Kalamazoo Harbor Master Plan
Technical Report

August 14, 2007

KALAMAZOO HARBOR MASTER PLAN
TECHNICAL REPORT

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INTRODUCTION

The communities that surround the Kalamazoo Harbor (city of Saugatuck, city of Douglas and Saugatuck Township) recognize the need to work together to assess the conditions of the harbor and find a common vision for the future. The harbor serves many functions and is a natural, cultural, and economic resource; in short, it is the lifeblood of the community.

The harbor, which includes the Kalamazoo River, Kalamazoo Lake and Douglas Harbor, extends from the mouth of the river to the I-196 bridge. To assist in the process of preparing the Kalamazoo Harbor Master Plan (Master Plan), the communities retained JJR, a firm of planners, environmental scientists and engineers that have extensive experience in the planning and design of waterfront communities and facilities. To help evaluate the condition of the harbor's sediments, the master planning team included the firms of RMT, Inc., for their expertise in environmental remediation and management of river sediments, and JJR, LLC.

The primary mission of the Master Plan is to:

1. Assess the facilities, uses and natural features of the harbor, and determine needs and opportunities for improvement, expansion and preservation.
2. Set parameters for harbor use and development to balance competing and complementary interests.
3. Understand the need to maintain the function of the harbor, and identify potential sources and mechanisms for funding maintenance and construction.
4. Understand the character of potential dredge material, determine a strategy for disposal, and identify a site(s) for disposal.

This report will summarize the master planning process and the findings of the team.

MASTER PLANNING PROCESS

To accomplish the Master Plan mission, the community and consultants established a planning process that encouraged public participation and input. The process followed by the master planning team included the following steps:

1. Meetings and Analysis
   - Attend a kickoff meeting with the Harbor Committee and local residents.
   - Conduct a site review and analysis of existing facilities and harbor conditions.
   - Perform a dredge review and analysis to outline potential disposal options.
   - Conduct workshop #1 with the Harbor Committee, local residents, business owners, and representatives of regulatory and resource agencies.

2. Develop Plan
   - Prepare preliminary harbor recommendations regarding harbor use and facilities.
   - Prepare preliminary dredge recommendations for limits of dredging, management of future sedimentation, and disposal of dredged sediments.
   - Conduct workshop #2 with the Harbor Committee, local residents, business owners, and representatives of regulatory and resource agencies.

3. Open House and final Master Plan
   - Conduct an open house with the local community to present the Master Plan.
   - Finalize the plan based on input from the open house, and from regulatory and resource agencies.

PHASE ONE: HARBOR ANALYSIS

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PHASE ONE: HARBOR ANALYSIS

KICKOFF MEETING

A project kickoff meeting was held on November 14, 2006, at Saugatuck City Hall. The purpose of the meeting was to define the project goals and gather pertinent data for the Master Plan. The meeting focused on four main points:

1. Understand how the harbor is currently utilized.
2. Review past studies and maintenance dredging efforts.
3. Discuss environmental issues that may impact harbor development.
4. Define the overall goals of this planning effort (i.e., What does success look like?).

The following summarizes the topics discussed and the community input gathered from the kickoff meeting.

Harbor Use

1. Who are typical users of the harbor?
   The users of the harbor can be categorized into the following groups:
   - Ten percent of users are transient day users who utilize local boat launches.
   - Thirty-five to forty percent of users are recreational visitors based in other harbors. Some stay as overnight transient visitors.
   - Fifty percent of the users are moored in the harbor at marinas or condominium/home-based docks.

   The harbor attracts a diversity of users, from jet skiers to kayakers to fishermen to large power boaters. The community believes that the diverse use of the harbor contributes to the economic viability of the harbor communities by creating more interest and energy at the waterfront.

   There are several commercial businesses that rely on the harbor for their livelihood including charter/tour boats, boat rentals and marine contractors.

   The harbor hosts several annual events including a fishing tournament, Venetian Festival/boat parade, July 4th fireworks, river fire event, and in the past, visits from Great Lakes cruise ships. The Saugatuck Chain Ferry connects downtown Saugatuck with the Saugatuck Peninsula and is a main attraction to harbor visitors.

   The natural environment is also considered an important “user” of the harbor area.

The harbor is used as a harbor of refuge and/or overnight transient harbor. Most of this use is boat anchoring in open water southwest of downtown Saugatuck; however, since there is a limited dinghy dock and no dinghy service, the harbor is not very welcoming. The volume of transient boaters does not appear adequate to support a dinghy service.

2. Where are key bottlenecks in the harbor/river?
   The following conflicts and problems of use were noted by community members:
   - There is limited maneuver room in the river and lake due to shallows.
   - Visitors lack knowledge of the shallow areas and Saugatuck Chain Ferry.
   - The Saugatuck Chain Ferry causes back-ups, but they are not unmanageable.
   - The "No Wake Zone" at the river narrows north of Saugatuck; the definition of "no wake" is often in question.

   The Allegan County Sheriff's Office and U.S. Coast Guard both maintain a positive relationship with the community, and their frequent presence in the harbor is welcomed.

3. Is there capacity and demand for additional users?
   Despite the bottlenecks noted above, the community believes that there is additional capacity in the harbor to expand facilities and use. The river channel handles traffic reasonably well, even at peak flow times. Removing the shallow water areas would significantly contribute to improving the function of the harbor. The community strongly believes that if the harbor had more usable lake area and more predictable water depths, the demand for harbor facilities would increase dramatically.

Harbor Facilities

1. Identify key facilities in the harbor.
   The public and private marinas, as well as personal boat docks, are essential elements of the harbor and adjacent communities. Tower Marine, as the only large full-service marina, is significantly important to the local economy.

   The harbor has three public boat launch facilities for power boats: a single-lane launch in downtown Saugatuck with no dedicated parking; a single-lane launch in Douglas with no dedicated parking; and a four-lane launch at Schultz Park with approximately 40 parking spaces. A fourth boat launch exists at the east end of Center Street in Douglas that provides access for canoes and kayaks only.

   Two publicly accessible fueling docks exist near downtown Saugatuck. Pump-out facilities are provided at most of the private marinas. These private facilities for fuel and pump-out appear to be adequately serving the boating public. Concern was expressed regarding potential impacts of these private facilities going out of business.

   There are no public shower and washroom facilities to serve transient boaters in the harbor.

2. What are the impressions of harbor facilities users?
   Harbor visitors are frustrated by the presence of shallow water zones covering a great deal of the harbor water. Local people report complaints from visitors and anecdotal evidence that the lack of open water has dissuaded many boaters from coming into the harbor for fear of getting stuck.

3. Are existing public boating facilities well located?
   The best boat launch in the harbor is located at the far east end in Schultz Park. Unfortunately, this launch is furthest from Lake Michigan, and shallow water depths could inhibit its use.

Dredging Issues

1. What is the frequency and location of past dredging practices?
   The U.S. Army Corp of Engineers (USACE) dredges the mouth of the river on a three year cycle that is not adequate according to reports by local boaters. Tower Marine performs maintenance dredging on a regular basis to provide access from the river channel to the marina. Some limited dredging has occurred in recent years related to boat launch construction and private docks.

2. What funding mechanisms have been considered or used?
   The USACE's efforts are funded out of the federal harbor budget, and Tower Marine pays for its own dredging. No larger scale dredging or funding efforts have been pursued in recent years.

3. Where have dredge spoils been disposed of to date?
   The USACE dredges sand and typically blows the material back onto the beach for beach nourishment. Tower Marine has its own upland disposal cells on the south side of Kalamazoo Lake.

4. Have the sediments been characterized for contaminants of concern and other parameters for disposal purposes?
   Limited chemical data has been provided to the master planning team. This limited data indicates that the sediments contain polychlorinated biphenyls (PCBs).

5. Where are problem areas for sediment deposition?
   Deposition is a problem on both sides of the river channel in Kalamazoo Lake and at the western edge of Douglas Harbor.

6. Have any disposal site candidates been identified?
   The City of Saugatuck owns property that was purchased years ago for an airport that was never built. This site should be considered as a disposal site.

Other Issues (Identified by the Community)

- Piers at the mouth of the river are in poor condition and will likely need significant repair.
- Long term siltation – what happens if no measures are taken?
- If there is a dead zone in the harbor, the harbor will die. Since the harbor is the lifeblood of the community, it must remain functioning.
- Ambassadorship is an issue for the entire community. How do we collectively sell experience to visitors?
- Long term ownership of marinas needs to be resolved to prevent sales for condominium development.
- Large condominium developments need to be limited to preserve the great open views that now exist in both communities.
- Establishment of a harbor authority needs to be explored to manage and maintain harbor facilities and uses.

The Definition of Project Success

To conclude the kickoff meeting, the attendees were asked what their vision of a successful Master Plan is. The responses are recorded below in no particular order.

- A harbor that functions (i.e., has deeper water)
- Diverse users (i.e., room for everyone)
- Marina services with hours that are adequate and stable
- Full use without being over capacity
- Room for wildlife, fisheries and the environment to thrive
- Preservation of old harbor lands (i.e., Saugatuck Peninsula)
- Public awareness and knowledge of need for improving the harbor, and of the harbor's importance in the preservation of the community
- Saugatuck Township involvement in the effort to preserve the harbor
- Working boat ramps and public access
- Visual access to the harbor (do not overbuild condominiums and block views)
- A return of cruise ships to the harbor
- Walking access to water's edge
- Existing marinas kept viable (Butler, Saugatuck Yacht, etc.)
- Transition to condominiums managed
- Port Authority or other mechanism created to maintain harbor
- The report for this effort is not kept on a shelf

HARBOR AND DREDGE ANALYSIS

Following the kickoff meeting, the master planning team performed a review of site conditions, and researched existing data relative to the river flow conditions, history and presence of contaminants.

Harbor Analysis Plan

A Harbor Analysis Plan (refer to Appendix A, Diagram A) was prepared to summarize the conditions of the harbor and the facilities within the harbor. The results are categorized and summarized as follows:

1. Bathymetry
   A bathymetric survey was prepared based on an actual survey of water depths in November 2006 (refer to Diagram B). A survey crew of two mapped Kalamazoo Lake and Douglas Harbor, and summarized their findings on a survey map. The survey demonstrates that significant portions of the harbor are less than 2 feet deep, even though this shallow water is not evident from a visual survey of the harbor. Approximately 27% of the middle of Kalamazoo Lake is less than 2 feet deep, and the shallow zones are located to either side of the river channel, which is the area most likely to be used for recreational boating.

2. Harbor Use Areas
   The Harbor Analysis Plan highlights use areas within the harbor, including travel lanes, marina facilities and informal anchorage areas in Kalamazoo Lake. The plan demonstrates that when these three uses are considered along with the locations of the shallow water areas, there is very little remaining open water within the harbor available for other recreational uses.

3. Wetland Systems and Public Lands
   The Harbor Analysis Plan highlights the locations of regulated wetland systems as mapped by JJR staff biologists. There are significant wetland systems within the harbor, particularly in the Douglas Harbor basin. Land with public ownership is also highlighted on the map as assets to the harbor community. Of particular note are the public street ends that terminate at the water and provide important points of water access.

4. Launch and Marina Facilities
   A review of launch facilities reveals that none of the harbor's public power boat launches have adequate parking for the number of launch lanes. The only launch that provides parking is at Schultz Park, which has approximately 40 parking spaces. Using a standard of 30 spaces per lane, the park should have at least 120 parking spaces. The Harbor Analysis Plan notes the location of the kayak launch at Wade's Bayou Memorial Park in Douglas.

   The plan documents the number of marina slips within the harbor and groups the slips by size. Major marinas are listed on the plan.

Harbor Environmental Concerns

Given the shallow conditions within the harbor, removal of accumulated sediments through dredging will be required to maintain and restore the harbor. As such, it is critical to understand the chemical and physical condition of the sediments, and the status of the Superfund cleanup.

The Master Plan study area lies within the U.S. Environmental Protection Agency (EPA) Kalamazoo River Superfund site designation, which begins well upstream of Plainwell and extends to Lake Michigan. The funding and timing for cleanup of the river and harbor through the Superfund process is uncertain. Facilitated discussions are ongoing between the EPA, the Principal Responsible Parties and other stakeholders. It appears that an agreement to clean up the river from the Allegan Dam eastward is forthcoming. The EPA and the Principal Responsible Parties have not committed to fund work in the Kalamazoo Harbor project area.

The sediments in the harbor contain PCBs and other contaminants based on the data provided by the Harbor Committee. The master planning team evaluated this and other publicly available sediment data (chemistry and grain-size information) to understand more fully the extent of the PCB impacts.

Based on the data, federal solid and hazardous waste regulations will require that the sediment, if removed from the harbor, must be managed as a "special" solid waste. The material is not considered a TSCA (toxic substance (or hazardous waste) based on the available data.

Since the harbor sediments do contain contaminants, any dredge spoils will need to be properly managed, according to state and federal regulations. Disposal options for the sediments are discussed in later sections of this report.

River Flow and Sedimentation Characteristics

JJR reviewed the river hydraulic model prepared by the Federal Emergency Management Agency (FEMA), U.S. Geological Survey (USGS) river gauge data and other available sources for river flow data. Peak storm flows and normal flow rates were evaluated to better understand the dynamic flow of the river through normal and peak flow periods.

The median flow rate of the Kalamazoo River is approximately 1,600 cubic feet per second. At current water levels, the waterway opening under the Blue Star bridge is approximately 2,400 square feet. This calculates to a mean velocity of approximately 0.7 feet per second. At the same location, the FEMA 100-year flood flow is 12,400 cubic feet per second with a waterway area of 4,200 square feet and a mean velocity of 3 feet per second.

River velocities as low as 1.0 foot per second can be self-scouring and carry sediments within the flow. At slower rates, sediments can separate from river flow and settle on the river bottom. The two bridges within the study area have waterway openings that provide scouring velocities for flows above the mean river flow rate. As the river passes through these areas of restriction, it widens

considerably into Douglas Lake and Kalamazoo Lake. As the river cross-section gets larger, the velocity of the flow slows considerably, resulting in sedimentation of the open water areas.

History of Sediment Deposition and Dredging

Historic photographs of the harbor, dredging records and historic bathymetric surveys of the river have been studied to determine the nature and extent of the sedimentation problem in the harbor over the last 135 years.

Although the sedimentation process is a naturally occurring one, man's use of the land and river have modified its shape, and the pattern and rate of sedimentation. In the late nineteenth and early twentieth century, the use of the river to transport timber and the clearing of land resulted in the fairly rapid sedimentation of the river, which necessitated a regular program of large-scale dredging. Limits of past dredging activity generally show that Kalamazoo Lake was maintained to a navigable depth across the entire lake, while the Douglas Harbor was primarily dredged to allow use and access to the western portions of the harbor. The last comprehensive dredging of the harbor area was in the 1930s, although regular maintenance dredging has been ongoing since that effort.

Shifts in land use in the last 70 years away from timber production and toward agriculture have resulted in de-acceleration of the rate of sedimentation in the harbor, although the process continues to occur.

Analysis of Recent Sedimentation Trends

An analysis of sedimentation patterns from 1986 to 2006 was conducted as part of this study, based on USACE soundings, harbor navigation maps and the recent bathymetric survey completed by JJR. This analysis concluded that:

1. Over the past 20 years, sedimentation has proceeded at an average rate of approximately 36,000 cubic yards per year. It should be noted that this rate is highly variable from year to year and highly dependant of peak river flows.
2. Douglas Harbor is effectively full of sediments, and Kalamazoo Lake is steadily filling from east to west.
3. Ongoing maintenance dredging by Tower Marine has kept sedimentation at bay at the west end of Kalamazoo Lake, but the trend is for deposition areas to encroach westward at a rate that the current maintenance work cannot keep pace with.
4. Without benefit of a comprehensive dredging approach, the shallow water areas will continue to grow.

Harbor of the Future

A series of four alternative future scenarios were prepared to illustrate distinctly different visions for the future of the harbor (refer to Appendix A, Diagrams C and D). The first plan assumed that basic maintenance dredging would occur as necessary to maintain access to existing facilities, but no more. In this case, the sedimentation process would proceed largely unchecked, and would result in an even greater area of the harbor becoming "islands" of shallow water or mud flats.

The second alternative assumes the dredging of all or most of the harbor, and the creation of a "sediment trap" in Douglas Harbor that would collect the bulk of the sediment for later dredging and disposal.

The third and fourth alternatives show stone structures within the harbor that would concentrate the flow of the river in a channel, and thereby increase flow velocity and reduce future sedimentation in the harbor. The stone structures could also act to contain sediments that would be stored within the harbor in Confined Disposal Facilities (CDF). The plans were different with regard to the location of CDFs, river channel or active-use areas.

The four alternatives were presented as "what if" scenarios, and no conclusions or recommendations were presented.

WORKSHOP #1

JJR conducted a public workshop to present the findings discussed above and receive public input. The workshop was held at Saugatuck High School on December 14, 2006. Attendees included members of the Harbor Committee, residents, business owners, and representatives from the Michigan Department of Environmental Quality (MDEQ) Land and Water Management Division and Michigan Department of Natural Resources (MDNR) Fisheries Division.

Federal and state regulatory and resource experts were invited to attend the workshop in order to provide input into the process. These professionals were not invited to provide definitive opinions or findings on the ideas presented, but to make them aware of the community's progress in defining a vision for the harbor and to provide them an opportunity to offer constructive input.

The most fruitful part of the workshop was the discussion regarding the four alternative future scenarios, which ranged from a minimal response to a dredge and channel approach. Key points learned from the discussion include:

1. The MDNR Fisheries Division is more receptive to dredging activity west of the Blue Star Highway, and may consider limited dredging to the east along the Douglas shore. Otherwise, they would support leaving Douglas Harbor untouched as shallow water fisheries habitat and would like to see some area of Kalamazoo Lake remain as shallow water.

2. Creating an in-basin CDF is unlikely to get MDEQ support, because it will fill existing lake bottom and shallow water habitat. While it could be argued that without dredging the lake bottom will be lost due to continued sedimentation, any proposal to fill the lake bottom will likely face significant scrutiny during the permitting process.
3. Channeling the river with stone structures raised the curiosity of the regulators and resource experts, but since it's not an approach with a substantial track record in Michigan, they were skeptical as to its feasibility.

Following the public workshop, the planning work entered the next phase in which harbor improvements and sedimentation management approaches were proposed.

PHASE TWO: PLAN RECOMMENDATIONS AND CONSENSUS BUILDING

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The purpose of Phase Two was to utilize the data and analysis of Phase One, and create a set of recommendations for the future improvement and development of the Kalamazoo Harbor. These recommendations are divided into two primary categories: Harbor Improvement Plan and Sediment Management Plan, and are summarized below.

HARBOR IMPROVEMENT PLAN

Review of Marina and Boating Market

The Master Plan provides recommendations for the expansion of marina facilities within the harbor. These recommendations are made, in part, based on the market support for improved facilities in southwest Michigan as well as on the specific physical characteristics of the harbor. While the master planning study does not include a market analysis of Kalamazoo Harbor, the following observations can be drawn from recent market studies that evaluated marina services along southern Lake Michigan, and from the professional experiences of the master planning team and community members.

- Participation in boating grew 47% from 1994-2004, a national trend that is reflected in the Great Lakes.
- Demand for boating products is projected to grow at a rate of 6% annually.
- Power boats are the largest segment of the boating population, representing 80% of boat equipment sales.
- The growth in demand for higher end, large boats (i.e., boats that require slips) is outstripping the lower end due to demographics of baby boomers. This demographic group is entering the prime age bracket for boat ownership and wealth creation, and is driving the demand for large boats.
- Records of boat registrations from 1996-2002 indicate that the greatest growth in boat registration as a percentage of existing boats is for those over 26 feet in length.
- Smaller community harbors have farther market reach than larger harbors (which tend to attract nearby boaters).
- Wisconsin has captured the largest portion of southern Lake Michigan growth due to the rapid development of harbor dockage facilities over the last 20 years, including substantial new dock facilities in Racine, Milwaukee and Sheboygan. These facilities serve the boating public from Chicago as well as local markets, despite their distance from Chicago.
- There has been limited growth in southwest Michigan boating facilities, due in large part to the physical limitations of local harbors.
- Chicago has limited growth potential for docks, and demand is projected to outstrip supply by 3,000 slips between the years 2005 and 2015.
- Lack of berths in a given market can act as a constraint to boat ownership, making it appear that demand for slips is lower than it actually is.

- The physical limitation of Kalamazoo Harbor in the form of extensive and growing shallow water areas has artificially constrained the demand for, and development of, new marina facilities.
- The number of marina slips in the harbor has only grown by about 5% over the last 10 years, significantly below the actual growth in boat ownership.

Boat registration trends in Michigan over the last five years have reflected many of the trends listed above (e.g., the growth in large boat registrations vs. small), but overall, the growth in boat registrations has lagged behind national and Great Lakes trends noted in other studies. Kalamazoo Harbor's proximity to the Chicago market, which has grown more aggressively than the Michigan market, will influence the market projections above the expectations of the Michigan-only market. Given the long term growth in boat ownership, a lack of competing opportunities in the region, the harbor's proximity to Chicago and southwest Michigan population centers, and the anticipated dredging of the harbor, allowing for a 50% growth in marina facilities over the next 10 to 20 years would be a reasonable projection to meet the market's needs.

It is estimated that the waterfront destination of Kalamazoo Harbor attracts from 1.5 to 2 million visitors annually. The impact of the failure to save Kalamazoo Harbor to local retailers, hoteliers, and restaurateurs, as well as to the state of Michigan is enormous. On the positive side, the potential to dredge the harbor and modestly expand water-based recreation facilities could provide a tremendous boost to the local and state economies that are currently struggling.

Potential Expansion and Improvement of Harbor Facilities

The following recommendations for harbor facilities are outlined on Diagram E: Harbor Improvement Plan (Appendix A), and include:

1. Identify Areas for Potential Private and Public Marina Facilities
   Given the long term demand for new boating facilities in southwest Michigan, the Kalamazoo Harbor presents a significant opportunity to meet these needs. At the same time, the community recognizes that the harbor, particularly Kalamazoo Lake, must support a range of uses and environments if the harbor is to thrive.

   Potential areas of expanding harbor facilities have been identified on the Harbor Improvement Plan, based on the following conditions:
   - Where existing natural and built features create a "shadow area" within the harbor that has limited value for open recreational use.
   - Where existing upland exists adjacent to the harbor that can provide room for land-based marina support facilities.
   - Where there is proximity to downtown Douglas and Saugatuck so that boating facilities can act as a direct economic stimulus to these commercial areas.
   - Where negative impacts to the natural environment would be minimized.

The Harbor Improvement Plan identifies zones within the harbor as potential areas for facilities expansion, while limiting the overall encroachment into the open waters of the harbor. Areas suitable for the expansion of marina facilities have been categorized into four types:

a. Retrofit and Expansion – Areas with existing docks and space for expansion
b. New Facilities and Marinas – Where limited or no docks currently exist
c. Limited Expansion – Where expansion is suitable, but demand restricted
d. Individual Docks – For riparian owners, typically at individual homes

Once the areas for expansion were identified, they were measured, and a marina planning standard of 20 slips per acre was applied to understand the approximate capacity of each area. Key areas for facility expansion include the area south of downtown Saugatuck that could be used for a small public marina and expansion of private facilities, the area west and east of Tower Marine that is suited for private marina facilities, and the area east and north of downtown Douglas that could include the renovation of an existing marina and the development of a public marina.

Both of the proposed marina facilities noted as potentially publicly owned (one each near Saugatuck and Douglas) are likely to be transient in nature and developed to accommodate day users and, in the future, overnight stays. These areas are more suited to transient use, since neither has sufficient land to support boater parking, but are adjacent to public parks that could be the site of modest boater bath facilities. Such improvements could be made in phases as funds become available, and specific needs are identified. The first phase in both cases should include a dinghy dock. A second phase could include dock slips for day visitors. A third phase could then include expanded docking for overnight or extended transient visitors, along with permanent boater shower and bath facilities. The current master plan for Wade's Bayou Memorial Park calls for bathroom facilities in this marina expansion area, and these bathrooms could be designed for potential expansion to include boater facilities in the future. Should a full-service transient marina be developed at Coughlin Park, the City of Saugatuck should consider working cooperatively with Sergeant Marina to share bathrooms and boater facilities, given its proximity to the park.

If boat slips are built within the marina expansion areas to the extent they are delineated on the Harbor Improvement Plan, there could be approximately 500-600 slips added to the harbor. This represents a 50% growth in boat slips that could occur over a 10- to 20-year timeframe given current market growth expectations.

Currently, plans are being prepared for consideration by Saugatuck Township that will outline a development and land use scenario for the McClendon parcel located in the northern area of the harbor. The plans may include boater facilities outside of the USACE Project Limits and within the development site. Given the site's location adjacent to the mouth of the river and USACE channel, it is unlikely that such boater facilities, if proposed, will affect the use and maintenance of the harbor area.

The Harbor Improvement Plan also delineates two mooring areas within the harbor for transient boaters. These two areas would replace the informal mooring area that is currently used within the harbor. The current location has adequate water depths to accommodate sail craft, but is located within two identified travel corridors within the harbor. As a temporary measure, the current mooring area needs to be marked with buoys. Once dredging occurs, the existing mooring area needs to be moved to the proposed locations and re-marked.

2. Establish a Pier Head Line

   A pier head line that restricts the overdevelopment of boating facilities should be established through the harbor. The Harbor Improvement Plan delineates the recommended line, and it follows the edge of the areas identified for future harbor expansions. Should the local communities adopt the pier head line as part of their respective zoning ordinances, the line would become the maximum limit of dock expansion allowed in the harbor.

   The City of Douglas has recently adopted a pier head line that varies based on the use of the waterfront. The line recommended as part of this study is consistent with the City of Douglas guidelines.

3. Modify Public Boat Launch Facilities

   The Harbor Analysis Plan identifies a deficiency in parking at all three of the boat launches used for power boats. The plan recommends that the parking facility at Schultz Park be expanded to accommodate an additional 40 to 80 parking spaces in the area south and west of the existing lot. The actual location and design of the lot expansion will require additional site planning, and will need to balance the demands of multiple park user groups while considering the value of the existing wooded areas on site. The Schultz Park launch is the primary launch for the harbor in terms of number of launch lanes, but the other launches also serve a vital purpose for the harbor.

   While the Spears Street ramp in downtown Saugatuck does not have any dedicated parking, there is a shuttle program in place that encourages use of the parking lot at the high school. Use of the shuttle has been growing in recent years as boaters are becoming aware of the program. In addition to local recreational boaters, many local marine related businesses rely on the ramp for water access. In addition, the launch helps facilitate emergency response and special event needs. The single-lane ramp is in poor condition, and the City of Saugatuck is currently pursuing funding to improve the facility.

   The single-lane launch at the end of Union Street in Douglas primarily serves local boaters with little or no need for parking. As private land development occurs on adjacent properties, there may be less area available for parking, which could diminish the ramp's value. The community should work with local property owners to determine if cooperative arrangements can be made to maintain parking at this facility, or seek the purchase of currently vacant property for long term parking needs. The site has adequate width to expand the ramp to two lanes, and given the demand for local water access, such an expansion should be pursued.

An improved kayak launch is included in the master plan for Wade's Bayou Memorial Park. This ramp is in an excellent location to take advantage of the growing demand for kayak boating, as it has great access to the natural, braided channels of the Kalamazoo River immediately upstream.

4. Designate Key Environmental Preservation Areas

   The Harbor Improvement Plan identifies key areas within the harbor in which the value of the natural systems outweighs the potential demand for new facilities. These areas are found primarily within Douglas Harbor and are privately held.

   The plan encourages maintaining a natural river edge where it currently exists, particularly in Douglas Harbor, and between downtown Saugatuck and the mouth of the river. The natural edge provides important wildlife and fisheries habitat, and helps filter stormwater before it discharges into the river.

   Regulated and otherwise valuable "green" resources of the harbor are identified on the Harbor Improvement Plan as either "Preservation Area" or "Maintain Naturalized Edge." Methods for implementing these recommendations include wetland/waterfront protection ordinances at the municipal level, building and paving setback requirements, covenants and deed restrictions for new developments, donation of land to local conservancies, conservation easements, and purchase of property development rights.

   All new upland development within the harbor basin should be required by ordinance to treat stormwater prior to release into the river or municipal system. This approach would encourage filtering of sediments and contaminants, and promote stormwater infiltration. Reconstruction of existing streets and parking lots in the basin should also include an update of stormwater management. Stormwater management techniques that could be considered include infiltration basins (e.g., rain gardens), vegetated drainage swales and oil/grit separators incorporated into stormwater structures.

5. Stabilize the Breakwaters at the Mouth of the Harbor

   Current low water conditions and ongoing wear and tear have contributed to a degradation of the condition of the breakwater piers that extend into Lake Michigan at the mouth of the river. A thorough analysis of their condition, including an underwater survey, should be conducted to fully assess the need for maintenance and/or reconstruction, and to determine potential costs and funding sources.

6. Improve Public Access to the Water from the Land Side

   Visual and physical access to the waterfront by non-boating visitors is critical to the success of the waterfront communities. While this study focuses on the future of the river itself, the need for shore area improvements must also be noted.

A number of land side improvements have been proposed in other sections of this report for local waterfront parks. These improvements, such as new boater/bathroom facilities at Coughlin Park, are linked directly to the use of the water. In addition to these types of improvements, there are opportunities to enhance other points of access such as public street ends.

In downtown Saugatuck, there are a number of street ends that terminate at the water. At the water's edge, these areas provide space for dockage, a boat launch at Spears Street, and the chain ferry at Mary Street. These water-based uses provide an important function and a revenue source for the City of Saugatuck, and add to the diverse activity of the waterfront. On the land side, the street ends provide space for parking, green space parks and pedestrian overlooks of the water. The Master Plan advocates the continuation of these existing uses, but with physical improvements to enhance their appearance and accessibility. The street ends that include parking could be improved to allow more landscaping and a more pedestrian inviting design, similar to the street end at Mason Street. Special street paving could allow automobile parking while giving a clear indication that the pedestrian is also welcome, particularly at the water's edge. The street ends that are green space should remain as such, but some, including the one at Lucy Street, are beginning to deteriorate and should be renovated.

The street ends outside of downtown Saugatuck should provide public access and be designed to reflect the more residential character of the adjacent lands. Parking should be provided where feasible and where demand exists, but not in a way that paves the right-of-way from edge to edge. Low-level activities could be encouraged at these street ends, such as shore fishing and bird watching.

As a matter of long term policy, the City of Saugatuck has leased the boat slips that exist on public lands and street ends to the adjacent land owners. There are a number of reasons why this policy supports the overall interests of the community, including (a) the protection of privacy and quiet enjoyment of the adjacent owners, (b) the provision of necessary support to the success of adjacent businesses that use them, (c) the increased ability of the City of Saugatuck to manage the use of the facilities, and (d) the increased "eyes on the street" surveillance of the facilities by adjacent owners who have a direct interest. In addition, in downtown Saugatuck, public access agreements along private waterfront property have been provided in exchange for the lease of street ends.

In addition to street ends and parks, the local community would be well served to work with private property owners and the USACE to provide safe access to at least one of the breakwaters at the mouth of the harbor.

The next critical step in land side improvements will be to connect the public access points together as a string of experiences that can be accessed by pedestrians and cyclists. This conscious effort to establish a walking route around the harbor would connect the communities to each other and to the many public assets that exist. Many times these connections are as simple as adding sidewalks to select streets and an easy to read sign system.

SEDIMENT MANAGEMENT PLAN

To support the existing use of the harbor and realize the opportunities to improve the harbor, the management and removal of sediments is critical. Without a plan to dredge the harbor, sedimentation will continue to expand the existing unusable portions of the harbor and choke off the economic vitality of Saugatuck and Douglas.

Sediment Disposal Options

A technical report detailing the characterization of the sediments, disposal options, costs and funding opportunities was prepared by RMT (refer to appendices). The results of this work are summarized here.

The sediments in the harbor contain contaminants that are the result of pollution that occurred at the paper mill previously located upstream in Plainwell. The primary contaminant of concern is PCB, and sediment samples taken as part of previous studies indicate elevated levels of PCB in the Kalamazoo Harbor sediments. The levels of PCB in the sediment are high enough to characterize the sediments as "Special" materials, but below the levels required to designate the material as "Hazardous."

The physical properties of the sediments can also be estimated from the previous studies. About half of the sediments can be categorized as silts and half as fine sands. The silts are more likely to hold the PCB contaminants than the fine sands.

Disposal options for any dredged sediments include:

1. Upland Disposal on Non-Riparian Property – This property could include the City of Saugatuck-owned parcels known as the "airport" site, the adjacent lands previously utilized as a landfill, the adjacent lands owned by the sewer authority, or other upland lands within a reasonable trucking distance of the site (approximately 15 miles). If disposal at the airport site is determined to be the best solution, the design of the fill should consider the potential for future use of the land (e.g., recreation, heliport, etc.).

2. Upland Licensed Landfills – Two of these landfills have been identified as suitable for this material.

3. In-Water CDF – The CDF approach was discussed at some length at workshop #1, and the resource and regulatory officials in attendance did not support this approach due to the potential loss of habitat and related impacts.

   The first option is the most likely solution for disposal, based on the anticipated levels of contamination and the lower costs as compared to landfill disposal.

Alternative strategies should be considered for the handling of the sediments to reduce project costs. These strategies include:

- Separating contaminated silts from clean fine sands. This approach could reduce the amount of material that requires special storage and make the remaining fill sand available for productive use in construction (e.g., as fill at city parks). Additional data on the sediment profile and contamination levels will be required before this analysis can occur.
- Pumping material to the airport site rather than trucking. A preliminary analysis of the costs of this approach indicates that there may be little or no savings; however, the investment in developing a dredge pipe system may be beneficial in the long term given the likelihood of phasing the dredge activity, and this option should remain under consideration.

Sediment Management Alternative Plans

Two alternative plans for dredging and sediment management have been prepared for consideration.

Alternative One (refer to Appendix A, Diagram F) proposes to dredge out a river channel up to the I-196 bridge as a public project, while leaving the dredging required to access the river channel as a responsibility of the local marina and property owners. Also proposed in this alternative is a set of linear stone structures that could channel the river flow and reduce the future deposition of sediments. This alternative would require the dredging of 350,000 cubic yards of sediments and the installation of 6,600 linear feet of stone structures. Key characteristics of this alternative include:

- Provides no open water recreation opportunities or anchorage area.
- Structures inhibit open use of water.
- Sedimentation will continue, but less than without structures.
- Structures may result in increased sedimentation at the “Cove” and mouth of the river.
- INITIAL COST……$20-$30 MILLION.
- Payback period for structures – 15-30 years.

Alternative Two (refer to Appendix A, Diagram G) proposes a more comprehensive dredging program to open up more recreational use of Kalamazoo Lake and provide boater access to the Douglas Harbor waterfront. This plan reflects the historic limits of dredging that has occurred in the harbor over the past 140 years. This alternative would result in the dredging of about 1,000,000 cubic yards of material. Private dredging to gain access to the public dredging area is assumed. Key characteristics of this alternative include:

- Alters the disposal site to a greater degree to allow 1,000,000 cubic yards of storage.
- More substantial recreational use of the public waters.
- More incentive for private development, day use of the harbor and economic stimulus for the local economy.
- INITIAL COST……$35-$45 MILLION.
- Dredging could be completed in phases.

Both alternatives assume that a program for ongoing maintenance dredging will be required. Sedimentation is a naturally occurring process, and it is assumed that the rate of sedimentation experienced over the last 20 years will continue. Alternative One will limit sedimentation, but without the benefit of a comprehensive sedimentation model, the effectiveness of the channeling structures is difficult to predict. The river's median flow rate has a velocity that is unable to stop the deposition of sediments in the river channel, even with the channelization of the river as proposed in Alternative One. Removal of the sediments would be dependant on the increase in velocity accompanying storm events, which are infrequent and unpredictable. Based on the evidence known, we estimate, conceptually, that the rate of sedimentation would be cut in half if the river channel structures were installed. The potential developments of this property will require that the community identify another property for sediment staging or opportunities for pumping sediments directly to the disposal site east of I-196.

Based on this analysis of the two alternatives and community input, **the preferred plan is Alternative Two.**

Both alternatives anticipate the need for a lakeshore staging area for sediment management. The plans identify an area of about 14 acres for this purpose, in and around the area currently used by Tower Marine for sediment dewatering and storage. Although the 14-acre site is significantly smaller than a desirable 40-acre site that could maximize the efficiency of the operation, it is believed to be large enough to work. The use of this site for sediment management may be necessary over the long term, but the community should look at alternatives in the future that could return the land to a higher and better use, and return more tax dollars to the local community.

Many dredging scenarios and sediment management techniques were developed and evaluated as part of the planning process. The Sediment Management Plan that resulted from this process considers costs, market demand for new facilities, the current and projected use of the harbor, fisheries habitat, and the role the harbor plays in the economic viability of the surrounding communities and the state of Michigan.

Based on an analysis of the costs of dredging, use of the harbor and potential market demand for new facilities, the Sediment Management Plan indicates large areas of Douglas Harbor and some areas of Kalamazoo Lake that may not be dredged to navigable depths, and will be left undisturbed in the short term. As sedimentation continues in the harbor, and if low water levels persist, there is a possibility that islands may form within the harbor. The community may need to decide in the future if limited dredging should be advocated in these areas to maintain open, albeit shallow, water. Such a proposal will need to take into account the concerns expressed by the MDNR regarding the preservation of fisheries habitat. Dredging to maintain open water would be consistent with the community's desire for maintaining open water in the harbor and the historic harbor maintenance patterns.

Dredge Phasing

Even with the potential to reduce costs below the estimates described above through separation of fine sands and silts, the high costs of dredging the harbor will likely dictate that the work will have to occur in phases as funds are made available. A Dredging Phasing Plan (refer to Appendix A, Diagram H) was prepared with community input and quantities of sediment removal estimated for each phase. The phases reflect the relative priority and need for dredging, and not the actual chronological order that the dredging may occur in. The community recognizes that funds may not be available to complete all of the dredging outlined on the plan, but believe that the full dredging plan must be accomplished if the harbor is to fully function as the lifeblood of the community.

Previously mentioned in this report is the idea of separating silts (which are more likely to hold contaminates) from the fine sands. The soils profile in the lake seems to indicate that the fine sands underlay the silts, such that it may be possible to excavate the upper layer of silt and leave the fine sands for a later phase of removal. In this manner, the phasing of the harbor could vary based on depth of excavation as well as geographic area. Further testing, referenced later in this report, will determine if this idea is feasible.

Dredging of the USACE Project Limits

The Master Plan assumes that the USACE will remain a part of maintaining an active, functioning harbor through regular efforts to dredge the entrance channel and river corridor within their Project Limits. Efforts of the local Lake Michigan lakeshore communities to work together to ensure the adequacy of USACE efforts and supplement this work with local dredging initiatives should be encouraged. Douglas and Saugatuck should continue to participate in this regional, cooperative coalition.

Dredging and the Natural Environment

Throughout the planning process, the MDNR Fisheries Division has consistently raised concerns over the effects of dredging on fisheries habitat, particularly related to the spawning of lake sturgeon. These concerns were expressed during the planning workshops, as referenced earlier in this report, and in a review of the final draft of this report.

In their response to the final draft, the Fisheries Division issued some general guidelines for scaling back dredging activities (refer to Appendix D). These concerns were shared with the community, and the plans included in this report reflect the community's consensus and response. The phasing of proposed dredging in Kalamazoo Lake puts a large part of the existing shallow water area as a last phase and priority for dredging, acknowledging the difficulty in funding the work and the concerns raised by the Fisheries Division. In the Douglas Lake area east of the Blue Star Highway bridge, the plan proposed dredging only along the existing river channel, which provides critical access to the existing boat launch ramps at Schultz Park, and along the shoreline adjacent to Douglas.

Following the first issue of this report, the Fisheries Division issued a more specific response as to the extent of dredging they would support within the project area. This response is included in this report in Appendix D. The primary practical difference between the Fisheries Division's plan and the plan the community supported is the dredging of the existing river channel between the Blue Star Highway bridge and the boat launch ramps at Schultz Park. This potential conflict will need to be resolved as harbor plans are refined beyond the scope of this study and specific proposals are submitted for permit consideration.

WORKSHOP #3 AND FINAL PUBLIC PRESENTATION

On January 23, 2007, a community workshop was held at Saugatuck High School to present and discuss the preliminary recommendations for harbor improvements and sediment management. Members of the Harbor Committee, the general public, and representatives of the MDEQ and MDNR attended and provided feedback to the master planning team.

Copies of the preliminary recommendations were distributed to the Harbor Committee and regulatory and resource agencies for more detailed review and comment. These comments were considered carefully and addressed in the final Master Plan as appropriate.

A final public presentation was held on April 10, 2007, to communicate to the community the final Master Plan, as recorded in this report.

MOVING FORWARD

MOVING FORWARD

For the Kalamazoo Harbor to survive as an economic, cultural and natural resource, significant effort will be required. More than anything, the success of this effort will require collaboration and cooperation between local governmental units, and county, state and federal government agencies.

POTENTIAL FUNDING SOURCES

The following potential funding sources for dredging the harbor have been identified:

1. Superfund
   Based on recent conversations with the EPA, they are close to settling with the remaining responsible parties on a plan to clean up upstream portions of the contamination in the Superfund site. While the harbor is considered part of the Superfund site, it is not part of the currently anticipated cleanup plans, based on the more significant health threats posed by the areas upstream. In Superfund projects, it is typical that the cleanup starts with the areas that most threaten public health and work towards the cleanup of less threatening areas.

   While the contaminants in Kalamazoo Harbor are not the sole reason that dredging must occur, their presence contributes significantly to the cost of removing the sediment. Should future negotiations for Superfund sponsored cleanups occur, it would seem reasonable and prudent that the local communities advocate for the responsible parties to fund the cost difference between removing and disposing of the contaminated sediments and removing them if they were uncontaminated.

2. Great Lakes Legacy Act
   The use of this funding pool is currently limited because the harbor is designated as a "Superfund" site, which in principle should be contributing to any cleanup of the harbor. One strategy being considered is to petition the United States Congress to downgrade the project area's designation from Superfund to an Area of Concern. Area of Concern is the appropriate designation for eligibility for Great Lakes Legacy Act funding. The harbor is currently listed as an Area of Concern, so any effort to change the Superfund status would need to leave the Area of Concern designation as is.

   The funding for the Great Lakes Legacy Act is drawing to a close, so the communities need to determine, through negotiations and discussions with the EPA and congressional representatives, if further Superfund actions may assist with the cleanup, or if the Superfund designation should be removed in order to pursue Great Lakes Legacy Act funding.

3. EPA Brownfield Program
   The EPA has grant programs in place to assess and clean up brownfields. The grants are typically in the $200,000 to $400,000 range, and for the needs of Kalamazoo Harbor, the most effective opportunity is to pursue a grant for assessing the harbor's contaminated sediments.

This application of the grant program is not typical, and further discussion will be necessary with the EPA to determine how to fit the harbor's needs with the grant.

4. MDNR Waterways Program Grants and MDEQ Coastal Zone Management Grants
   These grant programs have limited available funds, but could be used to fund, in part, additional engineering and environmental studies as the project moves forward.

