CENTRAL AND SOUTHERN FLORIDA PROJECT
MODIFIED WATER DELIVERIES TO
EVERGLADES NATIONAL PARK, FLORIDA

8.5 SQUARE MILE AREA

APPENDIX C
PRELIMINARY ENGINEERING AND COSTS

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JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
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PRELIMINARY ENGINEERING AND COSTS

1.0 GENERAL

This appendix provides a discussion of the Preliminary Engineering and Costs for the alternatives evaluated in the GRR. The alternatives have been evaluated based on hydrology using a simulation model. The simulation model and analysis results are discussed in Appendix A – Hydrologic and Hydrogeologic Model Report. Each of the alternatives is described using the following 12 general categories as discussed below. Each of the alternatives is described completely to allow for independent review of the document. Further, for comparison purposes, each category is identified under each alternative even if the category is not utilized in the evaluation. The categories or subsections of the report are as follows:

A. Plan Description. This section provides a brief description of the plan as formulated for the hydrologic and hydrogeologic modeling. This section also provides information as to whether flood protection or mitigation is provided by the alternative.

B. Levees and Canals. This section describes the levee and canal design criteria including lengths, widths and volumes. It also provides general location of the facilities. For the purposes of this analysis, it was assumed that a geotextile material would be required to provide stability to the levee. In many cases, this geotextile may not be required and may be eliminated during final design. Levee top width was estimated to be a minimum of 20-feet. This provides protection from overtopping affects. If it is determined during final design that a smaller cross-section is appropriate, the cost of the project will be adjusted.

It is understood that blasting of the canal has the potential for increasing seepage through the levee. Thus, flood mitigation is not provided by the levee but rather from the induced differential in head promoted by the levee-canal system. It must be noted that channel slope does not significantly impact its ability to transfer flow; rather, because of the porous nature of the limestone, flow is dependent on head gradient, not channel slope.

The internal levee is placed to mitigate the impact of surface runoff on the water within the seepage canal. The Supplemental EIS, provided as part of Volume I, identifies the historic water quality problems associated with surface runoff from the area and projects future water quality impacts based on surface flow.

C. Structures. Structures described in this section are the pump stations that are required for the alternative to function.

The use of the 200-foot approach section for the pump station is similar to that which was used in the 1992 GDM. The use of an approach section is considered the safest design for this planning level effort. If, during final design and further subsurface explorations, it is found that this approach section is not necessary, it can be eliminated and costs adjusted accordingly.

For the purposes of this evaluation, all pump stations are considered to use electric driven pumps. Emergency power will be provided by a diesel generator.

Alternatives that transfer water south to the C-111 system require a conveyance channel or pipe. For the purposes of these alternatives, a typical concrete pipe cost was used for estimating purposes. If local pre-cast vendors can provide appropriate conveyance facilities at a lower cost, they will be identified and used during the final design process as appropriate.

D. Seepage Barrier. The seepage barrier is a part of Alternative 3. It is discussed in detail within the discussion of that alternative. It is noted that the auger-cast pile seepage wall is just one option that can be used to place the seepage barrier. Other options, including constructing a grout curtain will be assessed in greater detail during the final design process should this Alternative be considered further.

E. Raise Roads. Raising the roads is Alternative 7 and will be discussed in that section. Raising the roads in-kind requires a significant volume of dirt to be brought onto the site. The possibility of using already purchased land as borrow areas will be investigated during final design should this Alternative be further considered. The advantage of an onsite borrow area is decreased cost of materials and the potential for use of the borrow area for water quality treatment.

F. Infrastructure. The infrastructure for each alternative consists of those facilities that are necessary to implement each alternative. For the most part, infrastructure consists primarily of the access roadway to the pump stations.

Stormwater runoff from the site typically infiltrates directly into the ground through the limestone surface aquifer. Historically, only minimal stormwater drainage facilities have been constructed in the 8.5 SMA and none are routinely maintained by the County. Any additional infrastructure to handle local drainage that may have to be constructed will be done so at public expense and is discussed in the Local Cost Analysis Appendix (Appendix F).

G. Real Estate Needs. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs.

H. Operations and Maintenance Requirements. Operations and maintenance requirements for each alternative generally fall into three categories: levees and canals, structures and pumps, and ecological. Levees

and canals require periodic inspection during their lifetime. Maintenance should be minimized through proper design.

Pump station operation and maintenance has been estimated to include the cost of operating the station. Additionally, as part of the annual costs, the cost of replacing the pumps at 25-years has been estimated.

Ecological operations and maintenance captures those costs associated with the management of the property, the periodic removal of nuisance species, and monitoring of water quality.

I. Permitting. Permitting considers those permits necessary to construct and operate the alternative. These permits are addressed in the FSEIS and are referenced herein.

J. Water Quality. An important question related to all of the alternatives associated with the 8.5 SMA is the potential impact on water quality. The Environmental Impact Statement that accompanies this report strives to identify the data that is available for water quality within the 8.5 SMA. Its findings, like many other studies in the past including those of Li 1997, Peer 1998 and DERM 1991, indicate that while there have been identified pollutants in both surface and groundwater samples, their origin and magnitude are not well known. The purpose of this section of the report is to evaluate the potential for impact of pollutants from the introduction of the various alternatives that are being considered.

It is important when evaluating the potential water quality impacts from the implementation of various alternatives that the source of the flow from these alternatives is understood. Alternatives1, 2B, 6B, 6C, 6D, 8A, and 9 all provide some form of seepage collection within their design. In the case of Alternatives 1, 2B, 6B, 6C, 6D, 8A, and 9, maintenance of 1983 water levels within the 8.5 SMA, while having increased water levels in the park is accomplished through the use of a seepage canal. Water from this canal is to be pumped back into L-31N for Alternative 1 and to the south and the C-111 buffer area for Alternatives 2B, 6B, 6C, 6D, 8A, and 9. Alternative 9 is proposed to deliver collected seepage water to both the L-31N and C-111 buffer area depending on the need. An evaluation of the potential water quality within the discharge from the seepage canal is important to the implementation of any of the alternatives.

Background

In the draft Analysis of Water Quality & Hydrologic Data from the C-111 Basin (Walker 1997) prepared for the Department of the Interior, water quality that can be expected within the C-111 Basin was investigated. The report evaluates potential inflows and outflows from the C-111 Basin and describes the

phosphorus loading that can be expected. The report indicates that the majority of water that reaches C-111 comes from discharges through S-335 to the north and seepage from the ENP. Figure 8 of that report, shows the total flows for calendar year 1991. The figure and the accompanying text indicate that a preponderance of the flow for this year (approximately 73 percent) originates as seepage from the ENP.

The report further goes on to state that an average concentration of phosphorus of ~6 ppb can be expected from the seepage water from the park. One of the key conclusions of the evaluation is:

> *"Phosphorus loads and concentrations in the L-31N and L-31W canals are controlled largely by deliveries from the North (S-334/S-335) and seepage from the ENP. Impacts of local watershed contributions are difficult to detect in the presence of large volumes of recycled seepage from ENP. Based on the apparent lack of response in canal phosphorus concentrations to rainfall events in recent years, it is likely that most of the local watershed contributions are in the form of seepage (from ENP) instead of direct runoff….."*

The report further concludes that:

> *"Relatively low phosphorus concentration measured at L-31N and L-31W structures in recent wet years reflect high ENP stages and high volumes of seepage from ENP…….Over the long term, concentrations (of phosphorus) may decline as a result of phosphorus load controls being implemented at inflows to the Water Conservation Areas."*

In summary, this report indicates that:

1. The majority of the flow that currently enters the L-31N system for discharge into the C-111 basin is comprised of seepage flow from ENP.

2. The average concentration of phosphorus in seepage water from the ENP is ~6 ppb.

3. Local watershed contributions to L-31N are in the form of seepage and not direct runoff.

The "Alternative Land Use Analysis – Eight and One-Half Square Mile Area, Final Report" (Peer, 1998)(Peer Report) also evaluated the potential impact on water quality based on various alternatives for the 8.5 SMA. The report concludes that "total phosphorus in ground water is currently un-affected by residential and agricultural activities in the 8.5 SMA and in the surrounding area". The report notes that the soils that comprise portions of the 8.5 SMA have a capacity to

absorb phosphorus. The report also notes that, if the soils loose their capacity for absorption of phosphorus, a degraded water quality may occur.

Flow within the L-31N Canal and C-111 System is comprised primarily of two sources of water: releases from S-335 to the north and seepage from the ENP. Evaluations by Walker, Li and Peer Consultants P.C. agree that, in general, the water quality within the 8.5 SMA, as it relates to phosphorus levels (the primary targeted pollutant for the ENP) is not significantly impacted by the residential or agricultural activities of the 8.5 SMA.

Water Quality Evaluation

The historic groundwater flow pattern, as identified in the FSEIS is generally from west to east. Thus, groundwater flow within the 8.5 SMA is from the ENP to L-31N, generally to the southeast. Thus, it can be expected that flow intercepted by the L-31N canal can be expected to exhibit the influence of a predominance of seepage from the ENP along with the pollutant loading associated with the 8.5 SMA. Walker, in his review of the C-111 water quality, concludes that water quality impacts to L-31N from the residential and agricultural areas are difficult to detect due to the preponderance of seepage from the ENP (Walker, 1997).

The seepage collection canals that are to be part of Alternatives 1, 2B, 6B, 6C, 6D, 8A and 9 are designed to collect groundwater from the area adjacent to the canals. This collection and conveyance of groundwater lowers the water table in the immediate area of the canal and thus provides mitigation to 1983 base conditions.

Simulations by the USACE using the MODBRANCH Model have estimated that the peak flow that will be required to be removed from the 8.5 SMA by the seepage canal system for any of the pumping alternatives is 500 cfs. This flow was developed based on a perceived worst case condition of a wet year (95 rainfall) with the addition of a 1 in 10-year storm. Thus, the highest peak flow that can be expected from the 8.5 SMA with any of the alternatives is 500 cfs. Average flow from the 8.5 SMA will be significantly less than this 500 cfs maximum.

An evaluation of the potential for water flow through the aquifer within the 8.5 SMA using the SEEPW finite element computer model has been accomplished. Water surface elevations in the ENP and within the 8.5 SMA were used to develop the potential flow through the levee into the 8.5 SMA. Only those flows within the upper zones of the aquifer (those that could be expected to impact surface waters) were considered. The estimated flow from the seepage into the canals has been estimated to range between 500 to 700 cubic feet/day/foot of canal depending upon the location of the canal. The estimated total average flows for the entire length of canal are provided in the following table.

Estimated Average Canal Flow
By Alternative

Alternative	Length of Seepage canal (ft)	Expected Average Flow (cfs)
Alternative 1	40,200	270
Alternative 2B	40,200	270
Alternative 6B	20,600	150
Alternative 6C	35,400	260
Alternative 6D	20,800	150
Alternative 9	40,200	270

Direct runoff from the watershed is expected to be negligible. This is because there are few avenues for direct runoff and the volumes of water are relatively small. Additionally, the high permeability of the surface aquifer makes it the primary path for stormwater drainage. Thus, rainfall that falls on the surface of the 8.5 SMA for the most part is captured within the confines of the area and infiltrates into the ground.

As discussed in the Peer Report, phosphorus that enters the ground due to stormwater impacts to the 8.5 SMA is typically bound in the soils. In the C-111 evaluation, Walker (Walker, 1997) found that it was difficult to detect changes in phosphorus levels due to stormwater infiltration from residential and agricultural area.

The USACE has also evaluated the potential for seepage based on the levee and seepage canal alignment proposed for Alternative 6D. In general, they have developed a flow net evaluation of seepage flow and have determined that approximately 700 cubic-ft/day/foot of canal occurs. Further, their evaluation has determined that approximately 36 percent of this flow comes from the L-31N Canal System. It has been estimated that the phosphorus levels in L-31N can be expected to be about 20 ppb. This level is derived from an analysis by USACE of the water quality at S-331.

It has also been determined that approximately 64 percent of the water in the seepage canal is from water which flows as seepage from the ENP. Phosphorus levels in the ENP have been estimated to be as little as 1 ppb. In his C-111 study, Walker estimates that the water quality of the seepage water from the ENP is ~6 ppb. The expected range of phosphorus levels from the 8.5 SMA seepage canals can thus be expected to range from 7 ppb to 12 ppb. The discharge standard for phosphorus is 10 ppb. Thus, if the upper range of phosphorus levels from the 8.5 SMA are realized, treatment will be required.

Treatment

Water quality treatment for seepage water from the 8.5 SMA must be considered because the discharge levels may not meet the 10-ppb discharge levels. The treatment that may be utilized is dependent on the alternative. This treatment is presented in the discussion on each of the alternatives presented subsequently in this section. However, the general concepts for treatment are discussed below.

Alternatives 1 and 9

Alternatives 1 and 9 contemplate the collection of seepage in a canal adjacent to the perimeter levee. Flow from this canal is anticipated to be discharged into the L-31N canal for conveyance northward and eventually into the ENP near S-332. It is anticipated that the phosphorus levels in the seepage water from the 8.5 SMA will be comprised primarily of seepage water from the ENP (Walker, 1997). Therefore, the seepage water quality will likely have phosphorus levels very close to the expected 6-ppb in the ENP. Thus, the discharge of seepage water into the L-31N will likely reduce the phosphorus concentrations in the canal. The water that is to be conveyed into Northeast Shark River Slough is expected to be treated in a treatment area prior to its conveyance. The construction of this Stormwater Treatment Area (STA) is a part of another Everglades restoration project and thus is not included in the cost of the projects in this report. It is postulated that the discharge in 8.5 SMA seepage water will reduce the levels of phosphorus in L-31N and thus may have a positive impact on the water quality conveyed to the STA and ultimately into the park.

Alternatives 2B, 6B, 6C, 6D, 8A, and 9

Alternatives 2B, 6B, 6C, 6D, 8A, and 9 all consider the conveyance of water from the 8.5 SMA to the south into the C-111 buffer area. All of these alternatives, except 8A include the construction of a seepage canal to collect water within the 8.5 SMA and maintain water level mitigation. Alternatives 2B, 6B, 6C and 9 have seepage canals that are immediately adjacent to the perimeter levee. This location means that the primary head differential across the levee to the canal is much greater than the gradient from east to west. Thus, as has been established, the groundwater flow which is normally from west to east will continue, and a preponderance of the water which enters the seepage canal will be from the ENP. Alternative 6D has a seepage canal which is some distance inside the perimeter levee and thus can be expected to be influenced by the L-31N.

Each of these alternatives discharges to the south, and into the C-111 buffer area. The range in phosphorus levels for this discharge will be between 7 ppb and 12 ppb. Since the 12-ppb is greater than the 10-ppb discharge standard, it is assumed that treatment must be provided. Best Management Practices, or

BMP's, can be of significant value in the reduction of pollutant loadings. One of the primary ways that BMP's can be implemented in the South Florida area is to allow for the capture and treatment both by infiltration and biological uptake. The C-111 buffer area is similar to the 8.5 SMA in that the limestone aquifer is at or near the surface. The construction of a STA requiring significant excavation of material is not considered appropriate. The BMP envisioned for this effort includes the construction of a treatment area within the C-111 buffer area. This treatment area will provide water quality treatment by both biological uptake and infiltration.

As stated above, the STA required for the treatment of seepage water discharged into L-31N is to be borne by the overall conveyance project (not in this project). Treatment for discharges to the south have been estimated for this project and is included in the discussion of each alternative.

K. Construction Plan. The construction plan outlines the time that it will take to construct the facilities. For Alternatives 1, 2B, and 9, the property necessary for the construction of the facilities has already been acquired and thus, construction of these alternatives can commence immediately upon the completion of the design and preparation of plans and specifications. Other alternatives require land purchase or condemnation. The taking of the land has been estimated to occur through either the willing seller or "quick take" condemnation process. The potential for delay due to condemnation is discussed for the appropriate alternatives.

Dewatering may be required for the construction of the various facilities depending on their location and hydrologic conditions at the time of construction. It is recommended that the USACE obtain a master permit covering the general dewatering process and allow contractors to submit alternative plans during the bid process.

L. Demolition. Demolition considers the removal of structures, house pads, septic systems and other man-made features on the acquired property. Costs for this have been estimated for both removing the structure and for regrading of the area to a more natural-like contour to facilitate wetland plant recruitment.

M. Cost Estimate. An estimate of the cost of each of the alternatives has been developed. The cost tables for each of the alternatives provide a detail of the cost of each line item and a summary of costs including contingencies, design, and construction management. All of the costs of each alternative are summarized on a table which also provides annual cost estimates for each project. The capital and Operation and Maintenance (O&M) costs for all alternatives are summarized in Tables C-3 and C-4.

The capital costs of each alternative are provided in the appropriate tables. These costs estimates are based on the valuation of the specific components that comprise each of the alternatives. The basis for these cost estimates is:

- Previous costs from the 1992 GDM updated as appropriate to account for time.
- Construction estimates from contractors and specialty firms including those used for pumps, pipelines, geotextiles, geomembranes and seepage barrier construction.
- Construction estimates from the SFWMD and USACE for recent construction projects for STAs and Pump Stations.
- Road construction costs based on recent bid documents for the area and the road construction requirements of Miami-Dade County.
- Demolition costs based on information supplied by the SFWMD for their recent land acquisition process under the Save Our Rivers program.

Construction cost uncertainty is included in the overall cost estimate and is based on the perceived imprecision of the cost values. In general, this value was determined to be 20 percent of construction costs. For Alternatives 4 and 5, the uncertainty has been reduced to 10 percent of construction costs, due to the limited new construction.

Land acquisition considers the cost of the land that is needed for each alternative. This land includes that needed for the placement of the structures and required for flood mitigation.

Planning, Engineering and Design (PED) has been estimated along with construction management. For the purposes of this planning level analysis, PED and Construction Management are estimated to total 20 percent of the construction estimate (including construction uncertainty).

MCACES costs estimates have been prepared for the Authorized Plan, Alternative 1 and the Recommended Plan, Alternative 6D with conditions.

In addition to the base costs for the project, the annual costs have been estimated. These annual costs include:

- interest during construction
- interest cost per year over the 50-year life of the project,

- annualized replacement costs of pumps (25-year life) and roadways (25-year for asphalt, 10-year for other),

- annualized operations and maintenance including energy, labor and normal servicing of facility equipment,

- ecological operations and maintenance which includes intensive environmental management for two years, fire management for five years and continuous management for 50-years.

Where appropriate, one time or replacement costs have been annualized over the 50-year life of the project using a discount rate of 6-5/8 percent.

Ecological operations and maintenance costs are estimated based on the number of non-natural (disturbed) acres below elevation 7.0 NGVD that are being acquired. Three levels of restoration can occur for these acquired areas. The base level is to acquire the property and remove above ground structures. The second level considers the clearing of the properties and regrading back to natural land surface. In this level, house pads and drives are removed. The final level consists of the regrading and removal of the disturbed material so that restoration potential is enhanced. The first two levels and the majority of level three assumes that natural recruitment will occur and that only periodic exotics removal is necessary. Level three also relies on intense management of the area for two years with an additional five years of management by fire.

2.0 ALTERNATIVE 1 - AUTHORIZED GDM PLAN

A. Plan Description. This plan consists of a levee around the north and west perimeter of the 8.5 SMA running from the L-31 North Canal to SW 168th Street (Richmond Drive). Approximately 100 feet interior of the centerline of this perimeter levee is a collection or seepage canal. Internal to the seepage canal is an interior berm or levee. This configuration is depicted on Figure C-1. The purpose of this configuration is to allow water levels within ENP to be raised to appropriate MWD levels. The seepage canal collects water which infiltrates through the perimeter levee to provide mitigation of potential water surface elevation changes within the 8.5 SMA. The interior levee is positioned to impede surface water from entering the seepage canal. Based on previous work effort, surface water from the residential area can be expected to have the potential for inferior quality water when compared to that of the seepage from the ENP.

Alternative 1 is considered to be a flood mitigation alternative. A flood mitigation alternative is one where water levels following the implementation of the alternative do not exceed those that existed prior to the implementation of the MWD Project. Thus, the alternative does not change the existing stormwater management level of service to the 8.5 SMA. Properties that currently

experience water above ground surface will, following the implementation of the alternative, continue to experience the same water levels.

Based on discussions with the ENP, it is projected that a water quality treatment area will be developed north of the 8.5 SMA, adjacent to the L-31N canal system. This area will treat water within the L-31N canal prior to its discharge to the ENP. The cost of this treatment area, which can be used for flow taken from the 8.5 SMA, is not included herein because this area is included in the conveyance and seepage project. However, the cost of providing monitoring for the discharge from the pump station has been estimated to be $147,033 per year. This is an annualized cost for the 50-year project life.

B. Levees and Canal. The perimeter levee has an estimated length of 40,200 feet, a top width of 20 feet and an elevation of 10.2 feet as shown on Figure C-2. The seepage canal is shown on Figure C-3 and varies in width and depth depending on the location relative to the proposed pump station S-357, located at the northeast junction of the seepage canal with canal L-31N. For this alternative, the width varies from 40 feet at the northeastern end to 15 feet at the southern end near SW 168th Street, with a variation in depth from 15 feet at the northern end to 8 feet at the southern terminus.

During the construction of the L-31N canal and in subsequent investigations, it has been found that the residential area is underlain by a thin layer of silt and peat. This thin layer of organic material is expected to pose no problems for either the construction or the stability of the levee because of its relatively shallow depth. Additionally, the Soil Survey of Dade County Area, Florida (1996) indicates that marl or limestone rock is exposed at or near the ground surface along the western and northern perimeter of the 8.5 SMA. Medium hard to hard highly permeable limestone rock is expected to be encountered from the ground surface to below the canal invert elevation.

The seepage canal is designed for the flow rates calculated by the USACE using the “MODBRANCH” model. Based on the results of the USACE analyses, a total flow rate of 500 cfs is anticipated at the northeast terminus of the seepage canal at canal L-31N. This flow rate can be equally distributed along the 40,200 feet of canal to allow sizing of the canal cross-sections for each segment shown on Figure C-1. The calculated canal sections are shown in Table C-1. A canal bottom slope of 0.000013 ft/ft was used to calculate the canal flow rate; this is a gradient of 0.5 feet over the 40,200 feet canal length. It is understood that construction of a canal with this type of tolerance is difficult and unnecessary in the context of the base material. Rather, the slope is provided as an idealized projection of a typical slope, understanding that the blasting of rock will result in a rougher, less exacting bottom configuration. The estimated excavation volume, assuming a 20% overcut, would be 958,000 cubic yards (cy).

The canal would be formed by drilling, blasting and excavating the limestone rock. The blasting and excavation should reduce the limestone rock to a graded cobble, gravel and sand mixture. The excavated material should be suitable for the levee construction provided the material is crushed and processed; the maximum particle size of the crushed rock should be less than 2 inches.

