**Item #8B:**

**Report On Infrastructure Projects & Reviews**

Public & Private Drainage - Discussion

*Lakes Of Long Grove Subdivision*

06/19/14

Integrated Lakes Management, Inc.
Lake and Pond Management
Restoration ▪ Consulting

April 1, 2014

Prabir Sen-Gupta
The Lakes of Long Grove
4148 Three Lakes Court
Long Grove, IL 60047

Re: The Lakes of Long Grove Outlet Structure Investigation

Dear Mr. Sen-Gupta,

Thank you for meeting with me and our partner, Biedyboys Construction and Excavating (BCE) on March 31, 2013. A brief summary of the project to date, and the findings of our site visit are described below, along with recommended next steps.

During the flooding of April, 2013, residents living along the South Basin indicated that flood waters from the lake backed up into their homes, causing property damage. Integrated Lakes Management (ILM) was asked to conduct a sediment probing study of the lakes to determine if sediment accumulation had caused the flooding. ILM presented the findings to the residents of The Lakes of Long Grove, indicating that sediment had accumulated throughout the lakes, and was potentially restricting flow in the culvert beneath Three Lakes Drive.

It was initially presented to ILM that the current water level in the lakes was the designed normal water level (NWL). Conversations with the Village of Long Grove, and property owners indicated that the culvert beneath Three Lakes Drive has been submerged below the water surface as long as all residents and Village personnel can recall.

The residents asked ILM to present cost estimates to remove sediment and clean out this culvert to improve flow through this culvert, with the goal of reducing future flooding. Cost estimates were developed and presented on July 24, 2013, September 24, 2013, and March 4, 2014 that included varying degrees of sediment removal, and installation of a concrete drop structure at the NWL at the "up-stream" end of the culvert to reduce further sedimentation within the culvert.

During a meeting with Village of Long Grove personnel and interested residents on March 17, 2014, ILM received the Record Drawings of the Lakes of Long Grove development from the Village of Long Grove. Upon review of the Record Drawings, it was observed that installation of a concrete drop structure on the west side of Three Lakes Drive would not be feasible, as the original designed NWL was at the invert (base) of the culvert beneath Three Lakes Drive, rather than above the culvert as had been indicated to ILM. The Record Drawing is attached as Exhibit A.

Discovering that the current water level in the lakes was above the designed NWL, ILM looked to the outlet of the East Basin to determine what was causing the current water level to be approximately 4.5-feet higher than NWL.

On March 31, the outlet on the north end of the East Basin was inspected. It should be noted that ILM and BCE are not Professional Engineers that can certify the integrity of structures such as levees and dams. However, we offer the following assessments based on our professional experience and understanding. Plan and profile drawings of the observed conditions are included with this letter.

**Levee/Berm Condition** – The levee, or berm on the north end of the East Basin is in poor to very poor condition. Seepage was evident along the entire base of the berm. Woody vegetation and trees were observed to be growing on top of and on the embankments. Numerous animal burrows were observed in the berm. Approximately halfway along the top of the berm, an eroded spillway was observed. The spillway did not appear to be a designed structure; rather, it appeared to have formed over time as a result of erosion along the top of the berm. A photo of the eroded spillway is included as Exhibit B. The water level on March 31, 2014 was very near the top of the berm. The eroded spillway was serving as the primary water control structure.

**High Water Level Drainage** – The Record Drawings show a concrete weir detail as the proposed high water overflow structure. During our site visit, a weir structure was not observed. Instead, an approximately 12-inch reinforced concrete pipe at the estimated high water level was identified. The inlet of the pipe was not protected with a grate, and was plugged with woody debris and leaves. A photograph of the high water level drainage inlet is included as Exhibit C. The outlet of the high water level drainage pipe did not have an outfall apron. While inspecting the outlet of the pipe it was observed that water was seeping around the outside of the pipe, and was not flowing through the inside of the pipe. When debris was manually cleared from the pipe inlet, water began draining freely through the high water level drainage pipe, indicating that this pipe is not plugged internally.

**Normal Water Level Drainage** – A second, approximately 12-inch reinforced concrete pipe that appeared to the primary NWL outlet structure was observed approximately 50-feet east of the high water level drainage pipe. There was no drainage present inside, or along the outside of this pipe. The spillway apron at the base of the pipe had been pulled away from the rest of the pipe by approximately 3-inches. A photograph of the outlet of the NWL pipe is included as Exhibit D. Based on the notes on the Record Drawing, the inlet of the NWL outlet pipe is approximately 4.5-feet below the current water surface.

**State Route 83 Drainage** - The drainage inlet beneath St. Rt. 83 was observed to be in poor to very poor condition. Woody debris from fallen trees was scattered around the inlet. A significant area of erosion, potentially caused by a broken drainage culvert was observed in the St. Rt. 83 embankment. This erosion may affect the integrity of the roadway if not addressed soon. The woody debris and poor condition of the inlet structure appeared to be backing up water at the base of the East Basin berm, and had created a wetland with standing water at the time of our visit. Wetland delineation flags were observed around the area at the base of the berm. Photographs of the St. Rt. 83 inlet pipe are included in Exhibit E.

**Conclusions**

The berm on the north end of the East Basin was not designed to retain water at the current water level for extended periods of time. Based on discussions with residents, it is thought that the water has been at the current level for over 10-years. The current water level is approximately 4.5-feet above the NWL.

The berm is showing signs of failure, evidenced by the seepage at the base, animal burrows, woody vegetation growth, and eroded spillway. If this berm is compromised, either during a high flow flood event, or by loss of structural integrity of the berm, all water currently in the lakes will be lost, and a costly repair will be necessary to restore the berm and lake level.

Flooding in the South Basin during April 2013 was likely due to the lack of flood retention capacity within the drainage system, and the submerged, and likely restricted flow beneath Three Lakes Drive.

**Recommended Next Steps**

Residents need to mobilize to address the high water level situation as soon as possible. The high water level has caused the lakes to lose their flood retention capacity, and is compromising the integrity of the retention berm. If the berm is compromised, the cost to repair and replace the berm will greatly exceed any maintenance or drainage pipe repair costs.

The first step for in addressing the drainage pipe repairs is to identify the source and location of the blockage in the NWL drainage pipe which drains toward St. Rt. 83. The source of the blockage can be determined by sending a camera up the drainage pipe. The camera will allow us to determine the condition of the pipe, the location of the lower end of the blockage in the pipe, and potentially the cause of the blockage. Having this information will allow us to determine if the blockage is located within the berm, or beyond the berm, beneath the water. The cost to send a camera up the pipe is $550.

Once the location of the NWL drain blockage is known, repair work can begin. If the blockage is determined to be beneath the water, and the pipe is in good condition, ILM proposes that an excavator be brought in to try breaking off the plugged area of the pipe in the water, allowing water to gain entry into the pipe. The excavator would work to clear debris from the pipe until the water level reaches the NWL. Once the NWL is achieved, the broken pipe would be repaired, and a grated inlet structure would be installed. The existing eroded spillway would be repaired with gravel, clay, and geotextile, to prevent further erosion.

If the camera investigation indicates that the pipe is in poor condition, or the plug is within the berm, the effort to repair the drainage outlet is significantly increased. Pumps will be necessary to drain the lake down to, or below the NWL. Once the water level is at or below the NWL, the existing drain pipe can be excavated out of the berm, and a new drain pipe, inlet, and outfall apron can be installed. The existing eroded spillway would be repaired with gravel, clay, and geotextile, to prevent further erosion. The cost of this repair work is not known at this time due to the potential permitting, design, and construction uncertainties.

All woody vegetation that is currently growing on the berm should be cut and removed, to reduce the risk of berm failure. The roots of woody vegetation create flow pathways for water to pass through the berm, causing seepage and loss of structural integrity.

The storm water inlet under St. Rt. 83 should be repaired as soon as possible. BCE has contacts with the Lake County Department of Transportation (DOT), and will notify them of the

conditions we observed. ILM encourages the Village of Long Grove to also make the Lake County DOT aware of this condition so that repair work can begin as soon as possible, so the St. Rt. 83 road embankment is not compromised, and water can flow away from the base of the berm when discharged.

The recommendations above may only reduce the risk of the berm being compromised, not eliminate the risk. If the landowners wish to engage an engineer who is certified to certify the integrity of these types of structures, ILM can reach out to our Engineering partners to expedite the project.

Once the water level is returned to the NWL, the lake is likely to look very different than it currently does, and it is likely to be smaller in surface area, and shallower. The elevated water level has caused significant erosion along the banks, as areas that were graded and designed to be above water during normal conditions have been submerged for more than 10 years. These areas and the current lake shoreline have eroded, leading to the heavy sediment deposits noted by ILM. The exposed banks should be stabilized with vegetation to reduce further erosion and sedimentation into the lake.