5. State of Michigan Clean Michigan Initiative
   This program funds the study and cleanup of brownfield sites in Michigan. The grant and loan programs typically require a developer partner and are utilized for upland sites. Like the EPA Brownfield Program, the cleanup of a harbor is not a typical application of this program. This program was approved by voters of the state with a fixed limit on the funding, and the majority of the dollars are already committed to other projects.

6. Taxing and Management Mechanisms
   - Brownfield TIF District – There may be an opportunity to create a brownfield and/or other Tax Increment Financing (TIF) district that could be an effective tool for creating matching funds for larger grant opportunities, such as the Great Lakes Legacy Act program, or for generating cleanup funds for the harbor. The designation of "Brownfield" for the harbor, and structuring of a TIF district, is largely untested in a harbor setting with multiple riparian owners, and will require the consultation of finance and legal experts.
   - Port Authority – Michigan law (PA 639) enables local governments to establish Port Authorities that can, among other things, take ownership of marina facilities, manage and maintain the harbor, and levy special assessments and/or taxes. Similar to the Brownfield TIF District opportunity above, the establishment of a Port Authority is a complicated matter and will require the consultation of finance and legal experts.
   - As an interim step in addressing immediate needs, the Harbor Committee formed to start the harbor master planning process could become a Harbor Commission. In this capacity, the commission could represent and advise local municipalities and help manage the immediate maintenance dredging needs.

7. Special Assessment District
   The communities could establish a special assessment district for the harbor that could provide some of the monies necessary for dredging, under Public Act 188 of 1954.

8. New Initiatives
   Currently, Michigan's legislature is contemplating a bill that could be utilized by communities with inland lakes to establish TIF districts to finance lake improvements. If this bill were to be adopted into law, it could be a reasonable quick way to generate funds as a match for grants or for ongoing maintenance.

FUTURE EFFORTS TO SUPPORT HARBOR DREDGING

In the months ahead, the following steps will need to be taken to move toward a solution:

1. Adoption of Master Plan by Local Communities
   The Master Plan will be a more effective tool for moving forward if each of the three surrounding communities adopt the plan in support of the policies and ideals.

2. Determination of Likely First Phase of Dredging
   Once a first phase is defined, and potential funding sources determined, grant applications can be filed to fund a sediment study and engineering of the work. Depending on the funding source selected, a source of matching funds may need to be identified.

3. Characterization of Sediments to be Dredged
   The MDEQ has established guidelines for the testing of sediments in areas to be dredged. The testing program must also take into account the need to understand if silt and sand sediments can be separated for disposal and/or productive reuse.

4. Engineering of Dredge Plans
   This work should include an analysis of whether dredge spoils should be pumped to the disposal site or trucked, as well as an analysis of reducing dredging costs through separation of silts and sands.

5. Disposal Site Confirmation and Assessment
   The community will need to confirm whether or not the “airport” property is the preferred disposal site and perform a more detailed analysis and design of the disposal facility. The requirements for a dewatering and staging site within the harbor will also need to be firmed up, as well as an agreement to use the property for such purposes established.

6. Establishment of Management/Ownership/Funding Authority
   The community should consider establishing a Port Authority or TIF district under new enabling legislation. The importance of such funding mechanisms cannot be understated as a means of generating matching funds for larger grant opportunities, as well as funds for regular maintenance and management of the harbor.

7. Pursuit of Funding and Permits
   Once a source of matching funds is determined and established, the pursuit of larger grants, such as a Great Lakes Legacy Act grant (or its replacement) can begin.

Short Term Efforts

In the boating season ahead, we propose that the following actions be completed for the harbor:

- Mark travel corridor with buoys.
- Fund and install improved dinghy dock.
- Fund and install improvements to the Spears Street boat launch.
- Continue maintenance dredging.

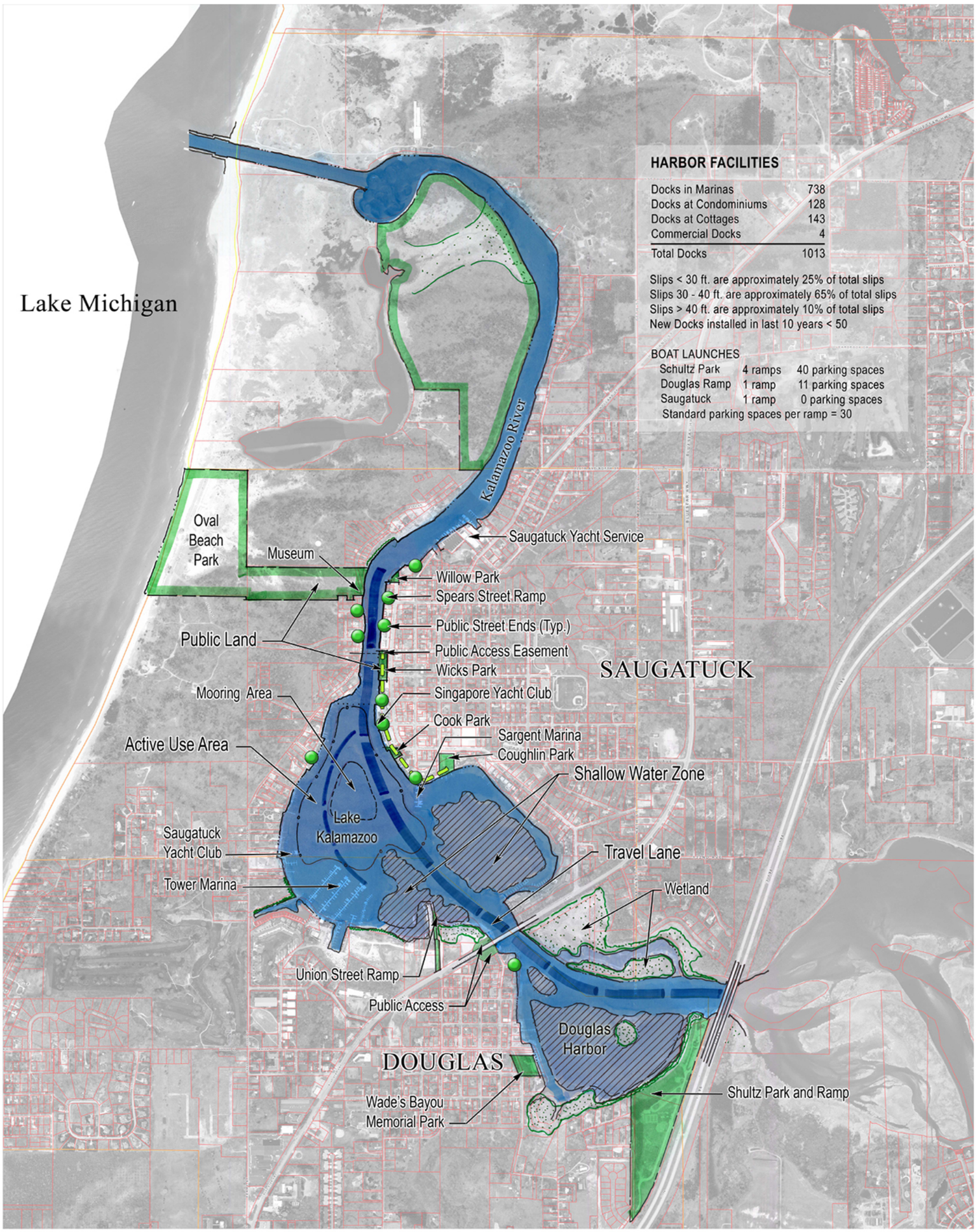
Related Study and Effort

Other areas of study and efforts should continue to ensure the success of the harbor. These could include:

- Investigate pedestrian access to the waterfront to study how the public points of access on the waterfront (e.g., street ends) are linked together to improve the visitor's experience and allow for community-to-community non-motorized connections.
- Consider zoning ordinance amendments to adopt a pier head line and protect the harbor's natural resources. The pier head line should be described by a surveyor or engineer to minimize future confusion and confrontations over its intent.
- Prepare and adopt, on a regional basis, a Kalamazoo Harbor/River watershed plan to improve the management of stormwater, erosion and sedimentation within the basin, all of which are contributing to the deposition of sediments within the harbor. The watershed plan should consider a watershed-based funding mechanism to maintain and improve the harbor and river. More locally, state-of-the-art stormwater management techniques should be encouraged through local site development ordinances.
- Prepare a market and engineering feasibility analysis to consider the opportunity to create public transient facilities as described in the Master Plan.
- Pursue funding and design for the expansion and improvement to the boat launch ramp facilities at Schultz Park and Union Street in Douglas.
- The community should monitor the design of the Blue Star bridge replacement to advocate pedestrian access and to ensure increased "air draft" (the height of the bridge above the water) to allow larger boats into the Douglas Harbor.
- The community should continue to work with the USACE to amend their federally mandated focus on commercial harbors to include recreational harbors in an effort to increase the frequency at which the area within the USACE's Project Limits is dredged. The community should also advocate that the USACE evaluate the condition of the breakwater piers as outlined in the Master Plan.

APPENDICES

APPENDIX A: JJR, LLC DIAGRAMS



HARBOR ANALYSIS PLAN

Kalamazoo Harbor Master Plan

JJR

April 5, 2007

Diagram A:
Harbor Analysis Plan

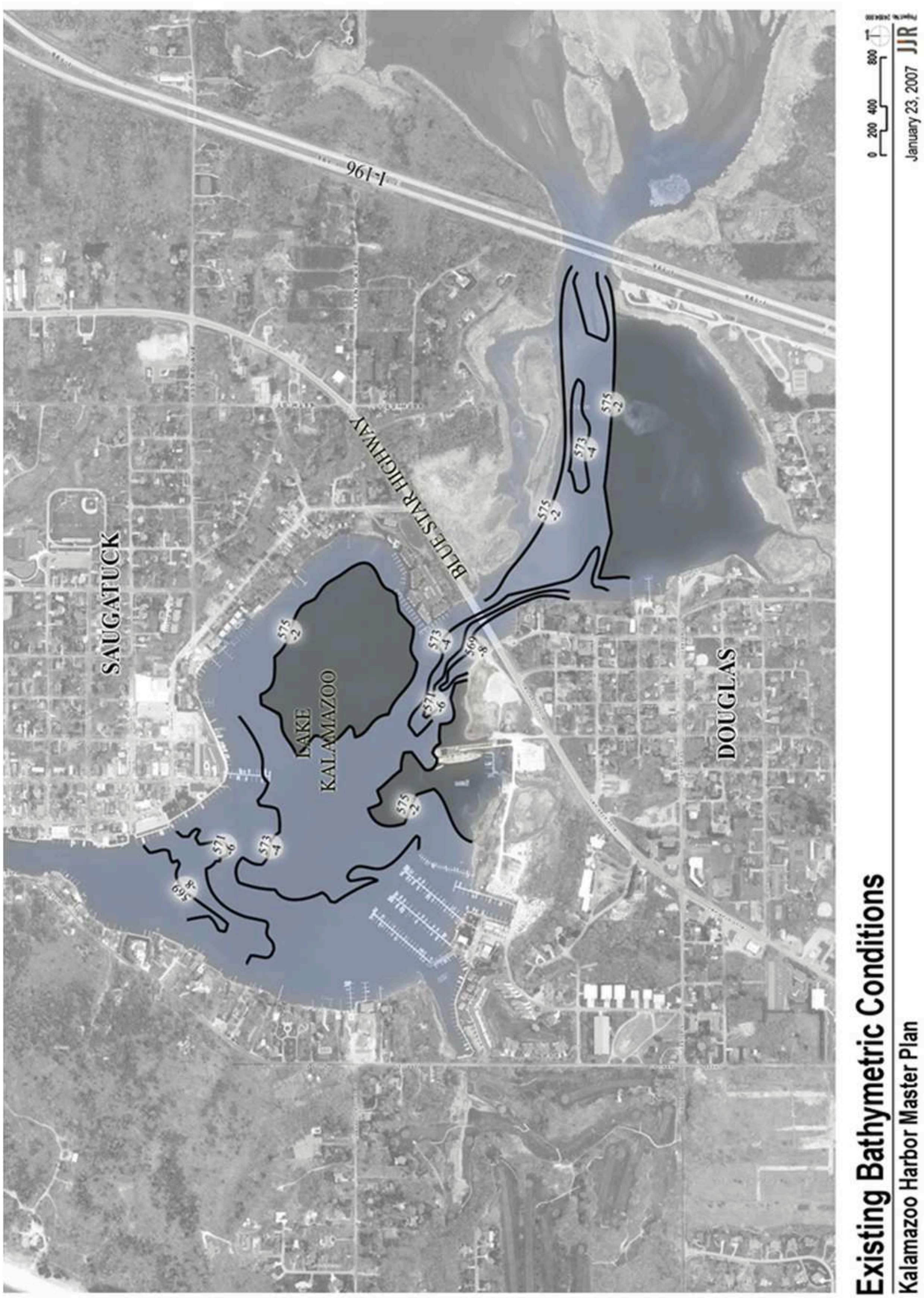
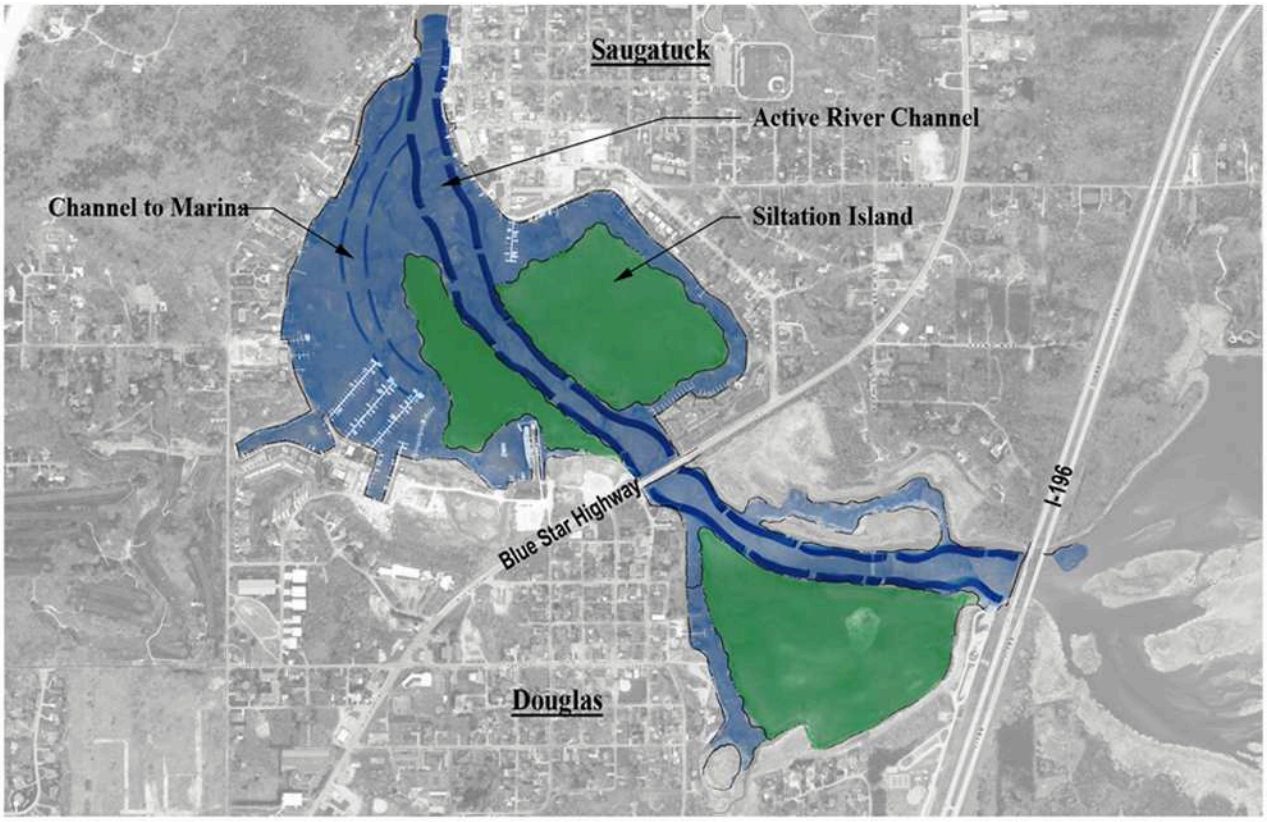


Diagram B:
Existing Bathymetric Conditions

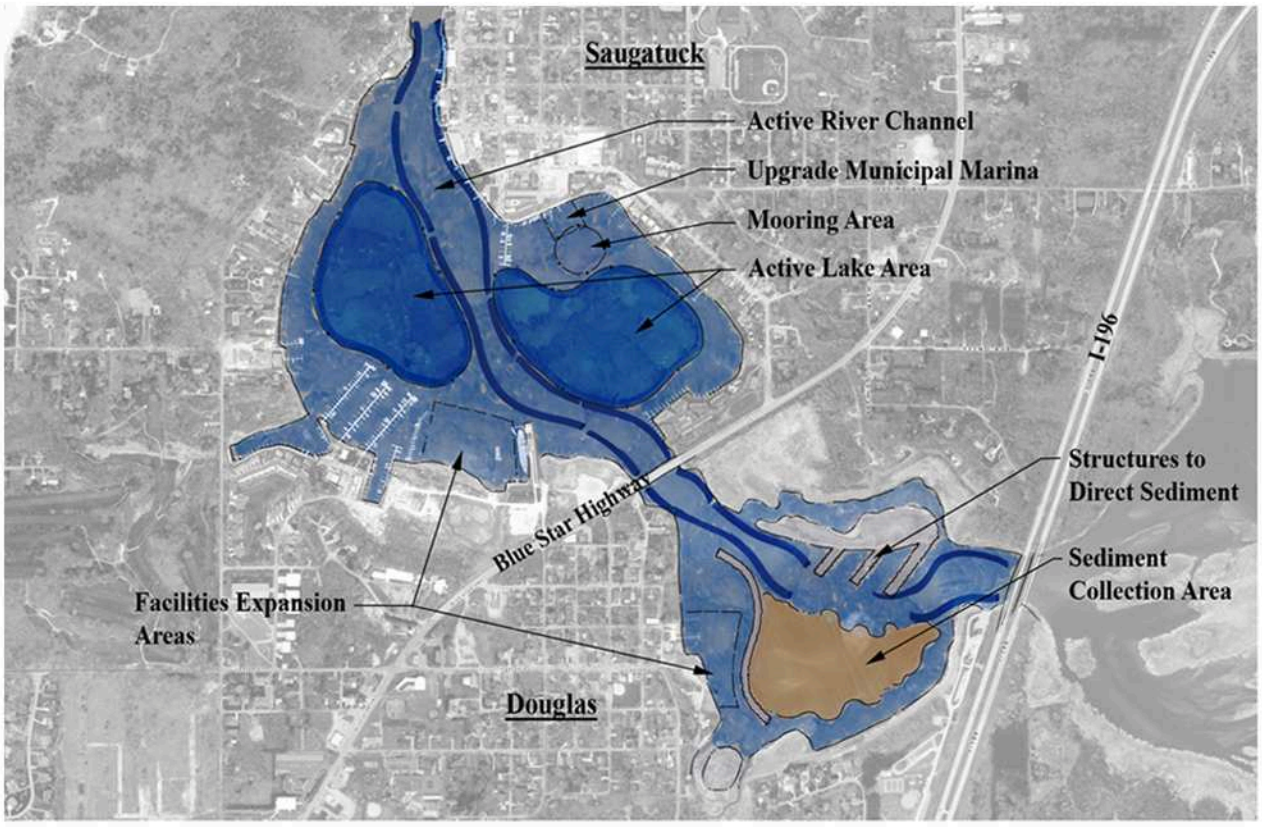


Future Alternative No. 1

Kalamazoo Harbor Master Plan

0 200 400 800

December 14, 2006 JJR



Future Alternative No. 2

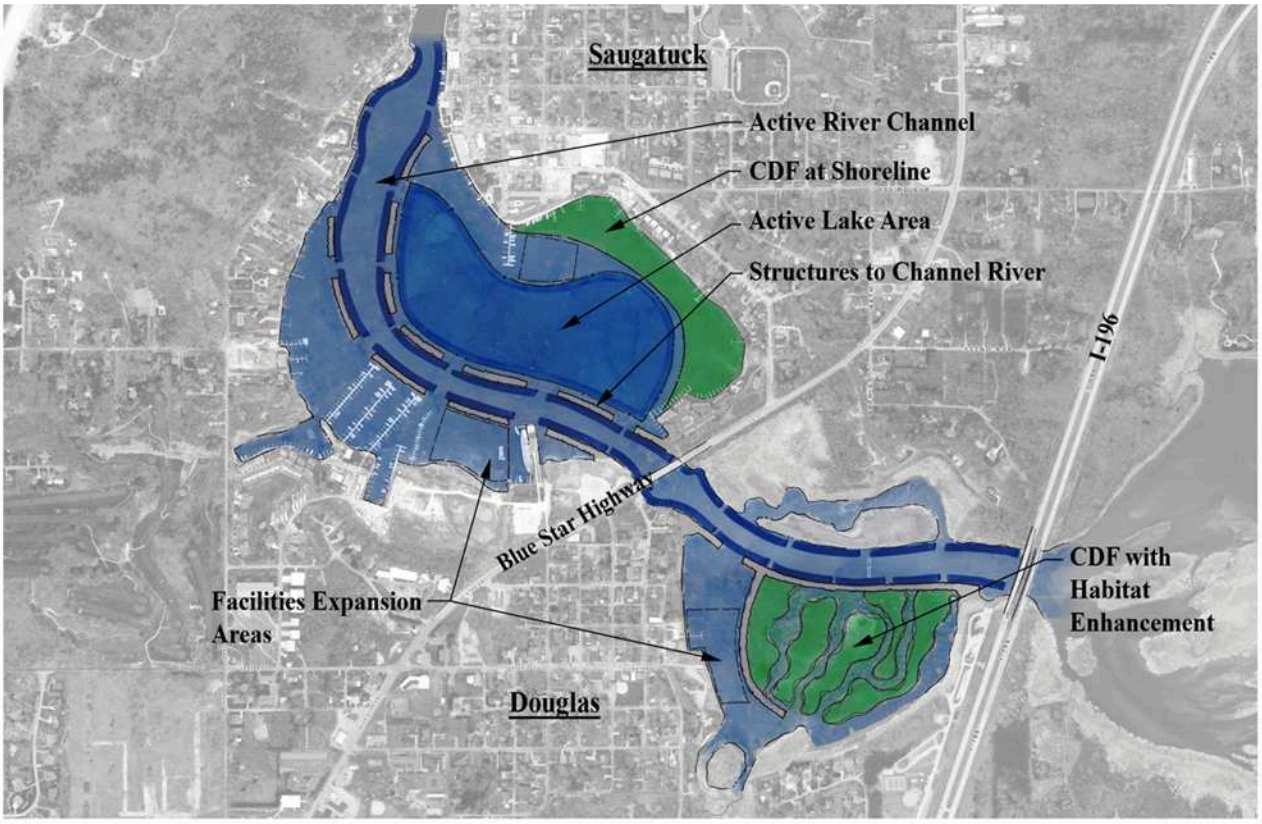
Kalamazoo Harbor Master Plan

0 200 400 800

December 14, 2006 JJR

Diagram C:

Future Alternatives 1 & 2



Future Alternative No. 3

Kalamazoo Harbor Master Plan

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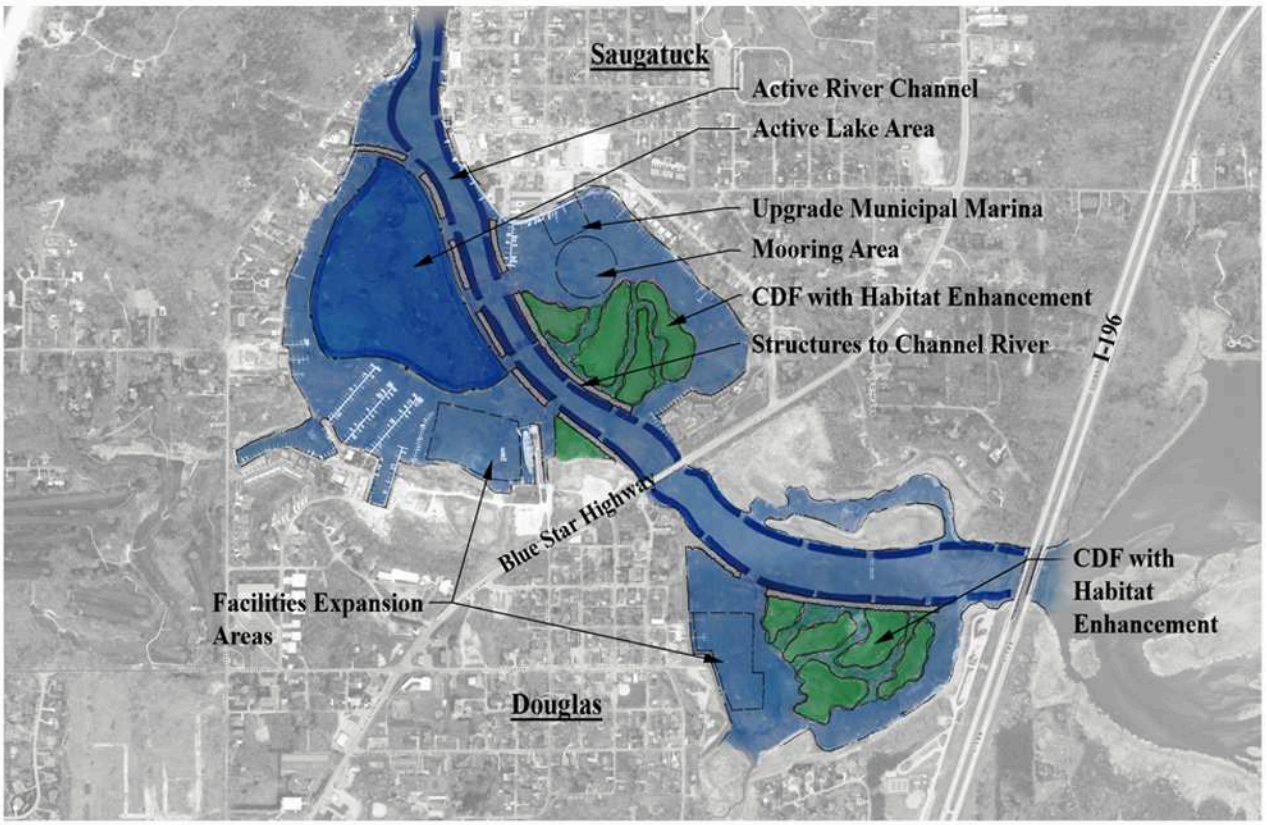
December 14, 2006 JJR



Future Alternative No. 4

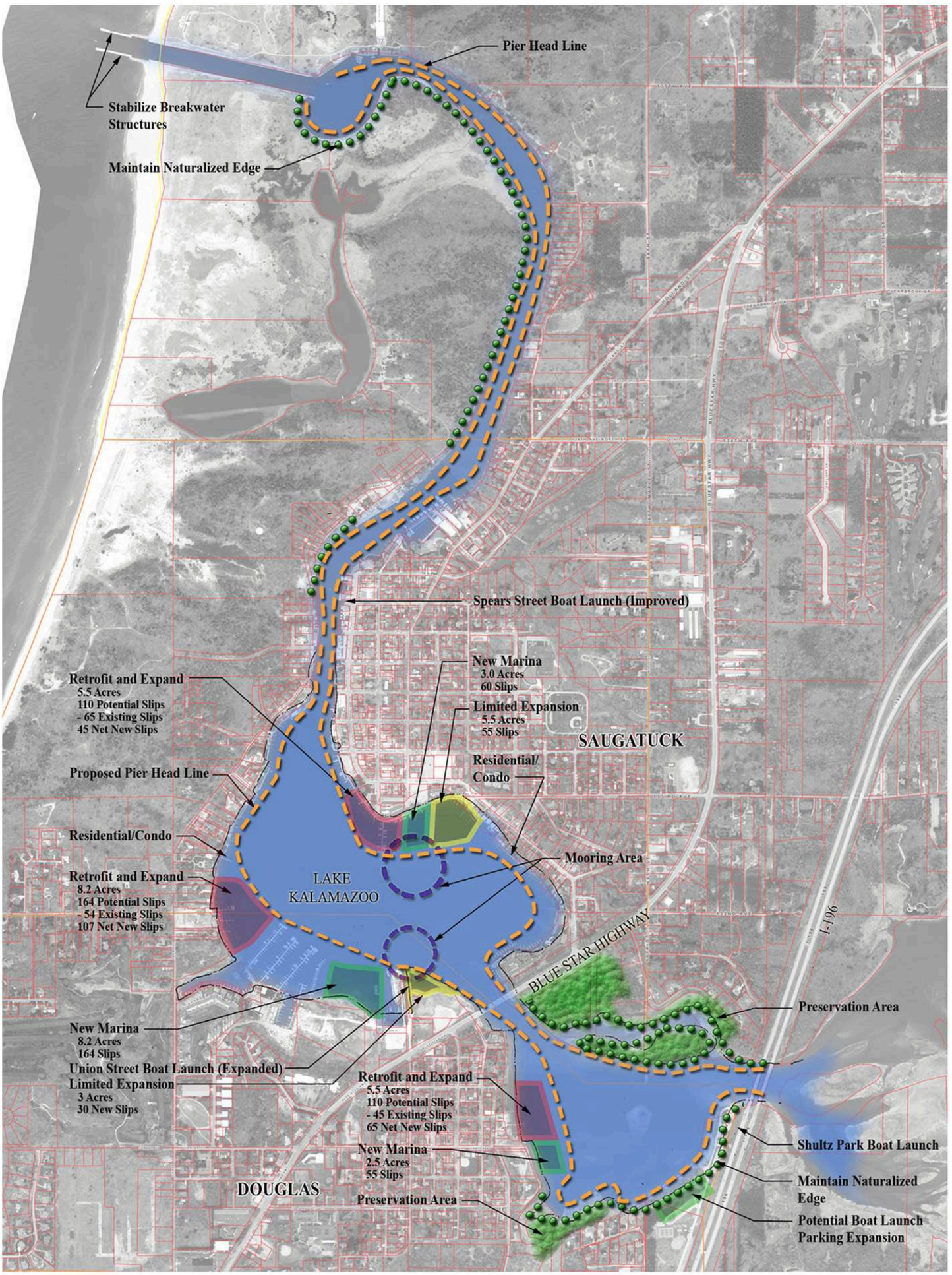
Kalamazoo Harbor Master Plan

0 200 400 800

December 14, 2006 JJR

Diagram D:

Future Alternatives 3 & 4



Harbor Improvement Plan

Kalamazoo Harbor Master Plan

0 200 400 800

April 5, 2007

JJR

Diagram E:

Harbor Improvement Plan

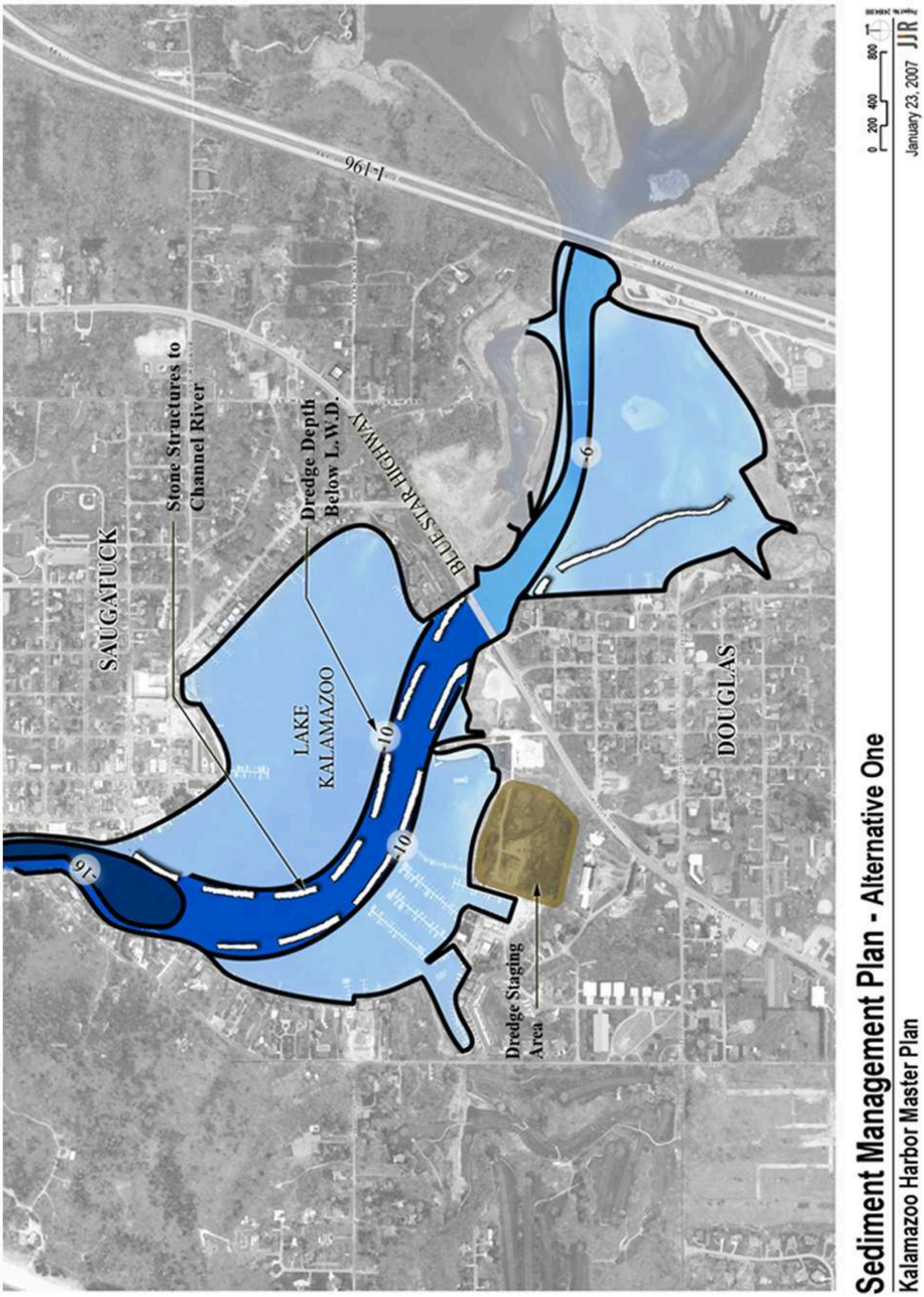
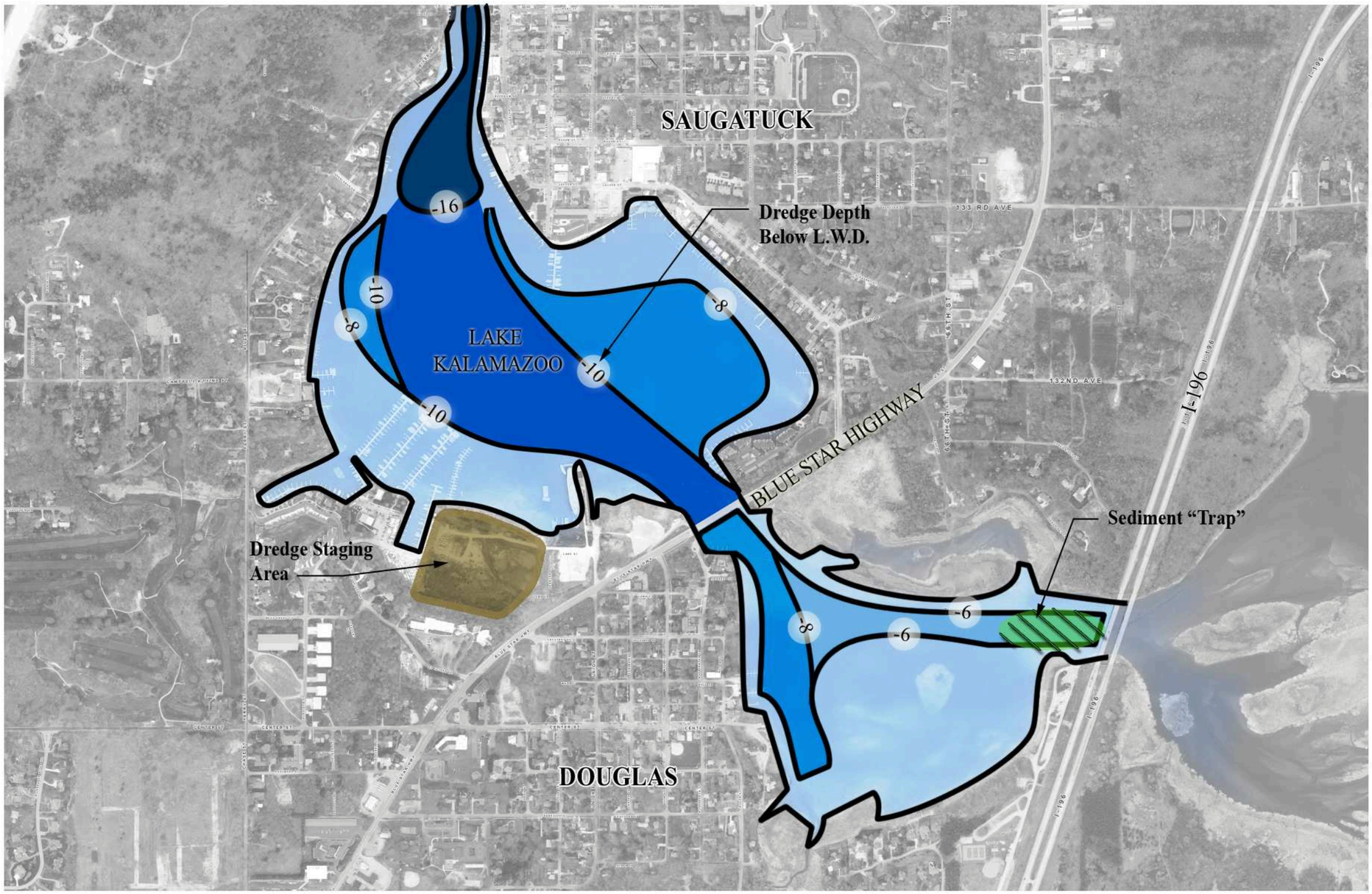


Diagram F:

Sediment Management Plan: Alternative One



Sediment Management Plan - Alternative Two

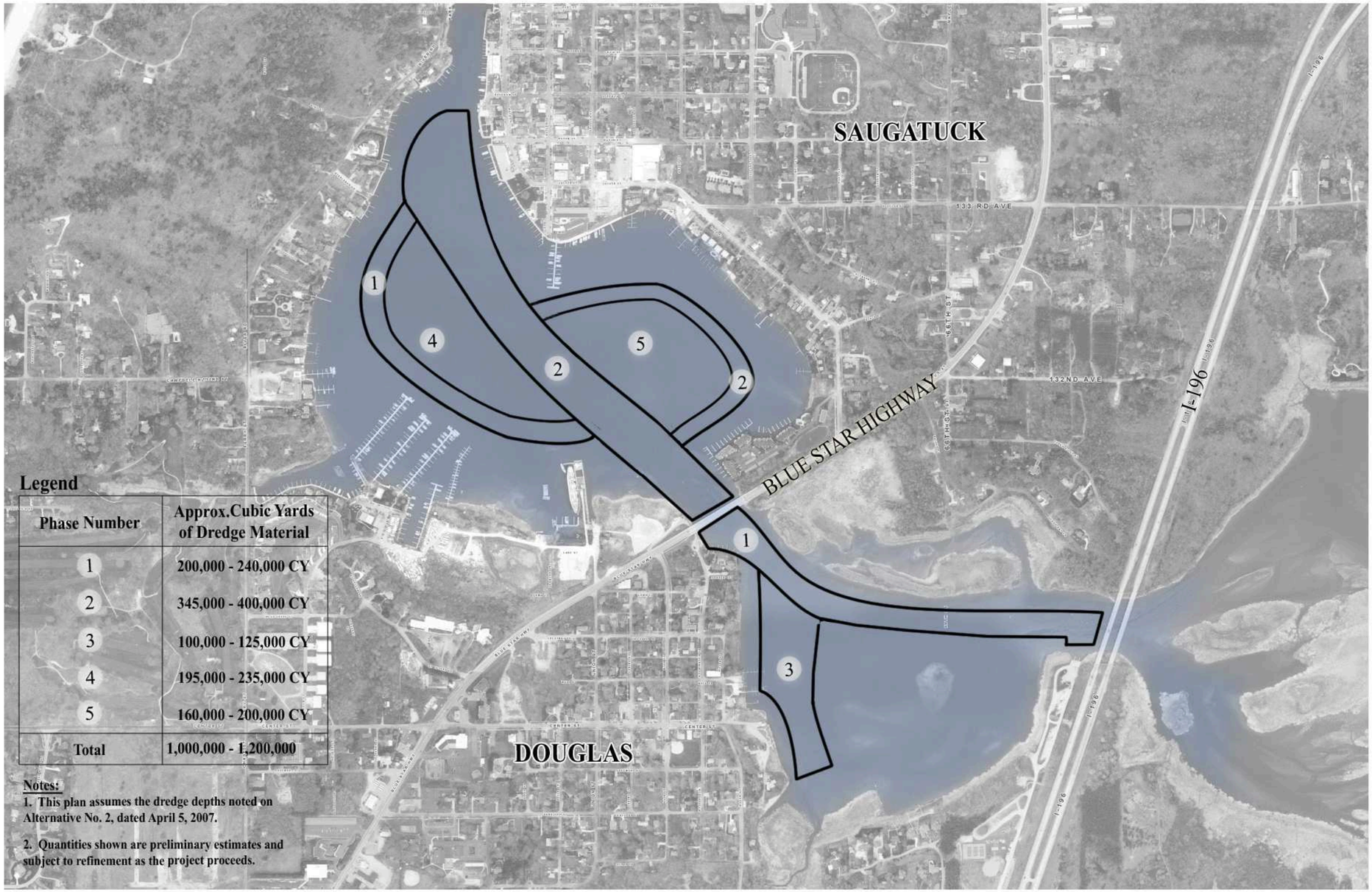
Kalamazoo Harbor Master Plan

0 200 400 800 north

January 23, 2007 JJR Project No. 24684.000

Diagram G:

Sediment Management Plan:
Alternative Two (Preferred)



Dredge Phasing Plan

Kalamazoo Harbor Master Plan

0 200 400 800 north

April 5, 2007

JJR Project No. 24884.000

Diagram H:
Dredge Phasing Plan

APPENDIX B: JJR, LLC TECHNICAL STUDIES

Summary of Water Level and River Flow Data for the Kalamazoo River

KALAMAZOO HARBOR STUDY

JJR NO. 24894.000 28-Dec-06

Summary of Water Level and River Flow Data for the Kalamazoo River

The Kalamazoo River watershed, located in southwest Michigan and to a small extent northern Indiana, is approximately 162 mile long, varies from 11 to 29 miles in width and drains approximately 2,020 square miles. The median daily flow rate at New Richmond, upstream from the mouth at Saugatuck, is 1640 cubic feet per second (cfs). The mean of daily gage readings over a ten year period varied from 1,010 cfs to 3,270 cfs. Peak flows over this same period were recorded as:

4,620 cfs	on Nov. 08, 1994
5,250 cfs	on Apr. 08 2003
6,970 cfs	on May 25, 2004
8,100 cfs	on Jan. 15, 2005

FEMA flood flows are estimated at:

8,400 cfs	for the 25 year flood
11,200 cfs	for the 50 year flood
12,400 cfs	for the 100 year flood
15,000 cfs	for the 500 year flood

Water levels at the mouth of the Kalamazoo River are controlled by the water level in Lake Michigan with the following historic water levels, using the International Great Lakes Datum of 1985 (IGLD85):

Minimum elevation	576.0	in May 1964
Maximum elevation	582.3	in Oct. 1986

Lake Michigan is also subject to storm induced water level rise. For a 1% probability storm (100 year storm) the water level rise is estimated to be 2.1 feet at Holland Michigan in December and 0.8 feet in July and August.

