CEDAR LAKE AQUATIC ECOSYSTEM FEASIBILITY STUDY

CEDAR LAKE, INDIANA

APPENDIX G
404(b)(1) Evaluation

U.S. Army Corps of Engineers
Chicago District

July 2016

Table of Contents

List of Figures

List of Attachments

PRELIMINARY
SECTION 404(B)(1) EVALUATION:
Cedar Lake Aquatic Ecosystem
Feasibility Study
Cedar Lake, Lake County, Indiana

July 2016

I. Project Description

a. Location

Cedar Lake is a 781 acre, glacially formed lake located within the Town of Cedar Lake, in Lake County, Indiana (Figure 1). Historically, the lake supported a biologically diverse ecosystem typical of northern glacial lakes. Today, the ecosystems and habitats of the Cedar Lake watershed are represented by highly degraded and fragmented patches of the once healthy ecosystem. Remnants of the natural ecosystem are rare; including scattered woodland plots and one large marsh located to the south of Cedar Lake (i.e., Cedar Lake Marsh) that was historically part of Cedar Lake before the lake level was lowered. The project study area is located in Section 4, Township 36 North, Range 4 West near Westville, Indiana as shown on the U.S. Geological Survey Westville and LaPorte West Topographical Quad Maps. The site is surrounded primarily by agricultural, rural residential, and forested areas.

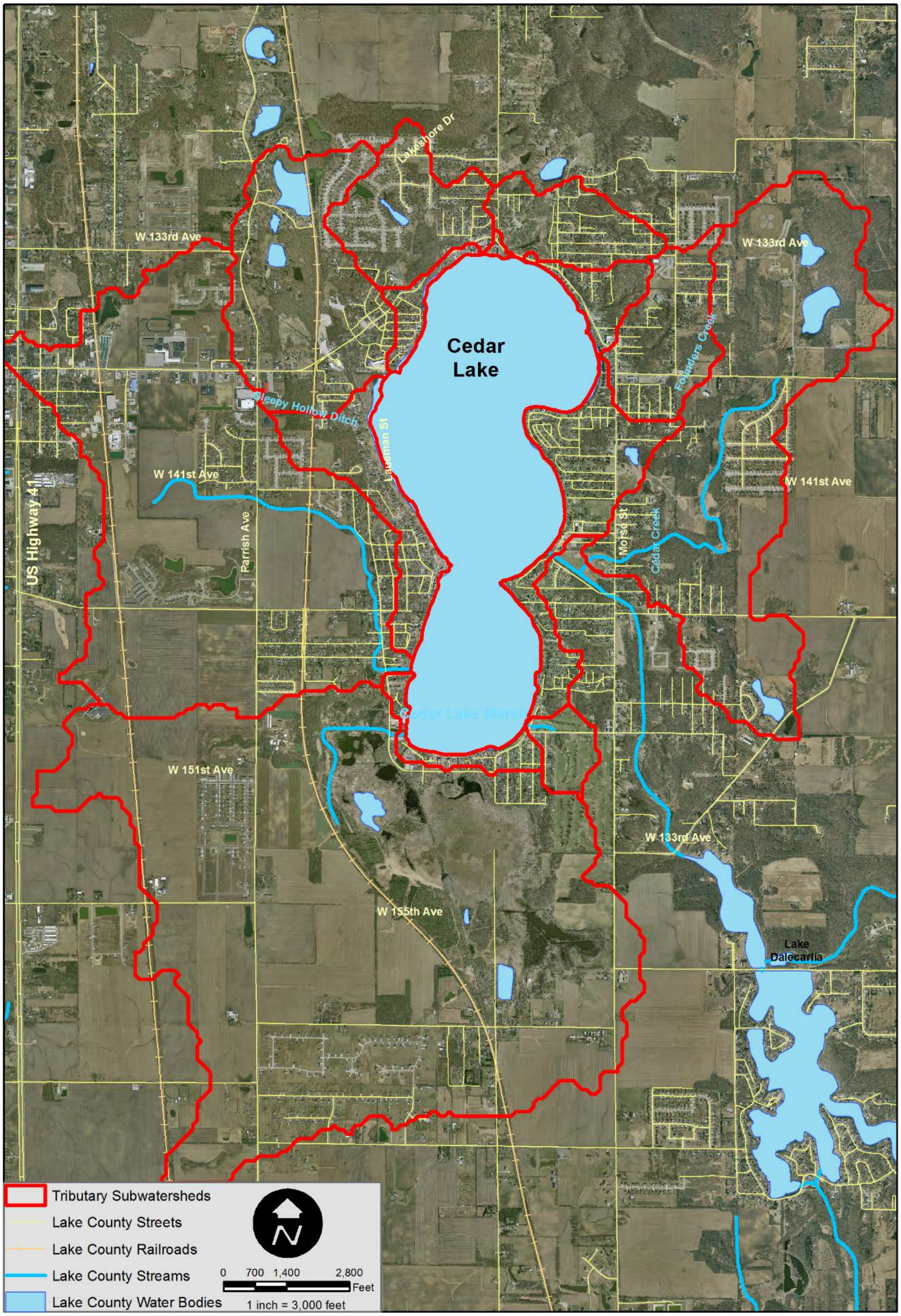

Figure 1: General Location Map

b. General Description

The non-Federal sponsor supports a locally preferred plan (LPP) for implementation by the U.S. Army Corps of Engineers (USACE) to restore the aquatic habitat structure and function of Cedar Lake. The LPP includes the following measures (Figure 2):

- Physical Substrate Restoration: Mechanically dredge 263,000 cubic yards of sediment from a 163 acre footprint in the south and central basins of the lake.
- Chemical Substrate Restoration: Treat 400 acre footprint of Cedar Lake with alum and/or sodium aluminate.
- Tributary Restoration: re-route Founders Creek to discharge into Cedar Lake.
- Littoral Macrophyte Restoration: Establish 35 ac emergent and 95 ac submergent aquatic vegetation along the shoreline of the lake within the littoral zone.
- Institutional Controls: Extend no wake zone from 200 to 400 ft from shoreline corresponding to approximately 35% of lake.
- Fish Community Management: Reintroduction of native fish species.

Implementation of the locally preferred plan (LPP), involves the following proper sequencing to optimize desired output. First, the reduction of non-native fish species will be carried out by the Town of Cedar Lake and the Indiana Department of Natural Resources (IDNR) through the one-time application of Rotenone. This will be carried out prior to the implementation of the components of the LPP. Then, sediment removal will be implemented with initial activities being construction of the sediment dewatering facility (SDF). Sediment will be mechanically dredged and hydraulically pumped and offloaded to the SDF. Dredging will likely occur in springtime so that algae that sink to the lake bottom during winter can be removed with the sediment. Chemical substrate restoration will follow dredging by treating the entire lake with alum, including areas that have been dredged, to ensure daylighted sediments are treated to achieve a reduction of available phosphorus in the exposed lakebed sediments to < 20 mg/kg. Institutional controls will extend no-wake zones so that native aquatic vegetation can become established. Re-routing Founders Creek can be implemented anytime during the construction process. Stocking of native fish species will be delayed until native aquatic vegetation has the ability to establish within the littoral zone of Cedar Lake.

Dredged sediments removed from Cedar Lake will be disposed at asediment dewatering facility (SDF). Solids generated during dredging activity will settle out within the SDF, accelerated by the introduction of a cationic polymer. Effluent from the SDF will ultimately return to Cedar Lake. Mechanically dredged material, not subject to Section 404/401 of the Clean Water Act, will not be used as fill for this project. Coordination with the State of Indiana suggests that water generated at the SDF discharged upstream of Cedar Lake is subject to the State of Indiana National Pollutant Discharge Elimination System (NPDES) point source discharge program and not Section 404/401 of the Clean Water Act. The anticipated location of the SDF is shown in Figure 3.

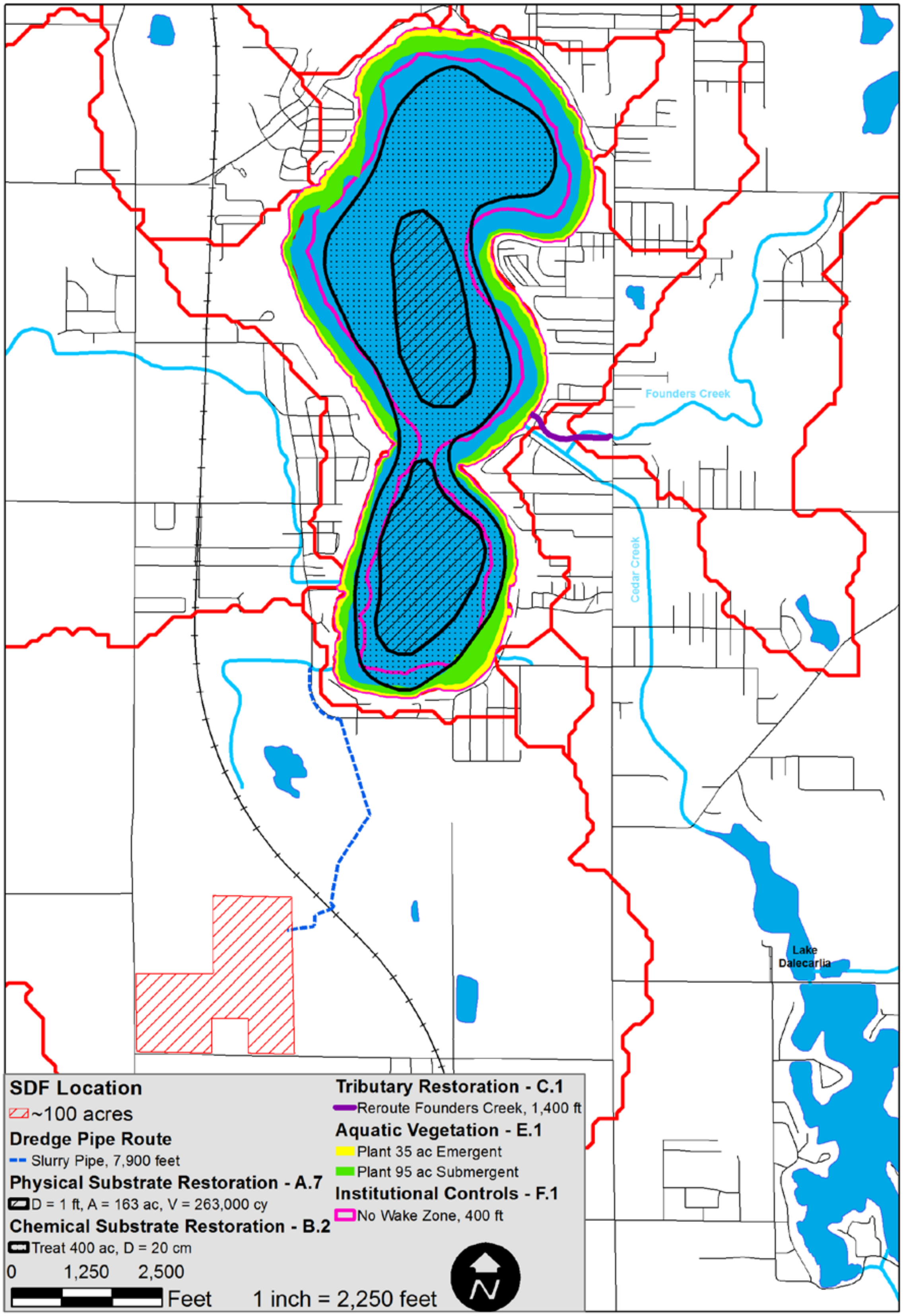

Figure 2: Layout Map of LPP

c. Authority and Purpose

SEC. 3065. CEDAR LAKE, INDIANA*. WRDA 2007*

> *(a) IN GENERAL.-The Secretary is authorized to plan, design, and construct an aquatic ecosystem restoration project at Cedar Lake, Indiana.*
> *(b) COMPLETE FEASIBILITY REPORT.-In planning the project authorized by subsection (a), the Secretary shall expedite completion of the feasibility report for the project for aquatic ecosystem restoration and protection, Cedar Lake, Indiana, initiated pursuant to section 206 of the Water Resources Development Act 1996 (33 U.S.C. 2330).*
> *(c) AUTHORIZATION.-*
> *(1) IN GENERAL.-There is authorized to be appropriated $11,050,000 to carry out the activities authorized by this section.*
> *(2) OTHER.-The Secretary is authorized to use funds previously appropriated for the project for aquatic ecosystem restoration and protection, Cedar Lake, Indiana, under section 206 of the Water Resources Development Act 1996 (33 U.S.C. 2330) to carry out the activities authorized by this section.*

This study was initiated by the Cedar Lake Enhancement Association (CLEA) to evaluate the applicability and feasibility of an ecosystem restoration project. Section 206 WRDA 1996 (Aquatic Ecosystem Restoration) projects are funded by the U.S. Army Corps of Engineers (USACE) and a non-federal sponsor. As presented above, Section 3065 of WRDA 2007 specifically authorized this project and has appropriated $11 million for the planning, design and construction of a feasible plan. This plan must be justified and supported by a detailed investigation indicating that the proposed actions are technically feasible and environmentally acceptable, and that they provide cost-effective ecosystem restoration benefits.

d. General Description of Dredged and Fill Material

1) General Characteristics of Material

Harza and USACE studies found that sediment in the deeper portions Cedar Lake are primarily silty clay with a relatively high percentage of fines. Shallow areas of the lake, adjacent to upland areas, consist of fine sand. Fine sediments cannot accumulate in the shallow near shore areas; a sediment transport model of Cedar Lake developed by Sandia National Labs suggests that sediments in these areas are constantly resuspended due to wind and boat induced wave action. Grain size analysis was conducted on the sediment samples from ten locations in Cedar Lake. The grain size results indicate that there is a relatively high percentage of fines in the sediments. The percent fines content in the sediment (smaller than #200 sieve) range between 75.7 and 95.3 percent. Sandia National Laboratories also measured the sediment density and particle size; results are documented in a report titled “Development of a Hydrodynamic, Sediment Transport, and Water Quality Model for Evaluation of Ecosystem Restoration Measures at Cedar Lake, Indiana” (Sandia 2007). In general, the average sediment density is 1.17 g/cm3 indicating that the material is very fluffy and not likely to settle once suspended.

2) Quantity of Material

Deeper portions of the central and southern basins of Cedar Lake will be mechanically dredged 1.0 feet and material hydraulically pumped for final disposition at the SDF site. Approximately 263,000 cubic yards of sediment will be removed from Cedar Lake and placed in an upland SDF. The mechanically dredged material will not be used as fill material and de minimis return resulting from the mechanical dredging activity itself is not subject to Section 404 of the Clean Water Act. Water generated from the SDF will be discharged upstream of Cedar Lake post-treatment and is subject to the State of Indiana NPDES point source discharge requirements.

The proposed Founders Creek reroute include filling in the existing creek with 641 cubic yards of native material excavated for the creation of the new channel. Approximately 3,800 cubic yards of native soil material will be generated for the creation of the new channel.

3) Source of Material

Dredge material will be removed from a 163 acre footprint in the south and central basins of Cedar Lake.

Fill material for the Founders Creek reroute will be generated on site. Fill materials required to stabilize the new stream channel will be clean, inert materials obtained from a commercial supplier with less than 5% fines. Seed and other plant materials will be obtained from a local supplier.

e. Description of Proposed Discharge Site

As stated in *(I.b) General Description*, dredged sediments removed from the southern basin of Cedar Lake will be disposed at a SDF. The mechanically dredged material will not be used as fill material and de minimis return resulting from the mechanical dredging activity itself is not subject to Section 404/401 of the Clean Water Act. Water generated from the SDF will be discharged upstream of Cedar Lake post-treatment and is subject to the State of Indiana NPDES point source discharge requirements.

1) Location

The Founders Creek reroute is located at the intersection of Morse Street and 138th Lane in the Town of Cedar Lake (see ***Figure 1***). Founders Creek currently flows southwesterly into Cedar Creek, approximately 800 feet downstream of Cedar Lake. Founders Creek is shown as unmapped floodplain according to the Federal Emergency Management Agency (FEMA) Flood Insurance Map (FIRM) for the Town, dated March 15, 1982. The proposed reroute includes the filling of approximately 270 linear feet of the existing creek; the proposed length of the relocated creek is approximately 950 feet. Although the existing flow for Founders Creek has yet to be determined, a 100-year design flow rate of 400 cfs has been assumed to determine the size of the proposed creek needed to maintain the conveyance of the existing creek. A seven-foot wide trapezoidal channel with 3:1 side sloped and a depth of four feet is planned. Additionally, a riparian corridor of 50 feet on each side of the creek would be restored along with the rerouting and remeandering of the stream.

2) Size

The proposed Founders Creek reroute includes filling in the existing creek with 641 cubic yards of native material excavated for the creation of the new channel. Approximately 3,800 cubic yards of native soil material will be generated for the creation of the new channel. Excess materials will be incorporated into the final grading at the fill site as much as practical. Excess or unsatisfactory materials will be hauled offsite and disposed of in accordance with applicable Federal, State, and local laws and regulations.

3) Type of Site

The proposed discharge site for the Founders Creek reroute would be in the open water of the existing creek channel.

4) Type of Habitat

Founders Creek currently outlets into Cedar Creek, which is the outlet to Cedar Lake. Model results suggest that adding clean nutrient free cool groundwater base flow from Founders Creek to Cedar Lake will increase water quality of Cedar Lake during summer months. Water sampling was conducted in the creek at its confluence with Cedar Creek in the summer of 2005 and found the water to be of high quality containing low nutrients and reduced temperature, indicative of a groundwater induced base flow. Founders Creek can be classified as a typical agricultural ditch and was previously known as Hog Pen Ditch. The creek was straightened and cleared of all viable habitats for small stream fishes and aquatic organisms. In 2007, a 20 acre forested tract adjacent to Founders Creek in the project area was clear cut to make way for residential development. The water quality entering Cedar Creek was subsequently observed to be markedly reduced as a result of the clear-cutting. In August 2007, the temperature was no longer cool in the creek and the banks were noticeably eroded and deposits were observed at the confluence with Cedar Creek. By the fall of 2009, 1,075 linear feet of forested riparian adjacent to Founders Creek had been restored as a result of the clear cut. The restoration included enhancing in-stream structure within Founders Creek and planting of approximately 2.5 acres of forested riparian area adjacent to the stream channel. Qualitative evaluation of the restored site's habitat in 2011 showed an increase in habitat value from the pre-impact evaluation. The newly created stream channel would be of high aquatic habitat value, similar to the restored reach.

