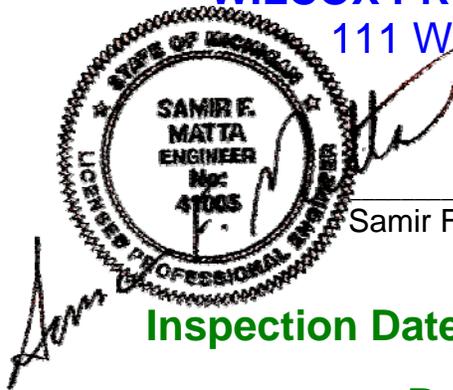




SAFETY INSPECTION REPORT OF LAKE GENEVA DAM ID #617

Prepared for:
LAKE GENEVA ASSOCIATION
1114 E. Geneva Drive
City of DeWitt, MI

Submitted by:
WILCOX PROFESSIONAL SERVICES, LLC
111 W. Edgewood Blvd., Suite 7
Lansing, MI 48911



Samir F. Matta, P.E. #41005

Inspection Dates: Dec 19, 2011 & March 27, 2012

Report Date: May 2012

Project # 11976.00003



TABLE OF CONTENTS

SECTION 1- CONCLUSIONS & RECOMMENDATIONS

SECTION 2- PROJECT INFORMATION

SECTION 3- FIELD INSPECTION

SECTION 4- STRUCTURAL STABILITY

SECTION 5- HYDROLOGY AND HYDRAULICS

SECTION 6- OPERATION AND MAINTENANCE

SECTION 7- EMERGENCY ACTION PLAN

APPENDIX A- FIGURES

APPENDIX B- MDEQ FLOOD DISCHARGE CORRESPONDENCE

APPENDIX C- PHOTOGRAPHS

APPENDIX D- EMERGENCY ACTION PLAN

NOTE:

The purpose of this inspection is to comply with Part 315, Dam Safety, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended and associated administrative rules.

This inspection was limited to a visual evaluation, review of previous reports and studies, any figures, construction documents and as constructed plans, when available. The intent of this report is to provide information regarding deficiencies/issues within the structure and to highlight potential elements of concern and not to be used as an in-depth analysis of the structure.



SECTION 1

CONCLUSIONS AND RECOMMENDATIONS

Lake Geneva Dam, ID #617, is located in the City of DeWitt, Clinton County, Michigan and is rated as a significant hazard structure. The normal head is about 12 feet and the height of the structure as defined by the Dam Safety Act is 14.4 feet. Overall, the Lake Geneva Dam is in good condition except as noted below. The dam appears to be stable and has the capacity to safely pass the 0.5% chance flood event. Following is a list of recommendations for eliminating deficiencies and bringing the dam into compliance with the Dam Safety Act.



within the top surface of the dam as shown in the picture to the left.

1. Check for burrowing animals and remove if present. Fill and compact any damaged areas by the animals. **Moles seem to be present**



2. Remove and dispose of all tree leaves away from the discharge pipe along the downstream end. Keep grass clippings and leaves to the west end along the widest



point of the dam. This will discourage animals from using the dam as a shelter and provide for better visual inspection of the dam condition

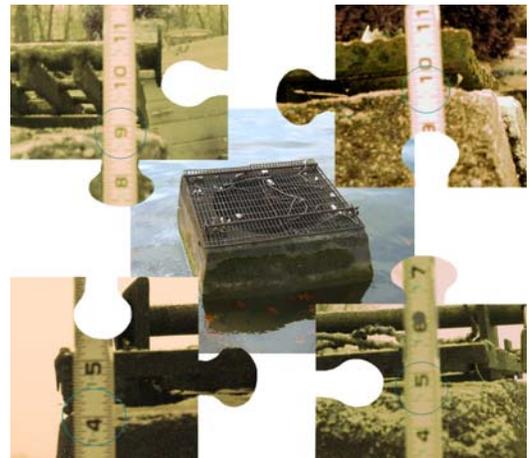
3. Reset rip rap and fill in eroded areas along the face of the dam along the entire face as to insure proper protection of the dam from wave actions causing this erosion.



4. Establish a regular inspection schedule to check for obvious damage or deficiencies related to the above mentioned elements.
5. The cracks along the south west corner of the outlet structure still seem stable with minor change. It is recommended that loose and cracked concrete be removed and repairs be made when feasible.



6. Either establish an appropriate and permanent bench mark to be used to verify potential settlement concerns with the outlet structure or permanently attach some leveling units to each corner as to confirm no changes. The structure is not level by any means but did not seem to have shifted much from its previous condition during the past inspection. It is recommended that an actual control point be established and verification shots be taken at each corner of the structure in order to use as a base measure during future investigations.
7. Communicate with property owners immediately downstream of the dam the need to alert the Contact Personnel from the Lake Association about any unusual or excessive flows in the stream leading to the river.



Some of the above items are not immediately critical to the stability of the dam. However, Item #1 should be investigated and corrected as discussed with the contacts from Lake Geneva Association after the inspection. Items # 2&3 should also be reviewed and rectified. Recommendations # 4&5 should be initiated within 6 months of this report except as indicated.



SECTION 2

PROJECT INFORMATION

Lake Geneva Dam is located in Section 8, City of DeWitt, Clinton County, Michigan. The dam impounds approximately 60 acres and discharges to an unnamed tributary of the Looking Glass River. The structure is designated as significant hazard. It is believed that the dam was constructed in the early 1960's as a recreational amenity for a residential development.