The FEMA 100 year flood elevation for Saugatuck/Douglas is 584.0, using the National Geodetic Vertical Datum (NGVD). (Although there is a small difference in the IGLD and NGVD, it is not significant for the general discussion herein.)

The FEMA 100 year flood flow of 12,400 cfs has been modeled for Saugatuck/Douglas using a mean Lake Michigan level of elevation 580.0 at the river mouth. Approximately 20 river and lake sections were input into the flow model fro lake Michigan to the I-196 Bridge and resulted in elevations of:

582.13 near the outlet of Kalamazoo Harbor (12,585 feet from Lake Michigan)
582.30 at the Blue Star Highway Bridge (16,510 feet from Lake Michigan)
582.81 at the I-196 Bridge (19,920 feet from Lake Michigan)

The small water level rise across Kalamazoo Harbor is attributed to the width of the harbor which allows to river surface to spread from approximately 300 feet wide at the Blue Star Bridge to over 1200 feet wide across the harbor. Much of the above water level rise across Douglas Lake is caused by the flow restrictions at the Blue Star Bridge.

The average velocity of river flow during this 100 year storm event is dependant on the area of the river cross section at each of the approximately 20 sections noted above. These varied from:

1.6 to 3.4 feet per second	for the River from the Kalamazoo Harbor to Lake Michigan
0.8 to 1.2 feet per second	across Kalamazoo Harbor
2.7 to 2.9 feet per second	through the Blue Star Bridge opening
1.5 to 1.8 feet per second	across Douglas Lake
2.2 to 2.4 feet per second	through the I-196 Bridge opening

Conceptual Evaluation of River Channeling through Kalamazoo Harbor

Conceptual Evaluation of River Channeling through Kalamazoo Harbor

A conceptual evaluation of the viability of channeling river flow through Kalamazoo Lake to create a river flow velocity that would be self scouring was undertaken. This involved the assessment of probable sediment particle size, the assessment of probable river velocity needed to scour these sediments and the assessment of normal and peak river flows.

The sediment data evaluated included sampling from the river bottom at the harbor outlet/turning basin (ERM Report May 1999) and from the sediment storage basin used by Tower Marine for the 2000 dredging project (CDM Report Jan 2001). The samples can be summarized as approximately 60% fine sand and 40% silt.

The next step was to develop the velocity at which a particle of given size begins to move on a stream bottom. This is referred to as the competent velocity and can be generally assumed to be 70% of the mean river flow velocity. The findings indicate that fine sand in a particle size range of 0.1 mm to 0.5 mm can begin to move at mean river velocities of 0.2 fps to 0.5 fps respectively. Actual river bottom and river flow conditions are much more irregular than these laboratory conditions; therefore, for this conceptual analysis a minimum design channel velocity of 1.0 fps will be used to establish self-scouring flows.

The daily low, mean and high flows for the most recent 10 year period were 1,010 cfs, 1,640 cfs and 3270 cfs respectively. During that same period peak flows were recorded as: 5,250 cfs on April 8, 2003; 6,970 on May 25, 2004; and 8,100 cfs on Jan 15, 2005. These are all significant storm events in comparison to the FEMA 25 yr, 50 yr and 100 yr predicted storm flows of 8,400 cfs, 11,200 cfs and 12,400 cfs respectively.

The final part of this assessment was to determine channel depths and widths that that could be considered self scouring under the above conditions. The minimum channel depth for a large harbor is generally 10 feet to allow a full range of recreational boating including medium size sail boats. Using a 200 foot wide channel, velocities are 0.5 cfs, 0.8 cfs and 1.6 cfs respectively for the daily low, mean and high flows listed above. Using a 250 foot wide channel, velocities are 0.4 cfs, 0.7 cfs and 1.3 cfs respectively for the daily low, mean and high flows listed above. The 250 foot width is approximately the minimum channel width of the river downstream of Kalamazoo Harbor; however, a 300 foot wide channel would generally be considered as desirable for the current mix of boating activities.

The above analysis does not consider the effects of high lake levels, which would diminish flow rates, or the actual volume of sediment that could be either deposited or scoured in a given year. These highly variable conditions would require a sophisticated hydrologic and sediment transport model which are beyond the scope of the elementary analysis. Also, if the river were to be channeled through Kalamazoo Harbor, sediment deposition may then occur down river at deeper and wider locations.

River channeling could be accomplished by dredging and armoring the cannel with heavy rock. These rock structures would generally rise above the lake surface and would require openings to serve boating access to the channel from adjacent marinas of other harbor facilities. However, the crest elevation may have to be below river level during significant floods to limit backing upstream water levels above current flood elevations.

The cost of channel structures would be high and should be compared to an annual dredging program which may achieve the same goals at a lower annualized cost without the potential downstream sedimentation. Also, parallel rock structures would have the negative effect of bisecting the harbor both visually and functionally. In effect, the harbor would become a river with marinas or boating areas lining the outside of the new channel. Public opinion expressed in meetings has strongly suggested that the open lake look and uses should be a top priority.

KALAMAZOO HARBOR STUDY

JJR No. 24894.000

28-Dec-06

Grain Size Summary from <u>Turning Basin at the Outlet of the Harbor</u>

Report by Dell Engineering (ERM), May 10, 1999

Note:
Samples 9905 and 9906 were adjacent to the shoreline and may represent native soils more than sediment and therefire were not included below.

Sample ID	Percentage				
	Clay / Silt	Fine Sand	Medium Sand	Coarse Sand /Gravel	
9901	47.5	35.8	14.7	2.0	
9902	56.6	30.9	12.5	0.0	
9903	37.7	36.9	23.7	1.8	
9904	46.3	33.9	19.9	0.0	
	188.1	137.5	70.8	3.8	400.2
	47.0%	34.4%	17.7%	0.9%	100.0%

47.0% Clay/Silt	53.0% Fine to Coarse Sand

KALAMAZOO HARBOR STUDY

JJR No. 24894.000 28-Dec-06

Grain Size Summary from Tower Marine Dredge Spoil Basin

Report by Camp Dresser & McKee, Jan 30, 2001

Note:
Per Tower Marine, dredge spoils in this basin came from the turning basin, Saugatuck city dock, chain ferry and Tower Marina in Kalamazoo Harbor.

Specimen No.	Percentage				
	Clay	Silt	Sand	Gravel	
33241	23	33	44	0	
33233	1	16	83	0	
33231	2	15	82	0	
33229	0	25	75	0	
33227	6	26	67	0	
33226	20	26	53	0	
33232	20	24	56	0	
33240	1	11	89	0	
33228	21	43	36	1	
33230	27	40	32	0	
33237	16	27	53	4	
33236	27	28	45	0	
33235	30	29	42	0	
33238	22	20	58	0	
33239	7	20	68	5	
33234	9	47	44	0	
	232	430	927	10	1599
	14.5%	26.9%	58.0%	0.6%	100.0%

41.4% Clay/Silt	58.6% Fine to Coarse Sand

Note:
The majority of the sand was fine sand with less medium sand and minimal coarse sand.

KALAMAZOO HARBOR STUDY

JJR No. 24894.000 28-Dec-06

Scouring Flow Rate for Sediment Particle Sizes

Reference:
Design of Small Dams, US Dept of Interior, Bureau of Reclamation, 1973.
The velocity at which a particle begins to move on a stream bottom is the competent bottom velocity.
The competent velocity from Fig H-13 can be estimates as v = 0.51(d)^.5
The bottom velocity is considered to be 70% of the of the mean channel velocity.

	particle size		competent bottom velocity		mean channel velocity	
	minimum (mm)	maximum (mm)	minimum (fps)	maximum (fps)	minimum (fps)	maximum (fps)
Fine Sand	0.10	0.50	0.161	0.361	0.230	0.515
Medium Sand	0.50	2.00	0.361	0.721	0.515	1.030
Coarse Sand	2.00	5.00	0.721	1.140	1.030	1.629

Conclusions:
Previous data indicates that the sediment in Kalamazoo Harbor is approximately 55% fine sand and 40% silt with some medium and coarse sand.
The above calculation is based on ideal laboratory conditions.
It is recommended that minimum design channel velocity of 1.0 fps to be used self scouring.

River Cross Section needed to Maintain Scour of Sediement

Assumptions:
Lake level limits water level rise and flow stays in channel
Channel depth of 10 feet.

		Velocity for Trial Cross Sections	
		2000	2500
	cfs	(sq ft)	(sq ft)
low daily mean flow	1,010	0.51	0.40
avg daily mean flow	1,640	0.82	0.66
high daily mean flow	3,270	1.64	1.31
2003 peak flow	5,250	2.63	2.10
2004 peak flow	6,970	3.49	2.79
25 yr flood	8,400	4.20	3.36

Conclusions:
A 200 foot wide channel could have sufficient scour velocity for a good part of the year
A 250 foot wide channel would be the maximum acceptable
The channel edges must be below the elevation of a 10 yr storm to limit the maximum velocity

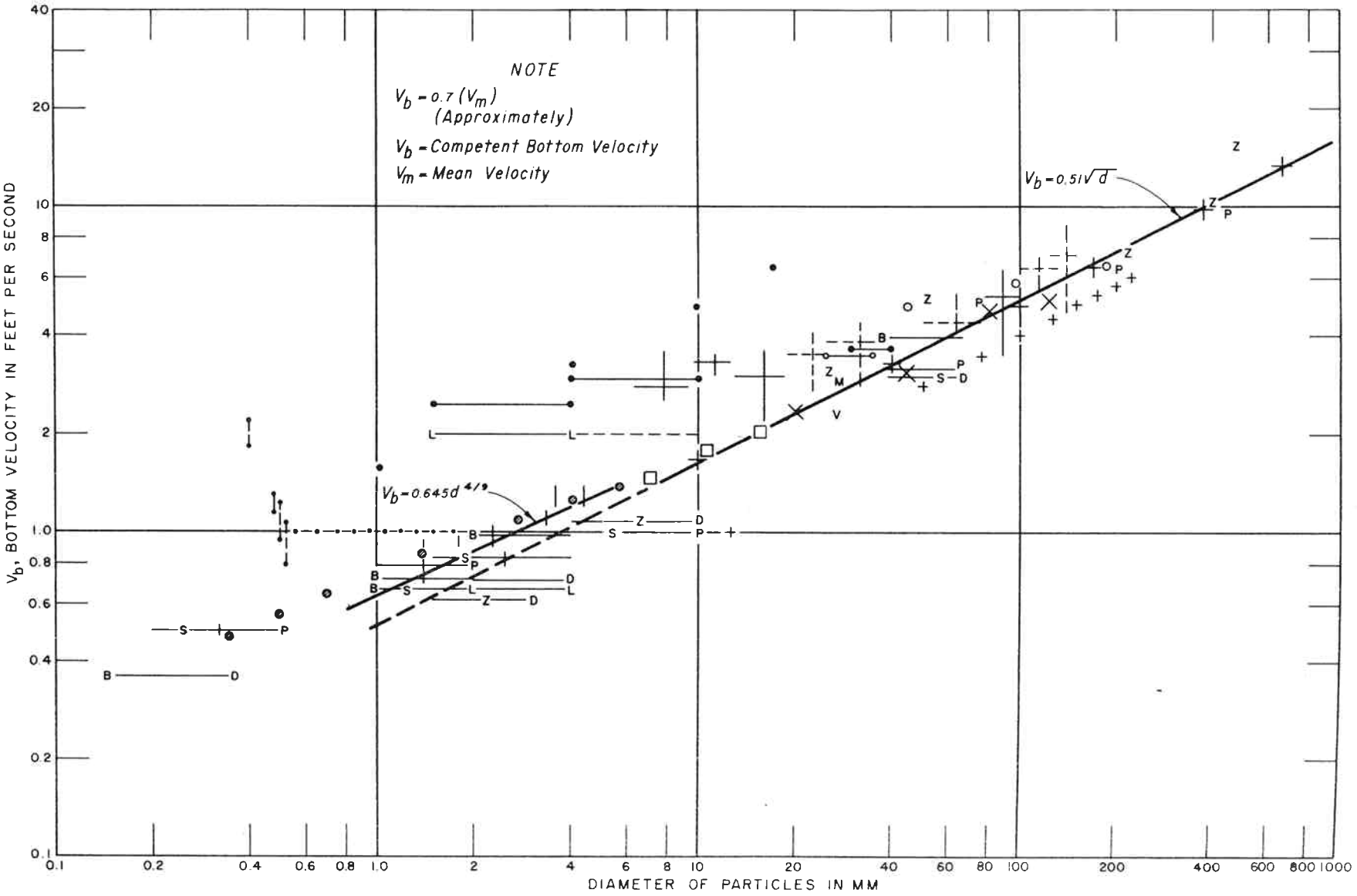


Figure H–13. Competent bottom velocity versus transportable sediment size. 288–D–2854.

Estimated Sedimentation Rates in Kalamazoo Lake

KALAMAZOO HARBOR STUDY

JJR No. 24894.000 21-Dec-06

Estimated Sedimentation Rates in Kalamazoo Lake

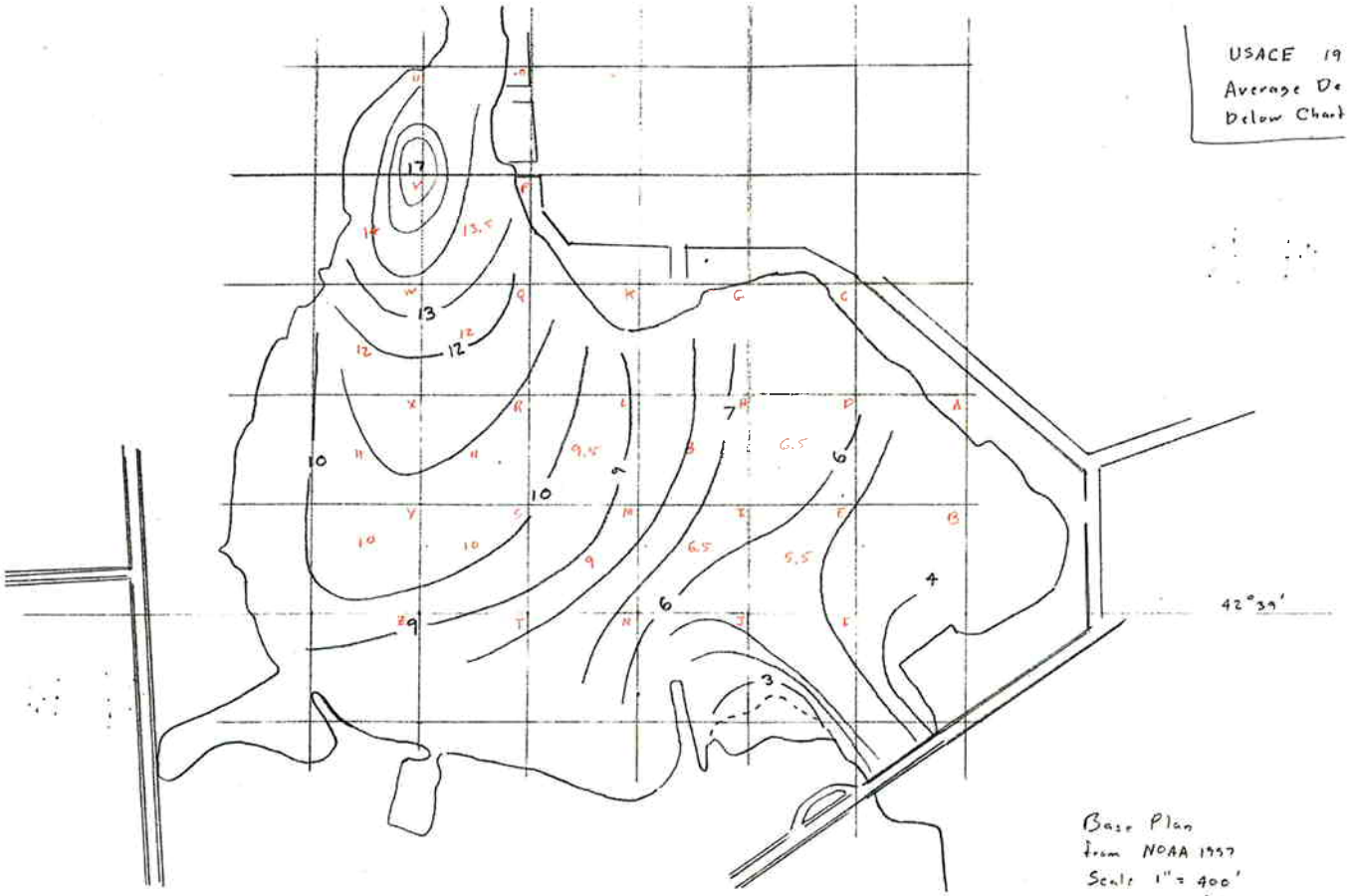
This calculation of sedimentation in Kalamazoo Lake utilized the following maps:

1 USACE project map dated 1986
2 Lake Michigan Boating Map, NOAA dated 1997
3 JJR bathymetric survey date Nov 2006

These maps were created for differing purposes but all maps used USACE LWD for soundings.
Due to maintenance dredging activities, not all areas of the harbor were included.
The results below are only intended to provide a general understanding of sedimentation rates.

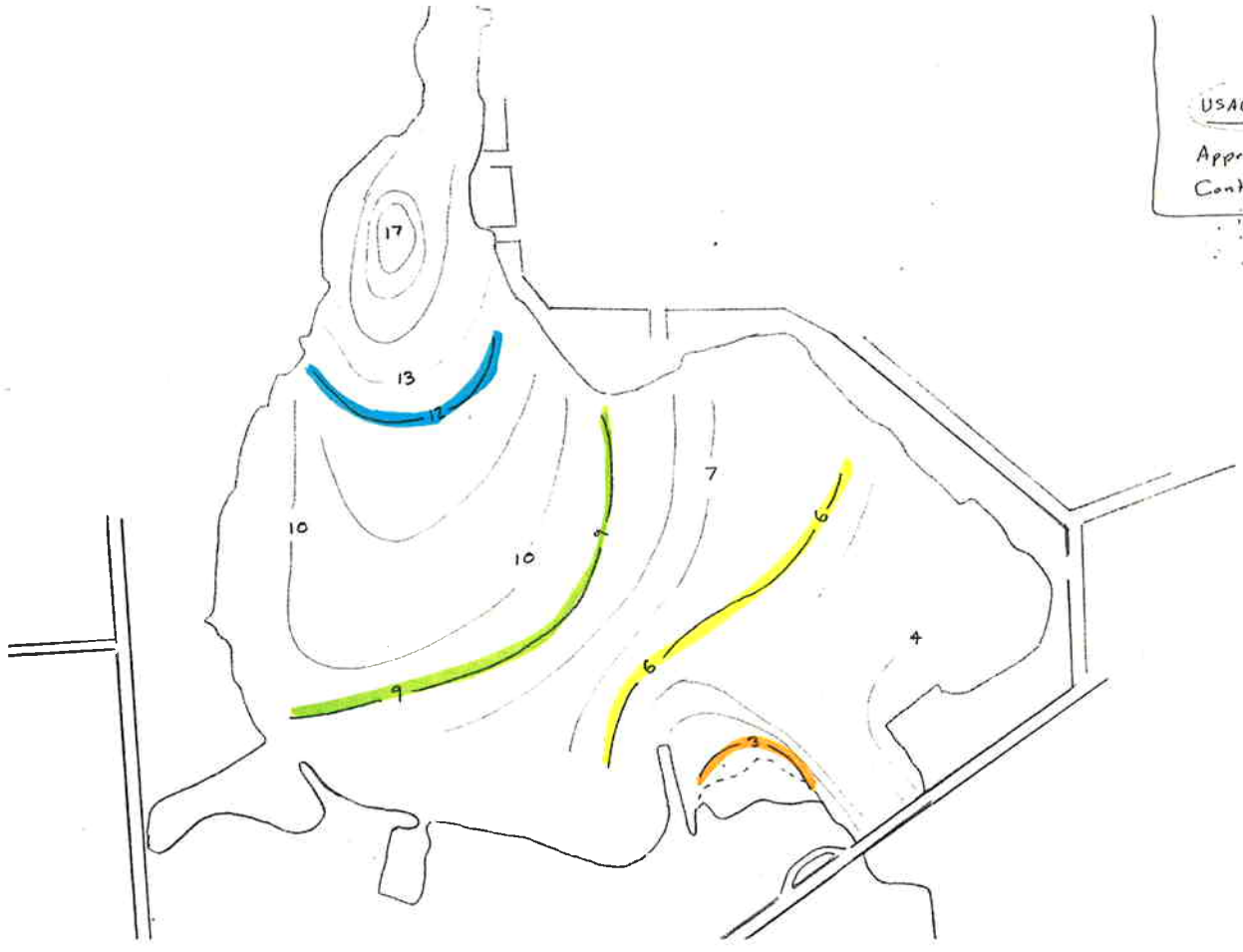
ZONE	AREA (sq ft)	YEAR 1986	1997	2006	Sedimentation 86 - 97	97 - 06	
A					(cu yds)		
B							
C							
D	250,000	6.5	2.0	1.5	41,667	4,630	
E	250,000	5.5	2.0	1.5	32,407	4,630	
F							
G							
H	250,000	8.0	2.0	2.0	55,556	0	
I	250,000	6.5	3.0	3.0	32,407	0	
J							
K							
L	250,000	9.5	4.0	3.0	50,926	9,259	
M	250,000	9.0	3.5	2.0	50,926	13,889	
N							
O							
P	230,000	13.3	9.0	7.0	36,630	17,037	
Q	250,000	12.0	7.0	5.5	46,296	13,889	
R	250,000	11.0	5.5	3.0	50,926	23,148	
S	250,000	10.0	5.5	3.5	41,667	18,519	
T							
U							
V	200,000	14.0	9.5	9.0	33,333	3,704	
W	250,000	12.0	7.0	6.0	46,296	9,259	
X	250,000	11.0	7.0	5.5	37,037	13,889	
Y	250,000	10.0	6.0	5.0	37,037	9,259	
Z							
				Totals	593,111	141,111	734,222
				Years	11	9	20
				Rate (cy/yr)	53,919	15,679	36,711

Conclusion:
A 36,000 cubic yard per year sedimentation rate could be used for conceptual study purposes.

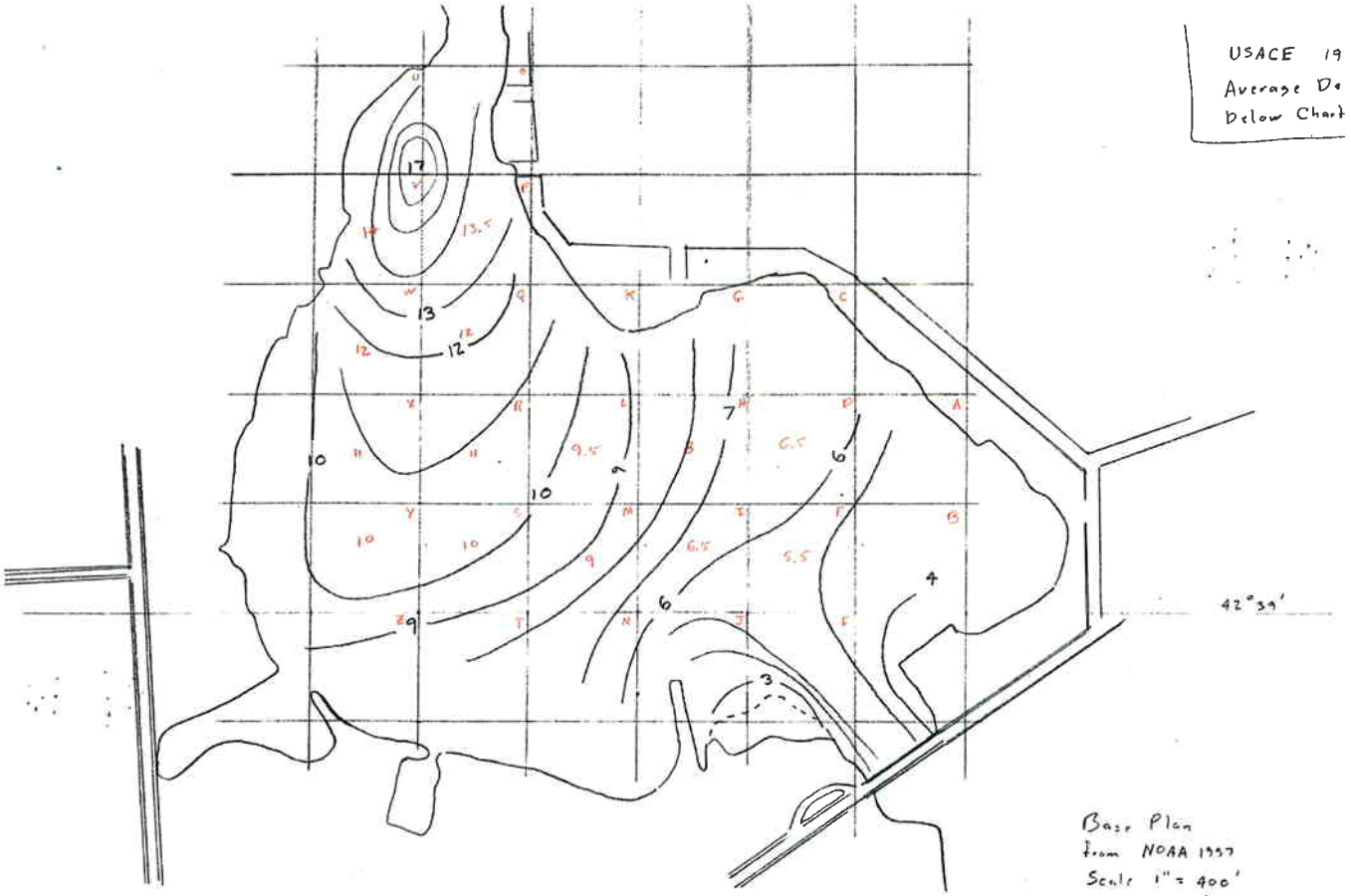


USACE 19
Average De
Below Chart

Base Plan
from NOAA 1997
Scale 1" = 400'
Grid at 500'



USACE 1986
Approx Depth
Contour Map



USACE 19
Average De
Below Chart

Base Plan
from NOAA 1997
Scale 1" = 400'
Grid at 500'

NOAA 1997

Approx Depth
Contour Map


JJR 2006 Surve
Average Depth
below Chart Dat
42°39'
Base Plan
from NOAA 1997
Scale 1" = 400'
Grid at 500'


JJR 2006
Approx Depth
Contour Map
1'+2'
3'+5'

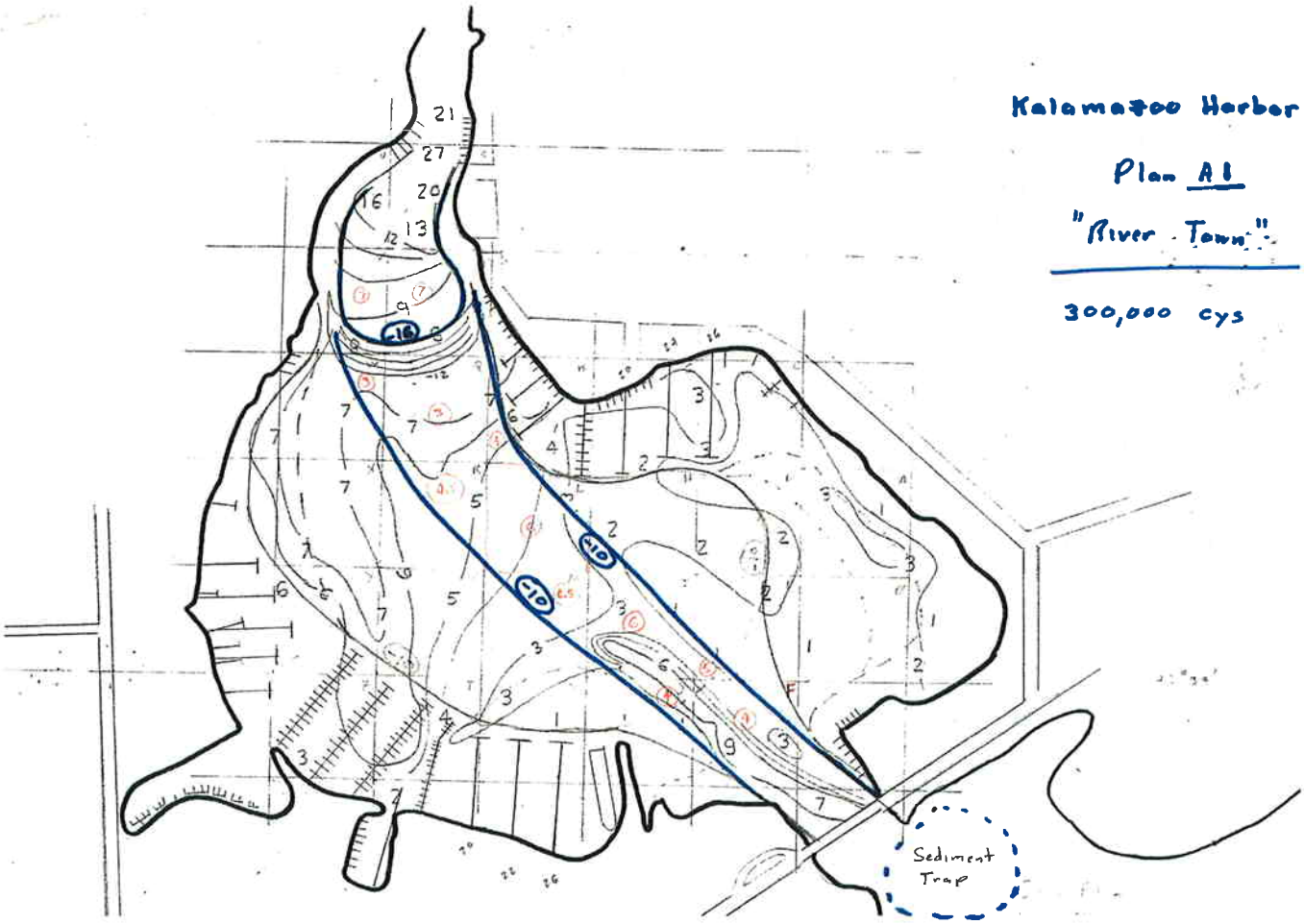
KALAMAZOO HARBOR STUDY

JJR No. 24894.000 27-Dec-06

Estimated Dredging Requirements for Concept Plans

This calculation of dredging in Kalamazoo Lake utilized the JJR bathymetric survey of Nov 2006 and proposed dredging master plans for the River channel only.
The results below are only intended to provide a general understanding of potential dredge volumes.

ZONE	PLAN A1			PLAN A2		
	area (sq ft)	depth (ft)	vol. (cys)	area (sq ft)	depth (ft)	vol. (cys)
A	0			0		
B	0			0		
C	0			0		
D	0		-	0		-
E	30,000	5.0	5,556	0		-
F	250,000	4.0	37,037	200,000		-
G	0			0		
H	30,000	8.5	9,444	0		-
I	200,000	6.0	44,444	0		-
J	50,000	4.0	7,407	200,000	6.0	44,444
K	50,000	4.0	7,407	0	4.0	-
L	200,000	6.0	44,444	0	6.0	-
M	110,000	6.5	26,481	0	6.5	-
N	0	8.0	-	200,000	7.0	51,852
O	0			0		
P	190,000	7.0	49,259	190,000	7.0	49,259
Q	250,000	3.0	27,778	0	3.0	-
R	110,000	4.5	18,333	0	4.5	-
S	0	5.5	-	250,000	5.0	46,296
T	0	6.0	-	0	6.0	-
U	0			0		
V	120,000	7.0	31,111	120,000	7.0	31,111
W	70,000	3.0	7,778	220,000	3.5	28,519
X	0	3.0	-	220,000	3.5	28,519
Y	0	4.0	-	60,000	4.0	8,889
Z	0			0		
			316,481			288,889

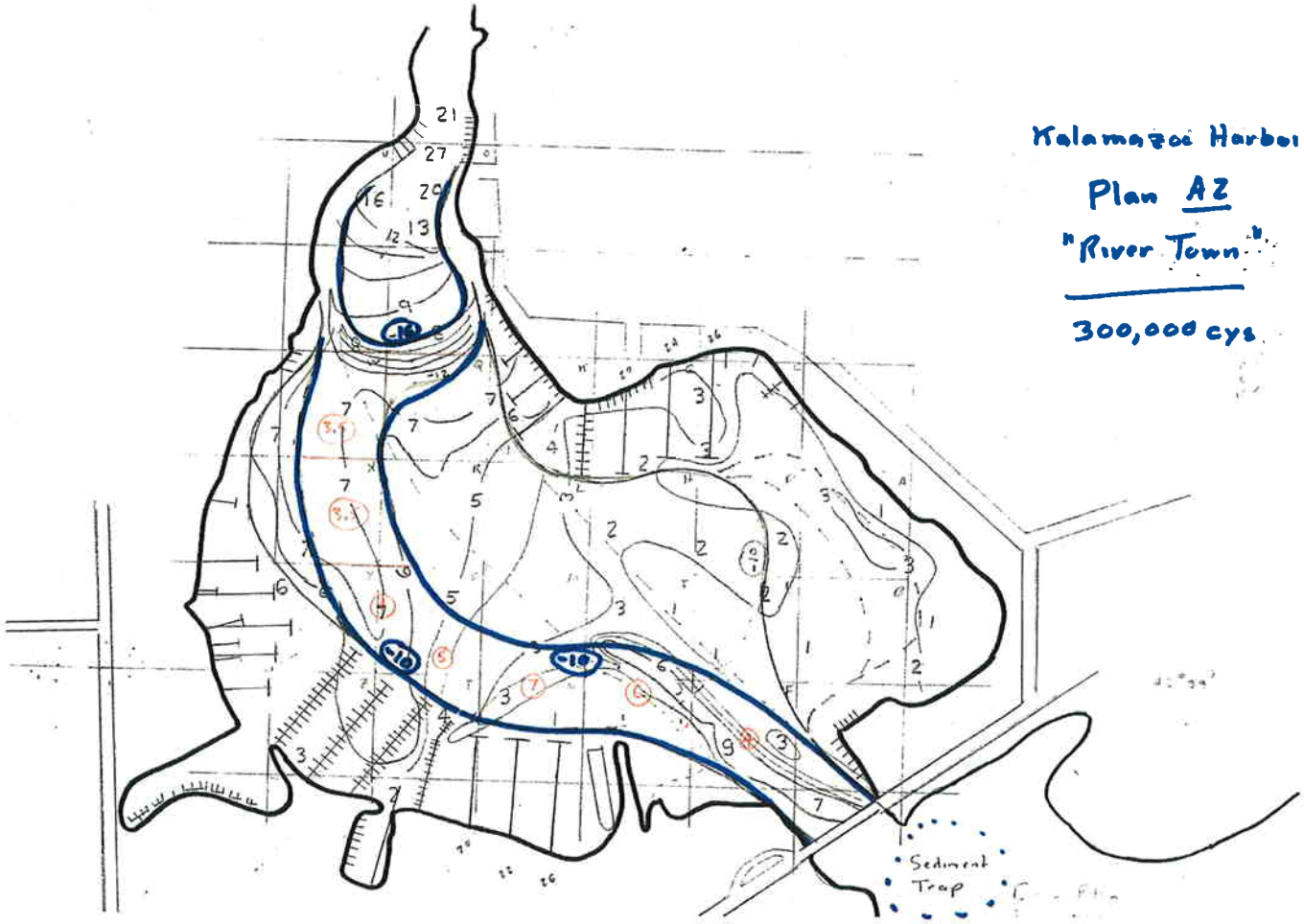


Kalamazoo Harbor

Plan A1

"River Town"

300,000 cys



Kalamazoo Harbor

Plan A2

"River Town"

300,000 cys

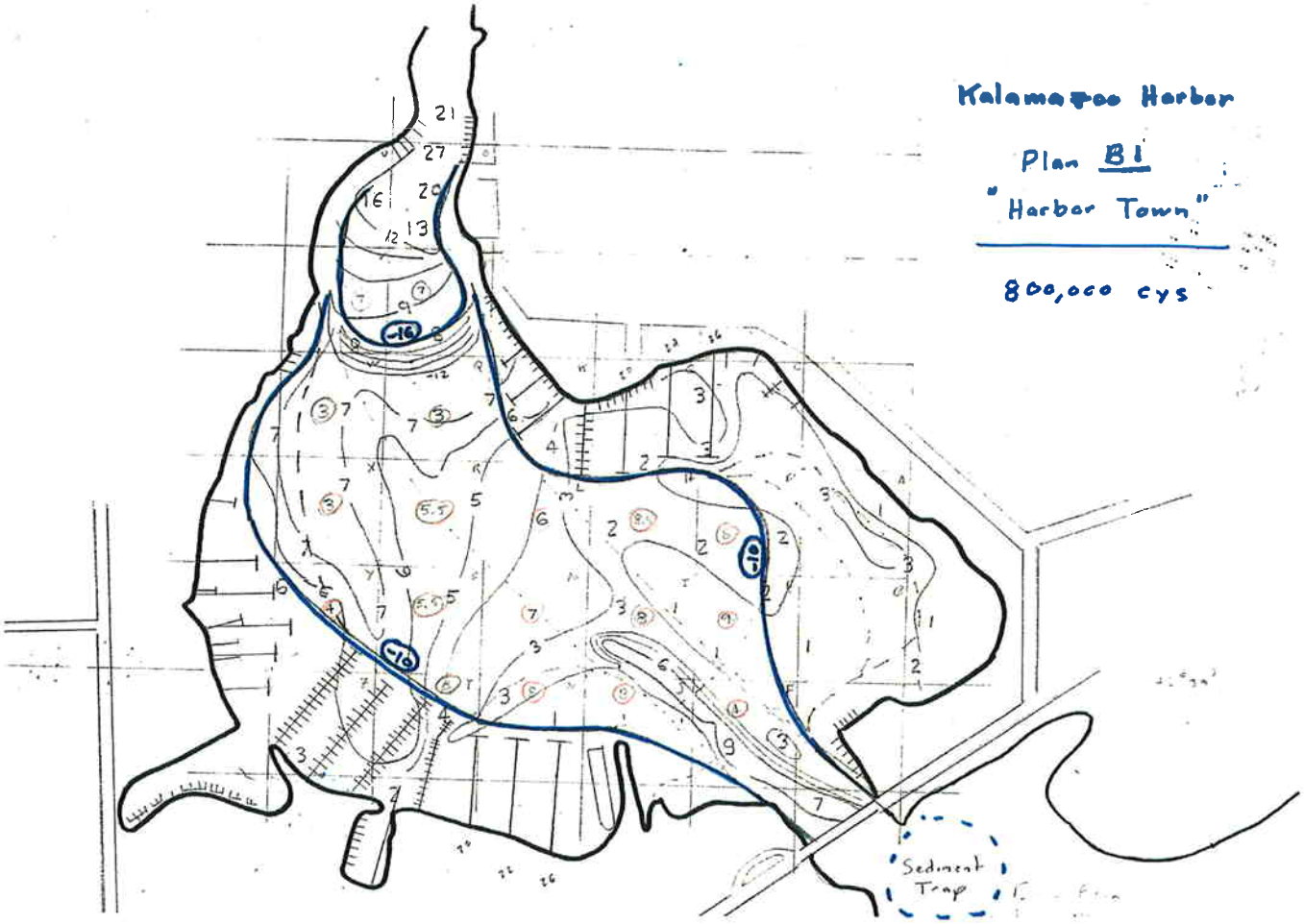
KALAMAZOO HARBOR STUDY

JJR No. 24894.000 27-Dec-06

Estimated Dredging Requirements for Concept Plans

This calculation of dredging in Kalamazoo Lake utilized the JJR bathymetric survey of Nov 2006 and proposed dredging master plans.
The results below are only intended to provide a general understanding of potential dredge volumes.

