Dam Safety Inspection Report

In compliance with Part 315, Act 451 of 1994

for the

Negaunee Lake Dam

Located in:

Section 35 of Town 17 North, Range 8 West, Evart Township, Osceola County, Michigan

Dam identification Number: 2674

Hazard Potential Classification: LOW

Owner:
NEGAUNEE LAKE ASSOCIATION

Attention: Keith Charette, Lake Maintenance Chair
3347 23rd Street
Wyandotte, MI 48192
Telephone: 734-558-1205
Email: kacharette@wyan.org

Date of Inspection:

June 29, 2023

Inspection and Report performed by:

David L. Schultz, P.E.
Michigan Professional Engineer License No. 37243

Schultz Land & Water Consulting, Inc.
4859 Townsend Court
Montague, Michigan 49437
Telephone: 231-893-7177
Email: DavidLSchultz@charter.net

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Disclaimer: Our dam safety inspection and report are intended to satisfy state and federal laws and their accompanying administrative rules under Part 315 of the Natural Resources and Environmental Protection Act, Public Act 451 of 1994 as amended. The purpose of this report is to evaluate the existing condition of the dam and point out any variances that may affect the dam's stability, and is limited to a visual investigation and review of existing data. The contents of the report should not be treated as an in-depth engineering evaluation of any variances that have been identified. Detailed evaluations, investigations or calculations may be advised based upon the findings of this report.

CONCLUSIONS AND RECOMMENDATIONS

The Negaunee Lake Dam continues to possess a Condition Assessment Rating of SATISFACTORY. This rating implies that no deficiencies were recognized, and that acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with accepted engineering standards, regulatory criteria and tolerable risk guidelines.

The Negaunee Lake Dam is owned and maintained by the Negaunee Lake Association. The dam is in good condition, with only minor maintenance items found to be needed. At the time of our inspection no structural deficiencies were found that might cause a failure of the dam. The Negaunee Lake Dam has sufficient spillway capacity, even without possessing a formal auxiliary spillway.

This report is the fifth inspection of the dam according to prior records, and is the third performed under the requirements of Part 315 of the Natural Resources and Environmental Protection Act (NREPA) and its administrative rules. No further studies are recommended or advised. All recommendations from the 2018 inspection have been implemented, namely: Trees and brush have been substantially removed from both upstream and downstream embankments, the embankments have been regularly mowed and a healthy turf surface is present, and aggregate has been added to the dam crest road.

Recommendations for continued improvement of the Negaunee Lake Dam consist of:

1. Construct a chute from the road edge down to the water level consisting of riprap, asphalt, or other acceptable material to convey stormwater in a non-erosive manner on both sides of the boat launch pavement.
2. Place a grate over the drop inlet at the principal spillway.
3. Continue to mow the embankment as needed to maintain a turf grass surface and deter brush intrusion.
4. Continue expanding the turf grassed embankment down the downstream embankment by removing brush where accessable.

PROJECT INFORMATION

The Negaunee Lake Dam is located in the northwest quarter of Section 35, Town 17 North, Range 8 West, Evart Township, Osceola County. The dam is located at the northwesterly end of Negaunee Lake and discharges into Sherlock Creek. Negaunee Lake is the first of seven lakes on Sherlock Creek between here and the Muskegon River. This implies that its small sized watershed accrues to the dam's structural safety, but that its failure could have a compounding negative impact downstream.

As iterated in previous inspection reports, the dam is a 210-foot long and 17.8-foot high earthen embankment dam that impounds approximately 80 acres at normal lake level. The dam's principal spillway is located near the center of the earth embankment and it controls the Negaunee Lake water level. This spillway is modified 30" diameter corrugated metal pipe (CMP) riser to an 18" diameter CMP outlet tube. Previous reports stated that the riser was modified by insertion of a 24" diameter CMP pipe that was later lined with an 18" diameter smooth lined corrugated plastic pipe (SLCPP). The dates these modifications were applied is not known.

In 1990, the association reported the dam crest was raised by approximately two feet. Prior to the 2007 report, a 12" diameter corrugated plastic pipe was added to serve as an emergency spillway. It is our opinion this pipe is unnecessary and could be removed in the future if so desired.

A number of excerpts from prior inspections and reports are included with this document, including measurements, calculations, sketches and checklists. No upgrades or significant repairs have been performed to the best of our knowledge since 2008, except in response to prior inspection report observations and recommendations. Records related to the original design and construction records were not available to us.

The dam is rated as a low hazard potential. Per observations documented in this and prior inspections there are no changes in occupancy or development downstream of the dam that would warrant a revision of this hazard potential classification.

FIELD INSPECTION

Dam Crest

The dam crest consists primarily of a 18' wide (+/-) gravel roadway (Negaunee Lake Drive) that drops slightly more than 1' in elevation from southwest to northeast across the embankment. The low point on the dam crest is approximately 3.5' above the normal lake level and would act as the emergency spillway in the event of what would be a very extreme rainfall event. The road conveys stormwater runoff along its edges, and no degradation was noted due to moving water at the time of our inspection.

Embankments

Upstream – The upstream embankment is stable, with improved vegetative conditions due the removal of trees and brush subsequent to the 2018 inspection. Two erosional areas were noted, running down the embankment from the road to the lake, along both sides of the boat launch slab. They are created from stormwater flowing off the road at local low points. These should both be stabilized by constructing a chute with a non-erosive surface.

Downstream – The upper portion of the downstream embankment is being regularly mowed. However the lower portion has not yet been reclaimed from the brush that continues to dominate. Since the lowest portion of the downstream embankment is where seepage and piping will most likely occur, continued efforts to open up the lower portion and force turf grass growth are advised.

At the time of our inspection, no burrows, seepage, slumping, piping or other evidence of embankment weakness were noticed.

Spillways

Principal Spillway – The principal spillway for Negaunee Lake and its dam is a standard drop-inlet structure with a horizontal outlet pipe. The hydraulic capacity of the inlet structure is relatively unimportant to the dam's safety, in that the lake can store much more than the 100-year runoff volume without overtopping the dam crest, even with zero discharges. Some degradation of the metal pipe was noticed, and this should continue to be observed closely in subsequent inspections. An unusual feature of this spillway is the presence of a slotted cone which is seated over the drop inlet. Its intended purpose is not known, but it isn't needed as a debris guard, since a larger screened cage already surrounds and protects the drop inlet. According to Mr. Charette, he plans on replacing the cone with a standard grate.

