2020 Biennial Inspection Report

Flat River Reservoir Dam
Coventry, Rhode Island
RI Dam ID No. 167

Flat River Reservoir Dam - Aerial photo taken by RTG on May 11, 2020.

Submitted: June 2, 2020

Prepared By:

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Geotechnical Waterfront Structural Civil Geo-Environmental

RTG Project No. 20102.00

Prepared For:

Soscia Holdings, LLC
6 Silver Maple Drive
Coventry, RI 02816

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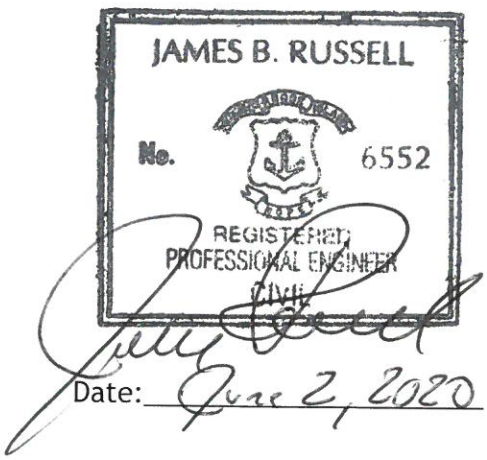
RI Dam ID No. 167

This Report was prepared under the direction of:



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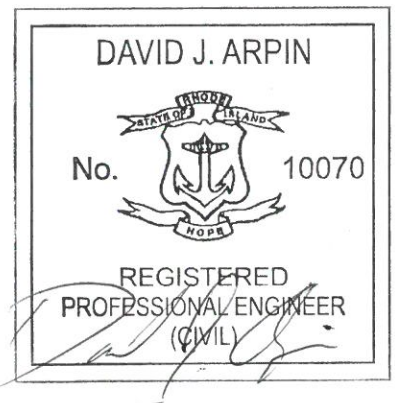

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1. Introduction

1.1 General

On May 11, 2020, RT Group, Inc. (RTG) performed the biennial (i.e., once every two years) inspection of the Flat River Reservoir Dam (the Dam). This visual inspection was performed for Soscia Holdings, LLC (SOSCIA) to provide an overall condition assessment of the Dam and its regulating structures. Summarized within this report are the results of the inspection and recommendations regarding needed repairs/maintenance.

The 2004 Biennial Inspection Report (RTG, June 2004) continues to be the authoritative document for providing detailed historical information regarding the Dam as well as the normal operating procedures and detailed engineering data. For brevity, and in an effort to provide a concise working report, the 2004 Biennial Inspection Report is referenced within this report whenever possible. A copy of the 2004 Biennial Inspection Report is available upon request.

1.1.1 Authority

SOSCIA recently acquired the Dam and the water rights/land beneath the Flat River Reservoir from the former owner, the Quidnick Reservoir Company (QRC). Accordingly, SOSCIA is now responsible for the operation of the Dam and its flow regulating structures. The Town of Coventry (the Town), by a separate lease agreement (QRC/Town, January 1, 2009), is responsible for performing routine maintenance (e.g., cutting/clearing brush, filling voids left from erosion, etc.) and making selected minor repairs (e.g., re-pointing stonework, footbridge repairs, etc.). We understand that SOSCIA and the Town have agreed to honor the previous agreement following the change in ownership.

1.1.2 Purpose and Scope

The purpose of this report is to provide an overall condition assessment of the Dam and its regulating structures in accordance with Rule 11, INSPECTIONS, of the RIDEM Rules and Regulations for Dam Safety (RIDEM, December 2007). The assessment is based on a review of existing information and the performance of a visual inspection. Subsurface investigations, laboratory testing, and detailed analyses (e.g., slope stability, hydraulic and hydrologic) were beyond the established Scope-of-Work. Based on the condition assessment, needed repairs and/or maintenance have been prioritized for implementation by SOSCIA and/or the Town.

1.2 Description of the Dam

1.2.1 Location

The Dam is located in the Town of Coventry, Kent County, Rhode Island (Figure 1-1). It is located on private property owned by SOSCIA and a dirt access road runs along the length of the Dam (Figure 1-2). The reservoir is surrounded by a mixture of low- to high-density residential housing, commercial property (e.g., camp grounds), and undeveloped woodlands.

1.2.2 Owner / Operator

The Dam is owned, operated, and maintained by SOSCIA, except as specified by a separate lease agreement with the Town. Operation is at the direction of SOSCIA and is carried out by their gatekeeper who lives at the Dam site. Contact information is provided below.

SOSCIA Holdings, LLC
6 Silver Maple Drive
Coventry, RI 02816
Contact: Mr. Greg Soscia, Member (401-439-1381)

Town of Coventry
1670 Flat River Road
Coventry, Rhode Island 02816-8911
Contact: Mr. Kevin McGee, Supt. Public Works (401-822-9110)

1.2.3 Purpose of Dam

The original purpose of the Dam was to impound water for power generation and process use by QRC member industries located downstream. Water impounded by the Dam is currently used for recreation and the water released to the Pawtuxet River is still used by downstream industries. Additionally, impounded and released water is important for the preservation of wetlands and wetland dependent plant and animal species.

1.2.4 General Description of Dam and Appurtenant Structures

The Dam was constructed in the late 1800's (a cut stone on one of the footbridge piers is engraved "1873") and consists of two earth embankments that extend from what appears to have been a natural island located in the middle of the south branch of the Pawtuxet River (Figure 1-2). Refer to the 2004 Biennial Inspection Report (RTG, June 2004) for more detail.

1.2.5 Size Classification

The Dam is an Intermediate Size Dam. Refer to the 2004 Biennial Inspection Report (RTG, June 2004) for more detail.

1.2.6 Hazard Classification

The Dam is a High Hazard Dam. Refer to the 2004 Biennial Inspection Report (RTG, June 2004) for more detail.

1.2.7 Normal Operating Procedure

SOSCIA owns, operates, and maintains the Dam, except as specified by a separate lease agreement with the Town. Refer to the 2004 Biennial Inspection Report (RTG, June 2004) for more detail.

1.3 Engineering Data

1.3.1 Design and Construction Records

Refer to the 2004 Biennial Inspection Report (RTG, June 2004) for more detail and note that in 2014 the existence of a concrete cut-off wall was reported within the south embankment of the Dam (Figure 1-2) (Refer to the 2014 Biennial Inspection Report, Photo Nos. 17 and 18).

In early May 2018, the Town completed loaming and seeding of a "Test Section" on the upstream slope and crest located south of the gate house (Figure 1-2) in accordance with plans previously submitted by RTG (RTG, May 15, 2013). During the completion of this work, it was found that along a portion of the "Test Section", the riprap that is currently visible at the toe of the upstream slope appears to continue up towards the crest beneath the surface of the upstream slope.

Based on the above findings, it is assumed that the riprap extends to the original crest of the Dam, and when it was raised in 1873, earth fill was placed directly over the riprap to its present-day configuration. It should be noted that the buried riprap was only present along about half of the length of the "Test Section" and may or may not be indicative of the upstream riprap configuration along the remainder of the north embankment or south embankment.

1.3.2 Drainage Area

The Flat River Reservoir drainage basin is about 57.5 square miles. The topography consists of rolling to flat terrain with elevations ranging from a high of about 680 feet down to about 247.8 feet at the spillway crest (Army Corps of Engineers Phase 1 Inspection Report, 1981) (all elevations in this report are referenced to NGVD 29).