ZONE	PLAN B1			PLAN B2		
	area (sq ft)	depth (ft)	vol. (cys)	area (sq ft)	depth (ft)	vol. (cys)
A	0			150,000	6.0	33,333
B	0			220,000	6.0	48,889
C	0			0		-
D	160,000	8.0	47,407	250,000	6.0	55,556
E	190,000	9.0	63,333	250,000	6.0	55,556
F	220,000	4.0	32,593	220,000	4.0	32,593
G	0			0		
H	250,000	8.5	78,704	250,000	6.0	55,556
I	250,000	8.0	74,074	250,000	7.0	64,815
J	160,000	8.0	47,407	160,000	8.0	47,407
K	50,000	4.0	7,407	50,000	4.0	7,407
L	250,000	6.0	55,556	250,000	5.5	50,926
M	250,000	7.0	64,815	250,000	7.0	64,815
N	130,000	8.0	38,519	130,000	8.0	38,519
O	0			0		
P	190,000	7.0	49,259	190,000	7.0	49,259
Q	250,000	3.0	27,778	250,000	3.0	27,778
R	250,000	5.5	50,926	250,000	5.5	50,926
S	250,000	5.5	50,926	250,000	5.5	50,926
T	30,000	6.0	6,667	30,000	6.0	6,667
U	0			0		
V	130,000	7.0	33,704	130,000	7.0	33,704
W	260,000	3.0	28,889	260,000	2.5	24,074
X	300,000	3.0	33,333	300,000	2.2	24,444
Y	130,000	4.0	19,259	110,000	4.0	16,296
Z	0			0		
			810,556			839,444

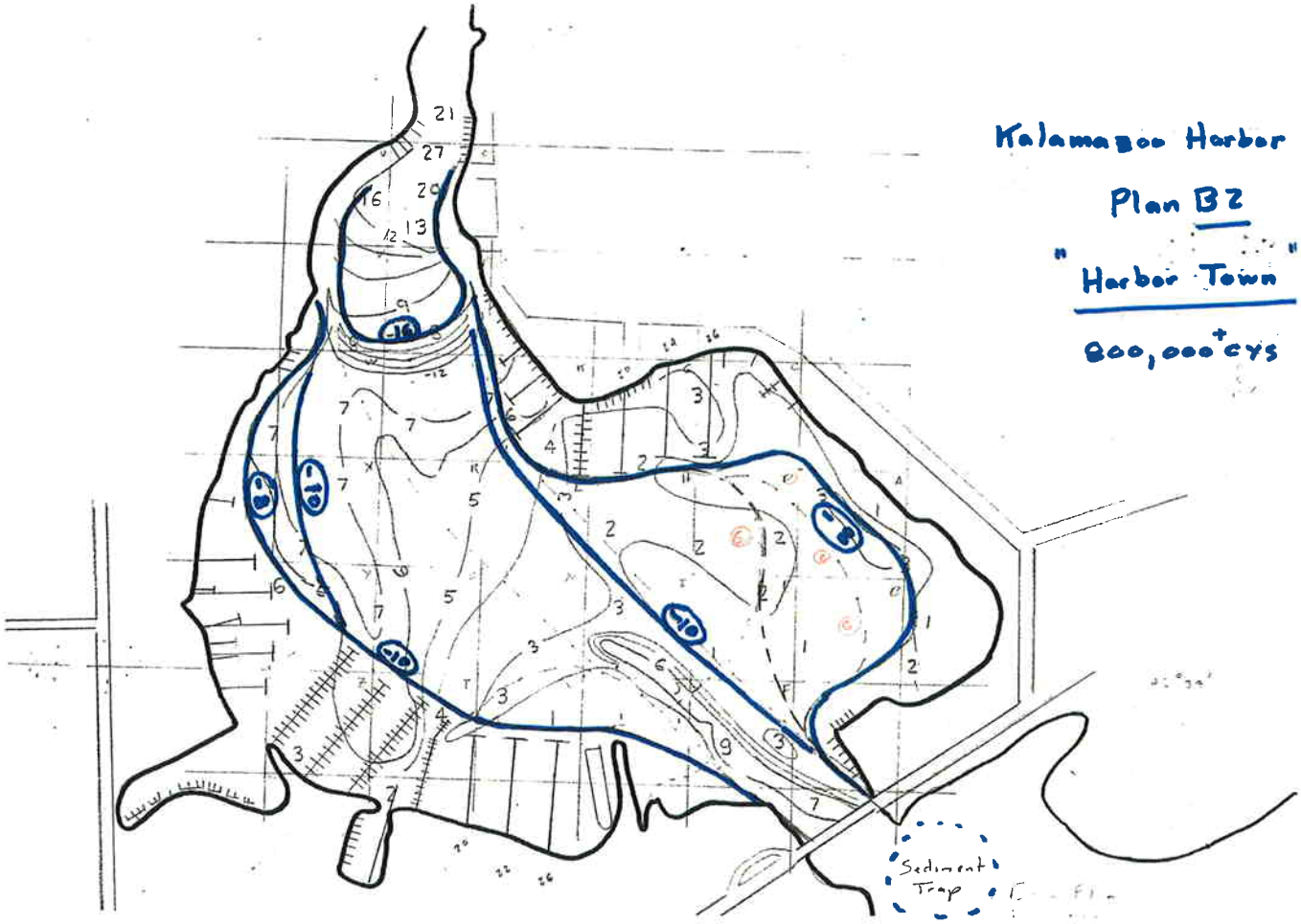


Kalamazoo Harbor

Plan B1

"Harbor Town"

800,000 cys



Kalamazoo Harbor

Plan B2

"Harbor Town"

800,000+ cys

KALAMAZOO HARBOR STUDY

JJR No. 24894.000 28-Dec-06

Grain Size Summary from Tower Marine Dredge Spoil Basin

Report by Camp Dresser & McKee, Jan 30, 2001

Note:
Per Tower Marine, dredge spoils in this basin came from the turning basin, Saugatuck city dock, chain ferry and Tower Marina in Kalamazoo Harbor.

Specimen No.	Percentage				
	Clay	Silt	Sand	Gravel	
33241	23	33	44	0	
33233	1	16	83	0	
33231	2	15	82	0	
33229	0	25	75	0	
33227	6	26	67	0	
33226	20	26	53	0	
33232	20	24	56	0	
33240	1	11	89	0	
33228	21	43	36	1	
33230	27	40	32	0	
33237	16	27	53	4	
33236	27	28	45	0	
33235	30	29	42	0	
33238	22	20	58	0	
33239	7	20	68	5	
33234	9	47	44	0	
	232	430	927	10	1599
	14.5%	26.9%	58.0%	0.6%	100.0%

41.4% Clay/Silt	58.6% Fine to Coarse Sand

Note:
The majority of the sand was fine sand with less medium sand and minimal coarse sand.

KALAMAZOO HARBOR STUDY

JJR No. 24894.000 28-Dec-06

Grain Size Summary from Tower Marine Dredge Spoil Basin
Report by Camp Dresser & McKee, Jan 30, 2001

Note:
Per Tower Marine, dredge spoils in this basin came from the turning basin, Saugatuck city dock, chain ferry and Tower Marina in Kalamazoo Harbor.

Specimen No.	Percentage				
	Clay	Silt	Sand	Gravel	
33241	23	33	44	0	
33233	1	16	83	0	
33231	2	15	82	0	
33229	0	25	75	0	
33227	6	26	67	0	
33226	20	26	53	0	
33232	20	24	56	0	
33240	1	11	89	0	
33228	21	43	36	1	
33230	27	40	32	0	
33237	16	27	53	4	
33236	27	28	45	0	
33235	30	29	42	0	
33238	22	20	58	0	
33239	7	20	68	5	
33234	9	47	44	0	
	232	430	927	10	1599
	14.5%	26.9%	58.0%	0.6%	100.0%

41.4% Clay/Silt	58.6% Fine to Coarse Sand

Note:
The majority of the sand was fine sand with less medium sand and minimal coarse sand.

Per RJ Peterson
Dredged from:

- Turning Basin
- City Dock / Chain Ferry
- Tower Marine

1.0 INTRODUCTION

This report summarizes sampling of dredged spoil material from Kalamazoo Lake near Douglas, Michigan. On November 2, 2000, various representatives (from Michigan Department of Environmental Quality (MDEQ), Equity Resource Environmental, Environmental Resource Management, Camp Dresser & McKee (CDM) and the property owner) conducted a site reconnaissance of the dredge spoils lagoon, located near the Tower Marine Marina. In addition to the site reconnaissance, representatives from CDM and MDEQ collected samples from the dredged spoils for chemical analysis.

The purpose of the site reconnaissance and sampling was to determine the origin of the spoil material, the chemical composition (particularly polychlorinated biphenyl (PCBs) levels), and the suitability of these dredged spoils material for reuse and future disposition of the dredged material.

2.0 SAMPLING RATIONAL AND ACTIVITIES

Prior to initiating any sampling, CDM and MDEQ staff placed wooden reference markers around the perimeter of the dredge spoil lagoon. Each of the reference markers were referenced with a hand held Global Positioning System (GPS) unit.

Based on the information provided by R.J. Peterson (Property Owner), Bill Burr (Equity Resource Environmental), and Tom Brunelle (Environmental Resources Management) in a meeting conducted prior to the sampling event, it was determined that the material within the dredge spoil lagoon was likely stratified into fine material overlying a coarser fraction, roughly equal in volume. The number of soil samples to collect from the dredge spoils lagoon was determined based on the dredge spoil sampling rule (MDEQ-Waste Management Division) of 6 samples per 10,000 cubic yards and one sample for each additional 10,000 cubic yards. The volume of the dredge spoils lagoon was estimated based on the assumption that the area of the lagoon was approximately 400' x 250' and the depth of the dredge spoil material was approximately 6'. Using these dimensions, the estimated volume of the lagoon was approximately 22,000 cubic yards. Therefore, it was determined that soil samples should be collected from 8 locations. Each sampling location was referenced with a hand-held GPS unit.

Soil samples were collected for laboratory analysis using a decontaminated stainless steel hand auger, a decontaminated stainless steel spoon, and dedicated aluminum pans. The eight sample locations were designated HA-1, HA-2, HA-3, HA-4, HA-5, HA-6, HA-7, and HA-8. There were two samples collected at each of the eight locations except at HA-2 where three samples were collected. At each location a sample was collected at a depth of 2 to 3 feet below the surface of the lagoon. This sample consisted of black silty muck. Another sample was collected at each of the eight locations from the sandy material immediately below the silty muck generally at a depth of 6 to 7 feet below the surface of the lagoon. However, the sandy sample collected from HA-5 was very fine grained and the sample collected from the material below the black sandy silt at HA-8 was a black silt with little to no sand content. A third sample was collected at HA-2 from a depth of 4.5 to 5.0 feet. This sample was dark gray and appeared to contain paper residual material.

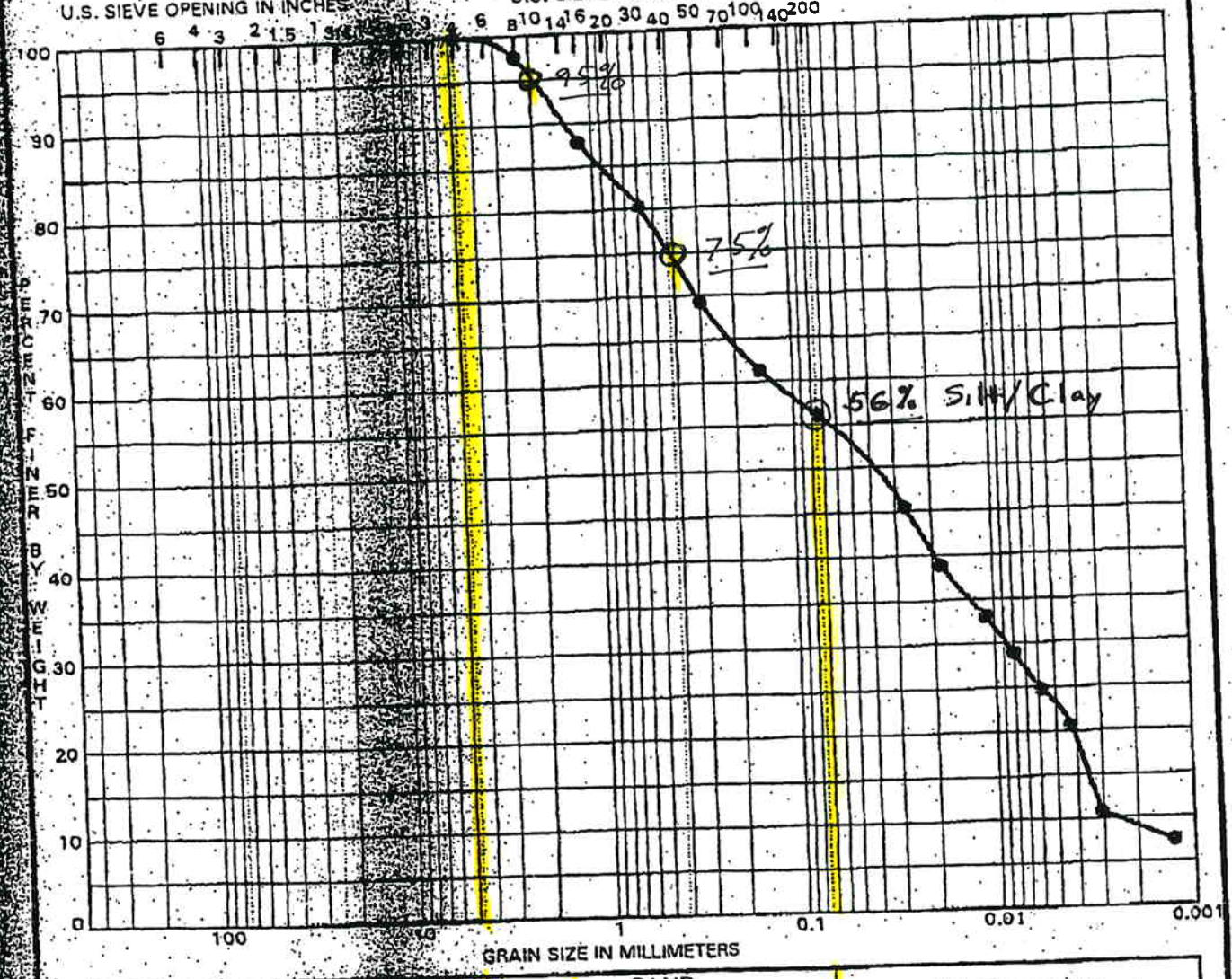
ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge [illegible] Douglas, MI. 1785-28963
CLIENT Northeast Analytical, Inc.

REPORT NO. AT332S-4-11-00
DATE 11/08/00

HYDROMETER



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33241	Tower [illegible] SF 7-7.5 feet						

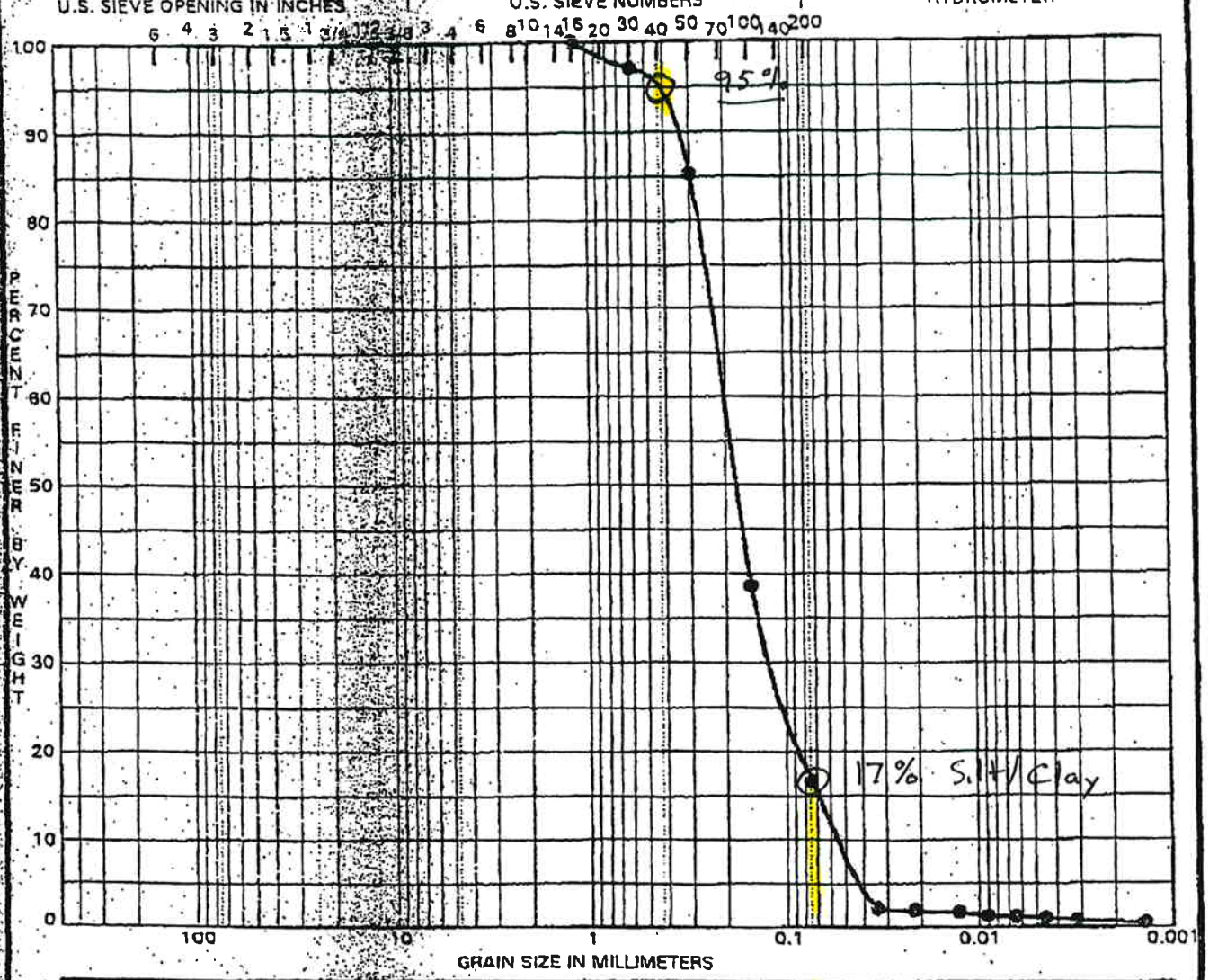
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33241	4.75	0.13	0.009	0.0026	0	44	33	23

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge Supply, Oculus, MI. 1785-28963
CLIENT Northeast Analytical, Inc.

REPORT NO. AT332S-4-11-00
DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

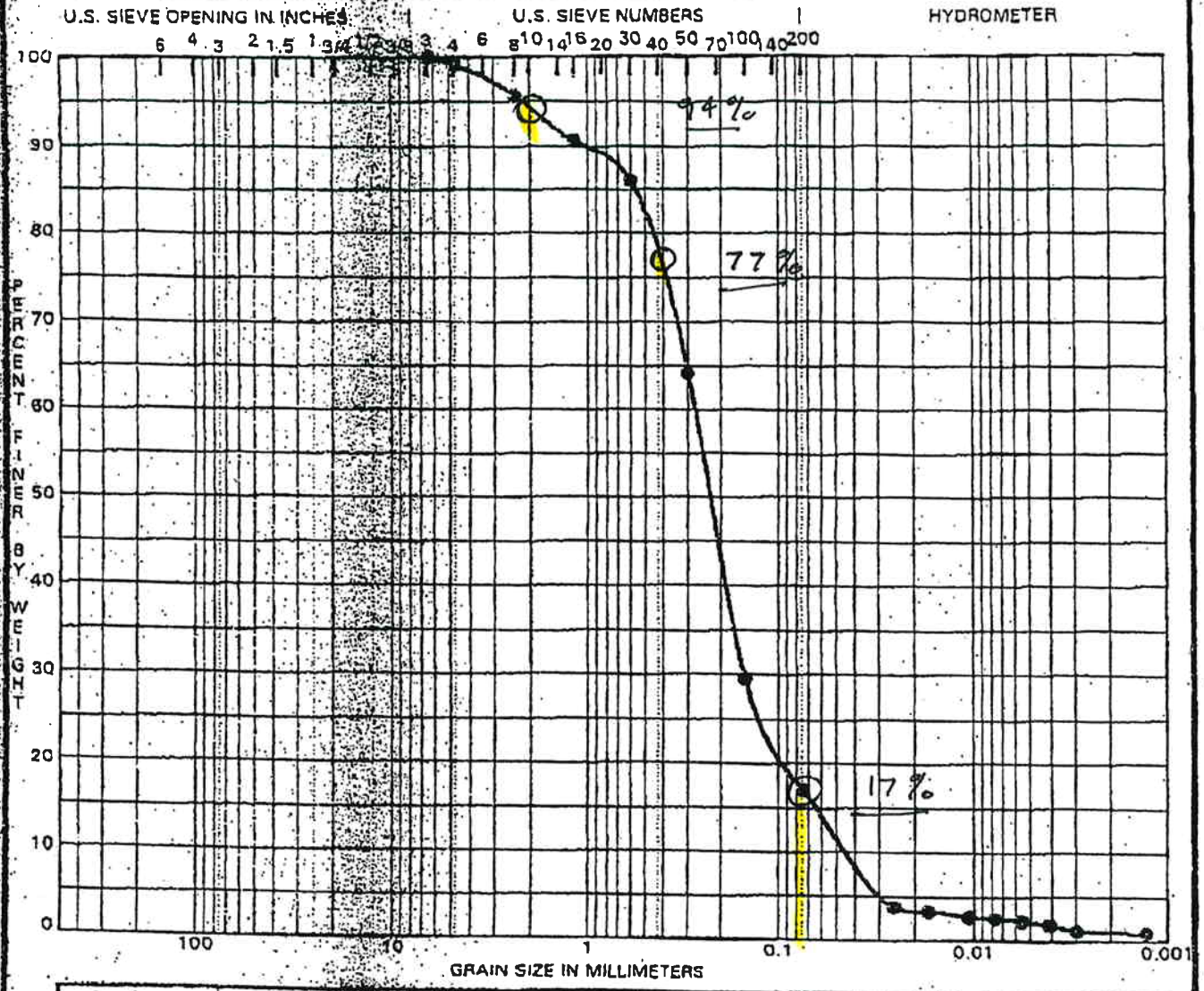
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33233	Tower Dr. 4C: 3.5-4.5 feet						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33233	1.19	0.21	0.114	0.0522	0	83	16	1

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge [illegible] Douglas, MI. 1785-28963 REPORT NO. AT332S-4-11-00
CLIENT Northeast Analytical, Inc. DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

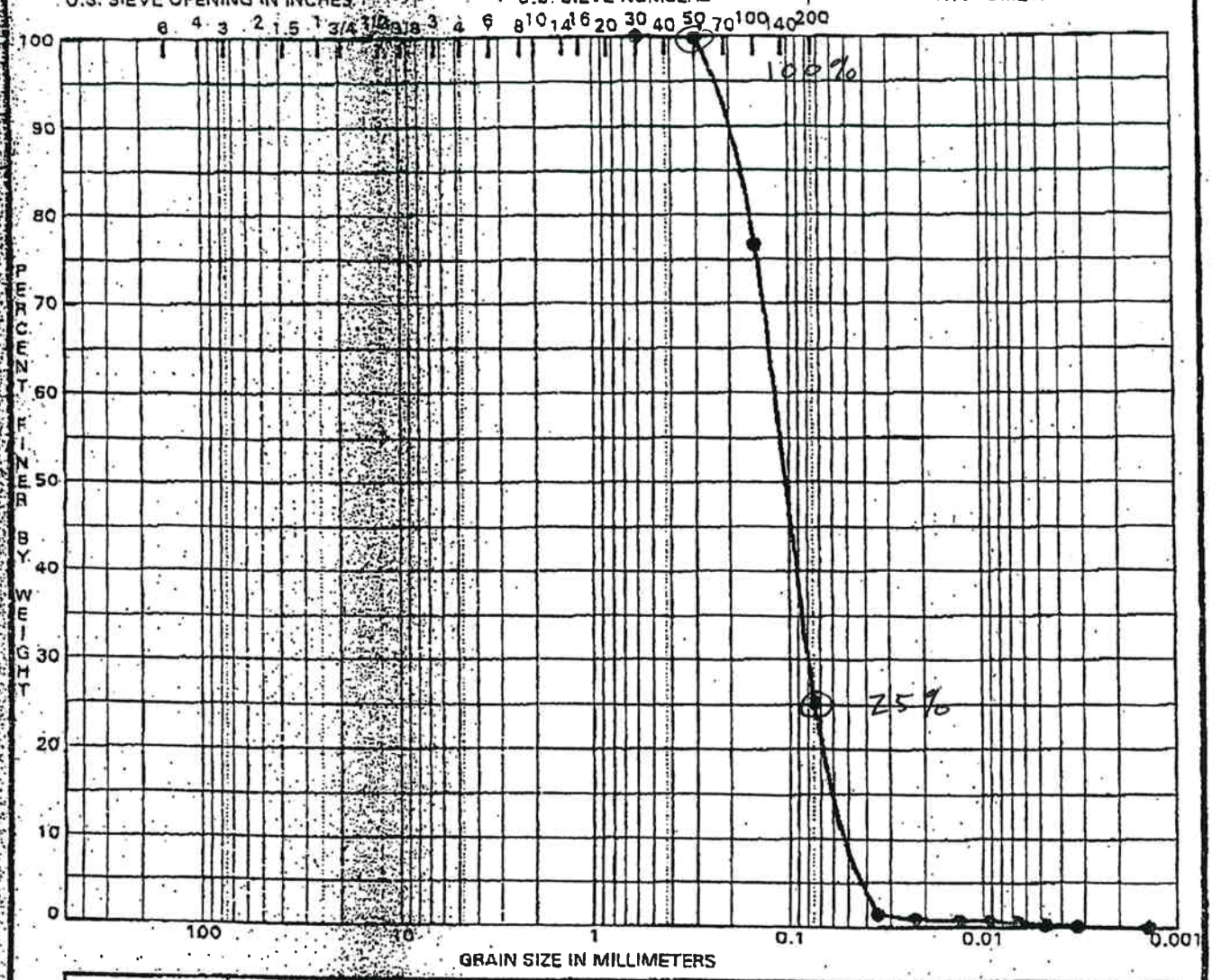
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33231	Tower 14-3C: 4-4.5 feet						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33231	6.35	0.28	0.152	0.0421	1	82	15	2
6.35 →								

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge [illegible], Douglas, MI. 1785-28963 REPORT NO.: AT332S-4-11-00
CLIENT Northeast Analytical, Inc. DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

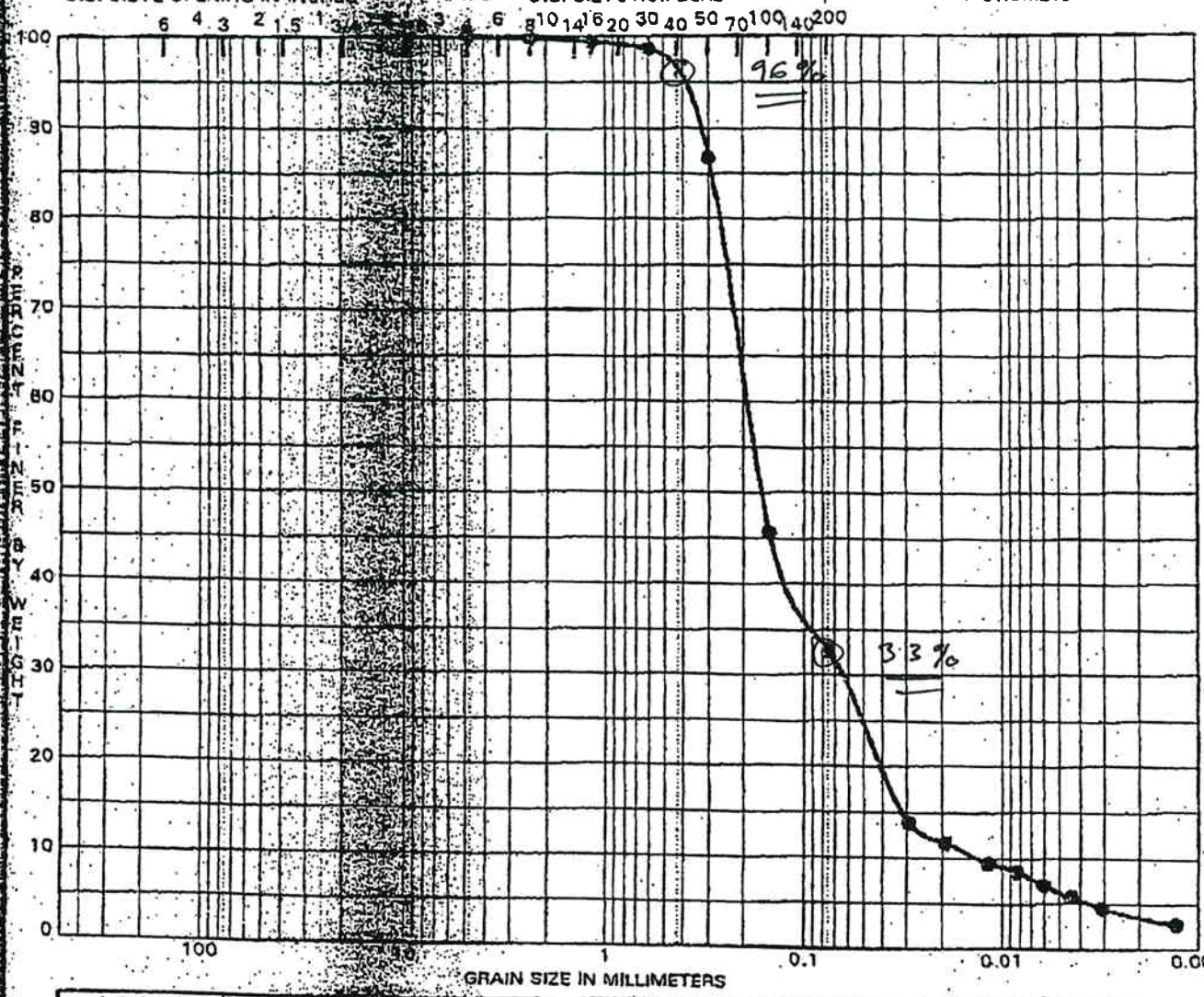
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33229	Tower/12-2C: 5-6 feet						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33229	0.30	0.12	0.080	0.0462	0	75	25	0
.60 -7								

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge [illegible] Douglas, MI. 1785-28963 REPORT NO. AT332S-4-11-00
CLIENT Northeast Analytical, Inc. DATE 11/08/00



COBBLES	GRAVEL (coarse, medium, fine)	SAND (coarse, medium, fine)	SILT OR CLAY

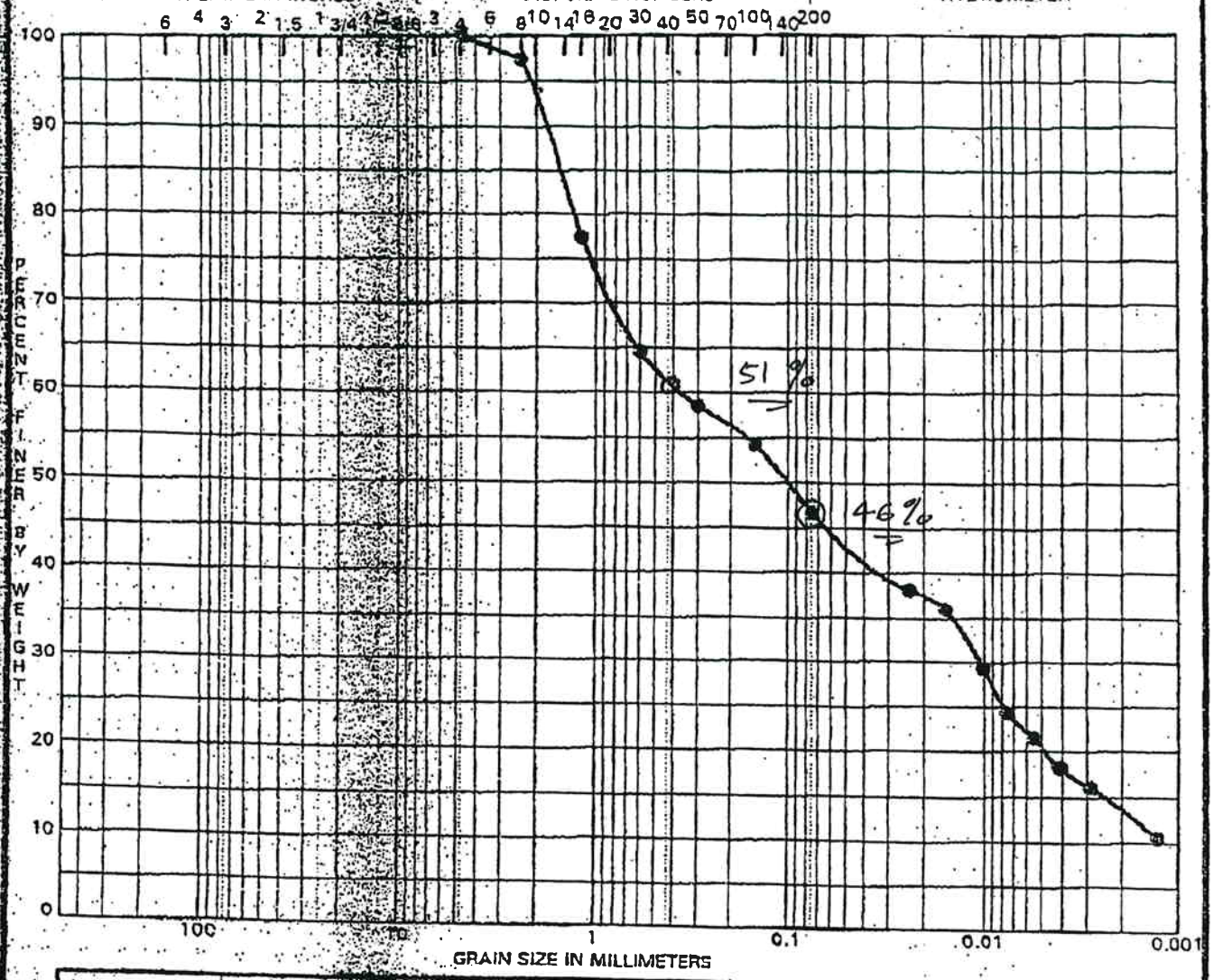
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33227	Tower [illegible] TC: 6-7 feet						

Specimen Identification	D75	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33227	4.75	0.19	0.066	0.0131	0	67	26	6

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge Spoil, Douglas, MI. 1785-28963 REPORT NO. AT332S-4-11-00
CLIENT Northeast Analytical, Inc. DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

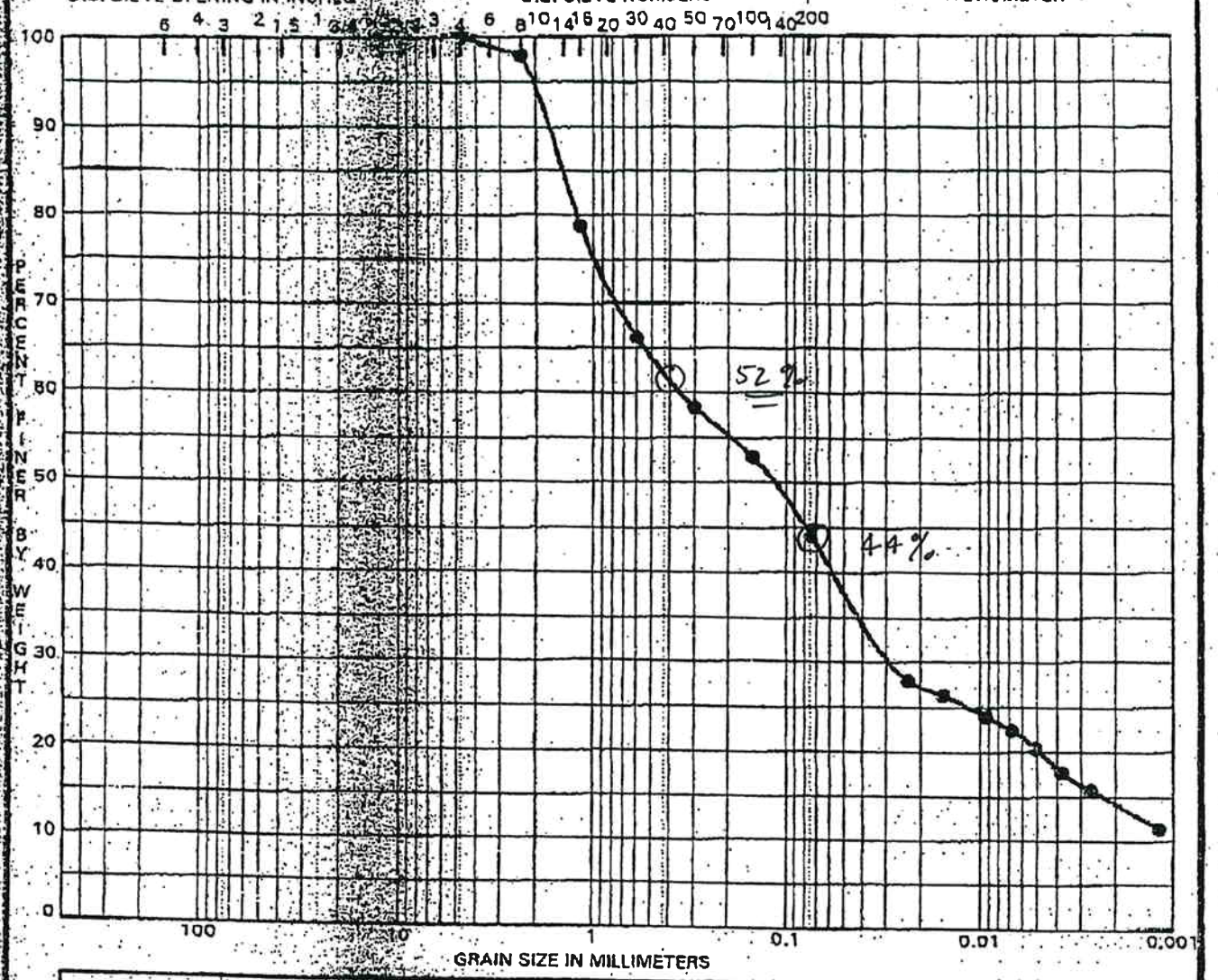
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33226	Tower [illegible] 1F; 2-3 feet						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33226	4.75	0.36	0.011		0	53	26	20
4.75 → 1								

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge [illegible] Douglas, MI. 1786-28963 REPORT NO. AT332S-4-11-00
CLIENT Northeast Analytical, Inc. DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

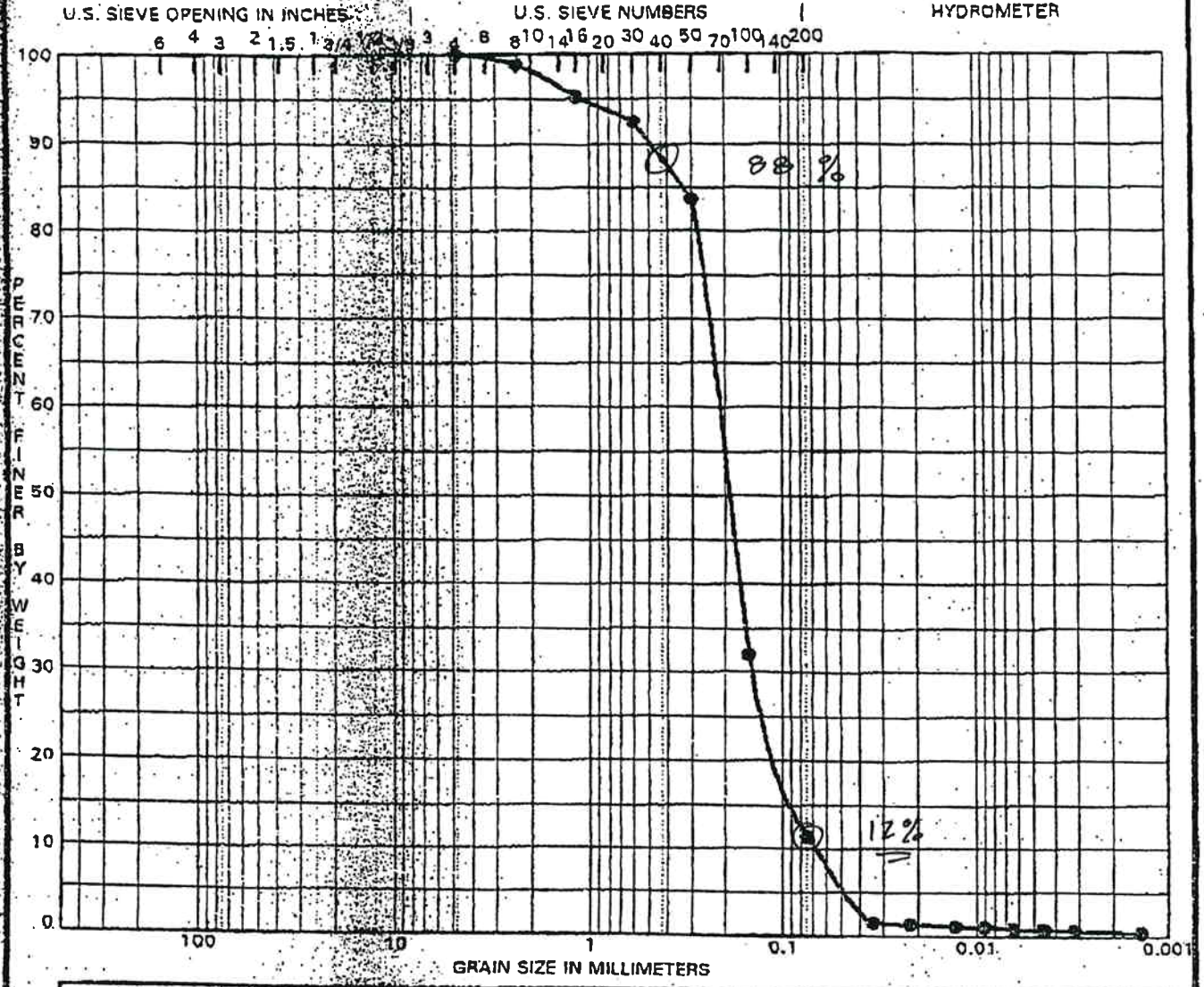
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33232	Tower Dock 4ft 2-3 feet						

Specimen Identification	D75	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33232	4.75	0.35	0.027		0	56	24	20
4.75 - 7								

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge Spoil, Douglas, MI. 1785-28963 REPORT NO. AT332S-4-11-00
CLIENT Northeast Analytical, Inc. DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

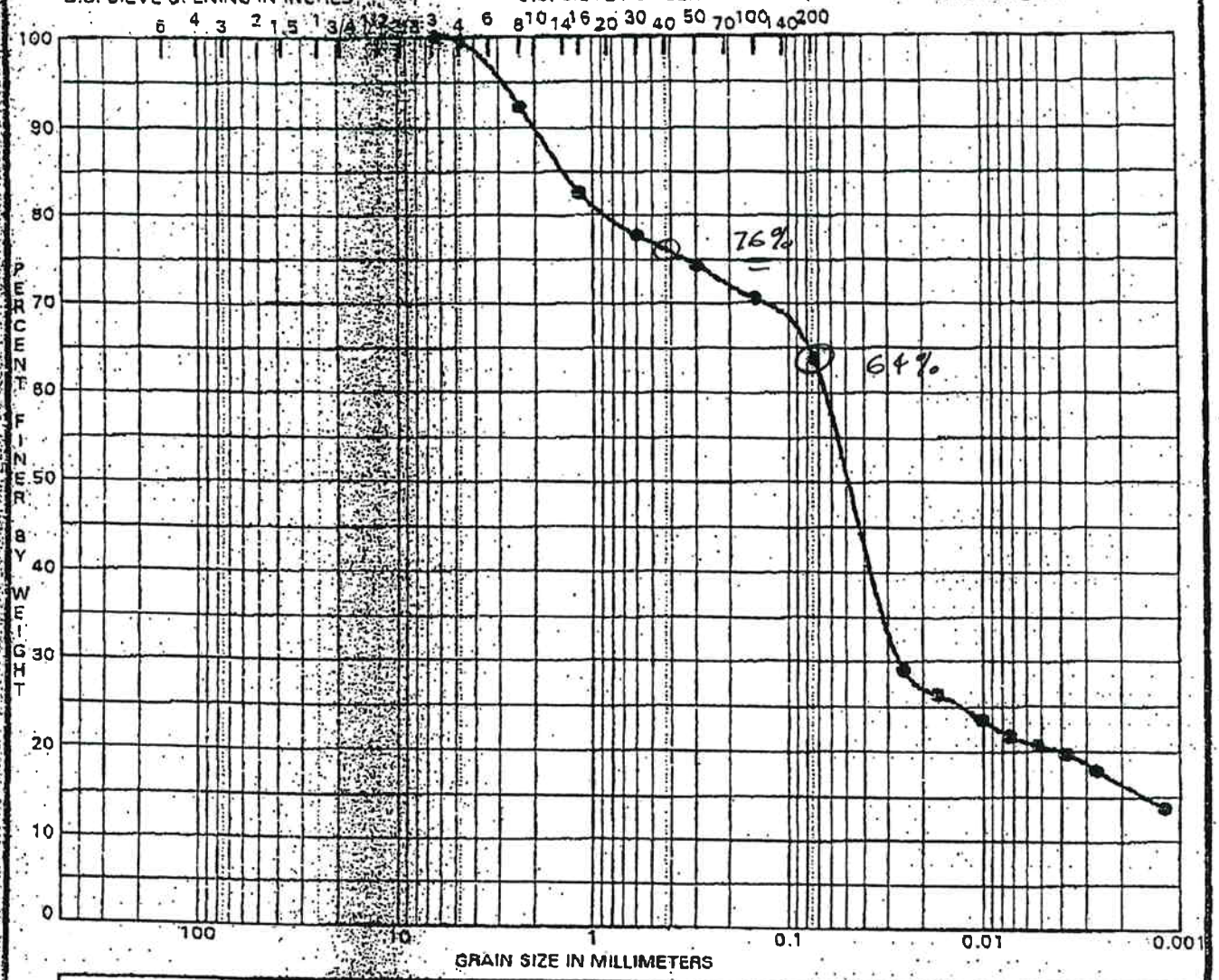
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33240	Tower 2A-SF: 3-4 feet					1.29	3.1