5) Timing and Duration of Dredging and Discharge

Dredging of Cedar Lake will be conducted in two dredging seasons.

Reroute of Founders Creek could be initiated anytime during the construction phase. The project sequencing will be as follows:

- Excavation and grading of new channel and installation of culverts under existing roadways, as necessary, for flow to outlet to Cedar Lake. Soil materials will be stockpiled on-site. Inlet will be plugged to prevent flow from Founders Creek until channel stabilization is complete.
- Stabilization of new channel with vegetation. Vegetation will consist of establishment of a combination of stormwater tolerant species within the channel (temporary cover species, permanent grasses, sedges, rushes, forbs, and shrubs) and a low profile prairie seed mix in the riparian zone (temporary cover, permanent grasses, sedges, and forbs).
- Removal of plug materials to allow flow into the new channel, and placement of plug material into existing Founders Creek confluence to prevent flow from entering the existing channel.

Filling of Founders Creek with material generated during the excavation of the new channel stockpile on-site. After fill is placed, compacted, and graded, the area will be stabilized with vegetation, and the outlet to Cedar Creek will be plugged and bank stabilized.

II. Factual Determinations

a. Physical Substrate Determinations

1) Substrate Elevation and Slope

Cedar Lake water levels are controlled by an outlet weir which sets the normal water level in the lake to 692.90 NGVD 29. Lake bottom elevations in the project area range from elevation 679 NGVD 29 to 691.9 NGVD 29 in the shallow bank areas. Appreciable slopes are noted in constricted areas of the lake, especially between the central and southern basin. The deepest portions of the lake, 13.9 feet, occur in the central basin and between the central and southern basins, along the central portion of the lake with the longest fetch.

The substrate elevation and slope of Founders Creek have been previously modified by channelization and ditching; increased gradient due to channelization.

2) Sediment Type

Harza and USACE studies found that sediment in the deeper portions Cedar Lake are primarily silty clay with a relatively high percentage of fines. Shallow areas of the lake, adjacent to upland areas, consist of fine sand. Fine sediments do not accumulate in the shallow near shore areas; a sediment transport model of Cedar Lake developed by Sandia National Labs suggests that sediments in these areas are constantly resuspended due to wind and boat induced wave action. Grain size analysis was conducted on the sediment samples from ten locations in Cedar Lake. The grain size results indicate that there is a relatively high percentage of fines in the sediments. The percent fines content in sediments found in deeper portions of the lake (smaller than #200 sieve) range between 75.7 and 95.3 percent. Sandia National Laboratories also measured the sediment density and particle size; results are documented in a report titled “Development of a Hydrodynamic, Sediment Transport, and Water Quality Model for Evaluation of Ecosystem Restoration Measures at Cedar Lake, Indiana” (Sandia 2007). In general, the average sediment density is 1.17 g/cm^3 indicating that the material is very fluffy and not likely to settle once suspended.

The substrate within Founders Creek currently consists of silt, sand and small gravel.

3) Dredge/Fill Material Movement

There would be no significant movement of sediment in Cedar Lake or in Founders Creek after construction. The new Founders Creek channel, and upland areas including the sediment dewatering facility, will be stabilized with erosion control matting, geotextile, and/or vegetation. In addition, the sediment bed within Cedar Lake will be treated with alum, which binds the sediment and phosphorous within the sediment to limit resuspension. Plantings along the shoreline of Cedar Lake will mitigate wind and boat induced wave action, prevent suspension of sediments along the shoreline, and stabilize the sediments.

4) Physical Effects on Benthos

Existing benthos within the construction zone at Cedar Lake would be displaced during dredging and any present in Founders Creek would be buried or smothered by the proposed activity. Impacts to the benthic invertebrate community through species composition would probably differ from that present before construction due to the change in local substrate post construction. These minor impacts are necessary to create improved conditions for benthic invertebrates. There are no significant adverse effects expected.

In the long term, aquatic habitat would be restored and/or enhanced to promote greater macroinvertebrate diversity.

5) Other Effects

There would be no other significant substrate impacts.

6) Actions Taken to Minimize Impacts

The new Founders Creek will remain plugged until the new channel is stabilized to prevent erosion of sediment downstream. Solids, ammonia and phosphorous will be removed from the water discharged from the SDF to minimize downstream impacts and prevent recontamination of the substrate within Cedar Lake. Sediment and erosion control best management practices will be used in all areas of active construction to reduce sediment loads. Applicable permits will be secured and the work will be coordinated with the regulatory agencies, including the EPA, IDEM, Indiana DNR, and the USFWS.

b. Water Circulation, Fluctuation, and Salinity Determinations

1) Water

a. Salinity – Not applicable to freshwater environments.
b. Water Chemistry – No significant impacts.
c. Clarity – Loss in water clarity expected during dredging from increased turbidity. Long-term improvement in clarity expected after alum application.
d. Color – Minor temporary color changes may results from increases in suspended solids during dredging.
e. Odor – No significant impacts
f. Taste – No significant impacts.
g. Dissolved Gas Levels – Minor temporary impacts in dissolved oxygen levels in Cedar Lake may occur in the immediate area of dredging due to increases in turbidity.
h. Nutrients – Increases in nutrient levels will likely occur in the immediate area of dredging due to increases in turbidity from resuspension of sediments. Long-term reduction in nutrient levels expected after alum treatment.
i. Eutrophication – Improvements in level of eutrophy.
j. Other Impacts – No other significant water impacts.

2) Current Patterns and Circulation

The current patterns, flow, velocity of water, stratification, and hydrologic regime in Cedar Lake will likely not be altered during implementation of the project. Founders Creek will be altered during the reroute to Cedar Lake; however, the design of the new stream channel will mimic the current conditions in the existing stream to protect the quality of the water in the stream. The volume of water flowing into Cedar Creek will likely be reduced with the reroute of Founders Creek to Cedar Lake; however, these minor impacts are necessary to improve the conditions in Cedar Lake. Overall, there are no significant adverse effects expected.

a. Current Patterns and Flow – Current patterns and flow within Cedar Lake will likely not be altered during implementation of the project. Current patterns and flow within Founders Creek will likely be altered during the reroute to Cedar Lake; however, this will be a temporary in duration. Once the new stream channel is completed, current patterns and flow within Founders Creek should be similar to those before implementation of the project since the design of the new stream channel will mimic current conditions. The volume of water flowing into Cedar Creek will likely be reduced with the reroute of Founders Creek to Cedar Lake; however, these minor impacts are necessary to improve the conditions in Cedar Lake. No significant adverse effects to current patterns and flow are expected.

b. Velocity – Velocity within Cedar Lake will likely not be altered during implementation of the project. Velocity within Founders Creek will likely be altered during the reroute to Cedar Lake; however, this will be temporary in duration. Once the new stream channel is completed, velocity within Founders Creek should be similar to what it was prior to implementation of the project since the design of the new stream channel will mimic current conditions. The velocity of water within Cedar Creek may be reduced with the reroute of Founders Creek to Cedar Lake; however, these minor impacts are necessary to improve the conditions in Cedar Lake. No significant adverse effects to velocity are expected.
c. Stratification – Stratification within Cedar Lake and Founders Creek will likely not be altered during implementation of the project. No significant adverse effects to stratification are expected.
d. Hydrologic Regime – Hydrologic regime within Cedar Lake will likely not be altered during implementation of the project. Hydrologic regime within Founders Creek will likely be altered during the reroute to Cedar Lake; however, this will be temporary in duration. Once the new stream channel is completed, hydrologic regime within Founders Creek should be similar to those before implementation of the project since the design of the new stream channel will mimic current conditions. Hydrologic regime within Cedar Creek may be affected due to the reroute of Founders Creek to Cedar Lake; however, these minor impacts are necessary to improve the conditions in Cedar Lake. No significant adverse effects to hydrologic regime are expected.

3) Normal Water Level Fluctuations

The proposed activities would have no significant impact on normal water level fluctuations upstream or downstream of Cedar Lake.

The proposed activities are also expected to have no significant impact on normal water level fluctuations within Founders Creek as the channel would be designed so as to maintain the conveyance capacity of the existing channel.

4) Salinity Gradients

Not applicable to freshwater environments.

5) Actions that will be Taken to Minimize Impacts

Alum treatment will consist of application of aluminum sulfate (alum) and sodium aluminate to prevent large decrease in pH during treatment, depending on the measured alkalinity in Cedar Lake at the time of alum treatment. Alum treatment will mitigate release of nutrients and solids during dredging.

c. Suspended Particulate/Turbidity Determinations

1) Expected Changes in Suspended Particulates and Turbidity in Vicinity of Dredging

There will be increases in suspended particulates and turbidity levels in the immediate area of the proposed dredging activity.

2) Effects on Chemical and Physical Properties of the Water Column

a. Light penetration – Localized turbidity increases would cause decrease on light penetration.
b. Dissolved oxygen – Minor impacts in dissolved oxygen levels may occur in the vicinity of dredging due to increases in turbidity.
c. Toxic metals and organics – Removal of highly organic sediment provides long-term improvements in Cedar Lake.
d. Pathogens – None are known in the construction area.
e. Aesthetics – There will be temporary increases in turbidity, noise, dust and visual disturbance at sediment dewatering facility and within Cedar Lake during implementation of the selected plan. Aesthetics would be improved in the long-term after native vegetation is established in the area and existing water quality is improved.
f. Other – No additional long-term negative impacts to system components not listed above are expected as a result of the proposed activities.

3) Effects on Biota

Overall, no significant impact on aquatic biota are expected to result from turbidity or suspended particulates associated with the dredging activity. Short-term impacts due to temporary increases in turbidity would be potential impacts to aquatic fish species that are site predators. However, the majority of fish within Cedar Lake will be eradicated through the one-time application of rotenone that will occur prior to components of the LPP. Native fish species will not be restocked within the lake until after dredging activities have been completed and native aquatic vegetation has been established within the littoral zone of the lake. Therefore, no long-term significant impacts to aquatic biota within Cedar Lake or Founders Creek are expected. This project is necessary to return ecological health to Cedar Lake.

a. Primary Production, Photosynthesis – Localized turbidity increases due to physical substrate restoration within Cedar Lake and channel construction within Founders Creek would cause a decrease in light penetration which could affect primary production; however, the effects would be temporary in duration. No significant long-term adverse effects are expected.
b. Suspension/Filter Feeders – Localized turbidity increases due to physical substrate restoration within Cedar Lake and channel construction within Founders Creek could affect suspension/filter feeders; however, the effects would be temporary in duration. No significant long-term adverse effects are expected.
c. Sight Feeders – Localized turbidity increases would affect sight feeders; however, the effects would be temporary in duration, lasting only as long as construction activities within Cedar Lake (e.g., physical substrate restoration) and Founders Creek (e.g., construction of channel) are occurring. No significant long-term adverse effects are expected.

4) Actions Taken to Minimize Impacts

Alum treatment will consist of application of aluminum sulfate (alum) and sodium aluminate to prevent large decrease in pH during treatment, depending on the measured alkalinity in Cedar Lake at the time of alum treatment. Alum treatment will mitigate release of nutrients and solids during dredging. Sediment and erosion control best management practices will be used in all areas of active construction to reduce sediment loads. Applicable permits will be secured and the work will be coordinated with the regulatory agencies, including the EPA, IDEM, Indiana DNR, and the USFWS.

d. Contaminant Determinations

The contaminant determination (Attachment 1) addresses the degree to which the sediment proposed for discharge will introduce, relocate, or increase the levels of contaminants at the disposal site. The determination considers the quality of the material to be discharged, the environment at the proposed disposal site, and the availability of contaminants. The contaminant determination documents the results of several sediment and soil sampling efforts conducted in spring 2007 and spring 2008. The following determinations are made:

- Sediment data collected in spring 2007 confirms elevated levels of TOC, ammonia-nitrogen, phosphorous, and metals in the sediment as well as low concentrations of several organic compounds. Further data collection and analysis conducted in spring 2008 suggests that though some metals exceed the State of Indiana RISC default closure values, the contaminant pathways of concern can be eliminated using site-specific data. It appears that the sediment can be disposed at the proposed sediment dewatering facility (SDF) site without land use restrictions.

- Results of the elutriate testing suggest that dredged material waters cannot be returned to Cedar Lake without treatment. Concentrations of phosphorous, ammonia, and total suspended solids in the return waters will likely cause a violation of discharge effluent restrictions as well as a violation of water quality standards at the discharge location. In addition, the levels of metals in the return waters, likely associated with suspended particles, indicate potential violation of water quality standards at discharge. An on-site water treatment process was developed to treat decant water from the SDF in 2009; however, additional observations made during a supernatant settling test conducted in 2013 demonstrated that suspended solids and phosphorus may be effectively removed by gravity settling in the SDF with the introduction of low concentrations of a cationic polymer prior to placement of dredged material in the SDF. In addition, elevated levels of ammonia may be removed or reduced to regulatory compliance levels by implementing various onsite alternatives implemented within the SDF.

- Designing a multi-cell configuration for the SDF will aid in the removal of suspended solids and phosphorus by incorporating long weir crest lengths into the water control structures that skim the top one or two inches of the supernatant water from the initial primary solids storage cell and subsequent secondary treatment cells. In addition to the multi-cell flow through cell configuration, interior baffle or diversion dikes should be implemented to minimize short circuiting and to increase hydraulic retention time prior to eventual discharge.

Continued coordination with the Indiana Department of Environmental Management (IDEM) on the acceptability of placement of dredged materials at the SDF site is required. In addition, during the design stage of the project, further coordination with the State will be required to obtain an NPDES for the discharge of water from the SDF.

A phase I HTRW investigation was completed for the proposed project. The HTRW investigation followed ASTM Standard Practices for Environmental Site Assessments, and USACE guidance. Based on review of the information obtained from the database search, there appears to be little potential for encountering HTRW or contaminated soil in the area of Founders Creek reroute. Founders Creek passes through what was, until recently, an undisturbed wetland; the site does not appear on any Federal or State listing of sites of concerns, there are no illegal dischargers, or known historical environmental problems within the reroute area. The soils in the area are native. No sediment or soil sampling was conducted in the Founders Creek reroute area.

e. Aquatic Ecosystem and Organism Determinations

1) Effects on Plankton

Ultimately, there will be a shift from an over abundance of phytoplankton, to a more balanced community of zooplankton and phytoplankton. Current conditions are in favor of phytoplankton and subsequently turns the entire lake green in the summer with blue-green algae.

The composition of phytoplankton and zooplankton within Founders Creek is unknown. It is unlikely that an over abundance of phytoplankton exists within Founders Creek as it does in Cedar Lake. Restoration measures within Founders Creek are not expected to impact phytoplankton or zooplankton communities long-term. There could be temporary minor effects due to turbidity from the construction of the new channel; however, these effects are only expected to last as long as construction activities are occurring.

2) Effects on Benthos

Refer to section II.a.4)

3) Effects on Nekton

Currently, the fish present in Cedar Lake are highly tolerant of poor water and sediment quality. These fish are able to reproduce by simply broadcasting their eggs over any given substrate. For the most part, these fish will be eradicated before dredging occurs, therefore there would not be any effects on nekton and fish eggs. Ultimately, this project would restore a healthy native glacial lake fish community.

Similar to Cedar Lake, fish present within Founders are for the most part considered highly tolerant species. However, in order to potentially avoid effects on nekton and fish eggs, construction of the channel would not occur during time periods when these species are actively reproducing or during rearing seasons. Some covering of nekton and fish eggs could potentially occur with the construction of the new channel and the filling in of the old channel; however, the overall benefit to fish eggs and nekton from the restoration of the channel is expected to outweigh any potential short-term negative impacts. Fish and other free-swimming organisms would tend to avoid the construction area; the construction area would be used again by these organisms soon after construction ends.

4) Effects on Aquatic Food Web

No significant long-term impacts on the food web are expected. Beneficial improvement to the food web are likely, due to expected increases in macroinvertebrate richness and abundance for both Cedar Lake and Founders Creek.

5) Effects on Special Aquatic Sites

a) Sanctuaries and Refuges – None present; no significant impact
b) Wetlands – Cedar Lake Marsh is located in the southern basin of Cedar Lake. Additionally, there is a 14 acre wetland located at the northern edge of Cedar Lake. No dredging or fill activities will be occurring within the two wetlands; therefore, no significant impacts are anticipated.
c) Mud Flats – None present; no significant impact
d) Vegetated Shallows – Cedar Lake Marsh is located in the southern basin of Cedar Lake and there is a 14 acre wetland located at the northern edge of Cedar Lake. No dredging or fill activities will be occurring within the two wetlands; therefore, no significant impacts are anticipated.
e) Coral Reefs – Not applicable to freshwater environments
f) Riffle and Pool Complexes – Founders Creek has been channelized in the past creating a single pool within the creek. Therefore, no significant impacts to riffle/pool complexes would result from restoring the historic connection between Founders Creek and Cedar Lake. It is likely that riffle/pool complexes could be restored through the restoration of the channel.

6) Threatened and Endangered Species

The recommended plan would not have any adverse effects to threatened or endangered state or Federal species. In a letter dated 20 November 2007, the USFWS concurred that any proposed alternatives would not have direct or indirect effects to Federally listed species.

7) Other Wildlife

No other wildlife would be significantly impacted by the proposed restoration activities.

8) Actions Taken to Minimize Impacts

General construction scheduling and sequencing would minimize impacts to reproducing macroinvertebrates and fishes. Biodegradable erosion control fabric, silt fencing and native plantings would be implemented within the Founders Creek construction site so as to minimize turbidity impacts associated with the proposed activity.

f. Proposed Discharge Site Determinations

1) Mixing Zone Determination

A mixing zone is not applicable to this project as no violation of applicable water quality standards is expected during construction.

2) Determination of Compliance with Applicable Water Quality Standards

The proposed activity would not cause significant or long-term degradation of water quality within Cedar Lake and would comply will all applicable water quality standards.

