September 2005

S-169 (Structure 169)
CENTRAL AND SOUTHERN FLORIDA (C&SF)

DRAFT GENERAL REEVALUATION REPORT AND ENVIRONMENTAL ASSESSMENT HENDRY COUNTY, FLORIDA

US Army Corps of Engineers
Jacksonville District
South Atlantic Division

SYLLABUS

This General Reevaluation Report (GRR) provides the results of a feasibility level study conducted to reevaluate the Nine-Mile Canal Basin, Hendry County, Florida, using current planning criteria and policies. The Nine-Mile Canal area is adjacent to Herbert Hoover Dike (HHD) southwest of Lake Okeechobee and is served by control structure 169 (S-169) and lock structure 310 (S-310). Nine-Mile Canal begins west of State Road 720, near the city of Clewiston, in Hendry County, Florida, and extends approximately 9 miles westerly to Lake Hicpochee.

The GRR was initiated to reevaluate the S-169 project area, since certain aspects of the previously authorized Central and Southern Florida (C&SF) Project, Part 1, Supplement 39, were not constructed. The Nine-Mile Canal and S-169 are addressed in C&SF Part I, Supplements 39, 44, and 45 and Part IV, Supplements 14 and 32. Authorized construction called for structures S-170 and S-47, which were never built; and structure S-169 and C-21 Canal to be built in different locations.

The goals identified in the Nine-Mile Canal area include the following: (a) provide a supply of water to the Industrial Canal to meet agricultural demands; (b) operate the S-310 lock as it is authorized to be used; (c) maintain the existing level of flood protection, as authorized; (d) minimize fish kills and damage to watercraft and marinas; and (e) limit the erosion downstream of S-310.

The benefits for this study are agricultural water supply. It was determined that an acceptable proxy for the value of the water used from the Industrial Canal would be the cost of the most likely alternate source, in the absences of the operation of S-310. It was assumed that under the implementation of any alternative that water users of the Industrial Canal would not be permitted to draw down the canal to a level that would impact private and commercial marinas, boats or recreational activities. Therefore, the most likely alternate method for supplying the Industrial Canal would be that the local users would build a pump station to bypass S-169 as a means of pumping water from C-21 into the Industrial Canal when the Lake Okeechobee stage is above 15.5 feet, S-310 is closed, and the Industrial Canal is approaching an unacceptable level. The average annual cost for the pump station alternative is estimated at $567,854, based on an economic life of 50 years, and an interest rate of 5-3/8 percent. This value is the basis for the average annual benefit that is used in the B/C ratio.

From the problems identified, alternatives were developed which provided contributions to the planning objectives. These alternatives were screened and the remaining alternatives were further evaluated to determine the NED plan. The remaining alternatives are as follows: (a) operate S-310 in an unauthorized manner, 24-hr, 7 days/week work schedule when Lake Okeechobee levels exceed 15.5 ft; (b) demolish the existing S-169 structure and construct a new water-control structure with four seven-foot barrels west of C-2, and (c) add an additional seven-foot barrel to the existing S-169 and construct a new water-control structure with four seven-foot barrels west of C-2.

The recommended plan consists of building a new water control structure west of C-2, demolishing the existing S-169, constructing an access bridge to Herbert Hoover Dike, modify the existing Culvert 2, and install telemetry control. A cost-benefit analysis was performed to identify the NED plan, with a project design that produced the maximum net benefits. The economic justification of the recommended plan was determined by comparing the equivalent average annual costs (i.e., interest, amortization, and maintenance costs) with an estimate of the equivalent average annual benefits, which would be realized over a 50-year period of analysis. Computed costs of alternatives are based on 2005 price levels. The total project cost of the recommended plan is estimated at $6,646,900 and has a benefit to cost ratio of 1.7. The recommended plan was not the NED plan. The NED plan was not selected since it requires the current operations that are trying to be avoided, which is operating S-310 in an unsafe and environmentally unsound manner.

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S-169 (STRUCTURE-169)
CENTRAL AND SOUTHERN FLORIDA (C&SF)
HENDRY COUNTY, FLORIDA

1.0 STUDY AUTHORITY

The Flood Control Act of 1948 (PL 80-858) authorized works necessary to afford flood protection to the rich agricultural development south of Lake Okeechobee, which includes the Nine-Mile Canal area. The Flood Control Act of 1954 (P.L. 83-780) recognized that the plan of improvement developed under PL 80-858 would require refinement and that modification, within the scope and purpose of the authorization, could be made at the discretion of the Chief of Engineers. The Flood Control Act of 1968 (P.L. 90-483) authorized the modification of Hurricane Gate Structure No. 2 (HGS-2) to navigation lock structure 310 (S-310).

This General Reevaluation Report (GRR) was initiated to reevaluate the S-169 project area, since certain aspects of the previously authorized Central and Southern Florida (C&SF) Project, Part 1, Supplement 39, were not constructed. Authorized construction called for structures S-170 and S-47, which were never built; and structure S-169 and C-21 Canal to be built in different locations. S-170 and S-47 were part of the proposed plan of improvement during general design as shown in Part 1, Supplement 39--General Design Memorandum of the C&SF Project, dated March 29, 1963. S-47 was to have been located in the west end of Canal 20 and would discharge up to 350 cfs from Canal 20 through Lake Hicpochee to the Caloosahatchee River (C-43) when discharge capacity is available in the river. S-170 was to have been located in Industrial Canal just downstream from its junction with C-21 and would pass the design discharge (280 cfs) from Industrial Canal to Lake Okeechobee through Hurricane Gate Structure No. 2 (HGS-2). If the project had been constructed, as originally authorized in Supplement 39, the Industrial Canal would not have been connected to the rest of the basin, via Canal 21. The problem would still exist. This GRR does not address the S-47 area, and a determination of its need has not been made. Operational changes to S-310 would not adequately address the problem, since doing so would cause safety issues. S-310 was not designed to operate, for water supply purposes, when the lake is above 15.5 feet, NGVD.

The initial appraisal was submitted under Operations and Maintenance (O&M) authority and was initiated by the attached letter of support, from the South Florida Water Management District (SFWMD) to CESAJ-DP, dated 31 March 1997. The SFWMD letter requested assistance from the Corps of Engineers in the Nine-Mile Canal drainage basin.

2.0 STUDY PURPOSE AND SCOPE

The purpose of this study is to determine the water supply problem or problems in the Nine-Mile Canal Basin served by control structure 169 (S-169) and lock structure 310 (S-310), formulate possible alternative solutions, and determine the Federal interest, if any.

This study was conducted through a partnership between the non-Federal sponsor, the South Florida Water Management District (SFWMD) and the U.S. Army Corps of Engineers (Corps), Jacksonville District. Other stakeholders included the Town of Clewiston, and various natural resource agencies.

The Nine-Mile Canal area is adjacent to Herbert Hoover Dike (HHD) southwest of Lake Okeechobee. Nine-Mile Canal begins west of State Road 720, near the city of Clewiston, in Hendry County, Florida, and extends approximately 9 miles westerly to Lake Hicpochee, see Figure 1. The subbasin served by S-169 and S-310 are discharge points for the easternmost portion of the Nine-Mile Canal Basin and a small area of the northwestern portion of the Miami Canal drainage area (EAA). The Nine-Mile Canal Basin is located within Florida Congressional District 23 (Hastings) and Florida Congressional District 16 (Foley).

The project basin area, shown on Figure 1 and outlined in yellow, is the Nine Mile Canal Basin. The project focused on the three structures, C-2, S-169 and S-310. The project area is shown in Figure 2. The project area is defined by areas served by S-169 and S-310 in addition to the Industrial Canal, C-21, and C-21 structures.

3.0 PRIOR STUDIES, REPORTS AND EXISTING WATER RESOURCE PROJECTS

S-169 is a portion of the Central and Southern Florida Project for Flood Control and Other Purposes (C&SF). The Nine-Mile Canal and S-169 are addressed in C&SF Part I, Supplements 39, 44, and 45 and Part IV, Supplements 14 and 32. These documents contain General and Detailed Design Memorandum for constructed features within the Nine-Mile Canal Basin. Canal 21 (C-21) and the addition of S-169 were presented in Part I, Supplement 39, and were approved on 5 August 1963. Design and location of C-21 and S-169 were modified in Supplement 45, and approved on 12 October 1970. A Letter Report dated 22 November 1971 was used to modify the October 1970 plan for C-21 and S-169. It also presented the design criteria for a portion of Canal 20 (C-20).

There are several water control structures present in the Nine-Mile Canal Basin, also known as the S-4 basin. Culverts No. 1, 1A, and 2 are located in HHD. Culverts No. 1 and 1A are located west of Culvert No. 2. S-169 is located on C-21 between Culvert No. 2 and Industrial Canal. C-21 is an east-west canal that has an optimum water surface elevation of 11 to 14 feet NGVD west of S-169 and 13 to 15.5 feet NGVD east of S-169. Industrial Canal has an optimum water surface elevation of 13 to 15.5 feet NGVD and is a north-south canal. S-310 is a navigation lock that replaced HGS-2 and connects Lake Okeechobee with Industrial Canal, see Figure 1.

S-4 is a pump station that receives flows from the Nine-Mile Canal Basin, and is located approximately three miles northwest of Clewiston. During normal operation, S-4 is operated to maintain the water level between elevations 11 and 14 ft., NGVD. During a hurricane alert, the headwater stage is drawn down to and held at 10.0 ft. NGVD.

Culverts No. 1, 1A, 2, and C-21 are Federal projects operated by the Corps, S-169 and S-310 are operated by SFWMD, Industrial Canal is a non-Federal canal. Local drainage canals and agricultural canals connect with Industrial Canal over its length. The agricultural region adjacent to Industrial Canal is a part of the Everglades Agricultural Area and USSC lands.

Uncompleted but authorized work in the basin includes improvement to the existing Nine-Mile Canal (to be called C-20). Control structure 47 (S-47) was authorized in conjunction with C-20 and would be at the west end of C-20 allowing regulation of discharges from C-20 to Lake Hicpochee and the Caloosahatchee River (C-43). Control structure 170 (S-170) was authorized in conjunction with S-169 but was not included in the recommended plan described in C&SF Part I, Supplement 45.

Additional local work in the area includes construction for dredging of the Industrial Canal a couple years ago.

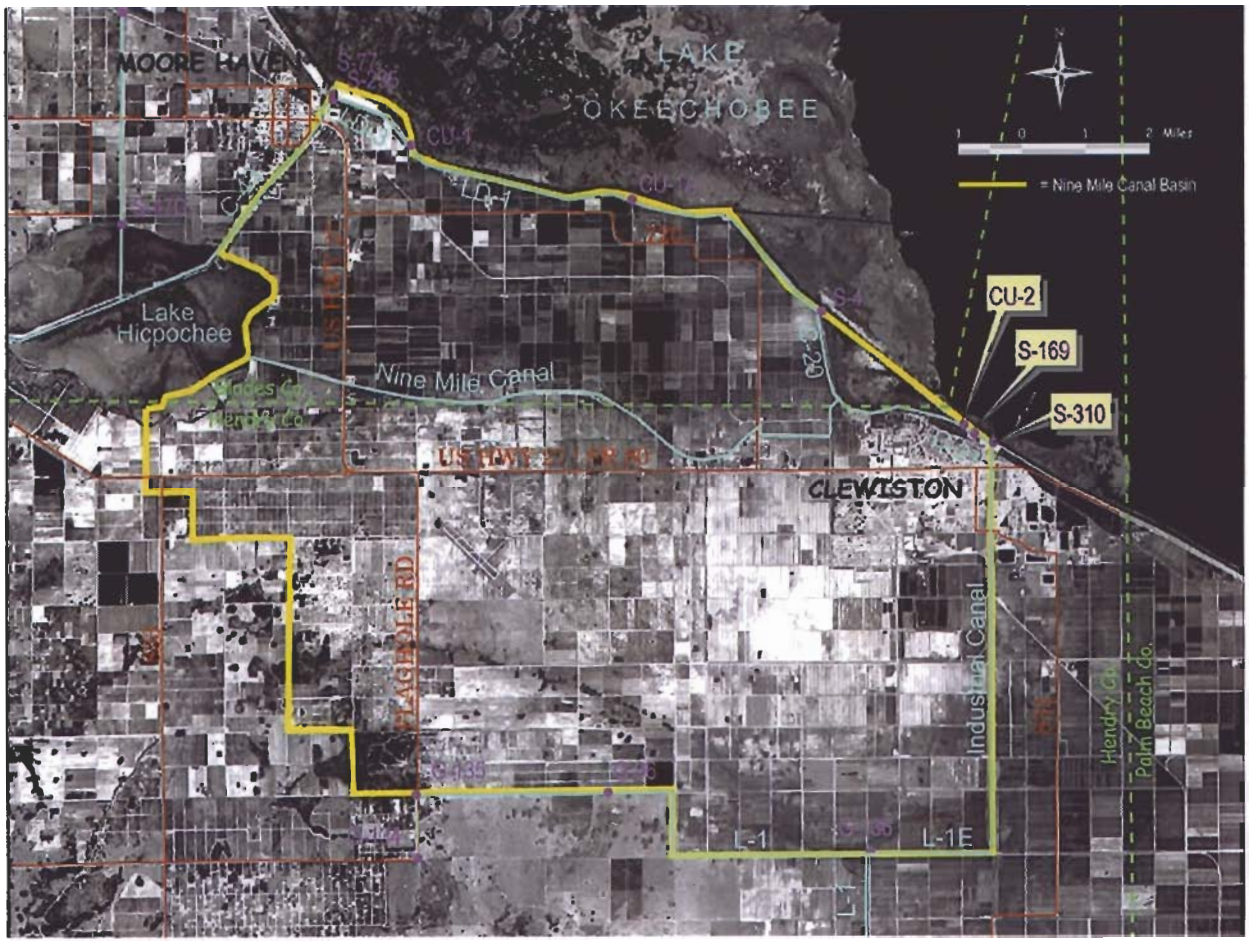

Figure 1 - Location Map

Comprehensive Everglades Restoration Program (CERP) – The Corps and local sponsor have begun the planning phases for several CERP components. Four such components are within or adjacent to the study area for this project. They are:

- EAA Storage Reservoirs Phase I
- Lake Okeechobee Watershed
- C-43 PIR
- Southwest Florida Feasibility Study

These projects are in various stages of planning, and will not have an effect on this particular project, since water volumes delivered to Industrial Canal will remain the same. The EAA Storage Reservoirs project plans to build water reservoirs within the EAA, east of Clewiston. Different users exist between those who would use the EAA project reservoirs and those who currently irrigate their fields from the Industrial Canal. The Lake Okeechobee Watershed project components are located outside of Hendry County. The Southwest Florida Feasibility Study is investigating water resources issues and opportunities for ecosystem restoration.

4.0 PLAN FORMULATION

The Corps uses a six step planning process, which provides a structured approach for problem solving through a rational framework that leads to sound decision making. The six steps are: Identifying Problems and Opportunities; Inventorying and Forecasting Conditions; Formulating Alternative Plans; Evaluating Alternative Plans; Comparing Alternative Plans; and Selecting a Recommended Plan. Forecasting Conditions was partially covered in Section 2 under Environmental Setting and the remainder is covered under scoping, which is the process of getting public and stakeholder input. The other four steps deal with some phase of developing and selecting alternatives and that is the primary purpose of this document. Development of alternatives and selection of the preferred alternatives is covered in sections three (3) through six (6).

4.1 Identifying Problems and Opportunities

Proper identification of problems and opportunities is the foundation for scoping in the planning process. The following water resource problems have been identified:

The water supply capabilities in the eastern portion of the Nine-Mile Canal Basin can not be depended on to safely, sufficiently, and economically meet the demands of the agricultural needs along the Industrial Canal without creating detrimental economic and environmental impacts to the immediate area. A method of providing an adequate supply of water in the Industrial Canal for agriculture and to prevent property damage must be found.

When Lake Okeechobee is above 15.5 feet, the safety features of the lock (Structure S-310) are disengaged in order to provide for water supply deliveries. As currently operated the lock gates are normally cracked partially open during the above scenario. This is considered an unauthorized and unsafe operation of the lock.

Navigation traffic has to wait on operations for water supply. Manual water supply operations are dependent upon the lake elevation. When the lock is partially opened the water rushes through, which causes erosion on the stream bank and scouring downstream of S-310. The main problem is that there is no constant water pool in the canal for recreation, commercial, or agricultural industry demands when the Lake is above 15.5, S-310 is closed, and irrigational operations are ongoing. Extreme drawdown adversely impacts recreational navigation in Industrial Canal.

There have been several instances in the recent past that resulted in detrimental effects being incurred due to water supply not being provided during non-duty hours. Typically, when water supply has not been provided, Industrial Canal has been drawn down to severely low levels by the agricultural community for irrigation. As a result, commercial, and governmental (Federal, State and Local) marinas and watercrafts have incurred structural damage when water has been resupplied to this eastern canal system. Additionally, large fish kills have been noted due to the drawn down effect of this same canal system.

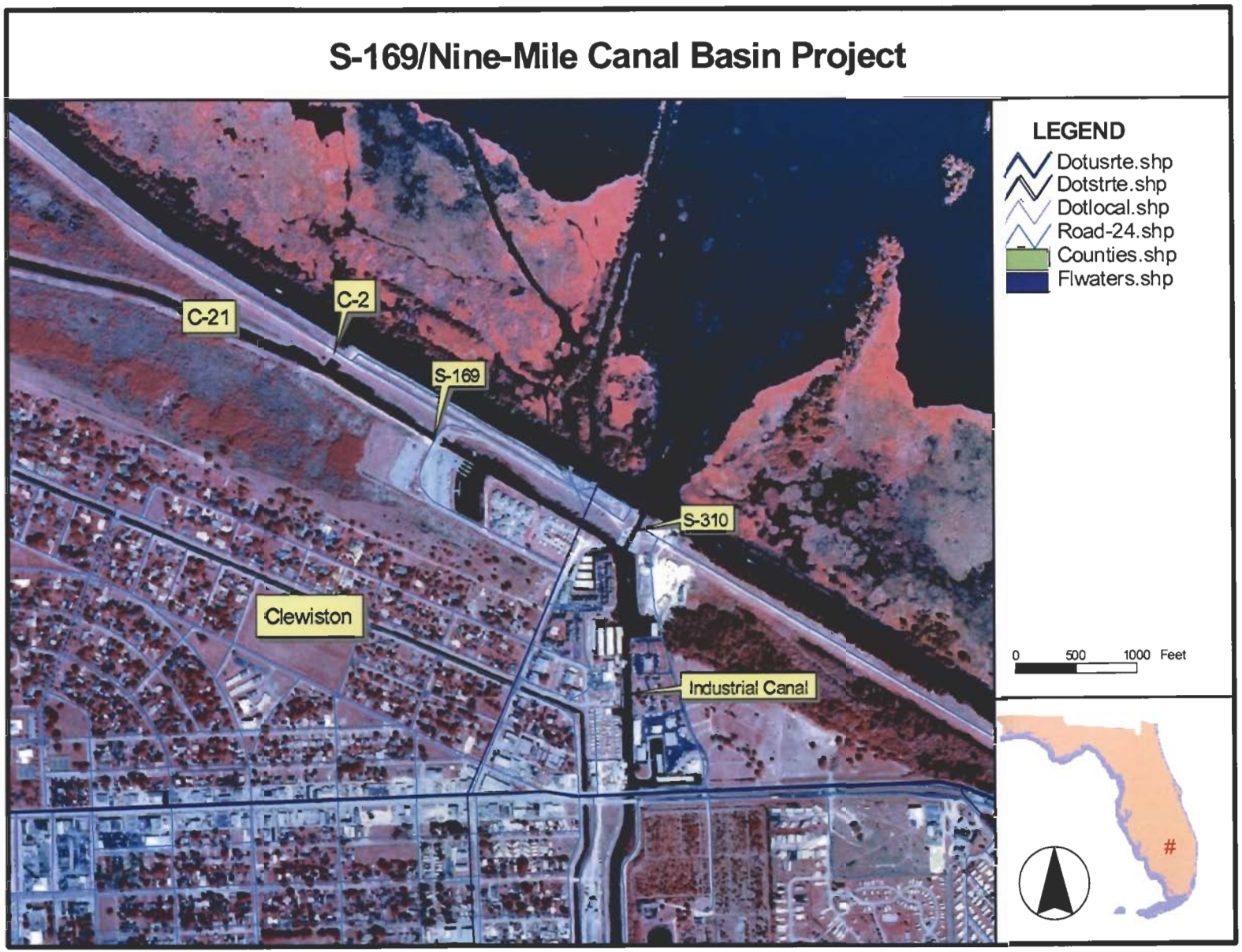

Figure 2 - S-169 Basin

There is a Federal and State concern that S-310 electrical and mechanical safety controls and features have to be overridden or bypassed to resupply water to try an alleviate the low water condition in this eastern canal system. These releases have been done in the past on Lake Okeechobee under emergency conditions and there has been some downstream erosion due to these discharges. The operation of cracking the lock to allow flow to provide irrigation waters to the Industrial Canal and to maintain a water level that will not cause property damage is extremely hazardous. Flow through S-310's partially opened gates produces hazardous velocities that have caused a scour hole downstream of the riprap protection, which could undermine the structural integrity of the lock. The flow has caused some bank erosion to the wooden bulkhead protecting the condominiums downstream of the lock on the southwest side of the Industrial Canal. The wooden bulkhead is currently being replaced with a concrete seawall.

Another concern in the area is that of trying to balance the need to maintain a safe water level for flood control with the need to maintain sufficient water to satisfy agricultural irrigation demands. Apparently water levels in the Industrial Canal above 16 feet NGVD cannot be tolerated, since that reportedly will cause damages. According to the SFWMD the City of Clewiston is protected up to elevation 16.5 feet and any long-term stages above 16.0 feet NGVD may cause seepage problems.

4.2 Inventorying and Forecasting Conditions

The second step of the planning process is to develop an inventory and forecasts of critical resources (physical, demographic, economic, etc....) relevant to the problems and opportunities under consideration in the planning area.

Economic development in the S-169 basin will be dependent upon the effectiveness of water control structures in the area to provide water supply to Industrial Canal at all times. Currently, S-310 is the only water control structure that allows water to flow from Lake Okeechobee to Industrial Canal and it has limited hours of operation. If this structure continues to be the only means of supplying water to Industrial Canal, there will be a continuation of the problems currently occurring in the immediate area and there will very likely be an increase in the number of incidents. These problems include: fish kills, structural damage to marinas and watercraft, and downstream erosion problems. The resultant impacts include economic damages to commercial fishermen, outdoor guides, and marina owners. Navigation lockages will likely increase in the future. The operation of S-310 in a manner, which it was not designed would continue to spawn safety concerns and eventually result in unscheduled future maintenance of the lock.

4.2.1 Regional Historic Conditions

The following is a brief history of South Florida since it is important to understand the pre-drained environment, the Corps project to be modified, and the reason for its construction from a regional perspective.

The interior of the southern half of Florida is dominated by the Everglades, "a vast, shallow sawgrass marsh, dotted with tree islands and interspersed with wet prairies and aquatic sloughs." The low, trough-shaped Everglades marshland is bordered on the east and west by higher lands - the Atlantic Coastal Ridge on the east and the Immokalee rise on the west. The predevelopment Everglades were 40 miles wide and 100 miles long.

The historic Everglades originated at the headwaters of the Kissimmee River. The Kissimmee naturally drained into shallow Lake Okeechobee, which originally had no well-defined outlet. During the

wet season, the lake regularly overflowed its banks and sent a sheet of freshwater south over the Everglades,

The historic Everglades extended west into the Caloosahatchee River and east into the Allapattah, Hungryland, and Loxahatchee Sloughs. Surface waters also drained to the east through the St. Lucie, New, and Miami Rivers. Some percentage also recharged the Biscayne Aquifer, or simply evaporated. Further south, the accumulated surface water found an outlet to the coastal estuaries, the receiving areas where freshwater mixes with salt, through low marshy breaches in the Atlantic Coastal Ridge. These shallow freshwater marshes, or "transverse glades" constituted an important source of freshwater inflows to south Biscayne Bay.

When Florida became a state in 1845, there were only 55,000 residents, most of who lived north of Gainesville. Agriculture had come to form the basis for this young economy. However, agricultural production in much of the state, particularly in the south, was limited by wetlands.

Draining these lands to make them more suitable for agriculture became a goal, and would do much to shape Florida's future and reshape its natural environment. In an effort to stimulate settlement, the federal government, under the Swamp and Overflowed Lands Act, declared two-thirds of the state swamp, overflowed, and "unfit for civilization". Under this Act, the federal government gave the state 24 million acres. The Act specifically required that proceeds from the sale of these lands be used for reclamation.

Reclamation of land for agricultural and residential uses became an increasingly desired goal following the flood of 1903. In the governor's race of 1904, Napoleon Bonaparte Broward was elected on a platform that advocated full-scale drainage of the Everglades to make it suitable for farming. Soon after his election, Broward created the Board of Drainage Commissioners, which had the critical authority to tax property owners. In 1907 he created the Everglades Drainage District (EDD). By 1928 the Drainage District had constructed more than 440 miles of canals, to include the St. Lucie, Hillsboro, North New River, Miami, and the Caloosahatchee. These systems of canals lowered Lake Okeechobee from 22 feet to 15, and lowered the water table in southeast Florida by 5 to 6 feet. The depression brought financial ruin to the EDD, but droughts of the 1930s and floods of 1947 and 1948 led to a more comprehensive management scheme for the Central and Southern Florida region. The Corps recommended and Congress approved the Central & Southern Florida Flood Control Project (C&SF), which would impact some 15,000 square miles of central and southern Florida. Water management project purposes included flood control, water supply (residential, industrial, and agricultural), reduction of over drainage and salt water intrusion, preservation of fish and wildlife resources, recreation, and navigation. The plan included the creation of the Everglades Agricultural Area (EAA) and Water Conservation Areas (WCAs) encompassing some 1.3 million acres; channelization of the Kissimmee River; a levee encircling Lake Okeechobee with control structures and pump stations; and local protective works along the developed lower east coast. The construction of the C&SF project required a non-Federal sponsor to share in project costs, and operation and maintenance of the various water control structures and operation schemes. In 1949 the Florida legislature created the Central and Southern Florida Flood Control District, later to become the South Florida Water Management District (SFWMD). The bulk of the construction for the C&SF project took place in the 1950s and 1960s, with an eventual cost of nearly $1 billion.

4.2.2 Existing Conditions

Land Use

The existing condition of the Nine Mile Basin watershed can be best described as primarily agricultural. There is relatively little undeveloped land remaining in the watershed and, there is no significant wetland or aquatic habitat remaining in the watershed.

Dominating the landward side of Lake Okeechobee are sugarcane plantations, improved pasture, row crops, and urban areas. The city of Clewiston is the largest community in the Nine-Mile Canal Basin and is located west of Industrial Canal. Agricultural lands surround the city, and U.S. Highway 27 traverses through the city. Wetlands in the Lake Okeechobee area have been greatly reduced, but some still exist as regional ecotypes. These wetlands represent an important set of valuable and productive ecosystems both landward and waterward of HHD. On the landward side, remaining wetlands are typically found along drainage ditches or low lying areas and are usually a result of impoundment rather than natural hydrology. Industrial Canal and C-21 create such wetlands in the vicinity of the canals due to water surface elevations in the canals and seepage through canal levees. Typical vegetation in these remnant wetlands includes Carolina willow, waxmyrtle (Myrica cerifera), button bush (Cephalanthus occidentalis), cattails (*Typha, spp.*), duckweed (*Lemna, spp.*), water hyacinth (*Eichhornia crassipes*), and water lettuce (*Pistia stratiotes*). The wetlands on the landward side of the lake are not considered the highest quality ecosystems, but they do support small fishes and invertebrates, and provide usable forage for wading birds.

Ecological

Although there is little continuous habitat available for many wildlife species on the landward side of Lake Okeechobee, a variety of wading birds, such as the great blue heron (*Ardea herodias*), great egret (*Casmerodius albus*), little blue heron (*Egretta caerulea*), tri-colored heron (*Egretta tricolor*), and endangered woodstork *(Mycteria americana*), are often observed foraging in the shallow toe ditches and isolated wetlands. Freshwater marshes on both the waterward and the landward sides of HHD are frequented by other animals including osprey (*Pandonion haliaetus*), common moorhen (*Gallinula chloropus*), raccoon (*Pyrocon lotor*), and American alligator (*Alligator mississippiensis*). Many turtles, frogs, and small fishes also utilize the abundant resources available within these aquatic systems. The endangered Everglades snail kite (*Rostrhamus sociabilis plumbeus*), and threatened bald eagle (*Haliaeetus leucocephalus*) are also present in the area.

4.2.3 Geotechnical Analysis

Subsurface investigation consisted of drilling four core borings between 25 to 60 feet deep. Two core borings were drilled at the proposed bridge site, and the other two were drilled at the proposed culvert location. Two core borings were drilled at the proposed bridge site to a depth of 60 feet. Material encountered in CB-S16903-01 consisted of a 12-foot layer of sandy fill material followed by layers of silty sand with some shell and few clay and poorly graded sand. The material encounter in CB-S16903-02 consisted of layers of silty and clayey sand interbedded with layers of soft limestone, sandstone, and clay. Two core borings were drilled at the proposed culvert site on canal C-21 to a depth of 25 feet. Core boring CB-S16903-03, located on the south bank of canal C-21, encountered an 8.2-foot layer of loose silty sand, average blow count of 3 and a phi angle 29 degrees. The sand overlies a 1.4-foot layer of very hard limestone with a phi angle of 40 degrees. The limestone overlies a 14.9-foot layer of loose silty sand, average blow count 7, phi angle 30 degrees. The material encountered in the boring CB-S16903-04,

located on the north bank of the canal consists of 4.2 feet of loose silty sand. The locations and detailed descriptions are provided in the Geotechnical Appendix, Appendix B.

4.2.4 Hydraulics and Hydrology

Basin Structure Description

S-169 is a gated culvert located near the east end of C-21, just north of Clewiston. During normal operation, at lake stages greater than 15.5 ft. NGVD, the gates on S-169 are operated automatically to maintain a stage in the Industrial Canal of between 14.7 and 15.2 ft. NGVD; at lake stages between 13.0 ft. NGVD and 15.5 ft. NGVD the gates are closed, and at lake stages below 13.0 ft. NGVD the gates are placed in the full open position. The Industrial Canal is not a Federally authorized navigation channel. The canal is privately owned. Agricultural water supplies are withdrawn from the Industrial Canal by farm-controlled pumps and culverts. Further information is provided in Appendix A.

Originally, HGS-2 served navigation in the Clewiston area, provided storm surge protection, and provided for irrigation and drainage flows for Industrial Canal. HGS-2 was converted to a navigation lock structure (S-310). S-310 is located in HHD at Industrial Canal, just north of Clewiston, and just east of S-169. During normal operation, S-310 is placed in the full open position when the lake stage is below 15.5 ft. NGVD. When the lake stage is greater than 15.5 ft. NGVD, the lock is operated daily between 5:30 AM and 8:00 PM and is closed between 8:00 PM and 5:30 AM. During a hurricane alert, the Corps closes S-310, otherwise, it is operated and maintained by the SFWMD.

Several seasonal residential structures are located in the vicinity of S-169 and S-310, adjacent to and south of C-21. There is a recreational park and boat docking facilities spanning an area on the lakeside of HHD that is parallel to C-21 from S-169 to just west of S-310. There are several marinas and numerous watercraft that use S-310 to navigate between Lake Okeechobee and Industrial Canal. In addition to recreational watercraft, commercial watercraft such as those operated by fish and tour guides rely upon S-310. Watercraft from the Corps' South Florida Operations office at Clewiston also rely upon S-310 and are docked adjacent to Industrial Canal.

Culvert No's 1, 1a, and 2 are three culvert structures that serve as a conduit for drainage flows to and irrigation water supply from Lake Okeechobee. Culvert No. 2 is located in HHD at C-21, downstream and just west of S-169. It has five flap gates and a slide gate on the lakeside and discharges water from the Nine-Mile Canal Basin to the lake when the stage in C-21 is greater than the stage in the lake. The slide gate can be opened as necessary to supply water to the basin for irrigation water supply. During a hurricane alert, the structure is closed. Culvert 2 was designed and located to provide flood control for the Nine-Mile Canal Basin before construction of many of the current flood control structures (S-4, S-235, S-169, etc.) and to provide irrigation to the Sugarland Drainage District, south of Clewiston.

There are two operational strategies for the water control structures in this area of the Nine-Mile Canal Basin served by pump station S-4: 1) operation under a hurricane alert, and 2) operation under normal conditions (i.e., any condition other than a hurricane alert). During a hurricane alert, S-310, S-235, and all LD-1 culverts (Culvert No. 2, Culvert 1, and Culvert 1A) are closed to prevent Lake Okeechobee flood flows or storm surges from entering the basin.S-169 is opened so flow from the Industrial Canal can be routed down C-21 to C-20 and then to S-4 to be pumped into the Lake Okeechobee rim canal. The canal stage at S-4 is pumped down to and held at 10.0 ft. NGVD for the duration of the alert. Operation during a hurricane alert supercedes any normal operation. A summary of the normal operations of these structures is given in the following paragraphs and Table 4-1.

Table 4-1

Lake Stage (ft., NGVD)	GATE STATUS			Canal Stage at S-4 (ft., NGVD)
	S-310	Culvert No. 2	S-169	
Over 15.5	Closed	Closed	Auto	11.0-14.0
13.0-15.5	Open	Closed	Closed	11.0-14.0
Below 13.0	Open	Open	Open	Below 13.0

When the Lake Okeechobee stage is above 15.5 ft. NGVD, excess water is discharged from the entire basin by gravity flow to the Caloosahatchee River (C-43) and by pumping to the lake by way of S-4. A stage of approximately 15.0 ft. NGVD is maintained in the Industrial Canal by S-169, with excess flow in the Industrial Canal passing through S-169 to C-21 and eventually either to C-43 or the lake via S-4. The canal stage at S-4 is held between 11.0 and 14.0 ft. NGVD.

When the Lake Okeechobee stage is between 13.0 and 15.5 ft. NGVD, S-169 is closed and discharge from that part of the basin draining to the Industrial Canal is to the lake by gravity flow through S-310. The rest of the basin drains by gravity flow to the Caloosahatchee River and by pumping to Lake Okeechobee by way of S-4. The stage in the Industrial Canal under these conditions is approximately equal to the lake stage. The stages in C-21 are held between 11.0 and 14.0 ft. NGVD by S-4.

When the Lake Okeechobee stage is below 13.0 ft. NGVD, S-169, Culverts No. 1, 1A, and 2, and S-310 are open. All areas in the basin are interconnected to each other and to Lake Okeechobee. Under these conditions, the stages in all the canals are approximately equal to the stage in the lake.

The current hydrologic conditions in the Nine-Mile Canal area are related to the water control activities undertaken in past years. Prior to the construction of S-169, Culverts No. 1, 1A, 2, and HGS-2 were to be used to provide irrigation water to an agricultural area south of Lake Okeechobee. HGS-2, located at the most northern end of Industrial Canal at Herbert Hoover Dike, provided water directly to Industrial Canal. In the 1970's, S-169 and C-21 were constructed east of Culvert No. 2 to provide flood damage prevention for areas adjacent to Industrial Canal. HGS-2 is the only means of providing water supply to Industrial Canal. In the early 1980's, HGS-2 was converted to a navigation lock and renamed S-310. The current Lake Okeechobee regulation schedule ranges from 13.5 to 15.5 feet with multiple operational zones in which discharges are controlled in part by advanced meteorological forecasting. The highest regulatory zone is Zone A. Currently, Zone A starts at 17.0 feet. In the 1970's Zone A began at 14.0 feet, but by the late 1970's this elevation was changed again to 16.5 feet.

Current operating procedures at S-310 are dictated by the water surface elevation of Lake Okeechobee. When the lake is below 15.5, the upstream and downstream lock doors are left open to navigation traffic, which also satisfies any irrigation water supply needs. When the lake is above 15.5, locking operations are conducted for navigation traffic and manual water supply operations are initiated. Manual water supply operations involve disengaging safety features of the lock to allow both the upstream and downstream lock doors to be partially opened which allows flow into Industrial Canal. Navigation traffic is forced to wait until these operations for water supply have been completed. When under manual water supply operations, water discharges from the lock at a rate dependent upon the lake elevation. Over the history of the project, this lock operation has contributed to streambank erosion and scouring downstream of S-310.

The operating procedures stated above occur during normal duty hours, between 5:30 AM and 8:00 PM, 7 days a week. During non-duty hours, 8:00 PM to 5:30 AM, S-310 is unmanned and closed to both navigation traffic and water supply. When the lake is above a stage of 15.5 and irrigation water supply is known to be needed during non-duty hours, SFWMD makes arrangements for personnel to perform the manual water supply operations through overtime pay.

Hydrology and Hydraulics Overview

The hydrology of Nine Mile Canal Basin is determined primarily by runoff from the highly agricultural watershed and operation of basin structure. The Nine Mile Canal is operated for both water supply and flood protection through maintaining an optimum level in the canal. The main canals in the project area are C-21 and the Industrial Canal, and primary control structures are S-310, S-169, and Cu-2. C-21 has an east to west alignment and is approximately 2.6 miles long. C-21 extends from the Industrial Canal westward to the junction with Canal 20 (C-20). The Industrial Canal has a north to south alignment and is approximately 6.3 miles long. The north end is located at the junction with the eastern end of C-21. The south end terminates into a railroad berm close to the eastern limits of Levee 1E. S-310 is located just north of the C-21 and the Industrial Canal junction. S-169 is located on the eastern end of C-21 at Station 18+66.38 approximately 1,866 feet west of the junction with the Industrial Canal. Cu-2 was constructed in 1934 as a part of the original HHD. Cu-2 is located west of S-169 at approximately Station 29+28 of the C-21 horizontal control alignment. Facilities along the Industrial Canal that divert water to and/or from the Industrial Canal are culvert structures south of United States Sugar Corporation's (USSC) Southline Station, South Florida Conservancy District's (SFCD) Unit P-5-W, USSC's irrigational pumps, Clewiston Station 3, East Hendry Station, and the J.D. Thornton pump. There are also inline structures along the Industrial Canal that consist of four bridges, a box culvert, and USSC's Southline Station. The inline Southline Station controls flow for culverts to the south. The study area, main canals, facilities, and other structures are shown in Appendix A, Hydraulics and Hydrology.

Hydraulic modeling for existing conditions was accomplished by using the Hydrologic Engineering Center's River Analysis System (HEC-RAS) version 3.0.1. The HEC-RAS software developed by the U.S. Army Corps of Engineers was used to perform one-dimensional, steady-flow analyses.

4.2.5 Socio-Economics Overview

This section includes a description of the demographics, local economy, and land uses of the study area. This descriptive information provides insight into the area's socio-economic characteristics and provides part of the basis for the different facets of the economic impact evaluation work in the rest of the appendix. For complete analysis see the Economic Evaluation, Appendix D.

Population and Economy

The bulk of the study area, which is primarily agricultural, lies within Hendry County. Hendry County is bordered by Glades County to the north, which contains the remaining portion of the study area, Collier County to the south, Palm Beach County to the east, and Lee County to the west. Both Hendry and Glades counties are home to Indian reservations. The 52,000-acre Big Cypress Seminole Indian Reservation is located in Hendry County north of the Big Cypress National Preserve and the 35,800-acre Brighton Seminole Indian Reservation is located in Glades County.

Population

The 2000 Census reported a population of 10,576 persons in Glades County and 36,210 persons in Hendry County. As shown in Table 4-2 below, between 1990 and 2000, both Glades and Hendry counties' populations grew at a rate in excess of the state growth rate of 23.5%. Although the population is growing at a rate faster than the state average, the counties are growing more slowly than other counties in the Southwest Florida region and remain sparsely populated with very low population densities.

Projections made by the Bureau of Economic and Business Research at the University of Florida forecasts continued growth in the population of the study area, though the rate of growth is expected to decline over the next thirty years. Despite the declining rate of growth, rates are expected to exceed those of the state of Florida.

Table 4-2: Population of Glades County, Hendry County and the state of Florida

	1990	2000		2010*		2020*		2030*	
County	Total	Total	Increase	Total	Increase	Total	Increase	Total	Increase
Glades	7,592	10,576	39.3%	12,821	21.2%	14,961	16.7%	15,000	0.3%
Hendry	25,772	36,210	40.5%	45,772	26.4%	55,521	21.3%	63,400	14.2%
Florida	**13,276,530**	**16,396,515**	**23.5%**	**18,776,412**	**17.5%**	**21,683,344**	**15.5%**	**23,198,000**	**7.0%**

Source: The U.S. Census Bureau, 2000 Census

* Population projections from Southwest Florida Regional Planning Council, Volume One of the Strategic Regional Policy Plan

Table 4-3 shows selected demographics of the two Counties and the State of Florida. Observe that the female population in Glades and Hendry Counties is approximately 6 percent lower than the state. The table also shows a higher percentage of people 65 years of age or older live in Glades County as compared to Hendry County. Glades County has about the same percentage with the State of Florida. Compared to the State of Florida, both Counties have a smaller population density.

Table 4-3: Selected Demographics

	Glades County	Hendry County	Florida
Female persons, percent	45.1%	44.4%	51.2%
Persons under 18 years of age	22.1%	30.0%	22.8%
Persons 65 years of age or older	18.8%	10.1%	17.6%
Persons per square mile	13.7	31.4	296.4

Source: The U.S. Census Bureau, 2000 Census

As shown in Table 4-4 below, the state of Florida as a whole has a larger percentage of Black/African-Americans and Hispanics/Latinos than the nation. Within the study area, Glades County has a smaller percentage of persons of Black/African-American and Hispanic/Latino origin than Hendry County and the state of Florida. However, Glades' proportion of persons belonging to the American Indian/Alaskan Native population is much greater than that of Hendry County, the state, and the nation.

Although in real terms, this population amounts to only about 520 persons in Glades County compared with about 300 in Hendry. Conversely, the proportion of Hendry County's Hispanic/Latino population is more than three times higher than that of the nation and more than two times higher than Glades County and the state of Florida. Hendry County has approximately 14,300 Hispanic persons out of a total population of 36,210 compared to approximately 1,600 in Glades County out of a population of 10,576.

The counties in the project area have relatively high poverty levels. Glades County has a poverty level of 15.2% and Hendry County, 24.1%. Hendry County's poverty level is almost twice that of the state and the nation.

Table 4-4: Racial/Ethnic Population Distribution

	White	Black	Hispanic or Latino	American Indian or Alaskan Native	Asian or Pacific Islander
United States	69.1%	12.3%	12.5%	0.9%	3.7%
Florida	65.4%	14.6%	16.8%	0.3%	1.8%
Glades County	68.6%	10.5%	15.1%	4.9%	0.3%
Hendry County	43.9%	14.7%	39.6%	0.8%	0.4%

Source: The U.S. Census Bureau, 2000 Census

Table 4-5:
Percent of Persons Below Poverty Level 1999

United States	12.4%
Florida	12.5%
Glades County	15.2%
Hendry County	24.1%

Source: U.S. Census Bureau, 2000 Census

The county seat of Hendry County is La Belle; however, the largest city in the county is Clewiston, which is approximately four square miles with a population of 6,460. Clewiston, which is home to approximately 20% of the county's population, is located in the northeastern portion of the project area bordering the southwestern shore of Lake Okeechobee. Just outside of the project boundary on the western shore of Lake Okeechobee is Moore Haven, the county seat of Glades County. Moore Haven is approximately one square mile. The 2000 Census reported a population of 1,635 persons in Moore Haven or about 15% of the total county population.

Economy

Both counties within the study area had a 2000 unemployment rate above that of the state of Florida and the United States. Real per capita income and the median household income for the counties were approximately 30% and 20% lower, respectively, than that for the state and the nation.

Table 4-6: Employment 2000

	Civilian Labor Force	Total Employed Persons	Civilian Unemployment Rate (%)
United States	140,863,000	135,206,000	4.00%
Florida	7,407,458	6,995,047	5.60%
Glades County	4,034	3,677	8.80%
Hendry County	15,814	14,579	7.80%

Source: The U.S. Census Bureau, 2000 Census

Table 4-7:
Real Per Capita Income ($) 1999

United States	21,587
Florida	21,557
Glades County	15,338
Hendry County	13,663

Source: The U.S. Census Bureau, 2000 Census

Table 4-8:
Median Household Income ($) 1999

United States	41,994
Florida	38,819
Glades County	30,774
Hendry County	33,592

Source: The U.S. Census Bureau, 2000 Census

The agricultural and natural resource industries, which are made up of interconnected enterprises responsible for the production and processing of food, fiber and mineral products, are vital to the economy of the state of Florida (Regional Economic Impacts of Florida's Agriculture and Natural Resources Industries, 2003). Like the state of Florida, both the production and processing of agricultural products is very important for the economies of both Hendry and Glades counties. In fact, the City of Clewiston in Hendry County is home to the United States Sugar Corporation, the country's largest producer of cane sugar and one of the country's largest orange juice producers.

The 1997 Census of Agriculture reported a total market value of $323,438,000 for agricultural products in Hendry County and $58,589,000 for Glades County. The average market value of agricultural products sold per farm in 1997 was $802,575 for Hendry County and $311,642 for Glades County. Crop sales in Hendry County accounted for 95% of the market value of agricultural products sold and livestock sales accounted for 5%. In contrast, Glades County's crop sales accounted for 65% of the total market value of agricultural products and the remaining 35% was comprised of livestock.

Florida is the largest producer of sugarcane in the United States, and Hendry and Glades counties are Florida's numbers one and two leading producers of sugarcane, respectively. In addition to sugarcane, cattle and citrus are the mainstays of Hendry County's local economy. While farming is an

important component of Glades County's economy, educational, health, and social service jobs, probably fueled by the relatively large elderly population, provide the majority of the county's employment.

Land Use

Agriculture is the predominant land use in the state of Florida and within the project area. Seventy percent of Florida's total land area is used for agricultural or forestry purposes. Within Glades County, there are about 495,360 county land acres, of which 380,377 acres or approximately 77% is farmland. This figure increased 3% from 1992. Hendry County has about 737,920 county land acres, of which 604,677 acres or approximately 82% is farmland. The county's land in farms increased 14% from 529,835 acres in 1992.

Table 4-9: Employment by Industry (%) 2000

INDUSTRY	Glades County	Hendry County
Agriculture, forestry, fishing and hunting, and mining	12.5	22.8
Construction	10.0	8.0
Manufacturing	5.4	10.0
Wholesale trade	2.4	3.3
Retail trade	9.6	9.9
Transportation and warehousing, and utilities	6.6	4.4
Information	1.0	1.6
Finance, insurance, and real estate	3.9	3.7
Professional, scientific, management, administrative, and waste management services	3.7	4.7
Educational, health, and social services	18.5	13.3
Arts, entertainment, recreation, accommodation, and food services	9.5	6.3
Other services (except public administration)	5.9	3.7
Public administration	10.9	8.3

Source: U.S. Census Bureau, 2000 Census

The 1997 Census of Agriculture reported 188 farms with an average farm size of 2,023 acres and a median farm size of 100 acres in Glades County. Average farm size in the county increased by 13% between 1992 and 1997. A total of 403 farms with an average farm size of 1,500 acres and a median size of 87 acres were reported for Hendry County. Average farm size in the county increased 10% between 1992 and 1997. Although Hendry County has more farms than Glades, on average, farms in Glades County are larger than farms in Hendry.

Land use in the project area is expected to remain primarily agricultural in the future. Based on trends in the movement of citrus southward from Central Florida due to several past winter freezes, citrus acreage in the project area is expected to increase. Sugarcane acreage is expected to continue to increase in the next coming years and then remain constant through 2020.

Table 4-10: Agricultural Land Use (acres)

	Glades County			Hendry County		
Crops	**1987**	**1992**	**1997**	**1987**	**1992**	**1997**
Sugarcane	*	*	14,847	*	980	54,008
Hay	1,238	187	2,440	1,423	645	995
Vegetables	*	722	*	8,581	6,197	9,936
Land in Orchards	5,522	8,827	10,596	57,975	112,031	114,618

Source: 1997 Census of Agriculture

* Undisclosed or Not Available

4.2.6 Future Without Project Conditions

S-310 will cease to be operated in an unsafe and unauthorized manner. When lake levels exceed 15.5 feet, S-310 will only operate as designed and the practice of cracking open the lock gates for water supply will be discontinued. This will result in reducing water available for irrigation and adversely impacting agriculture in the area. This would cause agricultural water shortages in Industrial Canal whenever water is pumped out for irrigation and possible damage to marine craft at certain times of the year. Farmers can not sustain agricultural activities under this condition. The status of Industrial Canal would continue to be dependent on agricultural usage that would govern the water levels. The area will remain largely rural and with an agricultural base.

To sustain irrigation activities, the most likely condition expected to exist in the future in the absence of a proposed project is to place a pump station on the south bank of C-21 just west of S-169 and to modify culvert no. 2 (C-2) as required. Installing a pump station just west of S-169 will provide the means of pumping water from C-21 into the Industrial Canal when the Lake Okeechobee stage is above 15.5 ft, S-310 is closed and the Industrial Canal stage is low.

The on-going Comprehensive Everglades Restoration Plan (CERP) project will contribute to changes in the future, which are beyond the scope of this project. Future CERP projects that are anticipated to be within or adjacent to the S-169 include the Caloosahatchee Reservoir with ASR, Caloosahatchee Backpumping with STA, and the Revised Lake Okeechobee Regulation Schedule.

4.2.7 Objectives & Constraints

The primary objective for the study of S-169 is to enable a dependable conveyance of water to meet agricultural demands, which was gathered from available permits. This objective is to be accomplished while ensuring that flood protection is maintained and that environmental and commercial interests are not detrimentally impacted by operations at S-310 and the agricultural surface water use from Industrial Canal. The developed objectives are as follows: (1) provide agricultural water supply during dry periods, (2) eliminate boat damage due to canal drawdown, (3) reduce/eliminate agricultural flooding, (4) reduce/lower existing & future structural flooding, (5) reduce/lower existing & future property damage flooding, (6) eliminate need to staff S-310 for open/close ops, (7) eliminate safety hazards associated w/ S-310 for water supply, (8) eliminate unauthorized operation of S-310, (9) reduce/eliminate scour and erosion in Industrial Canal, (10) provide access to Herbert Hoover dike across C-21, (11) allow boat passage along C-21, (12) reduce/eliminate fishkills/danger to wildlife. Measures were formulated to

meet these objectives and are described in Table 4-11. Constraints involved with meeting these objectives include the following: (1) project modifications can not reduce the existing level of flood protection; (2) maintain access to Herbert Hoover Dike; (3) can not operate S-310 when Lake Okeechobee water elevation is above 15.5 feet; (4) provide Florida manatee protection.

The developed goals are as follows: (a) provide a supply of water to the Industrial Canal to meet agricultural demands; (b) operate the S-310 lock as it is authorized to be used; (c) develop a compatible operational schedule with Lake Okeechobee; (d) minimize fish kills and damage to watercraft and marinas; and (e) limit the erosion downstream of S-310. Modifying some of the existing structures (S-310, S-169, Culvert 2) within the eastern portion of the basin was discussed. Studying the water resource needs of the entire basin was beyond the scope of this project, but could be addressed in a future authorized study, which would include three drainage districts and their water control structures.

4.3 Formulation of Alternatives / Plans

Alternative plans were formulated to meet the identified planning objectives while avoiding planning constraints. No alternative may diminish the authorized project purposes of flood control, without specific authorization to make such a change. Alternatives were built from one or more features or management measures. A measure is a feature or activity that can be implemented at a specific geographic site to address one or more of the planning objectives; they can be either structural or non-structural. Features are usually structural measures and typically require construction or assembly. Activities are usually nonstructural measures and often are actions, procedures, or policies that affect actions or procedures.

4.3.1 Measures Considered

Water levels at the water control structures in Industrial Canal will be monitored to try and maintain agricultural water supply needs and flood control. Table 4-11 shows the Measures that were considered and their relationship to the project objectives.

A pump station west of the S-169 structure could draw water from C-21 supplied through C-2 and pump into the Industrial Canal or other irrigation canals. Since S-169 will remain unchanged, there would be no improvement to local flooding.

Modifications to Culvert C-2 would have to be made to provide an improvement to water supply into the Canal. This will generally involve converting the five (5) flap gates and one (1) slide gate to telemetry-controlled, vertical slide gates.

The relocation of S-169 to a new location (S-169R) just west of C-2 would be a similar structure to the existing S-169, but with an additional barrel for increased capacity. This would allow Industrial Canal to be supplied by Culvert C-2, while maintaining control over flow westward into C-21.

A new access bridge would be needed at the existing site of S-169 if this structure is demolished. Access must be maintained to the Herbert Hoover Dike. Enlarging this new bridge to accommodate boat traffic is a possibility, but this would raise safety issues and add to the cost.

Operating the S-310 lock on a 24 hour/7 day a week schedule would provide the needed supply of water for irrigation and flood control. However, this would continue the practice of overriding safety features in order to crack open the lock gates.

Demolishing the existing S-169 structure would be necessary to maintain acceptable water levels east of the new S-169R in C-21 and the Industrial Canal during flood control operations.

Construction of a tie-back levee may be needed to prevent flanking on the north side of the proposed S-169R, between the structure and HHD. As water levels rise in the Industrial Canal area water could spill out of bank and flow between S-169R and the HHD. A tie-back levee would prevent this.

Simply modifying the existing S-169 structure might provide the needed supply of water, but it would still allow headwaters to be too high on S-169. Stages would exceed the 16.5 feet target level.

Placing a plug in the C-21 canal west of C-2 could allow water to flow through C-2 into C-21 and Industrial Canal without increasing levels westward into C-21. However, this would involve blocking C-21.

Filling the existing scour hole just below S-310 could be done to repair and eliminate future erosion in the area. This should obviously be done for any proposed project plan.

Proposed safety features include installing a boat safety barrier on the downstream side of S-310 and installing a trash rake and screen to the pump station.

4.3.2 Preliminary Alternatives

The following alternatives were developed from the measures that had been presented by the study team and are based on input from numerous stakeholders. All alternatives include a plan to maintain water level in Industrial Canal when Lake Okeechobee is above 15.5 and S-310 is closed.

Alternative 1

The without project condition consists of describing the project area's future, if there is no Federal action taken to solve the identified problems. When Lake Okeechobee level is 15.5 ft or lower, lock structure 310 (S-310) is left open. When lake levels exceed 15.5 ft, the lock is operated manually by South Florida Water Management District (SFWMD) 5:30am to 8:00pm from October through April and 5:30am to 9:00pm from May through September.

Alternative 2

This alternative would detail SFWMD providing personnel 24-hr/day, 7 days/week to operate S-310 when Lake Okeechobee levels exceed 15.5 ft, and during water shortages in the Industrial Canal. This would include additional man hours for lock tenders, which would result in 1657 overtime hours of operation per year for the S-310 lock and additional O&M costs. There have been several instances in the past that resulted in detrimental effects being incurred due to water supply not being provided during non-duty hours. When water supply has not been provided, the Industrial Canal has been drawn down to severely low levels by the agricultural community during their normal irrigation procedures. As a result, commercial, recreational and government watercraft have incurred damages, marinas have been structurally damaged, and fish kills have been observed. To temporarily eliminate this problem, lockmasters have been called during non-duty hours, when Lake Okeechobee levels exceed 15.5 ft NGVD, to open the S-310 to allow water into the Industrial Canal.

Table 4-11: Objective / Measure Matrix

OBJECTIVES \ MEASURES / FEATURES			a) Pump Station West of S-169	b) Modification of Structure C-2	c) Relocate S-169 just West of C-2	d) New Bridge at Old S-169 Location	e) Enlarge New Bridge at Old S-169 Site	f) 24/7 Operation of S-310	g) Demolish Existing S-169	h) Construct Tie-back Levee at Proposed S-169R Site	i) Modify Existing S-169	j) Place Plug in C-21 West of C-2	k) Fill scour hole and repair revetment	l) Install boat safety barrier on DS side S-310	m) Install trash rake and screen to pump station		x) No Action (No Project)		
1) Provide Agricultural Water Supply During Dry Periods			X	X	X			X	X		X	X							
2) Eliminate Boat Damage due to Canal Drawdown			X	X	X			X											
3) Reduce / Eliminate Agricultural Flooding					X			X		X									
4) Reduce / Lower Existing & Future Structural Flooding					X			X		X									
5) Reduce / Lower Existing & Future Property Damage Flooding			X	X	X			X											
6) Eliminate Need to Staff S-310 for Open/Close Ops			X		X						X	X							
7) Eliminate Safety Hazards Associated w/ S-310 for Water Supply			X	X	X						X	X							
8) Eliminate Unauthorized Operation of S-310			X	X	X						X	X							
9) Reduce / Eliminate Scour and Erosion in Industrial Canal					X								X						
10) Provide Access to Herbert Hoover Dike across C-21			X			X	X				X						X		
11) Allow boat passage along C-21						X	X		X										
12) Reduce / Eliminate fishkills/danger to wildlife					X									X	X				

Alternative 3

This alternative would consist of placing a pump station just west of S-169 as a means of pumping water from C-21 into the Industrial Canal when the Lake Okeechobee stage is above 15.5 feet, S-310 is closed. Hydraulics will help determine the need (if any) to make modifications to C-2 to supplement the flow. This alternative would also include the following:

a. Install a 4 bay 425 CFS irrigation pump station adjacent to the existing S-169, which would be located on south bank of the canal. The pump would convey water from the westside of S-169 to the eastside of S-169. Trash rake and screen would be fitted to both sides of the structure.

b. Access to Herbert Hoover Dike (HHD) would be required at all times during construction, therefore a temporary bridge would be considered in the scope of work for this pump station construction. Convert five 10-foot diameter flap gates on C-2 to vertical slide gates. Telemetry control would be required. The telemetry control would require an electrical/mechanical house.

Alternative 4

This alternative would consist of building a water control structure west of C-2, , and either:

(A) Demolishing the existing S-169 and constructing an access bridge for Herbert Hoover Dike in its place, or

(B) Modifying S-169 to provide water control and continuous vehicular access.

Modifications to C-2 may be required. Also, temporary access to Herbert Hoover Dike during construction/demolition will be evaluated.

Alternative 5

Modify the existing S-169 gates to allow continuous free flow and continuous vehicular access. Modifications to Culvert No. 2 may be required.

Alternative 6

Place a plug in C-21 west of Culvert No. 2 to allow water flow from Lake Okeechobee into C-21 and the Industrial Canal. Modifications to Culvert No. 2 to may be required.

4.4 Evaluation of Alternative Plans

In the evaluation step, the significant contributions or effects of an individual plan are quantified and judged. Evaluation, like all other planning steps, is also an iterative process. It begins with the first screening of measures and plans, and its detail and rigor increases as planning moves closer to a final decision.

4.4.1 Screening Alternatives

The evaluation of effects is a comparison of the future with-project to the future without-project conditions for each alternative. Corps Water Resource Development projects are evaluated in terms of acceptability; completeness; effectiveness; and efficiency. Completeness is the extent to which the

alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by the Federal and non-Federal entities. Effectiveness is the extent to which the alternative plans contribute to achieve the planning objectives. Efficiency is the extent to which an alternative plan is the most cost effective means of achieving the objectives. And finally, Acceptability is the extent to which the alternative plans are acceptable in terms of applicable laws, regulations, and public policy.

Though these criteria are largely subjective, there are minimum thresholds, below which an alternative plan may be dropped from consideration, this occurs both in the initial screening phase and later once alternatives are evaluated further. One criteria that is not subjective and is strictly adhered to, is that no preliminary alternative that may have a significant negative impact on the authorized project purposes of water supply and flood control, will be carried forward for further consideration.

4.4.2 Alternatives Eliminated from Further Consideration

Alternative 3

This alternative was eliminated and not analyzed in detail, since it is questionable that this alternative would perform as expected. The proposed pump station would have to draw water from Cu-2 to the east, but flow normally flows in the opposite direction. Stages west of Cu-2 may be adversely affected since there will be no control for flow going to the west from Cu-2. Additionally, the U.S. Fish and Wildlife Service does not support this alternative.

This alternative is the general scenario that was assumed for the future without project conditions. It is believed that local agricultural interests would likely construct some kind of pump facility to provide needed agricultural water.

Alternative 5

This alternative was eliminated due to the lack of optimum water levels in canals 20, 21, LD-1 and LD-3.

Alternative 6

This alternative was eliminated. C-21 cannot be permanently blocked due to flood control conveyance to pump station S-4. The U.S. Fish and Wildlife Service does not support this alternative.

4.4.3 Environmental Considerations

An Environmental Assessment (EA) was prepared, and is included in Appendix F of this report. The EA meets the requirements of the National Environmental Policy Act.

4.4.3.1 Water Quality

The State of Florida Water Quality Certificate conditions would be met during construction of the project. The Corps would employ various protective measures and monitoring to ensure compliance with State Water Quality Standards and ensure that the existing water quality is not lowered. The project would have positive benefits on water quality, in that, large quantities of water would no longer be

discharged on an emergency basis. This would help with deposits of phosphorus discharged to the Lake and would also stabilize the wetland hydro-period.

4.4.3.2 Fish and Wildlife Coordination

This project has been coordinated with the U.S. Fish and Wildlife Service (USFWS). The USFWS, in response to the Corps request, and in accordance with the Fish and Wildlife Coordination Act of 1973, provided a Planning Aid Letter dated January 28, 2003. A Draft Coordination Act Report (CAR) was provide July 2003 and a revised Draft CAR was provided September 2003. A final CAR is pending and the final report is anticipated upon the agency's review of this GRR. Per the request of the USFWS, the proposed project design has been changed to include a manatee protection grate on the southeast side of the new S-169R. USFWS communicated that most of the federally listed species present or potentially present in the project area have been previously impacted by habitat degradation due to wetland drainage, excess nutrient runoff, and a concurrent alteration of the hydroperiod. The project would have the potential to either benefit or adversely impact the endangered snail kite and the endangered wood stork. Other species found within Lake Okeechobee or occurring in the area include the endangered West Indian manatee, the threatened bald eagle, the threatened eastern indigo snake, and the endangered Okeechobee gourd. Impacts to any bird nesting would be mitigated by implementing the District's Migratory Bird Protection Plan.

The Corps, by letter dated August 19, 2004, initiated Coordination with the USFWS under Section 7 of the Endangered Species Act. In a December 30, 2004 letter, USFWS summarized the specific habitat requirements for each listed species, and recommended implementation of additional measures to minimize adverse effects to the wood stork and bald eagle. The USFWS concurred with the Corps determination and protective measures proposed for the Everglade snail kite, wood stork, West Indian manatee, bald eagle, eastern indigo snake, and Okeechobee gourd. Additional provisions were recommended to minimize adverse effects to the bald eagle and wood stork, in addition to, the inclusion of a removable manatee exclusion grate on the southeast side of the new S-169R. The Corps accepted provisions proposed for the species with limited acceptance of the USFWS Habitat Management Guidelines for the Wood Stork In the Southeast Region (1990). A letter dated February 28, 2005, was forwarded to the USFWS outlining the Corps' position.

4.4.3.3 Cultural Resources

There are no known cultural resources within the project area. Consultation with the Florida State Historic Preservation Officer (DHR Project File No. 2001-05533) has indicated that because of its location the project area is not likely to contain cultural resources eligible for listing in the National Register of Historic Places.

4.5. Real Estate Requirements

The proposed project is planned for construction within the previously provided existing right-of-way for Canal 21 and the Herbert Hoover Dike Project (portions of the previously authorized Central and Southern Florida Project) for which South Florida Water Management District (SFWMD) is the local sponsor. SFWMD will provide all the necessary lands required for the project construction, operation and maintenance, all necessary access, and other temporary areas required. In addition to the required lands within the existing right of way, there is a requirement for a Road Access Easement and a Temporary Stockpile Easement. No credit will be provided for such land previously provided, which is within the existing right-of-way. The estimated real estate requirements are provided in Appendix E.

It is anticipated that the excess material resulting from demolition of the existing structure and excavation required at other project sites would be taken to a local commercial landfill for disposal. It is further anticipated that all borrow material required for construction would be obtained from commercial sources. Material would be required as backfill for the proposed structure, for construction of both the north and south tieback levees, and for construction of the roadway access to the proposed bridge.

4.6 Socio-Economics Analysis

As discussed previously, Florida is the largest producer of sugarcane in the United States, and Hendry and Glades counties are Florida's numbers one and two leading producers of sugarcane, respectively. In addition to sugarcane, cattle and citrus are the mainstays of Hendry County's local economy. Sugarcane irrigation is all year round, with much of that occurring during the Grand Growth Phase (June to September) when the plant requires large amounts of water. However, depending on the weather not much irrigation is required during that period. When there is sufficient rainfall, as is usually the case in summer, very little irrigation is required. However, between November and May irrigation activities peak because of drought.

In early summer, Lake Okeechobee is lowered to prepare for the hurricane season and by late July, August, and September rain is expected to recharge the lake. Current operating procedures at S-310 are dictated by water surface elevation at Lake Okeechobee. When the lake is below 15.5, the upstream and downstream lock doors are left open to navigation traffic, which also satisfies any irrigation water supply needs. Exceedance curves calculated by water management using historical data indicate that the lake may exceed 15.5 feet between September and end of March at which time the S-310 locks are closed to prevent excess water flowing into the Industrial Canal. According to the exceedance analysis, there is a 25 % chance of Lake Okeechobee stages rising above 15.5 feet. That implies, between September and March, farmers would have to establish alternative sources of water to irrigate their farms. The assumption of establishing an alternative source for the water, instead of allowing crop failure, is based on several components. First, sugarcane is a perennial plant, and each planting produces four or more annual crops. The return value of the plant is not based on one crop yield but is spread over a life of four or more yields. Therefore, the cost to the agricultural economy would not only be the value of the current year's crop but would also be the lost value associated with the remaining crop potential of the lost plants. Also, the local economy is heavily reliant on the sugar cane as a source of income, not only in terms of the crop, but also the production of the sugar products processed from the raw commodity.

For this study, benefits resulting from any of the proposed alternatives would be agricultural water supply. No data was available to determine the value of the water used by the agricultural and municipal users of the canal. The users do not pay a fee for the water and the amount of water used by any user is not monitored. It was determined that an acceptable proxy for the value of the water used from the Industrial Canal would be the cost of the most likely alternate source, in the absences of the operation of S-310. It was assumed that under the implementation of any alternative that water users of the Industrial Canal would not be permitted to draw down the canal to a level that would impact private and commercial marinas, boats or recreational activities. The most likely alternate method for supplying the Industrial Canal would be the "Future Without Project Condition". Under this condition the local users would build a pump station to bypass S-169 as a means of pumping water from C-21 into the Industrial Canal when the Lake Okeechobee stage is above 15.5 feet, S-310 is closed, and the Industrial Canal is approaching an unacceptable level. The average annual cost for the pump station alternative is estimated at $567,854, based on an economic life of 50 years, and an interest rate of 5-3/8 percent. This value is the basis for the average annual benefit that is used in the B/C ratio.

A cost-benefit analysis was performed to select the NED plan, with a project design that produced the maximum net benefits. The economic justification of the proposed plan was determined by comparing the equivalent average annual costs (i.e., interest, amortization, and maintenance costs) with an estimate of the equivalent average annual benefits, which would be realized over a 50-year period of analysis. Computed costs of alternatives are based on 2005 price levels. Table 4-12 summarizes the total investment cost and total annual equivalent cost of the proposed alternative plans.

TABLE 4-12: Annualized Benefits And Costs

	ALTERNATIVE 2	ALTERNATIVE 4A	ALTERNATIVE 4B
Construction Cost	$115,100	$3,403,100	$3,638,300
PED Costs {E&D}	$9,500	$281,400	$303,300
Escalation	$11,500	$348,700	$405,200
Contingency	$31,700	$938,000	$1,010,900
Real Estate Cost	0$	$154,000	$154,000
S&A	$13,400	$397,700	$428,600
Interest During Construction	$2,757	$245,673	$264,279
Total Initial Cost	$183,957	$5,768,573	$6,204,579
Annualized Initial Cost	$10,666	$334,465	$359,745
Annual O&M	$3,320	$3,320	$3,320
Annual Salary Cost	$41,425		
Total Annual Cost	$55,411	$337,785	$363,065
Total Annual Benefits	$567,854	$567,854	$567,854
BCR	10.25	1.7	1.6
Net Benefits	$512,443	$230,069	$204,789

4.7 Plan Comparison

Table 4-13 provides a summary of the comparisons between the alternatives, and the contributions to the planning objectives.

Alternative 1 was not selected since it would not achieve the planning objectives.

Alternative 2 was not selected since it requires the same water-supply operations as existing conditions. Cracking the lock to provide water supply and associated operations leads to problems. S-310 was not designed to operate as currently operated for water supply when the lake is above 15.5 feet, NGVD (when S-310 is scheduled to be closed). Currently, when S-310 is closed, water supply from the lake via S-310 is provided by partially opening the lakeside and landside lock gates. This has caused downstream erosion problems. There have been several instances in the past that resulted in detrimental effects being incurred due to water supply not being provided during non-duty hours. When water supply has not been provided, the Industrial Canal has been drawn down to severely low levels by the agricultural community during their normal irrigation procedures. As a result, commercial, recreational and government watercraft have incurred damages, marinas have been structurally damaged, and fish kills have been observed. Adverse ecological impacts are also experienced from prolonged inundation of littoral zones, lowered water quality, loss of fish and wildlife habitat and utilization values, creation of

sandbars, bank erosion, and scouring of bottom substrates. In an effort to create a permanent solution, the Corps and sponsor, SFWMD, evaluated alternatives that would allow sufficient staging of water within the Industrial Canal and C-21 to meet irrigation and navigation needs with minimum or no adverse ecological impacts. Therefore, Alternative 2 cannot be selected since it requires the current operations that are trying to be avoided, which is operating S-310 in an unsafe and environmentally unsound manner.

Alternative 4B was not selected. This alternative considered adding an additional seven-foot barrel to the existing S-169 and constructing a new, water-control structure with four seven-foot barrels. Stages on the headwater side of S-169 were too high, which exceed the target of 16.5 feet at U.S. Highway 27. This alternative is not recommended since modeling results showed that stages during flood control operations were too high.

Table 4-13: Summary Comparison of Alternative Plans for S-169 (Nine Mile Canal)

1. PLAN DESCRIPTION	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Operation Change	ALTERNATIVE 4A Relocate S-169	ALTERNATIVE 4B Relocate S-169
	Future Without project. Cease to operate S-310 lock as irrigation structure.	Additional Lock Tender hours and O&M.	Move S-169 just west of C-2. Replace existing S-169 w/ new access bridge.	Const. new S-169 just west of C-2. Modify existing S-169.
2. IMPACT ASSESSMENT				
A. National Economic Development (NED)				
(1) Total Initial Cost	$0	$183,957	$5,768,573	$6,204,579
(2) Total Annual Cost	$0	$55,411	$337,785	$363,065
(3) Total Annual Benefits	$0	$567,854	$567,854	$567,854
(4) Net Benefits	$0	$512,443	$230,069	$204,789
(5) Benefit to Cost Ratio	0	10.25	1.7	1.6
B. Environmental Quality (EQ)				
(1) Air/Noise	Some noise levels during operation of locks.	Some noise levels during operation of locks.	Temporary increased noise levels during construction period.	Temporary increased noise levels during construction period.
(2) Water Quality	None	None	Some impacts during construction. No change to current water quality.	Some impacts during construction. No change to current water quality.
(3) Vegetation	None	None	Wetland vegetation may be disturbed.	Wetland vegetation may be disturbed.
(4) Threatened and Endangered Species	Manatees could be injured in the lock gates during operation.	Manatees could be injured in the lock gates during operation.	Provides for manatee protection. Woodstorks may be temporarily disturbed during construction.	Provides for manatee protection. Woodstorks may be temporarily disturbed during construction.
(5) Aquatic Birds	None	None	Wading birds may be temporarily disturbed during construction.	Wading birds may be temporarily disturbed during construction.
(6) Cultural Resources & Historic Properties	None	None	None	None

(7) Shoreline Erosion	No change. Erosion, due to discharges, would still be a problem.	No change. Erosion, due to discharges, would still be a problem.	Current erosion problem would be corrected.	Current erosion problem would be corrected.
(8) Fish and Wildlife Resources	Low water levels would continue to be of concern. Fish kills would continue.	Low water levels would continue to be of concern. Fish kills would continue.	Current low water levels and fish kills would be corrected.	Current low water levels and fish kills would be corrected.
C. Regional Economic Development (RED)	N/A	N/A	N/A	N/A
D. Other Social Effects (OSE)				
(1) Life, Health and Safety	Safety features must be overridden to operate lock for irrigation.	Safety features must be overridden to operate lock for irrigation.	Current safety issues would be corrected.	Current safety issues would be corrected.
(2) Community Cohesion (displacement of people and businesses)	None.	None.	Provides increased flood protection by lowering flood levels by 1 foot.	Provides decreased flood protection by raising the flood levels.
(3) Recreation	Low water levels have caused boating problems and known damages. Boaters can not use the lock when lake elevation is above 15.5 ft.	Low water levels have caused boating problems and known damages. Boaters can not use the lock when lake elevation is above 15.5 ft.	Boating problems would be corrected. Some impacts during construction.	Boating problems would be corrected. Some impacts during construction.
(4) Aesthetics	No change	No change	No change	No change
(5) Navigation	Low water levels have caused navigation problems.	Low water levels have caused navigation problems.	Navigation problems would be corrected. Some impacts during construction.	Navigation problems would be corrected. Some impacts during construction.
3. PLAN EVALUATION				
A. Contribution to Planning Objectives				
1) Provide Agricultural Water Supply During Dry Periods	Does not meet objective.	Does not meet objective.	Meets objective	Meets objective
2) Eliminate Boat Damage due to Canal Drawdown	Does not meet objective.	Does not meet objective.	Meets objective	Meets objective
3) Reduce / Eliminate Agricultural Flooding	Does not meet objective.	Does not meet objective.	Meets objective	Meets objective
4) Reduce / Lower Existing & Future Structural Flooding	Does not meet objective.	Does not meet objective.	Meets objective	Does not meet objective.
5) Reduce / Lower Existing & Future Property Damage Flooding	Does not meet objective.	Does not meet objective.	Meets objective	Does not meet objective.

6) Eliminate Need to Staff S-310 for Open/Close Ops	Does not meet objective.	Does not meet objective.	Meets objective	Meets objective
7) Eliminate Safety Hazards Associated w/ S-310 for Water Supply	Does not meet objective.	Does not meet objective.	Meets objective	Meets objective
8) Eliminate Unauthorized Operation of S-310	Does not meet objective.	Does not meet objective.	Meets objective	Meets objective
9) Reduce / Eliminate Scour and Erosion in Industrial Canal	Does not meet objective.	Does not meet objective.	Meets objective	Meets objective
10) Provide Access to Herbert Hoover Dike across C-21	Does not meet objective.	Does not meet objective.	Meets objective	Meets objective
11) Allow boat passage along C-21	Does not meet objective.	Does not meet objective.	Meets objective	Meets objective
12) Reduce / Eliminate fishkills/danger to wildlife	Does not meet objective.	Does not meet objective.	Meets objective	Meets objective
B. Response to Planning Constraints				
(1) Project modifications can not reduce the existing level of flood protection.	Meets constraint	Meets constraint	Meets constraint	Does not meet constraint.
(2) Maintain access to Herbert Hoover Dike.	Meets constraint	Meets constraint	Meets constraint	Meets constraint
(3) Can not operate S-310 when Lake Okeechobee water elevation is above 15.5 feet.	Does not meet constraint.	Does not meet constraint.	Meets constraint	Meets constraint
(4) Provide Florida manatee protection.	Does not meet constraint.	Does not meet constraint.	Meets constraint	Meets constraint
C. Response to Evaluation Criteria				
(1) Completeness	Not complete	Not complete	Most complete	Partially complete
(2) Effectiveness	Not effective	Not effective	Most effective	Partially effective
(3) Efficiency	Not efficient	Not efficient	Most efficient	Partially efficient
(4) Public acceptability	Not acceptable	Not acceptable	Fully acceptable	Not fully acceptable

4.8 Tentatively Selected Plan

It is recommended that Alternative 4A be the plan to be implemented to alleviate the agricultural water supply and flood control problems for the sub-basin served by S-169 and S-310. Alternative 4A is the NED plan and also the locally preferred plan. This alternative would consist of building a new water control

structure west of C-2; demolishing the existing S-169 and constructing an access bridge to Herbert Hoover Dike. Modifications to C-2 would also be required. This recommended plan would also include the following:

a. Demolish the existing S-169 and haul off-site to nearest landfill.

b. Construct a new bridge to allow access to HHD during construction. This would prevent having to build a temporary access bridge, but would require realignment of the access road at the bridge approach and exit. The new bridge would be constructed just to the west of S-169.

c. Construct new S-169 culvert structure west of Culvert 2. The new S-169 will require telemetry control.

d. Convert five 10-foot diameter flap gates on Culvert 2 to vertical slide gates. Telemetry control will be required.

e. Utilize the existing telemetry on the S-169's three gates on the Culvert 2 structure or the new S-169 structure to assist with the cost savings.

5.0 PLAN IMPLEMENTATION

Microcomputer Aided Cost Engineering System (MCACES) was used to calculate the construction cost estimate, which is presented in Appendix C, Design and Cost Estimate. Construction costs include the engineering and design necessary for the project, preparation of contract plans and specifications, supervision and contract administration, and the cost for all temporary or permanent construction easements for lands, rights-of-ways, relocations, and disposal areas.

5.1 Operation and Maintenance

The local sponsor is responsible for operation and maintenance of the proposed project. The estimated annual cost is $3,320, which includes operation and maintenance of the structure, regular mowing, and maintaining fences and gates.

Operations for S-310 would not change with the exception of not having to be partially opened to provide water supply when Lake Okeechobee stage is above 15.5 feet. S-169R would operate similarly to S-169. During irrigational operations, Cu-2 would be operated to maintain a stage in C-21 that would range from approximately 14.6 to 15.2 feet when Lake Okeechobee stage is above 15.5 feet. Optimum stages along the C-21 alignment from S-169 to S-169R would increase from the existing range of 11 to 14 feet to 14.6 to 15.5 feet. Additional operational details for S-310, Cu-2, and S-169R are described in the "Draft Water Control Plan", Appendix A.

5.2 Division of Responsibilities and Cost Sharing

This study is a reevaluation of a flood control project, which was authorized by the Flood Control Acts of 1948 and 1954. However, the recommended plan is to relocate a flood control feature for the purpose of agricultural water supply. Section 103 (c) (3) of the Water Resources Development Act of 1986 provides that non-Federal interests are responsible for 35 percent of costs allocated to agricultural water supply purposes in a Corps project, to be paid during construction, and for the allocated operation, maintenance, repair, replacement, and rehabilitation costs as they are incurred. Section 103 (c) (3) applies

to irrigation water outside the 17 western states and to other agricultural water supply functions in all areas. Table 5-1 details the total project costs and cost sharing for implementation of the project.

5.2.1 Federal Responsibilities

The U.S. Army Corps of Engineers is responsible for budgeting for the Federal share of costs for this project. The Federal share is estimated at $4,320,485 or 65 percent of the total implementation costs. Federal funding is subject to budgetary constraints inherent in the formulation of a national Civil Works budget for a given Fiscal Year. The Corps would perform the necessary pre-construction, engineering, and design required prior to construction. The Corps will also obtain the water quality certification, advertise, award, and construct this agricultural water supply project.

TABLE 5-1: Total Project Costs and Cost Sharing

ITEM	COST
STUDY COST	
General Reevaluation Report	$1,084,000
IMPLEMENTATION COSTS	
Preconstruction, Engineering and Design	$281,400
Construction Costs	$3,403,100
Contingency & Escalation	$1,286,700
Construction Management	$397,700
Real Estate Costs	$154,000
Water Quality Certification	$40,000
TOTAL PROJECT COST	**$6,646,900**
Federal Cost Share @ 65%	**$4,320,485**
Non-Federal Cost Share @ 35%	**$2,326,415**

5.2.2 Non-Federal Responsibilities and In-Kind Services

No in-kind services would be provided by the non-Federal sponsor. The non-Federal sponsor shall provide 35 percent of the implementation costs allocated for this project. The non-Federal share is estimated at $2,326,415 of the total implementation costs. The non-Federal sponsor must also assume other responsibilities before the project can be constructed. These additional responsibilities are as follows:

a. Provide a minimum of 35 percent of total project costs as further specified below:

1. Enter into an agreement which provides, prior to execution of the project cooperation agreement, 25 percent of design costs;

2. Provide, during the first year of construction, any additional funds needed to cover the non-federal share of design costs;

3. Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Federal Government to be necessary for the construction, operation, and maintenance of the project;

4. Provide or pay to the Federal Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

5. Provide, during construction, any additional costs necessary to make its total contribution equal to at least 35 percent of total project costs;

b. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

c. Do not use Federal funds to meet the non-Federal Sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized;

d. Operate, maintain, repair, replace and rehabilitate the project, or functional portion of the project, including mitigation, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

e. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

f. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

g. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

h. Assume, as between the Federal Government and the non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

i. Agree that, as between the Federal Government and the Non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

j. Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstruction or encroachments) which might reduce the level of protection it affords, hinder operation and maintenance, or interfere with its proper function, such as any new developments on project lands or the addition of facilities which would degrade the benefits of the project;

k. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

l. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total costs of construction of the Project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

m. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

n. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army", and all applicable Federal labor standards and requirements, including but not limited to 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act(formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*) ;

o. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a Non-Federal interest to participate in and comply with applicable Federal floodplain management and flood insurance programs, prepare a flood plain

management plan within one year after the date of signing a Project Cooperation Agreement, and implement the plan not later than one year after completion of construction of the project; and,

p. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, necessary for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

5.3 Views of Sponsor and Other Agencies

The South Florida Water Management District supports the project, as noted in the enclosed letter of intent. The City of Clewiston endorses the redesign and relocation of Structure S-169 and provided support to the Corps for this effort. The letter of support is attached to the EA, Appendix F.

In 1995 the City of Clewiston requested the South Florida Water Management District (SFWMD) to look at relocating Structure S-169 west in the Canal C-21 to the other side (just west) of the C-2 Culvert Structure. In 1997 the SFWMD sent the Corps a letter, requesting this study. An Initial Appraisal Report was completed in August of 1999, and the report was approved by the South Atlantic Division in March of 2000.

6.0 SUMMARY OF COORDINATION, PUBLIC VIEW AND COMMENTS

The Environmental Assessment (EA) was distributed to the appropriate Federal, State and local agencies. The EA contains letters and other pertinent correspondence received as a result of coordinating this project. A summary of the comments received and responses to these comments are provided in Section 6 of the EA.

7.0 RECOMMENDATIONS

I recommend that the selected plan described in this GRR for agricultural water supply in the Nine-Mile Canal Basin, Hendry County, Florida be authorized for Federal implementation under Section 103 (c) (3) of the Water Resources Development Act of 1986, as amended. The total estimated cost of the project is $6,646,900. The Federal cost share would be $4,320,485 with the remaining $2,326,415 being provided by the non-Federal sponsor, the South Florida Water Management District.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are approved for implementation.

ROBERT M. CARPENTER
Colonel, Corps of Engineers
Commanding

APPENDIX A

HYDRAULICS AND HYDROLOGY

FOR

S-169
GENERAL REEVALUATION REPORT
HENDRY COUNTY, FLORIDA

S-169/NINE-MILE CANAL BASIN
HENDRY COUNTY, FLORIDA

GENERAL REEVALUATION REPORT

APPENDIX A
HYDROLOGY AND HYDRAULICS

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I. INTRODUCTION

This appendix presents the hydrologic and hydraulic data and analyses used to re-evaluate water supply and flood control for the S-169/Nine-Mile Canal Basin General Reevaluation Report. The hydrologic and hydraulic objective is to enable a dependable conveyance of water to meet agricultural demands along the Industrial Canal when Lake Okeechobee stage is above 15.5 feet, NGVD 29, while ensuring flood protection is maintained. The original plan of improvement for the area is presented in Part 1, Supplement 39--General Design Memorandum, Nine-Mile Canal Area. Supplemental details about the constructed Central and Southern Florida Project are presented in Part 1, Supplement 45--Detailed Design Memorandum, Canal 21 and Control Structure 169 and as-built drawings (D.O. File No. 400-32,198). Topographic and hydrographic data including ground and water-surface elevations that are presented in this appendix are referenced to the North American Horizontal Datum of 1927 (NAD27) Florida State Plane East and the National Geodetic Vertical Datum of 1929 (NGVD29).

II. PROJECT AREA INFORMATION

A. LOCATION

The five sub-basins served by Lock Structure 310 (S-310) and Water-Control Structure 169 (S-169) are located in Glades, Hendry, and Palm Beach Counties, Florida. The sub-basins include the eastern portion of the Nine-Mile Canal Basin and an area in the northwestern portion of the Miami Canal drainage area also known as the Everglades Agricultural Area. The sub-basins border on the south and southwest shore of Lake Okeechobee. See Plate A-1 for vicinity of proposed work.

B. TOPOGRAPHY

Natural ground elevations in the project area range from approximately 13.0 to 20.0 feet. From U.S. Highway 27 to the south end of the Industrial Canal, spoil mound crest elevations on the east and west banks of the Industrial Canal range from approximately 20.0 to 25.0 feet. Along the Industrial Canal between U.S. Highway 27 and its north end, bank elevations range from approximately 16.5 to 22.0 feet. The eastern portion of Canal 21 (C-21) is surrounded by the Herbert Hoover Dike (HHD) on the north and by a spoil berm on the south. Crest elevations along the HHD are approximately 35.0 feet and crest elevations along the southern spoil berm range from 17.0 to 20.0 feet.

C. GEOLOGY AND SOILS

Most of the project area served by S-169 and S-310 is cultivated sugarcane fields. Typically, sugarcane fields are overburdened with muck. Generally, the remaining project area has some overburden of sediments. The sediments consist of loose, silty sand and some loose, silty clayey sand. The area is underlain by sand inter-bedded with lenses and thin beds of clay, silt, peat, and rock of varying hardness. The rock varies from hard limestone and sandstone to poorly cemented shell. See Section III, "HYDROLOGY," paragraph B2 for additional soil description data.

Subsurface investigations consisted of drilling four core borings – two at the proposed water-control structure location and two at the proposed bridge site. Refer to Appendix B for subsurface investigational data and results.

D. MAIN CANALS AND STRUCTURES

The main canals in the project area are C-21 and the Industrial Canal, and primary control structures are S-310, S-169, and Cu-2. C-21 has an east to west alignment and is approximately 2.6 miles long. C-21 extends from the Industrial Canal westward to the junction with Canal 20 (C-20). The Industrial Canal has a north to south alignment and is approximately 6.3 miles long. The north end is located at the junction with the eastern end of C-21. The south end terminates into a railroad berm close to the eastern limits of Levee 1E. S-310 is located just north of the C-21 and the Industrial Canal junction. S-169 is located on the eastern end of C-21 at Station 18+66.38 approximately 1,866 feet west of the junction with the Industrial Canal. Cu-2 was constructed in 1934 as a part of the original HHD. Cu-2 is located west of S-169 at approximately Station 29+28 of the C-21 horizontal control alignment. Facilities along the Industrial Canal that divert water to and/or from the Industrial Canal are culvert structures south of United States Sugar Corporation's (USSC) Southline Station, South Florida Conservancy District's (SFCD) Unit P-5-W, USSC's irrigational pumps, Clewiston Station 3, East Hendry Station, and the J.D. Thornton pump. There are also inline structures along the Industrial Canal that consist of four bridges, a box culvert, and USSC's Southline Station. The inline Southline Station controls flow for culverts to the south. The study area, main canals, facilities, and other structures are shown on Plate A-2.

E. SUB-BASIN DESCRIPTIONS

The sub-basins that divert water from or to the Industrial Canal define the area served by S-310 and S-169. Boundaries and acreage for lands that divert water from or to the Industrial Canal for irrigational and flood control purposes were obtained from permit information. The boundaries were delineated using 1995 digital orthophoto quarter-quadrangle aerial photography. The study area was subdivided into five sub-basins. The five sub-basins are USSC, SFCD, Clewiston, East Hendry, and JD Thornton. USSC and SFCD facilities serve for both water supply and flood control; whereas, Clewiston Station 3, East Hendry, and JD Thornton facilities serve only for flood control. Water-supply boundaries are shown on Plate A-3, and flood-control-drainage areas are shown on Plate A-4.

1. USSC

USSC's irrigational pumps and Southline Station screw-gate culverts serve approximately 8,960 acres or 14.0 square miles west of the Industrial Canal for water supply. USSC's Southline Station discharge pumps serve the same area west of the Industrial Canal for flood control.

2. SFCD

SFCD's Unit P-5-W screw-gate culverts serve approximately 9,775 acres or 15.3 square miles east of the Industrial Canal for water supply. SFCD's Unit P-5-W discharge pumps serve approximately 7040 acres or 11.0 square miles east of the Industrial Canal for flood

control. Unit P-5-W is the only irrigational facility serving the 15.3 square-mile sub-basin. However, there are other flood-control facilities that serve the sub-basin, so it is estimated that Unit P-5-W serves about 70% of the total area or approximately 11.0 square miles for flood control.

3. Clewiston

Clewiston Station 3 in conjunction with Clewiston Station 2 and the C-21 Culvert serves the Clewiston Drainage District. The pump stations and culvert primarily serve as flood-control facilities. The total area served by Clewiston Station 3, Clewiston Station 2, and the C-21 Culvert is approximately 3000 acres or 4.7 square miles. It is estimated that Clewiston Station 3 serves 40% of the total area, which equates to 1200 acres or 1.9 square miles.

4. East Hendry

East Hendry Station pumps serve approximately 1088 acres or 1.7 square miles east of the Industrial Canal for flood control.

5. JD Thornton

The J.D. Thornton pump serves approximately 67 acres or 0.1 square miles east of the Industrial Canal for flood control.

F. LAND USE

Land use in the sub-basins is predominantly agricultural. The main agricultural enterprise in the area is sugarcane. Reference Table A-1 for a breakdown of land use percentages for the sub-basins served by S-310 and S-169. Pasture areas include forested areas, water areas include small ponds and borrow areas, and urban areas include facilities, utilities, and a golf range.

G. AVAILABLE HYDROLOGIC DATA

Rainfall data from South Florida Water Management District's (SFWMD) Technical Publication 390, Rainfall Analysis of Daily Rainfall Maxima for C&SF, dated January 2001, were used for this study. General curve numbers based on the hydrologic soil group and soil group specifications were obtained from the United States Department of Agriculture (USDA) and the Natural Resources Conservation Service (NRCS) formally known as Soil Conservation Service (SCS) engineering handbooks. Soil type, hydrologic soil group, and land use that was used to determine the SCS weighted curve numbers for the sub-basins were obtained from existing soil-survey maps and land-use maps that were developed using metadata from USDA/NRCS and SFWMD.