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33240	4.75	0.22	0.140	0.0671	0	89	11	1
4.75 ↗								

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge Spoils, Douglas, MI. 1785-28963 REPORT NO. AT332S-4-11-00
CLIENT Northeast Analytical, Inc. DATE



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

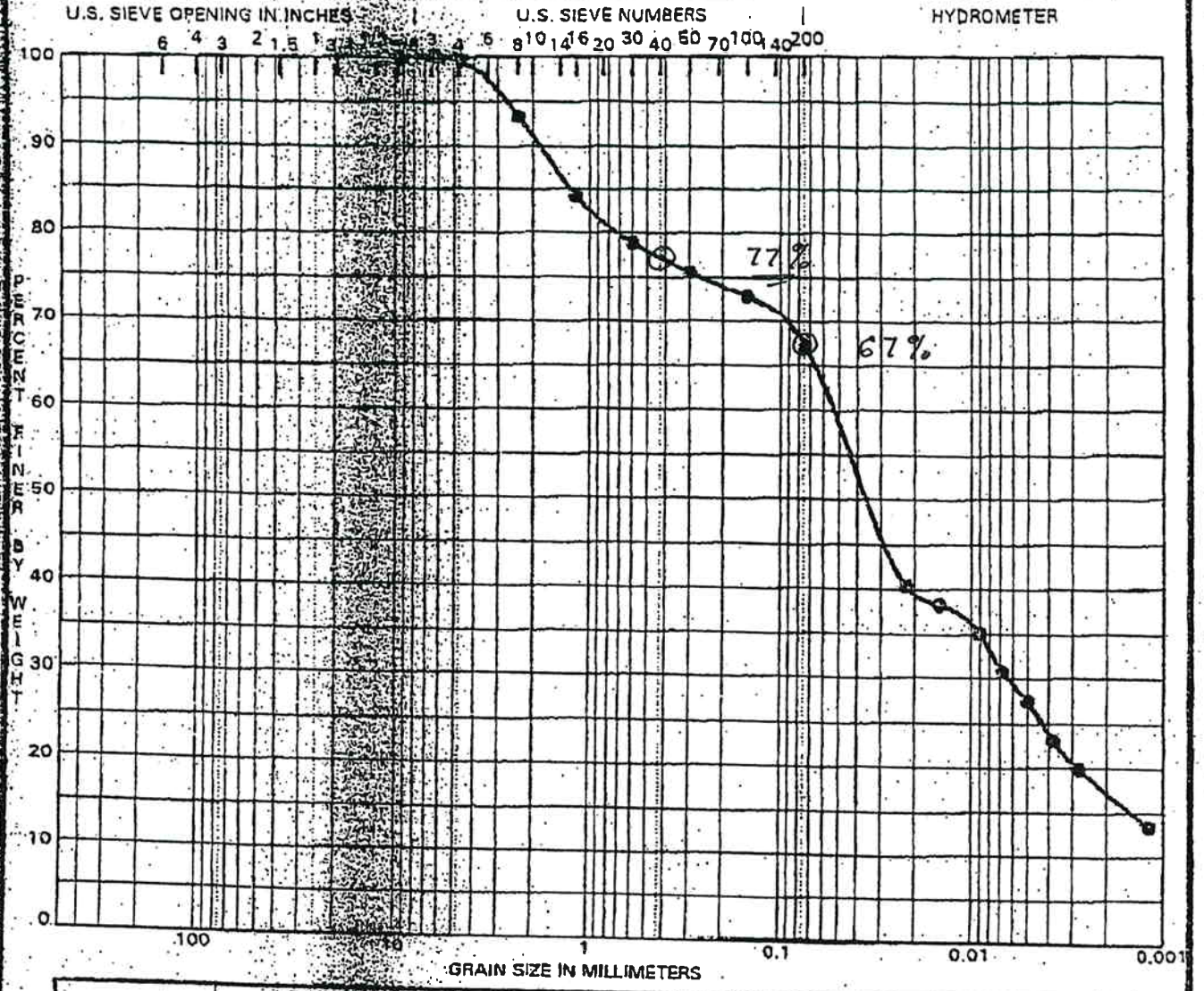
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33228	Tower 1A-2F: 2-3 feet						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33228	6.35	0.07	0.026		1	36	43	21
6.35 → 7								

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge Spoils, Douglas, MI. 1785-28963 REPORT NO. AT332S-4-11-00
CLIENT Northeast Analytical, Inc. DATE 11/08/00



COBBLES	GRAVEL (coarse / fine)	SAND (coarse / medium / fine)	SILT OR CLAY

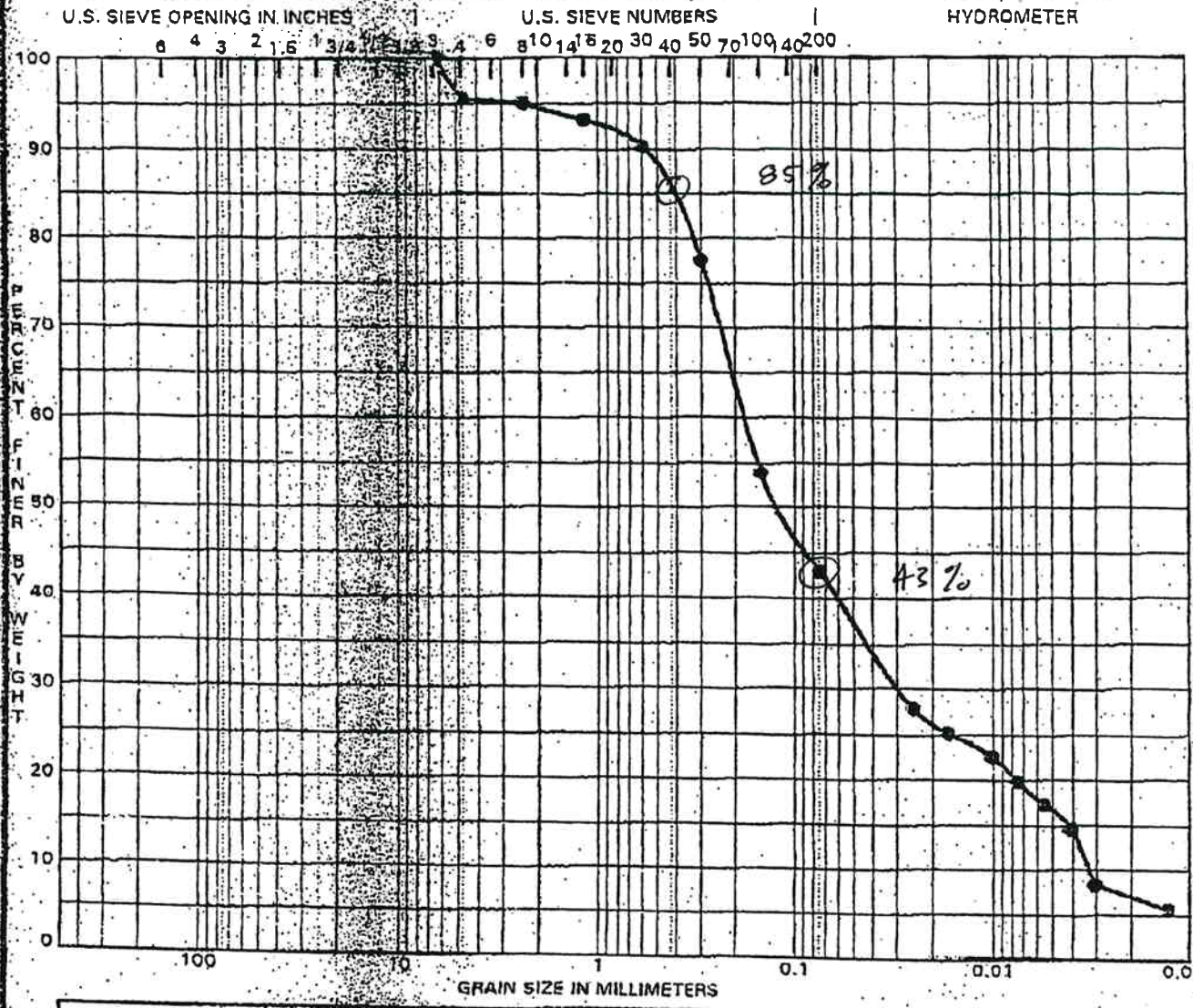
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33230	Tower Dredge Spoils 2-3 feet						

Specimen Identification	D[illegible]	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33230	[illegible]	0.05	0.007		0	32	40	27
6.35 →								

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Drados S[illegible] Douglas, MI. 1785-28983 REPORT NO. AT332S-4-11-00
CLIENT Northeast Analytical, Inc. DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

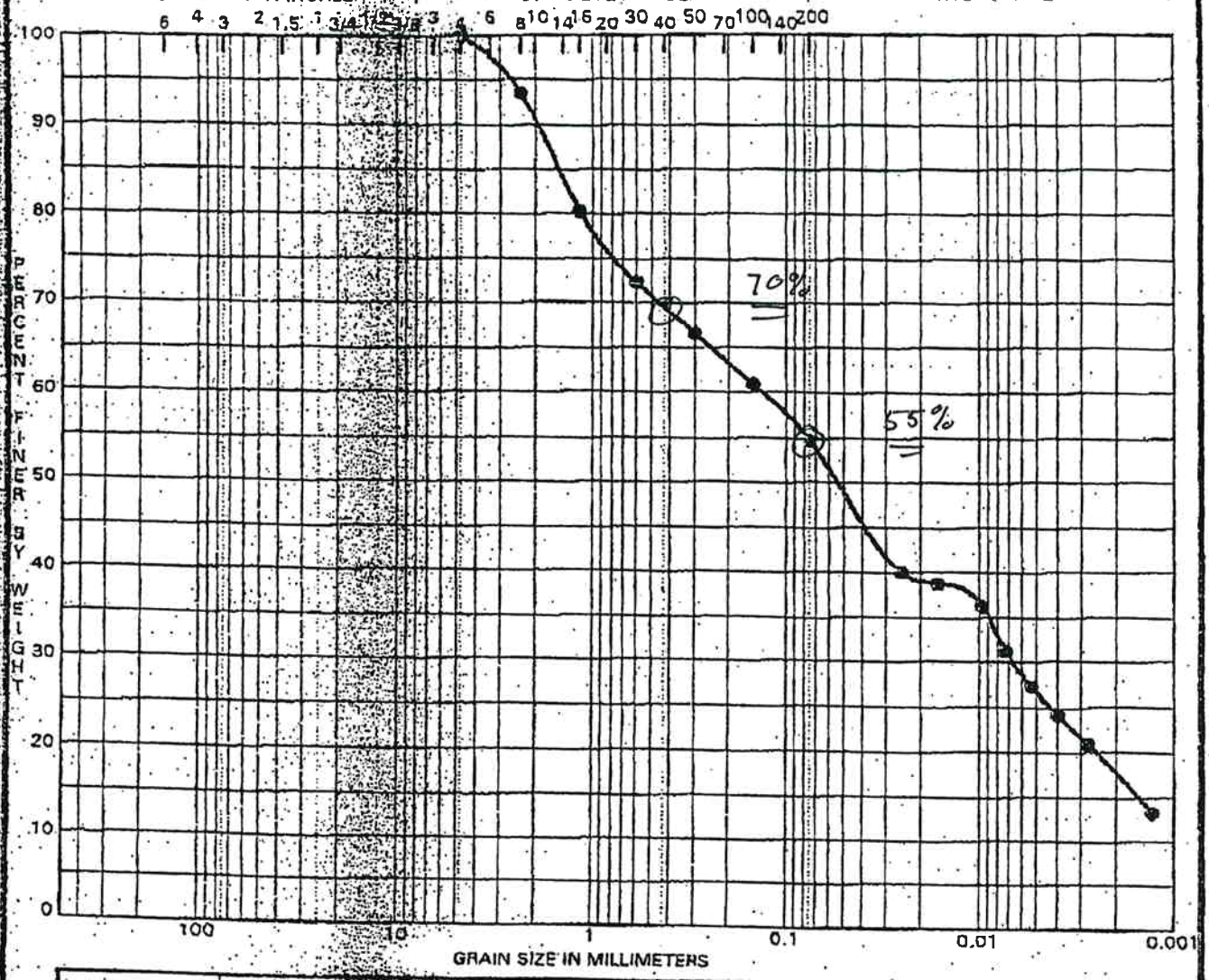
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33237	Tower [illegible]; 5-5.5 feet						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33237	6.35	0.18	0.030	0.0033	4	53	27	16
6.35 →								

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge Spoil - Douglas, MI. 1785-28963 REPORT NO. AT332S-4-11-00
CLIENT Northeast Analytical, Inc. DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33236	Tower S.S. SF: 3.5-4.5 feet						

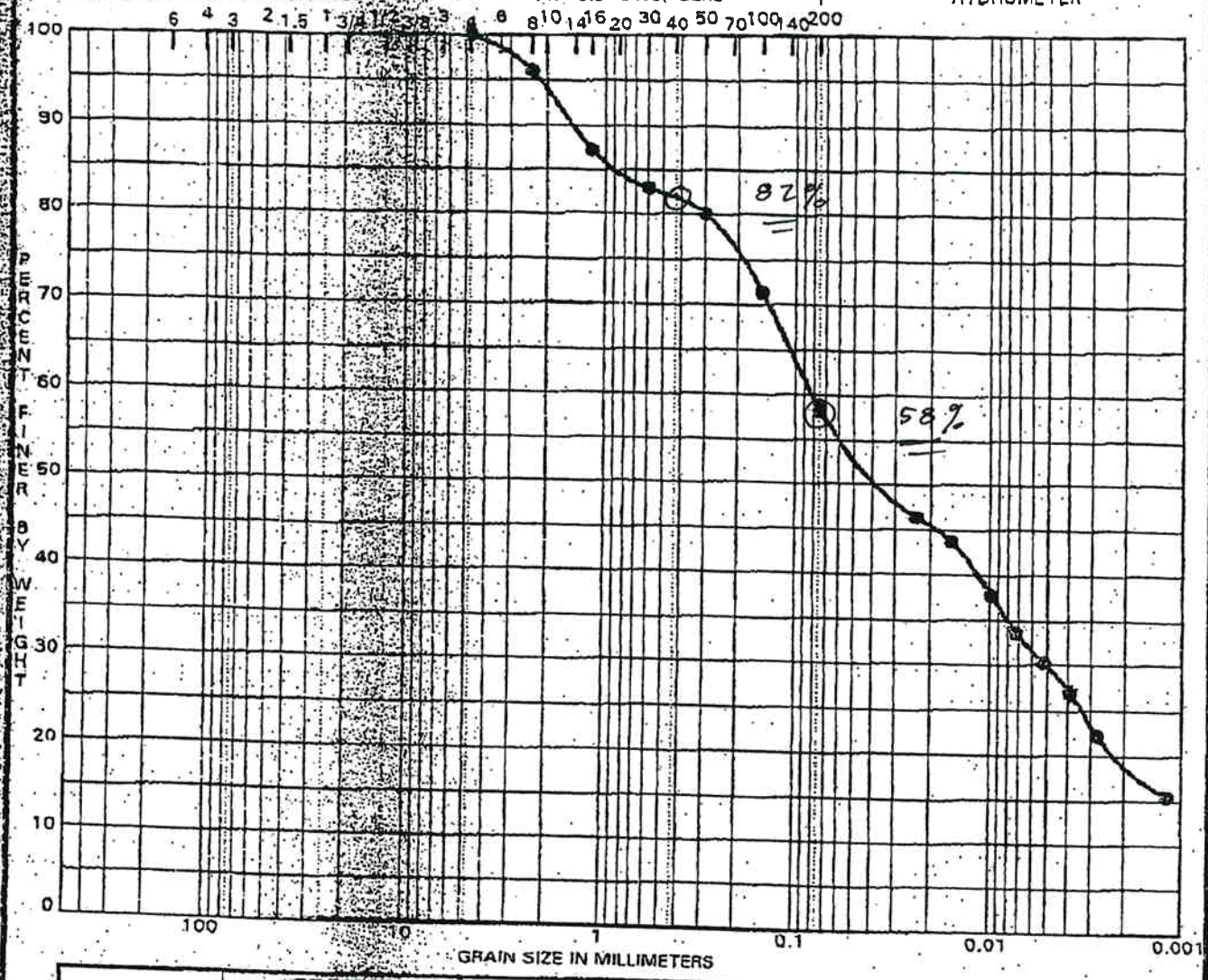
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33236	4.75	0.14	0.007		0	45	28	27
4.75 →								

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge S[illegible] Douglas, MI. 1785-28963
CLIENT Northeast Analytical, Inc.

REPORT NO. AT332S-4-11-00
DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

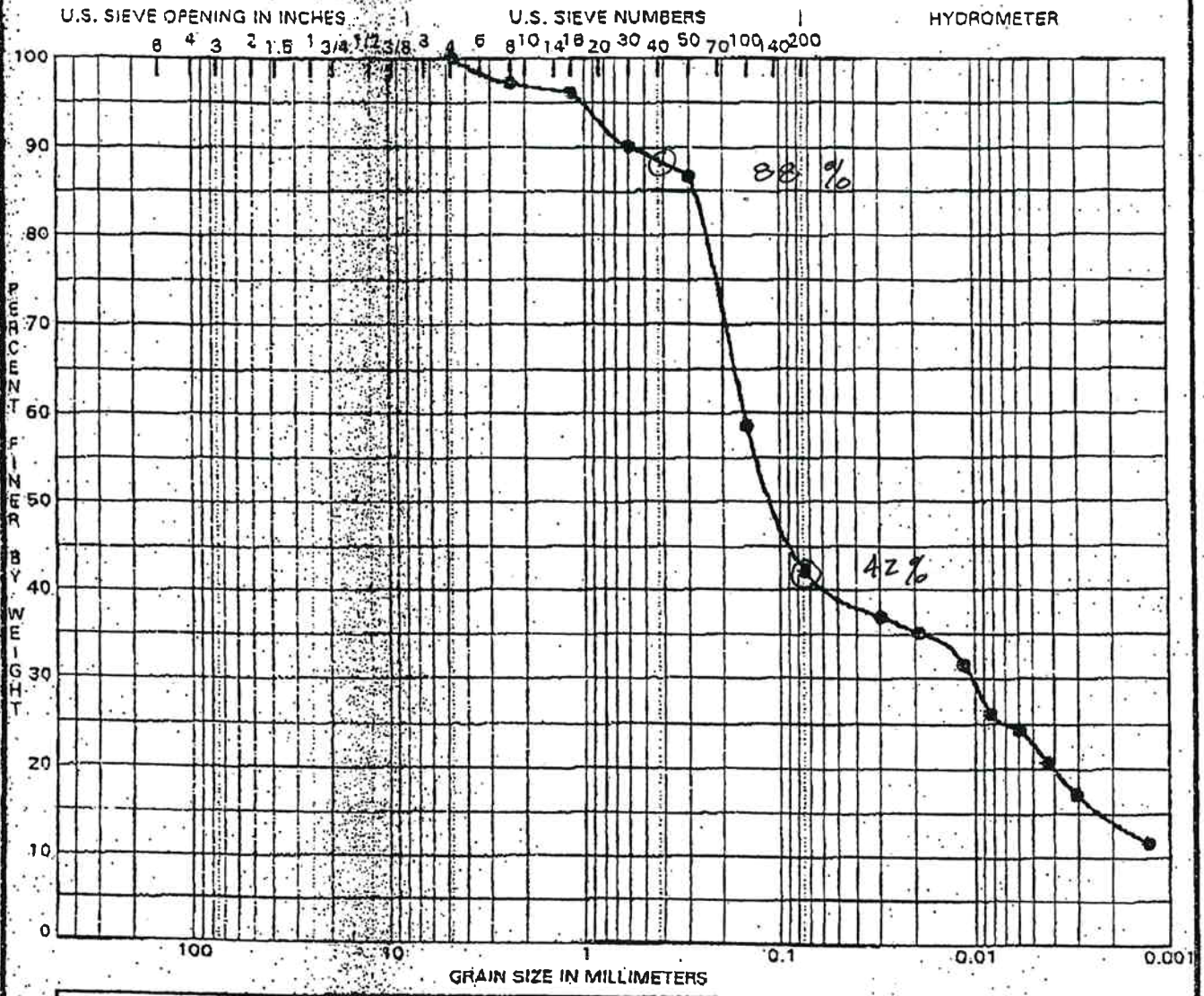
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
33235	Tower [illegible] 8-7 feet						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
33235	4.75	0.08	0.005		0	42	29	30
4.75 ↗								

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge Spoils, Douglas, MI. 1785-28963 REPORT NO. AT332S-4-11-00
CLIENT Northeast Analytical Inc. DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	33238	Tower 3S-7F: 3-3.5 feet						

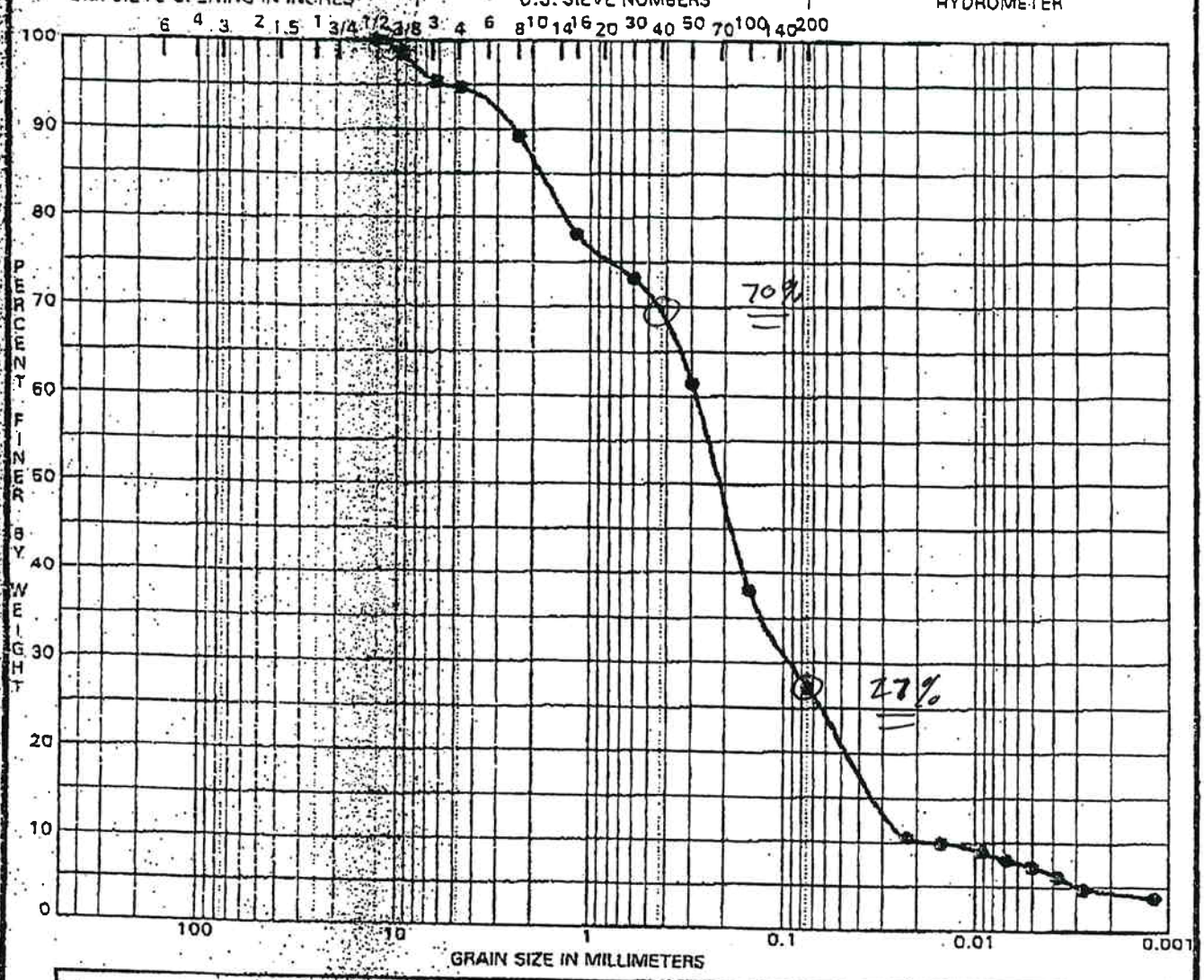
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	33238	4.75	0.16	0.011		0	58	20	22
		4.75 ↗							

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge Spoils, Douglas, MI. 1785-28963
CLIENT Northeast Analytical, Inc.

REPORT NO. AT332S-4-11-00
DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

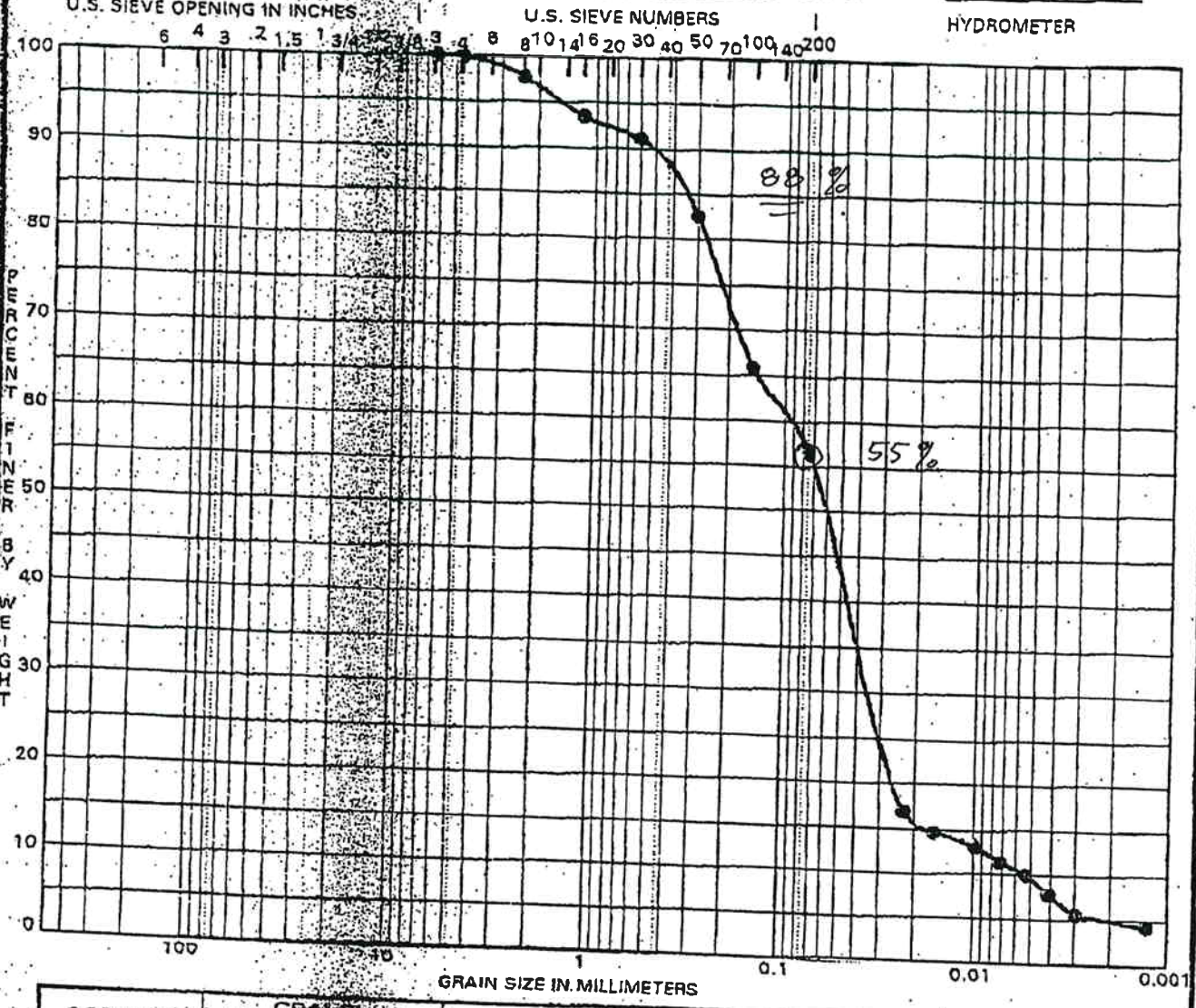
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 33239	Tower HA-2C: 5-5.5 feet						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 33239	12.50	0.29	0.090	0.0151	5	68	20	7
12.50 ↗								

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT Tower Dredge Spoils, Douglas, MI. 1785-28963
CLIENT Northeast Analytical, Inc.
REPORT NO. AT332S-4-11-00
DATE 11/08/00



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
33234	Tower ; HA-5F ; 2-3 feet						
	Tower ; HA-5F ; 2'-3'						

Specimen Identification	D150	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
33234	6.35	0.10	0.034	0.0054	0	44	47	9

KALAMAZOO HARBOR STUDY

JJR No. 24894.000 28-Dec-06

Grain Size Summary from Turning Basin at the Outlet of the Harbor

Report by Dell Engineering (ERM), May 10, 1999

Note:
Samples 9905 and 9906 were adjacent to the shoreline and may represent native soils more than sediment and therefire were not included below.

Sample ID	Percentage				
	Clay / Silt	Fine Sand	Medium Sand	Coarse Sand /Gravel	
9901	47.5	35.8	14.7	2.0	
9902	56.6	30.9	12.5	0.0	
9903	37.7	36.9	23.7	1.8	
9904	46.3	33.9	19.9	0.0	
	188.1	137.5	70.8	3.8	400.2
	47.0%	34.4%	17.7%	0.9%	100.0%

47.0% Clay/Silt	53.0% Fine to Coarse Sand

DELL ENGINEERING, INC. FORM 2.2

SEDIMENT/SURFACE WATER SAMPLING RECORD

Project Name: Saugatuck-Douglas Convention and Visitors Bureau Project Number: X6101.00.01

Location: Saugatuck, Michigan Sample Number: SAU9906

Recorded By: Tom Brunelle Duplicate Number:

Site: Kalamazoo River - Berthing Area Date: 10 April 1999 Time: 10:50 AM

Sampling Equipment: Eckman Dredge

Sample Description: Gray fine sand, trace medium sand, trace clay, trace shells

Color: Gray

Odor: No odor

Water Depth: 11.6 feet

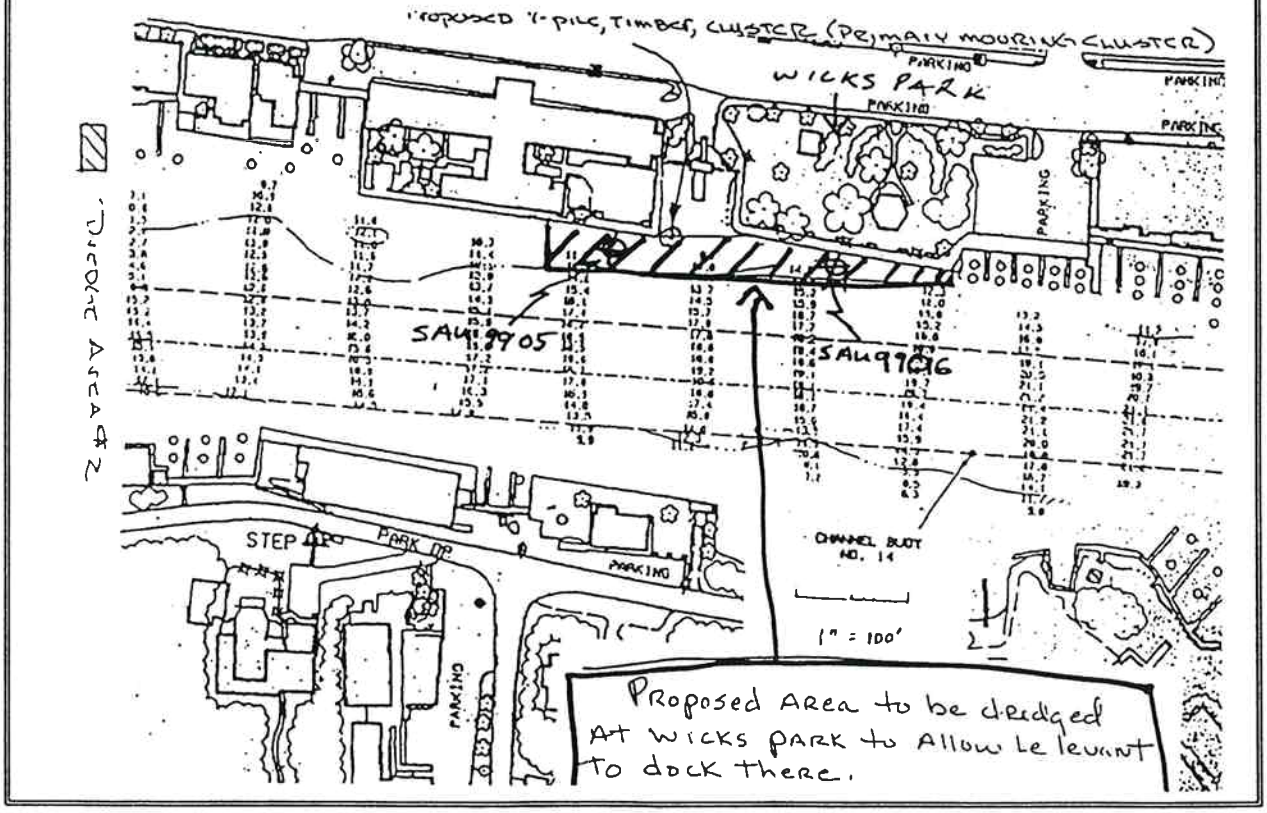
Depth Below Interface: 0 - 0.5 foot

Water Elevation (relative to 1955 Low Water Datum): 577.8 ft

Sampling Coordinates: N 42° 39.490', W 86° 12.366'

Comments: Sample contained trace of leaves and stems. Material too dense to obtain sample with corer.

Sample Point (Sketch)



DELL ENGINEERING, INC. FORM 2.2

SEDIMENT/SURFACE WATER SAMPLING RECORD

Project Name: Saugatuck-Douglas Convention and Visitors Bureau Project Number: X6101.00.01

Location: Saugatuck, Michigan Sample Number: SAU9905

Recorded By: Tom Brunelle Duplicate Number:

Site: Kalamazoo River - Berthing Area Date: 10 April 1999 Time: 10:15 AM

Sampling Equipment: Eckman Dredge

Sample Description: Gray fine sand, little medium sand, little gravel, trace clay

Color: Gray

Odor: No odor

Water Depth: 10.7 feet

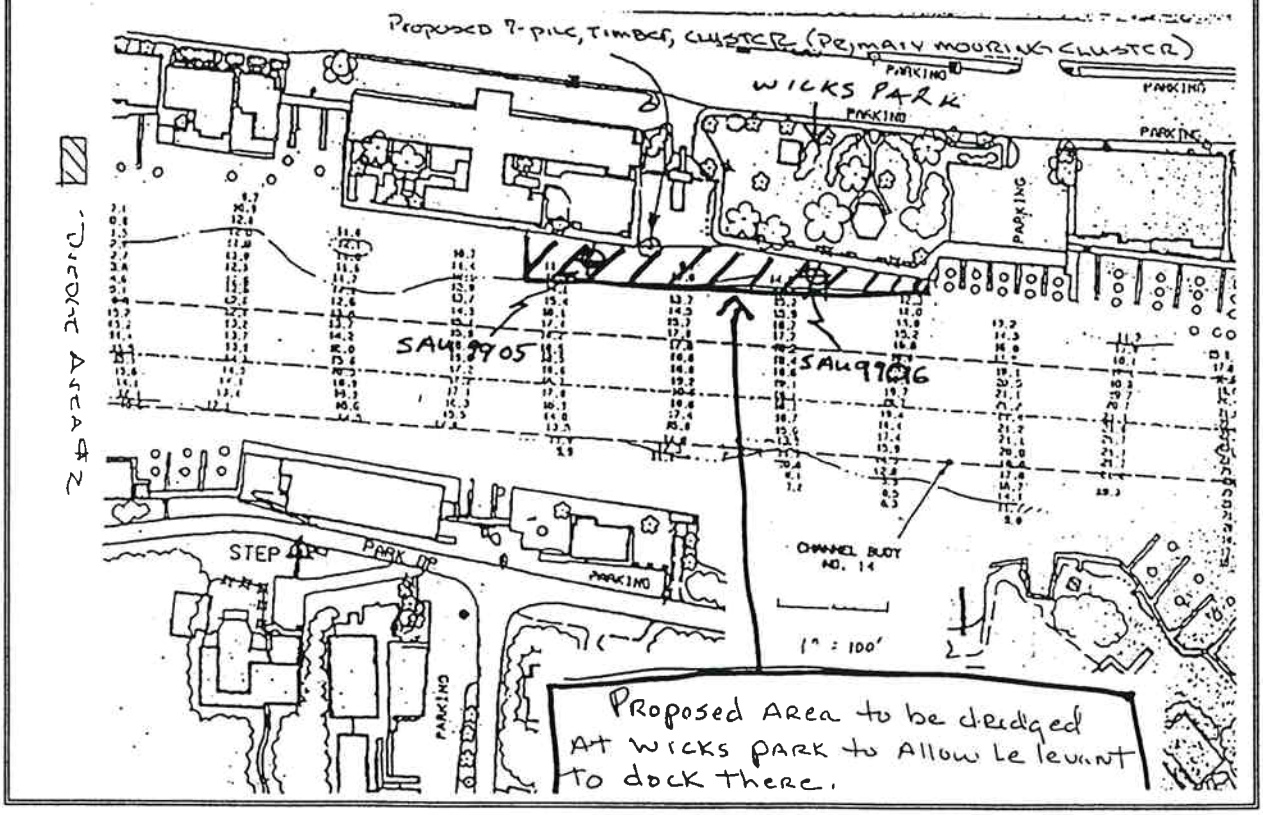
Depth Below Interface: 0 - 0.5 foot

Water Elevation (relative to 1955 Low Water Datum): 577.8 ft

Sampling Coordinates: N 42° 39.510', W 86° 12.358'

Comments: Sample contained piece of bone and piece of wood. Material too dense to obtain sample with corer

Sample Point (Sketch)



DELL ENGINEERING, INC. FORM 2.2

SEDIMENT/SURFACE WATER SAMPLING RECORD

Project Name: Saugatuck-Douglas Convention and Visitors Bureau Project Number: X6101.00.01

Location: Saugatuck, Michigan Sample Number: SAU9904

Recorded By: Tom Brunelle Duplicate Number:

Site: Kalamazoo River - Turning Area Date: 13 April 1999 Time: 9:05 AM

Sampling Equipment: Barrel Corer

Sample Description: Very loose, dark gray, organic clay, some organic particles, smooth texture

Color: Dark gray

Odor: Slight earthy odor

Water Depth: 10.8 feet

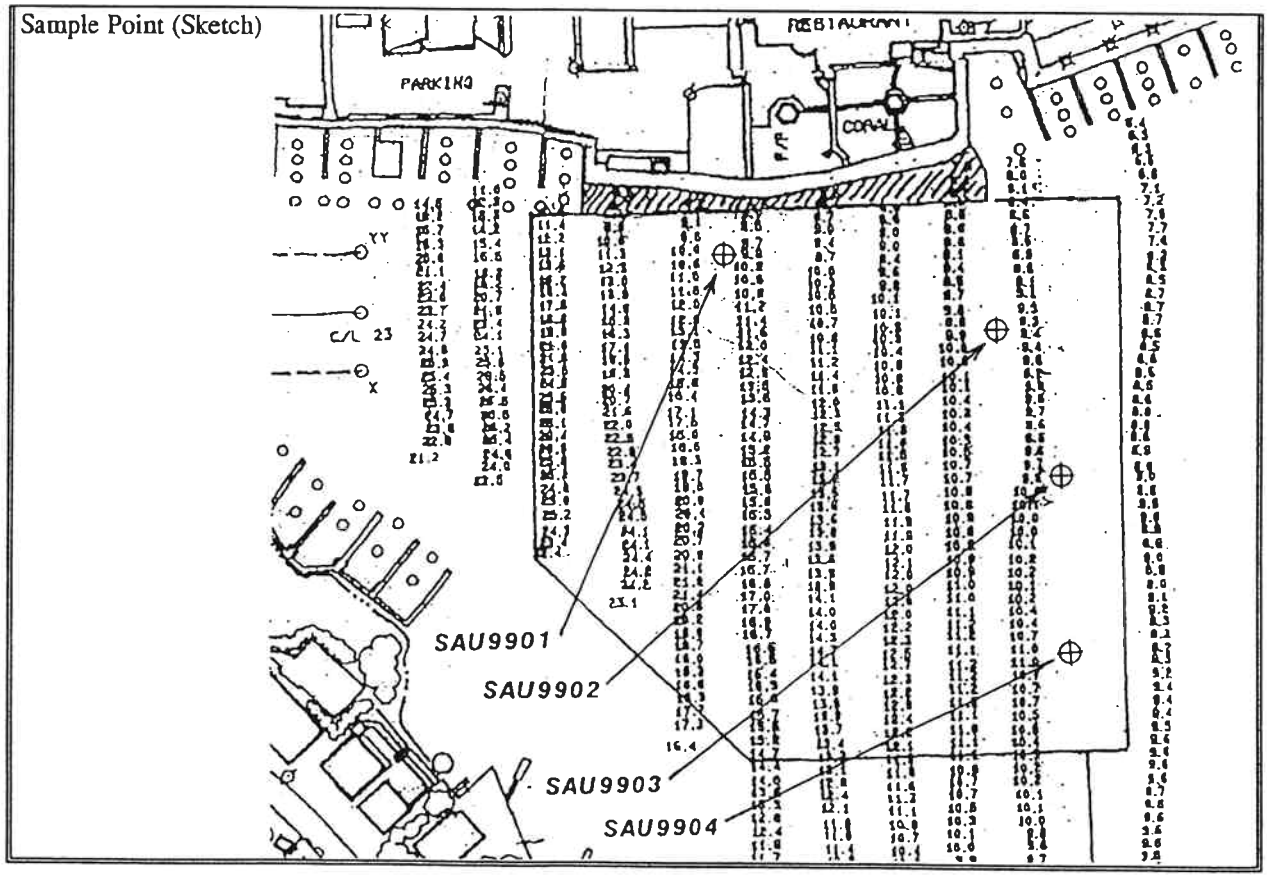
Depth Below Interface: 0 - 1.5 feet

Water Elevation (relative to 1955 Low Water Datum): 577.8 ft

Sampling Coordinates: N 42°39.316', W 86°12.464'

Comments:

Sample Point (Sketch)



DELL ENGINEERING, INC. FORM 2.2

SEDIMENT/SURFACE WATER SAMPLING RECORD

Project Name: Saugatuck-Douglas Convention and Visitors Bureau Project Number: X6101.00.01

Location: Saugatuck, Michigan Sample Number: SAU9903

Recorded By: Tom Brunelle Duplicate Number:

Site: Kalamazoo River - Turning Area Date: 13 April 1999 Time: 8:55 AM

Sampling Equipment: Barrel Corer

Sample Description: Very loose, dark gray, organic clay, some organic particles, smooth texture

Color: Dark gray

Odor: Slight earthy odor

Water Depth: 9.8 feet

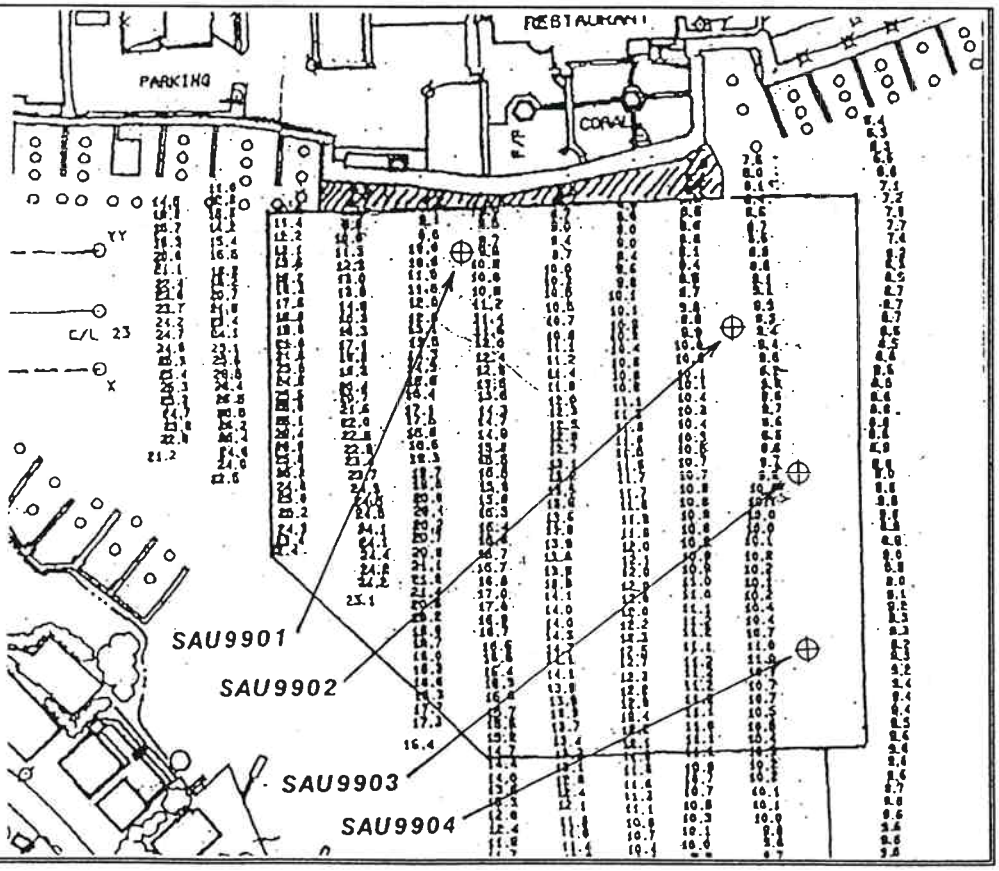
Depth Below Interface: 0 - 1.5 feet

Water Elevation (relative to 1955 Low Water Datum): 577.8 ft

Sampling Coordinates: N 42°39.211', W 86°12.368'

Comments:

Sample Point (Sketch)



DELL ENGINEERING, INC.

