Lake Worth Comprehensive Capital Improvement Implementation Project

October 2008

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FORT WORTH

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1.0 EXECUTIVE SUMMARY
2.0 PROJECT SUMMARY
5.0 WATER PROJECTS
7.0 ROAD PROJECT
8.0 FUNDING ANALYSIS

3.0 DREDGING AND DRAINAGE PROJECTS

4.0 PARKS, TRAILS, AND ACCESS MANAGEMENT PROJECTS

6.0 WASTEWATER PROJECTS

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

The Lake Worth Reservoir is the sole City-owned lake in Fort Worth. Built in 1914, the lake has been a trap for high sediment loads from its watershed, limiting its use as a natural and recreational resource. The City of Fort Worth has long desired to rehabilitate the lake and make it a premier green space and catalyst for development in Northwest Fort Worth. The City recognized that, as development continues in the northwest, the lake will become a central focal point for the City.

Over the past several years, the City has conducted several studies to consider dredging the lake, and other studies to look at infrastructure improvements in the area to support growth, including roads, water, wastewater, drainage, and parks improvements. With the onset of Barnett Shale gas extractions, the City identified a significant funding opportunity from its mineral rights in and around Lake Worth.

Freese and Nichols, Inc. was contracted by the City in 2007 to prepare a Capital Improvement Implementation Plan (CIIP) for improvements in and around the Lake Worth Reservoir. The primary focus of the project was to identify projects from the previous studies, and create a timed CIIP that would maximize the use of the lake as a natural, recreational, and development center. The project created a plan to begin the improvements, and make the transition from studying to implementing.

To ensure that the interests of the City as a whole, and the interests of surrounding cities, were included in the improvements, a Steering Committee was formed and participated throughout the project. The Steering Committee was made up of neighborhood organizations, municipal staff from Fort Worth and surrounding cities, private commercial organizations, and regulatory agencies. Newsletters were also prepared at strategic points in the project to keep the Steering Committee, City Council, and public abreast of the project progress. Public involvement for the project included four Steering Committee Meetings and three public meetings.

FNI, City staff, and the Steering Committee identified 14 projects, with a total project cost estimate of $117 Million, to implement in the CIP. The following list shows the projects, their estimated costs, and anticipated schedule:

PROJECT	COST ESTIMATE	DESIGN START	CONSTRUCTION START
Lake Dredging	$30,706,885	2008	2011
Arrow S/Casino Beach Boat Ramp Improvements	$630,804	2008	2009

PROJECT	COST ESTIMATE	DESIGN START	CONSTRUCTION START
Nature Trail (Phase I) and Lake Worth Parks Improvements	$9,000,000	2008	2010
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Woodvale Low Pressure Sewer System	$2,200,000	Under Design	2008
20" Northside III Water Main Along IH820 (Water Project #1)	$2,200,000	Under Design	2008
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Love Circle/Casino Beach Water (Water Project #2) & Sewer	$9,057,875	2010	2011
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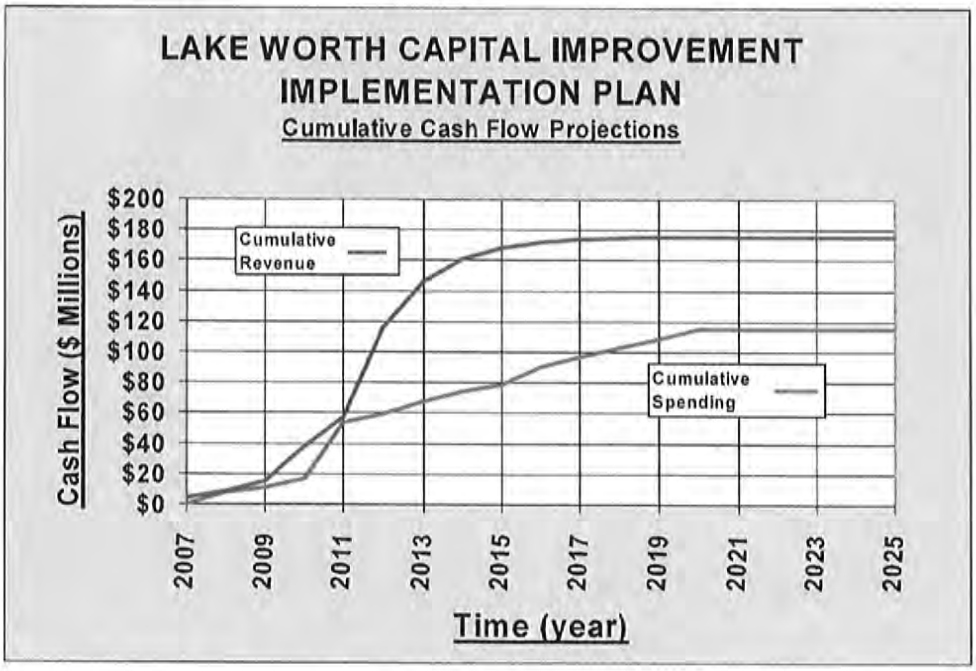
Watercress Low Pressure Sewer System	$4,428,576	2012	2013
Maintenance Fund	$9,550,000	2013	2013
Northside II Water Improvements (Water Project #3)	$26,554,064	2015	2017
SW Silver Creek Road Expansion	$9,073,855	2015	2016
Total:	**$117,077,508**		

The projects underwent a rigorous prioritization process to determine which projects met the appropriate criteria and to determine in what order they were to occur. The criteria selected by the Staff and Steering Committee to evaluate the projects included:

1. Value to City and region as a whole
2. Impact on growth and development
3. Recreational enhancement
4. Sustainability of improvements
5. Health and safety enhancement
6. Water quality enhancement
7. Future need for maintenance

A cash flow projection model was prepared in Excel to show coordination of the projects expenditures with expected gas revenues from City-owned property in and around Lake Worth. As shown in the graph below, the anticipated gas well revenues that are available for the Lake Worth Capital Improvements Plan should adequately cover the needed funds.



FNI and City staff also met with the Fort Worth District Corps of Engineers (COE) to determine what environmental permitting would be necessary to dredge Lake Worth. The COE expressed that its main concerns included protection of habitats at the dredging and disposal locations, identification and protection of wetlands at the dredging and disposal locations, protection of endangered species including Least Tern and Bald Eagle, monitoring of potential contamination in dredged materials, and monitoring of water quality of return water from the disposal site. The COE indicated that the Letter of Permission Process would likely be the appropriate permitting for this project.

As the final step of this project, a proposed amendment to the Lake Worth Area City Property gas well revenue policy was prepared for consideration by the City Council. This proposed amendment included the following elements:

1. 50% of the lease bonuses and royalties would go to the Water and Sewer CIP fund, with $117 Million of it going to the Lake Worth Capital Improvement Implementation Plan.
2. 25% of the lease bonuses and royalties would go to the Fort Worth Permanent Fund.
3. 25% of the lease bonuses and royalties would go to the Utility/Street Reconstruction CIP.

The City Staff presented the proposed Lake Worth Capital Improvement Implementation Plan and proposed amendment to the gas well revenue policy in a City Council pre-Council meeting on December 18, 2007, and the City Council adopted both items on January 8, 2008.

2.0 PROJECT SUMMARY

2.1 Introduction

The Lake Worth Reservoir is the sole City-owned lake in Fort Worth. Built in 1914, the lake has been a trap for high sediment loads from its watershed, limiting its use as a natural and recreational resource. The City of Fort Worth has long desired to rehabilitate the lake and make it a premier green space and catalyst for development in Northwest Fort Worth. The City recognized that, as development continues in the northwest, the lake will become a central focal point for the City.

Over the past several years, the City has conducted several studies to consider dredging the lake, and other studies to look at infrastructure improvements in the area to support growth, including roads, water, wastewater, drainage, and parks improvements. With the onset of Barnett Shale gas extractions, the City identified a significant funding opportunity from its mineral rights in and around Lake Worth.

Freese and Nichols, Inc. was contracted by the City in 2007 to prepare a Capital Improvement Implementation Plan (CIIP) for improvements in and around the Lake Worth Reservoir. The primary focus of the project was to identify projects from the previous studies, and create a timed CIIP that would maximize the use of the lake as a natural, recreational, and development center. The project created a plan to begin the improvements, and make the transition from studying to implementing.

2.2 Summary of Project Team

The City of Fort Worth created a team to prepare and submit the Lake Worth Capital Improvement Implementation Plan (LWCIIP). The team was made up of City staff members, the LWCIIP Steering Committee, and Freese and Nichols, Inc. The Freese and Nichols team also included Caye Cooke Associates for parks and access management analysis and Brown and Gay Engineers for wastewater analysis.

The City staff members included members from the Water Department, Department of Transportation and Public Works, Parks & Community Services Department, Department of Engineering, and the Finance Department. The LWCIIP Steering Committee was composed of members to represent the City as a whole, adjacent cities, neighborhood organizations, and interested agencies. The Steering Committee had the following participants:

- City of Lake Worth
- Lake Worth Alliance Neighborhood Organization
- Lockheed Corporation
- Texas Parks and Wildlife
- City of Fort Worth
- Town of Lakeside
- Northwest Tarrant County Times Record

2.3 Summary of Project Process

The Project Team conducted an organized process to determine the CIIP and provide recommendations to the City Council. The success of the project was in large part determined by the Steering Committee and public meetings, which were held at critical milestones throughout the project. Four Steering Committee meetings, three public meetings, and one City Council workshop were conducted to cover the following topics:

2.3.1 Steering Committee Meeting #1:

- Familiarize Committee with the project and discuss the improvement project types and general process.

2.3.2 Steering Committee Meeting #2 and Public Meeting #1:

- Discuss the master list of improvement projects and the criteria by which the projects will be prioritized.

2.3.3 Steering Committee Meeting #3 and Public Meeting #2:

- Discuss the prioritization of the improvement projects in accordance with the approved criteria.

2.3.4 Steering Committee Meeting #4 and Public Meeting #3:

- Discuss the proposed CIIP, cost estimates, and projected funding for the projects.

2.3.5 City Council Workshop:

- Present the proposed CIIP and gas revenue policy (discussed in Section 8.0)

Newsletters were also sent out after the Steering Committee meetings to keep the public abreast of the project progress and announce public meeting dates. The Appendix includes copies of the handouts for the Steering Committee and public meetings, and copies of the newsletters.

The projects identified in the CIIP were in the categories of dredging, drainage, parks, trails, access management, water, wastewater, and roadways. Available, existing studies for each category were reviewed to determine potential projects to be included in the CIIP. The following sections describe the projects in each of the categories and their estimated costs.

2.4 Project Prioritization

The Project Team developed a list of criteria to prioritize the projects and set a framework for the schedules of the projects. These criteria were aimed at obtaining the maximum benefit to the City and surrounding areas for the dollars spent on the projects. The following criteria were used to evaluate the projects:

2.4.1 Value To City And Region As A Whole

This criterion is intended to encourage the benefits of projects to as many Fort Worth and regional citizens as possible.

Scoring: Benefit to neighborhood = Score of 1 to 3; Benefit to Lake Worth area= Score of 4 to 6; Benefit to City and region = Score of 7 to 10

2.4.2 Impact On Growth/Development

Northwest Fort Worth is a high growth area, and the Lake Worth Reservoir area projects are key to promoting sustainable development and growth.

Scoring: Impact to future growth of neighborhood = Score of 1 to 3; Impact to future growth of Lake Worth area= Score of 4 to 6; Impact on future growth of region = Score of 7 to 10

2.4.3 Recreational Enhancement

Lake Worth Reservoir is the only City of Fort Worth owned lake, and this criterion measures the critical recreational aspects of the projects.

Scoring: Enhances 1 or less recreational activities = Score of 3; Enhances 2 recreational activities = Score of 5; Enhances 3 or more recreational activities = Score of 10

2.4.4 Sustainability Of Improvements

This criterion evaluates whether the life expectancy of the projects will be long-term or only short term.

Scoring: Anticipated project life of 1 to 9 years = Score of 1 to 5; Anticipated project life of 10 to 15 years = Score of 6 to 7; anticipated project life of 16 or more years = Score of 8 to 10

2.4.5 Health/Safety Enhancement

Protecting the health and safety of the general public is priority to the City of Fort Worth, and this criterion evaluates how projects enhance health and safety protection.

Scoring: Enhances health = Score of 1 to 3; Enhances health and property = Score of 4 to 6; Enhances safety to life and limb = Score of 7 to 10

2.4.6 Water Quality Enhancement

Protection of the water quality of Lake Worth has great impact on the aesthetics of the lake, health of the citizens, and health of the surrounding environment. This criterion evaluates the impact of projects on removal of and protection from sedimentation.

Scoring: No or limited impact on improving water quality = Score of 1 to 3; Provides water quality protection = Score of 4 to 6; Restores water quality = Score of 7 to 10

2.4.7 Future Need For Maintenance

All projects require some amount of maintenance to provide an appropriate life term. This criterion measures how frequently maintenance is required.

Scoring: Weekly to monthly maintenance required = Score of 1 to 3; Quarterly to annual maintenance required = Score of 4 to 6; Greater than annual maintenance required = Score of 7 to 10

Each identified project was scored based upon these criteria, and the sum of the scores represented the total prioritization score for the project, with a maximum of 70 points. The higher scores were listed in higher priority.

The initial number of projects identified for the CIP was 30; after deliberations in the Steering Committee meetings, it was determined that several projects needed to be combined to cut the number of total projects down to 14. This resulted in a much less complicated CIP program. The following is the list of the initial 30 projects, the total prioritization scores they received, and the initial project prioritization.

Project	Prioritization Score	Priority
Dredging area between Casino Beach and Hwy 199	70	1
Dredging area around Willow Island	69	2
Dredging area northwest of Goat Island	68	3
Dredging area south and west of Goat Island	67	4
Tree stump removal	66	5
Dredging area east of IH 820 along north shore	65	6
Dredging boat lanes above Hwy 199	65	7
Dredging around raw water intake at dam	56	8
Boat ramp repairs at Arrow S park	51	9
Boat ramp improvements at Casino Beach	51	10
Boat ramp improvements at Sunset Park	51	11
New boat ramp at Freemons Park	51	12
Love Circle force main and lift station	50	13
Watercress/Love Circle low pressure sewer system	50	14
Sedimentation dam on Live Oak Creek	49	15
Comanche Creek channel improvements	48	16
Sedimentation trap at Quebec Cove	47	17
24" waterline along FM 1886/Jacksboro Hwy	47	18
20" Northside III water main along IH 820	46	19
Sedimentation dam on Silver Creek	45	20
Woodvale low pressure sewer system	44	21

Project	Prioritization Score	Priority
10" Northside II Watercress water main	44	22
24" and 8" waterline along SH 199	42	23
Northside II 30" supply line	42	24
Access control/cable fencing	41	25
Connection to existing trail system	40	26
Primary bike and jogging trails	40	27
Expansion of southwest section of Silver Creek Rd.	39	28
24' and 16" Northside II waterline along IH 820	38	29
Trail heads	33	30

Once this initial prioritization process was performed, the team further refined the project list and prioritization. These refinements were based upon combining projects to result in 14 total projects, increasing the priorities of some projects based upon Steering Committee recommendations, and increasing the priorities of some projects that were already under design. The following are decisions that were made by the team concerning this:

- All dredging projects, including stump removal were combined into one project.
- The Arrow S/Casino Beach Boat Ramp Improvements were seen as priority projects; however, the team felt that the boat ramp projects for Sunset Park and Freemons Park could be delayed to later in the CIP.
- The Steering Committee felt that it was important to begin construction of the trails sooner to enhance the recreational aspects of the Lake and to begin attracting public to the green space. The trails projects were split into 2 projects, as is described in Section 4.0, and the Phase I trails project was moved up in priority.
- The Comanche Creek Drainage Channel, Woodvale Low Pressure Sewer System, and 20" Northside III Water Main Along IH820 projects were already under design, so were moved up in priority.
- The Steering Committee felt that it was important to prevent the nuisance and erosion-causing activities in the parks areas, so the Access Control Improvements project was moved up in priority.

- Cost estimates were prepared for the sedimentation control projects, and it was found that they would cost almost three times as much as the total dredging project. The team decided to delete the sedimentation control projects and replace them with a Maintenance Fund that would be used for periodic maintenance dredging and also maintenance of the other CIP projects.
- All Northside II water improvement projects were combined into one project.

Based upon these refinements, the final projects list and prioritizations were set as follows:

Project	Priority
Lake Dredging	1
Arrow S/Casino Beach Boat Ramp Improvements	2
Nature Trail (Phase I) and Lake Worth Parks Improvements	3
Comanche Creek Drainage Channel	4
Woodvale Low Pressure Sewer System	5
20" Northside III Water Main Along IH820 (Water Project #1)	6
Access Control Improvements	7
Love Circle/Casino Beach Water (Water Project #2) & Sewer	8
Sunset Park/Freemons Park Boat Ramp Improvements	9
Nature Trail (Phase II)	10
Watercress Low Pressure Sewer System	11
Maintenance Fund	12
Northside II Water Improvements (Water Project #3)	13
SW Silver Creek Road Expansion	14

2.5 Capital Improvements Implementation Plan (CIIP)

After the projects list and prioritizations were set, estimates of probable project costs were prepared for each project. The following sections describe the cost estimates for each project.

The project costs were sensitive to the duration of the CIIP due to construction cost inflation, and the dredging project cost was very sensitive to project duration and whether or not it was done as one project or several smaller projects. The cost analysis showed that a 25-year CIIP

with the dredging done in several small projects would cost approximately $48 million more than a 15-year CIIP with the dredging done in one project.

Another important consideration was to verify that the cumulative CIIP costs did not exceed the Lake Worth gas revenues collection rate. This funding analysis is described more fully in Section 8.0.

Based upon these considerations, it was found that a CIIP starting in 2008 and ending construction of all projects by 2020 would meet the project needs and projected available funding. The following list shows the CIIP, including projects in prioritized order, estimate of probable project costs, begin of design year, and begin of construction year.

	PROJECT	COST ESTIMATE	DESIGN START	CONSTRUCTION START
1	Lake Dredging	$30,706,885	2008	2011
2	Arrow S/Casino Beach Boat Ramp Improvements	$630,804	2008	2009
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	Total:	**$117,077,508**		

3.0 DREDGING AND DRAINAGE PROJECTS

3.1 Scope of this Analysis

3.1.1 The scope of this portion of the project included the following:

1. Review previous studies related to siltation and dredging analysis of Lake Worth.
2. Meet with City staff to review areas of proposed dredging and to develop new/additional areas of needed dredging.
3. Develop areas in need of tree stump removal and navigational devices.
4. Review previous studies related to environmental impacts and considerations, specifically those associated with polychloridnated byphenyls (PCB) contamination of lake sediment adjacent to the Naval Air Station Joint Reserve Base (NAS-JRB) and Air Force Plant 4.
5. Review previous studies related to watershed management to identify capital improvement projects for managing siltation into Lake Worth.
6. Receive input from City staff regarding drainage improvement projects that had been identified for the Lake Worth area.
7. Prepare maps of proposed dredging areas and potential disposal sites.
8. Prepare construction cost estimates of the sedimentation structures, tree stump and vegetation removal, and dredging and disposal projects.

3.2 Summary of Previous Studies

An important step in developing recommendations for future improvements was to gain an understanding of the history of Lake Worth's siltation issue. The siltation issue has been studied several times since the 1930's. One of the key points of this study was to make a summary review of the previous studies and consider them in developing recommendations for the CIIP. Table 3.1 contains a summary of the reports that were reviewed as part of this study.

Table 3.1 – Siltation and Dredging Studies for Lake Worth.

No.	Publication
1.	Taylor, T.U. Silting of Reservoirs. The University of Texas Bulletin. No. 3025, July 1, 1930.
2.	Taylor, T.U. Silting of Lake Worth. ASCE Bulletin. Date uncertain, approximately 1931.
3.	Freese and Nichols, Inc. City of Fort Worth, Lake Worth Silt Removal Study. 1955.
4.	Lockwood, Andrews, and Newman, Inc. Redevelopment Study of Lake Worth. 1962.
5	Lockwood, Andrews, and Newman, Inc. Feasibility and Economics of Upper Lake Worth. 1962.
6.	ECS Technical Services, Inc. for U.S. EPA. Lake Worth, Tarrant County, Texas – Environmental Inventory. 1979-1980.
7.	Carter and Burgess, Inc. Lake Worth Development Plan and Management Program. Date uncertain, approximately 1984.
8.	Alan Plummer and Associates, Inc. for U. S. Army Corps of Engineers, Ft. Worth District; Institute of Applied Sciences, University of North Texas. Lake Worth Silt Removal Study, Task 1 – Summary Report. August 1988.
9.	Alan Plummer and Associates, Inc. for U. S. Army Corps of Engineers, Ft. Worth District; Institute of Applied Sciences, University of North Texas; Urban Environment Associates. Lake Worth Clean Lakes Study, Phase I – Diagnostic/Feasibility Study, Task II - Evaluation of Alternatives – Preliminary Report. March 1989.
10.	Alan Plummer and Associates, Inc. for U. S. Army Corps of Engineers, Ft. Worth District; Institute of Applied Sciences, University of North Texas; Urban Environment Associates. Lake Worth Clean Lakes Study, Phase I – Diagnostic/Feasibility Study, Volumes I and II – Feasibility Study – Final Report. February 1990.
11.	Alan Plummer and Associates, Inc. for U. S. Army Corps of Engineers, Ft. Worth District; Institute of Applied Sciences, University of North Texas; Urban Environment Associates. Lake Worth Clean Lakes Study, Phase I – Diagnostic/Feasibility Study, Volume IV – Public Meetings/Hearing Transcripts. Amended February 1991.
12.	Alan Plummer and Associates, Inc. Lake Worth Water System Implementation Plan, Short Term Alternatives. October 1993.
13.	Alan Plummer and Associates, Inc. Lake Worth Clean Lakes Project, Phase II: Wetlands Enhancement Feasibility Study. March 1995.
14.	City of Fort Worth. Special Contract Documents for Lake Worth Wetlands Demonstration Project. February 1996.

15.	Camp Dresser and McKee, Inc. Clean Lakes Phase II Study for Lake Worth, Final Report; Task 4.0: Watershed Management Plan for Lake Worth; Task 5.0: Watershed Management Strategy for the Upper West Fork of the Trinity River. May 1997.
16.	Alan Plummer and Associates, Inc. Lake Worth Clean Lakes Project, Phase II: Implementation; Wetlands Enhancement Demonstration Project at Fort Worth Nature Center and Refuge. August 1997.
17.	U.S. Geological Survey. Data on Occurrence of Selected Trace Metals, Organocholorines, and Semivolatile Organic Compounds in Edible Fish Tissues From Lake Worth, Fort Worth, Texas. 1999.
18.	U.S. Geological Survey. Lake Worth Bottom Sediments – A Chronicle of Water-Quality Changes in Western Fort Worth, Texas, 1914-2001. 2001.
19.	Texas Water Development Board. Volumetric Survey of Lake Worth. February 2002.
20.	U.S. Geological Survey. Distribution and Sources of Polychlorinated Biphenyls in Woods Inlet, Lake Worth, Fort Worth, Texas. 2003.
21.	Miscellaneous correspondence folder from joint project between City of Fort Worth, U.S. Army Corps of Engineers, and North Central Texas Council of Governments. 2000 – 2001.