1.3.3 Reservoir Length and Surface Area

Length (ft)

A. Length of Normal Pool	18,000
B. Width of Normal Pool	Varies
C. Length of Maximum Pool	Not Available (NA)
D. Width of Maximum Pool	NA

Surface Area (acres)

A. Area of Normal Pool	950
B. Area of Maximum Pool	NA

1.3.4 Storage

Storage (acre-feet)

A. Normal Pool	4,195

B. Maximum Pool	NA

1.3.5 Elevations

A. Top of Dam	255 ±
B. Spillway Crest/Normal Pool	247.8 ±
C. Spillway Design Flood	½ PMF (7,100 cfs)
D. SDF Surcharge	5.3 ft (EL 253.2 ±)
E. Normal Pool	247.8 ±
F. Spillway Crest	247.8 ±
G. Upstream Water at Time of Inspection	248.0 ±
H. Low-Level Outlet Structure	230 ±
I. Streambed at Toe of Dam	230 ±

Principal Spillway

A. Type	Broad Crested Weir
B. Length of Weir (ft)	195 (176 minus piers)
C. Weir Crest Elevation	247.8 ±
D. Downstream Channel	238.9 ±
E. Downstream Water	239.4 ±

Note: The above dimensions, elevations, and surface areas were obtained from the historical information obtained (e.g., Army Corps of Engineer's Phase 1 Inspection Report, historic transverse sections) and/or a topographic and bathymetric survey completed by RTG.

1.3.6 Regulating Outlets

At a pool elevation of about 253.5 feet (water surface elevation 1.5 feet below the embankment crest elevation of 255 feet), the existing spillway has an estimated hydraulic capacity of about 7,700 cubic feet per second (cfs). At this same pool elevation, the three (3) 48-inch-diameter low-level outlet pipes have an estimated hydraulic capacity of about 750 cfs. Therefore, the total combined hydraulic capacity at a pool elevation of 253.5 feet is estimated at about 8,500 cfs. At a pool elevation of about 254.0 feet (water surface elevation 1.0 feet below the embankment crest), the total combined capacity is estimated at about 9,500 cfs.

1.3.7 Post-Construction Changes

The Dam has experienced several changes since its construction. A brief synopsis of the major changes, based on the historical information available, was presented in the 2004 Biennial Inspection Report. In addition, the following repairs were recently completed at the Dam:

- In 2011, the Town hired a Contractor to complete downstream apron, footbridge, and outlet structure repairs, which were necessitated by the record flooding that occurred in March 2010.

- In 2016, the QRC hired a Contractor replace the timber trash rack and the three (3) low-level outlet timber sluice gates, along with other minor improvements to the gate guides, the upstream masonry face of the gate house, and the existing geared gate operators.

- In November of 2017, Walco Electric of Providence, RI (WALCO) rewound the north low-level outlet gate motor and replaced the oil inside of its actuator.

- In the Spring of 2018, the Town completed loaming and seeding improvements to an approximately 115-foot-long "Test Section" of the north embankment's upstream slope and crest located immediately south of the gate house (Figure 1-2). This work was completed in order to address the lack of grass cover that is prevalent throughout the Dam and that has led to localized areas of erosion.

2. Visual Inspection

Mr. David Arpin, P.E. /RTG and Ms. Allison Gilmore/RTG completed the visual inspection of the Dam between about 8:00 and 11:00 AM on Monday, May 11, 2020. RTG personnel were accompanied during portions of the visual inspection by Mr. Greg Soscia, Mr. Doug Soscia, and Mr. Bruce Soscia of SOSCIA, Mr. Bruce Hagerman of the Town, and Mr. Ken Goodwin of the Johnson's Pond Civic Association. RTG personnel were also assisted by Mr. John Fonseca/SOSCIA during the visual inspection of the gatehouse.

The visual inspection was completed on a sunny day with temperatures ranging from about 55 to 60 degrees (F). The inspection generally proceeded from north to south, starting at the spillway and ending at the south entrance gate (Figure 1-2). A summary of the inspection follows.

2.1 Spillway

The spillway is comprised of a stone masonry broad-crested weir, including five (5) bays which are separated by stone masonry piers supporting a timber footbridge. The downstream area consists of exposed bedrock at the northern two bays and a raised grouted riprap apron at the southern three bays (Photo Nos. 1 and 2). The spillway and downstream area are contained to the north and south by stone masonry abutments.

The footbridge piers were observed to be mostly in fair condition. However, open joints were observed in some of the piers and vegetation was observed to be growing from them in some areas. Vegetation was also observed growing along the top of the piers (Photo No. 3). It is recommended that this vegetation be removed to prevent it from loosening the stonework and that the open joints in the piers be cleaned and repointed with grout.

Overgrown vegetation was observed in front of and behind the north and south masonry abutments (Photo Nos. 4 and 5) as well as adjacent to the spillway in the upstream and downstream areas (Photo Nos. 6 and 7). The vegetation behind the abutment walls could dislodge their masonry stones or cause the abutments to collapse should the larger trees become uprooted. The vegetation in the spillway could obstruct flow during a significant storm event. It is recommended that this vegetation be removed and any resulting voids or soil disturbance filled by placing, grading, and compacting granular material followed by loam and seed.

Historically, seepage and voids (i.e., possibly where previous chinking stones had fallen out) have been observed at several locations along the downstream face of the spillway and in the north wall of the grouted riprap apron. However, water was flowing over the spillway and apron in these areas at the time of the inspection and seepage could not be observed. It is recommended that the seepage continue to be monitored by SOSCIA and the Town and any voids be re-chinked as required. In addition, it is recommended that the non-grouted sections of the riprap apron continue to be monitored by SOSCIA and the Town for signs of displacement and grouted if required.

Several timber boards/braces were observed to be splintered and/or loose along the footbridge and footbridge handrails with fasteners becoming dislodged (Photo No. 8). It is

recommended that all splintered and loose boards/braces and loose fasteners be repaired/replaced as required.

Overall, and in accordance with Rule 11, INSPECTIONS of the RIDEM Rules and Regulations for Dam Safety (RIDEM, December 2007), the spillway was observed to be in fair condition.

2.2 Downstream Channel

The channel located downstream of the spillway runs along the toe of the north embankment, where it converges with the channel located downstream of the low-level outlet pipes (Figure 1-2). The right side of the downstream channel consists of a masonry training wall that transitions to an earthen slope further downstream. An earthen slope is also present along the left side of the downstream channel with boulders in some areas.

Heavy vegetation including mature trees and undergrowth was observed within the downstream channel which could obstruct flow during a significant storm event (Photo No. 9). Vegetation is also present behind and in front of the masonry training wall and has dislodged stones in some locations (Photo No. 10). It is recommended that this vegetation be removed from the downstream channel and near the masonry training wall. It is also recommended that voids in the wall be filled with appropriately sized stones, and the entire wall re-chinked with smaller stones.

Overall, the downstream channel was observed to be in fair condition.

2.3 North Embankment

The north embankment is about 500 feet long and about 15 feet wide at the crest (Figure 1-2). The embankment is about 25 feet high (max) with side slopes ranging from about 1.75H: 1V (Upstream Slope) to about 1.6H: 1V (Downstream Slope). Access ways exists along the downstream slope facilitating vehicular access to the left and right sides of the downstream outlet structure (Figure 1-2, Photo No. 11).