No drawings or design information is on file with the Michigan Department of Environmental Quality (MDEQ) or the owner. Four previous dam safety inspections were prepared by Mr. Leon Cook, P.E. in 1994, Advantage Civil Engineering, Inc. in January 1999 and Wilcox Professional Services, in 2003 and 2007. These reports should be on file with the MDEQ.



The dam consists of an outlet control structure and approximately 125 feet of earthen embankment. Level is controlled by a 5' long vertical 36" bituminous coated corrugated metal pipe that is encased in concrete. The concrete encasement forms a 4' x4' square structure. There is a notch formed in the concrete that appears to be constructed for the purpose of stop planks, however, the pipe was never removed to allow flow of water. The outlet pipe is a 21 inch bituminous coated corrugated metal pipe. The 21 inch pipe discharges to the unnamed tributary. There are no drawdown facilities, gates or stop planks. Inspection of the outlet pipe and the internal of the structure show no obvious signs of settlement or leakage which is a positive sign.



The earthen embankment is approximately 125 feet in length. The crown varies from 16 to 18 feet wide and the upstream and downstream slopes are generally 2



horizontal to 1 vertical and 4 horizontal to 1 vertical respectively.



Lake level is augmented by two wells adjacent to the lake. One well is located along the northwestern corner of the lake and one within the confines of Lake Geneva Park-west. Normal level is difficult to maintain due to evaporation and seepage losses through the embankment and surrounding shoreline, therefore, pumping by the two wells is needed during the summer season to maintain the lake at the desired level.





SECTION 3

FIELD INSPECTION



All references in this report to “left” or “right” are based on looking downstream. The benchmark elevation of 100.0 was assumed, as the southwest corner of the concrete outlet control structure, for the purpose of identifying pertinent topographic features of the dam and related appurtenances. No survey work was conducted by Wilcox for this report; however, field measurements were taken to confirm certain features on site.

The lake level on December 19, 2011, the date of our inspection, was 18.5” below the defined bench mark noted above or 98.458’ with no flow passing through the structure. This roughly indicates that the water level is 4.1 feet below the top of the dam as shown in the picture to the left. The downstream invert of the receiving channel was assumed to be the same or 86.5 producing a normal head of 11.958 feet.

It was also noted during our inspection that both augmentation wells that supplement the lake level were off however, the marking on the structure seems to show that the water level was within 6” of the top of the structure.

As discussed earlier, the outlet control structure consists of a 36 inch bituminous coated corrugated metal pipe (CMP) encased in a 4’x4’ concrete headwall structure. The concrete is in fair to good condition except for the southwest corner of the structure where some minor cracking seems to have opened up somewhat since the last inspection which will need to be repaired. Loose and fractured concrete should be shipped out and cleaned out before new epoxied concrete is used to stabilize the repair areas. But there is no significant indication of structural instability. If work cannot be completed in timely fashion, the structure should be inspected on a regular basis after each freeze and thaw cycle to insure that no concrete spalling or further deterioration has taken place.

It was noted in the earlier report that the north end of the structure was approximately 0.15 feet lower than the south end indicating the possibility of settlement. With the aid of a laser level and a 3’ regular level, we were able to determine, during our past inspections, that none of the corners of the structure are at the same level and that the southwest corner is about 4” to 4.5” higher than the northeast corner of the structure. This year, Wilcox returned to the site on December



19, 2012 but the lake surface was never frozen and could not measure the vertical elevation of each of the corners as done before so we can confirm the differential elevations but do not believe that much is changed.

Wilcox again recommends that an accurate and more elaborate survey be conducted to establish a base line elevation of all corners of the outlet structure so they can be compared in the future. Other quick solution would be to install some permanent flanged extensions at the lower three other corners as to make all corners leveled so it is easier to compare any changes in future inspections.

These elevations will be used during future monitoring to assess potential settlements if any. The possibility of settlement may be present but is not noticeable at this time. Further monitoring should be performed before next inspection.



The 36 inch diameter CMP is in good condition. Where exposed, the bituminous coating has mostly worn away; however, the pipe shows only minor signs of corrosion and is in good condition. The outlet control pipe is a 21 inch bituminous coated CMP and is in good condition. The bituminous coating on this pipe is also worn away where exposed. Riprap in front of the outlet pipe seems to block part of the pipe and impede some flows from draining. The riprap should be lowered to within 1/2" below the invert of the outlet pipe.



The upstream embankment was for the most part grass covered for the majority of its length. On the right side, a homeowner has constructed a wooden deck and wooden seawall in front of the structure. These features obscure the observation of the embankment and could hinder access to the control structure for future maintenance projects, but are of no immediate concern. Stone riprap adjacent to the wooden seawall seems to extend left along the majority of the embankment. The bank has eroded somewhat as noted before and needs to be re-stabilized. Upstream slope was about 2 horizontal to 1 vertical.



Lake Geneva Dam Inspection – 2011

The crown varies in width from 16 to 18 feet wide and is grass covered. In general, the crown is in good condition with no indications of settlement, slumping or cracking.

The downstream bank has been cleaned and maintained since our last inspection and seems to be in good shape. The downstream slope was 4 horizontal to 1 vertical for the first 18 feet, then 2.5 horizontal to 1 vertical for the remainder to the toe in the vicinity of the outlet pipe.

There were no indications of seepage or erosion at the toe of the slope but leaves and grass clippings have been disposed near the outlet



pipe which obstructs any visible views of possible issues and it is recommended that those be removed and placed further to the left on the flatter section of the dam. Riprap materials seem to be present at the end of the discharge pipe but are mostly covered with heavy brush material.

