Manchester Water Source Protection Plan

Trident Environmental Solutions 

May 5th, 2020

Trident Environmental Solutions

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BACKGROUND

ANALYSIS

DESIGN

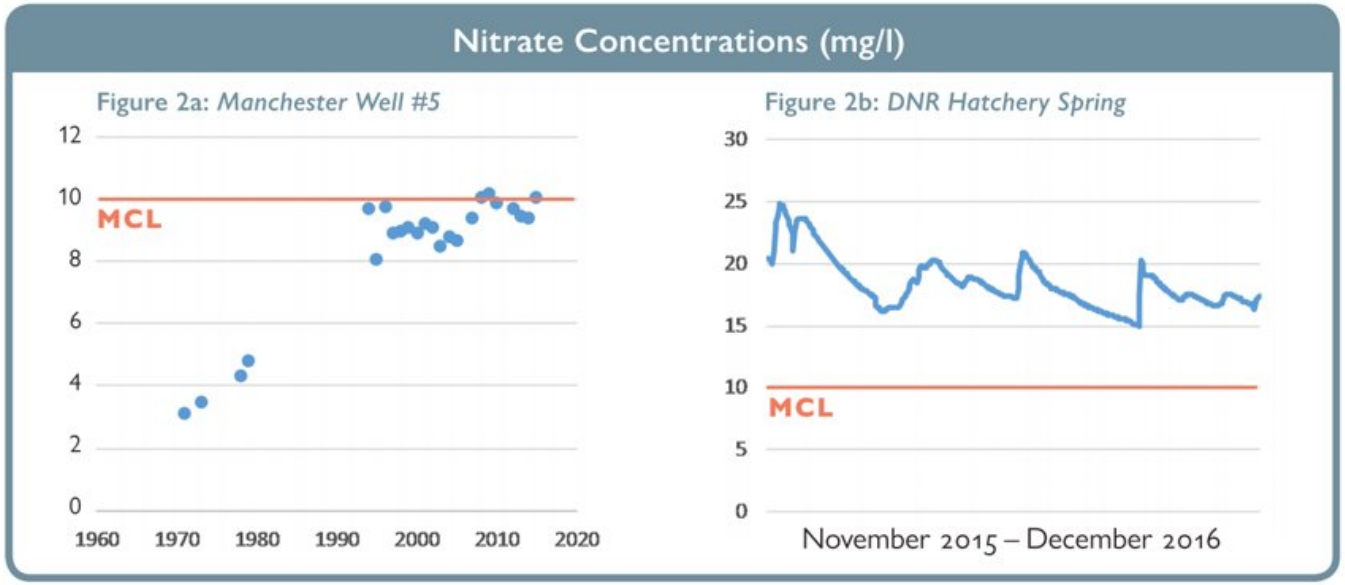
Developing a Nitrate Reduction Strategy

High nitrate concentrations in groundwater

Breaks MCL, health concern

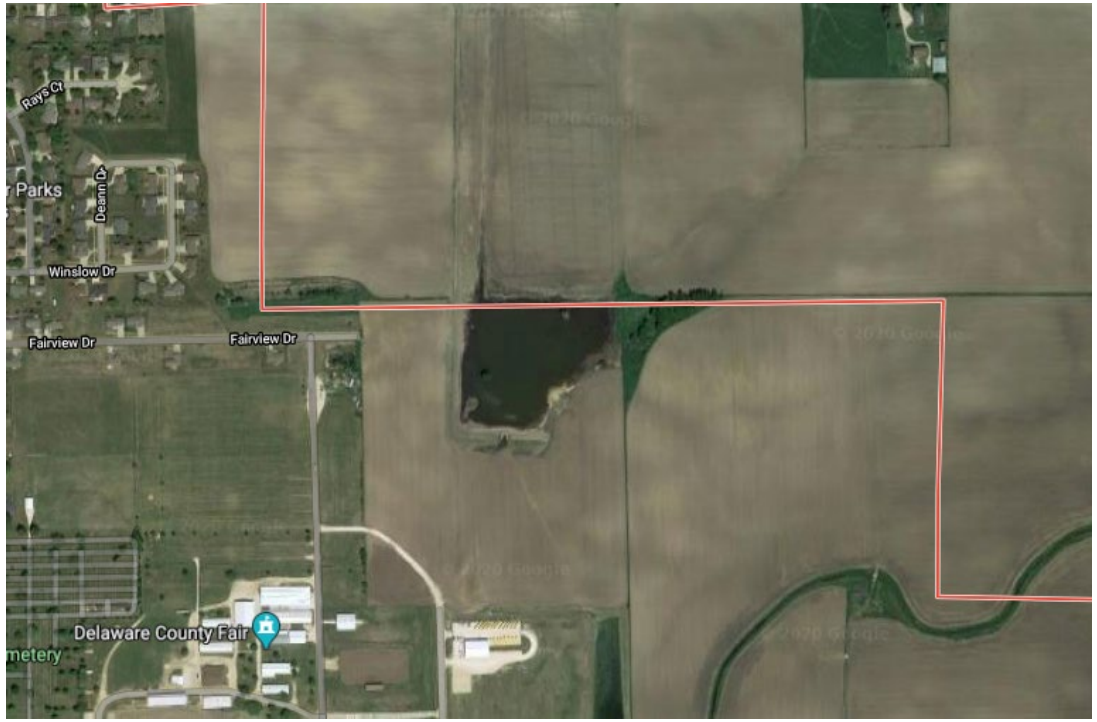
Ion exchange is used but costly

Analysis and development of alternatives



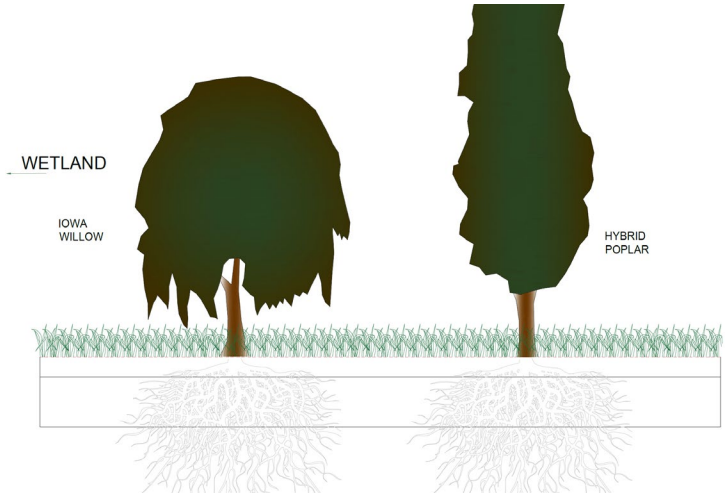
Data Courtesy of Dr. Claire Hruby (IDNR), Rebecca Ohrtman (IDNR), and Lori Scovel (Limestone Bluffs RCD)
Manchester Source Water Protection Team

Project Site

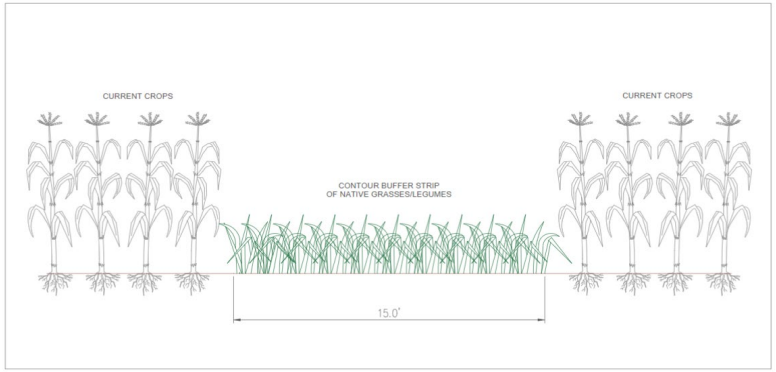


Design Selections

1. Wetland Riparian Buffer Zone



2. Contour Buffer Strips



3. Urban Nitrate Reduction Strategy

Did you know...

...that chemicals and fertilizers that you apply to your lawn are increasing your *water utility bill*?

Lawn chemicals and fertilizers contain nitrates that pollute your water and make it expensive to clean.

When too much fertilizer is applied, soil can't retain all the nitrate. The excess nitrate will runoff and seep into the ground. The City of Manchester gets its drinking water from an aquifer in the ground, directly below neighborhoods in Manchester.

Nitrate prevalence in our water has been continuing to rise causing water utility bills to increase. Small changes in how you care for you lawn can make a difference in your utility cost and decrease nitrate levels to keep water safe for everyone.

Lawn chemicals and fertilizers, when they are used properly, they are a great tool for making your lawn look great. Testing your lawn for what type of care and fertilizers it needs is a first great step. Slow release fertilizers, compost, and aeration are also effective ways to keep your lawn healthy. Small changes in lawncare can substantially improve your lawn and your water utility bill. There are many online resources to facilitate in caring for your lawn. Here are a few:

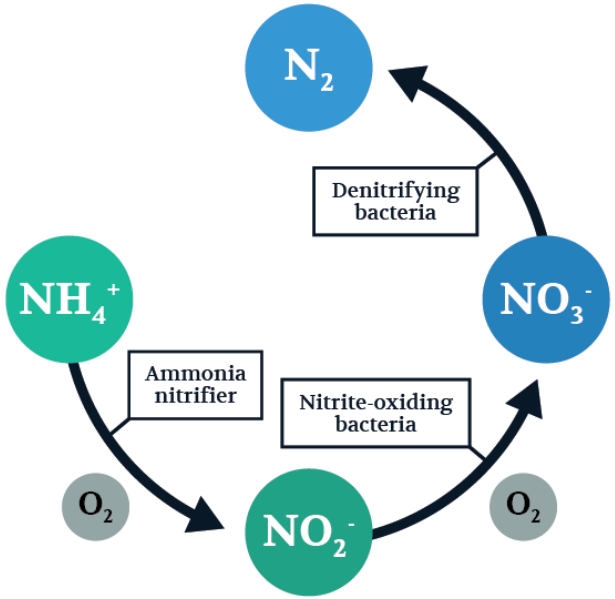
Lawncare Resources

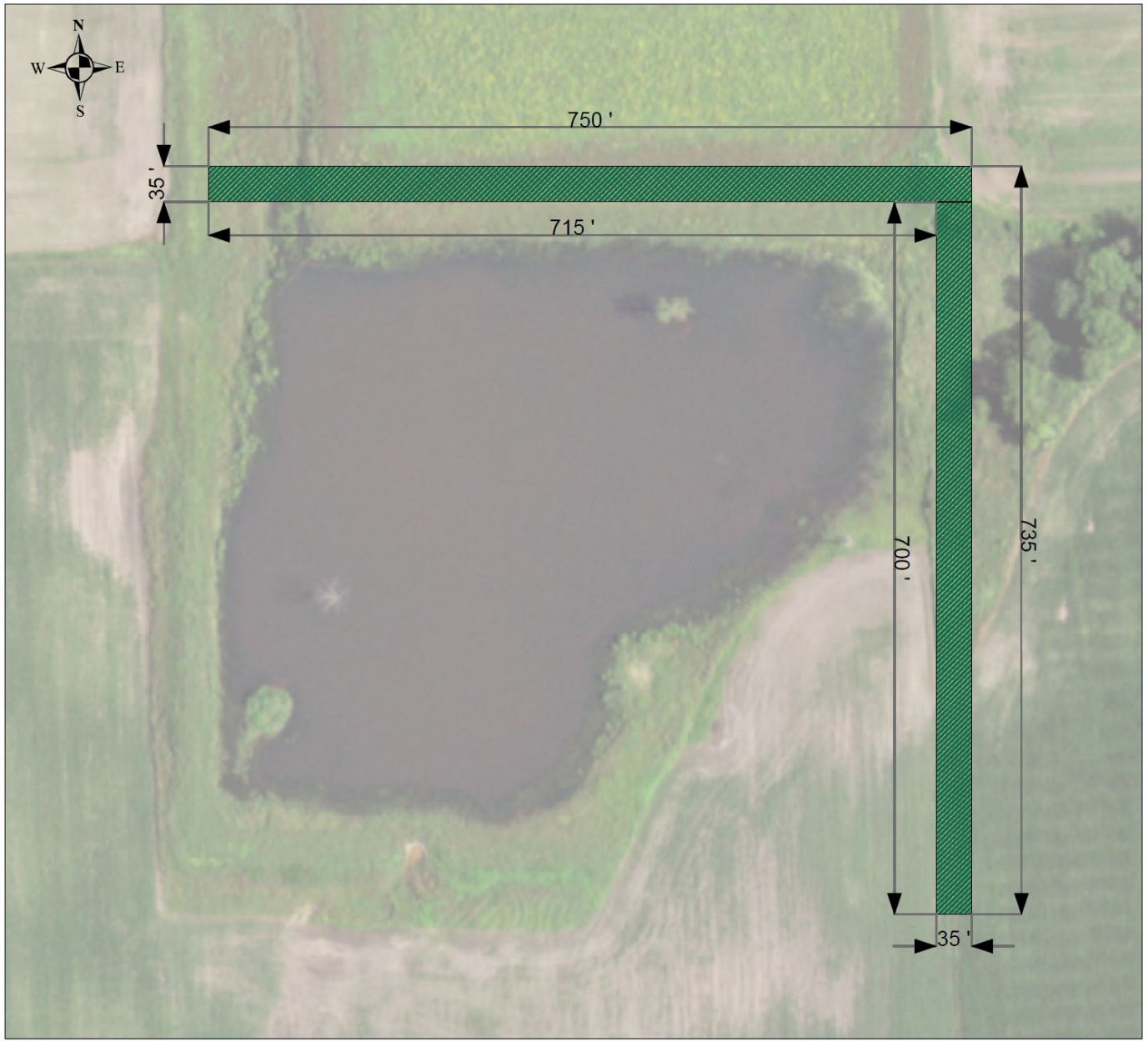
https://www.iowadnr.gov/About-DNR/DNR-News-Releases/ArticleID/168/Greening-Up-Your-Yard-What-You-Can-Do

https://www.iowaagriculture.gov/FieldServices/pdf/SoilQualityBrochure.pdf

https://www.extension.purdue.edu/extmedia/HO/HO-236-W.pdf

1. Wetland Riparian Buffer Zone





Analysis of Current Wetland

Flow Path or Vegetative cover type	N	Mean nitrogen removal effectiveness (%)	1SE	Relationship to buffer width		Approximate buffer width (m) by predicted effectiveness		
				Model	R^2	50%	75%	90%
All studies	66	74.2	4.0	y = 10.5*ln(x) + 40.5	0.137	3	28	112
Surface flow	18	33.3	7.7	y = 20.2*ln(x) – 21.3	0.292	34	118	247
Subsurface flow	48	89.6	1.8	y = 1.4*ln(x) + 84.9	0.016	np	np	np
Forest	22	90.0	2.5	y = -0.7*ln(x) + 92.5	0.003	np	np	np
Forested Wetland	7	85.0	5.2	y = -7.3*ln(x) + 104.3	0.203	np	np	np
Grass	22	53.3	8.7	y = 23.0*ln(x) – 13.6	0.277	16	47	90
Grass/forest	8	80.5	10.2	y = 18.1*ln(x) + 20.4	0.407	5	20	47
Wetland	7	72.3	11.9	y = 3.0*ln(x) + 68.9	0.005	np	np	np

Assessment of Groundwater Flow

Determining the Direction Ground Water Flows

Ground water usually flows toward, and eventually drains into, streams, rivers, and lakes. The flow of ground water in aquifers does not always mirror the flow of water on the surface. The following steps show how to determine the direction ground water is flowing and the hydraulic gradient within an unconfined aquifer:

Step 1. Determine the **water table elevation** at three locations. To do this subtract the **depth to water** from the **surface elevation** at each well. Can you find the water table elevation for each of the three wells shown in figure 1?