Secondary Spillway – A second culvert pipe penetrates the dam embankment north of the principal spillway. Its purpose is unclear, considering the excess storage and discharge capacity already present. It is our opinion that it is unnecessary, but its presence is no problem.

Emergency Spillway – The dam crest serves as Negaunee Lake Road and is also the only emergency spillway present for this structure. As with the secondary spillway, there is no reason to be concerned of lake levels rising this high, due to the size of Negaunee Lake and the small catchment serving it. Please refer to the Hydrology and Hydraulics section of this report for more information regarding lake storage and spillway conveyance capacities.

Upstream & Downstream Watercourses

Upstream Watercourse – Negaunee Lake is located adjacent to the embankment and outlet works, and is in all respects normal, with no apparent issues of concern. A private boat launch ramp is located adjacent to the dam embankment, and is in good condition, with the exception of adjacent erosion from stormwater runoff.

Downstream Watercourse – Sherlock Creek begins here, and its flow appears to be intermittent. During the inspection, no water was discharging through the principal spillway. The spillway does activate at times, as evidenced by a plunge pool located under the perched principal spillway pipe. A large undercut was noticed on an adjacent streambank downstream of the plunge pool, which may be formed by spillway discharges.

Structural Stability

The Negaunee Lake Dam is in a good and stable structural condition. No substantial deficiencies were found at the earthen embankments or spillways. The principal spillway pipes are made of metal, and the deterioration noticed during past and present inspections is not yet a concern. There was no evidence of seepage or animal related degradation of embankments. The upstream embankment needs chutes to facilitate runoff from the road to the lake in a non-erosive fashion.

Hydrology and Hydraulics

The Negaunee Lake Dam has a low hazard potential classification. Based on this classification, the dam must safely handle the 100-year recurrence interval (1.0% annual chance) flood. The MDEQ provided the design inflow peak rates and volumes in response to our discharge determination request of 6/20/23, and this document is attached to this report. The MDEQ estimated a 1.0% annual chance flood inflow rate of 420 cubic feet per second (cfs) and a total runoff volume of 120 acre-feet, which is the same as for the previous two inspections.

Flood routing of the inflow hydrograph past the principal spillway is not necessary, in that the entire runoff volume can be stored in the lake with no discharges and less than a 1.5' rise in the water level will result on this 80 acre lake. A conservative estimate of 300 acre-feet of floodwater storage is available in the lake below the lowest dam crest elevation. In comparison, the 1.0% annual chance, 24 hour rainfall depth for here is 6" which generates the 120 acre-feet of runoff volume. Therefore, it would take 15" of rain to generate the 300 acre-feet of runoff that the lake can safely hold without overtopping the embankment and dam crest.

Because of the excess storage volume available, no formal hydraulic calculations of the outlet works were performed. The prior inspector estimated that the principal (and secondary) spillways can convey approximately 5 cfs. Our estimate of the principal spillway capacity, without the slotted cone in place, can convey up to 15 cfs with lake levels 1.5' above the drop inlet. In either case, this is adequate to handle regular inflows to this spring fed lake.

Based on the above the dam has sufficient spillway capacity.

Operation & Maintenance

Operation and maintenance of the dam is the responsibility of the Negaunee Lake Association. Keith Charette is presently chairman of the Lake Committee, whose duties include the Negaunee Lake Dam. His contact information is included on the cover sheet of this report. It does not appear that frequent or extensive work on the dam is needed. However, regular mowing of the embankment, grading the road, and removing debris that floats to the principal spillway should be done when conditions indicate its need. Visual inspection of the downstream embankment toe for seepage, piping and burrows should also be regularly undertaken.

The prior dam inspector recommended establishing a log book to document any and all operations and maintenance activities, along with extreme high and low water levels when they occur. We agree with this, as a log book will serve as proof of due diligence should anything happen to cause damages.

It is worth considering a reconfiguration of the drop inlet and screened trash rack to facilitate access during an extreme rainfall event or other related emergency.

Due to the low hazard potential rating for this dam, an Emergency Action Plan (EAP) is currently not required. If the association wishes to demonstrate proactive measures for dam safety, an EAP would be part of its due diligence of dam ownership. Schultz Land & Water Consulting or another qualified consultant can assist the association in these endeavors.

APPENDIX A: 2023 PHOTOGRAPHS

Gravel road over the earthen embankment looking southwest from right abutment

Gravel road over the earthen embankment looking northeast from left abutment

Principal spillway with a screened trash rack over the drop inlet.

Looking down at principal spillway drop inlet.

Upstream embankment looking north.

Upstream embankment from center of dam looking southwest

Downstream embankment from north end of dam looking southwest. Note outlet end of secondary spillway shown with arrow.

Downstream embankment from south end of dam looking northeast.

Looking downstream from the center of the dam

Plunge pool area at outlet of principal spillway

Outlet channel downstream of principal spillway outlet

Downstream side of earthen embankment looking east shoing secondary spillway outlet.

Channelized road runoff on northeast side of boat launch causing erosion.

Minor erosion on northeast side of boat launch.

Channelized road runoff on southwest side of boat launch causing minor erosion.

