-- STILLWATER RESERVOIR DAM --
VISUAL
INSPECTION / EVALUATION REPORT

Dam Name: ***Stillwater Reservoir Dam***

State Dam ID#: ***108***

Owner: ***RIDEM Division of Fish & Wildlife***

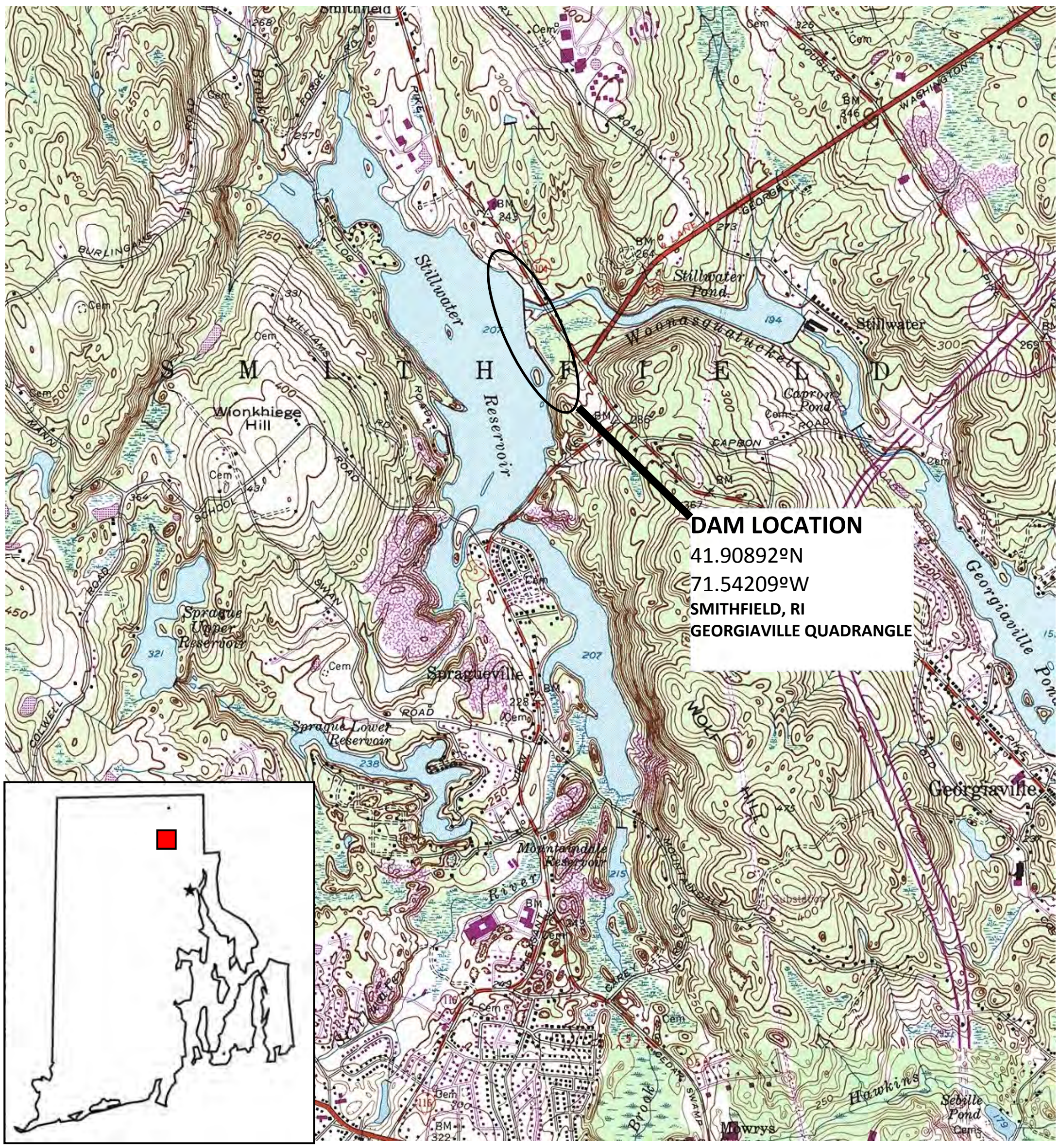
Town: ***Smithfield***

Consultant: ***Pare Corporation***

Date of Inspection: ***August 15 & 19, 2014***

INSPECTION SUMMARY

Dam Name (No):	Stillwater Reservoir Dam (108)
Location:	Smithfield
Hazard Classification:	High
Inspector:	David M. Matheson, P.E.
Inspection Date:	August 15 & 19, 2014



When describing the dam, "left" and "right" refer to the respective sides of the dam as viewed when facing downstream (with normal flow of water).

PREFACE

The assessment of the general condition of the dam reported herein was based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations were beyond the scope of this report unless reported otherwise.

In reviewing this report, it should be realized that the reported condition of the dam was based on observations of field conditions at the time of inspection, along with data available to the inspection team.

It is critical to note that the condition of the dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the reported condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

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Senior Vice President

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1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

The RIDEM Office of Compliance and Inspection has retained Pare Corporation of Foxboro, Massachusetts and Lincoln, Rhode Island to perform a visual inspection and develop a report of conditions for the Stillwater Reservoir Dam along the Woonasquatucket River in Smithfield, Rhode Island. This inspection and report were performed in accordance with current Rhode Island laws.

RIDEM will develop an overall condition rating based upon the data presented herein. It is understood that this rating will consider operational and structural deficiencies and will be presented under separate cover.

1.1.2 Purpose of Work

The purpose of this investigation was to inspect and evaluate the present condition of the dam and appurtenant structures in accordance with current dam safety regulations to provide information that will assist in both prioritizing dam repair needs and planning/conducting maintenance and operation.

The investigation was divided into three parts: 1) obtain and review reports, investigations, and data pertaining to the dam and appurtenant structures available within the Rhode Island Department of Environmental Management files; 2) perform a visual inspection of the site; and; 3) prepare and submit a final report presenting the evaluation of the structure, including recommendations and remedial actions.

1.1.3 Definitions

To provide the reader with a better understanding of the report, definitions of commonly used terms associated with dams are provided in Appendix B. Many of these terms may be included in this report. The terms are presented under common categories associated with dams which include: 1) orientation; 2) dam components; 3) hazard classification; 4) general; and 5) condition rating.

1.2 Description of Project

1.2.1 Location

The Stillwater Reservoir Dam is located in the town of Smithfield approximately a mile south of the town center. The dam impounds water along the Woonasquatucket River to form Stillwater Reservoir (also known as Stump Pond or Woonasquatucket Reservoir) and is situated along the eastern edge of the impoundment near coordinates 41.90892ºN/71.54209ºW. Please refer to the inspection summary for a locus plan depicting the area of the dam and its immediate surroundings.

