Appendix G – Civil Engineering

Mitchell Lake, San Antonio, TX

General Investigations Feasibility Study
Integrated Draft Feasibility Report and Environmental Impact Assessment

June 2021

US Army Corps
of Engineers®
Fort Worth District

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EXISTING CONDITIONS OF THE MITCHELL LAKE COMPLEX:
Mitchell Dam and Lake

Mitchell Lake has a surface area covering approximately 600 acres with an average water depth of less than 8 feet. It is located in southern Bexar County and is currently operated and managed by San Antonio Water System (SAWS). Mitchell Lake Dam was constructed in 1901 by the San Antonio Irrigation Company. In the 1970's, an eighty-seven-acre polder complex was constructed at the northern end of the lake to accept waste activated sludge from the Rilling Road Wastewater Treatment Plant. This practice continued until 1987, when the Dos Rios Wastewater Treatment Plant came online into operations. The upper complex currently consists of five decant basins (constructed in the 1980s) designated 1 through 5, and two polders (East and West). The polder complex area is protected by dikes and does not receive storm water runoff.

Mitchell Lake Dam consists of an earthen embankment that varies from 2 to 10-feet in height and is approximately 3,200 feet long. The embankment top width is 15 feet and its crest elevation 527 ft (NAVD88). The upstream slope is 2 feet horizontal to 1 foot vertical and the downstream slope is 2.5-ft horizontal to 1-foot vertical. Concrete rubble used for erosion protection is located at various locations along the upstream face of the dam. The dam is vegetated and there are large trees present at various points adjacent to the toe of the dam. A 55 feet wide concrete spillway is located along the eastern abutment and the normal water surface is maintained at 520.4 ft (NAVD88). In times of flooding, the dam's spillway is engaged. This spillway consists of eight (8), 36-inch diameter gate valves with invert elevations at 520.73 ft. Some of the gates are permanently welded in the open position and some of them can be operated. All are currently left fully open at all times. A 250-foot stone and mortar outfall channel proceeds from the spillway into a heavily eroded plunge pool. The pool discharges into Cottonmouth Creek which flows into the Medina River. Treated effluent (recycled water) is piped to the lake from the Leon Creek Water Recycling Center. This recycled water is used to maintain the normal pool elevation during dry periods.

The Polders complex has two pumping stations at the southern end of the basins 5 and 4 to allow for water circulation flows. There are three pumps at the southwest corner of basin 5 that allow for water to be pumped from the Mitchell Lake into the Polders complex. The water is pumped into Basin 5 then gravity flows through a pipe into Basin 1 which then gravity flows through a pipe into the West Polder. From there water will circulate by gravity through pipes to the East Polder, then to both Basin 3 and Basin 4, bypassing Basin 2. There is a pipe that connects Basin 4 to Basin 5 downstream, but also a single pump at the pump station on the southeast corner of Basin 4 allows for the water to be discharged back into Mitchell Lake. See Exhibit 1 for a depiction of the polder flow pattern:

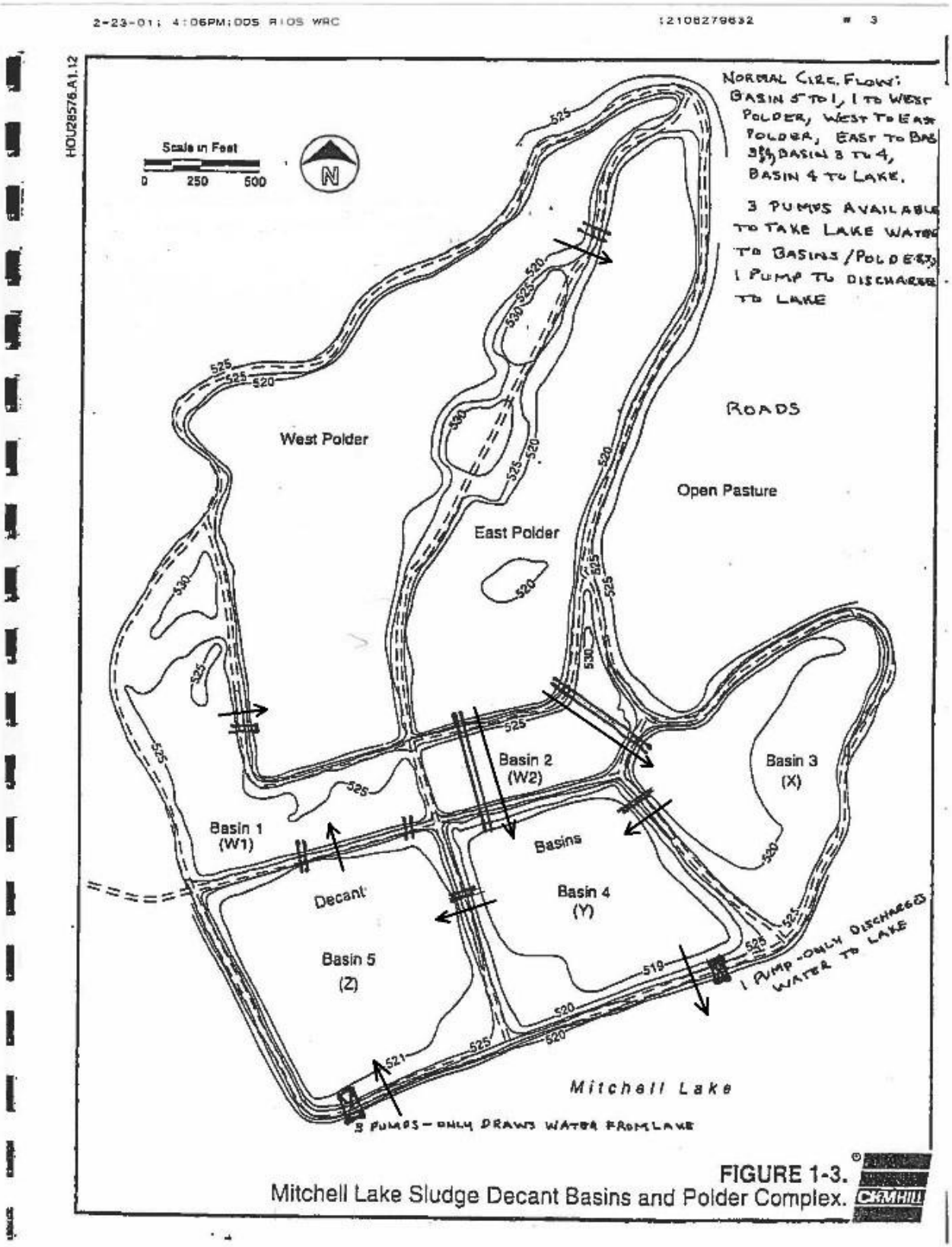

Exhibit 1 – Existing Polder Flow Patterns

FUTURE CONDITIONS WITH PROJECT:

Area 1 Option - Adjacent to Bird Pond

Bird Pond has an existing areal extent of approximately 3.17 acres that can be restored to a wetland feature. There is an opportunity to increase the perimeter to provide a larger wetland area, expanding it to 6.42 acres. Water would be supplied by pumping from Mitchell Lake through a pipeline system from a new pump near the existing southwest pump station to the north edge of Birds Pond Wetland. It is assumed that the existing pumps will not be adequate and new pumps will be required to meet the project demands; two 30 horsepower pumps would be installed to provide redundancy should one of the pumps fail or require repair. The entire area of wetlands to be filled is 27 acres, at a depth of 4 feet, to occur over a two-week fill period. This results in a flow rate of 1755 gpm through an approximately 10,500 feet long 10" diameter waterline. It is assumed that the existing power supply for the existing pumps is adequate to operate the new pumps; this assumption will be validated in the future. The pipeline would need to cross existing petrochemical pipeline right-of-way, but the petrochemical pipeline would not have to be relocated. The outfall from the Bird Pond Wetland should be designed with a drainage ditch to merge into the existing creek below Bird Pond. A culvert would be needed to cross the road between Bird Pond wetland and the Bird Pond creek. See Figure 1.

Wetland excavation criteria and limits:

The wetlands area should be excavated to establish average depth grading of 6" to 4' throughout with appropriate freeboard. These emergent wetlands must be allowed to be drained to 2 feet so that deeper holes retain water for refugia habitat. These deeper pockets should be four feet in depth with an approximate bottom radius of 4', sloped to meet back up with a 2' depth. The deeper pockets should be located 65 feet from the shoreline and no closer than 65 feet from each other around the perimeter of each wetland. All the excavated material can be disposed onsite, possibly for the new embankments for Area 6 – Polders. Water will be maintained at maximum depths during spring and fall months, allowed to draw down up to 1 foot during summer, and drain during the winter months to control cattails and promote diverse emergent vegetation.

Construction of a water control structure:

A stop log type water control structure should be installed to maintain the required 6" to 4' depths with appropriate freeboard. Logs may be removed to allow the wetland to be drained to 2' so that the deeper holes retain water to maintain maximum depths during spring and fall months, and additional logs removed to allow draw down up to 1' foot during the summer, and even more logs removed to drain during the winter months to control cattails and promote diverse emergent vegetation.

Annual operational and maintenance costs are roughly estimated to range from $10,000 to $15,000 for all of the emergent wetland areas.

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Area 1A - Adjacent to Bird Pond Existing

	Unit	Cut	Fill
Wetland Cell Earthwork	CY	4,800	0

Area 1B - Adjacent to Bird Pond Expanded Limits

	Unit	Cut	Fill
Wetland Cell Earthwork	CY	17,000	12,200

See Exhibit 2 below for an example stop log structure:

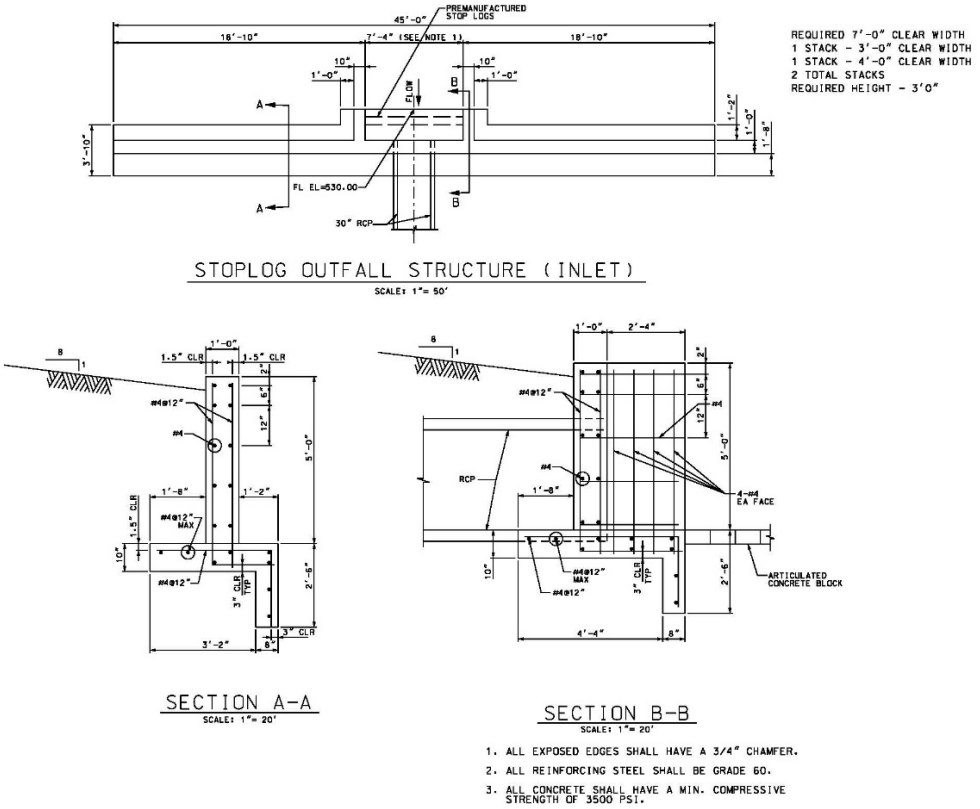

Exhibit 2 – Example Stop Log Structure

Area 2 Option - Central Wetlands

The Central Wetland area has an existing areal extent of approximately 10.46 acres that can be restored to a wetland feature. There is an opportunity to increase the perimeter to provide a larger wetland area, expanding it to 18.37 acres. Water supply to this wetland can provided from two sources depending on the restoration features upstream. If Bird Pond is included in the restoration project, then the flows from the drainage ditch and existing creek will provide the water supply. If nothing is restored upstream then water supply would be pumped through a pipeline system similar to the one explained in the previous section, with the outfall into the Central Wetlands rather than Bird Pond. The outfall from the Central Wetland would be a

drainage ditch along an existing creek to drain into the next wetland cell at Skips Pond. See Figure 1.

Wetland excavation criteria and limits:
The wetlands area should be excavated to establish average depth grading of 6" to 4' throughout with appropriate freeboard. These emergent wetlands must be allowed to be drained to 2 feet so that deeper holes retain water for refugia habitat. These deeper pockets should be four feet in depth with an approximate bottom radius of 4', sloped to meet back up with a 2' depth. The deeper pockets should be located 65 feet from the shoreline and no closer than 65 feet from each other around the perimeter of each wetland. All the excavated material can be disposed onsite, possibly for the new embankments for Area 6 – Polders. Water will be maintained at maximum depths during spring and fall months, allowed to draw down up to 1 foot during summer, and drain during the winter months to control cattails and promote diverse emergent vegetation.

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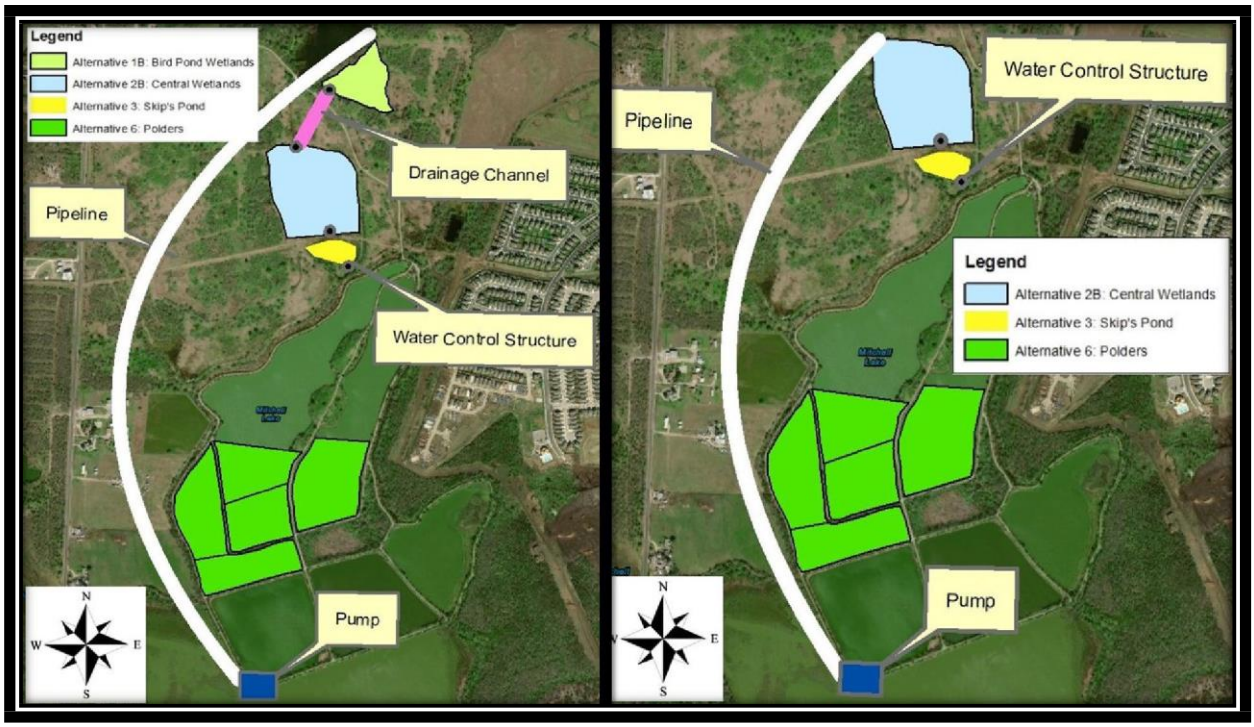
Area 2A - Central Wetlands Existing	Unit	Cut	Fill
Wetland Cell Earthwork	CY	13,550	12000

Area 2b - Central Wetlands Expanded Limits	Unit	Cut	Fill
Wetland Cell Earthwork	CY	29,600	26,000



Area 3 Option - Skip's Pond
The Skip's Pond area to be part of the restored wetland feature is 2.18 acres. The water supply would be from the discharge ditch coming out of the Central Wetland cells. See Figure 1.

Excavation at Skip's Wetland would be limited to 30% of the perimeter area for the feature to the same criteria and limits as described above for the Central Wetlands and would only include one 4' deep pocket with the dimensions described above.

Modification of one existing water control structure or construction of a new one is needed to maintain water levels as described above.

