Pretty Lake Engineering Feasibility Study

DRAFT

LaGrange County, Indiana

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PRETTY LAKE ENGINEERING FEASIBILITY STUDY
LAGRANGE COUNTY, INDIANA

EXECUTIVE SUMMARY

The Pretty Lake Conservation Club (PLCC) received an Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) grant to complete an engineering feasibility study for the Pretty Lake watershed. The goal of the study was to determine the feasibility of anticipated construction projects, prepare for physical design, and ensure project success. To be deemed feasible, a project needed to be acceptable to property owners, receive regulatory agency support, be physically constructible, and be environmentally, economically, and socially justifiable.

This study examined the feasibility of eight project sites within the Pretty Lake watershed, which were identified during the diagnostic study that was completed in 2006. The identified potential projects included grassy swales, a rock-lined channel, a raingarden at the elementary school, a detention basin, tile repair, a two-stage ditch, and tree canopy reduction to increase sunlight along the streambanks.

Of the eight projects studied, all were deemed feasible at some level. Based on the preliminary designs for each project, the estimated costs are as follows: construct 70 feet (21.3 meters) of grassy swale adjacent to CR E 490 S and install a domed storm grate on the existing catch basin for $ 4,117; construct a 1,900-square feet (176.5-square meter) raingarden at the Milford Elementary School for $8,257; construct approximately 300 feet (91.4 meters) of grassy swale and rock-lined channel along CR 480 S for $10,106; construct approximately 180 feet (54.9 meters) of grassy swale along CR E 480 S for $3,864; construct a 0.2 acre sediment basin (0.1 hectare) and 200 feet (61 meters) of drainage tile along CR E 890 S for $8,319; replace 160 feet (48.8 meters) of failed drainage tile and install a catch basin along CR E 430 S for $4,951; construct 1,585 feet (483.1 meters) of two-stage ditch along Deal Ditch (both Priority Ditch 1 and 2) for $86,767; and selectively cut and properly remove trees from a total of approximately 500 feet (152.4 meters) along Deal Ditch for $14,794. The total for all eight projects is $141,175.

It is recommended that the PLCC apply for a design/build LARE grant for the design and construction for five of the projects (Sites 1, 3, 4, 5, and 6) during the next LARE grant cycle. The PLCC should then apply for a design/build LARE grant for the design and construction of the two-stage ditch (Site 7) in 2011. Sites 2 and 8 could also be funded during the 2010 or 2011 funding cycle. In the interim, members of the PLCC should educate the local residents about the benefits of the defined projects and work to secure permission and approval from the residents associated with the two-stage ditch project.

ACKNOWLEDGEMENTS

The Indiana Department of Natural Resources Division of Fish and Wildlife Lake and River Enhancement Program and the Pretty Lake Conservation Club funded this feasibility study. JFNew assessed project feasibility and environmental impacts, and developed opinions of probable cost for the feasible projects within the Pretty Lake Watershed. Jim Mertz of the Pretty Lake Conservation Club provided initiative and assistance in getting this study completed. Special thanks to Doug Nusbaum and the IDNR LARE program for their assistance in providing information and identifying feasible projects. Thanks to the Pretty Lake Conservation Club members for support and watershed landowners for their assistance. Contributors to this project include Wayne Stanger, Mark Pranckus, Tom Estrem, Christine Dittmar, Betsy Ewoldt, Tyson Edwards, Holly Jones, Sara Peel, and John Richardson with JFNew.

Cover Photos: Top Left – Looking downstream at Deal Ditch from CR S 875 E
Top Right – Roadside drainage from CR E 480 S
Photos courtesy of JFNew.

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PRETTY LAKE ENGINEERING FEASIBILIY STUDY
LAGRANGE COUNTY, INDIANA

1.0 INTRODUCTION

1.1 Background

Pretty Lake has historically exhibited good water quality. Pretty Lake's nutrient levels have remained relatively low over the past 40 years and historical records from the past 40 years show the lake's Secchi disk transparency (a measure of water clarity) has been consistently greater than the regional median. In addition to exhibiting good water quality, Pretty Lake possesses an extremely diverse aquatic plant community and continues to be a good lake for fishing. More than 70 aquatic plant species were identified in the lake during the most recent assessment including more than 10 species of pondweeds (JFNew, 2008). Naturally-reproducing populations of largemouth bass and northern pike, a quality bluegill/redear sunfish fishery, and a successful walleye stocking program indicate that the lake has excellent water quality.

Despite the lake's excellent water quality and its ability to provide good fishing, lake residents, particularly long-time residents, have noticed changes in the lake over the past several years. These changes include a decrease in the size of the emergent plant community, an increase in the abundance of exotic species such as Eurasian watermilfoil, and a noted decrease in the lake's water clarity in portions of the lake following large rain events. These changes have negatively impacted the residents' enjoyment of the lake and increased their desire to protect the lake's health and future.

In 2006, JFNew conducted water quality sampling within Pretty Lake and Deal Ditch, the lake's main inlet, and the outlet stream, to identify potential water quality improvement projects. According to the study, Pretty Lake currently possesses good water quality, particularly in comparison to other lakes in the region and throughout the state; however, there is evidence that the lake's water quality could degrade in the future. The study recommended addressing both watershed-level and in-lake issues. Recommended watershed management techniques include: streambed and bank stabilization, homeowner best management practices, manure management planning, wetland restoration, use of the Conservation Reserve Program and conservation tillage, and stormwater filtration. Within the lake itself, Pretty Lake stakeholders are encouraged to develop a rooted plant management plan and consider restoration of emergent communities in selected locations to protect the lake's health. In 2007, the Pretty Lake Conservation Club (PLCC) received a grant from the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) Program to conduct an engineering feasibility study. The purpose of the current study is to determine the design and construction feasibility of several water quality improvement projects within the watershed of Pretty Lake.

1.2 Scope of the Study

The geographic scope of the study includes Pretty Lake and its 1,230-acre (497.7-ha) watershed in LaGrange County, Indiana with a focus on sites identified in the diagnostic

study as potential sites for watershed improvements. This feasibility study focuses on stormwater filtration practices adjacent to Pretty Lake and streambank stabilization along Deal Ditch, which drains into Pretty Lake (Figure 1). PLCC, JFNew, and Doug Nusbaum conducted a driving and walking tour of the watershed streams in October, 2007. The tour was completed to identify locations where projects could be implemented that would result in water quality improvements in the lake and its drainages. Based on the survey's findings, the following projects (Figure 1) were identified:

1. Construction of a grassy swale along CR E 490 S on the east end of Pretty Lake.
2. Creation of a raingarden adjacent to CR E 490 S at Milford Elementary School.
3. Construction of a grassy swale/rock-lined channel complex along CR E 480 S.
4. Construction of a grassy swale along CR E 480 S on the South end of Pretty Lake.
5. Creation of a sediment detention basin in an agricultural field adjacent to CR S 890 E.
6. Replacement of a broken tile and an increase in the size and location of the current catch basin on the north end of Pretty Lake between CR S 895 E and CR E 430 S.
7. Conversion of Deal Ditch into a two-stage ditch from CR S 875 E to CR E 400 S.
8. Stabilize eroding streambanks along Deal Ditch from CR E 400 S to CR E 430 S.

1.3 Goals and Objectives

The goal of this study was to identify feasible projects that could be designed and implemented within a reasonable timeframe. A feasible project is defined as one that can physically be constructed, is acceptable to landowners, is economically and ecologically justifiable, and can receive regulatory approval. The feasibility study is an attempt to ensure future project success by investigating all avenues that could potentially cause project failure.

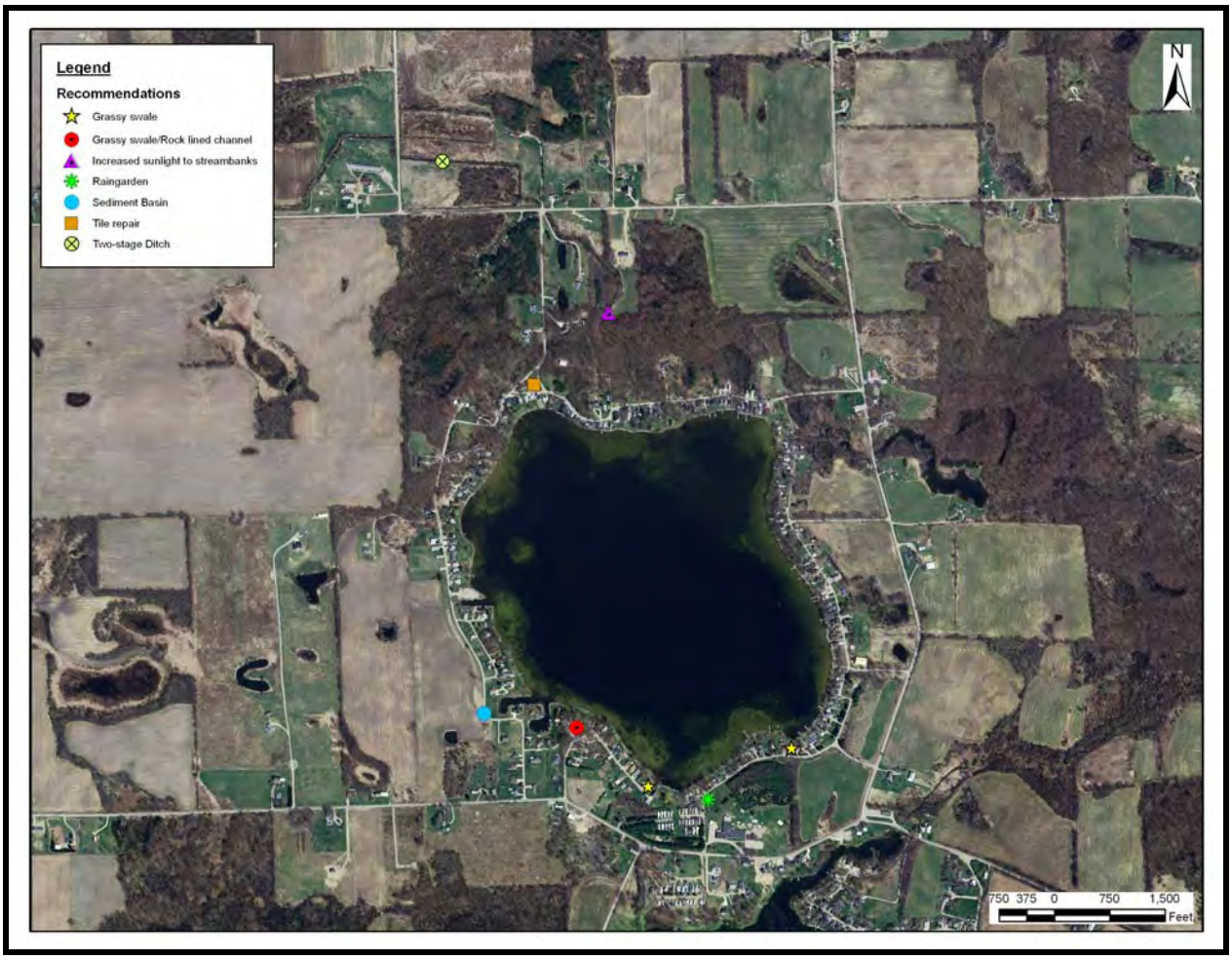

Figure 1. Engineering feasibility study proposed project location.

2.0 DESCRIPTION OF THE STUDY AREA

2.1 Location

Pretty Lake is a 184-acre (74.5-ha) natural lake that lies in the southeast corner of LaGrange County, Indiana (Figure 2). Specifically, the lake is located in Sections 15 and 16 of Milford Township 36 North, Range 11 East in LaGrange County, Indiana. The Pretty Lake watershed stretches out to the north and west of the lake encompassing approximately 1,230 acres (497.7 ha or 1.9 square miles; Figure 3). Water discharges through the lake's outlet in the northeast corner. Water from Pretty Lake's outlet combines with water from Mud Lake to flow north into Little Turkey Lake. Water from Little Turkey Lake exits through Turkey Creek and flows north until it empties into the Pigeon River near Mongo, Indiana. The Pigeon River transports water to the St. Joseph River, which eventually discharges into Lake Michigan.

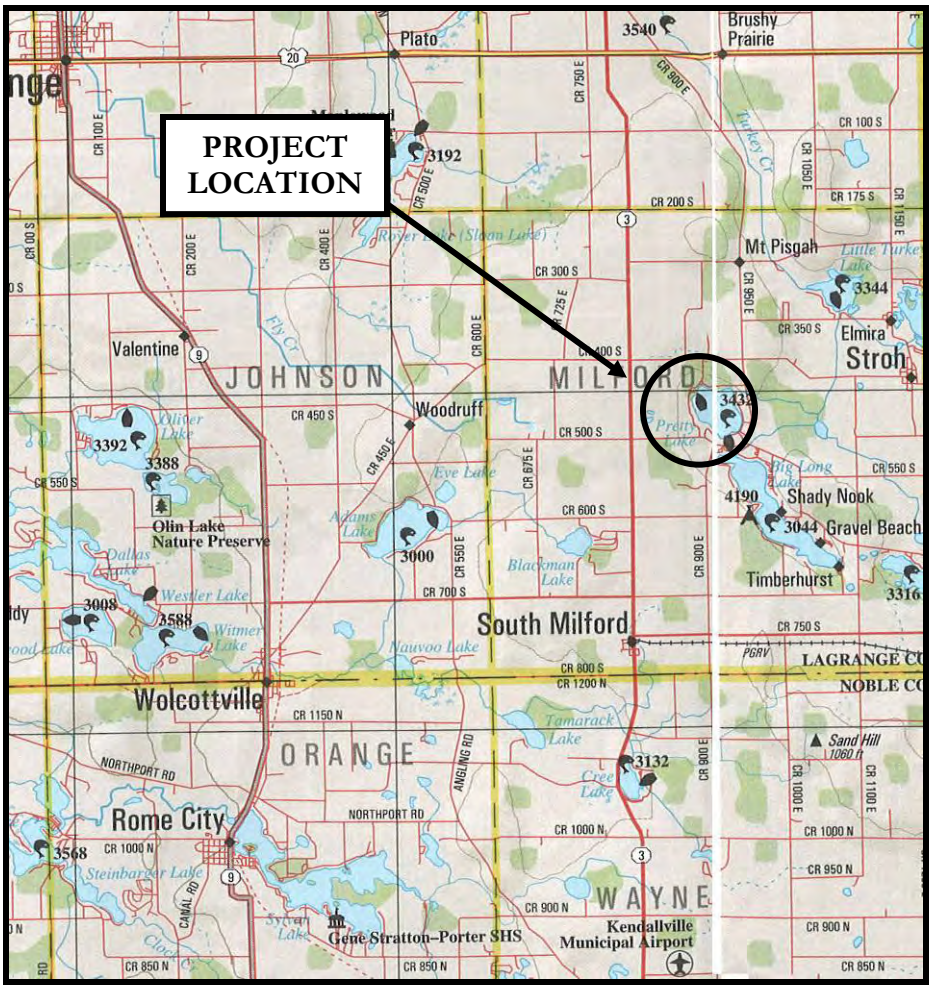

Figure 2. General location of the Pretty Lake watershed. Source: DeLorme, 1998.

Surface water drains to Pretty Lake via three primary routes: Deal Ditch, an unnamed tributary, which enters near the public access site, and via direct drainage. Deal Ditch drains approximately 651 acres (263.5 ha or 53%) of the watershed north of Pretty Lake (Table 1). This stream empties into Pretty Lake in the lake's northeast corner. An unnamed tributary transports water to Pretty Lake from the watershed west of the lake emptying into the lake along its western boundary. In total, this tributary drains 160 acres (64.7 ha) of the Pretty Lake watershed. The remaining 19% of the land in the Pretty Lake watershed (236 acres or 95.5 ha) drains directly to Pretty Lake or via a series of small swales along the lake's western shoreline. Figure 4 illustrates the boundaries of each of these subwatersheds of Pretty Lake. McGinty (1966) noted that the main inlet to Pretty Lake (Deal Ditch) supplied 80% of the surface water to the lake. However, it should be noted that a majority of water likely enters Pretty Lake as groundwater. Historic fluctuations in surface water level typically occurred due to a large spring associated with the lake (McGinty, 1966).

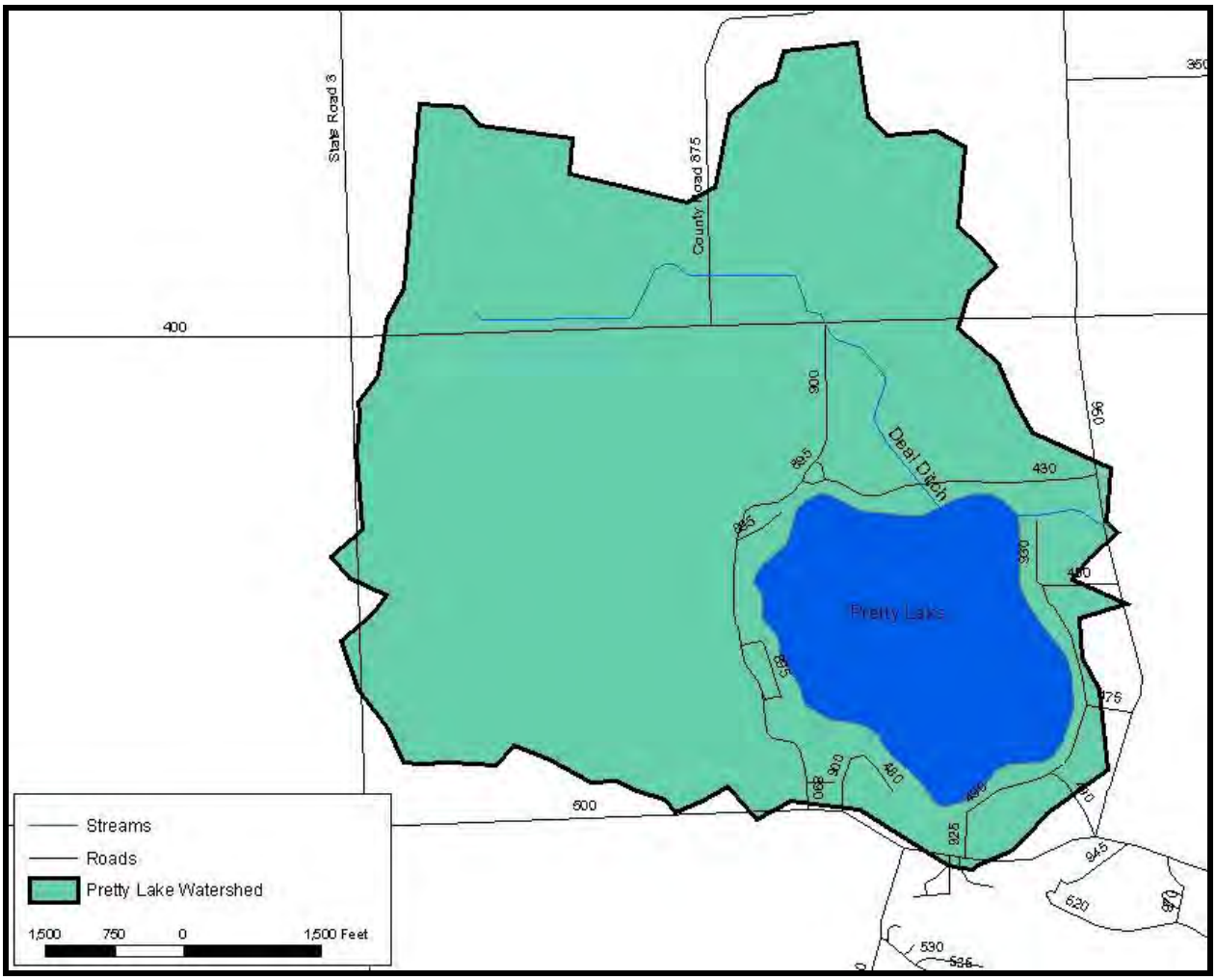

Figure 3. Pretty Lake watershed.

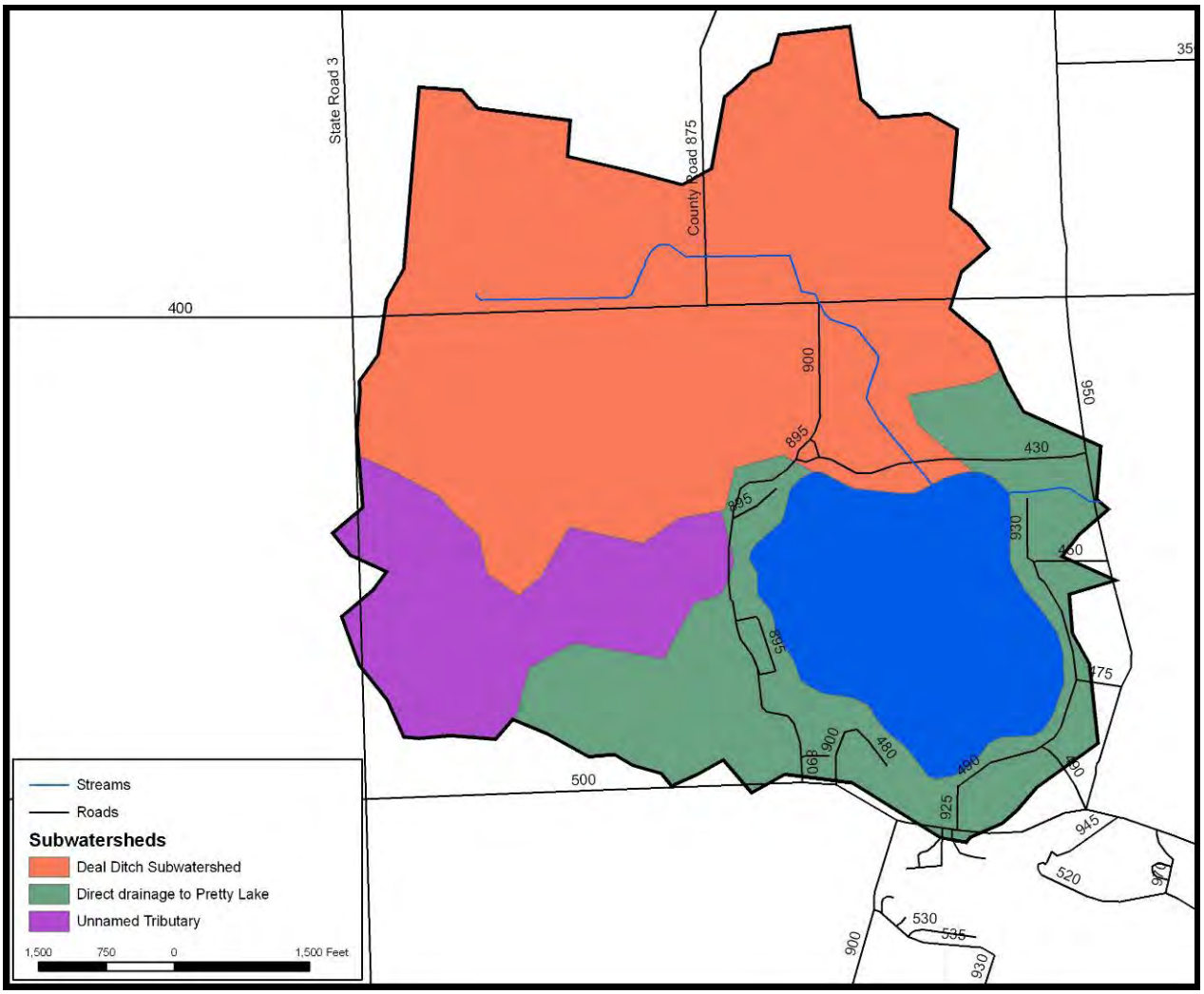

Figure 4. Pretty Lake subwatersheds.

Table 1. Watershed and subwatershed sizes for the Pretty Lake watershed.

Subwatershed/Lake	Area (acres)	Area (hectares)	Percent of Watershed
Deal Ditch	651	263.5	52.8%
Unnamed Tributary (West)	160	64.7	13.1%
Area draining directly to Pretty Lake	236	95.5	19.2%
Watershed Draining to Lake	**1,047**	**423.7**	**85.1%**
Pretty Lake	184	74.5	14.9%
Total Watershed	**1,231**	**498.2**	**100%**
Watershed to Lake Area Ratio	6.7:1		

2.2 Geologic History and Topography

Pretty Lake is a headwaters lake in the Great Lakes Basin. The lake and it's 1,231-acre (497.7-ha) watershed lie north of the north-south continental divide that separates the Mississippi River Basin (land that drains south to the Mississippi River) from the Great Lakes Basin (land that drains north to the Great Lakes). As part of the St. Joseph River

Basin, water exits Pretty Lake near the lake's northeast corner and flows east then north through LaGrange County as Turkey Creek. Turkey Creek combines with the Pigeon River south of Mongo, which eventually discharges into the St. Joseph River in Michigan directly north of Bristol, Indiana. The St. Joseph River flows northwest carrying water into Lake Michigan at St. Joseph/Benton Harbor.

The advance and retreat of the glaciers in the last ice age (the Wisconsin Age) removed, shaped and reshaped much of the landscape found in Indiana today. In the northern portion of the state, ground moraines, end moraines, lake plains, outwash plains, and other geologically complex features dominate the landscape. Further, the interaction of three glacial lobes, (Michigan Lobe, Saginaw Lobe, and the Erie Lobe, respectively) left behind a vast array of deposits and landforms that changed the region's hydrogeology. In comparison to the central portion of the state, surface water, groundwater and soils are more varied and complex. Large raised landforms such as the Valparaiso Moraine, the Maxinkuckee Moraine, and the Packerton Moraine, indicate the glacial margins of these ice sheets in the northern portion of the state. Major rivers in northern Indiana cut through course grained outwash and transect these dominant topographical features, suggesting a drainage pattern that was established an ice proximal and or subglacial environment. Later, outwash plains formed as the glacial melt waters flowed from retreating glaciers. This further altered the drainage of the landscape as dams between ice, morainal deposits and melt water pooled into lakes. As a result, lake plains and kettle lakes formed as stagnant water settled out and deposited silt and clay (Brown, et al, 1998).

The Saginaw and Erie Lobes of ice in the Wisconsin glacial age shaped much of the Pretty Lake watershed. The lake is located within a series of kettle lakes, knob and melt water channels that comprise the Packerton Moraine (Gray, 1989). This end moraine marks the edge of the Saginaw Lobe's advance and forms the southern boundary of Pretty Lake's watershed which indicates the general boundary between the St. Joseph River Basin and the Wabash River Basin. Gravel lithologies indicate that the Erie and Saginaw Lobes deposited sediments and modified existing landforms near Pretty Lake. These raised features are oriented in a northwest-southeast direction and occur in moraine deposits that were later sculpted by water from the melting Erie Lobe of ice (Brown and Jones, 1999).

The topography of the Pretty Lake watershed and its subsurface geology dictate surface drainage. The highest areas of the watershed lie along the watershed's southern and eastern edges, where the Erie Lobe of the last glacial age left end moraines. Along the watershed's northern boundary, the elevation nears 1030 feet (313.9 meters) above mean sea level. The ridges along the watershed's southwestern boundary are nearly as high (1020 feet or 310.9 meters), and are equally as steep as the ridge along the northern watershed boundary. Deal Ditch, its floodplain, and Pretty Lake occupy a lower elevation valley in the watershed. Pretty Lake, elevation 964 feet (293.8 m) above mean sea level, is the lowest point in the watershed. This surface water elevation is one of the highest elevations for lakes in LaGrange County (Grant, 1989).

2.3 Soils

The Wawasee-Hillsdale-Conover soil association covers the entirety of the Pretty Lake watershed (Hillis, 1980). The Wawasee-Hillsdale-Conover soil association is the most plentiful association covering 34% of LaGrange County. Soils in this soil association developed from glacial till and occur on till plains and moraines. Thirty percent of the soil association consists of Wawasee soils, while Hillsdale soils cover 17% and Conover soils cover 14%. Wawasee soils are well drained and occur on knobs and breaks between drainageways. Hillsdale soils are also well drained soils; however, they are typically found on ridges between drainageways and on level till plains. Conover soils are typically located on broad flats or along drainageways and are somewhat poorly drained. Boyer loamy sand, Oshtemo loamy sand, Chelsea fine sand, Metea loamy sand, and Martinsville sandy loam soils are minor components of this association. Whitaker soils are common on low areas in the landscape, while Rensselaer soils are located in depressions and drainageways and Houghton soils are found in low-lying pockets and deep depressions.

As Figure 5 indicates, highly erodible soils (HES) located on the most steeply sloped areas cover approximately 99 acres (40.1 hectares) or 8% of the Pretty Lake watershed, while potentially highly erodible soils (PHES) on steep-sloped soils cover approximately 450 acres (182.1 hectares) or 36% of the watershed. Highly erodible and potentially highly erodible soils border nearly the entire shoreline of Pretty Lake and cover much of the watershed lying directly north and west of the lake. In 1987, EarthSource created overlay maps identifying highly erodible soils in severely sloped areas (EarthSource, 1991). This overlay identified 66 acres (26.7 hectares) where highly erodible soils were mapped on severely sloped areas. EarthSource (1991) identified all of these areas as located adjacent to open drains or ditches and utilized for agricultural row crop production during the 1987 growing season.

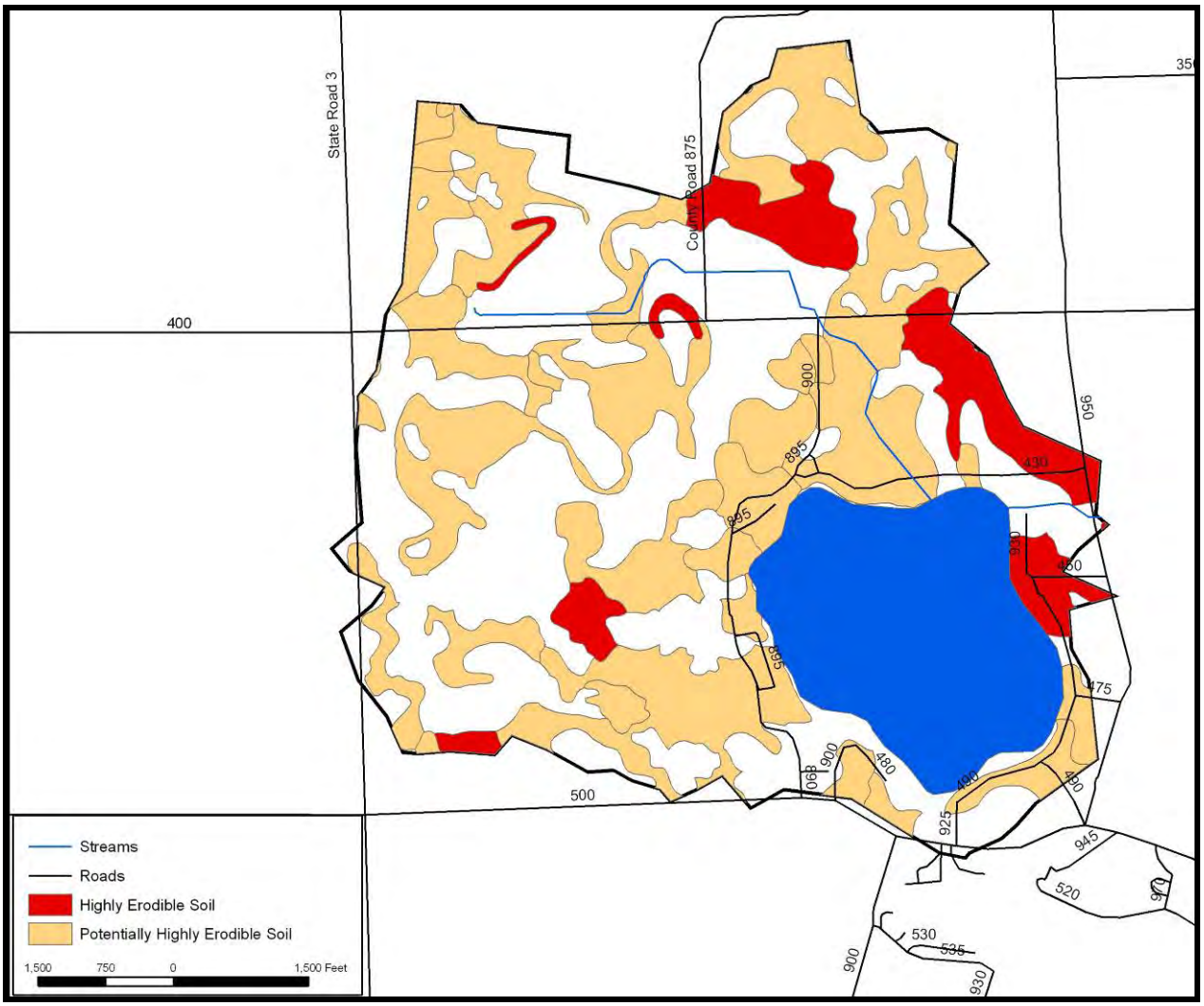

Figure 5. Highly erodible and potentially highly erodible soils within the Pretty Lake watershed.

2.4 Land Use

Figure 6 and Table 2 present current land use information for the Pretty Lake watershed (Land use data from the U.S. Geological Survey (USGS, 1998) form the basis of Figure 6). Like many Indiana watersheds, agricultural land use dominates the Pretty Lake watershed, accounting for approximately 67% of the watershed. Row crop agriculture makes up the greatest percentage of agricultural land use at 50.2%, while pastures or hay vegetate another 16.8%. Most of the agricultural land in the Pretty Lake watershed and throughout LaGrange County (USDA, 2002) is used for growing soybeans and corn. LaGrange County ranks the highest of all 92 state counties for forage (land used for hay, haylage, grass silage, and greenchop) production and sales of donkeys, ponies, mules, burrows, and horses and also cattle sales. Land uses other than agriculture account for the remaining 33% of the watershed. Natural landscapes, including forests and wetland, cover approximately 17% of the watershed. Most of the natural acreage in the watershed is associated with the forested and emergent and woody wetland area north of Pretty Lake. Additional smaller tracts are located near the headwaters of Deal

Ditch, in the northeastern corner of the watershed, and adjacent to the pond in the watershed's southwestern corner. These natural areas consist of small tracts of wooded or emergent wetlands or deciduous forest, and are scattered along the shoreline. Open water, including Pretty Lake and several small ponds, accounts for another 15% of the watershed. Most of the remaining 1.3% of the watershed is occupied by low intensity residential land, with less than 1% of high intensity residential or commercial land. Much of the residential land lies directly adjacent to Pretty Lake.

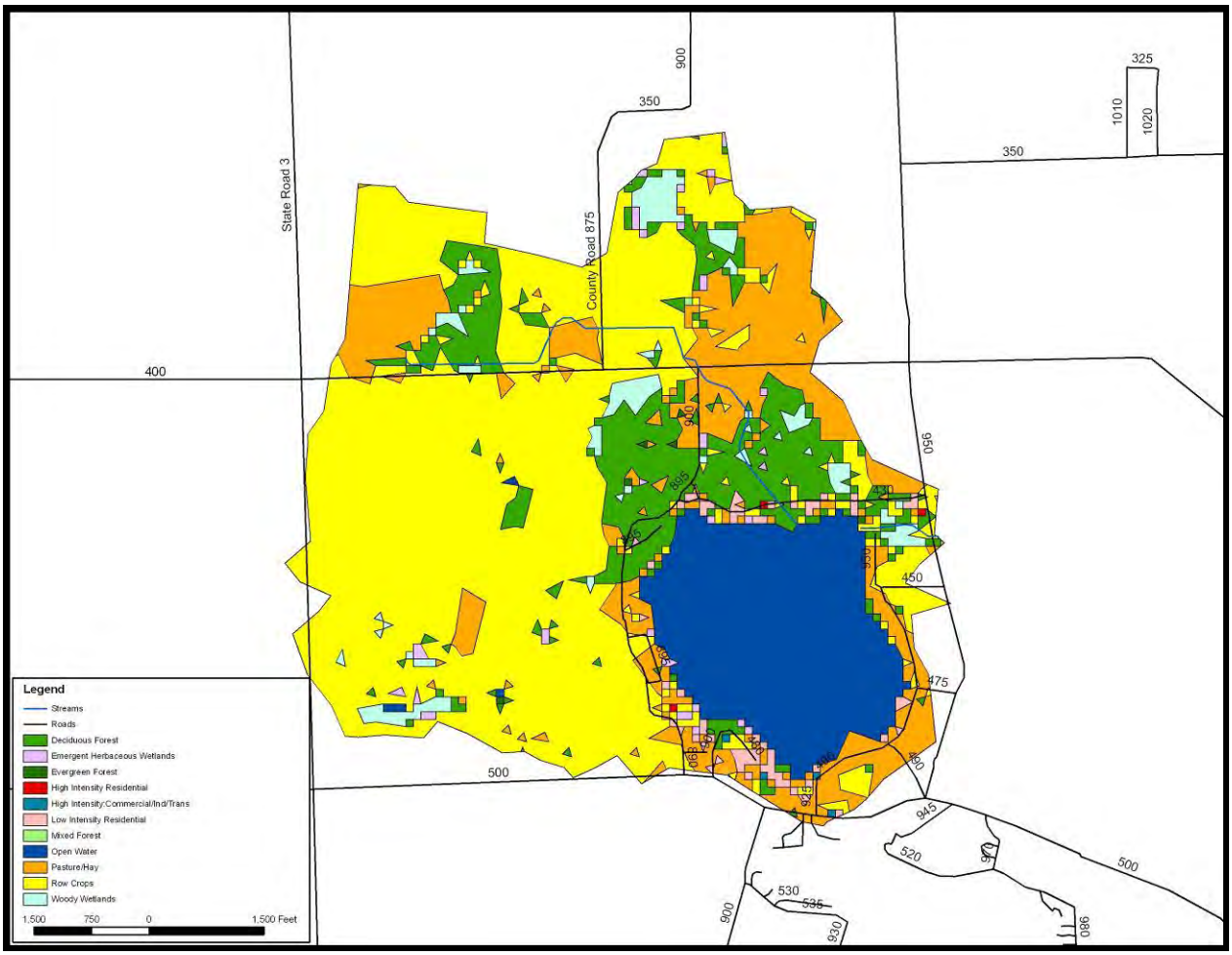

Figure 6. Land use in the Pretty Lake watershed. Source: USGS EROS, 1998.

Table 2. Detailed land use in the Pretty Lake watershed.

Land Use	Area (acres)	Area (hectares)	% of Watershed
Row Crops	618.1	250.3	50.2%
Pasture/Hay	207.0	83.8	16.8%
Open Water	187.2	75.8	15.2%
Deciduous Forest	155.5	63.0	12.6%
Woody Wetlands	37.6	15.2	3.1%
Low Intensity Residential	14.7	6.0	1.2%
Emergent Herbaceous Wetlands	8.3	3.4	0.7%
Evergreen Forest	1.1	0.4	0.1%
High Intensity Commercial	0.9	0.4	0.1%
High Intensity Residential	0.7	0.3	0.1%
Mixed Forest	0.2	0.1	<0.1%
Entire Watershed	**1,231.3**	**498.5**	**100.0%**

Source: USGS EROS, 1998.

2.5 Prior Studies

A variety of studies have been completed in the Pretty Lake watershed ranging in scale from general fisheries surveys to comprehensive diagnostic studies. Table 3 lists the prior studies that have been completed that involved Pretty Lake. A review of the historic fisheries and water quality can be found in the Pretty Lake Diagnostic Study (JFNew, 2006).

Table 3. Prior Studies

Year	Organization	Topic	Study/Report
1966	IDNR	Fisheries	Fish Management Report, Pretty Lake, LaGrange County, Indiana
1974	IDNR	Fisheries	Fish Management Report, Pretty Lake, LaGrange County, Indiana
1980	IDNR	Fisheries	Fish Management Report, Pretty Lake, LaGrange County, Indiana
1984	IDNR	Fisheries	Fish Management Report, Pretty Lake, LaGrange County, Indiana
1986	IDNR	Fisheries	Fish Management Report, Pretty Lake, LaGrange County, Indiana
1989	LaGrange County Com	Water Quality	LaGrange County Lakes Survey
1989-present	CLP	Water Quality	Indiana Clean Lakes Program
1991	EarthSource	Diagnostic Study	Pretty Lake Watershed Diagnostic Study
1996	IDNR	Fisheries	Fish Management Report, Pretty Lake, LaGrange County, Indiana
1998	IDNR	Fisheries	Fish Management Report, Pretty Lake, LaGrange County, Indiana
2005	IDNR	Fisheries	Success of Walleye Stocking Program
2006	JFNew	Diagnostic Study	Pretty Lake Watershed Diagnostic Study
2007	JFNew	Aquatic Plant Management	Pretty Lake Aquatic Plant Management Plan

3.0 POTENTIAL WATER QUALITY IMPROVEMENT PROJECTS

The goals of the visual watershed inspection were to identify, target, and select areas of concern and future management options. A watershed tour of Pretty Lake took place in October 2007. The tour included representatives from the PLCC, the IDNR LARE Program, and JFNew. During the tour, the eight potential water quality improvement projects identified in the diagnostic study were revisited to determine if significant changes occurred since the completion of the 2006 diagnostic study (Figure 1). Specifics regarding each of the project sites are listed in Appendix A. Refer to this appendix for information regarding the identified issue and potential solutions associated with each project.

Only those project areas listed in the diagnostic study were revisited for a couple of reasons. The main reason for this was determined by the budget. The grant scope included the re-evaluation of those sites listed in the diagnostic study and did not

include an investigation into other possible site locations. Results of the diagnostic study recommended those areas of most concern within the watershed, so it is assumed the projects investigated are most important for sustaining good water quality in the Pretty Lake watershed. Additionally, it was important to revisit the previously identified project areas to determine if a site has degraded since the initial watershed tour for the diagnostic study. Continued degradation and the rate of change at sites could have an impact on the priority for which each site should be pursued. If a significant water quality issue or improvement project outside the designated sites would have been present during the development of the feasibility study, it would have been pursued.

4.0 PROJECT REVIEW

Eight project sites were investigated to determine the feasibility of implementing water quality improvement projects (Figure 1). All projects are designed to reduce the amount of sediment and nutrients entering Pretty Lake. The different methods suggested for decreasing sediment and nutrient loading into Pretty Lake include: the construction of grassy swales, tile repair, creation of a detention basin in an agricultural field, reduced stream overhead tree canopy, ditch clean out, raingarden installation, and converting a traditional drainage ditch into a two-stage ditch. The scope of potential projects is variable from relatively simple grassy swales to the construction of a two-stage ditch for approximately 2,200 feet (670.6 meters).

4.1 Grassy swale along CR E 490 S (Site 1)

4.1.1 Site Description

An area within the county road easement adjacent to CR E 490 S was identified as a contributing source of sediment and nutrient loading into Pretty Lake (Figure 7). The area is a small channelized drainage that flows to a catch basin, which flows directly to Pretty Lake. The channel concentrates stormwater flow and is devoid of vegetation. There is little to no filtering of sediment and nutrients in the stormwater before it reaches the lake. The construction of a grassy swale is recommended to assist in the stabilization of the drainage channel bed and reduce the amount of nutrients and sediment being transported to the lake.

Figure 7. Location of grassy swale adjacent to CR E 490 S (Site 1).

4.1.2 Easement and Land Availability Determination

Site 1 is located within the county road easement. Jeff Brill, Superintendent of the LaGrange County Highway Department, was sent a letter regarding the potential construction of a grassy swale within the County easement. The letter was signed and returned to JFNew by Mr. Brill indicating he agreed with the conceptual design and would allow the development of a more detailed plan. A copy of the agreement can be found in Appendix B.

4.1.3 Preliminary Design and Conceptual Drawings

The conceptual design at Site 1 is to construct a grassy swale to control erosion, thereby reducing the amount of sediment and nutrients entering the lake. The existing grade of the channel will remain the same; however, the channel bed will be widened to approximately 6 feet (1.8 meters) and the overall width of the grassy swale will be approximately 24 feet (7.3 meters; Figure 8 and Figure 9). Creating a wider, flat-bottomed channel will allow flow to be more evenly dispersed within the channel, reducing the erosive potential of stormwater (Figure 10). Native grasses will be used to vegetate the drainage because they establish extensive root systems that help stabilize the soil and they have the ability to readily filter nutrients from the water. A grassy swale would increase channel stability, reduce erosion, and slowdown water movement, allowing sediments and nutrients time to settle. Additionally, a domed storm drain grate

will replace the current (flat top) storm drain grate, which will be capable of accepting larger flows of storm water without clogging with leaves and other debris (Figure 11).

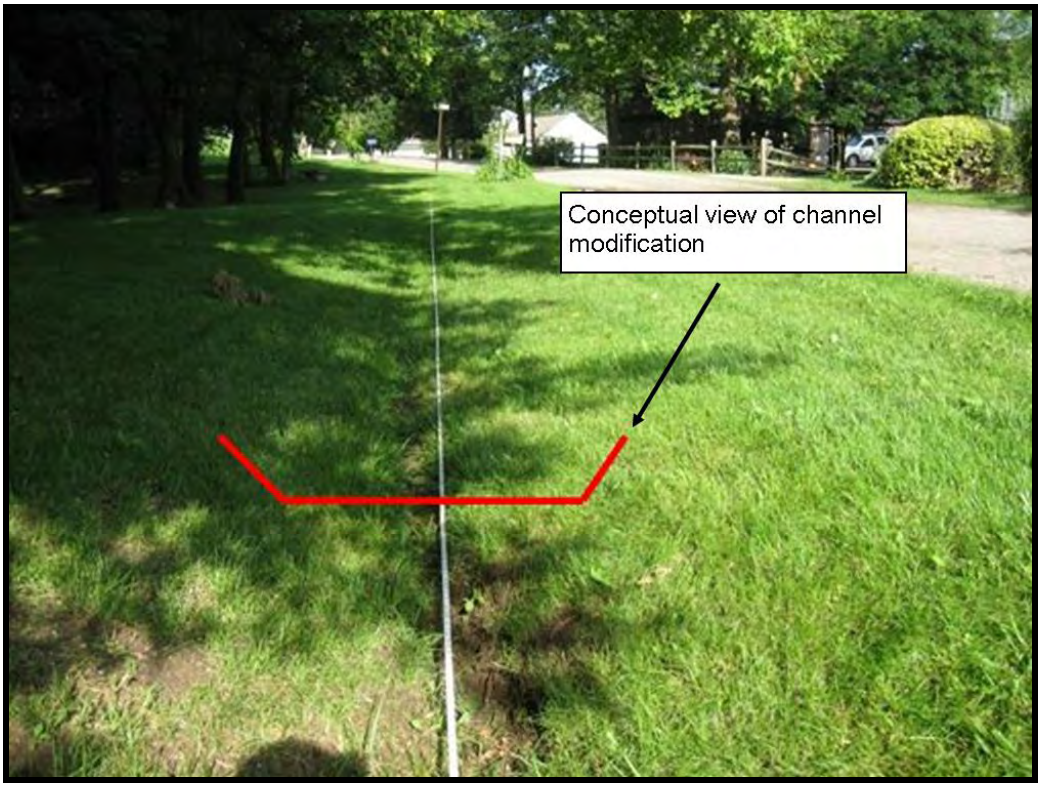

Figure 8. Proposed channel modification at Site 1 for Pretty Lake Feasibility Study.

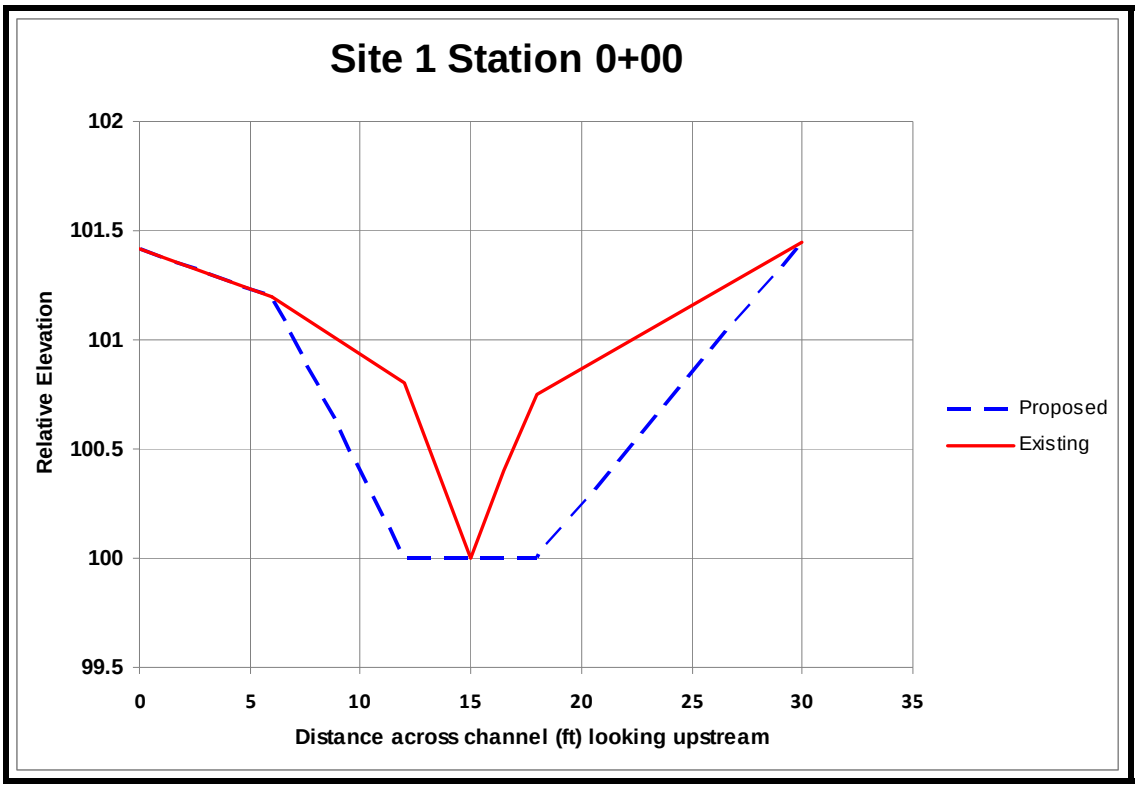

Figure 9. Typical existing cross section and proposed swale modification cross section for Site 1.

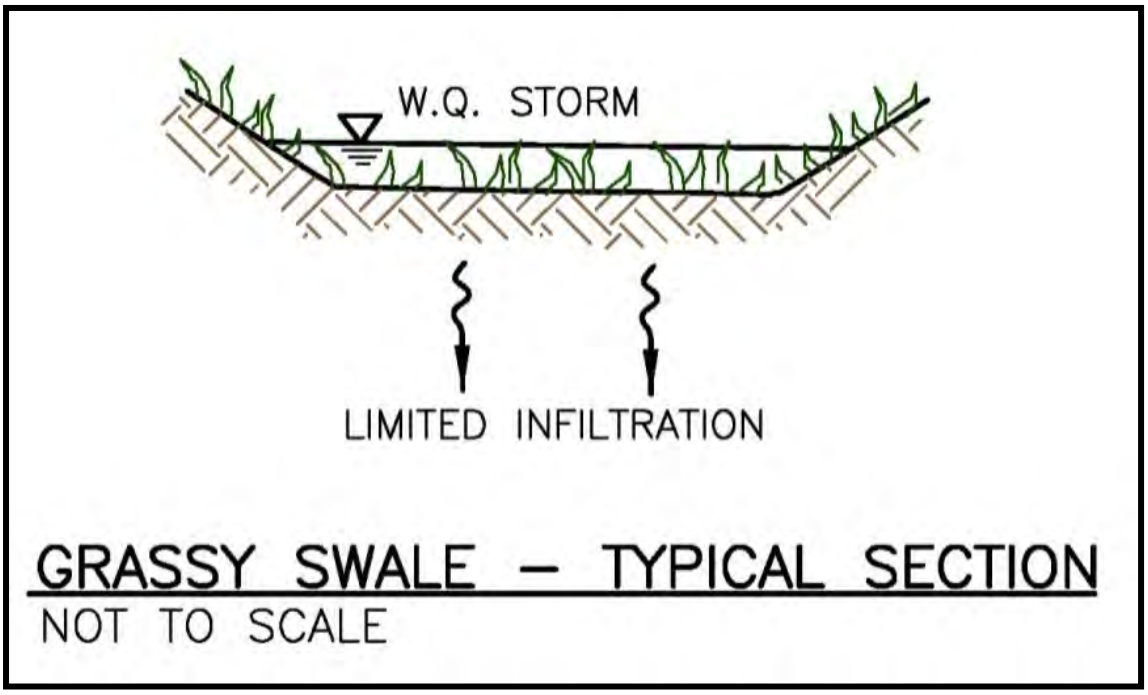

Figure 10. Conceptual drawing of a grassy swale cross-section.

Figure 11. Existing flat-top storm grate to be replaced with a domed storm grate.

4.1.4 Site Design Alternatives

An alternative action at Site 1 would be to take no action. If a "Do Nothing" action is taken the current channel will continue to erode and contribute to sediment loading into Pretty Lake. Aesthetically, the site will continue to degrade as more bare soil is exposed from the continued formation of the channel.

4.1.5 Permit Requirements

No regulatory permit will be required for this project. Preliminary authorization from the LaGrange County Highway Department has been obtained.

4.1.6 Wetland Functional Assessment

A wetland functional assessment is not required at this site as no wetland is connected to or in the proposed site location.

4.1.7 Biological and Habitat Integrity Survey

Site 1 is dominated by turf grass and contains very little habitat. No biological or habitat assessment was performed.

4.1.8 Environmental Impact Assessment

Newly exposed soils resulting from excavation could be a potential source of sediment to Pretty Lake. To minimize this, erosion control fabric will be installed once excavation is complete to assist with the stabilization of the newly formed channel. The overall environmental impact is minimal.

4.1.9 Unusual Physical and Social Costs

During construction residents using CR E 490 S could experience some inconvenience while using the road due to the presence of construction vehicles. Additionally, some standard maintenance work such as mowing the grassy swale a couple times a year will be required. Adjacent landowners should be educated about the proper time and frequency to mow the grassy swale. Also, some local residents may find the grassy swale unappealing because the surrounding area is dominated by turf grass; however, some flowering native plants could be added to the seed mix or plugs installed making the grassy swale not only functional, but aesthetically pleasing. Overall, no major social or physical concerns are associated with the implementation of the proposed improvement to Site 1.

4.1.10 Opinions of Probable Cost and Proposed Timeline

The estimated cost of the proposed project to construct 70 feet (21.3 meters) of grassy swale adjacent to CR E 490 S and install a domed storm grate on the existing catch basin is $ 4,117 (Table 4).

Table 4. Cost estimates for grassy swale along CR E 490 S and installation of storm grate (Site 1).

Item	Unit cost	Unit	Quantity	Total
Final design and permitting	$500	each	1	$500
Construction services	$982	each	1	$982
Mobilization/demobilization	$500	each	1	$500
Administrative services	$500	each	1	$500
Services Subtotal				**$2,482**
Erosion control material	$1	square yard	186	$186
Staples	$40	box	1	$40
Custom native seed mix	$525	acre	0.25	$131
Native plant plugs	$2	each	420	$840
Dome storm grate	$200	each	1	$200
Materials Subtotal				**$1,397**
Contingency	10% of construction subtotal			**$238**
Total				***$4,117***

The PLCC could apply for a 2009 LARE design-build grant to complete the project. The project does not require permits and could begin as soon as funding becomes available. Construction should occur between March and November with the preference for the majority of the work to occur before October so seeding can become established before winter.

4.2 Raingarden at Milford Elementary School (Site 2)

4.2.1 Site Description

Site 2 is located on the northwestern portion of the Milford Elementary School grounds adjacent to CR E 490 S (Figure 12). The site is an open area at the base of a slope and is currently being managed as turf grass (Figure 13). Approximately 80 feet (24.4 meters) up the slope from the base of the hill is an 8-inch (20.3-centimeter) diameter drainage tile that is connected to the roof drainage system of the Milford Elementary School (Figure 14). During storm events, rainfall from the roof empties out through this tile down the slope and drains to a storm drain located adjacent to the road. During large events, a portion of the rain bypasses the storm drain and flows over the road directly to Pretty Lake. Areas of erosion and sedimentation at the base of the hill and adjacent to the road were observed during the watershed tour and follow-up site visits.

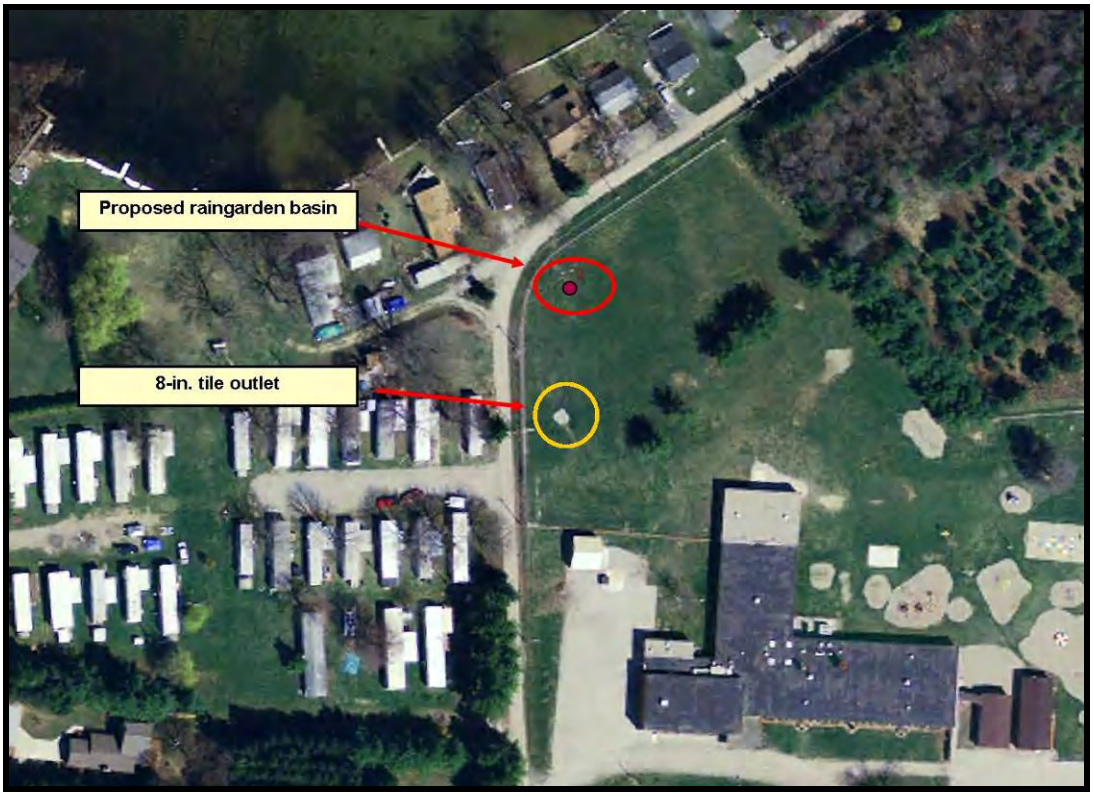

Figure 12. Plan view of proposed raingarden site located at the Milford Elementary School (Site 2).

Figure 13. Potential raingarden basin site at the Milford Elementary School (Site 2).

Figure 14. Example of the 8-inch (20.3-centimeter) diameter tile that drains the roofshed of the Milford Elementary School.

4.2.2 Easement and Land Availability Determination

The principal at the Milford Elementary School was contacted about the project idea after the watershed tour. The PLCC and JFNew received permission to access the site for a follow-up site survey. A letter describing the raingarden project was sent to the principal for her review. At this time, a response has not been received. A copy of the letter can be found in Appendix B. Before the final draft of the feasibility study is issued, the PLCC and JFNew will continue to pursue obtaining a written agreement for this project.

