Planning and Implementing a Lake Dredging Project

by Peter Berrini, PG, CLP

Berrini & Associates, LLC

Planning and implementing a Lake Dredging project can be a significant management effort

- It is important to gather the information necessary to make informed planning decisions, completing a dredging feasibility study can include determining:

  1) The extent of the sediment impaired area(s) of the lake,
  2) The quantity of sediment to be removed (cu. yds.),
  3) The physical & chemical characteristics of the sediment,
  4) The optimum method(s) of sediment removal,
  5) Where sediment can be placed (storage, dewatering,) etc
  6) How much the potential project is likely to cost, and
  7) If dredging is needed, how can the project be paid for…

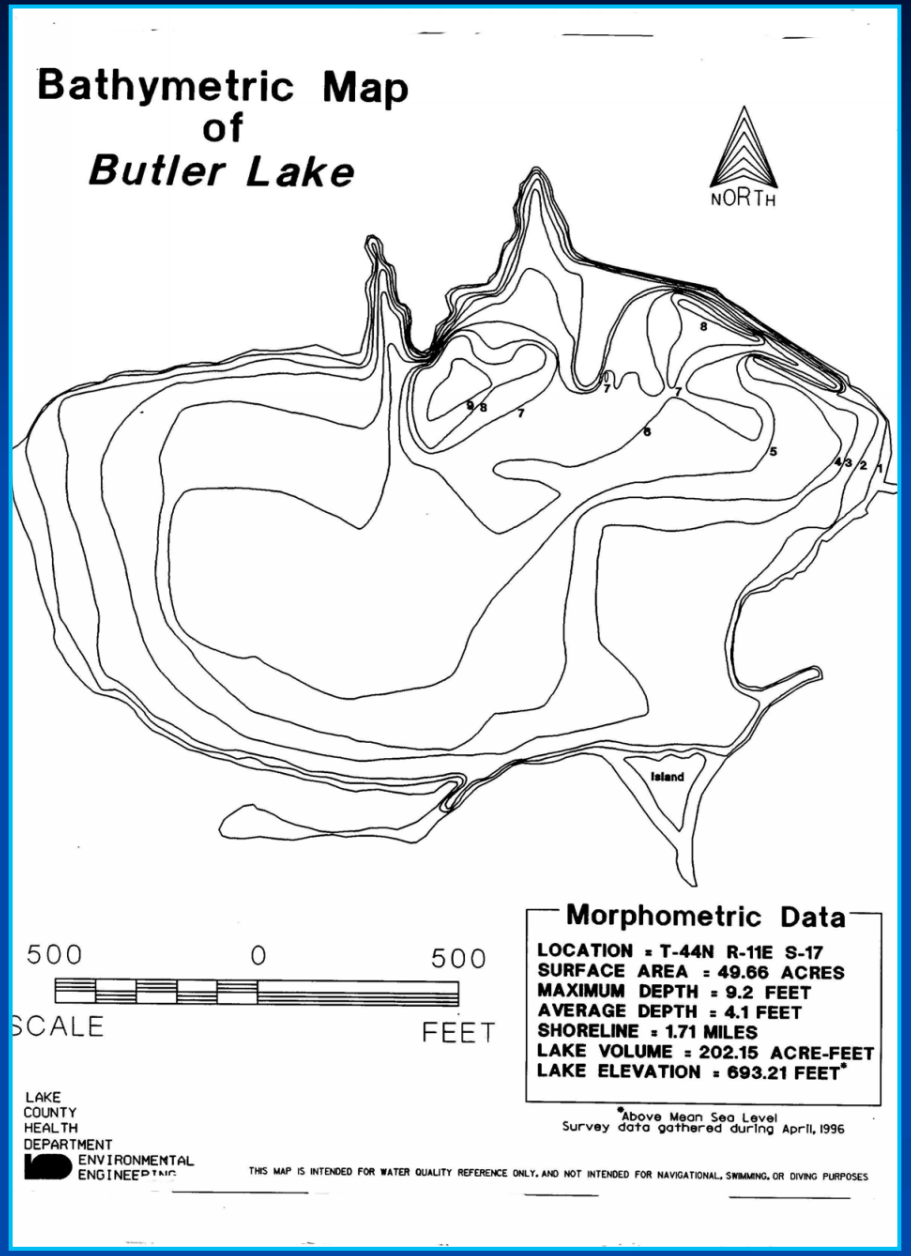
The Benefits of Sediment Removal as a Restoration Alternative

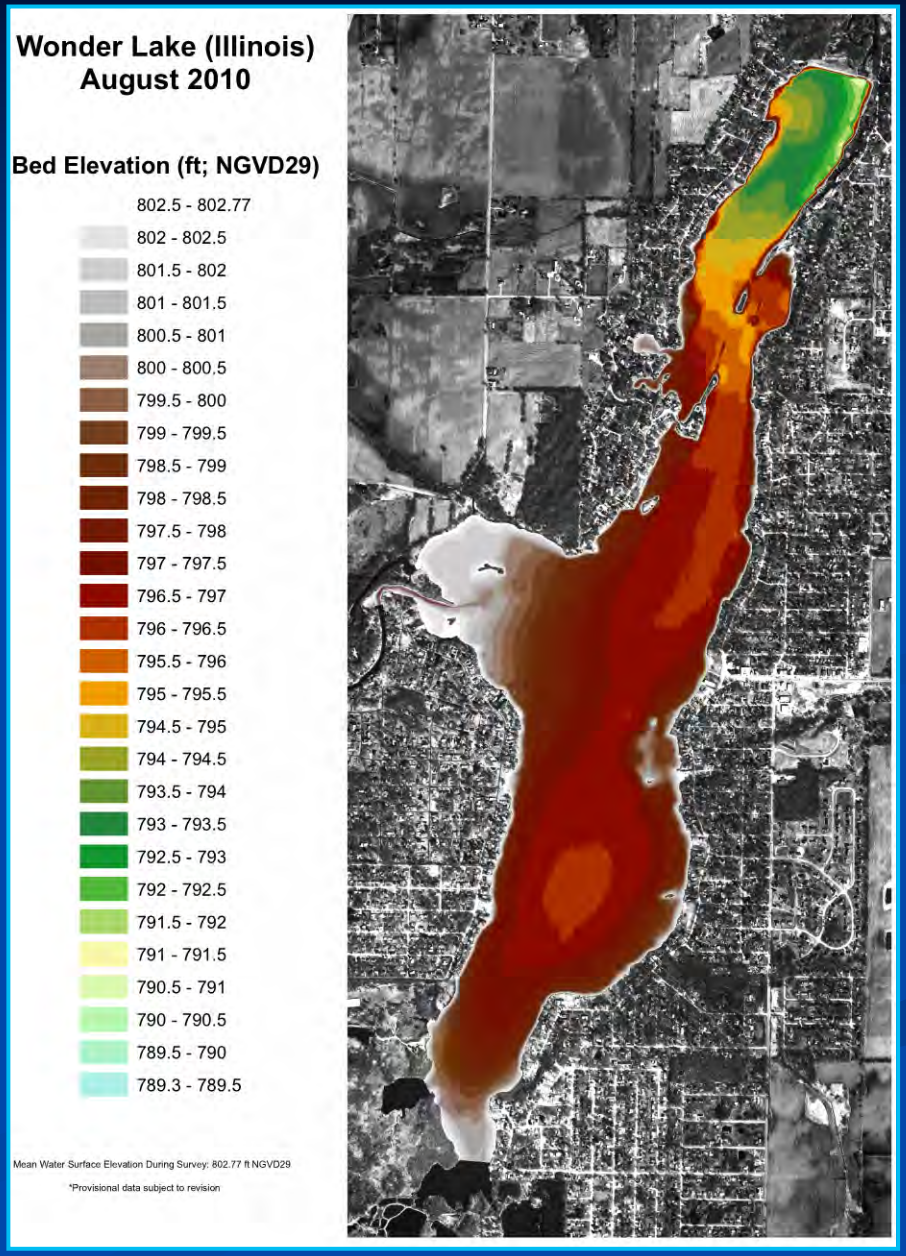
1) Increased water depths and overall storage capacity that has been lost to sediment deposition;
2) Improved and expanded recreational opportunities for safe boating and access;
3) A more balanced aquatic ecosystem resulting from expanded aquatic habitat, effective management efforts and deeper overwintering conditions
4) Water quality and clarity is likely to improve in addition to reducing internal nutrient (phosphorus) recycling from wind and wave re-suspension
5) Water supply reservoirs can increase storage volume to help prevent shortages during drought