To reach the dam from I-295, take exit 8B and merge onto RI-7 North/Douglas Pike/Douglas Turnpike toward North Smithfield. Turn left onto RI-116 North/George Washington Highway/Washington Highway after less than a mile. After 1.2 miles, turn right onto Farnum

Pike/RI-5. After about 0.3 miles, the dam and left dike will be on the left via a public parking area. To reach the right dike, take a right out of the public parking area onto Farnum Pike. After about ¼ mile, there will be a gravel based vehicle access path on the right with a locked bar gate. The dike is located about 600 feet up the path.

1.2.2 Owner/Caretaker

The dam is owned by RIDEM Division of Fish & Wildlife, who is responsible for operations and maintenance. The Owner's contact, Ms. Christine Dudley, Deputy Chief – Freshwater Fisheries, can be reached at 401-789-0281.

1.2.3 Purpose of the Dam

According to internet resources[1], Stillwater Reservoir Dam was built in 1853 to supply water for the manufacturing industry and was rebuilt in 1918. The dam currently impounds water for recreational purposes.

1.2.4 Description of the Dam and Appurtenances

EMBANKMENTS

The Stillwater Reservoir Dam is divided into three embankment sections as follows (from left to right):

<u>Left Dike:</u> The left dike is an approximate 500-foot long, 20-foot high earthen embankment with a riprap-protected upstream slope, an approximate 8-foot wide vegetated crest, and a vegetated downstream slope. Both the upstream and downstream slopes are about 2.5H:1V.

<u>Main Embankment:</u> The main embankment abuts the right side of the left dike and is broken into 2 subparts; the left embankment and the right embankment as referenced to the primary spillway.

The left embankment is an approximate 570-foot long, 30-foot high, earthen embankment supported along its upstream side by a vertical concrete wall, an approximatey 10-foot wide crest covered with grass and concrete sidewalks. A grassed downstream slope of approximately 3H:1V defines the downstream slope of the embankment. A boat ramp consisting of a concrete approach followed by concrete pavers that extend into the impoundment is located at the transition between the left dike and the left embankment.

The right embankment is an approximate 40-foot long earthen embankment with a riprapped and vegetated upstream slope at approximately 2.5H:1V, an approximate 20-foot wide vegetated crest, and a vegetated downstream slope at about 3H:1V.

<u>Right Dike:</u> The right dike is an approximately 600-foot long earthen embankment located about 400 feet right of the main embankment. The cross section of the left dike is similar in shape and construction to the left dike except the downstream slope is covered with riprap to protect this section during an overtopping event.

[1] http://www.geocaching.com/geocache/GC4PRA2_historic-smithfield-stump-pond?guid=54b89584-449a-4d71-93f4-3f39f4fadf73

APPURTENANT STRUCTURES

There are 4 appurtenant structures including a primary spillway, primary spillway by-pass outlet, a low-level outlet, and an auxiliary spillway.

Primary Spillway: The primary spillway is located on the right side of the main embankment. This structure consists of an approximate 100-foot wide uncontrolled concrete overflow section with concrete training walls. After water passes over the weir, it flows over a gently sloping concrete apron to the natural stream channel.

Primary Spillway By-pass Outlet: The primary spillway by-pass outlet consists of an approximate 3-foot wide gated concrete sluiceway built into the left side of the primary spillway with an invert about 8-feet below the normal pool line. An aluminum sluicegate and associated hand-wheel-operated controls can be accessed via a steel grate-platform near the upstream side of the spillway. The approach opening is protected by a steel trash rack. Once water flows through the gate, it enters an open channel delineated by the primary spillway left training wall and an internal concrete wall. Waters ultimately discharge into the primary spillway discharge channel near the end of the training wall.

Low Level Outlet: A low level outlet is located near the center of the main embankment and consists of 2 underground conduits with inverts near the base of the dam. The gates that control the flows within these conduits are located within a concrete gatehouse structure built adjacent and beyond the upstream wall. Discharge flows are transported through the dam and exit at an approximately 100-foot long concrete headwall at the downstream toe to a natural stream channel. After about 300 feet, the low level discharge channel converges with the channel from the primary spillway.

Auxiliary Spillway: In 2005, the right dike embankment was armored to perform as an auxiliary spillway to provide additional capacity.

1.2.5 Operations and Maintenance

The RIDEM Division of Fish & Wildlife is responsible for operations and maintenance at the dam.

1.2.6 Hazard Potential Classification

In accordance with current classification procedures under State of Rhode Island dam safety rules and regulations, Stillwater Reservoir Dam has been classified as a High hazard potential dam by RIDEM.

2.0 INSPECTION

2.1 Visual Inspection

Stillwater Reservoir Dam was inspected on August 15 & 19, 2014. At the time of the inspection, the outside temperature was near 70°F with mostly cloudy skies. Photographs to document the current condition of the dam were taken during the inspection and are included at the end of this report. The level of the impoundment appeared to be at normal operating levels. Underwater areas were not inspected as part of the field activity.

For reference purposes, a baseline was established along the crest of the dam and dike structures with Station 0+00 located at the left side/abutment of the Left Dike and extended to Station 21+60 at the right side/ abutment of the Right Dike. Observations are reported in relation to their location along the baseline as noted herein.

2.1.1 General Findings

Stillwater Reservoir Dam was found to have an overgrown left dike and right dike, a low level outlet whose gates operate with difficulty, hairline cracking along the full length of the upstream wall and sidewalk, hairline cracks along the primary spillway training walls, a crack along the boat ramp, and an overgrown embankment right of the primary spillway, and other dam safety deficiencies. The specific concerns are identified in more detail in the sections below:

2.1.2 Dam and Dike Embankments

The following was noted along the main embankment and along the two dikes during the inspection:

MAIN DAM EMBANKMENT

Upstream Side

- Left embankment:
    - The alignment of the wall appeared regular.
    - As brought to the inspector’s attention by the Owner’s representative, a distinct pattern of hairline cracks are present along the wall. Isolated vertical cracks appear to be spaced between 3 and 5 feet on center along the length of the wall. The cracks appear to extend through the wall and into the adjacent concrete sidewalk.
    - No cracks, separations, or signs of unusual movements were observed at the connection with the primary spillway.
    - A ¼ inch crack is present within the concrete approach at the boat ramp located at the connection with the left dike. The crack is oriented from upstream to downstream with no apparent differential settlement noted from one side of crack to the other.
    - No erosion or sinkholes were observed behind the wall.
    - No animal activity was noted.

- Right embankment:
  - Erosion is present along the shoreline near the primary spillway right training wall with shifted riprap and bare soils (Photo No. 10).
  - The slope above the riprap is vegetated with tall grass and weeds, obstructing views of the surface.

Crest

- Left embankment:
  - As noted in the wall section above several sequential hairline cracks were noted along the wall system which appeared to carry over to the sidewalk near the wall.
  - No holes, depressions, rutting, signs of puddling, and animal activity were observed.
  - The elevation of the crest appeared even with no low areas observed.
  - Along the downstream side of the crest, the surface is covered with a well-maintained grass that appears full and healthy.
  - No cracks, separations, or signs of unusual movements were observed at the contact with the left dike and at the contact with the primary spillway.
- Right embankment:
  - The surface of the crest along the right embankment is overgrown with tall grass and weeds, obstructing views of the surface.