Area 3 - Skip's Pond	Unit	Est Qty
Wetland Cell Excavation	CY	9350

Area 4 Option - Edward's Tank
The perimeter area around this wetland cell is 1.15 acres.
No excavation or grading of existing area will be done as a structural measure of improvement to meet the planting of diverse tree, shrub and/or herbaceous species. See Figure 1.

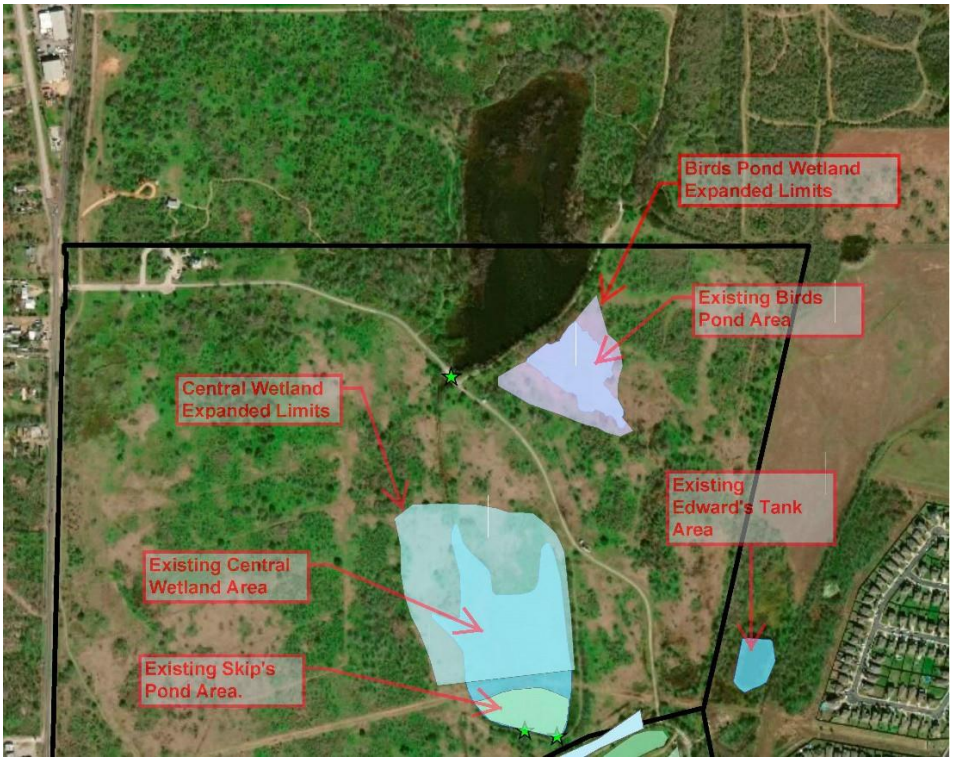


Figure 1 – Bird Pond, Central Wetlands, Skip's Pond and Edward's Tank

Area 5 Option - Linear Wetland
The perimeter area around this wetland cell is 4.43 acres.
No excavation or grading of existing area will be done as a structural measure of improvement to meet the planting of diverse tree, shrub and/or herbaceous species. See Figure 2.

Area 6 Option - Polders
The area of the Polders complex is 49.52 acres, consisting of two long cells divided as East and West and five basin cells. All of the cells are divided by perimeter berms that have a top of berm elevation at approximately 527. These 7 feet high berms would total approximately 2400 LF, with 6 feet top widths and 3:1 side slopes. In order to lower the water levels at different stages and times, additional berms would be added to the Polder cells from excavated materials of the constructed wetland cells as follows:
Construction of two berms at the south end of the West Polder
Construction of one berm at the south end of the East Polder
Construction of one berm at the southwest corner of Basin 1
See Figure 2.

<u>Water Control Structures:</u>
Modification/replacement of existing water control structures to drop the invert to a level that would allow the draining of the polder cells. Existing water control structures and pipes that cannot be modified to meet project objectives will be removed or fully grouted with flowable fill.

Installation of new water control structures to facilitate transfer of water across the new berms in the West Polder, East Polder, and Basin 1

Portable Pump:
A trailer mounted portable pump, operated and maintained by SAWS, would be used to move water from one polder to the other and allow flexibility in the control of the water levels. The current conceptual pumping rate is determined to be between 800 and 1300 gpm which will allow the operator to fill empty polders in approximately 3 to 5 days. It is anticipated that the operation of the polders will depend on the weather and how these areas are operated. It is anticipated that hoses will be used to move the water around so the pumping unit will be provided with adequate hoses to feed the water as required.

Another potential option would be the construction of a controlled outfall structure on the west side of Basin 1 to facilitate releasing water to filter through the northwest end of Mitchell Lake if the Mitchell Lake emergent wetland Area 7 Option would be implemented.

Annual operation and maintenance costs for the polder complex are roughly estimated to be around $5,000 to $8,000.

Area 6 – Polders	Unit	Est Qty
Berms Fill Material	CY	16,800

Figure 2 – Linear Wetlands and Polder Area

Area 7 Option - Fringe Wetlands (Coves 1, 2, and 3)
The perimeter area around the entirety of lake's edge is a total of 72.36 acres.
No excavation or grading of existing area will be done as a structural measure of improvement to meet the planting of diverse tree, shrub and/or herbaceous species. See Figure 3.

Area 8 Option - Island Habitat

This option would allow for development of new habitat areas within Mitchell Lake. A total of three islands can be built from excavated materials of the constructed wetlands. Island 1 would consist of 8.37 acres, Island 2 would consist of 14.70 acres and Island 3 would consist of 12.24 for a total of all islands to be 35.31 acres. Excavated material from the constructed wetlands in other options may be used to create islands in Mitchell Lake instead of hauling and disposing the material. This option would require transport using heavy equipment (haulers, barges, etc.) to move and place. The island area will be planted with diverse native emergent and aquatic vegetation. See Figure 3.

