Liberty Township Park Stormwater Demonstration Project

Showing new ways to protect streams when land is developed.

Liberty Township Park Stormwater Demonstration Project Team

Design:

Eco-Design and Engineering
Low Impact Design

URBAN WILD
sustainable
outdoor planning and design

Stormwater Consultants

Patridge Surveying LLC

ENVIROTECH CONSULTANTS, INC.
ECOSYSTEM PRESERVATION RESTORATION

Install:

LIBERTY
TOWNSHIP • FOUNDED 1808

DCH Landscaping

rain brothers

Outreach & Education:

FLOW
Friends of the Lower Olentangy Watershed

OhioEPA

This project was financed in part through a grant from the State of Ohio Environmental Protection Agency and the United States Environmental Protection Agency, under the provisions of Section 319(h) of the Clean Water Act.

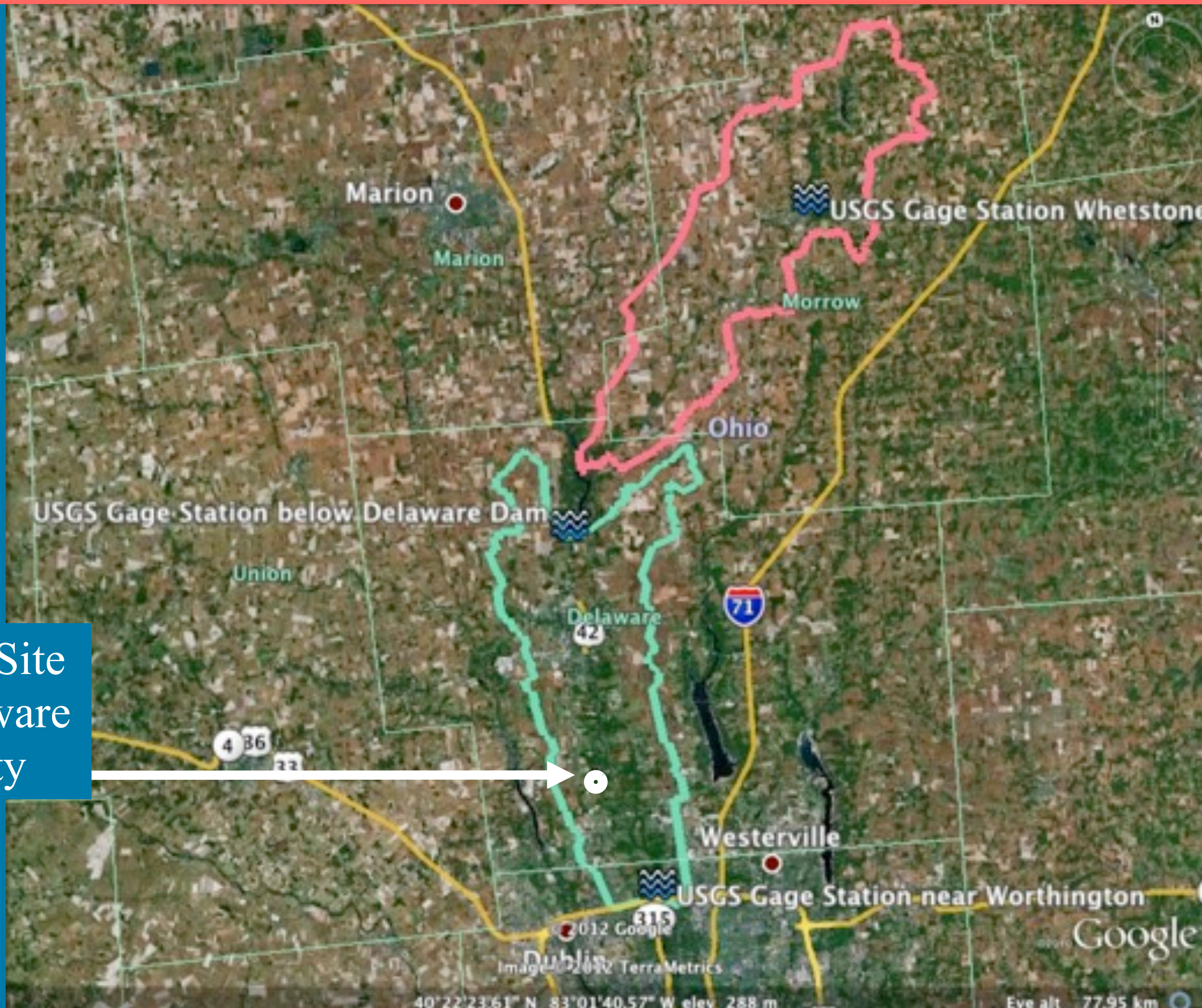
United States Environmental Protection Agency

Contents

- Background
- Project Targets
- Design Strategies
- Runoff Reduction and Costs
- Installation Lessons Learned
- Performance Results

• Background

Exceptional Warm-Water Habitat (EWH) in Portions of the Olentangy Watershed



Project Site in Delaware County

Olentangy EWH Fish & Bugs

Fish Banded Darter Black Crappie Black Redhorse Blackstripe Topminnow Bluegill Sunfish Bluntnose Minnow Brindled Madtom Brook Silverside Brown Bullhead Central Stoneroller Channel Catfish Common Carp Fantail Darter Fathead Minnow Flathead Catfish Gizzard Shad Golden-Redhorse Golden Shiner Green Sunfish Greenside Darter Johnny Darter Largemouth Bass Logperch Longear Sunfish Northern Hog Sucker Orangespotted Sunfish Pumpkinseed-Sunfish Quillback Rainbow Darter River Carpsucker River Redhorse Rock Bass Sand Shiner Saugeye Scarlet Shiner Silver Redhorse Silver Shiner Smallmouth Bass Spotfin Shiner Stonecat Madtom Striped Bass White Bass White Crappie White Sucker Yellow Bullhead

Photo: ODNR Division of Wildlife

Macroinvertebrates ("Bugs") Alderfly Aquatic worm Asian clam Blackfly Bryozoa Caddisfly Cranefly Crayfish Damselfly Divingbeetles Dobsonfly Dragonfly Fingernail clam Flatworm Gilled SnailIsopod Leech Limpet Mayfly Midge Fly Mosquito Pouch snail Riffle beetle Scud Stonefly Water penny beetle Water scavenger beetle Water scorpion Zebra mussel

Water Quality Status
Delaware County EWH Area Tributaries

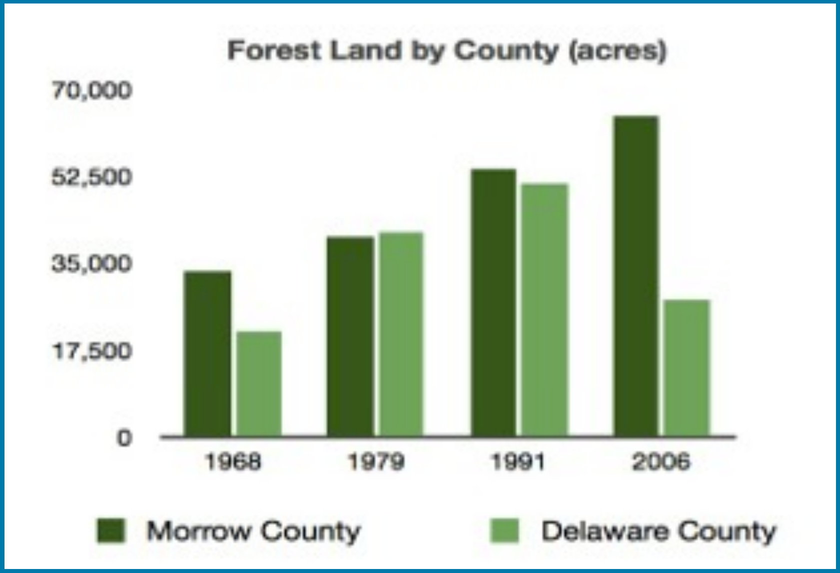
HUC 14 ending	Area and Location	Aquatic Life	Causes	Sources
120 020	37.1 sq mi From 23 & 315 to Powell Rd	***3/3 tested out of attainment***	Nutrients, Sediment, Habitat loss, Pathogens.	***Urbanization, Altered Hydrology***, HSTS
		8 more untested		
120 030	14.9 sq mi Powell Rd to Worthington	***1/1 tested out of attainment***	Nutrients, Sediment, Habitat loss, Pathogens.	***Urbanization, Altered Hydrology***, HSTS
		7 more untested		

This is what Urbanization looks like.