H. AVAILABLE HYDRAULIC DATA

U.S. Geological Survey (USGS) gaging station 264514080550700 is located at S-310. Currently, the gage is a satellite-data-collection platform with a water-stage shaft encoder and acoustic-doppler-velocity meter. USGS has reported that records for the S-310 gage are

poor. There is also a stilling well located inside of machinery house number two that can be used to take water-stage readings. S-169 is equipped with an upstream and downstream remote digital sensor that records water levels in C-21. S-169 is also equipped with digital sensors that record gate positions. There are no gages along the Industrial Canal with the exception of manually read staff gages.

I. EXISTING OPERATIONS

1. Water Supply

During irrigational operations, the Industrial Canal flows from north to south. When Lake Okeechobee stage is less than or equal to 15.5 feet, S-310 is open and water is drawn from the lake through S-310 and down the Industrial Canal to irrigational facilities. When Lake Okeechobee stage is greater than 15.5 feet, S-310 is closed and operated, so water supply from Lake Okeechobee cannot be provided unless S-310 gates are partially opened. Water supply from S-310 can also be diverted down C-21 through S-169 to irrigational facilities to the west. The three facilities that control water-supply deliveries from the Industrial Canal are SFCD's Unit P-5-W, USSC's irrigational pumps, and USSC's Southline Station.

2. Flood Control

During flood-control operations, the Industrial Canal flows from south to north. When Lake Okeechobee stage is less than or equal to 15.5 feet, S-310 is open and typically discharge from facilities along the Industrial Canal is routed through S-310 to Lake Okeechobee by gravity discharge. However, discharge can also be routed through S-169 to Pump Station 4 (S-4) or Structure 235 (S-235). When Lake Okeechobee stage is above 15.5 feet, gravity discharge through S-310 is not practicable. Discharge from facilities along the Industrial Canal is therefore routed down the Industrial Canal, to C-21, through S-169, and to C-20 and S-4 where it is pumped into the Lake Okeechobee rim canal via S-4. Some Industrial Canal discharge may be conveyed to S-235 to be discharged into the Caloosahatchee River. Hurricane operations also require Industrial Canal discharge to be routed through S-169 to S-4. There are five facilities that discharge into the Industrial Canal – Southline Station, Unit P-5-W, Clewiston Station 3, East Hendry Station, and the J.D. Thornton pump.

III. HYDROLOGY

A. C&SF PROJECT

As stated in Part 1, Supplement 45--Detailed Design Memorandum, S-169 and the eastern end of C-21 was sized to remove three-quarter inch per day runoff from the agricultural areas served plus 165 cubic feet per second (cfs) from the old Clewiston pumping station. The agricultural areas were defined as nine square miles east of the Industrial Canal and fourteen square miles west of the Industrial Canal. When applying the three-quarter inch per day over the nine-square-mile and fourteen-square-mile areas, the equivalent discharge was calculated as 180 and 280 cfs, respectively. The total discharge from areas served by S-169 and the eastern end of C-21 was calculated to equal 625 cfs – the design discharge.

B. RE-EVALUATION

Currently, all significant runoff from areas served is controlled with pumping facilities. Therefore, S-169R was sized to remove the cumulative rated pump capacity of pumping facilities served. The agricultural areas include USSC's 14 square miles, SFCD's 11 square miles, and J.D. Thornton Nursery's 0.1 square miles. The residential areas include Clewiston and East Hendry, 1.9 and 1.7 square miles, respectively. The cumulative rated pump capacity is equivalent to 1054 cfs as shown on Table A-2 – the design discharge for S-169R.

The SCS runoff-curve-number methodology was selected to analyze the rainfall and runoff relationship for the sub-basins served. The SCS method is used to compute abstractions and excess precipitation from storm rainfall. Abstractions include interception, depression storage, and infiltration; whereas, excess precipitation is equivalent to the direct runoff depth. For this report, the SCS method was used to determine the 24-hour precipitation depths and respective event return periods that result in runoff depths equivalent to the pump removal rates.

1. Rainfall

SFWMD Technical Publication 390, Rainfall Analysis of Daily Rainfall Maxima for C&SF, dated January 2001, was used for the analysis. The approximate 24-hour rainfall values for the area just south of Lake Okeechobee are shown on Table A-3.

2. Curve Numbers

Runoff curve numbers were estimated for each sub-basin by considering soil type, hydrologic soil group, land use, and antecedent moisture condition (AMC). Soil group specifications for each hydrologic soil group are shown on Table A-4 and typical curve numbers for differing hydrologic soil groups and land uses are shown on Table A-5. Weighted curve numbers computed for the five sub-basins are shown on Table A-6. The weighted curve numbers computed for each sub-basin were based on the soil type, soil group, land use, and AMC II conditions as shown in Table A-6. Soil type, hydrologic soil group, and land use information was obtained from existing soil survey maps and land use maps.

3. Methodology

Weighted curve numbers were used to determine soil storage values (S) for each sub-basin as shown in the following equation. Then, using the data shown on Table A-7 and setting the runoff depth in the following equation equal to the pump removal rates, the 24-hour precipitation for each sub-basin was determined.

$$Runoff = \frac{(\text{Precipitation} - 0.2 \cdot S)^2}{(\text{Precipitation} + 0.8 \cdot S)}$$

$$Where:$$

$$S = (1000 / CurveNumber) - 10$$

The results are shown in Table A-8. The results show how much precipitation is required to result in runoff depths equal to pump removal rates. Thus, based on the comparison of Table A-3 and Table A-8, the existing local flood-control pumping facilities are capable of removing the runoff volume per day of at least the 10-year, 24-hour event and in most cases more than the 25-year, 24-hour event.

Since local pumping facilities along the Industrial Canal control all significant flood discharge diverted to the Industrial Canal from adjacent lands that will be conveyed through S-169R, the design discharge for S-169R was determined to equal the cumulative rated pump capacity equivalent to 1054 cfs. This will allow for removal of 1.2, 1.3, and 2.6 inches of runoff per day from USSC, SFCD, and J.D. Thornton agricultural areas and 3.3 and 1.1 inches of runoff per day from Clewiston and East Hendry residential areas, respectively.

IV. HYDRAULICS

A. EXISTING CONDITIONS

1. General

a. Hydraulic Model

Hydraulic modeling for existing conditions was accomplished by using the Hydrologic Engineering Center's River Analysis System (HEC-RAS) version 3.0.1. The HEC-RAS software developed by the U.S. Army Corps of Engineers was used to perform one-dimensional, steady-flow analyses.

b. Survey Data

Survey data from three surveys were used for hydraulic analyses. Survey 01-042 was conducted to determine the navigational depths of the Okeechobee Waterway, Cross Lake Channel Route 1, Industrial Canal, and C-21 in February 2001. Most of the survey data were insufficient for hydraulic modeling purposes since the survey was solely hydrographic and conducted during extremely low stages. No side-slope, bank, and over-bank, elevations were obtained. Topographic and hydrographic survey 01-068 performed in May 2001 was required to cover areas to be modeled but not included in survey 01-042. Coverage along the Industrial Canal extends from north of U.S. Highway 27 to approximately 31,000 feet to the south. Cross sections were taken at 1,000-foot increments within the reach. Coverage along C-21 extends from S-169 to approximately 2,532 feet to the west. Cross sections were taken at 200-foot increments within the reach. Topographic and hydrographic survey 02-088 performed in June 2002 was required to cover areas originally covered by survey 01-042 since most of the data from survey 01-042 were insufficient and the area had recently been dredged. Survey 02-088 coverage along the Industrial Canal extends from the north end of the Industrial Canal to the U.S. Highway 27 bridge, and coverage along C-21 extends from the east end of C-21 to S-169. Survey 02-088 includes 27 cross sections. Detailed information about the bridges, culverts, and other structures within survey limits was obtained. Survey data is referenced to NAD 27 and NGVD 29.

c. Roughness Coefficient

A Manning's roughness value of 0.05 was used for over-bank areas with some weeds and medium-dense brush while a value of 0.04 was used for maintained over-bank areas with medium-height grass. A value of 0.03 was used for earthen canal sections while a value of 0.015 and 0.024 was used for concrete canal sections and corrugated metal pipe, respectively. Values were based on photographs, field inspection, technical references, consultation with other engineers, and engineering judgment.

2. Water Supply

a. Operations

Operations of water control structures are dependent on Lake Okeechobee stage. Current operations of structures that are part of the Central and Southern Florida Project for Flood Control and Other Purposes (C&SF) are described in the Water Control Plan for Lake Okeechobee and Everglades Agricultural Area, July 2000, and the Master Water Control Manual, Lake Okeechobee and Everglades Agricultural Area, Volume 3. Additional operational details can be found in SFWMD's Operations Control Center structure books. Irrigational operations for USSC's and SFCD's structures along the Industrial Canal are not well defined since operations depend on meteorological conditions and antecedent events. Flows used for hydraulic modeling were determined by assuming all irrigational facilities operating at maximum capability. With an upstream stage set at optimum stage and facilities downstream operating at maximum capability, the maximum irrigational flows were calculated.

USSC's Southline Station has three 36-inch, irrigational culverts. The culverts were assumed to be full open with a steady tailwater condition of 10.0 feet resulting in a submerged, uncontrolled condition. The culverts were modeled as submerged culverts. USSC also has two 33,000 gallon per minute (gpm) irrigational pumps that were assumed to be operating at rated capacity. SFCD's Unit P-5-W has two 36-inch, irrigational culverts. The culverts were assumed to be full open with a steady tailwater condition below culvert invert. SFCD's culverts were modeled as orifices. Irrigational facilities along the Industrial Canal are listed in Table A-9.

b. Hydraulic Modeling

Several cases were modeled to analyze the existing irrigational demand due to the dependency on Lake Okeechobee stage. One trial was run for Lake Okeechobee stage above 15.5 feet, in which, the maximum upstream stage of 15.2 feet was used. When Lake Okeechobee is above 15.5 feet, S-310 is closed and operated. S-169 is put on automatic operations and maintains its headwater stage at approximately 14.7 to 15.2 feet. Therefore an upstream stage of 15.2 feet was used, and the Industrial Canal from its north end to USSC's Southline Station defined the model reach. Other trials were run for Lake Okeechobee stage less than or equal to 15.5 feet, in which, upstream stages (Lake Okeechobee stage) of 15.5, 14.5, 13.5, and 13.0 feet were used. When Lake Okeechobee is less than or equal to 15.5 feet,

S-310 is scheduled to be open. Therefore, the waterway through S-310 was added to the model reach for the other trials run, and Lake Okeechobee became the northern limit of the model.

c. Starting Conditions

For the subcritical flow regime that exists, a boundary condition was necessary at the downstream end of the model for HEC-RAS to begin calculations. However, for the water-supply models, the upstream stage was the bounding condition; therefore, the following iterative procedure was used to determine the downstream boundary condition and corresponding water-supply demand for irrigation. For the case where Lake Okeechobee stage was greater than 15.5 feet and S-310 was closed, the maximum upstream stage was determined to be 15.2 feet since a stage greater than 15.2 feet would cause S-169 gates to open and make releases down C-21. The downstream boundary condition (known water-surface elevation) at USSC's Southline Station was estimated and culvert flow was calculated accordingly. The stage at SFCD's Unit P-5-W was estimated and culvert flow was calculated accordingly. USSC's two 33,000-gpm pumps were assumed to be withdrawing at rated capacity. The model was run with calculated flows, and the upstream stage and all assumed stages were checked. The procedure was repeated until an upstream stage of 15.2 feet was obtained and all estimated values equaled model results. For the other cases where Lake Okeechobee stage was at 15.5, 14.5, 13.5, and 13.0 feet, the above applied except the maximum upstream stage was Lake Okeechobee stage since S-310 was open.

d. Model Verification

A proper model calibration and verification process was not possible due to the lack and quality of available data. Stage and velocity readings are taken at the upstream end of the water-supply models at S-310 and used to calculate flow records. USGS has reported those records as poor. Stage and gate readings for S-169 are also taken at the upstream end and used to calculate flow records. There is no available data along the Industrial Canal. Sensitivity analyses were performed by modeling a range of flows and roughness values. A sensitivity analysis on Manning's n was performed to evaluate the potential range of results. The analysis was performed for the case where Lake Okeechobee stage was above 15.5 feet and S-310 was cracked to provide water supply. The results for the sensitivity analysis are shown in Figure A-1.

An attempt at model verification was achieved by developing an iterative process to estimate downstream stages using S-310 calculated flow records and using the model to compute upstream stages. Downstream stages were estimated and corresponding culvert flow through irrigational facilities was calculated. That process was repeated until irrigational flows equaled S-310 calculated flow records. The resulting downstream stages for the flow event were modeled and upstream model results were compared to the upstream average-daily stage records. Operational assumptions made were the following: Southline tailwater held constant at 10.0 feet, Unit P-W-5 tailwater held constant below culvert invert, and all irrigational facilities were irrigating at the same time.

For the event of 13 November 1987, a 1.77 percent difference was obtained when comparing the modeled upstream stage to S-310 gage data and a 0.72 percent difference when comparing to the S-169 gage data. For the event of 06 March 1988, a 1.34 percent difference was obtained when comparing the upstream model result to the S-169 gage data. For flows down C-21, the flow event for 23 February 1989 was run and the downstream boundary condition at S-169 headwater was set at the corresponding gage reading. Then, the upstream model result was compared to the S-310 gage reading. A 0.66 percent difference was obtained. The model was not calibrated to the gage data based on the quality of the data, assumptions made, and engineering judgment.

e. Modeling Results

Headwater and tailwater conditions for irrigational facilities and corresponding maximum water-supply deliveries for differing upstream stages are shown in Table A-10. Upstream stages ranging from 15.5 to 13.0 feet resulted in maximum water-supply deliveries ranging from 462 to 190 cfs. Figure A-2 is a graphical representation of upstream stages versus maximum irrigational capability. For the flows modeled, velocities in the Industrial Canal were typically less than 2.5 feet per second (fps). Results show that the highest velocities were located between the railroad bridge and inline box culvert but did not exceed 3.3 fps. Velocities through S-310, when open, ranged from 0.4 to 0.8 fps. However, much higher velocities can result from making water-supply releases through S-310's partially open gates. High velocities through S-310's partially opened gates have caused a scour hole to form and bank erosion problems to occur on the landside of S-310. There was a substantial amount of head loss occurring between the Davidson Road Bridge and the inline box culvert. Bridge piers, contraction and expansion caused by the box culvert, and shallower and narrower canal sections contributed to losses in that reach of the Industrial Canal. See Figure A-3 through Figure A-7 for water-surface profiles.

3. Flood Control

a. Operations

Operations of water control structures are dependent on Lake Okeechobee stage. Current operations of structures that are part of the C&SF Project are described in the Water Control Plan for Lake Okeechobee and Everglades Agricultural Area, July 2000, and the Master Water Control Manual, Lake Okeechobee and Everglades Agricultural Area, Volume 3. Additional operational details can be found in SFWMD's Operations Control Center structure books. Flood Control operations for USSC, SFCD, Clewiston Drainage District, East Hendry County Drainage District, and JD Thornton facilities along the Industrial Canal are not well defined since operations depend on meteorological conditions and antecedent events. For modeling purposes, it was assumed that all pumps along the Industrial Canal were discharging at rated capacity. Rated pump capacities and cumulative discharge for flood control facilities along the Industrial Canal are shown in Table A-2.

b. Hydraulic Modeling

Several cases were modeled to analyze the existing flood-control project due to the dependency on Lake Okeechobee stage and varying operational procedures. For the case when Lake Okeechobee stage was greater than 15.5 feet and for hurricane operations, all flood discharge from the Industrial Canal was routed to C-21 and through S-169. S-169 was modeled with gates fully opened where the downstream boundary condition determined a submerged or unsubmerged condition. The Industrial Canal from USSC's Southline Station to the C-21 junction and C-21 from the Industrial Canal junction to the western survey limit were modeled as one reach. For cases when Lake Okeechobee stage was less than or equal to 15.5 feet, all flood discharge from the Industrial Canal was routed through S-310. The Industrial Canal from USSC's Southline Station to the C-21 junction and the waterway through S-310 were modeled as one reach.

c. Starting Conditions

The western topographic and hydrographic survey limit on C-21 is located approximately 2,532 feet west of S-169. The downstream boundary condition was applied at that location for the flood-control models. Since stages west of S-169 are controlled by facilities to the west, mainly S-4 and S-235, the downstream boundary conditions considered ranged from 10.0 to 14.0 feet.

S-4 is the main flood-control structure for the Nine-Mile Canal Basin and runoff from the Industrial Canal tributary areas. It is operated to maintain headwater stages (C-20) between 10.0 and 14.0 feet. When Lake Okeechobee stage is above 15.5 feet and S-310 is closed, all flood-control discharge has to be routed down C-21 through S-169 to S-4. Stages in C-20 and C-21 west of S-169 typically range from 10.0 to 11.0 feet when the lake is above 15.5 feet according to optimum stages in C-20 and C-21. Optimum stages in C-20 and C-21 were verified with historical data. However, depending on antecedent events, stages could be higher. Therefore, a downstream boundary condition of 14.0 feet was used to evaluate maximum stages east of S-169 in C-21 and the Industrial Canal.

During a storm event, there is a possibility that inflow downstream of S-169 into C-21 and at the confluence of Sugarland Main Canal, C-21, and C-20 and discharge from the rest of the basin that is conveyed to S-4 in conjunction with antecedent storm events could cause the stage at S-4 to be on the high end of the operating range (14.0 feet). For that condition, the backwater effect from S-4 to the survey limit results in a higher stage at the downstream boundary location than that used to evaluate maximum stages east of S-169.

The backwater effect from S-4 to the western survey limit on C-21 was estimated using typical cross sections from as-built drawings and assuming a flow of 1335 cfs in C-21 west of Clewiston Pump Station 2 and a flow of 2535 cfs in C-20 to S-4. There was a minimal effect in C-20 (from S-4 to the C-21 and C-20 junction). However, there was a considerable effect from the C-20 and C-21 junction to the western survey limit on C-21. With a stage of 14.0 feet at S-4, the backwater effect from S-4 to the western survey limit on C-21 resulted in a stage of approximately 15.3 feet. A downstream boundary condition of 15.3 feet

resulted in a tailwater stage at S-169 of approximately 15.5 feet and a headwater stage of approximately 18.0 feet. That worst-case scenario cannot be confirmed without doing a basin-wide study to determine the amount of runoff from other areas of the basin that is conveyed to S-4 and obtaining surveys to model conveyance canals. A basin-wide study that was considered beyond the scope of this study would be necessary to determine if main flood-control facilities in the basin provide adequate flood protection. For hydraulic analyses performed for this study, it was assumed that S-4 would be capable of holding the stage to 14.0 feet or less at the downstream boundary condition location.

For normal operations and Lake Okeechobee stage greater than 15.5 feet, four trials were run with the downstream boundary condition set at 11.0, 12.0, 13.0, and 14.0 feet to determine effects on upstream stage. For hurricane operations, the downstream boundary condition was set at 10.0 feet since S-4 draws down the stage to 10.0 feet when a hurricane alert is declared. For normal operations and Lake Okeechobee stage less than or equal to 15.5 feet, the downstream boundary condition was set at Lake Okeechobee stage since S-310 is open. Three trials were run for a lake stage of 15.5, 14.5, and 13.5 feet.

d. Model Verification

A proper model calibration and verification process was not possible due to the lack and quality of available data. Stage and velocity readings are taken at the downstream end of the flood-control models at S-310 and used to calculate flow records. The USGS has reported those records as poor. Stage and gate readings for S-169 are also taken at the downstream end and used to calculate flow records. There are no gaging stations or high-water mark records for the Industrial Canal. However, a high-water mark on the existing staff gage at Southline Station was obtained during a field inspection on 16 and 17 October 2001. The age of the staff gage and the event that caused the high-water mark on the staff gage are unknown. A sensitivity analysis was performed for the Manning's roughness value to evaluate the potential range of results. The analysis was performed for the case where Lake Okeechobee stage was above 15.5 feet and the downstream boundary condition was set at 11.0 feet. The results for the sensitivity analysis for Manning's *n* are shown in Figure A-8.

An attempt at model verification was performed for two events using S-310 calculated flow records, average-daily stages recorded downstream, and the high-water mark on the upstream staff gage. The distribution of discharge from facilities along the Industrial Canal was the one operational assumption made. For the event of 28 August 1988, a 4.50 percent difference was obtained when comparing the modeled upstream stage to the upstream high-water mark. For the event of 04 November 1987, a 3.52 percent difference was obtained. The model was not calibrated to the high-water mark based on the unknown origin of the high-water mark, assumptions made, and engineering judgment.

e. Modeling Results

For cases where all flood discharge was routed through S-169, modeling results were the following. The current hydraulic design data for S-169 was not consistent with existing-conditions model output due to increased discharge and varying

tailwater conditions. See Table A-11 for a comparison of the current hydraulic design data versus existing-conditions model results. S-169 is designed to operate in a submerged condition with a culvert velocity of 5.3 fps. However, the majority of the time, S-169 operates in an unsubmerged condition resulting in a higher culvert velocity ranging from 9.1 to 11.6 fps. Canal velocities in other locations of the Industrial Canal and C-21 ranged from 0.4 to 3.8 fps. The highest velocities along the Industrial Canal are occurring downstream of the inline box culvert. Results also showed that stages at U.S. Highway 27 ranged from 15.4 to 17.2 feet. Minor problems such as seepage occur when long-term stages in this area approach 16.5 feet. In addition, results showed that from U.S. Highway 27 to USSC's Southline Station, Industrial Canal stages did not overtop the existing spoil mounds on the left and right banks, and upstream stages at Southline Station ranged from 18.4 to 19.2 feet. Head loss was the greatest between the Davidson Road Bridge and the inline box culvert and across S-169. See Figure A-9 through Figure A-13 for water-surface profiles. The C-21 hydraulic-design profile is shown on Plate A-5. Water-surface profile "A" is for the rated pump capacity of 1054 cfs and profile "B" is for the current design discharge of 625 cfs. See Plate A-6 for a plan view of the C-21 water-surface boundary resulting from a flow of 1054 cfs.

For cases where all flood discharge was routed through S-310, modeling results were the following. Velocities in the Industrial Canal ranged from 0.4 to 4.4 fps; whereas, velocities through S-310 ranged from 1.6 to 2.1 fps. Model results showed that stages at U.S. Highway 27 were below the seepage target elevation of 16.5 feet. For the worst case, the downstream boundary condition was set at 15.5 feet and the resulting stage at U.S. Highway 27 was 15.8 feet. Modeling results showed that from U.S. Highway 27 to Southline Station, Industrial Canal stages did not overtop the existing spoil mounds on the left and right banks, and upstream stages at Southline Station did not exceed 18.5 feet. Head loss was the greatest between the Davidson Road Bridge and the inline box culvert. See Figure A-14 through Figure A-16 for water-surface profiles.

B. RECOMMENDED PLAN

1. General

The previously described general information in Section IV, "HYDRAULICS," paragraph A1a through A1c of this appendix, applies for the recommended plan of improvement. Alternative plan 4A is the recommended plan. Alternative 4A proposes to demolish S-169, abandon its control house, and construct an access bridge in its place. A new, telemetry-controlled, water-control structure (S-169R) similar to S-169 would be constructed west of Culvert 2 (Cu-2). The south bank spoil berm between S-169 and S-169R would be improved for flood protection and a tieback from S-169R to the HHD would be required to prevent flanking. The plan of improvement would also require converting the five flap gates and upgrading the one slide gate on Cu-2 to six telemetry-controlled slide gates. Construction of control houses with generators at Cu-2 and S-169R would also be required. Alternative 4A is shown on Plate A-7 and Plate A-8.

2. Water Supply

a. Operations

Operations for S-310 would not change with the exception of not having to be partially opened to provide water supply when Lake Okeechobee stage is above 15.5 feet. S-169R would operate similarly to S-169. During irrigational operations, Cu-2 would be operated to maintain a stage in C-21 east of S-169R that would range from approximately 14.6 to 15.2 feet when Lake Okeechobee stage is above 15.5 feet. Optimum stages along the C-21 alignment from S-169 to S-169R would increase from the existing range of 10.0 to 14.0 feet to 10.0 to 15.5 feet. Additional operational details proposed for S-310, Cu-2, and S-169R are described in the Draft Water Control Plan. Irrigational operations for USSC and SFCD facilities along the Industrial Canal were assumed as described in Section IV, "HYDRAULICS," paragraph A2a of this appendix.

b. Hydraulic Modeling

The case for Lake Okeechobee stage above 15.5 feet was modeled to analyze the maximum irrigational capability for facilities along the Industrial Canal. Other cases where Lake Okeechobee stage was less than or equal to 15.5 feet and S-310 was opened, existing-conditions results apply. The model was divided into three reaches. The Industrial Canal from the C-21 junction to USSC's Southline Station, C-21 from the Industrial Canal junction to Cu-2, and C-21 from Cu-2 to the western survey limit defined the three reaches.

c. Starting Conditions

A maximum upstream stage of 15.2 feet was used. A stage above 15.2 feet would cause Cu-2 to close and prevent water-supply deliveries until the stage dropped to 14.6 feet. Starting conditions described in Section IV, "HYDRAULICS," paragraph A2c of this appendix for the case where Lake Okeechobee stage was greater than 15.5 apply with the exception that S-169R gates would not open and make releases to the west down C-21 until S-169R headwater stage reaches 15.5 feet.

d. Modeling Results

Headwater and tailwater conditions for irrigational facilities and corresponding maximum water-supply deliveries for differing upstream stages are shown in Table A-12. The only case that differed from existing conditions was the case where Lake Okeechobee was above 15.5 feet, S-310 was closed, and the upstream stage was set at 15.2 feet. Figure A-17 is a graphical representation of upstream stages versus maximum irrigational capability. For the flows modeled, velocities in the Industrial Canal did not exceed 3.3 fps with the highest velocities located between the railroad bridge and inline box culvert. There was a substantial amount of head loss occurring between the Davidson Road Bridge and the inline box culvert. Bridge piers, contraction and expansion caused by the box culvert, and shallower and narrower canal sections contributed to losses in that reach of the Industrial Canal. Velocities in

C-21 east of Cu-2 did not exceed 1.2 fps. Figure A-18 shows the water-surface profile for irrigational flow routed from Cu-2 to Southline Station.

3. Flood Control

a. Operations

Operations of S-310 would not change. S-169R would operate similarly to S-169's current operations. Cu-2 could be used as a supplementary flood-control structure to convey runoff when gravity discharge to Lake Okeechobee is practicable. Additional operational details for S-310, Cu-2, and S-169R are described in the Draft Water Control Plan. Flood-control operations for USSC, SFCD, Clewiston Drainage District, East Hendry County Drainage District, and JD Thornton facilities along the Industrial Canal were assumed as described in Section IV, "HYDRAULICS," paragraph A3a of this appendix.

b. Hydraulic Modeling

For the case when Lake Okeechobee stage was greater than 15.5 feet and for hurricane operations, all flood discharge from the Industrial Canal was routed to C-21 and through S-169R to be pumped into Lake Okeechobee via S-4 or to be discharged into the Caloosahatchee River via S-235. S-169R was modeled with gates fully opened. The Industrial Canal from USSC's Southline Station to the C-21 junction and C-21 from the Industrial Canal junction to the western survey limit was modeled as one reach. For other cases when Lake Okeechobee stage was less than or equal to 15.5 feet and flood discharge could be routed through S-310 to Lake Okeechobee, existing-conditions results apply.

c. Starting Conditions

The western topographic and hydrographic survey limit on C-21 is located approximately 766 feet west of S-169R. The downstream boundary condition was applied at that location for the flood-control models. Since stages west of S-169R would be controlled by facilities to the west, mainly S-4 and S-235, the downstream boundary conditions considered ranged from 10.0 to 14.0 feet.

S-4 is the main flood-control structure for the Nine-Mile Canal Basin and runoff from the Industrial Canal tributary areas. It is operated to maintain headwater stages (C-20) between 10.0 and 14.0 feet. When Lake Okeechobee stage is above 15.5 feet and S-310 is closed, all flood-control discharge would be routed down C-21 through S-169R to S-4. Stages in C-20 and C-21 west of S-169R typically range from 10.0 to 11.0 feet when the lake is above 15.5 feet according to current optimum stages in C-20 and C-21 that were verified with historical data. However, depending on antecedent events, stages could be higher. Therefore, a downstream boundary condition of 14.0 feet was used to evaluate maximum stages east of S-169R in C-21 and the Industrial Canal.

During a storm event, there is a possibility that inflow downstream of S-169R into C-21 and at the confluence of Sugarland Main Canal, C-21, and C-20 and

discharge from the rest of the basin that is conveyed to S-4 in conjunction with antecedent storm events could cause the stage at S-4 to be on the high end of the operating range (14.0 feet). For that condition, the backwater effect from S-4 to the survey limit results in a higher stage at the downstream boundary location than that used to evaluate maximum stages east of S-169.

The backwater effect from S-4 to the western survey limit on C-21 was estimated using typical cross sections from as-built drawings and assuming a flow of 1335 cfs in C-21 west of Clewiston Pump Station 2 and a flow of 2535 cfs in C-20 to S-4. There was a minimal effect in C-20 (from S-4 to the C-21 and C-20 junction). However, there was a considerable effect from the C-20 and C-21 junction to the western survey limit on C-21. With a stage of 14.0 feet at S-4, the backwater effect from S-4 to the western survey limit on C-21 resulted in a stage of approximately 15.3 feet. A downstream boundary condition of 15.3 feet resulted in a tailwater stage at S-169R of approximately 15.3 feet and a headwater stage of approximately 16.7 feet. The stage at the new bridge location would be approximately 16.8 feet, which is about 1.2 feet less than S-169's existing conditions headwater stage of 18.0 feet. That is the worst-case scenario that cannot be confirmed without doing a basin-wide study to determine the amount of runoff from other areas of the basin that is conveyed to S-4 and obtaining surveys to model conveyance canals. A basin-wide study that was considered beyond the scope of this study would be necessary to determine if main flood-control facilities in the basin provide adequate flood protection. For hydraulic analyses performed for this study, it was assumed that S-4 would be capable of holding the stage to 14.0 feet or less at the downstream boundary condition location.

For normal operations and Lake Okeechobee stage greater than 15.5 feet, trials were run with a downstream boundary condition of 11.0, 12.0, 13.0, and 14.0 feet. For hurricane operations, the downstream boundary condition was set at 10.0 feet since S-4 draws down the stage to 10.0 feet when a hurricane alert is declared. For normal operations and Lake Okeechobee stage less than or equal to 15.5 feet, existing conditions apply.

d. Modeling Results

For cases where all flood discharge was routed through S-169R, modeling results were the following. S-169R was designed to operate as a submerged, gated culvert. The design flow of 1054 cfs resulted in a maximum culvert velocity of 6.85 fps and a design head of 1.4 feet with gates full open. Canal velocities in other locations in the Industrial Canal and C-21 ranged from 0.4 to 4.6 fps. Results also showed that stages at U.S. Highway 27 ranged from 14.5 to 16.2 feet, which was about a foot lower than existing conditions and below the stage that causes minor seepage problems. See Table A-13 for S-169R hydraulic data. The comparison of Table A-11 and Table A-13 shows the difference between the original design, existing conditions, and alternative 4A hydraulic data for differing downstream boundary conditions. In addition, results showed that from U.S. Highway 27 to USSC's Southline Station, Industrial Canal stages did not overtop the existing spoil mounds on the left and right banks, and upstream stages at Southline Station ranged from 18.1 to 18.7. Head loss was the greatest between the Davidson Road Bridge and the inline box culvert and across S-169R. See Figure A-19 through Figure A-23 for water-surface profiles. The C-21 hydraulic-design profile for alternative 4A is shown on Plate A-9. See Plate A-10 for a plan view of the C-21 water-surface

boundary for alternative 4A. For cases where all flood discharge was routed through S-310, existing-conditions results apply.

V. HYDRAULIC DESIGNS

A. HYDRAULIC DESIGN CRITERIA

The hydraulic design criteria and procedures used herein are in accordance with standard engineering practice and applicable Corps of Engineers manuals, regulations and criteria relative to design and construction for civil works projects. Engineering criteria adopted to meet special local conditions are in accordance with that previously approved for similar projects.

B. DESIGN OBJECTIVE

The objective for this study is to provide a dependable conveyance of water to irrigational facilities along the Industrial Canal when Lake Okeechobee stage is above 15.5 feet while maintaining the existing level of flood protection. With alternative plan 4A being the recommended plan, it is proposed to construct a water-control structure west of Cu-2, convert five flap gates and upgrade one slide gate on Cu-2 to six telemetry-controlled, vertical slide gates, and replace S-169 with a bridge. Alternative 4A would allow water from Lake Okeechobee to be routed through Cu-2, to C-21, and down the Industrial Canal to irrigational facilities when Lake Okeechobee stage is above 15.5 feet. This would alleviate the need to partially open S-310 for water supply, which causes safety features to be overridden and streambank and erosion problems. S-169R would serve the same purpose as S-169. It would pass flood runoff from the Industrial Canal tributary area to S-4 and S-235 when gravity discharge via S-310 is not practicable and maintain optimum water levels east of the structure in C-21 and the Industrial Canal. S-169R would also provide supplemental water supply and flood control for facilities to the west that are currently served by Cu-2. Removing S-169 would be necessary to maintain acceptable water levels east of the proposed water-control structure in C-21 and the Industrial Canal during flood-control operations. Replacing S-169 with a bridge would maintain access to the HHD – thus access to S-310, Cu-2, S-4, the Clewiston recreational area, and S-169R.

C. PROJECT FEATURES

1. Access Bridge

An access bridge would be constructed to replace S-169. Since access to the HHD during construction would be required, it is proposed to construct the new bridge just to the west of S-169 so S-169 can be used for access during construction of the bridge. This would prevent having to build a temporary access bridge, but would require realignment of the access road at the bridge approach and exit. The bridge would be located at approximately Station 19+16 of the C-21 alignment. The bridge open area should be greater than or equal to 670 square feet to allow for adequate conveyance. The bridge should be vertically positioned such that pressure flow does not occur during water-supply and flood-control operations. Minimum

low cord of bridge arch along the canal width is recommended to be greater than or equal to 18.0 feet since stages at the new bridge location during flood-control operations could be as high as 16.8 feet.

2. New Water-Control Structure (S-169R)

S-169R would be constructed at about Station 36+32 on the C-21 alignment–approximately 1,766 feet west of S-169 and approximately 704 feet west of Cu-2. S-169R would be similar to S-169. It however would not require an improved access road across it as S-169 does, but would require an additional seven-foot barrel. It would be a four-barrel, seven-foot-diameter, corrugated-metal-pipe culvert structure with a reinforced concrete headwall on both the upstream and downstream side. The barrel length would be 60 feet, and the culverts would be gated on the upstream side. S-169R's protection elevation of 20.0 feet would be the same as the protection elevation of the existing S-169. The structure would be provided with telemetry-controlled, vertical slide gates that would withstand the maximum differential head. Riprap would be provided upstream and downstream of the structure to protect against erosion. A safety barrier would be provided upstream and downstream of the structure to insure safety to boaters. Remote digital sensors would be installed to record water levels in C-21 upstream and downstream of the structure, and sensors would be installed to record gate openings. The structure would require a control house and backup generator. See Table A-14 for hydraulic design data, Figure A-24 for discharge rating curve, and the Draft Water Control Plan for proposed operations.

S-169R would be a two-way structure similar to S-169. S-169R's primary function would be to maintain higher stages on the Industrial Canal side (east side) and convey storm runoff from the Industrial Canal tributary area from east to west. There are however conditions that may cause a reverse differential head and therefore flow from west to east in C-21.

First, when Lake Okeechobee stage is below 13.0 feet, all structures in the HHD that connect the basin to the lake are full open. S-169 is also full open. Therefore, stages in the Industrial Canal, C-21, and C-20 will be at lake stage. Flow to and from the lake and through S-169 is dependent on local water-supply or flood-control operations – flow can be in either direction. The same will apply for S-169R.

Second, when Lake Okeechobee is between 13.0 and 14.0 feet, storm runoff from the basin is typically gravity discharged to the lake via S-310, Cu-2, and possibly Culvert 1, and Culvert 1A. Some runoff will be conveyed to S-235 and discharged into the Caloosahatchee River. S-4 could be used to supplement flood-control operations if necessary. With S-169R located west of Cu-2, runoff that is currently conveyed to the lake through Cu-2 would have to pass through S-169R from west to east to Cu-2. The reverse differential head could be about one foot equating to about 880 cfs. For example, if the lake is around 13.0 feet and a significant rainfall event occurs, it is possible for stages west of S-169R to reach 14.0 feet if conveyance of runoff through Culvert 1, Culvert 1A, and S-235 is not adequate. S-4 could be put into operations to control stages in canals west of S-169R when stages reach 14.0 feet. Stages on the east side of S-169R would be closer to the lake stage of 13.0 feet. Therefore, the reverse differential head would be

around one foot. S-169R's gates would have to be designed to withstand the reverse differential head or would have to be full open to prevent gate failure due to the reverse differential head.

Currently, discharge of runoff through Cu-2 to the lake from areas west of Cu-2 is only practicable for the two above scenarios. Optimum stages on the C-21 side of Cu-2 range from 10.0 to 14.0 feet. Stages above 14.0 feet can be controlled by S-4. Alternative 4A proposes the same hydraulic connectivity for Cu-2 flood-control operations for the two scenarios that require conveyance of runoff through Cu-2 with the exception that runoff would have to pass through S-169R. A basin-wide study would be required to determine effects of runoff from areas outside of the study area for all possible scenarios.

3. Demolition of Structure 169

Demolition of S-169 would be required to maintain acceptable water levels east of the proposed water-control structure in C-21 and the Industrial Canal during flood-control operations. The S-169 control house would be abandoned. Any parts, equipment, and materials that are salvageable could be used for the new construction to assist with cost savings. It is recommended that the existing boat safety barrier and any existing warning signs and devices on the upstream side of S-169 remain. That would maintain the existing navigable waterway and prevent boats from navigating west of the barrier due to water-supply and flood-control operations.

4. Culvert 2

Cu-2 was constructed in 1934 as a part of the original HHD. The structure was designed to provide conveyance of runoff to Lake Okeechobee from the surrounding area and to permit irrigational withdrawals from Lake Okeechobee. Cu-2 is a six-barrel, ten-foot-diameter, corrugated-metal-pipe structure equipped with five flap gates and one manually operated slide gate. Conveyance of runoff to Lake Okeechobee via Cu-2 has become minimal due to improvements made in the area, optimum stages in C-21, and higher Lake Okeechobee stages. S-4 and S-235 are currently the primary flood-control structures for the Cu-2 service area.

Modifications to Cu-2 would be necessary. It is proposed to convert the five flap gates and one slide gate on Cu-2 to six telemetry-controlled, vertical slide gates. This would allow adequate conveyance for irrigation to Industrial Canal facilities and to facilities to the west of S-169R. Remote digital sensors on the north and south side of Cu-2 and telemetry-controlled gates would be required so that Cu-2 could be operated in conjunction with irrigational facilities along the Industrial Canal and S-169R. Telemetry-controlled gates would allow remote operation to maintain optimum stages in C-21. Construction of a control house with generator would also be required. See Figure A-25 for the water-supply rating curve and the Draft Water Control Plan for proposed operations.

It is recommended to convert all six gates on Cu-2 to telemetry-controlled, vertical slide gates and to limit flow to 1000 cfs during irrigational operations. Use of all six barrels during water supply or flood control operations would minimize the exit velocity.

Additional riprap protection on landside of Cu-2 and streambank protection for landside bank opposite of Cu-2 may be necessary. Monitoring is recommended and post project corrective action could be performed if necessary.

5. Levees

Modeling results for alternative 4A showed that during the design event of 1054 cfs, all flow in C-21 and the Industrial Canal remains in bank except along the north bank of C-21. Flow over C-21 north bank would however be controlled by the HHD since it is immediately adjacent to the north bank of C-21 in that vicinity. There is concern about flanking of S-169R, and there are a few other locations where freeboard was minimal. Alternative 4A would cause higher stages in C-21 between the existing S-169 and the proposed location of S-169R. The distance along C-21 is approximately from station 18+66.38 to station 36+32. Currently, stages in C-21 at that location typically range from 10.0 to 14.0 feet. For alternative 4A, optimum water supply stages would be as high as 15.5 feet. During flood-control operations, stages could get as high as 16.8 feet depending on antecedent events, runoff from the remaining areas of the basin, and ultimately S-4 headwater stage. A tieback levee to prevent flanking, improvements to C-21 south bank, and a low spot on the Industrial Canal east spoil mound will be discussed.

a. Tieback Levee

Elevations for top of north bank between C-21 station 18+66.38 and station 36+32 vary from 13.0 to 17.0 feet. The proposed higher stages of 15.5 to 16.8 feet in that area would cause water to spill over the north bank of C-21 onto the toe of the HHD. There is a possibility that S-169R could be flanked on the north side. Water could spill out of bank and flow between S-169R and the HHD. To prevent flanking of S-169R on the north side, a tieback levee from S-169R to the HHD is recommended. The tieback levee would extend perpendicularly from S-169R and tie into the HHD at S-169R's protection elevation of 20.0 feet. The levee would have a crown width of 15 feet and 1 on 3 side slopes.

b. Canal 21 South Bank Spoil Berm Improvements

The south bank between C-21 station 18+66.38 and station 36+32 is a spoil berm with a dirt access road on the crown. Crown elevations along the access road range from 17.0 to 20.0 feet. An optimum stage of 15.5 feet would result in about 1.5 to 4.5 feet of freeboard. During flood-control operations where stages could get as high as 16.8 feet, freeboard would range from 0.2 to 3.2 feet. It is therefore recommended to improve the south bank spoil berm from S-169R to the existing high ground at S-169 to the protection elevation of S-169R (20.0 feet). Improvements would provide the existing flood protection for the City of Clewiston. The existing side slope on the C-21 south bank would remain as is and side slopes for the new construction would be 1 on 3. The crown width would be 15.0 feet.

c. Industrial Canal East Spoil Mound

There is a low spot on the east spoil mound along the Industrial Canal located between the existing inline box culvert and SFCD's Pumping Unit P-5-W. The low area along the Industrial Canal eastern spoil mound was visited during the site visit of 2003. There is a possibility that minor overtopping would occur at this area during the design event of 1054 cfs. Modeling results show that there was very little freeboard at that location during the design event.

VI. OTHER ALTERNATIVES CONSIDERED

Five alternatives were considered during the hydraulic analysis including the recommended plan (alternative 4A). Other alternatives were discussed earlier in the study but were dismissed. Alternatives, other than the recommended plan, that were analyzed during the hydraulic study and a brief description of other alternatives considered will be discussed.

A. ALTERNATIVE 1 – No Action/Existing Conditions

This alternative is not recommended since existing problems caused by current operations of S-310 will not be addressed. These problems include agricultural productivity, fish kills, damage to watercraft, structural damage to marinas, scouring downstream of S-310 riprap, bank erosion, and unsafe operations. Unsafe operations have been defined as not safe for approaching vessels, and mechanical/electrical safety features of the lock have to be overridden during water supply operations when the lake is above 15.5 feet.

B. ALTERNATIVE 2 – Operational Change to S-310 Lock

This alternative is not recommended since it requires the same water-supply operations as existing conditions. Cracking the lock to provide water supply and associated operations can lead to problems stated for alternative 1. In addition, it was determined that S-310 will no longer be operated to provide water supply when the lake is above 15.5 feet. Therefore, alternative 2 cannot be selected since it requires the current operations that are trying to be avoided (operating S-310 to provide water supply when the lake is above 15.5). It is assumed that S-310 is not authorized for this type of operation.

C. ALTERNATIVE 3 – Construct a Pump Station

For alternative 3, flow from Lake Okeechobee through Cu-2 into C-21 would be able to go to the west or east. The proposed pump station would have to draw water from Cu-2 to the east, but flow normally flows in the opposite direction. Stages west of Cu-2 may be adversely affected since there will be no control for flow going to the west from Cu-2.

There are additional issues and negative support for alternative 3. The Fish and Wildlife Service does not support alternative 3. See the Fish and Wildlife Coordination Act Report for details. Additionally, alternative 3 does not consider improving flood control. Alternative 3 proposes to maintain the current level of flood control provided by S-169 since the

existing structure will remain as is. Although that is consistent with the scope of the project, resulting stages on the headwater side of S-169 were too high. Stages should be maintained below 16.5 north of U.S Highway 27 according to SFWMD and Clewiston City engineers. High culvert velocities through the existing S-169 are also a concern. Alternative 3 is not recommended due to the above concerns.

D. ALTERNATIVE 4B – Relocate S-169 (Modify Existing S-169)

Although this alternative considers adding an additional seven-foot barrel to the existing S-169 and constructing a new, water-control structure with four seven-foot barrels, stages on the headwater side of S-169 were too high. Stages exceed the target of 16.5 feet at U.S. Highway 27. This alternative is not recommended since modeling results showed that stages during flood control operations were too high.

E. OTHER ALTERNATIVES

Other alternatives were discussed early in the study, but all were dismissed. The other alternatives discussed involved boring culverts through the HHD, installing culverts in the HHD and constructing a small irrigational conveyance canal to the Industrial Canal, pumping over the HHD, and installation of a minimum flow structure at S-310. None of those alternatives are recommended since the existing Cu-2 structure in the HHD and existing canals can be used for that purpose and are authorized for water-supply and flood-control purposes.

VII. RECOMMENDATION

It is recommended that alternative 4A be implemented to alleviate the water-supply and flood-control problems for sub-basins served by S-169 and S-310. However, a basin-wide study is recommended to determine if other main flood-control facilities in the basin provide adequate flood protection.

S-169/NINE-MILE CANAL BASIN
HENDRY COUNTY, FLORIDA

DRAFT GENERAL REEVALUATION REPORT

DRAFT WATER CONTROL PLAN

I. GENERAL OBJECTIVES

This draft water control plan describes the proposed operating criteria for structures located within the S-169/Nine-Mile Canal Basin project area. All elevations referenced in this plan are from the 1929 National Geodetic Vertical Datum (NGVD) unless otherwise stated.

The Flood Control Act of 1948 (PL 80-858) authorized most of the works necessary to afford flood protection to the agricultural development south of Lake Okeechobee. The Flood Control Act of 1954 (PL 83-780) specifically recognized that the Comprehensive Plan of improvement would require refinement and that modifications, within the scope and purpose of the authorization, could be made at the discretion of the Chief of Engineers. The Flood Control Act of 1958 modified and extended the Comprehensive Plan to include improvements on the west side of the Everglades agricultural area in Hendry County. The Flood Control Act of 1968 (PL 90-483) authorized the modification of Hurricane Gate Structure No. 2 (HGS-2) to Navigation Lock Structure 310 (S-310).

The General Reevaluation Report (GRR) was initiated to re-evaluate the S-169/Nine-Mile Canal Basin project area due to water supply constraints, the potential for further damage to vessels, S-310 safety issues, and an increase in surface water discharge through S-169. HGS-2 was converted to a navigational lock, S-310, in 1980 to provide for raising Lake Okeechobee's regulation schedule to the 15.5 – 17.5 feet range. S-310 enables lake stages to be operated independently of canal stages with navigation continuing without interruption. When the lake is below 15.5 feet, S-310 can remain completely open, and a lake-level pool maintained in the Industrial Canal for local irrigation. However, when the lake is above 15.5 feet, S-310 operations must be initiated and water supply from the lake to the Industrial Canal is effectively cut off. In 1983, the lake was above 15.5 feet and S-310 was closed. Industrial Canal stages were adversely impacted by local irrigation withdrawals and dropped so low as to ground boats in the Clewiston Marina – additional grounding incidents have occurred since 1983. Currently, the only remedy that helps accommodate water supply for the Industrial Canal is to partially open the lock. This type of operation represents an unorthodox use of the lock and requires safety features to be overridden. This type of operations is also unsafe for approaching vessels and causes downstream erosion problems. The current capacity of surface water connections (1054 cfs) that convey runoff from the Industrial Canal tributary area to Canal 21 (C-21) and through S-169 exceeds the design capacity (625 cfs) of S-169 and the eastern portion of C-21. The above operational issues prompted a letter from the South Florida Water Management District (SFWMD) to the U.S. Army Corps of Engineers (Corps) on 31 March 1997 requesting assistance to resolve the problems. The initial appraisal was submitted under the Operations and Maintenance (O&M) Authority, and the study was conducted through a partnership between the non-Federal sponsor, the SFWMD, and the Corps.

Certain aspects of the Central and Southern Florida (C&SF) Project, Part 1, Supplement 39, General Design Memorandum, were not constructed. Authorized structures, Structure 170 (S-170) and Structure 47 (S-47), were never built. S-169 and C-21 were to be built in different locations. Furthermore, only part of Canal 20 (C-20) was constructed. Proposed improvements to convert the Nine-Mile Canal to flood control canal, C-20, to convey runoff to Lake Hicpochee were not constructed. To avoid confusion when referencing historical documents, the relocated

S-169 structure will be renamed S-169R. Instructions for the operation of S-169 in other documents will be replaced by the instructions contained in this document for S-169R. The final water control plan will be incorporated into the "Master Water Control Manual for Lake Okeechobee and Everglades Agricultural Area."

Structure S-169R will pass flood runoff from the Industrial Canal tributary area via C-21 to Pump Station 4 (S-4) when gravity discharge to the lake is not practicable. It will also maintain optimum water levels and prevent over drainage of the area and permit discharge from Lake Okeechobee via C-21 and C-20 to meet agricultural requirements in the S-4 Basin. S-169R will work in conjunction with other structures in the basin and specifically with Culvert 2 (Cu-2) in Levee Division 1 (LD-1) for water supply. Cu-2 is designed to provide conveyance of runoff to the lake from the surrounding area and to permit irrigation withdrawals from the lake.

II. CONSTRAINTS

A. Lake Okeechobee

The operations of S-169R and structures operated in conjunction will be very dependent on lake elevation. Any temporary deviation or authorized revision to the Lake Okeechobee regulation schedule would have to consider potential impacts to structure operations.

B. S-169R Maximum Discharge

S-169R discharge must not exceed the design discharge of 1054 cfs.

C. Cu-2 Maximum Discharge

The discharge of water from the lake through Cu-2 must not exceed 1000 cfs.

D. Manatee Operations

If a manatee is in the vicinity of gates during an initial gate adjustment, then operations will be suspended until the manatee leaves the area.

III. STANDING INSTRUCTIONS TO OPERATOR

S-169R discharge should be controlled with partial gate openings when the differential head exceeds 1.4 feet to limit flow to the design discharge of 1054 cfs. Cu-2 discharge should be controlled with partial gate openings to limit flow discharging from the lake through Cu-2 to 1000 cfs. Expected flows across the structures should be checked against the discharge rating curves. Simultaneous operation of all gates on S-169R and/or CU-2 during flood control and water supply operations will minimize the water exit velocity at the culvert outfall areas. In addition, when the lake is between 13.0 and 14.0 feet, there is a possibility that the C-21 stage west of S-169R could exceed the C-21 stage east of S-169R. If this occurs, S-169R gates should be open full to prevent damage to the gates due to the reverse differential head.

IV. OVERALL PLAN FOR WATER CONTROL

S-169R will operate in conjunction with S-310, S-4, LD-1 culverts, and Structure 235 (S-235) to maintain optimum canal stages in the Industrial Canal, C-21, and, C-20 and to control water levels in the S-4 basin according to Table 1.

Table 1 General Operating Plan

Lake Okeechobee Stage	Gate Status					Normal Range S-4 HW
		LD-1 Culverts				
	S-310	Cu-2	Cu-1/1A	S-169R	S-235	
Over 15.5	Closed	Auto [1]	Closed	Auto	Full Open	11-14
13-15.5	Full Open	Full Open	Closed	Closed	Full Open	11-14
Below 13	Full Open	Full Open	Full Open	Full Open	Closed	Below 13

[1] Automatic operation for water supply and closed for flood control operations. Cu-2 will be taken off of automatic operations and remain closed during flood control operations when the lake is above 15.5 feet

V. FLOOD CONTROL OPERATIONS

A. Lake Stage Less Than 13.0 Feet

S-310, LD-1 culverts, and S-169R will be full open; S-235 will be closed. S-310 and LD-1 culverts will provide conveyance of runoff from the basin. S-310 and Cu-2 can provide conveyance of runoff from the Industrial Canal and east of S-169R. Culvert 1 (Cu-1) and Culvert 1A (Cu-1A) can provide conveyance of runoff from west of S-169R. S-169R could also provide conveyance of runoff from the west to the lake via Cu-2 or S-310 when stages permit. S-235 and S-4 could be used to supplement conveyance of runoff from the basin.

B. Lake Stage From 13.0 to 15.5 Feet

S-310, Cu-2, and S-235 will be full open; S-169R, Cu-1, and Cu-1A will be closed. S-310, Cu-2, and S-235 will provide conveyance of runoff from the basin. S-310 and Cu-2 can provide conveyance of runoff from the Industrial Canal and east of S-169R. S-235 will be used to provide conveyance of runoff from west of S-169R. Cu-1, Cu-1A, and S-169R in conjunction with Cu-2, S-310, S-4, and S-235 could be used to supplement conveyance of runoff from the basin when stages permit. S-4 could be used to supplement conveyance of runoff from the basin.

C. Lake Stage Greater Than 15.5 Feet

S-235 will be full open and S-169R will be on automatic; S-310 and LD-1 culverts will be closed. S-235 and S-4 in conjunction with S-169R will provide conveyance of runoff from the basin. Automatic operations for S-169R are as shown in Table 2 and described as follows:

When the headwater elevation rises to 15.5 feet, the gates will begin to open.
When the headwater elevation rises or falls to 15.2 feet, the gates will become stationary.
When the headwater elevation falls to 14.9 feet, the gates will begin to close.

However, S-169R could be taken off of automatic and operated as needed if necessary. Cu-2 and S-310 will be closed; however, they could be used to supplement conveyance of runoff from the basin when stages permit.

Table 2 S-169R Automatic Operation Plan (Flood Control and Water Supply)

S-169R Headwater/East Side (Feet)	S-169R Gate Operations
$\geq$ 15.5	Opens
= 15.2	Stationary
$\leq$ 14.9	Closes

VI. HURRICANE OPERATIONS

When a hurricane alert is proclaimed, S-235, S-310, and L-D1 culverts will be fully closed and pumping initiated at S-4. In advance of the storm, the S-4 headwater stage shall be initially brought down to and maintained at elevation 10.0 feet. In advance of the storm, S-169R should be fully opened without exceeding the design discharge of 1054 cfs per the S-169R rating curve. The intent is to bring the east side of S-169R down to an elevation of 10.0 feet and then allow the canal to fluctuate with pumping operations until storm operations are complete. Gate operations may be made using remote telemetry; however, SFWMD should maintain operations within the S-169R design parameters not to exceed a maximum of 1054 cfs per the rating curve.

VII. WATER SUPPLY OPERATIONS

A. Lake Stage Less Than 13.0 Feet

S-310, LD-1 culverts, and S-169R will be full open; S-235 will be closed. S-310 and LD-1 culverts will provide irrigational water supply for the basin – S-310, Cu-1, Cu-1A, and Cu-2 will convey flow from the lake to the basin. The direction of flow through an open S-169R will depend on local irrigational operations.

B. Lake Stage From 13.0 to 15.5 Feet

S-310, Cu-2, and S-235 will be full open; S-169R, Cu-1, and Cu-1A will be closed. S-310, Cu-2, and S-235 will provide irrigational water supply for the basin. S-310 and Cu-2 will convey water supply to the east of S-169R. S-235 will convey water supply for areas west of S-169R. S-169R could be operated to provide supplemental water supply to areas west of S-169R. For that condition, conveyance would come from the lake via S-310 and Cu-2 and routed to the west via S-169R. S-235 could remain open or could be closed to raise the stage between S-169R and S-235, and Cu-1 could be operated to provide supplemental water supply when stages permit. Cu-1A can also be operated to supplement water supply for areas west of S-169R.

C. Lake Stage Greater Than 15.5 Feet

S-235 will be full open and S-169R and Cu-2 will be on automatic; S-310, Cu-1, and Cu-1A will be closed. Cu-2 and S-235 will provide irrigational water supply for the basin. Cu-2 will convey water supply to the east of S-169R. S-235 will convey water supply for areas west of S-169R. Automatic operations for S-169R and Cu-2 are as shown in Table 2 and Table 3 and described as follows, respectively:

When the headwater elevation rises to 15.5 feet, the gates will begin to open.
When the headwater elevation rises or falls to 15.2 feet, the gates will become stationary.
When the headwater elevation falls to 14.9 feet, the gates will begin to close.

When the tailwater elevation rises to 15.2 feet, the gates will begin to close.
When the tailwater elevation rises or falls to 14.9 feet, the gates will become stationary.
When the tailwater elevation falls to 14.6 feet, the gates will begin to open.

When the lake stage exceeds 15.5 feet and S-310 is closed, the landward side stage east of S-169R will be approximately 15.5 feet. If irrigational water supply is ongoing or required, S-169R and Cu-2 will switch to automatic operations. Cu-2 will provide water supply east of S-169R when the Cu-2 tailwater stage falls to 14.6 feet while S-169R will act as a relief valve and maintain stages below 15.5 feet.

S-169R could be taken off of automatic and operated to provide supplemental water supply to areas west of S-169R. For that condition, conveyance would come from the lake via Cu-2 and routed to the west via S-169R. S-235 could remain open or could be closed to raise the stage between S-169R and S-235, and Cu-1 could be operated to provide supplemental water supply when stages permit. Cu-1A can also be operated to supplement water supply for areas west of S-169R.

Table 3 Cu-2 Automatic Operation Plan (Water Supply)

Cu-2 Tailwater/South Side (feet)	Cu-2 Gate Operations
$\geq$ 15.2	Closes
=14.9	Stationary
$\leq$ 14.6	Opens

Gate status and operations shown in Tables 1, 2, and 3 may vary as needed to maintain optimum water stages in the S-4 Basin.

VIII. DROUGHT CONTINGENCY PLAN

This plan provides a basis for decisions regarding the implementation of water conservation measures during droughts and reviews of operational flexibility. The Drought Contingency Plan can be found in Appendix B, of the "Master Water Control Plan for Lake Okeechobee and Everglades Agricultural Area."

IX. HURRICANE OR TROPICAL STORM REGULATIONS

S-169R operations during a hurricane or tropical storm will follow the operations as outlined in Section VI, Hurricane Operations, of this document. Also, in accordance with the "Water Control Plan for Lake Okeechobee and Everglades Agricultural Area"(Jacksonville District, USACE, July 2000) for hurricane and tropical emergency response within the USACE, Jacksonville District, refer to CESAJ Plan 500-1-3, dated June 1999. These emergency action plans should be consulted for related emergency preparation and actions. Local emergency management offices should be notified as necessary.

X. DEVIATION FROM NORMAL REGULATION

The Jacksonville District Engineer is occasionally requested to deviate from the normal regulation of the project. Prior approval for a deviation is to be obtained from the Jacksonville District Office (SAJ) except as noted below. SAJ will in turn obtain the necessary approvals from the South Atlantic Division (SAD) except as noted below. Deviation requests usually fall into the following categories:

A. Emergencies

Some emergencies that can be expected include drowning and other accidents, failure of project facilities, and flushing of pollutants. Necessary action under emergency conditions is taken immediately, unless such action will create an equal or worse condition. The Jacksonville District of the U.S Army Corps of Engineers should be informed as soon as practicable. A written confirmation showing the deviation and conditions will be furnished to SAD after the incident.

B. Unplanned Minor Deviations

There are unplanned instances where there is a temporary need for a minor deviation from normal regulation although they are not considered emergencies. A change in releases is sometimes necessary for construction, maintenance, inspections, or freeze protection. These requested deviations are usually for duration of a few hours to a few days. Each request is analyzed on its own merits. Consideration is given to upstream watershed conditions, potential flood threat, conditions of lakes, and possible alternative measures. In the interest of maintaining good public relations, the request is complied with, providing there are no adverse effects on the overall project regulation for authorized project purposes. Approval for these minor deviations will normally be obtained from SAD by telephone. A written confirmation showing the deviation and conditions will be furnished to SAD.

C. Planned Deviations

Each condition should be analyzed on its merits. Sufficient data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes will be presented to SAD along with recommendations for review and approval.

XI. WATER QUALITY

The water supply operations described in Section VII will allow water to flow east from Cu-2 and south from S-310 to the Industrial Canal. This will maintain water and dissolved oxygen levels in the Industrial Canal.

XII. RECREATION

Several seasonal residential buildings are located adjacent to and south of C-21. There is a recreational park and boating facilities spanning an area on the lakeside of the Herbert Hoover Dike (HHD) that is parallel to C-21. On the landside of the HHD in the general vicinity of the project, there are three marinas with several boat ramps and a public boat ramp facility southeasterly of the existing S-169. However, there are no operations at S-169R or Cu-2 specifically for recreational activities.

XIII. FISH AND WILDLIFE

Cu-2 currently operates in accordance with the Manatee Protection Plan for Water Control Structures (SOP-1130-2-3); upon completion of construction, S-169R will also follow SOP-1130-2-3. This plan provides policies, guidelines, and operating procedures for the effective long-range management and operation of water control structures to reduce manatee risk. Manatees observed during culvert operations will result in culvert operations suspended until the manatee leaves the area. Please see the Manatee Protection Plan for further guidance. In addition, a physical barrier will be placed on S-169R to prevent structure-related injuries or mortality.

FIGURES

Sensitivity Analysis Results for Existing Conditions Water-Supply Models

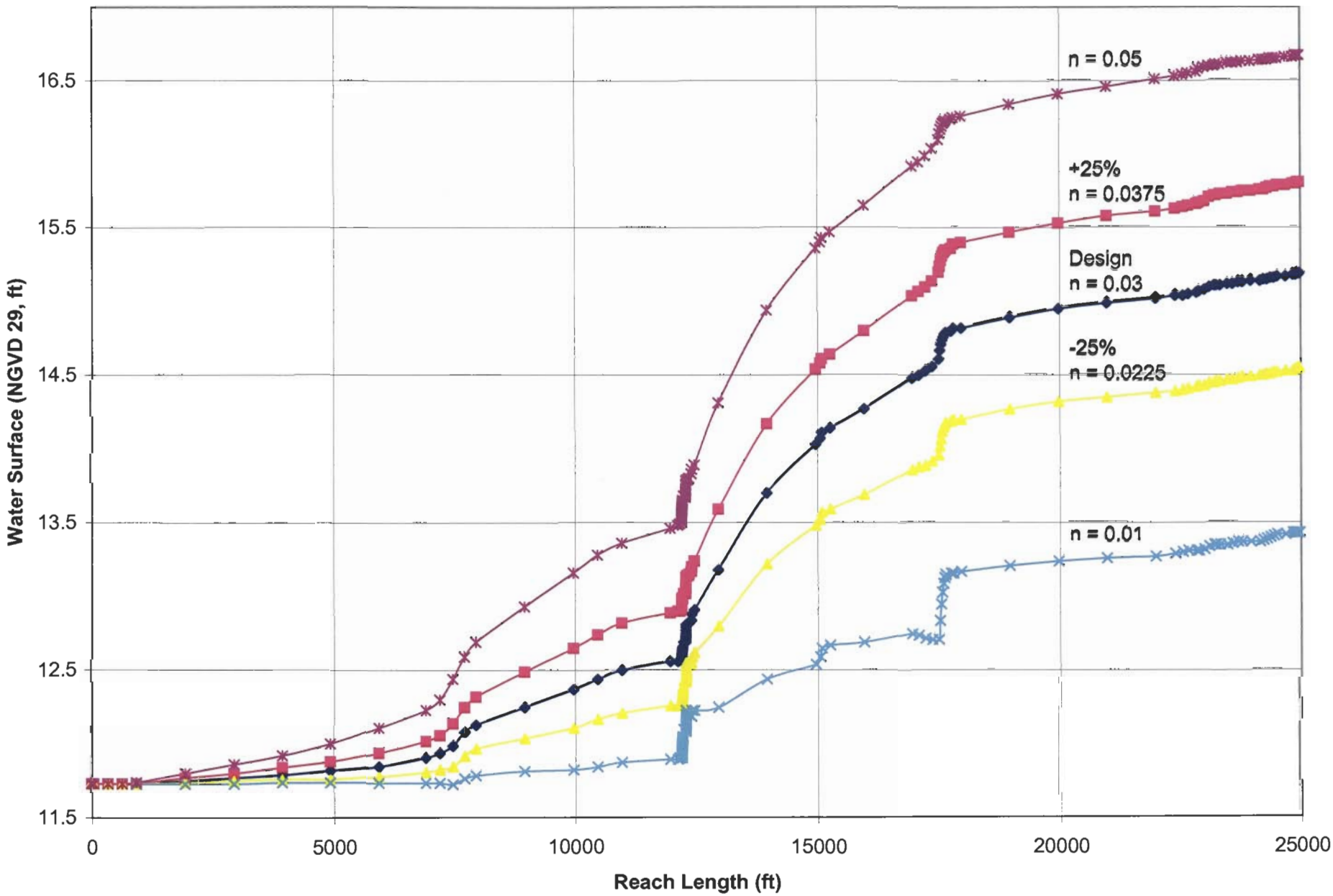


FIGURE A-1

Upstream Stage vs. Maximum Irrigational Capability - Existing Conditions

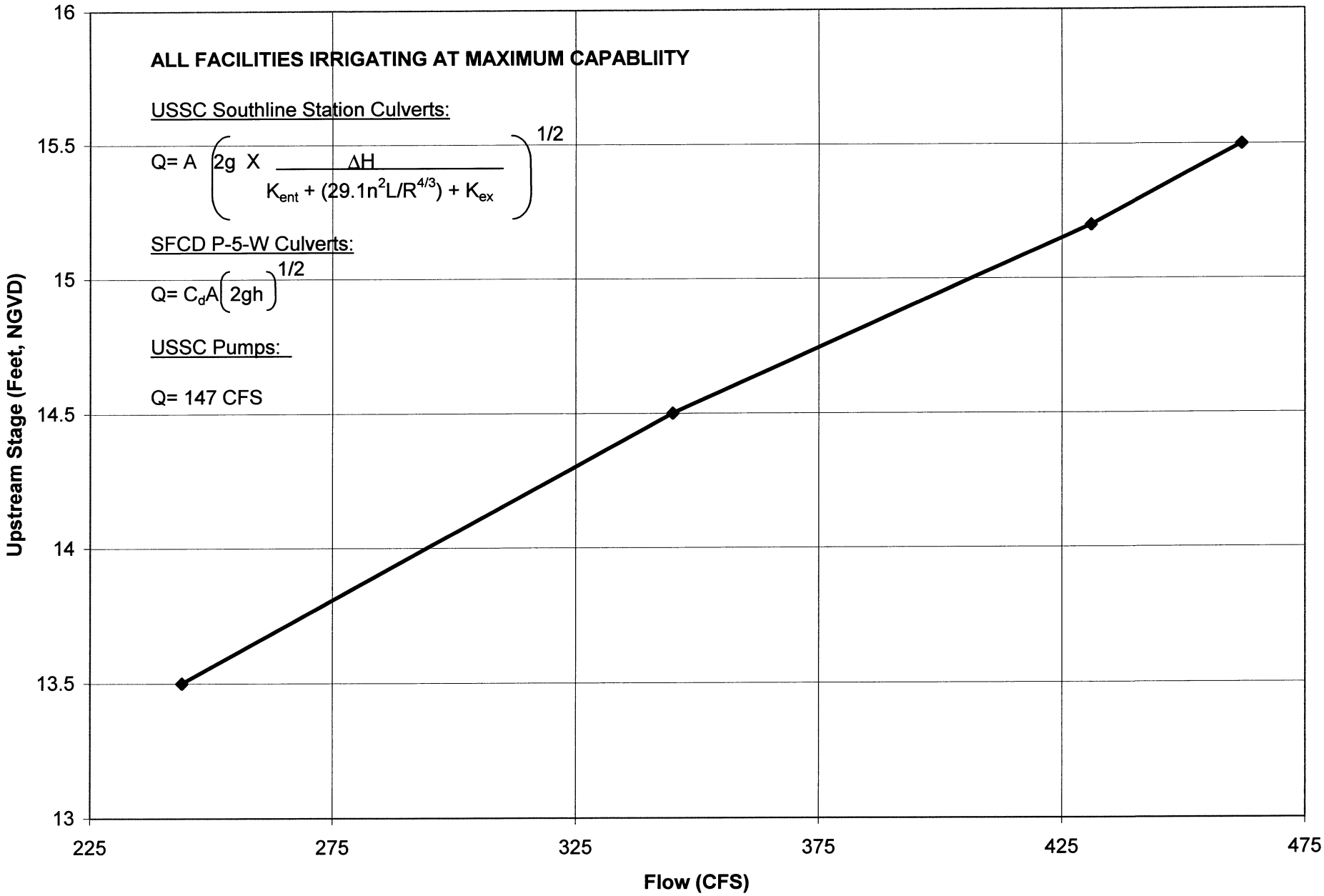


FIGURE A-2

Existing Conditions for Water Supply – Lake Above 15.5 Feet

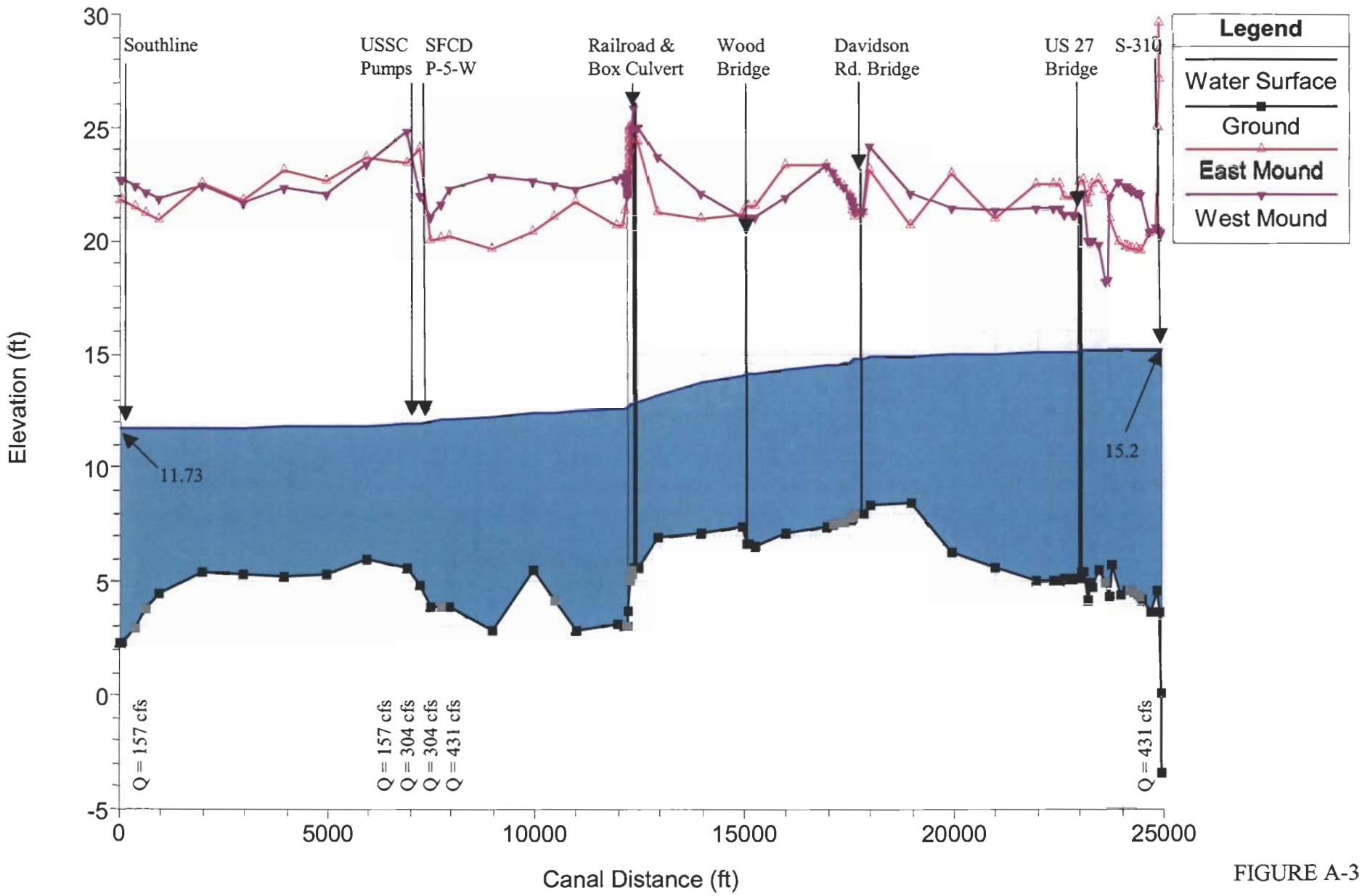


FIGURE A-3

Existing Conditions for Water Supply – Lake at 15.5 Feet

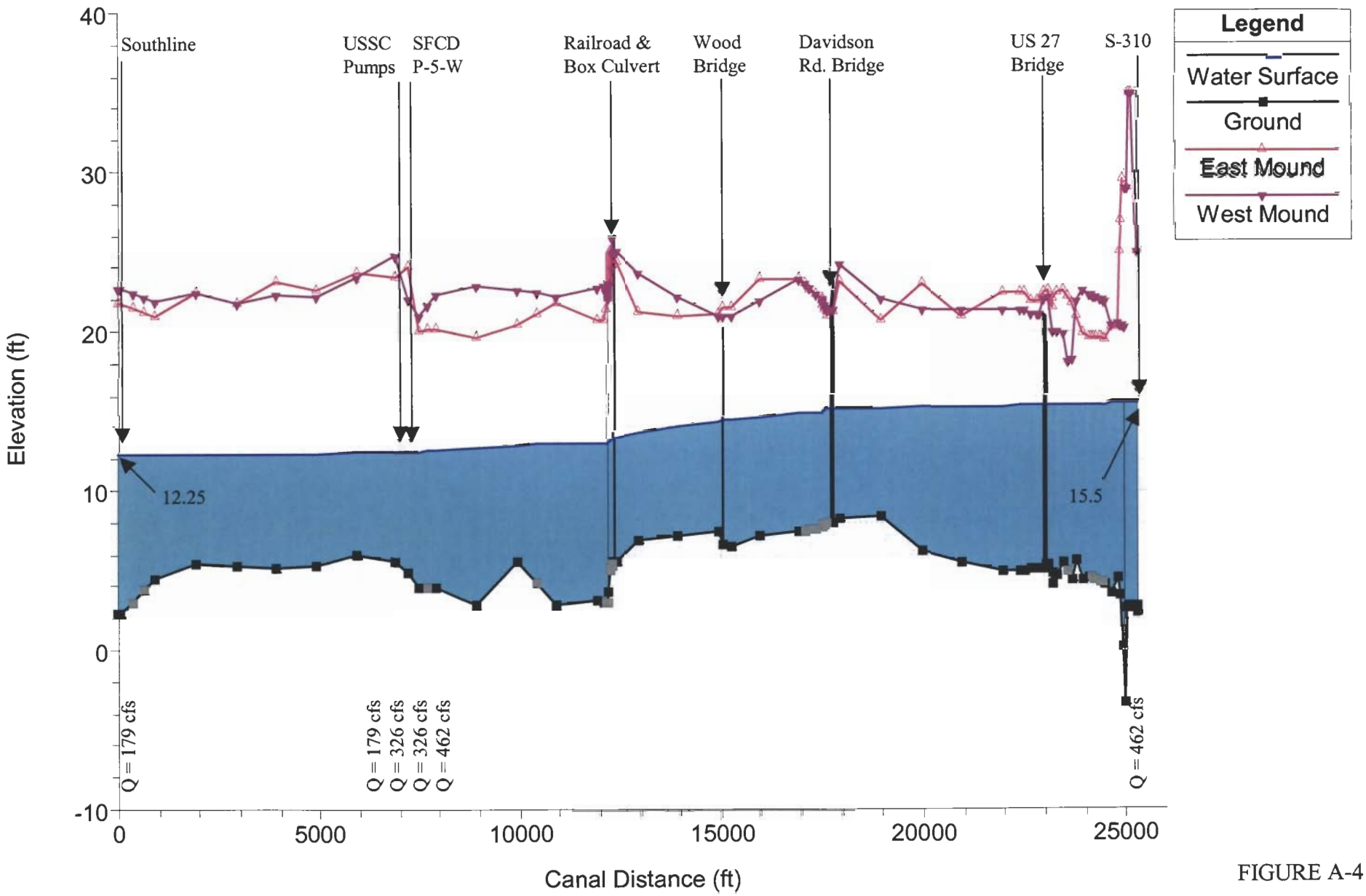


FIGURE A-4

Existing Conditions for Water Supply – Lake at 14.5 Feet

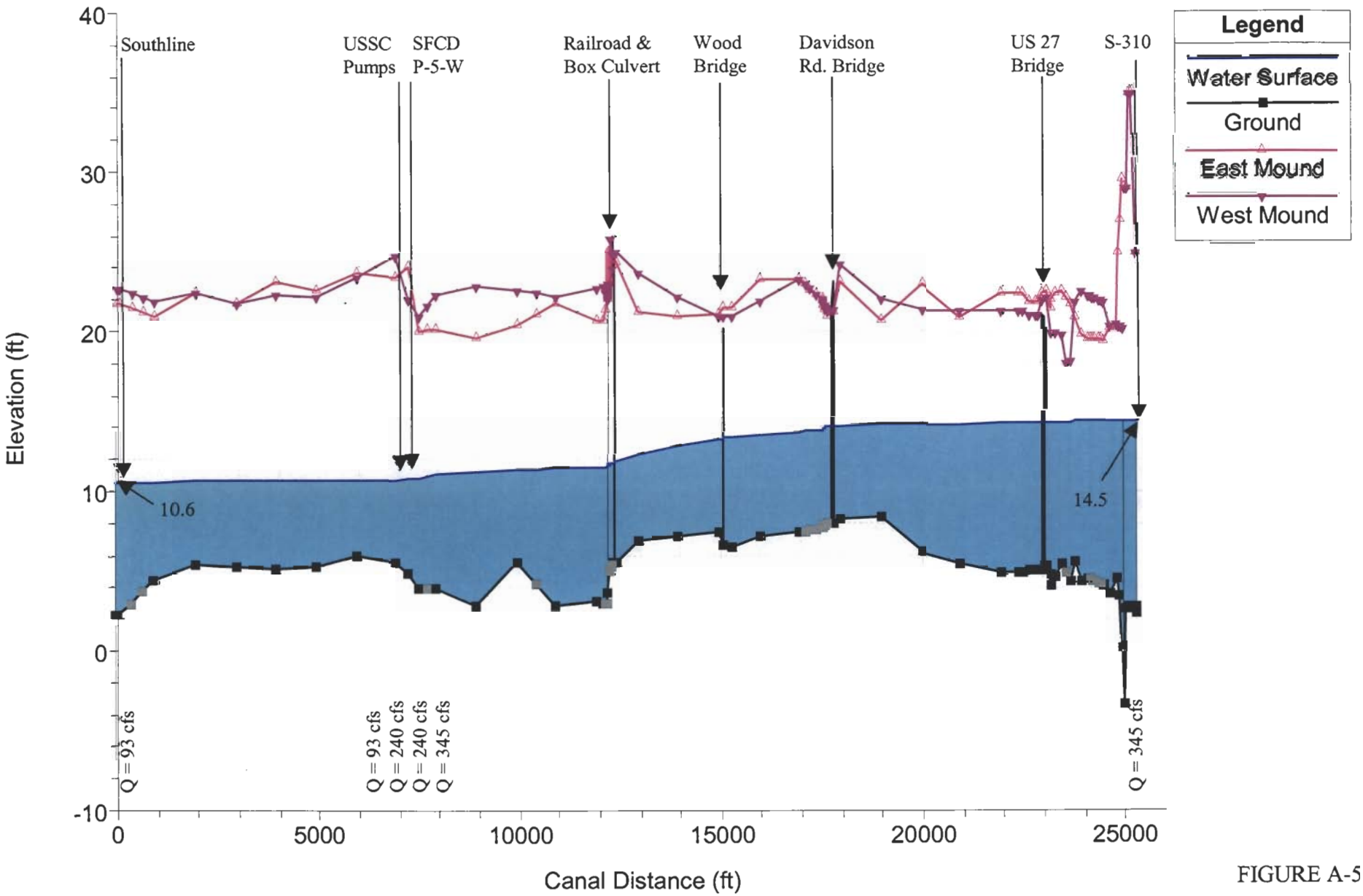


FIGURE A-5

Existing Conditions for Water Supply – Lake at 13.5 Feet

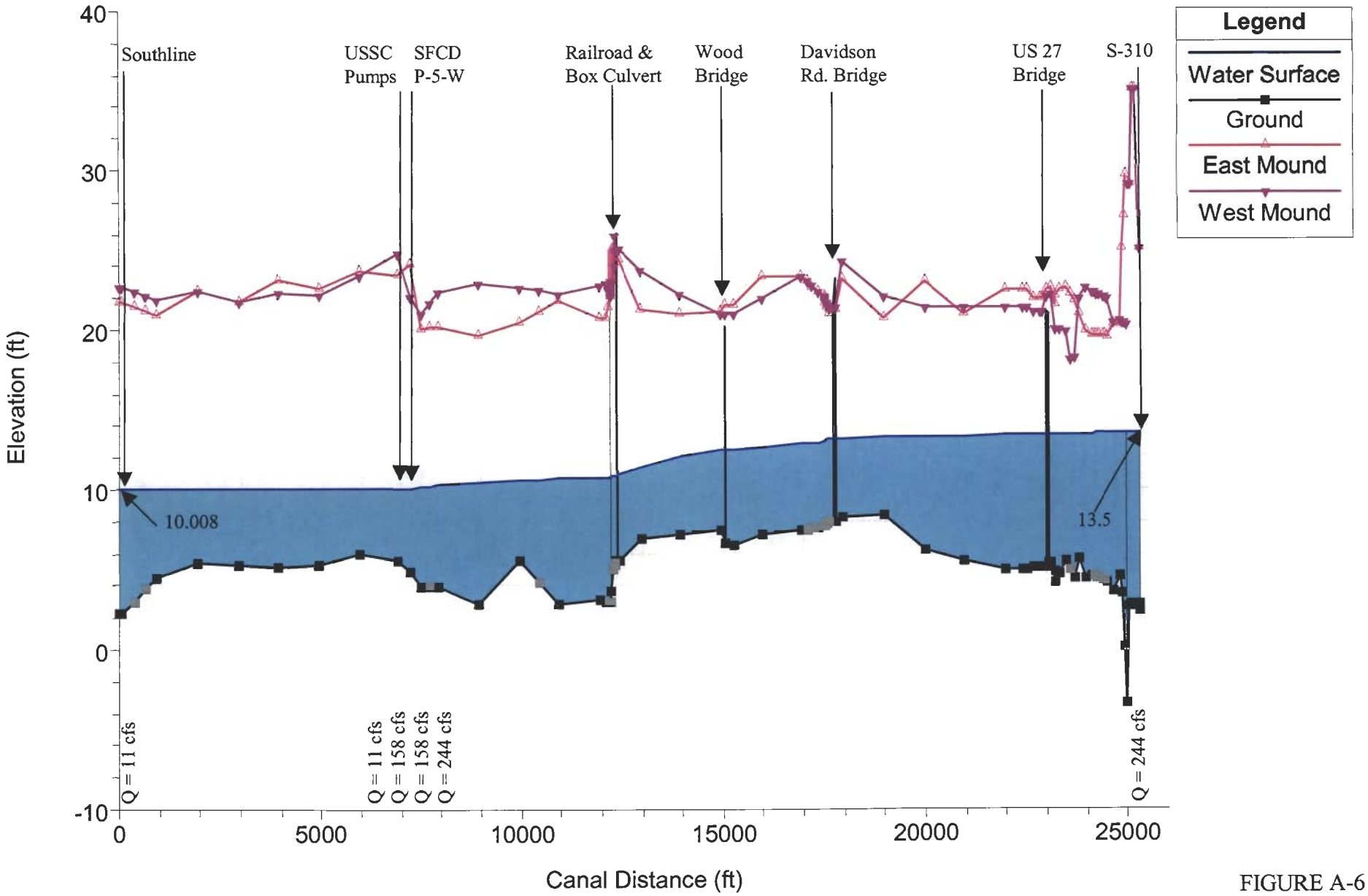


FIGURE A-6

Existing Conditions for Water Supply – Lake at 13.0 Feet

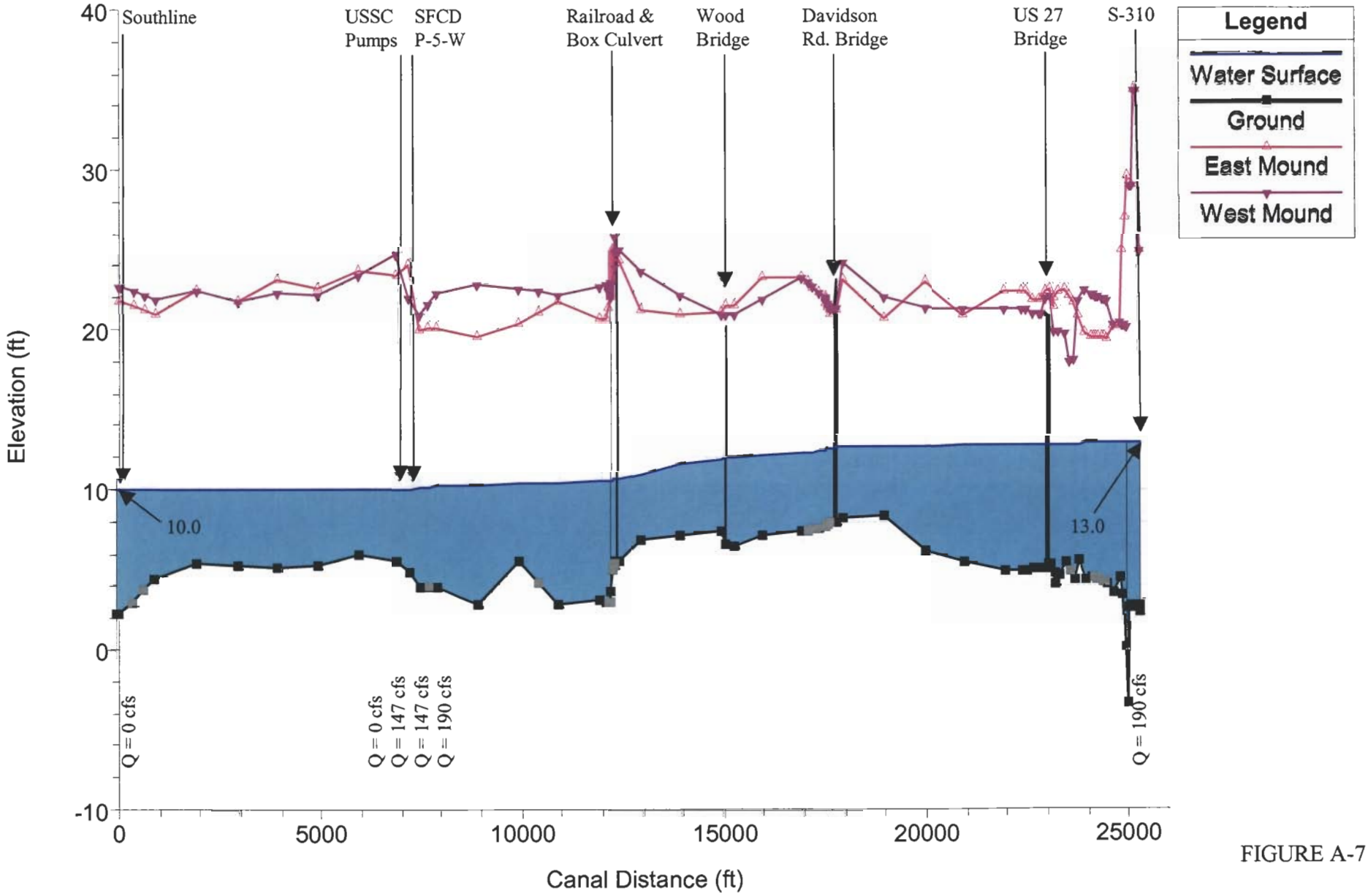


FIGURE A-7

Sensitivity Analysis Results for Existing Conditions Flood-Control Models

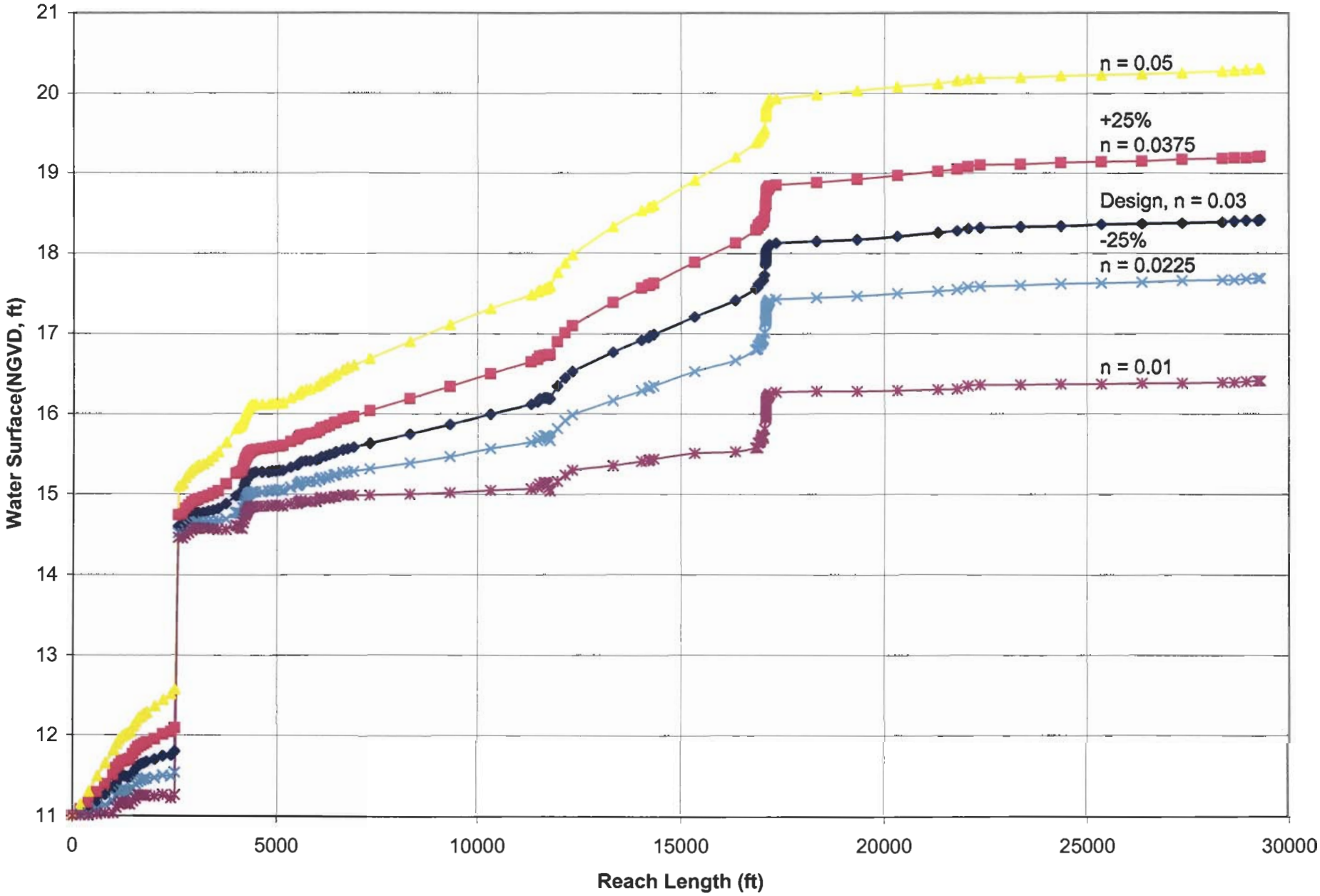


FIGURE A-8

Existing Conditions for Flood Control – Lake Above 15.5 Feet
Downstream Boundary Condition at 14.0 Feet

