CDM

Trinity River Vision

Evaluation of the Trinity River Floodway Channel Realignment

April 29, 2003

Final Report

Trinity River Vision Central City Channel Realignment Feasibility Study

April 2003

Prepared for:

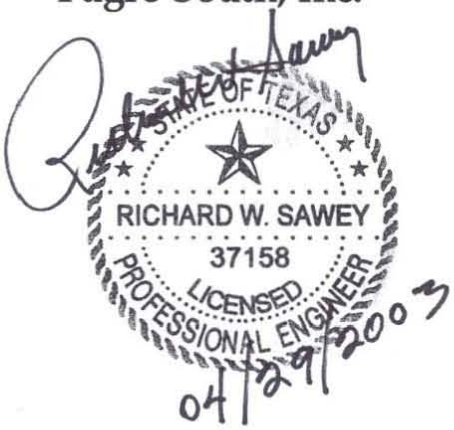
Tarrant Regional Water District

Texas Water Development Board

Prepared by:

CDM

In association with
Turner Collie and Braden, Inc.
Freese and Nichols
Zachry Construction Corp.
Fugro South, Inc.



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Study Summary

S.1 Background

Tarrant Regional Water District (TRWD) has participated with the North Central Texas Council of Governments, the U.S. Army Corps of Engineers (USACE) and the City of Fort Worth in addressing flooding, recreation, and water quality challenges for portions of the Upper Trinity River watershed since 1987. Presented below on **Figure S-1** is a map of the Trinity River Vision Master Plan river segment map with the Trinity River and its tributaries shown.

In 2000, the TRWD Board of Directors authorized participation in a Project Study Plan (PSP) titled "Multi-Purpose Reevaluation of the Clear and West Forks of Trinity River Project Study Plan". This PSP is a component of the USACE Upper Trinity River Feasibility Study. PSP's allow feasibility study co-sponsors to pursue individually the evaluation of flood damage reduction concepts.

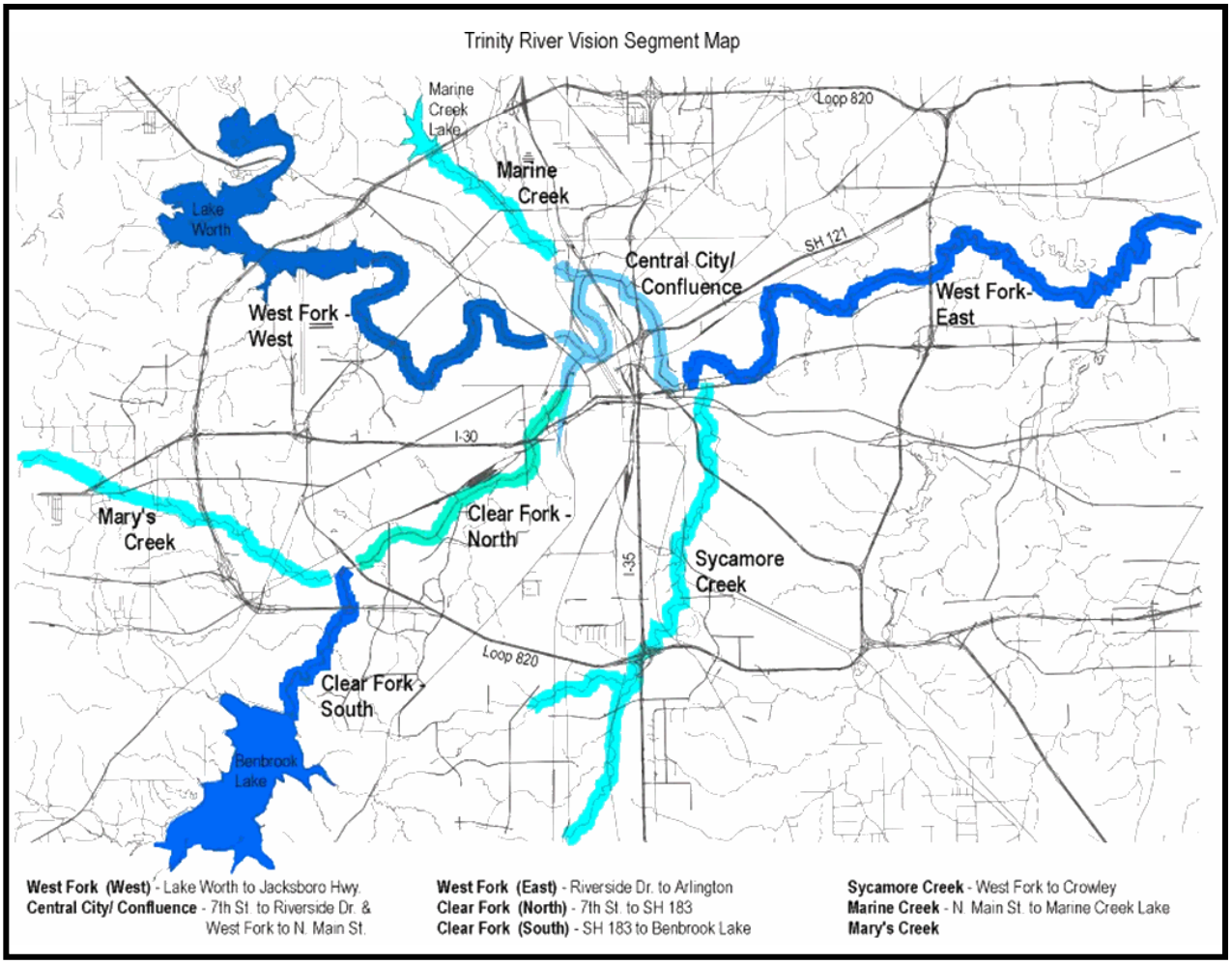


Figure S-1
Map of the Trinity River and Tributaries

Stakeholders recommended to TRWD and the USACE a modification to the PSP scope of work to include a detailed evaluation of flood channel improvements in the "Central City '' segment of the Clear Fork and West Fork of the Trinity River in late 2001. The tasks for the project relates to the feasibility of long-term measures to:

- reduce flood damages,
- improve water quality,
- provide stream bank protection and erosion control, and
- implement a framework to protect the river and the adjacent lands.

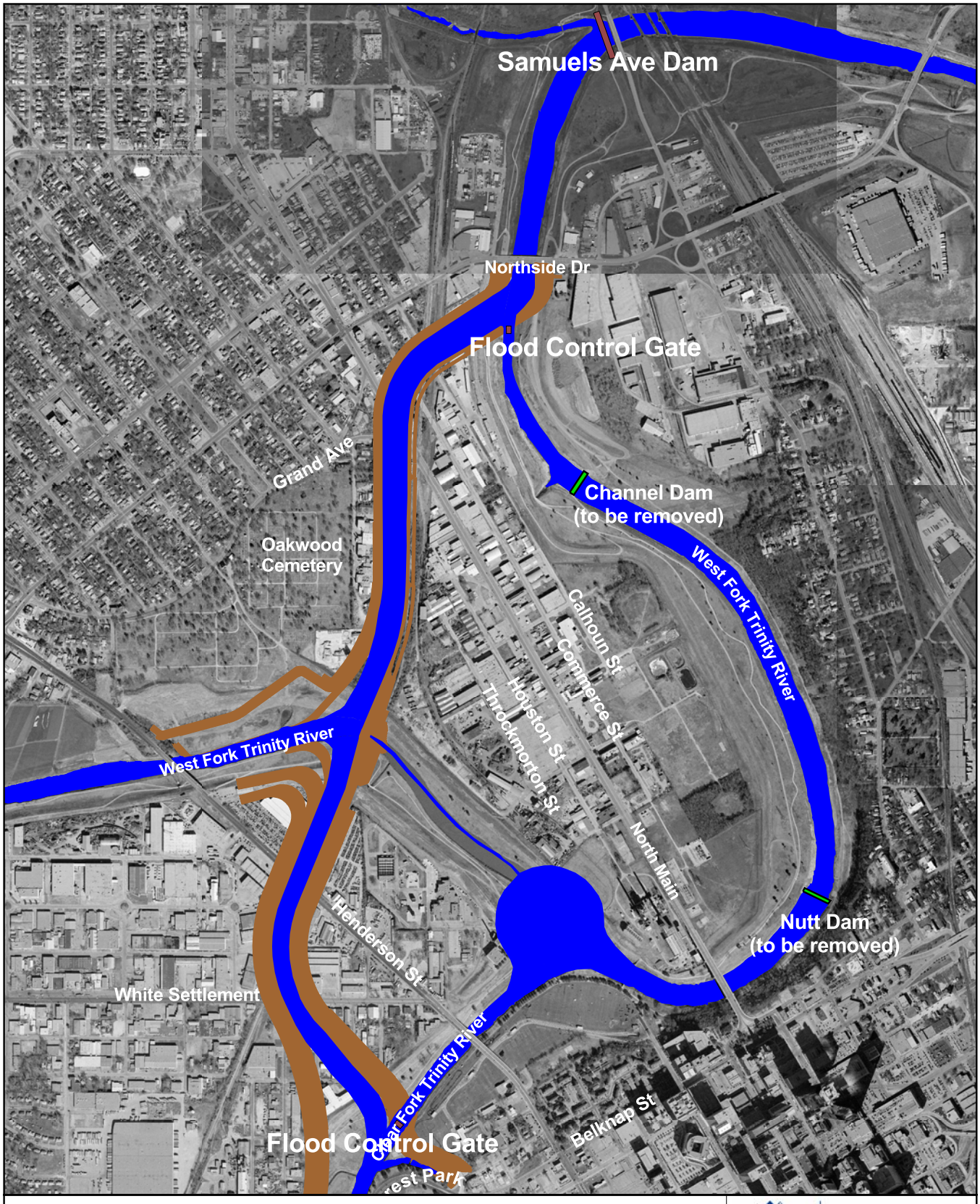
This report addresses the technical feasibility and financial obligation of creating a bypass channel to handle flood flows and to create a quiescent river segment on the Trinity adjacent to downtown Fort Worth. The quiescent river segment would begin at the confluence of the Clear Fork and the West Fork of the Trinity River to just upstream (south) of the Northside Drive Bridge. This area is within the Central City river segment of the Trinity River Vision Master Plan.

S.2 Bypass Channel Alternatives

Several flood relief bypass channel configurations were investigated to meet current flood protection requirements and to address the improvement of drainage of the interior ponding areas, or sumps, located behind the levees. However, for purposes of this study two alternative alignments for the bypass channel, referred to as "A" & "B" were evaluated. Alignments A and B are shown on **Figures S-2 and S-3** respectively. The realignment of a major flood control channel such as the Trinity River is a complex endeavor. The technical complexity is founded upon regulatory and permitting issues, baseline environmental discovery, environmental mitigation needs, and constructability approaches for such a major urban public works project.

From the planning level analyses performed, each of the alternative bypass alignments is **technically feasible**, in regard to the criteria presented below.

- A bypass channel, levees, and control structures can be designed to generally conform to USACE, FEMA, and City of Fort Worth regulatory requirements.
- It appears that suitable materials for construction of the bypass channel levee system are available onsite. Disposal of excess excavated materials have been included in the project costs.
- Re-instatement of transportation systems (City streets, State Highways, Railway and Bridges) is feasible.
- Relocation of utilities (water, sewer, storm drainage, natural gas, electrical distribution and transmission, fiber optic, cable and telephone) can be accomplished within the scope of total projected project costs.
- Environmental issues need further research and testing, however they can be managed effectively as a component of the overall concept development.



LEGEND

Existing Dams

New Levees

Sources:
Aerials (1999) provided by the City of Fort Worth.

N

Bypass Channel Alignment
Alternative A

September 2002

1000 0 1000 2000 Feet

Streams and Valleys, Inc.

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FIGURE S-2

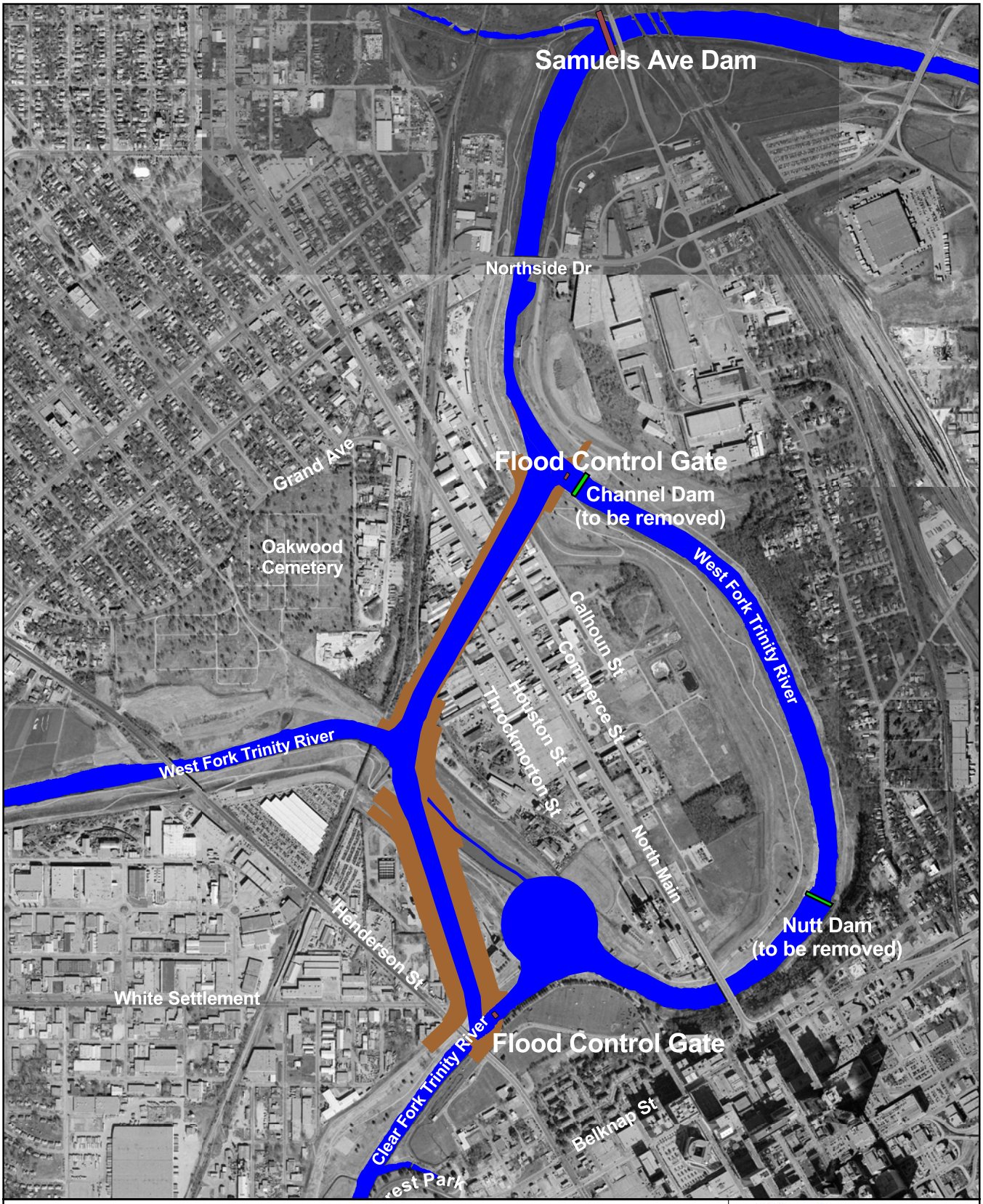

Samuels Ave Dam
Northside Dr
Grand Ave
Flood Control Gate
Channel Dam
(to be removed)
Oakwood
Cemetery
West Fork Trinity River
Calhoun St
Commerce St
Houston St
Throckmorton St
North Main
West Fork Trinity River
Nutt Dam
(to be removed)
Henderson St
White Settlement
Flood Control Gate
Clear Fork Trinity River
Belknap St
LEGEND
Existing Dams
New Levees
N
Bypass Channel Alignment
Alternative B
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) provided by the
City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE S-3

Detailed information is contained in the body of this report addressing each feasibility criteria listed. To determine the economic feasibility of the project, opinions of probable cost have been developed for major components. Presented on the **Table S-1** is a summary of the major cost items and the estimated cost in today's dollars. Inflation and interest for borrowed funds have not been included in the project costs. The total estimated cost of Alternative A is $ 320 million and Alternative B is $207 million. A companion report has been developed by Gideon-Toal that addresses economic development potential and possible funding strategies.

The following sections summarize the major elements considered for the feasibility analysis of the project.

S.2.1 Regulatory Issues

The Fort Worth Floodway (leveed sections of the Clear Fork and West Fork of the Trinity River) is a locally and federally regulated system under the jurisdiction of:

- the USACE as a federally designated floodway and through the Corridor Development Certificate Program and Section 404 of the Clean Water Act and by Title 33 CFR – Section 208.10 Flood Control Regulations
- Federal Emergency Management Agency (FEMA) as a regulated FEMA floodplain, and
- the City of Fort Worth through the CDC and Floodplain Development Permit Program.

Opinion of Probable Construction Cost		
Item/Description	**Alternative A – Cost in Millions $**	**Alternative B – Cost in Millions $**
Land Acquisition	$38.7	$10.6
Demolition	$14.4	$5.7
Utility Relocation and Demolition	$7.3	$6.5
Railroad Construction	$13.9	
By-Pass Channel Exc./Levee Construction	$31.9	$11.0
Valley Storage Balance	$49.2	$49.2
Water Control Structures	$32.2	$32.2
Storm Runoff/Water Quality Facilities	$5.1	$5.1
Roadway Construction/Reconstruction	$13.8	$8.6
White Settlement Road	$4.9	$4.6
Henderson Street	$4.5	
N. Main Street	$3.2	$2.8
Miscellaneous Street Modifications	$1.3	$1.3
Environ. Remediation Allowance – Project	$17.4	$15.6
Subtotal	**$223.9**	**$144.5**
Contingencies	$22.4	$14.5
Total	**$246.3**	**$159.0**
Project Administration		
Item/Description	**Alternative A – Cost in Millions $**	**Alternative B – Cost in Millions $**
Program Management	$17.5	$11.0
Permitting (EIS, 404, etc.)	$7.4	$4.8
Design, Survey, Testing & Constr. Management	$44.0	$29.0
Legal Assistance	$5.0	$3.0
Total	**$73.9**	**$47.8**
Grand Total	**$320.2**	**$206.8**

Table S-1
Alternative A & B

Each of these entities and programs limit the allowable hydrologic and hydraulic impacts associated with any development within the Upper Trinity River Study area, which includes the Central City segment of the overall master plan. Compliance with the regulatory programs presented above can be materially achieved with both bypass channel alternatives. Major design elements that are required for the compliance include:

- The top of levee for the bypass channel alternatives must equal the standard project flood elevation plus 4 feet.
- Loss of valley storage capacity must be minimal or mitigation is required. (No loss in the 100 yr. floodplain and not more than 5% in the SPF (Standard Project Floodplain).
- No increases in erosive flow velocities of the bypass channel unless adequate erosion control measures are provided.
- No adverse hydrologic or hydraulic impacts from project, upstream, adjacent and downstream of project area.

Based on the hydraulic analyses, approximately 2,300 acre-feet of valley storage would need to be replaced for this project. Possible locations of valley storage are shown on **Figure S-4**. An estimated cost of $48 million has been included in the project costs for valley storage and environmental mitigation, primarily associated with excavation of adjacent lands within or near the existing levees. This cost also includes allowances for disposal off-site of excavated materials.

S.2.2 Geotechnical Issues for Channel and Levee

Excavation for the bypass channel would result in large quantities of soil and rock. Conversely, the construction of the levees would require large quantities of high quality materials. Based on existing information on soils and geology in the study area, it is likely that much of the excavated materials would be suitable for levee construction. A typical cross section of the levee is shown in Section 3 of the main body of this report. For construction of Alternative A bypass channel and levees, 2.4 million cubic yards of material would be excavated and less than 1 million cubic yards of select material utilized for the levees. The estimated cost of the bypass channel and associated levees is $31.9 million for Alternative A.

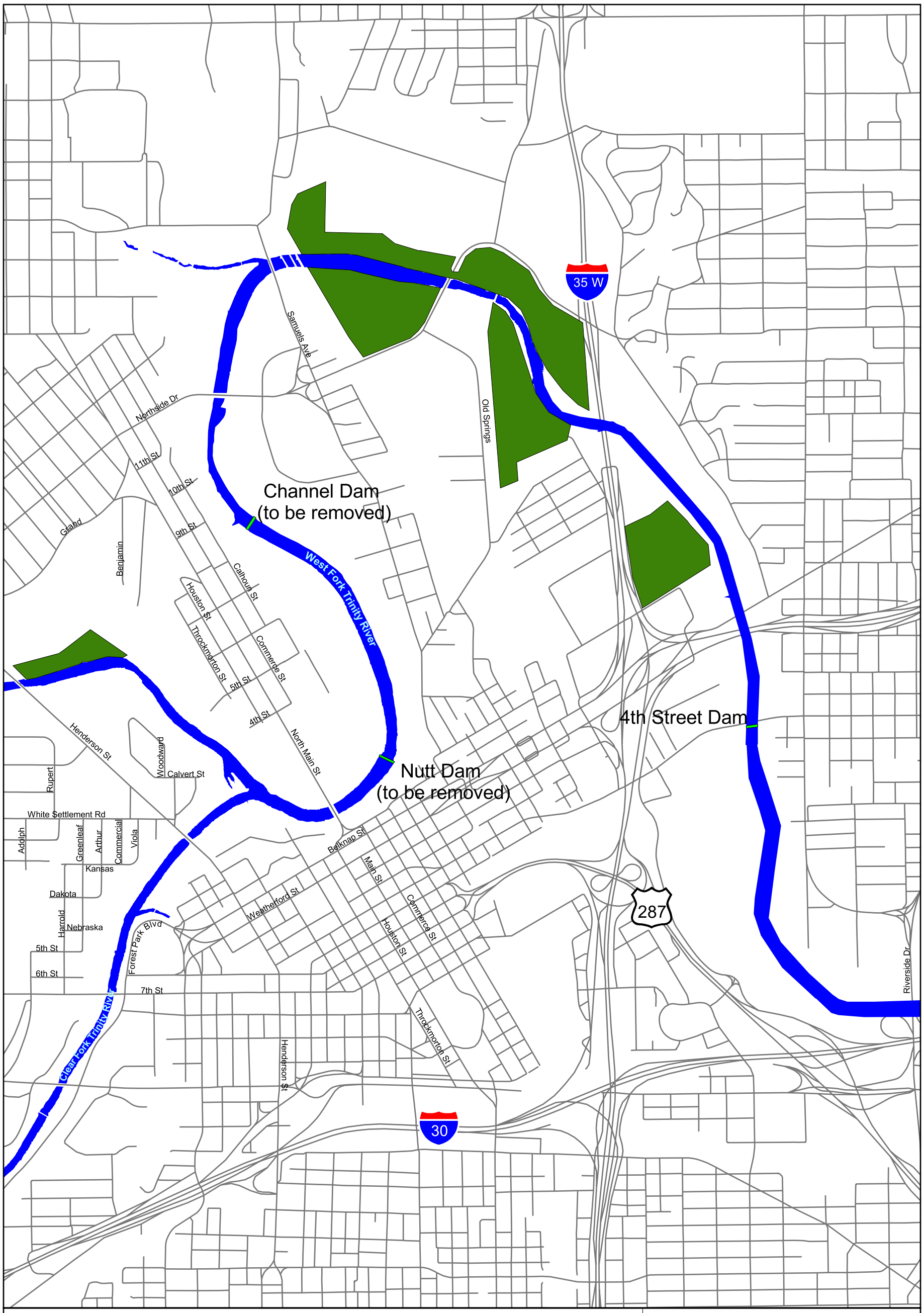
For construction of Alternative B bypass channel and levees, 1.1 million cubic yards of material would be excavated and approximately 700,000 million cubic yards of select material utilized for the levees. The associated estimated cost of the bypass channel and levees is $11 million.

S.2.3 Water Control Structures

New control structures for this concept include a dam located near Samuels Avenue and two gate structures to separate the bypass channel and the quiescent river segment. The dam near Samuels Avenue is envisioned to impound water at an approximate water surface elevation between 525 feet and 528 feet mean sea level (msl) and would impound water at higher water surface elevations up the Marine Creek Channel as well as the West Fork and Clear Fork of the Trinity River.

The existing water control structures on the Trinity River in the Central City river segment include the 4th Street Dam, Nutt Dam, and an unnamed channel dam. Nutt Dam and the unnamed channel dam would be removed with this project.

The estimated cost of the control structures is similar for both alternatives and is estimated at $32.2 million.


35 W
Samuels Ave
Northside Dr
11th St
10th St
9th St
Grand
Benjamin
Old Springs
Channel Dam
(to be removed)
West Fork Trinity River
Houston St
Calhoun St
Throckmorton St
Commerce St
5th St
4th St
North Main St
Henderson St
Woodward
Calvert St
Rupert
White Settlement Rd
Addiph
Greenleaf
Arthur
Commercial
Viola
Kansas
Dakota
Harrold
Nebraska
5th St
6th St
7th St
Forest Park Blvd
Clear Fork Trinity River
Nutt Dam
(to be removed)
4th Street Dam
Belknap St
Main St
Weatherford St
Houston St
Commerce St
Throckmorton St
287
Riverside Dr
30
LEGEND
Storage Mitigation Sites
Existing Dams
N
Potential Valley Storage Mitigation Sites
September 2002
1000 0 1000 2000 Feet
Sources:
City lots and streets provided by the City of Fort Worth.
Tarrant Regional Water District
Streams and Valleys, Inc.
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Freese · Nichols
Fugro
Zachry Construction Corporation

FIGURE S-4

S.2.4 Transportation Issues

For construction of the Alternative A bypass channel, several city streets, a state highway, and a railroad line would be impacted. Sections 3 and 4 address the details of the transportation issues for Alternative A and B, respectively.

The roadway improvements for Alternative A total $13.8 million. Relocation of the Fort Worth and Western railway line would be required for Alternative A, which is estimated to total $13.9 million.

Alternative B bypass channel alignment would require modifications to several city streets and a state highway. The estimated cost for the roadway improvements for Alternative B is $8.6 million. Alternative B bypass channel alignment does not impact the Fort Worth and Western Railway.

S.2.5 Utility Issues

The following utilities are located within the bypass channel alignments A and B: water (potable), sewer, storm drainage, natural gas, electrical distribution and transmission, cable, fiber optic lines, and telephone.

The estimated cost to relocate the utilities for Alternative A and B is $7.3 million and $6.5 million respectively.

S.2.6 Environmental Issues

The locations of the both bypass channel alignment options traverse through current or past commercial and industrial land uses. Therefore, environmental issues must be evaluated carefully. The study area and the surrounding properties, which could be redeveloped, could necessitate environmental cleanup of hydrocarbons, heavy metals and/or other toxins.

Allowances of $17.4 million and $15.6 million for environmental remediation associated with the channel excavation have been included in the project cost for Alternative A and B, respectively.

Contained in Section 3 and 4 of the main report are the details of the environmental issues for Alternative A and B, respectively.

S.2.7 Property Acquisition and Demolition

The bypass channel, levee system for the channel, relocated transportation systems and relocated utilities will require the acquisition of properties in and around the project area. In addition, structures located on these properties would have to be moved or demolished.

The estimated cost for the acquisition of properties and demolition of structures for Alternative A is a total of $53.1 million. Alternative B estimated cost for the acquisition of properties and demolition of structures total $16.2 million.

S.3 Conclusions

According to the September 1987, U.S. Army Corps of Engineers Fort Worth Floodway Appraisal Report, increased development in the watershed has reduced the level of flood protection during a Standard Project Flood event and has increased the severity of all flood events. The 1987 report indicates that the levees would be overtopped and fail with about a 450-year flood event causing catastrophic damage. The bypass channel concepts investigated in this study would however restore the level of flood protection within the interior quiescent zone.

The concepts evaluated in this study would undoubtedly focus attention on the surrounding areas and the opportunities for redevelopment. Much of the Paddock Bend neighborhood, for example, consists of underutilized or abandoned commercial and industrial sites nearby to downtown and the Fort Worth Stockyards. Rapid advances in environmental contamination assessment and remediation technology are making cleanup less costly, more predictable, and protective of public health. A more detailed understanding of the environmental remediation needs will permit a focused multi-disciplined approach to the issue. Coordination of the multi-

discipline expertise of environmental science, economic development, infrastructure engineering, planning, and financing and community development, through the City of Fort Worth Brownfield Program will be key to a successful brownfield redevelopment program.

This area has already been developed as commercial and industrial land uses and construction should have minimal impact on terrestrial wildlife habitat. During channel construction, the excavation would be isolated from the Trinity River until much of the new channel and levee system was in place. New levee construction, levee modification, bridge construction, railroad construction, would have negligible water quality impacts since these initial construction activities are located outside of the waters of the U.S. Some sediment could be washed from adjacent construction to the river but control measures would be required during construction to mitigate the transport of sediment. During excavation of the new channel tie-in to the river, some increased turbidity would be expected. However, these impacts would be temporary and would not significantly affect aquatic life downstream.

The envisioned flood relief bypass channel would include structural mitigation measures to enhance the quality of the environment including the construction of wetlands downstream of the dam near Samuels Avenue. Wetlands are important natural mechanisms in reducing pollutant loads downstream and would provide wildlife habitat as well. These wetlands areas are an integral component in restoring the valley storage which would be lost with the much shorter bypass channel construction, an important consideration for offsetting downstream flooding impact.

The bypass channel alternatives considered in this study need to meet the SPF plus 4 feet, flood protection requirement. The water surface elevations near Samuels Avenue Dam are only slightly higher than the base model elevations and further upstream on the West Fork and Clear Fork the water surface elevations are lowered around 3 feet. Therefore, the project does not have adverse hydrologic or hydraulic impacts. Yet the existing levee system within the Central City segment currently does not provide SPF protection. The areas not protected by SPF plus 4 feet, including the Marine Creek floodway and the Historic Stockyards Area would require special consideration by the Corps of Engineers to establish project specific flood protection criteria. After the criteria is set, further analysis will be required to address the need for mitigation, design elements for the proposed Samuels Avenue Dam and/or channel improvements.

In summary, the Trinity River Realignment concept is technically feasible, and within a general construction cost framework that appears to be achievable, contingent upon support from all levels of government and the private sector. The concept would not only provide flood protection benefits, it would also open the door to sustainable development goals, including mixed land uses near downtown and would provide a constant and controllable water surface along the quiescent river segment or "town lake". This would allow greater public access and recreational opportunities.

S.4 Recommendations

Based on the results of this preliminary investigation and the parallel planning and economic development studies conducted by Gideon-Toal, it is apparent that the Trinity River Floodway Realignment concept would provide tremendous benefits to Tarrant County, the City of Fort Worth, the Tarrant Regional Water District, and the citizens in the area. Because this concept could literally transform the area, and begin to address the flood potential due to increased runoff, it is recommended that a deliberate, well-planned program to systematically involve the community, coordinate with and enlist the support of local, county, regional, State, and Federal governments, to develop schedules, funding strategies, public/private partnerships, will be necessary to design and construct the Trinity River Realignment

in a manner consistent with community desires and available funding, be developed.

Various leaders from the community led by Congresswoman Kay Granger, George Shannon and the entire Board and staff of the Tarrant Regional Water District, Mayor Barr and the City Council of Fort Worth, the Executive Board and Executive Director of Streams & Valleys, Inc., the Texas Water Development Board, the North Central Texas Council of Governments, the U.S. Army Corps of Engineers, and others have all contributed to developing and enhanced vision for the Trinity River. This vision is founded on the Trinity River linking neighborhoods and becoming a quality of life focal point in Fort Worth.

In mid year 2002, Tarrant Regional Water District received planning grant assistance from the Texas Water Development Board's Research and Planning Fund. The grant supports the flood protection components provided in this Central City Realignment Feasibility Study which is a part of the Project Study Plan being pursued as a portion of the US COE Upper Trinity River Feasibility. The grant provided approximately 22% of the total study cost.

Every major project of this magnitude requires ongoing visioning and leadership from key stakeholders and others or the project will stagnate and balkanize into a myriad of conflicting interests. Accordingly, it is recommended that a committee structure be designed to maintain coherence, focus, and expertise so that interaction and information can produce results as the implementation process proceeds.

Section 1
Background

Tarrant Regional Water District (TRWD), Streams and Valleys, Inc., and the USACE, have undertaken a comprehensive Master Plan for the Trinity River and its tributaries in Tarrant County. This planning effort is also known as the Clear Fork/West Fork Project which is a component of the ongoing Upper Trinity River Feasibility Study, led by the North Central Texas Council of Governments (NCTCOG) representing the TRWD along with 14 other local governments in partnership with the Corps of Engineers. The Trinity River Master Plan effort was begun in 2000 and includes the study of over 70 miles of greenways. The Trinity River and its major tributaries traverse through all quadrants of the City of Fort Worth, including the historical confluence area that defines downtown, a section called the Central City segment. Consistent with the goals and vision of the Master Plan, the Master Plan partners, with additional funding support from the Texas Water Development Board, this study was initiated to investigate the technical and economic feasibility of creating a quiescent river segment in the Central City from the confluence of the Clear Fork and the West Fork of the Trinity River to just upstream of the Northside Drive bridge crossing in the Central City segment of the plan. This study entitled Evaluation of the Trinity River Floodway Realignment, evaluated long-term measures to reduce flood damages, improve water quality, provide stream bank protection and erosion control, and implement a framework to protect the river and adjacent lands. The project area is shown on **Figure 1-1**.

Tarrant Regional Water District retained CDM, Inc. to evaluate the conceptual engineering feasibility of the project. CDM lead the feasibility analysis and was assisted by Turner Collie & Braden, Inc., Freese and Nichols, Inc., Zachry Construction Corporation, and Fugro South.

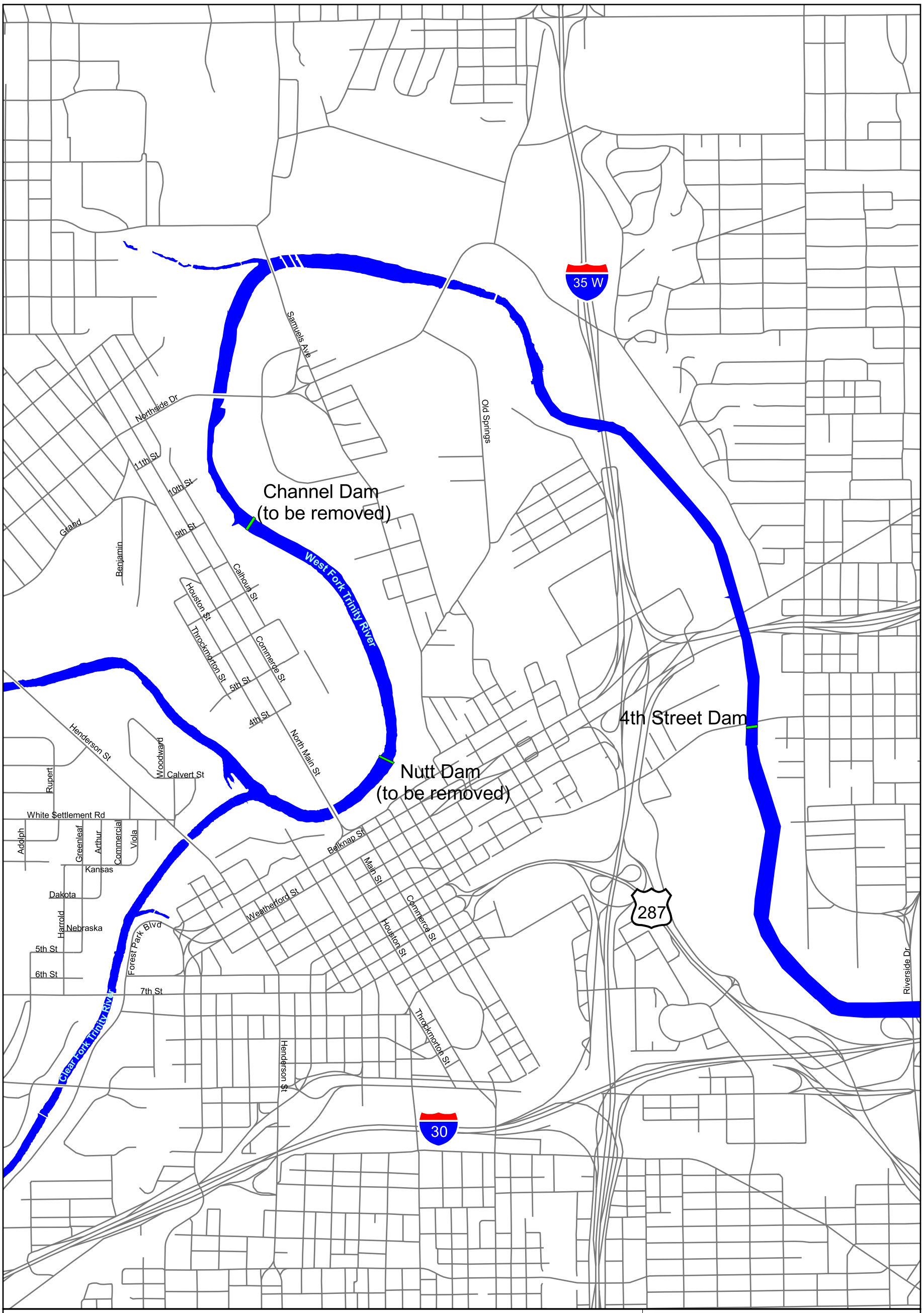
The feasibility analysis included evaluation of bridge crossings over a new bypass channel at Henderson Street, White Settlement Road, and North Main Street, floodgates to protect the created quiescent segment, new and modified sumps for local storm water drainage, transportation linkages, and relocations of utilities, land acquisition and demolition of structures which conflict with the project, and preliminary environmental restoration concepts for water quality enhancements. The major items in the scope of work are presented below:

Task	**1**	Kick-off Meeting
Task	**2**	Data compilation and Review
Task	**3**	Workshops (3)
Task	**4**	Preliminary Hydrologic and Hydraulic Analyses
Task	**5**	Geotechnical Input for Development of Alternatives
Task	**6**	Develop Channel Relocation Options
Task	**7**	Inventory Existing Utility Systems
Task	**8**	Civil and Structural Investigations
Task	**9**	Summary Report
Task	**10**	Project Management
Task	**11**	Federal and State Permit Identification and Preliminary Scheduling and Development of Funding Options

The original scope of services for this project included a sub-task to Task 6 titled 2 Dimensional modeling. A 2 dimensional modeling effort was to be conducted on a final design alternative to determine the most appropriate location and type of erosion control measures as well as, to fine tune

the hydraulic characteristics of the two bypass confluences with the West Fork. During the execution of the contract it was determined that there would not be one selected alternative that would benefit from this rigorous hydraulic analysis. Instead, there were additional hydrologic and hydraulic factors that needed to be looked at in greater depth to properly develop and define the recommended two channel design alternatives. These issues included an assessment of valley storage sites for mitigation, as well as, the assessment of valley storage reduction on downstream peak discharges and flood evaluations, bypass channel geometry changes based on the Urban Design Consultant workshops, and the assessment of removal of removal of the existing in-channel dams. The design team concluded that the 2 dimensional effort would not benefit the alternative analysis and the 2D analysis would better be performed once a final alternative has been chosen.

The Tarrant Regional Water District also retained the services of Gideon Toal, Inc. to conduct a companion study related to economic development, urban design and the land use issues associated with the realignment of the Trinity River.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Nutt Dam
(to be removed)
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West Fork Trinity River
Clear Fork Trinity River
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30
287
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Northside Dr
11th St
10th St
9th St
Grand
Benjamin
Houston St
Calhoun St
Throckmorton St
Commerce St
5th St
4th St
North Main St
Henderson St
Woodward
Calvert St
Rupert
White Settlement Rd
Addiph
Greenleaf
Arthur
Commercial
Viola
Kansas
Dakota
Harrold
Nebraska
5th St
6th St
7th St
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FIGURE 1-1

Section 2
Floodway Bypass Channel

To create a quiescent river segment from the confluence of the Clear Fork and the West Fork of the Trinity River to just upstream of the Northside Drive crossing would require construction of a floodway bypass channel to reroute the storm flows. This bypass channel and levee system would provide additional flood protection benefits, enhanced water quality, and environmental restoration opportunities. The project concept would support redevelopment of the surrounding area.

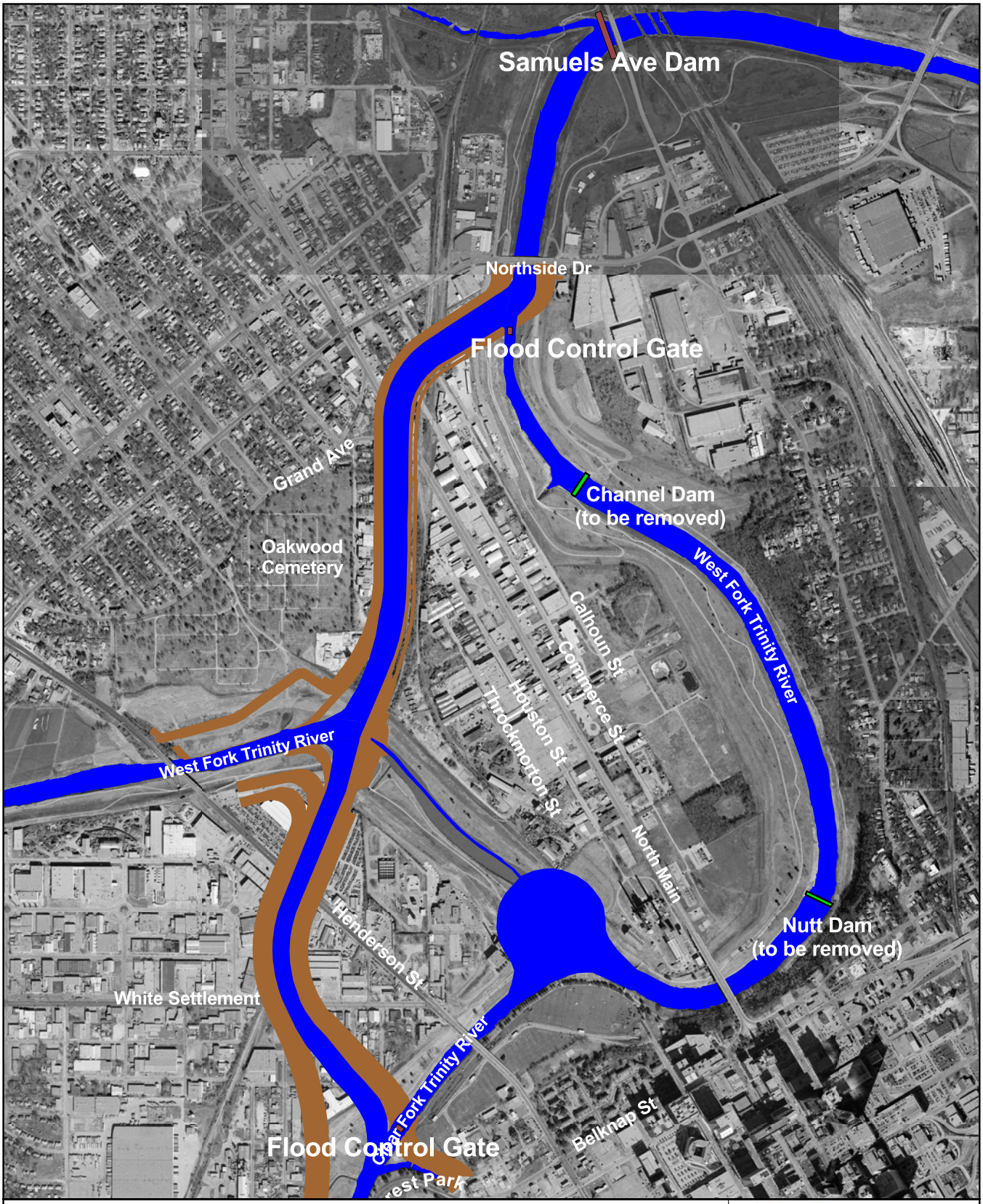
The vision of a quiescent river segment includes a higher constant water surface along a waterfront adjacent to downtown Fort Worth. To maintain a higher water surface elevation, the concept includes a stationary dam at or near where Samuels Avenue crosses the West Fork of the Trinity, just east of the confluence of Marine Creek. The concept also includes removal of the existing in-channel dams, including Nutt Dam, within the river segment. Importantly, the existing levees within the protected quiescent zone could be removed after construction of the bypass channel and flood gates. This would allow development to occur much closer to the water's edge and would accommodate the development of an urban waterfront.

The Trinity River Master Plan was started in August 2000 by Tarrant Regional Water District in association with Streams and Valleys, the City of Fort Worth, and the Corps of Engineers; the Central City Segment was described in the Master Plan to address the unique characteristics of the confluence area.

The general concept of a floodway relief system was first identified during the Trinity River Vision Master Plan Workshop held in October 2001. The workshop was a public forum used to present and discuss previous ideas, thoughts and concerns regarding the Trinity River Vision Master Plan. The purpose of the overall Master Plan is *"to preserve and enhance the river and its corridors, so that they remain essential greenways for open space, trails, neighborhood focal points, wildlife, and special recreation areas."* These riparian corridors are critical elements in preserving environmental quality and a high quality of life that attracts people to locate and stay in Fort Worth. As development, redevelopment, and capital projects proceed, it is imperative that the vision be implemented. Reservation or enhancement of these open spaces, recreation, and conservation areas will help the greater Fort Worth area support a growing population and economy, while continuing to provide essential flood protection.

2.1 Bypass Channel Alignments

Several channel, levee, and floodway combinations were investigated to identify planning considerations necessary to restore authorized flood protection levels. The Project Team narrowed the flood-relief channel configurations to two general alternatives, identified as "A" and "B". The general alignment of alternatives "A" and "B" is shown on **Figure 2-1 and 2-2**, respectively. These are conceptual in nature and do not represent proposed final alignments.



LEGEND

Existing Dams

New Levees

Sources:
Aerials (1999) provided by the City of Fort Worth.

N

Bypass Channel Alignment
Alternative A

September 2002

1000 0 1000 2000 Feet

Streams and Valleys, Inc.

CDM

Turner Collie & Braden Inc.

Zachry Construction Corporation

FIGURE 2-1

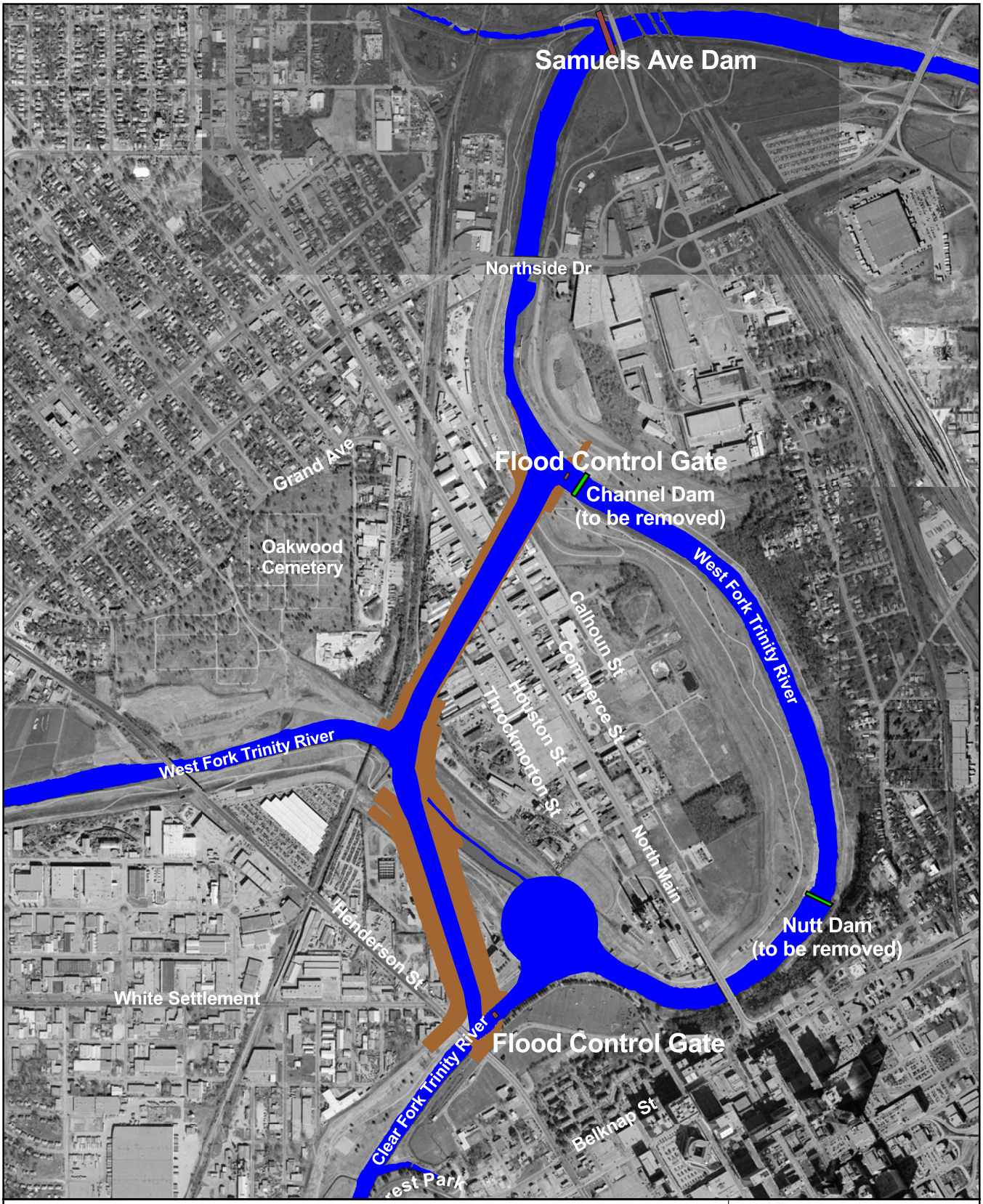

Samuels Ave Dam
Northside Dr
Grand Ave
Flood Control Gate
Channel Dam
(to be removed)
Oakwood
Cemetery
West Fork Trinity River
Calhoun St
Commerce St
Houston St
Throckmorton St
North Main
West Fork Trinity River
Henderson St
Nutt Dam
(to be removed)
White Settlement
Flood Control Gate
Clear Fork Trinity River
Belknap St
LEGEND
Existing Dams
New Levees
N
Bypass Channel Alignment
Alternative B
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) provided by the
City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 2-2

Alternative A includes a bypass channel alignment that begins on the Clear Fork between 7th Street and Henderson Street. The alignment traverses northwesterly to the western side of the existing Fort Worth and Western Railroad right-of-way. This alternative would necessitate the relocation of the railroad, which is discussed in subsequent sections. The bypass channel in this alternative would then traverse northeasterly generally following the route of the existing alignment of the railroad to just east of Main Street.

At this point, the channel would continue in an easterly direction and merge with the West Fork of the Trinity River upstream of the Northside Drive Bridge. The Alternative A bypass channel is approximately 9,540 feet in length.