Based on the Record Drawings, the invert (base) of the culvert beneath Three Lakes Drive is at the NWL, as described above. When the water level returns to the NWL, The culvert should be self-cleaning when water flows through it, and should not accumulate additional sediment that would restrict flows between the South Basin and the East Basin.

The changes in the lake appearance and repair costs must be weighed against the risk of additional flooding damages, and the potential cost associated with repairing the berm should it experience a total failure, draining the entire lake system. If the berm were to fail, the landowners would be responsible for any downstream property damages, as well as repair of the structure to restore the area to approved storm water discharge volumes.

At this time, our role has changed from that of a contractor providing pricing for proposed work to serving as a technical advisor/consultant. ILM is providing the information included in this letter to the residents of the Lakes of Long Grove as a courtesy based on our prior relationship. Any future technical advisor or consultant work will need to be billed to the client on a time and materials basis at our standard hourly rate of $120.

If you have any questions, please contact me at 847-244-6662. We look forward to continuing to work with you to resolve the issues related to your lakes and their maintenance.

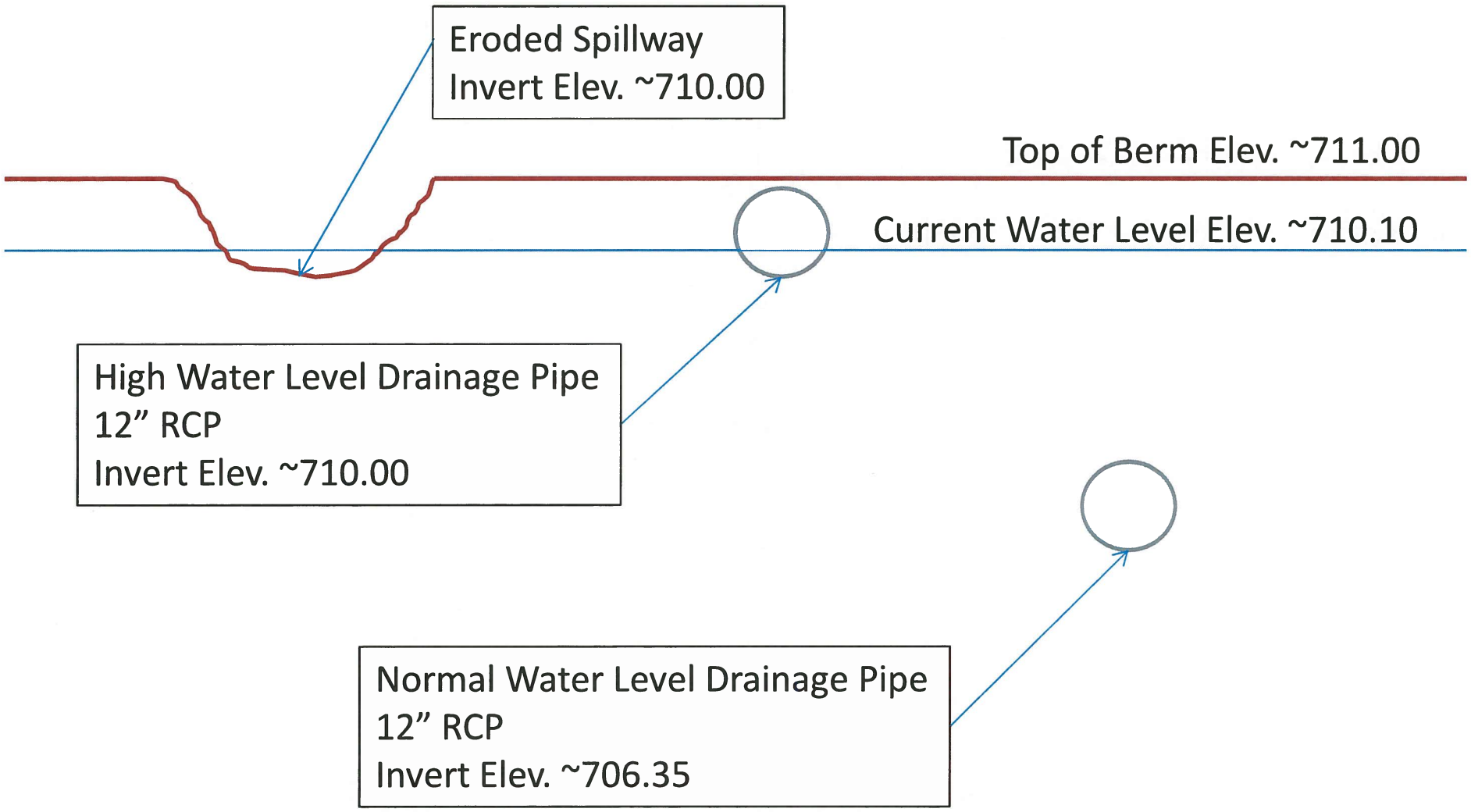
Sincerely,

Bill Santelik, PWS
Integrated Lakes Management

cc: Bill Biedermann, Biedyboys Construction and Excavation
David Lothspeich, Village of Long Grove

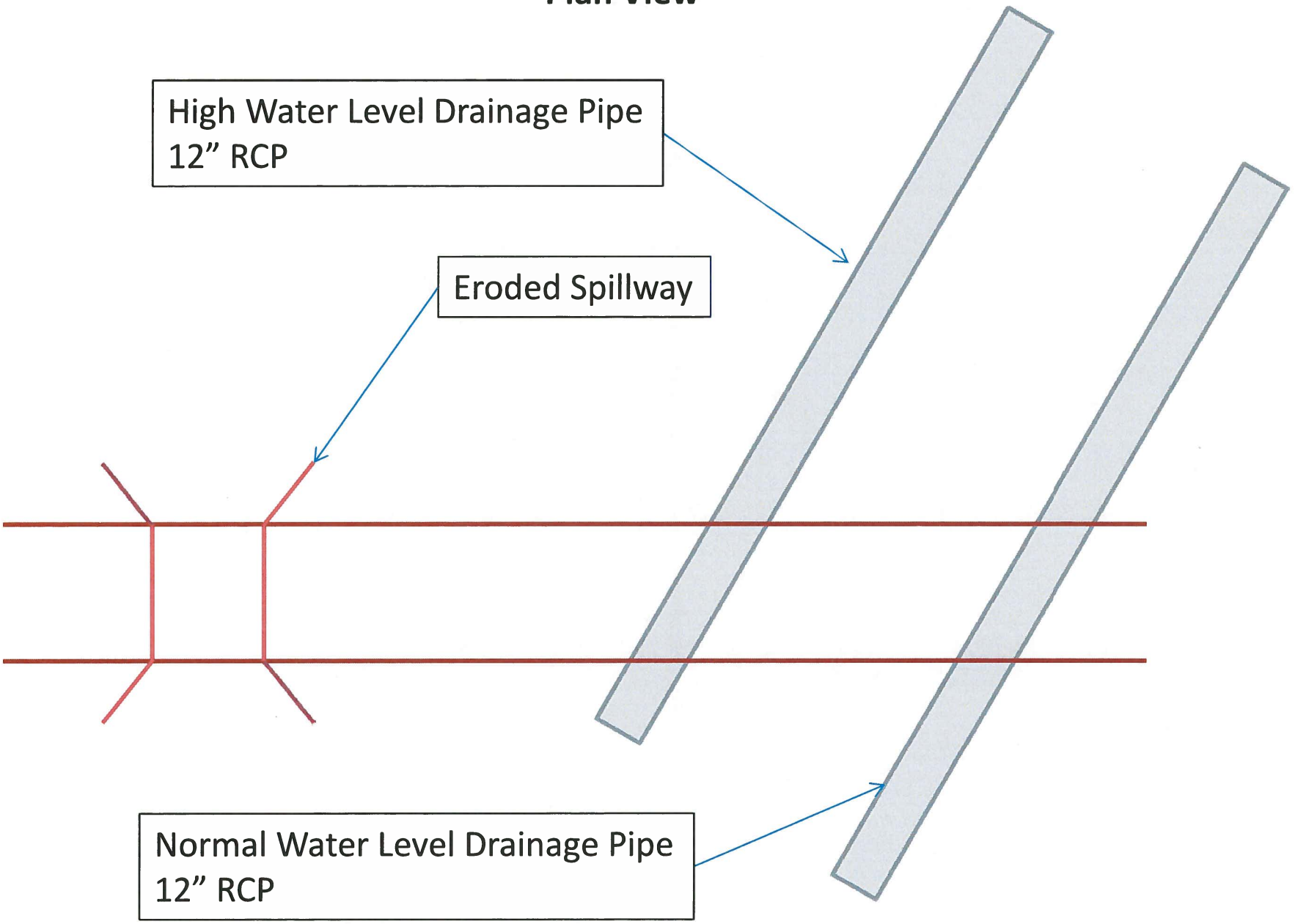
Exhibit A. (See attached large-format drawing)

