GLENWOOD, IOWA

AQUATIC CENTER WATER LOSS INVESTIGATION PRESENTATION

APRIL 29, 2025

Presented by: Jordan Wiegand, Mechanical Engineer

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BACKGROUND

1. Pool first opened in 2017;
2. Closed in 2022 due to broken fittings and water loss;
3. Noticeable slab settlement in mechanical area ;
4. Deep end pool joints resealed and broken fittings replaced - April 2023;
5. Additional leaks discovered and repaired – May 2023;
6. Water feature outlet pipe leak discovered – June 2023;
7. 20,000 gallon/day (3.5”) water loss reported – Start of 2024

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INVESTIGATION OBJECTIVES

Step 1 - Locate sources of water loss

Step 2 - Develop a comprehensive repair plan

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EVALUATION/ASSESSMENT APPROACH

1. Eagle Engineering Group
   a. City Engineer for Glenwood
      i. Elevation measurements
2. Burbach Aquatics, Inc. (BAI)
   a. Architect and Engineer
      i. Vessel and System Assessment
3. Ricchio Construction, Inc.
   a. Mechanical Contractor
      i. Dye Testing
      ii. Pipe Pressure Testing
      iii. Concrete Extraction
4. Albertson Engineering (AE)
   a. Structural Engineer
      i. Ground Penetrating Radar Investigation
      ii. Structural design review
5. Chosen Valley Testing (CVT)
   a. Geotechnical Engineer
      i. Soil boring and testing

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DYE TESTING (RICCHIO/BAI) 9-3-24

PROCEDURE

- Pool full
- Turned off pumps
- Extracted joint filler (Caulk)
- Prepped syringes with fluorescent dye
- Inject dye near exposed joint
- Record dye travel

Video: Location 5-1 Showing High Dye/Water Loss

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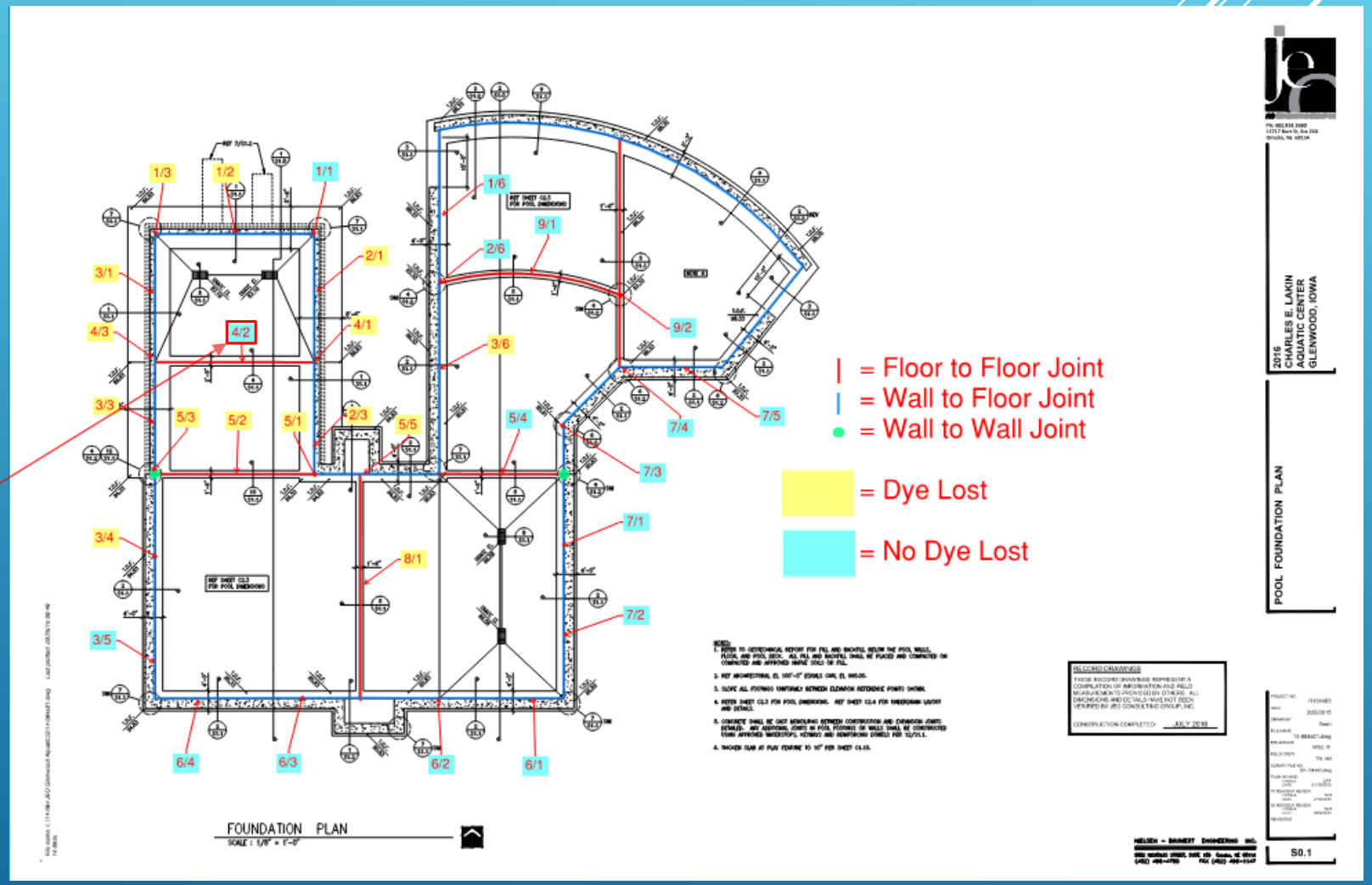
DYE TESTING (RICCHIO/BAI) 9-3-24

FINDINGS

- Dye escaped at most test locations in depths of 5 feet or greater.
- Four additional locations noted in shallow areas