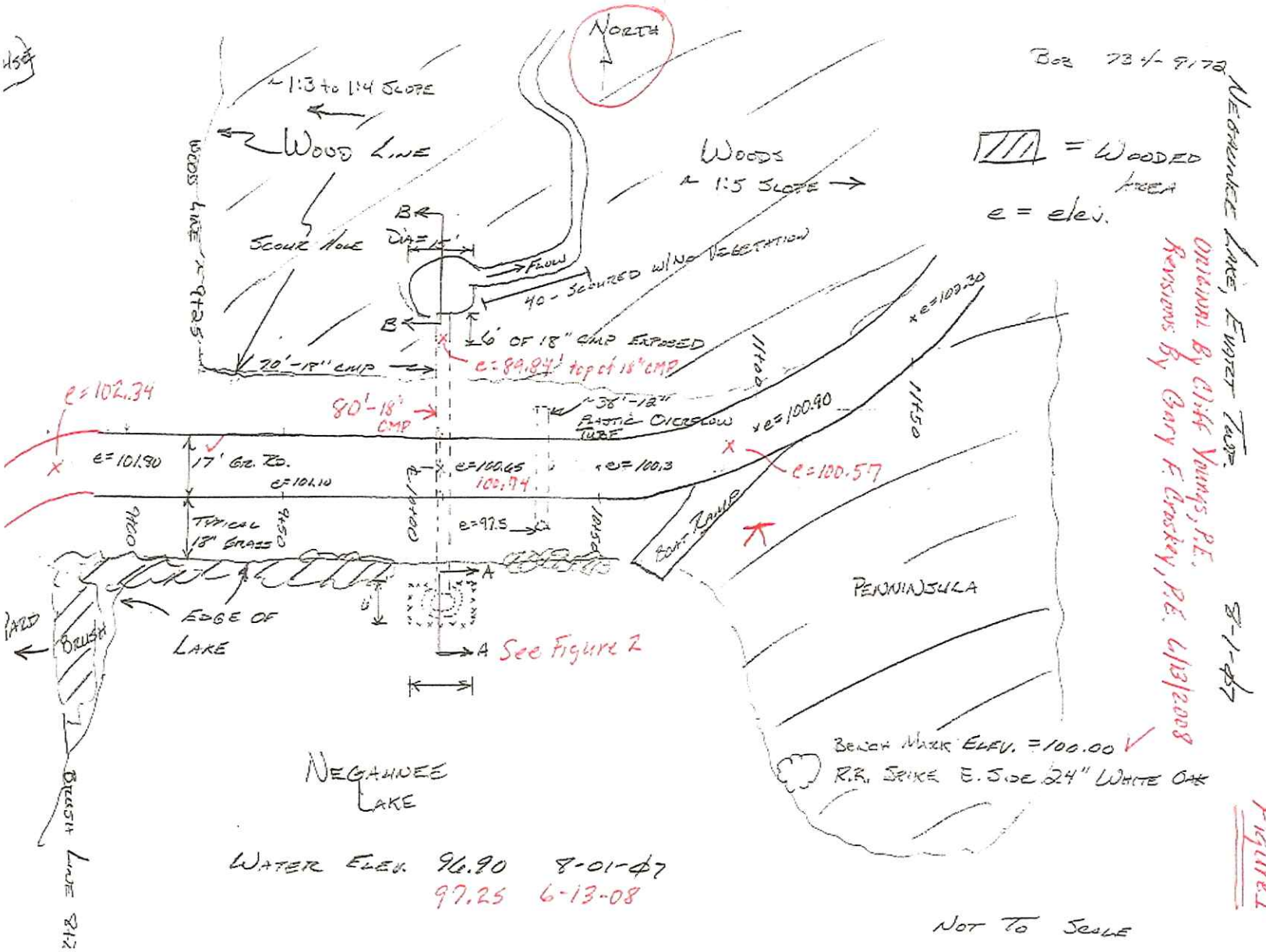

NORTH
1:3 to 1:4 SLOPE
WOOD LINE
WOODS
1:5 SLOPE
= WOODED AREA
e = elev.
SCOUR HOLE
FLOW
40' - SCOURED w/ NO VEGETATION
6' OF 18" CMP EXPOSED
e=89.84' top of 18" CMP
70'-18" CMP
80'-18" CMP
38'-12" PLASTIC CULVERT PIPE
e=102.34
e=101.90
17' Gr. Rd.
e=101.10
e=100.65
100.94
e=100.3
e=100.40
e=100.30
e=100.57
e=97.5
TYPICAL 18" GRASS
EDGE OF LAKE
BRUSH
PAVED
PENNINSULA
See Figure 2
NEGAUNEE LAKE
WATER ELEV. 96.90 8-01-07
97.25 6-13-08
BENCH MARK ELEV. = 100.00
R.R. SPIKE E. SIDE 24" WHITE OAK
NOT TO SCALE
Boz 73 +/- 9178
NEGAUNEE LAKE, ENTRY TWP.
ORIGINAL BY CLIFF YOUNGS, P.E. 8-1-07
REVISIONS BY GARY F. CROSKEY, P.E. 6/13/2008
1 of 3
FIGURE 1

