U.S. ARMY CORPS
OF ENGINEERS

Office of the Chief of Engineers
Value Engineering Study Team

VALUE ENGINEERING STUDY

SOUTHEAST LOUISIANA FLOOD CONTROL, JEFFERSON PARISH, LA

(ELMWOOD CANAL AND SUBURBAN CANAL REACHES)

Sponsored By:
U.S. Army Engineering District, New Orleans

March 1997

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

VALUE ENGINEERING TEAM STUDY

PROJECT DESCRIPTION AND BACKGROUND

PROJECT TITLE: Southeast Louisiana Flood Control - Elmwood and Suburban Canals
PROJECT LOCATION: Jefferson Parish, LA

The Elmwood and Suburban Canals represent two reaches of the Southeast Louisiana (SELA) Flood Control Project. The two canals are a part of the Jefferson Parish canal system. The Parish is the Local Sponsor/Partner for this portion of the larger SELA urban flood control project authorized to relieve chronic local flooding resulting from stormwater run off within the levees of the metropolitan New Orleans geographical area. Total project costs for the Jefferson Parish portion of the SELA Flood control Project is approximately $200 million.

Project objectives include development and implementation of an economically feasible flood control plan that will enable the system to experience a 10-year rainfall event without substantial residential flooding. Plans considered various combinations of pumping increases and canal improvements for the 10-year storm and likely feasible 50- and 100-year events.

The main components of the Elmwood and Suburban Canals include a paved trapezoidal canal for selected reaches of both canals and a U-Frame channel in two reaches of Suburban Canal. The VE study addresses reaches 10B, 11 and 12 of the Suburban Canal and reaches 31, 32, and 33 of Elmwood Canal. See Project Location Plan and Typical Sections shown on Drawing Nos. 1 and 2. Recent changes in minimum canal side slopes (from 2H:1V to 3H:1V) have resulted in changes to canal configuration including bottom width for trapezoidal sections and use of the concrete U-Frame in reach 11. These reaches and revised canal sections are further described as follows:

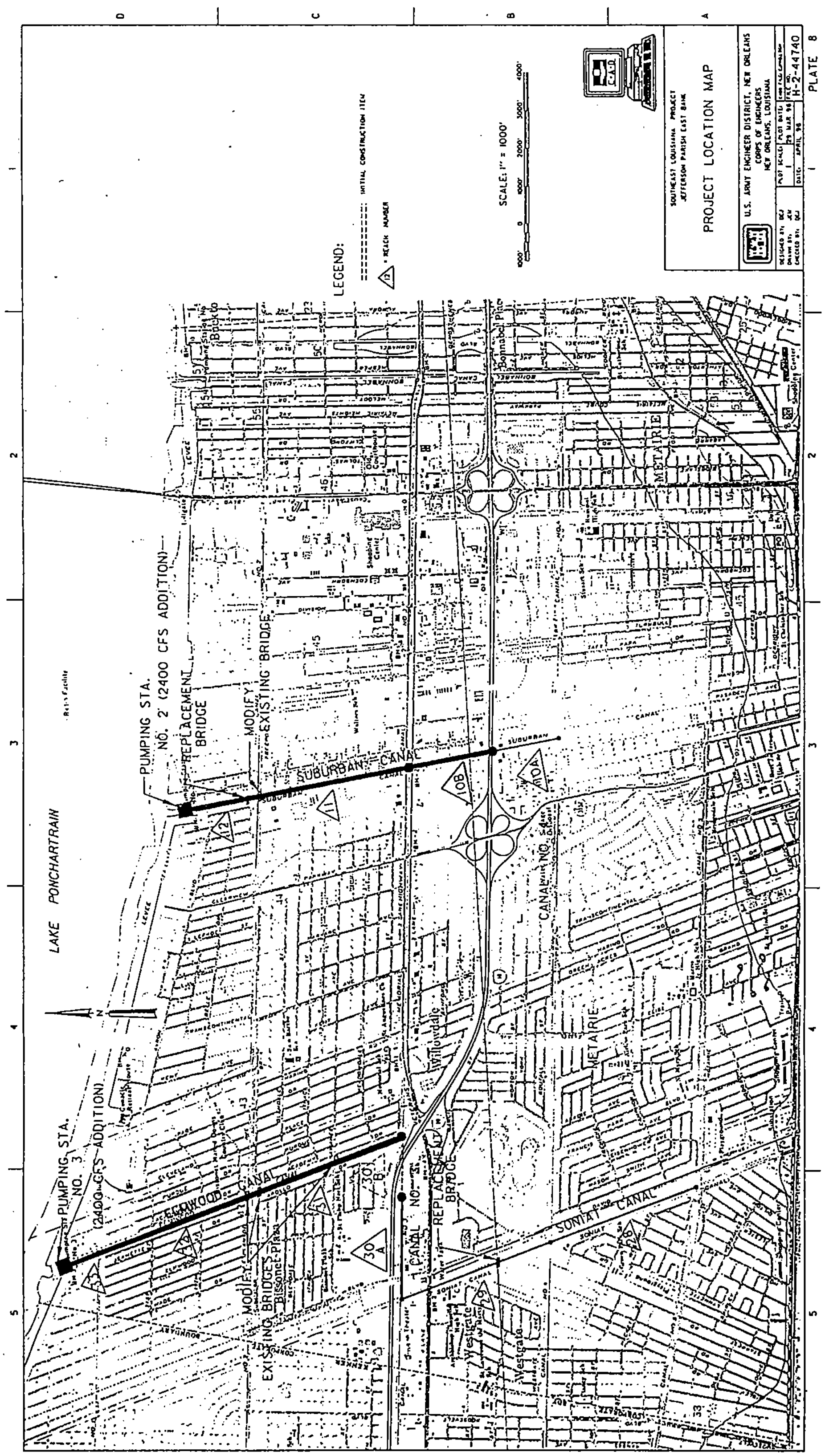
	Reach	Length (LF)	Top\Btm Width (FT)	Average Ht (FT)	*Revised Estimated Costs			
	10B	~~2,480~~ 1900	58\U-Frame	13	$ 9,918,781	$4.47	5.73	6.57
$2500/ft	11	4,100	58\U-Frame	13	$16,398,004	10.25	2.77	3.33
	12	1,770	145\62	13.9	$ 1,587,220		1.45	1.74
	31	4,250	168\88	13.3	$ 3,698,922		4.55	5.46
	32	4,375	168\84	14	$ 3,912,436		4.60	5.52
	33	1,000	177\92	14.1	$ 1,164,452		1.15	1.38
	Total Estimated Cost				$36,679,815			

*The estimated cost for the revised canal sections was developed by OVEST using revised quantities and existing project unit costs, and includes: 20% Contingencies and 12% Supervision and Inspection. See Appendix E for the Revised VE Study Baseline Estimate.

VALUE ENGINEERING TEAM STUDY

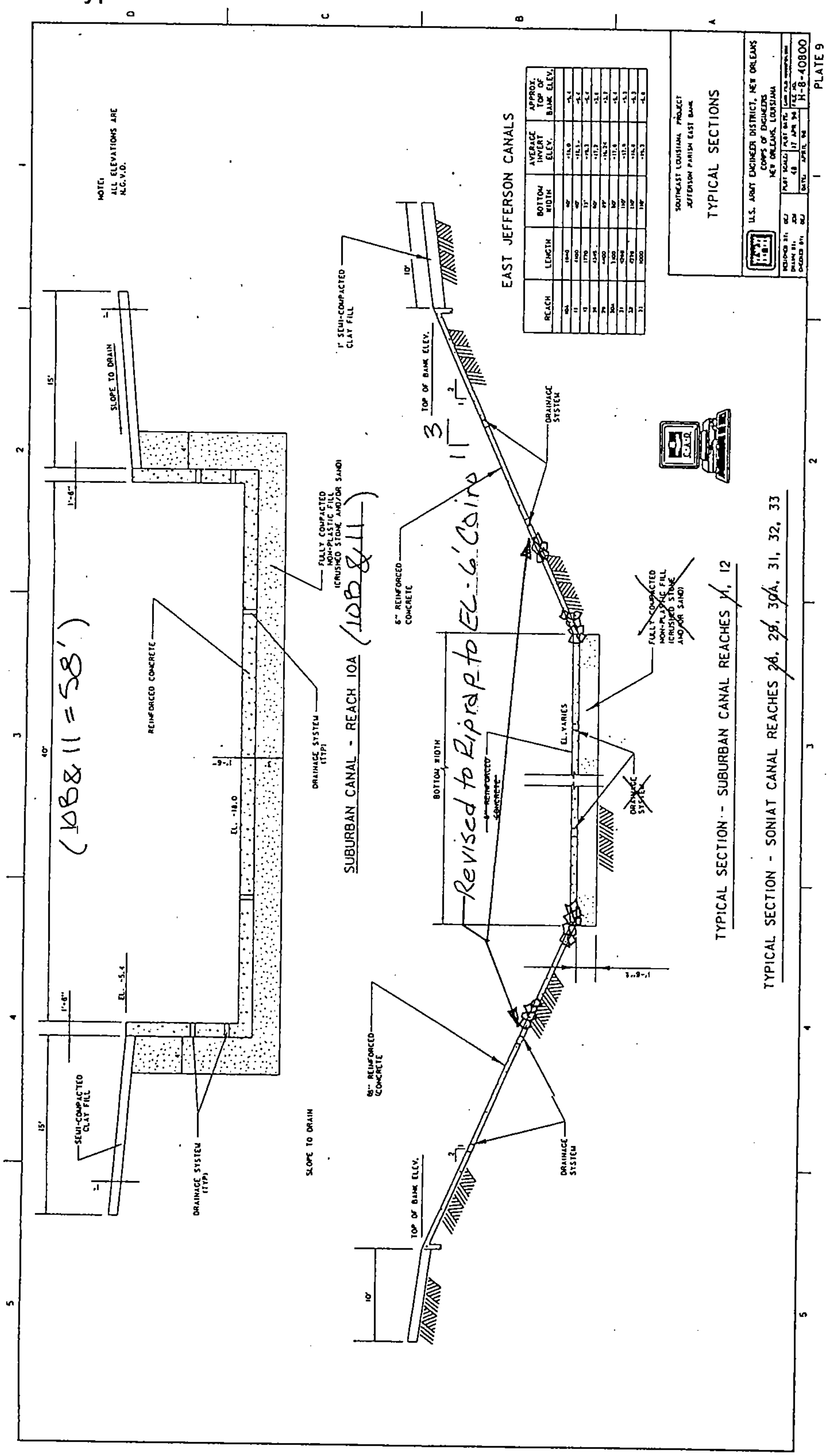
PROJECT DESCRIPTION AND BACKGROUND

Project Location Plan - Elmwood Canal and Suburban Canal



PROJECT DESCRIPTION AND BACKGROUND

Typical Sections - Elmwood Canal and Suburban Canal



VALUE ENGINEERING TEAM STUDY

EXECUTIVE SUMMARY

The Value Engineering study was initiated during the VE working conference conducted in the New Orleans District during February 18 through 21, 1997. The study was based on the District's *Jefferson and Orleans Parishes, Louisiana Urban Flood Control and Water Management, Reconnaissance Study*, dated July 1992, and *SELA Project Jefferson Parish Technical Report*, dated May 1996. A site tour was conducted with District design team members in December 1996, and OVEST team members revisited the reaches on February 18th. District representatives included: Frank Vicidomina, VEO; John Grieshaber, Geotechnical; Clyde Barr`e, Hydraulic\Hydrology, and Carl Anderson, Project Engineering.

The project was studied using the Corps of Engineers' standard value engineering (VE) methodology, consisting of five phases:

Information Phase: The team studied the drawings, figures, descriptions of project work, and cost estimates to fully understand the work to be performed and the functions to be achieved. Cost models were compared to determine areas of relative high cost to ensure that the team focused on those parts of the project which offered the most potential for cost savings.

Speculation Phase: The team speculated by conducting brainstorming sessions to generate ideas for alternative designs. All team members contributed ideas and critical analysis of the ideas was discouraged.

Analysis Phase: Following the Speculation Phase, the team analyzed these ideas and ranked them by priority for development. Ideas which did not survive critical analysis were deleted.

Development Phase: The selected priority ideas were developed with several members of the original VE study team during an intensive technical development session. Coordination was maximized as ideas were initiated for development. The proposal development was completed by OVEST, but original team members continued their support as proposals were fully coordinated by FAX and telephone. In addition to proposals, VE Team Comments are included for items of special interest which were not developed as technical proposals, but offer enhancements to the project. The reader is encouraged to review these comments which follow the VE study proposal recommendations.

Presentation Phase: Formal Presentation of the VE study recommendations will be coordinated through the New Orleans District for early April 1997.

The summary of the Value Engineering team recommendations is given on the following page.

VALUE ENGINEERING TEAM STUDY REPORT

SUMMARY OF RECOMMENDATIONS

During the Value Engineering study Speculation Phase, 41 ideas were suggested by team members. Of these ideas nearly 32 were selected for further investigation (many related ideas were combined) and 16 were developed as proposals offering specific revisions to project design and construction features. Also 6 of the ideas were developed to the level of a comment regarding specific project elements and are included for evaluation by project decision makers.

PROPOSAL NUMBER	RECOMMENDATION	POTENTIAL SAVINGS	RECOMMENDED ACTION**
C-1	Revise Trapezoidal Section with Rip Rap Slope and Toe (Elmwood Canal and Suburban Reach 12)	$ 1,543,144	NO
C-2	Covered Reinforced Double Concrete Arch in Lieu of U-Frame (Suburban Reaches 10B and 11)	($212,926)	NO
C-3	Paved Trapezoidal Section in Suburban Reach 10B	$ 7,142,736	NO
C-4	Composite Trap Section in Suburban 10B	$ 5,522,368	NO
C-5	Paved Trapezoidal Step-Down Section in Suburban Reaches 10B and Reach 11	$18,067,170	NO
C-6	Acquire Additional Right-of-Way for Reach 11, Build Concrete-Lined Trapezoidal Section	$6,556,620	
C-7	Install a "Tensar" Mattress in Lieu of Concrete Paving (Elmwood Canal and Suburban Reach 12)	$ 452,960	NO
C-8	Install 3-D Geo-Mat in Lieu of Reinforced Concrete Paving (Elmwood Canal and Suburban Reach 12)	$ 1,441,124	

SUMMARY OF RECOMMENDATIONS (continued)

PROPOSAL NUMBER	RECOMMENDATION	POTENTIAL SAVINGS	RECOMMENDED ACTION**
C-9	Use Steel Sheet Pile with Concrete Facing and Gravel Bottom in Lieu of Concrete U-Frame (Suburban Reaches 10B and 11)	$8,392,138	________
C-10	Use Prestressed Concrete Sheet Pile and Gravel Bottom in Lieu of Concrete U-Frame (Suburban Reaches 10B and 11)	$ 5,562,211	________
C-11	Use New Pump Station/Force Main in Suburban Canal in Lieu of All Channel and Pump Station Work	$16,117,748	________
C-12	Use New Pump Station/Force Main in Suburban Canal in Lieu of All Channel and Pump Station Work; Place F.M. Under Roadway -- Lake Villa Avenue	$12,941,948	________
C-13	Use New Pump Station and Force Mains at Canal No. 3 and Soniat; Install Erosion Protection on Canal No. 3 (I-10 to Duncan) and Soniat (W. Napoleon to Canal No. 3); Eliminate Pump Station Work on Elmwood and Canal Improvements on Elmwood, and Soniat (W. Metairie to W. Napoleon)	$29,841,914	________
C-14	Use New Pump Station and Force Mains at Canal No. 3 and Soniat; Install Erosion Protection on Canal No. 3 (I-10 to Duncan) and Soniat (W. Napoleon to Canal No. 3); Eliminate Pump Station Work on Elmwood and Canal Improvements on Elmwood, and Soniat (W. Metairie to W. Napoleon); Place F.M.'s Under Canal No. 3 and Elmwood Canal	$ 7,932,914	________

PROPOSAL NUMBER	RECOMMENDATION	POTENTIAL SAVINGS	RECOMMENDED ACTION**
C-15	Install 1,800 CFS Pump Station with River Discharge on Soniat Canal (Harahan); Use Suave Road and Jefferson Highway Corridor	$44,388,954	________
C-16	Install 1,800 CFS Pump Station with River Discharge on Soniat Canal (Harahan); Use Ivy and Tullulah Street Corridors	$47,865,954	________

TOTAL ADDITIVE SAVINGS* RANGE FROM $11,376,406 TO $67,306,902

*I	Savings for Trapezoidal Canal Sections (Proposal Nos. C-1 and C-8)	$ 2,984,268
	Savings for U-Frame Canal Sections (Proposal No. C-5)	18,067,170
	Total Additive Savings	$21,051,438
*II	Savings for Trapezoidal Canal Sections (Proposal Nos. C-1 and C-8)	$ 2,984,268
	Savings for U-Frame Canal Sections (Proposal No. C-9)	8,392,138
	Total Additive Savings	$11,376,406
*III	Total Additive Savings for Pump Station Alternatives (Proposal Nos. C-11 and C-16)	67,306,902

**Recommended Action may include: Approved; Recommended for additional study; or Rejcted (for reasons

PROPOSAL NO: C-1 PAGE NO: 1 OF 5
DESCRIPTION: Revise Trapezoidal Section with Rip Rap Slope and Toe (Elmwood Canal and Suburban Canal Reach 12)

ORIGINAL DESIGN:

The revised (1V:3H) trapezoidal canal section features a 6" reinforced concrete paved slope from top of bank to elevation 6' (Cairo Datum). Rip rap is used to complete the slope and canal invert which varies from approximately elevations 1' to 2' (CD). Rip rap is to be 18" in Elmwood reaches 31 and 32, and is to be 24" in Suburban and Elmwood reaches 12 and 33 where velocities increase near pumping stations. Recent field borings were examined to determine the nature of typical materials in the two canals. Sediment materials approximately 24" to 30" were present in upper reaches, and the reaches near the pumping station were clear to clay base (only a couple inches sediment was present). Reaches and revised sections are depicted (see Drawing Nos. 1 and 2).

PROPOSED DESIGN:

Construct a trapezoidal canal section with reinforced concrete slopes and a rip rap slope with a toe-in section to prevent erosion and undermining of the canal slopes. The canal bottoms will be excavated to grade and will remain as packed clay. It is expected sediment will accumulate along clay bottoms and this sediment material may be resuspended during peak flows, and the packed clay will remain with additional protection provided by the rip rap toe (see Drawing No. 3).

ADVANTAGES:

1. Critical slope protection is assured with rip rap toe.
2. Simpler construction, reduces time and cost.
3. Provides compatible transition from paved slope to invert.
4. An allowance is made for rip rap which is to remain in higher velocity reaches.

DISADVANTAGES:

Risk analysis should be performed to define rip rap toe depths needed.

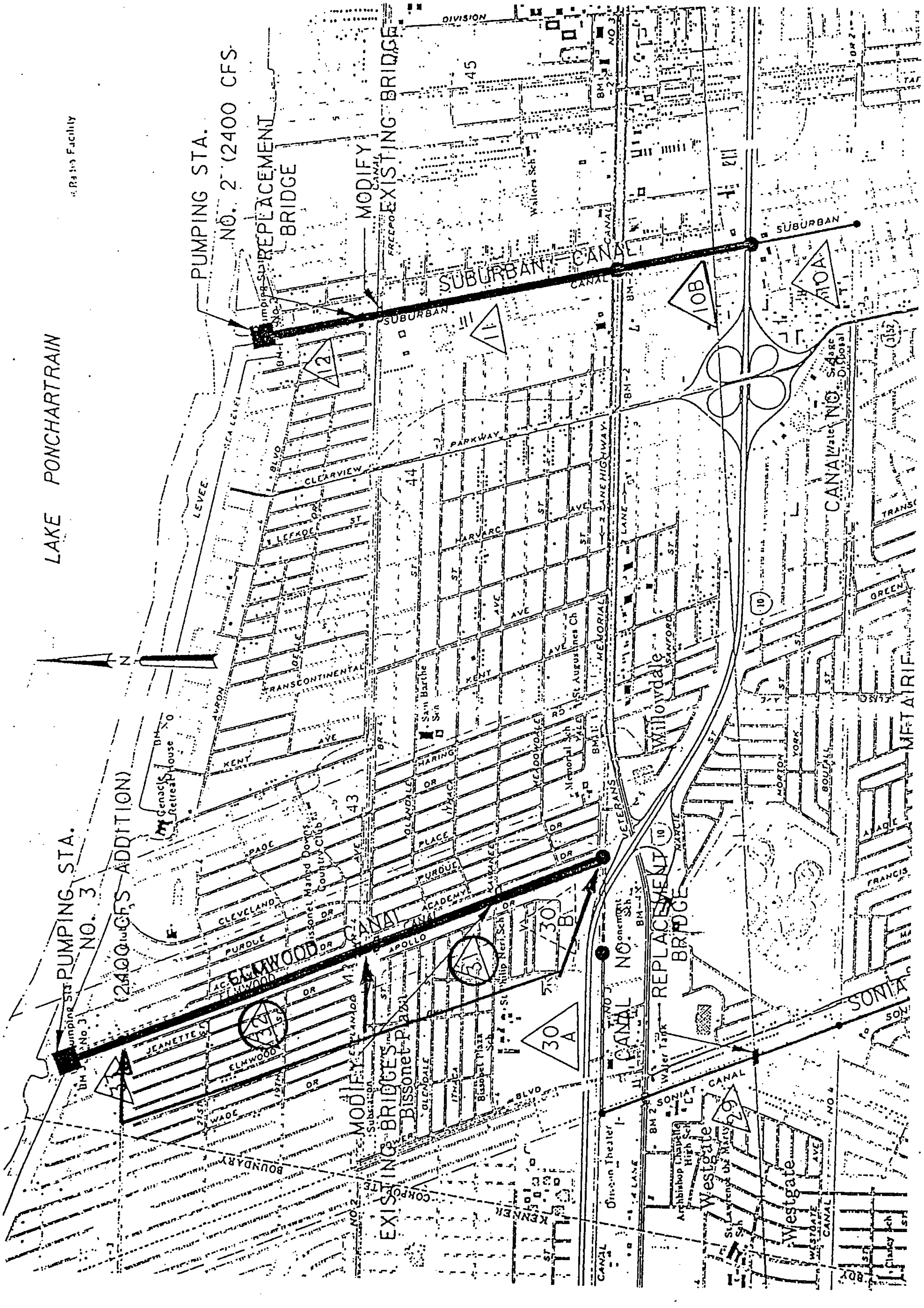
JUSTIFICATION:

A paved/rip-rapped/clay-bottom composite trapezoidal channel will provide flow characteristics needed for each reach. Sedimentation along the rip rap bottoms will eventually influence flows as an unpaved bottom will. Sediment material may be resuspended during peak flows, and the packed clay will remain with additional protection provided by the rip rap toe.

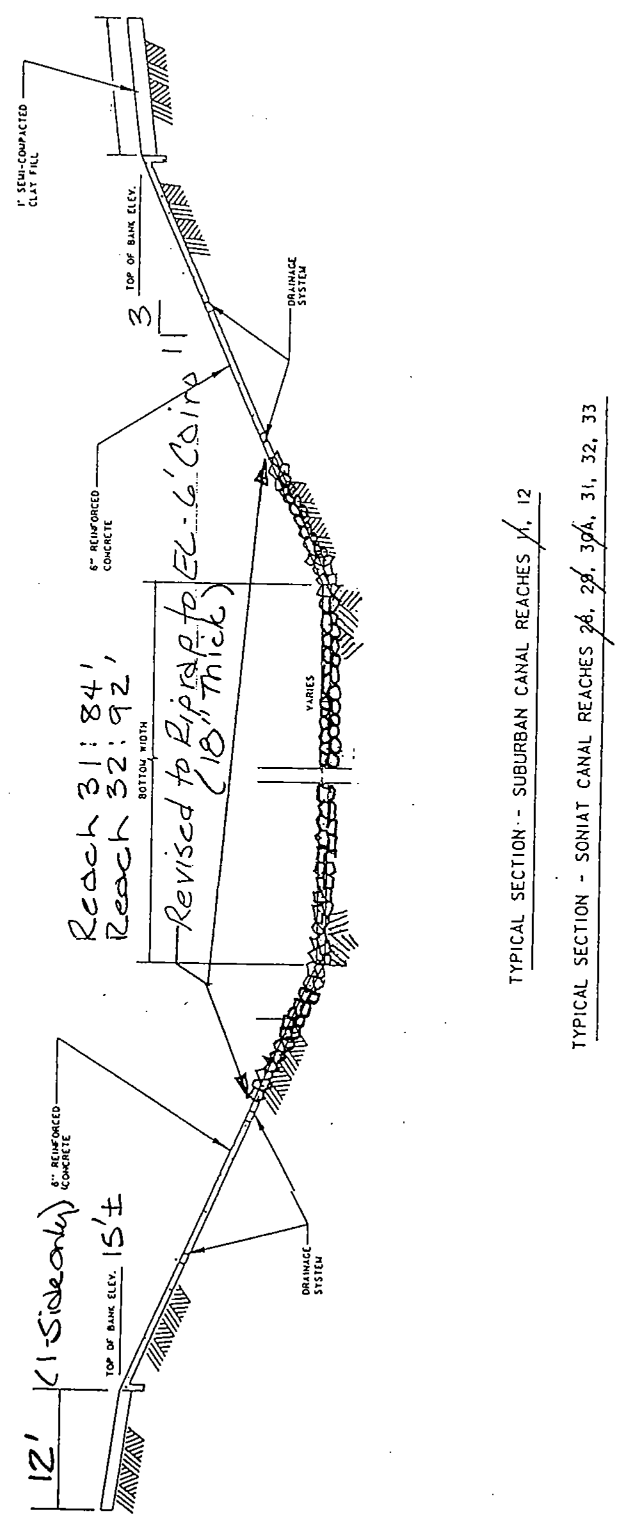
VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-1 | PAGE NO: 2 OF 5

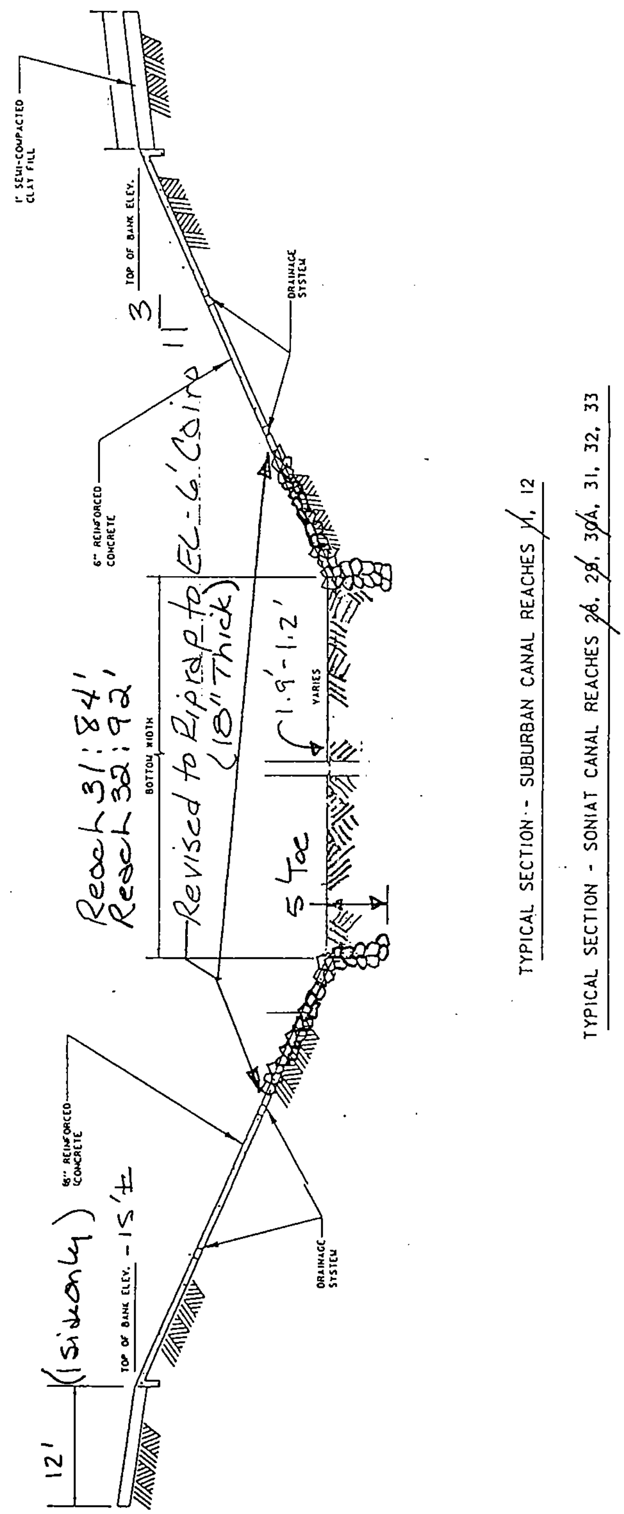
DRAWING NO. 1: Elmwood and Suburban Canals



DRAWING NO. 2: Revised Trapezoidal Canal Section



DRAWING NO. 3: Proposed Trapezoidal Section



COST ESTIMATE WORKSHEET

PROPOSAL NO: C-1

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
Rip rap	CY	32,600	$25.00	$815,000
Filter Cloth	SY	74,800	2.00	149,600
Excavation/Haul	CY	37,400	5.00	187,000
TOTAL DELETIONS				$1,151,600

ADDITIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
TOTAL ADDITIONS				$0

Net Savings (Deletes - Adds)	$1,151,600
Markups 34%	391,544
TOTAL SAVINGS	$1,543,144

Markups include 20% contingency and 12% construction management.

PROPOSAL NO:	C-2	PAGE NO: 1 OF 5
DESCRIPTION:	Covered Reinforced Double Concrete Arch in Lieu of U-Frame (Suburban Canal Reaches 10B and 11)	

ORIGINAL DESIGN:

U-Frame concrete channel section with 58' bottom width and 13' high walls to be constructed (see Drawing No. 1). Access is available within remaining servitude bordering the channel. Existing servitude is approximately 135' wide for Reach 10B and 110' in Reach 11 (see Drawing No. 2).

PROPOSED DESIGN:

Close Reaches 10B and 11 by installing a double barrel (side by side) reinforced concrete arch culvert system. Each barrel will be 30' wide by 13' high (see Drawing No. 3).

ADVANTAGES:

1. Open spaces for parks or playgrounds on the covered channel.
2. Eliminates danger or driving or walking into open canal.
3. Aesthetically pleasing.
4. Reduced construction time for arch culvert.
5. Eliminates open channel in proximity of residences.
6. Designated access road not necessary.

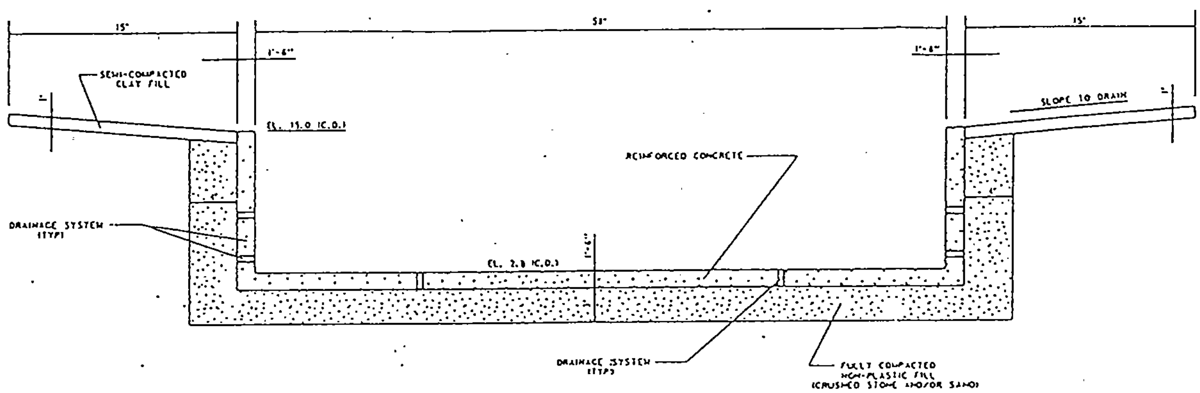
DISADVANTAGES:

1. Routine maintenance more difficult.
2. Restricts free flow over sides into channel (flow through top inlets).
3. Increases project cost approximately 1%.
4. May be considered a betterment, requiring Local Sponsor to pay 100% of the increased cost.

JUSTIFICATION:

The "ultimate system design" seems to be enclosed channels as evidenced by installations along Veterans' Highway and West Napoleon Canal. Since the difference in cost is on the order of only 1% more, the added recreational area and safety afforded the community may easily justify the added cost. Aesthetics will be greatly enhanced.

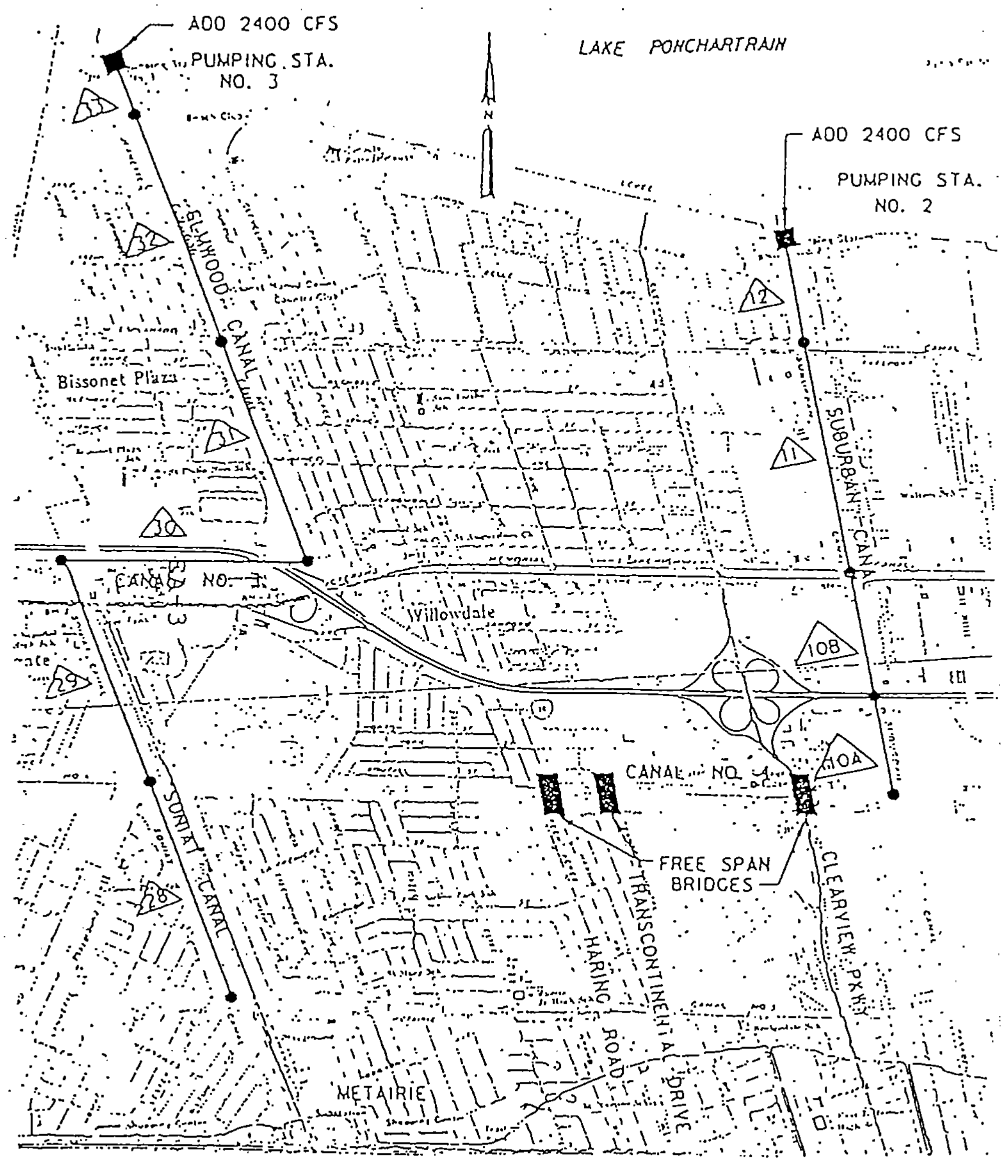
DRAWING NO. 1



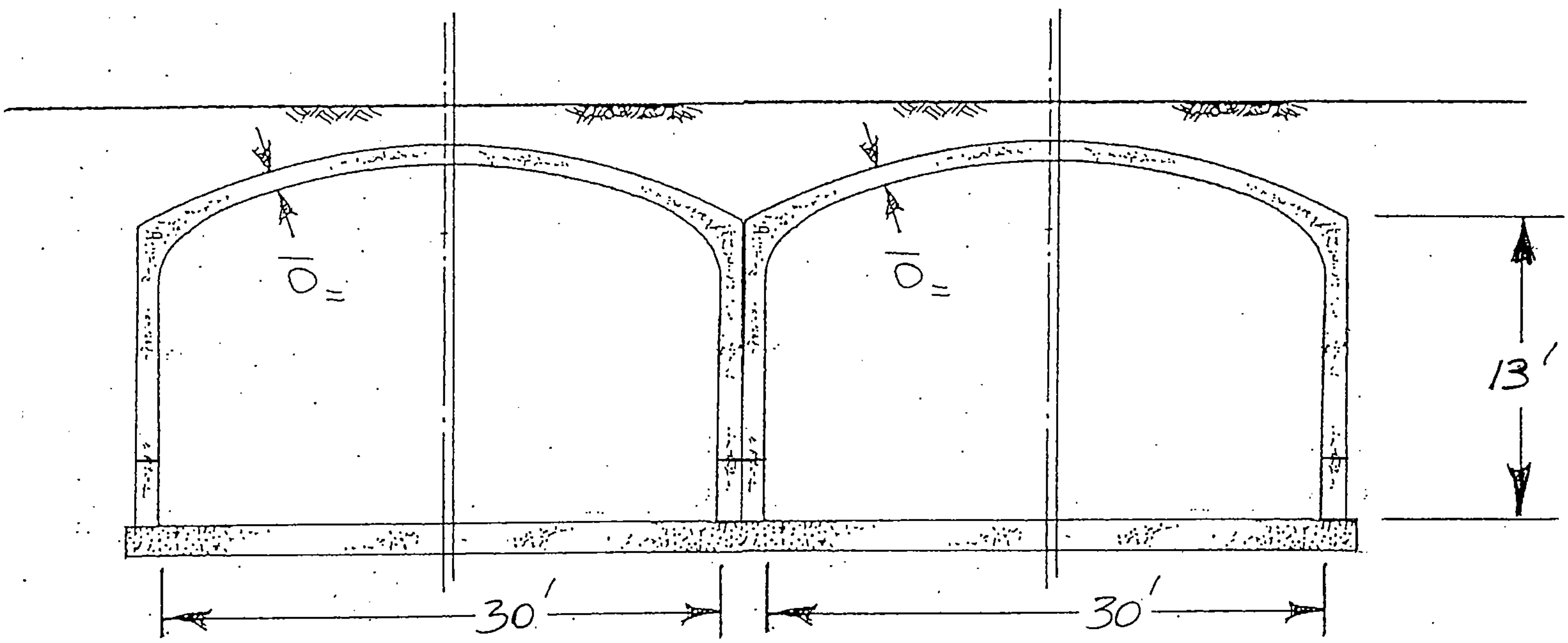
SUBURBAN CANAL – REACH 108

NOTE:
ALL ELEVATIONS ARE SHOWN IN CAIRO DATUM (C.D.)

DRAWING NO. 2


ADD 2400 CFS
PUMPING STA.
NO. 3
LAKE PONCHARTRAIN
ADD 2400 CFS
PUMPING STA.
NO. 2
ELMWOOD CANAL
Bissonet Plaza
SUBURBAN CANAL
CANAL NO. 3
Willowdale
CANAL NO. 4
FREE SPAN
BRIDGES
SONIAT CANAL
CLEARVIEW PKWY
HARING ROAD
TRANSCONTINENTAL DRIVE
METAIRIE

DRAWING NO. 3



NOTE: ESTIMATE FOR 12' HIGH ARCH ON 1' BASE PEDESTAL.

COST ESTIMATE WORKSHEET

PROPOSAL NO: C-2 PAGE NO: 5 OF 5

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
U-Frame Channel				
Reaches 10B & 11	LF	6,580	$2,975.00	~~$19,575,500~~ $15,000,000
TOTAL DELETIONS				$19,575,500 / 14.0 mil

ADDITIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
*12 X 30 Double Barrel				
Precast Concrete Arch	LF	6,580	$1,700.00	$11,186,000
Slab	LF	6,580	1,230.00	8,093,400
Soil Cover	CY	45,000	10.00	450,000
Fert & Seed	AC	10	500.00	5,000
TOTAL ADDITIONS				$19,734,400

Net Saving (Deletes - Adds)	($158,900)
Markups 34%	(54,026)
TOTAL SAVINGS	($212,926)

Markups include 20% contingencies and 12% construction management.

**Estimate includes $46/LF for crane rental and operation plus installation contingency, based on installation of 15 pieces per day.

NOTE: Expected minimum traffic loading on top and parallel to median direction may require enlarged section and increase arch cost.

PROPOSAL NO:	C-3	PAGE NO: 1 OF 6
DESCRIPTION:	Paved Trapezoidal Section in Suburban Canal Reach 10B	

ORIGINAL DESIGN:

U-Frame concrete channel section with 58' bottom width and 13' high walls to be constructed (see Drawing No. 1). Access is available within remaining servitude bordering the channel. Existing servitude is approximately 135' wide for Reach 10B (see Drawings No. 2 and 3).

PROPOSED DESIGN:

Construct a concrete-lined trapezoidal channel with 40' bottom width and 1 on 3 side slopes. A 12' access road will be provided along one side of channel (see Drawing No. 4).

ADVANTAGES:

1. Fits within existing easement, with exception of one parcel on northeast corner of Veterans' Highway.
2. Simpler construction, reduces time and cost.
3. Provides compatible transition from Reach 10A.