EWH Lower Olentangy 1988

EWH Lower Olentangy 2013

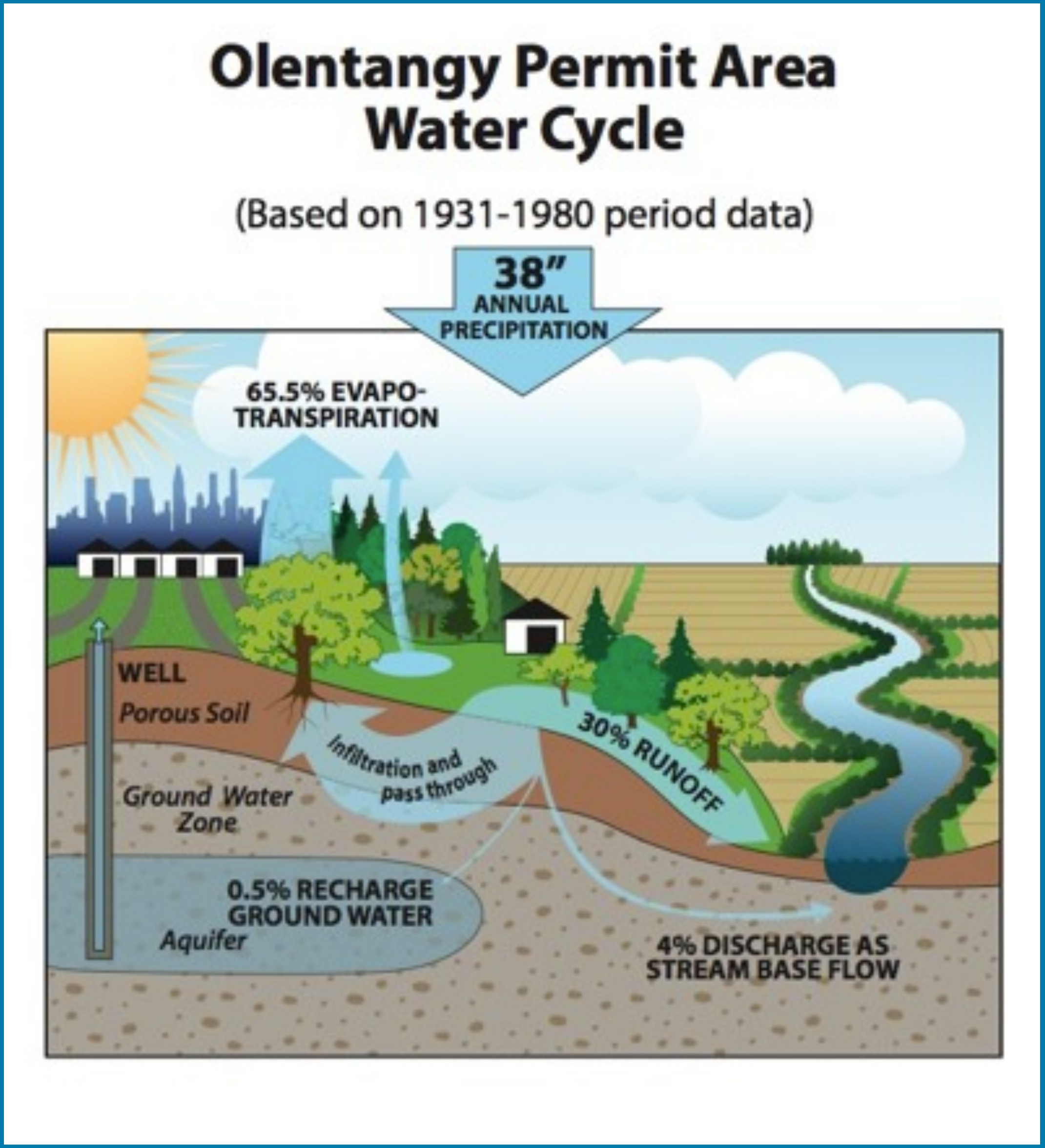
Rapidly Changing Land Use



- *The population of Liberty Township **grew 385%** from 1990 to 2010*

- *From 1991 to 2006, over 23,400 acres of Delaware County woodlands were lost during land development … a **46% decrease** in forest cover.*

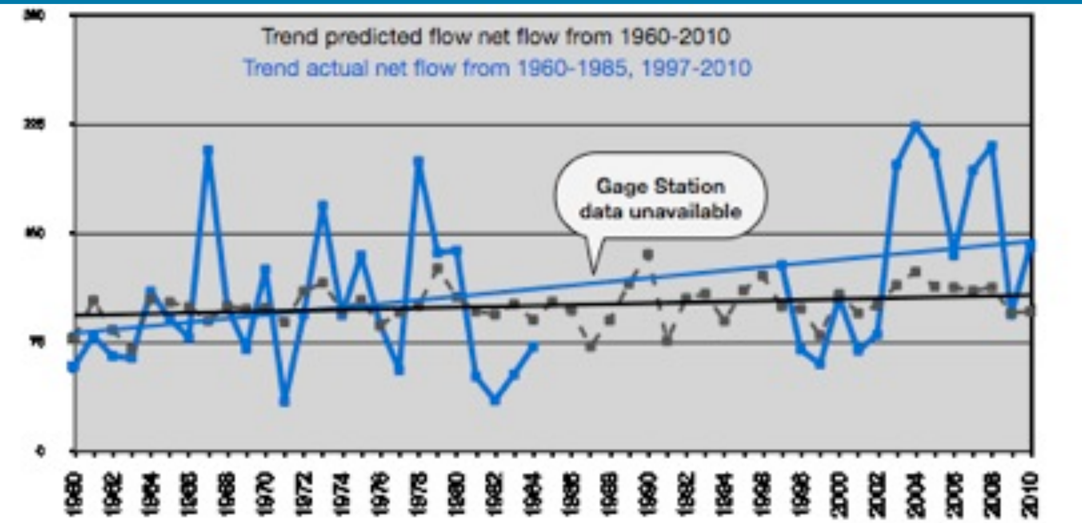
How Does This Alter Area Hydrology?