Preliminary Project Requirements "the Dredging Feasibility Study"

- Complete a Sedimentation Survey that includes water depth and sediment thickness measurements (*methods*)
- Determine optimum dredging limits, target depths and total quantity of sediment to be removed (*alternatives*)
- Characterize and analyze physical and chemical properties of sediment to be removed (*contaminants?*)
- Determine dredging method(s) (Hydraulic or Mechanical)
- Locate site(s) for Sediment Storage and/or Dewatering
- If implemented, obtain Regulatory Permits from Army Corps of Engineers, Illinois EPA, Illinois DNR, Illinois Historic Preservation Agency, Local and/or County

Bathymetric Maps Have Limitations

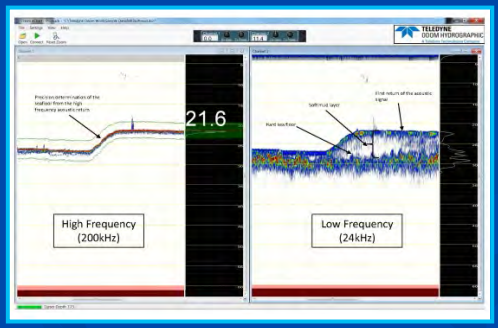




The Sedimentation Survey should include water depth and sediment thickness measurements along predetermined transects in order to develop cross sectional views of the lake

Figure 3. Sedimentation Survey Location Map
Lake Holiday, LaSalle County, Illinois