The receiving channel was heavily brush covered, but appeared adequate to accept normal discharge from the dam.



SECTION 4

STRUCTURAL STABILITY

There was no evidence of structural instability during the field inspection. As mentioned previously, there is some concern about potential settlement of the concrete structure that could not be verified at this time and that should be investigated further and some bank erosion due to wave actions that will require some addition of fill, geotextile fabric and additional riprap.

No stability calculations were performed or reviewed as part of this inspection report.





SECTION 5

HYDROLOGY AND HYDRAULICS

Lake Geneva Dam is classified as a significant hazard potential structure. In accordance with Part 315, Dam Safety, Natural Resources and Environmental Protection, PA 451, of 1994, as amended, this type of structure needs to be able to safely pass a 0.5% chance (200-year) frequency flood event. Flood discharge values were provided by the Hydrologic Studies and Dam Safety Unit of the Michigan Department of Environmental Quality (MDEQ), Water Resources Division. A copy of the e-mail response with the estimated values for the structure is contained in appendix B. The watershed area for this structure is estimated to be 0.65 square miles. The 0.5% chance peak inflow is 320 cfs with a flood volume of 96 acre-feet.

The normal lake level for Lake Geneva is assumed to be elevation 99.4 or 6" to 8" below the outlet structure elevation according to Lake Geneva Association personnel. According to Advantage Civil Engineering, Inc., a topographic map provided by the Clinton County Drain Commissioner showed the digitized lake area to be 60 acres at the normal lake elevation. The area of the 103 contour was also digitized by them to be 70 acres. Based on this information, they concluded that the 0.5% chance peak flood elevation is 101.00 assuming no discharge. The low point in the embankment was measured to be 102.5. This provides for 1.5 feet of freeboard which is adequate for this type of structure.

It should be noted that this estimate is conservative considering that no discharge was assumed and that the lake is normally lower than elevation 99.4, due to evaporation and seepage losses.



SECTION 6

OPERATION AND MAINTENANCE

Operation and maintenance of the Lake Geneva Dam is the responsibility of the Lake Geneva Association. The primary operational item is inspecting the dam and appurtenances to make sure that they are functioning properly.

Following is a list of items that should be checked periodically and corrected as necessary.

- Remove all burrowing animals from the dam embankment. Burrowing animals can decimate the structural stability of embankments.
- Maintain a vigorous growth of grass on the embankment. Mowing the embankments is a good idea as it will help to reduce the potential for burrowing animals and problems associated with trees and brush.
- Keep all trees and brush from getting established along the embankment.
- Keep the outlet structure, pipe and receiving channel clear of debris.
- Inspect the outlet structure after each freeze/thaw cycle to insure no concrete spalling has taken place.
- Review the stability of the outlet structure as to insure no settlements or damage to the pipe outlet within the structure.