*Note condition



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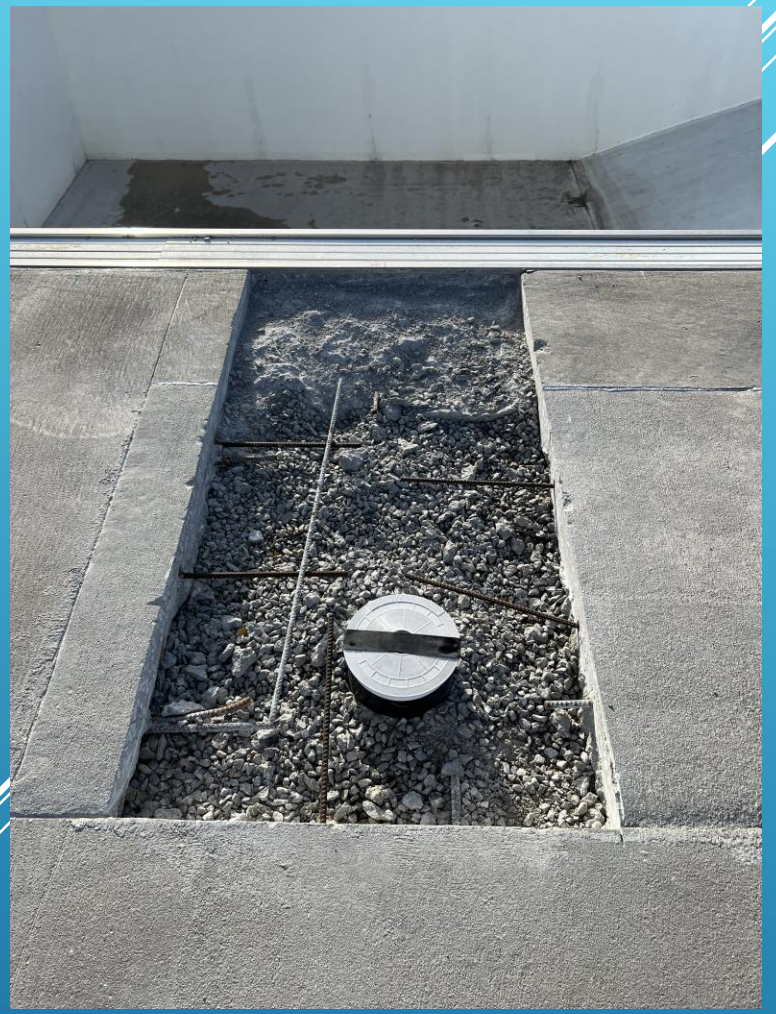
PIPE PRESSURE TESTING (RICCHIO) 10-5-24

PROCEDURE

- Empty pool
- Plug and pressure test pipes
  - Drain outlets
  - Water features
  - Floor inlets
  - Wall inlet water supply (Removed deck, installed test port)
- Static water test pool gutter system
- Index and document



Deck removal and new test port (1/3)

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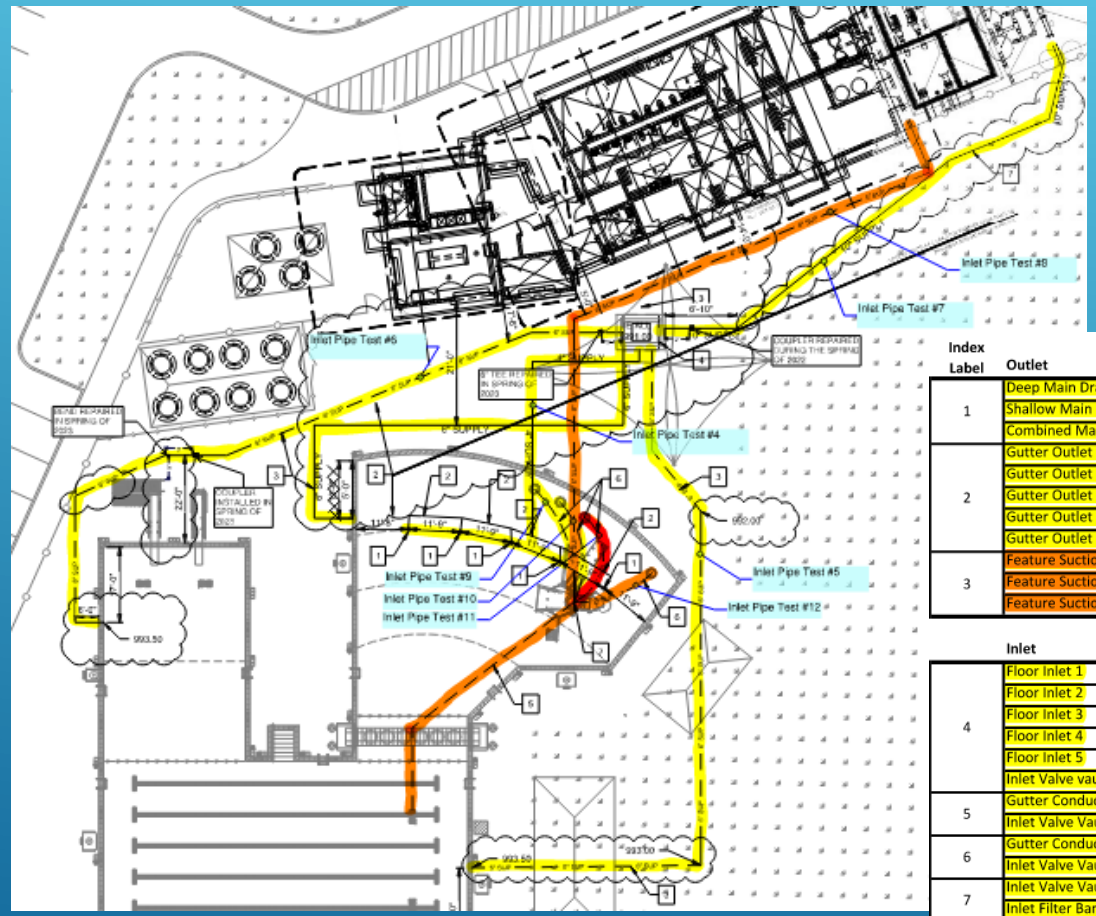
PIPE PRESSURE TESTING (RICCHIO) 10-5-24