Model Based on 'Hydrologic Atlas of Ohio' and 'Ohio's Water Budget' - ODNR

Annual Streamflow at Worthington (cfs)

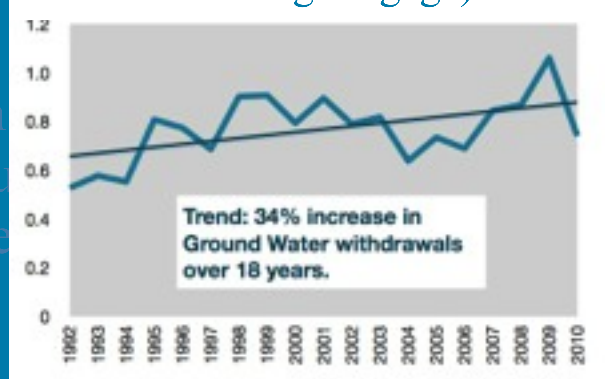
2010 trend is 34% higher than predicted



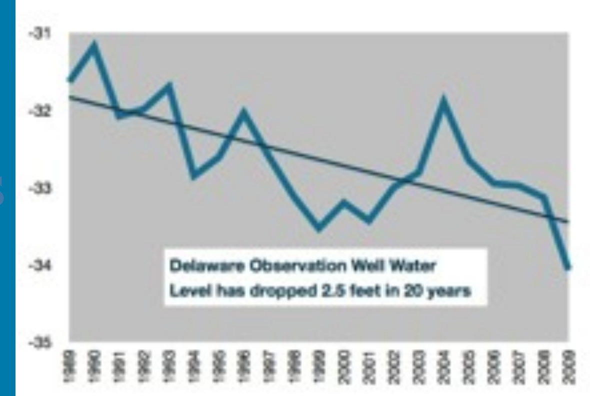
Predicted flow = % of precipitation over net area
(497 sq mi at Worthington less 393 sq mi Below Dam= 104 sq mi)
Actual net flow = cfs at Worthington less cfs Below Dam

Groundwater Situation

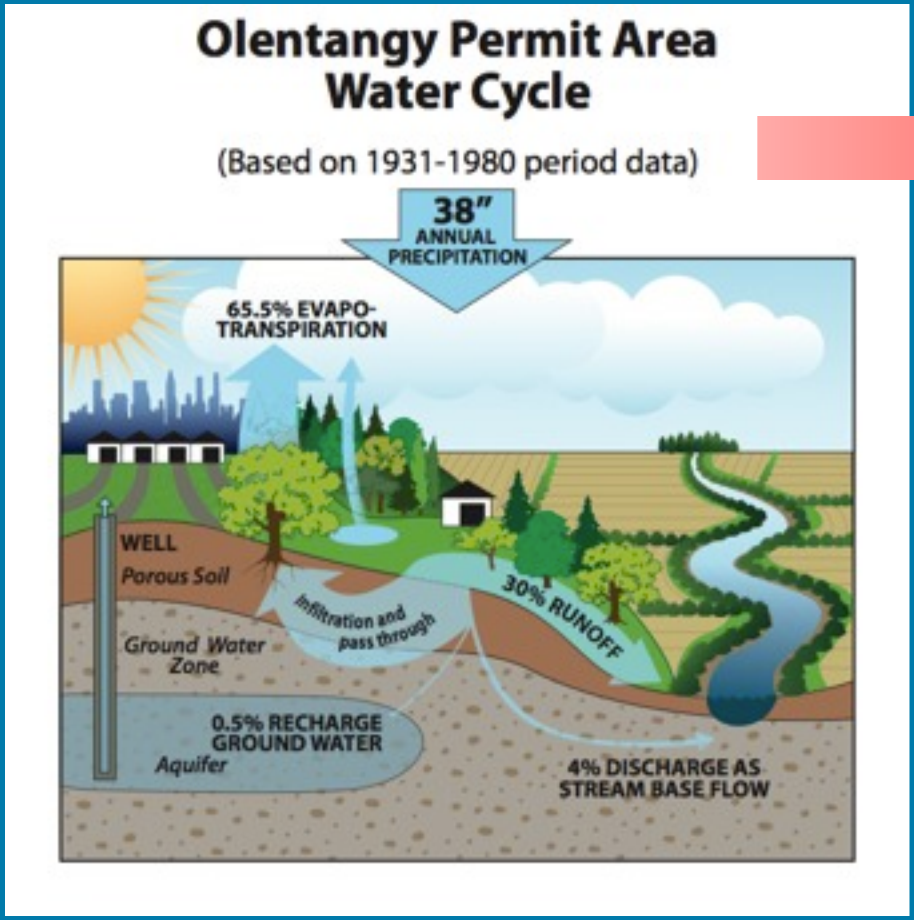
Public/Industrial Withdrawals (Billion Gallons, total above Worthington gage)

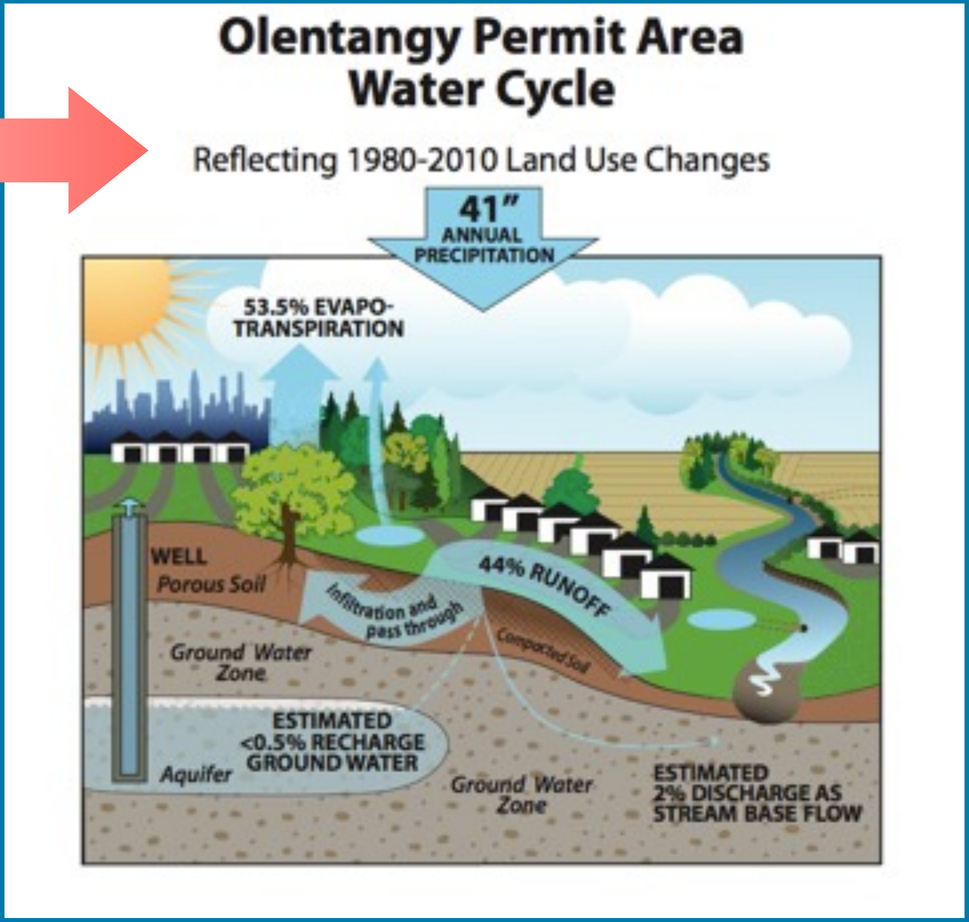


Observation Well Water Level (Feet)



The Cummulative Impact of Land Development Significantly Altered the Hydrology in Delaware County