The levee cross-sections are shown in Figures C-2 and C-3. A woven geotextile is recommended beneath the levees to stop migration of embankment fill into the porous limestone and to distribute the embankment load if localized peat/muck deposits are encountered. A geomembrane will be required on the ENP side of the perimeter levee to reduce the seepage through the levee. Additionally, a non-woven geotextile is recommended above/below the geomembrane to reduce the potential of punctures caused by the angular processed fill material. A total levee volume of 562,700 cy is required; this includes a 10% overage. Therefore, there is a net export of approximately 395,300 cy. The net export material will either be used in an expanded levee, stockpiled or sold.

C. Structures. A pump station designated S-357 (Figure C-4) is to be constructed at the northeastern end of the seepage collection canal. This facility will pump water into the L-31N canal for conveyance north to an area adjacent to ENP and Northeast Shark River Slough (NESRS). The pump station has a discharge capacity of 500 cfs. The pump station will be equipped with diesel powered axial flow pumps with a design head of less than 10 feet. A conveyance channel will be required for the S-357 pump station to connect it to canal L-31N. Additionally, 200 feet of the seepage canal will be lined with concrete and training walls constructed to connect the seepage canal to the pump intake structure.

The pump station will consist of a reinforced concrete structure supporting the pumps and a reinforced concrete gated spillway. A superstructure consisting of concrete block walls and reinforced concrete rigid frames will be used to house the pumping units. An intake structure with a bay for each pumping unit will be constructed including a trash rack and service bridge.

D. Seepage Barrier. This item is not required for this Alternative.

E. Raise Roads. This item is not required for this Alternative.

F. Infrastructure. A pump station access road will be constructed to El 10.2. This roadway will consist of a structural section of 2 inches of asphalt over 8 inches of limerock base. The road will be 20 feet wide including the shoulders. A diesel fuel storage tank will be required for the pump engines and electric utilities required for support equipment and lighting.

G. Real Estate Needs. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs. For this alternative, the land acquired by the USACE would be utilized at a cost of $4,110,200.

H. O&M Requirements. O&M for the levee will consist of an annual visual inspection. A detailed inspection plan will be developed; however, at a minimum, the following should be noted during each inspection:

- Surface erosion gullies
- Excessive levee settlement
- Exposure of the geomembrane

The crushed processed canal rock material should be relatively durable and not prone to erosion. Vegetating the slopes is not necessary; some natural vegetation may occur with time. The shallow rooted vegetation may also reduce slope erosion. Any identified problem should be corrected.

The O&M costs for the pump station have been estimated based on information supplied by both the Jacksonville District of the USACE and the SFWMD. This cost is $229,875 per year and consists of specific operations and maintenance activities needed to insure that the generators and pumps operate as designed.

I. Permitting. The permit requirements for this plan have been identified and discussed within the FSEIS located in Volume I.

J. Water Quality. Water from the seepage collector canal is to be discharged into L-31N for transference to the north and eventually into NESRS. As indicated in Section 1.0, the phosphorous levels in the seepage water can be expected to range between 7 ppb and 12 ppb. The discharge standard is 10 ppb. Therefore, water quality treatment should be provided. However, it must be noted that the phosphorus levels within L-31N are typically greater than 20 ppb. Thus, any discharge from seepage into L-31N will provide a reduction in the phosphorus levels within the Canal. Further, a STA is projected to be constructed as part of the water deliveries to North Shark River Slough. This STA will treat the water within L-31N and thus is not a part of this project.

K. Construction Plan. After clearing and grubbing the construction site, the basic construction sequence will consist of drilling, blasting and excavating the collection seepage canal in accordance with the canal dimensions presented in Table C-1. It is anticipated that the excavated canal surface will be relatively rough from the blasting/excavation process. The excavated material will be comprised of a graded material consisting of sand to rock size particles; relatively large pieces of rock may be generated by the blasting operation because of the relatively shallow blasting and variable limestone hardness. The canal blast rock

is suitable as fill for levee construction. This material can be excavated with conventional excavating equipment. A crusher will be required to reduce the limestone rock to sand-gravel gradation with maximum particle size less than 2 inches.

The blasting operation will produce transient vibrations that will attenuate with increased distance from the blast location. The vibrations produced by blasting should be barely perceptible to humans at a distance of approximately 1-mile and distinctly perceptible at a distance of ¼ to ½ mile. For structures located within a distance of ¼ mile of the blasting operations, vibration levels should be measured, and shot charges may need to be adjusted to maintain a vibration level below a peak particle velocity of 0.5 inches per second.

The levee construction will consist of the following general construction sequence:

(1) Place woven geotextile beneath levee embankment.

(2) Construct interior levee and core of perimeter levee.

(3) Shape levee surface.

(4) Place non-woven geotextile "cushion" on upstream 3:1 (H:V) face of perimeter levee in areas where geomembrane will be placed.

(5) Place non-woven geotextile above geomembrane.

(6) Complete construction of perimeter levee.

Dewatering will be required for the construction of the reinforced concrete pumping station. Blasting may also be required for foundation construction and for the intake canal and discharge pool.

L. Demolition. This Alternative calls for the placement of a perimeter levee, seepage canal, and internal levee on land that is owned or is in the process of being acquired by the USACE. If not currently cleared, the property will be cleared of all structures and regraded to facilitate the placement of the required facilities. Additionally, lands purchased by the SFWMD as part of the Save Our Rivers program may need to be regraded to meet wetland creation needs. Management of the purchased lands will reduce exotic vegetation and promote viable wetland habitat.

The SFWMD will be the entity that will manage the area that is allowed to migrate to wetland conditions. These costs will include not only demolition and disposal but will also provide information on costs to manage the property for the project

life. Structure removal costs have been developed from the information generated and described in the Appendix D, Real Estate.

M. Cost Estimate. The preliminary cost summary sheet for Alternative 1 is presented in Table C-2. The unit rates used to estimate the costs were obtained from the following sources:

(1) Current SFWMD projects

(2) Local contractors currently working on similar projects in Southern Florida

(3) Equipment manufacturers and suppliers

As shown in Table C-2, the preliminary cost estimate for Alternative 1 is approximately $30,585,500. This cost estimate includes pump station S-357. The annual cost of this alternative over the 50-year life of the project is estimated to be $2,766,000.

In addition to the Capital Costs associated with the alternative there are costs that can be considered for replacement of components or other annual costs. Replacement costs consider the cost of replacing facilities and structures. In this alternative, replacement costs consider the replacement of the pumps at the half-way point in the 50-year life-cycle and the replacement of the asphalt roadway. Annual costs consider the operations and maintenance costs for the pump station and ecological maintenance that has to occur. Replacement cost for pumps and roadways is annualized to $35,607. Annual cost for pump station operations and maintenance is $298,950.

Annual costs for ecological maintenance assume that the area that is to be converted to wetlands is regraded to appropriate contours for natural wetland recruitment. The cost of this regrading is considered a Capital Cost. Ecological operations and maintenance considers the effort necessary for the removal of nuisance species during the period (5-years) when natural recruitment is occurring. After 5-years, it is believed that the wetlands will be established and will not require the same level of effort expended initially. Alternative 1 considers no restoration of wetlands. Thus, the annual costs consider only the periodic removal of nuisance species at a cost of $20,000 per year. An additional annual cost is estimated for the water quality monitoring that will occur for the first five years of the project life. This cost is annualized at $147,033 for the 50-year project life. The capital and O&M costs for all alternatives are summarized on Tables C-3 and C-4.

N. Alternative Performance. Alternative 1 is designed to provide water surface level mitigation to the 8.5 SMA while improving the water elevations and flows within the ENP. Mitigation is provided by the alternative over most of the 8.5 SMA. A small area, immediately adjacent to L-31N, does not receive

mitigation. The extent of wetlands and their hydroperiod within the ENP is improved over the pre-MWD condition and thus, this alternative does allow for an improvement in the overall ENP ecological condition.

3.0 ALTERNATIVE 2B - MODIFIED GDM PLAN

A. Plan Description. Alternative 2B is a modification to Alternative 1 and thus consists of most of the same elements of Alternative 1. The primary difference is the location of the new pump station, S-357. Alternative 2B, a flood mitigation alternative, calls for the water collected in the internal seepage canal to be directed to the southwest corner of the 8.5 SMA at the berm terminus with SW168th Street and discharged to the C-111 system via a 96-inch diameter pipeline. This configuration is depicted on Figure C-6. For the purposes of this analysis, discharge to the C-111 system will be to the treatment areas located west of the L-31N extension. Thus, water quality treatment can be accomplished in this system.

As in Alternative 1, this plan consists of a levee around the north and west perimeter of the 8.5 SMA running from the L-31 North Canal to SW 168th Street. Approximately 100 feet interior of this perimeter levee is a collection or seepage canal as shown on Figure C-3. Internal to the seepage canal is an interior berm. The seepage canal collects water which infiltrates through the levee to mitigate for potential increased water surface elevations within the 8.5 SMA. The interior berm is positioned to prevent surface water from entering the seepage canal. Based on previous work effort, surface water from the residential area was expected to have the potential for inferior quality water when compared to that seeping from the ENP Expansion Area.

B. Levees and Canal. The perimeter levee has an estimated length of 40,200 feet, a top width of 20 feet and an elevation of 10.2 feet as shown on Figure C-2. The seepage canal shown on Figure C-3 varies in width and depth depending on the location relative to the proposed pump station S-357, located near SW 168th Street. For this alternative, the width varies from 15 feet at the northeastern end to 40 feet at the southern end near SW 168th Street, with a variation in depth from 8 feet at the northern end to 15 feet at the southern terminus.

During the construction of the L-31N canal and in subsequent investigations, it has been found that the residential area is underlain by a thin layer of silt and peat. This thin layer of organic material is expected to pose no problems for either the construction or the stability of the levee because of its shallow depth. Additionally, the Soil Survey of Dade County Area, Florida (1996) indicates that marl or limestone rock is exposed at or near the ground surface along the western and northern perimeter of the 8.5 SMA. Medium hard to hard highly

permeable limestone rock is expected to be encountered from the ground surface to below the canal invert elevation.

The seepage canal is designed for the flow rates calculated by the USACE using the "MODBRANCH" model. Based on the results of the USACE analyses, a total flow rate of 500 cfs is anticipated at the terminus of the seepage canal at SW 168th Street. This flow rate can be equally distributed along the 40,200 feet of canal to allow sizing of the canal cross-sections for each segment shown on Figure C-6. The calculated canal sections are shown in Table C-5. A canal bottom slope of 0.000013 ft/ft was used to calculate the canal flow rate; this is a gradient of 0.5 feet over the 40,200 feet canal length. It is understood that construction of a canal with this type of tolerance is difficult and unnecessary in the context of the base material. Rather, the slope is provided as an idealized projection of a typical slope, understanding that the blasting of rock will result in a rougher, less exacting bottom configuration. The estimated excavation volume, assuming a 20% overcut, would be approximately 918,000 cy.

The canal will be formed by drilling, blasting and excavating the limestone rock. The blasting and excavation should reduce the limestone rock to a graded cobble, gravel and sand mixture. The excavated material should be suitable for the levee construction provided the material is crushed and processed; the maximum particle size of the crushed rock should be less than 2 inches.

The levee cross-sections are shown in Figures C-2 and C-3. A woven geotextile is recommended beneath the levees to stop migration of embankment fill into the porous limestone and to distribute the embankment load if localized peat/muck deposits are encountered. A geomembrane will be required on the ENP side of the perimeter levee to reduce the seepage through the levee. Additionally, a non-woven geotextile is recommended above/below the geomembrane to reduce the potential of punctures caused by the angular processed fill material. A total levee volume of 562,700 cy is required. Therefore, there is a net export of approximately 355,300 cy. The net export material will either be used in an expanded levee, stockpiled or sold.

C. Structures. A pump station designated S-357 is to be constructed at the southeastern end of the seepage collection canal. This facility will pump water into the 96-inch diameter pipeline for conveyance south to the C-111 system. The pump station has a discharge capacity of 500 cfs and will be similar in configuration to the station used in Alternative 1 as shown on Figure C-4.

The pump station will be equipped with diesel powered axial flow pumps with a design head of less than 10 feet. A conveyance channel will be required for the S-357 pump station to connect it to canal L-31N. Additionally, 200 feet of the seepage canal will be lined with concrete and training walls constructed to connect the seepage canal to the pump intake structure.

The pump stations will consist of a reinforced concrete structure supporting the pumps and a reinforced concrete gated spillway. A superstructure consisting of concrete block walls and reinforced concrete rigid frames will be used to house the pumping units. An intake structure with a bay for each pumping unit will be constructed including a trash rack and service bridge.

D. Seepage Barrier. This item is not required for this Alternative.

E. Raise Roads. This item is not required for this Alternative.

F. Infrastructure. A pump station access road will be constructed to El 10.2. This roadway will consist of a structural section of 2 inches of asphalt over 8 inches of limerock base. The road will be 20 feet wide including the shoulders. A diesel fuel storage tank will be required for the pump engines and electric utilities required for support equipment and lighting.

G. Real Estate Needs. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs. For this alternative, the lands acquired by the USACE would be utilized at a cost of $4,110,200.

H. O&M Requirements. O&M for the levee should consist of an annual visual inspection. A detailed inspection plan will be developed; however, at a minimum, the following should be noted during each inspection:

- Surface erosion gullies
- Excessive levee settlement
- Exposure of the geomembrane

The crushed processed canal rock material should be relatively durable and not prone to erosion. Vegetating the slopes is not necessary; some natural vegetation may occur with time. The shallow rooted vegetation may also reduce slope erosion. Any identified problem should be corrected.

The O&M costs for the pump station has been estimated based on information supplied by both the Jacksonville District of the USACE and the SFWMD. This cost is $298,950 per year and consists of specific operations and maintenance activities needed to insure that the generators and pumps operate as designed. The cost increase over Alternative 1 is a result of the discharge to a pipe and not an open channel, resulting in additional pumping costs.

I. Permitting. The permit requirements for this project have been identified and discussed within the FSEIS located in Volume 1.

J. Water Quality. Water from the seepage canal which is to be constructed as part of Alternative 2B is envisioned to discharge through a 2,000 foot pipeline into the C-111 buffer area south of Richmond Drive. The phosphorus loadings

from this alternative can be expected to range between 7 ppb and 12 ppb. The discharge standard for phosphorus is 10 ppb. Thus, a treatment facility will have to be constructed. The treatment facility envisioned consists of an approximately 200-acre area located 2,000 feet south of Richmond Drive. Discharge from the seepage canal will be pumped to the treatment area. The treatment area will consist of a bermed area approximately 3,000 feet by 3,000 feet. Final design of the facility will establish water surface elevations within the treatment area. However, for planning purposes, it is expected that water surface elevations would be no more than 4-feet above ground surface. Water would enter an open water section of the facility. From there it would be directed, using baffles, to a shallower area were biological uptake can occur. It is expected that discharge from this facility can be directed to the C-111 system to the south.

K. Construction Plan. After clearing and grubbing the construction site, the basic construction sequence will consist of drilling, blasting and excavating the collection seepage canal in accordance with the canal dimensions presented in Table C-5. It is anticipated that the excavated canal surface will be relatively rough from the blasting/excavation process. The excavated material will be comprised of a graded material consisting of sand to rock size particles; relatively large pieces of rock may be generated by the blasting operation because of the relatively shallow blasting and variable limestone hardness. The canal blast rock is suitable as fill for levee construction. This material can be excavated with conventional excavating equipment. A crusher will be required to reduce the limestone rock to sand-gravel gradation with maximum particle size less than 2 inches.

The blasting operation will produce transient vibrations that will attenuate with increased distance from the blast location. The vibrations produced by blasting should be barely perceptible to humans at a distance of approximately 1-mile and distinctly perceptible at a distance of ¼ to ½ mile. For structures located within a distance of ¼ mile of the blasting operations, vibration levels should be measured, and shot charges may need to be adjusted to maintain a vibration level below a peak particle velocity of 0.5 inches per second.

The levee construction will consist of the following general construction sequence:

(1) Place woven geotextile beneath levee embankment.

(2) Construct interior levee and core of perimeter levee.

(3) Shape levee surface.

(4) Place non-woven geotextile “cushion” on upstream 3:1 (H:V) face of perimeter levee in areas where geomembrane will be placed.

(5) Place non-woven geotextile above geomembrane.

(6) Complete construction of perimeter levee.

Dewatering will be required for the construction of the reinforced concrete pumping station. Blasting may also be required for foundation construction and for the intake canal and discharge pool.

L. Demolition. Alternative 2B calls for the placement of a perimeter levee, seepage canal, and internal levee on land that is owned or is in the process of being acquired by the USACE. If not currently cleared, the property will be cleared of all structures and regraded to facilitate the placement of the required facilities. Additionally, lands purchased by the SFWMD as part of the Save Our Rivers Program may have to be regraded. Current practice is for the District to remove structures and other appurtenances on the property. That level of effort can be considered the minimum. This minimum level has not included regrading the area to promote natural wetland recruitment process. Therefore, the second level of management will include the regrading of the area to promote this natural wetland creation needs. A final level of effort would be the potential planting of appropriate wetland plants and the removal of exotics. A similar level of management of the purchased lands will have to occur to reduce exotic vegetation and promote viable wetland habitat.

The SFWMD will be the entity that will manage the area that is allowed to migrate to wetland conditions. These costs will include not only demolition and but will also provide information on costs to manage the property for the project life. Structure removal costs have been developed based on the results generated and described in the Real Estate Appendix.

M. Cost Estimate. The preliminary cost summary sheet for Alternative 2B is presented in Table C-6. The unit rates used to estimate the costs were obtained from the following sources:

(1) Current SFWMD projects.

(2) Local contractors currently working on similar projects in Southern Florida.

(3) Equipment manufacturers and suppliers.

As shown in Table C-6, the preliminary cost estimate for Alternative 2B is approximately $33,884,000. The primary difference between this cost estimate and Alternative 1 is the additional $2,652,600 for the 2,000 lf of 96-inch diameter pipeline and treatment area. The annual cost of this alternative over the 50-year life of the project is estimated at $3,087,000.

In addition to the Capital Costs associated with the alternative there are costs that can be considered either for replacement or as annual costs. Replacement costs consider the cost of replacing facilities and structures. In this alternative, replacement costs consider the replacement of the pumps at the half-way point in the 50-year life-cycle and the replacement of the asphalt roadway. Annual costs consider the operations and maintenance costs for the pump station and ecological maintenance that has to occur. Replacement costs for pumps and roadways are annualized to $35,607. Annual costs for pump station operations and maintenance are $298,950, and reflect the differing discharge process.

Annual costs for ecological maintenance assume that the area that is to be converted to wetlands is regraded to appropriate contours for natural wetland recruitment. The cost of this regrading is considered a Capital Cost. Ecological operations and maintenance considers the effort necessary for the removal of nuisance species during the period (5-years) when natural recruitment is occurring. After 5-years, it is believed that the wetlands will be established and will not require the same level of effort as initially expended. Alternative 2B considers no restoration of wetlands. Thus, the annual costs consider only the periodic removal of nuisance species at a cost of $20,000 per year. An additional annual cost is estimated for the water quality monitoring that will occur for the first five years of the project life. This cost is annualized at $147,033. The costs for this alternative are summarized on Tables C-3 and C-4.

N. Alternative Performance. Alternative 2B is designed to provide water surface level mitigation to the 8.5 SMA while improving the water elevations and flows within the ENP. Mitigation is provided by the alternative over most of the 8.5 SMA. A small area, immediately adjacent to L-31N does not receive mitigation. The extent of wetlands and their hydroperiod within the ENP is improved over the pre-MWD condition and thus, this alternative does allow for an improvement in the overall ENP ecological condition.

4.0 ALTERNATIVE 3 - DEEP SEEPAGE BARRIER PLAN

A. Plan Description. Alternative 3 consists of a perimeter levee around the north and west perimeter of the 8.5 SMA running from the L-31 North Canal to SW 168th Street. A seepage barrier is to be placed within the levee. This configuration is depicted on Figure C-7. The purpose of this seepage barrier is to allow water levels within ENP to be raised as specified in MWD and NSM. The seepage barrier reduces the potential of water conveyance from ENP into the 8.5 SMA.

Alternative 3 is considered to be a flood protection alternative. By USACE definition, a flood protection alternative provides protection to the residents within the 8.5 SMA to a 1 in 10-year flooding event. Based on the simulation of the alternative however, it was found that flood protection was not afforded by the

seepage barrier for all properties within the 8.5 SMA. Those properties not afforded flood protection by the seepage barrier will be afforded protection through flowage easements.

B. Perimeter Levee. The perimeter levee has an estimated length of 40,200 feet, a top width of 20 feet and an elevation of 10.2 feet as shown on Figure C-2.

During the construction of the L-31N canal and in subsequent investigations, it has been found that the residential area is underlain by a thin layer of silt and peat. This thin layer of organic material is expected to pose no problems for either the construction or the stability of the levee because of its shallow depth. Additionally, the Soil Survey of Dade County Area, Florida (1996) indicates that marl or limestone rock is exposed at or near the ground surface along the western and northern perimeter of the 8.5 SMA. Medium hard to hard highly permeable limestone rock is expected to be encountered from the ground surface to below the canal invert elevation.

A woven geotextile is recommended beneath the perimeter levee to stop migration of embankment fill into the porous limestone and to distribute the embankment load if localized peat/muck deposits are encountered. A geomembrane will be required on the ENP side of the perimeter levee to reduce the seepage through the levee. Additionally, a non-woven geotextile is recommended above/below the geomembrane to reduce the potential of approximately punctures caused by the angular processed fill material. A total levee volume of 444,900 cy is required. There is no fill available because a canal will not be constructed for this alternative. Therefore, approximately 444,9000 cy of import is required. Potential borrow material is available from the L-31N spoil banks located east of L-31N near Richmond Drive. This material should be similar in composition to the canal excavation material. It appears that there is sufficient material to complete the levee construction.

C. Structures. There are no flow control structures required for the implementation of the seepage barrier adjacent to the 8.5 SMA.

D. Seepage Barrier. Vertical seepage barriers are widely used as a method to reduce lateral seepage through permeable soils or rock. Installation of a seepage barrier at this location is problematic because of the presence of moderately hard to hard rock and the presence of voids and solution channels within the limestone. Conventional slurry wall construction is not practical even if the alignment is drilled and pre-blasted because of the irregular size of the blasted rock and risk of refusal of the excavation equipment in this type of material.

Deep mixing with multi-auger drilling equipment may be more appropriate for these geotechnical conditions. A system has been developed that includes pre-drilling the rock to required depth followed by in-situ mixing with either bentonite

or cement to produce overlapping circular columns. This technology has been used in limestone rock to depths in excess of 100 feet. One potential concern with this method or other similar methods, is the potential loss of fluid into the voids or solution channels. Close monitoring of the volume of mixed material will be required to detect losses; however, it is very likely some losses may go undetected. Significant fluid losses can cause a fully penetrating window to occur through the in-situ wall and may render parts of the wall relatively useless to reducing seepage flow. Small openings through the wall of less than 1% of the wall area can allow substantial seepage losses.

