Gainesville Regional Utilities

Deerhaven Generating Station

Coal Combustion Residuals Surface Impoundment System Inflow Design Flood Control System Plan (Version 2.0)

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1 Introduction

1.1 Overview

Title 40 of the Code of Federal Regulations (CFR) under Part 257, Subpart D (herein referred to as the CCR Rule) includes requirements for CCR surface impoundments, which are defined under §257.53 as "a natural topographic depression, man-made excavation, or diked area, which is designed to hold an accumulation of CCR and liquids, and the unit treats, stores, or disposes of CCR." Gainesville Regional Utilities (GRU) Deerhaven Generating Station (DGS) has a process pond system including two ash cells (Ash Cell #1 and Ash Cell #2, collectively referred to herein as the CCR surface impoundment system) and two pump back cells. Ash sluice water is discharged into the ash cells, bottom ash precipitates out, and the remaining decant water gravity flows to the adjacent pump back cells. The ash cells are designed for dewatering and temporarily holding precipitated ash, which is periodically dredged from the units. Only the ash cells are considered part of a CCR surface impoundment system. The pump back cells were specifically designed to store the decant water from the ash cells following sedimentation – these cells were not designed to hold ash and, to date, have not accumulated anything beyond de minimis ash quantities. Therefore, the pump back cells are not considered CCR surface impoundments as defined in the CCR Rule.

40 CFR §257.82 of the CCR Rule requires that GRU design, construct, operate and maintain an inflow design flood control system that can manage the flow into and from the surface impoundments under a specified inflow design flood which is dependent on the site's hazard classification potential. Based on the most recent assessment conducted by Universal Engineering Sciences (UES 2021), the surface impoundment system at DGS is classified as a low hazard potential impoundment. Therefore, a 100-year inflow design flood was used for this analysis.

This report presents an overview of the ash and pump back pond system, describes the specific inflows and outflows associated with each cell, discusses the selection of the inflow design flood, and presents the results of the hydrologic and hydraulic capacity analysis conducted by Innovative Technical Solutions (ITS).

2 Description of Cells CCR Surface Impoundment System

The CCR surface impoundment system was constructed using raised dikes and does not have spillways or other infrastructure that directly discharges over the top of the dikes in an overtopping event. Water discharges from the ash cells through subsurface culverts, which gravity-drain the decant water into adjacent pump back cells. The two pump back cells are connected to each other through a subsurface culvert. Water in the pump back cells is discharged by means of a pump station (located in Pump Back Cell #1) equipped with five pumps that recycle water to a variety of plant locations. The water from Pump Back Cell #1 is pumped to the following systems (GRU 2006):

1. Bottom ash sluice system for sluicing the bottom ash from Unit 2 boiler to the ash cells using two recycle pumps,
2. Front-End Treatment (FET) Plant for treatment and subsequent use in the cooling tower using two blowdown pumps,
3. Brine Concentrator Plant for treatment and subsequent use of the distillate in the power plant demineralizer or in the cooling tower using a recycle pump.

As mentioned earlier that the pump back cells are not a part of the CCR surface impoundments system, and an inflow flood control analysis is not required for these cells. However, the pump back and ash cells operate in a closed-loop for the ash sluicing operation. The pump back cells are, therefore, included in the inflow flood control analysis and plan.

For the purpose of a conservative engineering estimate, this pond capacity analysis was performed assuming that any infrastructure that allows water to discharge (i.e., leave the cells) from any of the ash and pump back cells and that are not critical for the plant operation are offline, while all inflows and outflows that are required for the routine plant operations are discharging into the ash cells over the course of the design flood. There are also two FET lime sludge settling cells located adjacent to the four cells discussed in this analysis. These two FET lime sludge cells are hydraulically connected to the pump back cells through gravity drainage, similar to the connection between the ash and pump back cells. It is assumed that the isolation valves that connect the lime sludge cells to the pump back cells will be closed during a 100-year flood event.