Area 8 - Island Habitat	Unit	Est Qty
Fill Material	CY	69,250

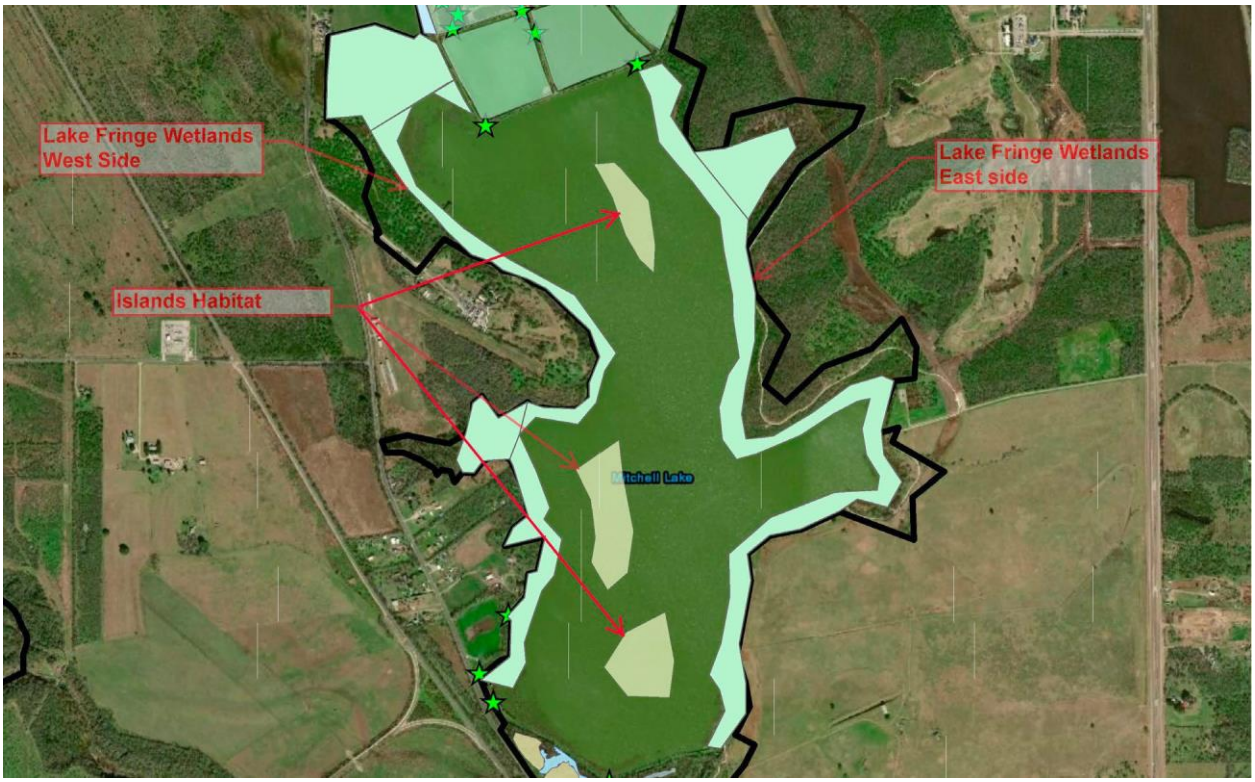


Figure 3 – Fringe Wetlands and Island for Habitat

Area 9 Option - Dam Forested Wetland

Just downstream of the dam along the middle area of the dam length is an existing drainage area that consists of 2.55 acres which can be enhanced to a wetland area. Adjacent to this existing drainage area a new wetland can be created consisting of 4.48 Acres. The wetland perimeter would be the limits of the required plantings and removal of invasive species. Within this perimeter excavation would be performed on 20% of the existing wetland and 30% on the created wetland. Excavation should provide 6" – 1' average depths and no deep holes are needed. This is part of a natural drainage area so no water control structures would be required. See Figure 4.