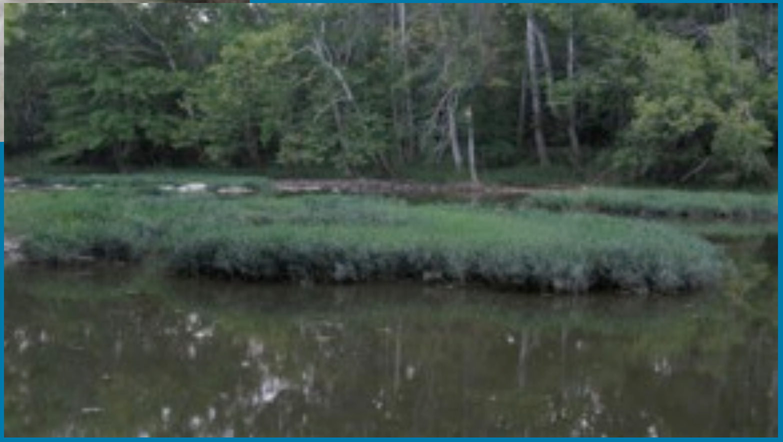




Evidence of More and Faster Stormwater Runoff in Streams near the Project Site

Increased Flooding: After upstream development, flooding frequency increased from about 1 to about 5 times a year on Wildcat Run.

Accelerated Streambank Erosion: A 'blow-out' in this natural pipe impairs stream function and clogs stream with sediment.



Less Groundwater Recharge & Base Flow: Longtime resident notices changes in river vegetation…more shallow water plants.


Is detention and draw-down the only and best treatment practice for frequently occurring small storms?

- Stormwater Demonstration Project Targets

Reduce the 3/4" storm runoff by at least 20%

Showcase a variety of attractive, easy to replicate (easily built and maintined) runoff-reduction practices

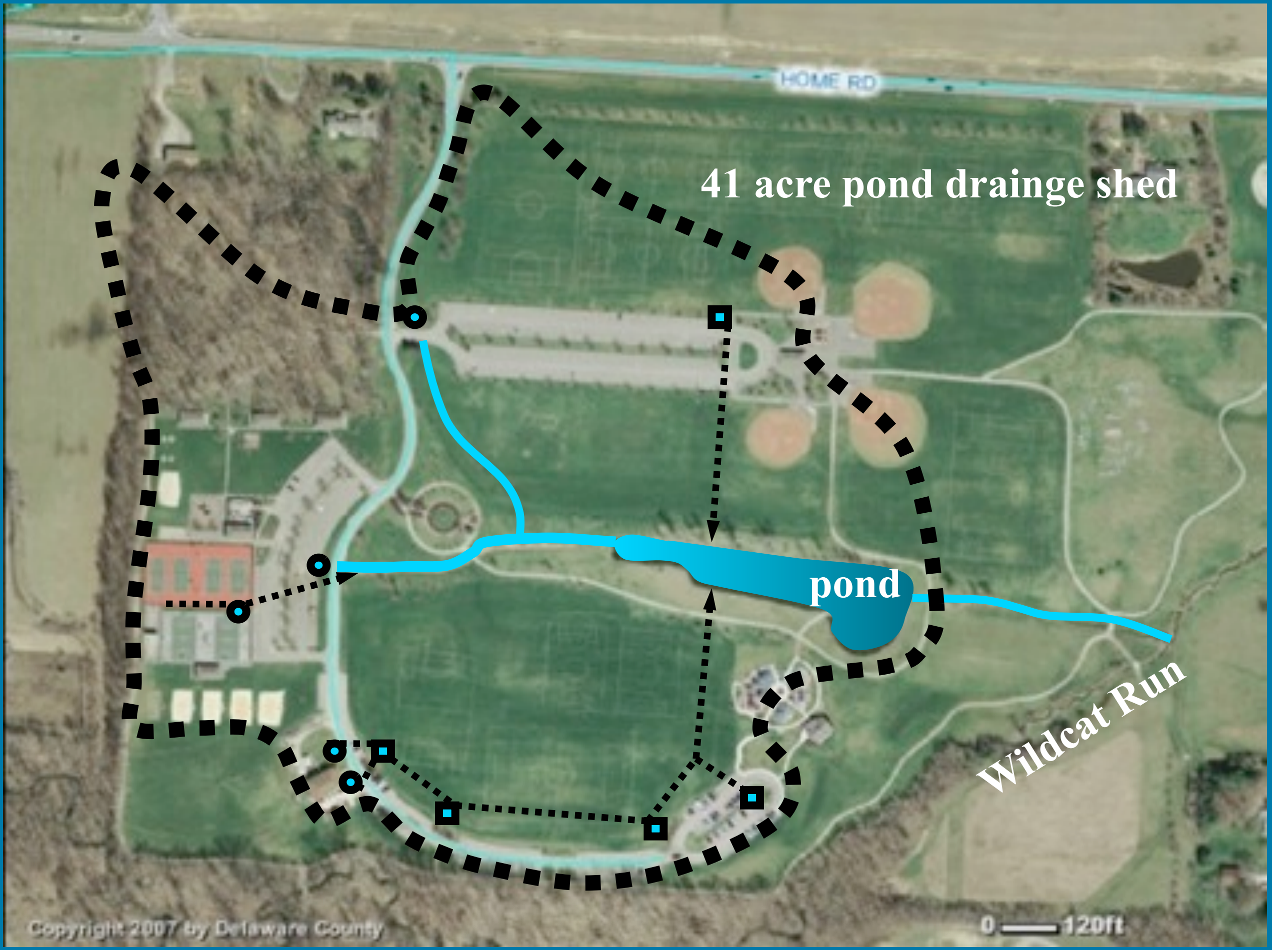
Test the performance of infiltration practices in tight, clayey soils

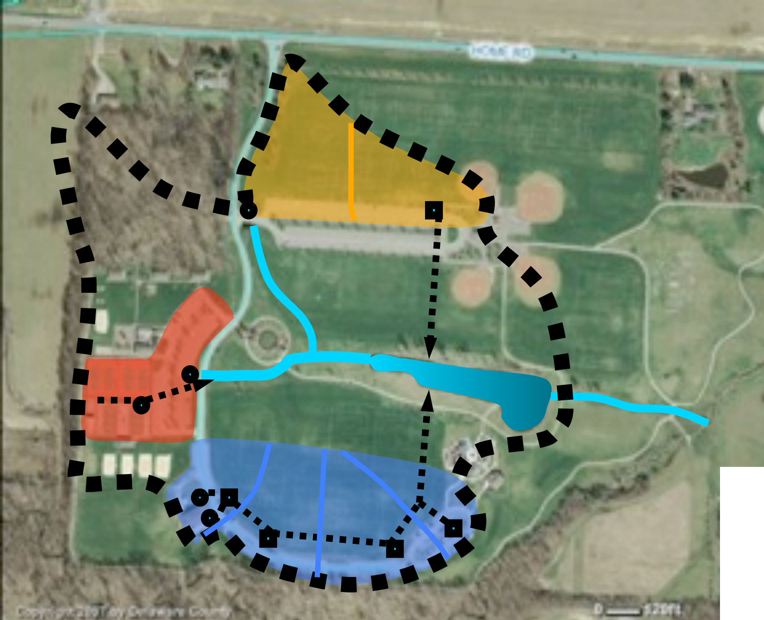
Measure the loading reduction

Influence the method of future development as Delaware County is built-out.