4.2.3 Preliminary Design and Conceptual Drawings

The conceptual design at Site 2 is a 1,900-square foot (176.5-square meter) raingarden designed to capture up to one inch (2.5 centimeters) of stormwater runoff from the roof of the Milford Elementary School and the surrounding watershed, a total of 1.63 acres (0.6 hectares; Figure 15). The average depth of the raingarden will be 9 inches (22.9 centimeters), which is typical for raingardens (Figure 16). The main input into the raingarden will be the 8-inch (20.3-centimeter) drainage tile that carries the roofshed. The raingarden will be planted with native plants that can take periods of both being inundated with water and dry periods without much water, and will be mulched. The raingarden will be connected to the tile outlet using a vegetated swale similar to the swales used at Site 1. The plants will treat stormwater runoff by increasing stormwater infiltration into the ground through their root canals, filtering sediments, and utilizing nutrients in the stormwater. A small diversion berm will be constructed on the hill on the east side of the watershed to divert flows back into the larger watershed. As discussed below, for the raingarden to have water quality benefits, the size of the watershed needs to be limited. The diversion berm is one way to confirm the watershed delineation.

During the development of the conceptual design, several tools were used to size the raingarden basin. Basin size was determined based on a combination of site characteristics such as soils and topography, watershed characteristics such as land use, and the use of a computer-generated stormwater model called RECARGA. RECARGA is a computer model developed by the University of Wisconsin to simulate the performance of raingardens and other biorention facilities (Atchison et al*.,* 2006). The model uses several different hydrologic submodels to estimate runoff, ponding time, and infiltration of captured stormwater. The model user can input different raingarden dimensions and design characteristics to evaluate the performance of the raingarden to treat stormwater. Two performance criteria used during the design of the raingarden: raingarden volume and maximum ponding time. To meet the performance criterion for raingarden volume, one-inch (2.54-centimeters) of rainfall from the defined watershed needed to be captured without overtopping the basin. A 1,900-square foot (176.5-square meter) facility will capture rainfall from the defined watershed (Figure 15). The second criterion, maximum ponding time, was limited to 48 hours because plant survival is limited in basins with longer periods of inundation. The native soils at the raingarden basin site consist of primarily sandy loam-type soils, which will allow for a maximum ponding time of less than 35 hours. Amending the soil to increase infiltration will not be required. For additional information on the design process, see Appendix C.

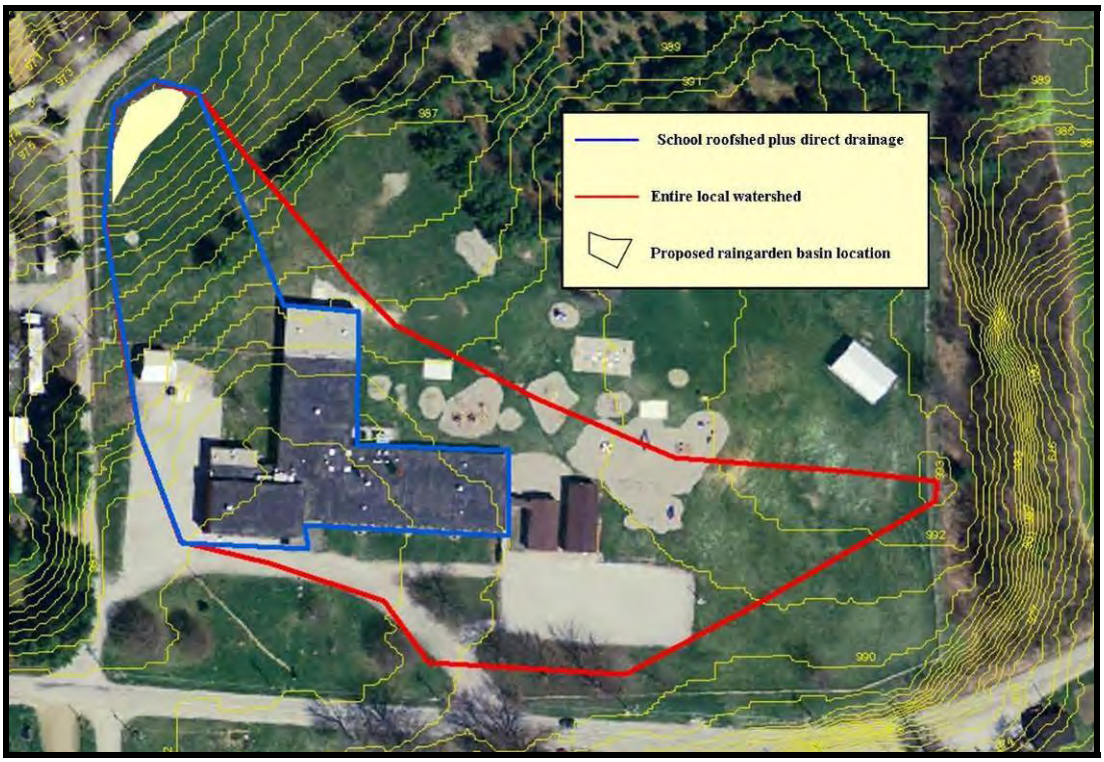

Figure 15. Watersheds of the Milford Elementary School property used during raingarden design analysis.

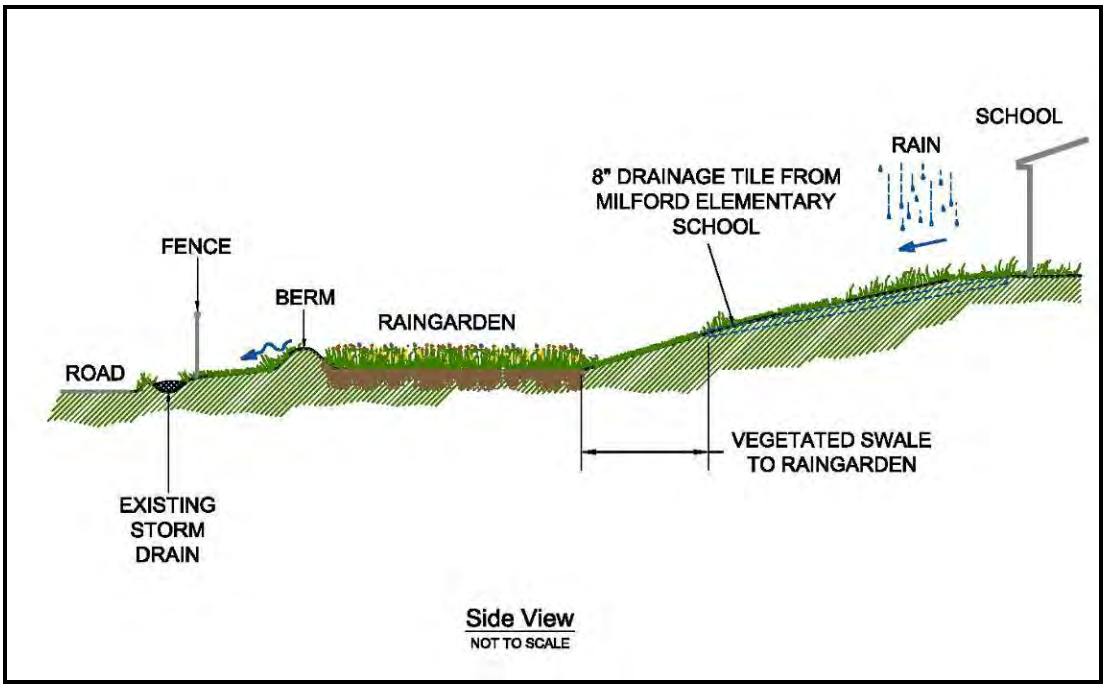

Figure 16. Conceptual design for the raingarden at Milford Elementary School (Site 2).

4.2.4 Site Design Alternatives

Different alternatives exist for Site 2 including increasing the size of the raingarden to capture either more stormwater within the existing watershed or capture more of the watershed. The RECARGA model indicates that to capture up the one-year storm event of 2.17 inches (5.5 centimeters) from the roofshed and immediate watershed the basin would need to be approximately 5,100 square feet (473.8 square meters). Another potential approach is to capture stormwater from the majority of the watershed surrounding the Milford Elementary School (3.67 acres; 1.5 hectares, Figure 15), instead of just the roofshed and the immediate watershed of 1.63 acres (0.6 hectares). The increased watershed area would require a 2,900-square foot (269.4-square meter) raingarden basin to capture and treat up to a 1-inch (2.5-centimeter) rain event. The site is constrained by topography and the presence of a fence so a basin larger than approximately 2,500 square feet (232.3 square meters) is not easily obtained.

The drainage tile could be extended from where it currently outlets on the hillside down to the storm drain at the base of the hill. The tile would be buried and not allow for stormwater to flow overland causing erosion and sedimentation into Pretty Lake. This alternative would not provide any stormwater treatment for nutrients and sediment carried by stormwater draining directly from the areas adjacent to the school grounds. Additionally, the stormwater volume and velocity would be unchanged.

The “Do Nothing” alternative is to leave the site as it is currently. If nothing is done, stormwater will continue to flow downhill towards the lake over turf grass before emptying into a storm drain. Without any significant changes in land use, such as increasing the amount of impervious surface within the watershed some moderate erosion and sedimentation will continue to occur. If the amount of impervious surface increases, it can be anticipated that the erosion and sedimentation will increase due to increased stormwater volumes and velocities.

4.2.5 Permit Requirements

No regulatory permit will be required for this project. Written permission from the appropriate entities at the Milford Elementary School including the principal and/or school board will be required upon the completion of the final design.

4.2.6 Wetland Functional Assessment

No wetland assessment was completed for Site 2 because this project does not involve a potential impact to any wetlands. The proposed raingarden basin is currently managed as turf grass and the surrounding area is a mix of residential and school grounds property.

4.2.7 Biological and Habitat Integrity Survey

No biological or habitat survey was performed because Site 2 does not involve a direct impact to a stream or other aquatic resource.

4.2.8 Environmental Impact Assessment

No environmental impact assessment was performed because Site 2 is currently managed as turf grass. The proposed project would have very little environmental impact to the existing conditions.

4.2.9 Unusual Physical and Social Costs

The social costs associated with the proposed raingarden include initial increased cost for maintenance, the presence of an "attractive nuisance" during storm events, and reduction in the area available for children to play. Over the long-term, a raingarden will reduce maintenance costs when compared to managed turf. A mature raingarden needs to be weeded once or twice per year, which can be done by hand and an annual mowing in either the spring or fall. There is very little to no material or equipment cost. During the first two to three years after the construction of the raingarden, the maintenance required includes frequent weeding, occasional watering, mulching, and annual mowing or "weedwhacking".

The raingarden is designed to capture and store stormwater for up to 35 hours. Without any additional fencing, school children will have access to the basin where there is between 9 inches (22.9 centimeters) and 12 inches (30.5 centimeters) of standing water. During and immediately after rain events, school staff will need to be vigilant in watching to make sure children are not playing in the water. The basin depth should not present a drowning hazard; however, anytime water and children are involved there is a need for increased awareness.

Constructing a raingarden would reduce the playground area by approximately 2,500 square feet (232.3 square meters). The majority of the playground equipment is located on the top of the hill away from proposed basin. There is also a large, flat open area adjacent the playground equipment that children can use during recess. The loss of playground area can be offset by using the raingarden as an environmental education facility, teaching plant identification and water quality principles.

4.2.10 Opinions of Probable Cost and Proposed Timeline

The estimated cost of the proposed project to construct a 1,900-square foot (176.5-square meter) raingarden at the Milford Elementary School is $8,257 (Table 5).

Table 5. Cost estimates for raingarden at the Milford Elementary School (Site 2).

Item	Unit cost	Unit	Quantity	Total
Final design	$1,000	each	1	$1,000
Construction services	$2,868	each	1	$2,868
Mobilization/demobilization	$1,000	each	1	$1,000
Administrative services	$500	each	1	$500
Services Subtotal				**$5,368**
Erosion control material	$1	square yard	240	$240
Staples	$40	box	1	$40
Native plant plugs	$2	each	600	$1,200
Grass seed for disturbed areas	$5	pound	5	$25
Mulch	$35	cubic yard	22	$770
Materials Subtotal				**$2,275**
Contingency	10% of construction subtotal			**$614**
Total				***$8,257***

The PLCC could apply for a 2010 LARE design-build grant to complete the project. A second option would be to apply for a LaGrange County Community Foundation grant. Other grants might also be available because the project involves a school, alternative stormwater best management practices, and outdoor education. These factors may qualify the project for additional funding that be used to either pay for the project or leveraged against other grants. The project does not require permits so after a grant is awarded the design and construction process could begin. Construction should occur between March and November with the preference for the majority of the work to occur before October so seeding and planting can become established before winter.

4.3 Grassy Swale/Rock-lined Channel Combination (Site 3)

4.3.1 Site Description

Site 3 is a small, channelized drainage located within both the county road easement and on private property along CR E 480 S (Figure 17 and Figure 18). The drainage flows along CR E 480 S until it reaches a catch basin, which drains directly into Pretty Lake. The channel concentrates stormwater flow and is devoid of vegetation. The lack of vegetation within the channel combined with an increase in grade where the channel bends has created an unstable, eroding channel bed. The construction of a grassy swale/rock-lined channel combination is recommended to stabilize the channel bed, reducing the amount of sediments and nutrients entering the lake (Figure 19).

Figure 17. Example of area at Site 3 where grassy swale treatment could be applied.

Figure 18. Example of area at Site 3 where rock-lined channel treatment could be applied.

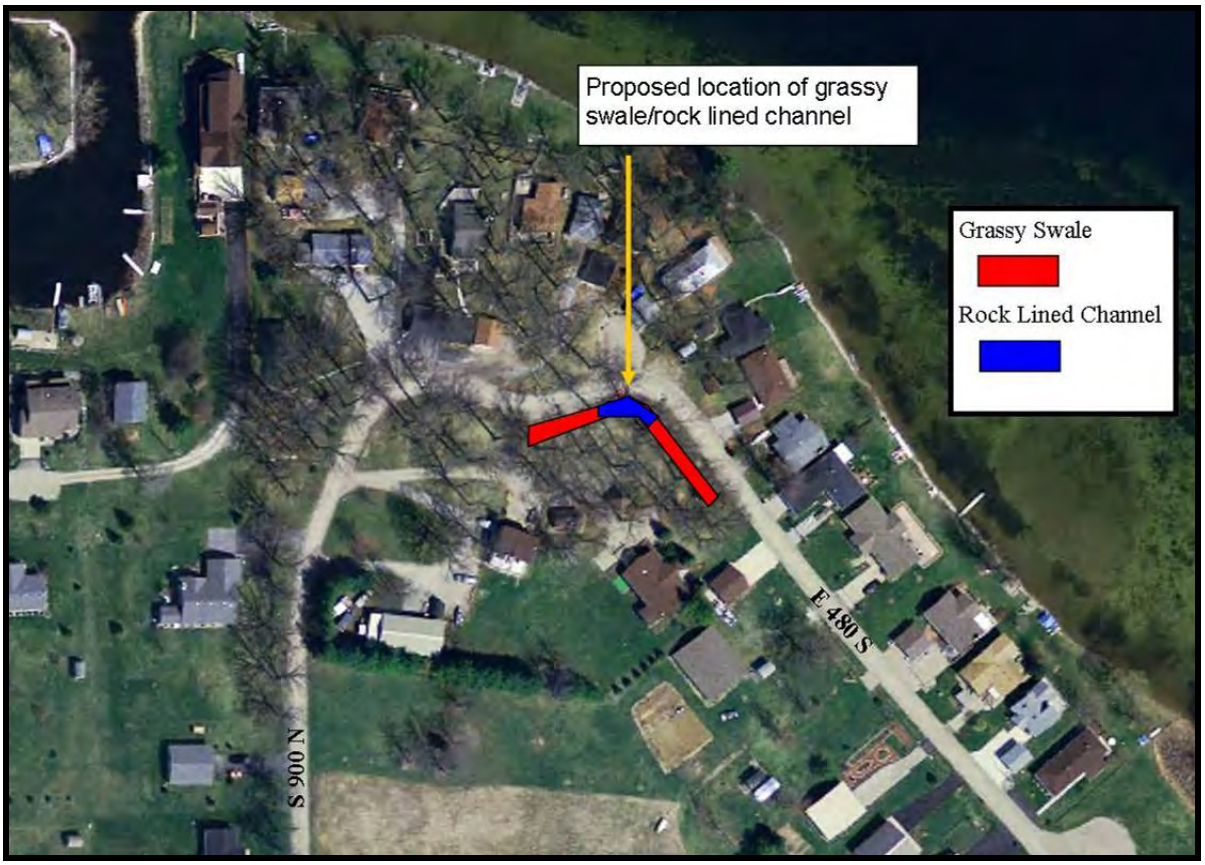

Figure 19. Location of proposed grassy swale and rock-lined channel at Site 3.

4.3.2 Easement and Land Availability Determination

Most of Site 3 is located within the 40-feet (12.2-meter) county easement off CR E 480 South. Jeff Brill, LaGrange County Highway Department Superintendent, was sent a letter regarding the potential construction of a grassy swale within the County easement. The letter was signed by Mr. Brill and returned stating he agreed with the conceptual design and would allow the development of a more detailed plan. A signed copy of the letter can be found in Appendix B. Additional permission from the landowner will be required to continue with the project at Site 3 because a portion of the project area is located outside of the road easement. The landowner has not been contacted through written communication yet; however, a member of the PLCC has spoke with the family about the project and they are receptive to the idea. Before the design is finalized, a written agreement from a representative of the family will be obtained.

4.3.3 Preliminary Design and Conceptual Drawings

The conceptual design at Site 3 is to install a grassy swale/rock-lined channel combination where erosion and sediment deposition are occurring. The current channel bed would be widened to approximately 6 feet (1.8 meters) and the overall width of the swale/rock-lined channel complex would be approximately 16 feet (4.9 meters; Figure 20 and Figure 21). The channel would be a grassy swale from the catch basin

upstream for approximately 174 feet (53.0 meters) then would become a rock-lined channel for approximately 93 feet (28.3 meters) until the grade decreased enough to become a grassy swale again for approximately 300 feet (91.4 meters; Figure 22). Approximately 48 tons (43.5 metric tons) of rock will be used for the rock-lined channel section. Widening the channel will allow water to be dispersed over a larger area reducing the erosive potential of stormwater. Grassy swales are effective at increasing channel stability and capturing sediments and nutrients at lesser grades, while rock-lined channels are required at steeper grades (Figure 23). The combination of the two treatments will increase channel stability, reduce erosion and slow down water movement allowing sediments and nutrients time to settle. Native grasses will be seeded and erosion control fabric will be installed in the grassy swale portions of the channel following excavation.

Figure 20. Proposed channel modification for grassy swale treatment at Site 3.

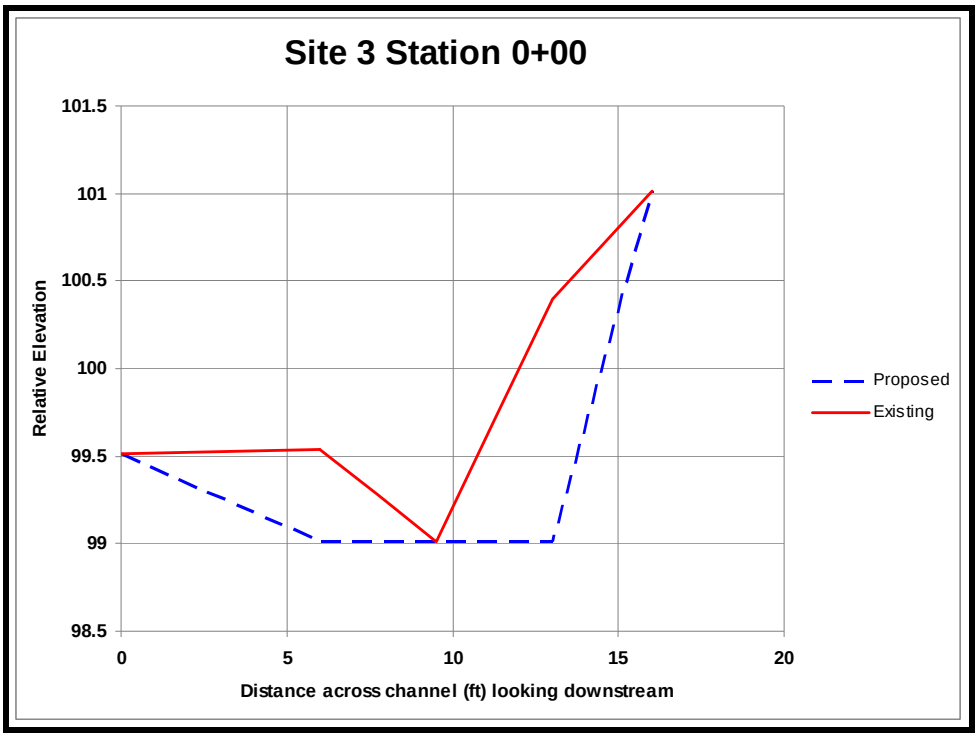

Figure 21. Example of existing and proposed cross sections of swale modification at Site 3.

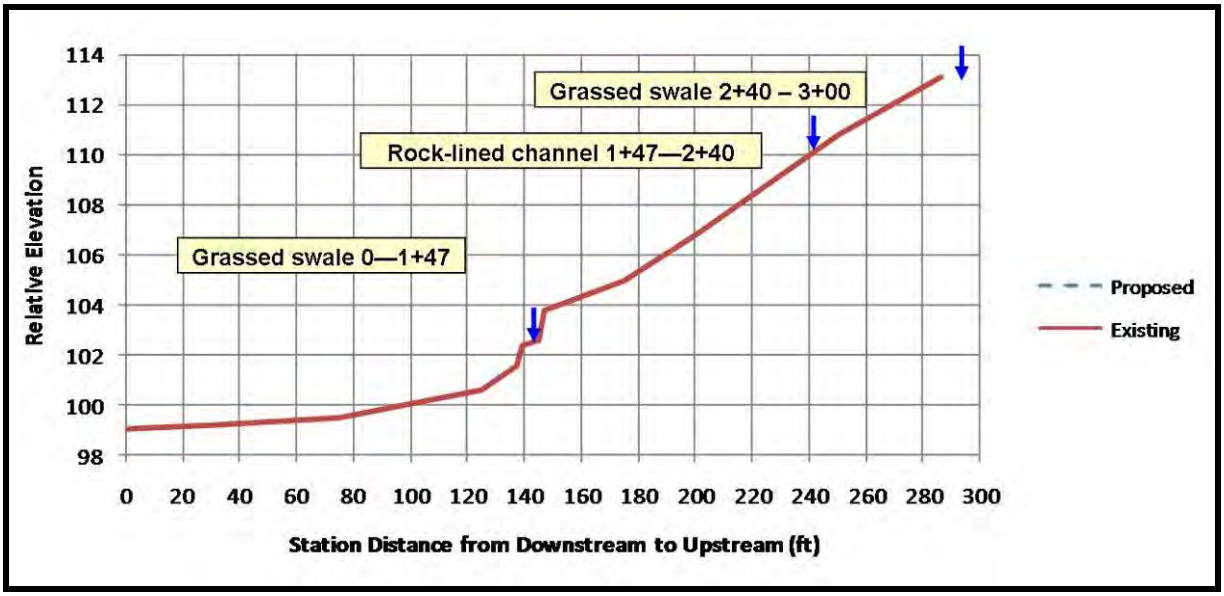

Figure 22. Profile of existing channel and proposed location of the two different stabilization techniques.

Figure 23. Bend in channel where the rock-lined channel could be utilized.

4.3.4 Alternative Actions

Alternatively, nothing could be done at Site 3, which would allow the current channel to continue to contribute sediment loading into Pretty Lake and potentially degrade the lake's good water quality.

4.3.5 Permit Requirements

No regulatory permit will be required for this project.

4.3.6 Wetland Functional Assessment

A functional wetland assessment was not done because no wetlands are located within the vicinity of the project site.

4.3.7 Biological and Habitat Integrity Survey

A formal biological and habitat integrity survey was not completed at Site 3. Site 3 offers little natural habitat because it is located within a residential area dominated by turf grass.

4.3.8 Environmental Impact Assessment

Little impact to the surrounding environment will result from construction at Site 3 because the surrounding area is residential and dominated by turf grass. Newly exposed soils resulting from excavation could be a potential source of sediment to Pretty Lake. To minimize this seeding of native grasses and installation of erosion control fabric will occur once construction is complete.

4.3.9 Unusual Physical and Social Costs

During construction, residents using CR E 480 S could experience some inconvenience while using the road due to the presence of construction vehicles; however, no major social or physical concerns are associated with the implementation of the proposed improvement to Site 3. Because the surrounding area is dominated by turf grass some residents could find the grassy swale aesthetically unpleasing due to the height of the grass in the swale. To increase the aesthetic appeal of the grassy swale some native flowering plants could be added to the planting plan. Additionally, some general maintenance such as mowing the swale will be required a couple times a year.

4.3.10 Opinions of Probable Cost and Proposed Timeline

The estimated cost of the proposed project to construct approximately 300 feet (91.4 meters) of grassy swale and rock-lined channel along CR 480 S is $10,106 (Table 6).

Table 6. Cost estimates for Site 3 grassy swale and rock-lined channel along CR E 480 S.

Item	Unit cost	Unit	Quantity	Total
Final design	$500	each	1	$500
Construction services	$2,232	each	1	$2,232
Mobilization/demobilization	$1,000	each	1	$1,000
Administrative services	$500	each	1	$500
Services Subtotal				**$4,232**
Erosion control material	$1	square yard	355	$355
Staples	$40	box	2	$80
Native plant plugs	$2	each	800	$1,600
Native seed mix	$525	acre	0.25	$131
Field Stone	$60	ton	48	$2,880
Materials Subtotal				**$5,046**
Contingency	10% of construction subtotal			**$828**
Total				***$10,106***

The PLCC could apply for a 2009 LARE design-build grant to complete the project. The project does not require permits and by the time the grant is awarded in July 2009, permission from all affected landowners will be obtained. Construction should occur between March and November with the preference for the majority of the work to occur before October so seeding can become established before winter.

4.4 Construction of Grassy Swale (Site 4)

4.4.1 Site Description

Site 4 is two small, channelized drainages where one runs parallel and the other runs perpendicular to CR E 480 S (Figure 24). The current channels concentrate stormwater flow and are dominated by turf grass (Figure 25). The drainages are directly contributing to sediment and nutrient loading into Pretty Lake. The construction of grassy swales is recommended for both channels to reduce the amount of sediment and nutrients entering the lake. Native grasses will be used to re-vegetate the channels, which will improve the stability and nutrient filtering capabilities of the drainage. Native plants will improve the functionality of the drainage because they establish extensive root systems and more readily filter nutrients from the water than traditional turf grass.

Figure 24. Location of Site 4 and areas recommended for the construction of a grassy swale, Note the NWI wetland to the south of the designated project area

Figure 25. Example at Site 4 of the narrow channel dominated by turf grass.

4.4.2 Easement and Land Availability Determination

The drainage located parallel to E 480 S is located within the county road easement while the drainage located perpendicular to E 480 S does extend into private property. Landowner permission for the section running perpendicular to the road was obtained after a letter was sent to the owners describing the project in detail. The letter was signed and returned to JFNew indicating their willingness to proceed with a more detailed designed and construction, if funds become available. Jeff Brill, the LaGrange County Highway Department Superintendent, returned a signed landowner permission letter. A copy of both signed permission letters can be found in Appendix B.

4.4.3 Preliminary Design and Conceptual Drawings

The preliminary design at Site 4 is to construct approximately 180 feet (54.9 meters) of grassy swale to control erosion, thereby reducing the amount of sediment and nutrients entering the lake. The current channel beds would be widened to approximately 6 feet (1.8 meters) and have an overall width of 16 feet (4.9 meters; Figure 26). The channels would be seeded with native grasses and erosion control blanket installed once excavation is complete. Widening the channel will allow stormwater flow to be more evenly dispersed along a flat bottom channel and seeding with native grasses will further increase channel stability through the extensive root systems that native grasses create. A grassy swale composed of native plants would increase channel stability, reducing erosion and slowdown water movement allowing sediments and nutrients time to settle improving the overall functionality of the drainage.

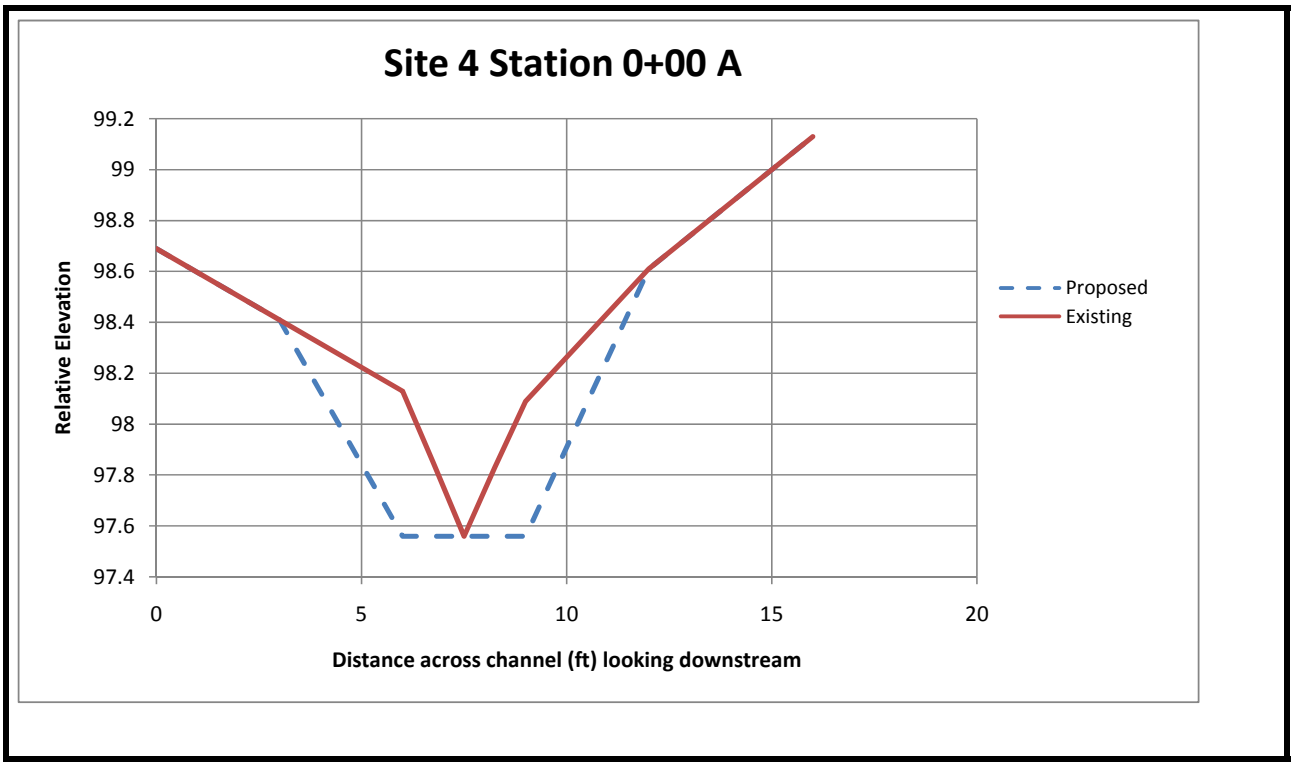

Figure 26. Example of existing and proposed cross sections of grassy swale treatment at Site 4.

4.4.4 Alternative Actions

As an alternative, no action could be taken at Site 4. If no action is taken, the potential for decreased water quality from increased sediment and nutrient loading into Pretty Lake from the drainage at Site 4 is possible. Making no improvements to the drainages at Site 4 would allow stormwater exiting those drainages to enter Pretty Lake with minimal treatment.

4.4.5 Permit Requirements

The Indiana Department of Environmental Management (IDEM) was contacted as part of the early coordination process. They were sent information regarding the conceptual design and asked to comment on the whether the proposed activity would require a permit and whether it was a permit-able activity. An IDEM 401 Water Quality Section permit will be required because the cross sectional area of the drainage is being changed. An IDEM individual permit application will be required.

The U.S. Army Corps of Engineers (ACOE) was contacted as part of the early coordination process. They responded by stating that they do not consider the project to be within their jurisdiction and will not require a permit. Copies of the information provided to the agencies and their response can be found in Appendix D.

4.4.6 Wetland Functional Assessment

Site 4 is bordered to the south by a National Wetland Inventory (NWI) wetland identified as a forested/shrub wetland (Figure 24). Because Site 4 is not identified as a wetland by the NWI and is dominated by a turf grass, a wetland functional assessment was not performed.

4.4.7 Biological and Habitat Integrity Survey

Some small trees are present at Site 4, which could provide some habitat for birds, but overall Site 4 provides minimal habitat because it is dominated by turf grasses. A formal biological and habitat integrity survey was not performed due to the lack of available habitat. Both drainages had water in them during a July site visit; however, there was no wetland plant community and no visual evidence of aquatic invertebrates or fish in the drainages.

4.4.8 Environmental Impact Assessment

A NWI wetland identified as a forested/ shrub wetland is located to the south of Site 4. Water from the NWI wetland is assumed to flow out through the channel perpendicular to CR E 480 S during periods of high water. The existing elevation of the drainages will not be altered so the impact to the NWI wetland is expected to be minimal because the elevation of the water level in the wetland will not be altered. No impact to the wetland should occur.

4.4.9 Unusual Physical and Social Costs

During construction residents using CR E 480 S could experience some inconvenience while using the road due to the presence of construction vehicles; however, no major social or physical concerns are associated with the implementation of the proposed improvement to Site 4. Because the surrounding area is dominated by turf grass some residents could find the grassy swale aesthetically unpleasing due to the height of the grass in the swale. To increase the aesthetic appeal of the grassy swale some native flowering plants could be added to the planting plan. Additionally, some general maintenance such as mowing the swale will be required a couple times a year.

4.4.10 Opinions of Probable Cost and Proposed Timeline

The estimated cost of the proposed project to construct approximately 180 feet (54.9 meters) of grassy swale along CR E 480 S is $3,864 (Table 7).

Table 7. Cost estimates for Site 4 grassy swale along CR E 480 S.

Item	Unit cost	Unit	Quantity	Total
Final design	$500	each	1	$500
Construction services	$1,052	each	1	$1,052
Mobilization/demobilization	$500	each	1	$500
Administrative services	$500	each	1	$500
Services Subtotal				**$2,552**
Erosion control material	$1	square yard	160	$160
Staples	$40	box	1	$40
Native plant plugs	$2	each	360	$720
Native seed mix	$525	acre	0.25	$131
Materials Subtotal				**$1,051**
Contingency	10% of construction subtotal			**$260**
Total				***$3,864***

The PLCC could apply for a 2009 LARE design-build grant to complete the project. The project does require an IDEM permit. After a grant is awarded in July 2009, a permit application should be submitted. Typically, the application process can take between one and six months. After a permit is received, construction should occur between March and November with the preference for the majority of the work to occur before October so seeding can become established before winter.

4.5 Detention Basin at Field Adjacent to CR E 890 S (Site 5)

4.5.1 Site Description

Site 5 is located adjacent to CR E 890 S in the southwestern corner of Pretty Lake. The primary project area is on the west side of the road in an agricultural field (Figure 27). It is an area located at the base of a hill. It is not currently being farmed. The PLCC worked with the farmer who rents the property to install a cool season grass buffer that runs approximately 1,200 feet (365.8 meters) along CR E 890 S. It is adjacent to land that is being farmed using no-till practices. There is an existing catch basin located adjacent to the county road (Figure 28). There is a metal culvert that drains the basin and crosses under the county road to a second basin on the east side of the road (Figure 29). A 6-inch (15.2-centimeter) tile apparently drains to the lake.

Figure 27. Example of the existing conditions at proposed sediment basin for Site 5.

Figure 28. Example of existing catch basin on the west side of CR E 890 S at Site 5.

Figure 29. Example of existing catch basin on the east side of CR E. 890 S at Site 5.

The secondary project site is located on the east side of road, directly across the road. The secondary site is a residential lawn that runs from CR E 890 S approximately 110 feet (33.5 meters) to Pretty Lake. The proposed project is to create a sediment basin within the agricultural field to capture and temporarily store stormwater running off the fields and allow it to either infiltrate into the ground or be released through a drainage tile.

4.5.2 Easement and Land Availability Determination

There are three parties affected by the proposed project. For the proposed sediment basin location, the owner of the property and the farmer that rents the ground were contacted. The homeowner for the secondary site where the tile line will cross their yard was contacted, as well. Each party was sent a letter describing the project along with an illustration of the conceptual design. All three affected parties returned a signed landowner agreement allowing the project to move forward if additional funds became available. Copies of the signed letters can be found in Appendix B.

4.5.3 Preliminary Design and Conceptual Drawings

The preliminary design is to install a sediment detention basin at the base of the hill on the west side of CR E 890 S (Figure 30). Captured stormwater will either infiltrate into the ground or be released through a perforated riser-drainage tile system, which empties into Pretty Lake. A sediment detention basin can be created by installing an earthen berm 2.5 feet (0.8 meters) high parallel to CR E 890 S for approximately 200 feet (61.0 meters). Within the basin, a 6-inch (15.2-centimeter) diameter slotted riser and a 6-inch (15.2-centimeter) solid plastic drainage tile will be installed. The plastic drainage tile will cross under CR E 890 S and empty into Pretty Lake.

The conceptual design was based on capturing stormwater from up to a 25-year/24-hour storm event of 4.4 inches (11.2 centimeters). The required storage in the basin for stormwater up to the 25-year event and 10 years of sediment storage is 21,357 cubic feet (689.7 cubic meters). The 6-inch (15.2-centimeter) diameter tile will draw the basin down within 24 hours after a storm event. This will allow sediment and nutrients to settle out, but not negatively affect the existing vegetation of cool season grasses. After construction, disturbed areas of the site will be re-seeded to cool season grasses. To successfully convert this area to warm season grasses, the area would need to be sprayed several times and then seeded. At this particular site, the benefits of converting the entire basin site to warm season grasses are relatively lower than the cost of the conversion from cool season grass to warm season grass. Once established, the cool season grasses will act to filter stormwater runoff effectively.

Figure 30. Conceptual design for detention basin and drainage tile at Site 5.

4.5.4 Alternative Actions

One alternative action would be to use the existing catch basins in the proposed design. The existing structures (Figures 28 and 29) are functioning similarly to the proposed project. The existing catch basin on the west side of CR E 890 S has a metal riser with holes that capture stormwater (Figure 28); however, there is no berm to store stormwater and the basin only picks up overland flow to the basin. A certain amount of stormwater must bypass the basin. Adding a berm will increase the amount of stormwater retention. It will not be possible to incorporate the existing catch basin into the proposed design because it is located within the footprint of the proposed berm. It will be easier to install a new riser and drainage tile than use the existing structure. One possible alternative to installing a new tile line under the road and through the homeowner's yard would be to tie into the existing line. This might be possible if the

existing tile line is in good shape. Using the existing tile line would potentially reduce the cost of the project, eliminate having to disrupt traffic patterns, and alleviate some of the concerns of the homeowner. See Section 4.5.9 for a more detailed description of the social costs of the proposed projects.

A second alternative action would be to take no action. A "Do Nothing" action would likely result in no change to the existing conditions. The farmer practices no-till farming and has a grassy buffer. There is some value in those practices to protecting the water quality of Pretty Lake. The existing catch basin does collect a given amount of stormwater; however, detention time and volume of stormwater captured is limited. A "Do Nothing" action would have greater significance if the farmer changes practices or a portion of the watershed was converted to impervious surface.

4.5.5 Permit Requirements

No regulatory permits will be required for the proposed project. No wetlands or regulated "Waters of the U.S." are impacted. There is no construction in a floodway. A permit or permission for the County Highway Department may be required to install a tile underneath a county road. The County Highway Superintendent has been supportive of other projects within the right of way of the county roads during the feasibility study.

4.5.6 Wetland Functional Assessment

No formal wetland functional assessment was performed because the proposed project location is not a wetland or is not connected to a wetland. When reviewing the NWI map of the area, there is an identified wetland to southwest of the project site; however, this is on the other side of a ridge and will not be impacted by the proposed project.

The drainage tile will outlet directly to Pretty Lake; however, there should be very little to no negative impact to the lake. The detention basin will act to filter sediment and nutrients from stormwater before it enters the drainage tile.

4.5.7 Biological and Habitat Integrity Survey

No formal biological or habitat survey was completed because the proposed project area consists of row-crop agriculture, cool season grasses (west side of CR E 890 S) and residential turf grass.

4.5.8 Environmental Impact Assessment

There should be very little to no negative impact due to the construction of the proposed project. The riser and drainage tile will be sized to have a drawdown in the basin of 24 hours. The basin is designed for 10 year– 24 hour event. Larger events will overtop the basin and enter the existing stormwater system of roadside ditches. Temporarily storing water should not cause additional water to back up on adjacent property owners.

4.5.9 Unusual Physical and Social Costs

There are a few potential physical and social costs for the proposed projects. Social costs include the interruption of farm activities, the temporary disruption in traffic flow as

the tile is installed under CR E 890 S, and the temporary disturbance to the east side property owner's yard and driveway. To mitigate these potential costs, the PLCC should work with the landowners to identify a timeframe that minimizes the interruptions to the farm schedule, plan to construct the road crossing in the morning after people have gone to work, and let individuals around the community know of the project so they can plan their daily commute.

Comments were received from both the renter of the agricultural property and the homeowner adjacent to the lake along with their signed agreements. Both expressed interest in tweaking or modifying the final design before construction could begin. The renter would like to see the shape of the basin modified to minimize the amount of additional row-crop area that is impacted. The homeowner wants to confirm that the tile line will not negatively impact his trees and that the yard and driveway is returned to their previous condition after construction.

4.5.10 Opinions of Probable Cost and Proposed Timeline

The estimated cost of the proposed project to construct a 0.2 acre sediment basin (0.08 hectare) and 200 feet (61.0 meters) of drainage tile along CR E 890 S is $8,319 (Table 8).

Table 8. Cost estimates for Site 5 sediment basin and drainage tile along CR E 890 S.

Item	Unit cost	Unit	Quantity	Total
Final design	$1,000	each	1	$1,000
Construction services	$3,984	each	1	$3,984
Mobilization/demobilization	$1,000	each	1	$1,000
Administrative services	$500	each	1	$500
Services Subtotal				**$6,484**
Erosion control material	$1	square yard	320	$320
Seed Mix - Cool Season Grass	$5	pounds	20	$100
Drainage Tile	$1	feet	160	$160
PVC - Pipe for Outlet	$3	feet	40	$120
Hickenbottom Structure (Riser)	$500	each	1	$500
Animal Guard	$15	each	1	$15
Materials Subtotal				**$1,215**
Contingency	10% of construction subtotal			**$620**
Total				***$8,319***

The PLCC could apply for a 2009 LARE design-build grant to complete the project. The project does not require a permit. After a grant is awarded in July 2009, the design and

construction process could begin. Construction should occur between October and March to minimize interference with agricultural practices.

4.6 Replace Broken Tile and Increase Size of Catch basin (Site 6)

4.6.1 Site Description

Site 6 is located on the north end of Pretty Lake between CR E 430 S and S 895 E (Figure 31). A small drainage channel has developed as a result of a broken tile. The tile, which should connect to an existing catch basin then drain directly to Pretty Lake is broken and has created a hole in a residential yard (Figure 32). Overland flow resulting from the hole has created a small drainage channel dominated by turf grass that now drains to the catch basin into Pretty Lake (Figure 33). The new drainage channel is believed to be contributing to sediment and nutrient loading into Pretty Lake. To stop the development of the new drainage channel, the broken tile needs to be repaired. Additionally, it is recommended that the old catch basin be moved to the east to make maintenance easier and increase the size to allow for greater treatment of stormwater before it enters Pretty Lake.

Figure 31. Conceptual plan view of tile replacement at Site 6.

Figure 32. Example of the tile blowout at Site 6.

Figure 33. Example of the channel that has formed as a result of the tile blowout at Site 6.

4.6.2 Easement and Land Availability Determination

Most of Site 6 is located outside of the county road easement. Landowner permission at Site 6 was obtained after a letter was sent to the owners describing the project in detail. The letter was signed and returned indicating their willingness to proceed with a more detailed design and construction should funding become available. A copy of the signed permission letter can be found in Appendix B.

4.6.3 Preliminary Design and Conceptual Drawings

The preliminary design at Site 6 is to replace the broken tile line with a new one of equal diameter and run the new tile line adjacent to the path of the existing channel, which would be filled in during construction. A new catch basin will be installed to the east of the existing basin and the size of the catch basin will be increased. The outlet for the new catch basin will tie into the tile line of the existing basin. From there, water will drain to Pretty Lake. Moving the catch basin to the east will allow for easier maintenance and greater filtration of stormwater and sediments from the road before it enters Pretty Lake. Replacing the broken tile will decrease the amount of sediment and nutrients entering the lake from the channel, which has formed as a result of the tile blowout.

4.6.4 Alternative Actions

An alternative to replacing the broken tile would be to widen the existing channel that has formed as a result of the broken tile and construct a grassy swale seeded with native grasses. Increasing the width of the current channel would help distribute flow through the channel reducing the erosive potential of stormwater while the use of native grasses would help stabilize the channel and filter out sediment and nutrients. Additionally, the location and size of the current catch basin would be altered as defined in the previous paragraph. Improvements to water quality at Site 6 would be greatest if a grassy swale is constructed because it will allow stormwater to be treated before it enters the catch basin. Replacing the tile will stop the development of the existing channel, which is contributing sediment and nutrients to the lake, but not treat the water in the tile. The landowner was not interested in developing a detailed plan for the construction of a grassy swale through their yard, therefore the alternative was deemed not feasible.

At Site 6, a “Do Nothing” action could be taken to replace the broken tile; however, if this is done the current channel would continue to increase in size and continue to contribute sediment and nutrients to Pretty Lake.

4.6.5 Permit Requirements

No permit is required at Site 6 because the tile is not a legal drain or a county tile.

4.6.6 Wetland Functional Assessment

A wetland functional assessment was not performed at Site 6 because the project area is not located in or connected to a wetland area.

4.6.7 Biological and Habitat Integrity Survey

Site 6 offers very little habitat because it is dominated by turf grass, therefore, a biological and habitat integrity survey was not completed.

4.6.8 Environmental Impact Assessment

During construction some excavation will be required to install the new tile and catch basin, which will create some newly exposed soil. To reduce the potential for sediment runoff to Pretty Lake the newly exposed soil will be seeded and covered with straw or erosion control fabric. The overall environmental impact from construction at Site 6 will be minimal.

4.6.9 Unusual Physical and Social Costs

During construction, residents using CR E 430 S and CR S 895 E could experience some inconvenience do to the presence of excavation equipment; however, the overall physical and social costs associated with the improvements to Site 6 are considered minimal. The homeowner expressed some concern over the project because they have several different tiles from around their home draining to the existing catch basin. During the development of the final design, the PLCC should meet with the landowner to assure him that his current drainage will not be negatively impacted.

4.6.10 Opinions of Probable Cost and Proposed Timeline

The estimated cost of the proposed project to replace 160 feet (48.8 meters) of failed drainage tile and install a catch basin along CR E 430 S is $4,951 (Table 9).

Table 9. Cost estimates for Site 6 drainage tile and catch basin along CR E 430 S.

Item	Unit cost	Unit	Quantity	Total
Final design	$500	each	1	$500
Construction services	$2,040	each	1	$2,040
Mobilization/demobilization	$500	each	1	$500
Administrative services	$500	each	1	$500
Services Subtotal				**$3,540**
Erosion control material	$1	square yard	142	$142
Seed Mix - Cool Season Grass	$5	pounds	2	$10
Drainage Tile	$1	feet	160	$160
Staples	$40	box	1	$40
Catch Basin	$500	each	1	$500
Additiona drainage tile to basin	$5	each	40	$200
Materials Subtotal				**$1,052**
Contingency	10% of construction subtotal			**$359**
Total				***$4,951***

The PLCC could apply for a 2009 LARE design-build grant to complete the project. The project does not require a permit. After a grant is awarded in July 2009, the design and construction process could begin. Construction should occur between March and November with the preference for the majority of the work to occur before October so seeding can become established before winter.

4.7 <u>Two-stage Ditch on Deal Ditch East of CR S 875 E (Site 7)</u>

4.7.1 Site Description

Site 7 is the portion of Deal Ditch east of CR S 875 E to the north side of CR E 400 S (Figure 34). The drainage is characterized by well-vegetated, moderately unstable streambanks with one to three feet (0.3 – 0.9 meters) of accumulated sediment within the channel (Figure 35). There is a wetland along the north side of the Ditch for approximately 870 feet (265.2 meters) that transition into an open field until the intersection of CR E 400 S. The south side of the ditch is bordered by a hay field for approximately 565 feet (172.2 meters) and becomes a wooded riparian area for approximately 825 feet (251.5 meters).

Deal Ditch is the main inlet into Pretty Lake and drains approximately 651 acres (263.5 hectares) or 53% of the watershed. It is also a legal drain, maintained by the LaGrange

County Drainage Board and supervised by the LaGrange County Surveyor. The County maintains an easement 75 feet (22.9 meters) wide from each bank that starts from the top of the bank. Potential designs were evaluated based on their ability to receive Drainage Board approval. The approach during the feasibility analysis was to evaluate conceptual designs based on physical engineering principles first then use project cost second. The third criterion was Drainage Board approval followed by landowner approval.

Figure 34. Aerial view of Deal Ditch – Site 7.

Figure 35. Example of the existing conditions at Deal Ditch – Site 7.

4.7.2 Easement and Land Availability Determination

The LaGrange County Drainage Board via the County Surveyor was contacted about a proposed project within Deal Ditch and the County easement. Written support for work within the legal drain and County easement was obtained with the comments that the drainage board will require a review and approval of the final plans. In addition, they requested that landowners be contacted and consulted prior to finalizing the design. Using this information, landowners were notified through the mail of the conceptual design. At this time, the PLCC and JFNew are waiting on their responses. We will continue to follow up with the landowners until the final draft of the feasibility report is issued. Copies of the agreements can be found in Appendix B.

4.7.3 Preliminary Design and Conceptual Drawings

The proposed water quality improvement project for Site 7 is to construct a two-stage ditch for approximately 550 feet (167.6 meters; Priority Ditch 1, Figure 36). An alternative would be to construct a two-stage ditch along the entire length of Site 7 for approximately 1585 feet (483.1 meters; Priority Ditch 1 and Priority Ditch 2, Figure 36). A two-stage ditch is recommended because the current channel is characterized by moderately unstable banks, an unstable channel bed, and has one to three feet (0.3 to 0.9 meters) of accumulated sediment within the channel. The goal of the two-stage ditch will be to improve the quality of the drainage by improving bank stability, transporting, sorting, and settling of sediment, increasing assimilation of nutrients in the floodplain, and improving in-stream habitat during periods of low flow. The creation of a two-stage ditch will allow periods of high flow to access a floodplain allowing sediments and nutrients to settle out of the water column. During periods of low flow, deposition of sediment in the main channel will be reduced because sediment conveyance will be improved due to a narrower, deeper channel. This may reduce the frequency of ditch

maintenance (cleaning out). Also, the quality of in-stream habitat will likely improve with increased conveyance of sediment as it will allow greater sorting and reduced deposition of sediment in the main channel.

Methods for calculating the dimensions of the two-stage ditch were taken from Powell et al. (2007) and were determined after a cross-sectional survey was completed. Powell et al. (2007) suggested the width of the bench be a minimum of three times the bankfull width. The bankfull width at Site 7 was determined to be approximately 14 feet (4.3 meters). The bench width will be a minimum of 43 ft (13.1 meters; Figure 37). Powell et al. (2007) noted the second channel banks usually have a 2:1 slope; however, for Site 7, the proposed bank slope will be 3:1, which will provide additional conveyance. To achieve a 3:1 slope on the second channel banks, the overall width would be approximately 65 feet (19.8 meters) from top of bank to top of bank (Figure 37). An NWI identified wetland is located along most of the left downstream bank or the north side of the ditch (Figure 36). To minimize the amount of work that would need to be done within the wetland, it was decided to apply 75% of the excavation needed to achieve the desired bench and second channel width to the right downstream bank and only 25% to the left downstream bank (Figure 36). At the downstream end of Site 7, the left downstream bank will account for 75 % of the excavation and the right downstream bank 25 % due to the close proximity to CR E 400 S.

The estimated total amount of excavated material for the construction of Priority Ditch 1 would be approximately 2,200 cubic yards (1682 cubic meters). If the entire length of Site 7 is constructed with a two-stage ditch then a total of 6,600 cubic yards (5046.1 cubic meters) would be required to be excavated. All spoils excavated from the construction of the two-stage ditch would be spread within the county easement and on the property to the south of Deal Ditch. Native grasses and erosion control fabric will be used to re-vegetate and control erosion from newly exposed soils on the bench and second channel banks following construction. Native grasses would be used to stabilize the bench and banks because they establish extensive root systems and assist in the uptake of nutrients and filtering of sediment. Areas that are currently being hayed would be replanted to a hay crop. On the west side of Deal Ditch in Priority Ditch 2, disturbed areas will be re-seeded to their existing cover type.

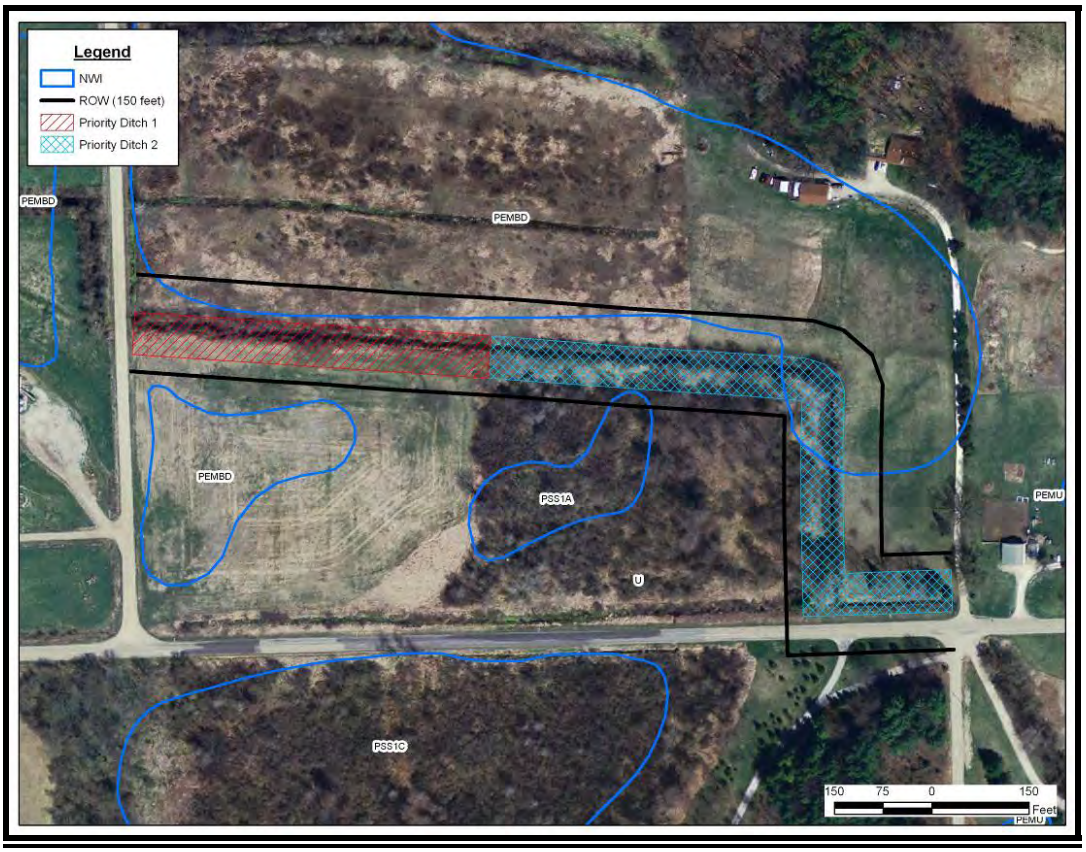

Figure 36. Proposed location of the two-stage ditch at Site 7 within the drainage easement and NWI identified wetlands.

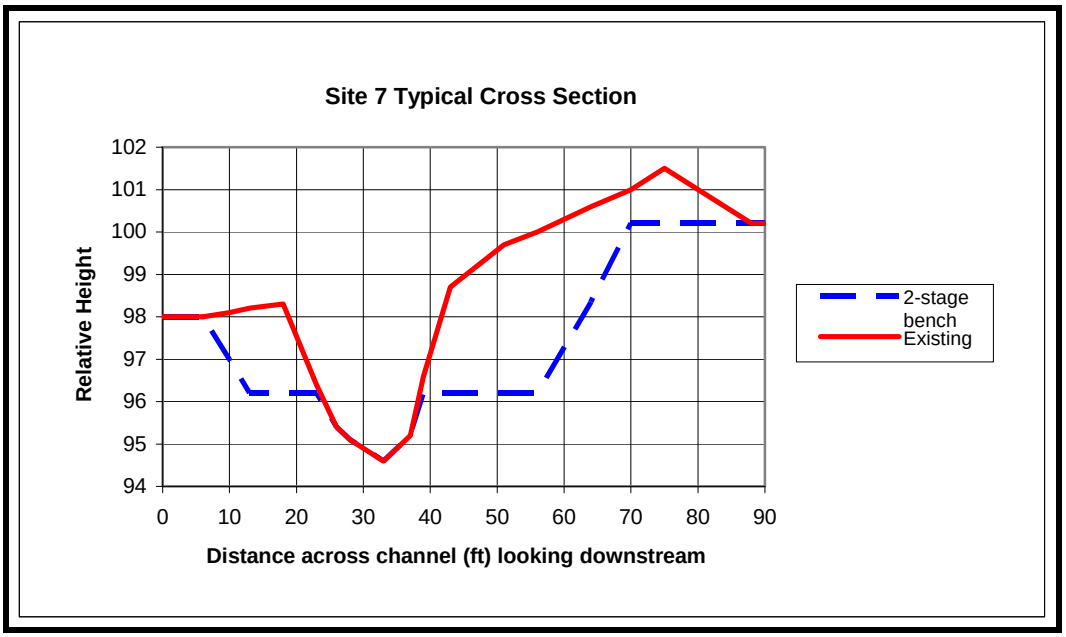

Figure 37. Proposed channel modification for the construction of a two-stage ditch at Site 7. The channel shown here does not include sediment deposited in the stream bed.

4.7.4 Alternative Actions

If the construction of a two-stage ditch is not feasible at Site 7, an alternative project would be to clean out a portion of Deal Ditch. *E. coli* levels in water samples taken from Deal Ditch during the 2006 diagnostic study of Pretty Lake Watershed measured above the Indiana state water quality standards (JFNew, 2006). As mentioned earlier, one to three feet of sediment was observed within the channel. *E.coli* can reside in sediments and contribute to *E. coli* to the water column under certain conditions. Given the location of Site 7 to a hog farm upstream that had historic problems with manure, it is reasonable to assume that the sediment might be contributing *E. coli* to Deal Ditch. Unfortunately, the interaction between *E. coli* in the sediments and the water column is complex and there is not a state standard for *E. coli* levels in sediments so the true benefit of removing sediment from Site 7 cannot be easily predicted. The total amount of sediment removed from the cleaning out of Deal Ditch at Site 7 would be approximately 300 cubic yards (229.4 cubic meters). Sediment removed from Deal Ditch would be spread out onto the County easement, seeded with either warm or cool season grasses, and mulched with the appropriate erosion control material. An additional step to the alternative would be to remove trees along the ditch bank at Site 7 to increase light transmission to the channel. UV light can kill E. coli. The majority of the riparian area upstream of Site 7 along Deal Ditch is wooded and provides little opportunity for UV treatment. Cleaning out of the ditch could also be done in coordination with the construction of the two-stage ditch. This would actually be preferred as this would increase the conveyance of water during periods of low flow and reduce the amount of sediment that would flush through the system.

