UNITED CONSULTING

REPORT

For City of Clarkston

Visual Dam Inspection and Geotechnical Exploration Report Review
Norman Road Dam
Clarkston Lake
DeKalb County
Clarkston, Georgia
CLIFS-18-GA-02795-01
November 7, 2018

625 Holcomb Bridge Road, Norcross, GA 30071 • 770-209-0029 • unitedconsulting.com

November 8, 2018

Mr. Keith Barker – City Manager
City of Clarkston
1055 Rowland Street
City Annex
Clarkston, GA 30021

c/o Mr. Larry Kaiser
Collaborative Infrastructure Services

Via Email: Kbarker@cityofclarkston.com

RE: Visual Dam Inspection and
Geotechnical Exploration Report Review
Norman Rd. Dam – Clarkston Lake
DeKalb County
Clarkston, Georgia
Project No.: CLIFS-18-GA-02795.01

Dear Mr. Barker:

Thank you for your confidence in United Consulting and for the opportunity to provide professional engineering services for the Norman Rd. Dam – Clarkston Lake located on Norman Rd in Clarkston, DeKalb County, Georgia. This report presents the results of a visual inspection of the dam and associated recommendations. A geotechnical exploration, structural assessment, or slope stability evaluation of the dam were not part of the scope of work. This report also provides review comments on the Draft Report titled “Report of Subsurface Exploration and Geotechnical Engineering Evaluation, Clarkston Lake Dam Reconstruction, Clarkston, DeKalb County, Georgia” by Willmer Engineering, Inc. Project No. 71.3983 dated November 6, 2014. This work was completed in accordance with our Contract dated October 21, 2018 signed by the City of Clarkston.

VISUAL DAM INSPECTION

United Consulting’s Rafael Ospina, P.E., conducted a Visual Dam Inspection on October 25, 2018. The visual inspection followed the general guidelines of the Georgia Safe Dams Program (GSDP) for inspection of dams. Detailed observation notes are provided in Attachment 1 in the Ga Safe Dams Program (GSDP) Inspection Form and attached Photos. The section below provides a summary of the key observations made during the visual inspection of the dam and associated recommendations:

Table 1: General Dam Information

Longitude / Latitude	-84.232431° / 33.807844
Max. Dam Height	13 feet
Dam Length	350 feet
Impoundment Area (at Dam Crest Elev. 944 ft-msl)	4.8 Acres (Approximate)
Max. Storage Volume (Crest Elev. 944 ft-msl)	20 to 30 acre-foot
GA Safe Dams Category	Exempt
Current Pool Elevation	941.5 ft-msl (Normal Pool Level)
Pool Free Board (current)	2.5 ft. (est.)
Crest Width	35 ft.
Upstream Slope	3H:1V
Downstream Slope	Varies 0.5H:1V to 2H:1V
Current Principal Spillway	OCS Inlet with 82"x48" Pipe-Arch CMP
Auxiliary (Emergency) Spillway(s)	24" CMP Overflow and Concrete Spillway Flume over Downstream Slope

Overall the dam is in poor condition with overgrown vegetation that prevents proper inspection, and steep downstream slopes with sloughs/wash out areas that have been partially stabilized with grouted riprap. We understand the dam has overtopped a couple of times during the last 8 years, and the sloughs/washout areas (that have since been stabilized with grouted rip-rap) may have been caused by the overtopping events or the steepness of the slope in some areas. The capacity of the spillway system to pass the design storm event (at least the 100-yr storm event) and allow the minimum required freeboard recommended by GA DNR Safe Dams Program (SDP) is unknown. The Principal Spillway Approach Concrete Flume appears to be undermined, as water is not flowing over the flume concrete slab, yet it is flowing into the overflow inlet structure through an opening in the brick wall (e.g. brick missing where water is flowing through) where the spillway concrete flume discharges into the inlet structure. Below is a summary of the observations of the general elements of the dam structure and recommendations as appropriate. Detailed observation notes are provided in Attachment 1 in the GSDP Inspection Form. A Photo Log of observations made during the Visual Dam Inspection is also included with the GSDP Inspection Form.

General Dam Inspection Observations and Recommendations

- Crest:
  - Norman Road is over the crest of the dam. The south lane shows pavement longitudinal cracking and settlement. The existing sidewalk on the south side of the road as well as the road concrete gutter show differential settlement and lateral movement towards the downstream slope (see Photos 1 to 4).
- Upstream Slope:
  - Access to the upstream slope for close examination was limited due to an existing fence that runs along Norman Road. Overgrown grassy vegetation over most of the upstream slope prevented visual observation for animal burrows, sloughs/instability and depressions/voids. The upstream slope is about 3H:1V. The slope on the right side (west) of the existing dock shows some historic erosion and/or slough scarps (not active – grass growing) near the crest, we note that the water level is about 6” to 12” below the original 12” topo 18” CMP spillway riser inlet that has been abandoned (grouted). The erosion/scarp may have been associated with some historic beach erosion. There are voids near the crest of the dam under the sidewalk on the right side of the dock. This void may be an animal burrow, or erosion caused during water dam overtopping events associated with major storms. The slope surface near the waterline appears somewhat soft (upper foot to foot and a half). Any voids on the upstream slope need to be backfilled with compacted fill and grassy vegetation needs to be kept to less than 6” in height to allow for proper inspection. The slope needs to be monitored for potential shallow sloughs and/or beach erosion and repair as necessary, and access should be made available through the fence to facilitate close examination of the upstream slope on both sides of the dock (see Photos 5 to 7).
- Downstream Slope:
  - The downstream slope has overgrown vegetation and steep slopes (0.5H:1V to 2H:1V) in some areas that prevent proper inspection for animal burrows, wet/seepage, instability and depressions. There are two areas that have sloughed/washed out in the past due to steep slopes and/or dam overtopping. The sloughed/washed out areas have been locally stabilized with grouted rip-rap and other type of materials (e.g. pavers, bricks, etc.). The overall stability of the downstream slope (Factor of Safety (FOS) against slope failure) is questionable. Cracking and settlement noted on the pavement over the crest of the dam indicates slope movement with factors of safety near unity (FOS $\leq$ 1.1 – large deformation with no complete failure). The slope stability of the dam needs to be evaluated for normal and maximum pool level conditions, and if necessary reconfigure the downstream slope to increase the factor of safety to acceptable levels:
    - FOS $\geq$ 1.5 for Long Term Condition – Normal Pool Level
    - FOS $\geq$ 1.3 for Short Term Condition - Maximum Pool Level (Crest Level)
    - FOS $\geq$ 1.1 Pseudo Static (Seismic) Condition - Normal Pool Level.