- Design Strategy

Get the most bang for the $:
Focus on Areas of Connected Imperviousness



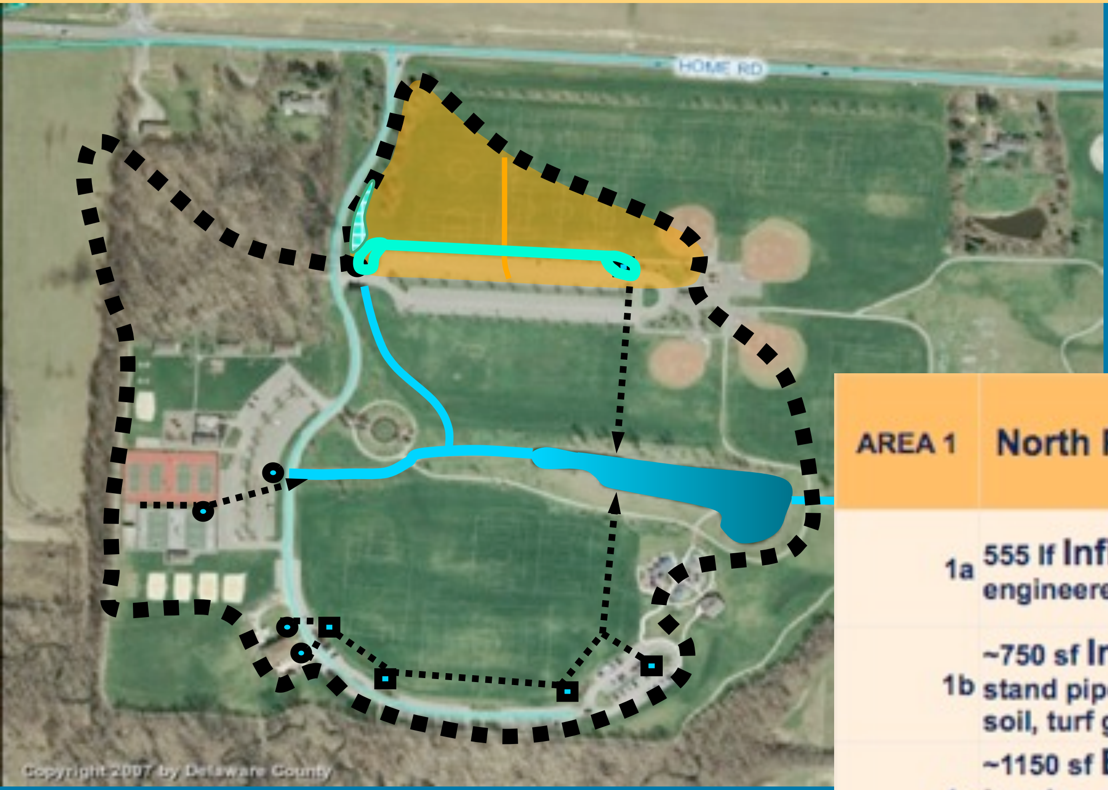


Focus Area Study...

14.9 selected acres (36% of 41 acre drainage area) generates 50% of the 3/4” event runoff.

DRAINAGE SHED	ACRE	CURRENT (POST CONSTRUCTION) WQV (cf) = acre x C x 3/4"/12x43,560 sf/acre — CURRENT LAND USE acre: woods c=0	turf c=0.25	imperv. c=0.95	C = WEIGHTED RUNOFF COEFF	CURRENT 3/4" WQV cf
DRAIN THROUGH POND TO WILDCAT RUN	**41**	3.65	28.50	8.85	0.38	**42287**
a) from w	1		0.85	0.15	0.36	966
b) from nw woods	3	3.00			0.00	0
c) w/3 shelter houses	1.5	0.45	0.90	0.15	0.25	1001
d) e of shelters w/road	0.6	0.20	0.40		0.17	272
e) parking/courts	3		0.15	2.85	**0.92**	7473
f) sand volleyball	1		1.00		0.25	681
g) soccer fields	4		4.00		0.25	2723
h) fields and nsw parking	5.1		4.30	0.80	0.36	4996
I) fields and nn parking	5		4.10	0.90	**0.38**	5118
j) fields and nse parking	5.5		5.00	0.50	0.31	4696
k) fields and playground	3		2.90	0.10	0.27	2232
l) fields and se parking	1		0.60	0.40	**0.53**	1443
m) fields and se parking	2		1.50	0.50	**0.43**	2314
n) fields and sw parking	2.7		2.20	0.50	**0.38**	2791
o) fields, sw parking, bldg	1.2		0.60	0.60	**0.60**	1960
p) pond	1.4			1.40	0.95	3621

AREA 1: Runoff Reduction and Costs



AREA 1	North Parking and Fields	3/4" Event Volume Reduction (cf)	Cost ($)	Cost per Volume ($/cf)
1a	555 lf **Infiltration trench**, engineered soil, turf grass seed	1260	$7,324	**$5.8**
1b	~750 sf **Infiltration basin** with stand pipe, compost amended soil, turf grass seed	775	$2,414	**$3.1**
1c	~1150 sf **Bio Retention basin**, compost amended soil, native sedge meadow plants	1030	$3,822	**$3.7**
1d	12 **Trees** adjacent to trench	71	$972	**$13.7**
1e	**No Mow Swale**	34	$0	**$0**
	TOTALS	**3170**	**$14,532**	**$4.6**
	BEFORE	**5118**		
	% RUNOFF REDUCTION	**62%**		

AREA 1: Design Features

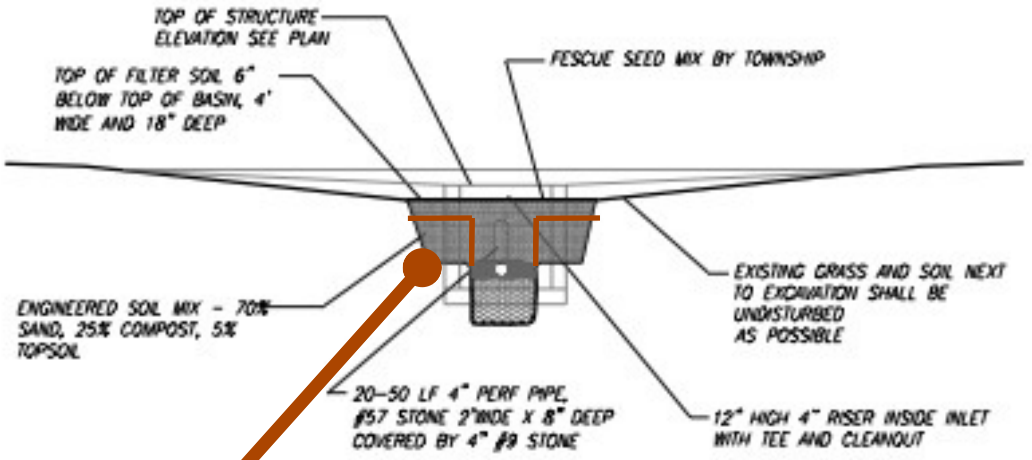
Mowable Infiltration Trench.

Stand-Pipe Promotes Infiltration

Treatment Trains: Trench underdrains to….

Sedge Meadow Bio-Retention …... or to No-Mow Grass Infiltration Basin

AREA 1: Lessons Learned



Smeared vs Scratched.
Digging method = Infiltration Rate

Planned vs Actual Excavation
Cross-section = Runoff Volume

Public access needed during seed germination. Unplanned $1,300 carved into plant budget.

AREA 1: Lessons Learned

Rain delays are an opportunity to check performance.

Infiltration is OK. But….

