Indian Lake Dam Inspection Report

Dam Identification No.: 687
Hazard Potential: Low
Section 31; T.5N. – R.11E.
Addison Township, Oakland County, Michigan
Located on tributary to West Branch of Stony Creek
Per Part 315, Act 451 of 1994

Prepared for:
Donald King, President
Indian Lake Improvement Association
75 Ridgemont Road
Oxford, MI 48370

Operator email: ddking3070@sbcglobal.net

Prepared By:

Spicer Group, Inc.
230 S. Washington
Saginaw, Michigan 48607
(989) 754-4717

Inspected By:

Mark A. Latsch, P.E. # 33631

Date of Inspection: November 18, 2013
Date of Final Report: December 31, 2013

Project No. 120452SG2013

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I. INTRODUCTION

The Indian Lake Dam was inspected pursuant to the requirements of Part 315, Dam Safety, Natural Resources and Environmental Protection Act, Act 451 of 1994. The Spicer Group conducted the 5-year inspection of the dam on November 18, 2013 as requested by the delegated authority of the dam, Indian Lake Improvement Association. The scope of this inspection is to identify conditions that constitute an existing or potential hazard to the dam. The identification of potential hazards is limited to the field visual inspection, review of previous reports, review of previous plans, and general computations. The contents of this report are not to be treated as a detailed engineering evaluation.

This inspection report will serve as a supplement to previous inspections performed on the dam and document work being performed this year. Previous inspection reports, drawings, sketches, calculations, etc. will be referred to as part of this inspection report. A summary of the design, construction, maintenance, and subsequent inspections of the dam are outlined in the Project Information section of this report.

The repairs completed in 2013 were performed under MDEQ Permit #13-63-0190-P.

II. CONCLUSIONS AND RECOMMENDATIONS

A. Overall Condition

The visual inspection of the dam indicates the dam and its appurtenant structures are in satisfactory. The wall deficiencies at the Bay locations noted in prior reports have been rehabilitated. The bays are numbered from west to east, where the most western bay is Bay 1 and the most eastern bay is Bay 6. The plan view of the dam with labeled bays is in the appendices of this report. In the past few months of 2013 a significant amount of work has taken place on the structure, especially rehabilitation of Bays 2, 3, 4, and 5. The dam is 80 years old and had been deteriorating, the Lake Association decided to take a more pro-active approach and develop a detailed work plan in 2012 to assist the Lake Association with prioritizing and budgeting for the future of the structure. The Lake Association approved the 2013 repairs as discussed herein. There was also a

permitted lake drawdown while this work proceeded to better complete the work and to further assess the spillway's current condition to allow maintenance patching and sealing. The following items listed are for the owner to monitor the dam on a regular basis as noted.

B. Observed Deficiencies/Prioritized Recommendations

Specific deficiencies and recommended corrective measures, listed in order of priority are as follows:

1. The west wall of the fixed crest spillway is deteriorating. Measures have been taken during the 2013 construction to slow the deterioration process by removal of deteriorated concrete to minimize moisture concentration and freeze thaw action. The wall has minor seepage near the fixed crest spillway where prior concrete repairs were performed. The joint between the spillway and wall was sealed with grout with the 2013 construction. The wall is in generally poor condition and has many cracks and efflorescence; however it is considered structurally stable.

    a. Monitor seepage adjacent to the newly constructed walls of Bay 2, 3, 4 and 5.

    b. Bay 6 has evidence of spalling and seepage at the contact point of the ground and concrete.

    c. Bay 1 has evidence of seepage and damp soil during prior inspections. There were three locations where a rust color was seeping down the wall.

    d. The deck over the fix crest spillway continues to deteriorate.

    e. The upstream face of the dam has deterioration, cracks, and efflorescence especially at locations of prior temporary patching.

2. Erosion from surface runoff is evident on the downstream face of the dam near the east and west corner of the dam.

Recommend: Install filter fabric and plain riprap in these areas.

3. There are trees and brush along the downstream slope of the earth embankment.

Recommend: Trees and brush allow passage for water to seep through the dam. The trees and brush should be removed from the downstream toe of slope.

C. Further Detailed Studies and/or Investigations

At this time, we do not recommend any further investigation of the dam, outside of the visual inspection required every five (5) years by an engineer and periodic inspection by the ILIA members.

D. Hazard Potential Classification

The hazard potential classification of the Indian Lake Dam is currently listed as a low hazard potential dam. Based on our inspection and the recent repairs, we do not recommend changing this classification.

The hazard potential classification is only an indication of the potential for loss of life and economic loss due to failure of the dam. It is our opinion that the hazard potential classification of "Low" not be raised for this structure. The hazard potential is not an indication of the stability or integrity of the dam.

III. PROJECT INFORMATION

A. General Description of Dam

The Indian Lake Dam is located in Section 31 of Addison Township, Oakland

County, Michigan. The Indian Lake Dam is situated between the northern and southern portions of Indian Lake in Oakland County, Michigan. The structure is a concrete buttress type dam consisting of an overflow spillway located between concrete bays and buttresses that extend east and west to the natural valley walls. There are six bays and a fixed concrete spillway. The crest of the dam is 150 feet in length. The Indian Lake Dam has a head of 16 feet and a spillway width of 20 feet. Downstream of the fixed crest spillway is an energy dissipating sill that extends the width of the spillway. The dam crest consists predominately of a concrete roadway, with asphalt repairs. The impoundment is about 58 acres and can store approximately 600 acre-ft of water under normal conditions and 900 acre-feet maximum.

B. Purpose of Dam

The Indian Lake Dam was originally constructed for residential development and recreational purposes. Currently, the lake is developed with lakeshore homes; Indian Lake is used for water recreation sports such as swimming, boating, fishing, and wildlife observation.

C. Available Design, Construction and Maintenance Information.

At the time of the inspection all requested information regarding the dam was available. Information regarding design and construction should be on file at the Michigan Department of Environmental Quality (MDEQ) – Dam Safety Unit. Spicer Group is also providing the current maintenance information and report from 2012.

A. Previous Inspection Reports

2012 Condition Evaluation and Recommendations- Spicer Group

2008 Dam Inspection Report – Spicer Group

2003 Dam Inspection Report – Hanson Engineering

Copies of these dam inspection reports and relevant information are on file with the ILIA, and the Michigan Department of Environmental Quality – Dam Safety Unit.

II. FIELD INSPECTION

Spicer Group performed a visual inspection of the dam on November 18, 2013. Photographs were taken and a field inspection checklist was completed in the field and office summarizing the inspection. The checklist and photographs are included in the appendices of this report. The following is a summary of the visual observations made during the inspection:

A. The rehabilitation of the walls at Bay 2, 3, 4, and 5 were just being completed during the inspection and were in new-like condition.

B. The temporary siphon tube was being removed during the inspection. As seen in the photos the water depth was about 18" below the spillway at the time of inspection.

C. 12-inch diameter concrete cores through the upper deck were taken to facilitate concrete placement. The concrete from the cores was considered to be in good condition within the deck even though there is significant deterioration along the fascias.

D. The approach channel is open and free of debris.

E. The spillway appears to be generally fair to good condition, maintenance patching and sealing were yet to be done.

F. The Bituminous Pavement should be removed along the west approach to the upper deck to reduce moisture and imminent freeze thaw deterioration.

G. The condition of the prior temporary patching along the upstream corbels is deteriorating. Consideration will need to be given in the future for removal of the patching to minimize trapped moisture and resulting freeze thaw deterioration.

H. Site security is satisfactory; as the structure is surrounded by private homes and is easily monitored by property owners. There are fenced gates at each end of the structure to limit access.

I. Minor scour adjacent to spillway should be stabilized.

III. STRUCTURAL STABILITY

The overall structural stability of the dam is satisfactory based on visual inspection. The

dam's concrete structures and embankments show no signs of potential failure. The outlet structures also appear to be in structurally satisfactory condition.

IV. HYDROLOGY AND HYDRAULICS

A. Hydrologic Design Data and information has been obtained from the MDEQ. Hydrologic information provided by the MDEQ has been obtained and is included in the appendix of this report. The design discharge for this dam is the 1% chance peak inflow into Indian Lake and calculated by the MDEQ to be 65 cfs. Low hazard dams are required to convey the 100yr (1% chance discharge flood) storm or the flood of record, whichever is greater. This design flow is lower than the 1% chance peak inflow to Indian Lake, estimated in 2008 at 160 cfs. But in 2013 it is estimated at 65 cfs.

B. Contributing Drainage Area

The MDEQ estimates the contributing drainage area to be 1.8 square miles or 1,152 acres. The MDEQ estimates the surface area of Indian Lake at normal flow to be 58 acres. This provides a ratio of 20 to 1 of contributing watershed drainage area to impoundment area in acres. The impoundment is about 58 acres and can store approximately 600 acre-ft of water under normal conditions and 900 acre-feet maximum.

C. Design Flood Determination

The design flood is determined by the MDEQ classification of the dam. Low hazard dams are required to convey the 100-year event or maximum observed event, whichever is greater. The MDEQ determined the 100-year peak flow into Indian Lake Dam to be 65 cfs.

D. Existing Spillway Capacity

As reported by JCK & Associates, on October 24th, 1994, the dam discharged 200 cfs. The 200 cfs exceeds the flow on the discharge request. Therefore, no further evaluations are necessary.

E. Routing of Spillway Design Flood.

Due to the fact that the dam can convey the required storm event, routing of the inflow hydrographs is not necessary.

F. Flood of Record

The largest flood of record is October 24th, 1994, with a discharge rate of 200 cfs. An engineering report from 1994 confirms the spillway can pass this flow.

V. OPERATION AND MAINTENANCE

A. Assessment of Operating Equipment and Procedures

The dam has a fixed crest spillway with no adjustment and no operating equipment for this structure, there are no stop logs or other flow control structures present.

B. Evaluation of Current Maintenance Plan

Until 2012 there has been no formal maintenance plan. The structure has just undergone a significant amount of concrete repair work. This does need to be entered into the maintenance log that is kept by members, this current activity should be noted and documented along with the repair detail and invoice from the contractor to document the repairs completed.

In addition to the items outlined in the operation and maintenance plan, all metal surfaces should be inspected on a regular basis. Sandblasting, cleaning, and painting should be performed as necessary. The remaining cracks and spalling in the concrete structure not repaired during this recent bout of construction; should be inspected each year for displacement or widening and repaired as necessary in the future.

APPENDIX A

MDEQ FLOW RATES

MDEQ DAM INVENTORY SHEET

2013 DAM INSPECTION CHECKLIST

Beaubien, Russell A.

From: deq-wrd-qreq [deq-wrd-qreq@michigan.gov]
Sent: Thursday, November 07, 2013 5:23 PM
To: Beaubien, Russell A.
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 6, 2013 (Process No. 20130515), as follows:

Tributary to West Branch Stony Creek at Indian Lake Dam, Dam ID 687, Section 31, T5N, R11E, Addison Township, Oakland County, has a total drainage area of 10.3 square miles and a contributing drainage area of 1.8 square miles. The design discharge for this dam is the 1% chance (100-year) flood. The 50%, 20%, 10%, 4%, 2%, 1%, 0.5%, and 0.2% chance peak flows are estimated to be 10 cubic feet per second (cfs), 15 cfs, 25 cfs, 40 cfs, 50 cfs, 65 cfs, 80 cfs, and 110 cfs, respectively. (Watershed Basin No. 12 Clinton).

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 517-284-5579, 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 517-284-5581, or by email at: TrumbleL@michigan.gov.