Area 9 - Dam Forested Wetland	Unit	Est Qty

Existing Wetland Excavation	CY	60
New Wetland Excavation	CY	120

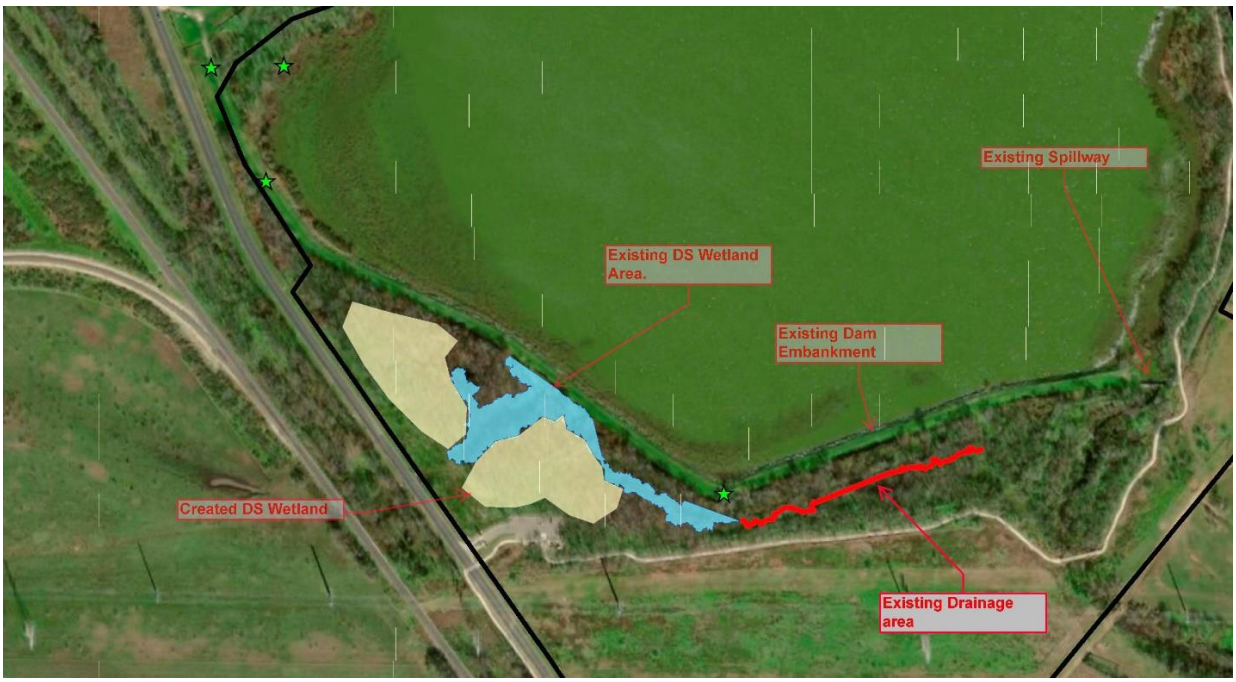


Figure 4 – Dam Forested Wetlands

Area 10 Option - Downstream Wetland

Approximately 3000 feet down stream of the existing dam along Cottonmouth Creek two new wetlands can be created. Two concepts were developed; one provided the maximized the footprint with minimal earthwork; the second concept maximized the footprint and ties into an adjacent project by the non-federal sponsor. These concepts varied in size from 14.00 to 19.10 acres; as the footprint grows larger, the required earthwork grows significantly from 419,000 CY of cut to 794,000 CY of cut. Most of this excess material would have to be disposed of offsite. Adjacent to these wetland cells the non-federal sponsor will construct two wetland cells with a water supply of treatment water from the lake. Water control structures at the non-federal sponsor wetland cells water can supply the newly created wetlands with the excavation of drainage ditches. See Figure 4.

Wetland excavation criteria and limits

Wetlands perimeter area should be excavated to establish average depth grading of 6” to 2’ throughout. In addition to the bottom grading of the wetlands there should be deeper pockets four feet in depth with an approximate bottom radius of 4’, sloped to meet back up with a 2’ depth. The deeper pockets should be located 65 feet from the shoreline and no closer than 65 feet from each other around the perimeter of each wetland. Some of the excavated material can be disposed onsite if the options for Area 6 – Polders and Area – Island Habitat are implemented, however most of this excess material will need to be disposed of offsite.

Construction of a water control structure

Stop log type water control structure should be place such that allows water levels to be controlled to maintain 6” to 4’ depths with appropriate freeboard. The wetland shall be allowed to be drained to 2’ so that the deeper holes retain water to maintain maximum depths during

spring and fall months, allowed to draw down up to 1’ foot during the summer, and drain during the winter months to control and promote diverse vegetation.

Area 10 - Downstream Wetland	Wetland Area	Est Qty (CY)
Wetland Cell Excavation – Minimal Grading	14.00 acres	419,000
Wetland Cell Excavation – Tie into Adjacent Non-Federal sponsor wetlands	19.00 acres	794,000