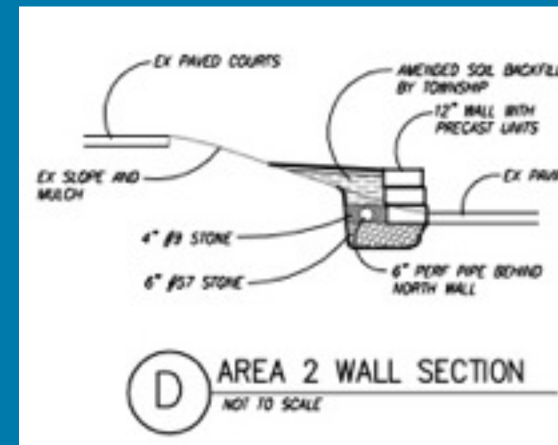
…this basin has a low spot.
Level basin = Improved reliability and Infiltration volume.

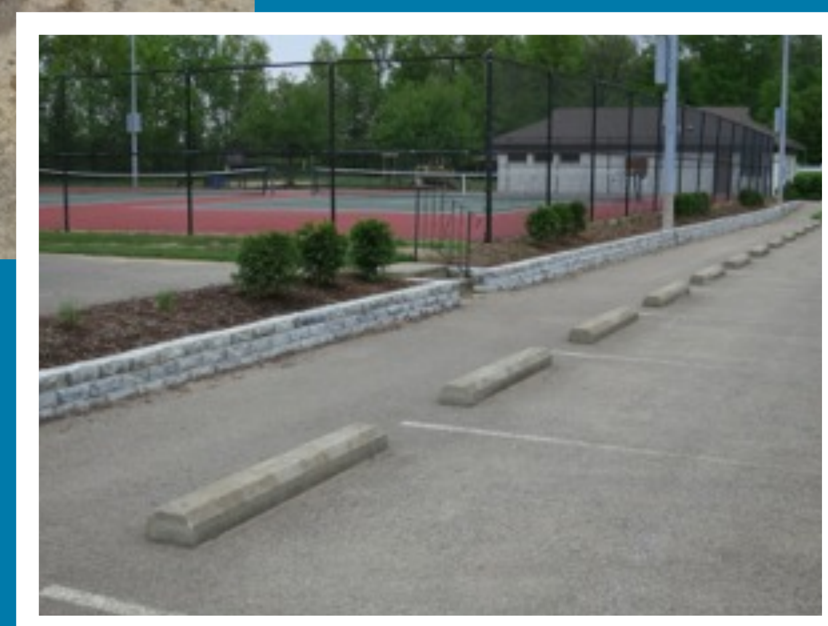
Simple string and line level used for the next basin.

AREAs 2-5: Runoff Reduction and Costs

AREAs 2-5	Ball Courts and West Parking	3/4" Event Volume Reduction (cf)	Cost ($)	Cost per Volume ($/cf)
2	125 lf **Infiltration trench,** compost amended soil, native seed mix	310	$3,091	$10.0
3	200 lf (300sf) **Stormwater planter** (150 sf fed by underdrain)	107	$7,122	$66.6
4a	2000 sf **Pervious Concrete**	1100	$35,709	$32.5
4b	10 **Trees** adjacent to pervious concrete stone storage layer	59	$2,114	$35.8
5a	360 sf Parking Lot **BioRetention Island** (fed by pervious concrete underdrain, with 12" stand pipe)	308	$4,464	$14.5
5b	530 sf **Parking Lot BioRetention Islands** (fed by pervious concrete underdrain)	230	$6,629	$28.8
	TOTALS	**2114**	**$59,129**	**$28.0**
	BEFORE	**7473**		
	% RUNOFF REDUCTION	**28%**		

AREAs 2-5: Design Features



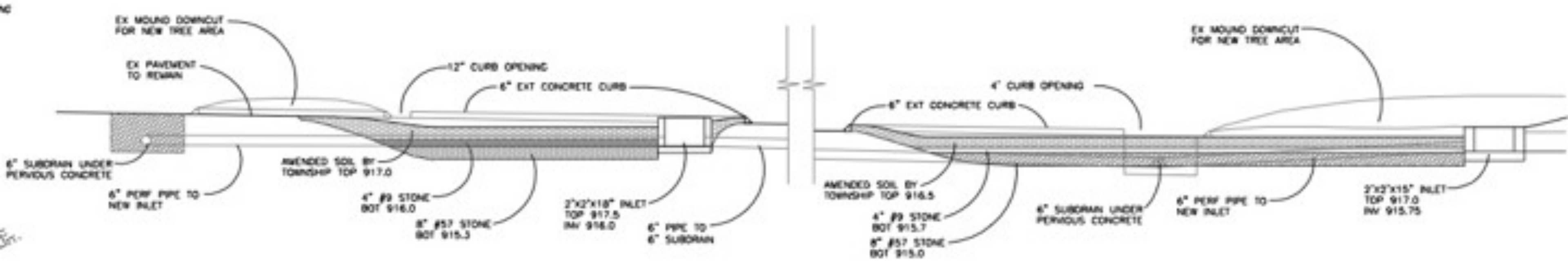


Ballcourt Infiltration Trench underdrains to bottom of 'Stormwater Planter'. Limestone-like wall units chosen for easy installation.

AREAs 2-5: Design Features

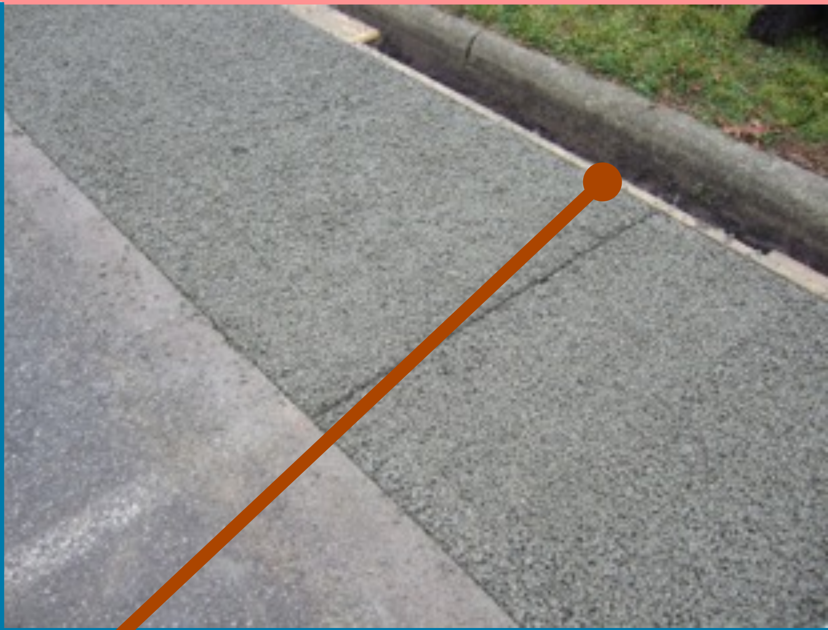
Before: Drainage Pattern

After: 4’ Wide Pervious Concrete Strips Underdrain to Parking Lot Bio-Retention. Trees placed at lower grade to access stored water.



AREAs 2-5: Lessons Learned

Pervious concrete roller loaned by OCA.



Existing blacktop broke during sawcut at 6” gap to curb.

Concrete truck can buckle cut asphalt edge.

December concrete pour….blankets for proper cure.

AREAs 2-5: Lessons Learned

Sediment clogs pervious concrete: bio-retention basin earthwork was sequenced after pervious concrete installation.