The **Alternative B** bypass channel begins on the Clear Fork just downstream of Henderson Street and traverses northerly. The bypass channel would parallel the existing eastern right-of-way of the Fort Worth and Western Railroad, until reaching Calhoun Street. The bypass alignment would then traverse in an easterly direction to intersect with the West Fork, further upstream of Northside Drive Bridge. The length of the Alternative B bypass channel is approximately 5,340 feet in length.

2.2 Hydraulic and Hydrologic Considerations

In order to determine the technical feasibility of this concept, the hydrology and hydraulics of the channel bypass and levee system, water impoundment dam and quiescent water front area had to be analyzed. The project boundaries for the hydraulic and hydrologic analysis were the Clear Fork upstream of Henderson St., the West Fork upstream of the Fort Worth and Western Railway Bridge, and downstream to Riverside Drive. **Figures 2-3 and 2-4** show the project limits and the component parts of the overall project as described below.

2.2.1 Regulatory Programs and Constraints

The Trinity River is a regulated floodway system coming under the jurisdiction of the Federal Emergency Management Agency (FEMA) as a regulated FEMA floodplain, the US Army Corps of Engineers through both the Corridor Development Certificate Program (CDC) and Section 404 of the Clean Water Act, and the City of Ft. Worth through the CDC and Floodplain Development Permit program. Each of these entities and programs set limits on the hydrologic/hydraulic impacts associated with any development within the Upper Trinity River study (UTS) area, which includes the proposed project area. These regulations set the design constraints that need to be addressed in order to ensure a successful design.

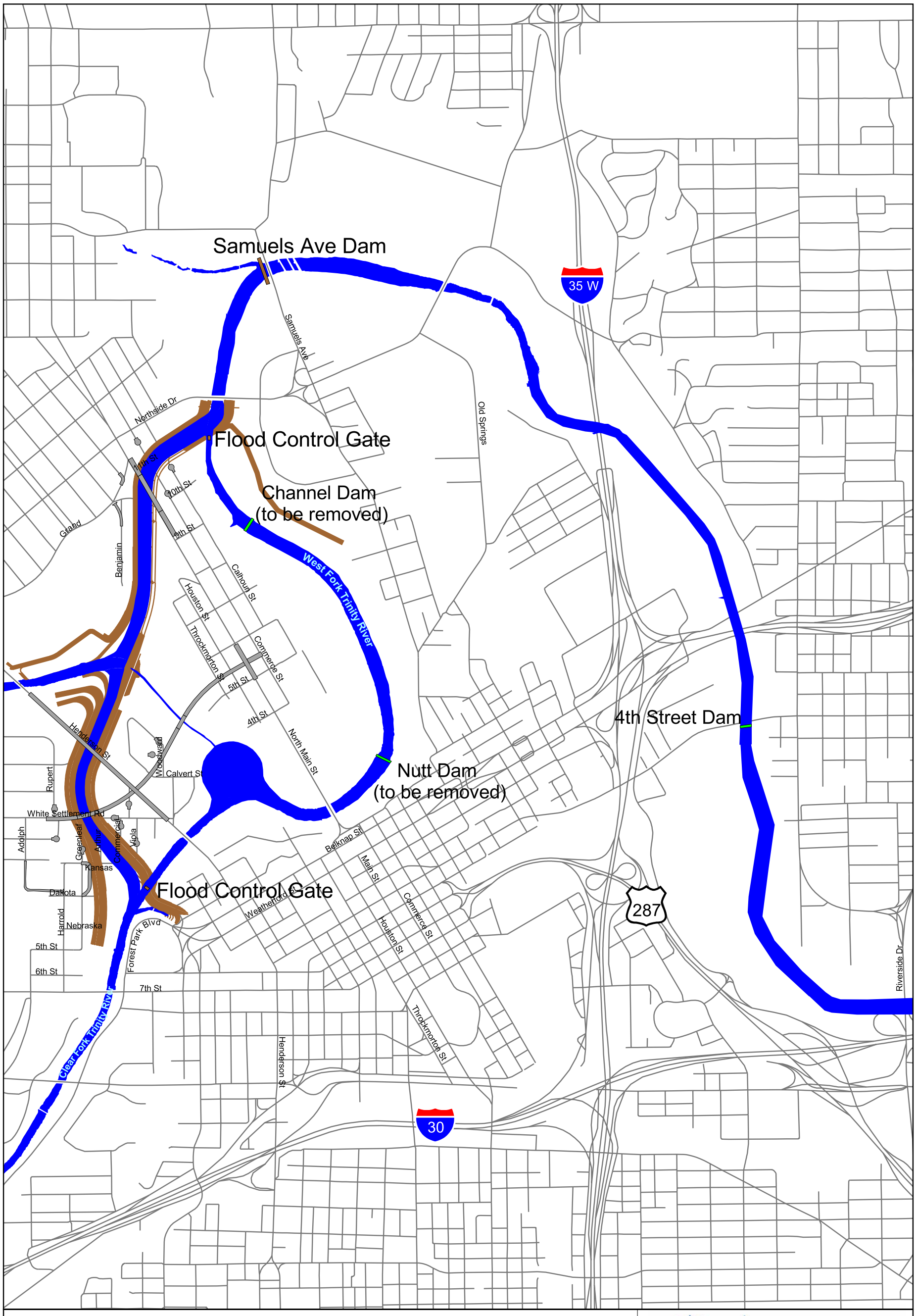

Samuels Ave Dam
Samuels Ave
35 W
Northside Dr
Flood Control Gate
Old Springs
11th St
10th St
9th St
Grand
Benjamin
Channel Dam
(to be removed)
West Fork Trinity River
Houston St
Calhoun St
Throckmorton St
Commerce St
5th St
4th St
North Main St
4th Street Dam
Henderson St
Woodward
Calvert St
Rupert
White Settlement Rd
Addiph
Greenleaf
Arthur
Commercial
Viola
Kansas
Dakota
Nebraska
Harrold
Nutt Dam
(to be removed)
Belknap St
Main St
Weatherford St
Commerce St
Houston St
Flood Control Gate
Forest Park Blvd
5th St
6th St
7th St
Clear Fork Trinity River
Henderson St
Throckmorton St
287
Riverside Dr
30
LEGEND
Existing Dams
New Roads
New Levees
N
Project Boundaries
Alternative A
September 2002
1000 0 1000 2000 Feet
Sources:
City lots and streets provided by the
City of Fort Worth.
Streams and Valleys, Inc.
CDM
consulting · engineering · construction · operations
Turner Collie & Braden Inc.
FREESE · NICHOLS
FUGRO
Zachry Construction Corporation

FIGURE 2-3

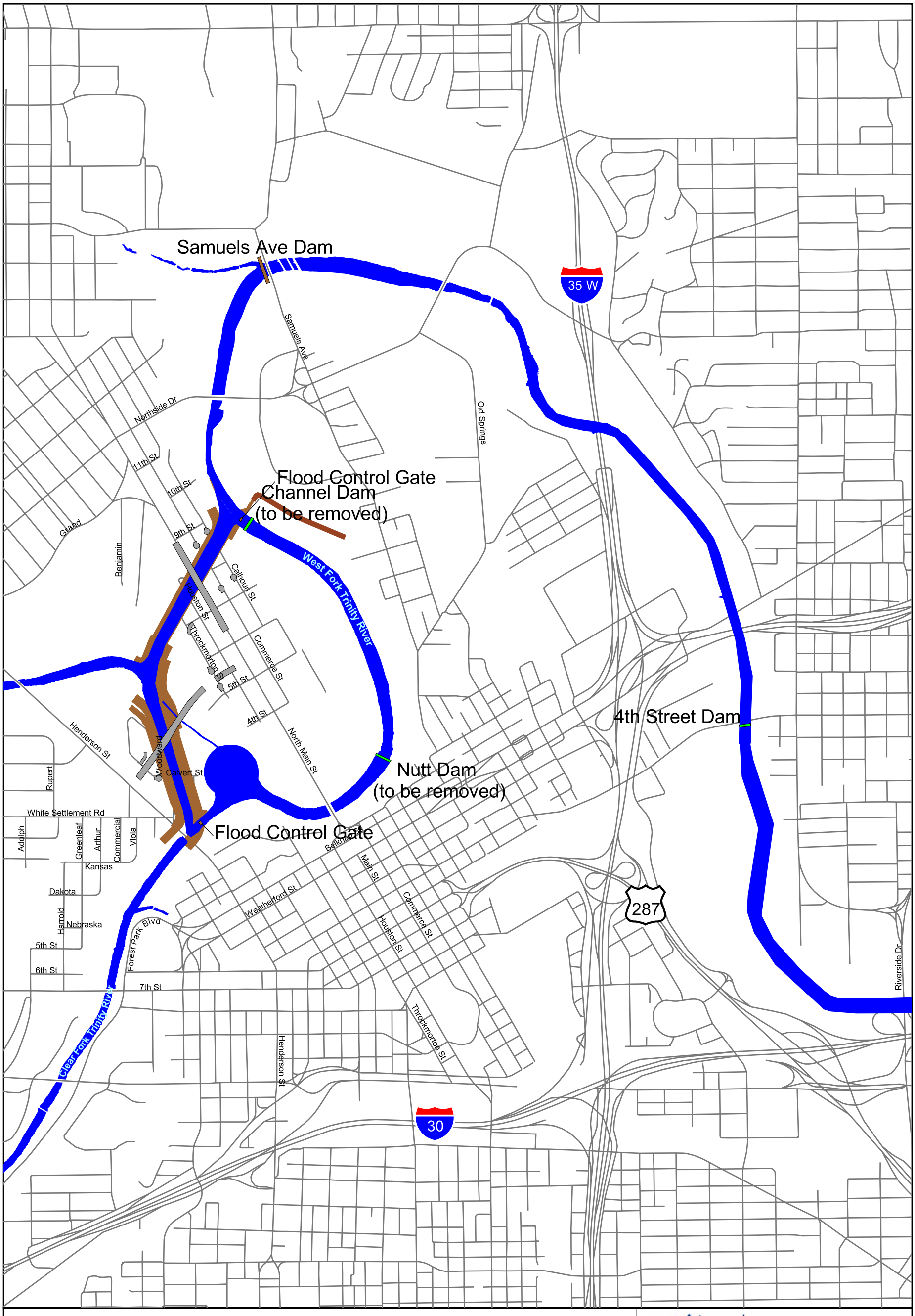

Samuels Ave Dam
Samuels Ave
35 W
Northside Dr
11th St
10th St
9th St
Grand
Benjamin
Flood Control Gate
Channel Dam
(to be removed)
West Fork Trinity River
Houston St
Throckmorton St
Calhoun St
Commerce St
5th St
4th St
North Main St
Henderson St
Woodward
Calvert St
Rupert
White Settlement Rd
Addolph
Greenleaf
Arthur
Commercial
Viola
Kansas
Dakota
Harrold
Nebraska
5th St
6th St
7th St
Forest Park Blvd
Flood Control Gate
Nutt Dam
(to be removed)
4th Street Dam
Belknap
Main St
Weatherford St
Houston St
Commerce St
287
Riverside Dr
Clear Fork Trinity River
Henderson St
Throckmorton St
30
LEGEND
Existing Dams
New Roads
New Levees
N
Sources:
City lots and streets provided by the
City of Fort Worth.
Project Boundaries
Alternative B
September 2002
1000 0 1000 2000 Feet
Streams and Valleys, Inc.
CDM
consulting · engineering · construction · operations
Turner Collie & Braden Inc.
FREESE · NICHOLS
FUGRO
Zachry Construction Corporation

FIGURE 2-4

There are four regulatory permitting protocols that affect the hydrologic and hydraulic design of the proposed Trinity River Floodway Realignment project. They are as follows:

- **Record of Decision – Upper Trinity River**

  The Record of Decision - Regional Environmental Impact Statement: Trinity River and Tributaries (ROD) is a document prepared by the USACE establishing criteria and constraints that must be met regarding any development within the Upper Trinity River boundaries. The ROD was prepared as a response to the increase in development within the Trinity River floodplain and the development's potential for adverse impacts on both the base flood elevations and river ecosystem. The ROD is triggered when a project requires review under Section 404 of the Clean Water Act. **Appendix A** contains the ROD summary document.

  The following is a summary of the hydrologic and hydraulic constraints contained in the ROD:

  - Hydraulic Impacts
    1. No rise in the 100-year flood elevation or Standard Project Flood (SPF) elevation (ultimate conditions).
    2. Maximum allowable loss of valley storage capacity for 100-year and SPF discharges will be 0% and 5% respectively.
    3. No increase in erosive velocities.
    4. Equal reduction of floodplain.
  - Cumulative Impacts
    1. Project upstream, adjacent and downstream effects to be considered.
  - Design Level of Flood Protection
    1. Top of Levee to be SPF +4 feet.
  - Criteria
    1. Runoff
    2. Habitat Mitigation
    3. Cultural Resources
    4. Other Regional Needs and Plans

  Of particular concern in this feasibility analysis is the "no-rise" limitation, maximum allowable storage loss, no increase in erosive velocity, cumulative impacts, and the design level of flood protection.

- **Corridor Development Certificate (CDC)**

  The CDC is a permitting program established by the North Central Texas Council of Governments (NCTCOG) and participant cities (including Ft. Worth). It is designed to implement the findings of the ROD. The CDC program has established a permitting methodology and set the base hydrologic and hydraulic criteria to be used when considering improvements within the Upper Trinity River jurisdictional boundaries. Additionally, the CDC program has adopted the USACE HEC-RAS and HEC-1 models as the established hydrologic and hydraulic models to be used when assessing the impacts of any proposed improvements within the UTS regulatory zone. Although the basis for the CDC program is the ROD, there are a few subtle differences. The following is a tabulation of the hydrologic and hydraulic constraints contained in the CDC:

  - Hydraulic Impacts
    1. No rise in the 100-year flood elevation or significant rise in the SPF elevation (ultimate conditions).
    2. Maximum allowable loss of valley storage capacity for 100-year and SPF discharges will be 0% and 5% respectively.
    3. No increase in erosive velocities.
    4. Equal reduction of floodplain.

- Cumulative Impacts
    1. Project upstream, adjacent and downstream effects to be considered.
- Preservation of Adjacent Project Storage

The CDC review process is triggered for any development that is proposed within the permit jurisdictional area. The City within which the project is proposed reviews the project analysis to see that it meets City criteria then it submits the data to the NCTCOG for final review and permit issuance. The USACE Fort Worth District, Hydrology and Hydraulics Section at the request of the City performs the technical review of the project compliance with the CDC hydrologic and hydraulic criteria.

- **FEMA Conditional Letter of Map Revision (CLOMR)/Letter of Map Revision (LOMR)**

The existing portion of the Trinity River to be bypassed has been mapped by FEMA under its Flood Insurance program and a FEMA regulated 100-year floodplain has been established. This mapped 100-year floodplain establishes the boundaries within which proposed development must meet established development criteria. Since the proposed bypass channel is a new channel, the CLOMR/LOMR process will require that there be:

- Establishment of existing condition hydraulic models that incorporate all floodplain modifications within the project area since the previous flood insurance study (FIS) was developed.
- No rise in the established 100-year floodplain elevation at the boundaries where the bypass channel ties back into the Clear Fork, and the West Fork.
- No increase in erosive velocities.

Additionally, the establishment of a bypass channel and levee system will require the modification of the 100-year flood designation for the quiescent area, the removal of the sump 100-year flood designation for the internal sump area and the establishment of a 100-year flood regulatory boundary within the bypass channel.

The FEMA review process is split into two separate reviews: CLOMR and LOMR. Prior to any physical modifications to the regulated floodplain a hydrologic and hydraulic analysis is undertaken to ensure that the FEMA requirements can and will be met by the proposed project. This information is gathered and submitted as part of the CLOMR permit application to the City for review. Upon City approval, the permit application is sent to FEMA for final review and permitting. Upon acceptance of the study by FEMA, a permit is granted allowing the project to begin. Once the project is complete, the LOMR process begins. Upon project completion a LOMR permit application is prepared which indicates that the final project as constructed is substantially in compliance with the conditions established in the CLOMR. The LOMR permit application is sent to the City for review. Upon City approval, the LOMR permit application is sent to FEMA for final review. Once FEMA has approved the permit, the FIS maps are updated to acknowledge the change in floodplain boundary.

- **City of Ft. Worth Floodplain Development Permit (FDP)**

The City of Ft. Worth FDP is required for all work within a FEMA regulated floodplain. This permit establishes design guidelines for improvements that are in addition to those required under the FEMA CLOMR/LOMR process. The following is an example of such a guideline:

Bridge Crossing – Low Chord elevation = 100-yr CDC elev. + 2 feet.

Since the project is within the CDC regulatory jurisdiction, all FDP requirements will be met through the CDC process.

- **Section 404 Permit**

  The USACE regulates the discharge of dredged or fill material into the waters of the US, which includes wetlands. The Section 404 permit or permits will be required during construction phases of the project. Provided in Appendix B is background information, the permitting process, regulatory approval and scheduling considerations for Section 404 permitting.

2.2.2 Channel Alignments

The Upper Trinity River has been the subject of a series of detailed hydrologic and hydraulic models developed and maintained by the USACE. These models form the basis of the hydrologic and hydraulic analysis of the proposed floodway improvements. These models are referred to as the Upper Trinity River Study models (UTS).

The hydrologic and hydraulic analysis of the Trinity River Floodway Realignment concept consists of the following stages, each to be discussed further in this section.

1. Hydrology and Hydraulic Base Models
2. Riverside Drive SPF Floodplain Reduction
3. Development of Updated Base Hydrologic and Hydraulic Models (UTS-CDC, UTS-FEMA and UTS-SPF).
4. Dam at Samuels Avenue
5. Bypass Channel Alignment – A & B are contained in Section 3 and 4.

Base Hydraulic Models:

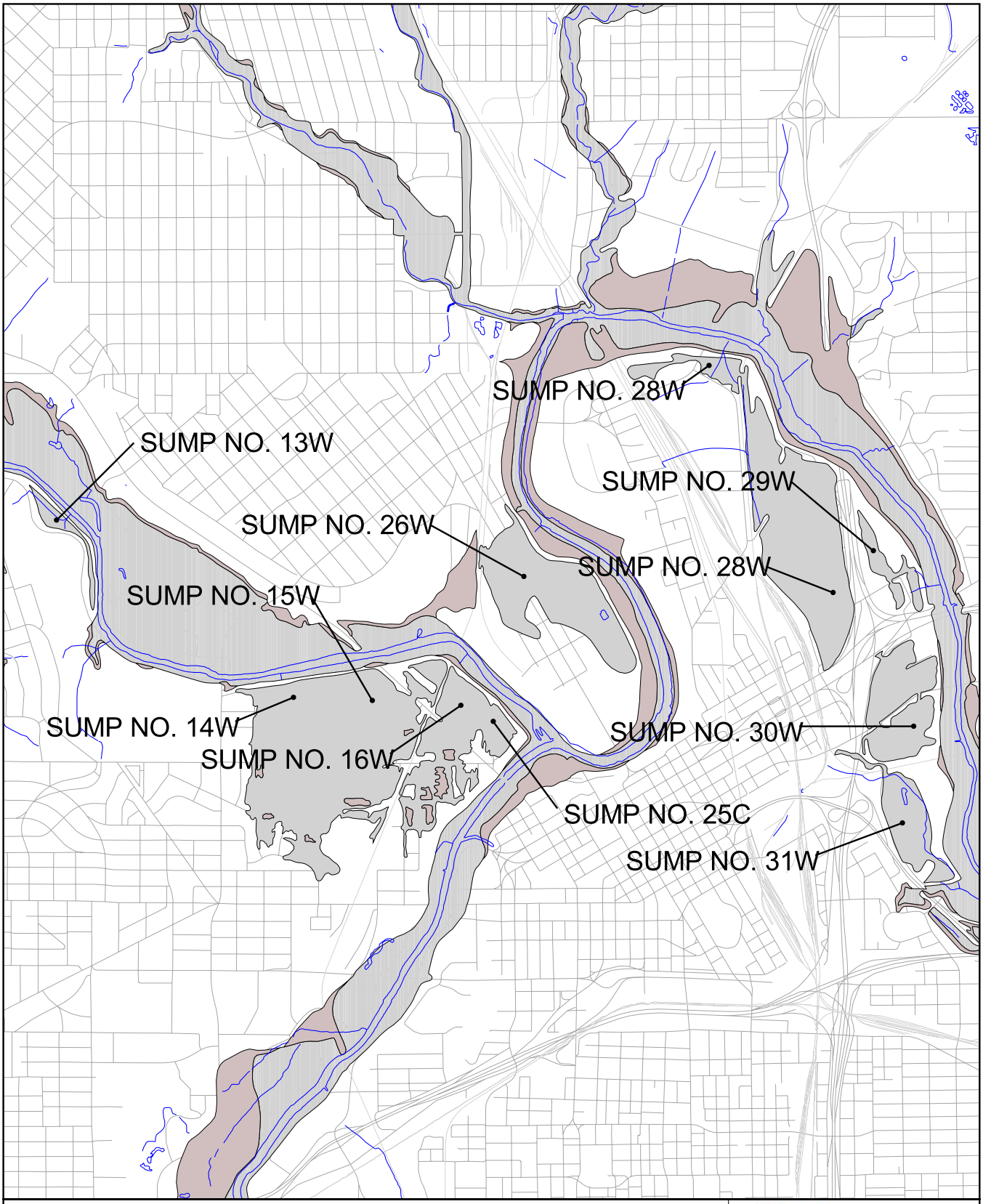
The base UTS hydraulic models consist of three HEC-RAS models. These hydraulic models are the UTS-CDC, UTS-FEMA and UTS-SPF HEC-RAS models described in the following sections. The hydraulic models set base flood elevations at each cross-section for each of the flows developed in the hydrology models. The impacts that bridges, culverts, channel conditions and characteristics have on the Upper Trinity River base flood elevations are determined through the hydraulic analysis. The proposed Trinity River Floodway Realignment concept impacts the existing channel geometry and characteristics. These impacts include the removal of a channel dam and Nutt dam, the proposed construction of a dam near Samuels Avenue and the realignment of a segment of the Trinity River through a bypass channel. Modifications of the hydraulic base models are necessary to assess the improvement impacts. The base hydraulic models are as follows:

- **UTS-Corridor Development Certificate (CDC) - HEC-RAS 3.0 Model**

  The UTS-CDC model is the base hydraulic model that incorporates all the existing channel geometry, parameters, obstructions, appurtenances, etc. This is a comprehensive hydraulic model that includes cross-sections on a relatively tight interval. The flows used to set the CDC flood elevations assume that the development of all contributing drainage areas has been projected to year 2050. This model includes flows for the 1-year, 2-year, 5-year, 10-year, 25-year, 50-year and 100-year flood events.

- **UTS-Federal Emergency Management Agency (FEMA) - HEC-RAS 3.0 Model**

  The UTS-FEMA model is the same base hydraulic model as the UTS-CDC model with different flows to establish the base flood elevations. The flows used to set the FEMA flood elevations consist of existing conditions development for all contributing areas. This model includes flows for the 10-year, 50-year, 100, and 500-year flood events. Shown on **Figure 2-5** is the current FEMA FIS map panel that encompasses the proposed project area and the established FEMA regulatory limits.



LEGEND

FEMA Floodplain Designation

Zone X (shaded)

Zone X (unshaded)

N

FEMA Floodplain Map

September 2002

2000 0 2000 4000 Feet

Sources:
City lots and streets provided by the City of Fort Worth.
FEMA map provided by the Tarrant Regional Water District.

Streams and Valleys, Inc.

CDM

Turner Collie & Braden Inc.

Freese-Nichols

Fugro

Zachry Construction Corporation

FIGURE 2-5

- **UTS-CDC Standard Project Flood (SPF) - HEC-RAS 3.0 Model**

  The UTS-CDC SPF model is generally the same base hydraulic model as the UTS-CDC model with minor modifications to extend and update cross-sectional information. This model incorporates all SPF flood elevations in the analysis. The flows used to set the CDC-SPF flood elevations assume that the development of all contributing drainage areas has been projected to year 2050. This model includes flows for 500-year and SPF flood events.

Base Hydrology Models:

The base hydrology models consist of separate HEC-1 models for each return period (1-year, 2-year, etc.) and for each of the development conditions (existing conditions and 2050 conditions) as outlined above for the Hydraulic models. The hydrology models establish the peak flows that are used in the subsequent hydraulic models to set flood stage elevations. The hydrology analysis determines the stormwater runoff entering the Trinity River based on the land use conditions of the contributing area. The river flows are then routed through river reaches, which attenuate peak flows depending on the amount of valley storage that is available within the floodplain. The proposed improvements to the Trinity River will impact the storage conditions within the Trinity River floodplain and will require modification of the hydrology base models to assess the impacts due to the anticipated loss of valley storage. The base hydrology models are as follows:

- **UTS-CDC – HEC-1 Hydrology Models**

  The UTS-CDC hydrology models include individual HEC-1 models to develop peak flows for the 1-year, 2-year, 5-year, 10-year, 25-year, 50-year and 100-year flood events under development conditions projected to year 2050.

- **UTS -FEMA – HEC-1 Hydrology Models**

  The UTS-FEMA hydrology models include individual HEC-1 models to develop peak flows for the 10-year, 50-year, 100-year and 500-year flood events under existing development conditions.

- **UTS-SPF – HEC-1 Hydrology Models**

  The UTS-SPF hydrology models include individual HEC-1 models to develop peak flows for the 500-year and SPF flood events under a 2050 development condition.

2.2.3 Riverside Drive SPF Floodplain Reduction

The U.S. Army Corps of Engineers (USACE) conducted a hydrologic/hydraulic analysis of the Riverside Drive crossings of the Trinity River. The location of the Riverside Drive crossing is shown on **Figures 2-3 and 2-4**. This crossing consists of two bridges in parallel. In profile, these bridges have different deck dimensions and roadway elevations. This staggered bridge arrangement increases the bridge profile exposed to flood flows in the Trinity River. The USACE, in the 1990 Upper Trinity River Basin Reconnaissance Report, determined through its hydrologic/hydraulic analysis that the bridge was a significant impediment to the SPF flows. The study included an analysis of the impacts to the SPF flood elevations if the bridges were widened and the upstream channel was modified such that the bridges would not impede the SPF flood flows.

It was also concluded in the study that the SPF elevations could be reduced by about 4 feet at the bridge location and that this reduction would travel upstream and potentially reduce the SPF flood elevations through the proposed project site.

The project team determined that any reduction in the SPF flood elevations would assist in the planning and preliminary conceptualization of the project. The latest UTS-CDC (SPF) hydraulic model was modified in an attempt to reproduce the USACE findings and therefore, set new reduced base SPF flood elevations through the project site. A series of model runs were made that removed the bridges from the active floodway and assessed different channel modifications. However they did not reproduce the flood

elevation reduction found in the original USACE study.

The CDC Model, completed in 1996, was a product of a comprehensive re-analysis of the Upper Trinity River Watershed. The CDC Model replaced the 1900 Reconnaissance Report hydrologic and hydraulic model. The SPF discharges in the CDC Model, downstream of Riverside Drive through Fort Worth and Arlington, are greater than the Reconnaissance Report SPF discharges in the same reaches. The CDC Model tailwater impacts are such that the modification of the Riverside Drive bridges do not appear to cause a significant enough reduction in the SPF water surface elevations through the project site. Therefore, these improvements were not included in any subsequent hydrologic/hydraulic analysis.

2.2.4 Development of Updated Base Hydrology and Hydraulic Models

The UTS hydrologic and hydraulic models were developed and incorporated into the CDC permit program in 1998. Since that time, there have been a number of channel modifications in the Trinity River that would impact the base flood elevations and are not included in the current UTS models. As indicated above, the FEMA CLOMR/LOMR process requires that the base model used for comparative purposes be updated to reflect the existing channel conditions. The channel modifications made to the Trinity River that may impact the proposed project since the creation of the UTS base models are as follows:

- Construction of 4th Street Dam
- Construction of Beach Street Dam
- Channel modifications such as laying back the side slopes of the channel banks and the removal of accumulated sediment from the channel bottom for a length of channel from Nutt Dam to Beach Street Dam.

The UTS-CDC, UTS-FEMA and UTS-SPF hydrologic models were updated to reflect these channel improvements. These updated models are now the base models that are used to compare and quantify the impacts of the proposed improvements to the Trinity River.

Contained in **Table 2-1** is a comparison of flows at key locations between the UTS models and the updated UTS models.

Presented in **Table 2-2** is a comparison of base flood elevations and velocities for the 100-year event at key locations between the UTS models and the updated UTS models.

As shown in Table 2-2 for the CDC model, there is only a small decrease in the CDC 100-year water surface elevation at key locations. This was only a small increase in CDC 100-year channel velocities.

DESCRIPTION	Original CDC Model PEAK FLOW (cfs)	Updated CDC Model PEAK FLOW (cfs)	Updated Minus Original (cfs)
WF flows from MC to Sycamore Creek	49654	49762	108
WF flows from Sycamore Creek to E 1st St	69957	70355	398
WF flows from E 1st St to R.M. 554.3	64155	64387	232
WF flows from R.M. 554.3 to Big Fossil Creek	62898	63094	196
WF flows from Big Fossil Creek to Village Creek	79706	79939	233

Table 2-1
Comparison of flows at key locations between the UTS models and the updated UTS models

CDC-100 Model				
Location Description	Base Model W.S. (ft)	Updated Model W.S. (ft)	Base Model Velocity (ft/s)	Updated Model Velocity (ft/s)
U/S of Clear Fork Confluence, West Fork near Pedestrian Bridge	537.26	537.23	7.34	7.35
U/S of West Fork Confluence, Clear Fork	537.14	537.11	6.84	6.85
D/S of West/Clear Fork Confluence, West Fork	536.31	536.28	8.44	8.45
D/S of Nutt Dam, West Fork	530.09	529.84	6.15	6.22
FEMA-100 Model				
Location Description	Base Model W.S. (ft)	Updated Model W.S. (ft)	Base Model Velocity (ft/s)	Updated Model Velocity (ft/s)
U/S of Clear Fork Confluence, West Fork near Pedestrian Bridge	536.72	536.74	7.50	7.54
U/S of West Fork Confluence, Clear Fork	536.68	536.71	6.48	6.48
D/S of West/Clear Fork Confluence, West Fork	535.83	535.82	8.36	8.41
D/S of Nutt Dam, West Fork	529.08	528.8	6.19	6.26
CDC-SPF Model				
Location Description	Base Model W.S. (ft)	Updated Model W.S. (ft)	Base Model Velocity (ft/s)	Updated Model Velocity (ft/s)
U/S of Clear Fork Confluence, West Fork near Pedestrian Bridge	551.14	551.2	6.10	6.08
U/S of West Fork Confluence, Clear Fork	551.07	551.13	6.37	6.35
D/S of West/Clear Fork Confluence, West Fork	550.02	550.09	9.79	9.77
D/S of Nutt Dam, West Fork	543.88	544.16	8.85	8.76

Table 2-2
Comparison of Base Flood Elevations at Key Locations Between the UTS Models and the Updated UTS Models

2.2.5 Dam at Samuels Avenue

The project concept includes establishment of a "permanent" water surface elevation through the entire project site. This water surface elevation would be maintained by a proposed dam in close proximity to Samuels Avenue. The proposed location of the dam is shown on **Figures 2-3 and 2-4**. A hydrologic/hydraulic analysis was conducted to determine the dimensions of a dam that would not adversely impact the regulatory flood elevations and would provide a standing water surface elevation sufficient to meet the requirements for establishing a stable water surface. The analysis was conducted in two phases. The first phase determined the cross-section and highest dam height elevation of a permanent impoundment that, with some minor upstream and downstream channel work, would not adversely impact the regulatory floodplain requirements. The second phase then consisted of conceptualizing a gate/water regulation system that would allow the water to be impounded above the dam crest height to the required water surface elevation. The permanent dam was determined to be approximately 390 feet across at an elevation of 515 feet ngvd. The gate structure consists of 8 leaf gates separated by 10 foot piers. The gates are conceived to allow for the impoundment of upstream water to an elevation of 525 feet ngvd. All subsequent HEC-RAS modeling considered a dam cross-section with the gates in the fully open position to pass flood flows.

The construction of a dam near Samuels Avenue would also require the removal of both the existing in-channel dam adjacent to the Tarrant Regional Water District offices, and the removal of Nutt Dam. The Samuels Avenue dam improvement and the removal of the channel dam and Nutt Dam are included in all subsequent channel alignment hydrologic and hydraulic analysis.

Shown in **Table 2-3** is a comparison of base flood elevations at key locations between the updated UTS model and the updated UTS model with the Samuels Avenue dam improvements. The Samuels Avenue dam analysis indicates that there is an increase in both the 100-year and SPF flood stages (increase upstream of the Dam and a decrease downstream of the Dam). The increases in flood stages are most pronounced from Samuels Avenue Dam to Nutt Dam. Upstream of Nutt Dam, the flood stage increases are greatly reduced. This is due to the removal of Nutt Dam and therefore, the elimination of its impact on the flood stages. Additional preliminary analysis was made to determine if it were possible to mitigate the impacts of Samuels Avenue Dam by improving the upstream and downstream channel. The analysis indicated that sufficient channel modifications could be made that would mitigate these flood stage increases without the additional channel work associated with the bypass channel. In other words, the Samuels Avenue dam and the associated increase in water surface elevation are not contingent upon the bypass channel being in place.

Table 2-4 is a comparison of channel velocities at key locations between the updated UTS model and the updated UTS model with the Samuels Dam improvements.

Presented in **Table 2-5** is a comparison of peak flows at key locations between the updated UTS model and the updated UTS model with the Samuels Dam improvements.

Table 2-6 is a comparison of storage volumes for each routing reach impacted by the proposed improvements for the SPF event between the updated UTS model and the updated UTS model with the Samuels Dam improvements.

2.3 Hydraulic Control Structures

The existing control structures located within the Central City segment of the Trinity River are Nutt Dam and an unnamed channel dam. Downstream of the study area is Beach Street Dam and 4th Street Dam. The location of these structures is shown on **Figures 2-3 and 2-4**. The elevation of these structures are; Nutt Dam – 520 feet ngvd, Channel Dam - 505.5 feet ngvd, 4th Street Dam- 500.5 feet ngvd, and Beach Street Dam – 494 feet ngvd.

Photographs of these existing structures are presented in **Figures 2-6** through **2-8**.

Figure 2-6
4th Street Dam

Figure 2-8
Channel Dam

Figure 2-7
Upstream view of Nutt Dam

FEMA-100 Model			
Station	Location Description	Base Model W.S. feet (msl)	Samuels Ave Dam W.S. feet (msl)
242813	U/S of Samuels Ave. Dam	525.28	530.94
242451	D/S of Samuels Ave. Dam	525.34	524.68
252042	U/S of Previous Location of Nutt Dam	532.72	532.64
252010	D/S of Previous Location of Nutt Dam	529.08	533.03
CDC-100 Model			
Station	Location Description	Base Model W.S. feet	Samuels Ave Dam W.S. feet
242813	U/S of Samuels Ave. Dam	526.21	531.39
242451	D/S of Samuels Ave. Dam	526.29	525.68
252042	U/S of Previous Location of Nutt Dam	533.09	533.28
252010	D/S of Previous Location of Nutt Dam	530.09	533.66
CDC-SPF Model			
Station	Location Description	Base Model W.S. feet	Samuels Ave Dam W.S. feet
242813	U/S of Samuels Ave. Dam	539.79	541.09
242451	D/S of Samuels Ave. Dam	539.78	539.31
252042	U/S of Previous Location of Nutt Dam	543.88	544.30
252010	D/S of Previous Location of Nutt Dam	543.88	544.78

Table 2-3

Comparison of Water Surface Elevations for the 100-Year FEMA, 100-Year CDC and CDC-SPF Models

Station	Updated Model FEMA-100	Samuels Ave Dam Model FEMA-100	Updated Model CDC-100	Samuels Ave Dam Model CDC-100	Updated Model CDC-SPF	Samuels Ave Dam Model CDC-SPF
243785*	6.23	8.35	5.95	7.82	9.09	8.88
243471*	6.11	5.96	5.84	5.57	8.49	8.26
242813	6.43	2.27	6.13	2.20	7.56	2.01
242451	5.05	6.5	4.78	6.14	6.71	9.71
242363	6.89	6.51	6.53	6.15	9.86	9.72

Table 2-4

Comparison of Flow Velocities for the 100-Year FEMA, 100-Year CDC and CDC-SPF Models
Units are ft/s

* 1000 ft D/S of Northside Dr.
* 1300 ft D/S of Northside Dr.

DESCRIPTION	A Updated CDC Model PEAK FLOW (cfs)	B Samuels Dam PEAK FLOW (cfs)	B-C Samuels Dam Minus Existing (cfs)
WF flows from Big Fossil Creek to VC	79939	79220	-719
WF flows from VC to Walker Branch	94591	94037	-554
WF flows from Walker Branch to State Hwy 157	95886	95133	-753
WF flows from State Hwy 157 to State Hwy 360	91421	90817	-604
WF flows from State Hwy 360 to Johnson Creek	89717	89114	-603
WF flows from Johnson Creek to Grand Prairie Gage	90545	89938	-607
WF flows from Mountain Creek to the Elm Fork	92244	91557	-687
TR at Elm Fork to Dallas Gage	119692	118940	-752
TR at Dallas Cage to AT&SF RR	119648	118880	-768

Table 2-5
Comparison of Peak Flows for the 100-Year CDC Model

Updated Model CDC-100	CDC Model (ac ft)	Updated CDC Model Improvements (ac ft)	Samuels Dam (ac ft)
From near confluence of CF & WF to D/S of Samuels Ave. Dam	4067	4115	4339
From near Rockwood Park To near confluence of CF & WF	5772	5679	5707
From 150 ft D/S of I-30 to D/S of Henderson	4306	3598	3610
Totals	14145	13392	13656
		Differential =	-264

Table 2-6
Comparison of Valley Storage for the CDC-SPF Model

Through the impoundment of water by a dam at Samuels Avenue, the water surface elevation can be raised. At this time, an elevation of 525 feet ngvd is assumed at the dam at Samuels Avenue. Therefore, the normal water surface elevation in the quiescent zone and the bypass channel would be 525 feet ngvd. One of the primary features of the envisioned improvements is the higher water level (normal conditions) in the Trinity River, both in the current main channel and in the new proposed bypass river channel. The bypass river channel could pass significant floods without adversely affecting the constant water levels in the original channel.

The proposed water control structures for both alternatives are similar and are discussed in detail in Sections 3-4 and Section 4-4.

2.4 Geotechnical Issues for Channel and Levee

Excavation of the bypass channel will result in large quantities of materials, such as soil and rock to be managed. Coincidentally, construction of the flood protection levees for the channel requires large quantities of high quality embankment materials. Because of the magnitude of the project, considerations of the local geology and subsurface materials are essential for project constructability and cost estimation purposes.

Test boring information was obtained from the USACE, Fort Worth District Office and from Tarrant Regional Water District. Presented below is a summary of the finding of the available geotechnical investigations. The technical memorandum regarding the data is contained in **Appendix C.**

- It is anticipated that the excavated soil and rock materials would be suitable for construction of the levees and bridge approaches. However, some sorting, special handling, or processing of several of the different materials would be required.
- Clay materials in the area are suitable for topsoil, however they are expansive and special consideration for foundations of future structures should be taken.
- It is possible that rock material will be encountered during the channel excavation. Rock is anticipated below approximate elevation 520 feet ngvd from the north bank of the West Fork to the northern end of the project. The rock is considered "soft", however specialized excavating equipment and procedures will be necessary.

For both alternatives considered, excess soil and rock quantities are expected after construction of the levees. The exact amount of excess material will be dependent on the usable material excavated. The location of both bypass channel alternatives traverse current or past commercial and industrial developed areas. It is possible that during the excavation of the channel, the discovery of environmental contamination to the soil or groundwater would occur. Exploratory excavation and further environmental research in the area will be needed prior to any excavation. Environmental issues are addressed in Section 2.7 of this report.

2.5 Transportation Systems

The creation of a new bypass channel would significantly affect roads, bridges and other transportation elements in the area. New bridges as well as the rerouting of existing roads would be necessary to maintain existing traffic flows to and through the area. This section addresses the transportation concerns due to location of a bypass channel and levees but not redevelopment of the area and the increased mobility that redevelopment may require.

The following concerns should be considered during design of relocated transportation systems:

- Adequate access to the new traffic generation land uses
- Interruption of access to businesses and residents
- Safety of the general public and the contractor's staff
- Easement and right-of-way issues
- Local, State and Federal Regulations, Codes and Laws
- Identification of unobstructed and efficient routes
- Consideration of vertical and horizontal changes in alignment

There are several transportation modes present within the study area. The current transportation system is oriented toward the movement of truck and automobile traffic. A single set of railroad tracks is located within the project area that

provides for an excursion tourist passenger train and some local freight traffic. Public transit within the area is limited and the area currently does not provide well-kept facilities for pedestrian mobility.

2.5.1 Roadway Systems

The bypass channel concept will result in conflicts with a State highway and major roadways. Existing roadways in the project area are shown on **Figure 2- 9.** The City of Fort Worth's "Proposed Street Development Standards, Roadway Standards and Master Thoroughfare Plan", February 2002 was used to classify the city streets. The type of streets encountered in the project area are classified into the following categories according to the above-referenced document.

- ***Principle Arterial:*** The main function of principal arterial streets is to carry traffic within the community and between major activity centers of the region. The principal arterial street system carries most of the traffic entering and leaving the urban area, as well as most of the through movement bypassing the central city. Principal arterials carry 30,000 to 45,000 vehicles per day (vpd) and serve high-density residential, retail, service, and industrial uses.

Henderson Street is a Principal Arterial and is shown in **Figure 2-10**.

- ***Major Arterial:*** The major arterial street system connects with the principal arterial system to accommodate trips of moderate length with a lower level of travel mobility and a higher level of land access. The major arterial street system distributes trips to geographic areas and serves major commercial and industrial districts. Such facilities may carry local bus routes and provide inter-community continuity, but should not penetrate identifiable neighborhoods. Major arterials are generally designed to carry 15,000 to 35,000 vpd.

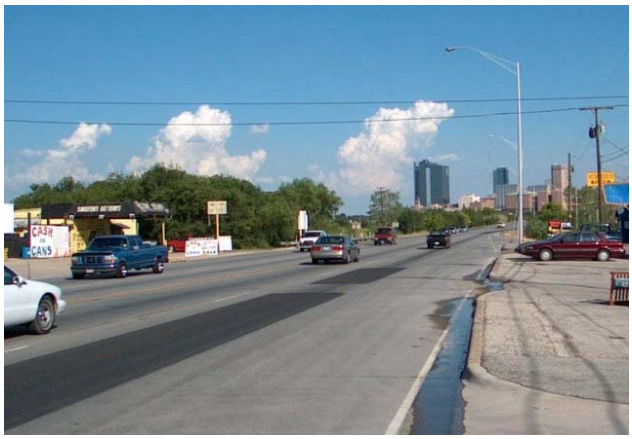


Figure 2-10
Henderson Street - Looking Southeast, Towards Downtown

Main Street and White Settlement Road are the Major Arterials, and are shown on **Figures 2-11** and **2-12**, respectively

Figure 2-11
Main Street - Looking South

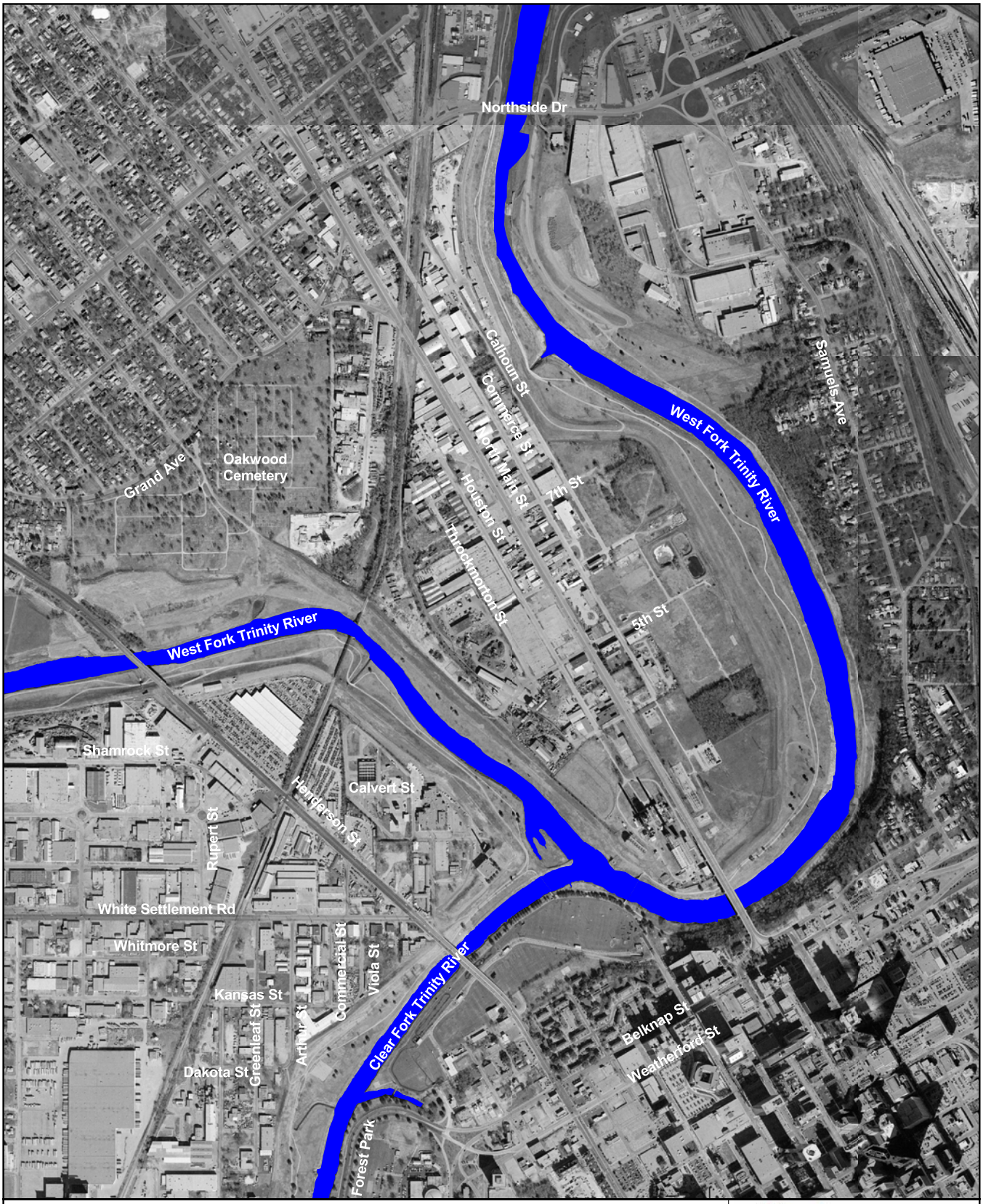

Northside Dr
Calhoun St
Commerce St
Main St
Houston St
Throckmorton St
7th St
5th St
Samuels Ave
West Fork Trinity River
Grand Ave
Oakwood Cemetery
West Fork Trinity River
Shamrock St
Calvert St
Henderson St
Rupert St
White Settlement Rd
Whitmore St
Kansas St
Commercial St
Viola St
Greenleaf St
Dakota St
Clear Fork Trinity River
Belknap St
Weatherford St
Forest Park
N
Existing Roadways
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) provided by the City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 2-9

Figure 2-12
White Settlement Road – Looking West

- ***Minor Arterial:*** Minor arterials are commonly located along neighborhood borders and collect traffic from residential areas and direct vehicles to the major arterial system. These streets are designed to carry 4,000 to 20,000 vpd.

- ***Industrial Streets:*** A new roadway classification is being established for industrial areas to recognize different types of vehicles with larger turning radii and heavier industrial type traffic. These roadways are basically minor arterials that route industrial vehicles from the arterial system to and within industrial districts.

- ***Residential Streets:*** Residential streets serve traffic within neighborhoods and should carry low traffic volumes, 200 to 4,000 vpd at slower speeds. There are three types of residential streets: collector, local, and limited local. The streets are used in subdivisions based on varying sizes and numbers of residential lots.

Presented on **Table 2-7** is the City's classification of the streets to be traversed by the alignment route.

Main Street, Henderson Street and White Settlement Road will be the roadways of main concern in maintaining traffic flow in the project area. Henderson Street is also designated State Highway 199. Any changes considered for Henderson Street will require close coordination with Texas Department of Transportation (TXDOT).

According to the North Main Street Corridor Study completed by Kimley Horn and Associates in July 2000, the automobile is the most viable transportation option in this area and the area experiences average traffic congestion. There is also significant truck traffic in the area. With the redevelopment and revitalization of the project area, truck traffic may become more prevalent, as the increase in retail will increase the demand for truck access. The Fort Worth Transportation Authority operates at least one bus route at 15-minute intervals on North Main Street. The City of Fort Worth is considering the development of a trolley to link Downtown, the Stockyards, and the Cultural District, which would progress through the study area.

Three pilot studies from the North Main Corridor Study are underway with funding from the 1998 Capital Improvements Program and a STEP Grant. The areas under consideration include: Paddock Bridge to 5th Street, Northside Drive to 20th Street, and 25th Street to 27th Street. The improvements are mainly pedestrian enhancements, including new sidewalks, bulb outs to allow more parking along the side of the street, trees and pedestrian lighting. A planted median will be installed from Northside Drive to 20th Street. Paddock Bridge will receive lights on top and underneath the bridge. Also, a sidewalk will be added to extend underneath the bridge to connect to the existing sidewalk along the street.

Street Name	Classification
Henderson Street	Principle Arterial
Main Street	Major Arterial
White Settlement Road	Minor Arterial
Arthur Street	Residential
Calhoun Street	Residential
Calvert Street	Residential
Commerce Street	Residential
Commercial Street	Residential
Greenleaf Street	Residential
Kansas Street	Residential
Rupert Street	Residential
Shamrock Street	Residential
Throckmorton Street	Residential
Viola Street	Residential
Whitmore Street	Residential

Table 2-7
Streets to be Traversed by Alignment Route

2.5.2 Bridge Systems

Currently, there are three roadway crossings of the river within the project area. Main Street crosses the Trinity River in the southern portion of the project. Henderson Street crosses the West Fork and the Clear Fork of the Trinity River.

A railroad bridge is also present in this area to allow rail traffic across the West Fork of the Trinity River. The railroad bridge is shown in **Figure 2-13.** This railroad bridge was constructed in 1902 and is one of the oldest surviving rail bridges in Tarrant County. The bridge is eligible for addition to the National Register and to the list of Texas Historic Landmarks.

There will be a need to provide additional access to the Paddock Bend Area, or "island," created by the bypass channel. The levees associated with the development of a bypass channel will be at a higher elevation than the existing levees. Accordingly, any new bridges will need to be designed for this elevation and have adequate length of roadway approach to allow for a reasonable approach slopes (<5%).

Figure 2-13
Railroad Bridge – Fort Worth and Western RR

2.5.3 Railroad

There is a single set of railroad tracks within the project area running north-south along the west side of the bypass channel alternatives. A tourist passenger train, the Tarantula operated by the Fort Worth and Western RR, runs to and from the Historic Stockyards Area and the City of Grapevine making two roundtrips per day along the line. One of the railroad depots is shown in **Figure 2-14.**

Figure 2-14
Grapevine Railroad Depot – Fort Worth and Western RR

The current railroad crossings are at-grade crossings, i.e. the intersections of railroad and roadways are at the same elevation. At these crossings, automobile traffic is halted until the train has passed. The current crossings have warning signals but no crossing arms. Relocation of the railroad assumed that the crossings remain at-grade for White Settlement and Main Streets crossings, but with enhanced signalization and barricading. An elevated grade separation of SH 199 and the railroad was included in the cost estimate for Alternative A (Henderson Crossing).