Downstream Side

- Left embankment:
  - No seepage, wet, or soft areas were observed along the surface of the downstream slope.
  - There were no signs of slides, sloughing, holes, erosion, or animal activity.
  - No cracks, separations, or signs of unusual movements were observed at the connection with the left and at the connection with the primary spillway.
  - The ground surface is covered with well-maintained grass with an isolated area of thinning grass between the low level outlet and the primary spillway.
- Right embankment:
  - The surface of the downstream slope along the right embankment is overgrown with tall grass and weeds, obstructing views of the surface limiting inspection.

LEFT DIKE EMBANKMENT

The left dike is overgrown with tall grass and weeds which obstructed views of the surface along the upper sides of the upstream slope, most of the crest, the entire downstream slope and toe, preventing a full inspection. The following observations were made:

- A grassed path created by foot traffic is present along the crest. The elevation of the path surface appeared level.
- The upstream shoreline was visible with an even coverage of riprap and no signs of erosion.
- The right and left abutment contacts were visible. No cracks or signs of unusual movement were noted at the points of contact.

RIGHT DIKE EMBANKMENT/AUXILIARY SPILLWAY

- The right dike is overgrown with tall grass and weeds similar to that observed along the left dike, preventing a full inspection. Viewable areas were limited to the shoreline, a path along the crest, and its abutment contact areas.
  - The elevation of the path along the crest appeared level.
  - The riprap along the shoreline was observed with full coverage and no signs of erosion.
  - No cracks or unusual movement were observed at the left and right abutment contact areas.

2.1.3 Appurtenant Structures

Primary Spillway

- At the time of the inspection, about 1-inch of water was passing over the spillway limiting the inspection of the approach and downstream side. However, the spillway appears sound with no significant cracking or signs of unusual movement.
- The training walls appear to have a regular alignment with no deficiencies. Similar to that observed along the main embankment wall and sidewalk, a distinct pattern of hairline cracks were observed up and down the training walls at approximately 3 to 5 feet on center.
- Water appeared to spill over the weir evenly with no interruptions in flow.
- The approach area opens into the impoundment. No debris was noted.
- The discharge area consists of a natural stream channel and is clear of debris.

Primary Spillway By-pass Outlet

- The by-pass outlet intake was underwater, preventing inspection.
- Part of the trash rack in front of the intake opening protruded above water with no deficiencies observed.
- The above-water areas of the headwall and the downstream face of the discharge headwall (before the open channel) appeared structurally sound with no deficiencies observed.
- No erosion was observed at the end of the open channel.
- Both the approach and discharge areas were clear of debris.
- No leakage was observed from the end of the closed conduit when the gate was closed.
- The caretaker successfully operated the gate with no apparent difficulties in turning the hand wheel.

Low Level Outlet

- The dam that was rebuilt in the early 1900s included a low level outlet consisting of two gate-control conduits with the controls contained within the gatehouse. The gates are operated with geared-actuators operated with circular hand wheels. The caretaker reported that the gates were rehabilitated over the past 10 years; however, they are still difficult to open and the owner prefers not to use these as there is a concern with not being able to close them. Therefore all operations to lower the reservoir are completed at the primary spillway outlet by-pass.
- The gatehouse structure appeared structurally sound.

- The approach openings were underwater, preventing inspection of the openings, condition of trash racks, sediment accumulation, and debris assessment.
- Both gates and their associated internal conduits were not inspected.
- The downstream concrete headwall appeared to have a regular alignment with no structural deficiencies noted.
- Erosion was observed along both sides of the downstream wall with bare soils and apparent crushed stone placed for maintenance-level repairs (Photo Nos. 58 and 59).
- No seepage was observed along the base of the downstream headwall; however, iron oxide staining is present along the face of the downstream headwall near the tailwater line. The source of the iron oxide discharge was not apparent as the staining appeared consistent across the length of the wall.
- No holes or depressions were observed behind the downstream headwall or along the alignment of the underground conduits through the dam.
- The low level outlet discharge area was clear of debris.

2.1.4 Downstream Area

The area directly downstream of the dam is a primarily wooded for about 1,000 feet before encountering Farnum Pike/RI-5 where the river channel crosses under a bridge. Beyond Farnum Pike, the river flows between industrial facilities and then turns to the right and crosses under a second bridge at Washington Highway/RI-116 then enters a valley before spilling into Stillwater Pond, through Stillwater Pond Dam #109 (about 5,000 feet downstream of the dam), into Capron Pond, and through Capron Pond Dam #110 (about 7,300 feet downstream of the dam).

2.1.5 Reservoir Area

The dam is situated along the edge of the reservoir. The impoundment is approximately 1,500 feet wide (west to east) and 4,000 feet long (north to south). The perimeter of the impoundment is generally wooded with light residential developments and apparently stable slopes. Flows enter into the impoundment from its most northern point via Woonasquatucket River.

2.1.6 Caretaker Interview

Mr. David Palumbo Jr., RIDEM Fish & Wildlife Employee, was present during a portion of the inspection. Information provided by Mr. Palumbo has been incorporated into this report.

2.2 Operation and Maintenance Procedures

An Operations and Maintenance (O&M) Manual was not available for review during the inspection. It is unknown if this plan exists.

2.2.1 Operational Procedures

Operable components include 2 low level outlet gates controlled from within the gatehouse and the primary spillway by-pass outlet gate.

The primary spillway by-pass outlet gate is used to maintain required minimum flow releases during low impoundment conditions, to draw down the impoundment in anticipation of storm events, and for scheduled maintenance purposes.

It was reported that the 2 low level outlet gates are difficult to operate and will require 2 or more workers to turn each handwheel. The caretaker prefers not to use these gates due to the concern that the gate(s) may seize or gate stem(s) may break during operation and become stuck in the open position.

2.2.2 Maintenance of Dam and Operating Facilities

A $2.4 million reconstruction project was completed in 2005. As paraphrased from an online article from votesmart.org, dated October 26, 2005[2]:

> The primary spillway, located on the western (right) edge of the main embankment, has been completely rebuilt to the previous width and crest elevation measurements, and has the capacity to withstand a 100-year flood event. A gated outlet has been incorporated into the primary spillway so that water can continue to be provided via regulated flow to the Smithfield wastewater treatment plant downstream during drought conditions. With modifications, the bypass channel can serve as a fish ladder in the future.
>
> Both the north (left) and south (right) dikes of the dam have been completely rebuilt to provide easy maintenance of the low back slopes as well as erosion protection from storm events. To bring the dam up to current standards, an emergency (auxiliary) spillway has been constructed on the south dike to handle overflow flooding in the case of an approximately 500-year storm event. A new, paved, 16-vehicle parking lot, with drainage improvements, and a refurbished gate house structure completed the work.

Scheduled maintenance appears to be limited to mowing the dam embankment between the primary spillway and the left dike area, maintaining clear approach and discharge areas at the 2 outlets and the primary spillway.