A concrete cut-off wall is located within the north embankment and is approximately in line with the top of slope on the upstream side (refer to the 2004 Biennial Inspection Report for more detail). The presence of this cut-off wall was confirmed previously and water level readings taken in Monitoring Well Nos. RTG-SB-01 and RTG-SB-02 (Figure 1-2) during the inspection indicate that the cut-off wall is functioning, but that the water levels in the wells are trending higher, relative to previous inspections with similar impoundment elevations.

The higher water levels in the monitoring wells could be an indication that seepage through the cut-off wall is increasing (Appendix B). If this trend continues, it could adversely affect the stability of the downstream slope. Accordingly, it is recommended that the frequency of monitoring for these wells be increased to semi-annually until such time that the recommendations contained in the *Stability and Seepage Analyses Report* (RTG, December 23, 2009) can be implemented.

The grass cover on the upstream slope, crest, and downstream slope was observed to be sparse with frequent bare areas throughout containing little to no loam (Photo Nos. 12 and 13). In addition, overgrown woody vegetation exists along the toe of the upstream slope

(Photo No. 13), adjacent to the gatehouse on the upstream slope (Photo No. 14), and at the downstream slope in some areas (Photo No. 15). Some rodent holes were also observed in the dense vegetation on the downstream slope.

It is recommended that the overgrown woody vegetation be cut, removed, and maintained. It is also recommended that all rodent holes be backfilled with granular material and compacted by "rodding" with a metal probe followed by loaming and seeding. With respect to the lack of grass cover, it is recommended that bare areas be loamed and seeded (i.e., similar to the "Test Section") in order to establish a healthy stand of grass to help minimize the potential for erosion from rainwater runoff and/or wave action.

Based on our observations of the "Test Section" (Figure 1-2), there appears to be established grass cover in this area, but some bare spots still exist (Photo No. 16). It is recommended that this area be aerated and over-seeded this upcoming Fall in order to help further promote the establishment of grass cover. However, it should be noted that this repair and other loaming and seeding repairs along the upstream slope, are considered to be an interim repair until such time that the recommendations contained in the *Stability and Seepage Analyses Report* (RTG, December 23, 2009) can be implemented.

In previous inspections, carpenter ant infestation was observed throughout the north embankment and was believed to be contributing to the erosion of the embankment in some areas. The Town contracted with an exterminator to eradicate the ants which appeared to be mostly successful based on previous Dam inspections. While a substantial ant presence was not observed during the inspection, it is recommended that SOSCIA and the Town continue to monitor for ant colonies and reinitiate the eradication program as required to control the population. In addition, it is recommended that the areas of current and previous ant infestation be excavated and re-compacted with imported granular fill as part of the recommended loaming and seeding work in accordance with the previously submitted plans (RTG, May 15, 2013).

There is an access road which connects the north and south embankments and allows for vehicular traffic between the two areas (Figure 1-2). A portion of this access way was observed to be blocked by fallen tree branches during the inspection (Photo No. 17) and it is recommended that these tree branches be removed in order to maintain access.

Overall, the north embankment was observed to be in fair condition.

2.4 Gate House and Low-Level Outlet Pipes

The gate house is located on the upstream side of the north embankment towards its southern end (Figure 1-2, Photo No. 18). It houses the gate operators for the Dam's three (3) 48-inch-diameter low-level outlet pipes and their electric-powered actuators. The low-level outlet pipes are constructed of cast iron and extend from the gate house to a downstream concrete outlet structure where water is discharged to the downstream channel. A timber trash rack exists immediately upstream of the low-level outlet pipes.

During the inspection, the gates were exercised by SOSCIA's gate operator, Mr. John Fonseca. Each of the gates were opened to about ½ of the gate height and all operated smoothly while opening. However, the middle gate actuator shut down at one point while opening due to overheating (a thermal overload switch is a built-in safety feature of the

actuator to help prevent permanent damage). The actuator continued operating following about a 1-minute pause after the shutdown.

Based on the age of the actuators and the lack of an efficient alternative for opening the gates should they fail; it is recommended that SOSCIA replace the existing actuators with updated technology. This could include, but would not be limited to removing and replacing the existing geared operators. Also, and as noted in previous inspection reports, it is recommended that emergency backup power systems be installed at the gate house in order to operate the gates in the event of a power outage.

In July 2018, RTG and its diving Subcontractor, Cavanagh Marine (CAVANAGH), cleaned existing tuberculation from the interior walls of the low-level outlet pipes in selected areas and performed a visual inspection of the cleaned/exposed surface. The exposed walls of the pipes were observed to be in fair condition as described in the inspection summary letter provided to the QRC (RTG, September 5, 2018). Moving forward, it is recommended that an observational approach be employed for monitoring the condition of the pipes on a biennial basis. Accordingly, it is recommended that a follow-up inspection be performed this year.

Overall, the gate house and low-level outlet pipes were observed to be in fair condition.

2.5 Downstream Outlet Structure

As mentioned, the downstream outlet structure is located on the downstream side of the north embankment at its southern end (Figure 1-2, Photo No. 19). Dense woody vegetation was observed growing around this structure. It is recommended that this vegetation be removed and any resulting voids or soil disturbance filled by placing, grading, and compacting granular material followed by loam and seed.

In June 2017, RTG and CAVANAGH inspected the underwater portions of the downstream outlet structure and observed concrete spalling and void areas around the base of the outlet structure. It is recommended that these areas be repaired.

Overall, the downstream outlet structure was observed to be in fair condition.

2.6 South Embankment

The south embankment is about 700 feet long and about 15 feet wide at the crest (Figure 1-2). The embankment is about 10 to 12 feet high with side slopes ranging from about 1.75H: 1V (Upstream Slope) to about 2.3H: 1V (Downstream Slope). A counterweight berm exists on the downstream slope (Photo No. 20).

The grass cover on the upstream slope, crest, and downstream slope was observed to be patchy with frequent bare areas throughout containing little to no loam and grass (Photo No. 21). Also, woody vegetation exists at the toe of the upstream slope (Photo No. 22). Rodent/turtle holes were observed in some locations along the upstream and downstream slopes.

During the visual inspection, two (2) areas of scour/erosion were observed along the upstream slope located approximately 275 and 360 feet north of the south entrance gate of

the Dam (Photo Nos. 23 and 24). Riprap appears to have been placed at the scour area located 360 feet north of the gate. Erosion was also noted along the toe of the upstream slope in some areas, but was difficult to see due to the dense woody vegetation present along the toe.

It is recommended that the overgrown woody vegetation be cut, removed and maintained. It is also recommended that all rodent holes be backfilled with granular material and compacted by "rodding" with a metal probe followed by loaming and seeding. In addition, it is recommended that the crest and upstream slope along the south embankment be loamed and seeded similar to the "Test Section" in order to reduce the likelihood of future erosion.

As part of the above work, it is recommended that all existing scour/erosion areas be excavated to native material, the exposed surface be scarified, and the excavation be filled with compacted granular material (e.g., silty sand). Please note that the above are considered to be interim repairs until such time that the recommendations contained in the *Stability and Seepage Analyses Report* (RTG, December 23, 2009) can be implemented.

Ant infestation was observed throughout the south embankment along the crest and upstream slope (Photo No. 25). It is recommended that SOSCIA and the Town monitor the south embankment for ant colonies and initiate the eradication program in this location to help eliminate the ant colonies that were observed. In addition, it is recommended that the areas of current ant infestation be excavated and re-compacted with imported granular fill as part of the recommended loaming and seeding work in accordance with the previously submitted plans (RTG, May 15, 2013).