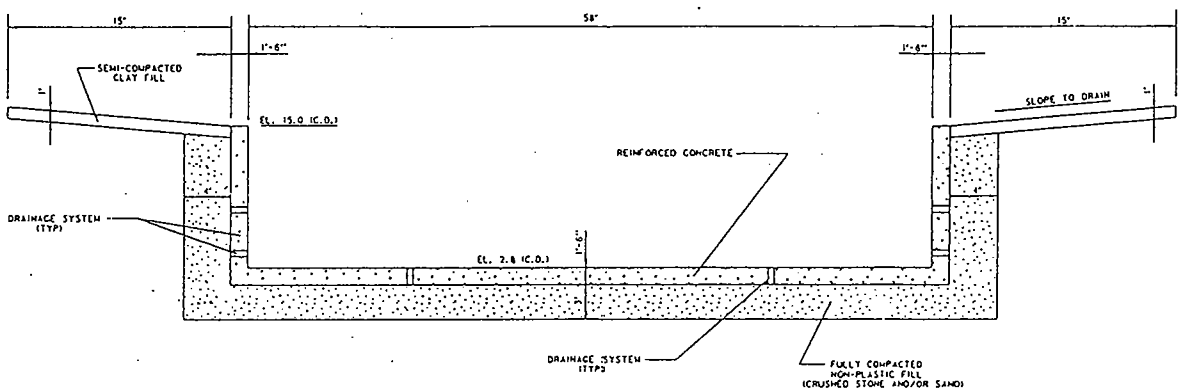
DISADVANTAGES:

Will require acquisition of one parcel of property, approximately 40' x 200' (40' along I-10 service road, 200' parallel to canal).

JUSTIFICATION:

A similar design was proposed previously for Suburban Canal, Reaches 11 and 12, having 1 on 2 side slope with 40' bottom width. This design was discarded when side slopes were revised to 1 on 3, because section became too wide to fit with access roads along both sides of channel. Since that requirement has been relaxed to one 12' access road on one side of the channel, a paved trapezoidal channel will fit within the existing 135' right-of-way of Reach 10B, except for one parcel described above (see Drawing No. 3).

DRAWING NO. 1



SUBURBAN CANAL – REACH 108

NOTE:
ALL ELEVATIONS ARE
SHOWN IN CAIRO DATUM (C.D.)

VALUE ENGINEERING TEAM STUDY REPORT

DOD SERVICE: USACE   VALUE ENGINEERING OFFICER: Frank Vicidomina

CONTROL NUMBER: CELMN-97-05

VALUE ENGINEERING STUDY REPORT ON

SOUTHEAST LOUISIANA FLOOD CONTROL

(ELMWOOD CANAL AND SUBURBAN CANAL)

JEFFERSON PARISH, LA

MARCH 1997

PREPARED FOR: U.S. ARMY CORPS OF ENGINEERS DISTRICT, NEW ORLEANS

VALUE ENGINEERING STUDY TEAM LEAD BY:

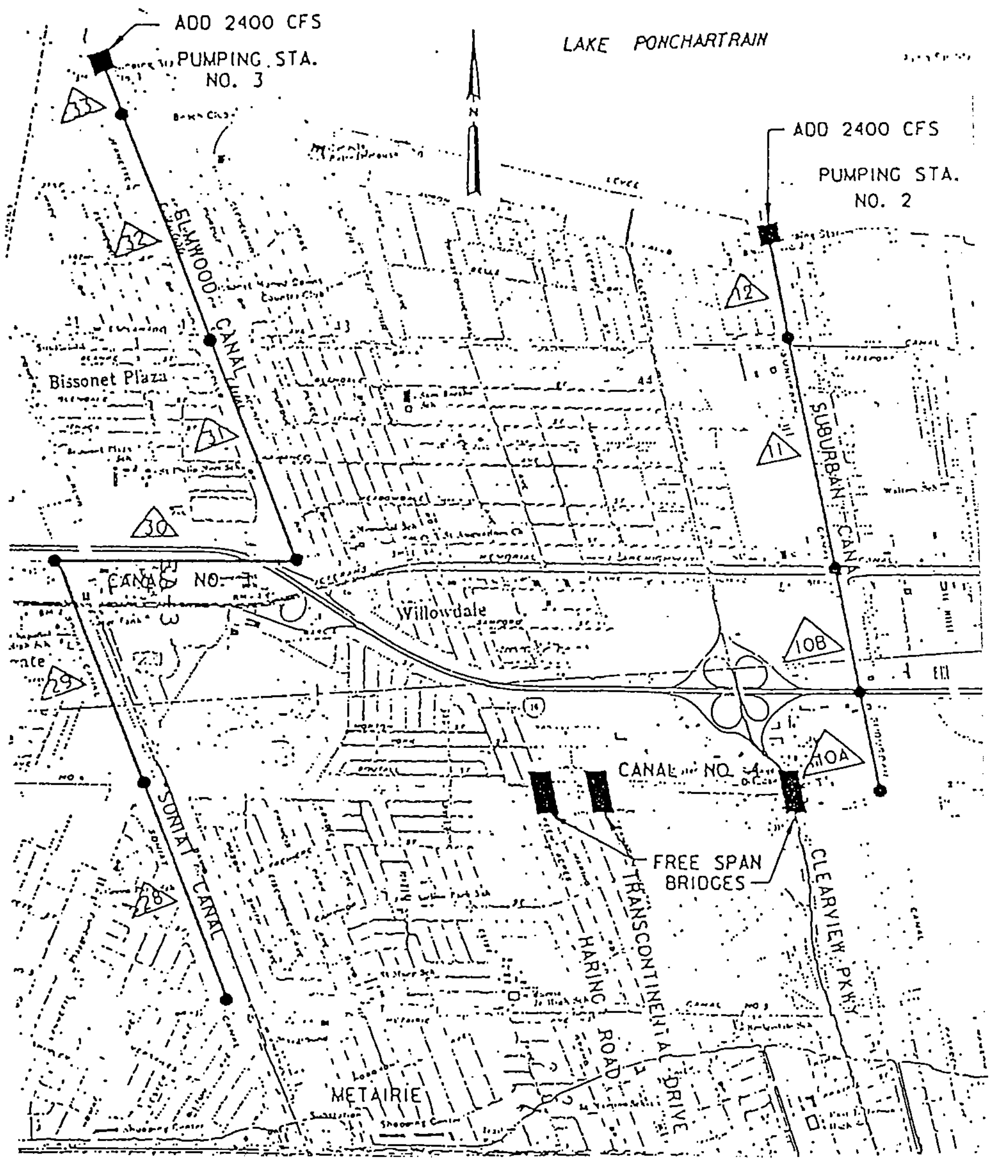
HQ, U.S. Army Corps of Engineers/OVEST
P.O. Box 889, 27 E. Bay Street
Savannah, Georgia 31408-0889
Telephone: 912-652-5448

TEAM LEADER: Fred McAuley, Telephone 912-652-5715

VALUE ENGINEERING TEAM MEMBERS:

Frank Vicidomina, CELMN, 504-862-1251
John Grieshaber, CELMN, 504-862-2979
Willis Newton, BCG/Jefferson Parish DCIP, 504-736-6780
Charles Claghorn, OVEST, 912-652-5173
Clyde Barr`e, CELMN, 504-862-2429
Carl Anderson, CELMN, 504-862-2610
Eara Merritt, OVEST, 912-652-5171
Fred McAuley, OVEST, 912-652-5715
Frank Eubanks, OVEST, 912-652-5958

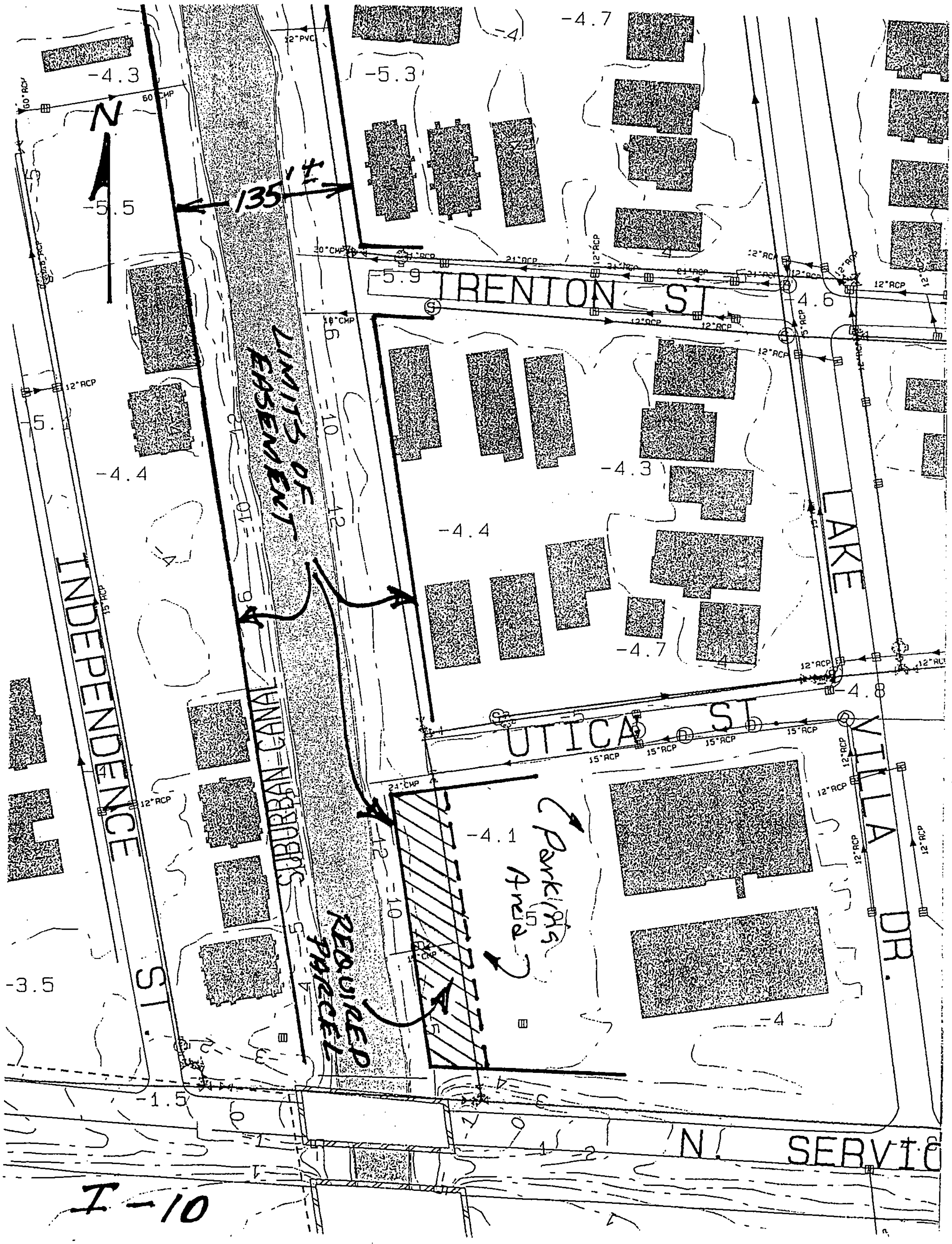
DRAWING NO. 2


ADD 2400 CFS
PUMPING STA. NO. 3
LAKE PONCHARTRAIN
N
ADD 2400 CFS
PUMPING STA. NO. 2
33
32
12
ELMWOOD CANAL
Bissonet Plaza
31
11
SUBURBAN CANAL
30
CANAL NO. 3
Willowdale
108
29
CANAL NO. 4
10A
FREE SPAN BRIDGES
SONIAT CANAL
28
TRANSCONTINENTAL DRIVE
HARING ROAD
CLEARVIEW PKWY.
METAIRIE

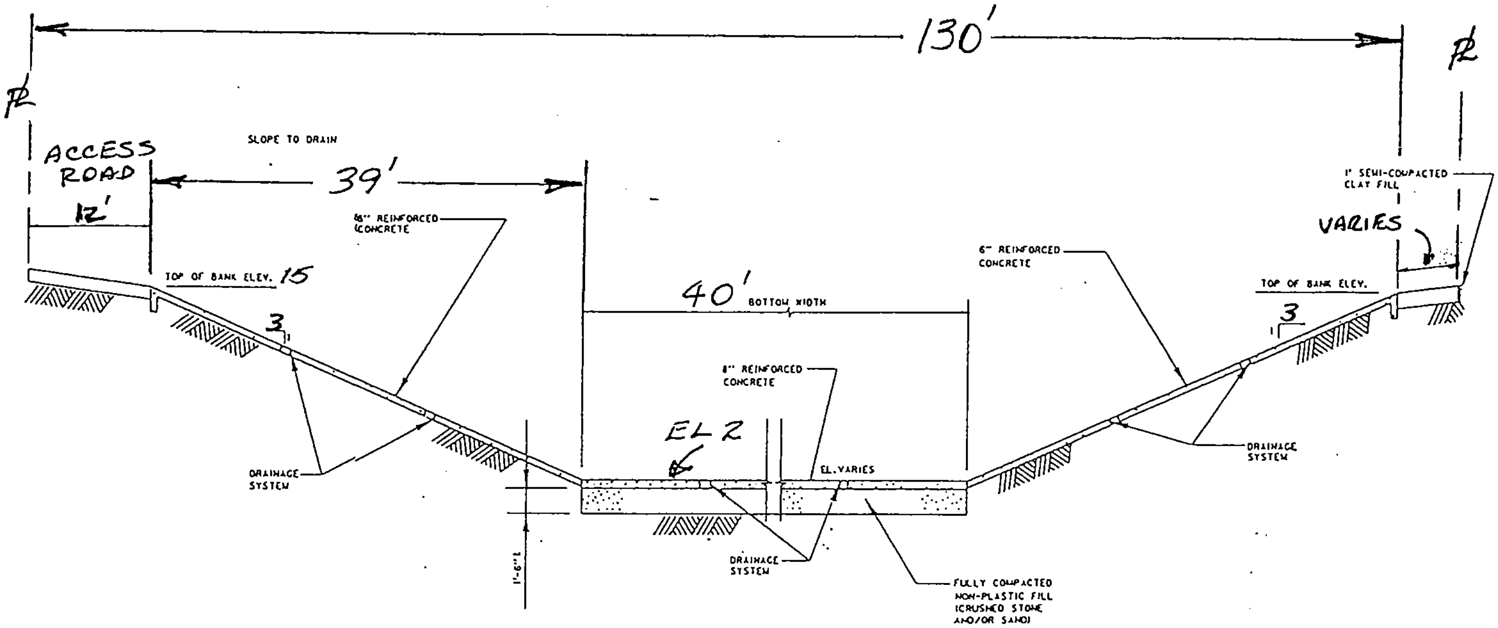
VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-3 PAGE NO: 5 OF 6

DRAWING NO. 3



DRAWING NO. 4



TYPICAL SECTION - SUBURBAN CANAL REACH 10B

COST ESTIMATE WORKSHEET

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
U-Frame Channel (Reach 10B)	LF	2,480	$2,975.00	$7,378,000
TOTAL DELETIONS				$7,378,000

ADDITIONS

NO

ITEM	U/M	QTY	UNIT COST	TOTAL
*Paved Trapezoidal Section	LF	2,480	$745.00	$1,847,600
**R/W Acquisition	SF	8,000	25.00	200,000
TOTAL ADDITIONS				$2,047,600

Net Savings (Deletes - Adds)	$5,330,400
Markups 34%	1,812,336
TOTAL SAVINGS	$7,142,736

Markups include 20% contingency and 12% construction management.

*Basis of unit cost, Technical Report Estimate, Page B-15, Reach 11 cost, 4,100', $2,771,086 (add 10% for increase slope to 1 on 3).

**Parcel 80' x 200', long side parallel to canal. Estimate acquisition cost $25/SF.

Note: Additional savings can be realized if the 8" concrete invert is deleted, leaving a bottom liner of appropriately sized crushed stone.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-4	PAGE NO: 1 OF 4
DESCRIPTION: Composite Trap Section in Suburban Canal Reach 10B	

ORIGINAL DESIGN:

U-Frame concrete channel section with 58' bottom width and 13' wall height to be constructed (see Drawing No. 1), with room for access available on either side of channel. Existing servitude is approximately 135' wide for Reach 10B (see Drawing No. 2).

PROPOSED DESIGN:

Construct a composite paved/rip rap lined trapezoidal channel with 65' bottom width, 1 on 3 side slopes, with a 4' high sheet pile wall at top slope of channel, from 4' below to top of bank. A 12' access road will be provided along one side of channel (see Drawing No. 3).

ADVANTAGES:

1. This configuration fits within existing easement, with exception of approximately 200' on northeast corner of Veterans' Highway.
2. Simpler construction, reduces time and cost.

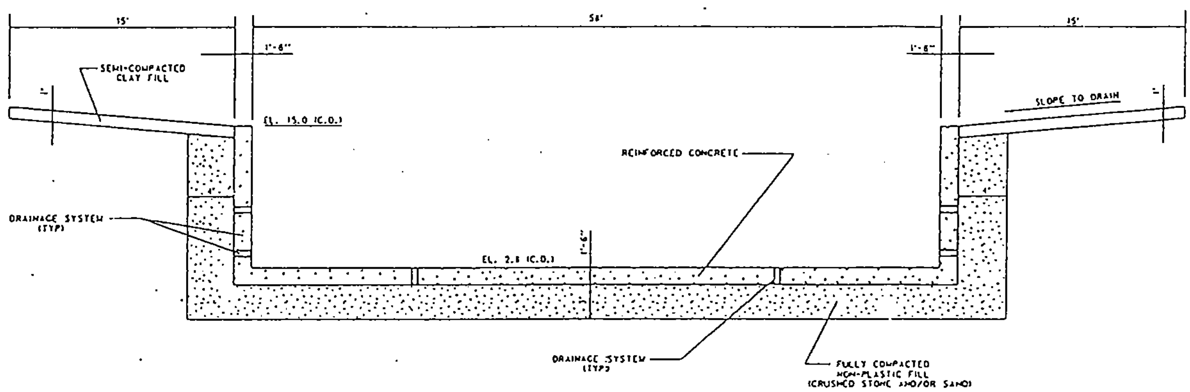
DISADVANTAGES:

1. Will require acquisition of one parcel of property, approximately 40' x 200' (40' along I-10 service road, 200' parallel to canal).
2. Bottom width of 65' required because of increased N-value over 40' wide paved section.

JUSTIFICATION:

This design is proposed for Reach 12. By modifying the upper section of the bank slope and adding a 4' high sheet pile wall, the resulting section will fit within the existing right-of-way.

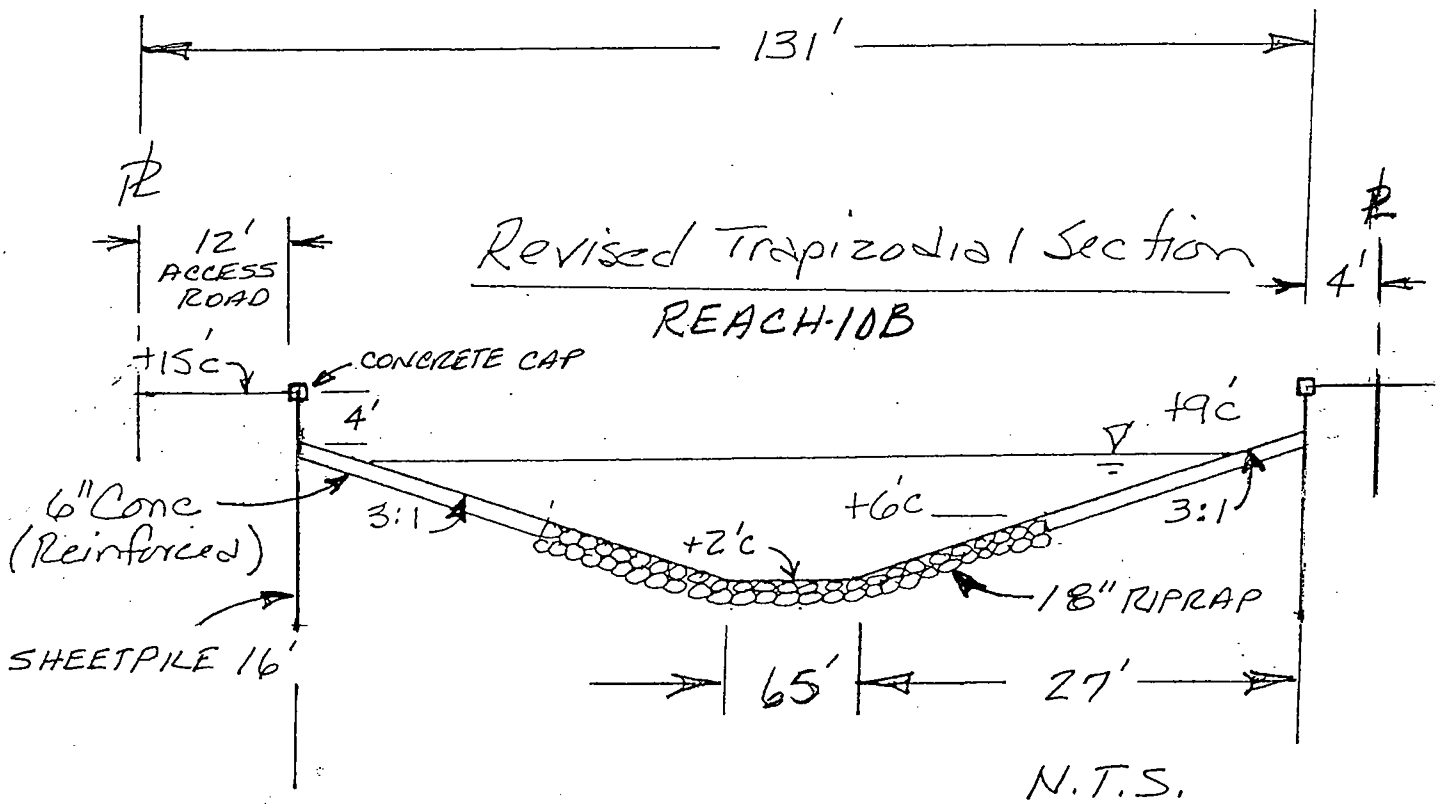
DRAWING NO. 1



SUBURBAN CANAL - REACH 108

NOTE:
ALL ELEVATIONS ARE
SHOWN IN CAIRO DATUM (C.D.)

DRAWING NO. 2


131'
℄
℄
12' ACCESS ROAD
4'
Revised Trapizodial Section
REACH-10B
+15'c
CONCRETE CAP
4'
+19'c
6" Conc (Reinforced)
3:1
+6'c
3:1
+2'c
18" RIPRAP
SHEETPILE 16'
65'
27'
N.T.S.

COST ESTIMATE WORKSHEET

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
U-Frame Channel	LF	2,480	$2,975.00	$7,378,000
TOTAL DELETIONS				$7,378,000

ADDITIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
Composite Trapezoidal Section	LF	2,480	$780.00	$1,934,400
Sheet Pile	SF	79,360	13.00	1,031,680
Concrete Cap (12" x 18")	CY	275	330.00	90,750
Right-of-Way Acquisition	SF	8,000	20.00	200,000
TOTAL ADDITIONS				$3,256,830

Net Savings (Deletes - Adds)	$4,121,170
Markups 34%	1,401,198
TOTAL SAVINGS	$5,522,368

Markups include 20% contingencies and 12% construction management.

PROPOSAL NO: C-5 PAGE NO: 1 OF 7

DESCRIPTION: Paved Trapezoidal Step-Down Section in Suburban Reaches 10B and Reach 11

ORIGINAL DESIGN:

U-Frame concrete channel section with 58' bottom width and 13' high walls to be constructed (see Drawing No. 1). Access is available within remaining servitude bordering the channel. Existing servitude is approximately 135' wide for Reach 10B and 110' in Reach 11 (see Drawing No. 2).

PROPOSED DESIGN:

Construct a concrete-lined trapezoidal channel with 40' bottom width and 1 on 3 side slopes. A 12' access road will be provided along one side of channel. A 4' step down, retained by capped sheet pile, will be provided at top of bank (see Drawing No. 3).

An alternative section, included for information only, is no sheet pile step down at top of bank, but a 4' U-Frame wall at channel bottom (see Drawing No. 4). The alternative section yields a smaller hydraulic section which must be verified for adequacy. Although it should provide a less costly section, it was not estimated for this proposal and is provided as concept only since hydraulic adequacy could not be verified.

ADVANTAGES:

1. Fits within existing easement, with exception of one parcel on northeast corner of Veterans' Highway.
2. Simpler construction, reduces time and cost.
3. This design is in place at Soniat Canal near Sauve Road.
4. Design plans and specifications already in use by Jefferson Parish.

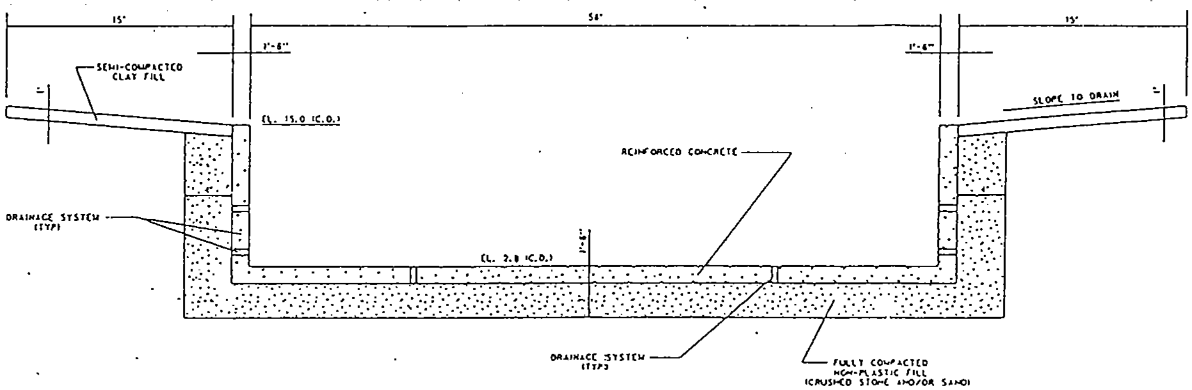
DISADVANTAGES:

1. Will require acquisition of one parcel of property, approximately 40' x 200' (40' along I-10 service road, 200' parallel to canal).
2. Soils conditions at Reach 11 may require adjustment of the proposed section.

JUSTIFICATION:

This design has been constructed by Jefferson Parish and is currently in use within the Parish Canal system. A similar simple trapezoidal design was proposed previously for Suburban Canal, Reaches 11 and 12, having 1 on 2 side slope with 40' bottom width. This design was discarded when side slopes were revised to 1 on 3, because a wider trapezoidal section would no longer fit existing easement with the restriction of an access road on both sides of the channel. Since then, the requirement has been relaxed to a 12' wide access road along one side of the channel. The modified trapezoidal section is approximately one-third the cost of U-Frame and considerably simpler to construct. Considering the extremely soft canal bottom, the trapezoidal section will not pose differential settlement problems of the nature expected for the U-Frame section (which is currently proposed not pile founded).

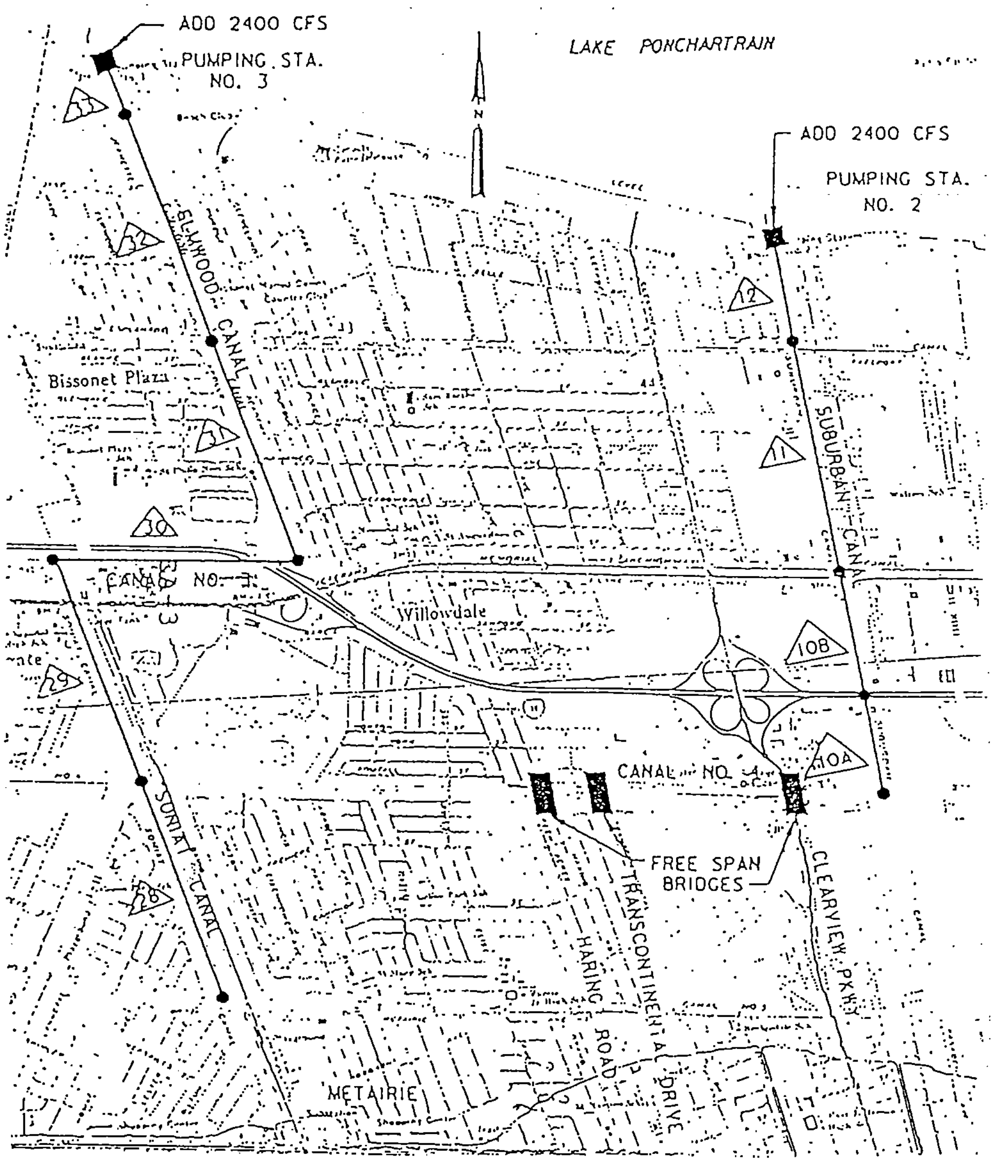
DRAWING NO. 1



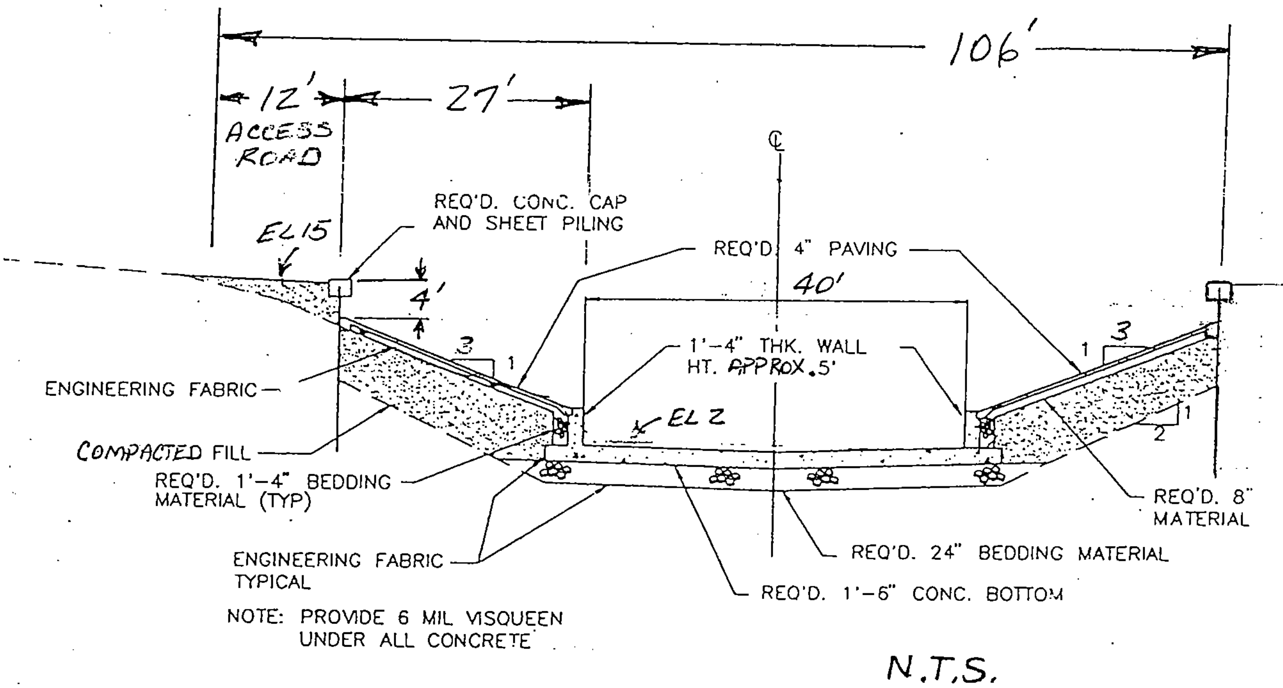
SUBURBAN CANAL – REACH 108, 11

NOTE:
ALL ELEVATIONS ARE
SHOWN IN CAIRO DATUM (C.D.)

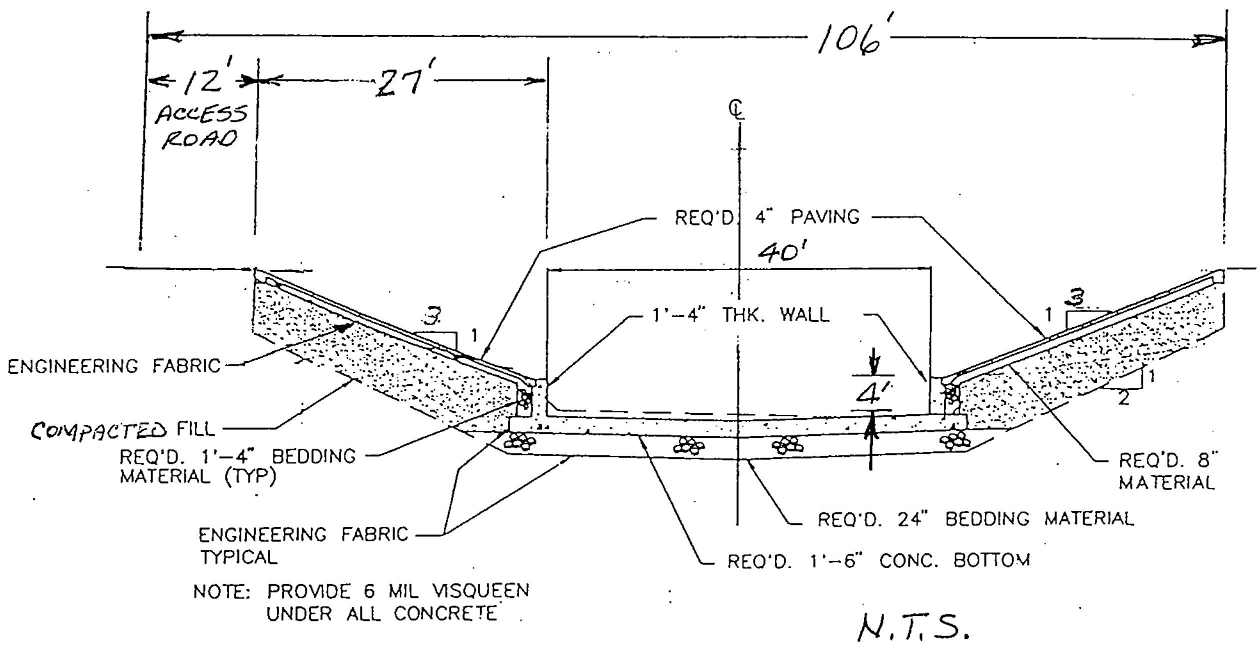
DRAWING NO. 2


ADD 2400 CFS
PUMPING STA. NO. 3
LAKE PONCHARTRAIN
ADD 2400 CFS
PUMPING STA. NO. 2
ELMWOOD CANAL
SUBURBAN CANAL
Bissonet Plaza
CANAL NO. 3
Willowdale
CANAL NO. 4
FREE SPAN BRIDGES
SORIAT CANAL
CLEARVIEW PKWY
HARING ROAD
TRANSCONTINENTAL DRIVE
METAIRIE

DRAWING NO. 3


106'
12'
27'
ACCESS ROAD
EL 15
REQ'D. CONC. CAP AND SHEET PILING
4'
REQ'D 4" PAVING
40'
3
1
1'-4" THK. WALL HT. APPROX. 5'
EL 2
ENGINEERING FABRIC
COMPACTED FILL
REQ'D. 1'-4" BEDDING MATERIAL (TYP)
ENGINEERING FABRIC TYPICAL
REQ'D. 24" BEDDING MATERIAL
REQ'D. 1'-6" CONC. BOTTOM
REQ'D. 8" MATERIAL
2
NOTE: PROVIDE 6 MIL VISQUEEN UNDER ALL CONCRETE
N.T.S.

DRAWING NO. 4



Alternative section presented for information only and is not the basis of this proposal.

COST ESTIMATE WORKSHEET

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
U-Frame Channel (Reach 10B)	LF	2,480	$2975.00	$7,378,000
Estimated Markups (34%)				~~2,508,520~~
TOTAL DELETIONS				$9,886,520

2,500 4.47

ADDITIONS

NO

ITEM	U/M	QTY	UNIT COST	TOTAL
*Paved Trapezoidal Section	LF	2,480	$1,200.00	$2,976,000
**R/W Acquisition	SF	8,000	*25.00	200,000
R/W Markups (34%)				68,000
TOTAL ADDITIONS				$3,244,000

Net Savings (Deletes - Adds)	$6,642,520
Markups Applied Above	
TOTAL SAVINGS	$6,642,520

Markups include 20% contingency and 12% construction management.

*Basis of unit cost: Completed construction cost for Soniat Canal at Sauve Road was $1,095/LF. This section had 1 on 25 side slope. $105/LF was added to compensate for slope change to 1 on 3. This is contract as-built cost and includes all markups.

*Channel footprint will be 106'. Depending on centerline alignments, real estate acquisition may require considerably less than 8,000 SF

**Parcel 80' x 200', long side parallel to canal. Estimate acquisition cost $25/SF, markups not included.

COST ESTIMATE WORKSHEET

PROPOSAL NO: C-5	PAGE NO: 7 OF 7

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
U-Frame Channel				
(Reach 11)		LF	4,100.00	$2,975
$12,197,500				
Estimated Markups (34%)				4,147,150
TOTAL DELETIONS				$16,344,650

ADDITIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
*Paved Trapezoidal Section	LF	4,100	$1,200.00	$4,920,000
TOTAL ADDITIONS				$4,920,000

Net Savings (Deletes - Adds)	$11,424,650
Markups Applied Above	
TOTAL SAVINGS	$11,424,650

Markups include 20% contingency and 12% construction management.

*Basis of unit cost: Completed construction cost for Soniat Canal at Sauve Road was $1,095/LF. This section had 1 on 25 side slope. $105/LF was added to compensate for slope change to 1 on 3. This is contract as-built cost and includes all markups.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-6 PAGE NO: 1 OF 9

DESCRIPTION: Acquire Additional Right-of-Way for Reach 11, Build Concrete-Lined Trapezoidal Section

ORIGINAL DESIGN:

U-Frame concrete channel section with 58' bottom width and 13' wall height to be constructed (see Drawing No. 1) with room for access available on either side of channel. Existing servitude is approximately 110' wide for Reach 11 (see Drawing No. 2).

PROPOSED DESIGN:

Buy 20 properties on the east side of Reach 11 (see Drawings No. 3, 4, and 5). This will allow an easement approximately 165' wide. Construct the paved trapezoidal channel, 40' bottom width, 1 on 3 side slopes, and one 12' access road, as is proposed for Reach 10B, requiring a width of 130' (see Drawing No. 6).

ADVANTAGES:

1. Allows construction of the larger but less costly concrete-lined trapezoidal section.
2. Removes homes nearest canal.
3. Allows access to be established along both sides of canal.
4. Simpler construction reduces time and cost.
5. Compatible with structures proposed for Reach 10B and 12.
6. Condemnations can be a tax advantage for homeowners.
7. Relocations costs are an incentive for homeowners to make the move.

DISADVANTAGES:

Requires relocation assistance to 18 homeowners and purchase of 20 properties total.

JUSTIFICATION:

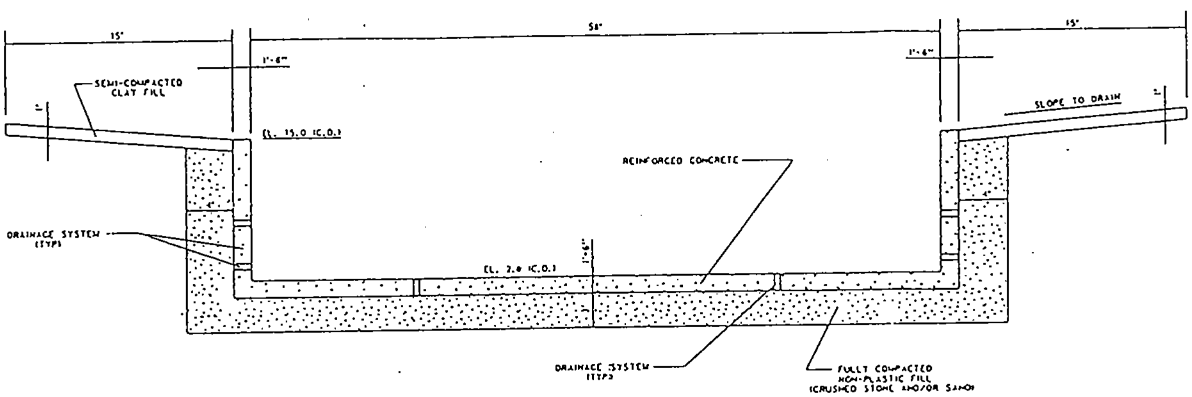
Currently, east side landowners are within 25' of top of canal bank. Channel construction will establish an access road along the est side of the channel, inviting traffic to traverse the area adjacent to the homes and creating new disturbance for the adjacent homes. Trapezoidal configurations within this reach will bring the road and the top of the bank closer to the east side homes.

(Justification continued)

Homeowners located adjacent to the canal experience a perception of decreased land value. Relocation expenses and tax advantages of condemnation would be a windfall to many affected landowners, allowing them to actually profit by a move to an upgraded location. They would even save the percentage of a real estate agent. Many vacant lots exist within the immediate area, should they desire to rebuild close by.

Acquiring homes and real estate is a cost effective method of constructing a less costly project. A wider section also provides greater storage capacity.