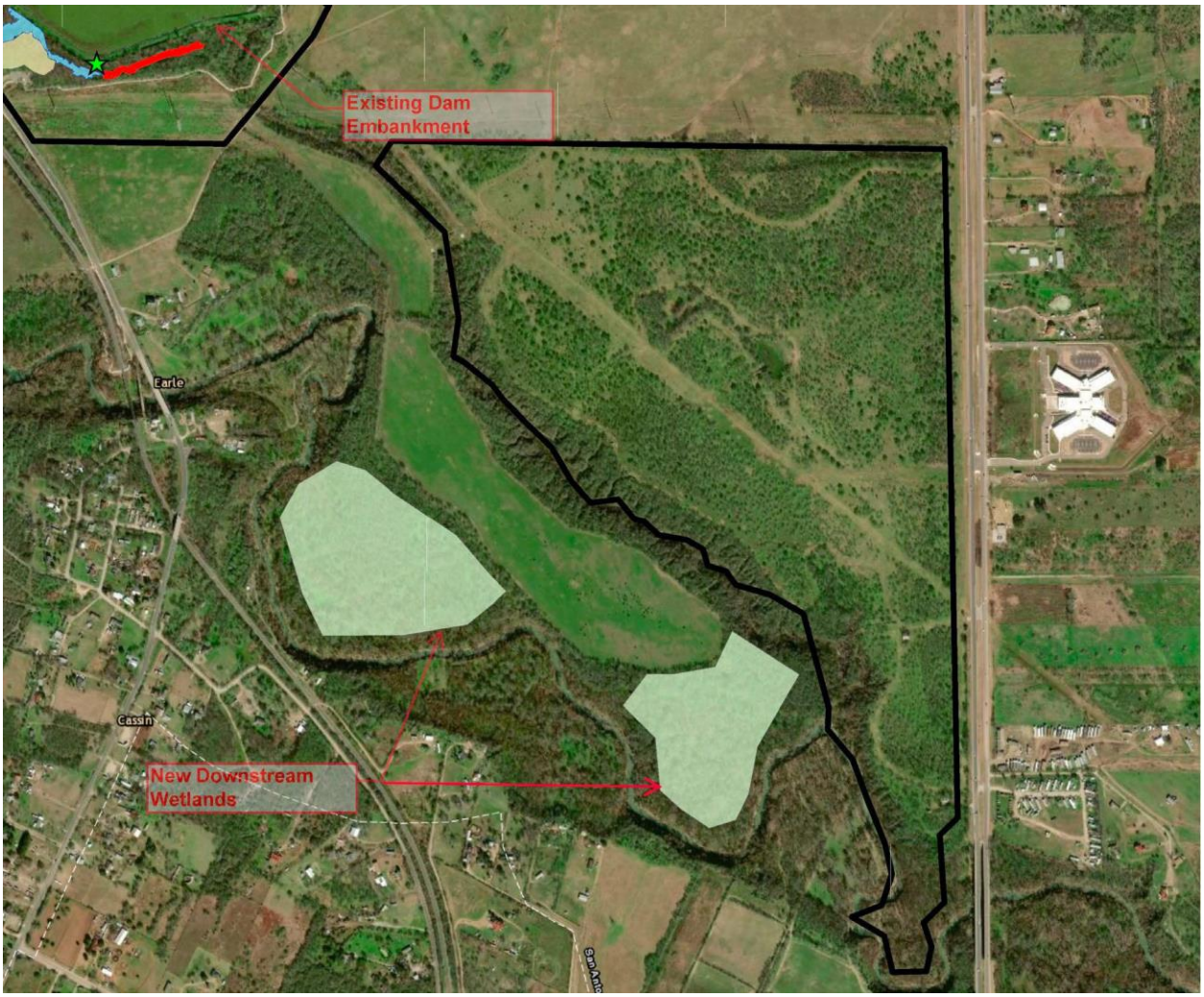


Figure 5 – Downstream Wetlands

Summary of Recommended Plan:

The Recommended Plan is Plan 6: Polders + Coves 1, 2 & 3 + Central Wetlands (2B) +Skip's Pond + Bird Pond (1B); recreational features are also recommended for incorporation. The Plan is detailed in the Report at section 4.13.

Habitat Features

1. Bird Pond Wetland, scale 1B (6.42 acres)
    a. Creates 6.42 acres of emergent wetlands
    b. 17,000 CY cut, 12,000 CY fill
    c. Drainage channel and water control structure (south) to connect to Central Wetlands
2. Central Wetland, scale 2B (18.37 acres)
    d. Creates 18.37 acres of emergent / submergent wetlands
    e. 29,600 CY cut, 26,000 CY fill
    f. Water control structure in the middle to connect to Bird Pond and Skip's Pond
3. Skip's Pond (2.18 acres)
    g. Creates 2.18 acres of emergent wetland
    h. 9,350 CY estimated excavation
4. Polders (49.52 acres)
    i. Creates 49.52 acres of mudflat habitat
    j. Construction of four berms (two in West Polder, one in East Polder and one with Basin 1). Total volume of fill for berms is 16,800 CY.
    k. Water control structures in East and West polders and Basin 1
5. Coves 1, 2 and 3, scale 7G (72.36 acres)
    l. Creates 72.36 acres of emergent / submergent wetlands
    m. Construction features are native plantings.
6. A 2-mile long, 10-inch pipeline is proposed to supply water from Mitchell Lake Polders to the upper chain of wetlands (Bird Pond, Central Wetlands and Skip's Pond).
7. Bird Blinds are added throughout the project area to add habitat value at low cost. Total count is six.

Recreation Features

1. Additional trails from Bird Pond to Skip's Pond – 2 miles
2. Boardwalks at Polders and Downstream Wetlands
3. Trailheads near new Bird Pond
4. Trailhead near Downstream Wetlands and Skip's Pond
5. Bird Blinds near Polders and Northern Chain of improved wetlands.

Civil Engineering related elements of the plan include grading, wetland excavation,

berm construction, culverts, stop log water control structures, and permanent and temporary pumps. Refer to earlier sections of this appendix for specific elements of each area.

The below exhibit depicts the recommended plan:

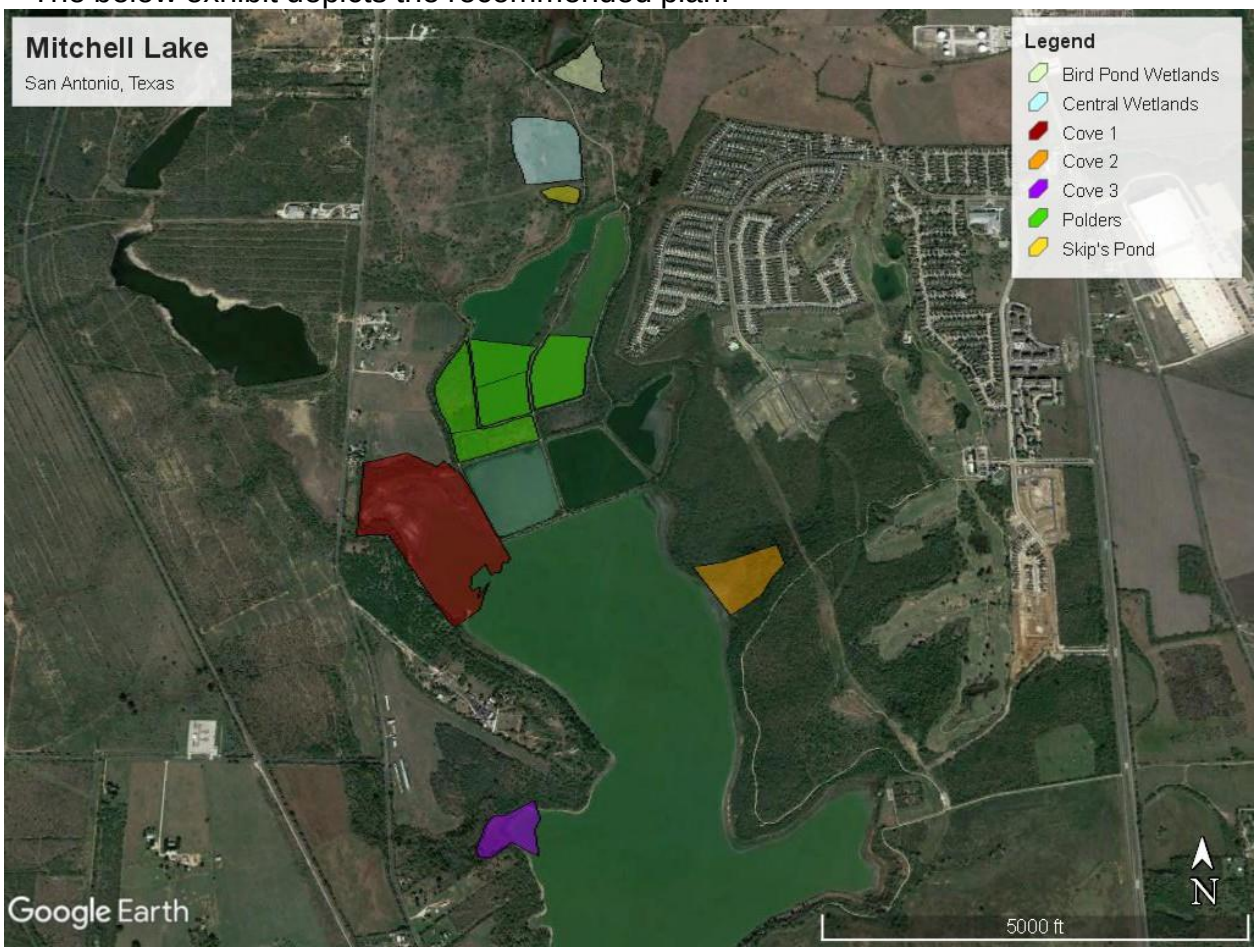


Figure 6 – Recommended Plan (Plan 6)

Below is a summary of the grading requirements:

Earthwork Summary Table - Recommended Plan (Plan 6)

Project Area	Cut(CY)	Fill(CY)
Area 1-Bird Pond (1B)	17000	12200
Area 2-Central Wetlands (2B)	29600	26000
Area 3-Skip's Pond	9350	0
Area 6-Polders	0	16800
Area 7-Fringe Wetlands (Coves 1, 2 and 3)	0	0
Project Totals	55950	55000
Net	**950**	**CY (Cut)**

This net 950 cubic yards of cut may be disposed of either onsite or offsite on SAWS owned property. If the future design results in a deficit of material, then fill would be

commercially purchased. Refer to Section 4.13 of the Main Report for tabulations of the areas and type of habitats created as a result of this wetland excavation and berm placement.

There are several recreational opportunities that can be incorporated alongside the ecosystem restoration project surrounding Mitchell Lake (Figure 7). The Mitchell Lake Audubon Center has recreation features in place currently, including picnic areas, walking (and road) trails, and bird blinds. Additional recreation features proposed are similar to those existing near Bird Pond, with the potential addition of two boardwalks forbird viewing; additional trails, leading from the Bird Pond Wetlands to Skip's Pond for approximately two miles; boardwalks positioned within the Polders; trailheads located atthe beginning of the natural trail near the Bird Pond Wetlands; several picnic tables placed throughout the study area near points of interest such as the Polders and Skip's Pond; bird blinds located throughout the study area near the Polders and the northern chain of improved wetlands. See Figure 7 for a schematic depiction of recreational opportunities in the project area:

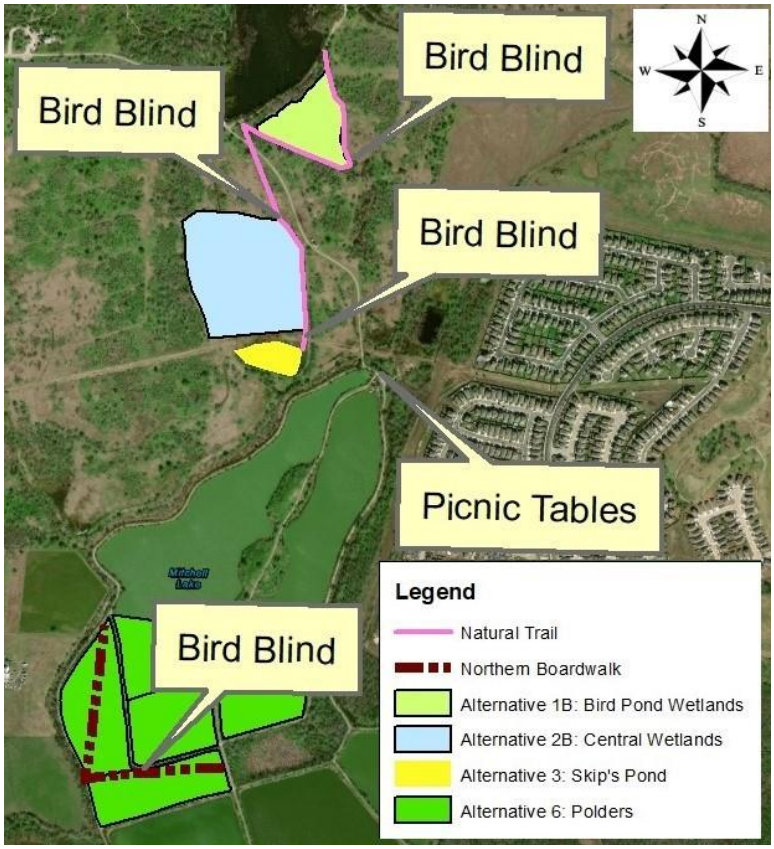


Figure 7-Recreational Opportunities

It is estimated that the project construction could be completed in approximately 540 days based on previous experience with projects of similar scope and magnitude. Establishment and preservation of the desired wetland habitats as well as operation and maintenance of the various project elements would be ongoing into the future.

List of Exhibits:

Exhibit 1 – Existing Polder Flow Patterns

Exhibit 2 – Example Stop Log Structure

List of Figures:

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References

EM	1110-2-38	Environmental Quality in Design of Civil Works Projects	3-May-79
EM	1110-2-1205	Environmental Engineering and Local Flood Control Channels	15-Nov-89