FINDINGS



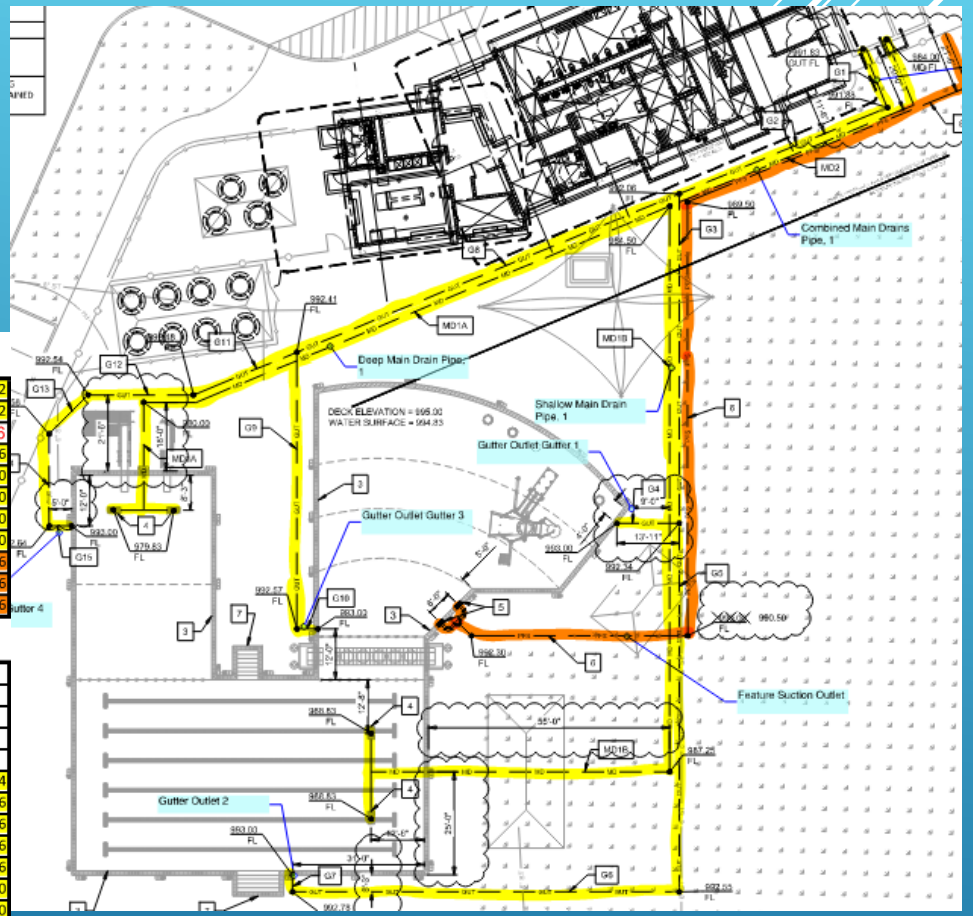
Supply piping

Yellow - Pass
Orange - Leak
Red – No Pressure

Index Label	Outlet	Test Port Dia
1	Deep Main Drain Pipe	12
	Shallow Main Drain Pipe	12
	Combined Main Drains Pipe	TBD 16
2	Gutter Outlet Surge Tank 1	16
	Gutter Outlet Gutter 1	10
	Gutter Outlet Gutter 2	10
	Gutter Outlet Gutter 3	10
	Gutter Outlet Gutter 4	10
3	Feature Suction Pipe Pump Connection	6
	Feature Suction Pipe Wall Connection 1	6
	Feature Suction Pipe Wall Connection 2	6

Index Label	Inlet	
4	Floor Inlet 1	TBD
	Floor Inlet 2	TBD
	Floor Inlet 3	TBD
	Floor Inlet 4	TBD
	Floor Inlet 5	TBD
	Inlet Valve vault	4
5	Gutter Conductor Lap Pool East	6
	Inlet Valve Vault	6
6	Gutter Conductor Deep Area West	6
	Inlet Valve Vault	6
7	Inlet Valve Vault	10
	Inlet Filter Bank, Valve 8B	10
8	Water Feature Valve	4
	Water Feature Pump Discharge Valve #X	6
9	ZD Bubbler 1	2
	Water Feature Valve	4
10	ZD Bubbler 2	2
	Water Feature Valve	4
11	ZD Bubbler 3	2
	Water Feature Valve	4
12	ZD Bubbler 4	2
	Water Feature Valve	4

Pipe Index



Return piping

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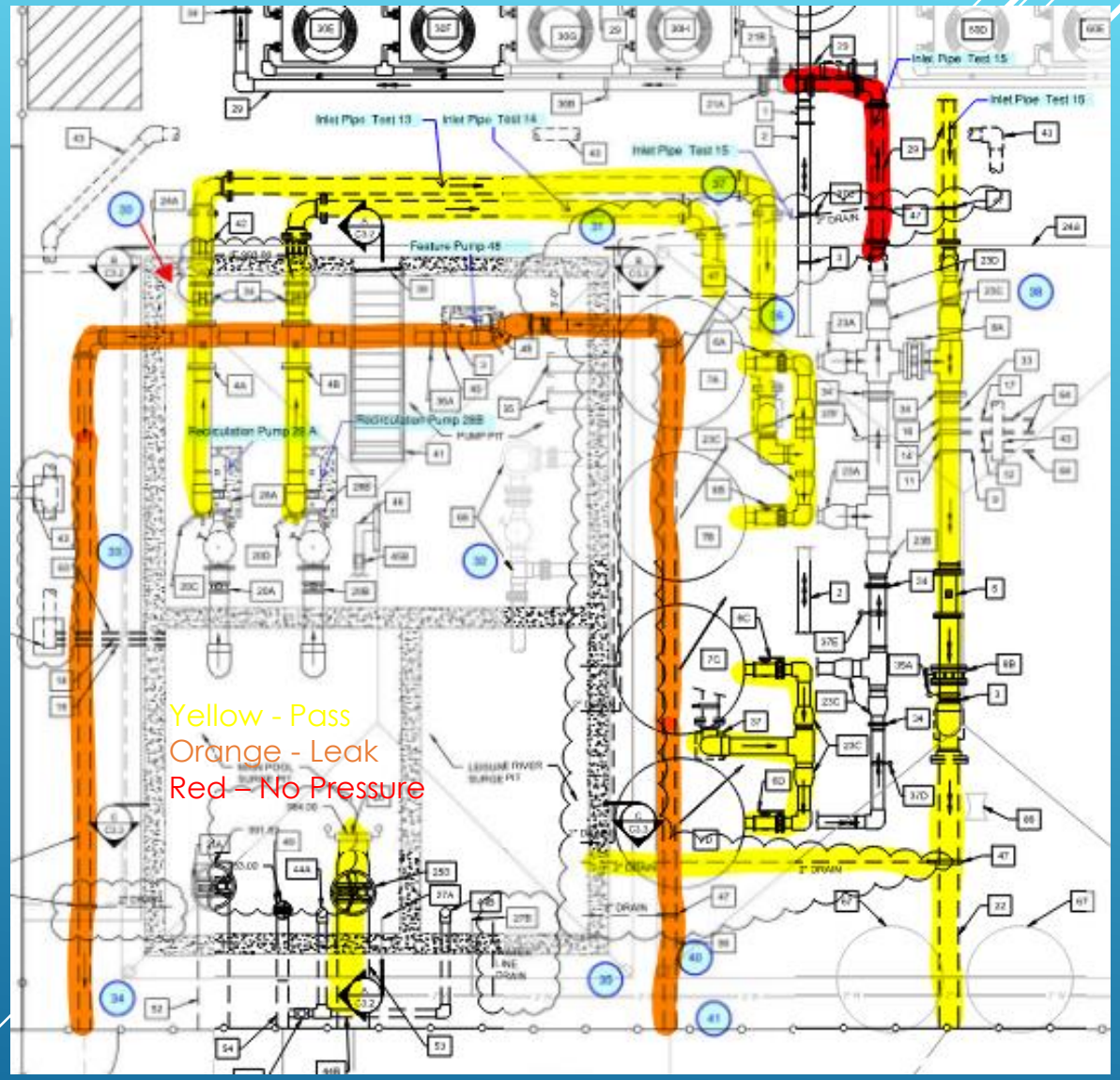
PIPE PRESSURE TESTING (RICCHIO) 10-5-24