2.6 Utility Systems

The following types of utilities are located within the Trinity River Realignment study area:

Water (potable)
Sewer (sanitary)
Storm Drainage
Gas (service)
Gas (high pressure distribution)
Electric (transmission)
Electric (distribution)
Cable Television
Telephone service
Fiber Optics

The utilities currently located in the study area are predominantly a result of past development in the vicinity, with the exception of major sewer mains and electrical transmission mains. Most of the study area was urbanized primarily as commercial and industrial land uses. Construction of the proposed bypass channel and modifications to the river sections would impact many of the existing utilities. Presented in this section are the existing utilities within the project area. Sections 3 and 4 address the utility relocations and/or modifications due to alignment Alternatives A and B, respectively.

2.6.1 Water (Potable)

The City of Fort Worth Water Department provides water service for the area. Distribution system pipeline sizes range from 2-inch in diameter to 8-inch in diameter. In addition to water service and distribution system lines, water transmission lines pass through sections of the project area. The water transmission pipeline sizes include 16-inch through 30-inch. The water lines are shown on **Figure 2-15**. Listed below are water transmission lines, which may be in conflict with the bypass channel alignment:

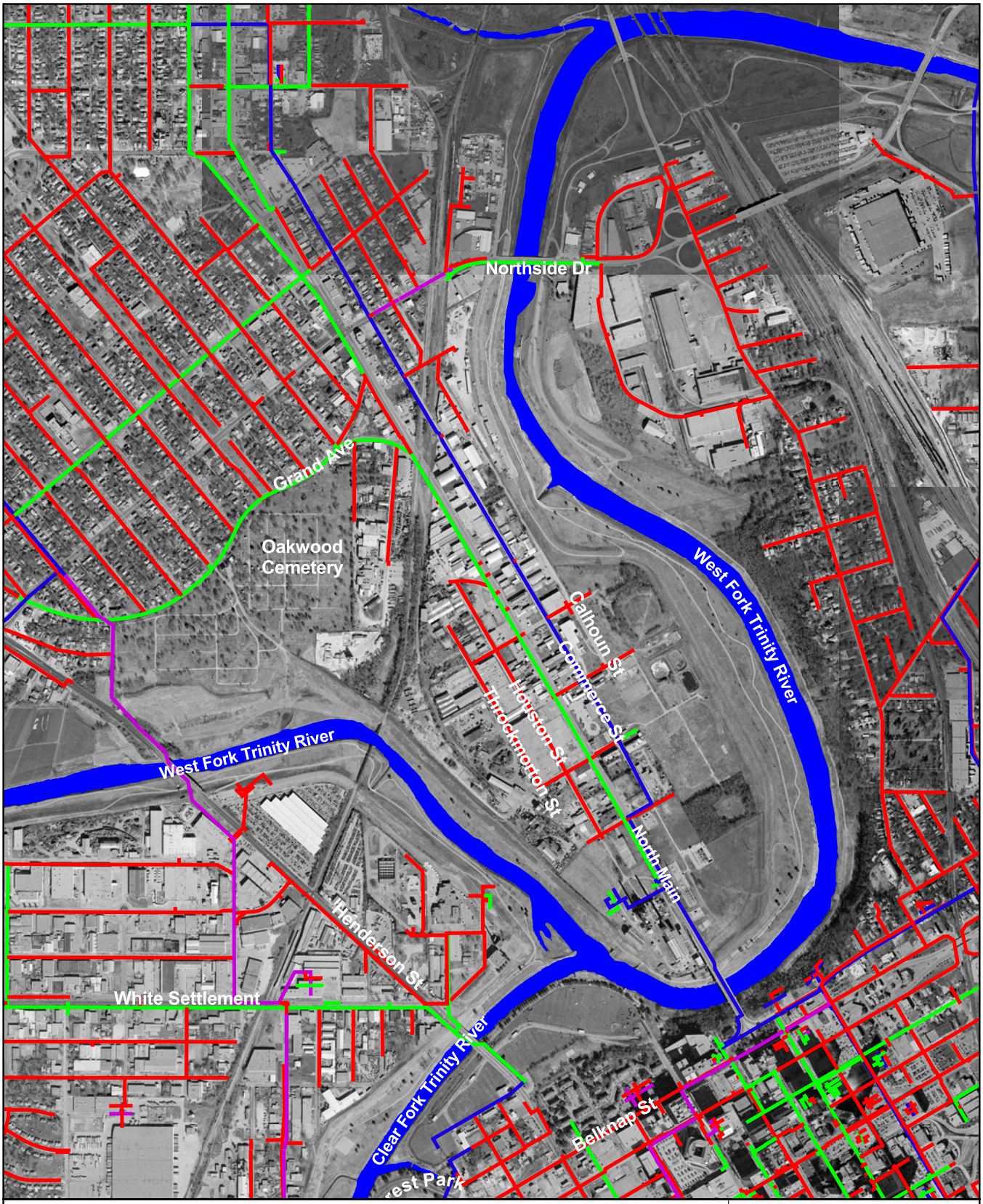

Northside Dr
Grand Ave
Oakwood Cemetery
West Fork Trinity River
Calhoun St
Commerce St
Houston St
Throckmorton St
North Main
West Fork Trinity River
Henderson St
White Settlement
Clear Fork Trinity River
Belknap St
LEGEND
Water Lines - Diameter (in)
< 8
10-16
18-24
> 24
N
Existing Utilities
Water (Potable)
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) and water base maps provided by the City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 2-15

- 16-inch line in White Settlement Road and Houston Street
- 30-inch line in Greenleaf
- 20-inch cast iron line in Commerce Street and Crosses Railroad
- 12-inch in Main Street and Crosses Railroad

2.6.2 Sewer System

The City of Fort Worth Water Department also provides sewer service for the area. Sanitary sewer laterals in the area range from 6-inch in diameter to 15-inch in diameter. Several large diameter main trunk lines (24-inch and 54-inch) pass through the study area. The sewer lines are indicated on **Figure 2-16** for the area. Listed below are sewer collection mains, which may be in conflict with the final bypass channel alignment.

- Main 439 54-inch Sanitary Sewer
- Main 132 24-inch Sanitary Sewer
- Main 248 54-inch Sanitary Sewer
- Main 178 24-inch Sanitary Sewer
- Main 54 Sanitary Sewer and 90-inch Sanitary Sewer and Siphon

The siphon structures for the siphon crossing for Main 132 are shown in **Figure 2-17.**

Figure 2-17
Sanitary Sewer Main 132 Siphon Crossing, (now abandoned), of The West Fork Trinity River Located North of The TXU Power Plant.

The siphon structures for the siphon crossing for Mains 248 & 1-I-1 are shown in **Figure 2-18**.

The siphon structures for the siphon crossing for Main 272-B is shown in **Figure 2-19**.

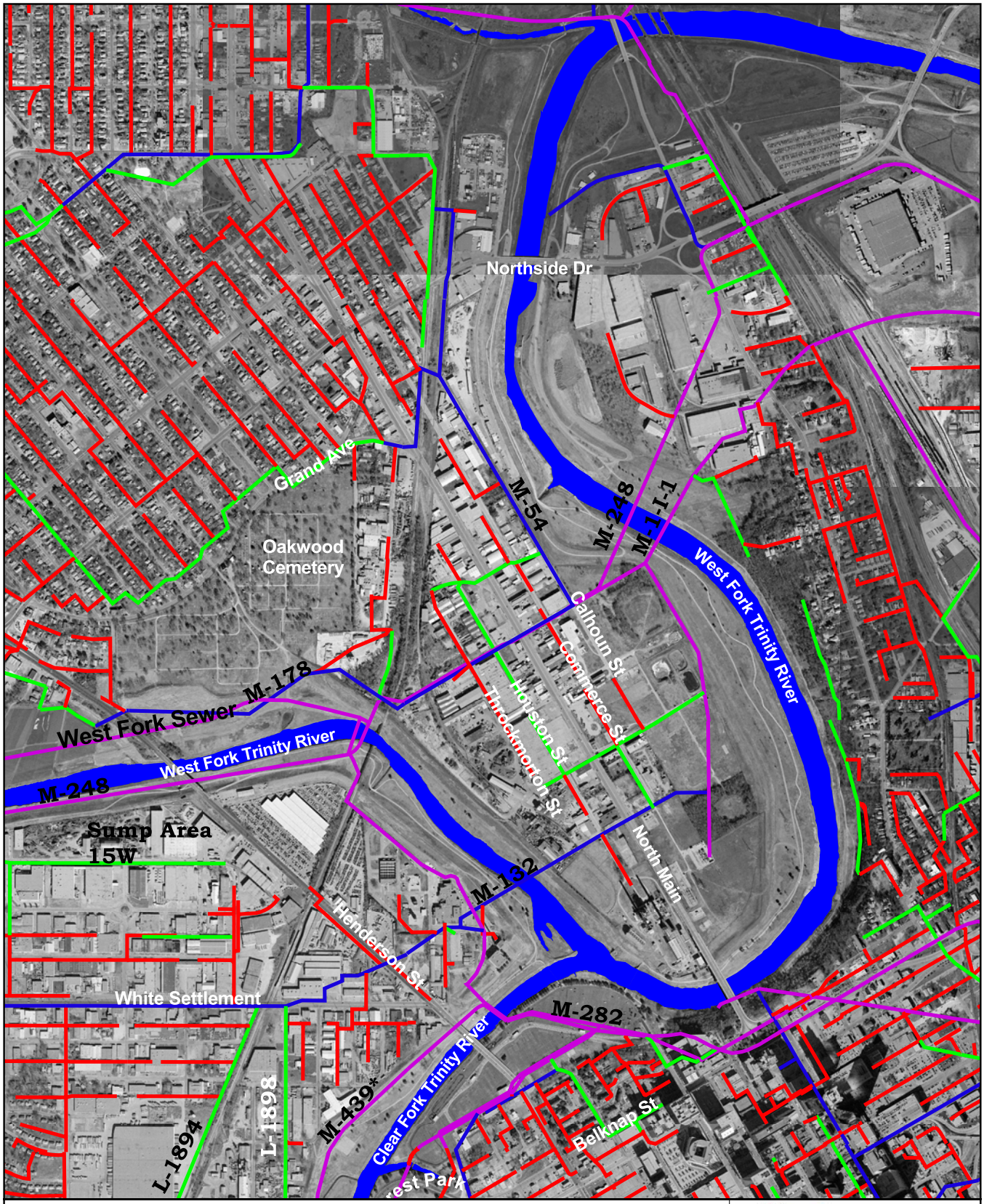

Northside Dr
Grand Ave
Oakwood Cemetery
M-54
M-248
M-1-1-1
West Fork Trinity River
Calhoun St
Commerce St
Houston St
Throckmorton St
North Main
M-178
West Fork Sewer
West Fork Trinity River
M-248
Sump Area 15W
M-132
Henderson St
White Settlement
M-282
Clear Fork Trinity River
Belknap St
M-439*
L-1898
L-1894
LEGEND
Sewer Lines & Mains
< 8
10-16
18-24
> 24
N
Existing Utilities
Sanitary Sewer
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) and sewer base maps provided by the City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 2-16

Figure 2-18
Sanitary Sewer Mains 248 (Foreground) And 1-I-1 (In The Distance) Siphon Crossings Of The West Fork Trinity River East Of North Main Street

Figure 2-19
Sanitary Sewer Main 272-B Siphon Crossing of Inlet to the Clear Fork Trinity River, Located North of Forest Park Blvd.

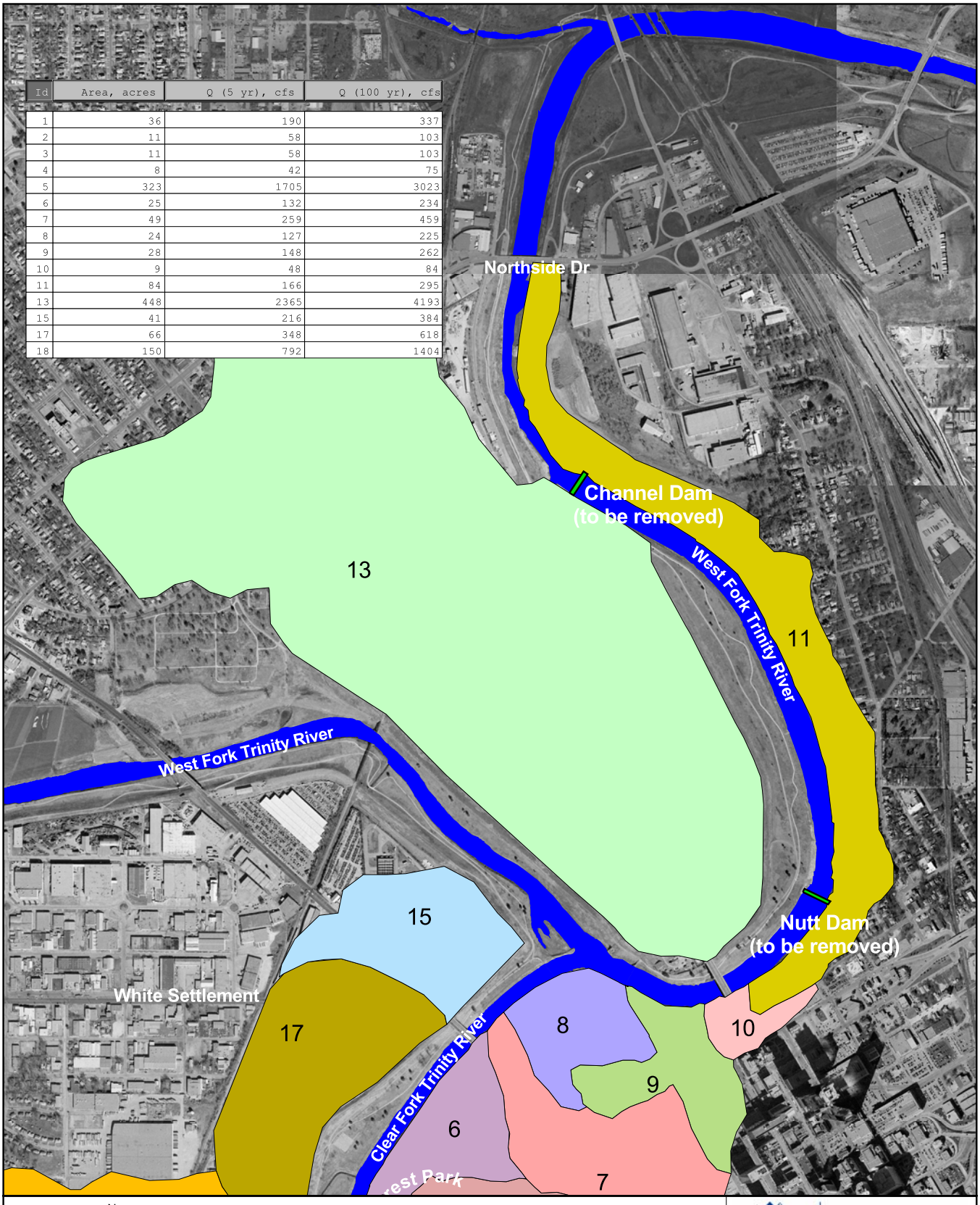
2.6.3 Storm Drainage System

The collection of storm water in the area includes sheet flow on the ground and in streets and some underground storm drainage conduits. All of the excess storm water is ultimately directed to the Trinity River. The City of Fort Worth Transportation and Public Works department owns and maintains the storm drainage system. Storm drainage pipe sizes range from 24-inch in diameter to 72-inch in diameter. Two areas located north and west of the project area drain under the railroad into the study area. A portion of the western side of the Downtown area of Fort Worth drains into a channel that flows into the Clear Fork of the Trinity. The storm drainage areas are indicated on **Figure 2-20**. Also shown on **Figure 2-20** is a table of the estimated stormwater flows for 5-year and 100-year rain events for each of the areas. Presented on **Figure 2-21** are the underground stormwater system and the sump areas. Sumps are areas in which storm water is allowed to collect and drain into the River after flood flows recede. Each of the sump areas and outfall locations are indicated and labeled with a designator on **Figure 2-21**. The outfall designator corresponds to the City of Fort Worth's numbering system, while the sump area numbering was designated by FEMA and shown on their FIS map. Photographs of several of the outfalls for the sump areas are shown on **Figures 2-22, 2-23, 2-24, 2-25 and 2-26**. The sumps are part of the existing City of Fort Worth Floodway and are maintained by Tarrant Regional Water District.

Figure 2-22
Gate Operators for Storm Drainage Sumps

Figure 2-23
Storm Drainage Outfall MW1

Figure 2-24
Storm Drainage Outfall MW2



Id	Area, acres	Q (5 yr), cfs	Q (100 yr), cfs
1	36	190	337
2	11	58	103
3	11	58	103
4	8	42	75
5	323	1705	3023
6	25	132	234
7	49	259	459
8	24	127	225
9	28	148	262
10	9	48	84
11	84	166	295
13	448	2365	4193
15	41	216	384
17	66	348	618
18	150	792	1404

N

Sources:
Aerials (1999) provided by the City of Fort Worth.
Drainage Areas delineated from information provided by the City of Fort Worth and the USACE.

Existing Storm Drainage Areas

September 2002

1000 0 1000 2000 Feet

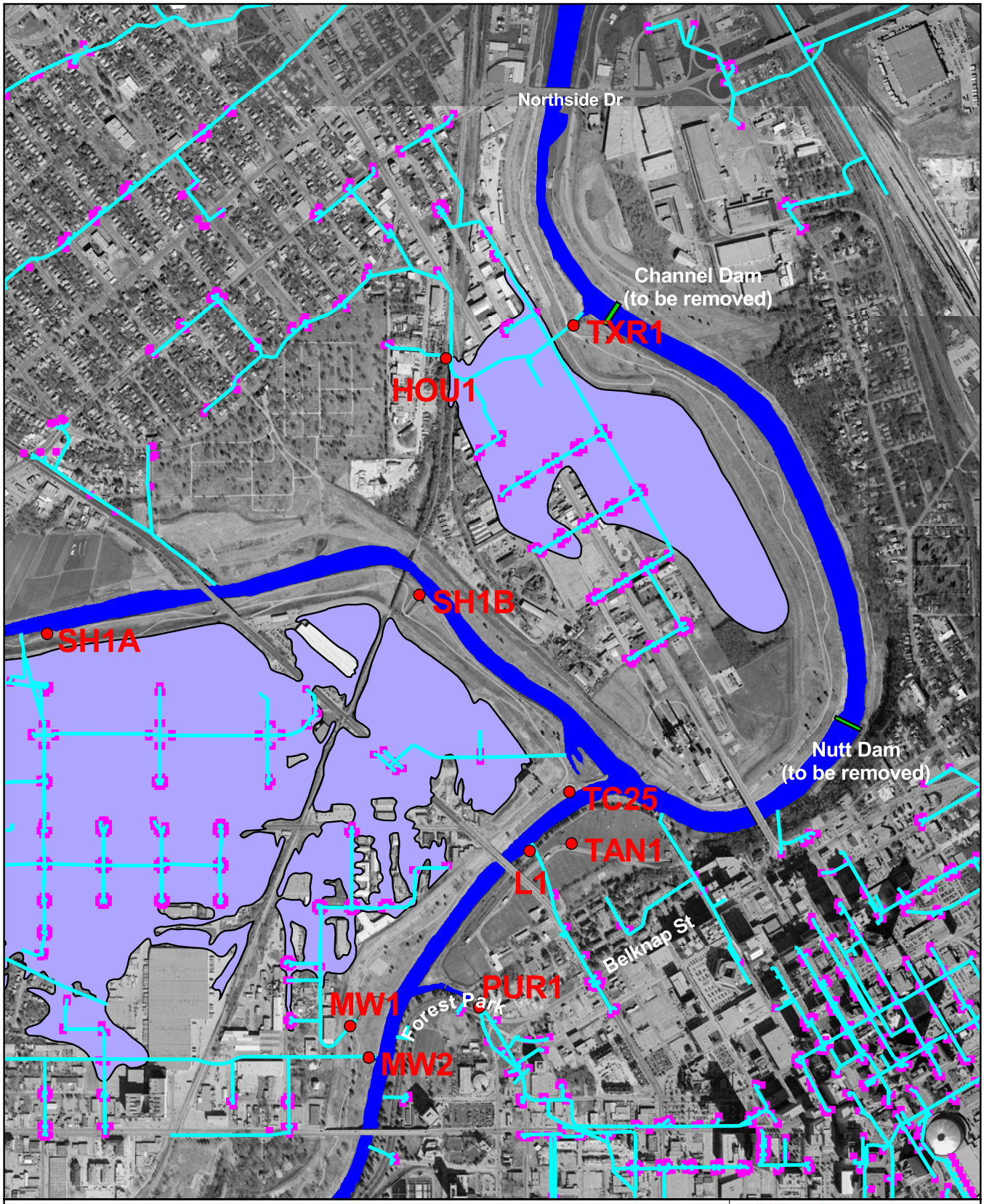
Streams and Valleys, Inc.

CDM

Turner Collie & Braden Inc.

Zachry Construction Corporation

FIGURE 2-20



LEGEND
- Storm Drain Outfalls
- Storm Drain Lines
- Storm Drain Inlets
- FEMA-designated Sump Areas

Sources:
Aerials (1999) and storm drain base maps provided by the City of Fort Worth.

N

Existing Utilities
Storm Drains

September 2002

1000 0 1000 2000 Feet

Streams and Valleys, Inc.

CDM

Turner Collie & Braden Inc.

Zachry Construction Corporation

FIGURE 2-21

Figure 2-25
Storm Drainage Outfall SH1B

Figure 2-26
Storm Drainage Outfall TXR1

2.6.4 Natural Gas

Natural gas service is extensive in the study area, and is currently provided by Oncor, formerly known as Lone Star Gas Company. The service lines range in size from 3-inch to 24-inch in diameter. The gas service lines are shown on **Figure 2-27**. A pressure regulating station is located on NE 9th street between Main and Commerce Streets.

A 20-inch diameter high-pressure gas distribution line, located in the project area, is owned by Koch Petroleum. It is our understanding that at this time, Koch is in the process of abandoning the line. A natural gas pipeline marker indicating a crossing of the Trinity River is shown on **Figure 2-28.**

Figure 2-28
Natural Gas

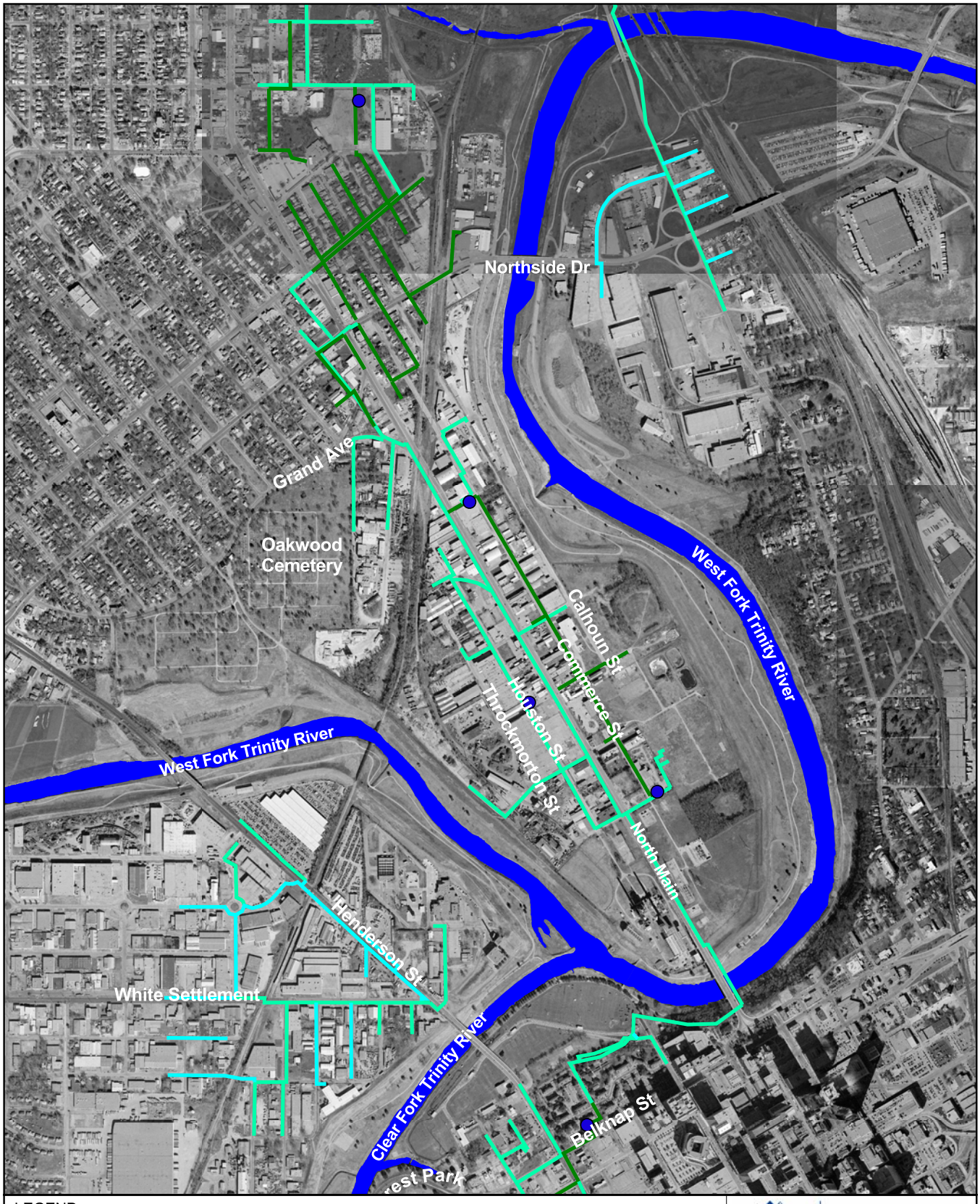

Northside Dr
Grand Ave
Oakwood Cemetery
West Fork Trinity River
Calhoun St
Commerce St
Houston St
Throckmorton St
North Main
West Fork Trinity River
Henderson St
White Settlement
Clear Fork Trinity River
Belknap St
LEGEND
Gas Pressure Reducing Stations
Gas Lines
Intermediate Pressure
Low Pressure
Unknown
N
Existing Utilities
Natural Gas
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) provided by the City of Fort Worth.
Gas line locations provided by Oncor.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 2-27

2.6.5 Electrical Transmission and Distribution

TXU Energy owns a generation facility, substation facility, transmission lines and distribution lines in the subject area. A photograph of the plant is shown on **Figure 2-29.** The generation facility and substation would not be relocated by this project. The electrical facilities are shown on **Figure 2-30**. The electrical distribution and transmission lines are located above ground. Shown on the photograph labeled **Figure 2-31** are overhead power lines along Main Street. It appears that no underground electrical conduits are located in the study area, other than a few service lines. Several electrical transmission and distribution lines cross the Trinity River and would require relocation or replacement.

Figure 2-29
TXU Power Generation Facility Photo

Figure 2-31
Overhead Power Lines

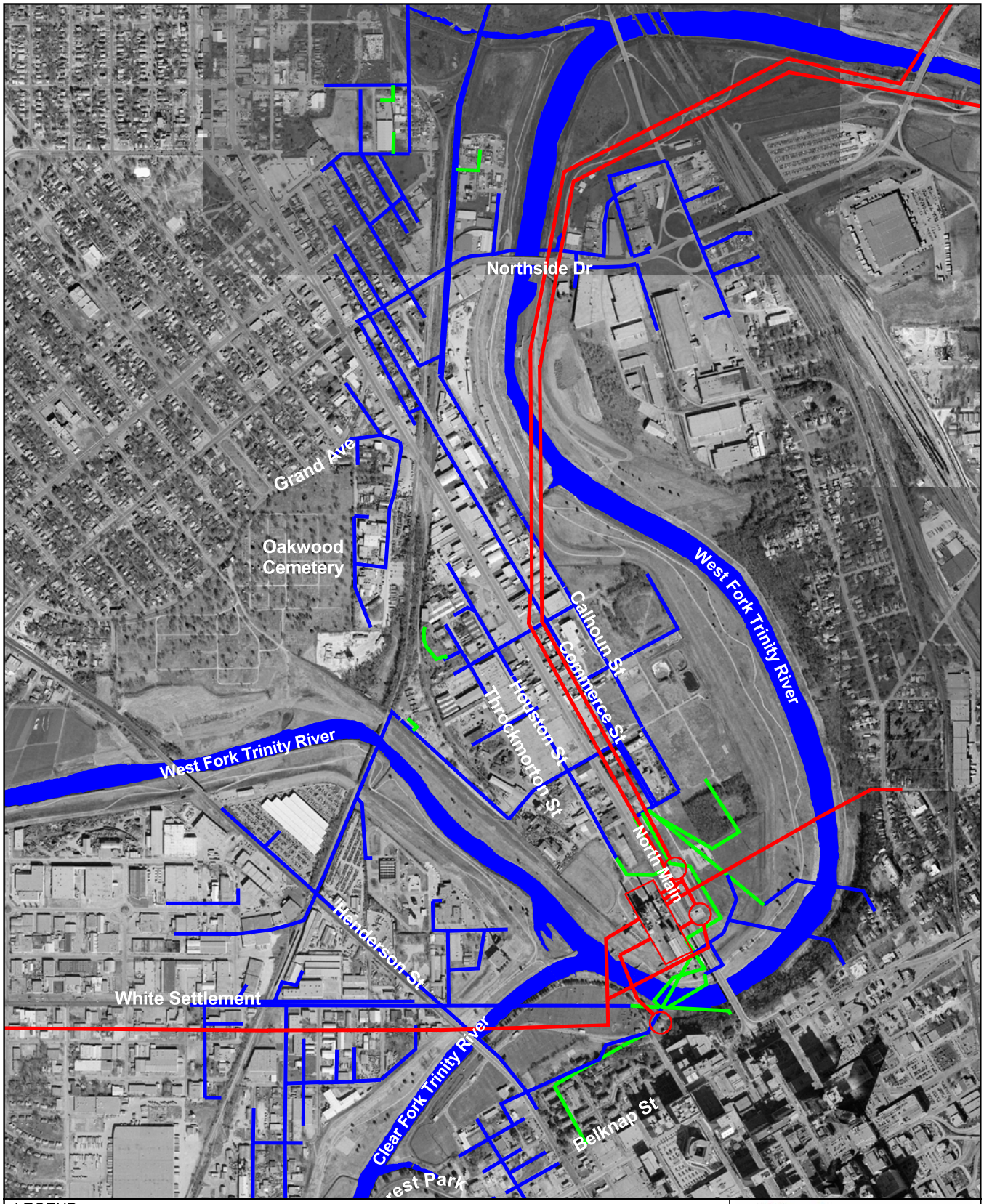

Northside Dr
Grand Ave
Oakwood Cemetery
West Fork Trinity River
Calhoun St
Commerce St
Houston St
Throckmorton St
North Main
West Fork Trinity River
Henderson St
White Settlement
Clear Fork Trinity River
Belknap St
LEGEND
Electric Stations
Electric Transmission Lines
Electric Distribution Lines
Aboveground
Underground
N
Existing Utilities
Electric Transmission and Distribution
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) provided by the City of Fort Worth.
Electric line locations provided by Oncor.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 2-30

2.6.6 Fiber Optic Cable

From available data on fiber optic lines, only one segment of overhead lines would be affected by the new channel. It appears no underground fiber optic conduits are within the project. The existing fiber optics line crosses the Clear Fork at Henderson Street. The line then heads west on White Settlement Road. **Figure 2-32** shows the fiber optic line.

2.6.7 Cable TV

Based on the available information, the existing cable lines are shown on **Figure 2-33**. Most of the cable lines are located on the western side of the study area.

2.6.8 Telephone

Maps of the area serviced with telephone lines were unavailable from local telephone providers. Telephone service is located extensively through out the service, but could be easily relocated if necessary.

2.6.9 General Issues Regarding Relocation of Utilities

During the relocation of utilities in the study area, several items should be addressed, regardless of the type of utility or nature of the installation. These items include:

- Interruption of service to businesses and residents
- Safety of the general public and the contractor's staff
- Easements and right-of-way issues
- Local, state and federal regulations, codes and laws

The relocation of the utilities present the same challenges as a new pipeline, when considering the "replacement" pipe. A list of some of the items to consider are presented below:

- Obtaining easement or right-of-way for new pipe and abandoning of existing pipe
- Determining an unobstructed and efficient route
- Vertical alignment for the gravity systems
- The utilities in the study area, which are located below ground, include water, sewer, storm drainage, gas distribution and transmission. Relocation of underground utilities poses several challenges:
- Determination of exact location of existing pipe (vertical and horizontal placement) can be difficult.
- Current condition of the conduit is not fully known until line is uncovered.
- Leaks in conduit are typically not evident until the line is uncovered.
- Type, size and material of connection pipe cannot be discerned until existing pipe is uncovered.
- Environmental issues are discussed in a following section.

The sanitary sewer and storm drainage systems are utilities in the project area that utilize gravity to transport product. Gravity systems conform to the natural topography and therefore provide greater system reliability and savings in energy costs for pumping, operation and maintenance. If gravity systems are not utilized, lift or pump stations are required and possibly back-up power sources. The vertical alignment of a gravity system is critical, in that a storm or sanitary sewer system line is dependent on the vertical location of the starting and ending point of the line. If relocation of a sewer line cannot remain a gravity line, then pumping stations and pressure mains are required.

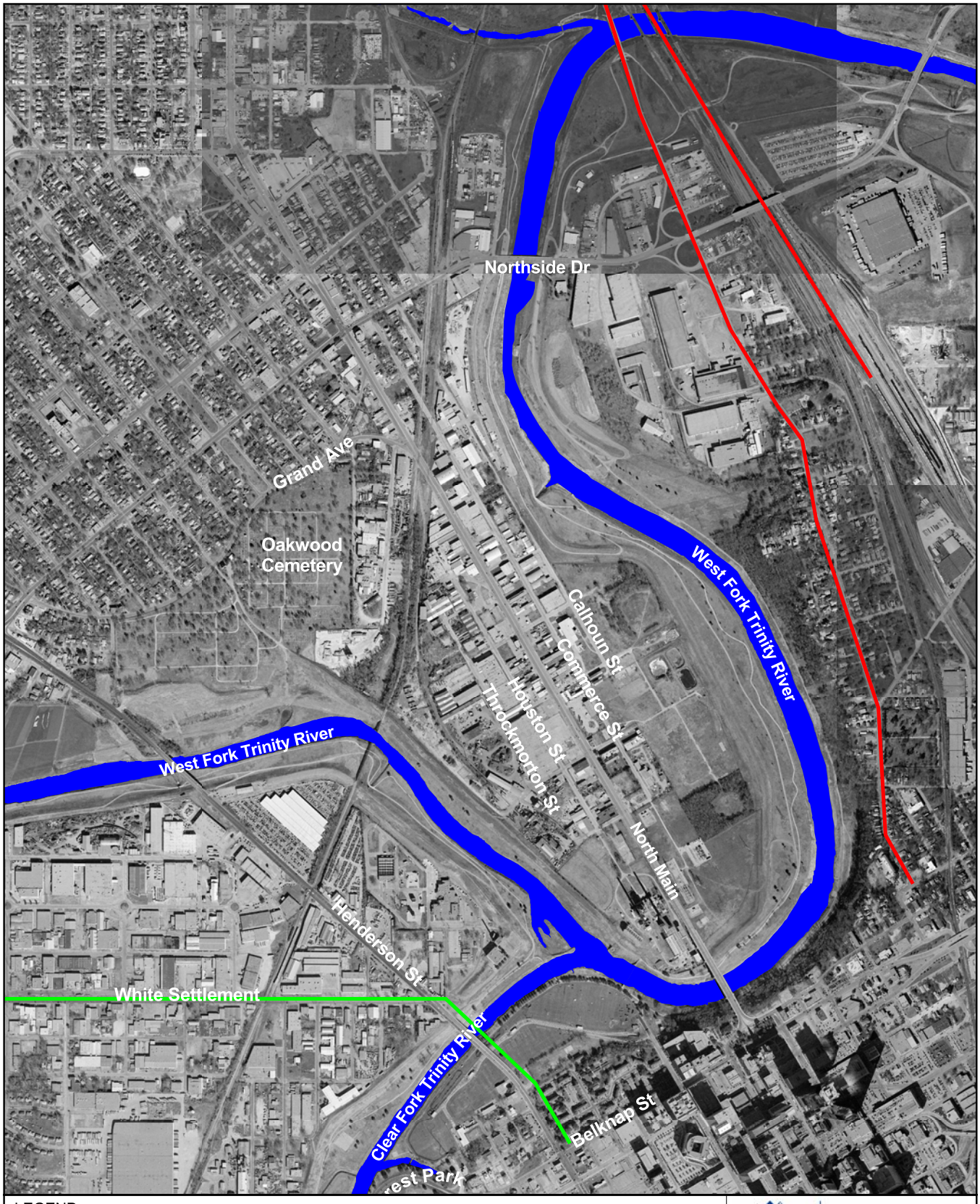

Northside Dr
Grand Ave
Oakwood Cemetery
West Fork Trinity River
Calhoun St
Commerce St
Houston St
Throckmorton St
North Main
West Fork Trinity River
Henderson St
White Settlement
Clear Fork Trinity River
Belknap St
LEGEND
Fiberoptics
Aerial
Underground
N
Existing Utilities
Fiber Optics
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) and water base maps provided by the City of Fort Worth.
Fiber optic line locations provided by E-Spire Communications, Level 3 Communications and Metromedia Fiber Network.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 2-32

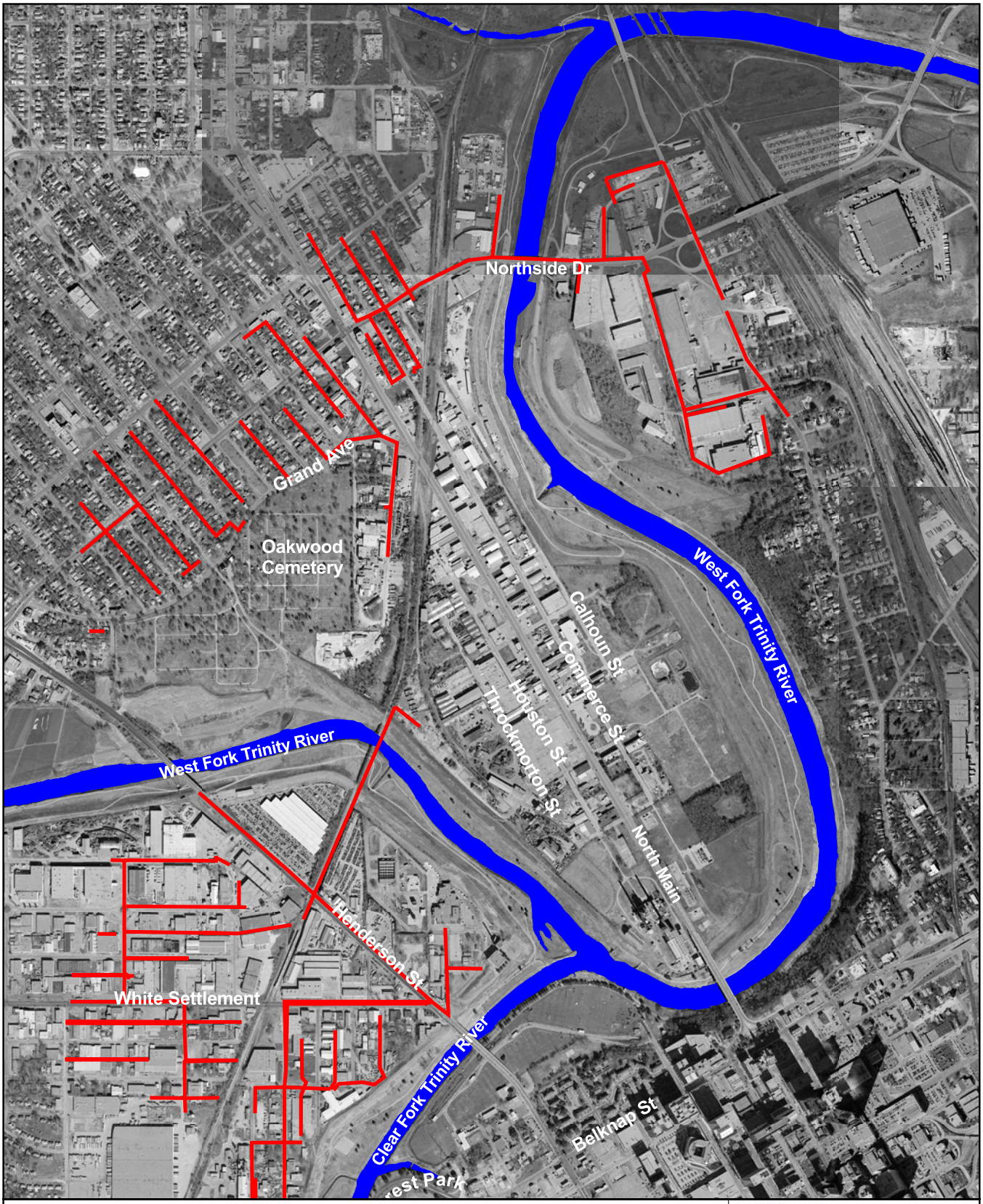

Northside Dr
Grand Ave
Oakwood Cemetery
West Fork Trinity River
Calhoun St
Commerce St
Houston St
Throckmorton St
North Main
West Fork Trinity River
Henderson St
White Settlement
Clear Fork Trinity River
Belknap St
LEGEND
Cable
N
Existing Utilities
Cable
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) and water base maps provided by the City of Fort Worth.
Cable line locations provided by Charter Communications.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 2-33

The water system, gas distribution and gas transmission systems are systems in which the product is transported by pressure. Relocation of pressure conduits also can pose challenges, some of which are listed below.

- Relocation of the line may require assessment of the pressure inducing system, (pumping stations, larger diameter transmission conduits).
- Additional safety precautions are necessary for pressure conduits transporting flammable products.

Excavation of existing utilities and trenches for relocated utilities may result in discovery of environmental concerns in the soil or groundwater. Exploratory investigations and environmental research in the area are recommended prior to any excavation. Also, contingency plans should be in place prior to excavation in the event environment concerns are discovered.

The relocation of the utilities in the concept study are based upon "in kind" replacement. Therefore, system capacity evaluations or capacity allowances for redevelopment of the area were not considered.

2.7 Environmental Issues

The implementation of a bypass channel on the Trinity River would divert flood flows from the confluence of the Clear Fork and the West Fork to just upstream of the Northside Drive crossing. The location of the both bypass channel alignment options traverse through current or past commercial and industrial developed areas. Therefore, environmental issues must be evaluated carefully. Properties within the study area may be in need of environmental cleanup of hydrocarbons, heavy metals and other toxins. This section provides an overview of potential environmental considerations in the project area. It does not define the type and extent of environmental contamination or environmental impacts within the area since this is largely unknown at this time.

2.7.1 Contaminated Sites

Areas of known soil and groundwater contamination were identified from information recorded in the North Main Street Corridor Study performed by Kimley Horn and Associates, July 2000, but no field research was conducted to verify the contamination. **Figure 2-34** illustrates these sites. Excavation for the bypass channel, roads or relocated utilities may result in discovery of environmental concerns in the soil or groundwater not yet identified. The necessary precautions and investigative studies must be completed prior to beginning any excavation.

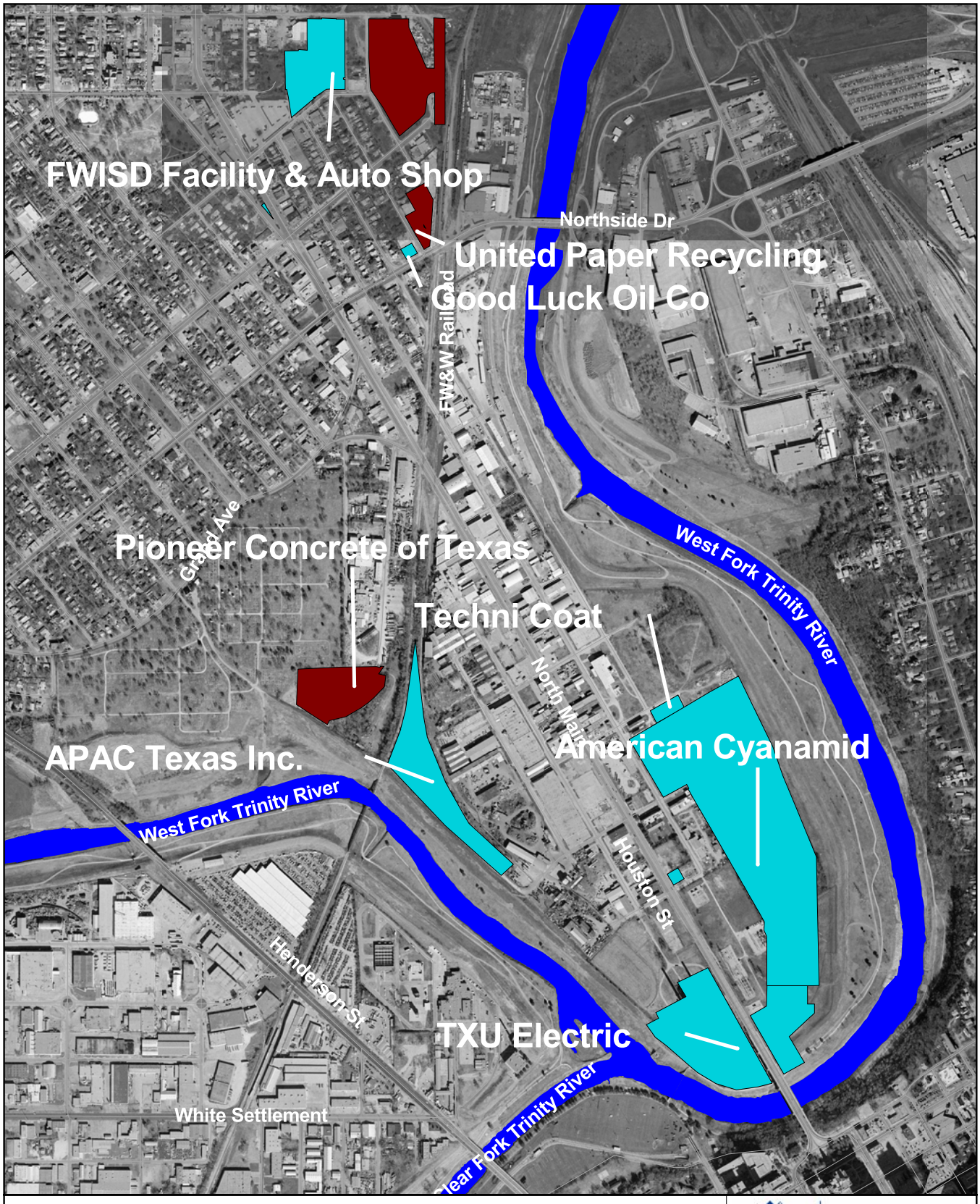
Currently, the consumption of fish from the Trinity River is banned by the Texas Department of Health (TDH). The ban was issued in January 1990 due to elevated concentrations of chlordane in fish tissue leading to unacceptable human health risk. Chlordane, an organochloride insecticide, is considered a legacy pollutant, a chemical that has been banned but remains in the environment due to its slow rate of decomposition. The Texas Natural Resource conservation Commission (TNRCC) defines the two portions of the Trinity River within the study area that are currently under the ban as follows:

- **Segment 0829 –** Clear Fork Trinity River Below Benbrook Lake

  Description: The lower one mile of the segment from 7th Street to the confluence with the West Fork Trinity River in downtown Fort Worth.

- **Segment 0806 –** West Fork Trinity River Below Lake Worth

  Description: The lower 22 miles of the segment from the Clear Fork Trinity River confluence in downtown Fort Worth to the end of the segment at the confluence with Village Creek.



LEGEND

Contaminated Sites
Groundwater
Soil

N

Contaminated Sites

September 2002

900 0 900 1800 Feet

Sources:
Aerials (1999) provided by the City of Fort Worth.
Environmental information input from the North Main Corridor Study.

Streams and Valleys, Inc.

CDM
Turner Collie & Braden Inc.
Freese-Nichols
Fugro
Zachry Construction Corporation

FIGURE 2-34

The portions of the Trinity River under this ban are illustrated below.

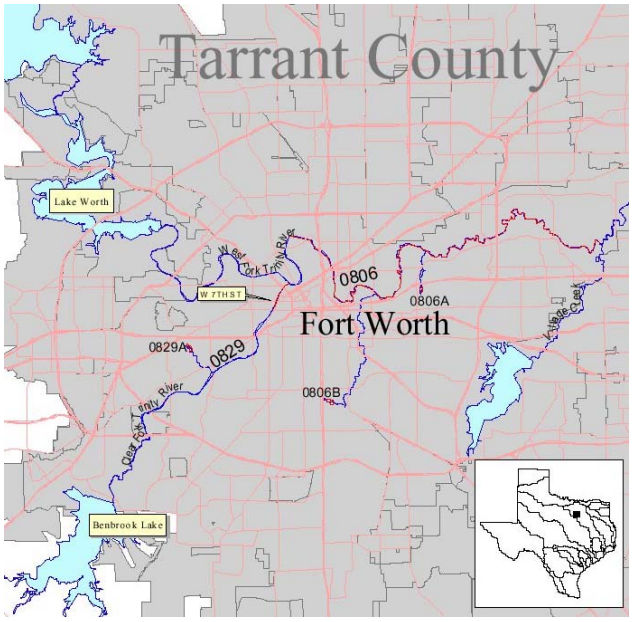


Figure 2-35
Areas of Trinity River Where Fish Consumption is Banned

The City of Fort Worth in a cooperative effort with the TNRCC and the United Stated Geological society (USGS) has begun a sampling program and established a total maximum daily load (TMDL) for these segments of the Trinity River. Although the data is limited, fish tissue data indicate that chlordane concentrations are decreasing as a result of natural attenuation processes[1]. As no new sources of chlordane are expected, chlordane levels are expected to decrease with the continuation of natural attenuation. In time, the fish tissue concentrations will decrease satisfactorily that the TDH will be able to remove the ban.

Fort Worth is designated as non-attainment for ozone, meaning that it does not meet federal standards for air quality for this contaminant. New projects and development must comply with air quality standards. It is not anticipated that this project would negatively impact air quality.

2.7.2 EPA Designated Sites

Sites within the area were identified as SARA, RCRA and/or CERCLA sites. **Figure 2-36** illustrates the number of identified sites within the project area. The presence or use of materials on a site does not necessarily denote a hazard. The designations SARA, RCRA and CERCLA are defined as follows:

- RCRA – Resource Conservation and Recovery Act

  RCRA sites were obtained from the accessing the RCRIS database, which is used by the EPA to track facilities regulated under RCRA, Subtitle C (hazardous waste handlers). RCRA labeled sites identify large quantity generators, persons or facilities generating more than 2200 pounds of hazardous waste per month, in the area.