There is an existing primary toe-drain system located on the downstream slope of the south embankment (Figure 1-2). A secondary toe-drain extension was installed by the Town in 2003/2004 to mitigate the observed presence of standing water on the downstream slope of the south embankment (Figure 1-2). The primary and secondary toe-drain systems each have their own individual outlet (Figure 1-2) and both were observed to be flowing clear (i.e., no turbidity or cloudiness).

Three (3) handhole cleanouts were installed within the secondary toe-drain (Figure 1-2). The handholes were opened during the inspection and standing water was observed at varying depths below the surface in each of them (Photo No. 26). It is recommended that the secondary toe-drain be cleaned out with a water jet drain cleaner.

As noted in the 2016 Biennial Inspection (RTG, October 3, 2016), a fallen birch tree was observed just north of the secondary toe drain outlet. The tree's roots are exposed and some soil within the downstream slope was disturbed with seepage observed. It is recommended that the tree and its root system be removed and the area backfilled with compacted granular material, loamed, and seeded. Following this work, it is recommended that the downstream area be monitored for seepage.

Dense vegetation including mature trees and reeds exists on the downstream slope of the counterweight berm along the entire length of the south embankment (Photo No. 27). It is recommended that this vegetation be removed from the downstream slope of the counterweight berm and within 10 feet downstream of the toe of the counterweight berm. Any resulting voids or soil disturbance should be filled by placing, grading, and compacting granular fill followed by loam and seed.

Overall, the south embankment was observed to be in fair condition.

3. Current Operation and Maintenance Procedures

3.1 General

SOSCIA owns, operates, and maintains the Dam (except as specified by a separate lease agreement with the Town). See Section 1.2.2 for more detail.

3.2 Maintenance of Dam and Operating Procedures

Grass and brush is cut and mowed by the Town on an as needed basis. Selected repairs are also completed by the Town on an as needed basis.

3.3 Emergency Warning System

The Final Emergency Action Plan (EAP) for the Dam was submitted to the Rhode Island Emergency Management Agency (RIEMA) in September 2008. The Town is responsible for designating an EAP Coordinator and this individual is responsible for establishing training schedules, coordinating EAP exercises, and maintaining the EAP including reviews, updates, and distribution of the document.

4. Hydraulic and Hydrologic Data

4.1 Spillway Design Flood

In accordance with past RIDEM regulations, the recommended Spillway Design Flood (SDF) for this Intermediate and High-Hazard Dam is the ½ Probable Maximum Flood (PMF). Based on Hydrologic and Hydraulic (H&H) Analyses completed by RTG for the Arctic Dam project, located downstream of the Flat River Reservoir Dam, the ½ PMF routed outflow at the Flat River Reservoir Dam is estimated at about 7,100 cfs (RTG 2009).

4.2 Experience Data

Based on the historical information obtained, the highest recorded reservoir elevation prior to the March 2010 flooding was about 29 inches over the spillway (about EL 250.2 feet) in 1936 (Army Corps of Engineers Phase 1 Report, 1981). All three low-level outlet gates were reportedly open during the 1936 storm event.

During the March 2010 flooding, the reservoir elevation was about 45 inches over the spillway (about EL 251.6 feet), as reported by the gate keeper. This exceeded the previous record set in 1936 by 16 inches. Only one of the three low-level gates was reportedly open during the March 2010 flooding.

4.3 Overtopping Potential

The hydraulic capacity of the spillway and the three (3) 48-inch-diameter concrete pipes (fully open) is about 9,500 cfs, with about 1.0 feet of freeboard. Based on this, and as mentioned previously, the estimated hydraulic capacity is greater than the ½ PMF routed outflow and the Dam should not be overtopped during its recommended SDF.

In accordance with the *Stability and Seepage Analyses Report* (RTG, December 23, 2009), the upstream/downstream slopes of the North Embankment and the upstream slope of the South Embankment have inadequate Factors of Safety with respect to slope stability during many of the load conditions evaluated. Accordingly, while we estimate that the Dam has sufficient hydraulic capacity to pass the SDF, the recommendations contained in the referenced report should be implemented in order to help minimize the potential for a slope stability failure during the conditions evaluated, including the SDF.

5. Structural Stability

Please refer to the *Stability and Seepage Analyses Report* (RTG, December 23, 2009). Copies of this report were submitted to the QRC and Town and are available upon request.

6. Assessment and Recommendations

6.1 Overall Assessment

Based on the visual inspection completed, the Flat River Reservoir Dam is considered to be in fair condition. The following recommendations are presented in the same order as presented in the report and their corresponding locations are shown on Figure 6-1. The recommendations are ranked for action as follows:

(1) High Priority;
(2) Priority, but coordinate with other planned site activities; and
(3) Maintenance.

In past Biennial Inspection Reports, some dam safety recommendations (e.g., upstream and downstream slope improvements) were given a numeric ranking of "(4) Long-Term Improvement" in order to allow time for funding to be secured to address them. However, this funding has not been secured and these recommendations have not been implemented to date. Accordingly, RTG has eliminated the subject numeric ranking and if a recommendation was considered critical for maintaining the safety of the Dam, regardless of whether or not it was considered a long-term improvement, it has been given a ranking of (1).

6.2 Spillway

A. Remove vegetation from the footbridge piers and their masonry joints and clean and repoint pier joints as required (3);

B. Remove overgrown vegetation located behind the spillway abutments and within the spillway in both the upstream and downstream areas and fill any resulting voids or soil disturbance by placing, grading, and compacting granular material followed by loam and seed (3);

C. Continue to monitor the spillway and the downstream spillway apron for changes in seepage (i.e., increased rate, turbidity, discoloration, etc.) (3);

D. Re-chink the masonry spillway and downstream spillway apron walls as required (3);

E. Continue to monitor the non-grouted portions of the downstream spillway apron for displacement and grout if required (3); and

F. Repair/replace loose and splintered timber boards and braces along the footbridge and footbridge handrails (1).

6.3 Downstream Channel

G. Remove overgrown vegetation located within the downstream channel and near the masonry training wall and fill any resulting voids or soil disturbance by placing,

grading, and compacting granular material followed by loam and seed (for areas along the side of the channel) or by placing riprap (for areas within the channel) (per Rule 10, Approvals of the RIDEM Rules and Regulations for Dam Safety {RIDEM, December 2007}, a Professional Engineer should be retained to plan the removal of trees 6 inches in diameter and larger) (3); and

H. Replace missing stones and re-chink the masonry training wall (3).

6.4 North Embankment

I. Implement semi-annual monitoring of the monitoring wells to help ascertain if seepage through the cut-off wall is increasing (1);

J. Remove heavy vegetation growing along the toe of the upstream slope, the upstream slope near the gate house, and the downstream slope adjacent to the Downstream Outlet Structure and fill any resulting voids or soil disturbance by placing, grading, and compacting granular material followed by loam and seed (3);

K. Backfill rodent holes with granular material and compact by "rodding" with a metal probe followed by loaming and seeding (1);

L. Loam and seed the crest and upstream slope in a similar manner to the "Test Section" along the remainder of the north embankment in order to reduce the likelihood of future erosion (please note that this is considered an interim repair until such time that recommendation "P" below can be implemented) (2);

M. Aerate and over-seed along the crest and upstream slope of the "Test Section" in the Fall (3);

N. Monitor ant colonies along the north embankment (3);

O. Excavate the previous areas of ant infestation, and re-compact with imported granular fill (complete prior to implementing recommendation "P" below (2); and

P. Implement the upstream and downstream slope improvements as outlined in the *Stability and Seepage Analyses Report* (RTG, December 23, 2009) (1).