FINDINGS

- Failed Pipes
  - Heater supply side stream
  - Zero depth bubbler #3
- Leaking Pipes
  - Water feature supply and outlet piping

13	Recirulation Pump 28A valve	8
	Filter valve 6A	6
	Filter valve 6B	6
14	Recirulation Pump 28B valve	8
	Filter valve 6C	6
	Filter valve 6D	6
15	Heat pump side stream supply valve 21A	4
	Field verify test termination location	TBD
	Heat pump side stream return valve 21 B	4
	Field verify test termination location	TBD
	Winterization pipe valve #TBD	2



Pool mechanical space piping

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CONCRETE SOUNDING (BAI) 10-5-24

PROCEDURE

- Tapped hammer throughout pool floor to explore any irregularities using audio cues

FINDINGS

- Definite hollow sounding concrete in areas shown
- Consistent with locations of dye loss

ASTM D4580 "Standard Practice for Measuring De-laminations in Concrete"

1.2.2 Procedure B, Chain Drag—This procedure consists of dragging a chain over the bridge deck surface. The detection of delamination is accomplished by the operator noting dull or hollow sounds. Tapping the bridge deck surface with a steel rod or hammer may be substituted for the chain drag.

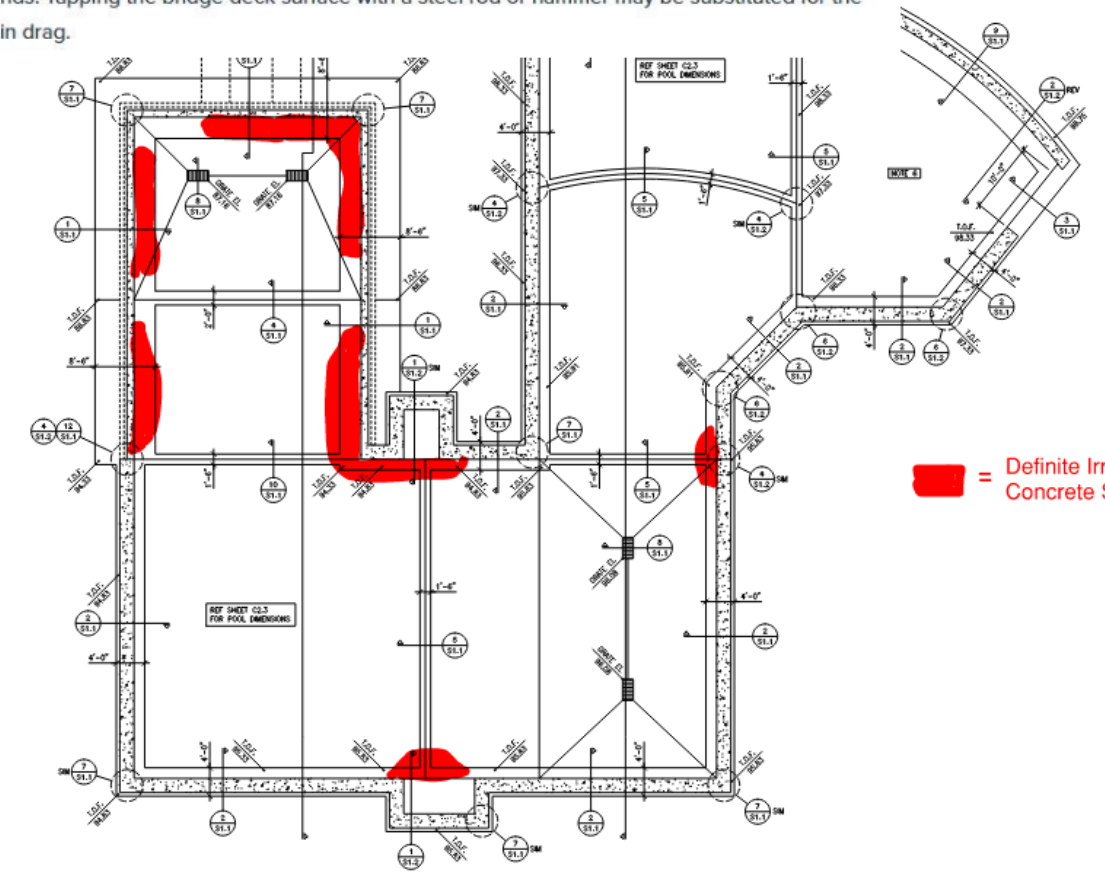

Exhibit Created by BAI

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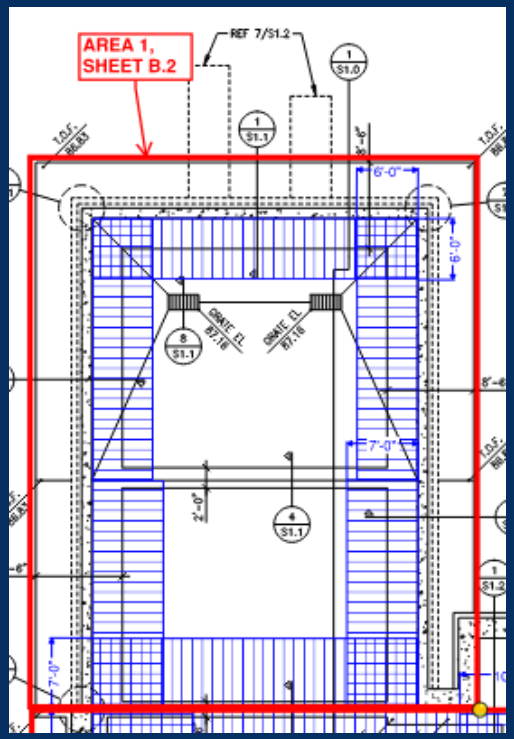
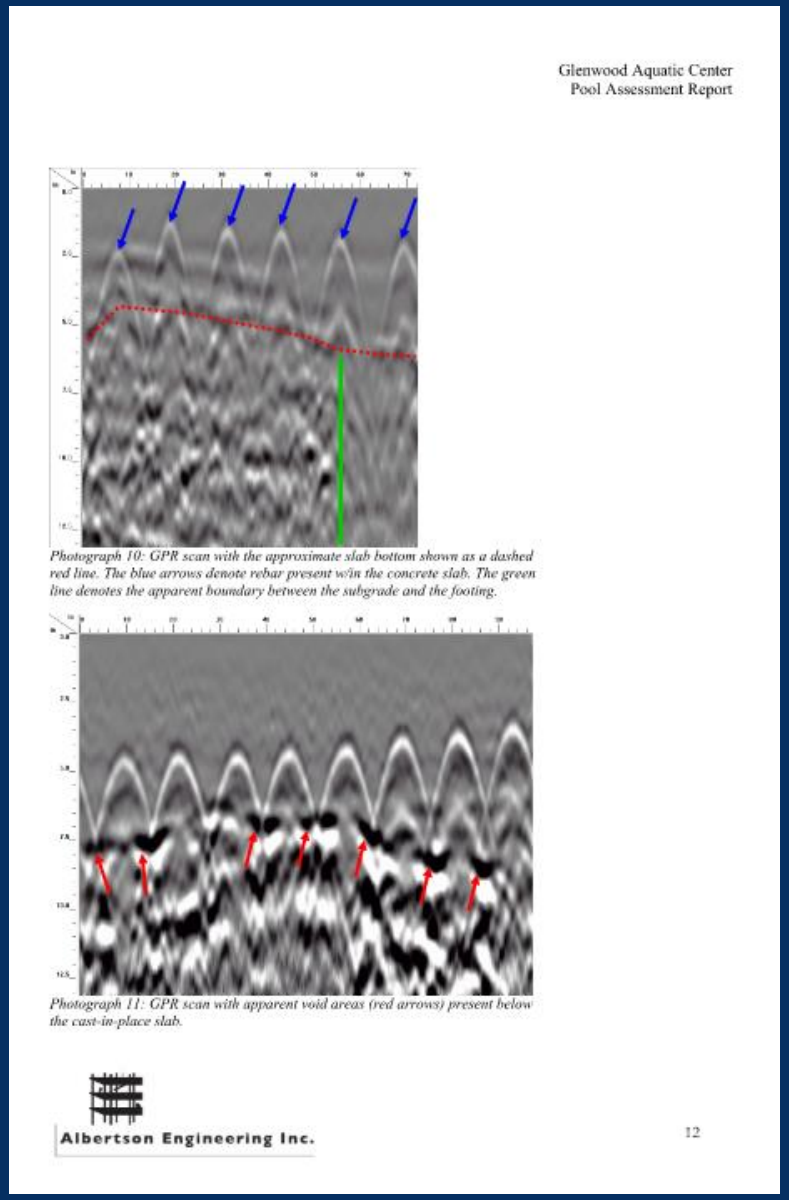
GROUND PENETRATING RADAR SCANNING (AEI) 11-19-24

PROCEDURE

- GSSI scanner device used in field
- Scan 6 – 7 foot lengths at 2 foot intervals
- Focused area around joints
- Interpreted scans and located apparent voids

Photograph 8: AEI's in-house GSSI Mini XT scanner used during the field review.





Glenwood Aquatic Center
Pool Assessment Report

Photograph 10: GPR scan with the approximate slab bottom shown as a dashed red line. The blue arrows denote rebar present w/in the concrete slab. The green line denotes the apparent boundary between the subgrade and the footing.

Photograph 11: GPR scan with apparent void areas (red arrows) present below the cast-in-place slab.

Albertson Engineering Inc.

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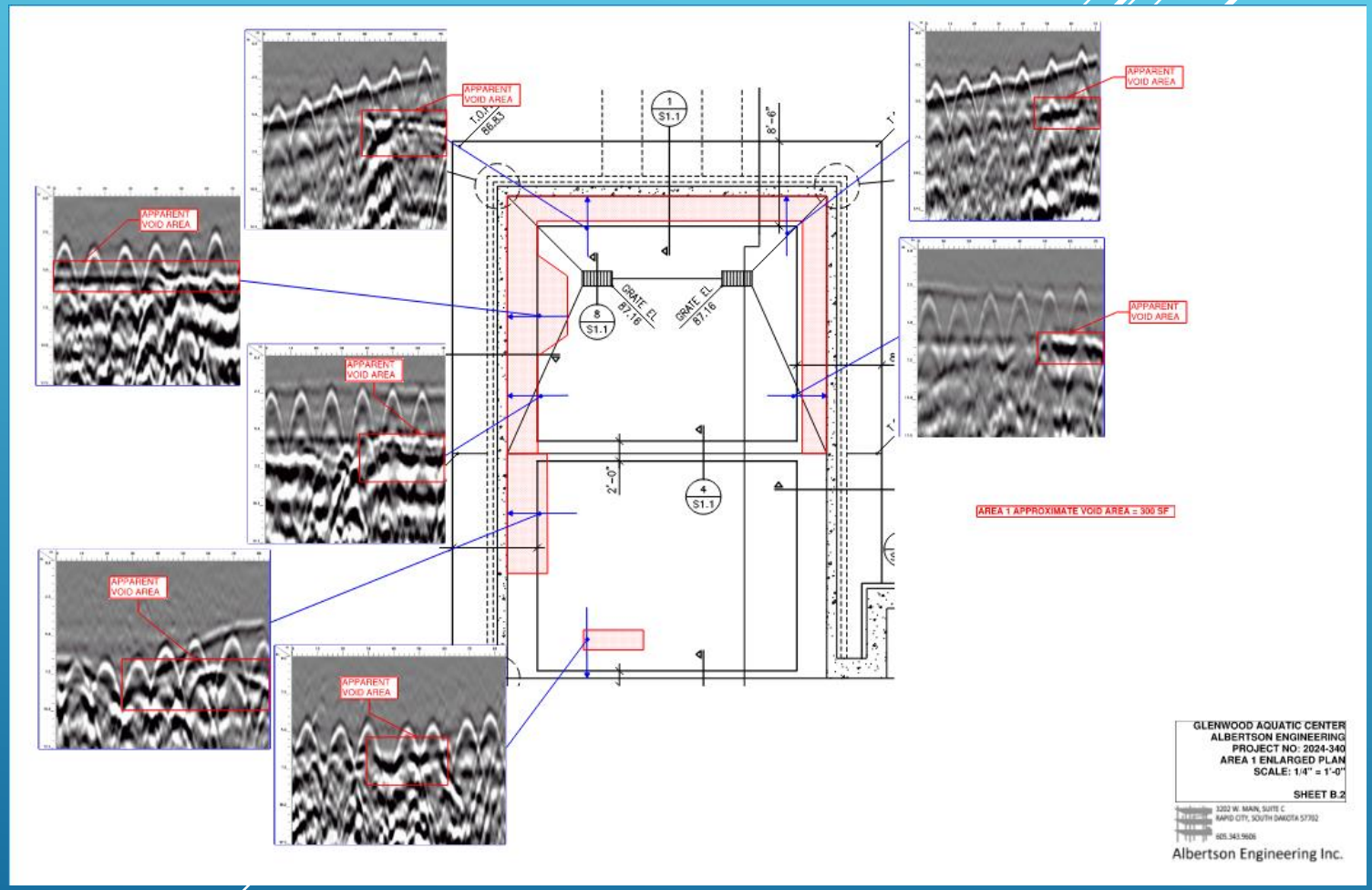
Glenwood Aquatic Center Pool Assessment Report – Photograph 8, Sheet B.1 (Clip), Page 12, Albertson Engineering