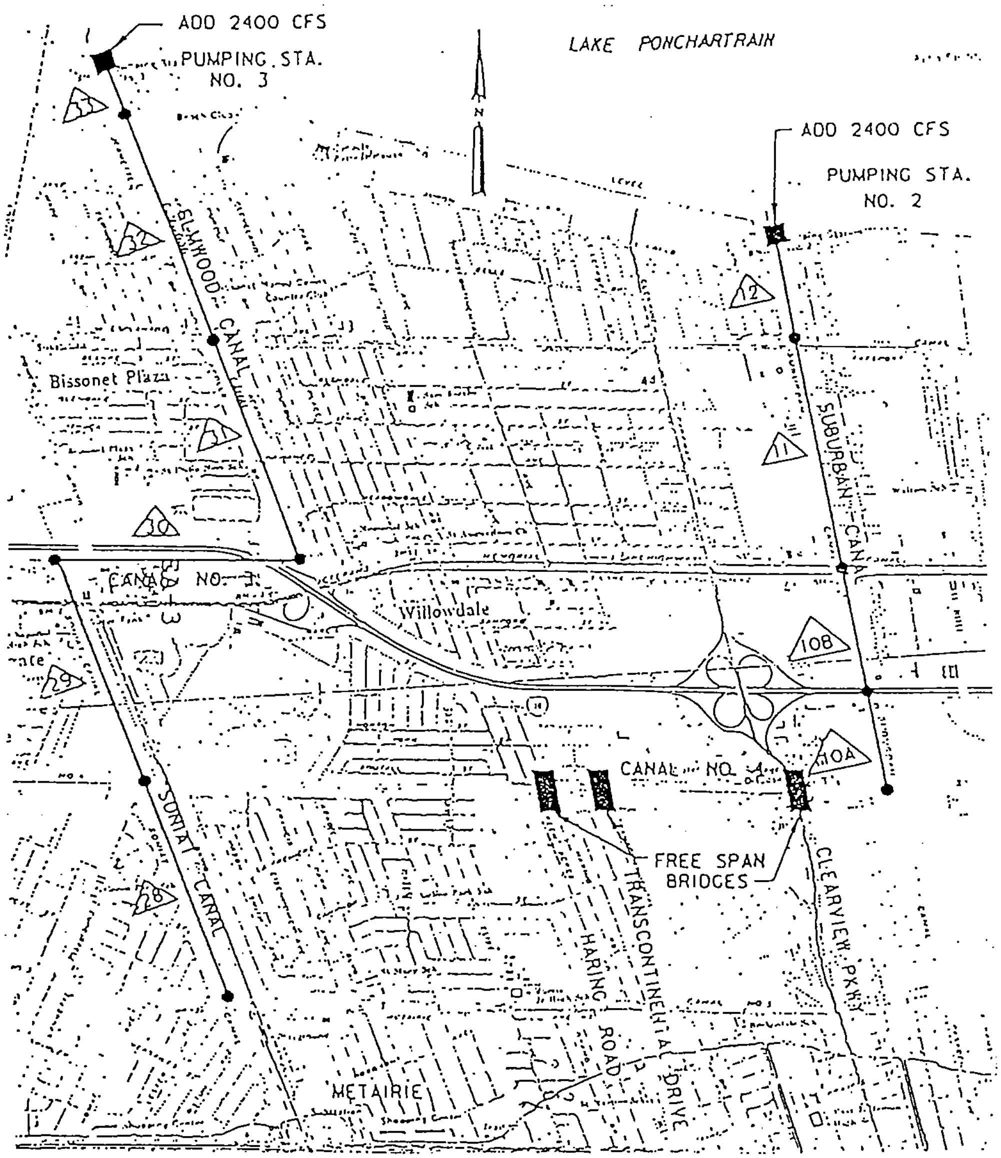
DRAWING NO. 1



SUBURBAN CANAL – REACH II

NOTE:
ALL ELEVATIONS ARE SHOWN IN CAIRO DATUM (C.D.)

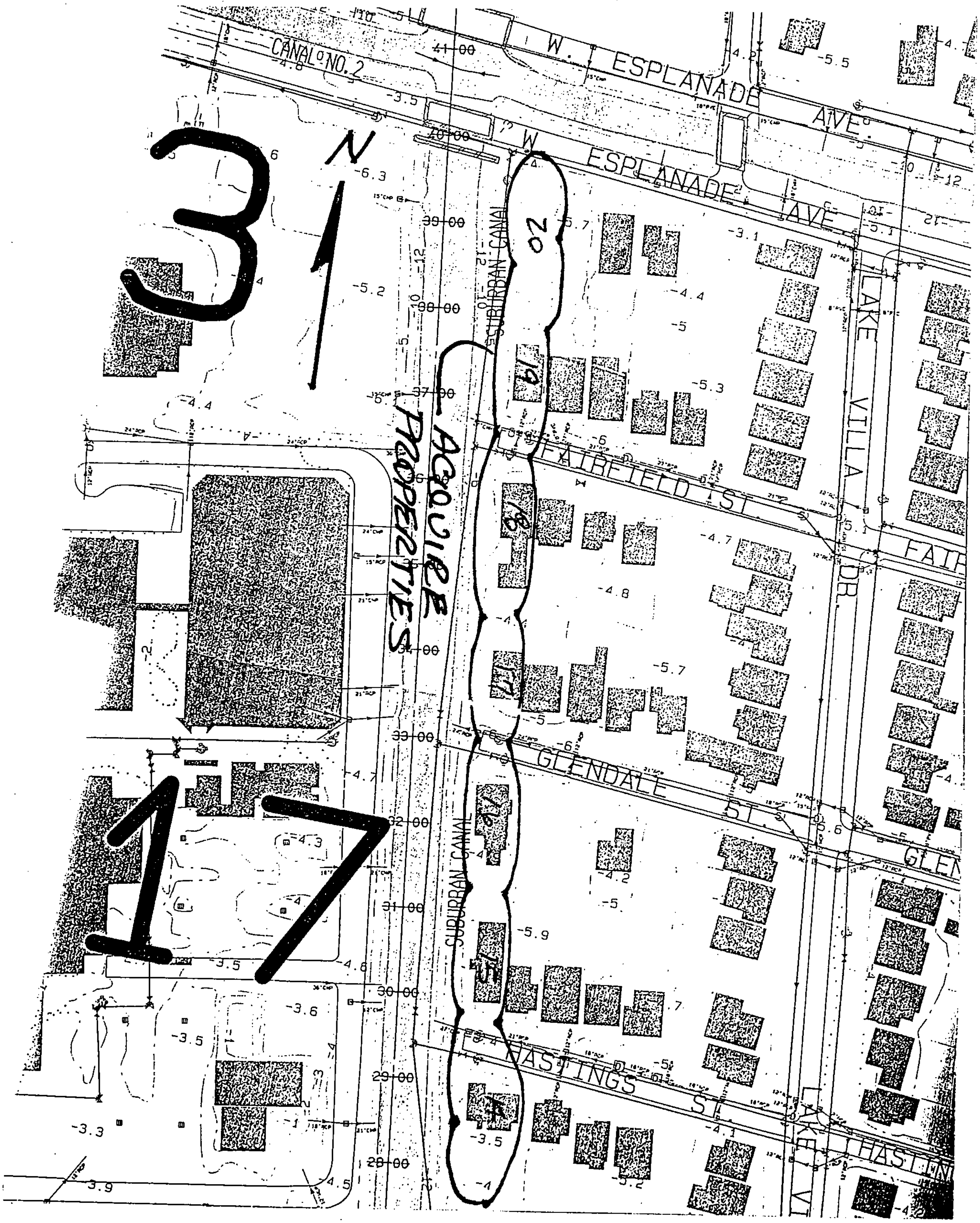
DRAWING NO. 2


ADD 2400 CFS
PUMPING STA. NO. 3
LAKE PONCHARTRAIN
ADD 2400 CFS
PUMPING STA. NO. 2
ELMWOOD CANAL
SUBURBAN CANAL
Bissonet Plaza
CANAL NO. 3
Willowdale
CANAL NO. 4
FREE SPAN BRIDGES
SONIAT CANAL
TRANSCONTINENTAL DRIVE
HARING ROAD
CLEARVIEW PKWY
METAIRIE
33
32
31
30
29
28
12
11
10B
10A

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-6 PAGE NO: 5 OF 9

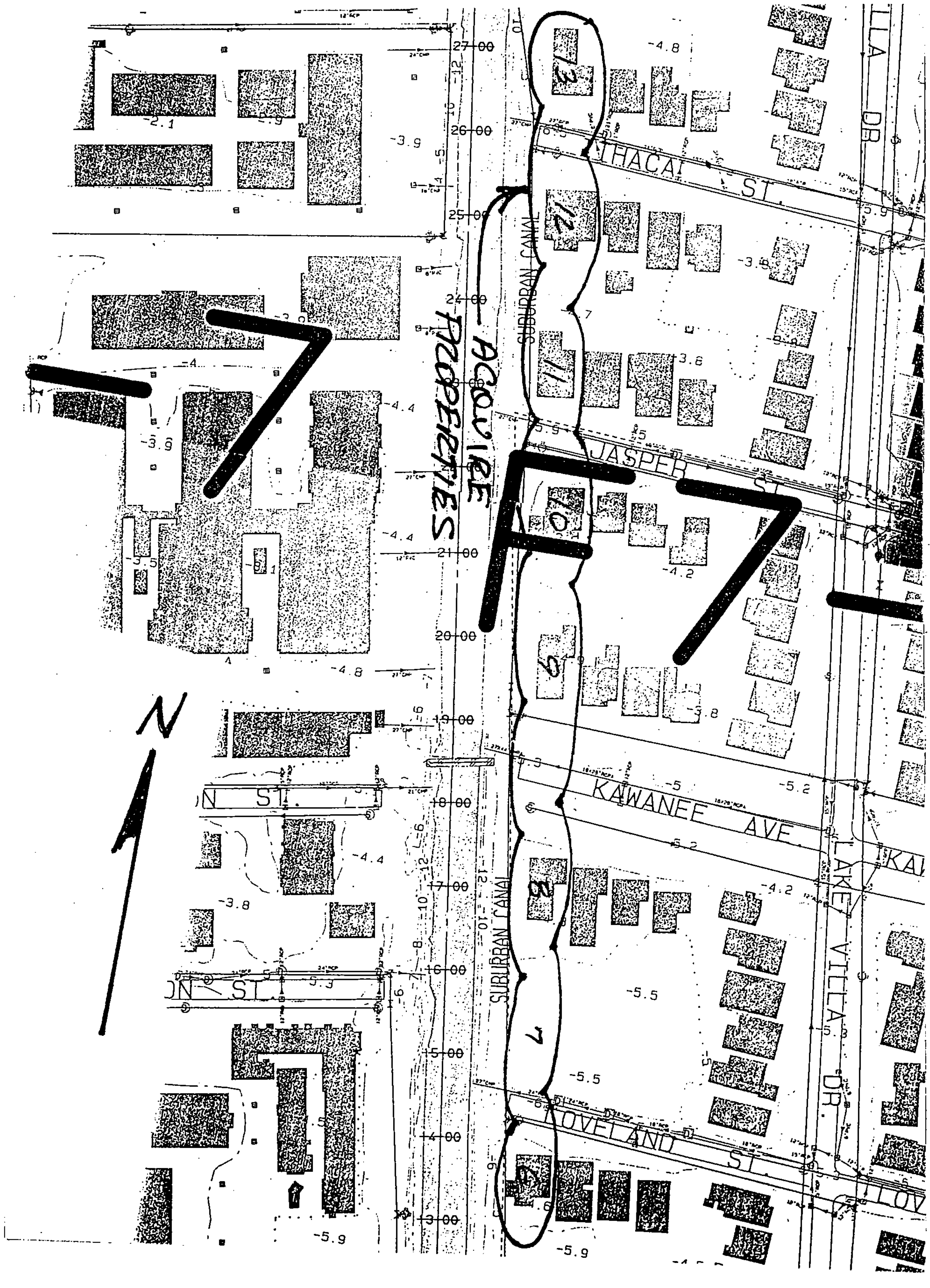
DRAWING NO. 3



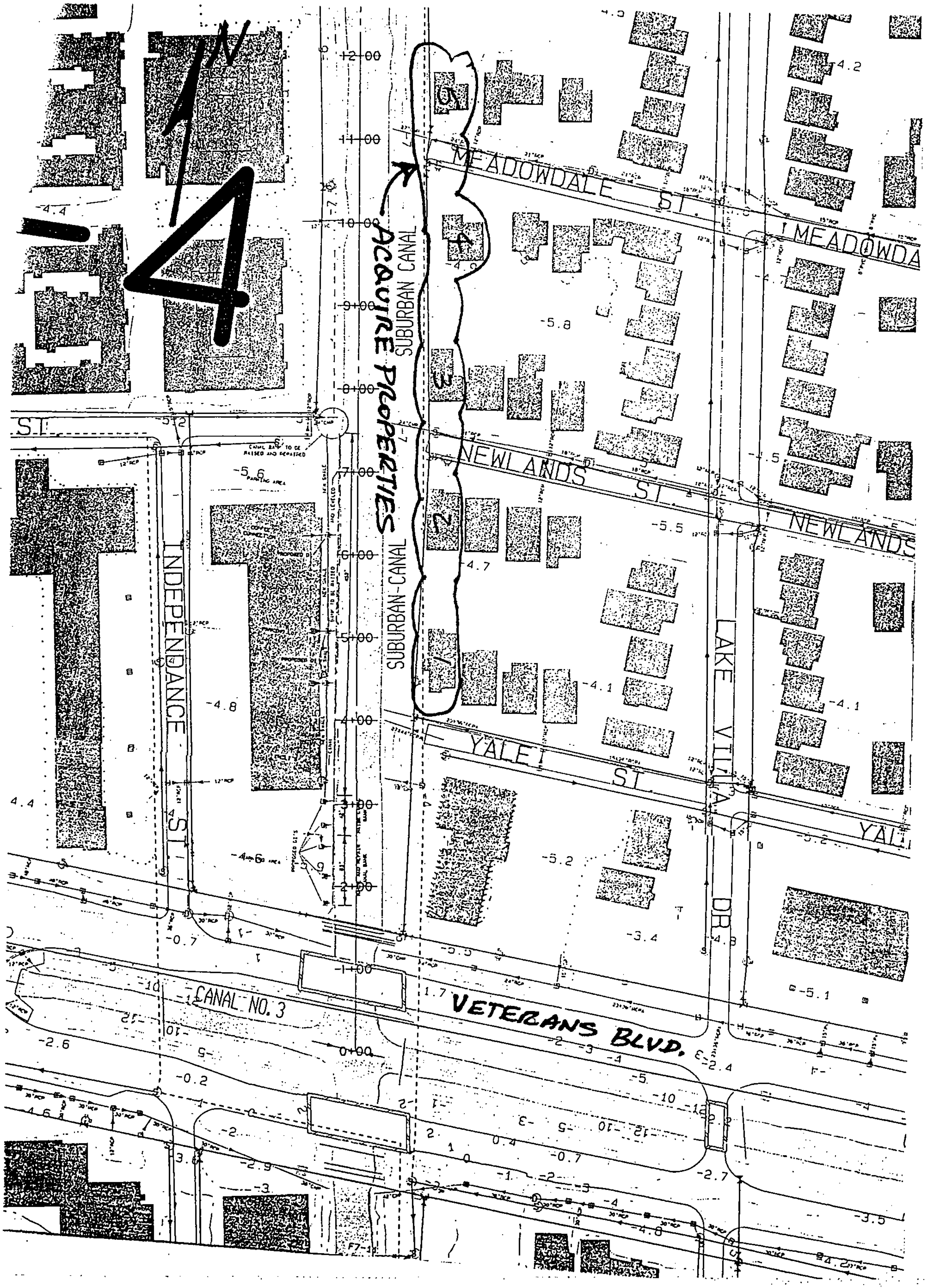
VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-6 PAGE NO: 6 OF 9

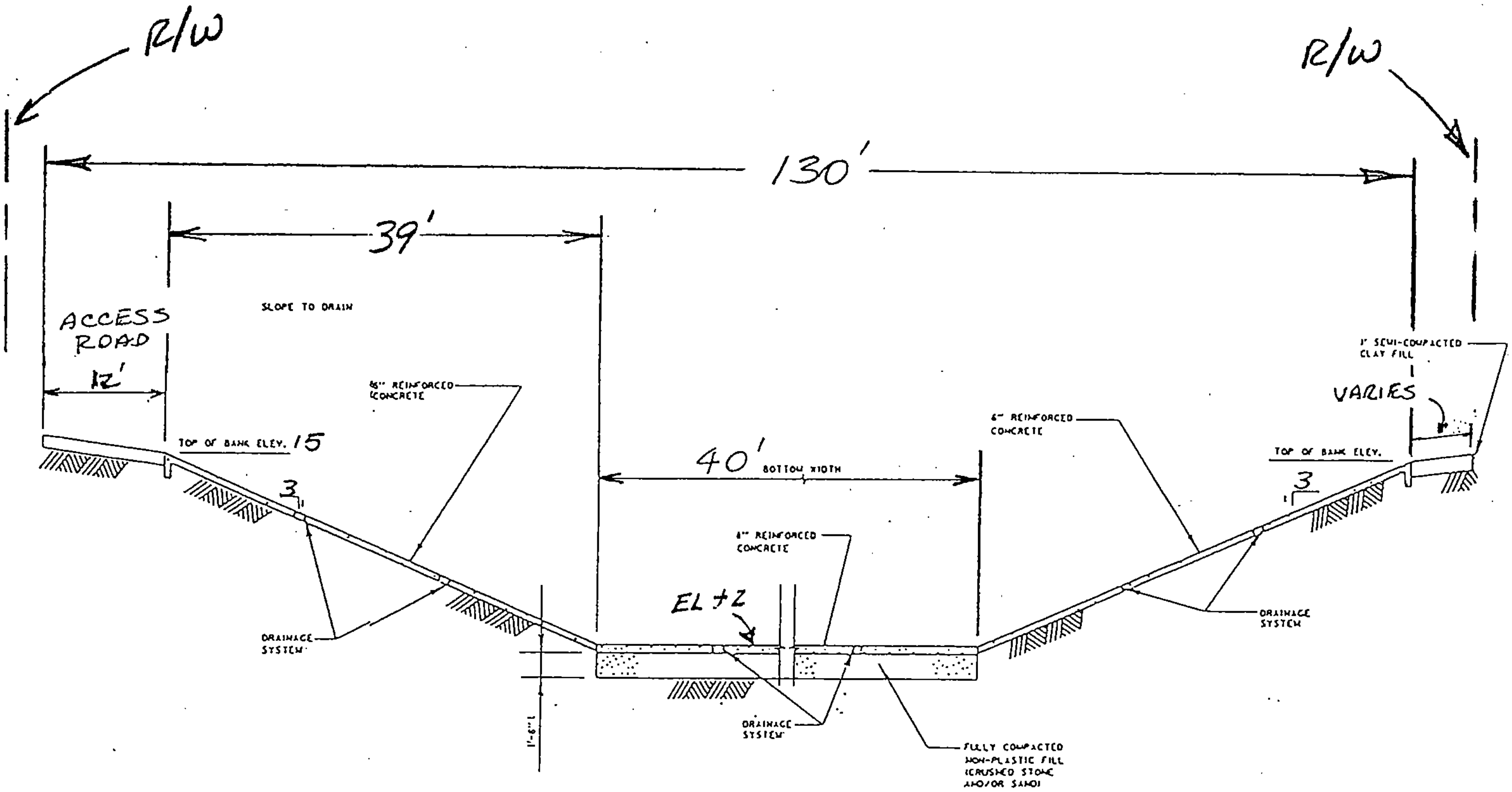
DRAWING NO. 4



DRAWING NO. 5


N
4
ACQUIRE PROPERTIES
1
2
3
4
5
SUBURBAN CANAL
SUBURBAN-CANAL
MEADOWDALE ST
MEADOWDA
NEWLANDS ST
NEWLANDS
YALE ST
YAL
INDEPENDANCE ST
LAKE VILLA DR
CANAL NO. 3
VETERANS BLVD.
12+00
11+00
10+00
9+00
8+00
7+00
6+00
5+00
4+00
3+00
2+00
1+00
0+00
-5.8
-5.5
-4.7
-4.1
-4.8
-5.2
-3.4
-5.1
-2.6
-0.2
-0.7
-2.7

DRAWING NO. 6



TYPICAL SECTION -- SUBURBAN CANAL REACH II

VALUE ENGINEERING PROPOSAL

PROPOSAL NO.: C-7 PAGE NO.: 1 OF 4

DESCRIPTION: Install a "Tensar" Marine Mattress in Lieu of Concrete Paving (Elmwood Canal and Suburban Canal Reach 12)

ORIGINAL DESIGN:

The current design requires a revised trapezoidal channel section on Reaches 12, 31, 32, and 33 consisting of a rip rap invert and side slopes up to El. 6'C. Above El. 6'C on the 3:1 side slope, 6" of reinforced concrete paving is specified to be installed (see Drawing No. 1).

PROPOSED CHANGE:

This proposal recommends that a 9" thick "Tensar" marine mattress be installed on the 3"1 side slopes in lieu of the 6" reinforced concrete paving (see Drawing No. 2).

ADVANTAGES:

Like Rocks

1. Reduces construction costs.
2. Will provide an "N" value similar to concrete. Not the same N Value Concrete
3. Will allow for maintenance vehicles.
4. Will conform to subsurface failures.
5. Will allow vegetation to grow through mattress.

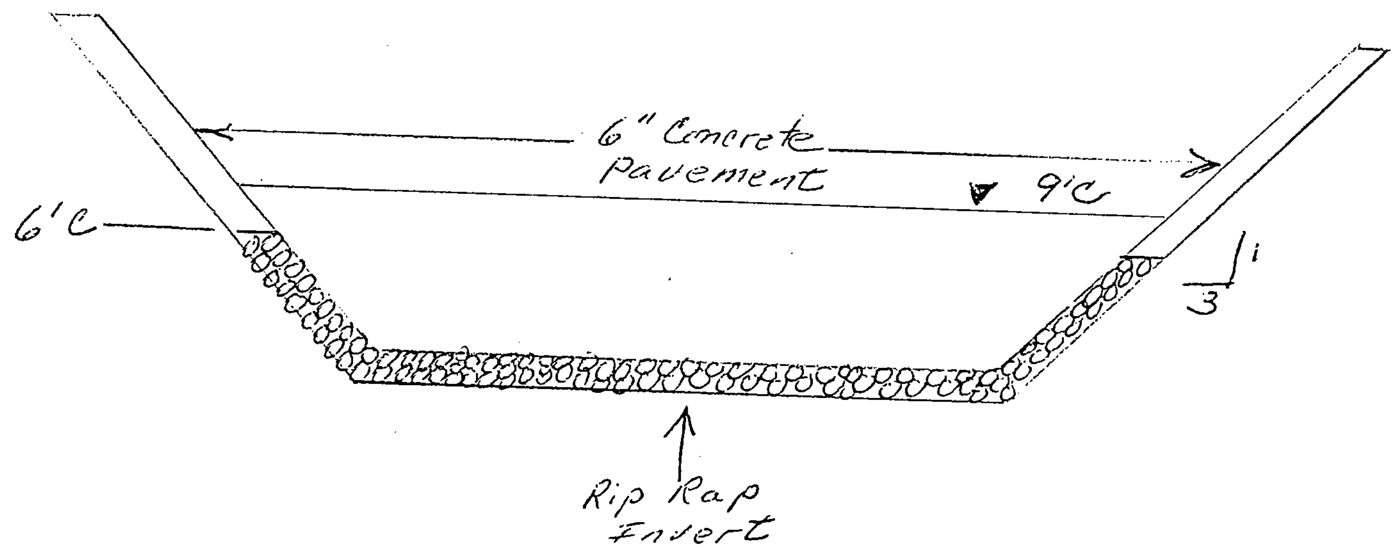
DISADVANTAGES:

May increase maintenance requirements.

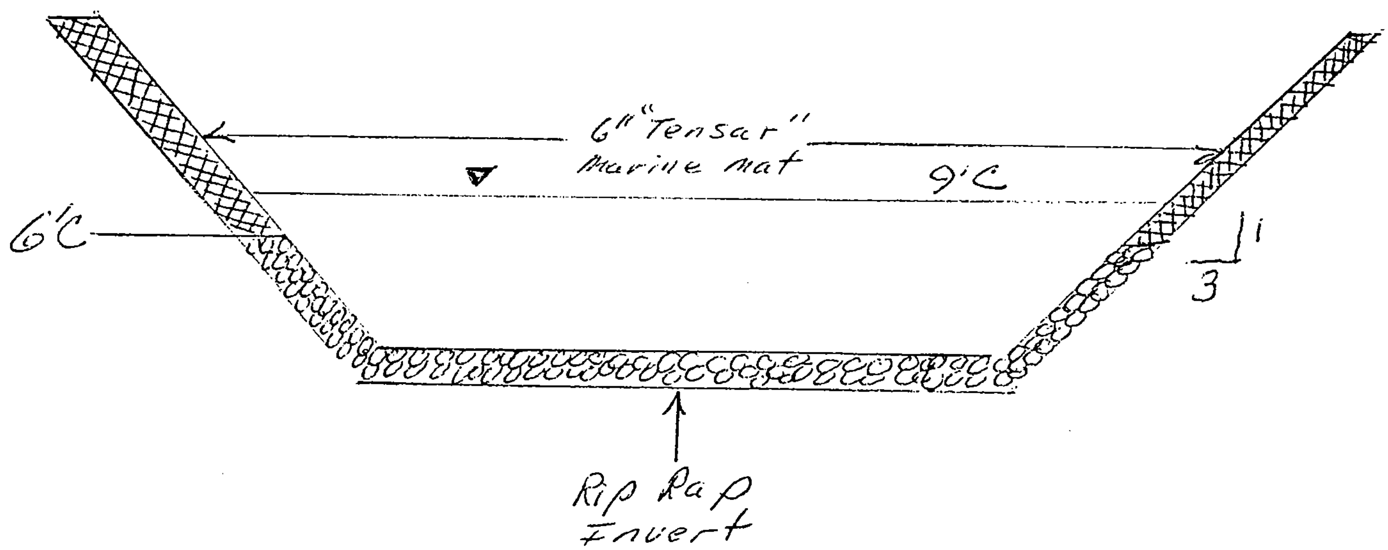
JUSTIFICATION:

This proposal should provide the same basic function of stabilizing the channel side slopes as the current design at a reduced cost. The marine mattress is a flexible, yet rugged, mattress for revetments and erosion protection. Small aggregate is locked within a geogrid structural mattress. The mattress is flexible and is used to replace concrete revetment systems or conventional rip rap without long-term maintenance or re-grading problems. They can be prefabricated and filled with stone off site for ease of installation or they can be constructed on site.

DRAWING NO. 1: ORIGINAL DESIGN DRAWING/SKETCH



DRAWING NO. 2: PROPOSED DESIGN DRAWING/SKETCH



DELETIONS

ITEM	U/M	QTY	COST	UNIT TOTAL
Concrete Pave Reach 12	CY	1,800	$180.00	$324,000
Concrete Pave Reach 31	CY	4,250	180.00	765,000
Concrete Pave Reach 32	CY	4,500	180.00	810,000
Concrete Pave Reach 33	CY	1,100	180.00	198,000
Joint Reach 12	SF	750	2.00	1,500
Joint Reach 31	SF	2,175	2.00	4,350
Joint Reach 32	SF	2,270	2.00	4,540
Joint Reach 33	SF	720	2.00	1,440
Total Deletions				$2,108,830

ADDITIONS

ITEM	U/M	QTY	COST	UNIT TOTAL
Marine Mat Reach 12	SY	7,200	$36.00	$259,200
Marine Mat Reach 31	SY	17,000	36.00	612,000
Marine Mat Reach 32	SY	18,000	36.00	648,000
Marine Mat Reach 33	SY	4,400	36.00	158,400
Filter Cloth	SY	7,200	2.00	14,400
Filter Cloth	SY	17,000	2.00	34,000
Filter Cloth	SY	18,000	2.00	36,000
Filter Cloth	SY	4,400	2.00	8,800
Total Additions				$1,770,000

Net Savings (Deletes - Adds)	$338,030
Markups @ 34%	114,930
Total Savings	$452,960

Markups include 20% contingencies and 12% SIOH.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO.:	C-8	PAGE NO.: 1 OF 4
DESCRIPTION:	Install 3-D Geo-Mat in Lieu of Reinforced Concrete Paving (Elmwood Canal and Suburban Canal Reach 12)	

ORIGINAL DESIGN:

The current design requires a revised trapezoidal channel section on Reaches 12, 31, 32, and 33 consisting of a rip rap invert and side slopes up to El. 6'C. Above El. 6'C on the 3:1 side slope, 6" of reinforced concrete paving is specified to be installed (see Drawing No. 1).

PROPOSED CHANGE:

This proposal recommends that the rip rap be carried up to El. 10'C and a 3-D geo-mat with topsoil/seed be installed up the side slope to the top of the channel (see Drawing No. 2).

ADVANTAGES:

1. Will reduce construction costs.
2. Will help stabilize side slopes.
3. More aesthetically pleasing channel.

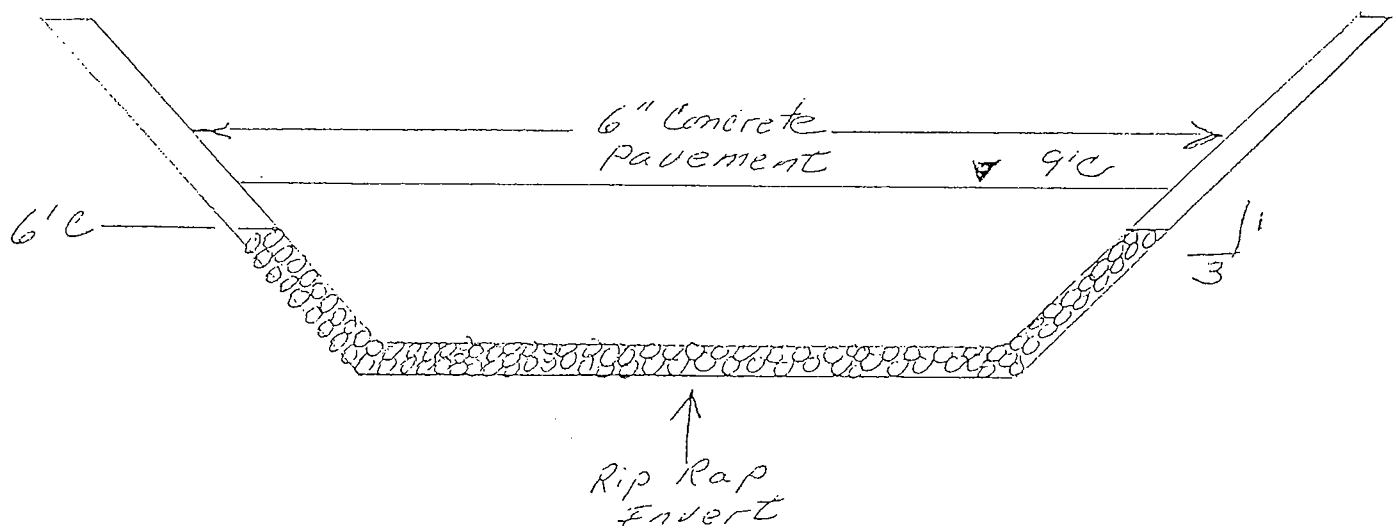
DISADVANTAGES:

1. Will increase "N" value. N is to high
2. Will necessitate maintenance mowing.
3. May have to use roads next to the channel for O&M.

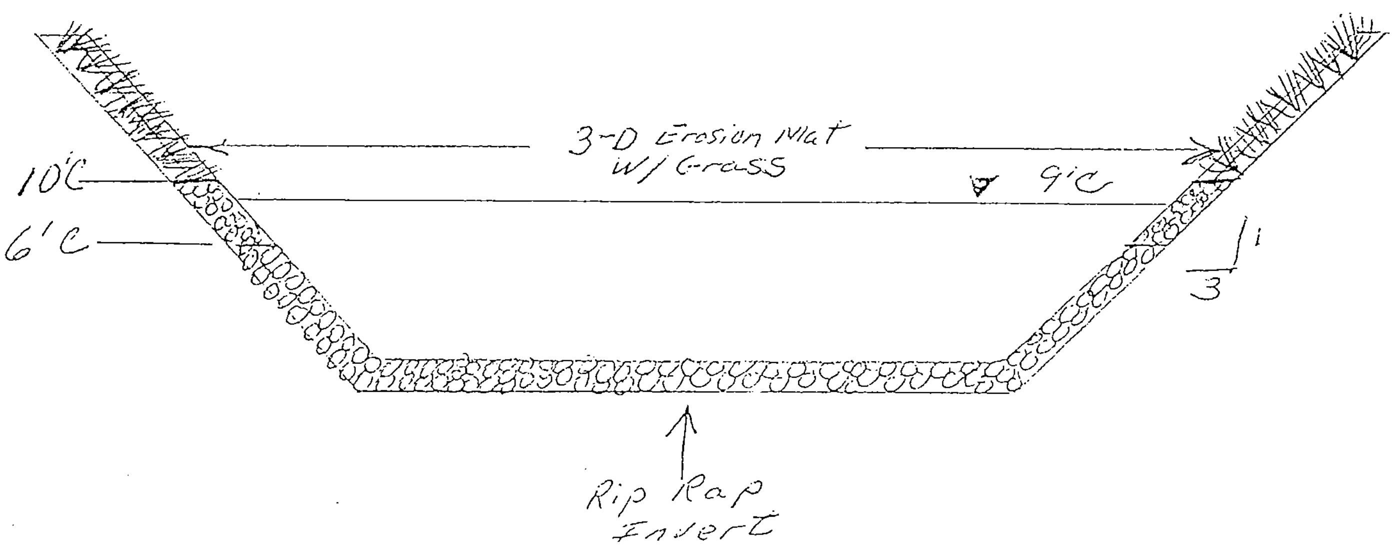
JUSTIFICATION:

This proposal will provide a similar function to the current design at a reduced cost. The 3-D erosion control mat will stabilize the side slopes equal to the concrete paving, but will increase the "N" value of the channel. The rip rap is raised up from El. 6' to 10' and a vegetation (grassed) side slope is not as smooth as concrete. If the "N" value can rise, then, this proposal will allow a more aesthetically pleasing and environmentally attractive channel section.

DRAWING NO. 1: ORIGINAL DESIGN DRAWING/SKETCH



DRAWING NO. 2: PROPOSED DESIGN DRAWING/SKETCH



COST ESTIMATING WORKSHEET

DELETIONS

ITEM	U/M	QTY	COST	UNIT TOTAL
Concrete Pave Reach 12	CY	1,800	$180.00	$324,000
Concrete Pave Reach 31	CY	4,250	180.00	765,000
Concrete Pave Reach 32	CY	4,500	180.00	810,000
Concrete Pave Reach 33	CY	1,100	180.00	198,000
Joint Reach 12	SF	750	2.00	1,500
Joint Reach 31	SF	2,175	2.00	4,350
Joint Reach 32	SF	2,270	2.00	4,540
Joint Reach 33	SF	720	2.00	1,440
Total Deletions				$2,108,830

ADDITIONS

ITEM	U/M	QTY	COST	UNIT TOTAL
Rip Rap Reach 12	CY	2,902	$45.00	$130,590
Rip Rap Reach 31	CY	5,974	45.00	268,830
Rip Rap Reach 32	CY	6,149	45.00	276,705
Rip Rap Reach 33	CY	1,874	45.00	84,330
Geotextile Reach 12	SY	5,311	2.00	10,622
Geotextile Reach 31	SY	11,948	2.00	23,896
Geotextile Reach 32	SY	12,298	2.00	24,596
Geotextile Reach 33	SY	3,130	2.00	6,260
3-D Geo-mat, Reach 12	SY	6,215	5.00	31,075
3-D Geo-mat, Reach 31	SY	15,583	5.00	77,915
3-D Geo-mat, Reach 32	SY	16,042	5.00	80,210
3-D Geo-mat, Reach 33	SY	3,667	5.00	18,335
Total Additions				$1,033,364

Net Savings (Deletes - Adds)	$1,075,466
Markups @ 34%	365,658
Total Savings	$1,441,124

Markups include 20% contingency & 12% SIOH.

PROPOSAL NO: C-9 PAGE NO: 1 OF 4

DESCRIPTION: Use Steel Sheet Pile with Concrete Facing and Gravel Bottom in Lieu of Concrete U-Frame (Suburban Canal Reaches 10B and 11)

ORIGINAL DESIGN:

The current design intent on Suburban Canal is to use a concrete U-Frame in Reach 10B (2,480 LF) and Reach 11 (4,100 LF) (see Drawing No. 1).

PROPOSED DESIGN:

Drive steel sheet pile under a cantilever design approach. Excavate the in situ soil to the desired elevation (approximately El. 0.0 cairo datum). Install helical soil anchors at 5' o.c. with a waler for redundancy on the cantilever design piling. Then place steel mesh on the exposed sheet piling and cover it with a 4"-6" layer of gunite concrete. Then complete the process by placing 2' of gravel bedding/rip rap on top of filter fabric to form the bottom of the canal (see Drawing No. 2).

ADVANTAGES:

1. Reduces construction time.
2. Simplifies overall construction process.
3. Reduces project cost.

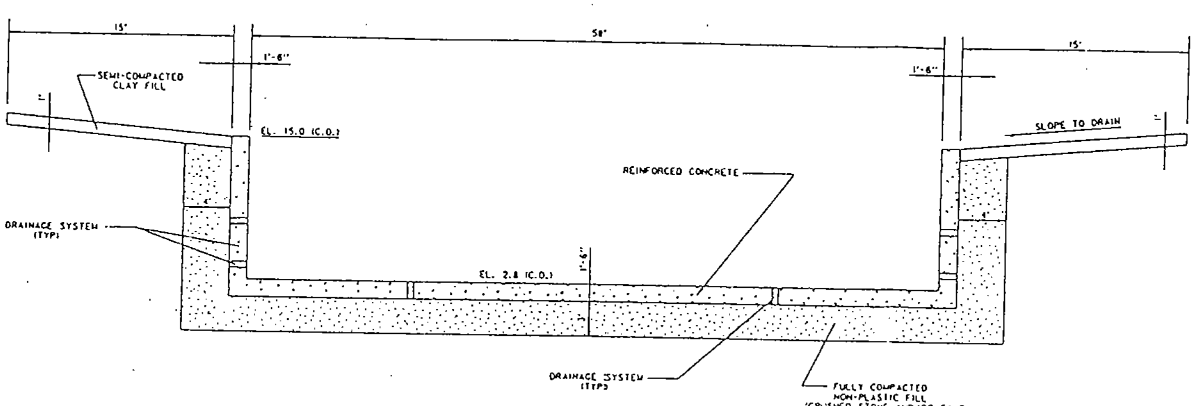
DISADVANTAGES:

Embedment depth of helical anchors may create rights-of-way concerns on Reach 11.

JUSTIFICATION:

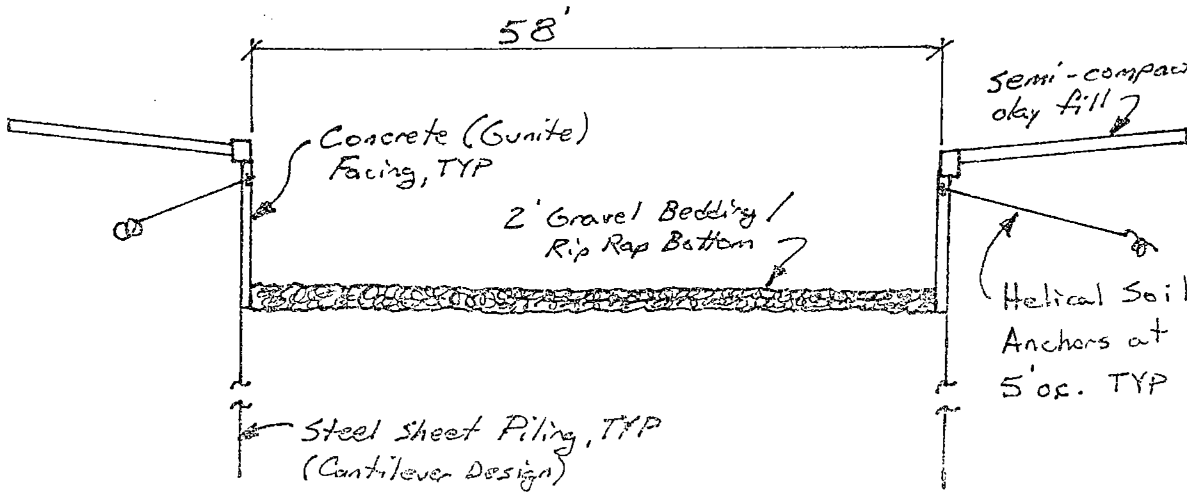
Implementing this proposal will reduce the number of steps required in the construction of each reach. It will provide the same cross-sectional profile with near equal manning's "N" value. In other words, the gravel/rip rap bottom should have minimal impact to flow due to the 13' depth of flow at full canal capacity.

DRAWING NO. 1



SUBURBAN CANAL – REACH 10B, 11

DRAWING NO. 2



can't tie Back into people's Back yard

COST ESTIMATE WORKSHEET

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL	
58' U-Frame in Reaches 10B and 11	LS	1	$19,580,950.00	$19,580,950	4.47 / 10.25 / 14.72
TOTAL DELETIONS				~~$19,580,950~~	15,000,000

ADDITIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
PZ-27 Sheet Pile (60' Long)	SF	789,600	$10.50	$8,290,800
Drive PZ-27	SF	789,600	2.50	1,974,000
Steel Mesh w/gunite	SF	184,240	5.00	921,200
Helical Soil Anchors at 5' o.c. w/waler	EA	2,632	350.00	921,200
2' Gravel Bottom	CY	28,300	25.00	707,500
Excavation	CY	36,800	5.00	184,000
Drainage Fabric	SY	48,300	7.00	338,100
TOTAL ADDITIONS				$13,336,800

Net Savings (Deletes - Adds)	$6,244,150	1,300,000
Markups 34.40%	2,147,988	
TOTAL SAVINGS	$8,392,138	

Markups include contingency (20%) and construction management (12%).

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-10 PAGE NO: 1 OF 4

DESCRIPTION: Use Prestressed Concrete Sheet Pile and Gravel Bottom in Lieu of Concrete U-Frame (Suburban Canal Reaches 10B and 11)

ORIGINAL DESIGN:

The current design intent on Suburban Canal is to use a concrete U-Frame in Reach 10B (2,480 LF) and Reach 11 (4,100 LF) (see Drawing No. 1).

PROPOSED DESIGN:

Drive prestressed concrete sheet pile under a cantilever design approach. Excavate the in situ soil to the desired elevation (approximately El. 0.0 cairo datum). Then complete the process by placing 2' of gravel bedding/rip rap on top of filter fabric to form the bottom of the canal (see Drawing No. 2).