3) Potential Effects on Human use Characteristics

Overall, no significant long-term negative impacts to municipal and private water supplies, water-related recreation, aesthetics, recreational, or commercial fisheries are expected. During project implementation, recreational uses of Cedar Lake will be limited and increases in no-wake zones are necessary to provide protection to aquatic plants that will be established in Cedar Lake. Long-term improvements in fisheries will result from implementation of fish community management measures. No known National Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves are present.

a) Municipal and Private Water Supply – No adverse effects to municipal and private water supplies are expected as a result of implementation of this project.
b) Recreational and Commercial Fisheries – Recreational fisheries will be temporarily impacted within Cedar Lake when Rotenone is applied to the lake to eradicate non-native and invasive species. However, recreational fishing is expected to benefit in the long-term as a result of stocking native fish species and fish community management. No long-term adverse effects are expected.
c) Water Related Recreation – Water related recreation is expected to be impacted as a result of implementation of institutional controls. As part of the institutional controls, the No Wake Zone will be extended from 200 feet to 400 feet; however, this is necessary to provide protection to aquatic plants that will be reestablished in Cedar Lake.
d) Aesthetics – No adverse effects to aesthetics are expected as a result of implementation of this project. Aesthetics are expected to benefit as a result of this project.
e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves – None are present within the project location.

g. Determination of Cumulative Effects on the Aquatic Ecosystem

The proposed project would reroute Founders Creek from Cedar Creek to Cedar Lake. Cedar Creek would no longer receive the benefits of having a clean nutrient free cool water source. However, because the properties adjacent to Founders Creek have been clear cut, it is assumed that this source of clean, cool, nutrient free water has already been eliminated from Cedar Creek. There are no significant adverse effects expected as a result of implementation of the Cedar Lake project.

h. Determination of Secondary Effects on the Aquatic Ecosystem

No significant impacts on the Cedar Lake ecosystem are expected as a result of the proposed activity.

III. Findings of Compliance of Non-Compliance with the Restrictions on Discharge

a. No adaptation of the Section 404(b) (1) guidelines was made for this evaluation.

b. No practical alternatives are available that produce fewer adverse aquatic impacts than the proposed plan.

c. The proposed project would comply with applicable water quality standards.

d. The project is in compliance with applicable Toxic Effluent Standards under Section 307 of the Clean Water Act; with the Endangered Species Act of 1973; with the National Historic Preservation Act of 1966; and with the Marine Protection, Research, and Sanctuaries Act of 1972.

e. The proposed dredging and fill activities would have no significant adverse impact on human health or welfare, including municipal and private water supplies, recreational and commercial fisheries, plankton, fish, shellfish, or wildlife communities (including community diversity, productivity, and stability), special aquatic sites, or recreational, aesthetic, and economic values.

f. Special measures will be implemented during restoration activities to minimize construction impacts, including:

- Alum treatment will consist of application of aluminum sulfate (alum) and sodium aluminate to prevent large decrease in pH during treatment, depending on the measured alkalinity in Cedar Lake at the time of alum treatment.
- Alum treatment will mitigate release of nutrients and solids into the water column during dredging.
- Sediment and erosion control best management practices will be used in all areas of active construction to reduce sediment loads.
- The new Founders Creek will remain plugged until the new channel is stabilized to prevent erosion of sediment downstream.
- Solids, ammonia and phosphorous will be removed from the water discharged from the upland sediment dewatering facility to minimize downstream impacts and prevent recontamination of the substrate within Cedar Lake.
- Applicable permits, including 401 certification for rerouting Founders Creek and NPDES point source discharge for sediment dewatering, will be secured and the work will be coordinated with the regulatory agencies, including the EPA, IDEM, Indiana DNR, and the USFWS.

g. On the basis of the Guidelines, the proposed dredging and discharge of fill material is specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse impacts to the aquatic ecosystem.

a. Conclusions

Based on all of the above, the proposed action is determined to be in compliance with the Section 404(b)(1) Guidelines, subject to appropriate and reasonable conditions, to be determined on a case-by-case basis, to protect the public interest.

Date _________________ _____________________________

Christopher T. Drew
Colonel, U.S. Army
District Commander

Attachment 1:

Memorandum for File – Contaminant Determination for the Cedar Lake Aquatic Ecosystem Feasibility Study

CELRC-TS-DH

MEMORANDUM FOR FILE

SUBJECT: Contaminant Determination for the Cedar Lake Aquatic Ecosystem Feasibility Study

1. Enclosed is the Contaminant Determination for the locally preferred plan (LPP), Alternative 6, recommended for implementation to restore the aquatic ecosystem of Cedar Lake. The contaminant determination addresses the degree to which the sediment proposed for discharge will introduce, relocate, or increase the levels of contaminants at the disposal site. The determination considers the quality of the material to be discharged, the environment at the proposed disposal site, and the availability of contaminants. The initial contaminant determination developed for the Cedar Lake Aquatic Ecosystem Restoration project in 2009 has been updated for consistency with the current project description. No new sediment or water quality data were collected to complete the current update, and although the State of Indiana Department of Environmental Management (IDEM) screening standards have changed, the data and conclusions were only reviewed as part of this update. Screening levels were not updated in the summary data tables. It is recommended that additional data analysis be conducted using current regulatory requirements at the time of design.

2. The contaminant determination documents the results of several sediment and soil sampling efforts conducted in spring 2007 and spring 2008. The following determinations have been made:

    - Sediment data collected in spring 2007 confirms elevated levels of TOC, ammonia-nitrogen, phosphorous, and metals in the sediment as well as low concentrations of several organic compounds. Further data collection and analysis conducted in spring 2008 suggests that though some metals exceed the State of Indiana RISC default closure values, the contaminant pathways of concern can be eliminated using site-specific data. It appears that the sediment can be disposed at the proposed sediment dewatering facility (SDF) site without land use restrictions.

    - Results of the elutriate testing suggest that dredged material waters cannot be returned to Cedar Lake without treatment. Concentrations of phosphorous, ammonia, and total suspended solids in the return waters will likely cause a violation of discharge effluent restrictions as well as a violation of water quality standards at the discharge location. In addition, the levels of metals in the return waters, likely associated with suspended particles, indicate potential violation of water quality standards at discharge. An on-site water treatment process was developed to treat decant water from the SDF in 2009; however, additional observations made during a supernatant settling test conducted in 2013 demonstrated that suspended solids and phosphorus may be effectively removed by gravity settling in the SDF with the introduction of low concentrations of a cationic polymer prior to placement of dredged material in the SDF. In addition, elevated levels of ammonia may be removed or reduced to regulatory compliance levels by implementing various onsite alternatives implemented within the SDF.

- Designing a multi-cell configuration for the SDF will aid in the removal of suspended solids and phosphorus by incorporating long weir crest lengths into the water control structures that skim the top one or two inches of the supernatant water from the initial primary solids storage cell and subsequent secondary treatment cells. In addition to the multi-cell flow through cell configuration, interior baffle or diversion dikes should be implemented to minimize short circuiting and to increase hydraulic retention time prior to eventual discharge.

3. TS-DH recommends continued coordination with the Indiana Department of Environmental Management on the acceptability of placement of dredged materials at the SDF site. In addition, during the design stage of the project, additional treatability studies and coordination with the State will be required to obtain an NPDES for the discharge of water from the SDF. Questions regarding this contaminant determination should be directed to Casey Pittman at (312) 846-5506.

JAY A. SEMMLER, P.E.
Chief, Hydraulics & Environmental
Engineering Section

Enclosure

Attachment 2:

Clean Water Act Section 404(b)(1) Contaminant Determination for Cedar Lake Aquatic Ecosystem Feasibility Study

Electronic Copies of Attachments Available Upon Request

Clean Water Act Section 404(b)(1) Contaminant Determination for Cedar Lake Aquatic Ecosystem Feasibility Study

Prepared by:

U.S. Army Corps of Engineers, Chicago District
231 South LaSalle Street Suite 1500
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June 3, 2009
(Updated May 2016)

CONTAMINANT DETERMINATION
CEDAR LAKE AQUATIC ECOSYSTEM FRASIBILITY STUDY
Table of Contents

List of Tables

List of Figures

Attachments

1. Executive Summary of Document Changes

The initial contaminant determination developed for the Cedar Lake Aquatic Ecosystem Restoration project in 2009, using data collected in 2007 and 2008, has been subsequently updated for consistency with the current project description. No new sediment or water quality data were collected to complete the current update, and although the State of Indiana Department of Environmental Management (IDEM) screening standards have changed, the data and conclusions were only reviewed as part of this update. Screening levels were not updated in the attached summary data tables. It is recommended that additional data analysis be conducted using current regulatory requirements at the time of design.

2. Introduction

2.1. Federal Clean Water Act Requirements

The Clean Water Act (CWA), specifically Section 404 (b)(1), requires the development and application of environmental guidelines covering a broad range of effects to human health and ecological systems. The 404(b)(1) guidelines, codified in 40 CFR 230, require that a contaminant determination be prepared for any discharge of dredged or fill material to the waters of the United States. "The term 'discharge of dredged material' means any addition of dredged material into waters of the United States. The term includes, without limitation, the addition of dredged material to a specified discharge site located in waters of the United States and the runoff or overflow from a contained land or water disposal area." The contaminant determination must address the degree to which the material proposed for discharge will introduce, relocate, or increase the levels of contaminants at the disposal site. The determination must consider the material to be discharged, the aquatic environment at the proposed disposal site, and the availability of contaminants.

Section 404(b)(1) of the CWA contains a number of evaluation provisions applicable when proposing dredged material disposal upland facilities. Section 230.10(b)(1) prohibits the disposal of dredged material that might violate applicable water quality standards, after consideration of disposal site dilution and dispersion. This provision is aimed at the effluent or runoff discharges from the upland disposal site. That same section requires consideration of "effects on municipal water supplies" and is reinforced at Section 230.50. This section specifically addresses municipal and private water supplies including groundwater, which is a potential concern for leachate pathway. Section 230.11(h) requires consideration of a broad range of secondary effects from proposed dredged material discharges. Pathways from an upland disposal site, such as plant or animal uptake, could be considered secondary effects under this section.

2.2. Approach

The U.S. Army Corps of Engineers (USACE) developed the *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities - Testing Manual (January 2003),* commonly referred to as the Upland Testing Manual or UTM, as a resource document providing technical guidance for evaluation of potential contaminant migration pathways from upland disposal facilities.

Disposal of dredged material in confined disposal facilities (CDFs) is one of the most commonly considered alternatives for dredged material. CDFs are also an option commonly considered for disposal of contaminated sediments dredged for purposes of sediment remediation, either as temporary rehandling sites or for final disposal. CDFs are also used for disposal of clean sediments where other options are too costly or present additional environmental problems. Facilities that handle beneficial-use type, or clean, materials are often referred as sediment dewatering facility's (SDF) as opposed to CDF, which is more commonly used to define facilities that handle contaminated materials. The procedures used in the UTM are equally applicable to both navigation dredging (or dredging activities of essentially the same character as navigation dredging, such as dredging soft-bottom flood control channels or reservoirs) and contaminated sediment remediation projects. CDFs and SDFs are designed and constructed specifically for disposal of dredged sediment and are designed for the unique properties of sediments, such as high water content and return flow of excess water as effluent to surface waters.

The UTM outlines a structured, sequential approach to sediment evaluation and testing to determine potential contaminant releases and contaminant-related environmental effects from upland disposal facilities and determine whether pathway-specific contaminant controls or management actions are necessary for the proposed upland disposal facility to avoid unacceptable adverse effects outside the site. The objective of the tiered testing approach is to make optimal use of the resources in generating the required information for a factual determination of compliance with the Clean Water Act Section 404(b)(1), using an integrated chemical, physical, and biological approach. The integrated chemical and physical approach is used to evaluate the environmental affects of upland disposal of sediments into a SDF for final disposition, generated during dredging of Cedar Lake.

2.3. Project Description

Cedar Lake is a 781-acre, glacially formed lake located in the Town of Cedar Lake, in Lake County, Indiana (see Figure 1). The lake was once a pristine glacial lake left by Wisconsinan Age glaciers with a small watershed of intermingled prairie, savanna, woodlands, and wetlands. Today, the ecosystems and habitats of the Cedar Lake watershed are almost completely removed, with only highly degraded and fragmented patches left. Remnants of the natural ecosystem are rare; most of these are scattered woodland plots and one large marsh to the south of Cedar Lake (Cedar Lake Marsh) that was historically a direct portion of Cedar Lake before the lake level was lowered.

The local sponsor supports Alternative 6 for implementation by the U.S. Army Corps of Engineers (USACE) to restore the aquatic structure and function of Cedar Lake. Alternative 6 includes the following measures (see Figure 2):

- Physical substrate restoration: Mechanically dredge 263,000 cubic yards of sediment from a 163-acre footprint in the south and central basins of the lake.
- Chemical substrate restoration: Treat 400-acre footprint of Cedar Lake with alum and/or sodium aluminate.
- Tributary restoration: re-route Founders Creek to discharge into Cedar Lake.
- Littoral Macrophyte restoration: Plant 35-ac emergent and 95-ac submergent aquatic vegetation along the shoreline of the lake within the littoral zone.
- Institutional Controls: Increase no wake zone from 200 to 400-ft from shoreline corresponding to approximately 35% of lake.
- Fish Community Management: Re-establish native glacial lake fish community.

Implementation of Alternative 6, or the locally preferred plan (LPP), involves the following proper sequencing to optimize desired output. Physical substrate restoration will be implemented first with initial activities being construction of the sediment dewatering facility (SDF) and effluent treatment works. Sediment will be mechanically dredged and hydraulically pumped and offloaded to the SDF. Dredging will likely occur in springtime so that algae that sink to the lake bottom during winter can be removed with the sediment. Chemical substrate restoration will follow dredging by treating the entire lake with alum, including areas that have been dredged, to ensure daylighted sediments are treated to achieve a reduction of available phosphorus in the exposed lakebed sediments to < 20 mg/kg. Institutional controls will increase no-wake zones so that aquatic vegetation can take hold (after removal of invasive benthic feeders). Stocking of native fish species will be delayed until aquatic vegetation has the ability to establish and the Town of Cedar Lake has removed non-native fish species from the lake using a one-time application of Rotenone. Re-routing Founders Creek can be implemented anytime during the construction process.

Dredged sediments removed from Cedar Lake will be disposed at an upland disposal site, or sediment dewatering facility (SDF), and the return water will be treated within the SDF before ultimately returning to Cedar Lake. The anticipated location of the SDF is shown in Figure 3.

2.4. Identification of Relevant Pathways at SDF Site

The sediment dewatering facility (SDF) will be located on agricultural property acquired by the Town of Cedar Lake. The property is surrounded by agriculture to the west and north, a residential development to the south, and agriculture/wetland (Cedar Lake Marsh) to the east.

An HTRW investigation of the SDF site was completed in August 2007 (Attachment 1). A search of environmental databases for the disposal property was performed in May 2007 as part of this investigation. Review of the database search overview map suggests that there are no wetlands on the disposal property nor is the project in the 100-year floodplain (see Figure 4). Relevant site SDF site conditions found during completion of the HTRW investigation are described below. While future use of the site has not been determined, it is likely that that the SDF site will be converted to open park land with soccer and/or baseball fields or other recreational uses. The property will not be actively farmed.

2.4.1. SDF Site Soil Composition

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS), now the National Resource Conservation Service (NRCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining, and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey provides representations of the soil patterns in a particular landscape. According to the State Soil Geographic Database and the Soil Survey Geographic database, site soils are consistent with the Morley series. Site soils are expected to have a silty loam texture. Slow infiltration rates may be present due to soils layers that impede downward movement or contain moderately fine texture. The soils are moderately well drained with a layer of low hydraulic conductivity. Soils are expected to be in a wet state high in the soil profile. The water table is expected three to six feet below the ground surface.

CBBEL performed a site specific investigation of soil types found at the SDF site in a report dated May 2008 (see Attachment 2). In general, CBBEL concluded that the soil types identified by the National Resource Conservation Service map clearly characterize the conditions at the SDF site (see Figure 5). Site soils have little to thin Aeolian silty deposits over silty clay loam and clay loam glacial till. In several areas of the property gravely substratum was identified as lenses in the soils. A number of soil map boundaries were adjusted following the CBBEL investigation as a result of drainage patterns exhibiting wetter conditions on the property than were previously identified, resulting in additional hydric soil of the Pewamo unit mapped on the property.

2.4.2. Groundwater Wells

There are no known federally registered USGS monitoring or public water supply wells within 1 mile of the SDF site. Information obtained from the Indiana Department of Natural Resources (IDNR) suggests that the ground-water resource of northern Indiana can be classified as being good to excellent. Exclusive of some areas in northwestern Indiana, well yields of from 200 to 2,000 gallons per minute can be expected in most areas. Approximately 500 wells are registered with the IDNR in the areas surrounding the SDF site. A portion of rural residents in areas adjacent to the SDF site use groundwater as their primary source of drinking water.

2.4.3. Soil and Water Quality

The soil and water quality on the SDF site are largely unknown. A history of agricultural use on the proposed SDF site indicates soils may contain residual pesticides, fungicides, rodenticides, and herbicides commonly used to maintain active crops. Fertilizer use on the SDF property suggests soils may contain excess nutrients; operation, use, and maintenance of mechanical farm equipment could lead to isolated occurrences of spilled gasoline, hydraulic fluid, and oil in the agricultural field.

Water quality in the drainage ditches and/or swales originating or passing through the proposed SDF site is largely unknown. Because the drainage ditches accept flow from agricultural runoff during storm events, the concentrations of suspended solids and nutrients in these and adjacent waterways may be elevated during periods of flow. Nonpoint source pollution from agricultural properties can affect the water quality of surroundings waterways in the area by promoting eutrophication and increasing sediment loading; excessive nutrients in the runoff can provide a nutrient rich environment for excessive algal growth.

2.4.4. Historical Land Use

Chicago District Planning Branch (CELRC-PL) conducted an investigation of past land use for the environmental assessment and concluded that the site has been farmland since the 1840s. The land is currently a mix of corn and wheat fields, and has remained agricultural land since it was purchased from the Federal government between 1851 and 1853. In early plat maps, the property is listed as the “Grand Prairie” to the west of Cedar Lake and Lowell, Indiana. While records show that the property contained barns, silos, and outbuildings (i.e. “McKinney Farm”), none of the structures are within the SDF construction boundaries. Adjacent parcels have remained agricultural land; no industrial or manufacturing operations have been conducted to the present.

