Initial Assessment of Potential Wetland Enhancements
Beach City Dam
Sugar Creek

Sustainable Rivers Program

U.S. Army Corps of Engineers
Huntington District
Huntington, West Virginia

September 2022

INTRODUCTION

Beach City Dam is located on Sugar Creek, in northern Tuscarawas and southern Stark counties, Ohio, near routes 21, 250 and 93. Beach City Dam is operated by the U.S. Army Corps of Engineers (USACE), Huntington District (District), with authorized purposes of flood control, recreation, and fish and wildlife conservation. Muskingum Watershed Conservancy District (MWCD) is a partner with the District in the operation of the system of dams and reservoirs within the Muskingum watershed, in which Beach City is located. The District operates the dams for flood risk management and the MWCD manages most of the reservoir areas behind the dams. Ohio Department of Natural Resources (ODNR) maintains a wildlife area around Beach City Lake also.

Sugar Creek, Beach City Dam, was identified for this Sustainable Rivers Program (SRP) project because the pool has existing habitat that may be enhanced by alteration of dam operations. A small recreation pool exists above Beach City Dam, but has been greatly impacted by sedimentation and its recreational value is significantly diminished. The current Beach City pool is held at 948 feet (ft; all elevations in this report are in ft above mean sea level, National Geodetic Vertical Datum of 1929) by a control weir. The original streambed elevation is 930 ft. This shallow pool is surrounded by existing, high-quality wetlands that developed within the flowage easement of the reservoir. Beach City also has a history of producing potentially Harmful Algal Blooms (HABs), which is partially attributed to the shallowness of the main part of the lake.

The initial goal for SRP work at Beach City Dam was to determine whether operation of the dam for a lower pool elevation could transition existing shallow water areas to high quality wetland habitat.

SRP work at Beach City Dam began in 2021. During the first year of study, the District gathered and analyzed baseline ecological and hydrologic data, determined project operational flexibility, coordinated with external agencies, and recommended future step for the Beach City project. This report details related outcomes and recommended actions.

LOCATION

The study area is located near the Village of Beach City, Ohio. The study area includes the headwaters and tailwaters of Sugar Creek associated with Beach City Dam, as well as the South Fork of Sugar Creek. Sugar Creek is a perennial tributary of the Tuscarawas River, and is part of the Muskingum River watershed. The watershed above Beach City Dam is approximately 300 square miles. The potential project influences would fall within District and MWCD property. The lake area within the impoundment of the dam is largely filled with sediment. Remaining pool areas are shallow and prone to high temperatures in summer months.

SCOPE ACTIVITIES

1. Data Gathering and Analyzation

Scope Task Description (excerpt from scope of work for the Beach City Dam analysis)

Gather baseline information to identify existing ecological conditions and the relationship with current hydrologic conditions. Broadly delineate and categorize the wetlands upstream of Beach City Dam. Determine the current inundation frequencies of the high-quality wetlands upstream of the dam. Forecast inundation frequencies for those same wetlands under alternative operational

scenarios. Complete bathymetric surveys of the pool to calculate the actual storage within the reservoir. Determine any adverse effects that altered operations may have on the pool such as recreation, existing wetlands, and infrastructure. Compile all the data collected into a single location, database, or document.

Analysis

SOILS AND GEOLOGY

According to the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) web soil survey, mapped soils within the overall study area include a wide variety of silt loam. Common silt loams within the study area are Coshocton silt loam (CpB), Coshocton-Guernsey silt loam (CsD), and Rush silt loam (RuA) (NRCS 2022). According to the NRCS, silt loam typically falls within Groups B and C of the hydrologic soil groups. These soils have a moderate infiltration rate of water when thoroughly wetted, and therefore have a moderate to low runoff potential. When looking specifically at wetland areas, according to the NRCS web soil survey, mapped soils become increasingly hydric. This suggests an increase in soil saturation, and ponding occurs at various times of year within these areas. Additional soils mentioned in Figures 1 and 2 follow: Melvin silt loam (Mc), Chili gravelly loam (CkB, CkC, & CmA), Conotton gravelly loam (CoD), Coshocton-Guernsey silt loam (CtD), Orrville silt loam (Or), Tioga loam (To), Udorthents (Ua), and Wheeling loam (WrA).

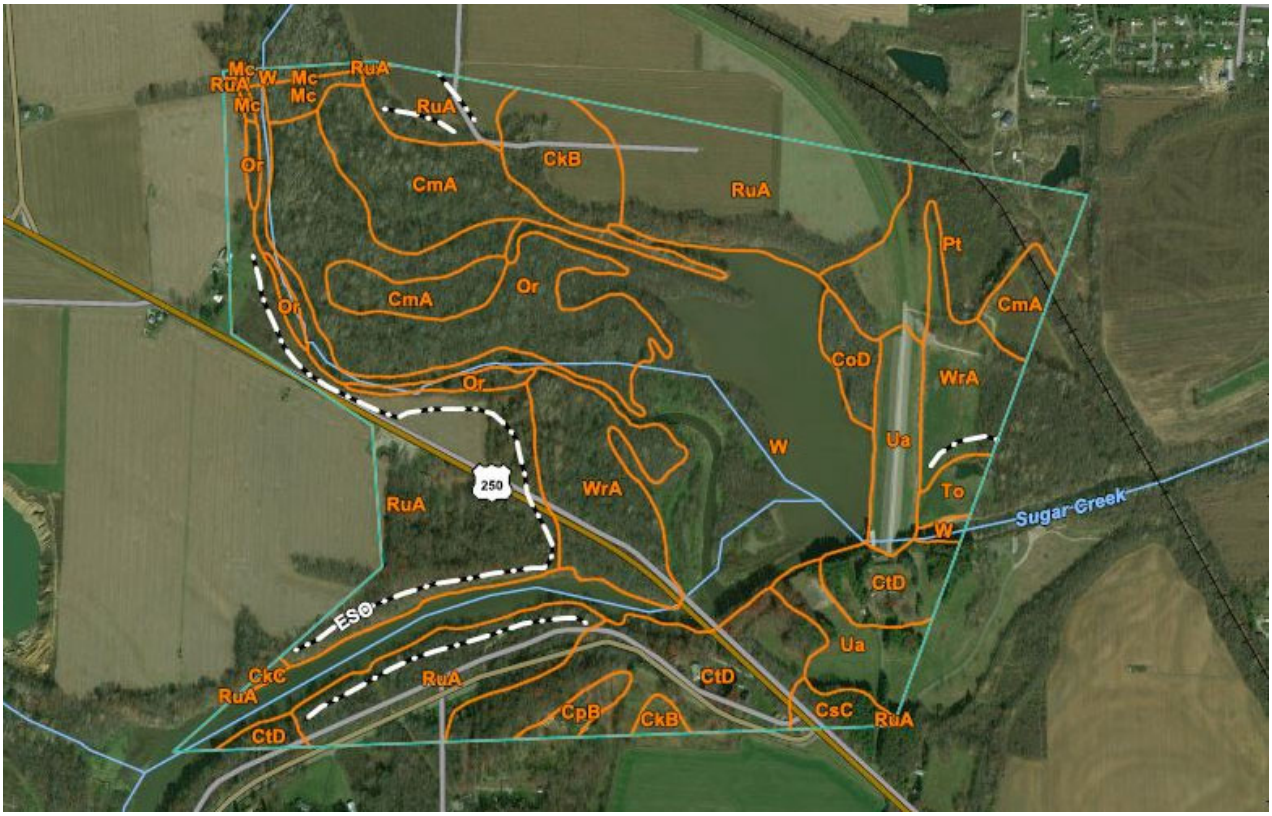

Figure 1. Soils around Beach City Dam and Lake by map unit and hydric soil rating (NRCS 2022).