SECTION 7

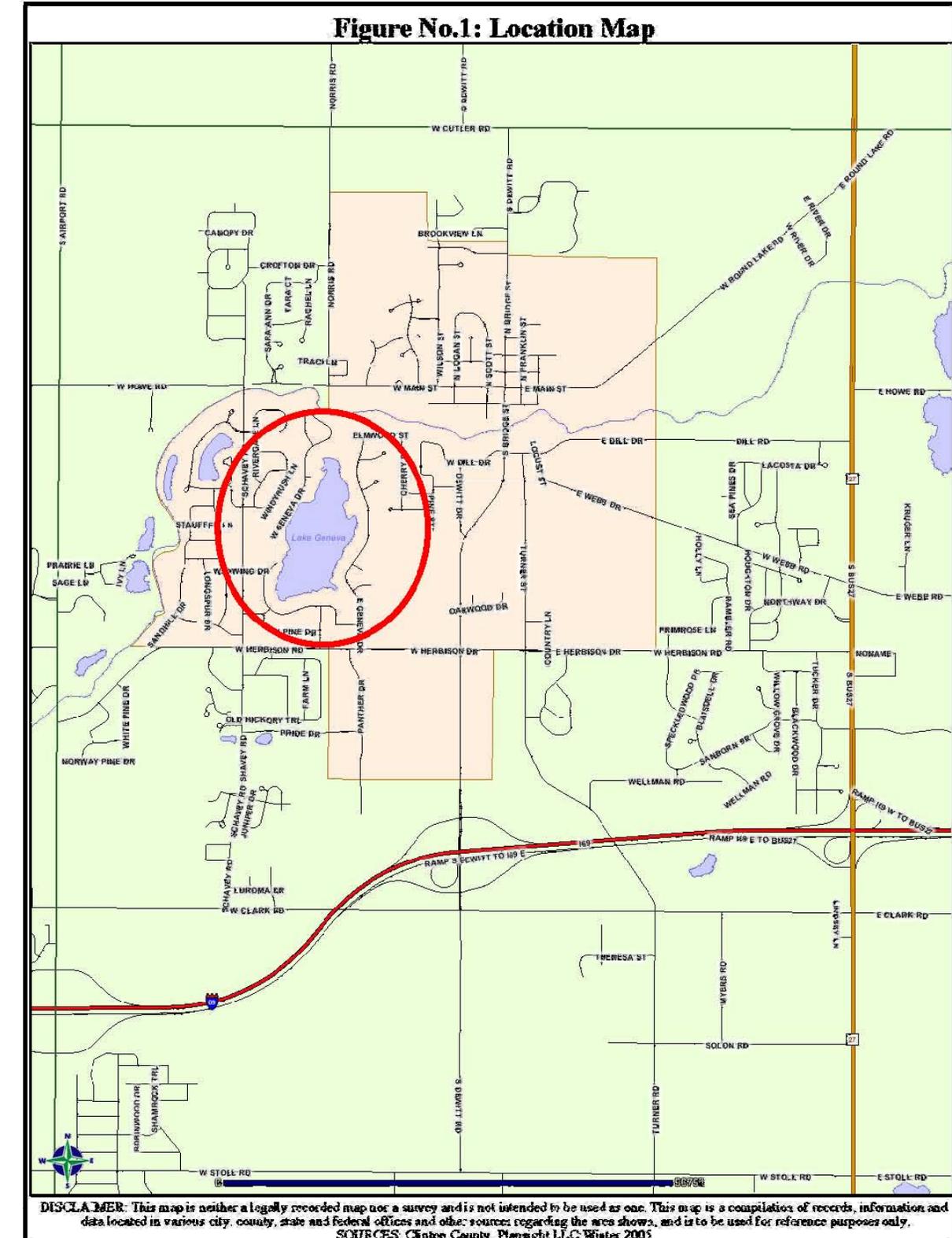
EMERGENCY ACTION PLAN

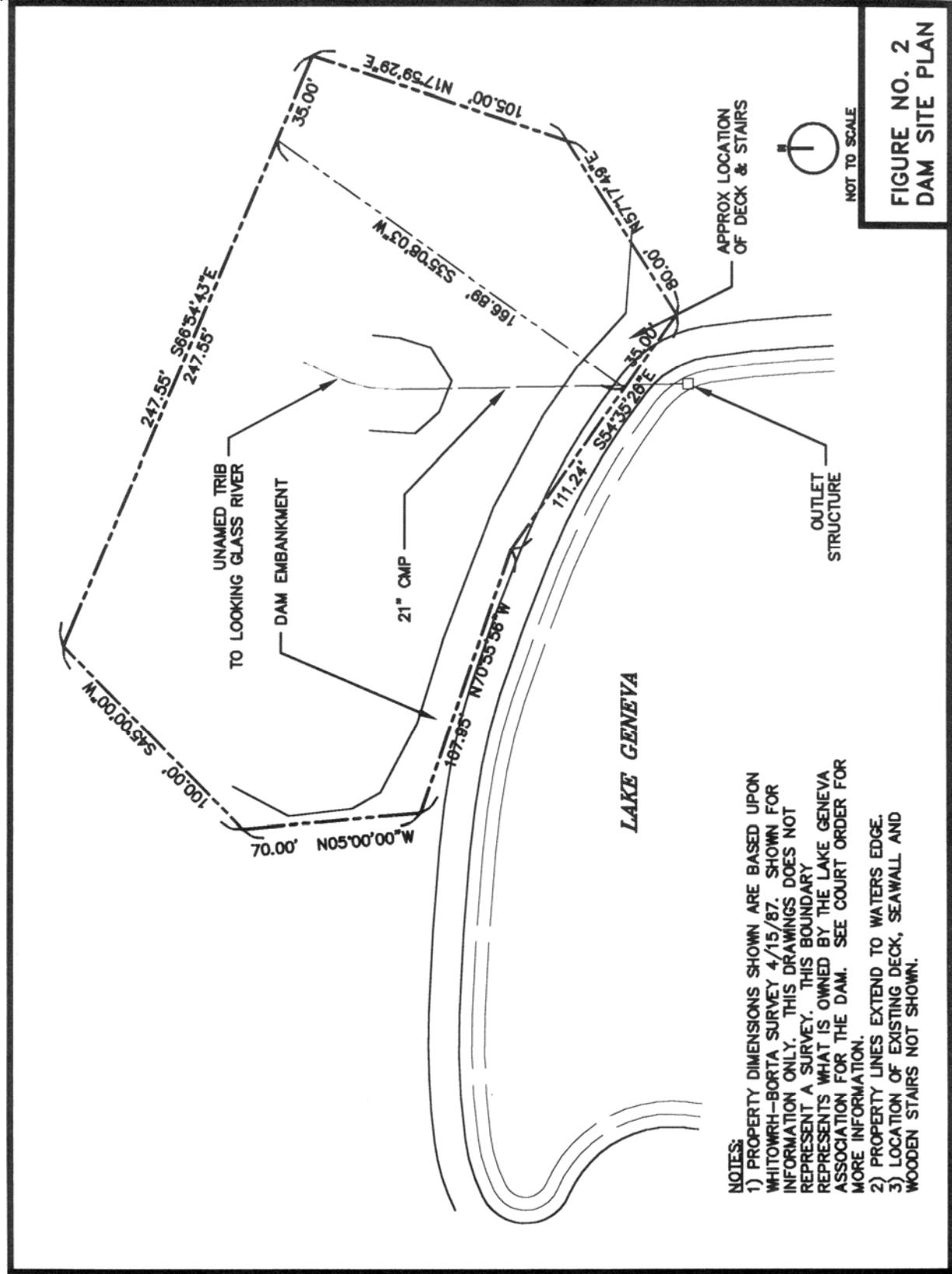
Lake Geneva Dam is rated as a significant hazard potential dam. Under provisions of the dam safety act, an emergency action plan (EAP) is required. The EAP has been updated and is included in this report as Appendix D. A copy will be forwarded by the Association to the Clinton County Emergency Coordinator and the MDEQ for their file.