3.3 Siltation Estimates

Lake Worth Dam was completed in 1914, creating a reservoir of 3,770 surface acres and 47,177 acre-feet of storage, and a drainage area of 1,970 square miles. The normal pool elevation is 594.0 feet msl. Within 15 years of the dam's completion, siltation had become an issue. Silt surveys in 1928 and 1930 indicated the reservoir had already lost 13% of its original storage volume due to siltation. During this time period, the annual siltation rate was estimated between 927 acre-feet to 1,000 acre-feet per year (1,496,000 to 1,742,000 cubic yards per year). Eagle Mountain Dam was constructed immediately upstream of Lake Worth and was completed in 1932. With the construction of Eagle Mountain Dam, 95 percent of Lake Worth's original watershed became regulated, leaving only 88 square miles of watershed remaining to deposit silt into the reservoir. As a comparison, since the construction of Eagle Mountain Dam, siltation estimates for Lake Worth have ranged from 3.8 acre-feet to 34 acre-feet per year (6,130 to 210,000 cubic yards per year).

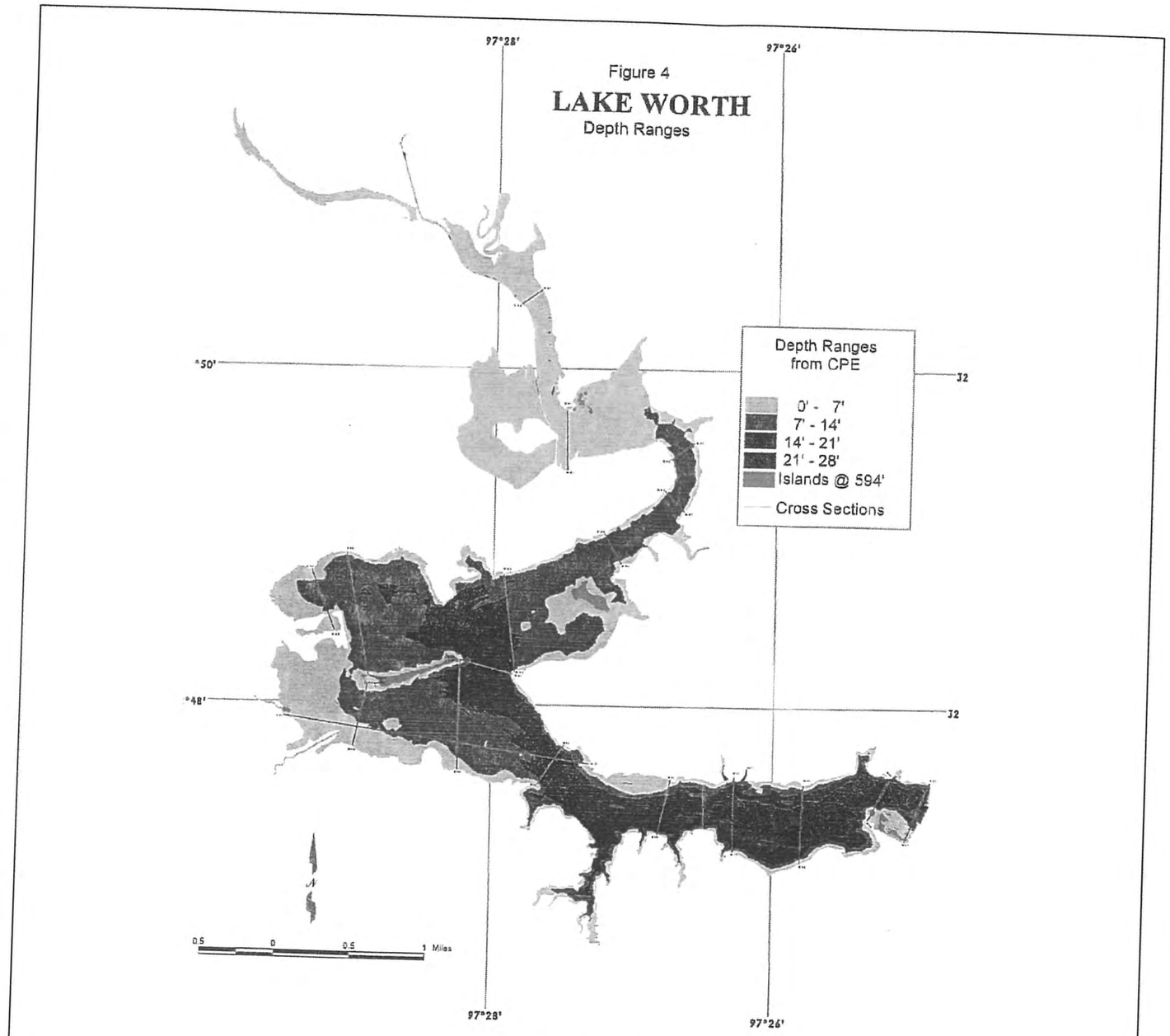
Silt surveys were made in 1931, 1969, 1988, and 2001, although data comparisons among these surveys is difficult due to differing methodologies. The 2001 Texas Water Development Board (TWDB) volumetric survey of Lake Worth estimated the volume to be 33,495 acre-feet, or 71 percent of its original volume and surface area. Figure 3.1 is a reproduction of a water depth map from the 2001 TWDB report. Figure 3.2 compares the elevation-area-storage curves for Lake Worth between 1969 and 2001. During this period, storage capacity was reduced by 3,571 acre-feet, or 7.6 percent, and surface area was reduced 32 acres, or one percent. (Note that all volume and surface area measurements reference to the dam's conservation pool elevation of 594.0 ft-msl.) Although a portion of these differences was likely due to different measurement methodologies, continued siltation was evident. Assuming an average annual siltation rate of 25 acre-feet (40,300 cubic yards) since the 2001 survey, a projected volume estimate in 2010 would be 33,270 acre-feet.

3.4 Proposed Dredging Projects

3.4.1 Previous Dredging Studies

In conjunction with the silt surveys and estimation of siltation rates, previous studies projected that portions of the lake would become unusable and unattractive areas of shallow water, emergent vegetation and eventually large mud flats would be present during periods of low lake levels. The concept of dredging the lake has been addressed in several studies. One proposal even considered raising Lake Worth Dam and the normal pool elevation in order to increase reservoir depth over the ever-accumulating sediment layers.

Three previous studies considered dredging programs to restore portions of the lake: the 1984 Master Plan Study, the 1990 Clean Lakes Study, and the 2001 USACE joint study. The 1990 study provided the greatest level of detail regarding possible dredging projects. Five dredging scenarios were developed and are summarized in Table 3.2.



LAKE WORTH COMPREHENSIVE CAPITAL IMPROVEMENT IMPLEMENTATION PROJECT

FORT WORTH

FIGURE 3.1
LAKE WORTH
DEPTH RANGES

NOTE 1: FIGURE WAS REPRODUCED FROM 2001 TEXAS WATER DEVELOPMENT BOARD VOLUMETRIC SURVEY OF LAKE WORTH

NOTE 2: "CPE" DENOTES THE CONSERVATION POOL ELEVATION OF 594.0 FT (MSL)

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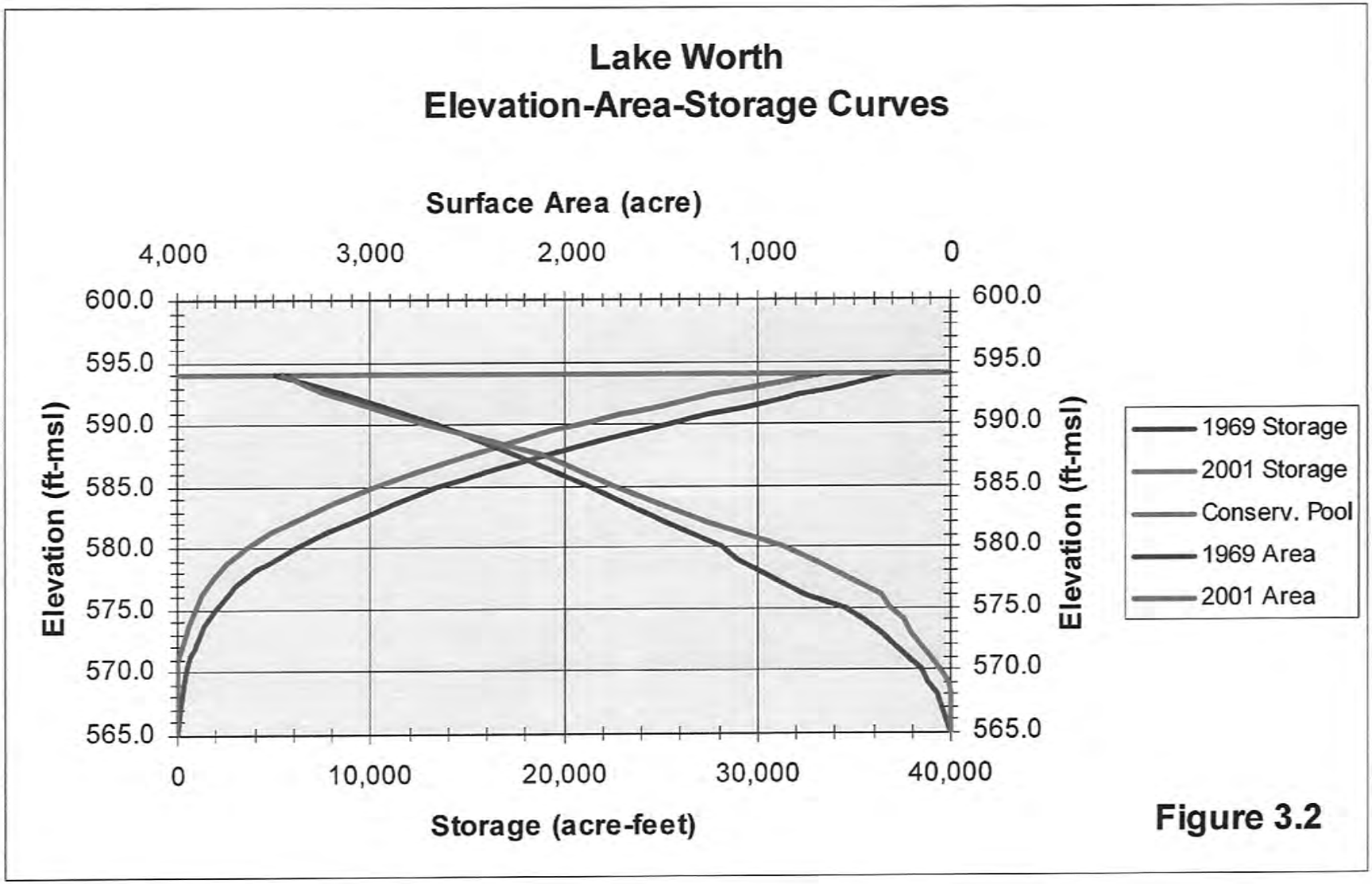

Lake Worth
Elevation-Area-Storage Curves
Surface Area (acre)
4,000
3,000
2,000
1,000
0
600.0
595.0
590.0
585.0
580.0
575.0
570.0
565.0
Elevation (ft-msl)
0
10,000
20,000
30,000
40,000
Storage (acre-feet)
1969 Storage
2001 Storage
Conserv. Pool
1969 Area
2001 Area

Figure 3.2

Table 3.2 – Dredging Scenarios from 1990 Study

Lake Section/Lake Depth	Sediment Volume (acre-feet)	Sediment Volume (Million cubic yards)	% of Total Sediment
Total Lake/All depths[1]	7,950	12.38	100%
South of Highway 199/ All depths	6,970	11.24	88%
South of Highway 199/ Depth less than 10 feet	3,100	5.00	39%
South of Highway 199/ Depth less than 6 feet	1,000	1.61	13%
South of Highway 199/ Selective sites	250	0.40	3%

Notes:
(1) The total volume of sediment in the lake does not agree with volumetric surveys performed prior to the 1990 study. Regardless, the comparison of various sediment conditions is useful.

Ultimately, the 1990 study recommended a selective dredging program that would dredge in various coves and in highly-traveled areas of the lake. The reason for a selective dredging cited the relatively high cost of dredging, lack of adequate funding at that time, relatively low production rates of dredging equipment and the resulting long duration of a more extensive dredging program. The study acknowledged the selective dredging would address the siltation issue in only a few limited areas of the lake.

The next significant study was the 2001 joint study between the City, the USACE and North Texas Council of Governments (NTCOG). This study targeted the same problem areas from previous studies, but increased the size of proposed dredging limits to address larger areas. This study considered six major dredge areas in portions of the lake with depths less than 10 feet. Table 3.3 summarizes this dredging proposal.

Table 3.3 – Dredging Areas from 2001 Joint Study

Location on the Lake	Dredge Volume (acre-feet)	Dredge Volume (CY)	% of Total
West of Goat Island and along the south shore	483	780,000	28%
Northwest of Goat Island, north of the peninsula	59	925,000	3%
West and south of Willow Island	573	925,000	33%
East and north of Willow Island	46	95,000	3%
South of Casino Beach, east of Highway 199	67	108,000	4%
South of Goat Island	493	795,000	29%
Total	1,721	2,778,000	100%

According to City staff, the 2001 joint study was not completed due to lack of funding from USACE as a result of reconstruction efforts following Hurricane Katrina and the start of the Iraq War. The joint study agreement would have shared study, design, and construction costs with one third by the City and two-thirds by USACE. Without the USACE's cost participation, the study was abandoned.

3.5 Benefits of Dredging

Previous studies have documented a wide range of reasons as to why a dredging program would be beneficial at Lake Worth. The following is a summary discussion of the major benefits.

3.5.1 Safety:

Discussions with City and lake management staff and steering committee and public meetings consistently cited safety as a primary reason for dredging shallow areas of the lake. Shallow water and tree stumps create dangerous conditions for boating, sailing, water skiing, and swimming. These conditions are exacerbated when lake levels are low, as a one to two foot drop in the lake level drastically affects large areas of the lake which can become less than four feet deep. These conditions are especially dangerous for new lake visitors who are unfamiliar with shallow areas. Another consequence of the shallow areas is that as lake levels drop and large areas become unusable, lake traffic is concentrated into smaller useable areas resulting in higher congestion. As part of

dredging operations, tree stumps and dilapidated boat docks would be removed to remove subsurface hazards.

3.5.2 Water Quality:

Lake Worth is a pass-through reservoir. Water released from Eagle Mountain Lake is drawn out at the City's raw water intake near the dam. For a reservoir of its size, Lake Worth has a comparatively short hydraulic residence time of 71 days. Past studies have documented Lake Worth's water quality as being eutrophic, or high in nutrient concentrations, with the nitrogen and phosphorous being the primary nutrients of concern. A 1986 study by the Texas Water Commission ranked 94 reservoirs throughout the state based on water quality and Lake Worth ranked 51st. In discussing the eutrophic condition of Lake Worth, it is important to understand the lake's water quality is dominated by Eagle Mountain Lake's water quality. The 1990 study documented that 85 percent of all nutrients in Lake Worth were the result of discharges from Eagle Mountain Lake. This means that the proposed dredging program will not have a significant effect on reducing dissolved nutrients in the lake's water.

Previous studies cited the primary water quality enhancements from a dredging program would be a decrease in both water turbidity and emergent vegetation growth. Large areas of the lake have depths less than four feet at low lake levels. Top sediment layers are the most recently deposited material and are not substantially consolidated. Shallow water depths and highly disturbable sediment result in higher turbidity of the water. Emergent vegetation, mostly in the form of cattails, typically grows in water depths less than four feet. Dredging and deepening of the lake would remove shallow emergent vegetation while encouraging the growth of submergent vegetation. Generally, submergent vegetation is preferred because it leads to increased fish habitat and can help limit water turbidity.

3.5.3 Aesthetics:

An important consideration was the increased aesthetic appearance of restoring shallow areas of Lake Worth to more appealing and usable depths. It has been widely

documented and discussed at steering committee and public hearing meetings that a one to two foot drop in lake elevation results in the south and west portions of the lake nearly becoming mud flats. Dredging would permanently restore large portions of the lake and reduce the "eye sores" seen during lower lake levels.

Historically, the City owned all land adjacent to the lake's shoreline and leased individual lots for residential development. Over the years, the City has transferred these leases into sale of the properties. A direct benefit of dredging would be the increased desirability of land surrounding the lake, which would ultimately translate into increased land values and an increased tax base for the City.

3.5.4 Recreational Use:

All of the factors previously mentioned would undoubtedly lead to increased recreational uses of Lake Worth. An improved and enhanced Lake Worth would serve as a valuable recreation resource for the City and the region as a whole. A consistent message from the steering committee was that Lake Worth was positioned to serve as a focal point of Fort Worth's projected growth to the north and west. The general feeling was that an enhanced lake would encourage higher quality development.

Recreational use and desirability of the lake have been shown to significantly impact the surrounding areas. The 1984 master planning study documented how lake usage peaked in the 1950's and 1960's and then declined thereafter. The study documented perceptions of higher crime rates, lower quality development, lower quality and/or neglect of infrastructure as being associated with deteriorating lake conditions and declining recreational use.

Another important aspect is that enhancing recreational use of Lake Worth would invite additional recreational uses of the surrounding lands. Twelve dedicated parks (Marion Samson, Wildwood, Live Oak, Freemens, West, Mosque Point, Arrows, Marina, Camp Joy/Island View, Vinca Circle, Plover Circle/Windswept Circle, and Love Circle) surround the lake and the 3,600 acre Fort Worth Nature Center encompasses the headwaters. Another 950 acres of City-owned, non-park dedicated surround the lake.

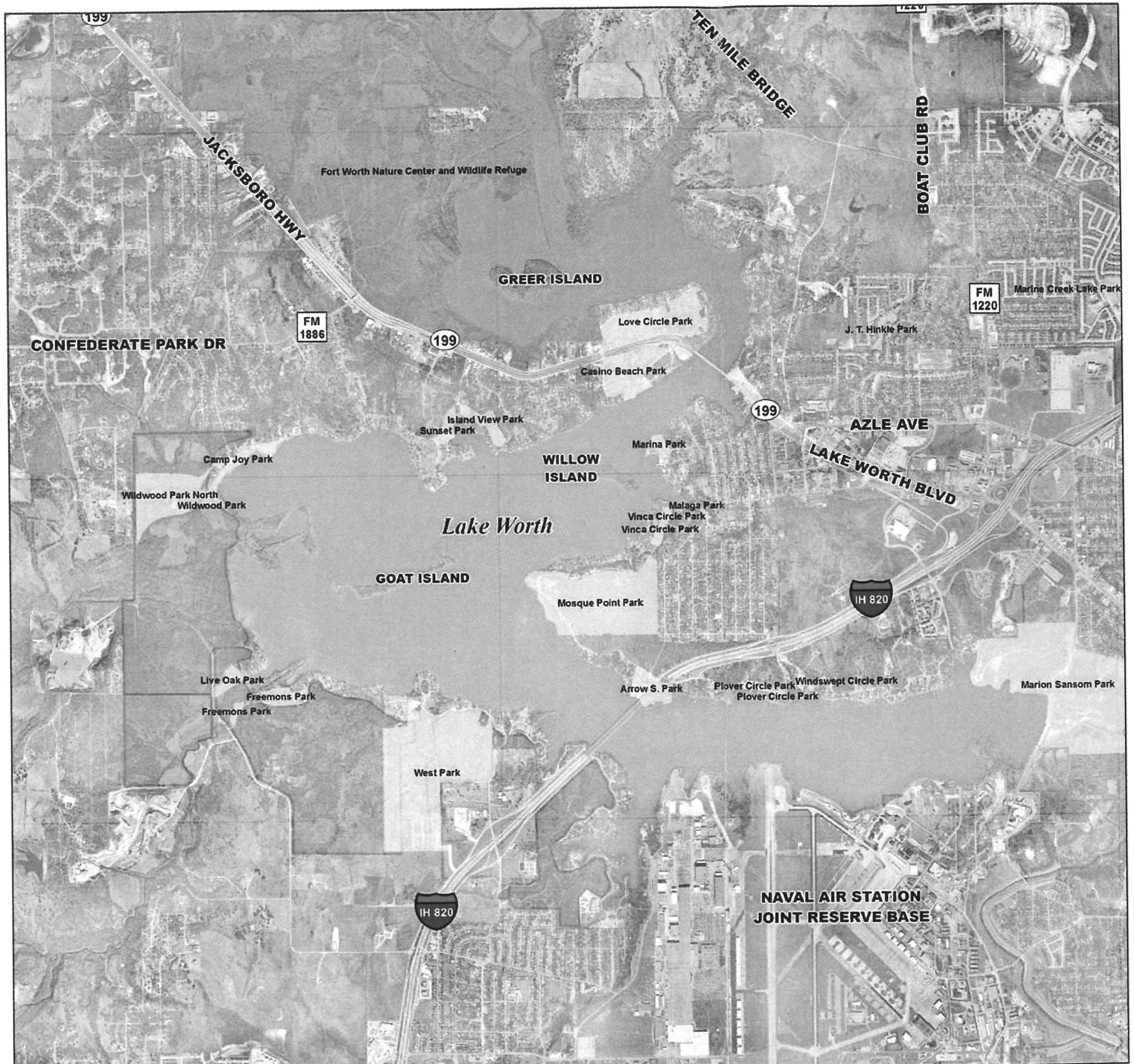
These lands provide the opportunity for Lake Worth to be both a recreation focal point and an important connection between the Nature Center to the north and the Trinity River Trail System to the south. Figure 3.3 shows City property surrounding Lake Worth.

3.5.5 Increased Storage

An additional benefit of dredging Lake Worth would be restoring storage capacity of the reservoir. Water rights are typically authorized on a reservoir's normal (or conservation) pool level, however, these rights are usually not modified to offset reduced storage due to sedimentation. Lake Worth is a "pass through" reservoir, accepting flows from Eagle Mountain Lake. The City has a contract with Tarrant County

Regional Water District, who operates Eagle Mountain Lake, to make sufficient releases to maintain a minimum lake level of 590 ft-msl. This is the minimum lake level needed to maintain adequate head on the raw water pump intakes located near the dam. The minimum lake level has been historically kept at least one foot above the contractual level, or a minimum of level of 591 ft-msl by releases from Eagle Mountain Lake.

Currently, the City draws approximately 490 acre-feet of raw water from Lake Worth daily. The reclaimed storage of 2,011 acre-feet would represent four days of raw water storage. In the rare event that discharges from Eagle Mountain Dam were interrupted, this reclaimed water storage could prove important for the City's water supply, albeit on a short-term emergency basis.



LAKE WORTH COMPREHENSIVE CAPITAL IMPROVEMENT IMPLEMENTATION PROJECT

FORT WORTH

FIGURE 3.3 CITY PROPERTY AROUND LAKE WORTH

Legend

- Fort Worth Property (Non Park)
- Fort Worth Property (Park)
- Fort Worth Nature Center

N
W E
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MAP PREPARED: JUNE 2, 2008

Freese and Nichols

0 1,000 2,000 3,000 4,000 5,000 6,000 Feet

The boundary lines and landowner information shown on this exhibit are intended for general, informational purposes only and may or may not depict actual property boundaries and/or ownership.

3.6 CIIP Dredging Study

This study relied most heavily on the 1990 and 2001 studies to develop technical recommendations for potential areas of dredging. Meetings with City staff were held to confirm these areas, as well as to develop new areas of possible dredging. Areas included along the north shore below the Loop 820 bridge, around the raw water intake near the dam, and selective dredging for boating lanes between the Highway 199 bridge and the Fort Worth Nature Center.