Figure 2. Soils within the wildlife area by map unit and hydric soil rating (NRCS 2022).

SURFACE WATERS AND OTHER AQUATIC RESOURCES

Review of the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) indicates there are multiple aquatic resources mapped within the study area. Streams in the study area contain habitats classified as: Freshwater Forested/Shrub Wetland and Freshwater Emergent Wetland (Figure 3). During the USACE site visit November 2-3, 2022, biologists observed the extent of the wetland areas around and upstream of Beach City Dam to verify the wetlands as mapped on the NWI. The wetlands proved to be abundant and of high quality as indicated. For this study, the limits and delineations of the NWI maps were adopted for analysis purposes (USFWS 2021b).

The Federal Emergency Management Agency (FEMA) Flood Map Service Center was consulted to find flood information on the project site. Most of the project area is located within the FEMA Flood Zone Hazard Area, indicating that it is a special flood hazard area and in the regulatory floodway (Figure 4; FEMA 2021).

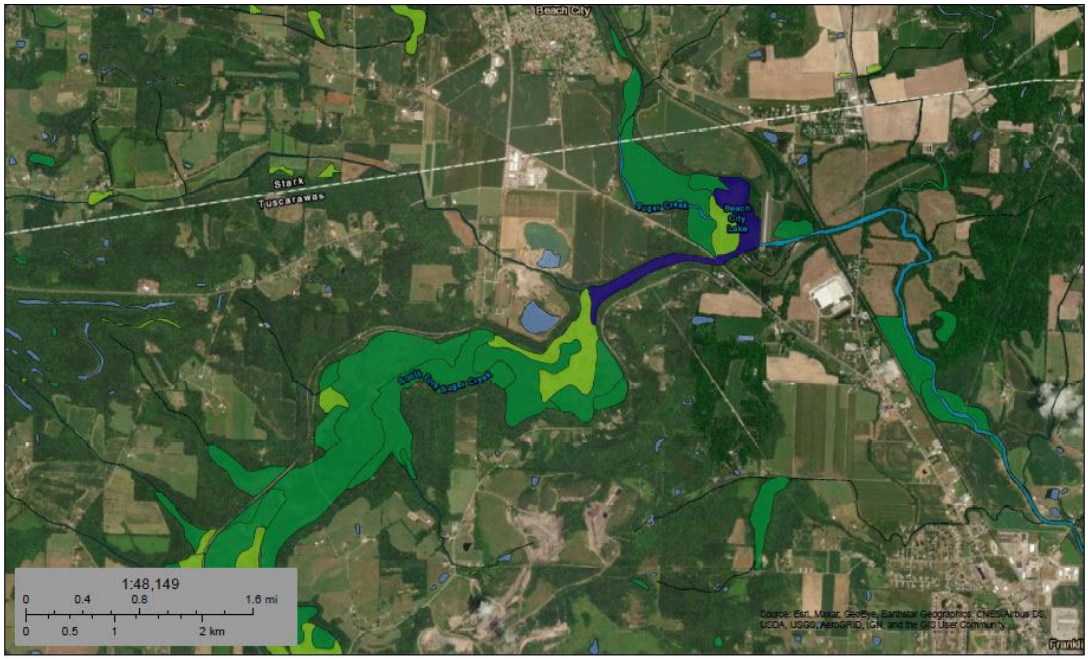

Figure 3. Mapped aquatic features (Beach City Lake, blue) and habitats (freshwater forested shrub wetlands, dark green, and freshwater emergent wetlands, light green; USFWS 2021b).

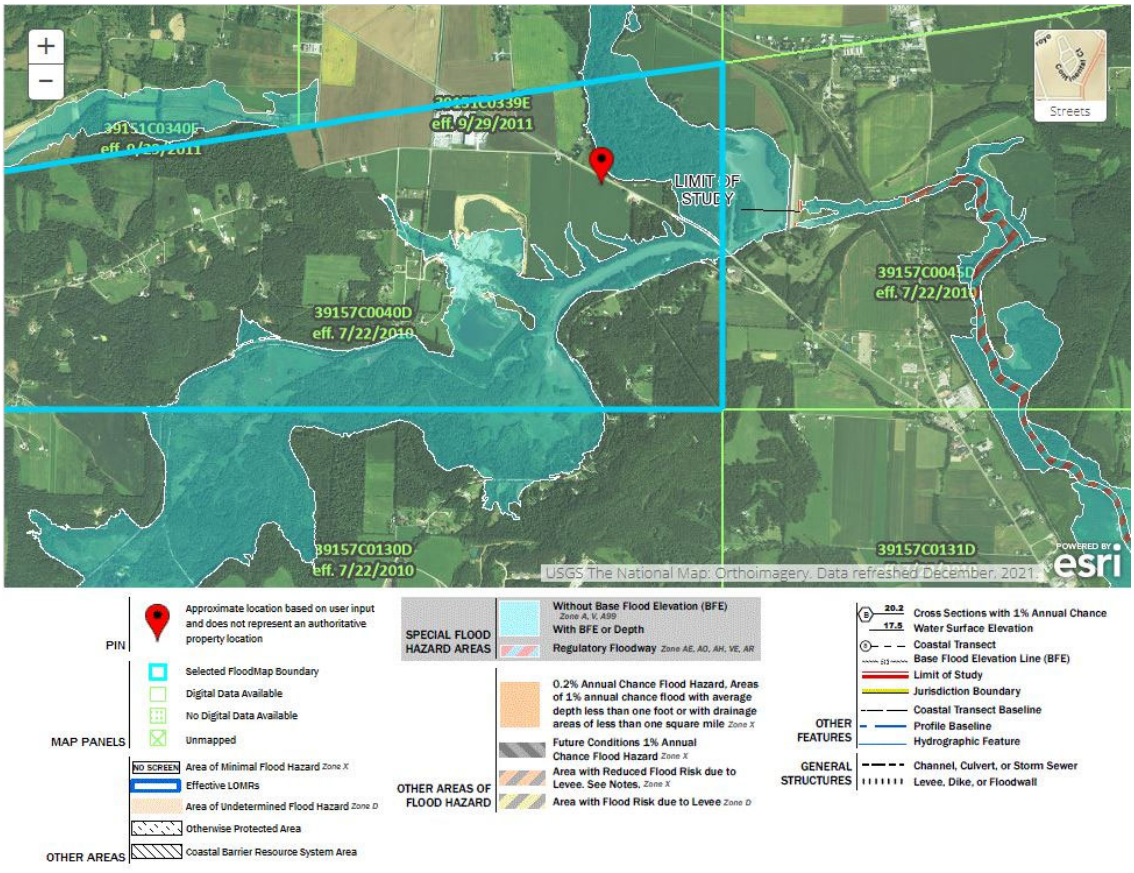

Figure 4. FEMA flood information map of the study area (FEMA 2021).