CELRC-PL review of county/regional records suggests that Anglo-American farmers (predominantly of Yankee background) first came to the Cedar Lake area during 1832-1835; the county was first surveyed by the Federal government in 1834. “Hoosier” emigrants (from Indiana, Kentucky, Tennessee, or Virginia) were a minority. The white settlers displaced a native population of Pottawatomie who came to northwest Indiana from Michigan in the 1760s. During 1830-1845 they occupied seasonal camps and semi-permanent villages throughout the Kankakee River basin. By 1836, most of the Pottawatomie had left Lake County after signing treaties and being “removed” to Iowa and Kansas. The Federal government surveyed Northwest Indiana between 1836 and 1850, and public lands were sold to squatters, speculators, and newly arrived farmers. During the late nineteenth and early twentieth centuries, the area became popular for tourism after the construction of the Monon Railroad connecting Cedar Lake and Chicago in 1882. The Lake remained a popular destination through the 1950s with a hotel/motel industry catering to the tourist crowd.

2.5. SDF Design and Management Characteristics

SDF preliminary design indicates that the facility will be capable of storing 263,000 cubic yards of dredged material generated from the dredging of Cedar Lake. Over dredging, ponding, and sediment bulking factors will be considered in the final design of the facility. Sediment will be removed from Cedar Lake using a mechanical dredge. Material will be placed in a barge that will be offloaded nearshore and dredged material will be offloaded from the barge using a hydraulic pump. Water from Cedar Lake will be used to dilute the sediment to aid in pumping of material to the SDF until return water generated from the SDF settling ponds can be recycled for pumping. The addition of a chemical coagulant may be necessary to aid settling of sediment within the SDF due to the fluffy nature of the sediments and the hydraulic offloading process; this condition, along with the number of settling cells and water control structures required in the SDF, will be considered further in the design stage of the project.

In general, site soils will be used to create the SDF to the maximum extent practicable. Soils within the top 12 inches will be stripped from the site and will be reused as topsoil post-dredging to stabilize the site. Deeper soils from the site will be used to construct the containment walls of the facility. Future use of the site will likely include recreational use by local residents of park services. In addition to public uses described in paragraph 1.4, local wildlife may also passively use the SDF site.

2.6. Need for Contaminant Evaluations

Cedar Lake has suffered the effects of cultural eutrophication (acceleration of lake succession through anthropogenic activities). Extremely high phosphorus and nutrient loading over the years from sewerage overflows, and non-point source pollution, may have enriched the sediments with nutrients and other contaminants, such as metals. While typically an inland lake like Cedar would have a natural sand sediment surface, Cedar Lake contains several feet of fine silts and clays that have been accumulated from years of suspended sediments contained in surface and agricultural runoff discharged to the lake from natural inlets and storm water inflows. Further evaluation of COCs are necessary; there is sufficient reason to believe that contaminants in the dredged material may be of concern that warrants a more detailed evaluation of potential COC effects at the disposal facility.

3. Tier 1

3.1. Tier 1 Objectives

The UTM uses a four-tiered evaluation process for each of the five pathways. This tiered approach should be initiated at Tier I for each pathway and is designed to aid in generating appropriate and sufficient, but not more than necessary, information to make decisions regarding the need for management actions. The Tier I evaluation includes a scoping process and an evaluation of existing information to determine the need for pathway evaluations, identify relevant pathways for the project, and identify contaminants of concern (COCs). The existing information for each relevant pathway is evaluated to determine if a decision on the need for management actions can be made and identify which pathways require more detailed evaluations in higher tiers.

3.2. Contaminant Transport and Pathways

3.2.1. Land Use

The land directly adjacent to Cedar Lake is primarily a combination of low and high density residential development. Cedar Lake watershed in general consists primarily of agricultural property; however, many agricultural areas within the Cedar Lake watershed are rapidly converting to residential area. A total of seven tributaries to Cedar Lake were delineated using online mapping tools, and GIS data corresponding to each of catchments was downloaded to estimate the tributary runoff, sediment, and contaminant loadings using Purdue

Universities L-Thia NPS GIS v2.3 Model for Cedar Lake. Basin delineations and drainage areas were determined from the national seamless 30-meter hydrologically corrected digital elevation model (DEM). A map showing land use by sub-basin is shown in Figure 6.

3.2.2. Sediment Physical Characteristics

Harza found, as part of a diagnostic dredging feasibility study (Harza 1998), that sediment in the deeper portions Cedar Lake are primarily silty clay with a relatively high percentage of fines. Shallow areas of the lake, adjacent to upland areas, consist of fine sand. Fine sediments cannot accumulate in the shallow near shore areas; a sediment transport model of Cedar Lake developed by Sandia National Labs suggests that sediments in these areas are constantly resuspended due to wind and boat induced wave action. Grain size of sediments that will be dredged as part of the restoration project were confirmed by grain size analyses completed during the Tier 2 investigation. Sandia National Laboratories also measured the sediment density and particle size; results are documented in a report titled "Development of a Hydrodynamic, Sediment Transport, and Water Quality Model for Evaluation of Ecosystem Restoration Measures at Cedar Lake, Indiana" (Sandia 2007). In general, the average sediment density is 1.17 g/cm^3 indicating that the material is very fluffy and not likely to settle once suspended.

3.2.3. Tributary Flows

Cedar Lake currently has seven inlets, plus direct drainage from properties adjacent to the Lake, that contribute water, sediment, contaminant, and nutrient loading. Because of the heavy agricultural use of the watershed, significant fertilizer runoff, dissolved solids, and nutrients drain into Cedar Lake during storm events. In addition, development in the watershed is rapidly converting agricultural property to residential developments which creates storm water runoff with elevated concentrations of suspended solids and metals. Suspended solids loading from disturbed land created during development of properties also contribute negatively to Cedar Lake. Estimates of tributary sediment and contaminant loading to Cedar Lake are included in Attachment 3.

3.2.4. Municipal Surcharges, Overflows, Bypasses and Septics

According to the Cedar Lake Watershed Ecosystem Restoration Local Existing Conditions Report (CBBEL 2008), there are approximately 290 acres of existing reported septic fields that are tributary to Cedar Lake, most of which are located west and south of Cedar Lake. There is a potential for additional septic fields to exist within the area, some of which may be failing. Sanitary sewer surcharge is also a problem in and around Cedar Lake; during the period of 2003 to 2007, extended surcharging was recorded 16 times. The average observed surcharge was 8 hours.

3.3. Potential Sources of Sediment Contamination

3.3.1. Storm Water Runoff

Storm water generated in the Cedar Lake watershed enters Cedar Lake in one of seven tributary inlets. Contaminants carried in storm water runoff, including metals, suspended solids, nutrients, and dissolved solids deposit in Cedar Lake. There is one outlet to Cedar Lake; the lake level and outflow from Cedar Lake into Cedar Creek is control by a broad crested weir set at elevation 695.308 NGVD29 (feet). Water, in general, does not flow out of Cedar Lake during periods of dry weather. The hydraulic residence time in Cedar Lake is more than one-year, which causes Cedar Lake to serve as a sink for incoming sediments and associated contaminants.

3.3.2. Municipal Surcharges, Overflows, Bypasses, and Septics

Sanitary surcharges and failing septic fields can contain contaminants such as nitrates, phosphorus, disease-causing bacteria and viruses, dissolved metals, detergents and solvents. It is difficult to determine the ultimate total loading of sanitary waste containing these contaminants to Cedar Lake. It unclear how much surcharge ultimately flows into Cedar Lake; in addition, the extent of any failing septic fields is unknown.

3.3.3. Other Sources

There are no current or past information that suggests the lake has received industrial or municipal wastewater discharges, previous dredged or fill discharges, landfill leachate/groundwater discharge, spills of oil or chemicals, releases from Superfund or other hazardous waste sites, or other illegal discharges.

3.4. Sources of Information Investigated

3.4.1. Historic Sediment Data

3.4.1.1. Indiana University 1984

In support of the Cedar Lake Restoration Feasibility Study produced by the Indiana University (IU) in 1984 on the condition of Cedar Lake, IU collected three sediment cores from Cedar Lake, see Figure 7, using a piston sampler; the length of the sediment cores varied between 1.0 to 5.5 meters (3.3 to 18 feet). Sediment samples were collected from three of the cores (C-1, C-2, and C-5 noted on Figure 7) and were analyzed for metals, total phosphorous, total nitrogen, pollen, percent organic matter, and particle size distribution. In general, IU results suggested that the concentrations of metals and nutrients were elevated in shallower sediments. It appears, based on analysis of the results presented, that the concentration of lead in the sediment may exceed the Indiana Department of Environmental Management (IDEM) Risk Integrated System of Closure (RISC) Residential default closure values, see Table 1.

Table 1: IU 1984 Sediment Sampling Results

Parameter	Mean Concentration (mg/kg)	Maximum Concentration (mg/kg)	RISC Residential Default (mg/kg)
Lead**	111	166	81
Zinc	118	255	10,000
Copper	47	62	920
Cadmium	1.9	3.6	7.5
Iron	28,471	32,500	-

**exceeds RISC standards (2007)

3.4.1.2. Indiana Department of Environmental Management 1987

The Indiana Department of Environmental Management (IDEM) collected two composite sediment samples in July 1987. Samples were composited from three individual grabs collected from the northern and southern basins of the lake; the locations of the grab samples are unknown. Samples were analyzed for general chemistry (cyanide, percent total solids, moisture, ammonia-nitrogen, etc), metals, semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), and pesticides. Analytical results for detected contaminants are summarized and compared to IDEMs Risk Integrated System of Closure (RISC) Residential default closure values in Table 2. A PCB advisory on fish consumption was issued due to the presence of PCB in carp tissue analyzed from the same study.

Table 2: IDEM 1987 Sediment Sampling Results

Detected Parameter (mg/kg)	Cedar Lake North Basin (mg/kg)	Cedar Lake South Basin (mg/kg)	RISC Residential (mg/kg)
Aluminum	826	1,390	-
Arsenic	ND	1.5	3.9
Barium	ND	7.1	1600
Calcium	4,080	10,500	-
Chromium	ND	1.9	38
Iron	1,890	2,800	-
Lead	3.8	6.4	81
Magnesium	1,650	5,060	-
Manganese	66.7	102	-
Nickel	ND	5.1	950
Zinc	8.5	12.7	10000
Heptachlor	0.0346	ND	0.93
Tetrachloroethylene	0.006	0.006	0.058

RISC standards (2007)

3.4.1.3. Harza 1998

Harza, in July 1998, collected 22 sediment samples from Cedar Lake, see Figure 8, in support of a dredging feasibility study. Sediment was collected using a weighted hollow-stem sediment corer; sediment collected represented the surficial 2 ½ foot of sediment. Samples were collected in plastic sleeves and transferred to a stainless steel bowl where they were homogenized, classified, and transferred to glass jars. Water quality was monitored at each sediment sampling location for temperature, dissolved oxygen (DO), conductivity, pH, total water depth, and secchi depth. Sediment samples were analyzed for total Kjedahl nitrogen (TKN), ammonia-nitrogen, total phosphorous, total solids (TS), total organic carbon (TOC), and particle size with hydrometer. Ten of the 22 samples were analyzed for total PCBs. Results are summarized in Table 3. PCBs were non-detect in all samples, and a majority of the sediment collected was classified as silty-sand, or sandy-silt. The investigation suggested very elevated concentrations of ammonia-nitrogen, phosphorous, and total organic carbon (TOC) in the sediment.

Table 3: Harza 1998 Sediment Sampling Results

	Minimum Concentration	Maximum Concentration	Average Concentration
% fines (<#200)	3	88	48
TKN (mg/kg)	151	8,580	5,558
Ammonia-N (mg/kg)	4.4	797	326
Total Phosphorous (mg/kg)	72.6	1,060	490
TS (%)	18	80.2	32.5
TOC (mg/kg)	1,090	132,000	81,900

3.5. Conclusion

The evaluation of existing conditions, historic data and records suggests that a Tier 1 evaluation alone is not sufficient to make a factual determination regarding compliance with the Clean Water Act Section 404(b)(1) for the proposed dredging activity for Cedar Lake. Therefore, it was determined that a Tier 2 evaluation is necessary to establish baseline information for the proposed dredging. The Tier 2 evaluation includes sediment and elutriate chemistry analysis as well as physical analysis. Results of the Tier 2 evaluation are included in the next section.

4. Tier 2

4.1. Introduction

As discussed previously, substrate restoration within Cedar Lake will require removal of sediments from the lakebed with the highest concentrations of available phosphorous. Dredging will be conducted in the southern and central basins of Cedar Lake and the dredged material will be placed at an upland SDF site for dewatering and final disposition. The purpose of sampling conducted as part of this Tier 2 evaluation is to 1) determine whether sediment in Cedar Lake is suitable for upland disposal, and 2) characterize the quality of the return water associated with dredging.

4.2. Tier 2 Objectives

Since the information assembled in Tier 1 was not sufficient to make a factual determination of compliance with the Clean Water Act Section 404(b)(1), a Tier 2 evaluation is required. The purpose of the Tier 2 evaluation is to make a contaminant determination using dredged material physical and chemical data. Sediment bulk chemistry will be analyzed to determine the concentrations of contaminants and nutrients found in the sediment. A second purpose of Tier 2 analysis is to determine if discharge of dredged water is in compliance with state water quality standards, in accordance with Section 401 of the Clean Water Act. Elutriate analysis will be evaluated to assess the quality of the discharge water associated with the dredging operation. Elutriate tests predict water column impacts from hydraulic dredging operations.

4.3. Sediment Sampling and Analysis

Four dredged material management units were established for characterization of sediments from the preliminary dredging basins in Cedar Lake. The sediment investigation conducted in April 2007 consisted of the collection of a series of sediment core and site water samples. The sampling and analysis results are provided as Attachment 4. Matrix Environmental, Inc., through contract with the USACE, conducted the sampling effort from April 2nd to April 5th, 2007. Objectives of the investigation included the following:

- Quantify the amount of nutrients and other compounds present in the sediment, which may be dredged from Cedar Lake in the future;
- Provide the analytical data necessary to determine if dredged material meets the IDEM Risk Integrated System of Closure (RISC) Residential default closure levels for upland placement of sediment;
- Provide the analytical data necessary to assess the nutrient and contaminant loading of dredged water as potentially returned to the water body;
- Provide the analytical data necessary to obtain Section 401 water quality certification from the State of Indiana for future dredging in support of the project or to obtain a sewer discharge permit if needed.

Twelve (12) sediment core samples, representative of four management units, were collected during this effort utilizing an Eijkelkamp hand operated piston sampler. Sample locations are presented in Figure 9. Sediment cores were obtained for the top 18 inches of sediment, which adequately characterizes 12 inches of sediment (removal of shallow layer achieves the most benefits to the lake) plus 6 inches of overdredged material. Sediment samples were analyzed for the parameters shown in Table 4. One site water sample was collected from Cedar Lake using a peristaltic pump for the characterization of background water quality and for preparation of the elutriate samples. Site water and elutriate samples were analyzed for the parameters shown in Table 5.

While sediment sampling was conducted in four management units to characterize all the sediment in Cedar Lake, samples collected in management units 2, 3, and 4 represent material that would be dredged from Cedar Lake implementing the LPP. It was unclear during initial stages of planning if dredging would be included as part of the recommended plan and where any dredging would be conducted. It was assumed during development of the sediment sampling plan that the entire lake may be dredged. Dredging is not being conducted in management unit 1 because of the relatively low concentration of phosphorous in the sediments in management unit 1.

Table 4: USACE 2007 Sediment Bulk Chemistry List of Analyses

Parameter	Acceptable Method(s)	Required Reporting Limit (mg/kg)
SVOCs	8270C	*Varies – below RISC residential*
VOCs	5035/8260B	*Varies – below RISC residential*
Total Pesticides	8081A	*Varies – below RISC residential*
Priority Pollutant Metals	6010B/7470/7471	*Varies – below RISC residential*
Total Phosphorus	365.2/4500PE	10
Ammonia Nitrogen NH3-N	350.2/4500B,C	10
Total Kjedahl Nitrogen (TKN)	351.3/4500B	25
Total Organic Carbon (TOC)	9060	25
% Total Solids/Moisture Content	160.3	NA
Grain Size Distribution with hydrometer	ASTM D422	NA

NA = not applicable

Table 5: USACE 2007 Site Water and Elutriate List of Analyses

Parameter	Acceptable Method(s)	Required Reporting Limit (mg/L)
Total Phosphorus	365.2	0.02
Ammonia Nitrogen NH3-N	350.2	0.1
TKN	351.3	0.4
Nitrate	353.2	0.1
Nitrite	354.1	0.02
Phenol	420.2	0.01
Cyanide	335.2	1.0
pH	150.1 (Electrode in field)	0.050 std unit
Hardness	2340B	5.0
Alkalinity	2320B	20.0
COD	410.4	5.0
Dissolved Oxygen (DO)	*Membrane electrode field*	NA
Temperature	*Electronic thermometer field*	NA
Priority Pollutant Metals	6010B/7470/7471	*Varies – to be approved by USACE (below IDEM WQS)*
Total Dissolved Solids	160.1	10.0
Total Suspended Solids	160.2	5.0
BOD	405.1	10
Oil and Grease	413.1	5.0

All sediment and water samples collected were packaged in a cooler with ice, secured with a custody seal, and shipped under a Chain-of-Custody form on the same day to the STL-Pittsburgh facility for overnight delivery via common carrier (Federal Express).

4.4. Sediment Physical Characteristics

Grain size analysis was conducted on the sediment samples from each of the management units. The grain size results indicate that there is a relatively high percentage of fines in the sediments within each management unit (see Table 6). The percent fines (smaller than #200 sieve) range between 75.7 and 95.3 percent. Sediment samples collected at locations CL2007-MU1-C01 and CL2007-MU2-C03 contain a relatively high percentage of sand (75 and 69.9 percent, respectively) and do not represent typical values that are expected for sediments that will be dredged from Cedar Lake; these samples were likely collected too near shore and are not summarized in percent fine analysis noted above.