**Profile View**



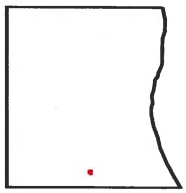

Integrated Lakes Management, Inc. April 1, 2014

**Plan View**




Integrated Lakes Management, Inc. April 1, 2014

# Lake County, Illinois



LakeCounty
Geographic Information System

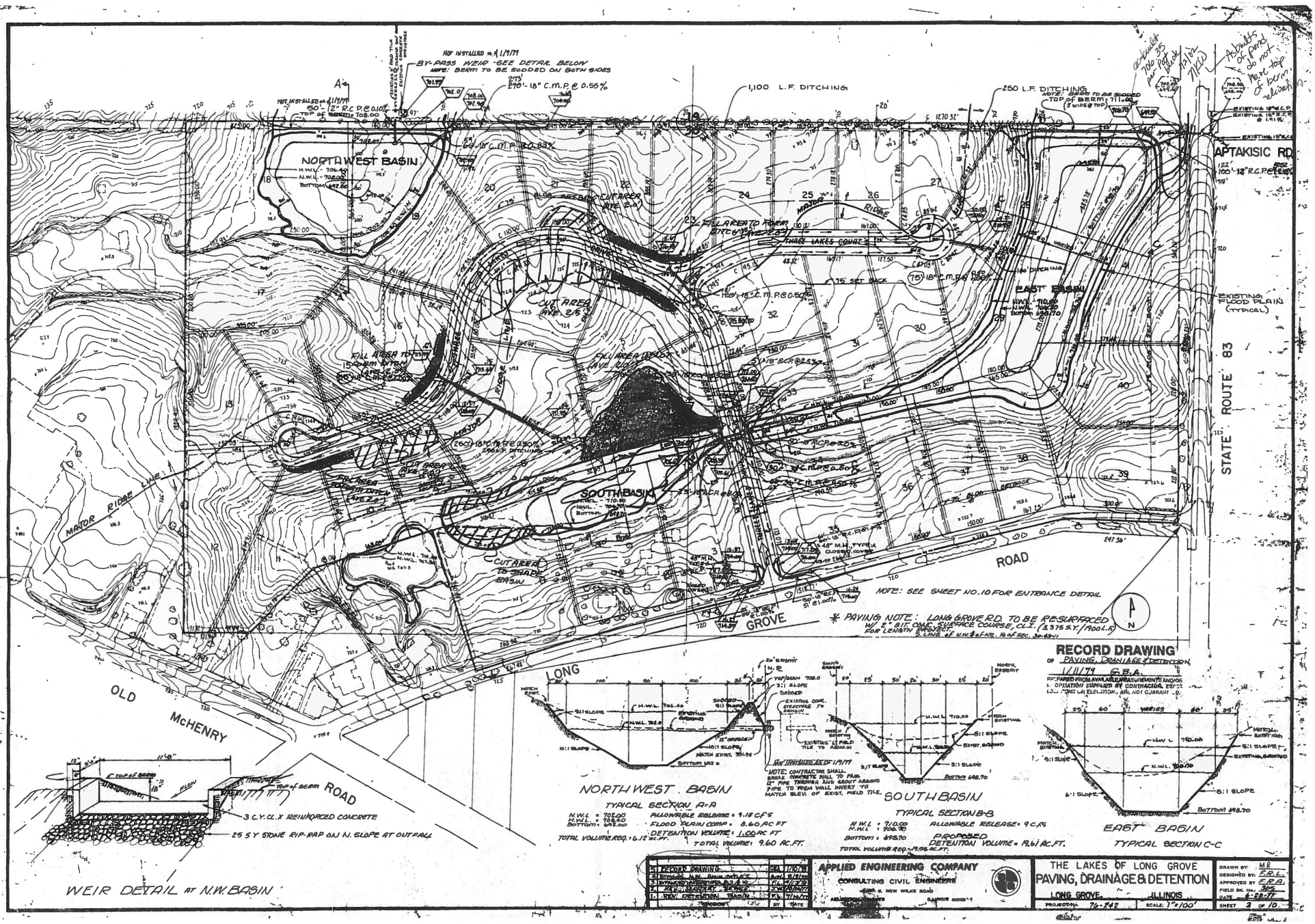
Lake County Department
of Information Technology
18 N County St
Waukegan IL 60085
(847) 377-2373

Map Printed on 04/13/2014

N

- Forest Preserves
- Lake County Border
- Streams
- Tax Parcels
- Trails
- 2011 Buildings

**Disclaimer** The selected soil feature layer may not occur anywhere in the current map extent. A Registered Land Surveyor should be consulted to determine the precise location of property boundaries on the ground. This map does not constitute a regulatory determination and is not a base for engineering design. This map is intended to be viewed and printed in color.



NORTHWEST BASIN
SOUTH BASIN
EAST BASIN
APTAKISIC RD.
STATE ROUTE 83
LONG GROVE ROAD
OLD McHENRY ROAD
MAJOR RIDGE LINE
THREE LAKES COURT
1,100 L.F. DITCHING
250 L.F. DITCHING
BY-PASS WEIR - SEE DETAIL BELOW
NOTE: BERM TO BE SODDED ON BOTH SIDES
EXISTING FLOOD PLAIN (TYPICAL)
NOTE: SEE SHEET NO. 10 FOR ENTRANCE DETAIL
* PAVING NOTE: LONG GROVE R.D. TO BE RESURFACED W/ 2" BIT. CONC. SURFACE COURSE, CL.I. (3,375 S.Y./1900 L.F.) FOR LENGTH PROJECT.
RECORD DRAWING
OF PAVING, DRAINAGE & DETENTION
1/11/79 G.B.A.
NORTHWEST BASIN
TYPICAL SECTION A-A
ALLOWABLE RELEASE = 9.18 C.F.S
FLOOD PLAIN COMP = 8.60 AC FT
DETENTION VOLUME = 1.00 AC FT
TOTAL VOLUME REQ. = 6.12 AC.FT.
TOTAL VOLUME: 9.60 AC.FT.
SOUTH BASIN
TYPICAL SECTION B-B
ALLOWABLE RELEASE = 9 C.F.S
PROPOSED DETENTION VOLUME = 19.61 AC.FT.
TOTAL VOLUME REQ. = 19.56 AC.FT.
EAST BASIN
TYPICAL SECTION C-C
3 C.Y. CL.X REINFORCED CONCRETE
25 S.Y. STONE RIP-RAP ON N. SLOPE AT OUTFALL
WEIR DETAIL AT N.W. BASIN
APPLIED ENGINEERING COMPANY
CONSULTING CIVIL ENGINEERS
THE LAKES OF LONG GROVE
PAVING, DRAINAGE & DETENTION
LONG GROVE, ILLINOIS
PROJECT NO. 76-242
SCALE: 1" = 100'
DRAWN BY: MR
DESIGNED BY: F.R.L.
APPROVED BY: F.R.A.
FIELD BK. NO.: 305
DATE: 6-28-77
SHEET 2 OF 10

Exhibit B.

Exhibit C.

Exhibit D.

Exhibit E.

Exhibit E.

Exhibit E.

Three Lakes Subdivision - Declaration of Covenant

1. THE LAKE LOTS. As an aesthetic benefit to the entire Lakes of Long Grove Subdivision and as a recreational benefit to certain lots, Developer will construct and develop three separate lakes in the Lakes of Long Grove Subdivision. Each lake will be constructed upon and cover portions of the following lots of the Lakes of Long Grove Subdivision (hereafter sometimes collectively called the "lake lots"):

| | |
|---|---|
| First Lake: | Lots 1, 2, 3, 4, 7,8 and 9; |
| Second Lake: | Lots 28, 29, 30, 31, 33, 34, 36, 37, 38, 39, 40 and 41; |
| Third Lake: | Lots 17, 18, 19 and 20. |

When constructed, each lake will be intended for the exclusive use and enjoyment of the owners of the lots upon which the lake is partially constructed. The portions of the lake lots not covered by the waters of the lake will form a common shoreline around the lake. To provide for the orderly use and enjoyment of each lake, the following easements are hereby declared which shall be binding upon the owners of the lake lots upon which each lake is constructed:

A. The owner of each lake lot as designated above hereby grants a reciprocal easement for the use and enjoyment of that portion of a lake situated upon the Owner's lot to each of the owners of lots upon which the same lake is constructed, and their respective guests and invitees. All owners of lake lots for the same lake, their guests and invitees, shall have the right to use the entire lake for swimming, boating and fishing.

