PROJECT DEFINITION REPORT

LAINHART & MASTEN DAMS

PS ID 100816

JANUARY 3, 2013

REVISION # 0

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Approvals

Jeffrey R. Kivett, P.E., Bureau Chief, Engineering and Construction — Date: 1/8/13

Joel Arrieta, Bureau Chief, Field Ops North — Date: 1-8-13

Document prepared by: Jim Orth, Extension: 2629

Project Location

The projects are located in northern Palm Beach County on the Loxahatchee River, just north of Indiantown Road (SR 706). See Figure 1.

Figure 1 - Project Location

Primary access to the east side of Lainhart and Masten Dams and to the west side of Lainhart Dam is relatively straight forward (Figure 2). There are two gates on the north side of Indiantown Road, east of the bridge over the Loxahatchee River. There are fairly well defined travel ways past the gates that lead up to the dams. To access the west side of Lainhart Dam one must travel west of the Loxahatchee River Bridge to Taylor Road. Access is through a gate and drive approximately 0.15 miles north of Indiantown road on the east side of Taylor Road. Masten Dam can be accessed from the west through this same gate. There is a dirt road inside the property which travels north to a fence, which can be followed as shown in Figure 2. One must then walk into the swamp to access the dam.

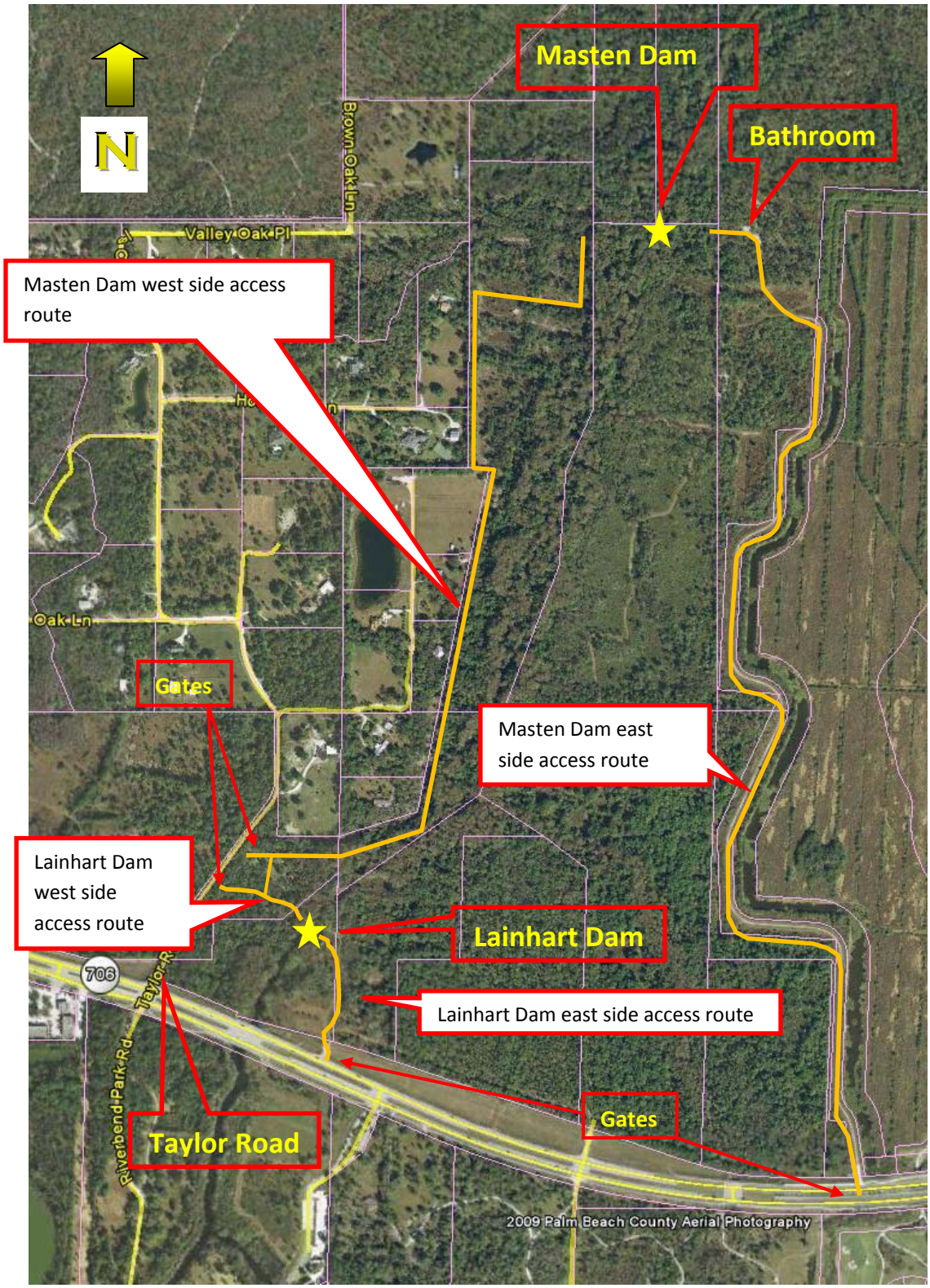

Figure 2 - Lainhart and Masten Dam access routes

Project Description

The Hydro-Data Management Section of the Infrastructure Management Bureau has requested the Engineering and Construction Bureau's assistance in finding a cost effective solution to a periodically shifting stage discharge relationship and potential leakage through the Lainhart Dam structure. There are indications the Masten Dam site has similar leakage and/or flow bypass. The Masten Dam is older than Lainhart dam and therefore may have structural issues. It would be more cost effective to evaluate both structures concurrently.

The project consists of an evaluation of the existing structure and site conditions at the two locations. Alternative solutions should be developed and evaluated, along with cost estimates and recommendations for implementing the most cost effective repair/modification at each site if shown to be necessary. The project may then include design and construction/implementation of the recommended solution(s) if shown to be warranted. The goals of the recommended solution(s) should result in reduced water losses and enable the long term stability of each structure. An additional goal of the project is to provide accurate, stable flow and stage monitoring for the river and ensure compliance with the established minimum flows and levels for the Northwest Fork of the Loxahatchee River (Chapter 40E-8, Florida Administrative Code).