- The stream channel that runs along the toe of the slope is overgrown and is wet due to permanent flow of water from the Principal Spillway system. The channel along the toe of the dam appears to be protected with rip-rap but steep slopes and/or overgrown vegetation prevents proper inspection. Due to the proximity of the principal spillway flow away channel along the toe the dam, the stream channel needs to be provided with proper erosion protection. Channel flow capacity and velocity need to be checked (hydraulics and hydrology, H&H Study) to make sure the stream channel and toe of the dam are protected from erosion.
- The right (west) end area of the downstream slope is very steep (0.5H:1V). There is a retaining wall that shows damage/movement, some hand placed bricks/pavers have been placed to provide some support to the retained soils. As indicated above, slope stability needs to be checked and if necessary provide slope stabilization to obtain the required minimum factors of safety indicated above (see Photos No. 8 to 11).
- See review comments and additional recommendations regarding slope stabilization in the second section of this report (Review Comments of Subsurface Exploration and Geotechnical Engineering Evaluation Report by Willmer Engineering, Inc.).

- Principal Spillway System:
  - During the visual inspection, water was not flowing over the principal spillway system approach concrete flume. Water was discharging into the spillway inlet structure below the concrete flume through an opening (brick missing) in the inlet wall. We recommend evaluating the source of the water and if the concrete flume has been undermined, backfill (grout) the void and re-establish flow over the spillway concrete flume. Two other pipes (an 18” RCP and a 24” CMP) also discharge to the inlet structure, there was no flow in these two pipes during the visual inspection (see Photos 12 and 14).
  - The principal spillway pipe-arch CMP appears to be in fair condition with no indication of pipe deflection or corrosion of concern. Some sediment, cobbles and boulders were noted at the bottom of the pipe. Need obstructions at the bottom of the pipe including sediment and cobbles/boulders should be removed so the flow capacity of the pipe is not impacted (see Photos 15 and 16).
  - There are a number of CMP culverts (two 60” CMPs and one 96” x 48” pipe-arch CMP) along/within the stream channel running along the toe of the dam discharging/passing flows from the dam principal spillway and Norman Road run-off discharge. Some of the stream flows from the principal spillway drains through one of the 60” CMPs that discharges under the ball fields at Milam Park. This pipe was partially blocked with a fallen tree across the entrance of the pipe at the time of the visual inspection. All culverts need to be kept free of any blockage that would impair the stream free flow during normal and extreme storm events (see Photos 17 to 19).

- There is an abandoned 12" to 18" CMP riser on the left side of the dam. The inlet riser appears to be part of the original principal spillway system for the dam (e.g. farm pond). The riser has been grouted. The pool level was 6" to 12" below the top of the riser at the time of the visual inspection. The outlet of the original spillway drain pipe under the dam was not exposed on the downstream slope. During future dam visual inspections, the area around the old drain pipe outlet needs to be checked for wetness/seepage (see Photo 20).

- Auxiliary (Emergency) Spillway System:
  - An auxiliary 24" CMP overflow pipe is located on the right dam abutment. This auxiliary spillway pipe appears to be the original pipe installed with the original 12" to 18" riser and drain pipe principal spillway system that has been abandoned. While this auxiliary spillway is functional, the base of the pipe at the outlet is corroded. This pipe could not be accessed for inspection due to the existing fence along Norman Rd. This pipe needs to be replaced (if needed) with a new pipe and properly sized for the dam spillway system to pass at least the 100-yr design storm event (see Photos 21 and 22).
  - In addition, a concrete-lined flume extends from the crest down to the toe of the downstream slope of the dam. This auxiliary spillway appears to serve as part of the emergency spillway system in the event that water overtops the dam during a heavy storm event. Some erosion on the sides and outfall of the concrete-lined flume has been repaired with small rip-rap. A construction joint or crack is located halfway down the concrete-lined flume. This joint shows some separation and movement down the slope. All cracks and joints need to be sealed to prevent water from entering the joint/crack and getting under the concrete slab (see Photos 23 and 24).

- Instrumentation and Monitoring Devises:
  - A number of temporary piezometers were installed during the geotechnical exploration completed by Willmer Engineering, Inc in 2014. Two 1" PVC piezometers were located during the visual inspection (B-6 and B-8). Other piezometers may have been abandoned or destroyed after they were installed. The two identified piezometers look in good condition. Water levels were not measured during the visual inspection (see Photos 25 and 26).

- Clarkston Lake:
  - The lake looks in good condition, no floating debris or dead trees or branches along the shore line were noted that may block the spillway system during large storm events. The lake should be Inspected periodically and remove any dead trees/branches along the lake shoreline that may block the spillway system (see Photo 27).

DRAFT GEOTECHNICAL EXPLORATION REPORT BY WILLMER ENGINEERING, INC.

United Consulting completed a review of the Draft Report titled "Subsurface Exploration and Geotechnical Engineering Evaluation, Clarkston Lake Dam Reconstruction, Clarkston, DeKalb County, Georgia" by Willmer Engineering, Inc. Project No. 71.3983 dated November 6, 2014. A site visit was completed by Wilmer in August 2014 to observe the condition of the dam.