[2] http://votesmart.org/public-statement/134286/governor-celebrates-completion-of-high-hazard-stillwater-reservoir-dam-reconstruction#.VHNe_Gd0zZ4

3.0 ASSESSMENTS AND RECOMMENDATIONS

3.1 Assessments

The Stillwater Reservoir Dam was found to have the following deficiencies:

1. The left dike, right dike, and the embankment between the right side of the primary spillway and the gravel knoll are overgrown with tall grass and weeds, limiting viewing and access for inspection.
2. Surface erosion is developing along the shoreline right of the primary spillway, and along the low level outlet discharge shoreline right and left of the headwall.
3. The 2 low level outlet gates are difficult to operate.
4. A 1/4 inch crack is present along the boat ramp.
5. Pattern cracking along the upstream walls and sidewalk, and along the primary spillway training walls.

The following recommendations and remedial measures generally describe the recommended approach to address current deficiencies at the dam. Prior to undertaking recommended maintenance, repairs, or remedial measures, the applicability of environmental permits needs to be determined for activities that may occur within resource areas under the jurisdiction of RIDEM or other regulatory agencies.

3.2 Recommendations

The following present additional studies, routine and recurrent operations and maintenance activities, and repairs recommended for addressing deficiencies noted during the inspection and the completion of this report. The recommendations provided below should be implemented in accordance with general dam safety practice. Further, if left unaddressed, many of the conditions identified above will continue to deteriorate and could compromise the future safety of the dam and appurtenant structures.

1. Regular maintenance activities should be continued to control and prevent growth of unwanted vegetation including mowing along the crest, roadway upkeep, clearing the approach and discharge areas at the low level outlet, and clearing the approach at the primary spillway.

    a. The following deficiencies can be addressed through scheduled maintenance-level tasks:

        - Cut the tall vegetation and remove trimmings from:
            - The left dike along the upstream slope, crest, and downstream slope to at least 15 feet beyond the toe.
            - The right dike along the upstream slope, crest, and downstream slope to at least 15 feet beyond the toe.
            - The embankment right of the primary spillway along the upstream slope, crest, and downstream slope to at least 15 feet beyond the toe.
        - Restore the following eroded areas:
            - The embankment shoreline right of the primary spillway.
            - Right and left of the of the low level outlet downstream headwall.

b. The continuation of scheduled clearing and mowing (i.e. late spring and fall) is recommended to keep the vegetation from returning along the entire dam embankment including the vegetation within the upstream riprap and within the primary spillway's discharge channel. The clearing should extend to within or to 15 feet beyond the downstream toe. When brush is cut down, it should be removed from the dam to permit a clear view of the embankment.

c. Vegetation removal, mowing, and fertilizing should be continued and performed at least twice per year to allow a clear view of the riprap and grassed surfaces. Mowing at longer intervals will likely require that the clippings be bagged and disposed of offsite or fully mulched to limit the build-up of thatch and the potential for choking of the grass.

2. Following the clearing of the overgrown and inaccessible areas described within this report, perform a follow-up inspection on the condition of these areas.

3. Complete an inspection/evaluation of the low level outlet gates to develop repair options. This may include completing inspections from within a floor access panel (if present), dive inspections, and/or an ROV video inspection from within the culverts.

   a. Based on the results of the low level outlet inspection and evaluation, repair the gates and/or opening mechanisms to a safe operable condition. It is standard practice to include a low level outlet or other means by which to draw down the level of the impoundment for all dams.

4. Fill the crack at the boat ramp with a sealed caulking system.

5. Develop and implement a program for monitoring the hairline cracks observed along the concrete at the upstream side of the dam and along the primary spillway training walls. Revisiting the condition of the cracks at the time of each biennial (i.e., 2-year) inspection is considered an adequate starting frequency. If the condition of the cracks get worse (i.e., become wider, increased number) it is recommended to decrease the monitoring intervals under the direction and evaluation of a licensed professional engineer experienced in concrete design.

6. Develop and implement a program for monitoring the stained areas along the low level outlet discharge area. The iron oxide staining along the headwall may indicate the presence of leakage through the embankment or out of the low level outlet discharge openings. The monitoring program should include looking for concentrated areas of staining, areas of suspended iron oxide flocculate within the tailwater, and swirling water along the surface (possible leakage exit). During times of low tailwater, periodically inspect the toe of the downstream wall for signs and of leakage. If leakage is found, record flow rate(s) and the respective height of the impoundment. If any of these conditions are found, review the findings with a registered professional engineer experienced in dam repair.

7. Implement a program of regular inspection and monitoring of the dam. As the dam is currently classified as a high hazard potential dam, the completion of a formal visual inspection by a RI registered professional engineer familiar with dam engineering is required every 2 years.

3.3 Alternatives

At this time, the dam is functioning as designed with maintenance level deficiencies; therefore, no additional studies or alternative repair measures are presented at this time.

COMMON DAM SAFETY DEFINITIONS

For a comprehensive list of dam engineering terminology and definitions refer to State of Rhode Island Rules and Regulations for Dam Safety, or other reference published by FERC, Dept. of the Interior Bureau of Reclamation, or FEMA.

Orientation

Upstream – Shall mean the side of the dam that borders the impoundment.
Downstream – Shall mean the high side of the dam, the side opposite the upstream side.
Right – Shall mean the area to the right when looking in the downstream direction.
Left – Shall mean the area to the left when looking in the downstream direction.

Dam Components

Dam – means any barrier made by humans, including appurtenant works that impounds or diverts water.
Embankment – means the fill material, including but not limited to rock or earth, placed to provide a permanent barrier that impounds water.
Crest – Shall mean the top of the dam, usually provides a road or path across the dam.
Abutment – Shall mean that part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment.
Appurtenant Works – means any ancillary feature of a dam including such structures as dikes, training walls, spillways, either in the dam or separate there from, low level outlet works, and water conduits such as tunnels, channels, pipelines or penstocks, either through the dam or its abutments.
Spillway – means a structure, a low area in natural grade or any part of the dam which has been designed or relied upon to allow normal flow or major flood flow to pass over or through while being discharged from a reservoir.

Hazard Classification

High Hazard – means a dam where failure or misoperation will result in probable loss of human life.
Significant Hazard – means a dam where failure or misoperation results in no probable loss of human life but can cause major economic loss, disruption of lifeline facilities or impact other concerns detrimental to the public's health, safety or welfare. Examples of major economic loss include but are not limited to washout of a state or federal highway, washout of two or more municipal roads, loss of vehicular access to residences, (e.g. a dead end road whereby emergency personnel could no longer access residences beyond the washout area) or damage to a few structures.
Low Hazard – means a dam where failure or misoperation results in no probable loss of human life and low economic losses.

General

EAP – Emergency Action Plan – Shall mean a predetermined (and properly documented) plan of action to be taken to reduce the potential for property damage and/or loss of life in an area affected by an impending dam failure.
O&M Manual – Operations and Maintenance Manual; Document identifying routine maintenance and operational procedures under normal and storm conditions.
Normal Pool – Shall mean the elevation of the impoundment during normal operating conditions.
Acre-foot – Shall mean a unit of volumetric measure that would cover one acre to a depth of one foot. It is equal to 43,560 cubic feet. One million U.S. gallons = 3.108 acre feet.