APPENDIX A

FIGURES





**FIGURE NO. 2
DAM SITE PLAN**

- NOTES:**
- 1) PROPERTY DIMENSIONS SHOWN ARE BASED UPON WHITWRH-BORTA SURVEY 4/15/87. SHOWN FOR INFORMATION ONLY. THIS DRAWINGS DOES NOT REPRESENT A SURVEY. THIS BOUNDARY REPRESENTS WHAT IS OWNED BY THE LAKE GENEVA ASSOCIATION FOR THE DAM. SEE COURT ORDER FOR MORE INFORMATION.
 - 2) PROPERTY LINES EXTEND TO WATERS EDGE.
 - 3) LOCATION OF EXISTING DECK, SEAWALL AND WOODEN STAIRS NOT SHOWN.

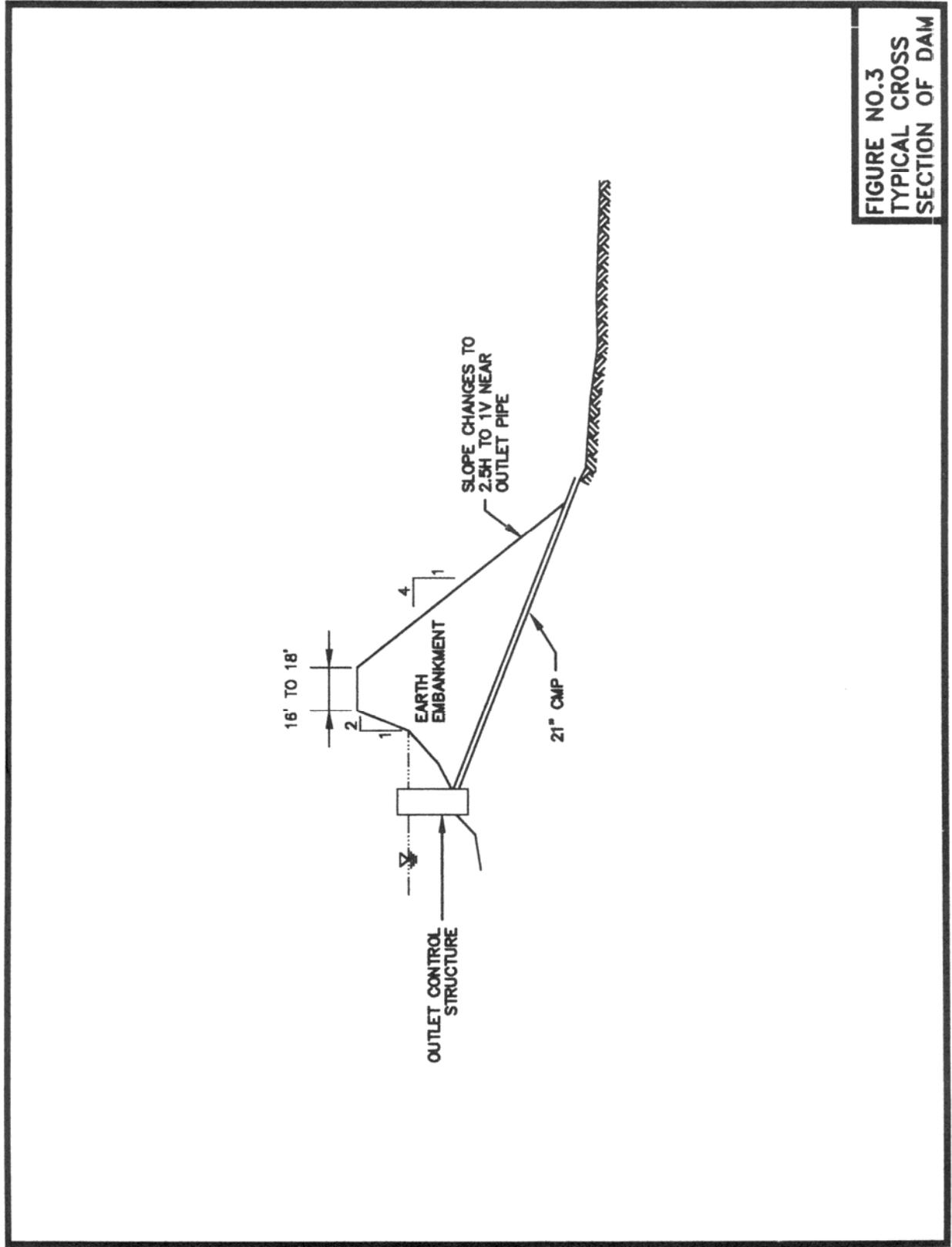


FIGURE NO.3
TYPICAL CROSS
SECTION OF DAM

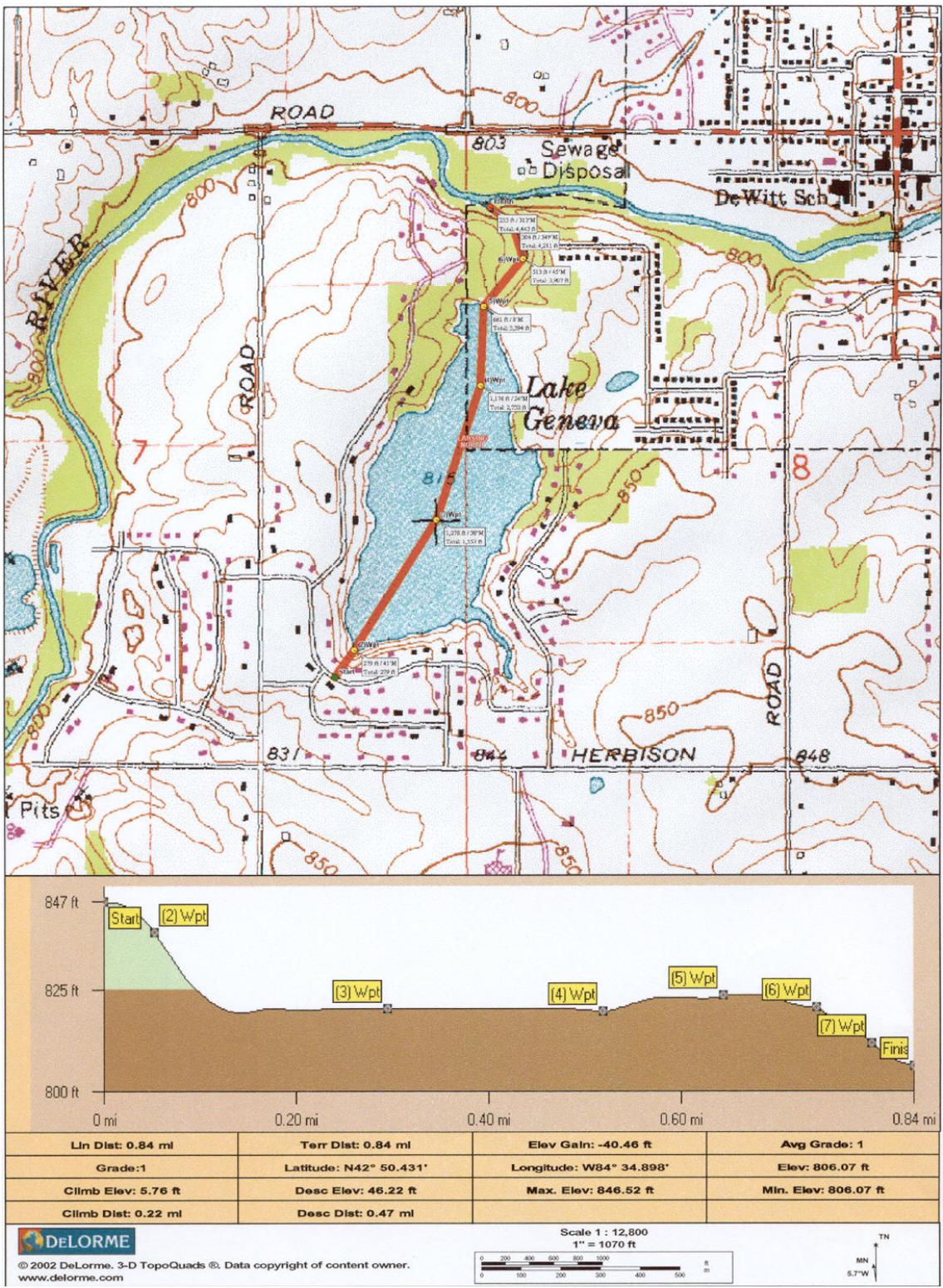


FIGURE NO. 4 – AREA TOPOGRAPHY



APPENDIX B

MDEQ FLOOD DISCHARGE CORRESPONDENCE



From: deq-wrd-qreq <deq-wrd-qreq@michigan.gov>
Sent: Wednesday, November 16, 2011 4:55 PM
To: Samir Matta
Subject: RE: flood or low flow discharge request (ContentID - 168812)

This reply is being sent via email only.

We have estimated the flood frequency discharges requested in your email of November 16, 2011 (Process No. 20110434), as follows:

Tributary to Looking Glass River at Lake Geneva Dam, Dam ID 617, Section 8, T5N, R2W, DeWitt Township, Clinton County, has a drainage area of 0.6 square miles. The design discharge for this dam is the 0.5% chance (200-year) flood.

The 0.5% chance peak flow is estimated to be 320 cubic feet per second. The 0.5% chance flood volume is estimated to be 96 acre-feet. (Watershed Basin No. 14B Looking Glass).

Please include a copy of this letter with your inspection report or any subsequent application for permit. These estimates should be confirmed by our office if an application is not submitted within one year. If you have any questions concerning the discharge estimates, please contact Ms. Susan Greiner, Hydrologic Studies and Dam Safety Unit, at 517- 241-1210, or by email at: GreinerS@michigan.gov. If you have any questions concerning the hydraulics or the requirements for the dam safety inspection report, please contact Mr. Luke Trumble of our Dam Safety Program at 517- 335-3170, or by email at: TrumbleL@michigan.gov.