An April 2015 survey of the topography of the cells and dikes (also referred herein to as *embankments*) conducted by Degrove Surveyors, Inc. (DSI), was used to validate the dimensions and configurations of the cells as previously documented in Burns and McDonnell (1981) drawings, which were certified as conforming to construction records. A total of 16 points (e.g., invert of a corrugated metal pipe) or areas shown in Burns and McDonnell (1981) with elevation were selected for comparison between the two drawings sets (IWCS 2016). The elevation measurements reported by DSI (2015) only deviated within a few inches of the elevations presented in Burns and McDonnell (1981). For the purposes of this analysis, the Burns and McDonnell (1981) drawing set was used to select the geometry of the cells used in the capacity estimates. However, one notable deviation identified by DSI (2015) was that the lowest elevation of the embankments surrounding Ash Cell #1 in the southwest corner is 194.86 National Geodetic Vertical Datum of 1929 (NGVD 29), which is slightly lower than that indicated in Burns and McDonnell (1981) drawing set; the maximum water elevation of 194.86 ft NGVD was used for estimating the capacity of the ash cells.

Figure 1 shows an aerial view of the arrangement of the cells. Access roads are located at the top of each of the dikes surrounding each of the cells. Two FET lime sludge cells, located adjacent to the ash cells, also gravity drain into the pump back cells. It was assumed that the valve that connects these cells to the pump back cells would be closed during the 100-year flood event. These FET lime sludge cells are, therefore, not included in this analysis. Figure 2 presents the flow of the various water and wastewater streams at the plant and those managed using the ash and pump back cells.

Table 1 presents the catchment area and critical water level elevations of each pond for each pond type. The maximum operating level and surrounding dike elevations of the cells are described in IWCS (2015). The catchment area of each pond is the area that will collect and divert precipitation for storage at that pond and was calculated using the dimensions presented in the Burns and McDonnell (1981) (i.e., Y 70, Rev 3) drawing set. The topographic survey conducted by DSI (2015) and Burns and McDonnell (1981) drawings indicated that the surrounding access roads typically crest at the road center; each pond catchment area includes the area encompassed by the center of the roads encircling each pond. It should be noted that the critical elevations and catchment areas are the same for each pond type.