For the purposes of this evaluation, the depth to the water retarding layer was estimated to be between 45 and 75 feet (Fish and Stewart). For the purposes of this alternative, the depth of the seepage barrier was estimated at 75 feet.

E. Raise Roads. This item is not required for this alternative.

F. Infrastructure. Pump station, control structures, or conveyance channels are not required for this alternative. Therefore, special infrastructure items are not required.

G. Real Estate Needs. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs. For this alternative, flowage easements and fee simple acquisition of 5,825 acres are required at an estimated cost of $110,194,150.

H. O&M Requirements. O&M for the levee should consist of an annual visual inspection. A detailed inspection plan will be developed; however, at a minimum, the following should be noted during each inspection:

- Surface erosion gullies
- Excessive levee settlement
- Exposure of the geomembrane

The spoil material from L-31N should be relatively durable and not prone to erosion. Vegetating the slopes is not necessary; some natural vegetation may occur with time. The shallow rooted vegetation may also reduce slope erosion. Any identified problem should be corrected.

I. Permitting. The permit requirements for this project have been identified and discussed within the FSEIS located in Volume 1.

J. Water Quality. Water quality is not anticipated to be an issue when considering this alternative because no direct discharge of water from the site will occur. Rather, water, which falls on the site and seepage through the seepage barrier, will continue to flow generally from west to east. As noted in the water quality evaluation, the impact of residential and agricultural areas to the flows in

L-31N and eventually to C-111 are undetectable. That is, the predominance of seepage from the ENP with relatively low phosphorus levels (6-ppb) will dominate the flow.

K. Construction Plan. After clearing and grubbing the construction site the levee construction will consist of the following general construction sequence:

(1) Install seepage barrier along length of levee.

(2) Place woven geotextile beneath levee embankment.

(3) Construct core of perimeter levee.

(4) Shape levee surface.

(5) Place non-woven geotextile "cushion" on upstream 3:1 (H:V) face of perimeter levee in areas where geomembrane will be placed.

(6) Place non-woven geotextile above geomembrane.

(7) Complete construction of perimeter levee.

L. Demolition. Alternative 3 does not provide the flood protection called for in the performance of this alternative. Therefore, flowage easements will have to be obtained from willing owners. If flowage easements are not granted, purchase of the property not receiving flood protection or mitigation must occur. The seepage barrier and levee structure will be on land that is owned or is in the process of being acquired by the USACE. If not currently cleared, the property will be cleared of all structures and regraded to facilitate the placement of the required facilities. Additionally, lands purchased by the Water Management District as part of the Save Our Rivers Program and other lands purchased to provide flood protection may have to be regraded to meet wetland creation needs. Management of the purchased lands will have to occur to reduce exotic vegetation and promote viable wetland habitat.

The SFWMD will be the entity that will manage the area that is allowed to migrate to wetland conditions. These costs will include not only demolition and but will also provide information on costs to manage the property for the project life. Structure removal costs have been developed based on historic information provided by the SFWMD and information from the Real Estate Appendix.

M. Cost Estimate. The cost estimates for Alternative 3 is approximately $235,802,000. The annual cost of this alternative over the 50-year life of the project is estimated at approximately $18,008,647. The preliminary cost summary sheet for Alternative 3 is presented in Table C-7. The unit rates used to estimate the costs were obtained from the following sources:

(1) Current SFWMD projects

(2) Local contractors currently working on similar projects in Southern Florida

(3) Equipment manufacturers and supplies

In addition to the Capital Costs associated with the alternative there are costs that can be considered as either replacement or as annual costs. Replacement costs consider the cost of replacing facilities and structures.

Annual costs for ecological maintenance assume that the area that is to be converted to wetlands is regraded to appropriate contours for natural wetland recruitment. The cost of this regrading is considered a Capital Cost. Ecological operations and maintenance considers the effort necessary for the removal of nuisance species during the period (5-years) when natural recruitment is occurring. After 5-years, it is believed that the wetlands will be established and will not require the same level of effort as initially expended. Alternative 3 considers no restoration of wetlands. Thus, the annual costs consider only the periodic removal of nuisance species at a cost of $20,000 per year. The costs for all alternatives are summarized on Tables C-3 and C-4.

N. Alternative Performance. Alternative 3 was envisioned to provide 1 in 10-year flood protection to the 8.5 SMA and thus allow for the increase in stage and duration of inundation within the 8.5 SMA; the seepage barrier serves to allow water levels within the ENP to reach their highest levels; however, necessary flood protection is not achieved by using only the seepage barrier. Therefore, flowage easements are required to provide flood protection for the 8.5 SMA.

5.0 ALTERNATIVE 4 - LANDOWNER'S CHOICE LAND ACQUISITION PLAN

A. Plan Description. This plan is considered a non-structural plan and is depicted on Figure C-8. The residents will have three options under this alternative: direct buy-out, designation of flowage easements, and life estates with flowage easements. Site specific modeling will be required to identify the extent to which each property will be affected by increased stages to allow residents to select the option that is most desirable.

Acquisition of flowage easements is a method of allowing additional levels of inundation to occur or provide private property without direct buyout. For this option, a property owner is allowed to decide whether the increased level of flooding that may occur due to the project is deleterious. The owner can then decide to keep the property, but allow the higher levels of water to flow across his

or her property. Flowage easements allow compensation to the homeowner at a lower rate than full buyout.

Life Estates with flowage easements, for the purposes of this evaluation, is a voluntary process wherein an owner sells the property for the project but is allowed to remain on the property until the owner is deceased. However, the owner must allow for a flowage easement for the property to accommodate the short-term implementation of the project. Thus, a property owner, who is willing to accept the additional levels of inundation caused by the raising of water levels in the ENP can be paid for the property now but retain use of the property as long as the owner remains alive.

Alternative 4 is considered to be a flood mitigation alternative. A flood mitigation alternative is one where water levels following the implementation of the alternative do not exceed those that existed prior to the implementation of the MWD Project. Thus, the alternative does not change the existing stormwater management level of service to the 8.5 SMA. Properties that currently experience water above ground surface will, following the implementation of the alternative, continue to experience the same water levels.

B. Levee and Canals. This item is not required for this Alternative.

C. Structures. This item is not required for this Alternative.

D. Seepage Barrier. This item is not required for this Alternative.

E. Raise Roads. This item is not required for this Alternative.

F. Infrastructure. The infrastructure that will be required for this alternative is not fully developed at this time. Since the alternative consists of the direct purchase of property, flowage easements, or life-estates with flowage easements, higher water elevations are considered a consequence of the residents selection. Thus, no pump stations, control structures or conveyance channels are projected. However, some local improvements to allow water to flow across properties are projected. The cost estimate associated with this alternative considers these costs.

G. Real Estate Needs. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs. For this Alternative, 6,413 acres are required at an estimated cost of $122,758,020.

H. O&M Requirements. O&M of structures is not required for this alternative. However, O&M is required for wetland areas created as a result of this effort. Operations and Maintenance levels are discussed under Section K – Demolition, below.

I. Permitting. The permit requirements for this project have been identified and discussed within the FSEIS contained in Volume I.

J. Water Quality. Water quality is not anticipated to be an issue when considering this alternative because no direct discharge of water from the site will occur. Rather, water which historically falls on the site and seepage from the ENP will continue to flow generally from west to east. As noted in the water quality evaluation in Section 1.0 of this Appendix, the impact of residential and agricultural areas to the flows in L-31N and eventually to C-111 are undetectable. That is, the predominance of seepage from the ENP with relatively low phosphorus levels (6-ppb) will dominate the flow. The purchase of a combination of flowage easements and fee simple acquisitions can be expected to reduce development and agricultural interests within the area and thus may have the potential for reducing potential pollutant loadings.

K. Construction Plan. A construction plan is not required for this Alternative. The primary effort for this alternative is the determination as to which properties will accept which alternative. Based on the information supplied by the SFWMD, there are a number of property owners who will likely be unwilling to accept any of these alternatives. For those properties, condemnation will have to occur. Based on the property acquisition schedule presented in Appendix D, Real Estate, property acquisition could be completed by July 2002.

L. Demolition. This alternative calls for the creation of open space within the entirety of the 8.5 SMA with the exception of the existing FAA site. The creation of open space is necessitated due to the periodic inundation of the area that will result from the increase of surface water elevations within the ENP. Thus, those private lands that are acquired through either direct purchase or life estates with flowage easements would become public lands under this alternative. With the purchase of the property, the question of what becomes of the land then becomes a concern. Historically, the area on the eastern portion of the 8.5 SMA has been found suitable for agriculture use. The area to the west, closer to ENP is primarily vacant or open land. Since the surface water elevations within the ENP would fluctuate during the wet and dry seasons, it is reasonable to assume that, depending on climate conditions, portions of the property may be suitable for periodic agricultural use. The western portion of the area will be subject to increased surface water elevations and extended periods of inundation. The final disposition of the properties purchased for this alternative will depend on the economic viability of the potential future uses. Thus, a decision as to whether limited agriculture use will be allowed on the eastern portion of the tract will have to be determined. If agriculture use is allowed to exist on the 8.5 SMA, runoff from it, like other areas, will have to meet final water quality standards by 2006. Therefore, stormwater treatment will likely be required for the agricultural areas.

Purchase of properties by the SFWMD as part of the Save Our Rivers Program has transferred some properties from private to public ownership. For the most part, structures that existed on the property have been razed and the demolition debris either removed or placed in low areas on the site. Most of these sites have raised areas where the former structure pads and access roads were located.

The goal of this analysis is to quantify the cost of the purchase of the property specifically as it addresses the dispensation of the existing structures and appurtenances. Three basic procedures for demolition of existing structures have been proposed. These include:

- Demolition of current structure without removal of fill pad. This option for demolition is similar in nature to what the SFWMD is currently doing with lands that it has purchased within the 8.5 SMA. The structure is razed but the fill pad and access road are left intact. Septic systems are collapsed and filled.

- Demolition of current structure, removal of fill pad and access road. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded to approach natural (pre-development) conditions. Natural recruitment is expected to foster wetland growth.

- Demolition of current structure, removal of fill pad and access road, exotics removal and land management. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded to approach natural (pre-development) conditions. Exotic species are removed from the site and the area is managed to promote natural wetland development. Based on historic information, the initial work effort to remove exotics and promote natural recruitment is significant. Subsequent efforts are greatly reduced.

As can be seen by the three optional procedures for land management presented above, the level of effort can range from the minimal clearing of the site through full site management. The cost estimate provides information on the cost for demolition and regrading as a capital cost. Additionally, an annual ecological operations and maintenance cost is provided to account for initial wetland establishment and continued operations and maintenance.

For the purposes of this evaluation, it is expected that areas purchased and unsuitable for agriculture use after increased water stages are achieved, would require both structure removal and land management. The SFWMD will be the entity that will manage the area that is allowed to migrate to wetland conditions. Structure removal costs have been developed and are included in the Real Estate Appendix.

M. Cost Estimate. The preliminary cost summary sheet for Alternative 4 is presented in Table C-8. As shown in Table C-8, the preliminary cost estimates for Alternative 4 is approximately $131,979,500. The annual cost of this alternative over the 50-year life of the project is estimated at $10,175,018. The estimated costs for demolition and land acquisition are believed to be reasonable estimates for these items. Direct purchase of property costs have been taken from the real estate estimates. Flowage Easements and Life Estates with Flowage Easements costs were developed as a portion of the total purchase price.

Annual costs for ecological maintenance assume that the area to be converted to wetlands is regraded to appropriate contours for natural wetland recruitment. The cost of this regrading is considered a Capital Cost. Ecological operations and maintenance considers the effort necessary for the removal of nuisance species during the period (5-years) when natural recruitment is occurring. After 5-years, it is believed that the wetlands will be established and will not require the same level of effort as initially expended. Alternative 4 considers extensive restoration of wetlands. Thus, the annual costs include initial intensive treatment, periodic burning, and the periodic removal of nuisance species. The total annualized cost is estimated to be $106,687. No additional cost is estimated for the water quality monitoring. The costs for all alternatives are summarized on Tables C-3 and C-4.

N. Alternative Performance. Alternative 4 is designed to provide water surface level mitigation to the 8.5 SMA while improving the water elevations and flows within the ENP. Mitigation is provided through a landowner's choice of options as discussed above. Water surface elevations and hydroperiods within the ENP are increased significantly.

6.0 ALTERNATIVE 5 - TOTAL BUY-OUT PLAN

A. Plan Description**.** This plan calls for the purchase of all of the property within the 8.5 SMA. Thus, this alternative can be considered a non-structural alternative. This configuration is depicted on Figure C-9. All properties within the 8.5 SMA area will be acquired by direct purchase. This will occur through the existing willing seller program and through other means of acquisition that may include condemnation and quick-take processes.

The disposition of the land for the long-term has not yet been established. In areas to the west where water elevations will greatly impact the property, existing structures and roadways will have to be removed. The regrading of the area to facilitate water flow along NESRS is appropriate. Areas located to the east, above the 7.0 contour line, can be expected to have limited affects from the existing L-31N canal. These lands can either be allowed to go fallow, have facilities fully removed, or potentially be leased back to agriculture interests.

Alternative 5 is considered to be a flood mitigation alternative. A flood mitigation alternative is one where water levels following the implementation of the alternative do not exceed those that existed prior to the implementation of the MWD Project. Thus, the alternative does not change the existing stormwater management level of service to the 8.5 SMA. Properties that currently experience water above ground surface will, following the implementation of the alternative, continue to experience the same water levels.

B. Levee and Canals. This item is not required for this alternative.

C. Structures. This item is not required for this alternative.

D. Seepage Barrier. This item is not required for this alternative.

E. Raise Roads. This item is not required for this alternative.

F. Infrastructure. This item is not required for this alternative.

G. Real Estate Needs. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs. For this Alternative, flowage easements and fee simple acquisition of 6,413 acres are required at an estimated cost of $164,765,770.

H. O&M Requirements. Operations and Maintenance of structures is not required for this alternative, rather, O&M is required for wetland areas created as a result of this effort. Operations and Maintenance levels are discussed under Section K – Demolition.

I. Permitting. The permit requirements for this project have been identified and discussed within the FSEIS in Volume 1.

J. Water Quality. Water quality is not anticipated to be an issue when considering this alternative because no direct discharge of water from the site will occur. Rather, water which falls on the site and seepage from the ENP will continue to flow generally from west to east. The predominance of seepage from the ENP with relatively low phosphorus levels (6-ppb) will dominate the flow. Additionally, the acquisition of all of the land west of the levee will reduce the potential pollutant loadings associated with development within the area. Pollutants associated with agriculture activities may continue to exist if agricultural leases for property are considered.

K. Construction Plan. A construction plan is not required for this alternative. The primary effort for this alternative is the determination as to how the properties will be acquired. Based on the information supplied by the SFWMD, there are a number of property owners who will likely be unwilling to sell their properties. For those properties, condemnation will have to occur. Based on the property acquisition schedule in Appendix D, Real Estate, property acquisition could be completed by June 2002.

L. Demolition. Alternative 5 is similar to Alternative 4 in that it calls for the creation of open space within the entirety of the 8.5 SMA with the exception of the existing FAA site. The creation of open space is necessitated due to the periodic inundation of the area that will result from the increase of surface water elevations within the ENP. Thus, all private lands would become public lands under this alternative. With the purchase of the property, the question of what becomes of the land then becomes a concern. Historically, the area on the eastern portion of the 8.5 SMA has been found suitable for agriculture usage. The area to the west, closer to ENP is primarily vacant or open land. Since the surface water elevations within the ENP would fluctuate during the wet and dry seasons, it is reasonable to assume that, depending on climate conditions, portions of the property may be suitable for periodic agricultural usage. The western portion of the area will be subject to increased surface water elevations and extended periods of inundation. The final disposition of the properties purchased for this alternative will depend on the economic viability of the potential future uses. Thus, a decision as to whether limited agriculture will be allowed on the eastern portion of the tract will have to be determined.

Purchase of property by the SFWMD (total buyout) has transferred some properties from private to public ownership. For the most part, structures that existed on the property have been razed and the demolition debris either removed or placed in low areas on the site. Most of these sites have raised areas where the former structure pads and access roads were located.

The goal of this analysis is to quantify the cost of the purchase of the property specifically as it addresses the dispensation of the existing structures and appurtenances. Three basic procedures for demolition of existing structures have been proposed. These include:

- Demolition of current structure without removal of fill pad. This option for demolition is similar in nature to what SFWMD is currently doing with lands that it has purchased within the 8.5 SMA. The structure is razed but the fill pad and access road are left intact. Septic systems are collapsed and filled.

- Demolition of current structure, removal of fill pad and access drive. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded

to approach natural (pre-development) conditions. Natural recruitment is expected to foster wetland growth.

- Demolition of current structure, removal of fill pad, access road, exotics removal and land management. This option provides for the demolition of the current structure including the removal of the fill pad, access road, septic system. Property is regraded to approach natural (pre-development) conditions. Exotic species are removed from the site and the area is managed to promote natural wetland development.

As can be seen by the three optional procedures for land management presented above, the level of effort can range from the minimal clearing of the site through full site management.

For the purposes of this evaluation, it is expected that areas unsuitable for agriculture use after increased water stages are achieved, would require both structure removal and land management. The SFWMD will be the entity that will manage the area that is allowed to migrate to wetland conditions. Structure removal costs have been developed based on information obtained during the real estate work effort and information supplied by the SFWMD. These costs will include not only demolition and disposal will also provide information on costs to manage the property for the project life.

M. Cost Estimate. The preliminary cost summary sheet for Alternative 5 is presented in Table C-9. The cost estimate for Alternative 5 is approximately $178,950,500. The annual cost of this alternative over the 50 year life of the project is estimated at $13,758,299.

Annual costs for ecological maintenance assume that the area to be converted to wetlands is regraded to appropriate contours for natural wetland recruitment. The cost of this regrading is considered a Capital Cost. Ecological operations and maintenance considers the effort necessary for the removal of nuisance species during the period (5-years) when natural recruitment is occurring. After 5-years, it is believed that the wetlands will be established and will not require the same level of effort as initially expended. Alternative 5 considers extensive restoration of wetlands. Thus, the annual costs include initial intensive treatment, periodic burning, and the periodic removal of nuisance species. The total annualized cost is estimated to be $106,687. No additional cost is estimated for the water quality monitoring. The costs for all alternatives are summarized on Tables C-3 and C-4.

N. Alternative Performance. Alternative 5 is similar to Alternative 4 in its method for reaching flood mitigation. Like Alternative 4, Alternative 5 allows water levels in the ENP to be raised significantly. Mitigation is provided by the purchase of all of the property within the 8.5 SMA.

7.0 ALTERNATIVE 6B - WESTERN PORTION OF 8.5 SMA AS BUFFER

A. Plan Description**.** This plan consists of a perimeter levee which bisects the existing 8.5 SMA at approximately the location of SW 202nd Street and the topographic elevation of 7.0-feet NGVD. Areas to the west of this main levee would be purchased. Areas to the east of the interior levee, shown in Figure C-10, would be allowed to remain in their current land use. The perimeter levee will run generally to the west from a location just south of existing structure G-211, run south around the FAA tract, and then south along SW 202nd Avenue. The terminus of this perimeter levee would be at a topographic high located at Richmond Drive (SW 168th Street). Approximately 200 feet interior of this perimeter levee is an interior levee. The purpose of this interior levee is to assure that seepage does not enter the western portion of the area.

Between the levees will be a seepage collection canal as shown on Figure C-3. The seepage canal is designed to keep the groundwater levels within this eastern portion of the area satisfactory for agriculture purposes. The purpose of this configuration is to allow water levels within ENP to be raised as specified in MWD or NSM levels. The seepage canal collects water which infiltrates through the levee to prevent deleterious changes on the water surface elevation within the 8.5 SMA. The interior levee is positioned to prevent surface water from entering the seepage canal. Based on previous work efforts, surface water from the residential area was expected to have the potential for inferior quality water when compared to that seeping from ENP Expansion Area.

A pipeline is projected to convey seepage water from the 8.5 SMA to the C-111 system. Specifically, the water will be directed to the western storage areas proposed between the seepage canal and the ENP. These storage areas may provide treatment for the conveyed water. If in the event that treatment cannot occur in the facilities, a treatment area can be constructed south of the 8.5 SMA in areas already purchased. The cost of this treatment area is included in the cost estimate.

B. Levees and Canal. The perimeter levee has an estimated length of 20,600 feet, a top width of 20 feet and an elevation of 10.2 feet as shown on Figure C-2.

The seepage canal shown on Figure C-3 varies in width and depth depending on the location relative to the proposed pump station S-357, located at the junction with SW 168th Street. For this alternative, the width varies from 15 feet at the northeastern end to 30 feet at the southern end near SW 168th Street, with a variation in depth from 8 feet at the northern end to 15 feet at the southern terminus. The seepage canal parallels the interior levee and both are approximately 20,600 feet long.

During the construction of the L-31N canal and in subsequent investigations, it has been found that the residential area is underlain by a thin layer of silt and peat. This thin layer of organic material is expected to pose no problems for either the construction or the stability of the levee because of its relatively shallow depth. Additionally, the Soil Survey of Dade County Area, Florida (1996) indicates that marl or limestone rock is exposed at or near the ground surface along the western and northern perimeter of the 8.5 SMA. Medium hard to hard highly permeable limestone rock is expected to be encountered from the ground surface to below the canal invert elevation.

The seepage canal is designed for the flow rates calculated by the USACE using the "MODBRANCH" model. Based on the results of the USACE analyses, a total flow rate of 500 cfs is anticipated at the terminus of the seepage canal at SW 168th Street. This flow rate can be equally distributed along the 20,600 feet of canal to allow sizing of the canal cross-sections for each segment shown on Figure C-10. The calculated canal sections are shown in Table C-10. A canal bottom slope of 0.000015 ft/ft was used to calculate the canal flow rate; this is a gradient of 0.25 feet over the canal length. The estimated excavation volume, assuming a 20% overcut, would be approximately 524,000 cy.

The canal will be formed by drilling, blasting and excavating the limestone rock. The blasting and excavation should reduce the limestone rock to a graded cobble, gravel and sand mixture. The excavated material should be suitable for the levee construction provided the material is crushed and processed; the maximum particle size of the crushed rock should be less than 2 inches.

The levee cross-sections are shown in Figures C-2 and C-3. A woven geotextile is recommended beneath the levees to stop migration of embankment fill into the porous limestone and to distribute the embankment load if localized peat/muck deposits are encountered. A geomembrane will be required on the ENP side of the perimeter levee to reduce the seepage through the levee. Additionally, a non-woven geotextile is recommended above/below the geomembrane to reduce the potential of punctures caused by the angular processed fill material. A total levee volume of approximately 355,700 cy is required. Therefore, there is a net export of approximately 168,300 cy. The net export material will either be used in an expanded levee, stockpiled or sold.