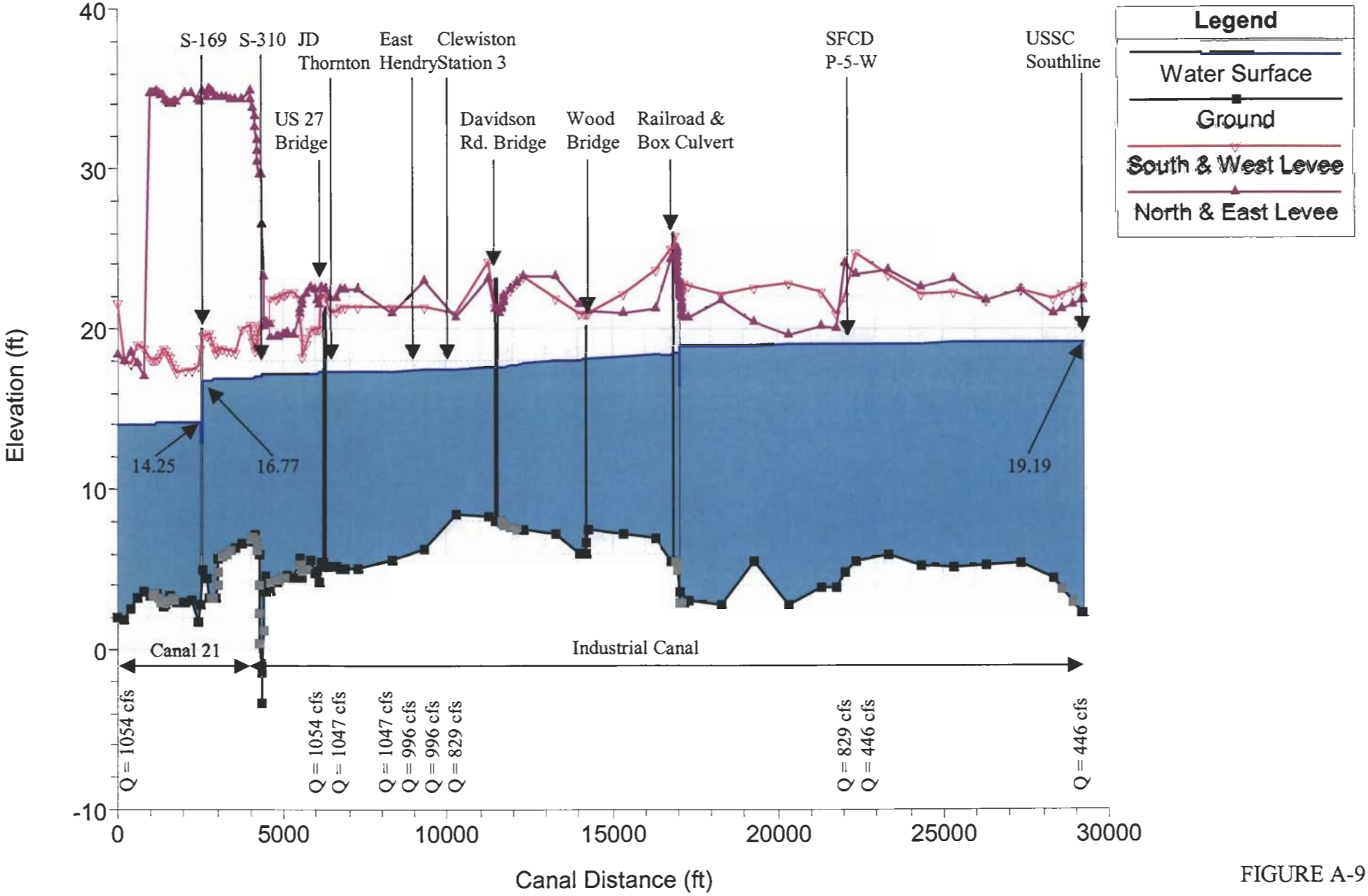


FIGURE A-9

Existing Conditions for Flood Control – Lake Above 15.5 Feet
Downstream Boundary Condition at 13.0 Feet

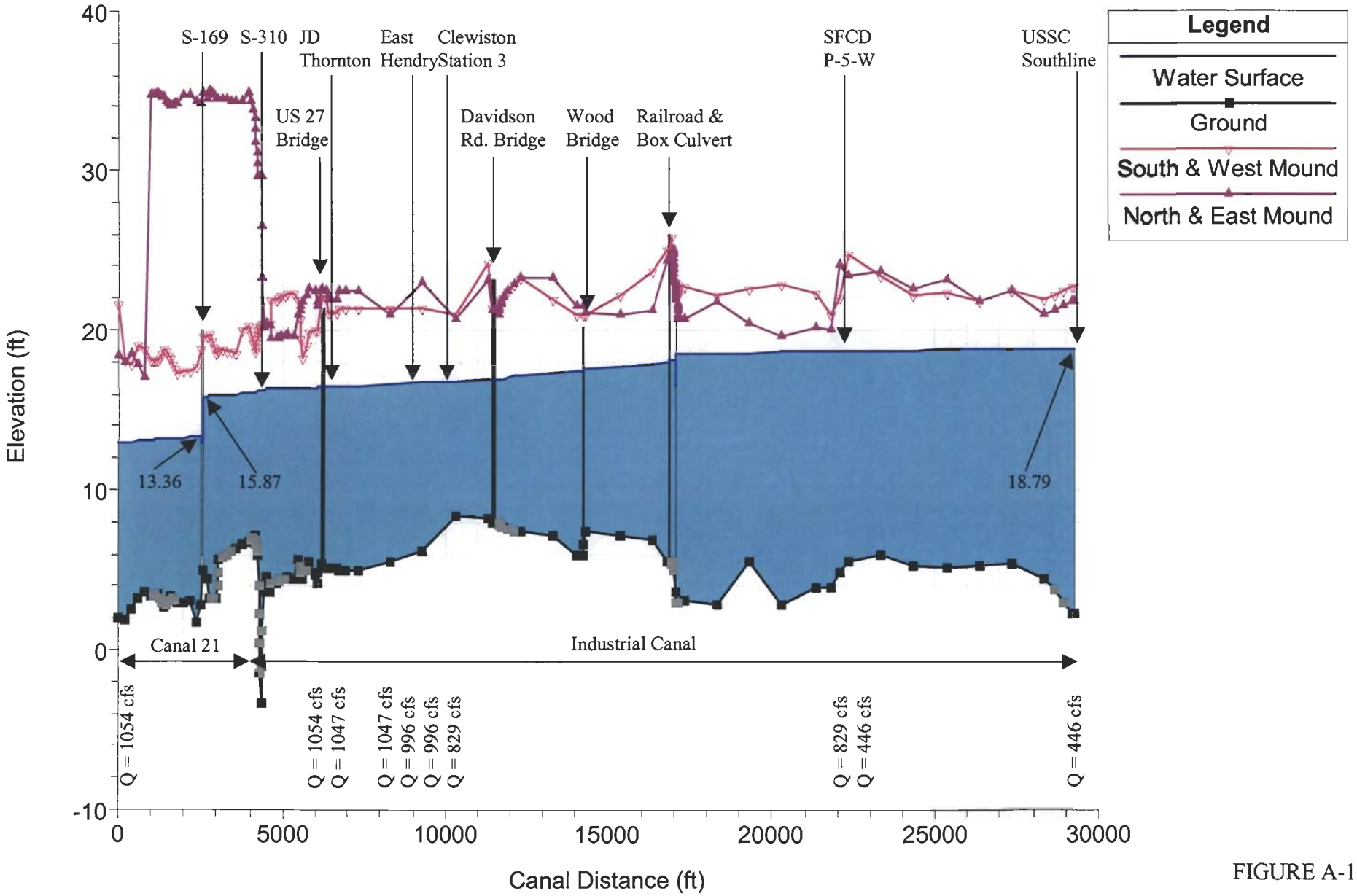


FIGURE A-10

Existing Conditions for Flood Control – Lake Above 15.5 Feet
Downstream Boundary Condition at 12.0 Feet

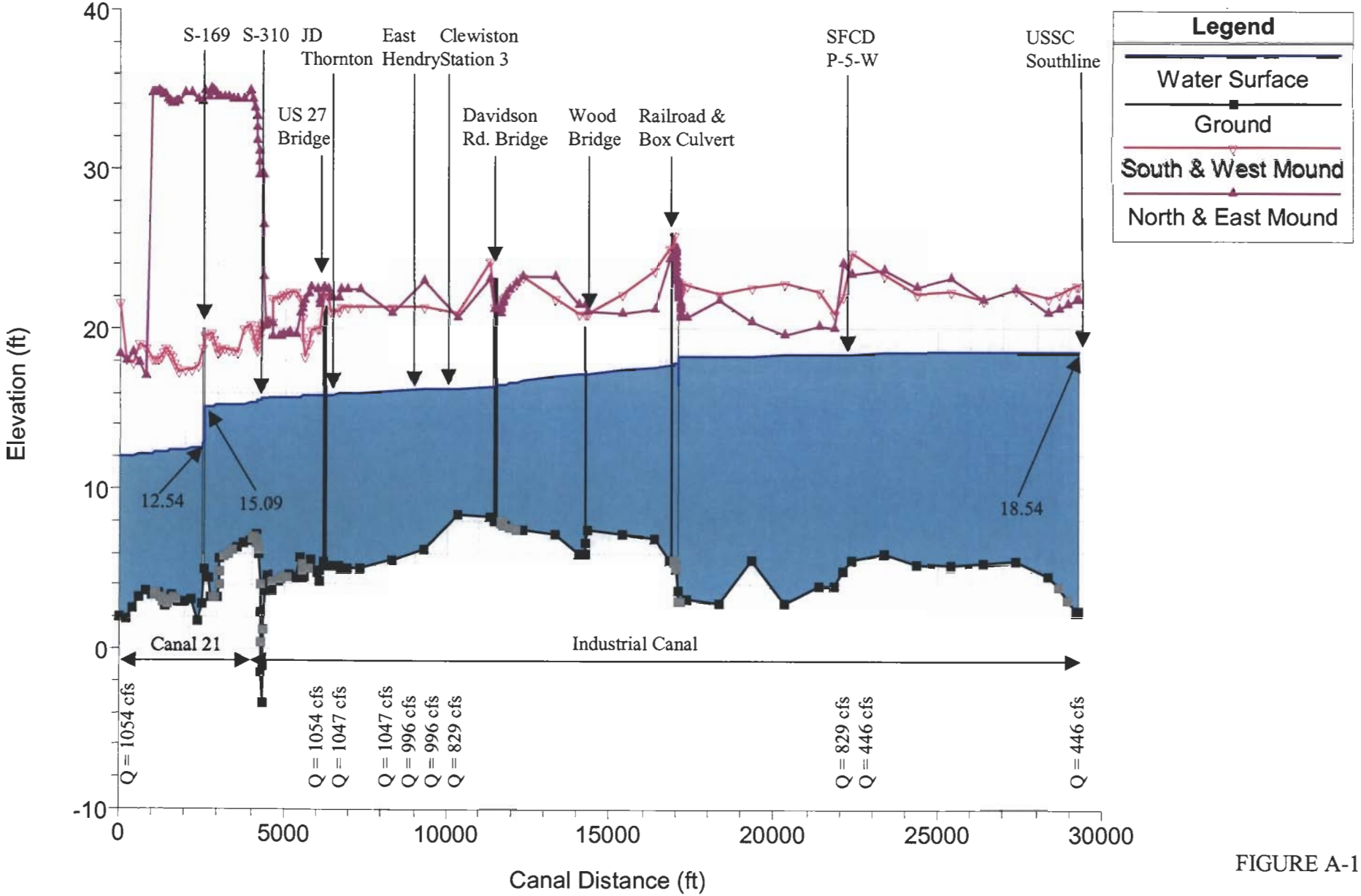


FIGURE A-11

Existing Conditions for Flood Control – Lake Above 15.5 Feet
Downstream Boundary Condition at 11.0 Feet

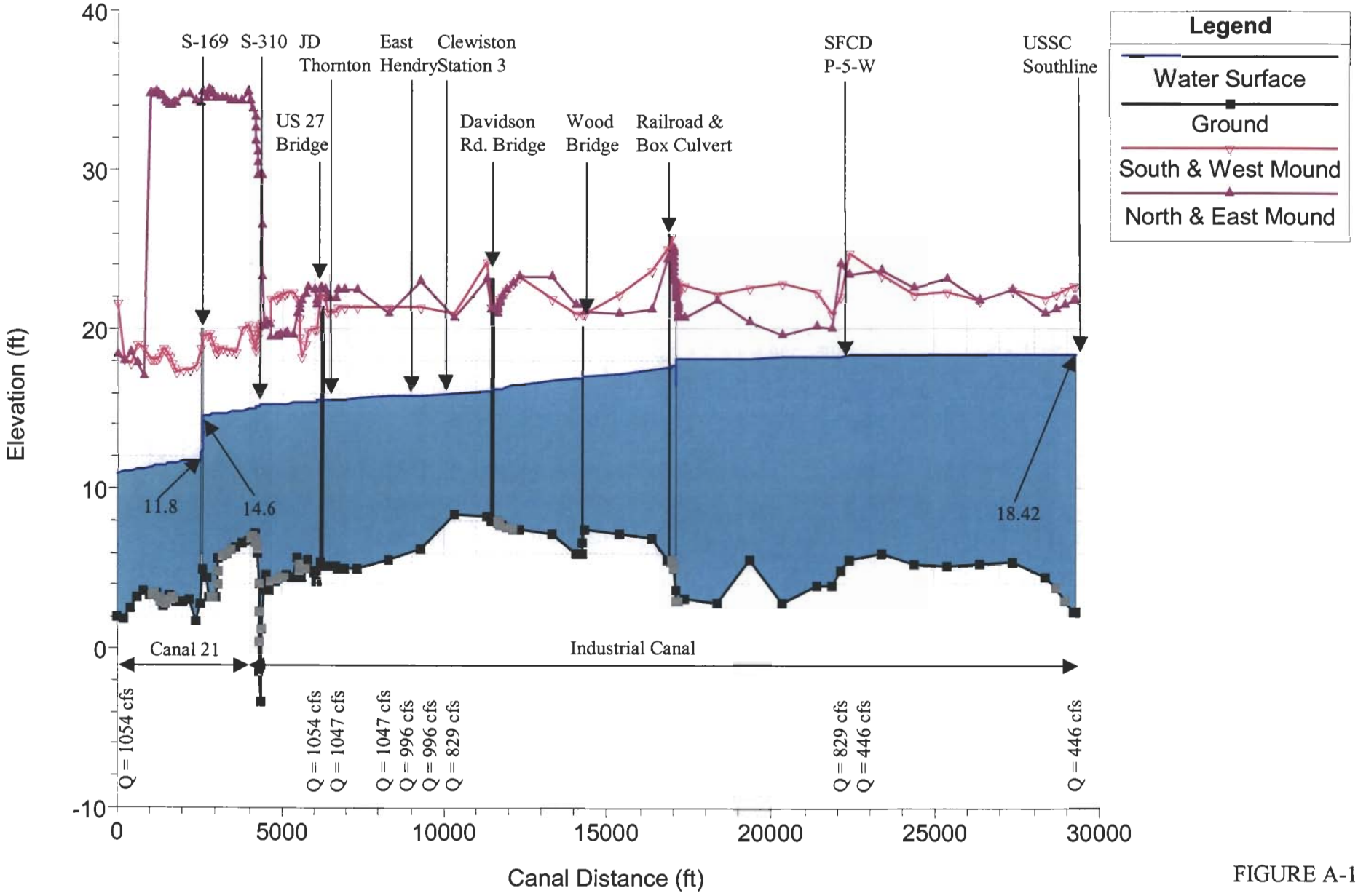


FIGURE A-12

Existing Conditions for Flood Control – Lake Above 15.5 Feet
Downstream Boundary Condition at 10.0 Feet (Hurricane Operations)

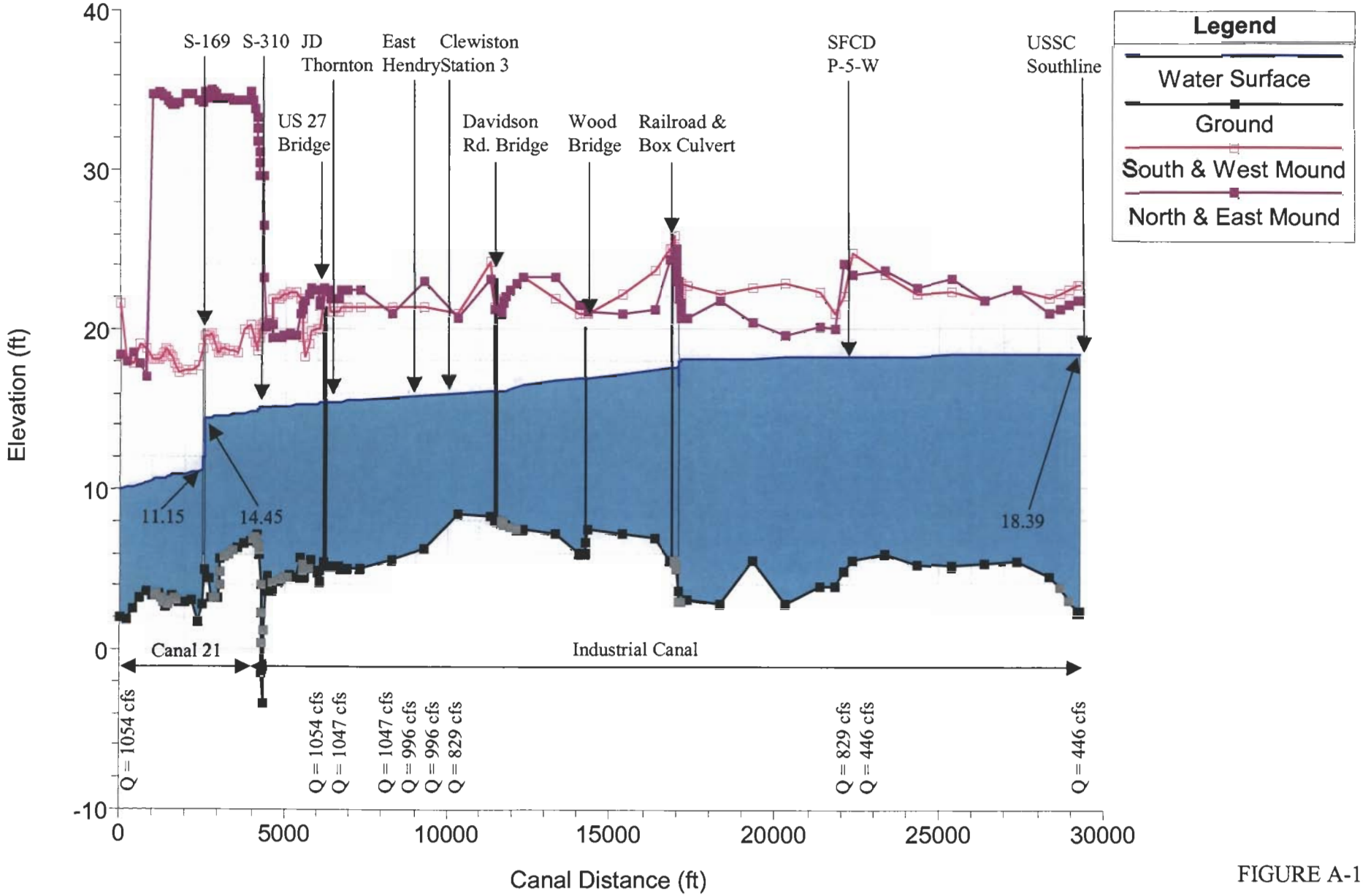


FIGURE A-13

Existing Conditions for Flood Control – Lake at 15.5 Feet

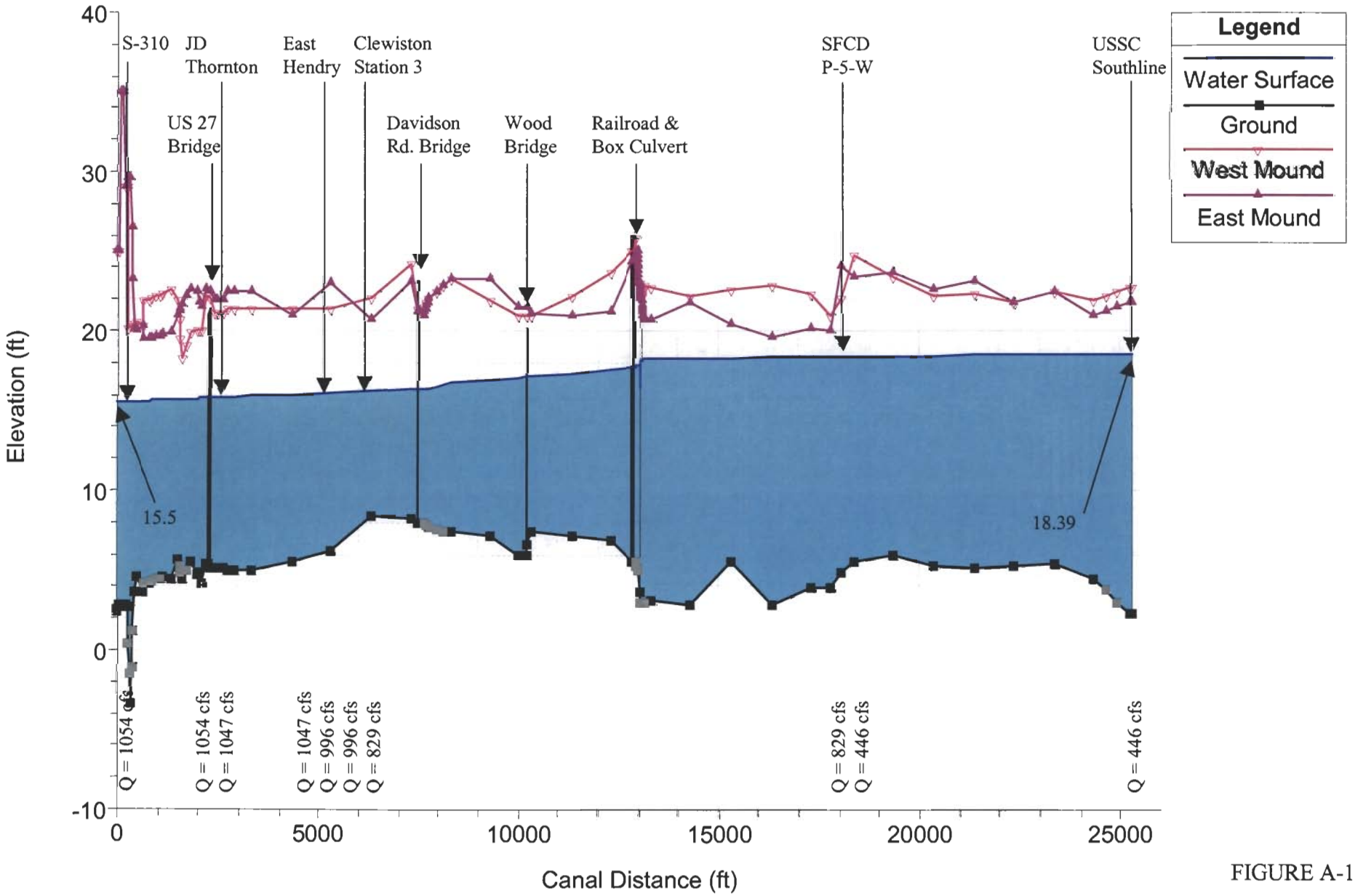


FIGURE A-14

Existing Conditions for Flood Control – Lake at 14.5 Feet

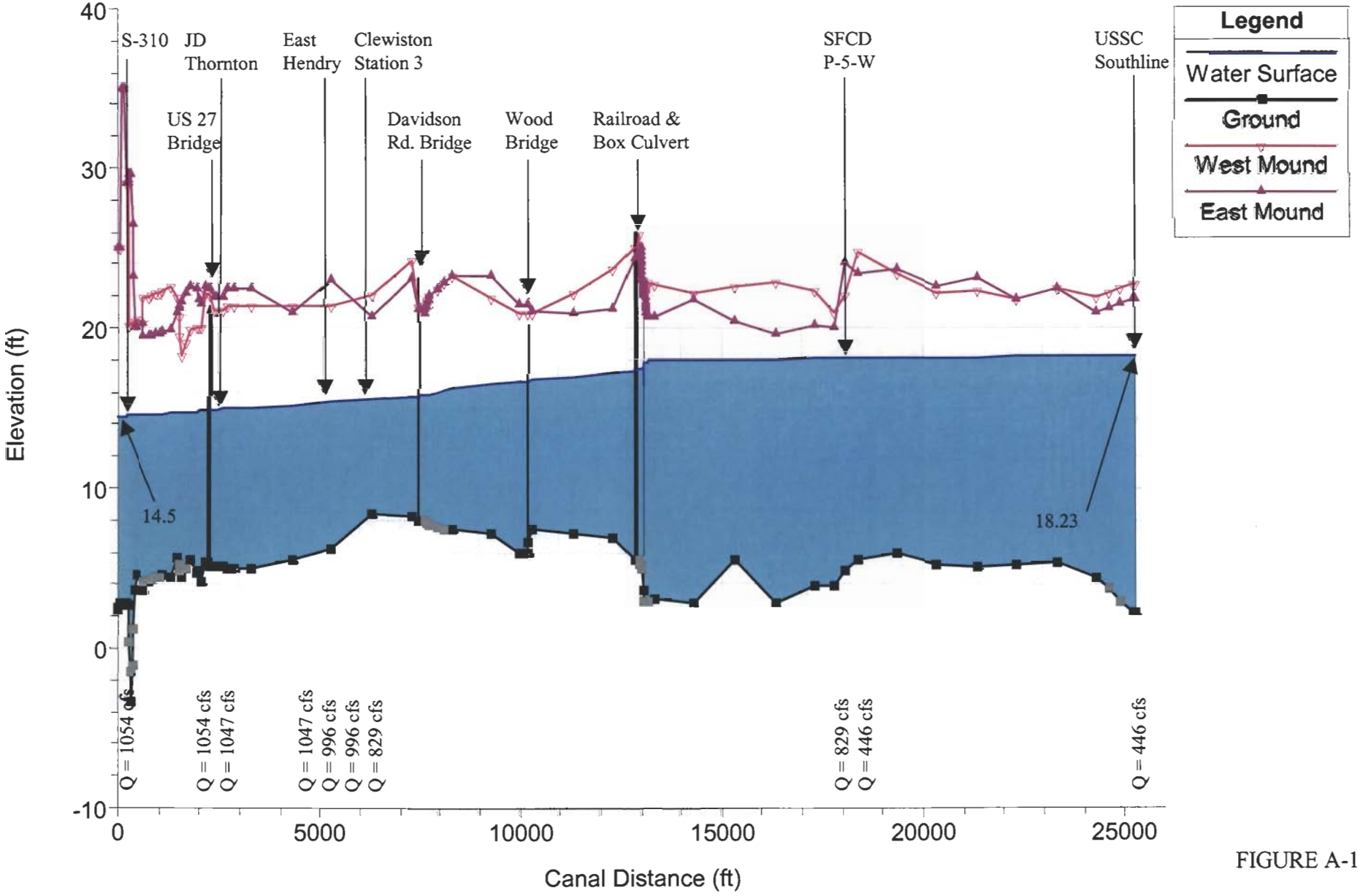


FIGURE A-15

Existing Conditions for Flood Control – Lake at 13.5 Feet

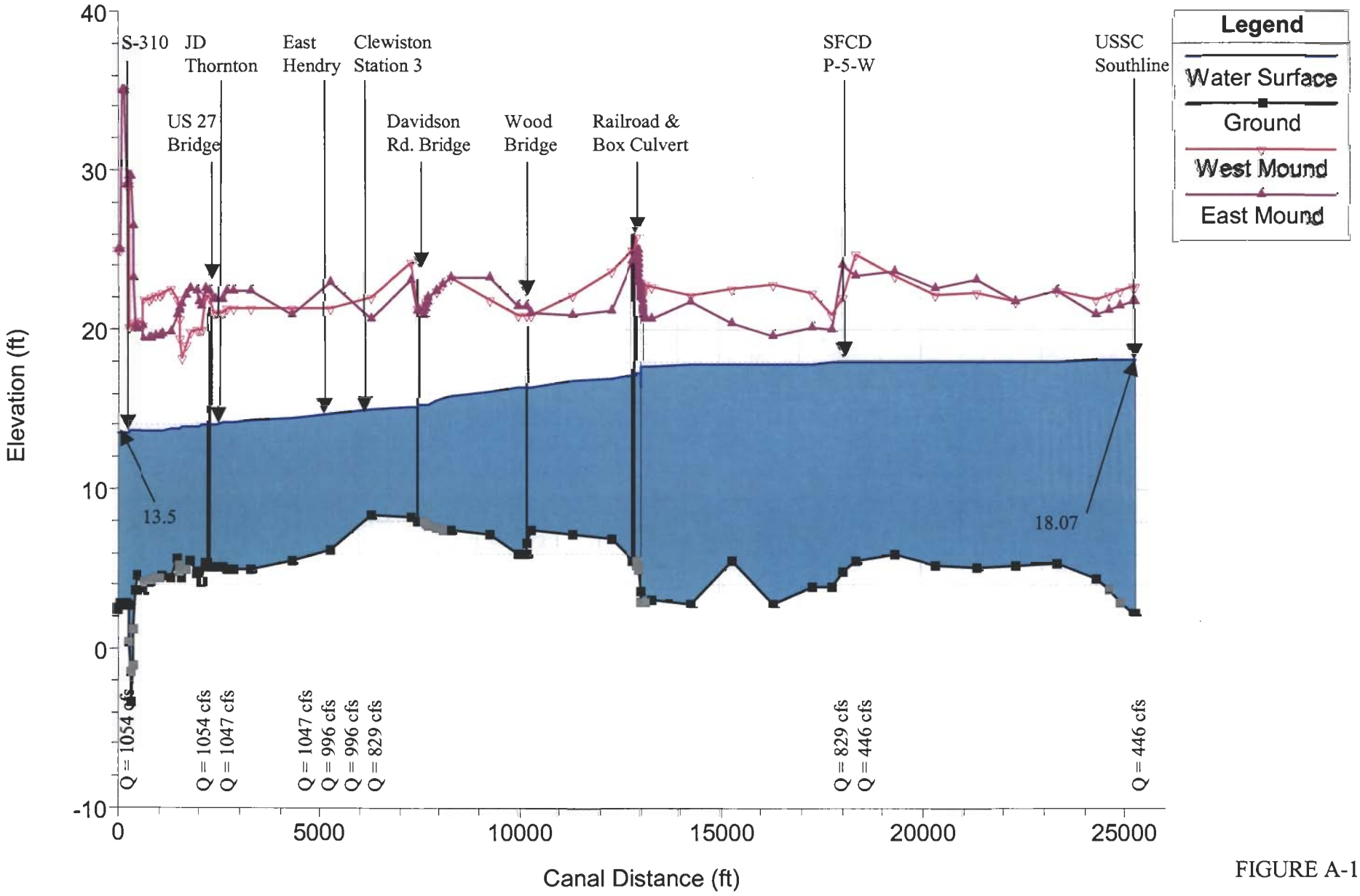


FIGURE A-16

Upstream Stage vs. Maximum Irrigational Capability - Recommended Plan

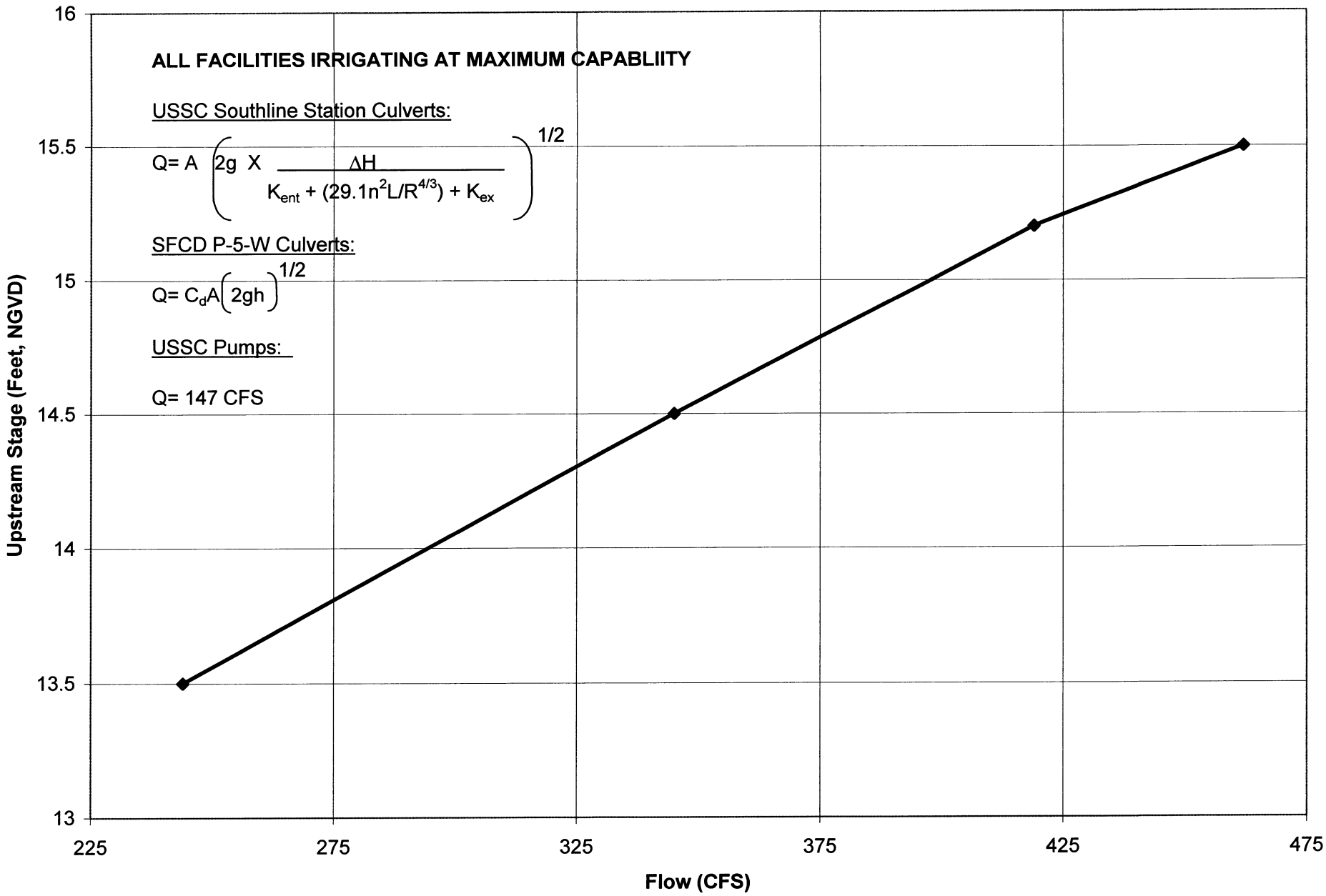


FIGURE A-17

Recommended Plan for Water Supply – Lake Above 15.5 Feet

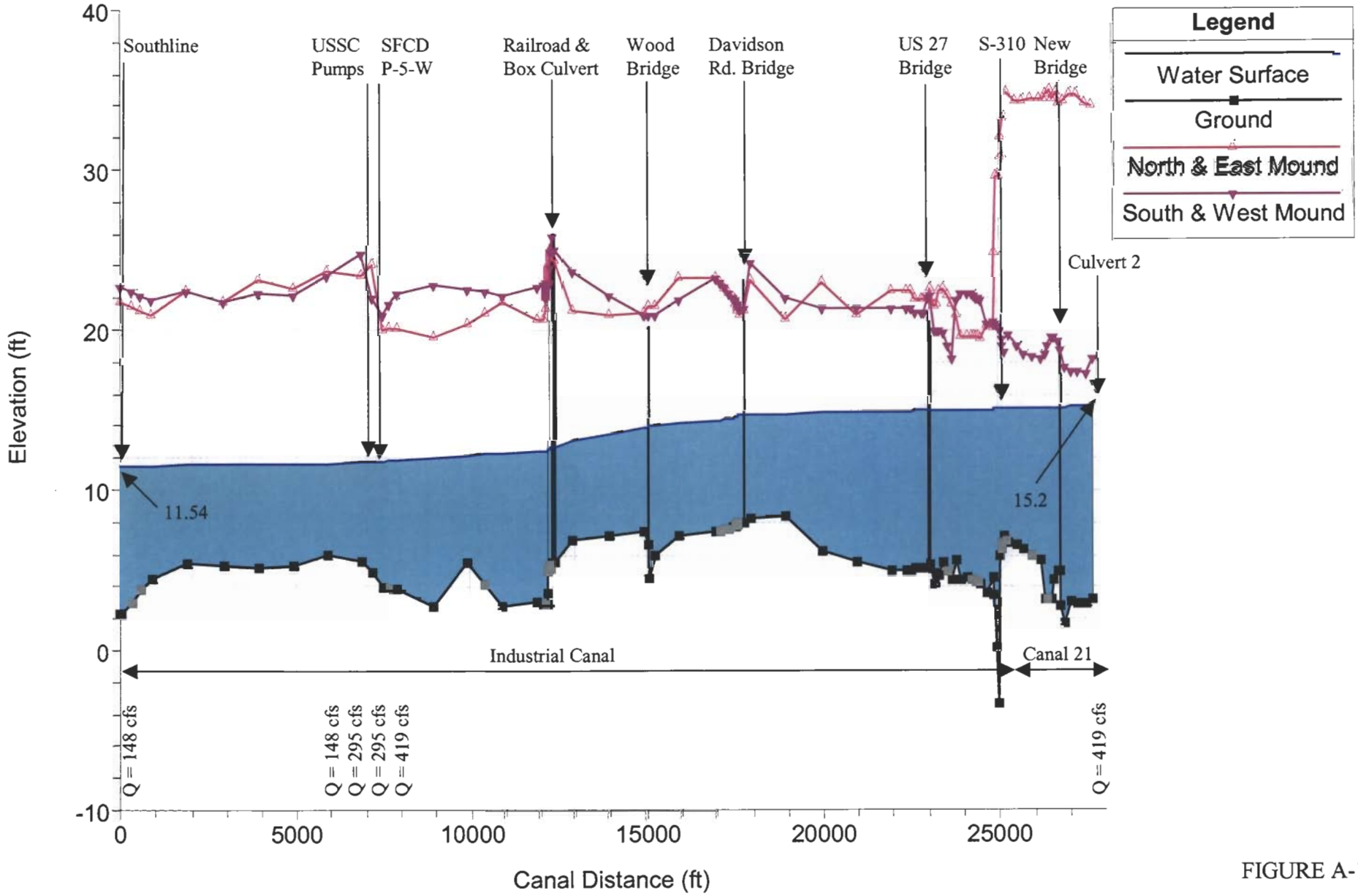


FIGURE A-18

Recommended Plan for Flood Control – Lake Above 15.5 Feet
Downstream Boundary Condition at 14.0 Feet

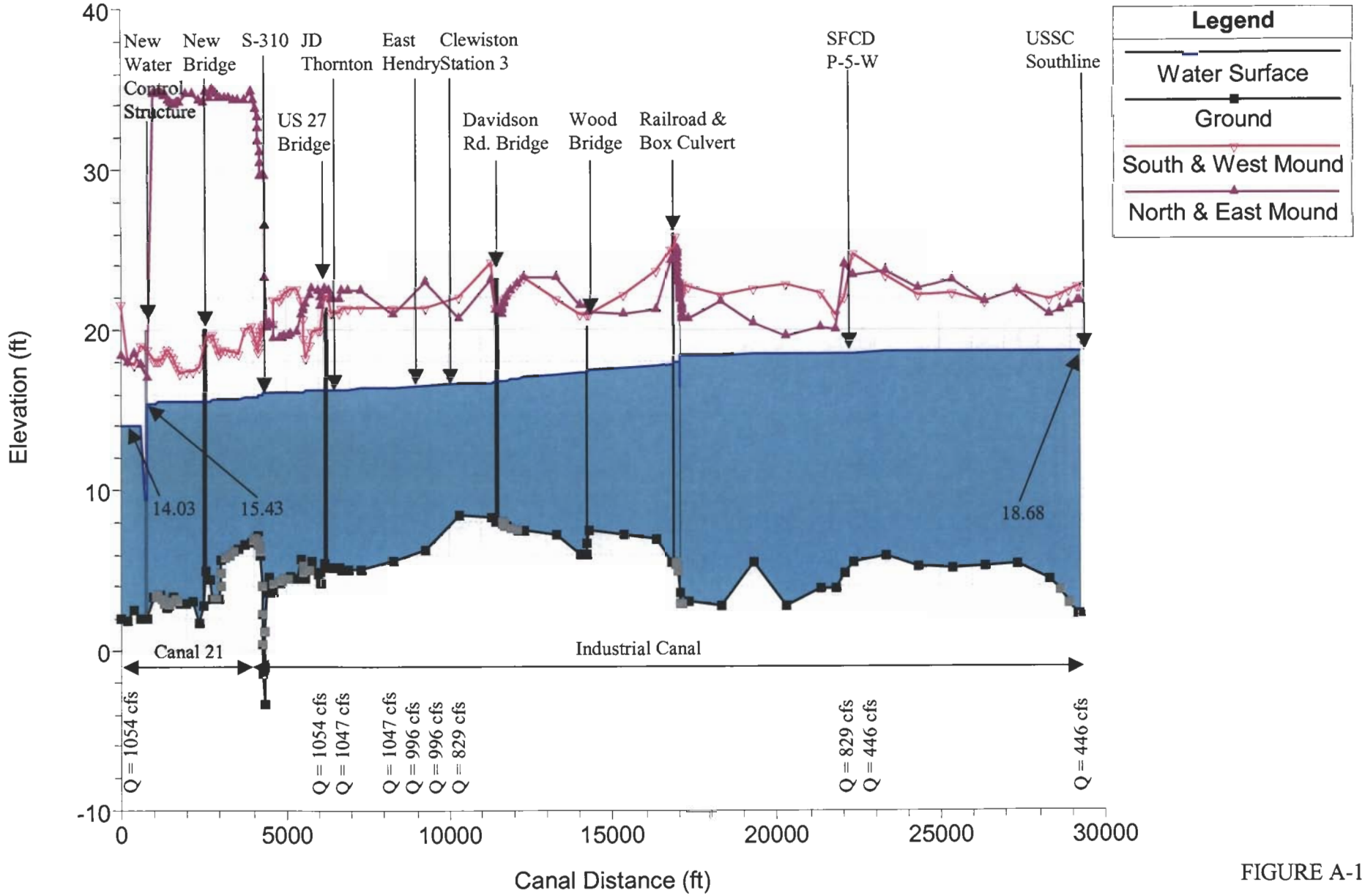


FIGURE A-19

Recommended Plan for Flood Control – Lake Above 15.5 Feet
Downstream Boundary Condition at 13.0 Feet

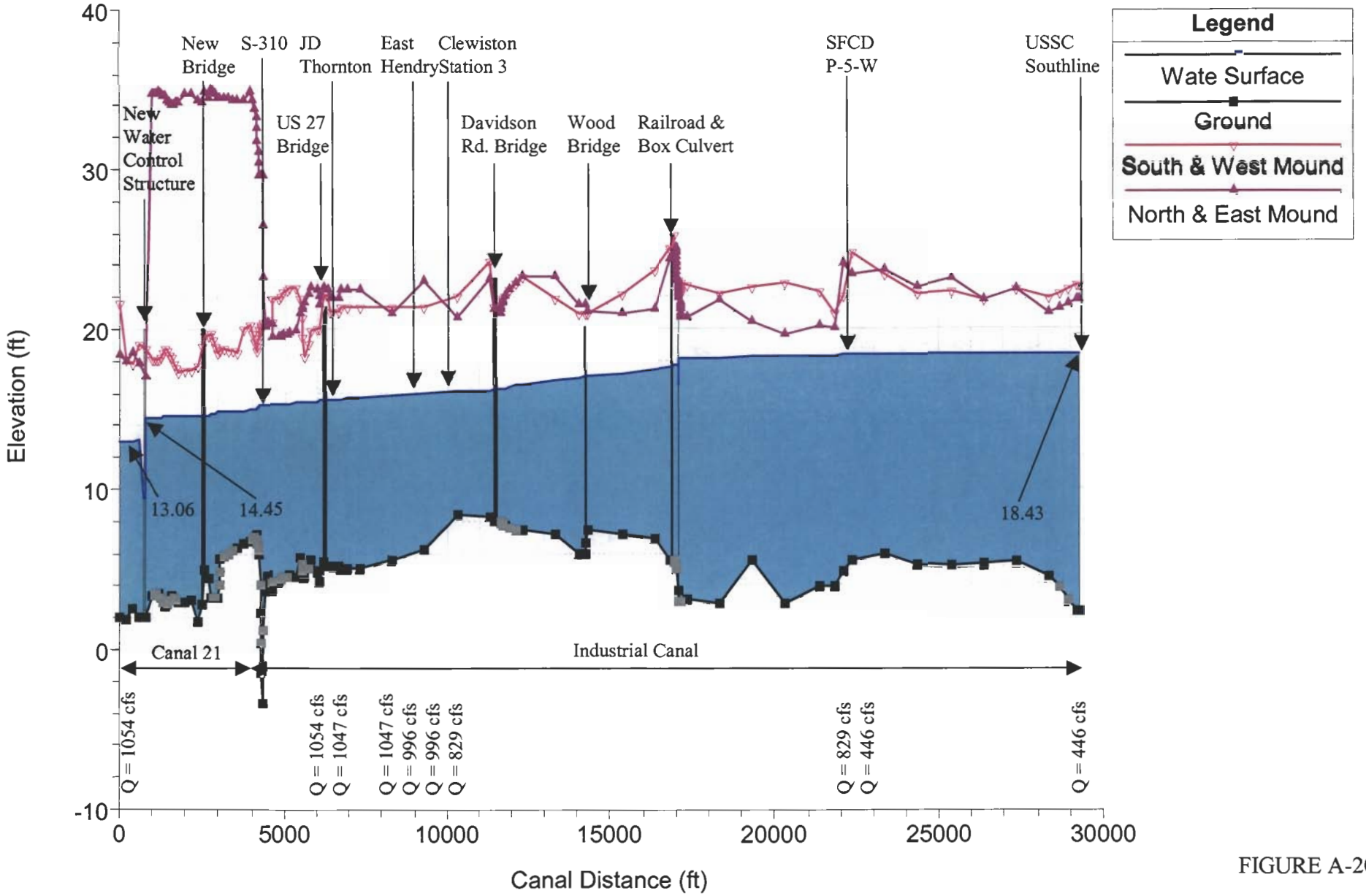


FIGURE A-20

Recommended Plan for Flood Control – Lake Above 15.5 Feet
Downstream Boundary Condition at 12.0 Feet

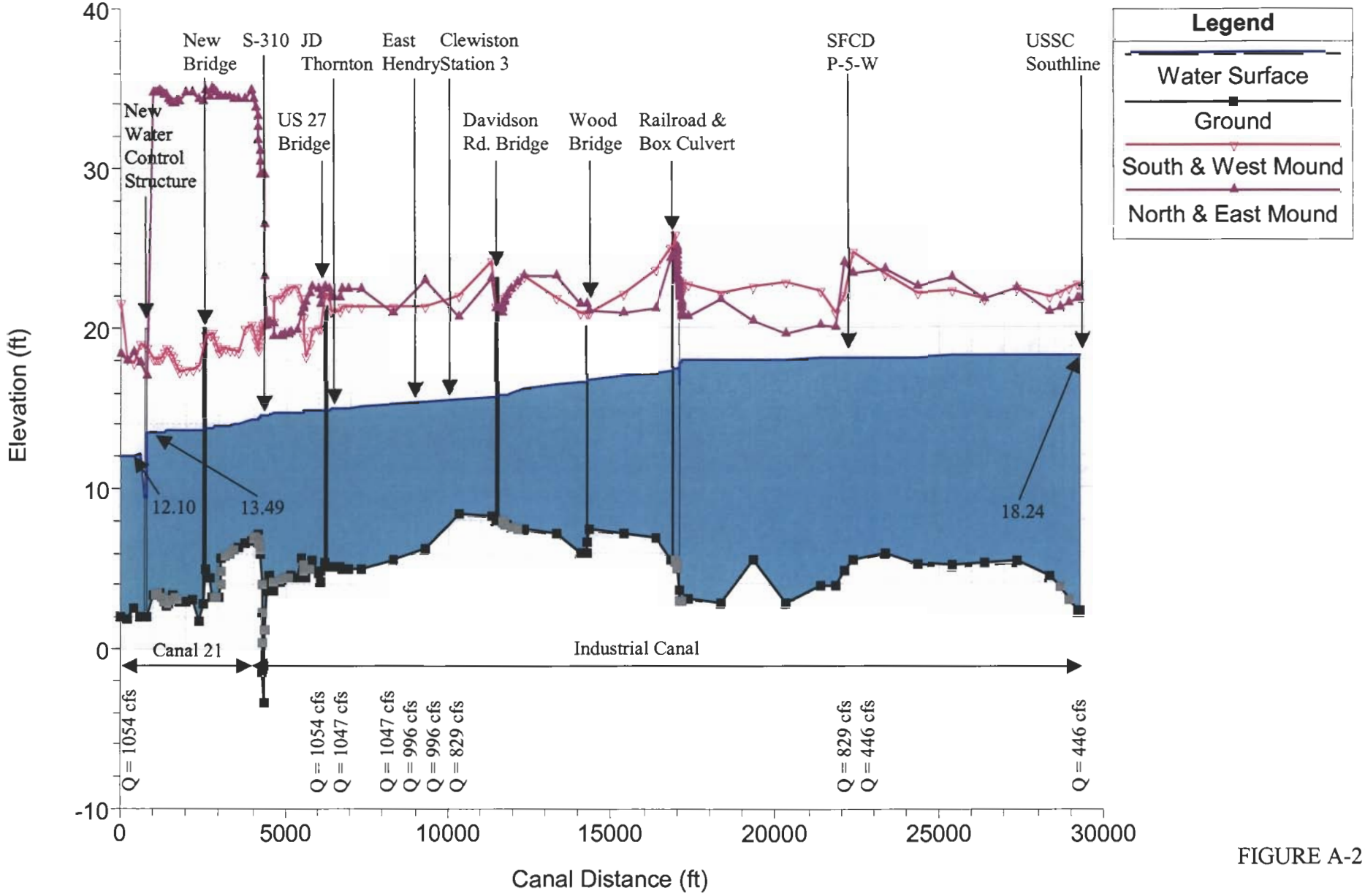


FIGURE A-21

Recommended Plan for Flood Control – Lake Above 15.5 Feet
Downstream Boundary Condition at 11.0 Feet

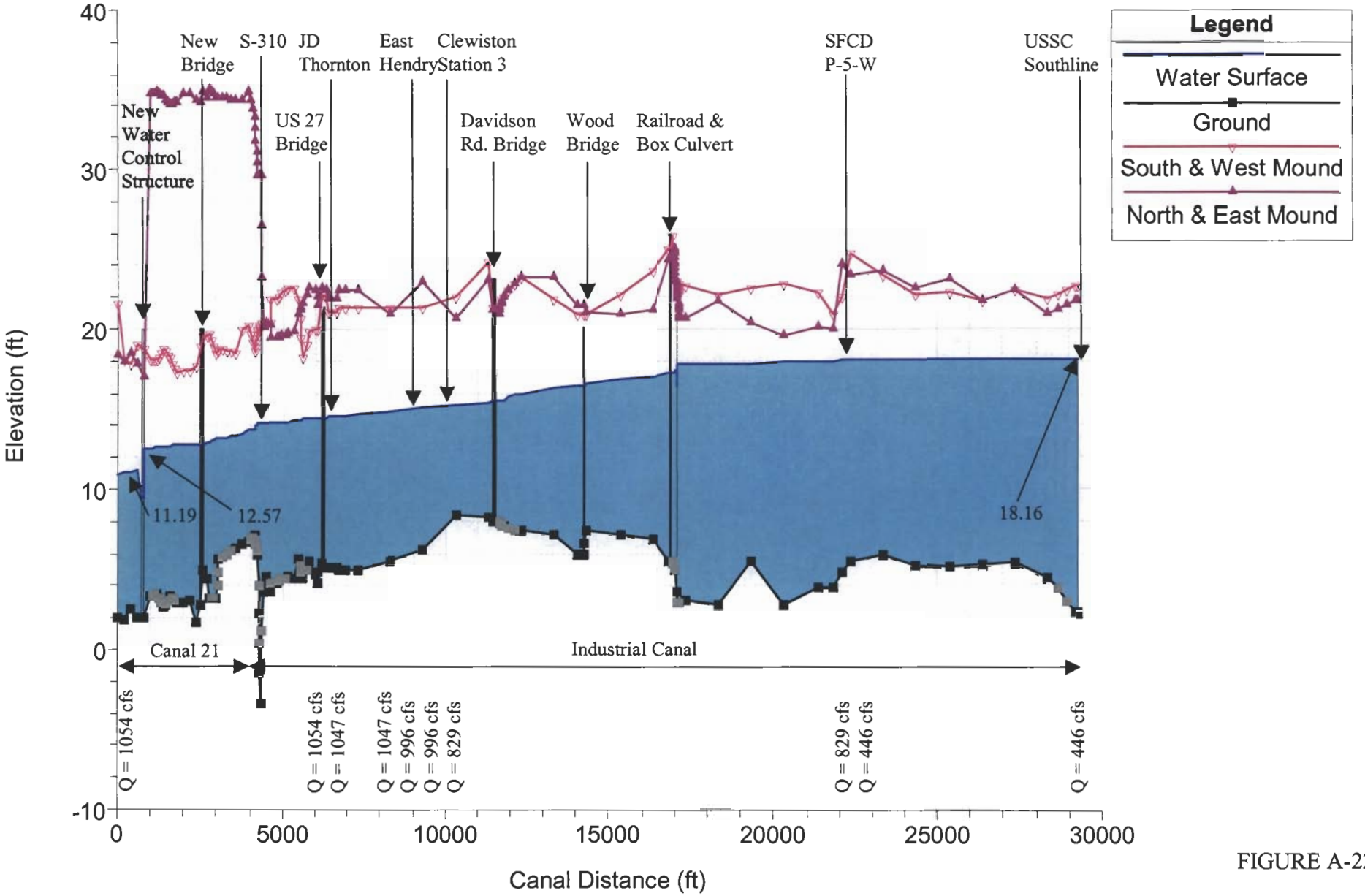


FIGURE A-22

Recommended Plan for Flood Control – Lake Above 15.5 Feet
Downstream Boundary Condition at 10.0 Feet (Hurricane Operations)

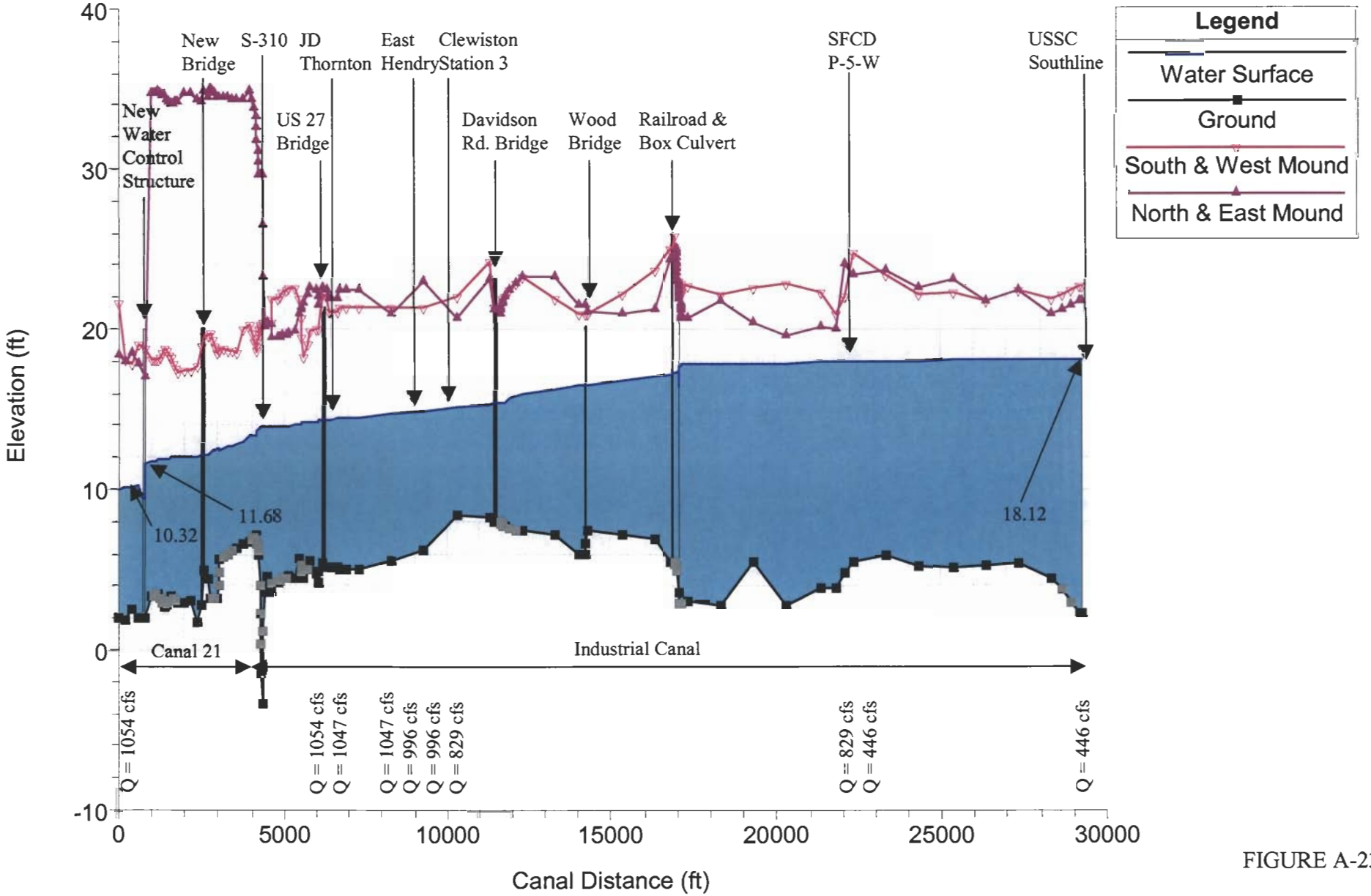


FIGURE A-23

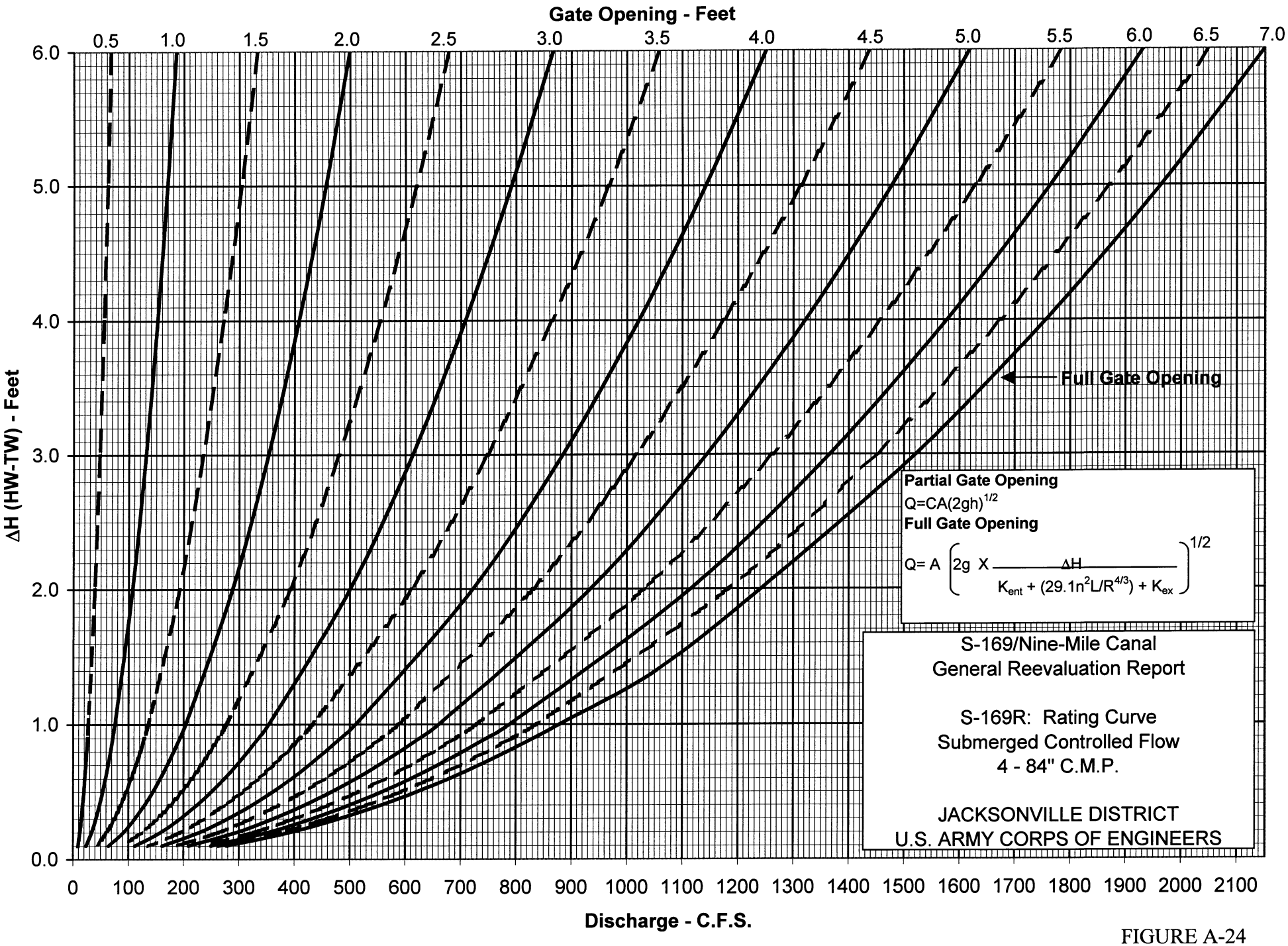

Gate Opening - Feet
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
ΔH (HW-TW) - Feet
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
Discharge - C.F.S.
Full Gate Opening
Partial Gate Opening
Q=CA(2gh)^1/2
Full Gate Opening
Q= A (2g X ΔH / (K_ent + (29.1n^2L/R^4/3) + K_ex))^1/2
S-169/Nine-Mile Canal
General Reevaluation Report
S-169R: Rating Curve
Submerged Controlled Flow
4 - 84" C.M.P.
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

FIGURE A-24

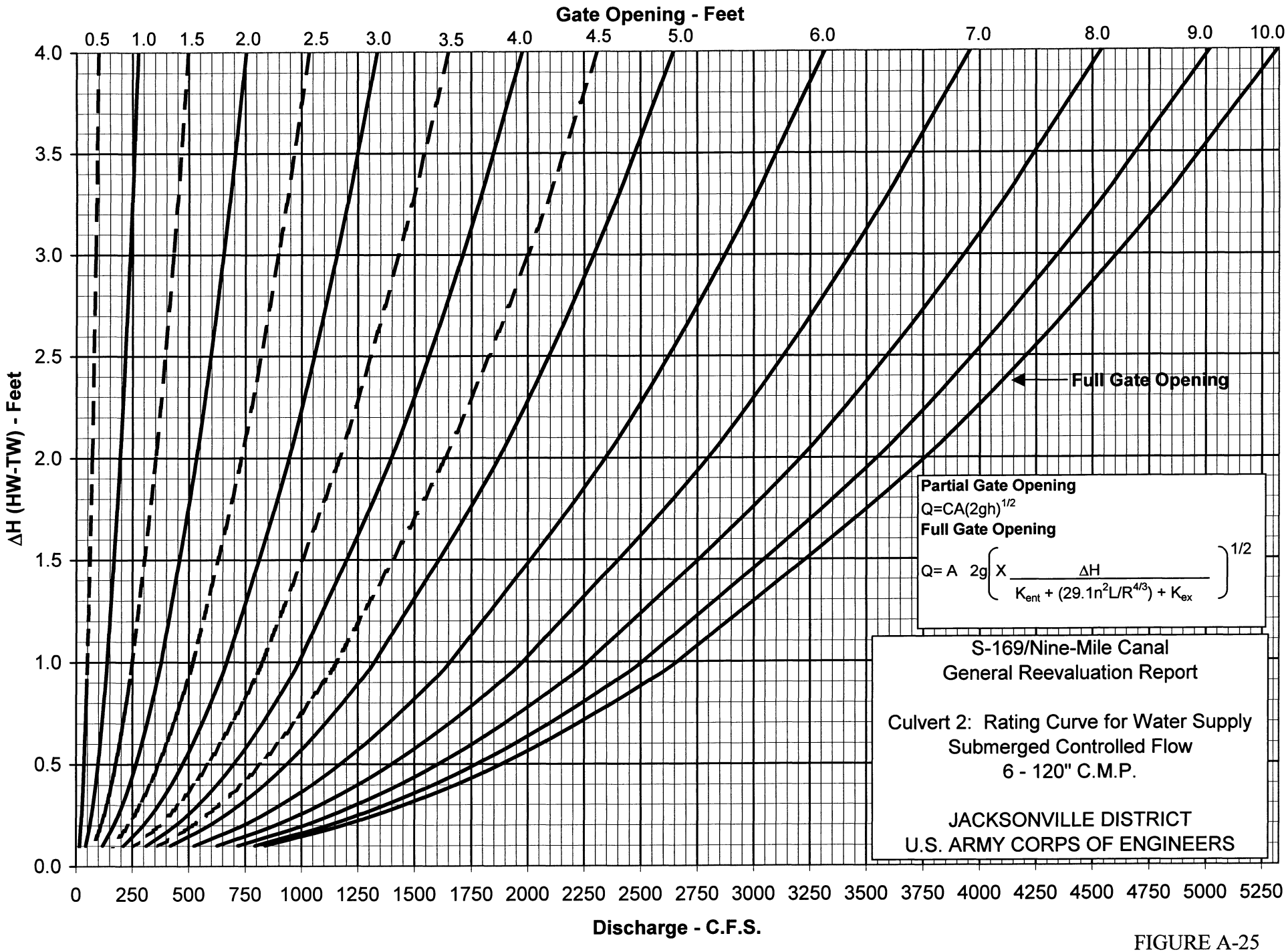

Gate Opening - Feet
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
6.0
7.0
8.0
9.0
10.0
ΔH (HW-TW) - Feet
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Discharge - C.F.S.
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
2750
3000
3250
3500
3750
4000
4250
4500
4750
5000
5250
Full Gate Opening
Partial Gate Opening
Q=CA(2gh)^1/2
Full Gate Opening
Q= A 2g (X ΔH / (K_ent + (29.1n^2L/R^4/3) + K_ex))^1/2
S-169/Nine-Mile Canal
General Reevaluation Report
Culvert 2: Rating Curve for Water Supply
Submerged Controlled Flow
6 - 120" C.M.P.
JACKSONVILLE DISTRICT
U.S. ARMY CORPS OF ENGINEERS

FIGURE A-25

TABLES

Table A-1 Land Use for Sub-Basins Served by S-310 and S-169

Sub-Basin	Pumping Facility	Agriculture (%)	Pasture[1] (%)	Wetland (%)	Water[2] (%)	Urban[3] (%)	Sub-Total (%)
USSC	Southline	95.3	0.0	0.5	2.0	2.2	100.0
SFCD	P-5-W	83.9	2.7	2.7	5.6	5.1	100.0
Clewiston	Clewiston Station 3	26.1	2.5	2.9	2.0	66.5	100.0
East Hendry	East Hendry	22.2	2.9	5.7	9.7	59.5	100.0
JD Thornton	JD Thornton	53.0	0.0	0.0	27.6	19.4	100.0
S-169 Basin Total		82.9	1.4	1.7	3.9	10.1	100.0

1. Pasture areas include forested areas.
2. Water areas include small ponds and borrow areas.
3. Urban areas include facilities, utilities, and a golf range.

Table A-2 Capacity and Cumulative Discharge for Industrial Canal Facilities

Facility	Rated Capacity		Approximate Drainage Area (SQ. MILES)	Equivalent Removal Rate (IN./DAY)
	(GPM)	(CFS)		
USSC/Southline	5 – 22,000 & 2 – 45,000	446	14	1.2
SFCD/P-5-W	2 – 48,000 & 2 – 38,000	383	11	1.3
Clewiston Station 3	2 – 37,500	167	1.9	3.3
East Hendry	1 – 14,000 & 1 – 9,000	51	1.7	1.1
JD Thornton	1 – 3,000	7	0.1	2.6
Cumulative Discharge	473,000	1054		

Table A-3 SFWMD Technical Publication 390 Data– Approximate 24-Hour Rainfall Values

Return Period	Storm Duration	Precipitation (Inches)
5-Year	24-Hour	4.5
10-Year	24-Hour	5.5
25-Year	24-Hour	7.0
50-Year	24-Hour	8.5

Table A-4 Hydrologic Soil Group Specifications

Hydrologic Soil Group	Soil Group Specification	
A		High infiltration rates. Soils are deep, well drained to excessively drained sands and gravels.
A/D	Not currently implemented	Drained/undrained hydrologic class of soils that can be drained and are classified
B		Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures
B/D	Not currently implemented	Drained/undrained hydrologic class of soils that can be drained and are classified
C		Slow infiltration rates. Soils with layers impeding downward movement of water, or soils with moderately fine or fine textures.
C/D	Not currently implemented	Drained/undrained hydrologic class of soils that can be drained and classified
D		Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.

Table A-5 Typical Runoff Curve Numbers for Hydrologic Soil Groups and Land Uses

(Antecedent moisture condition, AMC II, and Ia=0.33) Cover		Hydrologic Soil Group			
Land Use	Treatment or Practice Hydrologic Condition	A	B	C	D
AGRICULTURE	Improved Pasture	39	61	74	80
UPLAND FORESTS	Tree Plantations	47	67	81	88
	Coniferous Forest	36	60	73	79
	Hardwood Forest	36	60	73	79
	Hardwood Forest	36	60	73	79
WETLANDS	Hardwood Swamp	30	58	71	78
	Freshwater Marsh	30	58	71	78
RANGELAND	Mixed Rangeland	39	61	74	80
BARREN LAND	WATER	100	100	100	100
	Barrow Area	77	86	91	94
URBAN AND BUILT-UP	Residential-low density	47	66	77	81
	Recreational-marina	77	85	90	92
	Undeveloped Open Land	72	82	87	89

Table A-6 Weighted Curve Numbers for Sub-Basins Served by S-169 and S-310

Basin	Soil Description	Soil Group	Land Use Area (ac)										Total Area	Land %	Sub-Basin CN	Basin CN
					Wetlands			Barrenland		Urban & BUILT-UP						
			Agriculture: Improved Pasture	Upland Forest: Coniferous Forest	Hardwood Swamp	Freshwater Marsh	RANGELAND: Mixed Rangeland	Water	Barrow Area	Residential Low Density	Recreational -Marina	Transportation				
Southline	BOCA SAND	B/D	92.6									3.9	96.5	1.1	60.0	**41.1**
	IMMOKALEE SAND	A/D	1805		4.5			32.7	10.5	30.2		53.5	1937	21.6	40.1	
	MYAKKA SAND	A/D	365.1					1.4	11.1				377.6	4.2	40.3	
	BASINGER SAND	A/D	134.0					11.3				3.1	148.3	1.7	43.4	
	GATOR MUCK	A/D	420.2						5.2			6.3	431.8	4.8	39.3	
	OKEELANTA MUCK	A/D	401.1			11.7							412.7	4.6	38.7	
	HOLOPAW SAND	B/D	19.6										19.6	0.2	61.0	
	HALLANDALE SAND	A/D	170.3									2.3	172.6	1.9	38.9	
	RIVIERA SAND, LIMESTONE SUBSTRATUM	B/D	222.4		3.8					2.1		9.2	237.4	2.7	60.0	
	BOCA SAND, DEPRESSIONAL	B/D	33.9		0.1			1.6					35.5	0.4	62.7	
	OLDSMAR SAND, LIMESTONE SUBSTRATUM	B/D	103.6					4.3	4.8			7.3	120.0	1.3	61.8	
	HOLOPAW SAND, DEPRESSIONAL	B/D	5.5										5.5	0.1	61.0	
	PAHOKEE MUCK	A/D	199.0			4.2		0.7	10.5				214.3	2.4	40.9	
	TERRA CEIA MUCK	A/D	168.7						8.0				176.7	2.0	40.7	
	HALLANDALE SAND, DEPRESSIONAL	A/D	27.6										27.6	0.3	39.0	
	PLANTATION-MUCK	A/D	1426					12.0	1.6			21.5	1461	16.3	39.4	
	MARGATE SAND	A/D	2861		19.1			48.1	6.9			51.37	2987	33.3	39.9	
	LAUDERHILL MUCK	A/D	47.1					0.7	0.2		3.5	3.2	54.7	0.6	41.8	
	DANIA MUCK	A/D	30.8					5.6				4.8	41.2	0.5	46.2	
	WATER	D	1.0		1.9			0.2	0.04				3.1	0.03	80.3	
P-5-W	MYAKKA SAND	A/D	18.6					0.6					19.2	0.3	40.8	**42.2**
	GATOR MUCK	A/D	107.7						0.2	2.8			110.7	1.4	39.3	
	JUPITER FINE SAND	A/D	148.9	8.7	12.1			0.3		7.7			177.6	2.3	38.7	
	PAHOKEE MUCK	A/D	868.7	44.8	53.0			5.0	3.9	10.9		0.0	986.1	12.8	38.9	
	UDORTHENTS	B	16.5	3.2	1.9			31.2	37.6	11.2			101.6	1.3	82.7	
	AQUENTS, ORGANIC SUBSTRATUM	D	8.3	4.9	1.3					0.8		2.0	17.4	0.3	77.3	
	TERRA CEIA MUCK	A/D	192.8									3.5	196.3	2.6	38.8	
	PLANTATION-MUCK	A/D	367.5	14.1	8.4			20.4	7.8	49.1			467.3	6.1	42.9	
	MARGATE SAND	A/D	1572	115.7	114.7			42.3	70.9	107.8		2.3	2026	26.4	41.3	
	LAUDERHILL MUCK	A/D	1012	7.3				2.9	9.9	101.1		17.4	1150	15.0	40.0	
	DANIA MUCK	A/D	2132					20.6	8.1	62.4		14.3	2237	29.1	39.9	
	WATER	D		10.5	12.1			27.2	139.9	0.3			190.0	2.5	93.0	
Clewiston Station 3	IMMOKALEE SAND	A/D	115.5	5.2	4.6		0.1	6.6		407.6		51.6	591.2	48.6	70.4	**65.0**
	MYAKKA SAND	A/D	66.9				6.5	7.0		11.5		13.8	105.6	8.7	50.3	
	BASINGER SAND	A/D	54.4					2.4		72.6		1.1	130.5	10.7	44.8	
	GATOR MUCK	A/D	0.3	1.7						0.4			2.4	0.2	44.4	
	OKEELANTA MUCK	A/D	10.1							0.3			10.4	0.9	39.2	
	OLDSMAR SAND, LIMESTONE SUBSTRATUM	B/D	14.0							113.2			127.2	10.5	76.4	
	AQUENTS, ORGANIC SUBSTRATUM	D						1.0	0.3	7.8			9.1	0.7	83.4	
	DELRAY SAND, DEPRESSIONAL	A/D	2.6					0.2	0.04				2.8	0.2	43.7	
	HALLANDALE SAND, DEPRESSIONAL	A/D	0.2	8.0	14.0		2.7	0.1		7.3			32.3	2.7	68.3	
	PLANTATION-MUCK	A/D	18.5					0.1		14.1			32.6	2.7	57.2	
	MARGATE SAND	A/D	35.3	9.5	8.6			2.5	3.0	60.1		0.4	119.3	9.8	59.6	
	ADAMSVILLE VARIANT SAND	C		5.9	6.73		1.6			36.0			50.3	4.1	75.6	
East Hendry	GATOR MUCK	A/D	10.0							5.8			15.8	2.0	41.9	**50.0**
	UDORTHENTS	B						3.28		18.5			21.8	2.72	71.1	
	AQUENTS, ORGANIC SUBSTRATUM	A/D	14.3							3.8		0.6	18.6	2.33	40.3	
	PLANTATION-MUCK	A/D	120.8	9.1	15.5			2.26	57.8	88.5			293.9	36.74	48.8	
	MARGATE SAND	A/D	32.5	14.5	29.9			2.6		304.6		0.1	384.1	48.1	44.9	
	ADAMSVILLE VARIANT SAND	C								14.5		0.3	14.7	1.8	76.5	
	WATER	D						11.35		38.7			50.1	6.3	85.3	
JD Thornton	MARGATE SAND	A/D	34.0					17.7		3.7	6.7	2.0	64.0	100.0	60.0	**60.0**

Table A-7 Sub-Basin Hydrological Data

Sub-Basin	Pumping Facility	Area (mi^2)	Pump Removal Rates (in/day)	CN (AMC II)	S (in)
USSC	Southline	14.00	1.2	41.1	14.3
SFCD	P-5-W	11.00	1.3	42.2	13.7
Clewiston	Clewiston Station 3	1.90	3.3	65.0	5.4
East Hendry	East Hendry	1.70	1.1	50.0	10.0
JD Thornton	JD Thornton	0.10	2.6	60.0	6.7

Table A-8 Required Rainfall to Result in Runoff Depths Equal to Pump Removal Rates

Sub-Basin	Pumping Facility	24-Hour Precipitation (in/day)
USSC	Southline	7.65
SFCD	P-5-W	7.66
Clewiston	Clewiston Station 3	7.26
East Hendry	East Hendry	5.91
JD Thornton	JD Thornton	7.01

Table A-9 Industrial Canal Irrigational Facilities

Facility	Structure
USSC Southline	3 – 36" Diameter Culverts
USSC Pumps	2 – 33,000 gpm Pumps
SFCD P-5-W	2 – 36" Diameter Culverts

Table A-10 Irrigational Capability for Industrial Canal Facilities – Existing Conditions

Upstream Stage 15.5			
Facility	Headwater (Feet, NGVD)	Tailwater (Feet, NGVD)	Flow (CFS)
USSC Southline	*12.25	10.0	179
USSC Pumps	--	--	147
SFCD P-5-W	12.49	Less Than 7.0	136
Total Maximum Capability			462
Upstream Stage 15.2			
Facility	Headwater (Feet, NGVD)	Tailwater (Feet, NGVD)	Flow (CFS)
USSC Southline	*11.73	10.0	157
USSC Pumps	--	--	147
SFCD P-5-W	11.99	Less Than 7.0	127
Total Maximum Capability			431
Upstream Stage 14.5			
Facility	Headwater (Feet, NGVD)	Tailwater (Feet, NGVD)	Flow (CFS)
USSC Southline	*10.6	10.0	93
USSC Pumps	--	--	147
SFCD P-5-W	10.8	Less Than 7.0	105
Total Maximum Capability			345
Upstream Stage 13.5			
Facility	Headwater (Feet, NGVD)	Tailwater (Feet, NGVD)	Flow (CFS)
USSC Southline	*10.008	10.0	11
USSC Pumps	--	--	147
SFCD P-5-W	10.1	Less Than 7.0	86
Total Maximum Capability			244
Upstream Stage 13.0			
Facility	Headwater (Feet, NGVD)	Tailwater (Feet, NGVD)	Flow (CFS)
USSC Southline	*10.0	10.0	0
USSC Pumps	--	--	147
SFCD P-5-W	10.11	Less Than 7.0	**43
Total Maximum Capability			190

* Downstream Boundary Condition
** Operating Only One Culvert

Table A-11 Comparison of Structure 169 Hydraulic Data (Design vs. Existing Conditions)

STRUCTURE 169	DISCHARGE (CFS)	HEADWATER (Ft, NGVD)	TAILWATER (Ft, NGVD)	DOWNSTREAM BOUNDARY (Ft, NGVD)	CULVERT VELOCITY (FPS)
DESIGN	625	14.5	13.7	~13.2	5.3
MODELED	1054	16.8	14.3	14.0	9.1
MODELED	1054	15.9	13.4	13.0	9.1
MODELED	1054	15.1	12.5	12.0	9.1 to 9.4
MODELED	1054	14.6	11.8	11.0	9.3 to 10.3
MODELED	1054	14.5	11.2	10.0	9.5 to 11.6

Table A-12 Irrigational Capability for Industrial Canal Facilities – Recommended Plan

Upstream Stage 15.5			
Facility	Headwater (Feet, NGVD)	Tailwater (Feet, NGVD)	Flow (CFS)
USSC Southline	*12.25	10.0	179
USSC Pumps	--	--	147
SFCD P-5-W	12.49	Less Than 7.0	136
Total Maximum Capability			462
Upstream Stage 15.2			
Facility	Headwater (Feet, NGVD)	Tailwater (Feet, NGVD)	Flow (CFS)
USSC Southline	*11.54	10.0	148
USSC Pumps	--	--	147
SFCD P-5-W	11.80	Less Than 7.0	124
Total Maximum Capability			419
Upstream Stage 14.5			
Facility	Headwater (Feet, NGVD)	Tailwater (Feet, NGVD)	Flow (CFS)
USSC Southline	*10.6	10.0	93
USSC Pumps	--	--	147
SFCD P-5-W	10.8	Less Than 7.0	105
Total Maximum Capability			345
Upstream Stage 13.5			
Facility	Headwater (Feet, NGVD)	Tailwater (Feet, NGVD)	Flow (CFS)
USSC Southline	*10.008	10.0	11
USSC Pumps	--	--	147
SFCD P-5-W	10.1	Less Than 7.0	86
Total Maximum Capability			244
Upstream Stage 13.0			
Facility	Headwater (Feet, NGVD)	Tailwater (Feet, NGVD)	Flow (CFS)
USSC Southline	*10.0	10.0	0
USSC Pumps	--	--	147
SFCD P-5-W	10.11	Less Than 7.0	**43
Total Maximum Capability			190

* Downstream Boundary Condition

** Operating Only One Culvert

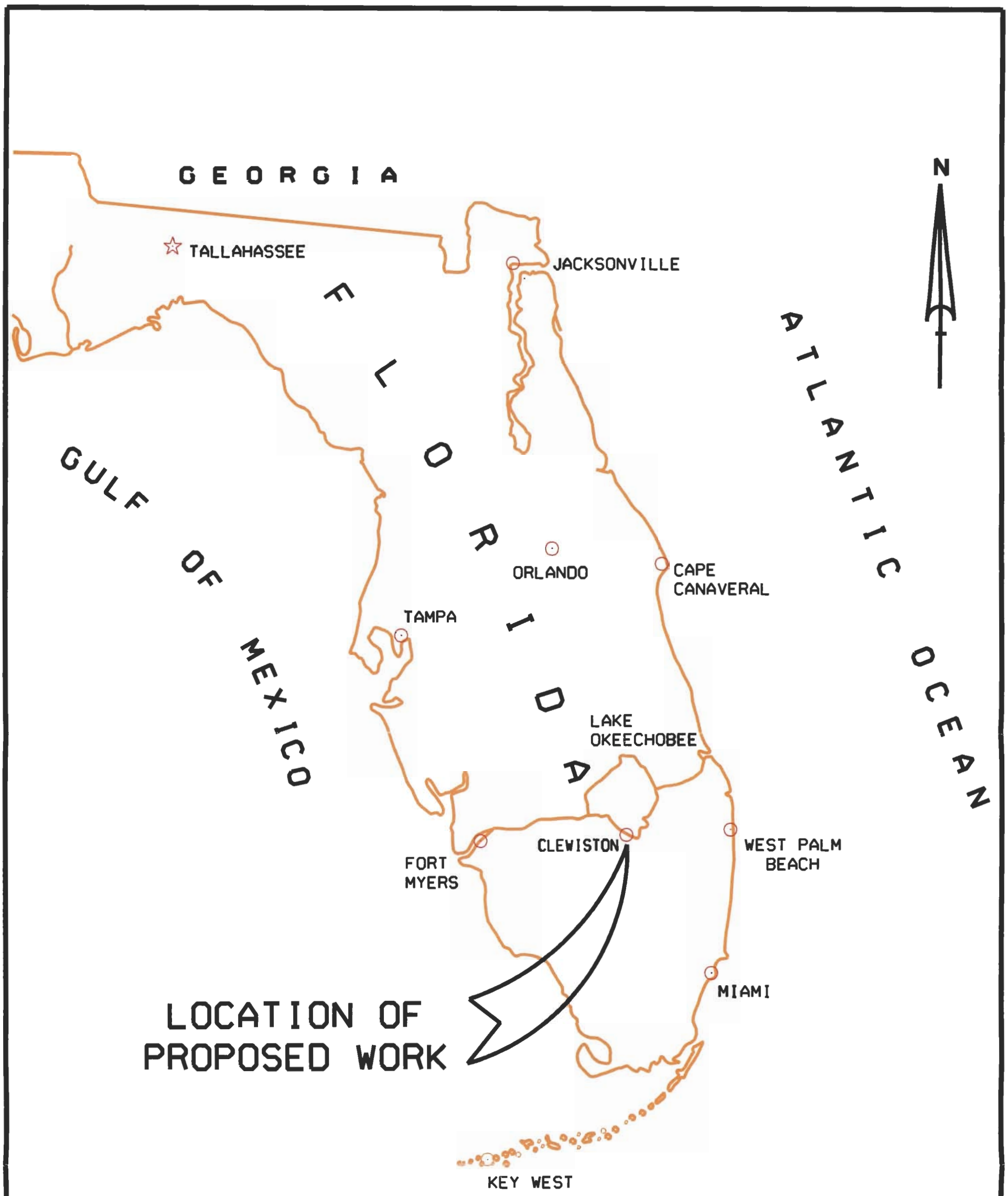
Table A-13 S-169R Hydraulic Data
(Recommended Plan – Alternative 4A)

STRUCTURE 169R	DISCHARGE (CFS)	HEADWATER (Ft, NGVD)	TAILWATER (Ft, NGVD)	DOWNSTREAM BOUNDARY (Ft, NGVD)	CULVERT VELOCITY (FPS)
MODELED	1054	15.4	14	14.0	6.85
MODELED	1054	14.5	13.1	13.0	6.85
MODELED	1054	13.5	12.1	12.0	6.85
MODELED	1054	12.6	11.2	11.0	6.85
MODELED	1054	11.7	10.3	10.0	6.85

Table A-14 S-169R Hydraulic Design Data

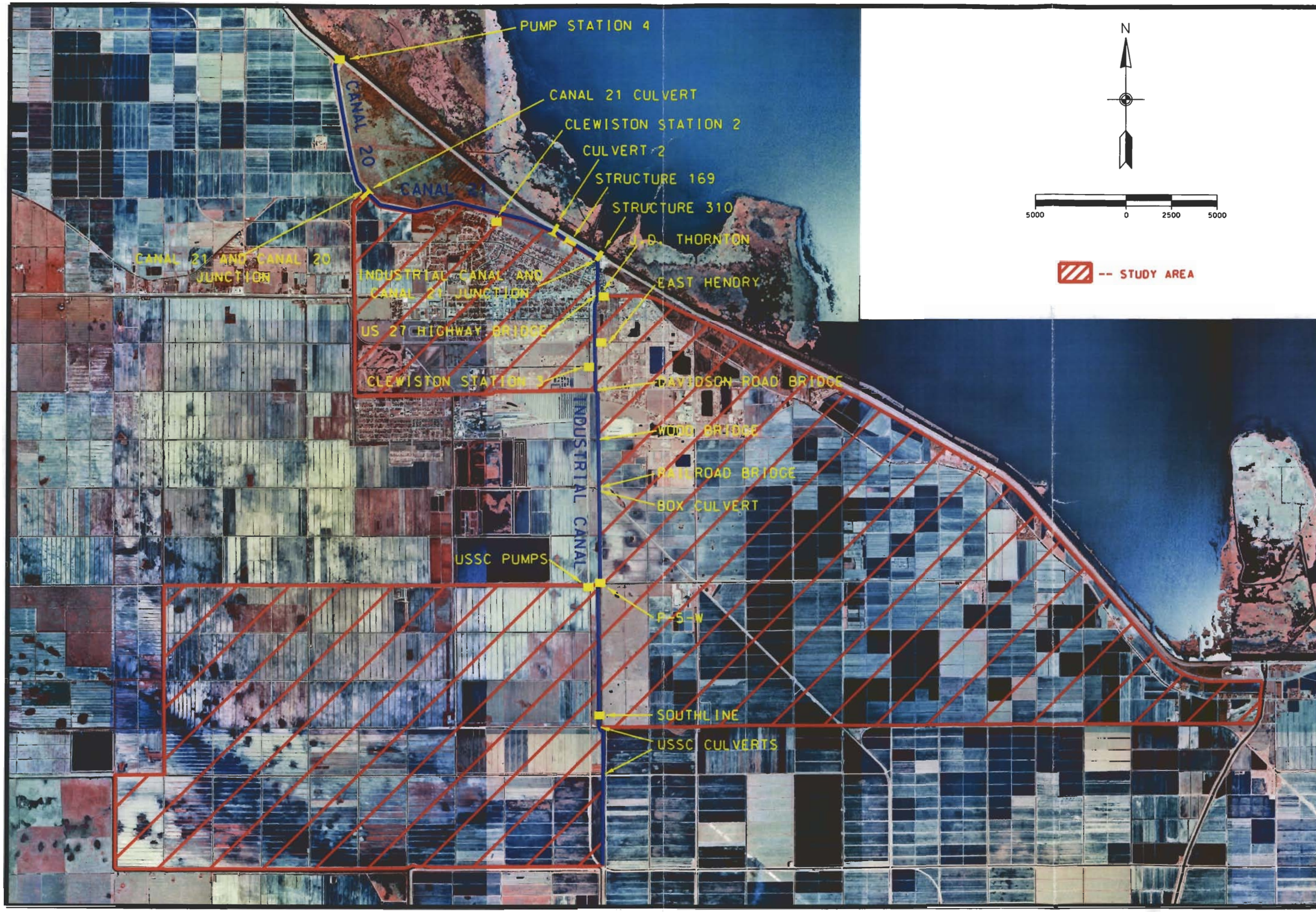
Design Conditions		
Discharge	1054	CFS
Headwater Elevation	15.4	FEET, NGVD
Tailwater Elevation	14.0	FEET, NGVD
Optimum Conditions		
Headwater Elevation	13.0 to 15.5	FEET, NGVD
Tailwater Elevation	10.0 to 14.0	FEET, NGVD
Maximum Head Difference		
Discharge	2061	CFS
Headwater Elevation	15.5	FEET, NGVD
Tailwater Elevation	10.0	FEET, NGVD
Culvert Data		
Number of Barrels	4	
Barrel Type	CMP	
Culvert Diameter	84	INCHES
Upstream Invert Elevation	2.5	FEET, NGVD
Downstream Invert Elevation	2.5	FEET, NGVD
Type of Control	Slide Gates	EAST SIDE
Canal Section		
Side Slopes (Vertical on Horizontal)	1 on 2	
Upstream Bottom Width	12.0	FEET
Upstream Bottom Elevation	3.0	FEET, NGVD
Downstream Bottom Width	12.0	FEET
Downstream Bottom Elevation	3.0	FEET, NGVD
Riprap Requirements		
Barrel Veloctiy	7.0	FPS
Upstream Length	80.0	FEET
Upstream Protection Elevation	20.0	FEET, NGVD
Downstream Length	80.0	FEET
Downstream Protection Elevation	20.0	FEET, NGVD
Protection Elevation		
Elevation	20.0	FEET, NGVD