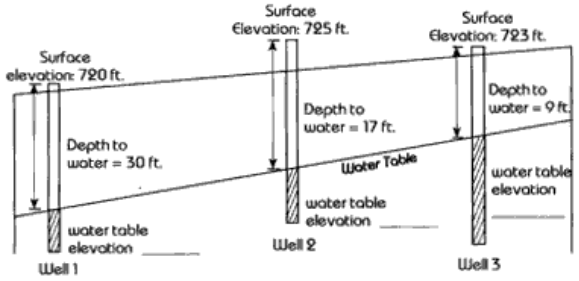
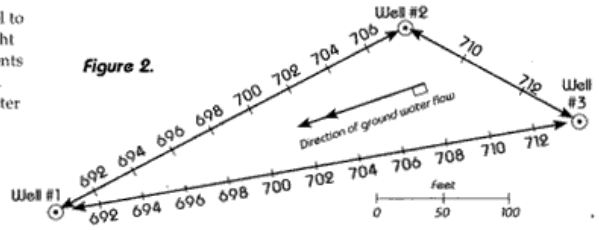


Figure 1.

Step 2. The well locations from step one are shown in figure 2. The difference in **water table elevations** between each of the wells is determined by subtracting the water table elevation of a well with a higher elevation from the water table elevation of a well with a lower elevation on each of the straight lines connecting the wells. These elevation differences are divided up into equal increments as shown in figure 2. Water table elevation levels have been placed on the figure by adding the initial water level to each increment. Draw straight lines connecting the increments which have the same values. These lines represent the water table contours.

Figure 2.



Step 3. The ground water will flow from higher elevations to lower elevations in the direction of maximum change in elevation. The line perpendicular to the straight lines which connect the elevation increments indicates the direction that ground water flows.

The vertical change in ground water elevation over horizontal distance, in the direction of ground water flow, is called the **hydraulic gradient.** It can be determined for this example using the following equation:

$$\text{Hydraulic Gradient} = \frac{\text{Water Table Elevation Change (in the direction of flow)}}{\text{Horizontal Distance between measurement points}}$$

This means the **water table elevation** decreases by ___ feet for every foot the ground water flows.