Purchased one of these …hope it works!

AREAs 6-10: Runoff Reduction and Costs

AREAs 6-10	Park Office and South Parking and Fields	3/4" Event Volume Reduction (cf)	Cost ($)	Cost per Volume ($/cf)
6a	150 gallon **rain tank**	15	$953	$63.5
6b	315 square foot **rain garden**	226	$779	$3.4
6c	2 **Trees** at Park Office	12	$258	$21.5
7	1,500 sf Bio **Retention basin,** amended ***native soil, no underdrain***	1572	$4,163	$2.6
8	2000 sf **Bio Retention basin,** engineered soil, underdrain with 12" stand pipe. *Upland plants.*	1128	$7,124	$6.3
9	2900 sf **Bio Retention basin,** engineered soil, underdrain with 12" stand pipe. *Wetland plants*	1121	$10,684	$9.5
10a	300 sf **Permeable pavers**	105	$1,920	$18.3
10b	630 sf **Infiltration basin,** stand pipe, mixed soil, No-Mow turf grass	282	$1,690	$6.0
	TOTALS	**4461**	**$27,571**	**$6.2**
	BEFORE	**8508**		
	% RUNOFF REDUCTION	**52%**		

AREAs 6: Rain Tank & Rain Garden

Residential Style Rain Garden with Native Trees and Shrubs.

Rain Tank overflows overland to Rain Garden. Feeds drip irrigation for continual use.

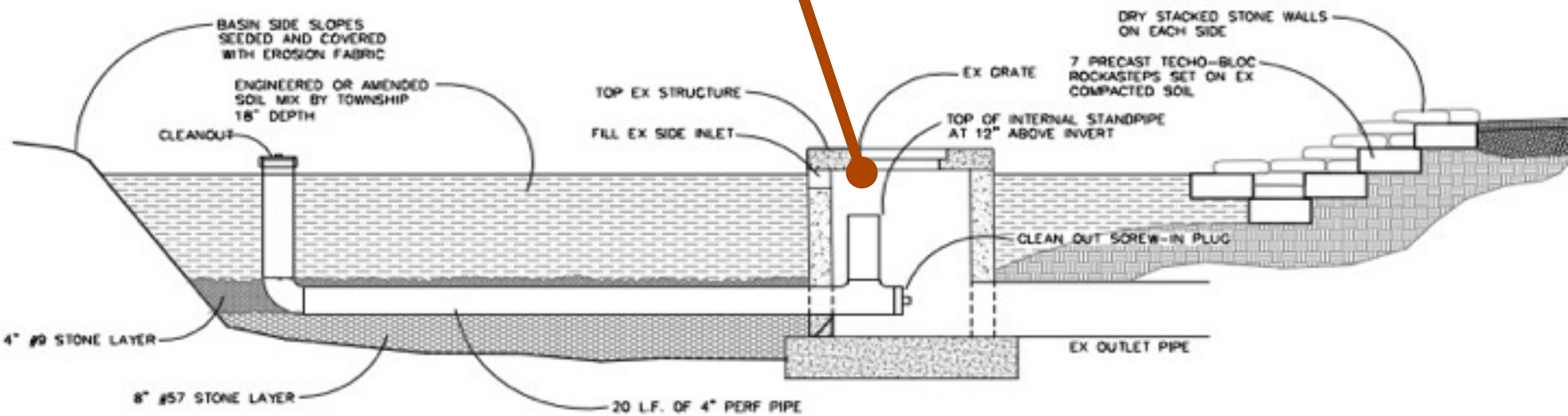
AREAs 6-10: Lessons Learned

Infiltration can work in tight, clay soil!

AREAs 7-9: Bio-Retention Basin Design

Sediment Trap built using Dimensional Rock-Steps

12" Standpipe in catch basin increases treatment volume



AREAs 7-9: Basin Planting Design

‘Woodland Pocket’ Bio-Retention Basins:

<u>Basin 7:</u>
Compost amended native soil.
No underdrain
Plants - FACW to OBL

<u>Basin 8</u>:
Sandy engineered soil.
With underdrain
Plants - FAC to FACU

<u>Basin 9:</u>
Sandy engineered soil
With underdrain
Plants - FAC to FACW

- Native Trees and Shrubs
- ~900/acre planting density
- Mostly 3 gallon Containers

AREAs 7-9: Lessons Learned

Compaction & Smoothing = Infiltration loss

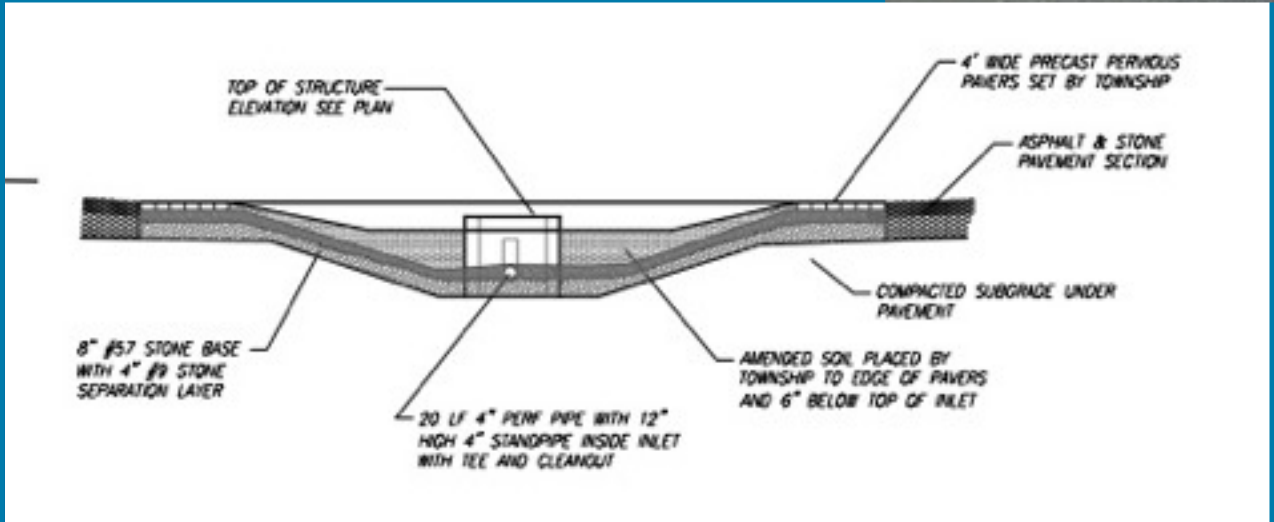
Plan sediment control (winter work stop)

Include Inspection & Maintenance Budget

AREAs 10: Permeable Pavers and Basin

Before

Nearly Complete. Pending: Seed with No-Mow Fescue



- Targets and Measure

Reduce the 3/4" storm runoff by at least 20%.