Project Scope

The Lainhart and Masten Dams were originally constructed in the 1930's by two local families in order to slow down the flow of freshwater between Indiantown Road (SR 706) and Trapper Nelson's settlement. The Lainhart Dam was rebuilt as a sheet pile weir structure around 1986 and has been subsequently broadened by adding concrete and rip rap on the upstream and downstream sides. Cypress logs have been anchored into the top of the concrete weir to facilitate safe boating over the top. Masten Dam is a sheet pile weir with a concrete cap also covered with logs and wood which underwent some improvements in 1986. Figures 2 and 3 are sections and site plans taken from the original design drawings. Any design or repair recommendations should take into consideration the rustic nature and functionality of the structures.

The project includes an initial evaluation of the existing structures, a review of the goals and regulations governing the Minimum Flows and Levels (MFLs), a structural investigation to define and evaluate any deficiencies, development of alternative repair and/or replacement solutions (if determined to be warranted), determination of cost estimates of the alternative solutions, recommendations of the most cost effective solution(s) and design and construction of the final, recommended solution(s) (if warranted). The scope of the project also includes a review of the methodologies and equipment used to calibrate and monitor flows if evaluations of the dams indicate no repair or replacement is recommended. If this review identifies potential problems or inefficiencies, alternative methodologies, equipment or locations shall be recommended.

Background

The Loxahatchee River and Estuary watershed is located on the southeastern coast of Florida in Martin and Palm Beach counties (*MFLs for the Northwest Fork of the Loxahatchee River, SFWMD 2002*). It includes the Northwest, Southwest and North Forks of the Loxahatchee River, a major drainage canal (C-18), the surrounding watershed, and the estuary. This system is of particular importance because the Northwest Fork was designated as Florida's first Wild and Scenic River in 1985. The river is located at the southern end of the Indian River Lagoon (part of the National Estuary Program), and includes a State park and an aquatic preserve. The Lainhart and Masten Dams are in a section of the river declared "Wild and Scenic". The Lainhart & Masten Dams control upstream stages in the Northwest fork of the Loxahatchee River and maintain a freshwater head to keep brackish water from traveling upstream. Saltwater has historically migrated upstream during low flow conditions and adversely impacted the freshwater habitat.