Sample Location Coordinates

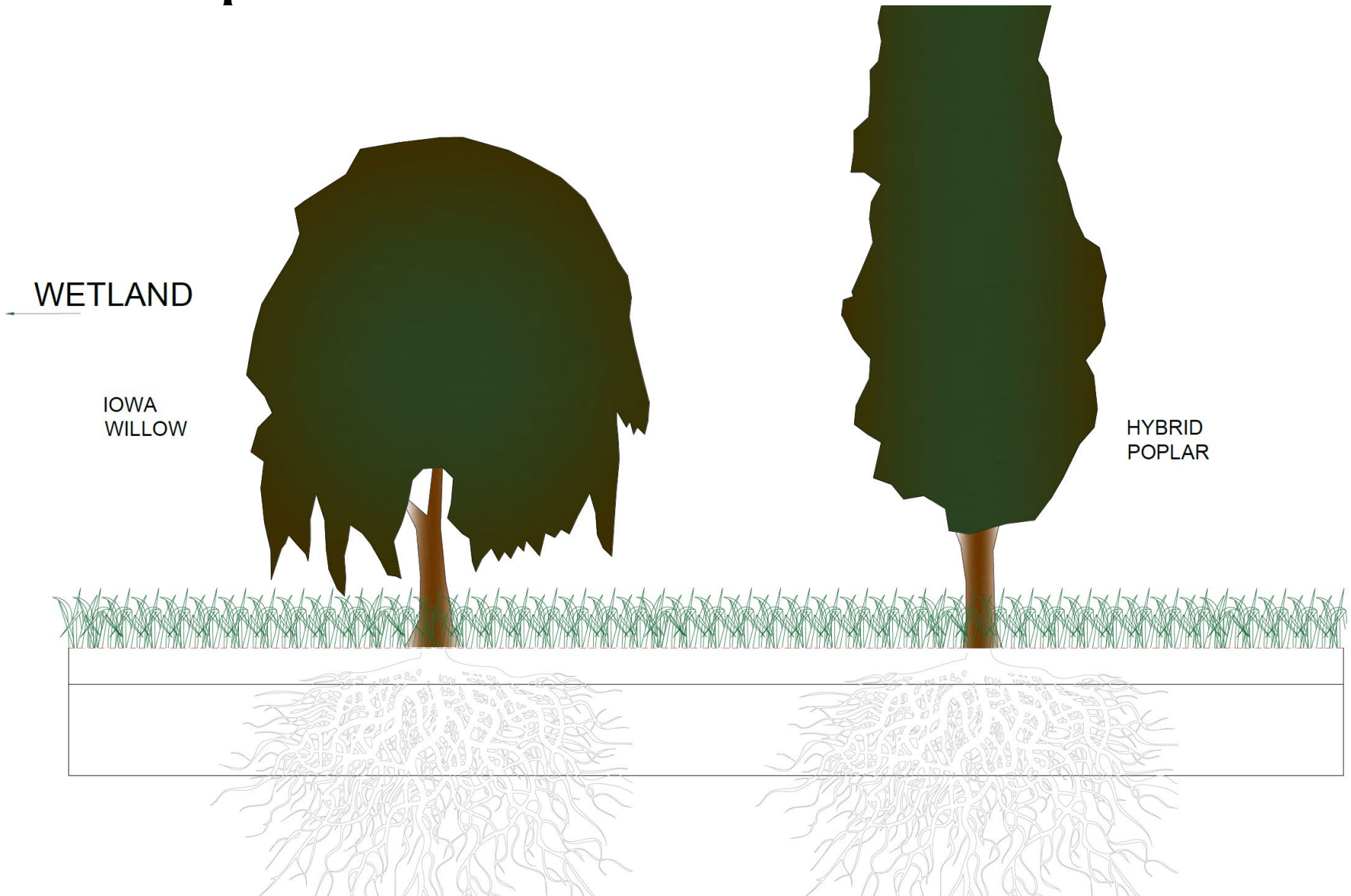
Sample Number, Latitude, Longitude

- 1: 42.5023839, -91.4484935
- 2: 42.502404, -91.4457929
- 3: 42.5014426, -91.4457588
- 4: 42.5005001, -91.4471490
- 5: 42.5005372, -91.4485682

Coordinates based on NAD 1983 UTM Zone 15N projected coordinate system

Design of Riparian Buffer Zone

Mature Riparian Buffer Zone

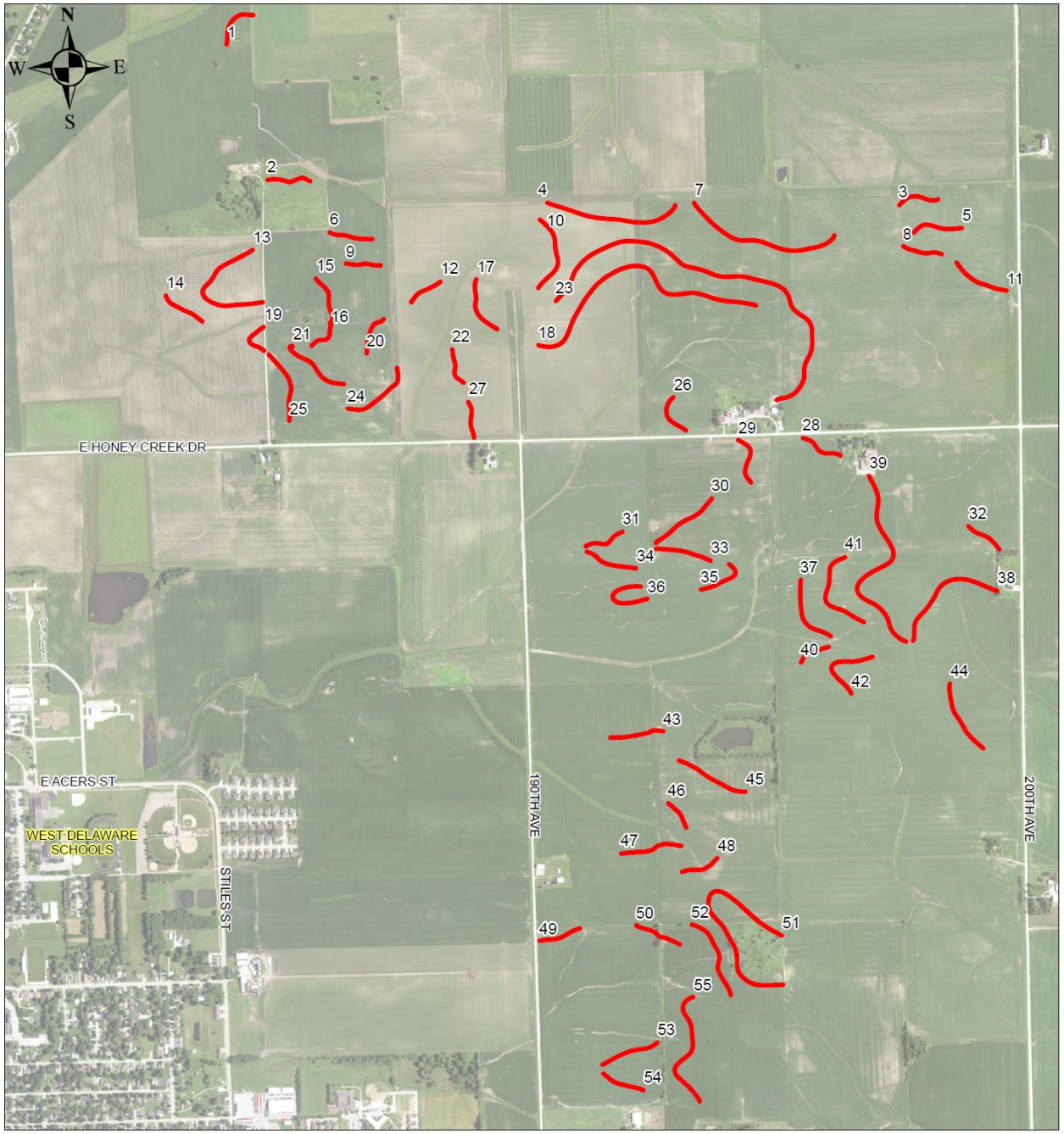


Cost of Riparian Buffer Zone

Material and Construction Costs

Riparian Buffer Zone				
3/8" Pea Gravel	6600	TON	$25.00	$165,000.00
Iowa Willows/Hybrid Poplars (8-9 ft poles - bag of 50)	6	BAG	$3,300.00	$19,800.00
Native Grass Seeding	1.17	ACRE	$150.00	$175.50
Trough Excavation	8500	CUB YD	$5.00	$42,500.00
Backfilll of Soil and Gravel	1900	CUB YD	$40.00	$76,000.00
Subtotal				$303,475.50