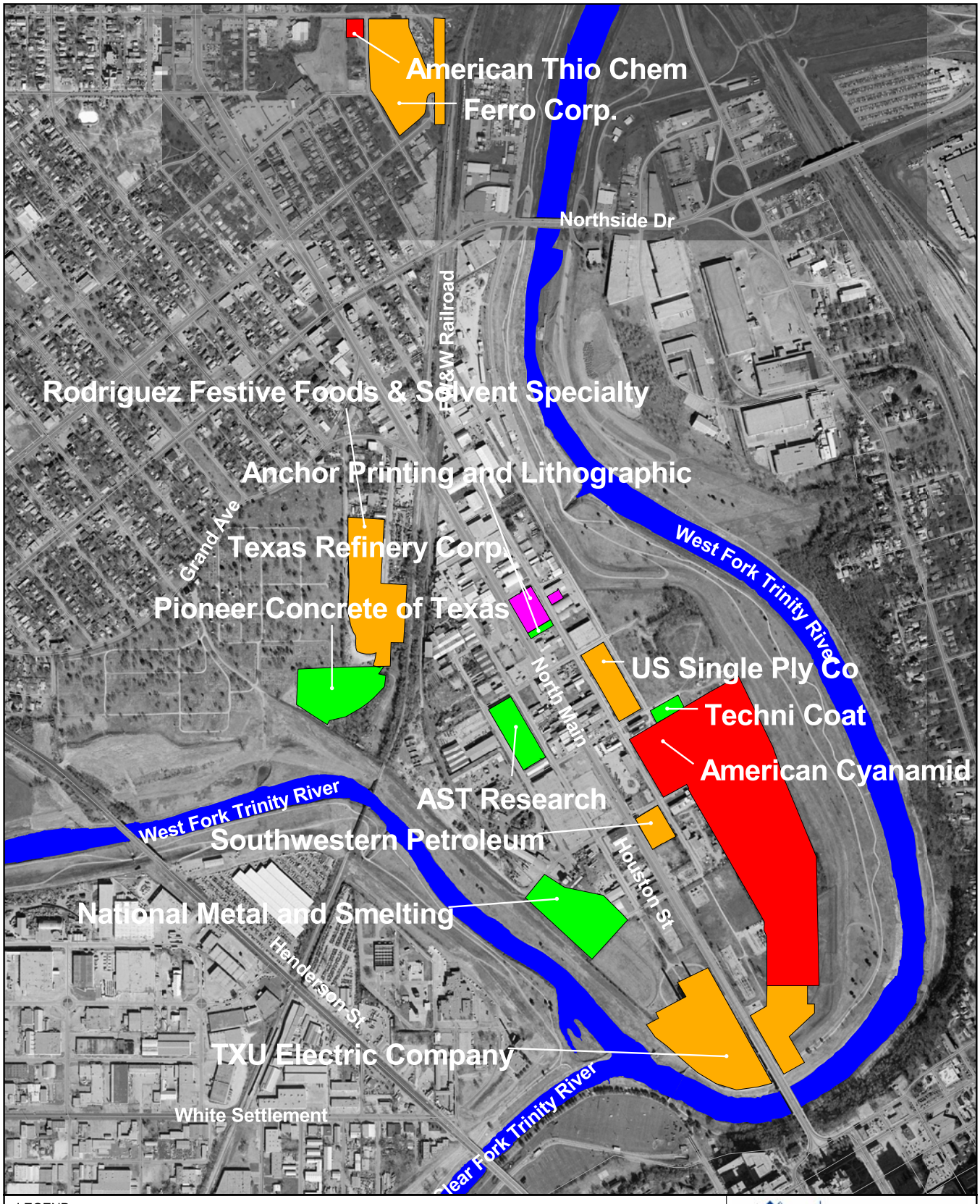
- CERCLA – Comprehensive Environmental Response, Compensation and Liability Act

CERCLA sites were obtained by accessing the CERCLIS database, which contains information on hazardous waste site assessment and remediation. A CERCLA identifier indicates that the site is either currently listed on the National Priorities List (NPL) or is being or has been investigated as a Superfund site.

- SARA – Superfund Amendments and Reauthorization Act

  SARA Title III is also known as the Emergency Planning and Community Right-To-Know Act (EPCRA). SARA labeled sites are regulated facilities that have hazardous and/or toxic chemicals present. These sites are required to participate in emergency planning and notify their communities of the existence of hazardous

[1] Texas Natural Resource Conservation Commission, "Eleven Total Maximum Daily Loads for Legacy Pollutants in Streams and Reservoirs in Fort Worth", EPA Approval Received May 2001, http://www.tnrcc.state.tx.us/water/quality/tmdl/fwleg.html.



LEGEND
EPA Designated Properties
CERCLA
RCRA
SARA
SARA & RCRA

Sources:
Aerials (1999) provided by the City of Fort Worth.
Environmental information input from the North Main Corridor Study.

N

EPA Sites

September 2002

900 0 900 1800 Feet

Streams and Valleys, Inc.

CDM
Turner Collie & Braden Inc.
Freese-Nichols
Fugro
Zachry Construction Corporation

FIGURE 2-36

and/or toxic chemicals, as well as scheduled and/or accidental releases.

2.7.3 Brownfields

A brownfield is defined as abandoned or idle commercial or industrial facilities where redevelopment is complicated by real or *perceived* contamination. The City of Fort Worth maintains a database of brownfields that includes sites that have been contaminated, as well as sites that were reported by anonymous individuals. A property listed as a brownfield in the database does not necessarily mean that it is contaminated. Sites listed as contaminated and EPA permitted may not mean that they have been included in the brownfield database**. Figure 2-37** illustrates the number of brownfields identified within the project area.

The brownfields appear as points along streets, as the fields were created by geocoding the addresses with ArcView GIS. Addresses of the brownfields were matched to their location along a roadway reference file, placing points at each location. Although the brownfields will actually encompass the entire lot, each brownfield is represented in **Figure 2-37** as a point on the street next to the lot.

The City of Fort Worth launched their Brownfields Economic Redevelopment Program in October 1999, and it may be available to assist in the redevelopment within the study area. The Brownfields program's purpose is to determine environmental conditions on properties and, if necessary, a program for remediation. The Fort Worth Department of Environmental Management was provided a $200,000 grant by the EPA to perform Phase I and Phase II environmental site assessments on properties selected for redevelopment under the program. The City has acquired the American Cyanamid and Technicoat properties, which they intend to place into the voluntary cleanup program.

2.7.4 Storage Tanks

Storage tanks, both aboveground and underground, were identified within the area to refine demolition costs of items within the channel alignment. Several of the sites identified as contaminated have known leaking underground storage tanks. This designation is not identified in the following figure, but the potential is ever present. **Figure 2-38** illustrates the number of tanks identified within the project area.

The storage tanks appear as points along streets, as the theme were created by geocoding the addresses with ArcView GIS in the same way that the brownfields were created. Addresses of the storage tanks were matched to their location along a roadway reference file, placing points at each location. Although the storage tanks are located within the lot and not on the street, each storage tank is represented in **Figure 2-38** as a point on the street next to the lot containing the tank(s).

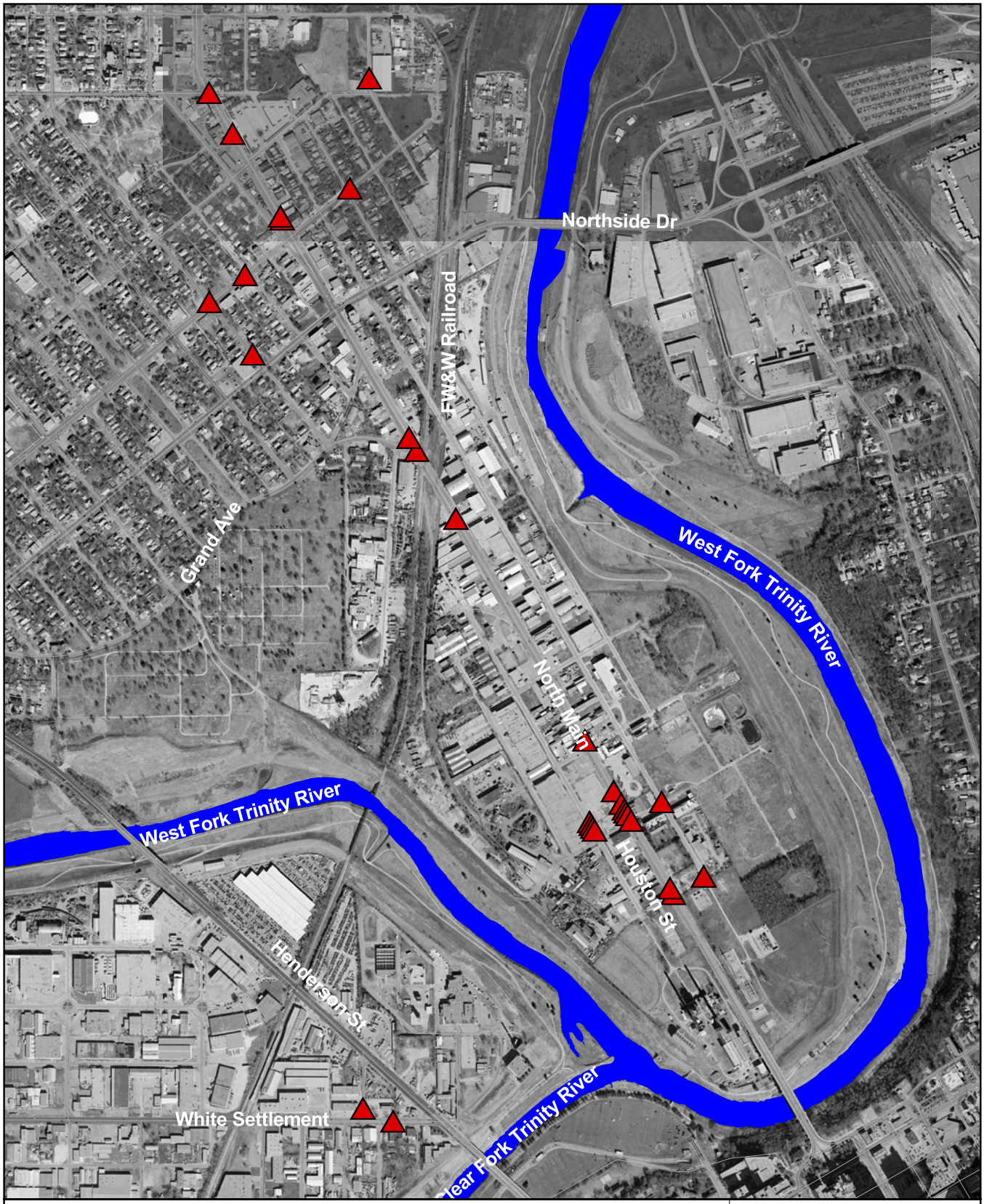
2.8 Property Acquisition and Demolition

The bypass channel, levee system for the channel, relocated transportation systems and relocated utilities would require the acquisition of properties in and around the project area.

The City of Fort Worth GIS files were used to obtain information on property plat, survey and subdivision data for the affected properties. The property information was then used to gather additional data from Tarrant Appraisal District. The data included:

- Addresses of property
- Legal Description
- Ownership data
- TAD appraisal value for land and building
- Size of property and size of land
- Classification of structure

Information on the size of the building "foot-prints" in the project area was available from the Corps of Engineers GIS files.



LEGEND

Brownfields

N

Sources:
Aerials (1999) provided by the City of Fort Worth.
Brownfields sites geocoded from information provided by the City of Fort Worth.

Brownfields

September 2002

900 0 900 1800 Feet

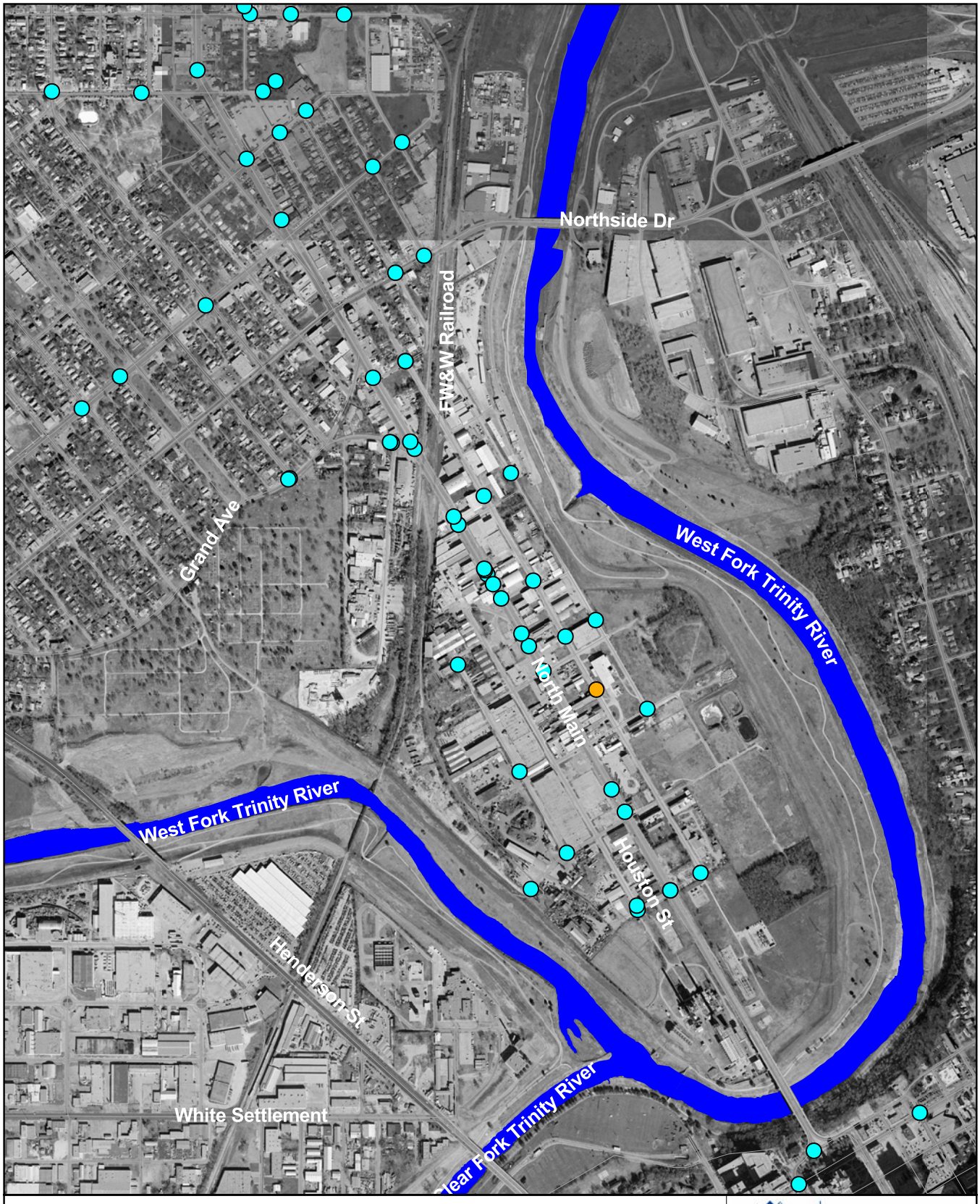
Streams and Valleys, Inc.

CDM

Turner Collie & Braden Inc.

Zachry Construction Corporation

FIGURE 2-37



LEGEND
Storage Tanks
AST
UST

N

Sources:
Aerials (1999) provided by the City of Fort Worth.
Environmental information input from the North Main Corridor Study.

Storage Tanks

September 2002

900 0 900 1800 Feet

Streams and Valleys, Inc.

CDM
Turner Collie & Braden Inc.
Fugro
Zachry Construction Corporation

FIGURE 2-38

The TAD appraisal value was used as a starting point for determination of the estimated cost of property acquisition. TRWD utilized independent real estate appraisers to review and modify the TAD appraisal value to represent market values for the property.

In addition to the acquisition of certain properties in the study area, removal or demolition of structures could be necessary to construct the project. Information on the type of building was available from TAD and the number of floors of the buildings was determined from the total square footage reported by TAD and the square footage of the footprint of the building. The type of building is established by a classification. TAD has 22 classes, most of which are commercial and industrial sites. The construction type and comments provided detailed information used for costing the demolition of the structures.

Section 3 Evaluation of Alternative A – Bypass Channel

3.1 Description and Alignment

Alternative A bypass channel is shown on **Figure 3-1**. The Alternative A alignment begins on the Clear Fork of the Trinity River between 7th Street and Henderson Street. The bypass channel then traverses northwest to the existing railroad. The bypass channel then traverses northeast in the general route of the existing alignment of the railroad to just past Main Street. At this point, the channel traverses east to intersect the West Fork of the Trinity River prior to Northside Drive. Alternative A bypass channel is approximately 9,540 linear feet.

The details of Alternative A are presented in the following sections with an opinion of probable construction cost provided. Contained in Section 3.10 is a summary of the construction cost items and a total project estimate for Alternative A.

3.2 Hydraulic and Hydrologic Considerations

The hydrologic and hydraulic analyses consisted of updating the base Upper Trinity Study (UTS) models with the TRWD channel, Beach Street dam and 4th Street dam improvements to establish updated base models. These models were then revised to include the proposed dam at Samuels Avenue and became the Samuels Avenue Dam models. The next step in the analysis required the conceptualization of a bypass channel template and alignment to establish a quiescent area. Both Alternative A and B bypass channels utilized the same channel template.

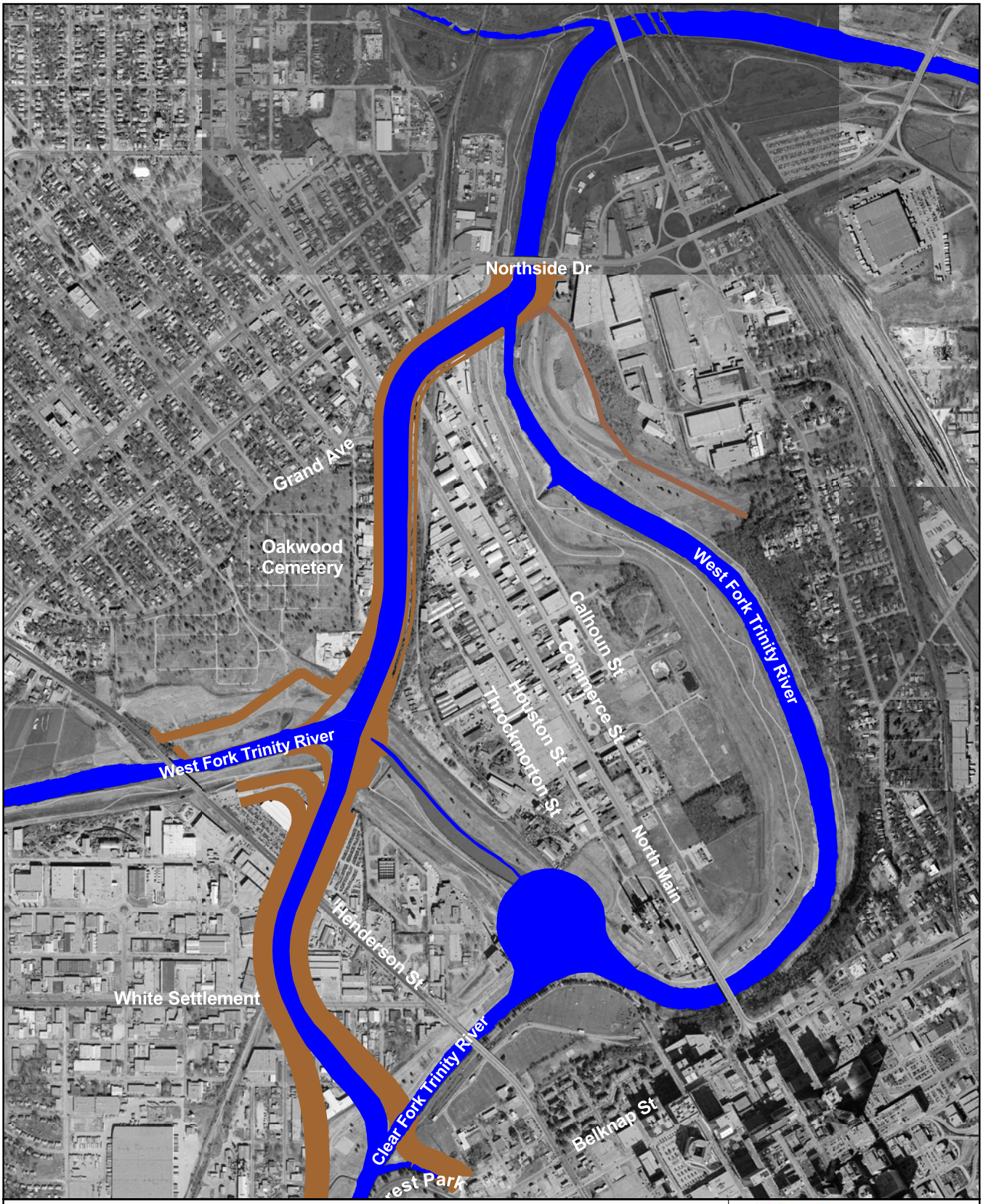
The bypass channel cross-section template for Alternative A channel is trapezoidal in shape consisting of a 3:1 horizontal to vertical side slope. This template only changed at the transition points back into the natural channels and where a vertical wall would be erected. A trapezoidal section is only one of a number of possible channel cross-section geometries. The analysis would be updated accordingly for the final channel geometry. Two channel alignments were developed to determine the size of the proposed bypass channel and its ability to meet the regulatory constraints. The following is a description of the Alternative A alignment and a tabular summary of their hydrologic and hydraulic impacts.

3.2.1 Bypass Channel A – Alignment

Figure 3-2 (contained in Appendix D) shows the alignment and conceptual grading plan for bypass Channel A. The bypass channel starts west of Henderson Street on the Clear Fork. It continues northeast along the north side of the existing Fort Worth and Western Railroad until it intersects the West Fork. This reach of the channel has a bottom width of approximately 80 feet and a top width of approximately 380 feet. The top of levee is at an elevation that equals the SPF plus 4 feet requirement. The bypass with the Clear Fork picks up West Fork flows and continues to follow the railroad right-of-way on the north side past its intersection with Main Street. The channel then turns east back under the railroad to tie into the south side of the Northside Drive Bridge. The channel through this reach has a bottom width of 100 feet and a top width of approximately 400 feet. The top of levee is at an elevation that equals the SPF plus 4 feet requirement. The channel is approximately 9,540 feet in length and bypasses approximately 15,250 linear feet of the existing channel.

3.2.2 Bypass Channel A - Hydrology

The hydraulic models were updated with the new Channel A alignment and reevaluated with an increasing series of flow values. This is referred to as a "storage run" and from it the amount of storage used in a channel reach for each increasing change in anticipated flow is determined. A revised stage storage relationship was developed for each of the storage routing reaches impacted



Bypass Channel Alignment
Alternative A

September 2002

FIGURE 3-1

by the proposed project. The updated hydraulic models were modified to account for the reduction in storage from the shortening of the flow path of the bypass channel and the reduction in storage due to the change in channel geometry.

Table 3-1 shows the comparison of storage volumes for each routing reach impacted by the proposed improvements for the SPF event. The Channel A alignment reduces the available flood storage by approximately 2,210 acre-feet.

Upon completion of the hydraulic model storage runs, the hydrologic models were updated with the revised stage storage relationships for the impacted routing reaches. **Table 3-2** is a comparison of the impacts this reduction in valley storage makes to the peak flows in the Trinity River. It indicates that the removal of approximately 2,210 acre-feet of valley storage translates to an increase in peak flows downstream of the project.

Routing Reach	CDC Model (ac ft)	Updated CDC Model Improvements (ac ft)	Alternative A (ac ft)
From near confluence of CF& WF to D/S of Samuels Ave. Dam	4067	4115	2147
From near Rockwood Park to near confluence of CF & WF	5772	5679	4616
From 150 ft D/S of I-30 to D/S of Henderson	4306	3598	4421
Totals	14145	13392	11184
Difference in Alignment A and Updated CDC Models =			2208

Table 3-1
Comparison of Valley Storage for the CDC-SPF Model

DESCRIPTION	Updated CDC Model PEAK FLOW (cfs)	Alt A PEAK FLOW (cfs)	Alt A Minus Existing (cfs)
WF flows from Sycamore Creek to E 1st St	70355	72265	1910
WF flows from E 1st St to R.M.554.3	64387	65628	1241
WF flows from R.M.554.3 to Big Fossil Creek	63094	64289	1195
WF flows from Big Fossil Creek Village Creek	79939	81304	1365
WF flows from Village Creek to Walker Branch	94591	95684	1093
WF flows from Walker Branch to State Hwy 157	95886	96966	1080
WF flows from State Hwy 157 to State Hwy 360	91421	92356	935

Table 3-2
Comparison of Peak Flows for the 100-Year CDC Model

3.2.3 Bypass Channel A – Hydraulics

The Samuels Avenue dam hydraulic model was updated to include the Channel A bypass channel. The update included removing the existing channel cross-sections from approximately Northside Drive bridge on the West Fork to Henderson on the Clear Fork and upstream of the Fort Worth and Western Railway Bridge on the West Fork. These sections were replaced by the Channel A bypass channel cross-sections. **Figure 3-2** shows the conceptual plan of the Channel A alignment, grading and revised cross-section numbering.

Manning's roughness coefficient of 0.035 was used for both the channel and the left and right overbanks. Standard contraction and expansion coefficients of 0.1 and 0.3, respectively, were used throughout the study reach with the exception of those influenced by bridges.

Lengths between stations, Left of Bank (LOB), Right of Bank (ROB) for Alternative A were determined by measuring from the conceptual plans. New or improved bridges were not modeled in this phase of the study.

The water surface elevations and velocities at selected cross-sections for Alternative A for each of the models are presented on **Table 3-3**. The velocities through the channel for Alternative A are listed in **Table 3-4.**

FEMA-100 Model			
STATION	Description	Updated Model W.S. (feet) msl	Alignment – A W.S. (feet) msl
244898	Channel A at Northside Dr.	526.2	532.11
258103	WF into Channel A	538.74	534.49
3423	Beginning of Channel A @ CF	539.06	536.62
CDC-100 Model			
STATION	Description	Updated Model W.S. (feet) msl	Alignment – A W.S. (feet) msl
244898	Channel A at Northside Dr.	527.18	532.28
258103	WF into Channel A	539.15	534.76
3423	Beginning of Channel A @ CF	539.63	536.75
CDC-SPF Model			
STATION	Description	Updated Model W.S. (feet) msl	Alignment – A W.S. (feet) msl
244898	Channel A at Northside Dr.	540.7	540.99
258103	WF into Channel A	552.1	547.87
3423	Beginning of Channel A @ CF	552.4	550.41

Table 3-3
Comparison of Water Surface Elevations for the 100-Year FEMA, 100-Year CDC and CDC-SPF Models

ALT A VELOCITIES (ft/s)						
Description	Model CDC-100	CDC-100	Model FEMA	FEMA	Model CDC-SPF	CDC-SPF
WF into Channel A	4.47	2.6	7.6	2.63	4.09	2.3
Channel A crossing RR		7.92		7.74		14.08
Channel A / WF @ Northside Dr	8.1	5.66	7.74	3.64	9.48	6.88
Beginning of Channel A on CF	6.52	8.3	6.31	7.94	6.7	7.45
Channel A @ Henderson		10.47		9.72		14.21

Table 3-4
Comparison of Flow Velocities for the 100-Year FEMA, 100-Year CDC and CDC-SPF Models

The alternative A channel alignment reduces the upstream flood stages of both the 100-year and SPF flood elevations significantly at Stations 258103 and 3423. The flood reduction averages approximately three (3) feet. This flood stage reduction is due to the reduction in channel flow path of approximately 6,250 linear feet caused by the bypass channel, the associated reduction in valley storage and the improved hydraulic section of the trapezoidal bypass channel. The reduction in flood stage reflects a potential flood control improvement. The SPF flood stage at 244898 is very slightly raised. However, there is a significant increase in 100-year flood stage that propagates upstream to the location of the existing Nutt dam. Since the 100-year flood stage increases are fully contained within the levee system, it is assumed that a variance could be obtained from the CDC process.

The reduction in flood stage translates into increased flow velocities within the proposed bypass channel. Erosion control measures would have to be included in the bypass channel concept to ensure that the channel retains its integrity under peak flows.

3.2.4 Summary

The Samuels Avenue Dam hydraulic model was revised to include Bypass Channel Alignment A.

A storage run was made to develop revised stage storage relationships for the impacted flood routing reaches. The Samuels Avenue Dam hydrologic models were then updated with this new information and new flows were generated. The following differences were noted between the Updated UTS hydrology models and the bypass Channel Alignment A hydrology models at locations within the proposed project site:

- There is a significant reduction in valley storage of approximately 2,300 ac-ft due to the channel bypass. This is due to the reduction in channel length; the bypass channel reduces the original channel length by approximately 6,250 ft. Additionally, the bypass channel is a more efficient hydraulic shape that provides for greater flow at lower elevations than the existing channel. Finally, the bypass channel reduces the flood stage elevations that in turn decrease the valley storage.

- The reduction in valley storage due to the bypass channel increases flood flows downstream of the project site.

A strict interpretation of the CDC and ROD requirements indicate that storage volume has to be recovered.

The analysis indicates that replacement valley storage will have to be provided within the project area or in close proximity to mitigate for the loss associated with the bypass channel. **Figure 3-3** shows the potential location of mitigation sites where the valley storage can be excavated to provide the 2,300 ac-ft of valley storage lost due to the bypass channel. This 2,300 ac-ft of valley storage does not account for any flows that are captured and contained within the quiescent area. It is possible that the Corps would allow this area to either be removed from the contributing areas in the hydrology model or the valley storage used by the quiescent area may be counted toward reducing the 2,300 ac-ft needed to mitigate the channel impacts.

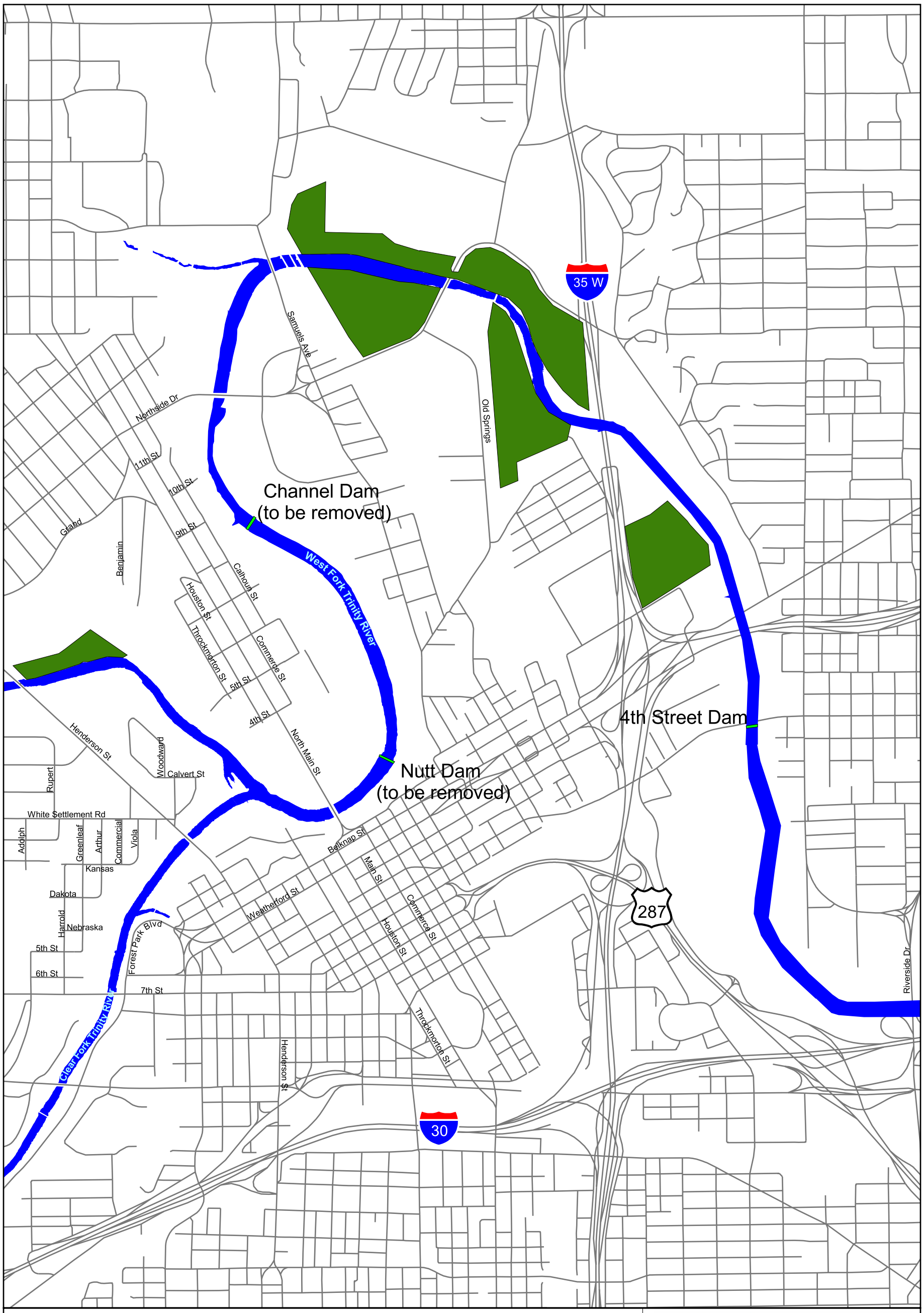
The valley storage mitigation requirement is a part of both the CDC and ROD as a reduction in valley storage has a potential to increase peak flood flows downstream. A review of the Alignment A and Alignment B alternatives indicates that without the recovery of the valley storage, peak flows will occur downstream. There is a limited potential that the reduction in peak flows downstream may be accomplished without the need for the complete recovery of the valley storage volumes. A phased analysis of the proposed valley storage mitigation areas may indicate that there is a cost-benefit relationship between the expense of recovering valley storage and the benefits associated with that recovery. In essence, there may be an optimal solution that may not require complete recovery of the valley storage volume. Only further analysis with proposed valley storage locations will determine if this is a valid option.

The re-routing of the natural channel by way of a bypass channel produces erosive flood flow velocities within the bypass channel. Erosion control measures such as geo-fabric, geo-textiles and/or structural controls will have to be included in the bypass channel design. Due to the complexity of the hydraulics associated with the re-routing of the West Fork, a two dimensional analysis is recommended to determine areas of erosive velocities to better target erosion control features.

3.3 Earthwork

As presented in the previous Section 3.2.4, additional valley storage is needed for the addition of the proposed bypass channel alignment Alternative A. The opinion of probable construction cost for replacement of valley storage is $48,000,000. The cost includes excavation of the soil, hauling the soil off-site and disposal costs. If the material excavated could be used nearby, the cost could be reduced. In addition to replacing valley storage, environmental mitigation of the area is required. An allowance of $1,200,000 has been included for mitigation activities.

To construct Alternative A bypass channel, approximately 2.4 million cubic yards of material would be excavated. Of the excavated material, 30% is expected to be rock excavation and 70% unclassified material (soil). The opinion of probable construction cost for excavation of the channel is $24,000,000.



LEGEND

Storage Mitigation Sites
Existing Dams

N

Potential Valley Storage Mitigation Sites

September 2002

1000 0 1000 2000 Feet

Sources:
City lots and streets provided by the City of Fort Worth.

Tarrant Regional Water District
Streams and Valleys, Inc.
CDM consulting · engineering · construction · operations
Turner Collie & Braden Inc.
Freese · Nichols
Fugro
Zachry Construction Corporation

FIGURE 3-3

Construction of the levees will require almost 780,000 cubic yards of high quality material. Based on geotechnical and geologic information for the area, it is reasonable to assume the material for the levee construction will be available from the excavated material from the channel. Possible cross-sections of the levee are shown in **Figure 3-4.**

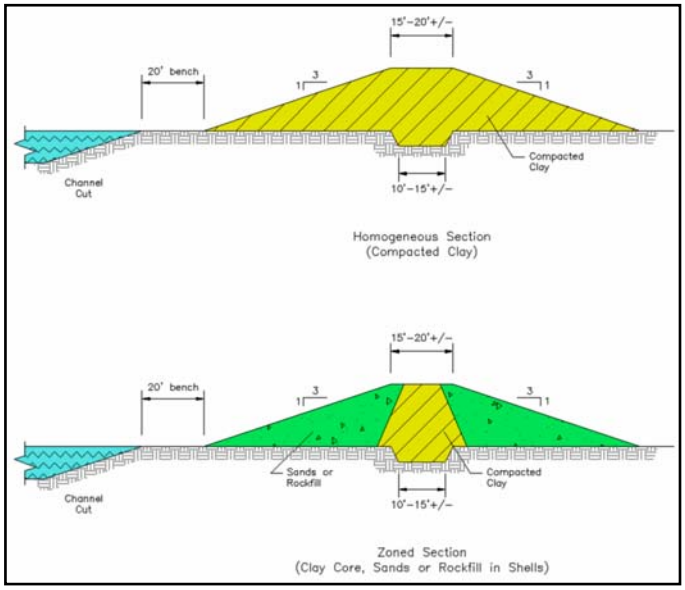


Figure 3-4
Typical Cross-Sections

For Alternative A, excess material is anticipated after excavation for the bypass channel. However, the exact amount of excess material will be dependent on the usable material excavated. This excess material will have to be hauled from the site or utilized elsewhere on the project. During the Project Team Workshop Number 2, it was determined that some of the excess fill material could be used to soften the exterior slope of the bypass channel levee. This would enhance access to the bypass channel and provide an opportunity for new development on the levee and near the channel. A modified cross-section is shown in **Figure 3-5.**

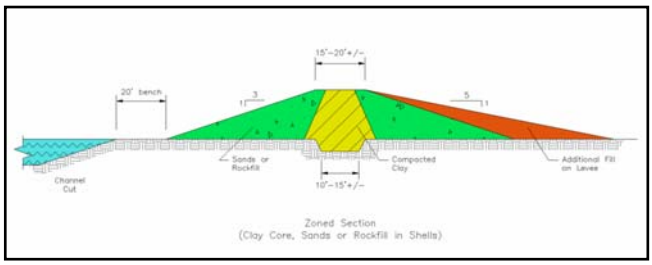


Figure 3-5
Typical Levee Cross-Section showing utilization of excess materials

Figure 3-6 is an artist rendering of a conceptual cross-section of portions of the bypass channel. A view of the areas to have additional fill is shown on **Figure 3-7.**

Embankment for the relocated streets and railroad are addressed in Section 3.5.

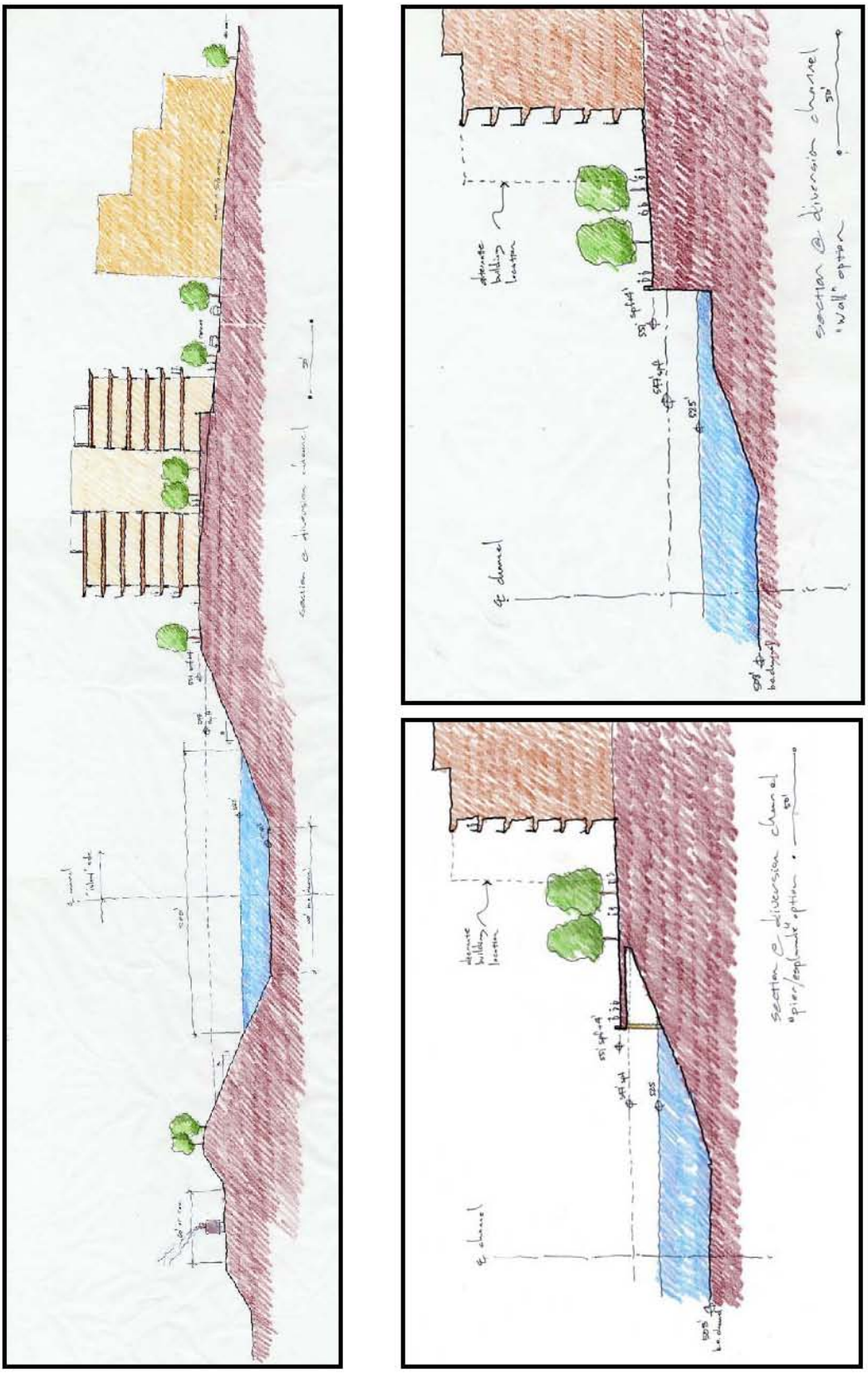
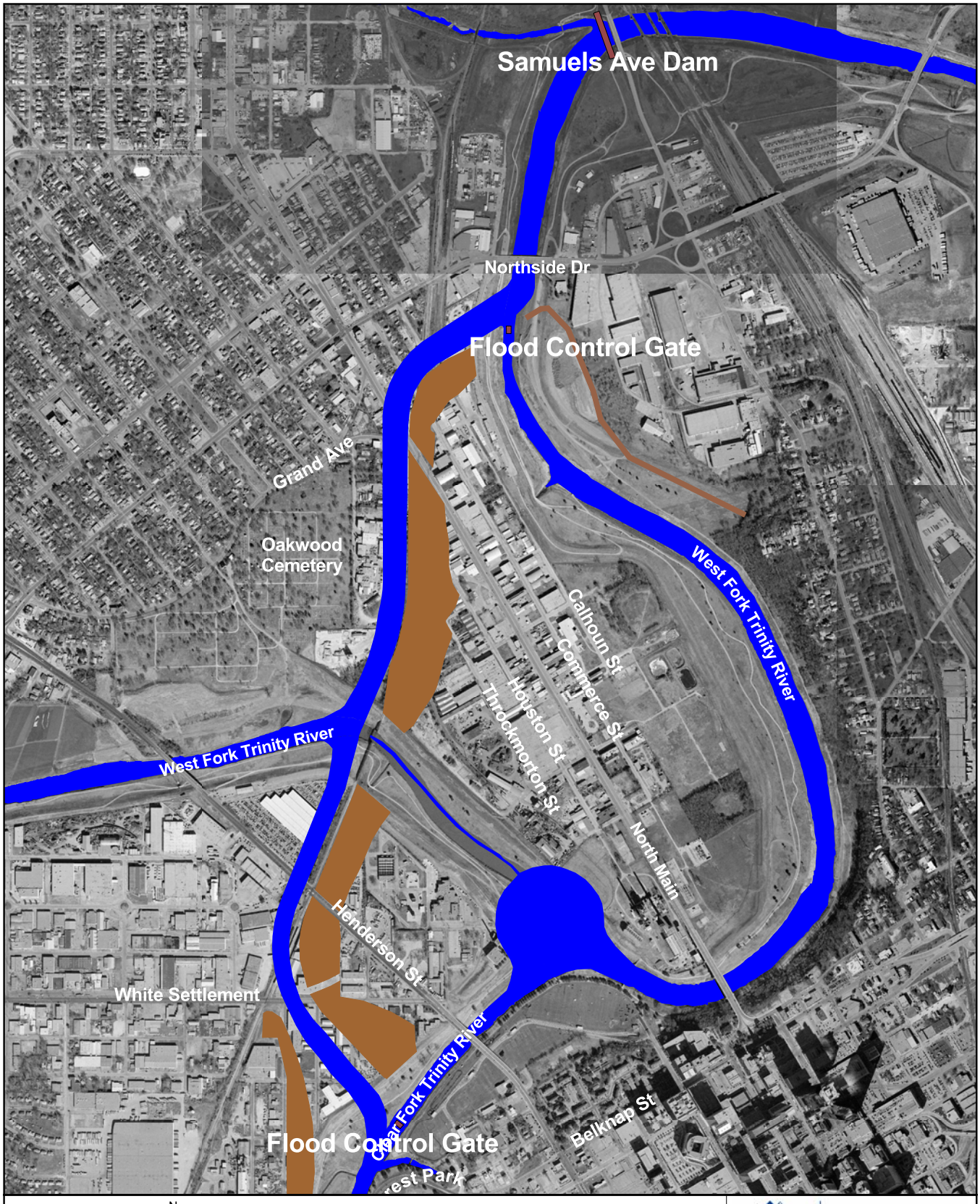


Figure 3-6
Conceptual Cross-Section of Portions of the Bypass Channel



LEGEND

Fill Areas

N

Bypass Channel Alignment - Alternative A
Areas of Additional Fill

September 2002

1000 0 1000 2000 Feet

Sources:
Aerials (1999) provided by the City of Fort Worth.

Streams and Valleys, Inc.

CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 3-7

3.4 Hydraulic Control Structures

One of the primary features of the concept improvements is the higher water level (normal conditions) in the Trinity River, both in the current main channel and in the new proposed bypass channel. The bypass channel is intended to pass significant floods without adversely affecting the constant water levels in the original channel. Three major hydraulic control structures are required to produce this condition. A gated dam on the main stem of the West Fork of the Trinity, to be located at approximately the confluence of Marine Creek and the Trinity will hold the normal water level during non-flooding conditions throughout the area upstream. Two gated control structures, one located at each of the junctions of the proposed bypass channel and the original channel, are planned to prevent flood flows from entering the original channel area. The locations of these proposed structures for Alternative A are shown in **Figure 3-7.**

3.4.1 Dam

A review of several alternatives for the dam and hydraulic gates was made in preparation for the first workshop. These included:

- Leaf or bascule gates. These types of gates operate by lying down of the gate with released water flowing over the top of the gate.
- Radial gates that operate by rotating upwards, allowing floodwaters to flow underneath.

A rubber dam that would hold the water when inflated and release it as it deflates.

Based on input from the workshop, it was determined that leaf gates would be preferable since they would likely be less expensive than other options evaluated, and would be much less visible over the lake than the radial gates. They would also provide more flexible release control and would likely be somewhat more dependable than a rubber dam. A typical dam section is shown on **Figure 3-8.**

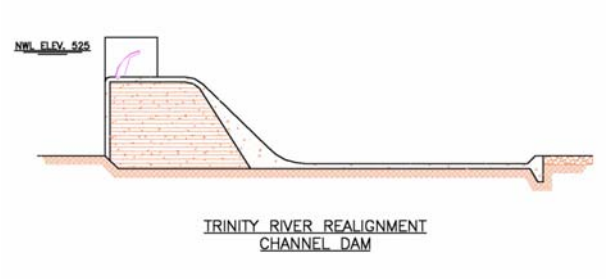


Figure 3-8

Based on hydraulic modeling of the various flood flows on the river, the dam was sized to operate with 8 gates, each 40 feet wide and 10 feet high. The gates would be on top of a concrete weir with a crest elevation of 515 feet ngvd and a normal water level of 525 feet ngvd. The gates would be controlled by hydraulic equipment inset into the intermediate structures (piers) located between each gate. The gates could be operated remotely which would avoid the construction of a bridge across the structure. If a higher water level of 528 feet ngvd were used, the gates and intermediate structures (piers) would be extended 3 feet with the crest left alone for hydraulic conveyance reasons. Estimates of the probable construction costs were prepared. These assumed that cofferdams would be built in the river channel to isolate the construction site and a diversion channel excavated to Marine Creek to bypass river flows during construction. This bypass channel would be left in place and the mouth of Marine Creek filled so that the higher water level would also be impounded up Marine Creek. Total estimated costs for the dam were $20,700,000 with a water level of 525 feet ngvd and $22,400,000 with a water level of 528. Costs for permitting are separate and included for the overall project. Detailed project costs are presented in **Section 3-10.**

3.4.2 Control Structures

Two hydraulic control structures are needed to isolate and protect the original channel from high flood level flows. These would consist of a 30 feet wide gated channel through the levee dividing the bypass channel from the original river channel. The gate within the structure would be a large vertical gate that would normally be in the open position to allow for both flow and boat traffic between the two areas. During times of flooding, the gate would slide vertically down into the closed position, preventing the higher flow levels in the bypass channel from entering. Each of the two structures would operate in the described manner.

As part of the initial workshop, two alternatives for connecting the gate and control structures with the levee system were reviewed. The first was to extend the levee out into the channel to match up directly with the gate housing structure. This will require long retaining walls perpendicular to the levee. The second was to transition the earthen levee to a high concrete wall that would abut the gate control housing. This option would provide a much narrower channel connecting the original river channel with the bypass channel and would provide more flexibility for aesthetic design opportunities. The costs for the two alternatives showed very little difference, with $11,200,000 for the embankment option and $11,000,000 for the concrete wall option. These are envisioned to operate at 525 feet ngvd normal water level, though the cost is not sensitive to small changes in the normal water level and would be adequate for a 528 feet ngvd level. Costs for permitting are separate and included for the overall project. Detailed project costs are presented in **Section 3-10.**

3.5 Transportation Systems

3.5.1 Roads

The route of bypass channel Alternative A crosses through more than ten different roadways and affects a number more. Main Street, Henderson Street and White Settlement Road would be the roadways of main concern in maintaining traffic flow, as they carry the largest volume of traffic within the area. Illustrated on **Figure 3-9** is a conceptual reconfigured roadway system for Alternative A. The bypass channel will sever the following roads:

- Whitmore Street
- Greenleaf Street
- Rupert Street
- Viola Street
- White Settlement Road
- Commercial St – Two (2) Locations
- Commerce St – Two (2) Locations on both sides of the bypass channel
- Calhoun St – Two (2) Locations on both sides of the bypass channel

The bypass channel would require removal of most of Arthur Street. The portion that remains could be connected to Kansas Street (north) and Dakota Street (south) to form a loop. A connector road would be added from Shamrock Street to Henderson Street to increase mobility in the industrial area south of Shamrock Street, as the connection to White Settlement Road is eliminated with the bypass channel.