Table 6: USACE 2007 Sediment Grain Size Analysis Results

Sample Location	% Sand	% Silt	% Clay	Percent Passing #200
CL2007-MU1-C01	75	17.5	7.4	25
CL2007-MU1-C02	22	58.6	19.3	77.9
CL2007-MU1-C03	16.4	66.5	17	83.5
CL2007-MU2-C01	14.3	60.8	24.9	85.7
CL2007-MU2-C02	19	62.7	18.4	81
CL2007-MU2-C03	69.9	19.1	10.9	30
CL2007-MU3-C01	4.7	72.6	22.7	95.3
CL2007-MU3-C02	18	54.4	27.6	82
CL2007-MU3-C03	15.3	61.6	23	84.6
CL2007-MU4-C01	6.4	66.3	27.3	93.6
CL2007-MU4-C02	15.3	57.3	27.4	84.7
CL2007-MU4-C03	13.1	61.3	25.6	75.7

4.5. Sediment Elutriate Results

Section 401 water quality compliance is typically determined using elutriate test results. The modified elutriate test is used to anticipate water quality for hydraulically dredged sediment that will be disposed in an upland SDF. The test consists of preparing and mixing a sediment sample with dredging site water to form a slurry, aerating the slurry, allowing the slurry to settle under quiescent conditions, then extracting an effluent elutriate sample for chemical analysis, see "Evaluation of dredged material proposed for disposal at island, nearshore, or upland confined disposal facilities- Testing Manual," Technical Report ERDC/EL TR-03-1, U.S. Army Engineer Research and Development Center, Vicksburg, MS. (U.S. Army Corps of Engineers 2003). The sediment and water collected from Cedar Lake was mixed to a concentration approximately equal to the expected average field inflow concentration, in this case at 15% solids concentration. Samples were allowed to settle for the standard 24 hours after aeration and a sample extracted. The elutriate test is a conservative estimate of contaminant partitioning into the water column.

Sediment samples collected from each management unit were used to prepare a composite sample from each management unit for slurry preparation. After the sediment was composited and homogenized for each management unit, a sub-sample of the homogenized sediment was collected and mixed with a sample of water from Cedar Lake. Consequently, one elutriate test was prepared for each management unit (CL2007-MU1-COMP, CL2007-MU2-COMP, CL2007-MU3-COMP, and CL2007-MU4-COMP). Elutriate samples were analyzed for the parameters given in Table 5. The elutriate sample and background water quality results are shown in Table 7.

Table 7: USACE 2007 Elutriate and Water Quality Results

Parameter Name	Water Quality Standards	Units	Reporting Limit	CL2007-MU1-COMP (Elutriate MU1)		CL2007-MU2-COMP (Elutriate MU2)		CL2007-MU3-COMP (Elutriate MU3)		CL2007-MU4-COMP (Elutriate MU4)		CL2007-MU2-C02-W (Background Water)	
Ammonia Nitrogen	1.1*	mg/L	5	**35.3**	J	**46.3**	J	**84.8**	J	**84.9**	J	0.25	
Chemical Oxygen Demand (COD)		mg/L	10	399		141		814		778		41.5	
Nitrate	10 (Nitrate + Nitrite)	mg/L	1	0.39	B J	0.37	B J	0.63	B J	0.45	B J	0.4	
Nitrite	1	mg/L	1	<1	G	<1	G	<1	G	<1	G	<0.1	
Percent Solids		%	1	20.6		29.7		21.4		21.6			
Total Cyanide	200	ug/L	10	4.8	B J	6.2	B J	11.2	J	15.2	J	<10	
Total Dissolved Solids		mg/L	50	265		205		340		680		417	
Total Kjeldahl Nitrogen		mg/L	3	39		46.5		52.8		87.2		2.2	B
Total phosphorus	1*	mg/L	2	**19.8**		**19**		**19.8**		**18.6**		0.086	B
Total Suspended Solids	12*	mg/L	200	**114000**		**64300**		**84400**		**89200**		<4	
Biochemical Oxygen Demand	10*	mg/L	2	78	R	84	R	201	R	189	R	3.6	
Chloride	230	mg/L	1	40.5	J	42.7	J	42.6	J	43.8	J	43.5	J
Hardness, as CaCO3		mg/L	250	4300		4100		5000		5300		136	
Oil & Grease (HEM)		mg/L	10	<10		<10		<10		<10		<5	
pH		No Units	--	7.5		7.6		7.5		7.4		8.2	
Sulfate		mg/L	1000	<1000	G	<1000	G	<1000	G	<1000	G	23.3	
Total Alkalinity		mg/L	500	645		959		1700		1570		112	
Total Recoverable Phenolics		mg/L	0.1	0.42		0.14		0.12		0.13		0.022	
Metals/Inorganics - Total													
Antimony	45,000	ug/L	20	1.6	B	6.8	B	5.2	B	9.8	B	0.22	B
Arsenic	0.175	ug/L	10	**29.1**		**77.3**		**52.9**		**126**		**0.83**	B
Beryllium	1.17	ug/L	10	**4.7**	B	**11.6**		**5.5**	B	**19**		<1	
Cadmium	2	ug/L	10	<10		**5.6**	B	**1.7**	B	**15.7**		<1	
Chromium VI	11	ug/L	20	**97.6**	J	**296**	J	**186**	J	**487**	J	2.2	J
Copper	21	ug/L	20	**82.3**		**480**		**292**		**814**		2	
Lead	7.7	ug/L	10	**190**		**1050**		**612**		**2020**		1.4	
Mercury	0.012	ug/L	2	**5.3**		**6.2**		**10.4**		**10.4**		<0.2	
Nickel	100	ug/L	10	**105**		**346**		**198**		**587**		1.2	
Selenium	35	ug/L	50	6.9	B	16.1	B	11.1	B	24.1	B	0.54	B
Silver	6.7	ug/L	10	<10		2.4	B	1	B	3.1	B	<1	
Thallium	48	ug/L	10	2.1	B	4.5	B	2.5	B	6.9	B	0.25	B
Zinc	230	ug/L	50	**859**		**2190**		**1540**		**3860**		4.1	B

* 327 IAC 5-10-4 effluent standard for summer, monthly average.
B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.
J = Estimated positive result.
UJ = Estimated result. Below reporting limits
# = Refer to IDEM Water Quality Standards Indiana Administrative Code Title 327 Article 2.
Bold = Exceed IDEM Water Quality Standards or Effluent Limitations for Lake Dischargers.

A review of the data in Table 7 shows that the concentrations of some metals (e.g., aluminum, barium, copper, iron, lead, zinc) and some water quality parameters (e.g., total suspended solids, ammonia nitrogen, total nitrogen, and phosphorus) in the elutriate samples exceed the background water quality in Cedar Lake. Indiana effluent limitations for discharges to lakes, or to water bodies that are within two (2) miles upstream of a lake, are identified in 327 IAC 5-10-4. Effluent limitations are established for $CBOD_5$, total suspended solids (TSS), ammonia (as nitrogen), and phosphorus. 327 IAC 5-10-4 also specifies that dissolved oxygen concentrations in the discharge may not fall below 6 mg/L (minimum daily average). Water quality-based limitations for any other toxic substance may be included in a discharge permit if the toxic substance is or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any applicable narrative or numeric water quality criteria or value promulgated under 327 IAC 2-1 or 327 IAC 2-1.5. For this reason, for those parameters without effluent limitations set forth in 327 IAC 5-10-4, the water quality standards identified in 327 IAC 2-1 are included for comparison in Table 7.

Concentrations of phosphorous (18.6 – 19.8 mg/L), ammonia (35.3 - 84.9 mg/L), and total suspended solids (64,300 – 114,000 mg/L) in the elutriate samples, without consideration of mixing, exceed the effluent limitations for lake dischargers (1 mg/L, 1.1 mg/L, and 12 mg/L respectively). In addition, concentrations of arsenic (29.1 – 126 µg/L), beryllium (4.7 – 19 µg/L), cadmium (1.7 – 15.7 µg/L), chromium (97.6 – 487 µg/L), copper (82.3 – 814 µg/L), lead (190 – 2020 µg/L), mercury (5.3 – 10.4 µg/L), nickel (105 – 587 µg/L), and zinc (859 – 3860 µg/L), in the elutriate samples, without consideration of mixing, exceed the general use water quality standards of the state.

During preparation of the elutriate test it was difficult for the laboratory to differentiate the line between settlable and unsettlable materials within the elutriate column. Because the sediment contains elevated levels of organic carbon and the particles are fine in nature, the suspended materials resulting from the elutriate test did not readily settle in the elutriate column; therefore, the elutriate results contain a very high fraction of suspended materials. The elevated levels of metals in the water column are likely due to the high fraction of suspended particles contained in the elutriate sample. This phenomenon may also partially contribute to the high concentration of ammonia and phosphorous found in the elutriate samples.

4.6. Sediment Bulk Chemistry Results

Twelve sediment samples collected from Cedar Lake were analyzed for the parameters shown in Table 4. Results are shown in Table 8. It is important to note that the sediment chemistry results do not quantify interactive toxicological effects, and are therefore useful only for a qualitative evaluation. In addition, the material that will be dredged from Cedar Lake is represented by samples collected in management units two, three, and four. Results from management unit one are included for informational purposes only.

Table 8: USACE 2007 Sediment Bulk Chemistry Results

Parameter Name	RISC Industrial Default Closure Level (mg/kg)	RISC Residential Default Closure Level (mg/kg)	Units	Reporting Limit	MU1-C01	MU1-C02	MU1-C03	MU1-C03-DUP	MU2-C01	MU2-C02	MU2-C03	MU3-C01	MU3-C02	MU3-C03	MU4-C01	MU4-C02	MU4-C03
Ammonia Nitrogen			mg/kg	37.7	53.2 J	225 J	325 J	433 J	965 J	1000 J	159 J	694 J	687 J	698 J	1560 J	615 J	714 J
Total Kjeldahl Nitrogen			mg/kg	1130	1620 J	3010 J	4330 J	7700 J	10300 J	12700 J	6310 J	8670 J	10200 J	6460 J	8690 J	5560 J	6470 J
Total phosphorus			mg/kg	377	100	279	248	421	1020 J	1320 J	374	880 J	510 J	639 J	1600 J	637 J	943 J
Percent Solids			%	1	71.1	25.1	27.8	21.1	16.9	13.3 J	21.3	16.5 J	19.6 J	19.9 J	12.3 J	27.7 J	21.2 J
TOC			mg/kg	3050	12200	63600	67200	86300	75100	116000 J	56300	77300 J	91500 J	64700 J	108000 J	55400 J	52800 J
Volatile Organic Compounds																	
1,1,1-Trichloroethane	1900	1.9	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
1,1,2,2-Tetrachloroethane	7	0.007	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
1,1,2-Trichloroethane	30	0.03	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
1,1-Dichloroethane	5600	5.6	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
1,1-Dichloroethene	58	0.058	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
1,2,4-Trichlorobenzene	5300	5.3	ug/kg	44	<44	<44	<44	<44	5.9 J	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
1,2,4-Trimethylbenzene	2500	2.5	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
1,2-Dibromoethane	0.34	0.00034	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
1,2-Dichloroethane	24	0.024	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
1,2-Dichloropropane	30	0.03	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
1,3,5-Trimethylbenzene	610	0.61	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
4-Methyl-2-pentanone	20000	20	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Acrolein	0.27	0.00027	ug/kg	880	<880	<880	<880	<880	<880	<880	<880	<880 UJ	<880 UJ	<880 UJ	<880 UJ	<880 UJ	<880 UJ
Acetone	28000	28	ug/kg	180	<180	<180	49 J	34 J	<180	230	<180	34 J	33 J	300 UJ	330 J	62 J	77 J
Benzene	34	0.034	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Bromodichloromethane	510	0.51	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Bromoform	600	0.6	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Bromomethane	52	0.052	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Carbon disulfide	10000	10	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	13 J	<44 UJ	<44 UJ	<44 UJ
cis-1,2-Dichloroethene	400	0.4	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Cyclohexane	69000	69	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Isopropylbenzene	11000	11	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Methyl ethyl ketone	35000	35	ug/kg	44	<44	<44	19	7 J	<44	87 J	<44	<44 UJ	14 J	120 UJ	120 J	22 J	21 J
Methyl tert-butyl ether	180	0.18	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Methylene chloride	23	0.023	ug/kg	44	<44 U	13 J B	6.6 J B	<44 UJ	<44 UJ	<44	<44 U	9.4 J	<44 UJ	10 J	<44 UJ	<44 UJ	<44 UJ
m-Xylene & p-Xylene	0		ug/kg	88	<88	<88	<88	<88	<88	<88	<88	<88 UJ	<88 UJ	<88 UJ	<88 UJ	<88 UJ	<88 UJ
n-Propylbenzene	36000	36	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
o-Xylene	0		ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Chlorobenzene	1300	1.3	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Chloroethane	650	0.65	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Chloroform	470	0.47	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Styrene	3500	3.5	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Tetrachloroethene	58	0.058	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Toluene	12000	12	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	3.7 J	<44 UJ	<44 UJ	<44 UJ
trans-1,2-Dichloroethene	680	0.68	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
trans-1,3-Dichloropropene	40	0.04	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Trichloroethene	57	0.057	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Vinyl acetate	2300	2.3	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Vinyl chloride	13	0.013	ug/kg	44	<44	<44	<44	<44	<44	<44	<44	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ	<44 UJ
Semi-Volatile Organic Compounds	***0***																
Benzoic acid	590000	590	ug/kg	12000	<12000	<12000	<12000	<12000	<12000	<12000	<12000	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ
Benzyl alcohol	48000	48	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Butyl benzyl phthalate	310000	310	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
2-Nitroaniline	670	0.67	ug/kg	12000	<12000	<12000	<12000	<12000	<12000	<12000	<12000	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ
1,2-Dichlorobenzene	17000	17	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
1,3-Dichlorobenzene	2300	2.3	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
1,4-Dichlorobenzene	2300	2.3	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
2,4-Dichlorophenol	1100	1.1	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
2,4-Dimethylphenol	9000	9	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
2,4-Dinitrophenol	290	0.29	ug/kg	12000	<12000	<12000	<12000	<12000	<12000	<12000	<12000	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ
2,4-Dinitrotoluene	0		ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
2,6-Dinitrotoluene	0		ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
4-Chloroaniline	970	0.97	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
2-Chlorophenol	450	0.45	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
2-Methylphenol	14000	14	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
2,4,5-Trichlorophenol	250000	250	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
4-Methylphenol	1100	1.1	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Acenaphthene	120000	120	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Acenaphthylene	18000	18	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Anthracene	51000	51	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Benzo(a)anthracene	5000	5	ug/kg	2500	29 J	<2500	<2500	<2500	150 J	180 J	<2500	120 J	<2500 UJ	130 J	200 J	110 J	<2500 UJ
Benzo(b)fluoranthene	5000	5	ug/kg	2500	42 J	42 J	<2500	<2500	70 J	450 J	<2500	460 J	78 J	250 J	430 J	140 J	200 J
Benzo(k)fluoranthene	39000	39	ug/kg	2500	32 J	<2500	<2500	<2500	250 J	<2500	<2500	<2500 UJ	<2500 UJ	48 J	77 J	41 J	<2500 UJ
Benzo(a)pyrene	500	0.5	ug/kg	2500	<2500	<2500	<2500	<2500	81 J	230 J	<2500	190 J	<2500 UJ	<2500 UJ	270 J	130 J	<2500 UJ
bis(2-Chloroethyl) ether	0.7	0.0007	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
bis(2-Chloroisopropyl) ether	27	0.027	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
bis(2-Ethylhexyl) phthalate	300000	300	ug/kg	2500	81 J	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Carbazole	5900	5.9	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Chrysene	25000	25	ug/kg	2500	29 J	<2500	<2500	<2500	190 J	<2500	<2500	150 J	94 J	170 J	260 J	140 J	<2500 UJ
Diethyl phthalate	450000	450	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Dimethyl phthalate	1100000	1100	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Di-n-butyl phthalate	760000	760	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Di-n-octyl phthalate	2000000	2000	ug/kg	2500	59 J	<2500	<2500	<2500	170 J	400 J	<2500	330 J	47 J	130 J	260 J	41 J	160 J
Dibenz(a,h)anthracene	500	0.5	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Dibenzofuran	4900	4.9	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
4-Chloroaniline	970	0.97	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
2-Chloronaphthalene	42000	42	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
2-Methylnaphthalene	3100	3.1	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
3,3'-Dichlorobenzidine	62	0.062	ug/kg	12000	<12000	<12000	<12000	<12000	<12000	<12000	<12000	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ
Fluorene	170000	170	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Fluoranthene	880000	880	ug/kg	2500	56 J	63 J	<2500	<2500	280 J	270 J	<2500	180 J	110 J	220 J	300 J	180 J	200 J
Hexachlorobenzene	2200	2.2	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Hexachloroethane	2800	2.8	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Hexachlorocyclopentadiene	400000	400	ug/kg	12000	<12000	<12000	<12000	<12000	<12000	<12000	<12000	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ	<12000 UJ
Indeno(1,2,3-cd)pyrene	3100	3.1	ug/kg	2500	<2500	<2500	<2500	<2500	66 J	200 J	<2500	140 J	<2500 UJ	<2500 UJ	250 J	85 J	<2500 UJ
Isophorone	5300	5.3	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ

Table 8: USACE 2007 Sediment Bulk Chemistry Results, Continued

Parameter Name	RISC Industrial Default Closure Level (mg/kg)	RISC Residential Default Closure Level (mg/kg)	Units	Reporting Limit	MU1-C01	MU1-C02	MU1-C03	MU1-C03-DUP	MU2-C01	MU2-C02	MU2-C03	MU3-C01	MU3-C02	MU3-C03	MU4-C01	MU4-C02	MU4-C03
Naphthalene	700	0.7	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Nitrobenzene	28	0.028	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
N-Nitrosodi-n-propylamine	0.6	0.0006	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
N-Nitrosodiphenylamine	9700	9.7	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Pentachlorophenol	28	0.028	ug/kg	12000	<12000	<12000	<12000	<12000	<12000	<12000	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Phenanthrene	13000	13	ug/kg	2500	17 J	<2500	<2500	<2500	95 J	110 J	<2500	71 J	<2500 UJ	75 J	110 J	76 J	<2500 UJ
Phenol	56000	56	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ	<2500 UJ
Pyrene	570000	570	ug/kg	2500	44 J	87 J	<2500	<2500	280 J	400 J	<2500	260 J	160 J	280 J	450 J	260 J	170 J
Pesticides	***0***																
4,4'-DDD	28000	28	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
4,4'-DDE	20000	20	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
4,4'-DDT	20000	20	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
Aldrin	250	0.25	ug/kg	320	<320	23 J PG	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
alpha-BHC	7.2	0.0072	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
alpha-Chlordane	9600	9.6	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
Atrazine	48	0.048	ug/kg	2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500	<2500 UJ	<2500 UJ	<2500 J	<2500 UJ	<2500 UJ	<2500 UJ
beta-BHC	26	0.026	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
gamma-BHC (Lindane)	9.4	0.0094	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
Dieldrin	96	0.096	ug/kg	320	7.8 J	<320	<320	38 J	<320	39 J	19 J	<320 UJ	<320 UJ	22 J PG	34 J	<320 UJ	<320 UJ
Endosulfan I	20000	20	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
Endosulfan II	20000	20	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
Endrin	990	0.99	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
Heptachlor	930	0.93	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
Heptachlor epoxide	470	0.47	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
gamma-Chlordane	9600	9.6	ug/kg	320	<320	<320	<320	<320	<320	<320	<320	<320 UJ	<320 UJ	<320 J	<320 UJ	<320 UJ	<320 UJ
Methoxychlor	160000	160	ug/kg	620	<620	<620	<620	<620	<620	<620	<620	<620 UJ	<620 UJ	<620 J	<620 UJ	<620 UJ	<620 UJ
Toxaphene	3900	3.9	ug/kg	13000	<13000	<13000	<13000	<13000	<13000	<13000	<13000	<13000 UJ	<13000 UJ	<13000 J	<13000 UJ	<13000 UJ	<13000 UJ
Metals/Inorganics - Total	***0***																
Antimony	5400	5.4	mg/kg	0.75	0.054 B	0.14 B	0.11 B	0.18 B	0.27 BJ	0.44 B	0.14 B	0.22 B	0.33 BJ	0.26 BJ	0.34 BJ	0.25 B	0.16 BJ
Arsenic	3900	3.9	mg/kg	0.38	2	**5.2**	2.7	**4.1**	**6.4** J	**8.9** J	**4.7**	**4.8** J	**6.5** J	**5.2** J	**8.2** J	**4.8** J	3.6 J
Beryllium	63000	63	mg/kg	0.38	0.11	0.48	0.35	0.45	0.89	0.91 J	0.36	0.7 J	0.81 J	0.64 J	1.3 J	0.65 J	0.46 J
Cadmium	7500	7.5	mg/kg	0.38	0.15	0.44	0.23	0.37	1.4 J	1.4 J	0.25	0.86 J	0.94 J	0.89 J	1.6 J	0.87 J	0.5 J
Chromium VI	38000	38	mg/kg	0.75	4.1 J	14.6 J	10.6 J	14.8 J	28 J	28.8 J	11.1 J	21.9 J	22.6 J	20.5 J	**40.4** J	18.7 J	14.9 J
Copper	920000	920	mg/kg	0.75	7.4	23.3	13	18.8	57.9 J	54.3 J	14.7	40 J	38 J	34.8 J	69.4 J	29.9 J	25.6 J
Lead	81000	81	mg/kg	0.38	17.6	35.7	12.8	28	**154 J**	**149** J	16.7	**98.2** J	**99.3** J	**92.9** J	**184** J	**83.6** J	61.3 J
Mercury	2100	2.1	mg/kg	0.12	0.034	0.1	0.052 B	0.083	0.16 J	0.22 J	0.058 B	0.14 J	0.15 J	0.13 J	0.21 J	0.13 J	0.086 J
Nickel	950000	950	mg/kg	0.38	6.1	22.1	16.4	22.5	34.6	36.5 J	18.3	26.3 J	30.2 J	24.3 J	46.7 J	23.2 J	17.7 J
Selenium	5200	5.2	mg/kg	1.9	0.29 B J	1.1 J	0.63 B J	0.94 B J	1.3 B J	1.8 B J	0.76 B J	1.1 B J	1.2 B J	0.99 B J	1.6 B J	0.86 B J	0.78 B J
Silver	31000	31	mg/kg	0.38	0.032 B	0.089 B	0.044 B	0.082 B	0.32 J	0.29 BJ	0.049 B	0.22 BJ	0.19 B	0.18 B	0.34 BJ	0.15 BJ	0.12 BJ
Thallium	2800	2.8	mg/kg	0.38	0.12	0.27	0.25	0.32	0.46	0.54 J	0.34	0.34 J	0.44 J	0.38 J	0.6 J	0.34 J	0.22 BJ
Zinc	10000000	10000	mg/kg	1.9	29.2	74.6	37.3	63.1	201 J	206 J	46.9	140 J	132 J	130 J	243 J	114 J	91 J

Bold = Exceeds IDEM RISC Residential default closure levels, Appendix I RISC Technical Guidance Document 2007
NS = Not sampled.
ND = Non-detect.
G = Elevated reporting limit. The reporting limit is elevated due to matrix interference.
B = Method blank contamination. The associated method blank contains the target analyte at a reportable level. J = Estimated result. Result is less than RL.
PG = The percent difference between the original and confirmation analyses is greater than 40%.

4.6.1. Miscellaneous Parameters

Results confirmed that the sediment contains elevated levels on ammonia-nitrogen, phosphorous, and total organic carbon (TOC) found during previous sediment investigations. Sediments contain elevated concentrations of total organic carbon (TOC) ranging from 12,200 mg/kg to 116,000 mg/kg; phosphorous concentrations range between 100 and 1,600 mg/kg; ammonia nitrogen concentrations range between 53.2 and 1,560 mg/kg; and total kjedahl nitrogen (TKN) concentrations range between 1,620 and 12,700 mg/kg. Percent solids range from 12.3 to 71% with average of 24%, confirming the fluffy nature of the sediment. Percent solids concentration found at CL2007-MU1-C01 and CL2007-MU2-C03 (75 and 69.9%, respectively) are not representative of the material that will be dredged from Cedar Lake. These samples were collected too near shore and contain a higher fraction of sand than is expected in the dredged sediment.

4.6.2. Organics

Various organic compounds were detected at very low concentrations in the sediment samples. Volatile organics: 1,2,4-Trichlorobenzene, acetone, methyl ethyl ketone, methylene chloride; Semi-volatile organics: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, di-n-octyl phthalate, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene; and Pesticides: aldrin, and dieldrin were detected in some of the sediment samples. However, the reported results are below the laboratories reporting limit and are flagged as estimated by the laboratory (little confidence in the value).

In the absence of sediment criteria, the sediment quality data generated by the laboratory was compared to the State of Indiana Risk Integrated System of Closures (RISC) Soil Default Closure Levels for Residential Land Use Applications. The 2007 RISC default values for residential land use applications are presented in Table 8. When compared to the RISC residential default closure value, all of the estimated concentrations of organics are below the RISC residential default closure values.

4.6.3. Metals

All sediment samples have reportable concentrations of metals. Sediment samples CL2007-MU1-C02, CL2007-MU1-C03-DUP, CL2007-MU2-C01, CL2007-MU2-C02, CL2007-MU2-C03, CL2007-MU3-C01, CL2007-MU3-C02, CL2007-MU3-C03, CL2007-MU4-C01, and CL2007-MU4-C02 exceed RISC residential default closure levels for arsenic (3.9 mg/kg)[1]. Sediment samples CL2007-MU2-C01, CL2007-MU2-C02, CL2007-MU3-C01, CL2007-MU3-C02, CL2007-MU3-C03, CL2007-MU4-C01, and CL2007- MU4-C02 exceed RISC residential

[1] 2016 IDEM OLQ updated screening level for arsenic (inorganic) is 5.9 mg/kg (versus 3.9 mg/kg (total arsenic) used at the time of the original analysis). Comparison of total arsenic results to current screening level suggests four samples (versus ten) may exceed the residential screening level; the fraction of inorganic arsenic in the sediment is unknown.

default closure level for lead (81 mg/kg) and confirm results found by Harza in 1998[2]. Sample CL2007-MU4-C01 also exceeds RISC residential default closure level for chromium VI (38 mg/kg); however, the result reported is measured as total chromium. It is unlikely that the concentration of chromium (total 40.4 mg/kg) is in the form of chromium VI and therefore chromium is not a contaminant of concern[3].

Reported concentrations of lead and arsenic exceed differing pathways of concern within the RISC guidelines; some of the arsenic samples exceed the migration to groundwater exposure pathway value (5.8 mg/kg) as well as the direct contact exposure pathway value (3.9 mg/kg). Lead exceedances are all related to the migration to groundwater pathway (81 mg/kg). In order to determine if sediment removed can be disposed of at the Town's proposed upland SDF site in a safe manner protective of the environment, and without future use or restrictive covenants, additional sediment collection and analysis is necessary to remove the pathways of exposure from concern using a RISC Tier II, or site specific approach, instead of RISC default closure tables, based on guidance provided by the Indiana Department of Environmental Management (IDEM). This approach considers background soil arsenic concentrations at the SDF site to address the direct contact exposure concern for arsenic. It also allows the consideration of leachability of metals from the sediments to determine if arsenic or lead will leach at concentrations that exceed that State drinking water standards. Comparison of lead concentrations found in the sediment to lead concentration in the soils at the SDF site is not necessary because the RISC residential direct contact exposure pathway for lead (400 mg/kg) is not exceeded in any of the sediment samples.

4.6.3.1. SDF Background Arsenic Soil Determination

Soil samples were collected the SDF site on May 6, 2008 to determine the concentration of total arsenic in the soils at the site to make a determination of background level in the soils. Sampling was conducted in accordance with the Sampling and Quality Assurance Plan (SQAP) approved by IDEM. Prior to sample collection, the local sponsor AE consultant, Christopher B. Burke Engineering, Ltd. (CBBEL) performed a reconnaissance soil survey to confirm the types and location of soils on the SDF site (Attachment 2). Sampling locations were selected such that four soil samples from each of the primary soil types (Elliot series, Pewamo series, and Markham series) found on the property were collected, resulting in the collection of twelve soil samples representative of soils across the extent of the SDF site (See Figure 10). Each soil sample submitted for analysis was a composite of soils collected in the top 12 inches of material encountered at each individual sample location. Results of the arsenic background sampling are summarized in Table 9; results and data analysis are included as Attachment 5. In general, the arsenic concentrations found in the soil samples collected at the SFD site range between 4.3 and 13.0 mg/kg.

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[2] 2016 IDEM OLQ updated residential screening level for lead is 270 mg/kg (versus 81 mg/kg used at the time of the original analysis). None of the 2007 sediment samples exceed the current screening level, suggesting that lead is not a contaminant of concern. Additional lead analyses described herein are retained for informational purposes only.
[3] 2016 IDEM OLQ updated residential screening level for total chromium is 1,000,000 mg/kg. Revised screening level supports previous conclusion that chromium is not a contaminant of concern.

Table 9: USACE 2008 SDF Background Soil Sampling Results

Sample Location	Total Arsenic Concentration (mg/kg)
CL 2008-SDF-SS-E1-1	6.9 J
CL 2008-SDF-SS-E1-2	7.5
CL 2008-SDF-SS-E1-3	5.6 J
CL 2008-SDF-SS-E1-4	4.3 J
CL 2008-SDF-SS-MAB2-1	8.5
CL 2008-SDF-SS-MAB2-2	8.0
CL 2008-SDF-SS-MAB2-3	6.2 J
CL 2008-SDF-SS-MAB2-4	13.0
CL 2008-SDF-SS-PC-1	5.1 J
CL 2008-SDF-SS-PC-2	5.6 J
CL 2008-SDF-SS-DUP (Pc-2)	4.8 J
CL 2008-SDF-SS-PC-3	7.0 J
CL 2008-SDF-SS-PC-4	7.8

J = estimated result

Arsenic concentrations found in Cedar Lake sediments collected in April 2007 range from 2.0 to 8.9 mg/kg; the direct contact exposure pathway found in the Risk Integrated System of Closure (RISC) for residential properties is 3.9 mg/kg[4]. The sediment data collected in 2007 were compared to the soil arsenic concentrations found at the SDF site to determine if the unconfined placement of sediment would be acceptable under RISC guidance. The decision rule for this study, as outlined in the SQAP, states that if the concentration of arsenic in the sediment exceeds the background concentration of arsenic at the SDF site in one or more samples from each management unit, sediment in that respective management unit will be considered unsuitable for upland unconfined disposal (without restrictive covenants). The background concentration of arsenic at the SDF site was determined for the soil type with the highest concentration of arsenic found in an individual sample, which was collected in the Markham soil series at 13.0 mg/kg. The statistical background concentration of arsenic in the samples collected from the Markham series is 11.8 mg/kg. Concentrations of arsenic in the sediment samples collected from Cedar Lake in April 2007 range between 2.0 and 8.9 mg/kg; total arsenic concentrations found in the sediment samples collected at Cedar Lake are less than the statistical background concentrations of arsenic found at the SDF site.

[4] 2016 IDEM OLQ updated screening level for arsenic (inorganic) is 5.9 mg/kg (versus 3.9 mg/kg (total arsenic) used at the time of the original analysis). Because four sediment samples may exceed the residential screening level, background determination for arsenic at the SDF site is warranted. 2007 RISC values and exposure pathways were retained for subsequent analysis.

4.6.3.2. Sediment Leachability Determination

Additional sediment samples were collected in April 2008 to confirm the total concentrations of arsenic and lead found in the sediment in 2007 and to determine the leaching capability of arsenic and lead in the sediment using the synthetic precipitation leaching procedure (results are included in Attachment 6). This analysis was performed to confirm that the leachable concentrations of lead and arsenic do not exceed that state drinking water standard, even though the total concentrations of lead and arsenic exceed the 2007 RISC migration to groundwater standard. Core samples were collected at the previously defined sampling locations (see Figure 9). Fine-grained sediments were encountered at depths ranging from the sediment surface to approximately 1.5 feet below sediment surface in Managements Units 2, 3, and 4. In Management Unit 1 fine-grained sediments were found in the first 10 to 12 inches and then dense gray clay was encountered.

Table 10 presents the results of chemical analyses of the sediment composite core samples. Bulk chemistry results are compared to 2007 RISC residential direct contact and migration to groundwater exposure pathways; SPLP results are compared to Maximum Contaminant Levels (MCLs) obtained from State of Indiana Drinking Water Standards. All sediment samples have reportable concentrations of total lead and arsenic. Sediment samples CL2008-MU1-C01, CL2008-MU2-C01, CL2008-MU2-C02, CL2008-MU2-C03, CL2008-MU3-C01, CL2008-MU3-C02, CL2008-MU3-C03, CL2008-MU4-C01, CL2008-MU4-C02, and CL2008-MU4-C03 exceed RISC residential migration to groundwater level for total lead. Sediment samples CL2008-MU1-C01, CL2008-MU1-C02 Duplicate, CL2008-MU1-C03, CL2008-MU2-C01, CL2008-MU2-C02, CL2008-MU2- C03, CL2008-MU3-C02, CL2008-MU3-C03, CL2008-MU4-C01, CL2008-MU4-C02 and CL2008-MU4-C03 exceed RISC residential levels migration to groundwater and/or direct contact pathway for total arsenic. Neither arsenic nor lead leach from the sediment above the MCLs.

Table 10: USACE 2008 SPLP Sediment Sampling Results[5]

	Total Lead (mg/kg)	Total Arsenic (mg/kg)	Lead SPLP (mg/L)	Arsenic SPLP (mg/L)
RISC Residential Soil Direct	400	3.9		
RISC Residential Migration to GW	81	5.4		
IDEM Drinking Water Standard			0.015	0.01
MU1-C01	**82 B**	**6.1**	0.0058 U	0.0027
MU1-C02	43 B	**4.9**	0.005 U	0.002 U
MU1-C02 Duplicate	38 B	**5.2**	0.005 U	0.002 U
MU1-C03	72 B	**6**	0.005 U	0.002 U
MU2-C01	**110 B**	**7.1**	0.005 U	0.0038
MU2-C02	**100 B**	**4.8**	0.0072	0.0079
MU2-C03	**88 B**	**6.8**	0.005 U	0.004
MU3-C01	**93 B**	3.4	0.005 U	0.0088
MU3-C02	**82 B**	**8.8**	0.005 U	0.002 U
MU3-C03	**94 B**	**8.1**	0.0057	0.0041
MU4-C01	**140 B**	**8.4**	0.005 U	0.0034
MU4-C02	**110 B**	**9**	0.0069	0.0026 J
MU4-C03	**85 B**	**6**	0.0086	0.0034

Bold = Exceeds IDEM 2007 RISC Residential default closure levels, Appendix I RISC Technical Guidance Document.
B = Method blank contamination. The associated method blank contains the target analyte at a reportable level.
J = Estimated positive result.
U = Undetected at the Limit of Detection
MCL's obtained from Appendix I of IDEMs RISC residential Tier 1 and State of Indiana Drinking Water Standards

4.7. Tier 2 Conclusions

Since the information assembled in Tier 1 was not sufficient to make a factual determination of compliance with the Clean Water Act Section 404(b)(1), a Tier 2 evaluation was required. The purpose of the Tier 2 evaluation is to make a contaminant determination using dredged material physical and chemical data. Elutriate analysis is conducted to determine the quality of the discharge water associated with the dredging operation for compliance with Section 401 of the Clean Water Act. Sediment bulk chemistry is analyzed for contaminants and nutrients found in the sediment to determine if the material can be placed upland without restrictions.

4.7.1. Water Quality

Results of the 2007 elutriate testing suggest that dredged material waters cannot be returned to Cedar Lake without treatment. Concentrations of phosphorous (18.6 – 19.8 mg/L), ammonia (35.3 - 84.9 mg/L), and total suspended solids (64,300 – 114,000 mg/L) in the return waters will

[5] 2016 IDEM OLQ updated residential screening level for arsenic and lead. Revised screening levels do not change results of analyses included herein.

likely cause a violation of discharge effluent restrictions as well as a violation of water quality standards at the discharge location. In addition, the levels of metals in the return waters, likely associated with suspended particles, indicate potential violation of water quality standards at discharge. Initially an on-site water treatment process was developed to treat decant water from the SDF; however, additional observations made during a supernatant settling test conducted in 2013 (see Attachment 7), demonstrated that suspended solids and phosphorus can be effectively removed by gravity settling in the SDF with the introduction of low concentrations of a cationic polymer prior to placement of dredged material in the SDF. In addition, elevated levels of ammonia can be removed or reduced to regulatory compliance levels by implementing various onsite alternatives implemented within the SDF. These alternatives could include, but would not be limited to, compressed air and/or fountain aeration, constructed wetland components utilizing vegetation and biological productivity for nutrient removal, rock and earthen riffles with alternating pools, sand and rock (gravel) filtration, and dilution, and will be determined during the design phase of the project.

Designing a multi-cell configuration for the SDF will allow for the effective removal of suspended solids and phosphorus by incorporating long weir crest length(s) (greater than 12 feet) into the water control structure(s) that are capable of skimming the top one or two inches of the supernatant water from the initial primary solids storage cell and subsequent secondary treatment cells. In addition to the multi-cell flow through cell configuration, interior baffle or diversion dikes should be implemented to minimize short circuiting and to increase hydraulic retention time prior to eventual discharge.