A second alternative that was investigated was the utilizing the property to the north of Priority Ditch 1 as a storm flow bypass channel (Figure 38). The conceptual idea would be to create a channel on the west side of CR S 875 E that routed storm flows into a constructed channel where the high flows could spill out into a constructed wetland. This would provide stormwater storage and treatment. The constructed channel would eventually connect back to Deal Ditch to drain excess water. A site investigation occurred to further explore this conceptual design. It was determined that significant excavation would be required to excavate the constructed channel and wetland to the appropriate grade. Deal Ditch is approximately six to eight feet (1.8 to 2.4 meters) below the existing grade of the proposed project area. The cost of excavating and disposing of approximately 16,000 cubic yards (12,233 cubic meters) of material would result in a project cost between $150,000 and $200,000. The conceptual design was deemed infeasible because the economic cost outweighed the potential benefit to Pretty Lake. The proposed two-stage ditch project within Deal Ditch provides similar function and benefits to Pretty Lake at a reduced cost.

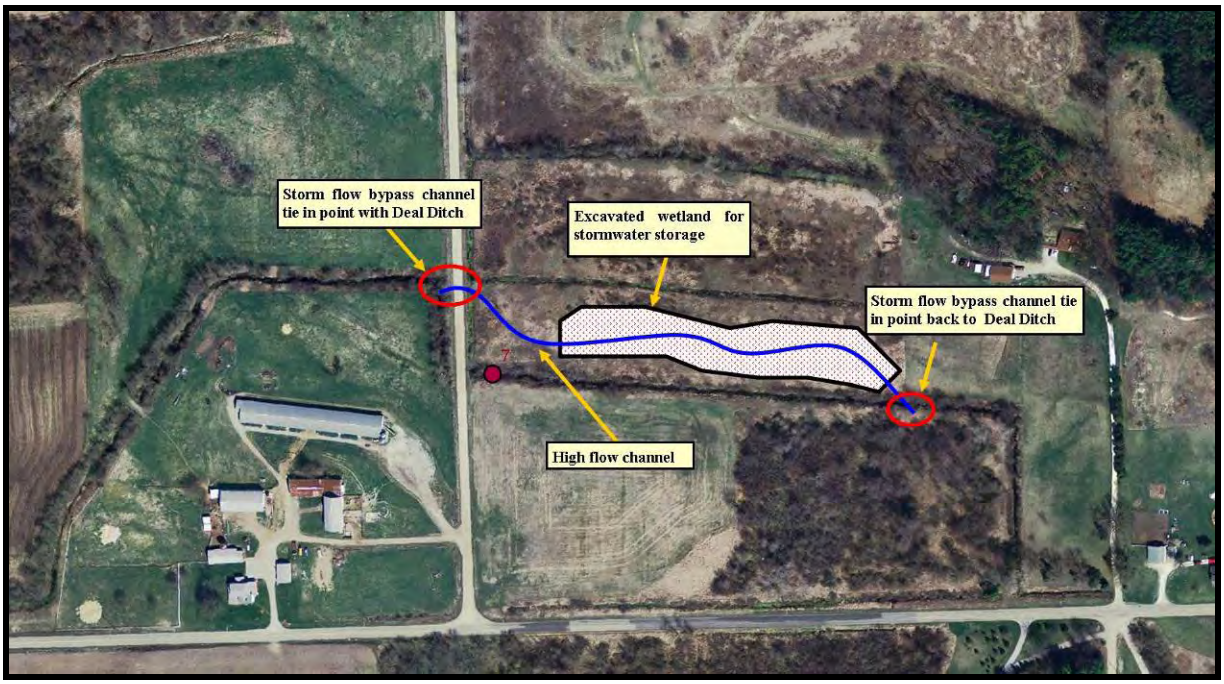

Figure 38. Alternative conceptual design for Site 7.

A third alternative would be to "Do Nothing" action. A "Do Nothing" approach would result in the current condition at Site 7 remaining relatively the same. The banks would likely remain moderately unstable with a significant amount of accumulated sediment in the bed. At some point, sediment may accumulate to a level that would require the Drainage Board to clean out the ditch to increase conveyance.

4.7.5 Permit Requirements

Regulatory permits such as IDEM 401 Water Quality Certification, IDNR Construction in a Floodway Permit, and an ACOE 404 Permit may be required at Site 7. Early coordination for Site 8 (next section) with the regulatory agencies determined that any project involving fill or dredging activities within Deal Ditch will require permits (Appendix D). Typically, the PLCC would be responsible for applying for and acquiring the permits to complete the project; however, the PLCC may request that the LaGrange County Drainage Board use the IDNR SEA 368 Review process to facilitate the permitting process. A SEA 368 Review is a formal process that county drainage boards and surveyors can use to coordinate their activities in legal drains with the regulatory agencies (I.C. 36-9-27-53.5). The meeting serves as a pre-application meeting to discuss any issues associated with a proposed project. The agencies are required to provide a summary to the drainage board and surveyor within 30 days of the meeting.

Besides regulatory permits from state and federal agencies, approval from the LaGrange County Drainage Board will be required to complete the project. As stated previously, feedback from the Drainage Board via the County Surveyor was solicited during the development of a conceptual design for Site 7. The Drainage Board supports a two-stage ditch or an alternative conceptual design of tree removal and sediment

clean-out (Appendix C). They have required a review and approval of the final plans before the project could begin.

4.7.6 Wetland Functional Assessment

According to the U.S. Fish and Wildlife Service, there is an NWI-identified wetland within and adjacent to most of Site 7 (Figure 36). The NWI wetland is coded as "PEMBD", which means that it is a seasonally flooded (D), saturated (B) emergent (EM), palustrine (P) wetland. It functions to store water during wet periods such as snow melt or spring rains. The wetland also provides old field and grassland habitat to wildlife (Figure 39). The proposed project will not have a negative impact on the existing functions of the NWI wetland to the north of Deal Ditch. Spoils from the two-stage ditch will be placed in the hay field to the south of the Ditch. Although the area is map as an NWI wetland, the area is currently being farmed and would not likely be considered a wetland after a wetland determination.

Figure 39. Example of the wetland habitat present in the NWI wetland to the north of Priority Area 1 for Site 7.

4.7.7 Biological and Habitat Integrity Survey

A Qualitative Habitat Evaluation Index (QHEI) assessment was completed on October 23, 2008. The QHEI was developed by the Ohio EPA for streams and rivers in Ohio (Rankin, 1989 and 1995). While the Ohio EPA originally developed the QHEI to evaluate fish habitat in streams, IDEM and other agencies routinely utilize the QHEI as a measure of general "habitat" health. Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrate; amount and quality of in-stream cover; channel morphology; extent and quality of riparian vegetation; pool, riffle, and run development and quality; and gradient are the metrics used to determine

the QHEI score. Each metric is scored individually then summed to provide the total QHEI score. QHEI scores typically range from 20 to 100.

The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of stream segments in Ohio indicate that values greater than 60 are *generally* conducive to the existence of warmwater faunas. Scores greater than 75 are characteristic of stream conditions that are capable of supporting exceptional warmwater faunas (Ohio EPA, 1999). IDEM indicates that QHEI scores less than 51 indicate poor habitat and may not support the stream's aquatic life use designation (IDEM, 2006).

The QHEI score for the project site is listed in Table 10. The datasheet is included in Appendix E. A QHEI score of 27 was determined for Site 7 suggesting habitat is poor within Deal Ditch and is likely not in support of its aquatic life use designation. A lack of suitable substrate, riffle/pool complexes and channelization characterize the habitat at Site 7.

Table 10. QHEI metrics with maximum and Site 7 scores.

Metric	Maximum score	Site 7
Substrate	20	-2
Instream Cover	20	12
Channel Morphology	20	4
Riparian Zone & Bank	10	7
Pool/Glide Quality	12	0
Riffle/Run Quality	8	0
Gradient	10	6
Total	100	27

4.7.8 Environmental Impact Assessment

Potential environmental impacts as a result of the proposed project could include increased sedimentation into Pretty Lake due to accumulated bed material at Site 7 moving downstream and loss of tree habitat adjacent to Deal Ditch. The loss of trees along a stream can negatively affect the summer habitat for the endangered Indiana

bat. Most of the trees are smaller than 10 inches (25.4 centimeters) in diameter, which is typically the minimum size used by Indiana bats for roosting. Trees should be removed between September 15 and April 15 to prevent disrupting their habitat while they might be using it. Overall, the proposed project should have little impact to the existing environment because the majority of the project is occurring within the existing footprint of the legal drain and disturbed areas will be restored to their previous conditions upon completion of construction.

4.7.9 Unusual Physical and Social Costs

The unusual physical and social costs associated with the proposed conceptual design include the temporary disturbance of the project area, the temporary loss of the use of a hay field, and an expansion of the county easement. The majority of the project will occur within the county easement, but because the construction of the two-stage ditch will increase the width of the drainage channel, moving the top of the ditch banks back, the county easement (75 feet; 22.9 meters) will start at the top of the new banks. The county easement would extend south an additional 30 feet (9.1meters) and north 15 feet (4.6 meters) from where it is currently located.

4.7.10 Opinions of Probable Cost and Proposed Timeline

The estimated cost of the proposed project to construct 1,585 feet (483.1 meters) of two-stage ditch along Deal Ditch (both Priority Ditch 1 and 2) is $86,767 (Table 11).

Table 11. Cost estimates for Site 7 two-stage ditch construction along Deal Ditch.

Item	Unit cost	Unit	Quantity	Total
Final design and permitting	$6,400	each	1	$6,400
Construction services	$57,645	each	1	$57,645
Mobilization/demobilization	$2,500	each	1	$2,500
Administrative services	$1,600	each	1	$1,600
Services Subtotal				**$68,145**
Erosion control material	$1	square yard	8981	$8,981
Seed Mix - Spoils Area	$50	acre	2	$100
Seed Mix - Water Season Grass	$300	acre	3	$900
Staples	$40	box	37	$1,480
Materials Subtotal				**$11,461**
Contingency	10% of construction subtotal			**$7,161**
Total				***$86,767***

The PLCC could apply for a 2010 LARE design-build grant to complete the project. The project will require permits from all three regulatory agencies (IDEM, IDNR, and COE). After a grant is awarded in July 2010, the SEA 368 process should begin. Typically, the permit process takes one to six months. After permits are obtained, construction should

occur between March and November with the preference for the majority of the work to occur before May so seeding can become established and use of areas where spoils have been placed can be returned to their previous condition.

4.8 Tree canopy reduction (Site 8)

4.8.1 Site Description

Deal Ditch enters into Pretty Lake at the north end of the lake (Figure 40). The channel is approximately 8 feet (2.4 meters) wide with an average water depth of less than 1 foot (0.3 meters) with streambanks that are approximately 8 feet (2.4 meters) high. Deal Ditch runs through an NWI-identified forested/shrub wetland in the middle of the project area (Figure 40). Erosion is occurring along the streambanks (Figure 41 and Figure 42) and the current channel offers high flows little access to a floodplain. A set of treatment options were investigated and developed for Site 8 and include rock grade controls, the construction of a two-stage ditch, armoring of stream banks, creation of a bench within the existing channel, and increasing the amount of sunlight to the streambanks. The goal of the different projects is to increase streambank stability and reduce erosion.

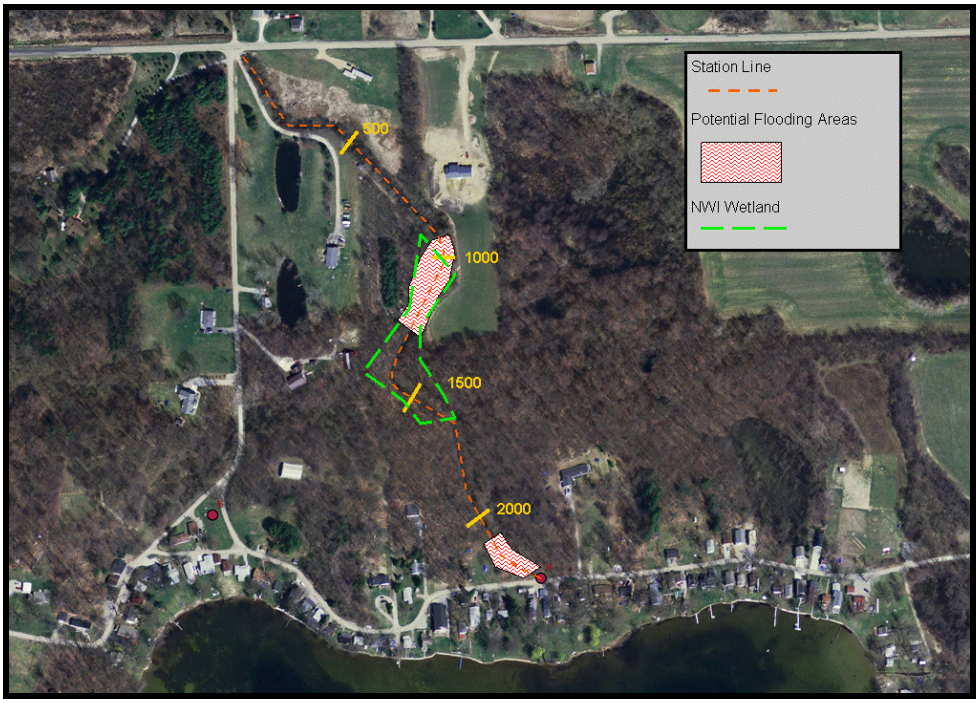

Figure 40. Site 8 with station line (feet), potential flooding areas, and NWI wetland identified.

Figure 41. Example of erosion occurring on the left downstream bank at Site 8.

Figure 42. Example of erosion occurring on streambank at Site 8.

4.8.2 Easement and Land Availability Determination

Preliminary approval from the LaGrange County Drainage Board via the county surveyor has been obtained for work within the county drainage easement (Appendix B). They have asked that the affected landowner's approval be obtained prior to granting the drainage board's final approval. At this time, affected landowners have been contacted and the PLCC and JFNew are waiting on their permission. Copies of their written permission will be included in the final draft.

4.8.3 Preliminary Design and Conceptual Drawings

Deal Ditch runs through a forested area at Site 8. Because of this, the amount of sunlight that is transmitted to the forest floor is minimal in most areas (Figure 43) and may be limiting the amount of vegetated cover on the streambanks (Figure 44). Increasing the sunlight to the streambanks by selectively removing trees along the length of Deal Ditch is suggested as a method to increase the amount of vegetation on the streambanks. The goal for reducing the canopy cover and increasing the amount of vegetative cover on the stream banks is to increase bank stability thereby, decreasing the erosive potential of high flow and overland flow. Decreasing the erosive potential of the stream banks would help reduce the amount of sediment and nutrients entering the stream that eventually reach Pretty Lake. An additional benefit from increased sunlight to the stream could be a reduction in *E. coli* concentrations, as UV light is known to kill *E. coli*.

This treatment type along Deal Ditch at Site 8 could take place along the entire length of the site or only in specific areas. The number of trees that would be removed to achieve this project is not known at this time. The amount of trees that would need to be removed may affect whether spot cutting or clear cutting would be utilized. For the purpose of the feasibility study, a 15% reduction in the tree canopy along Deal Ditch is recommended. Cost estimates were developed for applying this treatment to a total of 500 feet (153 meters) spread along the entire reach of Deal Ditch.

The conceptual method for increasing sunlight to the stream would be to fall all trees designated for removal. The stumps of trees dropped would remain to aid in bank stability. Trees would either be chipped on-site and taken offsite to a predetermined location or would be taken offsite and burned at a predetermined location.

One consideration would be the seasonal timing of the cutting activities to limit impact to the State-endangered Indiana bat. Trees should not be cut between April 15 and September 15 because it corresponds to the time when Indiana bats would be using trees along a stream corridor for roosting. Cutting outside this window minimizes the impact to Indiana bat populations.

Figure 43. Example of an area within Site 8 with minimal sunlight.

Figure 44. An example bank erosion and minimal vegetative cover on the left downstream bank at Site 8.

4.8.4 Alternative Actions

Several different alternative actions were explored during the development of the conceptual design for Site 8. During the feasibility analysis, the following designs were given a lower priority due to one or more reasons. The cost:benefit ratio, environmental impact, and landowner acceptance were a few of the factors that influenced the overall conceptual design.

Rock Grade Controls

The initial focus at Site 8 was to create a series of rock grade controls within the channel to reduce stream velocity and allow for greater access to the floodplain, thereby decreasing erosion and allowing sediments and particle-attached nutrients time to settle out of the water column. After a physical survey including four cross-sectional profiles and a longitudinal profile (Appendix C), it was determined this technique may not be a beneficial treatment option. An overall slope of 0.36% was determined from the longitudinal profile, which suggests this reach does not have a significant stream gradient that could contribute to bed instability. Additionally, some areas along the reach were identified as being prone to flooding because the banks are considerably lower than in some areas which could be undesirable for landowners in these areas (Figure 45).

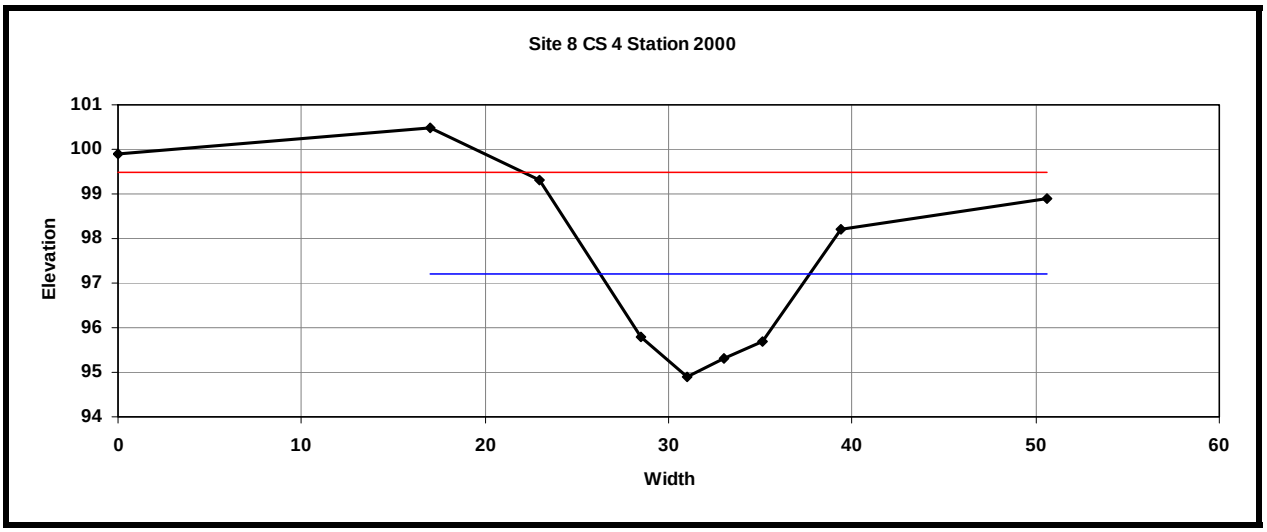

Figure 45. Site 8 cross-section 4 at Station 20+00, showing the potential for flooding during periods of high flow indicated by the red line.

Two-Stage Ditch

Another treatment option suggested for Site 8 is to install a two-stage ditch. The goals of the two-stage ditch and the methods used to develop the conceptual design are similar to those used for Site 7. See Section 4.7 for further details.

The bankfull widths determined from four cross-sectional surveys ranged from 10 feet (3.0 meters) at cross section (CS) 3 located at Station 15+00 (Figure 47) to 13 feet (4.0 meters) at CS 1 located at Station 0+65. While there is some variation in the geomorphology of the cross-sections, the overall shape of the channel is best represented by CS 2 and CS 3 (Figures 46 and 47). Using these two cross sections as a reference, the approximate width of the bench would be 30 to 33 feet (9.1 to 10.1 meters). Once a 3:1 slope is applied to the second channel banks, the overall width of the ditch would be approximately 60 feet (18.3 meters; Figure 46 and Figure 47). Native grasses would be used to re-vegetate the bench and second channel banks and erosion control blanketing would be installed following construction to reduce erosion. The amount of material to be excavated from the construction of a two-stage ditch at Site 8 would be approximately 12,500 cubic yards (9,557cubic meters). All spoils excavated from the construction of the two-stage ditch would be spread on the drainage easement and adjacent property. Site 8 is primarily wooded and will require the removal of trees to construct the two-stage ditch. The amount of trees that would need to be removed is not known at this time and would need to be determined by a final design of two-stage ditch project area. All trees removed would either be chipped on-site and hauled away to a predetermined location or removed from the site and burned at a predetermined location.

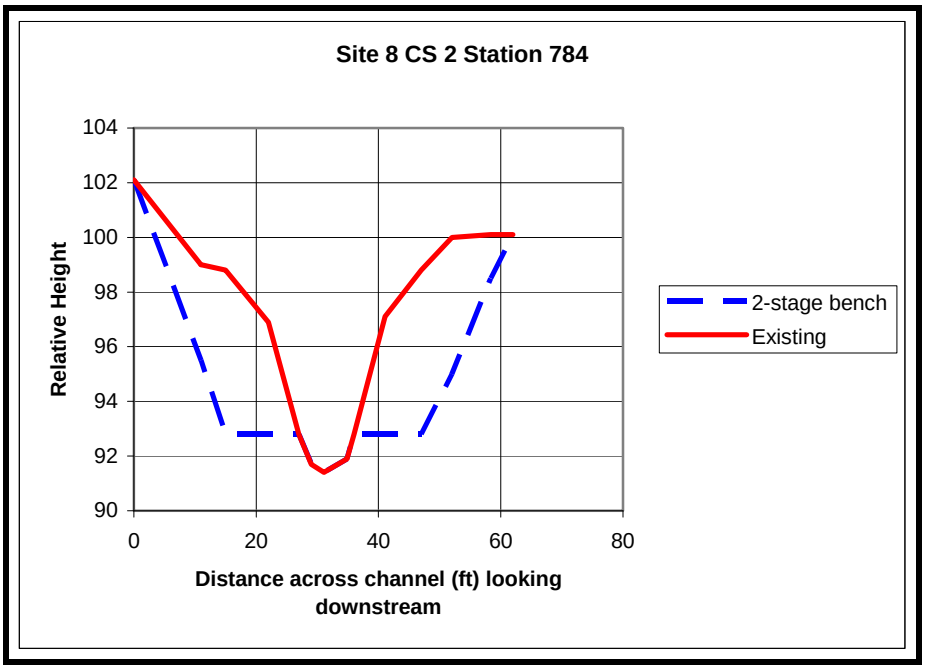

Figure 46. Site 8 cross-section 2 located at station 7+84.

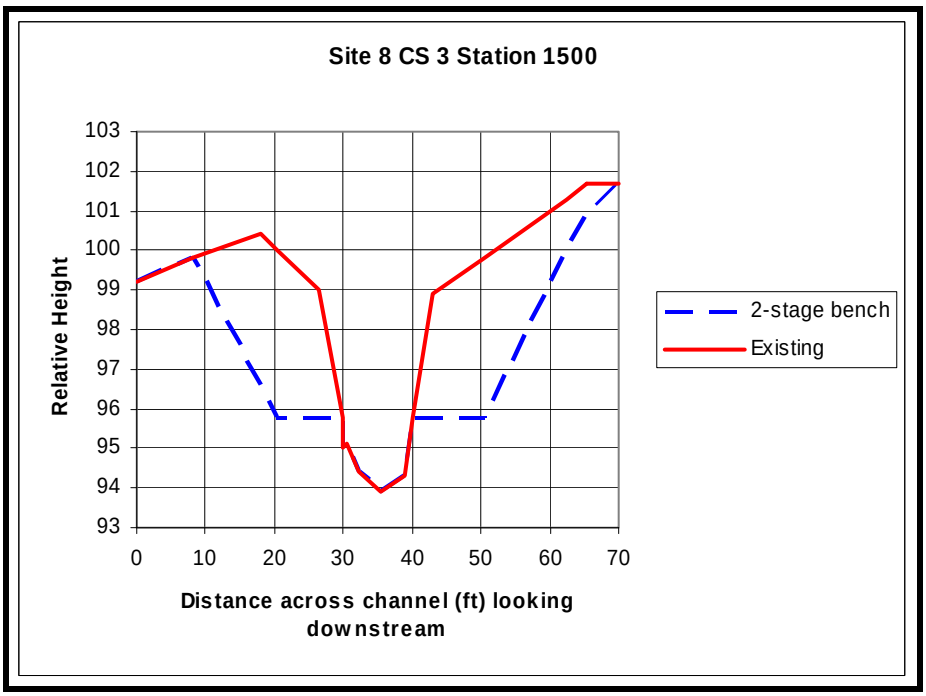

Figure 47. Site 8 cross-section 3 located at station 15+00.

Creation of a Bench within the Channel

A hybrid alternative to creating a two-stage channel through Site 8 would be to create a bench within the existing channel by installing stone, coir logs, or other material to narrow the width of the low flow channel. This narrower low flow channel would convey base flows and more effectively carry sediment through the channel. During a storm event, the stream would flow across the bench depositing sediments and nutrients. The

existing grade of the stream would not be modified. Conveyance capacity above the bench would be similar to existing conditions. One negative to the bench within the existing channel concept is that there would likely be an increase in the out of banks flooding along Deal Ditch because the low flow conveyance would be decreased.

Armoring of Banks

An alternative treatment to reduce streambank erosion would be to armor highly eroding sections of Deal Ditch with stone or equivalent erosion control material. This treatment would require minimum tree disturbance and not significantly change the current conveyance capacity of the stream. This treatment is less preferred because it has a low benefit to cost ratio. There is a significant amount of streambank that would require armoring to have the desired effect of protecting and improving the water quality of Deal Ditch.

4.8.5 Permit Requirements

The primary conceptual design of selectively removing trees along the banks to increase sunlight and re-establish vegetation along the streambanks would not require a regulatory permit from IDNR because all trees removed would be located above the ordinary high water level and no trees would be left in the floodway. A 404 regulatory permit from the ACOE and a 401 regulatory from IDEM would be required, but only in those areas designated as wetland. IDEM would only require a notification if the disturbance is less than 0.1 acres (0.04 hectares) or 300 feet (92 meters) and the ACOE would likely issue a regional general permit for the proposed activity. A final design for tree removal will be required to be approved by the LaGrange Drainage Board prior to implementation. Their initial approval was obtained in a letter sent to the Surveyor in December 2008.

Several of the alternative project types at Site 8 would require regulatory permits such as an IDEM 401 Water Quality Certification, an IDNR Construction in a Floodway Permit, and an ACOE 404 Permit. If one of the alternative projects is selected, it is recommended that the PLCC request that the LaGrange County Drainage Board use the IDNR 368 Review Process to facilitate the permitting process,. At a minimum, the PLCC would request a letter supporting the projects because they involve a legal drain.

4.8.6 Wetland Functional Assessment

Present at Site 8 is an NWI-identified forested/shrub wetland (Figure 40). The wetland is coded as “PFO1C”, which means that it is a seasonally flooded (C), deciduous (01) forested (FO), palustrine (P) wetland. It functions to store water in the floodplain of Deal Ditch during wet periods such as snow melt or spring rains. The wetland also provides forested habitat for wildlife. The proposed project will not have a negative impact on the existing functions of the NWI wetland. Selective cutting will be employed that will retain the forested characteristics of the site, but with a greater understory vegetation component. Trees will be felled and removed immediately from the wetland boundary.

4.8.7 Biological and Habitat Integrity Survey

A Qualitative Habitat Evaluation Index (QHEI) assessment was completed on October 22, 2008 at two different locations (Station 1 and Station 2). Station 1 was located near the upstream end of the reach and Station 2 was located near the downstream end of the reach.

The QHEI metric score for Site 8 is listed in Table 12. The datasheet is included in Appendix E. Station 1 and 2 received scores of 34.5 and 30.5 respectively, which would indicate the streams are non-supporting of aquatic life (IDEM, 2002).

Table 12. QHEI metrics with maximum and Site 8, Station 1 and 2 scores.

Metric	Maximum score	Station 1	Station 2
Substrate	20	7	3
Instream Cover	20	6	3
Channel Morphology	20	9	8
Riparian Zone & Bank Erosion	10	4.5	8.5
Pool/Glide Quality	12	2	2
Riffle/Run Quality	8	0	0
Gradient	10	6	6
Total	100	34.5	30.5

BEHI and Pfankuch

To assess the stability of the banks and channel at Site 8 a Bank Erosion Hazard Index (BEHI) and Pfankuch Channel Stability Rating (Pfankuch, 1975) score was determined at three locations including the two stations used during the QHEI assessment. The BEHI is a multivariate assessment of bank characteristics used to determine the overall stability of a stream bank (Rosgen, 2008). Seven categories are used to predict the erosive potential of the streambank and include ratio of study bank height to bankfull height, ratio of root depth to bankfull height, weighted root density, bank angle, surface protection and stratification of bank material. Each of the measured variables is converted to a BEHI value of 0 and 10 and given an adjective rating of very low to very high, respectively. The BEHI values are totaled and an overall BEHI score is determined.

In addition to the two stations evaluated for QHEI, one additional station located midway between Station 1 and Station 2 was evaluated for the BEHI. The BEHI metric scores for Site 8 is located in Table 13. The data sheet is included in Appendix E. Station 1 received the highest BEHI score (42.5), followed by Station 3 (40), and Station 2 (34.7). Stations 1 and 3 have an adjective rating of Very High and Station 2 High, suggesting that the streambanks of Deal Ditch at Site 8 are vulnerable to erosion. The adjective rating of Very High, High, and so on is relative to the channel type. For instance, the channel at Station 3 scores 34.7 and is rated as Very High while the channel at Station 2 scores 40 and is rated as High. The differences are due to the different Rosgen channel classification types (Rosgen, 1996).

Table 13. BEHI metric scores determined for Site 8 at Stations 1, 2 and 3.

BEHI Metric	Station 1	Station 2	Station 3
Ratio study bank height /bankfull	9.6	8	8.2
Root depth/study bank height	5	7	4.2
Weighted root density	8.7	9.8	7.8
Bank angle	4.2	3.2	3
Surface protection	10	7	6.5
Bank material	5	5	5
Stratificaiton of bank material	0	0	0
Total	42.5 (Very High)	40 (High)	34.7 (Very High)

The Pfankuch Channel Stability Rating (Pfankuch rating) is an index that designates a stream as having poor (unstable), fair (moderatly unstable) or good (stable) channel stability. Three areas of the stream are investigated including the upper and lower banks and the channel bottom. A total of fifteen metrics within those areas are given a rating of, poor, fair, good, or excellent. Some of the metrics observed include: mass erosion, debris jam potential, vegetative bank protection, cutting, deposition, brightness, rock angularity, and consolidation. For a complete listing of the metrics observed for the Pfankuch rating refer to the field data sheet in Appendix E. Ratings are assigned a value and the sum of the fifteen metrics is the overall Pfankuch score. Scores can vary from a minimum of 38 to a maximum of 152. In general, higher scores indicate decreased channel stability while lower scores suggest increased channel stability. The overall Pfankuch rating of a stream reach is dependent upon the stream type or Rosgen classification which the reach is located because some stream types are naturally more

unstable than others. For example, a C4 stream is considered stable with a Pfankuch score of 70-90, while a F4 stream is considered stable with a score of 85-110.

The Pfankuch rating score at Station 1 and 2 was 128 and 123, respectively (Table 14). Both sites are rated as "Poor" indicating that the channel specifically elements of the banks are unstable.

Table 14. Pfankuch ratings for Stations 1 and 2 at Site 8.

Bank location	Pfankuch Metric	Metric Score – Points (Rating)	
		Station 1	Station 2
Upper Banks	1	8 (Poor)	6 (Fair)
	2	6 (Good)	9 (Fair)
	3	4 (Good)	4 (Good)
	4	12 (Poor)	12 (Poor)
Lower Banks	5	1 (Excellent)	2 (Good)
	6	8 (Poor)	8 (Poor)
	7	6 (Fair)	4 (Good)
	8	12 (Fair)	6 (Good)
	9	16 (Poor)	16 (Poor)
Bottom	10	3 (Fair)	1 (Excellent)
	11	1 (Excellent)	3 (Fair)
	12	8 (Poor)	8 (Poor)
	13	16 (Poor)	16 (Poor)
	14	24 (Poor)	24 (Poor)
	15	3 (Fair)	4 (Poor)
Total Points		128	123
Modified Channel Stability Rating		Poor	Poor

4.8.8 Environmental Impact Assessment

There is the potential for the conceptual design and alternative projects to have a negative environmental impact, if they are not implemented correctly. The first major impact would be the placement of fill in the form of woody material into wetlands along the ditch corridor. This impact can be avoided or minimized by having wetland areas clearly marked in the field and providing the selected contractor guidance on which areas to avoid. The second impact would be the removal of potential Indiana bat roosting trees during the roosting season. This impact can be avoided or minimized by removing trees between September 15 and April 15. Additionally, bat roosting boxes could be hung on remaining trees. The third impact would be increased sedimentation and erosion due to heavy equipment tracking through the corridor and skidding logs. This impact could be minimized with proper erosion control techniques such as the use of silt fencing and temporary seeding. Additionally, disturbed areas should be seeded and covered with the appropriate erosion control material upon completion. In conjunction with minimizing the impacts to the Indiana bat, cutting should occur in the winter when the ground is frozen.

4.8.9 Unusual Physical and Social Costs

Unusual physical and social costs associated with the conceptual design and the alternative projects include a change in the nature and character of the current site conditions. The primary conceptual design and most of the alternative projects will require the removal of some or all of the trees along the stream corridor. This will visually change the appearance of the site. Residents along Deal Ditch may appreciate the aesthetics of their site and view the conceptual design and alternative projects in a negative manner. If the tree removal is done in an ecological sensitive manner and disturbed areas are re-vegetated, there should be minimal long-term impact to the site.

4.8.10 Opinions of Probable Cost and Proposed Timeline

The estimated cost of the proposed project to selectively cut and properly remove trees from a total of approximately 500 feet (152.4 meters) along Deal Ditch is $14,794 (Table 15). The cost estimate can also be used to develop a unit cost for canopy removal of $30/linear feet of streambank. This will allow the PLCC to develop additional cost estimates for either increasing or decreasing the amount of canopy removal during the final design and construction phase.

Table 15. Cost estimates for Site 8 selective tree removal along Deal Ditch.

Item	Unit cost	Unit	Quantity	Total
Final design	$1,600	each	1	$1,600
Construction services	$7,460	each	1	$7,460
Mobilization/demobilization	$2,500	each	1	$2,500
Administrative services	$1,600	each	1	$1,600
Services Subtotal				**$13,160**
Erosion control material - straw bales	$3	each	60	$180
Seed mix - Spoils area	$300	acre	1	$300
Seed mix - Warm Season Grass	$50	acre	2	$100
Materials Subtotal				**$580**
Contingency	10% of construction subtotal			**$1,054**
Total				***$14,794***

The PLCC could apply for a 2010 LARE design-build grant to complete the project. The primary conceptual design will not require an extensive permit process; however any of the alternative conceptual designs would require permits from all three regulatory agencies (IDEM, IDNR, and ACOE). After a grant is awarded in July 2010, trees should be inventoried and marked for removal. Cutting and removal should occur between October and March with the preference for the majority of the work to occur between December and February when the ground is frozen to minimize soil disturbance. Site clean-up and seeding should occur after removal of the trees and when soil conditions allow for proper grading of disturbed areas.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Pretty Lake currently has good water quality. To help maintain this level of water quality the PLCC is taking a proactive approach within their watershed to maintain their lake's good water quality. The Pretty Lake feasibility study outlines a number of projects designed to reduce the amount sediment, nutrient, and *E.coli* loading into Pretty Lake. Projects investigated included the construction of grassy swales, a rock-lined channel, tile repair, modifications to existing detention basins, the construction of a raingarden, selective tree canopy reduction, and converting a typical drainage ditch into a two-stage ditch. Recommendations to the PLCC are as follows.

1. Apply for a design/build LARE grant for the design and construction of a grassy swale for approximately 70 feet (21.3 meters) at Site 1 during the next LARE grant cycle. Design would begin in the summer of 2009 with construction to occur in the Fall of 2009. Construction should be completed by October to allow seeds to establish.

2. Apply for a design/build LARE grant for the design and construction of a grassy swale/rock-lined channel combination for approximately 300 feet (91.4 m) at Site 3 during the next LARE grant cycle. Design would begin in the summer of 2009 with construction to occur in the fall of 2009. Construction should be complete by October to allow seeds to establish.

3. Apply for a design/build LARE grant for the design and construction of a grassy swale for approximately 180 feet (54.9 meters) at Site 4 during the next LARE grant cycle. Design would occur in the summer of 2009 with construction occurring in the fall of 2009. Construction should be completed by October to allow seeds to establish.

4. Apply for a design/build LARE grant during the next LARE grant cycle for the design and construction of a 200 foot (70.0 meters) earthen berm at Site 5 to create a new sediment detention basin. Construction would take place after crops are harvested from the adjoining field.

5. Apply for a design/build LARE grant during the next LARE grant cycle to repair a broken tile and increase the size and location of the current catchbasin at Site 6. Construction would begin in the fall of 2009 and be completed no later than October 2009 to allow seeds to be properly established before winter.

6. Apply for a design/build LARE grant in 2010 for the design and construction of a two-stage ditch at Site 7 for a minimum length of priority area 1, but preferably the entire length of priority areas 1 and 2. Design would begin in the summer of 2010 and construction could occur during the summer or fall of 2011. Correspondence with the affected landowners should be maintained to secure landowner permission.

7. Applications for a design/build LARE grant for the design and construction of a raingarden at Site 2 or increasing sunlight on streambanks at Site 8 by removing tress along Deal Ditch could be included during any of next LARE grant cycles.

8. Continue communication with the affected landowners at Sites 7 and 8 to obtain landowner permission.

9. Work with landowners and lake residents to continue to proactively manage resources within the watershed.

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APPENDIX A

PROJECT SITE ISSUES AND POTENTAL SOLUTIONS

Pretty Lake 050919.03 Site Inspection 10-31-07

Site No: 1	**Location:** 490 S and 930E on SE side of road
Problem(s)/Description	**Potential Solution(s)**
Minor erosion in grass swale next to road due to hole cut in side of storm drain	- Repair hole in side of storm drain, fill and seed erosion rill
Storm drain not functioning properly	- Replace storm drain with different design capable of accepting higher flows.
Priority: 8	**Notes:**

Site No: 2	**Location:** 490S and 925E behind School
Problem(s)/Description	**Potential Solution(s)**
Sheet water from parking lot hitting fence and causing erosion	- Create Raingarden on School property and tile overflow to existing storm drain - Regrade and seed swale to direct runoff to strom drain
Roadside stormwater drain clogged and poorly designed	- Install new storm drain with better design and remove debris on regular maintenance schedule
Sediment along roadside	- Install tile along roadside and tie into storm drain
Priority: 1	**Notes:** Creating a raingarden or wetland on School grounds could also be used as an educational tool for the students and promote water quality. This site is also highly visible from the road and could also spark interest in the local residents.

Site No: 3	**Location:** 480S and 900E on South side of road
Problem(s)/Description	**Potential Solution(s)**
Erosion in roadside ditch	- Install more check dams (3) to reduce energy
Sediment movement through ditch	- Cut wider stream bed and vegetate - Install standpipe behind check dam and tile into storm drain at base of slope - divert road runoff to a larger area by regrading
Priority: 2	**Notes:** This site would be suitable to establish native savanna habitat to help stabilize the slopes

Site No: 4	**Location:** End of Cul-De-Sac on 480S
Problem(s)/Description	**Potential Solution(s)**
Channelized ditch along roadside causing minor erosion	- Regrade narrow ditch and widen to create bioswale with native vegetation
Priority: 5	**Notes:**

Site No: 5	**Location:** 890E Corner just north of 480S
Problem(s)/Description	**Potential Solution(s)**
Lake channel filling in with sediment	- Work with adjacent landowners to convert more farm ground to CRP - Install small berm to create temporary holding area
Priority: 6	**Notes:**

Site No: 6	**Location:** 430S and 900E
Problem(s)/Description	**Potential Solution(s)**
Storm drain full of sediment	- Replace storm drain with better design and maintain - Create bioswale or small WASCOB in yard
Clay tile broken in yard and creating sinkhole	- Repair tile or install riser and divert water to holding area
Priority: 4	**Notes:** Large tile down deep, may not be feasible to remove.

Site No: 7	**Location:** 400S and 875 E
Problem(s)/Description	**Potential Solution(s)**
Manure from hog farm causing high levels of E. coli in nearby Deal Ditch	- Create stream side wetlands along Deal Ditch
Priority: 7	**Notes:** Horse and Human urine were at high levels closer to the Lake based on the diagnostic study. Hog urine had nearly dropped out.

Site No: 8	**Location:** Deal Ditch confluence with Lake at 430S
Problem(s)/Description	**Potential Solution(s)**
E. coli in Deal Ditch, mostly from Horse and Human waste	- Create riparian wetlands upstream filter out E. coli - Remove woody vegetation along corridor to expose ditch to sunlight - install several check dams upstream
Priority: 3	**Notes:** Possible locations for wetlands were discussed: Rod Dunithon's property in the corner of woods next to Deal Ditch (400S) and at Veterinarian's property along Deal Ditch next to Lake.

APPENDIX B

LANDOWNER CORRESPONDENCE

JFNew
Full-Service Ecological Solutions™

708 Roosevelt Rd
Walkerton, Indiana 46574
Phone: 574-586-3400
Fax: 574-586-3446

Mark Pranckus
Aquatic Biologist
mpranckus@jfnew.com
Mobile: 574-229-8723

Corporate Office:
Walkerton, Indiana

Chicago, Illinois

Indianapolis, Indiana

Ann Arbor, Michigan

Grand Haven, Michigan

Cincinnati, Ohio

Madison, Wisconsin

Native Plant Nursery:
Walkerton, Indiana

www.jfnew.com

August 5, 2008

Jeff Brill
LaGrange County Highway Department
300 E. Factory St.
LaGrange, IN 46761

Dear Jeff:

The Pretty Lake Conservation Club (PLCC) received a Lake and River Enhancement (LARE) grant from the Indiana Department of Natural Resources (IDNR) to perform a feasibility study to look for projects that reduce the amount of sediment and nutrients being deposited into the lake. The feasibility study focuses on areas around the lake and within the watershed where erosion, sediment deposition, and nutrient loading are causing problems and develop solutions that are feasible from both a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the watershed, an area within the County road easement adjacent to E 490 S, located in Milford Township 36 N, Range 11E, Section 15, was identified as an area contributing to sediment and nutrient loading into the lake. The area is a small channelized drainage that flows to a catch basin, which flows directly to Pretty Lake. The channel concentrates stormwater flow and is devoid of vegetation. See enclosed pictures for site photos. A follow-up visit was completed to determine potential solutions to the problem and investigate the site more thoroughly. The proceeding paragraphs outline a potential treatment to the problem. For the project to continue into the design phase, the PLCC needs your written approval. At this point, your signature is a commitment to your willingness to consider the project and to move forward with turning a conceptual idea into a detailed design that can be later constructed, if funds become available.

Construct a Grassy Swale at Site 1

The conceptual design at Site 1 is to construct a grassy swale to control erosion, thereby reducing the amount of sediment and nutrients entering the lake. The current channel would be widened to disperse flow evenly across a flat bottomed channel and seeded with native grasses. A grassy swale would increase channel stability, reducing erosion and slowdown water movement allowing sediments and nutrients time to settle. Additionally, a half-domed storm drain grate will replace the current (flat top) storm drain grate, which will be capable of accepting larger flows of storm water without clogging due to leaves and other debris.

The PLCC would be responsible for all costs associated with the design and construction of this project including site preparation, construction, and clean-up. However, if the LaGrange County Highway Department wanted to contribute either money, materials, and/or labor to the construction of this site, the PLCC could count it towards the match requirements, if they obtained a construction grant. By signing this letter you indicate that a detailed design can occur. Before and during the design phase your input will be considered. We will contact you to let you know when we have received funding of the design project and the proposed project timeline.

Please sign below and return in the stamped envelope. Enclosed is a copy for your records. If you have questions before signing, please contact me and I will be happy to answer any questions you may have about the proposed idea or the feasibility/design/construction process. Questions about the Pretty Lake Conservation Club and their work to improve the water quality of Pretty Lake can be directed to Jim Mertz (260-351-3404).

Thank you,

Mark Pranckus

I agree with the proposed conceptual design as it has been explained to me by the Pretty Lake Conservation Club (PLCC) and their representatives, JFNew and by the documentation they have provided. I agree that the conceptual design is feasible to me, will result in no cost to me, and the PLCC shall proceed to develop detailed plans to construct this project.

Jeffrey L Brill (signed)

Jeffrey L. Brill (printed)

8-19-08 (date)

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Figure 1. Location of Site 1-Grassy Swale in the Pretty Lake Feasibility Study.

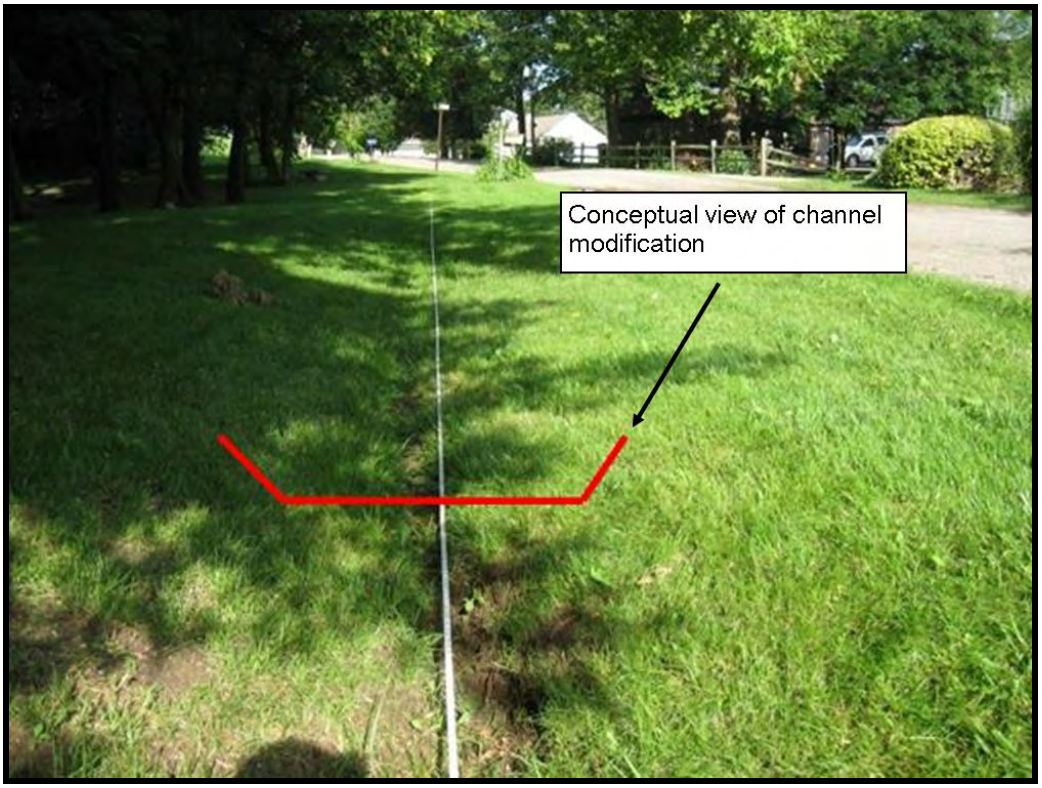

Figure 2. Proposed channel modification at Site 1 for Pretty Lake Feasibility Study.

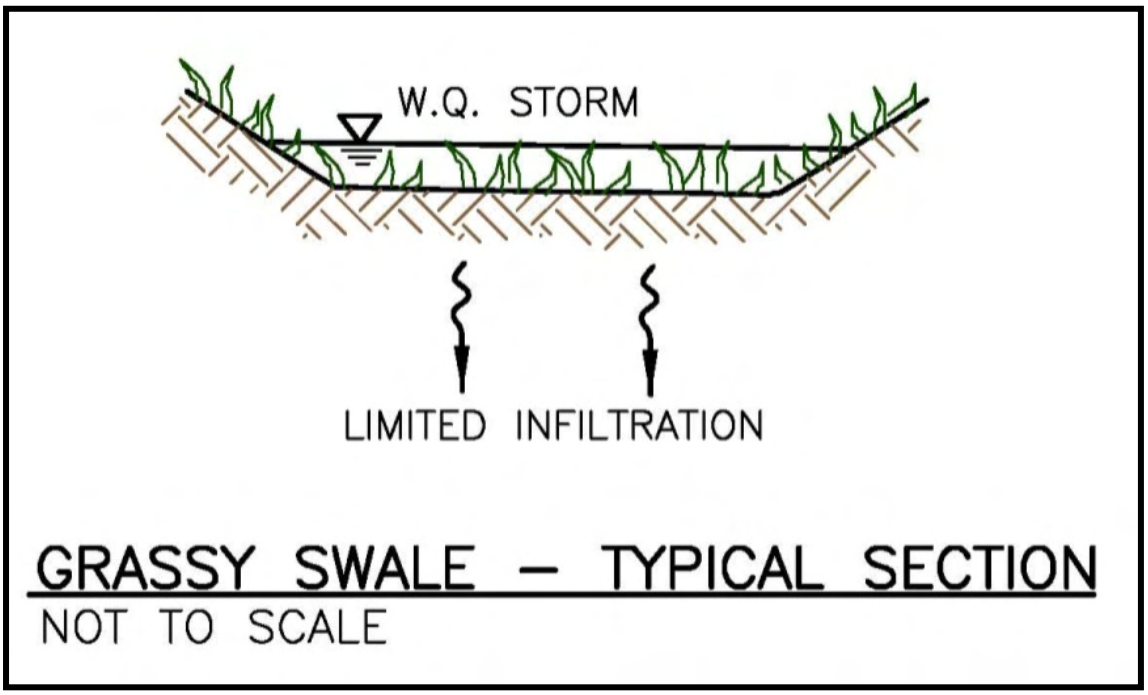

Figure 3. Conceptual drawing of a grassy swale for Site 1 for Pretty Lake Feasibility Study.

Figure 4. Example of a grassy swale.

Figure 5. Existing flat top storm drain to be replaced with a half-domed storm drain at Site 1.

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January 8, 2009

Principal Green
Milford Elementary School
9245 E. 500 S.
Wolcottville, IN 46795

RE: Raingarden at Milford Elementary School

Dear Principal Green,

The Pretty Lake Conservation Club (PLCC) is undertaking a feasibility study to reduce sediment and nutrient loading to the lake. The feasibility study looks at areas within the lake and watershed where erosion, sediment, and nutrient problems are occurring and develops solutions that are feasible from a technical standpoint and from a landowner cooperation standpoint. During an initial tour of Pretty Lake watershed, an area located on the Milford School grounds was identified as a possible project area for a raingarden. Below is the project description with supporting maps and figures on the attached pages. For the PLCC to move forward with the project, they need your written approval that the conceptual design is potentially feasible on the school property, if funds became available.

The conceptual design is to construct a raingarden at the base of the hill on the northwestern portion of the school grounds that captures the stormwater from the 8-inch tile that drains the school's roofshed (Figures 1 and 2). A raingarden is a shallow basin that captures and temporarily stores stormwater (Figure 3). The raingarden is planted with native plants that have extensive root systems that can increase stormwater infiltration and filter sediment and nutrients in the stormwater. The proposed raingarden is approximately 1,900 square feet with a maximum depth of 9 to 12 inches. It will capture up to a 1 inch rain event from the roofshed of the school and from water draining directly into the basin (Figure 4). The raingarden will be connected to the 8-inch drainage tile through the installation of a vegetated swale, which is essentially a drainage channel planted with species that can handle flowing water. Excess stormwater will exit through an emergency outlet in the basin and drain into storm drain located adjacent to the road. The soils at the location of the proposed raingarden are excellent for this type of stormwater feature. After most rain events, water will remain ponded for a maximum of 24 hours before it infiltrates into the ground.

Maintenance required for the raingarden includes weeding, mulching, and an annual weedwhacking or mowing. The first two years after the raingarden is constructed will require the most maintenance while the plants grow and become established. In the long term, the maintenance

time and cost is less than or equal to the amount of resources required for turf maintenance.

Besides providing water quality benefits to Pretty Lake, the raingarden could be used as an educational tool for teaching school children native plants, conservation, and basic biological principles. Students can participate in the planting and maintenance of the raingarden. There are some excellent resources available that can be provided to teachers to develop learning exercises.

For the project to continue into the design phase, the PLCC needs your written signature stating that you understand and agree with the conceptual idea of the project. At this point, your signature demonstrates your willingness to consider the project and to move forward with turning a conceptual idea into a detail design that can be later constructed, if funds become available.

The PLCC would be responsible for all costs associated with the design and construction of this project including site preparation, construction, and clean-up. By signing this letter, you indicate that you are not opposed to the PLCC proceeding with the design work. Before and during the design phase, your input into the design will be considered. We will contact you to let you know when we have received funding for the design project and the proposed project timeline.

Please sign below and return in the stamped envelope. Enclosed is a copy for your records. If you have questions before signing, please contact me and I would be happy to answer any questions you may have about the proposed idea or the feasibility/design/construction process. Questions about the Pretty Lake Conservation Club and their work to improve the water quality of Pretty Lake can be directed to Jim Mertz (260-351-3404).

Thank you,

Mark Pranckus

I agree with the proposed conceptual design as it has been explained to me by the Pretty Lake Conservation Club (PLCC) and their representatives, JFNew and by the documentation they have provided. I agree that the conceptual design is feasible to me, will result in no cost to me, and the PLCC shall proceed to develop detailed plans to construct this project.

_____ (signed) _____(date)

_____(printed)

Comments:

Figure 1. Location of proposed raingarden at Milford Elementary School

Figure 2. Ground level view of raingarden of proposed raingarden at Milford Elementary School.

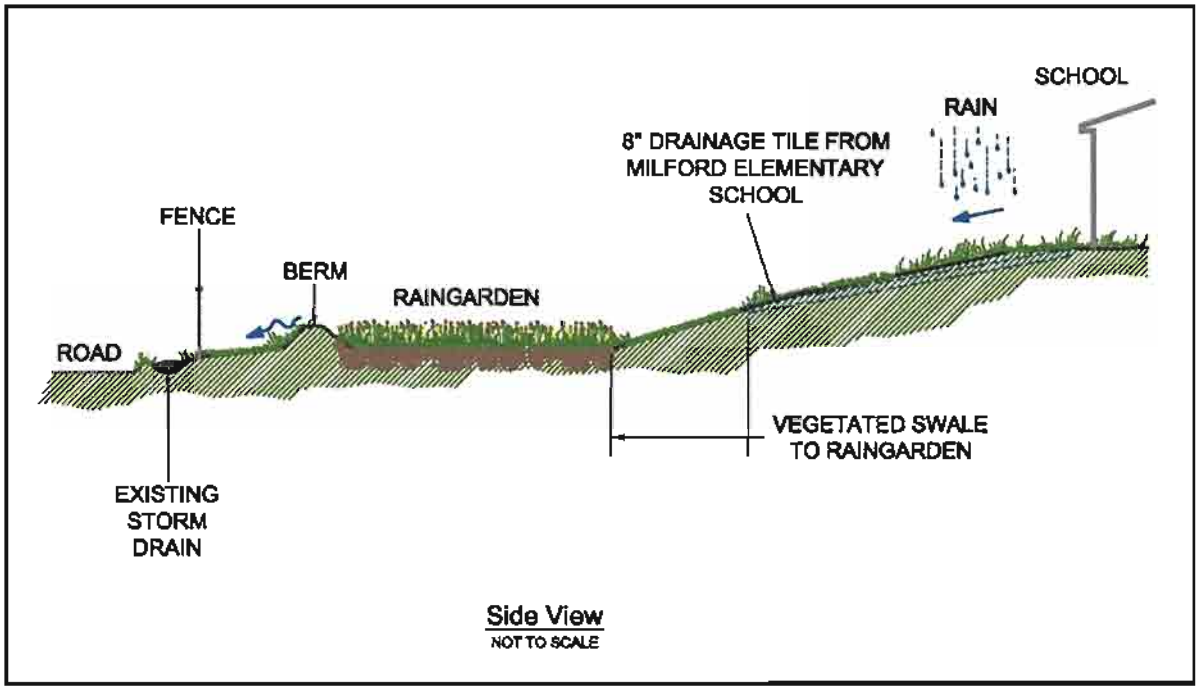

Figure 3. Typical raingarden garden conceptual design.

Figure 4. Approximate size of raingarden and contributing watershed.

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Native Plant Nursery:
Walkerton, Indiana

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August 5, 2008

Jeff Brill
LaGrange County Highway Department
300 E. Factory St.
LaGrange, IN 46761

Dear Jeff:

The Pretty Lake Conservation Club (PLCC) received a Lake and River Enhancement (LARE) grant from the Indiana Department of Natural Resources (IDNR) to perform a feasibility study to look for projects that reduce the amount of sediment and nutrients being deposited into the lake. The feasibility study focuses on areas around the lake and within the watershed where erosion, sediment deposition, and nutrient loading are causing problems and develop treatments that are feasible from both a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the watershed, an area within the county road easement adjacent to E 480 S, in Milford Township 36 N, Range 11E, Section 15, was identified as an area contributing to sediment and nutrient loading into the lake. The area is a small channelized drainage that flows to a catch basin which flows directly to Pretty Lake. The channel concentrates stormwater flow and is devoid of vegetation. See enclosed pictures for site photos. A follow-up visit was completed to determine potential solutions to the problem and investigate the site more thoroughly. The proceeding paragraphs outline a potential treatment to the problem. For the project to continue into the design phase, the PLCC needs your written approval. At this point, your signature is a commitment to your willingness to consider the project and to move forward with turning a conceptual idea into a detailed design that can be later constructed, if funds become available.

Site 3 Grassy Swale/ Rock Lined Channel

The conceptual design at Site 3 is to install a grassy swale/rock lined channel complex to reduce where erosion and sediment deposition are occurring. The current channel would be widened to disperse flow evenly across a flat bottomed channel, seeded with native grasses and lined with rock up and downstream of the bend where the channel gradient is increased. Grassy swales are effective at increasing channel stability and capturing sediments and nutrients at lesser grades, while rock-lined channels are required at steeper grades. The combination of the two treatments will increase channel stability, reduce erosion and slowdown water movement, which allows sediments and nutrients time to settle.

The PLCC would be responsible for all costs associated with the design and construction of this project including site preparation, construction, and clean-up. However, if the LaGrange County Highway Department wanted to contribute either money, materials, and/or labor to the construction of this site, the PLCC could count it towards the match requirements, if they obtained a construction grant. By signing this letter you indicate that a detailed design can occur. Before and during the design phase your input will be considered. We will contact you to let you know when we have received funding of the design project and the proposed project timeline.

Please sign below and return in the stamped envelope. Enclosed is a copy for your records. If you have questions before signing, please contact me and I would be happy to answer any questions you may have about the proposed idea or the feasibility/design/construction process. Questions about the Pretty Lake Conservation Club and their work to improve the water quality of Pretty Lake can be directed to Jim Mertz (260-351-3404).