We offer the following observations, comments and additional recommendations regarding the rehabilitation of the Norman Road Dam:

- The geotechnical exploration completed to evaluate the structural integrity of the dam was adequate. The exploration program included a sufficient number of geotechnical SPT borings, hand auger borings and DCP testing, installation of temporary piezometers and laboratory testing.

- Subsurface conditions encountered in the borings indicate that the dam was constructed with poorly compacted fill with standard penetration test (SPT) 'N' values ranging from 1 to 9 blows per foot (bpf) with an average of 3 bpf. Fill consisted of medium to fine sandy SILT, clayey medium to fine SAND, medium to fine SAND, and fine to medium to fine sandy CLAY. Lab testing indicated soils with fine contents (Passing #200 sieve) ranging from 34% to 60% fines with Plasticity Index (PI) values ranging from Non Plastic (NP) to 28%.

- A topographic survey of the dam was available to develop representative x-sections for slope stability analyses.

- Strength parameters selected for the dam and foundation soils for slope stability analyses were low but reasonable based on the SPT N values in the existing fill, alluvial soils, residual soils, as well as for compacted fill for reconstruction of the dam. A summary of the range of soil properties used for slope stability analyses is provided below:

	Friction Angle	Cohesion (psf)	Su (psf)	Unit Weight (pcf)	Hydraulic Conductivity, K (cm/sec)
Existing Fill	26º to 28º	0	--	90 to 110	--
	0	250			
Compacted Fill	30 º	100	500	120	$1x10^{-4}$
Alluvium	26º to 28º	0	--	105	--
Residual Soils	26º to 32º	0	--	105 to 115	$1x10^{-3}$

- Slope stability analyses indicate factors of safety against slope failure for the steady state – long term condition at normal pool level of 1.02, 1.79 and 0.95 for three x-sections analyzed. The two low FOS are for the sections of the dam where there is an open drainage channel at the toe of the dam (no CPM culvert) (full dam height of 13 feet). The low factors of safety, although somewhat low (more likely between 1.1 and 1.2), represent the existing condition of the dam showing cracks and settlement on the crest/road surface.

- Two Options for repair/reconstruction of the dam were presented in the report:
  - **Option 1:** Reconstructing the entire dam using suitable soils to provide a factor of safety of 1.5 under steady state seepage condition (Normal Pool Level) with a 2.5H:1V downstream slope or flatter where space is available. Where there is no space available (west end) a cantilever retaining wall would need to be constructed. An alternative to the cantilever retaining wall would be to extend the culvert and place compacted fill over it to achieve a 2.5H:1V slope or flatter. **This option would require to completely drain the lake, excavate the dam/roadway, and reconstruct the dam.**
  - **Option 2:** Reconstructing the portion of the dam south of the Norman Rd. centerline. In this option the entire embankment from the downstream toe of the slope to the centerline of Norman Rd. would be excavated and reconstructed as per Option 1 requirements for the downstream slope, toe drain, and retaining wall/extended pipe culvert. This option may require additional future maintenance of Norman Road to repair cracks or other pavement distress. **This option would require to completely drain the lake, provide excavation bracing support, and reconstruct the dam.**
- **Alternative Option 3** - While the two options presented in the report are doable, both options would require draining the lake, and complete or partial excavation of the dam which would require full or partial road closure. Another option that may be considered is to leave the dam as it is, and constructing a full pipe or box culvert with an underdrain (if required) along the existing stream channel/toe of the dam, and placing compacted fill over it to achieve a 2.5h:1V slope or flatter to get a minimum FOS of 1.5 FOS for steady state seepage condition. With this option, maintenance along the stream channel associated with overgrown vegetation, collection of debris, etc. would be reduced, and the overall esthetics of the area would be improved. As in Option 2, this option may require additional future maintenance of Norman Road to repair cracks or other pavement distress as the existing poorly compacted soils would be left in place. Additional slope stability and seepage analysis would need to be completed for design of the final culvert slope configuration.
- **Alternative Option 4:** An MSE wall was also considered as a potential option to provide more slope toe resistance (buttress effect) and allowing a flatter final slope above the MSE wall in order to achieve the required minimum FOS of 1.5 for steady state seepage condition. This option would also require draining the lake, partial road closure, providing excavation bracing support, excavating from the downstream toe to near the crest of the existing downstream slope, and constructing the MSE wall with stone baskets at the lower levels. More engineering and cost analyses would need to be completed to evaluate this option further.

- Dam repair/rehabilitation should consider completing (if not available) an H&H study to check the current dam spillway system capacity and the capacity of the channel and/or culverts passing the stream flows along the downstream toe of the dam. Installation of new pipe or box culverts along the toe of the dam should be sized to pass the required dam design storm events (at least the 100-yr storm event) without overtopping the dam and providing appropriate wave freeboard. The toe of the dam should be protected against stream flow erosion.

We appreciate the opportunity to provide dam engineering services to the City of Clarkston. Please let us know if you have any questions or if we can provide analyses of the selected alternative.