Sediment Measurement Options



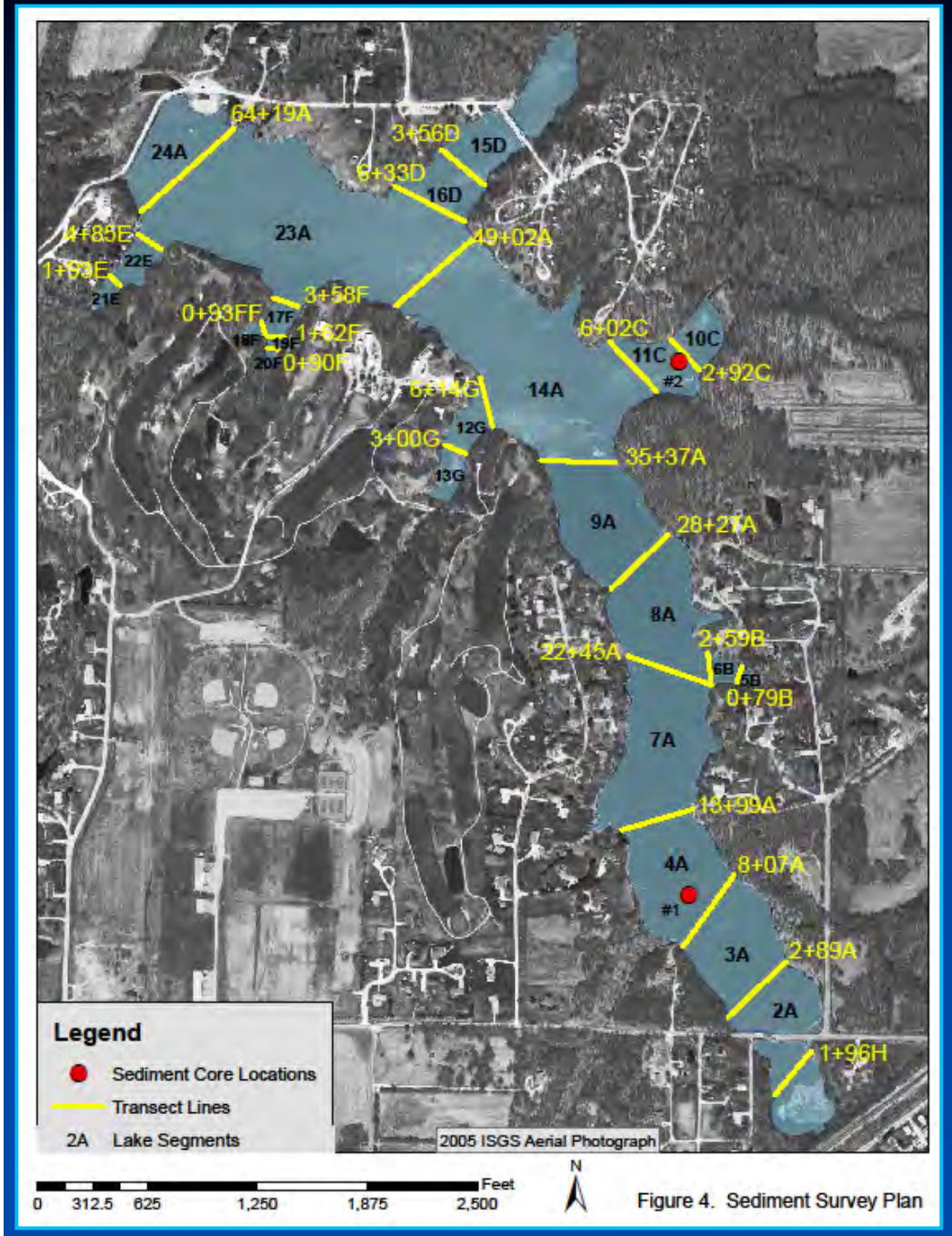
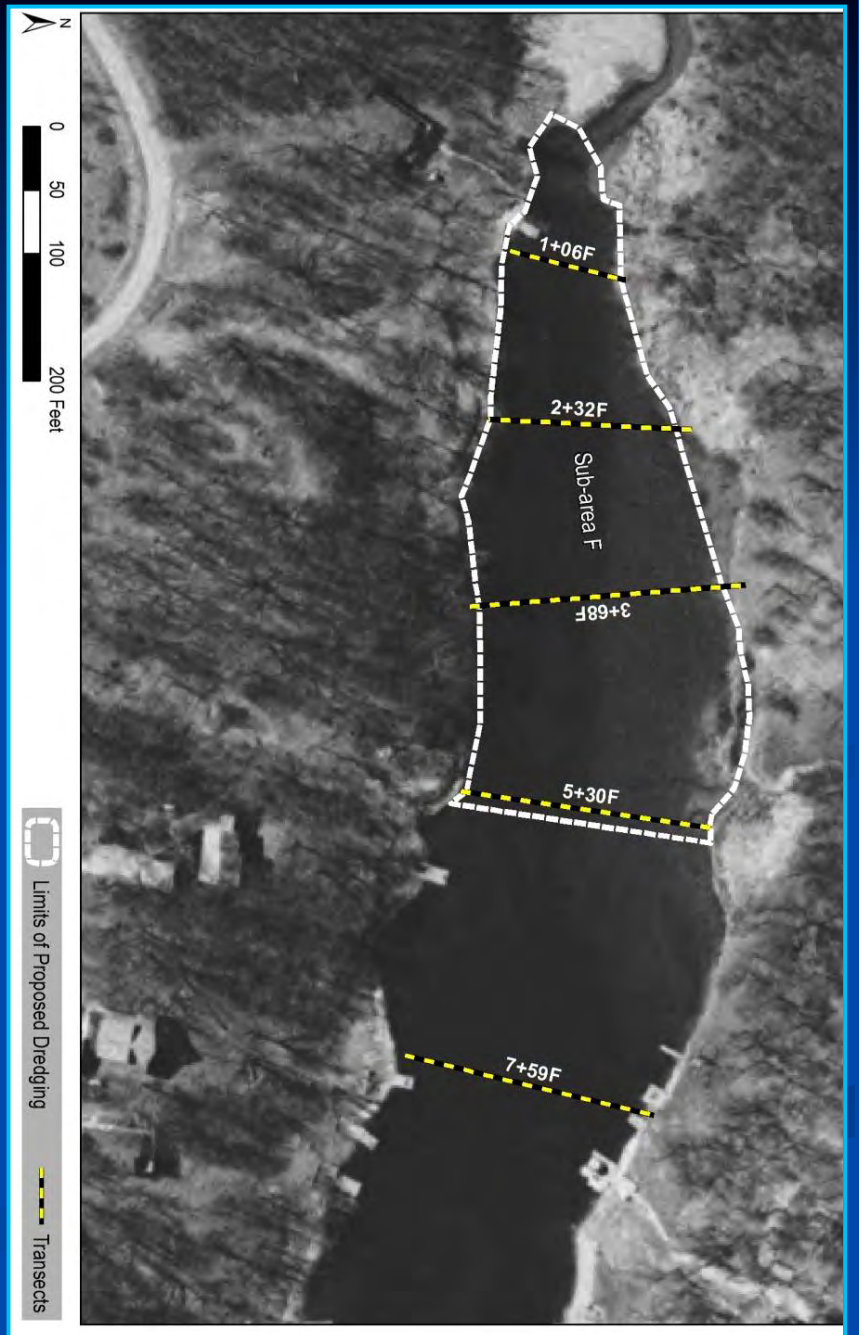
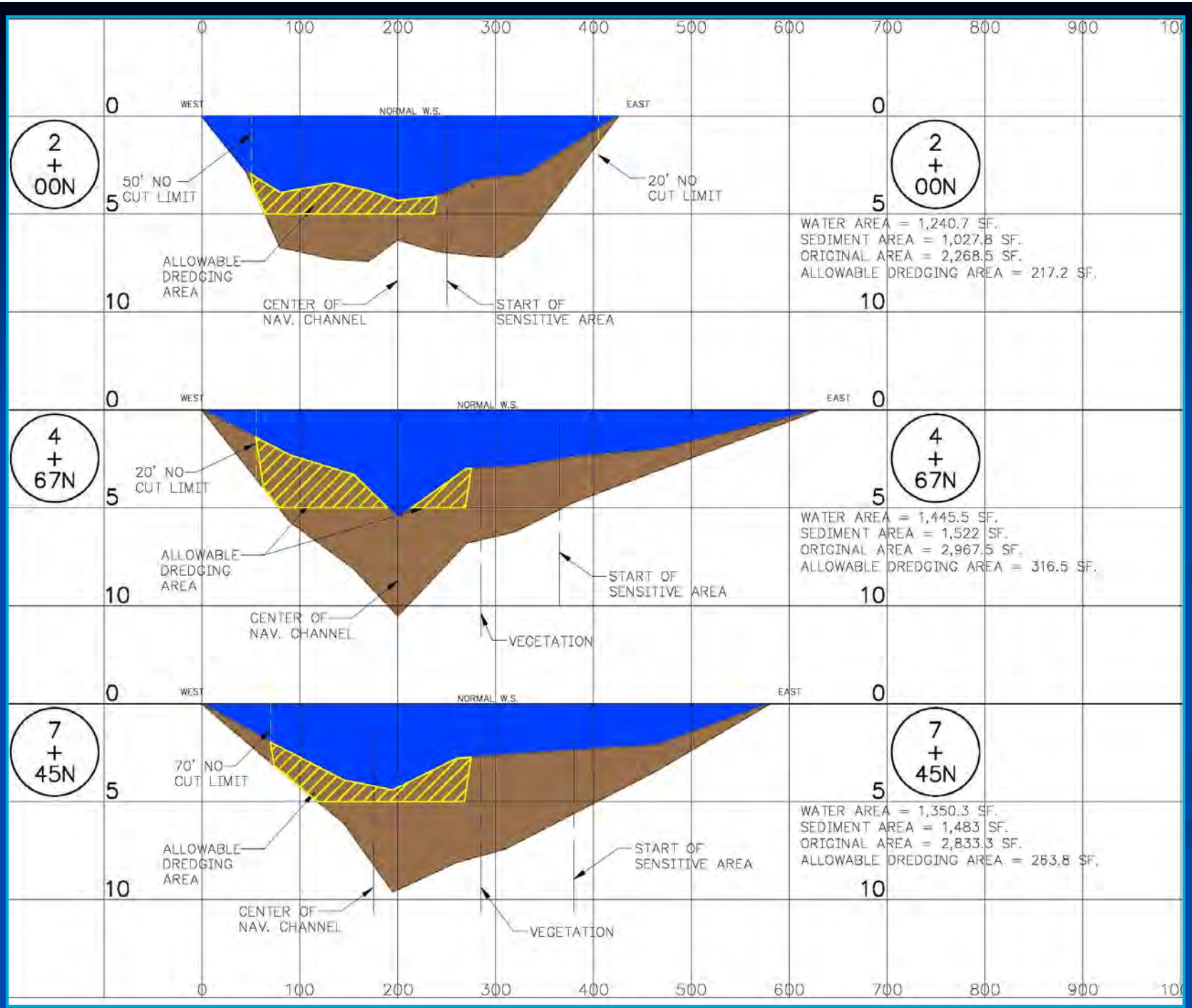
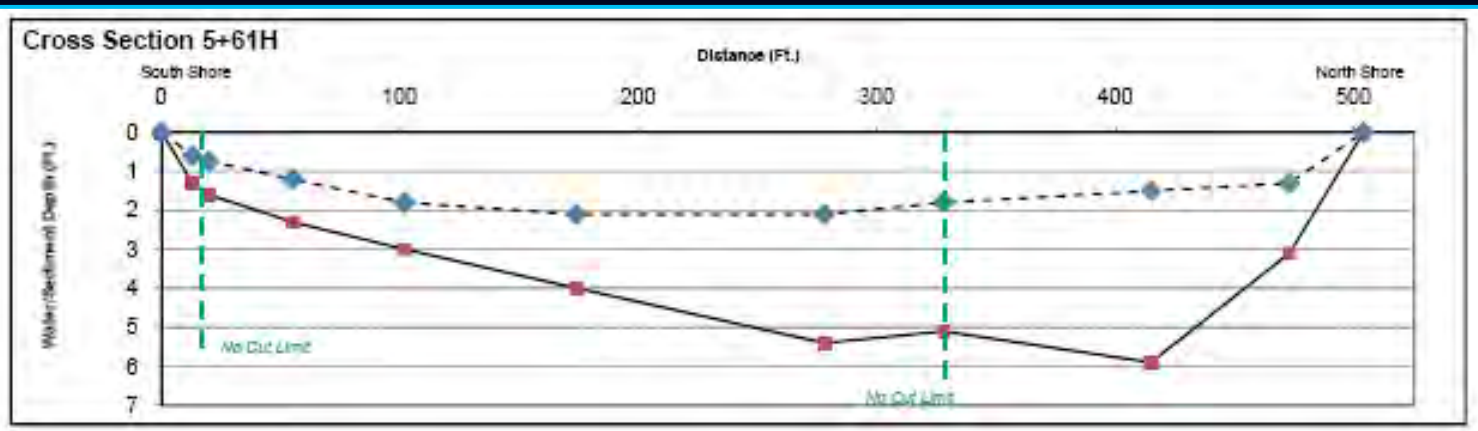
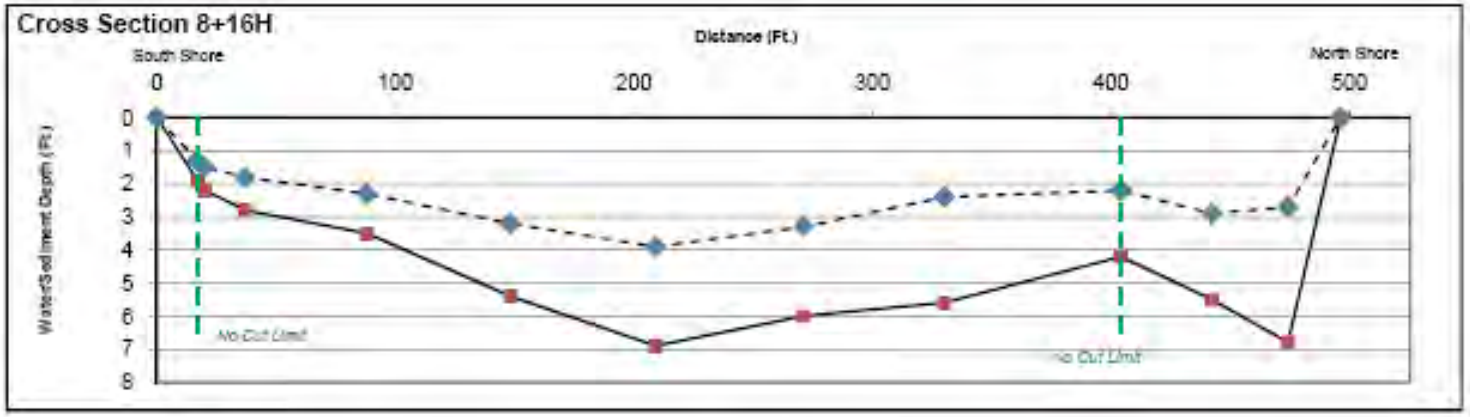