Florida law requires that the water management districts develop a priority list and schedule for the establishment of MFLs for surface waters and aquifers within their jurisdiction (Section 373.0421 F.S.). This list, included in the *District Water Management Plan* for the South Florida Water Management District (SFWMD 2000a), identified the need to develop a MFL for the Loxahatchee River by 2002.

In April 2003 the SFWMD adopted a Minimum Flows and Levels (MFL) Rule, Chapter 40E-8, Florida Administrative Code, which identified a MFL for the Northwest Fork of the Loxahatchee River. The Lainhart Dam functions as a stage and flow monitoring location where minimum flows and levels (MFL's) targets are measured as specified in the rule. A stage-discharge relationship has been calibrated for the Lainhart structure resulting in a structure rating curve. The upstream and downstream stages of the dam are continuously monitored. Flows are calculated based on the established relationship. Flows to the river can be increased by opening the G-92 structure and diverting flows from the C-18 Canal if the water is available.

The Lainhart structure is located within the natural channel of the river. The banks are naturally occurring, tree lined banks with little manmade structural improvement and are occasionally subject to erosion due to their natural condition. Eroding banks allow more flows through the area and can cause a change to the stage-discharge relationship. As a result, it becomes necessary to update the structure rating curve to accurately measure and report flow over the structure. This re-calibration is costly for the SFWMD. Lost and unaccounted flows through the structure understate the quantity of flow down the river. Proper flow measurement is required to assure compliance with the established minimum flows and levels for the Northwest Fork of the Loxahatchee River (Chapter 40E-8, Florida Administrative Code). Underestimating the flow down the river could falsely indicate an exceedence or a violation of the rule.

The Hydro-Data Management Section of the Infrastructure Management Bureau has requested the Engineering and Construction Bureau's assistance in finding a cost effective solution. They have recently recalibrated the stage-discharge rating curve which will work until further changes to the dam shift the

rating again. Alternative monitoring at G-92 is not feasible and there are no sites immediately near the Lainhart Dam conducive to flow monitoring with the quality required for MFL compliance. The river's "Wild and Scenic" designation and the dam's location within the floodplain create challenges associated with structural improvements and/or dam replacement. The established MFL's are site specific. Any changes affecting the location of the measurements will require modification to the Minimum Flows and Levels Rule, Chapter 40E-8, Florida Administrative Code. Structural repairs to stabilize leakage and bank erosion would ensure both structural stability of the dam and the stage-discharge relationship.

Repairs were performed on the Masten Dam in 1986 along with the Lainhart Dam reconstruction. The project included the addition of sheet pile to confine overflow to the concrete weir, the addition of cypress logs to the concrete weir to facilitate boat crossing, and the addition of canoe portage facilities. Erosion around the structure and surrounding floodplain has potentially decreased the effectiveness and jeopardized the integrity of the structure.

Permitting

The level of permitting required for the project will depend on the problem identified in the initial evaluation of the structures and the recommended solution(s). Limited stabilization can be conducted as a structure maintenance activity and does not require a permit. Replacement with new structures will require permits from the Florida Department of Environmental Protection (FDEP) and the United States Army Corps of Engineers (USACE). Relocation of the Lainhart Dam structure to a new location would require modification of the MFL Rule, Chapter 40E-8, Florida Administrative Code. It is anticipated the permitting will take longer than most projects given the environmentally sensitive nature of the location. Any impacts to the wetlands will require mitigation.

It is anticipated the "Wild and Scenic" designation will increase the level of justification required for approval of any improvements that will have an environmental impact. The designation and subsequent rules and management plan adopted as a result outline the steps required for any projects within the corridor. The approval process includes coordination with the Loxahatchee River Management Coordinating Council (see the Stakeholder section below). Significant coordination with the Permit Compliance and Acquisition Section will be required.

Right of Way

No known right of way permits are associated with the project.