Sincerely,

UNITED CONSULTING

GEORGIA REGISTERED No. 22149 PROFESSIONAL ENGINEER RAFAEL I. OSPINA

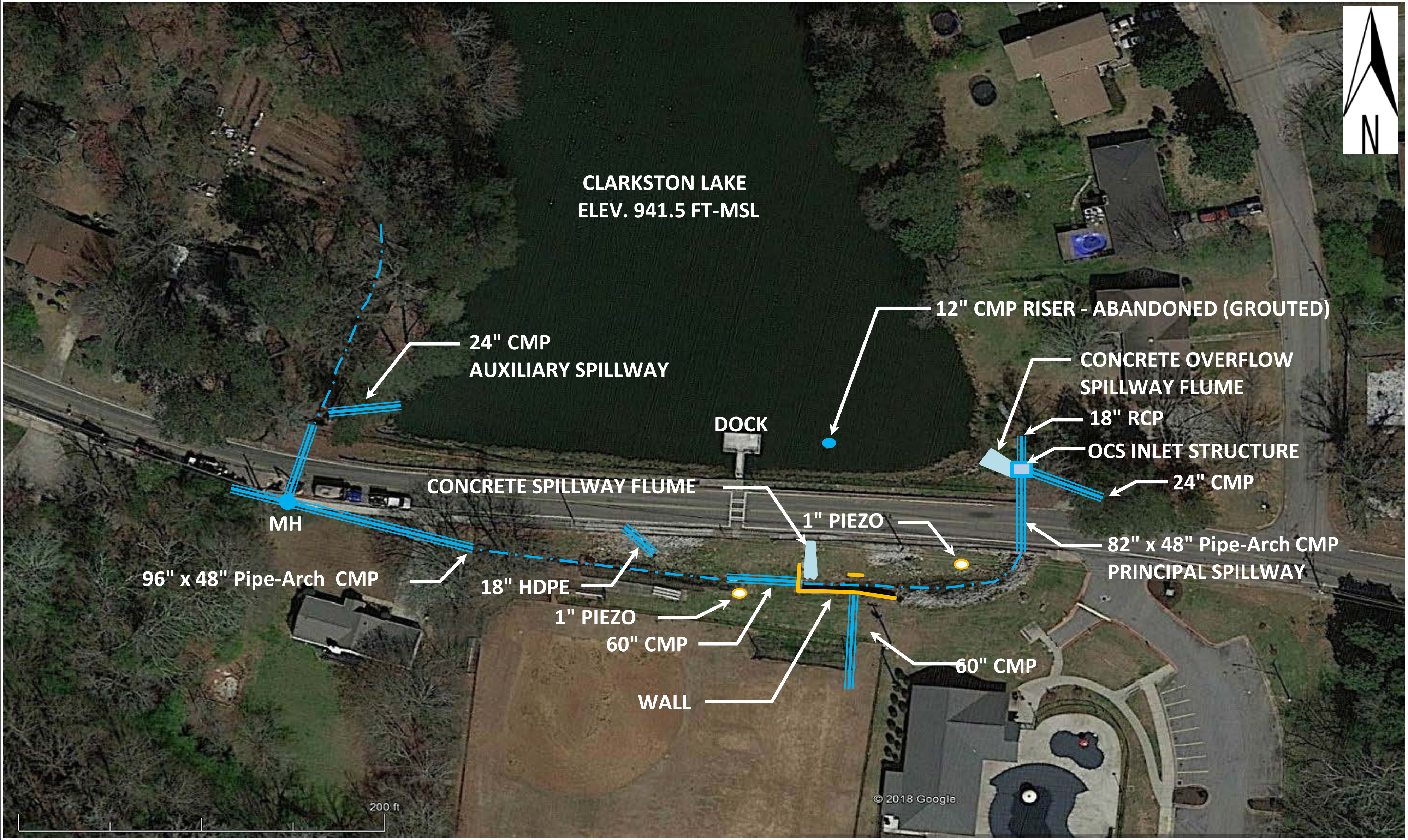
Rafael I. Ospina, P.E.
Consultant Geotechnical Engineer

Scott D. Smelter
Principal

RIO/SDS/nj

Attachments: Figure 1
Embankment (Earth) Dam Inspection Form
Photo Log

SP/Geotechnical Documents/ CLIFS-18-GA-02795-01.Inspection.docx



Basemap Source: Google earth Nov 2018

SCALE: As Shwon	DATE: Nov-7-2018	PROJECT No.: CLIFS-18-GA-02795-01	TITLE: Norman Road Dam Layout Plan Clarkston, DeKalb County, GA
PREPARED: RIO	CHECKED: SS	REVISIONS:	
CLIENT: City of Clarkston			UNITED CONSULTING 625 HOLCOMB BRIDGE ROAD

FIG.1

EMBANKMENT (EARTH) DAM INSPECTION FORM

Name of Dam	Norman Rioad Dam - Clarkston Lake	Date	10/25/18
Location of Dam (County)	DeKalb County - Clarkston, GA	Weather	Sunny, Clear - 70s F
Inspected By (Print Name)	Rafael I. Ospina, P.E.		

A. Crest (refer to Glossary for description)

1. How would you describe the vegetation on the crest? (Check all that apply)

Recently Mowed ☐ Overgrown ☑ Good Cover ☐ Sparse ☑ Other (describe)

Norman Road is over the crest of the dam. The road is provided with sidewalks and curb and gutters.

2. Are there any trees or other inappropriate vegetation on the crest? If yes, describe type of vegetation, size, location, etc. ☐ Yes ☑ No ☐ N/A

None observed.

3. Is there a paved road or driveway on the crest? If yes, describe condition (good condition, numerous cracks, newly paved): ☑ Yes ☐ No ☐ N/A

Norman Road (two lane) is over the crest. There are longitudinal pavement cracks along the south lane for most of the length of the dam. Some areas show settlement. The south sidewalk shows separation from the road curb and gutter with both vertical and lateral movement towards the downstream slope (see Photos 1 to 4).

4. Are there any depressions, ruts or holes on the crest? If yes, describe (size, location, etc.) ☑ Yes ☐ No ☐ N/A

There is settlement along the south lane within the central portion of the dam.

5. Are there any cracks on the crest? If yes, describe (length and width, location, direction of cracking, etc.) ☑ Yes ☐ No

See A.3 above.

6. Other observations on the Crest:

Crest is 35 feet wide. (see Photo No. 1)

B. Upstream Slope (refer to glossary for description)

1. What is the reservoir level today?

Pool: ☐ Normal ___ feet ☐ Above Normal ___ feet ☑ Below Normal 0.5 feet

2. How would you describe the vegetation on the upstream slope? (Check all that apply)

☐ Recently Mowed ☑ Overgrown ☑ Good Cover ☐ Sparse ☐ Other (describe)

Overgrown grassy vegetation prevents proper inspection of the upstream slope.