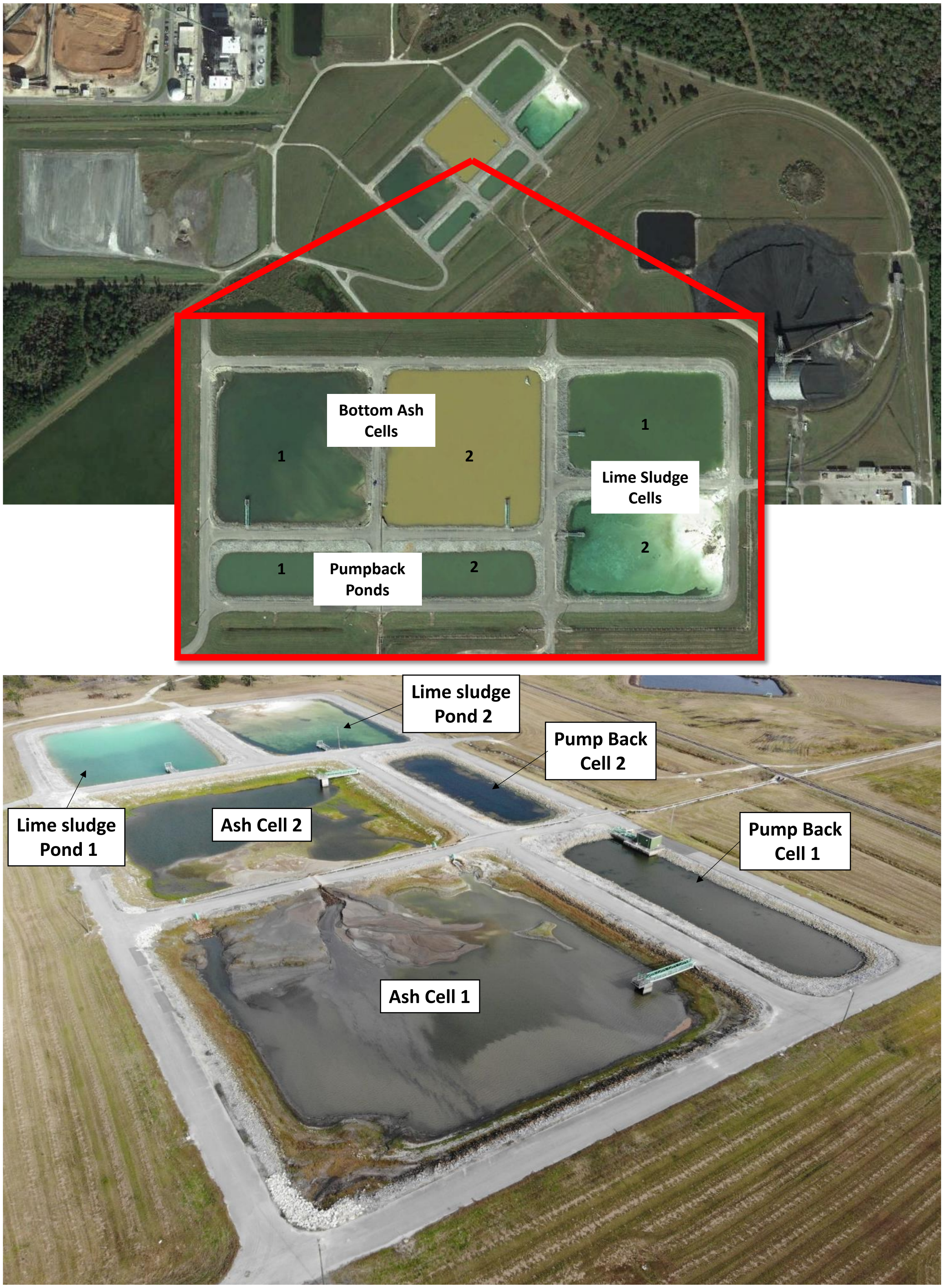

Figure 1. Layout of the CCR Surface Impoundment System (Ash Cells 1 and 2) and Adjacent Pump Back and Lime Sludge Cells