APPENDIX C

PHOTOGRAPHS











Lake Geneva Dam Inspection - 2011

APPENDIX D

EMERGENCY ACTION PLAN



TABLE OF CONTENTS

EMERGENCY CONTACT LIST

SECTION 1- INTRODUCTION

SECTION 2- RESPONSIBILITIES

SECTION 3- EMERGENCY CONDITIONS

SECTION 4- EMERGENCY ACTIONS

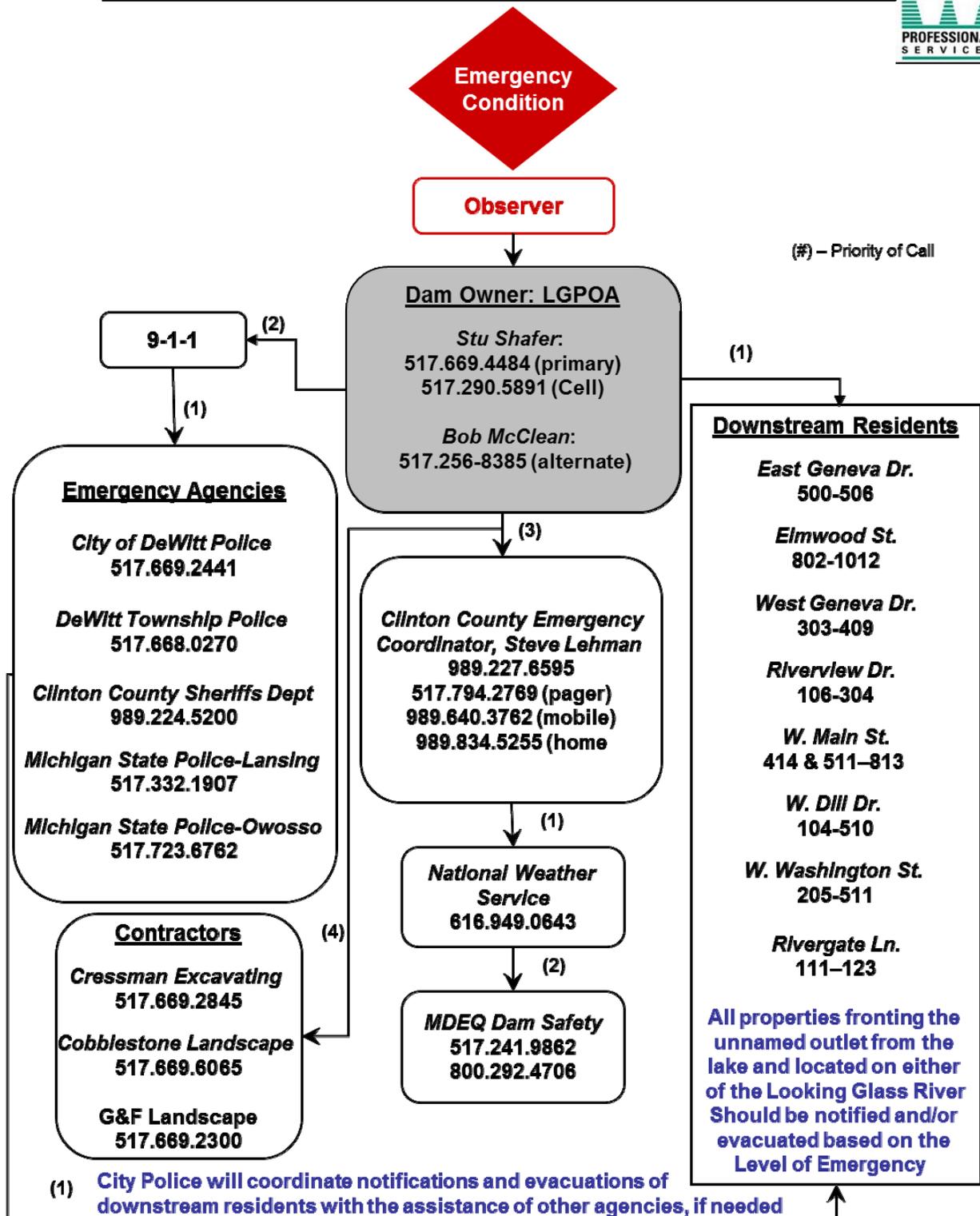
SECTION 5- EMERGENCY TERMINATION

APPENDIX A- LAKE GENEVA & SURROUNDINGS

NOTE: Wilcox's update of this Emergency Plan was limited to the verification of contacts and emergency phone numbers and to elements associated with the accuracy of information related to physical features only. No hydraulic evaluation or analysis was performed to verify the accuracy of the information presented by Advantage Civil Engineering, Inc.



Lake Geneva Dam Notification Flowchart





SECTION 1

INTRODUCTION

PURPOSE

The purpose of this Emergency Action Plan (EAP) is to safeguard lives and reduce damage to the property of the citizens of Clinton County, who live along the Looking Glass River, in the event of failure of Lake Geneva Dam or flooding caused by large flow releases from the dam. This EAP was developed by Advantage Civil Engineering, Inc. in 1999 and was updated by Wilcox Professional Services, LLC in 2003, 2007 and 2011.

DESCRIPTION OF DAM

Lake Geneva Dam is located in Section 8, City of DeWitt, Clinton County, Michigan. The dam impounds approximately 60 acres and discharges to an unnamed tributary of the Looking Glass River. The structure is designated as significant hazard. It is believed that the dam was constructed in the early 1960's as a recreational amenity for residential development.

The dam consists of an outlet control structure and approximately 125 feet of earthen embankment. Level is controlled by a vertical 36" corrugated metal pipe that is encased in concrete. The concrete encasement forms a 4' x4' square structure. The outlet pipe is a 21 inch corrugated metal pipe. The 21 inch pipe discharges to the unnamed tributary. The structural height of the dam as measured from the top of the embankment to the invert of the receiving stream is roughly 16 feet. The normal head is about 12 to 13 feet and the height of the dam as defined by the Dam Safety Act is 14.4 feet.

HAZARD AREA

The flood inundation map, developed by Advantage Civil Engineering, Inc., that illustrates the area of potential flooding during a "wet weather" failure is contained in appendix A. A "sunny day" failure would most likely be less severe once it reached the Looking Glass River. This inundation map was based upon limited calculations and analyses by Advantage and should be used as a guideline and not as a definitive boundary for potential flooding. The height of the flood wave near the unnamed tributary to the Looking Glass River was based upon the 4/9 rule which approximates the flood wave to be 4/9 of the structural height of the dam. The flood wave for Lake Geneva was estimated to be about 8 feet. The peak discharge from a dam break is



estimated to be 700 cubic feet per second (cfs). For comparison purposes, the 100-year discharge of the Looking Glass River in the vicinity of Lake Geneva is 2,865 cfs.