Height of Dam– means the vertical distance from the elevation of the uppermost surface of a dam to the lowest point of natural ground, including any stream channel, along the downstream toe of the dam.
Hydraulic Height – means the height to which water rises behind a dam and the difference between the lowest point in the original streambed at the axis of the dam and the maximum controllable water surface.
Maximum Water Storage Elevation – means the maximum elevation of water surface which can be contained by the dam without overtopping the embankment section.
Spillway Design Flood (SDF) – Shall mean the flood used in the design of a dam and its appurtenant works particularly for sizing the spillway and outlet works, and for determining maximum temporary storage and height of dam requirements.
Maximum Storage Capacity – The volume of water contained in the impoundment at maximum water storage elevation.
Normal Storage Capacity – The volume of water contained in the impoundment at normal water storage elevation.

Condition Rating

Unsafe – Means the condition of a regulated dam, as determined by the Director, is such that an unreasonable risk of failure exists that will result in a probable loss of human life or major economic loss. Among the conditions that would result in this determination are: excessive vegetation that does not allow the Director to perform a complete visual inspection of a dam, excessive seepage or piping, significant erosion problems, inadequate spillway capacity, inadequate capacity and/or condition of control structure(s) or serious structural deficiencies, including movement of the structure or major cracking.*
Poor – A component that has deteriorated beyond a maintenance issue and requires repair. The component no longer functions as it was originally intended.
Fair – Means a component that requires maintenance
Good – Meeting minimum guidelines where no irregularities are observed and the component appears to be maintained properly.

* Structural deficiencies include but are not limited to the following:

- Excessive uncontrolled seepage (e.g., upwelling of water, evidence of fines movement, flowing water, erosion, etc.)
- Missing riprap with resulting erosion of slope
- Sinkholes, particularly behind retaining walls and above outlet pipes, possibly indicating loss of soil due to piping, rather than animal burrows
- Excessive vegetation and tree growth, particularly if it obscures features of the dam and the dam cannot be fully inspected
- Deterioration of concrete structures (e.g., exposed rebar, tilted walls, large cracks with or without seepage, excessive spalling, etc.)
- Inoperable outlets (gates and valves that have not been operated for many years or are broken)

REFERENCES AND RESOURCES

The following reports were located within PARE's archived project files and through internet research:

1. Various internet sources as referenced within this report.

2. "Phase II Dam Inspection/Evaluation Report. Stillwater Reservoir Dam, RI #108" Louis Berger & Associates, Pare Engineering Corporation, 1999.

The following were referenced during the completion of the visual inspection and preparation of this report and the development of the recommendations presented herein:

1. "Design of Small Dams", United States Department of the Interior Bureau of Reclamation, 1987

2. "ER 110-2-106 - Recommended Guidelines for Safety Inspection of Dams", Department of the Army, September 26, 1979.

3. "Guidelines for Reporting the Performance of Dams" National Performance of Dams Program, August 1994.

The following provides an abbreviated list of resources for dam owners to locate additional information pertaining to dam safety, regulations, maintenance, operations, and other information relevant to the ownership responsibilities associated with their dam.

1. RIDEM Office of Compliance and Inspection Website: http://www.dem.ri.gov/programs/benviron/compinsp/

2. "Dam Owner's Guide To Plant Impact On Earthen Dams" FEMA L-263,September 2005

3. "Technical Manual for Dam Owners: Impacts of Plants on Earthen Dams" FEMA 534, September 2005

4. "Dam Safety: An Owners Guidance Manual" FEMA 145,December 1986

5. Association of Dam Safety Officials – Website: www.asdso.org/

6. "Dam Ownership – Responsibility and Liability", ASDSO

VISUAL DAM INSPECTION
LIMITATIONS

Visual Inspection

1. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of this report.

2. In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection, along with data available to the inspection team. In cases where an impoundment is lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions, which might otherwise be detectable if inspected under the normal operating environment of the structure.

3. It is critical to note that the condition of the dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Use of Report

4. The applicability of environmental permits needs to be determined prior to undertaking maintenance activities that may occur within resource areas under the jurisdiction of any regulatory agency.

5. This report has been prepared for the exclusive use of the RIDEM for specific application to the reference dam site in accordance with generally accepted engineering practices. No other warranty, expressed or implied, is made.

6. This report has been prepared for this project by PARE. This report is for preliminary evaluation purposes only and is not necessarily sufficient to support design of repairs or recommendations or to prepare an accurate bid.

Photo No. 1: An overview of the dam as seen from the Left Dike (beyond the left abutment of the dam).

Photo No. 2: The upstream side as seen from the left abutment.

Photo No. 3: A crack within the concrete at the top of the boat ramp located near the left abutment. The width of the crack was measured at 1/4 inch wide.

Photo No. 4: Continuous hairline crack along the sidewalk and through the upstream wall as viewed from the left abutment looking right.

Photo No. 5: View of the cracks along the sidewalk and upstream wall at the left-most wall section (near the left abutment) looking upstream.

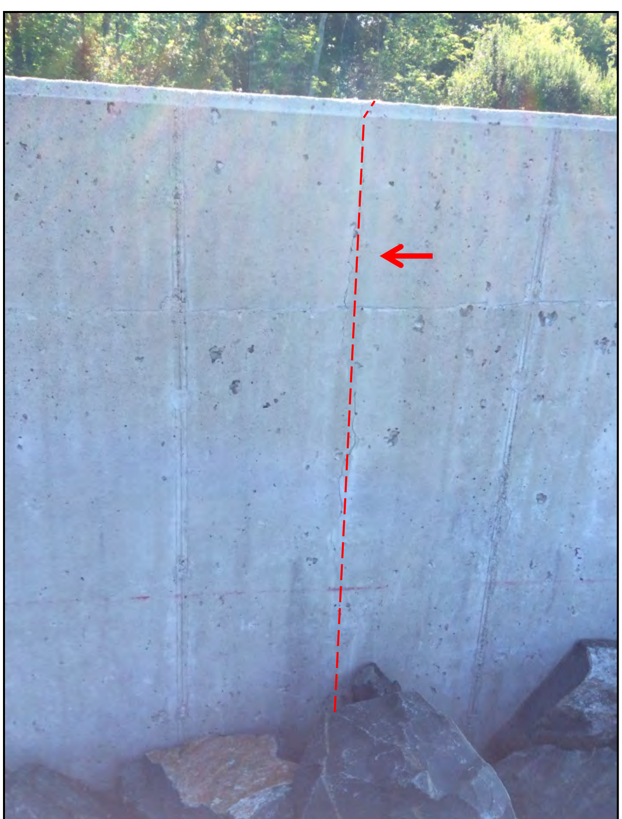


Photo No. 6: Typical cracks along the upstream wall extend through the wall. This is a photo of the upstream face at the second wall section from the left abutment.

Photo No. 7: The upstream side as seen from right of the gatehouse looking right.

Photo No. 8: The upstream side and crest as seen from left of the primary spillway looking left.