-----Original Message-----
From: russb@spicergroup.com [mailto:russb@spicergroup.com]
Sent: Wednesday, November 06, 2013 4:45 PM
To: deq-wrd-qreq
Subject: flood or low flow discharge request (ContentID - 168812)

Requestor: Russ Beaubien, P.E., CFM
Company: Spicer Group
Address: 230 S. Washington Ave
City: Saginaw, MI
Zip: 48607
Phone: 989-754-4717
Date: 11/06/2013
F50percent: Yes
F20percent: Yes
F10percent: Yes
F4percent: Yes
F2percent: Yes
F1percent: Yes
F0.5percent: Yes
F0.2percent: Yes
ContactAgency: None Selected
ContactPerson:
Watercourse: Tributary to West Branch Stony Creek
LocalName:
CountyLocation: Oakland
CityorTownship: Addison Township
Section: 31

Town: 5N
Range: 11E
Location: The Indian Lake Dam (ID#687) is located at the end of Ridgemont Road in Addison Township. The dam is close to the Oakland Twp & Addison Twp borders.
FFR1: Dam

Dam ID	687	National ID	MI00687	County	Oakland	County #	63
Dam Name	Indian Lake Dam			File	Yes	State	Michigan
Popular Name				Plan			
Pond Name	Indian Lake			Quad	S30SW		
1/4 Section	SE	Sec	31	Town	05N	Range	11E
DEQ District	Southeast Michigan						
City	Rochester			Distance (mi)	13	Population	7050
Additional Information							
Number of Plan Files Available	0			Phase I (PL92-367) Inspection			No
EAP	Not Required	EAP Last Updated		Jurisdiction	Oakland County		
Hazard	Low	Compliance Activity					
Condition	Poor	Condition Detail	Deficiency recognized				
Owner ID	706	Owner	Indian Lake Dam Association	Owner Type	Private		
Authority	Part 315	Del. Authority					
Inspection Date	10/24/2008	Inspector	Shawn P. Middleton, P.E.				
Report Date	12/16/2008	Next Inspection Date	12/31/2013				
Report Received	12/22/2008	Report Reply Date	2/3/2009	Action Requested			
Year Built	1928	Type	Buttress	Purpose	Recreation		
Top of dam to streambed (ft)	20	Design flood elevation to streambed (ft)	20				
Head - headwater minus tailwater at normal flow (ft)	16	Normal Freeboard (ft)					
Pond acres at normal flow	58	Max. storage (ac-ft)	900	Normal storage (ac-ft)	600		
River	Trib to W Br Stony Creek	Watershed	12	Drainage area (sq. mi)	1.75		
Design Flood	100 Year	Design inflow discharge (cfs)	200				
Max. Spillway Capacity (cfs)	395	Design outflow discharge (cfs)	200				
Spillway control	Uncontrolled	Spillway width (ft)	20	Crest length (ft)	150		
Permit No.		Repair Permit No.		Permit Expiration Date:			
DEQ/DNR Construction Approval		Property ID	None				
Year legal lake level established		Winter level (ft)		Summer level (ft)			
State Assessed	No						
Public Access	No	SCS/NRCS	None	Latitude	42.799143		
Trout Stream		FERC No.		Longitude	-83.200220		
Lamprey Barrier		Installed capacity (kw-hr)	0				
Fish Passage	No	Regulatory Agency	Michigan DEQ				
Private on Federal	No						

DAM INSPECTION WORKSHEET AND CHECKLISTS	
GENERAL INFORMATION / DESCRIPTION	
Name of Dam:	Indian Lake Dam
Dam Identification Number	687
Project Number:	117401SG2008
County:	Oakland County
Township	Addison Township
Town - Range:	5N – 11E
Quarter Section of Section:	SE ¼ Sec. 31
Impounded Lake, Stream, or River:	Indian Lake
Height of Dam:	20 feet
Length:	150 feet
Outlet Pipe(s) Size:	NA
Normal Head on Dam:	16 feet
Impoundment Size:	58 acres
Maximum Storage Capacity:	900 ac-ft
Normal Storage:	600 ac-ft
Purpose of Dam:	Residential and recreational
Owner:	Indian Lake Dam Association
Contact Name:	Larry Oshier
Owner Address:	75 Ridgemont Road
	Oxford, MI 48370
Owner Phone Number:	248-561-8514
Operator:	See Owner
Contact Name:	
Operator Address:	
Operator Phone Number:	
Hazard Potential Classification: (Circle 1)	High – 3 yr Significant – 4 yr **Low – 5 yr**
Emergency Action Plan (EAP) Required?	No
Is there an existing EAP?	No
Name of the Emergency Coordinator:	See owner
Emergency Coordinator Address:	
Emergency Coordinator Phone Number:	

DAM INSPECTION CHECKLIST/ OWNER INTERVIEW		
Date of Inspection:	10/24/2008	
Photographs:	Yes	
Tie down stationing along top of dam:		
		Observed Deficiencies
FIELD INSPECTION		
EARTH EMBANKMENT		
A.) Settlement		
1.) depressions	None visible	
2.) sinkholes	None visible	
3.) ruts and paths	None visible	
B.) Slope Stability (upstream/ downstream slopes)		
1.) Irregularity in alignment	None visible	
2.) Movement		
a.) sloughing	None visible	
b.) cracks	None visible	
c.) slides	None visible	
d.) slumps	None visible	
e.) beaching	None visible	
C.) Slope and Crown Protection		
1.) Vegetative Cover	Grass	
2.) Trees and brush	Yes, along downstream toe of slope	X
3.) Erosion From Surface Runoff	Yes, near east and west corner of dam	X
4.) Wave protection	None visible	
D.) Seepage, Boils, Piping		
1.) At contact points with all concrete structures	None visible at far east/west contact pts	
2.) Along downstream slopes	Minor Seepage Bay 1 and 6 (2-5 new const)	X
3.) Along downstream toe	None visible	
4.) Potential seepage areas		
a.) trees	Yes	X
b.) animal burrows	None visible	
5.) Drainage Systems		
a.) toe drains	None visible	
b.) filters	None visible	
c.) ditches	None visible	

*Number observed deficiencies from most critical to least critical (most critical being No. 1)

SPILLWAY AND OUTLET WORKS		
A.) Hydraulic Capacity		
1.) Principal Spillway	200 cfs	
2.) Auxiliary Spillway	N/A	
3.) Powerhouses	None visible	
4.) Other diversions or outlets, withdrawals	Low flow draw down according to 1994 report	
B.) Control Gates & Operating Mechanisms		
1.) Structural Members	Broken valve	
2.) Connections	None visible	
3.) Hoists	None visible	
4.) Cables	None visible	
5.) Power Supply	None visible	
6.) Gate Seals	None visible	
C.) Stop Logs and Stop Log Channels		
1.) Leakage	None visible	
2.) Deterioration	None visible	
3.) Corrosion	None visible	
D.) Obstruction to Flow		
1.) Approach Channel	No obstruction visible	
2.) Trash Racks	None visible	
3.) Outlet Channel	None visible	
4.) Sedimentation	None visible	
E.) Drawdown Facilities		
1.) Operation	Broken valve – non-operational	X
F.) Energy Dissipation		
1.) Stilling Basins	None visible	
2.) Plunge Pools	None visible	
3.) Baffles	Yes – transverse wall	
4.) Sills & Spillway Aprons	Yes – underwater during inspection	
5.) Erosion Protection	None visible	

*Number observed deficiencies from most critical to least critical (most critical being No. 1)

G.) Pipes		
1.) Joint Separation	None visible	
2.) Leakage	None visible	
3.) Protective Coatings	None visible	
4.) Settlement	None visible	
5.) Displacement	None visible	
H.) Sketch of Outlet Works	See appendix of report	
CONCRETE & MASONRY STRUCTURES		
A.) Surface Conditions		
1.) Spalling	Yes	X
2.) Cavitation	None visible	
3.) Cracks		
a.) Displacement and Separation	Yes (No structural significance)	X
b.) Seepage	Yes (Minor now that Bay 2,3,4,5 Rehab)	X
4.) Efflorescence	Yes	X
B.) Joints (Monolith)		
1.) Sealant or Fillers	Yes	X
2.) Movement	None visible	
3.) Seepage	Yes	X
OPERATION AND MAINTENANCE		
A.) Operation		
1.) Seasonal or Fluctuating Pond Levels	Fixed crest spillway – no pond fluctuation	
2.) Operation Records	Non-operational – No records	
3.) Periodic Drawdowns	Non-operational – No drawdowns except 2013 Construction had 24" drawdown	
4.) Instrumentation	None visible	
B.) Maintenance		
1.) Repairs	Concrete repairs	
2.) Periodic Maintenance		
a.) Wood	None visible	
b.) Metal	Rusted railing	X
c.) Concrete	Need preventative repairs	X
d.) Soils	No maintenance	
e.) Electrical	None visible	
f.) Mechanical	None visible	

*Number observed deficiencies from most critical to least critical (most critical being No. 1)

3.) Operation and Maintenance Plan	2012 Maintenance Plan being implemented	
4.) Site Security	Locked fences and chains	
C.) Emergency Action Plan		
1.) Warning systems	None visible	
2.) Notification Networks	No EAP	
GENERAL AREAS		
A.) Reservoir		
1.) Unique Features	None visible	
2.) Dead trees, debris in reservoir	None visible within influence	
B.) Shoreline		
1.) Erosion	None visible	
2.) Vegetation	Trees and brush	X
3.) Wave Protection	None visible	
C.) Upstream Watershed		
1.) Historic Development	Wooded / Residential	
2.) Present Development	Wooded / Residential	
3.) Proposed Development	Wooded / Residential	
D.) Downstream Floodplain		
1.) Flood Protection	None visible	
2.) Historic, present, proposed development	Wooded / Residential	
3.) Channel restrictions	None visible	
E.) Structural Stability		
1.) Embankment	Fair	
2.) Drop structure	None visible	
3.) Outlet structure / pipe(s)	None visible	
4.) Overall	Poor	
Further Detailed Studies?		
If yes, explain	No	
GENERAL COMMENTS/OVERALL CONDITIONS		
Recommend Changing Hazard Classification?	YES **NO**	

*Number observed deficiencies from most critical to least critical (most critical being No. 1)

DAM INSPECTION PREPARATION CHECKLIST	
Requested / Received information from MDNR?	Yes
Construction Plans, specifications,	Yes
Operations and Maintenance records,	
Design Calculations, Any Information	
Requested/ Received from OWNER?	Yes
Construction Plans, specifications,	Yes
Operations & Maintenance records,	
Design Calculations, Any Information	Yes
Set Date of Inspection with owner?	Yes
Weather, Owner Availability?	Cold
Operation of Gates/ Outlet Works?	N/A
What special instrumentation will be necessary?	None
Piezometers, Alignment Markers	
Benchmarks, Established Elevations	
Equipment:	
Survey (level or hand level, tripod, level rod):	X
Measuring equip. (tapes, rules, sounding lines):	X
Marking Paint/ Keel	X
Paper/ Pencil	X
Calculator	X
Scale	X
Map	X
Measuring Wheel	X
Seepage (bucket and timer)	
Camera/ Film	X
Binoculars	
Probe (undercutting) / Level Rod	X
Rubber Boots, Waders	X
Survey Field Book	X
File Folder	X
Boat	
Shovel	X
Hammer	X
Crack measuring device	X
Specialized Equipment (piezometers, etc.)	
Safety Equipment:	
Life Jacket	
Hard hats	X
Steel toed shoes	X
Lights	

*Number observed deficiencies from most critical to least critical (most critical being No. 1)

Interview with Owner	During and after field dam inspection
Comments, Date	11/18/2013
Inspection Checklist/ Forms	X
POST INSPECTION CHECKLIST	
Interview with Owner/ Operator	11/18/2013
Insure everything on inspection checklist is answered	Yes
Call Emergency Coordinator	N/A
What is needed in EAP for the County?	
Schedule a meeting with Owner and coordinator	
Prepare preliminary EAP (see EAP form)	
Inundation map	
List of possible flooded facilities, structures, etc.	
Time frame of flood wave	
Meeting with Emergency Coordinator and owner	
Final EAP	
Make revisions per results of meeting	
Preliminary Dam Inspection Report	
Submit preliminary dam inspection report to owner	
Final Dam Inspection Report	12/30/2013
Make revisions per owners request, if any	

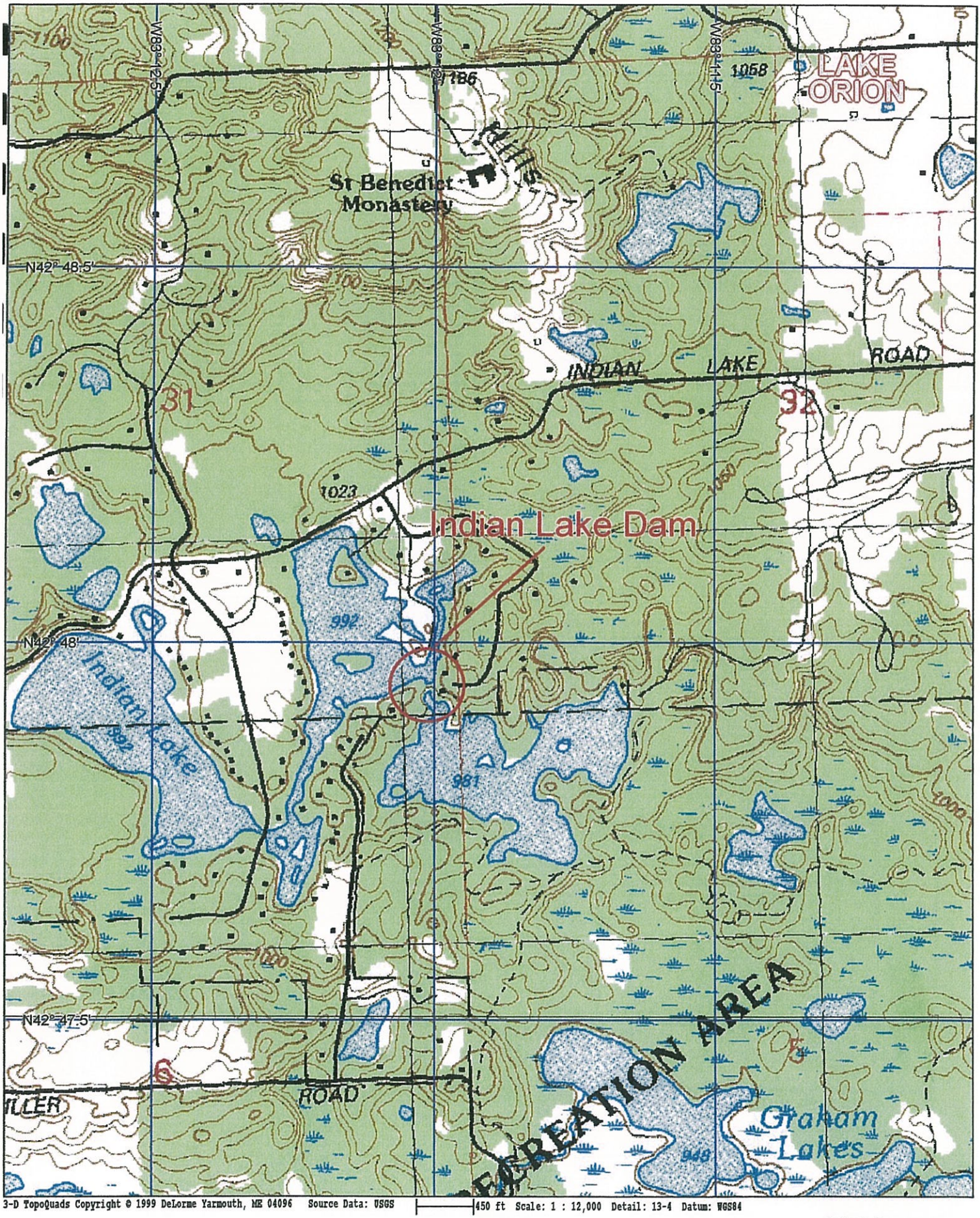
*Number observed deficiencies from most critical to least critical (most critical being No. 1)