Real Estate

The SFWMD owns the project lands landward of the floodplain. Lands below the floodplain and river are waters of the state.

Public Use

The Loxahatchee River is a navigable waterway open to the public. The dams are located in the "wild and scenic" section of the river. Kayaks and canoes typically boat over the weirs. Public access will need to be coordinated. County, state and federal coordination is required.

Stakeholder Considerations

The designation of the Northwest Fork as a component of the National Wild and Scenic River System was the result of a local grass-roots effort. Public involvement was invaluable during the designation process, so much so that the Loxahatchee River Wild and Scenic Designation and Preservation Act established the Loxahatchee River Management Coordinating Council (Council) to assist the FDEP and SFWMD in plan development. The Loxahatchee River Management Coordinating Council was established by Chapter 83-358, F.S. The Council is comprised of federal, state, and regional agencies and local representatives. It advises FDEP and SFWMD on matters that affect administration of the Loxahatchee River, to identify and resolve inter-governmental coordination problems and to enhance communications. Furthermore, the Council is responsible for the development of the Loxahatchee River Management Plan. Today the Council consists of representatives from the following agencies and organizations:

- City of Palm Beach Gardens
- Florida Department of Agriculture and Consumer Services
- Florida Department of Community Affairs
- Florida Department of State, Division of Historical Resources
- Florida Department of Transportation
- Florida Department of Environmental Protection
- Florida Fish and Wildlife Conservation Commission
- Jupiter Inlet District
- Palm Beach County
- Palm Beach County Farm Bureau
- Palm Beach County Conservation Community representative
- Loxahatchee River Environmental Control District
- Martin County
- Martin County Conservation Community representative
- National Park Service represented by U.S. Fish and Wildlife Service
- Northern Palm Beach County Improvement District
- River Land Owners represented by Gulfstream Boy Scouts of America
- River Users represented by Palm Beach Pack and Paddle Club
- South Florida Water Management District
- South Indian River Water Control District (SIRWCD)
- Town of Jupiter
- Treasure Coast Regional Planning Council

- United States Department of Interior, Bureau of Land Management
- United States Geological Survey
- Village of Tequesta

Public Outreach

Public outreach is required. The Loxahatchee River Management Coordinating Council was established as a focal point for public and governmental agency coordination on matters that affect the Loxahatchee River. The SFWMD Government and Community Affairs Unit will support the extensive outreach efforts for this project.

Operations

The C-18 Canal, with its many secondary and tertiary networks, is part of the regional primary drainage system of the SFWMD providing flood protection to an area of approximately 210 square miles. The C-18 Canal was constructed through the central portion of the Loxahatchee Slough in 1957 as part of the Central and Southern Florida (C&SF) Flood Control Project to improve drainage and provide flood protection for adjacent agriculture, residential, and industrial land as well as J.W. Corbett Wildlife Management area.

The G-92 Structure connects the C-18 Canal and the Loxahatchee Slough with the Northwest Fork. As a gated control structure, G-92 can pass 400 cfs in either direction. The structure is operated by remote telemetry from the SFWMD headquarters operations control room. Through a joint agreement with the SIRWCD, flows are discharged from G-92 into the C-18 in response to severe storm events. In the dry season, G-92 is operated to convey environmental flows to the Northwest Fork.

The recommended inspection and subsequent repairs or reconstruction of the Lainhart and Masten Dams are recommended to occur during the dry season. The G-92 structure can be closed to reduce flows over or around the structure allowing inspection, repair and/or replacement of the structures. These activities will have to be coordinated with the SFWMD, SIRWCD, Riverbend Park and the Loxahatchee River Management Coordinating Council.

Figure 3 - Watersheds and Canals of the Loxahatchee River

Operations and Maintenance

The project lies within the area of responsibility of the West Palm Beach Field Station. The existing Lainhart Dam structure was reconstructed and the Masten Dam was repaired and enhanced around 1986. Additional repair work was also performed in 2001 at both structures. Repair work consisted of installing Geo-tubes in select locations at both structures to limit leakage and bypass.

SCADA, Instrumentation, Telemetry

There are two monitoring sites located near the structure. Any potential impacts to these sites will have to be coordinated with the USGS and SFWMD SCADA and Hydro-Data Management Sections.