Photo No. 9: The upstream slope right of the primary spillway as viewed from the adjacent waterline right of the spillway approach. Note the heavy overgrowth that prevented inspection.

Photo No. 10: An eroded area behind the primary spillway left upstream wingwall looking downstream.

Photo No. 11: An overview of the crest as seen from the left abutment.

Photo No. 12: The downstream slope as seen from the left abutment.

Photo No. 13: The downstream slope as viewed from right of the gatehouse looking right.

Photo No. 14: A view of the concrete steps leading up to the gatehouse structure.

Photo No. 15: The downstream slope as seen from near station 10+00 looking left.

Photo No. 16: The downstream slope right of the primary spillway as viewed from the crest looking downstream. Note the tall grass and weeds.

Photo No. 17: An overview of the impoundment as seen from left of the primary spillway.

Photo No. 18: Left Dike: The upstream slope as seen from the left abutment.

Photo No. 19: Left Dike: The upstream slope as viewed from the right abutment.

Photo No. 20: Left Dike: An overview of the crest as seen from the left abutment. Note the vegetation along both the upstream and downstream shoulders, limiting inspection.

Photo No. 21: Left Dike: An overview of the crest as viewed from the right abutment. Note the thick vegetation along both the upstream and downstream shoulders, limiting inspection.

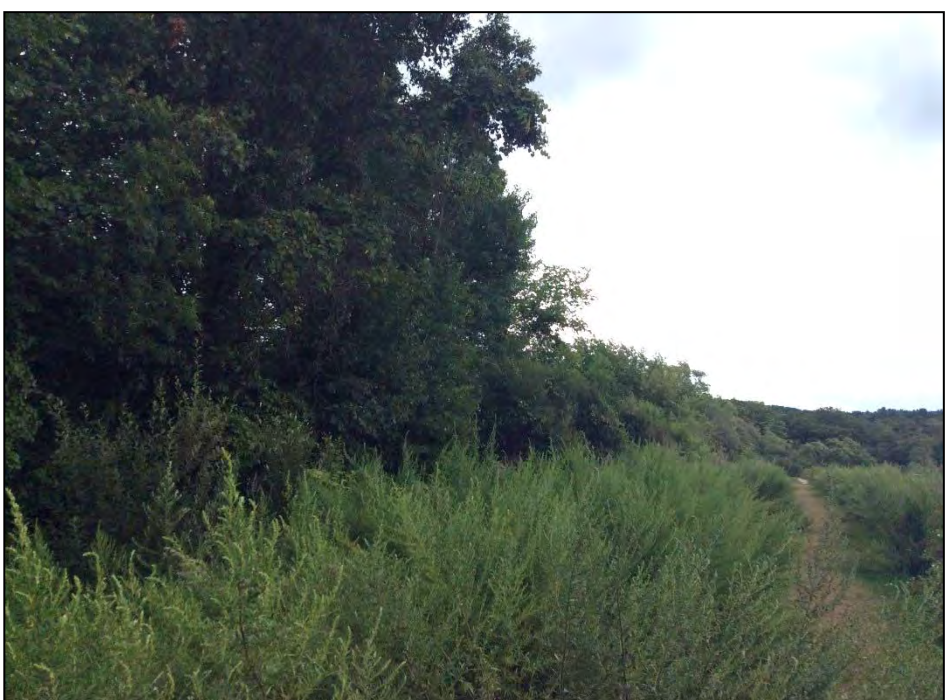


Photo No. 22: Left Dike: The downstream slope as seen from the left abutment. Note the thick overgrowth of tall grass weeds that limited access for a visual inspection.

Photo No. 23: Left Dike: The downstream slope as viewed from the right abutment. Note the thick overgrowth.

Photo No. 24: The gravel knoll between the spillway and the Right Dike as viewed from right of the primary spillway.

Photo No. 25: Right Dike: Overview of the Right Dike from its left abutment. Note the tall grass and weed growth that prevented a complete visual inspection of the ground surface.

Photo No. 26: Right Dike: The upstream slope as viewed from the left abutment of the right dike.

Photo No. 27: Right Dike: The upstream slope as viewed from near station17+40 looking left. Note the concrete wall at the top of the riprap.

Photo No. 28: Right Dike: The upstream slope as viewed from near station 18+90 looking right.

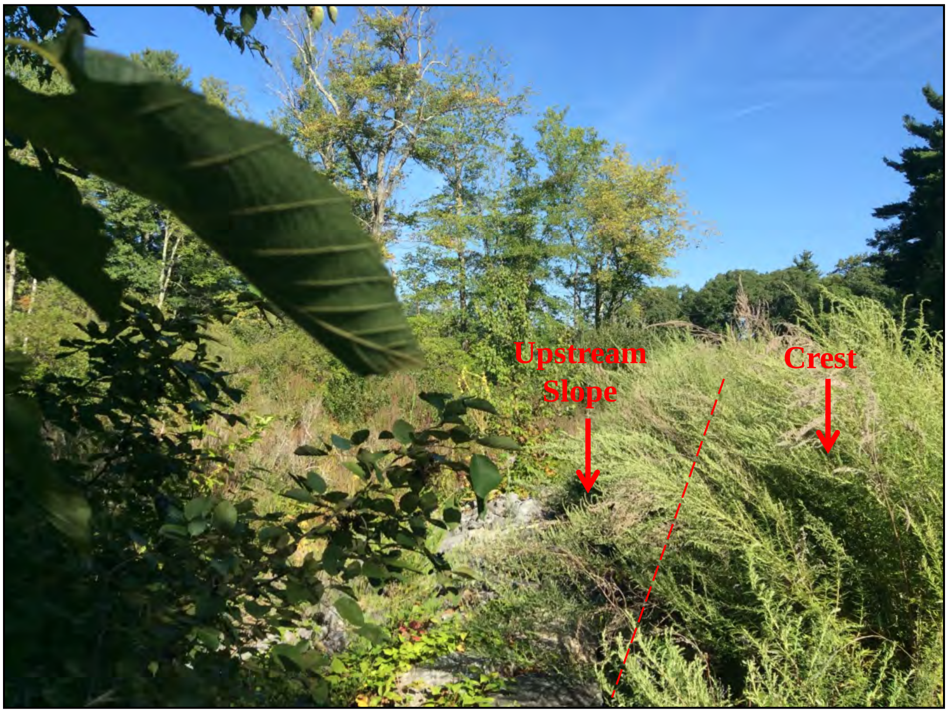


Photo No. 29: Right Dike: The upstream slope as viewed from the right abutment.

Photo No. 30: Right Dike: The crest as viewed from the left abutment.

Photo No. 31: Right Dike: The crest as viewed from near station 17+40 looking left.

Photo No. 32: Right Dike: The right abutment.

Photo No. 33: Right Dike: The crest as viewed from the right abutment.

Photo No. 34: Right Dike: The downstream slope as viewed from the left abutment.

Photo No. 35: Right Dike: The downstream slope as viewed from near station 18+80 looking right.