Thank you,

Mark Pranckus

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Jeffrey L Brill (signed)

Jeffrey L. Brill (printed)

8-19-08 (date)

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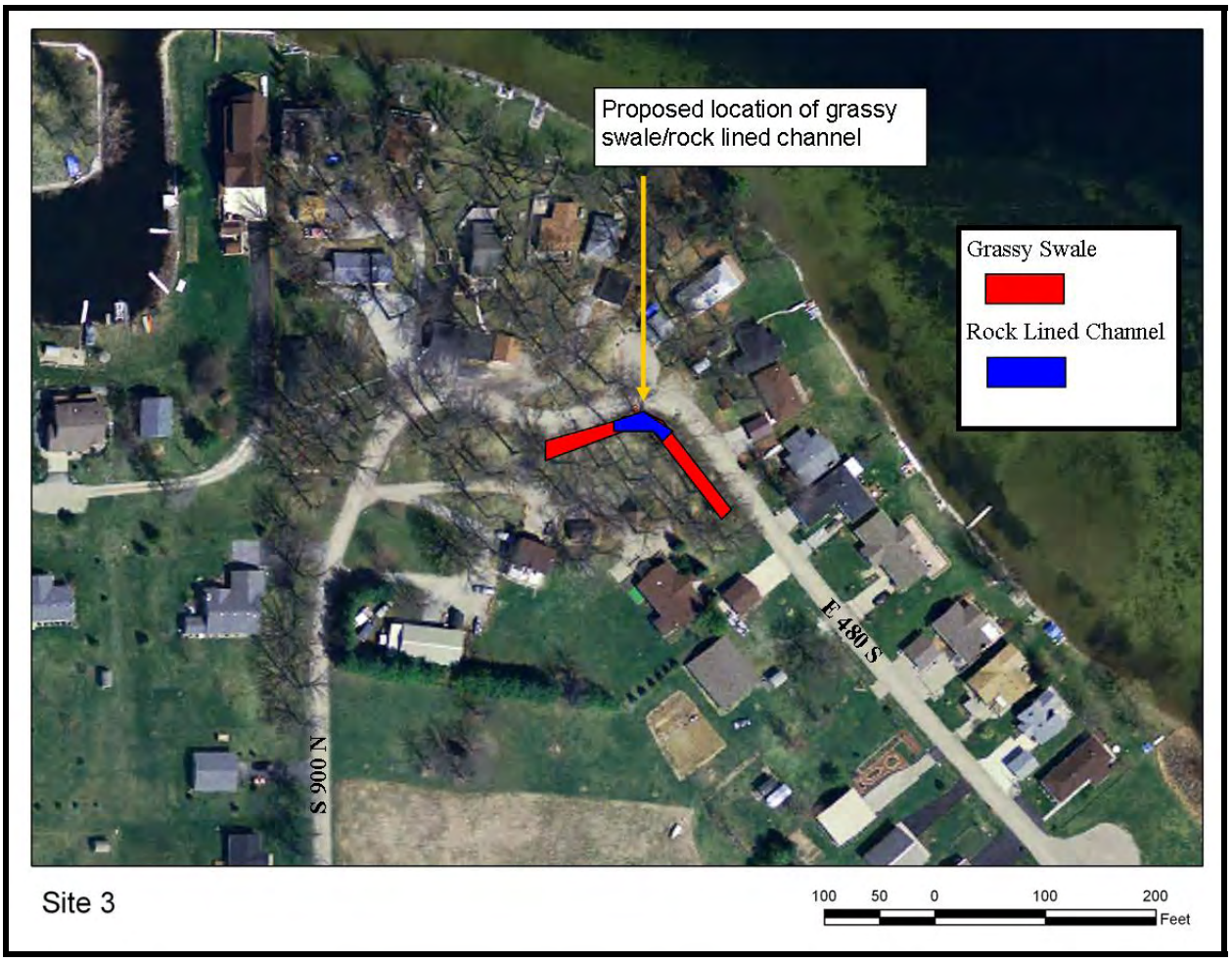

Figure 1. Proposed grassy swale and rock-lined channel at Site 3 for Pretty Lake Feasibility Study.

Figure 2. Example of the ditch channel devoid of vegetation at Site 3 for Pretty Lake Feasibility Study.

Figure 4. Proposed channel modification for grassy swale treatment at Site 3 for Pretty Lake Feasibility Study.

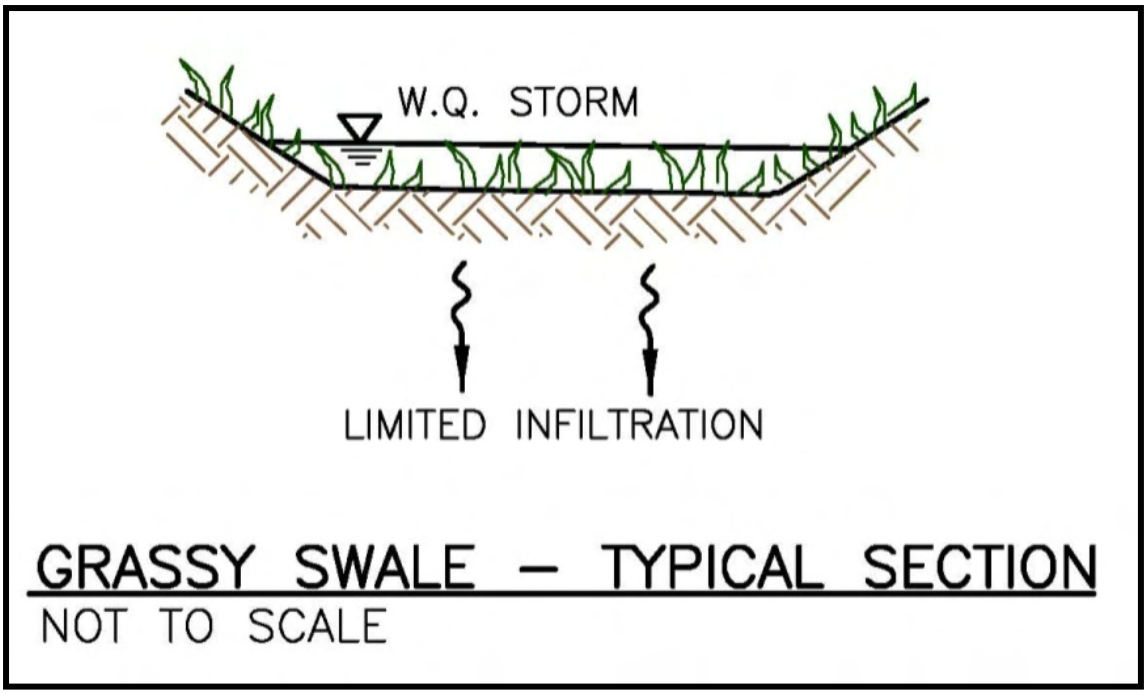

Figure 5. Conceptual drawing of a grassy swale for Site 3 for Pretty Lake Feasibility Study.

Figure 6. Example of a grassy swale.

Figure 7. Bend in channel where the rock lined channel will be utilized.

Figure 8. Example of a rock-lined channel treatment for Site 3. Note that the channel at Site 3 is not as large as the one shown above.

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Madison, Wisconsin

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August 5, 2008

Mr. and Mrs. Gross
9145 E 480 S
Wolcottville, IN 46795

Dear Mr. and Mrs. Gross:

The Pretty Lake Conservation Club (PLCC) received a Lake and River Enhancement (LARE) grant from the Indiana Department of Natural Resources (IDNR) to perform a feasibility study to look for projects that reduce the amount of sediment and nutrients being deposited into the lake. The feasibility study focuses on areas around the lake and within the watershed where erosion, sediment deposition, and nutrient loading are causing problems and develop solutions that are feasible from both a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the watershed, an area on your property was identified as an area contributing to sediment and nutrient loading into the lake. The area is a small channelized drainage that flows to a catch basin, which flows directly to Pretty Lake. The channel concentrates stormwater flow and is dominated by turf grass. See enclosed pictures for site photos. A follow up visit was completed to determine potential solutions to the problem and investigate the site more thoroughly. The proceeding paragraphs outline a potential treatment to the problem. For the project to continue into the design phase, the PLCC needs your written approval. At this point, your signature is a commitment to your willingness to consider the project and to move forward with turning a conceptual idea into a detailed design that can be later constructed, if funds become available.

Construct a Grassy Swale at Site 4

The conceptual design at Site 4 is to construct a grassy swale to control erosion, thereby reducing the amount of sediment and nutrients entering the lake. The current channel, while vegetated, is comprised mainly of turf grass and the function of the swale could be improved by seeded the channel with native grasses which provide greater channel stability due to their extensive root systems. Additionally, the channel would be widened to disperse the flow more evenly along a flat bottom channel providing additional channel stability. A grassy swale composed of native plants would increase channel stability, reducing erosion and slowdown water movement allowing sediments and nutrients time to settle.

The PLCC would be responsible for all costs associated with the design and construction of this project including site preparation, construction, and clean-up. By signing this letter you indicate that a

detailed design can occur. Before and during the design phase your input will be considered. We will contact you to let you know when we have received funding of the design project and the proposed project timeline.

Please sign below and return in the stamped envelope. Enclosed is a copy for your records. If you have questions before signing, please contact me and I will be happy to answer any questions you may have about he proposed idea or the feasibility/design/construction process. Questions about the Pretty Lake Conservation Club and their work to improve the water quality of Pretty Lake can be directed to Jim Mertz (260-351-3404).

Thank you,

Mark Pranckus

I agree with the proposed conceptual design as it has been explained to me by the Pretty Lake Conservation Club (PLCC) and their representatives, JFNew and by the documentation they have provided. I agree that the conceptual design is feasible to me, will result in no cost to me, and the PLCC shall proceed to develop detailed plans to construct this project.

Gene & Beth Gross (signed)

GENE & BETH GROSS (printed)

August 14, 2008 (date)

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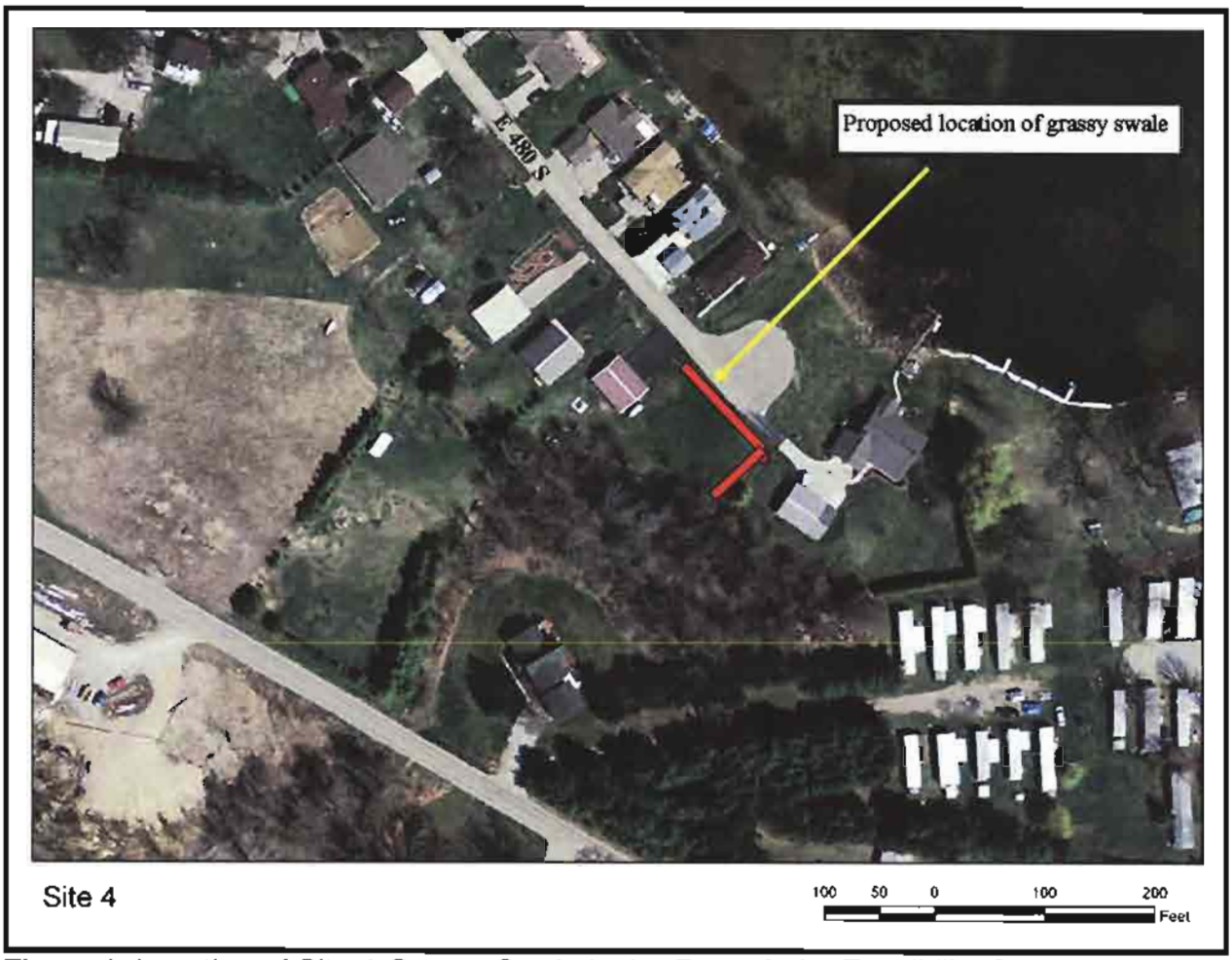

Figure 1. Location of Site 4-Grassy Swale in the Pretty Lake Feasibility Study.

Figure 2. Example at Site 4 of the narrow channel dominated by turf grass.

Figure 3. Proposed channel modification at Site 4 for Pretty Lake Feasibility Study.

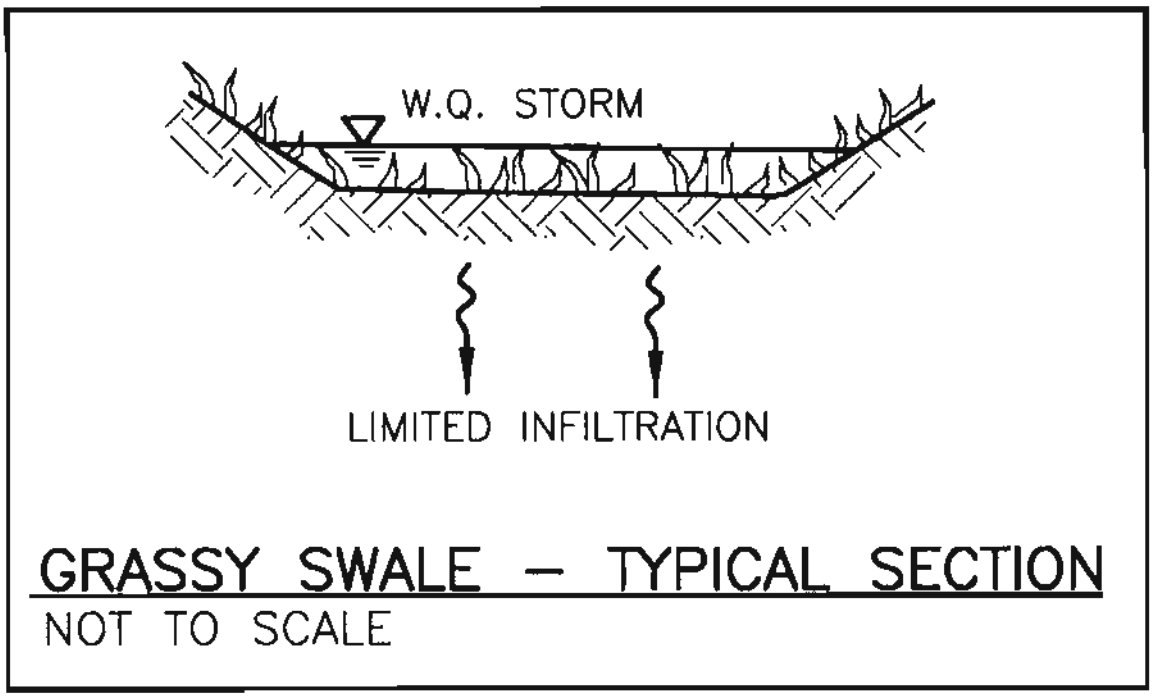

Figure 4. Conceptual drawing of a grassy swale for Site 4.

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Mark Pranckus

Aquatic Biologist

mpranckus@jfnew.com
Mobile: 574-229-8723

May 26, 2008

RD Wolheter
5405 S. State Road 3
Wolcottville, IN 46795

RE: Pretty Lake Feasibility Study

Dear RD:

The Pretty Lake Conservation Club (PLCC) is undertaking a feasibility study to reduce sediments and nutrient loading to the lake. The feasibility study looks at areas within the lake and watershed where erosion, sediment, and nutrient problems are occurring and develops solutions that are feasible from a technical standpoint and from a landowner cooperation standpoint. During an initial tour of Pretty Lake watershed, an area on property that you rent was identified as a potential location for a sediment reduction project. Jim Mertz from the PLCC contacted you for your permission for JFNew and PLCC to develop a conceptual design for the site. Enclosed with this letter is a project description and supporting figures. A copy of this letter has also been sent to Al and Jo Hutson for their review.

For the project to continue into the design phase, the PLCC needs the written signature of the landowner of the property that you rent stating that they understand and agree with the conceptual idea of the project. At this point, their signature is a commitment of their willingness to consider the project and to move forward with turning a conceptual idea into a detailed design that can be later constructed, if funds become available.

It is our understanding that your landlord lives in southern Indiana and may not be easily reached for their permission. We also assume that they would consult with you before agreeing to any conceptual design. Therefore, we are asking for your guidance on how to continue with either contacting your landlord or obtaining their permission to continue with the conceptual design and eventually construction, if funds become available.

The PLCC would be responsible for all costs associated with the design and construction of this project including site preparation, construction, and clean-up. By signing the letter, they indicate that a detailed design can occur. Before and during the design phase, their input or, your input with their permission, into the design will be considered. We will contact them and you to let you know when we have received funding for the design project and the proposed project timeline.

We have included you in the chain of correspondence because you farm their property and the project has a direct impact on you. If you have any questions, please contact me or Jim Mertz. We will be happy to answer any questions you may have about the proposed idea or the feasibility/design/construction process. We look forward to working with you on this project.

Thank you,

Mark Pranckus

I agree with the proposed conceptual design as it has been explained to me by the Pretty Lake Conservation Club (PLCC) and/or their representative, JFNew, and by the documentation they have provided. I agree that the conceptual design is feasible to me and that the PLCC shall proceed to develop detailed plans to construct this project. I grant access to the site to allow for proper design of this project.

R D Wolheter (signed) 6-28-08 Date

R D WOLHETER (printed)

JFNew
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Mark Pranckus

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www.jfnew.com

October 7, 2008

Dear Mrs. Goodpasteur:

RE: Pretty Lake Feasibility Study

The Pretty Lake Conservation Club (PLCC) is undertaking a feasibility study to reduce sediments and nutrient loading to the lake. The feasibility study looks at areas within the lake and watershed where erosion, sediment, and nutrient problems are occurring and develops solutions that are feasible from a technical standpoint and from a landowner cooperation standpoint. During an initial tour of Pretty Lake watershed, an area on your property was identified as a potential location for a sediment reduction project. Enclosed with this letter is a project description and supporting figures. Copies of this letter have also been sent to Al and Jo Hutson and RD Wolheter for their review.

For the project to continue into the design phase, the PLCC needs your written signature stating that you understand and agree with the conceptual idea of the project. At this point, your signature is a commitment to your willingness to consider the project and to move forward with turning a conceptual idea into a detail design that can be later constructed if funds become available.

The PLCC would be responsible for all costs associated with the design and construction of this project including site preparation, construction, and clean-up. By signing this letter, you indicate that a detailed design can occur. Before and during the design phase, your input into the design will be considered. We will contact you to let you know when we have received funding for the design project and the proposed project timeline.

Please sign below and return in the stamped envelope. Enclosed is a copy for your records. If you have any questions before signing, please contact me or Jim Mertz. We will be happy to answer any questions you may have about the proposed idea or the feasibility/design/construction process.

Thank you,

Mark Pranckus

I agree with the proposed conceptual design as it has been explained to me by the Pretty Lake Conservation Club (PLCC) and/or their representative, JFNew, and by the documentation they have provided. I agree that the conceptual design is feasible to me and that the PLCC shall proceed to develop detailed plans to construct this project. I grant access to the site to allow for proper design of this project.

Wanda J. Troyer, PoA (signed) 1-2-09
Date

WANDA J. Troyer PoA (printed)

HAZEL M. GOODPASTER

Plans may proceed, but this signed paper does not give authorized access to our property at this time.
No trees may be disturbed if the project proceeds.

~~I agree with the proposed conceptual design as it has been explained to me by the Pretty Lake Conservation Club (PLCC) and/or their representative, JFNew, and by the documentation they have provided. I agree that the conceptual design is feasible to me and that the PLCC shall proceed to develop detailed plans to construct this project. I grant access to the site to allow for proper design of this project.~~

Al Hutson

Jo Hutson (signed)

Dec 20, 2008
Date

AL HUTSON (printed)

Jo Hutson

Site 5 – Sediment Control Basin Project Description

Project Description

Site 5 is located along the west side of South 890 East at the property rented by RD Wolheter (Figure 1). The proposed project includes creation of a berm parallel to the road to capture stormwater and release it through a drain tile directly to the lake. The berm will measure approximately two feet high and is designed to capture rainfall from a 25-year return frequency storm event. Water will back up over approximately 0.3 acres (Figure 2) and be release through the drain tile and groundwater infiltration over a 24-hour period. This will allow for sediment to settle out of the water column before entering the lake while limiting water ponded periods so as not to kill the existing grass or other vegetation. The drainage tile will be installed below the grade of the road, through the residential lawn and driveway, and empty directly into the lake. To construct the berm, material from the basin will be excavated and used as fill material. The basin and the berm will be planted with either a mix of cool season grasses that can be hayed periodically during dry periods or native plants and grasses.

The tile through the road will require a road cut. Additionally, to install the tile to the lake, there will need to be a temporary disturbance to the lawn and driveway of Al and Jo Hutson. After the tile is installed, the road will be repaired according to LaGrange County specifications. The lawn and driveway will be repaired to near their previous conditions as possible.

This project will benefit Pretty Lake by capturing stormwater and allowing sediments to settle out of the water column, reducing storm volume and velocity and plants to uptake nutrients.

Figure 1. Location of Site 5 – Sediment control basin.

Figure 2. Overview of Site 5 – Sediment Control Basin.

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Madison, Wisconsin

Native Plant Nursery:
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August 6, 2008

Dennis and Judy Frehse
4295 S 895 E
Wolcottville, IN 46795

Dear Dennis and Judy:

The Pretty Lake Conservation Club (PLCC) received a Lake and River Enhancement (LARE) grant from the Indiana Department of Natural Resources (IDNR) to perform a feasibility study to look for projects that reduce the amount of sediment and nutrients being deposited into the lake. The feasibility study focuses on areas around the lake and within the watershed where erosion, sediment deposition, and nutrient loading are causing problems and develop solutions that are feasible from both a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the watershed, an area on your property was identified as an area contributing to sediment and nutrient loading into the lake. The area is a small channelized drainage that has formed due to a broken tile, which flows to a catch basin and then directly to Pretty Lake. See enclosed pictures for site photos. A follow-up visit was completed to determine potential treatments to the problem and investigate the site more thoroughly. The proceeding paragraphs outline a potential treatment to the problem. For the project to continue into the design phase, the PLCC needs your written approval. At this point, your signature is a commitment to your willingness to consider the project and to move forward with turning a conceptual idea into a detailed design that can be later constructed, if funds become available.

Site 6 Replace Tile and Catch Basin Relocation

The conceptual design at Site 6 is to replace the broken tile line with a new one of equal diameter and run the new tile line adjacent to the path of the existing channel, which would be filled in during construction. The new tile line would empty into a catch basin and then into Pretty Lake. The location of the current catch basin will be move slightly to the east and the size of the catch basin will be increased. The outlet for the catch basin will utilize the existing tile line that drains the current catch basin. Moving the catch basin to the east will allow for easier maintenance and greater filtration of stormwater and sediments from the road before it enters Pretty Lake. Replacing the broken tile will decrease the amount of sediment and nutrients entering the lake from the channel, which has formed as a result of the tile blowout.

The PLCC would be responsible for all costs associated with the design and construction of this project including site preparation,

construction, and clean-up. By signing this letter you indicate that a detailed design can occur. Before and during the design phase your input will be considered. We will contact you to let you know when we have received funding of the design project and the proposed project timeline.

Please sign below and return in the stamped envelope. Enclosed is a copy for your records. If you have questions before signing, please contact me and I would be happy to answer any questions you may have about the proposed idea or the feasibility/design/construction process. Questions about the Pretty Lake Conservation Club and their work to improve the water quality of Pretty Lake can be directed to Jim Mertz (260-351-3404).

Thank you,

Mark Pranckus

I agree with the proposed conceptual design as it has been explained to me by the Pretty Lake Conservation Club (PLCC) and their representatives, JFNew and by the documentation they have provided. I agree that the conceptual design is feasible to me, will result in no cost to me, and the PLCC shall proceed to develop detailed plans to construct this project.

Dennis Frehse (signed)

DENNIS FREHSE (printed)

1/5/08 (date)

I NEED TO TALK TO SOMEONE ABOUT THIS. THERE ARE other tiles that empty into the existing CATCH BASIN. It would be NICE to meet SOMEONE OUT HERE TO TALK THIS out.

JFNew
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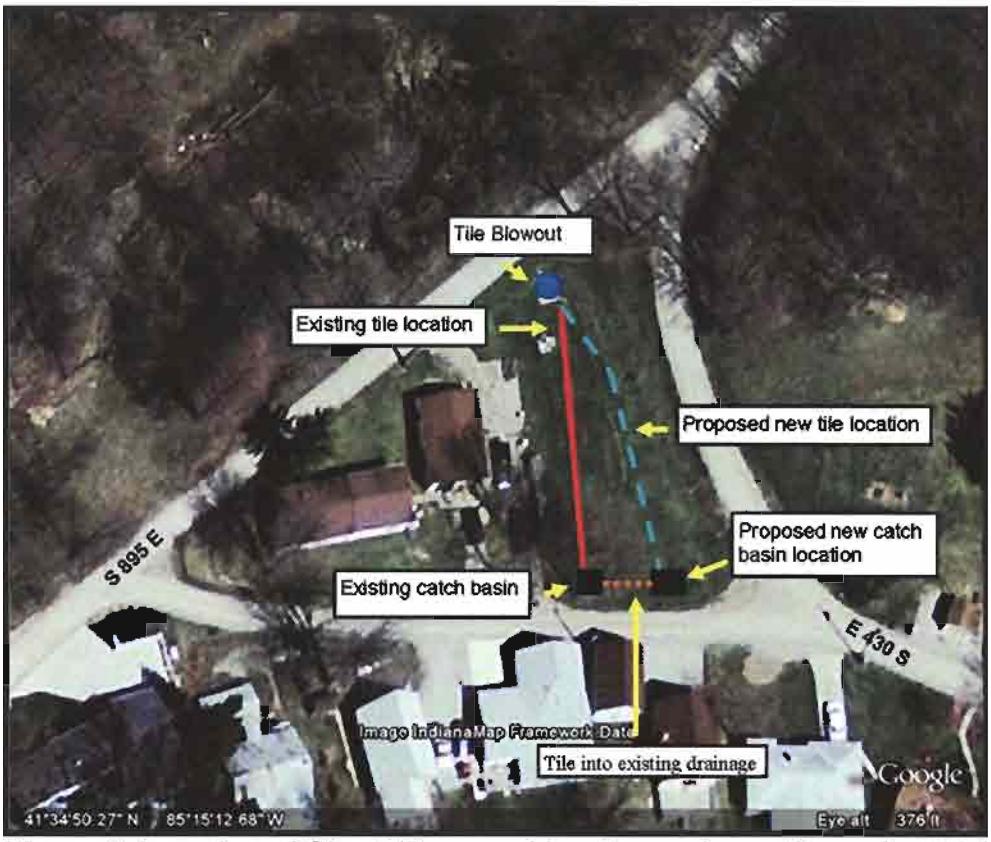

Figure 4. Location of Site 6-Proposed locations of new tile and catch basin at Site 6.

Figure 2. Example of the tile blowout at Site 6.

Figure 3. Example of channel that has formed as a result of the tile blowout at Site 6.

708 Roosevelt Rd
Walkerton, Indiana 46574
Phone: 574-586-3400
Fax: 574-586-3446

Mark Pranckus
Aquatic Biologist
mpranckus@jfnew.com
Mobile: 574-229-8723

December 30, 2008

Rex Pranger
LaGrange County Surveyor
114 W Michigan Street
County Office Building 2nd Floor
LaGrange, Indiana 46761

Dear Rex,

The Pretty Lake Conservation Club (PLCC) in LaGrange County, Indiana is completing an Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) Program-funded feasibility study to improve water quality in Pretty Lake. JFNew was contracted by the PLCC to complete the study. Deal Ditch, which drains into Pretty Lake on the north end, is an area of focus for water quality improvement projects. Specifically, the area of Deal Ditch from S 875 E to E 430 S. Along that length of Deal Ditch, we have designated two project areas, the section of Deal Ditch north of E 400 S to S 875 E (Site 7) and from E 400 S to E 430 S (Site 8). After a physical evaluation of both sites and a discussion on possible water quality improvement project options, a list of conceptual construction projects has been developed. The PLCC and JFNew are requesting your input on the suggested improvement projects in developing the feasibility report. Specifically, we would appreciate your input on which treatment types you and the Drainage Board would support and any associated comments. Enclosed is a description of the project areas and the potential treatment types for those areas.

Please review and provide your comments about the projects to be included in the final draft of the feasibility study. Comments may be submitted directly to me at the address provided on the left hand side of the letter or via email at mpranckus@jfnew.com. We would appreciate your comments by January 16, 2009.

Best regards,

Mark Pranckus
Project Manager

CC: Jim Mertz, PLCC
JFN File No. 050919.03

Project Locations

Both projects are located within the Pretty Lake Watershed in LaGrange County, Indiana (Figure 1).

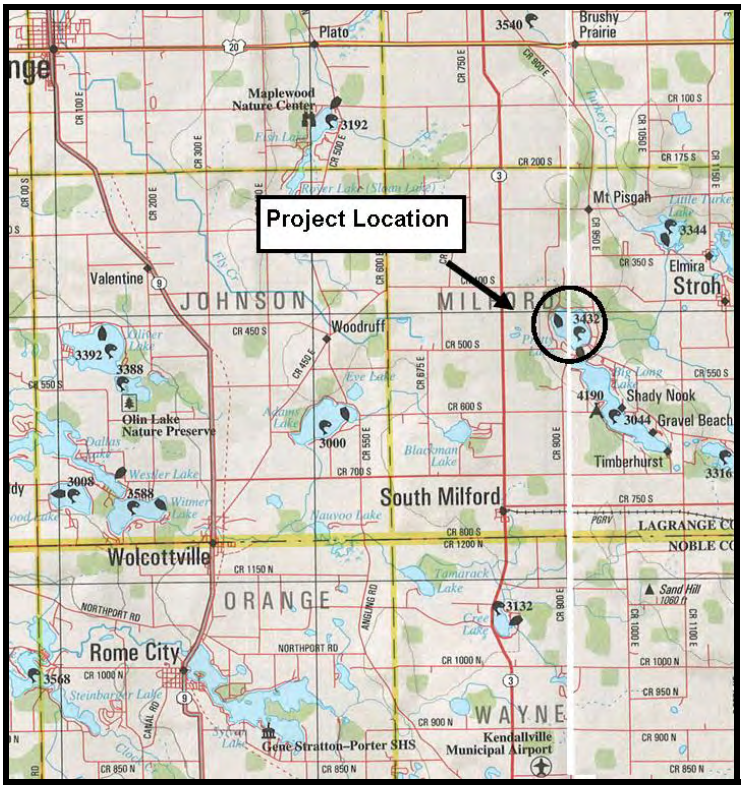

Figure 1. General view of project area.

Site 7-Two-stage ditch

The recommended water quality improvement project for Site 7 is to construct a two-stage channel (Figure 2) for approximately 550 ft (Priority Area 1) with a low flow channel width of approximately 14 ft (the existing channel width) and a bench width of 43 ft (Figure 3). To achieve a 3:1 slope on the second stage banks, the overall width would be approximately 65 ft. A two-stage ditch is recommended because the current channel is characterized by moderately unstable banks, an unstable channel bed, and several feet of accumulated sediment within the channel. A two-stage ditch will improve the quality of the drainage by increasing bank stability, transport sediment, increase assimilation of nutrients in the floodplain, and improve in-stream habitat during periods of low flow. A two-stage ditch allows periods of high flow to access a floodplain, settling sediments and nutrients out of the water column. During periods of low flow, deposition in the main channel will be reduced because a narrower, deeper channel increases sediment conveyance, which could reduce the frequency of ditch maintenance.

A second recommendation would be to construct a two-stage ditch along the entire length of Deal Ditch at Site 7 (Figure 2). The estimated total amount of excavated material for the construction of Priority Area 1 would be approximately 2,200 cubic yards. If the entire length of Site 7 is constructed with a two-stage ditch then a total of approximately 6,600 cubic yards would be required to be excavated. Grasses and erosion control fabric would be used to re-vegetate and control erosion from newly

exposed soils on the bench and second channel banks following construction. Areas that are currently being hayed would be replanted to a hay crop.

Site 7 – Alternative Treatment

An alternative treatment to the two-stage ditch at Site 7 is to remove the trees along the ditch, primarily on the north side, throughout Priority Area 1 (Figure 2). Additionally, approximately 1 to 3 ft of sediment would be removed from the channel bottom in Priority Area 1. During the sampling for the 2006 diagnostic study, Deal Ditch had *E. coli* levels above Indiana state water quality standards. One way to treat *E. coli* is to increase sunlight exposure to the water and remove sediments that might be contributing to the *E. coli* loads.

Notes on the Site 7 Conceptual Design

- To minimize impacts to NWI wetlands, 75% of the bench is on the south side of the ditch until it reaches CR E 400 S where 75% of the bench is on the north side (Figure 2).
- All spoils excavated from the construction of the two-stage ditch would be spread on the right-of-way and on the property to the south of Deal Ditch. The PLCC and JFNew would be responsible for securing permission to spread spoils outside of the legal drainage easement.
- Trees removed during the construction would be either burned or removed to an upland site for disposal.

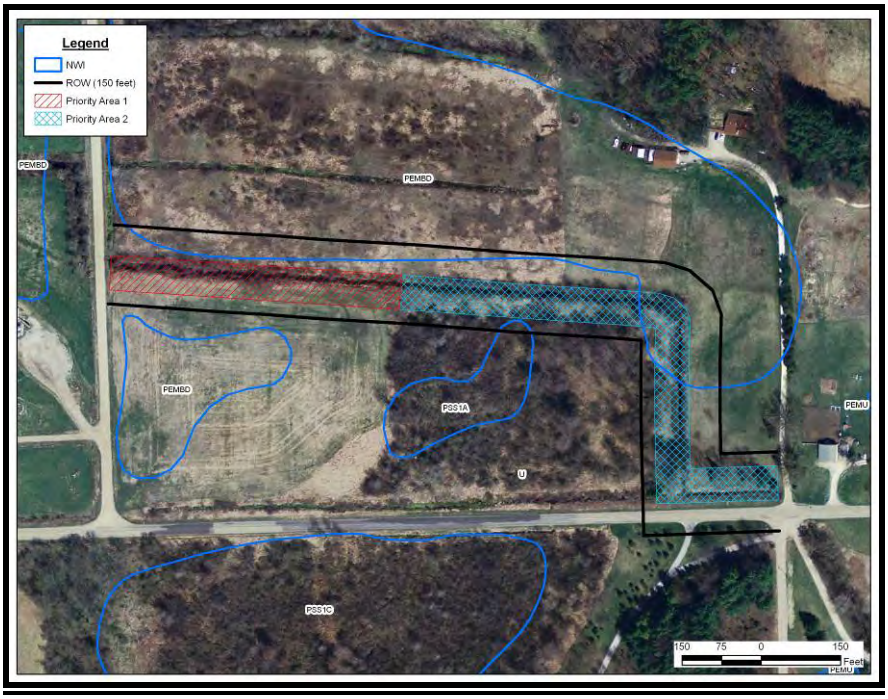

Figure 2. Proposed location of the two-stage ditch at Site 7 within the drainage easement and NWI identified wetlands.

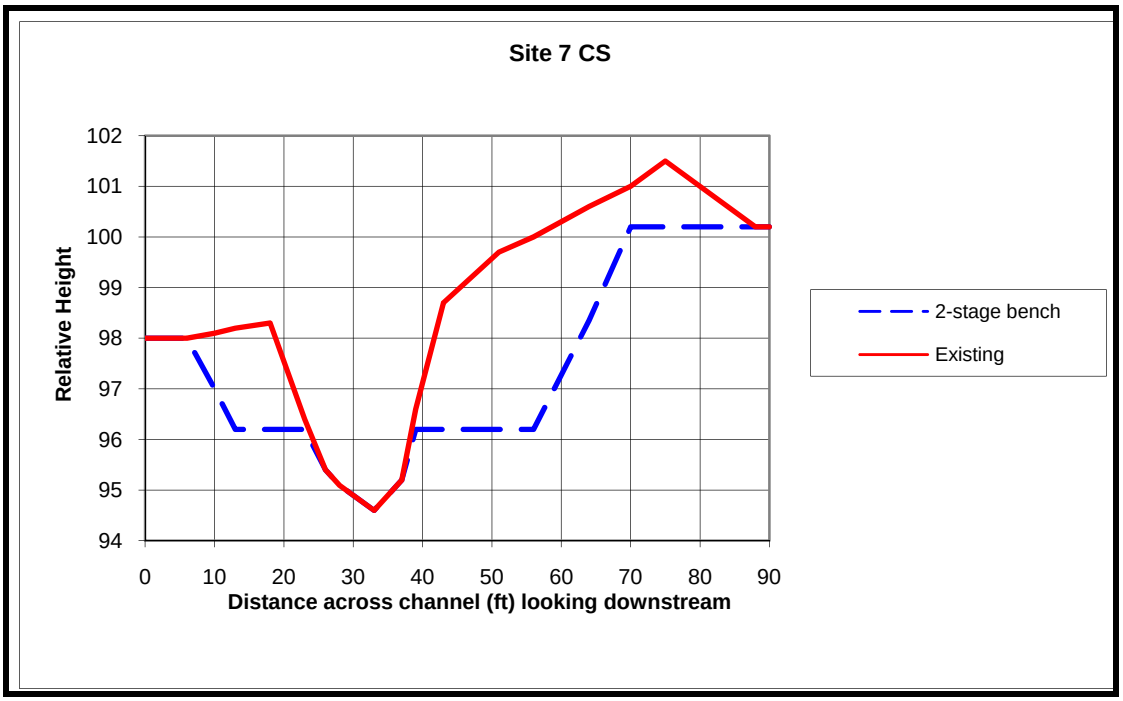

Figure 3. Proposed channel modification for the construction of a two-stage ditch at Site 7. The channel shown here does not include sediment deposited in the stream bed.

Site 8

Deal Ditch enters into the north end of Pretty Lake (Figure 4). The channel is approximately 8 feet wide with an average water depth of less than 1 foot with streambanks that are roughly 8 feet high. Deal Ditch runs through a forested/shrub wetland identified by the NWI in the middle of the project area (Figure 4). Erosion is occurring along the streambanks (Figure 5) and the current channel offers little high flow access to a floodplain. A set of treatment options were investigated and developed for Site 8 and include rock grade controls, the construction of a two-stage ditch, armoring of stream banks, creation of a bench within the existing channel, and increasing the amount of sunlight to the streambanks. The goal of these different projects is to increase streambank and bed stability and reduce erosion.

Figure 4. Site 8 with station line, potential flooding areas, and NWI wetland identified.

Figure 5. Example of erosion occurring on the left downstream bank at Site 8.

Rock Grade Controls

The initial focus at Site 8 was to create a series of rock grade controls within the channel to reduce stream velocity and allow for greater access to the floodplain, thereby decreasing erosion and allowing sediments and associated nutrients time to settle out of the water column. After a physical survey including four cross-sectional profiles and a longitudinal profile, it has been determined this technique may not be a beneficial treatment option. An overall bed slope of 0.36% was determined from the longitudinal profile, which suggests the stream grade is not contributing to bed instability. Additionally, some areas along the reach were identified as potential flood prone areas because the banks are considerably lower than in some areas and could be undesirable for landowners in those areas (Figure 4).

Two-Stage Ditch

Another treatment option suggested for Site 8 is to construct a two-stage ditch. The goals of the two-stage ditch are the similar as those listed earlier for Site 7. The approximate width of the bench would be 30 to 33 feet. Once a 3:1 slope is applied to the second stage banks the overall width of the ditch will be approximately 60 feet (Figure 7). Native grasses will be used to re-vegetate the bench and second stage banks and erosion control blanketing will be installed following construction to reduce erosion. The amount of material to be excavated from the construction of a two-stage ditch at Site 8 would be 12,500 cubic yards. All spoils excavated from the construction of the two-stage ditch would be spread on the drainage easement and adjacent property. As with Site 7, the PLCC and JFNew would be responsible for acquiring permission to use the adjacent properties.

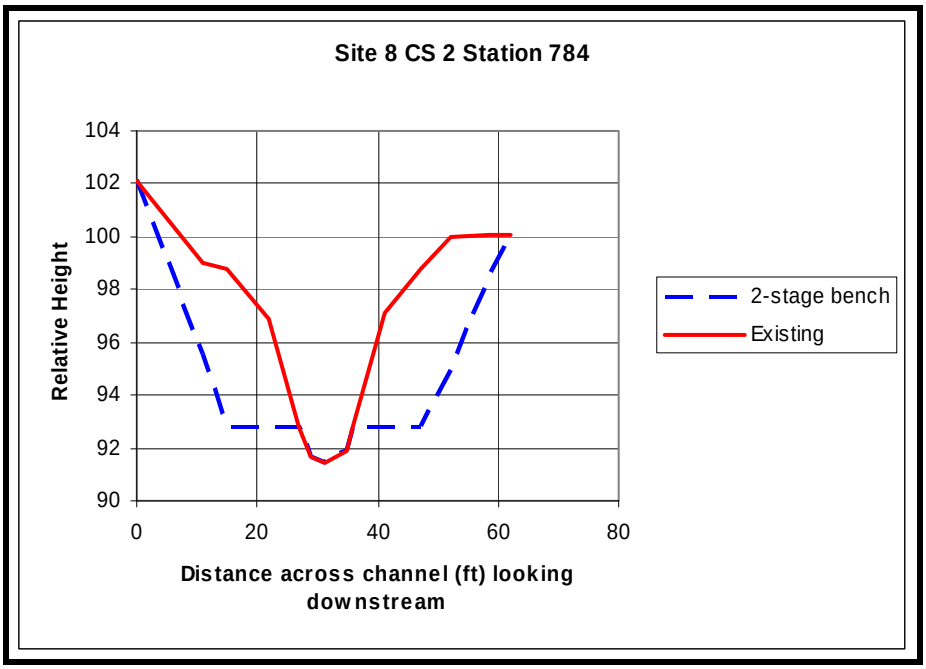

Figure 6. Site 8 cross-section 2 located at Station 784.

Creation of a Bench within the Channel

A hybrid alternative to creating a two-stage channel through Site 8 would be to create a bench within the existing channel by installing stone, coir logs, or other material to narrow the width of the low flow channel. This narrower low flow channel would convey base flows and more effectively carry sediment through the channel. During a storm event, the stream would flow across the bench depositing sediments and nutrients. The existing grade of the stream would not be modified.

Increased Sunlight to Streambanks

Deal Ditch runs through a forested area at Site 8. Because of this, the amount of sunlight that is transmitted to the forest floor is minimal in most areas (Figure 7) and may be limiting the amount of vegetated cover on the stream banks. Increasing the sunlight to the streambanks by removing trees along the length of Deal Ditch is suggested as method to increase the amount of vegetation on the stream banks. The goal for increasing the amount of grass cover on the stream banks is to increase bank stability and decrease the erosive potential of high flow. Decreasing the erosive potential of the stream banks would help reduce the amount of sediment and nutrients entering the stream that eventually reach Pretty Lake. An additional benefit from increased sunlight to the stream could be a reduction in *E. coli* concentrations, as UV light is known to kill *E. coli*.

This treatment type along Deal Ditch at Site 8 could take place along the entire length of the site or only in specific areas. The number of trees that would need to be removed for this project is not known at this time. The amount of trees that would need to be removed may affect whether spot cutting or clear cutting would be utilized. The stumps of cut trees would remain to aid in bank stability. Trees would either be taken off-site to a predetermined location or burned at a predetermined location.

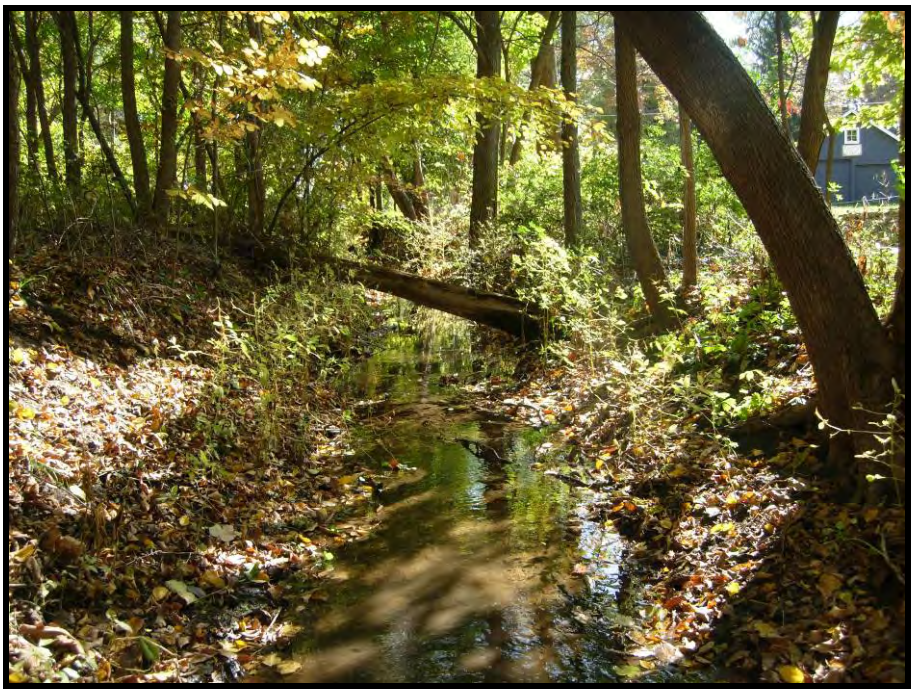
Figure 7. Example of an area within Site 8 that could use increased sunlight.

Armoring of Banks
An alternative treatment to reduce streambank erosion would be to armor highly eroding sections of Deal Ditch with stone or equivalent erosion control material. This treatment would require minimum tree disturbance and not significantly change the current conveyance capacity of the stream. This treatment is less preferred because it has a high cost to benefit ratio. There is a significant amount of streambank that would require armoring to have the desired effect of protecting and improving the water quality of Deal Ditch.

Permit Requirements
Several of the project types at both Sites 7 and 8 would require regulatory permits such as Indiana Department of Environmental Management (IDEM) 401 Water Quality Certification, Indiana Department of Natural Resources (IDNR) Construction in a Floodway Permit, and a U.S. Army Corps of Engineers (ACOE) 404 Permit. The PLCC would be responsible for applying for and acquiring the permits to complete the projects; however, the PLCC may request that the LaGrange County Drainage Board use the IDNR 368 Review Process to facilitate the permitting process. At a minimum, the PLCC would request a letter supporting the projects because they involve legal drains.

Requested Information
The PLCC and JFNew requests written comments regarding your opinions on the feasibility of accomplishing one or more of the projects described above. Please use the following pages to indicate which techniques are acceptable and which techniques are the preferred choices of the LaGrange County Drainage Board. Your feedback will be included in the feasibility study report under the analysis of Sites 7 and 8.

Pretty Lake Feasibility Study Site 7
LaGrange County Surveyor and Drainage Board Comments

- Please use the following to provide comments on which projects you and the drainage board would support or not support and any comments associated about the projects.

Site 7

Option 1: Two-stage ditch
Support (X) Potential ( ) Do not support ( )

Comments:
LANDOWNERS SHOULD BE CONSULTED AND APPROVE THE USE ON THEIR LAND.

Option 2: Tree removal and ditch cleanout
Support (X) Potential ( ) Do not support ( )

Comments:
No CONCERNS

-Additional Comments-
LAGRANGE COUNTY DRAINAGE BOARD AND SURVEYOR MUST REVIEW & APPROVE FINAL PLANS

Rex R Pranger (signed)
REX R PRANGER (printed)

1-6-09 Date

Pretty Lake Feasibility Study Site 8
LaGrange County Surveyor and Drainage Board Comments

- Please use the following to provide comments on which projects you and the drainage board would support or not support and any comments associated about the projects.

Site 8

Option 1: Rock grade controls
Support ( ) Potential ( ) Do not support (X)

Comments:
ROCK GRADE CONTROLS MAY RAISE WATER LEVELS IN THE DITCH AND BE AN OBSTRUCTION TO THE DRAIN.

Option 2: Two Stage Ditch
Support (X) Potential ( ) Do not support ( )

Comments:
LANDOWNER APPROVAL SHOULD ALSO BE OBTAINED

Option 3: Creation of bench within the channel
Support (X) Potential ( ) Do not support ( )

Comments:
NO CONCERNS AS LONG AS LOW FLOW LEVELS ARE NOT ELEVATED

Option 4: Increasing sunlight to streambanks (Tree clearing)
Support (X) Potential ( ) Do not support ( )

Comments:
NO CONCERNS WITH TREE REMOVAL. LANDOWNERS SHOULD HAVE INPUT ABOUT DISPOSAL OF THE TREES

Option 5: Armoring banks

Support (X) Potential ( ) Do not support ( )

Comments:

No Concerns as long a waterway is not restricted

-Additional Comments-

LaGrange County Surveyor and Drainage Board must review & approve Final Plans

Rex R Pranger (signed)

Rex R Pranger (printed)

1-6-09 Date

For Sites 7 and 8, only one copy of the supporting information sent to the landowner is included to reduce the size of Appendix.

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Grand Haven, Michigan

Cincinnati, Ohio

Madison, Wisconsin

Native Plant Nursery:
Walkerton, Indiana

www.jfnew.com

March 6, 2009

Tyrell Auston
9005 E 400 S
LaGrange, IN 46761

Dear: Mr. Auston

The Pretty Lake Conservation Club (PLCC) is undertaking a feasibility study to reduce sediments and nutrient loading to the lake. The feasibility study looks at areas within the lake and watershed where erosion, sediment, and nutrient problems are occurring and develops solutions that are feasible from a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the Pretty Lake watershed, Deal Ditch which is located on your property was identified as a potential location for a sediment reduction project. Enclosed with this letter is a project description and supporting figures.

Preliminary approval from the LaGrange County Drainage Board via the county surveyor has been obtained for work within the county drainage easement. At their request, they have asked that the affected landowner's approval be obtained prior to granting the drainage board's final approval.

The PLCC would be responsible for all costs associated with the design and construction of this project including site preparation, construction, and clean-up. At this point, your signature is a commitment to your willingness to consider the project and to move forward with turning a conceptual idea into a detailed design that can be later constructed if funds become available. We will contact you to let you know when we have received funding for the design project and the proposed project timeline.

Please review the information described on the following pages. If the project described is acceptable to you, please sign below and return in the stamped envelope. Enclosed is a copy for your records. If you have any questions before signing, please contact me and I will be happy to answer any questions you may have about the proposed idea or the feasibility/design/construction process. Questions about the Pretty Lake Conservation Club and their work to improve the water quality of Pretty Lake can be directed to Jim Mertz (260-351-3404).

Thank you

Mark Pranckus

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Madison, Wisconsin

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Walkerton, Indiana

www.jfnew.com

March 6, 2009

Betty Kuhn
40 Lane 275B
Turkey Lake, Hudson, IN 46747

Dear: Ms. Kuhn

The Pretty Lake Conservation Club (PLCC) is undertaking a feasibility study to reduce sediments and nutrient loading to the lake. The feasibility study looks at areas within the lake and watershed where erosion, sediment, and nutrient problems are occurring and develops solutions that are feasible from a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the Pretty Lake watershed, Deal Ditch which is located on your property was identified as a potential location for a sediment reduction project. Enclosed with this letter is a project description and supporting figures.

Preliminary approval from the LaGrange County Drainage Board via the county surveyor has been obtained for work within the county drainage easement. At their request, they have asked that the affected landowner's approval be obtained prior to granting the drainage board's final approval.

The PLCC would be responsible for all costs associated with the design and construction of this project including site preparation, construction, and clean-up. At this point, your signature is a commitment to your willingness to consider the project and to move forward with turning a conceptual idea into a detailed design that can be later constructed if funds become available. We will contact you to let you know when we have received funding for the design project and the proposed project timeline.

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Thank you

Mark Pranckus

Project Location and Description

The proposed project area is the portion of Deal Ditch east of CR S 875 E to the north side of CR E 400 S (Figure 1). The drainage is characterized by well-vegetated, moderately unstable streambanks with one to three feet of accumulated sediment within the channel. Deal Ditch is the main inlet into Pretty Lake and drains approximately 651 acres or 52.8% of the watershed. It is also a legal drain, maintained by the LaGrange County Drainage Board and supervised by the LaGrange County Surveyor. The County maintains an easement 75 feet wide from each bank that starts from the top of the bank (Figure 2).

Figure 1. Aerial view of project area.

Preliminary Design and Conceptual Drawings

The proposed water quality improvement project is to construct a two-stage ditch for approximately 550 feet (Priority Ditch 1, Figure 2). An alternative would be to construct a two-stage ditch along the entire length of Deal Ditch from CR S 875 E to CR E 400 or approximately 1585 feet (Priority Ditch 1 and Priority Ditch 2, Figure 2). A two-stage ditch is recommended because the current channel is characterized by moderately unstable banks, an unstable channel bed, and has one to three feet of accumulated sediment within the channel. The goal of the two-stage ditch will be to improve the quality of the drainage by improving bank stability, transporting, sorting, and settling of sediment, increasing assimilation of nutrients in the floodplain, and improving in-stream habitat during periods of low flow.

Figure 2. Proposed location of the two-stage ditch within the drainage easement and spoils area.

The overall width of the new channel from top of bank to top of bank will be approximately 65 feet (Figure 3). To minimize the amount of work that would need to be done within the wetland, it was decided to apply 75% of the excavation needed to achieve the desired bench and second channel width to the right downstream bank and only 25% to the left downstream bank (Figure 2). At the downstream end of the site, the left downstream bank will account for 75 % of the excavation and the right downstream bank 25 % due to the close proximity to CR E 400 S.

All spoils excavated from the construction of the two-stage ditch would be spread on the county drainage easement and on your property to the south of Deal Ditch (Figure 2). Native grasses and erosion control fabric will be used to re-vegetate and control erosion from newly exposed soils on the bench and second channel banks following construction. Native grasses are used to stabilize the bench and banks because they establish extensive root systems and assist in the uptake of nutrients and filtering of sediment. Areas that are currently being hayed would be replanted to a hay crop. On the west side of Deal Ditch in Priority Ditch 2, disturbed areas will be re-seeded to their existing vegetation.

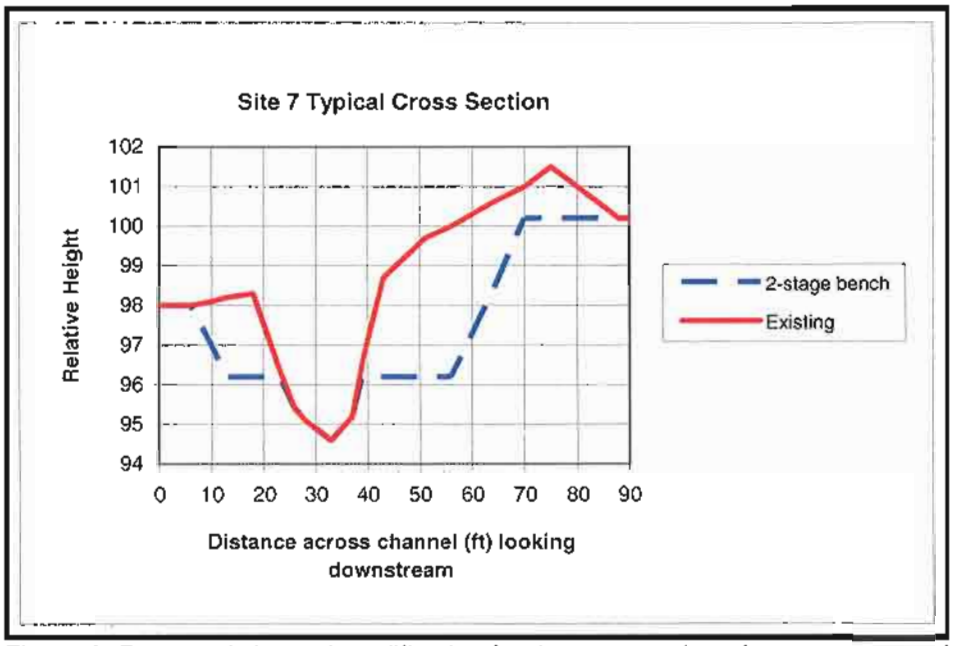

Figure 3. Proposed channel modification for the construction of a two-stage ditch. As you can see the existing ditch top of banks are at 20 feet and 43 and the newly constructed two-stage ditch top of banks are at 5 feet and 70 feet.

The County Surveyor supports this project; however, he has requested that we obtain your approval before continuing with the design. The majority of the project will occur within the county easement, but because the construction of the two-stage ditch will increase the width of the drainage channel, moving the top of the ditch banks back into your property further, the county easement (75 feet) will start at the top of the new banks. The county easement would extend south an additional 30 feet and north 15 feet from where it is currently located.

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Cincinnati, Ohio

Madison, Wisconsin

Native Plant Nursery:
Walkerton, Indiana

www.jfnew.com

March 6, 2009

Robert Atkison
9215 E 430 S
Wolcottville, IN 46795

Dear: Mr. Atkison

The Pretty Lake Conservation Club (PLCC) is undertaking a feasibility study to reduce sediments and nutrient loading to the lake. The feasibility study looks at areas within the lake and watershed where erosion, sediment, and nutrient problems are occurring and develops solutions that are feasible from a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the Pretty Lake watershed, Deal Ditch which is located on your property was identified as a potential location for a sediment reduction project. Enclosed with this letter is a project description and supporting figures.

Preliminary approval from the LaGrange County Drainage Board via the county surveyor has been obtained for work within the county drainage easement. At their request, they have asked that the affected landowner's approval be obtained prior to granting the drainage board's final approval.

The PLCC would be responsible for all costs associated with the design and construction of this project including site preparation, construction, and clean-up. At this point, your signature is a commitment to your willingness to consider the project and to move forward with turning a conceptual idea into a detailed design that can be later constructed if funds become available. We will contact you to let you know when we have received funding for the design project and the proposed project timeline.

Please review the information described on the following pages. If the project described is acceptable to you, please sign below and return in the stamped envelope. Enclosed is a copy for your records. If you have any questions before signing, please contact me and I will be happy to answer any questions you may have about the proposed idea or the feasibility/design/construction process. Questions about the Pretty Lake Conservation Club and their work to improve the water quality of Pretty Lake can be directed to Jim Mertz (260-351-3404).

Thank you

Mark Pranckus

I agree with the proposed conceptual design as it has been explained to me by the Pretty Lake Conservation Club (PLCC) and/or their representative, JFNew, and by the documentation they have provided. I agree that the conceptual design is feasible to me and that the PLCC shall proceed to develop detailed plans to construct this project. I grant access to the site to allow for proper design of this project.

_____ (signed)

_____ (printed)

_____ (date)

JFNew
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March 6, 2009

Harvey & Trina Oshman
1417 San Rafael Dr.
Dallas, TX 75218

Dear: Mr. & Mrs. Oshman

The Pretty Lake Conservation Club (PLCC) is undertaking a feasibility study to reduce sediments and nutrient loading to the lake. The feasibility study looks at areas within the lake and watershed where erosion, sediment, and nutrient problems are occurring and develops solutions that are feasible from a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the Pretty Lake watershed, Deal Ditch which is located on your property was identified as a potential location for a sediment reduction project. Enclosed with this letter is a project description and supporting figures.