APPENDIX B

SITE LOCATION MAP

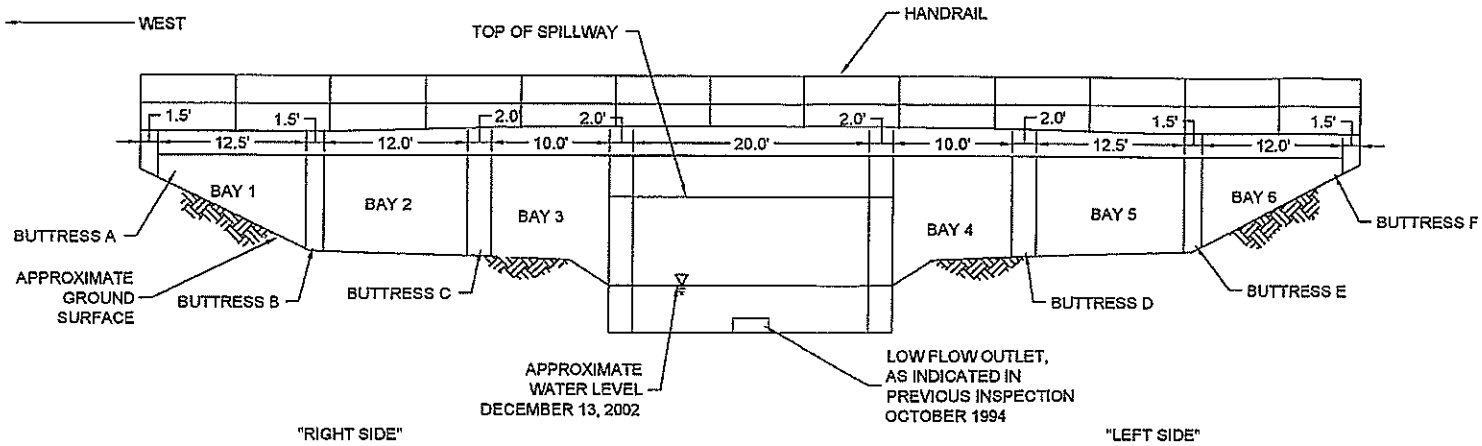
SCHEMATIC of INLET/OUTLET

DAM REPAIR DETAIL - 2013



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS 450 ft Scale: 1 : 12,000 Detail: 13-4 Datum: WGS84

Lake Orion Quadrangle
7.5 Minute Series



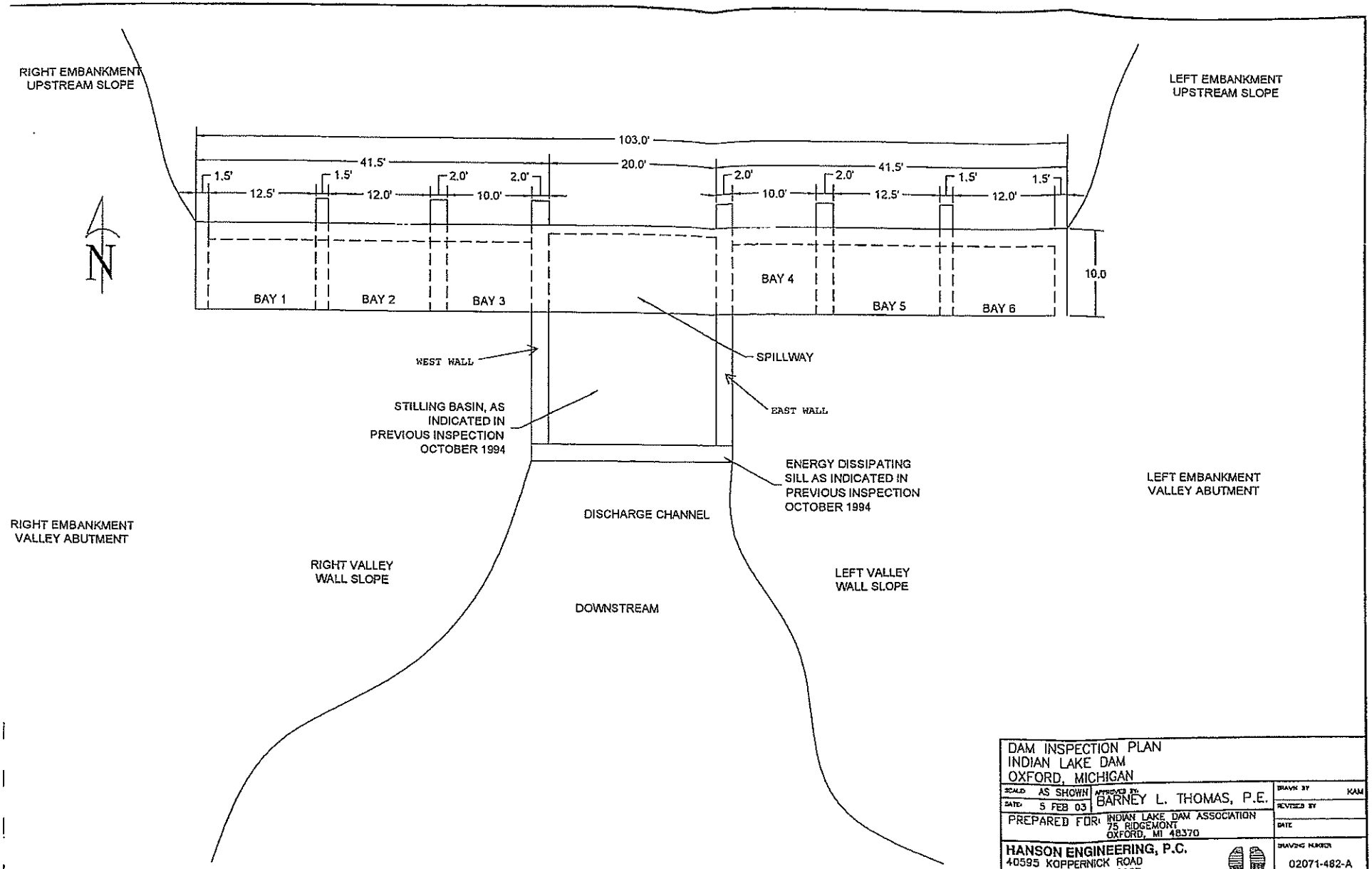
ELEVATION VIEW
SCALE: NONE

DAM INSPECTION ELEVATION VIEW
INDIAN LAKE DAM
OXFORD, MICHIGAN

SCALE: AS SHOWN	APPROVED BY: BARNEY L. THOMAS, P.E.	DRAWN BY	KAM
DATE: 5 FEB 03		REVISED BY	
PREPARED FOR: INDIAN LAKE DAM ASSOCIATION 75 RIDGEMONT OXFORD, MI 48370		DATE	

HANSON ENGINEERING, P.C.
40595 KOPPERNICK ROAD
CANTON, MICHIGAN 48187
Phone: (734) 454-6560 Fax: (734) 454-7423

DRAWING NUMBER: 02071-482-B

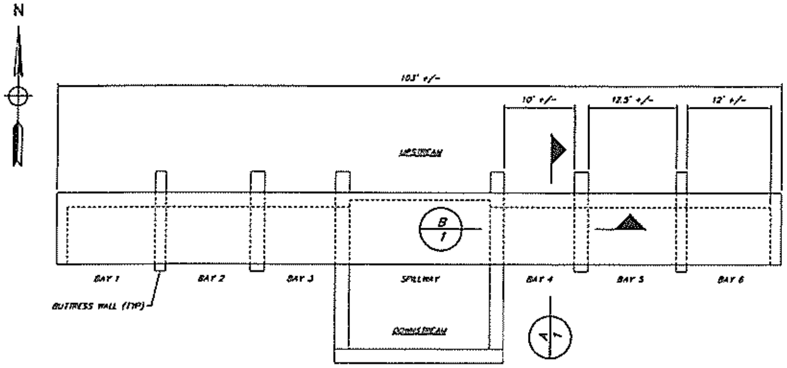


DAM INSPECTION PLAN
INDIAN LAKE DAM
OXFORD, MICHIGAN

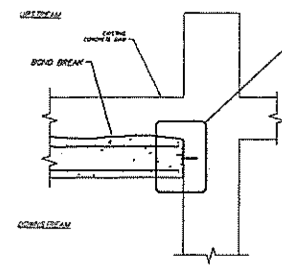
SCALE: AS SHOWN	APPROVED BY: BARNEY L. THOMAS, P.E.	DRAWN BY: KAM
DATE: 5 FEB 03		REVISED BY:
PREPARED FOR: INDIAN LAKE DAM ASSOCIATION 75 RIDGEMONT OXFORD, MI 48370		DATE:

HANSON ENGINEERING, P.C.
40595 KOPPERNICK ROAD
CANTON, MICHIGAN 48187
Phone: (734) 454-6560 Fax: (734) 454-7423

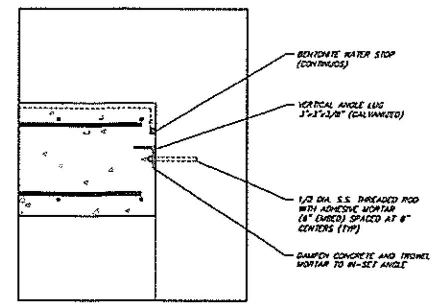
DRAWING NUMBER: 02071-482-A



PLAN VIEW OF DAM
SCALE: 1/8"=1'-0"



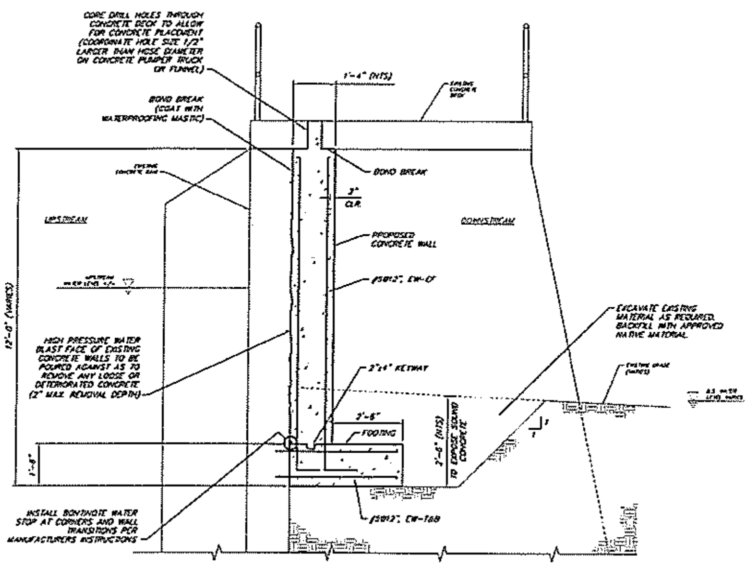
C/1 SECTION
SCALE: 1/2"=1'-0"