3.6.1 The following guidelines were used to develop dredging recommendations:

1. Portions of the lake with water depths greater than eight feet were not considered for dredging.
2. The northern portion of the lake, upstream of the Highway 199 bridge, would remain in its existing condition, which is used primarily for fishing and maintaining habitat consistent with the adjacent Nature Center.
3. Areas with known PCB contamination issues were to be avoided. These areas were generally south of the Loop 820 bridge and along the south shore line, adjacent to the Joint Reserve Base Naval Air Station/Air Force Plant 4. The PCB issue will be discussed later in Section 3.7.

The Texas Water Development Board (TWDB) performed a volumetric survey of Lake Worth in 2001. Figure 3.4 shows the lake bottom contour map generated from that survey. Potential dredging areas were evaluated based on expected water depth and the thickness of sediment overburden over native soils. Water depths are obviously affected by fluctuating lake levels. Figure 3.5 is a time plot of lake elevations over the last 25 years. For planning purposes, dredging areas were selected to provide approximately a six foot water depth at a lake elevation of 591 ft-msl, which is the minimum lake level required to be maintained by releases from Eagle Mountain Lake. Figure 3.6 summarizes the potential dredging areas identified in the CIIP.

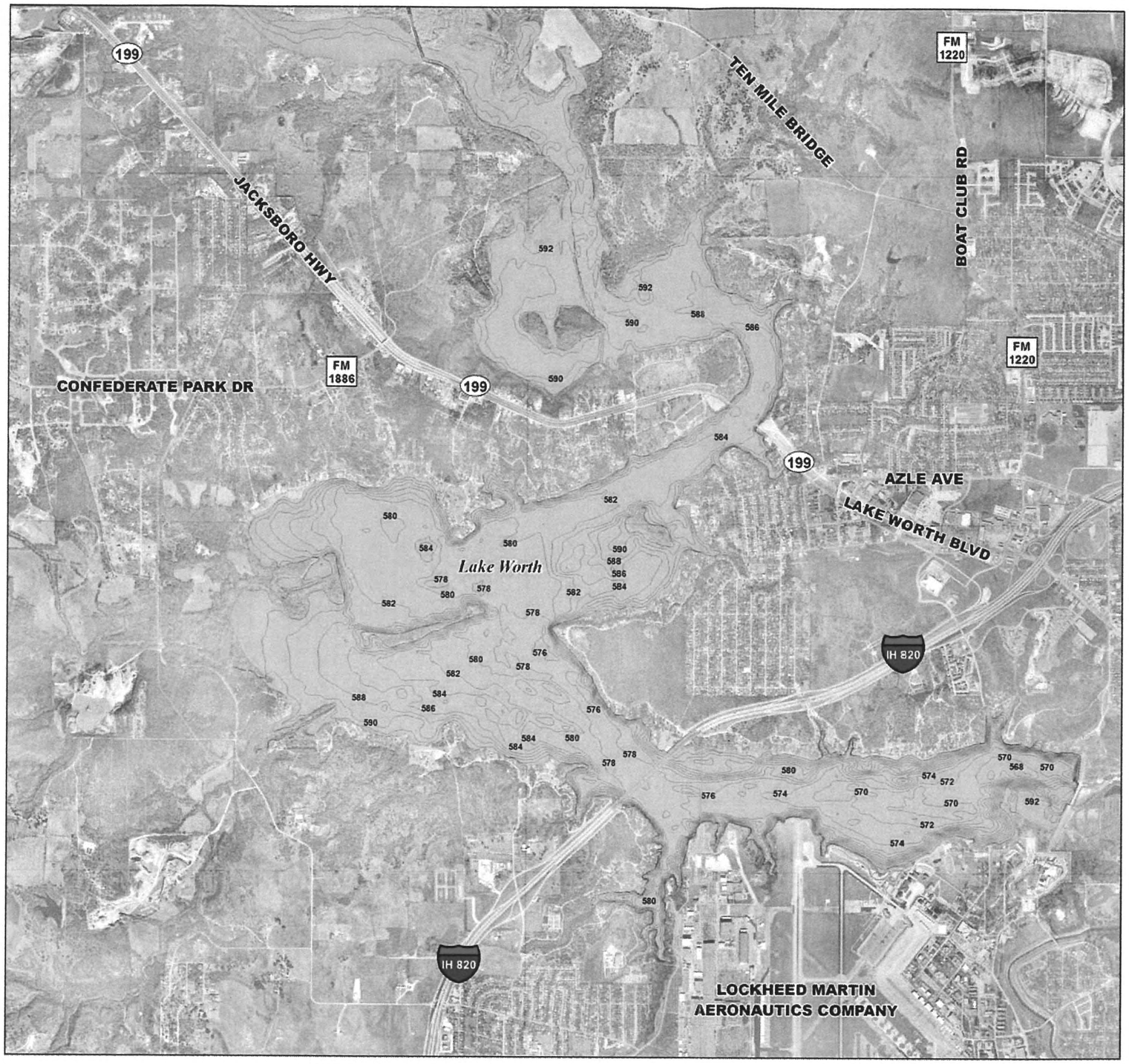
Several of the past siltation studies made estimates of silt depth throughout the lake. These depths ranged between just a few inches to over seven feet. In primary dredging areas, namely south and west of Goat Island and east and west of Willow Island, sediment thicknesses were

estimated to be three to four feet. Sediment thickness is an important consideration, as dredging productions can be substantially lower in removing native lake bottom as compared to minimal to moderately consolidated sediment.

Estimates from the 1990 and 2001 studies were used as the basis for developing dredge quantity estimates. New quantities were calculated for the north shore, Nature Center boating lanes, and raw water intake selective dredging areas. An annual siltation loading of 25 acre-feet was assumed and projected to a target start of dredging year in 2011. This additional loading was assumed to mainly affect the dredge areas along the west side of the lake. Table 3.4 summarizes the dredge quantity estimates developed for the CIIP study.

Table 3.4 – Proposed Dredge Areas and Quantity Estimates

Lake Location	Dredge Volume (acre-feet)	Dredge Volume (CY)	% of Total
South and west of Goat Island	992	1,600,000	49%
East and west of Willow Island	620	1,000,000	31%
Northwest of Goat Island	62	100,000	3%
South of Casino Beach	62	100,000	3%
North shore below Loop 820 bridge	155	250,000	8%
Boating lanes above Highway 199 bridge	58	93,000	3%
Raw water intake near dam	62	100,000	3%
Total	**2001**	**3,243,000**	**100%**



LAKE WORTH COMPREHENSIVE CAPITAL IMPROVEMENT IMPLEMENTATION PROJECT

FORT WORTH

FIGURE 3.4
2001 TWDB CONTOUR MAP OF LAKE WORTH

NOTE: CONTOURS FROM 2001
TEXAS WATER DEVELOPMENT BOARD
VOLUMETRIC SURVEY OF LAKE WORTH

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Freese and Nichols

0 1,000 2,000 3,000 4,000 5,000
Feet

JUNE 2, 2008 [TW67214]
H: \TMFIGURES\TWDB CONTOUR MAP OF LAKE WORTH.MXD

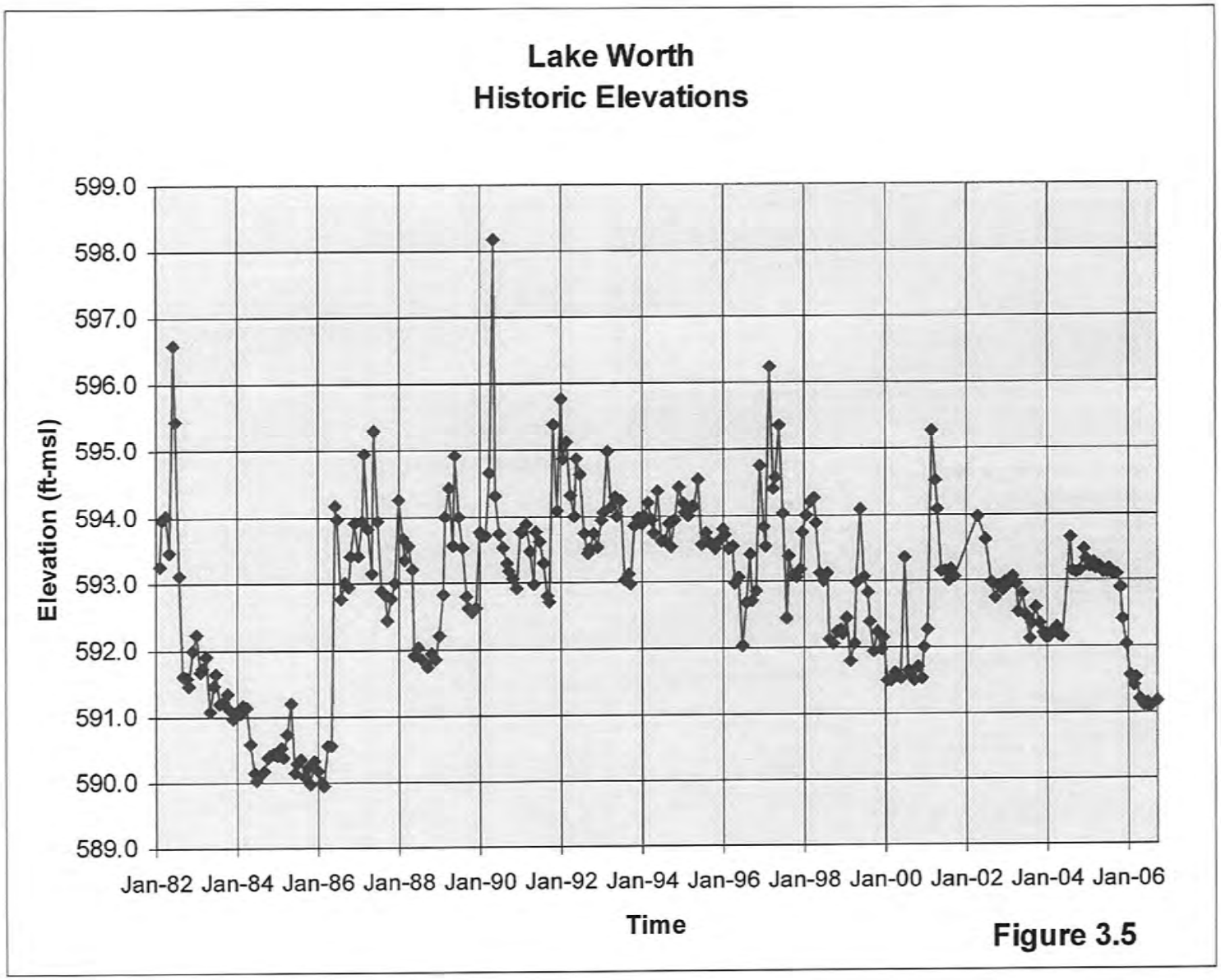
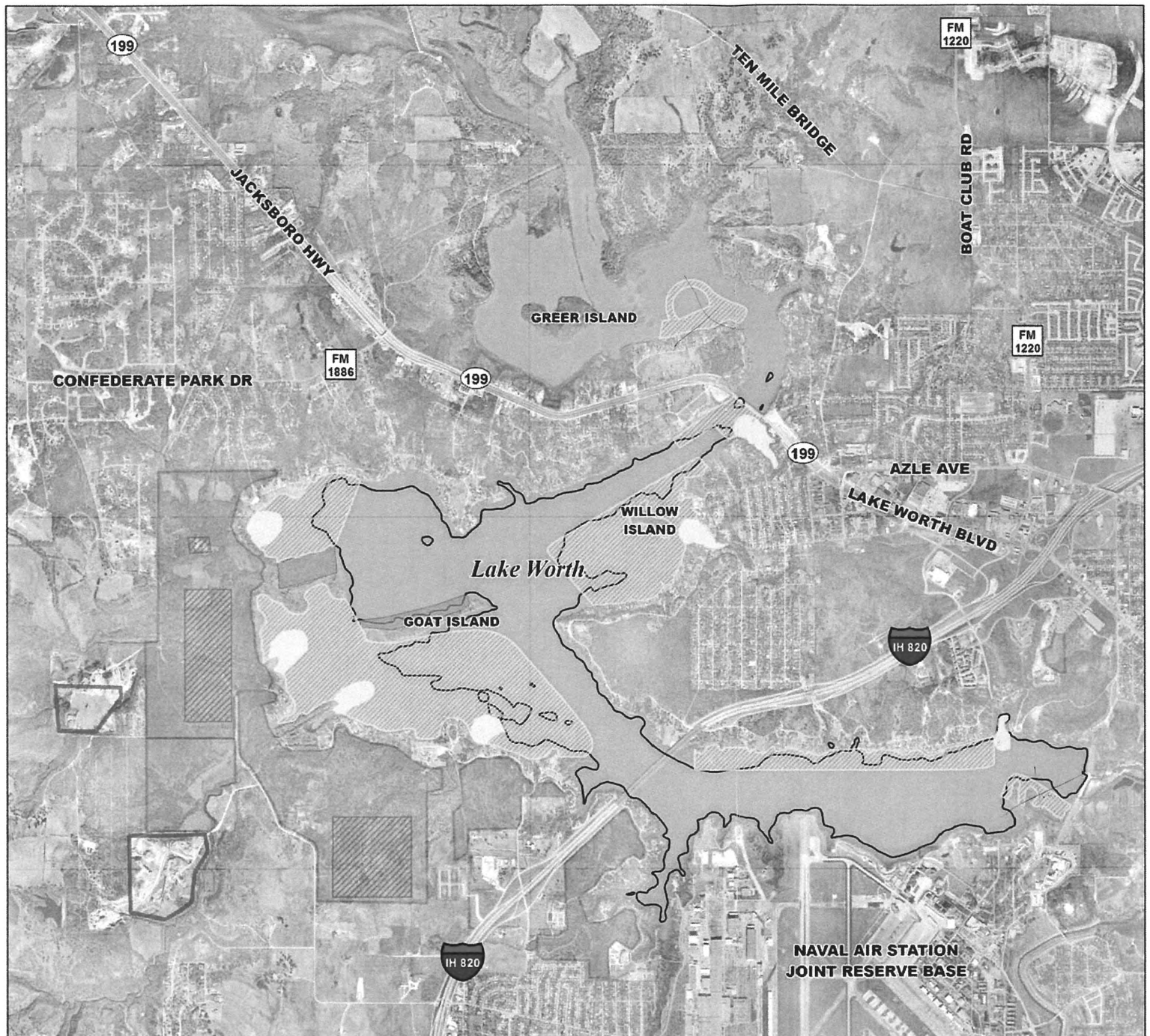

Lake Worth
Historic Elevations
599.0
598.0
597.0
596.0
595.0
594.0
593.0
592.0
591.0
590.0
589.0
Elevation (ft-msl)
Jan-82 Jan-84 Jan-86 Jan-88 Jan-90 Jan-92 Jan-94 Jan-96 Jan-98 Jan-00 Jan-02 Jan-04 Jan-06
Time

Figure 3.5



LAKE WORTH COMPREHENSIVE CAPITAL IMPROVEMENT IMPLEMENTATION PROJECT

FORT WORTH

FIGURE 3.6 POTENTIAL DREDGING AREAS

Legend

- Elevation 584 Contour
- City Property

Possible Disposal Areas

- In-Lake, City Property
- Off-site, City Property
- Off-site, Private Property

Proposed Dredge Areas

- Extended Depth
- Regular Depth

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Freese and Nichols

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Feet

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3.7 PCB Contamination

A significant consideration in the proposed dredging program is the known polychloridnated byphenyls (PCB) contamination of lake sediment adjacent to the Naval Air Station Joint Reserve Base (NAS-JRB) and Air Force Plant 4, more specifically in the Woods Inlet area. The USGS has published several studies which have investigated contaminant levels in the Lake Worth sediment. In 2000, the Texas Department of Health issued a consumption advisory on fish caught in Lake Worth, citing the fact that PCB's in lake sediment had led to contamination of fish tissues. This study was used as guidance in identifying potential dredging areas while avoiding areas with known PCB contamination. Currently, the City's approach is to not dredge in these areas in order to avoid the possible ramifications of having to mitigate this sediment material.

3.8 Dredging Methods and Pilot Study

The 1990 study sampled sediment in five locations and characterized the material as highly plastic clays with some silts. The report concluded hydraulic dredging and transport via pipelines would be feasible and the most efficient method to remove large quantities of material. Hydraulic dredging will utilize pipelines and booster pumps to transport the material to disposal sites. Consideration will need to be given to pipeline layouts across the lake and how lake traffic would be affected.

In conjunction with the watershed management study, a concept was developed to provide in-lake sediment traps where major tributaries confluence with the lake. While these in-lake traps need to be further evaluated for their feasibility, mechanical dredging (dragline, clamshell, amphibian excavation) may be required to over-dredge native soils in these areas to provide deeper areas to allow partial sedimentation to occur.

Concurrent with the CIIP, the City performed a pilot dredging study at Lake Worth. The scope of the study was to use both mechanical and hydraulic methods to dredge approximately 8,900 cubic yards of material. Dredge locations, methods, quantities, and disposal methods are summarized in **Table 3.6**.

Table 3.6 - Pilot Dredging Study

Location	Dredge Method	Quantity (CY)	Disposal Method
Quebec Cove	Mechanical	1,700	Offsite, truck haul
Willow Island	Hydraulic (6")	6,700	In-lake
Goat Island	Hydraulic (6")	500	In-lake

3.8.1 The pilot dredging study provided valuable lessons learned for a larger dredging project, including the following:

1. Importance of consistent methodologies in measuring dredge quantities
2. Typical obstructions and debris that will be encountered in lake sediment
3. Expected production rates and material handling for small dredges (an 8-inch dredge was used in the pilot study)
4. Familiarizing staff with environmental permitting requirements
5. Familiarizing staff with dredging and disposal operations

3.9 Disposal Considerations

Disposal of dredge material is a major factor in developing a dredging program. Two disposal options were considered in this study: offsite disposal into privately-owned quarries and offsite disposal onto City-owned land adjacent to the lake. In-lake disposal has also been considered in previous studies. Figure 3.6 shows the disposal locations discussed in previous studies.

The 2001 study identified four potential off-site disposal areas: three quarries west of the lake and one quarry approximately five miles east of the lake. A hydraulic dredging operation is fundamentally a pumping operation and is energy intensive. Pumping costs will increase with longer pipeline distances and greater elevation head differences between the lake and this disposal location. An additional consideration will be how to return decanted water back to Lake Worth so that net water consumption is minimized. There are two quarries west of the lake within one mile that appear to be prime disposal sites candidates. Because both of these sites are privately owned, it would be necessary for the City to seek competitive bids from owners to accept and dewater the dredged material.

As an alternative to off-site private disposal sites, evaluations were made for constructing a confined dike facility (CFD) on City-owned land near the lake. A CFD is a system of earthen dikes in which the dredge slurry is pumped into the dike, settlement occurs through various settling cells, and decanted water is separated and returned to the lake. For a dredge volume of three million cubic yards and a minimum dike height of 10 feet, approximately 115 acres would be needed for a CFD.

A conceptual siting analysis for the CFD was performed at two locations on City-owned land. The first site was immediately west of the lake in the floodplain of Silver Creek. This topography was relatively flat and conducive to a CFD. Major drawbacks were that the site is heavily wooded and would require substantial clearing. The majority of the site is located in the Silver Creek floodplain, and several existing roads would have to be relocated. The second site was along the lake's south shore. This site is more open, but its topography is steeper and there is less available land for a CFD. Both CFD sites were less than optimal. From a broader perspective, the City would need to consider if transforming these lands into disposal sites would be the best use of the land. Multiple issues would have to be considered, such as aesthetics, loss of natural habitat, floodplain alterations, and impacts to existing infrastructure.

3.10 Navigation Devices

The existing navigation devices at Lake Worth consist of warning buoys in areas of tree stumps, obstructions, shallow water, and a barrier line at the dam. According to lake management staff, these existing devices have been in service for several years and are in fair to poor shape. A significant draw back to the existing devices is that they do not address all of the problem areas across the lake. Many areas remain unmarked and only boaters with local knowledge of the lake can navigate certain areas, especially portions of the lake above the Highway 199 bridge. Through meetings with lake management staff, it was decided that a comprehensive navigational plan would be developed in conjunction with final dredging and tree stump removal plans. The navigation plan will reflect changes in lake bottom topography and the removal of underwater obstructions. Until this final navigational plan is established, it is recommended the existing devices and layout be maintained according to existing lake conditions.

3.11 Watershed Protection Analysis

Watershed protection is a broad issue that has been addressed with varying degrees of detail in previous studies. For the CIIP study, watershed protection issues were divided into two categories: 1) capital improvements projects and 2) development regulations.

3.12 Capital Improvement Projects

Eagle Mountain Dam controls 1,876 square miles of the West Fork of the Trinity River watershed. There is approximately 88 square miles of drainage area below Eagle Mountain Dam which flows into Lake Worth. **Figure 3.7** shows the contributing watershed map and **Table 3.5** summarizes the watersheds and the jurisdictions in which the subwatershed is located.

Table 3.5 – Jurisdictions Within Watershed

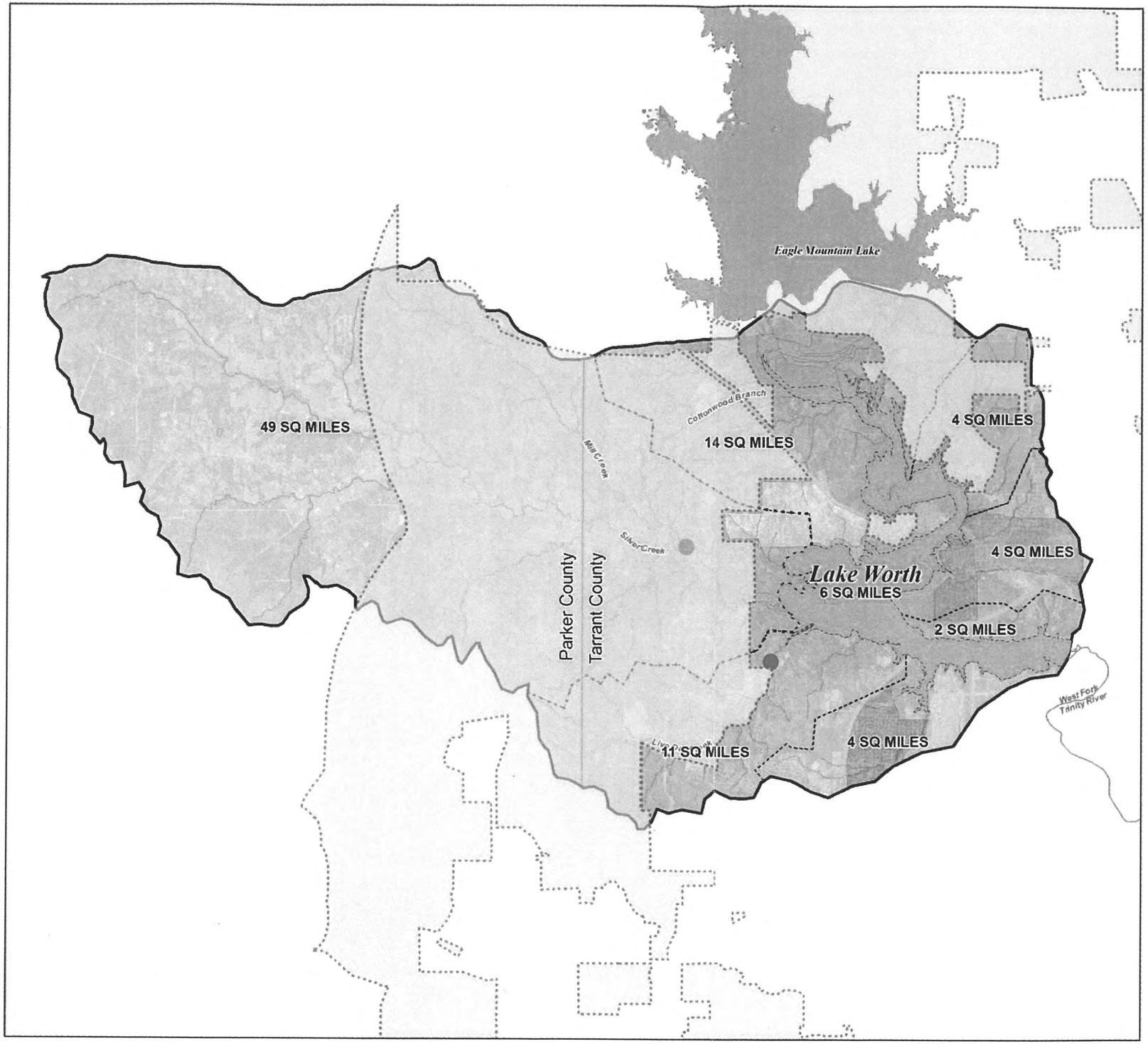
Subwatershed	Area (sq mi)	% of Total	Jurisdictions								
			City of Fort Worth	City of Lake Worth	City of Sansom Park	Town of Lakeside	City of Azle	City of White Settlement	Eagle Mountain Census Designated Place (CPD)	Tarrant County	Parker County
Silver Creek	49	55%	X							X	X
Live Oak Creek	11	12%	X							X	X
Nature Center	14	16%	X		X	X			X	X	
City of Sansom Park	4	5%	X		X				X		
City of Lake Worth	4	5%	X	X							
Loop 820	2	2%	X	X							
City of White Settlement	4	5%	X					X			
Total	**88**	**100%**	(Does not include 6 sq. mi. of Lake Worth surface area.)								