GROUND PENETRATING RADAR SCANNING (AEI) 11-19-24

Findings

- Several multiple apparent void areas
- Apparent void areas consistent with poor sounding concrete and dye loss locations
- Suggests water leaks are eroding the sub grade below the pool floor next to footings
- See Albertson's Report for complete assessment



Glenwood Aquatic Center Pool Assessment Report – Area 1 Sheet B.2, Albertson Engineering

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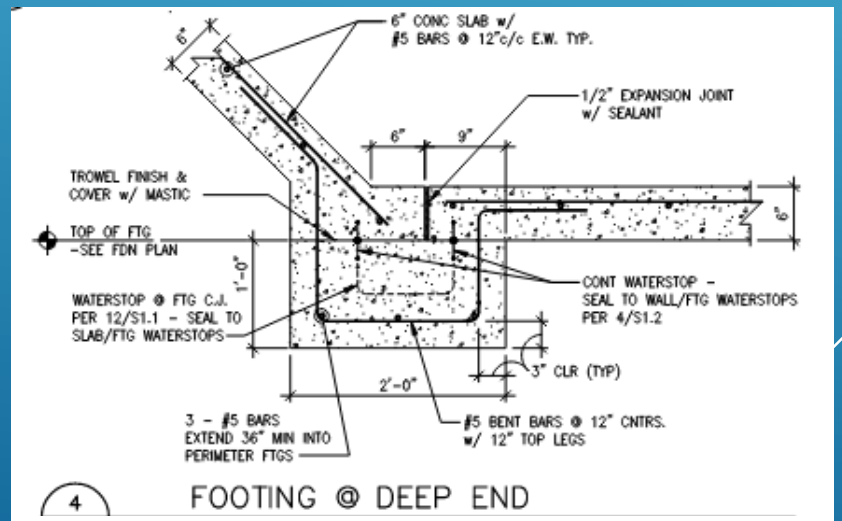
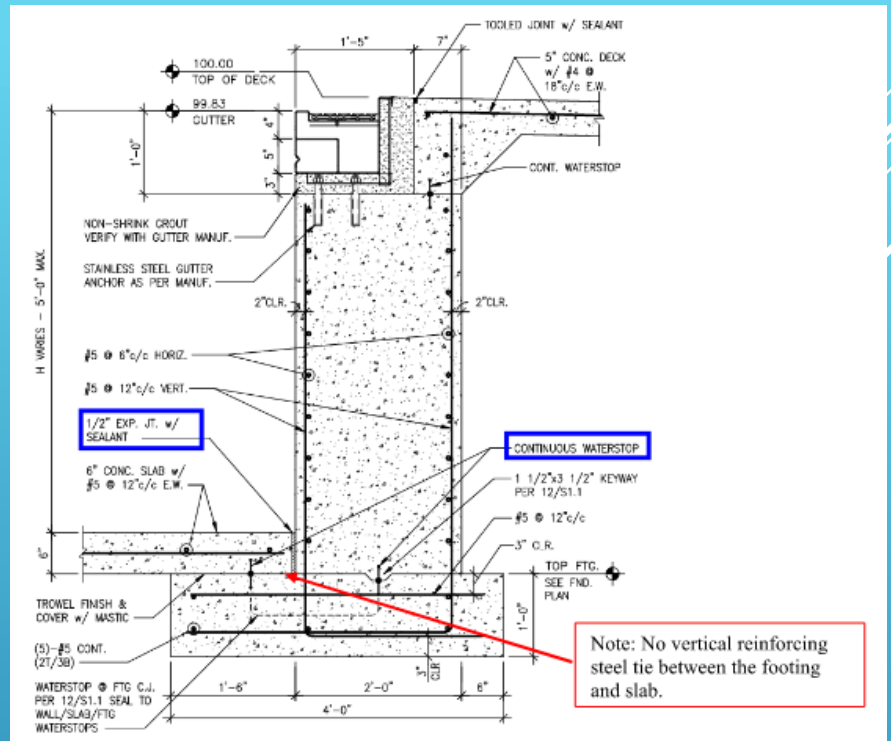
STRUCTURAL REVIEW

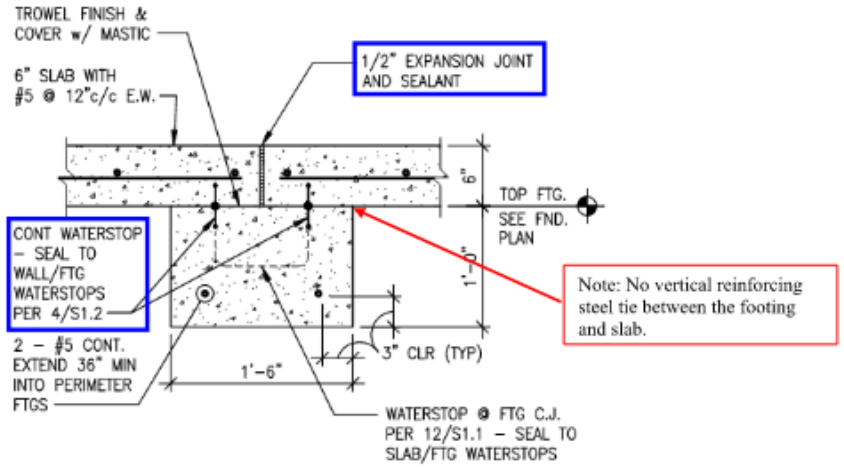
- Light duty 6" floor slab
- Single #5 rebar @ 12" c/c E.W., 1 ¼" at intersection
- Rebar clearance – 1 ½" to surface, 3" to grade
- 4" PVC waterstop
- Floor slab vertical reinforcement only at end of transition slope joint



Only Footing W/ Vertical Reinforcement



Photograph 3: Detail 2/S1.1 taken from the construction documents. This shows the typical floor slab to perimeter wall detail with the expansion joint sealant and waterstops labeled for clarity.