C. Structures. A pump station designated S-357 is to be constructed at the southern end of the seepage collection canal. This facility will pump water into the 96-inch diameter pipeline for conveyance south to the C-111 system. The pump station will have a discharge capacity of 500 cfs. The pump stations will be equipped with diesel powered axial flow pumps with a design head of less than 10 feet. Additionally, 200 feet of the seepage canal will be lined with concrete and training walls constructed to connect the seepage canal to the pump intake structure.

The pump station will consist of a reinforced concrete structure supporting the pumps and a reinforced concrete gated spillway. A superstructure consisting of concrete block walls and reinforced concrete rigid frames will be used to house the pumping units. An intake structure with a bay for each pumping unit will be constructed including a trash rack and service bridge.

D. Seepage Barrier. This item is not required for this Alternative.

E. Raise Roads. This item is not required for this Alternative.

F. Infrastructure. A pump station access road will be constructed to El 10.2. This roadway will consist of a structural section of 2 inches AC over 8 inches of limerock base. The road will be 20 feet wide including the shoulders. A diesel fuel storage tank will be required for the pump engines and electric utilities required for support equipment and lighting.

G. Real Estate Needs. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs. For this alternative, flowage easements and fee simple acquisition of 4,346 acres are required for an estimated cost of $114,959,000.

H. O&M Requirements. O&M for the levee will consist of an annual visual inspection. A detailed inspection plan will be developed; however, at a minimum, the following should be noted during each inspection:

- Surface erosion gullies
- Excessive levee settlement
- Exposure of the geomembrane

The crushed processed canal rock material should be relatively durable and not prone to erosion. Vegetating the slopes is not necessary; some natural vegetation may occur with time. The shallow rooted vegetation may also reduce slope erosion. Any identified problem should be corrected.

The O&M costs for the pump station has been estimated based on information supplied by both the USACE and SFWMD. This cost is $298,950 per year and consists of specific operations and maintenance activities needed to insure that the generators and pumps operate as designed.

I. Permitting. Permitting considers those permits necessary to construct and operate the alternative. These permits are addressed in the FSEIS and are referenced herein.

J. Water Quality. Water from the seepage canal which is to be constructed as part of Alternative 6B is envisioned to discharge through a 2,000 foot pipeline into the C-111 buffer area south of Richmond Drive. This alternative provides

planned flood protection for a limited area within the 8.5 SMA. This flood protection may lead to an increased density designation resulting in more homes and more septic treatment systems.

The phosphorus loadings from this alternative can be expected to range between 7 ppb and 12 ppb. The discharge standard for phosphorus is 10 ppb. Thus, a treatment facility will have to be constructed. The treatment facility envisioned consists of an approximately 200-acre area located 2,000 feet south of Richmond Drive in an area already owned for the planned C-111 buffer area. Discharge from the seepage canal will be pumped to the treatment area. The treatment area will consist of a bermed area approximately 3,000 feet by 3,000 feet. Final design of the facility will establish water surface elevations within the treatment area. However, for planning purposes, it is expected that water surface elevations of no more than 4-feet above ground surface will exist in the treatment area. Water would enter an open water section of the facility. From there it would be directed, using baffles, to a shallower area where biological uptake can occur. It is expected that discharge from this facility can be directed to the C-111 system to the south. The cost of this facility is included in the overall cost of this alternative.

K. Construction Plan. After clearing and grubbing the construction site, the basic construction sequence will consist of drilling, blasting and excavating the collection seepage canal in accordance with the canal dimensions presented in Table C-10. It is anticipated that the excavated canal surface will be relatively rough from the blasting/excavation process. The excavated material will be comprised of a graded material consisting of sand to rock size particles; relatively large pieces of rock may be generated by the blasting operation because of the relatively shallow blasting and variable limestone hardness. A crusher will be required to process the blast rock to produce the levee fill material. The rock should be crushed to a maximum particle size of 2 inches.

The blasting operation will produce transient vibrations that will attenuate with increased distance from the blast location. The vibrations produced by blasting should be barely perceptible to humans at a distance of approximately 1-mile and distinctly perceptible at a distance of ¼ to ½ mile. For structures located within a distance of ¼ mile of the blasting operations, vibration levels should be measured, and shot charges may need to be adjusted to maintain a vibration level below a peak particle velocity of 0.5 inches per second.

The canal blast rock is suitable as fill for levee construction. This material can be excavated with conventional excavating equipment. A crusher will be required to reduce the limestone rock to sand-gravel gradation with maximum particle size less than 2 inches.

The levee construction will consist of the following general construction sequence:

(1) Place woven geotextile beneath levee embankment.

(2) Construct interior levee and core of perimeter levee.

(3) Shape levee surface.

(4) Place non-woven geotextile “cushion” on upstream 3:1 (H:V) face of perimeter levee in areas where geomembrane will be placed.

(5) Place non-woven geotextile above geomembrane.

(6) Complete construction of perimeter levee.

Dewatering will be required for the construction of the reinforced concrete pumping station. Blasting may also be required for foundation construction and for the intake canal and discharge pool.

L. Demolition. Alternative 6B also calls for the creation of open space within a large portion of the 8.5 SMA area. The creation of open space is necessitated due to the periodic inundation of the area that will result from the increase of surface water elevations within the ENP. Thus, those private lands generally to the west of the perimeter levee would become public lands under this alternative. With the purchase of the property, the question of what becomes of the land then becomes a concern. Historically, the area on the eastern portion of the 8.5 SMA has been found suitable for agriculture usage. The area to the west, closer to the ENP is primarily vacant or open land. This alternative provides flood protection of the portion of land east of the perimeter levee. Therefore, it is expected that this land will be developed in accordance to the estimates in the Social Impact Assessment and Local Cost Analysis identified as Appendices E and F, respectively. The western portion of the area will be subject to increased surface water elevations and extended periods of inundation. The final disposition of the properties purchased for this alternative will depend on the economic viability of potential future uses.

Purchases by the SFWMD have transferred some properties from private to public ownership. For the most part, structures that existed on the property have been razed and the demolition debris either removed or placed in low areas on the site. Most of these sites have raised areas where the former structure pads and access roads were located.

The goal of this analysis is to quantify the cost of the purchase of the property specifically as it addresses the dispensation of the existing structures and appurtenances. Three basic procedures for demolition of existing structures have been proposed. These include:

- Demolition of current structure without removal of fill pad. This option for demolition is similar in nature to what the Water Management District is currently doing with lands that it has purchased within the 8.5 SMA. The structure is razed but the fill pad and access road are left intact. Septic systems are collapsed and filled.

- Demolition of current structure, removal of fill pad and access road. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded to approach natural (pre-development) conditions. Natural recruitment is expected to foster wetland growth.

- Demolition of current structure, removal of fill pad, access road, exotics removal and land management. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded to approach natural (pre-development) conditions. Exotic species are removed from the site and the area is managed to promote natural wetland development.

As can be seen by the three optional procedures for land management presented above, the level of effort can range from the minimal clearing of the site through full site management.

For the purposes of this evaluation, it is expected that areas to the west of the perimeter levee would require both structure removal and land management. The SFWMD will be the entity that will manage the area that is allowed to migrate to wetland conditions. These costs will include not only demolition and disposal, but will also provide information on costs to manage the property for the project life.

M. Cost Estimate. The preliminary cost summary sheet for Alternative 6B is presented in Table C-11. The cost estimate for Alternative 6B is $147,709,700. The annual cost of this alternative over the 50 year life of the project is estimated at $11,855,248.

In addition to the Capital Costs associated with the alternative there are costs that can be considered either replace or annual costs. Replacement costs consider the cost of replacing facilities and structures. In this alternative, replacement costs consider the replacement of the pumps at the half-way point in the 50-year life-cycle and the replacement of the asphalt roadway. Annual costs consider the operations and maintenance costs for the pump station and ecological maintenance that has to occur. Replacement costs for pumps and roadways is annualized to $35,607. Annual cost for pump station operations and maintenance is $298,950.

Annual costs for ecological maintenance assume that the area to be converted to wetlands is regraded to appropriate contours for natural wetland recruitment. The cost of this regrading is considered a Capital Cost. Ecological operations and maintenance considers the effort necessary for the removal of nuisance species during the period (5-years) when natural recruitment is occurring. After 5-years, it is believed that the wetlands will be established and will not require the same level of effort as initially expended. Alternative 6B considers extensive restoration of wetlands. Thus, the annual costs include initial intensive treatment, periodic burning, and the periodic removal of nuisance species. The total annualized cost is estimated to be $105,315. The annual costs for water quality monitoring are estimated to be approximately $147,033. The costs for this alternative are summarized on Tables C-3 and C-4.

N. Alternative Performance. Alternative 6B is designed to provide flood protection for the area east of the levee. Simulation results show that this alternative protects this area for the 1 in 10-year flood. Water levels within the ENP are raised significantly.

8.0 ALTERNATIVE 6C - MODIFIED WESTERN PORTION OF 8.5 SMA AS BUFFER (SOR BOUNDARY)

A. Plan Description**.** This plan was developed based on a request from the South Florida Water Management District following the public presentation of the Draft GRR/SEIS report on April 12, 2000. Generally, the USACE was requested to provide a review of a modification of original Alternative 6B. Original plan 6B consisted of a perimeter levee, seepage canal and internal levee which generally bisected the 8.5 SMA at approximately the location of SW 202nd Street and the topographic elevation of 7.0-feet NGVD.

Alternative 6C is similar in nature and design to Alternative 6B. This alternative, as developed by the SFWMD, consists of an exterior and interior levee as well as a seepage canal generally constructed as shown on Figure C-11. The location of the levee and canal system generally follows the eastern boundary of the area designated by SFWMD as the Phase 1 - Save Our Rivers (SOR) boundary. This area has been the subject of property purchases by SFWMD as part of the Save Our Rivers program. Alternative 6C has been developed as a flood mitigation alternative. That is, the goal for this alternative is not flood protection of the area to the east of the levee but flood mitigation.

Between the levees will be a seepage collection canal as shown on Figure C-111. The seepage canal is designed to keep the groundwater levels within this eastern portion of the area at the same levels as were found prior to the implementation of the MWD project. The purpose of this configuration is to allow water levels within ENP to be raised as specified in MWD or NSM levels. The seepage canal collects water which infiltrates through the levee to prevent

deleterious changes on the water surface elevation within the 8.5 SMA. The interior levee is positioned to prevent surface water from entering the seepage canal. Based on previous work efforts, surface water from the residential area was expected to have the potential for inferior quality water when compared to that seeping from ENP Expansion Area.

A pipeline is projected to convey seepage water from the 8.5 SMA to the C-111 system. Specifically, the water will be directed to the western storage areas proposed between the seepage canal and the ENP. These storage areas may provide treatment for the conveyed water. If in the event that treatment cannot occur in the facilities, a treatment area can be constructed south of the 8.5 SMA in areas already purchased. The costs of this treatment facility are provided in the cost estimate for this alternative.

B. Levees and Canal. The perimeter levee has an estimated length of 35,410 feet, a top width of 20 feet and an elevation of 10.2 feet as shown on Figure C-2. The seepage canal shown on Figure C-3 varies in width and depth depending on the location relative to the proposed pump station S-357, located at the southern terminus of the seepage canal and SW 168th Street. For this alternative, the width varies from 15 feet at the northeastern end to 40 feet at the southern end near SW 168th Street, with a variation in depth from 8 feet at the northern end to 15 feet at the southern terminus. The interior levee is 35,410 feet long and will parallel the seepage canal.

During the construction of the L-31N canal and in subsequent investigations, it has been found that the residential area is underlain by a thin layer of silt and peat. This thin layer of organic material is expected to pose no problems for either the construction or the stability of the levee because of its relatively shallow depth. Additionally, the Soil Survey of Dade County Area, Florida (1996) indicates that marl or limestone rock is exposed at or near the ground surface along the western and northern perimeter of the 8.5 SMA. Medium hard to hard highly permeable limestone rock is expected to be encountered from the ground surface to below the canal invert elevation.

The seepage canal is designed for the flow rates calculated by the USACE using the “MODBRANCH” model. Based on the results of the USACE analyses, a total flow rate of 500 cfs is anticipated at the terminus of the seepage canal at SW 168th Street. This flow rate can be equally distributed along the 35,410 feet of canal to allow sizing of the canal cross-sections for each segment shown on Figure C-11. The calculated canal sections are shown in Table C-13. A canal bottom slope of 0.000015 ft/ft was used to calculate the canal flow rate; this is a gradient of 0.25 feet over the canal length. The estimated excavation volume, assuming a 20% overcut, would be approximately 840,200 cy.

The canal will be formed by drilling, blasting and excavating the limestone rock. The blasting and excavation should reduce the limestone rock to a graded

cobble, gravel and sand mixture. The excavated material should be suitable for the levee construction provided the material is crushed and processed; the maximum particle size of the crushed rock should be less than 2 inches.

The levee cross-sections are shown in Figures C-2 and C-3. A woven geotextile is recommended beneath the levees to stop migration of embankment fill into the porous limestone and to distribute the embankment load if localized peat/muck deposits are encountered. A geomembrane will be required on the ENP side of the perimeter levee to reduce the seepage through the levee. Additionally, a non-woven geotextile is recommended above/below the geomembrane to reduce the potential of punctures caused by the angular processed fill material. A total levee volume of approximately 496,000 cy is required. Therefore, there is a net export of approximately 344,500 cy. The net export material will either be used in an expanded levee, stockpiled or sold.

C. Structures. A pump station designated S-357 is to be constructed at the southern end of the seepage collection canal. This facility will pump water into the 96-inch diameter pipeline for conveyance south to the C-111 system. The pump station will have a discharge capacity of 500 cfs. The pump stations will be equipped with diesel powered axial flow pumps with a design head of less than 10 feet. Additionally, 200 feet of the seepage canal will be lined with concrete and training walls constructed to connect the seepage canal to the pump intake structure.

The pump station will consist of a reinforced concrete structure supporting the pumps and a reinforced concrete gated spillway. A superstructure consisting of concrete block walls and reinforced concrete rigid frames will be used to house the pumping units. An intake structure with a bay for each pumping unit will be constructed including a trash rack and service bridge.

D. Seepage Barrier. This item is not required for this alternative.

E. Raise Roads. This item is not required for this alternative.

F. Infrastructure. A pump station access road will be constructed to El 10.2. This roadway will consist of a structural section of 2 inches AC over 8 inches of limerock base. The road will be 20 feet wide including the shoulders. A diesel fuel storage tank will be required for the pump engines and electric utilities required for support equipment and lighting.

G. Real Estate Needs. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs. For this alternative, fee simple acquisition of 1,743 acres is required for an estimated cost of $30,683,921.

H. O&M Requirements. O&M for the levee should consist of an annual visual inspection. A detailed inspection plan will be developed; however, at a minimum, the following should be noted during each inspection:

- Surface erosion gullies
- Excessive levee settlement
- Exposure of the geomembrane

The crushed processed canal rock material should be relatively durable and not prone to erosion. Planting vegetation on the slopes is not necessary as natural vegetation may occur with time. The shallow rooted vegetation may also reduce slope erosion. Any identified problem should be corrected.

The O&M costs for the pump station has been estimated based on information supplied by both the USACE and SFWMD. This cost is $298,950 per year and consists of specific operations and maintenance activities needed to insure that the generators and pumps operate as designed.

I. Permitting. Permitting considers those permits necessary to construct and operate the alternative. These permits are addressed in the FSEIS and are referenced herein.

J. Water Quality. Water from the seepage canal which is to be constructed as part of Alternative 6C is envisioned to discharge through a 2,000 foot pipeline into the C-111 buffer area south of Richmond Drive. The phosphorus loadings from this alternative can be expected to range between 7 ppb and 12 ppb. The discharge standard for phosphorus is 10 ppb. Thus, a treatment facility will have to be constructed. The treatment facility envisioned consists of an approximately 200-acre area located 2,000 feet south of Richmond Drive in an area already owned for the planned C-111 buffer area. Discharge from the seepage canal will be pumped to the treatment area. The treatment area will consist of a bermed area approximately 3,000 feet by 3,000 feet. Final design of the facility will establish water surface elevations within the treatment area. However, for planning purposes, it is expected that water surface elevations of no more than 4-feet above ground surface will exist in the treatment area. Water would enter an open water section of the facility. From there it would be directed, using baffles, to a shallower area where biological uptake can occur. It is expected that discharge from this facility can be directed to the C-111 system to the south. The cost of this facility is included in the overall cost of this alternative.

K. Construction Plan. After clearing and grubbing the construction site, the basic construction sequence will consist of drilling, blasting and excavating the collection seepage canal in accordance with the canal dimensions presented in Table C-12. It is anticipated that the excavated canal surface will be relatively rough from the blasting/excavation process. The excavated material will be comprised of a graded material consisting of sand to rock size particles; relatively

large pieces of rock may be generated by the blasting operation because of the relatively shallow blasting and variable limestone hardness. A crusher will be required to process the blast rock to produce the levee fill material. The rock should be crushed to a maximum particle size of 2 inches.

The blasting operation will produce transient vibrations that will attenuate with increased distance from the blast location. The vibrations produced by blasting should be barely perceptible to humans at a distance of approximately 1-mile and distinctly perceptible at a distance of ¼ to ½ mile. For structures located within a distance of ¼ mile of the blasting operations, vibration levels should be measured, and shot charges may need to be adjusted to maintain a vibration level below a peak particle velocity of 0.5 inches per second.

The canal blast rock is suitable as fill for levee construction. This material can be excavated with conventional excavating equipment. A crusher will be required to reduce the limestone rock to sand-gravel gradation with maximum particle size less than 2 inches.

The levee construction will consist of the following general construction sequence:

(1) Place woven geotextile beneath levee embankment.

(2) Construct interior levee and core of perimeter levee.

(3) Shape levee surface.

(4) Place non-woven geotextile “cushion” on upstream 3:1 (H:V) face of perimeter levee in areas where geomembrane will be placed.

(5) Place non-woven geotextile above geomembrane.

(6) Complete construction of perimeter levee.

Dewatering will be required for the construction of the reinforced concrete pumping station. Blasting may also be required for foundation construction and for the intake canal and discharge pool.

L. Demolition. Alternative 6C also calls for the creation of open space within the Phase 1 Save Our Rivers boundary. The creation of open space is necessitated due to the periodic inundation of the area that will result from the increase of surface water elevations within the ENP. Thus, those private lands generally to the west of the perimeter levee would become public lands under this alternative. With the purchase of the property, the question of what becomes of the land then becomes a concern. Historically, the area on the eastern portion of the 8.5 SMA has been found suitable for agriculture usage. The area to the

west, closer to the ENP is primarily open land with some limited residential use. This alternative provides flood mitigation of the portion of land east of the perimeter levee. Therefore, it is expected that this land will be developed in accordance to the estimates in the Social Impact Assessment and Local Cost Analysis identified as Appendices E and F, respectively. The western portion of the area will be subject to increased surface water elevations and extended periods of inundation.

Purchases by SFWMD through the Save Our Rivers program has transferred some properties from private to public ownership. For the most part, structures that existed on the property have been razed and the demolition debris either removed or placed in low areas on the site. Most of these sites have raised areas where the former structure pads and access roads were located.

The goal of this analysis is to quantify the cost of the purchase of the property specifically as it addresses the dispensation of the existing structures and appurtenances. Three basic procedures for demolition of existing structures have been proposed. These include:

- Demolition of current structure without removal of fill pad. This option for demolition is similar in nature to what the Water Management District is currently doing with lands that it has purchased within the 8.5 SMA. The structure is razed but the fill pad and access road are left intact. Septic systems are collapsed and filled.

- Demolition of current structure, removal of fill pad and access road. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded to approach natural (pre-development) conditions. Natural recruitment is expected to foster wetland growth.

- Demolition of current structure, removal of fill pad, access road, exotics removal and land management. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded to approach natural (pre-development) conditions. Exotic species are removed from the site and the area is managed to promote natural wetland development.

As can be seen by the three optional procedures for land management presented above, the level of effort can range from the minimal clearing of the site through full site management.

For the purposes of this evaluation, it is expected that areas to the west of the perimeter levee would require both structure removal and land management. The SFWMD will be the entity that will manage the area that is allowed to migrate to wetland conditions. The costs of this alternative will include not only demolition

and disposal, but will also provide information on costs to manage the property for the project life.

M. Cost Estimate. The preliminary cost summary sheet for Alternative 6C is presented in Table C-13. The cost estimate for Alternative 6C is $62,833,800. The annual cost for this alternative over the 50-year life of the project is estimated at $5,330,420.

In addition to the Capital Costs associated with the alternative, there are costs that can be considered either replacement or annual costs. Replacement costs consider the cost of replacing facilities and structures. In this alternative, replacement costs consider the replacement of the pumps at the half-way point in the 50-year life-cycle and the replacement of the asphalt roadway. Annual costs consider the operations and maintenance costs for the pump station and ecological maintenance that has to occur. Replacement costs for pumps and roadways is annualized to $35,607. Annual cost for pump station operations and maintenance is $298,950.

Annual costs for ecological maintenance assume that the area to be converted to wetlands is regraded to appropriate contours for natural wetland recruitment. The cost of this regrading is considered a Capital Cost. Ecological operations and maintenance considers the effort necessary for the removal of nuisance species during the period (5-years) when natural recruitment is occurring. After 5-years, it is believed that the wetlands will be established and will not require the same level of effort as initially expended. Thus, the annual costs include initial intensive treatment, periodic burning, and the periodic removal of nuisance species. The total annualized cost is estimated to be $55,423. The annual costs for water quality monitoring are estimated to be approximately $147,033. The costs for this alternative are summarized on Tables C-3 and C-4.

N. Alternative Performance. Alternative 6C is designed to provide flood mitigation for the area east of the levee. Simulation results show that this alternative fully provides this mitigation (Appendix A). Water levels within the ENP are raised significantly and localized impacts of drawdown in the seepage canal are reduced when compared to Alternatives 1, 2 and 9.

9.0 ALTERNATIVE 6D MODIFIED WESTERN PORTION OF 8.5 SMA AS BUFFER

A. Plan Description. This plan was also developed as a result of a request from the South Florida Water Management District following the public presentation of this report on April 12, 2000. Generally, the Corps was requested to provide a review of a modification of original Alternative 6B. The attempt was to modify the Alternative 6B to provide a further optimization of wetlands and the reduction in impacted residences. The Corps of Engineers developed the

alignment discussed herein. The original Alternative 6B consisted of a perimeter levee, seepage canal and internal levee which generally bisected the 8.5 SMA at approximately the location of SW 202nd Street and the topographic elevation of 7.0-feet NGVD.

Alternative 6D is similar in nature and design to Alternative 6B. This alternative consists of a perimeter levee as well as a seepage canal with interior levees on both sides of the canal generally constructed as shown on Figure C-12. The location of the perimeter levee generally bisects the area between Alternatives 6B and 6C. In contrast to Alternatives 6B or 6C, the seepage canal and interior levee are not located adjacent to the perimeter levee. Rather, the seepage canal and interior levees follow the same east-west alignment as in 6C; which is adjacent to the southern boundary of the FAA site. However, the seepage canal continues west to a location west of the FPL easement. Then it travels south to its terminus at Richmond Drive. To reduce the potential for water quality impacts due to runoff to the seepage canal, an interior levee will be constructed on both sides of the seepage canal. As was the case with Alternative 6C, Alternative 6D has also been developed as a flood mitigation alternative. That is, the goal for this alternative is not flood protection of the area to the east of the levee but flood mitigation.