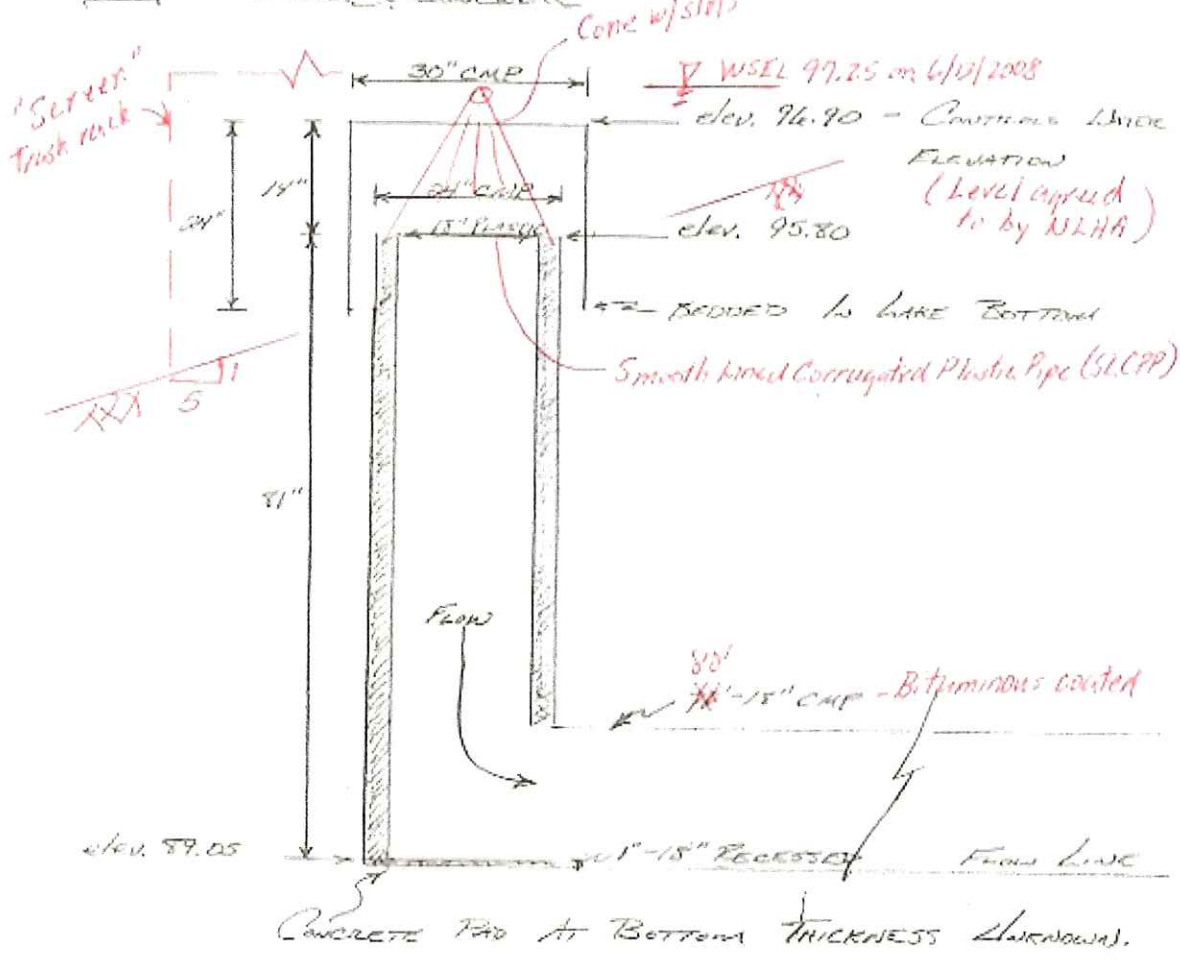
Figure 2

Wearinge Lake, Evart Twp. 8-1-07

ORIGINAL BY Cliff Youngs, P.E.
Revisions by Gary F. Gosbey, P.E. 6/13/2008

XXX Expandable Foam — Not To Scale

Stone & Concrete



A-A

Notes

1. Inner Plastic Tube Slid in Due To Many Rust Holes Leaking in 24" CMP Tube. 24" Tube Showing Some Corrosion.
2. All Elevations Reference Bench Mark Set @ 100.00 Illustrated On Pg 1 of 3

Figure 2

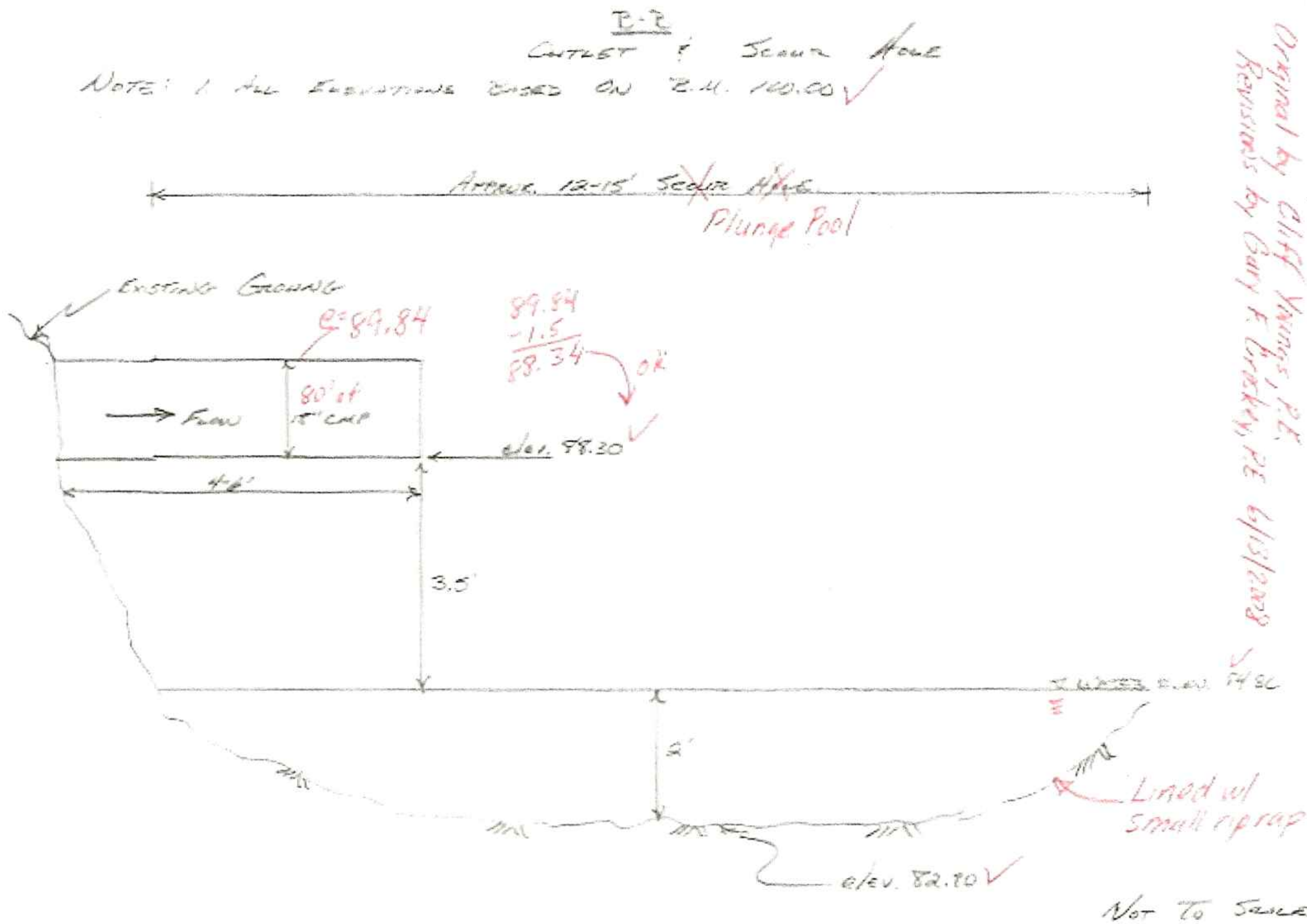
Lake, Evart Twp. 8-1-07

Original by Cliff Youngs, P.E.

Revisions by Gary F. Croskey, P.E. 6/13/2008

3 of 3

Figure 3



DAM SAFETY INSPECTION FIELD REPORT

1. **Name of Dam:** Negaunee Lake
   Dam ID No.:2674
   Date: 07/08/2013

2. **Owner(s)**: Negaunee Lake Association (NLA)
   Address: 4305 Lin-Nan Lane, Muskegon, MI 49441
   Phone: 231-780-5300
   OPERATOR: NONE, however, a Bob Lancaster does periodic O&M such as mowing.

3. **Location of Dam**: Section: 35, Town: 17 North, Range: 8 West
   County: Osceola
   River: Sherlock Creek

4. **Persons Present at Inspection:**

Name	Title
Gary F. Croskey, P.E.	Consultant
Greg LaFraugh	Board Member, Lake Negaunee Association

5. **Description of Dam:**
   210 foot long and 18 foot high earth embankment dam. The dam has a principal spillway located in the approximate center of the dam. The principal spillway controls the water level of Negaunee Lake. In 1990 modification of the road grade on the crest of the dam was raised 2 feet.