FISH AND WILDLIFE HABITATS

The study area contains forest stands of varying succession, open water, streams, freshwater forested/shrub wetland, and freshwater emergent wetlands. Furthermore, agricultural land that borders USACE property creates edge effects where changes in population and community structures occur at the boundary of two or more habitats. Areas as such exhibit variation throughout the range of the study area in the form of small habitat fragments.

FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES

According to the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool (USFWS 2021a), the study area is located within the range of the following federally listed species: Indiana bat (Myotis sodalis, endangered), Northern Long-eared bat (*Myotis septentrionalis*, threatened), and Monarch Butterfly (*Danaus plexippus*, candidate).

The following listed birds are protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act: Bald Eagle (*Haliaeetus leucocephalus*), Black-capped Chickadee (*Poecile atricapillus practicus*), Blue-winged Warbler (*Vermivora pinus*), Bobolink (*Dolichonyx oryzivorus*), Canada Warbler (*Cardelinia canadensis*), Cerulean Warbler *(Dendroica cerulea*), Prairie Warbler (*Dendroica discolor*), Prothonotary Warbler (*Protonotaria citrea*), Henslow's Sparrow (*Ammodramus henslowii*), Lesser Yellowlegs (*Tringa flavipes*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Rusty Blackbird (*Euphagus carolinus*), and the Wood Thrush (*Hylocichla Mustelina*).

There is no critical habitat listed for federally listed species in the project area.

STATE LISTED ENDANGERED AND THREATENED SPECIES

The following species have been listed as threatened or endangered within Stark County by the Ohio Division of Wildlife (ODNR): Small Purple-foxglove (*Agalinis purpurea var. parviflora*), Few-seeded sedge (*Carex oligosperma*), Green Spike-rush (*Eleocharis flavescens*), Simple Willow-herb (*Epilobium strictum*), Variegated Scouring-rush (*Equisetum variegatum*), Tawny Cotton-grass (*Eriophorum virginicum*), Bog Bedstraw (*Galium labradoricum*), Sharp-glumed Manna Grass (*Glyceria acutiflora*), Northern St. John's-wort (*Hypericum boreale*), Flat-leaved Rush (*Juncus platyphyllus*), Leggett's Pinweed (*Lechea pulchella*), Flat-stemmed Pondweed (*Potamogeton zosteriformis*), Marsh Five-finger (*Potentilla palustris*), Bog Willow (*Salix pedicellaris*), Pitcher-plant (*Sarracenia purpurea*), Hooded Ladies'-tresses (*Spiranthes romanzoffiana*), Drummond's Aster (*Symphyotrichum drummondii*), Flat-leaved Bladderwort (Utricularia intermedia), Small Cranberry (*Vaccinium oxycoccos*), Highbush-cranberry (*Viburnum opulus var. Americanum*), and Wild Rice (*Zizania aquatica*).

BATHYMETRY AND RESERVOIR STORAGE

Beach City Lake is a relatively small and shallow waterbody. Sedimentation has gradually filled conservation pool storage, thereby reducing lake depth and limiting the types of open water recreation available at this lake. However, this infilling of the conservation pool has not significantly reduced the flood storage capacity of the lake because the storage now filled with sediment was previously filled with water during normal conditions. Beach City also has a

history of producing potentially Harmful Algal Blooms (HABs) which can be attributed to the increasing shallowness of the main lake.

The District Water Quality Team completed bathymetric surveys of the lake to assist in calculating current storage volumes. The Water Quality Team attempted to use a shallow-draft Jon boat with a SonTek M9 Acoustic Doppler Current Profiler (ADCP) unit attached to the hull of the boat; however, the lake has sedimented in so much that the boat could not be launched. As a result, a remote-controlled vessel called an rQpod was used in conjunction with the ADCP to sample the deeper parts of the lake. Because most of the lake was too shallow, sampling consisted of kayaking into an area and measuring depths manually with a measuring rod. These values from the ADCP and manual readings were all input to Hypack software for analysis and the results revealed that the lake has an average depth of 30 inches and 72 acre-feet of storage (Figure 5).