The bypass channel would also bisect Main Street, Henderson Street, and White Settlement Road. Due to the traffic volume of these roads, the roads would be reconstructed in a manner to maintain flow to and through the area. A bridge would be required for each road crossing of the bypass channel, as described below.

The City of Fort Worth requires sidewalks on both sides of new streets, 4-feet minimum, or 5-feet minimum if adjacent to curb. Each roadway is considered urban by the City of Fort Worth. All new roads must meet the City of Fort Worth minimum pavement standards provided in **Table 3-5**. Henderson Street will have additional state regulations as it is also considered State Highway

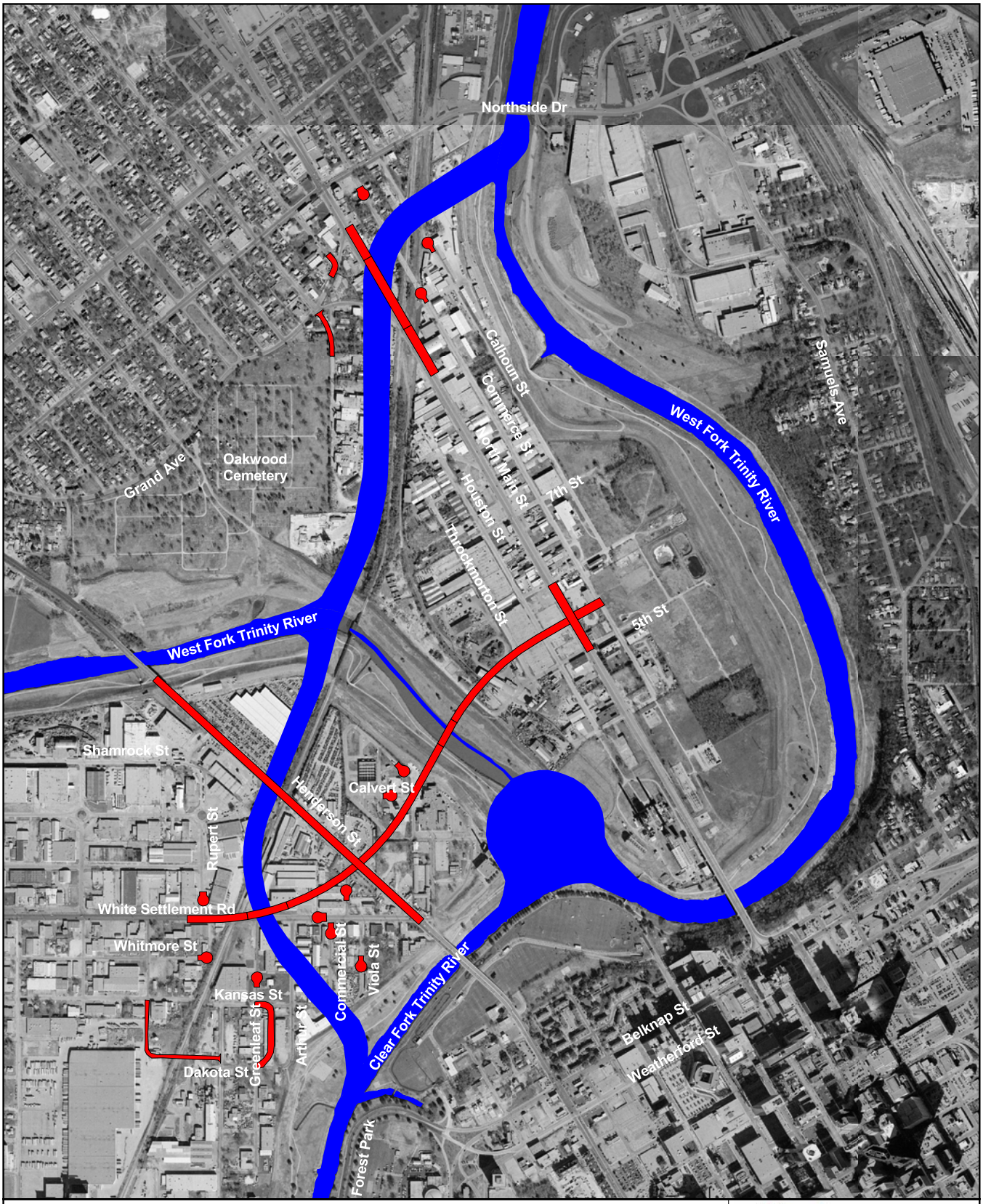

Northside Dr
Calhoun St
Commerce St
Houston St
Throckmorton St
Main St
7th St
5th St
Samuels Ave
West Fork Trinity River
Grand Ave
Oakwood Cemetery
West Fork Trinity River
Shamrock St
Calvert St
Henderson St
Rupert St
White Settlement Rd
Whitmore St
Kansas St
Dakota St
Greenleaf St
Arlington St
Commercial St
Viola St
Clear Fork Trinity River
Belknap St
Weatherford St
Forest Park
LEGEND
Proposed Roads
N
Proposed Roadways
Alternative A
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) and streets provided by the City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 3-9

Street Classification	Construction Standard
Principle Arterial and Industrial Streets	8" Reinforced Concrete 6" Stabilized Subgrade
Major and Minor Arterial Streets	7" Reinforced Concrete 6" Stabilized Subgrade
Local, Collector and Private Streets	6" Reinforced Concrete 6" Stabilized Subgrade
	6" H.M.A.C. 8" Stabilized Subgrade

Table 3-5
Minimum Pavement and Cross Sections

The roads would need to withstand the expected automobile, bus, and truck traffic. The current roads experience average congestion. Main Street was designed for greater traffic volumes than currently present, according to the North Main Corridor Study. This report assumes that the roads would not be widened.

The opinion of probable construction cost for Alternative A road improvements is $5,500,000. The cost includes allowances for land acquisition, embankment material, roadway construction and paving. The breakdown of the construction costs for each roadway segment for Alternative A is as follows:

- Main Street $ 560,000
- Henderson Street $1,070,000
- White Settlement Road $2,600,000
- Miscellaneous Street Modifications $1,250,000
- **Total** **$5,500,000**

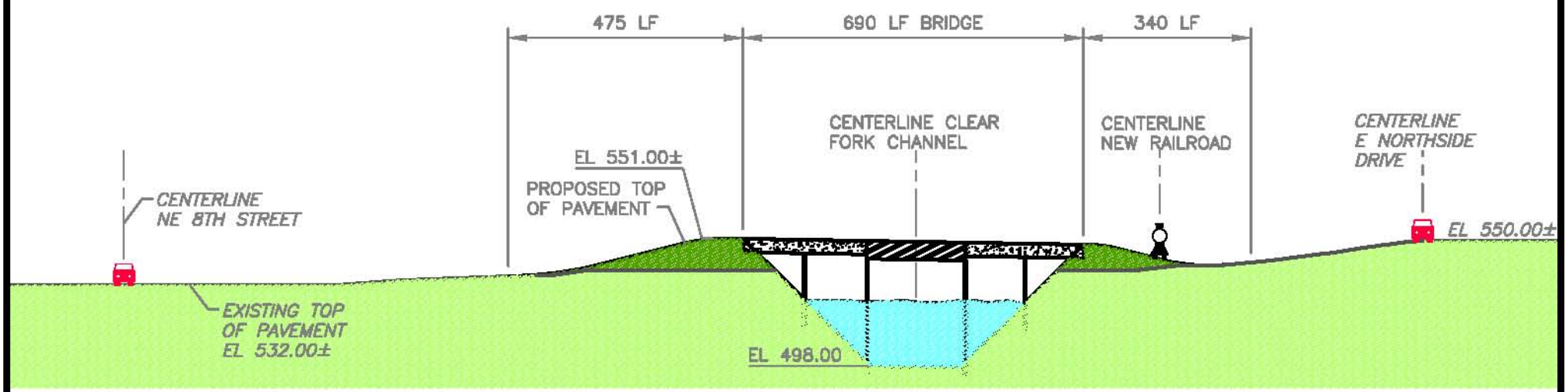
The total costs for Alternative A is summarized in **Section 3.10**

3.5.2 Bridges

Three major new bridges would be required with the implementation of Alternative A: Main Street, Henderson Street, and White Settlement Road. A bridge with a much narrower span is also envisioned over the remnant section of the old West Fork Channel and its crossing by the extension of White Settlement Road. New levees would be created with the development of a bypass channel, which will be at a higher elevation than the existing levees. New bridges would be designed with adequate approaches to achieve this elevation and maintain a reasonable slope.

The Main Street Bridge (also referred to as Paddock Viaduct) is a cherished landmark near the Downtown area, which would remain unaffected. A new Main Street bridge would be necessary at the Main Street crossing of the bypass channel at the current 11th Street intersection. This bridge would provide continued access through the "island" area formed by the bypass channel. A profile of the proposed Main Street Bridge is included in **Figure 3-10**. The bridge would be less than 700 feet in length. The approach to the bridge assumes a 5% slope on the east side and a 4.8% slope on the west side. Construction of the new Main Street Bridge is estimated at $2,580,000.

The two bridges along Henderson Street that cross the West Fork and Clear Fork of the Trinity River would be maintained. An additional bridge would be required on Henderson Street between the two existing bridges to allow traffic over the bypass channel. A profile of the proposed Henderson Street Bridge is included on **Figure 3-11**. The bridge will be 900 feet in length. Construction of Henderson Street Bridge is estimated at $3,400,000.



NORTH MAIN STREET PROFILE

Streams and Valleys, Inc.

CDM consulting · engineering · construction · operations

Turner Collie & Braden Inc.

Freese · Nichols

Fugro

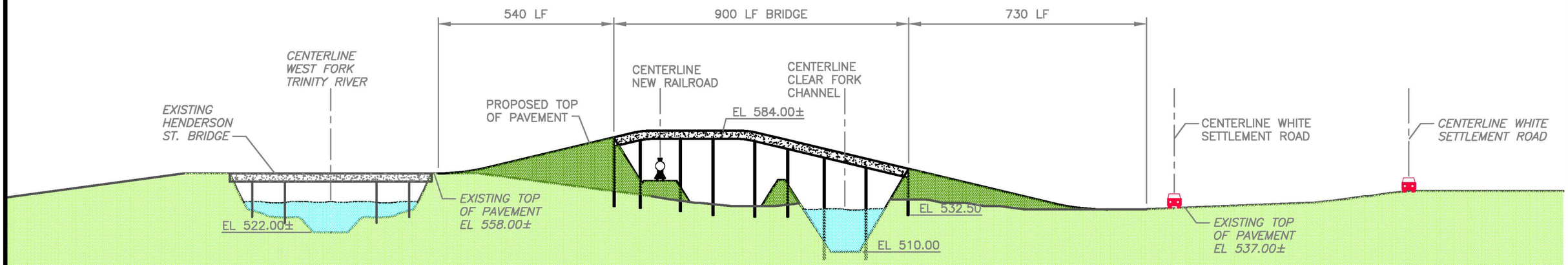
Zachry Construction Corporation

TRINITY RIVER CHANNEL REALIGNMENT PROJECT

NORTH MAIN STREET ALTERNATE A

SEPTEMBER 2002

FIGURE No 3-10



HENDERSON STREET PROFILE

Streams and Valleys, Inc.

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Turner Collie & Braden Inc.

Freese · Nichols

Fugro

Zachry Construction Corporation

TRINITY RIVER
CHANNEL REALIGNMENT PROJECT

HENDERSON STREET
ALTERNATE A

SEPTEMBER 2002

FIGURE No 3-11

White Settlement Road would be extended and bridges added for both alternatives to provide additional access to the "island" area. Two new bridges would be constructed for White Settlement Road, one over the proposed levee system for the bypass channel and the second one to cross the remnant section of the West Fork of the Trinity River. Profiles of the proposed White Settlement Road bridges are included in **Figure 3-12**. The construction of the White Settlement Road bridges is estimated at $2,300,000.

The historic railroad bridge in this area could be maintained but railroad traffic across the bridge would be abandoned. The railroad bridge could function as a pedestrian bridge or perhaps it could be relocated to a nearby site. A new railroad bridge would be required for the realigned Fort Worth and Western RR tracks. A profile of the proposed railroad bridge is included in **Figure 3-13**. Construction of a new railroad bridge is estimated at $7,450,000.

Bridge improvements, described above, for construction of Alternative A are estimated to cost $15,750,000. The breakdown of the construction costs for bridges for Alternative A is as follows:

- Main Street Bridge $2,600,000
- Henderson Street Bridge $3,400,000
- White Settlement Road Bridges (2) $2,300,000
- Railroad Bridge $7,450,000
- **Total** **$15,750,000**

The total project costs for Alternative A are summarized in Section 3.9

3.5.3 Railroad

The existing Fort Worth and Western (FW&W) railroad tracks would be relocated with the implementation of Alternative A. The tracks will be relocated west of their current location, as the bypass channel would follow along the existing railroad path. The profile of the path is illustrated in **Figure 3-13**. It is possible that one additional stop could be provided for the tourist passenger train, the Tarantula, to access the North Main Corridor development.

The current railroad crossings are at grade crossings with intersections of railroad and roadways at the same elevation. The proposed concept assumes the same type of crossings at White Settlement and Main Street. At these crossings, traffic along the roadways will be halted until the train has passed. Current crossings possess warning signs but planned crossings would possess crossing arms in addition to warning signs, and other traffic control features due to the expected increase in pedestrian and vehicular traffic in the study area. The crossing of the railroad at Henderson Street is assumed to have a grade separation structure, with Henderson Street routed over the railroad. The cost of the grade crossing is reflected in the Henderson Street bridge estimate.

The construction cost of relocating the railroad, including the new bridge is estimated at $13,900,000.

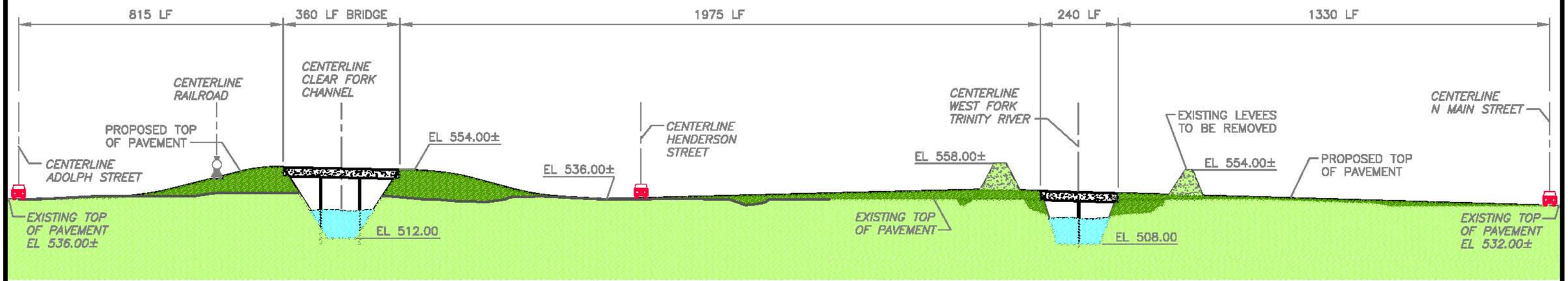
3.6 Utility Systems

The Alternative A bypass channel alignment was overlaid on the existing utilities within the project area and replacement scenarios were developed. The "in-kind" replacement of utilities with no betterments for increased capacity was used to determine project related costs. Contained in Section 3.10 is a summary of the anticipated costs for the total project.

3.6.1 Water (Potable)

Illustrated on **Figure 3-14** are water line abandonments and proposed new water lines to accommodate the bypass channel, levee and associated modifications.

Major modifications include the relocation of a 30-inch and 20-inch diameter water transmission line. The opinion of probable cost of the water line relocations is $500,000.



WHITE SETTLEMENT ROAD PROFILE

Streams and Valleys, Inc.

CDM consulting · engineering · construction · operations

Turner Collie & Braden Inc.

Freese-Nichols

Fugro

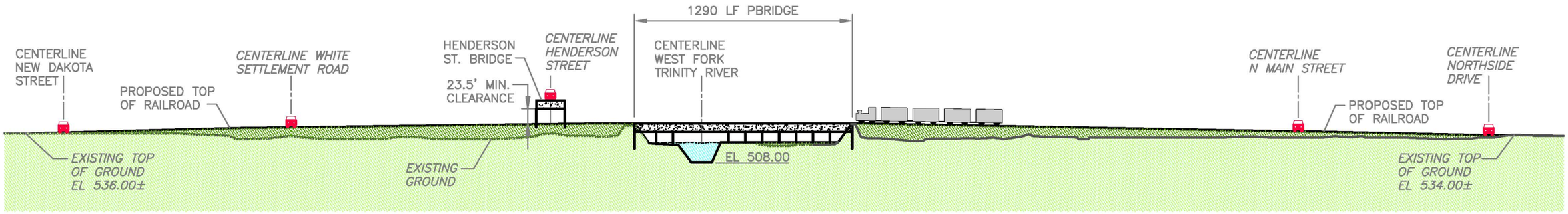
Zachry Construction Corporation

TRINITY RIVER CHANNEL REALIGNMENT PROJECT

WHITE SETTLEMENT ROAD ALTERNATE A

SEPTEMBER 2002

FIGURE No 3-12



RAILROAD PROFILE

Streams and Valleys, Inc.

CDM consulting · engineering · construction · operations

Turner Collie & Braden Inc.

FREESE · NICHOLS

FUGRO

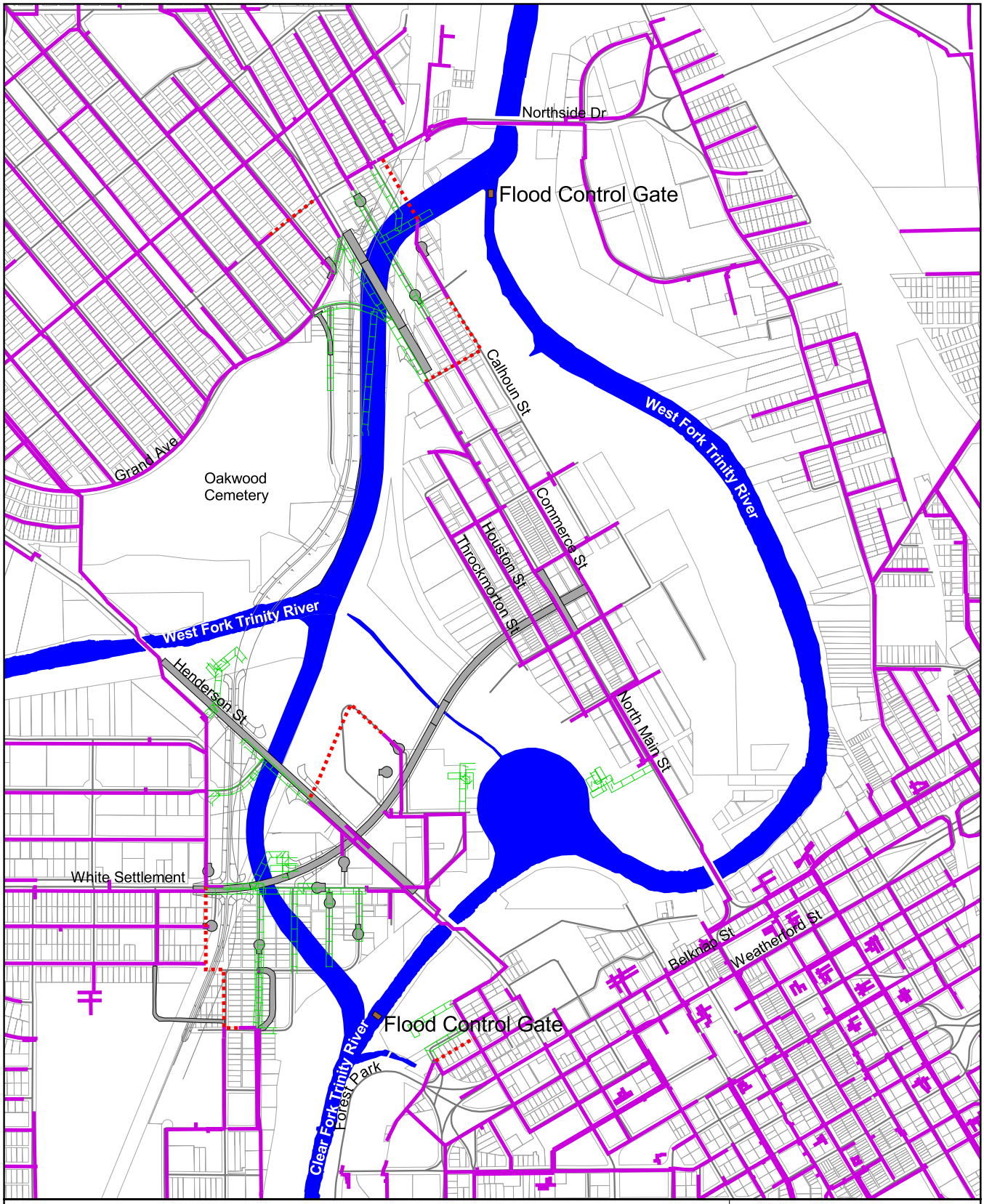
Zachry Construction Corporation

TRINITY RIVER
CHANNEL REALIGNMENT PROJECT

RAILROAD
ALTERNATE A

SEPTEMBER 2002

FIGURE No 3-13



LEGEND
Revised Water Lines
Demolition
Existing
Proposed
New Roads

N

Proposed Utilities - Water (Potable)
Alternative A

September 2002

Sources:
City lots and streets provided by the City of Fort Worth.
Water base maps provided by the City of Fort Worth.

1000 0 1000 2000 Feet

Streams and Valleys, Inc.

CDM
Turner Collie & Braden Inc.
Freese-Nichols
Fugro
Zachry Construction Corporation

FIGURE 3-14

3.6.2 Sewer System

Figure 3-15 depicts the sewer line relocations needed to accommodate the bypass channel, levee and associated modifications. Several large diameter sewer lines and siphon systems will have to be reconstructed. The opinion of probable cost of the sewer system relocations is $4,100,000.

3.6.3 Storm Drainage System

The existing stormwater drainage areas within the project area were shown on **Figure 2-20,** in Section 2. Alternative A would prompt modifications in the stormwater drainage areas. The revised storm drainage areas for Alternative A bypass channel alignment are shown on **Figure 3-16.**

The existing drainage system is presented in **Section 2.6.3.**

The storm drainage system surrounding the quiescent river segment will change once the bypass channel is in place. Since the bypass channel and levee system would convey the flood flows, the existing levees on the quiescent river segment will no longer be needed. It is likely that the levees will be removed to enhance access to the waterfront. When the levees are removed, more of the stormwater will directly run-off into the river segment in lieu of the current outfalls draining the sump areas. It is desirable that the quiescent river segment water surface elevation be maintained such that it does not increase more than 5 feet in elevation during the SPF storm event. Therefore, a stormwater pumping station would be needed to pump the excess stormwater from the protected, quiescent river segment. The water could be pumped into the bypass channel of the Trinity River. The opinion of probable construction cost for the stormwater pumping station is $4,700,000.

The storm drainage system relocations, stormwater pumping station, water quality feature within the project area are shown on **Figure 3-17**. The opinion of probable construction cost of the stormwater drainage system relocations is $540,000.

3.6.4 Natural Gas

Illustrated on **Figure 3-18** is the proposed abandonment of gas service and distribution system mains and replacement gas mains to accommodate the bypass channel, levee and associated modifications.

Major modifications include the relocation of a 24-inch high pressure main across the proposed bypass channel. The opinion of probable cost of the gas system relocations is $600,000.

3.6.5 Electrical Transmission and Distribution

Figure 3-19 depicts the electrical distribution and transmission line relocations needed to accommodate the bypass channel, levee and associated modifications. The opinion of probable cost of the electrical distribution and transmission system relocations is $500,000.

3.6.6 Fiber Optics, Cable and Telephone

Illustrated on **Figure 3-20** is the proposed demolition of the existing fiber optics line and the replacement line based on the anticipated roadway changes. The opinion of probable cost of the relocation of the overhead fiber optics line is $500,000.

The existing cable lines to be demolished and the proposed replacement lines are shown on **Figure 3-21**. The opinion of probable cost of the relocation of the cable lines for Alternative A is $200,000.

As presented in Section 2.6.7, the telephone service grid maps were unavailable. Estimates of telephone service to be reinstated were based on standard service and grids within the project area.

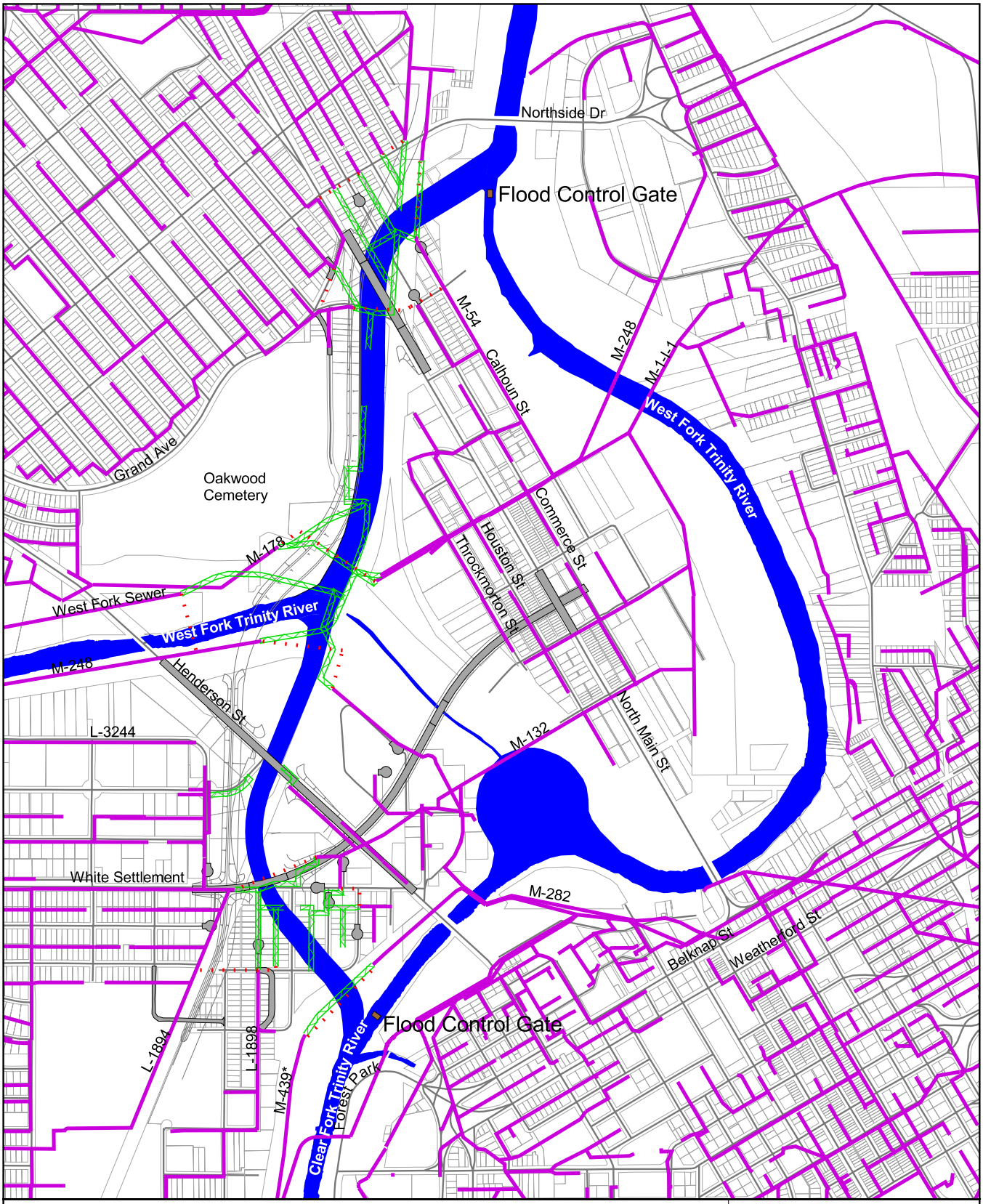

Northside Dr
Flood Control Gate
M-54
Calhoun St
M-248
M-1-1-1
West Fork Trinity River
Grand Ave
Oakwood
Cemetery
M-178
West Fork Sewer
West Fork Trinity River
M-248
Henderson St
Commerce St
Throckmorton St
Houston St
North Main St
L-3244
M-132
White Settlement
M-282
Belknap St
Weatherford St
Flood Control Gate
L-1894
L-1898
M-439*
Clear Fork Trinity River
Forest Park
LEGEND
Proposed Sewer Lines
Demolition
Existing
Proposed
New Roads
N
Proposed Utilities - Sanitary Sewer
Alternative A
September 2002
1000 0 1000 2000 Feet
Sources:
City lots and streets provided by the City of Fort Worth.
Sewer base maps provided by the City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 3-15

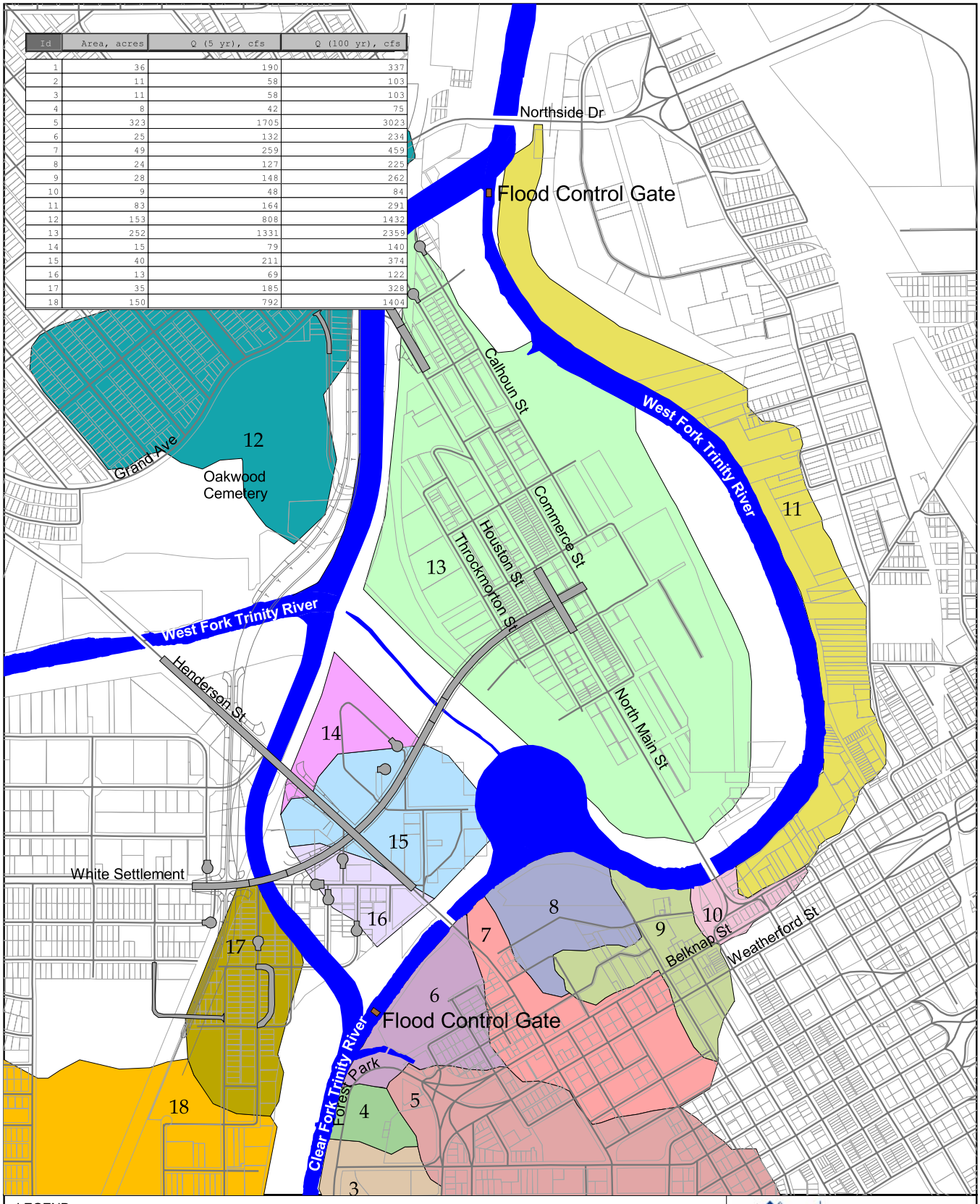
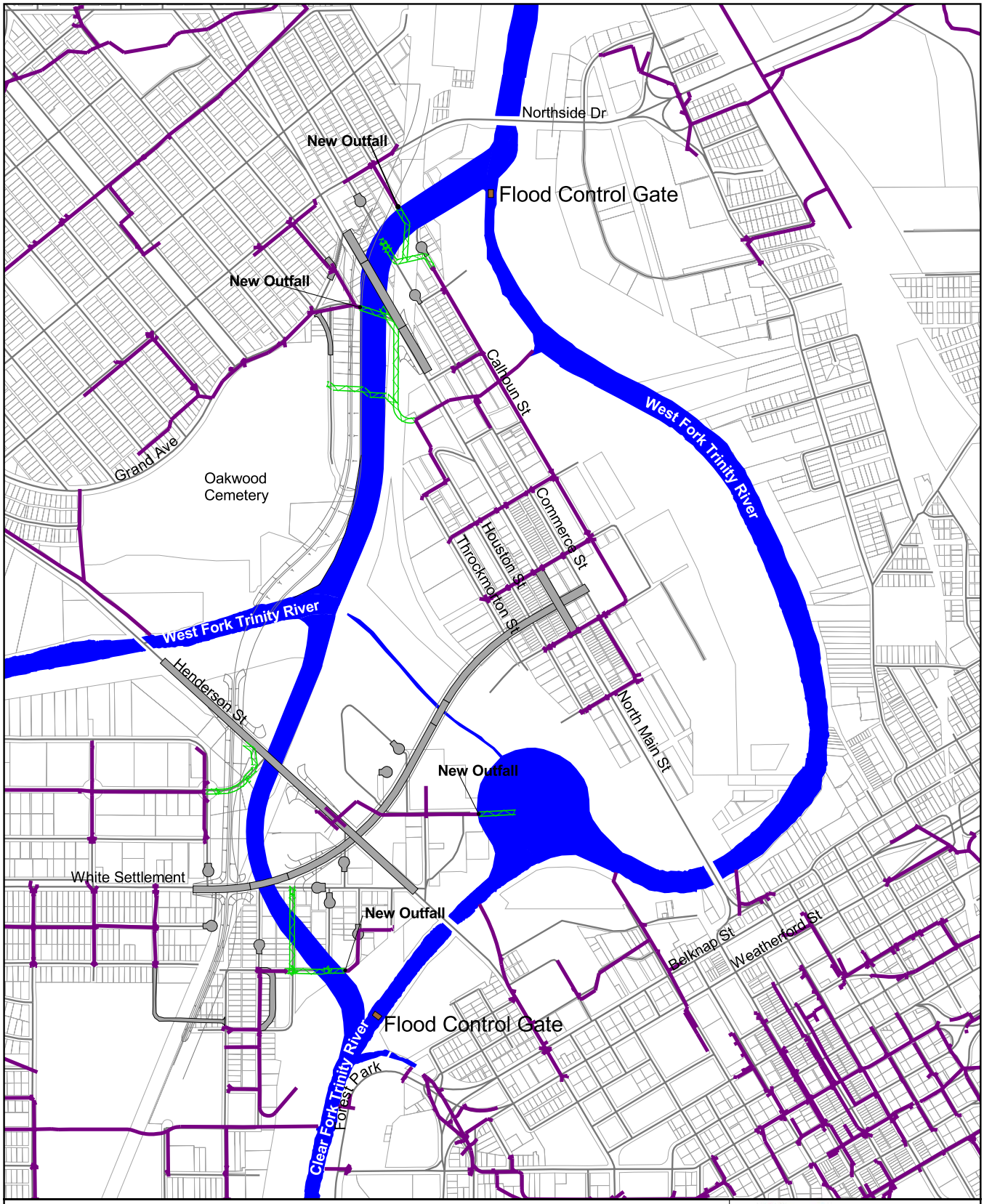

Id | Area, acres | Q (5 yr), cfs | Q (100 yr), cfs
1 | 36 | 190 | 337
2 | 11 | 58 | 103
3 | 11 | 58 | 103
4 | 8 | 42 | 75
5 | 323 | 1705 | 3023
6 | 25 | 132 | 234
7 | 49 | 259 | 459
8 | 24 | 127 | 225
9 | 28 | 148 | 262
10 | 9 | 48 | 84
11 | 83 | 164 | 291
12 | 153 | 808 | 1432
13 | 252 | 1331 | 2359
14 | 15 | 79 | 140
15 | 40 | 211 | 374
16 | 13 | 69 | 122
17 | 35 | 185 | 328
18 | 150 | 792 | 1404
Northside Dr
Flood Control Gate
Calhoun St
West Fork Trinity River
Grand Ave
Oakwood Cemetery
Commerce St
Houston St
Throckmorton St
North Main St
Henderson St
White Settlement
Belknap St
Weatherford St
Clear Fork Trinity River
Forest Park
Flood Control Gate
LEGEND
New Roads
N
Proposed Storm Drainage Areas
Alternative A
September 2002
1000 0 1000 2000 Feet
Sources:
City lots and streets provided by the City of Fort Worth.
Drainage areas delineated from topography provided by the City of Fort Worth and the USACE.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 3-16



LEGEND

Revised Storm Lines
- Demolition
- Existing
- New Roads

N

Proposed Utilities - Storm Drain
Alternative A

September 2002

1000 0 1000 2000 Feet

Sources:
City lots, streets and storm drain base maps provided by the City of Fort Worth.

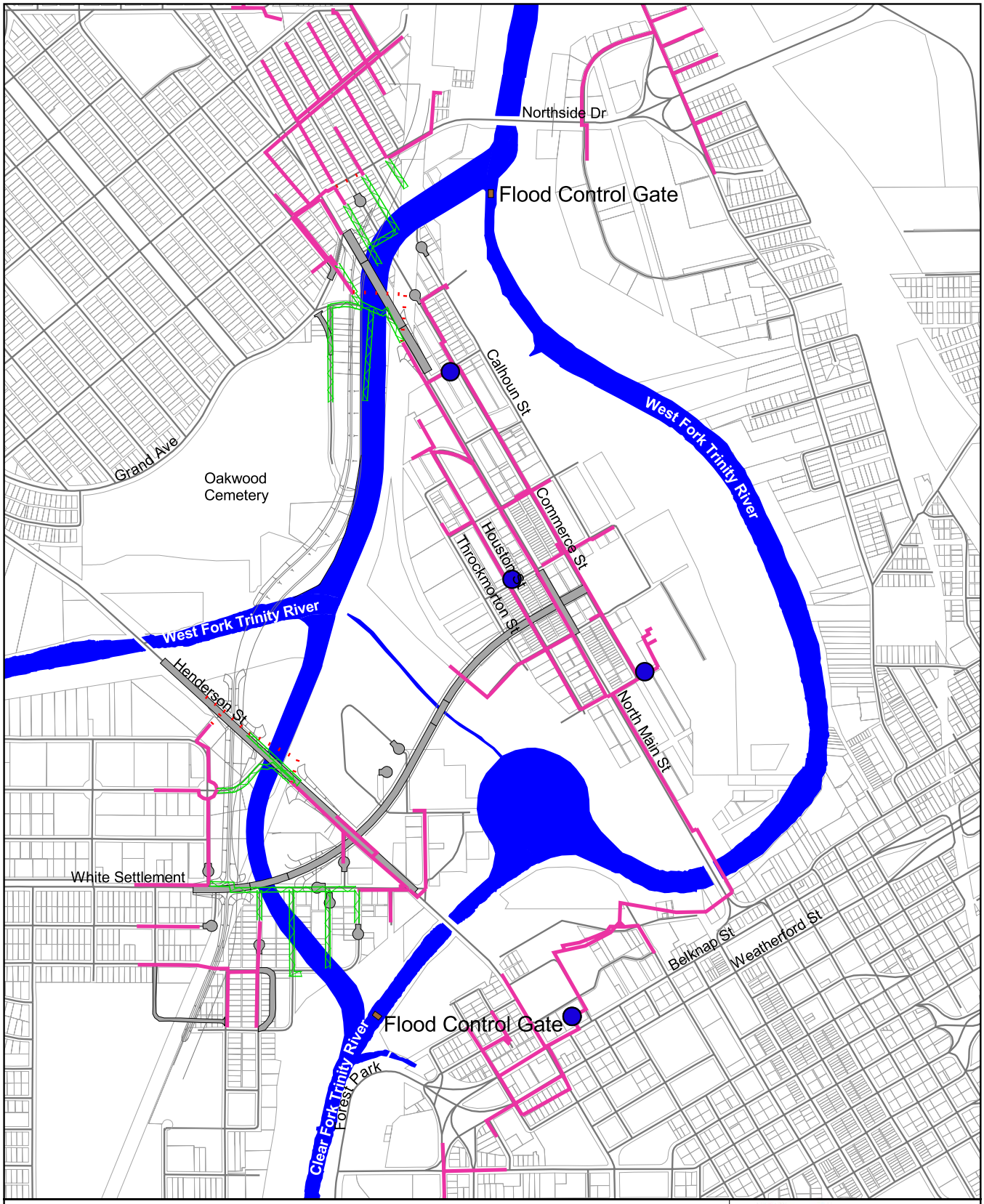
Streams and Valleys, Inc.

CDM

Turner Collie & Braden Inc.

Zachry Construction Corporation

FIGURE 3-17



LEGEND

Pressure Reducing Stations

Revised Gas
Demolition
Existing
Proposed
New Roads

N

Proposed Utilities - Gas
Alternative A

September 2002

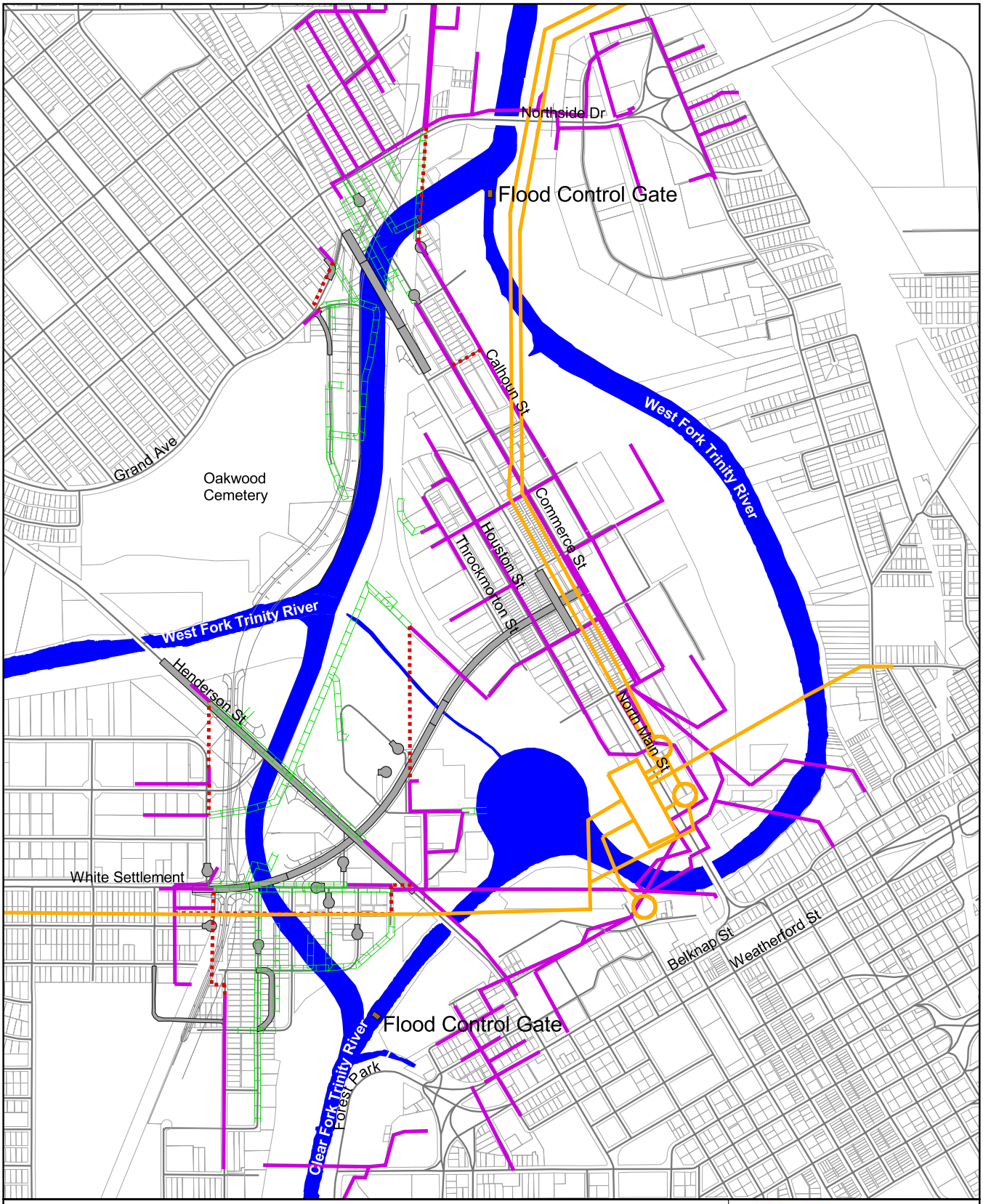
1000 0 1000 2000 Feet

Sources:
City lots and streets provided by the City of Fort Worth.
Gas lines input from maps provided by Oncor.

Streams and Valleys, Inc.

CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 3-18



LEGEND

- Electric Transmission
- Electric Stations

Revised Electric Distribution

- Demolition
- Existing
- Proposed
- New Roads

N

Proposed Utilities - Electric
Alternative A

September 2002

1000 0 1000 2000 Feet

Sources:
City lots and streets provided by the City of Fort Worth.
Electric distribution and transmission lines input from maps provided by Oncor.

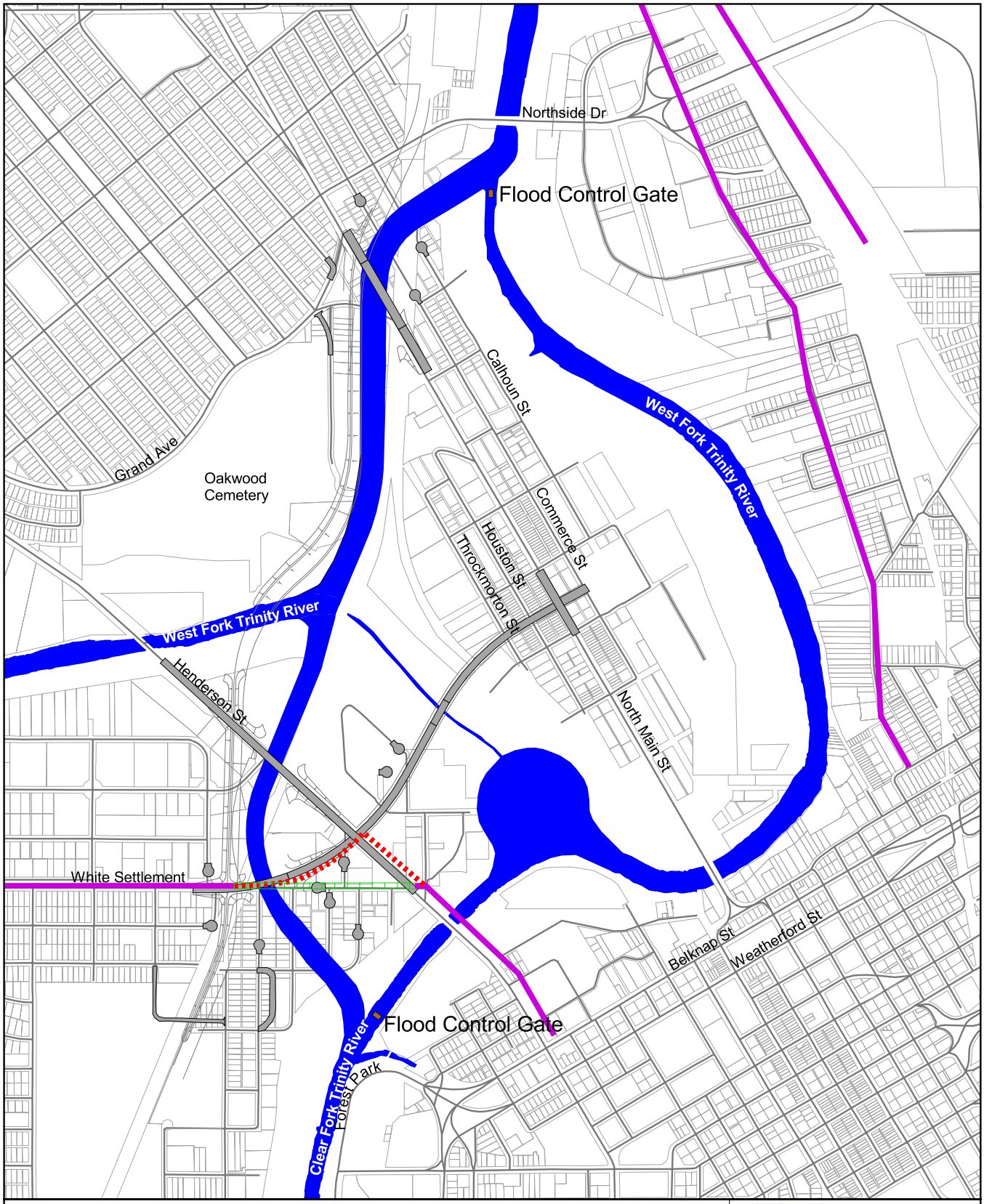
Streams and Valleys, Inc.

CDM

Turner Collie & Braden Inc.