ADVANTAGES:

1. Reduces construction time.
2. Simplifies overall construction process.
3. Reduces project cost.

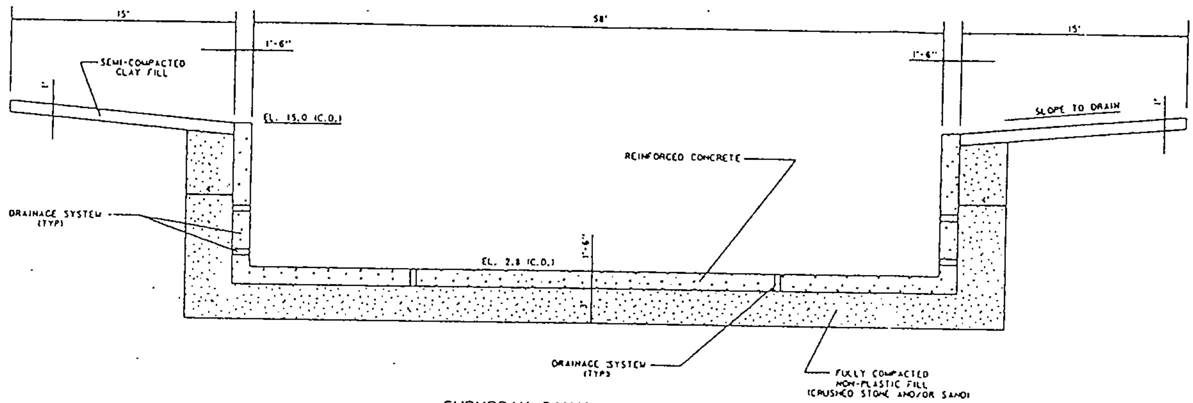
DISADVANTAGES:

None known.

JUSTIFICATION:

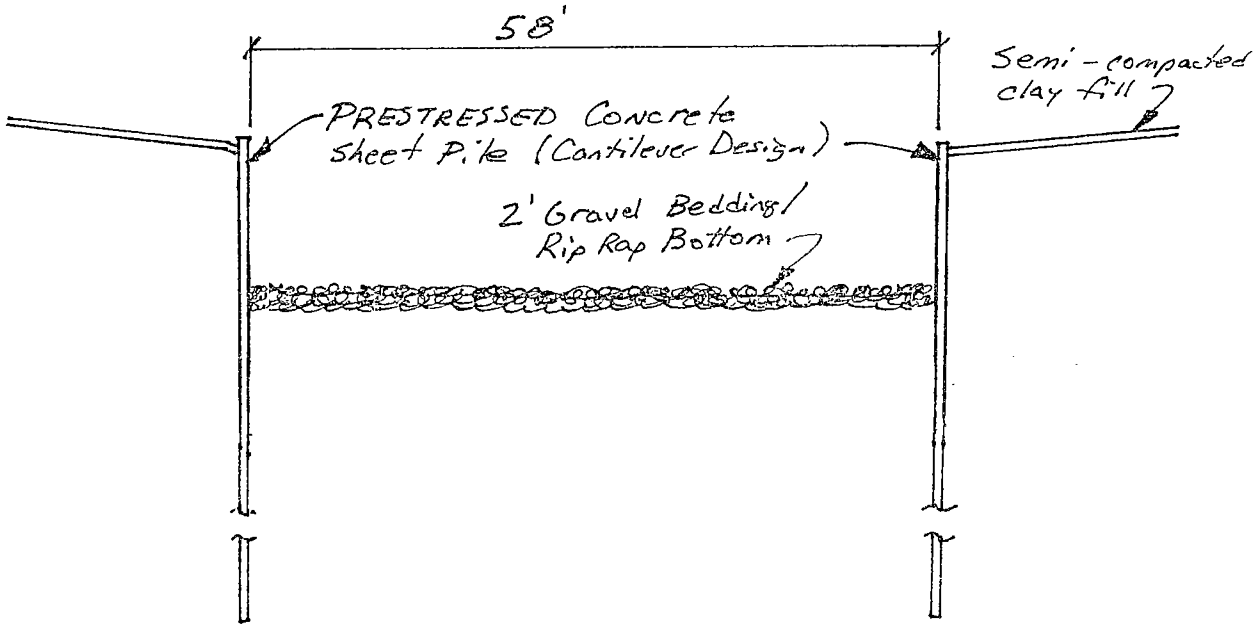
Implementing this proposal will reduce the number of steps required in the construction of each reach. It will provide the same cross-sectional profile with near equal manning's "n" value. In other words, the gravel/rip rap bottom should have minimal impact to flow due to the 13' depth of flow at full canal capacity.

DRAWING NO. 1



SUBURBAN CANAL – REACH 10B, 11

DRAWING NO. 2


58'
Semi-compacted clay fill
PRESTRESSED Concrete sheet Pile (Cantilever Design)
2' Gravel Bedding/ Rip Rap Bottom

COST ESTIMATE WORKSHEET

PROPOSAL NO: C-10

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL	
58' U-Frame in Reaches 10B and 11	LS	1	$19,580,950.00	$19,580,950	15,000,000
TOTAL DELETIONS				$19,580,950	15,000,000

ADDITIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
Sheet Pile (60' Long)	SF	789,600	$14.00	$11,054,400
Drive Sheet Pile	SF	789,600	4.00	3,158,400
2' Gravel Bottom	CY	28,300	25.00	707,500
Excavation	CY	36,800	5.00	184,000
Drainage Fabric	SY	48,300	7.00	338,100
TOTAL ADDITIONS				$15,442,400

Net Savings (Deletes - Adds)	$4,138,550
Markups 34.40%	1,423,661
TOTAL SAVINGS	$5,562,211

Markups include contingency (20%) and construction management (12%).

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-11 PAGE NO: 1 OF 5

DESCRIPTION: Use New Pump Station/Force Main in Suburban Canal in Lieu of All Channel and Pump Station Work

ORIGINAL DESIGN:

U-Frame channel modification, reach trapezoidal change modification. Reach 2,400 CFS P.S. addition at Suburban.

PROPOSED DESIGN:

Use 1,000 CFS pump station at Suburban and I-10 W. (1) 9' diameter force main located under centerline of canal; discharge via modified outfall at Suburban P.S. Install bank erosion protection on Reach 10B.

ADVANTAGES:

1. Smaller pump station capacity needed to lower flood stages given location of new station (must be computer modeled to verify).
2. Eliminates all canal and P.S. work on Suburban system.

DISADVANTAGES:

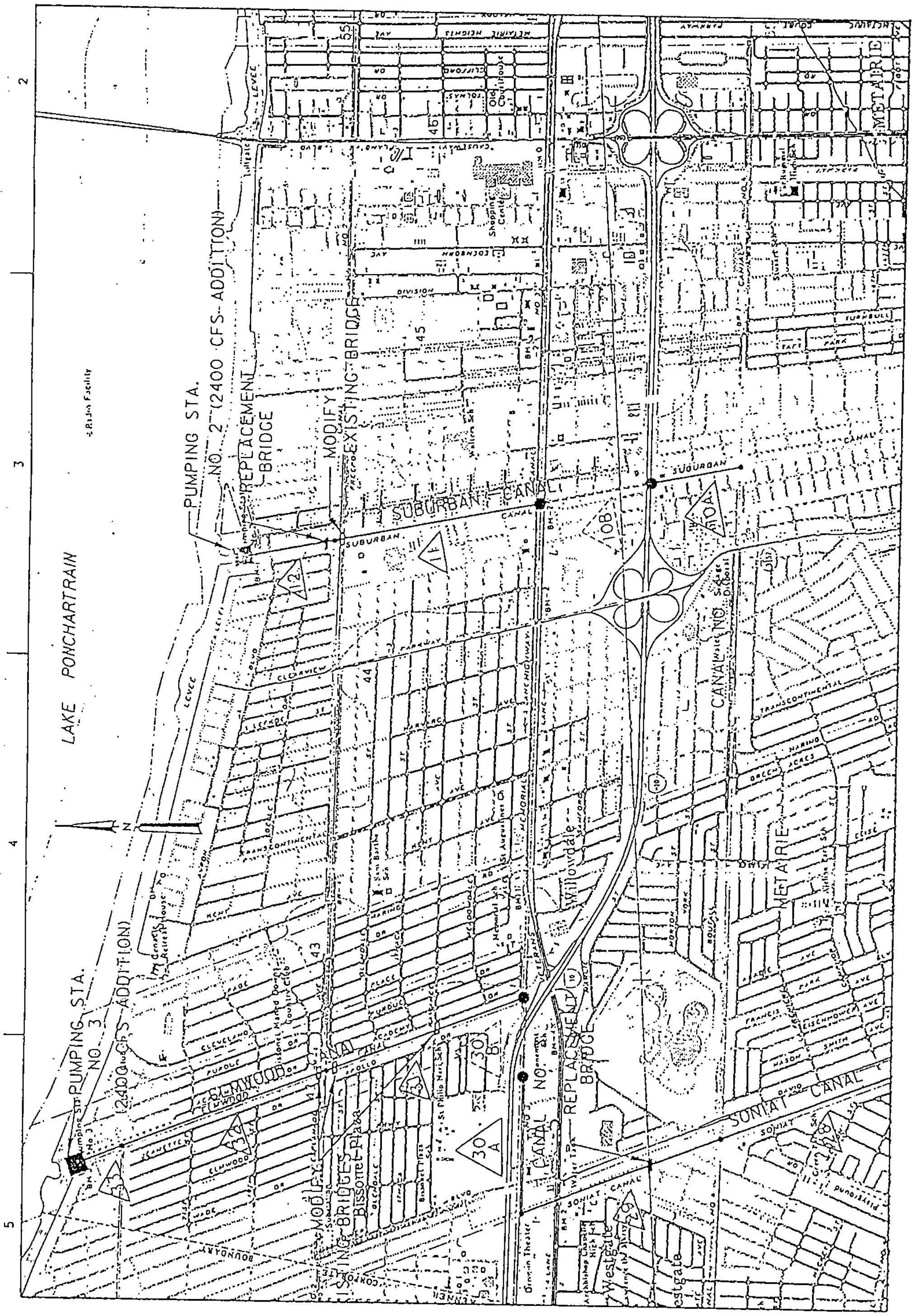
1. Addition of a major pump station to system; associated O&M.
2. Continued O&M on (grass) Suburban Canal.
3. Some residential disruption with new P.S.

JUSTIFICATION:

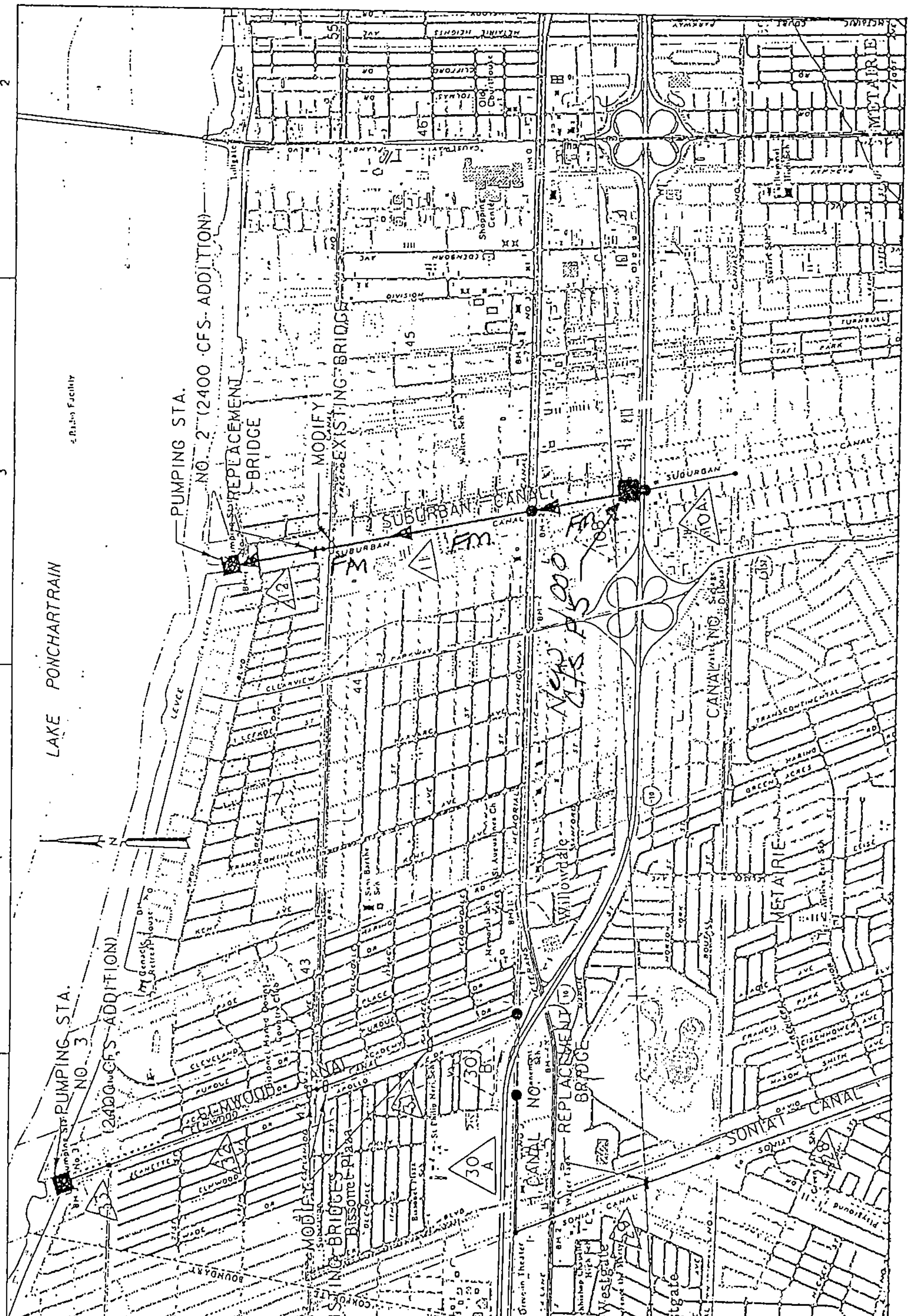
This pumping alternative becomes more attractive when considering the "U"-Frame channel. Cost savings are significantly less if alternate channel designs are used.

Note: Pump station capacity and F.M. size should be modified as per results of H&H computer modeling.

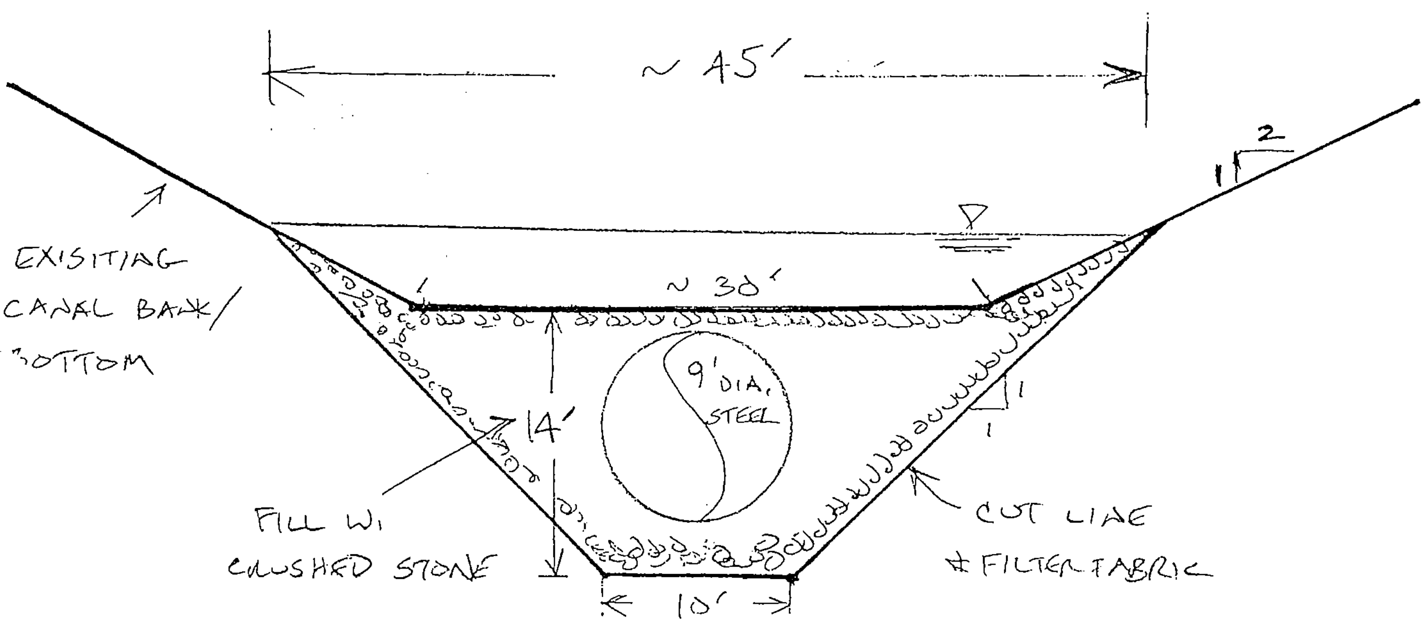
DRAWING NO. 1


PUMPING STA. NO. 2 (2400 CFS ADDITION)
REPLACEMENT BRIDGE
MODIFY EXISTING BRIDGE
SUBURBAN CANAL
LAKE PONCHARTRAIN
PUMPING STA. NO. 3 (2400 CFS ADDITION)
MODIFY EXISTING BRIDGES
REPLACEMENT BRIDGE
SONIAT CANAL
METAIRIE

DRAWING NO. 2


PUMPING STA. NO. 2 (2400 CFS ADDITION)
REPLACEMENT BRIDGE
MODIFY EXISTING BRIDGE
SUBURBAN CANAL
LAKE PONCHARTRAIN
PUMPING STA. NO. 3 (2400 CFS ADDITION)
SONIAT CANAL
METAIRIE

DRAWING NO. 3



PROPOSED SECTION

1" = 10'

COST ESTIMATE WORKSHEET

PROPOSAL NO: C-11

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
2,400 CFS Pump Station Increase at Suburban				$12,670,000
(1) P.S. O&M (PW)				1,620,000
Channel Mod Reach 10B & Channel Mod Reach 11	LS	1	19,580,950.00	19,580,950
Channel Mod Reach 12	LS	1	1,587,220.00	1,587,220
TOTAL DELETIONS				$35,458,170

ADDITIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
(1,000 CFS Pump Station [5] 250 CFS, 2,000 HP mixed flow pump units)	EA	1	$6,500.00/CFS	~~$6,500,000~~
(2) P.S. O&M (PW)			1,350,000.00	1,350,000
9' Dia F.M.	LF	7,200		11,700,000
Outfall	EA	1	300,000.00	300,000
Real Estate (for P.S.)	AC	1	4,500,000.00	1,000,000
(3) Canal O&M (PW)				100,000
Erosion Protection on Reach 10B	LF	2,480	1,000.00	2,480
TOTAL ADDITIONS				$23,434,000

Net Savings (Deletes - Adds)	$12,028,170
Markups 34%	4,089,578
TOTAL SAVINGS	$16,117,748

Markups include 20% contingencies and 12% SIOH.

(1)	2,400 CFS X $50/CFS/YR X 13.5	=	$1,620,000
(2)	1,000 CFS X $100/CFS/YR X 13.5	=	$350,000
(3)	15 AC X $500/AC/YR X 13.5	=	$101,250

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-12 PAGE NO: 1 OF 5

DESCRIPTION: Use New Pump Station/Force Main in Suburban Canal in Lieu of All Channel and Pump Station Work; Place F.M. Under Roadway -- Lake Villa Avenue

ORIGINAL DESIGN:

U-Frame channel modification, reach trapezoidal change modification. Reach 2,400 CFS P.S. addition at Suburban.

PROPOSED DESIGN:

Use 1,000 CFS pump station at Suburban and I-10 W. (1) 9' diameter force main located under centerline of canal; discharge via modified outfall at Suburban P.S. except place (1) 9' diameter force main under Lake Villa Avenue corridor (8,000 LF). Install erosion protection on Reach 10B.

1. Smaller pump station capacity needed to lower flood stages given location of new station (must be computer modeled to verify).
2. Eliminates all canal and P.S. work on Suburban system.

DISADVANTAGES:

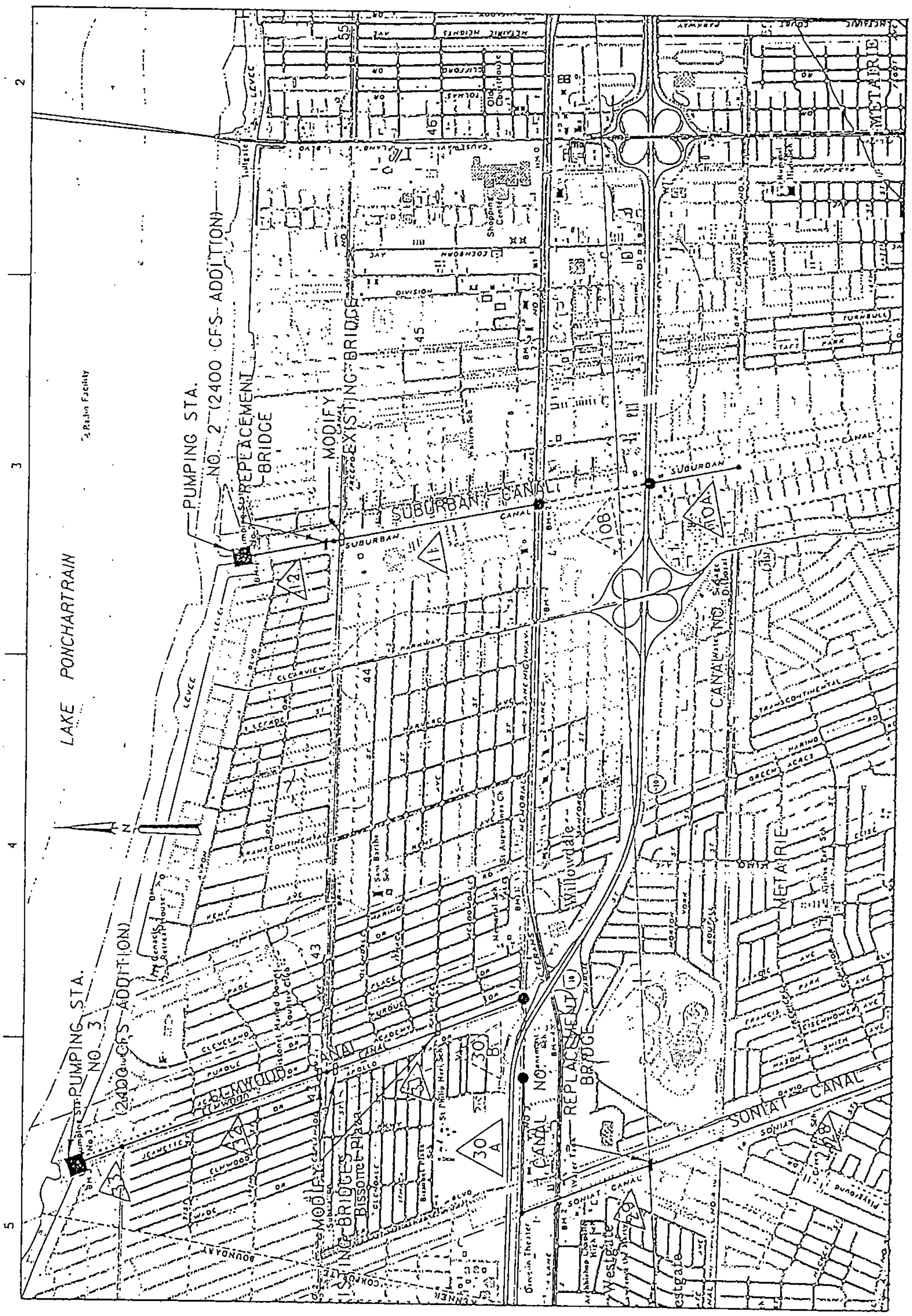
1. Addition of a major pump station to system; associated O&M.
2. Continued O&M on (grass) Suburban Canal.
3. Some residential disruption with new P.S.
4. Residential disruption caused by F.M. installation.

JUSTIFICATION:

This pumping alternative becomes more attractive when considering the "U"-Frame channel. Cost savings are significantly less if alternate channel designs are used.

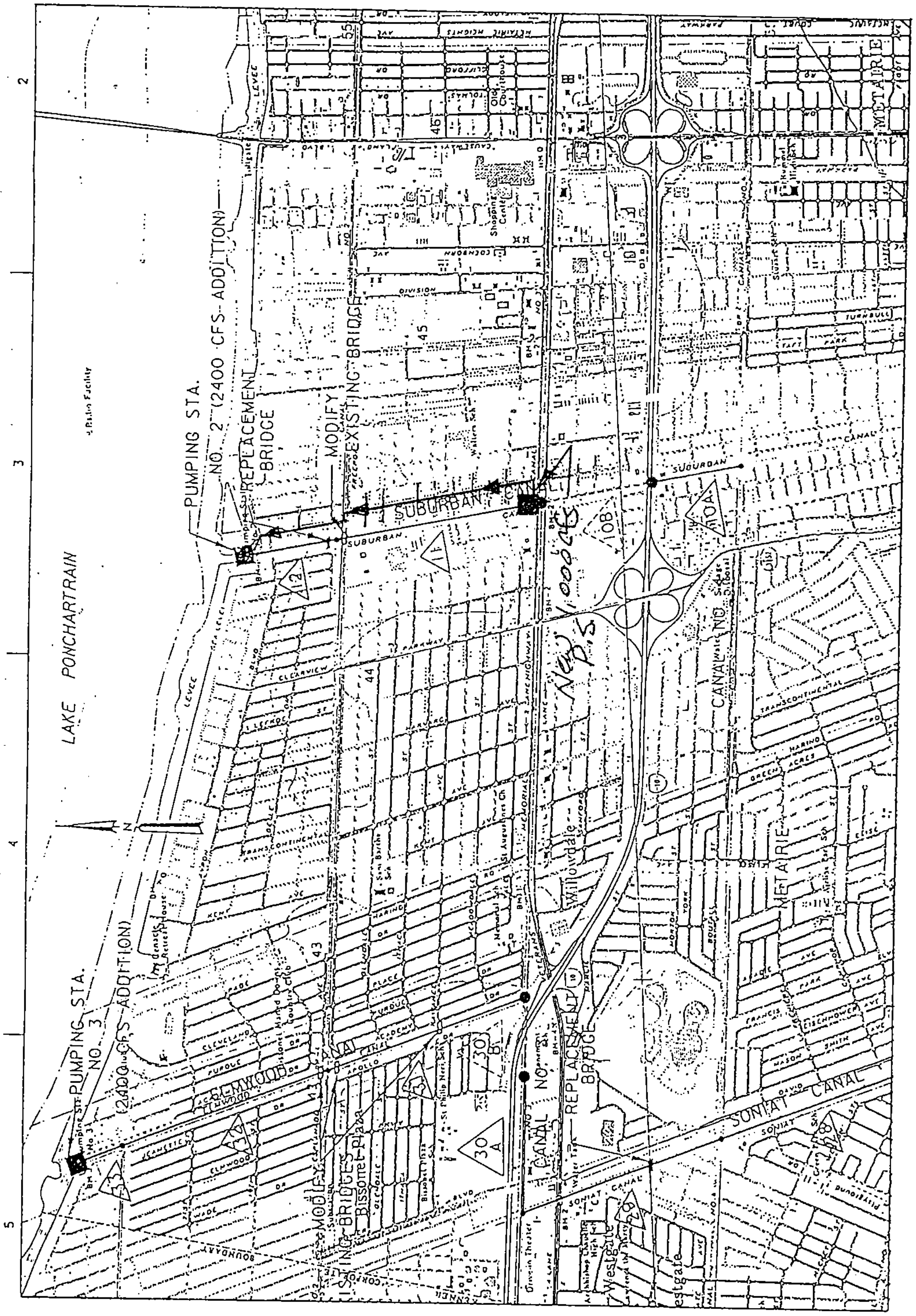
Note: Pump station capacity and F.M. size should be modified as per results of H&H computer modeling.

DRAWING NO. 1

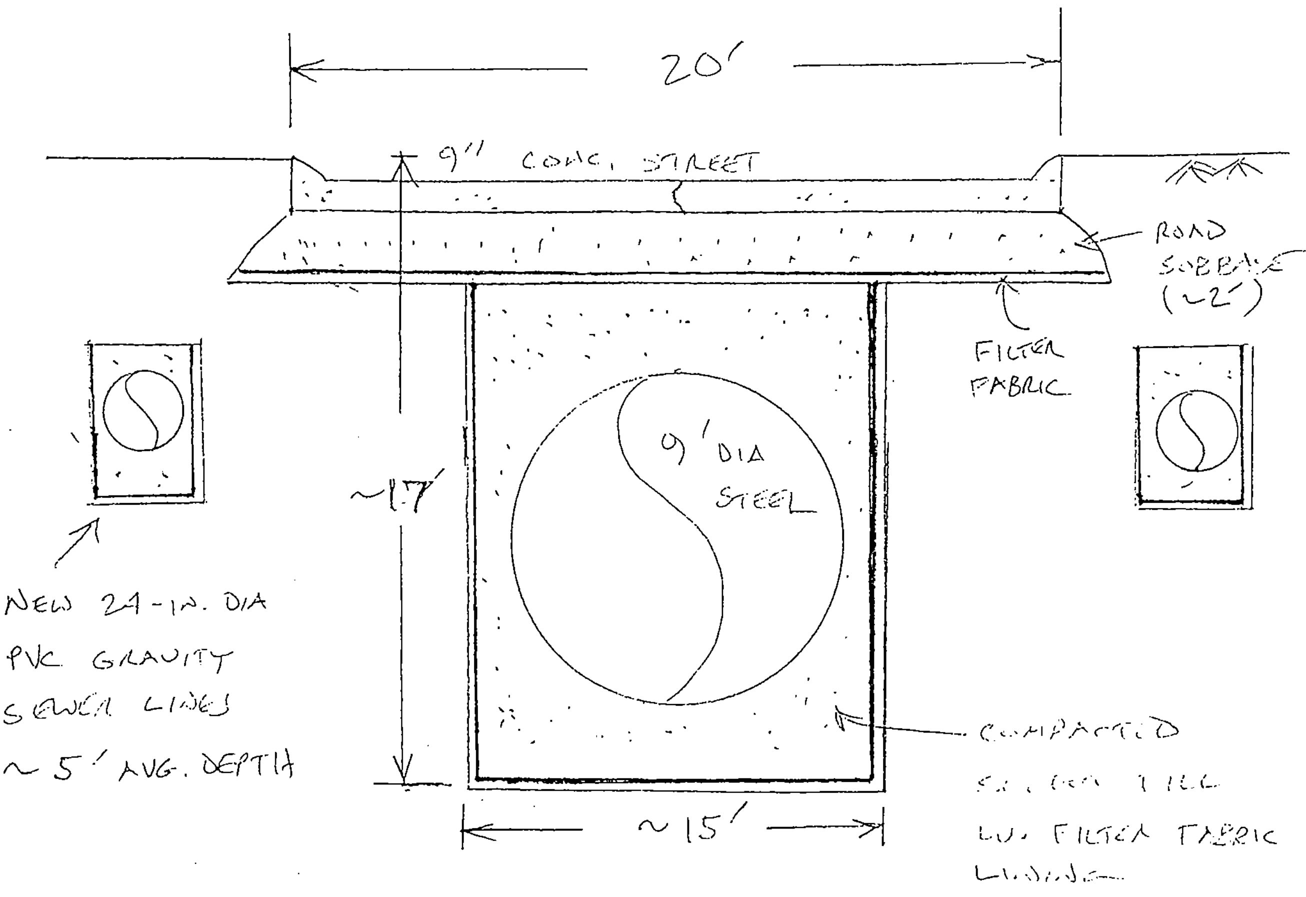


PUMPING STA. NO. 2 (2400 CFS ADDITION)
REPLACEMENT BRIDGE
MODIFY EXISTING BRIDGE
SUBURBAN CANAL
LAKE PONCHARTRAIN
PUMPING STA. NO. 3 (2400 CFS ADDITION)
ELMWOOD CANAL
MODIFY EXISTING BRIDGES
REPLACEMENT BRIDGE
SONIAT CANAL
METAIRIE

DRAWING NO. 2


LAKE PONCHARTRAIN
PUMPING STA. NO. 2 (2400 CFS ADDITION)
REPLACEMENT BRIDGE
MODIFY EXISTING BRIDGE
SUBURBAN
NEW P.S. 1,000 CFS
PUMPING STA. NO. 3 (2400 CFS ADDITION)
MODIFY EXISTING BRIDGES
CANAL NO. 3
REPLACEMENT BRIDGE
SONIAT CANAL
METAIRIE
LEVEE

DRAWING NO. 3



PROPOSED SECTION

1" = 5'

COST ESTIMATE WORKSHEET

PROPOSAL NO: C-12

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
2,400 CFS Pump Station Increase at Suburban				$12,670,000
(1) P.S. O&M (PW)				1,620,000
Channel Mod Reach 10B & Channel Mod Reach 11	LS	1	$19,580,950.00	$19,580,950
Channel Mod Reach 12	LS	1	1,587,220.00	1,587,220
TOTAL DELETIONS				$35,458,170

ADDITIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
(1,000 CFS Pump Station [5] 250 CFS, 2,000 HP mixed flow pump units)	EA	1	$6,500.00/CFS	$6,500,000
(2) P.S. O&M (PW)			1,350,000.00	1,350,000
9' Dia F.M.	LF	7,200		11,700,000
Outfall	EA	1	300,000.00	300,000
Real Estate (for P.S.)	AC	1	1,000,000	1,000,000
(3) Canal O&M (PW)				100,000
9' Dia F.M. at Roadway	LF	8,000		11,350,000
Canal No. 2 Crossing	LF	300	1,200.00	360,000
Canal No. 3 Crossing	LF	300	1,200.00	360,000
Other Utility Relocation	LS	1	200,000.00	200,000
Erosion Protection Reach 10B	LF	2,480	1,000.00	2,480,000
TOTAL ADDITIONS				$25,800,000
Net Savings (Deletes - Adds)				$9,658,170
Markups 34%				3,778
TOTAL SAVINGS				$12,941,948

Markups include 20% contingencies and 12% SIOH.

(1)	2,400 CFS X $50/CFS/YR X 13.5	=	$1,620,000
(2)	1,000 CFS X $100/CFS/YR X 13.5	=	$350,000
(3)	15 AC X $500/AC/YR X 13.5	=	$101,250

VALUE ENGINEERING PROPOSAL

PROPOSAL NO:	C-13	PAGE NO: 1 OF 5
DESCRIPTION:	Use New Pump Station and Force Mains at Canal No. 3 and Soniat; Install Erosion Protection on Canal No. 3 (I-10 to Duncan) and Soniat (W. Napoleon to Canal No. 3); Eliminate Channel and Pump Station Work on Elmwood, Soniat (W. Metairie to W. Napoleon)	

ORIGINAL DESIGN:

The following features currently provided are proposed to be eliminated by this proposal:

2,400 CFS addition to Elmwood P.S.
Channel modifications: Soniat -- W. Metairie to Canal No. 3.
Canal No. 3 -- Soniat to I-10
Elmwood -- Canal No. 3 to P.S. (All)

PROPOSED DESIGN:

New 1,800 CFS P.S. located at Canal No. 3 and Soniat; (2) 9' diameter steel pipe force mains under Power Boulevard all the way to lake (12,000'). Grade existing slopes to 1 on 3 and install geo-mat with rock bottom on Soniat Canal -- W. Napoleon to Canal No. 3 and Canal No. 3 13,800' west of Soniat and 3,100' east of Soniat (16,900 total). Eliminate all other work on Soniat, Canal No. 3, and Elmwood -- including Elmwood P.S.

ADVANTAGES:

*1. Smaller pump station capacity needed to lower flood stages given location of new station (must be computer modeled to verify).
2. Eliminate all canal and pump station work on Elmwood; reduce canal work on Soniat and No. 3.

DISADVANTAGES:

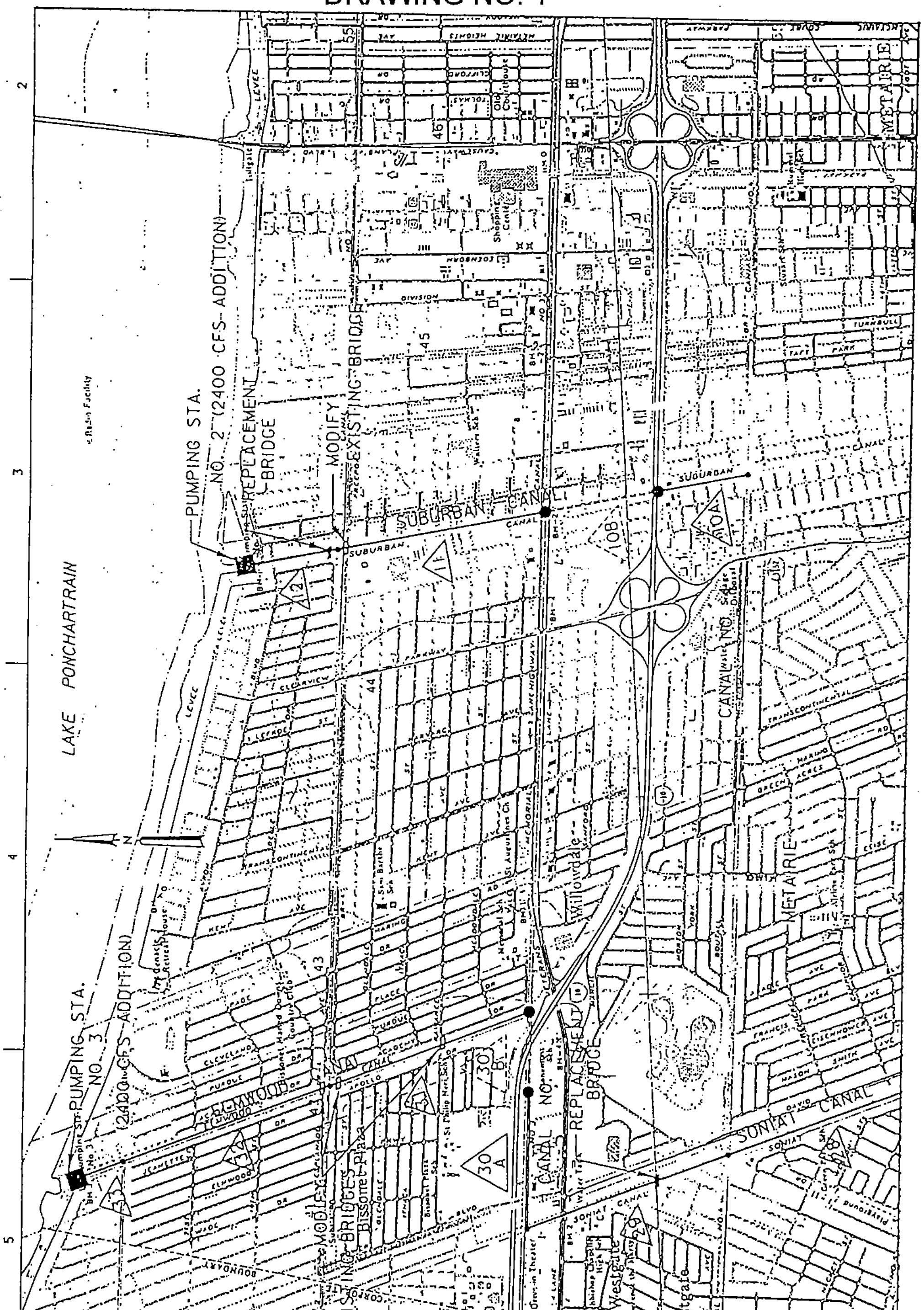
1. Addition of major pump station to system; association O&M.
2. Continued O&M on Soniat, Canal No. 3, and Elmwood Canals.
3. Traffic disruption on Power Boulevard.
4. Aesthetics and safety concerns of new outfall in lake.

JUSTIFICATION:

This pumping alternative becomes more attractive when considering the "U"-Frame channel. Cost savings are significantly less if alternate channel designs are used.

*Note: Station capacity/F.M. size should be modified as per results of computer H&H model.