2. Contour Buffer Strips



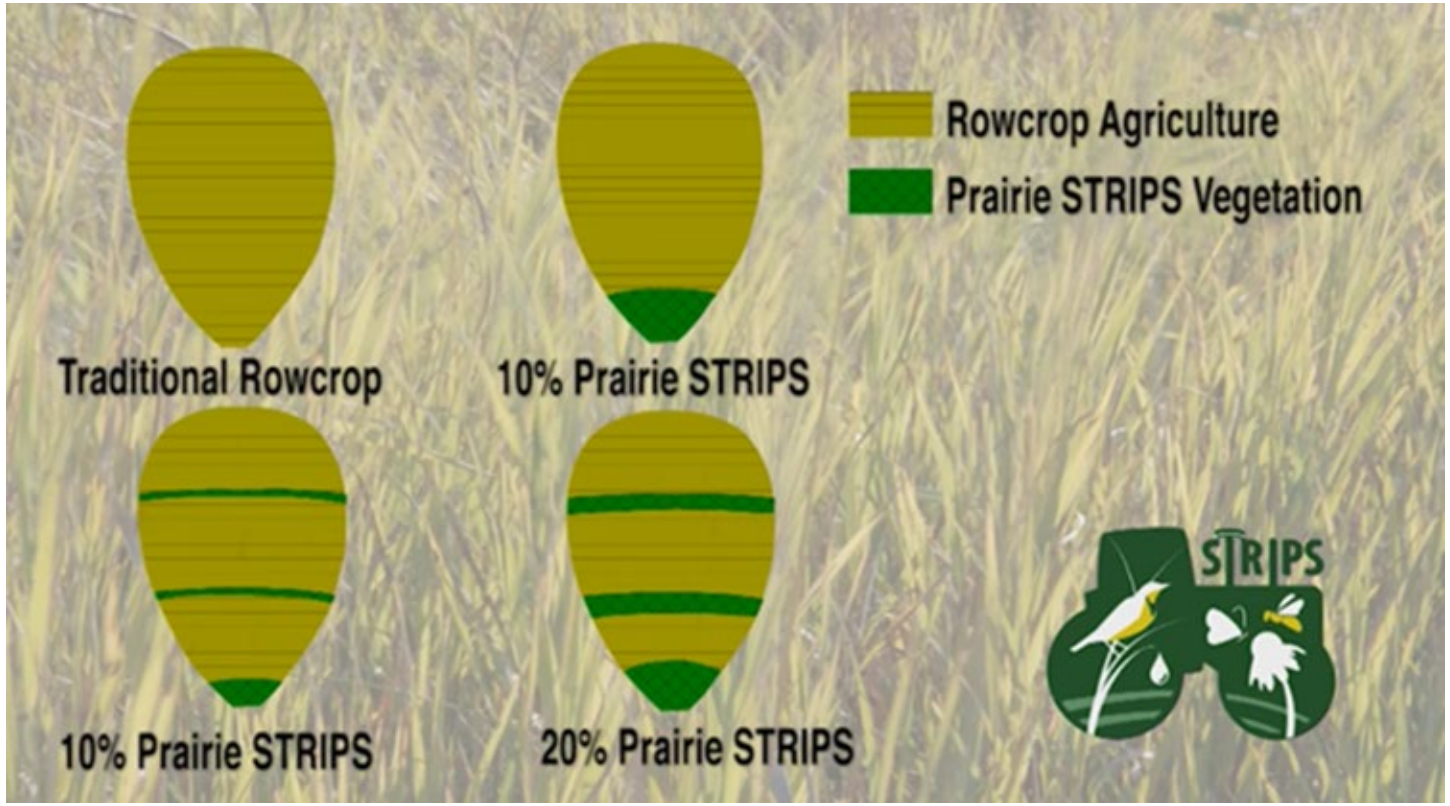
LEGEND

CONTOUR BUFFER STRIPS

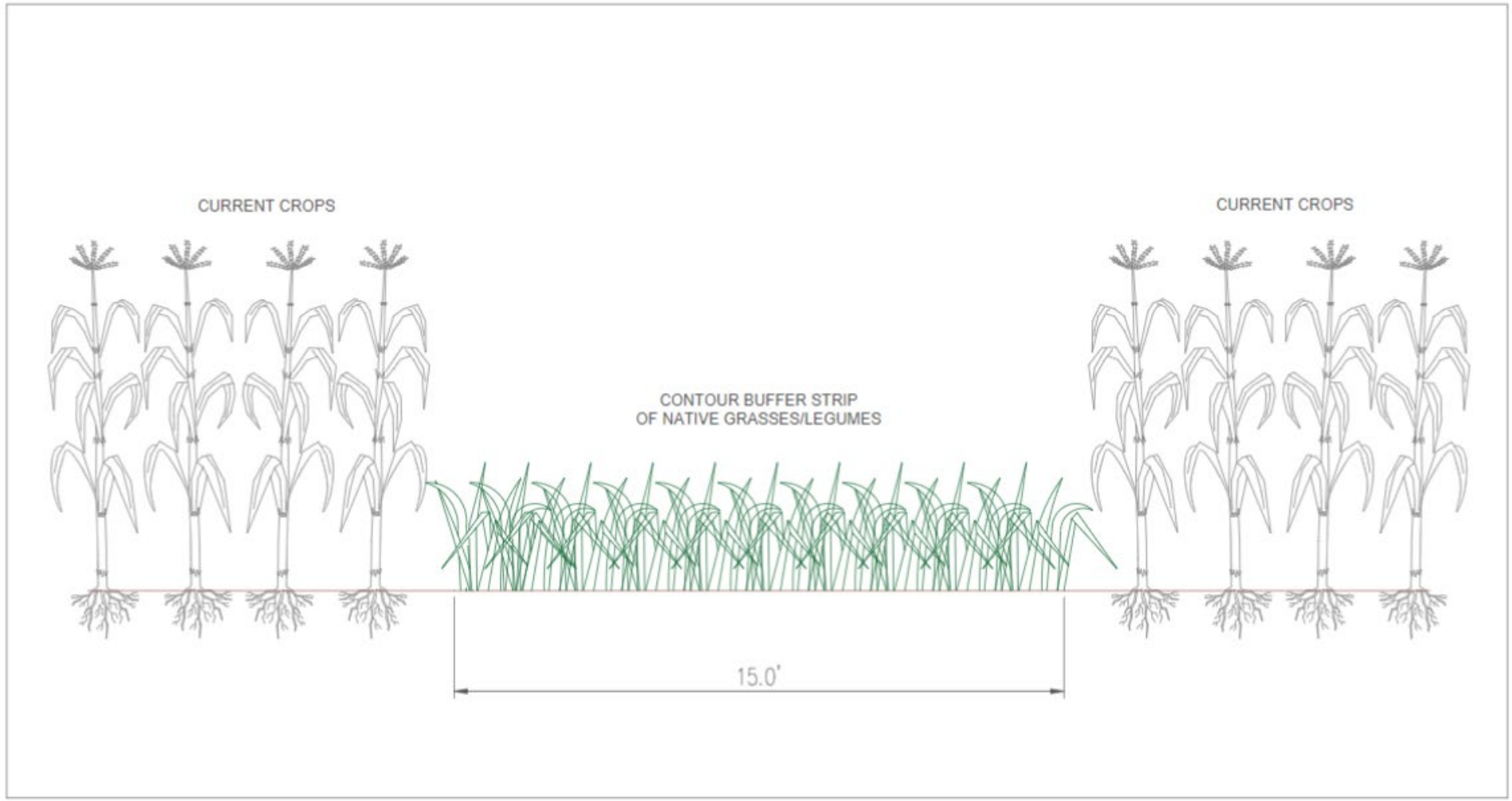
Investigation of Effectiveness

10 % Crop Replacement

Up to 85% Nitrate Removal



Design of Contour Buffer Strips



Total Length	95,418	ft
Total Area	32.9	acres

Cost of Contour Buffer Strip

Material and Construction Costs

Contour Buffer Strips				
Orchardgrass Seed	32.9	ACRE	$150.00	$4,935.00
Alfalfa Seed	32.9	ACRE	$150.00	$4,935.00
Seed Distribution	32.9	ACRE	$50.00	$1,645.00
Field Tilling	32.9	ACRE	$50.00	$1,645.00
Subtotal				$13,160.00

Farmer Foregone Income Estimates

Foregone Income (corn) payments				
1-year payment	32.9	ACRE	$250.00	$8,225.00
10-year payment	32.9	ACRE	$250.00	$82,250.00

3. Urban Nitrate Strategy

Your Best Lawn

How It Works **Contractors** **FAQs** **Reimbursement**

YOUR BEST LAWN
Green lawns don't have to cost the earth

Green Lawns Don't Have to Cost the Earth

Together with the cities of Iowa City and North Liberty and the Iowa Department of Natural Resources, we've created Your Best Lawn. Cleaner water in our streams starts in your backyard. We can help you get a lawn you are proud of with less chemicals.

Check out our soil health contractor list and learn about the rebates we offer to help you pay for soil quality restoration service.

Soil Quality

Better Lawns Made Easy

Got Soil Quality?

Prior to land development and agricultural cultivation, the native ecosystem of tallgrass prairie built and maintained soils with high organic matter and porosity. The high organic matter and porosity gave the landscape the ability to absorb rain and not shed runoff. Hardy native plants and grasses had deep root systems, which created pore spaces that allowed rainfall to percolate into the soil profile. Soils rich in organic matter support an entire ecosystem of microorganisms that contributed to soil health.

Iowa soils have been significantly altered by tillage for farming and grading practices associated with urban development. Years of tillage and soil erosion has caused the loss of more than half of Iowa's topsoil. The organic matter content was reduced from a healthy, sponge-like 10% to less than 2%. Often, topsoil that remains is completely removed during development for urban growth. Therefore, little to no organic matter is left and the graded soils are compacted.