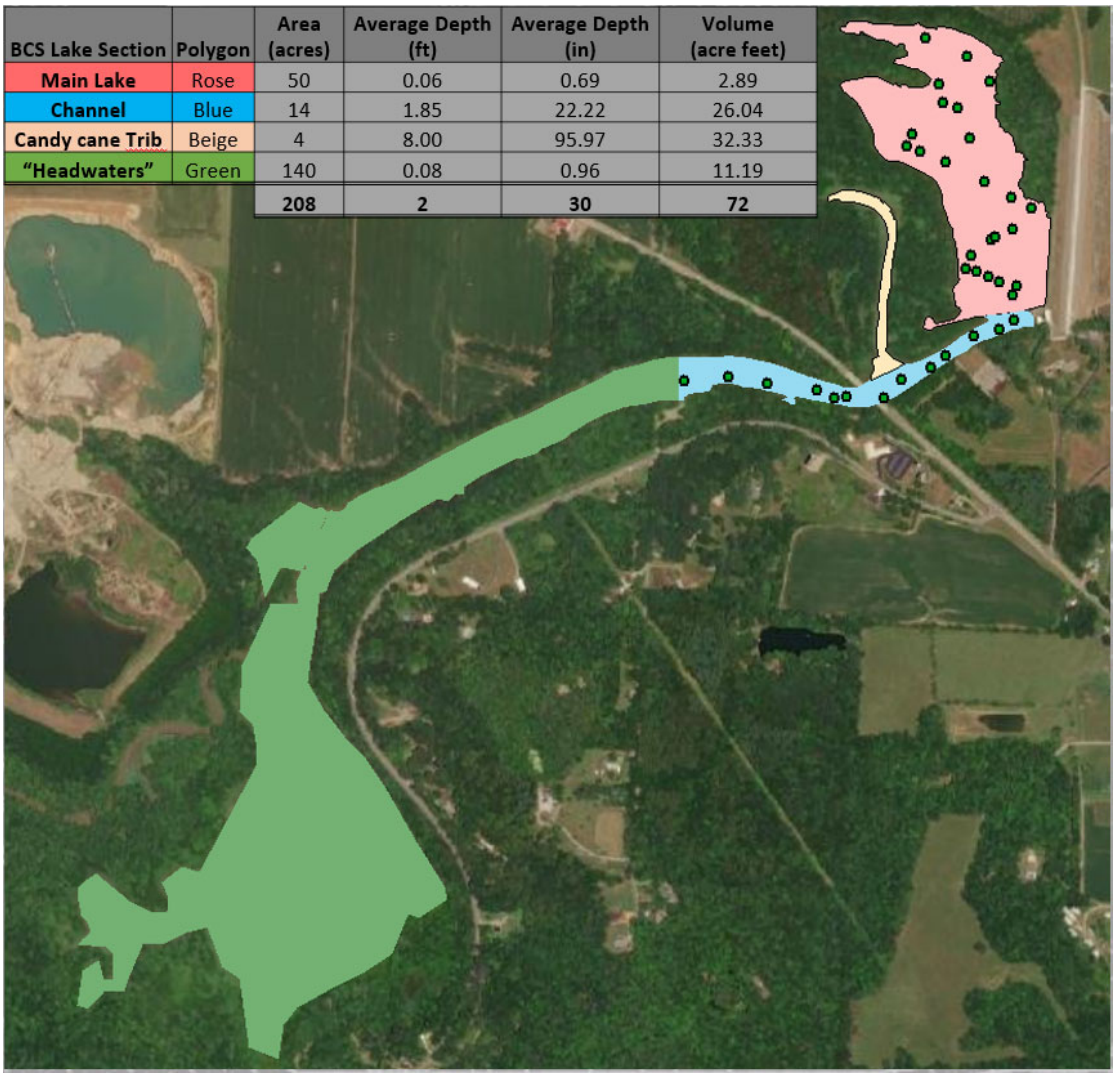

Figure 5. Bathymetry measurements taken at Beach City Lake in the summer of 2021 show that the lake has an average depth of 30 inches and 72 acre-feet of storage. The "Main Lake" section of the lake has an average depth of 0.7 inches.

OPERATIONAL ALTERNATIVE MODELING

District Water Management staff completed reservoir simulation modeling to simulate the changes in the frequency of fill for the lake that would result if stop logs were removed from culverts built into the control weir at Beach City Dam. Three operational alternatives were modeled: 1) a conservation pool alternative that utilizes the current configuration and operation with a reservoir control weir (elevation 948 ft), 2) a no-conservation pool alternative with flow passing through two weir culverts, and 3) a no-conservation pool alternative with flow through only a single weir culvert. The invert elevation of the culverts is 931 ft.

Methods

USACE Hydrologic Engineering Center (HEC) developed the ResSim software in part to simulate reservoir operations and alternatives for detailed regulation plan investigations. Version 3.5 of that software was used to construct and calibrate this predictive model and to examine operational alternatives.

A record of 35 water years (1 October 1986 to 30 September 2021) of hourly reservoir inflows, outflows, lake elevations, and downstream flow control data were obtained from the Corps Water Management Software (CWMS) database to build and calibrate the model for this Beach City Project. Data stored in CWMS are derived from meteorological, stream flow, and elevation gages within the watershed.

Calibration of the model to observed data was successful, although the modeling effort revealed that recorded lake elevations during the study period may be approximately 0.5 ft higher than actuality and could be adjusted pending future investigation. Calibration was focused on lower flow periods and elevations at or less than 948 ft as it was expected that frequency of fill would change the most at elevations below the current control weir structure.

Calibration results are presented in Figure 6 showing the entire record and a zoomed-in view (Figure 7) of a low flow period in 2016 that compares reservoir inflows and resulting elevations. The calibrated model generally predicts elevations that are potentially 0.5 ft below observed values. If future investigations reveal that the project lake gage readings are reading 0.5 ft high, the model yields nearly identical results. If the historical ratings are correct, then the model somewhat underpredicts the frequency of elevations at less than 948 ft resulting in conservative estimates.

The input for all three alternatives was the same 35-year data set data described earlier. Bathymetric survey data collected by the District Water Quality Team was used to update the elevation-storage curve for the reservoir and was utilized in all three alternatives. In all three model alternatives the flood gates were operated the same way for downstream control of water levels.

The conservation pool alternative included the existing structure of an outlet weir that maintains a small conservation pool of approximately 72 ac-ft between elevations 931 and 948 ft. Lake elevations exceeding 948 ft result in flows over this control weir and downstream.

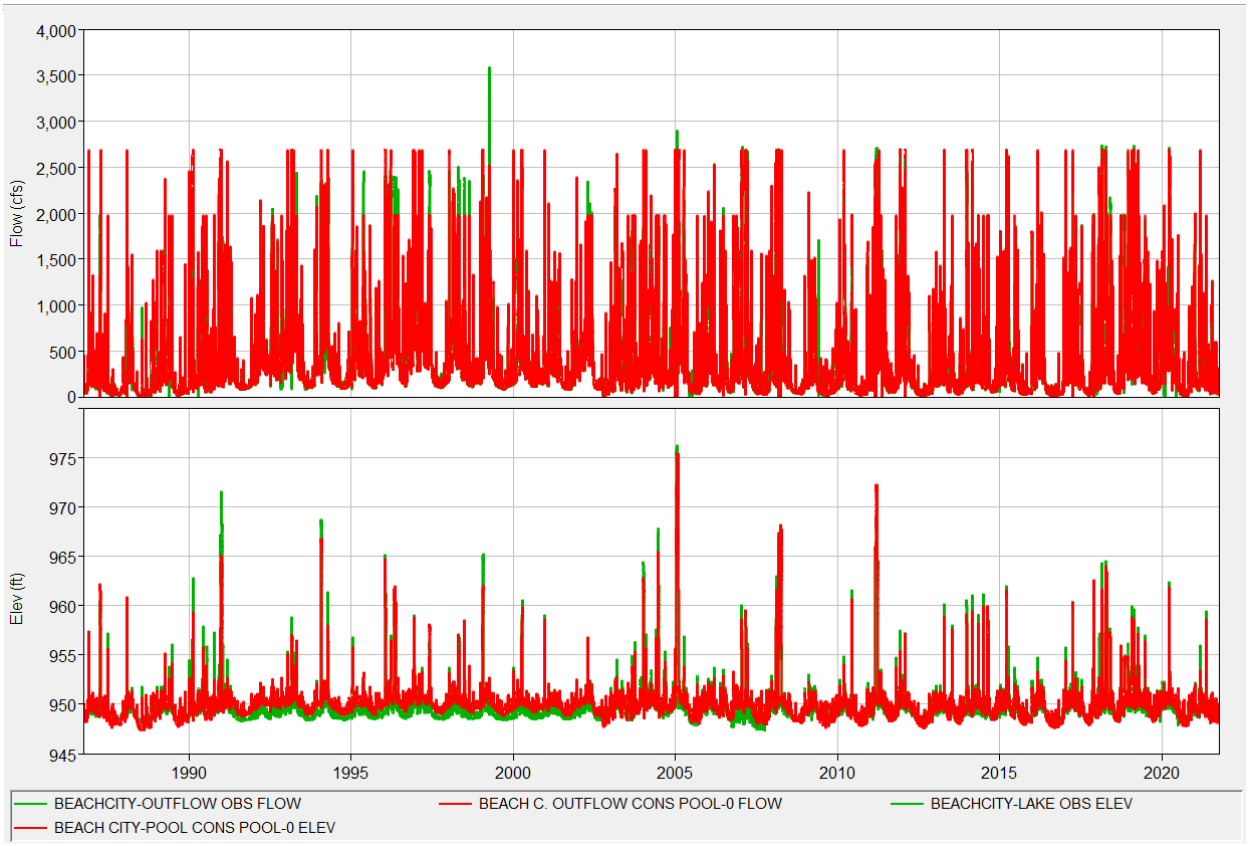

Figure 6. Comparison of observed flows and lake elevations with modeled results.