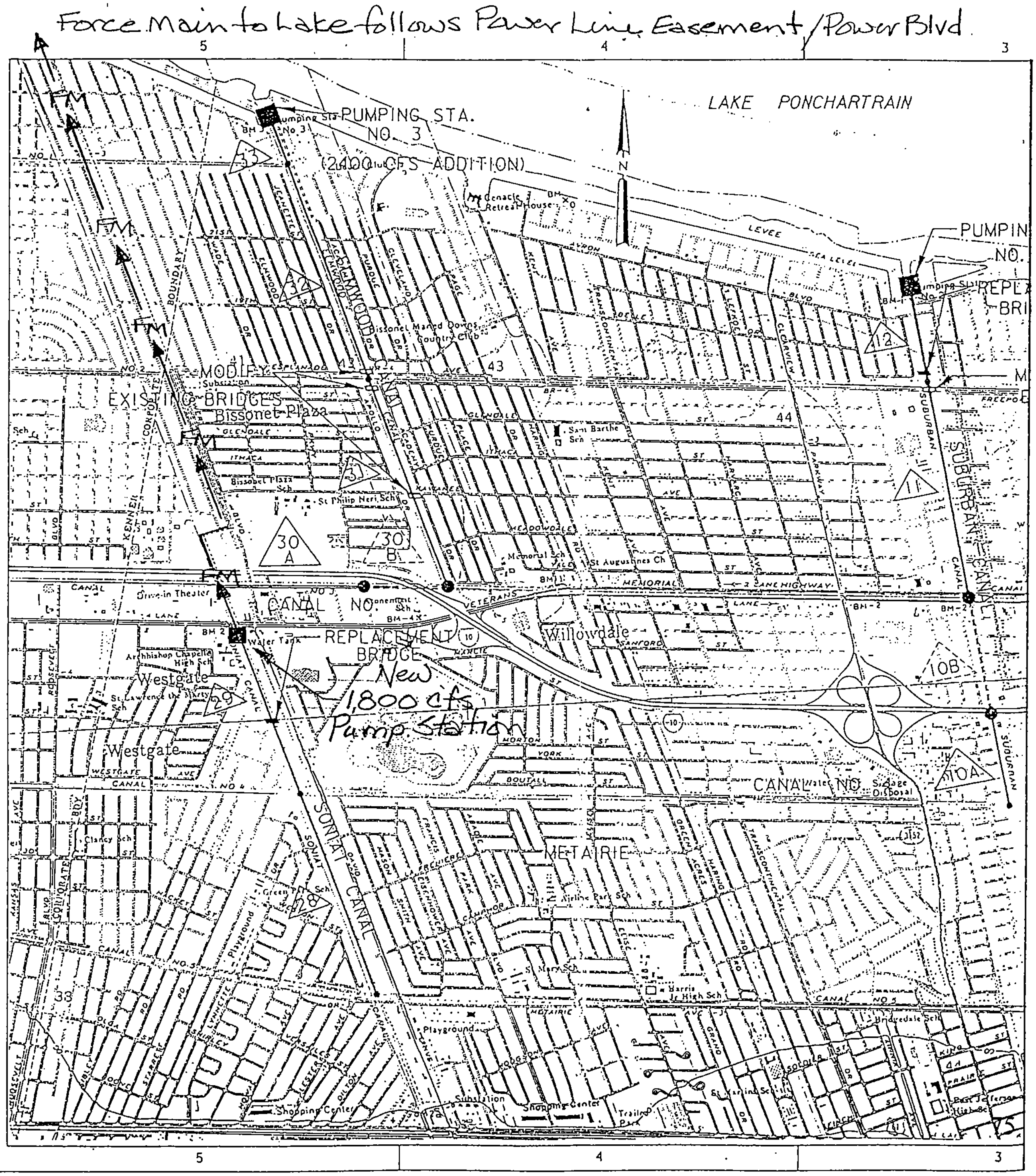
DRAWING NO. 1


PUMPING STA. NO. 2 (2400 CFS ADDITION)
REPLACEMENT BRIDGE
MODIFY EXISTING BRIDGE
SUBURBAN CANAL
LAKE PONCHARTRAIN
PUMPING STA. NO. 3 (2400 CFS ADDITION)
REPLACEMENT BRIDGE
SONIAT CANAL
METAIRIE

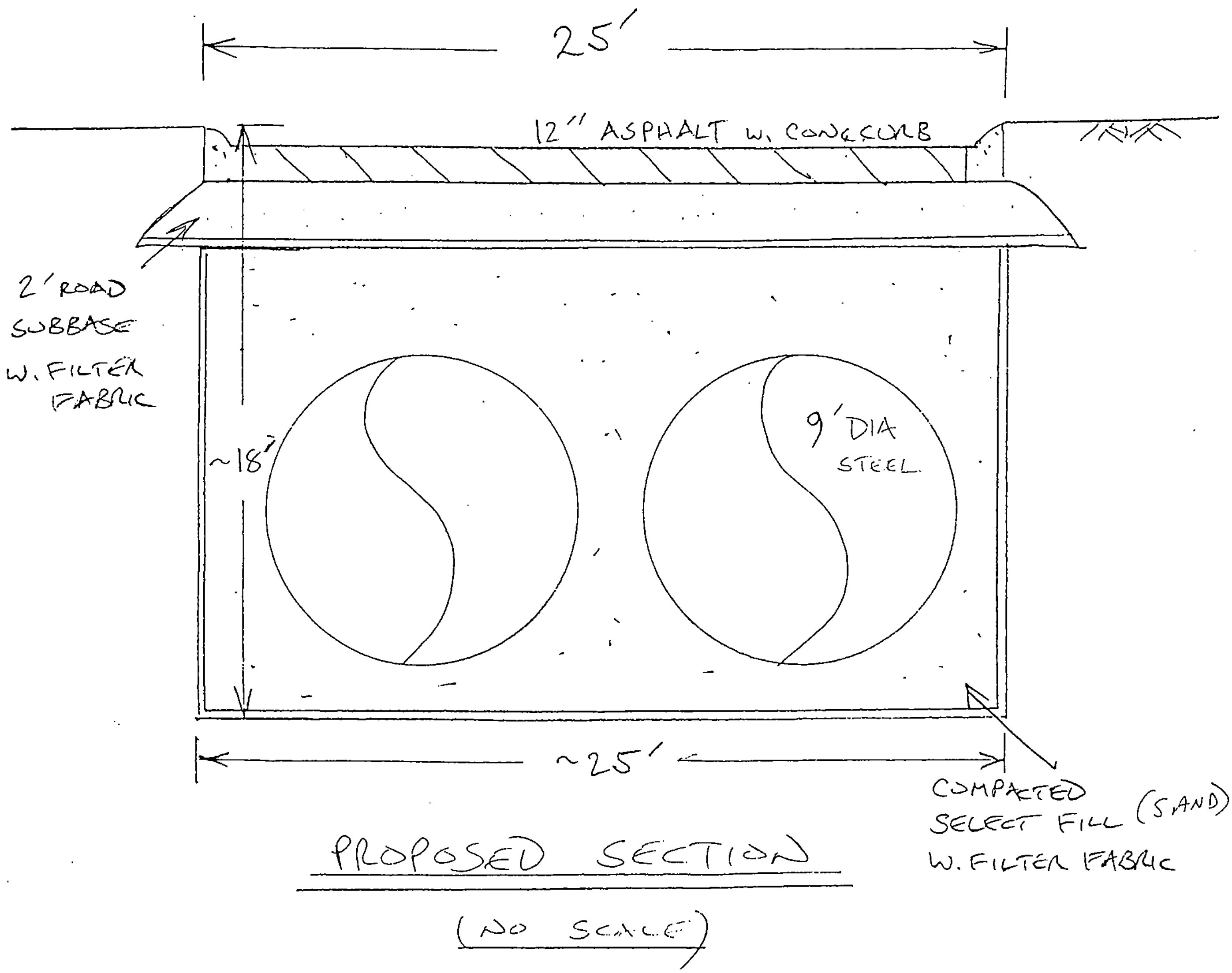
VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-13 PAGE NO: 3 OF 5

DRAWING NO. 2



DRAWING NO. 3


25'
12" ASPHALT W. CONC CURB
2' ROAD SUBBASE W. FILTER FABRIC
~18'
9' DIA STEEL
~25'
COMPACTED SELECT FILL (SAND) W. FILTER FABRIC
PROPOSED SECTION
(NO SCALE)

COST ESTIMATE WORKSHEET

PROPOSAL NO: C-13 | PAGE NO: 5 OF 5

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL	
2,400 CFS Pump Station					
Increase at Elmwood	LS	1	$12,670,000.00	$12,670,000	
P.S. Added O&M	LS	1	1,620,000.00	1,620,000	
Channel Modifications:					
All Soniat	LS	1	34,594,100.00	~~34,594~~,100	20,000,00
Canal No. 3					
-- Soniat to I-10	LS	1	17,180,364.00	17,180364	
All Elmwood	LS	1	6,529,621.00	6,529,621	
TOTAL DELETIONS				$72,594,085	1Y

ADDITIONS

ITEM	U/M	QTY	UNIT COST	TOTAL	
(1,800 CFS P.S. - (8)			10,000 To Low		
250 CFS 2,000 HP					
Mixed Flow Pumps)	LS	1	$6,000.00/cfs	$10,800,000	18,000,000
(2) P.S. O&M (PW)				2,430,000	
(2) 9' Dia F.M. w/ Roadway	LF	7,500\			
(2) 9' Dia F.M. w/o Road	LF	4,500/	Combined	28,100,000	
I-10 Crossing	EA	(2)	750,000.00	1,500,000	
Canal No. 2 Crossing	LF	300	1,500.00	450,000	
Canal No. 1 Crossing LF	400	1,500	600,000.00		
Outfall (New)	LS	1	1,000,000.00	1,000,000	
Real Estate for P.S. AC	1	500,000	500,000.00		
Other Utility Relocations	LS	1	1,000,000.00	$1,000,000	
(3) Soniat, Canal No. 3, and					
Elmwood Canal O&M (PW)	LS	1	348,000.00	358,000	
Re-grade Canal	CY	75,000	3.00	225,000	
Slopes	LF	16,900			
Geo-Mat/M____	SY	141,000	6.25	881,000	
Crushed Stone	TN	128,000	19.50	2,500,000	
TOTAL ADDITIONS				$50,324,000	8

Net Savings (Deletes - Adds)	$22,270,085
Markups 34%	7,571,829
TOTAL SAVINGS	$29,841,914

Markups include 20% contingencies and 12% SIOH..

(1) 2,400 CFS X $50/CFS/YR X 13.5 = $1,620,000

(2) 1,800 CFS X $100/CFS/YR X 13.5 = $2,430,000

(3) 50 AC X $500/AC/YR X 13.5 = $338,000

VALUE ENGINEERING PROPOSAL

PROPOSAL NO:	C-14	PAGE NO: 1 OF 5
DESCRIPTION:	Use New Pump Station and Force Mains at Canal No. 3 and Soniat; Install Erosion Protection on Canal No. 3 (I-10 to Duncan) and Soniat (W. Napoleon to Canal No. 3); Eliminate Pump Station Work on Elmwood and Canal Improvements on Elmwood, and Soniat (W. Metairie to W. Napoleon); Place F.M.'s Under Canal No. 3 and Elmwood Canal	

ORIGINAL DESIGN:

The following features currently provided are proposed to be eliminated by this proposal:

2,400 CFS addition to Elmwood P.S.
Channel modifications: Soniat -- W. Metairie to Canal No. 3.
Canal No. 3 -- Soniat to I-10
Elmwood -- Canal No. 3 to P.S. (All)

PROPOSED DESIGN:

Same as 1A except place (3) 10' diameter (note larger) force mains under centerline of Canal No. 3 and Elmwood Canal (14,700 LF total).

ADVANTAGES:

*1. Smaller pump station capacity needed to lower flood stages given location of new station (must be computed modeled to verify).
2. Eliminate all canal and pump station work on Elmwood; reduce canal work on Soniat and No. 3.

DISADVANTAGES:

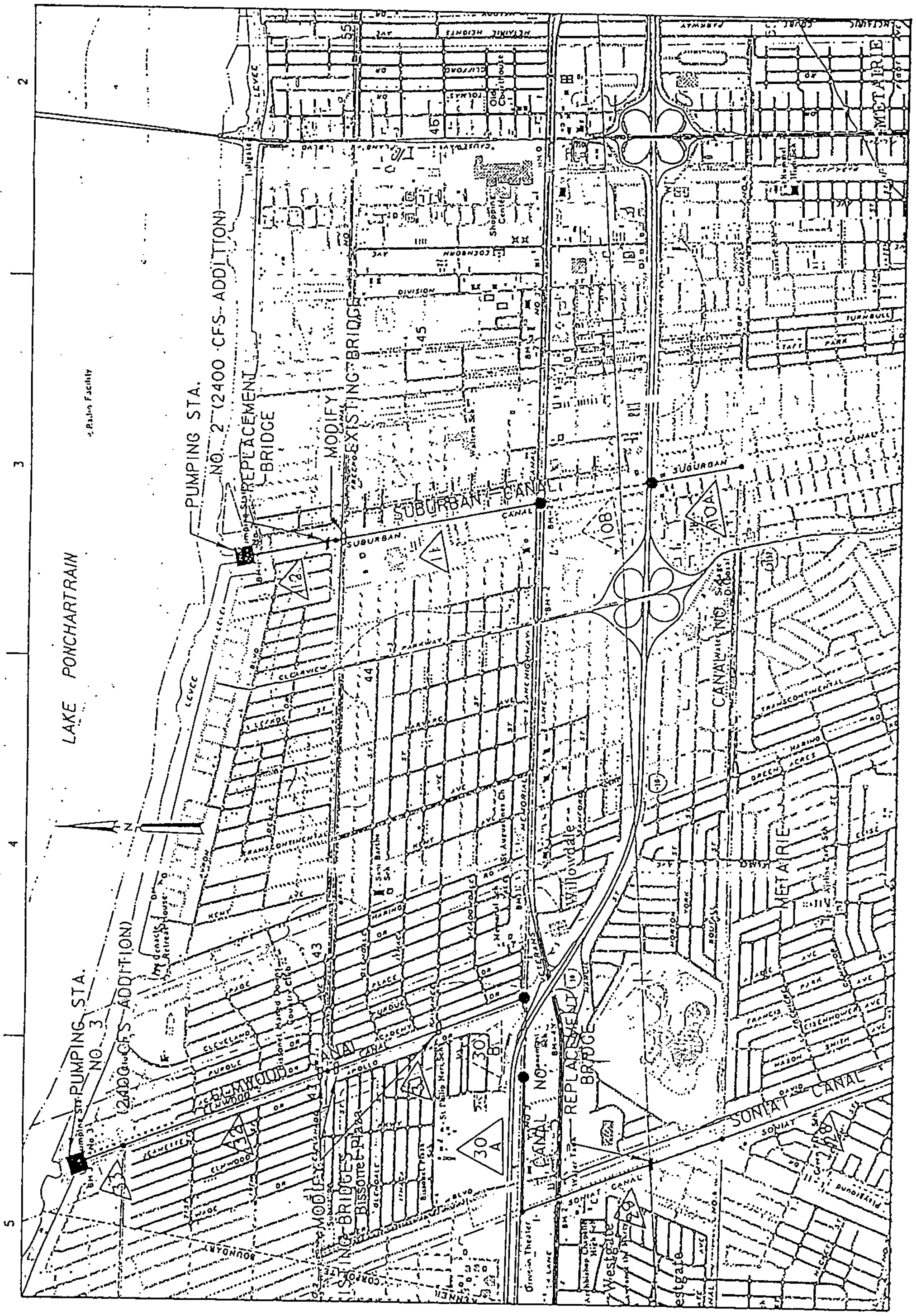
1. Addition of major pump station to system; association O&M.
2. Continued O&M on Soniat, Canal No. 3, and Elmwood Canals.

JUSTIFICATION:

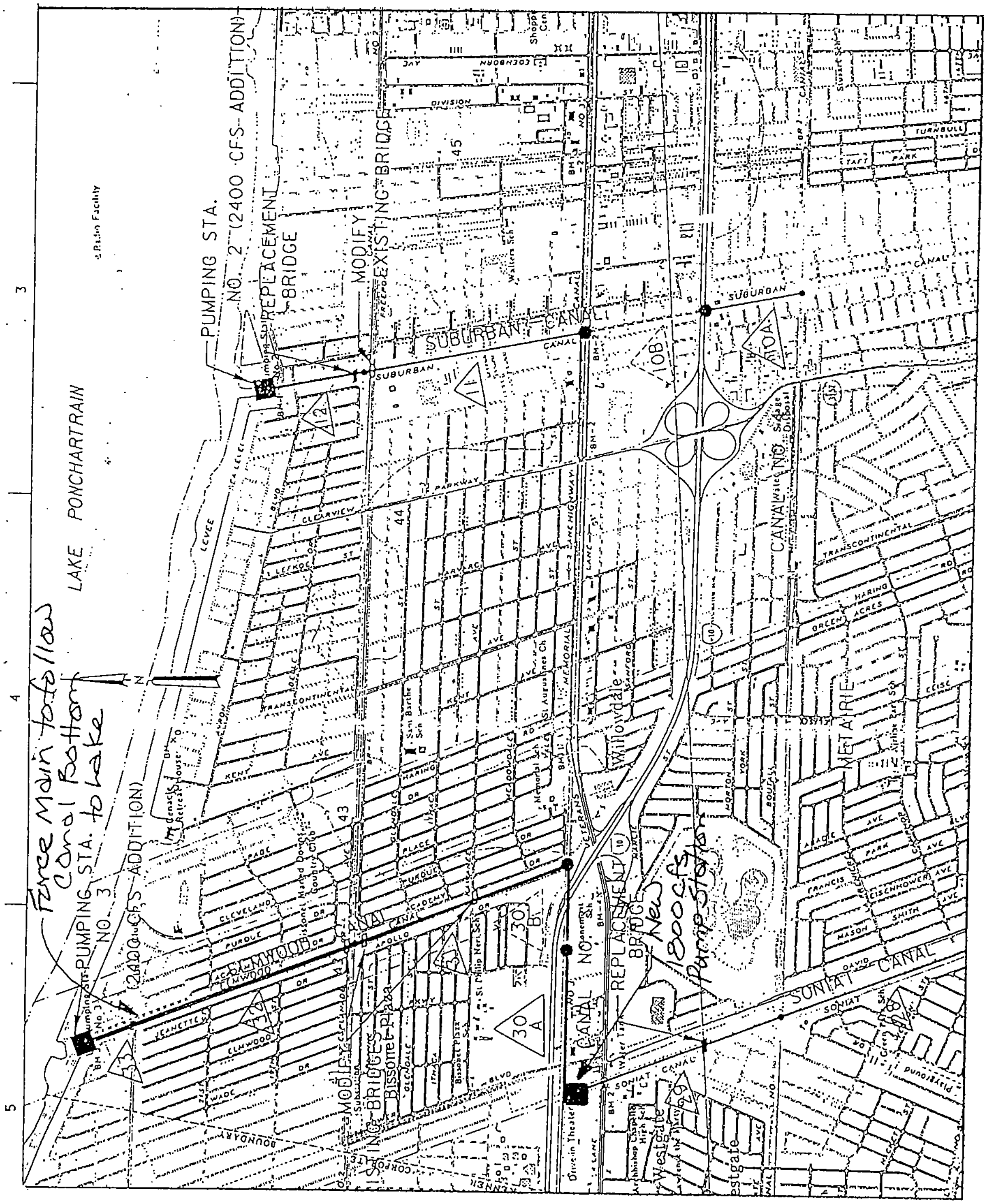
This pumping alternative becomes more attractive when considering the "U"-Frame channel. Cost savings are significantly less if alternate channel designs are used.

*Note: Station capacity/F.M. size should be modified as per results of computer H&H model.

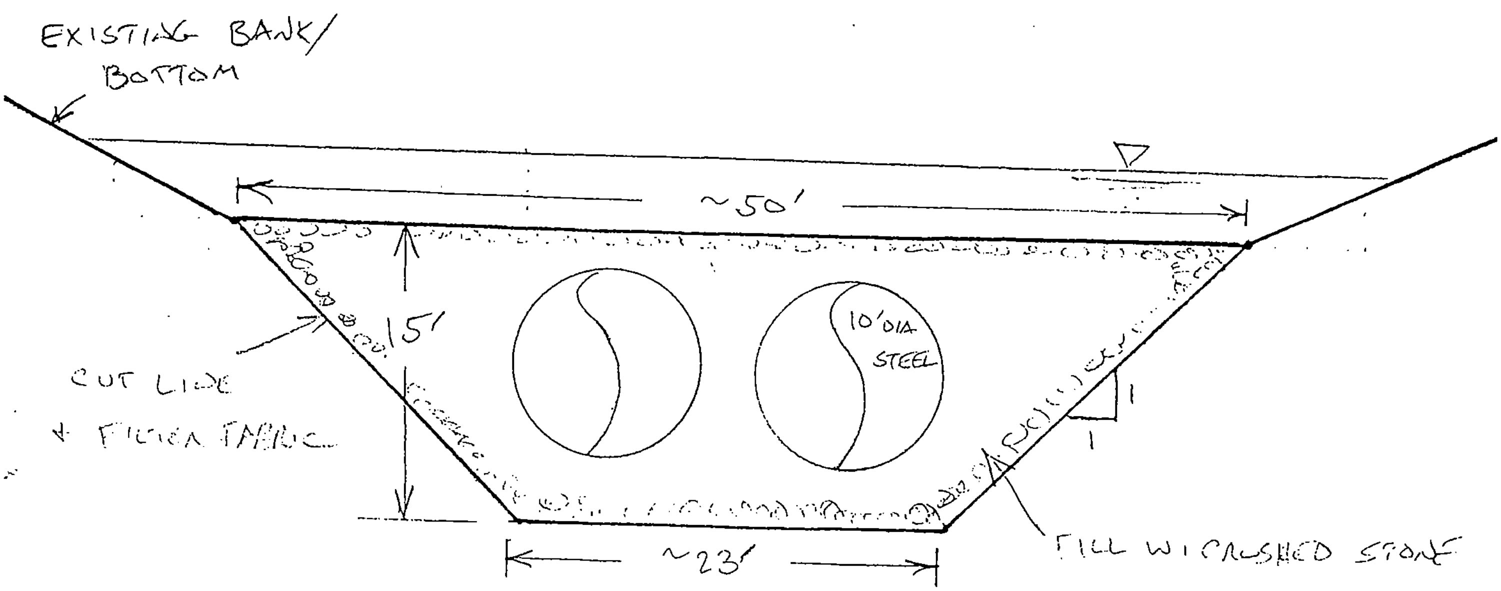
DRAWING NO. 1


PUMPING STA. NO. 2 (2400 CFS ADDITION)
REPLACEMENT BRIDGE
MODIFY EXISTING BRIDGE
SUBURBAN CANAL
LAKE PONCHARTRAIN
PUMPING STA. NO. 3 (2400 CFS ADDITION)
REPLACEMENT BRIDGE
SONIAT CANAL
METAIRIE

DRAWING NO. 2


PUMPING STA. NO. 2 (2400 CFS- ADDITION)
REPLACEMENT BRIDGE
MODIFY EXISTING BRIDGE
SUBURBAN CANAL
LAKE PONCHARTRAIN
Force Main to follow Canal Bottom Pump Sta. to lake
PUMPING STA. NO. 3 (2000 CFS- ADDITION)
ELMWOOD CANAL
MODIFY EXISTING BRIDGES
CANAL NO. 3
REPLACEMENT BRIDGE
New 1800 cfs Pump Station
SONIAT CANAL
METAIRIE
Willowdale

DRAWING NO. 3



PROPOSED SECTION

1" = 10'

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
Channel Modifications:				
All Soniat	LS	1	34,594,100.00	34,594,100
Canal No. 3				
-- Soniat to I-10	LS	1	17,180,364.00	17,180364
All Elmwood	LS	1	6,529,621.00	6,529,621
TOTAL DELETIONS				$72,594,085
2,400 CFS Pump Station Increase at Elmwood	LS	1	$12,670,000.00	$12,670,000
P.S. Added O&M	LS	1	1,620,000.00	1,620,000
Channel Modifications:				
All Soniat	LS	1	34,594,100.00	34,594,000
Canal No. 3				
-- Soniat to I-10	LS	1	17,180,364.00	17,180,364
All Elmwood	LS	1	6,529,621.00	6,529,621
TOTAL DELETIONS				$72,594,085

ADDITIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
(1,800 CFS P.S. - (8) 250 CFS 2,000 HP Mixed Flow Pumps)	LS	1	$6,000.00/cfs	$10,800,000
(2) P.S. O&M (PW)				2,430,000
Real Estate for P.S. AC	1	500,000	500,000.00	
(3) Soniat, Canal No. 3, and Elmwood Canal O&M (PW)	LS	1	358,000.00	358,000
Re-grade Canal	CY	75,000	3.00	225,000
Slopes	LF	16,900		
Geo-Mat/Mulch	SY	141,000	6.25	881,000
Crushed Stone	TN	128,000	19.50	2,500,000
(2) 10' Dia F.M. under Canals	LF	14,700		48,500,000
Outfall at Elmwood	LS	1	500,00.00	500,000
TOTAL ADDITIONS				$66,674,000

Net Savings (Deletes - Adds)	$5,920,085
Markups 34%	2,012,829
TOTAL SAVINGS	$7,932,914

Markups include 20% contingencies and 12% SIOH.

(1) 2,400 CFS X $50/CFS/YR X 13.5 = $1,620,000
(2) 1,800 CFS X $100/CFS/YR X 13.5 = $2,430,000
(3) 50 AC X $500/AC/YR X 13.5 = $338,000

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-15 PAGE NO: 1 OF 5

DESCRIPTION: Install 1,800 CFS Pump Station with River Discharge on Soniat Canal (Harahan); Use Suave Road and Jefferson Highway Corridor

ORIGINAL DESIGN:

The following features currently provided are proposed to be eliminated by this proposal:

2,400 CFS addition to Elmwood P.S.
Channel modifications: Soniat -- W. Metairie to Canal No. 3.
Canal No. 3 -- Soniat to I-10
Elmwood -- Canal No. 3 to P.S. (All)

PROPOSED DESIGN:

Install 1,800 CFS pump station, located on the southern corner of Soniat Canal and railroad crossing; use (2) 10' dia force mains down Suave Road, west on Jefferson Highway then south W. River outfall on Tallulah Street.

ADVANTAGES:

*1. Smaller pump station capacity needed to lower flood stages given location of new station (must be computer modeled to verify).
2. Eliminates all canal and P.S. work on Soniat, No. 3, and Elmwood systems.

DISADVANTAGES:

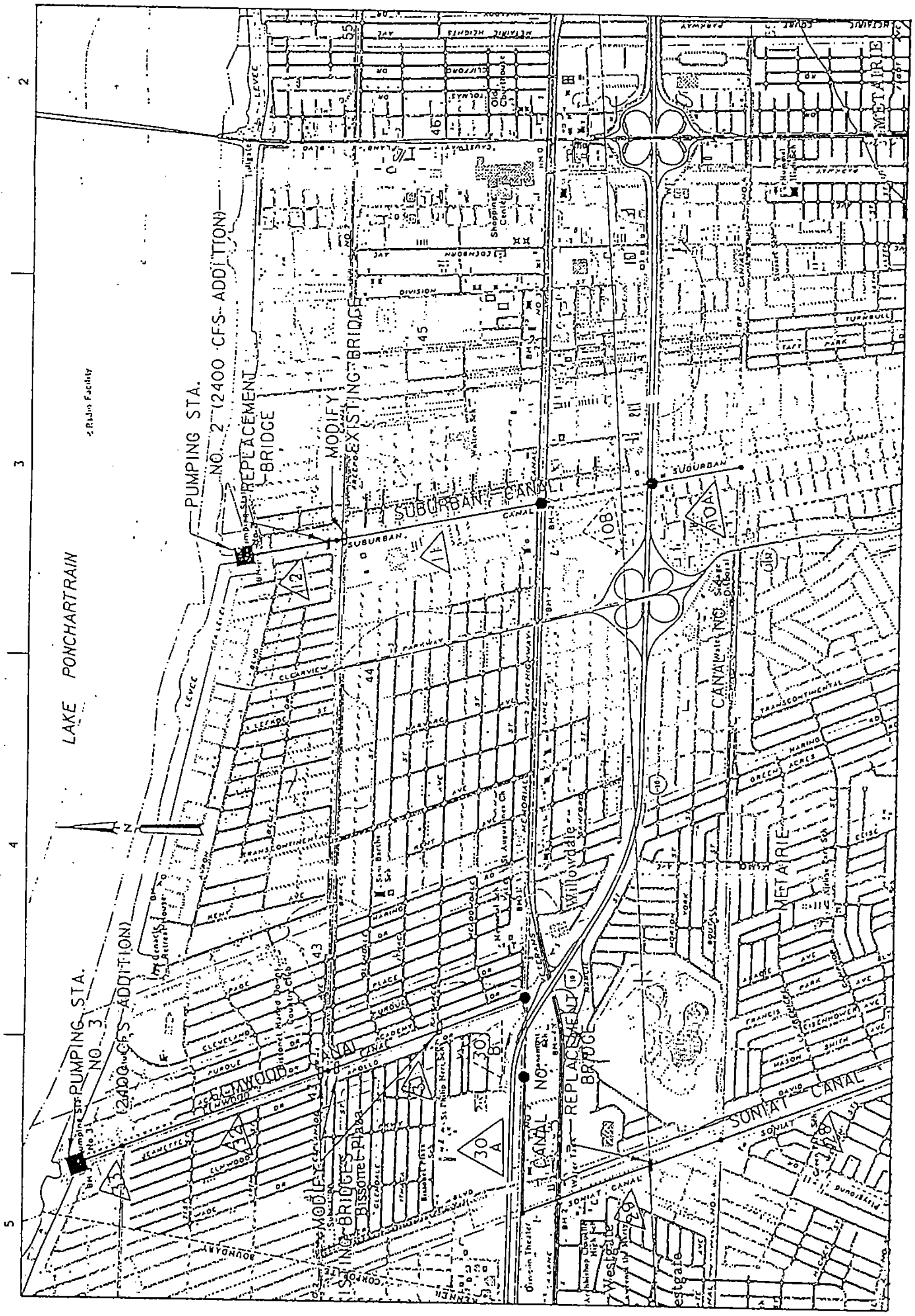
1. Addition of major pump station to system; associated O&M.
2. Continued O&M on Soniat, Canal No. 3, and Elmwood Canal.
3. Major traffic disruption on Suave Road and Jefferson Highway.
4. Residential disruption at new P.S. location and on Suave Road.

JUSTIFICATION:

This pumping alternative becomes more attractive when considering the "U"-Frame channel. Cost savings are significantly less if alternate channel designs are used.

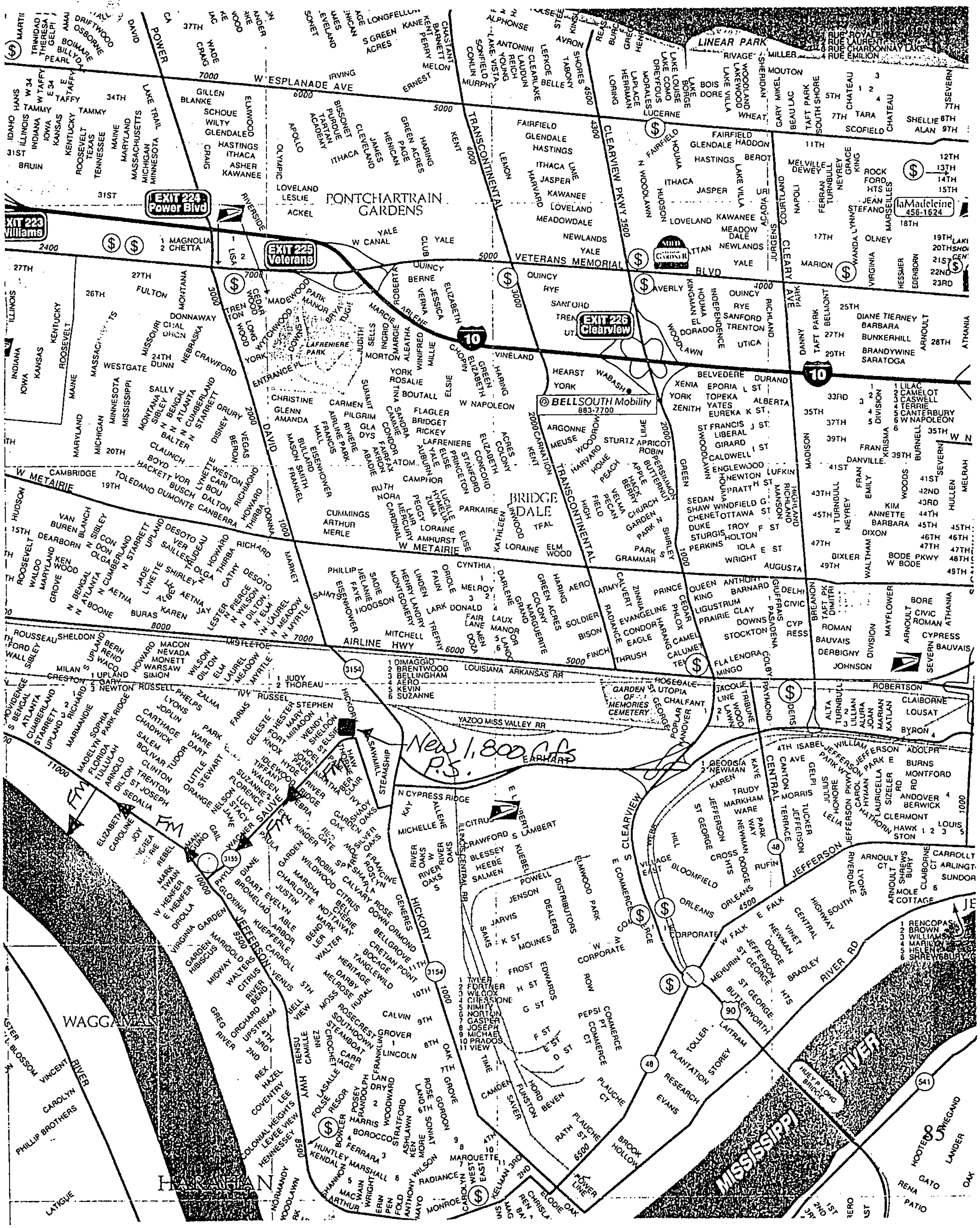
*Note: Station capacity/F.M. size should be modified as per results of H&H computer modeling.

DRAWING NO. 1



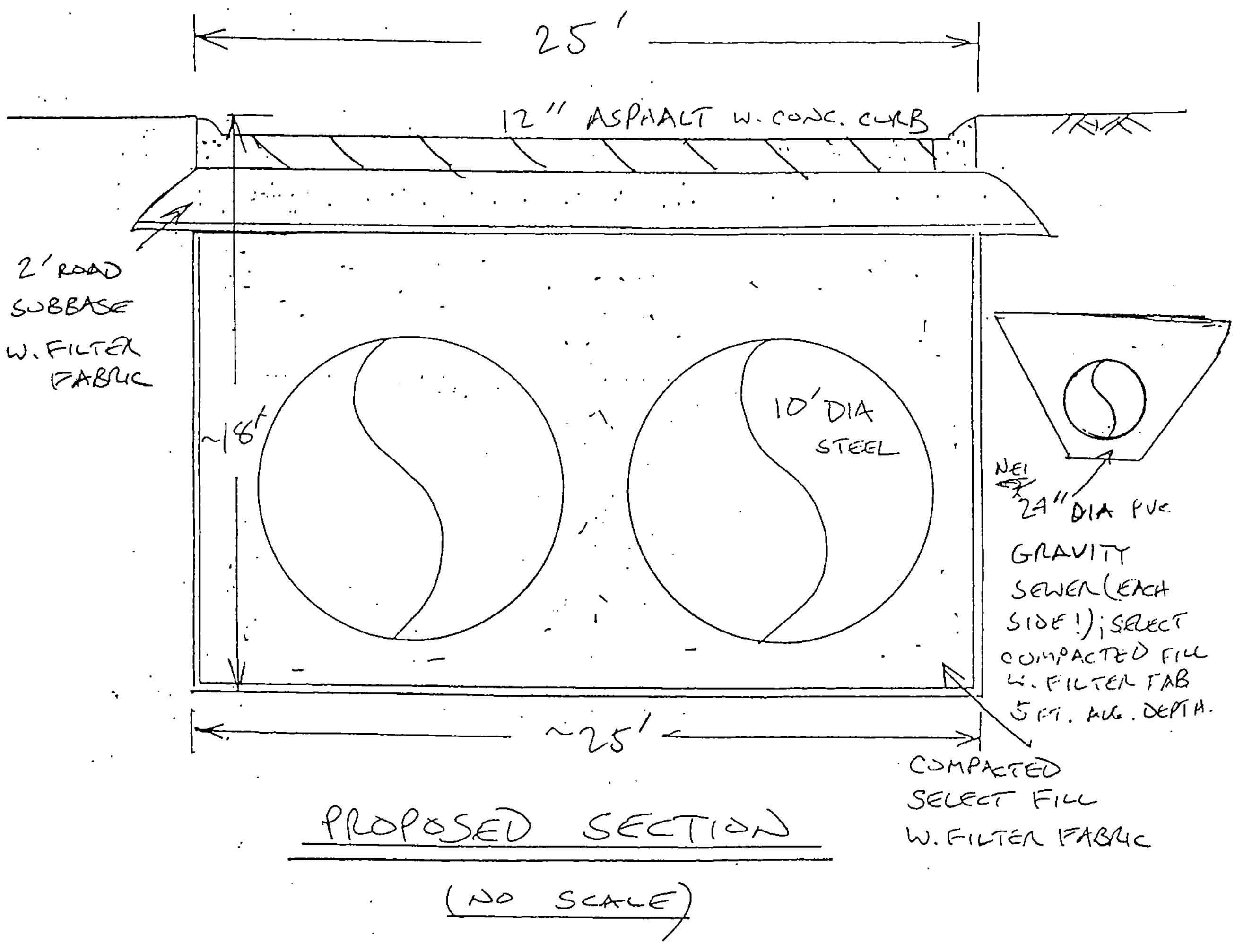
LAKE PONCHARTRAIN
PUMPING STA. NO. 2 (2400 CFS ADDITION)
REPLACEMENT BRIDGE
MODIFY EXISTING BRIDGE
SUBURBAN CANAL
PUMPING STA. NO. 3 (2400 CFS ADDITION)
ELMWOOD CANAL
MODIFY EXISTING BRIDGES
CANAL NO. 3
REPLACEMENT BRIDGE
SONIAT CANAL
METAIRIE

DRAWING NO. 2



85

DRAWING NO. 3


25'
12" ASPHALT W. CONC. CURB
2' ROAD SUBBASE W. FILTER FABRIC
~18'
10' DIA STEEL
24" DIA PVC GRAVITY SEWER (EACH SIDE!); SELECT COMPACTED FILL W. FILTER FAB 5 FT. AVG. DEPTH.
~25'
COMPACTED SELECT FILL W. FILTER FABRIC
PROPOSED SECTION
(NO SCALE)

COST ESTIMATE WORKSHEET

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
2,400 CFS P.S. Increase at Elmwood	LS	1	$12,670,00	$12,670,000
P.S. Added O&M (PW)	LS	1	$1,620,000	1,620,000
Channel Modifications:				
All Soniat	LS	1	34,594,100.00	34,594,100
Canal No. 3				
-- Soniat to I-10	LS	1	17,180,364.00	17,180364
All Elmwood	LS	1	6,529,621.00	6,529,621
TOTAL DELETIONS				$72,594,085

ADDITIONS

ITEM	U/M	QTY	UNIT COST	TOTAL
1,800 CFS P.S. (8- 250 CFS 2,000 HP mixed flow pumps)	LS	1	$6,000 (cfs)	$10,800,000
(2) P.S. O&M (PW)				2,430,000
(2) 10' dia F.M. W. Roadway & Sewer	LF	9,000	23,450,000.00	23,450,000
River Outfall	LS	1	750,000.00	750,000
Real Estate for P.S.	LS	1	500,000.00	500,000
Other Utility Relocations	LS	1	2,000,000.00	2,000,000
(3) Soniat, No. 3, Elmwood Canal continued O&M (PW)	LS	1	338,000.00	338,000
TOTAL ADDITIONS				$39,468,000

Net Savings (Deletes - Adds)	$33,126,085
Markups 34%	11,262,869
TOTAL SAVINGS	$44,388,954

Markups include 20% contingencies and 12% SIOH.

(1) 2,400 CFS X $50/CFS/YR X 13.5 = $1,620,000
(2) 1,800 CFS X $100/CFS/YR X 13.5 = $2,430,000
(3) 50 AC X $500/AC/YR X 13.5 = $338,000

VALUE ENGINEERING PROPOSAL

PROPOSAL NO:	C-16	PAGE NO: 1 OF 5
DESCRIPTION:	Install 1,800 CFS P.S. W. River Discharge on Soniat Canal (Harahan); Use Ivy and Tallulah Street Corridors	

ORIGINAL DESIGN:

The following features currently provided are proposed to be eliminated by this proposal:

2,400 CFS addition 70 Elmwood P.S.
Channel modifications: Soniat -- W. Metairie to Canal No. 3
Canal No. 3 -- Soniat to I-10
Elmwood -- Canal No. 3 70 P.S. (All)

PROPOSED DESIGN:

Same as 2A except, place P.S. on either northwest or northeast corner of Soniat Canal and RR. Use ivy and Tallulah Street corridors for F.M.'s.

ADVANTAGES:

*1. Smaller pump station capacity needed to lower flood stages given location of new station (must be computer modeled to verify).
2. Eliminates all canal and pump station work on Elmwood; reduces canal work on Soniat and No. 3.

DISADVANTAGES:

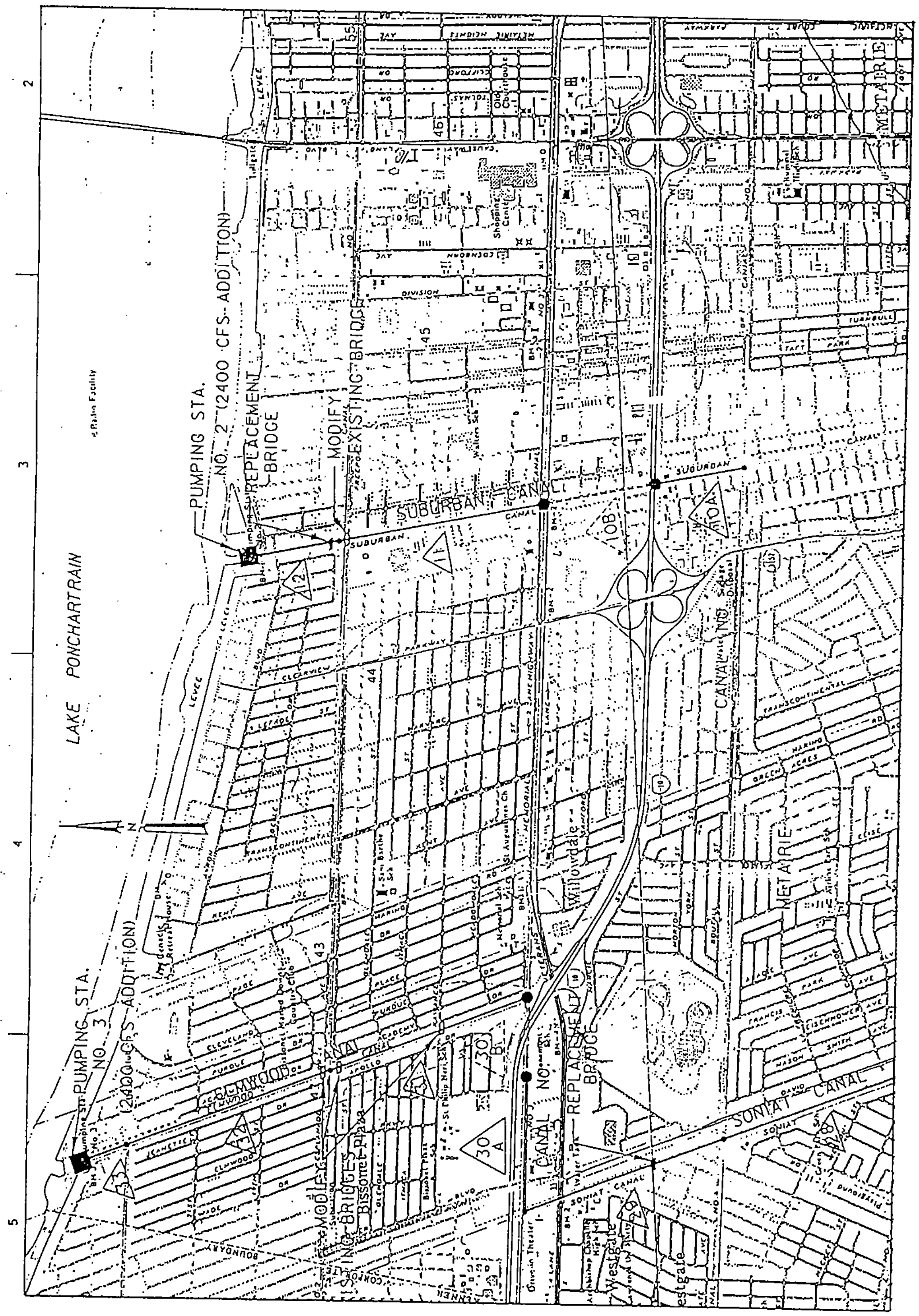
1. Addition of major pump station to system; associated O&M.
2. Continued O&M on Soniat, Canal No. 3, and Elmwood Canals.
3. Some industrial problems required for P.S..
4. Residential disruption on Ivy and Tallulah Streets.

JUSTIFICATION:

This pumping alternative becomes more attractive when considering the "U"-Frame channel. Cost savings are significantly less if alternate channel designs are used.

*Note: Station Capacity/F.M. size should be modified as per results of H&H computer modeling.