3. Are there any trees or other inappropriate vegetation on the slope? If yes, describe (type of vegetation, size, location, etc.): ☐ Yes ☑ No ☐ N/A

No inappropriate vegetation (trees) was noted during the inspection.

4. Are there any depressions, bulges, ruts or holes (such as animal burrows) on the slope? If yes, describe (size, location, etc.): **There was at least one hole noted under the side walk on the right side of the Dock. The hole may be associated with an animal burrow or erosion during overtopping events of the dam (two accounts during the last 8 years) (see Photo 7).**	☑ Yes ☐ No ☐ N/A
5. Are there any eroded areas on the slope, i.e., wave erosion along the shoreline? If yes, (describe size, location, severity, etc.): **There is a scarp (about 1 ft. high) near the top of the dam on the right side of the dam (right side of dock). The scarp (vegetated) may be associated with wave action erosion (beaching) or historic sloughing developed during dam overtopping events. The current pool level is about 0.5 ft. to 1 ft. below the original 12" to 18" CMP grouted riser and below the scarp (see Photo 6).**	☑ Yes ☐ No ☐ N/A
6. Are there any cracks, sloughs or slides (vertical cliffs) on the slope? If yes, describe (length width, height, location, etc.): **See B.5**	☑ Yes ☐ No ☐ N/A
7. Is there any type of slope protection along the shoreline, such as riprap? If yes, describe what type and its condition,(for example, riprap–inadequate, sparse): **None observed.**	☐ Yes ☑ No ☐ N/A
8. Other observations on the upstream slope. **None. The dam has approximately 2.5 feet of freeboard, about 6" below the Principal Spillway concrete-lined flume/OCS inlet structure. The upstream slope is approximately 3h:1v based on visual observations above the pool level.**	

C. Downstream Slope (refer to glossary for description)

1. How would you describe the vegetation on the downstream slope? (Check all that apply)

☐ Recently Mowed ☑ Overgrown ☑ Good Cover ☐ Sparse ☑ Other (describe)

In general, the slope has fair cover with two areas (left and right downstream slopes) that have been covered with grouted and not grouted rip rap and pavers to stabilize previous slope washouts/sloughs (see Photos 8 to 10).

2. Are there any trees or other inappropriate vegetation on the slope? If yes, describe (type of vegetation, size, location, etc.): **None observed.**	☐ Yes ☑ No ☐ N/A
3. Are there any depressions, bulges, ruts or holes (such as animal burrows) on the slope? If yes, describe (size, location, etc.): **None observed.**	☐ Yes ☑ No ☐ N/A
4. Are there any eroded areas on the slope (such as along abutment contacts)? If yes, describe size of area, location severity, etc. **None observed.**	☐ Yes ☑ No ☐ N/A

EMBANKMENT (EARTH) DAM INSPECTION FORM

5. Are there any cracks, sloughs or slides (vertical cliffs) on the slope? If yes, describe (length, width, height, location, etc.):

   Two areas one on the left side and one on the right side have been stabilized with grouted and not grouted rip rap and pavers. These two areas appear to be associated with previous washouts (dam overtopping) and/or steep slope instability/sloughs (see Photos 8 to 10). The right end of the downstream slope is steep (approximately 0.5h:1v) and a retaining wall containing a portion of this slope is damaged (see Photo 11).

   ☑ Yes ☐ No ☐ N/A

6. Are there any wet areas or areas of hydrophilic (lush, water-loving) vegetation? If yes, describe what type and its condition (for example, riprap – inadequate, sparse):

   The Principal Spillway discharges along a channel along the toe of the dam. The toe of the dam/channel is wet as there is a permanent stream of water discharging from the Principal Spillway OCS inlet structure. The channel is protected with rip-rap with vegetation growing through the rip-rap.

   ☑ Yes ☐ No ☐ N/A

7. Do any wet areas indicate seepage through the dam (such as rust-colored or stained water)? If yes, describe (for example, new area of seepage, no change from past observations, size or area, location):

   No seepage through the dam was observed during the inspection. However, overgrown vegetation near the toe of the dam prevented proper inspection. No rust-colored or stained water was noted.

   ☐ Yes ☑ No ☐ N/A

8. Are there any leaks (flowing water) from the slope or beyond the toe of the dam? If yes, describe (location, rate of flow, turbidity of flow):

   No flowing water noted at the time of the inspection. Water may be seeping through the toe channel with permanent flowing water from the Principal Spillway.

   ☐ Yes ☑ No ☐ N/A

9. Other observations on the downstream slope.

   The slope is very steep in some areas ranging from 0.5h:1v to 2:h:1v. There have been issues with slope stability in the past associated with washouts and or sloughs. No animal burrows were noted. Vegetation on the slope is not kept short (less than 6") for proper inspection.

D. Plunge Pool (refer to glossary for description)

1. Is there any type of erosion protection around the plunge pool (such as riprap)? If yes, describe what type and its condition(for example, riprap-adequate, inadequate, obstructed by vegetation):

   There is not a plunge pool. The spillway system discharge pipe-arch CMP discharges on a rip-rap lined channel No erosion was noted on the stream channel along the toe of the dam. Some vegetation is growing through the rip-rap (see Photo 16).

   ☑ Yes ☐ No ☐ N/A

2. Is there any erosion around the plunge pool? If yes, describe (size of area, location, severity, etc.):

   No issues with erosion noted within the discharge/plunge area.

   ☐ Yes ☑ No ☐ N/A

3. Other observations around the plunge pool:

   None.

EMBANKMENT (EARTH) DAM INSPECTION FORM

E. Principal and Emergency Spillways (refer to glossary for description)

1. What type of spillways does the dam have (such as corrugated metal, concrete or siphon pipe; concrete or earth channel)?