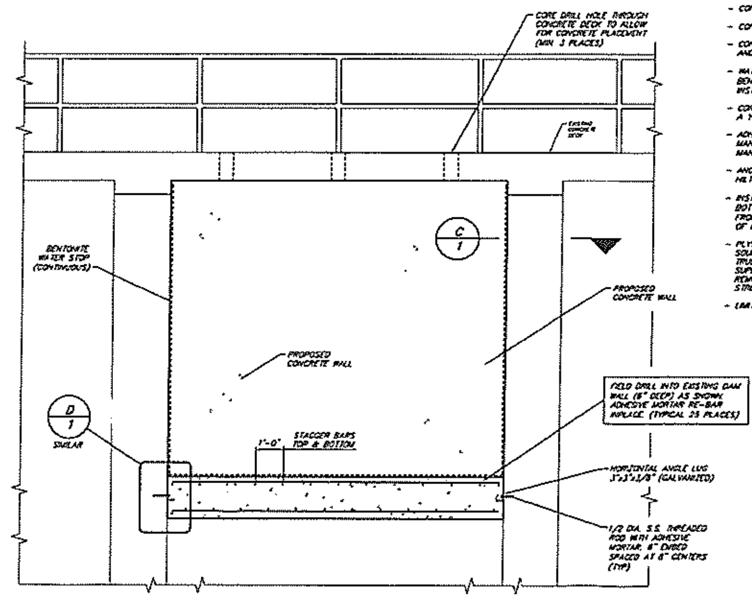
D/1 DETAIL
SCALE: 1 1/2"=1'-0"

CONCRETE AND ACCESSORIES

- ALL CONCRETE WORK SHALL BE PERFORMED IN ACCORDANCE WITH ACI 301 AND ACI 350
- CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3500 PSI AT 28 DAYS
- CONCRETE SHALL HAVE A SLUMP RANGE OF 2"-4"
- CONCRETE SHALL HAVE A AIR CONTENT OF 5%-7% BY VOLUME
- CONTRACTOR SHALL SUBMIT CONCRETE MIX DESIGN TO OWNER FOR REVIEW AND APPROVAL
- WATERSTOP SHALL BE CONTINUOUS 1" x 3/4" STRIPS CONTAINING 75% BENTONITE (WATERSTOP-RX-101 BY "CETCO" OR APPROVED EQUAL) INSTALL PER MANUFACTURERS INSTRUCTIONS
- CONCRETE REINFORCING STEEL SHALL CONFORM TO ASTM A615 AND HAVE A YIELD STRENGTH OF 60 ksi
- ADHESIVE MORTAR SHALL BE THE 2 COMPONENT SYSTEM HIT-HY-150 AS MANUFACTURED BY HILTI (OR APPROVED EQUAL). INSTALL PER MANUFACTURERS INSTRUCTIONS
- ANCHOR RODS SHALL BE HAS-150 THREADED RODS AS MANUFACTURED BY HILTI (OR APPROVED EQUAL)
- INSTALL VERTICAL ANGLE LUGS 6" FROM TOP OF FOOTING TO 6" FROM BOTTOM OF EXISTING CONCRETE DECK. INSTALL HORIZONTAL ANGLE LUGS 6" FROM BACK FACE OF EXISTING CONCRETE DAM WALL TO 6" FROM BACK SIDE OF PROPOSED CONCRETE FOOTING
- PLYWOOD FORM WORK SHALL BE CONSTRUCTED OF 5-PLY DOUGLAS FIR, SOUND SHEETS WITH CLEAN, TRUE EDGES. STEEL FORMS SHALL BE SMOOTH, TRUE AND UNDAMAGED. ALL FORM WORK SHALL BE STIFFENED OR BRACED TO SUPPORT THE WEIGHT OF THE CONCRETE WITH MINIMUM DEFLECTION. DO NOT REMOVE FORMS OR BRACING UNTIL CONCRETE HAS GAINED SUFFICIENT STRENGTH TO CARRY ITS OWN WEIGHT AND IMPOSED LOADS
- LIMIT LOADING ON EXISTING CONCRETE DECK TO 4 TONS.



A/1 SECTION
SCALE: 1/2"=1'-0"



B/1 SECTION (LOOKING UPSTREAM)
SCALE: 1/2"=1'-0"

BY	MARK	REVISIONS	DATE

INDIAN LAKE DAM
OAKLAND COUNTY, MICHIGAN

INDIAN LAKE DAM STRUCTURAL REPAIR DETAILS

Spicer group

DE. BY: MAL CH. BY: MAL
DR. BY: KMT APP. BY: MAL
PROJECT NO. 117401.2011
STDS.
SHEET 1 OF 1
DATE JUNE 2012
SCALE AS SHOWN
FILE NO. DF-1070-01

APPENDIX C

PHOTOGRAPHS

INDIAN LAKE DAM
2013

Upstream Face – Looking south-easterly during drawdown

Upstream Face – Looking south-westerly

INDIAN LAKE DAM
2013

Downstream Spillway – Looking NE prior to spillway patching and sealing

Downstream Spillway – Looking NW prior to spillway patching and removal of temporary siphon tube.

INDIAN LAKE DAM
2013

Deck Core – Typical of 8 cores taken

Typical Newly Constructed Wall – Looking at Bay 2

APPENDIX D

2012 Maintenance Plan

Indian Lake Dam

Condition Evaluation and Recommendations

Prepared For:

Indian Lake Dam Association
75 Ridgemont Road
Oxford, MI 48370

Prepared By:

June 2012

117401SG2011

TABLE OF CONTENTS

INTRODUCTION 2

FIELD EVALUTATION 2
- Field Inspection 2
- Concrete Consistency 3
- Original Sequence of Construction 3
- Evaluation of Repairs and Priorities 3

CONCLUSIONS/RECOMMENDATIONS 4

COST ESTIMATES 5

APPENDIX A
- Photo Documentation

APPENDIX B
- Rebound Hammer Results

APPENDIX C
- Drawing of Typical Bay Wall Replacement

INTRODUCTION

The purpose of this evaluation is to provide a condition assessment and to assist in establishing a long term repair and rehabilitation strategy as there are currently known structural deficiencies that need to be addressed. There is a history of performing regular repairs that seem very temporary and the Association would like to identify what options are available for longer term strategies in those areas as well. At the conclusion the Association needs direction and some guidance as to what the repair or replacement recommendations are and to provide rough estimates of costs.

FIELD EVALUATION

The field evaluation included the following:

1. Field Inspection and documented deterioration using photos **(Appendix A)**
2. Test Concrete Consistency and Strength using a "Rebound Hammer" that estimates the concrete strength from the rebound of a spring loaded piston striking the concrete. The readings, for the purpose of this evaluation, were not for actual concrete strengths, but rather to correlate consistency readings and lower strength readings that may also help predict future deterioration. **(Appendix B).** In addition the concrete was tapped with a hammer (sounded) to identify imminent spalling.
3. Determine probable sequence of construction to better understand where concrete was placed against hardened concrete as these are usually areas of leak and deterioration.
4. Evaluate Constructability and Priority of Structural Repairs as well as preservation repairs.

1. Field Inspection

Included in Appendix A is a methodical photo evaluation of each component of the dam. It is important in any evaluation to document the condition as the rate of additional deterioration is often more important than the actual deterioration as this allows for preventative action to be taken in a timely manner.

In my photo documentation I also included overall results of the rebound test as well as my field inspection comments and a brief overview of what I see as the need for repairs or preventative maintenance. For the main structural walls at each bay I gave my opinion as to the priority for replacement. As noted later in this evaluation the wall replacement is actually adding a new wall adjacent to the existing one. As noted at each evaluated bay....Bay No. 3 and 4 both have a high priority of replacement based on structural concerns with the advanced deterioration and leaking.

The deterioration in the walls is due to moisture/water leaking/leaching through the concrete and being affected by continual cycles of freezing and thawing. This conclusion was confirmed as 12" below the existing ground surface the concrete is not spalled or deteriorated. This also suggests that if earth was placed on the downstream side adjacent to the wall, this freeze thaw deterioration would likely not have been an issue.

2. Concrete Consistency

The results of the rebound hammer are illustrated on the sketches in **Appendix B**. Most of the readings were surprisingly consistent and generally good between 0.40 and 0.50 and the areas with those readings did not show as much deterioration. Bay 3 had the lowest readings of 0.30 and is also recommended for replacement.

The concrete appears to have been mixed and transported in small batches. There are many pour lines that illustrate the placement sequence and procedures. Several locations were noted where it was dumped/dropped at one location where it formed a cone. When they dump the concrete from up high, the concrete paste and stone separate resulting in the familiar honey comb. These areas have less strength and watertightness which is evident by observation of advanced freeze thaw deterioration.

It should also be noted that when an area shows a "spall" it means that the concrete may still be in tact, but sounding it with a hammer identifies that the concrete is separated below the surface.

3. Original Sequence of Construction

Long lasting patching repairs to the main walls of the dam are not feasible with the advanced deterioration, water/moisture migration, and freeze thaw. Long lasting solutions include complete replacement. Partial wall replacement is complicated by not only water control, but also the potential for continual leaking at the "cold joints" (joints where new concrete is poured against old). It is preferred to remove and replace all or portions of the damaged wall; however the risk of the cold joints leaking vs. the cost of replacement must be evaluated. If the existing wall was poured between the buttress walls than the replacement option would likely be preferred.

After inspection in detail of the original form joints and the upstream buttresses and downstream buttresses, I believe that the front (main) wall was cast with the front buttresses, and then the downstream buttresses were poured against the main wall (cold joint). Therefore removal of a portion of that wall will result in additional cold joints where there is not any (noticeable) now. This suggests other replacement strategies should be considered.

4. Evaluation of Repairs and Priorities.

To assist the association with the decision making process for a long term strategy for the dam it is necessary to evaluate the costs over a design life period. If the repairs are intended to last 50 + years with no or minimal annual costs, then the replacement option is likely the preferred option. Replacement cost for the dam would likely be over $1 million. Based on input from the Lake Association a long term plan, and project cost phasing seemed to be a better fit for the funding availability and coupled with the fact that the overall dam is NOT considered to be in poor condition.

While inspecting the dam I subjectively gave priority rating to both the replacement/repair of the structural dam walls in each bay as well as preservation repairs. Clearly complete replacement will offer a longer life span; therefore their needs to be a phased approach to partial repairs/replacements otherwise the complete dam replacement option would be pursued.

My definition of priorities (Low, Medium, High) relate to both structural importance as well as preventative maintenance longevity. Complete replacement adds new life, and maintenance prolongs the life of the existing structure. Below is my subjective rating system:

- Structural Wall Replacement (Anticipated life of replacement > 50 yrs)
  - High – replace within 5 years. (Bay 3 and 4)
  - Medium – replace within 10 years (Bay 2)
  - Low – expect to last 20-50+ years with repairs and freeze thaw protection

- Preventative Maintenance and Repairs (Anticipated life < 20 yrs)
  - High – current open cracks and spalls severely reducing long term life.
  - Medium – preventative maintenance like coatings/sealing that assists in preservation, however a decision could be made that the funding issues may not warrant it. Simply decide to wait until it needs repair.
  - Low – Currently is good condition and the cost of repair or maintenance may not justify any additional longevity at this time.

With my photo documentation in Appendix A I included my opinion as to the priority.

CONCLUSIONS/ RECOMENDATIONS

As the rehabilitation strategy (Prioritizing) is directly related to available funding and the expected time frame for future expenditures. My rating system and estimated life can be used by the Association to at least plan for future costs and can have some level of expectation. As I have not been involved in the history of the deterioration the accuracy of my estimates of repair duration obviously are not certain, but meant as a guide to assist with decision making with no guarantees of actual life. However, based on my 25+ years of experience with similar structures I feel my estimates are reasonable.

Although outside the scope of the original contract, I went ahead and developed a detailed plan for replacement of a typical Bay wall. The replacement detail strategy was made based on the above evaluation to stabilize the existing wall, coat with a mastic sealer, and construct an new wall adjacent to it. See **Appendix C** for the drawing and details.

In addition I also obtained a quote from an experienced, reputable, and reasonably pricing concrete contractor familiar with working on dams (Wobig Construction, Company out of Saginaw) to replace the walls. The quote is $24,000 for one wall and $11,000 for each additional wall constructed at the same time (Note: Due to access issues they plan to hand dig, and use smaller powered concrete buggies).

COST ESTIMATES

Below is my assessment of priorities for needed work with associated rough costs (other than the quote for the walls).