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Thank you

Mark Pranckus

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March 6, 2009

Arthur & Dorothy Hall
9060 E 430 S
Wolcottville, IN 46795

Dear: Mr. & Mrs. Hall

The Pretty Lake Conservation Club (PLCC) is undertaking a feasibility study to reduce sediments and nutrient loading to the lake. The feasibility study looks at areas within the lake and watershed where erosion, sediment, and nutrient problems are occurring and develops solutions that are feasible from a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the Pretty Lake watershed, Deal Ditch which is located on your property was identified as a potential location for a sediment reduction project. Enclosed with this letter is a project description and supporting figures.

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Thank you

Mark Pranckus

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Grand Haven, Michigan

Cincinnati, Ohio

Madison, Wisconsin

Native Plant Nursery:
Walkerton, Indiana

www.jfnew.com

March 6, 2009

Nicholas E. Hausbach
9010 E 400 S
Wolcottville, IN 46795

Dear: Mr. Hausbach

The Pretty Lake Conservation Club (PLCC) is undertaking a feasibility study to reduce sediments and nutrient loading to the lake. The feasibility study looks at areas within the lake and watershed where erosion, sediment, and nutrient problems are occurring and develops solutions that are feasible from a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the Pretty Lake watershed, Deal Ditch which is located on your property was identified as a potential location for a sediment reduction project. Enclosed with this letter is a project description and supporting figures.

Preliminary approval from the LaGrange County Drainage Board via the county surveyor has been obtained for work within the county drainage easement. At their request, they have asked that the affected landowner's approval be obtained prior to granting the drainage board's final approval.

The PLCC would be responsible for all costs associated with the design and construction of this project including site preparation, construction, and clean-up. At this point, your signature is a commitment to your willingness to consider the project and to move forward with turning a conceptual idea into a detailed design that can be later constructed if funds become available. We will contact you to let you know when we have received funding for the design project and the proposed project timeline.

Please review the information described on the following pages. If the project described is acceptable to you, please sign below and return in the stamped envelope. Enclosed is a copy for your records. If you have any questions before signing, please contact me and I will be happy to answer any questions you may have about the proposed idea or the feasibility/design/construction process. Questions about the Pretty Lake Conservation Club and their work to improve the water quality of Pretty Lake can be directed to Jim Mertz (260-351-3404).

Thank you

Mark Pranckus

JFNew
Full-Service Ecological Solutions™

708 Roosevelt Rd
Walkerton, Indiana 46574
Phone: 574-586-3400
Fax: 574-586-3446

Mark Pranckus
Aquatic Biologist
mpranckus@jfnew.com
Mobile: 574-229-8723

Corporate Office:
Walkerton, Indiana

Chicago, Illinois

Indianapolis, Indiana

Ann Arbor, Michigan

Grand Haven, Michigan

Cincinnati, Ohio

Madison, Wisconsin

Native Plant Nursery:
Walkerton, Indiana

www.jfnew.com

March 6, 2009

Alice Lower
4205 S 900 E
Wolcottville, IN 46795

Dear: Ms. Lower

The Pretty Lake Conservation Club (PLCC) is undertaking a feasibility study to reduce sediments and nutrient loading to the lake. The feasibility study looks at areas within the lake and watershed where erosion, sediment, and nutrient problems are occurring and develops solutions that are feasible from a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the Pretty Lake watershed, Deal Ditch which is located on your property was identified as a potential location for a sediment reduction project. Enclosed with this letter is a project description and supporting figures.

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March 6, 2009

Richard & Connie Miller
445 W. College Ave.
Waukesha, WI 53186

Dear: Mr. & Mrs. Miller

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Walkerton, Indiana

www.jfnew.com

March 6, 2009

Rod & Kathy Dunafin
9120 E 400 S
Stroh, IN 46789

Dear: Mr. & Mrs. Dunafin

The Pretty Lake Conservation Club (PLCC) is undertaking a feasibility study to reduce sediments and nutrient loading to the lake. The feasibility study looks at areas within the lake and watershed where erosion, sediment, and nutrient problems are occurring and develops solutions that are feasible from a technical standpoint and from a landowner cooperation standpoint. During an initial tour of the Pretty Lake watershed, Deal Ditch which is located on your property was identified as a potential location for a sediment reduction project. Enclosed with this letter is a project description and supporting figures.

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Thank you

Mark Pranckus

Project Location and Description

The proposed project area is the portion of Deal Ditch south of CR E 400 S to the north side of CR E 430 S (Figure 1). Deal Ditch is the main inlet into Pretty Lake and drains approximately 651 acres or 52.8% of the watershed. It is also a legal drain, maintained by the LaGrange County Drainage Board and supervised by the LaGrange County Surveyor. The County maintains an easement 75 feet wide from each bank that starts from the top of the bank. Deal Ditch enters into Pretty Lake at the north end of the lake (Figure 1). The channel is approximately 8 feet wide with an average water depth of less than 1 foot with streambanks that are approximately 8 feet high. Erosion is occurring along the streambanks (Figure 2 and Figure 3) and the current channel offers high flow little access to a floodplain. We investigated several different feasibility projects to stabilize the streambanks including increasing access to the floodplain creating a floodplain wetland and creating a two-stage ditch. After a further review, we are proposing to stabilize the banks by providing increased sunlight to the banks to encourage vegetation growth. This would be accomplished by selective removal of trees along the streambank.

Preliminary approval from the LaGrange County Drainage Board via the county surveyor has been obtained for work within the county drainage easement. At their request, they have asked that the affected landowner's approval be obtained prior to granting the drainage board's final approval.

Figure 1. Aerial view of Deal Ditch (shown by dashed orange lines) from CR E 400 S to CR E 430 S.

Figure 2. Example of erosion occurring on the left downstream bank.

Figure 3. Example of erosion occurring on streambank.

Preliminary Design and Conceptual Drawings

Deal Ditch runs through a forested area in the designated project area. Because of this, the amount of sunlight that is transmitted to the forest floor is minimal in most areas (Figure 4) and may be limiting the amount of vegetated cover on the streambanks (Figure 5). Increasing the sunlight to the streambanks by removing trees along the length of Deal Ditch is suggested as a method to increase the amount of vegetation on the stream banks. The goal for increasing the amount of vegetative cover on the stream banks is to increase bank stability thereby, decreasing the erosive potential of high flow and overland flow. Decreasing the erosive potential of the stream banks would help reduce the amount of sediment and nutrients entering the stream that eventually reach Pretty Lake. An additional benefit from increased sunlight to the stream could be a reduction in *E. coli* concentrations, as UV light is known to kill *E. coli*.

The canopy would be reduced by 15% by selectively cutting trees along the bank. Felled trees would be cut up and removed to a location where they would be either chipped or burned. Wood removed from your property could be made available for you, if you would want to cut it up for firewood. The exact locations will be determined in the follow-up design, but will likely occur within the county drainage easement. All disturbed areas will be re-seeded to the existing vegetation.

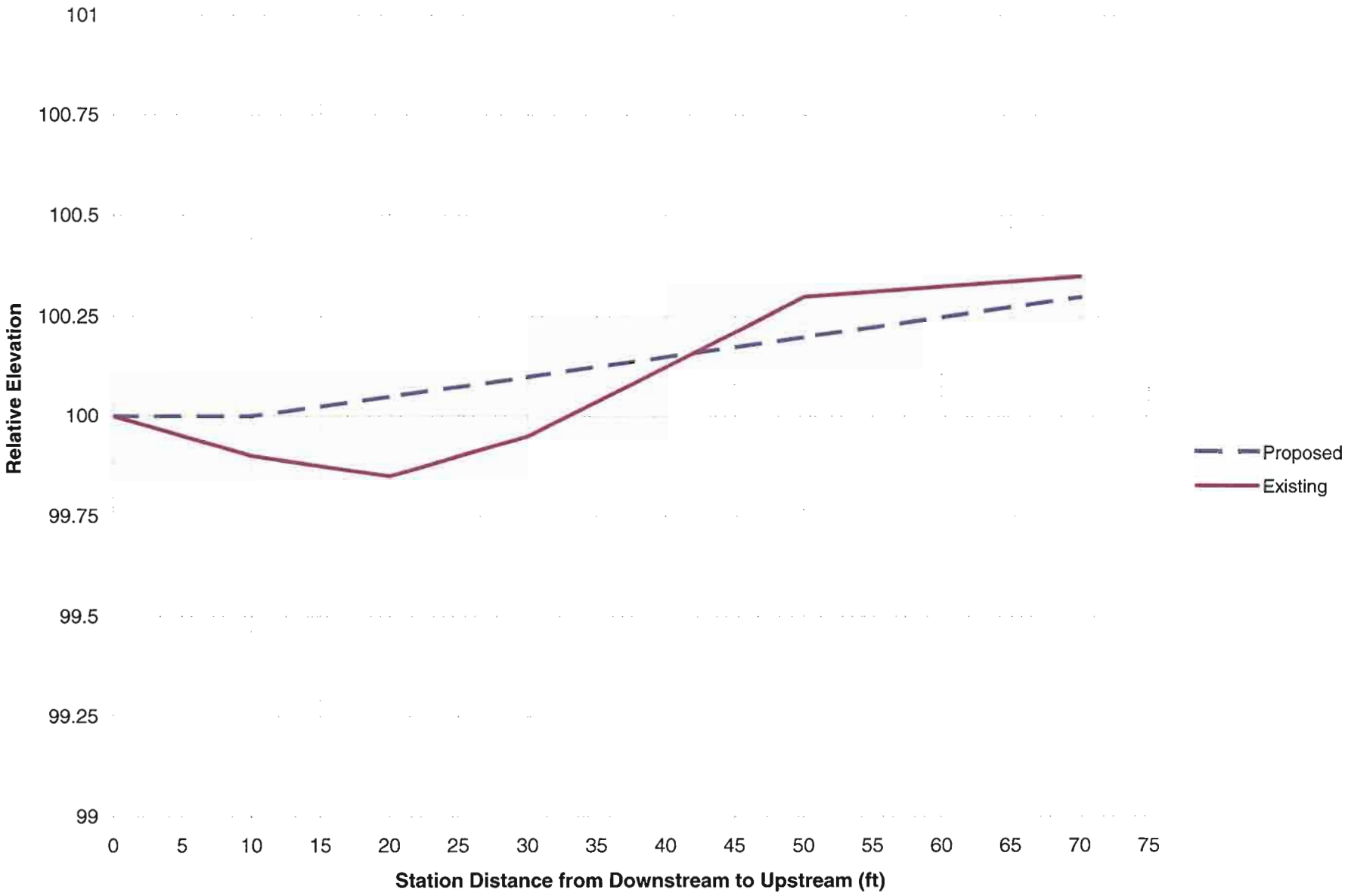
Figure 4. Example of an area with minimal sunlight.

Figure 5. An example of bank erosion and minimal vegetative cover on the left downstream bank.

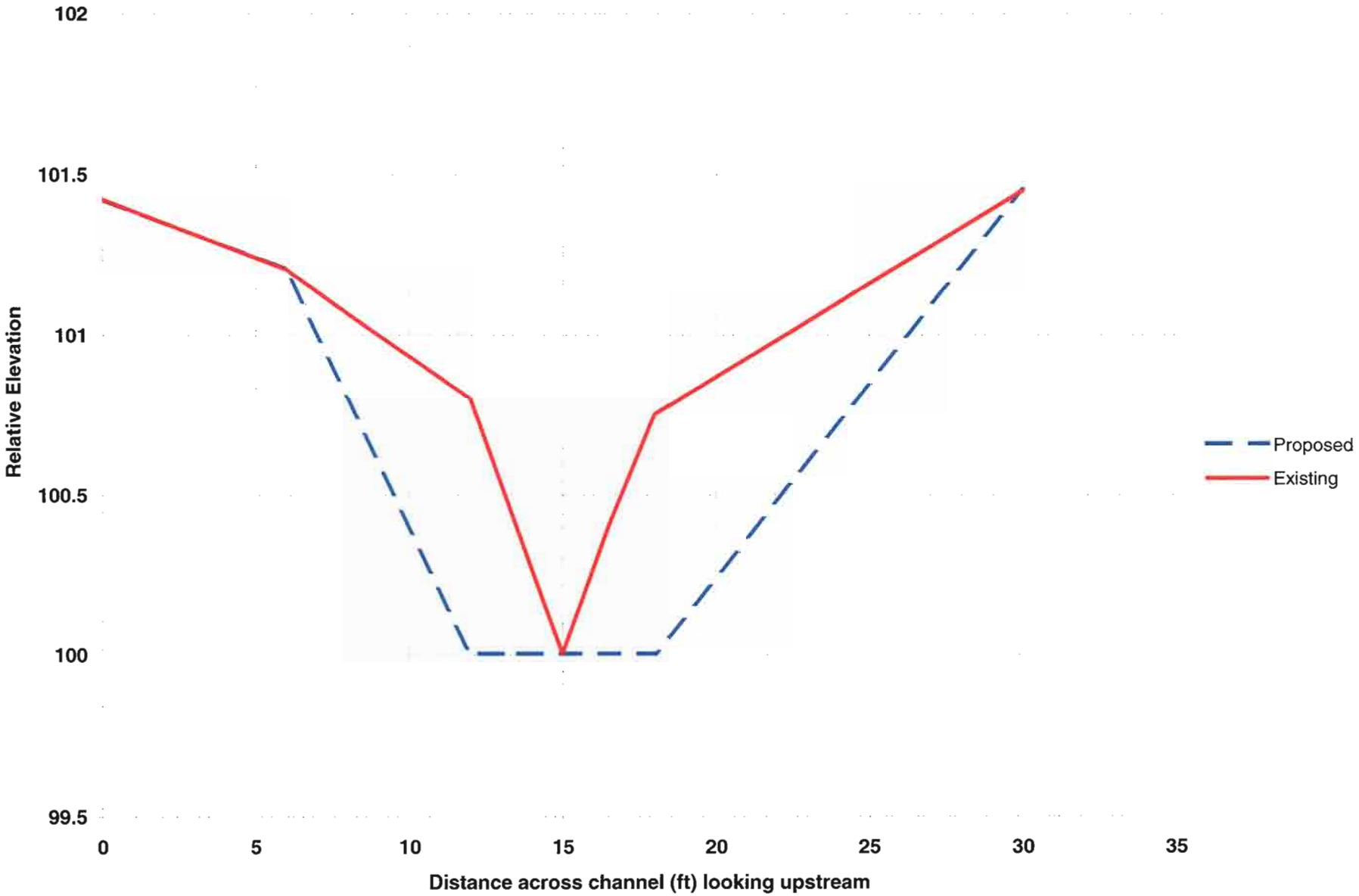
APPENDIX C

PROJECT DESIGN SPECIFICATIONS

Site 1 Center Line Profile



Site 1 Station 0+00



JFNew

JOB Site No. 2 & ~~South~~ Milford
SHEET NO. _____ OF Raingarden
CALCULATED BY _____ DATE _____
CHECKED BY _____ DATE _____
SCALE _____

Total Watershed Area

280 squares × 625 ft²/square = 175,000 ft

= 4.01 acres

School roof/shed + imperv. parking lot

53 squares × 625 ft²/square = 33,125 ft² (0.76 acres)

Total Imperious

100 squares × 625 ft²/square = 62,500 ft² (1.43 acres)

53
41
94

Roof + direct drainage

94 squares × 625 ft²/square = 58,750 ft² (1.35 acres)

Watershed Size		Raingarden basin size (% of WS size) 5%	8%	10%	12%
Total watershed	175,000 ft²	8750	14,000	17,500	21,000
Roof + direct drainage	58,750 ft²	2938	4700	5875	7050

Realistic Space in designated area w/in school grounds

↳ 2500 — 2900 ft²

JFNew

JOB
SHEET NO. OF
CALCULATED BY DATE
CHECKED BY DATE
SCALE

RECARGA Parmaters

Watershed Area

Model 1 Roofshed + direct drainge = 1.62 acres

Model 2 Total water = 3.67

Percent Impervious

Model 1 = 52.4%

Model 2 = 35.4

Pervious CN

68 - hydrologic group "B" - residential w/ 1 acre lots

Ksat of basin

0 - 50 in 2.0 in/hr (converted from μm/sec)

50 in + 0.6 in/hr (used conservative estimates from soil survey

Sandy loam

JFNew

JOB
SHEET NO. OF
CALCULATED BY DATE
CHECKED BY DATE
SCALE

Model 1 Results Summary (M1)

- Used conservative soil infiltration rates (2 in/hr ; 0.6 in/hr)
- Can take between 2.62 — 3.26" event before overtopping 2500 ft² basin
- 700 sqft is the smallest basin size to capture 1" of rain.
- Need a basin of 1800 sq ft or more to capture 2.17" rain w/o overtopping.
- Ponding is not an issue. All model runs (once corrected for soil properties) had ponding < 40 hrs.

Model 2 Results Summary (M2)

- Used same soil numbers as Model 1
- Smallest basin size to capture 1" of first flush is 1200 sqft
- Need a basin of 2500 sqft to capture 1.5" event, but overtops w/ 2.17" event
-

Summary

Need between 700 sqft (M1) & 1200 sqft (M2) to capture 1" of rain, but to capture any more need ~~between 1800 sqft~~ & 2500 sqft, (M1, M2 respectively)

JFN-001 / 2-03

Watershed Area:	7.62 acres
Percent Impervious:	52.4
Pervious CN:	68

Comments: Roofshed + direct drainage

Site: ~~South~~ Milford Elem. School

Date: 12/10/08

Run	Raingarden Size (sqft)	Rainfall Depth (in)	Depression Depth (in)	Root layer depth (in)	Root layer infiltration (in/hr)/Type	Storage layer depth (in)	Storage layer infiltration (in/hr)/Typ	Native layer infiltration (in/hr)	Hours ponded	No. of Overflows	Stay-on Volume (in)	Stay-on Volume (%)	Comments
1	2500	1.0	9"	26"	2.0 Sandy loam	—	—	clay, silt loam	60	0	1.0	100	No storage layer - no underdrain
2	"	"	"	"	4.0 "	—	—	"	60	0	1.0	100	
3	"	"	"	"	6.0 "	—	—	"	60	0	1.0	100	
x 4	"	1.0	9"	26	2.0 Sandy loam	15	2 Sandy loam	0.6 SiL	17	0	1.0	100	Included info about native soils
5	"	2.17	"	"	"	"	"	"	28.5	0	1.68	77.2	1-yr 24-hr event
6	"	2.62	"	"	"	"	"	"	30.0	1	1.82	69.6	2 yr 24-hr event
7	"	3.26	"	"	"	"	"	"	31.25	1	1.99	61.2	5 yr 24-hr event
8	"	3.77	"	"	"	"	"	"	32.0	1	2.10	55.9	10 yr 24-hr event
9	"	4.51	"	"	"	"	"	"	33.0	1	2.24	49.76	25 yr 24-hr event
10	1200	1.0	"	"	"	"	"	"	26.25	0	0.86	86.2	
11	600	1.0	"	"	"	"	"	"	28.75	1	0.72	71.9	
12	900	1.0	"	"	"	"	"	"	27.75	0	0.80	79.5	
13	700	1.0	"	"	"	"	"	"	28.5	0	0.76	74.6	
14	"	2.17	"	"	"	"	"	"	32.5	1	1.20	55.3	
15	"	1.5	"	"	"	"	"	"	30.75	1	0.97	64.4	
16	900	2.17	"	"	"	"	"	"	32.25	1	1.26	58.0	
17	1200	2.17	"	"	"	"	"	"	31.5	1	1.34	61.9	
18	1500	2.17	"	"	"	"	"	"	30.5	1	1.43	65.7	
19	1800	2.17	"	"	"	"	"	"	30	1	1.51	69.4	
20	1650	2.17	"	"	"	"	"	"	30.25	1	1.47	67.5	
21	2200	2.17	"	"	"	"	"	"	29.25	0	1.61	74.1	

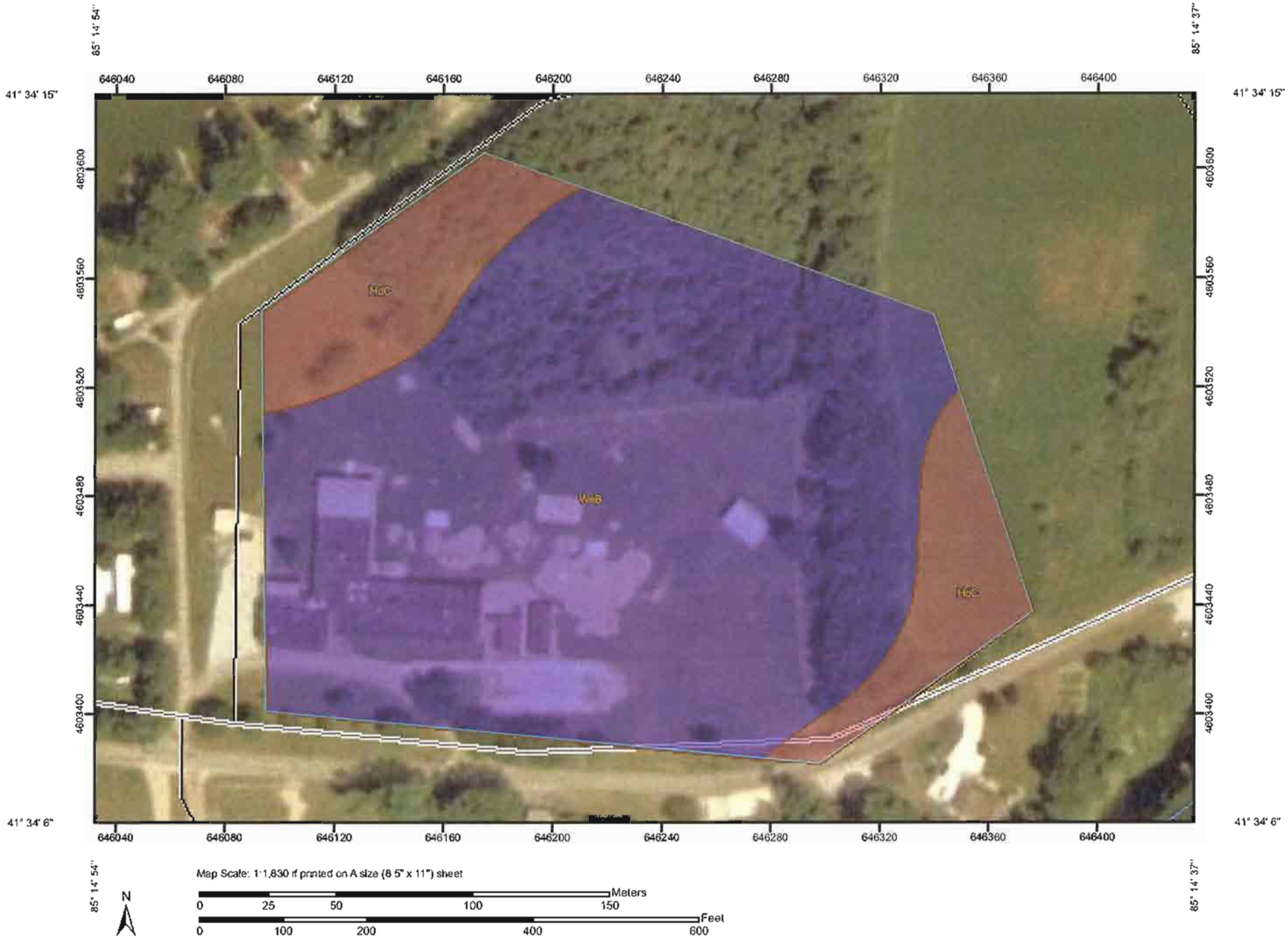
Watershed Area:	3.67
Percent Impervious:	35.4
Pervious CN:	68

Comments: Total watershed

Site: South Milford Elem. School Date: 12/10/08

Run	Raingarden Size (sqft)	Rainfall Depth (in)	Depression Depth (in)	Root layer depth (in)	Root layer infiltration (in/hr)/Type	Storage layer depth (in)	Storage layer infiltration (in/hr)/Typ	Native layer infiltration (in/hr)	Hours ponded	No. of Overflows	Stay-on Volume (in)	Stay-on Volume (%)	Comments
1	2500	1.0	9"	26	2.0 SaLo	15	2.0 SaLo	0.6 SaLo	24.5	0	0.98	96.6	
2	2500	2.17	"	"	"	"	"	"	30.5	1	1.61	74.1	
3	2000	1.0	"	"	"	"	"	"	25.75	0	0.92	92.2	
4	1500	1.0	"	"	"	"	"	"	27.25	0	0.87	87.4	
5	1000	1.0	"	"	"	"	"	"	28.75	1	0.82	81.9	
6	1200	1.0	"	"	"	"	"	"	28.25	0	0.84	84.2	
7	1200	1.5	"	"	"	"	"	"	30.5	1	1.14	75.6	
8	1500	1.5	"	"	"	"	"	"	30	1	1.17	78.0	
9	2000	1.5	"	"	"	"	"	"	29	1	1.23	82.0	
10	2500	1.5	"	"	"	"	"	"	28.25	0	1.29	85.7	
11	2200	1.5	"	"	"	"	"	"	28.75	0	1.25	83.5	
12	3000	2.17	"	"	"	"	"	"	29.75	1	1.67	76.8	
13	4000	2.17	"	"	"	"	"	"	28.75	0	1.78	81.9	
14	5000	2.17	"	"	"	"	"	"	27.75	0	1.88	86.6	
15	4500	2.17	"	"	"	"	"	"	28.25	0	1.83	84.3	
16	5000	2.62	"	"	"	"	"	"	29	1	2.07	79.0	

Hydrologic Soil Group—Lagrange County, Indiana
(South Milford School Raingarden Site Hydrologic Group)



Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Lagrange County, Indiana				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
HdC	Hillsdale sandy loam, 6 to 12 percent slopes	A	2.1	17.7%
WeB	Wawasee fine sandy loam, 2 to 6 percent slopes	B	9.7	82.3%
Totals for Area of Interest			**11.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Report—Physical Soil Properties

Physical Soil Properties– Lagrange County, Indiana														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct	Pct					
HdC—Hillsdale sandy loam, 6 to 12 percent slopes														
Hillsdale	0-10	45-85	5-50	2-12	1.40-1.70	14.11-42.34	0.08-0.22	0.0-2.9	1.0-3.0	.20	.20	5	3	86
	10-13	45-85	5-50	2-12	1.40-1.70	14.11-42.34	0.08-0.22	0.0-2.9	0.5-1.0	.20	.20			
	13-17	45-85	5-50	2-12	1.40-1.70	14.11-42.34	0.08-0.22	0.0-2.9	0.5-1.0	.20	.20			
	17-35	45-85	5-50	2-12	1.45-1.70	14.11-42.34	0.07-0.18	0.0-2.9	0.5-1.0	.17	.20			
	35-41	45-85	5-50	2-12	1.45-1.70	14.11-42.34	0.07-0.18	0.0-2.9	0.5-1.0	.17	.20			
	41-50	45-85	5-50	2-12	1.45-1.70	14.11-42.34	0.07-0.18	0.0-2.9	0.5-1.0	.17	.20			
	50-70	50-85	5-50	10-18	1.50-1.70	4.23-14.11	0.12-0.18	0.0-2.9	0.5-1.0	.20	.20			
	70-80	50-85	5-50	5-15	1.60-1.80	4.23-42.34	0.10-0.18	0.0-2.9	0.5-1.0	.28	.32			
WeB—Wawasee fine sandy loam, 2 to 6 percent slopes														
Wawasee	0-12	—	—	4-18	1.30-1.60	4.23-14.11	0.16-0.22	0.0-2.9	1.0-3.0	.28	.28	4	3	86
	12-22	—	—	18-27	1.50-1.70	4.23-14.11	0.04-0.16	3.0-5.9	0.5-1.0	.28	.28			
	22-35	—	—	18-27	1.50-1.70	4.23-14.11	0.04-0.16	3.0-5.9	0.5-1.0	.28	.28			
	35-38	—	—	18-27	1.50-1.70	4.23-14.11	0.04-0.16	3.0-5.9	0.5-1.0	.28	.28			
	38-60	—	—	12-18	1.80-2.00	4.23-14.11	0.02-0.04	0.0-2.9	0.5-1.0	.37	.43			

* Using watershed of roofshed of school plus direct drainage

U.S. Department of Agriculture
Soil Conservation Service

IN-ENG-10
Rev. 10/89
File Code 210-11

WORKSHEET IN-1: RUNOFF CURVE NUMBER (CN)

Client ~~South~~ Milford Elem. School Practice and ID Raingarden

_____ County Soil and Water Conservation District, Indiana

By MP Date 12/10/08 Checked by _____ Date _____

COVER TYPE	TREATMENT 1/	HYDROLOGIC CONDITION 2/	CURVE NUMBER (CN) Hydrolocic Soil Group (EFM Table IN-2-2) A	B	C	D	AREA, ACRES (%)	PRODUCT OF CN X ACRES
Row Crops	Straight Row	poor	72	81	88	91		
		good	67	78	85	89		
	Straight Row + CR	poor	71	80	87	90		
		good	64	75	82	85		
	Contoured + CR	poor	69	78	83	87		
		good	64	74	81	85		
Small Grain	Straight Row	poor	65	76	84	88		
	Straight Row + CR	good	63	75	83	87		
Pasture or Grassland		poor	68	79	86	89		
		good	39	61	74	80		
Meadow	Not Grazed	--	30	58	71	78		
Woods		poor	45	66	77	83		
		good	30	55	70	77		
Farmsteads		--	59	74	82	86		
Streets and Roads	Paved w/ Curb	--	98	98	98	98	56	55.8
	Paved w/ Ditches	--	83	89	92	93		
Residential 3/	1/4 acre lots	--	61	75	83	87		
	1/2 acre lots	--	54	70	80	85		
	1 acre lots	--	51	68	79	84	44	29.9
Other (Specify)								
					TOTALS		(%) ACRES	

1/ Crop residue cover (CR) applies if residue is on at least 5% of the surface throughout the year.
2/ See EFM Table 2-3 for definitions.
3/ Includes subdivision streets and driveways.

Weighted CN = $\frac{\text{Product Total}}{\text{Total Acres}}$ = _____; Use CN = 86

(Do not use less than CN 60 without approval of area engineer)

* Using entire watershed of school grounds → 4.01 acres

U.S. Department of Agriculture
Soil Conservation Service

IN-ENG-10
Rev. 10/89
File Code 210-11

WORKSHEET IN-1: RUNOFF CURVE NUMBER (CN)

Client ~~South~~ Milford Elem School Practice and ID Raingarden

_____ County Soil and Water Conservation District, Indiana

By MP Date 12/10/08 Checked by _____ Date _____

COVER TYPE	TREATMENT 1/	HYDROLOGIC CONDITION 2/	CURVE NUMBER (CN) Hydrolocic Soil Group (EFM Table IN-2-2) A	B	C	D	AREA, ACRES (%)	PRODUCT OF CN X ACRES
Row Crops	Straight Row	poor	72	81	88	91		
		good	67	78	85	89		
	Straight Row + CR	poor	71	80	87	90		
		good	64	75	82	85		
	Contoured + CR	poor	69	78	83	87		
		good	64	74	81	85		
Small Grain	Straight Row	poor	65	76	84	88		
	Straight Row + CR	good	63	75	83	87		
Pasture or Grassland		poor	68	79	86	89		
		good	39	61	74	80		
Meadow	Not Grazed	--	30	58	71	78		
Woods		poor	45	66	77	83		
		good	30	55	70	77		
Farmsteads		--	59	74	82	86		
Streets and Roads	Paved w/ Curb	--	98	98	98	98	36%	35.3
	Paved w/ Ditches	--	83	89	92	93		
Residential 3/	1/4 acre lots	--	61	75	83	87		
	1/2 acre lots	--	54	70	80	85	64%	43.5
	1 acre lots	--	51	68	79	84		
Other (Specify)								
					TOTALS		100 (%) ACRES	0.36(98) + 0.64(68)

1/ Crop residue cover (CR) applies if residue is on at least 5% of the surface throughout the year.
2/ See EFM Table 2-3 for definitions.
3/ Includes subdivision streets and driveways.

Weighted CN = Product Total / Total Acres = _____; Use CN = 79

(Do not use less than CN 60 without approval of area engineer)

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Indiana 41.630 N 85.429 W 944 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 2, Version 3
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2004

Extracted: Wed Dec 10 2008

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Docs | Return to State Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.35	0.55	0.67	0.89	1.09	1.28	1.37	1.63	1.88	2.17	2.48	2.84	3.33	3.79	5.11	6.37	8.08	9.78
2	0.42	0.66	0.81	1.08	1.32	1.56	1.66	1.97	2.27	2.62	2.98	3.39	3.96	4.49	6.02	7.47	9.47	11.44
5	0.51	0.79	0.97	1.33	1.67	1.97	2.10	2.48	2.85	3.26	3.67	4.11	4.75	5.33	7.05	8.64	10.83	12.98
10	0.58	0.89	1.09	1.52	1.93	2.30	2.46	2.90	3.33	3.77	4.22	4.68	5.37	6.01	7.88	9.55	11.88	14.15
25	0.66	1.01	1.25	1.77	2.29	2.75	2.95	3.50	4.01	4.51	4.99	5.48	6.21	6.91	8.99	10.73	13.22	15.64
50	0.73	1.11	1.37	1.96	2.58	3.12	3.34	3.99	4.57	5.10	5.60	6.10	6.87	7.62	9.85	11.63	14.21	16.73
100	0.79	1.20	1.49	2.14	2.87	3.50	3.76	4.52	5.17	5.73	6.25	6.74	7.53	8.33	10.71	12.49	15.17	17.74
200	0.86	1.28	1.60	2.33	3.16	3.90	4.20	5.08	5.83	6.39	6.92	7.40	8.20	9.05	11.57	13.34	16.09	18.68
500	0.95	1.40	1.74	2.58	3.57	4.46	4.82	5.90	6.76	7.31	7.84	8.29	9.10	10.00	12.71	14.40	17.24	19.84
1000	1.01	1.48	1.84	2.77	3.88	4.90	5.32	6.56	7.52	8.05	8.57	8.98	9.78	10.73	13.59	15.18	18.08	20.66

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.39	0.60	0.74	0.98	1.20	1.41	1.53	1.82	2.10	2.35	2.68	3.04	3.55	4.03	5.38	6.67	8.43	10.22
2	0.47	0.73	0.89	1.19	1.46	1.72	1.85	2.20	2.54	2.83	3.21	3.63	4.21	4.77	6.34	7.83	9.87	11.93
5	0.56	0.87	1.07	1.46	1.83	2.18	2.34	2.76	3.17	3.53	3.95	4.40	5.05	5.66	7.42	9.05	11.28	13.54
10	0.63	0.97	1.20	1.67	2.12	2.54	2.72	3.22	3.69	4.08	4.54	5.01	5.71	6.38	8.29	10.00	12.36	14.76
25	0.72	1.11	1.37	1.93	2.51	3.03	3.26	3.88	4.44	4.87	5.36	5.85	6.59	7.33	9.45	11.23	13.76	16.30
50	0.80	1.21	1.50	2.14	2.82	3.43	3.69	4.42	5.06	5.50	6.02	6.53	7.29	8.08	10.35	12.16	14.80	17.43
100	0.87	1.31	1.62	2.34	3.13	3.84	4.16	5.00	5.71	6.16	6.71	7.21	7.99	8.83	11.25	13.07	15.79	18.49
200	0.94	1.40	1.75	2.55	3.46	4.28	4.64	5.62	6.43	6.86	7.42	7.91	8.70	9.59	12.16	13.96	16.77	19.49
500	1.04	1.53	1.91	2.82	3.90	4.90	5.32	6.52	7.45	7.84	8.41	8.86	9.65	10.60	13.36	15.08	17.97	20.71
1000	1.11	1.62	2.02	3.03	4.26	5.38	5.87	7.25	8.28	8.64	9.19	9.60	10.38	11.37	14.29	15.90	18.87	21.57

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval

Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

* Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.32	0.50	0.61	0.81	0.99	1.16	1.24	1.47	1.71	2.02	2.31	2.67	3.15	3.59	4.86	6.09	7.75	9.38
2	0.38	0.60	0.73	0.98	1.21	1.41	1.50	1.78	2.06	2.44	2.77	3.18	3.74	4.25	5.72	7.15	9.07	10.96
5	0.46	0.72	0.88	1.21	1.52	1.78	1.90	2.24	2.58	3.03	3.41	3.86	4.48	5.05	6.70	8.26	10.37	12.43
10	0.52	0.81	0.99	1.38	1.75	2.07	2.21	2.61	3.00	3.51	3.92	4.40	5.06	5.68	7.47	9.12	11.37	13.55
25	0.60	0.91	1.13	1.59	2.07	2.46	2.64	3.13	3.59	4.17	4.62	5.12	5.84	6.52	8.51	10.23	12.63	14.95
50	0.66	0.99	1.23	1.76	2.32	2.78	2.98	3.55	4.07	4.71	5.17	5.70	6.44	7.17	9.30	11.07	13.57	15.97
100	0.71	1.07	1.33	1.92	2.57	3.10	3.33	3.98	4.57	5.27	5.75	6.27	7.05	7.83	10.09	11.88	14.45	16.91
200	0.77	1.14	1.42	2.07	2.81	3.43	3.69	4.44	5.10	5.85	6.34	6.87	7.66	8.48	10.88	12.65	15.31	17.78
500	0.84	1.23	1.53	2.27	3.14	3.88	4.19	5.08	5.84	6.65	7.15	7.66	8.46	9.34	11.91	13.62	16.36	18.85
1000	0.89	1.29	1.61	2.42	3.40	4.23	4.58	5.59	6.43	7.28	7.78	8.26	9.06	9.98	12.68	14.32	17.12	19.59

* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.
** These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.

Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Text version of tables

Mark Pranckus

From: Erin Switala
Sent: Wednesday, December 17, 2008 10:49 AM
To: Mark Pranckus
Subject: RE: SWMM inputs
Attachments: 20081217_prettylake_RECARGA_es.xls

Mark,

I actually did not end up using the FAR exactly, I kept getting confused on how it wants me to enter the depth (i.e. depth over the watershed or depth over the raingarden). So, I just guessed and checked until I got to zero runoff. I'm guessing that you were looking at the # of overflow events part of the results screen. That is misleading (or maybe even a mistake) because it will say zero overflow event and you will still have a large amount of runoff. I'll send out a little email note about that later today to everyone I know that uses RECARGA.

Attached is a spreadsheet that has the minimum sizes for zero runoff for the 1" and 1 yr events for both scenarios. Take a look at the FAR tab. They are pretty close to the SWMM results (at least for the 1" event). I can look at the SWMM model again see if I need to change the depressional storage to get a runoff value closer to the RECARGA if you want. Let me know if you want me to spend any more time on this or not and if you need anything else.

Erin

p.s. I'll save my recarga outputs in your file in a subfolder and the spreadsheet.

From: Mark Pranckus
Sent: Tuesday, December 16, 2008 4:32 PM
To: Erin Switala
Subject: RE: SWMM inputs

1. Yes. Default of 0.13
2. 0 – No underdrain
3. 68 – Residential with lots of 1 acre; Hydrologic group B. That was my best guess. If you think it should be something different, let me know.

Thanks,
Mark

Mark Pranckus
Ecological Resource Specialist

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From: Erin Switala
Sent: Tuesday, December 16, 2008 4:30 PM
To: Mark Pranckus
Subject: RE: SWMM inputs

Mark,

I was looking at the RECARGA FAR, and wanted to check on a couple of the inputs to see what you had used.

1) The hourly avg evaporation rate? Default on my version is 0.13 in/day
2) The underdrain diameter? I'm going to try 0 and see if that works b/c I'm thinking we aren't going to have an underdrain.
3) Pervious CN? I'll look up lawn and see what that is, but if you get a chance, just let me know what you used.

Thanks!
Erin

From: Mark Pranckus
Sent: Tuesday, December 16, 2008 10:25 AM
To: Erin Switala
Subject: RE: SWMM inputs

Erin,

Thanks for the information. Bringing it back to what the overall question(s) is :

What is the minimum size needed to capture the first flush (1") under each model scenario?

Related to that...are there any other benefits to increasing the size such as being able to store up to a 1-yr event?

Can you run the FAR and determine the facility size for each model for 1-in and 2.17-in and see what we come up with?

We'll use the results of both the RECARGA and SWMM to discuss the feasibility and provide a range of sizes for the basin. The final size would be determined in a separate design/build project.

Thanks,
Mark

Mark Pranckus
Ecological Resource Specialist

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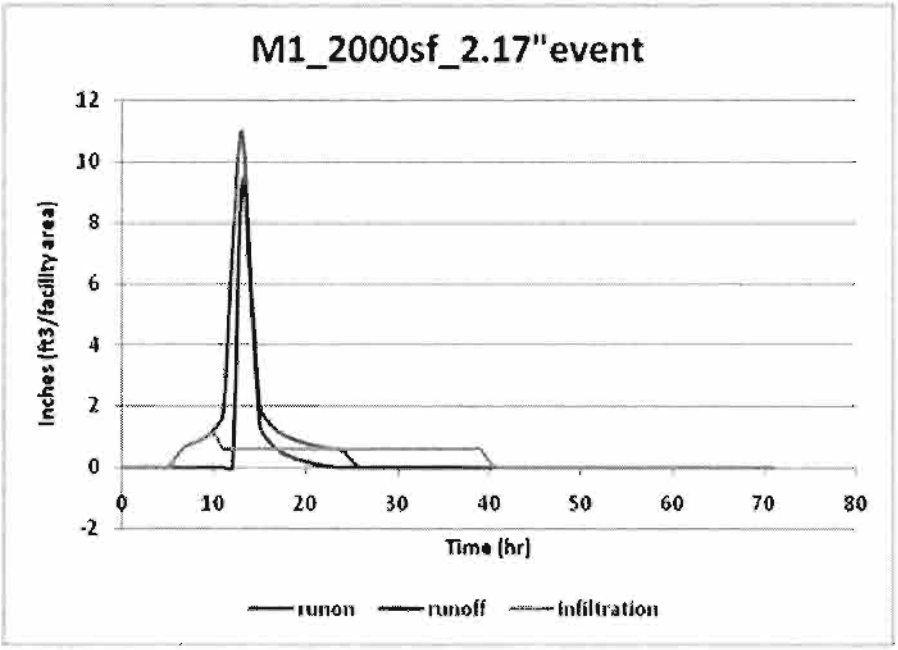
From: Erin Switala
Sent: Tuesday, December 16, 2008 9:51 AM
To: Mark Pranckus
Subject: RE: SWMM inputs

Mark,

I've looked into this briefly. The total runoff amounts are pretty similar to the SWMM model (actually slightly higher in the RECARGA model). I've saved the total amounts in the SWMM spreadsheet (here). It looks like the RECARGA runs are still giving quite a bit of runoff (overflow) from the raingardens during the peak of the events. I did not look at every single run, but I've looked at the ones you called out in your email that you thought were sufficient size. See graph below for example. I did save this spreadsheet with the summed amounts too, it's in the folder with the RECARGA model runs.



I don't know a ton about RECARGA, so I could be missing something, but it looks like you may need to do some additional runs. I did run across the Facility Area Ratio part in the user's manual. Have you used this? It says if you enter the target stayon and do not enter the facility area, you can hit RUN FAR and it will calculate the required facility to tributary area ratio to meet your target stayon. That might be worth trying, and might "speed up" the process so you don't have to do as many runs.

Let me know if you need more help with anything for this. I'd be happy to take a stab at RECARGA if needed.

Thanks,
Erin

From: Mark Pranckus
Sent: Monday, December 15, 2008 3:47 PM
To: Erin Switala
Subject: RE: SWMM inputs

Ok, it's me again. I don't know if this helps, but here's a linked to my model runs in RECARGA.

S:\Walkerton\PROJECTS\05\050919_PrettyLake_LARE\03_Feasibility\Data\Recarga Model Runs

File Name Syntax:

RGM(model version)_Raingarden Size_precipation event.txt

Example:
RGM1_700_2_17 – Model 1; 700 sqft facility with a 2.17" over 24-hour event.

There's a second file with a similar name for each model run, but it has a "W8" at the end. This is the file you want to check out. It includes the stepwise run-on and infiltration rates. We can copy and paste into a spreadsheet for easy review. You might have to convert to columns, depending on the model of Excel you have.

If you want to investigate what might be causing the difference, go ahead. Please document so I can include in the feasibility report. If it's going to take more than an hour or two, please let me know.

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From: Erin Switala
Sent: Monday, December 15, 2008 3:09 PM
To: Mark Pranckus
Cc: Scott Dierks
Subject: RE: SWMM inputs

Mark,

Okay, here's what I've got for the SWMM model results. I'll give you the quick summary and then let me know if you have any questions or want me to run any additional scenarios.

For the 1 year event, I used a SCS Type II distribution over 24 hours. For the 1" event I used a 6 hr duration and a 24 hr duration to compare the difference due to peak runoff. I set the model up with an "infiltration pump" that accounts for the infiltration into the ground under the raingarden. We usually use the most restrictive layer for the hydraulic

conductivity value. However in this case, the event sizes/durations we're talking about don't get down to the restrictive layer until after the event is over. I set the model up so that the pump rate changes (2 in/hr to a depth of 50 inch, then 0.6 in/hr), but that did not really matter in this case, as most of the water was gone by the time the wetting front would reach the more restrictive layer (depth of 50 in).

Here's a table that summarizes the minimum areas for several rain events and ponding depth scenarios. Note that the ponding times are based on a basin sized to hold the 1 year event. If a smaller basin is used, then the ponding times will increase for the smaller events (i.e. the 1 inch event). For example, if the minimum size to hold the 1", 24 hr event is used, then the ponding time for that event is 7.75 hrs for the entire watershed scenario.

Again, these are a good bit larger than you had estimated with RECARGA, and I'm not sure what is causing the difference without getting down to the nitty gritty of the models a bit more. Does RECARGA give you a peak or total runoff value? If so, we could compare those numbers to see if that is causing a difference between the results from the 2 models... I've saved this table and runoff values for the 1 yr event in the spreadsheet here: S:\Walkerton\PROJECTS\05\050919_PrettyLake_LARE\03_Feasibility\Data\For Ann Arbor\20081210 Data for Ann Arbor.xls

	9" ponding		12" ponding		18" ponding
v1: roof and direct runoff					
minimum area for 1" rainfall (24 hr)	**1600 SF**		**1300 SF**		**1000 SF**
minimum area for 1" rainfall (6 hr)	**1900 SF**		**1600 SF**		**1200 SF**
minimum area for 1 yr event (24 hr)	**3800 SF**		**3100 SF**		**2300 SF**
Ponding time for 1" event (24 hr)	**2.25 hr**		**3 hr**		**4.75 hr**
Ponding time for 1 yr event	**7.75 hr**		**10 hr**		**17.25 hr**
v2: entire watershed					
minimum area for 1" rainfall (24 hr)	**2400 SF**		**1950 SF**		**1450 SF**
minimum area for 1" rainfall (6 hr)	**2800 SF**		**2350 SF**		**1850 SF**
minimum area for 1 yr event (24 hr)	**5600 SF**		**4500 SF**		**3300 Sf**
Ponding time for 1" event (24 hr)	**2.5 hr**		**3.5 hr**		**5.25 hrs**
Ponding time for 1yr event	**7.5 hr**		**10.75 hr**		**19.5 hrs**
NOTE: Ponding times assume basin sized for 1 year event					

Please let me know if you have any questions, or if you need anything else.

Thanks,
Erin

From: Mark Pranckus
Sent: Monday, December 15, 2008 11:05 AM
To: Erin Switala
Subject: RE: SWMM inputs

Nope. Max ponding depth of 9". My earlier statement assumed that the basin would be dry between rain events so we had 9" X surface area's worth of stormwater storage.

Thanks for checking.

Mark Pranckus
Ecological Resource Specialist

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From: Erin Switala
Sent: Monday, December 15, 2008 11:01 AM
To: Mark Pranckus
Subject: RE: SWMM inputs

Mark,

So with a 2 ft berm and 9" of freeboard, does that mean you want a max ponding depth of 15 inches, or the entire 2 ft?

Just want to make sure I'm on the same page...

Thanks,
Erin

From: Mark Pranckus
Sent: Monday, December 15, 2008 9:45 AM
To: Erin Switala
Subject: RE: SWMM inputs

1. I believe those are gravel areas that correspond to playground equipment. I didn't include them into the impervious estimate.
2. No soil amendments. The sandy loam has more than enough infiltration.
3. Yes, there will be a U-shaped berm to match the topography. The freeboard in the basin will be 9-in with a total berm height of a 1-2'. You nailed it right on the head.

By the way, I gave you the wrong labor code. Please bill you time to the 150 (design) labor code.

Thanks,
Mark

Mark Pranckus
Ecological Resource Specialist

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From: Erin Switala
Sent: Monday, December 15, 2008 9:39 AM
To: Mark Pranckus
Subject: RE: SWMM inputs

Mark,

I will be working on setting up the SWMM model this morning and hopefully get you some answers this afternoon or tomorrow. I have a couple of questions:

1) There are several gray/tan areas on the aerial photo. Do you know if these are gravel, pavement, or dirt?
2) Are you planning to do any soil amendments in the raingardens? If so, how deep are you thinking? I'm guessing no since it's sandy loam, just wanted to double check.
3) Were you assuming a berm around the raingarden? I'm guessing 1-2 ft high looking at the topography, depending on how much grading etc is done..

Thanks,
Erin

From: Mark Pranckus
Sent: Friday, December 12, 2008 9:44 AM
To: Erin Switala
Subject: RE: SWMM inputs

Erin,

Here is the requested data. Copy to your server, if needed.

S:\Walkerton\PROJECTS\05\050919_PrettyLake_LARE\03_Feasibility\Data\For Ann Arbor

The two questions that I'm looking for SWMM to support the RECARGA modeling is for each of the two watershed scenarios are:

What is the minimum raingarden size to capture the first 1" of rain? I've modeled 700 sqft and 1200 sqft for the small and larger watershed sizes, respectively.

What is the total ponding time for 1", 1.5", 2.0" inch rain events in each of the basins? I've used a Ksat of 2.0 in/hour, which is on the conservative side of the soil survey estimates.

Here's a brief synopsis of my results from RECARGA. I'm going to tweak it a little, but fundamentally, it's going to tell me the same thing.

- For the small watershed, a basin of 700 sqft will capture 1" of rain; however to capture up to the 2.17" 1-yr 24-hour event we need an 1800 sqft basin to prevent overtopping
- For the large watershed, a basin of 1200 sqft will capture 1" of rain; however to capture 1.5" need a 2500 sq ft of basin before it overtops.
- THM – Can get a basin to capture 1" of rain; however, to capture anymore it needs to be significantly larger.
- THM – Ponding greater than 48 hours should not be a problem

Let me know if you SWMM model supports or refutes this information.

Please bill to 050919.03 Labor Code 149

Thanks,
Mark

Mark Pranckus
Ecological Resource Specialist

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From: Erin Switala
Sent: Wednesday, December 10, 2008 3:52 PM
To: Mark Pranckus
Subject: SWMM inputs

Mark,

Here's a list of the kinds of inputs we will need for the SWMM model:

Watershed size (ac)
Overall watershed slope (%)
Longest flow path
Width
% impervious cover (can be estimated from land use or aerial)
Type of prominent land cover for impervious and pervious areas (i.e. is it forested or lawn?) – we'll use this to figure out mannings n and surface storage
Soil texture for the watershed (i.e. silt loam, etc) - if it has many soil types we can do a weighted avg of the major types

Approximate site location for determining the design rainfall events

Then for the raingarden itself send anything you have in the way of a site plan or any constraints, also any soils info (or if you plan to enhance soils), etc.

That should cover most of it. Let me know if you have any questions on any those above.