A seepage canal is projected to keep the groundwater levels within this eastern portion of the area at the same levels as were found prior to the implementation of the MWD project. The purpose of this configuration is to allow water levels within ENP to be raised as specified in MWD or NSM levels. The seepage canal collects water which infiltrates through the levee to prevent deleterious changes on the water surface elevation within the 8.5 SMA. The interior levee is positioned to prevent surface water from entering the seepage canal. Based on previous work effort, surface water from the residential area was expected to have the potential for inferior quality water when compared to that seeping from ENP Expansion Area.

A pipeline is projected to convey seepage water from the 8.5 SMA to the C-111 system. Specifically, the water will be directed to the western storage areas proposed between the seepage canal and the ENP. These storage areas may provide treatment for the conveyed water. If in the event that treatment cannot occur in the facilities, a treatment area can be constructed south of the 8.5 SMA in areas already purchased. The costs of this treatment area are included in the cost estimate.

B. Levees and Canal. The perimeter levee has an estimated length of 34,500 feet, a top width of 20 feet and an elevation of 10.2 feet as shown on Figure C-2. The seepage canal shown on Figure C-3 varies in width and depth depending on the location relative to the proposed pump station S-357, located at the southern terminus of the seepage canal and SW 168th Street. For this alternative, the width varies from 25 feet at the northeastern end to 30 feet at the

southern end near SW 168th Street, with a variation in depth from 12.5 feet at the northern end to 15 feet at the southern terminus. The interior levee is approximately 21,000 feet long and will parallel both sides of the seepage canal.

During the construction of the L-31N canal and in subsequent investigations, it has been found that the residential area is underlain by a thin layer of silt and peat. This thin layer of organic material is expected to pose no problems for either the construction or the stability of the levee because of its relatively shallow depth. Additionally, the Soil Survey of Dade County Area, Florida (1996) indicates that marl or limestone rock is exposed at or near the ground surface along the western and northern perimeter of the 8.5 SMA. Medium hard to hard highly permeable limestone rock is expected to be encountered from the ground surface to below the canal invert elevation.

The seepage canal is designed for the flow rates calculated by the USACE using the "MODBRANCH" model. Based on the results of the USACE analyses, a total flow rate of 500 cfs is anticipated at the terminus of the seepage canal at SW 168th Street. This flow rate can be equally distributed along the 21,000 feet of canal to allow sizing of the canal cross-sections for each segment shown on Figure C-12. The calculated canal sections are shown in Table C-14. A canal bottom slope of 0.000024 ft/ft was used to calculate the canal flow rate; this is an average gradient of 0.50 feet over the canal length. The estimated excavation volume, assuming a 20% overcut, would be approximately 540,000 cy.

The canal will be formed by drilling, blasting and excavating the limestone rock. The blasting and excavation should reduce the limestone rock to a graded cobble, gravel and sand mixture. The excavated material should be suitable for the levee construction provided the material is crushed and processed; the maximum particle size of the crushed rock should be less than 2 inches.

The levee cross-sections are shown in Figures C-2 and C-3. A woven geotextile is recommended beneath the levees to stop migration of embankment fill into the porous limestone and to distribute the embankment load if localized peat/muck deposits are encountered. A geomembrane will be required on the ENP side of the perimeter levee to reduce the seepage through the levee. Additionally, a non-woven geotextile is recommended above/below the geomembrane to reduce the potential of punctures caused by the angular processed fill material. A total levee volume of 504,000 cy is required. Therefore, there is a net export of approximately 36,000 cy. The net export material will either be used in an expanded levee, stockpiled or sold.

C. Structures. A pump station designated S-357 is to be constructed at the southern end of the seepage collection canal. This facility will pump water into the 96-inch diameter pipeline for conveyance south to the C-111 system. The pump station will have a discharge capacity of 500 cfs. The pump stations will be equipped with diesel powered axial flow pumps with a design head of less than

10 feet. Additionally, 200 feet of the seepage canal will be lined with concrete and training walls constructed to connect the seepage canal to the pump intake structure.

The pump station will consist of a reinforced concrete structure supporting the pumps and a reinforced concrete gated spillway. A superstructure consisting of concrete block walls and reinforced concrete rigid frames will be used to house the pumping units. An intake structure with a bay for each pumping unit will be constructed including a trash rack and service bridge.

D. Seepage Barrier. This item is not required for this alternative.

E. Raise Roads. This item is not required for this alternative.

F. Infrastructure. A pump station access road will be constructed to El 10.2. This roadway will consist of a structural section of 2 inches AC over 8 inches of limerock base. The road will be 20 feet wide including the shoulders. A diesel fuel storage tank will be required for the pump engines and electric utilities required for support equipment and lighting.

G. Real Estate Needs. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs. For this alternative, flowage easements and fee simple acquisition of 2,881 acres are required for an estimated cost of $55,709,420.

H. O&M Requirements. O&M for the levee should consist of an annual visual inspection. A detailed inspection plan will be developed; however, at a minimum, the following should be noted during each inspection:

- Surface erosion gullies
- Excessive levee settlement
- Exposure of the geomembrane

The crushed processed canal rock material should be relatively durable and not prone to erosion. Planting vegetation on the slopes is not necessary as natural vegetation may occur with time. The shallow rooted vegetation may also reduce slope erosion. Any identified problem should be corrected.

The O&M costs for the pump station has been estimated based on information supplied by both the USACE and SFWMD. This cost is $298,950 per year and consists of specific operations and maintenance activities needed to insure that the generators and pumps operate as designed.

I. Permitting. Permitting considers those permits necessary to construct and operate the alternative. These permits are addressed in the FSEIS and are referenced herein.

J. Water Quality. Water from the seepage canal which is to be constructed as part of Alternative 6D is envisioned to discharge through a 2,000 foot pipeline into the C-111 buffer area south of Richmond Drive. The phosphorus loadings from this alternative can be expected to range between 7 ppb and 12 ppb. The discharge standard for phosphorus is 10 ppb. Thus, a treatment facility will have to be constructed. The treatment facility envisioned consists of an approximately 200-acre area located 2,000 feet south of Richmond Drive in an area already owned for the planned C-111 buffer area. Discharge from the seepage canal will be pumped to the treatment area. The treatment area will consist of a bermed area approximately 3,000 feet by 3,000 feet. Final design of the facility will establish water surface elevations within the treatment area. However, for planning purposes, it is expected that water surface elevations of no more than 4-feet above ground surface will exist in the treatment area. Water would enter an open water section of the facility. From there it would be directed, using baffles, to a shallower area where biological uptake can occur. It is expected that discharge from this facility can be directed to the C-111 system to the south. The cost of this facility is included in the overall cost of this alternative.

K. Construction Plan. After clearing and grubbing the construction site, the basic construction sequence will consist of drilling, blasting and excavating the collection seepage canal in accordance with the canal dimensions presented in Table C-12. It is anticipated that the excavated canal surface will be relatively rough from the blasting/excavation process. The excavated material will be comprised of a graded material consisting of sand to rock size particles; relatively large pieces of rock may be generated by the blasting operation because of the relatively shallow blasting and variable limestone hardness. A crusher will be required to process the blast rock to produce the levee fill material. The rock should be crushed to a maximum particle size of 2 inches.

The blasting operation will produce transient vibrations that will attenuate with increased distance from the blast location. The vibrations produced by blasting should be barely perceptible to humans at a distance of approximately 1-mile and distinctly perceptible at a distance of ¼ to ½ mile. For structures located within a distance of ¼ mile of the blasting operations, vibration levels should be measured, and shot charges may need to be adjusted to maintain a vibration level below a peak particle velocity of 0.5 inches per second.

The canal blast rock is suitable as fill for levee construction. This material can be excavated with conventional excavating equipment. A crusher will be required to reduce the limestone rock to sand-gravel gradation with maximum particle size less than 2 inches.

The levee construction will consist of the following general construction sequence:

(1) Place woven geotextile beneath levee embankment.

(2) Construct interior levee and core of perimeter levee.

(3) Shape levee surface.

(4) Place non-woven geotextile “cushion” on upstream 3:1 (H:V) face of perimeter levee in areas where geomembrane will be placed.

(5) Place non-woven geotextile above geomembrane.

(6) Complete construction of perimeter levee.

Dewatering will be required for the construction of the reinforced concrete pumping station. Blasting may also be required for foundation construction and for the intake canal and discharge pool.

L. Demolition. Alternative 6D also calls for the creation of open space west of the perimeter levee. The creation of open space is necessitated due to the periodic inundation of the area that will result from the increase of surface water elevations within the ENP. Thus, those private lands generally to the west of the perimeter levee would become public lands under this alternative. With the purchase of the property, the question of what becomes of the land then becomes a concern. Historically, the area on the eastern portion of the 8.5 SMA has been found suitable for agriculture usage. The area to the west, closer to the ENP, is primarily open land with some limited residential use. This alternative provides flood mitigation of the portion of land east of the perimeter levee. Therefore, it is expected that this land will be developed in accordance to the estimates in the Social Impact Assessment and Local Cost Analysis identified as Appendices E and F, respectively. The western portion of the area will be subject to increased surface water elevations and extended periods of inundation.

Purchases by SFWMD through the Save Our Rivers program has transferred some properties from private to public ownership. For the most part, structures that existed on the property have been razed and the demolition debris either removed or placed in low areas on the site. Most of these sites have raised areas where the former structure pads and access roads were located.

The goal of this analysis is to quantify the cost of the purchase of the property specifically as it addresses the dispensation of the existing structures and appurtenances. Three basic procedures for demolition of existing structures have been proposed. These include:

- Demolition of current structure without removal of fill pad. This option for demolition is similar in nature to what the Water Management District is currently doing with lands that it has purchased within the 8.5 SMA. The structure is razed but the fill pad and access road are left intact. Septic systems are collapsed and filled.

- Demolition of current structure, removal of fill pad and access road. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded to approach natural (pre-development) conditions. Natural recruitment is expected to foster wetland growth.

- Demolition of current structure, removal of fill pad, access road, exotics removal and land management. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded to approach natural (pre-development) conditions. Exotic species are removed from the site and the area is managed to promote natural wetland development.

As can be seen by the three optional procedures for land management presented above, the level of effort can range from the minimal clearing of the site through full site management.

For the purposes of this evaluation, it is expected that areas to the west of the perimeter levee would require both structure removal and land management. The SFWMD will be the entity that will manage the area that is allowed to migrate to wetland conditions. These costs will include not only demolition and disposal, but will also provide information on costs to manage the property for the project life.

M. Cost Estimate. The preliminary cost summary sheet for Alternative 6D is presented in Table C-15. The cost estimate for Alternative 6D is approximately $88,139,000. The annual cost for this alternative over the 50-year life of the project is estimated at $7,272,911.

In addition to the Capital Costs associated with the alternative there are costs that can be considered either replacement or annual costs. Replacement costs consider the cost of replacing facilities and structures. In this alternative, replacement costs consider the replacement of the pumps at the half-way point in the 50-year life-cycle and the replacement of the asphalt roadway. Annual costs consider the operations and maintenance costs for the pump station and ecological maintenance that has to occur. Replacement costs for pumps and roadways is annualized to $35,607. Annual cost for pump station operations and maintenance is $298,950.

Annual costs for ecological maintenance assume that the area to be converted to wetlands is regraded to appropriate contours for natural wetland recruitment. The cost of this regrading is considered a Capital Cost. Ecological operations and maintenance considers the effort necessary for the removal of nuisance species during the period (5-years) when natural recruitment is occurring. After 5-years, it is believed that the wetlands will be established and will not require the same level of effort as initially expended. Thus, the annual costs include initial intensive treatment, periodic burning, and the periodic removal of nuisance species. The total annualized cost is estimated to be $67,454. The annual costs for water quality monitoring are estimated to be approximately $147,033. The costs for this alternative are summarized on Tables C-3 and C-4.

N. Alternative Performance. Alternative 6D is designed to provide flood mitigation for the area east of the levee. Simulation results show that this alternative fully provides this mitigation (Appendix A). Water levels within the ENP are raised significantly and localized impacts of drawdown in the seepage canal are reduced when compared to Alternatives 1, 2, and 9.

10.0 ALTERNATIVE 7 - RAISE ALL ROADS PLAN

A. Plan Description. Alternative 7 was developed in response to residents comments during the Scoping Process. The residents stated that their primary need was for the raising of roads to permit them access to their property during times of high water. This alternative assumes that most of the structures within the area are already above flood levels. Raising the roads for the area consists of construction of in-kind roadways above the 1 in 10 year flood elevation. This configuration is depicted on Figure C-13. A cross section of both the dirt and paved roads is shown on Figure C-14. In-kind replacement means that if a road is currently constructed of asphalt it will be replaced with similar construction materials. If an existing roadway is dirt, it will be reconstructed in a similar manner. Internal drainage and seepage would be managed using flowage easements, culverts and other conveyance structures. Internal drainage would be routed to L-31N to reduce the potential for conveyance of surface water carrying potential pollutants to the ENP. Internal drainage features required to facilitate surface flow are discussed in the Local Cost Analysis Appendix.

Alternative 7 is considered to be a flood mitigation alternative. By USACE definition, a flood mitigation alternative limits damages to the residents within the 8.5 SMA from flood stages no greater than currently exist without project implementation. Thus, the alternative does not change the existing storm water management level of service to the 8.5 SMA.

B. Levee and Canals. This item is not required for this alternative.

C. Structures. This item is not required for this alternative.

D. Seepage Barrier. This item is not required for this alternative.

E. Raise Roads. According to the 8.5 Square Mile Area Study Committee Report to former Governor Lawton Chiles, dated April 1995, there are 55 miles of road located in the 8.5 SMA. Of this 55 miles, 49.7 miles are dirt roads and 5.3 miles are paved roads.

The 49.7 miles of dirt roads will be raised to elevation 10.2 NGVD. For purposes of construction cost estimating, it was assumed that the average elevation of the existing roads is 7.0 NGVD. Therefore, the roads will need to be raised an average of 3.2 feet. It was further assumed that the existing dirt roads are 24 feet wide with two 10-foot lanes and 2-foot shoulders.

Based on these assumptions, approximately 1,265,895 cy of fill are required. This fill will need to be imported. If the existing material along L-31N were utilized, this material would need to be crushed and processed.

The 5.3 miles of asphalt roadway also would be stabilized with Type B stabilization before placing the fill. Approximately 171,934 cy of fill and 74,624 sy of stabilization would be required. The roadway structural section would consist of 2 inches of asphaltic concrete over 8 inches of limerock base material.

Drainage structures will be required beneath the roadways to facilitate water movement from the ENP and storm water within the 8.5 SMA. These structures would consist of concrete culverts with drop inlets on either side of the roadway. Desilting basins would be required to connect the drainage swales to the drainage structures to reduce sediment buildup in the pipes. One structure would be required for every 1,000 feet of roadway for a total of about 300 structures.

F. Infrastructure. No additional infrastructure other than raising the roads is expected for this alternative.

G. Real Estate Needs. The vast majority of roadways within the 8.5 SMA have been constructed of dirt. These roadways exist along the property lines. Miami - Dade County has not accepted the right-of-way for these roadways and thus, any raising of the roads will require the purchase of easements. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs. For this alternative, flowage easements and fee simple acquisition of 5,839 acres of area required at an estimated cost of $110,514,250.

H. O&M Requirements. Roadway maintenance will be required. It is estimated that minor regrading of dirt roadways will be required every 6 months. For the main asphalt roadways, resurfacing should be anticipated every 10

years; annual maintenance would include crack filling and patching. Annual to biannual inspection/clearing of the drainage culverts will be required to confirm that excess sediment build-up is not occurring.

I. Permitting. Permitting considers those permits necessary to construct and operate the alternative. These permits are addressed in the FSEIS and are referenced herein.

J. Water Quality. Water quality is not anticipated to be an issue when considering Alternative 7 because no direct discharge of water from the site will occur. Rather, water, which historically falls on the site and seepage from the ENP, will continue to flow generally from west to east. As noted in the water quality evaluation, the impact of residential and agricultural areas to the flows in L-31N and eventually to C-111 are undetectable. That is, the predominance of seepage from the ENP with relatively low phosphorus levels (6-ppb) will dominate the flow. The purchase of a combination of easements and fee simple acquisitions is not expected to reduce development and agricultural interests within the area.

K. Construction. Roadway construction will consist of compaction of the Type B stabilized subgrade to 98% standard proctor relative compaction. The Type B stabilization shall have a Limerock Bearing Ratio (LBR) of at least 40. Roadway fill shall also be compacted to 98% standard proctor. For the asphalt paved roadways, the limerock base material shall also be compacted to 98% and have a LBR of at least 100. The asphaltic concrete shall be FDOT approved Type S.

The drainage culverts will be constructed prior to roadway construction. The drainage pipes will have at least 2-feet of cover. The pipe size required for the cross-drains has been estimated to be 24-inch diameter. Actual pipe locations, size and inlet spacing will be determined during the final design for this alternative.

L. Demolition. Alternative 7 consists of the raising of roadways within the 8.5 SMA in-kind. That is, existing dirt roads will be raised as dirt roads and existing paved roads will be raised as paved roads. Demolition will consist only of those properties already purchased by the USACE or the SFWMD.

M. Cost Estimate. The preliminary cost summary sheet for Alternative 7 is presented in Table C-16. The preliminary cost estimates for Alternative 7 is $134,590,400. The annual cost for this alternative over the 50 year life of the project is estimated at $10,806,622.

Annual costs for ecological maintenance assume that the area to be converted to wetlands is regraded to appropriate contours for natural wetland recruitment. The cost of this regrading is considered a Capital Cost. Ecological operations and

maintenance considers the effort necessary for the removal of nuisance species during the period (5-years) when natural recruitment is occurring. After 5-years, it is believed that the wetlands will be established and will not require the same level of effort as initially expended. Alternative 7 considers extensive restoration of wetlands. Thus, the annual costs include initial intensive treatment, periodic burning, and the periodic removal of nuisance species. The total annualized cost is estimated to be $106,687. No additional cost is estimated for the water quality monitoring, as there is no collection, conveyance or pumping facility in this alternative. The costs for all alternatives are summarized on Tables C-3 and C-4.

N. Alternative Performance. Alternative 7 is designed to provide water surface level mitigation to the 8.5 SMA while improving the water elevations and flows within the ENP. Mitigation is provided by the raising of all roadways within the 8.5 SMA to a level that is above the 1 in 10 year flood level. The simulations show that water levels in the ENP are significantly increased by the implementation of this alternative. However, since the water levels in the 8.5 SMA are also raised significantly, properties and flowage easements must also be obtained. Additionally, raising the roadways in-kind brings up the issue of continued maintenance. For the purposes of this evaluation, it was anticipated that asphalt roads would have a replacement life of 25 years. Dirt roads would have to be replaced, regraded, or reshaped often, potentially after each wet season or significant storm. Additionally, the cross drains that are placed within the 8.5 SMA to allow flow will likely be subject to a significant silt loading and thus require additional maintenance.

11.0 ALTERNATIVE 8A - WESTERN PORTION OF 8.5 SMA AS FLOW-WAY

A. Plan Description**.** This plan consists of a flow-way bounded by perimeter and interior levees as shown on Figure C-14. The flow-way sweeps from the northeast of the 8.5 SMA at canal L-31N to the southwest near the junction of SW 209th and 212th Streets and Richmond Drive. The flow-way generally follows the 7.0 feet NGVD elevation contour. Areas to the west of the interior levee would be purchased. Areas to the east of the interior levee would be allowed to remain in their current land use. The purpose of the containment levees is to channel flow through the western portion of the 8.5 SMA and to discharge water to the C-111 area. The flow-way between the levees is a shallow swale with an elevation of 6.0 feet. This configuration is shown in Figure C-15.

There is no internal seepage collection canal proposed for this alternative. A new pump facility planned for the area is designated as S-357. This pump facility is located at SW168th Street west of the interior levee, at the terminus of the flow-way. The purpose of this facility is to transfer water from within the flow-way to the C-111 project area.

The perimeter levee has a length of 24,860 feet, a top width of 20 feet and an elevation of 10.2 feet as developed in the GDM. The perimeter levee is shown on Figure C-2.

Alternative 8A is a flood mitigation alternative. By definition, the areas located east of the flow-way should not experience any increase in flood stages above that which existed prior to the implementation of the MWD project. This Alternative does not change the existing level of storm water management to the eastern area. Properties that currently experience water above the ground surface will continue to experience the same levels.

The flow-way is to be a shallow swale-like facility wherein flows would be allowed to spread across a relatively shallow pool area. The relatively slow velocity of the water as well as the natural vegetation that will comprise the swale bottom will aid in the treatment of water from the site. Additionally, this Alternative calls for the use of a treatment area south of Richmond Drive to allow water to flow south to the C-111 system, ostensibly along the surface. This surface flow would provide additional treatment.

B. Levees and Swale. The perimeter levee has an estimated length of 24,860 feet, a top width of 20 feet and an elevation of 10.2 feet as shown on Figure C-2 and the interior levee is 21,700 feet in length. The swale will be formed by grading a “V” shaped ditch with a cut of about 0.5 to 1-foot midway between the two levees. The swale will be about 1,000 feet wide and this material will be used as the levee fill.

During the construction of the L-31N canal and in subsequent investigations, it has been found that the residential area is underlain by a thin layer of silt and peat. This thin layer of organic material is expected to pose no problems for either the construction or the stability of the levee because of its relatively shallow depth. Additionally, the Soil Survey of Dade County Area, Florida (1996) indicates that marl or limestone rock is exposed at or near the ground surface along the western and northern perimeter of the 8.5 SMA. Relatively soft marl and limestone rock is expected to be encountered from the ground surface to a depth of 1 ft.

The swale will be formed with conventional earthmoving equipment. The excavated material (excluding organic matter) should be suitable for the levee construction.

The levee cross-sections are shown in Figures C-2 and C-3. A woven geotextile is recommended beneath the levees to stop migration of embankment fill into the porous limestone and to distribute the embankment load if localized peat/muck deposits are encountered. A geomembrane will be required on the ENP side of the perimeter levee to reduce the seepage through the levee. Additionally, a non-woven geotextile is recommended above/below the geomembrane to reduce

the potential of punctures caused by the angular processed fill material. A total levee volume of 339,000 cy is required. The swale width, and hence the volume of the swale will be adjusted as needed for the quantity of levee fill material. If there is a net export of material it will either be used in an expanded levee, stockpiled or sold.

C. Structures. A pump station designated S-357 is to be constructed at the southern end of the swale. This facility will pump water into a pipeline to a treatment area and channel south of Richmond Drive. The pump station will have a discharge capacity of 500 (cfs). The pump station will be equipped with diesel powered axial flow pumps with a design head of less than 10 ft.