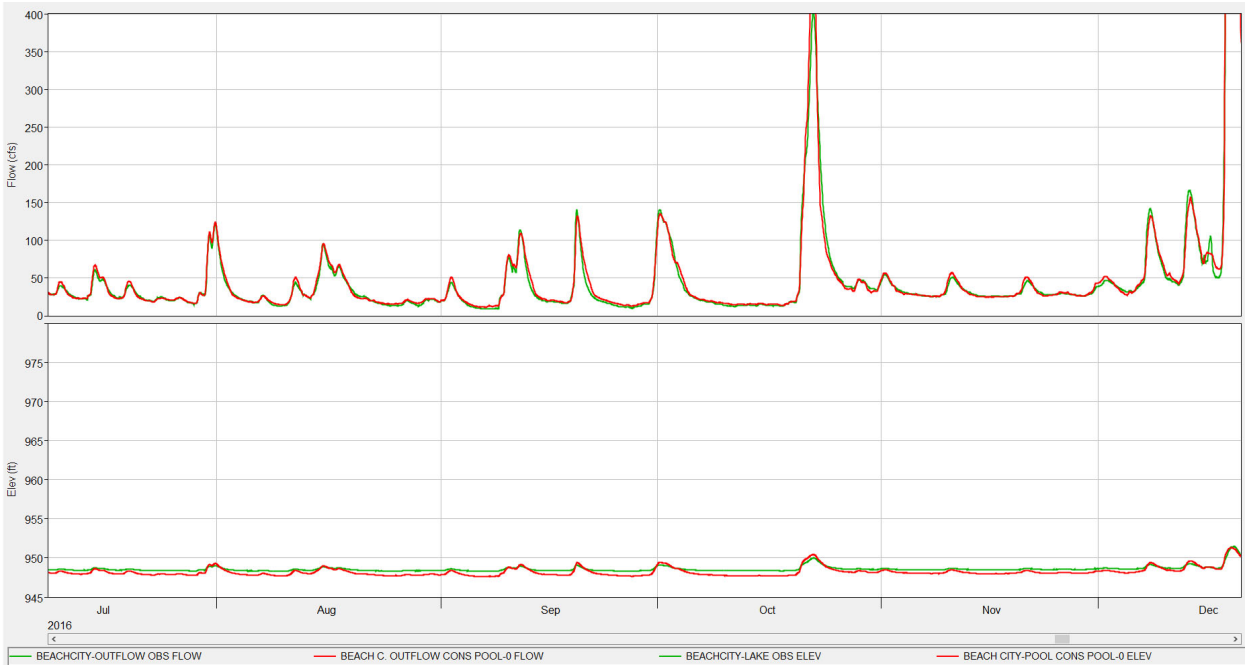

Figure 7. Comparison of observed low flows and lake elevations with modeled results.

Two no-conservation pool alternatives were modeled. The first no-conservation pool alternative operated with stop logs removed from both bypass culverts. The second no-conservation pool alternative operated with stop logs removed from only one bypass culvert. These alternatives both result in flows being discharged downstream beginning at a lake elevation of 931 ft. Above 948 ft, flows pass over the weir structure and through the culverts or culvert, depending on the alternative. New flow-elevation rating curves developed by the District Hydraulics and Hydrology Section which include culvert and weir flow were utilized to determine project outflow and modeled lake elevations. Additionally, the project guide curve within the no-conservation pool alternatives was updated to allow the release of the existing conservation pool volume of 72.48 ac-ft.

Frequency of fill curves from the conservation pool alternative and both no-conservation pool alternatives were produced by modeling hourly lake elevations during the period of record. A duration analysis was then completed within ResSim to determine percent exceedance of varying pool elevations for the period of record.

Results

Results of these ResSim analyses are presented in Figure 8 (frequency of fill curves), Table 1 (elevation-exceedance table), and Table 2 (frequency of fill table) below.

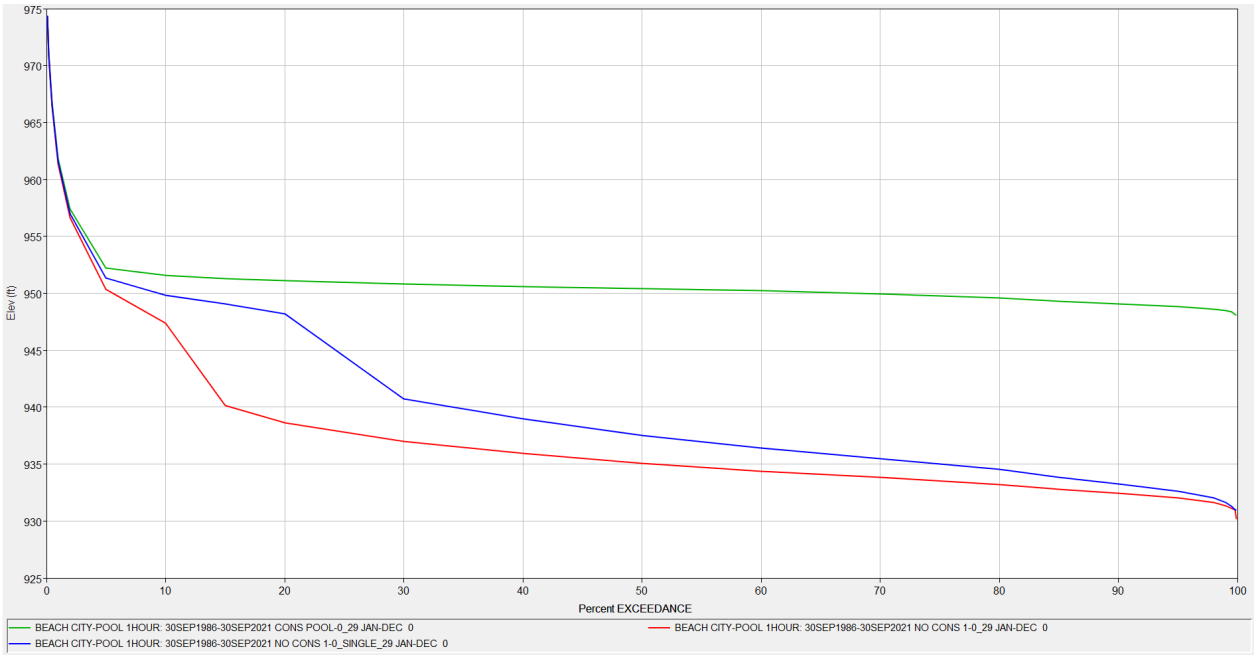

Figure 8. Frequency of fill curves for Beach City operational alternatives.

Table 1. Elevation-exceedance for Beach City operational alternatives.