FORM 2.2

SEDIMENT/SURFACE WATER SAMPLING RECORD

Project Name: Saugatuck-Douglas Convention and Visitors Bureau Project Number: X6101.00.01

Location: Saugatuck, Michigan Sample Number: SAU9902

Recorded By: Tom Brunelle Duplicate Number:

Site: Kalamazoo River - Turning Area Date: 13 April 1999 Time: 8:42 AM

Sampling Equipment: Barrel Corer

Sample Description: Very loose, dark gray, organic clay, some organic particles, smooth texture

Color: Dark gray

Odor: Slight earthy odor

Water Depth: 10.7 feet

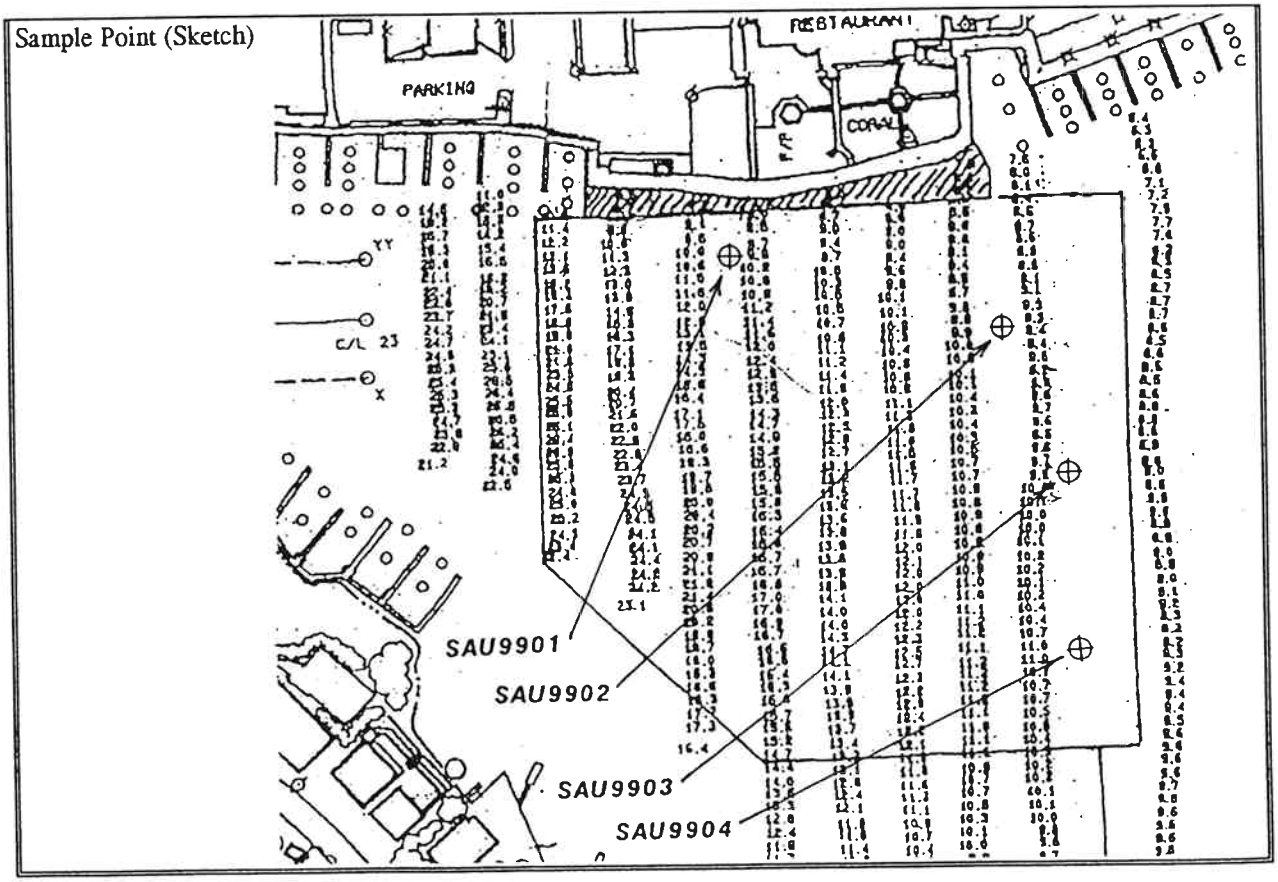
Depth Below Interface: 0 - 1.5 feet

Water Elevation (relative to 1955 Low Water Datum): 577.8 ft

Sampling Coordinates: N 42° 39.322', W 86° 12.357'

Comments:

Sample Point (Sketch)



DELL ENGINEERING, INC. FORM 2.2

SEDIMENT/SURFACE WATER SAMPLING RECORD

Project Name: Saugatuck-Douglas Convention and Visitors Bureau Project Number: X6101.00.01

Location: Saugatuck, Michigan Sample Number: SAU9901

Recorded By: Tom Brunelle Duplicate Number:

Site: Kalamazoo River - Turning Area Date: 13 April 1999 Time: 8:30 AM

Sampling Equipment: Barrel Corer

Sample Description: Very loose, dark gray, organic clay, some organic particles, smooth texture

Color: Dark gray

Odor: Slight earthy odor

Water Depth: 10.3 feet

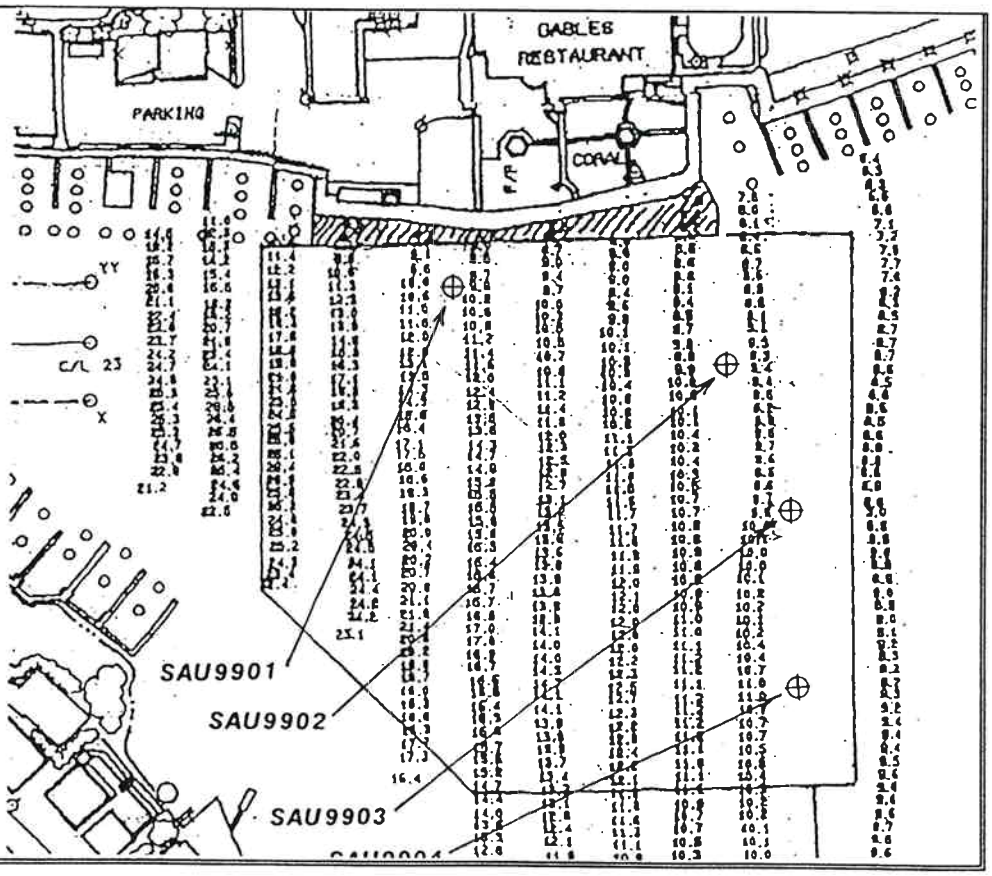
Depth Below Interface: 0 - 1.5 feet

Water Elevation (relative to 1955 Low Water Datum): 577.8 ft

Sampling Coordinates: N 42°39.365', W 86°12.387'

Comments:

Sample Point (Sketch)



PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name:	Saugatuck - Douglass Convention & Visitors Bureau	Sample ID:	SAU 9901
		Sample Source:	Kalamazoo Harbor Sediment
		Sample Depth:	NA
Work Order No.:	X6101.00.01	Date Collected:	4/13/99

Classification: Silty/Clayey SAND with organic fines (SC or SM) see note 4 below

Date Analyzed:	4/27/99	Performed By:	GML
Location of Test:	Dell Eng. Inc. Soils Lab	Checked By:	BTS

LOSS BY WASH TEST DATA

Weight of dry soil before washing (g):	71.2
Weight of dry soil after washing (g):	43.1
Weight of soil lost by washing (g):	28.1
Percentage of soil lost by washing (%):	39.5

SIEVE TEST DATA

SIEVE SIZE	WEIGHT RETAINED (g)	PERCENT RETAINED	CUMULATIVE % RETAINED	PERCENT FINER
1/4"	0.0	0.0	0.0	100.0
#4	0.2	0.3	0.3	99.7
#10	1.2	1.7	2.0	98.0
#40	10.5	14.7	16.7	83.3
#100	14.1	19.8	36.5	63.5
#200	11.4	16.0	52.5	47.5
PAN	5.7	47.5	100.0	0.0
TOTAL	43.1			

NOTES:

1: The total percent retained is based upon the initial weight of the sample.
2: The percent retained in the pan includes the soil passing the #200 sieve plus the soil lost by washing.
3: The minimum sample size of 100 grams was not provided.
4: Atterberg limits were not conducted. Therefore can not determine fines classification

PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name: Saugatuck - Douglass Convention & Visitors Bureau

Work Order No.: X6101.00.01

Sample ID: SAU 9901
Sample Source: Kalamazoo Harbor Sediment
Sample Depth: NA
Date Collected: 4/13/99

Classification: Silty/Clayey SAND with organic fines (SC or SM) see note 4 below

Date Analyzed: 4/27/99
Location of Test: Dell Eng. Inc. Soils Lab

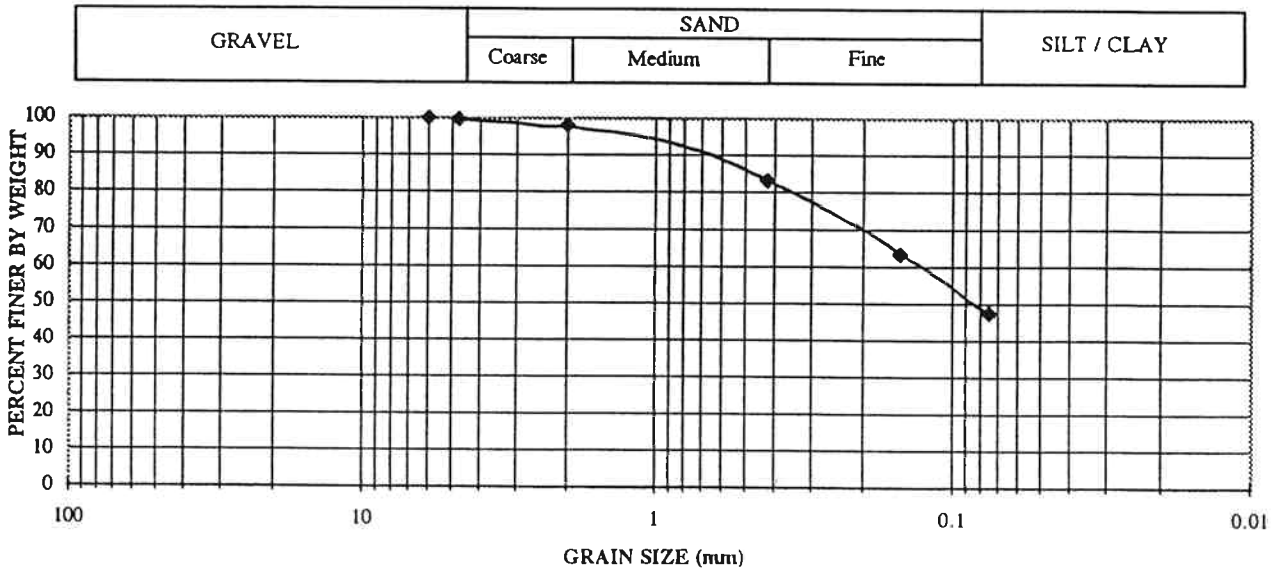
Performed By: GML
Checked By: BTS

GRAIN SIZE DATA

GRAIN SIZE	% FINER
1/4"	100.0
#4 (4.75 mm)	99.7
#10(2.00mm)	98.0
#40(425um)	83.3
#100(150um)	63.5
#200(75um)	47.5

0.3 % Gravel
1.7 % Coarse Sand
14.7 % Medium Sand
35.8 % Fine Sand
47.5 % Fines

GRAIN SIZE DISTRIBUTION



PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name:	Saugatuck - Douglass Convention & Visitors Bureau	Sample ID:	SAU 9902
		Sample Source:	Kalamazoo Harbor Sediment
		Sample Depth:	NA
Work Order No.:	X6101.00.01	Date Collected:	4/13/99

Classification: Sandy organic SILT or CLAY (OL or OH) see note 4 below

Date Analyzed:	4/30/99	Performed By:	GML/DJM
Location of Test:	Dell Eng. Inc. Soils Lab	Checked By:	BTS

LOSS BY WASH TEST DATA

Weight of dry soil before washing (g):	82.5
Weight of dry soil after washing (g):	41.1
Weight of soil lost by washing (g):	41.4
Percentage of soil lost by washing (%):	50.2

SIEVE TEST DATA

SIEVE SIZE	WEIGHT RETAINED (g)	PERCENT RETAINED	CUMULATIVE % RETAINED	PERCENT FINER
1/4"	0.0	0.0	0.0	100.0
#4	0.0	0.0	0.0	100.0
#10	0.0	0.0	0.0	100.0
#40	10.3	12.5	12.5	87.5
#100	11.3	13.7	26.2	73.8
#200	14.2	17.2	43.4	56.6
PAN	5.3	56.6	100.0	0.0
TOTAL	41.1			

NOTES:

1: The total percent retained is based upon the initial weight of the sample.
2: The percent retained in the pan includes the soil passing the #200 sieve plus the soil lost by washing.
3: The minimum sample size of 100 grams was not provided.
4: Atterberg limits were not conducted. Therefore can not determine fines classification

PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name: Saugatuck - Douglass Convention & Visitors Bureau

Work Order No.: X6101.00.01

Sample ID: SAU 9902
Sample Source: Kalamazoo Harbor Sediment
Sample Depth: NA
Date Collected: 4/13/99

Classification: Sandy organic SILT or CLAY (OL or OH) see note 4 below

Date Analyzed: 4/30/99
Location of Test: Dell Eng. Inc. Soils Lab

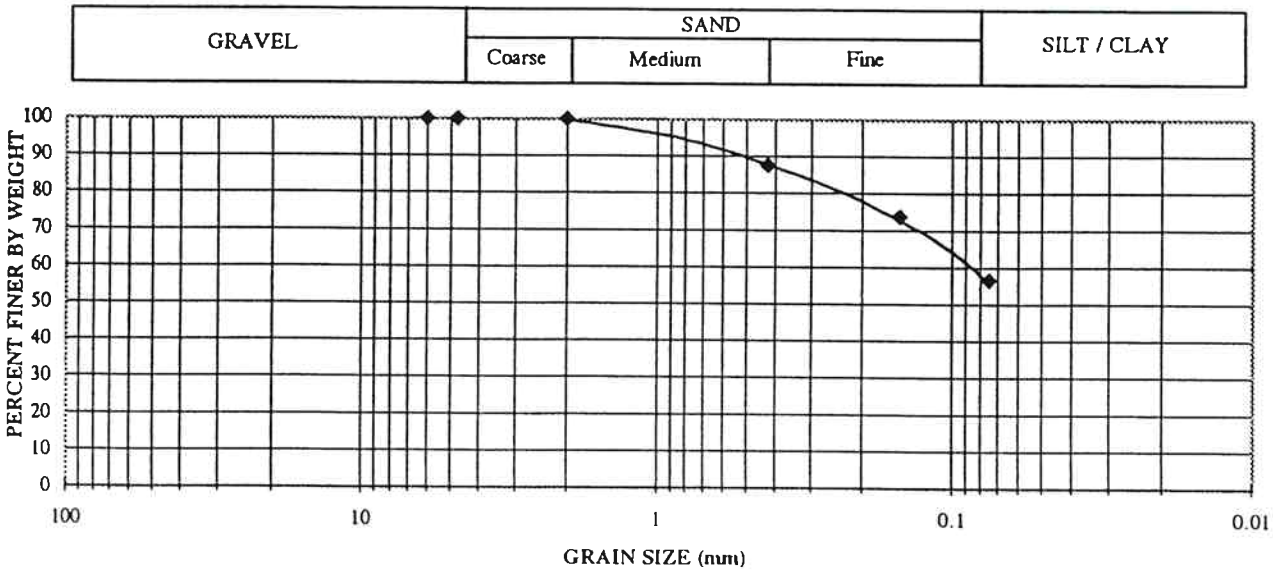
Performed By: GML/DJM
Checked By: BTS

GRAIN SIZE DATA

GRAIN SIZE	% FINER
1/4"	100.0
#4 (4.75 mm)	100.0
#10(2.00mm)	100.0
#40(425um)	87.5
#100(150um)	73.8
#200(75um)	56.6

0.0 % Gravel
0.0 % Coarse Sand
12.5 % Medium Sand
30.9 % Fine Sand
56.6 % Fines

GRAIN SIZE DISTRIBUTION



PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name:	Saugatuck - Douglass Convention & Visitors Bureau	Sample ID:	SAU 9903
		Sample Source:	Kalamazoo Harbor Sediment
		Sample Depth:	NA
Work Order No.:	X6101.00.01	Date Collected:	4/13/99

Classification: Silty/Clayey SAND with organic fines (SC or SM) see note 4 below

Date Analyzed:	4/27/99	Performed By:	GML
Location of Test:	Dell Eng. Inc. Soils Lab	Checked By:	BTS

LOSS BY WASH TEST DATA

Weight of dry soil before washing (g):	61.6
Weight of dry soil after washing (g):	43.5
Weight of soil lost by washing (g):	18.1
Percentage of soil lost by washing (%):	29.4

SIEVE TEST DATA

SIEVE SIZE	WEIGHT RETAINED (g)	PERCENT RETAINED	CUMULATIVE % RETAINED	PERCENT FINER
1/4"	0.0	0.0	0.0	100.0
#4	0.3	0.5	0.5	99.5
#10	0.8	1.3	1.8	98.2
#40	14.6	23.7	25.5	74.5
#100	12.3	20.0	45.5	54.5
#200	10.4	16.9	62.3	37.7
PAN	5.1	37.7	100.0	0.0
TOTAL	43.5			

NOTES:

1: The total percent retained is based upon the initial weight of the sample.
2: The percent retained in the pan includes the soil passing the #200 sieve plus the soil lost by washing.
3: The minimum sample size of 100 grams was not provided.
4: Atterberg limits were not conducted. Therefore can not determine fines classification

PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name: Saugatuck - Douglass Convention & Visitors Bureau

Work Order No.: X6101.00.01

Sample ID: SAU 9903
Sample Source: Kalamazoo Harbor Sediment
Sample Depth: NA
Date Collected: 4/13/99

Classification: Silty/Clayey SAND with organic fines (SC or SM) see note 4 below

Date Analyzed: 4/27/99
Location of Test: Dell Eng. Inc. Soils Lab

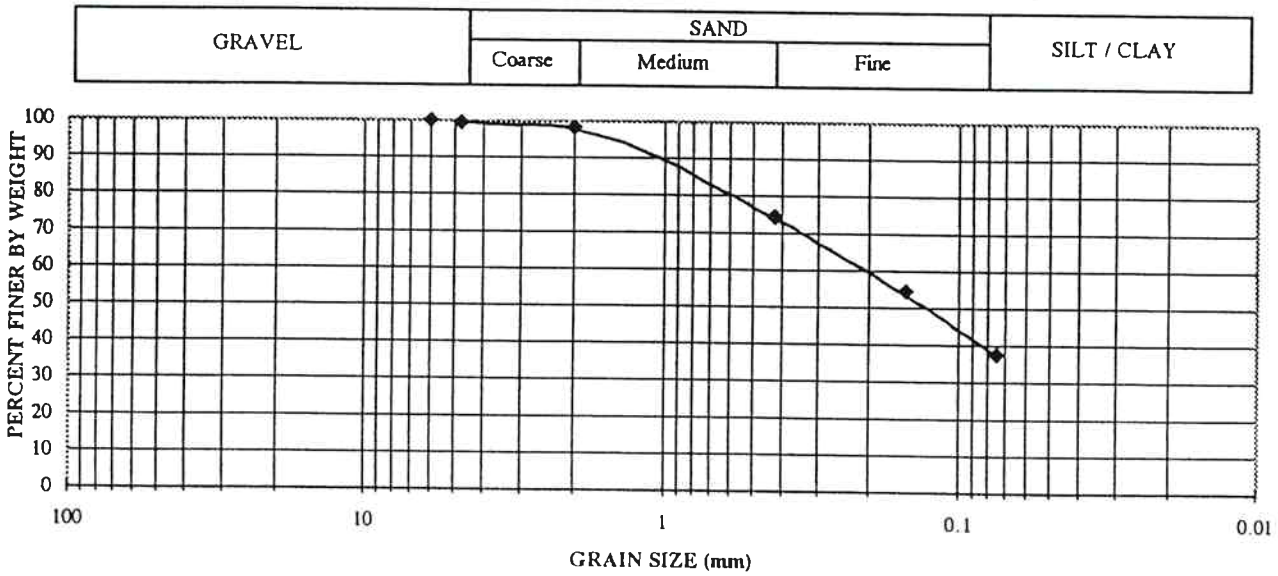
Performed By: GML
Checked By: BTM

GRAIN SIZE DATA

GRAIN SIZE	% FINER
1/4"	100.0
#4 (4.75 mm)	99.5
#10(2.00mm)	98.2
#40(425um)	74.5
#100(150um)	54.5
#200(75um)	37.7

0.5 % Gravel
1.3 % Coarse Sand
23.7 % Medium Sand
36.9 % Fine Sand
37.7 % Fines

GRAIN SIZE DISTRIBUTION



PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name:	Saugatuck - Douglass Convention & Visitors Bureau	Sample ID:	SAU 9904
		Sample Source:	Kalamazoo Harbor Sediment
		Sample Depth:	NA
Work Order No.:	X6101.00.01	Date Collected:	4/13/99

Classification: Silty/Clayey SAND with organic fines (SC or SM) see note 4 below

Date Analyzed:	5/3/99	Performed By:	GML/DJM
Location of Test:	Dell Eng. Inc. Soils Lab	Checked By:	

LOSS BY WASH TEST DATA

Weight of dry soil before washing (g):	67.0
Weight of dry soil after washing (g):	39.8
Weight of soil lost by washing (g):	27.2
Percentage of soil lost by washing (%):	40.6

SIEVE TEST DATA

SIEVE SIZE	WEIGHT RETAINED (g)	PERCENT RETAINED	CUMULATIVE % RETAINED	PERCENT FINER
1/4"	0.0	0.0	0.0	100.0
#4	0.0	0.0	0.0	100.0
#10	0.0	0.0	0.0	100.0
#40	13.3	19.9	19.9	80.1
#100	10.8	16.1	36.0	64.0
#200	11.9	17.8	53.7	46.3
PAN	3.8	46.3	100.0	0.0
TOTAL	39.8			

NOTES:

1: The total percent retained is based upon the initial weight of the sample.
2: The percent retained in the pan includes the soil passing the #200 sieve plus the soil lost by washing.
3: The minimum sample size of 100 grams was not provided.
4: Atterberg limits were not conducted. Therefore can not determine fines classification

PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name: Saugatuck - Douglass Convention & Visitors Bureau

Work Order No.: X6101.00.01

Sample ID: SAU 9904
Sample Source: Kalamazoo Harbor Sediment
Sample Depth: NA
Date Collected: 4/13/99

Classification: Silty/Clayey SAND with organic fines (SC or SM) see note 4 below

Date Analyzed: 5/3/99
Location of Test: Dell Eng. Inc. Soils Lab

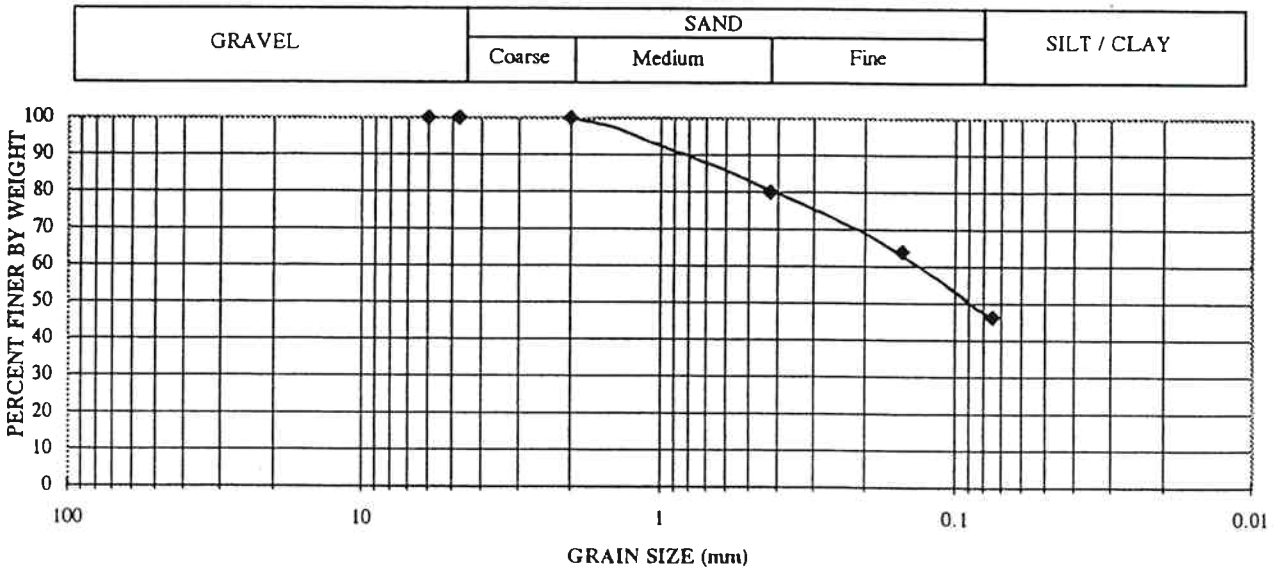
Performed By: GML/DJM
Checked By: BTS

GRAIN SIZE DATA

GRAIN SIZE	% FINER
1/4"	100.0
#4 (4.75 mm)	100.0
#10(2.00mm)	100.0
#40(425um)	80.1
#100(150um)	64.0
#200(75um)	46.3

0.0 % Gravel
0.0 % Coarse Sand
19.9 % Medium Sand
33.9 % Fine Sand
46.3 % Fines

GRAIN SIZE DISTRIBUTION



PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name:	Saugatuck - Douglass Convention & Visitors Bureau	Sample ID:	SAU 9905
		Sample Source:	Kalamazoo Harbor Sediment
		Sample Depth:	NA
Work Order No.:	X6101.00.01	Date Collected:	4/13/99
Classification:	Poorly graded SAND (SP)		
Date Analyzed:	4/27/99	Performed By:	GML
Location of Test:	Dell Eng. Inc. Soils Lab	Checked By:	MT

LOSS BY WASH TEST DATA

Weight of dry soil before washing (g):	232.3
Weight of dry soil after washing (g):	227.1
Weight of soil lost by washing (g):	5.2
Percentage of soil lost by washing (%):	2.2

SIEVE TEST DATA

SIEVE SIZE	WEIGHT RETAINED (g)	PERCENT RETAINED	CUMULATIVE % RETAINED	PERCENT FINER
1/4"	15.3	6.6	6.6	93.4
#4	23.5	10.1	16.7	83.3
#10	3.5	1.5	18.2	81.8
#40	20.5	8.8	27.0	73.0
#100	156.2	67.2	94.3	5.7
#200	7.7	3.3	97.6	2.4
PAN	0.4	2.4	100.0	0.0
TOTAL	227.1			

NOTES:

1: The total percent retained is based upon the initial weight of the sample.

2: The percent retained in the pan includes the soil passing the #200 sieve plus the soil lost by washing.

PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name: Saugatuck - Douglass Convention & Visitors Bureau

Work Order No.: X6101.00.01

Sample ID: SAU 9905
Sample Source: Kalamazoo Harbor Sediment
Sample Depth: NA
Date Collected: 4/13/99

Classification: Poorly graded SAND (SP)

Date Analyzed: 4/27/99
Location of Test: Dell Eng. Inc. Soils Lab

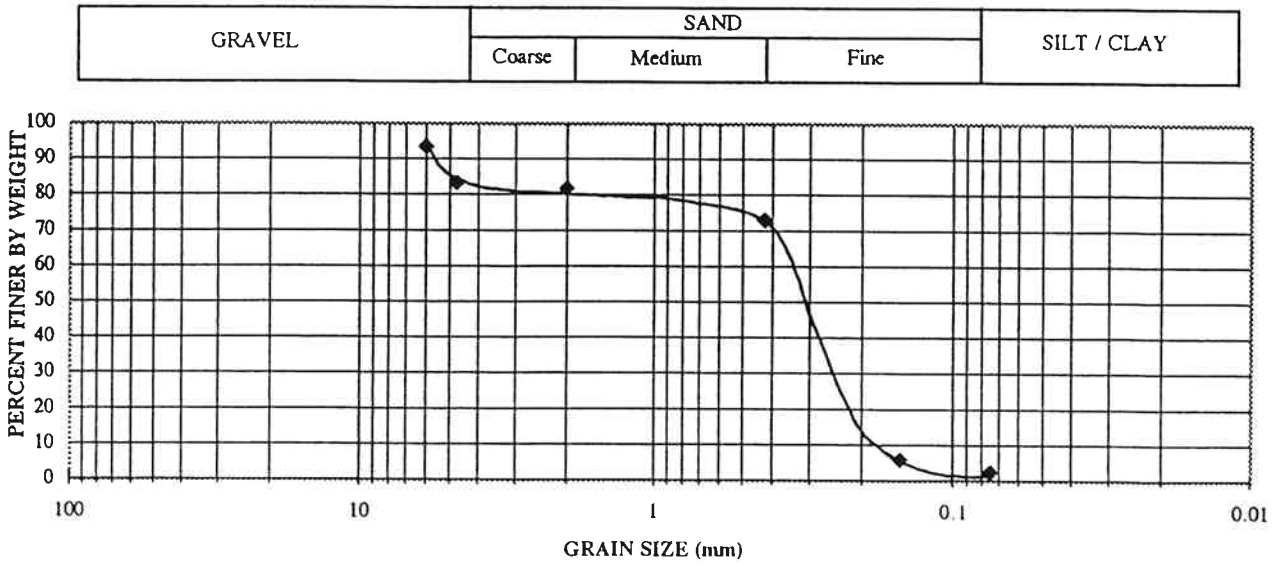
Performed By: GML
Checked By: BT

GRAIN SIZE DATA

GRAIN SIZE	% FINER
1/4"	93.4
#4 (4.75 mm)	83.3
#10(2.00mm)	81.8
#40(425um)	73.0
#100(150um)	5.7
#200(75um)	2.4

16.7 % Gravel
1.5 % Coarse Sand
8.8 % Medium Sand
70.6 % Fine Sand
2.4 % Fines

GRAIN SIZE DISTRIBUTION



PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name:	Saugatuck - Douglass Convention & Visitors Bureau	Sample ID:	SAU 9906
		Sample Source:	Kalamazoo Harbor Sediment
		Sample Depth:	NA
Work Order No.:	X6101.00.01	Date Collected:	4/13/99
Classification:	Poorly graded SAND (SP)		
Date Analyzed:	4/27/99	Performed By:	GML
Location of Test:	Dell Eng. Inc. Soils Lab	Checked By:	BTS

LOSS BY WASH TEST DATA

Weight of dry soil before washing (g):	283.9
Weight of dry soil after washing (g):	277.4
Weight of soil lost by washing (g):	6.5
Percentage of soil lost by washing (%):	2.3

SIEVE TEST DATA

SIEVE SIZE	WEIGHT RETAINED (g)	PERCENT RETAINED	CUMULATIVE % RETAINED	PERCENT FINER
1/4"	0.0	0.0	0.0	100.0
#4	24.3	8.6	8.6	91.4
#10	19.0	6.7	15.3	84.7
#40	45.2	15.9	31.2	68.8
#100	178.2	62.8	93.9	6.1
#200	10.0	3.5	97.5	2.5
PAN	0.7	2.5	100.0	0.0
TOTAL	277.4			

NOTES:

1: The total percent retained is based upon the initial weight of the sample.

2: The percent retained in the pan includes the soil passing the #200 sieve plus the soil lost by washing.

PARTICLE SIZE ANALYSIS OF SOILS
(ASTM D 422)

Project Name: Saugatuck - Douglass Convention & Visitors Bureau

Work Order No.: X6101.00.01

Sample ID: SAU 9906
Sample Source: Kalamazoo Harbor Sediment
Sample Depth: NA
Date Collected: 4/13/99

Classification: Poorly graded SAND (SP)

Date Analyzed: 4/27/99
Location of Test: Dell Eng. Inc. Soils Lab

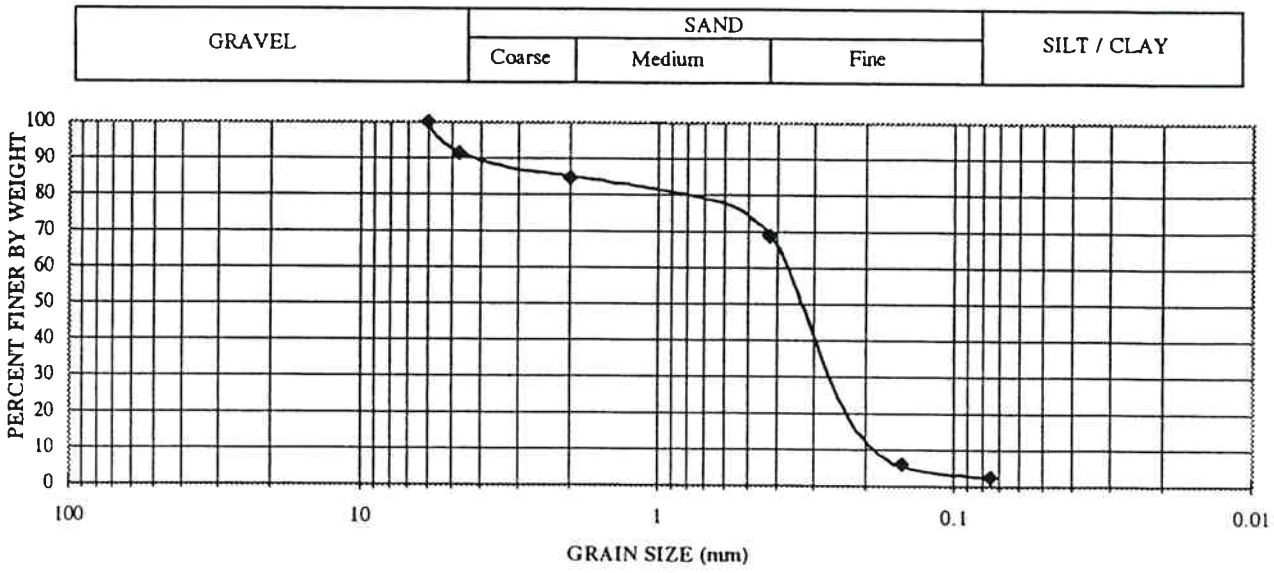
Performed By: GML
Checked By: BT

GRAIN SIZE DATA

GRAIN SIZE	% FINER
1/4"	100.0
#4 (4.75 mm)	91.4
#10(2.00mm)	84.7
#40(425um)	68.8
#100(150um)	6.1
#200(75um)	2.5

8.6 % Gravel
6.7 % Coarse Sand
15.9 % Medium Sand
66.3 % Fine Sand
2.5 % Fines

GRAIN SIZE DISTRIBUTION



APPENDIX C: RMT, INC. TECHNICAL MEMORANDUM

Technical Memorandum

Final

Date: **January 31, 2007**

To: **Bob Doyle, JJR**

cc: **Graham Crockford, RMT**

From: **Stacy McAnulty and Cassie Johnson, RMT**

Project No.: **7334.01**

Subject: **Summary of Environmental Information for the Kalamazoo Harbor Master Plan, Saugatuck, Michigan**

This Technical Memorandum summarizes the environmental information that RMT has prepared and analyzed on issues related to the buildup of sediment in Lake Kalamazoo and Douglas Harbor, near Saugatuck, Michigan. This Technical Memorandum provides information on several aspects of the project, including (1) a summary of the physical and chemical characteristics of the sediment in these areas, and implications for dredging and disposal; (2) a brief overview of past dredging practices and funding mechanisms; (3) site selection criteria and the identification of potential disposal sites; (4) potential costs for sediment management; and (5) identification of potential future funding mechanisms.

1. Sediment Characteristics and Implications for Management

An approximately 80-mile–long stretch of the Kalamazoo River, from Morrow Lake to Lake Michigan, is part of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site. Lake Kalamazoo and Douglas Harbor are located on this stretch of the Kalamazoo River and are part of the Superfund site (see figure in Attachment 1). The river was designated a Superfund site in 1990, after studies showed that polychlorinated biphenyls (PCBs) were present in the river sediment. Many sediment evaluations have been performed on the Kalamazoo River, beginning in the 1970s. Most of the sediment testing has been focused on areas substantially upstream from Lake Kalamazoo and Douglas Harbor, particularly in the areas upstream of the Lake Allegan Dam, which is located approximately 25 miles upstream from Saugatuck.

The data for the upstream reaches of the river were summarized in Remedial Investigation reports by Blasland, Bouck, and Lee (BBL, 2000a; BBL, 2000b). These reports indicate that the highest concentration of PCBs in the Kalamazoo River sediment (*i.e.*, 160 mg/kg) was found in the fine-grained silty sediment of the former Otsego Impoundment. The greatest volume of PCB-impacted sediment is located in Lake Allegan, where fine-grained sediment was found to contain up to 73 mg/kg PCBs. Course-grained sandy sediment contained lower concentrations of PCBs than fine-grained sediment.

The BBL reports indicate that data for the furthest downstream stretch of the Kalamazoo River (*i.e.*, the 28-mile stretch between the Lake Allegan Dam and Lake Michigan, which includes Lake Kalamazoo and Douglas Harbor) would be included in a subsequent remedial investigation. However, if such a report was prepared, it is not available to the public. Therefore, RMT has used data from various sources to summarize what is currently known about the sediment characteristics in Lake Kalamazoo and Douglas Harbor.