Principal Spillway: OCS Inlet with 82" x 48" Pipe-Arch CMP

Emergency Spillway: 24" CMP and Concrete-Lined Flume

Other: The concrete-lined flume extends from the crest of the dam (raodway) to the toe of the dam over the D/S Slope.

2. Has the emergency spillway activated (had flow) since the last inspection? If yes, describe (date(s) of flow, reason for activation, depth of flow, erosion damage if any):

We understand the dam has overtopped two times during the last 8 years. Some erosion on the right side and outfall area of the concrete-lined flume has been stabilized with rip-rap. The 24" CMP auxiliary spillway outfall shows some erosion/undercutting, the pipe is corroded away at the bottom of the outfall. (see Photos 21 to 24)

☑ Yes ☐ No ☐ N/A

3. For pipe spillways, is the intake obstructed in any way (such as with excessive debris)? If yes, describe (type of debris, reason for obstruction, etc.):

The concrete-lined approach flume leading to the OCS inlet is not obstructed. Water was not flowing over the flume at the time of the inspection. Water appears to be flowing under the concrete-lend flume as water was discharging below the flume discharge location through an opening in the OCS inlet wall (e.g. one brick missing) (see Photos 12 to 14).

☐ Yes ☑ No ☐ N/A

4. For pipe spillways, what is the condition of any trash racks (example, adequate, inadequate, damaged)?

N/A

5. For pipe spillways, are there any visible cracks, separations or holes in the pipe(s) (intake or outlet)? If yes, describe (location, width of crack or separation, etc.):

None observed in the 82' x 48" pipe-arch CMP (see Photos 15 and 16).

☐ Yes ☑ No ☐ N/A

6. For pipe spillways, are there any apparent leaks in the pipe(s)? If yes, describe (location, rate of flow from leak, etc.):

None observed (see Photo 15).

☐ Yes ☑ No ☐ N/A

7. For pipe spillways, how would you describe the overall condition of the pipe(s)? (Check all that apply)

☑ Functioning Normally ☐ Not Functional ☐ Deteriorated ☐ Damaged ☑ Adequate ☐ Inadequate

☐ Other (describe)

8. For concrete or earth channel spillways, is the entrance or channel obstructed in any way? If yes, describe (type of obstruction, location, etc.):

No obstructions of concern noted (see Photo 12).

☐ Yes ☑ No ☐ N/A

9. For earth channel spillways, how would you describe the vegetation in the spillway? (Check all that apply)

☐ Recently Mowed ☐ Overgrown ☐ Good Cover ☐ Sparse ☐ Other (describe)

Not Applicable. Spillways are concrete lined.

EMBANKMENT (EARTH) DAM INSPECTION FORM

10. For earth channel spillways, are there any trees or other inappropriate vegetation in the spillway? If yes, describe (type of vegetation, size, location, etc.):

    None observed.

    ☐ Yes ☑ No ☐ N/A

11. For earth channel spillways, are there any eroded areas in the spillway? If yes, describe (size of area, location, severity, etc.):

    None observed.

    ☐ Yes ☑ No ☐ N/A

12. For concrete channel spillways, are there any cracks or holes in the spillway? If yes, describe (width or crack or hole, location, etc.):

    The auxiliary concrete-lined flume extending from the roadway curb and gutter down to the downstream slope toe of the dam has a joint or crack about halfway down the slope that is open (1/4") that shows some movement towards the toe of the slope.

    ☑ Yes ☐ No ☐ N/A

13. For concrete channel spillways, are there any leaks or evidence of undermining (flow under the concrete)? If yes, describe (location, rate of flow from leak, indicators or undermining, etc.):

    See E.3 above (see Photo 13). Water is discharging at a rate of about 10 to 20 gpm (lake discharge base flow).

    ☑ Yes ☐ No ☐ N/A

14. For earth or concrete channel spillways, how would you describe the overall condition of the spillway? (Check all that apply)

    ☑ Functioning Normally ☐ Not Functional ☐ Deteriorated ☑ Damaged ☐ Adequate ☐ Inadequate

    ☑ Other (describe) Water draining under (undermined) the principal spillway entrance concrete-lined Flume.

15. Other observations on the spillways.

    N/A

F. *Instrumentation (refer to glossary for description)*

1. Are there any toe drains or any other seepage drains on the dam? If yes, describe the condition, (for example, clogged, free flowing, deteriorated, good condition):

   None Observed.

   ☐ Yes ☑ No

2. For drains, is an animal guard installed at the outlet of each drain? If no, which drains lack animal guards?

   N/A

   ☐ Yes ☐ No ☒ N/A

3. For drains, measure the rate of flow from each drain and record below (use additional pages if necessary.). See flow measurements below and updated historic data table attached with the additional data.

Designation/Location of Drain	Flow Rate (ml/sec)	Flow Rate GPM*	Turbidity of Flow (clear, muddy, etc.)

EMBANKMENT (EARTH) DAM INSPECTION FORM	
4. Are there any piezometers on the dam? If yes, describe the condition (for example, good condition, damaged, etc.): **There are two temporary 1" PVC Piezometers that were installed during a geotechnical exploration of the dam in 2014. Piezometers appear in good condition with PVC caps.**	☑ Yes ☐ No
5. For piezometers does each piezometer have a cap with lock? If no, which piezometers need caps (to prevent rain water intrusion) and/or locks (to prevent tampering)? **Caps on temporary piezometers are not locked (PVC cap only).**	☐ Yes ☑ No
6. For piezometers, are you able to take a measurement (depth to water) in each piezometer? If yes, record depth to water (in feet) in each piezometer, record on a separate page and attach to this form. **Piezometer water level measurements were not taken during the visual inspection. Refer to previous water level measurements in Draft Geotechnical Exploration Report dated November 6, 2014 by Wilmer Engineering Inc.**	☐ Yes ☑ No
7. Are there any other monitoring devises on the dam? If yes, describe what type and the condition (for example, monitoring wells – good condition, damaged, etc.): **No other monitoring devises were identified during the inspection.**	☐ Yes ☑ No
8. Other observations on instrumentation: ☑ N/A	
G. Photographs	
At a minimum, photographs should be taken of the crest, upstream slope, downstream slope, and any other notable features. List of photographs: See attached Photo Log with 27 photos with observations made during the inspection.	