6. **Dam Owner Questionnaire Completed?** Yes _x__ No__ (provided in 2008 Report)

7. **Prior Inspections:** 2007 by Cliff Youngs, P.E.; 2008 by Gary F. Croskey, P.E.

8. **Hazard Potential Classification:** LOW

ENGINEERING DATA

1. **Vicinity Map:** USGS quadrangle
2. **Geology Reports:** None
3. **Design Analysis:** None
4. **Plans:** Sketches are contained in the 2007 and 2008 Reports. INCLUDE IN THIS REPORT.

CONSTRUCTION DATA

1. **As-Built:** None. Historical Information provided in questionnaire. Dam constructed by original developers, Ed Morgan, Archie McLachlan, and Elmer McLachlan (attorney per subdivision plats) around 1959.

2. **Post Construction Surveys:** None except in 2007 and 2008 Reports.
3. **Construction History:** Built 1959-1961.

4. **Modifications:** 1990 road grade raised 2 feet with gravel and "overflow tube" was added. ROAD GRADING NOW INCLUDES GRADE TOWARDS UPSTREAM SLOPE.
5. **Borrow Sources:** Assumed local or native material on site, sandy loam.

OPERATION & MAINTENANCE DATA

1. Operation & Maintenance Plan and Procedures: No plan only mowing of grassed slopes is done by NLHA.
2. **Monitoring Systems:** None.
3. **Impoundment Level Records:** None.
4. **O&M Records:** None.
5. **Dam Incidences/Reports:** None.
6. **Pictures:** 2007 & 2008 Reports.

INSTRUMENTATION

1. Monuments, Benchmarks, Surveys: Yes, arbitrary benchmark 100.00 feet in elevation noted in 2007 Report. BM is RR spike east side of White Oak east of Dam.
2. **Observation Wells:** None.
3. **Weirs:** None.
4. **Piezometers:** None.
5. **Stream Gage Recorder:** None.

DATA

Elevation Top of Dam	100.6 feet	Length of Dam	210 feet
Elevation Normal Pool	96.9 feet	Top Width	17 feet
Elevation Tailwater	84.8 feet	Structural Height	17.8 feet
Elevation Streambed	82.8 feet	Hydraulic Height (Head)	12.1 feet
Normal Pool Area	80 acres	Normal Pool Capacity	288 ac-ft
Maximum Pool Area	85 acres	Maximum Pool Capacity	380 ac-ft

Note: Negaunee Lake Subdivision No. 4 plat, dated 1972, stated "Floodplain contour as established by Water Resources Commission USGS Datum (Elev. 1090.0)." Plat also showed lake level elevation was 1088.3 feet. Pool area and capacity estimated..

RESERVOIR

1. **Slope:** Rolling hills
2. **Bank:** Steep with woody vegetation
3. **Sedimentation**: None observed as upstream pond above causeway divides pond and may trap sediments entering the impoundment.

EARTH EMBANKMENTS

Embankment Length (ft)
Main: __X___ Left: ____ Right: _____ Other: _____ Total Length: 210 feet
Note: Y = yes; N = no; P = photo

	UPSTREAM	DOWNSTREAM	CREST 1	LEFT ABUT	RIGHT ABUT
Slope (horiz:vert)	5:1	3:1	N/A	N/A	N/A
Grass cover	Y	Y	N 1	Y	N
Trees, Brush, etc.	N	Y 3	N	Y	Y
Riprap	N	N	N/A	N	N
Erosion	N	Y 2 P 15	N	N	N
Cracks	N	N	N	N	N
Settlement	N	N	N	N	N
Animal Burrows	None seen	None seen	N	None seen	None seen
Debris	N	N	N/A	N	N
Seepage Boils	N/A	N	N/A	N	N
Slough Beaching	N	N/A	N/A	N	N
Drains	N/A	N	N/A	N	N

COMMENTS:

1. Private gravel road that receives periodic grading by the NLA Board. NOW GRADED TOWARDS UPSTREAM SLOPE.

2. Minor erosion left side of outlet tube in center of dam where gravel road runoff is channelled and protected by small riprap placed along toe of embankment. See Photo 15. STONE RIPRAP IN PLACE, NO CHANGE IN CONDITION.

3. TREES AND BRUSH STILL AT TOE OF SLOPE. RECOMMEND REMOVE TEN FEET FROM SLOPE.

SPILLWAYS AND OUTLETS

1. **Types and locations:** The dam has a principal spillway located in the approximate center of the earth embankment. The principal spillway controls the water level of Negaunee Lake. This spillway is modified 30-inch diameter helical Corrugated Metal Pipe (CMP) riser to a 18-inch diameter CMP outlet tube. The riser has been modified by insertion of a 24-inch CMP pipe that has been further lined with a 18-inch diameter Smooth Lined Corrugated Plastic Pipe (SLCPP). 12.5 foot
2. **Condition:** Good
   Cracks: N/A
   Displacement: None.
   Spalling: N/A
   Erosion: None.
   Seepage and Drainage: None
3. **CONTROLS:** None, top of principal spillway riser controls lake level.
   Gates: N/A
   Stoplogs: None.
   Hoists: Metal conical cone over riser, it was directed immediate removal by this inspector in 2008. NOT DONE. WILL BE REMOVED.
   Trashrack: Screen fence and posts.
4. **Inlet Channel:** Impoundment
5. **Outlet Channel:** Sherlock Creek
6. **Other/Rating Tables/Charts etc.:** None.

HYDROLOGIC AND HYDRAULIC DATA

HYDROLOGY

The 2013 peak inflows along with the runoff volumes were provided by the Michigan Department of Environmental Quality email, dated July 11, 2013 attached in this report as Appendix D. Data from previous reports is provided for comparison purposes only:

	2013		2008			
	Cfs	ac-feet	cfs	ac-feet	Cfs	Ac-feet
Flood Frequency	Inflow/ Outflow		Inflow/ outflow		Inflow/ outflow	
0.5%	550	160	550	210		
1.0%	420	120	420	160		
2.0%	290	90	290	120		
Drainage Area Total (sq mi)	0.91		0.91			
Drainage Area Contributing (sq mi)			0.91			

HYDRAULIC - Spillway Capacities, Rating Tables/Curves, and Questions

1. Description of principal spillway, including stilling basin.
   Are plans available: ___Yes _X_ No
   Capacity in cfs: 150
   without freeboard (top of dam), elevaton: 100.6 feet 5-8 cfs **
   operating capacity at elevation: elevation: 96.9 feet 0 cfs
   Note: ** Bi spillway calculations done due to restrictive nature of existing riser.