6.5 Gate House and Low-Level Outlet Pipes

Q. Rehabilitate the low-level outlets (e.g., slip-lining, cured in place pipe, etc.) (1);

R. Replace the existing electric-powered actuators in their entirety, which could include removing and replacing the existing geared operators (1); and

S. Perform a biennial dive inspection of the low-level outlet pipes (1).

6.6 Downstream Outlet Structure

T. Remove overgrown vegetation located around the downstream outlet structure and fill any resulting voids or soil disturbance by placing, grading, and compacting granular material followed by loam and seed (3); and

U. Repair the downstream outlet structure below the waterline (1).

6.7 South Embankment

V. Remove heavy vegetation growing along the toe of the upstream slope and fill any resulting voids or soil disturbance by placing, grading, and compacting granular material followed by loam and seed (3);

W. Backfill rodent/turtle holes with granular material and compact by "rodding" with a metal probe followed by loaming and seeding (1);

X. Loam and seed the crest and upstream slope in a similar manner as the "Test Section" along the entire south embankment in order to reduce the likelihood of future erosion (please note that this repair is considered to be an interim repair until such time that recommendation "FF" below can be implemented) (2);

Y. Repair the upstream scour/erosion areas as described previously (2);

Z. Eradicate the ant colonies that have appeared on the crest and upstream slope of the south embankment (2);

AA. Excavate the previous areas of ant infestation, and re-compact with imported granular fill (complete prior to implementing recommendation "FF" below) (2);

BB. Clean out the secondary toe-drain piping (1);

CC. Remove the fallen birch tree and its root system and fill any resulting voids or soil disturbance by placing, grading, and compacting granular material followed by loam and seed (1);

DD. Continue to monitor the seepage occurring at the downstream toe (3);

EE. Remove the dense vegetation from the counterweight berm downstream slope and within 10 feet downstream of the toe of the counterweight berm along the entire length of the south embankment. Fill any resulting voids or soil disturbance by placing, grading, and compacting granular material followed by loam and seed (per Rule 10, Approvals of the RIDEM Rules and Regulations for Dam Safety {RIDEM, December 2007}, a Professional Engineer should be retained to plan the removal of trees 6 inches in diameter and larger) (3);

FF. Implement the upstream slope improvements as outlined in the *Stability and Seepage Analyses Report* (RTG, December 23, 2009) (1).

6.8 General

GG. Clear the fallen tree branches from the access road located between the north and south embankments in order to maintain access (3); and

HH. Complete regular updates to the EAP (1).

7. Implementation

7.1 Design

SOSCIA should engage the services of a Professional Engineer experienced in the design and repair of earth dams to prepare plans and specifications for completing recommended repairs.

7.2 Permitting

SOSCIA should engage the services of a Professional Engineer to prepare the permit applications required for completing the recommend repairs. Note that the RIDEM Rules and Regulations for Dam Safety (RIDEM, December 2007) provide for an expedited permitting process for the repair of High and Significant Hazard Dams.

7.3 Temporary Construction Easements

SOSCIA owns the Dam and access to it. Therefore, temporary/permanent easements are not expected to be required from any abutting private owners or the Town.

7.4 Supporting Documents

Supporting documents for the Dam include the EAP and O&M instructions for the operation of the low-level outlet gate actuators that are posted in the gate house. As mentioned, the EAP should be updated regularly by the Town.

7.5 Estimated Costs

Detailed cost estimates are beyond our current Scope-of-Services. In addition, and in accordance with the existing Lease Agreement, the Town is responsible for completing some repairs while SOSCIA is responsible for others. Based on this, cost estimates are not being provided as part of this Biennial Inspection Report. If detailed cost estimates are required, RTG can provide these under separate cover upon request.

Figures

LOCATION MAP

Graphic Scale 1"=4,000'

4,000' 2,000' 0 4,000' 8,000'

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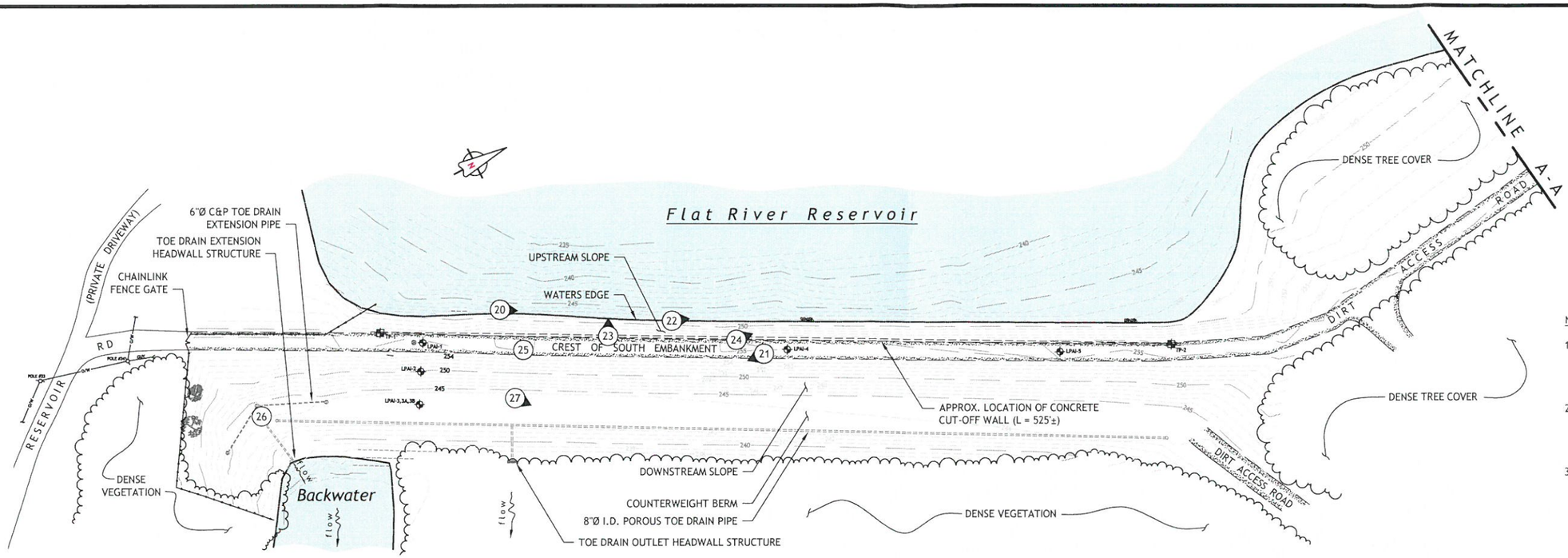
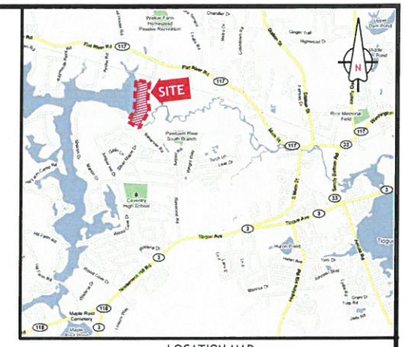
2020 BIENNIAL INSPECTION
FLAT RIVER RESERVOIR DAM
COVENTRY, RHODE ISLAND
Soscia Holdings, LLC