Zachry Construction Corporation

FIGURE 3-19



LEGEND

Revised Fiberoptics
Demolition
Existing
Proposed
New Roads

N

Proposed Utilities - Fiber Optics
Alternative A

September 2002

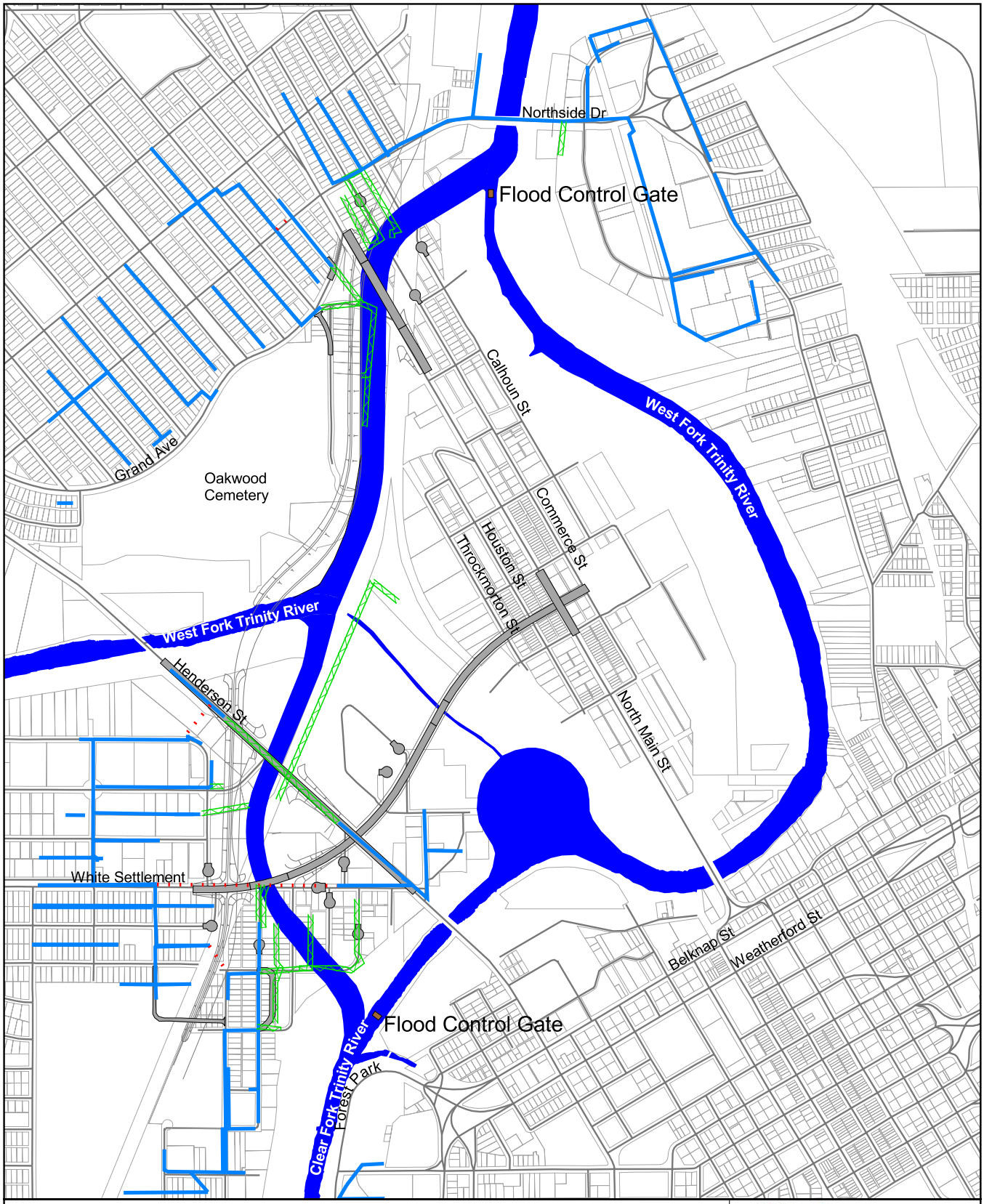
1000 0 1000 2000 Feet

Sources:
City lots and streets provided by the City of Fort Worth.
Fiber optics input from information provided by E-Spire Communications, Level 3 Communications, and Metromedia Fiber Network.

Streams and Valleys, Inc.

CDM
Turner Collie & Braden Inc.
Fugro
Zachry Construction Corporation

FIGURE 3-20



LEGEND
Revised Cable
Demolition
Existing
Proposed
New Roads

N

Proposed Utilities - Cable Lines
Alternative A

September 2002

1000 0 1000 2000 Feet

Sources:
City lots and streets provided by the City of Fort Worth.
Cable lines input from maps provided by Charter Communications.

Streams and Valleys, Inc.

CDM
Turner Collie & Braden Inc.
Fugro
Zachry Construction Corporation

FIGURE 3-21

3.7 Environmental Issues

The Alternative A bypass channel configuration intersects with one known contaminated property and two EPA designated sites. Prior to implementation of the bypass channel, the environmental issues associated with properties in the path of the channel will need to be assessed and resolved. The contaminated property within the Alternative A alignment is APAC Texas, Inc.

- **APAC Texas Incorporated (Groundwater Contamination)**
  A leaking underground storage tank was reported in 1992, which impacted groundwater and surface water used by humans/endangered species. The site has undergone a liability assessment, confirmation sampling and Phase III assessment of the area is in progress. The nature and extent of the contamination will be fully characterized and the appropriate cleanup technology identified under Phase III. The reported groundwater contamination is gasoline and diesel fuel.

The two EPA designated sites within the Alternative A's alignment are as follows:

- **Pioneer Concrete of Texas (RCRA-listed)**
  Pioneer Concrete operates a concrete batch plant and is recorded as large quantity generator of hazardous material. There have been numerous past dust complaints but have since been remedied. A leaking underground storage tank was reported in 1990, which has not impacted the groundwater and does not appear to have impacts to receptors.

  Currently Hansen Concrete Products is operating at this site.

- **Rodriquez Festive Foods and Solvent Specialty (SARA-listed)**
  Rodriquez Festive Foods is a SARA Title III regulated facility. Carbon dioxide (10,000 – 99,999 lbs stored in an above ground tank) and liquid nitrogen (10,000-99,999 lbs stored in an above ground tank) are reported to be stored at Rodriquez Festive Foods. Solvent Specialty is a SARA Title III regulated facility with at least three underground storage tanks on site.

Brownfields denote real or *perceived* contamination. Although there are three brownfield sites located within the alignment of Alternative A, the extent or existence of actual contamination is not known. Ten underground storage tanks are also located within the alignment of Alternative A, but the presence of storage tanks is indicative that they would need to be removed during excavation not that a leak is present.

The environmental areas impacted by Alternative A alignment are shown on **Figure 3-22.**

Because the area in which the bypass channel would pass includes commercial and industrial developments, environmental remediation of the project site is likely. The locations, extents, and character of these remediation efforts are unknown. However, in determining cost estimates for use in consideration of the financial feasibility of the project, assumptions have to be made. The area encompassed by the bypass channel is approximately 87 acres. An opinion of probable cost for environmental remediation for the area is $17,400,000.

The extent of remediation of environmental sites along the project area is largely unknown due to limited information. Additional information on environmental contamination of soil and water in the area would be a necessary component to be developed on a project of this nature.

Construction costs are summarized in Section 4.10.

3.8 Property Acquisition

Bypass channel alignment Alternative A would require the acquisition of all or part of about 200 properties. The estimated cost of property acquisition is $38,700,000.

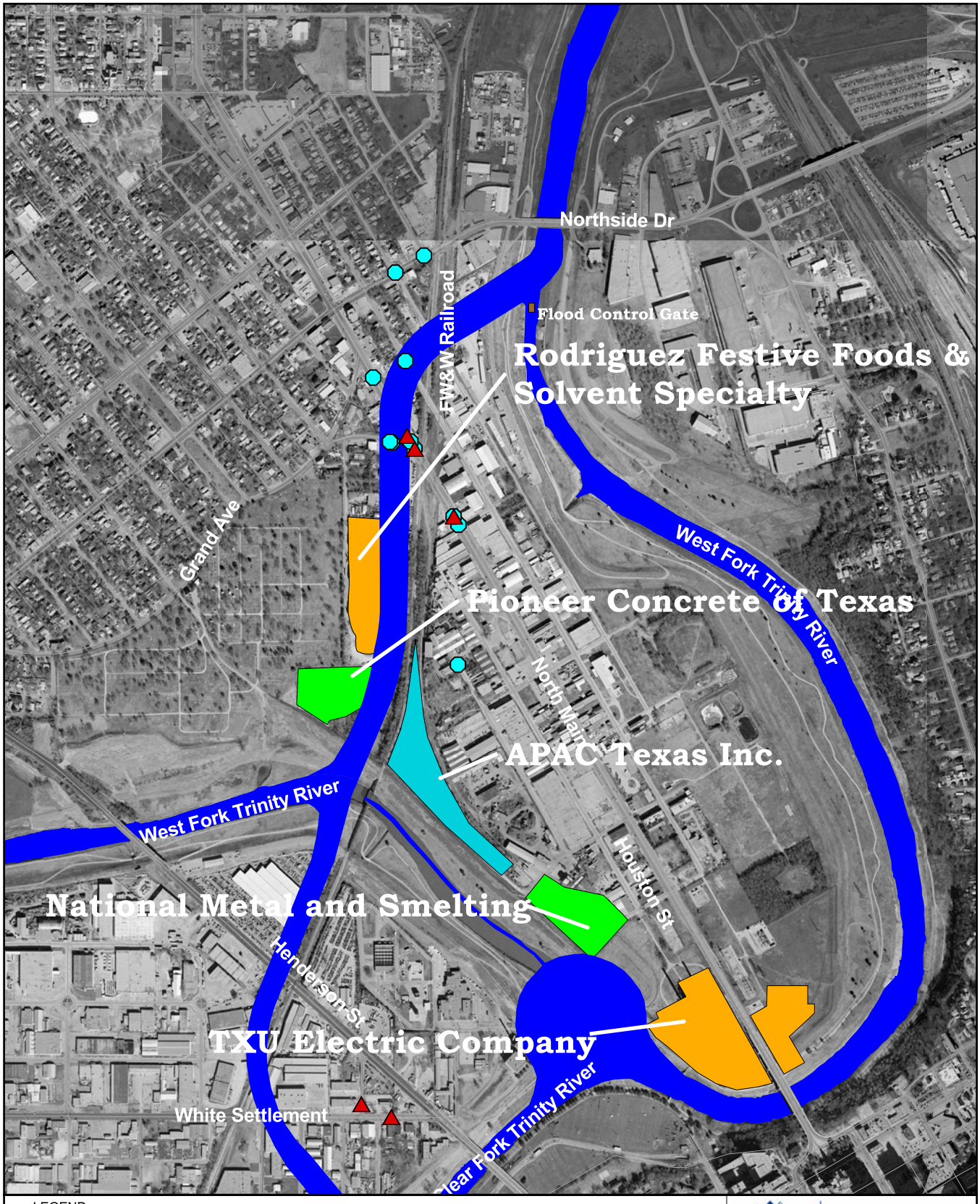

Northside Dr
Flood Control Gate
FW&W Railroad
Rodriguez Festive Foods &
Solvent Specialty
Grand Ave
West Fork Trinity River
Pioneer Concrete of Texas
North Main
APAC Texas Inc.
West Fork Trinity River
Houston St
National Metal and Smelting
Henderson St
TXU Electric Company
White Settlement
West Fork Trinity River
LEGEND
Brownfields
Storage Tanks
UST
Contaminated Sites
Groundwater
EPA Designated Properties
RCRA
SARA
N
Alternative A - Environmental
September 2002
Sources:
Aerials (1999) provided by
the City of Fort Worth.
900
0
900
1800 Feet
Streams
and
Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 3-22

3.9 Demolition

Bypass channel alignment Alternative A would require the demolition of 163 structures. The estimated cost of demolition is $14,400,000, which includes "knock down", hauling of debris and disposal costs. No specific allowances have been included for asbestos surveys, removal, stabilization or disposal, but some of this unknown cost is covered in the project contingency estimates.

3.10 Project Cost Summary for Alternative A

The opinions of probable cost prepared for this study are based on today's costs. Inflation has not been included in the costs, nor interest for borrowed capital.

Presented in **Table 3-6** is a summary of the project costs for the Alternative A –bypass channel alignment.

Trinity River Realignment Feasibility Study
Alternative A
Table 3-6

Opinion of Probable Construction Cost

Item/Description		Cost
Land Acquisition		**$38,700,000**
Demolition		**$14,400,000**
	Buildings and slabs	$13,600,000
	Paving/Parking Lot	$800,000
Utility Relocation and Demolition		**$7,300,000**
	Water Lines	$500,000
	Sewer Lines	$4,100,000
	Storm Drain System	$540,000
	Electrical Distribution and Transmission	$500,000
	Gas Transmission	$600,000
	Cable	$200,000
	Telephone	$360,000
	Fiber Optics	$500,000
Railroad Construction		**$13,900,000**
	Earth fill	$890,000
	Railroad Subgrade	$380,000
	Railway Construction	$2,380,000
	Railway Signaling ABS	$1,700,000
	Railway /Street crossings	$1,100,000
	Railway Bridge	$7,450,000
By-Pass Channel Ex./Levee Construction		**$31,900,000**
	Excavation	$24,000,000
	Embankment	$2,800,000
	Erosion Protection (bends, confluence)	$4,600,000
	Seeding	$300,000
	Service Roads	$200,000
Valley Storage Balance		**$49,200,000**
	Excavation for Valley Storage	$48,000,000
	Mitigation for Valley Storage Areas	$1,200,000

Water Control Structures		**$32,200,000**
	Control Gate North	$5,600,000
	Control Gate South	$5,600,000
	Trinity River Dam	$21,000,000
Storm Runoff/Water Quality Facilities		**$5,100,000**
	Outfalls Collection Systems	$100,000
	Aeration Fountain	$300,000
	Storm Water Pumping Station	$4,700,000
Roadway Construction/Reconstruction		**$13,800,000**
	White Settlement Road	**$4,920,000**
	Land Acquisition	$770,000
	Embankment	$250,000
	Roadway Paving	$1,600,000
	Bridge Construction (by-pass channel)	$1,400,000
	Bridge Construction (lake feature)	$900,000
	Henderson Street	**$4,470,000**
	Land Acquisition	$180,000
	Embankment	$240,000
	Roadway Paving	$650,000
	Bridge Construction	$3,400,00
	N. Main Street	**$3,160,000**
	Embankment	$71,000
	Roadway Paving	$489,000
	Bridge Construction	$2,600,000
	Miscellaneous Street Modifications	**$1,250,000**
		$1,250,000
Environ. Remediation Allowance – Project		**$17,400,000**
Subtotal		**$223,900,000**
Contingencies		**$22,400,000**
TOTAL		**$246,300,000**

Project Administration

Item/Description	Cost
Program Management	**$17,500,000**
Permitting (EIS, 404 etc.)	**$7,400,000**
Design, Survey, Testing & Constr. Management	**$44,000,000**
Legal Assistance	**$5,000,000**
TOTAL	**$73,900,000**

GRAND TOTAL	**$320,200,000**

Section 4
Evaluation of Alternative B - Bypass Channel

4.1 Description and Alignment

Alternative B bypass channel is shown on **Figure 4-1**. Alternative B begins on the Clear Fork at the downstream side of the Henderson Street Bridge and traverses northerly. The channel generally follows the Fort Worth and Western Railroad, until reaching Calhoun Street. The bypass alignment then traverses in an easterly direction to intersect with the West Fork, just prior to Northside Drive. The length of Alternative B bypass channel is approximately 5,550 linear feet.

4.2 Hydraulic and Hydrologic Considerations

The hydrologic and hydraulic analysis consisted of updating the base Upper Trinity Study (UTS) models with the TRWD channel and Beach Street dam and 4th Street dam improvements to establish updated base models. These models were then revised to include the proposed dam at Samuels Avenue and became the Samuels Avenue Dam models. The next step in the analysis required the design of a bypass channel template and alignment to establish a quiescent area. Both Alternative A and B bypass channels utilized the same channel cross-section template.

The bypass channel cross-section template for Alternative B bypass channel is trapezoidal in shape consisting of a 3:1 horizontal to vertical side slope. This template changed at the transition points back into the natural channels and where a vertical wall would be erected. Two channel alignments were developed to determine the size of the proposed bypass channel and its ability to meet the regulatory constraints. The following is a description of the Alternative B alignment and a tabular summary of their hydrologic and hydraulic impacts.

4.2.1 Bypass Channel B – Alignment

Figure 4-2 shows the alignment and conceptual grading plan for bypass Channel B. The bypass channel starts east of Henderson Street on the Clear Fork. It continues northeast along the south side of the existing Fort Worth and Western Railroad until it intersects the West Fork. This reach of the channel has a bottom width of approximately 80 feet and a top width of approximately 380 feet. The top of the levee is at an elevation that equals the SPF plus 4 feet requirement. The bypass channel with the Clear Fork picks up the West Fork flows and continues to follow the railroad on the south side past its intersection with Main Street. The channel then turns east to tie into the south side of the Northside Drive Bridge. The channel through this reach has a bottom width of 100 feet and a top width of approximately 400 feet. The top of levee is at an elevation that equals the SPF plus 4 feet requirement. The channel is approximately 5,550 feet in length and bypasses approximately 11,000 linear feet of the existing channel.

4.2.2 Bypass Channel B – Hydrology

The hydraulic models were updated with the new Channel B alignment and evaluated with an increasing series of flow values. This is referred to as a "storage run" and from it the amount of storage in a channel reach for each increasing change in anticipated flow is determined. A revised flood stage-storage relationship was developed for each of the storage routing reaches impacted by the proposed project. The updated hydraulic models were modified to account for the reduction in storage from the shortening of the flow path of the bypass channel and the reduction in storage due to the change in channel geometry. **Table 4-1** shows the comparison of storage volumes for each routing reach for the SPF event. The Channel B alignment reduces the available flood storage by approximately 2,135 acre-feet.

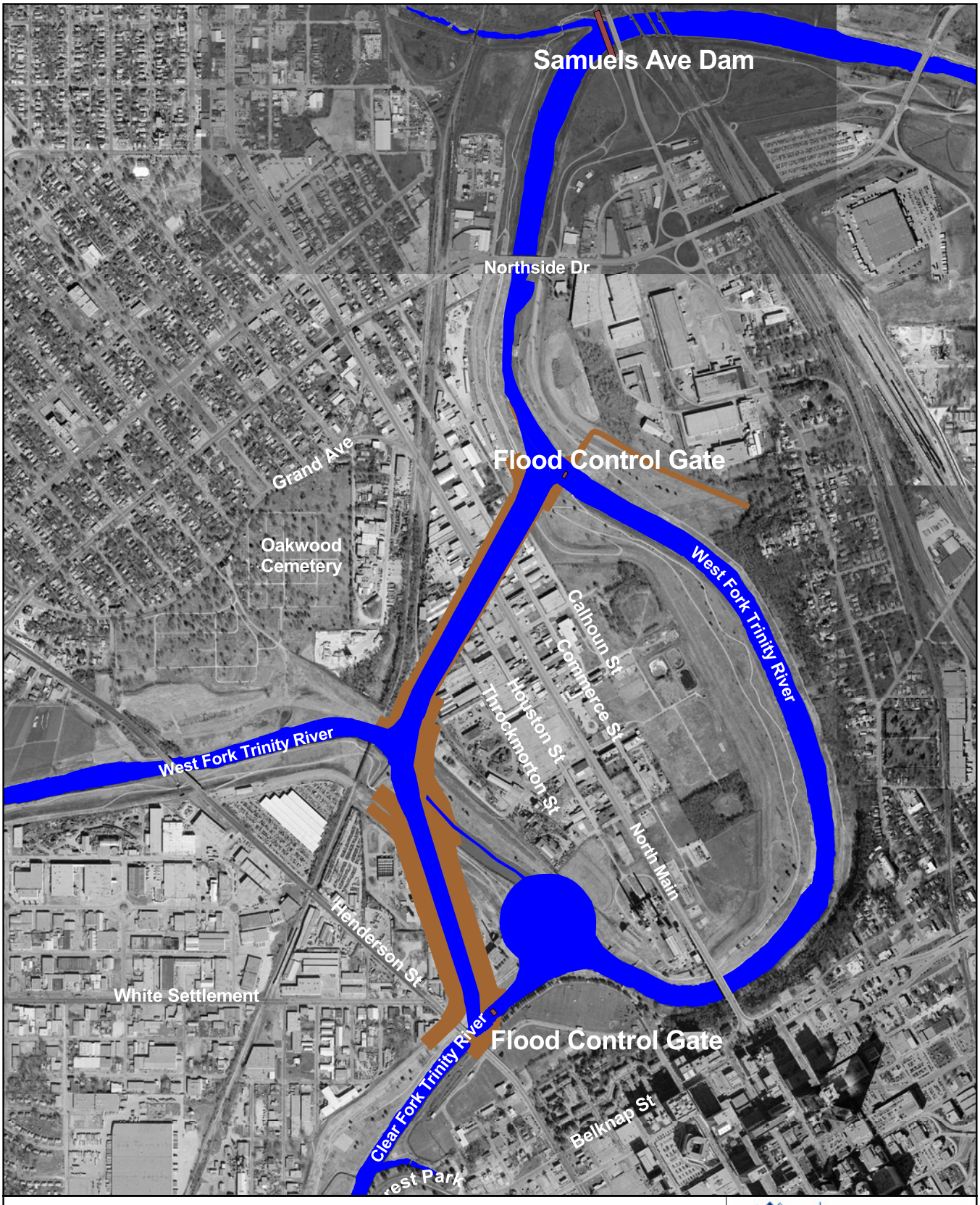

Samuels Ave Dam
Northside Dr
Grand Ave
Flood Control Gate
Oakwood Cemetery
West Fork Trinity River
Calhoun St
Commerce St
Houston St
Throckmorton St
North Main
West Fork Trinity River
Henderson St
White Settlement
Flood Control Gate
Clear Fork Trinity River
Belknap St
LEGEND
New Levees
N
Bypass Channel Alignment
Alternative B
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) provided by the City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 4-1

Routing Reach	CDC Model (ac ft)	Updated CDC Model Improvements (ac ft)	Alternative B (ac ft)
From near confluence of CF & WF to D/S of Samuels Ave. Dam	4,067	4,115	2,298
From near Rockwood Park to near confluence of CF & WF	5,772	5,679	4,910
From 150 ft D/S of I-30 to D/S of Henderson	4,306	3,598	4,049
Totals	14,145	13,392	11,257
Difference in Alignment B and Updated CDC Models =			**2135**

Table 4-1
Comparison of Valley Storage for the CDC-SPF Model

Upon completion of the hydraulic model storage runs, the hydrologic models were updated with the revised stage-storage relationships for the impacted routing reaches. **Table 4-2** is a comparison of the impacts this reduction in valley storage makes to the peak flows in the Trinity River. The removal of approximately 2,135 acre-feet of valley storage translates to an increase in peak flows downstream of the project.
meet the regulatory constraints. The following is a description of the Alternative B alignment and a tabular summary of their hydrologic and hydraulic impacts.

The storage values listed in tables 3-1 and 4-1 are true representations of the valley storage calculations for both Alt A and Alt B. Although Alt A is 4000' longer than Alt B, this 4000' bypasses a significant portion of the existing Clear Fork. This portion of the Clear Fork has a tiered cross-section and provides more valley storage per linear foot than the trapezoidal cross-section of linear foot than the trapezoidal cross-section of Alt A. The Alt B alternative does not bypass this section and includes the valley storage in its numbers. Therefore, there is almost no difference in available valley storage between Alt A and Alt B.

DESCRIPTION	Existing PEAK FLOW (cfs)	Alt B PEAK FLOW (cfs)	Alt B Minus Existing (cfs)
WF flows from Sycamore Creek	70355	72441	2086
WF flows from E. 1st St to RM.554.3	64387	65657	1270
WF flows from RM.554.3 to Big Fossil Creek	63094	64278	1184
WF flows from Big Fossil Creek to Village Creek	79939	81354	1415
WF flows from Village Creek to Walker Branch	94591	95658	1067

Table 4-2
Comparison of Peak Flows for the 100-Year CDC Model

4.2.3 Bypass Channel B – Hydraulics

The Samuels Avenue dam hydraulic model was updated to include the Channel B bypass channel. The update included removing the existing channel cross-sections from approximately the Northside Drive Bridge on the West Fork to just downstream of Henderson on the Clear Fork and upstream of the Fort Worth and Western Railroad Bridge on the West Fork. These sections were replaced by the Channel B bypass channel cross-sections. **Figure 4-2** (contained in Appendix D) shows the conceptual plan of the Channel B alignment, grading and revised cross-section numbering.

Manning's roughness coefficient of 0.035 was used for both the channel and the left and right overbanks. Standard contraction and expansion coefficients of 0.1 and 0.3, respectively, were used throughout the study reach with the exception of those influenced by bridges.

Lengths between stations, Left of Bank (LOB), and Right of Bank (ROB) for Alternative B were determined by measuring from the conceptual plans. New or improved bridges were not modeled in this phase of the study.

Presented on **Table 4-3** are the water surface elevations and velocities at selected cross-sections upstream and downstream of Alternative B. Cross-section locations are shown on **Figure 4-2**. Velocities for Alternative B for each of the models are presented in **Table 4-4**.

4.2.4 Summary

The Samuels Avenue Dam hydraulic model was revised to include Bypass Channel Alignment B. **Figure 4-2** shows the preliminary grading plan for Bypass Channel Alignment B. A storage run was made to develop revised stage-storage relationships for the impacted flood routing reaches. The Samuels Avenue Dam hydrologic models were then updated with this new information and new flows were generated. The following differences were noted between the updated UTS hydrology models and the bypass Channel Alignment B hydrology models at locations within the proposed project site:

FEMA-100 Model			
Station	Location Description	Updated Model W.S.	Alignment – B W.S.
244898	D/S of Alignment B at Northside Dr.	526.2	531.36
257426	WF into Channel B	537.72	534.25
1427	U/S of Alignment B, near Henderson	537.39	535.68
CDC-100 Model			
Station	Location Description	Updated Model W.S.	Alignment – B W.S.
244898	D/S of Alignment B at Northside Dr.	527.18	531.84
257426	WF into Channel B	538.18	535.96
1427	U/S of Alignment B, near Henderson	537.85	536.39
CDC-SPF Model			
Station	Location Description	Updated Model W.S.	Alignment – B W.S.
244898	D/S of Alignment B at Northside Dr.	540.7	541.87
257426	WF into Channel B	551.56	547.78
1427	U/S of Alignment B, near Henderson	551.3	549.83

Table 4-3
Comparison of Water Surface Elevations for the 100-Year FEMA, 100-Year CDC and CDC-SPF Models

ALT B VELOCITIES (ft/s)						
Description	Updated Model CDC-100	CDC-100	Updated Model FEMA	FEMA	Updated Model CDC-SPF	CDC-SPF
WF into Channel B	8.42	2.92	8.65	2.98	6.57	3.16
Channel B into WF		5.23		4.89		9.26
D/S of Alignment B at Northside Dr.	8.10	6.91	7.74	6.45	9.48	9.22
U/S of Alignment B, near Henderson	8.12	9.13	7.78	8.89	7.64	8.26

Table 4-4
Comparison of Flow Velocities for the 100-Year CDC and CDC-SPF Models

4.2.5 Hydraulic Analysis – Alternative B

- Reduces 100-year and SPF flood elevations upstream
- Increases erosive velocities
- Reduces channel length from ()lf to ()lf

4.3 Earthwork

As presented in the previous Section 4.2.4, additional valley storage is needed for the addition of the proposed bypass channel alignment Alternative B. The amount of valley storage needed is the same for Alternatives A and B. Possible locations of valley storage were shown on **Figure 3-3,** contained in Section 3**.** The opinion of probable construction cost for replacement of valley storage is $48,000,000. The cost includes excavation of the soil, hauling the soil off-site and disposal costs. If the material excavated could be used nearby, the cost could be reduced. In addition to replacing valley storage, environmental mitigation of the area is required. An allowance of $1,200,000 has been included for mitigation activities.

To construct Alternative B bypass channel, approximately 1.1 million cubic yards of material would be excavated. Approximately 30% of the excavated material is expected to be rock excavation and 70% unclassified material (soil).

Construction of the levees would require almost 720,000 cubic yards of high quality material. Based on the geotechnical and geologic information for the area, it is reasonable to assume the material for the levee construction will be available from the excavated material from the channel. Possible cross-sections for the levee are shown on **Figure 3-4**, contained in Section 3.

For Alternative B, excess material is anticipated after excavation for the bypass channel. However, the exact amount of excess material will be dependent on the usable material excavated. This excess material will have to be hauled from the site or utilized elsewhere on the project. During Project Team Workshop Number 2, it was determined that some of the excess fill material could be used to soften the exterior slope of the bypass channel levee. This would enhance access to the bypass channel and provide an opportunity for new development on the levee and near the channel. A modified cross-section is shown in **Figure 3-5**, contained in Section 3. **Figure 3-6**, contained in Section 3, is an artist rendering of a conceptual cross-section of portions of the bypass channel. A view of the areas to have additional fill are shown on **Figure 4-3.**

4.4 Hydraulic Water Control Structures

The water control structures including a dam and two flood flow control structures are shown on **Figure 4-3** and discussed in detail in Section 3-4. The conceptual design and cost of the water control structures for Alternative A and B are the same. The opinion of probable cost of the water control structures is $31,900,000.

4.5 Transportation Systems

4.5.1 Roads

The route of bypass channel Alternative B crosses through more than ten different roadways and affects a number more. Main Street and Henderson Street would be the roadways of main concern in maintaining traffic flow because these roads transport the largest volume of traffic within the area. **Figure 4-4** illustrates the proposed transportation system for Alternative B.

The following roads would be severed by the bypass channel, requiring relocation of streets for traffic flow:

- Calvert Street
- Throckmorton Street – Two (2) locations on both sides of the Henderson Street Extension
- Commerce Street - Two (2) locations on both sides of the bypass channel

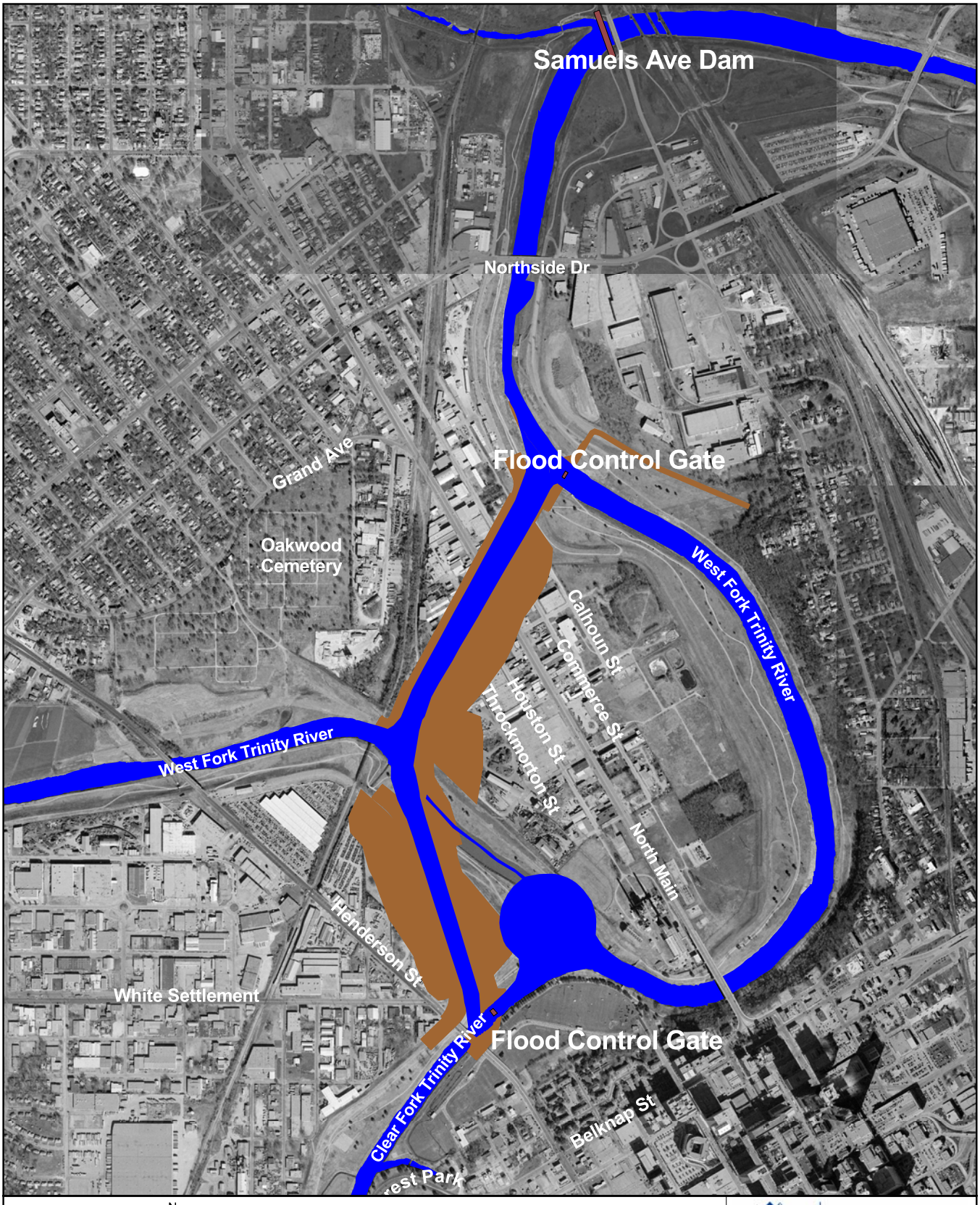

Samuels Ave Dam
Northside Dr
Grand Ave
Flood Control Gate
Oakwood Cemetery
West Fork Trinity River
Calhoun St
Commerce St
Houston St
Throckmorton St
North Main
West Fork Trinity River
Henderson St
White Settlement
Flood Control Gate
Clear Fork Trinity River
Belknap St
LEGEND
Fill Areas
N
Bypass Channel Alignment - Alternative B
Areas of Additional Fill
September 2002
1000 0 1000 2000 Feet
Sources:
Aerials (1999) provided by the City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 4-3

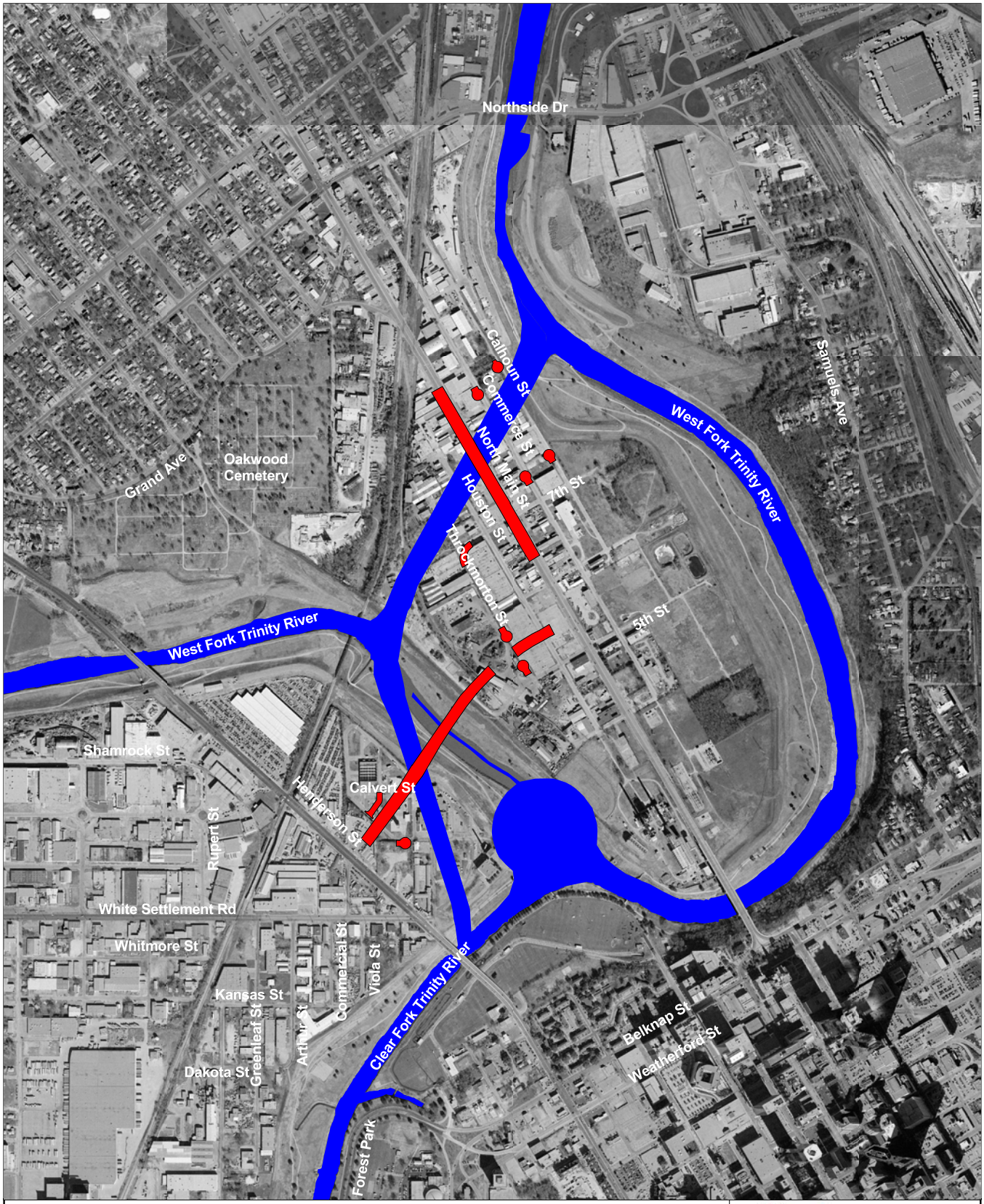

Northside Dr
Calhoun St
Commerce St
North Main St
Houston St
Throckmorton St
7th St
5th St
Samuels Ave
West Fork Trinity River
Grand Ave
Oakwood Cemetery
West Fork Trinity River
Shamrock St
Calvert St
Henderson St
Rupert St
White Settlement Rd
Whitmore St
Kansas St
Commercial St
Viola St
Greenleaf St
Dakota St
Clear Fork Trinity River
Belknap St
Weatherford St
Forest Park
LEGEND
Proposed Roads
N
Proposed Roadways
Alternative B
September 2002
Sources:
Aerials (1999) and streets provided by the City of Fort Worth.
1000 0 1000 2000 Feet
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 4-4

- Calhoun Street – Two (2) locations on both sides of the bypass channel

Construction of the bypass channel would require removal of a portion of Calvert Street. An additional piece would be added to maintain the loop within Calvert Street; the loop would be smaller in size than the original. A portion of Throckmorton Street at the northwestern end would be demolished with the construction of the bypass channel. The intersection of Throckmorton Street and 7th Street would be rebuilt with a greater curvature to avoid the bypass channel and associated levees.

The bypass channel would cross under Main Street. Due to the traffic volume of this road, it should be reconstructed in a manner to maintain traffic flow through the area. A bridge would be required, as described below. A road, referred to as the Henderson Street Extension, would be constructed to provide additional access to the "island" area.

The roadway standards would match or exceed the City of Fort Worth minimum pavement standards provided in **Table 3-5,** contained in Section 3. The current roads experience average congestion. Main Street was designed for more extensive development than is currently present, according to the North Main Corridor Study. This report assumes that the roads would not be widened.

Road improvements, described above, for construction of Alternative B will cost $4,200,000. The breakdown of the construction costs for road improvements for Alternative B is as follows:

■ Main Street	$1,050,000
■ Henderson Street Extension	$1,900,000
■ Miscellaneous Street Modifications	$1,250,000
■ **Total**	**$4,200,000**

4.5.2 Bridges

Two new bridges would be required with the implementation of Alternative B, one at Main Street and one at White Settlement Road. The new levees associated with the bypass channel would be at a higher elevation than the existing levees. New bridges would be designed with adequate approaches to achieve this elevation and maintain a reasonable slope.

The existing Main Street Bridge (also referred to as the Paddock Viaduct) is a cherished landmark near the Downtown area, which would remain unaffected. The new Main Street Bridge would be located at the bypass channel crossing and the current 8th Street intersection. A profile of the proposed Main Street Bridge is included in **Figure 4-5**. The bridge will be 1,800 feet in length. Construction of the Main Street Bridge is estimated at $1,700,000.

There will be a need to provide additional access to the "peninsula," or "island," created by the bypass channel. Henderson Street would be extended and a bridge constructed to provide this additional access. A profile of the proposed Henderson Street Extension bridges is included in **Figure 4-6**. The bridge crossings of the bypass channel and new water feature would be 450 feet and 250 feet in length, respectively. The approach to the bypass channel bridge assumes a 4.9% slope on the west side and a 5% slope on the east side. The new water feature bridge approach assumes a slope of 1% on the west side and 3% on the east side. Construction of the Henderson Street Extension bridges is estimated at $2,700,000.

Bridge improvements, described above, for construction of Alternative B will cost $4,400,000. The breakdown of the construction costs for the bridges in Alternative B is as follows:

- Main Street Bridge $1,700,000
- Henderson Street Extension Bridges $2,700,000
- **Total** **$4,400,000**

4.5.3 Railroad

Alternative B would not affect the Fort Worth and Western Railroad.

4.6 Utility Systems

Alignment B was superimposed over the existing utilities within the project area to determine replacement facilities. The sizes of the replacement lines were not evaluated for redevelopment of the area and replacement costs are based on existing capacity.

4.6.1 Water (Potable)

Illustrated on **Figure 4-7** is the proposed demolition of water lines and proposed new water lines to accommodate the bypass channel, levee and associated modifications.

Major modifications include the relocation of a 30-inch and 20-inch diameter water line. The opinion of probable cost of the water line relocations is $600,000.

4.6.2 Sewer System

Figure 4-8 depicts the sewer line relocations needed to accommodate the bypass channel, levee and associated modifications. Several large diameter sewer lines and siphon systems will have to be reconstructed. The opinion of probable cost of the sewer system relocations is $3,400,000.

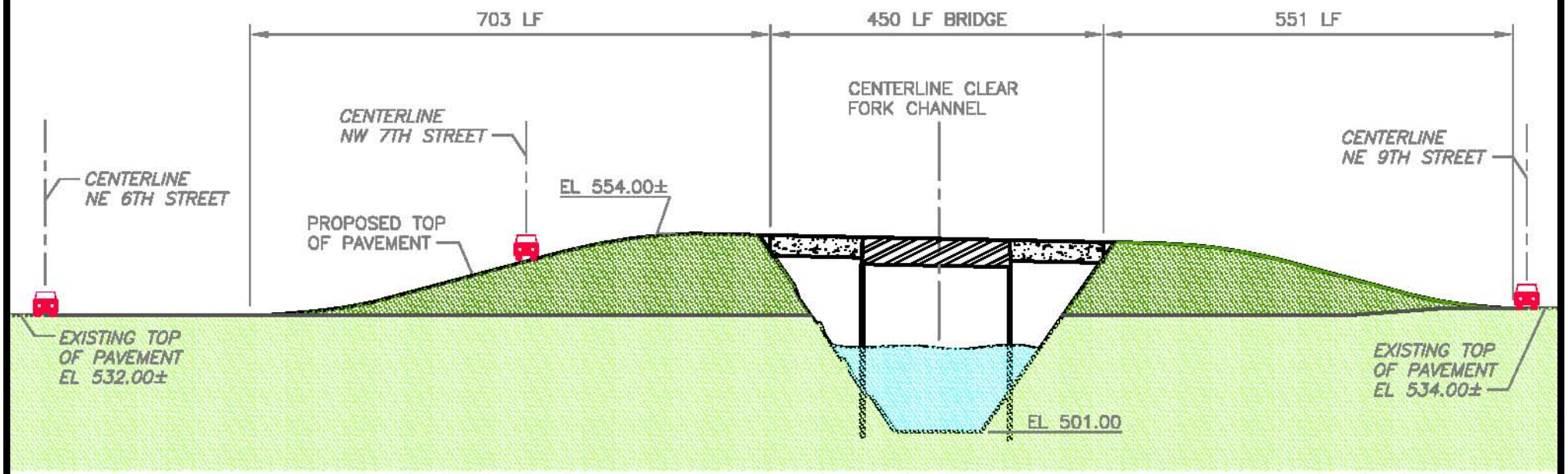
4.6.3 Storm Drainage System

The existing stormwater drainage areas within the project area were shown on **Figure 2-20**, contained in Section 2. Alternative B causes modifications in the stormwater drainage areas. Shown on **Figure 4-9** are the revised storm drainage areas for Alternative B bypass channel alignment.

The existing drainage system is presented in **Section 2.6.3.**

The storm drainage system surrounding the quiescent river segment will change once the bypass channel is in place. Since the bypass channel will convey the flood flows, the existing levees on the quiescent river segment will no longer be needed. It is likely that the levees will be removed to enhance access to the waterfront. When the levees are removed, more of the stormwater will directly run-off into the river segment in lieu of the current outfalls draining the sump areas. It is desirable that the quiescent river segment water surface elevation not increase be maintained such that it does not increase more than 5 feet in elevation during the SPF storm event. Therefore, a stormwater pumping station would be needed to pump the excess stormwater from the protected quiescent river segment. The water could be pumped into the bypass channel or the Trinity River downstream of the bypass channel. The opinion of probable construction cost for the storm water pumping station is $4,710,000.

The storm drainage system relocations, stormwater pumping station, water quality feature within the project area are shown on **Figure 4-10**. The opinion of probable construction cost of the stormwater drainage system relocations is $520,000.



NORTH MAIN STREET PROFILE

Streams and Valleys, Inc.

CDM consulting · engineering · construction · operations

Turner Collie & Braden Inc.

Freese · Nichols

Fugro

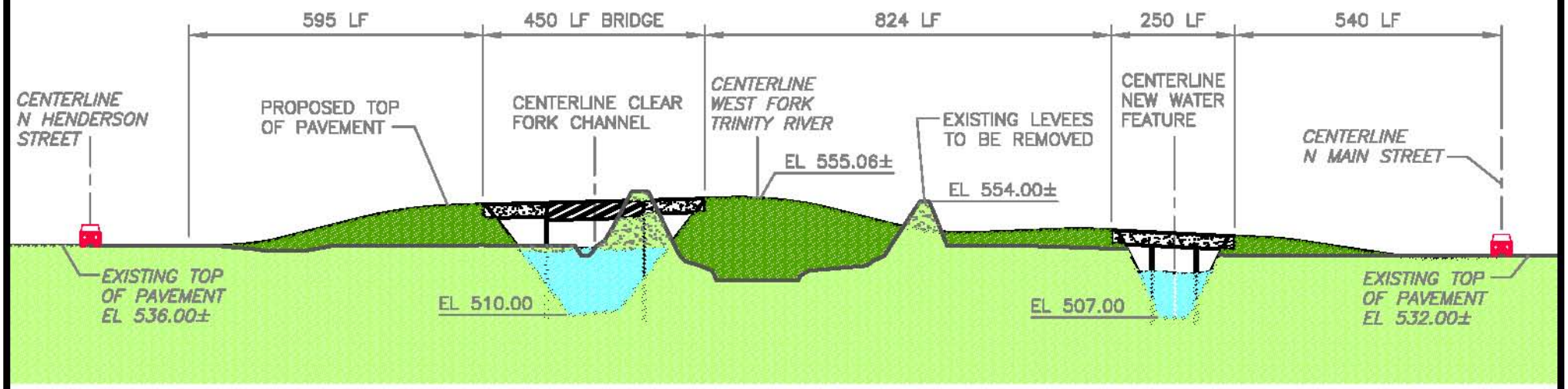
Zachry Construction Corporation

TRINITY RIVER CHANNEL REALIGNMENT PROJECT

NORTH MAIN STREET ALTERNATE B

SEPTEMBER 2002

FIGURE No 4-5



HENDERSON STREET EXTENSION PROFILE

Streams and Valleys, Inc.

CDM consulting · engineering · construction · operations

Turner Collie & Braden Inc.