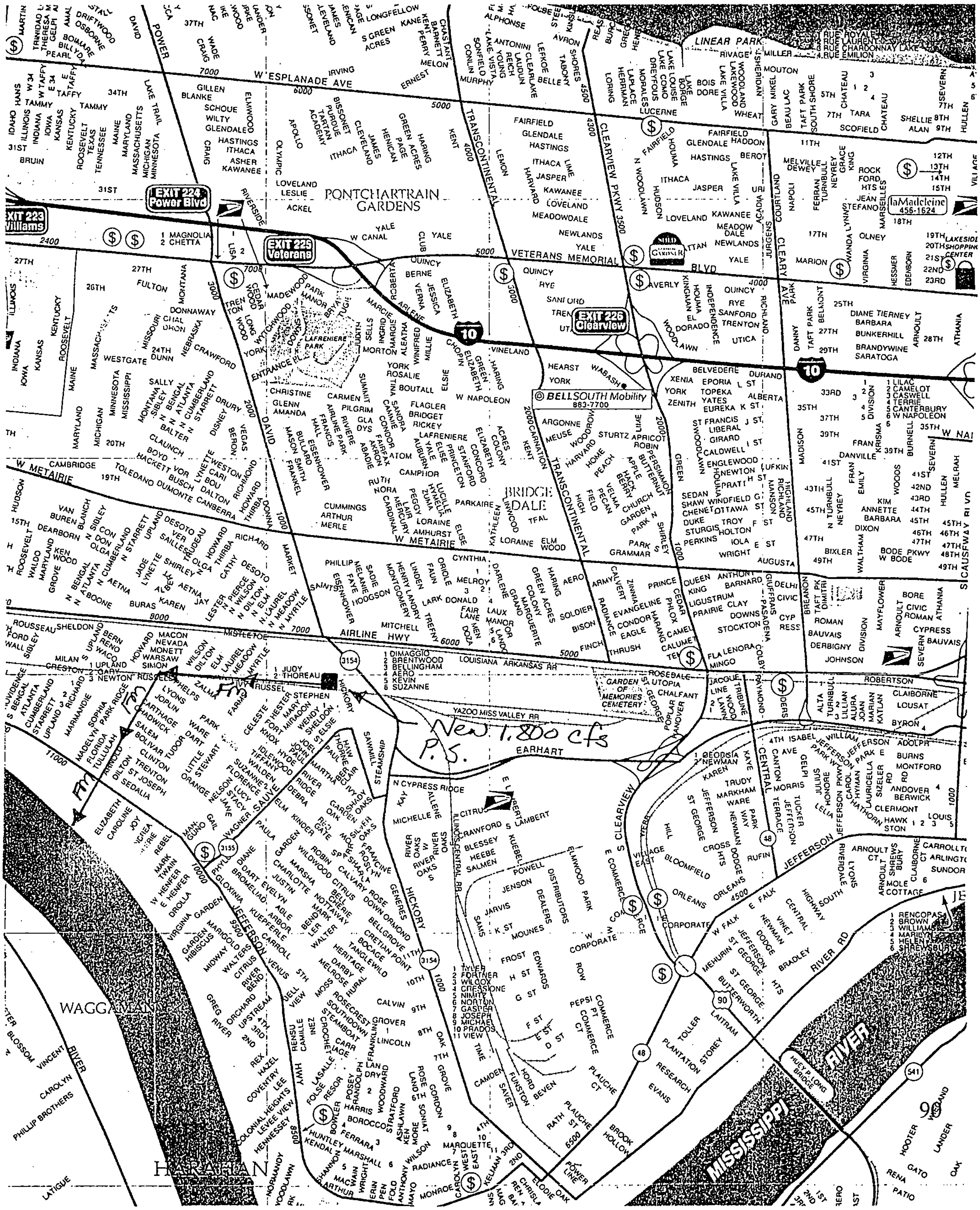
DRAWING NO. 1


PUMPING STA. NO. 2 (2400 CFS ADDITION)
REPLACEMENT BRIDGE
MODIFY EXISTING BRIDGE
SUBURBAN CANAL
LAKE PONCHARTRAIN
PUMPING STA. NO. 3 (2400 CFS ADDITION)
ELMWOOD CANAL
SONIAT CANAL
METAIRIE
2
3
4
5

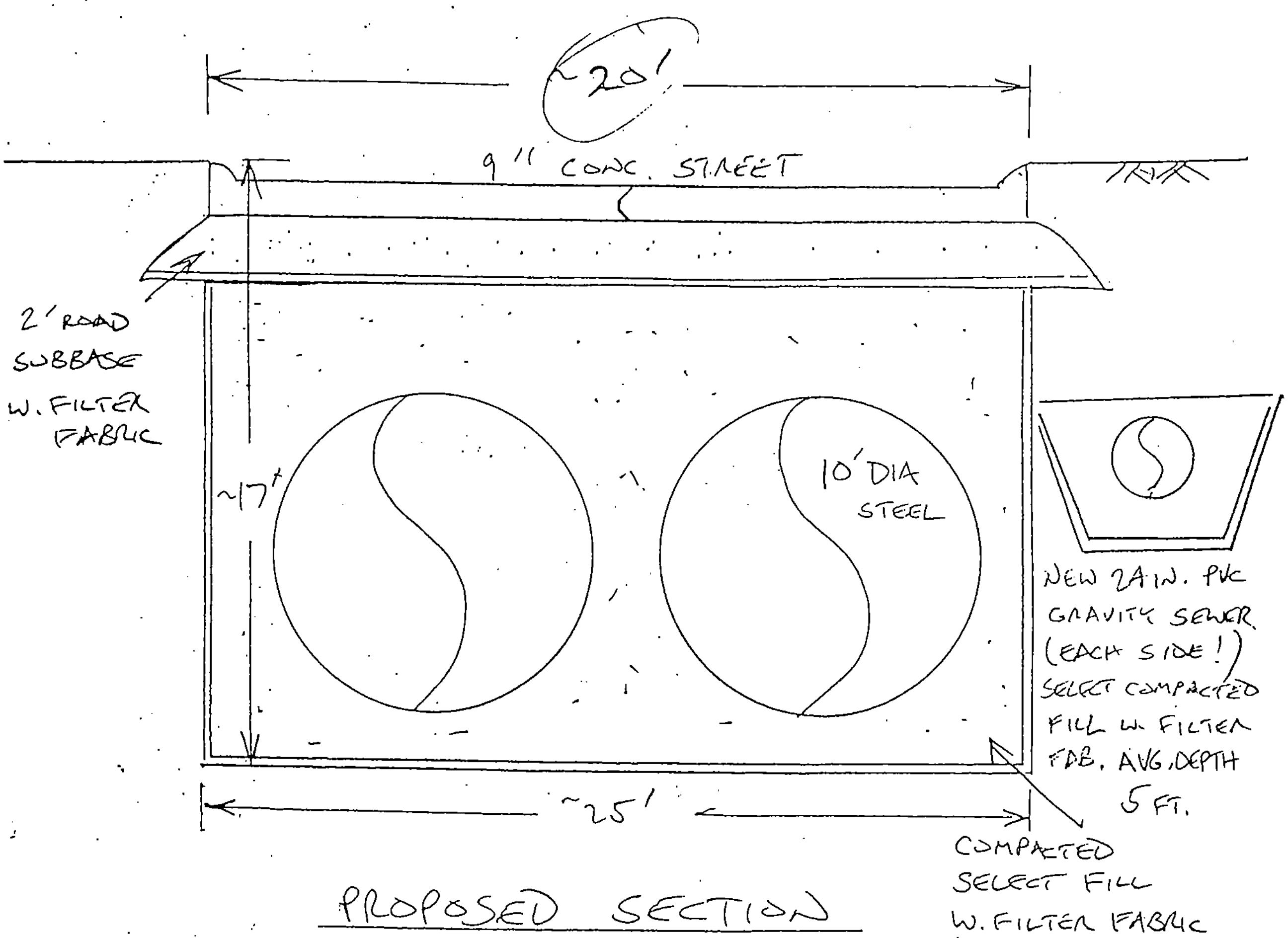
VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-16 PAGE NO: 3 OF 5

DRAWING NO. 2



DRAWING NO. 3



PROPOSED SECTION

(NO SCALE)

COST ESTIMATE WORKSHEET

PROPOSAL NO: C-16 PAGE NO: 5 OF 5

DELETIONS

ITEM	U/M	QTY	UNIT COST	TOTAL	
2,400 CFS P.S. Increase at Elmwood	LS	1	$12,670,00	$12,670,000	
P.S. Added O&M (PW)	LS	1	$1,620,000	1,620,000	
Channel Modifications:					
All Soniat	LS	1	34,594,100.00	34,594,100	20,000,000
Canal No. 3 -- Soniat to I-10	LS	1	17,180,364.00	17,180364	
All Elmwood	LS	1	6,529,621.00	6,529,621	
TOTAL DELETIONS				$72,594,085	

14

ADDITIONS

To low

8

ITEM	U/M	QTY	UNIT COST	TOTAL	
1,800 CFS P.S. (8- 250 CFS 2,000 HP mixed flow pumps)	LS	1	$6,000 (cfs) $10,000	$10,800,000	18,000,000
(2) P.S. O&M (PW)				2,430,000	
(2) 10' dia F.M. W. Roadway & Sewer	LF	9,000		23,450,000	
River Outfall	LS	1	N/A	750,000	
Real Estate for P.S.	LS	1	500,000.00	500,000	
Other Utility Relocations	LS	1	2,000,000.00	2,000,000	
(3) Soniat, No. 3, Elmwood Canal continued O&M (PW)	LS	1	338,000	338,000	
(2) 10' Dia F.M. & Sewer	LF	8,000		21,400,000	
Real Estate for P.S.				1,000,000	
RR Crossing				1,000,000	
Other Utility Relocations	LS	1	1,000,000.00	1,000,000	
TOTAL ADDITIONS				$36,918,000	

Net Savings (Deletes - Adds)	$35,676,085
Markups 34%	12,129,869
TOTAL SAVINGS	$47,865,954

Markups include 20% contingencies and 12% SIOH.

(1) 2,400 CFS X $50/CFS/YR X 13.5 = $1,620,000
(2) 1,800 CFS X $100/CFS/YR X 13.5 = $2,430,000
(3) 50 AC X $500/AC/YR X 13.5 = $338,000

1. **Suburban Reach - 10B Vary Size of Channel Increasing in Width from Upstream to Downstream** - Current concrete U-Frame design shows a cross section of 58' bottom width and 13' side height, constant for the entire 2,480' reach. The upstream end of this channel connects to Reach 10A Channel which has a 40' bottom width. There is no significant hydraulic inflow between Reach 10A and 10B. Hydraulic design of Reach 10B would balance the channel width, starting at 40' where it connects to Reach 10A, and increasing in width corresponding to anticipated side inflows progressing downstream, thereby optimizing the channel size and reducing construction cost. A hydraulic numerical modeling of the Reach 10B design would be necessary to optimize the channel section widths along the length of this reach.

2. **Comments on Reach 11** - Several modified trapezoidal sections are presented as alternatives to the U-Frame section of the current design. The sections may be combined, modified, or adapted, subject to verification by soils and hydraulic analyses. Consideration should be given to analyzing the effectiveness of the section with both a risk-based approach and an economic-impact approach.

Every attempt should be made to fit a (or modified trapezoidal) trapezoidal section within Reach 11. If soils conditions are as bad as stated, then we should expect massive differential settlement for a U-Frame section that is not pile founded, not to mention astronomical cost. A U-Frame section should be considered only as a last and no-other-possibility alternative.

Trapezoidal sections of bottom width less than 40' may not lower flood stages by the same amount in this subbasin, but how much less? For example, given the 10' right-of-way and lacing a 12' access road on the east bank, a trapezoidal channel with 1 on 3 slopes that has a 20' bottom width could be constructed. While at first glance it would appear that this design is hydraulically unacceptable, actual measurement comparing this to the 40' wide bottom 1 on 2, sloped channel (base plan) reveals otherwise. The above design is actually only 11 percent smaller in cross-sectional area and has a wetted perimeter only 4 percent grater. This design would not be as effective as the base plan but would the reduction in damage benefits be even close to the 2 to 3 fold cost difference between the base plan and the current U-Frame design? Is the project that best defines the National Economic Development (NED) plan being proposed? While the requirement to identify the NED plan in this subbasin has been circumvented by project authorization from the Reconnaissance Report, the authorization was based on the premise of the base trapezoidal plan and not the significantly more costly U-Frame design. Through the continuing feasibility study for other projects in this basin, a flood damage calculation model is now available. It appears that benefits and costs can be directly calculated for alternate design without much time and cost. Given the radical departure from the authorized project design cost, this type of benefit-cost optimization analysis appears warranted.

(Comment No. 2 continued)

On the west side of the channel, a paved access road exists beside the hospital to Ithaca Street. The road is being extended to approximately Kawanee Avenue. This establishes an existing public access along 2,200' of the 4,100' reach, and outside of the requirement easement. Relaxing the requirement for a 12' access road along this reach and the remainder of the reach will allow alternative trapezoidal sections to fit more easily.

A fortune can be saved in Reach 11 by optimizing the hydraulic section to reduce overall width, utilizing step-down sheet pile sections, prestressed concrete sections step down at the channel invert, increasing side slopes to the maximum permissible, reducing foundation factor of safety to 1.15, etc., and making risk-based decisions. Hydraulics has indicated a paved 40' wide trap section with 1V on 2H side slopes is equivalent to a 58' U-Frame. Current proposals use a 40' wide paved trap, but with 1V on 3H side slopes. This is a larger trap cross section than the 1V on 2H, and a smaller bottom width, 1V on 3H section will certainly be equivalent. Hydraulics needs to verify what that smaller bottom width is, further allowing a trapezoidal section to fit this reach.

Acknowledgment needs to be given to the model that exists in the field. Is it a safety hazard? Does it have vertical walls and present a safety hazard for both falls and ease of escape? What is the existing maintenance cost versus the discount rate of the increased cost of a U-Frame compared to (modified) trapezoidal? How has the existing earthen channel banks stood up for 40 years with such poor underlying strata? Are we over designing without consideration for costs and benefits? Also, if a U-Frame is the only acceptable way, than for little more, and possibly less life cycle cost (with use of a double arch culvert as proposed for Terry Parkway), this entire section can be closed and covered.

That seems a better, safer, and more aesthetic alternative to open channel U-Frame. This closed condition seems to be the "ultimate system design" employed by the parish as seen along stretches of Veterans' Highway and West Napoleon Canal.

3. **<u>Recess Access Road 4' Below Top of Bank</u>** - Consider modifying trapezoidal bank sections by recessing the access road 4' below top of bank. This can provide an enlarged overflow section while reducing the upper bank loading for improved bank stability. Improving the overflow capacity may also allow reduction of the channel bottom width and, therefore, overall section width.

4. **<u>Consider Falling Hazards for Canal System</u>** - Fencing along rights-of-way and/or at wall systems may be necessary. OSHA has identified falling hazards to the public on other C.O.E. projects for vertical distances over 5' high and has required structural alternatives including fencing or grade modifications.

5. **Develop Performance Specification for Concrete Pressure Pipes for Force Mains** - An alternative pressure pipe system should be considered in addition to the welded steel pipe presented in Proposal Nos. C-11 through C-16.

6. **Alternative Plan for SELA Plan** - An alternative plan to the SELA plan is being initiated for study by the District. The plan is identified in the 12 Feb 97 memorandum for the Chief of Planning Division by W. Eugene Tickner, Chief, Engineering Division, as Alternative No. 3B for the East Bank, Jefferson Parish. This plan provides paved canal side slopes from the top to El. 6.0' cairo datum and placing rip rap in the remaining side slope and invert. It also introduces a substantially enhanced canal pumping plan that will split the SELA planned 2,400 cfs for Duncan Pumping Station. The memo and enclosure No. 2 - Hydraulic Design Data further describes the alternative (attached following this comment).

This alternative plan demonstrates the need for maintaining flexibility for the SELA Flood Control Project to achieve optimum benefits and to achieve overall effectiveness in controlling and managing storm water through planned improvements to canal and pump systems. This proposed plan is bold in that it effects approximately 15,000 LF of canals and places a new pumping influence to Elmwood, Soniat, and Duncan Canals and the east/west feeder canals. It can provide a more nearly balanced pump influence/draw across miles of the Jefferson Parish drainage basins. The VE Team also identified this scheme in Speculation Item No. 33. This concept will likely initially increase costs; however, additional benefits should be captured and a better overall stormwater manage system is likely to be developed. The District and Jefferson Parish is encouraged to shift more emphasis on this alternative. It should be more developed and evaluated before other competing plans are acted on (such as advanced purchase of pumps for Pump Station No. 3).

Contact Directory
Value Engineering Team

VALUE ENGINEERING STUDY TEAM
SOUTHEAST LOUISIANA FLOOD CONTROL
ELMWOOD AND SUBURBAN CANALS

1. Frank Vicidomina, CELMN, 504-862-1251
2. Clyde Barr`e, CELMN, 504-862-2429
3. John Grieshaber, CELMN, 504-862-2979
4. Carl Anderson, CELMN, 504-862-2610
5. Willis Newton, BCG/Jefferson Parish DCIP, 504-736-6780
6. Charles Claghorn, OVEST, 912-652-5173
7. Eara Merritt, OVEST, 912-652-5171
8. Fred McAuley, OVEST, 912-652-5715

SPECULATION & DEVELOPMENT LIST

✓=Develop Idea ?=Investigation X=Deleted CMT=Comment

✓	1.	Put 1,800 cfs pump station at Canal No. 3 and Soniat Canal (minimum erosion protection on Soniat from Napoleon to pump station and minimum erosion protection on Canal No. 3. Eliminate work on Elmwood Canal and pump station. Eliminate all work on Soniat from W. Metairie to W. Napoleon [see Speculation Item No. 34]).
✓	2.	Put 1,800 cfs pump station upstream Soniat Canal (Harahan Area) (ditto changes of Speculation Item No. 1).
✓	3.	Put 1,200 cfs at Canal No. 3 and Soniat Canal. (Dito changes of Speculation Item No.) Add only 1,000 cfs at Elmwood pump station. Build canal improvements from W. Esplanade to Canal No. 3. Same as reach from W. Esplanade to Canal No. 1.
✓	4.	Put 1,200 cfs at upstream Soniat Canal and pump to river (dito changes from Speculation Items No. 2 and 3).
✓	5.	Pile founded L-Wall with gravel bottom.
X	6.	Sheet pile founded L-T wall (vibratory driven).
✓	7.	Sheet pile wall with concrete face -- gravel bottom.
✓	8.	Use marine mat for trapezoidal section side and bottom.
✓	9.	Use articulated concrete mat (ACM) for bottom and sides.
✓	10.	Only use ACM for slopes (leave rip rap bottom).
✓	11.	Tensar marine mat on bottom in lieu of rip rap.
?	12.	Enclose culvert for U-Frame reaches.
?	13.	Cold-formed sheet pile where sheet pile is used.
✓	14.	Use deep sheet pile with granite coating and gravel bottom.
✓	15.	Use concrete sheet pile with gravel bottom.
✓	16.	Revise side slopes to 2:1 (O&M $, U-Frame eliminated?).
✓	17.	Use soft bottom in lieu of rip rap (leave Reach No. 12).
?	18.	Put double arch culvert for U-Frame (See Speculation Item No. 12).
X	19.	Put floodwall on existing channel -- increase capacity.
✓	20.	Trapezoidal sections -- do what is on W. Esplanade to Canal No. 1 -- gravel (see Speculation Item No. 22).
✓	21.	Composite section -- 1:2 bottom and 1:3 top.
✓	22.	Recess access road 4' to 6' lower elevation.
✓	23.	Combine Speculation Items No. 20 and 22 -- drive on rock berm.
✓	24.	Re-evaluate width of 10b to balance in-flow.
✓	25.	Add erosion/filter geotextile on grass slopes (Reaches 21, 32, and 33; O&M issues -- 35' access; use existing roads adjacent to channel).
✓	26.	Trap and L Section (mix composite section).
X	27.	Eliminate U-Frame on Suburban -- buy some houses.
X	28.	Buy out where it floods (10 year).
✓	29.	Use precast panels with compression frames in lieu of U-Frame.

APPENDIX B: SPECULATION LIST (continued)

✓=Develop Idea ?=Investigation X=Deleted CMT=Comment

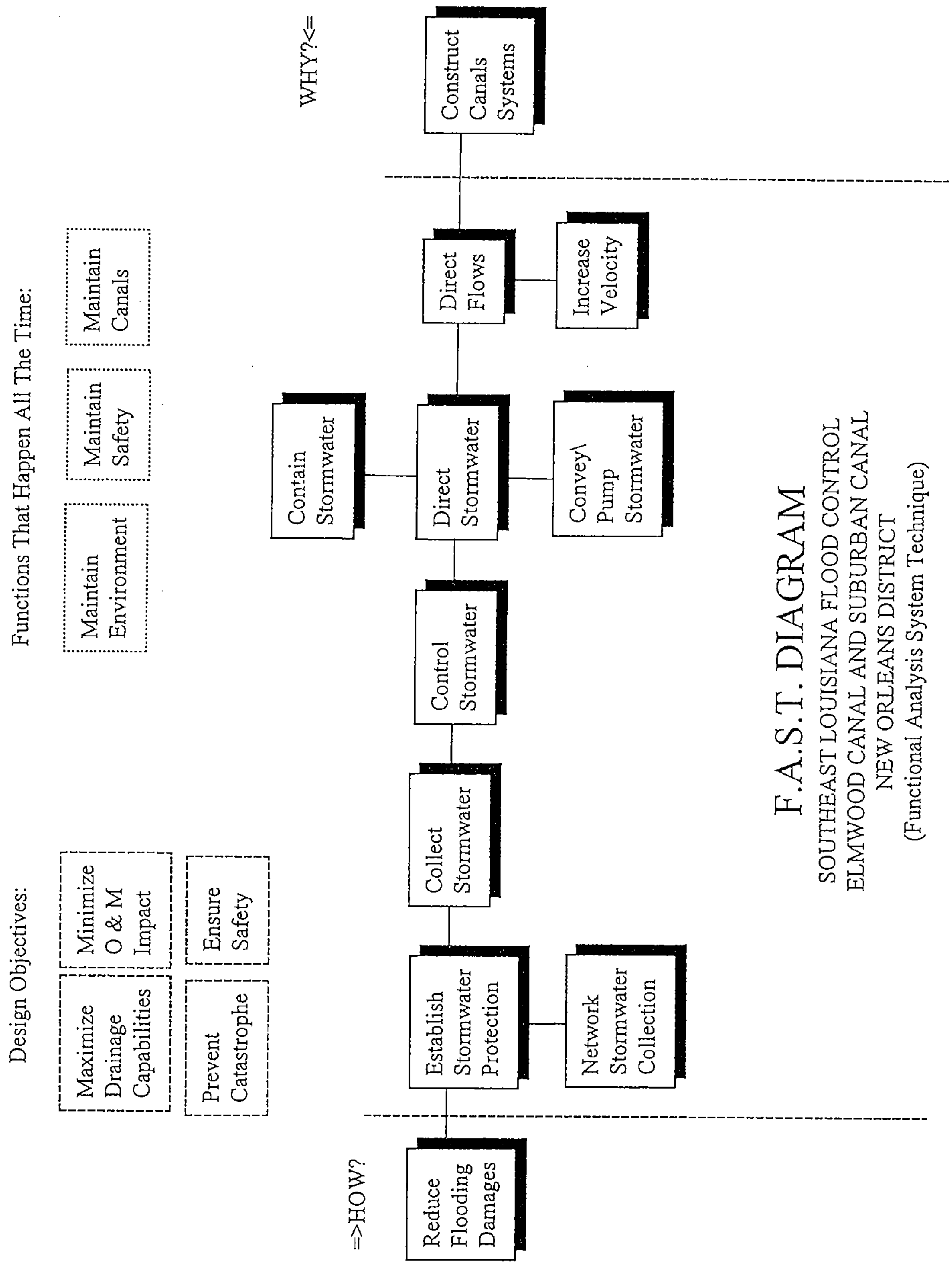
✓	30.	Reinforce grout mat for concrete slopes.
✓	31.	Fit trap section in Reaches No. 10 and 11 -- buy real estate.
✓	32.	Put pump station on upstream at Suburban at I-10 -- put force main in canal.
✓	33.	Split pump station improvements between Duncan and Elmwood pump stations (more canal improvements).
✓	34.	Put pump station at Canal No. 3 and Soniat -- put force main in canal.
X	35.	Use MSE wall system
CMT	36.	Add fence for all walls over 5' vertical.
X	37.	Delete heel on vertical wall section.
CMT	38.	Revise drainage per A-E design.
X	39.	Revisit sheet pile depths (tie back, etc.)
X	40.	Use battered pile inside channel.
X	41.	Use imbedded sheet pile stability wall.

VALUE ENGINEERING TEAM STUDY

DEVELOPMENT LIST

Team No.	Speculation Item(s)
1.	1, 2, 3, 4, 32, 33, 43
2.	5, 7, 12, 13, 14, 15, 18, 29, 40, 41
3.	8, 9, 10, 11, 25, 30
4.	4, 16, 17, 20, 21, 22, 23, 24, 26, 31, 35

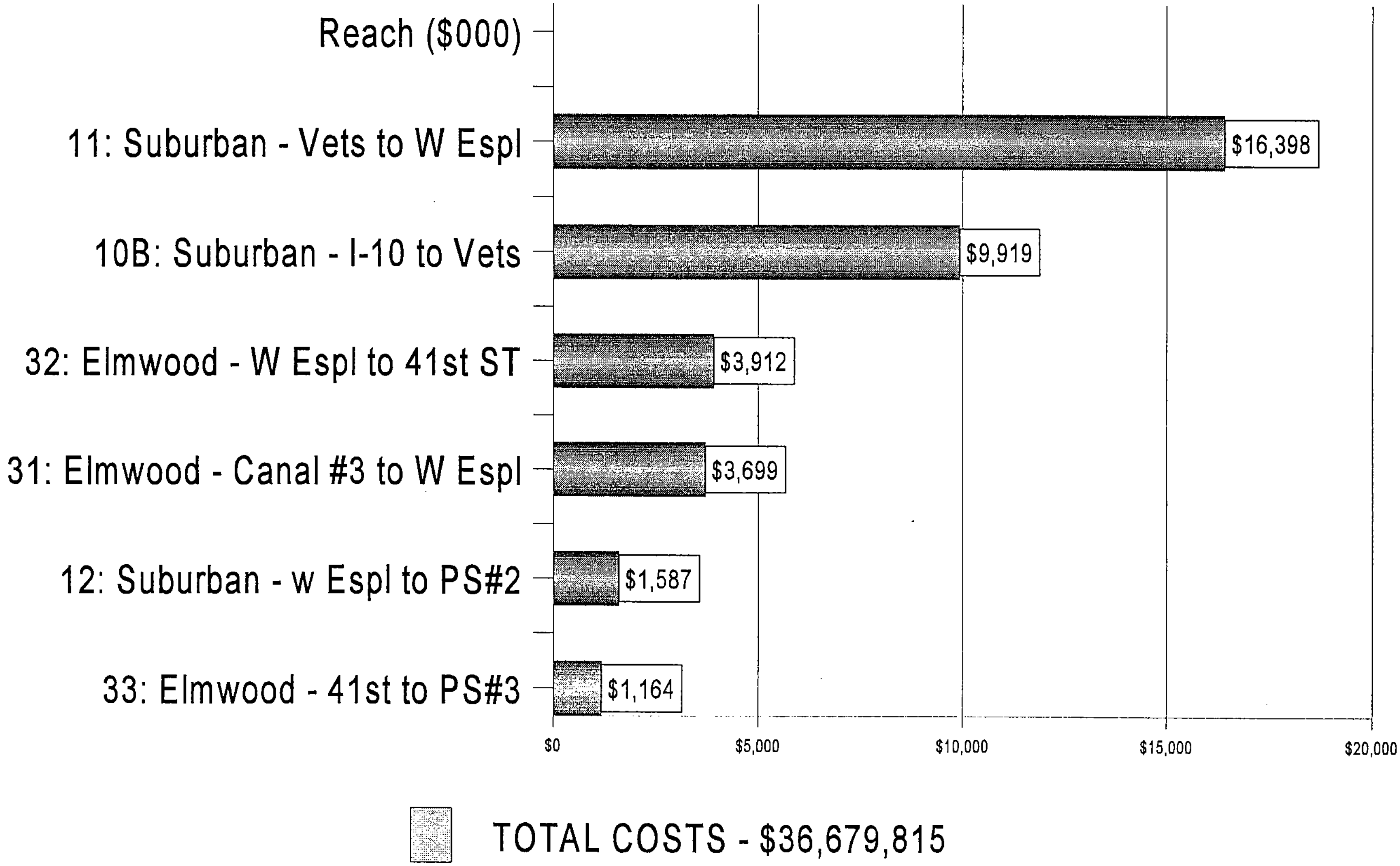
FAST DIAGRAM


F.A.S.T. DIAGRAM
SOUTHEAST LOUISIANA FLOOD CONTROL
ELMWOOD CANAL AND SUBURBAN CANAL
NEW ORLEANS DISTRICT
(Functional Analysis System Technique)
Design Objectives:
Maximize Drainage Capabilities
Minimize O & M Impact
Prevent Catastrophe
Ensure Safety
Functions That Happen All The Time:
Maintain Environment
Maintain Safety
Maintain Canals
=>HOW?
WHY?<=
Reduce Flooding Damages
Establish Stormwater Protection
Network Stormwater Collection
Collect Stormwater
Control Stormwater
Contain Stormwater
Direct Stormwater
Convey\ Pump Stormwater
Direct Flows
Increase Velocity
Construct Canals Systems

COST MODELS

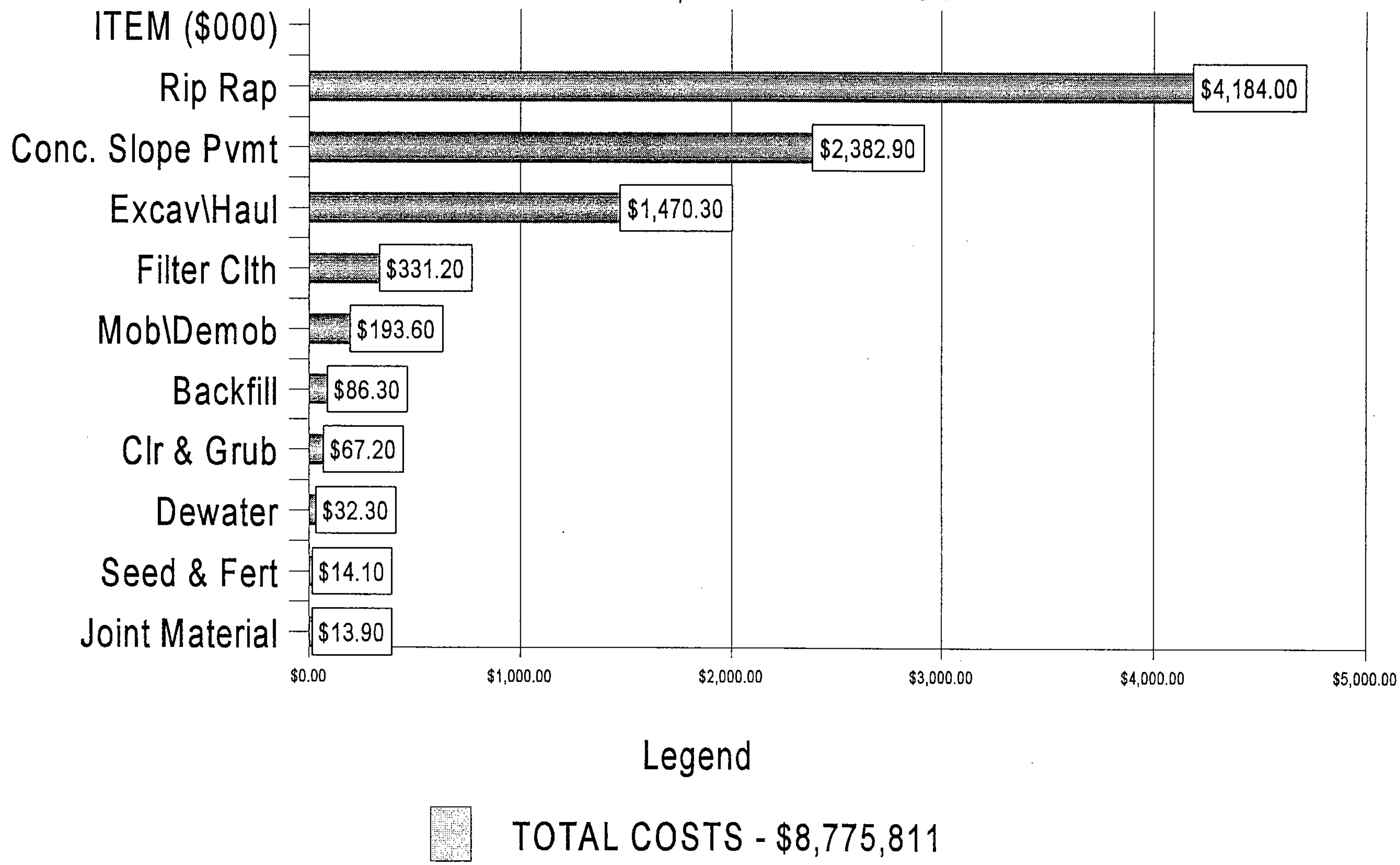
SOUTHEAST LOUISIANA FLOOD CONTROL

ELMWOOD & SUBURBAN CANALS, JEFFERSON PARISH

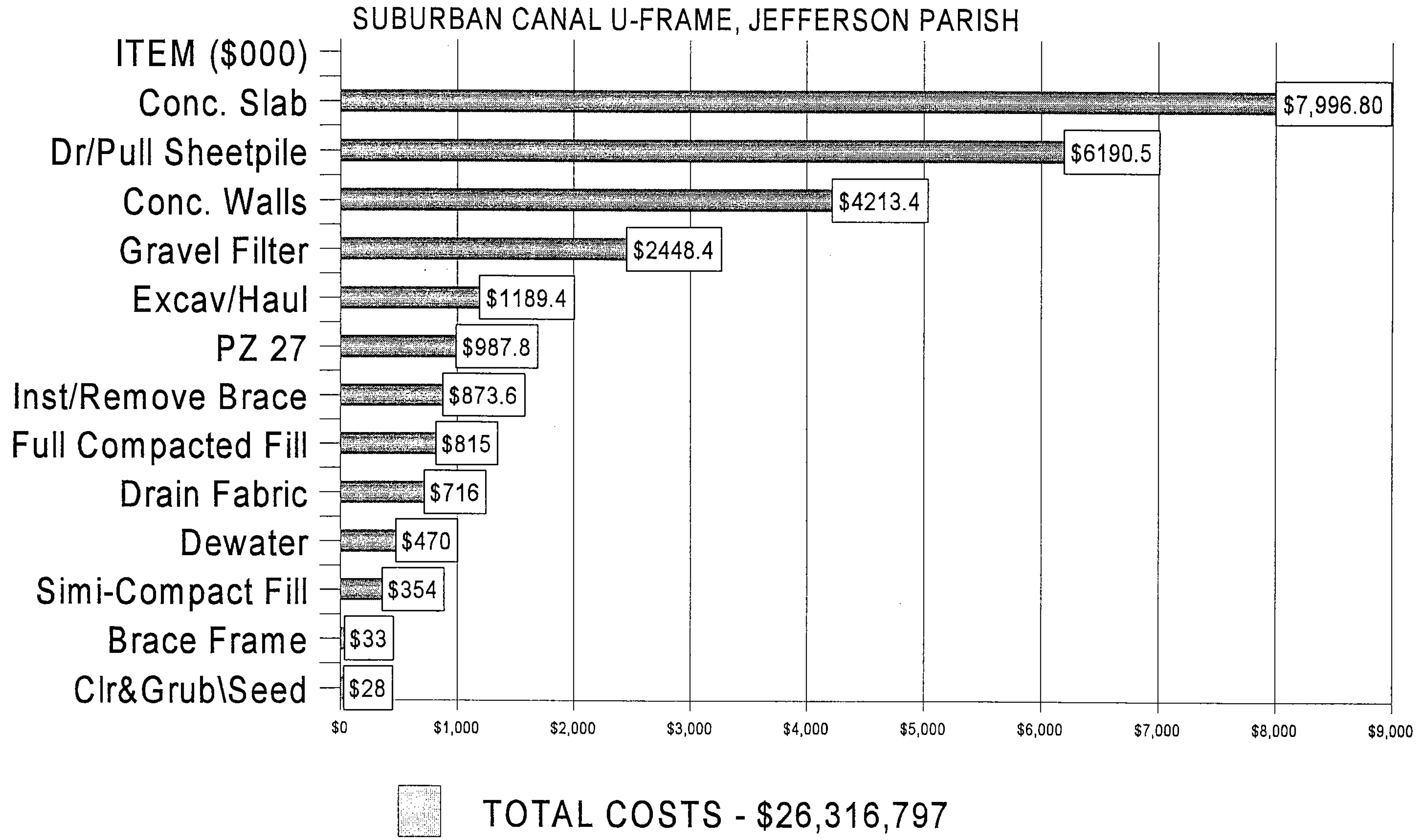


SOUTHEAST LOUISIANA FLOOD CONTROL

ELMWOOD CANAL, JEFFERSON PARISH



SOUTHEAST LOUISIANA FLOOD CONTROL

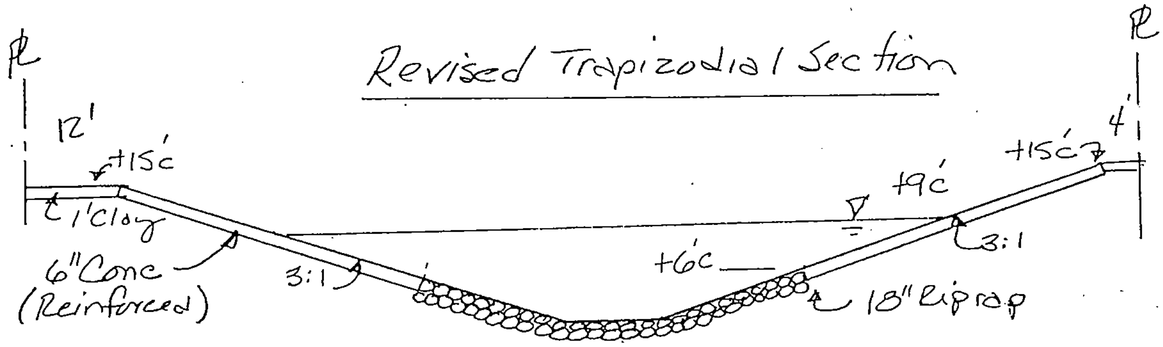


SUPPORTING DOCUMENTS FOR ALL PROPOSALS-- REVISED BASELINE ESTIMATE

VALUE ENGINEERING TEAM STUDY

Elmwood & Suburban Canals Revised Baseline Estimate (Page 1 of 3)

Reach	Btm Wdth	Side Slope	Invert Elevation	Elev T.O.B.	Length
12	62	3:1	1.1	15.0	1,770
31	88	3:1	1.9	15.2	4,250
32	84	3:1	1.2	15.2	4,375
33	92	3:1	1.1	15.2	1,000



Reach 31, Canal #3 (I-10) - W Esplanade:			
Mob/Demob	LS	--	$47,999
Site Work (Top Width 184'):			
C&G	7 Ac	$2,500	17,500
Excav/haul	100,800CY	5.00	504,000
Dewater	LS	--	8,000
Backfill - Clay	2,520CY	10.00	25,200
Riprap (18")	50,625CY	25.00	1,265,625
Reinf. Conc. Pvmt.	4,250CY	180.00	765,000
Joint Matrl	2,175SFY	2.00	4,350
Filter Cloth	55,000SY	2.00	110,000
Seed & Fert	3 Ac	1,500	4,500
			$2,752,174

VALUE ENGINEERING TEAM STUDY

Elmwood & Suburban Canals Revised Baseline Estimate (Page 2 of 3)

Reach 32, W Esplanade - 41st ST:			
Mob/Demob	LS	--	$47,999
Site Work (Top Width 180'):			
C&G	7 Ac	$2,500	17,500
Excav/haul	98,000CY	5.00	490,000
Dewater	LS	--	8,000
Backfill - Clay	2,600CY	10.00	26,000
Riprap (18")	55,700CY	25.00	1,392,500
Reinf. Conc. Pvmt.	4,500CY	180.00	810,000
Joint Matrl	2,270SFY	2.00	4,540
Filter Cloth	55,000SY	2.00	110,000
Seed & Fert	3 Ac	1,500	4,500
			$2,911,039
Reach 33, 41st ST - PS#3:			
Mob/Demob	LS	--	$48,068
Site Work (Top Width 188'):			
C&G	6 Ac	$2,500	15,000
Excav/haul	20,000CY	5.00	100,000
Dewater	LS	--	8,000
Backfill - Clay	1,300CY	10.00	13,000
Riprap (24")	18,200CY	25.00	455,000
Reinf. Conc. Pvmt.	1,100CY	180.00	198,000
Joint Matrl	720SFY	2.00	1,440
Filter Cloth	13,200SY	2.00	26,400
Seed & Fert	1 Ac	1,500	1,500
			$866,408
Subtotal Elmwood Canal			$6,529,621
Mark-up (20% Contingency and 12% S&A)			X 1.344
Total Elmwood Canal			$8,775,811

Reach 12, W Esplanade - PS#2:			
Mob/Demob	LS	--	$47,991
Site Work (Top Width 160'):			
C&G	2 Ac	$2,500	5,000
Excav/haul	26,800CY	5.00	134,000
Dewater	LS	--	8,000
Backfill - Clay	1,100CY	10.00	11,000
Riprap (24")	24,500CY	25.00	612,500
Reinf. Conc. Pvmt.	1,800CY	180.00	324,000
Joint Matrl	788SFY	2.00	1,376
Filter Cloth	17,800SY	2.00	35,600
Seed & Fert	1 Ac	1,500	1,500
			$1,180,967

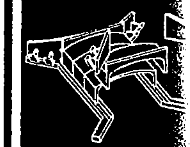
Subtotal Suburban Canal (Trap Section)	$1,180,967
Mark-up (20% Contingency and 12% S&A)	X 1.344
Total Suburban Canal (Trap Section)	$1,587,220

Reach 10B & 11, I-10 to W Esplanade (58' U-Frame):			
Mob/Demob	LS	--	$0
Reinf. Conc. Walls	9,500CY	330.00	3,135,000
Reinf. Conc. Slab	29,750SY	200.00	5,950,000
Filter Gravel	72,870CY	25.00	1,821,750
Drain Fabric	76,100SY	7.00	532,700
PZ 27	70,000SF	10.50	735,000
Drive & Pull	921,200SF	5.00	4,606,000
Brace Frame	70,000Lb	0.35	24,500
Install & Remove	650,000Lb	1.00	650,000
C&G	11Ac	$2,000	22,000
Excav/haul	177,000CY	5.00	885,000
Dewater	LS	--	350,000
Full Compact Backfill	50,500CY	12.00	606,000
Semi-Compact Backfill	26,300CY	10.00	263,000
			$19,580,950

Subtotal Suburban Canal (U-Frame Section)	$19,580,950
Mark-up (20% Contingency and 12% S&A)	X 1.344
Total Suburban Canal (U-Frame Section)	$26,316,797

Average Cost per LF: $26,316,797 / 6,580 LF = $3,999.51/LF

SUPPORTING DOCUMENTS FOR PROPOSAL NO. C-2

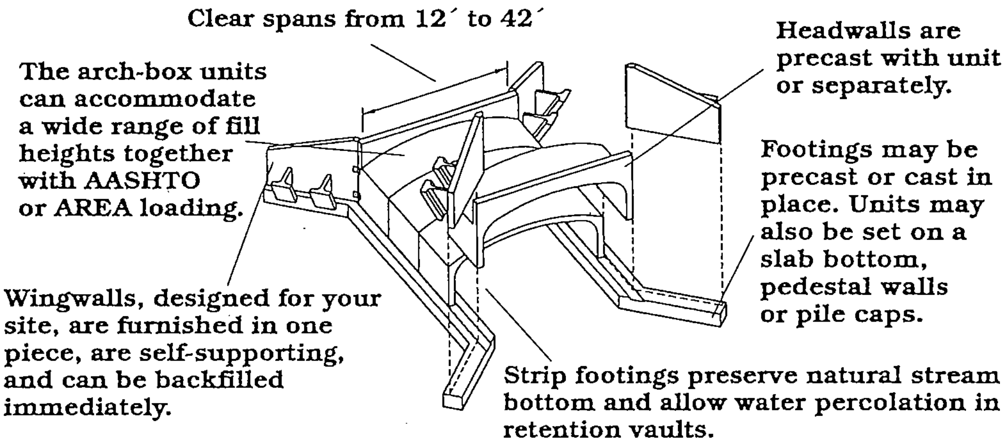


What is CON/SPAN?