PLATES



LOCATION MAP

PLATE A-1	S-169/NINE-MILE CANAL BASIN GENERAL REEVALUATION REPORT LOCATION OF PROPOSED WORK H&H APPENDIX DRAFT	File name: Reference files:	Designed by: Dwn by: Ckd by: Dated: D.O.FILE NO.	Scale: Plot date: Plot scale:	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS JACKSONVILLE, FLORIDA US Army Corps of Engineers Jacksonville District



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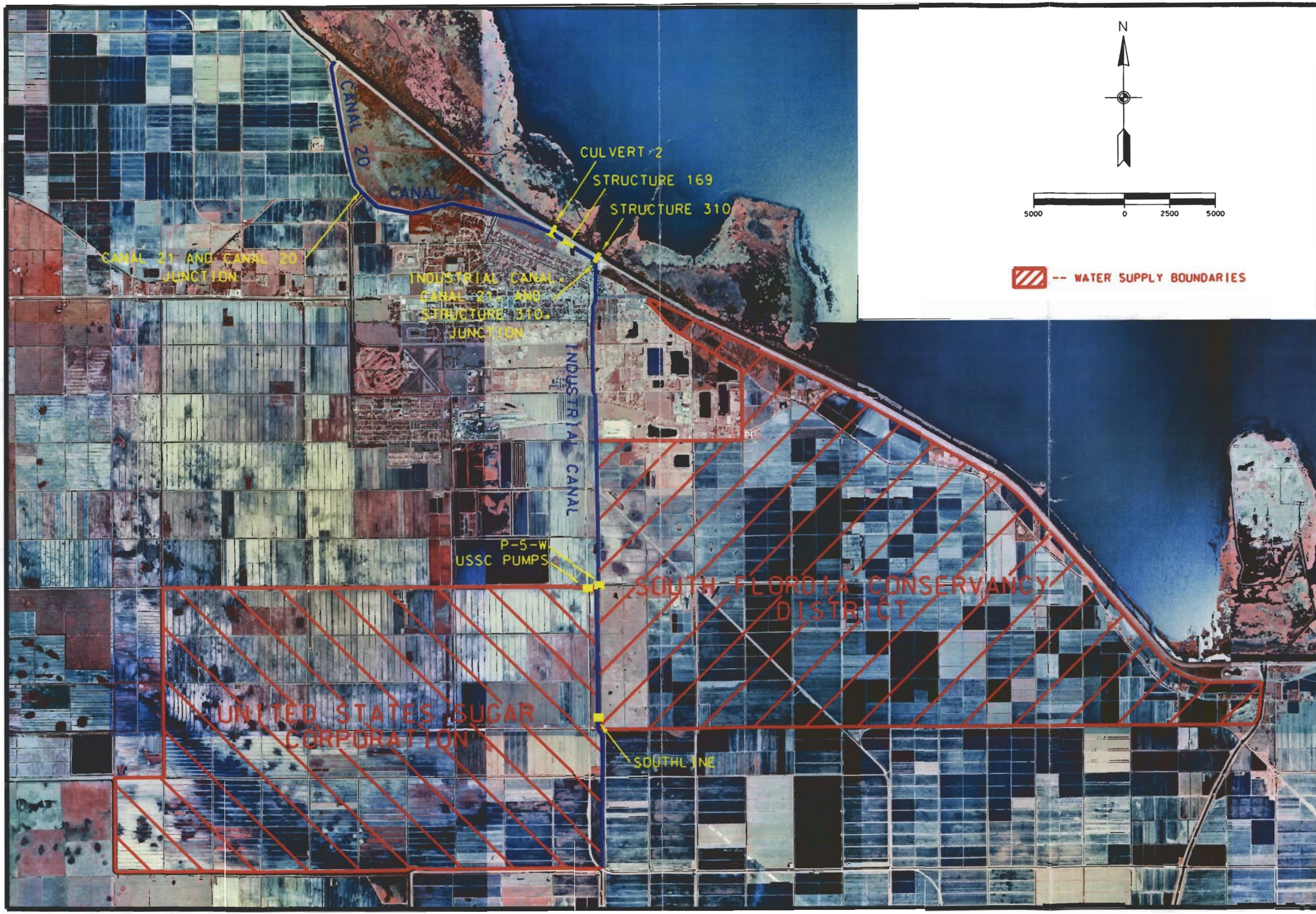
S-169/NINE-MILE CANAL BASIN
GENERAL REEVALUATION REPORT

MAIN CANALS, FACILITIES, AND STRUCTURES

H&H APPENDIX
DRAFT

PLATE
A-2



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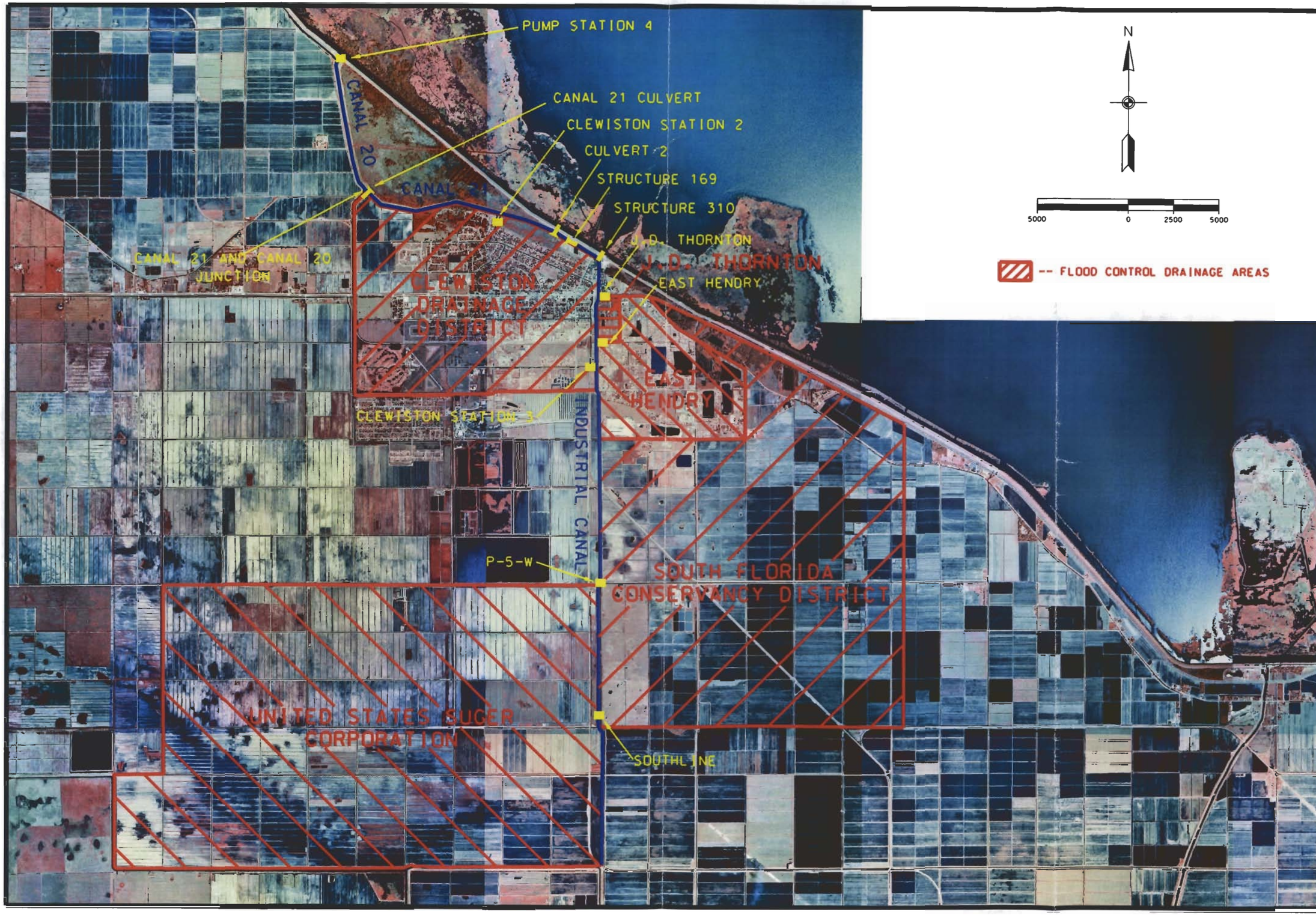
93-1869/NINE-MILE 'CANAL 'BASIN
GENERAL REEVALUATION REPORT
WATER-SUPPLY BOUNDARIES
H&H APPENDIX
DRAFT

PLATE
A-3



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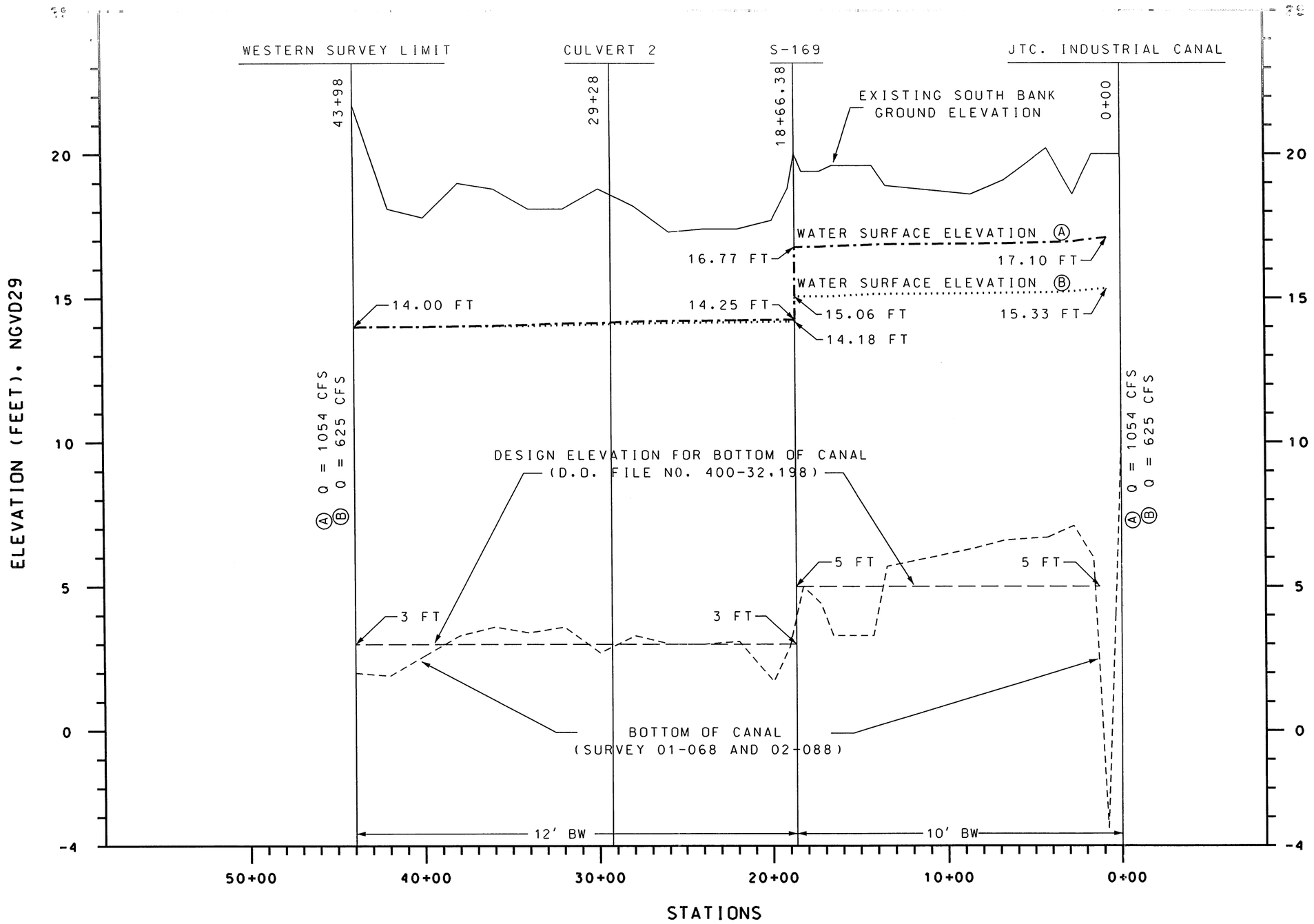
S-169/NINE-MILE CANAL BASIN
GENERAL REEVALUATION REPORT
FLOOD-CONTROL-DRAINAGE AREAS
H&H APPENDIX
DRAFT

PLATE
A-4



Ⓐ —·—·—·— EXISTING CONDITIONS - CANAL 21 WATER SURFACE PROFILE (1054 CFS)

Ⓑ ..... EXISTING CONDITIONS - CANAL 21 WATER SURFACE PROFILE (625 CFS)

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

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Reference files: | Dated: D.O.FILE NO.
File name:

S-169/NINE-MILE CANAL BASIN
GENERAL REEVALUATION REPORT
EXISTING CONDITIONS - CANAL 21 HYDRAULIC-DESIGN PROFILE
H&H APPENDIX
DRAFT

PLATE
A-5

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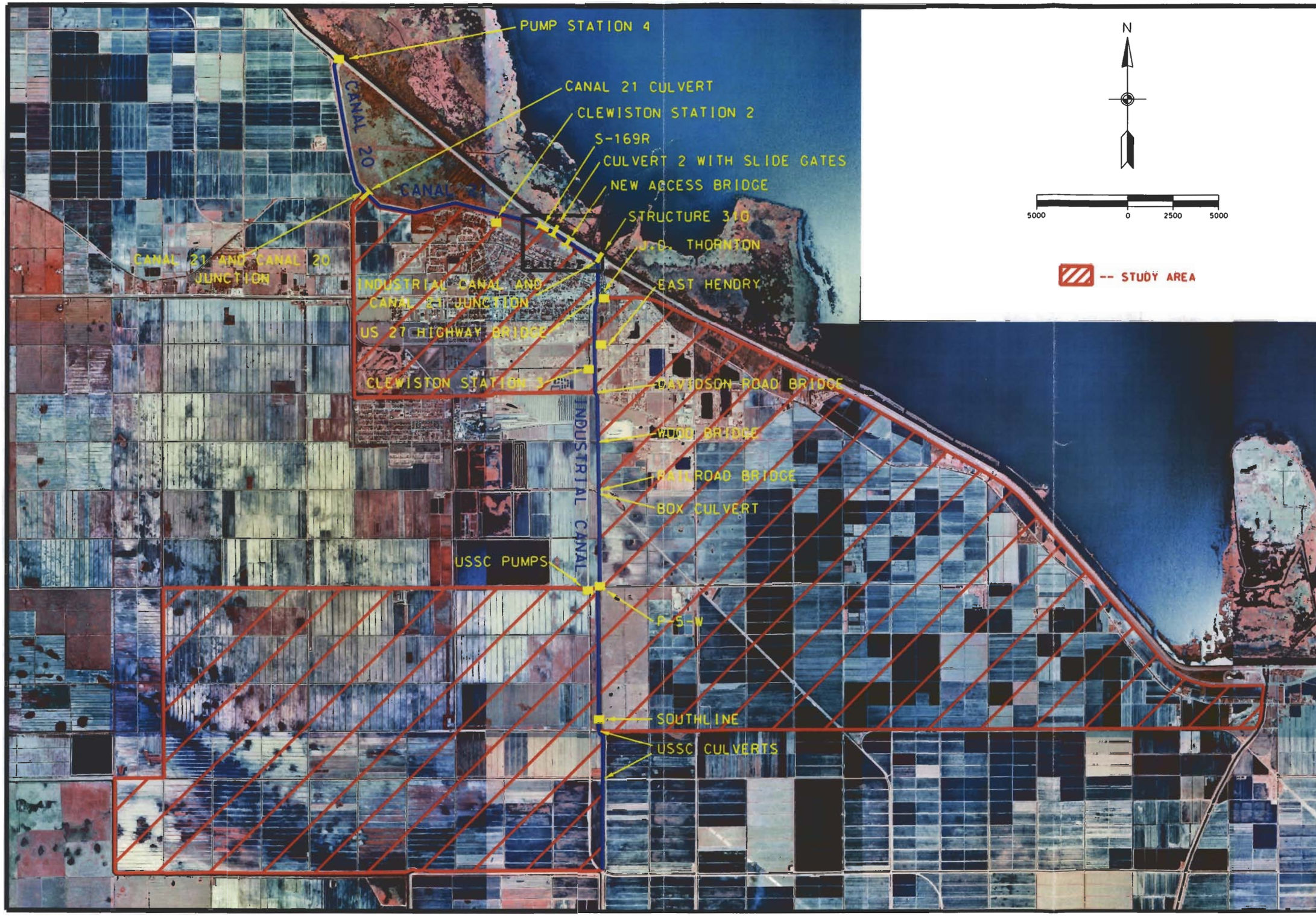
S-169/NINE-MILE CANAL BASIN
GENERAL REEVALUATION REPORT
EXISTING CONDITIONS - CANAL 21 WATER-SURFACE BOUNDARY
H&H APPENDIX
DRAFT

PLATE
A-6



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Reference files:

"S-169/NINE-MILE CANAL BASIN
GENERAL REEVALUATION REPORT

RECOMMENDED PLAN ALTERNATIVE 4A

H&H APPENDIX
DRAFT

PLATE
A-7

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Jacksonville District

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JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

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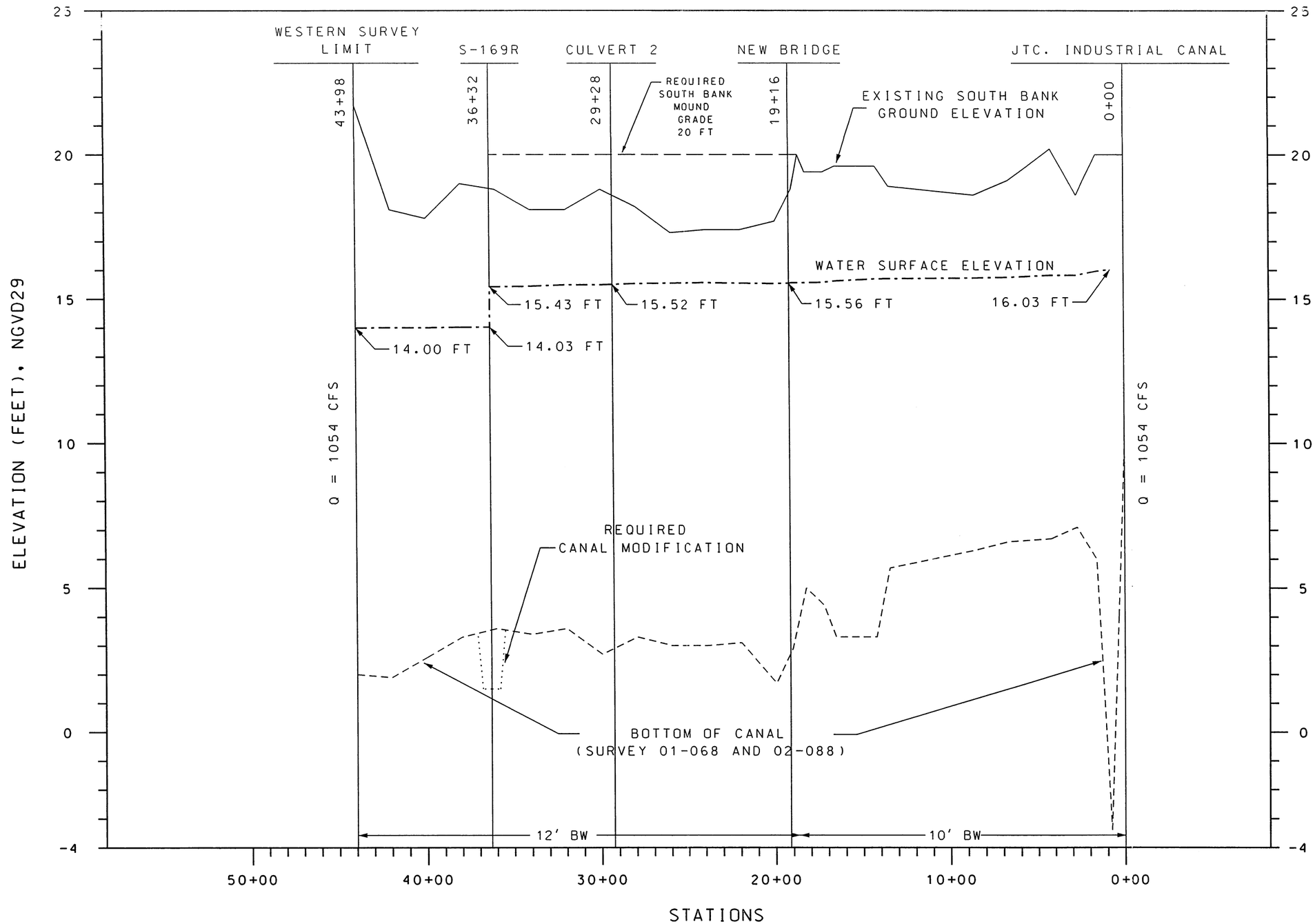
Ckd by:
Scale: AS SHOWN
Plot date:
Plot scale:
File name:
Reference files:
Dated:
D.O. FILE NO.

S-169/NINE-MILE CANAL BASIN
GENERAL REEVALUATION REPORT
RECOMMENDED PLAN ALTERNATIVE 4A (CANAL 21)
H&H APPENDIX
DRAFT

PLATE
A-8



ALTERNATIVE 4A - CANAL 21 WATER SURFACE PROFILE (1054 CFS)

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

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Reference files:
Dated:
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S-169/NINE-MILE CANAL BASIN
GENERAL REEVALUATION REPORT
ALTERNATIVE 4A - CANAL 21 HYDRAULIC-DESIGN PROFILE
H&H APPENDIX
DRAFT

PLATE
A-9

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Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

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Ckd by:
Scale: AS SHOWN
Plot date:
Plot scale:
File name:
Reference files:
Dated:
D.O. FILE NO.

S-169/NINE-MILE CANAL BASIN
GENERAL REEVALUATION REPORT
ALTERNATIVE 4A - CANAL 21 WATER-SURFACE BOUNDARY
H&H APPENDIX
DRAFT

PLATE
A-10

APPENDIX B

GEOTECHNICAL

FOR

S-169
GENERAL REEVALUATION REPORT
HENDRY COUNTY, FLORIDA

S-169
Geotechnical Report
Appendix B

1. General: The project consist of removing the existing three barrel culvert structure, S-169, constructing a new multiple barrel culvert structure 700 feet west of culvert C-2 on canal C-21to replace the existing S-169 culvert, constructing a tie-back levee from the new structure to the Herbert Hoover Dike and constructing a new 2 lane bridge at the existing S-169 culvert structure to provide access to Herbert Hoover Dike and structure S-310.

2. Location: This project is located on the east end of canal C-21 at Culvert S-169, adjacent to the south bank Herbert Hoover Dike and north of the city of Clewiston, Hendry County, Florida.

3. General Geology of the Region: Hendry County has been divided into three areas based on its landforms or physiographic features. Most of the county lies in the Sandy Flatlands province and is flanked by the Everglades on the east side and by the Big Cypress Swamp on the south. This project is located in the northern part of Hendry County in the Sandy Flatlands region. The Sandy Flatlands region is characterized by a blanket of surficial marine sand with interlayer layers of laterally discontinuous carbonate beds of limestone and cohesive sediments (clastis material) that is up to 200 feet thick. The sand is from the late Pleistocene marine terraces that were deposited when the sea level fluctuated from 25 to 70 feet above current sea level.

4. Subsurface Investigation: Subsurface investigation for this project consists of drilling four core borings at the approximate locations and depths shown in table 1. Two core borings were drilled at the proposed bridge site, CB-S16903-01 and –02. Two core borings were drilled at the proposed culvert location CB-S16903-03 and –04.

TABLE 1

CORE BORING	DEPTH	X	Y
	FEET		
CB-S16903-01	60	524,922	882,570
CB-S16903-02	60	524,973	882,683
CB-S16903-03	25	523,381	883,402
CB-S16903-04	25	523,554	883,463

The core boring locations is based on geographic coordinates NAD 27 and elevations in NGVD were documented using GPS for measuring elevations.

5. Drilling Procedures: The core borings were advanced using a standard splitspoon, driven 18–inches by a 140-pound hammer, falling 30-inch and/or cored using a 4-inch diamond core barrel when in rock was encountered. Each boring was sampled continuously. The blow count for each 6-inch interval was recorded. When material was encountered which was obviously rock or when the blow count exceed 50 blows or more for a 6-inch interval, the hole was advanced using a 4-inch diamond core barrel. All materials were described and classified in accordance with the Unified Soils Classification System.

6. Materials Encountered:

6.1 Proposed Bridge Site: Two core borings were drilled at the proposed bridge site to a depth of 60 feet. Material encountered in CB-S16903-01 consisted of a 12-foot layer of sandy fill material followed by layers of silty sand with some shell and few clay and poorly graded sand. The material encounter in CB-S16903-02 consisted of layers of silty and clayey sand interbedded with layers of soft limestone, sandstone, and clay. The loose silty, clayey sand has a range of blow counts between 3 to 7 blows per foot corresponding to a phi angle of 30 degrees. The dense silty sand layer has an average blow count of 22 blows per foot, which corresponds to a phi angle 36 degrees. The soft to dense sandstone has a phi angle of 38 degrees.

6.2 Proposed Culvert Site: Two core borings were drilled at the proposed culvert site on canal C-21 to a depth of 25 feet. The proposed invert elevation of the new culvert structure is 1.5 feet, NGVD. The existing ground in this area is 16.5 feet. Core boring CB-S16903-03, located on the south bank of canal C-21, encountered an 8.2-foot layer of loose silty sand, average blow count of 3 and a phi angle 29 degrees. The sand overlies a 1.4-foot layer of very hard limestone with a phi angle of 40 degrees. The limestone overlies a 14.9-foot layer of loose silty sand, average blow count 7, phi angle 30 degrees. The material encountered in the boring CB-S16903-04, located on the north bank of the canal consists of 4.2 feet of loose silty sand, with an average blow count of 10 blows per foot, which corresponded to a phi angle of 30 degrees. The silty sand overlies a 5.4-foot layer of soft peat with a phi angle of 20 degrees. The peat overlies a 0.9-foot layer of soft limestone. The soft limestone overlies a 15.0-foot layer of loose silty sand, average blow count of 4 and a phi angle of 29 degrees.

7. List of Alternatives: Five alternatives (1, 2, 3, 4a, and 4b) were evaluated. Alternative 4a is the alternative that is currently recommended.

The following is a list of all the Alternatives considered,

7.1 Alternative 1 - No Action - Existing Conditions

7.2 Alternative 2: Operational Change to S-310 Lock. Fill in the existing scour hole on the landside of lock structure S-310. The scour hole was cause by excess water release velocities from the lock. .

The recommended repair to the scour hole. The new design velocity is 10 fps. The scour hole should be fill with sand, gravel or concrete rubble and a 12-inch thick layer of gabions placed on woven filter fabric for a distance of 100 feet down stream.

7.3 Alternative 3: Construct a Pump Station on south bank of Canal C-21. The foundation for the new pump station will be founded on loose to medium dense sand with an estimated bearing capacity of 2 tons per square foot (tsf). Bank protection for the pump station should consist of 18-inches of riprap placed on 12-inches of bedding stone.

7.4 Alternative 4- Two Options were evaluated.

7.4a Alternative 4A: The project consist of removing the existing three barrel culvert structure, S-169, constructing a new multiple barrel culvert structure 700 feet west of culvert C-2 on canal C-21to replace the existing S-169 culvert, constructing a tie-back levee from the new structure to the Herbert Hoover Dike and constructing a new 2 lane bridge at the existing S-169 culvert structure to provide access to Herbert Hoover Dike and structure S-310.

The foundation for the new S-169 culvert structure should be founded on a loose to medium dense sand with a bearing capacity of 2 tsf. Riprap should be placed on both the upstream and downstream side of the structure.
For a design water velocity of 7 fps, the riprap should consist of 18-inches of stone placed on 12- inch layer of filter stone.

The proposed tieback levees on the north bank of canal C-21. The tie back levee will run from the proposed location of S-169 structure to the toe of the Herbert Hoover Dike. The levee will have a crest elevation of 20 feet, NGVD, with 15-foot crest width and 1 V on 3 H side slopes. The existing ground is approximately 18 foot within this reach.

The proposed tieback levee on the south bank canal C-21. The tie back levee will run from the proposed S-169 structure east approximately 1850 feet and tie into high ground at the existing S-169 structure. The levee will have a crest elevation of 20 feet, NGVD, with 15-foot crest width and 1 V on 3 H side slopes. The existing ground is range from approximately 15 feet to 20 feet.

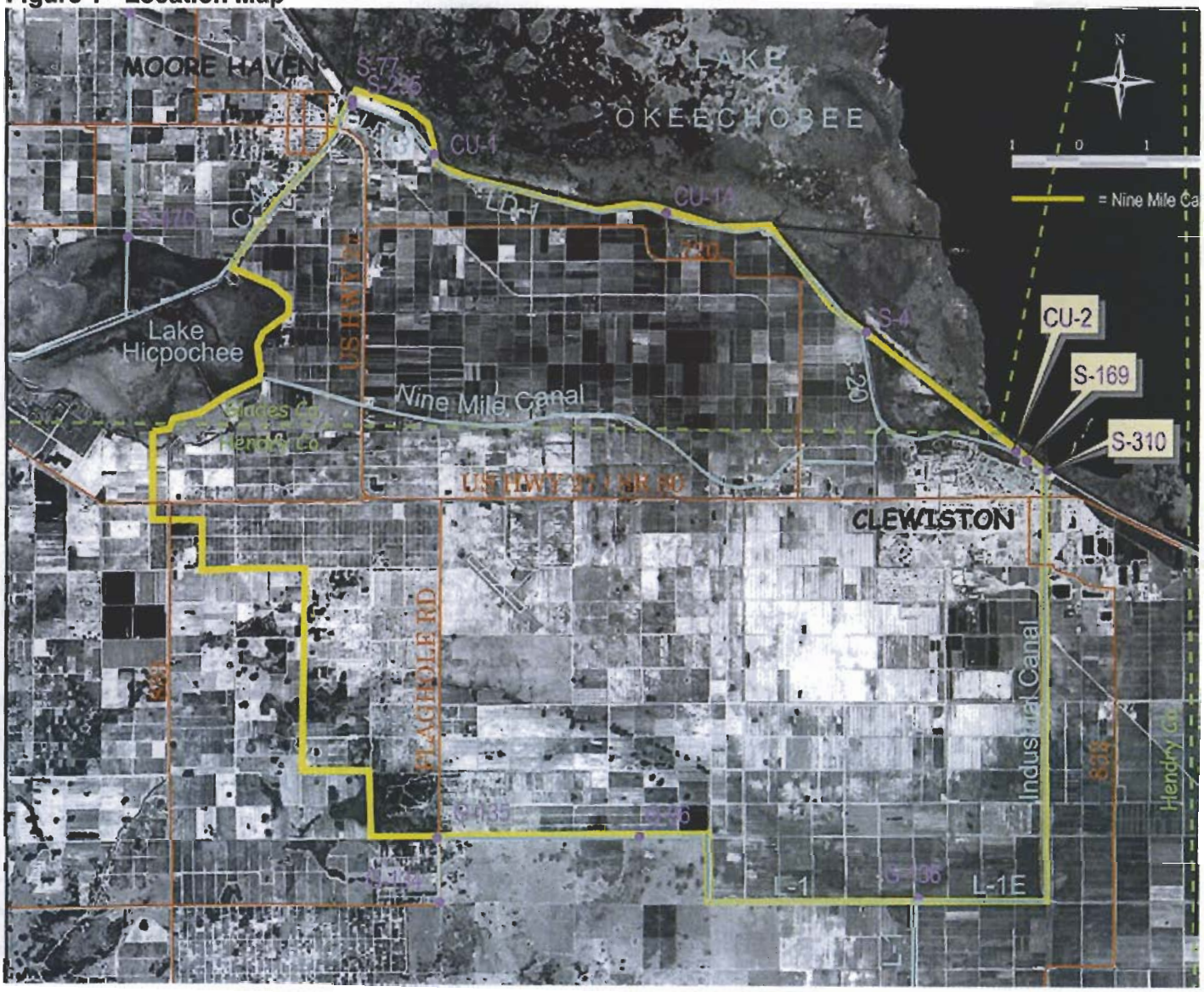
The new bridge foundation will consist of a pile foundation. The piles should be at least 60 feet deep. Additional geotechnical and subsurface investigations are recommended at the proposed bridge site to better define the piles foundation

7.4b Alternative 4B - Modify the existing S-169 culvert structure to accommodate an additional seven-foot barrel. Riprap should be placed on both the upstream and downstream side of the new water control structure. For a design water velocity of 7 fps, the riprap should consist of 18-inches of stone placed on 12-inches of filter stone.

8.0 Rehabilitation of the east and west spoil mounds along the Industrial Canal. The water level in this canal is control by the local farmers. No geotechnical investigation was performed in this reach at this time. However, based on visual inspection of the existing spoil mounts and canal excavation, the spoil mound consists of silty sand.

9.0. Description of Additional Geotechnical Investigation. Additional geotechnical and subsurface investigations are recommended at the proposed bridge site. The subsurface investigation should consist of drilling two additional core borings to a depth of 90 feet. The geotechnical investigation will consist of performing slope stability and seepage analysis for the foundation design for the proposed bridge, culverts and pump station.

Figure 1- Location Map



CORE BORINGS LOGS

Boring Designation CB-S16903-01

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 4 SHEETS

1. PROJECT	C&SF S-169/Nine Mile Basin Proposed New Bridge Site
2. BORING DESIGNATION	CB-S16903-01
LOCATION COORDINATES	X = 524,922 Y = 882,570
3. DRILLING AGENCY	Corps Of Engineers
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	L.C. Gregory
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	0.0 Ft.
7. DEPTH DRILLED INTO ROCK	0.0 Ft.
8. TOTAL DEPTH OF BORING	60.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, FLE (U.S. Ft.)
HORIZONTAL	NAD27
VERTICAL	NGVD29
11. MANUFACTURER'S DESIGNATION OF DRILL	CME-45 (land-based)
	☒ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 40 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	2
14. ELEVATION GROUND WATER	10.0 Ft.
15. DATE BORING	STARTED 02-12-03 / COMPLETED 12-13-03
16. ELEVATION TOP OF BORING	17.5 Ft.
17. TOTAL RECOVERY FOR BORING	83 %
18. SIGNATURE AND TITLE OF INSPECTOR	Steve Myers, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
17.5	0.0						17.5		
			FILL, sandy, mostly angular to subangular fine to coarse-grained sand-sized carbonate, little quartz, little silt, few fine gravel-sized limestone, strong reaction with HCl, dry, tan	100	1		SPT Sampler 16.0	17 18 16	34
				87	2		SPT Sampler 14.5	14 15 47	62
			At El. 14.5 Ft., little limestone, moist	100	3		SPT Sampler 13.0	18 19 19	38
				93	4		SPT Sampler 11.5	10 14 10	24
10.0	7.5			100	5		SPT Sampler 10.0	5 10 12	22
			FILL, mostly quartz, little carbonate, wet	73	6		SPT Sampler 8.5	4 5 11	16
			At El. 8.5 Ft., some shell, trace limestone	80	7		SPT Sampler 7.0	6 6 5	11
			At El. 7.0 Ft., few limestone	60	8		SPT Sampler 5.5	7 10 8	18
5.5	12.0		SAND, silty, mostly angular to subrounded fine to medium-grained sand-sized quartz, little carbonate, little silt, few shell up to 1/4", weak reaction with HCl, wet, gray (SM)	93	9		SPT Sampler 4.0	4 6 9	15
			At El. 4.0 Ft., little shell	67	10		SPT Sampler 2.5	5 8 9	17

0 5 10 15

SAJ FORM 1836
JUN 02

(Continued)

Boring Designation CB-S16903-01

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 4 SHEETS
PROJECT C&SF S-169/Nine Mile Basin	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD27	VERTICAL NGVD29
LOCATION COORDINATES X = 524,922 Y = 882,570	ELEVATION TOP OF BORING 17.5 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				80	11		SPT Sampler 1.0	3 5 4	9
				100	12		SPT Sampler -0.5	3 2 3	5
				100	13		SPT Sampler -2.0	2 1 5	6
			At El. -2.0 Ft., discontinue shell	100	14		SPT Sampler -3.5	2 1 4	5
			At El. -4.0 Ft., trace clay, dark gray	87	15		SPT Sampler -5.0	WOR 1 2	3
				87	16		SPT Sampler -6.5	1 2 3	5
				93	17		SPT Sampler -8.0	WOR 1 1	2
				80	18		SPT Sampler -9.5	1 1 1	2
				93	19		SPT Sampler -11.0	1 1 2	3
			At El. -11.0 Ft., few shell up to 1/8"	100	20		SPT Sampler -12.5	WOR 2 2	4
			At El. -12.5 Ft., some shell up to 1/4", discontinue carbonate	87	21		SPT Sampler -14.0	1 1 2	3
				80	22		SPT Sampler -15.5	2 2 2	4
			At El. -15.5 Ft., some shell up to 3/4"	73	23		SPT Sampler -17.0	1 1 2	3
			At El. -17.0 Ft., few clay, few silt	100	24		SPT Sampler	WOR	

15 20 25 30 35

(Continued)

Boring Designation CB-S16903-01

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 3 OF 4 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
C&SF S-169/Nine Mile Basin	State Plane, FLE (U.S. Ft.)	NAD27	NGVD29

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 524,922 Y = 882,570	17.5 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				100	24		SPT Sampler -18.5	2 2	4
				80	25		SPT Sampler -20.0	WOR 1 3	4
				67	26		SPT Sampler -21.5	4 6 9	15
				60	27		SPT Sampler -23.0	2 4 6	10
				40	28		SPT Sampler -24.5	WOR 5 3	8
			At El. -24.5 Ft., few shell up to 1/2"						
-25.5	43.0			60	29		SPT Sampler -26.0	2 10 15	25
			SAND, poorly-graded, mostly subrounded to rounded fine to medium-grained sand-sized quartz, few carbonate, trace silt, weak reaction with HCl, wet, gray (SP)	100	30		SPT Sampler -27.5	2 11 29	40
				100	31		SPT Sampler -29.0	15 21 42	63
				100	32		SPT Sampler -30.5	15 40 50	90
				60	33		SPT Sampler -32.0	19 32 48	80
				47	34		SPT Sampler -33.5	22 26 40	66
-33.5	51.0								
			SAND, silty, mostly subrounded to rounded fine-grained sand-sized quartz, little silt, trace carbonate, weak reaction with HCl, wet, dark gray (SM)	93	35		SPT Sampler -35.0	6 5 2	7
				87	36		SPT Sampler -36.5	7 9 10	19
				87	37		SPT Sampler	2 6	

35 40 45 50 55

SAJ FORM 1836-A
JUN 02

(Continued)

Boring Designation CB-S16903-01

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 4 OF 4 SHEETS
PROJECT C&SF S-169/Nine Mile Basin	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD27	VERTICAL NGVD29
LOCATION COORDINATES X = 524,922 Y = 882,570	ELEVATION TOP OF BORING 17.5 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				87	37		-38.0 SPT Sampler	10	16
				93	38		SPT Sampler -39.5	3, 12, 9	21
				67	39		SPT Sampler -41.0	14, 20, 14	34
-42.5	60.0			80	40		SPT Sampler -42.5	3, 5, 20	25

NOTES:

1. Soils are field visually classified in accordance with the Unified Soils Classification System.

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

Abbreviations:
WOR = Weight of Rods.

55 60 65 70 75

SAJ FORM 1836-A
JUN 02

Boring Designation CB-S16903-02

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 4 SHEETS

1. PROJECT	C&SF S-169/Nine Mile Basin Proposed New Bridge Site
2. BORING DESIGNATION	CB-S16903-02
LOCATION COORDINATES	X = 524,973 Y = 882,683
3. DRILLING AGENCY	Corps Of Engineers
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	L.C. Gregory
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	4.5 Ft.
7. DEPTH DRILLED INTO ROCK	1.0 Ft.
8. TOTAL DEPTH OF BORING	60.0 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, FLE (U.S. Ft.)
HORIZONTAL	NAD27
VERTICAL	NGVD29
11. MANUFACTURER'S DESIGNATION OF DRILL	CME-45 (land-based)
	☒ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 44 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	2
14. ELEVATION GROUND WATER	Not Determined
15. DATE BORING	STARTED 02-26-03 / COMPLETED 02-28-03
16. ELEVATION TOP OF BORING	14.4 Ft.
17. TOTAL RECOVERY FOR BORING	88 %
18. SIGNATURE AND TITLE OF INSPECTOR	Julie Minton, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
14.4	0.0						14.4		
			SAND, silty, mostly fine to medium-grained sand-sized quartz, little silt, trace organic matter, strong reaction with HCl, moist, brown (SM)	60	1		SPT Sampler	2 2 3	5
			At El. 12.9 Ft., tan	60	2		12.9 SPT Sampler	4 4 5	9
10.9	3.5			93	3 4		11.4 SPT Sampler	4 4 9	13
		Highly Weathered	LIMESTONE, very soft, highly weathered, aphanitic, porous, occasional clay, trace clay in some locations odor, tan	100	BOX 1		9.9 4 x 5-1/2" Diamond Set Bit 14 mins, 500 psi, 50 %		
				73	5		8.9 SPT Sampler	2 5 6	11
6.7	7.7			53	6 7		7.4 SPT Sampler	8 8 9	17
			SAND, silty, mostly fine-grained sand-sized quartz, little silt, little shell up to 1/4", strong reaction with HCl, moist, gray (SM) At El. 5.9 Ft., few shell	80	8		5.9 SPT Sampler	6 6 8	14
							4.4 Overwashed		
				100	9		3.9 SPT Sampler	4 6 9	15
				100	10		2.4 SPT Sampler	3 3 11	14
			At El. 0.9 Ft., trace shell	100	11		0.9 SPT Sampler	2 2 3	5
							-0.6		

0 5 10 15

SAJ FORM 1836
JUN 02

(Continued)

Boring Designation CB-S16903-02

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 4 SHEETS
PROJECT C&SF S-169/Nine Mile Basin	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD27	VERTICAL NGVD29
LOCATION COORDINATES X = 524,973 Y = 882,683	ELEVATION TOP OF BORING 14.4 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR CD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				100	12		SPT Sampler -2.1	2 2 3	5
-2.8	17.2			100	13		SPT Sampler -3.6	1 1 1	2
-3.6	18.0		SAND, clayey, mostly fine to medium-grained sand-sized quartz, little clay, trace shell, strong reaction with HCl, moist, gray (SC)		14				
			SAND, silty, mostly fine-grained sand-sized quartz, some silt, trace shell, strong reaction with HCl, moist, gray (SM)	100	15		SPT Sampler -5.1	1 1 2	3
				100	16		SPT Sampler -6.6	2 3 2	5
				100	17		SPT Sampler -8.1	WOH 1 1	2
-9.6	24.0			100	18		SPT Sampler -9.6	1 1 2	3
			SAND, clayey, mostly fine-grained sand-sized quartz, some clay, few shell up to 1/2", strong reaction with HCl, moist, gray (SC)	100	19		SPT Sampler -11.1	1 1 1	2
				100	20		SPT Sampler -12.6	1 1 1	2
				100	21		SPT Sampler -14.1	1 1 1	2
				100	22		SPT Sampler -15.6	1 1 2	3
				100	23		SPT Sampler -17.1	1 2 2	4
				73	24		SPT Sampler -18.6	1 1 2	3
-20.1	34.5			100	25		SPT Sampler -20.1	1 1 3	4
			LIMESTONE, very soft, aphanitic, porous,	100	26		SPT Sampler	1	

15 20 25 30 35

(Continued)

Boring Designation CB-S16903-02

DRILLING LOG (Cont. Sheet)	INSTALLATION: Jacksonville District	SHEET 3 OF 4 SHEETS
PROJECT: C&SF S-169/Nine Mile Basin	COORDINATE SYSTEM/DATUM: State Plane, FLE (U.S. Ft.)	HORIZONTAL: NAD27 / VERTICAL: NGVD29
LOCATION COORDINATES: X = 524,973 Y = 882,683	ELEVATION TOP OF BORING: 14.4 Ft.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			occasional clay, light gray	100	26		SPT Sampler -21.6	2 3	5
				100	27		SPT Sampler -23.1	3 3 3	6
-23.6	38.0			100	28		SPT Sampler -24.6	1 1 1	2
-25.6	40.0	Highly Weathered	SANDSTONE, soft, highly weathered, medium-grained, porous, olive green		29				
			SAND, poorly-graded with silt, mostly fine to medium-grained sand-sized quartz, few silt, weak reaction with HCl, wet, light gray (SP-SM)	100	30		SPT Sampler -26.1	1 2 12	14
					31				
				100	32		SPT Sampler -27.6	10 37 50	87
				70	33		SPT Sampler -28.6	14 59	
							-29.1 Advanced Boring		
				70	34		SPT Sampler -30.1	27 62	
							-30.6 Advanced Boring		
-32.1	46.5			80	35		SPT Sampler -32.1	12 27 18	45
			SAND, clayey, mostly fine to medium-grained sand-sized quartz, little clay, no reaction with HCl, moist, gray (SC)	80	36		SPT Sampler -33.6	3 6 11	17
			At El. -33.6 Ft., some clay	67	37		SPT Sampler -35.1	5 11 45	56
-35.1	49.5								
			CLAY, lean, little fine to medium-grained sand-sized quartz, no reaction with HCl, moist, dark gray (CL)	93	38		SPT Sampler -36.6	1 2 5	7
				100	39		SPT Sampler -38.1	4 4 8	12
-38.1	52.5								
			SAND, clayey, mostly fine to medium-grained sand-sized quartz, little clay, no reaction with HCl, moist, gray (SC)	87	40		SPT Sampler -39.6	19 10 11	21
				100	41		SPT Sampler	15 22	

35 40 45 50 55

SAJ FORM 1836-A
JUN 02

(Continued)

Boring Designation CB-S16903-02

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 4 OF 4 SHEETS
PROJECT C&SF S-169/Nine Mile Basin	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD27	VERTICAL NGVD29
LOCATION COORDINATES X = 524,973 Y = 882,683	ELEVATION TOP OF BORING 14.4 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR CD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				100	41		-41.1 SPT Sampler	23	45
				73	42		SPT Sampler -42.6	8 / 6 / 8	14
				67	43		SPT Sampler -44.1	1 / 15 / 22	37
-45.6	60.0			67	44		SPT Sampler -45.6	4 / 4 / 15	19

NOTES:

1. Soils are field visually classified in accordance with the Unified Soils Classification System.

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

Abbreviations:
WOH = Weight of Hammer.

55 60 65 70 75

SAJ FORM 1836-A
JUN 02

Boring Designation CB-S16903-03

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT	C&SF S-169/Nine Mile Basin Proposed New Culvert Site
2. BORING DESIGNATION	CB-S16903-03
LOCATION COORDINATES	X = 523,381 Y = 883,402
3. DRILLING AGENCY	Corps Of Engineers
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	L.C. Gregory
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	8.2 Ft.
7. DEPTH DRILLED INTO ROCK	1.4 Ft.
8. TOTAL DEPTH OF BORING	24.5 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, FLE (U.S. Ft.)
HORIZONTAL	NAD27
VERTICAL	NGVD29
11. MANUFACTURER'S DESIGNATION OF DRILL	CME-45 (land-based)
	☒ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 17 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	1
14. ELEVATION GROUND WATER	Not Determined
15. DATE BORING	STARTED 02-14-03 / COMPLETED 02-25-03
16. ELEVATION TOP OF BORING	18.6 Ft.
17. TOTAL RECOVERY FOR BORING	84 %
18. SIGNATURE AND TITLE OF INSPECTOR	Julie Minton, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
18.6	0.0						18.6		
			SAND, silty, mostly subrounded to rounded fine-grained sand-sized carbonate, some quartz, little silt, strong reaction with HCl, dry, tan (SM)	47	1		SPT Sampler 17.1	3 5 5	10
			At El. 17.1 Ft., trace shell, trace gravel	60	2		SPT Sampler 15.6	3 4 5	9
				87	3		SPT Sampler 14.1	3 2 1	3
			From El. 13.1 to 12.1 Ft., organic odor, black	73	4		SPT Sampler 12.6	1 1 2	3
				93	5		SPT Sampler 11.1	1 2 1	3
			From El. 11.1 to 9.1 Ft., organic odor, black	100	6		SPT Sampler 10.4	5 2/0.2'	
10.4	8.2	Sl. Weathered	LIMESTONE, fossiliferous, very hard, slightly weathered, aphanitic, porous, gray	100	BOX 1	RQD 100	10.0 4 x 5-1/2" Diamond Set Bit		
9.1	9.5			100			4 x 5-1/2" Diamond Set Bit 24 mins, 450 psi, 50 % 9.0		
9.0	9.6		At El. 9.2 Ft., pitted LIMESTONE, soft						
			SAND, silty, mostly fine-grained sand-sized quartz, little silt, little shell up to 1/4", strong reaction with HCl, moist, gray (SM)	93	7		SPT Sampler 7.6	1 6 6/0.4'	12+
				80	8		SPT Sampler 6.1	2 2 5	7
			At El. 5.4 Ft., trace shell	100	9 10		SPT Sampler 4.6	1 7 6	13
				100	11		SPT Sampler	3 5	

0 5 10 15

SAJ FORM 1836
JUN 02

(Continued)

Boring Designation CB-S16903-03

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District	SHEET 2 OF 2 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
C&SF S-169/Nine Mile Basin	State Plane, FLE (U.S. Ft.)	NAD27	NGVD29

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 523,381 Y = 883,402	18.6 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				100	11		3.1 SPT Sampler	6	11
				47	12		1.6 SPT Sampler	WOH 3 5	8
				100	13		0.1 SPT Sampler	2 3 6	9
				60	14		-1.4 SPT Sampler	WOH 3 4	7
				100	15		-2.9 SPT Sampler	WOH 3 2	5
				100	16		-4.4 SPT Sampler	1 1 1	2
-5.9	24.5			100	17		-5.9 SPT Sampler	WOR 1 2	3

NOTES:

1. Soils are field visually classified in accordance with the Unified Soils Classification System.

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

Abbreviations:
WOR = Weight of Rods.
WOH = Weight of Hammer.

Boring Designation CB-S16903-04

DRILLING LOG	DIVISION South Atlantic	INSTALLATION Jacksonville District	SHEET 1 OF 2 SHEETS

1. PROJECT	C&SF S-169/Nine Mile Basin Proposed New Culvert Site
2. BORING DESIGNATION	CB-S16903-04
LOCATION COORDINATES	X = 523,554 Y = 883,463
3. DRILLING AGENCY	Corps Of Engineers
CONTRACTOR FILE NO.	
4. NAME OF DRILLER	L.C. Gregory
5. DIRECTION OF BORING	☒ VERTICAL ☐ INCLINED
DEG. FROM VERTICAL	
BEARING	
6. THICKNESS OF OVERBURDEN	0.0 Ft.
7. DEPTH DRILLED INTO ROCK	0.0 Ft.
8. TOTAL DEPTH OF BORING	25.5 Ft.
9. SIZE AND TYPE OF BIT	See Remarks
10. COORDINATE SYSTEM/DATUM	State Plane, FLE (U.S. Ft.)
HORIZONTAL	NAD27
VERTICAL	NGVD29
11. MANUFACTURER'S DESIGNATION OF DRILL	CME-45 (land-based)
	☒ AUTO HAMMER ☐ MANUAL HAMMER
12. TOTAL SAMPLES	DISTURBED 19 / UNDISTURBED (UD) 0
13. TOTAL NUMBER CORE BOXES	2
14. ELEVATION GROUND WATER	Not Determined
15. DATE BORING	STARTED 02-28-03 / COMPLETED 02-28-03
16. ELEVATION TOP OF BORING	16.5 Ft.
17. TOTAL RECOVERY FOR BORING	88 %
18. SIGNATURE AND TITLE OF INSPECTOR	Julie Minton, Geologist

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR UD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
16.5	0.0						16.5		
			SAND, silty, mostly fine to medium-grained sand-sized quartz, little silt, few organic matter, strong reaction with HCl, moist, brown (SM)	80	1		SPT Sampler 15.0	1 3 5	8
			At El. 15.0 Ft., tan	73	2		SPT Sampler 13.5	5 5 6	11
12.3	4.2			67	3		SPT Sampler 12.0	12 15 7	22
			PEAT, moist, black (PT)		4				
				87	5		SPT Sampler 10.5	1 1 1	2
				53	6		SPT Sampler 9.0	1 1 1	2
				73	7		SPT Sampler 7.5	WOH 1 2	3
6.9	9.6			87	8		SPT Sampler 6.0	WOH 1 2	3
6.0	10.5	HW	LIMESTONE, very soft, highly weathered, aphanitic, pitted, light gray		9				
			SAND, silty, mostly fine-grained sand-sized quartz, little silt, few shell, strong reaction with HCl, moist, light gray (SM)	87	10		SPT Sampler 4.5	2 4 4	8
				93	11		SPT Sampler 3.0	2 2 5	7
			At El. 3.0 Ft., trace shell						
			From El. 2.1 to 2.0 Ft., little shell	100	12		SPT Sampler 1.5	2 4 4	8

0 5 10 15

(Continued)

Boring Designation CB-S16903-04

DRILLING LOG (Cont. Sheet)	INSTALLATION Jacksonville District		SHEET 2 OF 2 SHEETS
PROJECT C&SF S-169/Nine Mile Basin	COORDINATE SYSTEM/DATUM State Plane, FLE (U.S. Ft.)	HORIZONTAL NAD27	VERTICAL NGVD29
LOCATION COORDINATES X = 523,554 Y = 883,463	ELEVATION TOP OF BORING 16.5 Ft.		

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD CORD	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			At El. 0.0 Ft., some silt	100	13		SPT Sampler 0.0	3 3 5	8
				100	14		SPT Sampler -1.5	1 2 3	5
				100	15		SPT Sampler -3.0	2 2 3	5
				100	16		SPT Sampler -4.5	1 1 1	2
				100	17		SPT Sampler -6.0	WOH 1 1	2
				100	18		SPT Sampler -7.5	1 1 2	3
-9.0	25.5			100	19		SPT Sampler -9.0	1 1 1	2

NOTES:

1. Soils are field visually classified in accordance with the Unified Soils Classification System.

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

Abbreviations:
WOH = Weight of Hammer.

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

Designed by:
Dwn by: Ckd by:
Scale:
Dates: D.D.FILE NO.
Reference Files:
Drgs. name:

S-169/NINE-MILE CANAL BASIN
GENERAL REEVALUATION REPORT
CORE BORING LOCATION MAP
GEOTECHNICAL APPENDIX
DRAFT

PLATE
B1

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APPENDIX C

DESIGN AND COST ESTIMATE

FOR

S-169
GENERAL REEVALUATION REPORT
HENDRY COUNTY, FLORIDA

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1.0 PROJECT BACKGROUND

1.1 Project Location

The Nine-Mile Canal area is adjacent to Herbert Hoover Dike (HHD) southwest of Lake Okeechobee.

1.2 Alternative 4A components description

The technical team members and the South Florida Water Management District have included the following components for this project:

a. Construct a new culvert structure S-169.
b. Construct new bridge to replace the existing S-169 and provide access to HHD.
c. Convert five 10 feet diameter flap gates on Culvert No. 2 to vertical slide gates; and upgrade one existing slide gate to telemetry controlled vertical gate.
d. Construct two new generator houses. These generators will provide the electric power for the operation of the slide gates at S-169 and C-2, as well as the telemetry.
e. Demolish the existing S-169 structure, and abandon the existing S-169 control house.
f. Install remote digital sensors.
g. Improve South Bank and tie back levee to HDD.

See plate C-1 for location of the components of this project.

2.0 EXISTING CONDITIONS

2.1 Structure S-169

Culvert S-169 is located at the east of C-21, north of the city of Clewiston. During normal operation, at lake stages greater than 15.5 ft. NGVD, the gates on S-169 are operated automatically to maintain a stage in the Industrial Canal of between 14.7 and 15.2 ft. NGVD. At Lake Stages between 13.0 ft. NGVD and 15.5 ft. NGVD the gates are closed; and at Lake Stages below 13.0 ft. NGVD the gates are placed in the full open position.

The structure consists of three CMP barrels, 7 feet diameter, and 60 feet long. The culvert is equipped with three slide gates. The culvert was in good condition during a field inspection on April 2001.

2.2 Culvert C-2

Culvert 2 is located is located in section LD-1 of the Herbert Hoover Dike in the town of Clewiston. The culvert structure consists of six CMP barrels, 10 feet diameter, 105 long. The culvert is equipped with five flap gates and one slide gate.

Culvert 2 was inspected on April 2001. The overall condition of this culvert was good. Minor cracks and spalls were noted on the concrete elements such headwalls. The embankment was in good condition.

2.3 Geotechnical Data

The Geothechnical branch has prepared a report for this project. The report is attached to the Engineering Appendix.

2.4 Survey Data

A detailed survey was conducted for this report by EN-DT. The survey number is 01-068.

2.5 Hydraulic Data

The bridge and structure (S-169) would be constructed to satisfy the hydraulic requirements presented in the Hydrology and Hydraulics Appendix A.

3.0 STRUCTURAL DESIGN AND CONSTRUCTION CRITERIA

3.1 Loading Conditions

Each standard design was developed to withstand usual, unusual, and extreme loading conditions. Usual loading conditions include loads most frequently experienced by the structural system when performing its primary function throughout its normal service life. Unusual loading conditions, such as construction or maintenance operations, produce short duration loads, and their occurrences are not frequent. Extreme conditions such as the standard project floods, and hurricane wind force is the worse case scenario; extreme loads represent the widest deviation from the usual and unusual loading conditions.

3.2 Stability

EC 1110-2-291 criteria are followed for the Stability Analysis of Concrete Structures, which includes the overturning, flotation, and sliding checks. A structure importance factor and site information factor of 1.0 has been assumed for design.

3.3 Concrete

EM 1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures and ACI-318-99, Building Code Requirements for Structural Concrete are used for structural concrete design. A compressive strength of 3.5-ksi and yield strength of 60-ksi for tension reinforcement has been assumed for design.

3.4 Steel Sheet Pile

EM 1110-2-2504, Design of Sheet Pile Walls is used to design wing walls and cofferdams. Yield strength of 50-ksi has been assumed for sheet pile design.

3.5 Structural Steel

The Manual of Steel Construction, Allowable Stress Design, 9th Edition, is used to design wales and struts for cofferdams. Yield strength of 50-ksi is assumed for structural steel.

3.6 References

The following are additional references used to design the structures of this project: ASCE 7-98 Minimum Design Loads for Buildings and Other Structures.

EM 1110-2-2101	Working Stresses for Structural Design
EM 1110-2-2502	Retaining and Flood Walls
EM 1110-2-2400	Structural Design of Spillways, EM 1110-2-2902, Conduits, Culverts, and Pipes.
EM 1110-2-2007	Structural Design of Concrete Lined Flood Control Channel.

4.0 CIVIL/SITE WORK

4.1 General

Site characteristics include largely flat terrain in partially developed areas, with varying topographic features that include existing canals, roadways, utilities, and structures.

Although site constraints may limit the maximum size of the earth moving equipment, adequate work areas and access for construction equipment exists or can be developed at all sites. The site locations of the structures for this project don't require unique or extraordinary design considerations or construction methods.

Where the construction zone includes impacts to roadways, maintenance of traffic procedures is developed in accordance with FDOT standards. Site utilities in the proposed construction area may require relocation before construction starts.

4.2 Site Access

Existing County and State roads will provide access to the project site. Service roads will give access to structures.

4.3 Disposal / Borrow Areas

It is anticipated that the excess material resulting from demolition of the existing structure and excavation required at other project sites would be taken to a local commercial landfill for disposal. It is further anticipated that all borrow material required for construction would be obtained from commercial sources. Material would be required as backfill for the proposed structure, for construction of both the north and south tieback levees, and for construction of the roadway access to the proposed bridge.

4.4 Foundation

Two foundation conditions have been assumed for all structures. A structure is founded on either a concrete seal or existing soil.

4.5 Dewatering

Two types of dewatering systems have been assumed for this project: steel sheet pile cofferdam with underwater concrete seal, and open excavation with well points and sump pumps. Culvert installation is performed using the cut and cover method with sequential partitioned steel sheet pile cells. Cofferdams may be required for the construction of the new bridge.

4.6 Cofferdam

The standard cofferdam design includes steel sheet pile, wale, strut, underwater concrete seal, and rock anchors. It is assumed that PZ-40 steel sheet pile is

used to construct cofferdams and that pile tips are 5 to 10 feet below the bottom of the concrete seal. Other assumptions include W 36x359-wale size, W 36x359-strut size, ten-foot thick tremie plug, and one rock anchor per 125 square feet. A maximum water-cement ratio of 0.45 has been assumed for underwater concrete seals.

4.7 Maintenance of Traffic

Where necessary temporary by-pass roads will be constructed to direct vehicular traffic around the construction sites of the proposed structures. A temporary by-pass road may be required for construction of the new culvert structure S-169.

5.0 NEW CULVERT STRUCTURE S-169

5.1 General

The new culvert structure consists of four-84 inches corrugated metal pipes (CMP) of circular shape with slide gates. The gates include both local and remote controls for their operation. See plate C-1 for location.

Adjacent to the culvert structure a new control-building house will be constructed with electrical data collection and control systems that operate the gates as well as the emergency generator.

Plates C-2 and C-3 shows typical plan, elevations and section for the culvert.

Plates C-6 and C-7 show the new control house with the generator and electric and control system.

6.0 NEW BRIDGE AT THE LOCATION OF EXISTING S-169

6.1 General

The new bridge will be constructed parallel to the centerline of the road over the existing culvert S-169. See plate C-1 for exact location.

The bridge design, including maintenance of traffic is AASHTO and FDOT compliant and consistent with current industry practice.

The structure consists of prefabricated pre-cast modules Con Span bridge system. The inside clear dimension of the Con Span structure would be a minimum 65'-0". The height of the arch would be a minimum 18'-0".

Plate C-5 shows the plan and elevation of the proposed bridge.

7.0 MODIFICATIONS TO CULVERT STRUCTURE C-2

7.1 General

Alternative 4A recommends that Culvert 2 must be equipped with vertical slide gates. At the present this culvert has five (5) flap gates and one slide gate.

The new slide gates will be attached to the existing concrete head walls, and they will capable of being operated locally and remotely.

Adjacent to the culvert structure a new control-building house will be constructed with electrical data collection and control systems that operate the gates as well as the emergency generator.

Plate C-4 shows a typical slide gate and Culvert C-2.

8.0 MECHANICAL REQUIREMENTS

8.1 General

The existing S-169 structure is a gated culvert structure consisting of three, 7 feet diameter culverts with electric actuator-operated slide gates and telemetry control. This structure will be demolished and a new S-169 structure will be built to replace it at a new location shown in this report. The new S-169 structure will feature four, 7 feet diameter culverts that will have electric actuator-operated slide gates with telemetry control.

The existing C-2 structure is a gated culvert structure consisting of six-10 feet diameter culverts. Five culverts have flap gates and one culvert has a slide gate. All are manually operated. This structure will be rehabilitated to feature slide gates on all six culverts. All six-slide gates for the rehabilitated C-2 structure will be electric actuator-operated with telemetry control

8.2 LPG Generator Set and Fuel System

8.2.1 New Culvert Structure S-169

The existing S-169 structure currently has a fairly new 15 KW, LPG generator set being used for emergency, back-up power, to raise its gates by electric actuators. This generator sits in an enclosure complete with ventilation. A complete LPG fuel system, including a 250-gallon capacity LPG aboveground storage tank, supports the generator set for its fuel requirements.

The new S-169 structure will need a similar generator set-up as the existing. The existing generator set and associated fuel system is adequate and may be re-used and relocated to support the new S-169 structure. A new building will need to be constructed and fitted with appropriate ventilation. See Plate C-6 for a typical LPG generator and fuel system set-up.

8.2.2 Modifications to Culvert Structure C-2

The existing C-2 structure does not currently have emergency back-up power supplied by a generator set. A newly renovated C-2 structure may require a new, 25 KW, LPG, emergency back-up power generator set with all necessary appurtenances (an LPG fuel system, including a 250-gallon LPG tank and associated piping and valves) to lift the new and existing gates by electric actuator. The new generator set-up will require appropriate ventilation in a new generator set building. See Plate C-6 for a typical LPG generator and fuel system set-up.

9.0 ELECTRICAL REQUIREMENTS

9.1 General

The new S-169 structure and the rehabilitated C-2 structure will require a typical electrical system set-up as shown on Plate C-7. A new control/generator building will need to be constructed at each site to house the generator, electrical components, and gate control equipment.

9.2 New Culvert Structure S-169

As a minimum the electrical system at the new S-169 structure shall contain the following:

a. POWER SERVICE. A new 120/240-volt single-phase electrical service shall be provided by the Clewiston Utility Corporation from the nearby existing power lines. Transient Voltage Surge Suppression (TVSS) shall be provided at the site service entrance to protect electrical equipment.

b. BACKUP GENERATOR AND AUTOMATIC TRANSFER SWITCH. The existing S-169 15 KW generator set and automatic transfer switch may be re-used to support the new S-169 structure.

c. GROUNDING. The new S-169 structure will require a new grounding system. The structure's main grounding shall include a grounding loop consisting of ground rods and #4/0 ground wire, which will be bonded to the embedded

metallic masses, sheet pile, and structural steel. Frames or enclosures of electrical equipment shall be bonded to the grounding system. Ground conductors shall be bare, soft annealed copper cables and ground rods shall be of copper clad type, 3/4 inch in diameter by 10 feet long.

d. LIGHTING. Industrial fluorescent fixtures with electronic ballasts will provide interior lighting. Photoelectric cells and contactors will automatically control exterior lighting for security purposes.

e. WIRING. Insulated copper conductors shall generally be installed in either PVC coated rigid galvanized steel conduit or schedule 80 rigid plastic conduits. Conductors shall be rated for 600-volts and be of the insulated type: RHW, THW, THWN, or XHHW. All wiring shall conform to guide specifications UFGS-16120. Conductors shall be copper. Aluminum conductors shall not be used.

f. STILLING WELLS AND WATER LEVEL SENSORS. The latest South Florida Water Management District standards for stilling wells and water level sensors shall be used. The water level sensors are sole source items.

g. POWER DISTRIBUTION. A control center will be connected to the load side of the automatic transfer switch and will house a main breaker, combination starter for the gate motor, lighting panel, relay compartment, and a circuit for exterior lighting.

h. GATE AND MOTOR CONTROLS. Duplicate open-close push-button station in the control/generator building and at the structure shall be provided for manual gate control. Necessary open, close, automatic control relays, and limit switches shall be incorporated in the gate control circuit.

i. ELECTRIC MOTOR ACTUATOR. Electric motor actuators shall provide local and remote controls for gate operations. It shall be provided with a manual override feature. The electric operator will include, but not be limited to, the motor, actuator unit gearing, limit switch gearing, position limit switches, torque switches, stem nut, declutch lever, and hand-wheel as a self-contained unit. The actuator will have sufficient capacity to raise or lower the gate at a speed of 6-inch/min against the operating heads.

9.3 Modifications to Culvert Structure C-2

The new electrical system at the rehabilitated C-2 structure shall contain the same set-up as the new S-169 structure, which includes 120/240-volt single-phase power service, backup generator and automatic transfer switch, grounding, lighting, wiring, stilling wells, water level sensors, power distribution

panel, gate and motor controls, and electric motor actuator. The newly required 120/240-volt single-phase power service will be available from the nearby existing Clewiston Utility Corporation power lines. A new 120/240-volt, single phase, 25 KW LPG generator will be needed to provide emergency back-up electrical power for gate operations. A new automatic transfer switch shall be sized sufficiently to carry the load required. The generator and automatic transfer switch are sole source items and shall be manufactured by Onan.

9.4 Telemetry

The telemetry system installed at the new S-169 structure and the rehabilitated C-2 structure are typically the Remote Terminal Units (RTU) and communication channels to the South Florida Water Management District (SFWMD) control center. The automation components are broadly defined to include hardware, software, communications, and user interface elements. RTU shall be compatible with the existing SFWMD's Motorola MOSCAD system. RTU software shall be in accordance with the SFWMD standard load set. Appropriate software will be utilized to edit the basic interface program for each structure.

The existing S-169 Motorola MOSCAD system and antenna may be re-used and relocated to support the new S-169. A similar automated telemetry set-up will need to be installed at the rehabilitated C-2 structure. The automation components at these structures will eventually be operated and maintained by SFWMD and must conform to SFWMD standards in order to, (1), achieve cost efficiency in design, construction, operation and maintenance, and (2), meet safety, reliability, and performance requirements during routine and emergency operations.

10.0 COST ESTIMATE AND LIST OF PLATES

TABLE C-1..... PROJECT COST ESTIMATE

PLATE C-1..... SITE PLAN
PLATE C-2..... NEW CULVERT STRUCTURE S-169, PLAN
PLATE C-3..... NEW CULVERT STRUCTURE S-169, SECTIONS AND DETAILS
PLATE C-4..... CULVERT C-2, NEW SLIDE GATE
PLATE C-5..... NEW BRIDGE, PLAN AND ELEVATIONS
PLATE C-6..... MECHANICAL
PLATE C-7..... ELECTRICAL

S-169 GRR Alternatives; Final
Alternatives 2, 3, 4A(Rev.)
and 4B
No O&M Costs

Designed By: CESAJ-EN
Estimated By: Anthony L. DiPiero, P.E., C.C.E.

Prepared By: Anthony L. DiPiero, P.E., C.C.E.

Preparation Date: 04/06/05
Effective Date of Pricing: 10/09/03

Sales Tax: 6.50%

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Release 5.31

6 Apr 05:
Revised to adjust escalation for common FY pricing as follows:

Based on schedule 6 Dec 04; NTP issued in Aug, 2009

Alt. 2: Oct. 2003 to Nov. 2009
Alt. 3: Oct. 2003 to Aug. 2010
Alt. 4A: Nov. 2004 to May 2010
Alt. 4B: Oct. 2003 to May 2010

==========
30 Nov 04:
Current Revision for Alt. 4A includes adding manatee barrier per email request from EN-HH on 22 November 2004. Estimate was re-priced based on latest UPB. Manatee Barrier consists of HDPE grate on fiberglass rods mounted in a steel framework.

==========
Project scope of work based on draft input to GRR transmitted with memo from EN-HH dated 8 Oct 2003. Plates C-1 thru C-7 provided separately and in draft form.

O&M Costs are not included.

Construction Durations:

Alt. 2 180 days - 6 months

Alt. 3 730 days - 24 months

Alt. 4A 550 days - 18 months

Alt. 4B 550 days - 18 months

	QUANTY UOM	CONTRACT	ESCALATN	CONTINGN	PE&D	S&I	TOTAL COST	UNIT COST
A S-169 GRR Alternatives								
A- A Alt. 2 - Operational Changes		115,100	11,500	31,700	9,500	13,400	181,200	
A- B Alt. 3 - New Pump Station		5,748,800	672,100	1,605,200	481,600	680,600	9,188,300	
A- C Alt.4A; Move S-169, New Bridge		3,403,100	348,700	938,000	281,400	397,700	5,368,900	
A- D Alt.4B; Move S-169,Modifications		3,638,300	405,200	1,010,900	303,300	428,600	5,786,200	
TOTAL S-169 GRR Alternatives		12,905,300	1,437,500	3,585,700	1075700	1520300	20,524,600	
TOTAL S-169 GRR Alternatives; Final		12,905,300	1,437,500	3,585,700	1075700	1520300	20,524,600	

	QUANTY	UOM	CONTRACT	ESCALATN	CONTINGN	PE&D	S&I	TOTAL COST	UNIT COST
A S-169 GRR Alternatives									
A- A Alt. 2 - Operational Changes									
A- A/ 1 Revetment to repair scour hole									
A- A/ 1. 1 Armor Stone, Type B	800.00	TON	53,200	5,300	14,600	4,400	6,200	83,800	104.79
A- A/ 1. 2 Transport Railhead to Site	800.00	TON	6,600	700	1,800	500	800	10,500	13.09
A- A/ 1. 3 Place Med. Armor Stone by barge	800.00	TON	3,400	300	900	300	400	5,300	6.63
TOTAL Revetment to repair scour hole	500.00	CY	63,300	6,300	17,400	5,200	7,400	99,600	199.21
A- A/ 2 Safety Barrieres									
A- A/ 2. 1 Safety Barrier	2.00	EA	51,800	5,200	14,200	4,300	6,000	81,600	40782.11
TOTAL Safety Barrieres	2.00	EA	51,800	5,200	14,200	4,300	6,000	81,600	40782.11
TOTAL Alt. 2 - Operational Changes			115,100	11,500	31,700	9,500	13,400	181,200	
A- B Alt. 3 - New Pump Station									
A- B/ 1 New 4 bay, 425 cfs Pump Station									
A- B/ 1. 1 Input from Separate MCACES file			4,500,000	526,100	1,256,500	377,000	532,800	7,192,400	
TOTAL New 4 bay, 425 cfs Pump Station			4,500,000	526,100	1,256,500	377,000	532,800	7,192,400	
A- B/ 2 HHD Access - Temp. Bridge									
A- B/ 2. 1 Precast/Prestressed Members	2400.00	SF	195,100	22,800	54,500	16,300	23,100	311,800	129.92
A- B/ 2. 2 Deck Pavement	2400.00	SF	16,500	1,900	4,600	1,400	2,000	26,300	10.98
A- B/ 2. 3 Precast Conc. Medians	160.00	LF	8,100	900	2,200	700	1,000	12,900	80.49
A- B/ 2. 4 Abutments	60.00	CY	22,000	2,600	6,200	1,800	2,600	35,200	587.04
A- B/ 2. 5 Install/remove bridge	2.00	EA	29,000	3,400	8,100	2,400	3,400	46,400	23179.71
TOTAL HHD Access - Temp. Bridge			270,700	31,600	75,600	22,700	32,000	432,600	
A- B/ 3 Culvert 2 Mods w/ Telemetry									
A- B/ 3. 1 Remove & Install Gates,10'x10'	5.00	EA	649,800	76,000	181,400	54,400	76,900	1,038,600	207716.12
A- B/ 3. 2 Install/remove Dewatering Bulkd	2.00	EA	14,500	1,700	4,000	1,200	1,700	23,200	11589.86
A- B/ 3. 3 Telemetry (Less SFWMD Equipmt)	1.00	EA	81,300	9,500	22,700	6,800	9,600	129,900	129924.08
TOTAL Culvert 2 Mods w/ Telemetry			745,600	87,200	208,200	62,500	88,300	1,191,700	

	QUANTY	UOM	CONTRACT	ESCALATN	CONTINGN	PE&D	S&I	TOTAL COST	UNIT COST
A- B/ 4 Remote Digital Sensors @ C-2	2.00	EA	40,600	4,800	11,300	3,400	4,800	65,000	32481.02
A- B/ 5 Control House w/ Generator @ C-2									
A- B/ 5. 1 CONTROL BUILDING	223.00	SF	103,500	12,100	28,900	8,700	12,300	165,500	742.11
A- B/ 5. 2 CONTROL BLDG.- ELEC.	1.00	JB	88,300	10,300	24,700	7,400	10,500	141,200	141201.41
TOTAL Control House w/ Generator @ C-2			191,900	22,400	53,600	16,100	22,700	306,700	
TOTAL Alt. 3 - New Pump Station			5,748,800	672,100	1,605,200	481,600	680,600	9,188,300	
A- C Alt.4A; Move S-169, New Bridge									
A- C/ 1 New Bridge west of S-169									
A- C/ 1. 1 Precast/Prestressed Members	3000.00	SF	243,900	25,000	67,200	20,200	28,500	384,700	128.24
A- C/ 1. 2 Deck Pavement	3000.00	SF	20,600	2,100	5,700	1,700	2,400	32,500	10.84
A- C/ 1. 3 Precast Conc. Medians	160.00	LF	8,100	800	2,200	700	900	12,700	79.45
A- C/ 1. 4 Abutments x 2	60.00	CY	22,000	2,300	6,100	1,800	2,600	34,800	579.45
A- C/ 1. 5 Install precast	1.00	EA	14,500	1,500	4,000	1,200	1,700	22,900	22880.05
A- C/ 1. 6 Pile Foundation	2.00	EA	66,800	6,800	18,400	5,500	7,800	105,400	52693.52
A- C/ 1. 7 Pile Caps x 2	200.00	CY	44,000	4,500	12,100	3,600	5,100	69,500	347.35
A- C/ 1. 8 Approach slabs, 12" x 2	50.00	CY	7,300	700	2,000	600	900	11,500	230.73
TOTAL New Bridge west of S-169			427,200	43,800	117,700	35,300	49,900	674,000	
A- C/ 2 Re-align approach at new bridge			25,000	2,600	6,900	2,100	2,900	39,400	
A- C/ 3 New S-169 4 x 84" CMP									
A- C/ 3. 2 SITEWORK			907,600	93,000	250,100	75,000	106,100	1,431,800	
A- C/ 3. 3 CONCRETE			84,800	8,700	23,400	7,000	9,900	133,700	
A- C/ 3. 5 METALS & MISC.			309,800	31,700	85,400	25,600	36,200	488,700	
A- C/ 3.16 TELEMETRY & DIGITAL SENSORS			121,900	12,500	33,600	10,100	14,200	192,400	
TOTAL New S-169 4 x 84" CMP			1,424,000	145,900	392,500	117,700	166,400	2,246,600	
A- C/ 4 Control House w/ Generator @ New									
A- C/ 4. 8 Control House w/ Generator @ C-2			191,100	19,600	52,700	15,800	22,300	301,500	
TOTAL Control House w/ Generator @ New			191,100	19,600	52,700	15,800	22,300	301,500	
A- C/ 5 Demolish S-169									
A- C/ 5. 2 Sitework			16,000	1,600	4,400	1,300	1,900	25,200	
A- C/ 5. 3 Concrete			47,800	4,900	13,200	4,000	5,600	75,400	

	QUANTY UOM	CONTRACT	ESCALATN	CONTINGN	PE&D	S&I	TOTAL COST	UNIT COST
A- C/ 5. 5 METALS & MISC.		76,600	7,800	21,100	6,300	9,000	120,800	
TOTAL Demolish S-169		140,400	14,400	38,700	11,600	16,400	221,400	
A- C/ 6 Culvert 2 Mods w/ Telemetry								
A- C/ 6. 1 Remove & Install Gates,10'x10'	5.00 EA	649,800	66,600	179,100	53,700	75,900	1,025,200	205030.85
A- C/ 6. 2 Install/remove Dewatering Bulkd	2.00 EA	14,500	1,500	4,000	1,200	1,700	22,900	11440.03
A- C/ 6. 3 Telemetry (Less SFWMD Equipmt)	1.00 EA	81,300	8,300	22,400	6,700	9,500	128,200	128244.47
TOTAL Culvert 2 Mods w/ Telemetry		745,600	76,400	205,500	61,600	87,100	1,176,300	
A- C/ 7 Remote Digital Sensors @ C-2	2.00 EA	40,600	4,200	11,200	3,400	4,700	64,100	32061.12
A- C/ 8 Control House w/ Generator @ C-2								
A- C/ 8. 8 Control House w/ Generator @ C-2		191,100	19,600	52,700	15,800	22,300	301,500	
TOTAL Control House w/ Generator @ C-2		191,100	19,600	52,700	15,800	22,300	301,500	
A- C/ 9 Improve Berm along south bank		30,100	3,100	8,300	2,500	3,500	47,500	
A- C/10 Manatee Barrier for New S-169								
A- C/10. 1 Manatee Barrier		187,900	19,300	51,800	15,500	22,000	296,500	
TOTAL Manatee Barrier for New S-169		187,900	19,300	51,800	15,500	22,000	296,500	
TOTAL Alt.4A; Move S-169, New Bridge		3,403,100	348,700	938,000	281,400	397,700	5,368,900	
A- D Alt.4B; Move S-169,Modifications								
A- D/ 1 S-169 Conversion, add 1x84" bbl								
A- D/ 1. 2 SITEWORK		644,400	71,800	179,000	53,700	75,900	1,024,800	
A- D/ 1. 3 CONCRETE		36,700	4,100	10,200	3,100	4,300	58,300	
A- D/ 1. 5 METALS & MISC.		83,000	9,200	23,100	6,900	9,800	131,900	
TOTAL S-169 Conversion, add 1x84" bbl		764,000	85,100	212,300	63,700	90,000	1,215,000	
A- D/ 2 HHD Access - Temp. Bridge								
A- D/ 2. 1 Precast/Prestressed Members	2400.00 SF	195,100	21,700	54,200	16,300	23,000	310,300	129.28
A- D/ 2. 2 Deck Pavement	2400.00 SF	16,500	1,800	4,600	1,400	1,900	26,200	10.92
A- D/ 2. 3 Precast Conc. Medians	160.00 LF	8,100	900	2,200	700	900	12,800	80.09
A- D/ 2. 4 Abutments	60.00 CY	22,000	2,500	6,100	1,800	2,600	35,000	584.12
A- D/ 2. 5 Install/remove bridge	2.00 EA	29,000	3,200	8,100	2,400	3,400	46,100	23064.57

	QUANTY	UOM	CONTRACT	ESCALATN	CONTINGN	PE&D	S&I	TOTAL COST	UNIT COST
TOTAL HHD Access - Temp. Bridge			270,700	30,100	75,200	22,600	31,900	430,500	
A- D/ 3 Salvage items from S-169			0	0	0	0	0	0	
A- D/ 4 New S-169 4 x 84" CMP									
A- D/ 4. 2 SITEWORK			888,000	98,900	246,700	74,000	104,600	1,412,200	
A- D/ 4. 3 CONCRETE			84,300	9,400	23,400	7,000	9,900	134,100	
A- D/ 4. 5 METALS & MISC.			309,700	34,500	86,000	25,800	36,500	492,500	
A- D/ 4.16 TELEMETRY & DIGITAL SENSORS			121,900	13,600	33,900	10,200	14,400	193,900	
TOTAL New S-169 4 x 84" CMP			1,403,900	156,300	390,100	117,000	165,400	2,232,700	
A- D/ 5 Control House w/ Generator @ New									
A- D/ 5. 8 Control House w/ Generator @ C-2			191,900	21,400	53,300	16,000	22,600	305,200	
TOTAL Control House w/ Generator @ New			191,900	21,400	53,300	16,000	22,600	305,200	
A- D/ 6 Culvert 2 Mods w/ Telemetry									
A- D/ 6. 1 Remove & Install Gates,10'x10'	5.00	EA	649,800	72,400	180,500	54,200	76,500	1,033,400	206684.29
A- D/ 6. 2 Install/remove Dewatering Bulkd	2.00	EA	14,500	1,600	4,000	1,200	1,700	23,100	11532.28
A- D/ 6. 3 Telemetry (Less SFWMD Equipmt)	1.00	EA	81,300	9,100	22,600	6,800	9,600	129,300	129278.68
TOTAL Culvert 2 Mods w/ Telemetry			745,600	83,000	207,200	62,100	87,800	1,185,800	
A- D/ 7 Remote Digital Sensors @ C-2	2.00	EA	40,600	4,500	11,300	3,400	4,800	64,600	32319.67
A- D/ 8 Control House w/ Generator @ C-2									
A- D/ 8. 8 Control House w/ Generator @ C-2			191,900	21,400	53,300	16,000	22,600	305,200	
TOTAL Control House w/ Generator @ C-2			191,900	21,400	53,300	16,000	22,600	305,200	
A- D/ 9 Improve Berm along south bank			29,700	3,300	8,300	2,500	3,500	47,300	
TOTAL Alt.4B; Move S-169,Modifications			3,638,300	405,200	1,010,900	303,300	428,600	5,786,200	
TOTAL S-169 GRR Alternatives			12,905,300	1,437,500	3,585,700	1075700	1520300	20,524,600	
TOTAL S-169 GRR Alternatives; Final			12,905,300	1,437,500	3,585,700	1075700	1520300	20,524,600	

	QUANTY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
A S-169 GRR Alternatives								
A- A Alt. 2 - Operational Changes		84,900	12,700	4,900	10,300	2,300	115,100	
A- B Alt. 3 - New Pump Station		5,421,800	138,300	53,000	111,300	24,500	5,748,800	
A- C Alt.4A; Move S-169, New Bridge		2,511,900	376,800	144,400	303,300	66,700	3,403,100	
A- D Alt.4B; Move S-169,Modifications		2,685,500	402,800	154,400	324,300	71,300	3,638,300	
TOTAL S-169 GRR Alternatives		10,704,000	930,600	356,700	749,100	164,800	12,905,300	
TOTAL S-169 GRR Alternatives; Final		10,704,000	930,600	356,700	749,100	164,800	12,905,300	
ESCALATN							1,437,500	
SUBTOTAL							14,342,800	
CONTING							3,585,700	
SUBTOTAL							17,928,500	
PE&D							1,075,700	
SUBTOTAL							19,004,300	
S&I							1,520,300	
TOTAL INCL OWNER COSTS							20,524,600	

	QUANTY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
A S-169 GRR Alternatives									
A- A Alt. 2 - Operational Changes									
A- A/ 1 Revetment to repair scour hole									
A- A/ 1. 1 Armor Stone, Type B	800.00	TON	39,300	5,900	2,300	4,700	1,000	53,200	66.56
A- A/ 1. 2 Transport Railhead to Site	800.00	TON	4,900	700	300	600	100	6,600	8.31
A- A/ 1. 3 Place Med. Armor Stone by barge	800.00	TON	2,500	400	100	300	100	3,400	4.21
TOTAL Revetment to repair scour hole	500.00	CY	46,700	7,000	2,700	5,600	1,200	63,300	126.52
A- A/ 2 Safety Barrieres									
A- A/ 2. 1 Safety Barrier	2.00	EA	38,200	5,700	2,200	4,600	1,000	51,800	25901.51
TOTAL Safety Barrieres	2.00	EA	38,200	5,700	2,200	4,600	1,000	51,800	25901.51
TOTAL Alt. 2 - Operational Changes			84,900	12,700	4,900	10,300	2,300	115,100	
A- B Alt. 3 - New Pump Station									
A- B/ 1 New 4 bay, 425 cfs Pump Station									
A- B/ 1. 1 Input from Separate MCACES file			4,500,000	0	0	0	0	4,500,000	
TOTAL New 4 bay, 425 cfs Pump Station			4,500,000	0	0	0	0	4,500,000	
A- B/ 2 HHD Access - Temp. Bridge									
A- B/ 2. 1 Precast/Prestressed Members	2400.00	SF	144,000	21,600	8,300	17,400	3,800	195,100	81.29
A- B/ 2. 2 Deck Pavement	2400.00	SF	12,200	1,800	700	1,500	300	16,500	6.87
A- B/ 2. 3 Precast Conc. Medians	160.00	LF	5,900	900	300	700	200	8,100	50.36
A- B/ 2. 4 Abutments	60.00	CY	16,300	2,400	900	2,000	400	22,000	367.29
A- B/ 2. 5 Install/remove bridge	2.00	EA	21,400	3,200	1,200	2,600	600	29,000	14502.73
TOTAL HHD Access - Temp. Bridge			199,800	30,000	11,500	24,100	5,300	270,700	
A- B/ 3 Culvert 2 Mods w/ Telemetry									
A- B/ 3. 1 Remove & Install Gates,10'x10'	5.00	EA	479,600	71,900	27,600	57,900	12,700	649,800	129960.63
A- B/ 3. 2 Install/remove Dewatering Bulkd	2.00	EA	10,700	1,600	600	1,300	300	14,500	7251.36
A- B/ 3. 3 Telemetry (Less SFWMD Equipmt)	1.00	EA	60,000	9,000	3,400	7,200	1,600	81,300	81288.90
TOTAL Culvert 2 Mods w/ Telemetry			550,300	82,500	31,600	66,500	14,600	745,600	