Erin

Erin Switala
Ecological Resource Specialist
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Ann Arbor, MI 48104
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eswitala@jfnew.com www.jfnew.com

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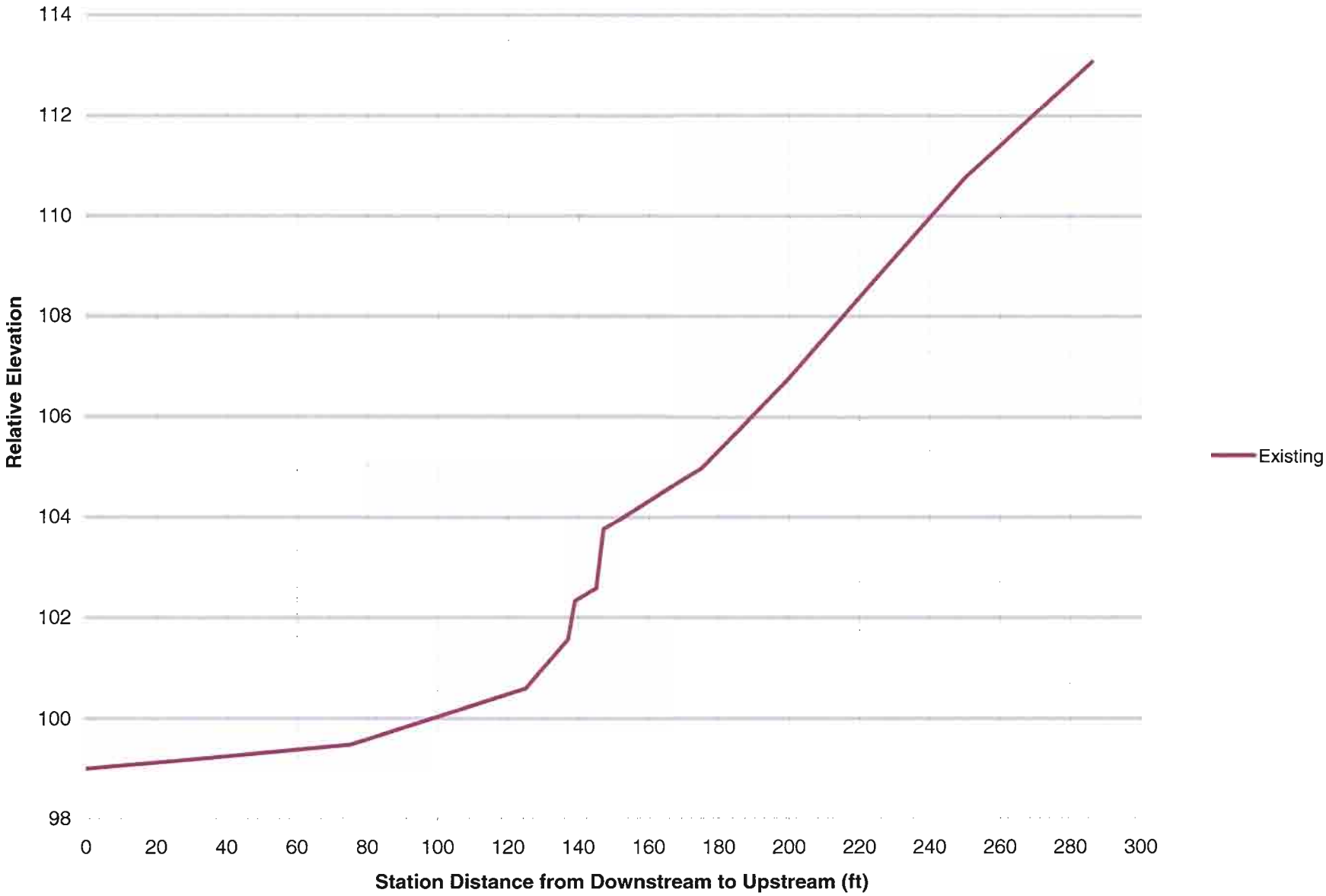
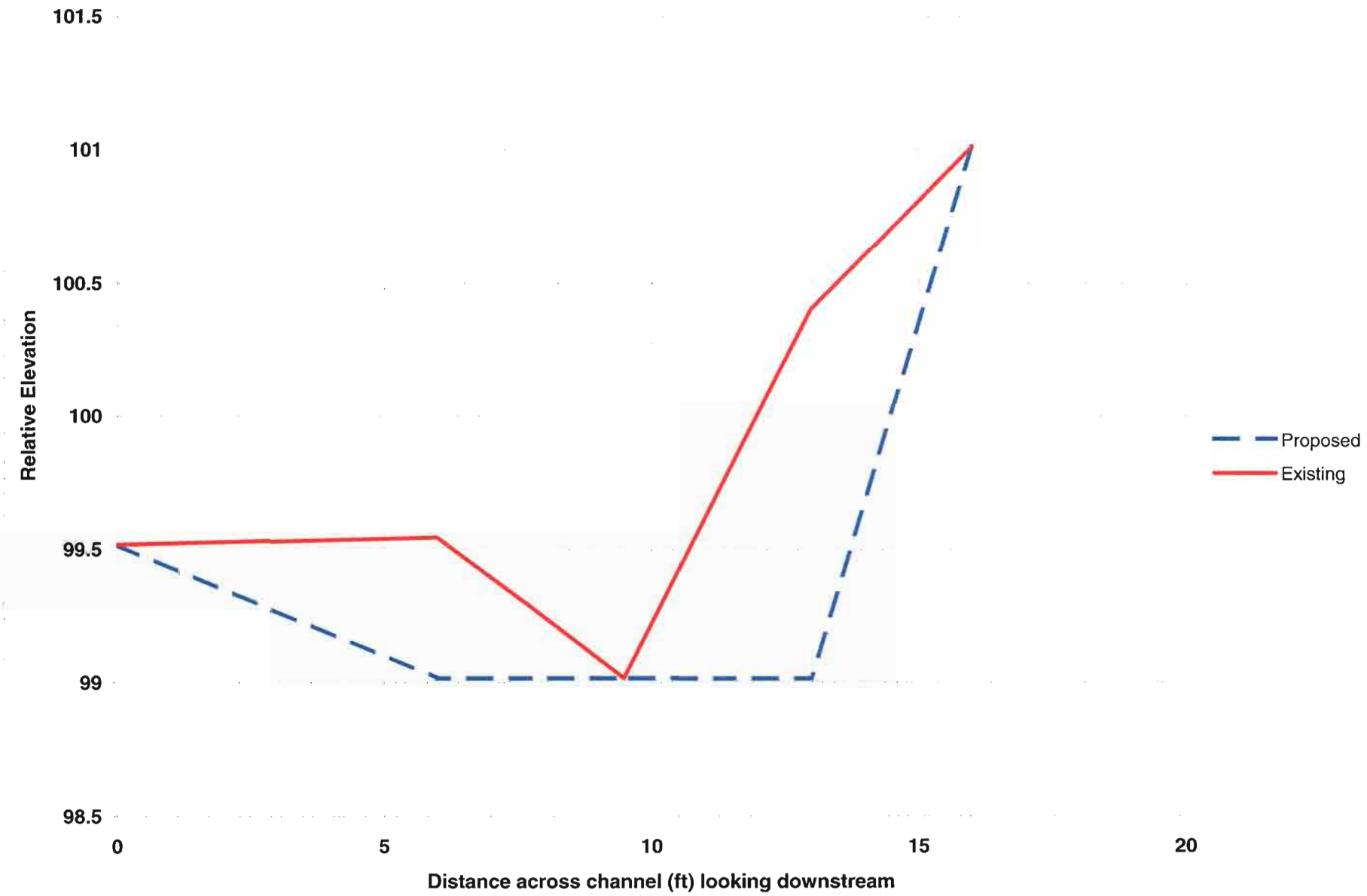
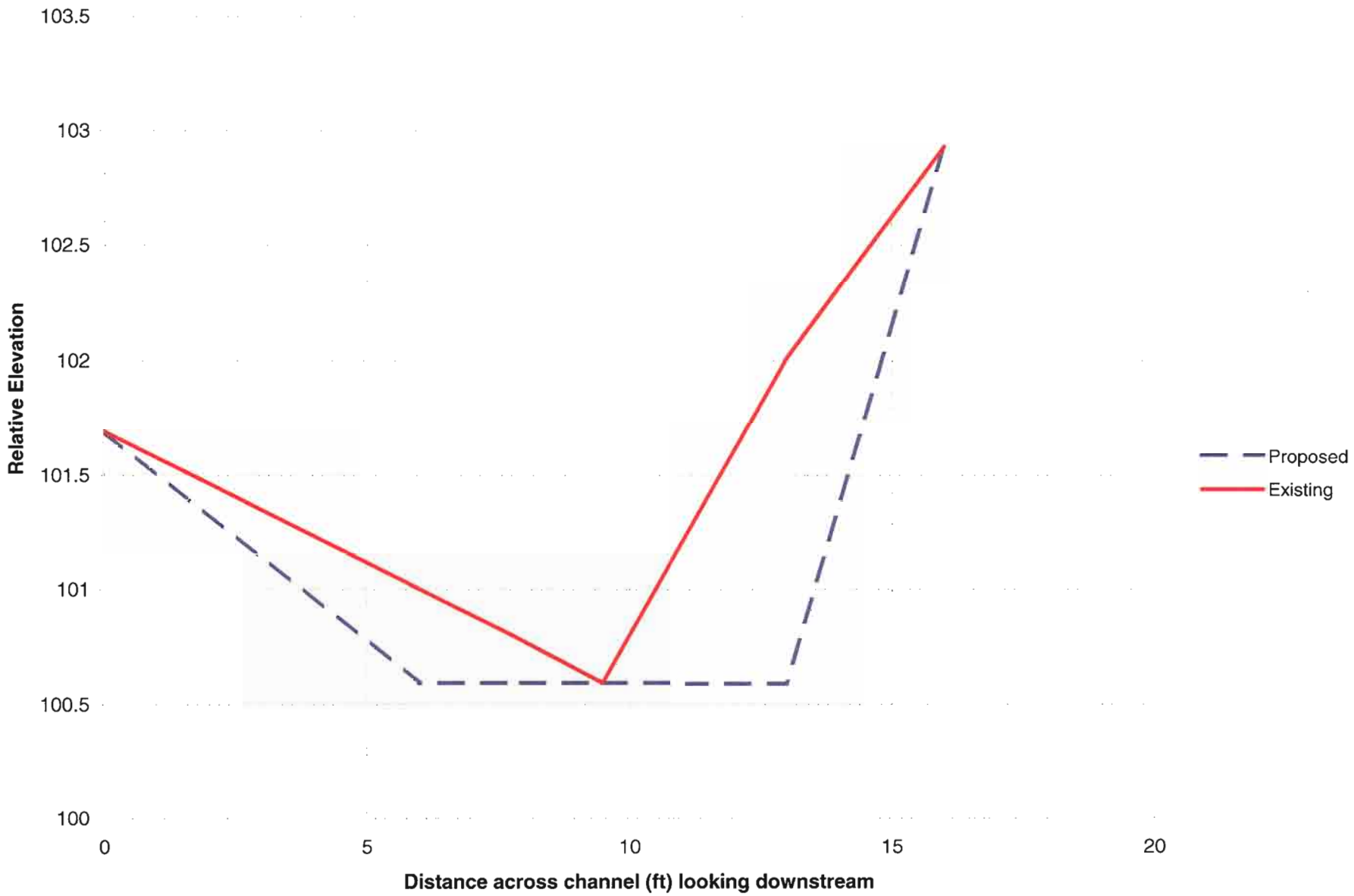


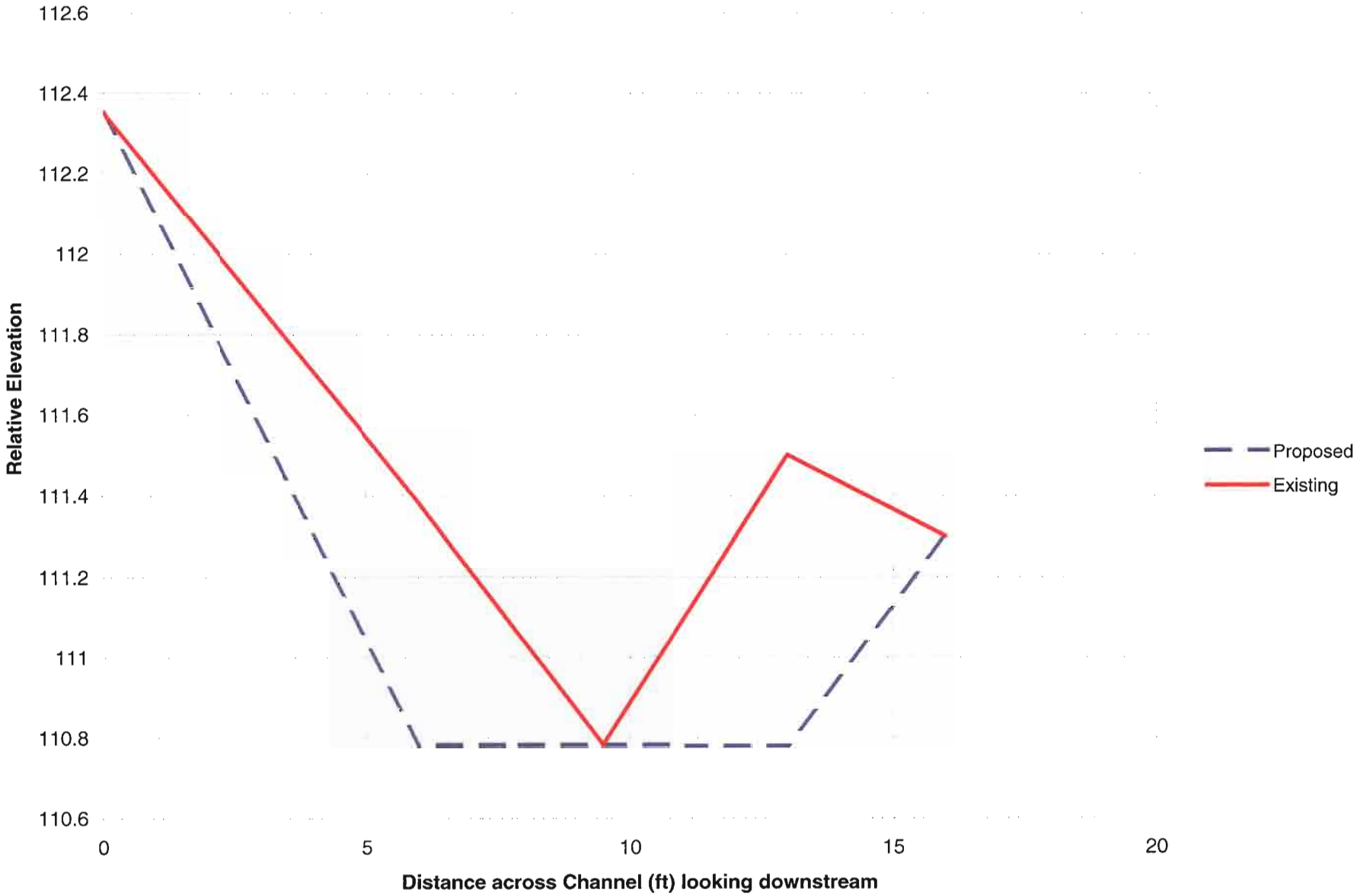
Site 3 Station 0+00



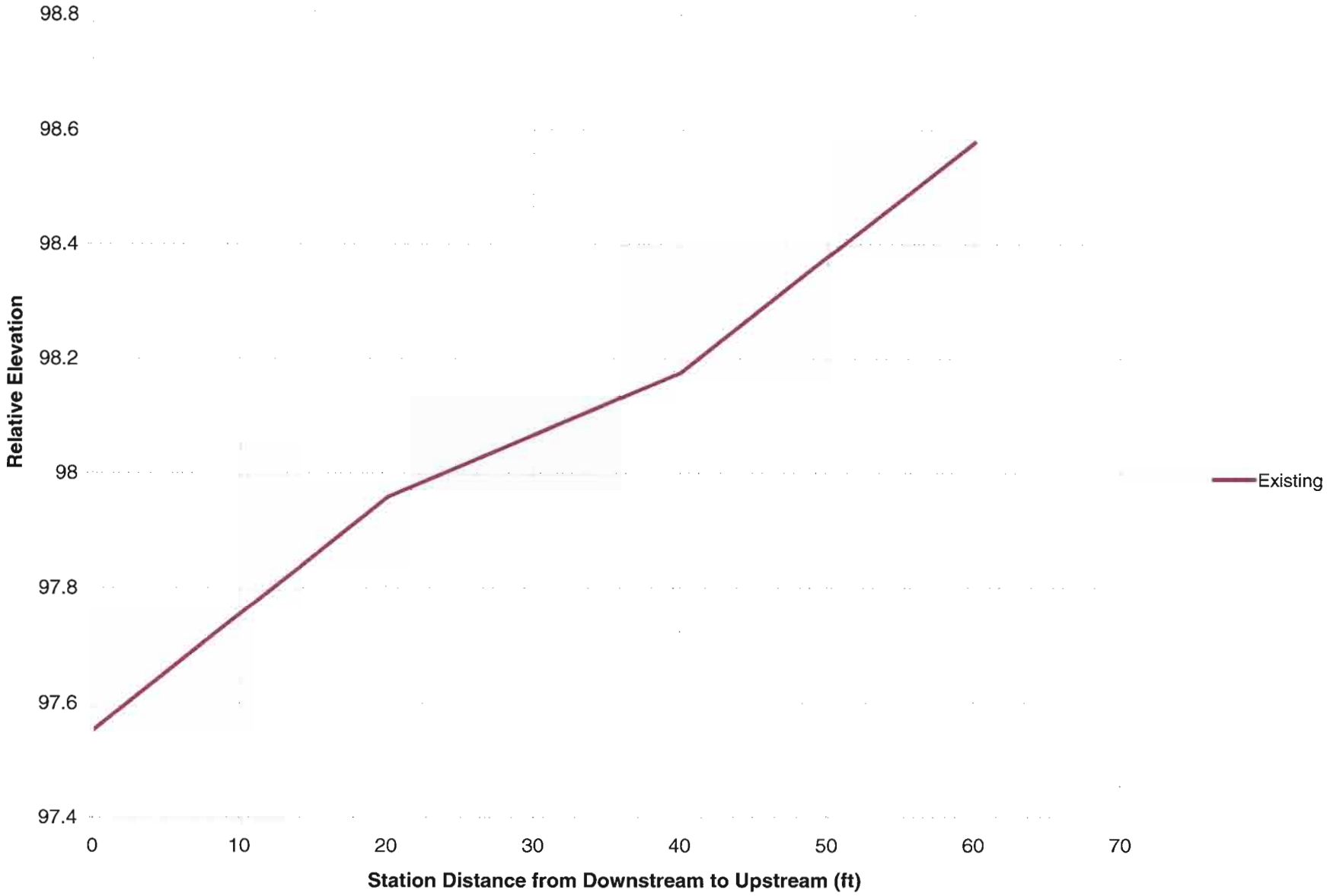
Site 3 Station 1+25



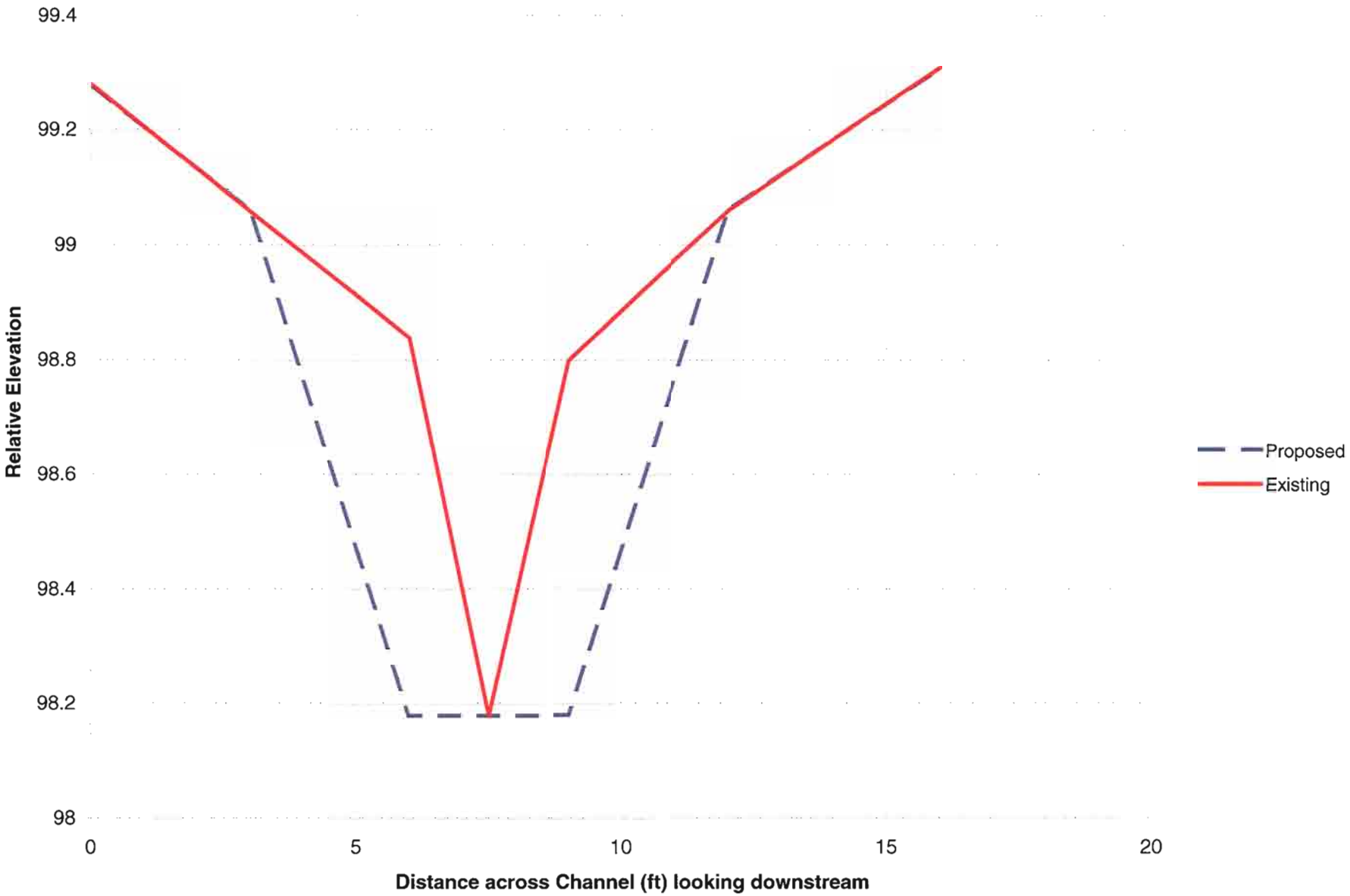
Site 3 Station 2+50



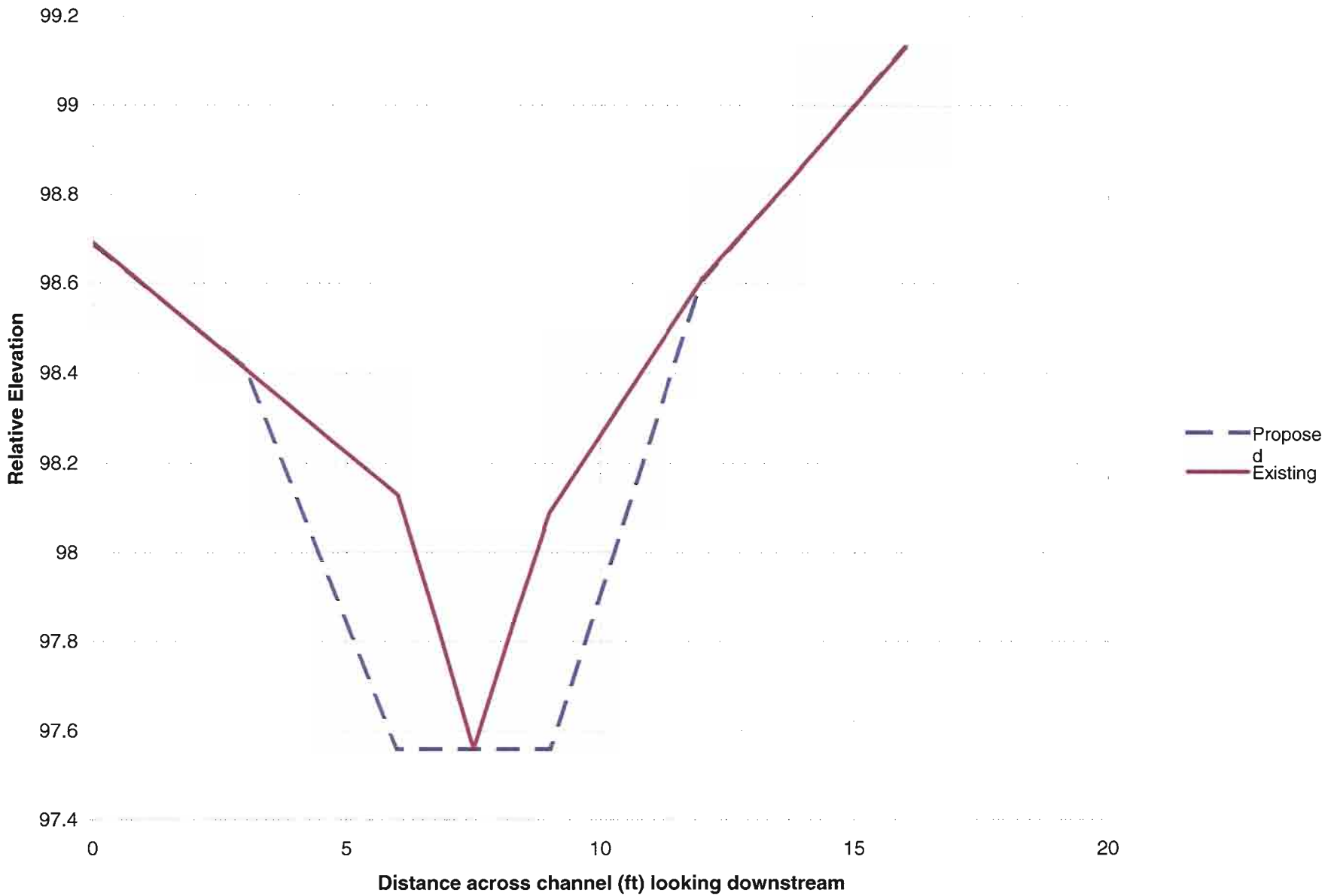
Site 4 Center Line Profile A



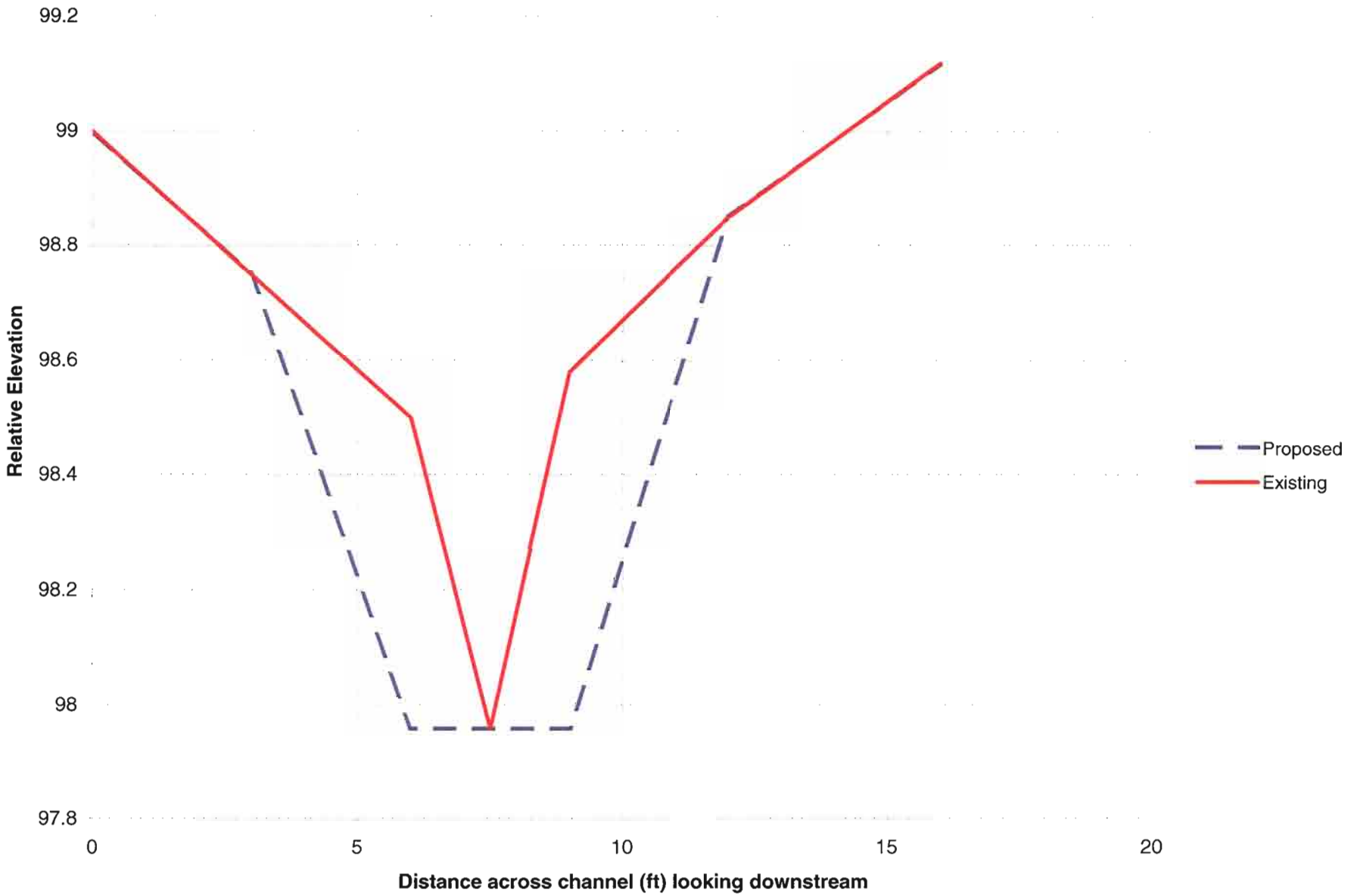
Site 4 Station 0+40 A



Site 4 Station 0+00 A



Site 4 Station 0+20 A



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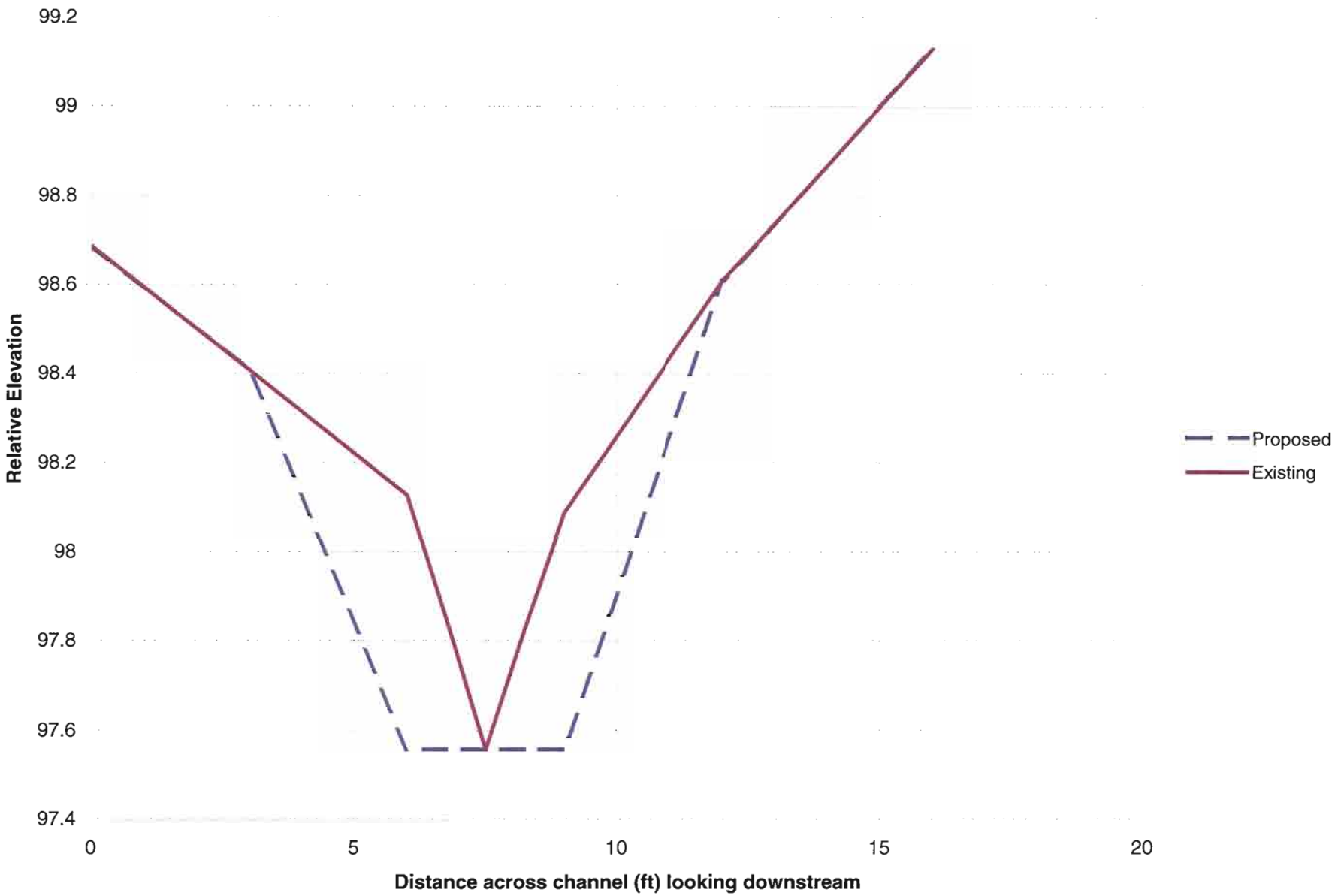
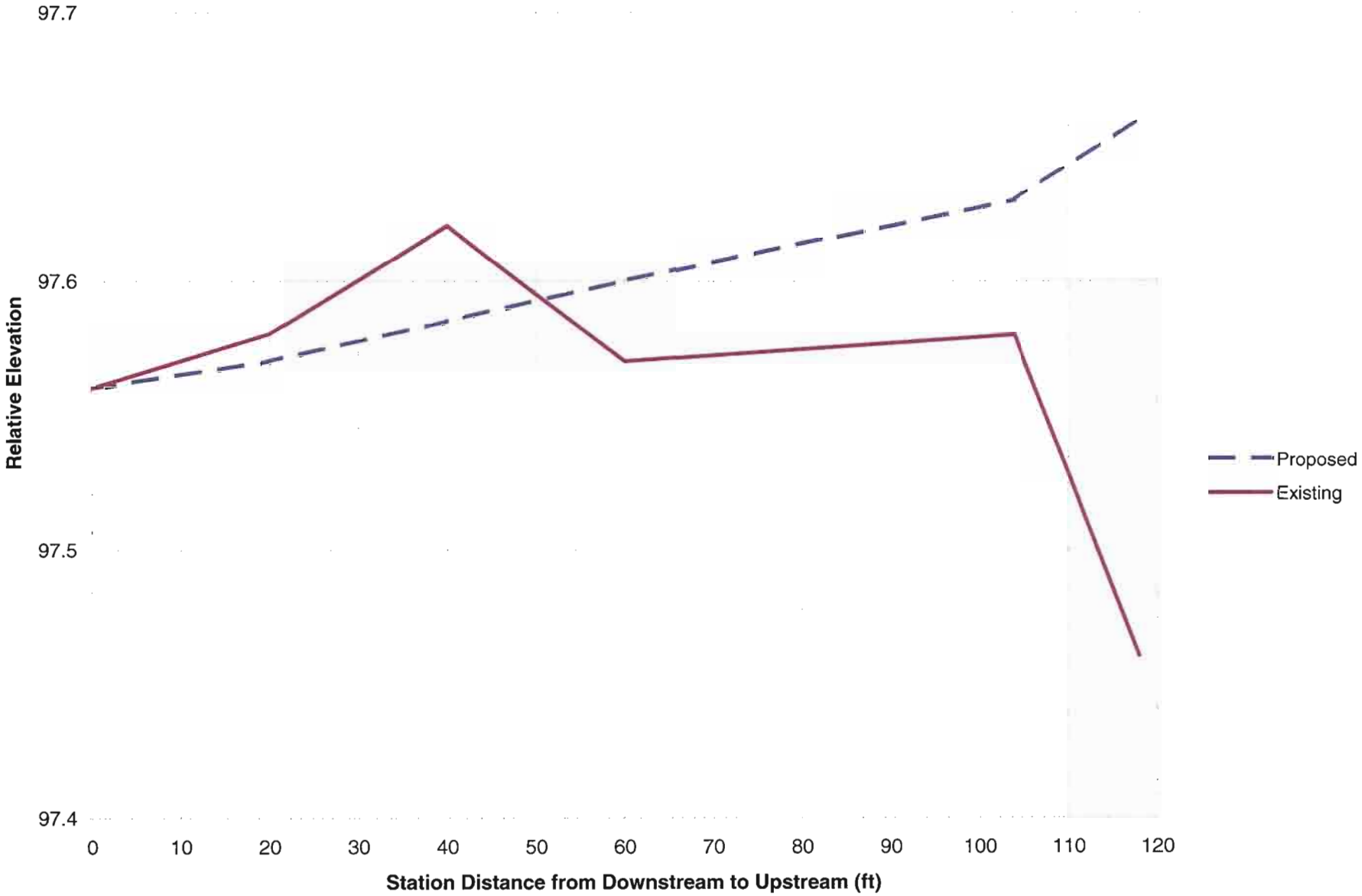
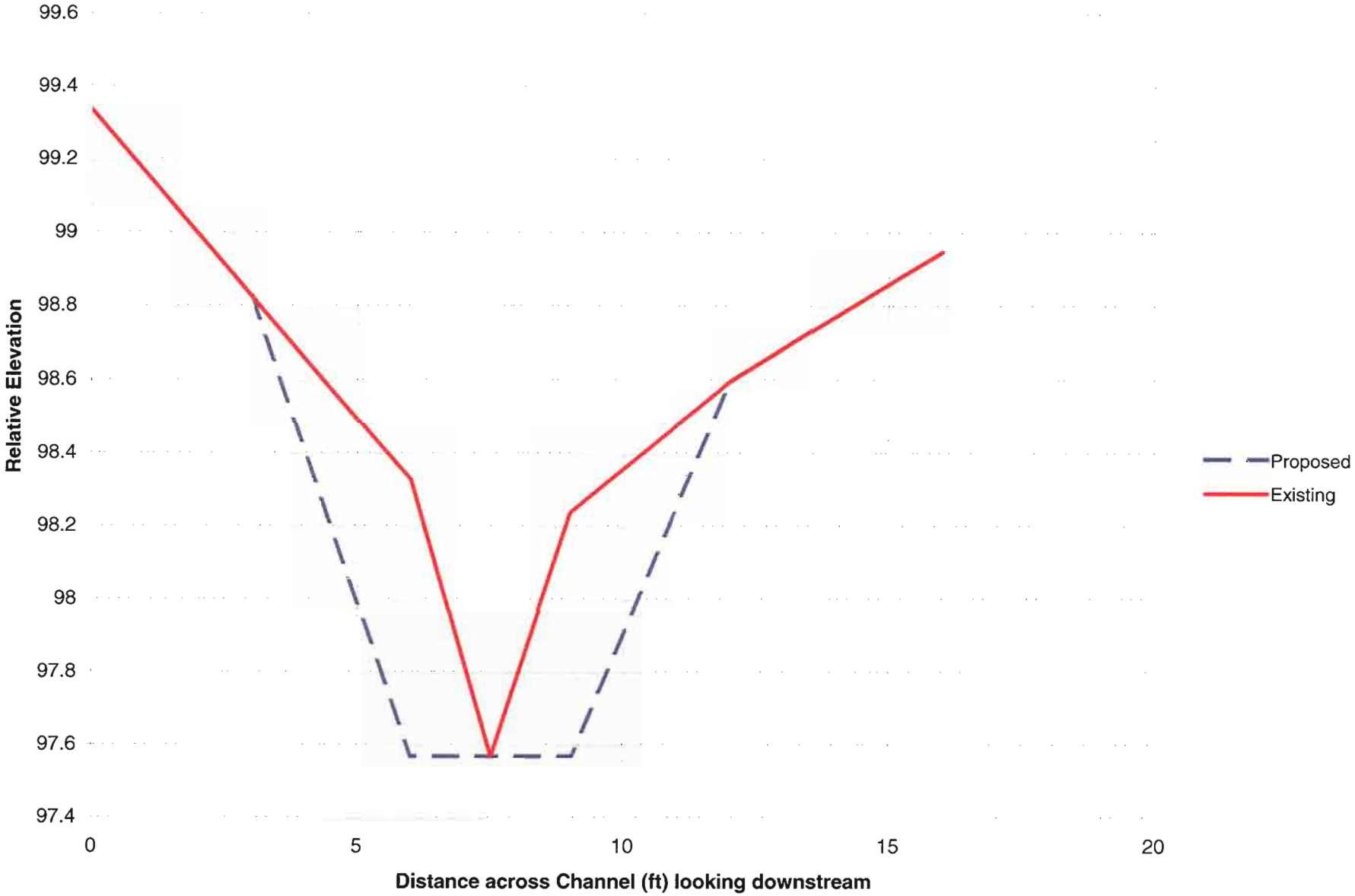


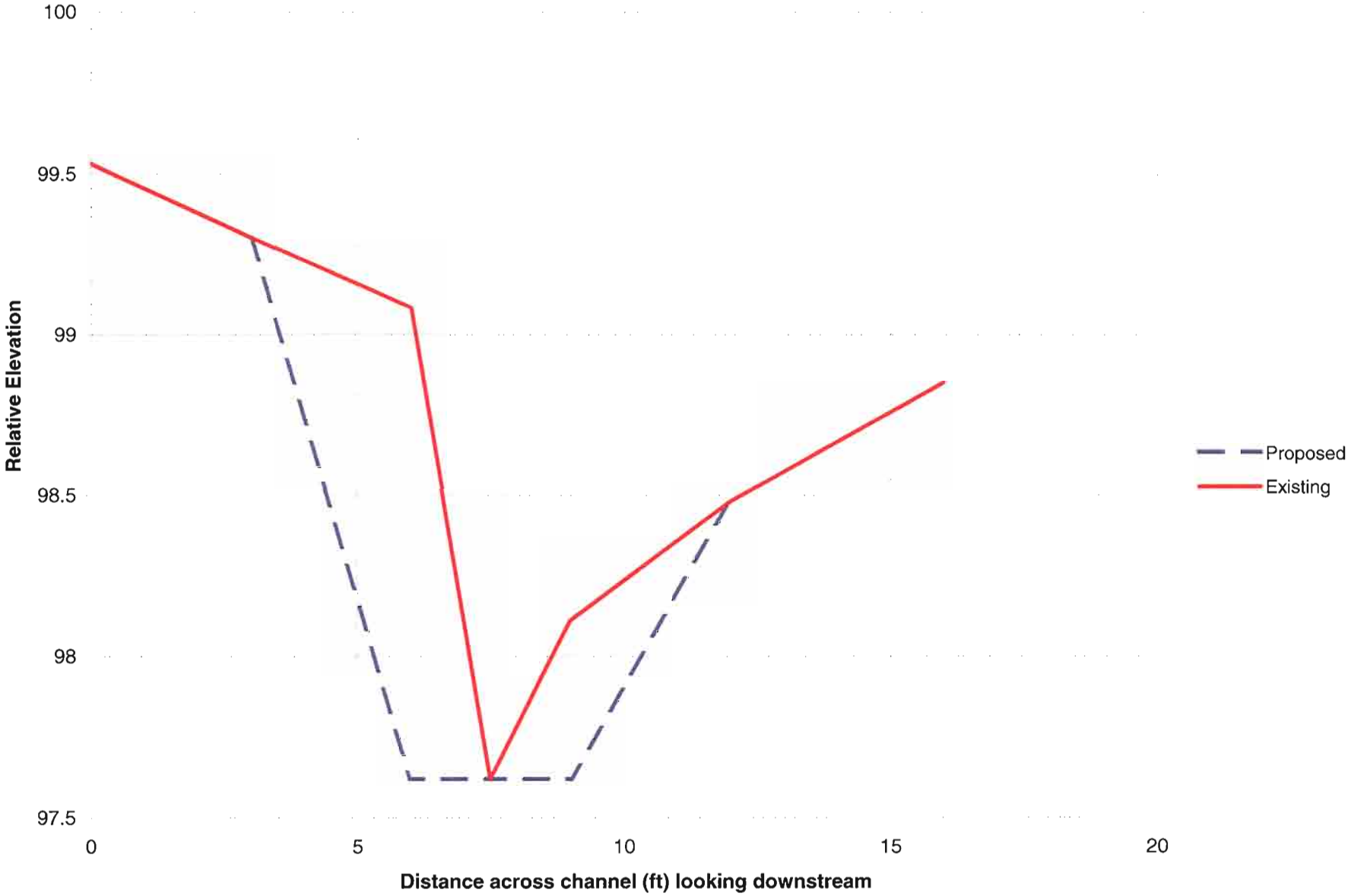
Site 4 Center Line Profile A



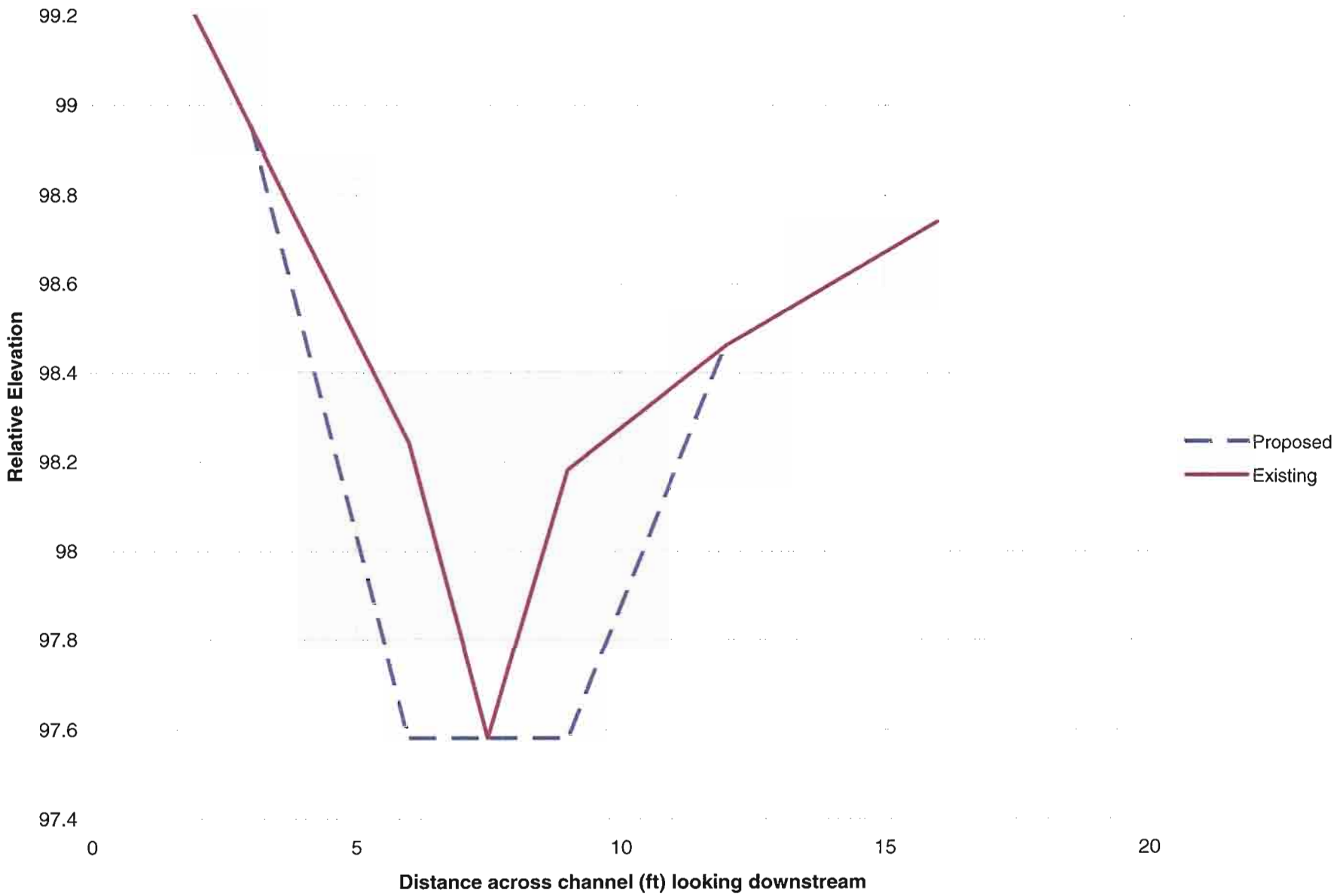
Site 4 Station 0+60 B



Site 4 Station 0+40 B



Site 4 Station 0+20 B



JFNew

JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

Design Criteria

10 yr - 24 Hr Rainfall = 3.9"

Curve Number = 75 (Straight Row - No-till)

Inches of runoff = 1.60"

Drawdown = 24 Hr.

Drainage Area = 2.8 ac.

Hydrologic Soils Group = "B" Wauseca soil series

25 yr - 24 Hr Rainfall = 4.4"

1.98"

Required Storage = 2.8 Ac x 1.60" runoff x 3630 = 16,262 cu.ft. (25 yr) (20,125)

Sediment Storage = 2.0 Tons x 2.8 ac. x 10 yrs = 56 Tons

56 Tons x 22 cu.ft per ton = 1232 cu.ft

Required Storage (16,262 cu.ft) + Sediment Storage (1232 cu.ft) = 17494 cu.ft. (21357 - 25 yr)

Area at Elevation

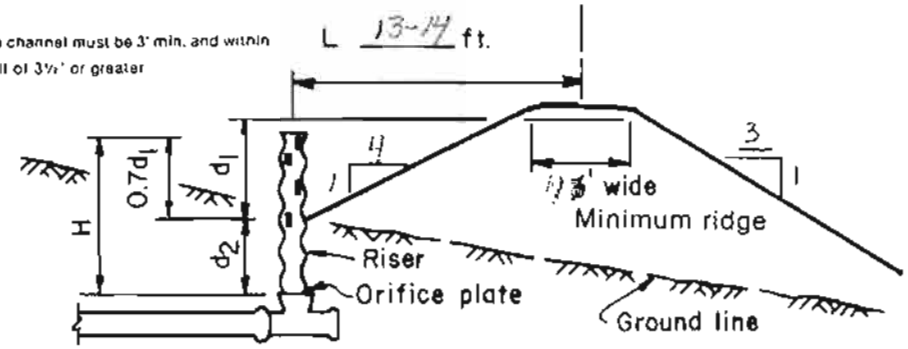
969.5 = 1800 sq.ft

971.0 = 7700 + 1800 = 9500 sq.ft

971.5 = 3100 + 9500 = 12600 sq.ft.

NOTE: This adjustment is [illegible]

Note. Riser height above channel must be 3' min. and within 6" of top of any fill of 3½' or greater



DESIGN HEAD FOR ORIFICE PLATE

REQUIRED STORAGE

Ridge No.	D.A Acres	Accum. D.A. / Acres	Required d Storage		
			Runoff Cu.Ft.	Sed. Cu.Ft.	Total Cu.Ft
25yr-24hr 1	2.8	2.8	19393	[illegible]	[illegible]

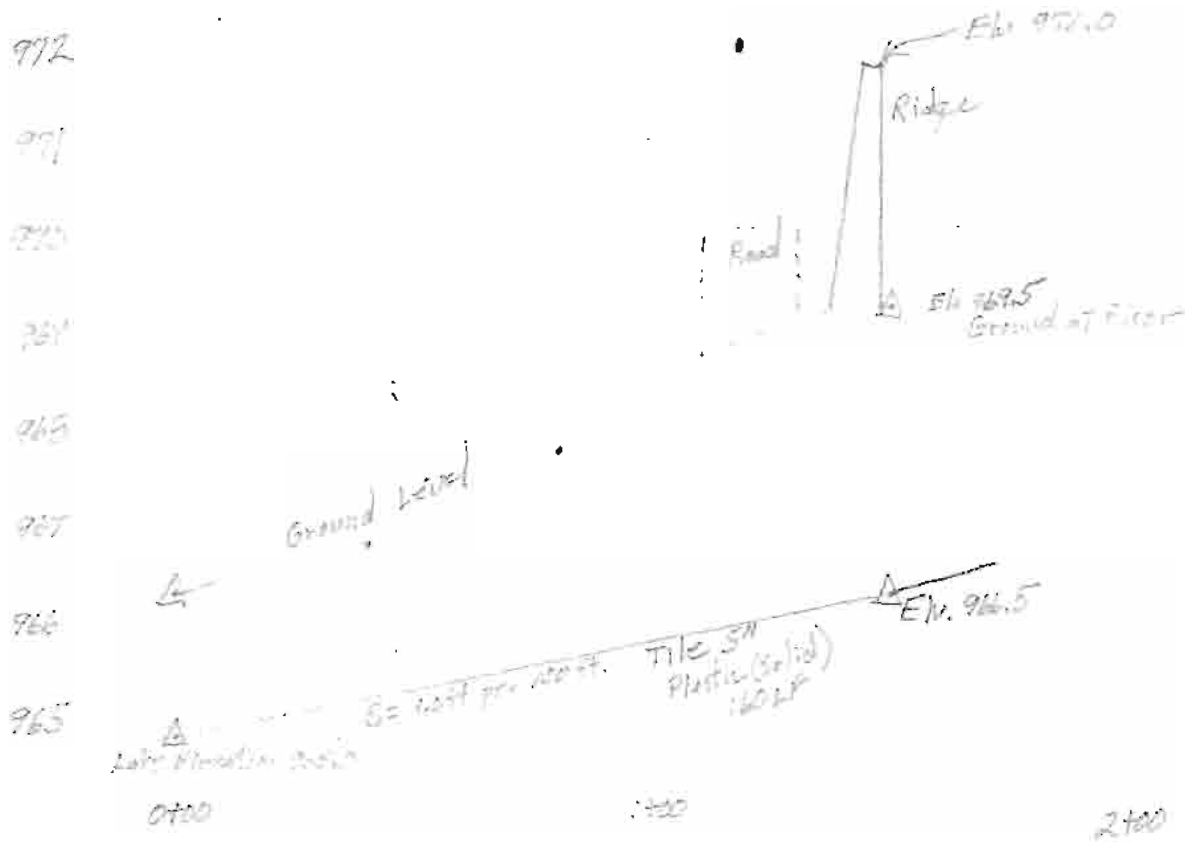
ORIFICE DESIGN

Ridge Length	Ridge Elev.	Channel Elev.	d_1 Ft	$0.7d_1$ Ft.	Orifice Elev.	d_2 Ft.	H Ft.
200	972.0	969.5	2.5	1.75			

ORIFICE DESIGN AND SUBSURFACE DRAIN

Ridge No.	Required Capacity CFS	Orifice Size Inches	Discharge Provided CFS	Accum. Discharge CFS	Drain Grade %	Drain Size Inches	Max. Drain Cap. CFS	Draw-down Hours	Channel Above Level Ridge		
									Depth Ft.	Channel Grade %	Vel 1 FPS
1	[illegible]	[illegible]	0.25	[illegible]	1.0	5	[illegible]	36	—	—	—

1 /SHOW VELOCITY ONLY IF GRADE EXCEEDS 0.6%



Tile Profile

U. S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

Designed	Approved By
Drawn	Title
Traced	Title
Checked	Drawing No.

AVAILABLE STORAGE COMPUTATION

Ridge number	Field slope %	Ridge elevation	Station	Design depth ft.	Cut depth ft.	Storage cu. ft./ft.	Average storage cu. ft./ft.	Dist. ft.	Storage cu. ft.
1	6	971.7	5+00	0	0	0			
	4	970.0	5+45	1.7	0	47.85	23.93	45	1077
	2	969.5	5+85	2.2	0	140.36	94.11	40	3764
	1	970.0	6+15	1.7	0	155.6	147.98	30	4439
	0.5	971.7	6+70	0	0	0	77.8	55	4279
									13559
1	6	971.8	5+00	0	0	0			
	4	970.0	5+50	1.8	0	53.46	26.73	50	1337
	2	969.5	5+90	2.3	0	153.70	103.58	40	4143
	1	970.0	6+20	1.8	0	174.96	164.33	30	4929
	0.5	971.8	6+80	0	0	0	87.48	60	5249
									15658
		—	Yardage	Computations	—				
(4:1 FS, 3:1 BS, 4.0' Top)									
			5+00	0	0				
	Elevation	971.7	5+50	1.8	0.2		.335	50	17
			5+90	2.3	1.04		.855	40	34
			6+20	1.8	0.17		.955	30	26
			6+80	0	0		.335	60	20
									97
Use	Elevation	972.0	5+00	0	0				
			5+55	2.0	0.82		0.41	55	23
			6+00	2.5	1.17		1.00	45	45
			6+50	2.0	0.82		1.00	50	50
			7+00	0	0		0.41	50	21
									139 cu yds
							20%		28
NOTE: Top soil stripping								Total	167 cu yds
	Basin - 50' x 150' x 0.667' = 185 cu yds								
	Ridge - 151' x 100' x 0.667' = 74 cu yds								

AVAILABLE STORAGE COMPUTATION

Ridge number	Field slope %	Ridge elevation	Station	Design depth ft.	Cut depth ft.	Storage cu. ft./ft.	Average storage cu. ft./ft.	Dist. ft.	Storage cu. ft.
1	6	972.0	5+00	0	0	0			
	6		5+55	2.0	0	49.3	24.7	55	1358
	3		6+00	2.5	0	129	89	45	4005
	1		6+50	2.5	0	216	173	50	8625
	0.5		7+00	0	0	0	108	50	5400
									19393
							Plus Excavation of 139 cu. yds. for Fill		3753
							From Basin	Area	23146

Cost Estimate

Rocky Lake - Sediment Basin

Tile Outlet

180	LF	5" Solid Plastic	0.75	120.00
20	LF	6" Sch 35 PVC - outlet pipe	2.50	50.00
1	Ea	Animal Guard		150.00
1	Ea	6" Hydrobrake Riser		120.00
1	Tak	Installation (Including Road) Dispose debris - Landscape around utilities (Assuming County will provide patching)		[illegible]
		sub-total		1105.00

Earth work

167	cu yds	Fill for Dike	3.00	501.00
74	cu yds	Top Soil Stripping for dike	4.00	296.00
165	cu yds	Top Soil Stripping for basin area	4.00	660.00
		Sub-Total		$ 1537.00

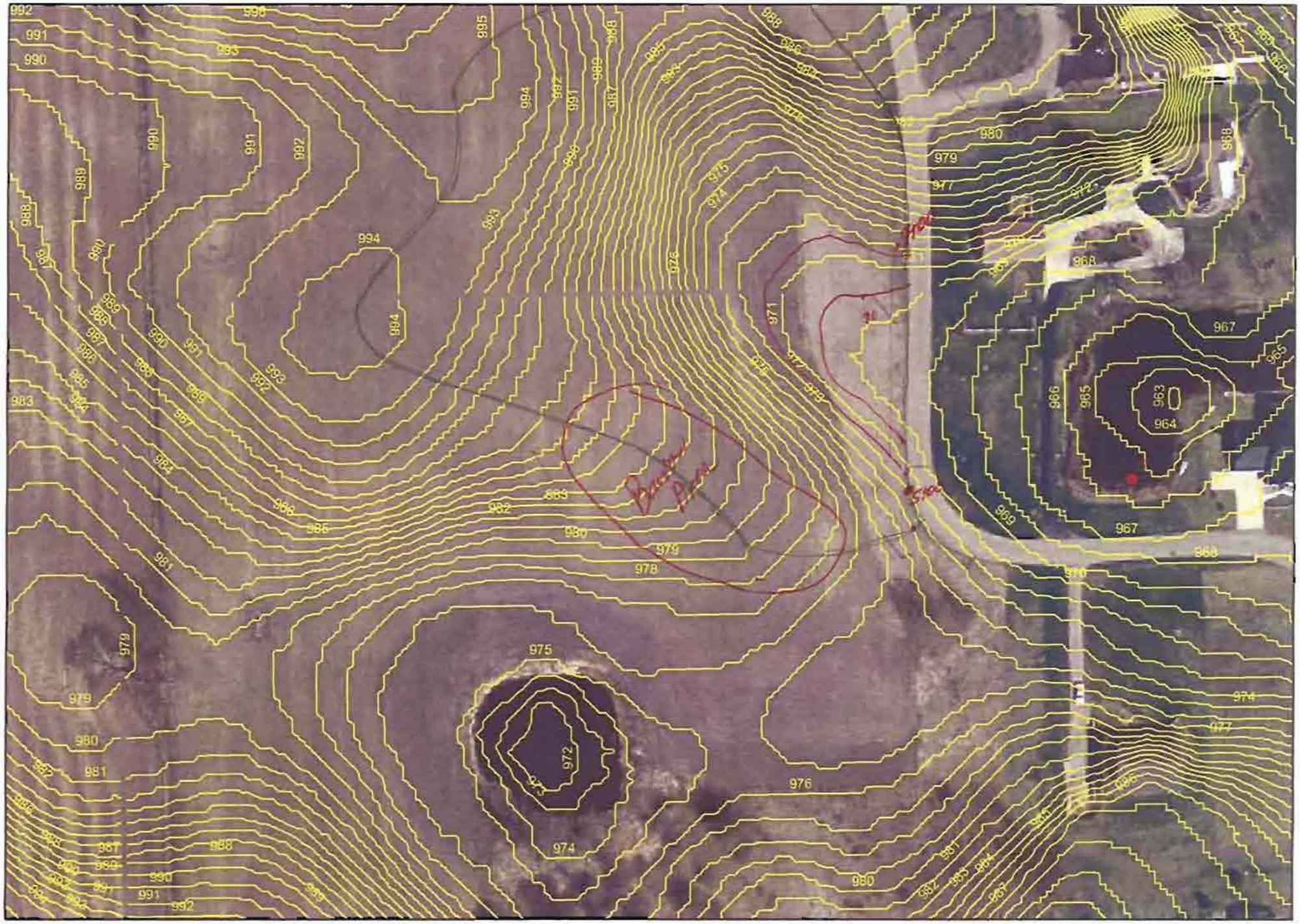
Seeding Disturbed Area and Dike

Seeding Basin

Permit to outlet tile into Lake [illegible]

Asphalt Patch Private Drive

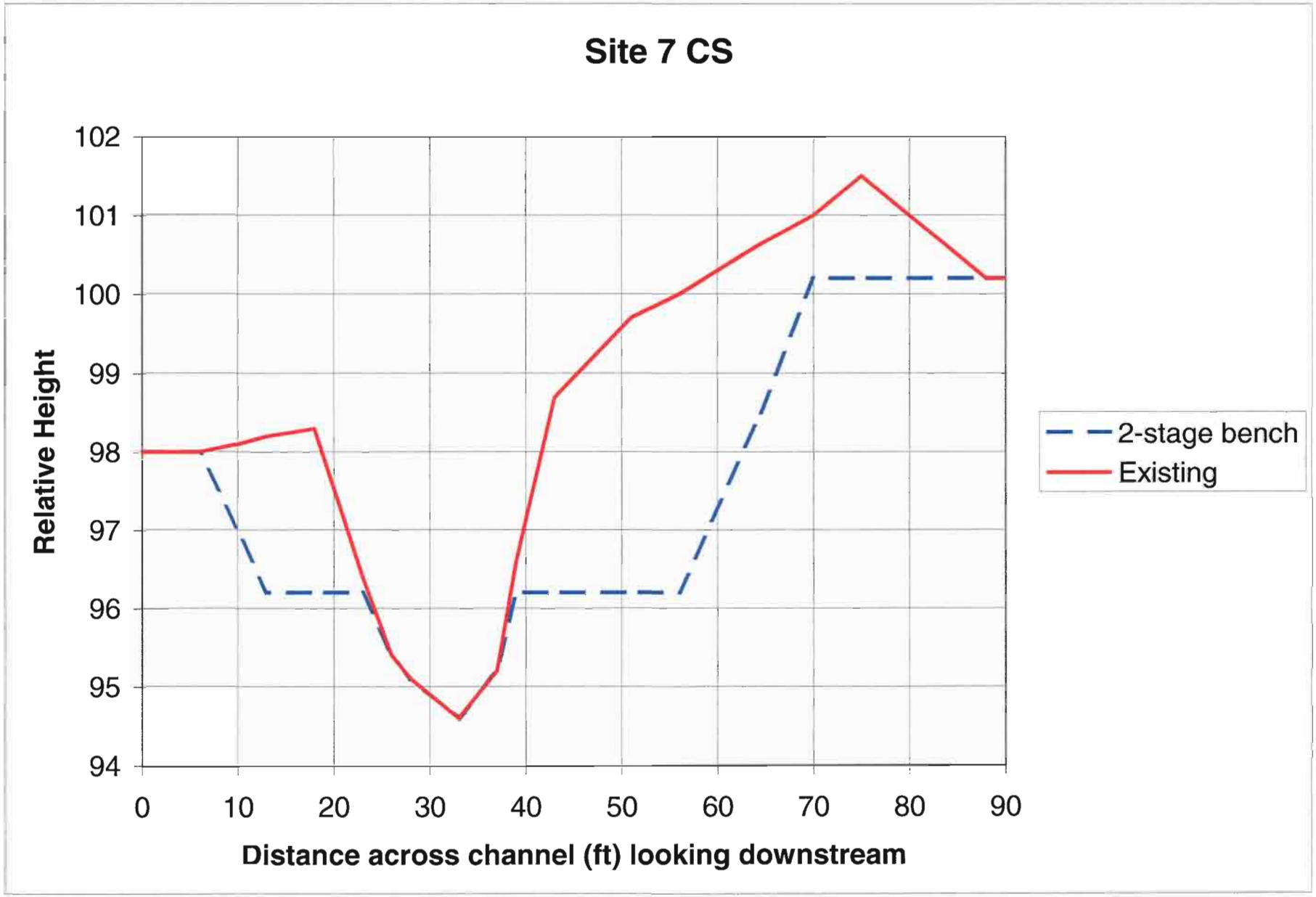
10% Total

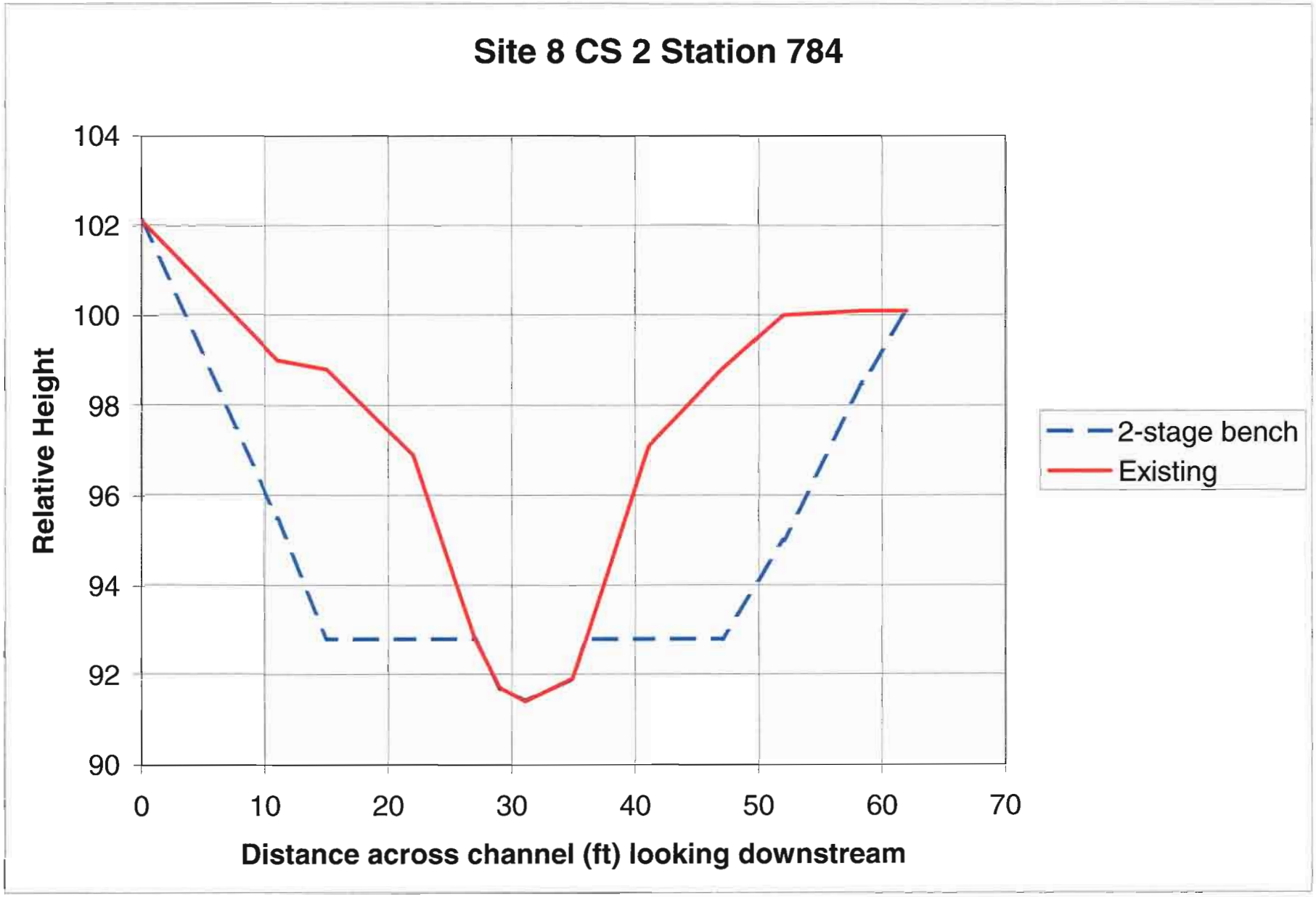


Site 5 Topographic Map

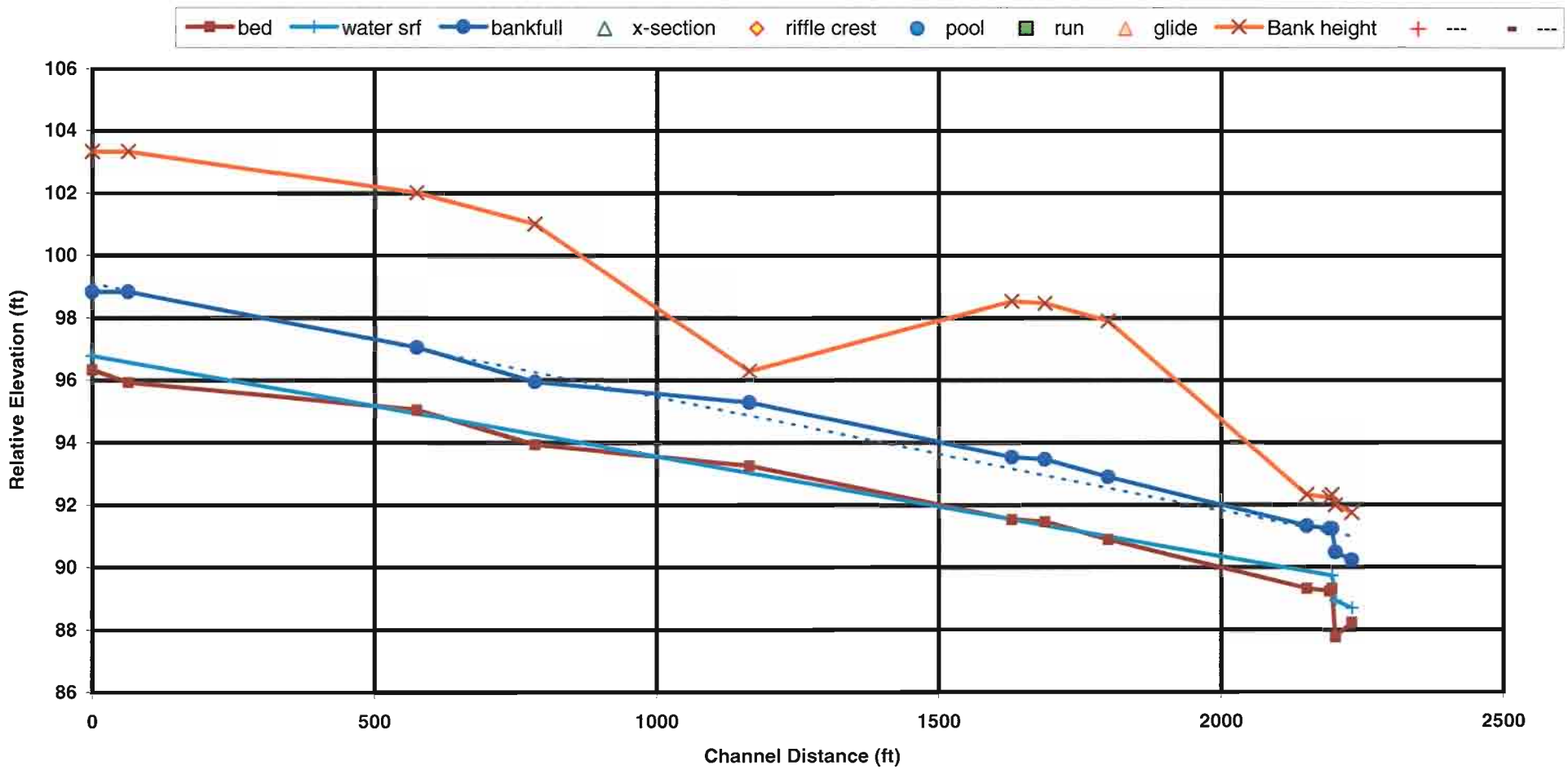
100sq.ft/Unit 2.8Ac

100 50 0 100 200 Feet


Site 7 CS
Relative Height
102
101
100
99
98
97
96
95
94
0
10
20
30
40
50
60
70
80
90
Distance across channel (ft) looking downstream
2-stage bench
Existing


Site 8 CS 2 Station 784
104
102
100
98
96
94
92
90
Relative Height
0
10
20
30
40
50
60
70
Distance across channel (ft) looking downstream
2-stage bench
Existing

Deal Ditch Site 8



APPENDIX D

PERMIT CORRESPONDENCE

JFNew
Full-Service Ecological Solutions™

708 Roosevelt Rd
Walkerton, Indiana 46574
Phone: 574-586-3400
Fax: 574-586-3446

Mark Pranckus
Aquatic Biologist
mpranckus@jfnew.com
Mobile: 574-229-8723

Corporate Office:
Walkerton, Indiana

Chicago, Illinois

Indianapolis, Indiana

Ann Arbor, Michigan

Grand Haven, Michigan

Cincinnati, Ohio

Madison, Wisconsin

Native Plant Nursery:
Walkerton, Indiana

www.jfnew.com

September 10, 2008

Indiana Department of Natural Resources
Christine Stanifer
402 West Washington St, Room W264
Indianapolis, IN 46204-2641

RE: Early coordination for proposed water quality improvement projects

Dear Christine,

The Pretty Lake Conservation Club (PLCC) in LaGrange County, Indiana is completing an Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) Program-funded feasibility study to improve water quality in Pretty Lake. Two proposed projects located in Milford Township 36 N, Range 11 E, Section 15, may require regulatory permits based on the conceptual designs. As part of the feasibility study, the PLCC is requesting your preliminary comments on the proposed projects. Enclosed is a brief description of the proposed projects including identified impacts to aquatic resources. Construction would be funded by grants over several years from the LARE program

Please review and provide your comments about the projects to be included in the final draft of the feasibility study. Comments may be submitted directly to me at the address provided on the left hand side of the letter or via email at mpranckus@jfnew.com. We would appreciate your comments by October 30, 2008.