Priority 1 – Restore Structural Integrity of Walls (within 2 years)

- Minimum – Replace Bay 3, Bay 4 $35,000
- Recommended – Replace Bay 2, 3 and 4 $46,000 (recommend)
  (Note: Bay 2 is expected to last another 10 yrs without replacement unless freeze thaw is prevented)

Priority 2 - Repairs (Repair new cracks and spalling)

- Repair Cracks and Spalls

a.	High Pressure Wash/Remove Deterioration	$5,000
b.	Repair Cracks and Spalls	$15,000

Priority 3 – Add Preventative Maintenance Sealer

a.	Seal from Sika Corporation est. $1-2/sft	$15,000
b.	Repair Railing/Bases and Coat	$5,000

Priority 4 - Add Freeze Thaw Protection Bay 1, 5, 6 and partial for 2, 3, 4

a.	Freeze Thaw Protection	$30,000

Priority 5 - Replace Deck (Note: Existing Deck will likely last another 20 yrs)

a.	Remove Existing Deck	$50,000
b.	Construct New Deck (10'wide)	$150,000

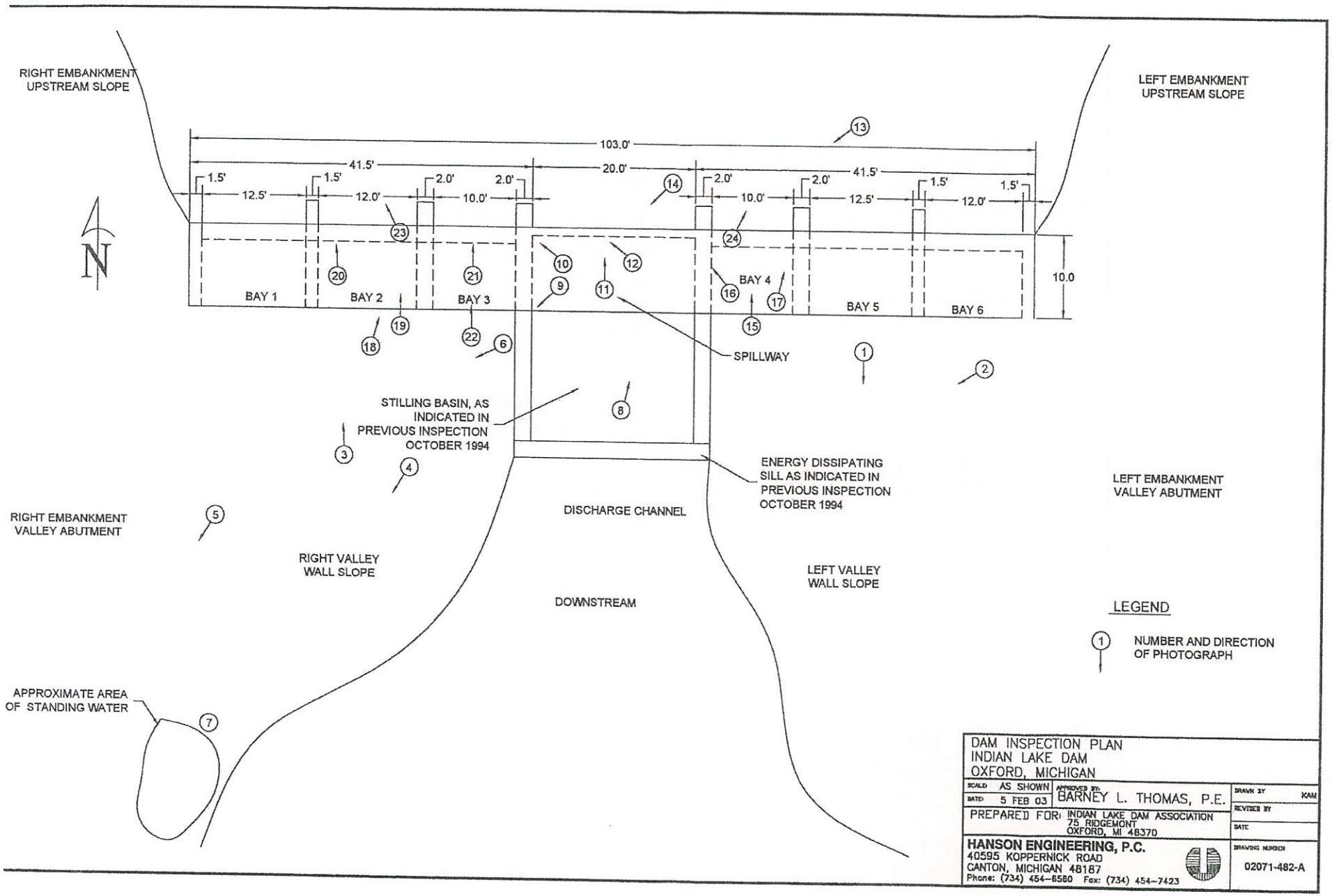
NOTES:

1. The cost estimates are rough estimates and are intended for general budgeting strategies. Prior to formalizing or approving a budget, more detailed estimates or actual contractor quotes should be obtained, similar to the concrete wall replacement.

2. BEFORE ANY WORK IS PERFORMED A PERMIT FROM MDEQ – DAM SAFETY UNIT IS REQUIRED.

Appendix A

Photo Documentation

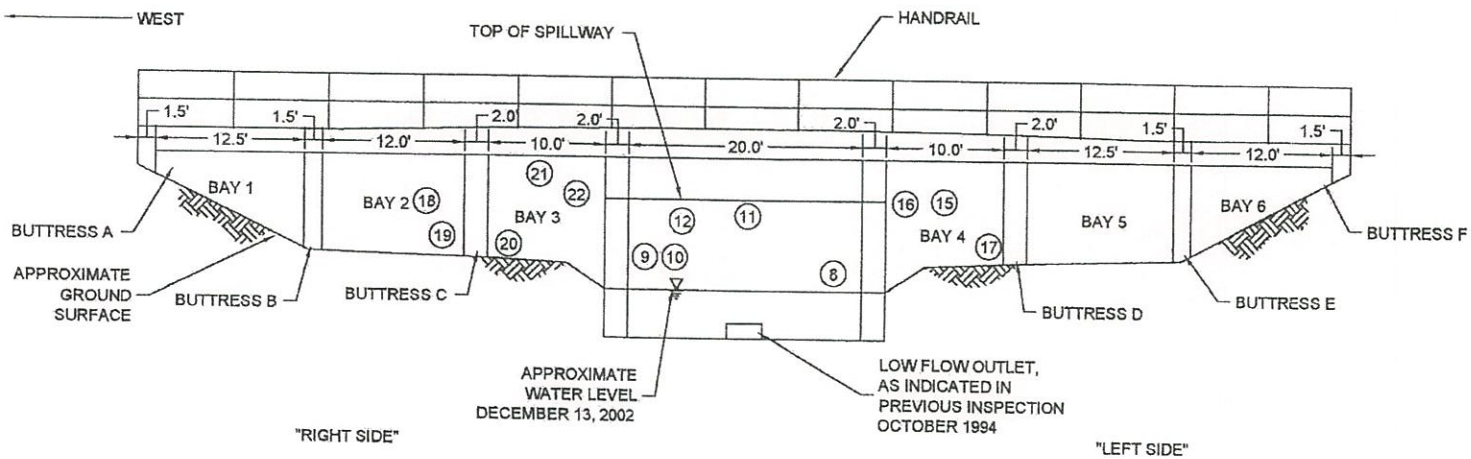


DAM INSPECTION PLAN
INDIAN LAKE DAM
OXFORD, MICHIGAN

SCALE: AS SHOWN	APPROVED BY: BARNEY L. THOMAS, P.E.
DATE: 5 FEB 03	DRAWN BY: KAM
PREPARED FOR: INDIAN LAKE DAM ASSOCIATION, 75 RIDGEMONT, OXFORD, MI 48370	REVISED BY:
	DATE:

HANSON ENGINEERING, P.C.
40595 KOPPERNICK ROAD
CANTON, MICHIGAN 48187
Phone: (734) 454-6560 Fax: (734) 454-7423

DRAWING NUMBER: 02071-482-A



ELEVATION VIEW
SCALE: NONE

LEGEND

(1) NUMBER AND LOCATION OF PHOTOGRAPH

DAM INSPECTION ELEVATION VIEW
INDIAN LAKE DAM
OXFORD, MICHIGAN

SCALE: AS SHOWN
DATE: 5 FEB 03
APPROVED BY: BARNEY L. THOMAS, P.E.
DRAWN BY: KAM
REVISED BY:
DATE:

PREPARED FOR: INDIAN LAKE DAM ASSOCIATION
75 RIDGEMONT
OXFORD, MI 48370

HANSON ENGINEERING, P.C.
40595 KOPPERNICK ROAD
CANTON, MICHIGAN 48187
Phone: (734) 454-6560 Fax: (734) 454-7423

DRAWING NUMBER: 02071-482-B

INDIAN LAKE DAM
OXFORD, MI
2012

BAY 1

Observations:

1. Poor Cone with Consolidation Issues at Lower Portion
2. Rust stains, however no spalling concrete, therefore likely from form ties.
3. No freeze thaw spalling which suggests minimal if any water leaking.
4. Buttress walls in good condition
5. Deck fascia has minor spalling and deterioration
6. Concrete Strength Uniform with an average reading of 0.40

Wall Repair Recommendation:

1. Low to Medium Priority for wall replacement
2. If not replaced insulate to reduce future freeze thaw

.

BAY 2

Observations:

1. Discoloration is a combination of prior patching and pour lines suggesting poor consolidation
2. Existing Patch is in Fair Condition.
3. Buttress Walls are in good condition.
4. Deck fascia has minor spalling and deterioration
5. Three 1'-2' long hairline cracks noted with some efflorescence.
6. Concrete Strength Left Half = 0.50, Right Half=0.40.

Wall Repair Recommendation:

1. Medium Priority for wall replacement
2. If not replaced insulate to reduce future freeze thaw

.

BAY 3

Observations:

1. Discoloration is a combination of prior patching and pour lines suggesting poor consolidation
2. Spalling area 4'x 4' at lower left corner..
3. Left buttress wall in good condition
4. Right buttress/slope wall of spillway has an area 4'x4' with imminent spall. Previously grouted cracks in generally good condition.
5. Deck fascia has minor spalling and deterioration
6. Concrete Strength Left Half = 0.40, Right Half=0.30. Suggesting lower strength

Wall Repair Recommendation:

1. **High Priority** for wall replacement
2. Repair Wingwall – Sawcut around spall 1" deep, remove unsound concrete, patch spall, repair cracks, and add sealer using Sika Brand Materials as recommended by Sika Corporation

.

BAY 4

Observations:

1. Severe Freeze Thaw spalling and moisture leaking.
2. Prior recent patching accelerated the freeze thaw by trapping moisture.
3. Concrete 12" down below soil grade is in good condition.
4. Buttress walls in generally good condition, small horizontal crack with efflorescence on west buttress wall
5. Deck fascia has minor spalling and deterioration
6. Concrete Strength Upper 2' = 0.50, Lower =0.00. Buttress Ave=0.45

Wall Repair Recommendation:

1. **High Priority** for wall replacement
2. Low to Medium Repair Wingwall – Sawcut around any spalls 1" deep, remove unsound concrete, patch spall, repair cracks, and add sealer using Sika Brand Materials as recommended by Sika Corporation

.

BAY 5

Observations:

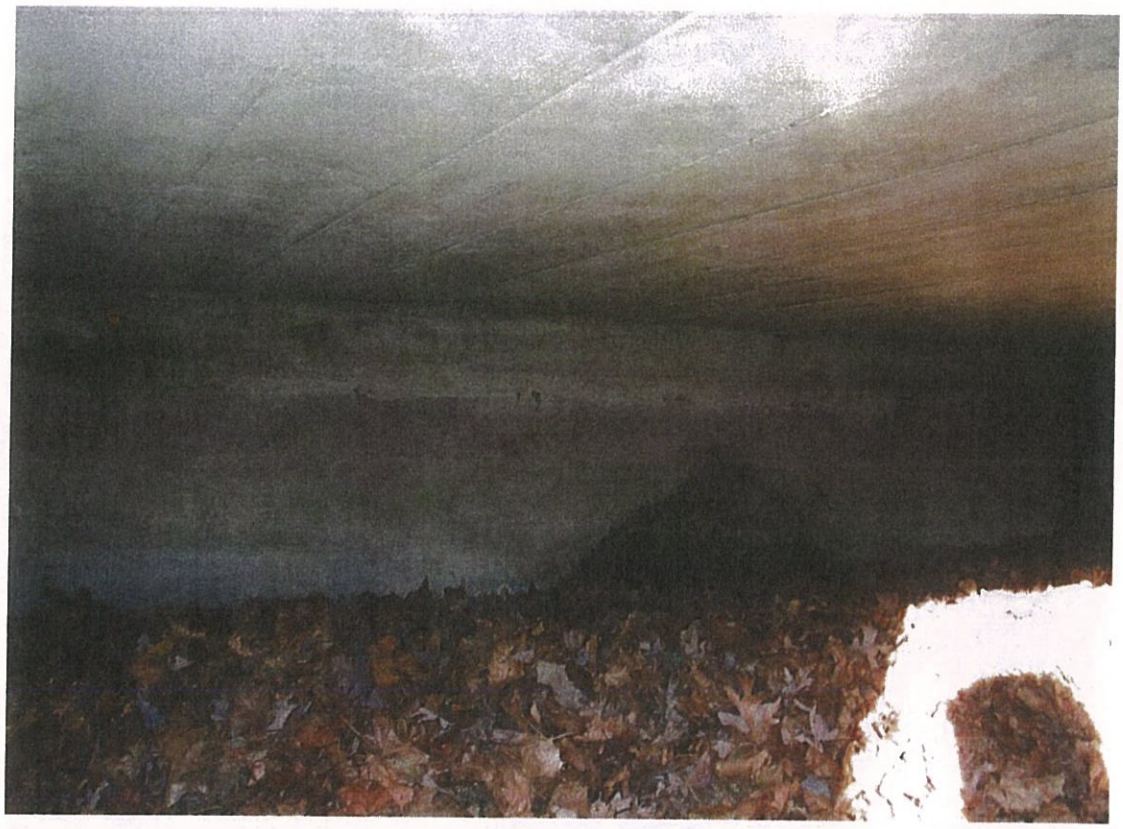
1. Discoloration is a combination of prior patching and pour lines
2. Concrete is in generally good condition except the lower left portion has a couple diagonal cracks with some efflorescence staining.
3. Concrete it in good condition 12" below grade at the lower left location
4. Buttress walls are in good condition
5. Concrete Strength Average =0.48.