CON/SPAN is a patented modular precast system for total set-in-place construction of bridges, culverts, underground structures and environmentally acceptable alternatives for underground containment.

- Each installation is custom designed and manufactured for your specific site requirements.
- Precast modular units are delivered to your site and set in place by crane.
- Backfilling can begin immediately.
- CON/SPAN is available from a national network of precast producers.

CON/SPAN's fully engineered system stands apart from other products through the strength of its distinctive arch action and extensive technical support.



- **Separate or integral closed ends are used for underground containment vaults.**
- **Variable modular configurations allow for practically unlimited lengths, widths and vertical clearances.**

How the CON/SPAN staff works for you

- One call to **800-526-3999** connects you with our design team of experienced professional engineers.
- We help owners, consultants and contractors evaluate CON/SPAN solutions for specific projects.
- We work with your local CON/SPAN network supplier to give you accurate pricing.
- We provide comprehensive design support and design aids for automated and manual plan preparation, and assistance through all phases from concept through installation.

How CON/SPAN saves you time and money

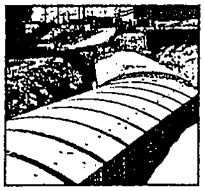
- The arch shape provides an economy of materials for a lower initial cost.
- Overall savings for a project is significant over cast-in-place.
- Fast installation—usually in hours. Road closings and detours are minimized, resulting in significant reductions in maintenance of traffic costs. A Maine DOT project study estimated a seven-month savings of construction time over cast-in-place construction.
- Eliminates two major bridge problems—costly maintenance of an exposed bridge deck and bridge deck icing.
- Off-site fabrication ensures tight adherence to specs, less on-site work and quality control of modular units.
- Long life cycle, low life cycle costs, virtually no maintenance.

The Technology Leader...Shaping The Future

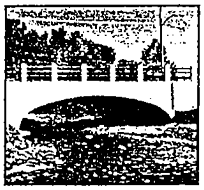
Brief case histories of featured photographs

#1 Greene County, OH: Entrance bridge into Afton Woods Residential Development has 50 lineal ft. of 36 ft. span x 13 ft. rise modular precast units with precast headwalls and wingwalls.

#2 Naples, FL: Triple-span residential development bridge connects two man-made lakes at Arbor Estates at the Vineyard with three spans of 40 lineal ft. of 12 ft. span x 8 ft. rise modular precast units. The aesthetic structure serves as a focal point for the area.



#3 Boone County, KY: Underground Modular Tanks for Glycol Recovery, Greater Cincinnati/Northern Kentucky International Airport includes two 150,000 gallon capacity tanks. Each has 96 lineal ft. of 24 ft. span x 10 ft. rise precast modular units and integral end walls. All spent glycol from this major airport's state-of-the-art central deicing system is piped to these tanks to be held for recycling or treatment. Below grade placement provides protection from potential hazards. Space above is fully utilized since units are designed as bridge components.

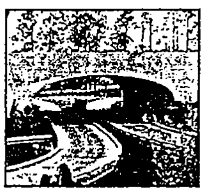


#4 Philadelphia, PA: Roadway bridge Ashton Road over Wooden Bridge Run, Pennypack Creek, provides the only access to an urban airport and four industrial businesses. It includes 52 lineal ft. of 36 ft. spans x 8 ft. 6 in. rise. *Winner of PCI Bridge Design Award for Excellence in Architectural and Engineering Design -- Best Bridge Spanning Less Than 65 Feet. "It really fits the site well -- the arch, texture, the lines and fascias. It's a nice compact, unobtrusive bridge for the site."* -- Judge's statement , Precast/Prestressed Concrete Institute.

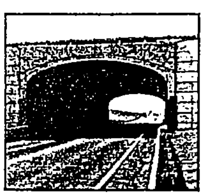
#5 Beavercreek, OH: Golf cart underpass and stream crossing are two of nine CON/SPAN installations for the Country Club of the North, a Jack Nicklaus Signature Course. Underpass has 102 lineal ft. of 12 ft. span x 8 ft. rise. Stream crossing has 16 lineal ft. of 12 ft. span x 6 ft. rise. Precast headwalls on both were set back to accommodate stone facing. *"The CON/SPAN System provided us with low profile structures that could be faced with stone. This fit into the attention we were giving to the use of the natural materials palette in the design elements of all the site features."* -- Mark Kline, Kinzelman/Kline, Landscape Architecture and Planning, Columbus, OH.

#6 Vandalia, OH: Precast vault for protected underground storage of chemical tanks for H.B. Fuller Automotive Technologies Systems Inc. (previously Koch PTI) has 96 lineal ft. of 24 ft. span x 11 ft. rise precast units to enclose eight - 5,000 to 10,000 gallon steel tanks. Modular end walls allow for future expansion of the vault. Paving above allows tankers to fill by gravity feed. Classified by EPA as above-ground storage. Monitoring systems and access for visual inspection. *"What they've done is put above-ground tanks below grade. It's the best of both worlds, and there isn't anything of this magnitude out there."* -- Captain Michael Blakesly, Fire Safety Officer, Butler Twp., OH.

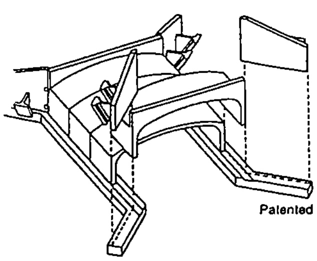
#7 Roseville, CA: One of four multi-span roadway bridges for Del Webb's **Sun City**. Bridge pictured has 68 lineal ft. of 20 ft. span x 7 ft. rise precast units with precast headwalls and wingwalls. Designed to function as an orifice to control downstream flooding. Project Manager Bruce Jacks of MacKay & Somps Civil Engineers and Duane Cobb, Del Webb's VP of Land Development report that *"during devastating flooding in other areas of the city, the structures performed as designed and inundation was limited to the predefined flood plain areas within the project. The structures are aesthetically pleasing and the units were set quickly -- in one day or less."*



#8 Collier County, FL: Roadway overpass/golf cart underpass for Grey Oaks Country Club has 60 lineal ft. of 32 ft. span x 12 ft. rise precast units with cast-in-place wingwalls and headwalls. Long span allows an open feeling for passage of two-way cart traffic over a lighted pond below a major roadway. James Ink, project coordinator for Peninsula Improvement Corporation states, *"Aesthetics and speed of installation were the reasons we chose CON/SPAN. We couldn't be more pleased, and are planning a second installation."*



#9 Wilmington, OH: State highway underpass below an airport taxi-way for Airborne Express (ABX, Inc.) international hub features 192 lineal ft. of 36 ft. span x 12 ft. rise precast units set on cast-in-place pedestal walls. Structure is one of two designed to carry a fully-loaded 747 cargo plane (900,000 lb.) over a relocated state highway. *"CON/SPAN was selected because it provided the required strength for heavy loading, had an attractive appearance, offered long term durability with low maintenance requirements and was the lowest cost solution."* -- Steve Gress, Project Manager for R.W. Armstrong Engineers, Indianapolis, IN.



CON/SPAN®
BRIDGE SYSTEMS

3100 Research Boulevard
P.O. Box 20266
Dayton, Ohio 45420-0266
(513) 254-2233
(800) 526-3999
Fax: (513) 254-8365

SUPPORTING DOCUMENTS FOR PROPOSAL NO. C-7

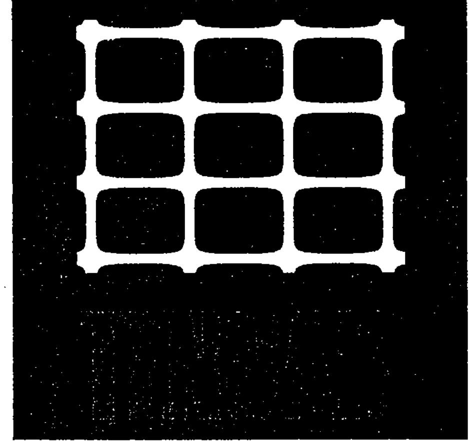
TENSAR®

For more information on Triton Coastal and Waterway Systems, please contact Tensar Earth Technologies, Inc. at 1-800-Tensar-1.

Tensar Geogrids are manufactured under the protection of U.S. Patent number 4,374,798. Other patents pending.

TRITON™

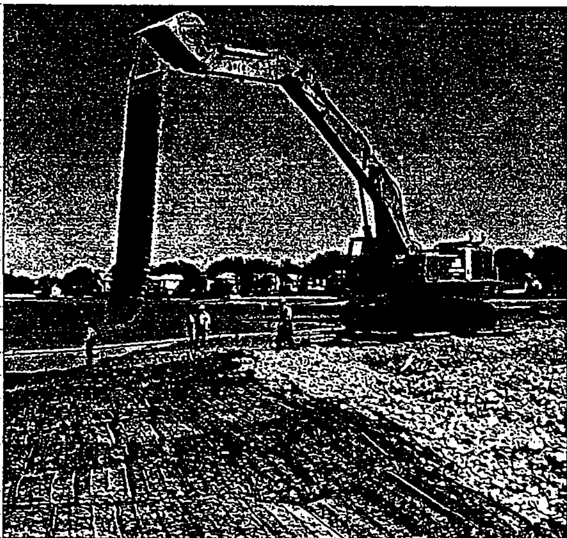
Coastal and Waterway Systems



A New Generation

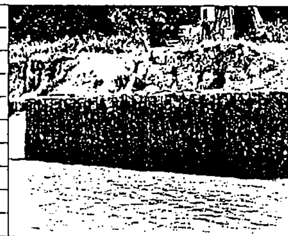
Triton™ systems are a family of composite marine structures used for a broad range of coastal and waterway construction applications. These marine composite structures are formed by confining abundant, relatively inexpensive, granular fills, such as sand and small aggregate, within a structural matrix of Tensar® polymer grids. Triton composite systems replace traditional steel, concrete, wood, and rip rap solutions because they offer:

- Excellent long term durability - Triton systems will not rust, rot, or corrode, even in the harshest saltwater environment.
- Dramatically lower cost - By using inexpensive and readily available fill materials within the composite structure, Triton systems are far more economical than conventional solutions.



Triton Marine Mattress - Boston Harbor, Massachusetts

Marine Wall - Gaspe Peninsula, Quebec



Spaced Breakwater, Triton Marine Cells - Virginia

The Triton series of composite structures includes:

- Triton marine mattresses
- Triton marine cells
- Triton marine walls

Triton systems offer the best combination of durability and reduced cost for erosion protection, marine foundation, and earth retention applications. Since they are largely composed of natural materials, they are far less likely to mar the landscape, as conventional structures often do. And, unlike conventional solutions, they are also highly flexible and adaptive, well suited for the "soft" engineering approach of designing structures that can adapt to natural forces rather than try to meet them head on. Triton systems can even provide an environment for plant and animal life.

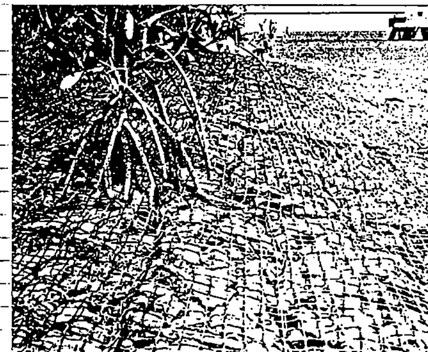
In every application, Triton systems offer lower cost, flexibility, and significant environmental and constructability advantages over conventional alternatives.

The Engineered Advantage™

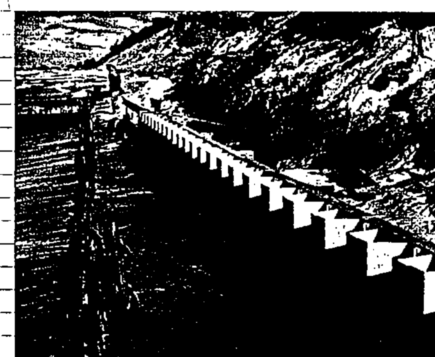
Triton Coastal and Waterway Systems are engineered around the use of Tensar geogrids and our specialized design technology. Tensar geogrids are high strength, polymeric grid structures that have been used for over a decade in demanding civil engineering applications.

The grids themselves are resistant to all naturally occurring forms of chemical, biological, and environmental degradation. Unlike steel or wood, they will not rot, rust, or corrode. And their polymeric construction provides other benefits — they are far less dangerous to work with than steel, and they present no environmental hazard.

Tensar Earth Technologies is the leader in the development of design technologies for geosynthetics and polymeric structures. Our continuous commitment to research and development has culminated in a new state of practice in civil engineering in the construction of earth retention, foundation, and road systems. Now that same design expertise is being applied to coastal and waterway applications.

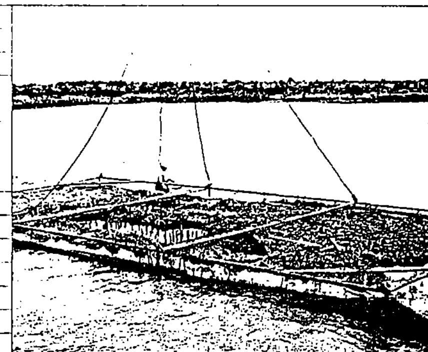


Triton Marine Mattress Revetment - Trinidad

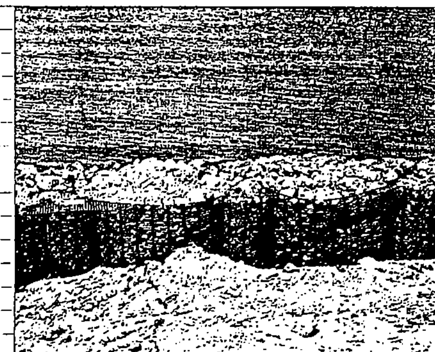


Vinyl Sheet Pile Wall - Lake Michigan

Photo courtesy of ShoreGuard



Triton Rectangular Cells as a wavebreak core - Calcasieu Lake, Louisiana



Triton Circular Cell Installation - James River

Triton Marine Mattresses, Cells, and Walls

Triton Systems can be used to build wave dissipation structures, revetments, dune stabilization systems, marine foundations, channel linings, and dredge material containment structures. These flexible, highly adaptive systems provide protection to beaches, shorelines, dunes, levees, and riverbanks. Triton Coastal and Waterway Systems consist of three composite structures: **Triton Marine Mattresses, Triton Marine Cells, Triton Marine Walls.**

Triton Marine Mattresses

A flexible yet rugged mattress for revetments, erosion protection and marine foundations. In the Triton mattress, small aggregate is locked within a Tensar geogrid structural matrix. Marine mattresses are flexible and replace concrete revetment systems or conventional rip rap without the long term maintenance or regrading problems. Mattresses can be prefabricated and filled with stone off-site for greater ease of installation.

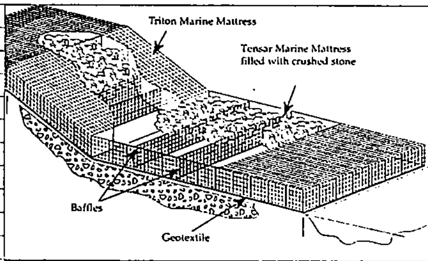
Triton Marine Cells

A composite cellular network of sand, aggregate, or dredge spoil confined within a Tensar grid matrix. Marine cells are ideal for wave breaks, foundations for levees and dikes, the creation of shoreline retention systems, and the construction of dredge spoil containment dikes.

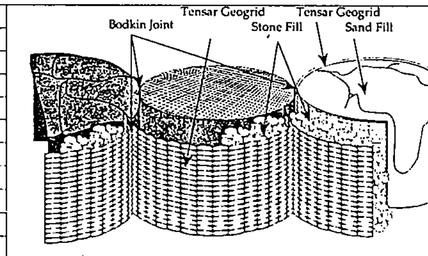
They are far less expensive than conventional solutions since they use inexpensive fill within the composite structure.

Triton Marine Walls

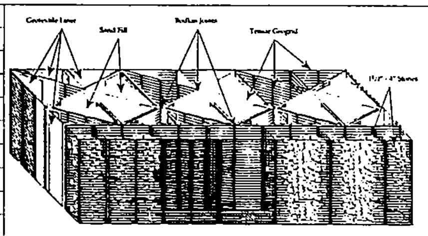
A marine wall system for bulkheads and piers in which both the reinforcement - Tensar geogrids - and the facing are not susceptible to corrosion. Marine walls are ideal in saline conditions. The facing systems for a Triton wall can consist of either precast or segmental concrete units or vinyl sheet piles, creating the widest availability of facing options for any coastal or waterway application.



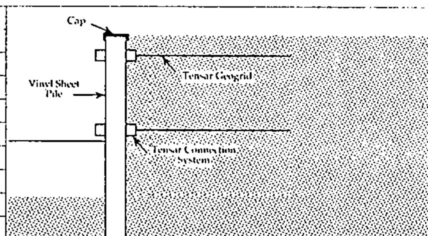
The Triton Marine Mattress is constructed of Tensar geogrids and stone fill with internal baffles to prevent fill shifting.



The Triton Circular Cell confines natural materials within a "hoop" of Tensar geogrids. A stone filled layer may be added for cell protection.



The Triton Rectangular Cell is most often used as a wavebreak or dike core, or as a foundation layer.



The Tensar Connection System is specially designed to attach Tensar Geogrid to Triton marine walls.

Foundations for Wave Breaks, Breakwaters, Groins, and Jetties

Triton Marine Mattresses are used as foundations to support offshore wave dissipation structures, which are usually totally submerged. These wave dissipation structures are created to "knock the legs" out from under the waves, reducing their height and strength. To protect against toe erosion and undercutting, Triton Marine Mattresses are used to build stable foundations for these structures.

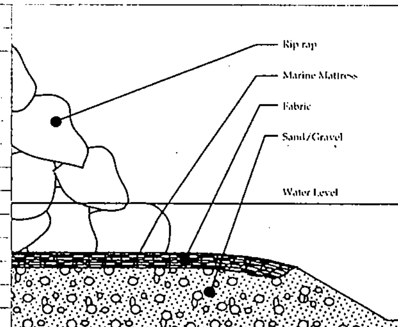
By placing the marine mattress beneath or against the structure, scour can be significantly reduced, contributing to the long term performance of the offshore wavebreak itself. Similarly, Triton mattresses can be used to form flexible foundations for jetties and groins. Long term confinement of the stone within the foundation mattress restricts lateral spreading of the base material and settlement of the structure.

Foundations for Levees and Dikes

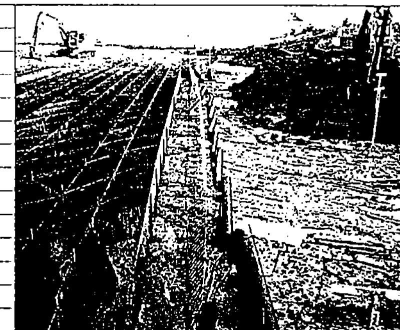
Levees and dikes are often constructed on extremely poor soil platforms. As a result, they can settle unpredictably, or, in extreme cases, the dike itself can fail catastrophically. In these cases, a layer of Triton Marine Cells can be used as a foundation pad to assure overall stability while minimizing settlement.


Photo courtesy of Breakwaters International

Triton Marine Mattresses can be pre-staged on a barge for offshore installations.



Riprap or other wavebreak structures can be installed on a foundation of Triton Marine Mattresses

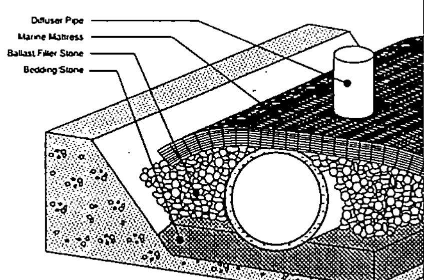


At this installation near Cardiff in the UK, Triton Cells formed the foundation of a barricade constructed as part of a tidal power generation project.

Foundations for Pipe Crossings and Sewage Outfalls

When pipe river crossings or sewage outfalls are constructed over the sea bed, undermining of the pipe system can lead to flexing which ultimately causes rupture and failure of the outfall. Additionally, sewage outfalls are especially vulnerable to storms or strong currents which can uncover the pipe, exposing it to damage.

Triton mattresses beneath the pipe can help minimize differential settlement by spreading the weight of the piping system over a larger area, reducing system flex and improving long term reliability. The pipe can also be covered with a layer of mattresses. The cover layer reduces the chance of undermining caused by scour and also provides protection to the piping system in the event of severe storms. Because Triton mattresses are integral structures, they are far less likely than rip rap to be dispersed during storm events.



Typical installation detail for sewer outfall.

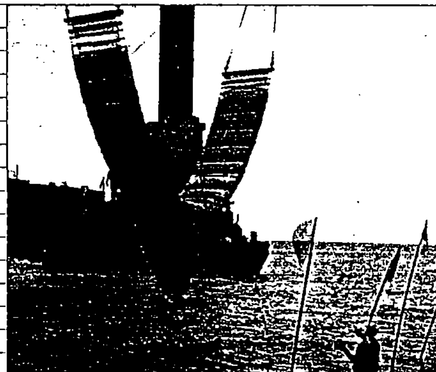


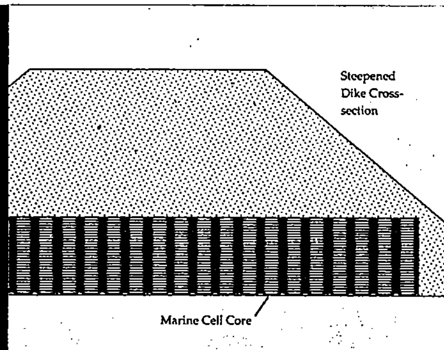
Photo courtesy of Breakwaters International

Triton Marine Mattresses being installed on the New Jersey Coast

Dredge Spoil Containment

Triton Marine Cells also lend themselves to the construction of highly secure and efficient dredge spoil containment structures. Conventional dikes normally must be built with relatively flat side slopes. As a result, they require an extensive "footprint," which may limit the overall storage capacity.

Triton Mattresses and Cells can be used in combination to create reinforced containment dikes with steeper side slopes and higher overall stability. The result is greater storage capacity. The economics of the Triton system are especially attractive considering that the reinforced core of the dike can be built with Triton cells that are filled with dredge spoil itself.



Triton Rectangular Cells as a containment dike core

Earth Retention Systems

Tensar reinforced soil structures can be used to construct piers, docking facilities, bulkheads, marina walls, or practically any type of structure that requires a reliable, corrosion-resistant earth retention system. And our experience in designing these reinforced soil composite walls is so extensive that Tensar reinforced walls can be reliably used even when heavily loaded or when placed over weak or uncertain soils.

The greatest advantage of using Tensar geogrids in these types of structures is their resistance to corrosion which means that the structural integrity of the system can be relied upon over the long term. Additionally, since corrosion is not a concern, lower quality fills can be used, greatly reducing costs.

A broad range of facing options is available, dependent upon job specifications. Triton marine walls have been designed to incorporate a vinyl sheet pile facing system, whose non-corrosive capabilities matches that of the grid. A concrete panel facing system has also been developed for higher wave impact applications. In less severe environments, an architectural finish can be specified through the use of our specially designed segmental concrete units. On every project, our design engineers can assist in determining the advantages and applicability of these facing options to allow the construction of the most cost-effective structure on a site specific basis.


Photo courtesy of Versa-Lok Retaining Wall Systems

Flood wall with segmental block facing and Tensar reinforcement - Rochester, MN.

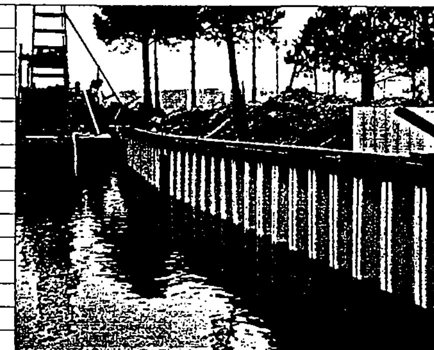
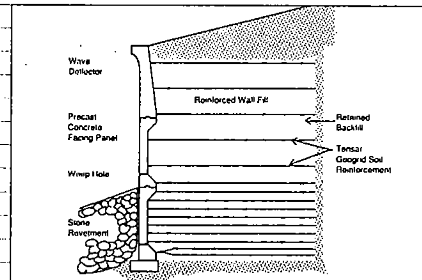
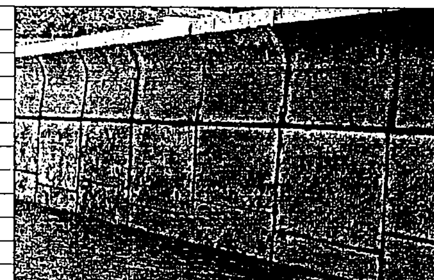


Photo courtesy of ShoreGuard

Vinyl Sheet Pile Wall - Southern Alabama



Typical wall section - Gaspe Peninsula Sea Wall


Completed photo of Gaspe Peninsula Sea Wall

SUPPORTING DOCUMENTS FOR PROPOSAL NO. C-8

Enkamat®

Erosion Control Matting

Properties and Dimensions (All values are typical unless otherwise stated)

ENKAMAT	7010	7020
Material		
Nylon 6 plus 2% by weight Carbon Black.		
Dimensions		
Weight (oz/sq. yd.)	8.0	12.0
Weight (oz/sq. yd.) minimum	7.3	11.1
Thickness (inches)	.4	.75
Width (inches)	39	39
Roll Length (feet)	500	277
Area (sq. yds./roll) minimum	180	100
Roll Gross Weight (lbs.)	92	77
Filament Diameter (inches) minimum	.014	.016
Typical Physical Properties*		
Tensile Strength - Length (lbs/ft)	190	250
Tensile Strength - Width (lbs/ft)	55	120
Tensile Elongation - Length (%)	70	75
Tensile Elongation - Width (%)	80	75
Minimum Physical Properties*		
Tensile Strength - Length (lbs/ft)	54	94
Tensile Strength - Width (lbs/ft)	27	54
Tensile Elongation - Length (%)	25	25
Tensile Elongation - Width (%)	25	25
Exposure (for 80% Strength Retention)		
Temperature Range	−100°F to 250°F	
Ph Range	3 to 12	

**ASTM 1682 strip test procedure modified to obtain filament bond strength used to indicate tensile properties of Enkamat matting.*

Typical physical properties are representative of the product in a full width application. However, due to the geometry and randomness of the product, some test results may be below the typical values stated. However, all products will have values greater than the minimum stated above. Minimum average lot values are available upon request.

Enkamat installed to provide vegetative reinforcement and erosion protection for channel way and slopes

ENKAMAT: NOW AVAILABLE IN MULTI-WIDTH ROLLS

Enkamat 7010 and 7020 are Available in Multiple Widths up to 15½′

The continuous surface of the wider widths eliminates problems occurring at the overlap and reduces installation time and expense. Call us at 704-258-5050 with your particular requirements.

Design And Installation Assistance

This brochure is intended as a general information piece. For technical help, specific information, or the name of our nearest distributor, please call or write: Akzo Industrial Systems Company, P.O. Box 7249, Asheville, North Carolina 28802, (704) 258-5050.

We believe the information contained herein to be reliable and accurate for applications of ENKAMAT®. Since conditions vary with each site, however, Akzo makes no guarantee of results and assumes no obligation or liability for such results, the suitability of the material or the information contained herein for the use contemplated, unless specifically made in writing by Akzo, or for safety or other damages occurring in connection with any installation. Furthermore, Akzo's liability under any claim shall be limited to the cost of the ENKAMAT materials or replacement thereof, at Akzo's option. This publication is not a license under which to operate and is not intended to suggest infringement upon or use of any existing patents or trademarks.

ENKAMAT is a registered Trademark of Akzo Industrial Systems Co. and is covered by a number of U.S. patents.

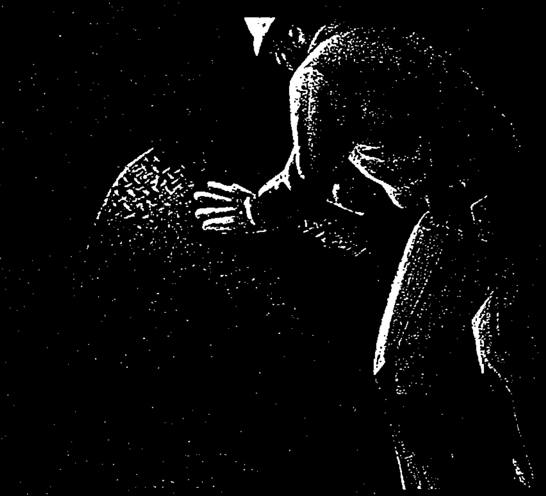
Fibers and Polymers Division

Akzo Industrial
Systems Company
One North Pack Square
P.O. Box 7249
Asheville NC 28802
Telephone (704) 258-5050
Telefax (704) 258-5059

02275/AKZ
BuyLine 1780

Enkamat®

Erosion Control Matting



Multiple solutions for:
- Ditches
- Slopes
- Pipeline Installations
- Ponds
- Slope Aquifer Interceptors
- Acid Slopes
- Earthen Dams
- Storm Channels
- Embankments
- Shoreline Protection
- Landfill Capping
- Landfill Perimeter Ditches
- Spillways
- Zoos

Gaining Ground Through Ingenuity℠

AKZO

Enkamat®

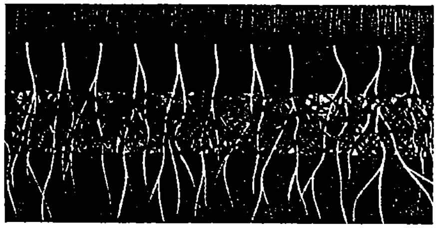
Erosion Control Matting

Enkamat: Function and Structure

Enkamat is a lightweight, flexible alternative to rigid concrete, asphalt, and rip-rap systems for controlling erosion. It is designed for use on slopes, banks, ditches, channels, spillways, landfills, shorelines, and other vulnerable erosion-prone areas.

Structurally, Enkamat is a three-dimensional geomatrix of heavy nylon monofilaments fused at their intersections. Ninety percent of this geomatrix is open space.

THE ROOT REINFORCING SYSTEM



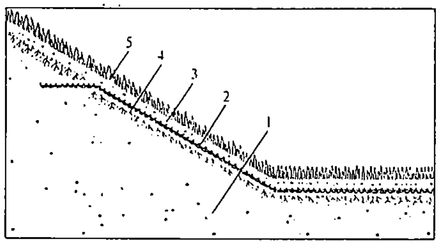
By providing open space for vegetative root growth, Enkamat supplements nature's own erosion control system. It encourages and anchors heavy plant growth which, coupled with the strength of Enkamat, provides a tough, natural ROOT REINFORCING SYSTEM (RRS) capable of enduring high flow velocities and depths. In effect, Enkamat increases the natural erosion resistance of vegetation, and the entire ROOT REINFORCING SYSTEM (RRS) acts to dissipate the energy of flowing water in an efficient and aesthetically pleasing way.

The Solution That Disappears

When installed properly, Enkamat replaces erosion scars with a uniform vegetative covering, even where slopes are steep or soil is poor. Unlike conventional rip-rap or concrete, the light-weight matting itself is buried beneath a natural plant covering. Enkamat has been used in all but the most arid climates worldwide* and is approved for erosion control by the Transportation Departments of more than 30 states.

*Note: for arid solutions, talk to us about Armater.™

Enkamat replaces a concrete-lined ditch in Pennsylvania hills, protecting channels on 22% grade against water velocities exceeding 20 feet/second. Matting supports vegetated channels on grades in excess of those allowed for rock rip-rap.



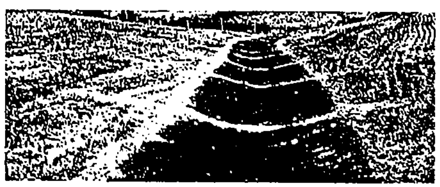
Enkamat lining is embedded into soil to form tough surface skin composite system.
1. Subsoil
2. Enkamat
3. Sediment
4. Root System
5. Vegetation

Before Vegetation Develops, Enkamat-

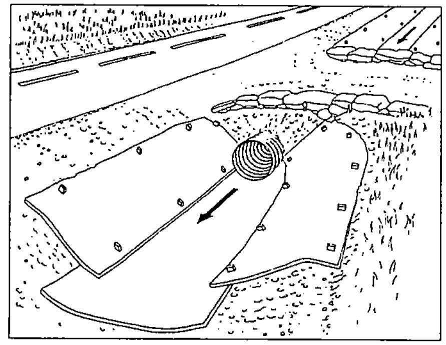
- Protects bare ground against erosion by wind and rain;
- Prevents seed washout;
- Acts as a dissipator of water energy by creating a myriad of near bottom eddies;
- Causes silt to fill the geomatrix developing a media for root development.

Stabilizes Channels

The ROOT REINFORCEMENT SYSTEM (RRS) resists the hydraulic lift and shear forces created by high volume discharges and velocities up

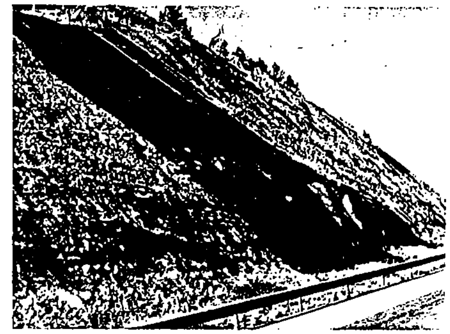


to 20 ft. per second. Concentrated lift and shear forces that would normally tear out grass clumps are instead distributed over the entire surface area of the ROOT REINFORCEMENT SYSTEM. In addition, fine eddy turbulences are prevented from isolating and uprooting of individual roots and clumps of vegetation.



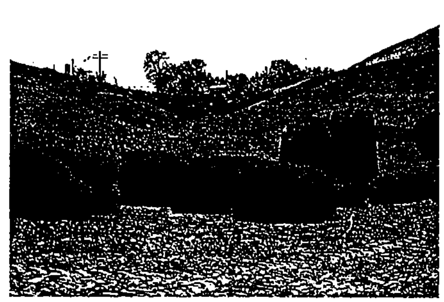
Anchors Slopes

The RRS adds significantly to the tensile strength of root systems on slopes. In fact, under water-saturated conditions, as soil cohesion and root anchorage strengths approach minima, the geomatrix becomes almost the sole support of over-stressed vegetative stands.



Vegetated Enkamat® Versus Concrete Channel Linings – A Comparison –

Enkamat	Concrete
1. Less Expensive	Very Expensive
2. Low Maintenance	High Maintenance
3. Self Healing Qualities	Subject to Undermining
4. Natural Appearance	Very Unnatural Appearance
5. Reduces Outflow Scour	Accelerates Outflow Scour
6. Resistant to Frost Heave	Susceptible to Frost Heave
7. Allows Groundwater Recharge	Inhibits Groundwater Recharge



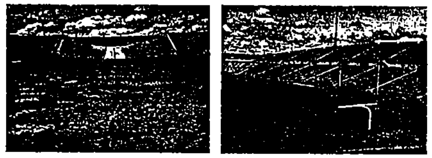
During installation, lightweight rolls of Enkamat matting can be easily handled by one worker.

Once plant roots have taken hold, Enkamat disappears beneath thick covering of vegetation that slows water flow and prevents erosion.

Enkamat 7010 and 7020 are Available in Multiple Widths up to 15½′

Enkamat® for Turf

Enkamat can also revive areas of worn-out or eroded turf. The old sod is removed with a sod cutter, then the soil is loosened and fertilized. The matting is rolled onto the soil, filled with appropriate soil mix, and sod installed. Even in high traffic areas, such as golf courses and athletic fields, the resilient matting remains open, allowing oxygen and moisture to reach plant roots.

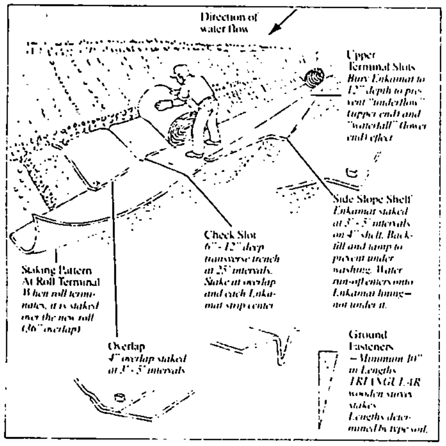


Enkamat can transform a worn-out playing field into a superior playing surface in an amazingly short period of time. Above, New Mexico State University Stadium at Las Cruces, New Mexico, before (left) and after (right) installation of Enkamat.

Installation

Enkamat is packaged in rolls that are easy to ship, store, and install. No heavy equipment is needed for installation of matting; a roll can be handled by a single worker.

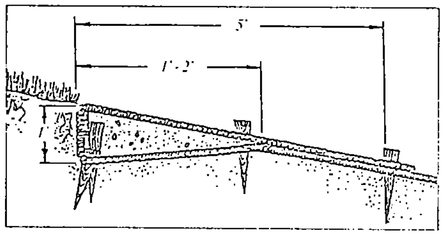
Ditch Lining



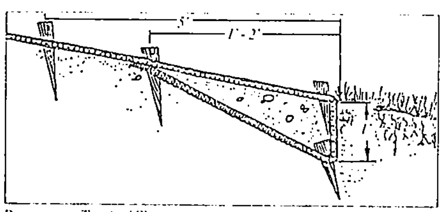
For a typical 8-foot side-slope ditch, three widths of Enkamat are installed with a 4-inch overlap, as follows:

1. Shape and compact ditch to specifications and dress site so that it is free of rocks, soil clumps, or vehicle imprints of any significant size that would prevent the Enkamat from lying flush to surface contours. Then cut side slope shelves and check slots as per the above drawing.
2. Starting downstream, cut terminal slot (see drawing) and align the initial roll along the ditch center-line, stake Enkamat into slot, then backfill. Roll the mat upstream over refilled terminal and stake as depicted. Then progress upstream with peaked side down, working across the check slots and pinning with temporary stakes to maintain tension and alignment. Then tuck mat into slots and stake. (Note: Stretch mat approximately 5% before staking; Enkamat edges should curl up.)
3. The side rolls should follow in staggered sequence behind the initial roll. Working outward from ditch center-line, overlap the first roll by 4" with another roll and lay it upslope onto the side slope shelf.
4. Proceeding upstream, stake overlaps and mat edges on side slope shelves at 3-foot intervals.
5. Repeat steps 3 & 4 with the remaining side slope roll.
6. If splicing a new roll is necessary, use 3-foot overlaps and shingle downstream.
7. Secure the upstream roll ends in a terminal slot.
8. Back-fill and tamp soil into check slots and both upper and lower terminal slots.
9. Distribute seed.

Note: Please consult the Enkamat Erosion Control Instruction Manual for complete installation specifics.



Upstream Terminal Slot

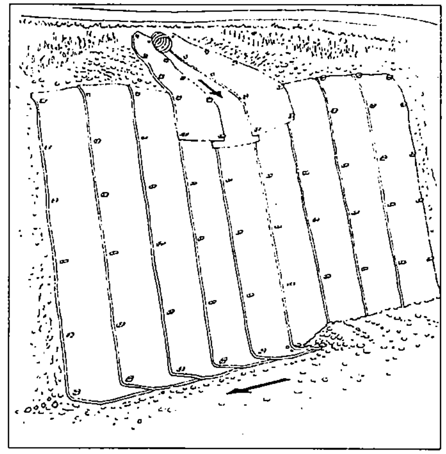


Downstream Terminal Slot

Berm Drop Swale

When storm waters are being dropped from a berm into a deep channel, the banks of the channel are first lined with Enkamat® as shown in the illustration. A shallow depression should be shaped to form a swale extending over the berm edge and downslope.

Then a culvert output channel on the berm is shaped and lined with Enkamat. This channel lining overlaps onto the bank lining.



Case Study: Acid Slope Stabilization Along A Texas Highway

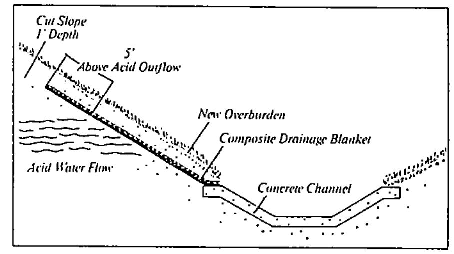
Groundwater moving through sulphide minerals can produce extremely acidic conditions in aquifers. If a highway is cut through an acidic aquifer, slope soils may have such a low pH that vegetation cannot grow, and erosion may proceed unchecked.

In May 1980, a layer of Enkamat sandwiched between two layers of a non-woven geotextile fabric was installed on such a slope, adjacent to Texas State Road 59, 9 miles north of Atlanta, Texas.