The pump station will consist of a reinforced concrete structure supporting the pumps and a reinforced concrete gated spillway. A superstructure consisting of concrete block walls and reinforced concrete rigid frames will be used to house the pumping units. An intake structure with a bay for each pumping unit will be constructed including a trash rack and service bridge.

D. Seepage Barrier. This item is not required for this Alternative .

E. Raise Roads. This item is not required for this Alternative .

F. Infrastructure. A pump station access road will be constructed to Elevation 10.2. This roadway will consist of a structural section of 2 inches AC over 8 inches of limerock base. The road will be 20 ft. wide with shoulders. A diesel fuel storage tank will be required for the pump engines and electric utilities required for support equipment and lighting.

G. Real Estate Needs. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs. For this Alternative, flowage easements and fee simple acquisition of an estimated 5,803 acres is required at an estimated cost of $126,957,950.

H. O&M Requirements. O&M for the levees should consist of an annual visual inspection. A detailed inspection plan will be developed; however, at a minimum, the following should be noted during each inspection:

- Surface erosion gullies
- Excessive levee settlement, and
- Exposure of the geomembrane.

Vegetating the slopes will be necessary because the surficial soil and weathered rock that will be used as fill are not as durable as the canal excavation material discussed in Alternatives 1, 2, 3, 6B, 6C, 6D and 9. Any identified problem should be corrected.

The O&M cost for the pump station has been estimated based on information supplied by both the USACE and SFWMD. This cost is $298,950 per year and consists of specific operations and maintenance activities needed to insure that the generators and pumps operate as designed.

I. Permitting. Permitting considers those permits necessary to construct and operate the Alternative. These permits are addressed in the FSEIS and are referenced herein.

J. Water Quality. Water from the collection swale which is to be constructed as part of Alternative 8A is envisioned to discharge through a 2,000 foot pipeline into the C-111 buffer area south of Richmond Drive. It is expected that the majority of this flow will be from both the ENP and the developed area to the east. The phosphorus loadings from this Alternative can be expected to range between 7 ppb and 12 ppb. The discharge standard for phosphorus is 10 ppb. Thus, a treatment facility will have to be constructed. The treatment facility envisioned consists of an approximately 200-acre area located 2,000 feet south of Richmond Drive in an area already owned for the planned C-111 buffer area. Discharge from the seepage canal will be pumped to the treatment area. The treatment area will consist of a bermed area approximately 3,000 feet by 3,000 feet. Final design of the facility will establish water surface elevations within the treatment area. However, for planning purposes, it is expected that water surface elevations of no more than 4-feet above ground surface will exist in the treatment area. Water would enter an open water section of the facility. From there it would be directed, using baffles, to a shallower area where biological uptake can occur. It is expected that discharge from this facility can be directed to the C-111 system to the south. The cost of this facility is included in the overall cost of this Alternative.

K. Construction Plan. After clearing and grubbing the construction site, the basic construction sequence will consist of grading the swale with conventional earthmoving equipment. The swale cut material is suitable as fill for levee construction provided the organic material is removed.

The levee construction will consist of the following general construction sequence:

(1) Place woven geotextile beneath levee embankment.

(2) Construct interior levee and core of perimeter levee.

(3) Shape levee surface.

(4) Place non-woven geotextile “cushion” on upstream 3:1 (H:V) face of perimeter levee in areas where geomembrane will be placed.

(5) Place non-woven geotextile above geomembrane.

(6) Complete construction of perimeter levee.

Dewatering will be required for the construction of the reinforced concrete pumping station. Blasting may also be required for foundation construction and for the intake canal.

L. Demolition. Alternative 8A calls for the creation of open space and floodway within the western portion of the 8.5 SMA area. The creation of open space and floodway is necessitated due to the inundation of the area that will result from the increase of surface water elevations within the ENP. Thus, those private lands generally to the west of the internal levee would become public lands under this Alternative. With the purchase of the property, the question of what becomes of the land becomes a concern. Historically, the area on the eastern portion of the 8.5 SMA has been found suitable for agriculture usage. The area to the west, closer to the ENP expansion area is primarily vacant or open land. Since the surface water elevations within the ENP would fluctuate during the wet and dry seasons, it is reasonable to assume that, depending on climate conditions, portions of the property may be suitable for periodic agricultural usage. The western portion of the area will be subject to increased surface water elevations and extended periods of inundation. The final disposition of the properties purchased for this Alternative will depend on the economic viability of the potential future uses.

Purchase of properties by the SFWMD has transferred some properties from private to public ownership. For the most part, structures that existed on the property have been razed and the demolition debris either removed or placed in low areas on the site. Most of these sites have raised areas where the former structure pads, and access roads were located.

The goal of this analysis is to quantify the cost of the purchase of the property specifically as it addresses the dispensation of the existing structures and appurtenances. Three basic procedures for demolition of existing structures have been proposed. These include:

- Demolition of current structure without removal of fill pad. This option for demolition is similar in nature to what SFWMD is currently doing with lands that it has purchased within the 8.5 SMA. The structure is razed but the fill pad and access road are left intact. Septic systems are collapsed and filled.

- Demolition of current structure, removal of fill pad and access road. This option provides for the demolition of the current structure including the removal of the fill pad, access road, and septic system. Property is regraded to approach natural (pre-development) conditions. Natural recruitment is expected to foster wetland growth.

- Demolition of current structure, removal of fill pad, access road, exotics removal and land management. This option provides for the demolition of the current structure including the removal of the fill pad and access road. The septic system is removed. Property is regraded to approach natural (pre-development) conditions. Exotic species are removed from the site and the area is managed to promote natural wetland development.

As can be seen by the three optional procedures for land management presented above, the level of effort can range from the minimal clearing of the site through full site management.

For the purposes of this evaluation, it is expected that areas to the west of the internal levee would require both structure removal and land management. The SFWMD will be the entity that will manage the area that is allowed to migrate to wetland conditions. These costs will include not only demolition and disposal but will also provide information on costs to manage the property for the project life. Structure removal costs have been developed and are included in the Real Estate Appendix.

M. Cost Estimate. The preliminary cost estimates for Alternative 8A is $153,726,000. The preliminary cost summary sheet for Alternative 8A is presented in Table C-17. The annual cost for this Alternative over the 50-year life of the project is estimated at $12,255,361.The unit rates used to estimate the costs were obtained from the following sources:

(1) Current SFWMD projects

(2) Local contractors currently working on similar projects in Southern Florida

(3) Equipment manufacturers and suppliers

In addition to the Capital Costs associated with the Alternative, there are costs that can be considered to be either replacement or annual costs. Replacement costs consider the cost of replacing facilities and structures. In this Alternative, replacement costs consider the replacement of the pumps at the half-way point in the 50-year life-cycle and the replacement of the asphalt roadway. Annual costs consider the operations and maintenance costs for the pump station and ecological maintenance that has to occur. Replacement costs for pumps and roadways is annualized to $35,607. Annual costs for pump station operations and maintenance is $298,950.

Annual costs for ecological maintenance assume that the area to be converted to wetlands is regraded to appropriate contours for natural wetland recruitment. The cost of this regrading is considered a Capital Cost. Ecological operations and maintenance considers the effort necessary for the removal of nuisance species

during the period (5-years) when natural recruitment is occurring. After 5-years, it is believed that the wetlands will be established and will not require the same level of effort as initially expended. Alternative 8A considers limited restoration of wetlands. The annual costs include initial intensive treatment, periodic burning, and the periodic removal of nuisance species. The total annualized cost is estimated to be $46,463. Water quality monitoring for the discharge from the pumping station is estimated at $147,033 per year. The costs for this Alternative are summarized on Tables C-3 and C-4.

N. Alternative Performance. Alternative 8A is designed to provide water surface level mitigation to the 8.5 SMA while improving the water elevations and flows within the ENP. Mitigation does not occur over most of the 8.5 SMA and thus, the purchase of easements to allow flow is a requirement. The extent of wetlands and their hydroperiod within the ENP is improved over the pre-MWD condition and thus, this Alternative does allow for an improvement in the overall ENP ecological condition.

12.0 ALTERNATIVE 9 - ADAPTIVE REFINEMENT OF GDM PLAN

A. Plan Description**.** Alternative 9 is a combination of Alternative 1 and Alternative 2B and has very similar structural features. This plan consists of a levee around the north and west perimeter of the 8.5 SMA running from the L-31 North Canal to SW 168th Street. Approximately 100 feet interior of this perimeter levee is a collection or seepage canal. Internal to the seepage canal is an interior berm. This configuration is depicted on Figure C-16. The purpose of this configuration is to allow water levels within ENP to be raised to appropriate MWD or NSM levels. The seepage canal collects water which infiltrates through the levee to prevent deleterious changes on the water surface elevation within the 8.5 SMA. The interior berm is positioned to prevent surface water from entering the seepage canal. Based on previous work effort, surface water from the residential area was expected to have the potential for inferior quality water when compared to that of the seepage canal.

The perimeter levee has a length of 40,200 feet, a top width of 20 feet and an elevation of 10.2 feet as developed in the GDM. The seepage canal will be cut to a similar depth throughout to allow for flow either to the north or to the south depending on the future improvements. For this Alternative, the width of the canal will be relatively consistent throughout its length as shown in Table C-18.

Alternative 9 contemplates the pumpage of water from the seepage canal initially to the north as is projected in Alternative 1. In the future, when improvements to the south have been completed, pumpage of seepage water could be to the south as is depicted in Alternative 2B. A pump station designated S-357A is to be constructed at the northeastern end of the seepage collection canal to pump water into the L-31N canal for conveyance north to the L-29 canal adjacent to

ENP and Northeast Shark River Slough. A similar pump station, S-357B, will be constructed at the southern terminus of the seepage canal.

Alternative 9 is considered to be a flood mitigation alternative. By USACE definition, a flood mitigation alternative limits damages to the residents within the 8.5 SMA from flood stages no greater than currently exist within the area. Thus, the alternative does not change the existing storm water management level of service to the 8.5 SMA.

B. Levees and Canal. The perimeter levee has an estimated length of 40,200 feet, a top width of 20 feet and an elevation of 10.2 feet as shown on Figure C-2. The seepage canal shown on Figure C-3 varies in width and depth depending on the location relative to the proposed pump stations S-357A or S-357B. The canal has been designed so that all of the seepage either flows north to pump station S-357A or south to pump station S-357B. For Alternative 9, the width varies from 40 feet at either end to 30 feet near the middle for Segments El-E and E-F shown in Table C-18, with a variation in depth from 15 feet at either end to 12.5 feet in the middle.

During the construction of the L-31N canal and in subsequent investigations, it has been found that the residential area is underlain by a thin layer of silt and peat. This thin layer of organic material is expected to pose no problems for either the construction or the stability of the levee because of its relatively shallow depth. Additionally, the Soil Survey of Dade County Area, Florida (1996) indicates that marl or limestone rock is exposed at or near the ground surface along the western and northern perimeter of the 8.5 SMA. Medium hard to hard highly permeable limestone rock is expected to be encountered from the ground surface to below the canal invert elevation.

The seepage canal is designed for the flow rates calculated by the USACE using the “MODBRANCH” model. Based on the results of the USACE analyses, a total flow rate of 500 cfs is anticipated at either end the seepage canal as presented for Alternatives 1 and 2. This flow rate can be equally distributed along the 40,200 feet of canal to allow sizing of the canal cross-sections for each segment shown on Figure C-16. The calculated canal sections are shown in Table C-18. A canal bottom slope of 0.000013 ft/ft was used to calculate the canal flow rate; this is a gradient of 0.5 feet over the 40,200 feet canal length. The estimated excavation volume, assuming a 20% overcut, would be approximately 1,254,450 cy.

The canal will be formed by drilling, blasting and excavating of the limestone rock. The blasting and excavation should reduce the limestone rock to a graded cobble, gravel and sand mixture. The excavated material should be suitable for the levee construction provided the material is crushed and processed; the maximum particle size of the crushed rock should be less than 2 inches.

The levee cross-sections are shown in Figures C-2 and C-3. A woven geotextile is recommended beneath the levees to stop migration of embankment fill into the porous limestone and to distribute the embankment load if localized peat/muck deposits are encountered. A geomembrane will be required on the ENP side of the perimeter levee to reduce the seepage through the levee. Additionally, a non-woven geotextile is recommended above/below the geomembrane to reduce the potential of punctures caused by the angular processed fill material. A total levee volume of approximately 562,700 cy is required. Therefore, there is a net export of approximately 691,750 cy. The net export material will either be used in an expanded levee, stockpiled or sold.

C. Structures. Pump stations designated S-357A and S-357B are to be constructed at the northeastern and southern ends of the seepage collection canal, respectively. The S-357A pump station constructed initially, will pump water into the L-31N canal for conveyance north to the L-29 canal adjacent to ENP and NESRS. The S-357B pump station constructed in the future, will pump water into the 96-inch diameter pipeline for conveyance south to the C-111 system. Each pump station will discharge to a capacity of 500 cfs.

The pump stations will be equipped with diesel powered axial flow pumps with a design head of less than 10 feet. A conveyance channel will be required for the S-357 pump station to connect it to canal L-31N. Additionally, 200 feet of the seepage canal will be lined with concrete and training walls constructed to connect the seepage canal to the pump intake structure.

The pump stations will consist of a reinforced concrete structure supporting the pumps and a reinforced concrete gated spillway. A superstructure consisting of concrete block walls and reinforced concrete rigid frames will be used to house the pumping units. An intake structure with a bay for each pumping unit will be constructed including a trash rack and service bridge.

D. Seepage Barrier. This item is not required for this Alternative.

E. Raise Roads. This item is not required for this Alternative.

F. Infrastructure. A pump station access road will be constructed to El 10.2. This roadway will consist of a structural section of 2 inches asphalt over 8 inches of limerock base. The road will be 20 feet wide including the shoulders. A diesel fuel storage tank will be required for the pump engines and electric utilities required for support equipment and lighting.

G. Real Estate Needs. The Real Estate Appendix (Appendix D) outlines the methodology for the evaluation of real estate costs. For this Alternative, the lands acquired by the USACE would be utilized at a cost of $4,110,200.

H. O&M Requirements. O&M for the levee should consist of an annual visual inspection. A detailed inspection plan will be developed; however, at a minimum, the following should be noted during each inspection:

- Surface erosion gullies
- Excessive levee settlement
- Exposure of the geomembrane

The crushed processed canal rock material should be relatively durable and not prone to erosion. Vegetating the slopes is not necessary; some natural vegetation may occur with time. The shallow rooted vegetation may also reduce slope erosion. Any identified problem should be corrected.

The O&M costs for the pump stations has been estimated based on information supplied by both the USACE SFWMD. This cost is $298,950 per year and consists of specific operations and maintenance activities needed to insure that the generators and pumps operate as designed. The cost of operations and maintenance is expected to be similar because only one set of pumps is expected to be operational at any one time.

I. Permitting. Permitting considers those permits necessary to construct and operate the Alternative. These permits are addressed in the FSEIS and are referenced herein.

J. Water Quality. During the initial stages of Alternative 9, seepage water will be collected and discharged to the north, to L-31N. Treatment will be within a treatment area to be constructed as part of another conveyance project, as discussed under Alternative 1. During the later phases of this Alternative, seepage water will be handled as in Alternative 2. That is, water from the seepage canal is envisioned to discharge through a 2,000-foot pipeline into the C-111 buffer area south of Richmond Drive in an area already owned for the planned C-111 buffer area. The phosphorus loadings from this Alternative can be expected to range between 7 ppb and 12 ppb. The discharge standard for phosphorus is 10 ppb. Thus, a treatment facility will have to be constructed. The treatment facility envisioned consists of an approximately 200-acre area located 2,000 feet south of Richmond Drive. Discharge from the seepage canal will be pumped to the treatment area. The treatment area will consist of a bermed area approximately 3,000 feet by 3,000 feet. Final design of the facility will establish water surface elevations within the treatment area. However, for planning purposes, it is expected that water surface elevations of no more than 4-feet above ground surface will exist in the treatment area. Water would enter an open water section of the facility. From there it would be directed, using baffles, to a shallower area where biological uptake can occur. It is expected that discharge from this facility can be directed to the C-111 system to the south. The cost of this facility is included in the overall cost of this Alternative.

K. Construction Plan. After clearing and grubbing the construction site, the basic construction sequence will consist of drilling, blasting and excavating the collection seepage canal in accordance with the canal dimensions presented in Table C-18. It is anticipated that the excavated canal surface will be relatively rough from the blasting/excavation process. The excavated material will be comprised of a graded material consisting of sand size to rock size particles; relatively large pieces of rock may be generated by the blasting operation because of the relatively shallow blasting and variable limestone hardness. A crusher will be required to process the blast rock to produce the levee fill material. The rock should be crushed to a maximum particle size of 2 inches.

The blasting operation will produce transient vibrations that will attenuate with increased distance from the blast location. The vibrations produced by blasting should be barely perceptible to humans at a distance of approximately 1-mile and distinctly perceptible at a distance of ¼ to ½ mile. For structures located within a distance of ¼ mile of the blasting operations, vibration levels should be measured, and shot charges may need to be adjusted to maintain a vibration level below a peak particle velocity of 0.5 inches per second.

The canal blast rock is suitable as fill for levee construction. This material can be excavated with conventional excavating equipment. A crusher will be required to reduce the limestone rock to sand-gravel gradation with maximum particle size less than 2 inches.

The levee construction will consist of the following general construction sequence:

(1) Place woven geotextile beneath levee embankment.

(2) Construct interior levee and core of perimeter levee.

(3) Shape levee surface.

(4) Place non-woven geotextile “cushion” on upstream 3:1 (H:V) face of perimeter levee in areas where geomembrane will be placed.

(5) Place non-woven geotextile above geomembrane.

(6) Complete construction of perimeter levee.

Dewatering will be required for the construction of the reinforced concrete pumping station. Blasting may also be required for foundation construction and for the intake canal and discharge pool.

L. Demolition. Alternative 9 calls for the placement of a perimeter levee, seepage canal, and internal levee on land that is owned or is in the process of being acquired by the USACE. If not currently cleared, the property will be cleared of all structures and regraded to facilitate the placement of the required facilities. Additionally, lands purchased by the SFWMD may have to be regraded to meet wetland creation needs. Additionally, management of the purchased lands will reduce exotic vegetation and promote viable wetland habitat.

The SFWMD will be the entity that will manage the area that is allowed to migrate to wetland conditions. Structure removal costs have been developed from the information generated and described in the Real Estate Appendix. These costs will include not only demolition and disposal but will also provide information on costs to manage the property for the project life.

M. Cost Estimate. The preliminary cost estimate for Alternative 9, shown in Table C-19, is approximately $39,903,700. The annual cost for this Alternative over the 50-year life of the project is estimated at $3,581,334. This cost estimate includes both the pumping stations S-357A and S-357B and the 2,000 lf of 96-inch diameter pipeline. The preliminary cost summary sheet for Alternative 9 is presented in Table C-19. The unit rates used to estimate the costs were obtained from the following sources:

(1) Current SFWMD projects

(2) Local contractors currently working on similar projects in Southern Florida

(3) Equipment manufactures and suppliers.

In addition to the Capital Costs associated with the alternative, there are costs that can be considered to be either replacement or annual costs. Replacement costs consider the cost of replacing facilities and structures. In this Alternative, replacement costs consider the replacement of the pumps at the half-way point in the 50-year life-cycle and the replacement of the asphalt roadway. Annual costs consider the operations and maintenance costs for the pump station and ecological maintenance that has to occur. Replacement costs for pumps and roadways is annualized to $71,214. Annual cost for pump station operations and maintenance is $298,950. This is the same number used for the other alternatives with only one pump station because it is assumed that only one pump station will be operating at any given time.

Annual costs for ecological maintenance assume that the area that is deemed to be converted to wetlands is regraded to appropriate contours for natural wetland recruitment. The cost of this regrading is considered a Capital Cost. Ecological operations and maintenance considers the effort necessary for the removal of nuisance species during the period (5-years) when natural recruitment is occurring. After 5-years, it is believed that the wetlands will be established and

will not require the same level of effort as initially expended. Alternative 9 considers minimal restoration of wetlands. Thus, the annual cost includes only periodic maintenance estimated to be $20,000. Water quality monitoring for the discharge from the pumping station is estimated at $147,033 per year. The costs for all alternatives are summarized on Tables C-3 and C-4.

N. Alternative Performance. Alternative 9 is designed to provide water surface level mitigation to the 8.5 SMA while improving the water elevations and flows within the ENP. Mitigation is provided by the alternative over most of the 8.5 SMA. A small area, immediately adjacent to L-31N does not receive mitigation. The extent of wetlands and their hydroperiod within the ENP is improved over the pre-MWD condition and thus, this Alternative does allow for an improvement in the overall ENP ecological condition.

13.0 PROJECT IMPLEMENTATION

13.1 Implementation

One of the essential components of the evaluation of alternatives is the time that it will take to implement. Alternative 1, the Authorized GDM Plan, can be completed by the December 31, 2003 schedule that has been mandated for the project (subject to funding constraints). If other alternatives are to be implemented, the period for implementation should be compared to Alternative 1.

Portions of Alternative 1 have been in the process of implementation for some time. All of the land that would be required in the construction of Alternatives 1, 2B, 3 and 9 have been acquired fee simple (Alternative 3 requires additional land as flowage easements). Remaining work efforts for these alternatives includes design, permitting and construction. Monitoring and operations and maintenance efforts begin following construction and continue for the appropriate periods.

The other alternatives (3,4,5,6B,6C,6D,7,and 8A) require the purchase of additional property and/or easements for their implementation. Based on the information supplied by the SFWMD, there are a number of property owners who will likely be unwilling to accept any of these Alternatives. For those properties, condemnation will have to occur. Based on the land acquisition schedule presented in Appendix D, Real Estate, land acquisition for Alternatives 3,4,5,6B,6C, 6D, 7 and 8A can occur within 18 months from January 8, 2001, as shown below.

Land Acquisition Time

Alternative	Required Acreage		Acquisition Time (months)	Acquisition Date
	Land Purchase	Flowage Easement		
1	663(1)	-	0	July 2002
2B	663(1)	-	0	July 2002
3	-	5825	18	July 2002
4	-	6413	18	July 2002
5	6413	-	18	July 2002
6B	4046	150	18	July 2002
6C	1743	-	18	July 2002
6D	2335	546	18	July 2002
7	-	5839	18	July 2002
8A	5803	-	18	July 2002
9	663(1)	-	0	July 2002

(1) Land has been purchased for these Alternatives.

The implementation schedule for each alternative is shown on Figure C-17. For each alternative, design and land acquisition activities would begin in January 2001. The alternatives could be completed by the dates shown on Figure C-17, provided the following scheduling constraints are met:

- Condemnation authority will be available for use in land acquisition and property required for construction is purchased by June 2002.
- Environmental Resource Permit submitted and approved within 11 months of project start
- Project is self mitigating through overall hydrologic restoration of north-east Shark River Slough

Also, it is assumed that if a Post Authorization Report (PAC) report is approved, it can be received by January 2001.