Figure 4. Sediment Survey Plan




0
100
200
300
400
500
600
700
800
900
WEST
NORMAL W.S.
EAST
2 + 00N
50' NO CUT LIMIT
20' NO CUT LIMIT
ALLOWABLE DREDGING AREA
CENTER OF NAV. CHANNEL
START OF SENSITIVE AREA
WATER AREA = 1,240.7 SF.
SEDIMENT AREA = 1,027.8 SF.
ORIGINAL AREA = 2,268.5 SF.
ALLOWABLE DREDGING AREA = 217.2 SF.
4 + 67N
20' NO CUT LIMIT
ALLOWABLE DREDGING AREA
CENTER OF NAV. CHANNEL
START OF SENSITIVE AREA
VEGETATION
WATER AREA = 1,445.5 SF.
SEDIMENT AREA = 1,522 SF.
ORIGINAL AREA = 2,967.5 SF.
ALLOWABLE DREDGING AREA = 316.5 SF.
7 + 45N
70' NO CUT LIMIT
ALLOWABLE DREDGING AREA
CENTER OF NAV. CHANNEL
START OF SENSITIVE AREA
VEGETATION
WATER AREA = 1,350.3 SF.
SEDIMENT AREA = 1,483 SF.
ORIGINAL AREA = 2,833.3 SF.
ALLOWABLE DREDGING AREA = 263.8 SF.


Cross Section 5+61H
Distance (Ft.)
South Shore
North Shore
0
100
200
300
400
500
0
1
2
3
4
5
6
7
No Cut Limit
No Cut Limit


Cross Section 8+16H
Distance (Ft.)
South Shore
North Shore
0
100
200
300
400
500
0
1
2
3
4
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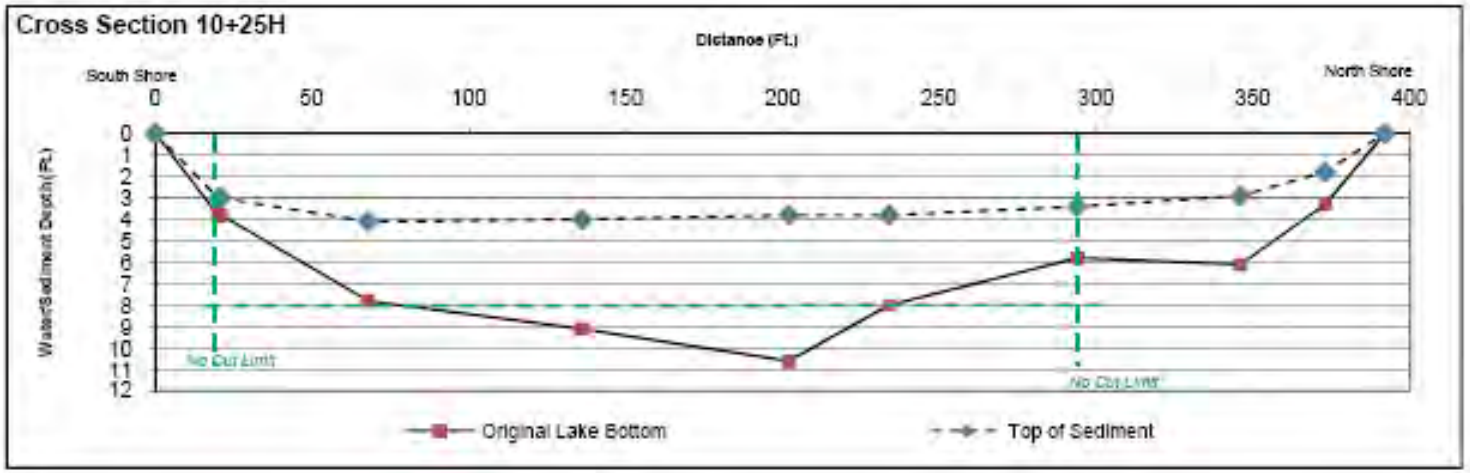
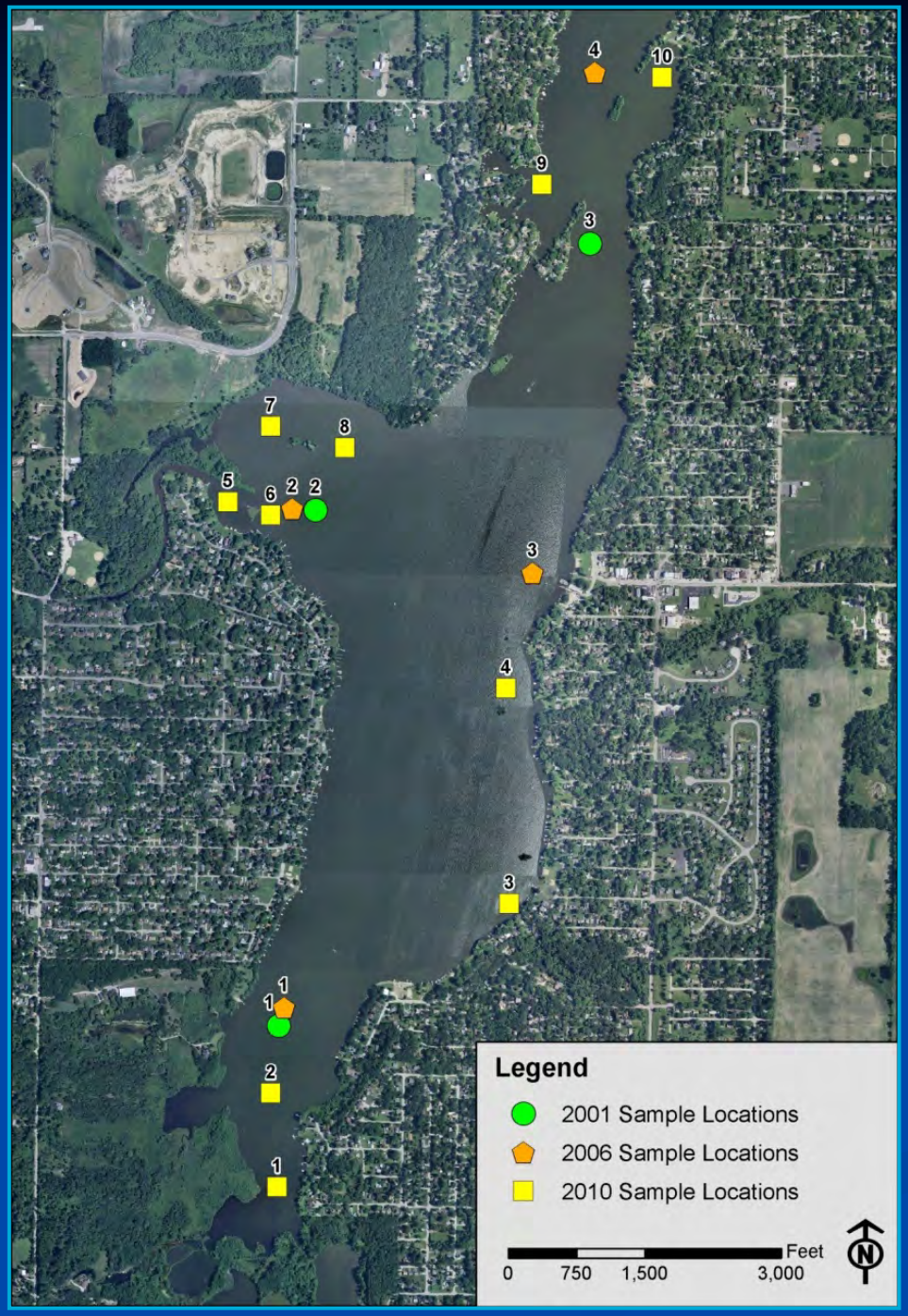
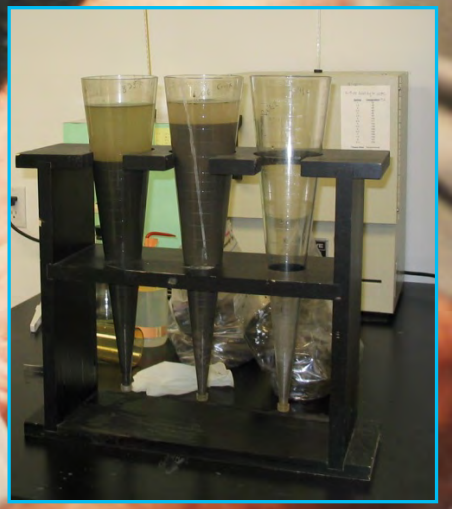
6
7
8
No Cut Limit
No Cut Limit