In reviewing past studies, the only capital improvement projects that were specifically identified for protection of Lake Worth were two sedimentation dams on the main stems of Silver Creek and Live Oak Creek. However, it appears these sedimentation dams were

LAKE WORTH COMPREHENSIVE CAPITAL IMPROVEMENT IMPLEMENTATION PROJECT

FORT WORTH

FIGURE 3.7 CONTRIBUTING WATERSHED MAP



Legend

CITY (Acreage, % of Total)

- City of Azle (53 ac., 0.09%)
- Eagle Mountain CDP (2062 ac., 3.43%)
- City of Fort Worth (15750 ac., 26.2%)
- City of Lake Worth (1460 ac., 2.43%)
- Town of Lakeside (1019 ac., 1.7%)
- Parker County (26173 ac., 43.54%)
- City of Sansom Park (23 ac., 0.04%)
- Tarrant County (12848 ac., 21.37%)
- City of White Settlement (721 ac., 1.2%)
- Lakes
- City of Fort Worth ETJ
- Lake Worth Watershed
- County Boundary
- Subwatershed Boundary
- Streams
- Potential Sedimentation Dams

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N W E S

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0 6,000 12,000 18,000 Feet

MAP PREPARED: JUNE 2, 2008

[FTW07211] CONTRIBUTING WATERSHED MAP

recommended in concept only, as there was no documentation of any preliminary sizing, siting, or design.

3.12.1 In order to develop cost estimates for the current CIIP, conceptual level designs had to be developed for the sedimentation dams. General assumptions followed these basic guidelines:

1. The dam would be sited to generally create a high length-to-width ratio for reservoir shape. To serve as sedimentation structures, the design intent would be to create long, shallow impoundments with a long hydraulic residence time to allow settling of suspended sediment. USGS topographic maps were used for the siting analysis.
2. Dams would be earthen embankments with ungated concrete spillways.
3. Due to size of the contributing drainage areas, the dams would require substantial overflow spillways as well as low-flow spillways to maintain base flows.

Early in the project, the sedimentation structures were conceptually described as small "stock ponds" to reduce sediment loading into Lake Worth. However, a closer consideration showed these structure would actually need to be relatively large dams and settling reservoirs in order to serve the sedimentation function for their contributing drainage areas. A major factor driving the cost estimates was land acquisition needed for the dam and reservoir. Since these structures would result in impacts to jurisdictional waters of the U.S., it was assumed environmental mitigation would be required in the form of purchasing additional land for conservation purposes. As a result, land acquisition generally represented over 50 percent of total project costs.

A second sedimentation dam approach considered constructing multiple dams, smaller in size, on the various tributaries into Silver Creek and Live Oak Creek. This method was based on a similar project by the Natural Resources Conservation Service in controlling sedimentation into reservoirs at Fort Hood, near Killen, Texas. For this approach, a generic dam design was

developed and a total of 26 dam locations were identified. The same design concepts regarding structure and reservoir configurations were assumed as those used for the larger regional dam approach. As in the regional dam approach, land acquisition cost for the dam, reservoir, and environmental mitigation was the driving factor.

The multiple sedimentation dam approach would intercept sediment runoff from the watershed to reduce loading into Lake Worth. However, this approach has two primary drawbacks. First, project costs are high associated with acquiring land, performing environmental permitting and mitigation, and constructing new dams. Second, building new sedimentation reservoirs would ultimately shift the maintenance dredging burden onto multiple locations instead of a single location at Lake Worth.

3.13 Development Regulation

The second aspect of watershed management addressed in past studies focused on the need for development regulations to control land uses and construction practices to manage erosion and sedimentation discharges. A central theme to all of the recommendations from these studies was that watershed-wide cooperation would be needed among controlling jurisdictions in order to implement consistent development guidelines. As Figure 3.7 shows, there are currently nine entities within the 88 square mile watershed that control development.

3.13.1 The primary recommendations from these studies was to institute development ordinances to regulate the following:

1. Land use guidelines, taking into consideration the potential for soil erodability
2. Steep slope protection
3. Drainage corridor and critical environmental features protection
4. Non-point source runoff
5. Impervious cover and development intensity
6. Land use zoning
7. Erosion and sediment controls during construction

8. Housekeeping practices for pesticide/fertilizer use, hazard waste, and used oil disposal
9. Regulations for illegal dumping and misuse of storm drainage systems
10. On-site stormwater detention and water quality control
11. Creation and protection of buffer zones
12. Policy for near-lake sewage collection and treatment

Over time, regulations have evolved to address some of these recommendations. Currently, the Integrated Stormwater Management program (iSWM) serves as the best vehicle through which to address watershed management issues. ISWM is a regional program that codifies watershed management practices. In addition to implementing and enforcing iSWM guidelines, the City may consider a special overlay district for the immediate Lake Worth area to include more stringent or specialized protection controls. Concurrent to developing this CIIP, the City has contracted with Jacobs/Carter and Burgess to conduct a watershed management study and develop additional recommendations.

3.14 Drainage Projects

One drainage project was addressed in this study was the Comanche Trail Low Water Crossing project. The project consisted of channel improvements to Comanche Creek through portions of the cities of Fort Worth and Lake Worth and included redesign of a low water road crossing of Comanche Trail at Comanche Creek. During the course of this CIIP study, design of the low water crossing project was completed. The construction phase is awaiting a funding agreement between Fort Worth and Lake Worth to be finalized. The design project was independent of this study and was being performed by Kimley-Horn and Associates, Inc. under the direction of the City of Lake Worth.

3.15 Cost Estimates

A large in-land dredging project in Texas is not a common project and there are few projects similar in size and scope with which construction costs could be compared. However, the City

of Dallas' dredging of White Rock Lake in 1997 to 1998 served as a useful reference. That project consisted of hydraulic dredging of approximately 2.9 million cubic yards of sediment and pumping the material 23 miles (primarily downhill) to an off-site quarry south of Dallas. Several discussions were held with a project superintendent for the contractor who performed the White Rock Lake project. These discussions proved valuable in evaluating the Lake Worth dredging project.

The basic method in preparing dredging cost estimates was on a unit price per cubic yard of material to be dredged, transported, and disposed. The first method in calculating costs was to use unit costs from the White Rock Lake project in 1997 and adjust for inflation to 2011. The White Rock unit costs were reported as $5.00 per cubic yard. Assuming annual inflation rate of four percent over the 14 year period resulted in a unit cost of approximately $8.70 per cubic yard.

A second, more detailed analysis evaluated USACE dredging bid tabulations since 2004. The USACE has an extensive bid tabulation data base which organizes dredging projects according to project location, dredging quantity, and dredging method. In some cases disposal method was also reported. The following guidelines were used in making the evaluations:

3.15.1 Only dredging projects within 500 miles of Dallas/Fort Worth were used for the analysis.

3.15.2 Only hydraulic dredging projects were selected.

3.15.3 Unit costs per cubic yard were calculated from the total contract price and the total dredge volume.

3.15.4 Unit costs were adjusted to account for disposal costs. Disposal costs were estimated based on construction costs of preparing a CFD on City-owned land, which was calculated to be $4.50 per cubic yard for the 115-acre CFD discussed previously. Follow-up discussions with USACE engineering staff confirmed this was a reasonable CFD disposal assumption.

3.15.5 Unit costs were plotted against total dredge quantities to develop cost curves.

Figure 3.8 is a typical cost curve developed from 2006 and 2007 USACE dredging projects, adjusted to include disposal costs. Upper and lower envelopes were drawn around the data points, as well as an average cost curve. The graph demonstrates that economy of scale is an important factor in dredging projects. As dredge quantities exceeded two million cubic yards, unit costs leveled out. According to USACE staff and the White Rock Lake contractor, this trend is a result of larger projects justifying mobilizing larger dredging equipment, which translates into higher daily production rates and lower overall unit costs. Based on **Figure 3.8**, a unit cost of $7.50 per cubic yard was assumed for a three million cubic yard dredging project. Project mobilization was calculated separately as five percent of the construction subtotal. A 10 percent inflation factor was included to account for a projected start date in 2011.

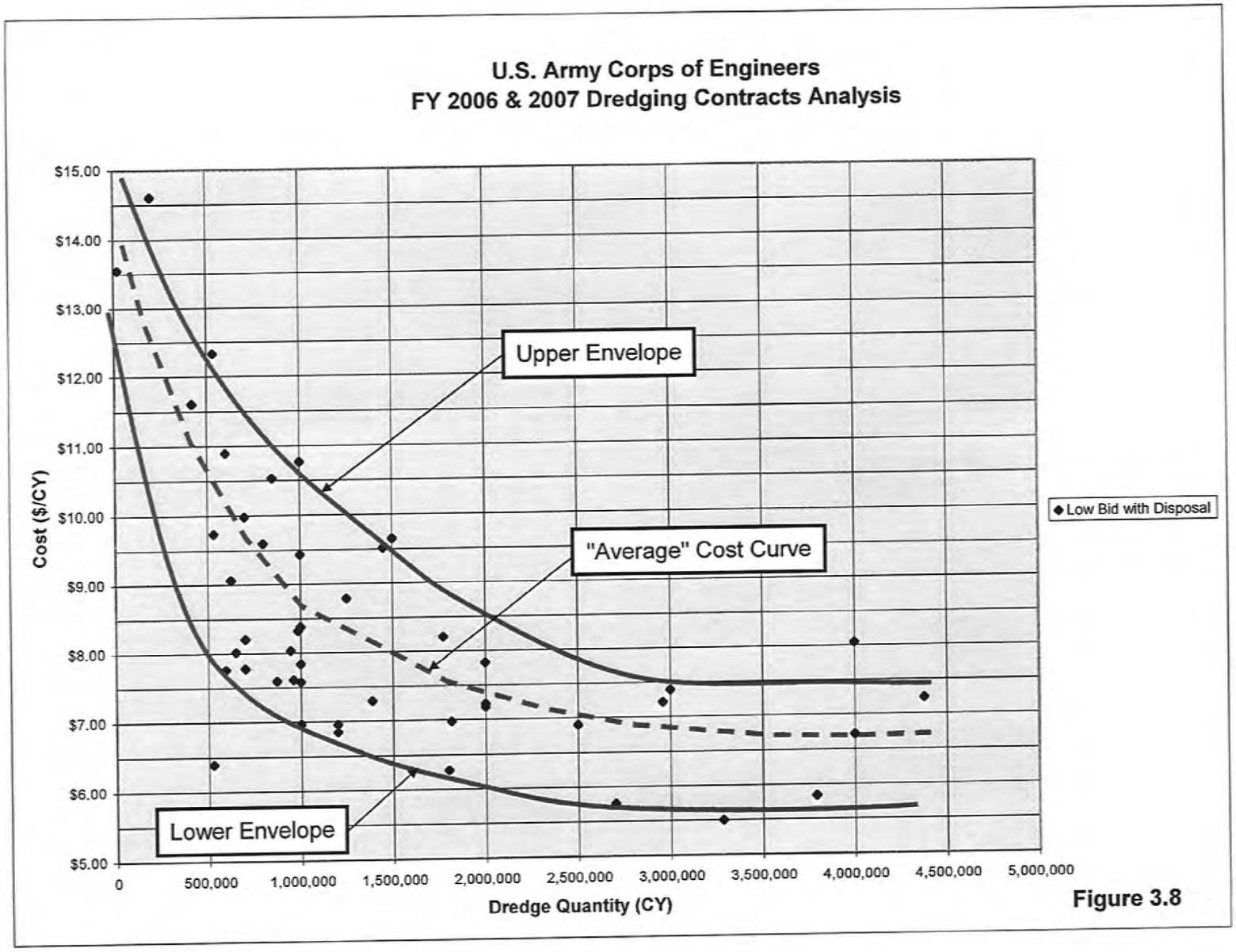
Dredging operations are energy-intensive operations, relying on diesel or electrically-operated hydraulic dredges and booster pumps to remove and transport the material. These CIIP costs estimates were developed in late summer/early fall 2007, at which times diesel fuel costs were approximately $2.90 per gallon. Annual inflation factors of 3% to 5% were generally assumed. However, since late fall 2007, energy prices have escalated at a much faster rate. According to Department of Energy fuel price graphs, diesel prices in December 2007 were approximately $3.40/gal and by April 2008 had reached $4.10/gal. Dredging costs will be a function of energy costs. Any future dredging program should take into consideration the volatility of fuel prices when developing and estimating construction costs.

An early consideration of the City was purchasing dredging equipment and staffing its own dredging operation to spread the work over an approximate 10-year period. Analysis of dredging costs showed this approach has several drawbacks:

1. An annual dredging production of 300,000 cubic yards would justify only a relatively small (eight- to ten-inch) hydraulic dredge. As a result, daily production rates would be relatively low.

2. In light of fuel price escalation and volatility over the last two years, a 10-year dredging program would likely be subject to more price volatility than a shorter duration, more intense dredging program.
3. Input from the steering committee and public meetings consistently favored a shorter duration, more intense dredging program, as compared to a lower production, longer duration option. Citizens want the lake restoration to be completed as soon as possible.
4. As Figure 3.8 demonstrated, large quantity dredging costs which can justify large dredges lead to higher production rates and overall lower unit costs. In summary, larger dredging projects have been shown to be more cost effective.

The cost estimates for the dredging and drainage projects are shown in Appendix A.


U.S. Army Corps of Engineers
FY 2006 & 2007 Dredging Contracts Analysis
Cost ($/CY)
$15.00
$14.00
$13.00
$12.00
$11.00
$10.00
$9.00
$8.00
$7.00
$6.00
$5.00
0
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3,500,000
4,000,000
4,500,000
5,000,000
Dredge Quantity (CY)
Upper Envelope
"Average" Cost Curve
Lower Envelope
Low Bid with Disposal

Figure 3.8

4.0 PARKS, TRAILS, & ACCESS MANAGEMENT PROJECTS

4.1 Scope of this Analysis

The existing conditions data was collected by visual observation and photographic documentation from onsite visits by automobile and on foot. Boundaries used for this analysis were Silver Creek Road North on the west, Fort Worth Nature Center and Wildlife Refuge on the north, Roberts Cutoff Road on the east, and Silver Creed Road and the Naval Air Station Joint Reserve Base (NASJRB) on the south sides. This study includes existing parks, roads, and neighborhoods adjacent to Lake Worth, as well as the Fort Worth Nature Center and Wildlife Refuge. This study excludes the following sites: the NASJRB, Camp Carter (YMCA), and Camp Leroy Shuman (BSA). The following conditions were examined:

4.1.1 Existing parks adjacent to and near Lake Worth – The City owns numerous parks adjacent to Lake Worth in various conditions; historic, used, new, undeveloped, etc. This study focuses on general equipment conditions and ADA accessibility and includes the following parks:

- Arrow-S Park - Picnic, ramp, fishing dock, play area, bbq pits
- Camp Joy Park -Play area, picnic tables, swing set
- Casino Beach Park - Ball fields, small play area, boat ramp
- Freemons Park - Greenspace
- Island View Park - Swimming, play area
- Live Oak Park - Greenspace
- Love Circle Park - Greenspace
- Malaga Park - Ball field, Play area
- Lake Worth Marina Park - Picnic, marina, clubhouse
- Marion Sansom Park - Picnic tables, shelters, overlooks
- Mosque Point Park - Picnic shelter, overlook, trail to lake
- Plover Circle Park - Greenspace
- Royal Family Park - Picnic tables, play area, pond
- Sunset Park - Historic pavilion with fire pit, play area
- Vinca Circle Park - Greenspace
- West Park - Greenspace, planned for development
- Wildwood North Park - Greenspace
- Wildwood Park - Greenspace
- Windswept Park - Greenspace

4.1.2 Existing Access Control Measures and Problems – Numerous parcels of undeveloped park land or other city-owned land exist adjacent to the roadways and parks. This study identifies locations where erosion or other damage has occurred due to unauthorized access. This study also identifies measures that have been taken to control access and recommends different options for controlling access.

4.1.3 Existing Roads Adjacent to and near Lake Worth – Existing roads can be classified hierarchically as highways, major arterials, minor arterials, collectors, and local roads. Each road has a different capacity to accommodate on-street or off-street trails. In many sections of this study area, topography in the street right-of-way affects the constructability of trails in that right-of-way. Two major bridges exist in the project area, the IH 820 bridge across Lake Worth and the SH 199 (Jacksboro Highway) Bridge.

4.1.4 Potential Locations of New Trails – Land, roadway right-of-way, and on-street corridors were evaluated for the suitability of adding new hike and bike trails.

4.1.5 Alternate Routes – Alternate routes were studied to determine the following:

- existing city land on which a new trial could be developed
- existing trails that could be incorporated into an overall trail system
- potential connections to existing parks and existing trails.

4.1.6 Effects of Uncontrolled Access – In many areas of the project, access to undeveloped public land is either not controlled or poorly controlled. Unauthorized users have been seen riding ATVs, motorcycles, and bicycles, and dumping trash. Repetitive use of motorized recreational vehicles is particularly damaging to the natural drainage processes and causes significant erosion. Such illegal uses also contribute to wildlife habitat degradation and even loss of habitat. This study documents several such cases.

Figure 4. 2 – *Trail by Erosion*

Figure 4. 1 – *Trail by Erosion*

4.2 Summary of Previous Studies

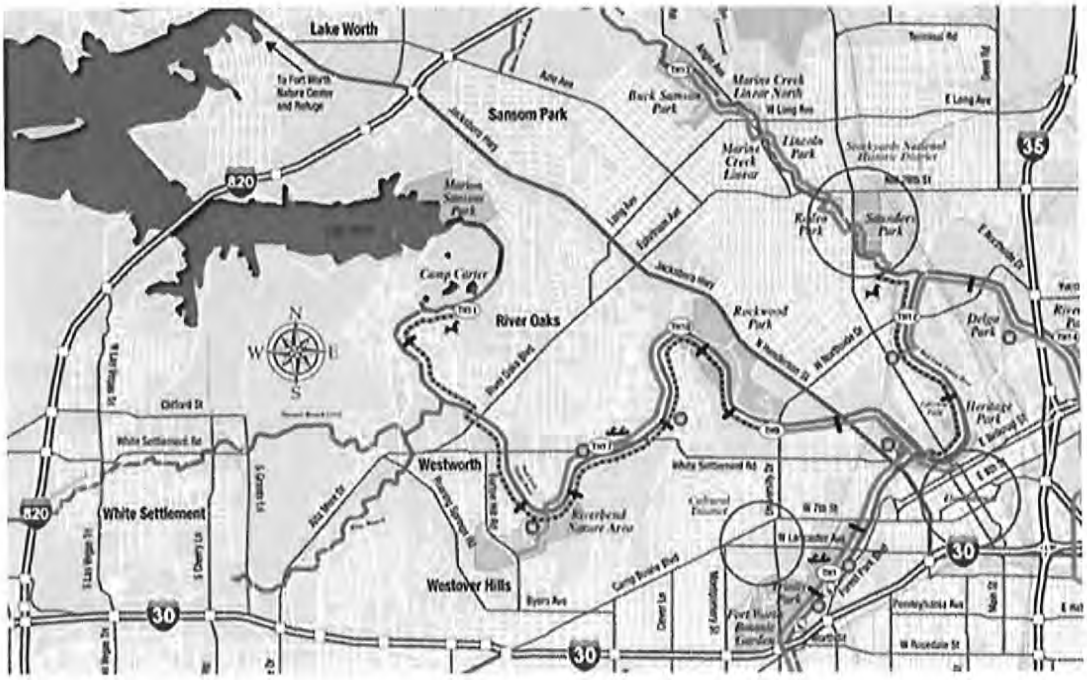
The scope of work included examining recent studies of recreational opportunities in the Lake Worth area. Studies examined included the following reports.

4.2.1 City of Fort Worth Park, Recreation & Open Space Master Plan, 2004

The Master Plan inventoried existing neighborhood, community and regional parks within the Lake Worth area (Park Planning District 2). The plan states that the parks around Lake Worth "are isolated from the population of the City by distance and the physical barrier of Loop 820."

The City of Fort Worth identified the continued development of intermodal transit opportunities as a growing urban trend. The master plan states that major parks in the City should be linked by Multi-Use Trails built to AASHTO standards typically made of concrete and measuring 8 to 12.5 feet in width. The Master Plan also acknowledges the Trinity Trail Management Guidelines for regional trail standards for trails within the Trinity River corridor. Multi-use park trails provide access to park facilities or natural areas and range in width from 6 to 12.5 feet.

4.2.2 Trinity River Vision – A Master Plan for the Trinity River and Major Tributaries in Greater Fort Worth, 1999



Northwest portion of Trinity River Vision plan

The Trinity River Master Plan emphasized the importance of using the river corridors to connect parks and lakes, activity centers, and neighborhoods. The portion of the plan above shows the connection to Marion Sansom Park along the Trinity River which is depicted on the "Park and Access Management Plan" for Lake Worth.

Nearly forty miles of surfaced trails exist within the floodplain of the Trinity River and Marine Creek. Surfaces are provided for biking, walking, in-line skating and horseback riding. Currently an existing concrete paved trail can be accessed at the trail head on Meandering Road south of the dam.

Current Trinity River trail head at Meandering Road

4.2.3 Preserving Native Texas – A Master Plan for the Fort Worth Nature Center & Refuge, 2003

The Fort Worth Nature Center occupies more than 3,600 acres on the upper portion of Lake Worth. The mission of the Nature Center Master Plan is to establish a signature open space and preserve that reflects the regional character. The master plan includes recommendations for new facilities, updating existing facilities and providing new infrastructure. The Nature Center utilizes upper Lake Worth (north of Jacksboro Highway) for environmental education and canoeing. Greer Island supports trails and pavilion.