All alternatives can be constructed by December 2003; however, based on the schedules presented on Figure C-17; there is no allowance for slippage in the schedules for the majority of the alternatives.

13.2 COST BASIS COMPARISON

The initial and annual cost summary for each alternatives are shown in Tables C-3 and C-4. These estimates were based on the following sources:

(1) Current SFWMD projects.

(2) Local contractors currently working on similar projects in Southern Florida.

(3) Equipment manufacturers and supplies.

The initial costs shown in Table C-3 also include a 20% construction contingency.

It is appropriate to compare these project costs to the costs presented in the USACE MWD June 1992 document and the Peer Consultants report dated August 1998. A cost for Alternative 1 was presented in these two documents and will be used for the basis of comparison. A summary of the costs is presented below.

Cost Comparison – Alternative 1

Source	Design, Permits, and Construction	Real Estate	Total
USACE, June 1992	$23,625,000	$7,664,000	$31,289,000
Peer, August 1998	$22,532,343	$14,512,313	$37,044,674
HDR, March 2000	$26,475,300	$4,110,200	$30,585,531

The above comparison shows that the current HDR cost estimate for design, permits, and construction is within 8% of the USACE cost estimate. However, if the USACE cost were increased by a 3% compounded interest rate to account for inflation, the USACE present cost would be $29,932,875. Also, the USACE cost was adjusted to reflect a 20% construction contingency instead of the 25% value included in the June 1992 document. This means the HDR cost is approximately 12% less than the USACE cost in terms of present value. The Peer Consultants cost in terms of present value would be 23,906,815. This is 20% less than the USACE cost and 10% less than the HDR cost. The HDR cost is within 2% of the average of the USACE and Peer Consultants total consultants cost.

Land valuation was highly varied for the three cost estimates. The HDR land valuation is more reliable than the other values because it is based on actual real

estate appraisals and on the actual cost of property that USACE has already purchased.

There were no other alternatives that could be used for a cost comparison; however, based on the above comparison, the HDR cost model appears to be of sufficient accuracy to allow a reliable comparison of the alternatives. The components of the other alternatives are similar to Alternative 1, and therefore the cost estimates for these Alternatives should also be of similar accuracy.

13.3 Grouping of Alternatives

From an engineering perspective the following criteria can be used to evaluate the alternatives:

- Cost
- Schedule

Potential uncertainties in design and construction have been considered in both the schedule and the cost.

A relative comparison of the annualized cost for the alternatives is presented below.

Grouping of Alternatives Based on Annualized Cost

Annualized Cost	Alternatives
< $5,000,000	1,2B, and 9
$5,000,001 to $10,000,000	6C and 6D
> $10,000,000	3,4,5,6B,7, and 8A

It is also appropriate to compare the construction schedules for the different alternatives. The estimated completion dates are presented below.

Estimated Completion Date

Alternative	Completion Date
1	December 2003
2B	December 2003
3	December 2003
4	December 2002
5	December 2002
6B	December 2003
6C	December 2003
6D	December 2003
7	September 2003
8A	December 2003
9	December 2003

The grouping of the Alternatives by completion date is shown below.

Grouping of Alternatives Based on Completion Date

Date	Alternatives
December 2002	4, 5
September 2003	7
December 2003	1, 2B, 3, 6B, 6C, 6D, 8A, 9

Based on the grouping of alternatives by cost and completeness schedule, it appears that Alternatives 1, 2B and 9 are the least expensive; however, all of the alternatives can be constructed by December 2003.

14.0 Recommended Plan

After carefully weighing all of the project data, a Recommended Plan was selected in the GRR. The Recommended Plan, is the Alternative which best satisfies the project goals and objectives of this project and is consistent with the overall goals and objectives of the MWD. The Recommended Plan selected is Alternative 6D with conditions. This plan, as discussed in the GRR, provides the optimum solution for providing flood mitigation to landowners in the 8.5 SMA and environmental enhancement to the ENP by balancing the environmental and social benefits.

An MCACES evaluation of the construction costs associated with the Recommended Plan and the Authorized Plan (Alternative 1) is provided as an attachment to this appendix. These two MCACES evaluations allow a comparison of the construction costs associated with the two alternatives. The MCACES evaluations provided do not include costs for Engineering during Construction or Construction Management. These costs are shown in the tabulation of total cost for each of the alternatives.

The Appendix D, Real Estate includes an estimate of the cost of acquisition of both property and easements for all of the alternatives, including 6D, the Recommended Plan. This Appendix further develops a Real Estate Chart Of Accounts which shows the expected Real Estate Costs for the project. This cost is estimated to total $70,359,100, including $13.452,710 of prior expenditures. This cost is also reflected in the tabulation below.

	Alternative 1 Authorized Plan	**Alternative 6D Recommended Plan**
MCACES Construction Cost	$28,633,184	$27,188,230
Construction Management and Engineering During Construction	$ 5,726,637	$ 5,427,646
MCACES Real Estate	$ 10,046,350(1)	$ 73,925,330
Total Costs	$44,406,171	$106,541,206

Note:

(1) MCACES Real Estate Estimate for Alternative 1 is taken from the 1992 GDM. This includes those both those costs related to Alternative 1 and those associated with additional land purchases for DOI. Actual cost of real estate acquisition for the Corps project was $4,110,200.

CENTRAL AND SOUTHERN FLORIDA PROJECT
MODIFIED WATER DELIVERIES TO EVERGLADES NATIONAL PARK, FLORIDA

8.5 SQUARE MILE AREA

APPENDIX C
PRELIMINARY ENGINEERING AND COSTS

TABLES

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

July 2000

HDR Engineering, Inc.

Table C-1
Canal Dimensions
Alternative 1
Authorized GDM Plan

Corp. Calculated Flow Rate =	500 cfs	Delta H =	0.5 ft
Total Length =	40,170 ft	Slope =	1E-05 ft/ft
Flow Rate per LF =	0.0124471 cfs/lf	El. G.S. =	6.5 ft/ft

Segment – South to North	Segment Length	Canal Dimensions		
		Bottom Width	Bottom Depth	Bottom Elevation
		(ft)	(ft)	(ft)
I-J	6125	15	8	-1.5
H-I	930	20	9.5	-3
G-H	5625	25	11	-4.5
F-G	2980	25	11	-4.5
E-F	5260	30	12.5	-6
E1-E	3680	30	12.5	-6
D-E1	4960	40	12.5	-6
C-D	5350	40	15	-8.5
A-C	5260	40	15	-8.5

Table C-2
Preliminary Cost Summary Sheet
Alternative 1
Authorized GDM Plan

Description	Quantity	Unit	Unit Cost	Extended Cost
Blast and Excavate	957,904	CY	$7.00	$6,705,327
Crush and Process Rock	957,904	CY	$2.00	$1,915,808
Perimeter Levee				
On-site Haul & Place				
1/2 Mile (20%)	88977	CY	$2.00	$177,954
1 Mile (25%)	111221	CY	$2.75	$305,858
2 Miles (25%)	111221	CY	$3.50	$389,274
3 Miles (30%)	133465	CY	$4.50	$600,594
Shape and Compact	444885	CY	$1.40	$622,838
Internal Levee				
On-site Haul & Place				
1/2 Mile (20%)	18750	CY	$2.00	$37,500
1 Mile (25%)	25000	CY	$2.75	$68,750
2 Miles (25%)	25000	CY	$3.50	$87,500
3 Miles (30%)	31250	CY	$4.50	$140,625
Shape and Compact	117832	CY	$1.40	$164,965
Geofabrics				
Geomembrane and non-woven geotextile(perimeter levee)	1944228	SFT	$0.55	$1,069,325
Woven Geotextile (perimeter and interior levee)	368225	SY	$1.40	$515,515
Pump Station Access Road				
Fill	1000	CY	$12.00	$12,000
8" Rock Base	2224	SY	$8.50	$18,904
2" Wear Surface	1986	SY	$6.50	$12,909
Conveyance Channel				
S-357 Pump Station Discharge	1	EA	$500,000	$500,000
Demolition (1)				
Clear and Grub	0	AC	$2,000	$0
Homes (wells, septic, pads etc.)	0	EA	$8,000	$0
Pump Station North S-357 (500 cfs)	1	EA	$5,040,000	$5,040,000
Subtotal Construction				$18,385,647
Contingency (20%)				$3,677,129
Total Construction Cost				$22,062,776
Planning, Engineering, Design, Construction Management (20%)				$4,412,555
Real Estate (2)	663	AC		$4,110,200
Total				$30,585,531

(1) Assumes no restoration necessary
(2) Real Estate Costs are taken from the Real Estate Appendix

Tables C-3
Initial Cost Summary
March 2000 Price Levels

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6B	Alternative 6C	Alternative 6D	Alternative 7	Alternative 8A	Alternative 9
Channels and Canals											
Blast and Excavate	$6,705,327	$6,423,859	$0	$0	$0	$3,666,320	$5,881,492	$3,778,542	$0	$3,796,564	$4,390,560
Crush and Process Rock	$1,915,808	$1,835,388	$0	$0	$0	$1,047,520	$1,680,426	$1,079,583	$0	$976,259	$2,508,892
Perimeter Levee	$2,096,518	$2,096,518	$2,469,109	$0	$0	$1,269,621	$1,686,319	$1,855,334	$0	$1,183,900	$2,096,518
Internal Levee	$499,340	$499,340	$0	$0	$0	$259,835	$446,638	$487,473	$0	$273,709	$499,340
Geofabrics	$1,584,840	$1,584,840	$1,487,629	$0	$0	$1,051,826	$1,397,043	$1,451,620	$0	$922,050	$1,584,840
Pump Station(s)											
S-357	$5,040,000	$5,040,000	$0	$0	$0	$5,040,000	$5,040,000	$5,040,000	$0	$5,040,000	$5,040,000
S-357B											$5,040,000
Access Road (S-357)	$43,813	$43,698	$43,698	$0	$0	$43,813	$43,813	$53,413	$0	$43,813	$43,813
Conveyance Channel (S-357)	$500,000	$500,000	$0	$0	$0	$500,000	$500,000	$500,000	$0	$500,000	$1,000,000
Seepage Barrier			$82,804,313								
Main Asphalt Roadways									$2,064,995		
Dirt Roadways									$5,696,527	$0	$0
Miscellaneous Drainage Structures									$8,400,000		
Canal Road Crossing								$672,000			
Pipeline and Treatment Area to C-111		$2,652,600				$2,652,600	$2,652,600	$2,652,600		$2,652,600	$2,652,600
Demolition	$0	$0	$422,957	$6,986,000	$10,746,000	$7,212,000	$2,998,000	$4,950,000	$558,000	$3,200,000	$0
Total Construction Costs	$18,385,647	$20,676,244	$87,227,706	$6,986,000	$10,746,000	$22,743,534	$22,326,331	$22,520,565	$16,719,522	$18,588,896	$24,856,564

Tables C-3
(Continued)
Initial Cost Summary
March 2000 Price Levels

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6B	Alternative 6C	Alternative 6D	Alternative 7	Alternative 8A	Alternative 9
Land Costs	$4,110,200	$4,110,200	$110,194,150	$122,758,020	$164,765,770	$114,959,000	$30,683,921	$55,709,420	$110,514,250	$126,957,950	$4,110,200
Total Construction and Real Estate Costs	$22,495,847	$24,786,444	$197,421,856	$129,744,020	$175,511,770	$137,702,5341	$53,010,249	$78,229,988	$127,233,772	$145,546,846	$28,966,764
Construction Cost Uncertainty (20%)	$3,677,129	$4,135,249	$17,445,541	$698,600	$1,074,600	$4,548,707	$4,465,266	$4,504,114	$3,343,904	$3,717,779	$4,971,313
Planning, Engineering and Design	$1,985,650	$2,233,034	$9,420,592	$691,614	$1,063,854	$2,456,302	$2,411,243	$2,431,221	$1,805,708	$2,007,601	$2,684,509
Construction Management	$2,426,905	$2,729,264	$11,514,057	$845,306	$1,300,266	$3,002,147	$2,947,075	$2,972,715	$2,206,977	$2,453,734	$3,281,066
Total Non-Construction Costs	$8,089,684	$9,097,548	$38,380,191	$2,235,520	$3,438,720	$10,007,155	$9,823,584	$9,909,050	$7,356,590	$8,179,114	$10,936,888
Total Initial Costs	$30,585,531	$33,883,992	$235,802,046	$131,979,540	$178,950,490	$147,709,689	$62,833,833	$88,139,038	$134,590,361	$153,725,961	$39,903,652
Rounded	**$30,585,500**	**$33,884,000**	**$235,802,000**	**$131,979,500**	**$178,950,500**	**$147,709,700**	**$62,833,800**	**$88,139,000**	**$134,590,400**	**$153,726,000**	**$39,903,700**

Annual Cost Summary

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6B	Alternative 6C	Alternative 6D	Alternative 7	Alternative 8A	Alternative 9
Total Project Investment	$33,794,254	$37,438,803	$260,540,214	$145,825,596	$197,724,369	$163,206,066	$69,425,754	$97,385,747	$148,710,408	$169,853,542	$44,090,035
Interest and Amortization	$2,333,279	$2,584,911	$17,988,647	$10,068,331	$13,651,612	$11,268,342	$4,793,407	$6,723,867	$10,267,509	$11,727,308	$3,044,137
Operations and Maintenance Costs	$249,875	$318,950	$20,000	$106,687	$106,687	$404,265	$354,373	$366,404	$106,687	$345,413	$318,950
Equipment Replacement Costs	$35,607	$35,607	$0	$0	$0	$35,607	$35,607	$35,607	$432,426	$35,607	$71,214
Water Quality Monitoring Costs	$147,033	$147,033	$0	$0	$0	$147,033	$147,033	$147,033	$0	$147,033	$147,033
Total Annual Cost	**$2,765,794**	**$3,086,502**	**$18,008,647**	**$10,175,018**	**$13,758,299**	**$11,855,248**	**$5,330,420**	**$7,272,911**	**$10,806,622**	**$12,255,361**	**$3,581,334**

Table C-4
Annual Cost Summary

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6B	Alternative 6C	Alternative 6D	Alternative 7	Alternative 8A	Alternative 9
Interest Rate	6.625%	6.625%	6.625%	6.625%	6.625%	6.625%	6.625%	6.625%	6.625%	6.625%	6.625%
	0.000181507	0.000181507	0.000181507	0.000181507	0.000181507	0.000181507	0.000181507	0.000181507	0.00018151	0.000181507	0.00018151
Construction Start	Oct-00	Oct-00	Oct-00	Oct-00	Oct-00	Oct-00	Oct-00	Oct-00	Oct-00	Oct-00	Oct-00
Construction Complete	Dec-03	Dec-03	Dec-03	Dec-03	Dec-03	Dec-03	Dec-03	Dec-03	Dec-03	Dec-03	Dec-03
Total number of days	1156	1156	1156	1156	1156	1156	1156	1156	1156	1156	1156
Number of days to mid period	578	578	578	578	578	578	578	578	578	578	578
Initial Cost	$30,585,500	$33,884,000	$235,802,000	$131,979,500	$178,950,500	$147,709,700	$62,833,800	$88,139,000	$134,590,400	$153,726,000	$39,903,700
Interest During Construction	$3,208,754	$3,554,803	$24,738,214	$13,846,096	$18,773,869	$15,496,366	$6,591,954	$9,246,747	$14,120,008	$16,127,542	$4,186,335
Annualized Interest	$1,129,644	$1,251,471	$8,709,108	$4,874,529	$6,609,356	$5,455,508	$2,320,703	$3,255,325	$4,970,960	$5,677,714	$1,473,803
Interest Cost per Year	$2,333,279	$2,584,911	$17,988,647	$10,068,331	$13,651,612	$11,268,342	$4,793,407	$6,723,867	$10,267,509	$11,727,308	$3,044,137
Replacement Costs for Pumps and Roadways[(1)]	$35,607	$35,607				$35,607	$35,607	$35,607	$432,426	$35,607	$71,214
Operation and Maintenance[(2)]	$229,875	$298,950				$298,950	$298,950	$298,950		$298,950	$298,950
Ecological Operations and Maintenance[(3)]	$20,000	$20,000	$20,000	$106,687	$106,687	$105,315	$55,423	$67,454	$106,687	$46,463	$20,000
Water Quality Monitoring Costs[(4)]	$147,033	$147,033				$147,033	$147,033	$147,033		$147,033	$147,033
Total Annual Cost	$2,765,794	$3,086,502	$18,008,647	$10,175,018	$13,758,299	$11,855,248	$5,330,420	$7,272,911	$10,806,622	$12,255,361	$3,581,334

(1) Assumes replacement of Asphalt roads and pumps @ 25-years, replacement of dirt roads @ 10-years - pump cost 1/2 of full station costs.
(2) Assumes energy, labor, and miscellaneous costs
(3) Assumes intensive management for two years (four times/year), fire management for five years, continuous maintenance for life of project (50-years)
(4) Cost to monitor point source discharge (pumpage)

Table C-5
Canal Dimensions
Alternative 2B
Modified GDM Plan

Corp. Calculated Flow Rate =	500 cfs	Delta H =	0.5 ft
Total Length =	40,170 ft	Slope =	1.24E-05 ft/ft
Flow Rate per LF =	0.0124471 cfs/lf	El. G.S. =	6.5 ft

Segment – South to North	Segment Length	Canal Dimensions		
		Bottom Width (ft)	Bottom Depth (ft)	Bottom Elevation (ft)
A-C	5260	15	8	-1.5
C-D	5350	20	9.5	-3
D-E1	4960	25	11	-4.5
E1-E	3680	30	12.5	-6
E-F	5260	30	12.5	-6
F-G	2980	40	12.5	-6
G-H	5625	40	12.5	-6
H-I	930	40	15	-8.5
I-J	6125	40	15	-8.5

Table C-6
Preliminary Cost Summary Sheet
Alternative 2B - Modified GDM Plan

Description	Quantity	Unit	Unit Cost [1]	Extended Cost
Blast and Excavate	917,694	CY	$7.00	$6,423,859
Crush and Process Rock	917694	CY	$2.00	$1,835,388
Perimeter Levee				
On-site Haul & Place				
1/2 Mile (20%)	88977	CY	$2.00	$177,954
1 Mile (25%)	111221	CY	$2.75	$305,858
2 Miles (25%)	111221	CY	$3.50	$389,274
3 Miles (30%)	133465	CY	$4.50	$600,594
Shape and Compact	444885	CY	$1.40	$622,838
Internal Levee				
On-site Haul & Place				
1/2 Mile (20%)	18750	CY	$2.00	$37,500
1 Mile (25%)	25000	CY	$2.75	$68,750
2 Miles (25%)	25000	CY	$3.50	$87,500
3 Miles (30%)	31250	CY	$4.50	$140,625
Shape and Compact	117832	CY	$1.40	$164,965
Geofabrics				
Geomembrane and nonwoven geotextile(perimeter levee)	1944228	SFT	$0.55	$1,069,325
Woven Geotextile (perimeter and interior levee)	368225	SY	$1.40	$515,515
Pump Station Access Road				
Fill	1000	CY	$12.00	$12,000
8" Rock Base	2224	SY	$8.50	$18,908
2" Wear Surface	1986	SY	$6.50	$12,791
Conveyance Channel				
S-357 Pump Station Discharge	1	EA	$500,000	$500,000
Demolition [1]				
Clear and Grub	0	AC	$2,000	$0
Homes (wells, septic, pads etc.)	0	EA	$8,000	$0
Pump Station South S-357 (500 cfs)	1	EA	$5,040,000	$5,040,000
Pipeline to C-111, (96-inch-diameter)	2000	LF	$960.00	$1,920,000
Treatment Area				
Blast and Excavate	62333	CY	$3.50	$218,167
Crush and Process Rock	62333	CY	$2.00	$124,667
Perimeter Levee (Haul, shape, compact)	62333	CY	$4.40	$274,267
Woven Geotextile	82500	SY	$1.40	$115,500
Subtotal Construction				$20,676,244
Contingency (20%)				$4,135,249
Total Construction Cost				$24,811,493
Planning, Engineering, Design, Construction Management (20%)				$4,962,299
Real Estate [2]	663	AC		$4,110,200
Total				$33,883,992

(1) Assumes no restoration necessary.
(2) Real Estate Costs are taken from the Real Estate Appendix

Table C-7
Preliminary Cost Summary Sheet
Alternative 3
Deep Seepage Barrier Plan

Description	Quantity	Unit	Unit Cost	Extended Cost
Blast and Excavate	0	CY	$7.00	$0
Crush and Process Rock	0	CY	$2.00	$0
Perimeter Levee				
On-site Haul & Place				
1 Mile (20%)	88977	CY	$2.50	$222,442
2 Mile (25%)	111221	CY	$3.50	$389,274
3 Miles (25%)	111221	CY	$4.50	$500,495
4 Miles (30%)	133465	CY	$5.50	$734,059
Shape and Compact	444885	CY	$1.40	$622,838
Internal Levee				
On-site Haul & Place				
1/2 Mile (20%)	0	CY	$2.00	$0
1 Mile (25%)	0	CY	$2.75	$0
2 Miles (25%)	0	CY	$3.50	$0
3 Miles (30%)	0	CY	$4.50	$0
Shape and Compact	0	CY	$1.40	$0
Geofabrics				
Geomembrane and nonwoven geotextile(perimeter levee)	1767480	SFT	$0.55	$972,114
Woven Geotextile (perimeter levee)	368225	SY	$1.40	$515,515
Pump Station Access Road				
Fill	0	CY	$12.00	$12,000
8" Rock Base	0	SY	$8.50	$18,908
2" Wear Surface	0	SY	$6.50	$12,791
Conveyance Channel				
S-357 Pump Station Discharge	0	EA	$500,000	$0
Demolition [1]				
Clear and Grub	11	AC	$2,000	$22,957
Homes (wells, septic, pads etc.)	50	EA	$8,000	$400,000
Seepage Barrier	52325	LF	$1,583	$82,804,313
Pump Station South S-357 (225 cfs)		EA	$2,817,600	$0
Pipeline to C-111 (84-inch-diameter)		LF	$672.00	$0
Subtotal Construction				$87,227,706
Contingency (20%)				$17,445,541
Total Construction Cost				$104,673,247
Planning, Engineering, Design, Construction Management (20%)				$20,934,649
Real Estate [2]	5825	AC		$110,194,150
Total				$235,802,046

(1) Assumes no restoration necessary, 50 relocations from Real Estate Appendix
(2) Real Estate Costs are taken from the Real Estate Appendix.