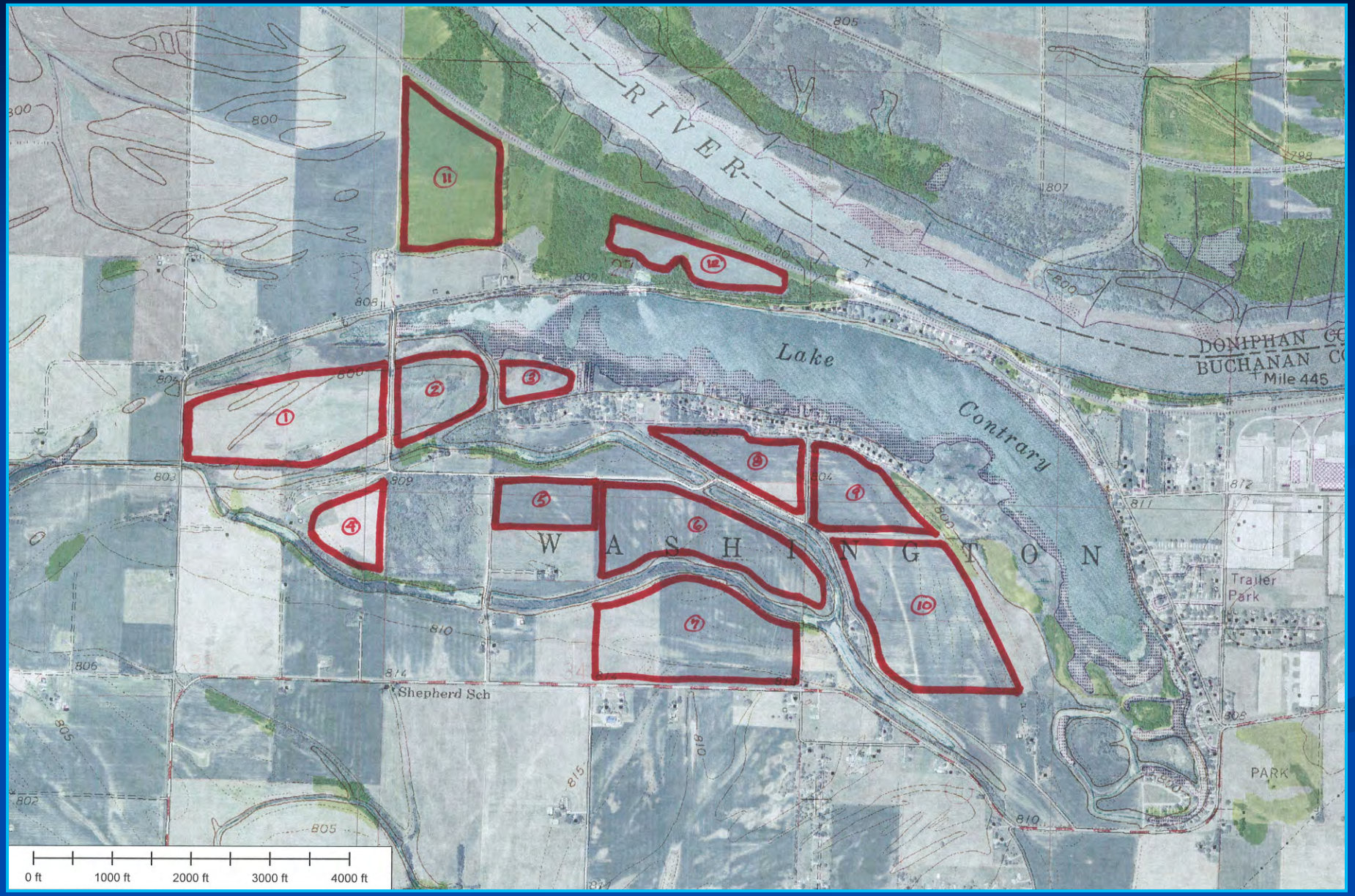

Cross Section 10+25H
Distance (Ft.)
South Shore
North Shore
0
50
100
150
200
250
300
350
400
0
1
2
3
4
5
6
7
8
9
10
11
12
No Cut Limit
No Cut Limit
Original Lake Bottom
Top of Sediment


4
10
9
3
7
8
5
6
2
2
3
4
3
1
1
2
1
Legend
2001 Sample Locations
2006 Sample Locations
2010 Sample Locations
Feet
0
750
1,500
3,000
N


This is NOT contaminated sediment!