The Nature Center currently maintains soft surface nature trails. The interior roadways (Shoreline Road, Buffalo Road, Broadview Drive) allow for on street biking. The Master Plan recommends the addition of 8' wide concrete bike trails throughout the property. The Nature Center currently requires site users to pay an entrance fee at the guard house near Jacksboro Highway.

Fort Worth Nature Center Existing Trail Map

4.2.4 Conclusion

Based on the review of these studies and input from the Park Department and community groups, the goal must be to connect Lake Worth and its amenities to adjacent neighborhoods, recreational features and greater Fort Worth. To meet this goal, the proposed trails will link the parks along the lake and to connect the lake to city's Trinity River trail system. The "Park and Access Management Plan" examines other connections to the Trinity River trail system and creates a looped system for Lake Worth. A future goal will be to link Lake Worth and the Fort Worth Nature Center with a trail along Shoreline Drive.

4.3 Parks improvement projects

4.3.1 General ADA Accessibility improvements

With the exception of parks that have been recently updated, the parks located in this study area generally have poor to non-existent ADA access. At a minimum, access should be provided from parking lots to the following amenities:

- Picnic tables
  - Need at least one accessible table for wheelchairs in each park
- Shade structures
- Playgrounds
  - inaccessible play structures should be upgraded or replaced to provide accessible play components
  - play surface should conform to ADA standards, and a ramp should be provided into the play area for each accessible playground
- Restroom facilities (if any)
- Overlooks

4.3.2 Upgrade existing park facilities per previous report recommendations

Previous reports detail the existing conditions and proposed updates for the parks in this study area.

Figure 4. 3 – *Existing Playground*

4.3.3 General Cleanup/Graffiti removal

1. Numerous examples of graffiti and dumping exist in the parks and city lands.

   a. Methods for dealing with graffiti

      - Graffiti-resistant coatings
      - Regular inspection
      - Immediate removal
        - Invite local civic groups to participate
        - Law enforcement patrols after park hours

   b. Methods for dealing with trash

      - Control access to undeveloped land
      - Regular inspection
      - Immediate removal
      - Law enforcement patrols after park hours

Figure 4. 4 - *Graffiti at Mosque Point Park*

Figure 4.5 – *Graffiti at Mosque Point Park*

4.4 Trails Projects and Phasing

4.4.1 Trail Location

The main trail loops around Lake Worth from the existing Trinity River Trail through Marion Sansom Park, under the IH 820 Bridge, across SH 199, through Casino Beach Park to Silver Creek Road N, along Heron Drive, and to the NASJRB. See Figure 4.6 "Trails Projects."

4.4.2 AASHTO/TXDOT Requirements Examined

Trails recommended in this report will be required to follow AASHTO guidelines and TXDOT requirements when located in TXDOT right-of-way.

The trail portion of this study examined the option of creating a second, shorter loop by adding a connection across Lake Worth on or adjacent to the IH 820 Bridge. TXDOT has indicated that they would strongly discourage adding trail along IH 820 due to its status as an Interstate Highway and due to the cost required to add to an existing bridge or to build a secondary bridge next to the IH 820 Bridge.

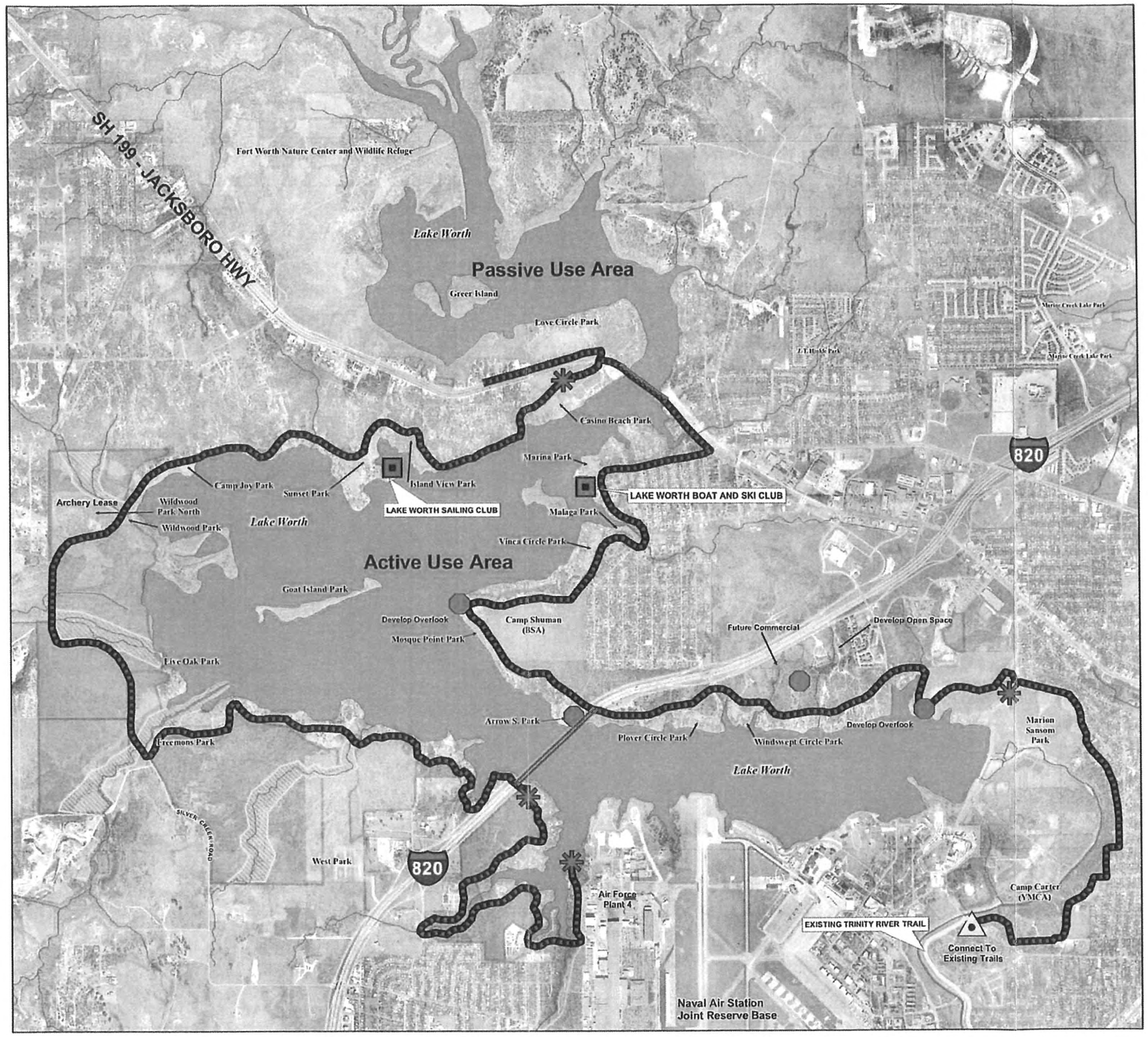
An alternate opportunity to cross Lake Worth occurs at the SH 199 (Jacksboro Highway) bridge. The existing bridge has a 6 foot wide barrier separated walking path on the south side of the bridge. Although AASHTO prefers a 10 foot width for barrier separated shared use paths on bridges, flexibility is allowed for existing conditions. A minimum 42 inch barrier will be required on both sides of the trail. This location has been chosen as the Lake Worth crossing. (See Figure 4.6 "Trails Projects")

Figure 4.7 – *Arrow-S Boat Launch under IH 820*

Figure 4.8 – *SH 199*

4.4.3 Trail Material and Width

In general, the trail will be 8 foot wide reinforced concrete. In areas where the trail is not in street right-of-way, the trail will be constructed to support emergency vehicular traffic.



LAKE WORTH COMPREHENSIVE CAPITAL IMPROVEMENT IMPLEMENTATION PROJECT

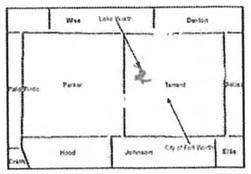
FORT WORTH

FIGURE 4.6 TRAILS PROJECTS

Legend

- Connection to Existing Trails
- Existing Marina
- Park Development
- Trail Head
- Primary Bike & Jogging Trail
- Veloweb at Lake Marine Park
- Lake Worth
- Erosion Control - Green belt
- City Owned Property
- Parks

MAP PREPARED: APRIL 18, 2008



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4.4.4 Trail Amenities

1. Typical amenities to be included in the construction of the trail:

   a. Signage

      - Trail maps
      - Educational Information
        - Historic
        - Safety
        - Biologic
        - Ecologic

   b. Kiosks

      - Emergency Phone
      - Trail Maps
      - City Information
      - Water

   c. Pull-offs

      - Benches
      - Trash Receptacles
      - Room for bikes
      - Overlook Signage

   d. Mileage Markers

4.4.5 Phases

1. The following are phasing recommendations for implementing the trail portion of the plan:

   a. Phase I

      - Improve Access control to existing damaged lands (see Access Management Projects below)
      - Repair erosion in damaged lands
      - Repair habitat loss in damaged lands
      - Remove graffiti
      - Remove trash
      - Connect Trinity River Trail to SH 199 (Jacksboro Highway)
      - Restore existing park amenities (per previous reports)
      - Add new park amenities (per previous reports)
      - Improve the following parks per previous plans:
        - Windswept Circle Park
        - Plover Circle Park

- Arrow-S Park
- Mosque Point Park
- Vinca Circle Park
- Malaga Park
- Lake Worth Marina Park

b. Phase II

- Connect SH 199 to The Point – Adjacent to NASJRB at the end of Bomber Road
- Improve the following parks per previous plans
  - Casino Beach
  - Island View Park
  - Sunset Park
  - Camp Joy Park
  - Wildwood Park
- Connect along Heron Drive to Las Vegas Trail
- Connect along Shore View Drive from Las Vegas Trail to Bomber Road

4.5 Access Management Projects

4.5.1 Existing Control Measures

1. Current access is controlled by several methods:

- A single steel cable strung loosely between wooden posts. (see fig below)

Figure 4.9 – *Loose Cable*

- Tree stumps set in the middle of a created path. (see fig below)

Figure 4.10 – ***Tree Stumps as Access Control***

- Signage (see fig below)

Figure 4.11 - ***Signage***

4.5.2 Provide controlled access at areas where damage is occurring. See "Park and Access Management Plan" (Figure 4.12)

(Images courtesy Google Maps)

A1 Wildwood North Park adjacent to Watercress Drive on the north side. (See Figure 4.13 below)

This area exhibits significant erosion and habitat loss. Access to the site generally occurs at a single point on Watercress Drive in an open, un-wooded area, or from a utility easement on the west side of the park. Numerous trails cut through the park and a large denuded area lies just off the road. Access should be controlled primarily along Watercress Drive. Access should also be controlled from the utility easement if possible. See paragraph 4.5.3 below.

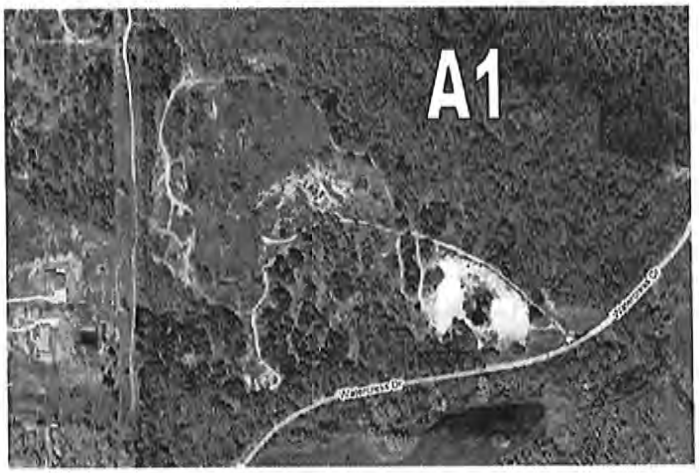
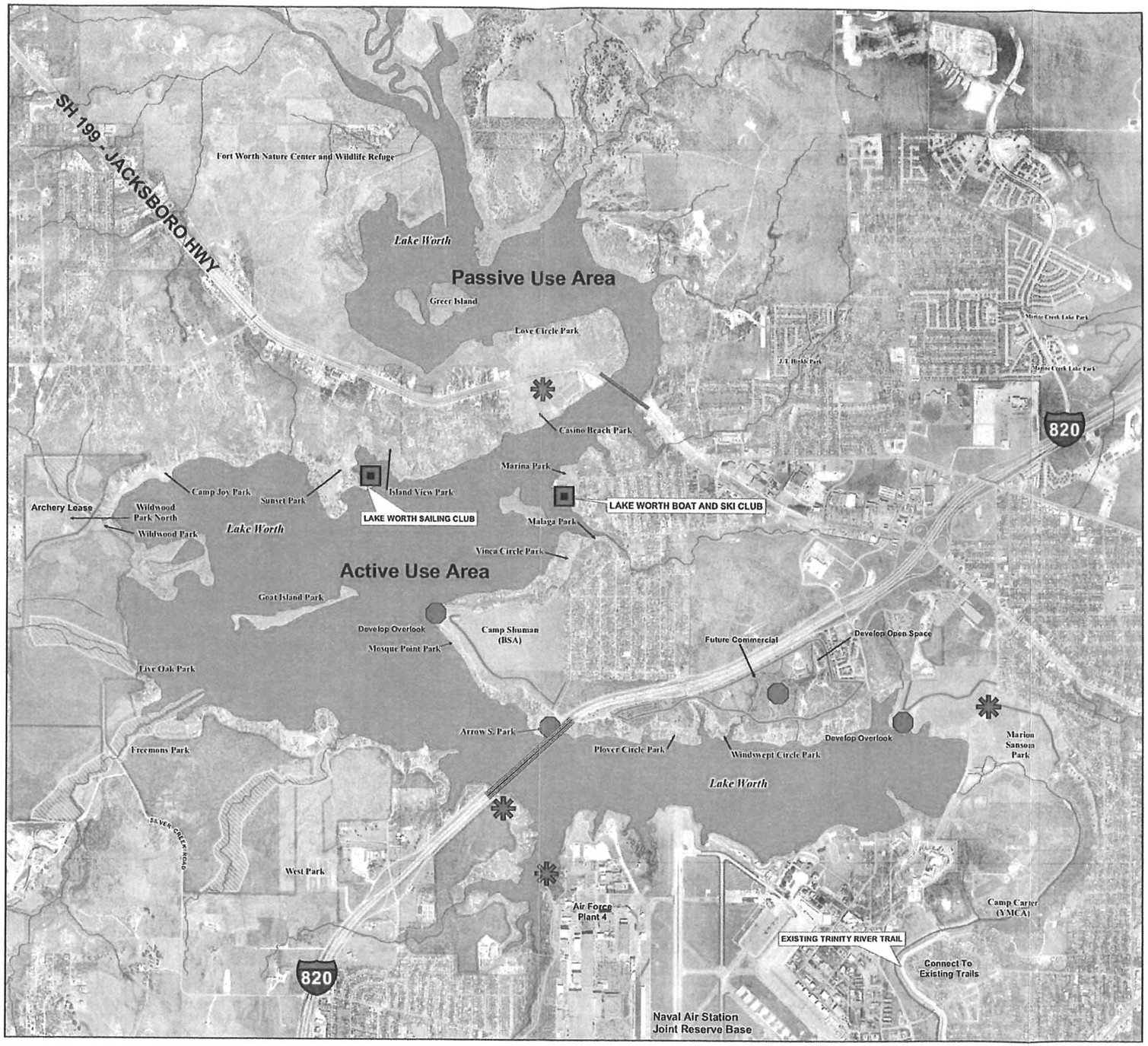


Figure 4.13 – *Wildwood North Aerial*



LAKE WORTH COMPREHENSIVE CAPITAL IMPROVEMENT IMPLEMENTATION PROJECT

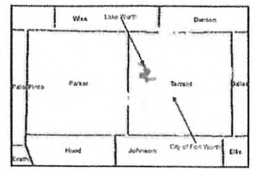
FORT WORTH

FIGURE 4.12 PARK AND ACCESS MANAGEMENT PLAN

Legend

- Existing Marina
- Park Development
- Trail Head
- Lake Worth
- Access Control
- Erosion Control - Green belt
- City Owned Property
- Parks

MAP PREPARED: APRIL 16, 2008



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A2 Mosque Point Park east of Cahoba Drive. (See Figure 4.14 below)

This area exhibits significant erosion and habitat loss. Access to the site generally occurs at a single point along Cahoba Drive, but numerous secondary access points exist along Cahoba Drive and Malaga Drive. Erosion caused by motorized vehicles creates most of the damage. Access should be controlled at open areas along Cahoba Drive and Malaga Drive. See paragraph 4.5.3 below.

Figure 4.14 – *Mosque Point Park Aerial*

A3/A4 A3 is the area bound by the NW Frontage Road for IH 820 and Cahoba Drive.

A4 is the area south of Cahoba Drive and east of the IH 820 Bridge to Plover Circle. (See Figure 4.15 below)

Neither of the areas currently exhibits erosion or habitat loss in. However, if access to nearby areas is controlled, unauthorized users may migrate to this area if its access is left uncontrolled. Access should be controlled along all adjacent roads. See paragraph 4.5.3 below.

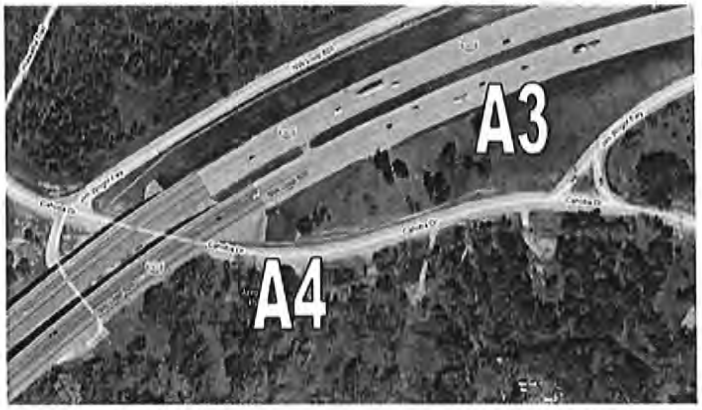


Figure 4.15– ***Area A4 and A3 Aerial***

A5 A5 is the area bound by the Northwest Frontage Road for IH 820, Cahoba Drive and Quebec St. (See Figure 4.16 below)

This area exhibits significant erosion and habitat loss. Access to the site occurs at numerous points along Cahoba Drive. The major access from the IH 820 service road occurs just west of the off-ramp. A network of eroded trails from unauthorized use exists on the eastern half of the area, with a large denuded area adjacent to the IH 820 off-ramp. There are numerous secondary access points spread out along the site. Access should be controlled at all points along all roads bounding the site. See paragraph 4.5.3 below.

Figure 4.16 – *Area A5 Aerial*

A6/A7 A6 is the area north of Cahoba Drive and east of Quebec St.

A7 is the area south of Cahoba Drive in Marion Sansom Park. (See Figure 4.17 below)

Both areas exhibit significant erosion and habitat loss. Access to both areas occurs primarily along Cahoba Drive at numerous points. A6 has a network of trails created by unauthorized use that, if left unchecked, will become a large, entirely denuded area. A7 currently has several trails leading to the water's edge with significant erosion next to the road and next to the water. Access should be controlled all along Cahoba Drive. See paragraph 4.5.3 below.

Figure 4.17 – ***Area A6/A7 Aerial***

Figure 4.18 – ***Unauthorized Trash dumped at Marion Sansom Park***

In general, once access is controlled, erosion must be repaired and habitat restored. Regular oversight and maintenance must occur to prevent future recurrence of problems.

4.5.3 Options for Controlling Access (see estimate for cost differences)

1. TXDOT Metal Beam Guardrail
   a. Most expensive option
   b. Visually intrusive – looks like a highway guardrail
   c. Difficult to circumvent

2. TXDOT Cable Fence
    a. Relatively inexpensive
    b. Not as visually intrusive as the Metal Beam Guardrail
    c. Easier to circumvent than other options
    d. Difficult to gate
3. Four Foot (4') Chain Link Fence
    a. Least expensive option
    b. Not particularly visually attractive
    c. Easy to circumvent
    d. Easy to add gates

4.6 Cost Estimate

The project cost estimates are included in Appendix A.

5.0 WATER PROJECTS

5.1 Scope of this Analysis

5.1.1 The scope of the water portion of this project included the following:

1. Review the 2005 City of Fort Worth Water Master Plan to determine projects for the Lake Worth Area.
2. Receive input from City Staff on adjustments or refinements of the Water Master Plan projects to meet the goals of the Lake Worth Capital Improvements Implementation Program.
3. Meet with City of Fort Worth Wholesale Customers (City of Lake Worth) to obtain updated information on water demands, needs, and schedules.
4. Prepare phasing recommendations of the water projects to comply with hydraulic needs.
5. Prepare revised project cost estimates and maps of the proposed water projects for the CIIP.

5.2 Summary of Previous Studies

The 2005 City of Fort Worth Water Master Plan prescribed several water transmission main projects to support the aggressive growth in northwest Fort Worth. Currently, the areas around Lake Worth Reservoir are supplied by the Westside III, Northside II, and Northside III pressure planes. The Master Plan recommends a Northside II 24" water main along Jacksboro Highway from IH820 to the north to support future growth in that area. In addition, the Master Plan proposes a Northside II 36"/30" water main from the existing 48" water main near Anderson Park to provide additional supply in the future from the Eagle Mountain WTP to the area around the Lake Worth Reservoir. Finally, the Master Plan recommends a Northside II 24" transmission main loop around the west and north side of the Lake Worth Reservoir, tying in to the proposed 24" main along Jacksboro Highway.

The City Staff and FNI also met with the City of Lake Worth to discuss their water supply needs, and they indicated that the 20" Northside III project in item 2 above was their greatest need from Fort Worth.

5.3 Water Improvement Projects

5.3.1 The water system projects indicated above in Section 5.2 were captured into the proposed CIIP. However, subsequent refinements by City of Fort Worth Water Department Staff have resulted in the following adjustments to the water projects:

1. A 20" and 16" water main would be constructed along IH820 from the south, across the Lake Worth Reservoir bridge, tying into the proposed 24" waterline at Jacksboro Highway. This line would transfer the water system in the area from the Westside III Pressure Plane to the Northside II Pressure Plan.
2. Extend a 20" Northside III water main south along IH820 to serve an existing low pressure area immediately south of the City of Lake Worth, and provide capacity for a future delivery point for the City of Lake Worth.
3. Provide an 8" Northside II loop around Love Circle Park for commercial development in that area.
4. Provide a 10" Northside II waterline along Watercress Road to supply Fort Worth water customers along the north Lake edge and in the shared Fort Worth/Lakeside CCN.
5. Provide a 10" Northside II waterline along the south Lake edge between Vinca Circle Park and Marina Park to serve Fort Worth water customers in that area.

These projects are displayed on Figure 5.1.

Water Project #1

20" Northside III water main along IH820. this project, as indicated in item 2 above, will provide adequate water pressure to the existing low pressure area south of the City of Lake Worth, and provide capacity for a future delivery point for the City of Lake Worth.

Water Project #2

This project will complete a loop around the area immediately north of lake Worth Reservoir, providing adequate fire flow for the existing Fort Worth water customers in the area and supporting redevelopment at Love Circle and Casino Beach. This project includes:

- The 10" Northside II waterline along Watercress Road as indicated in Item 4 above.
- The proposed 24" Northside II water main along Confederate Park Road and along Jacksboro Highway south to the Jacksboro Bridge across Lake Worth Reservoir.