FIGURE 1-1
SITE VICINITY MAP

SHEET 1 of 3
DATE JUN. 2020
PROJ No. 20102.00

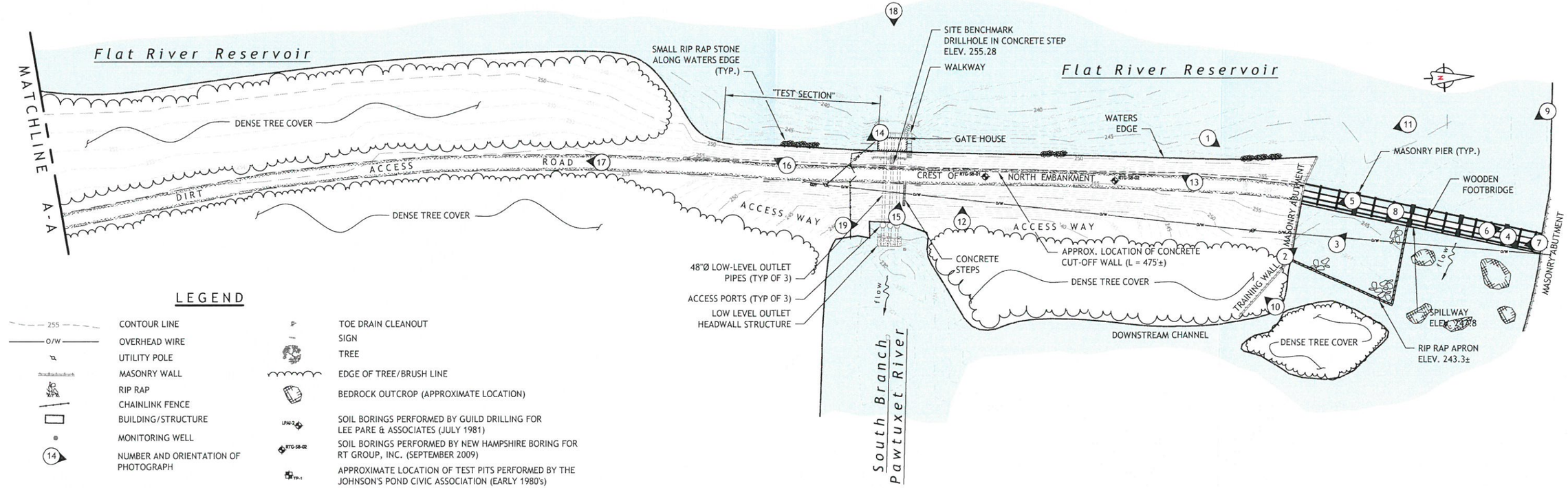




LOCATION MAP

NOTES:

1. EXISTING TOPOGRAPHIC AND BATHYMETRIC INFORMATION SHOWN ON THIS PLAN WAS OBTAINED FROM A FIELD SURVEY PERFORMED BY RT GROUP, INC. BETWEEN JULY 28, 2009 AND AUGUST 7, 2009.
2. THE FIELD SURVEY WAS PERFORMED TO DEVELOP A PROJECT SITE PLAN FOR UNDERTAKING REPAIRS/IMPROVEMENTS AT THE FLAT RIVER RESERVOIR DAM. THE SURVEY WAS NOT PERFORMED TO ESTABLISH PROPERTY LINES/BOUNDARIES.
3. VERTICAL DATUM BASIS IS NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29). ELEVATION ESTABLISHED BY RT GROUP, INC. USING OFF-SITE GEODETIC SURVEY DISK LW1061, EL. 257.39 (NGVD 29)



LEGEND

- CONTOUR LINE
- OVERHEAD WIRE
- UTILITY POLE
- MASONRY WALL
- RIP RAP
- CHAINLINK FENCE
- BUILDING/STRUCTURE
- MONITORING WELL
- NUMBER AND ORIENTATION OF PHOTOGRAPH
- TOE DRAIN CLEANOUT
- SIGN
- TREE
- EDGE OF TREE/BRUSH LINE
- BEDROCK OUTCROP (APPROXIMATE LOCATION)
- SOIL BORINGS PERFORMED BY GUILD DRILLING FOR LEE PARE & ASSOCIATES (JULY 1981)
- SOIL BORINGS PERFORMED BY NEW HAMPSHIRE BORING FOR RT GROUP, INC. (SEPTEMBER 2009)
- APPROXIMATE LOCATION OF TEST PITS PERFORMED BY THE JOHNSON'S POND CIVIC ASSOCIATION (EARLY 1980's)

Graphic Scale 1"=80'

80' 40' 0 80' 160'

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FLAT RIVER RESERVOIR DAM
COVENTRY, RHODE ISLAND
Soscia Holdings, LLC

FIGURE 1-2
SITE PLAN

SHEET 2 of 3
DATE JUN. 2020
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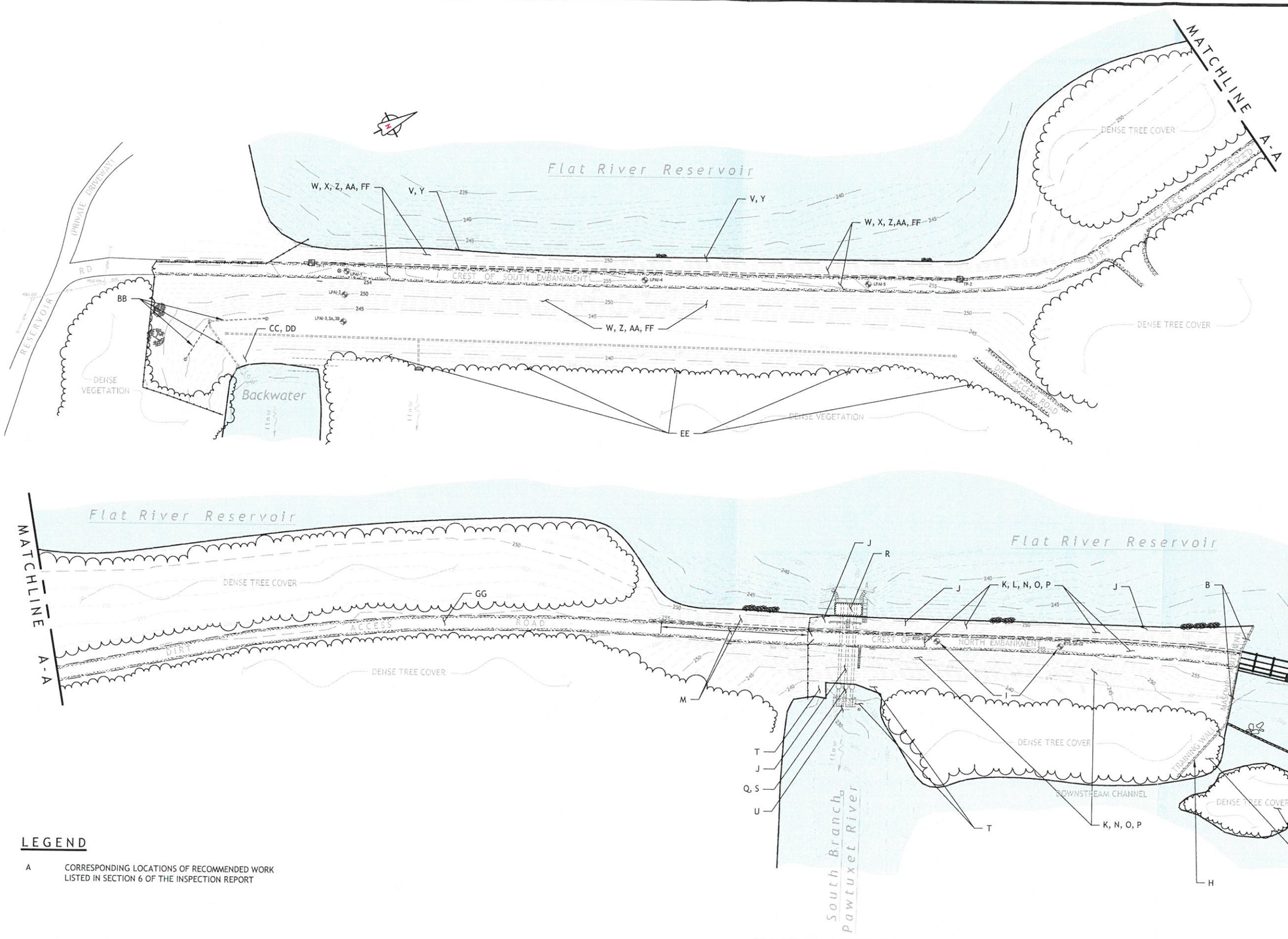