Clean Water Is Everyone's Business

These compacted soils with no organic matter cause nearly all the water to runoff during rainfall. Stormwater runoff flows untreated to storm sewers, and washes associated pollutants directly into nearby streams, rivers, lakes and wetlands.

Yards with poor soil quality contribute to water quality issues because of their inability to infiltrate water or make it available in the yard for the turfgrass. Rainfall runs off the yard instead of providing water for the grass. Any applications of pesticide and fertilizer may also travel in runoff to nearby water bodies, negatively impacting water quality in your neighborhood and beyond.

Upgrade Your Soil for a Better Lawn

A compacted, nutrient poor soil with low organic matter content also requires more time and money to stay green! This guide provides information that will help you create a beautiful, healthy lawn that requires less water and reduced fertilizer and pesticide applications.

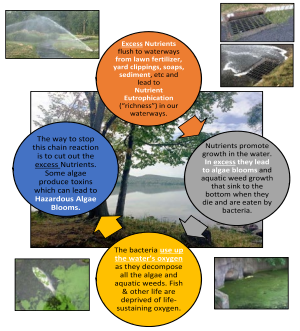
Rainscaping Iowa
Landscapes for clean water

Nutrient Pollution

is present in many Rockland County waterbodies.
This is due to **excess Nitrogen and Phosphorus nutrients** carried by our outdoor activities and stormwater that quickly carry the excess nutrients to storm drains, then to the nearest waterways leaving little opportunity for soil and plants to filter them out.

This leads to **Nutrient Eutrophication** ("richness"), a top Water Quality Issue in NYS, that impairs our waters.

Aren't Nutrients Good for Waterbodies?
YES!
How Do They Cause Harm?



Are Nutrient-Impaired Waters Harmful for Human Recreation?
If Hazardous Algae Blooms form, recreation would be impacted.

Nutrient Pollution Solutions

Fertilizer: Over-fertilized lawns is a significant source of excess nutrients in local waterbodies. If using fertilizer see **Rockland County's Fertilizer Law**, and **Look for the Zero** in the middle number indicating phosphorus-free (see links on back).

Trash: The grate in the street leads directly to local waters where we fish and recreate. Dispose of trash and Pet Waste Properly!

Improperly managed **Septic Systems** send pathogens and nutrients to local waterways and ground water.

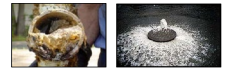
Soaps: Many Soaps (particularly car wash soap) contain phosphorus. Use phosphorus-free items since wastewater plants can't remove it all and direct car wash-water to the lawn which will filter it out, but never to the storm drain.

Leave the Leaves and Grass-Clippings as free, organic fertilizer which will directly return nutrients to your lawn. Many fall flooding issues are a result of blocked storm drains.

Water-Smart Landscaping: Grass alone can require 2-3x the water of a **drought-tolerant mixed landscape** which typically use no fertilizers (less watering and maintenance!).

Shredding your leaves with a mulching mower will reduce their volume and speed up decomposition time.

Sanitary Sewer Overflows (SSOs):
Washing **grease/cooking oils** down drains or flushing **wipes** (including 'flushable') or disposables **clogs sewer lines causing overflows** during heavy rainfall to local waterways (and homes) that carry nutrients, bacteria and other pathogens. **Pour cooled grease/cooking oil into a container then seal & discard with garbage. Wipe pan clean with a dry paper towel prior to washing**.



Water-wise Landscaping will soak up Nutrient & Stormwater Pollution!

*A **drought-tolerant mixed landscape** will use less water and be less maintenance once established. Creating a **Rain Garden** in a wet, shallow depression with water-tolerant native plants in the very wet zone (middle), and moderately wet zone (edges) will capture and recharge water. Rain Gardens are designed to hold standing water for less than 24 hours (no mosquitos).*

CCE's Fact-Sheets for Water-Wise Landscaping, Rain Gardening, Xeriscaping, Fertilizing, etc:
http://rocklandcce.org/fact-sheets

EPA Water-Smart Landscapes:
https://www3.epa.gov/watersense/outdoor/landscaping_tips.html

Photo sources courtesy of USEPA, NYSDEC, Keep Rockland Beautiful, Wikipedia

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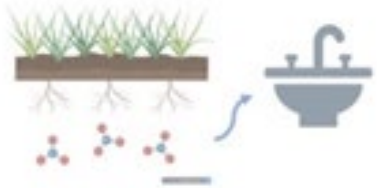

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https://www.extension.purdue.edu/extmedia/HO/HO-236-W.pdf

Cost of Implementing Urban Nitrate Strategy

Materials, Mailing and Design Costs

Urban Nitrate Removal Education Brochure				
Printing Brochures	2400	EA	$0.10	$240.00
Stamps	2400	EA	$0.55	$1,320.00
Brochure Design	1	LS	$1,000.00	$1,000.00
Subtotal				$2,560.00

Total Cost of Project

Material and Construction Costs

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL
Contour Buffer Strips				
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Stamps	2400	EA	$0.55	$1,320.00
Brochure Design	1	LS	$1,000.00	$1,000.00
Subtotal				$2,560.00
TOTAL				**$319,195.50**

Total Project Costs

Construction Subtotal	$319,195.50
10% Contingencies	$31,919.55
20% Engineering and Administration	$63,839.10
Total Project Cost	**$414,954.15**

Thank you, questions?

Trident Environmental Solutions