	QUANTY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
A- B/ 4 Remote Digital Sensors @ C-2	2.00	EA	30,000	4,500	1,700	3,600	800	40,600	20322.23
A- B/ 5 Control House w/ Generator @ C-2									
A- B/ 5. 1 CONTROL BUILDING	223.00	SF	76,400	11,500	4,400	9,200	2,000	103,500	464.31
A- B/ 5. 2 CONTROL BLDG.- ELEC.	1.00	JB	65,200	9,800	3,700	7,900	1,700	88,300	88344.73
TOTAL Control House w/ Generator @ C-2			141,600	21,200	8,100	17,100	3,800	191,900	
TOTAL Alt. 3 - New Pump Station			5,421,800	138,300	53,000	111,300	24,500	5,748,800	
A- C Alt.4A; Move S-169, New Bridge									
A- C/ 1 New Bridge west of S-169									
A- C/ 1. 1 Precast/Prestressed Members	3000.00	SF	180,000	27,000	10,400	21,700	4,800	243,900	81.29
A- C/ 1. 2 Deck Pavement	3000.00	SF	15,200	2,300	900	1,800	400	20,600	6.87
A- C/ 1. 3 Precast Conc. Medians	160.00	LF	5,900	900	300	700	200	8,100	50.36
A- C/ 1. 4 Abutments x 2	60.00	CY	16,300	2,400	900	2,000	400	22,000	367.29
A- C/ 1. 5 Install precast	1.00	EA	10,700	1,600	600	1,300	300	14,500	14502.73
A- C/ 1. 6 Pile Foundation	2.00	EA	49,300	7,400	2,800	6,000	1,300	66,800	33400.25
A- C/ 1. 7 Pile Caps x 2	200.00	CY	32,500	4,900	1,900	3,900	900	44,000	220.17
A- C/ 1. 8 Approach slabs, 12" x 2	50.00	CY	5,400	800	300	700	100	7,300	146.25
TOTAL New Bridge west of S-169			315,300	47,300	18,100	38,100	8,400	427,200	
A- C/ 2 Re-align approach at new bridge			18,400	2,800	1,100	2,200	500	25,000	
A- C/ 3 New S-169 4 x 84" CMP									
A- C/ 3. 2 SITEWORK			669,900	100,500	38,500	80,900	17,800	907,600	
A- C/ 3. 3 CONCRETE			62,600	9,400	3,600	7,600	1,700	84,800	
A- C/ 3. 5 METALS & MISC.			228,600	34,300	13,100	27,600	6,100	309,800	
A- C/ 3.16 TELEMETRY & DIGITAL SENSORS			90,000	13,500	5,200	10,900	2,400	121,900	
TOTAL New S-169 4 x 84" CMP			1,051,100	157,700	60,400	126,900	27,900	1,424,000	
A- C/ 4 Control House w/ Generator @ New									
A- C/ 4. 8 Control House w/ Generator @ C-2			141,100	21,200	8,100	17,000	3,700	191,100	
TOTAL Control House w/ Generator @ New			141,100	21,200	8,100	17,000	3,700	191,100	
A- C/ 5 Demolish S-169									
A- C/ 5. 2 Sitework			11,800	1,800	700	1,400	300	16,000	
A- C/ 5. 3 Concrete			35,300	5,300	2,000	4,300	900	47,800	

	QUANTY	UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
A- C/ 5. 5 METALS & MISC.			56,500	8,500	3,300	6,800	1,500	76,600	
TOTAL Demolish S-169			103,600	15,500	6,000	12,500	2,800	140,400	
A- C/ 6 Culvert 2 Mods w/ Telemetry									
A- C/ 6. 1 Remove & Install Gates,10'x10'	5.00	EA	479,600	71,900	27,600	57,900	12,700	649,800	129960.63
A- C/ 6. 2 Install/remove Dewatering Bulkd	2.00	EA	10,700	1,600	600	1,300	300	14,500	7251.36
A- C/ 6. 3 Telemetry (Less SFWMD Equipmt)	1.00	EA	60,000	9,000	3,400	7,200	1,600	81,300	81288.90
TOTAL Culvert 2 Mods w/ Telemetry			550,300	82,500	31,600	66,500	14,600	745,600	
A- C/ 7 Remote Digital Sensors @ C-2	2.00	EA	30,000	4,500	1,700	3,600	800	40,600	20322.23
A- C/ 8 Control House w/ Generator @ C-2									
A- C/ 8. 8 Control House w/ Generator @ C-2			141,100	21,200	8,100	17,000	3,700	191,100	
TOTAL Control House w/ Generator @ C-2			141,100	21,200	8,100	17,000	3,700	191,100	
A- C/ 9 Improve Berm along south bank			22,200	3,300	1,300	2,700	600	30,100	
A- C/10 Manatee Barrier for New S-169									
A- C/10. 1 Manatee Barrier			138,700	20,800	8,000	16,800	3,700	187,900	
TOTAL Manatee Barrier for New S-169			138,700	20,800	8,000	16,800	3,700	187,900	
TOTAL Alt.4A; Move S-169, New Bridge			2,511,900	376,800	144,400	303,300	66,700	3,403,100	
A- D Alt.4B; Move S-169,Modifications									
A- D/ 1 S-169 Conversion, add 1x84" bbl									
A- D/ 1. 2 SITEWORK			475,600	71,300	27,300	57,400	12,600	644,400	
A- D/ 1. 3 CONCRETE			27,100	4,100	1,600	3,300	700	36,700	
A- D/ 1. 5 METALS & MISC.			61,200	9,200	3,500	7,400	1,600	83,000	
TOTAL S-169 Conversion, add 1x84" bbl			563,900	84,600	32,400	68,100	15,000	764,000	
A- D/ 2 HHD Access - Temp. Bridge									
A- D/ 2. 1 Precast/Prestressed Members	2400.00	SF	144,000	21,600	8,300	17,400	3,800	195,100	81.29
A- D/ 2. 2 Deck Pavement	2400.00	SF	12,200	1,800	700	1,500	300	16,500	6.87
A- D/ 2. 3 Precast Conc. Medians	160.00	LF	5,900	900	300	700	200	8,100	50.36
A- D/ 2. 4 Abutments	60.00	CY	16,300	2,400	900	2,000	400	22,000	367.29
A- D/ 2. 5 Install/remove bridge	2.00	EA	21,400	3,200	1,200	2,600	600	29,000	14502.73

	QUANTY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
TOTAL HHD Access - Temp. Bridge		199,800	30,000	11,500	24,100	5,300	270,700	
A- D/ 3 Salvage items from S-169		0	0	0	0	0	0	
A- D/ 4 New S-169 4 x 84" CMP								
A- D/ 4. 2 SITEWORK		655,400	98,300	37,700	79,100	17,400	888,000	
A- D/ 4. 3 CONCRETE		62,200	9,300	3,600	7,500	1,700	84,300	
A- D/ 4. 5 METALS & MISC.		228,600	34,300	13,100	27,600	6,100	309,700	
A- D/ 4.16 TELEMETRY & DIGITAL SENSORS		90,000	13,500	5,200	10,900	2,400	121,900	
TOTAL New S-169 4 x 84" CMP		1,036,200	155,400	59,600	125,100	27,500	1,403,900	
A- D/ 5 Control House w/ Generator @ New								
A- D/ 5. 8 Control House w/ Generator @ C-2		141,600	21,200	8,100	17,100	3,800	191,900	
TOTAL Control House w/ Generator @ New		141,600	21,200	8,100	17,100	3,800	191,900	
A- D/ 6 Culvert 2 Mods w/ Telemetry								
A- D/ 6. 1 Remove & Install Gates,10'x10'	5.00 EA	479,600	71,900	27,600	57,900	12,700	649,800	129960.63
A- D/ 6. 2 Install/remove Dewatering Bulkd	2.00 EA	10,700	1,600	600	1,300	300	14,500	7251.36
A- D/ 6. 3 Telemetry (Less SFWMD Equipmt)	1.00 EA	60,000	9,000	3,400	7,200	1,600	81,300	81288.90
TOTAL Culvert 2 Mods w/ Telemetry		550,300	82,500	31,600	66,500	14,600	745,600	
A- D/ 7 Remote Digital Sensors @ C-2	2.00 EA	30,000	4,500	1,700	3,600	800	40,600	20322.23
A- D/ 8 Control House w/ Generator @ C-2								
A- D/ 8. 8 Control House w/ Generator @ C-2		141,600	21,200	8,100	17,100	3,800	191,900	
TOTAL Control House w/ Generator @ C-2		141,600	21,200	8,100	17,100	3,800	191,900	
A- D/ 9 Improve Berm along south bank		22,000	3,300	1,300	2,700	600	29,700	
TOTAL Alt.4B; Move S-169,Modifications		2,685,500	402,800	154,400	324,300	71,300	3,638,300	
TOTAL S-169 GRR Alternatives		10,704,000	930,600	356,700	749,100	164,800	12,905,300	
TOTAL S-169 GRR Alternatives; Final		10,704,000	930,600	356,700	749,100	164,800	12,905,300	
ESCALATN							1,437,500	
SUBTOTAL							14,342,800	
CONTING							3,585,700	
SUBTOTAL							17,928,500	

	QUANTY UOM	DIRECT	OVERHEAD	HOME OFC	PROFIT	BOND	TOTAL COST	UNIT COST
PE&D							1,075,700	
SUBTOTAL							19,004,300	
S&I							1,520,300	
TOTAL INCL OWNER COSTS							20,524,600	

	QUANTY	UOM	NHRS	LABOR	EQUIPMN	MATERIA	OTHER	TOTAL COST	UNIT COST
A S-169 GRR Alternatives									
A- A Alt. 2 - Operational Changes	200		8,400	6,900	45,100	24,600		84,900	
A- B Alt. 3 - New Pump Station	5300		1676100	1569200	2116400	60,000		5,421,800	
A- C Alt.4A; Move S-169, New Bridge	****		627,100	264,000	1492600	128,300		2,511,900	
A- D Alt.4B; Move S-169,Modifications	****		660,000	281,000	1624500	120,000		2,685,500	
TOTAL S-169 GRR Alternatives	****		2971600	2121000	5278500	332,800		10,704,000	
TOTAL S-169 GRR Alternatives; Final	****		2971600	2121000	5278500	332,800		10,704,000	
OVERHEAD								930,600	
SUBTOTAL								11,634,600	
HOME OFC								356,700	
SUBTOTAL								11,991,400	
PROFIT								749,100	
SUBTOTAL								12,740,500	
BOND								164,800	
TOTAL INCL INDIRECTS								12,905,300	
ESCALATN								1,437,500	
SUBTOTAL								14,342,800	
CONTING								3,585,700	
SUBTOTAL								17,928,500	
PE&D								1,075,700	
SUBTOTAL								19,004,300	
S&I								1,520,300	
TOTAL INCL OWNER COSTS								20,524,600	

	QUANTY	UOM	NHRS	LABOR	EQUIPMN	MATERIA	OTHER	TOTAL COST	UNIT COST
A S-169 GRR Alternatives									
A- A Alt. 2 - Operational Changes									
A- A/ 1 Revetment to repair scour hole									
A- A/ 1. 1 Armor Stone, Type B	800.00	TON	0	0	0	14,700	24,600	39,300	49.13
A- A/ 1. 2 Transport Railhead to Site	800.00	TON	100	2,100	2,800	0	0	4,900	6.13
A- A/ 1. 3 Place Med. Armor Stone by barge	800.00	TON	0	1,100	1,400	0	0	2,500	3.11
TOTAL Revetment to repair scour hole	500.00	CY	100	3,200	4,200	14,700	24,600	46,700	93.39
A- A/ 2 Safety Barrieres									
A- A/ 2. 1 Safety Barrier	2.00	EA	100	5,200	2,700	30,300	0	38,200	19118.11
TOTAL Safety Barrieres	2.00	EA	100	5,200	2,700	30,300	0	38,200	19118.11
TOTAL Alt. 2 - Operational Changes			200	8,400	6,900	45,100	24,600	84,900	
A- B Alt. 3 - New Pump Station									
A- B/ 1 New 4 bay, 425 cfs Pump Station									
A- B/ 1. 1 Input from Separate MCACES file			1000	1500000	1500000	1500000	0	4,500,000	
TOTAL New 4 bay, 425 cfs Pump Station			1000	1500000	1500000	1500000	0	4,500,000	
A- B/ 2 HHD Access - Temp. Bridge									
A- B/ 2. 1 Precast/Prestressed Members	2400.00	SF	0	0	0	144,000	0	144,000	60.00
A- B/ 2. 2 Deck Pavement	2400.00	SF	100	3,600	900	7,800	0	12,200	5.07
A- B/ 2. 3 Precast Conc. Medians	160.00	LF	0	600	400	5,000	0	5,900	37.17
A- B/ 2. 4 Abutments	60.00	CY	200	8,000	800	7,400	0	16,300	271.10
A- B/ 2. 5 Install/remove bridge	2.00	EA	400	11,300	10,100	0	0	21,400	10704.58
TOTAL HHD Access - Temp. Bridge			800	23,500	12,200	164,100	0	199,800	
A- B/ 3 Culvert 2 Mods w/ Telemetry									
A- B/ 3. 1 Remove & Install Gates,10'x10'	5.00	EA	3200	111,000	41,100	327,500	0	479,600	95925.00
A- B/ 3. 2 Install/remove Dewatering Bulkd	2.00	EA	200	5,700	5,000	0	0	10,700	5352.29
A- B/ 3. 3 Telemetry (Less SFWMD Equipmt)	1.00	EA	0	0	0	0	60,000	60,000	60000.00
TOTAL Culvert 2 Mods w/ Telemetry			3400	116,700	46,200	327,500	60,000	550,300	

	QUANTY	UOM	NHRS	LABOR	EQUIPMN	MATERIA	OTHER	TOTAL COST	UNIT COST
A- B/ 4 Remote Digital Sensors @ C-2	2.00	EA	0	10,000	10,000	10,000	0	30,000	15000.00
A- B/ 5 Control House w/ Generator @ C-2									
A- B/ 5. 1 CONTROL BUILDING	223.00	SF	100	5,300	900	70,200	0	76,400	342.71
A- B/ 5. 2 CONTROL BLDG.- ELEC.	1.00	JB	0	20,600	0	44,600	0	65,200	65207.96
TOTAL Control House w/ Generator @ C-2			100	25,900	900	114,800	0	141,600	
TOTAL Alt. 3 - New Pump Station			5300	1676100	1569200	2116400	60,000	5,421,800	
A- C Alt.4A; Move S-169, New Bridge									
A- C/ 1 New Bridge west of S-169									
A- C/ 1. 1 Precast/Prestressed Members	3000.00	SF	0	0	0	180,000	0	180,000	60.00
A- C/ 1. 2 Deck Pavement	3000.00	SF	200	4,400	1,100	9,700	0	15,200	5.07
A- C/ 1. 3 Precast Conc. Medians	160.00	LF	0	600	400	5,000	0	5,900	37.17
A- C/ 1. 4 Abutments x 2	60.00	CY	200	8,000	800	7,400	0	16,300	271.10
A- C/ 1. 5 Install precast	1.00	EA	200	5,700	5,000	0	0	10,700	10704.58
A- C/ 1. 6 Pile Foundation	2.00	EA	400	13,200	7,000	29,100	0	49,300	24653.00
A- C/ 1. 7 Pile Caps x 2	200.00	CY	100	1,700	800	30,000	0	32,500	162.51
A- C/ 1. 8 Approach slabs, 12" x 2	50.00	CY	0	400	0	5,000	0	5,400	107.95
TOTAL New Bridge west of S-169			1100	34,000	15,100	266,200	0	315,300	
A- C/ 2 Re-align approach at new bridge			300	7,700	9,800	1,000	0	18,400	
A- C/ 3 New S-169 4 x 84" CMP									
A- C/ 3. 2 SITEWORK			5100	187,800	90,100	392,000	0	669,900	
A- C/ 3. 3 CONCRETE			800	26,900	2,200	33,500	0	62,600	
A- C/ 3. 5 METALS & MISC.			1300	47,700	26,800	154,100	0	228,600	
A- C/ 3.16 TELEMETRY & DIGITAL SENSORS			0	10,000	10,000	10,000	60,000	90,000	
TOTAL New S-169 4 x 84" CMP			7300	272,500	129,000	589,600	60,000	1,051,100	
A- C/ 4 Control House w/ Generator @ New									
A- C/ 4. 8 Control House w/ Generator @ C-2			100	25,900	900	114,200	0	141,100	
TOTAL Control House w/ Generator @ New			100	25,900	900	114,200	0	141,100	
A- C/ 5 Demolish S-169									
A- C/ 5. 2 Sitework			200	7,700	3,600	400	0	11,800	
A- C/ 5. 3 Concrete			900	22,400	4,600	0	8,300	35,300	

	QUANTY	UOM	NHRS	LABOR	EQUIPMN	MATERIA	OTHER	TOTAL COST	UNIT COST
A- C/ 5. 5 METALS & MISC.			1000	36,300	20,200	0	0	56,500	
TOTAL Demolish S-169			2100	66,500	28,400	400	8,300	103,600	
A- C/ 6 Culvert 2 Mods w/ Telemetry									
A- C/ 6. 1 Remove & Install Gates,10'x10'	5.00	EA	3200	111,000	41,100	327,500	0	479,600	95925.00
A- C/ 6. 2 Install/remove Dewatering Bulkd	2.00	EA	200	5,700	5,000	0	0	10,700	5352.29
A- C/ 6. 3 Telemetry (Less SFWMD Equipmt)	1.00	EA	0	0	0	0	60,000	60,000	60000.00
TOTAL Culvert 2 Mods w/ Telemetry			3400	116,700	46,200	327,500	60,000	550,300	
A- C/ 7 Remote Digital Sensors @ C-2	2.00	EA	0	10,000	10,000	10,000	0	30,000	15000.00
A- C/ 8 Control House w/ Generator @ C-2									
A- C/ 8. 8 Control House w/ Generator @ C-2			100	25,900	900	114,200	0	141,100	
TOTAL Control House w/ Generator @ C-2			100	25,900	900	114,200	0	141,100	
A- C/ 9 Improve Berm along south bank			300	9,100	11,500	1,600	0	22,200	
A- C/10 Manatee Barrier for New S-169									
A- C/10. 1 Manatee Barrier			1500	58,800	12,100	67,800	0	138,700	
TOTAL Manatee Barrier for New S-169			1500	58,800	12,100	67,800	0	138,700	
TOTAL Alt.4A; Move S-169, New Bridge			****	627,100	264,000	1492600	128,300	2,511,900	
A- D Alt.4B; Move S-169,Modifications									
A- D/ 1 S-169 Conversion, add 1x84" bbl									
A- D/ 1. 2 SITEWORK			4400	149,600	63,100	262,900	0	475,600	
A- D/ 1. 3 CONCRETE			400	13,200	1,000	12,900	0	27,100	
A- D/ 1. 5 METALS & MISC.			400	13,500	7,000	40,700	0	61,200	
TOTAL S-169 Conversion, add 1x84" bbl			5200	176,400	71,100	316,400	0	563,900	
A- D/ 2 HHD Access - Temp. Bridge									
A- D/ 2. 1 Precast/Prestressed Members	2400.00	SF	0	0	0	144,000	0	144,000	60.00
A- D/ 2. 2 Deck Pavement	2400.00	SF	100	3,600	900	7,800	0	12,200	5.07
A- D/ 2. 3 Precast Conc. Medians	160.00	LF	0	600	400	5,000	0	5,900	37.17
A- D/ 2. 4 Abutments	60.00	CY	200	8,000	800	7,400	0	16,300	271.10
A- D/ 2. 5 Install/remove bridge	2.00	EA	400	11,300	10,100	0	0	21,400	10704.58

	QUANTY	UOM	NHRS	LABOR	EQUIPMN	MATERIA	OTHER	TOTAL COST	UNIT COST
TOTAL HHD Access - Temp. Bridge			800	23,500	12,200	164,100	0	199,800	
A- D/ 3 Salvage items from S-169			0	0	0	0	0	0	
A- D/ 4 New S-169 4 x 84" CMP									
A- D/ 4. 2 SITEWORK			5100	187,800	89,500	378,000	0	655,400	
A- D/ 4. 3 CONCRETE			800	26,900	2,200	33,200	0	62,200	
A- D/ 4. 5 METALS & MISC.			1300	47,700	26,800	154,100	0	228,600	
A- D/ 4.16 TELEMETRY & DIGITAL SENSORS			0	10,000	10,000	10,000	60,000	90,000	
TOTAL New S-169 4 x 84" CMP			7300	272,500	128,500	575,300	60,000	1,036,200	
A- D/ 5 Control House w/ Generator @ New									
A- D/ 5. 8 Control House w/ Generator @ C-2			100	25,900	900	114,800	0	141,600	
TOTAL Control House w/ Generator @ New			100	25,900	900	114,800	0	141,600	
A- D/ 6 Culvert 2 Mods w/ Telemetry									
A- D/ 6. 1 Remove & Install Gates,10'x10'	5.00	EA	3200	111,000	41,100	327,500	0	479,600	95925.00
A- D/ 6. 2 Install/remove Dewatering Bulkd	2.00	EA	200	5,700	5,000	0	0	10,700	5352.29
A- D/ 6. 3 Telemetry (Less SFWMD Equipmt)	1.00	EA	0	0	0	0	60,000	60,000	60000.00
TOTAL Culvert 2 Mods w/ Telemetry			3400	116,700	46,200	327,500	60,000	550,300	
A- D/ 7 Remote Digital Sensors @ C-2	2.00	EA	0	10,000	10,000	10,000	0	30,000	15000.00
A- D/ 8 Control House w/ Generator @ C-2									
A- D/ 8. 8 Control House w/ Generator @ C-2			100	25,900	900	114,800	0	141,600	
TOTAL Control House w/ Generator @ C-2			100	25,900	900	114,800	0	141,600	
A- D/ 9 Improve Berm along south bank			300	9,100	11,200	1,600	0	22,000	
TOTAL Alt.4B; Move S-169,Modifications			****	660,000	281,000	1624500	120,000	2,685,500	
TOTAL S-169 GRR Alternatives			****	2971600	2121000	5278500	332,800	10,704,000	
TOTAL S-169 GRR Alternatives; Final			****	2971600	2121000	5278500	332,800	10,704,000	
OVERHEAD								930,600	
SUBTOTAL								11,634,600	
HOME OFC								356,700	
SUBTOTAL								11,991,400	

	QUANTY	UOM	NHRS	LABOR	EQUIPMN	MATERIA	OTHER	TOTAL COST	UNIT COST
PROFIT								749,100	
SUBTOTAL								12,740,500	
BOND								164,800	
TOTAL INCL INDIRECTS								12,905,300	
ESCALATN								1,437,500	
SUBTOTAL								14,342,800	
CONTING								3,585,700	
SUBTOTAL								17,928,500	
PE&D								1,075,700	
SUBTOTAL								19,004,300	
S&I								1,520,300	
TOTAL INCL OWNER COSTS								20,524,600	

No errors detected...

* * * END OF ERROR REPORT * * *

SUMMARY REPORTS SUMMARY PAGE

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PROJECT OWNER SUMMARY - Level 4.....2
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PROJECT INDIRECT SUMMARY - Level 4.....7
PROJECT DIRECT SUMMARY - Level 2.....12
PROJECT DIRECT SUMMARY - Level 4.....13

No Detailed Estimate...

No Backup Reports...

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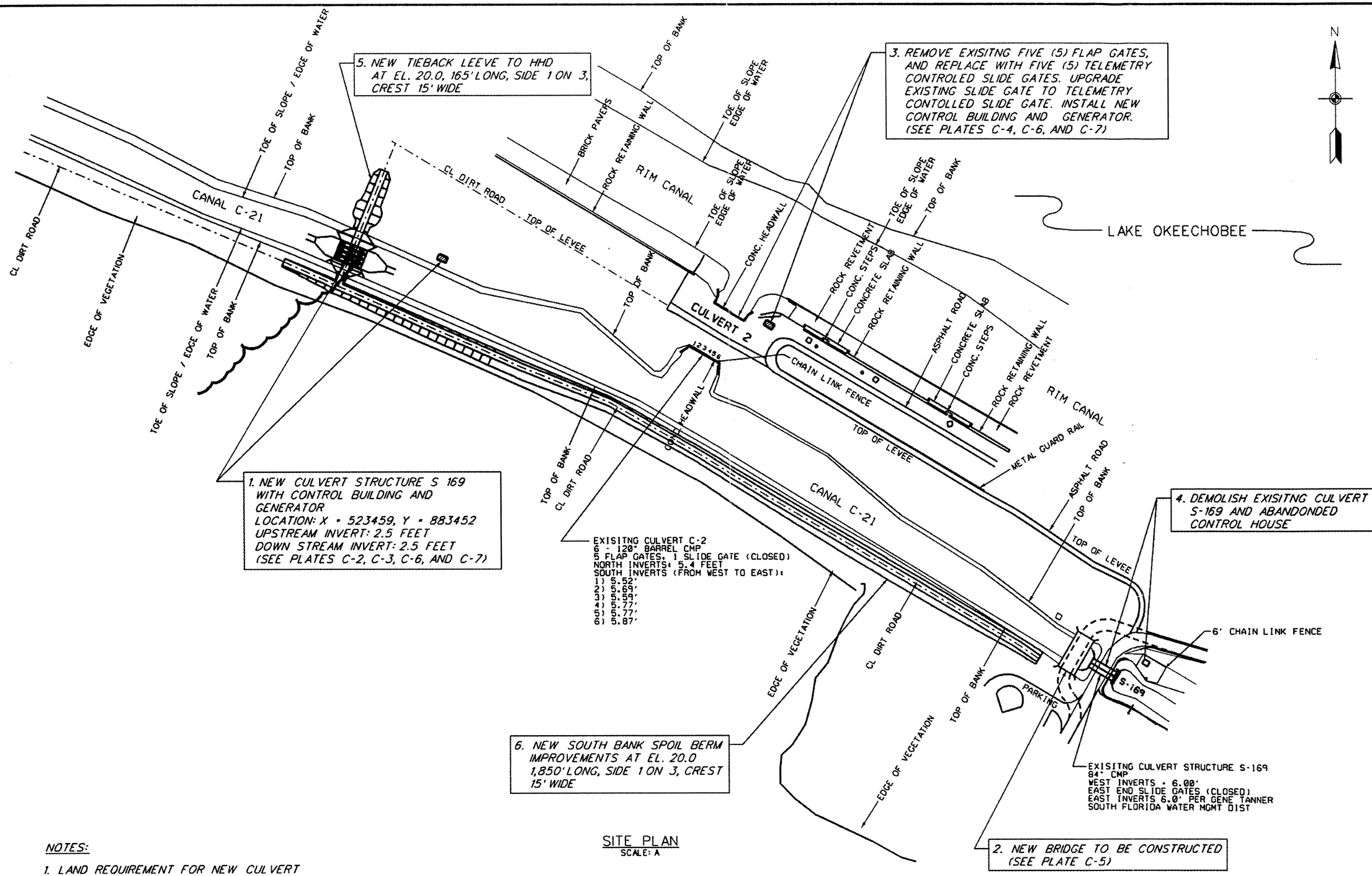

SITE PLAN
SCALE: A

NOTES:

1. LAND REQUIREMENT FOR NEW CULVERT STRUCTURE S-169 AND CONTROL BUILDING WITH GENERATOR: 300' x 300' (2.1 AC).

2. LAND REQUIREMENT FOR NEW BRIDGE: 400' x 200' (1.8 AC).

PRELIMINARY

GRAPHIC SCALES

"A" 200' 0 200'

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

Designed by: W.Z.M.
Dwn by: B.J.S.
Ckd by: 10/04
D.O.FILE NO. N/A
Dated:

File name: S169EVAL_C1.DGN
Reference files: S-169BRDRDN_B.DGN

S-169/NINE MILE CANAL BASIN
GENERAL REEVALUATION REPORT

SITE PLAN
STRUCTURES

Scale: AS SHOWN

PLATE NO.
C-1

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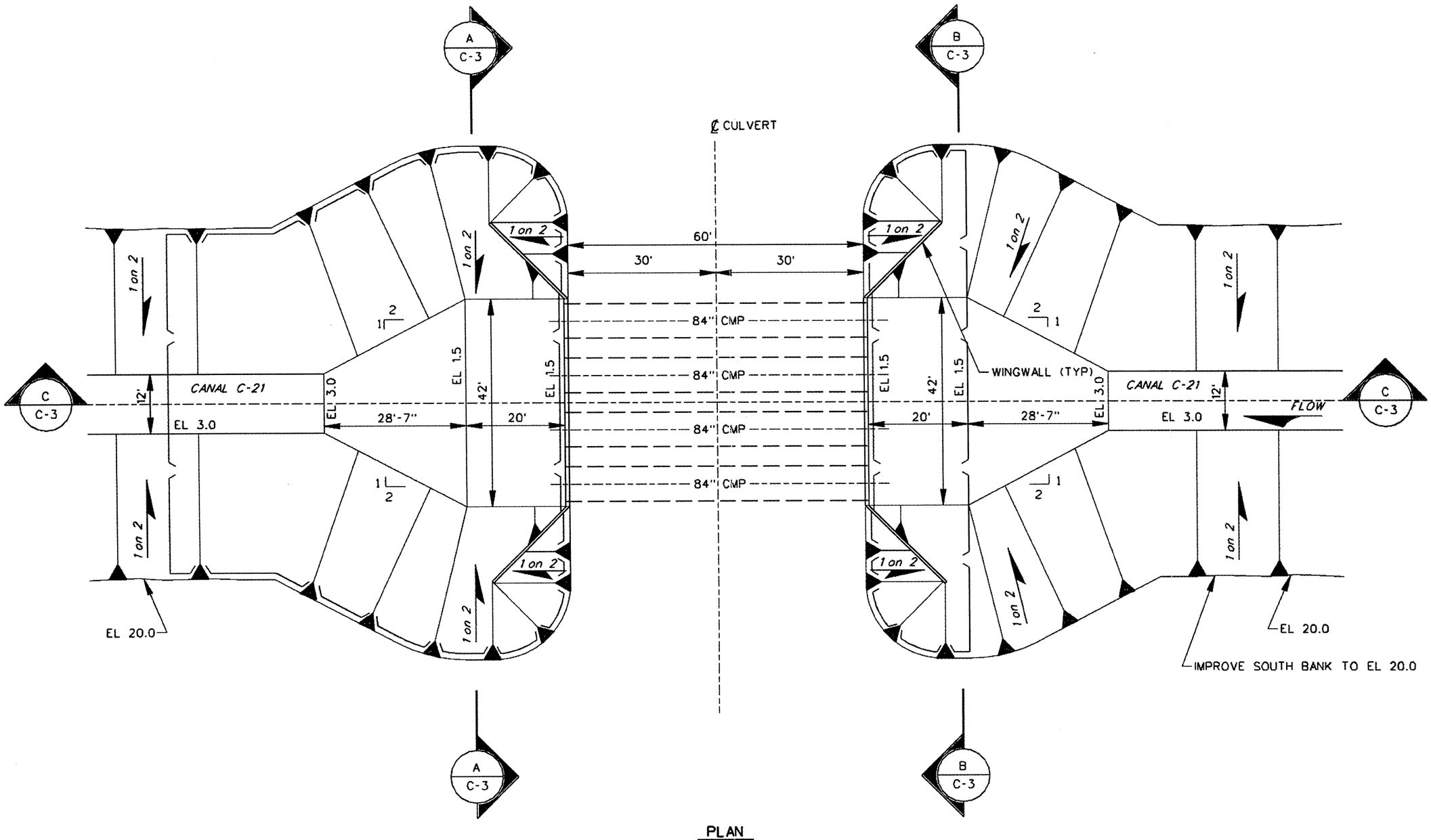


PLAN
SCALE: A

PRELIMINARY

GRAPHIC SCALE
"A" 10' 0 10' 20'

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

D.O.FILE NO. N/A

Designed by: M.Z.M.
Dwn by: B.J.S.
Ckd by: 10/04

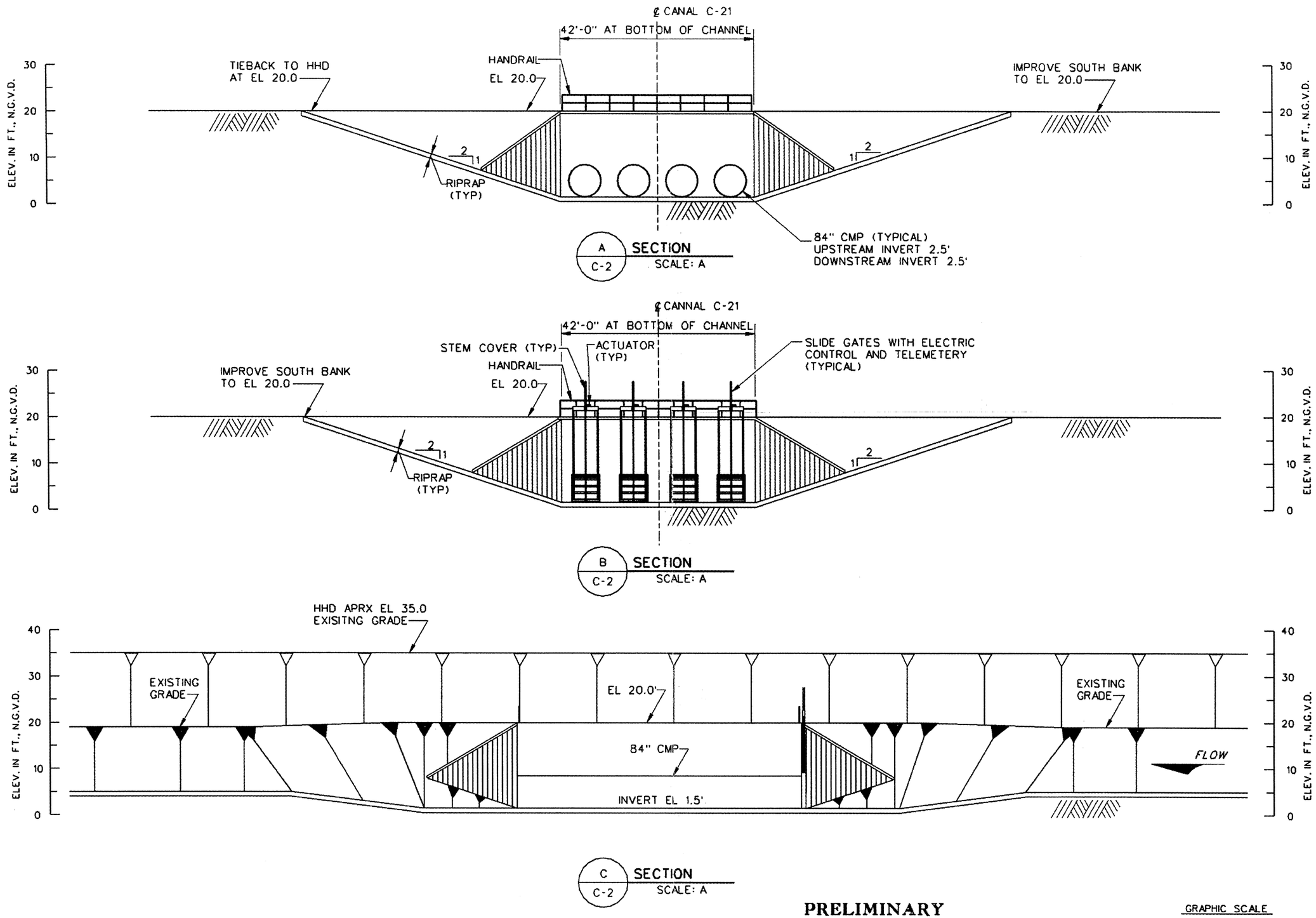
File name: S169EVAL_C2.DGN
Reference files: S-169BRDRDM_B.DGN

S-169/NINE MILE CANAL BASIN
GENERAL REEVALUATION REPORT

NEW CULVERT STRUCTURE S-169
STRUCTURES
GENERAL PLAN

Scale: AS SHOWN

PLATE NO.
C-2



PRELIMINARY

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

Designed by: M.Z.M.
Dwn by: B.J.S.
Ckd by: 10/04
D.O.FILE NO. N/A
Dated:

File name: S169EVAL_C3.DGN
Reference files: S-169BRDM_B.DGN

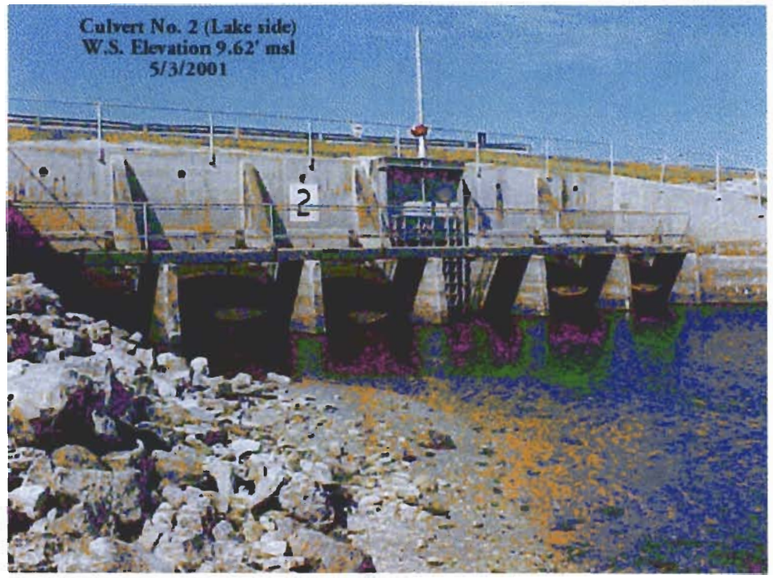
S-169/NINE MILE CANAL BASIN
GENERAL REEVALUATION REPORT

NEW CULVERT STRUCTURE S-169
STRUCTURES
SECTIONS

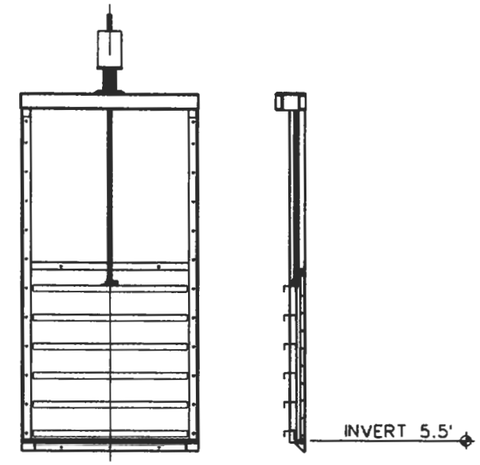
Scale: AS SHOWN

PLATE NO.
C-3

...\New Files 4-1\S169EVAL_C3.dgn 4/1/2005 9:36:10 AM



CULVERT C-2 TO BE MODIFIED BY REPLACING EXISITNG FLAP GATES (5) WITH SLIDE GATES.



NEW SLIDE GATE
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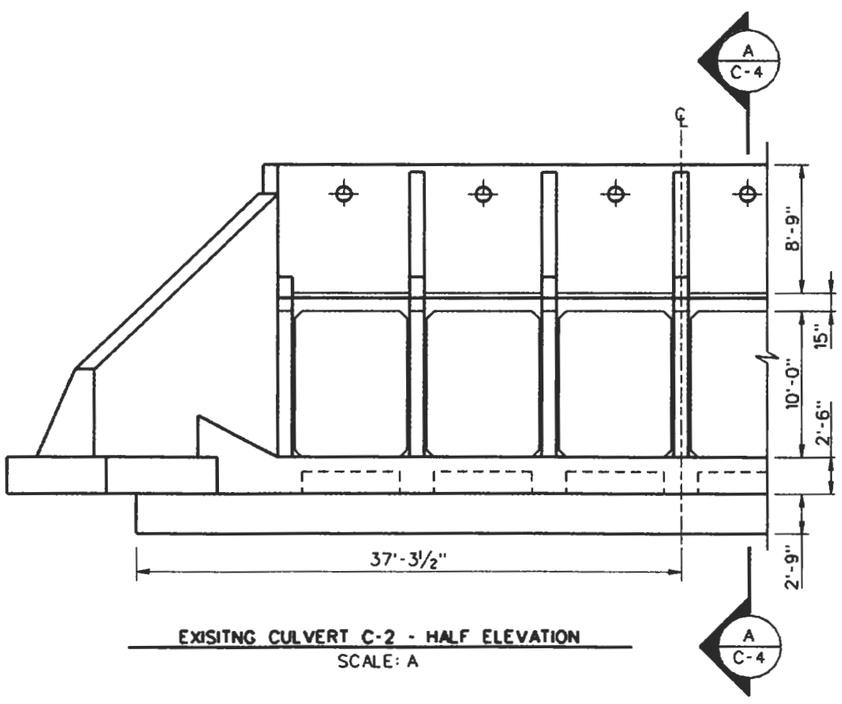

EXISITNG CULVERT C-2 - HALF ELEVATION
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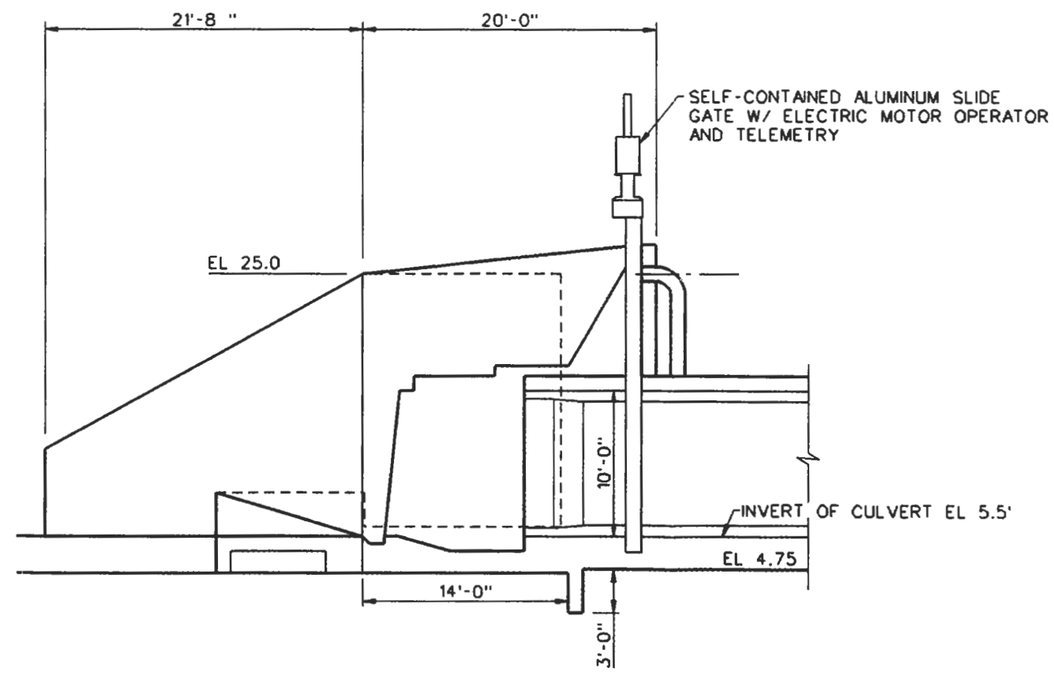

A / C-4 EXISITNG CULVERT C-2 - SECTION
SCALE: A

PRELIMINARY

GRAPHIC SCALE
"A" 10' 0 10'

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
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JACKSONVILLE, FLORIDA

Designed by: M.Z.M.
Dwn by: B.J.S.
Ckd by: 10/04
D.O.FILE NO. N/A
Date:

File name: S169EVAL_C4.DGN
Reference Files: S-169BRDRDM_B.DGN

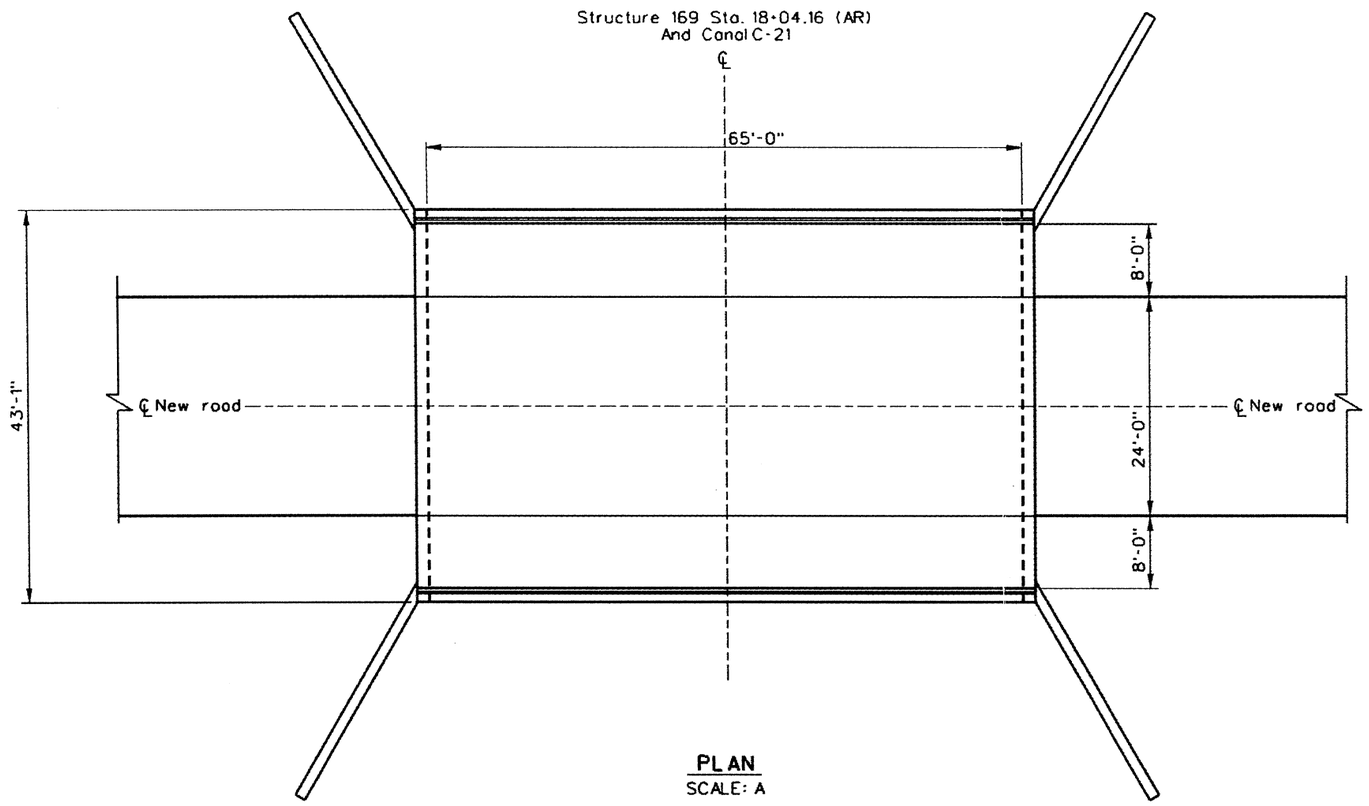
S-169/NINE MILE CANAL BASIN
GENERAL REEVALUATION REPORT

EXISITNG CULVERT STRUCTURE C-2
STRUCTURES
GATE ELEVATION AND SECTION

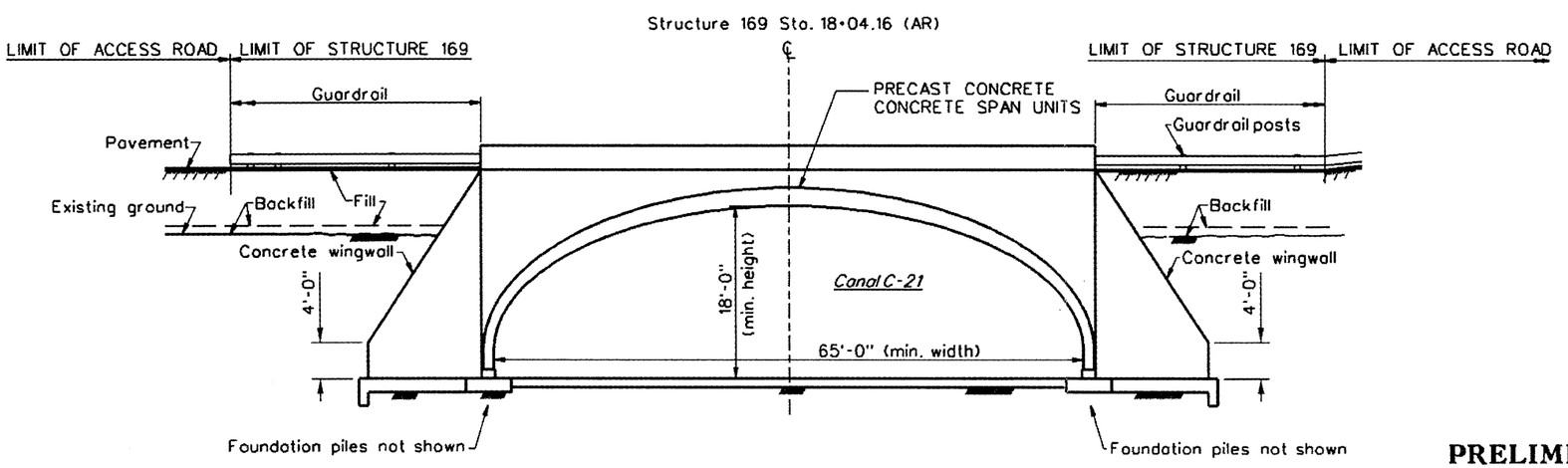
Scale: AS SHOWN

PLATE NO.
C-4

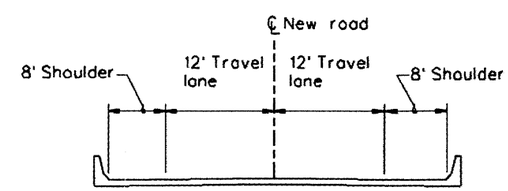
\New Files 4-1\S169EVAL_C4.dgn 4/1/2005 9:37:08 AM



PLAN
SCALE: A



ELEVATION
SCALE: A



BRIDGE ROADWAY GEOMETRY
SCALE: A

PRELIMINARY

GRAPHIC SCALES
"A" 96" 12" 0 8' 16'

US Army Corps of Engineers
Jacksonville District

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JACKSONVILLE, FLORIDA

D.O.FILE NO. N/A

Designed by: P.P.P.
Dwn by: B.J.S.
Ckd by: 10/04
Date:

File name: PLATE4.DGN
Reference files: S-169BRDROW_B.DGN

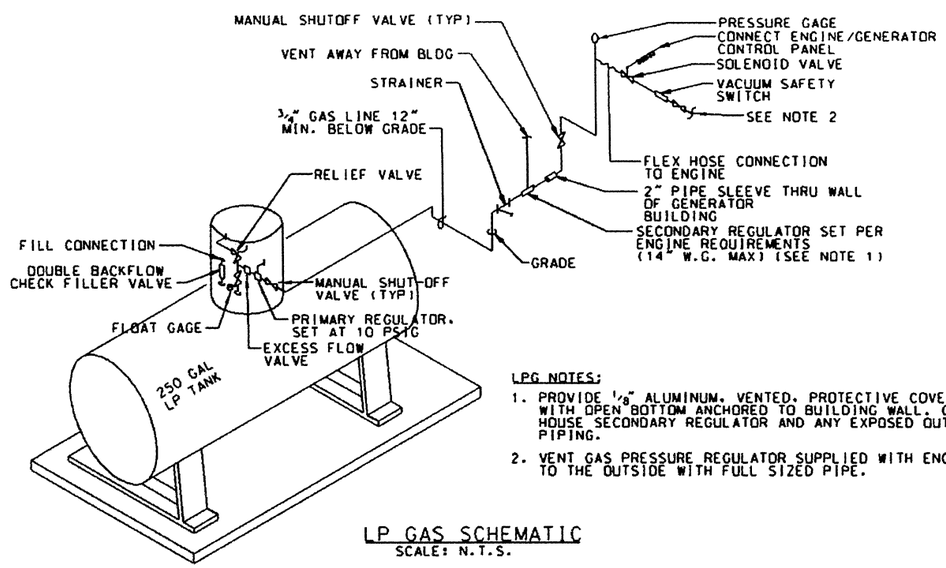
S-169/NINE MILE CANAL BASIN
GENERAL REEVALUATION REPORT

NEW BRIDGE S-169 (CONSPAN SYSTEM)
STRUCTURES
PLAN AND ELEVATION

Scale: AS SHOWN

PLATE NO.
C-5

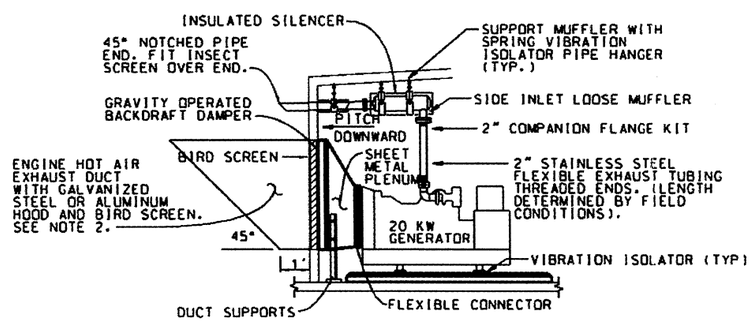
\New Files 4.1\S169EVAL_C5.dgn 4/1/2005 9:38:00 AM



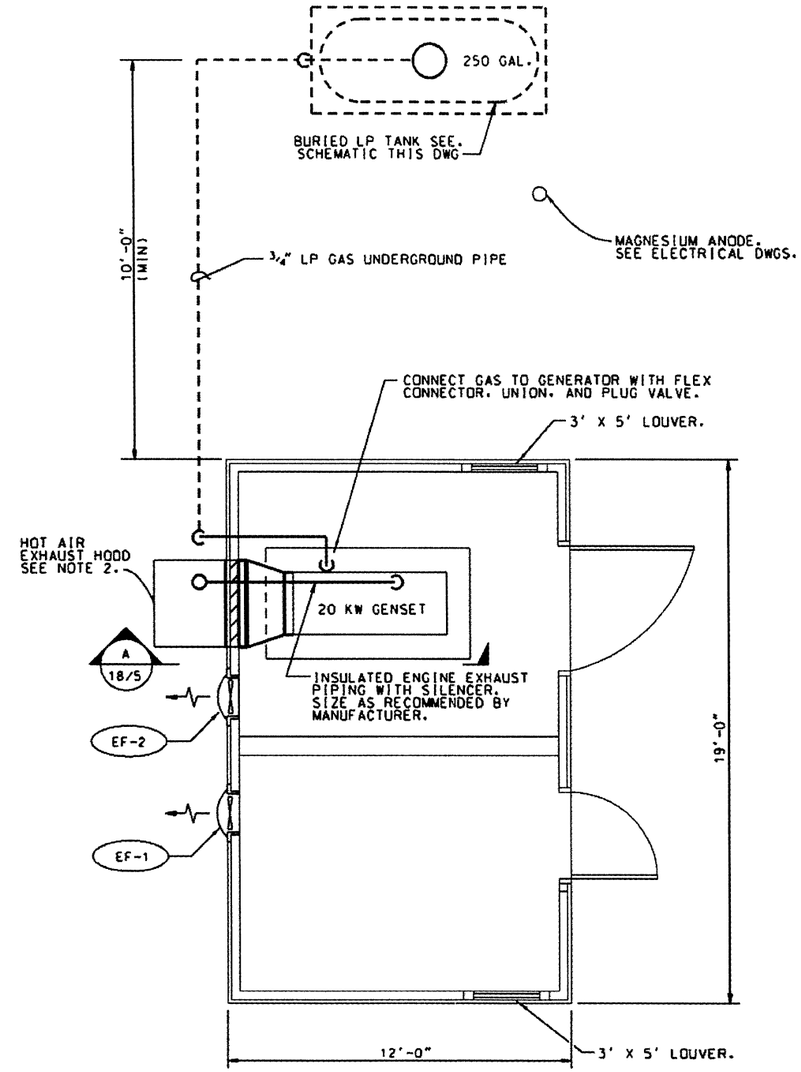
LPG NOTES:

1. PROVIDE 1/8" ALUMINUM. VENTED. PROTECTIVE COVER WITH OPEN BOTTOM ANCHORED TO BUILDING WALL. COVER SHALL HOUSE SECONDARY REGULATOR AND ANY EXPOSED OUTDOOR PIPING.
2. VENT GAS PRESSURE REGULATOR SUPPLIED WITH ENGINE/GENERATOR TO THE OUTSIDE WITH FULL SIZED PIPE.

LP GAS SCHEMATIC
SCALE: N.T.S.



A 18/5 SECTION
SCALE: N.T.S.



CONTROL BUILDING PLAN
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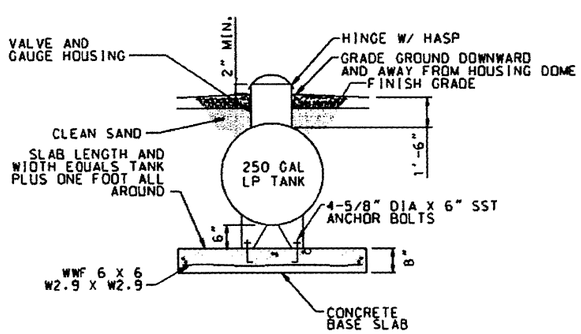


LP TANK BASE SLAB DETAIL
SCALE: N.T.S.

EXHAUST FAN SCHEDULE

UNIT NO. (MARK)	CFM *	S.P. (IN H2O)	MOTOR		RPM *	MAX. SONES	DRIVE	TYPE	NOTES
			V/PH/HZ	MIN. HP					
EF-1	2678	0.50	120/1/60	3/4	1300	25	BELT	SIDEWALL PROPELLER	1.2
EF-2	2678	0.50	120/1/60	3/4	1300	25	BELT	SIDEWALL PROPELLER	1.3

* APPROXIMATIONS

EXHAUST FAN SCHEDULE NOTES:

1. PROVIDE UNITS WITH DISCONNECT SWITCHES.
2. CONTROLLED BY A STANDARD WALL TOGGLE SWITCH.
3. PROVIDE THERMOSTAT SET AT 85°F TO ENERGIZE FAN. PROVIDE A WALL SWITCH TO OVERIDE THERMOSTAT.

NOTES:

1. HVAC FEATURES FURNISHED AS PART OF PREFABRICATED BUILDING. SEE DRAWING XX/XX FOR DETAILS ON LOCATIONS AND CONFIGURATIONS.
2. THE HOT AIR EXHAUST DUCT AND EXHAUST PIPE ASSEMBLIES SHALL WITHSTAND WINDS UP TO 140 MPH AND MEET THE REQUIREMENTS OF ASCE 7-98. EXHAUST DUCT SIZE AND LOCATION TO SUIT EQUIPMENT FURNISHED.
3. LPG FUEL SYSTEM AND GENERATOR SET-UPS/DESIGNS SHOWN ON THIS DRAWING APPLY TO S-650X1 AND S-650X2.

PRELIMINARY

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

Designed by: T.T.T.
Dwn by: B.J.S.
Ckd by: 10/04
D.O.FILE NO. N/A

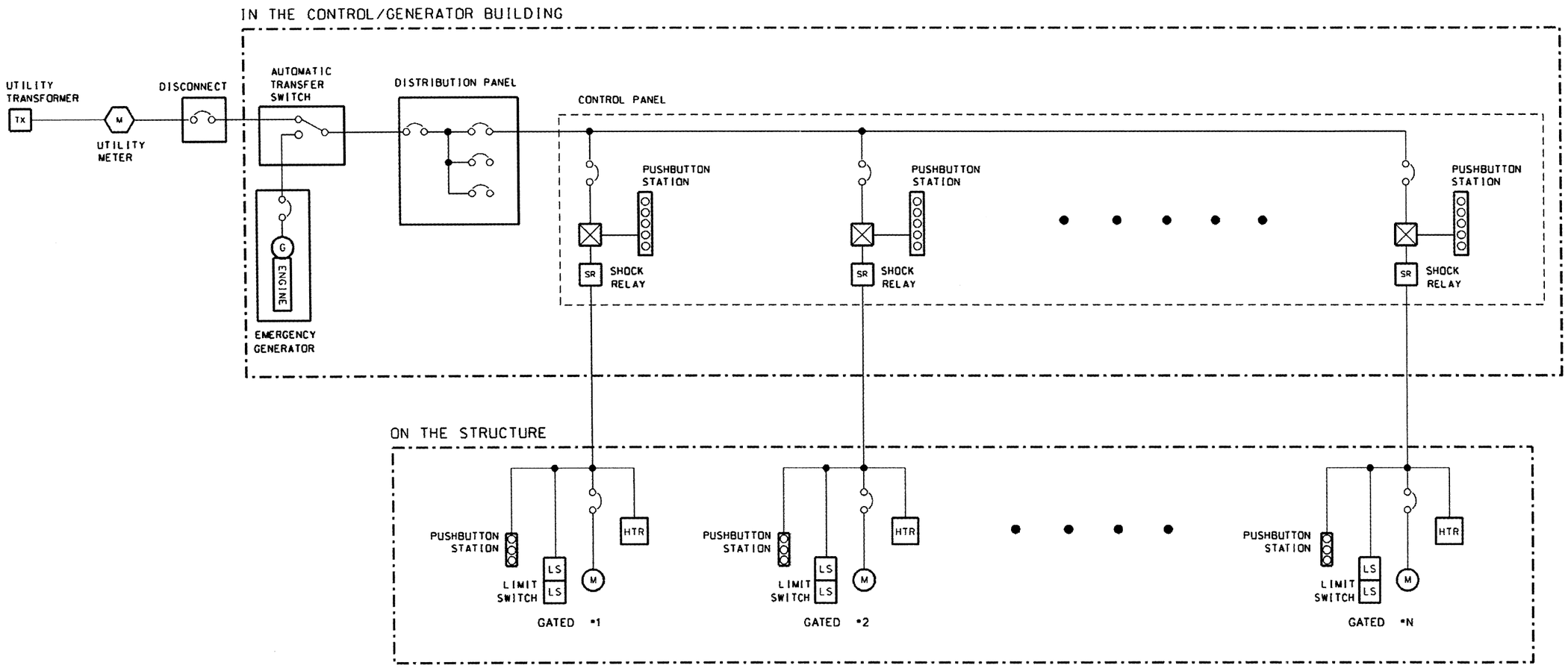
File name: S169EVAL_C6.DGN
Reference files: S-169BRDRDM_B.DGN

S-169/NINE MILE CANAL BASIN
GENERAL REEVALUATION REPORT
GENERATOR INSTALLATION
MECHANICAL
GENERAL ARRANGEMENT

Scale: N.T.S.

PLATE NO.
C-6

\New Files 4.1\S169EVAL_C6.dgn 4/1/2005 9:28:45 AM



GATED SPILLWAY/CULVERT/TUNNEL SINGLE LINE DIAGRAM
N.T.S.

NOTE:

VOLTAGE SHOULD BE 120/240V, 1 PH, 3W FOR STRUCTURES WITH SMALL MOTOR LOAD AND 208Y/120V, 3 PH, 4W FOR STRUCTURES WITH SMALL MOTOR LOAD AND 208Y/120V, 3 PH 4 W FOR STRUCTURES WITH LARGE MOTOR LOADS

PRELIMINARY

US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

D.O.FILE NO. N/A

Designed by: P.P.P.
Dwn by: B.J.S.
Ckd by: 10/04
Dated:

File name: S169EVAL_C7.DGN
Reference files: S-169BRDROM_B.DGN

S-169/NINE MILE CANAL BASIN
GENERAL REEVALUATION REPORT

CONTROLS
ELECTRICAL
SINGLE LINE DIAGRAM

Scale: N.T.S.

PLATE NO.
C-7

\New Files 4-1\S169EVAL_C7.dgn 4/1/2005 9:39:32 AM

APPENDIX D

ECONOMIC EVALUATION

FOR

S-169
GENERAL REEVALUATION REPORT
HENDRY COUNTY, FLORIDA

APPENDIX D
S-169
Central And Southern Florida (C&SF)
Hendry County, Florida

SOCIO-ECONOMICS

The S-169/Nine-Mile Canal project was initiated in March 1997 by the South Florida Water Management District (SFWMD) in a letter requesting assistance from the Corps of Engineers in the Nine-Mile Canal drainage basin. The Nine-Mile Canal is a local drainage ditch. Improvement of the ditch was originally proposed in the C&SF study, and would have become Canal 20, however this portion of the project was not implemented. This study has investigated water resource opportunities in Hendry and Glades Counties, and part of the South Florida Conservation District subbasin (area served by P-5-W east of Industrial Canal) located in Palm Beach County in relation to the subbasin of the Nine-Mile Canal Basin served by S-169. The study resulted in the formulation of solutions to address multiple opportunities to include: agricultural water supply in the Industrial Canal, obstruction of commercial navigation and stream bank erosion caused by operation of S-310, and environmental impacts related to lack of water in the Industrial Canal.

PURPOSE OF INVESTIGATION

The overall purpose of this project was to determine the problem or problems in the subbasin of the Nine-Mile Canal Basin served by S-169, formulate possible alternative solutions, and determine Federal interest, if any. A list of alternatives to address the problem or problems will be provided.

The socio-economic objectives of the investigation are to assess the economic effects of the alternative water resource management plans formulated in the initial appraisal phase of the S-169/Nine Mile Canal Study. The economic evaluation of the alternative management plans includes 2 principal elements:

Socio-economic Profile of Study Area: This profile will focus on population and economic forecasts for the region. It identifies the socio-economic environment surrounding Glades and Hendry Counties.

Evaluation of Project Cost: Project costs include all expenditures required to implement the alternative plans. The Federal government and the State of Florida will share these costs. Project costs include those for initial construction; land; relocation; rights of way; rehabilitation, replacement, and repair; and operations and maintenance (O&M), including the costs of post-construction monitoring and adaptive management.

STUDY AREA

The study area is located in the Nine-Mile Canal area adjacent to the Herbert Hoover Dike southwest of Lake Okeechobee. The project area includes portions of Hendry and Glades Counties and is included in the six-county Southwest Florida Regional Planning area[1]. The main city within the project boundaries is Clewiston, which is located in Hendry County. Just outside of the western periphery of the project in Glades County is the city of Moore Haven

ORGANIZATION OF THE REPORT

The report is divided into six sections. Section 1 gives the overview of the socio-economic setting of the study area. It develops a socio-economic profile for the region that include demographics and general statistics. Section 2 describes the sugarcane and irrigation cycles in Southwest Florida, which is a prelude to the problem. Section 3 presents the problem: the existing condition, the without project condition, and the alternatives to address the problem. Section 4 is devoted to the methodology. Section 5 discusses benefits, costs and the benefit-cost analysis. Finally, section 6 presents a summary of the economic analysis of the alternative plans and conclusions.

1. POPULATION AND ECONOMY

Overview

This section of the appendix includes a description of the local economy and demographics of the study area. This descriptive information provides insight into the study area's socio-economic characteristics.

[1] The Southwest Florida region consists of Charlotte, Collier, Glades, Hendry, Lee, and Sarasota Counties.

General

The bulk of the study area, which is primarily agricultural, lies within Hendry County. Hendry County is bordered by Glades County to the north, which contains the remaining portion of the study area, Collier County to the south, Palm Beach County to the east, and Lee County to the west. Both Hendry and Glades Counties are home to Indian reservations. The 52,000-acre Big Cypress Seminole Indian Reservation is located in Hendry County north of the Big Cypress National Preserve and the 35,800-acre Brighton Seminole Indian Reservation is located in Glades County.

Population

The 2000 Census reported a population of 10,576 persons in Glades County and 36,210 persons in Hendry County. As shown in Table 1, between 1990 and 2000, both Glades and Hendry Counties' populations grew at a rate in excess of the state growth rate of 23.5%. Although the population is growing at a rate faster than the state average, the Counties are growing more slowly than other Counties in the Southwest Florida region and remain sparsely populated with very low population densities.

TABLE 1
POPULATION OF GLADES COUNTY, HENDRY COUNTY AND FLORIDA STATE

	1990	2000		2010*		2020*		2030*	
County	Total	Total	Increase	Total	Increase	Total	Increase	Total	Increase
Glades	7,592	10,576	39.30%	12,821	21.20%	14,961	16.70%	15,000	0.30%
Hendry	25,772	36,210	40.50%	45,772	26.40%	55,521	21.30%	63,400	14.20%
Florida	13,276,530	16,396,515	23.50%	18,776,412	17.50%	21,683,344	15.50%	23,198,000	7.00%

Source: The US Census Bureau, 2000 Census; *Population projections from Southwest Florida Regional Planning Council, Volume one of the Strategic Regional Policy Plan.

Projections made by the Bureau of Economic and Business Research at the University of Florida forecasts continued growth in the population of the study area, although the rate of growth is expected to decline over the next thirty years. Despite the declining rate of growth, rates are expected to exceed those of the State of Florida.

Table 2 shows selected demographics of the two Counties and the State of Florida. Observe that the female population in Glades and Hendry Counties is approximately 6

percent lower than the state. The table also shows a higher percentage of people 65 years of age or older live in Glades County as compared to Hendry County. Glades County has about the same percentage with the State of Florida. Compared to the State of Florida, both Counties have a smaller population density.

TABLE 2
SELECTED DEMPGRAPHICS

	Glades County	Hendry County	Florida
Female persons, percent	45.1%	44.4%	51.2%
Persons under 18 years of age	22.1%	30.0%	22.8%
Persons 65 years of age or older	18.8%	10.1%	17.6%
Persons per square mile	13.7	31.4	296.4

Source: The U.S. Census Bureau, 2000 Census

As shown in Table 3 below, the State of Florida as a whole has a larger percentage of Black/African-Americans and Hispanics/Latinos than the nation. Within the study area, Glades County has a smaller percentage of persons of Black/African-American and Hispanic/Latino origin than Hendry County and the State of Florida. However, Glades' proportion of persons belonging to the American Indian/Alaskan Native population is much greater than that of Hendry County, the state, and the nation. Although in real terms, this population amounts to only about 520 persons in Glades County compared with about 300 in Hendry. Conversely, the proportion of Hendry County's Hispanic/Latino population is more than three times higher than that of the nation and more than two times higher than Glades County and the state of Florida. Hendry County has approximately 14,300 Hispanic persons out of a total population of 36,210 compared to approximately 1,600 in Glades County out of a population of 10,576.

TABLE 3
RACIAL/ETHNIC POPULATION DISTRIBUTION

RACIAL/ETHNIC POPULATION DISTRIBUTION					
	White	Black	Hispanic or Latino	American Indian or Alaskan Native	Asian or Pacific Islander
United States	69.1%	12.3%	12.5%	0.9%	3.7%
Florida	65.4%	14.6%	16.8%	0.3%	1.8%
Glades County	68.6%	10.5%	15.1%	4.9%	0.3%
Hendry County	43.9%	14.7%	39.6%	0.8%	0.4%

Source: The U.S. Census Bureau, 2000 Census

The counties in the project area have relatively high poverty levels. Glades County has a poverty level of 15.2% and Hendry County, 24.1%. Hendry County's poverty level is almost twice that of the state and the nation.

TABLE 4
PERCENT OF PERSONS BELOW POVERTY LEVEL 1999

United States	12.4%
Florida	12.5%
Glades County	15.2%
Hendry County	24.1%

Source: U.S. Census Bureau, 2000 Census

The county seat of Hendry County is La Belle; however, the largest city in the county is Clewiston, which is approximately four square miles with a population of 6,460. Clewiston, which is home to approximately 20% of the county's population, is located in the northeastern portion of the project area bordering the southwestern shore of Lake Okeechobee. Just outside of the project boundary on the western shore of Lake Okeechobee is Moore Haven, the county seat of Glades County. Moore Haven is approximately one square mile. The 2000 Census reported a population of 1,635 persons in Moore Haven or about 15% of the total county population.

Economy

Both counties within the study area had a 2000 unemployment rate above that of the State of Florida and the United States. Real per capita income and the median

household income for the counties were approximately 30% and 20% lower, respectively, than that for the state and the nation.

TABLE 5
EMPLOYMENT 2000

	Civilian Labor Force	Total Employed Persons	Civilian Unemployment Rate (%)
United States	140,863,000	135,206,000	4.00%
Florida	7,407,458	6,995,047	5.60%
Glades County	4,034	3,677	8.80%
Hendry County	15,814	14,579	7.80%

Source: The U.S. Census Bureau, 2000 Census

TABLE 6
REAL PER CAPITA INCOME ($) 1999

United States	21,587
Florida	21,557
Glades County	15,338
Hendry County	13,663

Source: The U.S. Census Bureau, 2000 Census

TABLE 7
MEDIAN HOUSEHOLD INCOME

UNITED STATES	$41,994
FLORIDA	$38,819
GLADES COUNTY	$30,774
HENRY COUNTY	$33,592

Source: The U.S. Census Bureau, 2000 Census

The agricultural and natural resource industries, which are made up of interconnected enterprises responsible for the production and processing of food, fiber and mineral products, are vital to the economy of the State of Florida (Regional Economic Impacts of Florida's Agriculture and Natural Resources Industries, 2003). Like the State of Florida, both the production and processing of agricultural products is very important for the economies of both Hendry and Glades Counties. In fact, the City of Clewiston in Hendry County is home to the United States Sugar Corporation, the country's largest producer of cane sugar and one of the country's largest orange juice producers.

The 1997 Census of Agriculture reported a total market value of $323,438,000 for agricultural products in Hendry County and $58,589,000 for Glades County. The average market value of agricultural products sold per farm in 1997 was $802,575 for Hendry County and $311,642 for Glades County. Crop sales in Hendry County accounted for 95% of the market value of agricultural products sold and livestock sales accounted for 5%. In contrast, Glades County's crop sales accounted for 65% of the total market value of agricultural products and the remaining 35% was comprised of livestock.

TABLE 8
EMPLOYMENT BY INDUSTRY (%) 2000

INDUSTRY	Glades County	Hendry County
Agriculture, forestry, fishing and hunting, and mining	12.5	22.8
Construction	10.0	8.0
Manufacturing	5.4	10.0
Wholesale trade	2.4	3.3
Retail trade	9.6	9.9
Transportation and warehousing, and utilities	6.6	4.4
Information	1.0	1.6
Finance, insurance, and real estate	3.9	3.7
Professional, scientific, management, administrative, and waste management services	3.7	4.7
Educational, health, and social services	18.5	13.3
Arts, entertainment, recreation, accommodation, and food services	9.5	6.3
Other services (except public administration)	5.9	3.7
Public administration	10.9	8.3

Source: U.S. Census Bureau, 2000 Census

Florida is the largest producer of sugarcane in the United States, and Hendry and Glades Counties are Florida's two leading producers of sugarcane. In addition to sugarcane, cattle and citrus are the mainstays of Hendry County's local economy. While farming is an important component of Glades County's economy, educational, health, and social service jobs, probably fueled by the relatively large elderly population, provide the majority of the county's employment.

Land Use

Agriculture is the predominant land use in the State of Florida and within the project area. Seventy percent of Florida's total land area is used for agricultural or forestry purposes. Within Glades County, there are about 495,360 county land acres, of which 380,377 acres or approximately 77% is farmland. This figure increased 3% from 1992. Hendry County has about 737,920 county land acres, of which 604,677 acres or approximately 82% is farmland. The county's land in farms increased 14% from 529,835 acres in 1992.

The 1997 Census of Agriculture reported 188 farms with an average farm size of 2,023 acres and a median farm size of 100 acres in Glades County. Average farm size in the county increased by 13% between 1992 and 1997. A total of 403 farms with an average farm size of 1,500 acres and a median size of 87 acres were reported for Hendry County. Average farm size in the county increased 10% between 1992 and 1997. Although Hendry County has more farms than Glades, on average, farms in Glades County are larger than farms in Hendry.

Land use in the project area is expected to remain primarily agricultural in the future.

TABLE 9
AGRICULTURAL LAND USE (ACRES)

	Glades County			Hendry County			
Crops	1987	1992	1997	1987	1992	1997	
Sugarcane	*	*	14,847	*	980	54,008	
Hay	1,238	187	2,440	1,423	645	995	
Vegetables	*	722	*	8,581	6,197	9,936	
Land in Orchards	5,522	8,827	10,596	57,975	112,031	114,618	

Source: 1997 Census of Agriculture
*Undisclosed or Not Available

Based on trends in the movement of citrus southward from Central Florida due to several past winter freezes, citrus acreage in the project area is expected to increase. Sugarcane acreage is expected to continue to increase in the next coming years and then remain constant through 2020.

2. INFLUENCE OF S-310 OPERATION ON SUGARCANE GROWTH CYCLE AND IRRIGATION CYCLE AT THE INDUSTRIAL CANAL

As was explained in the previous section, sugarcane production is an important economic activity in the Hendry and Glades Counties and its production has increased considerably since 1960. In 1997/98, Florida contributed an estimate of 55.7% of the cane sugar and 22% of the total sugar produced in the United States. High rates of fertilizers and other amendment are normally applied in an attempt to maintain yield. Sugarcane yields depend, among other things, on the availability of water. The planting starts in August and continues through January and the crop is ready for harvest in 12 to 18 months, usually starting about the second week of October to the second week of April. Sugarcane is a perennial plant, and each planting produces four or more annual crops.

Sugarcane irrigation is all year round, with much of that occurring during the Grand Growth Phase (June to September) when the plant requires large amounts of water. However, depending on the weather not much irrigation is required during that period. When there is sufficient rainfall, as is usually the case in summer, very little irrigation is required. However, between November and May irrigation activities peak because of drought.

In early summer, Lake Okeechobee is lowered to prepare for the hurricane season and by late July, August, and September rain is expected to recharge the lake. Current operating procedures at S-310 are dictated by water surface elevation at Lake Okeechobee. When the lake is below 15.5, the upstream and downstream lock doors are left open to navigation traffic, which also satisfies any irrigation water supply needs. Exceedance curves calculated by water management using historical data indicate that the lake may exceed 15.5 feet between September and end of March at which time the S-310 locks are closed to prevent excess water flowing into the Industrial Canal. According to the exceedance analysis, there is a 25 % chance of Lake Okeechobee stages rising above 15.5 feet. That implies, between September and March, farmers would have to establish alternative sources of water to irrigate their farms.

The assumption of establishing an alternative source for the water, instead of allowing crop failure, is based on several components. First, sugarcane is a perennial plant, and each planting produces four or more annual crops. The return value of the plant is not based on one crop yield but is spread over a life of four or more yields. Therefore the cost to the agricultural economy would not only be the value of the current year's crop but would also be the lost value associated with the remaining crop potential of the lost plants. Also the local economy is heavily reliant on the sugar cane as a source of income not only in terms of the crop but also the production of the sugar products processed from the raw commodity.

3. PROBLEM STATEMENT

The water supply capabilities in the Nine-Mile Canal Basin will not be reliable due to concerns about safety with the current operating procedures. There is considerable concern over the fact that the S-310 is currently being used in an unauthorized and unsafe manner. The operating procedure of cracking the lock to allow water to flow from Lake Okeechobee to provide water for irrigation to the Industrial Canal and to maintain a water level that will not cause property damage is extremely hazardous. Major problems resulting from the discontinued use of S-310 in this manner will result in loss of agricultural productivity, fish kills, damage to watercraft, structural damage to marinas, and erosion of the tail water stream bank. A method of providing an adequate supply of water in the Industrial Canal for agriculture and to prevent property damage must be found.

Existing Condition

Currently, S-310 is the only water control structure that allows water to flow from Lake Okeechobee to Industrial Canal and it has limited hours of operation. If this situation remains unchanged problems, including fish kills, damage to watercraft, and structural damage to marinas currently occurring in the immediate area are likely to increase. These problems will result in impacts that include economic damages to commercial fishermen and marina owners. The operation of S-310 in a manner in which it was not designed will continue to spawn liability and safety concerns and eventually result in unscheduled future maintenance of the lock.

Future With-out Plan Conditions

S-310 will cease to be operated in an unsafe and unauthorized manner. When lake levels exceed 15.5 ft, S-310 will only operate as designed and the practice of cracking the lock for water supply will be discontinued. That will reduce water available for irrigation and will adversely impact agriculture in the Industrial Canal and possibly cause damage to marine craft at certain times of the year. Farmers cannot sustain agricultural activities under this condition.

To sustain irrigation activities, the most likely condition expected to exist in the future in the absence of a proposed project is to place a pump station on the south bank of C-21 just west of S-169 and to modify culvert no. 2 (C-2) as required. Installing a pump station just west of S-169 will provide the means of pumping water from C-21 into the Industrial Canal when the Lake Okeechobee stage is above 15.5 ft, S-310 is closed and the Industrial Canal stage is low.

Alternative Plans

The alternative plans have been formulated in the initial phase of the S-169/Nine-Mile Canal Study. Each alternative consists of structural and operational changes to the Hendry and Glades Counties C&SF Projects. Issues related to flood control, water supply and environmental impacts in the Industrial Canal were addressed in four alternatives:

Alternative 1- No Action-Existing Conditions

The without project condition will consist of the project area's future if there is no Federal action taken to solve the identified problem(s). When Lake Okeechobee level is 15.5 ft or lower, S-310 is left open. On the other hand when lake levels exceed 15.5 ft, South Florida Water Management District (SFWMD) operates the lock manually from 5:30am to 8:00pm between October and April and from 5:30am to 9:00pm between May and September. Currently, S-310 is the only water control structure that allows water to flow from Lake Okeechobee to Industrial Canal and it has limited hours of operation. If this

situation remains unchanged problems, including agricultural productivity, fish kills, damage to watercraft, and structural damage to marinas currently occurring in the immediate area are likely to increase. These problems will result in impacts that include economic damages to commercial fishermen and marina owners. Due to the negative impacts this alternative is not considered feasible.

Alternative 2 – Change Operations of S-310

Alternative 2 is a 24-hr, 7-days/week work schedule when Lake Okeechobee stages exceed 15.5 ft. This would insure that the Industrial Canal would always be available for water supply for agricultural interest without adversely impacting fish, watercraft, and marinas. In addition to the operational change at S-310 this alternative would repair damages that have resulted from the previous practice of cracking the lock. This alternative would also require a removable boat safety barrier to be installed. This alternative was eliminated since cracking the lock to provide water supply is unsafe for approaching vessels and has caused bank erosion. Additionally, the normal operating mechanisms have to be overridden in order to make releases through the structure, which typically cause mechanical/electrical safety features of the lock to be overridden. The general consensus was that S-310 would not be operated in this manner.

Consideration was also given to operating the lock on a continual basis in order to transport water from the lake down into the canal. An engineering analysis was done in order to determine the feasibility of such an operational change and it was determined that even if the lock were operated on a continual basis there would not be sufficient water transported to keep the canal at a level required to meet the agricultural and other users of the canal (marinas, boat owners and other water supply users).

Alternative 4 – Relocate S-169 (2 Options)"

This alternative will consist of building a water control structure west of C-2; that would move water to the Industrial Canal without operation of S-310 and meet the needs of the numerous users. The alternative could be implemented in one of two ways,

(A) Demolishing the existing S-169 and constructing an access bridge for Herbert Hoover Dike in its place, or

(B) Modifying S-169, if necessary, to provide water control and continuous vehicular access.

Alternative 4a – Relocate S-169 (New Bridge)

This alternative involves demolishing the existing S-169 and control house and hauling off-site to nearest landfill. It will require constructing a new bridge west of existing S-169; and constructing a new S-169 culvert structure just west of C-2. The new S-169 will require telemetry control. Any parts or equipment that are salvageable can be used for the new construction to assist with cost savings. This alternative would also convert five 10-foot diameter flap gates on C-2 to vertical slide gates. This alternative will also require construction of two new control houses.

Alternative 4b – Relocate S-169 (Modify S-169 Gates)

This alternative will require the south bank of existing S-169 to be demolished and the addition of one seven-foot barrel to the existing S-169 structure; reconstruction of south bank to transition at a 1:10 ratio; removal of three vertical slide gates from the existing S-169; and construction of a new S-169 culvert structure just west of C-2. The new S-169 will require telemetry control. Any parts or equipment that are salvageable can be used for the new construction to assist with the cost savings. This alternative would also convert five 10-foot diameter flap gates on C-2 to vertical slide gates. This alternative will also require construction of two new control houses. However, this alternative was eliminated since stages resulting from the design flow are too high.

4. METHODOLOGY

A number of methodological approaches are used to achieve the objectives of this study. Factors considered prior to developing the methodologies used to evaluate the economic effects of the alternative operation and management plans include: economic theory, Federal policy, data, time and budgetary constraints. These factors are discussed below.

Methodology For Conducting Economic Analysis

The approach that is used to identify the NED plan is the benefit-cost analysis. Consistent with U.S. Army Corps of Engineers Guidance, a benefit-cost analysis is required to evaluate alternative water resource plans. A cost-benefit analysis was performed to select the NED plan with a project design that produced the maximum net benefits. The economic justification of the proposed plan will be determined by comparing the equivalent average annual costs (i.e., interest, amortization, and maintenance costs) with an estimate of the equivalent average annual benefits, which would be realized over a 50-year period of analysis. Computed costs of alternatives are based on 2005 price levels.

The development of costs and benefits follows standard practices. The value of all goods and services used in the project is estimated on the cost side.

Data

The data and information collected and analyzed for this study come from three main sources.

- Informal information (a mix of qualitative and quantitative data) collected through interviews with informed observers. Examples of the organizations contacted include SFWMD and United States Sugar Corporation (contacted to obtain information on sugarcane growth and irrigation cycles).
- Data for initial construction/implementation, land acquisition, monitoring, and periodically recurring costs for OMRR&R (operation, maintenance, repair, replacement, and rehabilitation), have been developed through engineering design and cost estimation.
- Data on Operation and Management was obtained from the existing management at S-169.

5. PLAN OPTIMIZATION

Maximizing net benefits is an economic concept aimed at sizing a project to the point where the greatest excess of benefits over costs occurs. The maximization of benefits was the basis for determining the NED plan, since that is the project purpose.

Benefits

For a study such as this the benefits resulting from any of the alternatives would be water supply, and the savings as a result of the prevention of commercial and private boat damages. Of these two categories water supply is the major benefit category.

For the purpose of this analysis there was no data available to determine the value of the water used by the agricultural and municipal users of the canal. The users do not pay a fee for the water and the amount of water used by any user has not been monitored. These two pieces of data are critical in determining the value of benefits of water supply. It was determined that an acceptable proxy for the value of the water used from the Industrial Canal would be the cost of the most likely alternate source, in the absences of the operation of S-310.

It was assumed that under the implementation of any alternative that water users of the Industrial Canal would not be permitted to draw down the canal to a level that would impact private and commercial marinas, boats or recreational activities.

The most likely alternate method for supplying the Industrial Canal would be the future "with-out" project condition. Under this condition the local users would build a pump station to bypass S-169 as a means of pumping water from C-21 into the Industrial Canal when the Lake Okeechobee stage is above 15.5 feet, S-310 is closed, and the Industrial Canal is approaching an unacceptable level.

The average annual cost for the pump station alternative is assumed to be $567,854 based on an economic life of 50 years and an interest rate of 5-3/8 percent. This value is the basis for the average annual benefit that will be used in the B/C ratio.

Costs

Data for initial construction/implementation, land acquisition, monitoring, and periodically recurring costs for OMRR&R (operation, maintenance, repair, replacement, and rehabilitation), have been developed through engineering design and cost estimation. The main issues requiring economic evaluation attention include equivalent time basis calculations, price levels, and timing of project spending.

For purposes of this report and analysis, NED costs (National Economic Development Costs, as defined by Federal and Corps of Engineers policy), are expressed in 2003 price levels, and are based generally on costs estimated to be incurred over a 50-year period of analysis. Costs of a plan represent the value of goods and services required to implement and operate/maintain the plan. Costs components include total initial costs of construction, PED, S&A and interest during construction (IDC). The O&M cost are annual estimates for fully implemented components.

Water Resources Committee (WRC) guidelines stipulate that benefits and costs are to be expressed in average annual equivalents by appropriate discounting and annualizing. A directed rate of 5-3/8 percent applicable to Federal projects has been used for economic analysis of alternative plans presented in this report. A period of 50 years was selected for economic analysis due to type of project.

Interest During Construction

Engineering Regulation (ER) 1105-2-100 requires that interest during construction (IDC) be computed which represents the opportunity cost of capital incurred during the construction period. Interest was computed for construction and PED costs from the middle of the month in which the expenditures were incurred until the first of the month following the estimated construction completion date.

The IDC schedule was calculated using an interest rate of 5-3/8 percent for a period of 13 months for Alternative 2 and 25 months for Alternative 4a and 4b. The interest during construction calculation makes costs incurred before the base year equivalent in time value to other benefits and costs

Benefit Cost Analysis

Table 10 summarizes the total investment cost and total annual equivalent cost of all plans, and does not consider the previously described engineering or operational limitations All costs have been annualized for 50 years. For the purpose of comparison, Table 10 shows the cost of all components of 2, 4a and 4b. The NED plan is that

alternative plan that produces the maximum net benefits consistent with the Federal objective. The total annual benefits are estimated to be $567,854.

TABLE 10
ANNUALIZED BENEFITS AND COSTS

	ALTERNATIVE 2	ALTERNATIVE 4A	ALTERNATIVE 4B
Construction Cost	$115,100	$3,403,100	$3,638,300
PED Costs {E&D}	$9,500	$281,400	$303,300
Escalation	$11,500	$348,700	$405,200
Contingency	$31,700	$938,000	$1,010,900
Real Estate Cost	0$	$154,000	$154,000
S&A	$13,400	$397,700	$428,600
Interest During Construction	$2,757	$245,673	$264,279
Total Initial Cost	$183,957	$5,768,573	$6,204,579
Annualized Initial Cost	$10,666	$334,465	$359,745
Annual O&M	$3,320	$3,320	$3,320
Annual Salary Cost	$41,425		
Total Annual Cost	$55,411	$337,785	$363,065
Total Annual Benefits	$567,854	$567,854	$567,854
BCR	10.25	1.7	1.6
Net Benefits	$512,443	$230,069	$204,789

Observe that Alternative 2 produces the maximum net benefits of $512,443, and a benefit-to-cost (B-C) ratio of 10.25. Although Alternative 2 appears to be the NED plan, the alternative was eliminated because it would necessitate the operation of the lock in a hazardous manner, cracking the lock to provide water supply, which is unsafe for approaching vessels and causes bank erosion and scouring. Additionally, the normal operating mechanisms have to be overridden in order to make releases through the structure, which typically cause mechanical/electrical safety features of the lock to be overridden. The other option considered under this scenario would be the continuous operation of the lock to provide the needed water. This option was also dropped, since continuous operation would not provide the needed quantity of water to meet the minimum needs of the users.

6. SUMMARY OF NED PLAN ECONOMICS

The recommended plan for the S-169/Nine-Mile Canal project is the solution that is economically justified and engineeringly feasible. A summary of the total annual benefits and costs for each alternative plan that was economically analyzed is presented in Table 10. The NED plan is that alternative plan that produces the maximum net benefits consistent with the Federal objective. Because Alternative 2 was eliminated on grounds of potential engineering risk, the NED plan for the S-169/Nine-Mile Canal project is Alternative 4a. The total annual benefit for Alternative 4a is $567,854. The total annual cost to construct and maintain the NED plan for the 50-year project life is $337,785, resulting in a benefit-to-cost (B-C) ratio for the NED plan of 1.7. Therefore, implementation of the NED plan at S-169/Nine Mile Canal is economically justified.

APPENDIX E

REAL ESTATE

FOR

S-169
GENERAL REEVALUATION REPORT
HENDRY COUNTY, FLORIDA

U.S. Army Corps of Engineers

REAL ESTATE PLAN
For
Central & Southern Florida Project,
S-169 (Structure-169)
Prepared by:

Department of the Army
Jacksonville District
Corps of Engineers

Real Estate Division

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1. STATEMENT OF PURPOSE

This Real Estate Plan is tentative in nature for planning purposes only and both the final real property acquisition lines and the real estate cost estimates provided are subject to change even after approval of the General Reevaluation Report.