% Exceedance	Elevation w/Conservation Pool (ft)	Elevation No-Conservation Two Culverts (ft)	Elevation No-Conservation One Culvert (ft)
0.1	974.29	974.34	974.42
0.2	971.05	970.79	970.88
0.5	966.75	966.41	966.53
1	961.86	961.39	961.60
2	957.41	956.66	957.00
5	952.24	950.35	951.32
10	951.57	947.37	949.81
15	951.29	940.12	949.09
20	951.12	938.63	948.17
30	950.82	937.00	940.75
40	950.60	935.96	938.95
50	950.41	935.09	937.53
60	950.25	934.39	936.39
70	949.95	933.82	935.49
80	949.59	933.22	934.54
85	949.31	932.78	933.84
90	949.06	932.41	933.25
95	948.82	932.01	932.61
98	948.60	931.62	932.03
99	948.45	931.32	931.60
99.5	948.36	931.12	931.29
99.8	948.15	931.00	931.00
99.9	948.10	930.16	931.00

Table 2 shows the frequency of selected lake elevations from 947 to 951 ft where the model has predicted the most amount of change between the alternatives. Dramatic reductions in frequency were noted under both no-conservation pool alternatives. Although, passing flow through a single culvert instead of utilizing both culverts increased frequency of inundation by more than 100% between elevations 947 and 948 ft and by approximately 33% at elevation 951 ft. Table 2 provides the easiest format for these results to be used in the forecasting of potential future impacts to the areas upstream of Beach City Dam.

Table 2. Frequency of fill of select elevations for Beach City operational alternatives.

Elevation (ft)	% Exceedance W/Conservation Pool	% Exceedance No-Conservation Two Culverts	% Exceedance No-Conservation One Culvert
947	100.0	10.3	21.6
948	100.0	8.9	20.2
949	91.3	7.3	15.5
950	68.4	5.6	9.4
951	24.0	4.6	6.1

ELEVATION MAPPING

The District produced maps using ArcGIS that document key elevations within the project area. These maps show elevation lines that correlate with different scenarios as predicted in the Operational Alternative Modeling (OAM) detailed above. The elevations listed in Table 2 of the OAM (947 to 951 ft) were included in the maps to help the District visualize potential effected areas if the conservation pool were lowered or removed (Figures 9 to 12).

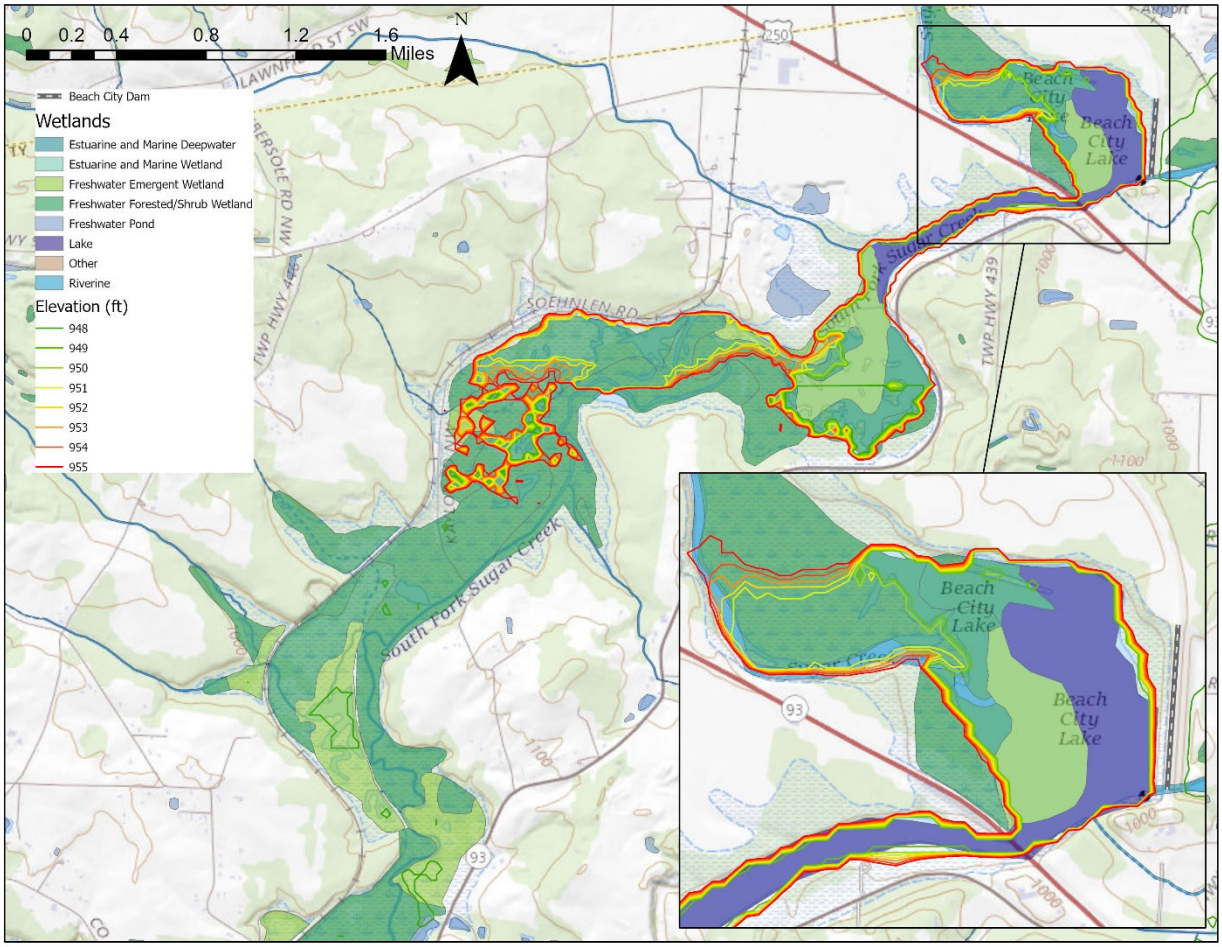

Figure 9. Elevation map of Beach City Lake and upstream area with contour lines for elevations 948 to 955 ft with NWI map wetlands layer.