Potential Sediment Storage and Dewatering Sites



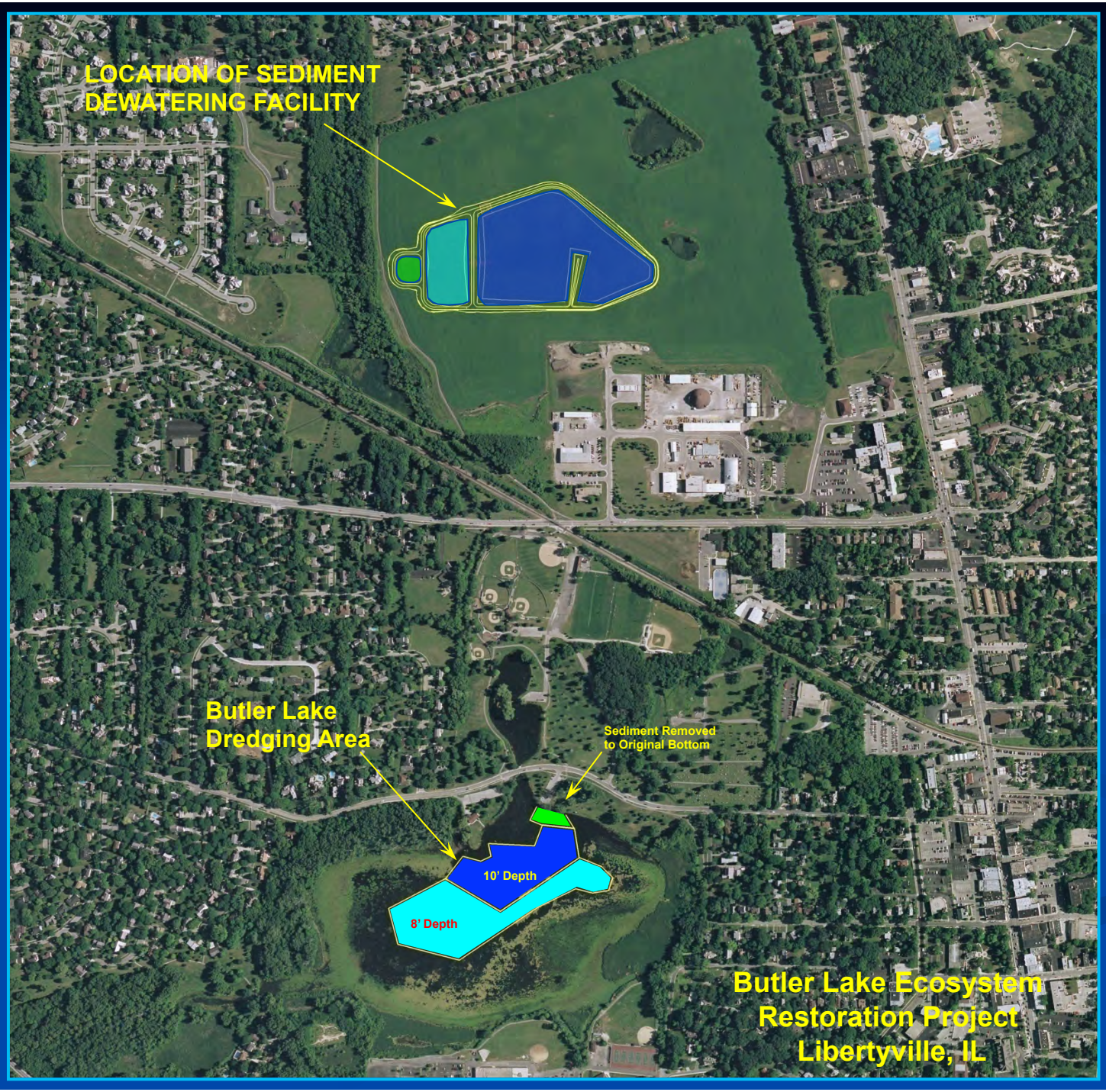
Sediment Storage Site Evaluation Matrix

Site Evaluation Criteria	SW Nelson Rd. West	SW Nelson Rd. East	Christie Lane NW	SW Nelson Rd. SW	CR-201 NE	SW Nelson Rd. South	State Route U North	CR-199 West
Total Site Acreage	48.0	8.0	3.0	16.0	18.0	49.0	66.0	29.0
Usable Acreage (assume 80% of site)	38.4	6.4	2.4	12.8	14.4	39.2	52.8	23.2
Type of Storage Site	Upland Dikes	Geotubes	Geotubes	Upland Dikes	Upland Dikes	Upland Dikes	Upland Dikes	Upland Dikes
Storage Capacity in CY **	495,615	82,602	30,976	165,205	185,856	505,940	681,471	299,434
Total Length of Perimeter Embankment (ft.)								
Estimated Earthwork Quantity (cy)								
Dist. - Lake to Storage Site	800	700	300	2,300	2,400	2,300	3,500	800
Dist. - Lake to Farthest Pt.	11,000	10,000	9,000	9,000	9,000	5,500	5,500	5,500
Min. Dredging Dist. (ft.)	800	700	300	2,300	2,400	2,300	3,500	800
Max. Dredging Dist. (ft.)	11,800	10,700	9,300	11,300	11,400	7,800	9,000	6,300
Avg. Dredging Dist. (ft.)	5,900	5,350	4,650	5,650	5,700	3,900	4,500	3,150
Average Site Elevation	800.0	800.0	800.0	805.0	810.0	810.0	810.0	805.0
Lake Surface Elevation (avg.)	798.0	798.0	798.0	798.0	798.0	798.0	798.0	798.0
Avg. Elev. above Lake	2.0	2.0	2.0	7.0	12.0	12.0	12.0	7.0
Terminal (Pumping) Elev.	12.0	12.0	12.0	17.0	22.0	22.0	22.0	17.0
Booster Pump (s) for dredged sediment	Yes	Yes	Yes	Yes	Yes	No	No	No
Return Water back to Lake	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity	Gravity
Adj. Homes/Buildings	Low	Low	Low	Low	Low	Low	Low	Moderate
Land Cost (if applicable)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Road or RR Crossings for Pipeline	1	0	0	1	2	2	2	1
Suitability of Topography	Good	Partial Wetland	Partial Wetland	Good	Good	Good	Good	Good
Suitability of Soils	Good	Good	Good	Good	Good	Good	Good	Good
Impact to Habitat	None	Low	Low	None	None	None	None	None
Aesthetic Impact	Low	Low	Low	Low	Moderate	Moderate	Moderate	Moderate
Amt. of Timber to Clear	None	Low	Low	None	Low	None	None	None

** Assume 10 ft. average sediment height for Upland Dike Sites; storage volume includes 1.2 sediment bulking factor

Types of Storage Sites:

- Floodplain Sites - earthen SDF with pumped effluent back to lake
- Upland Sites - earthen SDF with gravity flow efluent to lake
- In-Lake or Adjacent Wetland Sites - Consists of limited in-lake storage created by filling geotextile tubes


LOCATION OF SEDIMENT
DEWATERING FACILITY
Butler Lake
Dredging Area
Sediment Removed
to Original Bottom
10' Depth
8' Depth
Butler Lake Ecosystem
Restoration Project
Libertyville, IL

Various site characteristics and obstacles must be considered for the dredge pipeline access, sediment storage and dewatering requirements

Permitting Requirements

- Joint Application Permit to be completed and submitted to USACE, Illinois EPA and IL DNR
- Section 401 Water Quality Certification (EPA)
- Anti-Degradation Assessment (EPA)
- Illinois DNR Dam Permit may be required for storage and dewatering impoundment:
- Illinois EPA Storm Water Permit (NPDES ILR10)
- Illinois Historic Preservation Agency (Phase 1 Archeological Survey)
- Local and County Permits as Required

Corps determines IF, and what type of 404 permit is required

Nationwide Permits are a series of general permits issued by the Corps for minor projects in certain areas. All nationwide permits have special conditions which must be met in order for a project to qualify for nationwide permit status. Some nationwide permits also require pre-construction notification to the Corps prior to the initiation of any activities.