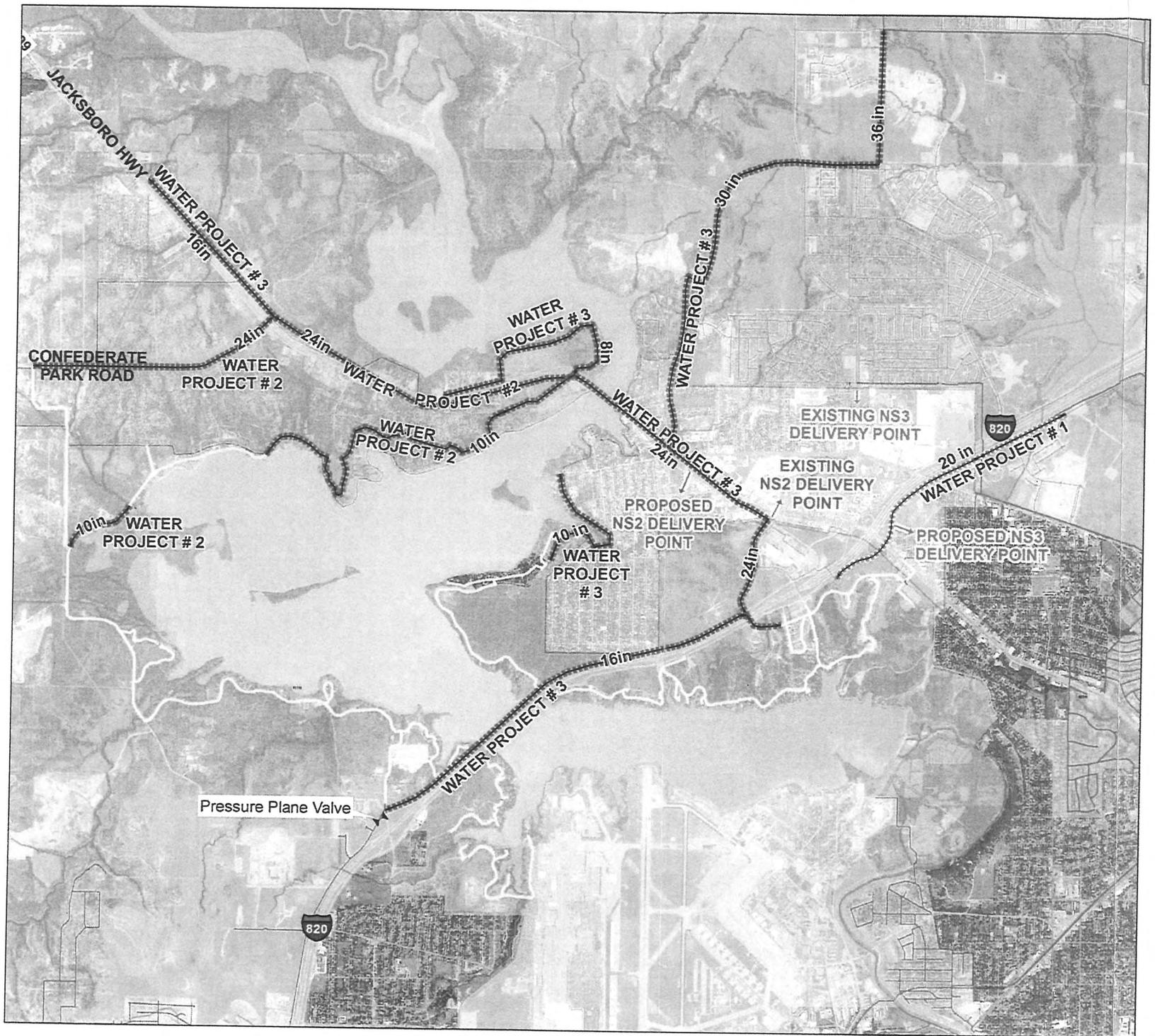
Water Project #3

This project will provide additional volume and capacity of water for future growth around the Lake Worth Reservoir. The projects included are:

- 24" Northside II water main across the Jacksboro Bridge over the Lake Worth Reservoir, 24" water main south to IH820, and 16" water main south along IH 820. This project will complete the full water main loop around the Reservoir and provide adequate fire flow and capacity for 36"/30" Northside II transmission main from the existing 48" transmission main near Anderson Park down to Jacksboro Highway. This project will provide increased water volume from the Eagle Mountain WTP to support growth around the Reservoir.
- 8" Northside II water main loop around Love Circle Park to allow commercial development.
- 16" Northside II water main along Jacksboro Highway north from Confederate Park Road to provide capacity for future growth to the north.
- 10" Northside II water main from Vinca Circle Park to Marina Park to provide adequate fire flow and capacity for existing Forth Worth water customers in that area.

5.4 Cost Estimates

The water project cost estimates are included in Appendix A.



LAKE WORTH COMPREHENSIVE CAPITAL IMPROVEMENT IMPLEMENTATION PROJECT

FORT WORTH

FIGURE 5.1 PROPOSED WATER PROJECTS

LEGEND

Future Water Lines

- NS2 Pressure Plane
- NS3 Pressure Plane
- Existing Lake Worth Lines (FTW)
- WS3 Pressure Plane
- NS3 Pressure Plane
- NS2 Pressure Plane
- Holly Pressure Plane

CCNs

- City of Azle
- City of Fort Worth
- City of Lake Worth
- Town of Lakeside

MAP PREPARED: JUNE 5, 2008

Freese and Nichols

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6.0 WASTEWATER PROJECTS

6.1 Scope of Analysis

6.1.1 The scope of this evaluation consists of

1. Reviewing the current City of Fort Worth Wastewater Master Plan and Lake Worth Wastewater Planning studies and compile projects proposed to provide service to the Lake Worth Reservoir area.
2. Evaluating the phasing of wastewater projects to meet the City's financial and development requirements.
3. Preparing a map of proposed wastewater projects.
4. Preparing and updating opinions of probable cost for the identified projects.

6.2 Summary of Previous Studies

6.2.1 The City of Fort Worth has had several studies performed for providing wastewater service to the residents living on and adjacent to Lake Worth. These studies and evaluations include

1. Lake Worth Clean Lakes Study, February 1990, Alan Plummer and Associates, Inc.
2. Lake Worth Innovative Sewer System Preliminary Design, December 1995, Alan Plummer and Associates, Inc.
3. Lake Worth South Shore Low-Pressure System – Preliminary Design, November 2002, Alan Plummer and Associates, Inc.

6.3 Town of Lake Worth Coordination

The Town of Lake Worth operates its municipal wastewater collection system in and around the lake front areas to be served by the City of Fort Worth. Lake Worth is also a wholesale wastewater customer of the City of Fort Worth, so any wastewater generated by the lake residents and potentially conveyed through the Lake Worth collection system will eventually end

up back in the Ft Worth collection system. Meetings were held with the Lake Worth staff and their consultants, Kimley-Horn, to identify any Lake Worth facilities that may be able to be shared and improved by the City of Fort Worth in order to provide service to the areas around the Lake.

6.4 Previous Wastewater Projects

Lake Worth was constructed in 1914 by the City of Fort Worth as a source of drinking water for the City. Initially the lake front property was used for camping but in 1959 the City allowed the properties to be leased and permanent residences constructed on the lots. Approximately 560 lots on the Lake were leased by the City to the residents. These lots had on-site septic systems to provide wastewater service. Over the years there was a concern over the impact of these septic systems percolating into the Lake on the overall water quality in the Lake. Septic tank design criteria has become more stringent since many of the septic systems were installed, and most of the individual septic tank systems would not be in compliance with current regulations. In addition, many of the individual septic systems had documented overflow problems in the undersized leach fields. To begin addressing these problems the City participated in a US Corps of Engineers Clean Lakes Study in 1990. In addition the City decided to offer the lots for sale to the leasees. After documentation of the potential water quality problems these septic systems posed to the overall Lake quality, the Ft Worth City Council passed an ordinance requiring residents to connect to the City's sewer system prior to having the opportunity to purchase the lot. The City constructed the initial low pressure sewer system to serve approximately 100 lots on Cahoba Drive in 1997 to demonstrate the feasibility of using a low pressure system around the lake.

In 2005 the City installed a combination low pressure / gravity system to serve approximately 210 lots along portions of the South Shore of the Lake on Heron Drive between Bomber Drive and Goodnight Circle at Silver Creek Road, and the City is currently in the design phase of providing service to approximately 110 additional lots along Woodvale Drive, Malaga Drive, and Vincia Circle located north of Loop 820 and west of the Jacksboro Highway (SH 199) on the North Shore.

6.5 Wastewater Improvements Projects

Currently there are still approximately 139 unsewered lots on the north shore of Lake Worth: Watercress Drive West and Love Circle. The Watercress Lane West portion extends along Watercress Drive west of SH 199 approximately 200 ft past Meandering Court to serve approximately 83 lots including those on Peninsula Club Circle, North Lake Drive, and Island View Drive. The Love Circle portion extends along Love Circle to Shoreline Drive northeast of the SH 199 Lake Worth Bridge to serve approximately 56 lots including those on Surfside Drive. In order to convey these wastewater flows to the Fort Worth wastewater collection system, it will be necessary to install a lift station, bore under Lake Worth near the SH 199 bridge and install a force main to connect into a City of Fort Worth lift station located near the intersection of Norris Valley Drive and John's Way. A layout of the proposed service areas is shown in Figure 6-1.

Due to the topography, the residents are generally located below the street, and because of the high cost of installing a gravity sewer system for each resident, a low pressure grinder pump system is recommended in both areas. In the Love Circle area a gravity sewer could possibly be installed in the street to take discharge from each grinder pump, but a small diameter force main is proposed for the minimal flows to be experienced and the lower cost to install the system. On Watercress low pressure force mains will be required with an intermediate lift station.

A low pressure, small diameter sewer system involves an individual grinder pump station located at each residence. The grinder pump pumps into a small diameter force main located in the street right-of-way. The grinder pump discharge line will be 2-inches in diameter based on using centrifugal pumps. The grinder pump tank will be installed in the yard at a location where all gravity lines on the lot can be routed. The septic tank(s) on each lot connected to the grinder pump system will be disconnected and filled according to the City's plumbing code. Each grinder pump will have a check valve and an isolation valve at the grinder tank and a second check valve at the property line. All solids introduced into the grinder pump station will be ground up and then pumped into the low pressure sewer force main in the street. Each time the grinder pump is activated, the contents of the grinder pump tank are removed, reducing the likelihood that the contents in the tank will become septic and create odors. Each resident will be responsible for connecting to the grinder pump tank and taking their septic tank out-of-service

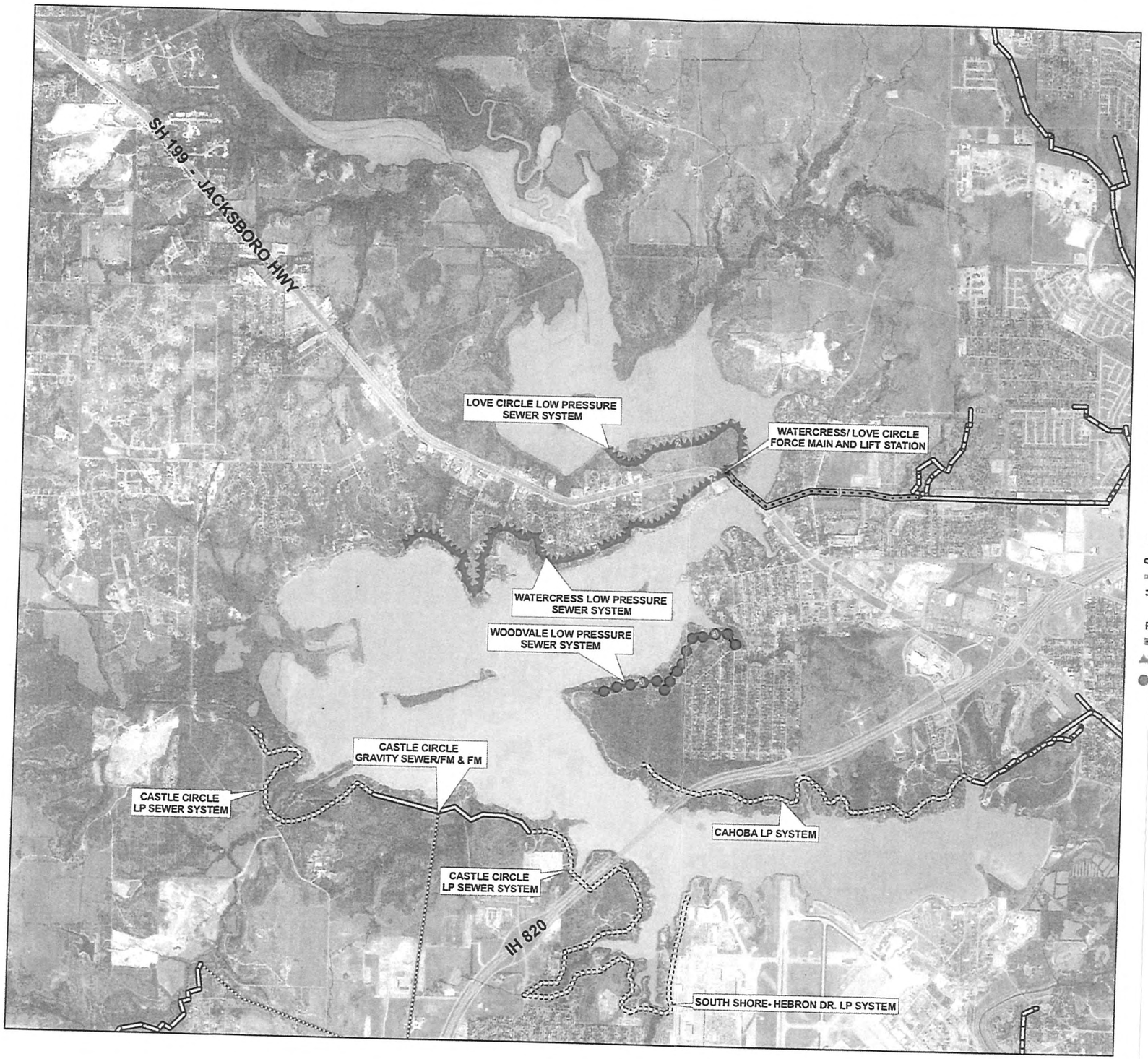
as well as providing an electrical connection for the grinder pump control panel. A typical grinder pump layout as prepared by the City of Fort Worth staff is shown in Figure 6-2.

6.5.1 Watercress Drive

Watercress Drive extends west of SH 199 along the north shore of Lake Worth approximately 4.6 miles to Silver Creek Road on the west side of the Lake. The sewer system is proposed to extend approximately 2 ½ miles west along Watercress past Meandering Court to serve approximately 83 lots. Only approximately 60 of these lots now have houses on them. The elevation varies from approximately 595 to 625 along the route which will necessitate the use of a low pressure force main system with individual grinder pumps. An intermediate duplex lift station with a capacity of approximately 50 gpm (0.072 mgd) is proposed near the intersection of Island View Drive and Watercress Drive with approximately 7,500 LF of 2 ½-inch force main to the proposed Love Circle / Watercress Lift Station at SH 199. The system would include approximately 10,500 LF of 1½ -inch low pressure force main.

6.5.2 Love Circle

Love Circle is the extension of Watercress on the east side of SH 199 and follows the north shoreline of Lake Worth approximately one mile until it intersects Shoreline Drive at Surfside Drive to serve approximately 56 lots. Only about 40 of the lots have a residence on them. The elevation generally falls from approximately 607 at Surfside to approximately 601 at SH199. By using grinder pumps the elevation of a gravity line could drop along the route to provide sufficient slope for a 6-inch gravity sewer line but a 1 ½- inch force main would be less expensive to install. Approximately 5,500 LF of 1 ½-inch low pressure force main would discharge into a new lift station located at SH 199 to receive the flows from the Love Circle and Watercress Drive systems.



LAKE WORTH COMPREHENSIVE CAPITAL IMPROVEMENT IMPLEMENTATION PROJECT

FORT WORTH

FIGURE 6.1 PROPOSED SANITARY SEWER PROJECTS

LEGEND

- Existing Gravity Main
- Existing Force Main
- Existing Low Pressure System
- PROPOSED LOVE CIRCLE LIFT STATION

PROPOSED SANITARY SEWER MAINS

- 1 - LOVE CIRCLE FM AND LIFT STATION
- 2 - WATERCRESS / LOVE CIRCLE LP SYSTEM
- 3 - WOODVALE LOW PRESSURE SYSTEM

MAP PREPARED: APRIL 10, 2008

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Feet

Type 3 Typical Installation

Grinder Pump to Force Main

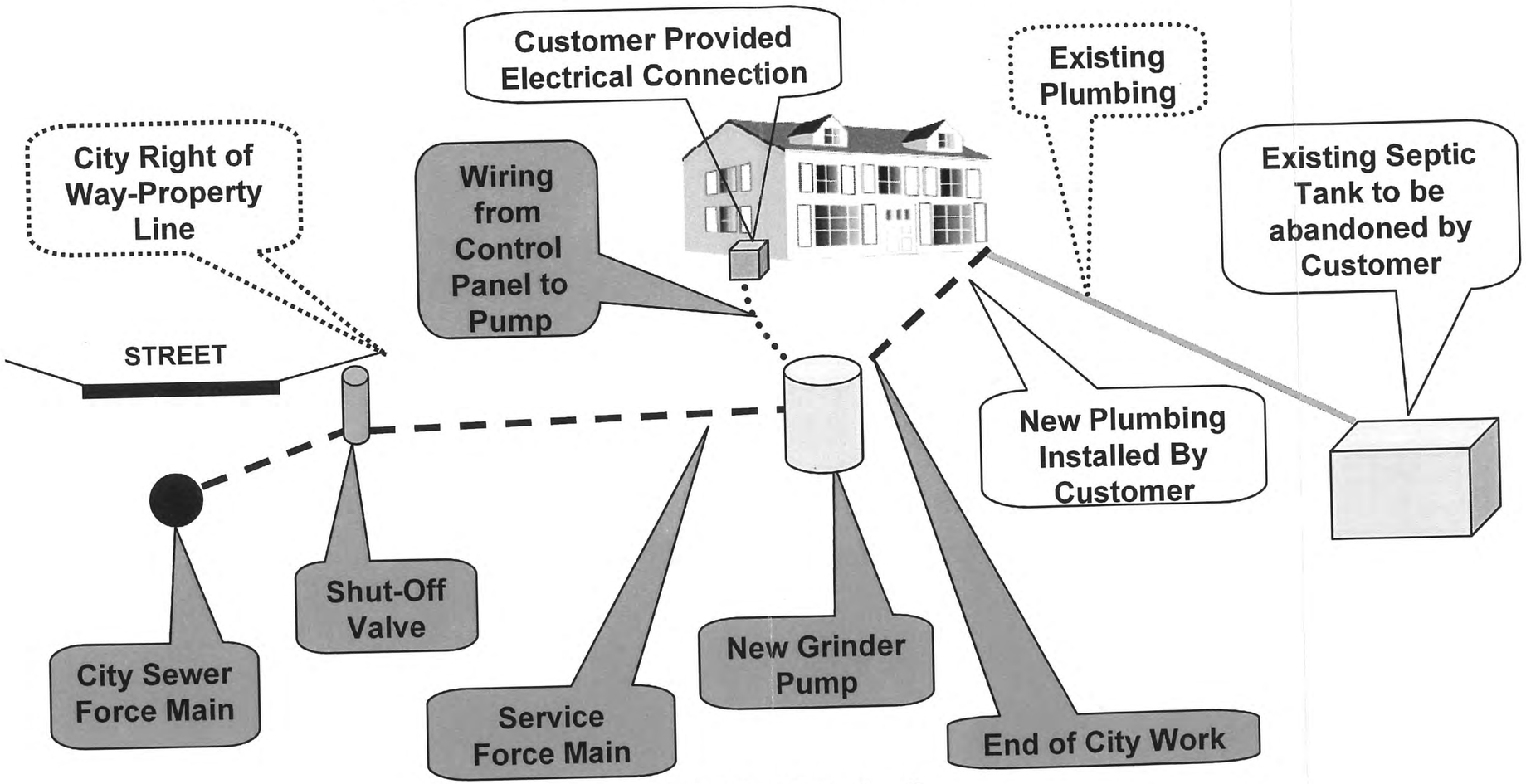


FIGURE 6-2

6.5.3 Love Circle / Watercress Force Main

In order to cross Lake Worth and discharge into a City of Fort Worth wastewater collection system, it will be necessary to construct a lift station on the north side of the SH 199 Lake Worth Bridge and bore a crossing under Lake Worth. The force main would need to be installed in a carrier pipe to protect the

force main from damage and contain any sewage leak from the force main under the Lake. The total design flows into the lift station would be approximately 80 gpm (0.115 mgd) in order to maintain a maximum of 5 fps velocity in a 3-inch force main. In order to discharge into the closest City of Fort Worth collection system the force main would cross Lake Worth about 150 ft east of SH 199, then follow Greenbriar Cresent to Lakeside Drive then to Norris Valley Drive, approximately 6,800 LF, before discharging into a City of Fort Worth Lift Station located approximately 100 ft west of the intersection of Norris Valley Drive and Johns Way, that pumps into a 12-ich cast iron force main that runs approximately 3,700 lf to a manhole on a 21-inch VC interceptor (M-279 "B") located south of Shady Dell.

6.5.4 Design Issues

During design of the individual grinder pumps for each lot, it will be imperative to identify the actual location of each existing service lateral from each home and the actual location of the septic tank in order to properly locate each grinder pump station. In addition, the location and condition of the home electrical supply panel should be evaluated to insure that the grinder pump can be powered from the main electrical supply panel should be accomplished by the home owner prior to the disconnection of the septic tank. An individual drawing of each home to be connected should be prepared and reviewed and approved by the home owner. Minimal disruption of landscaping will be important in routing the force main from the grinder pump to the street in order to maintain good public relations with the home owner. Directional drilling should be utilized wherever possible on the

lots to minimize damage to yards and driveways.

The low pressure sewer force main should be 150 psi high-density polyethylene (HDPE), should have cleanouts approximately every 500 LF, air release valves at the high points in the line, and detection tape in the pipe trench, and should have approximately 4-ft of cover to allow for any future road improvements.

A sufficient supply of spare pumps should be ordered to quickly allow the change out any malfunctioning unit by the City.

6.6 Projections of Cost / Project Phasing

Completing the Love Circle low pressure system and the Lift Station and force main across Lake Worth (Phase I) should be completed initially to provide service to the most lots for the least cost. The cost estimate for this project is included in Appendix A with the cost estimate for the Love Circle/Casino Beach Water and Sewer project. The Watercress system (Phase II) can be added after the Love Circle system and the Lift Station and force main are complete. The cost estimate for this project is included in Appendix A.

7.0 ROAD PROJECT

7.1 Scope of this Analysis

7.1.1 The scope of the road portion of this project included the following:

1. Review the City of Fort Worth Thoroughfare Plan to determine future road improvements listed in the Lake Worth Reservoir area.
2. Receive input from City Staff on which projects from the Thoroughfare Plan are candidates to include in the CIIP.
3. Prepare revised project cost estimates and maps of the proposed road projects for the CIIP.