In general, a failure of the dam could have a significant impact on the Looking Glass river floodplain, both upstream and downstream. Lake Geneva is located within the City of DeWitt and could impact residents of the City as well as DeWitt Township. If a dam break occurred during the 100-year peak flow in the Looking Glass River, the additional flow would essentially equate to a 500-year flood event.

It should be pointed out that tributary drainage area for Lake Geneva is 0.6 square miles while the tributary drainage area for the Looking Glass River in the vicinity of Lake Geneva is 234 square miles. It is not likely that a failure of the Lake Geneva Dam would occur at the same time as a large flood event on the Looking Glass River. Also, the flows from a dam failure would have a tendency to attenuate once it reached the Looking Glass River. Therefore, the flood inundation area illustrated on the included map is similar to a 100-year floodplain.



SECTION 2

RESPONSIBILITIES

The Lake Geneva Association (the Association) is responsible for all operation and maintenance activities associated with the dam. In addition, the Association is responsible for implementing this emergency plan as well as keeping the plan updated and current.

Coordination

Emergency action is a coordinated effort between the Lake Geneva Association and the appropriate state, county and local agencies. In the event that an emergency situation develops, the Association will contact the Clinton County Central Dispatch Center by dialing 911. The initial emergency coordination will be handled by the 911 dispatcher. When identifying an emergency situation, the Association should follow the following format:

- | | |
|-----------------|---|
| Alert: | Failure and/or flooding is not imminent, but a more serious condition could develop |
| Warning: | Failure and/or flooding is imminent. |

The Association will be responsible for coordination and management of on-site activities, such as preventative actions discussed later in this plan.

Evacuation

The City of DeWitt Police Department will be responsible for coordinating evacuation.

Records

The Association is responsible for keeping a data base of available records concerning the dam. The records should include, but are not limited to: design drawings; past inspection reports; and updated copies of the emergency action plan.



SECTION 3

EMERGENCY CONDITIONS

Emergency conditions can develop at a dam at anytime and usually when you least expect it. In general, dam failure can be classified as either “wet weather” or “sunny day” failures. Following is a brief description of these types of failure mechanisms.

Wet Weather Failure

Wet weather failures normally occur during a large flood event. A large flood event can develop due to excessive runoff caused by large precipitation events, snow melt and/or the combination of rain and snow melt. Recent evaluations of the Lake Geneva Dam indicate that it has adequate spillway capacity to pass the 0.5% chance (200-year) flood event, however, if the spillway or discharge pipe were to become clogged during a large flood event, it is possible that the embankment could be overtopped which may lead to catastrophic failure of the dam. Furthermore, heavy precipitation or snow melt can cause a rapid rise in reservoir level which causes an increase in internal pressures in the embankment. This can lead to internal erosion (piping) of the embankment or sudden shifting or settlement of the embankment.

Sunny Day Failure

Sunny Day failures occur during a period of little or no precipitation or snow melt. Sunny day failures can be caused by internal piping of the embankment, earthquakes, vandalism or plugging of the outlet with debris. Wave action from wind or boats as well as burrowing animals can have an effect on the structural stability of the embankment.

Either “wet weather” or “sunny day” failures can lead to slow or rapid failures. Association members should make periodic inspections of the dam, especially during and after large flood events to check for potential problems.



SECTION 4

EMERGENCY ACTIONS

Once an emergency situation has been identified, the Lake Geneva Association should begin the notification process immediately as indicated on the Emergency Action Telephone List contained within this document.

NOTIFICATION

The notification process should begin with calling 911 and alerting the dispatcher to the current status of the emergency. After 911 contact, the Association should evaluate the seriousness of the emergency. If the situation warrants, a contractor should be contacted to assist in stopping or mitigating the failure. MDEQ Dam Safety personnel should be contacted and consulted with in making the determinations of the emergency.

PREVENTATIVE ACTIONS

Depending on the type of failure and the degree to which it has progressed, it may be possible to perform preventative measures to stop or slow the progress of the failure. This normally requires the assistance of a contractor that has sufficient equipment and access to materials. The association should keep an updated list of several different contractors that could be available during an emergency situation.

Possible preventative actions include:

- Placing sandbags to temporarily increase freeboard
- Installing additional culverts to provide additional hydraulic capacity
- Installing steel sheet piling to serve as a temporary cut-off wall
- Placing additional fill where needed
- A controlled breach of the embankment section

EVACUATION

As indicated above, the City of DeWitt Police Department is responsible for coordinating evacuation efforts as necessary. An inundation map that illustrates the area of potential flooding should be used as a general guideline for performing the evacuations.



SECTION 5

EMERGENCY TERMINATION

EMERGENCY CONDITIONS

The Lake Geneva Association is responsible for determining the end of an emergency situation. However, the Association is encouraged to consult with MDEQ and the Clinton County Emergency Coordinator before terminating the emergency.

DISASTER RESPONSE

The City of DeWitt Police Department, in consultation with the Clinton County Emergency Management Coordinator, will evaluate a proper timetable for the termination of both the evacuation and the disaster response activities.

CRITIQUE AND AFTER ACTION REPORT

Should an emergency situation occur, a critique should be conducted including all participants and interested parties, with the results being used to revise and improve the emergency plan.



APPENDIX A

Lake Geneva & Surroundings