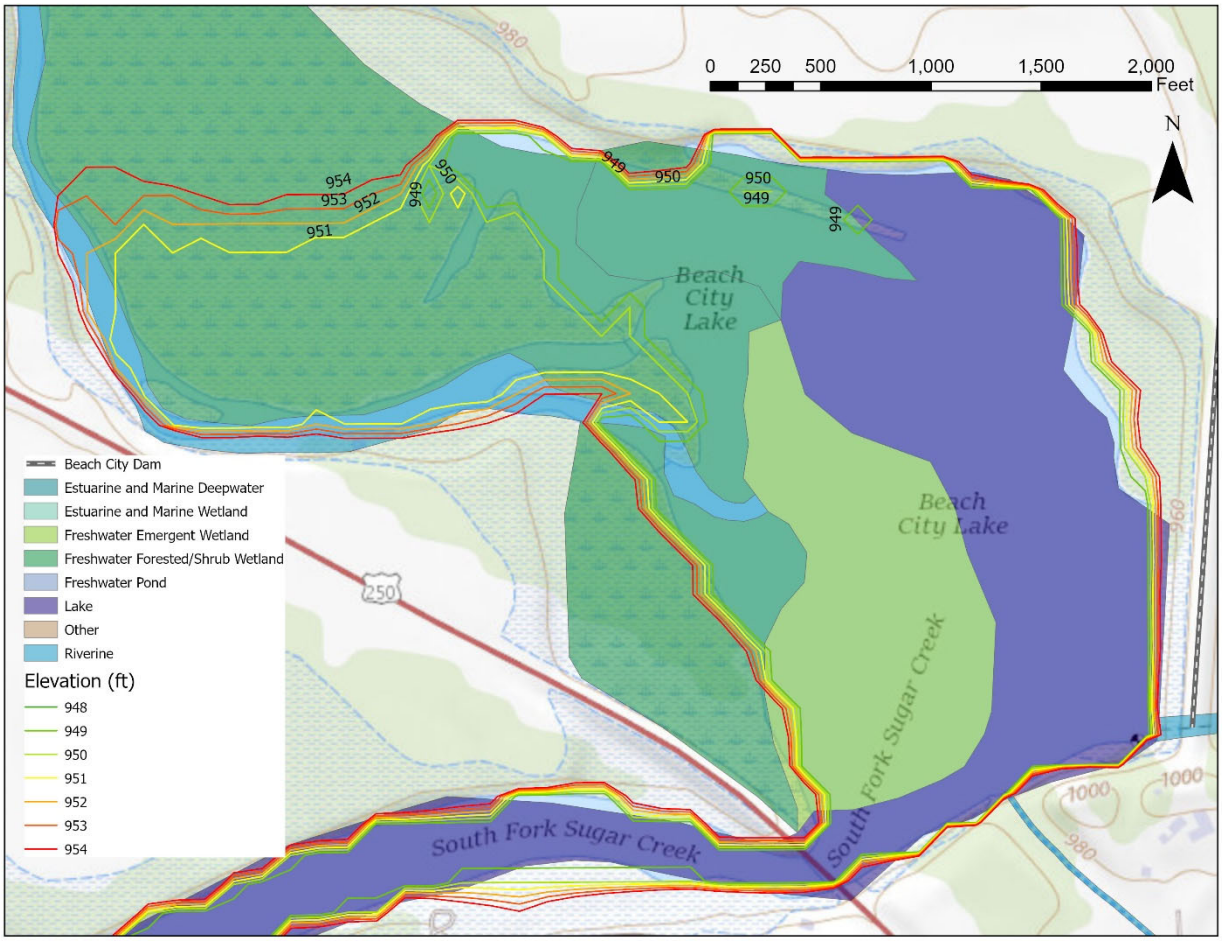

Figure 10. Elevation map of Beach City Lake with contour lines for elevations 948 to 954 ft with NWI map wetlands layer.

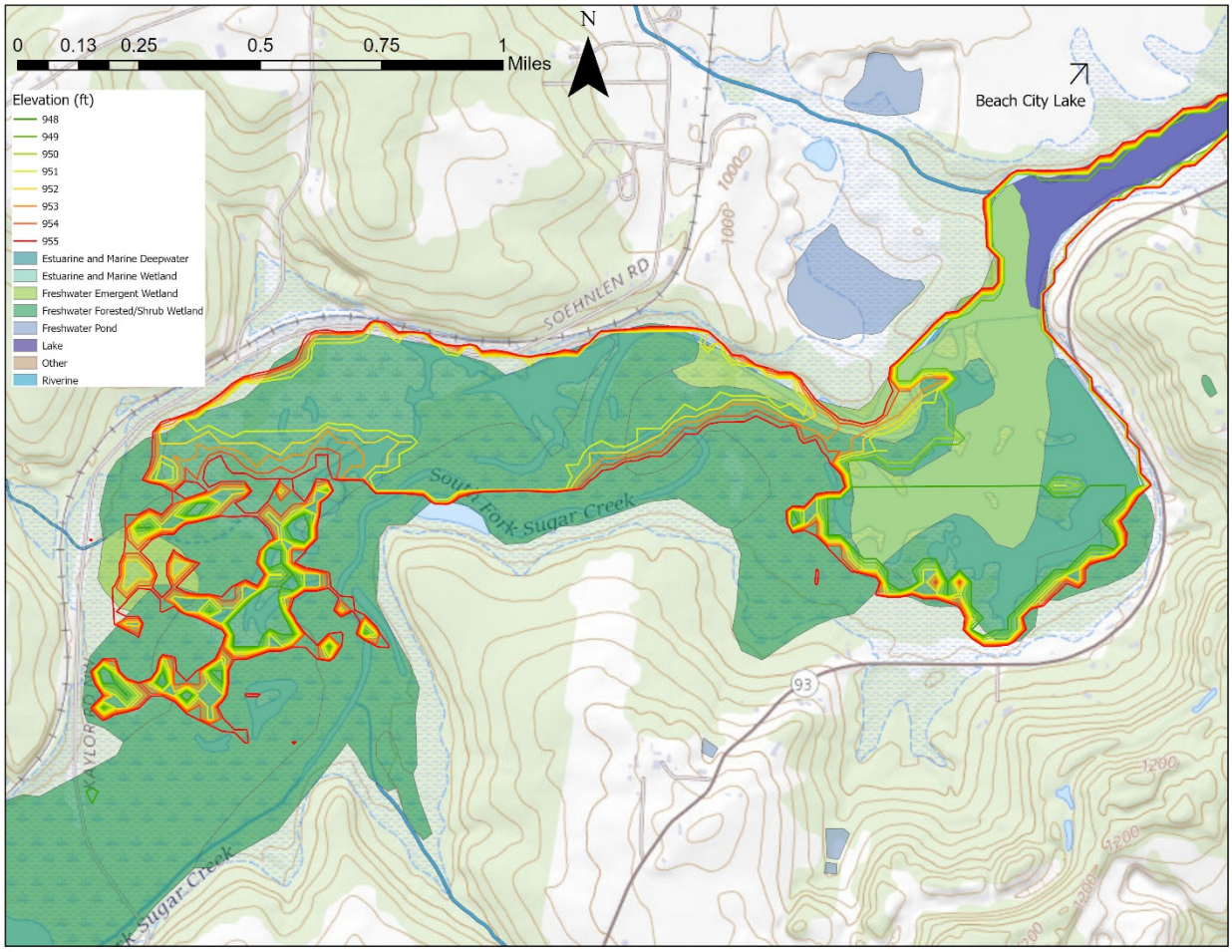

Figure 11. Elevation map of upstream area from Beach City Lake with contour lines for elevations 948 to 954 ft with NWI map wetlands layer.