7.2 Summary of Previous Studies

The City of Fort Worth Thoroughfare Plan shows several proposed major and minor arterials to support growth in the areas around the Lake Worth Reservoir. On the west side of the Lake Worth Reservoir, the Plan shows a major arterial extension of Silver Creek Road for growth from IH820 south of the Reservoir to Jacksboro Highway northwest of the Reservoir. It also shows a major arterial along existing Confederate Park Road, and a minor arterial existing Nine Mile Bridge Road, both north of the Reservoir.

On the east side of the Reservoir, minor arterials are shown for an extension of existing Ten Mile Bridge Road, an extension of the Cromwell Marine Creek Road, and an extension of existing Hodgkins Road.

7.3 Road Improvement Project

The Project Team determined that construction of the first 6,200 feet of the Silver Creek Road major arterial from IH820 to the northwest would best fit the goals of the Project. Interest has been expressed by developers to develop this area due to the immediate availability of water infrastructure. The road project would further attract development to this area. The Project

Team determined that it would be best not to include the rest of Silver Creek Road to the north at this time, since development would determine the alignment of the road to the north.

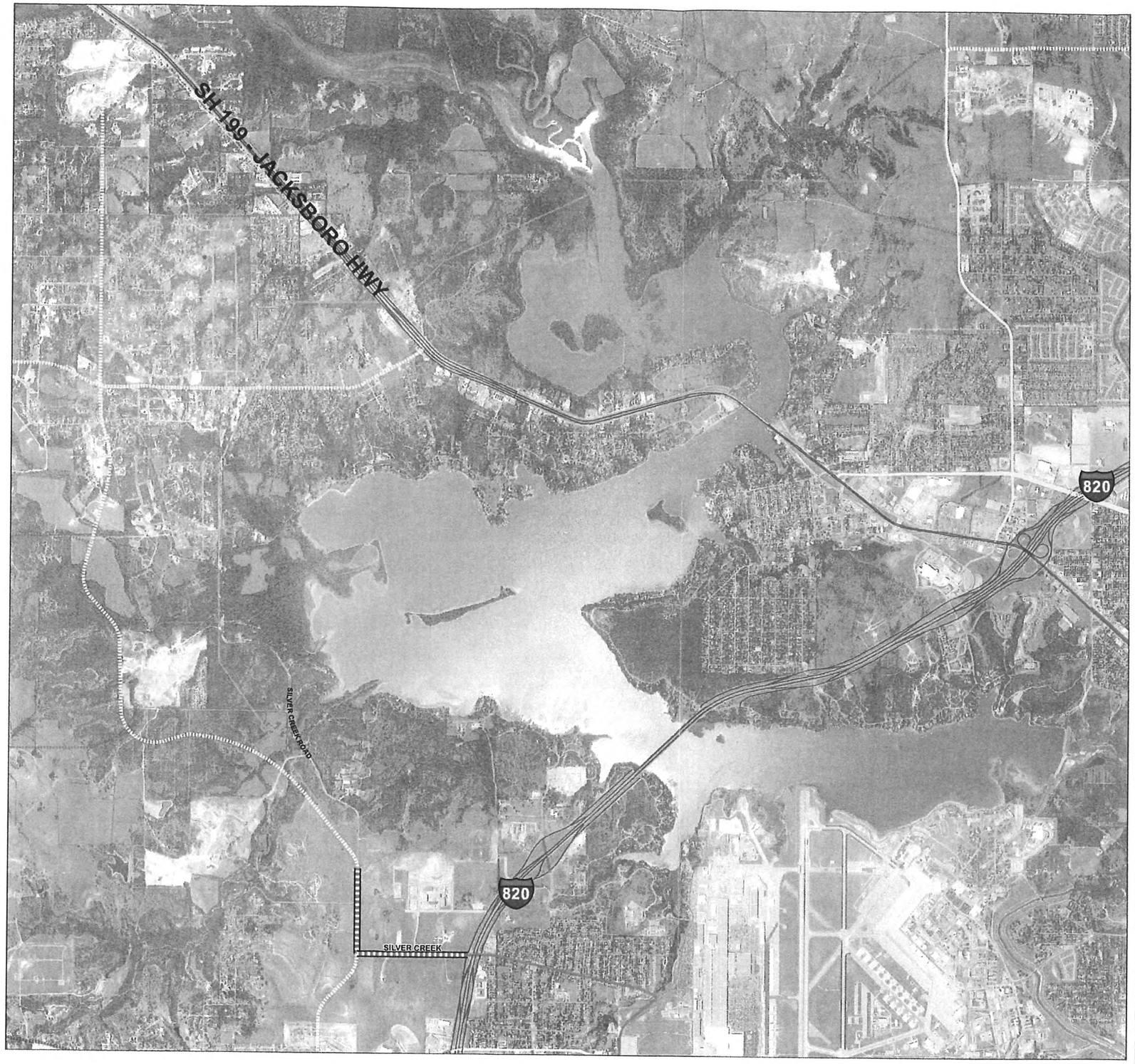
Figure 7.1 shows the City of Fort Worth's Thoroughfare Plan in the area around the Lake Worth Reservoir, and the proposed Silver Creek Road project.

7.4 Cost Estimate

The road project cost estimate is included in Appendix A.

LAKE WORTH COMPREHENSIVE CAPITAL IMPROVEMENT IMPLEMENTATION PROJECT

FIGURE 7.1
LAKE WORTH AREA THOROUGHFARE PLAN AND ROAD PROJECT



Legend

- PROPOSED SECTION OF SILVER CREEK ROAD
- MINOR ARTERIAL-EXISTING
- MINOR ARTERIAL-PROPOSED
- MAJOR ARTERIAL-EXISTING
- MAJOR ARTERIAL-PROPOSED
- PRINCIPAL ARTERIAL-EXISTING
- PRINCIPAL ARTERIAL-PROPOSED
- TOLLWAY / FREEWAY-EXISTING
- TOLLWAY / FREEWAY-PROPOSED

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[FTW5714] H:\THOROUGHFARE MAP 4-14-08.RGW

8.0 FUNDING ANALYSIS

8.1 Basis of Funding

One of the goals of this project was to determine how much of the funding for the CIIP projects could be generated by the anticipated gas well revenues in the City of Fort Worth properties at the Lake Worth Reservoir. If there were not adequate funds available from the gas well revenues, other funding mechanisms would be evaluated to make up the difference.

8.1.1 The City of Fort Worth intends to bid leases for gas production in 5 zones, as displayed in Figure 8.1:

- Marion Sansom Park
- Lake Worth Zone 1A
- Lake Worth Zone 1B
- Lake Worth Zone 2
- Lake Worth Zone 3

Each zone includes a portion under the Reservoir and a portion under land, except for Marion Sansom Park, which is all under land. Currently, gas lease bids have already been received for Marion Sansom Park and Lake Worth Zone 1A.

As indicated in Section 8.3 below, it was found that the anticipated gas well revenues would be adequate to fund to the CIIP projects, with a significant portion left over for other uses within the City.

8.2 Gas Well Revenue Policies

8.2.1 The Project Team evaluated the City Council's gas well revenue policy to determine the applicability of these revenues for funding of the CIIP projects. At the onset of this project, the Council's policy included the following elements:

1. 100% of gas well revenue under the Reservoir and under Water Department properties around the Reservoir would go to the Water Fund for water and wastewater projects.

2. 100% of gas well revenue under the Parks Department properties around the Reservoir would go to the Land Fund for parks projects.

8.2.2 As indicated in Section 8.3 below, the Project Team found that less than half of the anticipated gas well revenues from the 5 production zones would be needed for the CIIP projects, and that the rest could be used for other City needs. Therefore, the Project Team proposed, and the City Council adopted, a revised gas well revenue policy with the following elements:

1. 50% of the lease bonuses and royalties would go to the Water and Sewer CIP fund, with $117 Million of it going to the Lake Worth Capital Improvement Implementation Plan.
2. 25% of the lease bonuses and royalties would go to the Fort Worth Permanent Fund.
3. 25% of the lease bonuses and royalties would go to the Utility/Street Reconstruction CIP.

8.3 Gas Well Revenue/Cash Flow Model

8.3.1 A gas well production and revenue projection model was prepared to determine the anticipated funding available for the CIIP projects from the gas well revenues. The model was an Excel spreadsheet that displayed a timed projection based upon assumptions for well life, royalty percentage, market rate, volume of in-place gas, percent recovery of in-place gas, yearly depletion rates, and bonus amounts. The Fort Worth Department of Engineering reviewed historical data from other gas well production sites in the City, and the following assumptions were made:

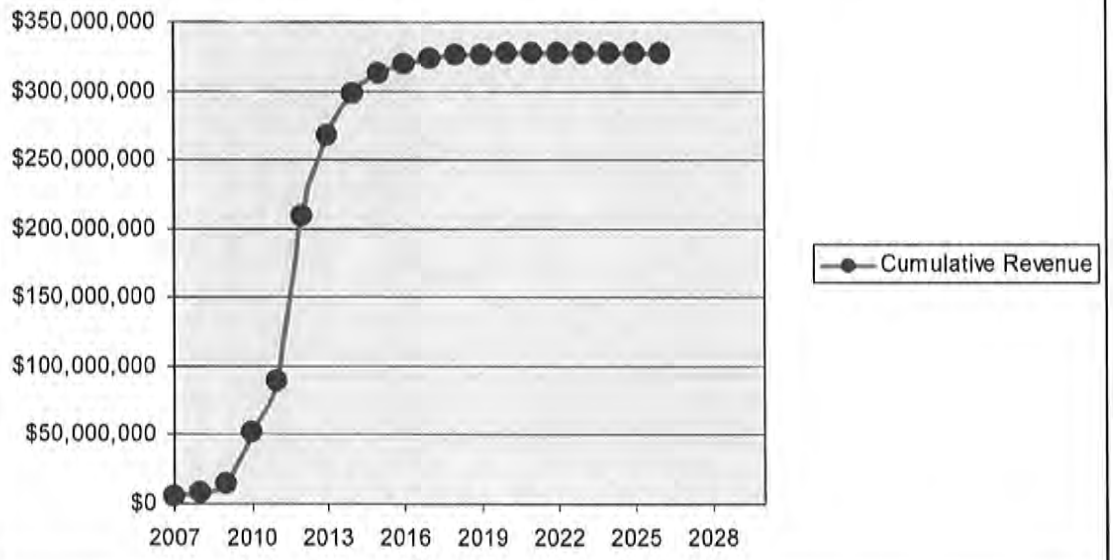
1. Well Life – 15 years
2. Royalty – 25%
3. Market Rate - $5.00 per MCF
4. In-place Gas Volume – 225,000 MCF per acre
5. In-place Gas Recovery – 20%

6. Depletion – 50% (1st, 2nd, and 3rd years)
7. Bonus - $9,000 per acre

Assumptions on the gas lease dates were also made. The Marion Sansom Park and Zone 1A have already been leased in 2007; Zone 1B assumed lease date 2008; Zone 2 assumed lease date 2009; Zone 3 assumed lease date 2010.

With these assumptions, the total anticipated gas well revenues were modeled, and are displayed in Figure 8.2. As shown, it is anticipated that approximately $327,000,000 will be generated in revenues from these lease areas.

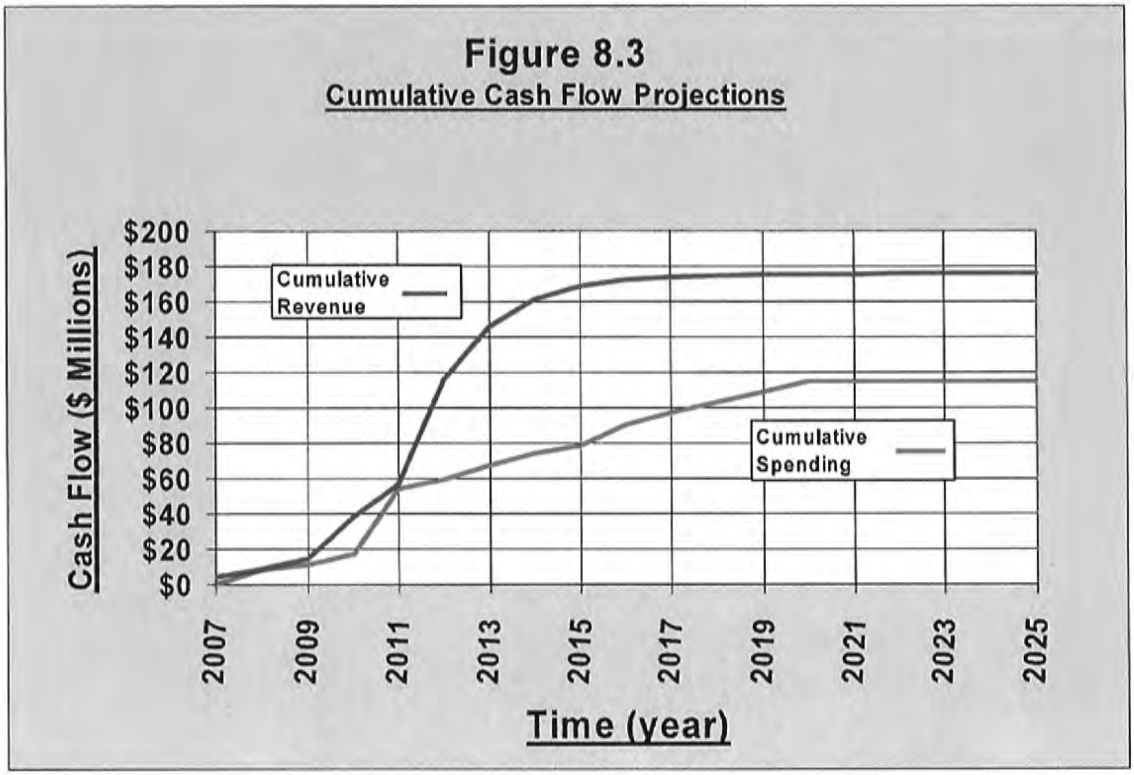
Figure 8.2
Anticipated Total Cumulative Gas Well Revenues

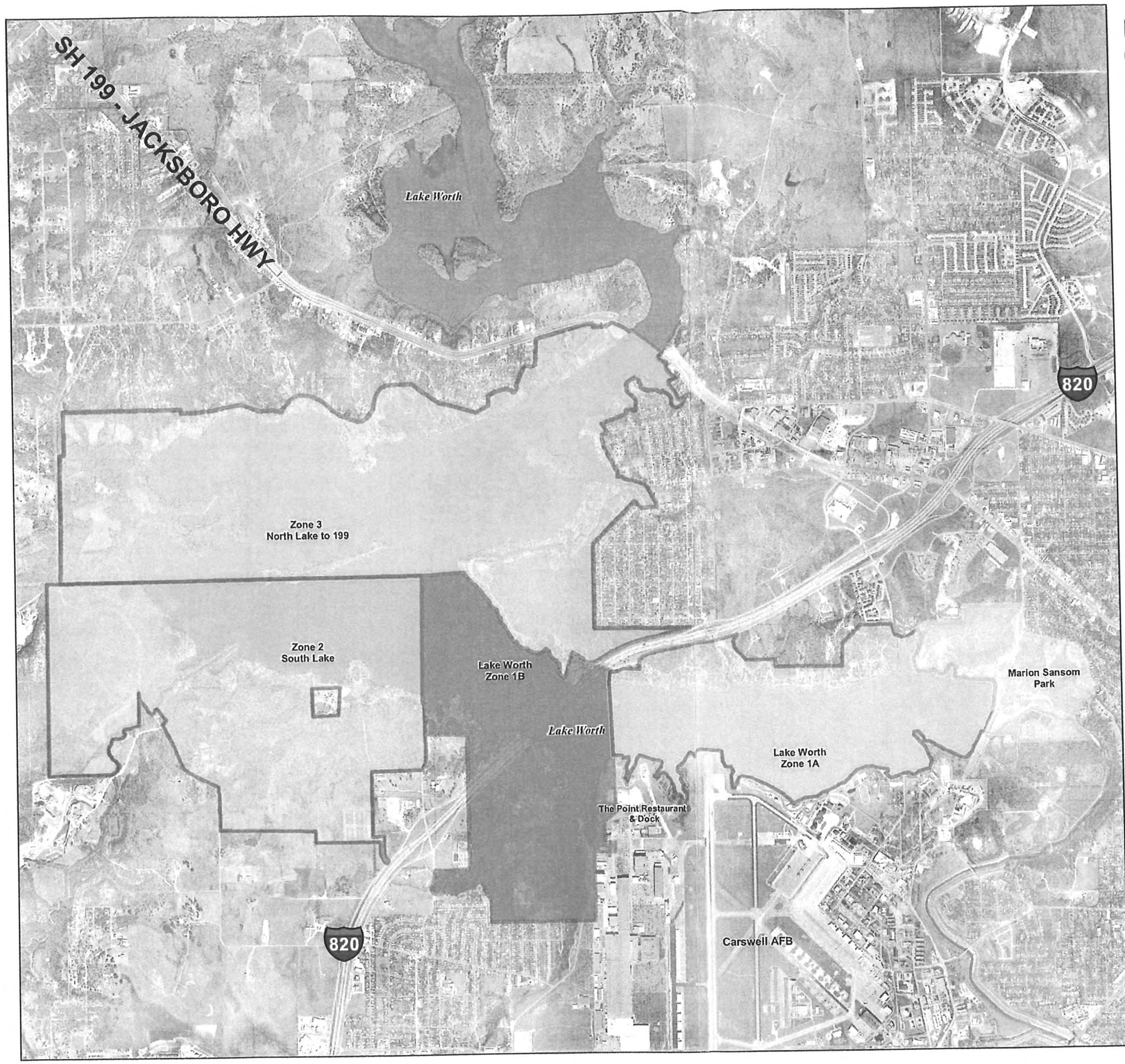


As discussed in Section 8.2, the proposed gas well revenue policy established for 50% of these revenues to be used for the Water and Sewer CIP fund and the Lake Worth Capital Improvement Implementation Plan. The 50% projected revenues were plotted with the

anticipated CIIP funding needs, showing the cash flow chart in Figure 8.3 below. This figure shows that the anticipated revenues should adequately cover the required CIIP funding needs.

Figure 8.3
Cumulative Cash Flow Projections





LAKE WORTH COMPREHENSIVE CAPITAL IMPROVEMENT IMPLEMENTATION PROJECT

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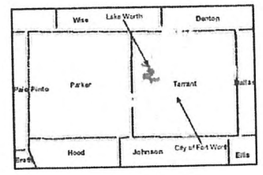
FIGURE 8.1
LAKE WORTH
GAS PRODUCTION ZONES

MAP PREPARED- APRIL 14, 2008

Legend

- Marion Sansom Park
- Lake Worth Zone 1A
- Lake Worth Zone 1B
- Zone 2 - South Lake
- Zone 3 - North Lake to 199
- Lake Worth

	Land Acreage:	Water Acreage:
Marion Sansom Park -	207.55	0.00
Lake Worth Zone 1A -	136.00	618.00
Lake Worth Zone 1B -	433.27	425.73
Zone 2 - South Lake -	1013.58	431.42
Zone 3 - North Lake to 199 -	885.09	1231.91



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PROJECT #8
LOVE CIRCLE/CASINO BEACH WATER & SEWER

Love Circle force main and lift station

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	0.25 mgd Lift Station	1	LS	$500,000.00	$500,000
2	6" Force Main	6,500	LF	$75.00	$487,500
3	Lake Worth Bore	1,000	LF	$350.00	$350,000
4	Isolation Valves	3	EA	$500.00	$1,500
5	2" Air Release Valves	12	CY	$4,000.00	$48,000
6	Construction Contingency @ 5%	1	LS	$69,350.00	$69,350
7	Lift Station Electrical/Instrumentation	1	LS	$100,000.00	$100,000
8	Mobilization @ 5%	1	LS	$77,817.50	$77,818

CONSTRUCTION SUBTOTAL	$1,634,168
ENGINEERING/TESTING/SURVEY @ 12%	$196,100
STARTUP	$10,000
10% PROJECT CONTINGENCY	$184,027
TOTAL	$2,024,294

Love Circle/Casino Beach low pressure sewer system and gravity main

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Low Pressure Sewer Force Main	3,500	LF	$50.00	$175,000
2	10" PVC Gravity main	9,500	LF	$60.00	$570,000
3	5' dia. Manholes	22	EA	$5,000.00	$110,000
4	Grinder Pumps / Connections	30	EA	$9,000.00	$270,000
5	Road Bores	30	EA	$500.00	$15,000
6	Driveway Bores	30	LF	$150.00	$4,500
7	Isolation Valves	7	EA	$250.00	$1,750
8	1" Air Release / Vaccuum Valve	2	EA	$3,000.00	$6,000
9	Construction Contingency @ 5%	1	LS	$57,612.50	$57,613
10	Mobilization @ 5%	1	LS	$60,493.13	$60,493

CONSTRUCTION SUBTOTAL	$1,270,356
ENGINEERING/TESTING/SURVEY @ 12%	$152,443
STARTUP	$5,000
10% PROJECT CONTINGENCY	$142,780
TOTAL	$1,570,578

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PROJECT #8
LOVE CIRCLE/CASINO BEACH WATER & SEWER

24" Waterline along FM 1886/Jacksboro Highway

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	24" Waterline along FM 1886	8,200	LF	$144.00	$1,180,800
2	24" Waterline along Jacksboro Highway	10,500	LF	$144.00	$1,512,000
3	38" Bored Steel Casing	1,800	LF	$475.00	$855,000
4	18" Bored Steel Casing	300	LF	$225.00	$67,500
5	Connection to Existing Waterlines	1	EA	$5,000.00	$5,000
6	24" Gate Valves	7	EA	$12,000.00	$84,000
7	16" Gate Valves	1	EA	$3,000.00	$3,000
8	10" Gate Valves	1	EA	$1,200.00	$1,200
9	8" Gate Valves	2	EA	$1,000.00	$2,000
10	2" Air Valves	7	EA	$5,000.00	$35,000
11	12" Blowoff Valves	7	EA	$5,000.00	$35,000
12	Grassing	13	AC	$3,500.00	$45,500
13	SWPPP	1	LS	$10,000.00	$10,000
14	Paving Repair	1,200	SY	$35.00	$42,000
15	Mobilization @ 5%	1	LS	$193,900.00	$193,900
	CONSTRUCTION SUBTOTAL				$4,071,900
	ENGINEERING/TESTING/SURVEY @ 12%				$488,628
	10% PROJECT CONTINGENCY				$456,053
	TOTAL				$5,016,581

10" Northside II Watercress East/Casino Beach water main

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	10" Waterline	3,500	LF	$60.00	$210,000
2	Connection to Existing Waterlines	1	EA	$5,000.00	$5,000
3	10" Gate Valves	3	EA	$1,200.00	$3,600
4	1" Air Valves	2	EA	$4,500.00	$9,000
5	Fire Hydrants	8	EA	$3,000.00	$24,000
6	Grassing	1	AC	$3,500.00	$3,500
7	SWPPP	1	LS	$2,500.00	$2,500
8	Paving Repair	2,500	SY	$35.00	$87,500
9	Mobilization @ 5%	1	LS	$17,255.00	$17,255
	CONSTRUCTION SUBTOTAL				$362,355
	ENGINEERING/TESTING/SURVEY @ 12%				$43,483
	10% PROJECT CONTINGENCY				$40,584
	TOTAL				$446,421