The future applicant's contact information is below, if needed for the review process.

Jim Mertz
Pretty Lake Conservation Club
4690 South 930 East
Wolcottville, Indiana 46795
260-336-6065

Thanks,

Mark Pranckus

CC: JFN 050919.03

JFNew
Full-Service Ecological Solutions™

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Cincinnati, Ohio

Madison, Wisconsin

Native Plant Nursery:
Walkerton, Indiana

www.jfnew.com

September 10, 2008

U.S. Army Corps of Engineers
Regulatory Office CELRE-ET-RG
P.O. Box 1027
Detroit, MI 48231-1027

RE: Early coordination for proposed water quality improvement projects

To Whom It May Concern:

The Pretty Lake Conservation Club (PLCC) in LaGrange County, Indiana is completing an Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) Program-funded feasibility study to improve water quality in Pretty Lake. Two proposed projects located in Milford Township 36 N, Range 11 E, Section 15, may require regulatory permits based on the conceptual designs. As part of the feasibility study, the PLCC is requesting your preliminary comments on the proposed projects. Enclosed is a brief description of the proposed projects including identified impacts to aquatic resources. Construction would be funded by grants over several years from the LARE program

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Thanks,

Mark Pranckus

CC: JFN 050919.03

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Grand Haven, Michigan

Cincinnati, Ohio

Madison, Wisconsin

Native Plant Nursery:
Walkerton, Indiana

www.jfnew.com

September 10, 2008

Indiana Department of Environmental Management
401 Water Quality Section
WQ 65-42
100 N. Senate Ave.
Indianapolis, IN 46204-2251

RE: Early coordination for proposed water quality improvement projects

Dear Brad,

The Pretty Lake Conservation Club (PLCC) in LaGrange County, Indiana is completing an Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) Program-funded feasibility study to improve water quality in Pretty Lake. Two proposed projects located in Milford Township 36 N, Range 11 E, Section 15, may require regulatory permits based on the conceptual designs. As part of the feasibility study, the PLCC is requesting your preliminary comments on the proposed projects. Enclosed is a brief description of the proposed projects including identified impacts to aquatic resources. Construction would be funded by grants over several years from the LARE program

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The future applicant's contact information is below, if needed for the review process.

Jim Mertz
Pretty Lake Conservation Club
4690 South 930 East
Wolcottville, Indiana 46795
260-336-6065

Thanks,

Mark Pranckus

CC: JFN 050919.03

Project Background

The Pretty Lake Conservation Club (PLCC) in LaGrange County, Indiana received a grant from the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) Program to study the feasibility of several projects to improve water quality for Pretty Lake and aquatic resources within Pretty Lake. Two projects were identified that may require regulatory permits based on the conceptual designs. Each project is described in scope and impact below. Basic supporting figures are included for evaluation proposes. The objective of this early coordination is to solicit agency feedback about the purposed projects. This information should not be viewed as any form of an application to complete the outlined activities. A formal application will follow after the PLCC decides to move forward with a more comprehensive design.

Project Locaitons

Both projects are located within the Pretty Lake Watershed in LaGrange County, Indiana (Figure 1).

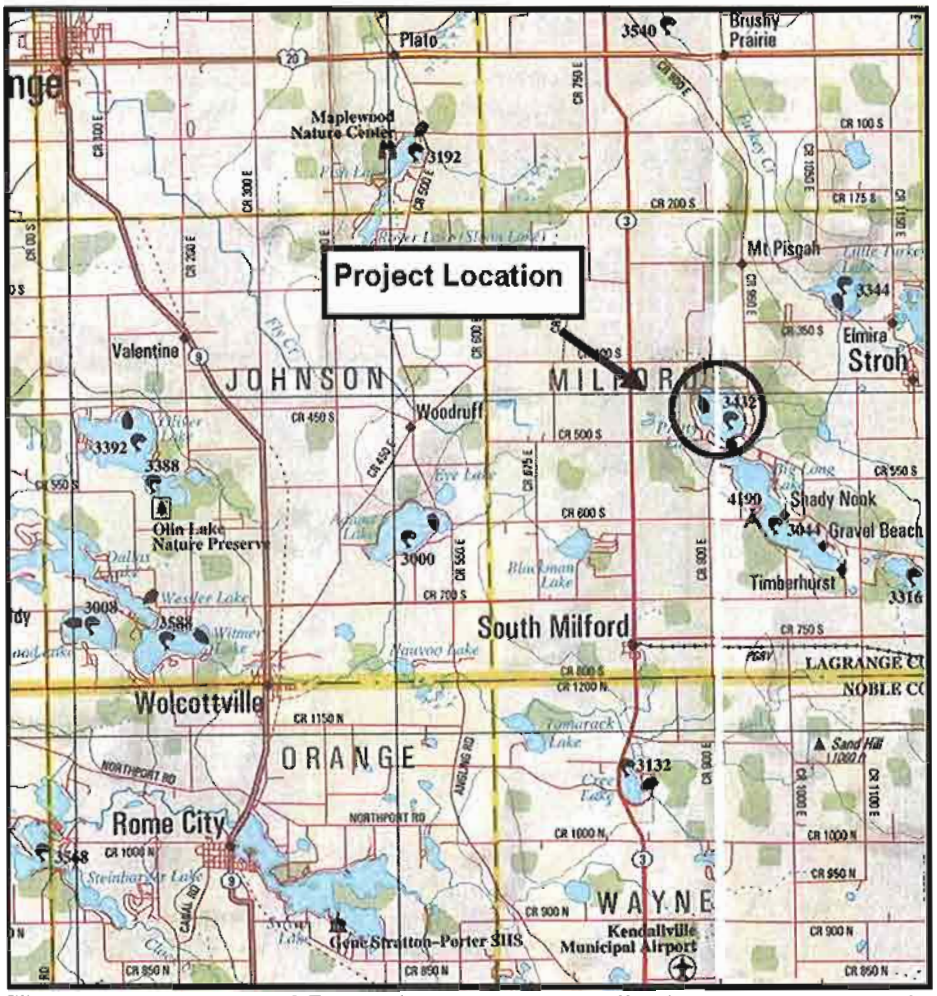

Figure 1. Location of Pretty Lake water quality improvement projects.

Site 1-Grassy Swale

The area is a small channelized drainage, roughly 170 feet in total length that flows to a catch basin, which flows directly to Pretty Lake. The drainage is divided into two sections, one positioned perpendicular to E 480 S (Figure 2; Figure 3) and another running parallel to E 480 S (Figure 2; Figure 4). A NWI wetland is located to the South of Site 1 (Figure 2) and is identified as a forested/shrub wetland. Water from the NWI wetland is assumed to flow out through the channel set perpendicular to E 480 S during periods of high water. Both channels are about 3 feet wide and dominated by turf grass. The conceptual design at Site 1 is to construct a grassy swale to control erosion, thereby reducing the amount of sediment and nutrients entering the lake. The current channel would be widened to roughly 6 feet, seeded with native grasses and erosion materials installed (Figure 4; Figure 5). All materials excavated from Site 1 would be deposited in a proper upland site. The elevation of the channel bed would not be altered so that the hydrology of the existing wetland would not be impacted. A grassy swale composed of native plants would increase channel stability, reducing erosion and slowdown water movement allowing sediments and nutrients time to settle.

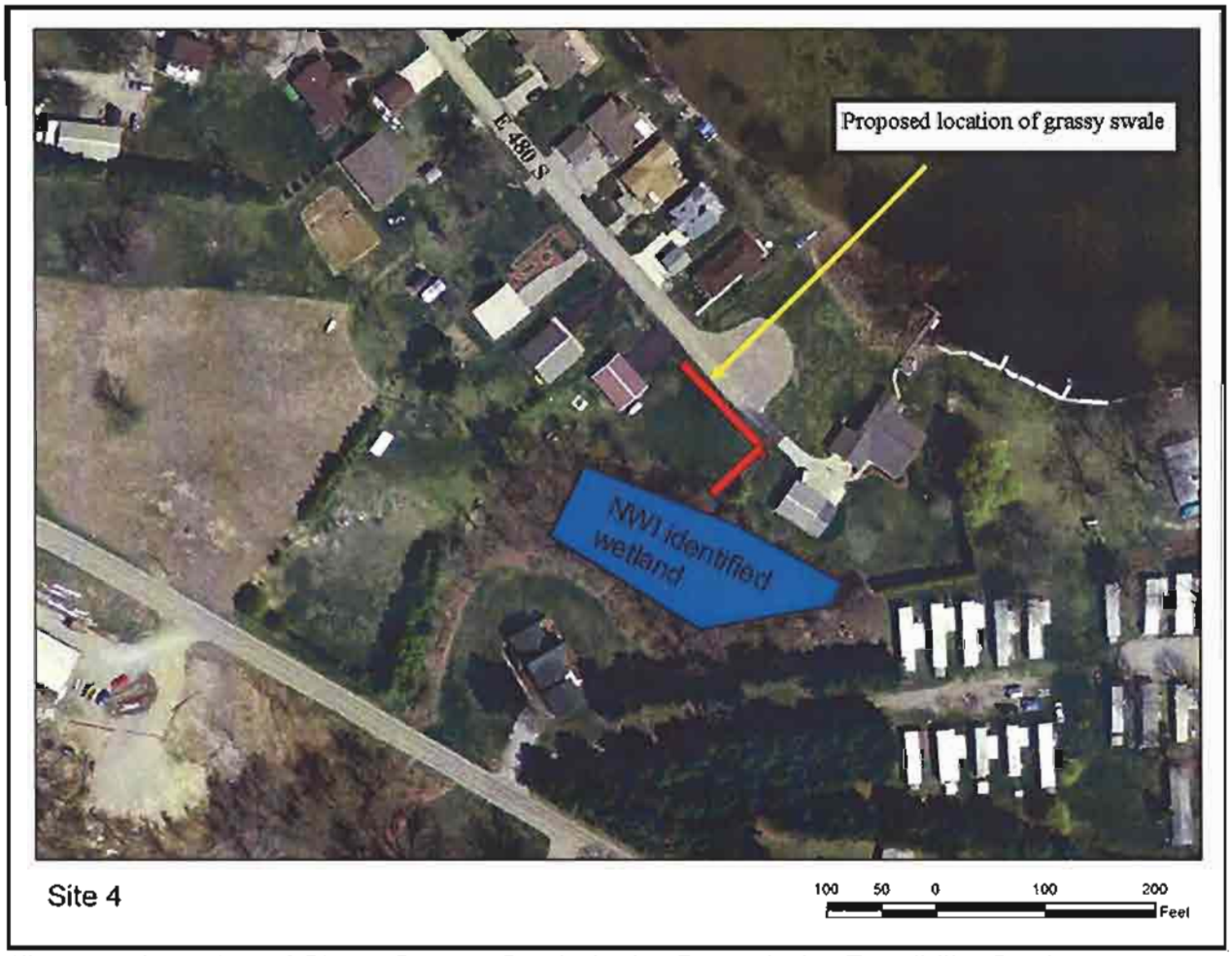

Figure 2. Location of Site 1-Grassy Swale in the Pretty Lake Feasibility Study.

Figure 3. View of channel positioned perpendicular to the E 480 S. Note the dominate vegetation is turf grass.

Figure 4. View of channel running parallel to E 480 S and conceptual view of proposed channel modification.

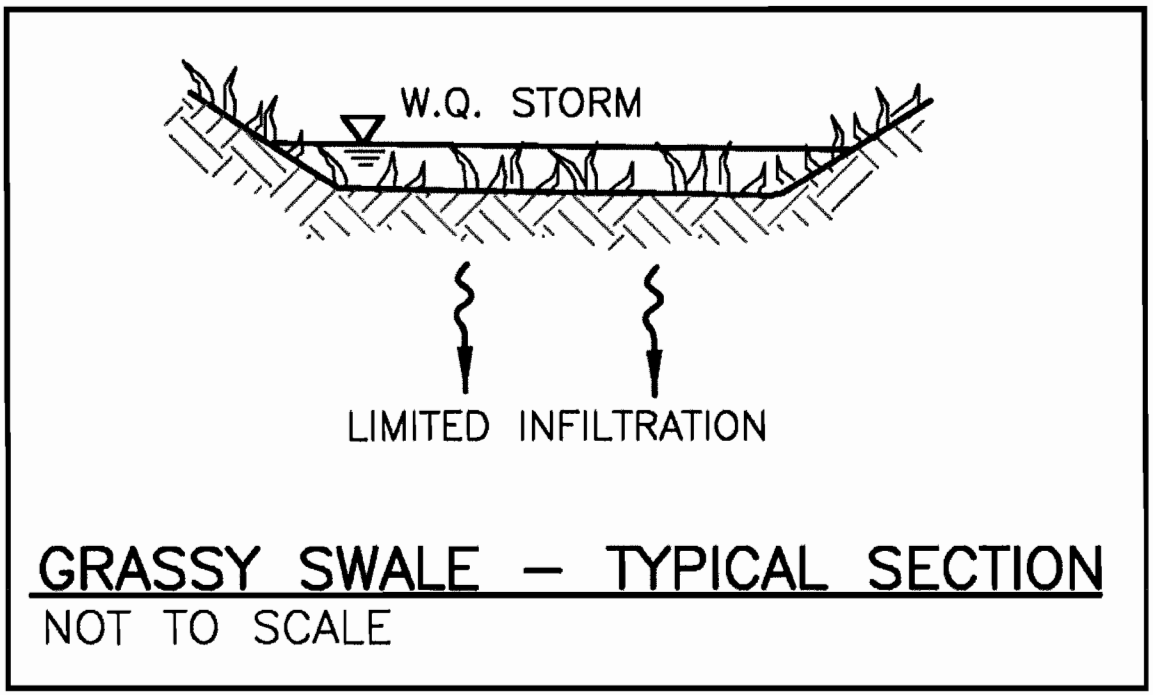

Figure 5. Conceptual drawing of a grassy swale for Site 1.

Site 2-Rock grade controls

Deal Ditch enters into Pretty Lake at the North end of the lake (Figure 6). The channel is approximately 8 feet wide with an average water depth of < 1 foot and with streambanks roughly 8 feet high. Deal Ditch runs through a NWI-identified forested/shrub wetland identified located in the middle of the project area (Figure 6). Erosion is occurring along the streambanks (Figure 7) and there is little access to the floodplain. The conceptual design at Site 2 is to install up to eight rock grade control structures evenly along the roughly 2200 feet section of Deal Ditch that runs from E 400 S to E 430 S (Figure 6; Figure 8; Figure 9). The rock grade controls will reduce stream velocity and allow for greater access to the floodplain thereby decreasing erosion and allowing sediments and nutrients time to settle.

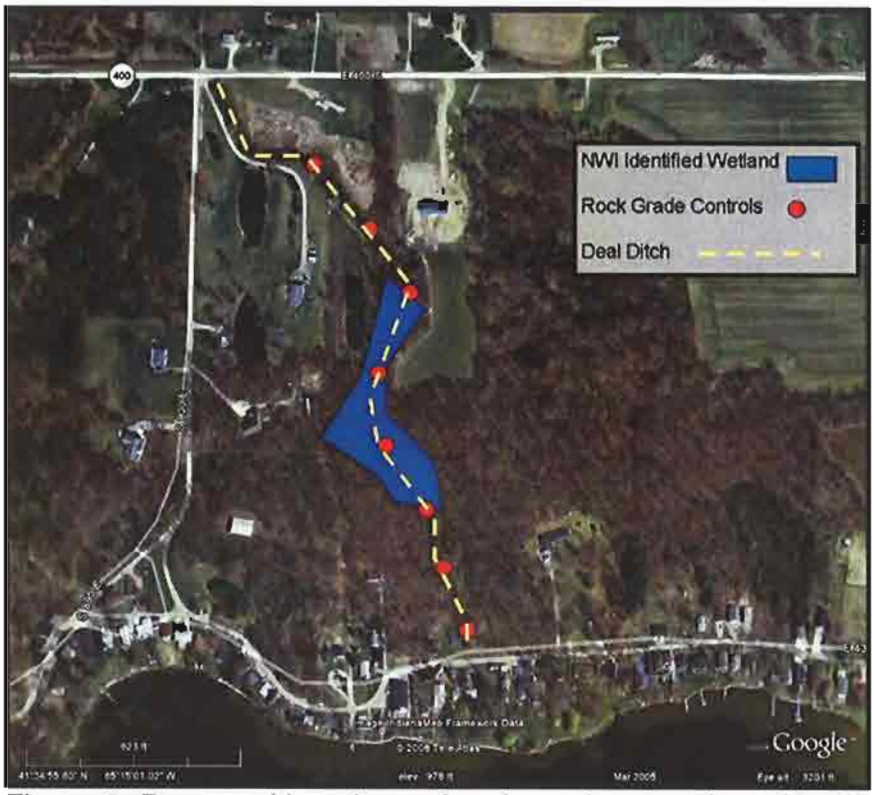

Figure 6. Proposed locations of rock grade controls at Site 2 and location of NWI identified wetland.

Figure 7. Example of erosion occurring on stream bank at Site 2

Each grade control will consist of approximately 8.4 cubic yards of rock installed in the channel. Each structure will have a height of approximately 1.5 feet at the highest point and width of approximately 8 feet. The total length of the structure will be approximately 29.5 feet including fore slope and back slope.

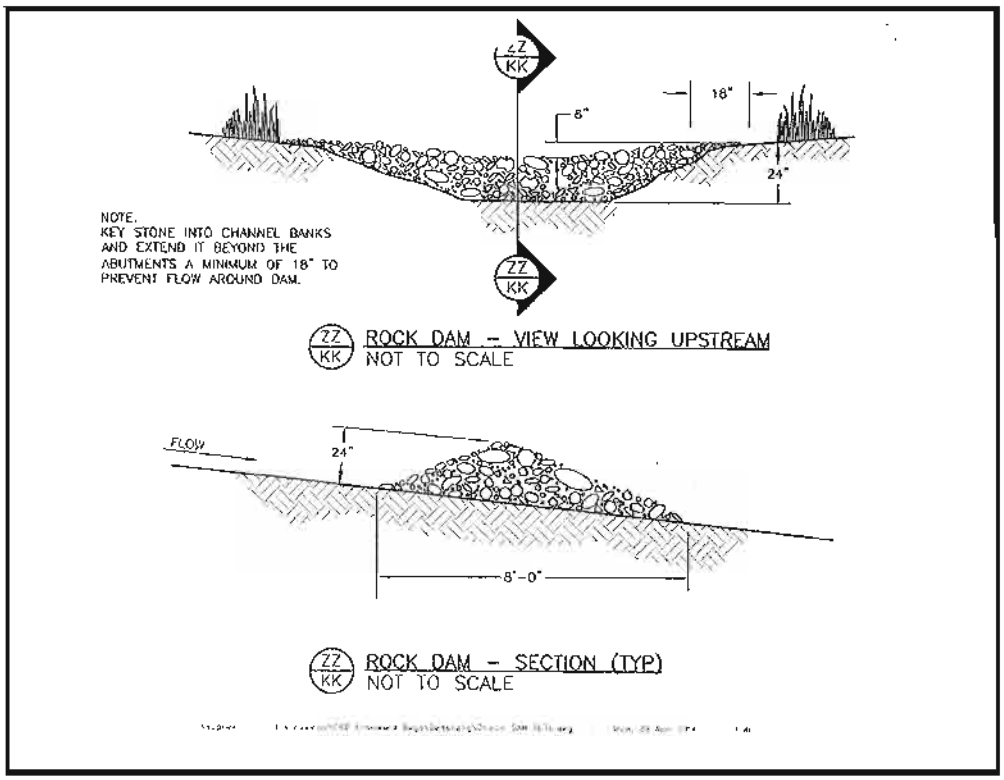

Figure 8. Conceptual drawing of a rock grade control to be used at Site 2.

Figure 9. Example of rock grade control.

Indiana Department of Natural Resources

Mitchell E. Daniels, Jr., Governor
Robert E. Carter, Jr., Director

Environmental Unit
Christie Stanifer, Environmental Coordinator
402 West Washington Street, W264
Indianapolis, IN 46204-2641

September 18, 2008

JF New and Associates
Mark Pranckus
708 Roosevelt Road
Walkerton, IN 46574-1220

RE: 2 proposed projects to improve water quality and aquatic resources for Pretty Lake: (1) grassy swale, and (2) rock grade controls
CTS-ER-13543

Dear Mr. Pranckus:

This is an informational letter in response to your request for an Environmental Review, which was received on September 12, for the above referenced project in LaGrange County. We would like you to know that the review is in process. Please refer to the above ER # on all future correspondence regarding this project.

Future submittals:
We request two (2) entire copies (including cover letter) of your submittal to expedite the review. One copy will be mailed to the region biologist for review regarding fish, wildlife, and botanical resource impacts, and the other copy will be routed through the appropriate staff for review of jurisdictional authority and information regarding state listed species or significant natural features. You will receive only one (1) response letter back after the reviews are complete.
**** No need to submit an additional copy for this review if you did not.**

Note regarding SHPO reviews:
Please include a 3rd copy of the submittal if a response is required from the State Historic Preservation Officer (SHPO). SHPO will respond to the submittal in a separate letter. Or, if a copy of the submittal was sent to SHPO separately, then please indicate that in your submittal. **If your current submittal did not included 3 copies, and the project requires a review from SHPO, then please send a copy directly to SHPO.**

If you have any questions or comments, please contact me at (317) 232-4160, toll free at (877) 928-3755, or via email at cstanifer@dnr.in.gov. You may also contact Jayme Kennedy, Environmental Secretary, at the numbers above or at jkennedy@dnr.in.gov.

Sincerely,

Christie L. Stanifer
Environmental Coordinator
Division of Fish and Wildlife

An Equal Opportunity Employer
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Mark Pranckus

From: Baldwin, Brad [bbaldwin@idem.IN.gov]
Sent: Friday, October 31, 2008 10:00 AM
To: Mark Pranckus
Subject: Pretty Lake LARE Comments (PLCC)

Mark,

I am a day late on your request for comment. Please find following my comments and concerns for each site:

Site 1 - Grassy Swale:

- If the existing channel is not a jurisdictional stream, then there are no concerns with widening, shaping and planting at this location.
- If the existing channel is jurisdictional, then the widening, shaping and planting would require an Individual Permit for changing the cross sectional area, etc.
- You indicate that a forested/scrub-shrub wetland is located to the south of the project, but did not indicate whether there are impacts (temporary and/or permanent.
- If the channel is not jurisdictional, and you do not propose fill or mechanical clearing impacts to the wetland, then 401 would not have jurisdiction for the project as conceptually proposed.
- You will need to contact the Corps to determine if there will be any 404 permit requirements.

Site 2 - Deal Ditch Rock Grade Controls:

- If the banks are actually 8' high, then 1.5' high grade control structures most likely would not be a concern regarding the chemical, physical and biological integrity of the stream. As long as the grade of the structure were gradual, and did not have a more vertical that lateral profile, I would agree that grade control structures would be beneficial to water quality if there is an erosion and sedimentation issue with this stream and into Pretty Lake. The PLCC would need to document and present this information for the purpose and need aspect of a 401 submittal.
- The cross-sectional view of the conceptual structure, and the example photo of a rock grade control structure appear to be more like a rock weir or in stream sediment control. I know that the drawing is not to scale, but if that were the proposed size/height compared to channel size/area, then this may not be an approvable impact/discharge.
- This portion of the project would require a Individual Permit for changing the cross-sectional area, flow path, velocity, etc. of the stream. Detailed, to scale cross-sections would be required with the submittal.

Please feel free to contact me if you have further questions or need clarification of any comments.

Thank you,

Brad C. Baldwin
Project Manager
Wetlands & Storm Water Section
IDEM - Office of Water Quality
Phone: (317) 234-5647

THIS IS NOT A PERMIT

State of Indiana
DEPARTMENT OF NATURAL RESOURCES
Division of Water

Early Coordination/Environmental Assessment

DNR #: ER-13543 **Request Received:** September 12, 2008

Requestor: JF New and Associates
Mark Pranckus
708 Roosevelt Road
Walkerton, IN 46574-1220

Project: 2 proposed projects to improve water quality and aquatic resources for Pretty Lake: (1) grassy swale, and (2) rock grade controls

County/Site info: LaGrange

The Indiana Department of Natural Resources has reviewed the above referenced project per your request. Our agency offers the following comments for your information and in accordance with the National Environmental Policy Act of 1969.

Regulatory Assessment: This proposal may require the formal approval of our agency pursuant to the Lowering of the Ten Acre Lake Act (IC 14-26-5) for any proposal to locate, make, dig, dredge, construct, reconstruct, repair, or reclean a ditch or drain having a bottom depth lower than the normal water level of a lake within one-half (1/2) mile. Please submit more detailed plans to the Division of Water's Technical Services Section if you are unsure whether or not a permit will be required.

Natural Heritage Database: The Natural Heritage Program's data have been checked.
To date, no plant or animal species listed as state or federally threatened, endangered, or rare have been reported to occur in the project vicinity.

Fish & Wildlife Comments: Fish, wildlife, and botanical resource losses as a result of this project can be minimized through implementation of the following measures.
Revegetate all bare and disturbed areas with a mixture of grasses (excluding all varieties of tall fescue) and legumes as soon as possible upon completion; low endophyte tall fescue may be used in the ditch bottom and side slopes only.
Minimize and contain within the project limits inchannel disturbance and the clearing of trees and brush.
Appropriately designed measures for controlling erosion and sediment must be implemented to prevent sediment from entering the stream or leaving the construction site; maintain these measures until construction is complete and all disturbed areas are stabilized.

Contact Staff: Christie L. Stanifer, Environ. Coordinator, Fish & Wildlife
Our agency appreciates this opportunity to be of service. Please do not hesitate to contact the above staff member at (317) 232-4160 or 1-877-928-3755 (toll free) if we can be of further assistance.

Date: November 3, 2008

J. Matthew Buffington
Environmental Supervisor
Division of Fish and Wildlife

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
REGULATORY OFFICE
P.O. BOX 1027
DETROIT, MICHIGAN 48231-1027

REPLY TO
ATTENTION OF:

February 6, 2009

Engineering & Technical Services
Regulatory Office
Permit No. LRE-2008-01044-144-J08

Jim Mertz
Pretty Lake Conservation Club
4690 South 930 East
Wolcottville, Indiana 46795

Dear Mr. Mertz,

Please note the date of your approved jurisdiction determination form for Deal Ditch dated January 17, 2008 has been changed to January 17, 2009. The enclosed jurisdiction determination form reflects this correction. Should you have any questions, please contact me at (313)226-6448 or E-mail: sabrina.m.miller@usace.army.mil. Please refer to File Number: LRE-2008-01044-144-J08.

Sincerely,

ORIGINAL SIGNED BY

Sabrina M. Miller, M.S.
Project Manager
Enforcement Branch

Copies Furnish:
JFNew, Mark Pranckus
IDEM, Brad Baldwin

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): January 17, 2009

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:
Detroit District File No. LRE-2008-01044-144 Pretty Lake Conservation Club

C. PROJECT LOCATION AND BACKGROUND INFORMATION: JD form for Deal Ditch Section 15 Township 36, Range 11 East. Site 2: approximately 2,300 linear feet of Deal Ditch on the north side of Pretty Lake .

State: Indiana County/parish/borough: Lagrange City: Milford Township
Center coordinates of site (lat/long in degree decimal format): Lat. 41.58246111° **N**, Long. 85.25092777° **W**.
Universal Transverse Mercator:
Name of nearest waterbody: Pretty Lake
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Lake Michigan
Name of watershed or Hydrologic Unit Code (HUC): 04050001 St. Joseph

- ☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
- ☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

- ☒ Office (Desk) Determination. Date: January 15, 2008
- ☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** *"navigable waters of the U.S."* within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

- ☐ Waters subject to the ebb and flow of the tide.
- ☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** *"waters of the U.S."* within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
   - ☐ TNWs, including territorial seas
   - ☐ Wetlands adjacent to TNWs
   - ☒ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
   - ☐ Non-RPWs that flow directly or indirectly into TNWs
   - ☒ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
   - ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
   - ☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
   - ☐ Impoundments of jurisdictional waters
   - ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
   Non-wetland waters: 2,300linear feet: 8width (ft) and/or acres.
   Wetlands: acres.

   c. **Limits (boundaries) of jurisdiction** based on: **Not Applicable.**
   Elevation of established OHWM (if known): .

2. **Non-regulated waters/wetlands (check if applicable):**[3]

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[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: .

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. TNW
Identify TNW: .

Summarize rationale supporting determination: .

2. Wetland adjacent to TNW
Summarize rationale supporting conclusion that wetland is "adjacent": .

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. Characteristics of non-TNWs that flow directly or indirectly into TNW

(i) General Area Conditions:
Watershed size: **Pick List**
Drainage area: **Pick List**
Average annual rainfall: inches
Average annual snowfall: inches

(ii) Physical Characteristics:
(a) Relationship with TNW:
☐ Tributary flows directly into TNW.
☐ Tributary flows through **Pick List** tributaries before entering TNW.

Project waters are **Pick List** river miles from TNW.
Project waters are **Pick List** river miles from RPW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Project waters are **Pick List** aerial (straight) miles from RPW.
Project waters cross or serve as state boundaries. Explain: .

Identify flow route to TNW[5]: .
Tributary stream order, if known: .

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[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):

Tributary is:
- ☐ Natural
- ☐ Artificial (man-made). Explain: .
- ☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):

Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):

- ☐ Silts
- ☐ Sands
- ☐ Concrete
- ☐ Cobbles
- ☐ Gravel
- ☐ Muck
- ☐ Bedrock
- ☐ Vegetation. Type/% cover:
- ☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:

Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
- ☐ Dye (or other) test performed: .

Tributary has (check all that apply):
- ☐ Bed and banks
- ☐ OHWM[6] (check all indicators that apply):
  - ☐ clear, natural line impressed on the bank
  - ☐ changes in the character of soil
  - ☐ shelving
  - ☐ vegetation matted down, bent, or absent
  - ☐ leaf litter disturbed or washed away
  - ☐ sediment deposition
  - ☐ water staining
  - ☐ other (list):
  - ☐ the presence of litter and debris
  - ☐ destruction of terrestrial vegetation
  - ☐ the presence of wrack line
  - ☐ sediment sorting
  - ☐ scour
  - ☐ multiple observed or predicted flow events
  - ☐ abrupt change in plant community
- ☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
- ☐ High Tide Line indicated by:
  - ☐ oil or scum line along shore objects
  - ☐ fine shell or debris deposits (foreshore)
  - ☐ physical markings/characteristics
  - ☐ tidal gauges
  - ☐ other (list):
- ☐ Mean High Water Mark indicated by:
  - ☐ survey to available datum;
  - ☐ physical markings;
  - ☐ vegetation lines/changes in vegetation types.

(iii) Chemical Characteristics:

Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

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[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7] Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):

- ☐ Riparian corridor. Characteristics (type, average width): .
- ☐ Wetland fringe. Characteristics: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:

Properties:

Wetland size: acres

Wetland type. Explain: .

Wetland quality. Explain: .

Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:

Flow is: **Pick List**. Explain: .

Surface flow is**: Pick List**

Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .

- ☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:

- ☐ Directly abutting
- ☐ Not directly abutting
  - ☐ Discrete wetland hydrologic connection. Explain: .
  - ☐ Ecological connection. Explain: .
  - ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW

Project wetlands are **Pick List** river miles from TNW.

Project waters are **Pick List** aerial (straight) miles from TNW.

Flow is from: **Pick List.**

Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .

Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):

- ☐ Riparian buffer. Characteristics (type, average width): .
- ☐ Vegetation type/percent cover. Explain: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**

Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   ☒ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: Deal Ditch is known to have an average water depth of one foot year round.
   ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☒ Tributary waters: **2,300** linear feet **8** width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
☒ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
☒ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: **Wetlands evident in aerial photos and National Wetland Inventory maps are contiguous with Deal Ditch.**

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: **approxiamtely 5** acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. **ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]**
☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

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[8] See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.
[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☐ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: .
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
☐ Office concurs with data sheets/delineation report.
☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☒ U.S. Geological Survey Hydrologic Atlas: .
☐ USGS NHD data.
☒ USGS 8 and 12 digit HUC maps.
☒ U.S. Geological Survey map(s). Cite scale & quad name: STROH, IN 1:24,000.
☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Lagrange County, IN Sheet 25.
☒ National wetlands inventory map(s). Cite name: ORM2 USFWS NWI .
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date): ORM2 aerials (i3 Nationwide Prime) dated July31, 2006.
or ☐ Other (Name & Date): .
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: Several wetlands identified using aerial photographs within the project areas. These wetlands are contiguous and/or adjacent with Deal Ditch; NRCS hydric soils.

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
REGULATORY OFFICE
P.O. BOX 1027
DETROIT, MICHIGAN 48231-1027

REPLY TO
ATTENTION OF:

January 26, 2009

Engineering & Technical Services
Regulatory Office
File No. LRE-2008-01044-144

Jim Mertz
Pretty Lake Conservation Club
4690 South 930 East
Wolcottville, Indiana 46795

Dear Mr. Mertz,

This letter is in response to your request for a jurisdictional determination dated September 10, 2008 for the water quality improvement project, Site #2: rock control grades, associated with Deal Ditch, located in Section 15 of Township 36 North, Range 11 East, Lagrange County, Indiana.

In the Deal Ditch, as in all waters of the United States, including their adjacent wetlands, any discharge of dredged and/or fill material must be authorized by the Department of the Army. The authority of the Corps of Engineers to regulate the discharge of dredged and/or fill material is contained in Section 404 of the Clean Water Act and regulations promulgated pursuant to that Act. Filling and grading work, mechanized land clearing, the sidecasting of excavated material, and the installation of certain pile-supported structures constitute or otherwise involve discharges of dredged and/or fill material under the Corps' regulatory authority.

Please be advised that the project proposal in question involves waterbodies and wetlands within the jurisdiction of the Corps of Engineers. Any discharges of dredged and/or fill material into Deal Ditch, Pretty Lake or their adjacent wetlands will require a Corps permit. This jurisdiction determination is valid for a period of five years from the date of this letter unless new information warrants revision of the determination before the expiration date.

For your convenience, the necessary permit application can be found on our website at *www.lre.usace.army.mil/regulatory*. Plan view and cross-sectional view drawings, in 8 ½" x 11" formats, should accompany the application. Drawings and the appropriate sections of the application form should include a description of all quantities, dimensions, and nature of materials to be placed and soil to be moved within wetland areas. We also advise you to contact the Indiana Department of Natural Resources (IDNR), Division of Water at (317) 234-5647 for a determination of State Permit requirements.

Our assertion of jurisdiction is based on our documentation that the waterbodies in question are waters of the United States and recognition that the use, degradation, or destruction of these waters could affect interstate commerce. Specifically, the Deal Ditch flows into Pretty Lake which combines with the outflow of Mud Lake and flows north into Little Turkey Lake, which flows into Turkey Creek, which flows north to the Pigeon River, which flows into the St. Joseph River, a navigable water of the United States.

This letter contains an approved jurisdictional determination for the property in question. If you object to this determination, you may request an administrative appeal under Corps regulations at 33 Code of Federal Regulations (CFR) Part 331. We have enclosed a Notification of Appeal Process (NAP) fact sheet and a Request For Appeal (RFA) form. If you request to appeal this determination you must submit a completed RFA form to the Corps' Great Lakes and Ohio River Division office at following address:

Michael Montone
Appeals Review Officer
U.S. Army Corps of Engineers
Great Lakes and Ohio River Division
550 Main Street
Room 10032
Cincinnati, Ohio 45202-3222

In order for an RFA to be accepted by the Corps, the Corps must determine that the RFA is complete, that it meets the criteria for appeal under 33 CFR Part 331.5, and that it has been received by the Division office within 60 days of the date of the NAP sheet. If you decide to submit an RFA form, it must be received at the above address by **March 26, 2009**. It is not necessary to submit an RFA form to the Division office if you do not object to the determination in this letter. You may contact Mr. Montone at (513) 684-6212 and send him a facsimile at (513) 684-2460.

Thank you for giving us the opportunity to review this proposal. Should you have any questions, please contact me at (313) 226-7495 / E-Mail sabrina.m.miller@usace.army.mil. Please refer to File No. LRE-2008-01044-144 in any future communications with this office.

We are interested in your thoughts and opinions concerning your experience with the Detroit District, Corps of Engineers Regulatory Program. If you are interested in letting us know how we are doing, you can complete an electronic Customer Service Survey from our web site at: **http://per2.nwp.usace.army.mil/survey.html**. Alternatively, you may contact us and request a paper copy of the survey that you may complete and return to us by mail or fax. Thank you for taking the time to complete the survey, we appreciate your feedback.

Sincerely,

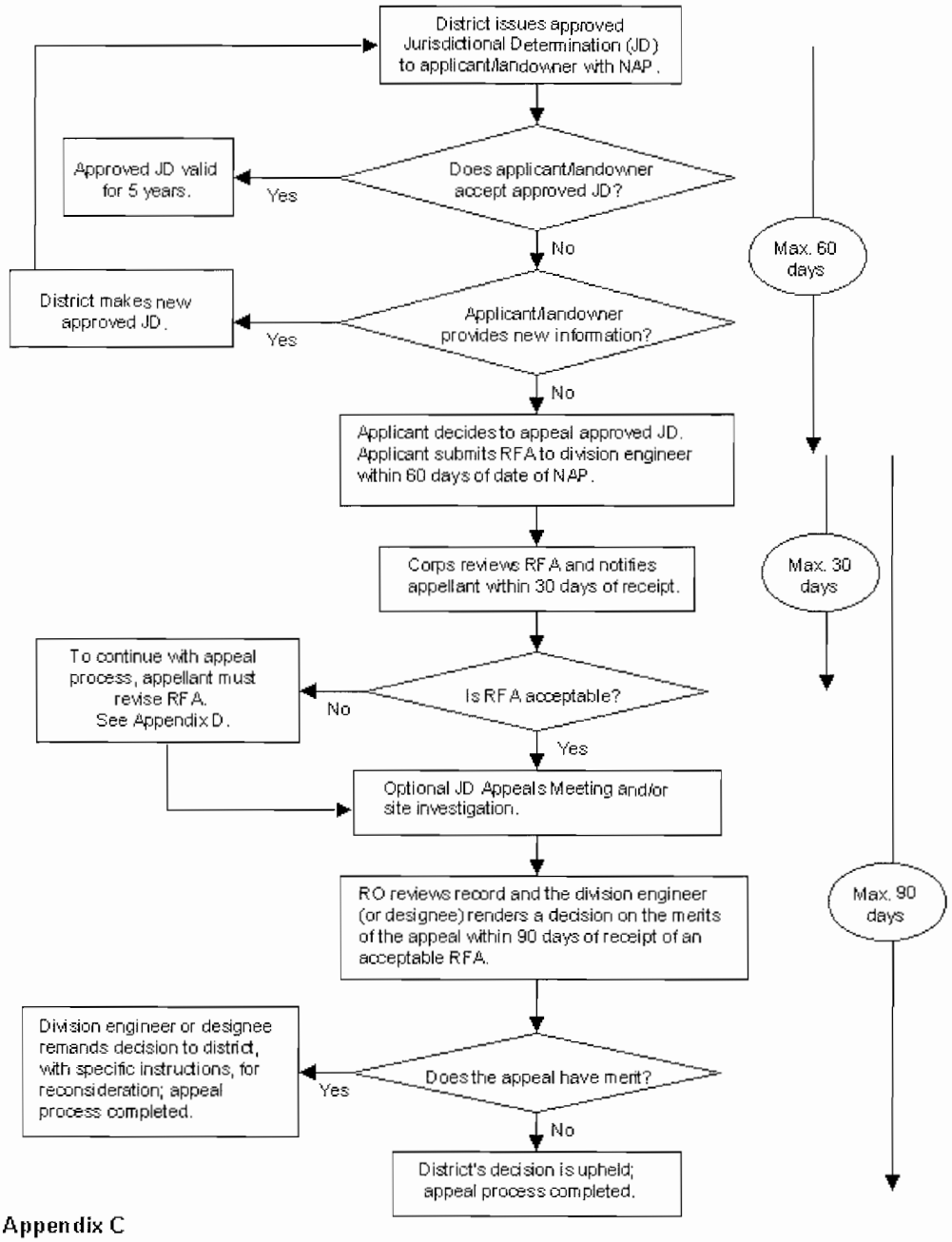
ORIGINAL SIGNED BY

Sabrina M. Miller, M.S.
Project Manager
Enforcement Branch

Enclosures:
Site Map
Flowchart
NAP Document

Copies Furnished:
IDEM, Brad Baldwin
USACE, South Bend Field Office
JFNew, Mark Pranckus

Administrative Appeal Process for Approved Jurisdictional Determinations



Appendix C

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: Jim Mertz	File Number: LRE-2008-01044-144	Date: 26 January, 2009
Attached is:		See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of permission)	B
	PERMIT DENIAL	C
X	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/inet/functions/cw/cecwo/reg or Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

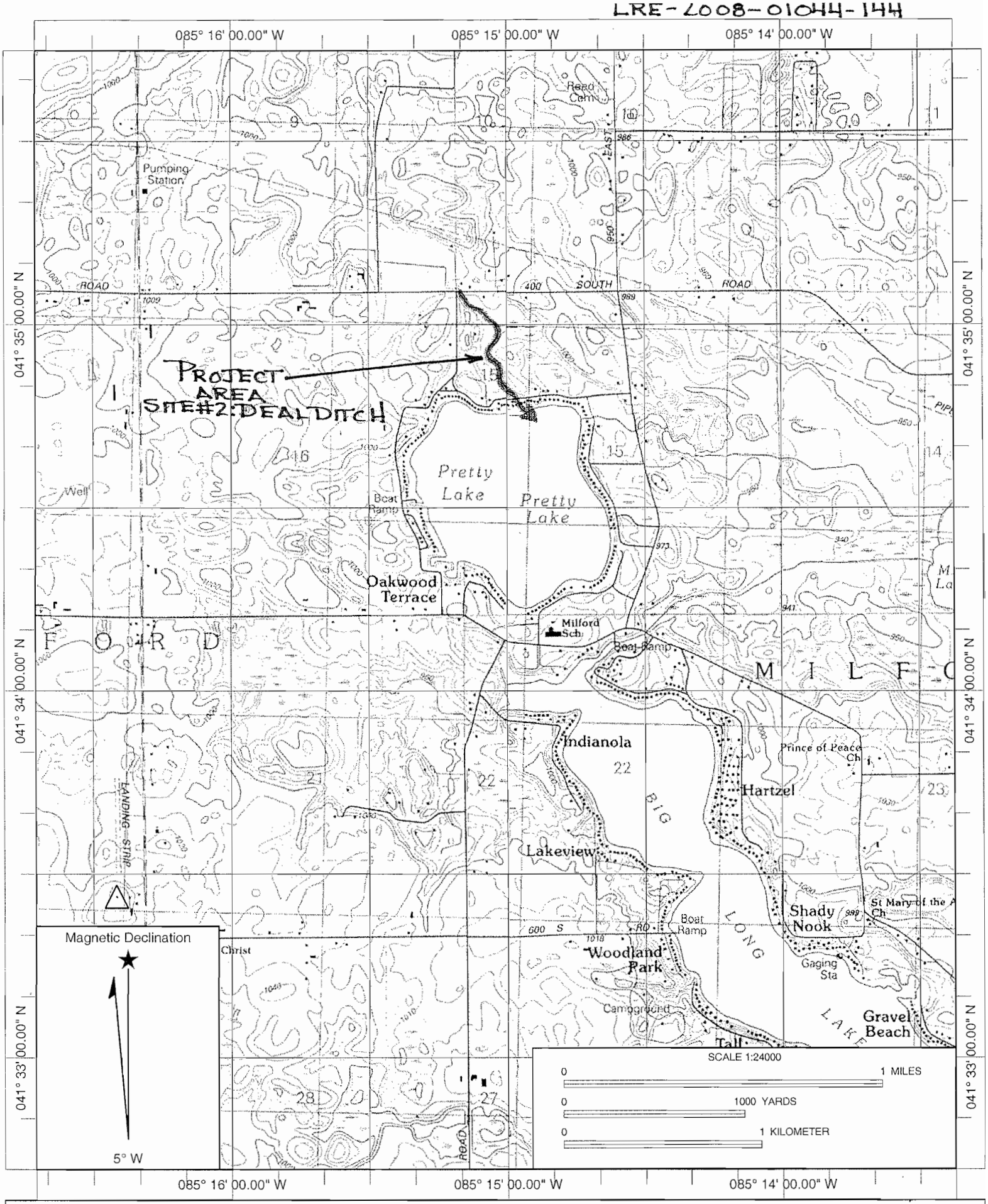
POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:	If you only have questions regarding the appeal process you may also contact:
Sabrina Miller 313-226-7495	Mike Montone, Appeal Review Officer Great Lakes and Ohio River Division 550 Main Street, Room 10032 Cincinnati, Ohio 45202-3222 Tel. (513) 684-6212 Fax. (513) 684-2460

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.

	Date:	Telephone number:
_____ Signature of appellant or agent.		

LRE-2008-01044-144



Name: STROH
Date: 1/23/2009
Scale: 1 inch equals 2000 feet

Location: 041° 34' 13.25" N 085° 15' 02.44" W NAD27
Caption: LRE-2008-01044-144:
Pretty Lake Conservation Club Site#2: Deal Ditch
APPROX. PROJECT AREA

Datum: NAD27

Copyright (C) 1997, Maptech, Inc.

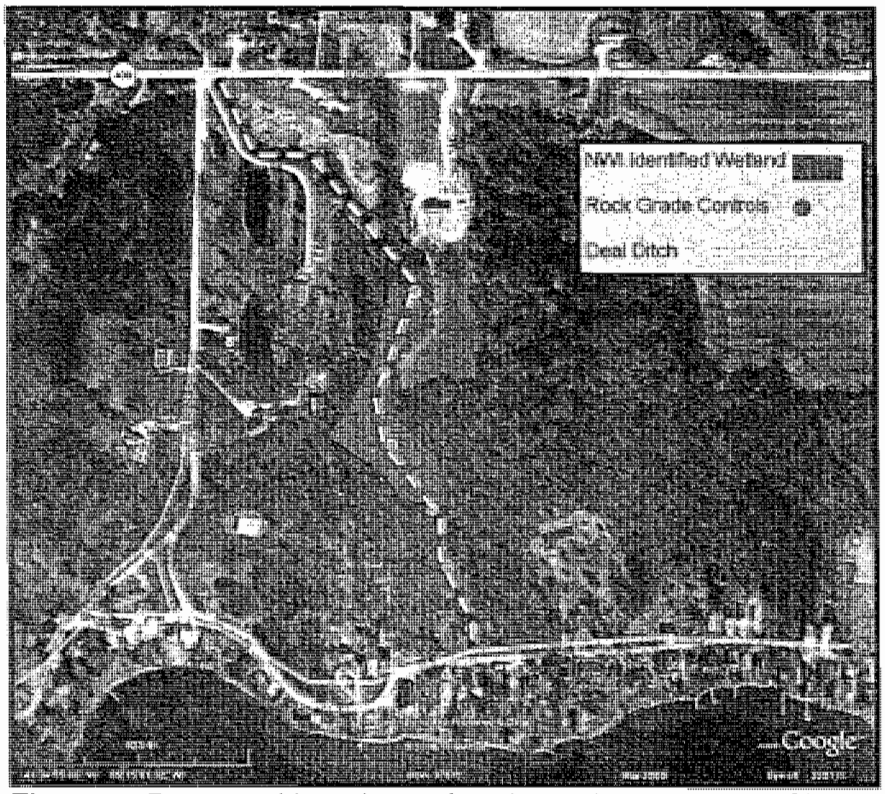


Figure 6. Proposed locations of rock grade controls at Site 2 and location of NWI identified wetland.

Figure 7. Example of erosion occurring on stream bank at Site 2

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): January 17, 2008

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:
Detroit District File No. LRE-2008-01044-144 Pretty Lake Conservation Club

C. PROJECT LOCATION AND BACKGROUND INFORMATION: JD form for Deal Ditch Section 15 Township 36, Range 11 East. Site 2: approximately 2,300 linear feet of Deal Ditch on the north side of Pretty Lake .

State: Indiana County/parish/borough: Lagrange City: Milford Township
Center coordinates of site (lat/long in degree decimal format): Lat. 41.58246111° **N**, Long. 85.25092777° **W**.
Universal Transverse Mercator:
Name of nearest waterbody: Pretty Lake
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Lake Michigan
Name of watershed or Hydrologic Unit Code (HUC): 04050001 St. Joseph

- ☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
- ☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

- ☒ Office (Desk) Determination. Date: January 15, 2008
- ☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

- ☐ Waters subject to the ebb and flow of the tide.
- ☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
   - ☐ TNWs, including territorial seas
   - ☐ Wetlands adjacent to TNWs
   - ☒ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
   - ☐ Non-RPWs that flow directly or indirectly into TNWs
   - ☒ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
   - ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
   - ☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
   - ☐ Impoundments of jurisdictional waters
   - ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
   Non-wetland waters: 2,300linear feet: 8width (ft) and/or acres.
   Wetlands: acres.

   c. **Limits (boundaries) of jurisdiction** based on: **Not Applicable.**
   Elevation of established OHWM (if known): .

2. **Non-regulated waters/wetlands (check if applicable):**[3]

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[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: .

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: .

   Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": .

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) **General Area Conditions:**
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) **Physical Characteristics:**
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .
   Tributary stream order, if known: .

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[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.

[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):

Tributary is:
- ☐ Natural
- ☐ Artificial (man-made). Explain: .
- ☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):

Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):

- ☐ Silts
- ☐ Sands
- ☐ Concrete
- ☐ Cobbles
- ☐ Gravel
- ☐ Muck
- ☐ Bedrock
- ☐ Vegetation. Type/% cover:
- ☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:

Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
- ☐ Dye (or other) test performed: .

Tributary has (check all that apply):
- ☐ Bed and banks
- ☐ OHWM[6] (check all indicators that apply):
  - ☐ clear, natural line impressed on the bank
  - ☐ changes in the character of soil
  - ☐ shelving
  - ☐ vegetation matted down, bent, or absent
  - ☐ leaf litter disturbed or washed away
  - ☐ sediment deposition
  - ☐ water staining
  - ☐ other (list):
  - ☐ the presence of litter and debris
  - ☐ destruction of terrestrial vegetation
  - ☐ the presence of wrack line
  - ☐ sediment sorting
  - ☐ scour
  - ☐ multiple observed or predicted flow events
  - ☐ abrupt change in plant community
- ☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
- ☐ High Tide Line indicated by:
  - ☐ oil or scum line along shore objects
  - ☐ fine shell or debris deposits (foreshore)
  - ☐ physical markings/characteristics
  - ☐ tidal gauges
  - ☐ other (list):
- ☐ Mean High Water Mark indicated by:
  - ☐ survey to available datum;
  - ☐ physical markings;
  - ☐ vegetation lines/changes in vegetation types.

(iii) Chemical Characteristics:

Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

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[6]A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7]Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):

- ☐ Riparian corridor. Characteristics (type, average width): .
- ☐ Wetland fringe. Characteristics: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:

Properties:

Wetland size: acres

Wetland type. Explain: .

Wetland quality. Explain: .

Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:

Flow is: **Pick List**. Explain: .

Surface flow is**: Pick List**

Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .

- ☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:

- ☐ Directly abutting
- ☐ Not directly abutting
  - ☐ Discrete wetland hydrologic connection. Explain: .
  - ☐ Ecological connection. Explain: .
  - ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW

Project wetlands are **Pick List** river miles from TNW.

Project waters are **Pick List** aerial (straight) miles from TNW.