B. No motor powered boats of any type shall be used at any time upon any of the lakes of the Lakes of Long Grove Subdivision. In addition thereto either the Village of Long Grove or the Long Grove Fire Prevention District may withdraw water from any of said lakes whenever necessary for fire control.

5. MAINTENANCE: Developer agrees on its behalf and on behalf of the subsequent owners of any of the lake lots as hereinabove designated, that each lake shall be maintained by the owners of the lake lots surrounding such lake, at their expense, including without limitation in such maintenance, mosquito abatement and control, and necessary dredging.



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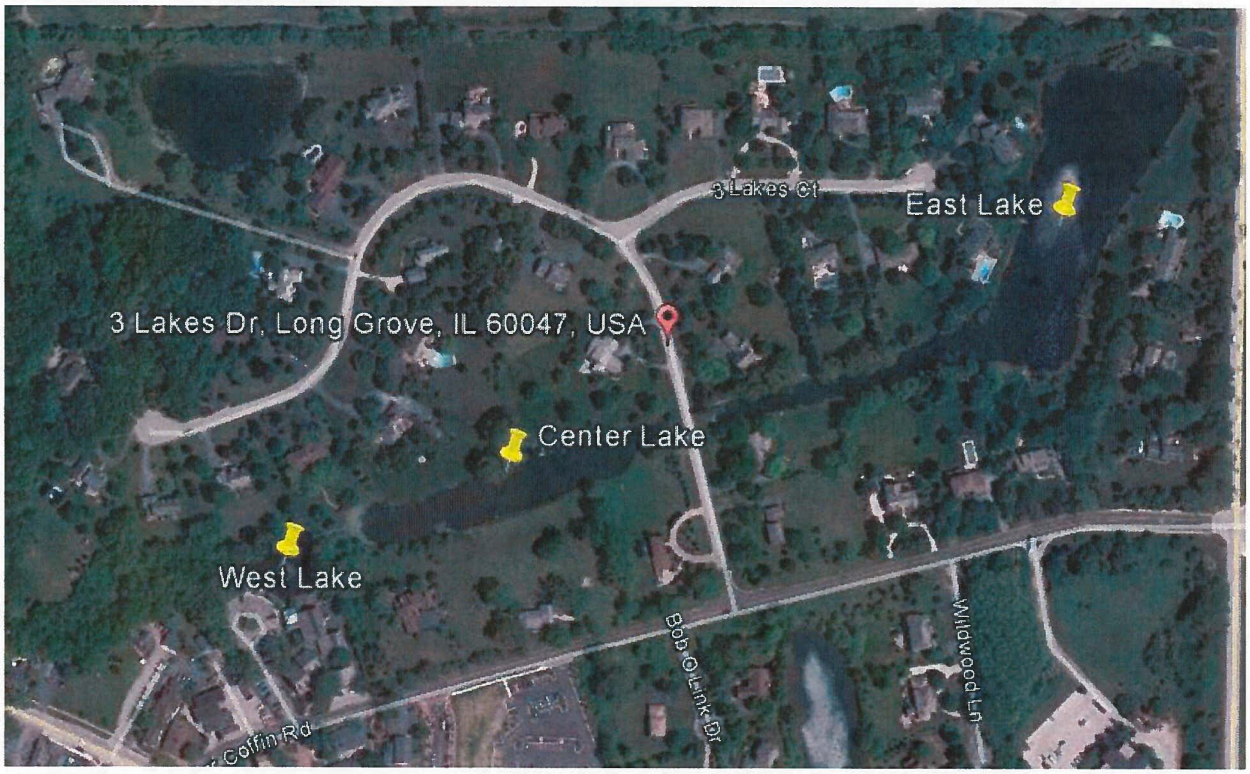
Integrated Lakes Management, Inc.
Lake and Pond Management
Restoration ▪ Consulting

# 3 Lakes Drive
Long Grove, IL

# SEDIMENT PROBING REPORT
May 2, 2013




Prepared For: Dave Lothspeich
Village of Long Grove
3110 RFD
Long Grove, IL 60047

Prepared By: Sandy Kubillus, Certified Lake Manager
Senior Environmental Consultant
Integrated Lakes Management
120 Le Baron St.
Waukegan, IL 60085
(847) 244-6662

Integrated Lakes Management, Inc.
Lake and Pond Management
Restoration ▪ Consulting

# 3 Lakes Drive
Long Grove, IL

# SEDIMENT PROBING REPORT
May 2, 2013

## INTRODUCTION

Ponds typically accumulate sediment and nutrients, and often support nuisance aquatic weed and algae growth, especially as they age. This report includes mapping of three small lakes for sediment thickness, water depth, and total depths, physical characterization of the type of sediment and a brief investigation as to the source of sediment.

The three areas investigated are shown on the cover page as East Lake, Center Lake and West Lake.

## RESULTS

**Table 1: Bathymetric and Sediment Probing Results:**

| | East Lake | Center Lake | West Lake |
|---|---|---|---|
| Size of Lake(acres) | 4.7 | 1.7 | 0.5 |
| Average water depth (ft.)* | 4.9 | 3.4 | 6.2 |
| Maximum water depth: | 7.6 | 5.9 | 9.5 |
| | | | |
| Average sediment thickness (ft.)** | 0.9 | 2.4 | 2.2 |
| Maximum sediment thickness (ft.) | 3.7 | 5.0 | 5.2 |
| Sediment volume (cubic yards)*** | 6,950 | 6,500 | 1,775 |
| Recommended sediment removal volume**** | 4,500 | 6,200 | 1,675 |

*Based on average of points probed.
** Based on average depth multiplied by area.
***Wet sediment volume, which is ~ 50% water. Once this material is removed and dried it should a smaller volume.
****Recommended sediment removal volumes are based on areas with one foot of sediment accumulation or more.

The results from each probe are listed at the end of this report.

## OBSERVATIONS

- A major flood occurred two weeks prior to the site visit and one of the residents identified the debris line between the West and Center Lakes (Figure 11). Apparently the problem was that the outlet to the Center Lake was blocked. The water in all three lakes was slightly flowing at 0.1 – 0.3 feet of depth at the time of the site visit.
- Both the West and East Lakes do not have outlet culv erts but have swales lined with plants and soil. These areas may be one source of sediment to the downstream areas.
- The West Lake shoreline was surrounded by rock. Two of the neighbors had major shoreline restoration projects completed using decorative rock a few weeks prior to the flood.
- Portions of the West Lake have natural shoreline. The remaining sections consist of mowed lawn and the restaurant parking lot. Shorelines for the Center and East Lake consist primarily of mowed lawn to the shoreline with no native plant buffer zone. Sections of these shorelines are eroded and contributing sediment to the lakes.
- No aquatic plants or algae were visible at the time of the site visit.
- The sediment in all three lakes consisted of organic rich muck.
- The Floodplain map (Figure 14) for these lakes does not show a major inflow, so most of the sediment within these ponds appears to be due to shoreline erosion and soil washing into the ponds from nearby properties.