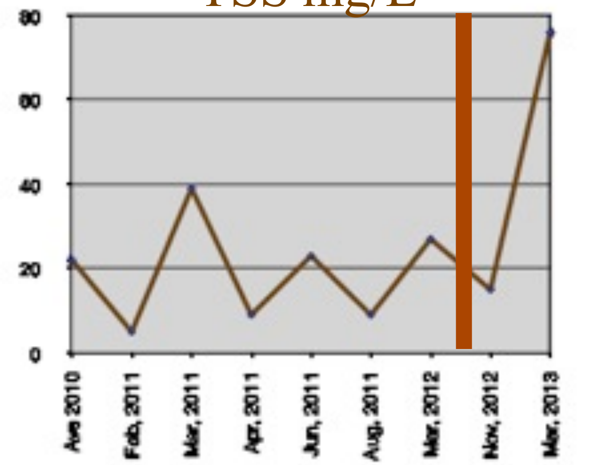
DRAINAGE SHED	3/4" WQV cf
DRAIN THROUGH POND TO WILDCAT RUN	**42287**
Runoff Reduction Area 2-5	-2114
Runoff Reduction Area 1	-3170
Runoff Reduction Area 6-10	-4461
RESULTING RUNOFF THROUGH POND	**32542**
% REDUCTION	**23%**

Totals 3/4" event reduction of 9745 cf. Construction costs ~$101,500. Average of $10.4 per cubic foot runoff reduction.

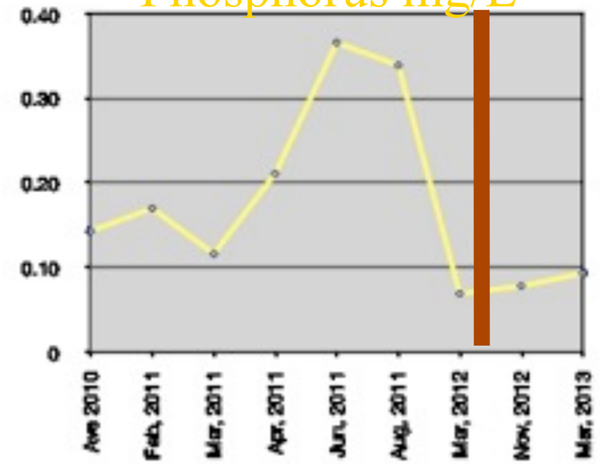
• Targets and Measure

Measure the loading reduction…OEPA chemical sampling at pond effluent.   Install June, 2012 - April, 2013. No conclusions yet.

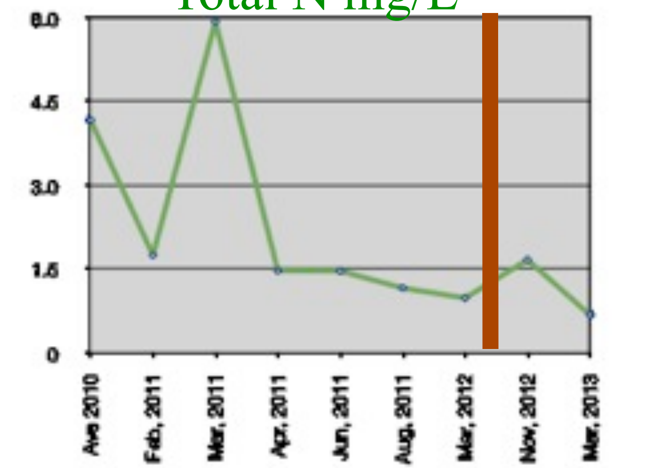
TSS mg/L



Phosphorus mg/L



Total N mg/L



Outreach and Education Potential

INNOVATIVE STORMWATER TREATMENT AT LIBERTY PARK

THE PROBLEM

SAME RAIN + CHANGED LAND = MORE RUNOFF

Stormwater runoff is the leading cause of water quality impairment in the nation. Between 1990 and 2010, Liberty Township experienced population growth of 385%. This rapid conversion of woods and farm fields to housing and roads drastically increased the volume and speed of stormwater that sheds off the land and into streams.

As a result of development upstream of the park, Wildcat Run began flooding over the park footbridge on a regular basis. More and faster stormwater runoff increases flooding, carries pollutants into streams, and erodes stream channels. That causes two problems. The stream becomes incised - too deep for floodwaters to spread into the floodplain. The streams become clogged with silt and pollutants, killing aquatic life.

PROJECT GOALS

SHOW NEW WAYS TO PROTECT WATERWAYS

Liberty Park is demonstrating new stormwater treatment practices that reduce runoff by infiltrating stormwater into the ground using stone, soil and vegetation. Commonly used detention ponds control the speed of runoff, but not the volume. Future land development can use infiltration to reduce runoff, protect streams and recharge groundwater.

- Showcase a variety of attractive, easy to replicate runoff-reduction practices
- Reduce runoff from a 3/4 inch rainfall by 20%
- Demonstrate infiltration in hard clay soils
- Influence methods for future development

Healthy River, Endangered Tributaries

The Olentangy River in southern Delaware County is a State Scenic River with exceptional warm-water habitat, and is home to a wide variety of fish and other aquatic species. Although the main stem of the Olentangy meets state water quality standards, the tested tributaries do not. As Liberty Township continues to grow, new ways of managing stormwater are essential to saving these streams and maintaining the River's exceptional habitat.

Project Partners

Liberty Park Office

FLOW Office
www.olentangywatershed.org

Ohio EPA Section 319(h)
Clean Water Act Funding

For more information

Visit the Liberty Park Stormwater Demonstration site at http://tinyurl.com/libertyparkstormwater

WALKING TOUR

Visit the demonstration sites shown on this map to learn about steps Liberty Park took to treat stormwater on site, helping to ensure the health of Wildcat Run and the Olentangy River.

Signs at each demonstration site explain the stormwater treatment methods used at that location. Use your smartphone to scan the QR code on any of the signs to access more information at the Liberty Park Stormwater Demonstration Project website.

① NORTH SIDE PARKING AREA	Parking lot and soccer field runoff is treated by a stone INFILTRATION TRENCH connected to BIO-RETENTION BASINS at each end. Turf grass grows over the trench, so maintenance is as easy as mowing the yard. NATIVE TREES suitable for wet conditions are planted next to the trench to help soak up stormwater.
② BALL COURTS	A stone INFILTRATION TRENCH treats runoff from between the tennis and basketball courts. This trench is topped with soil and planted with DEEP-ROOTED NATIVE PRAIRIE FLOWERS that soak up water and provide colorful bird and butterfly habitat.
③ STORMWATER PLANTER	Overflow from the ball court trench flows to a STORMWATER PLANTER. A retaining wall contains the planting area landscaped with native plants to use the water stored underground.
④ ⑤ WESTERN PARKING AREA	Stormwater soaks through a 4-foot wide PERVIOUS CONCRETE EDGE strip, and into underground stone storage layers. Underdrains move water to 2 parking lot BIO-RETENTION ISLANDS, where native plants help treat the water. Additional native trees are planted at strategically lowered elevations in lawn near the pervious concrete to improve their access to stored water.
⑥ PARK OFFICE RAIN HARVESTING & RAIN GARDEN	A 150-gallon RAIN TANK harvests roof runoff and feeds a drip irrigation system. The nearby RAIN GARDEN captures and treats additional roof runoff, and is planted with NATIVE TREES, SHRUBS and FLOWERS suitable for use in a stylish home landscape.
⑦ ⑧ ⑨ SOUTH PARKING AREA	Three BIO-RETENTION BASINS were built to treat stormwater running off the parking lots and soccer fields, and to compare the effectiveness of differing construction techniques. These basins were REFORESTED with native trees and shrubs that will mature into WOODLAND POCKETS within the landscape. EARTHEN BLEACHERS were built for the soccer fields using excess soil from constructing the bioretention basins.
⑩ PLAYGROUND PARKING TURNAROUND	Runoff from the pavement will soak through a PERMEABLE PAVER edge treatment surrounding an INFILTRATION BASIN.
TURTLE MOUND	This play area was constructed with dirt removed for the project. In fact no excavated soil left the park.

Reduce Stormwater Runoff = Clean Streams