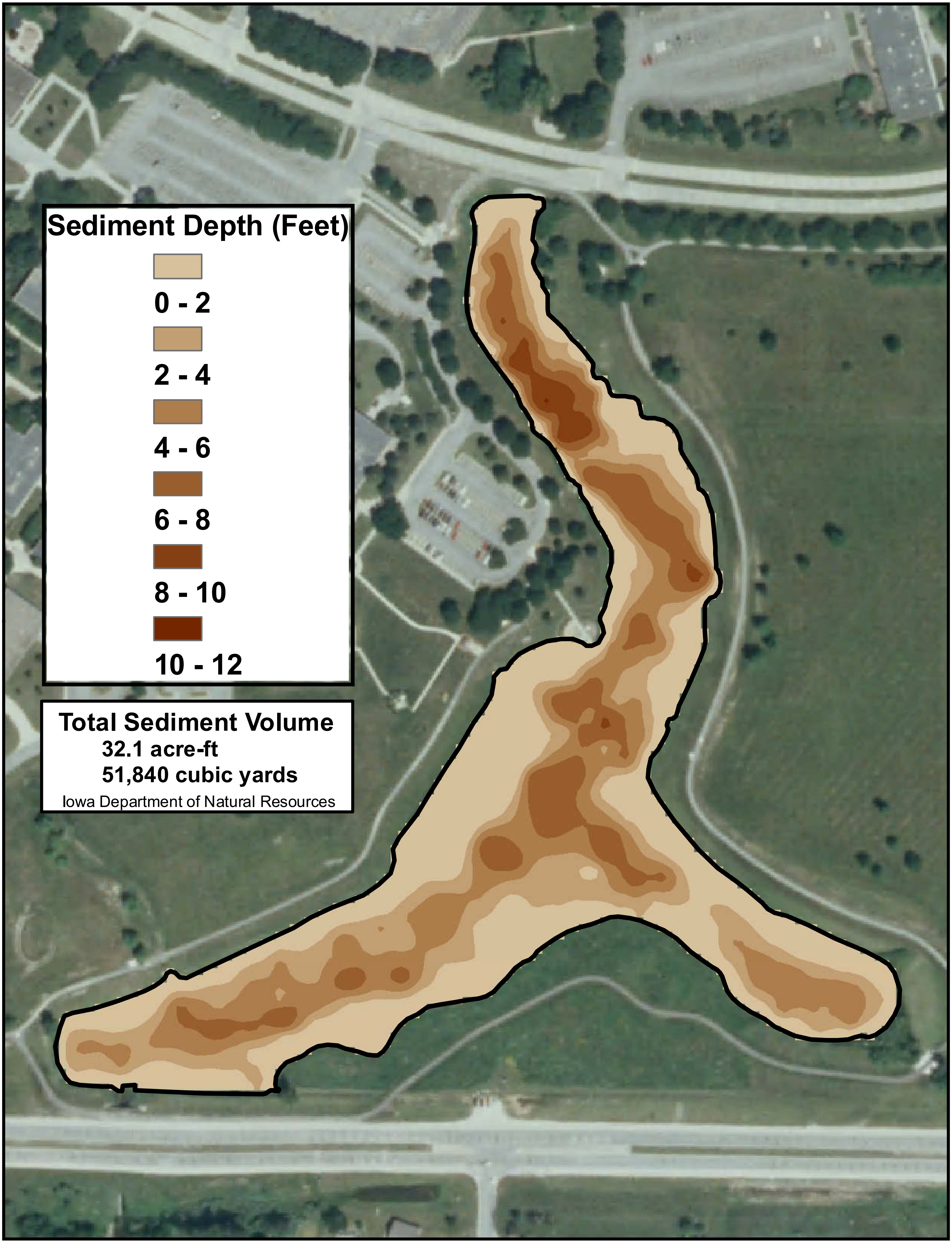

Retention ponds, channel stabilization, and native planting (left window) where installed in this area to slow the runoff of stormwater and treat it before releasing to Saylor Creek.







Bio-retention cells (left and right window) In 2008, the City of Ankeny extended First Street to the west to join Hwy 415 and incorporated bio-retention cells into the street design. The stormwater inlets were designed to direct the first flush from the street into the bio-retention cell to capture pollutants before the water flows to the storm drain. Higher flow rates are directed to the stormwater drains, since the first flush normally carries the majority of pollutants to the cell. Native plants are used in the bio-retention cell to promote infiltration.



Sediment Depth (Feet)
0 - 2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
Total Sediment Volume
32.1 acre-ft
51,840 cubic yards
Iowa Department of Natural Resources