Information Technology

There are two monitoring sites located near the structure. Any impacts will have to be coordinated with the IT Bureau.

Environmental

The area around the dams is Loxahatchee River floodplain and environmentally sensitive lands. Care will be required during the inspection and construction periods to minimize impacts. If the recommended solution qualifies as a maintenance activity, minimal impacts would be anticipated as a result of the project. Major construction or relocation of the structures could impact environmentally sensitive lands.

Coordination with SHPPO and other archaeological agencies may be required depending on the final recommendations. The project site is located near and in a very significant cultural resource area. A survey of the general area was conducted a few years ago for the District which confirmed the high significance level. If any of the proposed work will go beyond the footprint of the dam, the area will have to be identified, and an archeological survey will have to be conducted.

Due to the wild and scenic nature of the river, threatened and endangered species may be present. It is not anticipated the project will impact the FDEP Total Maximum Daily Load (TMDL) program nor will coordination with the District's TMDL coordinator be required. The project is not in known Tribal Lands.

Monitoring

There are no structures downstream of the Masten Dam that would impede manatee migration upstream so any improvements or construction taking place at Masten Dam would require manatee monitoring. Alligators may pose a threat, therefore, monitoring during inspection and construction is recommended for safety reasons. Turbidity monitoring during construction will be required.

Commissioning

The stage-discharge rating curve for Lainhart Dam will require re-calibration if a repair or replacement of the structure is determined to be necessary. Commissioning of any impacted monitoring stations may be required.

Lessons Learned

No known lessons learned on similar projects have been identified for consideration in this project.

Conceptual Alternative Options

It appears there is adequate but limited access for each structure on both banks to facilitate repair, although the west bank of Masten Dam is the most challenging due to the distance between the uplands and the structure. One must traverse over wetlands to access the structure from the west. The east bank of each of the structures is more accessible by heavier equipment. Repair of the existing structure is preferred. Consideration for use of in situ methods of filling voids or leaks through the injection of grout, cement or alternative technologies such as an expanding structural geotechnical polymer may provide viable design solutions for rehabilitation of the existing structures. Relocation of the structure(s) is another alternative to consider. Relocation of the Lainhart Dam to just downstream of Indiantown Road would allow easier construction access and may create minimal environmental impacts. Consideration should also be given to moving the MFL monitoring site if this alternative is determined to be less costly and create less environmental impacts to the River.

Cost Estimates

An initial study of potential alternatives with cost estimates will be required to accurately determine the most cost effective permanent solution(s). A cost estimate to replace the existing structures with similar structures at the current location has been prepared and appears in Appendix A. The estimated construction cost to rebuild Lainhart Dam is approximately $360,000. The estimated construction cost to rebuild Masten Dam is approximately $600,000. These estimates do not include environmental mitigation costs or access provisions through the wetlands to the west side of Masten Dam. Some allowance has been added to create stabilized work areas at each structure and building a stabilized access road to the west bank of the Masten Dam site.

Recommendations

A detailed inspection should be performed during low flow conditions (normally April) to further define the existing conditions at each structure. A dive inspection should be commissioned to investigate

potential piping under each structure and a remedial plan developed based on the results of the inspection and initial evaluation.

An initial study to define and recommend a permanent solution is recommended. The study should include a review of the methodologies and equipment used to calibrate and monitor flows and consideration should be given to moving the MFL monitoring site if this alternative is determined to be less costly and create less environmental impacts to the River.

The schedule should be developed to include adequate time for coordination with the stakeholders and permitting.

Project Milestones

No project milestones have been identified.

Resource Requirements

List Functions	Skill of Functional Employees	Identify Employees	Total FTEs Required for Complete Project
Engineering	Civil, Geotech, CADD		.2 (400 hrs)
Permitting	Scientist		.05 (100 hrs)
Project/Construction Manager	PM/CM, CI		.05 (100 hrs)
Survey	Surveyor		.05 (100 hrs)
Total Resource Requirements			**.35 (700 hrs)**

Note: Resource requirements are for an initial study to define project deficiencies, evaluate and recommend a solution. Estimates for the recommended solution should be developed with the initial study.