Flow is from: **Pick List.**

Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .

Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):

- ☐ Riparian buffer. Characteristics (type, average width): .
- ☐ Vegetation type/percent cover. Explain: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**

Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   - ☐ TNWs: linear feet width (ft), Or, acres.
   - ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   - ☒ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: Deal Ditch is known to have an average water depth of one foot year round.
   - ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☒ Tributary waters: **2,300** linear feet **8** width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
☒ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
☒ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: **Wetlands evident in aerial photos and National Wetland Inventory maps are contiguous with Deal Ditch.**

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: **approxiamtely 5** acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. **ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]**
☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

---

[8] See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.
[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☐ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: .
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
☐ Office concurs with data sheets/delineation report.
☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☒ U.S. Geological Survey Hydrologic Atlas: .
☐ USGS NHD data.
☒ USGS 8 and 12 digit HUC maps.
☒ U.S. Geological Survey map(s). Cite scale & quad name: STROH, IN 1:24,000.
☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Lagrange County, IN Sheet 25.
☒ National wetlands inventory map(s). Cite name: ORM2 USFWS NWI .
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date): ORM2 aerials (i3 Nationwide Prime) dated July31, 2006.
or ☐ Other (Name & Date): .
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: Several wetlands identified using aerial photographs within the project areas. These wetlands are contiguous and/or adjacent with Deal Ditch; NRCS hydric soils.

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
REGULATORY OFFICE
P.O. BOX 1027
DETROIT, MICHIGAN 48231-1027

REPLY TO
ATTENTION OF:

January 27, 2009

Engineering & Technical Services
Regulatory Office
File No. LRE-2009-00056-144-J09

Jim Mertz
Pretty Lake Conservation Club
4690 South 930 East
Wolcottville, Indiana 46795

Dear Mr. Mertz,

This letter is in response to the project proposal you recently submitted in your letter dated September 10, 2008, to widen a roadside grassy swale (Site #1) on the south side of E480S, Section 16 of Milford Township, LaGrange County, Indiana.

We have determined that a Department of Army permit is not required for the work indicated on the enclosed plans, provided that there is no discharge of fill and/or dredged material into the wetlands, specifically the NWI identified wetland south of the proposed project area as depicted in the plans you submitted. The wetlands south of Site #1 as shown on the plans you submitted, are likely within the jurisdiction of the Corps of Engineers. Filling and grading work, mechanized land-clearing, and the sidecasting of excavated material constitute or otherwise involve discharges of dredged and/or fill material under the Corps' regulatory authority, as contained in Section 404 of the Clean Water Act and the regulations promulgated pursuant to that Act.

If your client's project plans change and subsequently include the discharge of fill into wetlands, please complete and submit a permit application that includes a description of all quantities, dimensions, and nature of material to be placed and soil to be moved within wetland areas. For your convenience, the necessary permit application can be found on our website at *www.lre.usace.army.mil/regulatory*.

To fully document your proposed activity, we have made your project proposal letter and copies of the enclosed plans a part of our permanent records. Any construction activity other than shown on the plans may render this determination invalid.

The fact that a Corps permit is not required does not relieve you of the obligation to obtain required approvals from other agencies that may have regulatory jurisdiction. Should you have any questions, please contact me at (313) 226-7495, or E-Mail:sabrina.m.miller@usace.army.mil. Please refer to File Number: LRE-2009-00056-144-J09 in all future communications with this office.

Thank you for giving us the opportunity to review this proposal. We are interested in your thoughts and opinions concerning your experience with the Detroit District, Corps of Engineers Regulatory Program. If you are interested in letting us know how we are doing, you can complete an electronic Customer Service Survey from our web site at: http://per2.nwp.usace.army.mil/survey.html. Alternatively, you may contact us and request a paper copy of the survey that you may complete and return to us by mail or fax. Thank you for taking the time to complete the survey, we appreciate your feedback.

Sincerely,
ORIGINAL SIGNED BY

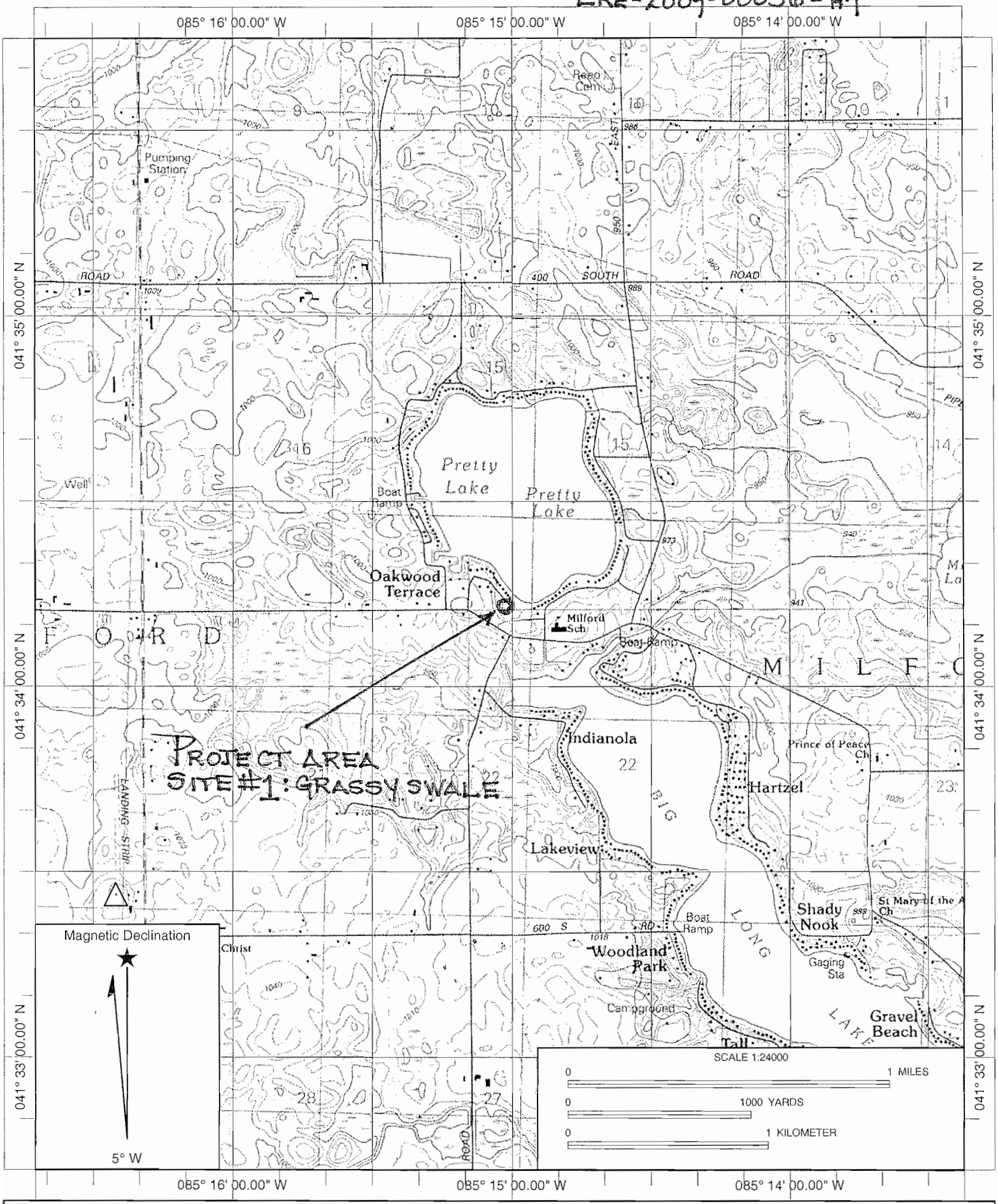
Sabrina M. Miller, M.S.
Project Manager
Enforcement Branch

Enclosures

Copies Furnished

IDEM, Brad Baldwin
JFNew, Mark Pranckus
USACE, South Bend Field Office

LRE-2009-00056-144



Name: STROH
Date: 1/23/2009
Scale: 1 inch equals 2000 feet

Location: 041° 34' 13.25" N 085° 15' 02.44" W NAD27
Caption: LRE-2009-00056-144:
Pretty Lake Conservation Club Site#1: E480S Drainage Swale
APPROX. PROJECT AREA

Datum: NAD27

Copyright (C) 1997, Maptech, Inc.

Site 1-Grassy Swale

The area is a small channelized drainage, roughly 170 feet in total length that flows to a catch basin, which flows directly to Pretty Lake. The drainage is divided into two sections, one positioned perpendicular to E 480 S (Figure 2; Figure 3) and another running parallel to E 480 S (Figure 2; Figure 4). A NWI wetland is located to the South of Site 1 (Figure 2) and is identified as a forested/shrub wetland. Water from the NWI wetland is assumed to flow out through the channel set perpendicular to E 480 S during periods of high water. Both channels are about 3 feet wide and dominated by turf grass. The conceptual design at Site 1 is to construct a grassy swale to control erosion, thereby reducing the amount of sediment and nutrients entering the lake. The current channel would be widened to roughly 6 feet, seeded with native grasses and erosion materials installed (Figure 4; Figure 5). All materials excavated from Site 1 would be deposited in a proper upland site. The elevation of the channel bed would not be altered so that the hydrology of the existing wetland would not be impacted. A grassy swale composed of native plants would increase channel stability, reducing erosion and slowdown water movement allowing sediments and nutrients time to settle.

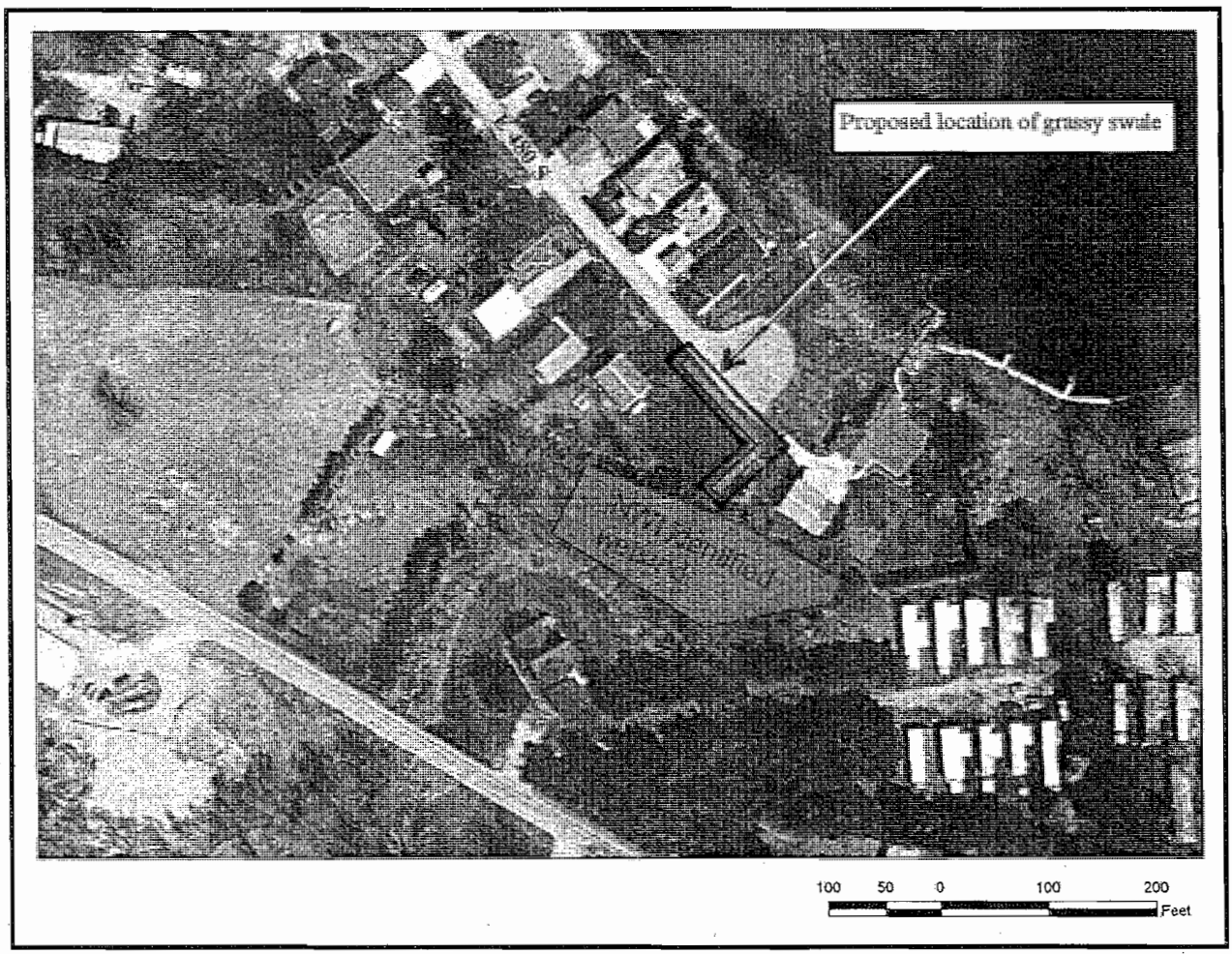


Figure 2. Location of Site 1-Grassy Swale in the Pretty Lake Feasibility Study.

APPENDIX E

QHEI, BEHI, AND PFANKUCH

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location
		Deal Ditch	Site 7

Surveyor	Sample Date	County	Macro SampleType	Habitat Complete	QHEI Score:
TLE	10-23-08	LaGrange			27

1-Substrate (20 points maximum)

Substrate Score: -2

Check 1 Predominant Pool & 1 Predominant Riffle

Check all that are present — P=Pool, R=Riffle

Predominant P	Predominant R	Present P	Present R		Predominant P	Predominant R	Present P	Present R	
☐	☐	☐	☐	Bldrs/Slabs(10)	☐	☐	☐	☐	Hardpan(4)
☐	☐	☐	☐	Boulders(9)	☐	☐	☐	☐	Detritus(3)
☐	☐	☐	☐	Cobble(8)	☒	☒	☐	☐	Muck(2)
☐	☐	☐	☐	Gravel(7)	☐	☐	☑	☑	Silt(2)
☐	☐	☐	☐	Sand(6)	☐	☐	☐	☐	Sludge(1)
☐	☐	☐	☐	Bedrock(5)	☐	☐	☐	☐	Artificial(0)

Substrate Quality (check only 1, or check 2 and AVERAGE)

Substrate Origin: ☐ Limestone(1) ☐ Hardpan(0) ☐ Lacustrine(0) ☐ Tills(1) ☐ Sandstone(0) ☐ Shale(-1) ☐ Wetlands(0) ☐ Rip/Rap(0) ☐ Coal fines(-2)

Silt Cover: ☒ Silt heavy(-2) ☐ Silt moderate(-1) ☐ Silt normal(0) ☐ Silt free(1)

Embeddedness: ☒ Extensive(-2) ☐ Moderate(-1) ☐ Low/Normal(0) ☐ None(1)

NOTE: ignore sludge originating from point sources; score based on natural substrates

☐ >4 substrates present(2)

Comments:

2-Instream Cover (20 points maximum

Instream Cover Score: 12

Type (check ALL that apply)

☐ Undercut banks(1) ☐ Deep pools(2) ☐ Oxbows(1)
☐ Overhanging vegetation(1) ☐ Rootwads(1) ☒ Aquatic macrophytes(1)
☐ Shallows(in slow water)(1) ☐ Boulders(1) ☐ Logs and woody debris(1)
☐ Rootmats(1)

Amount (check only 1, or 2 and AVERAGE)

☒ Extensive >75% (11)
☐ Moderate 25-75% (7)
☐ Sparse 5-25% (3)
☐ Nearly absent <5% (1)

Comments: completely filled w/ aquatic veg.

3-Channel Morphology (20) (check only one per category, OR two and AVERAGE)

Channel Score: 4

Sinuosity	Development	Channelization	Stability	Modifications/Other	
☐ High (4)	☐ Excellent (7)	☐ None (6)	☐ High (3)	☐ Snagging	☐ Impound
☐ Moderate (3)	☐ Good (5)	☐ Recovered (4)	☐ Moderate (2)	☐ Relocation	☐ Islands
☐ Low (2)	☐ Fair (3)	☐ Recovering (3)	☒ Low (1)	☐ Canopy Removal	☐ Leveed
☒ None (1)	☒ Poor (1)	☒ Recent or no recovery (1)		☑ Dredging	☑ Bank shaping
				☐ One side channel modifications	

Comments: typical drainage ditch that is filled in w/ sed, organic matter

4-Riparian Zone & Bank Erosion (10 points maximum)

Riparian Score: 7

Left/Right banks looking downstream (For each category, check only one per bank, OR two per bank and AVERAGE).

Riparian width (per bank) 3.25

L	R	
☒	☐	Wide >50m (4)
☐	☒	Moderate 10-50m (3)
☐	☒	Narrow 5-10m (2)
☐	☐	Very narrow <5m (1)
☐	☐	None (0)

Erosion/Runoff-Floodplain quality (past 100 ft Riparian) (most predominant per bank) 1.5 + 3.5

L	R	
☐	☒	Forest, Swamp (3)
☒	☐	Shrub or Old field (2)
☒	☐	Residential, Park, New field (1)
☐	☐	Fenced pasture (1)

2.25

L	R	
☐	☐	Conservation Tillage (1)
☐	☐	Urban or Industrial (0)
☐	☐	Mining, Construction (0)
☐	☒	Open Pasture/Rowcrop (0)

Bank Erosion (per bank) 1.5

L	R	
☐	☐	None or little (3)
☒	☐	Moderate (2)
☐	☒	Heavy/Severe (1)

Comments:

5a-Pool/Glide Quality (12 points maximum

Pool/Glide Score: 0

Max pool depth (check one)

☐ >1m (6)
☐ 0.7-1m (4)
☐ 0.4-0.7m (2)
☐ 0.2-0.4m (1)
☒ <0.2m (pool=0)

Morphology (check only one, OR check two and AVERAGE)

☐ Pool width > riffle width (2)
☐ Pool width = riffle width (1)
☒ Pool width < riffle width (0)

Pool/Run/Riffle current velocity (check all that apply)

☐ Eddies (1) ☐ Torrential (-1)
☐ Fast (1) ☐ Interstitial (-1)
☐ Moderate (1) ☐ Intermittent (-2)
☐ Slow (1) ☒ No pool (0)

Comments:

5b-Riffle/Run Quality (8) (check only one per category, OR two and AVERAGE)

Riffle/Run Score: 0

Riffle/run depth (check one)

☐ Generally>10cm, Max>50cm (4)
☐ Generally>10cm, Max<50cm(3)
☐ Generally 5-10cm (1)
☒ Generally<5cm (riffle=0)

Riffle/run substrate

☐ Stable-e.g. cobble, boulder (2)
☐ Mod. stable-e.g. pea gravel (1)
☒ Unstable-e.g. sand, gravel (0)

Riffle/run embeddedness

☐ Extensive (-1) ☐ Normal/Low (1)
☐ Moderate (0) ☐ None (2)
☒ No riffle (0)

Comments:

6-Gradient (10 points maximum)

Gradient Score: 0

Average width: 13' Gradient: (ft/mile) Drainage Area: (square miles)

Comments:

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location

Surveyor	Sample Date	County	Macro SampleType	☐ Habitat Complete	QHEI Score: 27

Impacts/Miscellaneous

Major Suspected Impacts (Check all that apply)

- ☐ None
- ☐ Industrial
- ☐ WWTP
- ☒ Agricultural
- ☒ Livestock
- ☐ Silviculture
- ☐ Construction
- ☐ Urban Runoff
- ☐ Suburban
- ☒ Channelization
- ☐ Riparian Removal
- ☐ Flow Alteration
- ☐ CSOs
- ☐ Mining
- ☐ Landfills
- ☐ Natural

Pollution Impact Comments:

- farm just UPS

Miscellaneous QHEI Information

Subjective rating (1-10): 1
Aesthetic rating (1-10): 2
Canopy Cover (% Open): 95

% Riffle: –
% Run: 100
% Glide: –
% Pool: –

Is reach representative of stream? Yes

General QHEI Notes:

* Ditch is very monotypic
* only aspect that changes is Riparian area composition => transitions from wetland on LDB + field on RDB => Forested/Residential on LDB + forested on RDB

— Channel is extremely full of deposited sediment + organic matter.

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Site 8

Sample #	bioSample #	Stream Name	Location
			Deal Ditch Station 1

Surveyor	Sample Date	County	Macro SampleType	Habitat Complete	QHEI Score: 34.5

1-Substrate (20 points maximum)

Substrate Score: 7

Check 1 Predominant Pool & 1 Predominant Riffle

Check all that are present — P=Pool, R=Riffle

Predominant P	Predominant R		Present P	Present R	Predominant P	Predominant R		Present P	Present R
☐	☐	Bldrs/Slabs(10)	☐	☐	☐	☐	Hardpan(4)	☐	☐
☐	☐	Boulders(9)	☐	☐	☐	☐	Detritus(3)	☒	☒
☐	☐	Cobble(8)	☐	☐	☐	☐	Muck(2)	☒	☒
☐	☐	Gravel(7)	☒	☒	☐	☐	Silt(2)	☒	☒
☒	☒	Sand(6)	☐	☐	☐	☐	Sludge(1)	☐	☐
☐	☐	Bedrock(5)	☐	☐	☐	☐	Artificial(0)	☐	☐

Substrate Quality (check only 1, or check 2 and AVERAGE)

Substrate Origin: ☐ Limestone(1) ☐ Hardpan(0) ☐ Lacustrine(0) ☒ Tills(1) ☐ Sandstone(0) ☐ Shale(-1) ☐ Wetlands(0) ☐ Rip/Rap(0) ☐ Coal fines(-2)

Silt Cover: ☐ Silt heavy(-2) ☒ Silt moderate(-1) ☐ Silt normal(0) ☐ Silt free(1)

Embeddedness: ☐ Extensive(-2) ☐ Moderate(-1) ☐ Low/Normal(0) ☒ None(1)

NOTE: ignore sludge originating from point sources; score based on natural substrates

☐ >4 substrates present(2)

Comments:

2-Instream Cover (20 points maximum

Instream Cover Score: 6

Type (check ALL that apply)

☐ Undercut banks(1) ☐ Deep pools(2) ☐ Oxbows(1)
☒ Overhanging vegetation(1) ☐ Rootwads(1) ☐ Aquatic macrophytes(1)
☒ Shallows(in slow water)(1) ☐ Boulders(1) ☒ Logs and woody debris(1)
☐ Rootmats(1)

Amount (check only 1, or 2 and AVERAGE)

☐ Extensive >75% (11)
☐ Moderate 25-75% (7)
☒ Sparse 5-25% (3)
☐ Nearly absent <5% (1)

Comments:

3-Channel Morphology (20) (check only one per category, OR two and AVERAGE)

Channel Score: 9

Sinuosity	Development	Channelization	Stability	Modifications/Other	
☐ High (4)	☐ Excellent (7)	☐ None (6)	☐ High (3)	☐ Snagging	☐ Impound
☐ Moderate (3)	☐ Good (5)	☐ Recovered (4)	☒ Moderate (2)	☐ Relocation	☐ Islands
☒ Low (2)	☐ Fair (3)	☒ Recovering (3)	☐ Low (1)	☐ Canopy Removal	☐ Leveed
☐ None (1)	☒ Poor (1)	☐ Recent or no recovery (1)		☒ Dredging	☒ Bank shaping
					☐ One side channel modifications

Comments:

4-Riparian Zone & Bank Erosion (10 points maximum)

Riparian Score: 4.5

Left/Right banks looking downstream (For each category, check only one per bank, OR two per bank and AVERAGE).

Riparian width L	Riparian width R	(per bank)	Erosion/Runoff-Floodplain quality (past 100 ft Riparian) L	R	(most predominant per bank)	L	R		Bank Erosion L	R	(per bank)
☐	☐	Wide >50m (4)	☐	☐	Forest, Swamp (3)	☐	☐	Conservation Tillage (1)	☐	☐	None or little (3)
☐	☐	Moderate 10-50m (3)	☐	☐	Shrub or Old field (2)	☐	☐	Urban or Industrial (0)	☒	☒	Moderate (2)
☒	☒	Narrow 5-10m (2)	☐	☒	Residential, Park, New field (1)	☐	☐	Mining, Construction (0)	☐	☐	Heavy/Severe (1)
☐	☐	Very narrow <5m (1)	☐	☐	Fenced pasture (1) 6.5	☒	☐	Open Pasture/Rowcrop (0)			2
☐	☐	None (0) 2									

Comments:

5a-Pool/Glide Quality (12 points maximum

Pool/Glide Score: 2

Max pool depth (check one)

☐ >1m (6)
☐ 0.7-1m (4)
☐ 0.4-0.7m (2)
☒ 0.2-0.4m (1)
☐ <0.2m (pool=0)

Morphology (check only one, OR check two and AVERAGE)

☐ Pool width > riffle width (2)
☐ Pool width = riffle width (1)
☒ Pool width < riffle width (0)

Pool/Run/Riffle current velocity (check all that apply)

☐ Eddies (1) ☐ Torrential (-1)
☐ Fast (1) ☐ Interstitial (-1)
☐ Moderate (1) ☐ Intermittent (-2)
☒ Slow (1) ☐ No pool (0)

Comments:

5b-Riffle/Run Quality (8) (check only one per category, OR two and AVERAGE)

Riffle/Run Score: 0

Riffle/run depth (check one)

☐ Generally>10cm, Max>50cm (4)
☐ Generally>10cm, Max<50cm(3)
☐ Generally 5-10cm (1)
☒ Generally<5cm (riffle=0)

Riffle/run substrate

☐ Stable-e.g. cobble, boulder (2)
☐ Mod. stable-e.g. pea gravel (1)
☒ Unstable-e.g. sand, gravel (0)

Riffle/run embeddedness

☐ Extensive (-1) ☐ Normal/Low (1)
☐ Moderate (0) ☐ None (2)
☒ No riffle (0)

Comments:

6-Gradient (10 points maximum)

Gradient Score: 6

Average width: 6.0' *Gradient:* _____ *(ft/mile)* *Drainage Area:* _____ *(square miles)*

Comments:

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location

Surveyor	Sample Date	County	Macro SampleType	Habitat Complete	QHEI Score: 34.5

Impacts/Miscellaneous

Major Suspected Impacts (Check all that apply)

- [ ] None
- [ ] Industrial
- [ ] WWTP
- [x] Agricultural
- [ ] Livestock
- [ ] Silviculture
- [ ] Construction
- [ ] Urban Runoff
- [ ] Suburban
- [x] Channelization
- [ ] Riparian Removal
- [ ] Flow Alteration
- [ ] CSOs
- [ ] Mining
- [ ] Landfills
- [ ] Natural

Pollution Impact Comments:

Miscellaneous QHEI Information

Subjective rating (1-10):
Aesthetic rating (1-10):
Canopy Cover (% Open): 75

% Riffle: 5
% Run: 1
% Glide:
% Pool: 5

Is reach representative of stream? Yes

General QHEI Notes:

no real riffle, pool complexes

IDEM — OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample # | bioSample # | Stream Name | Location: Site 8, Station 2

Surveyor | Sample Date: 10-22-08 | County | Macro SampleType | ☐ Habitat Complete | **QHEI Score: 30.5**

1-Substrate (20 points maximum)

Substrate Score: 3

Check 1 Predominant Pool & 1 Predominant Riffle

Check all that are present — P=Pool, R=Riffle

Predominant P	Predominant R		Present P	Present R		Predominant P	Predominant R		Present P	Present R
☐	☐	Bldrs/Slabs(10)	☐	☐		☐	☐	Hardpan(4)	☐	☐
☐	☐	Boulders(9)	☐	☐		☐	☐	Detritus(3)	☒	☒
☐	☐	Cobble(8)	☐	☐		☐	☐	Muck(2)	☒	☒
☐	☐	Gravel(7)	☒	☐		☒	☐	Silt(2)	☐	☐
☐	☒	Sand(6)	☐	☐		☐	☐	Sludge(1)	☐	☐
☐	☐	Bedrock(5)	☐	☐		☐	☐	Artificial(0)	☐	☐

Substrate Quality (check only 1, or check 2 and AVERAGE)

Substrate Origin: ☐ Limestone(1) ☐ Hardpan(0) ☐ Lacustrine(0) ☒ Tills(1) ☐ Sandstone(0) ☐ Shale(-1) ☐ Wetlands(0) ☐ Rip/Rap(0) ☐ Coal fines(-2)

Silt Cover: ☐ Silt heavy(-2) ☒ Silt moderate(-1) ☐ Silt normal(0) ☐ Silt free(1)

Embeddedness: ☐ Extensive(-2) ☒ Moderate(-1) ☐ Low/Normal(0) ☐ None(1)

NOTE: ignore sludge originating from point sources; score based on natural substrates

☐ >4 substrates present(2)

Comments:

2-Instream Cover (20 points maximum

Instream Cover Score: 3

Type (check ALL that apply)

☐ Undercut banks(1) ☐ Deep pools(2) ☐ Oxbows(1)
☐ Overhanging vegetation(1) ☐ Rootwads(1) ☐ Aquatic macrophytes(1)
☒ Shallows(in slow water)(1) ☐ Boulders(1) ☒ Logs and woody debris(1)
☐ Rootmats(1)

Comments:

Amount (check only 1, or 2 and AVERAGE)

☐ Extensive >75% (11)
☐ Moderate 25-75% (7)
☐ Sparse 5-25% (3)
☒ Nearly absent <5% (1)

3-Channel Morphology (20) (check only one per category, OR two and AVERAGE)

Channel Score: 8

Sinuosity	Development	Channelization	Stability	Modifications/Other	
☐ High (4)	☐ Excellent (7)	☐ None (6)	☐ High (3)	☐ Snagging	☐ Impound
☐ Moderate (3)	☐ Good (5)	☐ Recovered (4)	☒ Moderate (2)	☐ Relocation	☐ Islands
☒ Low (2)	☐ Fair (3)	☒ Recovering (3)	☐ Low (1)	☐ Canopy Removal	☐ Leveed
☐ None (1)	☒ Poor (1)	☐ Recent or no recovery (1)		☒ Dredging	☒ Bank shaping
					☐ One side channel modifications

Comments:

4-Riparian Zone & Bank Erosion (10 points maximum)

Riparian Score: 8.5

Left/Right banks looking downstream (For each category, check only one per bank, OR two per bank and AVERAGE).

Riparian width L	Riparian width R	(per bank)	Erosion/Runoff-Floodplain quality (past 100 ft Riparian) L	R	(most predominant per bank)	L	R		Bank Erosion L	R	(per bank)
☒	☐	Wide >50m (4)	☒	☒	Forest, Swamp (3)	☐	☐	Conservation Tillage (1)	☐	☐	None or little (3)
☐	☒	Moderate 10-50m (3)	☐	☐	Shrub or Old field (2)	☐	☐	Urban or Industrial (0)	☒	☒	Moderate (2)
☐	☐	Narrow 5-10m (2)	☐	☐	Residential, Park, New field (1)	☐	☐	Mining, Construction (0)	☐	☐	Heavy/Severe (1)
☐	☐	Very narrow <5m (1)	☐	☐	Fenced pasture (1)	☐	☐	Open Pasture/Rowcrop (0)			
☐	☐	None (0)									

3.5

Comments:

5a-Pool/Glide Quality (12 points maximum

Pool/Glide Score: 2

Max pool depth (check one)

☐ >1m (6)
☐ 0.7-1m (4)
☐ 0.4-0.7m (2)
☒ 0.2-0.4m (1)
☐ <0.2m (pool=0)

Morphology (check only one, OR check two and AVERAGE)

☐ Pool width > riffle width (2)
☐ Pool width = riffle width (1)
☒ Pool width < riffle width (0)

Pool/Run/Riffle current velocity (check all that apply)

☐ Eddies (1) ☐ Torrential (-1)
☐ Fast (1) ☐ Interstitial (-1)
☐ Moderate (1) ☐ Intermittent (-2)
☒ Slow (1) ☐ No pool (0)

Comments:

5b-Riffle/Run Quality (8) (check only one per category, OR two and AVERAGE)

Riffle/Run Score: 0

Riffle/run depth (check one)

☐ Generally>10cm, Max>50cm (4)
☐ Generally>10cm, Max<50cm(3)
☐ Generally 5-10cm (1)
☒ Generally<5cm (riffle=0)

Riffle/run substrate

☐ Stable-e.g. cobble, boulder (2)
☐ Mod. stable-e.g. pea gravel (1)
☒ Unstable-e.g. sand, gravel (0)

Riffle/run embeddedness

☐ Extensive (-1) ☐ Normal/Low (1)
☐ Moderate (0) ☐ None (2)
☒ No riffle (0)

Comments:

6-Gradient (10 points maximum)

Gradient Score: 6

Average width: 8' Gradient: (ft/mile) Drainage Area: (square miles)

Comments:

IDEM OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location

Surveyor	Sample Date	County	Macro SampleType	☐ Habitat Complete	QHEI Score: 30.5

Impacts/Miscellaneous

Major Suspected Impacts (Check all that apply)

- ☐ None
- ☐ Industrial
- ☐ WWTP
- ☒ Agricultural
- ☐ Livestock
- ☐ Silviculture
- ☐ Construction
- ☐ Urban Runoff
- ☐ Suburban
- ☒ Channelization
- ☐ Riparian Removal
- ☐ Flow Alteration
- ☐ CSOs
- ☐ Mining
- ☐ Landfills
- ☐ Natural

Pollution Impact Comments:

Miscellaneous QHEI Information

Subjective rating (1-10): % Riffle:
Aesthetic rating (1-10): % Run: 100
Canopy Cover (% Open): 50 % Glide:
% Pool:

Is reach representative of stream? Yes

General QHEI Notes:

* can expect to score low because channelized.

* Little vegetation on banks other than trees

- silt deposits common

 Site 1 - near UPS End of Deal Ditch near 400S

Worksheet 3-10. Pfankuch (1975) channel stability rating procedure, as modified by Rosgen (1996, 2001c, 2006b).

Reach 2: Level III

Stream: **Location:** **Valley Type:**

Observers: **Date:**

Location	Key	Category	Excellent Description	Excellent Rating	Good Description	Good Rating	Fair Description	Fair Rating	Poor Description	Poor Rating
Upper Banks	1	Landform slope	Bank slope gradient <30%.	2	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	3	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	4	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense soil-binding root mass.	3	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9	<50% density plus fewer species and less vigor indicating poor, discontinuous and shallow root mass.	12
Lower Banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	1	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank Height Ratio (BHR) = 1.0–1.1.	2	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3	Bankfull stage is not contained; overbank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio >1.4. Bank-Height Ratio (BHR) >1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	8
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	4	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	4	Some new bar increase, mostly from coarse gravel.	8	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well rounded in 2 dimensions.	3	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	8	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30–50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water too.	1	Common. Algae forms in low velocity and pool areas. Moss here too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4

Excellent Total = 2 **Good Total =** 10 **Fair Total =** 24 **Poor Total =** 92

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50
Fair (Mod. Unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+

Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95
Fair (Mod. Unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+

C3	C4	C5	C6	D3	D4	D5	D6
60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
106+	111+	111+	106+	133+	133+	133+	126+

G1	G2	G3	G4	G5	G6
40-60	40-60	85-107	85-107	90-112	85-107
61-78	61-78	108-120	108-120	113-125	108-120
79+	79+	121+	121+	126+	121+

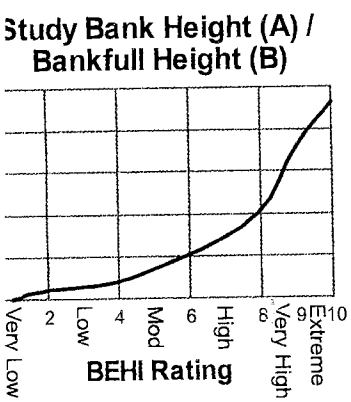
Grand Total = 128

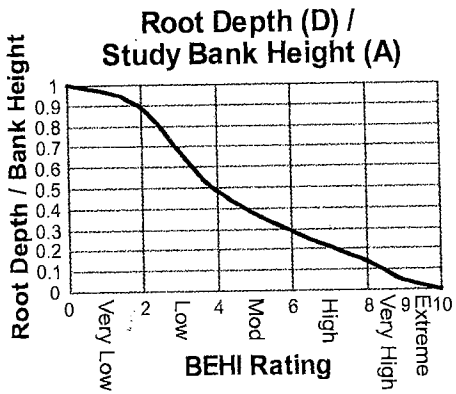
Existing Stream Type = G6

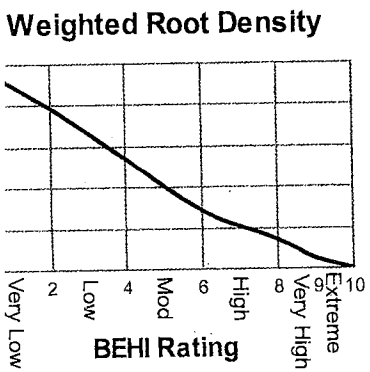
***Potential Stream Type =**

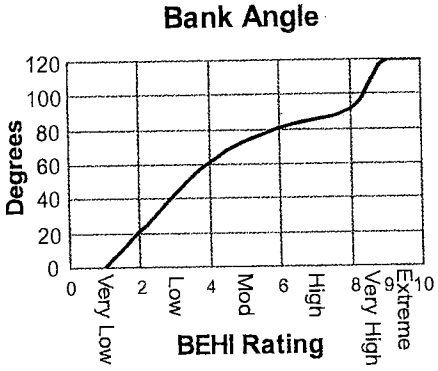
Modified Channel Stability Rating = Poor

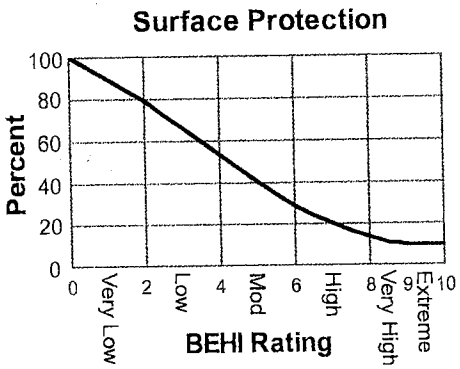
*Rating is adjusted to potential stream type, not existing.











7. Streambank erodibility criteria showing conversion of measured ratios variables to a BEHI rating (Rosgen, 1996, 2001b, 2006b). Use **Worksheet** ables to determine BEHI score.

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001b, 2006b). Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream: Doal Ditch		Location: site 8,	
Station: 1		Observers: TLE	
Date: 10-22-08	Stream Type:	Valley Type:	

						BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	8 (A)	Bankfull Height (ft) =	2.5 (B)	(A) / (B) =	3.2 (C)	9.6
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	3 (D)	Study Bank Height (ft) =	8 (A)	(D) / (A) =	.375 (E)	5
Weighted Root Density (G)						
Root Density as % =	25 (F)			(F)×(E) =	9.375 (G)	8.7
Bank Angle (H)						
Bank Angle as *Degrees* =	65 (H)					4.2
Surface Protection (I)						
Surface Protection as % =	5 (I)					10

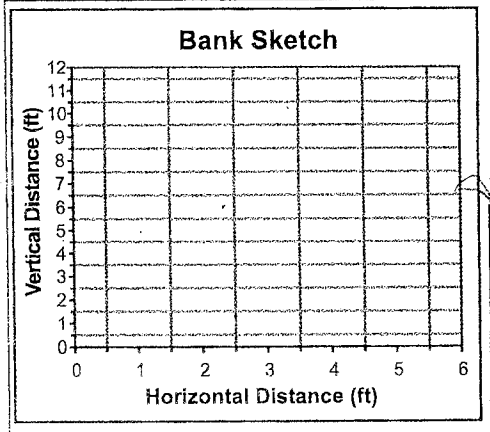
Bank Material Adjustment:
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform med. to large cobble)
- **Gravel or Composite Matrix** (Add 5-10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (No adjustment)

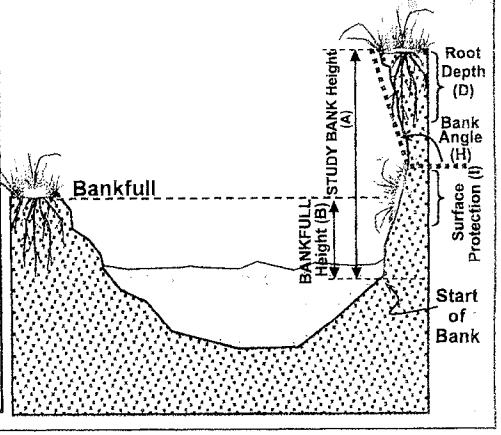
→ **Bank Material Adjustment** 5

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage —

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

→ **Adjective Rating** and **Total Score** Very H 42.5





Worksheet 3-10. Pfankuch (1975) channel stability rating procedure, as modified by Rosgen (1996, 2001c, 2006b).

Stream: **Location:** **Valley Type:**

Observers: **Date:**

Location	Key	Category	Excellent Description	Excellent Rating	Good Description	Good Rating	Fair Description	Fair Rating	Poor Description	Poor Rating
Upper Banks	1	Landform slope	Bank slope gradient <30%.	2	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	3	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	4	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense soil-binding root mass.	3	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9	<50% density plus fewer species and less vigor indicating poor, discontinuous and shallow root mass.	12
Lower Banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	1	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank Height Ratio (BHR) = 1.0–1.1.	2	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3	Bankfull stage is not contained; overbank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio >1.4. Bank-Height Ratio (BHR) >1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	8
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	4	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	4	Some new bar increase, mostly from coarse gravel.	8	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well rounded in 2 dimensions.	3	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	8	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30–50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water too.	1	Common. Algae forms in low velocity and pool areas. Moss here too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4

Excellent Total = **Good Total =** **Fair Total =** **Poor Total =**

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50
Fair (Mod. Unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+

Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95
Fair (Mod. Unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+

C3	C4	C5	C6	D3	D4	D5	D6
60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
106+	111+	111+	106+	133+	133+	133+	126+

G1	G2	G3	G4	G5	G6
40-60	40-60	85-107	85-107	90-112	85-107
61-78	61-78	108-120	108-120	113-125	108-120
79+	79+	121+	121+	126+	121+

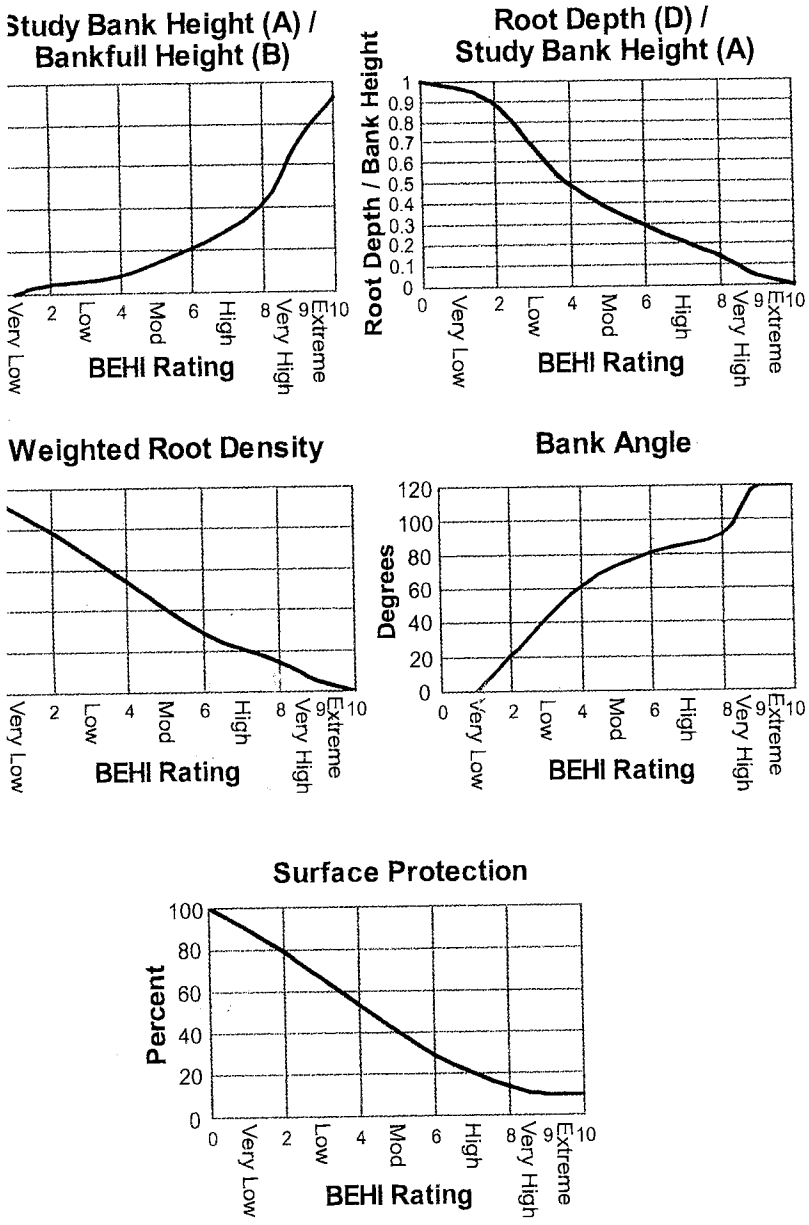
*Rating is adjusted to potential stream type, not existing.

Grand Total =

Existing Stream Type =

***Potential Stream Type =**

Modified Channel Stability Rating =



7. Streambank erodibility criteria showing conversion of measured ratios variables to a BEHI rating (Rosgen, 1996, 2001b, 2006b). Use **Worksheet** ables to determine BEHI score.

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001b, 2006b). Use **Figure 3-7** with BEHI variables to determine BEHI score.

Stream: Deal Ditch		Location: Site 8	
Station: 2		Observers: TE	
Date: 10-22-08	Stream Type:	Valley Type:	

						BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	5.5 (A)	Bankfull Height (ft) =	2.4 (B)	(A) / (B) =	2.29 (C)	8.2
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	2.5 (D)	Study Bank Height (ft) =	5.5 (A)	(D) / (A) =	.45 (E)	4.2
Weighted Root Density (G)						
Root Density as % =	40 (F)			(F)×(E) =	18 (G)	7.8
Bank Angle (H)						
Bank Angle as *Degrees* =	45 (H)					3
Surface Protection (I)						
Surface Protection as % =	25 (I)					6.5

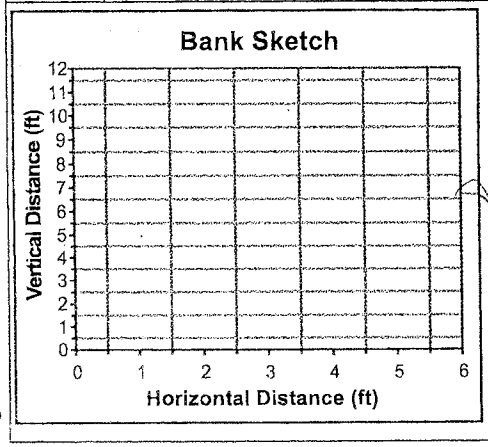
Bank Material Adjustment:
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform med. to large cobble)
- **Gravel or Composite Matrix** (Add 5-10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (No adjustment)

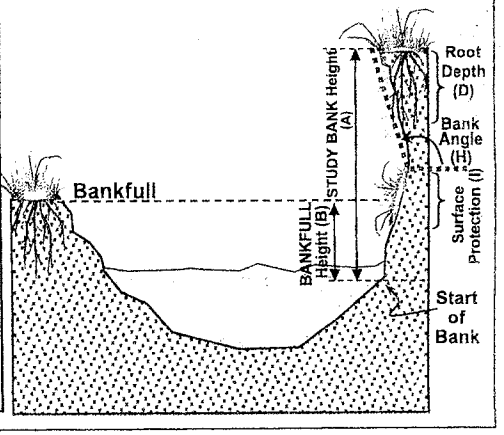
Bank Material Adjustment 5

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage —

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and **Total Score** High 34.7





Reach 2: Level III

near DWS end of reach

Worksheet 3-10. Pfankuch (1975) channel stability rating procedure, as modified by Rosgen (1996, 2001c, 2006b).

Stream: Dead Ditch **Location:** Site 8 Station 5 **Valley Type:**

Observers: **Date:**

Location	Key	Category	Excellent Description	Excellent Rating	Good Description	Good Rating	Fair Description	Fair Rating	Poor Description	Poor Rating
Upper Banks	1	Landform slope	Bank slope gradient <30%.	2	Bank slope gradient 30–40%.	4	Bank slope gradient 40–60%.	6	Bank slope gradient > 60%.	8
	2	Mass erosion	No evidence of past or future mass erosion.	3	Infrequent. Mostly healed over. Low future potential.	6	Frequent or large, causing sediment nearly yearlong.	9	Frequent or large, causing sediment nearly yearlong OR imminent danger of same.	12
	3	Debris jam potential	Essentially absent from immediate channel area.	2	Present, but mostly small twigs and limbs.	4	Moderate to heavy amounts, mostly larger sizes.	6	Moderate to heavy amounts, predominantly larger sizes.	8
	4	Vegetative bank protection	> 90% plant density. Vigor and variety suggest a deep, dense soil-binding root mass.	3	70–90% density. Fewer species or less vigor suggest less dense or deep root mass.	6	50–70% density. Lower vigor and fewer species from a shallow, discontinuous root mass.	9	<50% density plus fewer species and less vigor indicating poor, discontinuous and shallow root mass.	12
Lower Banks	5	Channel capacity	Bank heights sufficient to contain the bankfull stage. Width/depth ratio departure from reference width/depth ratio = 1.0. Bank-Height Ratio (BHR) = 1.0.	1	Bankfull stage is contained within banks. Width/depth ratio departure from reference width/depth ratio = 1.0–1.2. Bank Height Ratio (BHR) = 1.0–1.1.	2	Bankfull stage is not contained. Width/depth ratio departure from reference width/depth ratio = 1.2–1.4. Bank-Height Ratio (BHR) = 1.1–1.3.	3	Bankfull stage is not contained; overbank flows are common with flows less than bankfull. Width/depth ratio departure from reference width/depth ratio >1.4. Bank-Height Ratio (BHR) >1.3.	4
	6	Bank rock content	> 65% with large angular boulders. 12"+ common.	2	40–65%. Mostly boulders and small cobbles 6–12".	4	20–40%. Most in the 3–6" diameter class.	6	<20% rock fragments of gravel sizes, 1–3" or less.	8
	7	Obstructions to flow	Rocks and logs firmly imbedded. Flow pattern w/o cutting or deposition. Stable bed.	2	Some present causing erosive cross currents and minor pool filling. Obstructions fewer and less firm.	4	Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling.	6	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	8
	8	Cutting	Little or none. Infrequent raw banks <6".	4	Some, intermittently at outcurves and constrictions. Raw banks may be up to12".	6	Significant. Cuts 12–24" high. Root mat overhangs and sloughing evident.	12	Almost continuous cuts, some over 24" high. Failure of overhangs frequent.	16
	9	Deposition	Little or no enlargement of channel or point bars.	4	Some new bar increase, mostly from coarse gravel.	8	Moderate depostion of new gravel and coarse sand on old and some new bars.	12	Extensive deposit of predominantly fine particles. Accelerated bar development.	16
Bottom	10	Rock angularity	Sharp edges and corners. Plane surfaces rough.	1	Rounded corners and edges. Surfaces smooth and flat.	2	Corners and edges well rounded in 2 dimensions.	3	Well rounded in all dimensions, surfaces smooth.	4
	11	Brightness	Surfaces dull, dark or stained. Generally not bright.	1	Mostly dull, but may have <35% bright surfaces.	2	Mixture dull and bright, i.e., 35–65% mixture range.	3	Predominantly bright, > 65%, exposed or scoured surfaces.	4
	12	Consolidation of particles	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly loose assortment with no apparent overlap.	6	No packing evident. Loose assortment, easily moved.	8
	13	Bottom size distribution	No size change evident. Stable material 80–100%.	4	Distribution shift light. Stable material 50–80%.	8	Moderate change in sizes. Stable materials 20–50%.	12	Marked distribution change. Stable materials 0–20%.	16
	14	Scouring and deposition	<5% of bottom affected by scour or deposition.	6	5–30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	30–50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools.	18	More than 50% of the bottom in a state of flux or change nearly yearlong.	24
	15	Aquatic vegetation	Abundant growth moss-like, dark green perennial. In swift water too.	1	Common. Algae forms in low velocity and pool areas. Moss here too.	2	Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick.	3	Perennial types scarce or absent. Yellow-green, short-term bloom may be present.	4
			Excellent Total =	1	**Good Total =**	16	**Fair Total =**	14	**Poor Total =**	88

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	C1	C2
Good (Stable)	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60	38-50	38-50
Fair (Mod. Unstable)	44-47	44-47	91-129	96-132	96-142	81-110	46-58	46-58	61-78	65-84	69-88	61-78	51-61	51-61
Poor (Unstable)	48+	48+	130+	133+	143+	111+	59+	59+	79+	85+	89+	79+	62+	62+

Stream Type	DA3	DA4	DA5	DA6	E3	E4	E5	E6	F1	F2	F3	F4	F5	F6
Good (Stable)	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63	60-85	60-85	85-110	85-110	90-115	80-95
Fair (Mod. Unstable)	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86	86-105	86-105	111-125	111-125	116-130	96-110
Poor (Unstable)	87+	87+	87+	87+	87+	97+	97+	87+	106+	106+	126+	126+	131+	111+

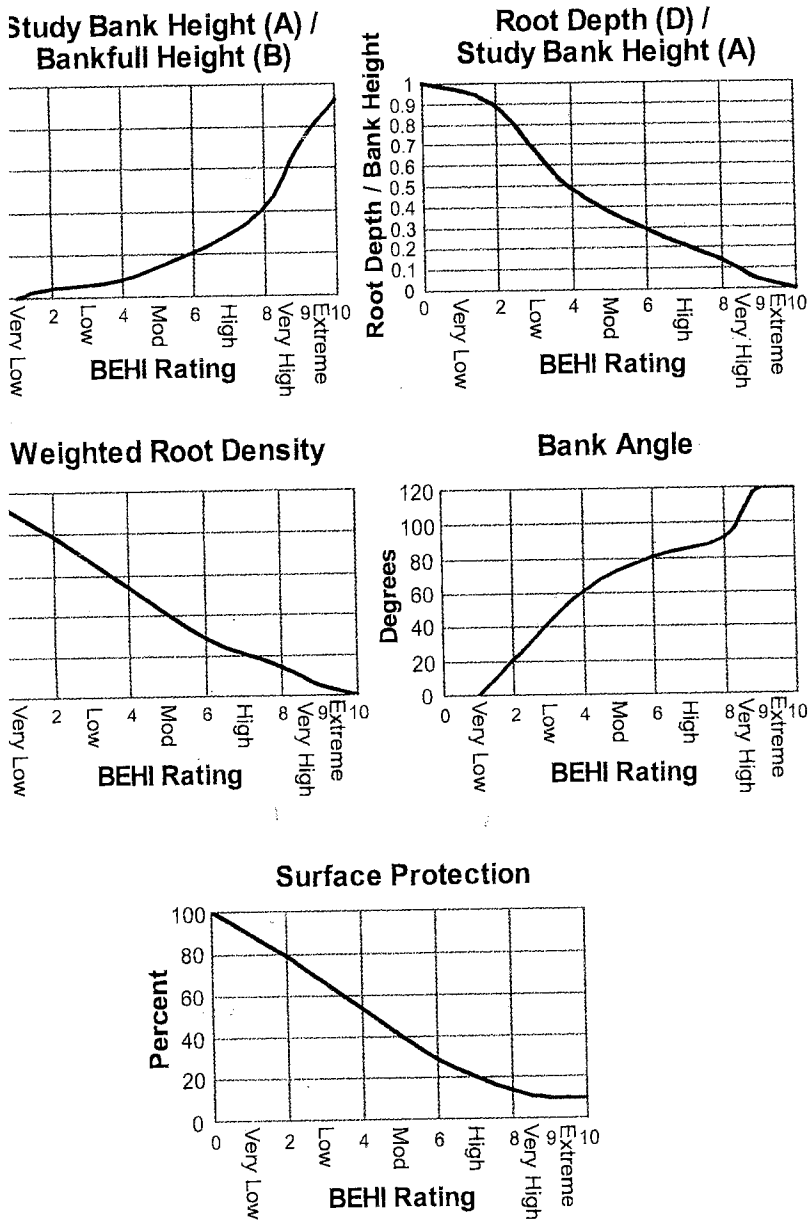
C3	C4	C5	C6	D3	D4	D5	D6
60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98
86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125
106+	111+	111+	106+	133+	133+	133+	126+

G1	G2	G3	G4	G5	G6
40-60	40-60	85-107	85-107	90-112	85-107
61-78	61-78	108-120	108-120	113-125	108-120
79+	79+	121+	121+	126+	121+

Grand Total =	123
Existing Stream Type =	
***Potential Stream Type =**	
Modified Channel Stability Rating =	Poor

*Rating is adjusted to potential stream type, not existing.

Cor 6 Channel



7. Streambank erodibility criteria showing conversion of measured ratios variables to a BEHI rating (Rosgen, 1996, 2001b, 2006b). Use **Worksheet** ables to determine BEHI score.

Worksheet 3-11. Form to calculate Bank Erosion Hazard Index (BEHI) variables and an overall BEHI rating (Rosgen, 1996, 2001b, 2006b). Use **Figure 3-7** with BEHI variables to determine BEHI score.

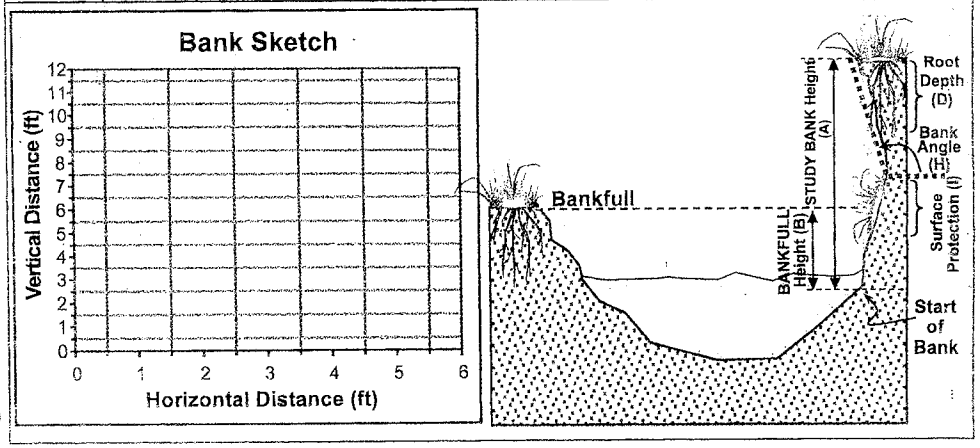
Stream:	Dogl Ditch	Location:	Site 8
Station:	5	Observers:	TLE
Date: 10-22-08	Stream Type:	Valley Type:	

						BEHI Score (Fig. 3-7)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	5 (A)	Bankfull Height (ft) =	2.5 (B)	(A) / (B) =	2 (C)	8
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.0 (D)	Study Bank Height (ft) =	5 (A)	(D) / (A) =	.2 (E)	7
Weighted Root Density (G)						
Root Density as % =	20 (F)			(F)×(E) =	4 (G)	9.8
Bank Angle (H)						
Bank Angle as *Degrees* =	45 (H)					3.2
Surface Protection (I)						
Surface Protection as % =	20 (I)					7

Bank Material Adjustment:
- **Bedrock** (Overall Very Low BEHI)
- **Boulders** (Overall Low BEHI)
- **Cobble** (Subtract 10 points if uniform med. to large cobble)
- **Gravel or Composite Matrix** (Add 5–10 points depending on percentage of bank material that is composed of sand)
- **Sand** (Add 10 points)
- **Silt/Clay** (No adjustment)

Bank Material Adjustment 5

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: —

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score Very High 40