Table C-8
Preliminary Cost Summary Sheet
Alternative 4
Landowner's Choice Land Acquisition Plan

Description	Quantity	Unit	Unit Cost [1]	Extended Cost
Blast and Excavate	0	CY	$7.00	$0
Crush and Process Rock	0	CY	$2.00	$0
Perimeter Levee				
On-site Haul & Place				
1/2 Mile (20%)	0	CY	$2.00	$0
1 Mile (25%)	0	CY	$2.75	$0
2 Miles (25%)	0	CY	$3.50	$0
3 Miles (30%)	0	CY	$4.50	$0
Shape and Compact	0	CY	$1.40	$0
Internal Levee				
On-site Haul & Place				
1/2 Mile (20%)	0	CY	$2.00	$0
1 Mile (25%)	0	CY	$2.75	$0
2 Miles (25%)	0	CY	$3.50	$0
3 Miles (30%)	0	CY	$4.50	$0
Shape and Compact	0	CY	$1.40	$0
Geofabrics				
Geomembrane and non-woven geotextile(perimeter levee)	0	SFT	$0.55	$0
Woven Geotextile (perimeter and interior levee)	0	SY	$1.40	$0
Pump Station Access Road				
Fill	0	CY	$12.00	$0
8" Rock Base	0	SY	$8.50	$0
2" Wear Surface	0	SY	$6.50	$0
Conveyance Channel				
Pump Station Discharge	0	EA	$500,000	$0
Demolition [1]				
Clear and Grub	79	AC	$2,000	$158,000
Homes (wells, septic, pads etc.)	44	EA	$8,000	$352,000
Regrade to Wetland (scrape down 0.5 feet and remove unusable material)	1619	AC	$4,000	$6,476,000
Subtotal Construction				$6,986,000
Contingency (10%)				$698,600
Total Construction Cost				$7,684,600
Planning, Engineering, Design, Construction Management (20%)				$1,536,920
Real Estate [2]	6413	AC		$122,758,020
Total				$131,978,540

(1) Based on Ecological Restoration Need
(2) Real estate costs are taken from the Real Estate Appendix. ('Includes cost for easements, fee simple, life estates and those costs required for implementation including raising septic tanks and wells and relocation costs.)

Table C-9
Preliminary Cost Summary Sheet
Alternative 5 – Total Buy-Out Plan

Description	Quantity	Unit	Unit Cost [1]	Extended Cost
Blast and Excavate	0	CY	$7.00	$0
Crush and Process Rock	0	CY	$2.00	$0
Perimeter Levee				
On-site Haul & Place				
1/2 Mile (20%)	0	CY	$2.00	$0
1 Mile (25%)	0	CY	$2.75	$0
2 Miles (25%)	0	CY	$3.50	$0
3 Miles (30%)	0	CY	$4.50	$0
Shape and Compact	0	CY	$1.40	$0
Internal Levee				
On-site Haul & Place				
1/2 Mile (20%)	0	CY	$2.00	$0
1 Mile (25%)	0	CY	$2.75	$0
2 Miles (25%)	0	CY	$3.50	$0
3 Miles (30%)	0	CY	$4.50	$0
Shape and Compact	0	CY	$1.40	$0
Geofabrics				
Geomembrane and non-woven geotextile(perimeter levee)	0	SFT	$0.55	$0
Woven Geotextile (perimeter and interior levee)	0	SY	$1.40	$0
Pump Station Access Road				
Fill	0	CY	$12.00	$0
8" Rock Base	0	SY	$8.50	$0
2" Wear Surface	0	SY	$6.50	$0
Conveyance Channel				
Pump Station Discharge	0	EA	$500,000	$0
Demolition [1]				
Clear and Grub	79	AC	$2,000	$158,000
Homes (wells, septic, pads etc.)	514	EA	$8,000	$4,112,000
Regrade to Wetland (scrape down 0.5 feet and remove unusable material)	1619	AC	$4,000	$6,476,000
Subtotal Construction				$10,746,000
Contingency (10%)				$1,074,600
Total Construction Cost				$11,820,600
Planning, Engineering, Design, Construction Management (20%)				$2,364,120
Real Estate [1]	6413	AC		$164,765,770
Total				$178,950,490

(1) Based on Ecological Restoration Need
(2) Real Estate Values are taken from the Real Estate Appendix. ('Includes cost for easements, fee simple, life estates and those costs required for implementation including raising septic tanks and wells and relocation costs.)

Table C-10
Canal Dimensions
Alternative 6B
Western Portion of 8.5 SMA Area as Buffer

Corps Calculated Flow Rate =	500 cfs	Delta H	0.5 ft
Total Length =	20600 ft	Slope =	2.4E-05 ft/ft
Flow Rater per LF =	0.024272 ft/lf	El. G.S =	6.5 ft/ft

Segment – South to North	Segment Length	Canal Dimensions		
		Bottom Width (ft)	Bottom Depth (ft)	Bottom Elevation (ft)
A-B	--	--	--	--
B-C	--	--	--	--
C-D	--	--	--	--
D-D1	--	--	--	--
D2-D1	7600	25	11	-4.5
D1-E	13000	30	15	-8.5

Table C-11
Preliminary Cost Summary Sheet
Alternative 6B – Western Portion of 8.5 SMA Area as Buffer

Description	Quantity	Unit	Unit Cost	Extended Cost
Blast and Excavate	523,760	CY	$7.00	$3,666,320
Crush and Process Rock	523,760	CY	$2.00	$1,047,520
Perimeter Levee				
On-site Haul & Place				
1/2 Mile (20%)	59052	CY	$2.00	$118,104
1 Mile (40%)	118104	CY	$2.75	$324,787
2 Miles (40%)	118104	CY	$3.50	$413,365
Shape and Compact	295261	CY	$1.40	$413,365
Internal Levee				
On-site Haul & Place				
1/2 Mile (20%)	12085	CY	$2.00	$24,171
1 Mile (40%)	24171	CY	$2.75	$66,469
2 Miles (40%)	24171	CY	$3.50	$84,597
Shape and Compact	60427	CY	$1.40	$84,597
Geofabrics				
Geomembrane and non-woven geotextile(perimeter levee)	1290344	SF	$0.55	$709,689
Woven Geotextile (perimeter and interior levee)	244383	SY	$1.40	$342,137
Pump Station Access Road				
Fill	1000	CY	$12.00	$12,000
8" Rock Base	2224	SY	$8.50	$18,904
2" Wear Surface	1986	SY	$6.50	$12,909
Conveyance Channel				
S-357 Pump Station Discharge	1	EA	$500,000	$500,000
Demolition [1]				
Clear and Grub	74	AC	$2,000	$148,000
Homes (wells, septic, pads etc.)	353	EA	$8,000	$2,824,000
Regrade to Wetland (scrape down 0.5 feet and remove unusable material)	1060	AC	$4,000	$4,240,000
Pump Station South S-357 (500 cfs)	1	EA	$5,040,000	$5,040,000
Pipeline to C-111, (96-inch-diameter)	2000	LF	$960	$1,920,000
Treatment Area				
Blast and Excavate	62333	CY	$3.50	$218,167
Crush and Process Rock	62333	CY	$2.00	$124,667
Perimeter Levee (Haul, shape, compact)	62333	CY	$4.40	$274,267
Woven Geotextile	82500	SY	$1.40	$115,500
Subtotal Construction				$22,743,534
Contingency (20%)				$4,548,707
Total Construction Cost				$27,292,241
Planning, Engineering, Design, Construction Management (20%)				$5,458,448
Real Estate [2]	4346	AC		$114,959,000
Total				$147,709,689

(1) Based on Ecological Restoration Need

(2) Real Estate Costs are taken from the Real Estate Appendix. ('Includes cost for easements, fee simple, life estates and those costs required for implementation including raising septic tanks and wells and relocation costs.)

Table C-12
Canal Dimensions
Alternative 6C
Modified Western Portion of 8.5 SMA as Buffer (SOR Boundary)

Corps Calculated Flow Rate =	500 cfs	Delta H	0.5 ft
Total Length =	35410 ft	Slope =	1.14E-05 ft/ft
Flow Rater per LF =	0.0141203 ft/lf	El. G.S =	6.5 ft/ft

Segment - South to North	Segment Length	Canal Dimensions		
		Bottom Width (ft)	Bottom Depth (ft)	Bottom Elevation (ft)
A-B	3575	15	8	-1.5
B-C	2625	20	9.5	-3
C-D	1300	20	9.5	-3
D-E	2630	25	11	-4.5
E-F	5265	25	11	-4.5
F-G	2600	30	12.5	-6
G-H	1330	30	12.5	-6
H-I	5300	40	12.5	-6
I-J	2625	40	12.5	-6
J-K	8160	40	15	-8.5

Table C-13
Preliminary Cost Summary Sheet
Alternative 6C – Modified Western Portion of 8.5 SMA as Buffer (SOR Boundary)

Description	Quantity	Unit	Unit Cost	Extended Cost
Blast and Excavate	840,213	CY	$7.00	$5,881,492
Crush and Process Rock	840,213	CY	$2.00	$1,680,426
Perimeter Levee				
On-site Haul & Place				
1/2 Mile (20%)	78433	CY	$2.00	$156,867
1 Mile (40%)	156867	CY	$2.75	$431,384
2 Miles (40%)	156867	CY	$3.50	$549,034
Shape and Compact	392167	CY	$1.40	$549,034
Internal Levee				
On-site Haul & Place				
1/2 Mile (20%)	20774	CY	$2.00	$41,548
1 Mile (40%)	41548	CY	$2.75	$114,256
2 Miles (40%)	41548	CY	$3.50	$145,417
Shape and Compact	103869	CY	$1.40	$145,417
Geofabrics				
Geomembrane and non-woven geotextile(perimeter levee)	1713844	SF	$0.55	$942,614
Woven Geotextile (perimeter and interior levee)	324592	SY	$1.40	$454,428
Pump Station Access Road				
Fill	1000	CY	$12.00	$12,000
8" Rock Base	2224	SY	$8.50	$18,904
2" Wear Surface	1986	SY	$6.50	$12,909
Conveyance Channel				
S-357 Pump Station Discharge	1	EA	$500,000	$500,000
Demolition [1]				
Clear and Grub	31	AC	$2,000	$62,000
Homes (wells, septic, pads etc.)	147	EA	$8,000	$1,176,000
Regrade to Wetland (scrape down 0.5 feet and remove unusable material)	440	AC	$4,000	$1,760,000
Pump Station South S-357 (500 cfs)	1	EA	$5,040,000	$5,040,000
Pipeline to C-111, (96-inch-diameter)	2000	LF	$960	$1,920,000
Treatment Area				
Blast and Excavate	62333	CY	$3.50	$218,167
Crush and Process Rock	62333	CY	$2.00	$124,667
Perimeter Levee (Haul, shape, compact)	62333	CY	$4.40	$274,267
Woven Geotextile	82500	SY	$1.40	$115,500
Subtotal Construction				$22,326,331
Contingency (20%)				$4,465,266
Total Construction Cost				$26,791,597
Planning, Engineering, Design, Construction Management (20%)				$5,358,319
Real Estate [2]	1743	AC		$30,683,921
Total				$62,833,833

(1) Based on ecological restoration need apportioned from Alternative 6B.
(2) Real Estate Costs are taken from the Real Estate Appendix. ('Includes cost for easements, fee simple, life estates and those costs required for implementation including raising septic tanks and wells and relocation costs.)

Table C-14
Canal Dimensions
Alternative 6D
Modified Western Portion of 8.5 SMA as Buffer

Corps Calculated Flow Rate =	500 cfs	Delta H	0.5 ft
Total Length =	20,773 ft	Slope =	2.407E-05 ft/ft
Flow Rater per LF =	0.02406971 cfs/lf	El. G.S =	6.5 ft/ft

Segment - South to North	Segment Length	Canal Dimensions		
		Bottom Width (ft)	Bottom Depth (ft)	Bottom Elevation (ft)
C1-E1	9098	25	12.5	-6
E1-I1	11675	30	15	-8.5

Table C-15
Preliminary Cost Summary Sheet
Alternative 6D – Modified Western Portion of 8.5 SMA as Buffer

Description	Quantity	Unit	Unit Cost	Extended Cost
Blast and Excavate	539,792	CY	$7.00	$3,778,542
Crush and Process Rock	539,792	CY	$2.00	$1,079,583
Perimeter Levee				
On-site Haul & Place				
1/2 Mile (5%)	19127	CY	$2.00	$38,254
1 Mile (30%)	114763	CY	$2.75	$315,598
2 Miles (40%)	153017	CY	$3.50	$535,560
3 Miles (25%)	95636	CY	$4.50	$430,361
Shape and Compact	382543	CY	$1.40	$535,560
Internal Levee				
On-site Haul & Place				
1/2 Mile (40%)	48747	CY	$2.00	$97,495
1 Mile (40%)	48747	CY	$2.75	$134,055
2 Miles (20%)	24374	CY	$3.50	$85,308
3 Miles (0%)	0	CY	$4.50	$0
Shape and Compact	121868	CY	$1.40	$170,616
Geofabrics				
Geomembrane and non-woven geotextile(perimeter levee)	1671784	SF	$0.55	$919,481
Woven Geotextile (perimeter and interior levee)	380099	SY	$1.40	$532,138
Pump Station Access Road				
Fill	1000	CY	$12.00	$12,000
8" Rock Base	2864	SY	$8.50	$24,344
2" Wear Surface	2626	SY	$6.50	$17,069
Conveyance Channel				
S-357 Pump Station Discharge	1	EA	$500,000	$500,000
Demolition (1)				
Clear and Grub	51	AC	$2,000	$102,000
Homes (wells, septic, pads etc.)	242	EA	$8,000	$1,936,000
Regrade to Wetland (scrape down 0.5 feet and remove unusable material)	728	AC	$4,000	$2,912,000
Canal/Road Crossings	280	LF	$2,400	$672,000
Pump Station South S-357 (500 cfs)	1	EA	$5,040,000	$5,040,000
Pipeline to C-111, (96-inch-diameter)	2000	LF	$960	$1,920,000
Treatment Area				
Blast and Excavate	62333	CY	$3.50	$218,167
Crush and Process Rock	62333	CY	$2.00	$124,667
Perimeter Levee (Haul, shape, compact)	62333	CY	$4.40	$274,267
Woven Geotextile	82500	SY	$1.40	$115,500
Subtotal Construction				$22,520,565
Contingency (20%)				$4,504,113
Total Construction Cost				$27,024,678
Planning, Engineering, Design, Construction Management (20%)				$5,404,936
Real Estate (2)	2881	AC		$55,709,420
Total				$88,139,038

(1) Based on Ecological Restoration Need
(2) Real Estate Costs are taken from the Real Estate Appendix, including raising septic tanks and wells and relocation costs.) (Includes cost for easements, fee simple, life estates and those costs required for implementation)

Table C-16
Preliminary Cost Summary Sheet
Alternative 7 – Raise All Roads Plan

Description Fill Development and Canal Construction	Quantity	Unit	Unit Cost [1]	Extended Cost
Blast and Excavate	0	CY	$7.00	$0
Crush and Process Rock	0	CY	$2.00	$0
Perimeter Levee				
On-site Haul & Place				
1/2 Mile (20%)	0	CY	$2.00	$0
1 Mile (25%)	0	CY	$2.75	$0
2 Miles (25%)	0	CY	$3.50	$0
3 Miles (30%)	0	CY	$4.50	$0
Shape and Compact	0	CY	$1.40	$0
Internal Levee				
On-site Haul & Place				
1/2 Mile (20%)	0	CY	$2.00	$0
1 Mile (25%)	0	CY	$2.75	$0
2 Miles (25%)	0	CY	$3.50	$0
3 Miles (30%)	0	CY	$4.50	$0
Shape and Compact	0	CY	$1.40	$0
Main Asphalt Roadways, 5.3 miles [1]				
Fill (fill depth of 2.2 ft)	171934	CY	$5.50	$945,635
8" Rock Base	74624	SY	$8.50	$634,304
2" Wear Surface	74624	SY	$6.50	$485,056
Dirt Roadways, 49.7 miles [1]				
Fill (fill depth of 2.2 ft)	1265895	CY	$4.50	$5,696,527
Miscellaneous Drainage Structures [2]	300	EA	$28,000	$8,400,000
Conveyance Channel				
Pump Station Discharge	0	EA	$500,000	$0
Demolition [3]				
Clear and Grub	79	AC	$2,000	$158,000
Homes (wells, septic, pads etc.)	50	EA	$8,000	$400,000
Subtotal Construction				$16,719,522
Contingency (20%)				$3,343,904
Total Construction Cost				$20,063,426
Planning, Engineering, Design, Construction Management (20%)				$4,012,685
Real Estate [4]	5839	AC		$110,514,250
Total				$134,590,361

(1) Assumes replacement inking. Range to bring to Miami-Dade County standards discussed in text.
(2) Assumed number of conveyance connections needed to maintain flow.
(3) Based on Ecological Restoration Need
(4) Real Estate Costs are taken from the Real Estate Appendix.
(Includes cost for easements, fee simple, life estates and those costs required for implementation including raising septic tanks and wells and relocation costs.) (Includes cost for easements, fee simple, life estates and those costs required for implementation including raising septic tanks and wells and relocation costs.)

Table C-17
Preliminary Cost Summary Sheet
Alternative 8A – Western Portion of 8.5 SMA as Flow-Way

Description	Quantity	Unit	Unit Cost [1]	Extended Cost
Excavate	542,366	CY	$7.00	$3,796,564
Crush and Process Rock	488,130	CY	$2.00	$976,259
Perimeter Levee				
On-site Haul & Place				
1/2 Mile (20%)	55065	CY	$2.00	$110,130
1 Mile (40%)	110130	CY	$2.75	$302,858
2 Miles (40%)	110130	CY	$3.50	$385,456
Shape and Compact	275326	CY	$1.40	$385,456
Internal Levee				
On-site Haul & Place				
1/2 Mile (20%)	12731	CY	$2.00	$25,461
1 Mile (40%)	25461	CY	$2.75	$70,019
2 Miles (40%)	25461	CY	$3.50	$89,115
Shape and Compact	63653	CY	$1.40	$89,115
Geofabrics				
Geomembrane and non-woven geotextile(perimeter levee)	1203224	SFT	$0.55	$661,773
Woven Geotextile (perimeter and interior levee)	185912	SY	$1.40	$260,277
Pump Station Access Road				
Fill	1000	CY	$12.00	$12,000
8" Rock Base	2224	SY	$8.50	$18,904
2" Wear Surface	1986	SY	$6.50	$12,909
Conveyance Channel				
Pump Station Discharge	1	EA	$500,000	$500,000
Demolition [1]				
Clear and Grub	35	AC	$2,000	$70,000
Homes (wells, septic, pads etc.)	319	EA	$8,000	$2,552,000
Regrade to Wetland (scrape down 0.5 feet and remove unusable material)	289	AC	$2,000	$578,000
Pump Station South S-357 (500 cfs)	1	EA	$5,040,000	$5,040,000
Pipeline to C-111, (96-inch-diameter)	2000	LF	$960.00	$1,920,000
Treatment Area				
Blast and Excavate	62333	CY	$3.50	$218,167
Crush and Process Rock	62333	CY	$2.00	$124,667
Perimeter Levee (Haul, shape, compact)	62333	CY	$4.40	$274,267
Woven Geotextile	82500	SY	$1.40	$115,500
Subtotal Construction				$18,588,896
Contingency (20%)				$3,717,779
Total Construction Cost				$22,306,675
Planning, Engineering, Design, Construction Management (20%)				$4,461,335
Real Estate [2]	5803	AC		$126,957,950
Total				$153,725,961

(1) Based on Ecological Restoration Need
(2) Real Estate Costs are taken from the Real Estate Appendix. (Includes cost for easements, fee simple, life estates and those costs required for implementation including raising septic tanks and wells and relocation costs.)

Table C-18
Canal Dimensions
Alternative 9 – Adaptive Refinement of GDM Plan

Corp. Calculated Flow Rate = 500 cfs **Delta H = 0.25 ft (Middle to each end)**
Total Length = 40,170 ft **Slope = 1E-05-05 ft/ft**
Flow Rate per LF = 0.0124 cfs/lf **El. G.S. = 6.5 ft**

Segment South to North	Segment Length	Canal Dimensions		
		Bottom Width (ft)	Bottom Depth (ft)	Bottom Elevation (ft)
A-C	5260	40	15	-8.5
C-D	5350	40	15	-8.5
D-E1	4960	40	12.5	-6
E1-E	3680	30	12.5	-6
E-F	5260	30	12.5	-6
F-G	2980	40	12.5	-6
G-H	5625	40	12.5	-6
H-I	930	40	15	-8.5
I-J	6125	40	15	-8.5

Table C-19
Preliminary Cost Summary Sheet
Alternative 9 – Adaptive Refinement of GDM Plan

Description Fill Development and Canal Construction	Quantity	Unit	Unit Cost	Extended Cost
Blast and Excavate	1,254,446	CY	$3.50	$4,390,560
Crush and Process Rock	1,254,446	CY	$2.00	$2,508,892
Perimeter Levee				
On-site Haul & Place				
1/2 Mile (20%)	88977	CY	$2.00	$177,954
1 Mile (25%)	111221	CY	$2.75	$305,858
2 Miles (25%)	111221	CY	$3.50	$389,274
3 Miles (30%)	133465	CY	$4.50	$600,594
Shape and Compact	444885	CY	$1.40	$622,838
Internal Levee				
On-site Haul & Place				
1/2 Mile (20%)	18750	CY	$2.00	$37,500
1 Mile (25%)	25000	CY	$2.75	$68,750
2 Miles (25%)	25000	CY	$3.50	$87,500
3 Miles (30%)	31250	CY	$4.50	$140,625
Shape and Compact	117832	CY	$1.40	$164,965
Geofabrics				
Geomembrane and non-woven				
Geotextile perimeter levee)	1944228	SFT	$0.55	$1,069,325
Woven Geotextile (perimeter and interior levee)	368225	SY	$1.40	$515,515
Roadway				
Fill	1,000	CY	$12.00	$12,000
8" Rock Base	2,224	SY	$8.50	$18,904
2" Wear Surface	1,986	SY	$6.50	$12,909
Conveyance Channel				
S-357A and S-357B Pump Station Discharge	2	EA	$500,000	$1,000,000
Demolition [1]				
Clear and Grub	0	AC	$2,000	$0
Homes (wells, septic, pads etc.)	0	EA	$8,000	$0
Pump Station S-357A (500 cfs)	1	EA	$5,040,000	$5,040,000
Pump Station S-357B (500 cfs)	1	EA	$5,040,000	$5,040,000
Pipeline to C-111, (96-inch-diameter)	2000	LF	$960.00	$1,920,000
Treatment Area				
Blast and Excavate	62333	CY	$3.50	$218,167
Crush and Process Rock	62333	CY	$2.00	$124,667
Perimeter Levee (Haul, shape, compact)	62333	CY	$4.40	$274,267
Woven Geotextile	82500	SY	$1.40	$115,500
Subtotal Construction				$24,856,564
Contingency (20%)				$4,971,313
Total Construction Cost				$29,827,876
Planning, Engineering, Design, Construction Management (20%)				$5,965,575
Real Estate [1]	663	AC		$4,110,200
Total				$39,903,652

(1) Real Estate Costs are taken from the Real Estate Appendix