2. AUTHORIZATION

The Flood Control Act of 1948 (PL 80-858) authorized works necessary to afford flood protection to the rich agricultural development south of Lake Okeechobee, which includes the Nine-Mile Canal area. The Flood Control Act of 1954 (PL 83-870) recognized that the plan of improvement developed under PL 80-858 would require refinement and that modification, within the scope and purpose of the authorization, could be made at the discretion of the Chief of Engineers. The Flood Control Act of 1968 (PL 90-483) authorized the modification of Hurricane Gate Structure No. 2 (HGS-2) to navigation lock structure 310 (S-310).

This General Reevaluation Report (GRR) was initiated to reevaluate the S-169 project area, since certain aspects of the previously authorized Central and Southern Florida (C&SF) Project, Part 1, Supplement 39, were not constructed. Authorized construction called for structures S-170 and S-47, which were never built; and structures S-169 and C-21 Canal to be built in different locations.

3. PROJECT LOCATION

The primary control structures are S-169 and S-310. The main canals in the project area are C-21 and the Industrial Canal. Water Control Structure 169 (S-169) and Lock Structure 310 (S-310) serve the five sub-basins in Glades, Hendry, and Palm Beach Counties, Florida. The sub-basins include the eastern portion of the Nine-Mile Canal Basin and an area in the northwestern portion of the Miami Canal drainage area also known as the Everglades Agricultural Area. The sub-basins border on the south and southwest shore of Lake Okeechobee. See Plate A-1 for vicinity of proposed work in this appendix.

The Nine-Mile Canal area is adjacent to Herbert Hoover Dike (HHD), southwest of Lake Okeechobee. Nine-Mile Canal

begins west of State Road 720, near the city of Clewiston, in Hendry County, Florida, and extends approximately 9 miles westerly to Lake Hicpochee (see Figure 1, Main Report). The sub-basin served by S-169 and S-310 are discharge points for the easternmost portion of the Nine-Mile Canal Basin and a small area of the northwestern portion of the Miami Canal drainage area.

C-21 has an east to west alignment and is approximately 2.6 miles long. C-21 extends from the Industrial Canal westward to the junction with Canal 20 (C-20). The Industrial Canal, owned by the City of Clewiston, has a north to south alignment and is approximately 6.3 miles long. The north end is located at the junction with the eastern end of C-21. The south end terminates into a railroad berm close to the eastern limits of Levee 1E. S-310 is located just north of the C-21 and the Industrial Canal junction. S-169 project is located in the City of Clewiston, Henry County in Township 43 South, Range 34 East and in sections 9 and 10. It is located on the eastern end of C-21 at Station 18+66.38 approximately 1,866 feet west of the junction with the Industrial Canal. The study area, main canals, facilities, and other structures are shown on Plate A-2 and Plate A-3 in this appendix.

4. PROJECT DESCRIPTION

The current S-169 will be demolished and it's control house will be abandon. A new S-169 will replace the demolished S-169 with a new access bridge. A new, telemetry-controlled, water-control structure (S-169R) similar to S-169 would be constructed west of Culvert 2 (Cu-2). The south bank spoil berm between S-169 and S-169R will be improved for flood protection and a tieback from S-169R to the Herbert Hoover Dike would be require to prevent flanking. The plan of improvement will also require converting the five flap gates on Cu-2 and upgrade of one slide gate to telemetry-controlled slide gates. Construction of control houses with generators at Cu-2 and S-169R is also proposed.

5. PROJECT FEATURES

a.) Access Bridge - An access bridge would be constructed to replace S-169 bridge. Construction of the new bridge will occur just west of the existing S-169 bridge. The current S-169 bridge will be used to provide

access during construction; therefore, no real estate for a temporary access bridge is required.

b.) New Water-Control Structure (S-169R) S-169R is proposed to be constructed as a two-way structure similar to S-169 to maintain higher stages on the Industrial Canal side (east side) and convey storm runoff from the Industrial Canal tributary area from east to west. S-169R is proposed to be constructed on the C-21 alignment-approximately 1,766 feet west of S-169 and approximately 704 feet west of Cu-2. S-169R consists of a four-barrel, seven-foot-diameter, corrugated-metal-pipe culvert structure with a reinforced concrete headwall on both the upstream and downstream side. The structure will be provided with telemetry-controlled, vertical slide gates.

Riprap will be provided upstream and downstream of the structure to protect against erosion. A safety barrier would be provided upstream and downstream of the structure to insure safety to boaters. Remote digital sensors would be installed to record water levels in C-21 upstream and downstream of the structure, and sensors will be installed to record gate openings. The structure will require a control house and backup generator. Access to the structure is via the dirt service road on top of the south bank spoil berm or the dirt service road on the HHD.

c.) Culvert 2 - Modifications to Cu-2 would be necessary. It is proposed to convert the five flap gates and one slide gate to telemetry-controlled, vertical slide gates. Remote digital sensors on the north and south side of Cu-2 and telemetry-controlled gates will be required so that Cu-2 could be operated in conjunction with irrigational facilities along the Industrial Canal and S-169R. Construction of a control house with generator will also be required. Construction access and staging area will be supplemented by using a barge. Additional riprap protection on landside of Cu-2 and streambank protection for landside bank opposite of Cu-2 may be necessary.

d.) Levees The proposed project would cause higher stages in C-21 between the existing S-169 and the proposed location of S-169R. A tieback levee to prevent flanking, improvements to C-21 south bank, and a low spot on the Industrial Canal east spoil mound is recommended.

1. **Tieback Levee -** To prevent flanking of S-169R on the north side, a tieback levee from S-169R to the HHD is recommended. The tieback levee would extend perpendicularly from S-169R and tie into the HHD at S-169R's protection elevation of 20.0 feet. The levee would have a crown width of 15 feet and 1 on 3 side slopes.

2. **Canal 21 South Bank Spoil Berm Improvements** - Improve the south bank spoil berm from S-169R to the existing high ground at S-169 to the protection elevation of S-169R (20.0 feet). Improvements would provide the existing flood protection for the City of Clewiston. The existing side slope on the C-21 south bank would remain as is and side slopes for the new construction would be 1 on 3. The crown width would be 15.0 feet.

6. GOVERNMENT OWNED LANDS

a. Federal

There are no federally owned lands within the project limits.

b. Non-Federal

The local sponsor for this project is the South Florida Water Management District. The Sponsor previously acquired a perpetual easement for right of way, construction, operation and maintenance of the Sponsor's project works, over and across the lands described in deed number 25390 from State of Florida Board of Trustees of the Internal Improvement Trust Fund (TIIF). In said deed, SFWMD obtained the rights to convey such lands to the Federal Government. SFWMD provided the Federal Government a right-of-entry over the lands for the construction of the said projects and provided, in perpetuity, the Federal Government the right to enter upon said lands for inspection purpose only.

7. REAL ESTATE REQUIREMENTS

The proposed project is planned for construction within the previously provided existing right-of-way for Canal 21 and the Herbert Hoover Dike Project (portions of the previously authorized Central and Southern Florida Project)

for which South Florida Water Management District (SFWMD) is the local sponsor. SFWMD will provide all the necessary lands required for the project construction, operation and maintenance, all necessary access, and other temporary areas required. In addition to the required lands within the existing right of way, there is a requirement for a Road Access Easement and a Temporary Stockpile Easement

The acreages, more-or-less, for the main features are as follows:

Main Features	**Acreage**
S-169R Bridge	0.06
Levee	3.15
Culvert/Tailback Levee	0.75
Additional Tie-in to Access Road	0.04
Access Road	3.75
Stockpile/Staging area	1.84
Total	9.59

8. ESTATES

There are three estates required for the project. Of the three estates, SFWMD will be required to re-certify a perpetual easement for the right of way for all necessary work required for construction, operations and maintenance and over and across the previously provided right of way lands for project purposes. Such re-certification is necessary since the Government retained, in perpetuity, only the right to enter upon the existing right of way land for inspection purposes only. The other two estates proposed for this project consists of a standard estate for a road access easement. The Sponsor will be required to obtain and certify the easement in perpetuity until deauthorization of the project by Congress or until it is determined that it is no longer needed for project purposes. This perpetual road access will provided ingress and egress from Francisco street and onto S-169, and to provide public access onto the Herbert Hoover Dike, and other recreational areas. In addition, a non-standard estate is necessary for a temporary stockpile area that will be used to store the demolished S-169 debris and other materials.

a) **ROAD ACCESS EASEMENT**

A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. ____ and ____) for the location, construction, operation, maintenance, alteration and replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B); 5/ subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

b) TEMPORARY STOCKPILE EASEMENT

A temporary easement and right-of -way in, on, over and across the land described, for a period not to exceed five (5) years, beginning with date possession of the land is granted to the _____, for use by the _____, the United States, its representatives, agents, and contractors as a stockpile area, including the right to store, deposit and/or remove fill and excavated material thereon; and to perform any other work necessary and incident to the construction of the _____ Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights arid privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

9. NAVIGATION SERVITUDE

There are no project lands for which navigational servitude will be exercised.

10. INDUCED FLOODING

There will be no induced flooding directly associated with this project.

11. REAL ESTATE BASELINE COST ESTIMATE

A summary of the real estate costs using a June 2004 valuation date is as follows:

a) Lands and Damages:

Easements	**Acres**	**Unit Value**	**Total**
Permanent Access Road	3.75	$24,000	$ 90,000
Temporary Stockpile	0.88	1,056	3,019
			$ 93,000(R)

b) Acquisition/Administrative Costs

Federal	
Project Planning	15,000
Non-Federal	
Acquisitions	15,000
Total Acquisition/Administrative Costs	**30,000**
Contingencies (*25%)	30,750
Total Estimated Real Estate Costs	**$154,000(R)**

No credit will be provided for such land previously provided, which are within the existing right of way, therefore, no appraisal for the existing right-of-way is required.

The real estate cost estimate is for lands and damages, for ownership verification and certification, and crediting purposes.

12. RELOCATION ASSISTANCE BENEFITS

There are no persons or businesses to be relocated as a result of this project.

13. RELOCATION, ALTERATION, VACATIONS, AND ABANDONMENTS (PUBLIC LAW 85-500)

Relocations of utilities or facilities are not anticipated within the project limits. During the design phase, if a relocation is found to be necessary, an "Attorney's Opinion of Compensibility" will be completed.

14. MINERALS

No known minerals exist in the project area.

15. NON-FEDERAL SPONSOR'S AUTHORITY TO PARTICIPATE

The South Florida Water Management District was created by virtue of Florida Statutes, Chapter 373, Section 069. The South Florida Water Management District was created to further the State policy of flood damage prevention, preserve natural resources of the State including fish and wildlife and to assist in maintaining the navigability of rivers and harbors. (There are other enumerated purposes but they are not directly applicable to this project.) The South Florida Water Management District is specifically empowered to

> Cooperate with the United States in the manner provided by Congress for flood control, reclamation, conservation, and allied purposes in protecting the inhabitants, the land, and other property within the district from the effects of a surplus or a deficiency of water when the same may be beneficial to the public health, welfare, safety, and utility. (Section 373.103)

To carry out the above purposes, the South Florida Water Management District is empowered to

> ...hold, control, and acquire by donation, lease, or purchase, or to condemn any land, public or private, needed for rights-of-way or other purposes, and may remove any building or other obstruction necessary for the construction, maintenance, and operation of the works; and to hold and have full control over the works and rights-of-way of the district.

The term works of the district is defined by Section 373.019 to be

> ...those projects and works, including, but not limited to, structures, impoundments, wells, and other water courses, together with the appurtenant facilities and accompanying lands, which have been officially adopted by the governing board of the district as works of the district.

Section 373.139 specifically empowers the South Florida Water Management District to acquire fee title to real property and easements therein by purchase, gift, devise, lease, eminent domain, or otherwise for flood control, water storage, water management, and preservation of wetlands, streams and lakes, except that eminent domain powers which may be used only for acquiring real property for flood control and water storage.

16. REAL ESTATE MILESTONES

The Sponsor will certify the availability of lands necessary for construction of the proposed project upon request. No credit will be provided for Lands, easements, right-of-way previously provided under the mentioned projects. However, the Sponsor will be entitled to incidental costs of acquiring such interests, as determined by the Government, subject to an audit to determine the reasonableness, allocability, and allowability of costs.

17. PRESENCE OF CONTAMINANTS (HAZARDOUS, TOXIC AND RADIOACTIVE WASTES)

There have been no hazardous or toxic wastes identified within the project area.

18. ATTITUDE OF LANDOWNERS/ Other Real Estate Issues

Preliminary indications are that the property owners directly affected by the project are City of Clewiston, SFWMD, and other State Agencies, which fully support the proposed federal project. (If additional lands are required to support this project, this statement may change.)

No real estate issues relevant to planning, designing or implementing are expected. No real estate issues that may impacts the project schedules, budgets, PCA, or quality of the deliveries is anticipated. If such are revealed then the Project Management Plan will be updated, as required.

19. M-CACES FOR REAL ESTATE

01	Lands & Damages	$ 93,000(R)0
01AA	Project Planning	$ 15,000
01B--	ACQUISITIONS	
01B20	BY LOCAL SPONSOR (LS)	$ 15,000
01B40	REVIEW OF LS	
TOTAL REAL ESTATE COST EXCLUDING CONTINGENCY		$ 30,000
REAL ESTATE CONTINGENCY (25% COST)		$ 30,750
TOTAL PROJECT REAL ESTATE COST		$ 154,000(R)

20. REAL ESTATE MAP

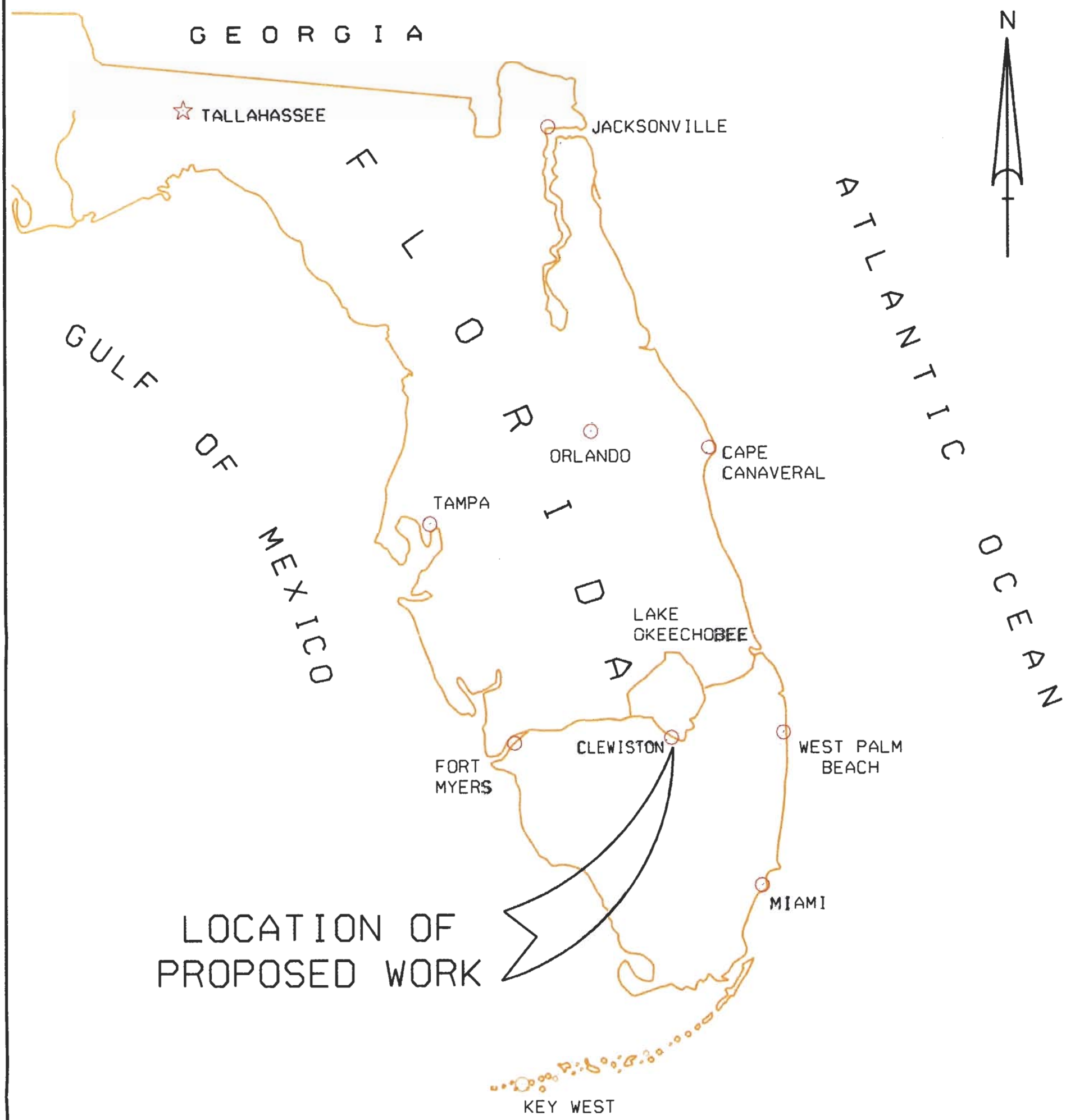
Plate A-1 Vicinity Map
Plate A-2 Project Location and other structures
Plate A-3 Water Supply Boundary Map
Plate A-4 Real Estate Planning Map.

PLATES A1 THRU A4

11 X 17 FOLDOUTS

A1 THRU A3 COLOR

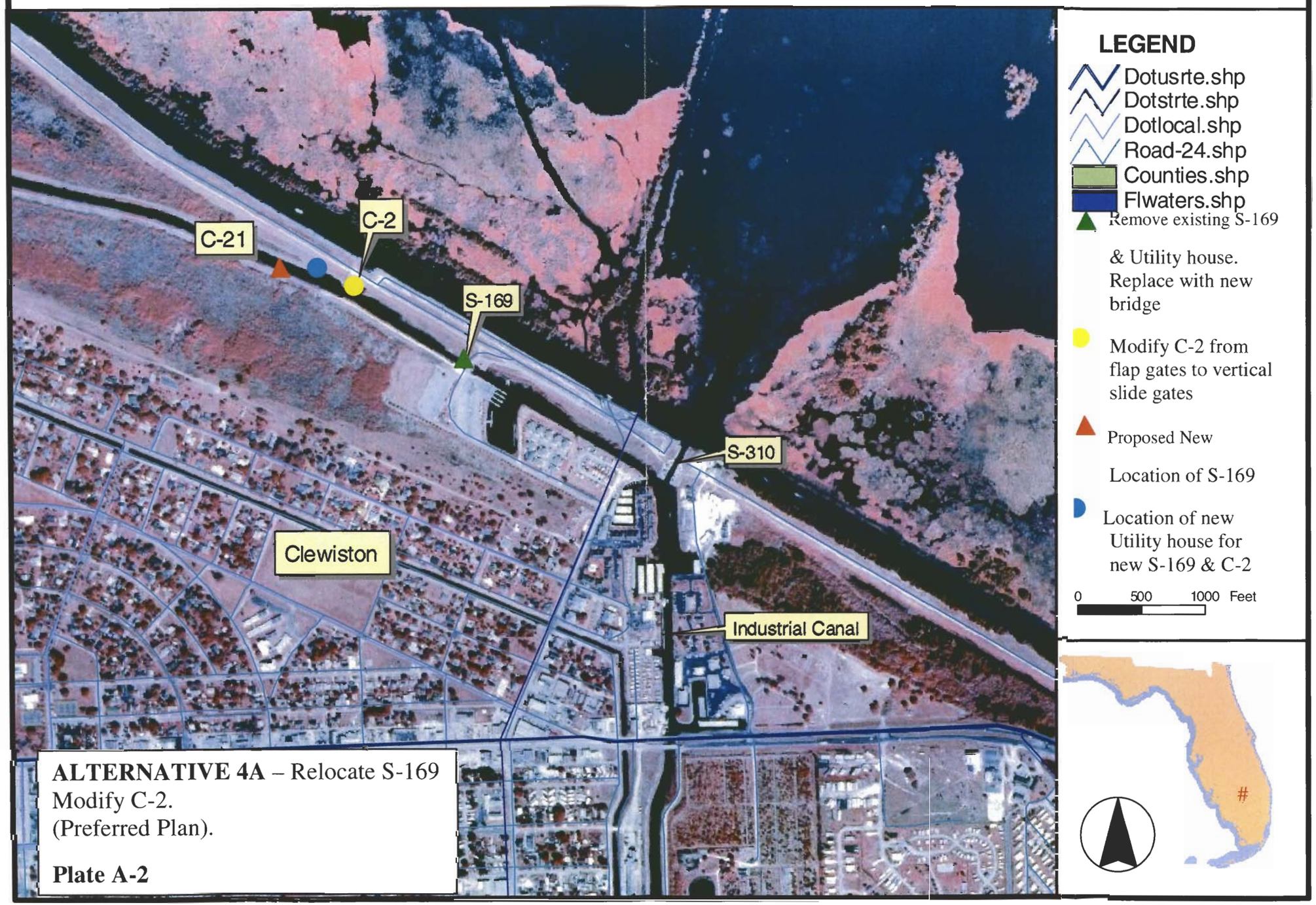
A-4 B & W



LOCATION MAP

PLATE A-1	S-169/NINE-MILE CANAL BASIN GENERAL REEVALUATION REPORT LOCATION OF PROPOSED WORK H&H APPENDIX DRAFT	File name: Reference files:	Designed by: Dwn by: Ckd by: Dated: D.D.FILE NO.	Scale: Plot date: Plot scale:	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS JACKSONVILLE, FLORIDA	US Army Corps of Engineers Jacksonville District

S-169/Nine-Mile Canal Basin Project



ALTERNATIVE 4A – Relocate S-169
Modify C-2.
(Preferred Plan).

Plate A-2

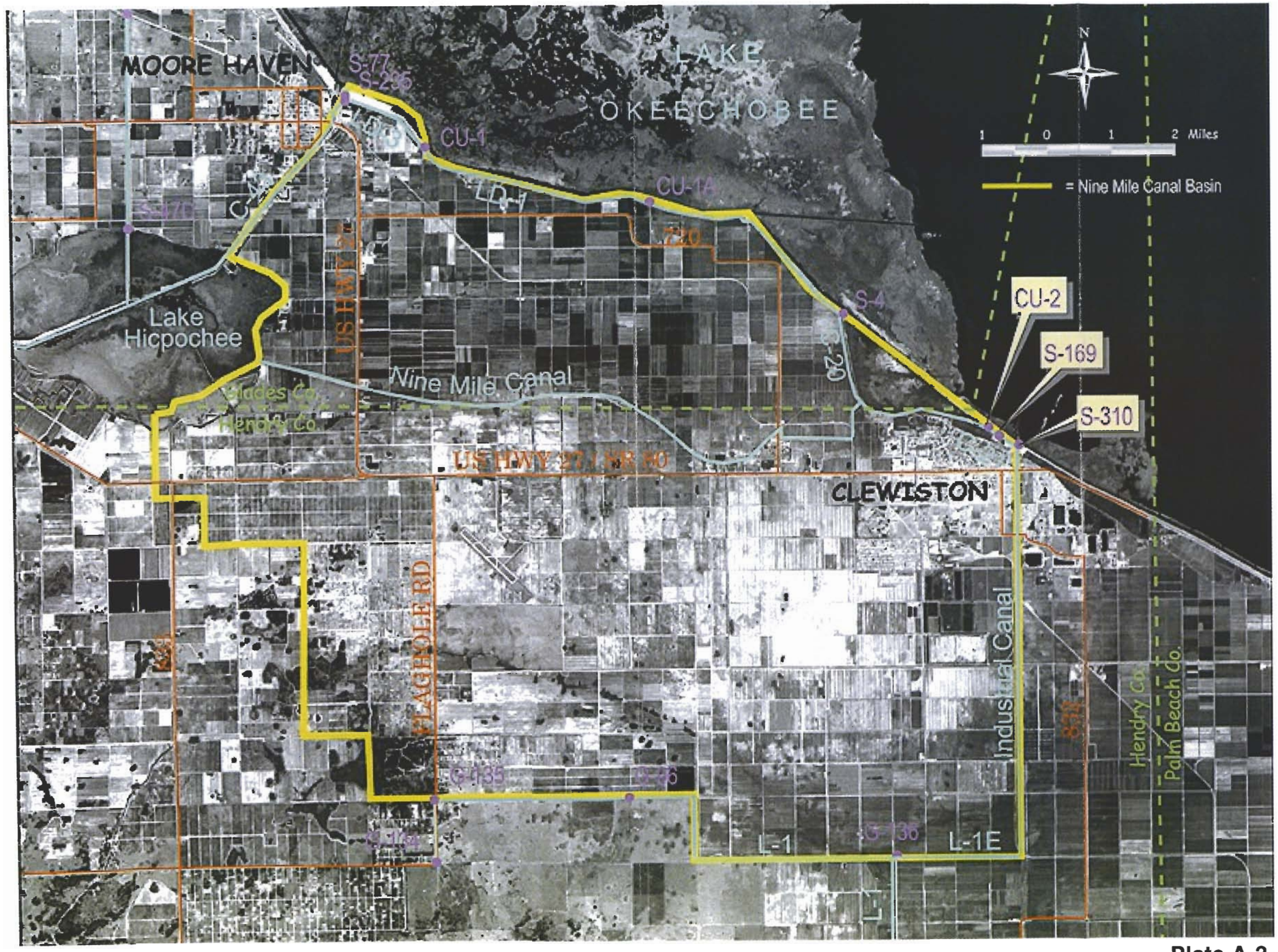
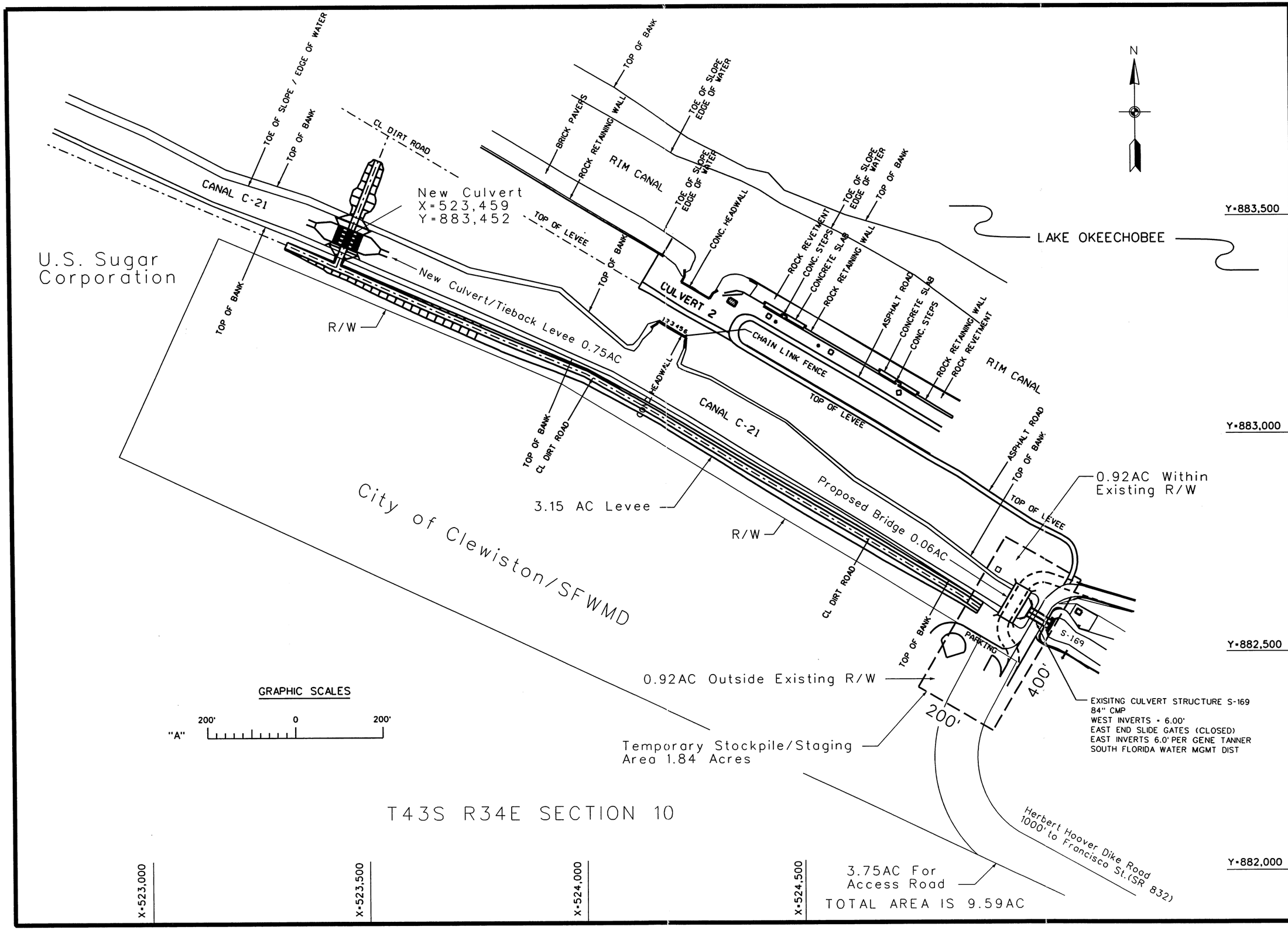

MOORE HAVEN
S-77
S-295
LAKE
OKEECHOBEE
CU-1
CU-1A
LD-1
S-470
720
S-4
CU-2
S-169
S-310
Lake
Hicpochee
US HWY 27
Nine Mile Canal
Glades Co.
Hendry Co.
US HWY 27 / SR 80
CLEWISTON
PEAGHDLE RD
Industrial Canal
833
Hendry Co.
Palm Beach Co.
G-135
G-136
L-1
L-1E
N
1 0 1 2 Miles
= Nine Mile Canal Basin

Plate A-3



US Army Corps of Engineers
Jacksonville District

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

Revised: 6/15/05

Designed by:
Dwn by:
Ckd by:

File name: S169EVAL_RE.DGN
Reference files:

S-169/NINE MILE CANAL BASIN
GENERAL REEVALUATION REPORT

REAL ESTATE
PLANNING MAP

Scale: AS SHOWN

PLATE
A-4

APPENDIX F

ENVIRONMENTAL ASSESSMENT

FOR

S-169
GENERAL REEVALUATION REPORT
HENDRY COUNTY, FLORIDA

JULY 2005

MODIFICATION OF
S-169
CLEWISTON, HENDRY COUNTY, FLORIDA

U.S. Army Corps
of Engineers
JACKSONVILLE DISTRICT

ENVIRONMENTAL ASSESSMENT
ON
THE MODIFICATION OF S-169
CLEWISTON, HENDRY COUNTY, FLORIDA

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ENVIRONMENTAL ASSESSMENT
ON
MODIFICATION OF S-169
CLEWISTON, HENDRY COUNTY, FLORIDA

1 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1 PROPOSED ACTION

The U.S. Army Corps of Engineers (USACE), in partnership with the South Florida Water Management District (SFWMD), proposes to move Structure No. 169 (S-169) west of Culvert Number 2 (Cu-2) on Canal 21 (C-21), in Clewiston, south of Lake Okeechobee, Hendry County, Florida **(Figure 1)**. The USACE and SFWMD also propose to construct a bridge where the S-169 is currently located to allow access to the Herbert Hoover Dike, in addition to, modifying C2 flap gates to vertical sliding gates. Cu-2 and S-169 are located on C-21, and Structure 310 (S-310) which regulates flow from Lake Okeechobee, is located at the intersection of C-21 and the Industrial Canal **(Figure 2)**. C-21 and the Industrial Canal are located along the northern and eastern boundary of Clewiston, respectively. The proposed action would begin construction in 2005.

Figure 1. Location map of Clewiston

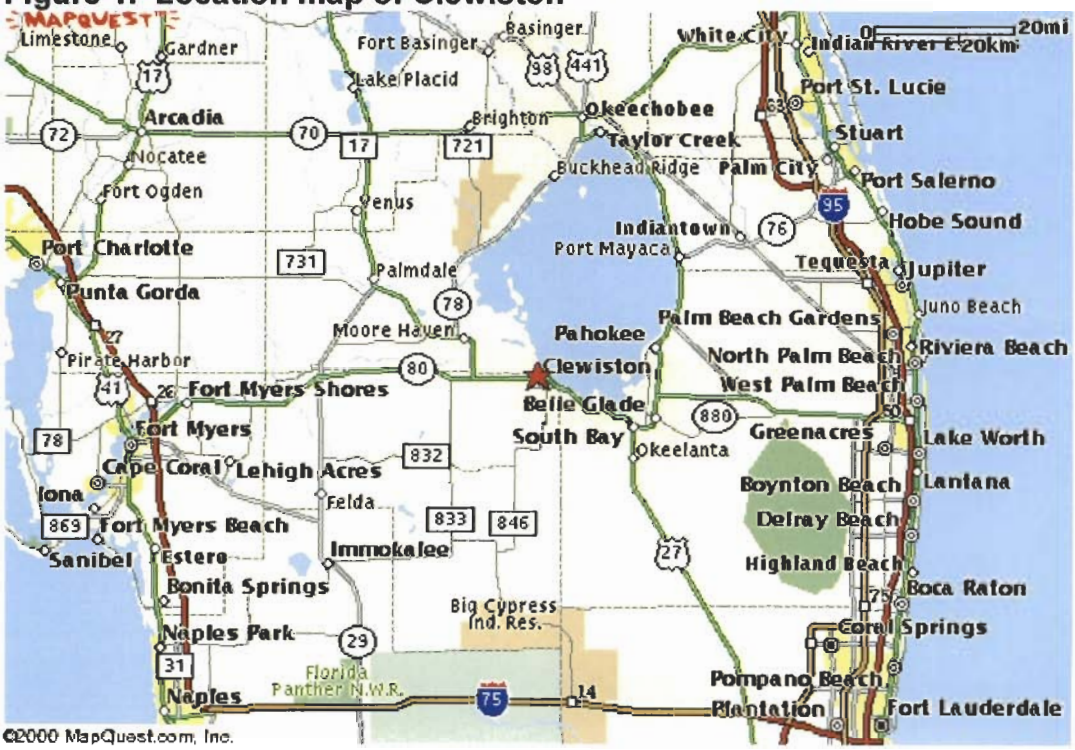
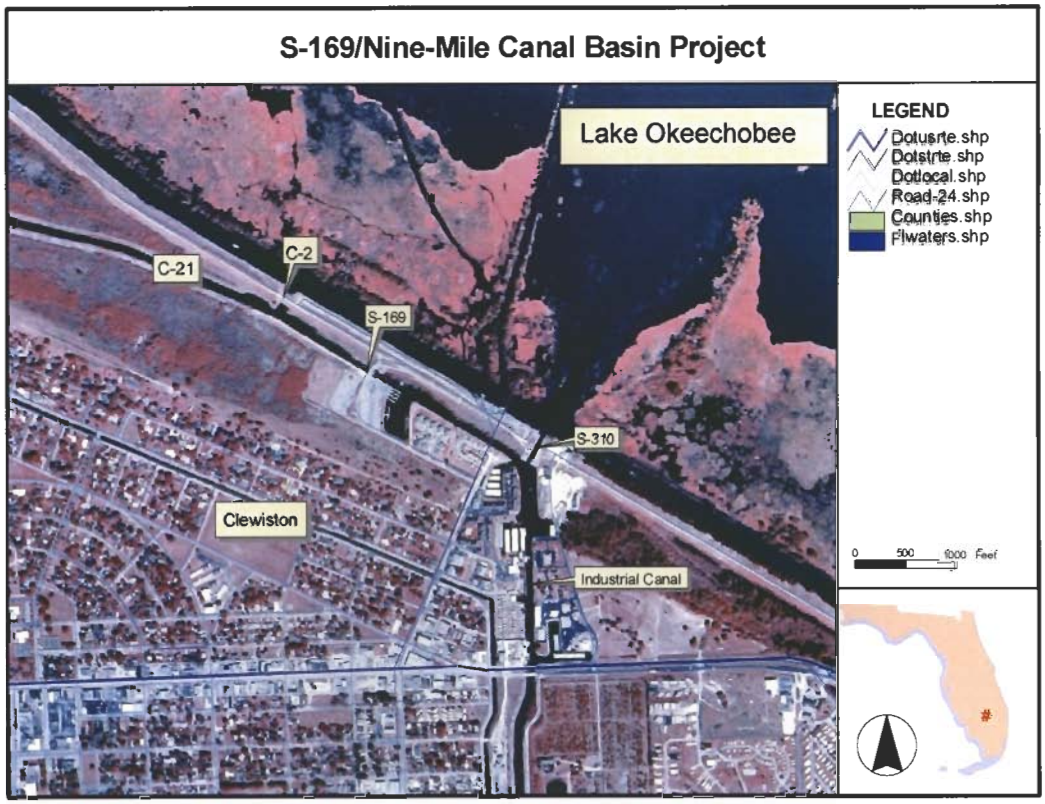


FIGURE 2. Project site



1.2 PROJECT AUTHORITY

Project authorization is received under the Flood Control Act of 1948 which also includes evaluation and modification of canal tributaries, flood control structures and culverts within the Nine Mile Canal Basin. Subsequent authorization to reevaluate and modify existing flood control structures is found within the Flood Control Acts of 1954 and 1968

1.3 NEED FOR THE ACTION

Intervention is necessary to maintain optimum water delivery to agricultural users located along the Industrial Canal and C-21. Currently, when water levels in Lake Okeechobee (The Lake) are above 15.5 feet NGVD (National Geodetic Vertical Datum) or below 11 feet NGVD, difficulty is encountered getting water from the Lake to consumptive users along the Industrial Canal. These users are primarily the agricultural communities located south and east of Clewiston whose heavy irrigation demands are met by pumping water from the Industrial Canal. A large percentage of these irrigation users, do not possess the required "Consumptive Use" permits issued by the SFWMD or they operate under expired permits. Water use in this area is largely unregulated. Users are currently able to draw unlimited amounts of water from the Industrial Canal.

During irrigation activities, the Industrial Canal flows from north to south. Normally flows are routed to the irrigation facilities along the Industrial Canal via S-310 when the stage level in Lake Okeechobee is equal to or less than 15.5 feet. When the Lake's stage level is 15.5 feet or greater, S-310 is either partially or completely closed and water is directed to irrigation facilities to the west from C-21 via S-169. Three pumping facilities control irrigation deliveries, the South Florida Conservation District (SFCD) Unit P-5-W, United States Sugar Corporation (USSC) irrigation pumps, and USSC Southline Station. The waters from these facilities are controlled by S-169 and S-310 (Appendix A, Draft Hydraulics and Hydrology Report, 2004).

During flood-control operations, the Industrial Canal flows from south to north. When the Lake's stage elevation is equal to or less than 15.5 feet, S-310 is opened and water is routed through S-310 to the Lake by gravity discharge. Waters during this time can also be routed through S-169 to Pump Station 4 (S-4) or Structure 235 (S-235) by gravity discharge. When stage elevations are above 15.5 feet gravity discharge is terminated. Flows are then routed down the Industrial Canal to C-21 through S-169 for discharge to C-20 and S-4 (the main flood-control structure for the Nine-Mile Canal Basin and runoff from the Industrial Canal tributary areas). From S-4, the waters are then pumped into the Lake's rim canal. Some flood waters at this time can also be conveyed to S-235 for discharge to the Caloosahatchee River. During flood conditions five facilities discharge to the Industrial Canal, the USSC Southline Station, the SFCD Unit P-5-W, Clewiston Station 3, the East Hendry Station, and the J.D. Thornton pump (Appendix A, 2004).

S-169 was designed and sized to remove three-quarter inch of runoff per day from the agricultural areas served, in addition to, removing 165 cubic feet per second (cfs) from the old Clewiston pumping station. The agricultural areas were defined as nine square miles east of the Industrial Canal and fourteen square miles west of the Industrial Canal. The total discharge from areas served by S-169 is equal to 625 cfs, the designed discharge velocity (Appendix A, 2004).

As a temporary solution for water conveyed to the irrigation facilities, the SFWMD operates Structure 310 (S-310) on extended hours during elevated water conditions, droughts, and low water elevations, to allow adequate flow from the Lake into the Industrial Canal and C-21. This operation requires the locks' safety features to be disengaged, in addition to, the sustained and partial opening of locks upstream and downstream of S-310. Such prolong operations have adverse impacts on the locks' structural design and canals navigation depths. Adverse ecological impacts are also experienced from prolonged inundation of littoral zones, lowered water quality, loss of fish and wildlife habitat and utilization values, creation of sandbars, bank erosion, and scouring of bottom substrates. In an effort to create a permanent solution, the Corps and sponsor, SFWMD, are evaluating alternatives that would allow sufficient staging of water within the Industrial Canal and C-21 to meet irrigation and navigation needs with minimum or no adverse ecological impacts.

1.4 OBJECTIVES OF THE ACTION

The current objective is to evaluate and devise an alternative that would provide adequate flow to the Industrial Canal and C-21 via the S-310, S-169 and Cu-2. Through the GRR (General Reevaluation Report) and this EA (environmental assessment), the USACE and SFWMD would determine the preferable and environmentally sound alternative to resolve the problems outlined in the above section. If the preferred alternative involves modifying the existing S-169 and associated structures, the USACE and SFWMD would design and construct the recommended alternative. The objectives of the action would be to accomplish the following:

- Improve water control in the Industrial Canal and C-21;
- Reduce or eliminate erosion caused by water releases from Lake Okeechobee;
- Protect fish and wildlife species, habitat, and values within the scope of the project area.
- Remove exotic vegetation established along the shores of the site

1.5 SCOPE OF THIS ENVIRONMENTAL ANALYSIS

1.5.1 HISTORY OF THE PLANNING AND SCOPING PROCESS

The Flood Control Act of 1948 (PL 80-858) authorized work(s) necessary to afford flood protection to the rich agricultural development south of Lake Okeechobee, which includes the Nine-Mile Canal area. The Flood Control Act of 1954 (P.L. 83-780) recognized that the plan of improvement developed under PL 80-858 would require refinement, and that, modification within the scope and purpose of the authorization, could be made at the discretion of the Chief of Engineers. The Flood Control Act of 1968 (P.L. 90-483) authorized the modification of Hurricane Gate Structure No. 2 (HGS-2) to navigation lock Structure 310 (S-310).

The GRR was initiated to reevaluate the S-169 project area, since certain aspects of the previously authorized Central and Southern Florida (C&SF) Project, Part 1, Supplement 39, were either never constructed or placed in a different location. Two structures authorized under the C&SF project, S-170 and S-47 were never built, and S-169 and C-21 were built in different locations.

A scoping letter was mailed on May 7, 2001, to various members of the public, including federal and state agencies, local municipalities, local libraries, special interest organizations, and individuals who had previously requested to be on the mailing list for project announcements and scoping letters. The scoping letter described the preliminary array of alternatives for the project. A copy of the scoping letter and public comments to that letter are in Appendix A. A public workshop was held in Clewiston on June 12, 2001. A summary of the meeting is found in Appendix B.

1.5.2 RELEVANT PLANNING DOCUMENTS

Relevant planning documents include:

- Central and Southern Florida (C&SF) Project, Part I, Supplement 45, Detail Design Memorandum—Canal 21 and Control Structure 169 (issued in 1969)
- C&SF Project, Part IV, Supplement 32, General and Detail Design Memorandum—Lock Structure 310 (issued in 1976)
- Environmental Assessment on Maintenance Dredging Industrial Canal, Hendry County, Florida, to dredge a northern section of the Industrial Canal from the U.S. Army Corps of Engineers Clewiston Field Office to S-310, and the eastern section of C-21.
- U.S. Fish and Wildlife Service, Planning Aid Letter (January 2002).

1.5.3 ISSUES STUDIED IN DETAIL

The issues that have influenced the formulation of alternatives are described below.

1.5.3.1 FISH AND WILDLIFE

Certain alternatives might harm fish or wildlife, including State or Federally listed threatened or endangered species. Any alternative that is chosen must not jeopardize the critical habitat of the following Federally-listed endangered species: West Indian manatee (*Trichechus manatus*), wood stork (*Mycteria americana*), bald eagle (*Haliaeetus leucocephalus*), eastern indigo snake (*Drymarchon corais couperi*), snail kite (*Rostrhamus sociabilis plumbeus*), or Okeechobee gourd (Curcubita okeechobeensis ssp.). Potential effects of the alternatives on fish and wildlife shall be evaluated in Section 3, Affected Environment and Section 4, Environment Consequences.

1.5.3.2 WATER QUALITY

This project addresses water flow to and from Lake Okeechobee. Currently, phosphorus levels in the lake do not meet the State Total Maximum Discharge Levels (TMDLs). The potential impacts to water quality of Lake Okeechobee, in particular the phosphorus levels, must be addressed. The evaluation would also address the possibility of water quality treatment for basin discharges to the lake.

1.5.3.3 FLOOD CONTROL

Modification of S-169 might result in decreasing flood control protection for the basin, including the area between Ortona Lock and Moore Haven. The potential effects of the alternatives on flood control would be analyzed by hydrologic modeling of the basin, if considered necessary.

1.5.3.4 WATER SUPPLY

The project would address the issue of providing sufficient water supply within the Industrial Canal and would also address navigation/irrigation needs on the C-21.

1.5.4 ISSUES ELIMINATED FROM FURTHER STUDY

1.5.4.1 COMPREHENSIVE EVERGLADES RESTORATION PROGRAM (CERP)

The USACE and various local sponsors have begun the planning phases for over twelve CERP components. Three such components are within or adjacent to the study area for this project. They are:

- EAA Storage Reservoirs Phase I
- Lake Okeechobee Watershed
- Southwest Florida Feasibility Study

As these projects are in various stages of Planning, they will not have an effect on this particular project. The EAA Storage Reservoirs project plans to build water reservoirs within the EAA, west of Clewiston. Different users exist between those who would use the EAA project reservoirs and those who currently irrigate their fields from the Industrial Canal. The Lake Okeechobee Watershed project components are located outside of Hendry County. The Southwest Florida Feasibility Study is investigating water resources issues and opportunities for ecosystem restoration.

1.6 DECISIONS THAT MUST BE MADE

This Environmental Assessment will evaluate whether to modify S-169 and other associated structures and, if so, evaluate and compare alternatives to accomplish the desired goal(s).

1.7 APPLICABLE LEGAL AND REGULATORY REQUIREMENTS AND COORDINATION

1.7.1 LEGAL REQUIREMENTS

This project must be in compliance with various Federal environmental statutes, including, but not limited to, the National Environmental Policy Act, Endangered Species Act, Clean Water Act, and National Historic Preservation Act. Compliance with Federal statutes is discussed in Chapter 4 (Environmental Consequences).

1.7.2 REGULATORY REQUIREMENTS

Water Quality Certification (WQC) (Section 1341 of the Clean Water Act, previously cited as 401 Certification) would be obtained from the Florida Department of Environmental Protection, and a National Pollutant Discharge Elimination System (NPDES) permit may be required.

1.7.3 COORDINATION REQUIREMENTS

This project has been coordinated with the U.S. Fish and Wildlife Service (FWS) under the Fish and Wildlife Coordination Act. The Draft Coordination Act Report provided by the FWS is appended to this document (Appendix D). The final CAR is pending FWS' receipt and review of the draft Environmental Assessment of the proposed action. All other coordination with FWS in accordance with Section 7 has been completed.

2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 EVALUATION OF ALTERNATIVES

The alternative section is considered the heart of this EA. This section describes in detail the no-action alternative, the proposed action, and other reasonable alternatives that were studied in detail. Then based on the information and analysis presented in the sections on the Affected Environment and the Probable Impacts, this section presents the beneficial and adverse environmental effects of all alternatives in comparative form, providing a clear basis for choice among the options for the decision maker and the public.

2.2 DESCRIPTION OF PROPOSED ALTERNATIVES

2.2.1 ALTERNATIVE 1: NO ACTION

A no action alternative would prohibit evaluation and corrective action of problems created by the current extended and non-design operation of S-310 and associated control structures. This alternative would further restrict sufficient water delivery to agricultural users along the Industrial Canal and navigational users of C-21. Adverse environmental and structural impacts identified with this alternative would include reduced agricultural productivity, fish kills, damage to watercrafts, structural damage to marinas, scouring downstream of the S-310 riprap, bank erosion, and unsafe lock operations. Note: Unsafe operation is defined as less than optimum waterway depth and creation of shoals that interfere with general navigation; also, the overriding of existing mechanical/electrical safety features when the Lake is above 15.5 feet NGVD or below 13 feet NGVD. Due to adverse environmental impacts and safety concerns, this alternative is not considered practical.

2.2.2 ALTERNATIVE 2: OPERATIONAL CHANGE TO S-310 LOCK

This alternative would require extending operation and maintenance (O&M) hours when lake elevations exceed or decrease below optimum levels. Additional manhours for lock tenders and O&M would result in approximately 1657 overtime hours of operation per year. This alternative would also include the repair of revetment and bedding at an existing scour hole downstream of S-310. About 500 cubic yards of sand would be necessary to bring the area to existing bottom grade. A removable boat safety barrier would be installed on the downstream side of S-310 to prevent boats from entering the lock during emergency operations.

Alternative 2 has been identified as the National Economic Development (NED) plan and provides the highest benefits to cost (B/C) ratio. This alternative, however, would require the same water supply operations as presently employed. Operating the lock to provide water supply with the associated operations would lead to unsafe conditions as outlined in Alternative 1. Such operations are not recommended. Future operation of S-310 would no longer allow provision for water supply when the Lake is above 15.5 feet NGVD. Alternative 2 is further not recommended since it would maintain lock operations that are to be avoided. This alternative also has high O&M costs, the potential to cause boat damage (during nighttime operations), bank erosion, and ecological damage.

2.2.3 ALTERNATIVE 3: CONSTRUCT A PUMP STATION

This alternative would involve constructing (on the south bank of C-21) adjacent to the existing S-169, a four-bay irrigation pump station capable of processing flows of 425 cubic foot per second (cfs). The pump would convey water from the west side of S-169 to the east side. A trash rake and screen would be fitted to both sides of the structure. However, it is questionable if Alternative 3 would perform as expected. For Alternative 3, flow from Lake Okeechobee through CU-2 into C-21 would be able to go either west or east. The proposed pump station would need to draw water from CU-2 from the east, but normally flow is to the west, the opposite direction. Stages west of CU-2 could be adversely affected, since there would be no control for flow going to the west from CU-2.

2.2.4 ALTERNATIVE 4A: RELOCATE S-169 (NEW BRIDGE)

For this alternative, the existing S-169 would be demolished and three vertical gates would be removed, with the debris taken to an approved landfill. In the footprint of the demolished structure, a new 65-foot-long bridge would be constructed with a temporary bridge providing access to the Herbert Hoover Dike. A new S-169 culvert with telemetry control would be constructed west of CU-2. A tieback levee would be placed on the north side of the C-21 to prevent water from flanking the structure. This alternative also includes converting the five existing 10-foot diameter flap gates on CU-2 to vertical slide gates; these gates would have telemetry controls. This alternative was later modified during informal coordination with the FWS to include a retractable manatee barrier at the new S-169 construction.

2.2.5 ALTERNATIVE 4B: RELOCATE S-169 (MODIFY EXISTING S-169)

This alternative would require demolishing the south bank of the existing S-169, removing three existing vertical slide gates, and adding one 7-foot barrel to the existing structure. A new S-169 structure with telemetry control would be constructed west of CU-2. On the north side of C-21, a tieback levee would be constructed to prevent water from flanking the structure. This alternative would also includes converting five existing 10-foot diameter flap gates on CU-2 to vertical slide gates; these gates would also be controlled by telemetry.

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

2.3.1 ALTERNATIVE 5: MODIFY EXISTING S-169

This alternative consisted of modifying the existing S-169 gates to allow continuous free flow and continuous vehicular access. This alternative was eliminated from further study because of lack of optimum water levels in Canals 20, 21, LD-1 and LD-3 would be affected.

2.3.2. ALTERNATIVE 6: PLUG IN C-21

This alternative consisted of placing a plug in C-21 west of CU-2 to allow water flow from Lake Okeechobee into C-21 and the Industrial Canal through CU-2. The gates on CU-2 and S-169 would have to be modified. This alternative was eliminated from further study because it would not provide adequate flood protection for the town of Clewiston.

2.3.3 OTHER ALTERNATIVES

Several other alternatives were discussed but later dismissed. The other alternatives included: boring culverts through the Herbert Hoover Dike (HHD), cutting a small canal through the Dike, pumping over the dike and constructing a small irrigation conveyance canal to the Industrial Canal, and building a pipeline directly to the irrigation areas. None of the alternatives were considered feasible or recommended, since the existing CU-2 structure in the HHD and existing canals can be used for the identified purpose and are already authorized for water supply and flood control purposes.

2.4 SUMMARY COMPARISON OF THE ALTERNATIVES AND THE PREDICTED ENVIRONMENTAL EFFECTS OF ALL ALTERNATIVES

Table 1 provides a summary of potential impacts for each of the project alternatives. Of the alternatives, Alternative 4A has the least adverse environmental impacts and is the NEPA preferred alternative. Chapter 4 (Environmental Effects) contains a more detailed discussion of impacts of the alternatives.

Table 1: Summary of Direct and Indirect Impacts

ALTERNATIVE ENVIRONMENTAL FACTOR	Alternative 1 No Action Status Quo	Alternative 2 Operational Change to S-310	Alternative 3 Construct a Pump Station	Alternative 4A Relocate S-169 (New Bridge)	Alternative 4B Relocate S-169 (Modify Existing S-169)
PROTECTED SPECIES	Continued hazard to manatees and other species	Manatees could be impacted.	Area will be checked for protected species.	Area will be checked for protected species.	Area will be checked for protected species.
SHORELINE EROSION	No change	No major impacts	No major impacts	No major impacts	No major impacts
FISH AND WILDLIFE RESOURCES	Low water levels would continue to be of concern	No impacts	Entrainment threat to fish and other aquatic life	No major impacts	No major impacts
VEGETATION	No change. Grasses and small shrubs exist in area	No impacts.	Some grasses will be disturbed, but will be replanted	Tieback levee would impact wetlands.	Tieback levee would impact wetlands.
WATER QUALITY	Future degradation of the lake will be slowed, but not eliminated	No impacts.	Impacts due to re-suspension of nutrients	Some impacts during construction	Some impacts during construction
HISTORIC PROPERTIES	No change	No change	No change	No change	No change

ALTERNATIVE ENVIRONMENTAL FACTOR	Alternative 1 No Action Status Quo	Alternative 2 Operational Change to S-310	Alternative 3 Construct a Pump Station	Alternative 4A Relocate S-169 (New Bridge)	Alternative 4B Relocate S-169 (Modify Existing S-169)
RECREATION	Low water levels could cause boats to ground in the canal	Boaters could not use the lock when lake elevation is above 15.5 ft.	Bank fishing use impacts during construction	Some impacts during construction	Some impacts during construction
AESTHETICS	No change	No impacts	Pump station would add visual impacts	Some visual impacts	Some visual impacts
NAVIGATION	No change	Some impacts due to changed schedule	Some impacts during pumping cycles	Some impacts	Some impacts due to water level increases.
ECONOMICS	No change	Some impacts from overtime increases	Construction dollars added to local economy	Construction dollars added to local economy	Construction dollars added to local economy
ENERGY REQUIREMENTS AND CONSERVATION	No change	Some impacts due to schedule changes	Some Impacts due to pump operations	Some impacts because of construction and relocation	Some impacts because of construction and relocation
ESSENTIAL FISH HABITAT	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

2.5 IDENTIFICATION OF THE PREFERRED ALTERNATIVE

According to the economic report, Alternative 1 is not feasible, Alternative 2 is the recommended or NED plan with a B/C ratio of 3.72; Alternative 3 should be dropped because it is doubted that it will perform as anticipated; Alternative 4A has a B/C ratio of 1.82; and Alternative 4B has a B/C ratio of 2.04. Alternative 4A is the locally preferred and accepted alternative.

3 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

Chapter 3: Affected Environment succinctly describes the relevant resources of the areas that would affect or that would be affected by the alternatives if they were implemented. In conjunction with the description of the No-Action Alternative in Chapter 2 and with the predicted effects of the No-Action Alternative in Chapter 4, this chapter establishes the scientific baselines against which the decisionmakers and the public can compare the effects of all action alternatives.

3.2 DESCRIPTION OF GENERAL ENVIRONMENTAL SETTING

The project area consists of Lake Okeechobee, its littoral zone, the rim canal, Herbert Hoover Dike (HHD), C-21, Industrial Canal, S-310, S-169, CU-2, a municipal park, marina, and sections of the town of Clewiston adjacent to the C-21 and Industrial Canal. The town of Clewiston is mainly residential areas, small businesses, and agricultural lands. Flood waters from the town drain via small farm canals or the Nine-Mile Canal into either the Industrial or C-21 Canals. The water from these areas are then pumped into Lake Okeechobee through the S-4 Pump Station on Canal Number 20 (C-20).

The Industrial Canal primarily serves as a water supply canal from Lake Okeechobee to the sugarcane fields to the south. The canal also serves as water access to the Okeechobee Waterway for the USACE SFOO. Additionally, the canal is important to the business community of Clewiston by providing access for vessels needing to reach marine facilities. Two marinas that operate along the canal provide a point of entry for many visitors and locals using Lake Okeechobee. The Industrial Canal is not a Federally authorized navigation channel. The canal is privately owned. Agricultural water supplies are withdrawn from the Industrial Canal by farm-controlled pumps and most water withdrawals are non-permitted.

The C-21 canal is a flood control feature that intersects the Industrial Canal at S-310. The C-21 runs along the northern boundary of Clewiston, approximately parallel to the HHD, and connects to C-20. Shoreline vegetation along the outside edge of the rim canal and C-21 is limited and consists of grasses and small shrubs with a hardwood wetland west of CU-2.

3.3 THREATENED AND ENDANGERED SPECIES

3.3.1 FEDERALLY LISTED SPECIES

Five federally listed threatened or endangered animal species and one listed plant species are present or potentially present in or adjacent to the project area. Most of these species have been previously impacted by habitat degradation due to wetland drainage, excess nutrient runoff, and alteration of hydroperiod.

3.3.1.1 SNAIL KITE **(FIGURES 3 AND 4)**

The endangered snail kite (*Rostrhamus sociabilis plumbeus*) **Figure 3**, occupies the watersheds of the Everglades, Lakes Okeechobee and Kissimmee, and upper St. Johns River. Critical habitat for the snail kite is immediately adjacent to the project area inside of the HHD. The snail kite can be found foraging in native wetlands and in canals and ditches adjacent to the project area. This medium-sized raptor has a highly specific diet composed almost entirely of Florida apple snails (*Pomacea paludosa*) **Figure 4**, which are found in palustrine, emergent, long hydroperiod wetlands. The snail kite's survival is dependent on the hydrology and water quality of the apple snail's habitat (USFWS 1999).

FIGURE 3: Snail Kite

U. S Geological Survey
http://www.mbr-pwrc.usgs.gov/id/framlst/i3300id.html

FIGURE 4: Apple Snail
http://www.applesnail.net

3.3.1.2 WOOD STORK **(FIGURE 5)**

The endangered wood stork (*Mycteria americana*) is found in freshwater and estuarine habitats for nesting, roosting, and foraging. Typical foraging sites include freshwater marshes and stock ponds, shallow seasonally flooded roadside or agricultural ditches, narrow tidal creeks or shallow tidal pools, managed impoundments, and depressions in cypress heads and swamp sloughs. Wood storks use a specialized feeding behavior called tactolocation, or grope feeding, whereby it wades through the water with its beak immersed and partially open; when it touches a prey item, the beak snaps shut, and the wood stork raises its head and swallows what it has caught (Kahl 1964). This method of feeding requires a specialized habitat, much of which has been previously altered.

FIGURE 5: Wood Stork Fishing and in Flight

3.3.1.3 WEST INDIAN MANATEE **(FIGURE 6)**

The endangered West Indian manatee (*Trichechus manatus*) is regularly found in Lake Okeechobee and in the rim canal, as well as in agricultural canals (USFWS 1999, Penny Husted, pers. comm.). This large aquatic mammal migrates along the Florida coast through fresh, brackish, and marine water, with a seasonal distribution based on water temperatures. Water colder than 20 degrees Centigrade increase the manatee's susceptibility to cold-stress and cold-induced mortality. Distribution is also controlled by aquatic vegetation availability, proximity to channels of at least 2 m depth, and location of fresh water sources (USFWS 1999).

FIGURE 6: West Indian Manatee

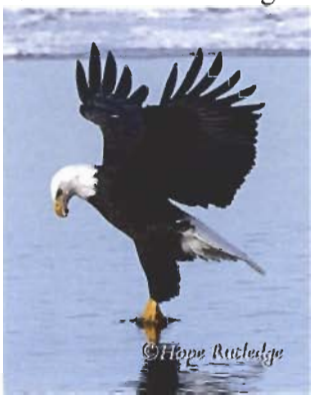
Boat-caused mortality is one of the principal threats to the manatee. Two confirmed watercraft-caused mortalities (1984 and 1993) occurred adjacent to the project area (USFWS). Although no structure-related deaths have been recorded in the project area, manatee mortality caused by water control structures and navigation locks continues to be a potential threat to the species.

3.3.1.4 BALD EAGLE **(FIGURES 7 AND 8)**

The threatened bald eagle (*Haliaeetus leucocephalus*) is relatively common and breed throughout the state. Nest sites are usually located near large rivers, lakes, or estuaries where they feed mainly on fish and water-dependent birds (USFWS 1999). Although no nests have been recorded in or immediately adjacent to the project area, bald eagles may be encountered during construction.

FIGURE 7: Bald Eagles Perched

FIGURE 8: Bald Eagle



3.3.1.5 EASTERN INDIGO SNAKE **(FIGURES 9 AND 10)**

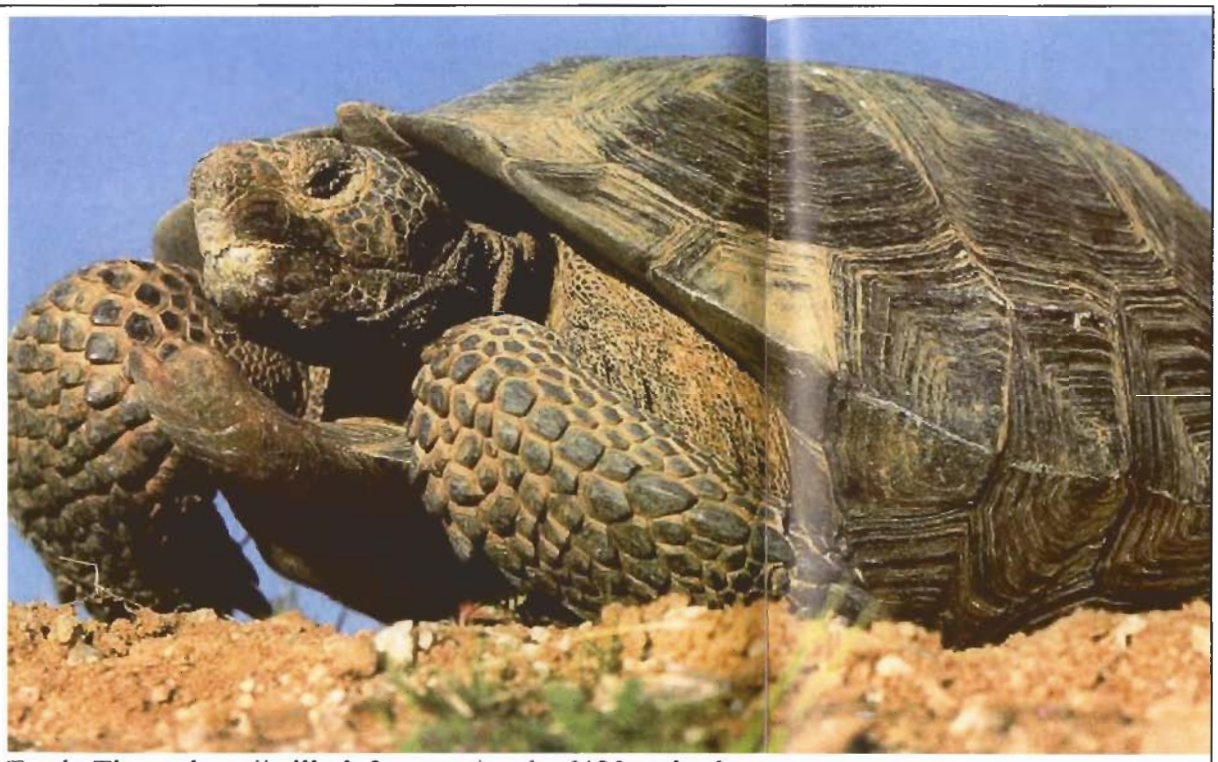
The threatened eastern indigo snake (*Drymarchon corais couperi*) **FIGURE 9**, is present throughout the state, but the population has been greatly reduced due to loss of habitat and collection by reptile sellers.

FIGURE 9: Indigo Snake

http://www.parcplace.org/education/sparc/trip15.htm

The indigo snake seems to be strongly associated with high, dry, well-drained sandy soils, closely paralleling the sandhill habitat preferred by the gopher tortoise (**Figure 10**). During warmer months, indigos also frequent streams and swamps, and individuals are occasionally found in flat woods. Gopher tortoise burrows and other subterranean cavities are commonly used as dens and for egg laying. The home range of indigos varies considerably according to season. Eastern indigo snakes may be encountered during construction

FIGURE 10: Gopher Tortoise (*Gopherus polyphemus)*



Turtle Times: http://millerb.8m.com/gopher%20tortise.htm

Gopher tortoises are quite territorial. They may live in one burrow for most of their lives. Their burrows may be as long as 30 feet and as deep as 12 feet.

3.3.1.6 OKEECHOBEE GOURD **(FIGURES 11 AND 12)**

The endangered Okeechobee gourd (*Cucurbita okeechobeensis*) is a vine that was locally common in the extensive pond apple (*Annona glabra*) forest that historically grew south of Lake Okeechobee (Small 1922). The Okeechobee gourd is now restricted in the wild to two small populations, one of which is around the shoreline of Lake Okeechobee. The survival of the Okeechobee gourd **(Figure 12)** in south Florida is threatened by the water-regulation practices of the lake and continued expansion of exotic vegetation (USFWS 1999).

FIGURE 11: Okeechobee Gourd

Paul Rebmann
http://2bnthewild.com/plants/H454.htm

Figure 12:
Immature Fruit

South Fl Water
Management District

3.3.2 STATE LISTED SPECIES

The following are species (in addition to those mentioned in Section 3.3.1) that are listed by the State of Florida as either Threatened (T), Endangered (E), or a Species of Special Concern (SSC), and may be found in the project area: little blue heron (*Egretta caerulea*)-SSC, tricolored heron (*Egretta tricolor*)-SSC, and white ibis (*Eudocimus albus*)-SSC (FWC 1997). These wading birds nest in mixed-species rookeries near Lake Okeechobee, as well as elsewhere in the state. The breeding success of the rookeries is affected by the quality and quantity of prey species such as frogs, fish, and aquatic macroinvertebrates (e.g., crayfish). The birds can be found foraging in the canals of the project area, as well as along the rim canal.

3.4 OTHER FISH AND WILDLIFE RESOURCES

Lake Okeechobee has a large littoral zone along its southern and western margins with a remnant hardwood wetland located west of Culvert 2 (CU-2). The littoral zone provides habitat for economically/recreationally important fish species, aquatic reptiles, amphibians, invertebrates, and for waterfowl and wading bird nesting and feeding (Flaig and Havens 1995). At least 40 different fish species can be found in the lake. Other wading birds not mentioned in the above two sections that also nest along the lake's shoreline include the American anhinga (*Anhinga anhinga*), great egret (*Casmerodius albus*), cattle egret (*Bubulcus ibis*), great blue heron (*Ardea herodius*), and glossy ibis (*Plegadis falcinellus*) .

Typical vegetation is located along the Industrial, C-20 and C-21 canals' include non-native species such as water lettuce (*Pistia stratiotes*) , water hyacinth (*Eichhornia crassipes*) and native species such as spatterdock (*Nuphar luteum*) and cattail (*Typha* spp.). Common reptile species found in the canals include American alligator (*Alligator mississippiensis*), banded water snake (*Nerodia fasciata*), cottonmouth (*Agkistrodon piscivorus*), and a variety of turtles and frogs.

Shoreline alterations during new bridge construction and levee tie-back construction have the potential to impact wetland and upland habitats. Marsh wetland provide habitat for the apple snail and the upland area provide habitat for the Okeechobee gourd. The extent of impact to the species, if any, would be evaluated during the public comment period. Adverse impacts would be avoided to the fullest extent practicable and any unavoidable impacts would require mitigation. If mitigation is required, input would be requested from the USFWS and Florida DEP in the development of a mitigation and monitoring plan.

3.5 WATER QUALITY

As detailed in the Draft Lake Okeechobee Restoration Action Plan, surrounding agricultural activities are discharging large quantities of nutrients into the lake and watershed. Phosphorus is of particular concern; it has been identified as the key component in the Lake's eutrophication. It is reasonable to assume that excessive nutrients and phosphates are received into the Industrial Canal and surrounding canal systems. S-310 receives and controls flow directly from the Lake and S-169 and CU-2 receives and control flows to C-21 and the Industrial Canal. The Lake Okeechobee Restoration Action Plan is addressing measures to reduce nutrient and phosphorus loading within the lake and watershed to 40 ppb. This project would employ protective measures and monitoring to ensure compliance with State Water Quality Standards during construction.

A water quality analysis was not part of this study. The project would employ the standard water control measures with turbidity monitoring to ensure existing water quality would not be degraded. Phosphorus levels in Lake Okeechobee currently do not meet the State's Total Maximum Discharge Levels (TMDL's). The Industrial Canal (which receives water from Lake Okeechobee) serves as a primary source of water for the sugarcane fields to the south and also conveys untreated discharge back to Lake Okeechobee. The Corps is presently involved in a study to restore the water quality of Lake Okeechobee. This report will evaluate phosphorus loading in the watershed and will determine the means needed to remove existing contaminants.

The work under this proposal, would not increase the lake's phosphate levels.

3.6 AIR QUALITY

No significant sources of air quality pollutants are located in the vicinity of the site. Hendry County is in compliance with Florida Department of Environmental Protection (FDEP) air quality standards (FDEP 2001).

3.7 NOISE

Ambient noise levels in the project area are low to moderate. The major noise producing sources are adjacent residential and marina areas, and airboats that operate in the canals and Lake Okeechobee.

3.8 AESTHETIC RESOURCES

The project area is located in a mostly developed area, with residential areas, marinas, and agricultural areas.

3.9 RECREATION RESOURCES

The Industrial and C-21 Canals are used as a point of entry for boaters accessing Lake Okeechobee. Recreation in the area includes boating, fishing, bird watching, and general uses of the municipal park located in the area. Freshwater fishing retail sales in the five counties surrounding Lake Okeechobee were estimated at more than $117 million during 2000 (FWC 2003).

3.10 NAVIGATION

The Industrial Canal serves as water access through the S-310 Lock to the Okeechobee Waterway for the USACE, SFOO, as well as for the public. The canal provides access for commercial and recreational vessels using marina facilities.

3.11 HISTORIC PROPERTIES

There are no known cultural resources within the project area. Consultation with the Florida State Historic Preservation Officer (DHR Project File No. 2001-05533) has indicated that because of its location the project area is not likely to contain cultural resources eligible for listing in the National Register of Historic Places.

4 ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

Chapter 4: Environmental Consequences and Chapter 3: Affected Environment form the **scientific and analytic basis** for the summary comparison of effects presented in Chapter 2 of this EA. Chapter 4 presents the predicted effects of all alternatives and the predicted effects on the quality of the human environment. This chapter focuses on the following eight types of effects:

- Direct, indirect, and cumulative effects
- Adverse effects that cannot be avoided
- Relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity
- Irreversible and irretrievable commits of resources that would be involved if the alternatives were implemented

4.2 PREDICTED EFFECTS ON RELEVANT AFFECTED RESOURCES OF ALL ALTERNATIVES

4.2.1 EFFECTS OF ALTERNATIVE 1: NO ACTION STATUS QUO/FUTURE WITHOUT PROJECT

Manual lake operations would continue with this alternative when elevations exceed 15.5 feet or fall below 13 feet (in extreme cases, 11 feet). Lock operating hours during these periods would be 5:30 a.m. to 8:00 p.m. from October through April and 5:30 a.m. to 9:00 p.m. from May through September. The "no action" without project alternative, also assumes that water quality improvements would occur from stormwater retrofits proposed in urban areas under the Comprehensive Everglades Restoration Plan. Critical water resources projects would occur in coordination with projects proposed under the SFWMD Surface Water Improvement Plan and local government proposed improvements. With these programs and projects in place, lake degradation would be slowed but not eliminated, and no additional impacts would occur to fish and wildlife habitat areas or species.

4.2.2 EFFECT OF ALTERNATIVE 2: OPERATIONAL CHANGE TO S-310

This alternative would maintain a 24-hour and 7-day per week operation of S-310 when lake levels exceed 15.5 feet. This alternative would further allow the SFWMD to operate S-310 as a water control structure, in addition to, its current operation as a navigational lock. This alternative would evaluate the changes that would occur as a result of actions undertaken during water shortages in the Industrial Canal. The authorized use of S-310 would also be evaluated with this alternative. Project action would also include repair of an existing revetment and

bedding, in addition to filling of a 6-foot scour-hole downstream of S-310. The revetment would be designed for a maximum average velocity of 10 feet per second (fps). Approximately 500 cubic yards of fill would be required to bring the scour-hole bottom elevation to existing grade. A removable boat safety barrier would be installed on the downstream side of S-310, to prevent boats from entering the lock during emergency operations. Associated costs include additional man-hours for lock tenders and additional O&M costs for S-310, which would result in 1654 overtime hours of operation per year

The constant requirement to adjust water levels associated with this alternative would impact apple snail habitat and transport while in the water, and indirectly impact a critical food source for the Snail kite. Further, a higher occurrence of bank erosion would result, impeding general navigation with shoal buildups and would increase the need for maintenance dredging of the canals. This alternative would increase concerns regarding the safe operation of S-310, given normal operation of the lock would have to be over-ridden. The project's goal is to eliminate 1) the current operation of the lock, 2) eliminate or reduce the increased man-hours of operations, and 3) provide adequate flow to the Industrial Canal.

Given the increased level of monitoring and the associated cost, this alternative did not receive the support of the sponsor and was eliminated from further evaluation.

4.2.3 EFFECTS OF ALTERNATIVE 3: CONSTRUCTION OF A PUMP STATION

This alternative would require the installation of a 4-bay irrigation pump station adjacent to the existing S-169 on the south bank of the C-21. The pump would convey water from the westside of S-169 to the eastside of S-169 and into the Industrial Canal when 1) Lake Okeechobee stage is above 15.5 feet, 2) S-310 is closed, 3) and the Industrial Canal stage is low. The pump station capacity would be 425 cfs. The intake water surface elevation would be 10 to 12 feet. The discharge water surface elevation would be 13 to 15.5 feet, and the design head 5.5 feet. This alternative also includes the installation of a trash rake and screen on both sides of the structure. Modifications of CU-2 may be necessary to supplement the flow. Access to the Herbert Hoover Dike would be required at all times during construction, and would require construction of a temporary bridge. This feature would be considered in the scope of work for the pump station construction.

It's probable the high velocity pump proposed to convey water would directly impact fish, amphibians, invertebrates, and other aquatic life through entrainment and impingement. Excess water velocities would also adversely affect fish and wildlife resources through erosion and sedimentation, periphyton detachment and scouring of fish and aquatic macroinvertebrates. Scouring velocity has been defined as 1 fps for substrates of fine gravel or smaller (http://www.aquatext.com 2000). The Corps riprap specifications for some of the alternatives indicate that maximum canal velocities could be up to 8 fps. Velocities are dependent on operations and maximum velocities would likely occur during storm conditions. The Corps anticipates that velocities at S-310 would either be lowered or unchanged. Flows of 7 to 8 fps

would occur only when culverts were fully opened and flow of 1054 cfs are received. This type of flow is not likely to occur and velocities would be controlled with gate opening.

This alternative has a high associated cost and would therefore be cost prohibited. This alternative was eliminated from further evaluation.

4.2.4 EFFECTS OF ALTERNATIVES 4A & 4B

4.2.4.1 Alternative 4A: Relocate S-169 and Construct New Bridge

This alternative would require the removal of the existing S-169 with disposal at the nearest landfill. A new 65-foot-long, 3-cell box culvert bridge would be constructed to replace the existing S-169 and provide access to the HHD. The design flow would be 1054 cfs. Stages of 12.6 and 11.2 were headwater and tailwater result for a flow of 1054 cfs with gates fully opened. A new S-169 culvert structure would be installed on the C-21 west of Culvert 2. The new S-169 would have a diameter of 84 inches, an invert elevation of 2.5 feet with slide gates and telemetry controls. Five 10-foot diameter flap gates at CU-2 would be converted to vertical slide gates with telemetry controls. If required, a tieback levee, approximately 70 meters in length would extend from the new S-169R through the forested wetlands north of C-21 perpendicular to the HHD. Manatee protection devices are proposed for the new S-169 structure, lock and spillways. No such devices are proposed for any existing culverts.

This alternative would eliminate the need for additional man-hours, unauthorized operation and safety concerns, and would provide the necessary flows to the Industrial Canal and C-21. This alternative would substantially reduce bank erosion and waterway scouring. Construction of the levee and tieback may impact hardwood/forested wetlands west of S-310 and north of CU-2. Mitigation may be necessary, if impacts are unavoidable. This alternative is the preferred plan.

This alternative could have some adverse impacts on fish and wildlife resources. The alternative has the potential to result in losses to fish and other aquatic organisms from the encroachment on habitat and chemical processes associated with the pumping station. This could result in loss of habitat for the apple snail, from this shoreline disturbance, with impacts to the Eastern indigo snake, gopher tortoise, and Okeechobee gourd. Activities within the waterway and increased traffic from construction vessels also have the potential to adversely impact the manatee.
The wood stork feeding patterns could be disrupted due to changes in the distribution, timing, and available quantity of water flows. Bald eagles nest sites are usually located near large rivers, lakes, or estuaries where they feed primarily on fish and water-dependent birds. Although no nests have been recorded in or immediately adjacent to the project area, bald eagles may be encountered during construction. The extent of these impacts would be evaluated during the public comment period and design phase of the project Adverse impacts would be avoided to the fullest extent practicable and unavoidable impacts could require mitigation. Any required mitigation would be coordinated with the USFWS and the Florida DEP.

4.2.4.2 Alternative 4B: Relocate and Modify S-169

This alternative would require demolition of that portion of S-169 along the south bank and addition of one 7-foot barrel to the remaining portion of the structure. Three existing vertical slide gates would be removed from the existing S-169. The south bank would be reconstructed to transition at a 1:10 (lateral:longitudinal) ratio. The existing S-169 would be modified and left in place to serve as support for the road access across the C-21 to the HHD. A new S-169R would also be constructed on the C-21 Canal west of Culvert CU-2. The design flow would be 1054 cfs. Stages of 14.2 and 12.9 were headwater and tailwater results for a flow of 1054 cfs with gates fully opened. A temporary bridge would be constructed to allow access to HHD during construction. If required a tieback levee approximately 70 meters in length would extend from the new S-169 through the forested wetlands north of C-21 perpendicular to the HHD.

This alternative could have some adverse impacts on fish and wildlife resources. The alternative has the potential to result in losses to fish and other aquatic organisms from the encroachment on habitat and chemical processes associated with the pumping station. This could result in loss of habitat for the apple snail, from this shoreline disturbance, with impacts to the Eastern indigo snake, gopher tortoise, and Okeechobee gourd. Activities within the waterway and increased traffic from construction vessels also have the potential to adversely impact the manatee. The wood stork feeding patterns could be disrupted due to changes in the distribution, timing, and available quantity of water flows. Bald eagles nest sites are usually located near large rivers, lakes, or estuaries where they feed primarily on fish and water-dependent birds. Although no nests have been recorded in or immediately adjacent to the project area, bald eagles may be encountered during construction. The extent of these impacts would be evaluated during the public comment period and design phase of the project Adverse impacts would be avoided to the fullest extent practicable and unavoidable impacts could require mitigation. Any required mitigation would be coordinated with the USFWS and the Florida DEP.

This alternative would maintain staging elevations at least 1-foot or higher than existing optimum staging elevation. Elevations which exceed 15.5 feet would not receive the support of SFWMD.

4.3 WATER QUALITY

The proposed alternative associated with this project would not increase phosphate levels. The Corps would employ various protective measures and monitoring to ensure existing water quality is not lowered. Currently, phosphorus levels in the lake do not meet the State Total Maximum Discharge Levels (TMDLs). The Industrial Canal serves primarily as a water supply source from Lake Okeechobee to sugarcane fields to the south and conveys untreated discharge back to Lake Okeechobee. The Corps is presently involved in another study to restore the water quality of Lake Okeechobee. This report would evaluate watershed phosphorus loading and would determine ways to remove these contaminants.

4.4 AIR QUALITY

The project would not contribute to any long-term adverse impacts on this value. The impacts associated with the project are temporary and no significant impact would occur.

4.5 NOISE

Construction operations would temporarily increase the ambient levels in the project area. No significant or permanently impacting changes should result.

4.6 AESTHETICS

The project area is located in a mostly developed area, with residential areas, marinas, and agricultural areas. The project will not have an impact on the aesthetics of the area.

4.7 RECREATION

The Industrial and C-21 Canals are used as a point of entry for boaters accessing Lake Okeechobee. Recreation in the area includes boating, fishing, bird watching, and general uses of the municipal park located in the area. Freshwater fishing retail sales in the five counties surrounding Lake Okeechobee were estimated at more than $117 million during 2000 (FWC 2003). The project should have positive benefits on these components. ee.

4.8 NAVIGATION

The Industrial Canal serves as water access through the S-310 Lock to the Okeechobee Waterway for the USACE, South Florida Operating Office (SFOO), as well as for the public. The canal provides access for commercial and recreational vessels using marina facilities. The project would not have a significant impact on navigation. Disruption to navigation could result during construction with some delays. This impact would be temporary and would return to normal after construction is completed.

4.9 HISTORIC PROPERTIES

No impacts are proposed to property eligible for listing in the National Register of Historic Places.

4.10 SOCIO-ECONOMIC

Maintaining sufficient staging elevations within the canals would ensure adequate water is available at all time to meet demand. The local economy is heavily dependent on agriculture, any loss of production would produce a significant economic hardship on certain segments of the population in Glade and Hendry Counties. The irrigation of sugarcane crops is heavily dependent on water found within the Industrial Canal. Implementation of the selected plan would ensure adequate water levels are maintained not only in the Industrial Canal but within the C-21.

4.11 CUMULATIVE IMPACTS

Cumulative impact is the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions

regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7).

No adverse cumulative or secondary impacts are associated with the project.

4.11.1 PROTECTED SPECIES.

Five federally listed threatened or endangered species are present or potentially present in or adjacent to the project area (FWS, 2004). They include the endangered Everglade snail kite, endangered wood stork, endangered West Indian manatee, threatened bald eagle, threatened eastern indigo snake, and endangered Okeechobee gourd. These species have been previously impacted by habitat degradation due to wetland drainage, nutrient-laden stormwater runoff, and a concurrent alteration of the hydroperiod (FWS, 2004).

The snail kite survival is dependent upon the survival of the Florida apple snails. The snail's wetland habitat has been drastically altered and impacted by the factors listed above. The wood stork feeding patterns have been disrupted due to changes in the distribution, timing, and available quantity of water flows. The manatee migrates along the Florida coast through fresh, brackish, and marine waters, and exhibits a seasonal distribution based on water temperatures (FWS, 2004). The manatee distribution is also controlled by aquatic vegetation availability, proximity to channels of at least 2 meters in depth, and location of freshwater sources (FWS, 2004). This issue of manatee having access where they may become stranded or harmed is a concern for the FWS. Bald eagles nest sites are usually located near large rivers, lakes, or estuaries where they feed primarily on fish and water-dependent birds. Their distribution is influenced by the availability of suitable nest and perch sites near large, open waterbodies, typically with high amounts of water to-land edge (FWS, 2004). The eastern indigo snake habitat includes pine flatwoods, scrubby flatwoods, high pine, dry prairie, tropical hardwood hammocks, edges of freshwater marshes, agricultural fields, coastal dunes, and human-altered habitats. The Okeechobee gourd survival in south Florida is threatened by the water-regulation practices in Lake Okeechobee, the continued expansion of exotic vegetation in the lake, aggressive weeds and predation of seeds by animals.

Most, if not all of the species listed above can be found within the project vicinity or adjacent area. In response to the Corps' request for Section 7 consultation regarding the above listed species, the FWS issued an opinion on the species by letter dated December 30, 2004 (see, Appendix C). In assessing the project's potential impact on the snail kite, it was determined that effect on the species would need to be based on the potential for the lowering of lake levels. The FWS found that the project would not exacerbate low-water conditions in Lake Okeechobee. To minimize adverse effect to the wood stork, the FWS recommended implementation of special conditions for the wood stork. The FWS found that manatee habitat in the immediate project area was poor. However, the West Indian manatee is regularly found in Lake Okeechobee. In order to reduce the risk of take to *de minimus* level, given the manatee use of the adjoining structures, and high potential for stranding or entrapment, the FWS recommended that the Corps install, operate, and maintain a retractable manatee barrier on the east side of the proposed

S-169R. It was determined that several eagle's nests are active around the edge of the lake, and the potential exist that nesting territory could be established within the project area before the project was completed. It was recommended that the Corps recheck the most recent information regarding nest distribution several months prior to beginning construction. Protective measures were recommended for the eastern indigo snake, as well as, the gopher tortoise. The measures should remain in effect during construction. For the Okeechobee gourd, the FWS had no record of the species being present in the immediate vicinity of the proposed construction. The Corps voluntarily committed to surveying the area for the species prior to construction. The FWS concurred with the Corps's determination that the project may affect but is not likely to affect the listed species with inclusion of the protective measures as outlined above. The Corps would require the contractor's use of protective measures designed for each species, including pre-construction surveying by qualified individuals to ensure avoidance and relocation, if warranted.

4.11.2 WATER QUALITY.

There are no cumulative adverse impacts associated with the project. The project will not result in increased discharges of phosphorus into Lake Okeechobee.

4.12 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

4.12.1 IRREVERSIBLE

An irreversible commitment of resources is one in which the ability to use and/or enjoy the resource is lost forever. One example of an irreversible commitment might be the mining of a mineral resource.

No resources would be irreversibly lost through the implementation of any of the alternatives proposed for this project.

14.12.2 IRRETRIEVABLE

An irretrievable commitment of resources is one in which, due to decisions to manage the resource for another purpose, opportunities to use or enjoy the resource as they presently exist are lost for a period of time. An example of an irretrievable loss might be where a type of vegetation is lost due to road construction. The existing hardwood wetland west of CU-2 has the potential for impacts from construction of a tieback levee. With careful design and construction of the levee, wetland impact could be avoidable. If impacts are unavoidable, the Corps would coordinate the development of a mitigation and monitoring plan with the USFWS and State DEP during the project's water quality certification phase. Any required mitigation would be included in the project's plans and specifications for implementing.

4.13 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

The forested wetland that exist west of CU-2 could be impacted by the project. During the design phase of the project, it is anticipated that these potential wetland impacts can be avoided. The wetland resources in this area have been extensively degraded and provide minimal benefits to fish and wildlife species. This position is further document in the USFWS Planning Aid

Letter of January 28, 2002. Here it states that resources in the area have been degraded due to extended hydroperiod and excess nutrients. Impacts to wetland resources would not have an adverse impact on fish and wildlife resources. However, during the water quality certification phase of the project mitigation may be required to offset unavoidable project impacts. Should mitigation be required, the Corps would coordinate the mitigation and monitoring proposal with the necessary resource agencies. The mitigation would include the planting of indigenous marsh species along the shoreline, given the sparse and denuded shoreline that exists within the project area. Vegetated shallows or littoral zones would have beneficial components for the wood stork, apple snail, Snail kite, and other aquatic species found in the area.

4.14 LOCAL SHORT-TERM USES AND MAINTENANCE/ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Construction activities would have a temporary and short-term impact on the biological resources of the project area. Although the area would be somewhat environmentally stressed during construction, all systems are expected to fully recover within a few months of impact.

4.15 INDIRECT EFFECTS

Indirect effects would occur due to the construction of another S-169 structure in the canal. This second obstruction to passage of fish and other aquatic organisms would hinder, but not stop, movement of these organisms along the canal.

4.16 ENVIRONMENTAL COMMITMENTS

The U.S. Army Corps of Engineers through the project plans and specifications would ensure a commitment of avoidance, minimization, or mitigation of adverse effects to fish and wildlife species and habitats during construction activities. The project would include standard safety construction precautions for federal listed species that may occur in the project area. Environmental commitments would include: 1) pre-construction surveys to check for eagle nests distribution in the area, 2) pre-construction surveys for the indigo snake with relocation of any gopher tortoises in the construction area; 3) protection measures for the wood stork, 4) a pre-construction survey to determine the presence of the Okeechobee gourd found within the project area; and 5) installation of a retractable manatee barrier on the east side of the new S-169R, in addition to, culverts proposed with diameters of 70- to 84-inches to allow sufficient flow and prevent manatee entrapment within the culverts. Also, acoustic sensors may be installed on the new vertical lift gates to ensure that manatees are not trapped, harmed or killed, by gates or water delivery.

See Appendix C, Pertinent Correspondence for specifications commitments regarding the affected species. Each species commitment in the contract specifications would contain requirements as following:

- The Contractor shall keep construction activities under surveillance,

management, and control to minimize interference with, disturbance to, and damage to fish and wildlife. Species that require specific attention along with measures for their protection shall be listed in the Contractor's Environmental Protection Plan prior to the beginning of construction operation.

- In the event that a threatened or endangered species is harmed as a result of construction activities, the Contractor shall cease all work and notify the Contracting Officer. The order of contact within the Corps of Engineers shall follow established procedures.

4.17 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

4.17.1 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

Environmental information on the project has been compiled and this Environmental Assessment has been prepared. The project is in compliance with the National Environmental Policy Act.

4.17.2 ENDANGERED SPECIES ACT OF 1973

During the project's alternatives formulation, a Planning Aid Letter (PAL) was received from FWS dated January 28, 2002. This PAL outlined FWS review of each alternative, identified potential impacts, and provided recommendations for protection of the listed species. The FWS reviewed found that Alternative 5 (modification of S-169 in the existing location) would be the better structural alternative with Alternatives 1 and 2 the more ecological and cost-effective alternatives. A recommended was made that the Corps re-evaluate Alternatives 1 and 2. from an ecological and cost-effective perspectives.