Project Deliverable and Schedule

Permanent Repairs

Fiscal Year	Deliverable	Duration
	Study Alternatives, recommend solution	1 year
	Survey & Geotechnical	3 months
	Design (permanent solution)	12 months
	Public Outreach	Project duration
	Permitting	12 months (start at 60% plans)
	Bid Process	GB approval by July
	Notice to Proceed	End of wet season/beginning of dry season
	Construction	Start: September
	Construction	Complete : End of June

Project Funding Sources

The funding for this project has not been secured. The funding source would be tied to replacement projects under funding for restoration strategies.

References

References include a copy of the Minimum Flows and Levels, Chapter 40E-8, Florida Administrative Code, the original design plans, the Loxahatchee River National Wild and Scenic River Management Plan, the Restoration Plan for the Northwest Fork of the Loxahatchee River and photographs of the structure. These are located in: https://webtop.cerpzone.org/webtop/drl/objectId/0b009f578305260b

Photographs

Lainhart Dam - West bank looking southeast

Lainhart Dam - East bank looking southwest

Log installation on the top of Lainhart Dam

Lainhart Dam - East bank looking southwest, flow under the rock appears to bypass main structure

Lainhart Dam - West bank just downstream of structure

Lainhart Dam - West bank just downstream of structure

Masten Dam from east bank looking west

Masten Dam from east bank looking west

Masten Dam approaching from east bank looking west

Project Schematic Diagram

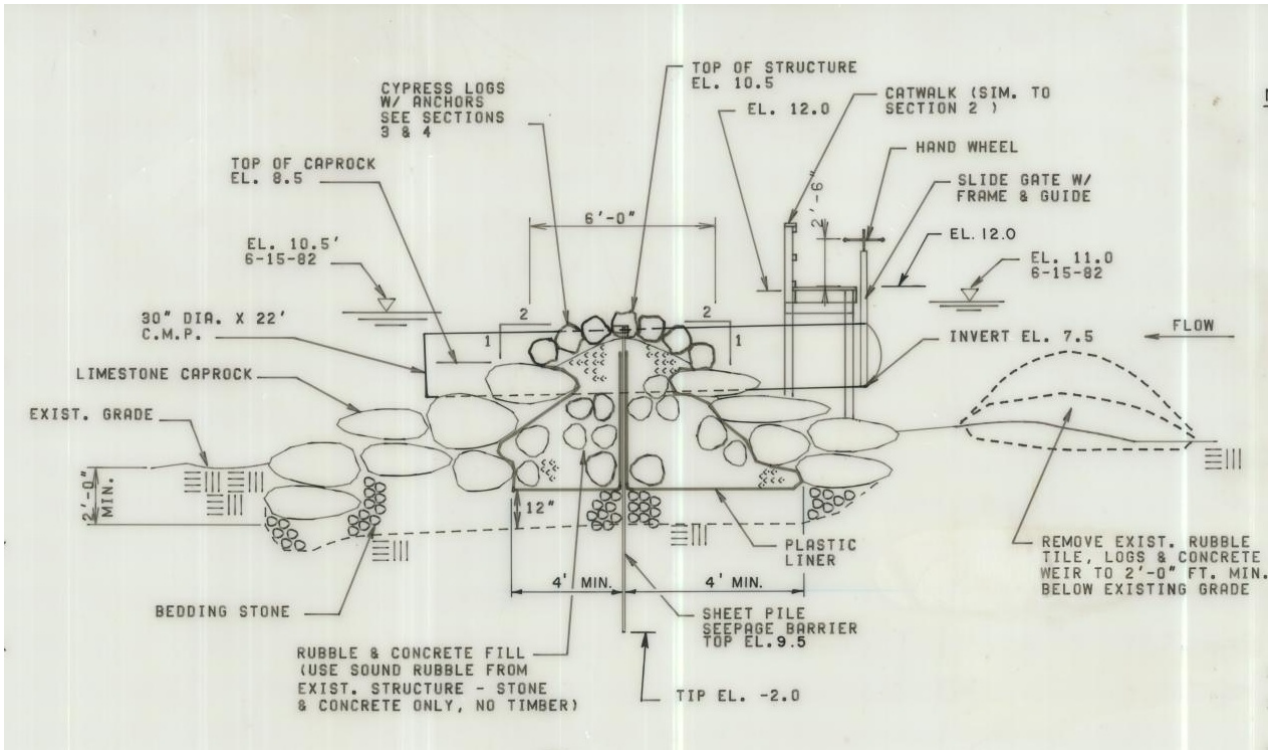

Figure 4 - Existing Lainhart Dam Section (from 1986 replacement plans)