LEGEND

A CORRESPONDING LOCATIONS OF RECOMMENDED WORK LISTED IN SECTION 6 OF THE INSPECTION REPORT

Graphic Scale 1"=80'

80' 40' 0 80' 160'

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FLAT RIVER RESERVOIR DAM
COVENTRY, RHODE ISLAND
Soscia Holdings, LLC

FIGURE 6-1
OBSERVED DEFICIENCIES AND RECOMMENDATIONS PLAN

SHEET 3 of 3
DATE JUN. 2020
PROJ No. 20102.00

Appendix A
Photographs

Photo No. 1:
Spillway, looking northeast,
photo taken on May 11, 2020.

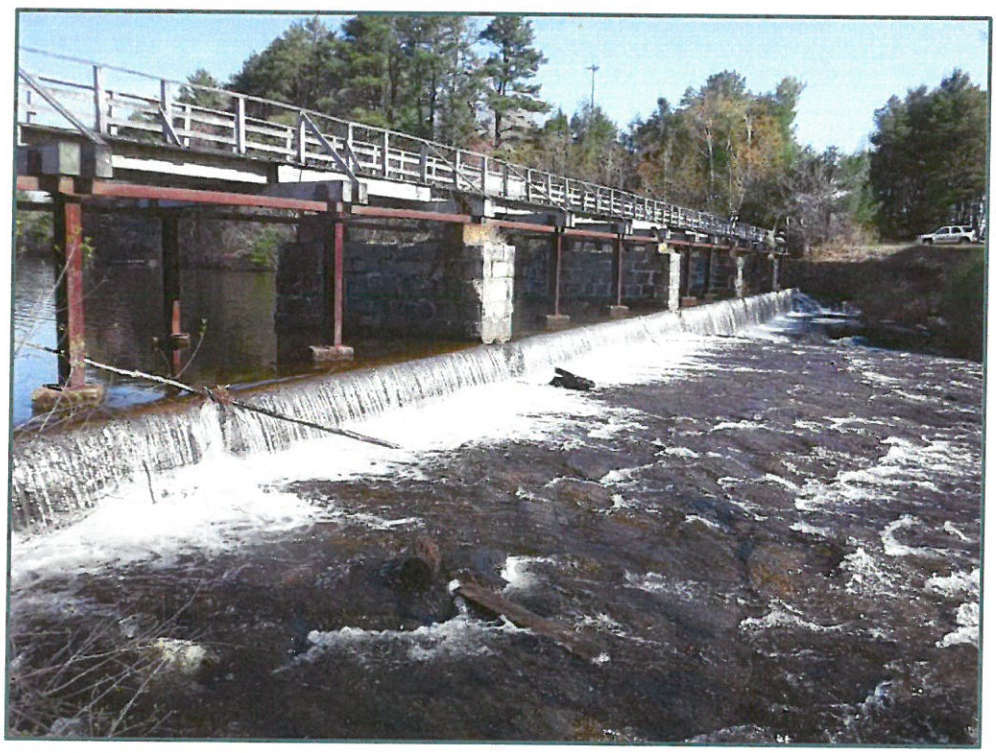


Photo No. 2:
Spillway, looking north,
photo taken on May 11, 2020.

Photo No. 3:
Vegetation growing along the top of the spillway piers and open joints within the spillway piers with vegetation, looking northwest, photo taken on May 11, 2020.

Photo No. 4:
Overgrown vegetation in front of and behind the north abutment wall, looking northeast, photo taken on May 11, 2020.

Photo No. 5:
Overgrown vegetation behind the south abutment wall, looking south, photo taken on May 11, 2020.

Photo No. 6:
Overgrown vegetation along the left side of the upstream spillway area, looking north, photo taken on May 11, 2020.

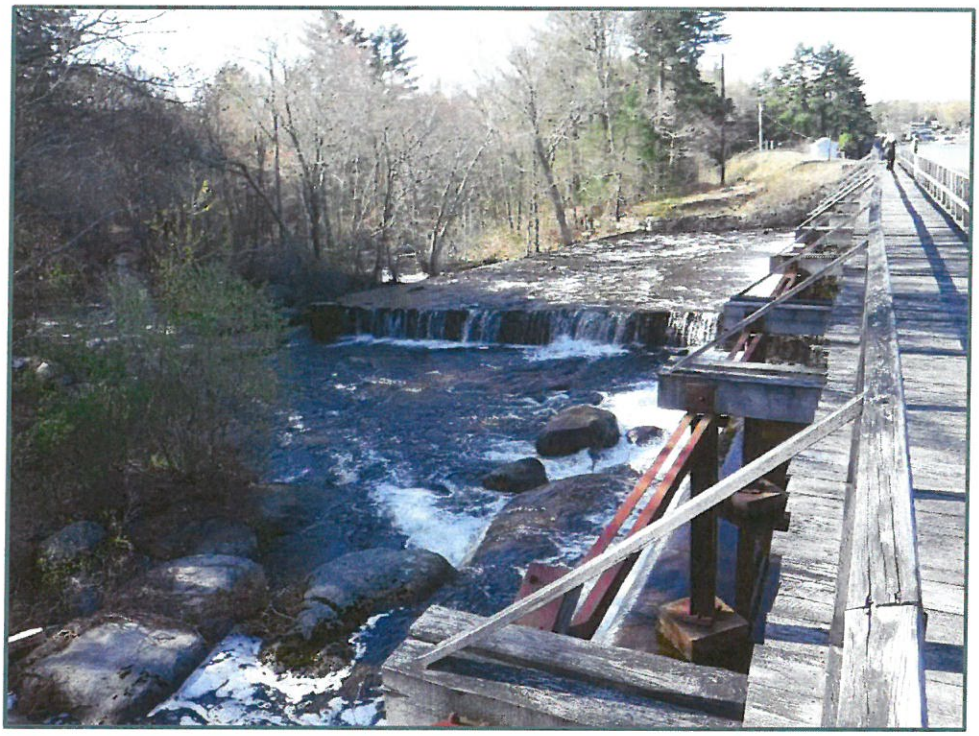


Photo No. 7:
Overgrown vegetation along the left side of the downstream spillway area, looking south, photo taken on May 11, 2020.

Photo No. 8:
Loose timber handrail and fastener along the timber footbridge, looking southeast, photo taken on May 11, 2020.

Photo No. 9:
Downstream channel, looking southeast,
photo taken on May 11, 2020.

Photo No. 10:
Voids within and heavy vegetation at the downstream masonry training wall,
looking southwest, photo taken on May 11, 2020.