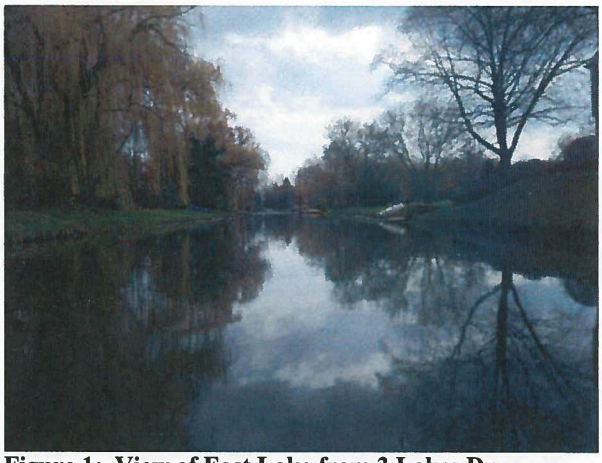


**Figure 1: View of East Lake from 3 Lakes Dr.**

**Figure 2: Shoreline erosion at East Lake.**

**Figure 3: View of main portion of East Lake.**

**Figure 4: Outlet channel for East Lake, near Rt. 83.**

**Figure 5: Inlet for East Lake on 3 Lakes Dr.**

**Figure 6: Center Lake facing west.**

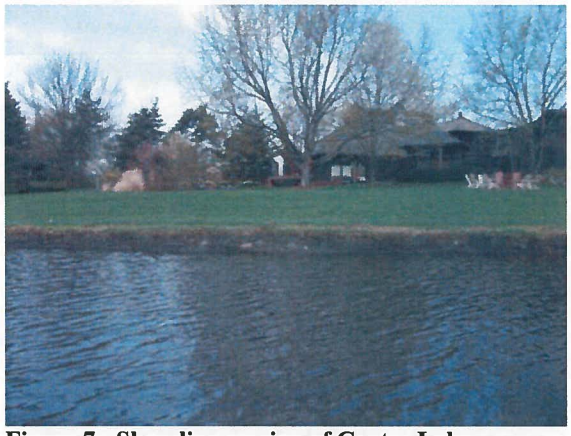


**Figure 7: Shoreline erosion of Center Lake.**

**Figure 8: Shoreline erosion of Center Lake**

**Figure 9: Inlet for Center Lake.**

**Figure 10: Outlet for Center Lake. This outlet was plugged during the April flood event.**

**Figure 11: Debris line from recent flood between the West and Center Lakes.**

**Figure 12: West lake facing west.**

**Figure 13: West Lake facing south to the restaurant.**

**Figure 14: Floodplain map for the 3 Lakes area.**

## RECOMMENDATIONS

- The Center and West Lakes contain a significant amount of sediment that should be removed. Many of these areas have over two feet of sediment. The narrow channel of the East Lake also contains significant sediment deposits.
    - Estimated cost to remove sediment in the Center Lake is $124K ($20/cubic yards (CY)) - $279K ($45/CY) for 6,200 CY.
    - Estimated cost to remove sediment in the West Lake is $33.5K - $75K for 1,675 CY.
    - Estimated cost to remove sediment in the East Lake is $90K - $202K for 4,500 CY. This can be reduced if only the narrow portion is dredged.
    - These cost estimates include dredging and the sediment bags; they do not include moving the sediment to the final storage location. Permitting costs should be minimal if sediment disposal and muddy water can be kept onsite. This can be accomplished if the lake is lowered so that it is not flowing offsite at the time of dredging.

- The main source of sediment to the lakes appears to be shoreline erosion. Mowed lawn has very shallow root systems and provides little protection to the shoreline soils. It is recommended that a native plant buffer of at least 15 – 20 feet be installed around the shoreline of all of the lakes wherever possible.

- The outlets to the West Lake and the East Lake consist of swales that are cut channels. Typically pond outlets consist of culverts with grates that catch debris, or rock lined channels. The existing dirt channels may also be a source of sediment to downstream areas.

- This report is a good first step in determining which areas to dredge. The next step is for the community to determine their budget and priorities. Often a long-term fund is established for major projects such as dredging.
    - If dredging is to begin in the next two years then disposal areas should be determined and the permitting process should be started. Depending on the method utilized for dredging and the disposal location, permitting can be quite variable and early investigation into the requirements is recommended.

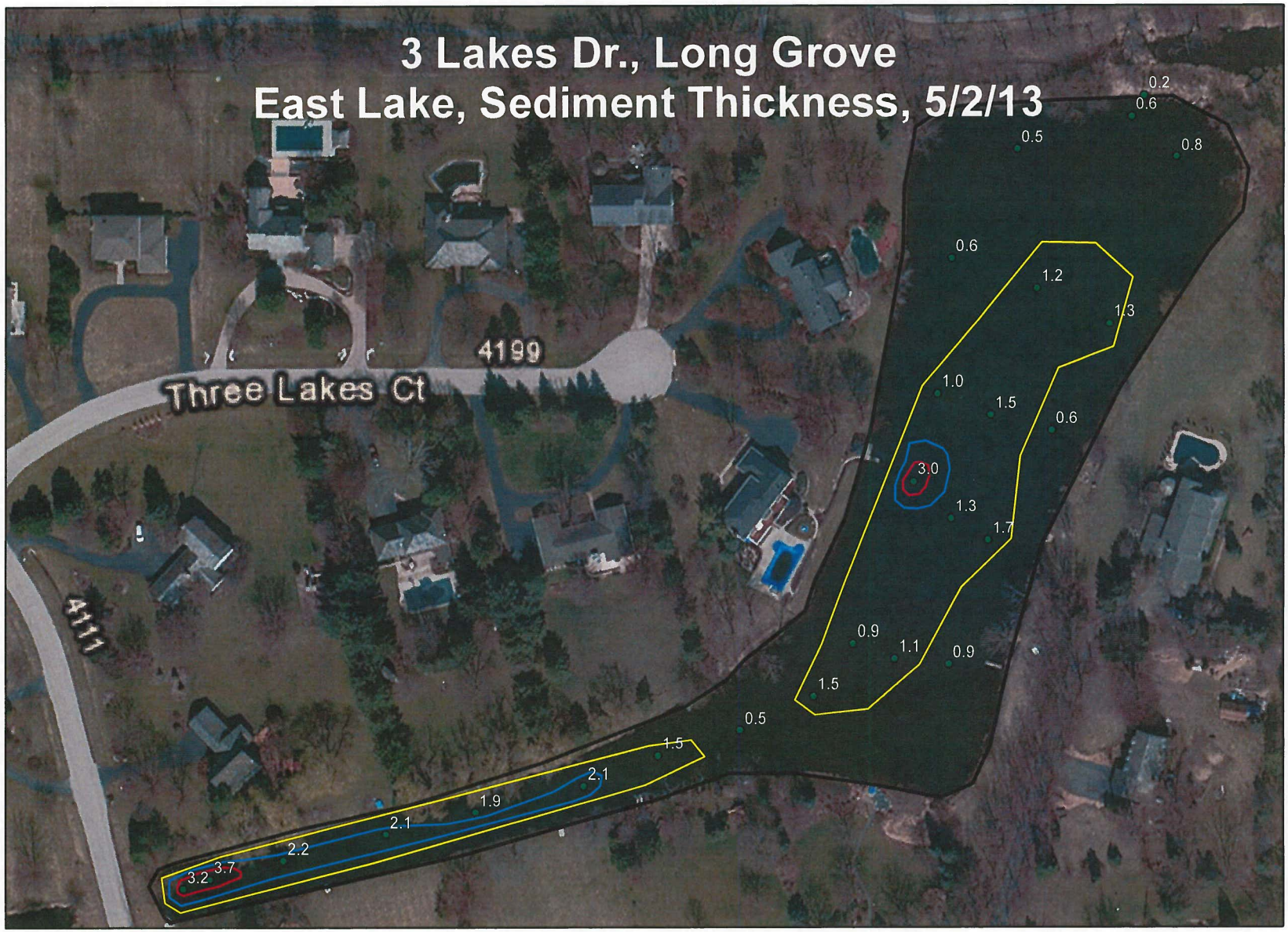
| East Lake | | | |
|---|---|---|---|
| | Sediment | Water Depth | Total Depth |
| | feet | feet | feet |
| 1 | 0.2 | 0.0 | 0.2 |
| 2 | 0.8 | 5.4 | 6.2 |
| 3 | 0.5 | 5.8 | 6.3 |
| 4 | 0.6 | 4.8 | 5.4 |
| 5 | 1.2 | 7.4 | 8.6 |
| 6 | 1.3 | 3.5 | 4.8 |
| 7 | 0.6 | 4.1 | 4.7 |
| 8 | 1.5 | 7.0 | 8.5 |
| 9 | 1.0 | 6.0 | 7.0 |
| 10 | 3.0 | 5.5 | 8.5 |
| 11 | 1.3 | 6.8 | 8.1 |
| 12 | 1.7 | 4.8 | 6.5 |
| 13 | 0.9 | 5.6 | 6.5 |
| 14 | 1.1 | 7.6 | 8.7 |
| 15 | 0.9 | 5.8 | 6.7 |
| 16 | 1.5 | 5.4 | 6.9 |
| 17 | 0.5 | 6.0 | 6.5 |
| 19 | 1.5 | 4.7 | 6.2 |
| 20 | 2.1 | 4.7 | 6.8 |
| 21 | 1.9 | 4.8 | 6.7 |
| 22 | 2.1 | 4.5 | 6.6 |
| 23 | 2.2 | 4.3 | 6.5 |
| 24 | 3.7 | 2.7 | 6.4 |
| 25 | 3.2 | 2.6 | 5.8 |
| 26 | 0.6 | 2.9 | 3.5 |
| Average | 1.4 | 4.9 | 6.3 |
| Maximum | 3.7 | 7.6 | 8.7 |

## Center Lake

| | Sediment | Water Depth | Total Depth |
|---|---|---|---|
| | feet | feet | feet |
| 1 | 2.3 | 2.9 | 5.2 |
| 2 | 4.1 | 1.2 | 5.3 |
| 3 | 2.1 | 1.6 | 3.7 |
| 4 | 4.4 | 2.9 | 7.3 |
| 5 | 4.1 | 5.9 | 10.0 |
| 6 | 5.0 | 4.2 | 9.2 |
| 7 | 2.8 | 3.5 | 6.3 |
| 8 | 2.3 | 2.7 | 5.0 |
| 9 | 4.4 | 4.5 | 8.9 |
| 10 | 2.8 | 2.7 | 5.5 |
| 11 | 4.4 | 4.5 | 8.9 |
| 12 | 3.7 | 2.8 | 6.5 |
| 13 | 3.9 | 5.6 | 9.5 |
| 14 | 3.3 | 2.2 | 5.5 |
| 15 | 1.4 | 2.1 | 3.5 |
| 16 | 3.1 | 4.4 | 7.5 |
| 17 | 2.8 | 5.4 | 8.2 |
| 18 | 3.0 | 2.6 | 5.6 |
| Average | 3.3 | 3.4 | 6.8 |
| Maximum | 5.0 | 5.9 | 10.0 |