2. Description of auxiliary spillway, including stilling basin.
   Are plans available: __Yes _X_ No N/A
   Capacity in cfs:
   Operating capacity at elevation:_ ft cfs
   Note: No auxiliary reported.

3. Storage capacity curves for reservoir:

Elevation (feet)	Area (acres)	Capacity (acre-feet)
96.9	80	288
98.6	85	370
100.6	90	550

Note:. Maximum capacity estimated.

5. Please attach one graph displaying the spillway and tailwater rating curves.
   Note: See Appendix D for spillway calculations.

6. Sensitivity analysis of estimated flows.

Frequency	Flow (cfs)	Pool Elevation (ft)	Tailwater Elevation (ft)	Head (ft) (Pool Elev. –Tailwater Elev.)
0.5% (200-yr)	550			
1.0% (100-yr)	420			
2.0% (50-yr)	290			

7. **State development in downstream floodplain at various elevations**:
   Agricultural land

8. **Has downstream development constrained use of any outlet works or spillways?** NO

9. **Will downstream erosion resulting from normal or design flood discharges**

jeopardize the safety of the structure? NO

10. **Have ice jams or debris affected past operation of the dam?** (past history of any occurrence should be included if available). None provided.

11. **What is the existing hydraulic capacity of the structure (no freeboard). What is the probability of its capacity being exceeded?** 78 cfs, <1.0%.

12. **Give the magnitude of the recommended spillway design flood in terms of discharge, and volume in acre-feet?** 420 cfs, 120 ac-ft **What percent of maximum storage capacity of the dam is this runoff volume?** 100% with no outflow.

13. **What is the most probable mode of hydraulic failure?** This answer should include:
    a) **Type of failure**, i.e. overtopping, erosion, piping, etc.: Piping/Overtopping
    b) **Probability of occurrence**: <<<<< 1.0% chance
    c) **Estimated downstream consequence**: No downstream consequences.

14. **Would a failure of the structure at flood frequency discharge less than the recommended spillway design flood significantly increase the downstream hazard for loss of life and the economic loss?** NO, see 2007 Report.

15. **Will structural failure at maximum controlled pool elevation (top of dam) cause a downstream flood wave that could result in higher hazard conditions?** NO

16. **Will structural failure at normal controlled pool elevation cause a downstream flood wave that could result in a higher hazard classification?** NO

17. **Is further detailed hydrologic or hydraulic study warranted?** If so, explain why.
    No.

18. **Will routing the recommended spillway design flood through to pool significantly (by more than 10%) attenuate the peak?** _X_ Yes __ No

19. **Does the stilling basin adequately dissipate energy over expected range of discharges?** YES

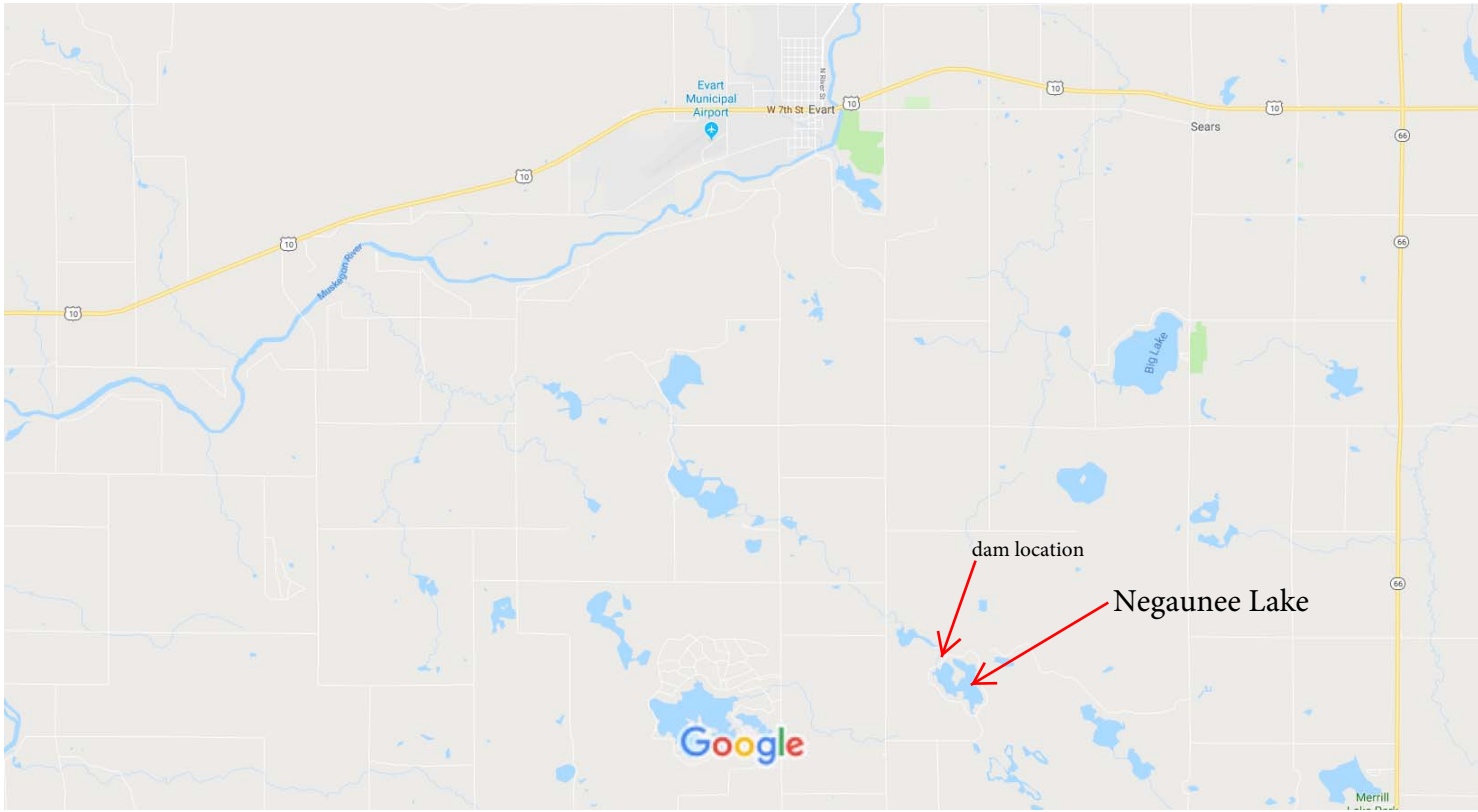
We have processed the discharge request submitted by email on June 20, 2023 (Process No. 20230353), as follows:

Sherlock Creek at Negaunee Lake Dam, Dam ID 2674, Section 35, T17N, R8W, Evart Township, Osceola County, has a drainage area of 0.91 square miles. The design discharge for this dam is the 1% chance (100-year) flood. The 1% and 0.5% chance peak flows are estimated to be 420 cubic feet per second (cfs) and 550 cfs, respectively. The 1% chance flood volume is estimated to be 120 acre-feet. (Watershed Basin No. 22 Muskegon).