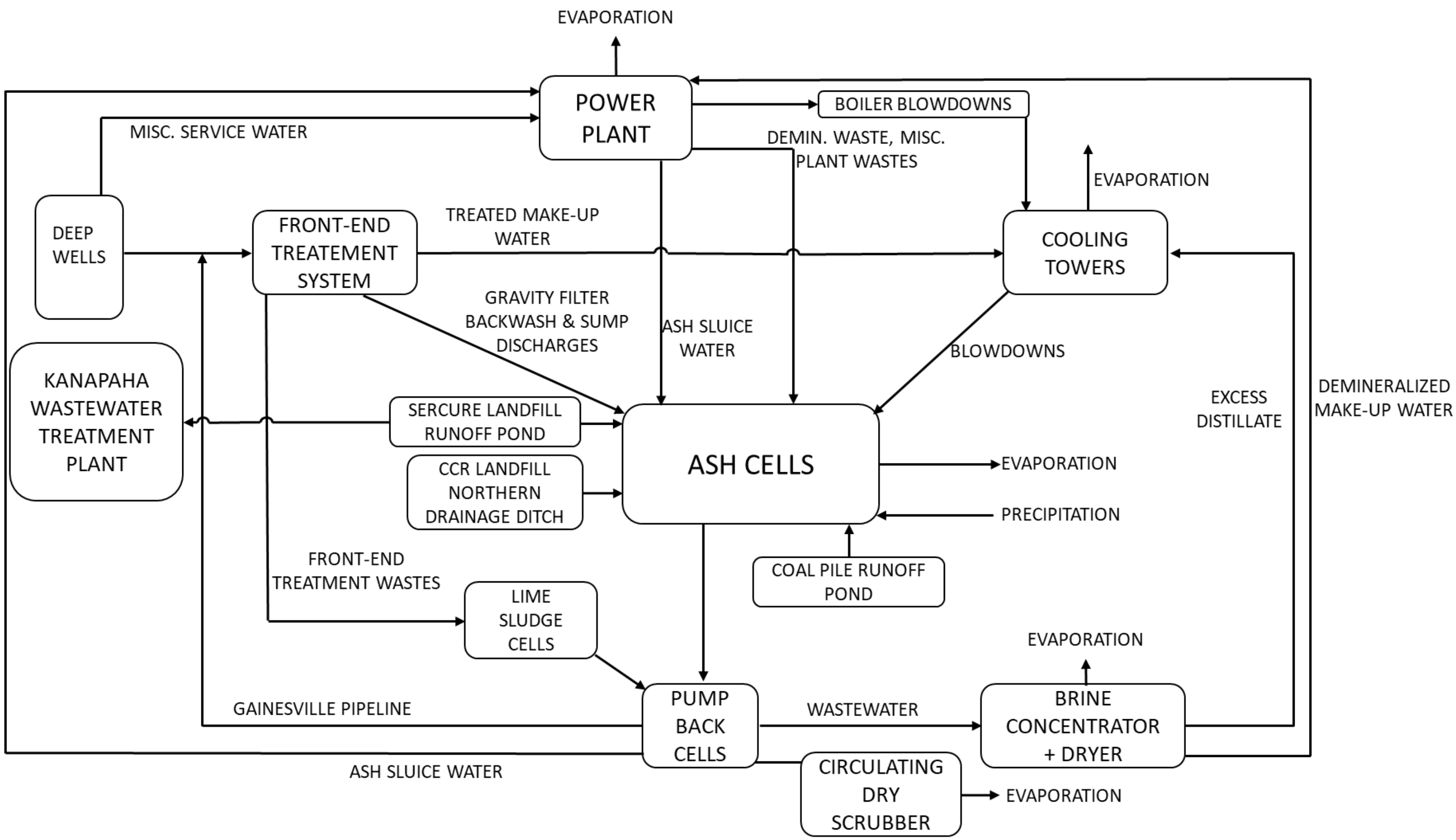

Figure 2. Flow of Various Water and Wastewater Streams at Deerhaven Generating Station

Table 1. Pond Water Levels and Catchment Areas per Pond

Location	Maximum Operating Elevation (Feet NGVD)	Surrounding Dike Elevation (Feet NGVD)	Catchment Area (Square Feet)
Ash Cells	193	194.86	136,000
Pump Back Cells	186	188	57,000

3 Ash cells

The ash cells serve as settling basins to precipitate bottom ash which is sluiced from the site's coal-fired combustion unit (i.e., Unit 2). The ash cells also serve as temporary storage for a variety of site process water blowdowns (i.e., wastewater streams) before these are treated and recycled on onsite. Ash Cell #1 has three process water intake points, and Ash Cell #2 has two intake points. Each ash cell has a single discharge point.

3.1 Inflows

Table 2 presents the major categories and total daily discharge rate of the inflows that are critical for the routine plant operation. These inflows can be directed to either of the ash cells, as shown in Figure 2. Ash sluice water is another stream that would continue to inflow into the ash cells during routine plant operation. The bottom ash is collected in an ash hopper underneath the boiler. The bottom ash accumulated in the hopper is frequently sluiced as a slurry using sluice pumps into one of the two ash cells (i.e., Ash Cell 1, Ash Cell 2) that together comprise the CCR surface impoundment system. The flowrates or volumes pumped by these pumps are not monitored. It should be noted that the water used for sluicing the ash is pumped out from the pump back cells. The ash sluice water, therefore, has no net effect on the ash and pump back cells' water balance. This flow was, therefore, excluded from the analysis.