## West Lake

| | Sediment | Water Depth | Total Depth |
|---|---|---|---|
| | feet | feet | feet |
| 1 | 2.8 | 5.5 | 8.3 |
| 2 | 3.3 | 4.8 | 8.1 |
| 3 | 5.2 | 4.8 | 10.0 |
| 4 | 4.4 | 5.2 | 9.6 |
| 5 | 2.9 | 7.9 | 10.8 |
| 6 | 1.5 | 9.5 | 11.0 |
| 7 | 2.6 | 6.2 | 8.8 |
| 8 | 2.8 | 5.7 | 8.5 |
| 9 | 3.8 | 6.2 | 10.0 |
| Average | 3.3 | 6.2 | 9.5 |
| Maximum | 5.2 | 9.5 | 11.0 |




Integrated Lakes Management, Inc.
Lake and Pond Management
Restoration ▪ Consulting

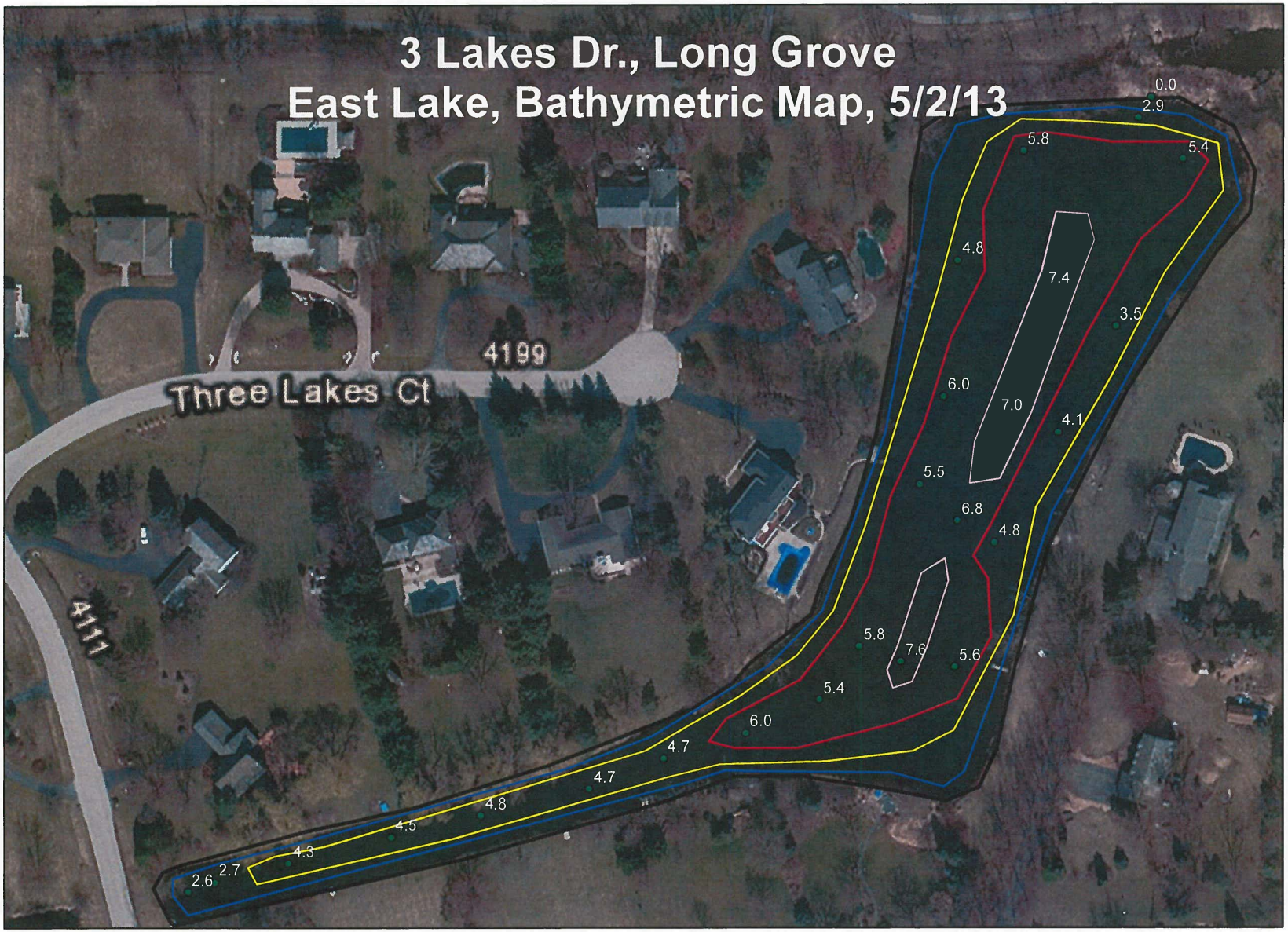
N

0 125 250 500 Feet

1 inch = 137 feet

**Legend**

- 1 ft sediment
- 2 ft sediment
- 3 ft sediment
- East lake shoreline
- EastLake

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N