Chemical Characteristics

The most comprehensive chemical data currently available for sediment in Lake Kalamazoo and Douglas Harbor appear to be from testing performed by Camp Dresser & McKee in March 2000 (CDM, 2000). These data are summarized on the attached figures (Attachment 2) and include PCB concentrations at five sampling intervals in the uppermost 3 feet of sediment (*i.e.*, 0 to 2 inches, 2 to 6 inches, 6 to 12 inches, 12 to 24 inches, and 24 to 36 inches). PCB concentrations were generally higher in Kalamazoo Lake sediment than in Douglas Harbor sediment. The data show that the highest concentrations of PCBs in the sampled intervals were in the range of 5 to 20 mg/kg. The highest concentrations of PCBs were generally found between 0.5 and 2 feet below the sediment surface, with PCB concentrations generally lower in the 2- to 3-foot sampling interval. This trend of decreasing PCB concentrations with sediment depth is similar to the trend observed in Lake Allegan (BBL, 2000b), where PCB concentrations were nondetectable in two thirds of the sediment samples collected at 2 to 3 feet below the sediment surface. RMT was not able to locate chemical data for in-place sediment located more than 3 feet below the sediment surface.

Two other sources of PCB data include data collected by Dell Engineering in 1999 near the northernmost edge of Kalamazoo Lake (Dell, 1999) and data collected by CDM in 2001 in a dredge disposal area utilized by Tower Marine, located adjacent to Kalamazoo Lake (CDM, 2001). No PCBs were detected in the samples collected by Dell Engineering, and PCB concentrations in the Tower Marine dredge disposal area ranged from nondetectable to 2.6 mg/kg (see Attachment 3).

CDM and Dell also analyzed the soil samples collected in the Tower Marine dredge disposal area and the northernmost edge of Kalamazoo Lake for metals. The sample results from the Tower Marine disposal area showed that arsenic concentrations in the more near-surface samples (*i.e.*, 2 to 4.5 feet below ground surface), which consisted of silty sediment, were generally slightly above the Michigan Cleanup Criterion for residential sites (*i.e.*, up to 12 mg/kg, as compared to the criterion of 7.6 mg/kg). Arsenic concentrations were generally below this criterion in the deeper samples, which were collected in sandy sediment. The sample results from the northernmost edge of Kalamazoo Lake showed that arsenic concentrations in clay sediment ranged from 9.3 to 9.9 mg/kg. RMT recommends establishing background arsenic levels for comparison of these data. Data from both studies are summarized in Attachment 3.

In addition, a plume of trichloroethene (TCE)–impacted groundwater has been discovered just southwest of Kalamazoo Lake in the Village of Douglas. An informational bulletin from the Michigan Department of Environmental Quality (MDEQ) indicates that TCE impacts are present in groundwater in the vicinity of Wick's Creek, which discharges to Kalamazoo Lake. The potential for TCE impacts to be present in Kalamazoo Lake sediment or surface water in this area should be taken into consideration as the Kalamazoo Harbor project proceeds.

Physical Characteristics

A limited amount of information on the physical characteristics of sediment in the vicinity of Kalamazoo Lake was contained in the two reports referenced above (Dell, 1999; and CDM, 2001). The Dell report indicates that two sediment samples collected in the top 0.5 foot of sediment along the bank of the Kalamazoo River, just north of Kalamazoo Lake, were primarily sand, while four samples collected in the top 1.5 feet of sediment at the northernmost edge of Kalamazoo Lake consisted of organic clay. The samples collected by CDM in the Tower Marine dredge disposal area consisted of both black silty clay and sandy sediment (CDM, 2001). Additional physical data may have been recorded during the chemical sediment sampling activities performed by CDM (CDM, 2000; Attachment 2). However, since a final report has not been issued, RMT has not been able to gain access to this information.

On the basis of the available physical information, the apparent declining trend of PCB concentrations with sediment depth, the typical geology in this area of southwestern Michigan, and the reduction in river velocity that would be associated with the expanded width of the river at Kalamazoo Lake and Douglas Harbor, it is likely that the physical characteristics include finer grained sediment near the sediment surface, particularly in areas located outside of the main river channel, where water velocities would be lower.

Implications for Sediment Management

There are several implications related to the chemical and physical characteristics of the sediment dredged from Kalamazoo Lake and Douglas Harbor, including dredging methods, regulatory testing requirements, disposal requirements, and project costs.

- **Dredging methods** – Sediment can typically be dredged using either mechanical or hydraulic means. Mechanical dredging is typically used when debris is present and to minimize water management costs. Hydraulic methods are often employed for maintenance dredging due to higher production rates, but significantly more water is generated which must be managed in an appropriate manner. For environmental dredging of contaminated sediment, typically more engineering controls (*i.e.*, silt curtains) are required to control the migration of suspended sediment from the dredging area (*i.e.*, to limit downstream transport). In addition, water management and solids management costs are higher due to contaminants and regulatory requirements.
- **Regulatory and testing requirements for sediment** – Current Michigan regulations and guidelines must be considered as part of the planning for future dredging activities. In August 2006, the MDEQ issued a memorandum that details sampling requirements for sediment investigations and remediation, including site characterization and verification sampling for remediation projects (MDEQ, 2006).

  Current Michigan regulations related to sediment disposal must also be taken into consideration. For all dredging projects greater than 1,000 cubic yards in volume, and for projects in designated USEPA Areas of Concern like the Kalamazoo River, the MDEQ requires sampling of the sediment for potential constituents of concern prior to its disposal. Michigan Solid Waste Rules (Part 115) govern waste characterization for dredge spoils, and the MDEQ has several review criteria for which the results are compared (see Attachment 4). If concentrations are below the review criteria, then the sediment can be placed on-shore in an area near the water body from which the sediment was removed. If concentrations exceed the review criteria, additional testing for the leachability of the contaminants is typically required.
- **Superfund cleanup and relationship to future dredging activities** – In discussions with the USEPA Remedial Project Manager, Sheri Kolak, RMT learned that a number of stakeholders are discussing remediation and natural resource damage issues through mediated negotiations. These negotiations will end soon (1 to 2 months), at which time the USEPA will announce the outcomes. Ms. Kolak indicated that any remediation performed will begin at the upstream end of the Superfund site. The USEPA considers the PCB levels in our study area to be "quite low" and have indicated that they are focused on addressing areas with the greatest PCB mass (*e.g.*, Lake Allegan). Ms. Kolak is aware of the Tower Marine dredging project, and encouraged us to work with the State (Mr. Mark Desharm, Ms. Wendy Fitzner) to obtain permitting for the project. She said it is unlikely that any dredging will be performed in the harbor/lake as part of the Superfund cleanup "in the foreseeable future." The Baseline Ecological Risk Assessment for the Superfund Site (CDM, 2003) identified that a PCB concentration range of 0.5 to 0.6 mg/kg in sediment was protective of environmental species.
- **Disposal requirements and costs** – Michigan Solid Waste Rules (Part 115) also govern waste characterization and disposal requirements for dredge spoils. These Rules contain a review criterion of 1 mg/kg for the disposal of dredge spoils containing PCBs, and other criteria for other potential compounds, such as metals (see Attachment 4). If concentrations of potential contaminants in the dredge spoils are below

the review criteria, the dredge spoils can be placed, without further testing, in an area located adjacent to the shore of the dredged waterway.

The MDEQ may also approve disposal of the material at a further off-site location; however, the Agency is likely to require testing to be certain that potential contaminants will not leach from the material at concentrations that may pose a risk to groundwater. If the material contains contaminants at concentrations above the review criteria, leachability testing is required, regardless of the disposal location. If the material contains PCBs at concentrations above Michigan's Cleanup Criteria for residential sites (*i.e.*, 4 mg/kg), or other compounds, such as metals, at concentrations above Michigan's Cleanup Criteria for residential sites, the MDEQ would require that the soil be covered to prevent direct contact. In addition, groundwater monitoring would likely be required, and restrictive covenants would likely be needed. If the dredge spoils are disposed at an off-site location, the concentration thresholds for cover placement and restrictive covenants are likely to be even lower (*e.g.*, 1 mg/kg for PCBs). If the dredge spoils contain PCB concentrations above 50 mg/kg, the material would need to be managed as a Toxic Substances Control Act (TSCA) waste, and disposed at a landfill approved to accept such waste.

2. Overview of Past Dredging Operations

In 1998, Tower Marine was issued a permit by the MDEQ for the dredging of 22,000 cubic yards of sediment from an area near the southern shoreline of Kalamazoo Lake. The permit allowed for the material to be placed into a contained upland area, located adjacent to the shore. These dredging activities were funded by Tower Marine. As summarized above, the dredged material was sampled by CDM in 2000, with samples analyzed for compositional PCBs and metals (CDM, 2001). All PCB results were below the Michigan Cleanup Criterion for residential sites (4 mg/kg). Tower Marine subsequently prepared a table, which reported an average PCB concentration of 0.74 mg/kg, based on the sampling performed by CDM.

Reportedly, the sediment was dredged and pumped to the adjacent upland area, and water was allowed to drain back into the lake. RMT is not aware of the ultimate fate of the dredged material that was placed in the upland area (*i.e.*, whether it was left in-place, with or without a cover; or whether it was taken to an alternative location for disposal).

3. Potential Future Disposal Sites for Dredge Spoils

A number of criteria will have an impact on the ultimate selection of a dredge disposal site. These criteria include factors that affect the feasibility of using the disposal site, the overall cost, and regulatory and community acceptance. Dredge disposal sites should be compared using the following criteria:

- **Feasibility** – In order for a dredge disposal site to be feasible, there must be a feasible way to transport the dredged materials to the disposal area. The physical characteristics of the dredged material must be compatible with the selected transportation method, and the physical and chemical characteristics must be acceptable and appropriate for the disposal site.
- **Overall cost** – Costs for various disposal options could be wide-ranging, and will include both direct costs (*i.e.*, transportation and disposal costs) and indirect costs (*e.g.*, costs for permitting, testing, regulatory interaction).
- **Regulatory and community acceptance** – Regulatory and permitting requirements for different disposal options will differ, and should therefore be considered when evaluating the overall feasibility, overall costs, and the time frames for implementation. In addition, community perspectives and potential concerns need to be considered, with the intent of minimizing negative impacts.

After considering these criteria, RMT has identified three potential options for disposing of dredged sediment. As planning proceeds and more information becomes available (*e.g.*, sediment volumes and project-specific physical and chemical characteristics), these options should be evaluated using the criteria listed above.

Option 1: Upland Disposal on Available Property

This option involves final disposition of dredge spoils on upland property, assuming this is appropriate for the contaminant levels found in sediment. For example, the City owns two parcels of land, which are located approximately 4 miles northeast of Kalamazoo Lake, that may be potential disposal sites for dredged sediment (Attachment 5). Upland parcels may be feasible for sediment disposal; however, more project-specific information, including the chemical characteristics of the sediment and the physical site setting (*e.g.*, site topography, location of any wetlands on the properties, etc.) is needed in order to assess the suitability of the disposal locations. If the concentrations of PCBs and any other potential constituents of concern (e.g., metals) are below the MDEQ's review criteria (Attachment 4), or if engineering controls (*e.g.*, a cover) can be constructed to address any exceedences, **an upland property disposal option would be much less costly than the option of disposing sediment at a Subtitle D landfill facility.**

Option 2: Upland Licensed Landfills

RMT contacted a number of solid waste landfills in the area of Kalamazoo Harbor and identified two facilities that could be feasible for the disposal of dredged materials: Autumn Hills RDF in Zeeland, Michigan, and Ottawa County Farms Landfill, in Coopersville, Michigan. These facilities are located approximately 20 miles and 40 miles from Saugatuck, respectively, and are licensed to accept PCB-containing sediment. These facilities are feasible options for the disposal of sediment, if the sediment cannot be disposed on the City-owned properties.

Option 3: In-Water Confined Disposal Facility (CDF)

In-water CDFs are sometimes used for the disposal of dredged sediment. The Army Corps of Engineers (ACOE) operates or uses 47 such facilities in its Detroit District, in which Saugatuck is located. These CDFs are generally used by the ACOE for the disposal of the dredge spoils from its navigational dredging activities; however, the ACOE does accept applications from parties wishing to use its facilities. Unfortunately, there are no existing ACOE CDFs in the immediate vicinity of Saugatuck. The ACOE indicates that its nearest facility is located in Holland, which is approximately 20 miles north of Saugatuck. While it would likely be feasible to transport dredged material from Saugatuck, down the Kalamazoo River to Lake Michigan and north to Holland, the ACOE indicates that transportation and materials-handling costs would likely be very high. In addition, the CDF at Holland is nearing its capacity. The ACOE is currently encouraging the removal of the clean sediment in the Holland CDF for beneficial reuse, in order to extend its life. The next nearest disposal facility used by the ACOE is located in Grand Haven, which is approximately 40 miles north of Saugatuck on Lake Michigan. This facility is a privately-owned on-shore facility, which the ACOE contracts for use. The construction of an in-water CDF in the vicinity of the Kalamazoo Harbor project was discussed at the project meeting on December 14, but the MDEQ indicated that they would not likely approve this option.

4. Potential Costs for Sediment Management

JJR has indicated that two dredging scenarios are being evaluated for Kalamazoo Lake, including one scenario ("River Town"), which would require that approximately 360,000 cubic yards of sediment be dredged, and a second scenario ("Harbor Town"), which would require that approximately 960,000 cubic yards of sediment be dredged. RMT has developed conceptual cost ranges for each of these scenarios, assuming that the dredging

activities will be performed in an environmentally sound manner and in compliance with current state and federal regulations and requirements.

These costs are conceptual in nature and include a number of reasonable, yet conservative assumptions. As the dredging project moves forward, RMT would evaluate a number of cost saving ideas, such as:

- Separating or segregating fine-grained and coarse-grained sediments - PCBs and metals tend to be absorbed to organic matter and fine-grained sediment. If feasible, segregation of the physical types of deposits (fine-grained and coarse-grained) may provide cost savings for management and disposal.
- Pumping versus trucking of dredge spoils - once the sediment has been characterized, further evaluation of conveyance, dewatering, and solids management may identify more cost-effective approaches.
- Phasing the sediment dredging activities - refining the dredge plan to conduct the sediment removal in phases that allows budgeting and execution of the dredging plan over time.
- Improved dredging equipment - new dredging equipment is being pilot tested at several sites to reduce water entrainment, yet allow a flowable dredge spoil that can be pumped.
- Beneficial reuse of sediment - upon further sediment characterization, it may be possible to beneficially reuse sediments that are not impacted by PCBs or metals (at levels of concern).

Option 1: Upland Disposal on Available Property

- **Conceptual costs** – RMT estimates that this option would cost a total of approximately $35 to $40 per cubic yard, including $25 to $30 per cubic yard for dredging, dewatering, and water management; $6 per cubic yard for transportation and disposal; and $4 per cubic yard for engineering and permitting (approximately 10% of the total cost). For the "River Town" scenario (360,000 cubic yards), the total project cost may be on the order of $13 to $17 million, while the "Harbor Town" scenario (960,000 cubic yards) would be on the order of $34 to $40 million.
- **Key assumptions** – For conceptual costing purposes, RMT has assumed that hydraulic dredging would be performed, based on an assumption that the sediment is a fine to medium sand that drains well. RMT has assumed that a 40-acre staging and sediment dewatering area would be available at the edge of the harbor (within about 2,000 feet of the dredging areas). The dredged sediment would be directed into Geotubes® for dewatering, which would be staged on a stone-covered liner. The water would be directed to a catch basin and subsequently returned to the harbor/river. The sediment would be dredged at a rate of approximately 1,500 in-place cubic yards per day (or 1,950 in-place tons per day). Preparation for the upland disposal area at the City-owned property was assumed, which included the construction of haul roads, and staging area for dewatered dredge spoil disposal.

Option 2: Upland Disposal at a Licensed Landfill Facility

- **Conceptual costs** – This disposal option would add approximately $35 per cubic yard, bringing the total project cost up to approximately $75 per cubic yard. Therefore, if all of the dredged sediment needed to be disposed at a licensed landfill facility, for the "River Town" scenario, the total project cost would be on the order of $25 to $30 million, while the "Harbor Town" scenario would be on the order of $50 to $70 million.
- **Key assumptions** – The same assumptions were made for this scenario as for Option 1, except that the ultimate disposal location is a licensed landfill facility that accepts PCB-containing sediment. The weight of the disposed sediment was assumed to be 1.3 tons per cubic yard.

5. Potential Future Funding Mechanisms

RMT has researched and evaluated several potential funding options for future dredging-related activities, including grant programs administered by state and federal agencies. On the basis of RMT's research, two programs appear to be the most promising, as follows:

- **Michigan Department of Natural Resources (MDNR) Waterways Program Grants** – Grants administered by the MDNR Waterways Program are aimed at improving boating opportunities in Michigan. There are two types of grants: (1) preliminary engineering (up to $60,000), and (2) infrastructure improvements (over $60,000). Activities that may fit into the category of preliminary engineering include sediment testing, preparing plans and specifications, and completing permit applications. Dredging activities aimed at increasing water depth may fit into the second category. There is no preset total funding limit for the program. Decisions are made on a project-specific basis annually. Preliminary engineering studies are typically funded rather quickly, while funding for infrastructure improvements is subject to legislative approval. In 2006, the Program approved a total of between $1.5 to $2.0 million in grants. A large proposal (e.g., $1.0 million) would not be out of the question. The grant applicant must cover 25 to 50 percent of the total project cost, depending on how the funding will be used. Applications for MDNR Waterways Program Grants are accepted annually, with the next round of applications due on April 1, 2007.
- **Michigan Department of Environmental Quality (MDEQ) Coastal Zone Management Grants** – This is the program through which the City of Saugatuck obtained grant funding for the Kalamazoo Harbor Master Plan. The MDEQ has indicated that grant applications for activities such as engineering evaluations (*e.g.*, a disposal options analysis) or the implementation of dredging to improve spawning or other habitat, would likely be competitive proposals in this Program. Funding for dredging aimed only at improving boating, without providing any additional environmental benefit, would not likely be competitive. Total available funding in 2006 was over $1 million. The maximum grant amount for a single project is $50,000. While grants administered by this Program are smaller than those potentially available through the MDNR Waterways Program, the MDEQ has indicated that it likes to find opportunities to provide additional funding to previous recipients, in order to follow through with the project. The grant applicant must cover at least 50 percent of the total project cost. A Request for Proposals will be sent out to municipalities in January or February 2007, with applications due in April or May.

RMT also spoke with contacts at the USEPA, the U.S. Army Corps of Engineers (ACOE), and the MDEQ regarding other potential grant programs; however, based on the information we have found to date, those programs do not appear to be viable options for the Kalamazoo Harbor Project. The USEPA administers a grant program authorized by the Great Lakes Legacy Act; however, the USEPA project manager indicates that the Kalamazoo Harbor project would not be eligible because there are potentially responsible parties for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site and no Record of Decision has yet been reached for the river. The ACOE periodically dredges a stretch of the Kalamazoo River located downstream from Lake Kalamazoo for navigational purposes, and the ACOE has a cost-sharing program for navigational dredging. RMT's understanding is that the dredging activities in Kalamazoo Lake and Douglas Harbor would be for commercial, as well as recreational boating purposes. However, the ACOE indicates that this project is unlikely to receive funding or other assistance. A third potential option that RMT researched, funding through the MDEQ Clean Michigan Initiative, also does not appear viable, because past funding for sediment remediation projects was for specific approved projects, and there is no additional appropriation at this time.

Summary, Conclusions, and Recommendations

The actual project cost for future dredging activities will depend upon a number of factors, including the following:

- Contaminant levels (PCBs, metals) found throughout the profile of the sediment deposit

- Physical characteristics and material handling properties of the sediment
- Volume of sediment to be dredged
- Amount of debris present in the lake/harbor
- Permitting and regulatory requirements for dredging, dewatering, and final disposition of the solids

The City-owned property is a lower cost option for final disposition of the dredge spoils, which should be explored further with MDEQ. Regardless, dredging a large volume of sediment (*e.g.*, 1 million cubic yards) will result in a multi-million dollar project cost. As such, the City may want to consider implementing a phased, or staged approach to future dredging activities, as follows:

1. **Pursue funding options through the MDNR and the MDEQ** – Engage contacts at the MDNR and the MDEQ, as well as legislative representatives on project funding mechanisms. RMT recommends that the City apply for MDNR and MDEQ grants, which are due in April 2007. These funding sources can support sediment testing, design and permitting, and a limited amount of dredging activities.
2. **Conduct sediment sampling and analysis** – RMT recommends that a focused sediment investigation be performed to characterize the key chemical and physical properties of the sediment deposits targeted for removal.
3. **Refine the dredging approach and cost estimates** – The cost estimates developed by RMT are conceptual and preliminary in nature, and reflect numerous assumptions and uncertainties. RMT recommends that a phased dredging plan be developed, focusing first on the City's primary areas of concern for sediment accumulation. A more refined dredging plan, volume estimates, and cost estimate are needed for the City's planning purposes.
4. **Obtain MDEQ input on permitting requirements for City-owned property** – Once the sediment data is available, RMT can explore the permitting requirements with the appropriate MDEQ representatives. Additional input from the MDEQ regarding the proposed dredging project and permitting requirements is needed to secure the City-owned property as a final disposition option.
5. **Discuss dredging project and federal funding needs with political representatives** – Continue to pursue federal funding sources through your local and state representatives.

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BBL. 2000b. Blasland, Bouck & Lee, Inc. (BBL). 2000. Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site RI/FS, remedial investigation report, Phase I. Prepared for Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site, Kalamazoo and Allegan Counties, Michigan. October 2000.

Dell. 1999. Sediment sampling report. Saugatuck Harbor, Michigan. Prepared for Saugatuck/Douglas Convention and Visitors Bureau. Dell Engineering, Inc. May 10, 1999.

Camp Dresser & McKee (CDM). 2000. Kalamazoo Lake – total PCB concentrations. Draft figures 7 through 11. Draft figures provided to Tower Marine by the MDEQ. September 15, 2000.

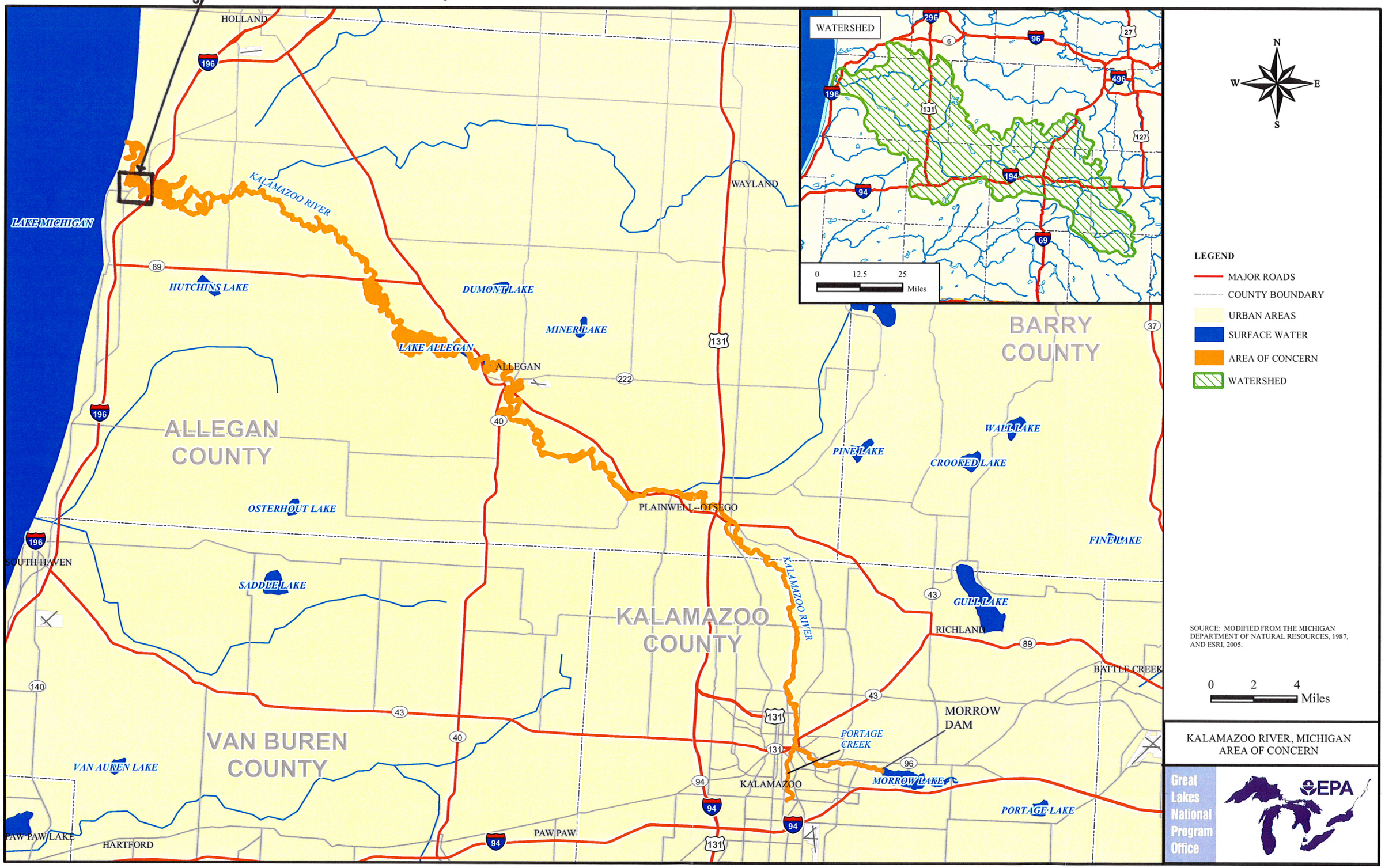
Camp Dresser & McKee (CDM). 2001. Sampling activities at Kalamazoo Lake. Prepared for MDEQ-EPD. January 30, 2001.

Camp Dresser & McKee (CDM). 2003. Final (Revised) baseline ecological risk assessment. Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site. Prepared for the MDEQ. April 2003.

Michigan Department of Environmental Quality (MDEQ). 2006. Remediation and Redevelopment Division (RRD) operational memorandum No. 4. Site characterization and remediation verification – Attachment 3. August 2, 2006.

Attachment 1
Figure Showing Kalamazoo River Superfund Site

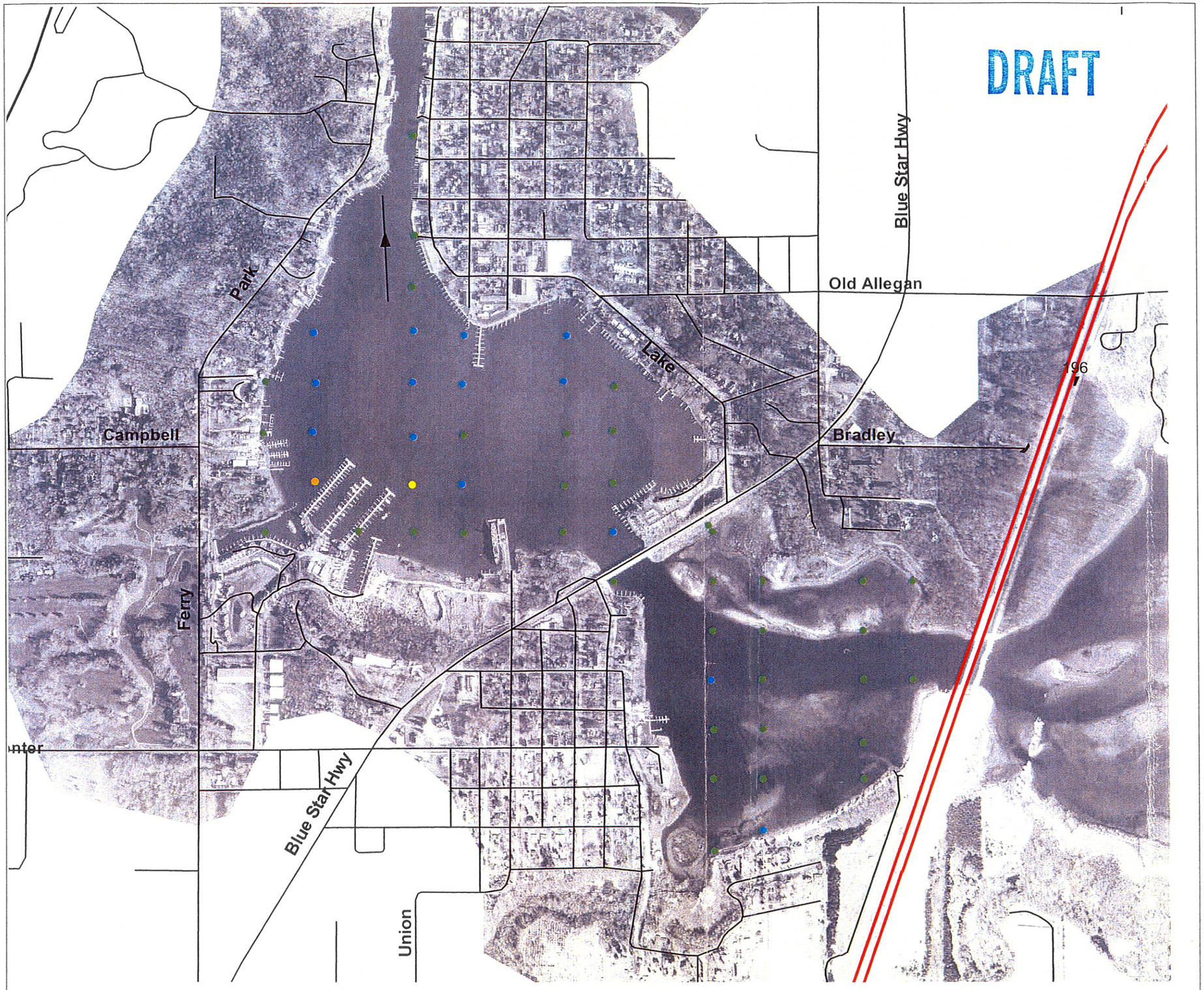
Saugatuck/Douglas Project Location (Approximate)



*Note added by RMT, January 2007

Attachment 2
Draft Figures Summarizing PCB Concentrations with Depth (CDM, 2000)

DRAFT



Kalamazoo Lake
Depth Interval: 0-2 inches

Legend

Total PCB Conc. (mg/kg)

- 0.0 - 0.12
- 0.12 - 0.5
- 0.5 - 1.0
- 1.0 - 5.0
- 5.0 - 20.0
- 20.0 - 50.0
- >50
- Highways
- Local roads
- Railroads
- Direction of Flow

Note: Base map data derived from Michigan Framework.

N

0 1000 2000 Feet

1:10,000 *

* on 11" x 17" landscape printout

CDM Camp Dresser & McKee

One Woodward Ave., Suite 1500
Detroit, Michigan 48226
Phone: (313) 963-1313
Fax: (313) 963-3130

Prepared By:
A. Ploof
Date:
Sept. 15, 2000

Kalamazoo Lake
Total PCB Concentration
Depth Interval 0-2 inches

Figure 7

DETDd007273/e:/projects/Kalamazoo/Basemap/kzoobase.apr

DRAFT

Kalamazoo Lake
Depth Interval: 2-6 inches

Park

Lake

Campbell

Ferry

Blue Star Hwy

Old Allegan

Bradley

196

Union

nter

Legend

Total PCB Conc. (mg/kg)

- 0.0 - 0.12
- 0.12 - 0.5
- 0.5 - 1.0
- 1.0 - 5.0
- 5.0 - 20.0
- 20.0 - 50.0
- >50
- Highways
- Local roads
- Railroads
- Direction of Flow

Note: Base map data derived from Michigan Framework.

N

0 1000 2000 Feet

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Prepared By:
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Date:
Sept. 15, 2000

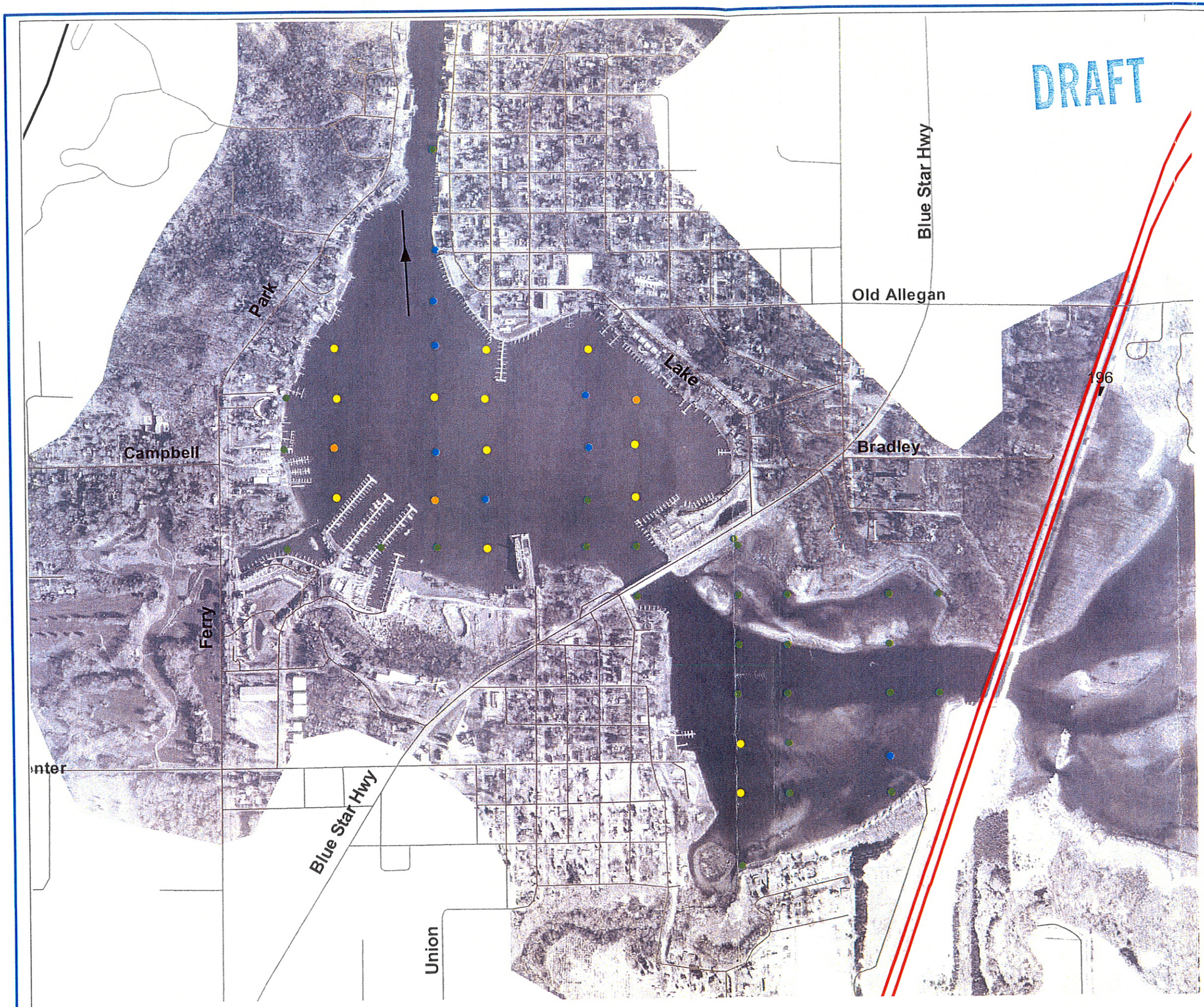
Kalamazoo Lake
Total PCB Concentration
Depth Interval 2-6 inches

Figure 8

DETDd007273/e:/projects/Kalamazoo/Basemap/kzoobase.apr

DRAFT

Kalamazoo Lake
Depth Interval: 6-12 inches



Legend

Total PCB Conc. (mg/kg)

- 0.0 - 0.12
- 0.12 - 0.5
- 0.5 - 1.0
- 1.0 - 5.0
- 5.0 - 20.0
- 20.0 - 50.0
- >50
- Highways
- Local roads
- Railroads
- Direction of Flow

Note: Base map data derived from Michigan Framework.

N

0 1000 2000 Feet

1:10,000 *

* on 11" x 17" landscape printout

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Prepared By:
A. Ploof
Date:
Sept. 15, 2000

Kalamazoo Lake
Total PCB Concentration
Depth Interval 6-12 inches

Figure 9

DETDd007273/e:/projects/Kalamazoo/Basemap/kzoobase.apr

DRAFT

Kalamazoo Lake
Depth Interval: 12-24 inches

Park
Lake
Campbell
Ferry
Blue Star Hwy
Old Allegan
Bradley
196
Union
nter

Legend

Total PCB Conc. (mg/kg)

- 0.0 - 0.12
- 0.12 - 0.5
- 0.5 - 1.0
- 1.0 - 5.0
- 5.0 - 20.0
- 20.0 - 50.0
- >50
- Highways
- Local roads
- Railroads
- Direction of Flow

Note: Base map data derived from Michigan Framework.

N

0 1000 2000 Feet

1:10,000 *

* on 11" x 17" landscape printout

DETDd007273/e:/projects/Kalamazoo/Basemap/kzoobase.apr

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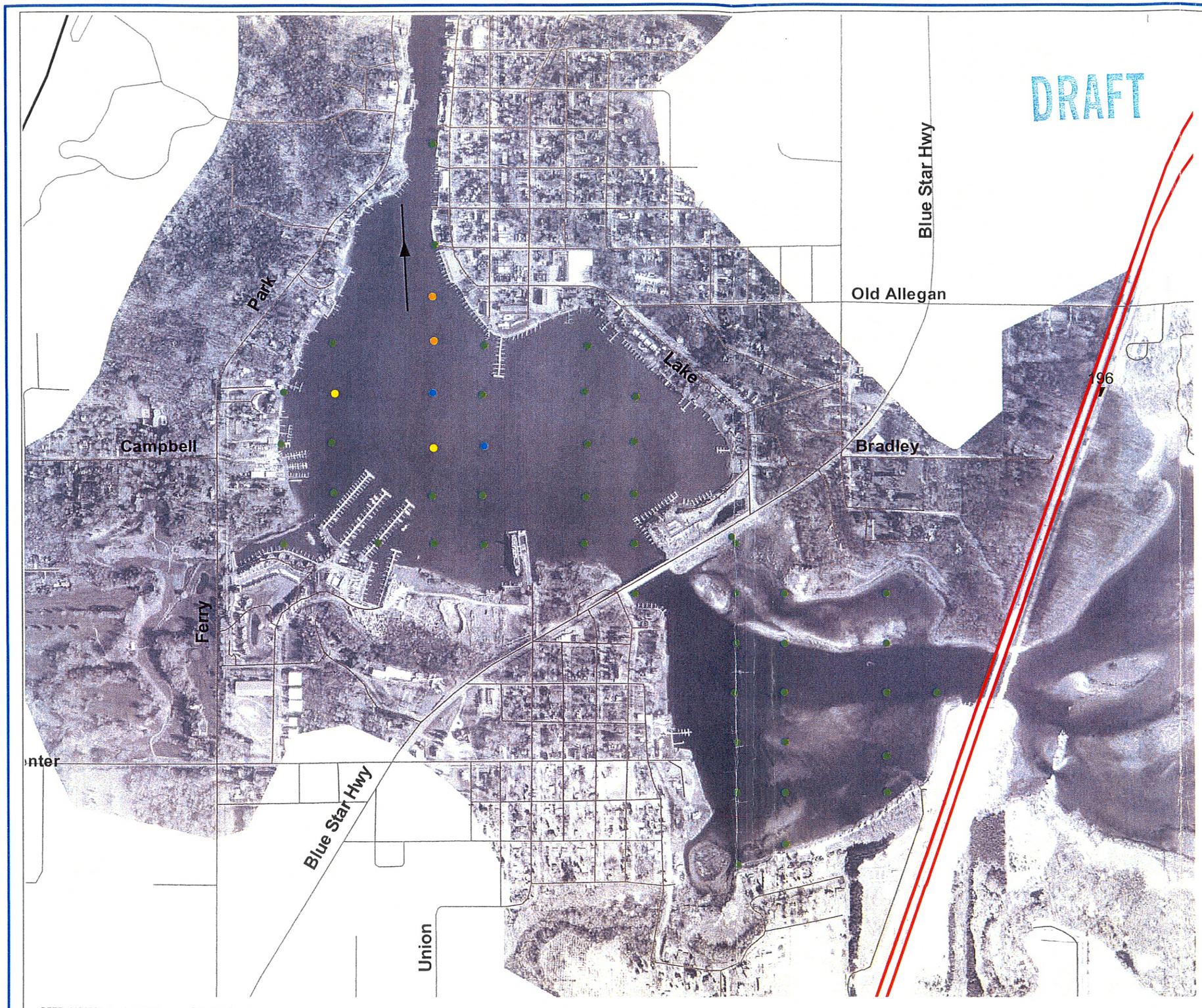
Sept. 15, 2000

Kalamazoo Lake
Total PCB Concentration
Depth Interval 12-24 inches

Figure 10



DETDd007273/e:/projects/Kalamazoo/Basemap/kzoobase.apr

Kalamazoo Lake
Depth Interval: 24-36 inches

Legend

Total PCB Conc. (mg/kg)

- 0.0 - 0.12
- 0.12 - 0.5
- 0.5 - 1.0
- 1.0 - 5.0
- 5.0 - 20.0
- 20.0 - 50.0
- >50
- Highways
- Local roads
- Railroads
- Direction of Flow

Note: Base map data derived from Michigan Framework.