Freese · Nichols

Fugro

Zachry Construction Corporation

TRINITY RIVER CHANNEL REALIGNMENT PROJECT

HENDERSON STREET EXTENSION ALTERNATE B

SEPTEMBER 2002

FIGURE No 4-6


Flood Control Gate
West Fork Trinity River
Oakwood Cemetery
Calhoun St
Commerce St
Houston St
Throckmorton St
West Fork Trinity River
North Main
Henderson St
White Settlement Rd
Flood Control Gate
Belknap
Weatherford St
Clear Fork Trinity River
Forest Park Blvd
LEGEND
Proposed Water Lines
Demolition
Existing
Proposed
New Roads
N
Proposed Utilities - Water (Potable)
Alternative B
September 2002
800 0 800 1600 Feet
Sources:
City lots and streets provided by the City of Fort Worth.
Water base maps provided by the City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 4-7

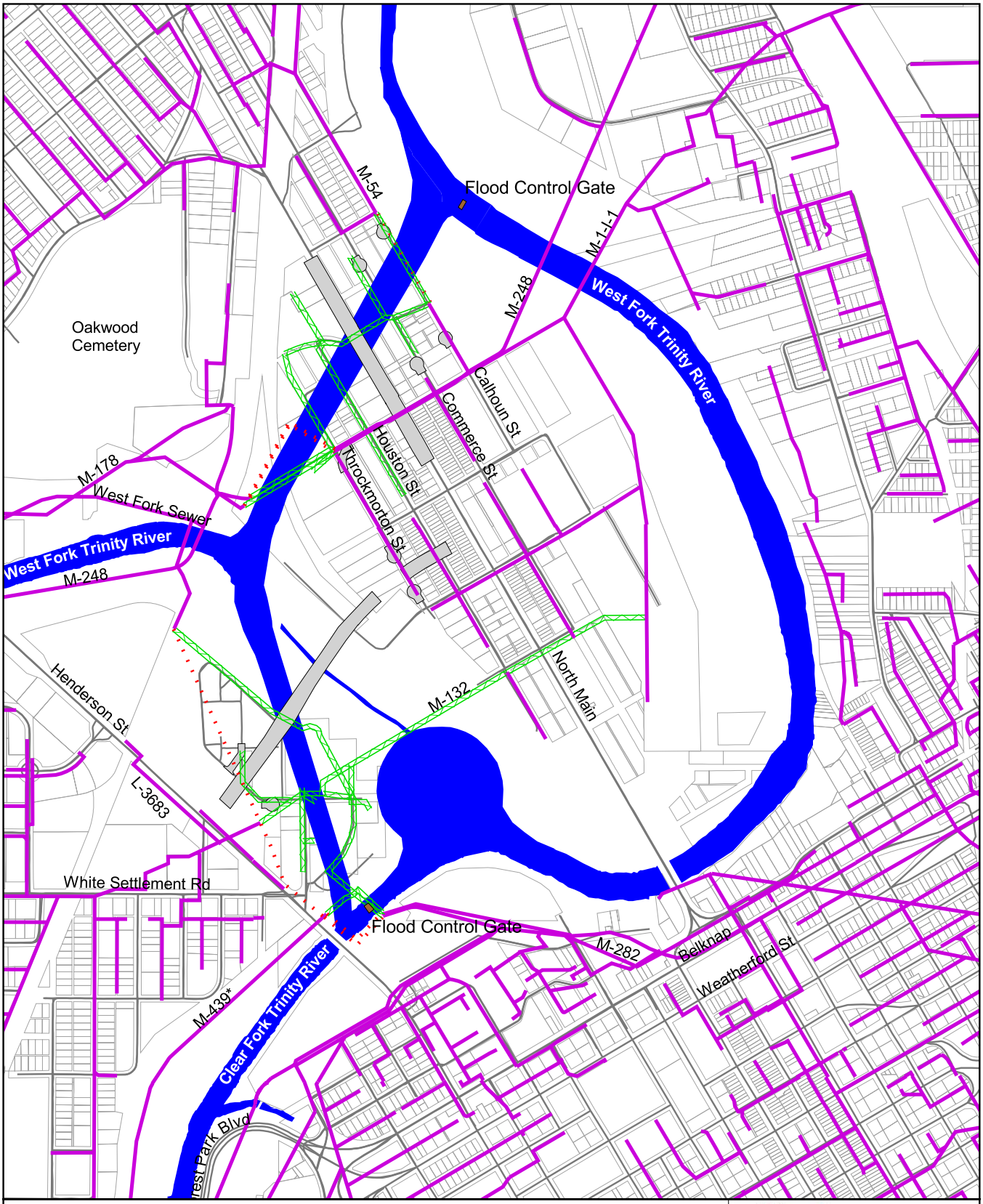

Flood Control Gate
M-54
M-1-1-1
M-248
West Fork Trinity River
Oakwood Cemetery
Calhoun St
Commerce St
Houston St
Throckmorton St
M-178
West Fork Sewer
West Fork Trinity River
M-248
Henderson St
M-132
North Main
L-3683
White Settlement Rd
Flood Control Gate
M-282
Belknap
Weatherford St
M-439*
Clear Fork Trinity River
Forest Park Blvd
LEGEND
Proposed Sewer Lines
Demolition
Existing
Proposed
New Roads
N
Proposed Utilities - Sanitary Sewer
Alternative B
September 2002
800 0 800 1600 Feet
Sources:
City lots and streets provided by the City of Fort Worth.
Sewer base maps provided by the City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 4-8

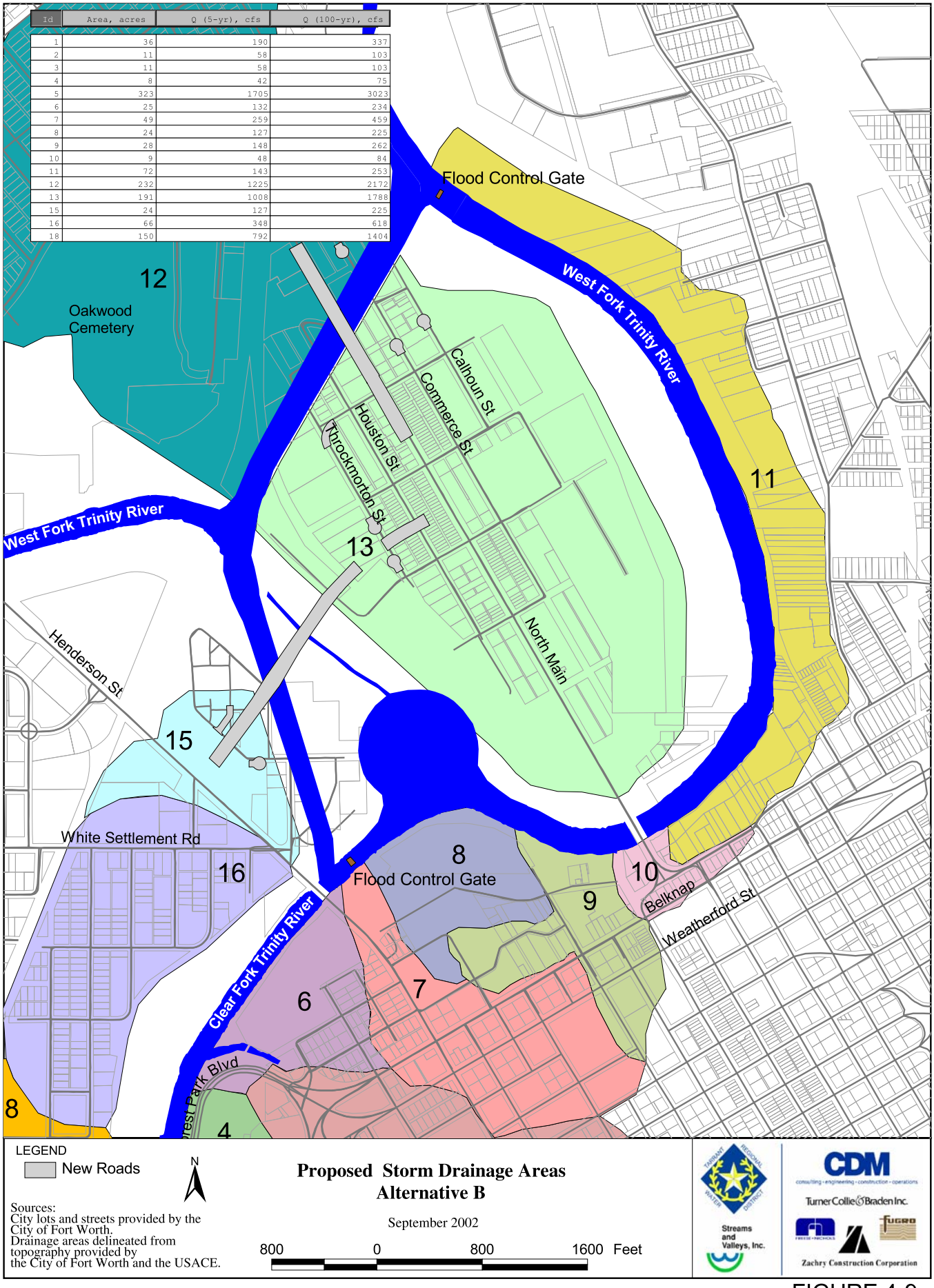

Id | Area, acres | Q (5-yr), cfs | Q (100-yr), cfs
1 | 36 | 190 | 337
2 | 11 | 58 | 103
3 | 11 | 58 | 103
4 | 8 | 42 | 75
5 | 323 | 1705 | 3023
6 | 25 | 132 | 234
7 | 49 | 259 | 459
8 | 24 | 127 | 225
9 | 28 | 148 | 262
10 | 9 | 48 | 84
11 | 72 | 143 | 253
12 | 232 | 1225 | 2172
13 | 191 | 1008 | 1788
15 | 24 | 127 | 225
16 | 66 | 348 | 618
18 | 150 | 792 | 1404
Flood Control Gate
West Fork Trinity River
Oakwood Cemetery
Calhoun St
Commerce St
Houston St
Throckmorton St
North Main
Henderson St
White Settlement Rd
Flood Control Gate
Clear Fork Trinity River
Belknap
Weatherford St
Forest Park Blvd
LEGEND
New Roads
N
Sources:
City lots and streets provided by the City of Fort Worth.
Drainage areas delineated from topography provided by the City of Fort Worth and the USACE.
Proposed Storm Drainage Areas
Alternative B
September 2002
800 0 800 1600 Feet
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 4-9

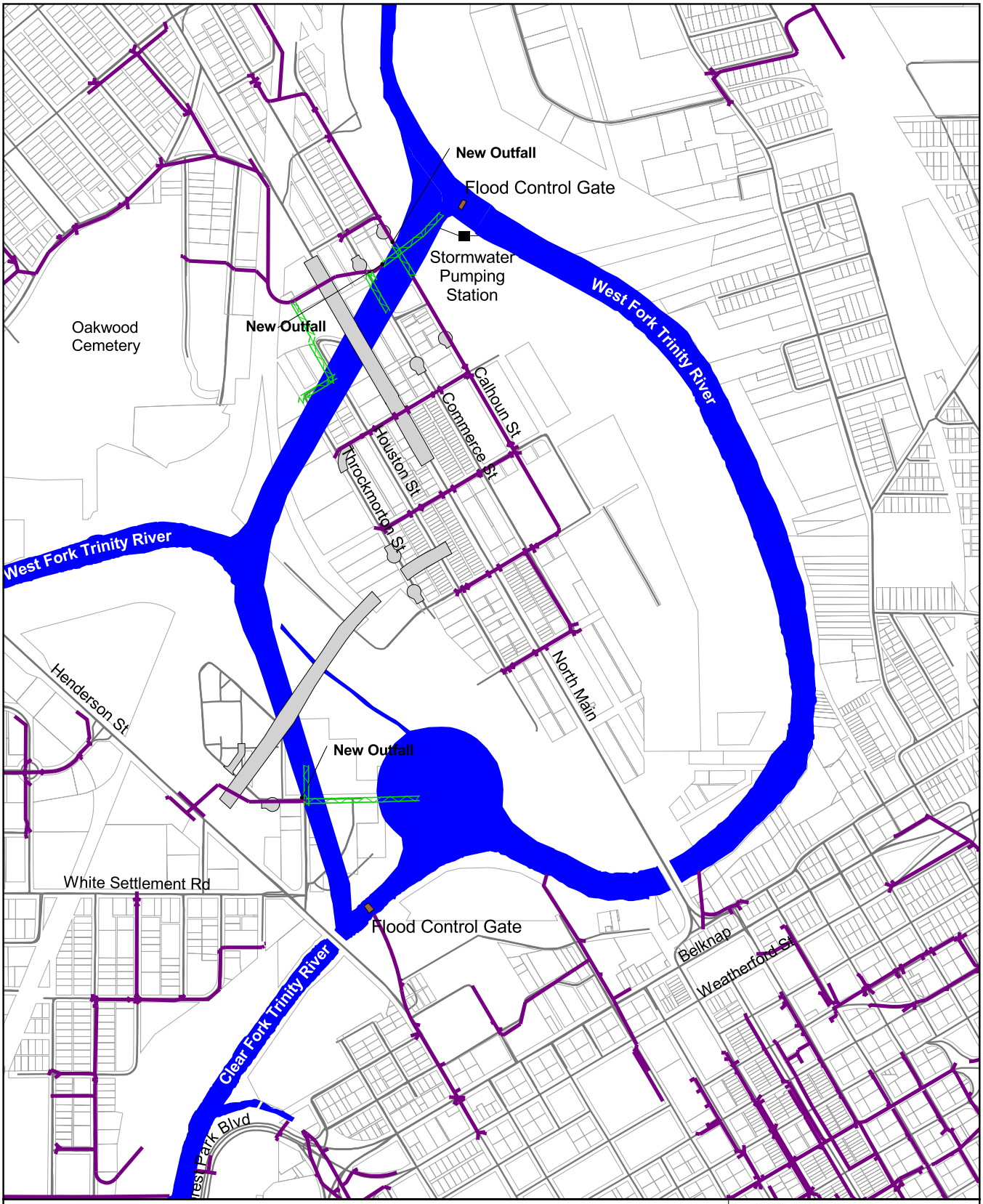

New Outfall
Flood Control Gate
Stormwater Pumping Station
West Fork Trinity River
Oakwood Cemetery
New Outfall
Calhoun St
Commerce St
Houston St
Throckmorton St
West Fork Trinity River
Henderson St
North Main
New Outfall
White Settlement Rd
Flood Control Gate
Belknap
Weatherford St
Clear Fork Trinity River
Park Blvd
LEGEND
Revised Storm Lines
Demolition
Existing
New Roads
N
Proposed Utilities - Storm Drain
Alternative B
September 2002
800 0 800 1600 Feet
Sources:
City lots, streets and storm drain base maps provided by the City of Fort Worth.
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 4-10

4.6.4 Natural Gas

Illustrated on **Figure 4-11** is the proposed demolition of gas service and distribution system mains and proposed new gas mains to accommodate the bypass channel, levee and associated modifications.

Major modifications include the relocation of a 24-inch high pressure main across the proposed bypass channel. The opinion of probable cost of the gas system relocations is $400,000.

4.6.5 Electrical Transmission and Distribution

Figure 4-12 depicts the electrical distribution and transmission line relocations needed to accommodate the bypass channel, levee and associated modifications. The opinion of probable cost of the electrical distribution and transmission system relocations is $300,000.

4.6.6 Fiber Optics, Cable & Telephone

Illustrated on **Figure 4-13** is the proposed demolition of the existing fiber optics line and the replacement line based on the anticipated roadway changes. The opinion of probable cost of the relocation of the overhead fiber optics line is $500,000.

The existing cable lines to be demolished and the proposed replacement lines are shown on **Figure 4-14**. The opinion of probable cost of the relocation of the cable lines for Alternative B is $200,000.

As presented in section 2.6.7 the telephone service grid maps were unavailable. Estimates of telephone service to be reinstated were based on standard service and grids within the project area.

4.7 Environmental Issues

The Alternative B bypass channel intercepts one known contaminated property and two EPA designated sites. Prior to implementation of the bypass channel, the environmental issues associated with properties in the path of the channel will need to be assessed and resolved. The contaminated property within the Alternative B alignment is APAC Texas, Inc.

- **APAC Texas Incorporated (Groundwater Contamination)**
  A leaking underground storage tank was reported in 1992, which has impacted groundwater and surface water used by humans/endangered species. The site has undergone a liability assessment, confirmation sampling and Phase III assessment of the area is in progress. The nature and extent of the contamination will be fully characterized and the appropriate cleanup technology identified under Phase III. The reported groundwater contamination is gasoline and diesel fuel.

The two EPA designated sites within the Alternative B alignment are as follows:

- **AST Research (RCRA-listed)**
  AST Research, Inc. is a RCRA permitted facility.

- **Texas Refinery Corporation (SARA & RCRA-listed)**
  The Texas Refinery Corporation produces asphalt felts, coatings, sealants, lubricants and grease and is considered a large quantity generator of hazardous waste. The Texas Refinery Corporation is a SARA Title III regulated facility. A total of more than 30 chemicals from clay and sand to brand name solvents and cleaners are reported to be stored on site. Chemicals reported to have been released both on and off-site by the company from 1988 to 1998 include antimony compounds, dichloromethane, diethanolamine, ethylene glycol, xylene, (mixed isomers), and zinc compounds.

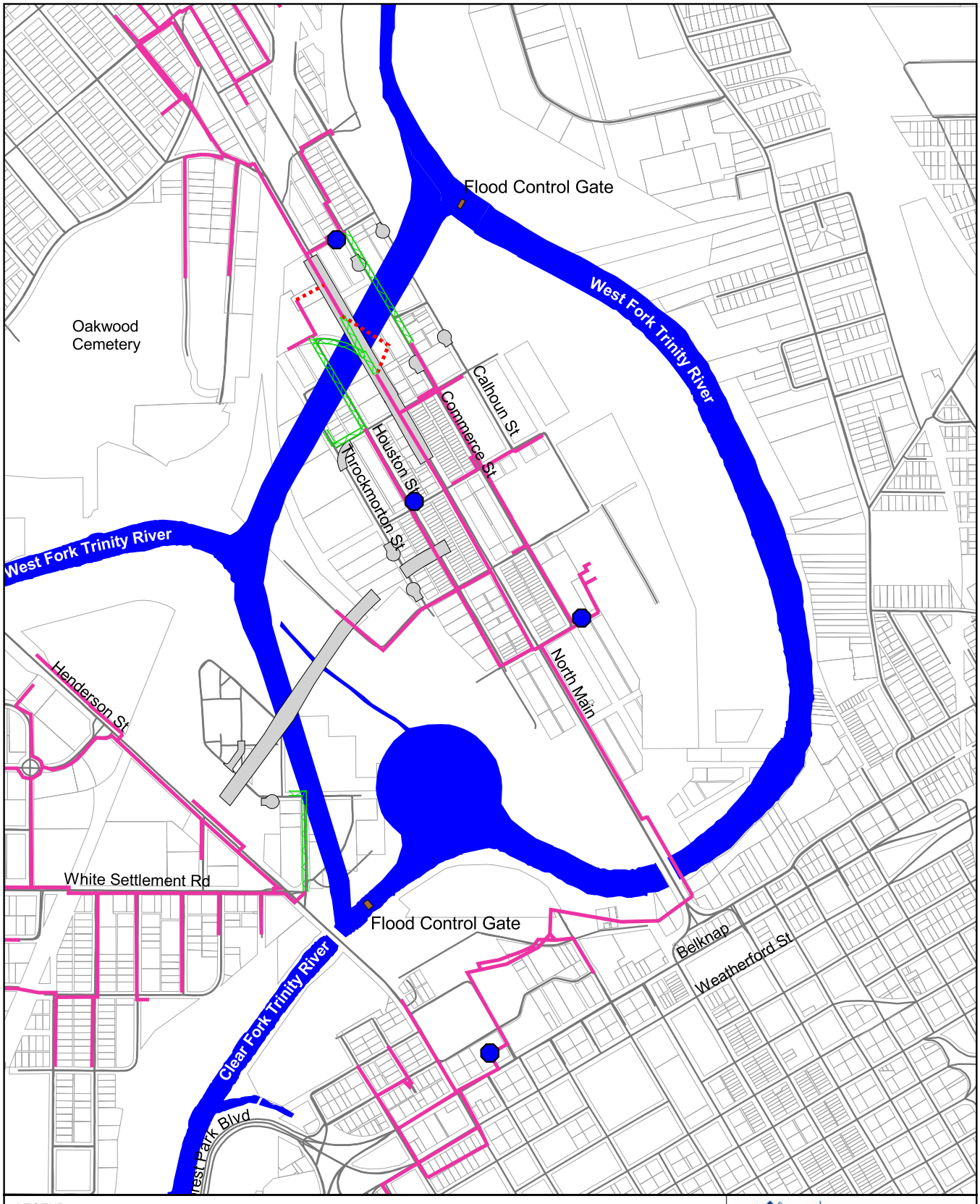
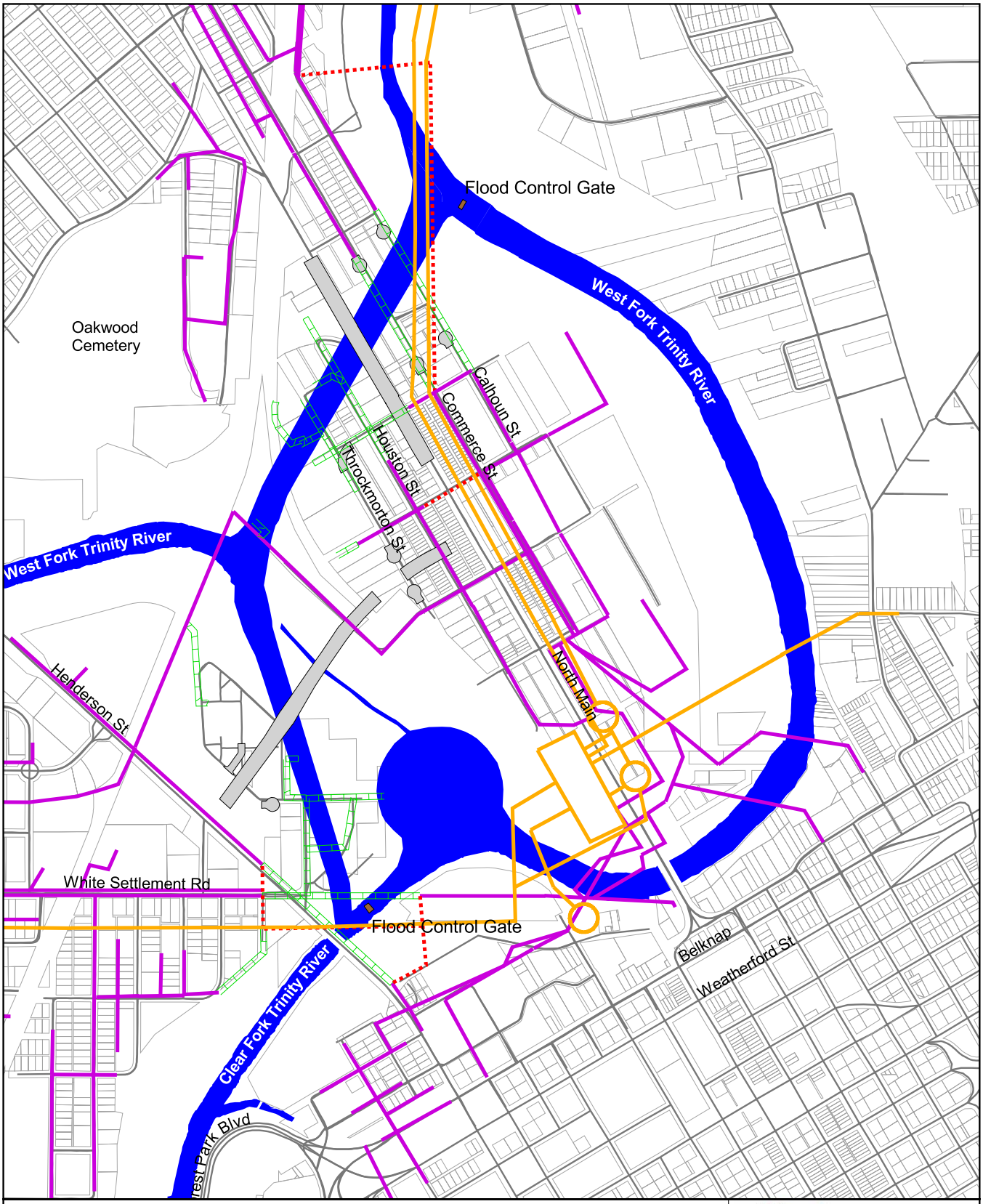

Flood Control Gate
West Fork Trinity River
Oakwood Cemetery
Calhoun St
Commerce St
Houston St
Throckmorton St
West Fork Trinity River
Henderson St
North Main
White Settlement Rd
Flood Control Gate
Belknap
Weatherford St
Clear Fork Trinity River
West Park Blvd
LEGEND
Pressure Reducing Stations.
Proposed Gas
Demolition
Existing
Proposed
New Roads
Sources:
City lots and streets provided by the City of Fort Worth.
Gas lines input from files provided by Oncor.
N
Proposed Utilities - Gas
Alternative B
September 2002
800 0 800 1600 Feet
Streams and Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 4-11



LEGEND
- Electric Stations
- Electric Transmission
- Proposed Electric Distribution
- Demolition
- Existing
- Proposed
- New Roads

Sources:
City lots and streets provided by the City of Fort Worth. Electric transmission and distribution lines input from maps provided by Oncor.

N

Proposed Utilities - Electric
Alternative B

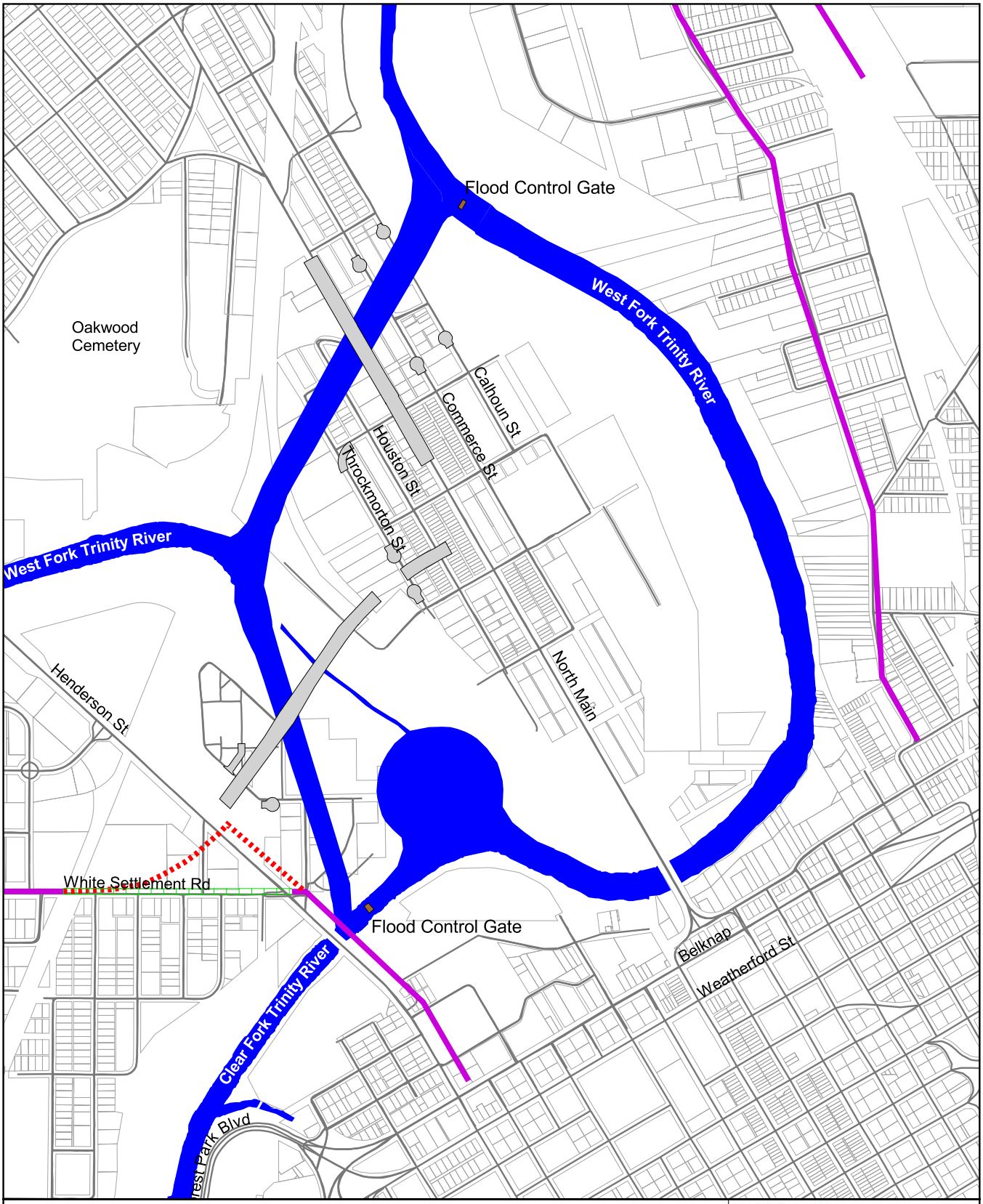
September 2002

800 0 800 1600 Feet

Streams and Valleys, Inc.

CDM
Turner Collie & Braden Inc.
Fugro
Zachry Construction Corporation

FIGURE 4-12



LEGEND
Proposed Fiber Optics
Demolition
Existing
Proposed
New Roads

N

Proposed Utilities - Fiber Optics
Alternative B

September 2002

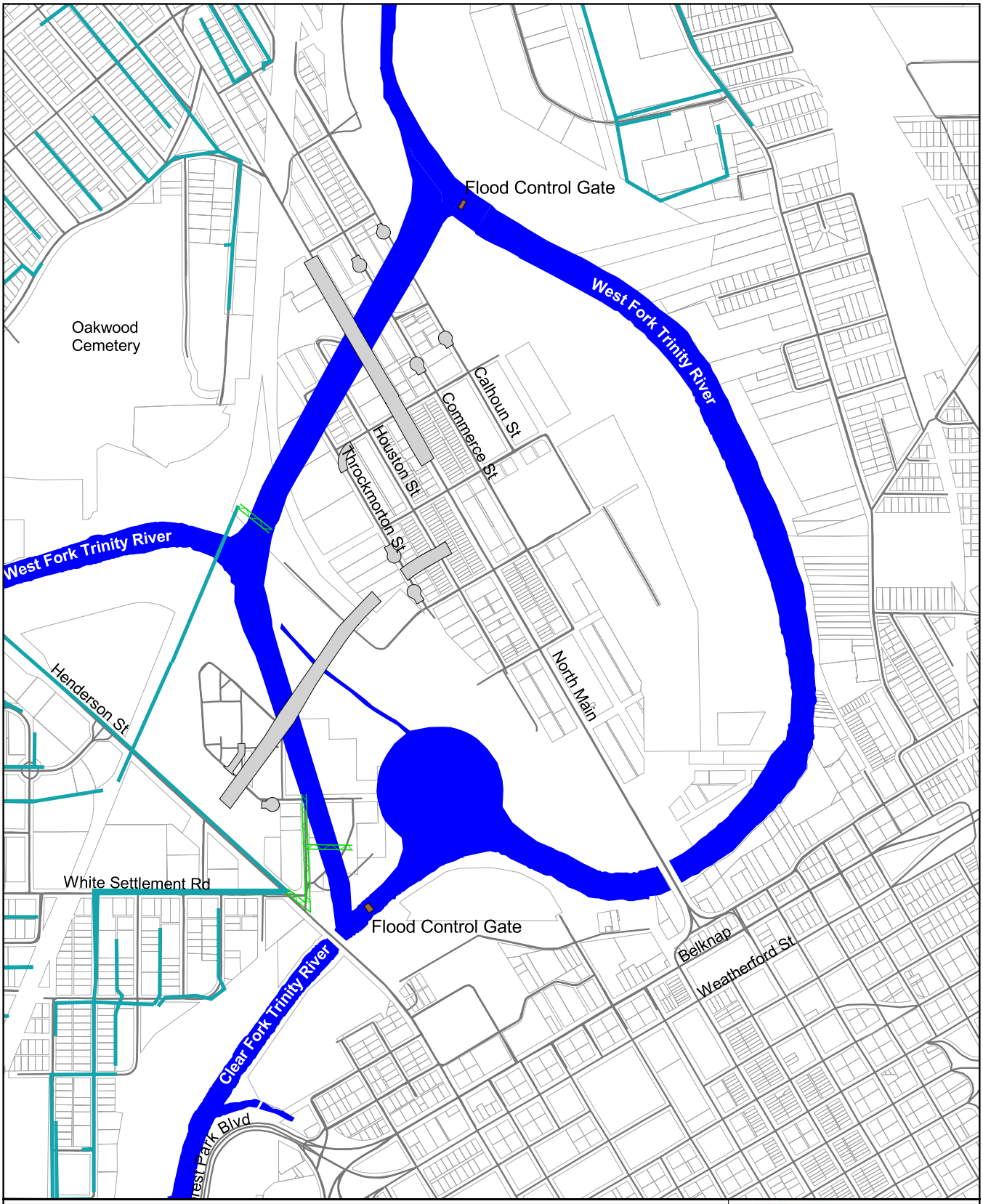
800 0 800 1600 Feet

Sources:
City lots and streets provided by the City of Fort Worth.
Fiber optic lines input from information provided by E-Spire Communications, Level 3 Communications and Metromedia Fiber Network.

Streams and Valleys, Inc.

CDM
Turner Collie & Braden Inc.
Fugro
Zachry Construction Corporation

FIGURE 4-13



LEGEND
Proposed Cable
Demolition
Existing
New Roads

Sources:
City lots and streets provided by the City of Fort Worth.
Cable lines input from maps provided by Charter Communications.

N

Proposed Utilities - Cable Alternative B

September 2002

800 0 800 1600 Feet

Streams and Valleys, Inc.

CDM

Turner Collie & Braden Inc.

Zachry Construction Corporation

FIGURE 4-14

Brownfields denote real or *perceived* contamination. There are no brownfield sites located within the alignment of Alternative B. Ten underground storage tanks are located within the alignment of Alternative B, but the presence of storage tanks is indicative that they will need to be removed during excavation not that a leak is present.

Because the area in which the bypass channel will pass includes commercial and industrial developments, environmental remediation of the project site is likely. The location, extent, and character of any remediation are unknown. However, in determining cost estimates for use in determining the financial feasibility of the project, assumptions have to be made. The area encompassed by the bypass channel is approximately 78 acres. An opinion of probable cost for environmental remediation for the area is $15,600,000.

The environmental areas impacted by the Alternative B alignment are shown on **Figure 4-15**.

The exact amount for remediation of environmental sites along the project area is not known but would be refined as the project moves forward. Construction costs are summarized in Section 4.10.

4.8 Property Acquisition

Bypass channel alignment Alternative B requires the acquisition of 62 properties. The estimated cost of property acquisition is $10,600,000.

4.9 Demolition

Bypass channel alignment Alternative B requires the demolition of 68 structures. The estimated cost of demolition is $5,700,000, which includes "knock down", hauling of debris and disposal costs. No specific allowances have been included for asbestos surveys, removal, stabilization or disposal, but some of this unknown cost is covered in the project contingency estimates.

4.10 Project Cost Summary for Alternative B

The opinions of probable cost prepared for this study are based on today's costs. Inflation has not been included in the costs, nor interest for borrowed capital.

Presented in **Table 4-5** is a summary of the project costs for the Alternative B bypass channel alignment.

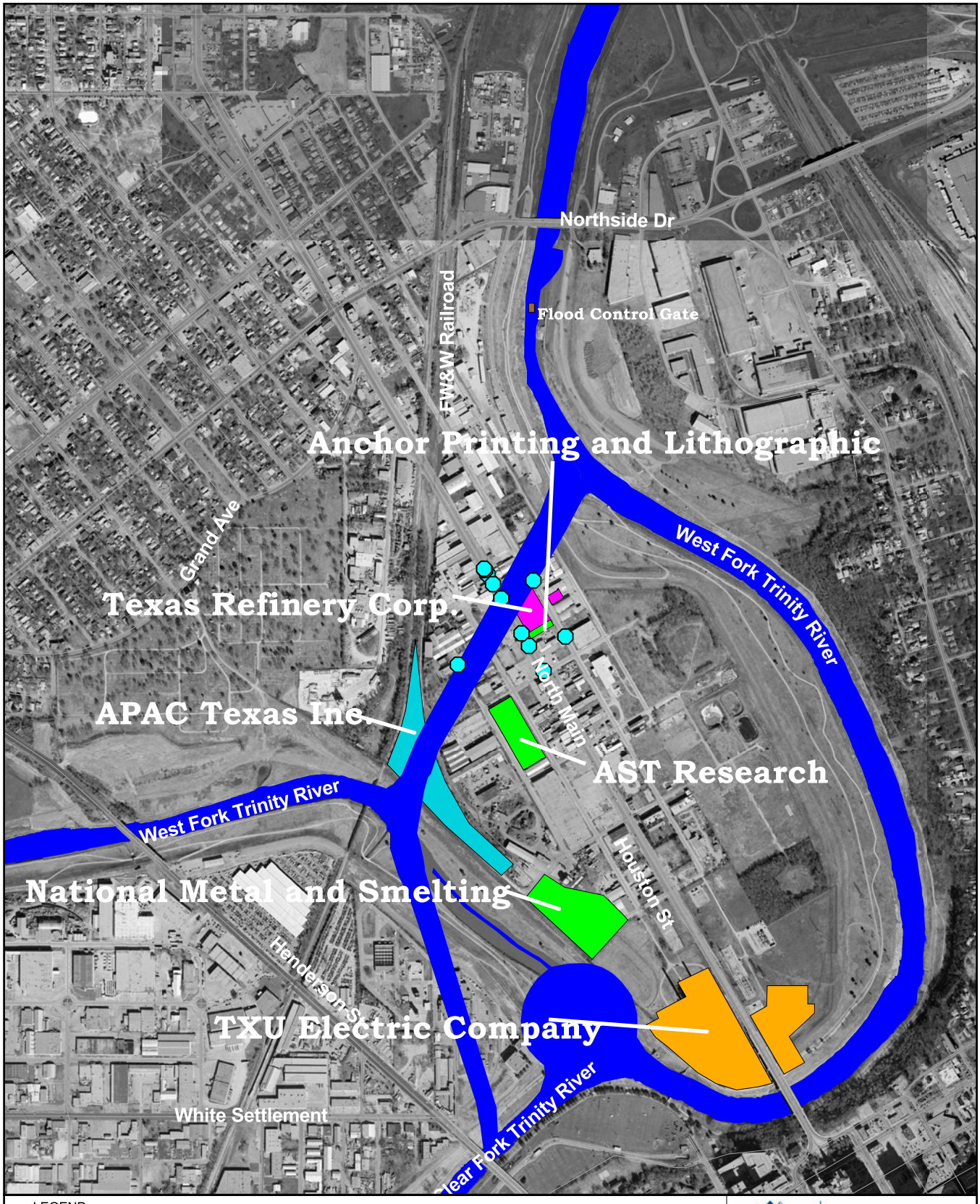

Northside Dr
Flood Control Gate
FW&W Railroad
Anchor Printing and Lithographic
Grand Ave
West Fork Trinity River
Texas Refinery Corp.
North Main
APAC Texas Inc.
AST Research
West Fork Trinity River
Houston St
National Metal and Smelting
Henderson St
TXU Electric Company
White Settlement
West Fork Trinity River
LEGEND
Storage Tanks
UST
Contaminated Sites
Groundwater
EPA Designated Properties
RCRA
SARA
SARA & RCRA
N
Alternative B - Environmental
September 2002
Sources:
Aerials (1999) provided by
the City of Fort Worth.
900
0
900
1800 Feet
Streams
and
Valleys, Inc.
CDM
Turner Collie & Braden Inc.
Zachry Construction Corporation

FIGURE 4-15

Trinity River Realignment Feasibility Study
Alternative B
Table 4-5

Opinion of Probable Construction Cost

Item/Description		Cost
Land Acquisition		**$10,600,000**
Demolition		**$5,700,000**
	Buildings including slabs	$5,200,000
	Paving/Parking Lot	$500,000
Utility Relocation and Demolition		**$6,500,000**
	Water Lines	$600,000
	Sewer Lines	$3,400,000
	Storm Drain System	$800,000
	Electrical Distribution and Transmission	$300,000
	Gas Transmission	$400,000
	Cable	$200,000
	Telephone	$300,000
	Fiber Optics	$500,000
By-Pass Channel Ex./Levee Construction		**$11,000,000**
	Excavation	$5,5000,000
	Embankment	$20800,000
	Erosion Protection (bends, confluence)	$3,100,000
	Seeding	$200,000
	Service Roads	$200,000
Valley Storage Balance		**$49,200,000**
	Excavation for Valley Storage	$48,000,000
	Mitigation for Valley Storage Areas	$1,200,000
Water Control Structures		**$32,200,000**
	Control Gate North	$5,600,000
	Control Gate South	$5,600,000
	Trinity River Dam	$21,000,000

Water Quality Facilities/Storm Water PS		**$5,100,000**
	Outfalls Collection Systems	$100,000
	Aeration Fountain	$300,000
	Storm Water Pumping Station	$4,700,000
Roadway Construction/Reconstruction		**$8,600,000**
	White Settlement Road	**$4,600,000**
	Land Acquisition	$450,000
	Embankment	$650,000
	Roadway Paving	$800,000
	Bridge Construction (by-pass channel)	$1,700,000
	Bridge Construction (lake feature)	$1,000,000
	N. Main Street	**$2,750,000**
	Land Acquisition	$170,000
	Embankment	$160,000
	Roadway Paving	$720,000
	Bridge Construction	$1,700,,000
	Miscellaneous Street Modifications	**$1,250,000**
		$1,250,000
Environ. Remediation Allowance – Project		**$15,600,000**
Subtotal		**$144,500,000**
Contingencies		**$14,500,000**
Total		**$159,000,000**

Project Administration

Item/Description	Cost
Program Management	**$11,000,000**
Permitting (EIS, 404 etc.)	**$4,800,000**
Design, Survey, Testing & Constr. Management	**$29,000,000**
Legal Assistance	**$3,000,000**
Total	**$47,800,000**

Grand Total	**$206,800,000**

Section 5 Discussions, Conclusions, and Recommendations

5.1 Discussions

This study focused on investigating the feasibility of creating a quiescent river segment from near the confluence of the Clear Fork & West Fork of the Trinity River to a point just upstream (south) of the Northside Drive crossing. The concept includes a dam near the Samuels Avenue crossing of the West Fork of the Trinity River downstream of its confluence with Marine Creek. This general concept was identified during the Trinity River Vision Public Workshop in October 2001.

The dam near Samuels Avenue is envisioned to impound water at an approximate water surface elevation between 525 feet and 528 feet nvgd and would impound water up the Marine Creek Channel as well as the West Fork and Clear Fork of the Trinity River. The concept would entail the removal of existing in channel dams, including Nutt Dam, in the river segment.

Several flood relief bypass channels configurations were investigated to restore the originally designed flood protection and to address the improvement of drainage of the interior ponding areas, or sumps, located behind the levees. This feasibility analysis also included a preliminary review of environmental restoration concepts within the Central City segment. More detailed evaluations were performed on two flood relief channel alignments to assess the relative impact on physical facilities, such as roads, bridges and utilities, as well as to gauge the level of real estate, environmental, and cultural resources impacted.

5.2 Conclusions

According to the September 1987, USACE Fort Worth Floodway Appraisal Report, increased development in the watershed has reduced the level of flood protection during a Standard Project Flood event and has increased the severity of all flood events. It is now considered that the levees would be overtopped and fail with about a 450-year flood event causing catastrophic damage.

This study investigated new channel and levee systems to restore the level of flood protection within the study area and improve interior drainage behind the levees. The channel and levee systems identified as Alternatives A & B would meet or have minimal variances from the hydraulic impact criteria established in the Record of Decision Regional Environmental Impact Statement Trinity River and Tributaries by the U.S. Army Corps of Engineers on April 29, 1988. Variances from the criteria established in the Record of Decision are limited to public interest factors not accounted for in the Regional Environmental Impact Statement and which are overwhelmingly warranted in the "best overall public interest."

It is important to note that the hydraulic effort undertaken so for is at the feasibility level, modifications to the project plan will assist in better reaching the requirements of the CDC regulations. That being said, the following applies to the analysis. Valley storage can be found to replace that valley storage lost by the bypass channels, preliminary studies have been undertaken to locate areas likely to provide that storage. The development of these areas can be done in a manner such that the volume lost for the 100-year event is put back into the river system within the 100-year elevation differential and the volume lost between the 100-year event and the SPF event can be put back into river between that elevation differential. The requirements state there will be no increases in *erosive* velocities. For all areas where there is a velocity increase but it is not

considered to be erosive it is assumed that the conditions of the regulations are met. For all other cases, appropriate erosion control measures can be undertaken to mitigate for the increase in erosive velocities. Further refinement of the base plan may assist in the reduction of these velocities as well. In regard to the 100-year floodplain, it has been assumed that increases in the 100-year flood plain within a fully leveed portion of the system will not be problematic. Care has been taken to ensure that there are no upstream increases in 100-year flood elevation when the system rejoins both the Clear Fork and the West Fork.

The concept evaluated in this study would undoubtedly focus attention on the surrounding areas and the opportunities for redevelopment. Much of the Paddock Bend neighborhood, for example, consists of underutilized or abandoned commercial and industrial sites nearby to downtown and the Fort Worth Stockyards. Fortunately rapid advances in environmental contamination assessment and remediation technology are making environmental cleanups less costly, more predictable, and protective of public health. A more detailed understanding of the environmental remediation needs will permit a focused multi-disciplined approach to the issue. Coordination of the multi-discipline expertise of environmental science, economic development, infrastructure engineering, planning, financing and community development, through the City of Fort Worth Brownfield Program will be required for successful Brownfield redevelopment program.

The flood relief bypass channel investigated in this study involves the acquisition of real property, excavation of a new channel, road, highway, and railroad conflicts and adjustments, utility relocations and the raising of the height of the levee system in the study area. This area has already witnessed urban development with commercial and industrial land uses and construction should have minimal impact on terrestrial wildlife habitat. During channel construction, the excavation would be isolated from the Trinity River until much of the new channel and levee system was in place. New levee construction, levee modification, bridge construction, railroad construction, would have negligible water quality impacts since these construction activities are located outside of the stream waters. Some sediment would be washed from adjacent construction to the river but control measures would be required to mitigate the transport of sediment. During excavation of the new channel tie-in to the river, some increased turbidity would be expected. However, these impacts would be temporary and would not significantly affect aquatic life downstream.[1]

The envisioned flood relief bypass channel would include structural mitigation measures to enhance the quality of the environment including the construction of wetlands downstream of the dam near Samuels Avenue. Wetlands are important natural mechanisms in reducing pollutant loads downstream and would provide wildlife habitat as well. These wetlands areas can be used in restoring valley storage, which would be lost with the much shorter bypass channel construction, an important consideration for offsetting downstream flooding impact.

An indirect benefit of the bypass channel concept is that it not only addresses restoring flood protection levels, but it also provides a working "laboratory" compatible with the Fort Worth Strategic Goals 2002 – 2006.

Specifically, the Fort Worth City Council identified that the creation of clean, attractive neighborhoods, creation of a diversified economic base and creation of job opportunities, and the revitalization of the Central City in neighborhoods and commercial corridors as 3 of the top 6 priorities in the planning timeframe.

This Trinity River concept investigated in this study not only offers tremendous opportunities with respect to these priorities, it also addresses many other City Council strategic priorities such as promotion of sustainable development, provision

[1] Reconnaissance Report, Upper Trinity River Basin, Vol. II, March 1990, U.S. Army Corps of Engineers

of open spaces, and encouragement of well designed public/private development.

In summary, the Trinity River Realignment concept is technically feasible, and within a general construction cost framework that appears to be achievable contingent upon support from all levels of government and the private sector. The concept would not only provide flood protection benefits, it would also open the door to sustainable development goals, including mixed land uses near downtown and would provide a constant and controlled water surface along the quiescent river segment creating a "town lake". This would allow greater public access and recreational opportunities.

5.3 Recommendations

Based on the results of this preliminary investigation and the parallel planning and economic development studies conducted by Gideon-Toal, it is apparent that the Trinity River Floodway Realignment concept could provide tremendous benefits to Tarrant County, the City of Fort Worth, the Tarrant Regional Water District (District), and the citizens in the area. Because this concept could literally transform the area, and would begin a process to address the flood potential due to increased flood flows, it is recommended that a deliberate, well-planned program to systematically involve the community, to coordinate with and enlist the support of local, county, regional, State, and Federal governments, to develop schedules, funding strategies, public/private partnerships, to design and construct a channel realignment consistent with community desires and available funding, be developed. More specifically and assuming that the concept presented in this report and the companion study prepared by Gideon-Toal receives the full support and endorsement of the Tarrant Regional Water District, the City of Fort Worth, Tarrant County, Streams and Valleys, Inc. and others, it is recommended that local sponsors quickly mobilize a program management team with strong engineering, planning, environmental, a project management expertise, coupled with in-depth local knowledge and experience:

- to recommend project packages,
- to coordinate with all affected jurisdiction,
- to develop permitting strategies,
- to develop funding concepts and recommendations,
- to organize a public/private forum
- to discuss planning and redevelopment issues,
- to conduct public education and outreach,
- to provide design services for certain facilities via task order according to critical or urgent need
- to provide integrated document control
- to provide quality control and oversight of all designs and construction
- to develop a risk management plan
- to develop a claim's management plan
- to develop an integrated scheduling and budgeting plan

Various community leaders led by Congresswoman Kay Granger, George Shannon and the entire Board and staff of the Tarrant Regional Water District, Mayor Barr and the City Council of Fort Worth, the Executive Board and Executive Director of Streams & Valleys, Inc., the Texas Water Development Board, the North Central Texas Council of Governments, the U.S. Army Corps of Engineers, and others have all contributed to developing and enhancing the vision of a Trinity River that would truly link the

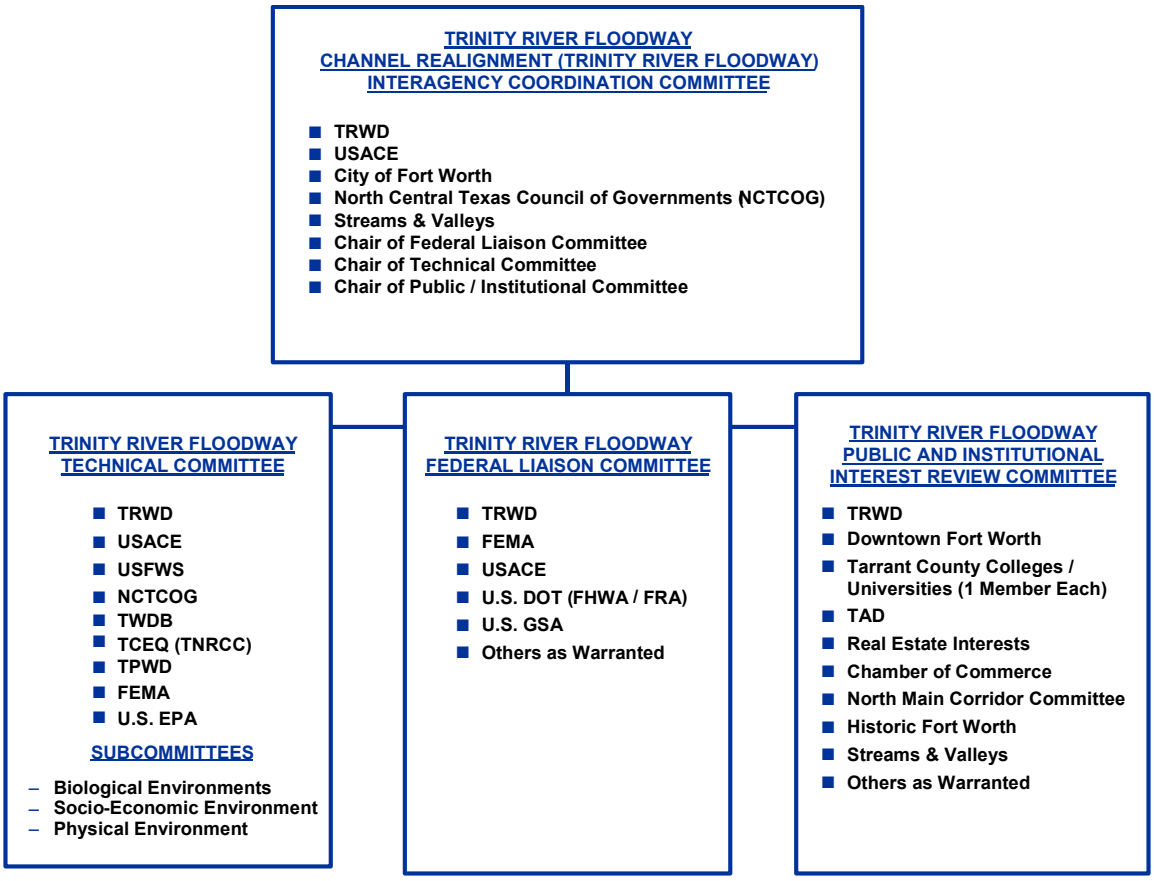
City's neighborhoods and become a focal point of the quality of life in Fort Worth. Every major project of this magnitude requires ongoing envisioning and leadership from key stakeholders and others or the project will stagnate and balkanize into a myriad of conflicting interests. Accordingly, it is recommended that the local sponsors establish a committee structure designed to maintain coherence, focus, and expertise so that interaction and information can produce results. For example:

- A coordination committee where the results of meetings with the other working committees can be "rolled up", reviewed, revised, and re-directed as necessary to stay on tract and schedule

- A technical committee charged with the review/comment/critique of the relevant studies being prepared by an integrated U.S. Army Corps of Engineers/consultant team. The principal studies are the NED plan and the draft Environmental Impact Statement. The value of this committee is to achieve "buy-in" by the key resource agencies.

- A Federal Liaison Committee charged with determining and articulating the specific federal interests in the floodway/channel re-alignment project so these may be properly accounted for in the NED plan and in the DEIS/FEIS.

- A Public/Institutional Interests Review Committee charged with identifying key beneficial and adverse economic and social effects of the proposed project for input to the technical committee. This group is the pulse of the local community whose broad support is essential.


TRINITY RIVER FLOODWAY
CHANNEL REALIGNMENT (TRINITY RIVER FLOODWAY)
INTERAGENCY COORDINATION COMMITTEE
TRWD
USACE
City of Fort Worth
North Central Texas Council of Governments (NCTCOG)
Streams & Valleys
Chair of Federal Liaison Committee
Chair of Technical Committee
Chair of Public / Institutional Committee
TRINITY RIVER FLOODWAY
TECHNICAL COMMITTEE
TRWD
USACE
USFWS
NCTCOG
TWDB
TCEQ (TNRCC)
TPWD
FEMA
U.S. EPA
SUBCOMMITTEES
Biological Environments
Socio-Economic Environment
Physical Environment
TRINITY RIVER FLOODWAY
FEDERAL LIAISON COMMITTEE
TRWD
FEMA
USACE
U.S. DOT (FHWA / FRA)
U.S. GSA
Others as Warranted
TRINITY RIVER FLOODWAY
PUBLIC AND INSTITUTIONAL
INTEREST REVIEW COMMITTEE
TRWD
Downtown Fort Worth
Tarrant County Colleges / Universities (1 Member Each)
TAD
Real Estate Interests
Chamber of Commerce
North Main Corridor Committee
Historic Fort Worth
Streams & Valleys
Others as Warranted

Appendix A – Record of Decision

Record of Decision -
Regional Environmental Impact Statement:
Trinity River and Tributaries

I. Introduction

Since its early history, the U.S. Army Corps of Engineers has played an important role in the development of the nation's water resources. Originally, this involved construction of harbor fortifications and coastal defenses. Later duties included the improvement of waterways to provide avenues of commerce and reduce flood hazards. An important part of its mission today is the protection of the nation's waterways through the administration of the Regulatory Program. The Corps is directed by Congress under Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403) to regulate all work or structures in or affecting the course, condition, or capacity of navigable waters of the United States. Section 9 (33 USC 401) directs the Corps to regulate the construction of any dam or dike across a navigable water of the United States. The intent-of these laws is to protect the navigable capacity of waters important to interstate commerce.