Photo No. 11:
North embankment, looking south,
photo taken on May 11, 2020.

Photo No. 12:
Typical sparse grass cover along the downstream slope of the north embankment,
looking west, photo taken on May 11, 2020.

Photo No. 13:
Typical sparse grass cover along the crest/upstream slope and overgrown woody vegetation along the base of the upstream slope of the north embankment, looking southwest, photo taken on May 11, 2020.

Photo No. 14:
Overgrown woody vegetation along the upstream slope of the north embankment near the gate house, looking southeast, photo taken on May 11, 2020.

Photo No. 15:
Overgrown woody vegetation along the downstream slope of the north embankment, looking west, photo taken on May 11, 2020.

Photo No. 16:
"Test Section" at the crest and upstream slope of the north embankment, looking southwest, photo taken on May 11, 2020.

Photo No. 17:
Fallen tree branches obstructing the access way between the north and south embankments, looking south, photo taken on May 11, 2020.

Photo No. 18:
Gatehouse and downstream outlet structure, looking east, photo taken on May 11, 2020.

Photo No. 19:
Thick woody vegetation near the downstream outlet structure, looking north,
photo taken on May 11, 2020.

Photo No. 20:
South embankment, looing northeast,
photo taken on May 11, 2020.

Photo No. 21:
Sparse vegetative cover and bare areas on the crest and downstream slope of the South Embankment, looing south, photo taken on May 11, 2020.

Photo No. 22:
Woody vegetation along the toe of the upstream slope of the South Embankment, looing northeast, photo taken on May 11, 2020.

Photo No. 23:
Scoured/eroded area along the upstream slope of the south embankment about 275 feet north of the south gate, looking northwest, photo taken on May 11, 2020.

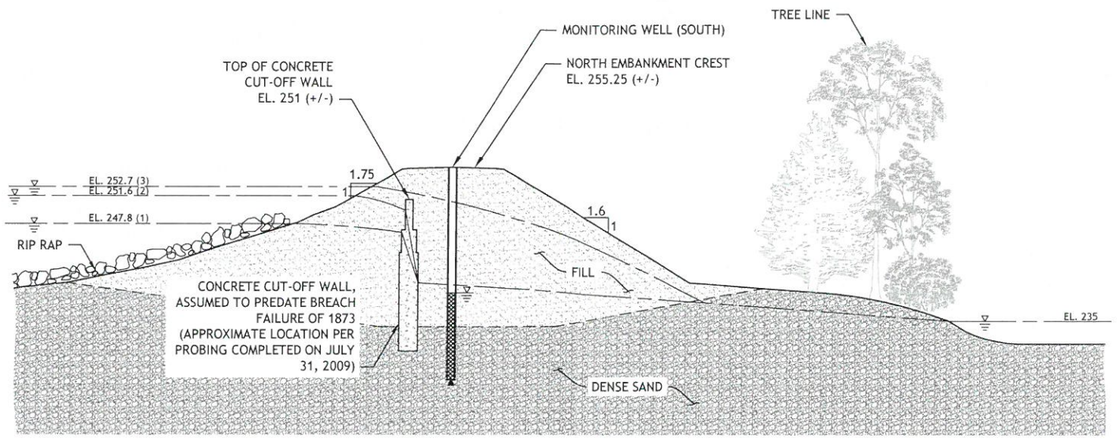
Photo No. 24:
Scoured/eroded area along the upstream slope of the south embankment about 360 feet north of the south gate, looking north, photo taken on May 11, 2020.

Photo No. 25:
Ant colony along the crest of the south embankment, looking down, photo taken on May 11, 2020.

Photo No. 26:
Standing water within the secondary toe-drain cleanout, looking down, photo taken on May 11, 2020.

Photo No. 27:
Heavy vegetation along the downstream side of the counterweight berm, looking northeast, photo taken on May 11, 2020.

Appendix B
Monitoring Well Data



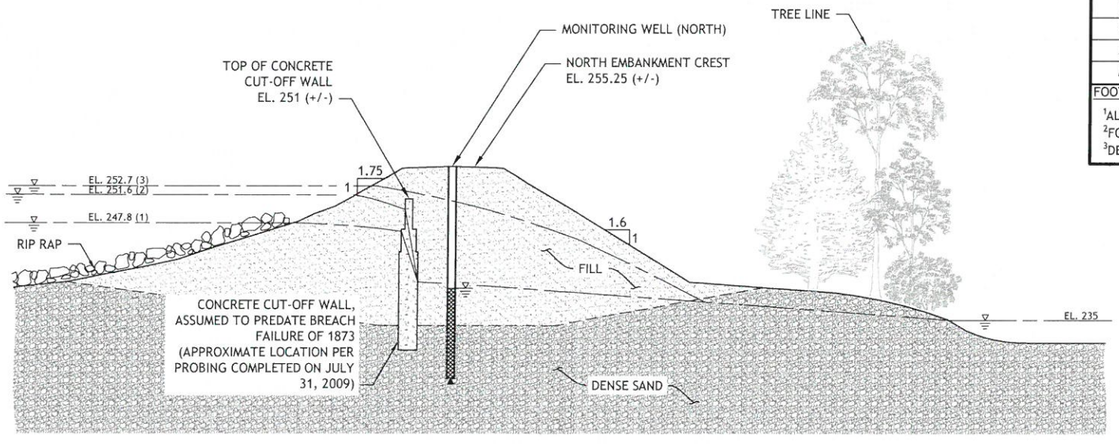
SECTION AT RTG-SB-01

SCALE: 1" =20'-0"

MONITORING WELL LOG					
DATE	IMPOUNDMENT ELEVATION (FT)[1,2]	MONITORING WELL			
		RTG-SB-01		RTG-SB-02	
		DEPTH (FT)[3]	ELEVATION (FT)[1]	DEPTH (FT)[3]	ELEVATION (FT)[1]
September 1, 2009	248.0	17.32	237.93	15.91	239.34
May 21, 2012	247.8	16.55	238.70	16.08	239.17
May 12, 2014	247.5	16.20	238.80	15.50	239.38
May 18, 2016	247.9	16.15	238.85	15.52	239.36
May 30, 2018	247.8	16.16	238.84	15.56	239.32
May 11, 2020	248.0	15.73	239.27	15.32	239.56

FOOTNOTES:

[1]ALL ELEVATIONS ARE REFERENCED TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
[2]FOR REFERENCE, THE TOP OF THE SPILLWAY CREST IS EL. 247.8 FT.
[3]DEPTH MEASURED FROM THE TOP OF CASING.



SECTION AT RTG-SB-02

SCALE: 1" =20'-0"

NOTES:

1. THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN SOIL BORINGS AND PROBES. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE SPECIFIC LOCATION AND ON THE DATES INDICATED. SOIL AND ROCK CONDITIONS, AND WATER LEVELS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURING AT THE BORING LOCATIONS. ALSO THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE CONDITIONS AT THE SOIL BORING LOCATIONS.
2. ALL ELEVATIONS SHOWN ARE IN REFERENCE TO NGVD 1929.
3. WATER ELEVATION SHOWN ASSUMES THAT ALL THREE LOW-LEVEL OUTLET GATES ARE OPEN.

FOOTNOTES:

(1) = NORMAL OPERATING CONDITION
(2) = HIGHEST OBSERVED (MARCH 2010)
(3) = ½ PMF

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APPENDIX B
MONITORING WELL DATA

SHEET 1 of 1
DATE JUN. 2020
PROJ No. 20102.00