Photo No. 36: Right Dike: The downstream slope as viewed from the right abutment.

Photo No. 37: Right Dike: The impoundment as viewed from near station 17+30.

Photo No. 38: The primary spillway approach as viewed from the right looking downstream from the water line.

Photo No. 39: The primary spillway approach as viewed from the embankment crest right of the spillway looking upstream.

Photo No. 40: The primary spillway weir as seen from the left.

Photo No. 41: The primary spillway discharge apron as viewed from the embankment crest right of the spillway looking downstream and slightly left.

Photo No. 42: The primary spillway by-pass outlet discharge channel as viewed from the gate control looking downstream after the gate was opened.

Photo No. 43: The primary spillway discharge apron as seen from the left looking slightly downstream.

Photo No. 44: The primary spillway approach as viewed from the left looking slightly upstream.

Photo No. 45: The primary spillway discharge channel as viewed from the embankment crest right of the spillway.

Photo No. 46: The primary spillway discharge channel as seen from the left.

Photo No. 47: The Owner's representative successfully demonstrated the operability of the primary spillway by-pass outlet gate.

Photo No. 48: The primary spillway by-pass outlet approach as seen from the left.

Photo No. 49: The trash rack at the outlet approach as viewed from the left.

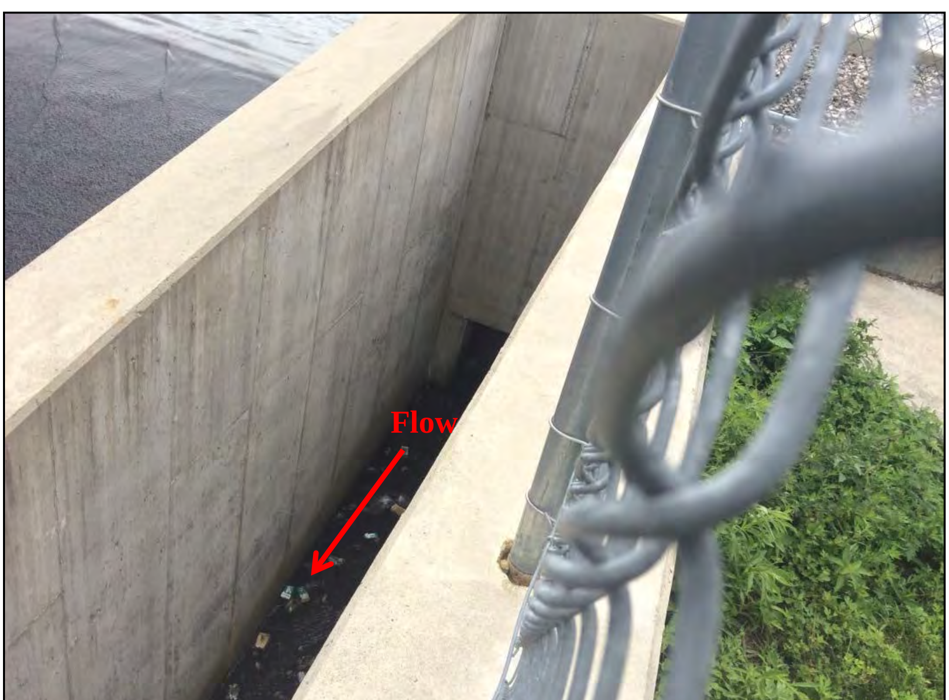


Photo No. 50: The outlet discharge opening looking upstream from left of the primary spillway.

Photo No. 51: The primary spillway by-pass outlet discharge channel looking downstream.

Photo No. 52: The low level outlet gatehouse as seen from the left.

Photo No. 53: The gatehouse as seen from the right.

Photo No. 54: The entrance to the gatehouse structure.

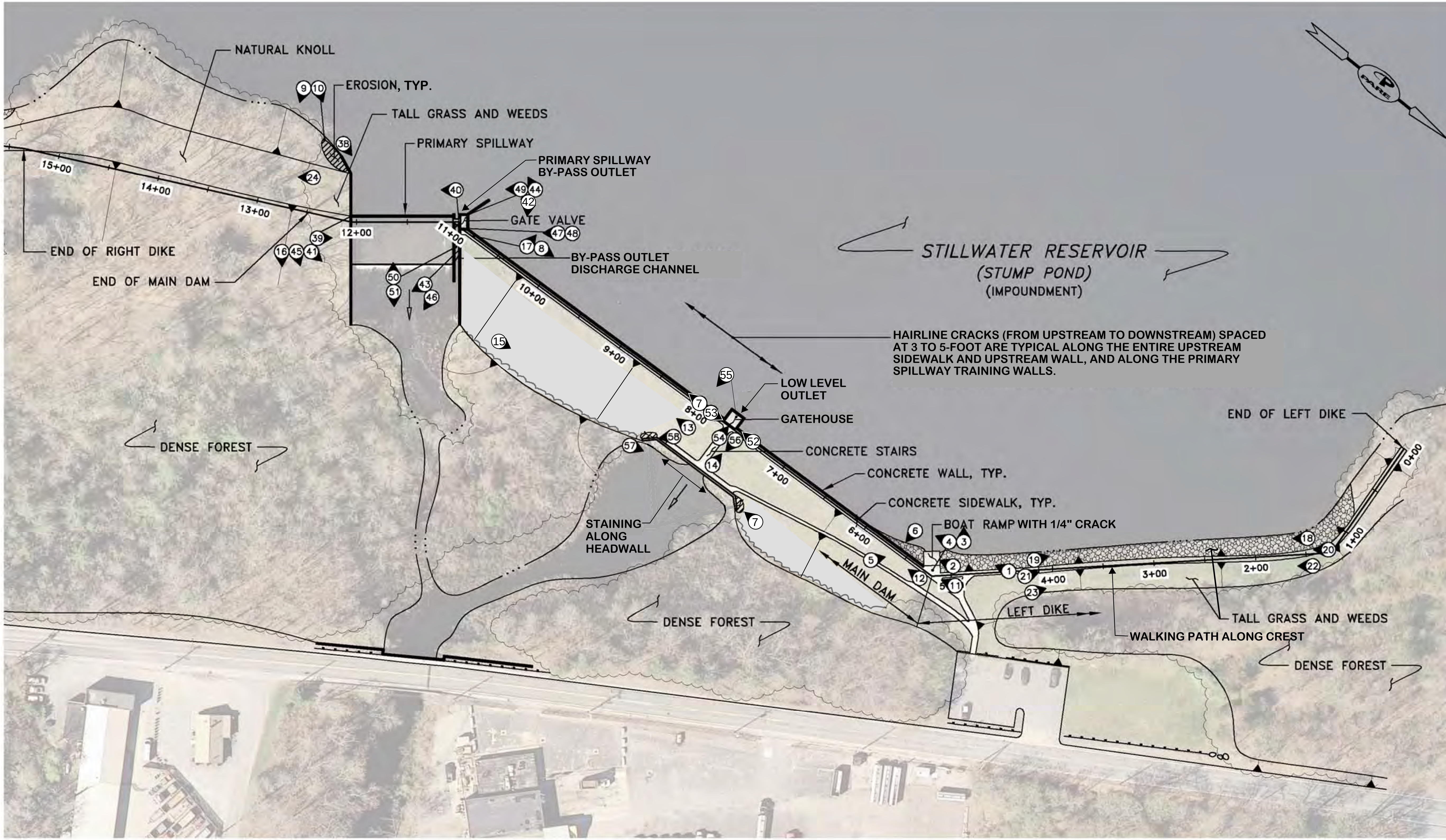
Photo No. 55: The hand wheels that control the two gates within the original gatehouse. Photo looking downstream.