Photograph 2: Detail 5/S1.1 taken from the construction documents. This shows the typical floor slab expansion joint detail with the expansion joint sealant and waterstops labeled for clarity.

STRUCTURAL REVIEW

Construction photos sourced from Glenwood Aquatic Center Facebook page

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CONCRETE EXTRACTIONS (RICCHIO) 3-7-25

PROCEDURE

- Cut and extract two 3'x3' floor sections
- Expose and maintain waterstop condition for observation
- Observe sub floor condition
- Observe rebar, concrete design and placement

Deep End Opening

Waterstop

Floor Joint Opening

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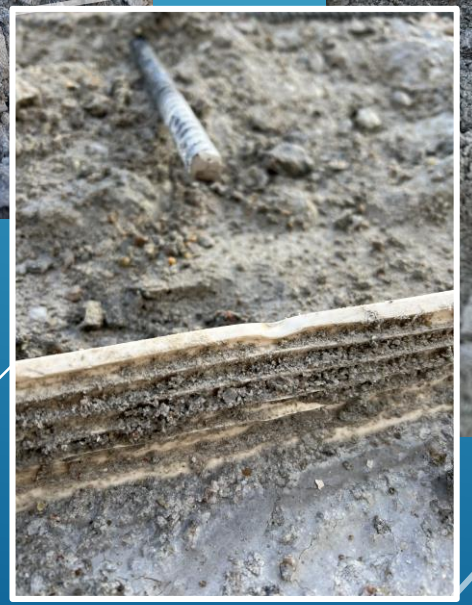
CONCRETE EXTRACTIONS (RICCHIO) 3-7-25

FINDINGS

- Floor thickness ranges from 4-6 inches (6" design thickness)
- Waterstop is intact but not consolidated
- Confirmed no vertical reinforcement
- Rebar is in contact with waterstop creating poor concrete consolidation at each rebar location



GEOTECHNICAL (CVT)

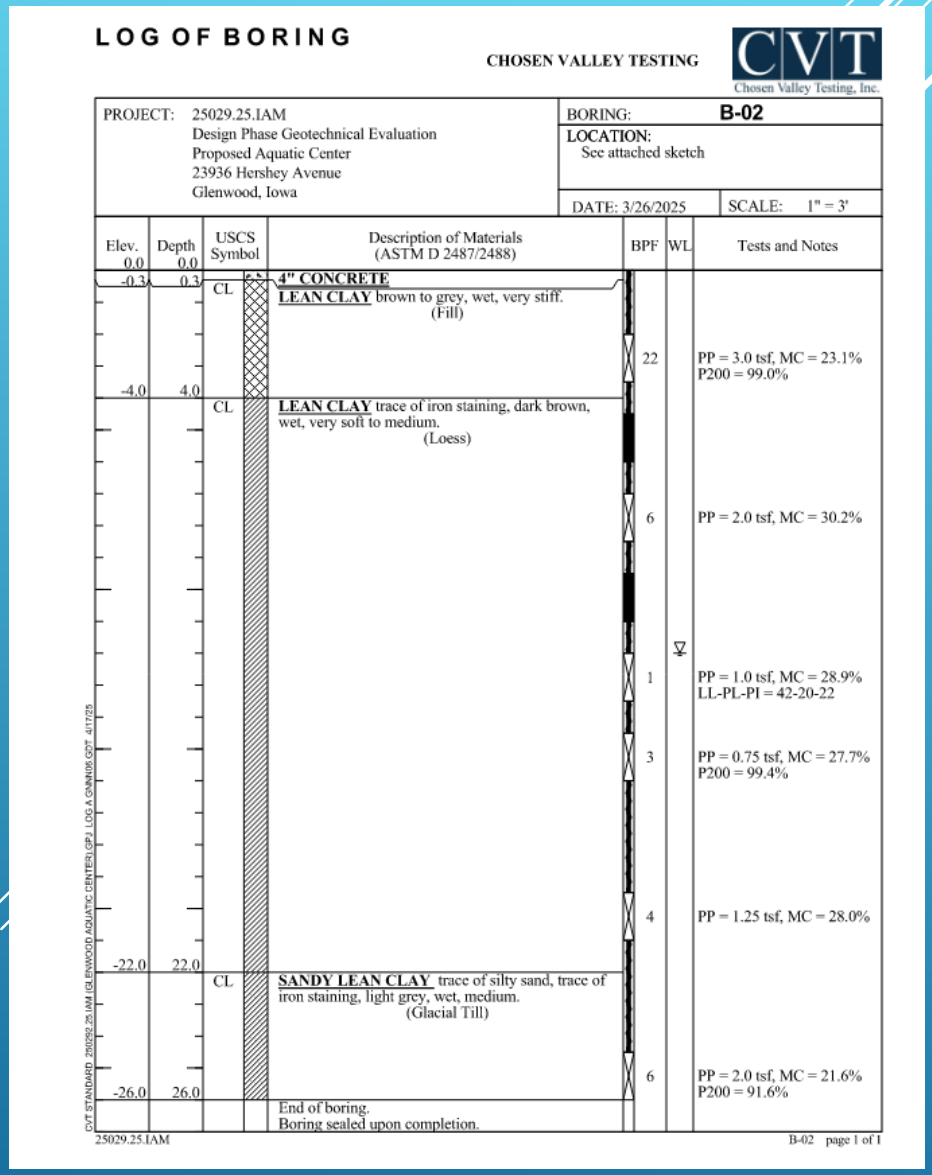
3-26-25

PROCEDURE

- Single test boring at the center of the vessel to depth of 26 feet
- Soils testing

FINDINGS

- Lean clay fill directly below pool slab to 4 foot depth. Lean clay loess at 4 – 22 feet. Both are considered highly frost susceptible
- Glacial till 22 feet to end of boring
- Ground water located at12 feet below top of boring



LOG OF BORING

CHOSEN VALLEY TESTING

CVT Chosen Valley Testing, Inc.