A draft Fish and Wildlife Coordination Act Report (CAR) found that six federally listed species would be impacted by the project (i.e., manatee, snail kite, wood stork, bald eagle, eastern indigo snake and Okeechobee gourd). Additional information, however, was considered needed (from the Corps) for an assessment of the project's potential impacts on the species and to conclude consultation. Communication was initiated with the FWS prior the agency's receipt of the informal request for Section 7 consultation. During this time, the FWS recommended barriers or sensory exclusion devices be placed on the C-21 and Industrial Canals to prevent manatees from entering these systems. A further recommendation was that the Corps avoid impacts to local remnant forested wetland west of CU-2 and provide mitigation for unavoidable wetland impacts. The Corps agreed to features as outlined by the FWS, with exception of the full protection measures for the wood stork. During the design phase all attempts would be made to avoid any impacts to existing wetland. If avoidance is not possible, mitigation would be proposed to offset project-related impacts. Any mitigation proposal would be coordination with the appropriate resource agencies. The final FWCA report is anticipated on FWS' receipt and review of this environmental document.

The Corps by letter dated August 19, 2004, initiated Coordination with the FWS under Section 7 of the Endangered Species Act. Extensive communication with the FWS, Corps, and SFWD

occurred to resolve the FWS' recommendation for exclusionary devices on both ends of C-21. In a December 30, 2004 letter, FWS summarized the specific habitat requirements for each listed species, and recommended implementation of additional measures to minimize adverse effects to the wood stork and bald eagle. The FWS concurred with the Corps' determination and the protective measures proposed for the federally listed species (Everglade snail kite, wood stork, West Indian manatee, bald eagle, eastern indigo snake, and Okeechobee gourd). FWS recommended additional provisions to minimize adverse effects to the bald eagle and wood stork, in addition to, the inclusion of a removable manatee exclusion grate on the southeast side of the new S-169R. The Corps accepted provisions proposed for the species with limited acceptance of the FWS Habitat Management Guidelines for the Wood Stork in the Southeast Region (1990). A letter dated February 28, 2005, was forwarded to the FWS outlining the Corps' partial acceptance of the wood stork protective measures. The nearest wood stork colony is located 30 miles from the project area and core foraging or nesting areas are about 18.5 miles from the project. Habitat used by the wood stork would be avoided to fullest extent practicable. The FWS issuance of the final CAR is anticipated after the agency's receipt and review of this environmental document. All pertinent agencies correspondence has been included in Environmental Appendix C.

4.17.3 FISH AND WILDLIFE COORDINATION ACT OF 1958

This project has been coordinated with the U.S. Fish and Wildlife Service (USFWS). A Draft Coordination Act Report (CAR) dated July 2003 was submitted by the USFWS. A final CAR is pending and the final report is anticipated upon the agency's review of this document. There have been no changes in the project's design with exception of the inclusion of a retractable manatee barrier on east side of the new S-169R. This protective barrier was included as a project feature after coordination with and approval by the USFWS. The project would be in full compliance with the Act.

4.17.4 NATIONAL HISTORIC PRESERVATION ACT OF 1966

Archival research and consultation with the Florida State Historic Preservation Officer (SHPO), have been conducted in accordance with the National Historic Preservation Act, as amended; the Archeological and Historic Preservation Act, as amended and Executive Order 11593. SHPO consultation was initiated. In a July 24th, 2001, response, the SHPO concurred with the Corps' no adverse effect determination. The project will not affect historic properties included in or eligible for inclusion in the National Register of Historic places. The project is in compliance with this Act.

4.17.5 CLEAN WATER ACT OF 1972

The project is in compliance with this Act. A Section 401 water quality certification permit has been requested from the Florida Department of Environmental Protection. All State water quality standards would be met. A Section 404(b) evaluation is included in this report as Appendix A.

4.17.6 CLEAN AIR ACT OF 1972

No air quality permits would be required for this project. This project has been coordinated with U.S. Environmental Protection Agency (EPA) and is in compliance with Section 309 of the Act.

Correspondence from EPA can be found in Appendix C and discussion of any issues therein can be found in the Public and Agency Involvement section of this statement.

4.17.7 COASTAL ZONE MANAGEMENT ACT OF 1972

As this is an inland site, the project should have no coastal effects. This act is not applicable.

4.17.8 FARMLAND PROTECTION POLICY ACT OF 1981

No prime or unique farmland would be impacted by implementation of this project. This act is not applicable.

4.17.9 WILD AND SCENIC RIVER ACT OF 1968

No designated Wild and Scenic river reaches would be affected by project related activities. This act is not applicable.

4.17.10 MARINE MAMMAL PROTECTION ACT OF 1972

The MMPA does not allow activities that alter the behavior or critical habitat of marine mammals. Penalties are imposed for such activities that harm, harass, or kill protected species. The marine mammal of concern that occurs in the project area, surrounding rim canals, and Lake Okeechobee is the West Indian manatee (*Trichechus manatus*). Features associated with the project would install 70- to 84-inch diameter culverts to allow sufficient flow and prevent manatee entrapment within the canal systems. A retractable manatee barrier would also be placed on the east side of the new S-16R structure. The features as outlined would ensure the species is not trapped, harmed, or killed by normal gate operations or construction activities. This project would be in compliance with the Act.

4.17.11 ESTUARY PROTECTION ACT OF 1968

No designated estuary would be affected by project activities. This act is not applicable.

4.17.12 FEDERAL WATER PROJECT RECREATION ACT

The principles of the Federal Water Project Recreation Act, (Public Law 89-72) as amended, have been fulfilled by complying with the recreation cost sharing criteria as outlined in Section 2 (a), paragraph (2).

4.17.13 FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976

The project has been coordinated with the National Marine Fisheries Service (NMFS) and is in compliance with the act.

4.17.14 SUBMERGED LANDS ACT OF 1953

The project would occur on submerged lands of the State of Florida. The project would be coordinated with the State and should comply with this act.

4.17.15 COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990

There are no designated coastal barrier resources in the project area that would be affected by this project. These acts are not applicable.

4.17.16 RIVERS AND HARBORS ACT OF 1899

During construction general navigation may encounter some delays and obstructions. The impacts however would be temporary. The contractor would be required to maintain public access to the waterway and to avoid activities that severely impede or restrict general navigation. The proposed action has been subject to the public notice, public hearing, and other evaluations normally conducted for activities subject to the act. The project is in full compliance.

4.17.17 ANADROMOUS FISH CONSERVATION ACT

Anadromous fish species would not be affected. The project has been coordinated with the National Marine Fisheries Service and is in compliance with the act.

4.17.18 MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

No migratory birds would be affected by project activities. The project is in compliance with these acts.

4.17.19 MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

The term "dumping" as defined in the Act (3[33 U.S.C. 1402](f)) does not apply to the disposal of material for beach nourishment or to the placement of material for a purpose other than disposal (i.e. placement of rock material as an artificial reef or the construction of artificial reefs as mitigation). Therefore, the Marine Protection, Research and Sanctuaries Act does not apply to this project. The disposal activities addressed in this EA have been evaluated under Section 404 of the Clean Water Act.

4.17.20 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

This act requires preparation of an Essential Fish Habitat (EFH) Assessment and coordination with the National Marine Fisheries Service (NMFS). An independent EFH Assessment may be coordination prior to preparation of the NEPA document. Alternatively, the NEPA document (EA or EIS) may serve as this assessment if it includes the required elements as follows: (1) a description of the proposed action (parts of chapters 1.0 and 2.0); (2) analysis of individual and cumulative effects on EFH, Federally managed fisheries, and associated species such as major prey species, including affected life history stages (parts of chapters 3.0 and 4.0); (3) the Districts' view regarding effects; and (4) proposed mitigation, if applicable. Information on

essential fish habitat, managed species, and life history stages can be obtained from the NMFS web sites. The project would not adversely impact resources under the agency's purview.

No Essential Fish Habitat for Marine species is found in the project vicinity and, therefore, this act does not apply.

4.17.21 E.O. 11990, PROTECTION OF WETLANDS

The potential exist that some wetlands may be impacted by the proposed activity. However, it is believed that careful project design may be able to avoid all wetland impacts that might be associated with construction of the levee and tieback. All efforts to avoid or minimize wetland impacts would be use, such as modifying project design and shifting the footprint of the structure. Any unavoidable wetland impacts would be offset with a mitigation that has received input from the USFWS and State DEP. The project would be in compliance with the goals of this Executive Order.

4.17.22 E.O. 11988, FLOOD PLAIN MANAGEMENT

The project is in the base flood plain (100-year flood) and has been evaluated in accordance with this Executive Order. The project is in compliance.

4.17.23 E.O. 12898, ENVIRONMENTAL JUSTICE

On February 11, 1994, the President of the United States issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. The Executive Order mandates that each federal agency make environmental justice part of the agency mission and to address, as appropriate, disproportionately high and adverse human health or environmental effects of the programs and policies on minority and low-income populations. The project would benefit this segment of the population by delivering water in quantities sufficient to sustain the area's agricultural users. There should not be any adverse effects on minority or low-income populations. The project complies with this Executive Order.

4.17.23 E.O. 13045, DISPARATE RISKS INVOLVING CHILDREN

On April 21, 1997, the President of the United States issued Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*. The Executive Order mandates that each federal agency make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks. The project proposes no such risks or adverse actions on children. This act is not applicable.

4.17.24 E.O. 13089, CORAL REEF PROTECTION

There are no coral reefs that would be impacted by this freshwater project.

4.17.25 E.O. 13112, INVASIVE SPECIES

Due to the build up of structures around and along the canal and maintenance of the levees to prevent vegetation other than grasses from taking hold, no extensive stands of any vegetation types exist in the project area. Some Brazilian pepper has invaded a wetland area south of the C-21 Canal. No action will be undertaken by this project to remove or destroy any invasive species found in the area.

5 LIST OF PREPARERS

5.1 PREPARERS

Annon I. Bozeman, Environmental Protection Specialist
Catherine L. Brooks, Biologist
Grady Caulk, Archeologist
Paul Karch, Environmental Engineer
Mark White, Civil Engineer

5.2 REVIEWERS

Kenneth Dugger, Chief, Gulf Coast Section
Janet Cushing, Biologist

6 PUBLIC INVOLVEMENT

6.1 SCOPING AND DRAFT EA

A scoping letter dated May 7, 2001 was issued for this action. The draft EA and Finding of No Significant Impact (FONSI) will be made available to the public by notice of availability.

6.2 AGENCY COORDINATION

Agency coordination letters are found in Appendix C.

6.3 LIST OF RECIPIENTS

Copies of the draft EA would be forwarded to individuals, agencies, and other interested parties as identified in the complete mailing list contained in Appendix C.

6.4 COMMENTS RECEIVED AND RESPONSE

6.4.1 U.S FISH AND WILDLIFE SERVICE (USFWS)

The USFWS in response to the Corps request and in accordance with the Fish and Wildlife Coordination Act of 1973, provided a Planning Aid Letter dated January 28, 2003. USFWS communicated that most of the federally listed species present or potentially present in the project area have been previously impacted by habitat degradation due to wetland drainage, excess nutrient runoff, and a concurrent alteration of the hydroperiod. The project would have the potential to either benefit or adversely impact the endangered snail kite and the endangered wood stork. Other species found within Lake Okeechobee or occurring in the area include the endangered West Indian manatee, the threatened bald eagle, the threatened eastern indigo snake, and the endangered Okeechobee gourd.

Identifying several areas of concern, the USFWS recommended that the Corps re-evaluate the need for the project, and communicated that from an ecological and cost-effective perspective, Alternatives 1 and 2 would be the best alternatives due to their non-structural nature. The USFWS further communicated that the Corps, in consultation with the cooperating agencies, should identify an alternative that can maintain or improve the current ecological conditions in Lake Okeechobee and the Nine Mile Canal Basin. The alternation should also be consistent with the Central and Southern Florida Project and the goals of the CERP. A copy of the USFWS letter is included in Appendix C.

6.4.2 USFWS COORDINATION ACT

A Revised Draft Fish and Wildlife Coordination Act Report dated September 22, 2003, is included in Appendix C. In this report, USFWS evaluate each alternative and make recommendations with respect to federally listed species occurring within the immediate or surrounding project vicinity. The Corps commitment to the protection of federally listed threatened and endangered species would include: 1) checking the project area prior to construction for the presence of the bald eagle; 2) ensuring protection measures for the eastern indigo snake would remain in place throughout construction and surveying for and relocating the gopher tortoise if found within the project area; 3) ensuring measures are in place for the wood stork as identified in the FWS Habitat Management Guidelines for the Wood Stork in the Southeast Region; 4) surveying the project to determine the presence of the Okeechobee gourd; and 5) installing a manatee retractable barrier on the east side of the new S-169R structure.

6.4.3 FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION (FDEP)

In response to the Corps' letter dated May 7, 2001, the FDEP commented that specific information on problems associated with inadequate drainage were not present. FDEP outlined several areas that should be addressed in the project's Environmental Assessment, in addition to, providing how sediments would be removed and handled with Alternatives 3 and 6.

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APPENDIX A - SECTION 404(B) EVALUATION

SECTION 404(b) EVALUATION
MODIFICATION OF S-169
CLEWISTON, HENDRY COUNTY, FLORIDA

I. Project Description

a. Location. The proposed work will be performed near Hebert Hoover Dike, on Structure 169 and Culvert 2 on Canal 21 in Clewiston, Hendry County, Florida.

b. General Description. The proposed plan calls for modifications to Structure S-169, the construction of a replacement S-169, a bridge across the existing S-169 to gain access to the Herbert Hoover Dike, and modification of the C-2 flap gates to vertical sliding gates.

c. Authority and Purpose. The Flood Control Act of 1948 authorized the construction of S-169 and the realignment of C-21 to allow the diversion of water flow from the Industrial Canal to Pump Station 4 during times when gravity discharge to Lake Okeechobee was not possible.

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. Soil and dirt will be used to construct the tie-back levee at the site of the new S-169 structure. This material will be similar to material used to construct the Herbert Hoover Dike around Lake Okeechobee. Riprap would be placed along the waterline to prevent erosion and help stabilize the levee.

(2) Quantity of Material. It is anticipate that approximately 50 cubic yards of material will be needed to construct the tie-back levee.

(3) Source of Material. The material to be used to construct the tie-back levee will be obtained from commercial sources.

e. Description of the proposed Discharge Site.

(1) Location. The tie-back levee and replacement S-169 will be constructed approximately 1000 feet west of the existing structure.

(2) Size. The tie-back levee and replacement structure will impact less than an acre, and final project design may be able to avoid impacts to the sparse wetland in the area.

(3) Type of Site. The site selected is approximately the same type of site where the existing structure is currently located.

(4) Type of Habitat. The replacement structure and tie-back levee will impact a small isolated wetland adjacent to the canal at the base of HHD.

(5) Timing and Duration of Discharge. Construction of the tie-back levee and the replacement structure will take approximately 2 years to complete.

f. Description of Disposal Method. Material will be brought to the site by truck and used to construct the levee and structure.

II. Factual Determinations

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. The tie-back levee will be raised with side slopes of 1V : 4H. The elevations of the new structure will be similar to elevations of the existing structure. Finished elevations will be determined during actual design and construction of the new structure.

(2) Sediment Type. Core borings have not been completed yet, but it is anticipated that material used for tie-back levee construction will be compatible with, and similar to, the material which was used to construct the Herbert Hoover Dike.

(3) Dredge/Fill Material Movement. Riprap material will be used to stabilize the dike base and prevent erosion. No movement of material is anticipated.

(4) Physical Effects on Benthos. It is not anticipated that this project will have any significant or long term effect on benthic organisms.

b. Water Circulation, Fluctuation and Salinity Determination.

(1) Water Column Effects. Turbidity impacts on the water column will be minimized through the use of silt curtains. Any impacts will be temporary and the water will quickly return to normal once construction is completed.

(2) Current Patterns and Circulation. No impacts are anticipated to current patterns and water circulation in the canals.

(3) Normal Water Level Fluctuations and Salinity Gradients. Construction of the replacement S-169 structure will not impact water level fluctuations and salinity.

c. Suspended Particulate/Turbidity Determinations. Construction of the replacement S-169 structure will not increase suspended particles or turbidity in the canals.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site. Use of silt curtains to prevent increases in suspended particles and turbidity during construction will prevent problems in the water column. Once construction is complete, water conditions will quickly return to normal.

(2) Effects on the Chemical and Physical Properties of the Water Column.

(a) Light Penetration. No permanent impacts to light penetration will occur through construction of this project.

(b) Dissolved Oxygen. No adverse impacts to the dissolved oxygen levels of the water in the canals will occur as a result of project construction.

(c) Toxic Metals, Organics, and Pathogens. Construction of this project will not introduce any toxic materials or pathogens into the canal waters.

(d) Aesthetics. Construction of the project will introduce some aesthetic changes into the area. The new bridge, control gates and new S-169 structure will quickly blend in with the other buildings and structures in the project area.

(3) Effects on Biota.

(a) Primary Productivity and Photosynthesis. No effects.

(b) Suspension/Filter Feeders. No effects.

(c) Sight Feeders. No effects.

d. Contaminant Determinations.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton None.

(2) Effects on Benthos. None.

(3) Effects on Nekton. None.

(4) Effects on the Aquatic Food Web. None.

(5) Effects on Special Aquatic Sites.

(a) Hardground and Coral Reef Communities None.

(b) Sanctuaries and Refuges. None.

(c) Wetlands. Construction of the tieback levee would propose no impact to wetland, if constructed properly.

(d) Mud Flats. None.

(e) Vegetated Shallows. None.

(f) Riffle and Pool Complexes. None.

(6) Endangered and Threatened Species. None.

(7) Other Wildlife. None.

(8) Actions to Minimize Impacts. It is not anticipated that any work undertaken by this project will create or introduce contaminants into the water, soil or air.

f. Proposed Disposal Site Determinations. Not applicable.

(1) Mixing Zone Determination. Water passing through the S-169 structure will mix and mingle with water from the C-1 Canal west of where it currently mixes. As such, no changes in mixing rates, duration or timing is anticipated.

(2) Determination of Compliance with Applicable Water Quality Standards. This project should have no impact on water quality standards and will comply with all rules and regulations pertinent to water quality.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supplies. No effects.

(b) Recreational and Commercial Fisheries. No effects.

(c) Water Related Recreation. No adverse effects.

(d) Aesthetics. No adverse or long term effects.

(e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. No effects.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. Since the project involves replacing an existing structure with a similar structure, the construction of a bridge and

the replacement of one type of water control gate with another type, the cumulative effects on the aquatic ecosystem should be minimal.

h. Determination of Secondary Effects on the Aquatic Ecosystem. No effects.

III. Findings of Compliance or Non-compliance with the Restrictions on Discharge.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. No practicable alternative exists which meets the study objectives that does not involve discharge of fill into waters of the United States.

c. After consideration of disposal site dilution and dispersion, the discharge of fill materials will not cause or contribute to, violations of any applicable State water quality standards for Class III waters. The discharge operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

d. The replacement of the S-169 structure with a bridge to access the Herbert Hoover Dike and replacement of the flap gates at C-2 with vertical lift gates will not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended. The potential for manatees to become entrapped when entering the canal system would be very minimal. Three 70- to 84-inch diameter culverts are proposed at the new S-169R structure, and the east side of the structure would be equipped with a retractable manatee barrier. The associated features of the project would afford the species the widest protection possible. Precautions would be in place for the manatee during construction (i.e., standard manatee precautions would be required of the contractors). The project may include manatee protection systems (i.e., acoustic sensors) on the new vertical lift gates. This determination will be made when the final threatened and endangered species coordination with the USFWS is concluded.

e. The placement of fill material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur.

f. On the basis of the guidelines, the proposed disposal site for the discharge of dredged material is specified as complying with the requirements of these guidelines.

APPENDIX B - COASTAL ZONE MANAGEMENT CONSISTENCY

FLORIDA COASTAL ZONE MANAGEMENT PROGRAM
FEDERAL CONSISTENCY EVALUATION PROCEDURES

MODIFICATION OF S-169
CLEWISTON, HENDRY COUNTY, FLORIDA

1. Chapter 161, Beach and Shore Preservation. The intent of the coastal construction permit program established by this chapter is to regulate construction projects located seaward of the line of mean high water and which might have an effect on natural shoreline processes.

Response: This chapter is not applicable to this project.

2. Chapters 163(part II), 186, and 187, County, Municipal, State and Regional Planning. These chapters establish the Local Comprehensive Plans, the Strategic Regional Policy Plans, and the State Comprehensive Plan (SCP). The SCP sets goals that articulate a strategic vision of the State's future. Its purpose is to define in a broad sense, goals, and policies that provide decision-makers directions for the future and provide long-range guidance for an orderly social, economic and physical growth.

Response: The proposed project has been coordinated with various Federal, State and local agencies during the planning process.

3. Chapter 252, Disaster Preparation, Response and Mitigation. This chapter creates a state emergency management agency, with the authority to provide for the common defense; to protect the public peace, health and safety; and to preserve the lives and property of the people of Florida.

Response: The proposed project involves replacing S-169 with a bridge to gain access to Herbert Hoover dike and replacing the C-2 flap gates with vertical slide gates within Hendry County. Therefore, this project would be consistent with the efforts of Division of Emergency Management.

4. Chapter 253, State Lands. This chapter governs the management of submerged state lands and resources within state lands. This includes archeological and historical resources; water resources; fish and wildlife resources; beaches and dunes; submerged grass beds and other benthic communities; swamps, marshes and other wetlands; mineral resources; unique natural features; submerged lands; spoil islands; and artificial reefs.

Response: The proposed project would comply with the intent of this chapter.

5. Chapters 253, 259, 260, and 375, Land Acquisition. This chapter authorizes the state to acquire land to protect environmentally sensitive areas.

Response: Since the affected property already is in public ownership, this chapter does not apply.

6. Chapter 258, State Parks and Aquatic Preserves. This chapter authorizes the state to manage state parks and preserves. Consistency with this statute would include consideration of projects that would directly or indirectly adversely impact park property, natural resources, park programs, management or operations.

Response: The proposed project area does not contain any state parks or aquatic preserves nor are there any within the immediate vicinity of the project that would be affected. The project is consistent with this chapter.

7. Chapter 267, Historic Preservation. This chapter establishes the procedures for implementing the Florida Historic Resources Act responsibilities.

Response: This project has been coordinated with the State Historic Preservation Officer (SHPO). Historic Property investigations were conducted in the project area. An archival and literature search, in addition to a magnetometer survey of the proposed borrow area were conducted. The SHPO concurred with the Corps determination that the proposed project will not adversely affect any significant cultural or historic resources. The project will be consistent with the goals of this chapter.

8. Chapter 288, Economic Development and Tourism. This chapter directs the state to provide guidance and promotion of beneficial development through encouraging economic diversification and promoting tourism.

Response: This project is consistent with the goals of this chapter.

9. Chapters 334 and 339, Transportation. This chapter authorizes the planning and development of a safe balanced and efficient transportation system.

Response: No public transportation systems would be impacted by this project.

10. Chapter 370, Saltwater Living Resources. This chapter directs the state to preserve, manage and protect the marine, crustacean, shell and anadromous fishery resources in state waters; to protect and enhance the marine and estuarine environment; to regulate fishermen and vessels of the state engaged in the taking of such resources within or without state waters; to issue licenses for the taking and processing products of fisheries; to secure and maintain statistical records of the catch of each such species; and, to conduct scientific, economic, and other studies and research.

Response: This freshwater project will have no impact on saltwater living resources. This chapter does not apply.

11. Chapter 372, Living Land and Freshwater Resources. This chapter establishes the Game and Freshwater Fish Commission and directs it to manage freshwater aquatic life and wild animal life and their habitat to perpetuate a diversity of species with densities and distributions which provide sustained ecological, recreational, scientific, educational, aesthetic, and economic benefits.

Response: Coordination with the Fish and Wildlife Conservation Commission (FWCC) will determine if the proposed action is consistent with State policies and practices as set forth in this chapter. The Corps believes the project will fully comply with this Act. Measures would be in place to ensure no unnecessary alteration of habitat would occur. Pre-construction surveys would be performed to locate species that would be adversely impacted by construction activities. Species requiring relocating, especially the gopher tortoise, would be coordinated with the FWCC prior to any actions to relocate. Only individuals certified by the State would undertake actions related to the species. Further project safeguards would protect the manatee from entrapment within the new canal system by installing culverts with diameters of 70- to 84-inches, and equipping the east end of the new S-169 R with a retractable manatee barrier. The project may include manatee acoustic sensors on the new vertical lift gates. This decision will be made during final species coordination with the USFWS and after an evaluation of cost.

12. Chapter 373, Water Resources. This chapter provides the authority to regulate the withdrawal, diversion, storage, and consumption of water.

Response: This project does not involve water resources as described by this chapter.

13. Chapter 376, Pollutant Spill Prevention and Control. This chapter regulates the transfer, storage, and transportation of pollutants and the cleanup of pollutant discharges.

Response: The contract specifications will prohibit the contractor from dumping oil, fuel, or hazardous wastes in the work area and would require the contractor adopt safe and sanitary measures for the disposal of solid wastes. A spill prevention plan will be required.

14. Chapter 377, Oil and Gas Exploration and Production. This chapter authorizes the regulation of all phases of exploration, drilling, and production of oil, gas, and other petroleum products.

Response: This project does not involve the exploration, drilling or production of gas, oil or petroleum product and therefore, this chapter does not apply.

15. Chapter 380, Environmental Land and Water Management. This chapter establishes criteria and procedures to assure that local land development decisions consider the regional impact nature of proposed large-scale development. This chapter also deals with the Area of Critical State Concern program and the Coastal Infrastructure Policy.

Response: This project will not have any regional impact on resources in the area. Therefore, the project is consistent with the goals of this chapter.

16. Chapters 381 (selected subsections on on-site sewage treatment and disposal systems) and 388 (Mosquito/Arthropod Control). Chapter 388 provides for a comprehensive approach for abatement or suppression of mosquitoes and other pest arthropods within the state.

Response: The project will not further the propagation of mosquitoes or other pest arthropods.

17. Chapter 403, Environmental Control. This chapter authorizes the regulation of pollution of the air and waters of the state by the Florida Department of Environmental Regulation (now a part of the Florida Department of Environmental Protection).

Response: An Environmental Assessment addressing project impacts has been prepared and will be reviewed by the appropriate resource agencies including the Florida Department of Environmental Protection. Environmental protection measures will be implemented to ensure that no lasting adverse effects on water quality, air quality, or other environmental resources will occur. Water Quality Certification will be sought from the State prior to construction. The project complies with the intent of this chapter.

18. Chapter 582, Soil and Water Conservation. This chapter establishes policy for the conservation of the state soil and water through the Department of Agriculture. Land use policies will be evaluated in terms of their tendency to cause or contribute to soil erosion or to conserve, develop, and utilize soil and water resources both onsite or in adjoining properties affected by the project. Particular attention will be given to projects on or near agricultural lands.

Response: The proposed project is not located near or on agricultural lands; therefore, this chapter does not apply.

APPENDIX C – COORDINATION ACT REPORT

S-169/Nine-Mile Canal Basin General Reevaluation Report

Revised Draft Fish and Wildlife Coordination Act Report

Submitted to:
Jacksonville District
U.S. Army Corps of Engineers
Jacksonville, Florida

Prepared by: Steve Schubert and Robert Pace
Approved by: James J. Slack, Field Supervisor

U.S. Fish and Wildlife Service
South Florida Ecological Services Office
Vero Beach, Florida

September 22, 2003

EXECUTIVE SUMMARY

The degree of water control in the Nine-Mile Basin is not sufficient to safely provide agricultural water supply for users connected to the Industrial Canal when stages in Lake Okeechobee are greater than 15.5 feet. When lake stages are higher than 15.5 feet, the S-310 (the connection to the lake) is designed to be closed to control water levels in the Industrial Canal and C-21 east of S-169. However, the South Florida Water Management District (SFWMD) has been operating the S-310 to allow water to stage in the Industrial Canal for water supply when the lake is greater than 15.5 feet.

Operating the S-310 in a non-navigational manner (*i.e.*, allowing water to free-flow through partially opened lock gates) when the lake surface is higher than 15.5 feet is unsafe because the flow velocity resulting from such operations can cause sediment scouring which can undermine the structural integrity of the lock and also cause formation of sandbars further downstream which can be a hazard to navigation. Such operations are unsafe for approaching vessels and have caused bank erosion. Additionally, the normal mechanical or electrical safety features of the lock have to be overridden in order to make releases through the structure.

The selected plan for this project recommends corrective actions intended to provide water flow from the lake into the C-21 and Industrial canals when the S-310 navigational structure is closed. Alternative plans were evaluated based on the following goals: 1) enable a dependable conveyance of water to meet permitted agricultural demands along the Industrial Canal; and 2) maintain the current level of flood control.

Improved water control will be facilitated by replacing S-169 with an access bridge, modifications to Culvert No. 2, and installation of a new water control structure in the C-21 Canal. The Flood Control Act of 1948 authorized the construction of the S-169 and the C-21 Canal to allow the diversion of flow from the Industrial Canal to Pump-Station 4, located northwest of Clewiston, during times when gravity discharge to Lake Okeechobee was not feasible. The authority for the General Reevaluation Report (GRR) corresponds with the original 1948 authority. The GRR documents the re-analysis of a previously completed study, using current planning criteria and policies, which is required due to changed conditions and/or assumptions. The results may affirm the previous plan; reformulate and modify it, as appropriate; or find that no plan is currently justified. The SFWMD, acting as local sponsor for this GRR, must support any selected alternative arising from the GRR, because they would provide the local cost share, should the selected plan proceed to detailed design and construction.

The ecological benefits of this project are minimal. Withdrawal of lake water when lake stages are greater than 15.5 feet NGVD would provide ecological benefits to the lake. However, this project proposes to reduce the maximum irrigational capability of facilities along the Industrial Canal from the existing condition of 462 cfs (when the lake is at 15.5 feet and S-310 is open) to 419 cfs. A 10-day irrigational event equivalent to 419 cfs (and that volume which would just exceed the total monthly permitted usage for Industrial Canal water users) is estimated to reduce

the lake stage by only 0.02 feet. The potential adverse ecological effects of additional contaminated stormwater runoff that may be discharged into the lake from the Industrial Canal have been discounted by the U.S. Army Corps of Engineers (Corps). They noted that "there will be no runoff in addition to existing conditions. Existing discharge pump capacities of facilities along the Industrial Canal was used for the with project discharge surface water routing. With project operations will be the same as existing operations" (Annon Bozeman, Corps, personal communication 2003).

Any wetlands that are impacted as a result of this project will need to be mitigated. This would include the remnant forested wetland that could be impacted by the tieback levee, if necessary in the selected plan, adjacent to the new water control structure. The Service awaits more details on the size and location of the tieback levee before we can provide specific recommendations regarding compensatory mitigation.

The Service believes that Alternatives 2 through 5 are similar in their ecological consequences for the removal of water out of Lake Okeechobee when the S-310 is closed. Alternative 4A is the Corps' selected plan. If the Corps can demonstrate that a structural solution is needed for this project, then the Service would support the selected plan if our recommendations (Section X of this report) are followed.

The Service's objectives in providing recommendations on this project are to make it more environmentally compatible with fish and wildlife resources in the project area, consistent with the basic project purpose. We have developed recommendations regarding: 1) alternative evaluation and selection; 2) threatened and endangered species; 3) water flows to Lake Okeechobee; 4) wetland mitigation; and 5) additional studies. Standard construction precautions or measures should be implemented to avoid adverse effects on the eastern indigo snake, West Indian manatee, wood stork, bald eagle, and snail kite. An effect determination has not yet been conducted by the Corps. The Service is awaiting the opportunity to review an effect determination from the Corps.

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LIST OF ACRONYMS AND ABBREVIATIONS USED IN THE TEXT

C&SF	Central and Southern Florida Project
CERP	Comprehensive Everglades Restoration Plan
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
EAA	Everglades Agricultural Area
ESA	Endangered Species Act
DEP	Florida Department of Environmental Protection
FWC	Florida Fish and Wildlife Conservation Commission
FWCA	Fish and Wildlife Coordination Act
GRR	General Reevaluation Report
HHD	Herbert Hoover Dike
MGD	Million Gallons per Day
NGVD	National Geographic Vertical Datum
PAL	Planning Aid Letter
Service	U.S. Fish and Wildlife Service
SFCD	South Florida Conservation District
SFWMD	South Florida Water Management District
SSC	Species of Special Concern
T	Threatened
USGS	U.S. Geological Survey
USSC	United States Sugar Corporation
WSE	Water Supply Environmental

I. IDENTIFICATION OF PURPOSE, SCOPE AND AUTHORITY

A. Purpose and Scope

The objective of the Control Structure 169 (S-169)/Nine-Mile Canal Basin Project is to reaffirm, reformulate, or modify the S-169 and/or other structures in the basin to facilitate better surface water control in the C-21 Canal and to the Industrial Canal from Lake Okeechobee. When the lake's surface elevation is less than 15.5 feet National Geographic Vertical Datum (NGVD), the navigational Canal Lock Structure 310 (S-310) is open and water can flow between the lake and Industrial Canal. When the lake's surface elevation is higher than 15.5 feet, the S-310 is closed. During these times, the South Florida Water Management District (SFWMD) has been opening the S-310 during non-duty hours to allow water to flow from Lake Okeechobee into the Industrial Canal. The water in the Industrial Canal is utilized by United States Sugar Corporation (USSC) and South Florida Conservation District (SFCD) lands that are adjacent to the Industrial Canal located south and east of the City of Clewiston. Water usage and discharges are not metered by these entities; however, according to the SFWMD, the majority of the water withdrawals from this canal are carried out by entities that do have active Consumptive Use Permits.

Operating the S-310 in a non-navigational manner (*i.e.*, allowing water to free-flow through partially opened lock gates) when the lake surface is higher than 15.5 feet, is unsafe because the flow velocity resulting from such operations can cause sediment scouring which can undermine the structural integrity of the lock and also cause formation of sandbars further downstream which can be a hazard to navigation. Such operations are unsafe for approaching vessels and have caused bank erosion. Additionally, the normal mechanical or electrical safety features of the lock have to be overridden in order to make releases through the structure. For a permanent solution to this water supply problem, the Corps is considering several alternatives that will eliminate the need to operate the S-310 for water supply when the lake is above 15.5 feet, NGVD. The existing optimum conditions of 15.2 to 14.7 in the Industrial Canal would remain and water would be diverted from the lake through Culvert No. 2 on an "as needed" basis in accordance with existing water use allocation permits whenever the lake elevation is higher than 15.5 feet.

B. Authorities

Once finalized, this Fish and Wildlife Coordination Act (FWCA) Report will constitute the report of the Secretary of the Interior as required by section 2(b) of the FWCA (16 U.S.C. 661 et seq.), which establishes fish and wildlife conservation as a coequal purpose or objective of federally funded or permitted water resource development projects. The FWCA allows for reports and recommendations from the U.S. Fish and Wildlife Service (Service) and the State agency exercising administration over wildlife resources [in this case, the Florida Fish and Wildlife Conservation Commission (FWC)] to be integrated into Corps reports seeking authorization for the Federal action. The FWCA also grants authority to the Corps to include fish and wildlife conservation measures within these projects.

The Flood Control Act of 1948 authorized the construction of the S-169 and C-21 Canal to allow the diversion of flow from the Industrial Canal to Pump Station 4, located northwest of Clewiston, during times when gravity discharge to Lake Okeechobee was not feasible.

A General Reevaluation Report (GRR) documents the re-analysis of a previously completed study, using current planning criteria and policies, which is required due to changed conditions and/or assumptions. The results may affirm the previous plan; reformulate and modify it, as appropriate; or find that no plan is currently justified. The authority for this GRR corresponds with the original 1948 authority. The SFWMD, acting as local sponsor for this GRR, must support any selected alternative arising from the GRR, because they would provide the local cost share, should the selected plan proceed to detailed design and construction.

II. PREVIOUS SERVICE INVOLVEMENT IN THE PROJECT

The Service responded to a separate, but related action proposed by the Corps. On April 12, 2001, the Corps requested consultation under section 7 of the Endangered Species Act (ESA) on a maintenance dredging permit of 15,000 cubic yards of material from the Industrial Canal. On May 1, 2001, the Service concurred with a "may affect, not likely to adversely affect" determination (Consultation Log 4-1-01-I-196) on the project for the West Indian manatee (*Trichechus manatus*) and wood stork (*Mycteria americana*). This activity is significant to the S-169 Project in that, following the dredging, more water could stage in the Industrial Canal, thereby potentially affecting the need for this project. The Corps has stated that the additional storage as a result of dredging is insignificant [(Annon Bozeman, Corps, personal communication 2003); 15,000 cubic yards equals 3,029,610 gallons – approximately 1.6 percent of the daily average permitted usage]. The informal consultation for this dredging does not cover the additional actions considered in this report.

On July 27, 2001, biologists from the Corps and Service conducted a site investigation of the project area. The purposes of the investigation were:

- to identify land uses in the project area,
- to determine the quality of the various aquatic, littoral, and riparian habitats for fish and wildlife that may be affected by the project, and
- to estimate potential habitat usage of the project area by federally listed threatened or endangered species.

On January 28, 2002, the Service submitted a Planning Aid Letter (PAL) to the Corps for this project. Recommendations and concerns included the adequate demonstration of need for the project, and the effects on lake levels, federally listed species, and other fish and wildlife resources.

III. AREA SETTING

A. Project Location

The project area is located between Lake Okeechobee and the City of Clewiston in Hendry County (Figure 1). The major features in the project area are Lake Okeechobee, its littoral zone, the rim canal, Herbert Hoover Dike (HHD), C-20 Canal, C-21 Canal, Industrial Canal, S-310, S-169, Culvert No. 2, S-4 Pump Station, a municipal park, and two marinas. The Nine-Mile Canal, LD-1 and LD-3 connector canals, Culvert Nos. 1 and 1A, Lake Hicpochee, and S-235 are major features that are included in operations of the basin but are outside of the study area and scope.

B. Description of Study Area

1. Hydrological Description

Flood waters from Clewiston and most of the Nine-Mile Canal Basin drain into the C-21, C-20, and Industrial canals, and then into the lake through either the S-310, Culvert No. 2, or the S-4 Pump Station. There is potential for some runoff from the basin to be discharged through S-235 to the Caloosahatchee River (C-43) or routed down the Nine-Mile Canal to Lake Hicpochee or through Culvert No. 1 or Culvert No. 1A to Lake Okeechobee. This project will not increase the stormwater runoff over existing conditions. Existing discharge pump capacities of facilities along the Industrial Canal were used for the with project discharge surface water routing. With project operations will be the same as existing operations.

When lake stage is below 13.0, discharge from the Industrial Canal is routed to the lake through an open S-310. If conditions are favorable, discharge from the Industrial Canal can flow through an open S-169 and to the lake via an open Culvert No. 2, Culvert No. 1, Culvert No. 1A, or S-4.

When lake stage is between 13.0 and 15.5 discharge from the Industrial Canal is routed to the lake through an open S-310. Discharge could be routed through S-169 and to the lake via Culvert No. 2, S-4, Culvert No. 1, or Culvert No. 1A if conditions are favorable or through an open S-235 to the Caloosahatchee; however, that is prevented since S-169, Culvert No. 1, and Culvert No. 1A are scheduled to be closed.

When the lake stage is higher than 15.5 feet, the S-310 lock is opened for boat traffic from 5:30 a.m. to 8:00 p.m. (October to April) or to 9:00 p.m. (May to September). When lake stage is above 15.5, discharge from the Industrial Canal is routed through S-169 to S-4 or to an open S-235. S-310 becomes operational when lake stage is above 15.5 to maintain optimum conditions in the Industrial Canal and C-21 east of S-169. Optimum conditions in the Industrial Canal north of U.S. Highway 27 and in C-21 east of S-169 is 15.5 when S-310 is initially closed and range from 15.2 to 14.7 when S-169 is put on automatic. Normally, S-169 gates will remain closed unless the headwater stage reaches 15.2. At that time the gates will begin to open. S-169 gates will become stationary at 15.0 and begin to close at 14.7. S-169 gates can be taken off of auto

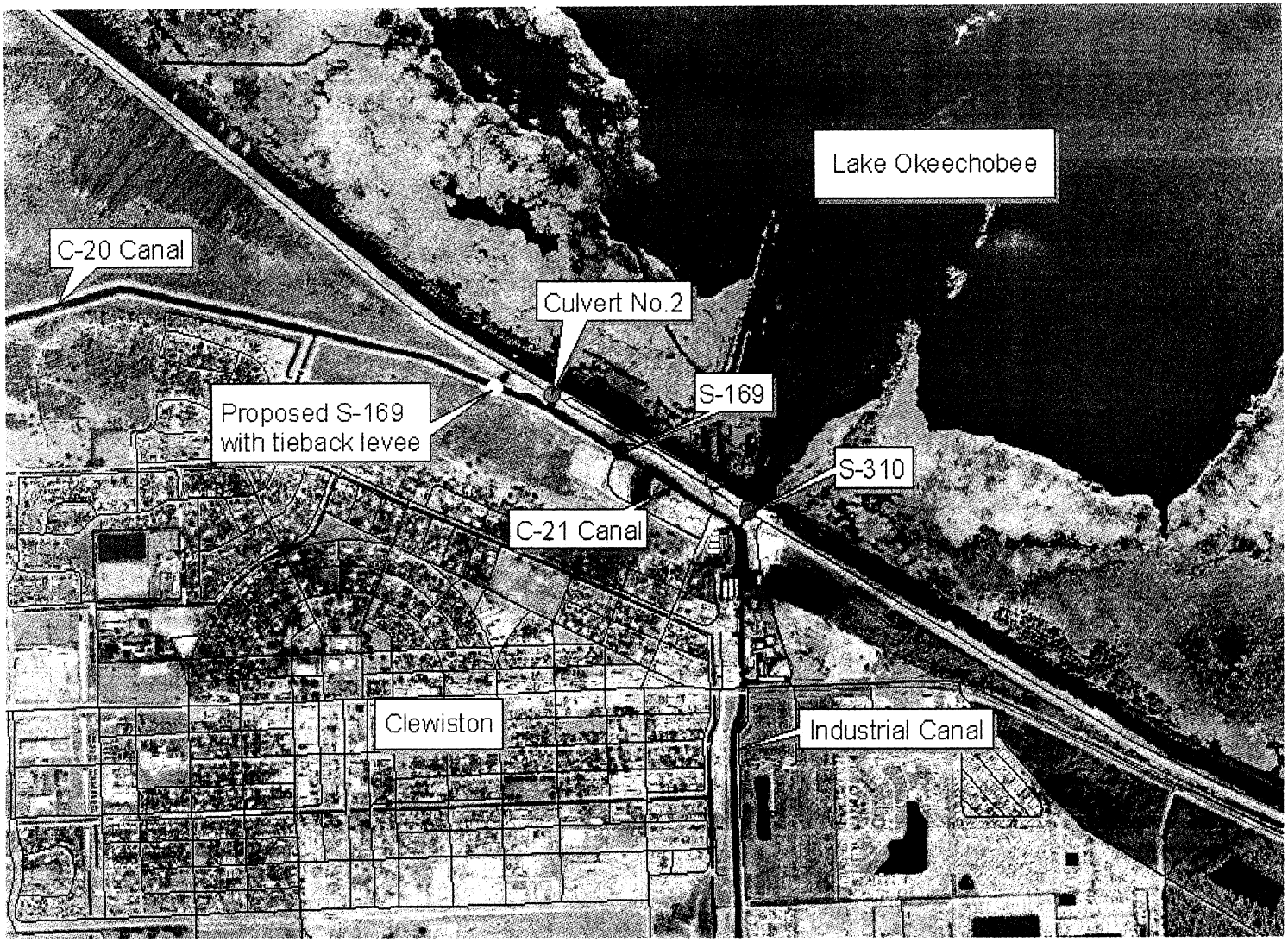

Figure 1. S-169 Project Area and Associated Structures.

and water can be supplied to the west through S-169 after coming through S-310 in addition to going down the Industrial Canal. Currently water supply cannot be conveyed to the Industrial Canal from Lake Okeechobee unless S-310 serves two purposes -- water control and water supply. Water supply cannot come through S-169 from the west to the Industrial Canal when lake stage is above 15.5 since S-169 tailwater (west side) is typically maintained around 11.0 and optimum conditions range from 11.0 to 14.0.

South of the project area, agricultural water supplies are withdrawn from the Industrial Canal by farm-controlled pumps (USSC and SFCD). The water comes from Lake Okeechobee through S-310. At this time, the accuracy of the present water withdrawal data is not clear. This is due to the quality of flow records at S-310, the lack of water usage monitoring at agricultural facilities, and the potential for non-permitted water withdrawals from the Industrial Canal. S-310 is equipped with a U.S. Geological Survey (USGS) gauging station and a stilling well. The records are reported as poor. Recent information provided by the Corps indicated that under existing conditions, when the lake is greater than 15.5 feet and the S-310 is "cracked," the maximum irrigational capability of facilities along the Industrial Canal is approximately 431 cubic feet per second (cfs). Tailwater conditions at agricultural facilities and pump capacities of irrigational pumps control the irrigational capability in addition to lake stage. The 431 cfs was based on an upstream stage of 15.2, a tailwater condition of 10.0 at USSC's Southline Station, a tailwater condition below culvert invert at SFCD's P-5-W, USSC's pumps running at full capacity, and culverts fully open.

The maximum monthly water use allocation for facilities along the Industrial Canal is 2544.12 million gallons. Assuming a constant flow equal to the estimated maximum of 431 cfs, the monthly allocation would be exhausted in 9.1 days.

When free flow occurs between the Industrial Canal and the lake (*i.e.,* the lake is less than 15.5 feet) and if water usage was high enough, it is theoretically possible, although it has never happened, to drain the lake to approximately 8.0 feet NGVD. The Industrial Canal bottom elevation of approximately 8.0 feet at the Davison Road Bridge would prevent flow from the lake down the Industrial Canal if stages approach 8.0. The lowest lake stage on record is 8.97 feet, NGVD, and occurred during the drought of 2001 on May 24, 2001. The maximum irrigational capability for facilities along the Industrial Canal when lake stage is 15.5 is approximately 462 cfs and is reduced to approximately 190 cfs as lake stage decreases to 13.0 and tailwater conditions remain constant. Operations of structures in central and southern Florida and water restrictions during drought conditions should prevent extremely low lake stages. A combination of an extreme drought and releases to the east, west, and south would have to be investigated to determine how low the lake may get and is beyond the scope of this project.

The S-169 is located on the C-21 Canal approximately 2000 feet west of the S-310. The S-169 gates are open when the lake stage is below 13 feet, closed when the lake stage is between 13 and 15.5 feet, and on "automatic" when the lake stage is greater than 15.5 feet. Currently, when Lake Okeechobee stage is below 13 feet, S-310, S-169, and all of the LD-1 culverts (all culverts

mammals, passerine and other small birds, and some reptiles utilize the area. There is also a potential for the federally listed eastern indigo snake (*Drymarchon corais couperi*) to be present.

3. Fish and Wildlife Resources

a. Federally Listed Species

Five federally listed threatened or endangered animal species and one listed plant species are present or potentially present in or adjacent to the project area. They include the endangered snail kite (*Rostrhamus sociabilis plumbeus*), endangered wood stork (*Mycteria americana*), endangered West Indian manatee (*Trichechus manatus*), threatened bald eagle (*Haliaeetus leucocephalus*), threatened eastern indigo snake (*Drymarchon corais couperi*), and endangered Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeensis*). These species have been previously impacted by habitat degradation due to wetland drainage, nutrient-laden stormwater runoff, and a concurrent alteration of the hydroperiod. This project has a potential to either benefit or adversely impact primarily three of these species - snail kite, wood stork, and manatee.

The snail kite occupies the watersheds of the Everglades, lakes Okeechobee and Kissimmee, and the upper St. Johns River. "Each of these watersheds has experienced, and continues to experience, pervasive degradation due to urban development and agricultural activities" (Service 1999). Critical habitat was designated for the snail kite in 1977 and, since then, has not been revised. It is present immediately adjacent to the project area inside of the HHD, but also includes the Arthur R. Marshall Loxahatchee National Wildlife Refuge, Water Conservation Area 2, portions of Water Conservation Area 3, portions of Everglades National Park, western portions of Lake Okeechobee, the Strazzulla and Cloud Lake reservoirs in St. Lucie County, and portions of the St. Johns Marsh in Indian River County. A complete description of the critical habitat is available in 50 Code of Federal Regulations 17.95 (Service 1999). The snail kite could also be found foraging in a number of native wetlands and in canals and ditches adjacent to the project area. This medium-sized raptor has a highly specific diet composed almost entirely of Florida apple snails (*Pomacea paludosa*), which are found in palustrine emergent, long-hydroperiod wetlands. As a result, the snail kite's survival is directly dependent on the hydrology and water quality of its habitat (Service 1999). Determination of effect of this project on snail kite habitat would be based on the potential for the lowering of lake levels. If this occurred during high lake stages, little change would likely result. However, if this occurred during low lake stages then foraging habitat as well as apple snail habitat could be reduced or lost. According to the 2002 Annual Snail Kite Demography Report, "the 2001 breeding season was impacted by a widespread drought, resulting in the complete absence of nesting activity and the dispersion of kites from virtually all of the surveyed wetlands, with the exception of central Florida lake habitats (Martin *et al.* 2002)." The long term effects of this loss to future snail kite population viability are unknown. This response to low lake levels underscores the necessity for the accurate determination of this project's effects on lake levels and the linkage to other compounding negative effects on this species.

The wood stork is primarily associated with freshwater and estuarine habitats for nesting, roosting, and foraging. They have nested, at one time or another, in every county in south Florida. Currently, the closest recorded wood stork colony to the project area is approximately 30 miles away. Typical foraging sites include freshwater marshes and stock ponds, shallow, seasonally flooded roadside or agricultural ditches, narrow tidal creeks or shallow tidal pools, managed impoundments, and depressions in cypress heads and swamp sloughs. Wood storks use a specialized feeding behavior called tactolocation, or grope feeding. A foraging wood stork wades through the water with its beak immersed and partially open (7 to 8 cm). When it touches a prey item, a wood stork snaps its mandibles shut, raises its head, and swallows its prey (Kahl 1964). This unique feeding method gives it specialized habitat requirements; the habitats on which wood storks depend have been disrupted by changes in the distribution, timing, and quantity of water flows in south Florida. The loss and degradation of wetlands in central and south Florida are principal threats to the wood stork. The Everglades Agricultural Area (EAA) alone eliminated 802,900 ha of the original Everglades - an important loss of spatial extent of wood stork habitat (Service 1999).

The West Indian manatee is regularly found in Lake Okeechobee and in the rim canal, which is directly adjacent to the project site. This large, aquatic mammal migrates along the Florida coast through fresh, brackish, and marine waters, and exhibits a seasonal distribution based on water temperatures. Waters colder than 20 degrees C increase the manatee's susceptibility to cold-stress and cold-induced mortality. Distribution is also controlled by aquatic vegetation availability, proximity to channels of at least 2 m in depth, and location of fresh water sources (Service 1999). Watercraft-caused mortality is one of the principal threats to the manatee. Two confirmed watercraft-caused mortalities (1984 and 1993) occurred adjacent to the project area in the rim canal. Manatee mortality caused by water control structures and navigational locks is another potential threat to the species. Although no structure-related deaths have been recorded from the project area, there was one undetermined manatee death (1996) and one due to natural causes (1984) in the rim canal adjacent to the project area. In addition to the Corps' willingness to follow the standard construction precautions to protect manatees, the Service wants to ensure that any new or modified water control structures or pumps are designed and operated to avoid any increased risk of harm or mortality to manatees.

The bald eagle is slated to be removed from the endangered species list. They are considered common and known to breed throughout the state. Nest sites are usually located near large rivers, lakes, or estuaries where they feed primarily on fish and water-dependent birds. Their distribution is influenced by the availability of suitable nest and perch sites near large, open waterbodies, typically with high amounts of water-to-land edge (Service 1999). Our most recent nesting data for bald eagles shows no active nests close to the proposed construction, with the two nearest active nests about 10 miles and 12 miles away from the immediate project construction site. The closer of the two nests is in Palm Beach County along the lake's rim canal at South Bay West, east of S-354. Because several eagle nests are active around the edge of Lake Okeechobee, there is a possibility that a new nesting territory could be established before

construction of the project, so we recommend that the Corps check again the most recent information regarding nest distribution several months prior to beginning any construction.

The eastern indigo snake is present throughout the State, but its abundance is reduced to a point where it is uncommon. Habitat includes pine flatwoods, scrubby flatwoods, high pine, dry prairie, tropical hardwood hammock, edges of freshwater marshes, agricultural fields, coastal dunes, and human altered habitats. This species was listed as a result of dramatic population declines caused by over-collecting for the domestic and international pet trade as well as mortalities caused by rattlesnake collectors who gassed gopher tortoise burrows to collect snakes. Since its listing, habitat loss and fragmentation by residential and commercial expansion have become much more significant threats to this species (Service 1999). Eastern indigo snakes could be encountered during construction, therefore, implementation of the standard construction practices to avoid adverse effect on this species is expected.

The endangered Okeechobee gourd is a vine that was locally common in the extensive pond apple (*Annona glabra*) forest that once grew south of Lake Okeechobee (Small 1922). The Okeechobee gourd is now restricted in the wild to two small disjunct populations - one along the St. Johns River which separates Volusia, Seminole, and Lake counties in north Florida, and a second around the shoreline of Lake Okeechobee. Currently, the survival of the Okeechobee gourd in south Florida is threatened by the water-regulation practices in Lake Okeechobee, the continued expansion of exotic vegetation in the lake, aggressive weeds (esp. moonflower, *Ipomoea alba*), and predation of seeds by animals (*e.g.*, rabbits and feral pigs). Additionally, Lake Okeechobee plants are moderately infected with at least three viruses - cucumber mosaic virus, watermelon mosaic virus 2, and squash mosaic virus. Further research is needed to evaluate the temporal changes in the prevalence of these viruses and to determine the extent to which the fitness of Okeechobee gourd populations are being negatively impacted (Decker-Walters 2002). Although the Okeechobee gourd could grow in any given year in any suitable shoreline areas inside the HHD or along the rim canal, we have no records of the species being present in the immediate vicinity of the proposed construction.

b. State Listed Species

Table 1 lists the 15 State listed animal species, and their respective designation, that may occupy the project area (data from Cox and Kautz 2000). Most of these species are wading or water birds, and probably have the highest likelihood of being encountered or affected by construction activities in the project area. The American alligator is common in and around the project area and is also likely to be observed on a regular basis.

Table 1. State listed animals, and their respective status, that may be present in the S-169/Nine-Mile Canal Basin Project Area; T = Threatened, and SSC = Species of Special Concern (data from Cox and Kautz 2000; federally listed species not included).

Species Name	Common Name	Status
Ajaia ajaja	Roseate spoonbill	SSC
Alligator mississippiensis	American alligator	SSC
Aramus guarauna	Limpkin	SSC
Blarina carolinensis (=brevicauda) shermani	Sherman's short-tailed shrew	SSC
Centropomus undecimalis	Common snook	SSC
Egretta thula	Snowy egret	SSC
Egretta caerulea	Little blue heron	SSC
Egretta rufescens	Reddish egret	SSC
Egretta tricolor	Tricolored (=Louisiana) heron	SSC
Eudocimus albus	White ibis	SSC
Falco sparverius paulus	Southeastern American kestrel	T
Gopherus polyphemus	Gopher tortoise	SSC
Grus canadensis pratensis	Florida sandhill crane	T
Pelecanus occidentalis	Brown pelican	SSC
Rynchops niger	Black skimmer	SSC

c. Other Fish and Wildlife Resources

At least 40 different fish species can be found in Lake Okeechobee. Bull *et al.* (1995) evaluated fish distribution in Lake Okeechobee using a semi-balloon trawl net between July 1987 and January 1991. They reported that 98 percent of the total catch, in terms of numbers and biomass, was composed of 7 species: threadfin shad (*Dorosoma petense*), black crappie (*Pomoxis nigromaculatus*), Florida gar (*Lepisosteus platyrhincus*), gizzard shad (*Dorosoma cepedianum*), white catfish (*Ameiurus catus*), redear sunfish (*Lepomis microlophus*), and bluegill (*Lepomis macrochirus*). The commercial fisheries generate $6.3 million annually, and consist of a trotline fishery for catfish (*Ameiurus* spp. and *Ictalurus* spp.), and a haul seine fishery for catfish and bream (*Lepomis* spp.; Bell 1987). The recreational fishery, primarily for largemouth bass, (*Micropterus salmoides*), generates $22.1 million annually and has an estimated asset value of $100 million (Bell 1987).

The habitat quality for fish in the C-21 and Industrial canals is marginal. Potential habitat limitations may result from lack of shallow water (needed for foraging and/or reproduction), low dissolved oxygen concentrations, excessive turbidity, impediments to movements (from the various water control and navigational structures), contaminants or pathogens in runoff, and direct discharges from the marina/watercraft. The diversity of fish species found in the canals would be similar to those found in the lake, although as a result of these habitat limitations, they

would be present at lower abundances. Evidence of past fishing activities was present during the site inspection in the form of improperly discarded trash and used fishing line. Utilization by other animals such as turtles, alligators, amphibians, small mammals, and wading birds is likely to occur but is also probably limited due to poor habitat quality and human disturbance.

Lake Okeechobee supports several large, mixed-species wading bird rookeries. Northwest of the project area in Glades County and southeast in Palm Beach County there are 12 wading bird colonies near the lake's shoreline. The nesting species include American anhinga (*Anhinga anhinga*), great egret (*Casmerodius albus*), cattle egret (*Bubulcus ibis*), little blue heron (*Egretta caerulea*), great blue heron (*Ardea herodius*), tricolored heron (*Egretta tricolor*), white ibis (*Eudocimus albus*), and glossy ibis (*Plegadis falcinellus*). The breeding success of these rookeries is tied, in part, to the quality and quantity of prey species (*e.g.*, fish, frogs, and aquatic macroinvertebrates) that are in turn affected by lake levels. Additional waterfowl species observed on the lake include black skimmer (*Rynchops niger*), brown pelican (*Pelecanus occidentalis*), and double-crested cormorant (*Phalacrocorax auritus*; Lotspeich and Associates 1998). During drought conditions, the lake may also serve as a critical regional refuge for wading birds (Smith *et al.* 1995).

Lake Okeechobee is one of the premier waterfowl hunting areas in the state. Resident species of waterfowl include the Florida mottled duck (*Anas fulvigula fulvigula*), fulvous whistling duck (*Dendrocygna bicolor*), and wood duck (*Aix sponsa*). Lake Okeechobee is a significant habitat for wintering migratory waterfowl along the Atlantic Flyway. Approximately 20 species of waterfowl regularly winter in Florida. Wintering areas, such as Florida, are important in the annual cycle of migratory waterfowl. Habitat conditions during this non-breeding period affect survival and subsequent reproduction. Ducks must maintain or improve their body condition during winter to avoid mortality during the spring migration and to meet the physiological demands of the nesting season. Among the most abundant migratory species are northern pintail (*Anas acuta*), American wigeon (*Anas americana*), northern shoveler (*Anas clypeata*), ring-necked duck (*Aythya collaris*), blue-winged teal (*Anas discors*), and green-winged teal (*Anas crecca*) (Florida Fish and Wildlife Conservation Commission 2003).

IV. FISH AND WILDLIFE RESOURCE CONCERNS

A. Introduction

Implementation of this project has a small potential to either ameliorate or exacerbate some of the current impacts affecting the ecology of Lake Okeechobee. "Sustained high lake levels (*i.e.*, greater than 15 feet) are related to deleterious changes, including, declines in wading bird habitat and submerged aquatic vegetation, dominance by inundation-tolerant plants such as cattail, decreased macroinvertebrate diversity, and lower gamefish abundance within native vegetation"(Aumen and Gray, 1995). The main purpose of this project is to enable a more dependable conveyance of water to meet agricultural demands along the Industrial Canal during times when the lake stage is greater than 15.5 feet. The phrase "a more dependable conveyance

of water" implies that it will be easier to remove additional water (over existing conditions) from the lake. Therefore, modifying Culvert No. 2 and S-169 to enable a more dependable conveyance of water to meet agricultural demands along the Industrial Canal during times when the lake stage is greater than 15.5 feet could lessen high-water impacts to the lake's ecology. Conversely, allowing more water to be withdrawn from the lake for agricultural usage may result in additional contaminated stormwater surface flows back into the lake. Even if existing water volumes would not change, there is the potential for increased unknown water usage in the future as a result of this project. Additionally, construction activities could pose some temporary and permanent impacts to fish and wildlife.

B. Resource Concerns

1. Historic and Current Impacts on Resources of Lake Okeechobee

Historically, one of the largest impacts to the Lake Okeechobee ecosystem resulted from construction of the Herbert Hoover Dike. The construction of the dike, beginning in 1927 with modifications until 1967, destroyed much of the historic littoral zone, eliminating thousands of acres of valuable and diverse habitats and "forever changed" the ecological character of the lake. The confining nature of the dike allows water managers to control water levels in the lake for the purpose of water supply and flood control and only secondarily for ecological benefit. Historically, the lake's littoral and riparian zones were a mix of freshwater marshes, pond apple forest, hardwood swamps, and cypress swamps. Although some of these natural areas still remain, the introduction of controlled drainage for agriculture and land development has resulted in a significantly different set of vegetative cover types outside the HHD. Inside the dike, the remaining wildlife habitats consist primarily of freshwater marsh, wetland hardwoods interspersed with willow (*Salix* sp.), cattails (*Typha* sp.) and melaleuca (*Melaleuca quinquenervia)* (Richardson and Harris 1995, Lotspeich and Associates 1998).

Water control structures and canals provide the capacity to convey water of degraded quality into the vicinity of the proposed structural modifications. Stormwater runoff from the City of Clewiston and most of the Nine-Mile Canal Basin flows into the C-20, C-21 and Industrial canals and then into the lake through culverts, Pump Station 4, and the S-310. A lesser amount of flow can also go through the S-235 into the Caloosahatchee River under appropriate conditions. The Corps has noted that "there will be no runoff in addition to existing conditions. Existing discharge pump capacities of facilities along the Industrial Canal was used for the with project discharge surface water routing. With project operations will be the same as existing operations" (Annon Bozeman, Corps, personal communication 2003).

Excess nutrient-driven algal blooms have occurred in the lake with greater frequency and intensity. According to a June 13, 2001, letter to the SFWMD from Florida Department of Environmental Protection (DEP), "water quality within the canals is of poor quality, containing high levels of phosphorus, as well as pesticides and herbicides..." (Hall 2001). The letter also stated, "Lake Okeechobee is on the verge of hypereutrophication. . ." and that ". . . phosphorus

loadings to the lake from all inflows are many times higher than the proposed Total Maximum Daily Load limit. Water treatment is not provided for the drainage discharged to the lake at either the S-310/Industrial Canal or the S-4 Pump Station" (Hall 2001). There are five discharge facilities along the Industrial Canal. USSC's Southline Station has seven pumps with a total capacity of 446 cfs. SFCD's P-5-W has four pumps with a total capacity of 383 cfs. Clewiston Station 3 has two pumps with a total capacity of 167 cfs. East Hendry Station has two pumps with a total capacity of 51 cfs and, J.D. Thornton has one pump with a capacity of 7 cfs. Discharge pumped into C-21 was not included in the analysis since the facilities are located outside of project area. However, field verification by the Corps in October 2001 revealed that only one pump station (Clewiston Station 2) discharges into C-21. There are some culverts in addition to Clewiston Station 2 that discharge into C-21 where the discharge is dependent on headwater and tailwater conditions.

Water control structures and canals have also caused an unnatural hydroperiod. Lake level regulation has adversely affected the littoral zone vegetative communities and resulted in higher trophic level disturbances (Havens 2003). As a result, exotic plants and fishes have displaced native species. However, despite these impacts, the lake's littoral and pelagic zones are still ecologically critical to lake functions and values. These zones are very valuable habitats for many species of wading birds, waterfowl, raptors, recreationally and commercially important fisheries, aquatic reptiles, amphibians, and macroinvertebrates.

2. Operational Schedule Effects on Lake Levels and Snail Kites

Extreme water level fluctuations can adversely affect snail kite nesting. Snail kite nesting almost always occurs over water, which deters predation. Nesting substrates include small trees or shrubs. Nesting also can occur in herbaceous vegetation, such as sawgrass (*Cladium jamaicense*), cattail, rush (*Scirpus* spp.), and reed (*Phragmites* sp.). Nests are more frequently placed in herbaceous vegetation around Lake Okeechobee during periods of low water when dry conditions beneath the willow stands (which tend to grow to the landward side of the cattails, bulrushes and reeds) prevent snail kites from nesting in woody vegetation. Nests constructed in herbaceous vegetation on the waterward side of the lake's littoral zone are more vulnerable to collapse due to the weight of the nests, wind, waves, and boat wakes, and are more exposed to disturbance by humans (Service 1999).

3. Potential Structural and Operational Effects on Manatees

West Indian manatee is another federally listed species that has been negatively impacted in the past within the project area and have the potential to be impacted by this project. From 1984 to 1996 four manatee deaths have been recorded within or near the project area. Two deaths were watercraft related, one was listed as natural, and one listed as unknown. The Service is proposing installation of devices to block movement of manatees through the modified Culvert No. 2 and the relocated S-169 (see Section VIII. C. of this report for further discussion).

4. Minimizing Adverse Effects of New, Modified, or Removed Structures

Some limited impacts are expected on habitat and water quality from the modification, removal, or installation of water control structures. Short-term construction-related effects include increased water turbidity and heavy equipment noise (which may disturb wildlife). Implementation of erosion and sedimentation controls could limit the adverse effects of construction-related turbidity. Construction noise is an effect that would be difficult to remediate.

More long-term or permanent effects include loss of riparian and aquatic habitat at new installation sites and potential impacts to fish, manatees, and other aquatic organisms through entrainment and impingement at new or modified structures. While any loss of habitat is generally undesirable, the potentially impacted habitats in the immediate construction footprint in this case are marginal with the exception of the wetland hardwood forest west of Culvert No. 2. Loss of organisms from impingement and entrainment can be reduced through the use of exclusion devices; however, with the exception of manatees, additional information would be needed to verify the magnitude of this threat to fish and wildlife resources prior to the Service making that recommendation. Additional information may be available from the FWC, SFWMD, Corps, DEP, USGS, or planning personnel for the City of Clewiston.

C. Planning Objectives

As currently planned, we anticipate that this project is not likely to have a measurable benefit on any of the federally or State listed species, or other fish and wildlife resources mention previously in this report. The potential for this project to alleviate high water stages within Lake Okeechobee could be slightly beneficial to fish and wildlife in the littoral zone of the lake, including listed species. The primary purpose of this project is for agricultural water supply (secondarily to alleviate wear on the navigational lock that is now used as a water control structure) and as such, the Service believes that the best ecological planning objective for this project is one of "do no harm" in the realm of regional water management. The Service believes that the incorporation of stormwater treatment facilities for runoff from the City of Clewiston and the Nine-Mile Canal Basin would allow project managers to assist in meeting the lake Total Maximum Daily Load, and we would then agree that the project would provide significant ecological benefits. Such facilities were not part of the original scope of the project, but should be considered in future water resource planning in the project area.

V. EVALUATION METHODOLOGY

A. Hydrologic Evaluations by the Corps and SFWMD

The Corps and SFWMD, with assistance from personnel of the City of Clewiston, were responsible for the hydrologic evaluations and modeling of flow and stage height within the C-21 and the Industrial canals. The SFWMD also stipulated that no further increase in canal water elevation was desirable due to safety concerns.

Currently, the average annual flow through the S-310 structure is approximated. The USGS gauging station 264514080550700 is located at S-310. The gauge is a satellite data collection platform with a water-stage shaft encoder and acoustic-doppler velocity meter. However, the records are reported as poor by USGS. There is also a stilling well located inside of machinery house number two that can be used to take water-stage readings. There are no gauges along the Industrial Canal with the exception of manually read staff gauges. Velocity recordings and lock cross-sectional geometry are used to calculate average-daily flows at S-310. Design flow through the S-169 is 625 cfs. S-169 is equipped with upstream and downstream remote, digital sensors that record water levels in C-21. S-169 is also equipped with digital sensors that record gate positions. Headwater, tailwater, and gate opening recordings are used to calculate average-daily flows at S-169. The design flow for the "with-project" condition is equivalent to the existing capacity of pumps along the Industrial Canal (1054 cfs). However, at this time, we have no information on the average annual flow through Culvert No. 2, or the actual withdrawal or discharge volumes of water from agricultural users of the Industrial Canal.

Due to the poor quality of the flow data through S-310 and actual water usage, we are unable at this time to estimate the effects of this project on elevation changes within the lake. Therefore, it is difficult to predict the changes in habitat or the effects on species that would accompany water elevation changes. The Corps has stated that "more water than what is currently being withdrawn will not be removed from the lake. . ." If more water is withdrawn from the lake, it is possible that water withdrawals from another area of the lake could be reduced, thereby having a net neutral effect on lake levels. This coordination in operational decisions is done on a short-term basis within the framework of the Water Supply Environmental (WSE), in accordance with the Adaptive Protocols for Lake Okeechobee (SFWMD 2002). The adaptive protocols do not include, however, deviations from the WSE schedule, such as backpumping to relieve flooding of agricultural lands in the EAA or backpumping for water supply during drought (*e.g.* the April 27, 2001, Emergency Order in the 2001 drought).

VI. FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

The need for this project is based on agricultural water supply and flood protection. Given the small construction footprint and the urbanized nature of the project area, we do not foresee any changes in the fish and wildlife resources within the project area that would occur without this project. One could make the assumption that the rate and amount of ecological degradation would slow due to the effects of the Comprehensive Everglades Restoration Plan (CERP) and other similar efforts, however, no quantifiable measure could be ascribed to that assumption at this time. The time needed for the lake's systems to either utilize or flush the current levels of phosphorus, with no additional inputs, has been estimated at 100 years or greater.

VII. DESCRIPTIONS OF ALTERNATIVES AND THE SELECTED PLAN

A. Alternatives Evaluated by the Corps

Alternative 1 - No Action - Existing Conditions

Alternative 1 is the "no-action" alternative, also called the Future Without Project condition. When the Lake Okeechobee water level is 15.5 feet or lower, S-310 is open and water is available to the Industrial Canal on an "as needed" basis. When lake levels exceed 15.5 feet, the lock is operated manually by the SFWMD for navigation from 5:30 a.m. to 8:00 p.m. for October through April and 5:30 a.m. to 9:00 p.m. for May through September. This alternative assumes that other water resource projects would occur, such as components of the CERP, Critical Restoration Projects, SFWMD Surface Water Improvement Management Plan, and local government stormwater retrofits in urban areas. With these programs and projects in place, future degradation of the lake would likely be slowed but probably not eliminated.

Alternative 2 - Operational Change to S-310 Lock

This alternative would require a 24-hr, 7 days/week work schedule for the S-310 when Lake Okeechobee levels exceed 15.5 feet. This alternative would allow the SFWMD to operate the S-310 as a water control structure in addition to its current operation as a navigational structure. This alternative would evaluate the changes that may occur as a result of these actions during water shortages in the Industrial Canal. Authorized usage of S-310 would also be evaluated. Rehabilitation of the revetment and bedding for the scour hole downstream of S-310 would be required. The depth of the scour hole is approximately 6 feet and would require approximately 500 cubic yards of fill. The revetment would be designed for a maximum average velocity of 10 fps. The installation of a removable boat safety barrier on the downstream side of S-310 would be needed to prevent boats from entering the lock during emergency operations. Costs would include additional man-hours for lock tenders and additional operation and maintenance costs, which would result in 1657 overtime hours of operation per year for S-310 lock.

Alternative 3 - Construct a Pump Station

This alternative would require the installation of a 4-bay irrigation pump station adjacent to the existing S-169, on the south bank of the C-21 Canal. The pump would convey water from the west side of S-169 to the eastside of S-169 and into the Industrial Canal when the Lake Okeechobee stage is above 15.5 feet, S-310 is closed, and the Industrial Canal stage is low. The pump station capacity would be 425 cfs. The intake water surface elevation would be 10 to 12 feet. The discharge water surface elevation would be 13 to 15.5 feet. The design head would be 5.5 feet. A trash rake and screen would be fitted to both sides of the structure. Modifications to the Culvert No. 2 may be necessary to supplement the flow. Access to HHD would be required at all times during construction, therefore a temporary bridge would be considered in the scope of work for this pump station construction.

Alternative 4A – Relocate S-169 and Install a Bridge

This alternative would require the removal of the existing S-169 and disposal at the nearest landfill. A temporary access bridge would be constructed to allow access to the HHD during construction. A new, 65-foot long, 3-cell box culvert bridge would be constructed to replace the existing S-169 and provide access to the HHD. The design flow would be 1054 cfs. Stages of 12.6 and 11.2 were headwater and tailwater results for a flow of 1054 cfs with gates full open. A new S-169 culvert structure would be installed on the C-21 Canal west of Culvert No. 2. The new S-169 would have a diameter of 84 inches, an invert elevation of 2.5 feet, slide gates, and require telemetry control. Approximately 100 feet of riprap would be placed on both canal banks around the structure to control erosion. The five 10-foot diameter flap gates on Culvert No. 2 would be converted to vertical slide gates, and telemetry control would be required. If required, a tieback levee approximately 70 meters in length could extend from the new S-169 through the forested wetlands north of C-21 perpendicularly to the HHD.

Alternative 4B – Relocate and Modify the Existing S-169

This alternative would require the demolition of the south bank of the existing S-169 and the addition of one seven-foot barrel to the structure. Three vertical slide gates would be removed from the existing S-169. The south bank would be reconstructed to transition at a 1:10 (lateral: longitudinal) ratio. This alternative is different from Alternative 4A in that the existing S-169 would be modified and left in place to serve as support for the road access across the C-21 Canal to the HHD. A new S-169 would still need to be constructed as in Alternative 4A on the C-21 Canal west of Culvert No. 2. The design flow would be 1054 cfs. Stages of 14.2 and 12.9 were headwater and tailwater results for a flow of 1054 cfs with gates full open. A temporary bridge would be constructed to allow access to HHD during construction. If required, a tieback levee approximately 70 meters in length could extend from the new S-169 through the forested wetlands north of C-21 perpendicularly to the HHD.

Alternative 5 – Modify the Existing S-169 Gates

This alternative would require the modification of the existing S-169 gates to allow continuous free flow and continuous vehicular access to the HHD. Modifications to Culvert No. 2 may be required. This alternative was eliminated because it would not provide for optimum water levels in the C-20 Canal, C-21 Canal, LD-1, and LD-3.

Alternative 6 – Install a Plug in C-21 Canal

This alternative would require the placement of a plug in the C-21 Canal west of Culvert No. 2 to allow water to flow from Lake Okeechobee through Culvert No. 2 into C-21 and the Industrial canals. Modifications to Culvert No. 2 may be required. This alternative was eliminated. The C-21 Canal cannot be permanently blocked due to flood control conveyance to Pump Station S-4 west of Culvert No. 2.

B. Alternative Proposed by the DEP

Alternative 7 – Disconnect the S-310 and Industrial Canal

An additional alternative was proposed by the DEP. To our knowledge, it has not been fully evaluated by the Corps. It included routing the Industrial Canal around to the west and separating it from the S-310 and associated marinas. It would be directly connected to the C-21 Canal. All basin drainage and stormwater runoff would then be provided with water quality treatment by a stormwater treatment area adjacent to the S-4 Pump Station. This alternative is only conceptual at this time, so it is difficult to determine benefits or adverse effects on fish and wildlife. However, the intent of this alternative was to reduce the amount of nutrients and contaminants that would enter the lake with stormwater runoff. The Service supports the concept of reducing nutrient loads to the lake, but this proposal would have to be thoroughly evaluated to determine its feasibility.

C. Preliminarily Selected Plan

The local sponsor objected to Alternative 2 due to safety issues. Boats could be unintentionally drawn into the S-310 if it were operated as a water control structure during nighttime hours and have caused bank erosion. Additionally, the normal operating mechanisms have to be overridden in order to make releases through the structure, which typically cause mechanical or electrical safety features of the lock to be overridden. Additionally, the S-310 was never intended to be operated as a water control structure. Alternative 3 has been deemed by the Corps to be too costly. Alternative 4B would produce water levels a foot higher in the C-21 Canal than Alternative 4A, and the SFWMD has indicated that they could not tolerate higher canal stages due to safety reasons. Alternatives 5 and 6 were eliminated early in the planning process for various reasons (Section VII. A. of this report). Therefore, the Corps and the SFWMD have decided that Alternative 4A is the preliminarily selected plan. Additionally, the Corps has agreed to install manatee protection devices on the locks and spillways, but not the culverts. Therefore, as proposed, neither the new S-169 nor Culvert No. 2 would have manatee protection devices.

VIII. POTENTIAL BENEFICIAL AND ADVERSE EFFECTS OF THE PROJECT

The direct construction-related effects of this project appear to be minor for any of the alternatives. However, the Service finds that operational decisions at the new structures, combined with the operation of other Central and Southern Florida Project (C&SF) Project facilities around the lake, will dictate the degree of project impacts on regional water management, especially potential changes to water stages and water quality in the littoral zone of Lake Okeechobee

A. Removal of Vegetation and Habitat

The construction of new, or the modification of existing structures would have some temporary and permanent adverse impacts to local fish and wildlife resources. Any type of construction associated with this project could cause short-term temporary increases in water turbidity. Resuspension or erosion of sediment can also increase the biochemical oxygen demand in the water and result in lower dissolved oxygen concentrations. Nutrients that were previously sequestered in sediments may also become suspended and bioavailable and then result in nuisance algal blooms which can also lower dissolved oxygen concentrations at night. If extreme enough, this can result in fish kills.

The construction of the tieback levee (if needed in the selected plan) through the wetland hardwood forest would represent a permanent loss of that habitat. The area of potential wetland impact is unknown at this time, and would depend on the dimensions and final location of the levee. Losses to wetlands should be avoided or will need to be mitigated. Options for mitigation would be to purchase credits in a wetland mitigation bank, or onsite wetland/habitat restoration, such as construction of a shallow littoral shelf along existing canals.

The installation of new water control structures, including riprap that may be needed to protect the structures from flood waters and upstream and downstream canal side slopes and bottom from high culvert velocities, will cause permanent conversion or loss of previously vegetated habitat coincident with the project footprint. However, the existing canal bank and internal canal habitats present in the project area are considered of marginal quality and therefore, only of lower value to fish and wildlife. Modifications to the canal shorelines could be included that would provide shallow, near shore habitat for wading birds.

B. Disturbance of Wildlife During Construction

Temporary construction-related impacts such as noise or the operation of heavy equipment could affect roosting or foraging wading or other water birds including state and federally listed species such as wood stork, bald eagle, and snail kite. Additionally, although we have limited data for this species' utilization of the immediate project area, the federally listed eastern indigo snake could be encountered during construction. Based on this and other species occurrence records, the Service expects that the Corps and local sponsor, including all subcontractors, will implement standard protection measures, procedures, and/or guidelines for manatee, bald eagle, snail kite, wood stork, and eastern indigo snake.

C. Potential Structural and Operational Effects on Manatees

In accordance with draft criteria for modified culverts (Service 2003), and previous guidance on water control structures for the protection of manatees, the Service recommends that any modifications that occur to structures as a result of this project include anti-impingement and/or anti-entrainment features for the prevention of take (as defined in section 7 of the ESA) of the West Indian manatee. This would require, in part:

a) a 3-feet separation between the bottom of trash rakes, if installed, and bottom substrate,

b) an 8-inch maximum spacing for grates covering culvert openings less than 36 inches,

c) the maintenance of low intake velocities (*i.e.*, less than 1 foot per second) at any pipe or culvert opening that presents a threat to manatees (*i.e.,* where an impinged manatee could drown, or an entrained manatee would be harmed within or on the downstream side of the pipe or culvert), and

d) a case-by-case review to determine whether or not to exclude manatee access on existing culverts greater than 36 inches and less than 6 feet in diameter [a decision to exclude manatee access should be weighed against the potential loss of manatee habitat (for foraging, calving, freshwater, migratory corridor, warmwater refugia, and refugia from watercraft or other forms of harassment) versus the risk of manatee injury, or death if the culvert remains accessible].

e) Existing culverts greater than 6 feet in diameter can safely pass manatees, since manatees would be able to turn around. Unless there are other reasons/risks, such as other hazards downstream or risk of entrapment, culverts of this size do not need exclusion devices.

Draft criteria for new culverts and the protection of manatees (Service 2003) are as follows:

a) New culverts in manatee-accessible waters should be a minimum of 6 feet in diameter if manatee access is desirable. Box culverts are preferred over round culverts. Bridges are most preferred. A 3 feet clearance at low water condition is warranted.

b) New culverts less than 6 feet and greater than 36 inches need review on a case-by-case basis as described above.

c) New culverts 36 inches or less should be excluded from manatee access as described above.

In accordance with criterion (e) above for existing culverts and criterion (c) for new culverts, we recommend that manatees be excluded from the new S-169 and both ends of the modified Culvert No. 2. This is necessary to keep manatees out of the Industrial Canal when the S-310 is closed. We realize that it is impossible to entirely exclude manatees from entering the Industrial Canal through the S-310 when it is open or operational, but we believe exclusion provisions at S-169 and Culvert No. 2 would provide a level of protection to the species and block access from the C-21 to the S-4 Pump Station.

The above general and project-specific guidance represents the views of the Service. The three provisions below were recommended by the Corps in a March 12, 2003, email to the Service. According to that message, the S-169 and Culvert No. 2 would be operated according to the Corps' draft standard operating procedures (not yet accepted by the Service) which are in effect at other HHD culverts and extension levee culverts to avoid harm to manatees. These operating procedures are as follows:

"a) When the vertical lift gates are being opened from the closed position, they will be raised to an initial opening of 2.5 feet and then closed to the desired setting. This will allow resting manatee to be flushed through the culvert rather than being pinned and drowned at the point of the gate opening.

b) When the flap gate culverts are being opened by winch or crane, the shape of the flap gate and the slow operation will alert the manatee to move before a strong current could trap it at the point of the gate opening

c) If manatees are observed during culvert operations, the personnel responsible for opening closing those culverts will wait until the manatee moves away from the area in order to prevent entrapment in shallow water, possible harassment in developed areas and potential starvation."

The Service finds that if the Corps follows our recommendation to install manatee exclusion devices at Culvert No. 2 and the new S-169, the Corps' proposed culvert operating criteria would not be needed for this project.

D. Effects of Lake Water Levels on Fish and Wildlife

We have little information on the actual volumes or flow velocities of water moving into or out of the lake through the project structures. The Corps has stated that maximum irrigation capabilities of 419 cfs (or 271 Million Gallons per Day [MGD]) of water supply flow out of the lake and into the Industrial Canal would not be changed, but they did not indicate whether or not maximum conditions are currently being realized. Therefore, we cannot adequately predict operational effects of this project on lake levels other than to note a commitment from the Corps that the current WSE, including emergency declarations, will be followed. Under the same scenario, a maximum of 1054 cfs (681 MGD) of flood waters could flow west through the relocated S-169, C-20, to the S-4 Pump Station and into the lake. The Corps has noted that, "under the water supply condition, there will be plenty of water available for water supply. Quantitative analysis would not be cost effective and would be unnecessary to determine the decreased volume of Lake Okeechobee due to retrofitting Culvert No. 2" (Annon Bozeman, Corps, personal communication 2003).

E. Effects of Pumps and Scouring Velocity

The operation of high velocity pumps to move water, as in Alternative 3, represents a potential threat to fish and other aquatic resources. Pumps can cause direct loss of fish, amphibians, invertebrates, and other aquatic life through entrainment and impingement. The significance of this threat to local resources as a result of this project would require detailed studies beyond the scope of this report. Additional fishery and aquatic organism sampling or information would be needed to more accurately assess this threat; however, since the selected plan does not include the use of pumps, this information is not necessary. If the selected plan changes to include pumps, this recommendation should be revisited.

Excess water velocities can adversely affect fish and wildlife resources through erosion and sedimentation, periphyton detachment, and scouring of fish and aquatic macroinvertebrates. Scouring velocity has been defined as 1 fps for substrates of fine gravel or smaller (http://www.aquatext.com 2000). The Corps did not perform a scouring analysis for this project. Riprap specifications for some of the alternatives indicated that the maximum expected canal velocities could be up to 8 fps. These anticipated maximum canal velocities would likely only occur during storm conditions and therefore, may not be easily remediated. According to recent information provided by the Corps, "velocities at S-310 would be lower or not changed. Velocities are dependent on operations. The 7 and 8 fps referred to above is for 1054 cfs with culverts full open. That scenario is not likely to occur very often and velocities can be controlled with gate opening otherwise. With-project velocities would be minimally different or not change from existing conditions" (Annon Bozeman, Corps, personal communication 2003).

F. Summary of Consultation Under the Endangered Species Act

On May 21, 2001, the Corps requested a list of species that may be present in the project area. The Service responded with a letter on June 7, 2001, stating that the following species could be potentially affected by the project: West Indian manatee, wood stork, and snail kite. After additional review, and in an email to Janet Cushing of the Corps, the Service indicated that two additional listed species may be affected by the project: eastern indigo snake and Okeechobee gourd.

According to a recent check of our eagle database, two bald eagle nests were found within the general vicinity of the study area. Both nests were active in 2000, but inactive in 2001. More current data are not available at this time. The closer of the two nests is located in Palm Beach County approximately 10 miles from the S-310. The location is along the lake's rim canal at South Bay West, east of S-354. The other nest is located at the Mills Ranch in Hendry County and is approximately 12 miles away. It is near the G-152 on the L-2. Although neither of these nests is close enough to be directly affected by project construction, the presence of several eagle nests along the HHD suggests that a new eagle nesting territory could become established prior to project construction. Therefore, even if the Corps reaches a determination that the project is not

likely to adversely affect this species, we recommend that the Corps include a commitment in its Biological Assessment to review again the distribution of eagle nests in the area several months before construction is scheduled to begin.

This draft FWCA report contains several recommendations to reduce the potential impact of the project on listed species, particularly the West Indian manatee and the eastern indigo snake. The Service recommends that the Corps fully consider these and any other available measures prior to submitting a Biological Assessment for our review.

IX. EVALUATION OF THE PROJECT

This project is primarily intended to facilitate water removal from Lake Okeechobee for agricultural water users of the Industrial Canal when lake stages are greater than 15.5 feet. Secondary purposes of the project are to eliminate the use of the navigational lock as a water supply structure when lake stages are greater than 15.5 feet and to maintain navigation in the canals adjacent to Lake Okeechobee. Farm pump operators have not recorded volumes of water withdrawn from or discharged into the Industrial Canal. However, the Corps has stated that no more additional water will be withdrawn from the lake and no additional pollutant loads will enter the lake over the existing conditions.

The Corps' preliminarily selected alternative (Alternative 4A) was chosen based on cost, boating safety, and flooding concerns. Through a process of elimination, the Corps and local sponsor determine it to be the best way to facilitate water movement from the lake into the Industrial Canal when lake levels are greater than 15.5 feet. This alternative calls for the relocation of the S-169 to the west of Culvert No. 2, modifications to Culvert No. 2, and the construction of an access bridge for the HHD at the current S-169 location.

Consideration of ecological benefits or adverse impacts is not evident in the written evaluation of alternatives provided so far by the Corps. The Service finds that the project is likely to have limited potential to benefit fish and wildlife. The reduction in lake stage when levels are greater than 15.5 feet will be minimal. The conversion of the existing S-169 to a bridge would remove an impediment to fish and other aquatic life movement within that section of the C-21 Canal and from the Industrial Canal to Culvert No. 2. Removal of this impediment may also improve the quality of the aquatic habitat in that reach by facilitating more water movement through the C-21 Canal, thereby potentially alleviating stagnant or low-dissolved oxygen conditions that may develop in the C-21 or Industrial canals during droughts or the dry season. Potential adverse effects, such as impacts to the remnant forested wetland by construction of the tieback levee, could be mitigated through construction of compensatory wetlands of equivalent function and value.

A. The Service's Discussion of Alternatives with the Corps

In the Service's January 28, 2002, PAL to the Corps, we presented reasoning that might support the selection of Alternative 1 - the "No-Action" alternative. We questioned the necessity of this project for the following reasons:

1. no data were presented that indicated that there are flooding problems in the eastern portion of the Nine-Mile Canal Basin,

2. no data were presented on the effects of the recently dredged Industrial Canal (to an elevation that is close to the invert elevation of the S-310 and 8 feet below the mean lake level of 12.56 feet) on the need for the project,

3. no data were presented on the effects of anticipated CERP projects on the need for this project, and

4. no data were presented on historic (*i.e.,* over the last 20 years) lake stage duration over 15.5 feet.

At this time, these concerns have been addressed. The Corps has indicated that the no-action alternative represents an emergency discharge condition at S-310 when the lake is greater than 15.5 feet. They responded that the dredging conducted in the Industrial Canal was maintenance dredging for navigation, and that additional storage due to the dredging is insignificant. They stated that no immediate effects of CERP projects are foreseen due to the longevity of CERP studies, authorization process, and construction - there is an immediate need for this project with or without anticipated CERP projects. According to records from 1931 to 2001, the lake exceeded 15.5 about 26 percent of the time. However, records from the 1992 through 1999 that reflect a rainy period indicate the lake exceeded 15.5 about 40 percent of the time.

B. Relationship to the CERP and the C&SF Project

The scope of this project, or at least the scope of the operation of this project, may be affected by the implementation of Lake Okeechobee-linked CERP projects (*e.g.,* Lake Okeechobee Watershed, Everglades Agricultural Area, Indian River Lagoon - South, Regional Aquifer Storage and Recovery, and C-43 Basin Storage Reservoir). All of these projects will be designed to result in, at least in part, ecologically more beneficial lake stages. We recommend that the Corps include an analysis of the potential relationships of the S-169 to the future condition with these CERP projects in the NEPA documentation for the S-169 Project. For example, the Everglades Agricultural Area Project (which will be designed to provide water supply for agricultural interests in the EAA) will likely not have components close enough to the S-169 project area to reasonably expect that additional water supply from the EAA Project would be available to water consumers currently dependent on the Industrial Canal as the source.

X. CONCLUSIONS AND RECOMMENDATIONS

Objectives identified by the Service in providing recommendations on this project are to protect and conserve fish and wildlife resources in the project area consistent with the basic project purpose. This includes developing recommendations to make this project more environmentally compatible and to further enhance the diversity and abundance of fish and wildlife resources in the study area.

A. Alternative Evaluation and Selection

1. The Service believes that Alternatives 2 through 5 are similar in their consequences for the removal of water out of Lake Okeechobee. We understand that the current operation of the S-310 is unauthorized and may undermine the lock and be unsafe to boaters when the lake is greater than 15.5 feet. We could support the selected plan (Alternative 4A) if our recommendations (Section X of this report) are followed.

2. At this time, the Service cannot support Alternative 3. Alternative 3 is unsatisfactory due to the installation of a new pump station which the Service believes to be a potential entrainment threat to fish and other aquatic life resources.

3. At this time, the Service cannot support Alternative 6. Alternative 6 is unsatisfactory due to the placement of a permanent plug in the C-21 Canal. This plug represents a barrier to fish and other aquatic life movement in the C-21 Canal and eliminates the possibility of diverting contaminated stormwater runoff from the western portion of the Nine-Mile Canal Basin into the Industrial Canal where it could be used for agricultural purposes rather than being discharged into Lake Okeechobee. The Corps has noted that flow through S-169 from west to east is not likely. Typically, when flow does go through S-169 from west to east, the Lake is below 13 feet and the Nine-Mile Canal Basin is open to the Lake. Runoff is free to flow from the Lake or to the Lake via a number of culverts.