Based on the data collected over five years (September 1, 2016 through August 31, 2021), the average daily cooling tower blowdown flow to ash cells is approximately 80,700 gallons. The flow rates of other miscellaneous plant and FET system wastewater streams that are routed to the ash cells are not monitored. It should be noted that the GRU has the capability to temporarily hold these wastewater streams within the plant sumps and stop pumping these to the ash cells without compromising the plant operation. GRU indicated that these wastestreams have been stored at the plant and not pumped to the ash cells for 2-3 days during maintenance/repair events in the past. It was assumed that approximately 100,000 gallons of these wastewater streams would be pumped to the ash cells on a daily basis during the 100-year flood event for a conservative analysis. The ash cells are estimated to receive a total of 180,700 gallons per day of cooling tower blowdowns and other miscellaneous power plant wastewaters. It is assumed that both the ash cells are available to receive the plant process water during and following the storm event.

A 100-year, 24-hour precipitation event was used to estimate the 100-year inflow design flood. The precipitation associated with a 100-year, 24-hour storm for Gainesville is estimated to be 9.72 inches (NOAA 2021). Based on the catchment area presented in Table 1, a 100-year, 24-hour storm is estimated to add approximately 1.65 million gallons of liquids to the ash cells. Overall, the ash cells are expected to receive approximately 1.83 million gallons of liquids during a 100-year, 24-hour storm event.

Table 2. Surface Impoundment System Design Flood Inflow Rates

Inflows	Inflow Rate (gallons per day)
Cooling Tower Blowdowns	80,700
Plant Wastewaters	100,000
Rainfall (100-year, 24-hour storm)	1,648,000
Total	**1,828,700**

It should be noted that water is also periodically pumped to Ash Cell #1 from three onsite runoff ponds. However, these flows are not included in this analysis because these pumps will not be operated if Ash Cell #1 was operating at or above its maximum allowed elevation (i.e., 193 ft NGVD) or if the pumps for the pump back cells were offline (IWCS 2015). For a conservative analysis, it was assumed that the water elevation in the ash cells would be at 193 ft NGVD at the start of the 100-year flood event.

3.2 Outflows

The water loss associated with evaporation was not included in pond capacity modeling for a conservative analysis. Each ash cell has a single discharge point, known as a stoplog structure. The structure is a raised rectangular concrete vault located about 50-feet away from the edge of the cells. One of the walls of the structure consists of horizontally-arranged, 1-foot wide wooden planks. These planks are used to retain bottom ash in the cells while allowing water to decant into the stoplog structure. The decanted process water is discharged into the adjacent pump back pond via a 12-inch diameter glass-fiber-reinforced pipe, which runs beneath the embankment separating each ash cell from its adjacent pump back cell. It was assumed the surface impoundment system would continue to discharge the decant water into the pump back cells at a rate needed to sluice the bottom ash to ash cells.

4 Pump Back Cells

The pump back cells provide storage for ash sluice decant water, lime sludge decant water, and other blowdown water prior to pumping to onsite treatment or use for additional bottom ash sluicing. The pump control building and adjacent pump station are located on the northeast corner of Pump Back Cell #1 (Figure 1). As described previously, the pump back cells at DGS are not CCR surface impoundments. Although not required by the CCR rule, these cells were included in the analysis as these cells are operated with ash cells as a closed-loop system to sluice the bottom ash, which would continue to occur during a 100-year flood event.

4.1 Inflows

The only potential process inflows to the pump back cells are the discharges from the ash cell and lime sludge pond stoplog structures. As described previously, the isolation valves connecting the lime sludge cells to the pump back cells will be closed in the event of an impending 100-year flood event. It was assumed the ash cell would continue to discharge the decant water into the pump back cells at a rate needed to sluice ash to ash cells. Based on the catchment area presented in Table 1, a 100-year, 24-hour storm is estimated to add approximately 690,700 gallons of liquids to the pump back cells.

4.2 Outflows

There are five pumps at the pump station located in Pump Back Cell #1. As described earlier, two of these pumps pump decant water for sluicing the bottom ash from Unit 2 boiler, and the other three are used for pumping water to FET Plant and Brine Concentrator Plant. It was assumed that only sluice pumps would be operated during the 100-year flood event. Discharges to the FET and Brine Concentrator Plants from the Pump Back Cell#1 were assumed to be suspended during the 100-year flood event for a conservative analysis.