N/A = Not Applicable

**GPM (gallons per minute): to convert from oz/sec multiply by 0.4688; to convert from ml/se multiply by 0.01585*

1.) Crest (Looking West) – Road Pavement Surface Cracking & Settlement; Poor Condition. Road pavement surface over the dam has longitudinal cracks and settlement along the west to east traffic lane as well as settlement. The side walk and road drainage curb & gutter also show cracking and differential settlement. The dam crest is 30 to 35 feet wide.	
2.) Crest (Looking West) – Road Pavement Surface Cracking & Settlement; Poor Condition. Road pavement surface area with longitudinal cracking and more pronounce settlement from about Road Sta. 521+00 to Sta. 522+25.	
3.) Crest (Looking West) – Road Side Walk and Curb & Gutter Settlement; Poor Condition. Side walk and curb & gutter show deferential settlement and translational movement towards the downstream slope near Road Sta. 520+75.	

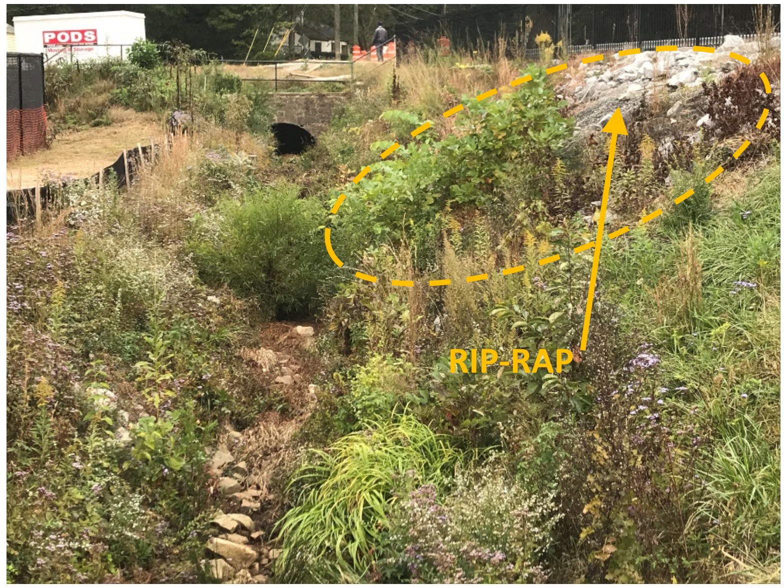
4.) Crest (Looking West) – Road Side Walk and Curb & Gutter Settlement; Poor Condition. Close up of side walk and curb & gutter showing deferential settlement and translational movement towards the downstream slope near Road Sta. 520+75.	
5.) Upstream Slope (Looking East) – Vegetation; Poor Condition. The slope is overgrown and prevents proper inspection for animal burrows, depressions/settlement, and instability. The slope is approximately 3h:1v. Approximately 2.5 ft. of freeboard.	
6.) Upstream Slope (Looking West) – Vegetation, Instability; Poor Condition. The slope is overgrown along the shoreline and prevents proper inspection for animal burrows. The slope surface above the pool level is irregular and appears to show a scarp of historic movement/sloughing near the crest.	

7.) Upstream Slope (Looking West) – Animal Burrows and/or Undermine; Poor Condition. The side walk along the upstream slope has a localized undermined area or animal burrow just west of the lake dock.	
8.) Downstream Slope (Looking West) – Vegetation & Instability; Poor Condition. The downstream slope has overgrown grassy vegetation and is locally steep that prevents for proper inspection for animal burrows and wet/seepage areas, including area near the toe/drain channel. The slope varies from 1h:1v to 2h:1v.	
9.) Downstream Slope (Looking North) – Instability; Poor Condition. The east slope (left slope) shows an area that has been stabilized with rip-rap and grouted pavers near the crest.	

10.) Downstream Slope (Looking West) – Vegetation & Instability; Poor Condition.

The downstream slope has overgrown grassy and shrubbery vegetation preventing proper inspection for animal burrows, wet/seepage areas, instability and erosion. The slope varies from 0.5h:1v (west end) to 2h:1v.

The west slope (right slope) shows an area that has been stabilized with grouted rip-rap from the crest to near the toe of the slope.



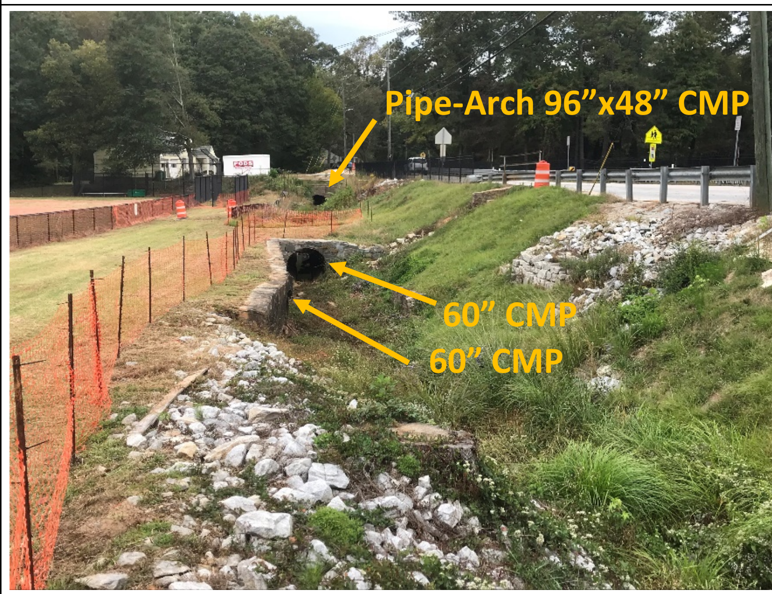
11.) Downstream Slope (Looking North) – Steep Slope & Retaining Wall Stability; Poor Condition.