Regional Permits are a type of general permit that may be issued by a division or district engineer after compliance with the other procedures of this regulation. After a regional permit has been issued, individual activities falling within those categories that are authorized by such regional permits do not have to be further authorized by the procedures of this regulation.

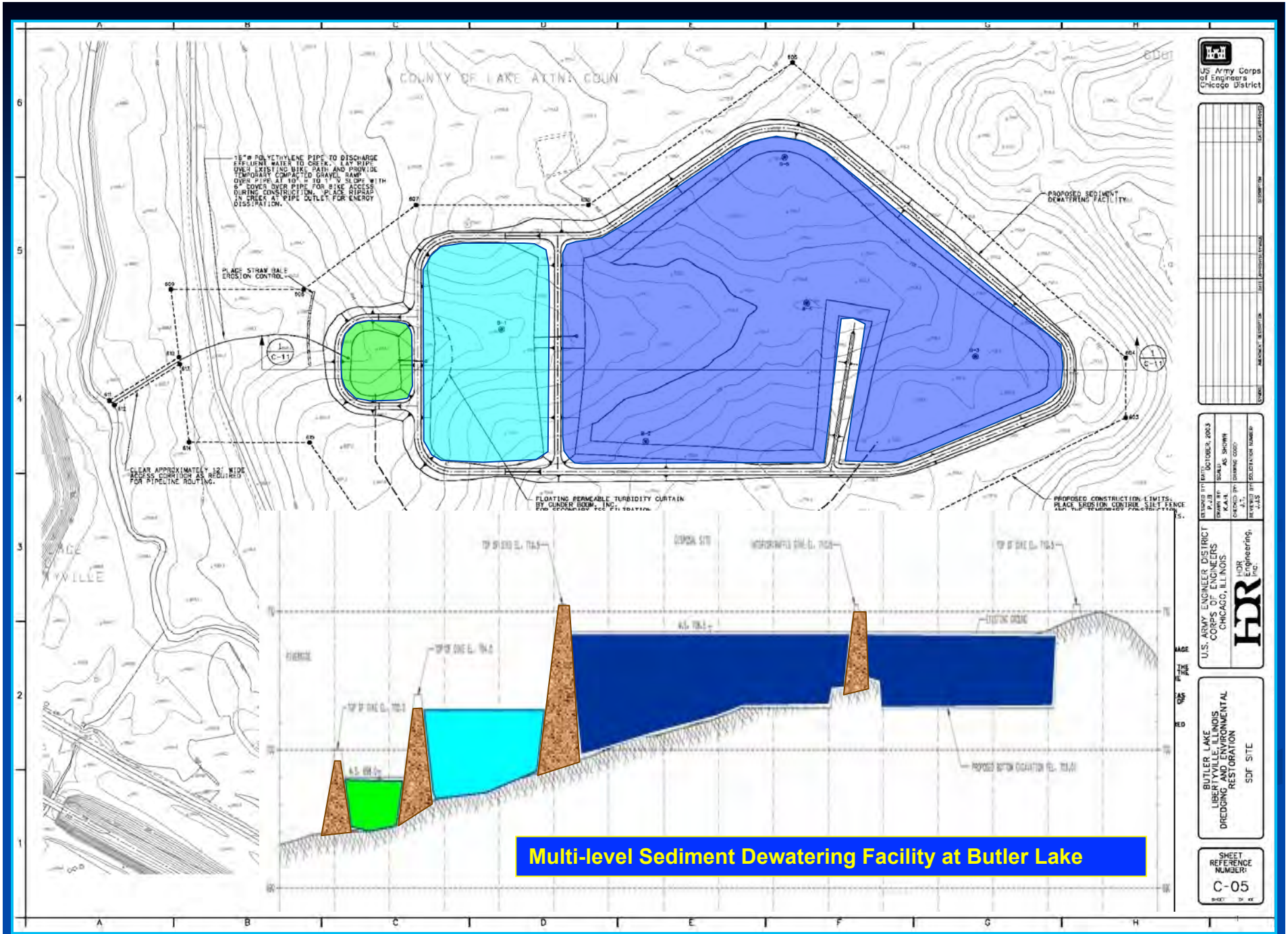
Individual Permits are required if your project does not fall under the criteria for a general permit or letter of permission. If your project requires an individual permit, the Corps issues a Public Notice advising all interested parties of the proposed activity. This Public Notice process helps the Corps to evaluate the probable impact of the project as part of the public interest review. Illinois EPA and DNR may also issue separate Public Notices for individual Permits, which generally require substantial additional information and documentation.

Joint Permit Application

- Construction projects in Illinois waterways, floodplains and wetlands often require both State and Federal authorization. This application packet is designed to simplify the approval process for the applicant seeking project authorizations from the U.S. Army Corps of Engineers (USACE), The Illinois Department of Natural Resources/Office of Water Resources (IDNR/OWR) and the Illinois Environmental Protection Agency (IEPA).
- Anyone proposing to construct, operate or maintain any dam, dock, pier, wharf, sluice, levee, dike, building, utility and road crossings, piling, wall, fence or other structure in; or **DREDGE**, fill or otherwise alter the bed or banks of any stream, lake, wetland, floodplain or floodway **subject to State or Federal regulatory jurisdiction** should apply for agency approvals. The appropriate copy of the joint application form, drawings, and copy of any additional support information should be sent to each of the regulatory agencies. Approvals may be required by any or all of the agencies.
- Applications filed simultaneously with USACE, IDNR/OWR, and IEPA will be processed concurrently in an independent manner, and should result in expedited receipt of all agency determinations. If a permit is not required by one or more of the agencies, they will inform the applicant and the other agencies. Coordination with the regulatory and other review agencies is recommended as early as possible during the project planning stage.

Dredging & Dewatering Options

- Hydraulic Cutterhead, Swinging Ladder, Horizontal Auger, Low Turbidity, High Solids, Diver Operated
- Mechanical Excavation: Wet, Dry, Clamshell and Bucket
- Conventional Upland Containment Area Designs based on retention and gravity settling of solids
- Geotextile Tubes - both in-lake and upland
- Treatment Options such as Polymers, Flocculants, etc.
- On-Site Mechanical Dewatering Systems


COUNTY OF LAKE ILLINOIS
PROPOSED SEDIMENT DEWATERING FACILITY
PLACE STRAW BALE EROSION CONTROL
FLOATING PERMEABLE TURBIDITY CURTAIN BY CUNDER BOOM, INC.
PROPOSED CONSTRUCTION LIMITS; PLACE EROSION CONTROL SILT FENCE
CLEAR APPROXIMATELY 12' WIDE ACCESS CORRIDOR AS REQUIRED FOR PIPELINE ROUTING.
EXISTING GROUND
PROPOSED BOTTOM EXCAVATION EL. 701.0
Multi-level Sediment Dewatering Facility at Butler Lake
US Army Corps of Engineers Chicago District
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS CHICAGO, ILLINOIS
HDR Engineering, Inc.
BUTLER LAKE LIBERTYVILLE, ILLINOIS DREDGING AND ENVIRONMENTAL RESTORATION
SDF SITE
SHEET REFERENCE NUMBER:
C-05

Hydraulic dredge with rotating basket type cutterhead capable of excavating large volumes of sediment and transporting a slurry via pipeline.