Wall Repair Recommendation:

1. Low to Medium Priority for wall replacement
2. If not replaced insulate to reduce future freeze thaw

.

BAY 6



Observations:

1. Concrete in generally good condition.
2. There is a spall that is 2'high x 5' long. And is relatively shallow with little accelerated freeze thaw spalling around it.
3. The spall follows a pour cone discoloration area with noticeable unconsolidated concrete.
4. Buttress walls are in good condition .
5. Deck fascia has minor spalling and deterioration
6. Concrete Strength Average = 0.46

Wall Repair Recommendation:

1. Low Priority for wall replacement
2. If not replaced insulate to reduce future freeze thaw

.

SPILLWAY WIINGWALLS

Observations:

1. The wingalls are in generally fair condition. Previous crack repairs are in generally good condition.
2. There are some areas of continual deterioration and spalling especially near the low water line.
3. Deck facia is deteriorating and spalling.
4. Concrete Strength Average = 0.45

Repair Recommendations:

1. Low to Medium Priority for wall replacement
2. Medium Priority for wall and deck repairs
3. Repairs: Sawcut around any spalls 1" deep, remove unsound concrete, patch spall, repair cracks, and add sealer using Sika Brand Materials as recommended by Sika Corporation

SPILLWAY

Observations:

1. The spillway appears to have a vertical structural wall with the sloped spillway mainly to redirect water and not as a structural element.
2. The concrete of the sloped spillway is in generally good sound condition especially for its age. Only a few small areas of localized deterioration, which are along the pour lines and along the upper portion adjacent to the spillway crest.
3. The spillway vertical structural wall could not be observed, however the visible portions appeared to be in good condition.

Repair Recommendations:

1. Very Low Priority for wall replacement
2. Lop Priority for sloped wall repairs, however the upper spillway crest portion needs to be monitored and inspected without water flowing over it. Some minor patching repairs at that time may be warranted.

UPSTREAM FACE

Observations:

1. The wall and short front buttresses appear to have been poured monolithic (at the same time). It then makes sense that the downstream buttresses were poured against the dam face wall which is what the cold joints suggest.
2. The walls are in generally fair condition at and above the waterline. The buttress walls are in fair condition except the cap portions are in poor condition. It was noted by local resident that the front wall of Bay 4 had a horizontal section of deteriorated concrete. This is consistent with the poor condition and water/moisture migration through that bay.
3. There are some areas of continual deterioration and spalling especially near the low water line.
4. Deck facia is deteriorating and spalling.

Repair Recommendations:

1. Low Priority for wall replacement as new walls will be placed behind
2. Medium to High Priority for wall, buttress and deck repairs.
3. Repairs: Sawcut around any spalls 1" deep, remove unsound concrete, patch spall, repair cracks, and add sealer using Sika Brand Materials as recommended by Sika Corporation

DECK AND RAILINGS

Observations:

1. Top concrete surfaces are in generally fair condition with some pitting.
2. Top bituminous surface at west approach should be removed (if not already done)
3. The railings are deteriorating at the concrete interface. The railings are still able to support significant loading noting that deck is closed to pedestrian traffic.
4. Deck facia is deteriorating and spalling.

Repair Recommendations:

1. Medium Priority for deck repairs and preventative maintenance
2. Low to Medium Priority for railing repairs.
3. Repairs: Sawcut around any spalls 1" deep, remove unsound concrete, patch spall, repair cracks, and add sealer using Sika Brand Materials as recommended by Sika Corporation. Clean and coat the lower 3" of the railing posts....long term repairs would include replacement of the post bases or complete rail replacement.

Appendix B

Rebound Hammer Results

Spicer group
ENGINEERS SURVEYORS PLANNERS
OFFICE LOCATIONS
SAGINAW, MI
ST. JOHNS, MI
DETROIT, MI
CARO, MI
TEMPE, AZ
HEADQUARTERS
230 S. WASHINGTON AVE.
SAGINAW, MI 48607
989.754.4717
800.833.0062
Fax 989.754.4440

Project _____ Sheet # _____ of _____

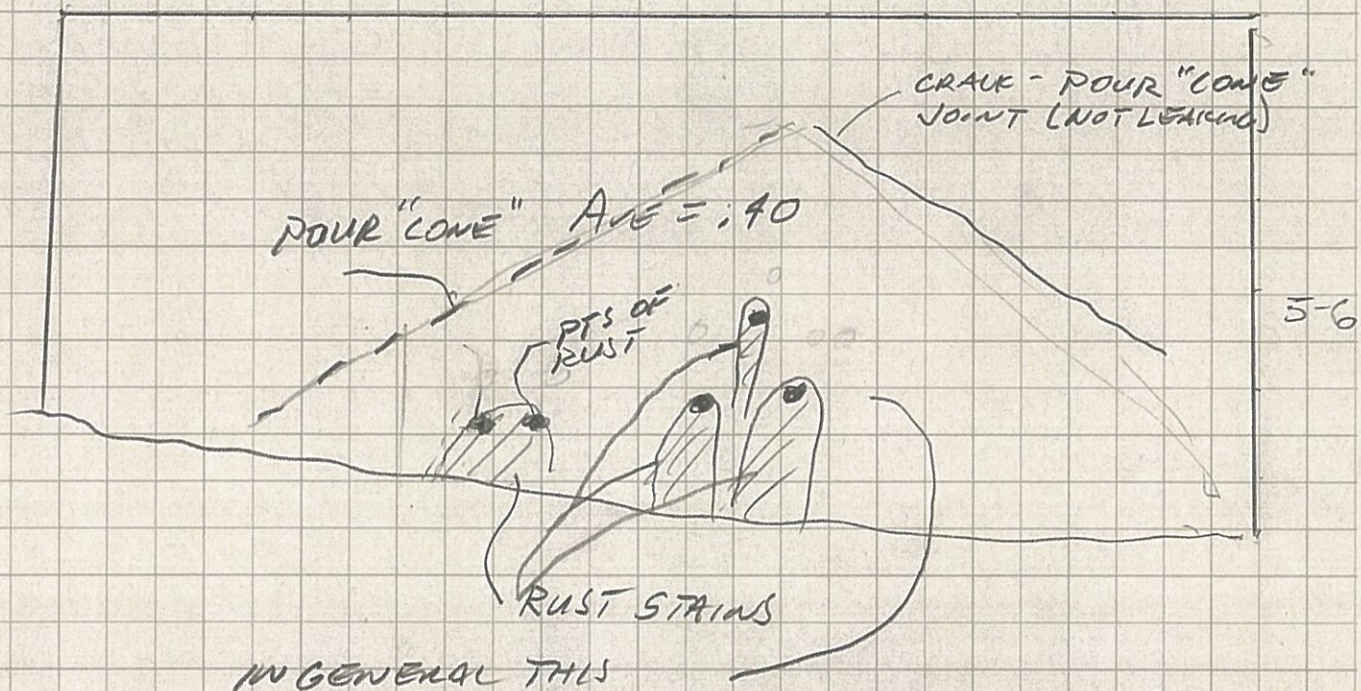
Project # _____

Subject _____ Comp. by _____ date _____

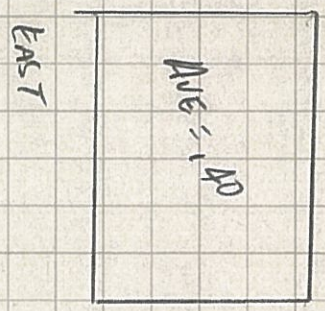
Chkd. by _____ date _____

BAY 1 Rvsd. by _____ date _____

12.5'



IN GENERAL THIS AREA IS DEFINED BY UPPER POUR COLOR PYRAMID RUST AREA DUE TO ISSUES WITH CONSOLIDATION. NO SPALLING SUGGESTS MINIMAL IF ANY WATER LEAKING.



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800.833.0062
Fax 989.754.4440

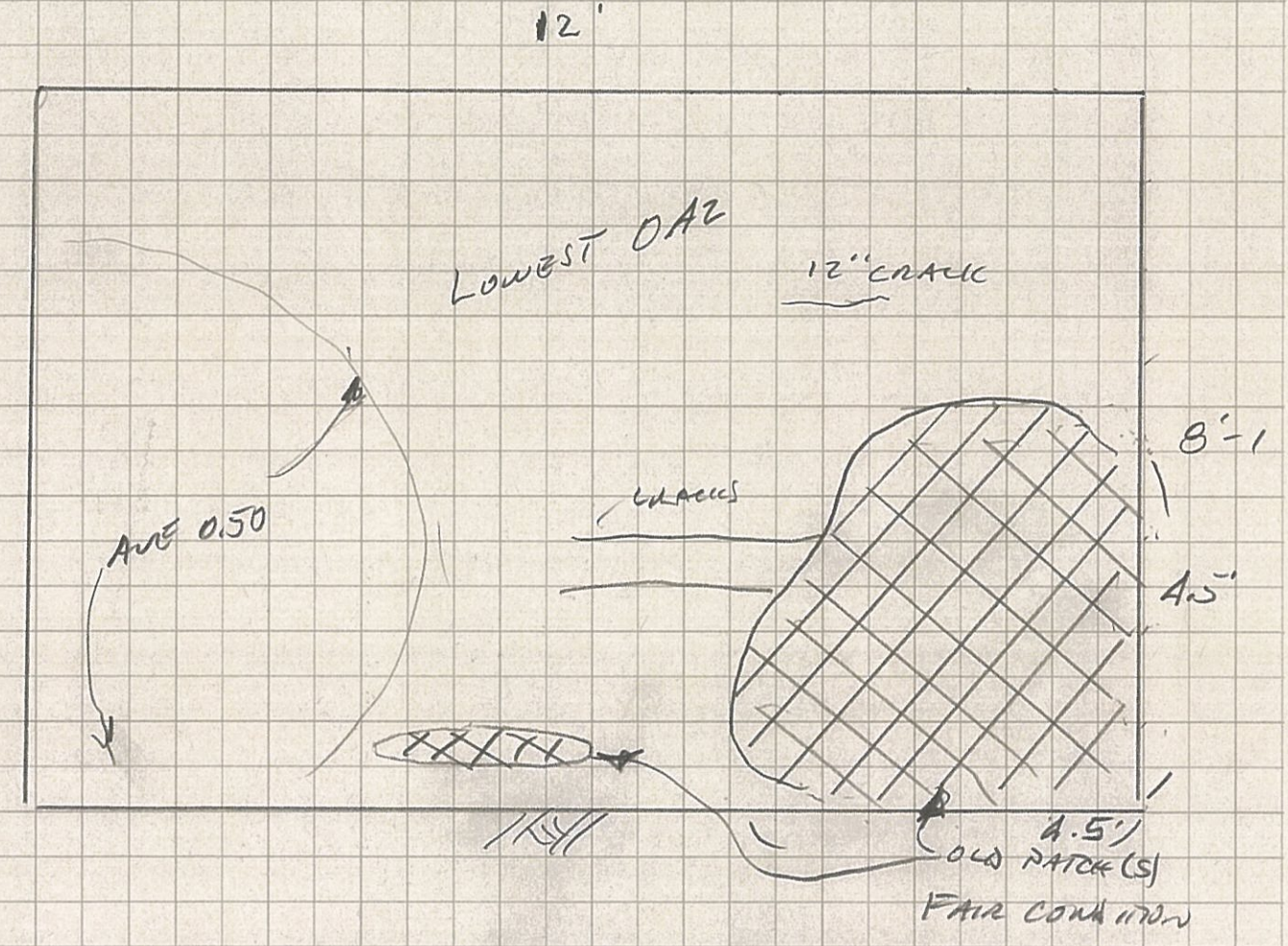
Project _____ Sheet # _____ of _____

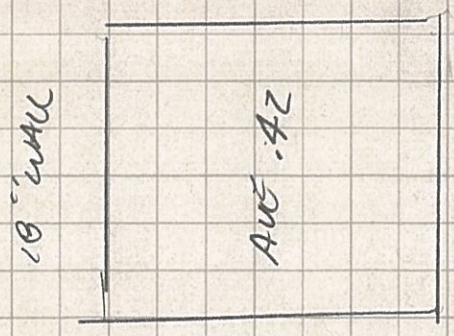
Project # _____

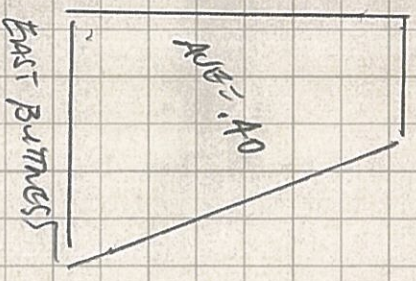
Subject _____ Comp. by _____ date _____

Chkd. by _____ date _____

BAY 2 Rvsd. by _____ date _____







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Caro, MI
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230 S. Washington Ave.
Saginaw, MI 48607
989.754.4717
800.833.0062
Fax 989.754.4440