During the design phase, and prior to final design and permitting, additional sediment testing and characterization should be completed. Direct communication with IDEM regarding effluent testing and compliance requirements should be initiated, particularly with regards to the sediment settling observations and supernatant analytical results obtained during the 2013 evaluation. The discharge of water from the SDF will be regulated by the State of Indiana National Pollutant Discharge Elimination System (NPDES) point source program. A permit for discharge of effluent from this facility will be obtained during the design stage of the project.

4.7.2. Sediment Quality

Sediment data confirms elevated levels of TOC, ammonia-nitrogen, phosphorous, and metals in the sediment as well as low concentrations of several organic compounds. Ten sediment samples collected in 2007 exceed RISC residential default closure levels for arsenic[6]; seven sediment samples exceed RISC residential default closure level for lead[7]. One sediment sample exceeds RISC residential default closure level for chromium VI; however, the result reported is measured

[6] 2016 IDEM OLQ updated screening level for arsenic (inorganic) is 5.9 mg/kg (versus 3.9 mg/kg (total arsenic) used at the time of the original analysis). Comparison of total arsenic results to current screening level suggests four samples (versus ten) may exceed the residential screening level; the fraction of inorganic arsenic in the sediment is unknown.

[7] 2016 IDEM OLQ updated residential screening level for lead is 270 mg/kg (versus 81 mg/kg used at the time of the original analysis). None of the 2007 sediment samples exceed the current screening level, suggesting that lead is not a contaminant of concern. Additional lead analyses described herein are retained for informational purposes only.

as total chromium[8]. It is unlikely that the concentration of chromium is in the form of chromium VI and therefore chromium is not a contaminant of concern. In addition, all of the estimated concentrations of organics are below the RISC residential default closure values.

Further data collection and analysis suggests that though the lead and arsenic concentrations found in the sediment exceed the RISC migration to groundwater exposure pathway, arsenic and lead do not leach at concentrations that would affect the groundwater; SPLP results are below the State drinking water standards. In addition, total arsenic concentrations at the SDF site, through a background determination approved by IDEM, suggests that there is no statistical difference between the concentrations of arsenic found in the sediment and the background concentration of arsenic at the SDF site. As such, it appears that the sediment can be disposed at the SDF site without restrictions. Ongoing coordination with IDEM will resolve any issues related to this approach. TOC, phosphorus, and ammonia-nitrogen will be controlled at the SDF site by dewatering the SDF and permanently vegetating the site to prevent erosion of the material back into waters of the State.

[8] 2016 IDEM OLQ updated residential screening level for total chromium is 1,000,000 mg/kg. Revised screening level supports previous conclusion that chromium is not a contaminant of concern.

References

1. U.S. Army Corps of Engineers (USACE) 2003. *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities — Testing Manual.* ERDC/EL TR-03-1, January 2003.
2. James, Scott C. Ph.D. et al. (Sandia 2007). *Development of a Hydrodynamic, Sediment Transport, and Water Quality Model for Evaluation of Ecosystem Restoration Measures at Cedar Lake, Indiana*. October 2007.

Figures

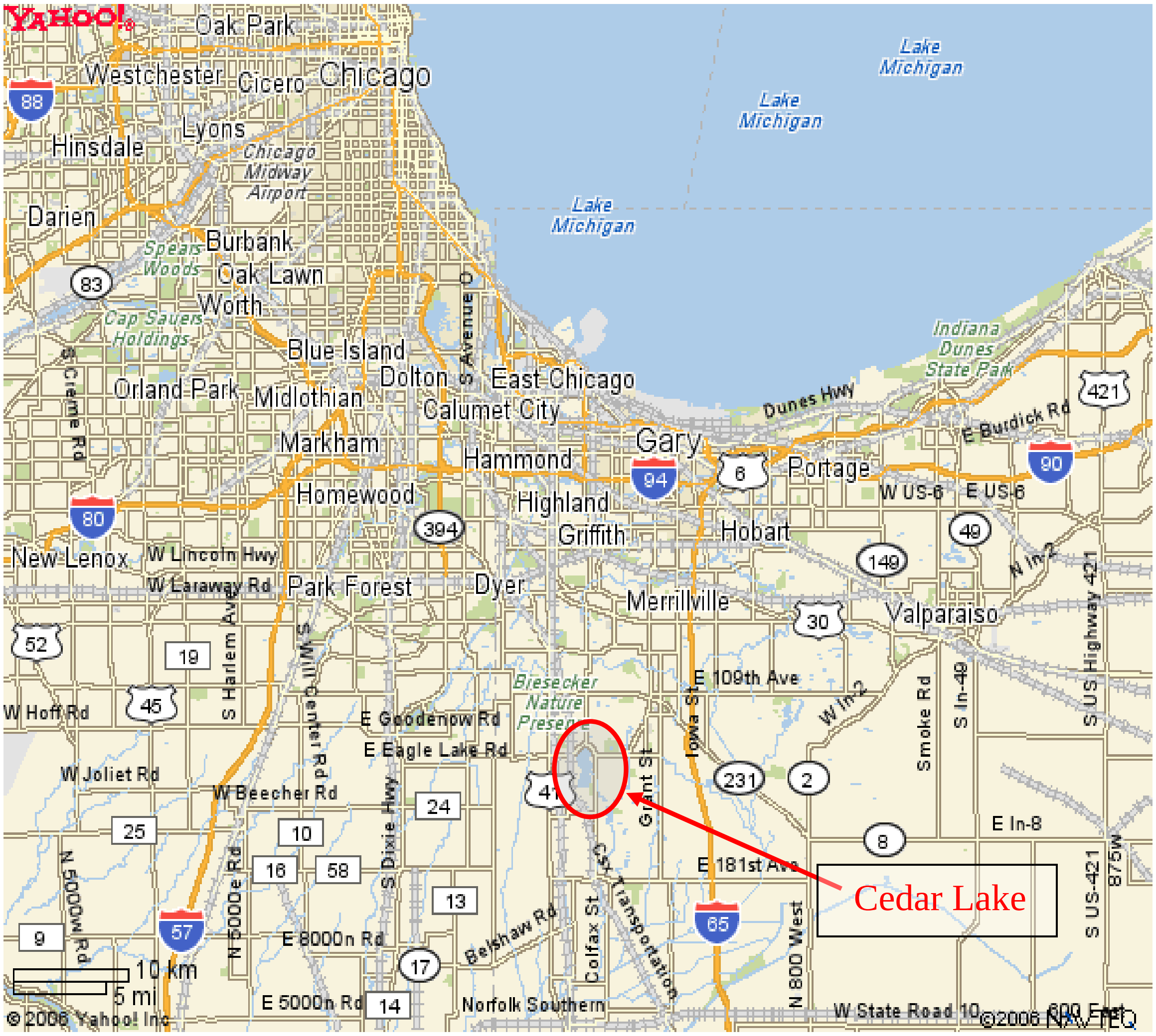
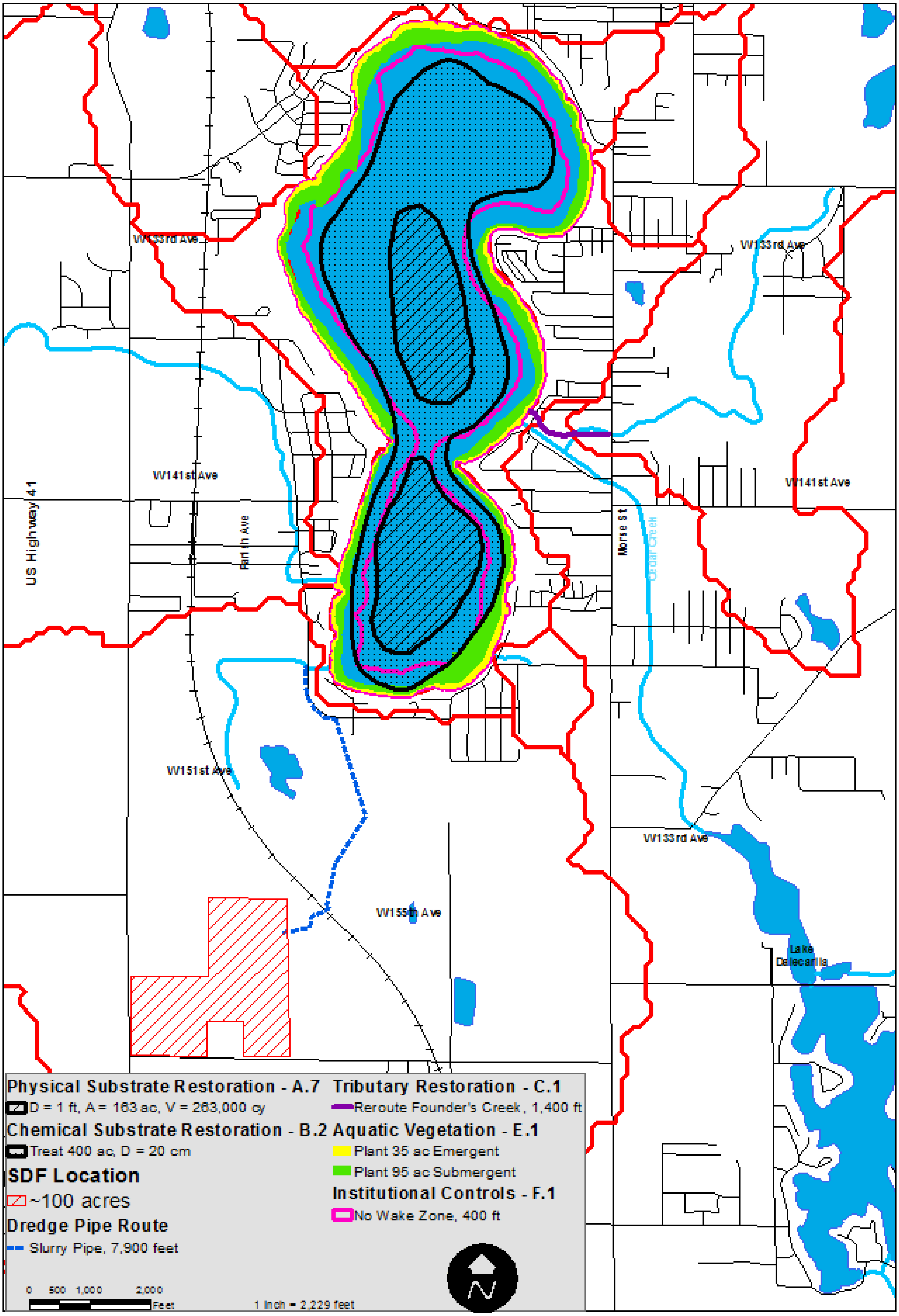


Figure 1: Project Location Map



W133rd Ave
W133rd Ave
W141st Ave
W141st Ave
US Highway 41
Parrish Ave
Morse St
Cedar Creek
W151st Ave
W133rd Ave
W155th Ave
Lake Dalecarlia
Physical Substrate Restoration - A.7
D = 1 ft, A = 163 ac, V = 263,000 cy
Chemical Substrate Restoration - B.2
Treat 400 ac, D = 20 cm
SDF Location
~100 acres
Dredge Pipe Route
Slurry Pipe, 7,900 feet
Tributary Restoration - C.1
Reroute Founder's Creek, 1,400 ft
Aquatic Vegetation - E.1
Plant 35 ac Emergent
Plant 95 ac Submergent
Institutional Controls - F.1
No Wake Zone, 400 ft
0 500 1,000 2,000
Feet
1 inch = 2,229 feet
N

Figure 2

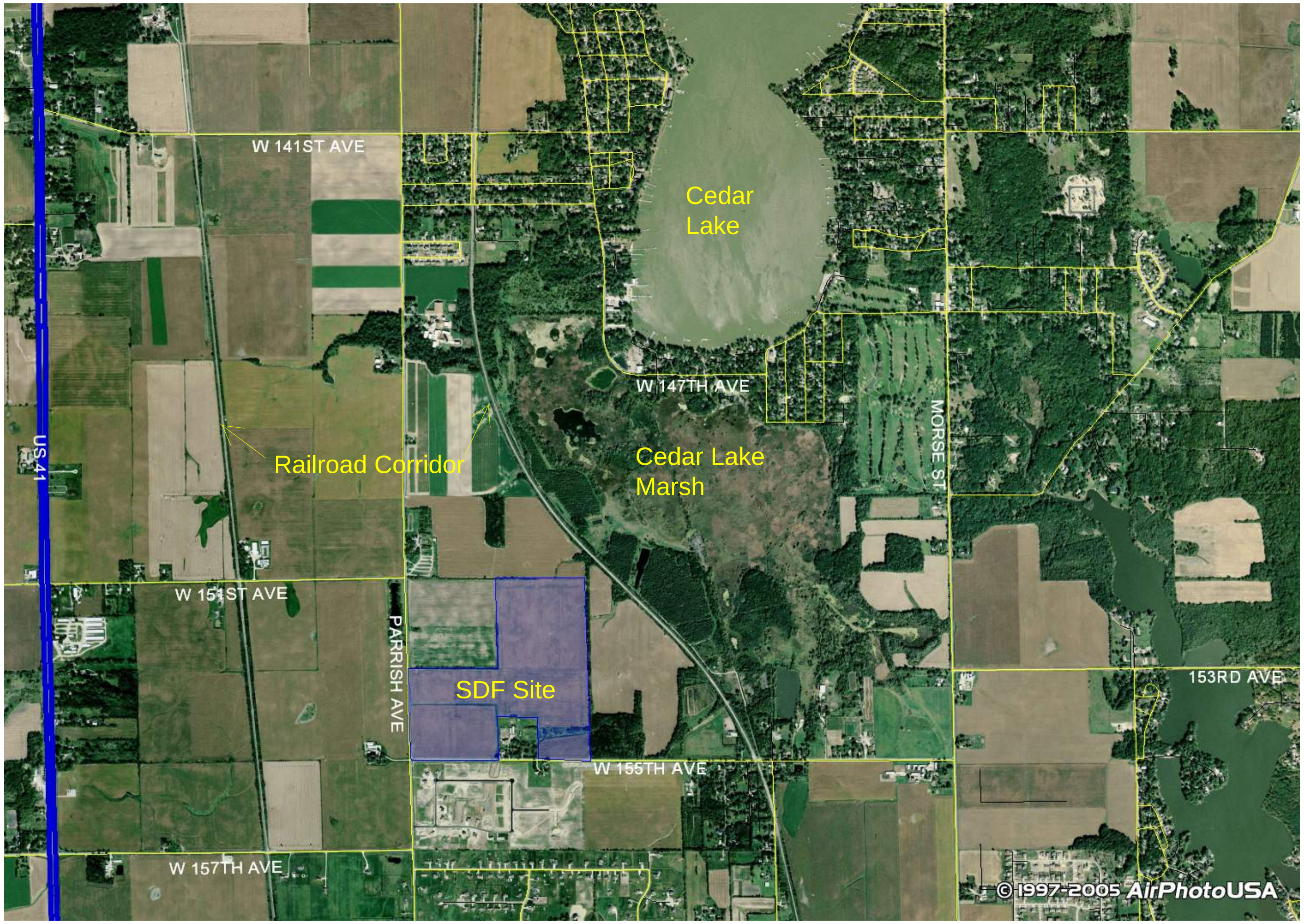


Figure 3: Sediment Dewatering Facility Location Map

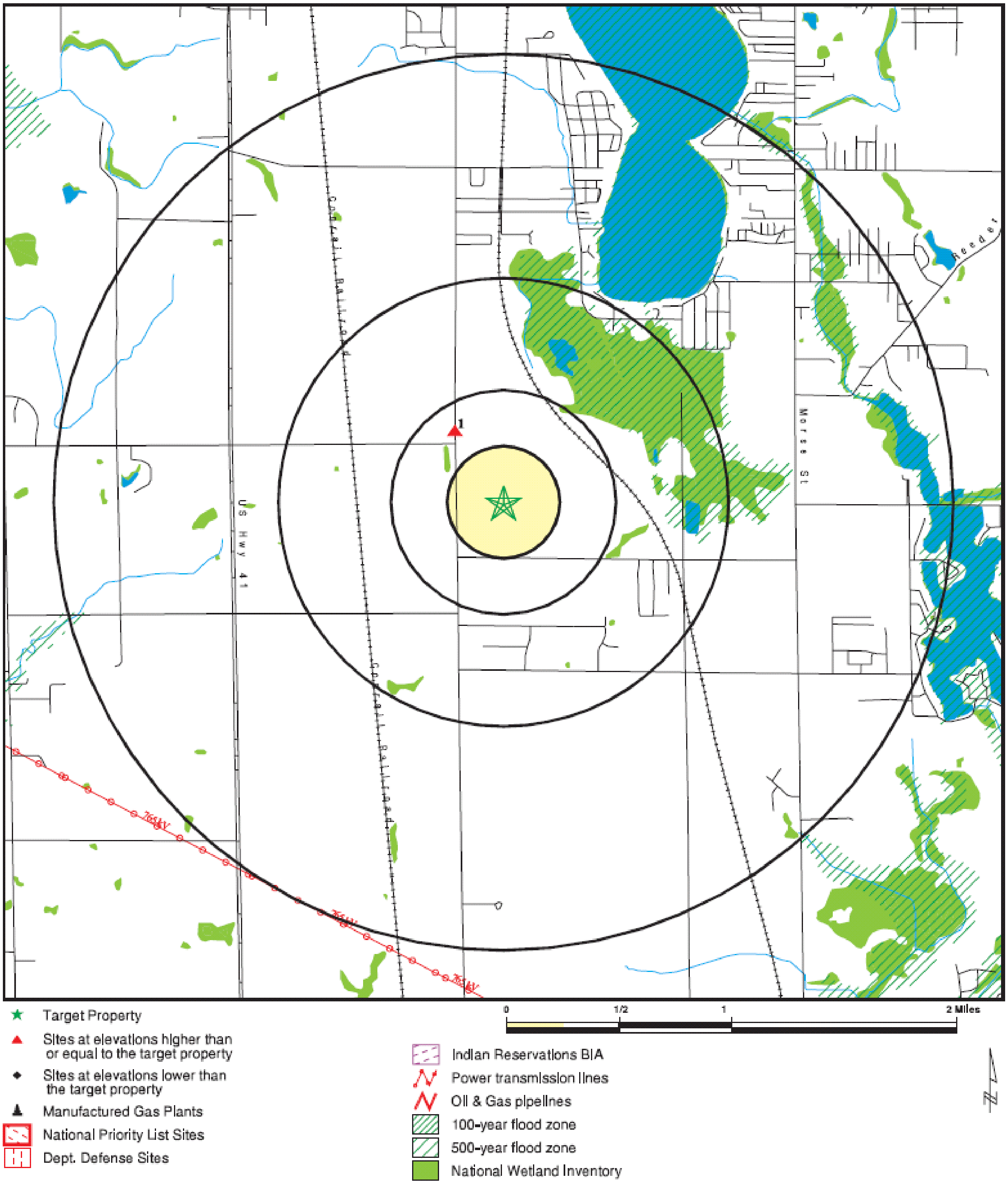


Figure 4: HTRW Investigation EDR Radius Map

Soil Map–Lake County, Indiana
(Cedar Lake Disposal Site)