N

0 1000 2000 Feet

1:10,000 *

* on 11" x 17" landscape printout

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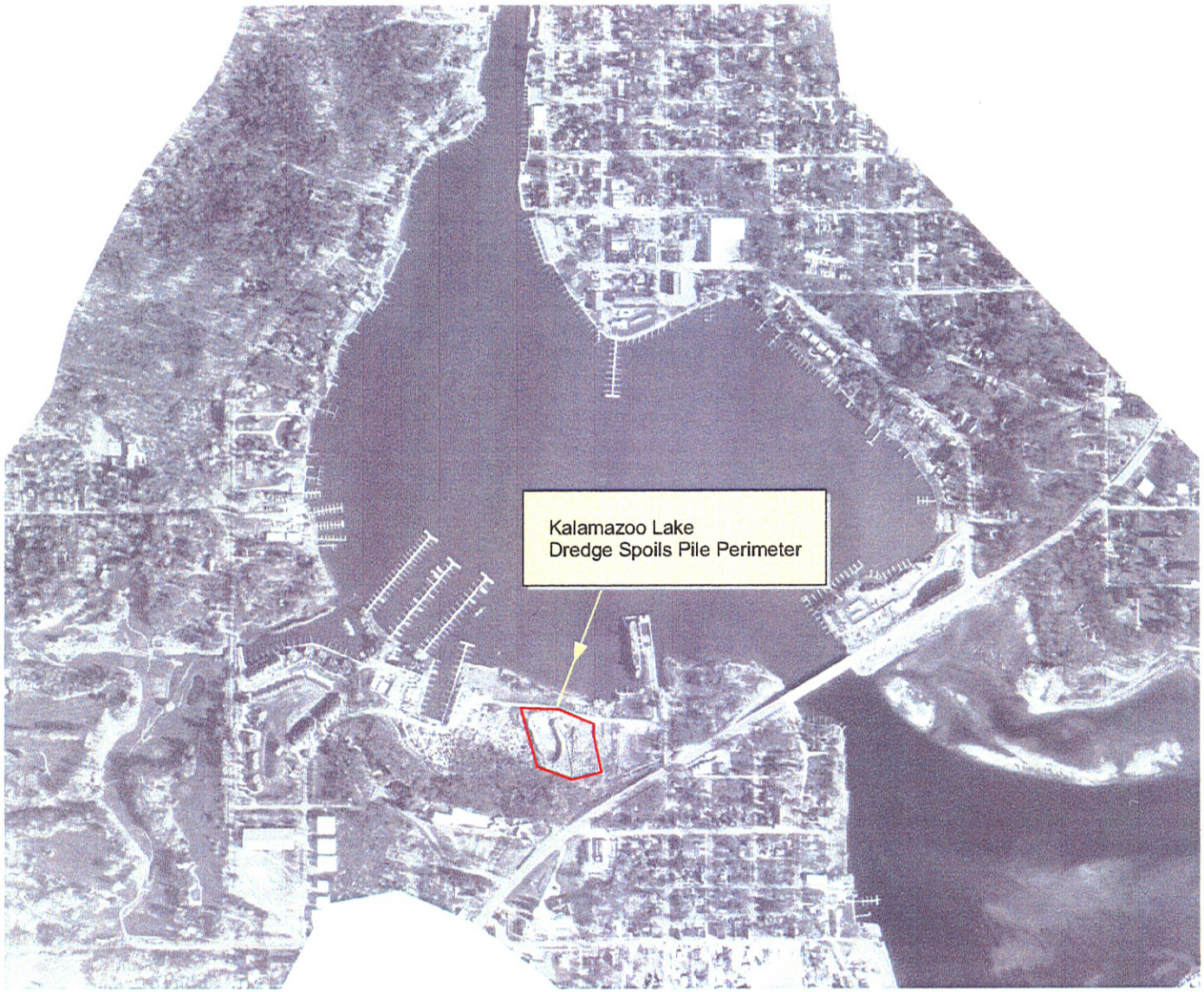
Date:
Sept. 15, 2000

Kalamazoo Lake
Total PCB Concentration
Depth Interval 24-36 inches

Figure 11

Attachment 3
Figures and Tables Summarizing PCB and Metals Concentrations
(CDM, 2001; Dell, 1999)



DETDL100041/c:/proj/28963/_gis/KzooLake/kl.apr

N

Legend

Perimeter of Sampling Event

Notes:
(1) Aerial photographs taken by Air Land Surveys, Inc. on 4/24/1999

0 500 1000 Feet

(on 11" x 17" landscape printout)

CDM Camp Dresser & McKee

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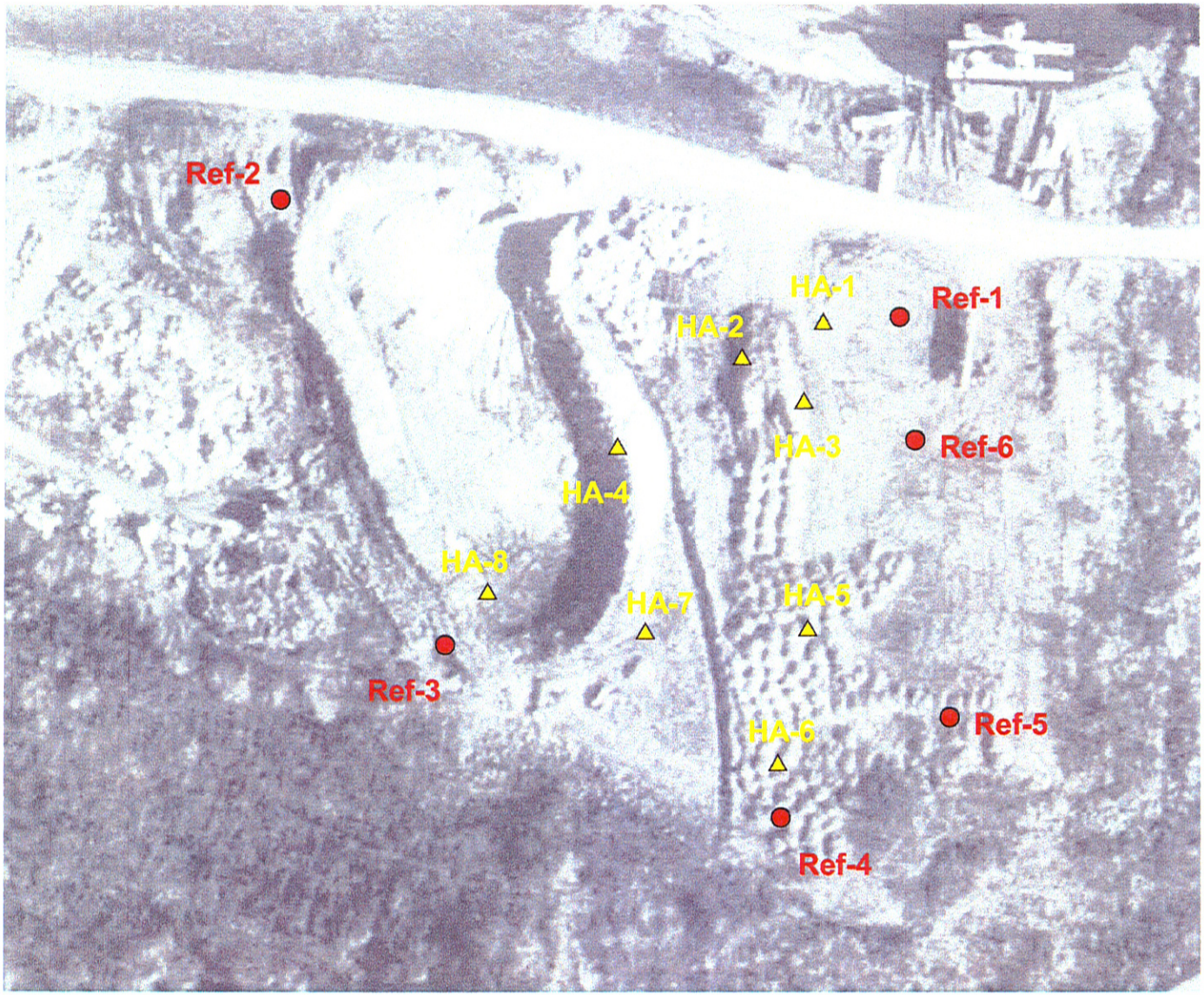
Date:
11/3/00

Allied Paper, Inc./Portage Creek/ Kalamazoo River Superfund Site

Overall View of Kalamazoo Lake

Figure No. 1



DETDL100041/c:/proj/28963/_gis/KzooLake/kl.apr

N

Legend

Sample Locations

Reference Location

Sample Location

Notes:
(1) Aerial photographs taken by Air Land Surveys, Inc. on 4/24/1999

0 50 100 Feet

(on 11" x 17" landscape printout)

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Prepared By:
A. Santini
Date:
11/3/00

Allied Paper, Inc./Portage Creek/ Kalamazoo River Superfund Site

Dredge Spoils Sampling and Reference Locations

Figure No. 2

Table 1 – Kalamazoo Lake - Dredge Spoils Lagoon Sample Results

November 2, 2000	Parameter	*Part 201 Residential Direct Contact Criteria	**Statewide Default Background Levels	Tower:HA-1F:2'-3'	Tower:HA-1C:6'-7'	Tower:HA-2F:2'-3'	Tower:HA-2R:4.5':5'	Tower:HA-2C:5'-6'
EPA Method								
Method 6010B	Arsenic (mg/kg)	7.6	5.8	12.0	3.1	12.0	NA	<5.72
	Barium (mg/kg)	37,000	75.0	284	83.5	250	NA	29.7
	Cadmium (mg/kg)	550	1.2	1.2	<0.493	1.23	NA	<0.481
	Chromium III (mg/kg)	790,000	18.0	74.8	13.5	60.2	NA	9.13
	Copper (mg/kg)	20,000	32.0	46.7	10.1	40.1	NA	5.23
	Lead (mg/kg)	400	21.0	132	21.6	107	NA	7.71
	Manganese (mg/kg)	25,000	440	1,000	380	917	NA	117
	Selenium(mg/kg)	2,600	0.41	<2.6	<2.7	<2.6	NA	<2.6
	Silver (mg/kg)	2,500	1.0	0.747	<0.552	0.611	NA	<0.538
	Zinc (mg/kg)	170,000	47.0	179	35.2	148	NA	15.0
	Nickel (mg/kg)	40,000	20.0	35.3	7.3	28.2	NA	3.54
Method 7471A	Mercury (mg/kg)	160	0.13	0.815	0.119	0.682	NA	0.0341
Method 8082	Total PCB (mg/kg)	4.0	Not available	2.60	0.098	1.26	0.126	<0.0568
Method 8270 B/N	Bis (2-ethylhexyl) phthalate (mg/kg)	2,800	Not available	<0.962	<0.425	<0.828	NA	<0.390

*Soil: Residential and Commercial I, Part 201 Generic Cleanup Criteria, June 6, 2000

** Soil; Residential and Commercial I, Part 201 Generic Cleanup Criteria, June 6, 2000 and MERA (Default Type A Cleanup Criteria) Operational Memorandum #15, September 30, 1993

NA – Not Analyzed

111 denotes analytical data above Residential and Commercial I Direct Contact Criteria

222 denotes analytical data above statewide background levels

Table 1 (cont'd) – Kalamazoo Lake - Dredge Spoils Lagoon Sample Results

November 2, 2000	Sample ID/NEA ID							
	Parameter	*Part 201 Residential Direct Contact Criteria	**Statewide Default Background Levels	Tower:HA-3F:2'-3'	Tower:HA-3C:4'-4.5'	Tower:HA-4F:2'-3'	Tower:HA-4C:3.5'-4.5'	Tower:HA-5F:2
EPA Method								
Method 6010B	Arsenic (mg/kg)	7.6	5.8	9.5	<5.10	8.4	<5.55	8.7
	Barium (mg/kg)	37,000	75.0	250	38.2	223	28.7	227
	Cadmium (mg/kg)	550	1.2	<1.03	<0.428	0.744	<0.467	<0.972
	Chromium III (mg/kg)	790,000	18.0	46.6	5.84	43.1	4.95	53.6
	Copper (mg/kg)	20,000	32.0	32.9	6.23	33.6	2.69	38.4
	Lead (mg/kg)	400	21.0	75.9	9.42	69.2	5.66	79.3
	Manganese (mg/kg)	25,000	440	880	163	828	112	855
	Selenium(mg/kg)	2,600	0.41	<2.5	<2.7	<2.6	<2.5	<2.6
	Silver (mg/kg)	2,500	1.0	0.582	<0.479	<0.821	<0.522	0.458
	Zinc (mg/kg)	170,000	47.0	116	16.6	108	11.5	120
	Nickel (mg/kg)	40,000	20.0	22.5	4.04	21.6	3.01	23.6
Method 7471A	Mercury (mg/kg)	160	0.13	0.45	0.0346	0.429	0.0437	0.465
Method 8082	Total PCB (mg/g)	4.0	Not available	1.22	<0.0528	0.903	0.351	1.23
Method 8270 B/N	Bis (2-ethylhexyl) phthalate (mg/kg)	2,800	Not available	<0.810	<0.379	<0.753	<0.380	<0.792

*Soil: Residential and Commercial I, Part 201 Generic Cleanup Criteria, June 6, 2000

** Soil; Residential and Commercial I, Part 201 Generic Cleanup Criteria, June 6, 2000 and MERA (Default Type A Cleanup Criteria) Operational Memorandum #15, September 30, 1993

NA – Not Analyzed

111 denotes analytical data above Residential and Commercial I Direct Contact Criteria

222 denotes analytical data above statewide background levels

Table 1 (cont'd) – Kalamazoo Lake - Dredge Spoils Lagoon Sample Results

November 2, 2000	Sample ID/NEA ID						
	Parameter	*Part 201 Residential Direct Contact Criteria	**Statewide Default Background Levels	Tower:HA-5F:6'-7'	Tower:HA-6F:3.5'-4.5'	Tower:HA-6C:5'-5.5'	Tower:HA-7F:3'-3.5'
EPA Method							
Method 6010B	Arsenic (mg/kg)	7.6	5.8	9.5	11.0	4.26	5.2
	Barium (mg/kg)	37,000	75.0	171	229	78.5	110
	Cadmium (mg/kg)	550	1.2	<0.862	1.12	<0.353	<0.59
	Chromium (mg/kg)	790,000	18.0	33.2	61.1	10.8	21.2
	Copper (mg/kg)	20,000	32.0	29.0	46.9	7.31	18.0
	Lead (mg/kg)	400	21.0	53.5	95.9	18.0	31.9
	Manganese (mg/kg)	25,000	440	702	834	333	422
	Selenium(mg/kg)	2,600	0.41	<2.7	<2.5	<2.6	<2.7
	Silver (mg/kg)	2,500	1.0	<0.964	0.754	<0.395	<0.66
	Zinc (mg/kg)	170,000	47.0	97.3	169	26.0	53.4
	Nickel (mg/kg)	40,000	20.0	20.1	31.0	6.57	11.6
Method 7471A	Mercury (mg/kg)	160	0.13	0.357	0.663	0.105	0.184
Method 8082	Total PCB (mg/kg)	4.0	Not available	0.807	1.55	<0.0621	0.518
Method 8270 B/N	Bis (2-ethylhexyl) phthalate (mg/kg)	2,800	Not available	<0.695	<0.823	<0.416	0.659

*Soil: Residential and Commercial I, Part 201 Generic Cleanup Criteria, June 6, 2000

** Soil; Residential and Commercial I, Part 201 Generic Cleanup Criteria, June 6, 2000 and MERA (Default Type A Cleanup Criteria) Operational Memorandum #15, September 30, 1993

NA – Not Analyzed

111 denotes analytical data above Residential and Commercial I Direct Contact Criteria

222 denotes analytical data above statewide background levels

Table 1 (cont'd) – Kalamazoo Lake - Dredge Spoils Lagoon Sample Results

November 2, 2000	Sample ID/NEA ID					
	Parameter	*Part 201 Residential Direct Contact Criteria	**Statewide Default Background Levels	Tower:HA-7C:5'-5.5'	Tower:HA-8F:3'-4'	Tower:HA-8F:7'-7.5'
EPA Method						
Method 6010B	Arsenic (mg/kg)	7.6	5.8	5.1	<2.6	11.0
	Barium (mg/kg)	37,000	75.0	90.3	46.9	223
	Cadmium (mg/kg)	550	1.2	<0.519	<0.592	<0.837
	Chromium (mg/kg)	790,000	18.0	18.7	9.69	37.1
	Copper (mg/kg)	20,000	32.0	17.9	9.72	27.3
	Lead (mg/kg)	400	21.0	30.0	17.7	62.4
	Manganese (mg/kg)	25,000	440	346	186	1,090
	Selenium(mg/kg)	2,600	0.41	<2.7	<2.6	<2.6
	Silver (mg/kg)	2,500	1.0	<0.581	<0.662	<0.937
	Zinc (mg/kg)	170,000	47.0	52.5	22.6	113
	Nickel (mg/kg)	40,000	20.0	11.3	5.76	23.0
Method 7471A	Mercury (mg/kg)	160	0.13	0.174	0.115	0.347
Method 8082	Total PCB (mg/kg)	4.0	Not available	0.298	0.606	0.969
Method 8270 B/N	Bis (2-ethylhexyl) phthalate (mg/kg)	2,800	Not available	<0.440	<0.469	1.260

*Soil: Residential and Commercial I, Part 201 Generic Cleanup Criteria, June 6, 2000

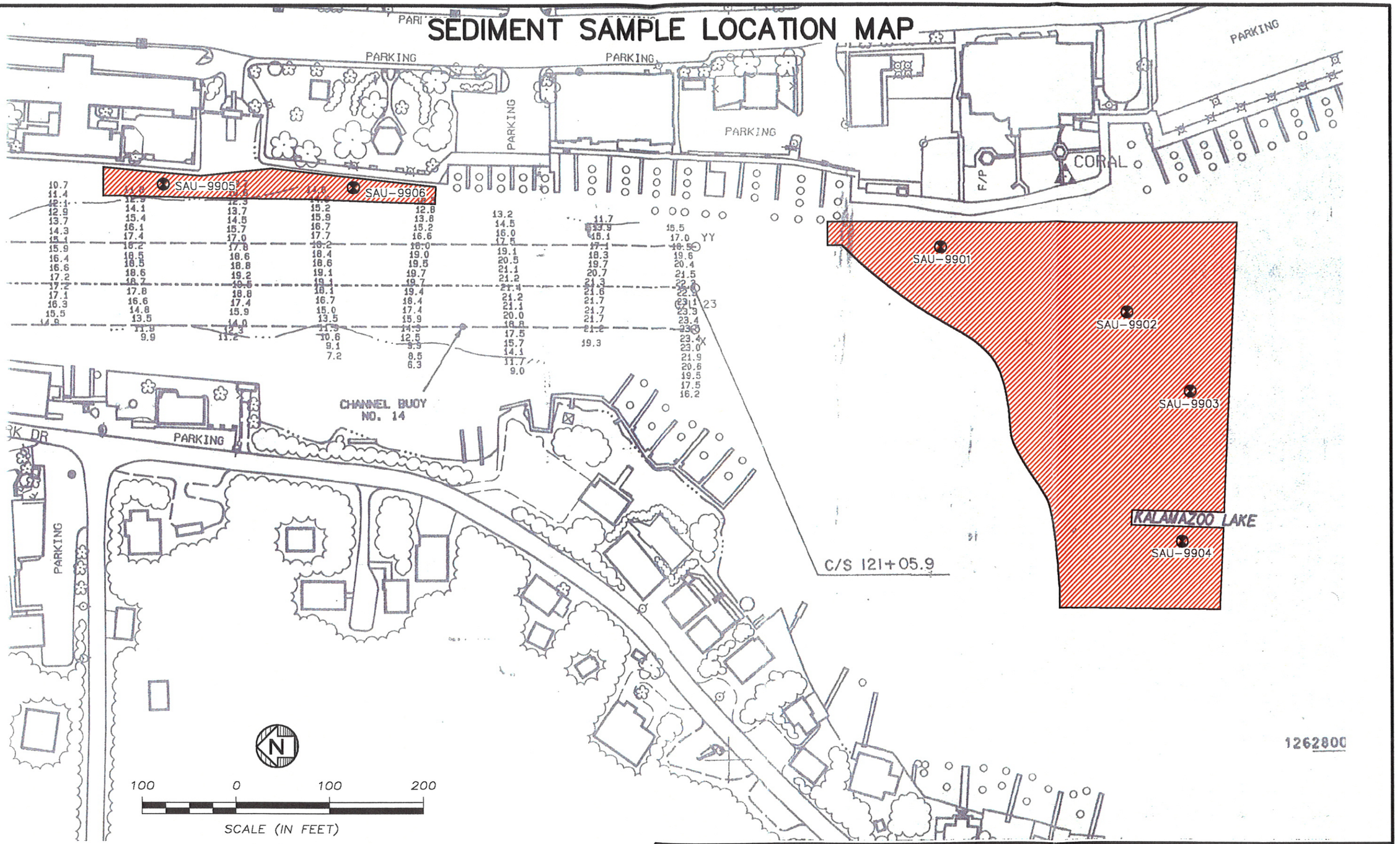
** Soil; Residential and Commercial I, Part 201 Generic Cleanup Criteria, June 6, 2000 and MERA Operational Memorandum #15, September 30, 1993

NA – Not Analyzed

111 denotes analytical data above Residential and Commercial I Direct Contact Criteria

222 denotes analytical data above statewide background levels

SEDIMENT SAMPLE LOCATION MAP



LEGEND

- PROPOSED DREDGE AREAS
- SEDIMENT SAMPLING LOCATION

X6101-02.DWG 5/10/1999 11:53 AM
REVISIONS TO BE MADE ON THE CADD FILE ONLY

A member of the ERM Group

ERM

SAUGATUCK/DOUGLAS
CONVENTION AND VISITORS BUREAU
SAUGATUCK, MICHIGAN

CHK'D

X6101.00.01

Dell Engineering, Inc. Civil Engineering • Environmental Consulting
3352 128th Avenue, Holland, MI 49424-9263

FIGURE 2

Table 1

SUMMARY OF METAL RESULTS

Saugatuck/Douglas Convention and Visitors Bureau
Saugatuck, Michigan

Parameter (mg/kg)	SAU9901	SAU9902	SAU9903	SAU9904	95% Upper Confidence Limit	Statewide Default Background (a)	Part 201 Residential Drinking Water Protection	Part 201 Residential Direct Contact	Part 201 Groundwater/ Surface Water Protection	Default Clay (b)
Arsenic	9.5	9.3	9.9	9.4	9.83	5.8	23	6.6	70	34.3
Barium	140	130	140	120	143.76	75	1,300	30,000	1,000,000	249.3
Cadmium	0.072	0.072	0.14	0.083	0.13	1.2	6.0	210	250,000	3
Chromium	28	28	33	28	32.19	18	1,000,000	630,000	1,000,000	49.8
Copper	30	25	31	27	31.49	32	160,000	16,000	1,000,000	35.9
Mercury	0.037	<0.028	0.13	<0.028	0.115	0.13	1.7	130	47	0.25
Manganese	680	630	680	610	691.87	440	2.0	20,000	200,000	690.2
Lead	56	53	63	54	61.81	21	1.0	400	ID	39.6
Selenium	<0.045	<0.045	<0.045	<0.045	NA	0.41	4.0	2,100	88,000	1.34
Silver	<0.42	<0.42	0.44	<0.42	NA	1	4.5	2,000	230,000	3.56
Zinc	120	110	130	120	129.61	47	2,400	140,000	1,000,000	98.2

Notes:
(a) Statewide default background concentrations for naturally-occurring soil per MERA Operational Memorandum #15, dated September 30, 1993.
(b) Default clay concentration per Michigan Background Soil Survey dated April 1991
- Part 201 criteria per MDEQ Environmental Response Division Operational Memorandum #18 dated January 29, 1999
- Shaded values exceed the statewide default background concentrations
- All samples collected on 13 April 1999 from the proposed cruise ship turning area.
- Samples SAU9905 and SAU9906 contained <5% material passing a #200 sieve and were, therefore, not submitted for environmental analysis.

Table 2

SUMMARY OF SYNTHETIC PRECIPITATION LEACHING PROCEDURE RESULTS

Saugatuck/Douglas Convention and Visitors Bureau
Saugatuck, Michigan

Parameter (mg/L)	SAU9901	SAU9902	SAU9903	SAU9904	Part 201 Residential Drinking Water Criteria	Act 307 Type B Drinking Water Criteria
Arsenic	0.0041	<0.001	0.0013	<0.001	0.050	0.001
Barium	0.3	0.37	0.3	0.21	2.000	2.400
Chromium	0.012	0.0017	<0.001	<0.001	0.100	0.120
Manganese	0.16	0.023	<0.01	<0.01	0.050	0.050
Lead	<0.001	<0.001	<0.001	<0.001	0.004	0.004
Zinc	0.12	0.064	0.028	0.054	2.400	2.300

Notes:
- Part 201 criteria per MDEQ Environmental Response Division Operational Memorandum #18 dated January 29, 1999.
- Type B criteria per former Act 307 Operational Memorandum #8, Revision 3, dated February 4, 1994.
- Shaded values exceed the residential drinking water criteria.
- Samples collected on 13 April 1999 from the proposed cruise ship turning area.

Attachment 4
MDEQ Review Criteria for Dredged Materials

Review Criteria and Detection Limits for Metals

The target method detection limits in soil should be used for the totals analysis, and the target method detection limit in water should be used for leachate analysis (TCLP/SPLP). The sample results are used to compute a 95% Upper Confidence Level (UCL) result for comparison to the review criteria. The total metals analysis UCL result is compared first to the Background Criteria. If all results are below background, no further analysis will be required. If the UCL result is above background, the UCL result is compared to the 20X Drinking Water Value and Direct Contact Value. If either of these values are exceeded, then the leachate testing is required and special disposal requirements are likely. The leachate analysis UCL result is compared to the Health-Based and Aesthetic Drinking Water Values. If the leachate UCL result is below the criteria and the totals analysis UCL result is below the Direct Contact Value, then the material may be authorized for unrestricted disposal. However, if the leachate UCL result is below the criteria and the totals analysis UCL result is above the Direct Contact Value, then the material will have restricted disposal requirements. Likewise, if the leachate analysis UCL result is above the applicable groundwater criteria, there also will be restricted disposal requirements. The method for computing the 95% UCL result and the method for establishing a site specific background value for a disposal area is provided in the Verification of Soil Remediation document at: http://www.deq.state.mi.us/documents/deq-wmd-hwp-versoils.pdf

	GROUNDWATER (ug/l;ppb)				SOIL (ug/kg;ppb)				
Chemical	Health-Based Drinking Water Value [R 709(2)(a)(b)]	Aesthetic Drinking Water Value [R 709(2)(c)(d)]	GSI Value {A} [R 713]	Target Method Detection Limit in Water {B}	20X Drinking Water Value [R 711(2)]	20X GSI Value	Direct Contact Value [R 711(5)]	Target Method Detection Limit in Soil {B}	Statewide Default Back-Ground (PPM)
Aluminum	ID	50 {H}	{D}	20	1,000 {C}	{C,D}	ID	500	6,900
Antimony	2.4 {C}	NA	4,300 {C,Q}	5	48 {C}	86,000	91,000	500	NA
Arsenic	0.02 {C}	NA	11 {C,Q}	1	0.4 {C}	220 {C}	720 {C}	100	5.8
Barium	2,400 {C}	NA	630 {C}	200	48,000 {C}	12,600	1.8E+7	1,000	75
Beryllium	51,000	NA	{D}	1	1.02E+06	{D}	2.10E+06	200	NA
Boron	420 {C}	NA	{D}	10	8,400 {C}	{D}	1.6E+7	2,000	NA
Cadmium	3.5 {C}	NA	0.64 {C,E}	0.2	70 {C}	{D}	1.3E+5	50	1.2
Chromium III {J}	37,000 {C}	NA	77 {C}	50	7.4E+5	1,500 {C}	3.9E+8	2,500	18
Chromium VI {J}	120 {C}	NA	7.3 {C}	1	2,400 {C}	150 {C}	1.2E+6	200	18
Cobalt	1,000	NA	2,000	10	2.00E+03	4.00E+04	2.10E+06	500	6.8
Copper	1,300 {C}	1,000	18 {C,E}	25	20,000 {C}	370 {C}	9.8E+6	1,000	32
Iron	ID	300 {C}	{D}	100	6,000 {C}	{D}	ID	2,000	12,000
Lead	4 {C,O}	NA	6.6 {C,E,Q}	3	80 {C}	130 {C}	4E+5	1,000	21
Manganese	170 {C}	50 {C}	{D}	20	1,000 {C}	{D}	1.2E+6	2,000	440
Mercury (Inorganic)	2.1 {C}	NA	0.0013 {C}	0.2	42 {C}	0.026 {C}	78,000	100	0.13
Nickel	530 {C}	NA	57 {C,E}	50	11,000 {C}	1,100 {C}	2E+7	1,000	20
Selenium	35 {C}	NA	5 {C,Q}	5	700 {C}	100 {C}	1.3E+6	500	0.41
Silver	33 {C}	100	0.1 {C}	0.5	660 {C}	2 {C}	1.2E+6	500	1
Thallium	0.58 {C}	NA	6.3 {C,Q}	2	12 {C}	130 {C}	22,000	500	NA
Vanadium	61 {C}	NA	8 {C}	20	1,200 {C}	160 {C}	2.2E+6	1,000	NA
Zinc	2,300 {C}	5,000 {C}	81 {C,E}	20	46,000 {C}	1,600 {C}	8.6E+7	1,000	47

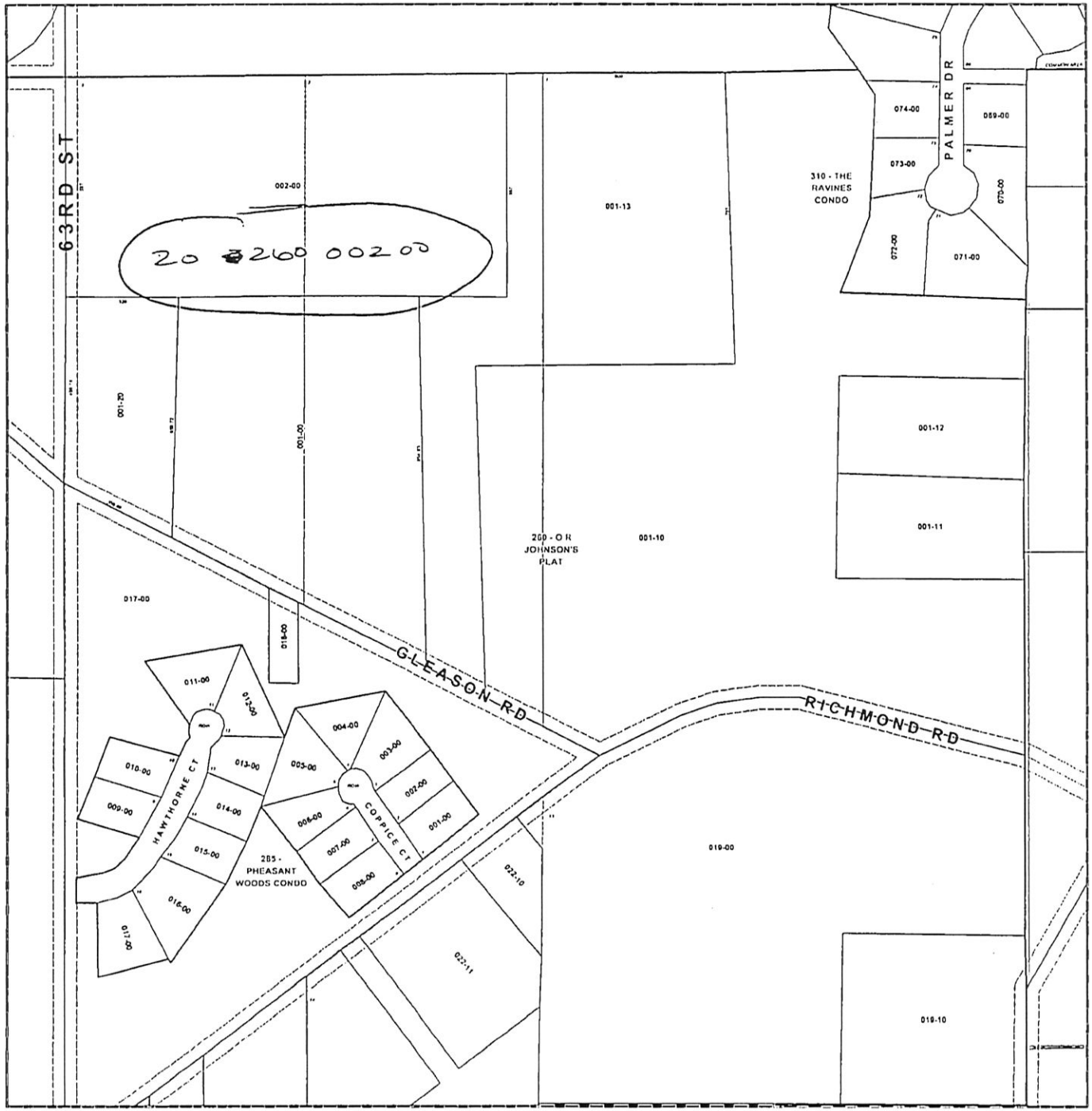
Review Criteria and Detection Limits for PNAs and PCBs

The target method detection limits in soil should be used for the totals analysis, and the target method detection limit in water should be used for leachate analysis (TCLP/SPLP). The sample results are used to compute a 95% Upper Confidence Level (UCL) result for comparison to the review criteria. The totals analysis UCL result is compared first to the 20X Drinking Water Value and Direct Contact Value. If either of these values are exceeded, then the leachate testing is required and special disposal requirements are likely. The leachate analysis UCL result is compared to the Health-Based and Aesthetic Drinking Water Values. If the leachate UCL result is below the criteria and the totals analysis UCL result is below the Direct Contact Value, then the material may be authorized for unrestricted disposal. However, if the leachate UCL result is below the criteria and the totals analysis UCL result is above the Direct Contact Value, then the material will have restricted disposal requirements. Likewise, if the leachate analysis UCL result is above the applicable groundwater criteria, there also will be restricted disposal requirements. The method for computing the 95% UCL result and the method for establishing a site specific background value for a disposal area is provided in the Verification of Soil Remediation document at: http://www.deq.state.mi.us/documents/deq-wmd-hwp-versoils.pdf

	GROUNDWATER (ug/l;ppb)				SOIL (ug/kg;ppb)			
Chemical	Health-Based Drinking Water Value [R 709(2)(a)(b)]	Aesthetic Drinking Water Value [R 709(2)(c)(d)]	GSI Value {A} [R 713]	Target Method Detection Limit in Water {B}	20X Drinking Water Value [R 711(2)]	20X GSI Value	Direct Contact Value [R 711(5)]	Target Method Detection Limit in Soil {B}
Acenaphthene	1,200	NA	{D}	5	24,000	{D}	4.5E+7	330
Acenaphthylene	25	NA	{D}	5	500	{D}	9.3E+5	330
Anthracene	7,000	NA	1.1E+5 {Q}	5	1.4E+5	2.2E+6	2.6E+8	330
Benzo(a)anthracene	0.0049	NA	0.31 {Q}	5	{G}	{G}	180	330
Benzo(b)fluoranthene	0.0049	NA	0.31 {Q}	5	{G}	{G}	180	330
Benzo(k)fluoranthene	0.0049	NA	0.31 {Q}	5	{G}	{G}	180	330
Benzo(g,h,i)perylene	25	NA	{D}	5	{G}	{G}	9.3E+5	330
Benzo(a)pyrene	0.0049	NA	0.31 {Q}	5	{G}	{G}	180	330
Chrysene	0.0049	NA	0.31 {Q}	5	{G}	{G}	180	330
Dibenzo(a,h)anthracen	0.0049	NA	0.31 {Q}	5	{G}	{G}	180	330
Fluoranthene	840	NA	370 {Q}	5	17,000	7,400	3.1E+7	330
Fluorene	840	NA	14,000 {Q}	5	17,000	2.8E+5	3.1E+7	330
Indeno(1,2,3-cd)pyrene	0.0049	NA	0.31 {Q}	5	{G}	{G}	180	330
2-Methylnaphthalene	ID	NA	{D}	5	ID	{D}	ID	330
Naphthalene	250	NA	29	5	5,000	580	9.3E+6	330
Phenanthrene	25	NA	{D}	5	500	{D}	9.3E+5	330
Pyrene	520	NA	11,000	5	10,000	2.2E+5	1.9E+7	330
PCB's	0.018	NA	2E-5	0.2	{G}	{G}	1,000	330

Attachment 5
Information on City-owned Properties
For Potential Use As Disposal Sites

12000 LF x 18,000 LF
@500' 24x36
@200' scale 60"x90"
L A K E M I C H I G A
SAUGATUCK DUNES STATE PARK
Gibson
Gibson Cem.
Rest Area
MICHIGAN DUNES STATE CORRECTIONAL FACILITY
Pelican Peak
Water Tank
Ridgewood Beach
Goshorn Lake
Boat Ramp
Singapore
Lights
Oxbow
Old Saugatuck Light House
Cem
Golf Course
CITY LOTS
15 AC.
26 AC.
Saugatuck
Sewage Disposal Ponds
Kalamazoo Lake
River Bluff Park
S A U G A T U C K
KALAMAZOO
Golf Course
St Peters
Douglas Beach Park
Boat Ramp
Douglas Bayou
Douglas
Schultz Park
RIVER
Public Access
Indian Point
Hosp
Trailer Park
Cem



N
W E
S

Scale: 1" = 400'

This map was compiled for tax administration purposes only. It does not represent a legal property survey.

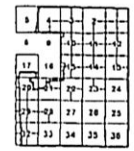
Taxyear: 2006

Map Printed: 09/07/2006

Saugatuck Twp T3N R16W

Gap
Overlap

Parcel Prefix: 03-20-011-



SECTION 11 NE

N
W E
S

Scale: 1" = 400'

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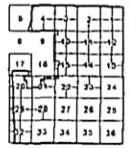
Taxyear: 2006

Map Printed: 09/07/2006

Saugatuck Twp T3N R16W

Gap
Overlap

Parcel Prefix: 03-20-011-



SECTION 11 NW

APPENDIX D: MDNR HARBOR ENVIRONMENTAL CONCERNS

MDNR Fisheries Division Response **February 22, 2007**

From: Scott Hanshue [HANSHUSK@michigan.gov]
Sent: Thursday, February 22, 2007 11:56 AM
To: kolak.shari@epa.gov; Bob Doyle; David.L.Foster@lre02.usace.army.mil; Joseph Haas; harringh@michigan.gov; Kameron Jordan; Milnem@michigan.gov; wesleyj@michigan.gov; Ben Zimont; brian.j.bouwhuis@usace.army.mil
cc: Bernie Fekete; Kirk Harrier
Subject: Kalamazoo Harbor Master Plan

MDNR Fisheries Division comments on the Kalamazoo Harbor Master Plan

Thank you for the opportunity to review and comment on the draft Harbor Plan. Fisheries Division supports the development of a master plan and recommends the surrounding communities adopt the plan in its final form to direct future harbor development.

As stated at the workshops held on December 14, 2006 and January 23, 2007 Fisheries Division does not support extensive dredging of the shallow water habitats in Kalamazoo and Douglas Lakes. These shallow water habitats are the most biologically productive areas in the lakes and provide critical habitat for a variety of species including the State threatened lake sturgeon. With the exception of maintenance dredging of the current facilities, future marina development and dredging activities should be limited downstream of the Blue Star Highway bridge. We recommend the Harbor Master Plan focus on a scaled down version of Alternative Two. The plan should identify and prioritize locations suitable for future marina expansion, concentrating on areas will require the least amount of maintenance dredging. This approach will allow for the targeting of scarce revenues and planned marina expansion as demand increases. To prevent future conflicts, the plan should note that not all areas of the lakes are suited for navigation of large craft or future marina development.

Please note other Divisions within the Department of Natural Resources may have comments or concerns regarding the proposed plans.

Please contact me if you have any questions.

Scott Hanshue
Fisheries Management Biologist
Southern Lake Michigan Management Unit
621 North 10th Street
Plainwell, Michigan 49080

hanshusk@michigan.gov
tx: 269-685-6851 ext. 118
fax: 269-685-1362

MDNR Fisheries Division **August 2007**

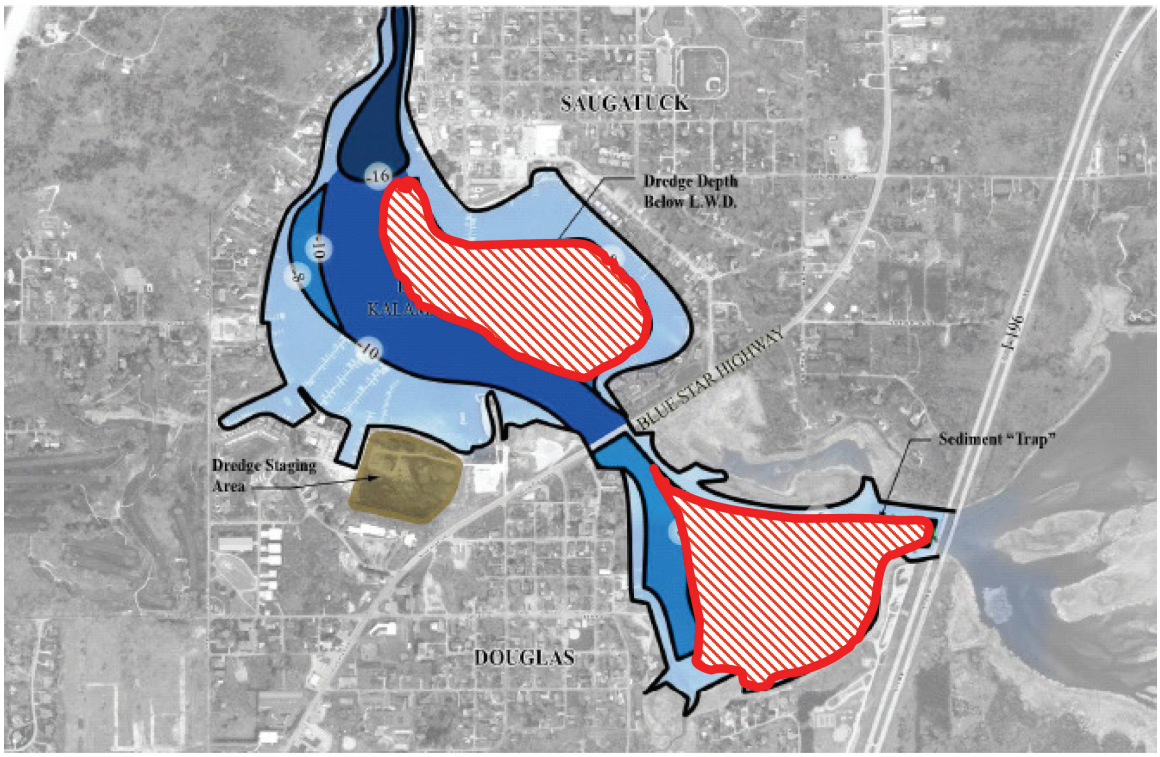
Harbor Environmental Concerns

Lake Sturgeon

Lake sturgeon is a migratory fish species found in many large rivers and lakes in North America with Michigan in the center of its historic range. Lake Michigan populations have historically spawned in the Kalamazoo River and along shorelines near Ganges, Pier Cove and Saugatuck in Allegan County. Populations in and around Michigan were estimated to number in the hundreds of thousands. Since the mid-nineteenth century, exploitation and habitat degradation have resulted in a substantial decline. Today, these populations are believed to be at 1% of their former size. The most significant occurrences for this species in the United States are currently in Michigan and Wisconsin. In response to a continuous period of low abundance, Michigan Department of Natural Resources listed this species as threatened under the Endangered Species Act.

This is the only sturgeon species native to the Great Lakes basin. The distinct shape of these fish and comparatively large size of adult lake sturgeon makes them hard to confuse with other Great Lakes fish species. Lake sturgeon are generally bottom dwelling and occur in large rivers and shallow areas of large lakes where small benthic organisms that serve as food are abundant. While adult sturgeon are most often associated with deep run and pool habitats of rivers, juvenile sturgeon prefer shallow areas were they feed on small benthic organisms, such as crustaceans, and aquatic insect larvae.

Protection of shallow water habitats in the Kalamazoo harbor is critical to the continued survival of the Kalamazoo River population of lake sturgeon. The Harbor Master Plan must ensure that future development options are compatible with this species habitat needs. Therefore, critical shallow water habitats in Lake Kalamazoo and Douglas Harbor will be identified as environmental preservation areas where no dredging would be allowed. In addition, because lake sturgeon are more active in the harbor during certain time periods, unconfined dredging would not be allowed during April 15 through July 15 and September 1 through November 1.



Areas within the red lines would be closed to all dredging. Areas outside of the red lines could be dredged to depths indicated in current plan. Dredging should not occur during April 15-July 15 and September 1-November 1.