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 Floodplain Management Unit, at 517-927-3838, 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. Michael Size of our Dam Safety Unit at 989-619-4295, or by email at: SizeM@michigan.gov.

From: EGLE-Automated <EGLE-Automated@michigan.gov>
Sent: Tuesday, June 20, 2023 10:30 AM
To: EGLE-wrd-qreq <EGLE-wrd-qreq@michigan.gov>
Subject: Flood or Low Flow Discharge Request

Requestor: David L. Schultz, P.E.
Company: Schultz Land & Water Consulting, Inc.
Address: 4859 Townsend Court
City/State: Montague, MI
ZIP Code: 49437
Phone: 2318937177
Date: 06/20/2023
1 percent
0.5 percent
Contact Agency:
Contact Person:
Watercourse: Negaunee Lake
Local Name: Sherlock Creek
County: Osceola
City/Township: Evart Township
Section: 35
Town: 17N
Range: 08W
Location: Dam ID #2674. ~1 mile north of Mesceola Road (county line) on Negaunee Lake Drive.
FFR1: Dam
Email: DavidLSchultz@Charter.net<mailto:DavidLSchultz@Charter.net>


Evart Municipal Airport
W 7th St
Evart
Sears
Muskegon River
Big Lake
dam location
Negaunee Lake
Google
Merrill
Map data ©2018 Google
5000 ft