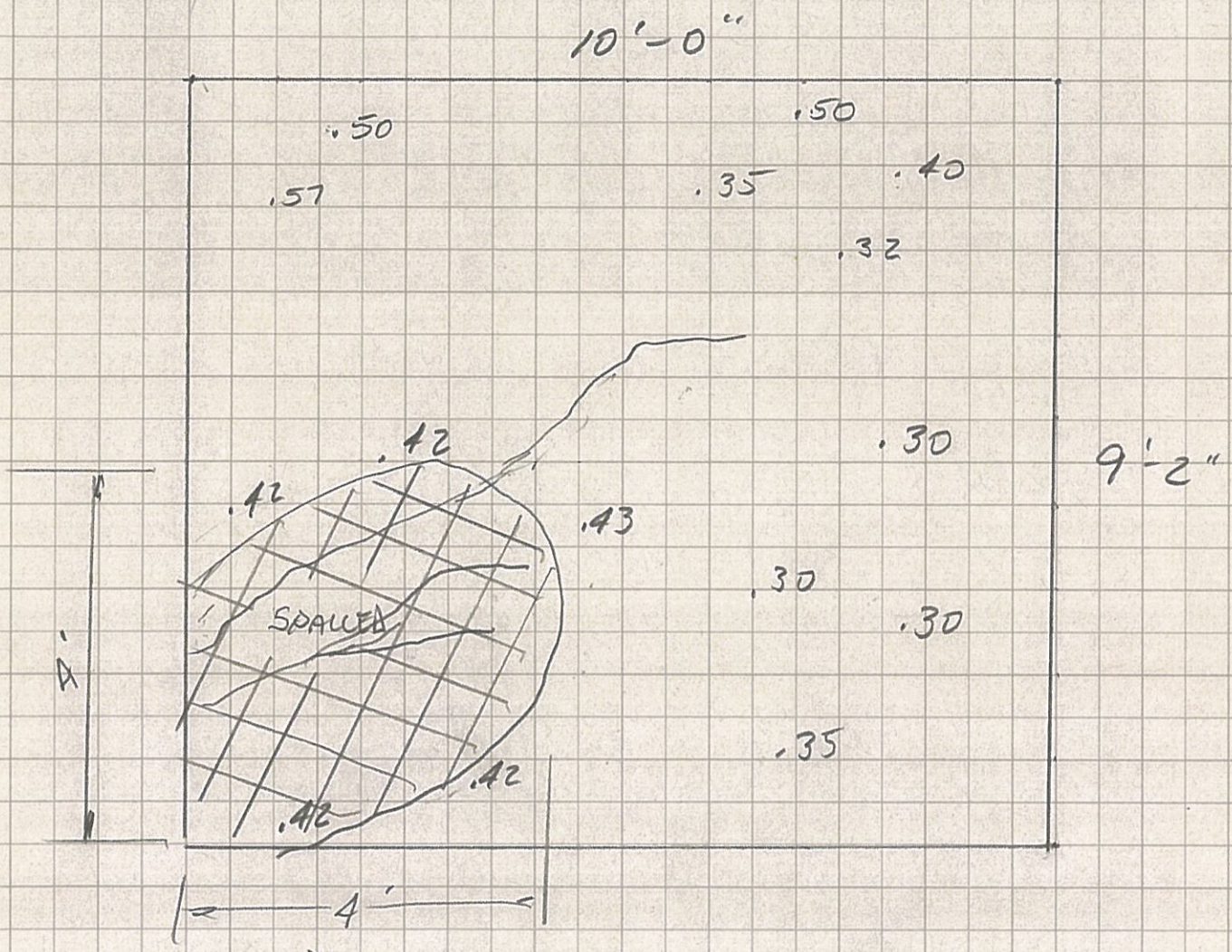
Project _____ Sheet # _____ of _____

Project # _____

Subject _____ Comp. by _____ date _____

Chkd. by _____ date _____

BAY 3 Rvsd. by _____ date _____



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Project _____ Sheet # _____ of _____

Project # _____

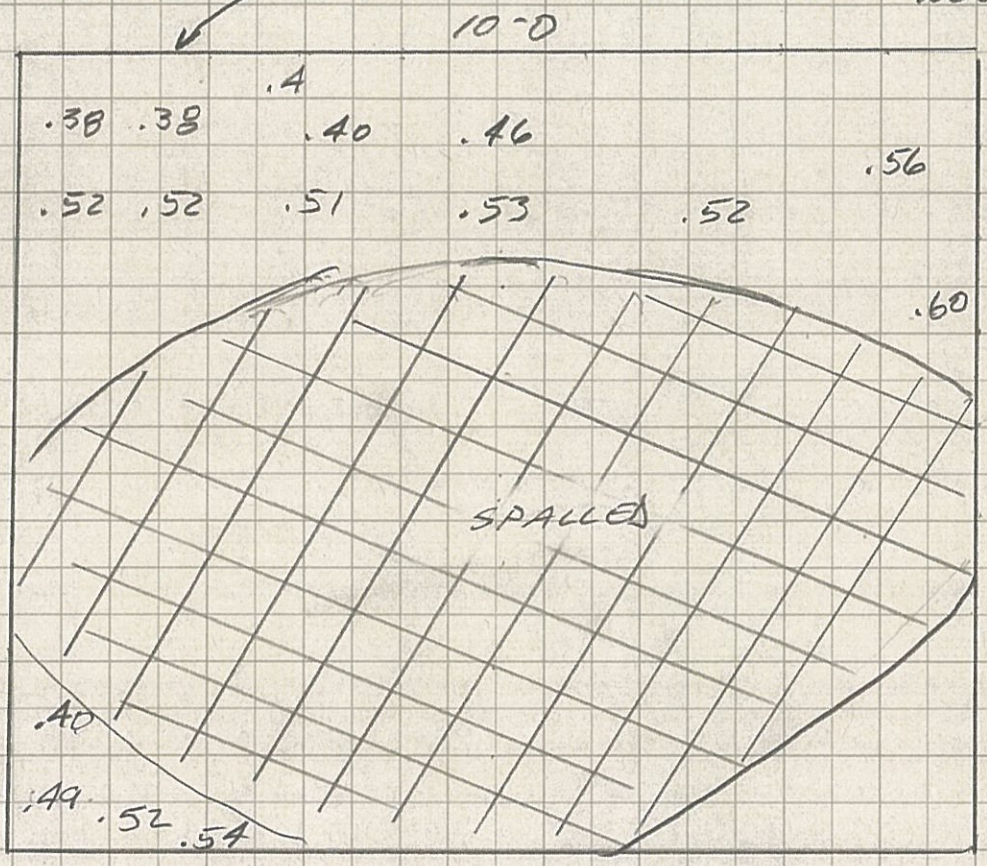
Subject _____ Comp. by _____ date _____

Chkd. by _____ date _____

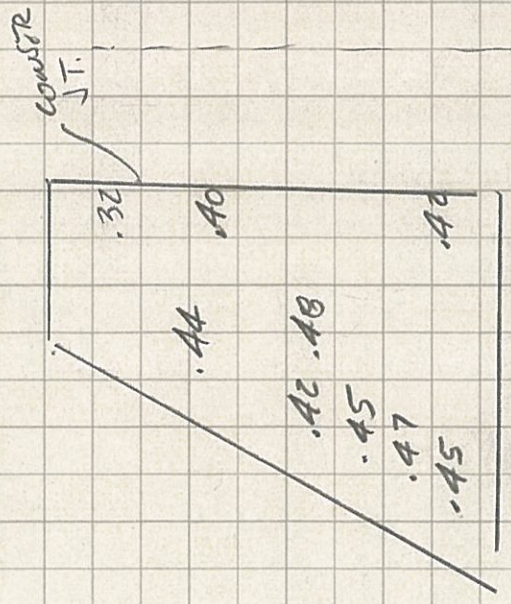
BAY 4 Rvsd. by _____ date _____

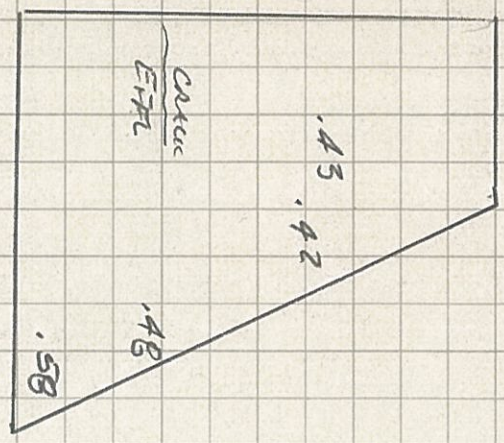
CONC REBOUND HAMMER RESULTS.

CEILING (AVE .50)



GOOD CONC





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Office Locations
Saginaw, MI
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Headquarters
230 S. Washington Ave.
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989.754.4717
800.833.0062
Fax 989.754.4440