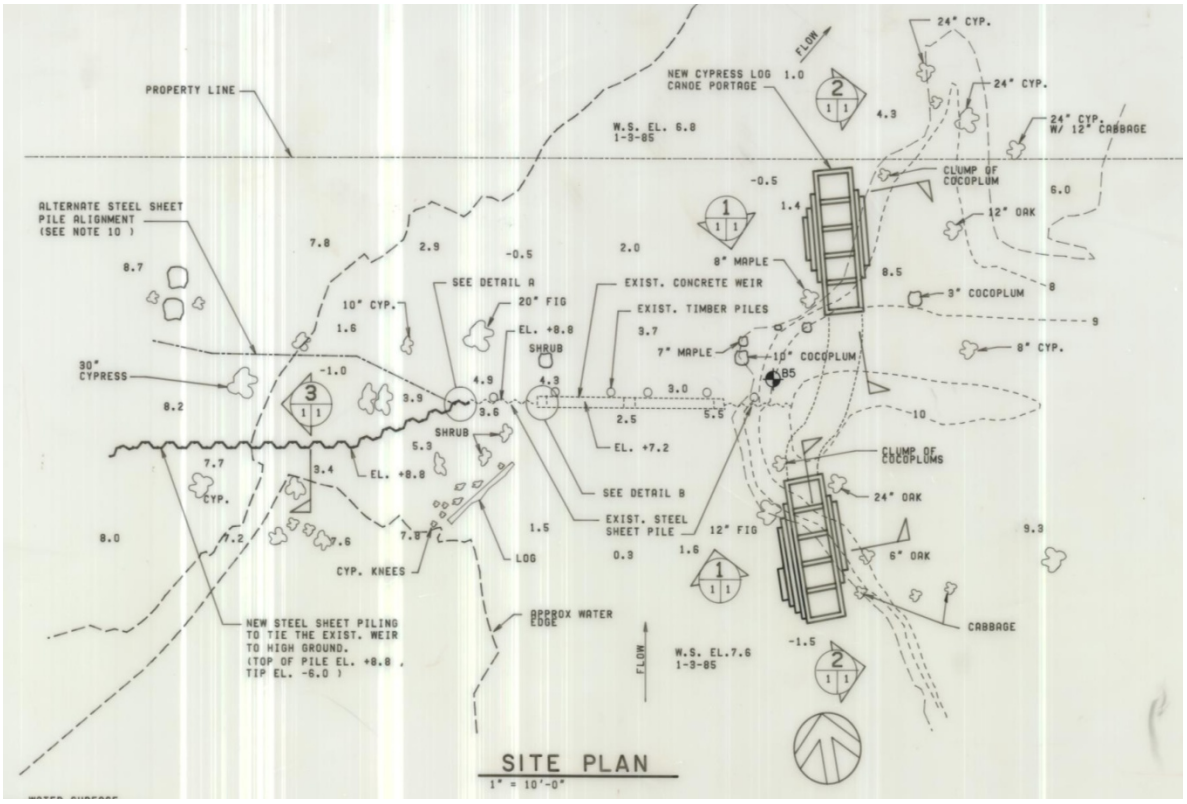

Figure 5 - Existing Masten Dam Site Plan (from 1986 repair plans)