TOTAL PROJECT #8 **$9,057,875**

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PROJECT #9
SUNSET PARK/FREEMONS PARK BOAT RAMP IMPROVEMENTS

Boat ramp improvements at Sunset Park

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Mobilization	1	LS	$10,072.00	$10,072
2	Care of Water	1	LS	$20,144.00	$20,144
3	Erosion/Sedimentation Controls	1	LS	$5,036.00	$5,036
4	Excavation	2,000	CY	$15.00	$30,000
5	Compacted Fill	1,000	CY	$15.00	$15,000
6	Gravel Underdrain	100	CY	$90.00	$9,000
7	Reinforced Concrete Boat Ramp	175	CY	$500.00	$87,500
8	Rock Riprap & Bedding	557	CY	$100.00	$55,700
9	Parking Lot (flexible base and HMAC)	1	LS	$100,000.00	$100,000
10	Mobilization @ 5%	1	LS	$16,622.60	$16,623

CONSTRUCTION SUBTOTAL	$349,075
ENGINEERING/TESTING/SURVEY @ 15%	$52,361
10% PROJECT CONTINGENCY	$40,144
INFLATION COST (5 YEARS AT 3%)	$70,332
TOTAL	$511,912

New boat ramp at Freemons Park

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Mobilization	1	LS	$10,072.00	$10,072
2	Care of Water	1	LS	$20,144.00	$20,144
3	Erosion/Sedimentation Controls	1	LS	$5,036.00	$5,036
4	Excavation	2,000	CY	$15.00	$30,000
5	Compacted Fill	1,000	CY	$15.00	$15,000
6	Gravel Underdrain	100	CY	$90.00	$9,000
7	Reinforced Concrete Boat Ramp	175	CY	$500.00	$87,500
8	Rock Riprap & Bedding	557	CY	$100.00	$55,700
9	Parking Lot (flexible base and HMAC)	1	LS	$100,000.00	$100,000
10	Mobilization @ 5%	1	LS	$16,622.60	$16,623

CONSTRUCTION SUBTOTAL	$349,075
ENGINEERING/TESTING/SURVEY @ 15%	$52,361
10% PROJECT CONTINGENCY	$40,144
INFLATION COST (5 YEARS AT 3%)	$70,332
TOTAL	$511,912

TOTAL PROJECT #9 **$1,023,823**

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PROJECT #10
PHASE II TRAIL

Primary bike and jogging trails

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Prepare ROW (clearing and grubbing)	657,378	SY	$1.35	$887,460
2	Underbrush Clearing	262,951	SY	$1.25	$328,689
3	Excavation of ROW	9,130	CY	$5.50	$50,216
4	Mass Grading	87,651	CY	$12.00	$1,051,806
5	Reinforced concrete sidewalk	51,875	SY	$45.00	$2,334,353
6	Bermuda Hydromulch Seeding	1,503,500	SF	$0.18	$270,630
7	Vegetative Watering	1	LS	$109,004.48	$109,004
8	Stone Retaining Walls (ERWS)	5,450	FF	$25.00	$136,256
9	Trail Signage	99	EA	$350.00	$34,527
10	Kiosks	5	EA	$5,000.00	$27,251
11	Benches	4	EA	$1,500.00	$5,723
12	Trash Receptacles	5	EA	$1,000.00	$5,450
13	Concrete Pad	818	SF	$4.50	$3,679
14	Pedestrian Bridges	218	LF	$1,800.00	$392,416
15	Bridge Abutments	2	PR	$30,000.00	$65,403
16	Trail Monument Distance Markers	15	EA	$1,275.00	$18,762
17	Mobilization @ 5%	1	LS	$286,081.26	$286,081

CONSTRUCTION SUBTOTAL	$6,007,706
ENGINEERING/TESTING/SURVEY @ 15%	$901,156
10% PROJECT CONTINGENCY	$690,886
INFLATION COST (6 YEARS AT 3%)	$1,267,922
TOTAL	$8,867,670

Trail Heads

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Trail Heads	7	EA	$20,000.00	$140,000
2	Security Lighting at Trail Head	1	LS	$100,000.00	$100,000
3	Concrete Access Roads to Parks - 25' Wide Concrete Road	5,556	SY	$35.00	$194,444
4	Select fill subgrade	926	CY	$22.50	$20,833
5	Grading and Excavation	1,852	CY	$18.00	$33,333
6	Bermuda Hydromulch Seeding	40,000	SF	$0.18	$7,200
7	Mobilization @ 5%	1	LS	$24,790.56	$24,791

CONSTRUCTION SUBTOTAL	$520,602
ENGINEERING/TESTING/SURVEY @ 15%	$78,090
10% PROJECT CONTINGENCY	$59,869
INFLATION COST (6 YEARS AT 3%)	$109,873
TOTAL	$768,434

TOTAL PROJECT #10 **$9,636,104**

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Conceptual Estimates of Probable Project Cost

PROJECT #11
WATERCRESS LOW PRESSURE SEWER SYSTEM

Watercress West low pressure sewer system

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Low Pressure Sewer Force Main	12,000	LF	$50.00	$600,000
2	Grinder Pumps / Connections	90	EA	$9,000.00	$810,000
3	100,000 gpd Intermediate Lift Station	1	LS	$400,000.00	$400,000
4	6" Force Main	7,500	LF	$75.00	$562,500
5	Road Bores	90	EA	$500.00	$45,000
6	Driveway Bores	90	LF	$150.00	$13,500
7	Isolation Valves	24	EA	$250.00	$6,000
8	1" Air Release / Vaccuum Valve	5	EA	$3,000.00	$15,000
9	Lift Station Electrical/Instrumentation	1	LS	$242,000.00	$242,000
10	Mobilization @ 5%	1	LS	$134,700.00	$134,700

CONSTRUCTION SUBTOTAL	$2,828,700
ENGINEERING/TESTING/SURVEY @ 12%	$339,444
STARTUP	$10,000
10% PROJECT CONTINGENCY	$317,814
INFLATION COST (8 YEARS AT 3%)	$932,617
TOTAL	$4,428,576

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Conceptual Estimates of Probable Project Cost

PROJECT #12
MAINTENANCE FUND

$9,500,000 Maintenance Fund

	Maintenance Fund Investment Amount				$9,500,000
	Assumed Simple Interest Rate (annual)				4%
	Maintenance Cash Flow Available per year				$380,000

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Conceptual Estimates of Probable Project Cost

PROJECT #13
NORTHSIDE II WATER IMPROVEMENTS

10" Northside II Watercress West water main

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	10" Waterline	13,500	LF	$60.00	$810,000
2	Connection to Existing Waterlines	3	EA	$5,000.00	$15,000
3	10" Gate Valves	7	EA	$1,200.00	$8,400
4	1" Air Valves	3	EA	$4,500.00	$13,500
5	Fire Hydrants	28	EA	$3,000.00	$84,000
6	Grassing	3	AC	$3,500.00	$10,500
7	SWPPP	1	LS	$5,000.00	$5,000
8	Paving Repair	9,000	SY	$35.00	$315,000
9	Mobilization @ 5%	1	LS	$63,070.00	$63,070

CONSTRUCTION SUBTOTAL	$1,324,470
ENGINEERING/TESTING/SURVEY @ 12%	$158,936
10% PROJECT CONTINGENCY	$148,341
INFLATION COST (10 YEARS AT 3%)	$561,185
TOTAL	$2,192,932

24" and 8" water line along SH 199

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	24" Waterline attached to Hwy 199 Bridge	2,000	LF	$300.00	$600,000
2	24" Waterline (trenched)	2,000	LF	$144.00	$288,000
3	8" Waterline	8,500	LF	$48.00	$408,000
4	38" Bored Steel Casing	300	LF	$475.00	$142,500
5	16" Bored Steel Casing	300	LF	$200.00	$60,000
6	Connection to Waterlines	3	EA	$5,000.00	$15,000
7	2" Air Valves	3	EA	$5,000.00	$15,000
8	12" Blowoff Valves	1	EA	$5,000.00	$5,000
9	Fire Hydrants	18	EA	$3,000.00	$54,000
10	Grassing	8	AC	$3,500.00	$28,000
11	SWPPP	1	LS	$7,500.00	$7,500
12	Paving Repair	800	SY	$35.00	$28,000
13	Mobilization @ 5%	1	LS	$82,550.00	$82,550

CONSTRUCTION SUBTOTAL	$1,733,550
ENGINEERING/TESTING/SURVEY @ 12%	$208,026
10% PROJECT CONTINGENCY	$194,158
INFLATION COST (10 YEARS AT 3%)	$734,514
TOTAL	$2,870,247

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PROJECT #13
NORTHSIDE II WATER IMPROVEMENTS

Northside II 30" supply line

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	36" Waterline	6,500	LF	$216.00	$1,404,000
2	30" Waterline	12,500	LF	$180.00	$2,250,000
3	54" Bored Steel Casing	200	LF	$675.00	$135,000
4	48" Bored Steel Casing	300	LF	$600.00	$180,000
5	Connection to Waterlines	2	EA	$10,000.00	$20,000
6	36" Gate Valves	3	EA	$25,000.00	$75,000
7	30" Gate Valves	3	EA	$20,000.00	$60,000
8	3" Air Valves	4	EA	$6,000.00	$24,000
9	12" Blowoff Valves	4	EA	$5,000.00	$20,000
10	Grassing	14	AC	$3,500.00	$49,000
11	SWPPP	1	LS	$10,000.00	$10,000
12	Paving Repair	1,000	SY	$35.00	$35,000
13	Mobilization @ 5%	1	LS	$213,100.00	$213,100
14	30' Permanent Easement	375,000	SF	$4.00	$1,500,000
15	40' Temporary Easement	760,000	SF	$0.40	$304,000

CONSTRUCTION SUBTOTAL	$6,279,100
ENGINEERING/TESTING/SURVEY @ 12%	$753,492
10% PROJECT CONTINGENCY	$703,259
INFLATION COST (10 YEARS AT 3%)	$2,660,486
TOTAL	$10,396,337

24" and 16" Northside II water main along IH820

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	24" Waterline	7,500	LF	$144.00	$1,080,000
2	16" Waterline	12,000	LF	$96.00	$1,152,000
3	16" Wateline attached to IH820 bridge	3,000	LF	$250.00	$750,000
4	38" Bored Steel Casing	800	LF	$475.00	$380,000
5	30" Bored Steel Casing	800	LF	$375.00	$300,000
6	24" Gate Valves	2	EA	$12,000.00	$24,000
7	16" Gate Valves	6	EA	$3,000.00	$18,000
8	2" Air Valves	6	EA	$5,000.00	$30,000
9	12" Blowoff Valves	2	EA	$5,000.00	$10,000
10	10" Blowoff Valves	4	EA	$4,500.00	$18,000
11	Grassing	14	AC	$3,500.00	$49,000
12	SWPPP	1	LS	$10,000.00	$10,000
13	Paving Repair	1,000	SY	$35.00	$35,000
14	Mobilization @ 5%	1	LS	$192,800.00	$192,800
15	30' Permanent Easement	585,000	SF	$4.00	$2,340,000
16	40' Temporary Easement	780,000	SF	$0.40	$312,000

CONSTRUCTION SUBTOTAL	$6,700,800
ENGINEERING/TESTING/SURVEY @ 12%	$804,096
10% PROJECT CONTINGENCY	$750,490
INFLATION COST (10 YEARS AT 3%)	$2,839,162
TOTAL	$11,094,548

TOTAL PROJECT #13	**$26,554,064**

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PROJECT #14
SOUTHWEST SILVER CREEK ROAD EXPANSION

Expansion of southwest section of Silver Creek Road

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Road Improvements	6,200	LF	$900.00	$5,580,000.00

SUBTOTAL	$5,580,000
ENGINEERING/TESTING/SURVEY @ 10%	$558,000
10% PROJECT CONTINGENCY	$613,800
INFLATION COST (10 YEARS AT 3%)	$2,322,055
TOTAL	$9,073,855

Appendix A

Cost Estimates

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PROJECT #1
DREDGING

Dredging area between Casino Beach and Highway 199

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Dredging - Hydraulic	100,000	CY	$3.00	$300,000
2	Disposal - Dredged Material	100,000	CY	$4.50	$450,000
3	Mobilization @ 5%	1	LS	$37,500.00	$37,500

CONSTRUCTION SUBTOTAL	$787,500
ENGINEERING/TESTING/SURVEY @ 10%	$78,750
INFLATION COST (3 YEARS AT 3%)	$80,325
TOTAL	$946,575

Dredging area around Willow Island

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Dredging - Hydraulic	1,000,000	CY	$3.00	$3,000,000
2	Disposal - Dredged Material	1,000,000	CY	$4.50	$4,500,000
3	Mobilization @ 5%	1	LS	$375,000.00	$375,000

CONSTRUCTION SUBTOTAL	$7,875,000
ENGINEERING/TESTING/SURVEY @ 10%	$787,500
INFLATION COST (3 YEARS AT 3%)	$803,248
TOTAL	$9,465,748

Dredging area northwest of Goat Island

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Dredging - Hydraulic	100,000	CY	$3.00	$300,000
2	Disposal - Dredged Material	100,000	CY	$4.50	$450,000
3	Mobilization @ 5%	1	LS	$37,500.00	$37,500

CONSTRUCTION SUBTOTAL	$787,500
ENGINEERING/TESTING/SURVEY @ 10%	$78,750
INFLATION COST (3 YEARS AT 3%)	$80,325
TOTAL	$946,575

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Conceptual Estimates of Probable Project Cost

PROJECT #1
DREDGING

Dredging area between Casino Beach and Highway 199

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Dredging - Hydraulic	100,000	CY	$3.00	$300,000
2	Disposnl - Dredged Material	100,000	CY	$4.50	$450,000
3	Mobilization @ 5%	1	LS	$37,500.00	$37,500

CONSTRUCTION SUBTOTAL	$787,500
ENGINEERING/TESTING/SURVEY @ 10%	$78,750
INFLATION COST (3 YEARS AT 3%)	$80,325
TOTAL	$946,575

Dredging area around Willow Island

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Dredging - Hydraulic	1,000,000	CY	$3.00	$3,000,000
2	Disposal - Dredged Material	1,000,000	CY	$4.50	$4,500,000
3	Mobilization @ 5%	1	LS	$375,000.00	$375,000

CONSTRUCTION SUBTOTAL	$7,875,000
ENGINEERING/TESTING/SURVEY @ 10%	$787,500
INFLATION COST (3 YEARS AT 3%)	$803,248
TOTAL	$9,465,748

Dredging area northwest of Goat Island

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Dredging - Hydraulic	100,000	CY	$3.00	$300,000
2	Disposal - Dredged Material	100,000	CY	$4.50	$450,000
3	Mobilization @ 5%	1	LS	$37,500.00	$37,500

CONSTRUCTION SUBTOTAL	$787,500
ENGINEERING/TESTING/SURVEY @ 10%	$78,750
INFLATION COST (3 YEARS AT 3%)	$80,325
TOTAL	$946,575

Dredging area south and west of Goat Island

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Dredging - Hydraulic	1,600,000	CY	$3.00	$4,800,000
2	Disposal - Dredged Material	1,600,000	CY	$4.50	$7,200,000
3	Mobilization @ 5%	1	LS	$600,000.00	$600,000

CONSTRUCTION SUBTOTAL	$12,600,000
ENGINEERING/TESTING/SURVEY @ 10%	$1,260,000
INFLATION COST (3 YEARS AT 3%)	$1,285,196
TOTAL	$15,145,196

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PROJECT #1
DREDGING

Dredging area east of IH820 along north shore

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Dredging - Hydraulic	250,000	CY	$3.00	$750,000
2	Disposal - Dredged Material	250,000	CY	$4.50	$1,125,000
3	Mobilization @ 5%	1	LS	$93,750.00	$93,750

CONSTRUCTION SUBTOTAL	$1,968,750
ENGINEERING/TESTING/SURVEY @ 10%	$196,875
INFLATION COST (3 YEARS AT 3%)	$200,812
TOTAL	$2,366,437

Dredging boat lanes above Highway 199

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Dredging - Hydraulic	93,000	CY	$3.00	$279,000
2	Disposal - Dredged Material	93,000	CY	$4.50	$418,500
3	Mobilization @ 5%	1	LS	$34,875.00	$34,875

CONSTRUCTION SUBTOTAL	$732,375
ENGINEERING/TESTING/SURVEY @ 10%	$73,238
INFLATION COST (3 YEARS AT 3%)	$74,702
TOTAL	$880,315

Dredging around raw water intake at dam

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Dredging - Hydraulic	101,000	CY	$3.00	$303,000
2	Disposal - Dredged Material	101,000	CY	$4.50	$454,500
3	Mobilization @ 5%	1	LS	$37,875.00	$37,875

CONSTRUCTION SUBTOTAL	$795,375
ENGINEERING/TESTING/SURVEY @ 10%	$79,538
INFLATION COST (3 YEARS AT 3%)	$81,128
TOTAL	$956,041

TOTAL PROJECT #1	**$30,706,885**

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PROJECT #2
ARROW S/CASINO BEACH BOAT RAMP IMPROVEMENTS

Boat ramp repairs at Arrow S Park

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Mobilization	1	LS	$5,069.00	$5,069
2	Care of Water	1	LS	$10,138.00	$10,138
3	Erosion/Sedimentation Controls	1	LS	$2,534.50	$2,535
4	Gravel Underdrain	100	CY	$90.00	$9,000
5	Reinforced Concrete Boat Ramp	175	CY	$500.00	$87,500
6	Rock Riprap & Bedding	557	CY	$100.00	$55,700
7	Parking Lot (flexible base and HMAC)	1	LS	$50,000.00	$50,000
8	Mobilization @ 5%	1	LS	$10,997.08	$10,997

CONSTRUCTION SUBTOTAL	$230,939
ENGINEERING/TESTING/SURVEY @ 15%	$34,641
10% PROJECT CONTINGENCY	$26,558
TOTAL	$292,137

Boat ramp improvements at Casino Beach

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Mobilization	1	LS	$5,069.00	$5,069
2	Care of Water	1	LS	$10,138.00	$10,138
3	Erosion/Sedimentation Controls	1	LS	$2,534.50	$2,535
4	Gravel Underdrain	100	CY	$90.00	$9,000
5	Reinforced Concrete Boat Ramp	175	CY	$500.00	$87,500
6	Rock Riprap & Bedding	557	CY	$100.00	$55,700
7	Parking Lot (flexible base and HMAC)	1	LS	$50,000.00	$50,000
8	Mobilization @ 5%	1	LS	$10,997.08	$10,997

CONSTRUCTION SUBTOTAL	$230,939
ENGINEERING/TESTING/SURVEY @ 15%	$34,641
10% PROJECT CONTINGENCY	$26,558
INFLATION COST (5 YEARS AT 3%)	$46,530
TOTAL	$338,667

TOTAL PROJECT #2 **$630,804**

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Conceptual Estimates of Probable Project Cost

PROJECT #3
PHASE I TRAIL AND LAKE WORTH PARKS

Connection to existing Trinity Trail system

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Prepare ROW (clearing and grubbing)	80,000	SY	$1.35	$108,000
2	Underbrush Clearing	32,000	SY	$1.25	$40,000
3	Excavation of ROW	1,111	CY	$5.50	$6,111
4	Mass Grading	10,667	CY	$12.00	$128,000
5	Reinforced concrete sidewalk	6,667	SY	$45.00	$300,000
6	Bermuda Hydromulch Seeding	180,000	SF	$0.18	$32,400
7	Vegetative Watering	1	LS	$50,000.00	$50,000
8	Stone Retaining Walls (ERWS)	5,000	FF	$25.00	$125,000
9	Trail Signage	12	EA	$350.00	$4,200
10	Kiosks	3	EA	$5,000.00	$15,000
11	Benches	2	EA	$1,500.00	$3,000
12	Trash Receptacles	2	EA	$1,000.00	$2,000
13	Concrete Pad	500	SF	$4.50	$2,250
14	Pedestrian Bridges - (1) 100' estimated	100	LF	$1,800.00	$180,000
15	Bridge Abutments (2 per Bridge)	1	PR	$30,000.00	$30,000
16	Trail Monument Distance Markers	3	EA	$1,275.00	$3,825
17	Mobilization @ 5%	1	LS	$51,489.31	$51,489

CONSTRUCTION SUBTOTAL	$1,081,275
ENGINEERING/TESTING/SURVEY @ 15%	$162,191
10% PROJECT CONTINGENCY	$124,347
INFLATION COST (6 YEARS AT 3%)	$228,202
TOTAL	$1,596,016

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PROJECT #3
PHASE I TRAIL AND LAKE WORTH PARKS

Primary bike and jogging trails - Phase 1

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
1	Prepare ROW (clearing and grubbing)	548,770	SY	$1.35	$740,840
2	Underbrush Clearing	219,508	SY	$1.25	$274,385
3	Excavation of ROW	7,622	CY	$5.50	$41,920
4	Mass Grading	73,169	CY	$12.00	$878,034
5	Reinforced concrete sidewalk	43,304	SY	$45.00	$1,948,687
6	Bermuda Hydromulch Seeding	1,204,450	SF	$0.18	$216,801
7	Vegetative Watering	1	LS	$90,995.52	$90,996
8	Stone Retaining Walls (ERWS)	4,550	FF	$25.00	$113,744
9	Trail Signage	82	EA	$350.00	$28,823
10	Kiosks	5	EA	$5,000.00	$22,749
11	Benches	3	EA	$1,500.00	$4,777
12	Trash Receptacles	5	EA	$1,000.00	$4,550
13	Concrete Pad	682	SF	$4.50	$3,071
14	Pedestrian Bridges	182	LF	$1,800.00	$327,584
15	Bridge Abutments	2	PR	$30,000.00	$54,597
16	HWY 199 Crossing	1	LS	$10,000.00	$10,000
17	Trail Monument Distance Markers	12	EA	$1,275.00	$15,663
18	Mobilization @ 5%	1	LS	$238,861.02	$238,861

CONSTRUCTION SUBTOTAL	$5,016,081
ENGINEERING/TESTING/SURVEY @ 15%	$752,412
10% PROJECT CONTINGENCY	$576,849
INFLATION COST (6 YEARS AT 3%)	$1,058,640
TOTAL	$7,403,983

TOTAL PROJECT #3 **$8,999,999**

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PROJECT #4
COMANCHE CREEK DRAINAGE CHANNEL

Cost is approximately $1,300,000 per City of Lake Worth

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PROJECT #5
WOODVALE LOW PRESSURE SEWER SYSTEM

Cost is approximately $2,200,000 per design consultant for City of Fort Worth

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PROJECT #6
20" NORTHSIDE III WATER MAIN ALONG IH820

Cost is approximately $2,200,000 per design consultant for City of Fort Worth

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Conceptual Estimates of Probable Project Cost

PROJECT #7
ACCESS CONTROL IMPROVEMENTS

Access Control/Cable Fencing

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	PRICE	AMOUNT
	Cable Sections				
1	A1	4,224	LF	$20.00	$84,480
2	A2	10,560	LF	$20.00	$211,200
3	A3	6,336	LF	$20.00	$126,720
4	A4	14,256	LF	$20.00	$285,120
5	A5	6,336	LF	$20.00	$126,720
6	A6	3,696	LF	$20.00	$73,920
7	A7	1,584	LF	$20.00	$31,680
8	Gates (20' wide vehicular access)	47	EA	$1,000.00	$47,000
9	Mobilization @ 5%	1	LS	$49,342.00	$49,342

CONSTRUCTION SUBTOTAL	$1,036,182
ENGINEERING/TESTING/SURVEY @ 12%	$124,342
10% PROJECT CONTINGENCY	$116,052
INFLATION COST (10 YEARS AT 3%)	$439,035
TOTAL	$1,715,612