4. It is now an appropriate time to also determine how additional future withdrawals from Lake Okeechobee to the Industrial Canal, as a result of this project, will be coordinated with the SFWMD's Adaptive Protocols for Lake Okeechobee Operations and the Minimum Flows and Levels rulemaking.

B. Threatened and Endangered Species

1. At this time, six federally listed species may be impacted by this project. They are the West Indian manatee, snail kite, wood stork, bald eagle, eastern indigo snake, and Okeechobee gourd. Consultation on these species has not been concluded. With the current level of data, we cannot adequately assess the potential impacts of the project on these species. The Service expects that all available standard construction

conditions, local operating procedures, and/or habitat management guidelines will be implemented for these species during the construction phase for all components of the project to avoid any adverse effects on those federally listed species.

2. The Service recommends exclusion of manatees from the C-21 and Industrial canals to the extent practicable. In accordance with recently drafted culvert criteria for manatees (Service 2003), this will require the installation of manatee exclusion devices on the new S-169 and both ends of the modified Culvert No. 2.

3. Should blasting be necessary, the Corps must monitor local wildlife activity during this action. Care should be taken to avoid unnecessary disturbance of roosting, foraging, or wading birds or other local wildlife such as perching birds, raptors, waterfowl, mammals, reptiles, amphibians, and fish that utilize associated habitats. A qualified fish and wildlife biologist, approved by the Service and the FWC, should be present throughout blasting activities to monitor fish and wildlife response and offer advice to construction personnel.

4. The Corps will notify the Service's Vero Beach Field Office no later than 1 month prior to start of the construction phase for any of the components so that we may, if necessary, ensure that precautions are in place, and if necessary, monitor effects of construction activities on threatened and endangered species.

5. For additional species listed as threatened, endangered, or of special concern by the State of Florida, the Corps should consult with the FWC regarding those species' habitat needs and additional recommendations to conserve those species.

C. Water Flows to Lake Okeechobee

Movement of water to and from Lake Okeechobee should be regulated in a manner consistent with the high and low water targets from the Lake Okeechobee Conceptual Model (Havens 2003). The operating schedule will also need to adhere to any Total Maximum Daily Loads that are developed for Lake Okeechobee or any other hydraulically connected water body.

D. Wetland Mitigation

Additional information is needed on the dimensions and location of the tieback levee in the selected plan. The Corps should attempt to avoid impacts on the remnant forested wetland between the HHD and the C-21 Canal; if such impacts are unavoidable, compensatory mitigation should be included in the project plans.

E. Additional Studies

The Corps and SFWMD should install flow monitoring equipment in the basin to accurately assess the amount of water being withdrawn from, and pumped into, the lake by specific water users. Those data were not available for this project, and thereby hampered this environmental effects analysis. For example, the snail kite response to low lake levels during the recent drought underscores the necessity for the accurate determination any project's effects on lake levels and the linkage to other compounding negative effects on this species.

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APPENDIX D – PERTINENT CORSPONDENCE

5-21-

Planning Division
Environmental Branch

Mr. Stephen Forsythe
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960-3559

Dear Mr. Forsythe:

The U.S. Army Corps of Engineers (Corps), Jacksonville District, is currently preparing NEPA documentation for a reevaluation of Control Structure 169 (S-169), located on Canal 21 (C-21), north of Clewiston, Hendry County, Florida. Different alternatives for allowing more water into the Industrial Canal will be reviewed. The local sponsor of the planned project is the South Florida Water Management District.

Pursuant to Section 7 of the Endangered Species Act, as amended, the Corps is requesting a list of any threatened or endangered species or critical habitat that may be present in the proposed project area. Enclosed please find a copy of the Scoping letter, which includes a map of the project area (enclosure 1), and gives a detailed description of the proposed project. If you have any suggestions, questions, or require additional information, please contact Ms. Janet Cushing at 904-232-2259.

Sincerely,

James C. Duck
Chief, Planning Division

Enclosure

5/14 Cushing/CESAJ-PD-ES/2259/ALS 5-14-01
Cintron/CESAJ-PD-ES 5/15-01
Smith/CESAJ-PD-E
BC Clark/CESAJ-DP-R 5-18
Duck/CESAJ-PD

L: group/pdes/cushing/Sec7-S169

Planning Division
Environmental Branch

JUL 19 2001

Mr. James J. Slack
Field Supervisor
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960-3559

Dear Mr. Slack:

Enclosed is a Scope of Work (SOW) and Cost Estimate for your office to prepare a Planning Aid Letter and Fish and Wildlife Coordination Act Report for the S-169/Nine-Mile Canal Basin Project.

If acceptable, please sign the SOW and return a copy to this office. We will process a MIPR to transfer funds in October 2001.

Sincerely,

James C. Duck
Chief, Planning Division

Enclosures

7/19
Cushing/CESAJ-PD-ES/3277
Cintron/CESAJ-PD-ES
Smith/CESAJ-PD-E
BC Clark/CESAJ-DP-R 7-19-01
Duck/CESAJ-PD

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11-1-01

Planning Division
Environmental Branch

NOV 0 1 2001

Mr. James J. Slack
Field Supervisor
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960-3559

Dear Mr. Slack:

As requested by Mr. Steve Schubert, enclosed is all available hydrologic information relative to the structural and operational design of the existing structures operated by the U.S. Army Corps of Engineers or South Florida Water Management District for the S-169/Nine-Mile Canal Basin project (enclosure 1). We have not determined a target elevation for the Industrial Canal as we wish to incorporate your recommendations into our modeling efforts. As further studies occur during the plan formulation process, we will forward copies of the reports to you. Also enclosed is the MIPR to transfer funds to your agency (enclosure 2).

In accordance with the Scope of Work for this project, please send a Planning Aid Letter to assist us in our plan formulation of alternatives. If you have questions, please contact Ms. Janet Cushing by phone at 904-232-2259, or by e-mail at janet.a.cushing@usace.army.mil.

Sincerely,

James C. Duck
Chief, Planning Division

Enclosures

Copy Furnished:

Mr. Steve Schubert, U.S. Fish and Wildlife Service, 1339 20th Street, Vero Beach, Florida 32960-3559

10/31 Cushing/CESAJ-PD-ES /als 10-31-01
Cintron/CESAJ-PD-ES 10/31
Dugger/CESAJ-PD-E
Strain/CESAJ-PD-P
Clark/CESAJ-DP-R 10/31
Dyck/CESAJ-PD

L: group/pdes/cushing/infolett

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

June 7, 2001

Mr. James C. Duck
Chief, Planning Division
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Duck:

This is in response to your letter of May 21, 2001, requesting a list of federally threatened or endangered species or critical habitat in the area of Control Structure 169 (S-169) located on Canal 21 (C-21), north of Clewiston, Hendry County, Florida.

The Fish and Wildlife Service (Service) finds that three federally listed species may be found in the project area, or have the potential to be affected by the project. They are: the West Indian manatee (*Trichechus manatus*), wood stork (*Mycteria americana*), and snail kite (*Rostrhamus sociabilis plumbeus*). Critical habitat for snail kite (50 CFR 17.95) is present immediately adjacent to or in the project area, along the interior of the Herbert Hoover Dike, encompassing the rim canal and the shoreline habitat of the lake northwest of Control Structure 310 (S-310). Additionally, the Service's manatee mortality data indicate four deaths from 1984 to1996 adjacent to or in the project area. These data further indicate that manatees may occupy the rim canal and associated canals in the project area.

The Service is concerned that implementation of this project could cause additional lowering of lake water levels and might adversely affect listed species. Therefore, the Service recommends that the Corps of Engineers (Corps) continue informal consultation on this project after an alternative has been selected.

This letter does not fulfill the requirements of informal or formal consultation, nor does it constitute a Biological Opinion as described under Section 7 of the Endangered Species Act (ESA).

If modifications are made in the project proposal or if additional information on listed species is needed, please contact Steve Schubert at (561) 562-3909, ext. 249.

Sincerely yours,

Rob Ruck for

James J. Slack
Field Supervisor
South Florida Ecological Services Office

cc: FWCC, Vero Beach, FL (Steve Lau)

FLORIDA DEPARTMENT OF STATE
Secretary
International Relations
of Elections
Division of Historical Resources
Division of Library and Information Services
Division of Licensing
Division of Administrative Services

MEMBER OF THE FLORIDA CABINET
State Board of Education
Trustees of the Internal Improvement Trust Fund
Administration Commission
Division of Bond Finance
Department of Revenue
Department of Law Enforcement
Department of Highway Safety and Motor Vehicles
Department of Veterans' Affairs

FLORIDA DEPARTMENT OF STATE
Katherine Harris
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Mr. James C. Duck
Planning Division, Environmental Branch
Jacksonville District, Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

July 24, 2001

RE: DHR Project File No. 2001-05533
Received by DHR May 10, 2001
Information Request for S-169/Nine Mile Canal Basin General Re-Evaluation Report
Hendry County, Florida

Dear Mr. Duck:

Our office received and reviewed the above referenced project. Based on the information provided and a review of our records, it is the opinion of this office that Flood Control Structure S-169 is not eligible for listing in the National Register. Therefore, no historic properties will be affected by this undertaking.

If you have any questions concerning our comments, please contact Scott Edwards, Historic Preservation Planner, by electronic mail sedwards@mail.dos.state.fl.us, or at 850-245-6333 or 800-847-7278.

Sincerely,

Janet Snyder Matthews

Janet Snyder Matthews, Ph.D., Director
Division of Historical Resources
State Historic Preservation Officer

JSM/Ese

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

NOV 6 2001

Ecosystem Restoration Program Division
South Florida Restoration Branch

Mr. Joseph Schweigart
Deputy Executive Director, Everglades Restoration
South Florida Water Management District
P. O. Box 24680
West Palm Beach, Florida 33416-4680

Dear Mr. Schweigart:

As a part of our partnership with you, the South Florida Water Management District (SFWMD), we would like to finalize the scope of study for S-169/Nine-Mile Canal Basin General Re-Evaluation Report (GRR) Project.

Engineers from our office and other local agencies have researched, surveyed and performed site visits to verify the existing structures and their design criteria within the project area. Enclosure 1 is a map depicting the layout of the existing water control structures. Enclosure 2 is a spreadsheet with details of each of the structures shown on this map. Our coordination efforts with SFWMD, the Diston Island Conservancy District, the South Florida Water Conservancy District, the Clewiston Drainage District, Sugarland Drainage District, and the United States Sugar Corporation have determined that identified structures should be included in the GRR scope of study.

We are currently constructing an existing conditions Hydrologic and Hydraulic (H&H) model for this project. Please be advised that this modeling effort cannot proceed much further unless the existing structure information is finalized. Therefore, we request that your office review this information and provide your concurrence to proceed as shown, or provide us with an alternate resolution.

Please contact Mr. Brad Clark, Project Manager, 904-232-3302, if you have any questions or require any additional information.

Sincerely,

Richard E. Bonner, P.E.
Deputy District Engineer
for Project Management

Enclosures

Copy Furnished:

Mr. Gene Tanner, Director, South Florida Water Management District, Clewiston Field Station, State Road 832, Route 1 Box 103, Clewiston, Florida 33440
Ms. Karen Estock, U.S. Army Corps of Engineers, South Florida Operations Office, 525 Ridgelawn Road, Clewiston, Florida 33440-5399
Mr. Tommy Strowd, Director of Operations, South Florida Water Management District, P. O. Box 24680, West Palm Beach, Florida 33416-4680

bcc:
CESAJ-PD-PF (Rote) (w/encl)
CESAJ-PD-ES (Cushing) (w/encl)
CESAJ-EN-HH (Weston) (w/o encl)
CESAJ-EN-HH (Holand) (w/o encl)
CESAJ-EN-HH (Hashtak) (w/o encl)

BC Clark/DR-S 11-6-01
skk/1463 5 Nov 01
KBH Brooks-Hall/DR-S
OWD Duke/DR
DRB Bonner/DP

File: L:drive/user/k3drsbec/S-169/Nine-Mile Canal Basin GRR Project.doc

LOCATION (as labeled on dwg.)	PERMIT NUMBER	ID	SOURCE	ANNUAL ALLOCATION (MGY)	GPM	CFS	PROJECT NA
				8211 (3 CULVERTS, 2 PUMPS)	**15622.15**	**34.81**	
USSC SOUTHLINE STATION	26-00040-W	1	INDUSTRIAL CANAL	CULVERT			TOWNSITE PI
USSC SOUTHLINE STATION	26-00040-W	2	INDUSTRIAL CANAL	CULVERT			TOWNSITE PI
USSC SOUTHLINE STATION	26-00040-W	3	INDUSTRIAL CANAL	CULVERT			TOWNSITE PI
USSC	26-00040-W	1	INDUSTRIAL CANAL	PUMP			TOWNSITE PI
USSC	26-00040-W	2	INDUSTRIAL CANAL	PUMP			TOWNSITE PI
				UNKNOWN ALLOCATION (2 CULVERTS)			
SFCD UNIT 5 STATION	50-00887-W	1	INDUSTRIAL CANAL	CULVERT			SOUTH FLOR
SFCD UNIT 5 STATION	50-00887-W	2	INDUSTRIAL CANAL	CULVERT			SOUTH FLOR
				UNKNOWN ALLOCATION (1 CULVERT)			
JISTON STATION 2	NO PERMIT NUMBER	STA 2	C21	CULVERT			CLEWISTON I
				2756 (1 PUMP)	**5243.53**	**11.68**	
CLEWISTON IRRIGATION PUMP	26-00137-W	1	C20/C21	PUMP			CLEWISTON I
				18688 (2 PUMPS)	**35555.56**	**79.22**	
SUGARLAND MAIN STATION	26-00138-W	MAIN ST-1	C20/C21	PUMP			GROVE
[1]SUGARLAND MAIN STATION	26-00138-W	MAIN ST-2	C20/C21	PUMP			GROVE
				13277 (8 PUMPS,2 CULVERTS)	**25260.65**	**56.28**	
DISTON EAST END STATION	22-00063-W	EAST 5	C43 VIA LD-1 & LD-3	PUMP			DISTON IS. C
DISTON EAST END STATION	22-00063-W	EAST 5a	C43 VIA LD-1 & LD-3	PUMP			DISTON IS. C
DISTON EAST END STATION	22-00063-W	EAST 5b	C43 VIA LD-1 & LD-3	PUMP			DISTON IS. C
DISTON STATION 2	22-00063-W	PS2	C43 VIA LD-1 & LD-3	PUMP			DISTON IS. C
DISTON STATION 2	22-00063-W	PS2	C43 VIA LD-1 & LD-3	PUMP			DISTON IS. C
DISTON STATION 2	22-00063-W	1	C43 VIA LD-1 & LD-3	CULVERT			DISTON IS. C
BENBOW IRRIGATION PUMP	NO PERMIT NUMBER		C43 VIA LD-1 & LD-3	PUMP			BENBOW
DISTON STATION 1	22-00063-W	4	C43 VIA LD-1 & LD-3	PUMP			DISTON IS. C
DISTON STATION 2	22-00063-W		C43 VIA LD-1 & LD-3	PUMP			DISTON IS. C
N STATION 3	22-00063-W	1-A	C43 VIA LD-1 & LD-3	CULVERT			DISTON IS. C

NOTE: Annual allocations were obtained from water use re-issue permits with an expiration date of October 15, 1991.

[1] Pump is not operational.

* Land Use - Agricultural, Recreational, and Golf and Landscape.

** Land Use - Agricultural and Landscape.

LOCATION (as labeled on dwg.)	PERMIT NO.	ID	SOURCE	TOTAL CAPACITY (GPM)	CFS	PROJECT NAME
USSC SOUTHLINE STATIION	26-00040-S	SOUTHLINE	INDUSTRIAL CANAL	200,000 GPM (7 PUMPS)	445.60	SOUTHLINE PUMF
SFCD UNIT 5 STATION	50-00887-S	P5W	INDUSTRIAL CANAL	172,000 GPM (4 PUMPS)	383.22	SFCD UNIT 5
CLEWISTON STATION 3	NO PERMIT NO.	STA No.3	INDUSTRIAL CANAL	75,000 GPM (2 PUMPS)	167.10	
EAST HENDRY STATION	26-00042-S		INDUSTRIAL CANAL	23,000 GPM (2 PUMPS)	51.24	EAST HENDRY CC
JD THORNTON	26-00038-S		INDUSTRIAL CANAL	3,000 GPM (1 PUMP)	6.68	J D THORNTON
WISTON STATION 2	NO PERMIT NO.	STA No.2	C21	126,000 GPM (3 PUMPS)	280.73	
SUGARLAND MAIN STATION	NO PERMIT NO.		C20/C21	(1 CULVERT)		
NINE-MILE CANAL CULVERT	NO PERMIT NO.		Nine-Mile Canal	(1CULVERT)		
[1]DISTON STATION 1	22-00063-W	PS1 3,PS1 3A	C43 VIA LD-1 & LD-3	112,000 GPM (2 PUMPS)	249.54	DISTON IS. CONS I
[1]DISTON STATION 2	22-00063-W	PS2	C43 VIA LD-1 & LD-3	140,000 GPM (2 PUMPS)	311.92	DISTON IS. CONS I
[1]DISTON EAST END STATION	22-00063-W	EAST END	C43 VIA LD-1 & LD-3	(1 CULVERT)		DISTON IS. CONS I

[1] Water control structures at the Diston Stations were originally permitted for water use but some are being used as discharge structures.

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Planning Division
Environmental Branch

MAY 07 2001

TO THE ADDRESSEES ON THE ENCLOSED LIST:

The U.S. Army Corps of Engineers, Jacksonville District (Corps), is requesting your assistance in gathering information that will help define issues and concerns to be addressed in a National Environmental Policy Act (NEPA) document being prepared for the Control Structure 169 (S-169)/Nine-Mile Canal Basin Project. The document will be integrated with the General Reevaluation Report. The Flood Control Act of 1948 authorized the construction of S-169 and the realignment of C-21 to allow the diversion of flow from the Industrial Canal to Pumping Station 4, located northwest of Clewiston, during times when gravity discharge to Lake Okeechobee was not possible. The current objective of the S-169/Nine-Mile Canal Basin Project is to reaffirm, reformulate, or modify S-169 and/or other structures in the basin to improve drainage and water control in Canal 21 and to the Industrial Canal. S-169 is located on the eastern end of Canal 21 (C-21), southwest of Lake Okeechobee and north of Clewiston, Hendry County, Florida (Figure 1).

Presently, the extended drought has greatly lowered water levels in Lake Okeechobee. The agricultural community to the east of Clewiston is pumping water out of the Industrial Canal as their normal irrigation procedures. The lake's low water level and the agricultural use of water from the canal have resulted in extremely low water levels in the Industrial Canal; this has led to watercraft damages, impediments to navigation, structural damages to marinas, and fish kills.

As a temporary solution, the South Florida Water Management District has been operating Canal Lock Structure 310 (S-310) during non-duty hours to allow water flow into the Industrial Canal. For a permanent solution, the Corps is considering several alternatives to allow more water to stage in the Industrial Canal. Currently there are six alternative plans that will be evaluated in the NEPA document:

issues and alternative plans to be analyzed. The meeting will be held as follows:

DATE/TIME: Tuesday, June 12, 2001 at 7 p.m.

PLACE: John Boy Auditorium
1200 South W.C. Owen Ave.
Clewiston, Florida 33440

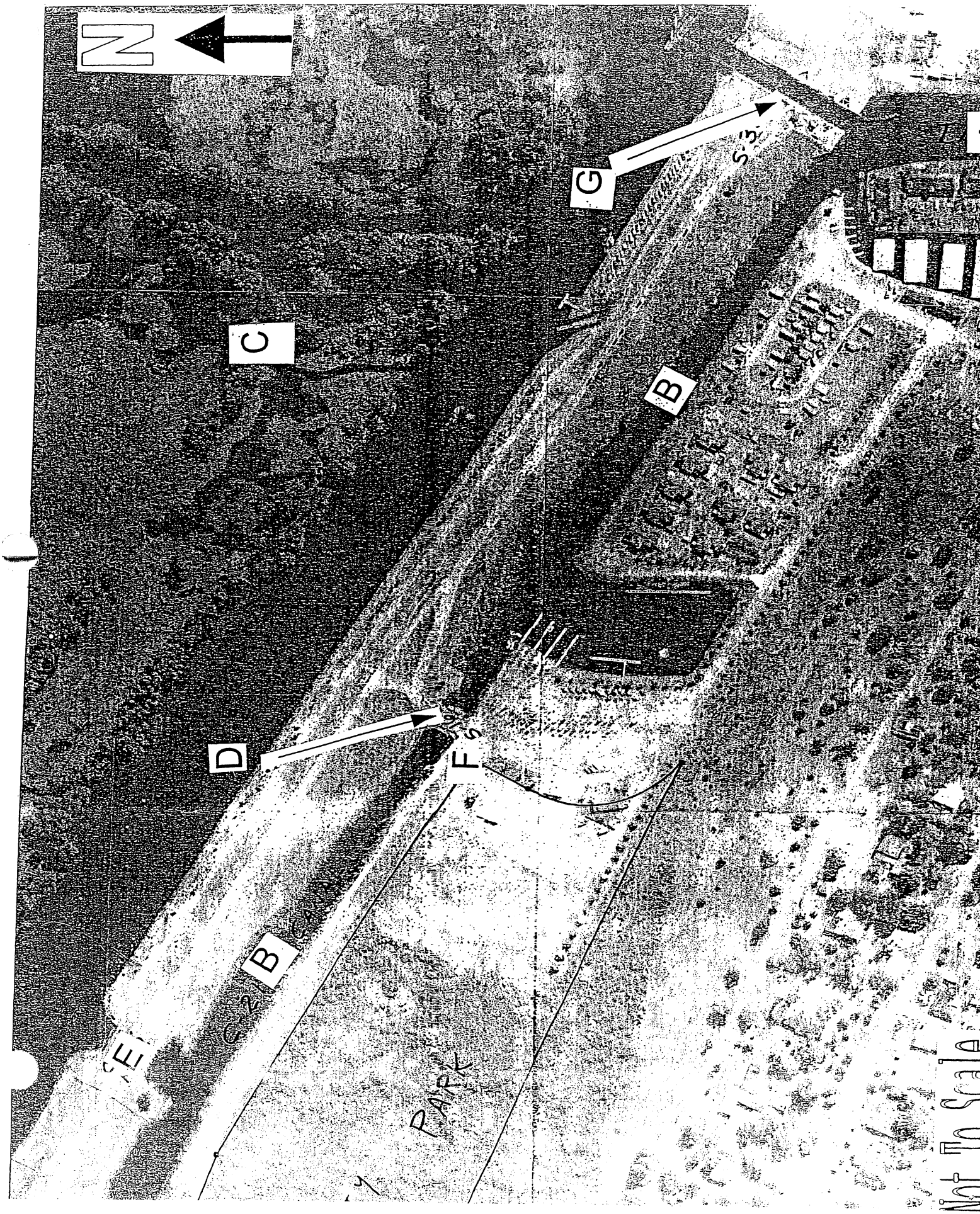
If you know of others who may wish to comment on this activity, then please advise them of this request for public comments. Letters should be addressed to the letterhead address to the attention of Planning Division, Environmental Branch, South Florida Section, within 30 days from the date of this letter. If you have questions, please contact Ms. Janet Cushing by telephone at 904-232-2259, or by e-mail at Janet.A.Cushing@usace.army.mil.

Sincerely,

James C. Duck
Chief, Planning Division

Enclosure

Figure 2



Figure

Director
Office of Env Compliance
Dept of Energy, Room 4G064
1000 Independence Ave SW
Washington DC 20585

Bureau of Indian Affairs
Attn: Joe Frank
Acting Superintendent
6075 Stirling Road
Hollywood, Florida 33024

Mr. John Folks
Florida Dept of Agriculture
Room 171 C-28
3128 Conner Blvd
Tallahassee, Florida 32399-1650

Ms. Christine Coffin
U S D A
15600 SW 288th Street
Suite 402
Homestead, Florida 33033

Ms. Karen Estock
USACE Area Engineer
South Florida Ops Office
525 Ridge Lawn Road
Clewiston, Florida 33440-5399

Ms. Diane Conway
U S D A
609 SW Park Street
Okeechobee, Florida 34972

STATE AGENCIES

Executive Director
South Florida Water Mgmt
District
P O Box 24680
West Palm Beach, Florida 33416-
4680

Ms. Olivia McClean
South Florida Water Mgmt
District
P O Box 24680
West Palm Beach, Florida 33416-
4680

Ms. Cherie Trainor
Florida State Clearinghouse
Dept of Community Affairs
2555 Shumard Oak Blvd
Tallahassee, Florida 32399-2100

Mr. Herbert Zebuth
Southeast District
Florida Dept of Env Protection
1900 S Congress Ave (Suite A)
West Palm Beach, Florida 33406

Ms. Bonnie Kranzer
Governor's Commission
1550 Madruga Avenue, Suite 220
Coral Gables, Florida 33146

Florida Dept of Transportation
605 Suwannee Street MS 46
Tallahassee, Florida 32399-0450

State Historic Preservation
Officer
Division of Historical Resources
R A Gray Building
500 South Bronough Street
Tallahassee, Florida 32399-0250

Mr. Mike Slayton
South Florida Water Mgmt
District
P O Box 24680
West Palm Beach, Florida 33416-
4680

Mr. Lewis Hornung
South Florida Water Mgmt
District
P O Box 24680
West Palm Beach, Florida 33416-
4680

Mr. Ernie Barnett, Director
Office of Ecosystem Planning
Florida Dept of Env Protection
3900 Commonwealth Blvd MS 45
Tallahassee, Florida 32399-3000

Executive Director
Florida Fish & Wildlife
Conservation Commission
620 S Meridian Street
Tallahassee, Florida 32399-1600

Commissioner Bob Crawford
Dept of Agriculture & Consumer
Svcs
3125 Conner Blvd Room 269
Tallahassee, Florida 32399-1650

The Arthur R Marshall Foundation
Florida Environmental Institute, Inc.
P O Box 2621
Palm Beach, Florida 33480

Mr. Max Quackenbos
St. Lucie River Initiative
1778 NW Palmetto Terrace
Stuart, Florida 34994-9423

Mr. Wayne Nelson
FADE
P O Box 16061
West Palm Beach, Florida 33416

Ms. Brenda H Marshall
Trust for Public Lands
7900 Red Road Suite 25
Miami, Florida 33143

Mr. Manley Fuller, III
Florida Wildlife Federation
P O Box 6870
Tallahassee, Florida 32314-6870

Mr. Robert Bendick, State Director
The Nature Conservancy
222 S Westmonte Drive Suite 300
Altamonte Springs, Florida 32714-4269

The Wilderness Society
4203 Ponce De Leon Blvd
Coral Gables, Florida 33146

Mr. Jim Haggart
Caloosahatchee River Citizens Association
12591 Coconut Creek Court
Fort Meyers, Florida 33908

Mr. Doug Coward
1000 Friends of Florida
1833 SE Hideaway Circle
Port St. Lucie, Florida 34952

Ms. Rosa Durando
Audubon Society of The Everglades
10308 Heritage Farms Road
Lake Worth, Florida 33467

Tropical Audubon Society
5530 Sunset Drive
Miami, Florida 33143

Ms. Mary Munson
Co-Chairperson
Defenders of Wildlife
1101 14th Street NW Suite 1400
Washington DC 20005

Ms. Shannon Estenoz
World Wildlife Fund
P O Box 19630
Plantation, Florida 33318

Ms. Elaine Usherson
Sierra Club, Loxahatchee
298 NW 11th Street
Boca Raton, Florida 33432

Mr. Joseph Podgor
Friends of the Everglades
244-A Westward Drive
Miami Springs, Florida 33166

Ridge Audubon Society
P O Box 148
Babson Park, Florida 33827

Lake Region Audubon Society
115 Lameraux Road
Winter Haven, Florida 33884

National Parks & Conservation Association
Attn: Ms. Kim Swatland
1546 Polk Street
Hollywood, Florida 33020-5426

Mr. John Rains, Jr.
Izaak Walton League
5314 Bay State Road
Palmetto, Florida 32561-9712

Mr. Dave Balman
Airboat Assoc of Florida
P O Box 650611
Miami, Florida 33165

Mr. Roderick Tirrell
Sierra Club Florida Chapter
2101 NE 55 Court
Fort Lauderdale, Florida 33308-3111

Ms Doris Cutshall
Head Librarian
Barron Library
461 N Main Street
La Belle, Florida 33935-5179

Mr. Jim Threewits
County Coordinator
Glades County Administration
P O Box 1018
Moore Haven, Florida 33471

Ms. Phyllis Lilley
Branch Manager
Belle Glade Branch Public
Library
530 S Main Street
Belle Glade, Florida 33430

Ms. Pam Brown, Director
Glades County Public Library
P O Box 505, Riverside Drive
Moore Haven, Florida 33471

Okeechobee Waterway Association
Attn: Gail A Byrd
P O Box 2756
Clewiston, Florida 33440

Belle Glade Chamber of Commerce
Attn: Daniele Penule
Executive Director
540 South Main Street
Belle Glade, Florida 33430

Mr. Bill Mathis, Mayor
Muncipal Complex
110 SW Avenue E
Belle Glade, Florida 33430

Ms. Phyllis Liley
Branch Manager
South Bay Public Library
375 SW 2nd Avenue
South Bay, Florida 33493

Ms. Susan Cocking
Miami Herald
One Herald Plaza
Miami, Florida 33132

Mr. David Flesler
Sun-Sentinal
200 E Las Olas Blvd
Fort Lauderdale, Florida 33301

Mr. Curtis Morgan
Miami Herald
One Herald Plaza
Miami, Florida 33132

Southwest Florida Regional Planning Council

4980 Bayline Drive, 4th Floor, N. Ft. Myers, FL 33917-3909 (941) 656-7720

P.O. Box 3455, N. Ft. Myers, FL 33918-3455 SUNCOM 749-7720

FAX 941-656-7724

July 26, 2001

Ms. Cherie Trainor
Florida State Clearing House
Florida Department of Community Affairs
2555 Shumard Oak Boulevard
TALLAHASSEE, FL 32399-2100

RE: IC&R Project #2001-187
USACE # Scoping Notice
SAI #FL200105130295C
Council Staff Final Comments Regarding The U.S. Army Corps of Engineers' Scoping Study For Control Structure 169 (S-169), Nine Mile Canal Basin, City of Clewiston, Hendry County.

Dear Ms. Trainor:

The staff of the Southwest Florida Regional Planning Council reviews various proposals, Notifications of Intent, Preapplications, permit applications, and Environmental Impact Statements for compliance with regional goals, objectives and policies, as determined by the Strategic Regional Policy Plan. The staff reviews such items in accordance with the Florida Intergovernmental Coordination and Review Process (Chapter 29I-5, F.A.C.), and adopted regional clearinghouse procedures.

The following designations determine Council staff procedure in regard to the reviewed project. These four designations are:

Less Than Regionally Significant and Consistent: No further review of the project can be expected from Council.

Less Than Regionally Significant and Inconsistent: Council does not find the project of regional importance, but will note certain concerns as part of its continued monitoring for cumulative impact within the noted goal area.

Regionally Significant and Consistent: The project is of regional importance, and appears to be consistent with Regional goals, objectives and policies.

Regionally Significant and Inconsistent: The project is of regional importance and does not appear to be consistent with Regional goals, objectives and policies. Council will oppose the project as submitted, but is willing to participate in any efforts to modify the project to mitigate the concerns.

Printed on Recycled Paper

Regional staff finds that the proposed activities are **Regionally Significant and Consistent** with the adopted Southwest Florida Strategic Regional Policy Plan. The determination of "Regional Significance" is based upon the importance of the Nine-Mile Canal Basin to the City of Clewiston and Hendry County. "Consistency" is based upon a determination that the proposed activities are consistent with the Southwest Florida Strategic Regional Policy Plan. Consistency is further predicated upon the following conditions:

1. Regional staff supports the City of Clewiston's recommendation in support of Alternative #4. It appears that implementation of this alternative would relieve use conflicts between navigation and irrigation.

2. Staff also recommends that any solution eventually adopted by the permitting agencies lead to a permanent solution. The importance of the canal basin to both agricultural interests and navigation is too great to allow for continued conflicts. A permanent fix should be found.

Should you, or any other party, request this finding to be reconsidered, please contact Nichole Gwinnett, IC&R Coordinator, with this request, or with any questions concerning staff review of this item. This recommendation will be discussed at the next scheduled Council meeting. Should Council action differ from the staff recommendation, you will be notified.

Sincerely,

SOUTHWEST FLORIDA REGIONAL PLANNING COUNCIL

Wayne E. Daltry
Executive Director

cc: Ms. Nichole Gwinnett, IC&R Coordinator, Southwest Florida Regional Planning Council
Ms. Janet Cushing, U.S. Army Corps of Engineers
Ms. Maureen Finnerty, Superintendent, Everglades National Park
Chief, Protected Species Branch, National Marine Fisheries Service
Mr. Richard Harvey, U.S. Environmental Protection Agency
Mr. Stephen W. Forsythe, State Supervisor, U.S. Fish and Wildlife Service
Water Resources Division, U.S. Geological Survey
Mr. Joe Frank, Acting Superintendent, Bureau of Indian Affairs
Ms. Linda McCarthy, Florida Department of Agriculture
Ms. Diane Conway, U.S. Department of Agriculture
Ms. Olivia McClean, South Florida Water Management District
Mr. Herbert Zebuth, Florida Department of Environmental Protection
Ms. Bonnie Kranzer, Governor's Commission On A Sustainable South Florida
Ms. Mary Ann Poole, Florida Fish and Wildlife Conservation Commission

ccc: Mr. M. Franklyn Jones, Director of Engineering Planning, U.S. Sugar Corporation
Mr. Tom Jones, South Florida Agricultural Council
Okeechobee Waterway Association
Mr. Lester B. Baird, County Administrator, Hendry County
Honorable James L. Pittman, Mayor, City of Clewiston
Mr. Thomas C. Perry, Jr., P.E., Johnson-Prewitt & Associates, Incorporated

DIVISIONS OF FLORIDA DEPARTMENT OF STA
Office of the Secretary
Office of International Relations
Division of Elections
Division of Corporations
Division of Cultural Affairs
Division of Historical Resources
vision of Library and Information Services
vision of Licensing
Division of Administrative Services

MEMBER OF THE FLORIDA CABINET
State Board of Education
Trustees of the Internal Improvement Trust Fund
Administration Commission
Florida Land and Water Adjudicatory Commission
Siting Board
Division of Bond Finance
Department of Revenue
Department of Law Enforcement
Department of Highway Safety and Motor Vehicles
Department of Veterans' Affairs

FLORIDA DEPARTMENT OF STATE
Katherine Harris
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Mr. James C. Duck
Planning Division, Environmental Branch
Jacksonville District, Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

July 24, 2001

RE: DHR Project File No. 2001-05533
Received by DHR May 10, 2001
Information Request for S-169/Nine Mile Canal Basin General Re-Evaluation Report
Hendry County, Florida

Dear Mr. Duck:

Our office received and reviewed the above referenced project. Based on the information provided and a review of our records, it is the opinion of this office that Flood Control Structure S-169 is not eligible for listing in the National Register. Therefore, no historic properties will be affected by this undertaking.

If you have any questions concerning our comments, please contact Scott Edwards, Historic Preservation Planner, by electronic mail sedwards@mail.dos.state.fl.us, or at 850-245-6333 or 800-847-7278.

Sincerely,

Janet Snyder Matthews

Janet Snyder Matthews, Ph.D., Director
Division of Historical Resources
State Historic Preservation Officer

JSM/Ese

JOHNSON-PREWITT & ASSOCIATES, INC.

850 WEST VENTURA AVENUE P.O. BOX 1029, CLEWISTON, FLORIDA 33440 (863) 983-9188 FAX (863) 983-9854

I. CLARK TULLOS, P.E., P.L.S.
RMANDO L. BENAVIDES, P.E., P.L.S.
IARK A. HATFIELD, P.L.S.
HOMAS C. PERRY, JR., P.E.

July 20, 2001

Wayne Daltry
Southwest Regional Planning Council
P.O. Box 3455
N. Fort Myers, Florida 33918-3455

RE: USACOE Study for Control Structure 169/Nine Mile Canal Basin
City of Clewiston, Hendry County, Florida
IC&R Project # 2001-187 SAI # FL200105130295C

Dear Mr. Daltry:

This letter is in response to your May 29, 2001 letter to Cherie Trainor, Florida State Clearing House, Florida Department of County Affairs, concerning the above referenced study. Johnson-Prewitt & Associates, Inc., serves as City Engineer for the City of Clewiston.

Your letter ask three questions which we wish to address.

This project is not related or a part of the maintenance dredging project addressed in SAI # FL200104180182C.

The USACOE May 7, 2001 announcement of the public workshop could be interpreted to mean the problems addressed the study are caused by the current drought. While the drought has adversely affected the Industrial Canal and cause the same damages to occur as have been noted by the USACOE and City of Clewiston the cause is different. The problems addressed in this letter and by this project occur when the lake stages are higher than 15.0' and well above any stages occurring during a drought.

The operation of S-310 at stage higher than 15.0' cause problems with irrigation supply and runoff discharges. These problems occur in a normal rainfall year.

The solution suggested in the alternates are a permit fix which will be needed yearly. It is also noted that water use and irrigation by the agricultural community is limited by permit and is currently being curtailed due to the drought.

The City of Clewiston wishes to promote Alternate 4 presented by the USACOE. Please find attached a resolution enacted by the City Commission which iterates the Commissions backing of the action proposed in Alternate 4.

Should you or your staff wish to discuss these issues I will be happy to facilitate a meeting. I can be reached at 863-983-9188.

Sincerely,

Thomas C. Perry Jr.

Thomas C. Perry, Jr., P.E.

cc: James Duck, Chief Planning Division, USACOE
Cherie Trainor, Florida State Clearing House
Nichole Gwinnett, IC&R Coordinator
Glenn Heath, Senior Planner
Maureen Finnerty, Superintendent, Everglades National Park
Chief, Protected Species Branch, National Marine Fisheries Service
Mr. Richard Harvey, U.S. Environmental Protection Agency
Mr. Stephen W. Forsythe, State Supervisor, U.S. Fish and Wildlife Service
Water Resources Division, U.S. Geological Survey
Mr. Joe Frank, Acting Superintendent, Bureau of Indian Affairs
Ms. Linda McCarthy, Florida Department of Agriculture
Ms. Diane Conway, U.S. Department of Agriculture
Ms. Olivia McClean, South Florida Water Management District
Mr. Herbert Zebuth, Florida Department of Environmental Protection
Ms. Bonnie Kranzer, Governor's Commission on a Sustainable South Florida
Ms. Mary Ann Poole, Florida Fish and Wildlife Conservation Commission

RESOLUTION 2001-11

A RESOLUTION OF THE CITY OF CLEWISTON, FLORIDA, SUPPORTING THE USACOE REEVALUATION OF THE S-169/NINE MILE CANAL BASIN

WHEREAS, the City of Clewiston operates and maintains the boat launching facilities near Hoover Dike in Clewiston under a lease agreement with the South Florida Water Management District; and

WHEREAS, Structure S-169 serves to control surface water discharge from the Industrial Canal; and

WHEREAS, the lock through Hoover Dike in the Industrial Canal is placed in operation upon the Lake Okeechobee water level reaching 15.50 feet and above; and

WHEREAS, the Industrial Canal serves as a drainage and irrigation conveyance canal for legal users; and

WHEREAS, Lake Okeechobee, the Industrial Canal, and the public launch area provide economic and recreational benefits to the citizens of Clewiston, the State of Florida, and many visitors; and

WHEREAS, the lock on the Industrial Canal serves as the only means of providing irrigation water supply to the Industrial Canal; and

WHEREAS, when irrigation water is supplying the Industrial Canal, the lock cannot be used for boat traffic; and

WHEREAS, if the Structure S-169 was relocated to the west of culvert number 2, and if culvert number 2 was "fitted" with proper control gates, irrigation supply could be directed from culvert number 2 to the Industrial Canal, rather than through the lock, thereby relieving the conflict between use of the lock for irrigation purposes and boat traffic purposes.

WHEREAS, increased discharge capacity through S-169 will better protect the City of Clewiston from flooding.

NOW, THEREFORE, BE IT RESOLVED: That the City of Clewiston hereby endorses the redesign and relocation of Structure S-169 and supports the USACOE efforts to undertake studies to accomplish the same.

ADOPTED in session the 16th day of July, 2001

CITY OF CLEWISTON, FLORIDA

By: James L. Pittman, Mayor

ATTEST:

By: Mali Chamness, City Clerk

Certified to be a true and correct copy of the original.
Iva Pittman
Deputy Clerk
City of Clewiston, Florida

By: Iva Pittman
Deputy Clerk

Date: 7-20-01

MEMORANDUM

Date: July 10th, 2001

To: Interested Party

From: U.S. Army Corps of Engineers
Jacksonville District

Re: S-169/Nine Mile Canal Basin General Reevaluation Study
Summary of June 12th 2001 Public Workshop

On June 12th 2001, the United States Army Corps of Engineers (Corps) convened a public workshop at John Boy Auditorium in Clewiston, FL to discuss the S-169/Nine Mile Canal Basin General Reevaluation Study. The study will consider modifications to S-169 while addressing the water resource demands of the Nine Mile Canal Basin. Attending the workshop as representatives for the Corps was Mr. Brad Clark, Ms. Janet Cushing, Mr. Grady Caulk, Ms. Jocelyn Gaffney, Ms. Stephanie Jenkins, Ms. Tiphanie Jinks, Ms. Karen Estock, Mr. Dan Peck, Mr. Sam Honeycutt, and Mr. Curt Thompson. Also attending the workshop were representatives from the South Florida Water Management District, the local sponsor, Ms. Vicki Lehr, Mr. Gene Tanner, and Mr. Fred Remen. Mr. Tommy Perry a representative for Johnson and Prewitt, consultants for the City of Clewiston, was also present.

The workshop convened with a description of the workshop goals and public participation process by Ms. Jinks. Mr. Clark then briefly summarized the background of the project and the General Reevaluation process. Written materials were provided which detailed this process and the opportunities for public involvement in the process. Mr. Clark indicated that there would be subsequent public workshops to consider and refine the alternatives. Mr. Clark then proceeded to explain the reasons for initiating this study. He described them as problems associated with lack of adequate water supply which contributes to fish kills, flood control, safety and navigation, and commercial benefits for fisherman, guides, and marina owners.

Next, Ms. Cushing discussed NEPA, the National Environmental Policy Act and the two documents that are the result of the NEPA process-the Environmental Impact Statement (EIS) or the Environmental Assessment (EA). Afterwards, Ms. Cushing explained the public involvement part of the NEPA process, saying that an agency is required to involve the public in the preparation of an Environmental Assessment.

Finally, the floor was turned over to Mr. Clark and Ms. Jinks to begin the public question and answer session. Members of the public were asked to fill out a sign-in card and indicate their interest in speaking. Forms for written comments were also provided. Written comments could either be turned in at the meeting or mailed in afterwards. No comments were mailed in afterwards. Some of the comments provided at the meeting are summarized below.

One commentator felt that the main problem with S-169 is that it will not pass the flood waters being pumped into the Industrial Canal when the lake is above 15.5 ft. MSL. The commentator

suggested that the flow capacity of S-169 be increased by enlarging it or moving it west of Culvert No. 2. Alternatives should also consider the scenic trailhead project.

The next commentator stated that a pump should be included to raise the water level in the Industrial Canal to between 11.0 and 12.5 feet to alleviate problems with irrigation and the marinas being dry.

Another commentator stated that whatever is done needs to take into consideration problems with irrigation and drainage. The commentator also stated that we need to look at the drainage as well as the lands that are tributary to C-21 that are utilizing C-21 water through S-169. The size and location of S-169 should also be considered when choosing an alternative. S-169 should be moved further west.

The next commentator was concerned with how the project will impact the pool between Ortona Lock and Moore Haven where two unregulated culverts are located on C-43.

One commentator wanted to know what mechanism is going to be in place when the levels in the Industrial Canal are raised and how will boat traffic be accommodated.

The workshop adjourned.

STATE OF FLORIDA
DEPARTMENT OF COMMUNITY AFFAIRS
"Dedicated to making Florida a better place to call home"

JEB BUSH
Governor

STEVEN M. SEIBERT
Secretary

July 9, 2001

Mr. James C. Duck
Department of the Army
Jacksonville District Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

RE: Department of the Army - Jacksonville District Corps of Engineers - Scoping Notice - Control Structure 169 (S-169)/Nine-Mile Canal Basin Project - Hendry County, Florida
SAI: FL 200105130295C

Dear Mr. Duck:

The Florida State Clearinghouse, pursuant to Executive Order 12372, Gubernatorial Executive Order 95-359, the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended, and the National Environmental Policy Act, 14 U.S.C. §§ 4321, 4331-4335, 4341-4347, as amended, has coordinated the review of the above-referenced project.

The Department of Environmental Protection (DEP) offers a number of comments and concerns regarding information contained in the Notice. DEP states that the Notice does not, among other issues, present plan goals, objectives, and policies clearly; does not list current problems; does not provide adequate water-level information; does not adequately assess backpumping; and does not address how sediment issues will be handled. Please refer to the enclosed DEP comments for more detail.

The South Florida Regional Planning Council (SFRPC) states that it does not have enough information regarding the project's scope and requests that the Corps of Engineers respond to a list of provided questions. We have enclosed the SFRPC's comments for your review and consideration.

2555 SHUMARD OAK BOULEVARD • TALLAHASSEE, FLORIDA 32399-2100
Phone: (850) 488-8466/Suncom 278-8466 FAX: (850) 921-0781/Suncom 291-0781
Internet address: http://www.dca.state.fl.us

CRITICAL STATE CONCERN FIELD OFFICE
2796 Overseas Highway, Suite 212
Marathon, FL 33050-2227
(305) 289-2402

COMMUNITY PLANNING
2555 Shumard Oak Boulevard
Tallahassee, FL 32399-2100
(850) 488-2356

EMERGENCY MANAGEMENT
2555 Shumard Oak Boulevard
Tallahassee, FL 32399-2100
(850) 413-9969

HOUSING & COMMUNITY DEVELOPMENT
2555 Shumard Oak Boulevard
Tallahassee, FL 32399-2100
(850) 488-7956

Based on the information contained in the notice of intent and the comments provided by our reviewing agencies, the state does not object, at this stage, to the project's continued development. However, please be aware that the project is subject to review by the state of Florida for consistency with the Florida Coastal Management Program (FCMP). Consequently, the Corps should provide the Florida State Clearinghouse with a consistency determination in accordance with 15 C.F.R. 930.39 as soon as it becomes available. We encourage the Corps to coordinate submission of this determination with the submission of the project's draft Environmental Assessment.

Thank you for the opportunity to review this project. If you have any questions regarding this letter, please contact Ms. Jasmin Raffington at (850) 922-5438.

Very truly yours,

Sandra Davis Duncan for

Steven M. Seibert
Secretary

JFM/hv

Enclosures

cc: Robert Hall, Department of Environmental Protection
Wayne Daltry, South Florida Regional Planning Council

Southwest Florida Regional Planning Council

4980 Bayline Drive, 4th Floor, N. Ft. Myers, FL 33917-3909 (941) 656-7720

P.O. Box 3455, N. Ft. Myers, FL 33918-3455 SUNCOM 749-7720

FAX 941-656-7724

May 29, 2001

Ms. Cherie Trainor
Florida State Clearing House
Florida Department of Community Affairs
2555 Shumard Oak Boulevard
TALLAHASSEE, FL 32399-2100

RE: IC&R Project #2001-187
USACE # Scoping Notice
SAI #FL200105130295C
Council Staff Comments Regarding The U.S. Army Corps of Engineers' Scoping Study For Control Structure 169 (S-169), Nine Mile Canal Basin, City of Clewiston, Hendry County.

Dear Ms. Trainor:

The staff of the Southwest Florida Regional Planning Council reviews various proposals, Notifications of Intent, Preapplications, permit applications, and Environmental Impact Statements for compliance with regional goals, objectives and policies, as determined by the Strategic Regional Policy Plan. The staff reviews such items in accordance with the Florida Intergovernmental Coordination and Review Process (Chapter 29I-5, F.A.C.), and adopted regional clearinghouse procedures.

Normally, staff provides such projects with a recommendation as to whether or not the project is regionally significant (or less than regionally significant) and whether the project is consistent with the adopted Strategic Regional Policy Plan. However, periodically Regional staff encounters items where a consistency determination is not at issue, and an exchange of information between agencies is beneficial. The tussock removal issue for Lake Okeechobee is one such item.

Regional staff has previously commented to your office upon activities related to the above-referenced scoping study. Staff commented upon SAI #FL200104180182C, which concerned maintenance dredging of the Industrial Canal. Staff found the proposed maintenance dredging to be "Regionally Significant and Consistent", based upon a recommendation that standard manatee protection measures be followed during the maintenance dredging process.

The Corps' scoping study requests that respondents provide comments in support of one of six possible alternative measures to be taken to alleviate low water levels in the Industrial Canal. Regional staff does not that we currently have enough information to recommend selection of one of the six alternatives. Therefore, with a copy of this letter, staff is requesting that the Corps of Engineers and/or the South Florida Water Management District respond to the following questions:

1. What is the relationship between the scoping study and the previous maintenance dredging permit request? Does the selection of one of the alternatives impact the proposed maintenance dredging?

2. If pumpage by the agricultural community to the east of Clewiston has contributed to navigational and water quality problems within the Industrial Canal, should not the agricultural pumping be halted, or at least limited? Likewise, the low lake levels would seem to require that normal water uses be curtailed in some fashion.

3. Given the fact that the area is currently suffering through a drought, and that the coming rainy season could alleviate the low water levels in the lake and the canal, would any of the proposed six alternative actions require permanent alterations to S-310, the Industrial Canal, and/or the Basin, or are the six alternatives merely temporary?

Regional staff believes that responses to the above-questions will aid us in forming an opinion as to which of the six alternatives is the best solution to the problems within the Nine-Mile Canal Basin. We are willing to meet with the Corps of Engineers, and/or its agents, to discuss the proposed activities and the staff comments. Likewise, staff would be willing to meet with other agencies or parties concerning any issues regarding the proposed alternatives. Please contact Mrs. Nichole Gwinnett, IC&R Coordinator, or Mr. Glenn Heath, Senior Planner, with any such request, or with any questions concerning staff review of this item.

Sincerely,

SOUTHWEST FLORIDA REGIONAL PLANNING COUNCIL

Wayne Daltry
Executive Director

WED/geh

cc: Ms. Nichole Gwinnett, IC&R Coordinator, Southwest Florida Regional Planning Council
Ms. Janet Cushing, U.S. Army Corps of Engineers
Ms. Maureen Finnerty, Superintendent, Everglades National Park
Chief, Protected Species Branch, National Marine Fisheries Service
Mr. Richard Harvey, U.S. Environmental Protection Agency
Mr. Stephen W. Forsythe, State Supervisor, U.S. Fish and Wildlife Service
Water Resources Division, U.S. Geological Survey
Mr. Joe Frank, Acting Superintendent, Bureau of Indian Affairs
Ms. Linda McCarthy, Florida Department of Agriculture
Ms. Diane Conway, U.S. Department of Agriculture
Ms. Olivia McClean, South Florida Water Management District
Mr. Herbert Zebuth, Florida Department of Environmental Protection
Ms. Bonnie Kranzer, Governor's Commission On A Sustainable South Florida
Ms. Mary Ann Poole, Florida Fish and Wildlife Conservation Commission

ccc: Mr. Larry Slayback, Florida Department of Transportation
Mr. Gene Duncan, Miccosukee Tribe of Indians
Mr. Craig Tepper, Seminole Tribe of Indians
Ms. Rosa Durando, Audubon Society of The Everglades
Mr. Fran Stallings, Save the Manatee
Mr. Carrol Head, President, Friends of Lake Okeechobee
Ms. Brenda H. Marshall, Trust For Public Lands
Mr. M. Franklyn Jones, Director of Engineering Planning, U.S. Sugar Corporation
Ms. Barbara Miedema, Sugar Cane Growers Cooperative
Florida Citrus Mutual
Dr. Peter Rosendahl, Flo-Sun, Incorporated
Mr. Ed English, Gulf Citrus Growers
Mr. Joe Pearce, Florida Cattlemen's Association
Mr. Tom Jones, South Florida Agricultural Council
Mr. John W. Dunckelman, Florida Sugar Cane League, Incorporated
Okeechobee Waterway Association
Mr. Lester B. Baird, County Administrator, Hendry County
Honorable James L. Pittman, Mayor, City of Clewiston

Department of Environmental Protection

Jeb Bush
Governor

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

David B. Struhs
Secretary

June 13, 2001

Ms. Jasmin Raffington
Florida State Clearinghouse
Department of Community Affairs
2555 Shumard Oak Boulevard
Tallahassee, Florida 32399-2100

Re: Department of the Army, Corps of Engineers, Scoping Notice, Control Structure 169, Nine-Mile Canal Basin Project, Hendry County

RECEIVED
JUN 19 2001
State of Florida Clearinghouse

SAI: F200105130295C

Dear Ms. Raffington:

We have reviewed the above-referenced Scoping Notice and offer the following comments.

Comments:

The proposed project and its six alternatives need to be clarified in the Environmental Assessment (EA) so that the stated objectives are compatible and complimentary.

The Goals, objectives, and problems to be resolved are neither clearly presented, nor are their proposed solutions. In one paragraph the objective is stated as, "The current objective of the S-169/Nine-Mile canal Basin Project is to reaffirm, reformulate, or modify S-169 and/or other structures in the basin to improve drainage and water control in Canal 21 and to the Industrial Canal." Problems associated with inadequate drainage were not presented. In another paragraph, the problem to be addressed is presented as, "The lake's low water level and the agricultural use of water from the canal have resulted in extremely low water levels in the Industrial Canal; this has led to water craft damages, impediments to navigation, structural damage to marinas, and fish kills." In the information provided, the stated problem of low water levels in the Industrial Canal and lake does not seem to relate to the objective to "improve drainage and water control in the Canal 21." A third paragraph contains another objective of the proposed project, "to allow more water to stage in the Industrial Canal." This objective is related to the stated problem.

Information is not provided relative to the frequency of the low water level in the Industrial Canal or the water level at which related problems occur. At about 9 feet NGVD, Lake Okeechobee is at the lowest level ever recorded. A statement is made that, "As a temporary solution, the South Florida Water Management District has been operating Canal Lock Structure 310 (S-310) during non-duty hours to allow water to flow into the Industrial Canal." Normal operating procedure is for the S-310 Boat Lock to remain fully open 24 hours a day, when the lake level drops below 15.5 feet NGVD.[1] As a result, the lake and the Industrial Canal would be at the same elevation. Recently, for a period of about two weeks, the SFWMD operated the boat lock to allow compliance personnel to determine both agricultural water withdrawals from the Industrial Canal and conformance with water allocations during the drought. Currently, the boat lock is fully opened at all times.

Most of the alternatives seem to be designed to allow water levels in the Industrial Canal to be maintained at an unspecified level that would be higher than the current very low level in the lake. The following questions are associated with this objective and should be addressed in the EA.

1) What water level is considered necessary and why?
2) How often would the problem reoccur if no action were taken?
3) What is the cost benefit ratio associated with the proposed solutions?
4) What other causes such as shoaling, erosion and sedimentation could exist for the problems listed in the Corps document; and,
5) What solutions would address these problems?

Some of the current problems are not listed. Lake Okeechobee is on the verge of hypereutrophication. Eight primarily agricultural drainage pump stations with a capacity in excess of 1100 cfs discharge directly into the Industrial Canal. An even larger discharge is pumped into the C-21 Canal. Phosphorus loading to the lake from all inflows is many times higher than the proposed Total Maximum Daily Load limit. Water quality treatment is not provided for the drainage discharged to the lake at either the S-310/Industrial Canal or the S-4 Pump Station. Questions related to this discharge are:

1) How will discharge to the lake at C-2 be altered?
2) How will the alternatives affect both the quantity and quality of water discharged to Lake Okeechobee? and,
3) How will the project address the current lack of adequate water quality treatment for basin discharges to the lake?

Subsequent to the Lake Okeechobee Technical Advisory Committee Report in the mid-1980s, suggestions have been made to provide treatment for basin discharges. Some of these suggestions have involved routing the Industrial Canal around and separating it from the S-310 Boat Lock and the associated marinas. It would be directly connected to the C-21 Canal. All basin drainage would be provided with water quality treatment by a stormwater treatment area adjacent to the S-4 Pump Station when the lake is 15.5 feet NGVD or higher. The EA should explain how the alternatives would affect such a proposal.

---

[1] Local boating interests find it inconvenient to pass through an operational boat lock.

One of the issues raised during the 1999 Restudy of the Central and South Florida Flood Control Project was the potential redirection of flow from much of this basin to its natural, historic location, south to the Everglades. Although not included in the Comprehensive Everglades Restoration Project (CERP) because of time limitations, redirection of this flow with water quality treatment could be explored in the near future when addressing the issue of the potential shortfall of 245,000 acre-feet of water for Everglades National Park and Florida Bay. Water quality within the canals is of poor quality, containing high levels of phosphorus, as well as pesticides and herbicides, and will need to be improved before it is directed to the Everglades. The EA will also need to determine if other CERP issues may affect this basin, and if so, what are they, and how will they be evaluated and subsequently considered?

The potential impacts related to backpumping need to be assessed. By increasing the volume of water available in the C-21 and Industrial Canal, the potential for flooding lands downstream is increased with heavy rain events. The EA needs to address how this water will be managed. With the adoption of the Lake Okeechobee phosphorus TMDL last month, it is not appropriate to generate additional phosphorus loads to the lake. Overall, any modifications to the lake and its surrounding watershed need to be consistent with the current phosphorus reduction restoration goal as mandated by Section 373.4595, Florida Statutes. The EA needs to explain how the proposed alternatives will address this issue.

The EA also needs to describe how the sediments to be removed from canals related to alternatives 3 and 6 will be handled. Sediments from C-21 and the Industrial Canal are laden with phosphorus from the various agricultural activities and will need to be properly disposed. They should not be allowed to return to the lake.

A re-evaluation of the project will be conducted during the environmental documentation and permitting stage. Future consistency will be based in part on adequate consideration of comments presented in this and subsequent reviews, as well as a determination of consistency with the 1999 C&SF Project Comprehensive Review Study.

Questions related to the technical aspects of this project should be referred to either Mr. Herb Zebuth at 561/681-6703, or Ms. Kimberly Shugar at 850/921-9395. If you have questions regarding this letter, or if we may be of further assistance at this time please give me a call at (850) 487-2231.

Sincerely,

Robert W. Hall
Office of Intergovernmental Programs

cc: Herb Zebuth
John Outland
Kimberly Shugar
Ron Blackburn

SAI Routing Sheet

COUNTY: Hendry

Message:

DATE: 05/13/2001

SAI#: FL200105130295C

PROJECT TO BE REVIEWED BY: (Div/Program)	ASSIGNED REVIEWERS (Print Last Name)	IS PROJECT LOCATED IN APPROVED DRI? (Circle Yes/No) YES: Is Project Consistent with DO?	NO: Is Project DRI Scale?	Is Project CONSISTENT w/ COMPLAN?	Is Project CONSISTENT w/ FCMP?	Do you have any COMMENTS on project?	DATE REVIEW COMPLETED	RVWR/ SUPV INIT
DCP	RWD	YES / NO	YES / NO	NA			5/17/01	RWD
5/17/01 (Date Rec'd)		Monitoring Letter? YES / NO	Monitoring Letter? YES / NO					
Complete and forward to Div/Prog Below no later than: 05/28/2001								
CMP	Vinson	Wetlands? YES / NO	Stormwater? YES / NO			X	6/22	HW
5/21/01 (Date Rec'd)								
Complete and forward to ACC Coordinator no later than: 06/12/2001								

UNIT COORDINATORS for Intergovernmental Coordination and Review:

ACC	Agency Contact Coordinator	DiAnne Cobb	Room 310.02	414-5497
CMP	Florida Coastal Management Program	DiAnne Cobb	Room 310.02	414-5497
FCT	Florida Communities Trust (Ofc of Sec)	Keith McCarron	Room 310C	922-1703
DCP	Division of Community Planning	Debbie Johnson	Room 365.02	488-2356

The attached document requires a Coastal Zone Management Act/Florida Coastal Management Program consistency evalutation and is categorized as one of the following:

___ **Federal Assistance to State or Local Government (15 CFR 930, Subpart F). Agencies are required to evaluate the consistency of the activity.**

_X_ **Direct Federal Activity (15 CFR 930, Subpart C). Federal Agencies are required to furnish a consistency determination for the State's concurrence or objection.**

___ **Outer Continental Shelf Exploration, Development or Production Activities (15 CFR 930, Subpart E). Operators are required to provide a consistency certification for state concurrence/objection.**

___ **Federal Licensing or Permitting Activity (15 CFR 930, Subpart D). Such projects will only be evaluated for consistency when there is not an analogous state license or permit.**

Project Description:

Department of the Army - District Corps of Engineers - Scoping Notice - Control Structure 169 (S-169)/Nine-Mile Canal Basin Project - Hendry County, Florida.

EO. 12372/NEPA ☐ No Comment ☐ Comments Attached ☐ Not Applicable

Federal Consistency ☐ No Comment/Consistent ☐ Consistent/Comments Attached ☐ Inconsistent/Comments Attached ☐ N/A

INSTRUCTIONS:

1. UNIT COORDINATORS are responsible for logging in, logging out, and hand-carrying/mailing project packages to the next reviewing unit on this form, or to the ACC if all review requirements have been met. Failure to meet internal suspense dates may result in loss of opportunity to comment on critical issues.

2. Requests for EXTENSIONS should be made prior to due date, especially if COMMENTS will be submitted. Contact your UNIT COORDINATOR, who will request the EXTENSION from the ACC.

3. Agency COMMENTS on SAIs will be sent to the State Clearinghouse (SCH) and should be prepared in LETTER format for the Secretary's signature. Forward the project package to the next review unit while your COMMENTS are being drafted. Coordinate your comments with other reviewers prior to finalizing.

COUNTY: Hendry

Message:

DATE: 05/13/2001
COMMENTS DUE DATE: 06/12/2001
CLEARANCE DUE DATE: 06/25/2001
SAI#: FL200105130295(

STATE AGENCIES	WATER MANAGEMENT DISTRICTS	OPB POLICY UNITS
Community Affairs Environmental Protection Fish & Wildlife Conserv. Comm State X Transportation	South Florida WMD	Environmental Policy/C & ED

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Project Description:

Department of the Army - District Corps of Engineers - Scoping Notice - Control Structure 169 (S-169)/Nine-Mile Canal Basin Project - Hendry County, Florida.

Yasmin Roffington

To: Florida State Clearinghouse
Department of Community Affairs
2555 Shumard Oak Boulevard
Tallahassee, FL 32399-2100
(850) 922-5438 (SC 292-5438)
(850) 414-0479 (FAX)

EO. 12372/NEPA

- [x] No Comment
- [ ] Comments Attached
- [ ] Not Applicable

Federal Consistency

- [x] No Comment/Consistent
- [ ] Consistent/Comments Attached
- [ ] Inconsistent/Comments Attached
- [ ] Not Applicable

FAXED

From:
Florida Department of Transportation
District One - Southwest Area Office
P.O. Box 1030
Fort Myers, FL 33902-1030

Division/Bureau:

Reviewer: J. Philips / G. Saybeck

Date: 6-12-01

COUNTY: Hendry

Message:

DATE: 05/13/2001
COMMENTS DUE DATE: 06/12/2001
CLEARANCE DUE DATE: 06/25/2001
SAI#: FL200105130229

STATE AGENCIES	WATER MANAGEMENT DISTRICTS	OPB POLICY UNITS
Community Affairs Environmental Protection Fish & Wildlife Conserv. Comm State X Transportation	South Florida WMD	Environmental Policy/C & ED

The attached document requires a Coastal Zone Management Act/Florida Coastal Management Program consistency evalutation and is categorized as one of the following:

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Project Description:

Department of the Army - District Corps of Engineers - Scoping Notice - Control Stru[illegible] 169 (S-169)/Nine-Mile Canal Basin Project Hendry County, Florida.

RECEIVED
JUN 18 2001
State Florida Clearinghouse

Jasmine Raffington

To: Florida State Clearinghouse
Department of Community Affairs
2555 Shumard Oak Boulevard
Tallahassee, FL 32399-2100
(850) 922-5438 (SC 292-5438)
(850) 414-0479 (FAX)

EO. 12372/NEPA

- [x] No Comment
- [ ] Comments Attached
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- [ ] Not Applicable

FAXED

From:
Florida Department of Transportation
District One - Southwest Area Office
P.O. Box 1030
Fort Myers, FL 33902-1030

Division/Bureau:

Reviewer: J. Philips / [illegible]

Date: 6-12-01

Southwest Florida Regional Planning Council

4980 Bayline Drive, 4th Floor, N. Ft. Myers, FL 33917-3909 (941) 656-7720

P.O. Box 3455, N. Ft. Myers, FL 33918-3455 SUNCOM 749-7720

FAX 941-656-7724

May 29, 2001

Ms. Cherie Trainor
Florida State Clearing House
Florida Department of Community Affairs
2555 Shumard Oak Boulevard
TALLAHASSEE, FL 32399-2100

RE: IC&R Project #2001-187
USACE # Scoping Notice
SAI #FL200105130295C
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Printed on Recycled Paper

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Sincerely,

SOUTHWEST FLORIDA REGIONAL PLANNING COUNCIL

Wayne Daltry
Executive Director

WED/geh

cc: Ms. Nichole Gwinnett, IC&R Coordinator, Southwest Florida Regional Planning Council
Ms. Janet Cushing, U.S. Army Corps of Engineers
Ms. Maureen Finnerty, Superintendent, Everglades National Park
Chief, Protected Species Branch, National Marine Fisheries Service
Mr. Richard Harvey, U.S. Environmental Protection Agency
Mr. Stephen W. Forsythe, State Supervisor, U.S. Fish and Wildlife Service
Water Resources Division, U.S. Geological Survey
Mr. Joe Frank, Acting Superintendent, Bureau of Indian Affairs
Ms. Linda McCarthy, Florida Department of Agriculture
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Mr. M. Franklyn Jones, Director of Engineering Planning, U.S. Sugar Corporation
Ms. Barbara Miedema, Sugar Cane Growers Cooperative
Florida Citrus Mutual
Dr. Peter Rosendahl, Flo-Sun, Incorporated
Mr. Ed English, Gulf Citrus Growers
Mr. Joe Pearce, Florida Cattlemen's Association
Mr. Tom Jones, South Florida Agricultural Council
Mr. John W. Dunckelman, Florida Sugar Cane League, Incorporated
Okeechobee Waterway Association
Mr. Lester B. Baird, County Administrator, Hendry County
Honorable James L. Pittman, Mayor, City of Clewiston

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

July 8, 2003

James C. Duck
Chief, Planning Division
U.S. Army Corps of Engineers
701 San Marco Boulevard
Jacksonville, Florida 32207-8175

Dear Mr. Duck:

The enclosed draft report is submitted in compliance with the Scope of Work for the S-169/Nine Mile Canal Basin General Reevaluation Report in which a draft Fish and Wildlife Coordination Act (FWCA) report is to be provided for your review. This report is provided in accordance with the FWCA, as amended (16 U.S.C. 661 *et seq.*) and the Endangered Species Act (ESA) of 1973, as amended (87 Stat. 884; 16 U.S.C. 1531 *et seq.*).

This letter does not constitute a Biological Opinion as described under section 7 of the ESA. The U.S. Army Corps of Engineers (Corps) has not yet submitted a biological assessment or effect determination for this project as required by the ESA. We anticipate that the effect determination will be sent for our review after the draft Environmental Assessment (EA) is issued, but before this FWCA report is finalized. Additionally, after consultation is concluded, if modifications are made to the selected plan, or if additional information involving potential impacts on listed species becomes available, reinitiation of consultation may be necessary.

By copy of this letter, the Service is soliciting comments within 45 days from the Florida Fish and Wildlife Conservation Commission (FWC), and their comments will be considered by the Service in preparing a final FWCA report. A copy of the comments will be included as an appendix to our final report, which will then constitute the Secretary of the Interior's views and recommendations for the S-169/Nine Mile Canal Basin General Reevaluation Report, in accordance with section 2 (b) of the FWCA. The final FWCA report will be incorporated in the Corps' final EA for full disclosure and public review and comment in accordance with the provisions of the National Environmental Policy Act.

Please contact Steve Schubert at 772-562-3909, extension 249, regarding the findings and recommendations contained in this draft report. The cooperation of your staff and the staff of the local sponsor, the South Florida Water Management District, is greatly appreciated.

Sincerely yours,

James J. Slack
Field Supervisor
South Florida Ecological Services Office

Enclosure

cc:
FWC, Vero Beach, Florida (Joe Walsh)
FWC, Tallahassee (Carol Knox)
SFWMD, West Palm Beach, Florida (Victoria Lehr)
Corps, Jacksonville, Florida (Kathy Meyers)
BRD, USGS, Miami, Florida (Ronnie Best)
Service, Atlanta, Georgia (Cynthia Dohner)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

September 22, 2003

James C. Duck
Chief, Planning Division
U.S. Army Corps of Engineers
701 San Marco Boulevard
Jacksonville, Florida 32207-8175

Dear Mr. Duck:

The enclosed revised draft report is submitted in compliance with the Scope of Work for the S-169/Nine-Mile Canal Basin General Reevaluation Report in which a draft Fish and Wildlife Coordination Act (FWCA) report is to be provided for your review. This report is provided in accordance with the FWCA, as amended (16 U.S.C. 661 *et seq.*) and the Endangered Species Act (ESA) of 1973, as amended (87 Stat. 884; 16 U.S.C. 1531 *et seq.*).

This letter does not constitute a biological opinion as described under section 7 of the ESA. The U.S. Army Corps of Engineers (Corps) has not yet submitted a biological assessment or effect determination for this project as required by the ESA. We anticipate that the effect determination will be sent for our review after the draft Environmental Assessment (EA) is issued, but before this FWCA report is finalized. Additionally, after consultation is concluded, if modifications are made to the selected plan, or if additional information involving potential impacts on listed species becomes available, reinitiation of consultation may be necessary.

By copy of this letter, the Service is soliciting comments within 45 days from the Florida Fish and Wildlife Conservation Commission, and their comments will be considered by the Service in preparing a final FWCA report. A copy of the comments will be included as an appendix to our final report, which will then constitute the Secretary of the Interior's views and recommendations for the S-169/Nine-Mile Canal Basin General Reevaluation Report, in accordance with section 2 (b) of the FWCA. The final FWCA report will be incorporated in the Corps' final EA for full disclosure and public review and comment in accordance with the provisions of the National Environmental Policy Act.

Please contact Steve Schubert at 772-562-3909, extension 249, regarding the findings and recommendations contained in this revised draft report. The cooperation of your staff and the staff of the local sponsor, the South Florida Water Management District, is greatly appreciated.

Sincerely yours,

James J. Slack
Field Supervisor
South Florida Ecological Services Office

Enclosure

cc: w/ enclosure
Corps, Jacksonville, Florida (Kathy Meyers)
FWC, Vero Beach, Florida (Joe Walsh)
Service, Atlanta, Georgia (Cynthia Dohner)
Service c/o Corps, Jacksonville, Florida (Miles Meyer)
SFWMD, West Palm Beach, Florida (Victoria Lehr)
USGS, Miami, Florida (Ronnie Best)

2-28-05

Planning Division
Environmental Branch

FEB 28 2005

Mr. James J. Slack
Field Supervisor, South Florida
Ecological Services Field Office
U.S. Fish and Wildlife Services
1339 20th Street
Vero Beach, Florida 32960-3559

Dear Mr. Slack:

Reference is made to the U.S. Fish and Wildlife Service (FWS) letter dated December 30, 2004, submitted in response to the U.S. Army Corps of Engineers (Corps) species effect determinations and request for consultation under the Endangered Species Act (FWS Log Number: 4-1-04-I-8885) regarding impacts associated with the modifications and relocations proposed at Structure 169 (S-169). The project is located south of the Herbert Hoover Dike and west of the Industrial Canal in Clewiston, Hendry County, Florida.

The FWS has communicated concurrence (with clarification as outlined in your letter) to the endangered species effect determination submitted by the Corps. As indicated in past discussions with representatives of your staff and as outlined in your letter, the sponsor, South Florida Water Management District, has approved the installation of a retractable manatee barrier on the east side of S-169R. Additionally, the Corps will ensure the project area is surveyed for the presence of the Okeechobee gourd prior to construction. This commitment also extends to the protection provisions recommended for the 1) bald eagle which recheck nest distribution prior to construction; 2) eastern indigo snake protection measures to remain in effect during construction, as well as, during any gopher tortoise relocation that may be required by the Florida Fish and Wildlife Conservation Commission. With respect to the protection

measures as recommended in the FWS *Habitat Management Guidelines For The Wood Stork In the Southeast Region (1990)*, there are no known wood stork colonies within 30 miles of the project area

(Draft CAR, 2003). Additionally, the project is not located within the core foraging areas (18.5 miles from the nesting colony) or within identified roosting habitat areas. The only potential for wood stork impact would be at a forested wetland located north of Canal-21 and perpendicular to the Herbert Hoover Dike. Tieback levee construction would extend 70 meters into the wetland area. The Corps believes these potential impacts can be avoided during the project design phase.

In an effort to ensure the species the widest protection possible, the Corps is willing to commit to plan and specifications protection measures as outlined in the Wood Stork Habitat Management Guidelines under Section IV, Management Zones and Guidelines for Feeding Sites, and Section VII, Legal Considerations (Federal and State of Florida Statutes).

If you have any questions or desire to discuss this project further, please contact Ms. Catherine L. Brooks, by telephone at 904-232-2130 or email catherine.l.brooks@saj02.usace.army.mil.

Sincerely,

James C. Duck
Chief, Planning Division

bcc:
CESAJ-PD-ES (M. Meyer)

Brooks/CESAJ-PD-EG/2130 18 Feb 05
Dugger/CESAJ-PD-EG
D. Ross/CESAJ-DP-I 2/2/05
Mason/CESAJ-PD-E
Duck/CESAJ-PD

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

December 30, 2004

James C. Duck
Chief, Planning Division
U.S. Army Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

Attention: Catherine L. Brooks

Service Log No.: 4-1-04-I-8885
Letter Dated: August 19, 2004
Project: Structure 169 Modifications
County: Hendry

Dear Mr. Duck:

The Fish and Wildlife Service (Service) has reviewed the biological assessment and effect determinations for the proposed modifications to, and relocation of, the existing Structure 169 (S-169), located south of the Herbert Hoover Dike (HHD) and west of the Industrial Canal, in Clewiston, Hendry County, Florida. This letter represents the Service's analysis of the effects of the proposed action in accordance with section 7 of the Endangered Species Act of 1973, as amended (ESA) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). The Service issued a draft Fish and Wildlife Coordination Act (FWCA) report for this project on September 22, 2003. In that report, we outlined several concerns and made recommendations relating to: (1) alternative evaluation and selection; (2) threatened and endangered species; (3) water flows to Lake Okeechobee; (4) wetland mitigation; and (5) additional studies. We anticipate the U.S. Army Corps of Engineers' (Corps) issuance of a draft Environmental Assessment and General Re-evaluation Report by December 2004. Afterwards, we will issue a final FWCA report.

PROJECT DESCRIPTION

The Corps has initiated consultation under the ESA for modifications to the S-169. The initial authorization for modification of existing flood control structures and culverts was received under the Flood Control Act of 1948 (PL 80-858). Subsequent structural modifications received authorization under the Flood Control Acts of 1954 and 1968. These modifications are needed to address water supply problems in the Nine-Mile Canal Basin associated with the S-169 and lock Structure 310 (S-310). The S-169 and S-310 are discharge points for the easternmost portion (*i.e.*, Industrial Canal) of the Nine-Mile Canal Basin and a small area of the northwestern portion of the Miami Canal drainage area.

TAKE PRIDE® IN AMERICA

The degree of water control in the Nine-Mile Canal Basin is not sufficient to safely provide agricultural water supply for users connected to the Industrial Canal when stages in Lake Okeechobee are greater than 15.5 feet. When lake stages are higher than 15.5 feet, the S-310 (the connection to the lake) is designed to be closed to control water levels in the Industrial Canal and Canal 21 (C-21) east of S-169. However, the South Florida Water Management District (District) has been operating the S-310 to allow water to stage in the Industrial Canal for water supply when the lake stage is greater than 15.5 feet.

Operating the S-310 in a non-navigational manner (*i.e.,* allowing water to free-flow through partially opened lock gates) when the lake surface is higher than 15.5 feet, is unsafe because the flow velocity resulting from such operations can cause sediment scouring which can undermine the structural integrity of the S-310 and also cause formation of sandbars farther downstream, which can be a hazard to navigation. Such operations are unsafe for approaching vessels and have caused bank erosion. Additionally, the normal mechanical or electrical safety features of the lock have to be overridden in order to make releases through the structure.

A permanent solution has been proposed that would address the water supply problem. The project would include:

(1) Demolition of the existing S-169 and installation of a span bridge to maintain access to the HHD;

(2) Relocation of the existing S-169 further west down the C-21 (to be named S-169R), and the installation of vertical slide gates on this new structure;

(3) Construction of a tieback levee from the new S-169R, north to the HHD;

(4) Retrofitting of the Culvert Number 2 including installation of vertical slide gates;

(5) Construction of a control building with generator at the new S-169R location; and

(6) Improvements to 1,850 linear feet of the south bank of the HHD by raising the dike to 20 foot elevation.

THREATENED AND ENDANGERED SPECIES

Five federally listed threatened or endangered animal species and one listed plant species are present or potentially present in or adjacent to the project area. They include the endangered Everglade snail kite (*Rostrhamus sociabilis plumbeus*), endangered wood stork (*Mycteria americana*), endangered West Indian manatee (*Trichechus manatus*), threatened bald eagle (*Haliaeetus leucocephalus*), threatened eastern indigo snake (*Drymarchon corais couperi*), and endangered Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeensis*). These species have been previously impacted by habitat degradation due to wetland drainage, nutrient-laden stormwater runoff, and a concurrent alteration of the hydroperiod.

In your biological assessment, the Corps determined that the project is "not likely to adversely affect" the snail kite, wood stork, or bald eagle. You also concluded that the project "may affect" the West Indian manatee, eastern indigo snake, and Okeechobee gourd. The Corps has made a commitment to implement standard construction precautions and other conservation guidance for these three species. If you believe that this implementation would avoid take of these three listed species, then your determination for the manatee, indigo snake, and Okeechobee gourd should have been "may affect, but is not likely to adversely affect." For the purpose of this review and consultation, we have assumed that clarification is accepted by the Corps.

Everglade Snail Kite

The snail kite occupies the watersheds of the Everglades, Lakes Okeechobee and Kissimmee, and the upper St. Johns River. "Each of these watersheds has experienced, and continues to experience, pervasive degradation due to urban development and agricultural activities" (Service 1999). Critical habitat was designated for the snail kite in 1977 and, since then, has not been revised. It is present immediately adjacent to the project area inside of the HHD, but also includes the Arthur R. Marshall Loxahatchee National Wildlife Refuge, Water Conservation Area 2, portions of Water Conservation Area 3, portions of Everglades National Park, western portions of Lake Okeechobee, the Strazzulla and Cloud Lake reservoirs in St. Lucie County, and portions of the St. Johns Marsh in Indian River County. A complete description of the critical habitat is available in 50 Code of Federal Regulations 17.95 (Service 1999). The snail kite could also be found foraging in a number of native wetlands and in canals and ditches adjacent to the project area. This medium-sized raptor has a highly specific diet composed almost entirely of Florida apple snails (*Pomacea paludosa*), which are found in palustrine emergent, long-hydroperiod wetlands. As a result, the snail kite's survival is directly dependent on the hydrology and water quality of its habitat (Service 1999). Determination of effect of this project on snail kite habitat would be based on the potential for the lowering of lake levels. If this occurred during high lake stages, little change would likely result. However, if this occurred during low lake stages, then foraging habitat as well as apple snail habitat could be reduced or lost. According to the 2002 Annual Snail Kite Demography Report, "the 2001 breeding season was impacted by a widespread drought, resulting in the complete absence of nesting activity and the dispersion of kites from virtually all of the surveyed wetlands, with the exception of central Florida lake habitats" (Martin et al. 2002). The long term effects of this loss to future snail kite population viability are unknown. This response to low lake levels underscores the necessity for the accurate determination of this project's effects on lake levels and the linkage to other compounding negative effects on this species. At this point in the planning process, it does not appear that this project will exacerbate low-water conditions in Lake Okeechobee.

Wood Stork

The wood stork is primarily associated with freshwater and estuarine habitats for nesting, roosting, and foraging. They have nested, at one time or another, in every county in south Florida. Currently, the closest recorded wood stork colony to the project area is approximately

30 miles away. Typical foraging sites include freshwater marshes and stock ponds; shallow, seasonally flooded roadside or agricultural ditches; narrow tidal creeks or shallow tidal pools; managed impoundments; and depressions in cypress heads and swamp sloughs. Wood storks use a specialized feeding behavior called tactolocation, or grope feeding. A foraging wood stork wades through the water with its beak immersed and partially open (7 to 8 centimeters). When it touches a prey item, a wood stork snaps its mandibles shut, raises its head, and swallows its prey (Kahl 1964). This unique feeding method gives it specialized habitat requirements; the habitats on which wood storks depend have been disrupted by changes in the distribution, timing, and quantity of water flows in south Florida. The loss and degradation of wetlands in central and south Florida are principal threats to the wood stork. The Everglades Agricultural Area alone eliminated 802,900 hectares (1,984,001 acres) of the original Everglades, an important loss of spatial extent of wood stork habitat (Service 1999). To minimize adverse effects to wood storks, we recommend the implementation of the Service's draft *Species Guidelines for the Wood Stork* as a special condition for this project.

West Indian Manatee

The West Indian manatee is regularly found in Lake Okeechobee and in the rim canal, which is directly adjacent to the project site. This large aquatic mammal migrates along the Florida coast through fresh, brackish, and marine waters, and exhibits a seasonal distribution based on water temperatures. Waters colder than 20 degrees Celsius increase the manatee's susceptibility to cold-stress and cold-induced mortality. Distribution is also controlled by aquatic vegetation availability, proximity to channels of at least 2 meters in depth, and location of freshwater sources (Service 1999). Watercraft-caused mortality is one of the principal threats to the manatee. Two confirmed watercraft-caused mortalities (1984 and 1993) occurred adjacent to the project area in the rim canal. Manatee mortality caused by water control structures and navigational locks is another potential threat to the species. Although no structure-related deaths have been recorded from the project area, there was one undetermined manatee death (1996) and one due to natural causes (1984) in the rim canal adjacent to the project area. In addition to the Corps' willingness to follow the standard construction precautions to protect manatees, the Service wants to ensure that any new or modified water control structures or pumps are designed and operated to avoid any increased risk of harm or mortality to manatees. According to the biological assessment, the Corps is also "investigating the possibility of including manatee protection systems (*i.e.*, acoustic sensors) on the new vertical lift gates."

The issue of manatee access to areas where they may become stranded or harmed (or any other form of take as defined by the ESA) is a concern for the Service. In accordance with the Marine Mammal Protection Act (MMPA), take of manatees is unauthorized; therefore, the Service cannot issue an incidental take statement for this species. Consequently, if the Service concludes that the S-169 project increases the risk of take to manatees, then formal consultation would need to be initiated with the Corps. However, due to requirements of the MMPA, the Service would not be able to conclude formal consultation and construction of the project would be in violation of both the MMPA and ESA.

Currently, manatees have access to approximately 25 miles of C-21, C-20, and lateral agricultural canals via the structures in the project area and the Culvert Number 1 (Cul-1) and Culvert Number 1A (Cul-1A) west of the project area. In July of 2004, three manatees entered the C-21 via the S-310. They moved to a point in the C-20 west of the location of the proposed S-169R. Manatee habitat in this area (as well as the remainder of the C-20 and C-21) is poor, and there was a risk of stranding and/or entrapment. These animals eventually moved back into Lake Okeechobee via Culvert Number 2 (Cul-2). They could have traveled west through the C-20 towards the S-235 (but not exited into the Caloosahatchee River because of a manatee barrier on the west side of the S-235). The manatees could have also entered Lake Okeechobee through either Cul-1 or Cul-1A if these structures were open and accessible.

The proposed alignment of the S-169R would provide an opportunity to limit manatee access to the C-20/C-21 system if constructed with an appropriate manatee barrier. Manatees would still have access to a short section of the C-21 on the east side of the S-169R, through the S-310 and Cul-2, when open and accessible. It is not feasible to "manatee-proof" the S-310 because it is a navigational structure. Cul-2 would provide an additional exit point back into Lake Okeechobee for manatees in the C-21; therefore, we are not recommending installation of a barrier on that culvert at this time. Manatees could still access the western portion of the C-20/C-21 system through Cul-1 and Cul-1A; however, the Service believes that this would be a rare event as those culverts would only be open when the lake stage is less than 13 feet. In the event that this occurs, manatees could become stranded on the west side of the S-169R if a manatee barrier was installed on this structure.

On November 2, 2004, the Service sent the Corps an email stating that if the Corps could accept the installation of a retractable manatee barrier on the S-169R, then informal consultation could proceed (email from Steve Schubert to Catherine Brooks). In order to reduce the risk of take to a *de minimus* level, the Service proposed that the Corps install, operate, and maintain a retractable manatee barrier on the east side of the proposed S-169R. This barrier would be constructed concurrently with the S-169R, and operated to eliminate manatee access through the structure from the east to the west. Should a manatee be found in the waters west of the S-169R (presumably having entered from the lake through either Cul-1 or Cul-1A), the barrier could be opened to allow the trapped manatee to move to the east side of the proposed S-169R, and back into Lake Okeechobee through either Cul-2 or S-310. If and when manatee barriers are placed on Cul-1 and Cul-1A through a more comprehensive strategy for manatee protection around Lake Okeechobee, then the retractable barrier on the S-169R would be permanently set to eliminate manatee access through that structure.

On November 8, 2004, a teleconference was held between the Corps and Service to discuss manatee issues. During the teleconference, the Corps indicated that they would install the removable manatee barrier on the east side of the S-169R, pending acceptance by the local sponsor for the project, the District.

On December 15, 2004, the Service received an email from the Corps (email from Miles Meyer to Barry Rosen) indicating that both the Corps and the District agree to installation of a removable manatee barrier on the east side of the S-169R when the new S-169R is constructed.

Bald Eagle

The bald eagle is slated to be removed from the endangered species list. They are considered common and known to breed throughout the State. Nest sites are usually located near large rivers, lakes, or estuaries where they feed primarily on fish and water-dependent birds. Their distribution is influenced by the availability of suitable nest and perch sites near large, open waterbodies, typically with high amounts of water-to-land edge (Service 1999). Our most recent nesting data for bald eagles shows no active nests close to the proposed construction, with the two nearest active nests about 10 miles and 12 miles away from the immediate project construction site. The closer of the two nests is in Palm Beach County, along the lake's rim canal at South Bay West, east of S-354. Because several eagle nests are active around the edge of Lake Okeechobee, there is a possibility that a new nesting territory could be established before construction of the project, so we recommend that the Corps recheck the most recent information regarding nest distribution several months prior to beginning any construction.

Eastern Indigo Snake

The eastern indigo snake is present throughout the State, but its abundance is reduced to a point where it is uncommon. Habitat includes pine flatwoods, scrubby flatwoods, high pine, dry prairie, tropical hardwood hammock, edges of freshwater marshes, agricultural fields, coastal dunes, and human-altered habitats. This species was listed as a result of dramatic population declines caused by over-collecting for the domestic and international pet trade, as well as mortalities caused by rattlesnake collectors who gassed gopher tortoise (*Gopherus polyphemus*) burrows to collect snakes. Since its listing, habitat loss and fragmentation by residential and commercial expansion have become much more significant threats to this species (Service 1999). Eastern indigo snakes could be encountered during construction; therefore, implementation of the standard construction practices to avoid adverse effect on this species is expected. The Corps has indicated a commitment to require adherence to the Service's *Standard Protection Measures for the Eastern Indigo Snake* as a special condition for this project. These measures will remain in effect during construction, as well as, during any gopher tortoise relocation that may be required by the Florida Fish and Wildlife Conservation Commission.

Okeechobee Gourd

The endangered Okeechobee gourd is a vine that was locally common in the extensive pond apple (*Annona glabra*) forest that once grew south of Lake Okeechobee (Small 1922). The Okeechobee gourd is now restricted in the wild to two small disjunct populations: one along the St. Johns River which separates Volusia, Seminole, and Lake Counties in north Florida, and a second around the shoreline of Lake Okeechobee. Currently, the survival of the Okeechobee gourd in south Florida is threatened by the water-regulation practices in Lake Okeechobee, the

continued expansion of exotic vegetation in the lake, aggressive weeds (especially moonflower [*Ipomoea alba*]), and predation of seeds by animals (*e.g.,* rabbits and feral pigs). Additionally, Lake Okeechobee plants are moderately infected with at least three viruses: cucumber mosaic virus, watermelon mosaic virus 2, and squash mosaic virus. Further research is needed to evaluate the temporal changes in the prevalence of these viruses and to determine the extent to which the fitness of Okeechobee gourd populations are being negatively impacted (Decker-Walters 2002). Although the Okeechobee gourd could grow in any given year in any suitable shoreline areas inside the HHD or along the rim canal, we have no records of the species being present in the immediate vicinity of the proposed construction. The Corps has indicated that a survey for the species within the project area will be conducted by a qualified botanist prior to construction.

In the event of any effect on listed species from this project, the Service's South Florida Ecological Services Office in Vero Beach will be contacted immediately at 772-562-3909. Based on the Corps' acceptance of the above provisions, including the installation of a removable manatee exclusion grate on the southeast side of the new S-169R, the Service is able to concur with the Corps' determination for the Everglade snail kite, wood stork, West Indian manatee, bald eagle, eastern indigo snake, and Okeechobee gourd.

This letter fulfills the requirements of section 7 of the ESA and no further action is required. If modifications are made to the project, if additional information involving potential effects to listed species becomes available, or if a new species is listed, reinitiation of consultation may be necessary.

Thank you for your cooperation and effort in protecting Florida's natural resources. If you have any questions regarding this project, please contact Steve Schubert at 772-562-3909, extension 249.

Sincerely yours,

James J. Slack
Field Supervisor
South Florida Ecological Services Office

cc:
Corps, Jacksonville, Florida (Catherine Brooks, Daphne Ross, Janet Cushing)
District, West Palm Beach, Florida (Vincent Loehrlein)
FWC, Vero Beach, Florida (Joe Walsh)
Service, Jacksonville, Florida (Miles Meyer)

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