Additionally, the Corps is directed by Congress under Section 404 of the Clean Water Act (33 USC 1344) to regulate the discharge of dredged and fill material into all waters of the United States, including adjacent wetlands. The intent of this law is to protect the nation's waters from the indiscriminate discharge of material capable of causing pollution, and to restore and maintain their chemical, physical, and biological integrity. Because the District Engineer's decision to issue or deny a permit under these laws is a significant Federal Action, various other statutes, principally Public Law 91-190 (the National Environmental Policy Act, or NEPA) come into play. Among other things, NEPA requires the consideration of the direct, indirect, and cumulative impacts of an action (40 CFR 1508-25(C)).

Late in 1984 and early in 1985, it became apparent that numerous unrelated development projects were being proposed along the Trinity River and its tributaries in Dallas, Denton, and Tarrant Counties, Texas. Most involved modification of the river channel and/or flood plain in some form or another, and most required a Corps of Engineers permit as a result. Because, individually or cumulatively, these projects were felt to have the potential to compromise the existing protection afforded to flood plain residents, because of perceived impacts to wetlands and other natural resources, and because of competing public demands for other uses of the river channel and flood plain, the District Engineer determined that it was necessary to develop a regional perspective in order to properly evaluate the impacts of individual permit decisions in accordance with the spirit and intent of NEPA and other applicable laws.

The Draft Regional Environmental Impact Statement (EIS), published in May 1986, analyzed a number of scenarios which were specifically designed to identify possible, significant cumulative impacts associated with different permitting strategies for the Trinity River flood plain. In addition to developing a baseline condition, it examined

three groups of conditions based on a) maximizing environmental quality, b) ultimate implementation of the Federal Emergency Management Agency's (FEMA) minimum criteria for the flood insurance program, and c) maximizing economic development.

The results of the Draft Regional EIS indicated strongly that there are potential cumulative impacts associated with individual flood plain development projects which are both measurable and significant. Additionally, the Draft Regional EIS indicated that the permitting approach adopted by the Corps of Engineers had the potential to have significantly different impacts on a number of regional parameters, especially flood hazards. Even though the analyses were not complete, and the public comment on the Draft Regional EIS indicated that there was much work to follow, the implications to the ongoing Regulatory Program could not be overlooked. In response to this, the Corps formulated a set of interim criteria to be in effect until the Record of Decision was rendered.

Many of the comments received on the Draft Regional EIS indicated that the slate of alternatives analyzed did not represent a realistic approach to regulatory strategies. In many cases, the predicted results were publicly unacceptable. Two important examples include the overtopping of the Dallas Floodway levees under two of the scenarios, and a substantial downstream shift in the Dissolved Oxygen "sag" resulting in noncompliance with State Water Quality Standards in the reach below the Trinidad gage. After careful analysis of the public and agency input, several new scenarios were formulated for analysis in the Final Regional EIS.

In addition to updating the baseline, three scenarios, representing the same three broad categories that had been previously addressed, were developed. Many people suggested that the Maximum Development scenarios analyzed in the Draft Regional EIS were too extreme, either because they conflicted with an ongoing project, or because levees were physically impractical in some portions of the flood plain. In response to this criticism, we agreed to replace them with a "Composite Future" scenario. Each city was tasked to provide the North Central Texas Council of-Governments (NCTCOG) a delineation of the "most likely" limits of maximum encroachment within their jurisdiction. NCTCOG compiled each city's individual prediction and presented the resultant set of maps to local staffs and local elected officials before providing them to the Corps for analysis.

The Modified Floodway scenario of the Final Regional EIS replaced the floodway-based scenarios of the Draft Regional EIS as a representative compromise between maximum (realistic) development and maximum (realistic) environmental quality. In this scenario, the Corps defined the geographic limits of a drainageway incorporating the FEMA concept with significant technical variations. For the third scenario, the Corps revised and represented a Maximum Environmental Quality scenario, hydraulically identical to the revised baseline because it incorporated no additional flood plain projects except water quality, recreation, and wildlife enhancements. of the scenarios, or alternatives, examined in the Final Regional EIS, this is the environmentally preferred alternative.

The extensive coordination and public involvement characteristic of the Regional EIS process continued during the comment period on the Final Regional EIS, which extended from its release on October 22, 1987, through January 31, 1988. During this period, I held a public meeting at Lamar High School at which eleven people submitted statements. My staff attended in excess of twenty meetings with local government staffs, public agencies, and citizen groups. In addition, sixty-six written comments on the Final Regional EIS were received.

II. Discussion of Issues and Factors

Most of the formal public comment and discussion with local governments centered on three general issues: the appropriate level of flood protection (100-year vs. SPF), the level of accuracy of the hydraulic and hydrologic analyses displayed in the Regional EIS, and the issue of equity as it pertains to governmental regulation. "Benefits" and "costs" of an action, whether it be a proposed project or a proposed regulation, do not always occur to the same group of people, let alone in the same order of magnitude. The definition of the "public interest" which is at the heart of the Regional EIS calls for an assessment of the tradeoffs inherent between public demands for enhanced environmental quality in the river corridor and for its use for needed public facilities, and economic development and the rights of private landowners.

A major concensus achieved through the review of the Final Regional EIS is that additional regional increases in flood hazards for either the 100-year or Standard Project Flood are undesirable, and that the thrust of flood plain management, in the short term, should be to stabilize the flood hazard at existing levels through regulation. Future efforts on the part of both the Corps and local organizations may be required to reduce flood hazard over the long term.

The Regional EIS is probably the most comprehensive such study done in the United States. It has highlighted the need for planning for the region and cooperation among the governmental entities along the Trinity River corridor to achieve quality development. The document was developed for the sole purpose of establishing a permitting strategy for the Trinity River and its tributaries. It does not contain a technical baseline that will remain current over time and is not to be used as a design document. Design decisions requiring water surface predictions based on critical storm centerings, and which are sensitive to valley storage computations, must be based on detailed site-specific engineering analyses. Other site-specific public or private flood control management decisions should likewise be based on current technical analyses. Further, flood insurance data must be obtained from the FEMA and not from the Regional EIS.

Neither the Regional EIS nor this Record of Decision encroaches upon the responsibility of design engineers or the authority of local governments. The Regional EIS, its public review, and this Record of Decision serve only to establish and document the "best overall public interest" as it applies to the Trinity River and its tributaries. It remains the responsibility of design engineers to perform competent work in accordance with professional design practices. Permit applicants which proposed flood plain modifications and/or site-specific flood control structures will need to satisfy review agencies as to the reasonableness of design assumptions.

Throughout the development of this Record of Decision, the Corps has worked closely with the NCTCOG to insure consistency with their COMMON VISION program. The criteria listed below for the West Fork, Elm Fork, and Main Stem are consistent with the Statement of Principles for Common Permit Criteria submitted by the Steering Committee of local government officials. Because of the massiveness of this undertaking and the importance of its impact on future growth, the comments from the cities and other governmental entities have been carefully considered.

III. Decision

Based on my consideration of the data developed and presented in both the Draft

and Final Regional EIS's and my careful consideration of all public input, I have determined that, for the purposes of the Regional EIS study area, my Regulatory Program will be henceforth based on the following criteria. The baseline to be used in analyzing permit applications will be the most current hydraulic and hydrologic model of the specific site in question. The burden of proof of compliance with these criteria rests with the permit applicant. Variance from the criteria would be made only if public interest factors not accounted for in the Regional EIS overwhelmingly indicate that the "best overall public interest" is served by allowing such variance.

A. Hydraulic Impacts--Projects within the SPF Flood Plain of the Elm Fork, West Fork, and Main Stem. The following maximum allowable hydraulic impacts will be satisfied, using reasonable judgment based on the degree of accuracy of the evaluation, and using cross sections and land elevations which are representative of the reaches under consideration:

1. No rise in the 100-year or SPF elevation for the proposed condition will be allowed.

2. The maximum allowable loss in storage capacity for 100-year and SPF discharges will be 0% and 5% respectively.

3. Alterations of the flood plain may not create or increase an erosive water velocity on-or off-site.

4. The flood plain may be altered only to the extent permitted by equal conveyance reduction on both sides-of the channel.

B. Hydraulic Impacts --Tributary Projects. For tributaries with drainage areas less then 10 square miles, valley storage reductions of up to 15% and 20% for the 100-year and Standard Project Floods, respectively, will be allowed. For tributaries with intermediately-sized drainage areas (10 square miles to 100 square miles), the maximum valley storage reduction allowed will fall between 0% and 15% for the 100-year flood and 5% and 20% for the Standard Project Flood. Increases in water surface elevations for the 100-year flood will be limited to approximately zero feet. Increases in water surface elevations for the Standard Project Flood will be limited to those which do not cause significant additional flooding or damage to others. Projects involving tributary streams with drainage areas in excess of 100 square miles will be required to meet the same criteria as main stem projects (see "A" above).

C. Cumulative Impacts. The upstream, adjacent, and downstream effects of the applicant's proposal will be considered. The proposal will be reviewed on the assumption that adjacent projects will be allowed to have an equitable chance to be built, such that the cumulative impacts of both will not exceed the common criteria.

D. Design Level of Flood Protection. The engineering analysis will include the effects of the applicant's proposal on the 100-year and Standard Project Floods and should demonstrate meeting FEMA, Texas Water Commission, and local criteria, as well as Corps, for both flood events.

1. For levees protecting urban development, the minimum design criterion for the top of levee is the SPF plus 4.0, unless a relief system can be designed which will prevent catastrophic failure of the levee system.

2. For fills, the minimum design criterion is the 100-year elevation, see above, plus one foot.

E. Borrow Areas. The excavation of "borrow" areas to elevations lower than the bottom elevation of the stream is generally hydrologically undesirable. The volume of such excavations, above the elevation to which the area can be kept drained, can be considered in hydrologic storage computations.

F. Preservation of Adjacent Project Storage. The applicant will be required to respect the valley storage provided by adjacent projects by ensuring that their hydraulic connection to the river is maintained. If the project blocks the hydraulic connection of the adjacent project, then the applicant will be required to provide additional valley storage to offset the loss caused by the blockage of the hydraulic connection.

G. Special Aquatic Sites. Value-for-value replacement of special aquatic sites (i.e. wetlands, pool and riffle complexes, mud flats, etc.) impacted by non-water dependent proposals will be required.

These criteria will be used by the Corps for the express purpose of evaluating new permit applications received subsequent to the effective data. They will not be used to reevaluate any flood plain project already constructed or permitted. They apply to permit applications from public agencies as well as private sector applications. In addition to the criteria discussed above, the following guidelines will be used by my staff in evaluating permit applications:

A. Runoff. Site drainage systems should minimize potential erosion and sedimentation problems both on site and in receiving water bodies.

B. Habitat Mitigation. A standardized, habitat-based evaluation method should be used to evaluate the impacts of the applicant's proposal to fish and wildlife resources. Guidelines for the quality and quantity of mitigation are as follows:

1. Category 2 resources--habitat of high value which is scarce, or is becoming scarce in the ecoregion--no net loss of habitat value. Category 2 resources in the study area include vegetated shallows, riffle and pool complexes, and riparian forests, as well as wetlands (see above for mitigation of wetlands). A buffer strip of natural vegetation 100 feet wide on each side of the channel for main stem projects, and 50 feet for tributaries, should be maintained.

2. Category 3 resources--habitat of medium-to-high value that is relatively abundant in the ecoregion--no net loss of habitat value while minimizing the loss of the habitat type. (This means to reduce the loss of the habitat and compensate the remainder of loss of habitat value by creation or improvement of other Category 2 or 3 resources.) Category 3 resources in the study area include deep water, native rangeland, upland forests, and upland shrubland.

3. Category 4 resources--habitat of low-to-medium value—mitigation should be to minimize the loss of habitat value, which can be accomplished by avoidance or improving other habitat types. Category 4 resources in the study area include

cropland and improved pasture.

C. Cultural Resources. Cultural resources, including prehistoric and historic sites, will be identified and evaluated according to National Register of Historic Places Criteria. Identification procedures may involve literature review, pedestrian survey, and excavation to identify buried cultural materials. Sites which are eligible for inclusion in the National Register of Historic Places will be treated by measures which range from avoidance, to preservation in place, to mitigation through excavation.

D. Other Regional Needs and Plans. Consideration will be given when evaluating permit applications of the proposal's impact on regional facilities which have been identified as important through the Regional EIS process. These include, but are not limited to, a linear hike/bike system linking large flood plain parks throughout the Metroplex, the Trinity Tollway, and sites for regional stormwater detention basins. (Specific locations and plans for these facilities will continue to evolve through coordination with NCTCOG and local governments.) Applicants will be urged to design projects which do not preclude future implementation of these regional assets.

It is my conclusion that the criteria and guidelines set forth above represent the best available definition of the "overall public interest," taking into account the rights of individual landowners and the direct, indirect, and cumulative impacts of individual actions under my purview. Further, I conclude that these policies represent all the practical means known to me to avoid or minimize environmental harm within that framework. This document will therefore provide the specific framework within which we will operate the Fort Worth District's Regulatory Program within the Regional EIS study area.

JOHN E. SCHAUFELBERGER
Colonel, Corps of Engineers
District Engineer

Appendix B – Section 404 Permit Approach and Process

Section 404 Permit Approach and Process

Trinity River Floodway Channel Realignment

Overview

The U.S. Corps of Engineers (USACE), working in conjunction with the Tarrant Regional Water District, the City of Fort Worth, and selected A/E firms, is working on determining the feasibility of long-term measures to reduce flood damages, improve water quality, provide stream bank protection and erosion control, and implement a framework to protect the river and the adjacent lands.

One primary measure under consideration is the feasibility of creating a quiescent river segment from approximately the confluence of the Clear Fork and West Fork of the Trinity River to just upstream of the Northside Drive crossing. To create this feature, a new bypass floodway channel would be needed to divert flood flows around this quiescent zone. Additionally, this concept would include a stationary weir at or near where Samuels Ave. crosses the West Fork of the Trinity just east of the confluence of Marine Creek. This general concept, which was identified during the Trinity River Vision Public Workshop in October 2001, would include removal of existing in-channel dams, including Nutt Dam, in the river segment.

Several channel, levee, and floodway combinations have been investigated to evaluate planning considerations necessary to restore originally designed flood protection levels. The feasibility analysis includes preliminary environmental restoration concepts for water quality enhancements. Other features include bridges at Henderson Street, White Settlement Road, and North Main Street, floodgates to protect the previously on channel segment, new sumps for local drainage, a small lake near the confluence of the Clear Fork and West Fork, provisions for recreation opportunities, and transportation access and neighborhood linkages.

Under Section 404, USACE regulates the discharge of dredged or fill material into waters of the United States, which includes wetlands. The purpose of this portion of the feasibility study is to provide a general permitting approach for acquiring a Section 404 permit, or permits, from the USACE for work that would occur within their jurisdiction resulting from the various activities in waters of the United States.

Outlined in this portion of the report is the permitting approach and process for obtaining a Section 404 USACE permit for the proposed Trinity River Floodway Realignment. Three primary subsections have been prepared to include an overview of the USACE's regulatory program, the individual permitting process, and general scheduling considerations.

Two types of projects are considered within the context of scheduling considerations, those projects dependant of the EIS, and those projects independent of the EIS. The Section 404 permit process would apply similarly to both types of projects.

U.S. Army Corps of Engineers Regulatory Program

The USACE has been regulating activities in the Nation's waters since 1890. Until the 1960's, the primary purpose of the regulatory program was to protect navigation. As a result of laws and court decisions, the program was broadened to include consideration of the full public interest for both the protection and utilization of water resources.

In 1972, amendments to the Federal Water Pollution Control Act added what is commonly called Section 404 of the Clean Water Act. The objective of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters, including wetlands. The USACE is authorized to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material

into waters of the United States at specified sites. Selection of such sites must be in accordance with guidelines developed by the U.S. Environmental Protection Agency (EPA) in conjunction with the Secretary of the Army. These guidelines are known as the 404 (b) (1) Guidelines. Under Section 404, the USACE is delegated the authority to determine impacts to waters of the U.S. and for making the determination to issue or deny permits for projects that adversely affect resources. Other laws that often affect the processing of applications for USACE permits include the Fish and Wildlife Coordination Act, Endangered Species Act, National Environmental Policy Act, and the National Historic Preservation Act among others.

Primary guidance for administration of the program is contained in Department of the Army regulations (33 Code of Federal Regulations (CFR) Parts 320 through 330), which provide the District Engineer the regulations required to administer the day-to-day operation of the program. These regulations have evolved over time, changing to reflect added authorities, developing case law, and, in general, the concerns of the public.

The permit evaluation process is the mechanism through which the USACE would make its decision to issue or deny a permit for work adversely affecting wetlands and other waters of the United States. Under Section 404 of the Clean Water Act, certain impacts exceed what is considered “minimal” within the regulatory program. Because of the expected impacts to waters of the United States associated with the Trinity River Floodway channel realignment project, it is expected that an individual permit, or permits, would be required for the activities.

The Section 404 Individual Permit Process

Maximizing the probability for a favorable permit decision involves the careful preparation of all environmental and planning analyses and documentation, the conduct of informative and productive meetings with resource agencies and the USACE, and maintaining close coordination with the resource agencies and USACE personnel throughout the application review process.

The following discussion presents the permitting process in objective terms so that the specific steps in the process can be identified. As stated previously, an individual permit would likely be required for the proposed activities. The process is generally comprised of three basic steps, which include: 1) Pre-application Consultation, 2) Application Preparation and Submittal, and 4) Regulatory Decision making and Approval.

Pre-Application Consultation

The USACE's individual 404 Permit Program is applied nationally through numerous USACE districts. While these districts operate the program within a common set of regulations and guidelines, each district exercises discretionary authorities and decision-making in order to accommodate local circumstances and situations. Often, objection to projects comes from the resource agencies (U.S. Fish & Wildlife Service, Texas Parks & Wildlife Dept., etc.

To obtain a timely and favorable decision on a permit application, early coordination with the resource agencies to develop an acceptable mitigation plan is often the best approach. If the resource agencies can accept a plan for mitigation of resource loss, the overall process would often run with fewer impediments. It must be emphasized that mitigation has to accompany a strong purpose and need for the proposed facility as well as a solid analysis of environmental impact.

Pre-application consultation usually involves one or several meetings between the applicant, USACE district staff, interested resource agencies (local, state and federal), and sometimes the interested public. The primary purpose of such meetings is to encourage informal discussions on the proposed project before the applicant makes irreversible commitments of resources (i.e. funds, detailed design, etc.). The process is designed to provide the applicant with an assessment of the viability of the more obvious

alternatives available to accomplish the project purpose, to discuss measures for reducing the impacts of the project, and to discuss the factors the USACE must consider in its decision making process.

Application Preparation and Submittal

Much of the time involved in the evaluation of large, complex or potentially controversial projects can be reduced if the applicant supplies adequate information required for the evaluation. This information can help to expedite the process and deflect potential opposition by demonstrating responsible project planning and mitigation development. Preparation of the Section 404 permit application includes the following major tasks:

1. Preparation of the overall permit application information;
2. Environmental affects;
3. Preparation of the project alternatives analysis; and,
4. Preparation of the mitigation plan.

Overall Permit Application Information

Preparation of the General Permit Application would need to include the following:

- Identification and description of all project activities and components
- Explanation of the interrelationships between the project components
- A map identifying the location of the project components and area of coverage by each component
- Approximate dimensions of all structures, fills, and excavations
- Typical plan and cross section views (81/2-inch by 11-inch) of the project and associated components.
- Description of the fill material to the used at the project site and description of any material to be dredged.
- The amount (cubic yards) of fill material to be used and material to be dredged, and location of disposal site(s).
- Explanation of the requirements for discharges of dredged and fill material into waters of the United States
- Names and addresses of adjoining property owners, lessees, etc., whose property adjoins the project site must also be provided. This information would include the complete names and full mailing addresses of the adjacent property owners (public and private), lessees, etc.
- Purpose of and Need for the Project
- Service area of the project and population served.

Environmental Affects

The USACE would be evaluating the existing site conditions relevant to the physical/chemical, biological, and socioeconomic resources and determining potential impacts to these resources resulting from the project. The following table lists those resources to be evaluated.

Resource Types

RESOURCE TYPE	FACTORS
Physical/Chemical	Topography Soils and Geology Currents Circulation or Drainage Patterns Suspended Particulates and Turbidity Water Supplies and Quality Floodplains and Flood Control Erosion and Accretion Patterns Surface Water Ground Water Hazardous Waste and Substances Air Quality Noise
Biological	Special Aquatic Sites (Wetlands) Wildlife and Aquatic Species Wildlife and Aquatic Habitat Vegetation Communities Threatened and Endangered Species
Socioeconomic (Human Use Characteristics)	Parks and Other Recreational Areas Cultural Resources (Historic/Prehistoric) Traffic and Transportation Patterns Energy Consumption or Generation Navigation Safety Land Use Economic Activity Aesthetics Demographics

Source: 33 Code of Federal Regulations Parts 320 through 330.

An explanation of the kind of information necessary for each factor is located at the end of this section.

Alternatives Analysis

The development of an alternatives analysis discussing the alternative sites considered is paramount for the proposed project activities. This would include an explanation of why the preferred design was selected and the reason(s) for the project design.

In regards to the designs of the project(s), it would be important to demonstrate why other sites in the vicinity could not be used for the facility. Other useful information to include in the alternatives analysis is an explanation of the process in selecting the preferred design, and the coordination activities that occurred in the process.

The purpose of the alternatives analysis for this project is to show that an effort has been made to site the facility at a suitable location while minimizing adverse impacts to the existing environment, which includes wetlands and other waters of the United States.

Justification of this public and private need would include information on population increase projections for the service area and an explanation why existing facilities would not be able to meet the forecasted demand. This information and supporting data would be included in the alternatives analysis.

Information supporting the application would also need to describe the extent and permanence of the beneficial and/or detrimental effects that the project and associated facilities would have on the public and private uses to which the area is suited. The public use to which the area is best suited would include a park/nature area, and a combination of passive/active recreational areas The project(s) have a positive benefit in that the project(s) can be described as a public use project since one of the purposes would be to provide a continuing and enhanced recreational resource to the public.

Mitigation Plan

Federal law recognizes that unavoidable adverse effects to waters of the United States and other resources occur. The concept is to create high quality wetlands or waters (credits) so that they can be used to mitigate for unavoidable losses. When mitigation was first proposed as a means to reduce losses, many 404 permit applicants elected to fill the wetlands resource as a first choice and then proposed mitigation as a means to offset the loss. This approach gradually fell into disfavor among the resource agencies and a different approach to mitigation was developed and agreed to by the USACE and the resource agencies. This approach involves requiring the applicant to prove that all means to avoid a resource has taken place. Next, the applicant must show that if adverse effects cannot be avoided, then everything practicable is done to minimize the adverse impact. Finally, the applicant can propose to mitigate or replace the resource impacted.

The purpose of mitigation is to replace the function and value of the impacted area. The functions and values of the impacted areas are estimated the consultant, and provided to the USACE and resource agencies for their concurrence. This estimate is part of the assessment used by USACE to evaluate the permit and includes the general physical/chemical, biological, and socioeconomic review as mentioned previously. These are several variations to the replacement of the resource; but, typically, these mitigation concepts are not proposed or accepted until every reasonable effort has been made to avoid impacts and to minimize impacts to the resource.

Mitigation Plan Alternatives

Many approaches to mitigating impacts have been accepted by USACE. These approved approaches include on-site mitigation, off-site mitigation, mitigation banking, and in-lieu fee.

On-Site Mitigation

The standard practice for waters of the United States mitigation is to create the same type and kind of resource that would be impacted by a proposed project. The location for mitigation is typically within the original project extent. Preliminary design and monitoring plans are developed with approval by USACE with input from the resource agencies. After the permit is issued, detailed construction drawings, planting plans, and monitoring specifications are required and approved.

Off-Site Mitigation

Usually the USACE requires off-site mitigation to occur within the same watershed. However, there are no set requirements. If these areas were purchased for mitigation purposes, the process described for the typical mitigation plan would still be required. Site selection and preliminary design with monitoring plans are developed with approval by USACE with input from the resource agencies. After the permit is issued, detailed construction drawings, planting plans, and monitoring specifications are approved.

Mitigation Banking

The Trinity River Mitigation Bank is a mitigation bank within the Fort Worth District that has been approved and credits are currently available. If approved by the USACE, there would be mitigation bank

credits that could be available to mitigate for the proposed project activities. Therefore, obtaining credits from a local mitigation bank is an option.

As with all mitigation options, there would be a requirement to demonstrate to the USACE that there is no practicable alternative to the discharge of dredged or fill material in a water of the U.S. and all appropriate and practicable measures to minimize adverse impacts have been included in the project prior to utilizing the bank credits. In addition, when utilizing a mitigation bank or in-lieu fee, the applicant must clearly demonstrate to the USACE that this form of compensatory mitigation would result in a higher quality benefit and environmental gain than would on-site or off-site mitigation. For this reason, traditional mitigation measures including in-kind and on-site compensations would typically be preferred by the USACE.

Regulatory Decision Making and Approval

Once a complete permit application is received by the USACE, a formal review process is initiated. A copy of the standard individual permit application is provided in Appendix A for review and reference. The Fort Worth District USACE's Regulatory Branch operates under what is referred to as the project manager system. Under this system one individual is responsible for handling an application from receipt to final decision. For the typical project, the project manager prepares a public notice, evaluates the impacts of the project and all comments received, and drafts or oversees drafting of appropriate documentation to support a recommended permit decision. The permit decision document includes a decision of the environmental impacts of the project, the findings of the public interest review process, and any special evaluation required by the type of activity such as compliance determinations with the 404 (b) (1) Guidelines.

Of great importance to the project evaluation is the USACE public interest balancing process. The public benefits and detriments of all factors relevant to each application are evaluated and balanced. The following general criteria are considered in evaluating all individual permit applications:

1. The relevant extent of public and private needs is considered.

2. Where unresolved conflicts of resource use exist, the practicability of using reasonable alternative locations and methods to accomplish project purposes is considered.

3. The extent and permanence of the beneficial and/or detrimental effects that the proposed project may have on public and private uses is evaluated.

The guiding principle in arriving at the decision to issue or deny a permit is the consideration of the public interest. No permit is granted if the proposed project is found to be contrary to the public interest.

The USACE endeavors to balance the benefits, which may be reasonably expected to accrue from a project against its reasonably foreseeable adverse impacts. The USACE regulations at 33 CFR 320.4 list twenty separate factors typically relevant to a proposed project that must be considered in evaluating a project. These factors include the following:

ConservationEconomics
Aesthetics General Environmental Concerns
Wetlands Historic Properties
Fish and Wildlife Values Flood Hazards
Floodplain Values Land Use
Navigation Shore Erosion and Accretion
Recreation Water Supply and Conservation
Water Quality Energy Needs
Safety Food and Fiber Production
Mineral Needs Consideration of Property Ownership
Needs and Welfare of the Public

A more detailed explanation of these factors has been provided in Appendix A.

How the 404 (b)(l) Guidelines are used to Evaluate a Project

The 404 (b)(l) Guidelines provide the environmental criteria that must be satisfied before an individual permit can be issued. All permit applications must comply with the Guidelines in order for the permit to be issued. The EPA reviews each public notice for individual permit applications and provides comments to the USACE regarding the proposed project's compliance with the Guidelines. In general, permit applicants fail to comply with the Guidelines when alternatives to the project proposal are found to be practicable and result in less adverse impact on the aquatic environment.

The Guidelines also require a determination as whether the discharge of dredged or fill material into special aquatic sites would result in the violation of other laws or standards including state water quality standards; toxic effluent standards; Department of Commerce standards to protect marine sanctuaries; and, the Endangered Species Act. Additionally, the USACE would determine, through application of the Guidelines, if the proposed discharges would contribute to significant degradation of wetlands or other waters of the United States.

The Guidelines also specify that all appropriate and practicable measures be applied to minimize harm to the aquatic ecosystem. According to the Guidelines, an alternative is practicable if it is available and capable of being done after taking into consideration the cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the applicant which could reasonably be obtained, utilized, expanded or managed in order to fulfill the basic purpose of the proposed activity may be considered. It would be necessary to demonstrate that the preferred site is the most practicable site in terms of impact to environmental resources. Also, it would be necessary to show that, when compared to other potential sites, the preferred site is the most reasonable and practicable when considering cost, existing technology, and logistics. It would be important to provide justification for; (1) Why other available property with fewer resources cannot be used; (2) Why the design cannot be modified to reduce adverse impacts; and, (3) Why another alternative cannot achieve the project purpose.

It is important to consider that the 404 (b)(l) Guidelines presume that all practicable alternatives for the discharge, which do not involve discharges in a special aquatic site, have less adverse impacts on the special aquatic site, unless clearly demonstrated otherwise. The burden of proof to clearly demonstrate that these presumptions are false rests with the applicant. By providing strong project alternatives analysis, it can be shown why the preferred site and design are necessary to achieve the basic purpose, and why other practicable and reasonable alternatives do not exist.

As presented previously, the USACE would determine if all other reasonable and practicable alternatives were considered to achieve the basic purpose of the project. The information as part of the alternatives analysis need to clearly demonstrate that other suitable sites are not available due to cost reasons, inaccessibility, or some other constraining factor(s). In short, supporting information must be presented that would rebut the presumptions of the Guidelines that other practicable alternatives do not exist or would not be reasonable.

General Scheduling Considerations

Individual permit decisions are made by the USACE within two to three months from receipt of a complete application. Projects with impacts exceeding 10 acres can take 8 to 12 months for the decisions. This time period varies depending upon factors including the type and nature of the project, availability of information for environmental documentation and the alternatives analysis; acceptance of proposed mitigation features; and, pre-application coordination efforts.

As discussed in the summary of this section, two types of projects are considered within the context of scheduling considerations, those projects dependant of the EIS, and those projects independent of the

EIS. The Section 404 permit process would apply similarly to both types of projects. For project dependant of the EIS, such as the actual realignment of the floodway, the schedule presented below could begin pre-application efforts prior to completion and record of decision of the EIS, but it would be likely that the permit application would not be considered complete by the USACE prior to the record decision. However, the completion of the EIS could help to expedite the USACE Section 404 Individual permit review time. Projects that are independent of the EIS could be initiated once complete project information is available.

Given the fact that the project(s) are in the feasibility stage, it is important to not that the schedule presented is intended to provide a general framework for the permits schedule, rather than a definite timeline.

The following table presents the estimated project schedule for completing the permit application, final mitigation plan, and coordination tasks.

Section 404 Individual Permit Schedule

Major Tasks	Months														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pre-Application Efforts															
Cultural Resources Review Confirmation															
Threatened/Endangered Species Review Confirmation															
Site Alternatives Analysis															
Permit Application															
Final mitigation Plan															
Completeness Determination															
Application Coordination (USACE Review)															
Public Notice (30-day)															
Public Hearing (if necessary)															
Permit Issuance															

Conclusion

In summary, for the Trinity River Realignment Section 404 individual permit coordination, it is recommended that the steps highlighted be followed:

1 A pre-application meeting with the USACE and resource agencies occurs to discuss the project proposal and preliminary mitigation plan options. Additional meetings may be required dependent upon the results of the USACE and resource agency review.

2 Verification of the preliminary waters determination, cultural resource review(s), and the results of threatened and endangered species review(s).

3 Preparation of the individual permit application and submittal to the USACE. Associated information to be provided would include typical plan and cross section views of the project and the associated components, mitigation plan options, and other information (i.e., environmental documentation including application of 404(b)(l) guidelines) identified at the pre-application meeting. Mitigation for wetland or waters of the U.S. losses also should be proposed in this stage.

4 Determination is made by the USACE as to whether the application is complete. USACE notifies applicant if additional information is required. An identification number is then assigned to the completed application.

5 The USACE issues a public notice for the proposed project. It is anticipated that a 30-day comment period would be issued for the project (typical for most standard individual permit applications).

6 The USACE's Public Interest Review Process is initiated which includes the interested general public, special interest groups (i.e., Sierra Club, Audubon Society, etc.), local, state, and federal agencies.

7 Upon completion of the public notice comment period, the USACE reviews all comments and objections/recommendations. The results of the USACE review are forwarded to the applicant for review and comment (rebuttal or resolution).

8 The USACE continues the review process and consults with other state and federal agencies as necessary. The District Engineer may request additional information, as determined appropriate, from the applicant.

9 The USACE then determines if a public hearing should be conducted.

10 The District Engineer then makes the decision for issuance or denial of the permit. Issuance of the permit can include issuance with or without special conditions dependent upon the process and recommendations.

Resource Types

Topography: Information on topography includes the range of elevation for the project area and physiogeographic region. Information on impacts would include how the topography would be altered as a result of the project.

Soils and Geology: Description of the soil types and geologic formations for the project area and adjacent areas. Identification of the hydric or non-hydric status of the soils would also be addressed. Impacts would discuss how the existing soils and geology would be altered.

Currents. Circulation or Drainage Patterns: Information on the currents and circulation patterns would be related to the effect on the Trinity River. Information on drainage patterns is in regards to surface drainage for the site and surrounding area. Information regarding impacts would address suspected changes to the current and circulation patterns and drainage patterns resulting from the construction, operation, and maintenance of the project(s).

Suspended Particulates and Turbidity: Information on these factors would also be primarily for the impact to the trinity River and what short-term and long-term effects the project(s) would have on the existing conditions.

Water Supplies and Quality: Existing conditions information and a determination of potential impacts to water supplies and water quality would be necessary. Specifically, information addressing current usage for the Trinity by various entities would be needed, as well as providing current water quality data.

Floodplains and Flood Control: This information would include the identification and discussion of floodplain areas within and adjacent to the protect area. The potential impacts to these areas would also need to be identified, such as, filling or excavation within the floodplains. Additionally, information on the project site relative to flood control projects or activities within or potentially affected by the project would need to be included.

Erosion and Accretion Patterns: Potential impacts from the project resulting in erosion, accretion, and sedimentation beyond the existing conditions would need to be addressed.

Surface Water: This information would include identification of existing surface water features (i.e., streams, ditches, ponds, etc.) on and adjacent to the project site. Potential impacts, direct and indirect, to these water features from the construction, operation, and maintenance of the project(s) must also be presented.

Groundwater: Identification of shallow and deep aquifer systems within the project area and local vicinity would be necessary. Potential impacts to any groundwater system would be provided also.

Hazardous Wastes and Substances: This information would include identification of contaminated sites within or adjacent to the site, and the disturbance of these sites resulting from the project.

Air Quality: This information would address the existing air quality conditions for the region, the need to obtain any state or federal air permit for the project, and potential impacts to the air quality as a result of the project construction, operation, and maintenance activities.

Noise: The existing conditions for noise at the project site would be described and noise impacts resulting from the construction, operation, and maintenance of the project(s) would be discussed.

Biological Resources: The USACE would evaluate various biological resources as part of the permit evaluation process.

Special Aquatic Sites: Information on the existing wetland conditions (i.e. wetland type and acreage) would be evaluated and integrated into the submittal to the USACE.

Wildlife and Aquatic Species: A description of the types of wildlife and aquatic species that exist within the project area is necessary. Also, displacement impacts to these species from the project must be addressed.

Wildlife and Aquatic Habitat: Habitat existing conditions for the wildlife and aquatic species would be described also, as well as a description of expected impacts to these resources.

Vegetation Communities: An existing conditions description of the representative vegetation communities (i.e., upland wooded areas, riparian corridors, grassland, etc.) that are present at the site would be provided along with anticipated project impacts.

Threatened and Endangered Species: An existing conditions description of any potential habitat for identified Threatened and Endangered species that are present at the site would be provided along with anticipated project impacts.

Parks and Other Recreational Areas: This information would include the identification, location and description of any parks and recreational areas adjacent to and near the project site. This would include city and neighborhood parks, state parks and recreational areas. Lake Houston would also be considered a recreational area.

Cultural Resources: Any information regarding historic and prehistoric resources would be provided along with anticipated project impacts.

Traffic and Transportation Patterns: Information on the existing conditions for the area's traffic and transportation patterns would be required. Also, any proposed roads as part of the project would need to be addressed when discussing project impacts.

Energy Consumption or Generation: This would focus primarily on what the anticipated energy consumption would be to construct, operate, and maintain the project(s). This would include gas and electricity usage estimates for construction equipment and other construction activities; energy utilization estimates for operation of the facility and energy utilization for maintenance activities.

Navigation: Information on navigation would concentrate on those features where potential impact or interference with navigation may occur. Efforts would be towards determining the location of any features that would interfere with boating activities. The proposed project area is not within a Section 10 navigable waterway.

Safety: This factor would apply not only to the construction, operation, and maintenance of the project(s), but would also include safety considerations for the general public.

Land Use: This would include information on the existing land use designation for the project site and surrounding area. Compatibility of the project with the existing and future anticipated land use for the project area and surrounding property would also be addressed.

Economic Activity: Information on the economic activity for the area would address current median incomes for the surrounding population, identification of major industry, unemployment rate, labor force and similar information. Elaboration on the positive economic impact (i.e., new jobs, enhancement of the area services, etc.) from the project would be important.

Aesthetics: This information would address the aesthetics of the existing conditions and how the project(s) would blend in with, or enhance the surrounding area.

Demographics: Information on the local population would be addressed including rates of growth; population breakdown by age, gender, and racial composition; average household sizes; and similar information.

Appendix C – Trinity River Realignment Feasibility Study – Initiation of Geotechnical Research

MEMORANDUM

FUGRO

To: Amy Robinson, CDM **Date:** March 22, 2002

Copy: Robert Patton, Fugro

From: Bruce Bailey, Fugro **File:** 0702-1006-1

Subject: Trinity River Floodway Realignment Feasibility Study
Initiation of Geotechnical Research

This summary report was prepared in response to your request dated March 7, 2002 and is based on a review of available information from geology maps and from test borings (drilled by others). We understand that two possible channel alignments are being considered at this stage (Alignment "A" and Alignment "B"). For Alignment A, the bottom elevation ranges from El. 514 at the Clear Fork tie-in (upstream) near Forest Park Boulevard to El. 496 at the West Fork tie-in (downstream) near Northside Drive. For purposes of this report, we assumed that the bottom elevation will vary linearly along the alignment and, further, that the bottom elevation will be similar for Alignment B.

Geology information was obtained from the Geologic Atlas of Texas-Dallas Sheet (Bureau of Economic Geology, the University of Texas at Austin, 1972, revised 1988). The proposed channel sites are mapped as being situated in recent alluvium and fluviatile terrace deposits over Cretaceous bedrock deposits. The bedrock in the area includes the Fort Worth and Duck Creek Limestone and Kiamichi Formation of the Washita Group over the Goodland Limestone of the Fredricksburg Group. In the vicinity of the proposed channels, the contact between the Kiamichi and Goodland formations is estimated, on a preliminary basis, to be near Els. 500 to 525. The Kiamichi formation is composed of clay (or shale) and limestone in alternating beds ranging from a few inches to 5 feet in thickness (mostly clay-shale). The Goodland Limestone consists of limestone with clay (or shale) beds, with the upper limestone described as massive (mostly limestone). The alluvial and terrace deposits include flood-plain deposits and indistinct low terrace deposits composed of clays, silts, sands, and gravel, generally with buried channels. The bedrock surface was formed by erosion during periods of large flow volumes (glacial meltwaters) with buried valleys. In the flood-plain alluvial deposits, groundwater will occur near or above the normal water levels in the river channels. In the terrace deposits at higher elevations, groundwater occurs through more permeable sands and gravels with horizontal flow over the bedrock surface.

Test boring information was obtained from the Corps of Engineers (USACE), Fort Worth District Office (with the help of John Wise, Chief of the Geotechnical Section) and from the Tarrant Regional Water District (TRWD, with the help of Kirk Thomas). Calls were also made to the City of Fort Worth (Transportation and Public Works and Water Utilities) and to TxDOT (Fort Worth District), but as yet no information has been obtained from these agencies. The information from TWRD was developed by USACE, but on full-size drawing sets. All of this work was for the Fort Worth Floodway project with dates on the plans and boring logs ranging from 1953 to 1964. The test borings were drilled along the

channel and levees, with concentrations of borings around bridge and drainage structures. No attempt was made to evaluate this information in detail at this stage due to the volume of material. Efforts were made to estimate rock surface elevations in the vicinity of the proposed channels and to note the general soil and rock types shown on subsurface profiles and selected boring logs.

The following are responses to the items included in your March 7 memo, based on the above-described findings and our general experience in the area.

1. Whether the excavated material would be suitable for construction of the levees and bridge approaches.

It is anticipated that the excavated soil and rock materials would be suitable for construction of levees and bridge approaches. However, some sorting, special handling, or processing of several of the different types of materials would be required.

It appears that most of the overburden alluvial and terrace soils (possibly 60 to 75 percent) would consist of clays which would classify as CL and CH according to the Unified Soil Classification System (USCS). The remaining alluvial and terrace soils (25 to 40 percent) would consist of clayey and silty sands, sands, and gravel (SM, SC, SP, GC, GM, GP, etc.). These soils typically would by in a moist to very moist condition as a result of being near or below the groundwater level. As such, some drying may be required for satisfactory compaction. This could be best accomplished by constructing during a dry season. The clays will be excellent for use in levees and nearly all of the soils would be suitable for use in bridge approaches.

The limestone bedrock materials could be broken down to a maximum size of about 6 inches and placed as a soil fill. It may also be possible to place some of the limestone as a rockfill (larger size and thicker lifts) in some areas, depending on final use. Shale bedrock materials should be broken down to a finer size (possibly 1 to 2 inches maximum) and placed as a soil fill. These materials could be used in levee shells or for bridge approaches, if properly placed and compacted. Generally, the limestone is not durable enough to use as riprap.

2. Whether the excavated material may be used as topsoil.

Although it is not possible to tell from information obtained to date from the boring logs, most of the clays in the area are expansive. As such, they typically form seasonal drying cracks into which organic material collects to form relatively deep surficial zones of dark gray or dark brown clays, often to depths of several feet. These dark gray or dark brown clays should be of sufficient fertility to serve as topsoil. As typical for construction of this type, these soils would need to be sorted and stockpiled for this purpose.

3. The possibility of encountering rock material during the excavation of the new channel.

The test boring data review to date indicates that the southern portion of both proposed alignments will be entirely in soil to as far north as the north bank of the existing West Fork Trinity River. Northward from that point, the upper part of the excavation will be in soil to the rock surface which is estimated to be between Els. 515 and 520. Below these elevations, the excavation will be in the limestone and shale bedrock. In general, the limestone is regarded as a "soft" rock on the basis of unconfined

compressive strength. However, it is still a rock and will require considerably more excavation effort than the overburden soils. Often it is possible to pre-loosen the rock with a single-tooth ripper on a large dozer. Rock excavation can also be accomplished with large backhoes or similar equipment with rock teeth on the bucket. The excavation effort will also depend on bed thickness.

4. The likelihood of encountering groundwater during the excavation of the new channel.

As described above, groundwater is expected to be near or above the water surface levels in the existing river channels (above Els. 500 to 510) in the alluvial soils in the southern portion of the proposed channel alignments. In the terrace soils north of the north bank of the existing West Fork Trinity River, groundwater is expected to occur as horizontal seepage flow over the bedrock surface.

Since the new channel excavations will extend below the water surface level in the existing river channels, it is expected that groundwater inflow will be encountered, particularly in the deeper portions of the excavations. Groundwater flow quantities are anticipated to be greater in the alluvial soils at the south end of the proposed alignments. Most of the flow will occur through sand and gravel layers, both in the alluvial and in the terrace soils. It is anticipated that the inflow rates could be handled with surface pumping dewatering methods. However, the need for large pumps and piping in this regard is probable. The inflow should be directed to sump pits and away from active work areas.

5. The anticipated permeability of the excavated material and likelihood of needing a core wall in the levee.

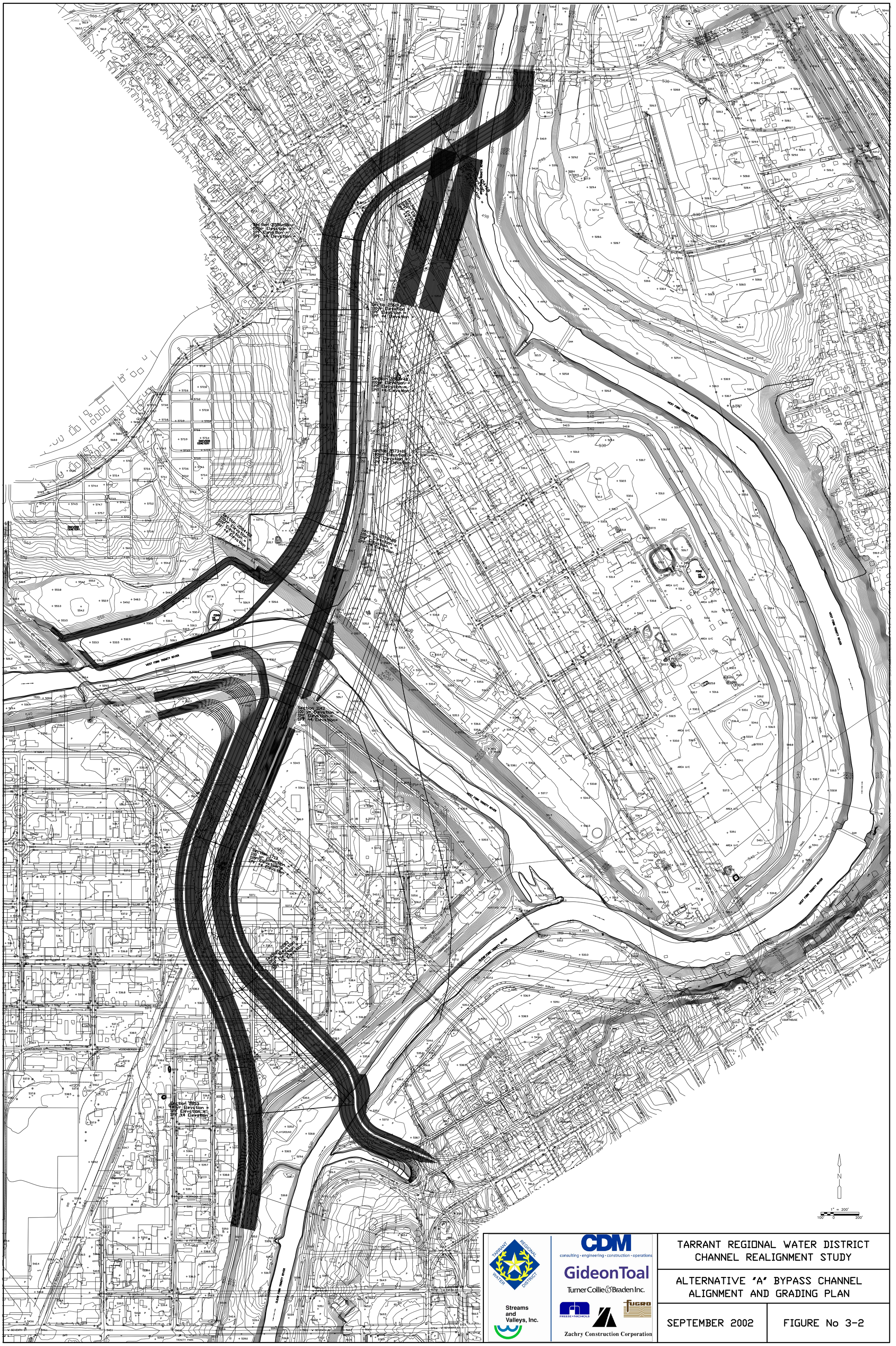
A wide range of permeabilities would be expected for the excavated materials, depending primarily on how they are sorted, processed, and compacted. It is anticipated that overburden clays would make up most of the total volume of excavated materials. These soils if properly compacted should be relatively impervious (coefficient of permeability of 10^{-7} cm/sec or less). These clays would be excellent for homogeneous levee sections or as core materials for zoned levee sections. Excavated sands, gravel, and rock could be used in levee shell zones.

It is envisioned that a material type schedule would be developed for the project and that several alternate sections and methods proposed as part of the contract documents. It appears likely that there will be enough clays excavated to permit use of homogeneous levee sections consisting primarily of clays. However, this may result in excessive haul distances. In these cases, or for levee slope stability, the use of a zoned levee section with a clay core may be preferable.

It is also envisioned that a cutoff trench will be needed in the levee cross section. This would extend through weathered surface soils to depths of perhaps 3 to 5 feet below the stripped ground surface beneath the levees.

We trust this information will be of benefit. We suggest that we meet to discuss these and other geotechnical-related aspects of the project at a time that meets with your schedule.

Appendix D – Oversized Figures



TARRANT REGIONAL WATER DISTRICT
CHANNEL REALIGNMENT STUDY

ALTERNATIVE "A" BYPASS CHANNEL
ALIGNMENT AND GRADING PLAN

SEPTEMBER 2002

FIGURE No 3-2

Streams and Valleys, Inc.

CDM consulting · engineering · construction · operations

GideonToal

Turner Collie & Braden Inc.

FREESE · NICHOLS

FUGRO

Zachry Construction Corporation

Section 2469+86
100yr CDC Elevation =
SPF Elevation =
SPF +4 Elevation =

Section 2474+84
100yr CDC Elevation =
SPF Elevation =
SPF +4 Elevation =

Section 2447+76
100yr CDC Elevation =
SPF Elevation =
SPF +4 Elevation =

Section 2438+66
100yr CDC Elevation =
SPF Elevation =
SPF +4 Elevation =

Section 2484+71
100yr CDC Elevation =
SPF Elevation =
SPF +4 Elevation =

Section 2434+61
100yr CDC Elevation =
SPF Elevation =
SPF +4 Elevation =

Section 4+17
100yr CDC Elevation =
SPF Elevation =
SPF +4 Elevation =

Section B-34
100yr CDC Elevation =
SPF Elevation =
SPF +4 Elevation =

Section 2+23
100yr CDC Elevation =
SPF Elevation =
SPF +4 Elevation =

VEST FORK TRINITY RIVER

CLEAR FORK TRINITY RIVER

N

1" = 200'
100' 0 200'

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FREESE · NICHOLS

FUGRO

Zachry Construction Corporation

TARRANT REGIONAL WATER DISTRICT
CHANNEL REALIGNMENT STUDY

ALTERNATIVE "B" BYPASS CHANNEL ALIGNMENT AND GRADING PLAN

SEPTEMBER 2002

FIGURE No 4-2