PROJECT: 25029.25.IAM
Design Phase Geotechnical Evaluation
Proposed Aquatic Center
23936 Hershey Avenue
Glenwood, Iowa

BORING: B-02
LOCATION: See attached sketch
DATE: 3/26/2025
SCALE: 1" = 3'

Elev.	Depth	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
0.0	0.0					
-0.3	0.3	CL	4" CONCRETE LEAN CLAY brown to grey, wet, very stiff. (Fill)			
				22		PP = 3.0 tsf, MC = 23.1% P200 = 99.0%
-4.0	4.0	CL	LEAN CLAY trace of iron staining, dark brown, wet, very soft to medium. (Loess)			
				6		PP = 2.0 tsf, MC = 30.2%
					▽	
				1		PP = 1.0 tsf, MC = 28.9% LL-PL-PI = 42-20-22
				3		PP = 0.75 tsf, MC = 27.7% P200 = 99.4%
				4		PP = 1.25 tsf, MC = 28.0%
-22.0	22.0	CL	SANDY LEAN CLAY trace of silty sand, trace of iron staining, light grey, wet, medium. (Glacial Till)			
				6		PP = 2.0 tsf, MC = 21.6% P200 = 91.6%
-26.0	26.0		End of boring. Boring sealed upon completion.			

C:\VT STANDARD 250252_25.IAM (GLENWOOD AQUATIC CENTER).GPJ LOG A GINN06.GDT 4/17/25

25029.25.IAM B-02 page 1 of 1

Boring Log B-02, Chosen Valley Testing

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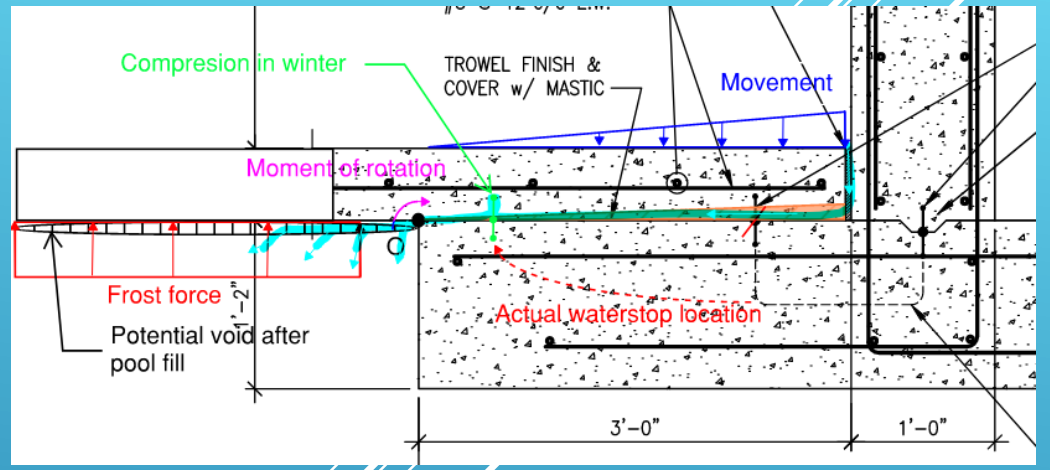
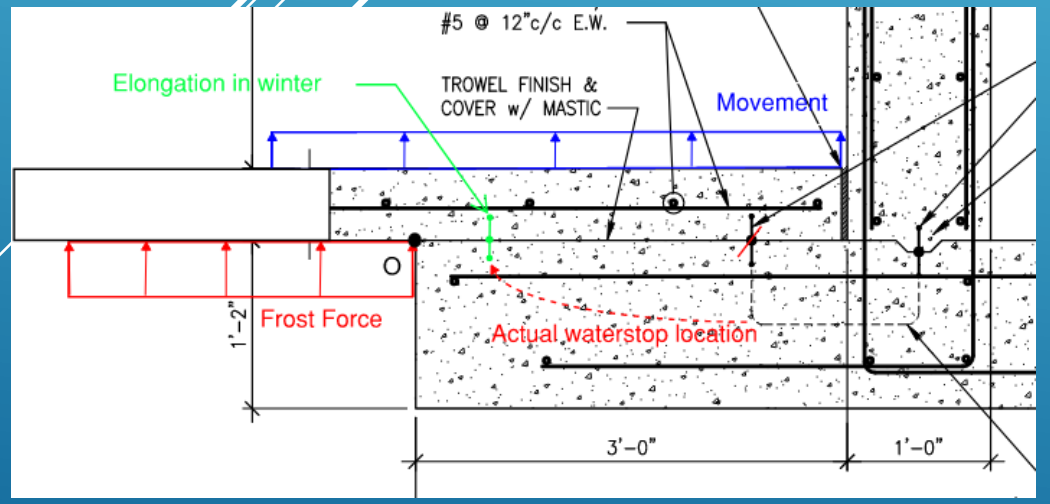
ELEVATIONS (EAGLE) 11-20-24 – 4-10-25

Eagles elevations measurements indicated the following

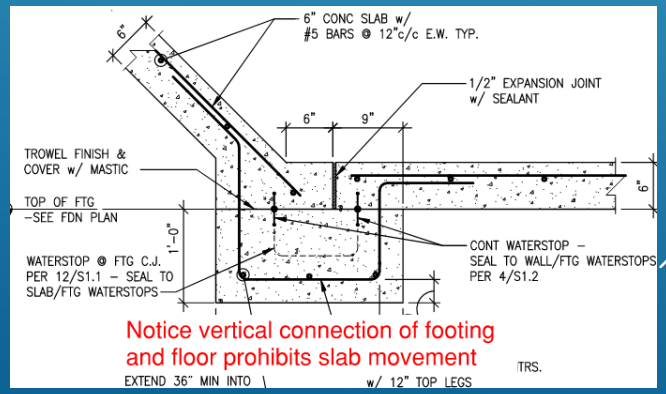
- There is significant movement of upwards of 2 inches +/- between fall and spring
- Some negative movement is occurring
- Greater movement in pool deep end
- Settlement back to 1/10’ – 2/10’ after spring thaw
- Spring fill should further settle floor slabs



Negative floor movement



Positive elevation floor movement



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SUMMARY

The Aquatic Center has been constantly dealing with issues of water loss through its years of operation and water loss rate has increased each season of operation.

The forces on the pool floor resulting from frozen sub grade has caused the floor to rise as much as two inches per winter.

The adverse floor movement and inadequate waterproofing and structural connection between the floor and concrete footings allows water to leak at high rates.

Water leakage at the floor joints is apparently eroding base material creating voids under the pool floor.

Pool structure movement has caused pipe breaks and leaks.

RECOMENDATIONS

Continued use of the pool in its current condition will have high operation costs and increased deterioration of the pool vessel and pipe network integrity.

The geotechnical evaluation recommendation to remedy the pool vessel structural support requires removal of up to 5 feet of existing soil and under the pool. The soil should be replaced with non frost sensitive soil.

Additionally given the presence of ground water an active dewatering system should be installed. A full envelope of free draining base and wall backfill is required for an effective dewatering system.

These remedies along with an improved pool vessel structural design requires a full pool vessel replacement solution.

- QUESTION & COMMENTS

THANK YOU

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