0 125 250 500 Feet

1 inch = 137 feet

**Legend**

- 1 ft
- 3 ft
- 5 ft
- 7 ft
- East lake shoreline
- EastLake

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N

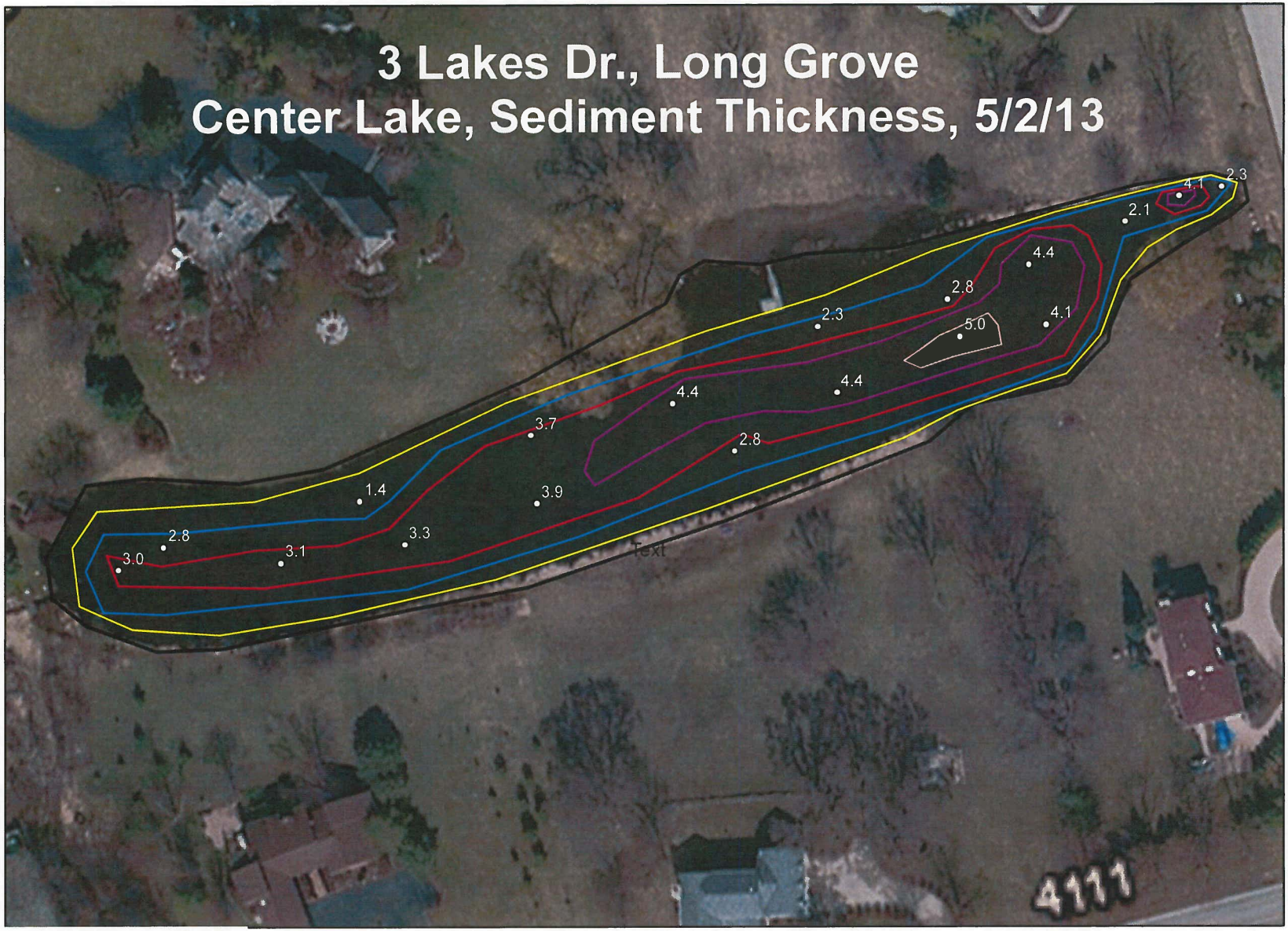
0 125 250 500 Feet

1 inch = 137 feet

**Legend**

East lake shoreline

EastLake

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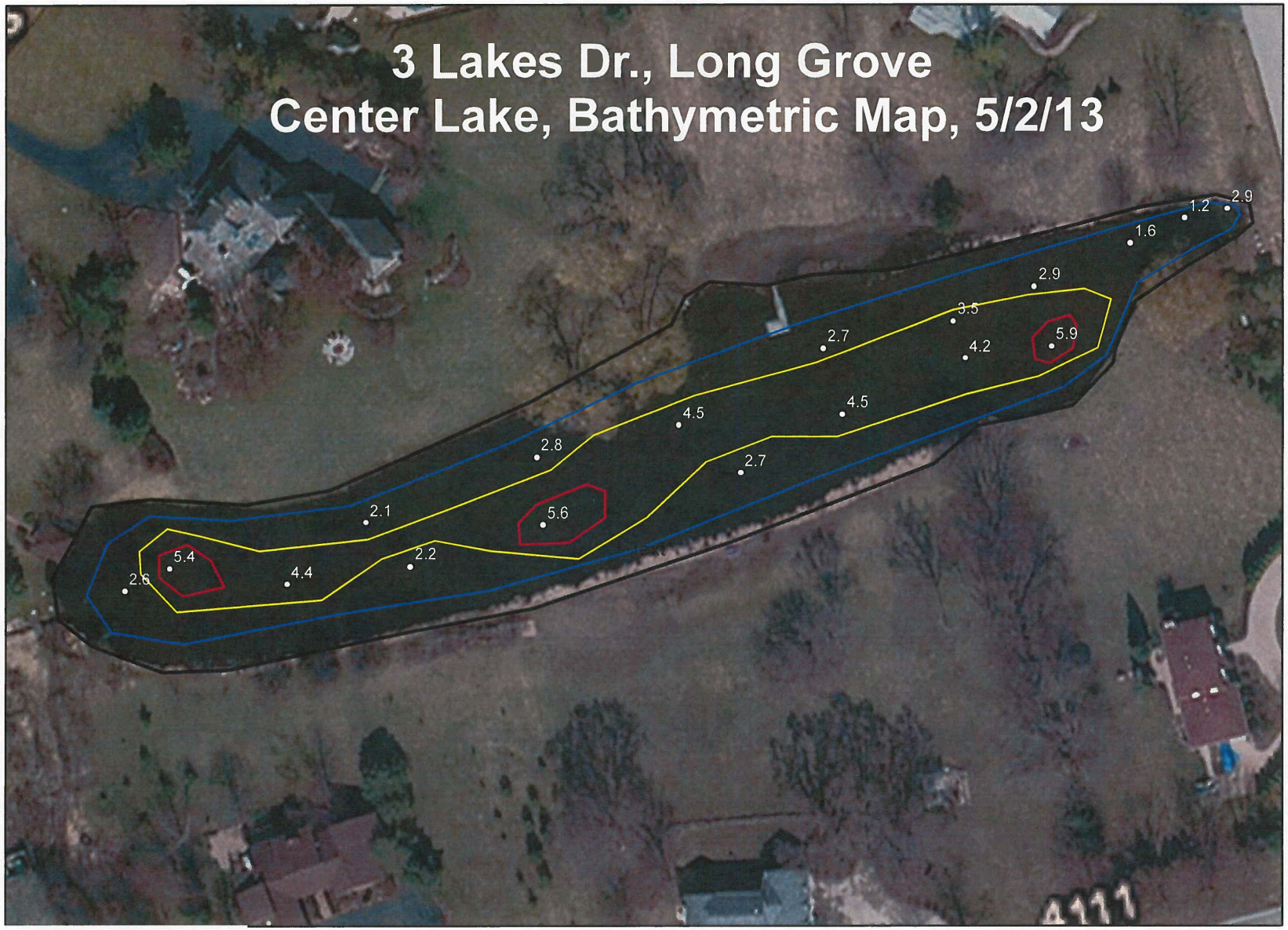
N

0 75 150 300 Feet

1 inch = 83 feet

**Legend**

- 1 ft sediment
- 2 ft sediment
- 3 ft sediment
- 4 ft sediment
- 5 ft sediment
- Center lake shoreline
- CenterLake

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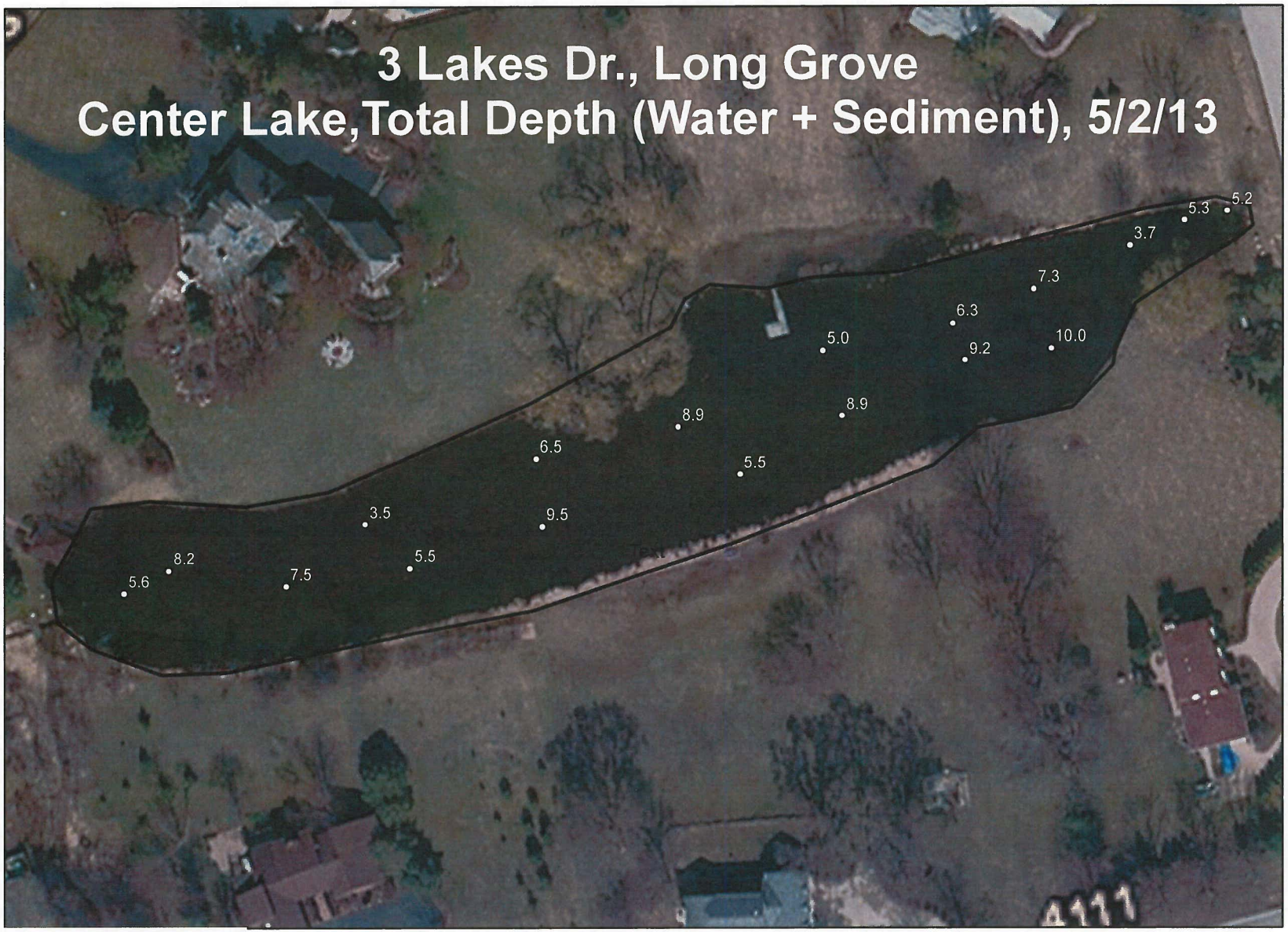
N