There is a retaining wall at the west end (right side) of the downstream slope and channel running along the toe of the dam that is damaged; some stone blocks have been placed (not cemented) to provide some lateral support to the retain soils/slope. The slope is overgrown and prevents proper inspection. The downstream slope in this area is steep at about 0.5h:1v slope.

12.) Principal Spillway – Overflow Concrete Flume (Looking East) Poor to Fair Condition.

The concrete overflow flume leading to the overflow concrete inlet structure (OCS) looks in fair condition, however, water from the lake was not flowing over the concrete slab. The slab appears to be undermined and water is flowing under the slab (See Photo 13) into the OCS structure through an opening in the OCS brick wall. The flume is approximately 8 feet wide near the entrance, 6 feet wide at the OCS inlet and approximately 2 feet deep.

13.) Principal Spillway – Overflow Concrete Flume (Looking West) Poor Condition. Looking at water draining from the lake under the concrete overflow flume. Flowing at an estimated 15 to 20 gpm.	
14.) Principal Spillway – Overflow Concrete Structure (OCS) (Looking East) Fair Condition. Looking inside the OCS drop inlet. An 18” RCP pipe enters from the north side, a 24” CMP enters from the east, and the principal spillway pipe-arch 82” – 48” CMP pipe discharges to the south. The OCS drop inlet is approximately 5 x 7 feet in inside dimensions.	
15.) Principal Spillway – Discharge Pipe-Arch 82” – 48” CMP (Looking North-Upstream) Fair Condition. Looking inside the 82” – 48” Pipe-Arch CMP. Some sediment and rock cobles/boulders on the bottom of the pipe-arch. No evidence of pipe deformation or corrosion of concern noted.	

16.) Principal Spillway – Discharge Pipe-Arch 82"– 48" CMP (Looking North) Fair Condition. Looking at outfall of the Pipe-Arch 82" – 48" CMP. Some rock cobles/boulders on the bottom of the pipe. No evidence of pipe undercutting or corrosion of concern noted. Discharge channel protected with rip-rap.	
17.) Principal Spillway – Flow Away Channel/Toe Channel Erosion Protection (Looking North) Fair Condition. The flow away channel has overgrown grass which prevents proper evaluation for erosion and erosion protection. The toe channel appears to be lined with riprap along segments of the channel, if not all (covered with vegetation). A 60" CMP culvert is located halfway the flow away channel, and a 96" x 48" pipe-arch culvert is located at the far end of the open toe stream channel. Another 60" CMP drains out under the park ball field (See Photo 18).	
18.) Principal Spillway – Flow Away 60" CMP Culvert Under Park Ball Field (Looking South) - Obstructions Poor Condition. Inlet 60" CMP pipe partially discharging stream under the park ball fill. Pipe entrance is partially blocked with a fallen tree.	

19.) Principal Spillway – Flow Away Pipe-Arch 96" x 48" CMP Culvert (Looking West) - Obstructions Fair Condition. Entrance of 96" x 48" Pipe-Arch CMP at downstream end of flow away channel along toe of dam downstream slope. Some sediment present at the bottom of the pipe.	
20.) Abandoned Principal Spillway 12" to 18" CMP Riser (Looking North) Fair Condition. An abandoned (grouted) 12" to 18" CPM Riser is located within the lake on the east side of the dam. An abandoned drainpipe outlet on the dam downstream slope could not be located during the visual inspection. The pool level was about 6" to 12" below the top of the abandoned CMP riser.	
21.) Auxiliary 24" CMP Spillway Pipe – Corrosion (Looking Northwest) Poor Condition. An auxiliary 24" CMP is located on the east side of the lake just north of the dam west groin. Access to the observe the condition of the CPM pipe inlet was not available at the time of the inspection (locked gate entrance).	

22.) Auxiliary 24" CMP Spillway Pipe - Corrosion (Looking Northeast) Poor Condition. The auxiliary 24" CMP spillway pipe is corroded at the bottom of the pipe and shoes some undercutting. The pipe discharges south into an earthen channel that drains into a culvert under Norman Rd.	
23.) Auxiliary Roadway Concrete Flume Spillway (Looking North) - Erosion Poor to Fair Condition. An auxiliary roadway concrete flume spillway is located over the downstream slope on the east side (left) of the downstream slope. Some historic erosion was noted on the west slope above the concrete flume and at the flume discharge point. Some small rip-rap has been placed to protect the eroded areas.	
24.) Auxiliary Roadway Concrete Flume Spillway (Looking South) – Cracks Poor Condition. The concrete flume has a construction joint or crack down halfway the flume. The joint/crack shows some separation/movement down the slope.	

25.) Monitoring Devices – 1" PVC Temporary Piezometers (Looking North) Fair Condition. A 1" PVC temporary piezometer (B-6) located on the south side of the spillway channel (south of 60" CMP Culvert Area).	
26.) Monitoring Devices – 1" PVC Temporary Piezometers (Looking North) Fair Condition. A 1" PVC temporary piezometer (B-8) located on the downstream slope on the east side (left side) of the dam.	

27.) Clarkston Lake – General View (Looking North) – Fair to Good Condition

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GBC GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

Copyright 2015 by Geoprofessional Business Association (GBA). Duplication, reproduction, or copying of this document, or its contents, in whole or in part, by any means whatsoever, is strictly prohibited, except with GBA's specific written permission. Excerpting, quoting, or otherwise extracting wording from this document is permitted only with the express written permission of GBA, and only for purposes of scholarly research or book review. Only members of GBA may use this document as a complement to or as an element of a geotechnical-engineering report. Any other firm, individual, or other entity that so uses this document without being a GBA member could be commiting negligent or intentional (fraudulent) misrepresentation.