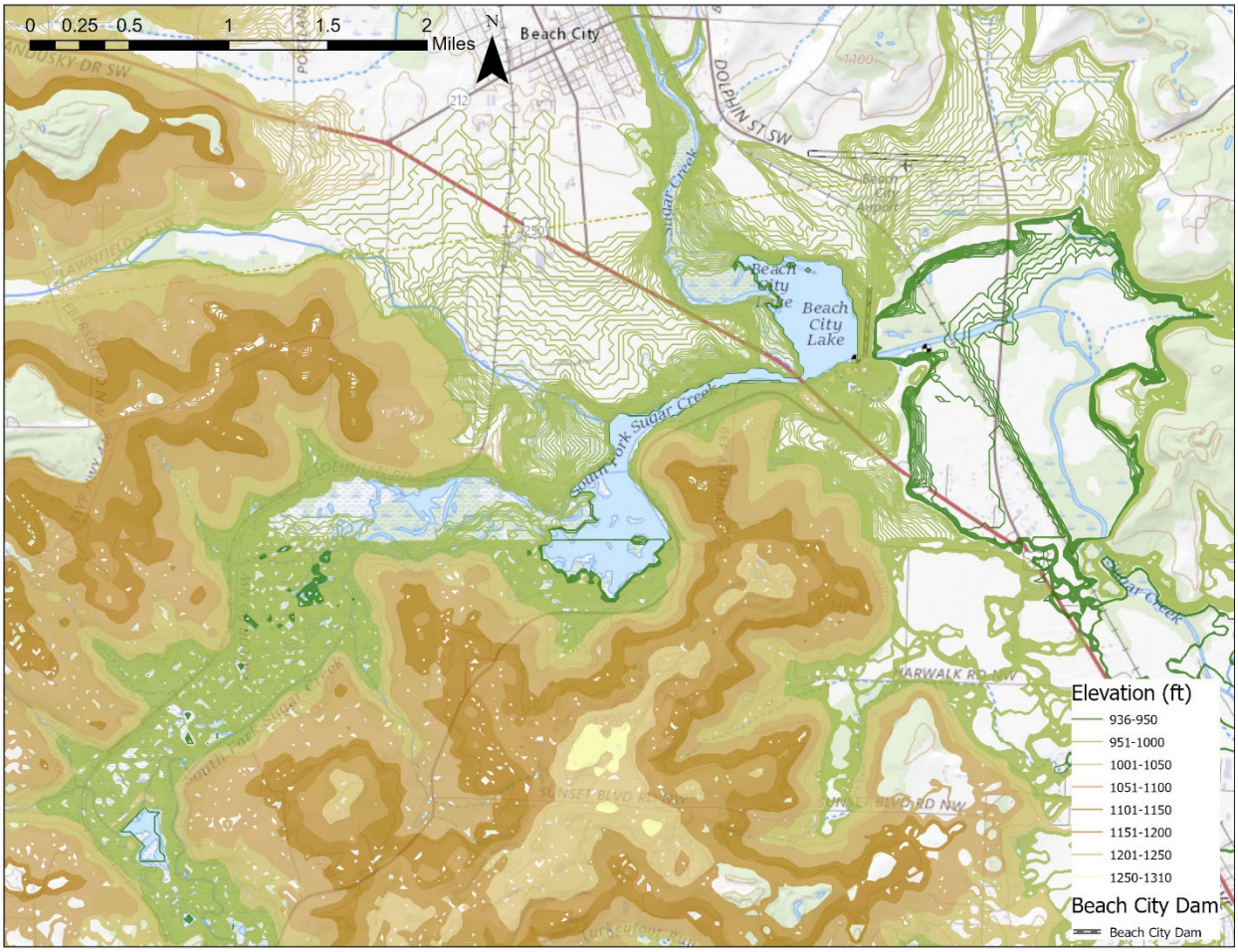

Figure 12. Elevation contour map of Beach City Lake and upstream area.

2. Determine Operational Flexibility of the Pool*(excerpt from scope of work)*

Using the current Water Control Plan for Beach City Dam, determine the operational flexibility that may allow for pool drawdowns, including seasonal drawdowns. Develop a strategy to modify the Water Control Plan, if viable.

Analysis

The District has flexibility to exercise a drawdown within the pool. In order to exercise a drawdown of the pool using the stop log structures within the weir, the District would need to seek a deviation from the Water Control Plan (WCP). The District could operate up to three years with a different lake elevation. In that three-year period, the District would need to decide if the change should be made a permanent part of the project operations or not. If the variation from the WCP were to be permanent, then the District would need to finalize the study, conduct NEPA review and documentation, public review, and to revise the WCP to include the new measure.

3. External Agency Coordination *(excerpt from scope of work)*

Coordination with federal, state, and local agencies on potential pool operation changes and alternatives. Coordination would include Ohio Environmental Protection Agency (OEPA), Ohio Department of Natural Resources (ODNR), US Fish and Wildlife Service (USFWS), Ohio State Historic Preservation Office (OSHPO), Muskingum Watershed Conservancy District (MWCD), etc.

Analysis

The District coordinated with agencies and setup two online agency meetings, one on December 13, 2021, and one on January 13, 2022. Agencies that participated in these meetings included a representative from the Ohio Office of The Nature Conservancy (TNC), MWCD, ODNR, along with email coordination with USFWS. From these early meetings, the consensus was that the current "lake" conditions did not provide any beneficial natural habitat during the warm summer months to the local wildlife population as the water was too warm and the conditions were not conducive to traditional boating recreation. There was also support in making the current "lake" area into healthier habitat for summer use. There was support from the agencies with moving forward with finding an alternative that may create a different, more beneficial form of recreation in the area, such as wetland habitat that could support migratory birds.

The initial coordination on the project was positive among the participants and opens the way for continued coordination in the future. As the project progresses more agency coordination will be necessary and additional agencies will be added to the list of participants as needed.

Development of Alternatives for Test Proposal

4. Formulate and Document Alternatives for Test Proposal *(excerpt from scope of work)*

Formulate test strategies to provide potential impacts/benefits from permanent operational changes. Document alternatives/proposals for further development and coordination.

Analysis

With the baseline information gathered and the operational alternative modeling conducted the District determined that there is additional information that needs to be gathered before a test can be formulated and conducted at Beach City Dam. First, the stop log structures within the weir needs to be inspected and analyzed by engineering team members in order to determine the conditions and level of operability. If the structures are not able to be removed or operated, then a test could not be conducted until they were.

Secondly, as suggested by the modeling, it seems that there is potential for the wetlands upstream to be adversely affected by the pool lowering. It is the District recommendation that additional studies or modeling would be needed in order to get a better idea and representation of what a drop in the pool could do to the wetlands upstream and how far it may reach. There are extensive, high-quality wetlands directly upstream of the dam and without additional modeling of the potential effects the project may do more harm than good to surrounding environment that would result in

irreversible, adverse impacts to the environmental along with potential penalties to the District. The District may partner with ERDC in order to complete these modeling efforts.

CONCLUSION

Moving forward with the Beach City SRP project, the District recommends the following actions:

- Determine the conditions and operability of the stop log structures and bypass conduits.
- Conduct more extensive wetland forecasting and hydrologic modeling to determine the potential benefits to the habitat enhancement areas and the potential impacts to the high quality wetlands upstream due to a lower pool elevation. The District intends to partner with ERDC to complete these modeling efforts.
- Continue to coordinate with agency partners and keep them involved in the development of the project.
- Develop steps for future project development, alternatives, and testing possibilities. Alternatives could include the introduction of seasonal pools, use of gates to control the pool instead of the weir, etc.
- Identify any additional habitat uplift measures that can be implemented onsite.

Based on the completed OAM, the District feels these are the best next steps regarding potential wetland enhancements in the Beach City pool. Additional scoping documentation would be necessary to continue the work, if there is interest.

RESOURCES

Federal Emergency Management Agency. 2021. "Floodplain Map". *Floodplain Maps*, https://msc.fema.gov/portal/home

Natural Resource Conservation Service. 2022. "Soil Map". *Web Soil Survey,* https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

U.S. Fish and Wildlife Service. 2021a. "IPaC Resource List". *IPaC: Information for Planning and Consultation,* https://ipac.ecosphere.fws.gov

U.S. Fish and Wildlife Service. 2021b. "NWI Map". National Wetlands Inventory, https://www.fws.gov/wetlands/data/mapper.html