0 75 150 300 Feet

1 inch = 83 feet

**Legend**

- 1 ft
- 3 ft
- 5 ft
- Center lake shoreline
- CenterLake

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N

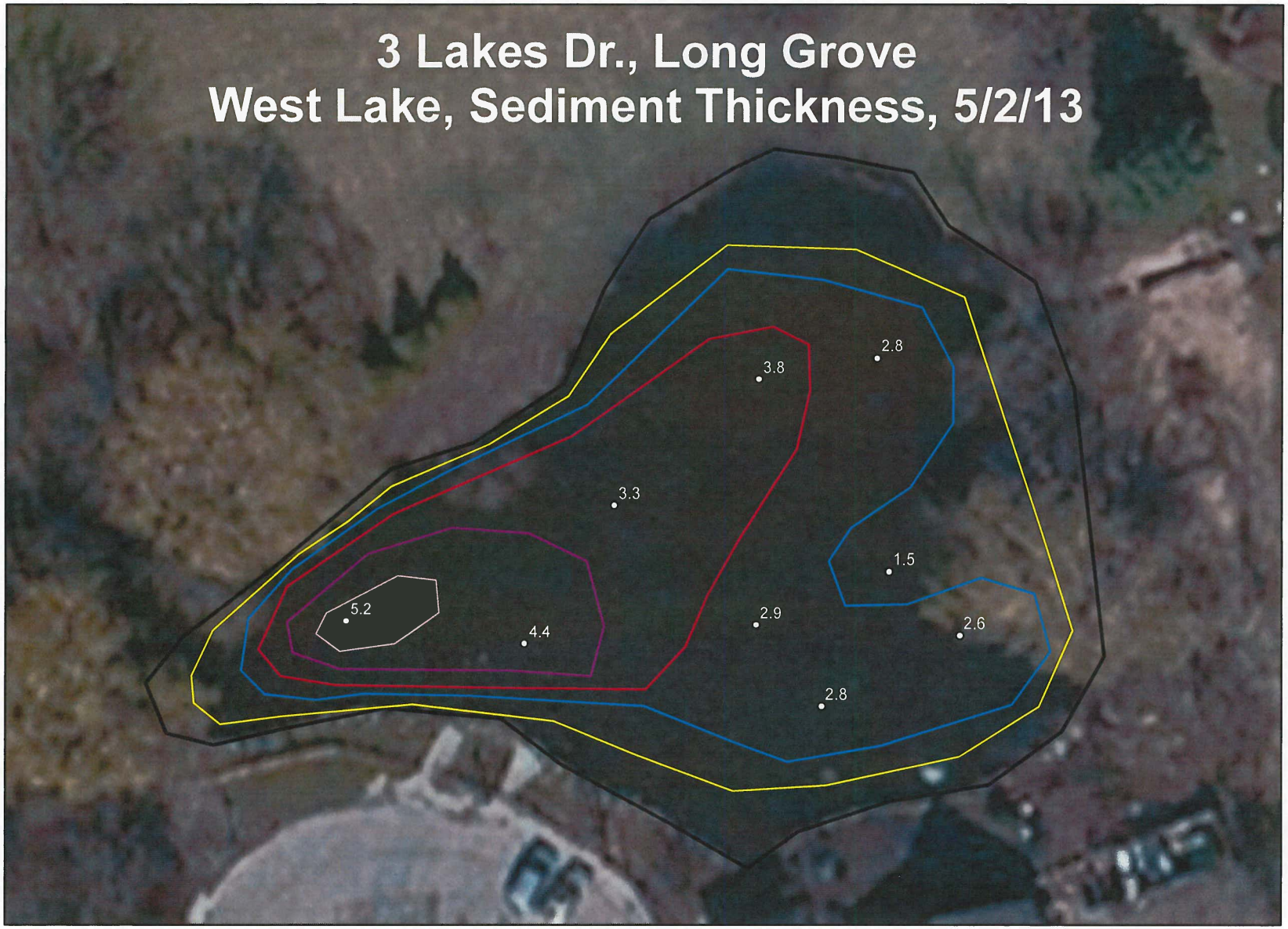
0 75 150 300 Feet

1 inch = 83 feet

**Legend**

Center lake shoreline

CenterLake

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N

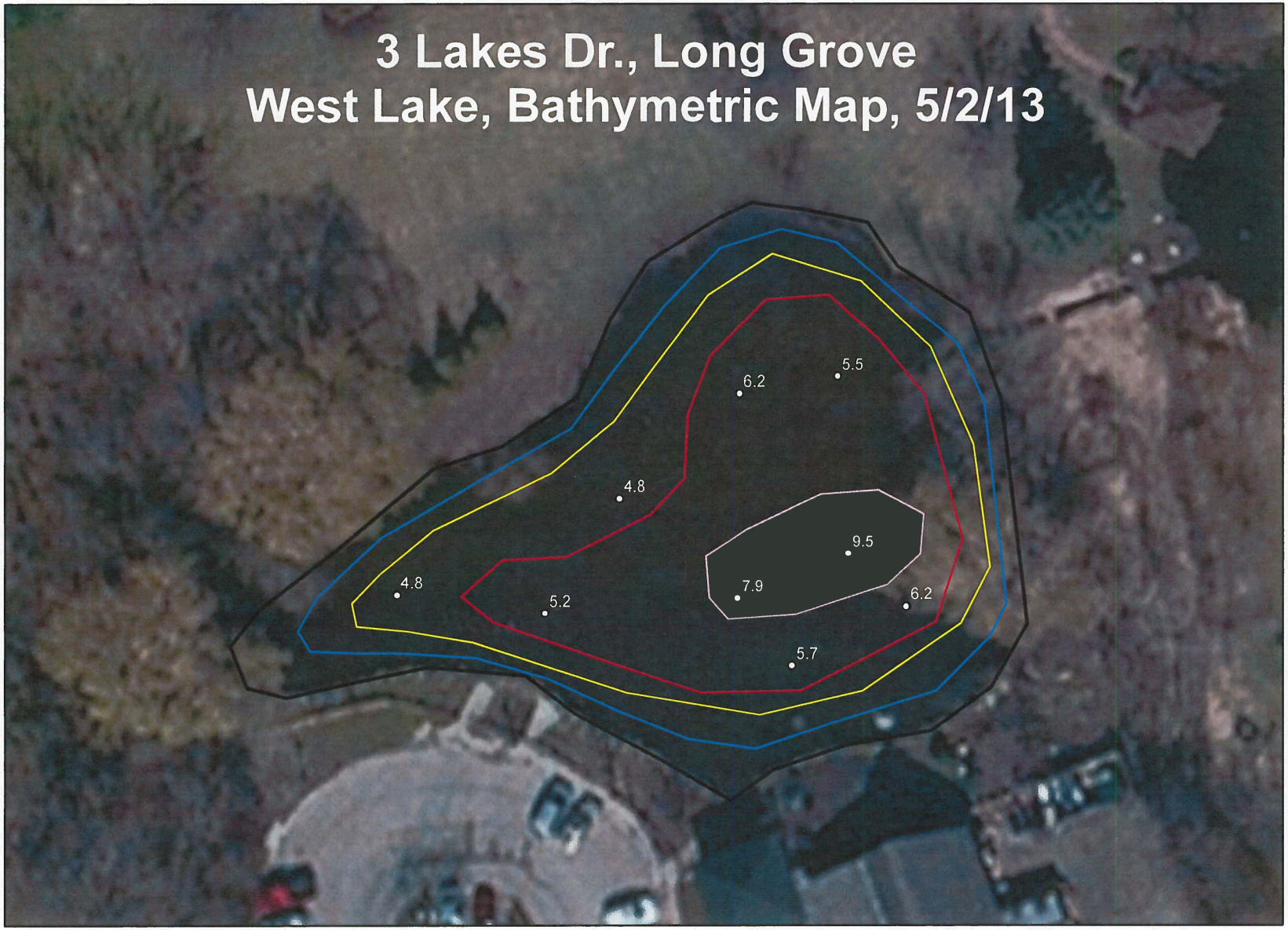
0 30 60 120 Feet

1 inch = 33 feet

**Legend**

- 1 ft sediment
- 2 ft sediment
- 3 ft sediment
- 4 ft sediment
- 5 ft sediment
- Shoreline
- WestLake

# 3 Lakes Dr., Long Grove
# West Lake, Bathymetric Map, 5/2/13

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N

0 35 70 140 Feet

1 inch = 40 feet

**Legend**

- 1 ft
- 3 ft
- 5 ft
- 7 ft
- 9 ft
- Shoreline
- WestLake

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N

0 35 70 140 Feet

1 inch = 40 feet

**Legend**

Shoreline

WestLake