NOAA Atlas 14, Volume 8, Version 2
Location name: Evart, Michigan, USA*
Latitude: 43.8255°, Longitude: -85.2316°
Elevation: 1098 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.281** (0.217-0.364)	**0.333** (0.258-0.433)	**0.426** (0.328-0.554)	**0.508** (0.389-0.663)	**0.630** (0.471-0.853)	**0.730** (0.532-0.996)	**0.837** (0.590-1.16)	**0.950** (0.644-1.35)	**1.11** (0.724-1.60)	**1.24** (0.785-1.80)
10-min	**0.411** (0.318-0.533)	**0.488** (0.377-0.634)	**0.624** (0.480-0.811)	**0.744** (0.570-0.971)	**0.922** (0.689-1.25)	**1.07** (0.780-1.46)	**1.22** (0.864-1.70)	**1.39** (0.943-1.97)	**1.62** (1.06-2.35)	**1.81** (1.15-2.64)
15-min	**0.501** (0.388-0.650)	**0.595** (0.460-0.773)	**0.761** (0.586-0.989)	**0.908** (0.695-1.18)	**1.12** (0.841-1.52)	**1.30** (0.951-1.78)	**1.49** (1.05-2.07)	**1.70** (1.15-2.40)	**1.98** (1.29-2.86)	**2.21** (1.40-3.21)
30-min	**0.720** (0.557-0.935)	**0.856** (0.661-1.11)	**1.09** (0.841-1.42)	**1.30** (0.998-1.70)	**1.62** (1.21-2.19)	**1.88** (1.37-2.56)	**2.15** (1.52-2.98)	**2.44** (1.65-3.46)	**2.85** (1.86-4.12)	**3.18** (2.02-4.63)
60-min	**0.956** (0.739-1.24)	**1.11** (0.861-1.45)	**1.40** (1.08-1.82)	**1.67** (1.28-2.18)	**2.09** (1.57-2.84)	**2.44** (1.78-3.34)	**2.82** (2.00-3.94)	**3.24** (2.20-4.61)	**3.84** (2.51-5.57)	**4.33** (2.75-6.30)
2-hr	**1.19** (0.932-1.53)	**1.37** (1.07-1.76)	**1.71** (1.34-2.20)	**2.04** (1.58-2.63)	**2.56** (1.95-3.46)	**3.00** (2.22-4.08)	**3.49** (2.50-4.84)	**4.04** (2.78-5.70)	**4.83** (3.19-6.95)	**5.48** (3.51-7.90)
3-hr	**1.34** (1.06-1.71)	**1.52** (1.20-1.94)	**1.88** (1.48-2.40)	**2.24** (1.75-2.87)	**2.82** (2.17-3.81)	**3.33** (2.49-4.52)	**3.90** (2.82-5.39)	**4.55** (3.15-6.41)	**5.49** (3.66-7.89)	**6.27** (4.04-9.01)
6-hr	**1.60** (1.27-2.01)	**1.79** (1.43-2.25)	**2.19** (1.74-2.76)	**2.60** (2.05-3.29)	**3.29** (2.57-4.41)	**3.91** (2.96-5.26)	**4.61** (3.38-6.32)	**5.41** (3.80-7.57)	**6.59** (4.44-9.41)	**7.58** (4.94-10.8)
12-hr	**1.85** (1.49-2.29)	**2.07** (1.67-2.57)	**2.53** (2.03-3.15)	**3.01** (2.40-3.75)	**3.79** (3.00-5.03)	**4.51** (3.46-6.00)	**5.32** (3.93-7.21)	**6.23** (4.42-8.64)	**7.59** (5.17-10.7)	**8.73** (5.74-12.3)
24-hr	**2.11** (1.72-2.58)	**2.37** (1.93-2.90)	**2.89** (2.35-3.55)	**3.43** (2.77-4.22)	**4.31** (3.44-5.64)	**5.10** (3.96-6.71)	**6.00** (4.49-8.05)	**7.02** (5.03-9.63)	**8.52** (5.86-11.9)	**9.77** (6.50-13.7)
2-day	**2.41** (1.99-2.91)	**2.70** (2.23-3.26)	**3.28** (2.70-3.97)	**3.87** (3.16-4.71)	**4.84** (3.91-6.24)	**5.70** (4.47-7.40)	**6.68** (5.05-8.86)	**7.78** (5.64-10.6)	**9.41** (6.54-13.1)	**10.8** (7.23-15.0)
3-day	**2.63** (2.19-3.15)	**2.95** (2.45-3.54)	**3.58** (2.96-4.30)	**4.20** (3.46-5.07)	**5.21** (4.23-6.66)	**6.11** (4.82-7.86)	**7.12** (5.41-9.36)	**8.25** (6.01-11.1)	**9.90** (6.93-13.7)	**11.3** (7.63-15.6)
4-day	**2.83** (2.36-3.37)	**3.17** (2.65-3.77)	**3.83** (3.19-4.58)	**4.48** (3.71-5.38)	**5.52** (4.50-7.00)	**6.44** (5.10-8.24)	**7.47** (5.70-9.77)	**8.61** (6.30-11.5)	**10.3** (7.23-14.1)	**11.7** (7.93-16.1)
7-day	**3.35** (2.83-3.95)	**3.74** (3.15-4.40)	**4.46** (3.76-5.28)	**5.17** (4.32-6.14)	**6.28** (5.16-7.86)	**7.26** (5.79-9.16)	**8.33** (6.41-10.8)	**9.52** (7.02-12.6)	**11.3** (7.97-15.3)	**12.7** (8.69-17.4)
10-day	**3.83** (3.26-4.48)	**4.25** (3.61-4.98)	**5.05** (4.27-5.92)	**5.80** (4.88-6.84)	**6.98** (5.75-8.65)	**8.00** (6.41-10.0)	**9.11** (7.05-11.7)	**10.3** (7.66-13.6)	**12.1** (8.62-16.4)	**13.6** (9.35-18.5)
20-day	**5.19** (4.47-5.99)	**5.77** (4.97-6.66)	**6.79** (5.82-7.86)	**7.70** (6.56-8.96)	**9.06** (7.52-11.0)	**10.2** (8.24-12.5)	**11.4** (8.88-14.4)	**12.7** (9.47-16.4)	**14.5** (10.4-19.3)	**15.9** (11.1-21.5)
30-day	**6.37** (5.53-7.29)	**7.08** (6.14-8.11)	**8.28** (7.15-9.51)	**9.31** (8.00-10.7)	**10.8** (8.98-12.9)	**12.0** (9.72-14.5)	**13.2** (10.3-16.5)	**14.5** (10.9-18.6)	**16.2** (11.7-21.5)	**17.6** (12.3-23.7)
45-day	**7.91** (6.92-8.98)	**8.78** (7.67-9.97)	**10.2** (8.86-11.6)	**11.3** (9.82-13.0)	**12.9** (10.8-15.3)	**14.2** (11.5-17.0)	**15.4** (12.1-18.9)	**16.6** (12.5-21.1)	**18.2** (13.2-23.9)	**19.4** (13.7-26.0)
60-day	**9.26** (8.15-10.5)	**10.3** (9.00-11.6)	**11.8** (10.3-13.4)	**13.1** (11.4-14.9)	**14.7** (12.3-17.2)	**15.9** (13.1-19.0)	**17.1** (13.5-20.9)	**18.3** (13.8-23.0)	**19.7** (14.3-25.7)	**20.7** (14.7-27.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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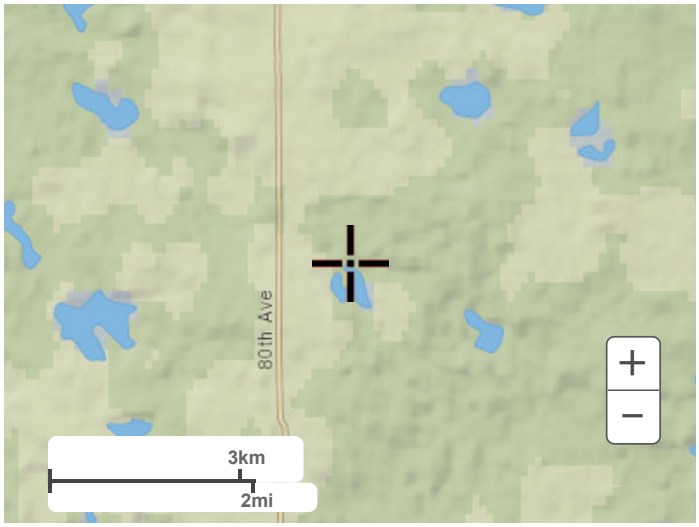
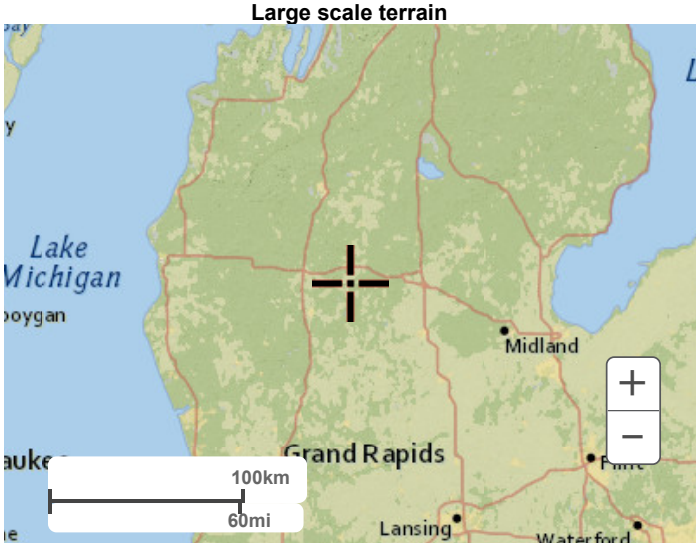
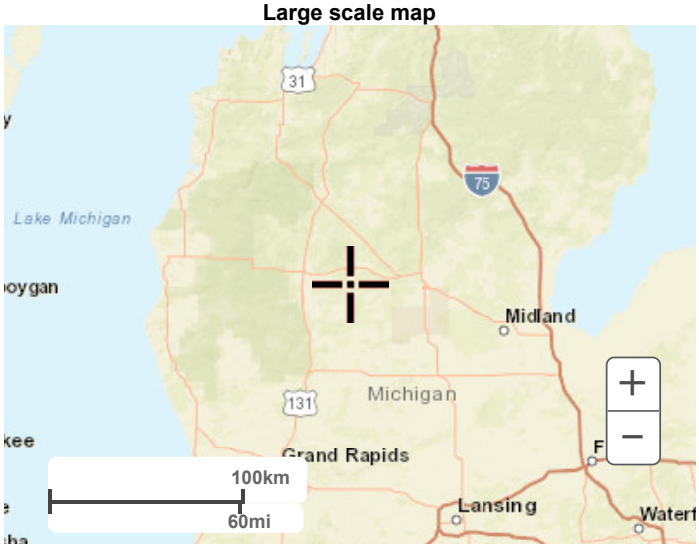
PF graphical



Large scale terrain



Large scale map



Large scale aerial