5 Analysis Methodology

This capacity analysis estimates the remaining capacity of the ash and pump back cells after a 100-year, 24-hour design storm. A 100-year, 24-hour precipitation event was used to estimate the 100-year inflow design flood under the worst-case scenario. These conditions would provide capacity between the maximum allowable operating water level (i.e., 193 ft and 186 ft NGVD 29 for the ash and pump back cells, respectively) to the lowest level of the dike crest surrounding the cells (i.e., 194.86 ft and 188 ft NGVD 29 for the ash and pump back cells, respectively). For the purpose of a conservative estimate, the analysis excludes water discharges other than that needed for the bottom ash sluicing operation and includes all the inflows as described in the preceding sections.

The following equation was used to estimate the cubic feet of capacity for each pond type associated with its top two feet of freeboard:

$$V = LBD - H(L+B)D^2 + \frac{4}{3}H^2D^3$$

Where,

L = the length of the cell between the top interior edges of the embankment (feet)

B = the width of the pond between the top interior edges of the embankment (feet)

D = the depth of water above the maximum operating elevation when the pond surface is at the surrounding dike elevation (feet)

H = the internal side slope configuration given as horizontal:vertical (unitless)

The surface impoundment system capacity available between the elevations of 193 and 194.86 ft NGVD was estimated to be approximately 3.1 million gallons. The pump back cells capacity available between the elevations of 186 and 188 ft NGVD was estimated to be approximately 0.97 million gallons.

6 Results

Table 2 presents the total inflows, including the precipitation inflow during a 100-year, 24-hour storm and the remaining capacity of the ash and pump back cells before and after the storm event. The cells have adequate capacity to store the process water inflows, the inflow associated with a 100-year 24-hour storm, and provide an additional 8.6 days of capacity for process water inflows following the storm event.

Table 3. Total Inflows and Remaining Capacity Following a 100-year, 24-Hour Design Storm

Inflows/Remaining Capacity	Inflow Rate (gallons per day)	
	Ash Cells	Pump Back Cells
Total Inflow	1,828,700	690,700
Available Capacity before 100-year, 24-hour Storm	3,096,600	973,400
Available Capacity after 100-year, 24-hour Storm	1,267,900	282,700

7 References

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IWCS (2015). Gainesville Regional Utilities Deerhaven Generating Station Coal Combustion Residual Pond and Pump Back Pond Operations and Maintenance Plan. Prepared for GRU by Innovative Waste Consulting Services, LLC, October 2015.

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UES (2016). Geotechnical Consulting Services: Coal Combustion Residual (CCR) Impoundment Initial Hazard Potential Classification. Prepared by Universal Engineering Sciences for Innovative Waste Consulting Services, LLC. September 2016.

US EPA (2014). Assessment of Dam Safety of Coal Combustion Surface Impoundments – Gainesville Regional Utilities, Deerhaven Plant, Florida. Final report prepared for the United States Environmental Protection Agency by CDM Smith, May 2014.

8 Professional Engineer Certification

This plan was prepared under the supervision, direction and control of the undersigned registered professional engineer (PE). The undersigned PE is familiar with the requirements of 40 CFR 257.82. The undersigned PE certifies that this hydrologic and hydraulic capacity analysis meets the requirements of 40 CFR 257.82. This certification was prepared per the requirement of 40 CFR 257.82(c)(5).

Name of Professional Engineer: Pradeep Jain

Company: Innovative Technical Solutions

Signature: Pradeep Jain Digitally signed by Pradeep Jain Date: 2021.09.30 21:42:34 -04'00'

Date: September 30, 2021

PE Registration State: Florida

PE License No.: 68657

PRADEEP JAIN LICENSE No. 68657 ★ STATE OF FLORIDA PROFESSIONAL ENGINEER

This item has been digitally signed and sealed by Pradeep Jain, PE, on the date adjacent to the seal.

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