Photo No. 56: The low level outlet discharge channel as seen from the crest.

Photo No. 57: The low level outlet downstream headwall as viewed from the right. Note the staining within the riprap and along the wall.

Photo No. 58: Erosion behind the right side of the low level outlet downstream headwall. Photo looking right and slightly downstream. Erosion is typical along both sides except there is more bare ground on the left side.

Photo No. 59: Overview of the low level outlet downstream headwall as seen from the left. Note the erosion behind the wall. The circled area is a former lifting eye used for installing the pre-cast wall section.



SITE SKETCH – DAM/DIKE

SCALE: 1"=100'±

NOTES AND LEGEND

1. PLAN DEVELOPED FROM NOTES TAKEN DURING THE INSPECTION AND AVAILABLE AERIAL IMAGERY FROM RIGIS. INFORMATION IS PROVIDED FOR REFERENCE PURPOSES ONLY.

(#) DENOTES APPROXIMATE LOCATION AND DIRECTION OF PHOTOGRAPH.

1+00 BASELINE AND STATIONING

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ENGINEERS • SCIENTISTS • PLANNERS
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FOXBORO, MA 02035
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SCALE ADJUSTMENT GUIDE

0" 1"

BAR IS ONE INCH ON ORIGINAL DRAWING.

STILLWATER RESERVOIR DAM

RI DAM No. 108
SMITHFIELD, RHODE ISLAND

OWNER: RIDEM FISH & WILDLIFE

REVISIONS:

PROJECT NO.:	11130.03
DATE:	AUGUST 2014
SCALE:	AS SHOWN
DESIGNED BY:	DMM
CHECKED BY:	DMM
DRAWN BY:	LMC
APPROVED BY:	JMB

SITE SKETCH

FIGURE NO.: 1

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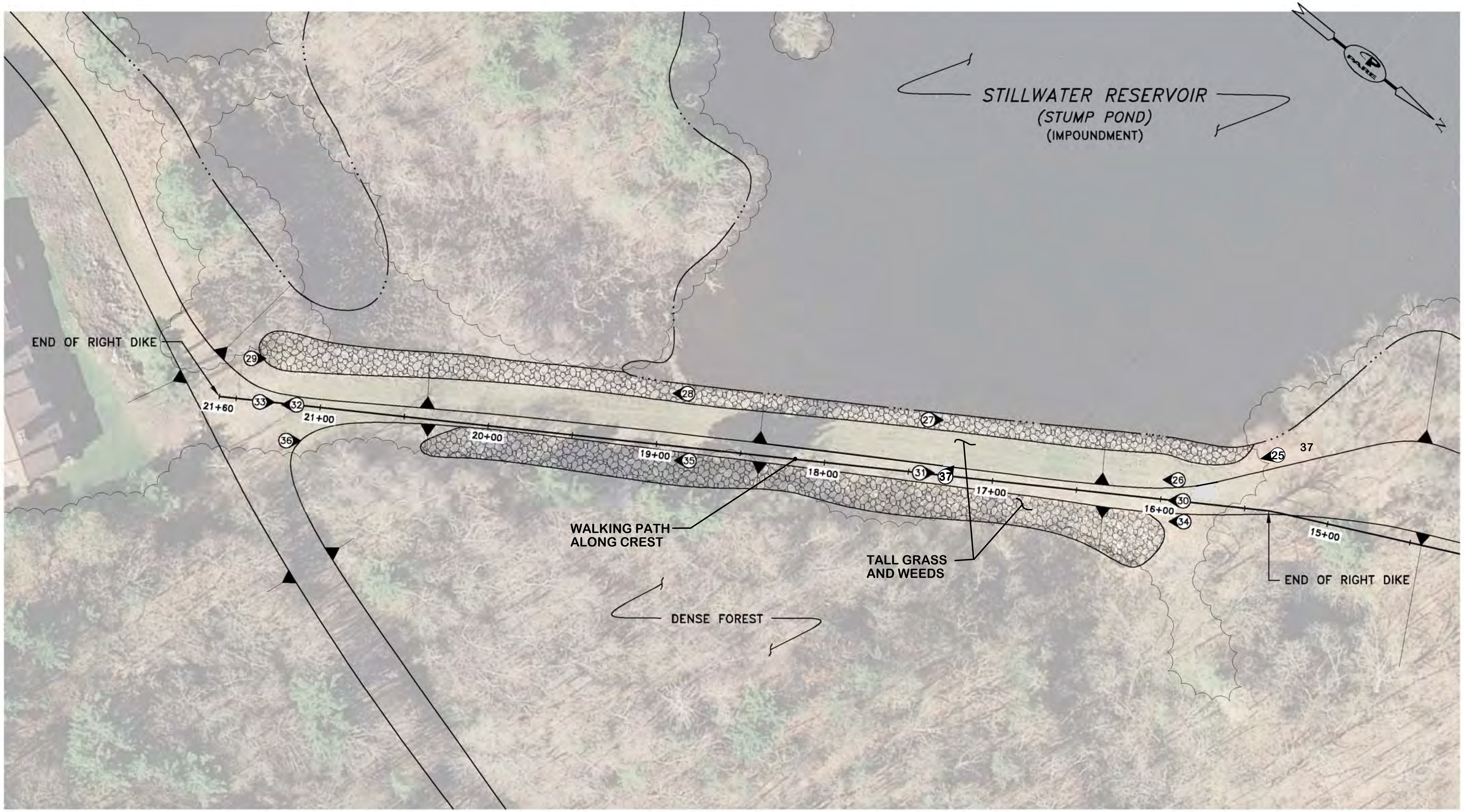

SITE SKETCH – DIKE

SCALE: 1"=60'±

NOTES AND LEGEND

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SCALE ADJUSTMENT GUIDE
0" 1"
BAR IS ONE INCH ON ORIGINAL DRAWING.

STILLWATER RESERVOIR DAM
RI DAM No. 108
SMITHFIELD, RHODE ISLAND
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REVISIONS:

PROJECT NO.:	11130.03
DATE:	AUGUST 2014
SCALE:	AS SHOWN
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CHECKED BY:	DMM
DRAWN BY:	LMC
APPROVED BY:	JMB

SITE SKETCH

FIGURE NO.: 2

Z:\JOBS\11 Jobs\11130.03 Addendum 4 37 Dam Inspections\Inspections\Inspection Round 12\108 Stillwater Reservoir\Drawings\FIG 1 SITE SKETCH.dwg