Appendix A

Cost Estimate

Jack Ismalon
Lead Cost Estimator
561-682-6187

South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

LAINHART: SHEET PILES DAM STRUCTURE

Item Code	Description	Quantity	Unit	Approx. Unit Cost	Total Cost
Division 2: Sitework					
Subdivision 2.1: Site Preparation					
2.104	Mobilization and Demobilization @ 10% from Total Direct Cost	0.10	LS	215,000.00	21,500.00
2.110	Floating Turbidity Barrier	200.00	LF	28.00	5,600.00
2.115	Clearing & grubbing, brush, including stumps	1.00	Acre	4,650.00	4,650.00
2.120	Pave a working area on both sides of the structuref (200'LX 50'W)+20%	450.00	CY	22.00	9,900.00
				Site Preparation =	**41,650.00**
Subdivision 2.3: Piling					
2.305	Demolish and Remove Existing Weir Structure, and haul from site	1.00	LS	30,000.04	30,000.04
2.310	Drive Steel "H" Pile @ 40' long to Support Weir and Pedestrian Walkway (10 Ea x 40' L)	400.00	LF	112.00	44,800.54
2.320	Drive Permanent Sheet Pile Weir from both sides of the Canal (35' LF x 20' L)+(45'LF X 30'L)	2,050.00	SF	42.00	86,100.14
2.325	Install concrete cap on top of all sheet pile wall	80.00	LF	165.00	13,200.00
2.328	Install 6' wide, wooden elevated walkway and portage ramps, includes handrail	75.00	LF	144.00	10,800.00
2.330	Attached Cypress Logs at the overflow weir area, (6" to 12" dia), 3 loges per LF of sheet pile, at the overflow weir area	240.00	LF	32.00	7,680.02
				Piling =	**192,580.74**
				Division 2: Sitework =	**234,230.74**
				Subtotal	234,230.74
				FIELD & OFFICE OH - 11.00%	25027.95
				MURKUP (PROFIT) - 15.00%	37,883.22
				BONDS - 1.50%	3,412.90
				CONTINGENCY - 25.00%	56,881.71
				TOTAL BUDGET COST:	**357,436.53**

Jack Ismalon
Lead Cost Estimator
561-682-6187

South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

MASTEN: SHEET PILES DAM STRUCTURE

Item Code	Description	Quantity	Unit	Approx. Unit Cost	Total Cost
Division 2: Sitework					
Subdivision 2.1: Site Preparation					
2.104	Mobilization and Demobilization @ 10% from Total Direct Cost	0.10	LS	380,000.00	38,000.00
2.110	Floating Turbidity Barrier	300.00	LF	28.00	8,400.00
2.112	Pave a working area on both sides of the structuref (200'LX 50'WX1' H)+20%	450.00	CY	22.00	9,900.00
2.115	Clearing & grubbing, brush, including stumps	2.00	Acre	4,650.00	9,300.00
2.120	Pave a roadway between two structres, (4,600'LX 20'WX.67'H)+20%, including hauling up to 30 miles round trip	2,800.00	CY	28.00	78,400.00
				Site Preparation =	**144,000.00**
Subdivision 2.3: Piling					
2.305	Demolish and Remove Existing Weir Structure, and haul form site	1.00	LS	30,000.01	30,000.01
2.310	Drive Steel "H" Pile @ 40' long to Support Weir and Pedestrian Walkway (12 Ea x 40' L)	480.00	LF	112.00	53,760.65
2.320	Drive Permanent Sheet Pile Weir from both sides of the Canal (45' LF x 20' L)+(65'LF X 30'L)	2,850.00	SF	42.00	119,700.20
2.325	Install concrete cap on top of all sheet pile wall	110.00	LF	165.00	18,150.00
2.328	Install 6' wide, wooden elevated walkway and portage ramps, includes handrail	75.00	LF	144.00	10,800.00
2.330	Attached Cypress Logs at the overflow weir area, (6" to 12" dia), 3 loges per LF of sheet pile, at the overflow weir area	330.00	LF	32.00	10,559.96
				Piling =	**242,970.82**
				Division 2: Sitework =	**386,970.82**
				Subtotal	386,970.82
				FIELD & OFFICE OH - 11.00%	41552.96
				MURKUP (PROFIT) - 15.00%	62,896.08
				BONDS - 1.50%	5,666.31
				CONTINGENCY - 25.00%	94,438.55
				TOTAL BUDGET COST:	**591,524.69**