Project _____ Sheet # _____ of _____

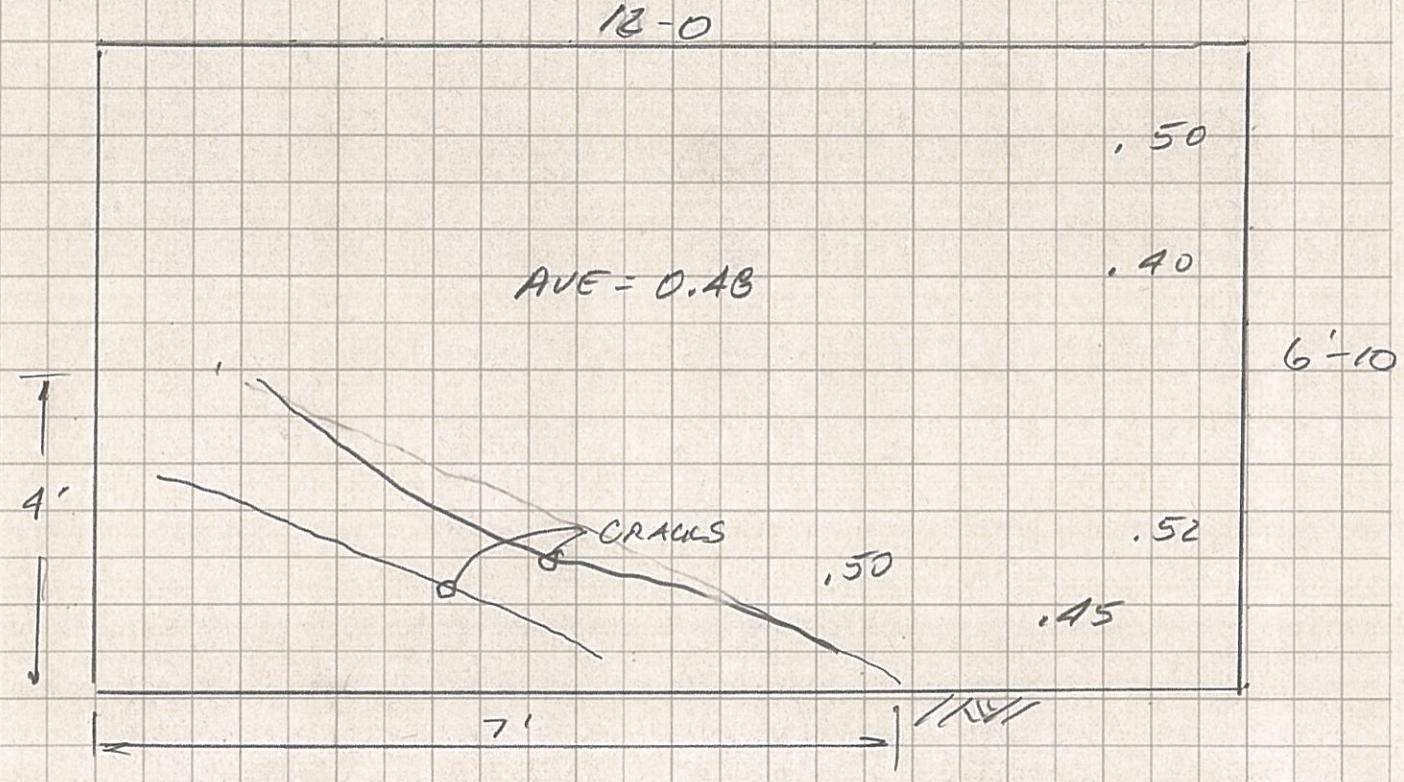
Project # _____

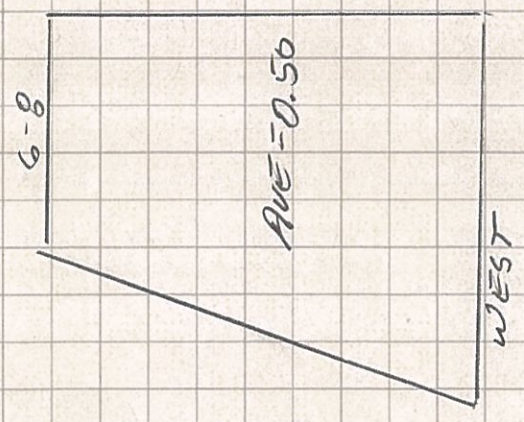
Subject _____ Comp. by _____ date _____

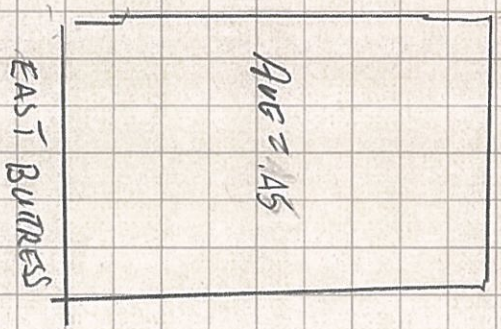
Chkd. by _____ date _____

BAY 5 Rvsd. by _____ date _____

CEILING = .50 +







Spicer group
ENGINEERS SURVEYORS PLANNERS
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Project _____ Sheet # _____ of _____

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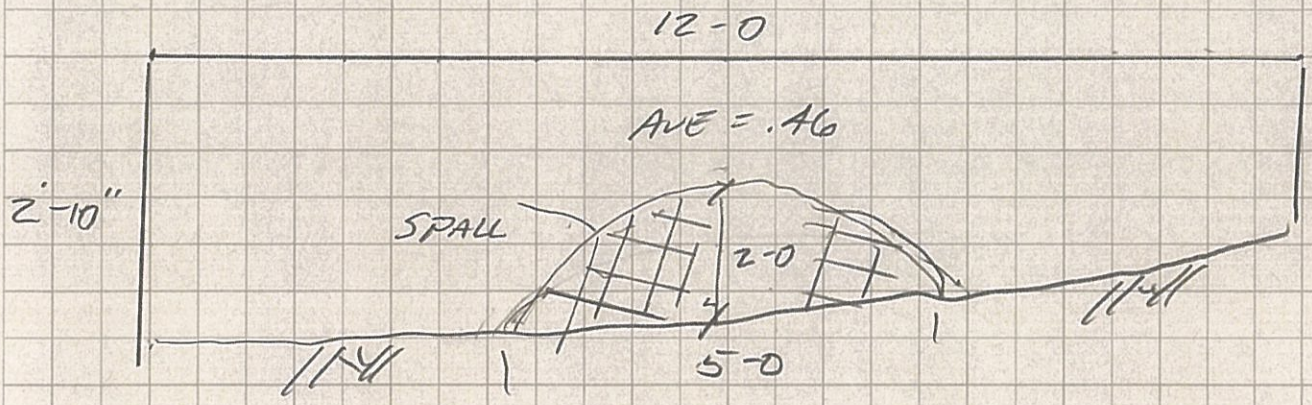
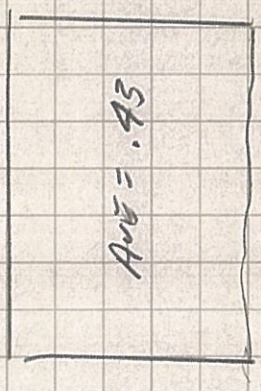
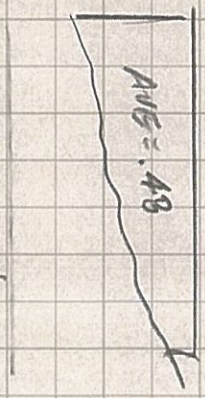
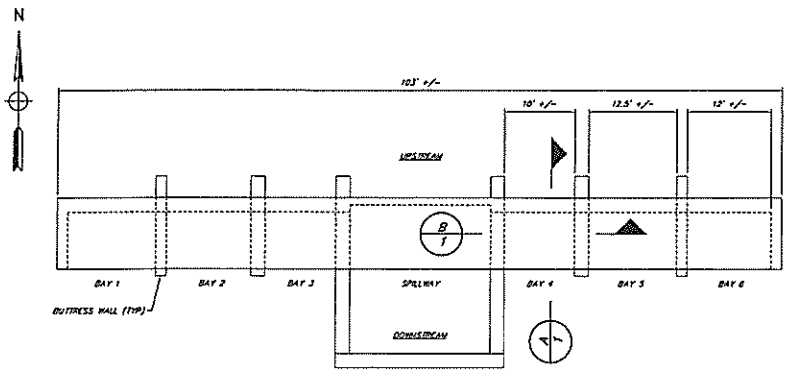




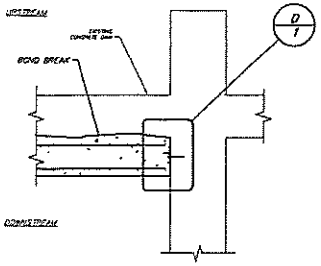


Appendix C

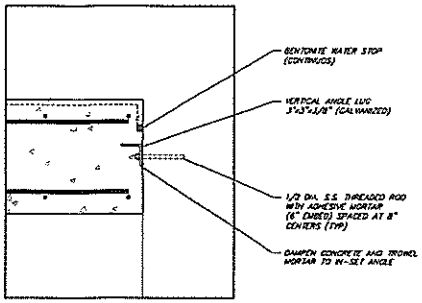
Drawing of Typical Bay Wall Replacement



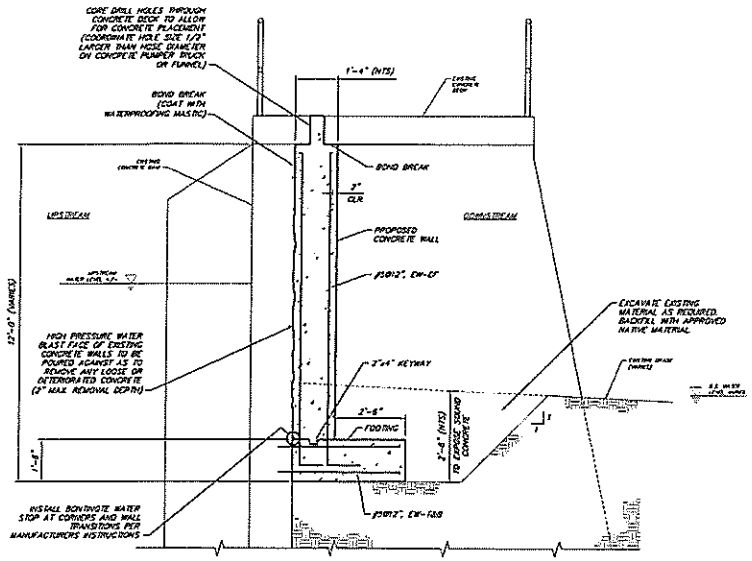
PLAN VIEW OF DAM
SCALE: 1/8"=1'-0"



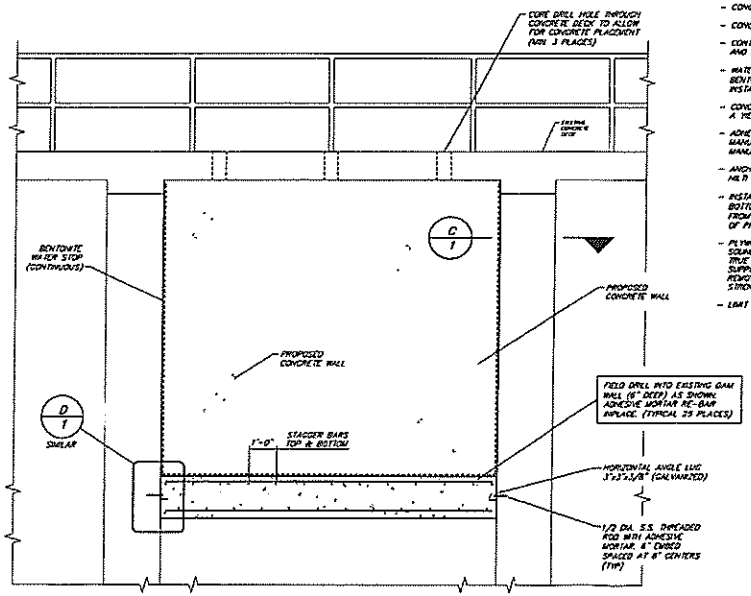
C / 1 SECTION
SCALE: 1/2"=1'-0"



D / 1 DETAIL
SCALE: 1 1/2"=1'-0"



A / 1 SECTION
SCALE: 1/2"=1'-0"



B / 1 SECTION (LOOKING UPSTREAM)
SCALE: 1/2"=1'-0"

CONCRETE AND ACCESSORIES

- ALL CONCRETE WORK SHALL BE PERFORMED IN ACCORDANCE WITH ACI 301 AND ACI 350
- CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF 3500 PSI AT 28 DAYS
- CONCRETE SHALL HAVE A SLUMP RANGE OF 3"-4"
- CONCRETE SHALL HAVE A AIR CONTENT OF 5%-7% BY VOLUME.
- CONTRACTOR SHALL SUBMIT CONCRETE MIX DESIGN TO OWNER FOR REVIEW AND APPROVAL
- WATERSTOP SHALL BE CONTINUOUS 1" x 3/4" STRIPS CONTAINING 75% BENTONITE (WATERSTOP-RX-101 BY "CETCO" OR APPROVED EQUAL) INSTALL PER MANUFACTURERS INSTRUCTIONS.
- CONCRETE REINFORCING STEEL SHALL CONFORM TO ASTM A615 AND HAVE A YIELD STRENGTH OF 60 ksi.
- ADHESIVE MORTAR SHALL BE THE 2 COMPONENT SYSTEM HIT-HY-150 AS MANUFACTURED BY HILTI (OR APPROVED EQUAL) INSTALL PER MANUFACTURERS INSTRUCTIONS.
- ANCHOR RODS SHALL BE HAS-150 THREADED RODS AS MANUFACTURED BY HILTI (OR APPROVED EQUAL)
- INSTALL VERTICAL ANGLE LUGS 6" FROM TOP OF FOOTING TO 6" FROM BOTTOM OF EXISTING CONCRETE DECK. INSTALL HORIZONTAL ANGLE LUGS 6" FROM BACK FACE OF EXISTING CONCRETE DAM WALL TO 8" FROM BACK SIDE OF PROPOSED CONCRETE FOOTING
- PLYWOOD FORM WORK SHALL BE CONSTRUCTED OF 5-PLY DOUGLAS FIR, SOUND SHEETS WITH CLEAN, TRUE EDGES. S.T.&G. FORMS SHALL BE SMOOTH, TRUE AND UNDAMAGED. ALL FORM WORK SHALL BE STIFFENED OR BRACED TO SUPPORT THE WEIGHT OF THE CONCRETE WITH MINIMUM DEFLECTION. DO NOT REMOVE FORMS OR BRACING UNTIL CONCRETE HAS GAINED SUFFICIENT STRENGTH TO CARRY ITS OWN WEIGHT AND IMPOSED LOADS.
- LIMIT LOADING ON EXISTING CONCRETE DECK TO 4 TONS.

BY	MARK	REVISIONS	DATE

THE WORK REPRESENTED BY THIS DRAWING WAS PERFORMED BY THE ENGINEER FOR THIS SPECIFIC APPLICATION AND SPECIFIC LOCATION DESCRIBED HEREIN IN ACCORDANCE WITH THE CONDITIONS PREVALENT AT THE TIME THE WORK WAS MADE. THE ENGINEER DOES NOT WARRANT THAT THIS TEST IS VALID FOR ANY OTHER LOCATION, CONDITION, DESIGN OR PURPOSE.

INDIAN LAKE DAM
OAKLAND COUNTY, MICHIGAN

INDIAN LAKE DAM STRUCTURAL REPAIR DETAILS

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DE. BY: MAL	CH. BY: MAL	PROJECT NO.	
DR. BY: KMT	APP. BY: MAL	117401.2011	
STDS.		SHEET 1 OF 1	
DATE: JUNE, 2012		FILE NO.	
SCALE: AS SHOWN		DF-1070-01	

PLOTTING SCALE
PEN
FILL
ACTUAL