Hydraulic dredge equipment with both horizontal auger type cutterhead for soft sediment and swinging ladder with basket type cutterhead for maneuverability and versatility.

Hydraulic dredge equipment with conventional upland sediment storage and dewatering facilities.

Hydraulic dredge mobilization and pipeline assembly.

Hydraulic dredge slurry discharge from pipeline and water control structures at dewatering facilities.

Clarified effluent return water being discharged from sediment dewatering facilities must be 15 mg/l or less of total suspended solids to satisfy Illinois EPA permit requirements.

Fine grained sediment that does not settle within a 24 hour period may require a polymer or flocculent to achieve necessary return water clarity.


FISHPRO
Client:
Site Name:
Sample:
Date:
Time:
Collected by:
Grab
Composite

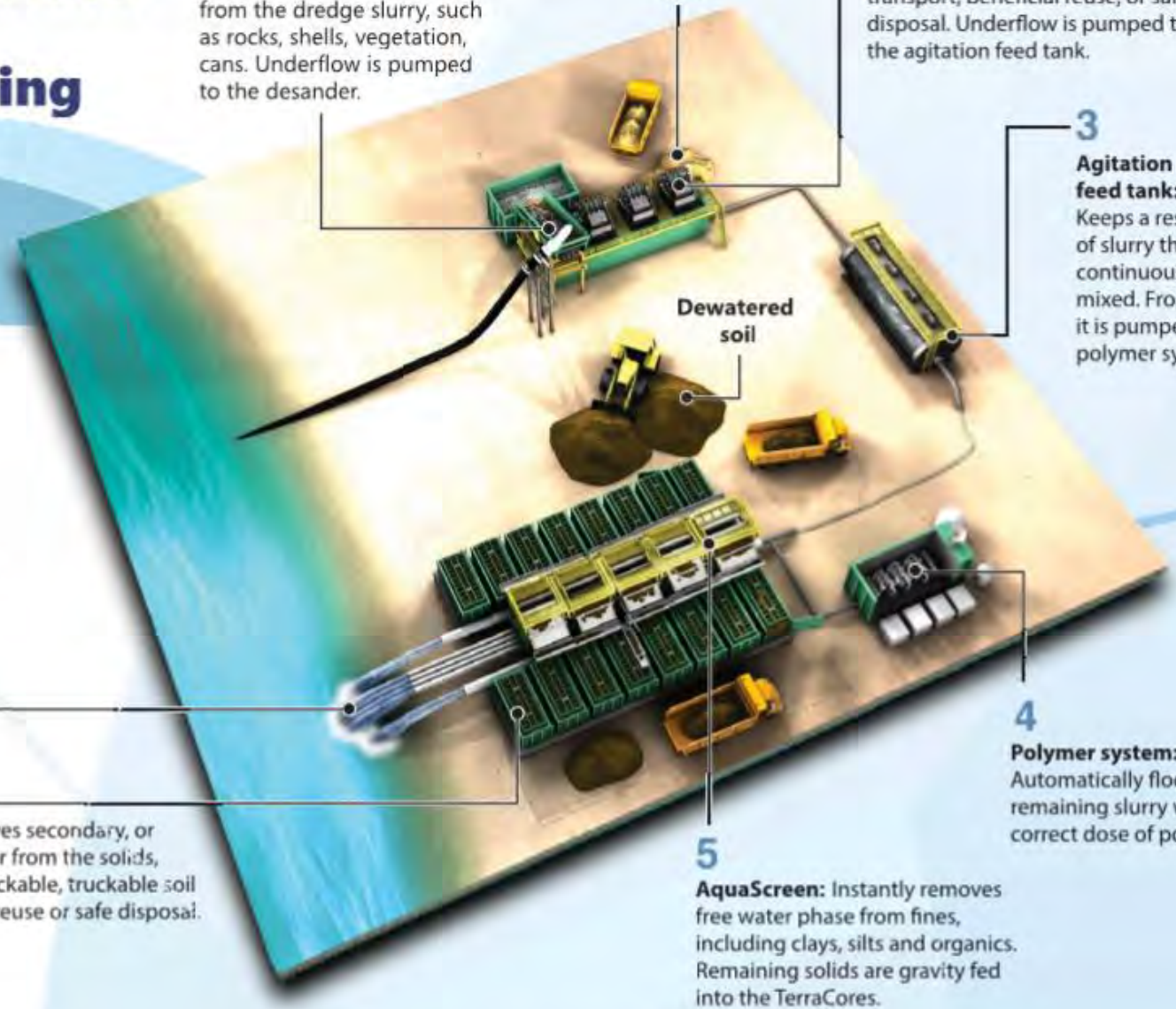
An in-lake island may be constructed by filling geotextile tubes with sediment and pumping sediment into the interior as an alternative to upland sediment storage and dewatering facilities. However, regulatory permitting is very restrictive for this alternative

Geotextile tubes and mechanical dewatering systems can be used when land for sediment storage and dewatering is limited

Geotextile tubes can provide an effective dewatering option depending on specific project conditions

Mobile Mechanical Dewatering Systems can provide an effective dewatering option for small spaces and allow for immediate removal of stockpiled soil

Genesis Water Rapid Dewatering System™



1
Vibra-Snap: Removes, dries and stockpiles bulky debris from the dredge slurry, such as rocks, shells, vegetation, cans. Underflow is pumped to the desander.

2
Desander: Removes, dries, and stockpiles sand, which is ready for transport, beneficial reuse, or safe disposal. Underflow is pumped to the agitation feed tank.

3
Agitation feed tank: Keeps a reserve of slurry that is continuously mixed. From there it is pumped to the polymer system.

4
Polymer system: Automatically flocculates remaining slurry with the correct dose of polymer.

5
AquaScreen: Instantly removes free water phase from fines, including clays, silts and organics. Remaining solids are gravity fed into the TerraCores.

6
TerraCore: Rapidly removes secondary, or capillary, water from the solids, producing stackable, truckable soil for beneficial reuse or safe disposal.


McLanahan

From Wet Lake Sediment to Stackable Soil

Coarse Material Separator and Hydrocyclone

Clarifier, Polymers and Clear Return Water

Loading Trucks for Transport to Placement Site

Recovered Soil for Future Beneficial Use

A modified high solids “Dry Dredge” can excavate material and pump a thickened slurry of “lava” consistency, which reduces dewatering and is efficient at filling geotextile tubes.

A barge mounted excavator or crane equipped with a clamshell excavating unit allows mechanical dredging in a river or waterbody without a water level drawdown.

The Bunn Park Lagoon, which is a Springfield Park District golf course lake was mechanically excavated after a water level drawdown. Sediment was placed on adjacent areas and re-vegetated with turf grass.

Mechanical dredging with long reach excavators at Bunn Park Lagoon

Mechanically excavated sediment placed in a confined area for drying, grading and re-vegetation.


Upland sediment storage and dewatering impoundments are often permitted dams and must be decommissioned by breaching to eliminate impounding capability

Sediment drying and consolidation allows for rapid establishment of vegetation due to soil fertility. Extensive agronomic testing at Univ. of Illinois has confirmed that most lake and river sediment has excellent agricultural potential. The options for Beneficial Reuse vary depending on the type of sediment dredged ….


A restored lake can provide increased water storage capacity, in addition to enhanced recreational opportunities and improved habitat.