Figure 5: Sediment Dewatering Facility Site Soil Map

12/13/2007

Cedar Lake, Indiana

Subwatershed Deliniation Based on 30-meter USGS Hydrographic Corrected DEM
NRCS Curve Numbers created based on Landuse and Soil Classification Data

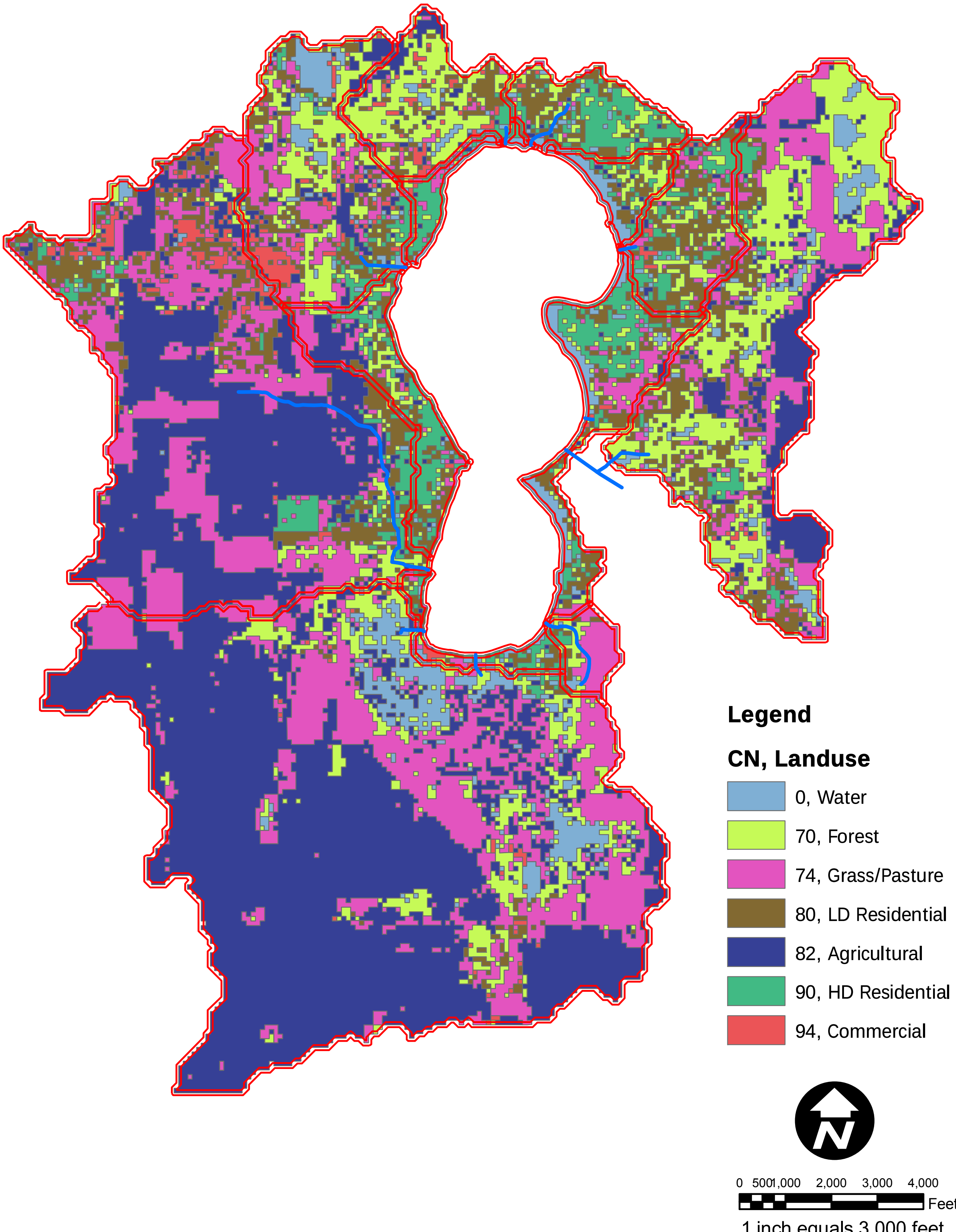


Figure 6: Cedar Lake Watershed Land Use Map

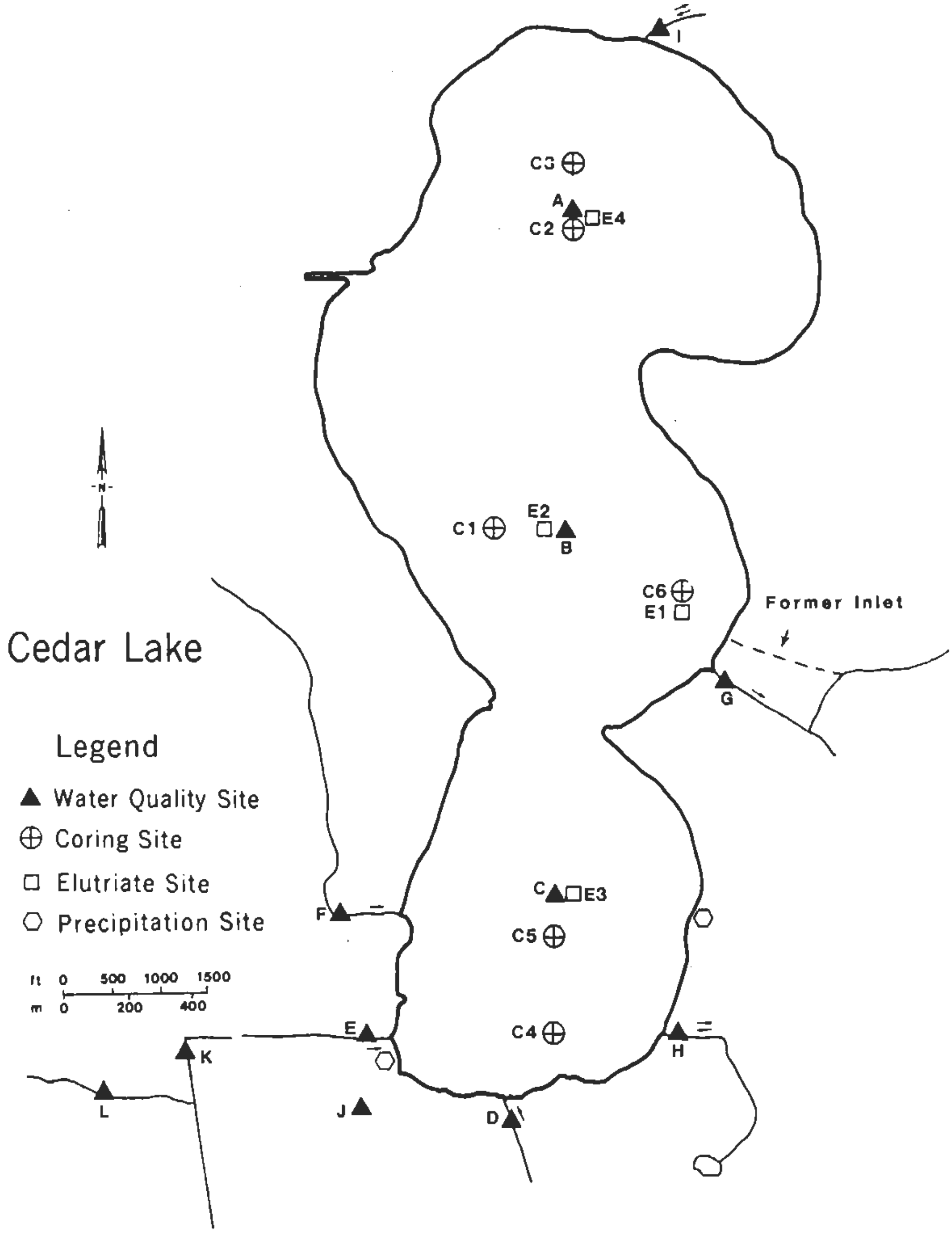
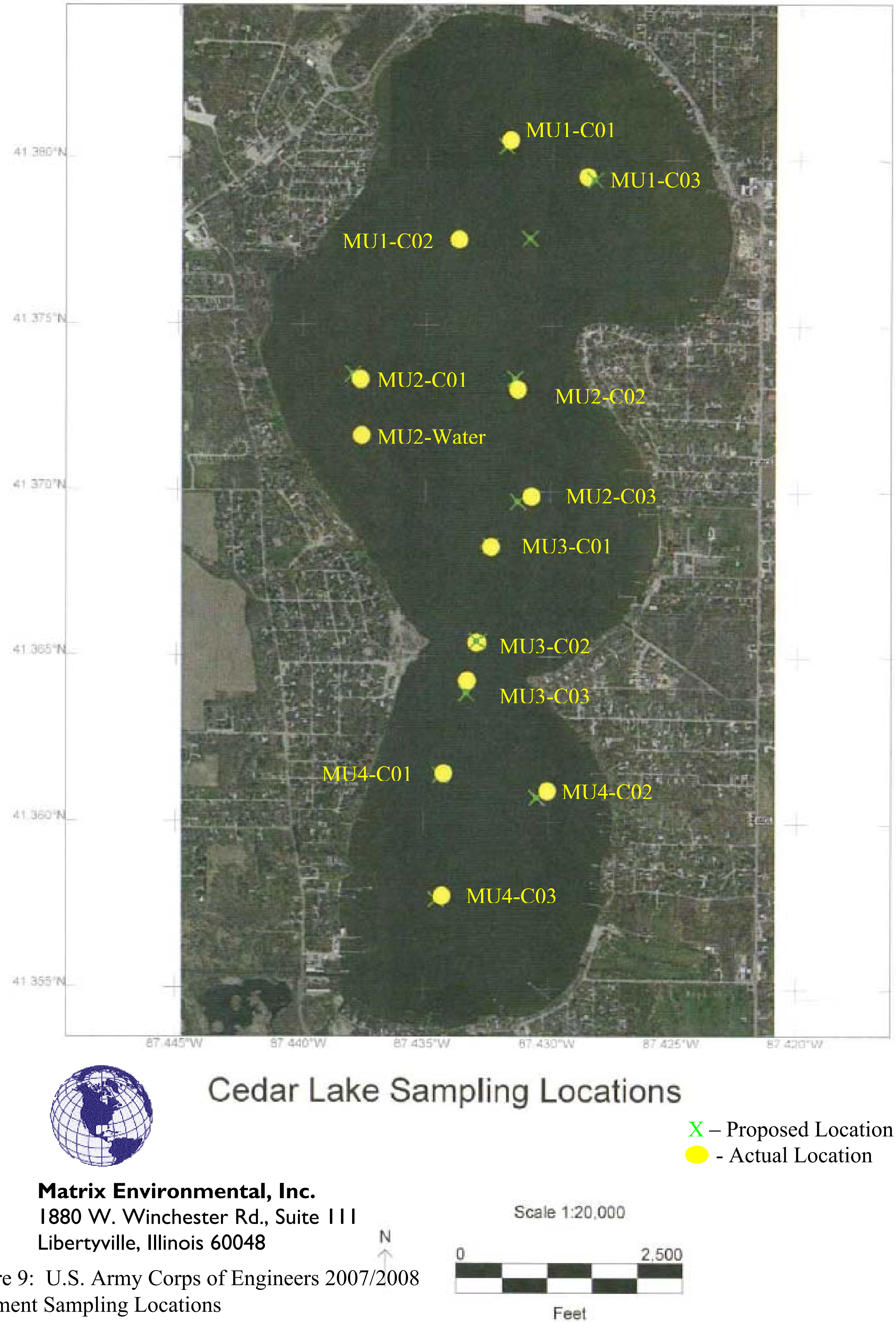


Figure 7: Indiana University 1984 Sediment Sampling Locations.

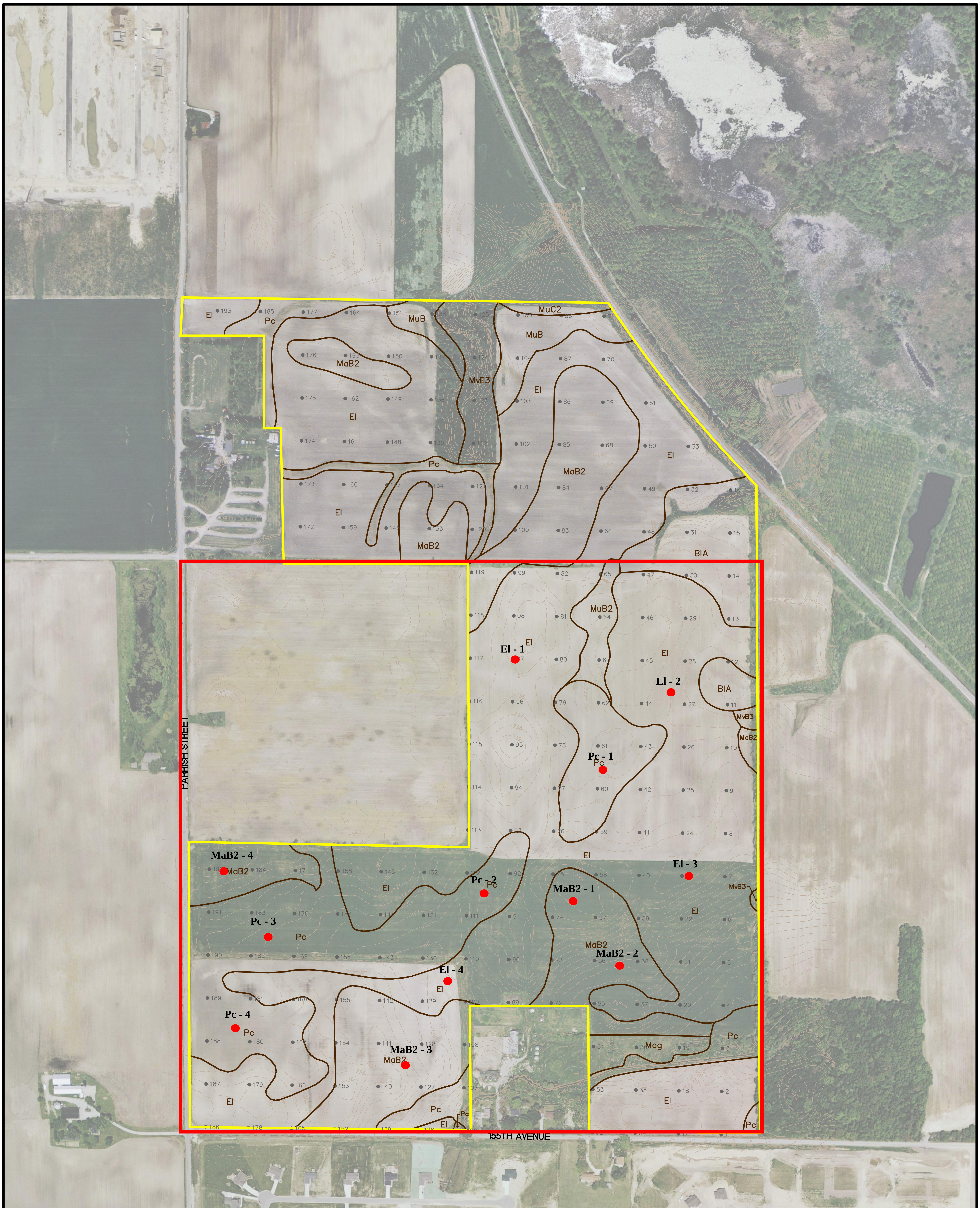
Figure 8: Harza 1998 Sediment Sampling Locations

HARZA Consulting Engineers and Scientists



Matrix Environmental, Inc.
1880 W. Winchester Rd., Suite 111
Libertyville, Illinois 60048

Figure 9: U.S. Army Corps of Engineers 2007/2008 Sediment Sampling Locations



Map Unit	Soil Name	Slope Class	Hydrologic Soil Group	Hydric
BIA	BLOUNT	0-2 %	C	N
El	ELLIOTT	0-2 %	C	N
MaB2	MARKHAM	2-6 %	C	N
Mag	MARKHAM, gravelly substratum	2-6 %	C	N
MuB	MORLEY	2-6 %	C	N
MuB2	MORLEY	2-6 %	C	N
MuC2	MORLEY	6-12 %	C	N
MvB3	MORLEY	2-6 %	C	N
MvE3	MORLEY	18-25 %	C	N
Pc	PEWAMO	0-2 %	C	Y

• - GRID INTERCEPT

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05/01/2008
DATE

SM1 DRAWING NO. | SHEET 1 OF 1 | DATE: 04/30/2008 | PROJECT NO. 06-0015

CHRISTOPHER B. BURKE
ENGINEERING WEST, LTD.
116 West Main Street, Suite 201
St. Charles, Illinois 60174
(630) 443-7755

CLIENT:
TOWN OF CEDAR LAKE

NO.	DATE	NATURE OF REVISION

DSGN.	PVH/PDK
DWN.	EAM
CHKD.	PDK
SCALE: 1" = 200'	
06-0015-SOIL MAP.DWG	

TITLE:
CEDAR LAKE SEDIMENT DEWATERING FACILITY
SOIL MAP

Figure 10: Sediment Dewatering Facility 2008 Soil Sampling Locations

Figure 1: Soil Sample Locations

Attachments available digitally upon request

Attachment 1

Sediment Dewatering Facility HTRW Investigation

Attachment 2

CBBEL Sediment Dewatering Facility Site Soil Investigation

Attachment 3
USACE L-Thia Tributary Sediment and Contaminant Loading

Attachment 4

USACE 2007 Sediment Sampling Report

Attachment 5

USACE 2008 SDF Sampling Report (Arsenic Background)

Attachment 6

USACE 2008 Sediment Sampling Report (SPLP Results)

Attachment 7

HDR Memorandum, Sediment Placement VE Evaluation