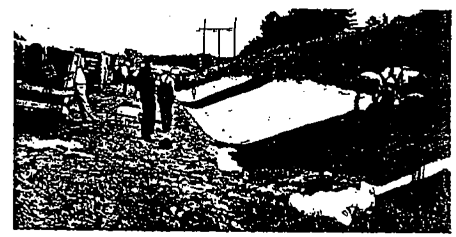
Before installing, 8 inches of highly acidic surface soil was removed from the 21-foot drop and downslope. The cut extended 8 inches beneath the original roadside drainage ditch.

Then the Enkamat "sandwich blanket" was installed, a clean 8-inch layer of overburden was placed on top of the "sandwich blanket" and seeded.

With the new drainage, the seed grew and flourished. Acidic waters from the slope now seep through the fabric layer and are routed downslope through the Enkamat layer into a drainage ditch. The fabric also prevents soil from entering and obstructing flow in the Enkamat. The site of acidic emission has disappeared beneath permanent vegetation. An alternate design for the disposal of acid water is to drop it into a concrete-lined channel.



Before installing Enkamat on an acid slope next to Texas highway, 8 inches of acid-contaminated soil was removed.



An Enkamat "sandwich blanket" (Enkamat between two layers of non-woven geotextile fabric) was installed along slope, extending from above site of acid seepage to 8 inches below original roadside drainage ditch.

"Sandwich blanket" was then covered with a clean soil and seeded. Acidic water is now intercepted and conveyed harmlessly to a drainage ditch.

The Manning Equation

To determine channel capabilities for carrying off predetermined water volume, the following equations are commonly applied. However, since some of the variables are rather nebulous and published energy dissipation values of (n), at best, are rough approximations, it behooves the design engineer to use his best judgment in applying them.

The generalized Manning equation:

EQUATION A: $V = \frac{1.49 R^{2/3} S^{1/2}}{n}$

Where:
V=Average water velocity (f/s)
R=Hydraulic radius (f)
S=Hydraulic gradient (f/f)
n=Coefficient of roughness factor

EQUATION B: HYDRAULIC RADIUS
R=A/W.P.
Where:
A=Cross sectional area
W.P.=Wetted perimeter

EQUATION C: Carrying Capacity
Q=AV
Where:
Q=Carrying capacity of channel (cfs)
A=Cross sectional area (f^2)
V=Average water velocity (f/s)

Table A-1 Enkamat® Channel Performance Data

Site		North Dakota DOT	Pennsylvania DOT	
Slope (S_o=%)		3.4	22.5	
Depth (ft.)		1.0	0.4	0.5
Enkamat Condition	**Estimated "n" Value**	**Velocities (Ft/Sec) Calculated for Constant Depth (Not Vegetated)**		
Bare	0.04	6	8	9
Silt (Partial)	0.03	8	11	12
Silt (Full)	0.02	12	16	18
Received from Authorities		**Computed**	**Measured**	
Depth (ft)		0.8	?	
Velocity (f/s)		7.8	10	
		(n=?)	(n=0.04)	

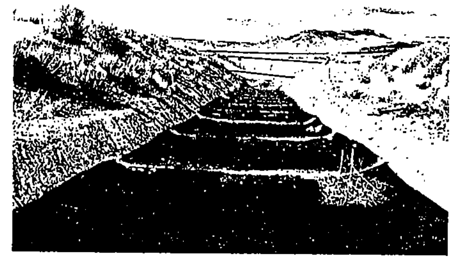
Table A-2 "n" Values

Estimated for Various Enkamat Channel Lining Conditions at S = 5%, Water Flow Depth = 2 - 12 inches

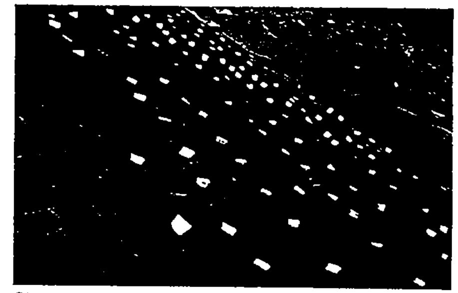
Not Vegetated		Vegetated	
Condition	"n"	Condition	"n"
Bare	0.045 - 0.035	Short Growth	0.15 - 0.03
Silt (Partial)	0.035 - 0.025	Medium Growth	0.35 - 0.03
Silt (Full)	0.025 - 0.015	High Growth	0.40 - 0.04

Enkamat 7010 and 7020 are Available in Multiple Widths up to 15½′

Enkamat® erosion control matting replaces rip-rap and concrete for:



Ditches
Controls water velocities up to 20 ft./sec.; mechanically strengthens root systems.



Slopes and Banks
Used on slopes up to 1:1 and steeper; requires no heavy equipment to install.

Pond Banks, Shorelines
Provides a natural vegetative cover instead of concrete; withstands wave action and prevents undercutting.

Aquifer Interceptor
Intercepts acidic water flow, preventing vegetative burnout. Reroutes subsurface water, preventing blowouts.

Roadside Storm Channel

Installed in a storm channel in North Dakota, Enkamat caused run-off to slow, silt to drop from water and fill the matting. As anchorage for roots increased, plants took hold and can now withstand velocities in excess of 10 feet/second at 1 foot depth. Matting has been in place more than 8 years.

After installation in a storm channel, the matting quickly becomes a reinforcing matrix for soil and plant roots. Once plant roots have taken hold, Enkamat disappears beneath a thick covering of vegetation that slows water flow and prevents erosion.

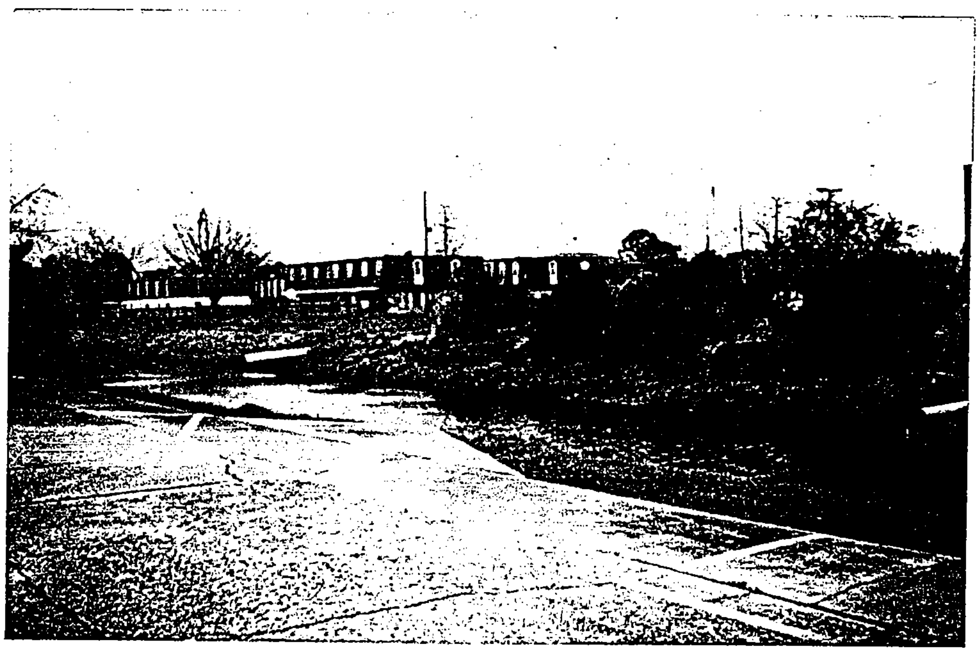
Enkamat channel in the Badlands of North Dakota withstands velocities in excess of 10 feet/second at 1 foot depth. Functioning as an energy dissipator, Enkamat causes silt to drop out of water and fill the matting, thus increasing anchorage. Matting has been in place over 8 years.

SUPPORTING DOCUMENTS FOR

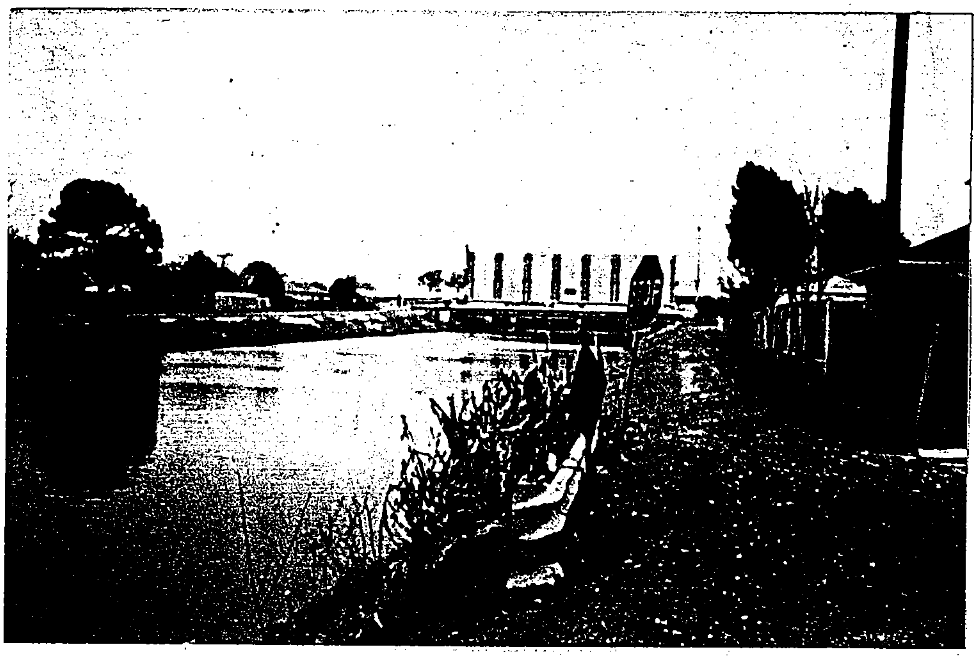
PROPOSAL NOS.

C-11, C-12, C-13, C-14, C-15, & C-16

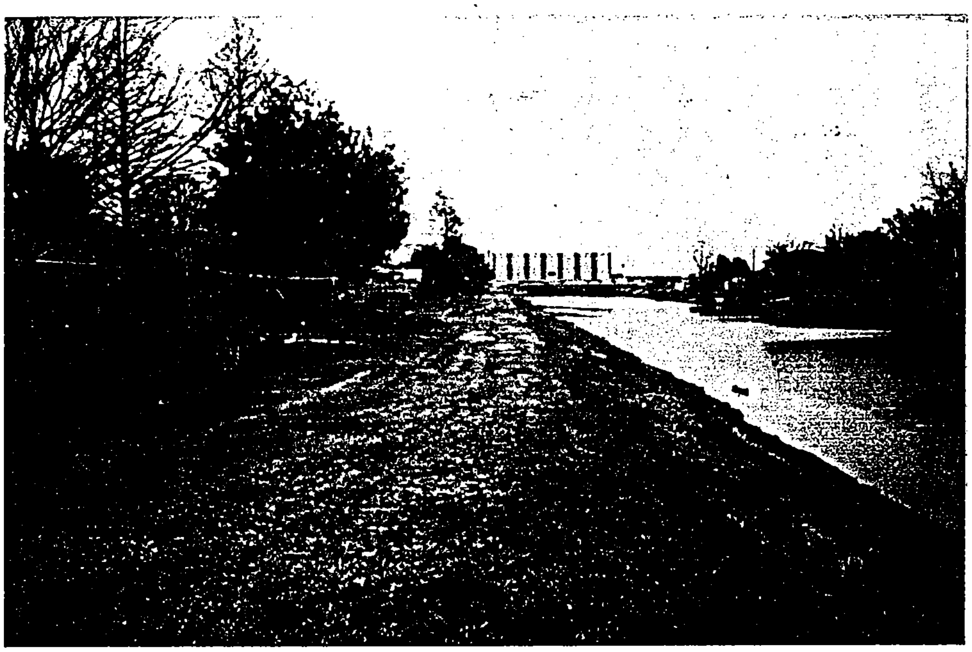
Suburban Canal - Reach 11



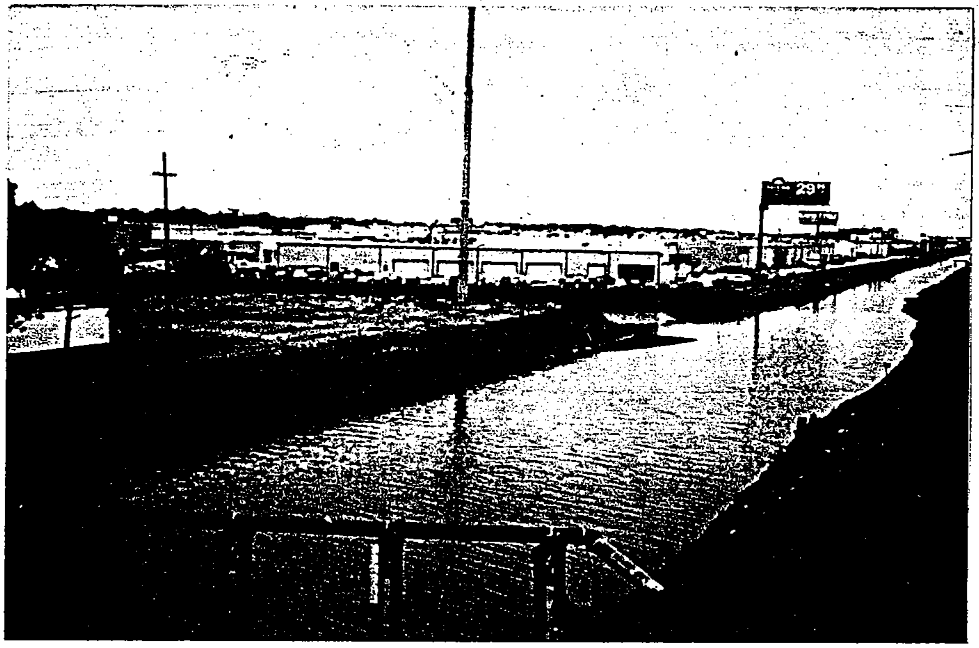
Suburban Canal - Utica Street



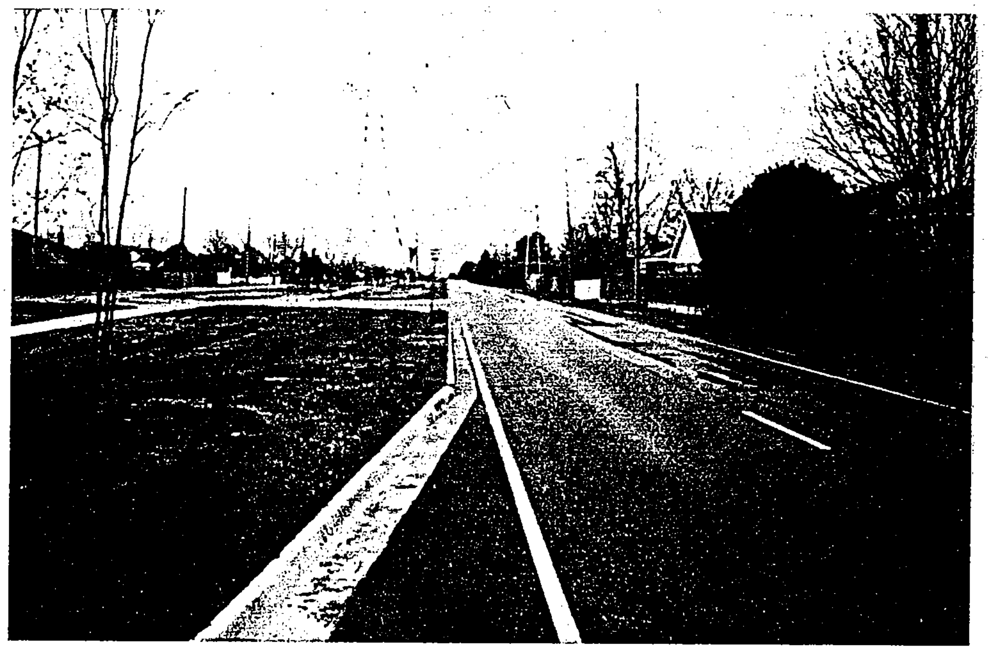
Suburban Canal - PS#2



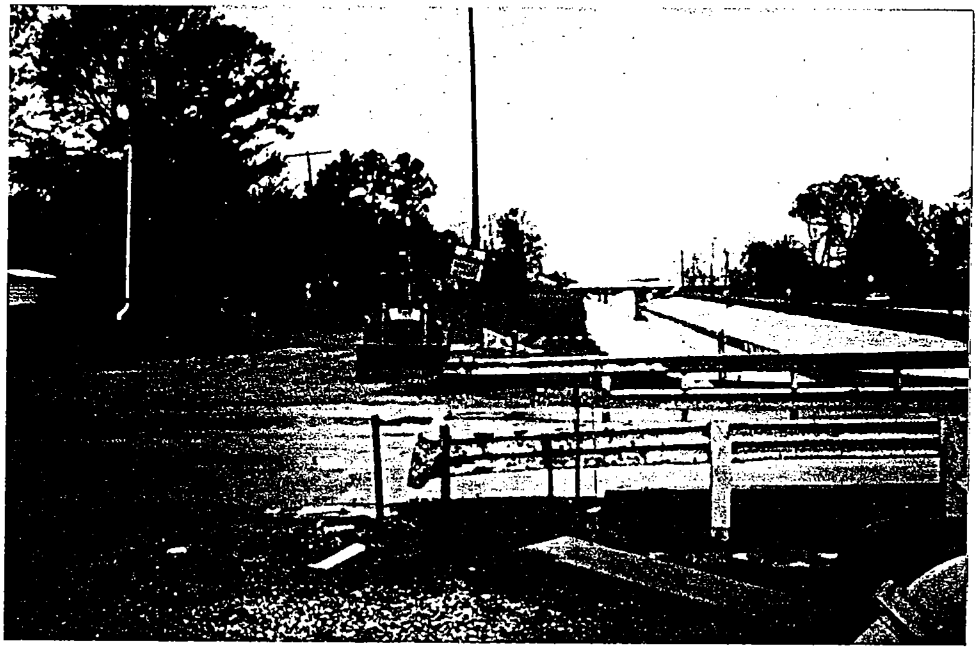
Suburban Canal - PS#2



Canal No 3 - Soniat Canal

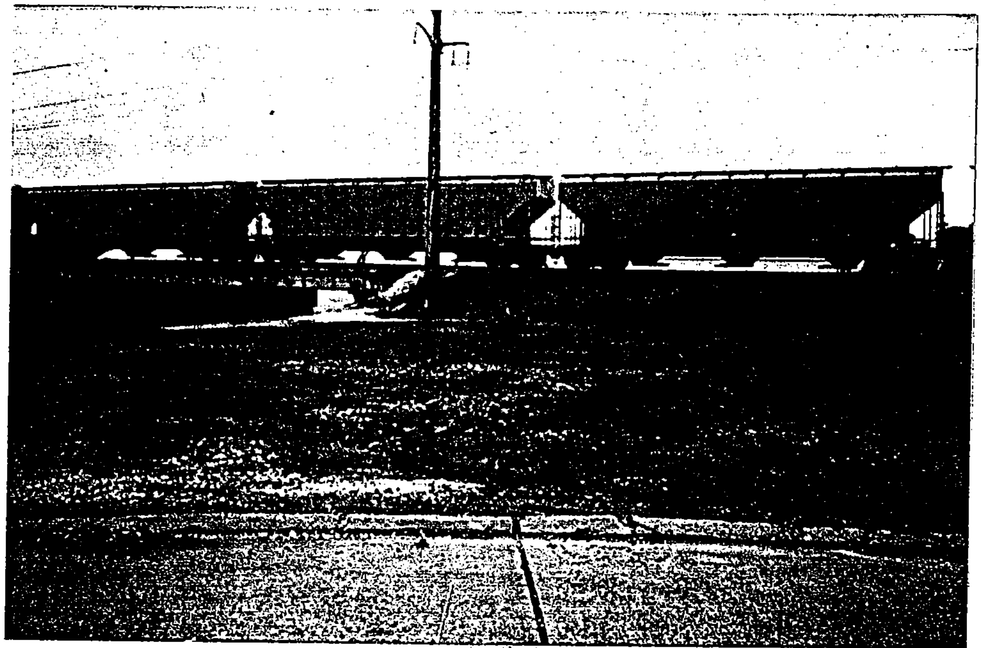


Power Blvd

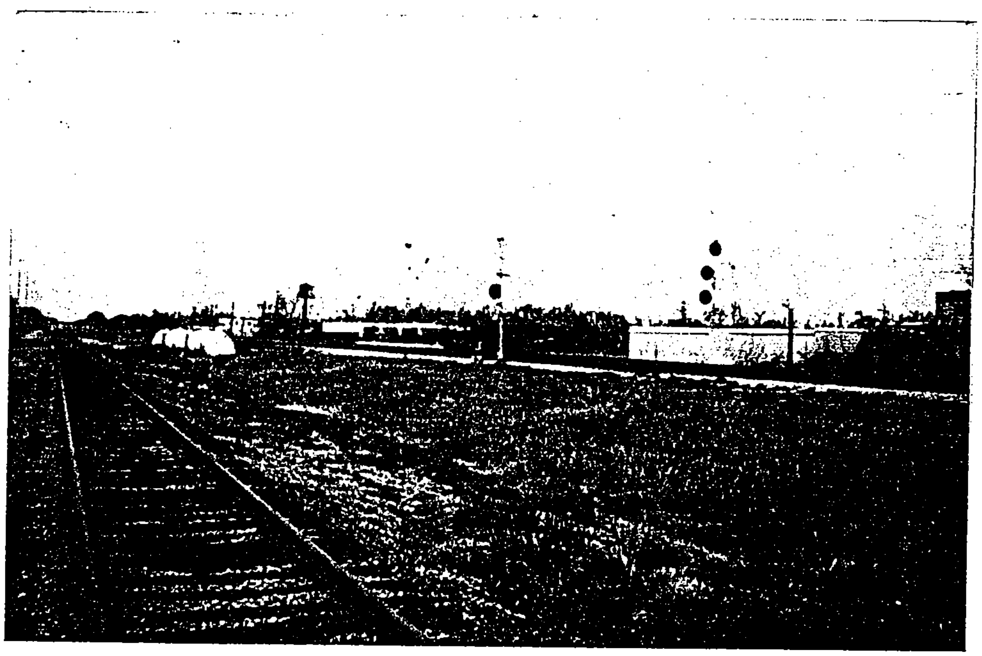


Sonict Canal - Suave Road

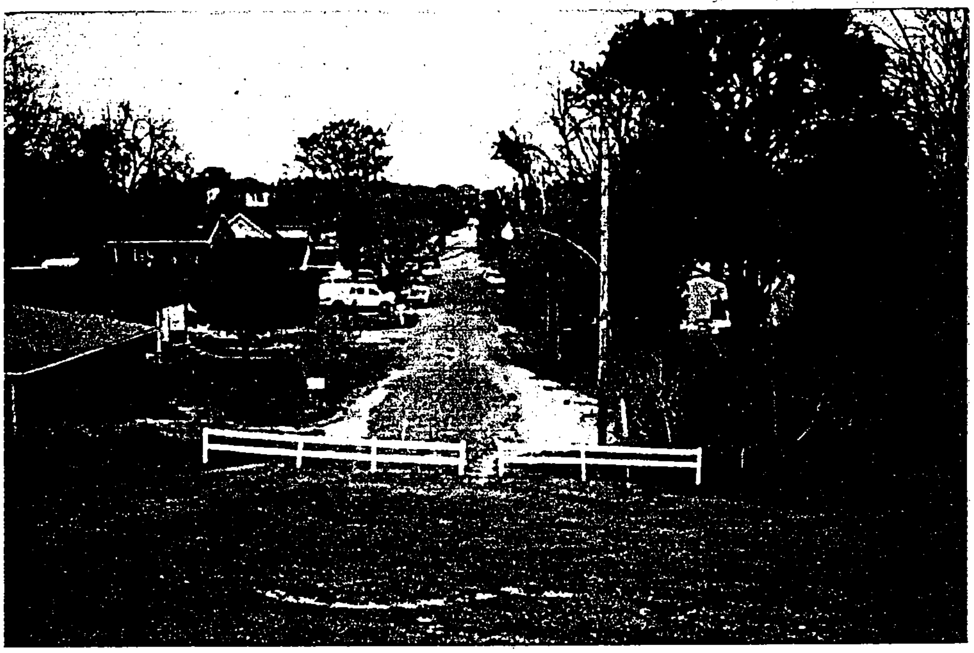
Suave Road - Hawthorne



S.E. Corner Soniat Canal @
R.R. Crossing

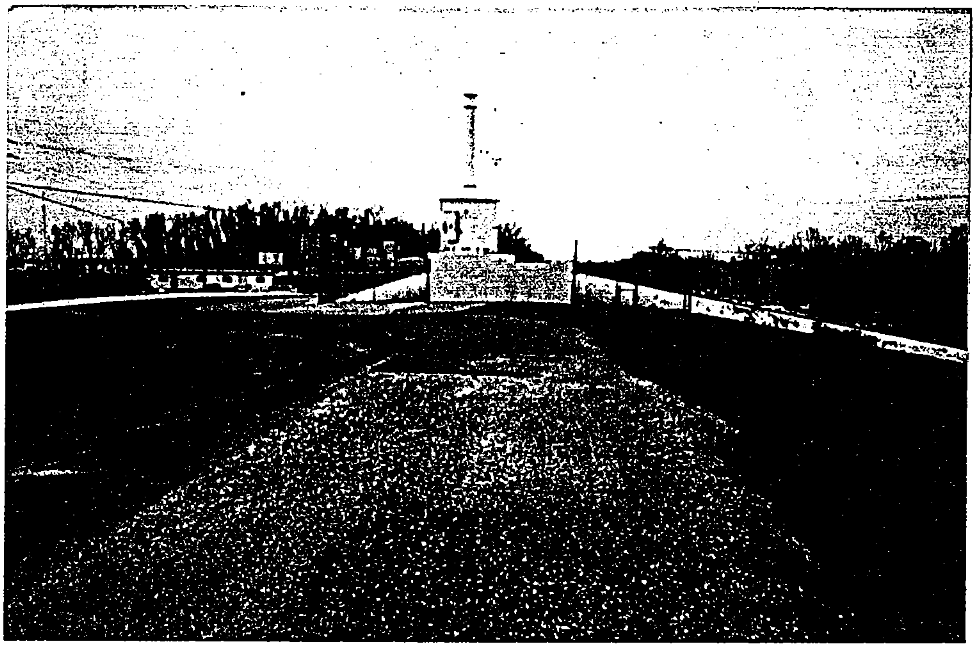


N.E./N.W Corners Soniat Canal @
R.R. Crossing



Tallulah St Corridor to River

Valerie St Corridor to River

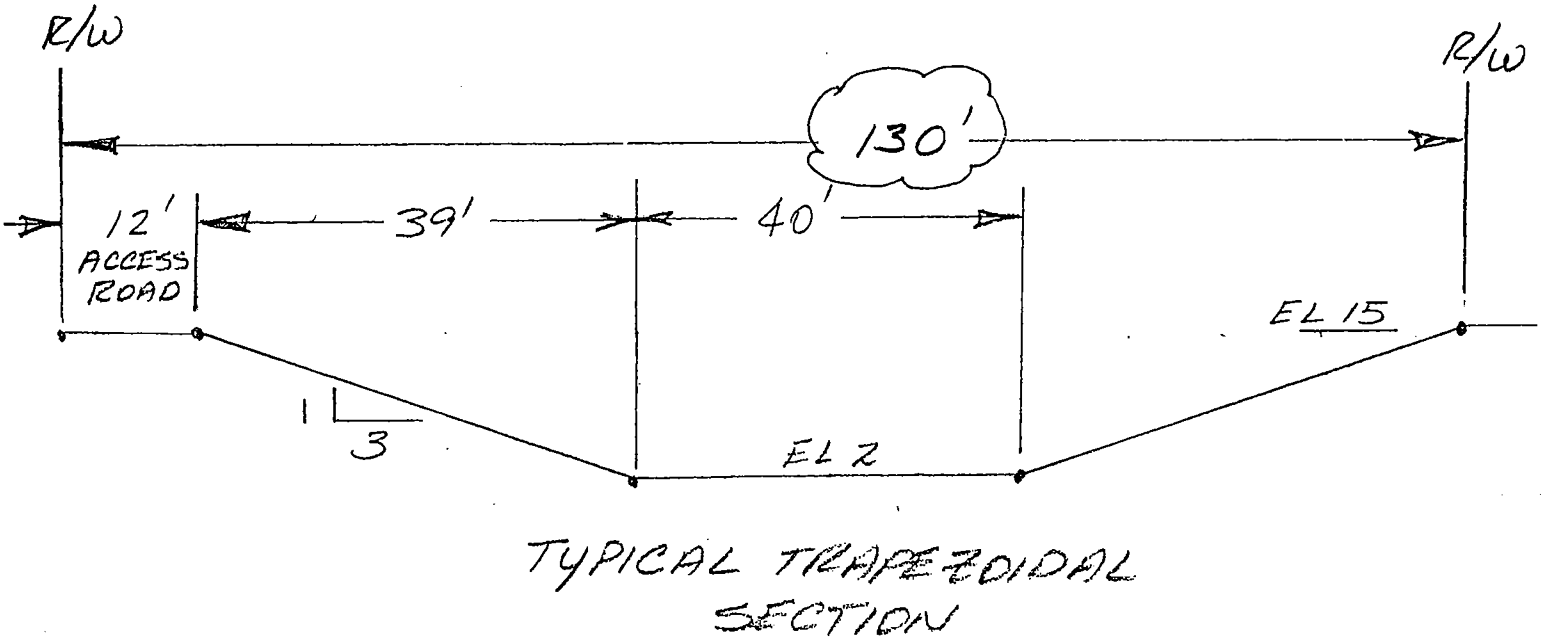


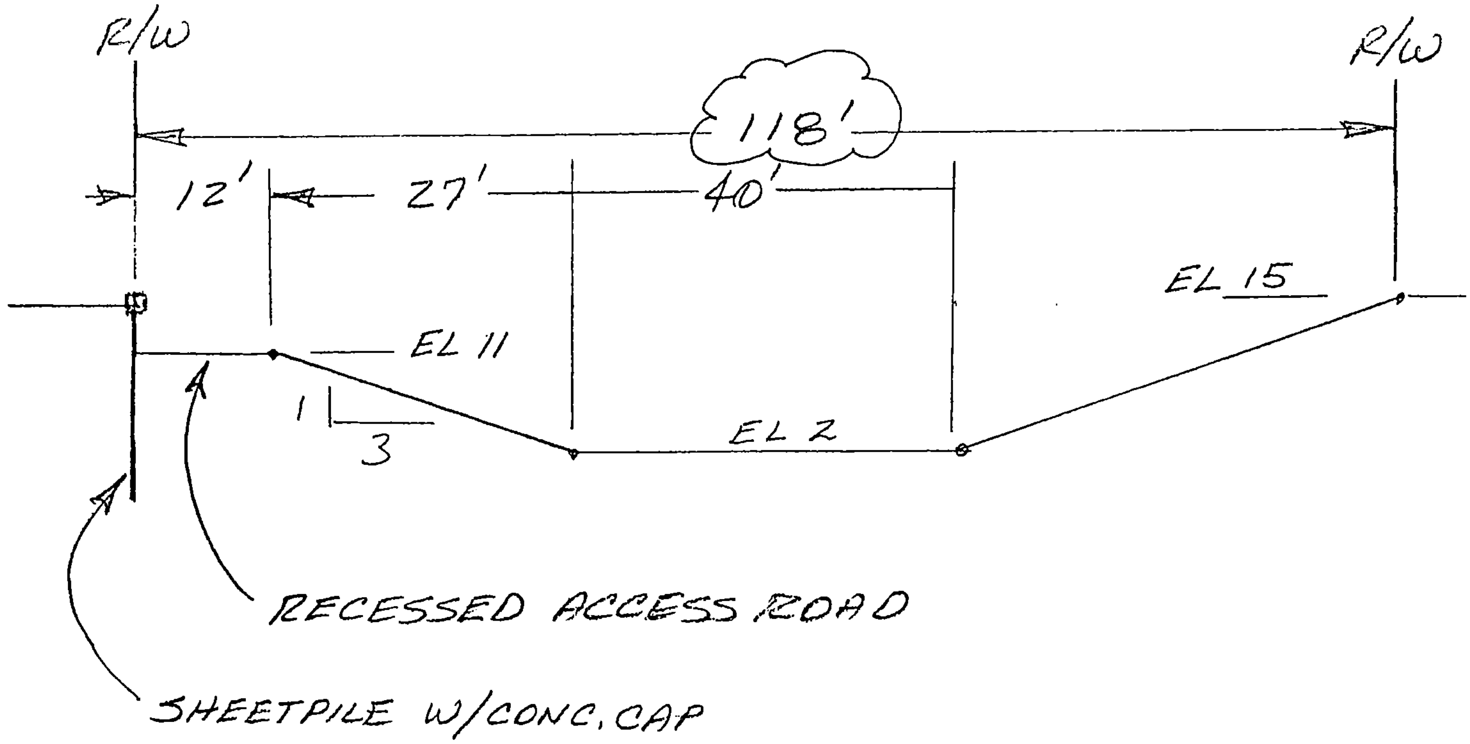
Existing (2) 54 I.D. Wastewater
Outfall Lines on Florida St.
(1 block u/s of Tallulah St.

SUPPORTING DOCUMENTS FOR COMMENT NO. 3

VALUE ENGINEERING COMMENTS

DRAWING FOR COMMENT NO. 3





SUPPORTING DOCUMENTS FOR COMMENT NO. 5

Winter 1996

Volume 26, Number 4

DIGEST Concrete Pressure Pipe

The City of Winnipeg Chooses Concrete Pressure Pipe

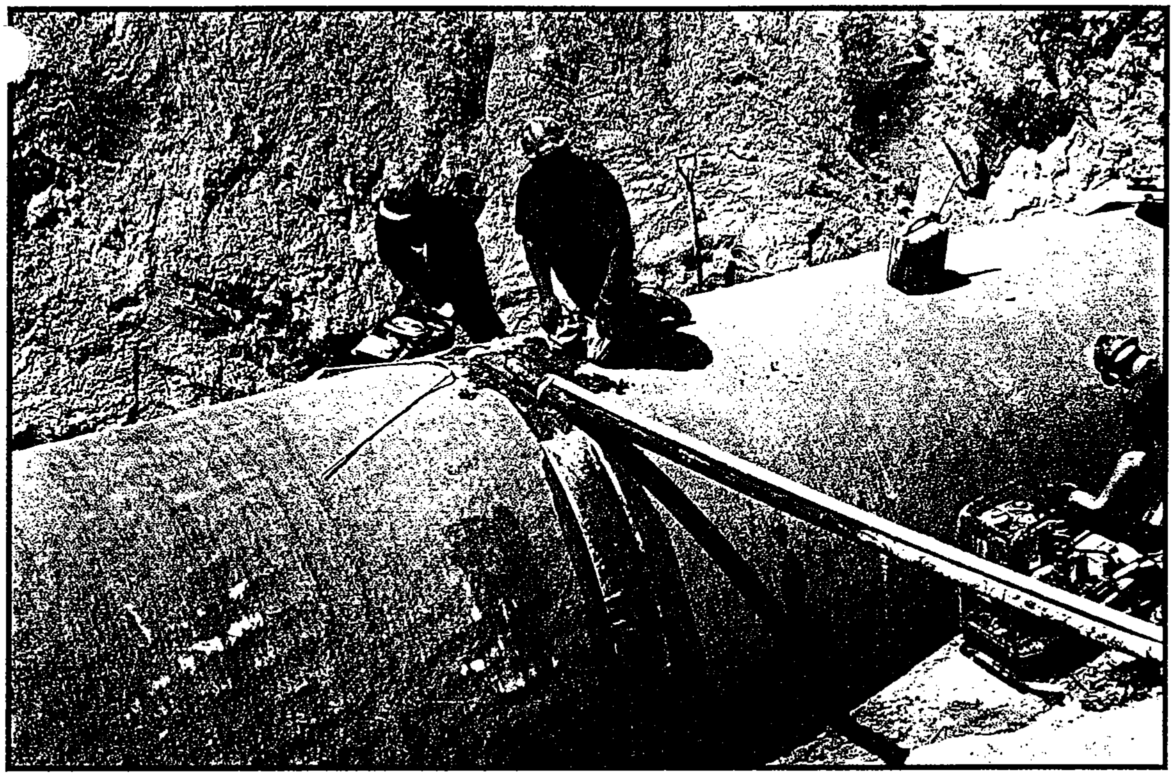
Once again, when large diameter water transmission pipe was needed, Concrete Pressure Pipe was selected. The project requirements were stringent and the construction schedule compressed. The City of Winnipeg, Manitoba, Canada, needed to expand its supply system but it also needed to install the new pipe to a most ambitious schedule. Personalized service by the pipe supplier, a partnership philosophy of project management and Concrete Pressure Pipe made the task easy.

Winnipeg's construction contractor, Nelson River Construction, Inc., prepares to install a 54-inch (1350 mm) diameter closure section for the inlet pipe.

The City of Winnipeg is located in the western Canadian province of Manitoba, at the junction of the Red and Assiniboine Rivers, almost at the geographic center of North America. With an ethnically diverse population of 637,700, Winnipeg is characterized by slow but steady growth. It is the eighth largest city in Canada and dominates the Manitoba economy as a major grain, financial, manufacturing and transportation center.

Winnipeg's water system is made up of a complex, but integrated group of parts that deliver water from Shoal Lake to the businesses and residences. Since completion in 1919, the 100-mile (160 km) long Shoal Lake Aqueduct has provided a reliable water supply. Winnipeg's water works system has expanded to serve 170,000 commercial and residential customers across approximately 108 square miles (270 square km) of the developed portion of Winnipeg. The Shoal Lake Aqueduct conveys water to the city by gravity. In Winnipeg, pump stations move the water into and through the distribution system. The head works for the distribution system is the Deacon Reservoir, initially constructed in 1972, and Deacon Booster Pumping Station, completed in 1978. Subsequent enlargements to the Deacon Reservoir were constructed in 1977 and 1996 by addition of reservoir cells to the current total capacity of 4100 ML. Other regional reservoirs provide for daily distribution system operational storage.

The 1996 expansion resulted in construction of two new cells and installation of 4,360 feet (1331 m) of reservoir cell interconnecting pipe and Booster Station connection line.



The joints for this 84-inch (2100 mm) diameter Prestressed Concrete Cylinder Pipe were protected by pouring grout into a grout band wrapped around the pipe.

Selection of PCCP for the project was natural, given the match of pipe capability with project requirements.

Project bid documents were made available in February of 1995, and construction started in May.

The City of Winnipeg Waterworks, Waste and Disposal Department designed and managed the construction of the entire project and Nelson River Construction, Inc., of Winnipeg, was the pipe installation contractor. All of the PCCP was

.lthough a number of pipe materials were considered, Prestressed Concrete Cylinder Pipe was selected based upon its superior physical and performance characteristics. Pipe comparison requirements included:

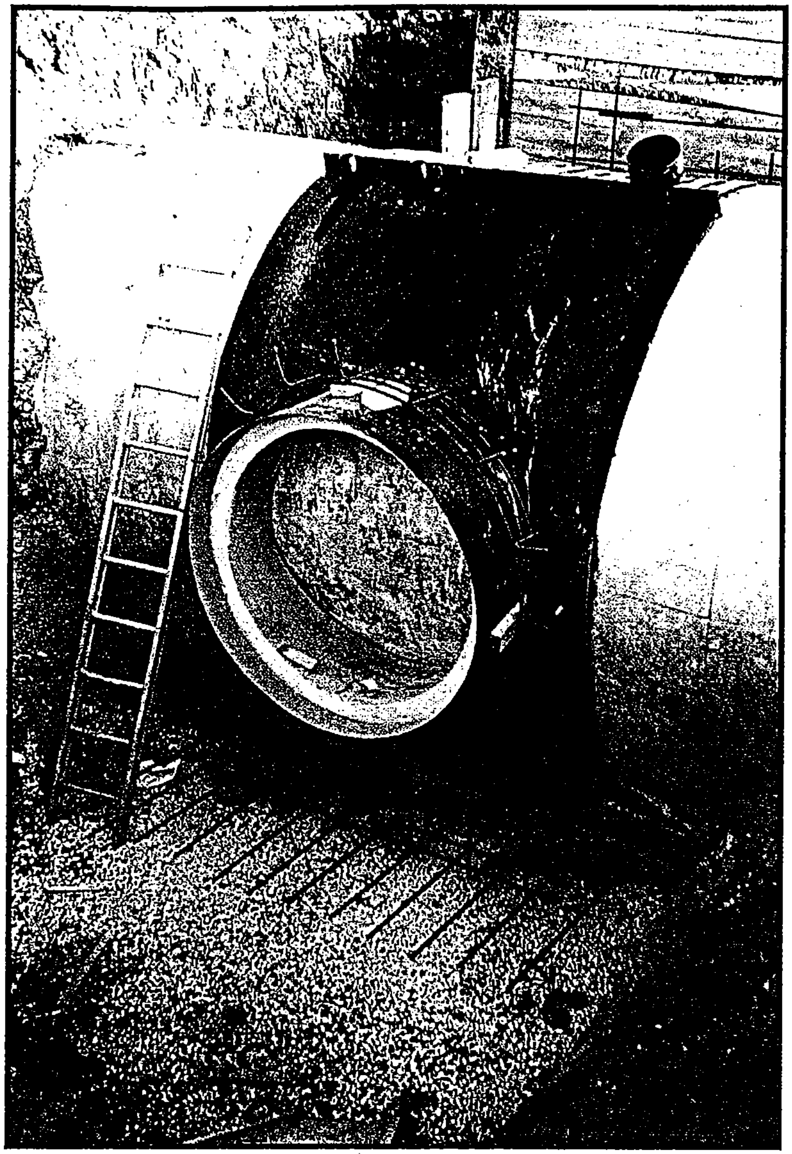
- Joint systems were required to be bottle-tight to leakage into or out of the pipe. Water quality and conservation were both important. Concrete Pressure Pipe's preformed bell and Carnegie spigot joint rings with O-ring seals meet the requirement.
- The reservoir interconnections imposed high external loads due to substantial burial depths. Concrete Pressure Pipe is ideally suited to high external loads.
- The nature of the site was such that some differential ground movement was expected and therefore the pipe selected must be able to tolerate the movement and remain intact and round. PCCP is a rigid pipe with plenty of beam strength, well able to withstand the expected movement.
- Typically in water systems, material's resistance to corrosion is important, no less for Winnipeg. PCCP's concrete lining, in contact with the water, and its portland cement-rich mortar coating, in contact with the surrounding soils, totally prevent corrosion of the reinforcing steel elements of the pipe.
- The project involved pipe sizes from 54-inch (1350 mm) to 84-inch (2100 mm) in diameter. PCCP, as well as other Concrete Pressure Pipe types are readily available in a whole range of large sizes, as well as smaller ones also.

WE ARE INTERESTED IN WHAT YOU HAVE TO SAY

The American Concrete Pressure Pipe Association is conducting a survey of pressure pipe owners/specifiers/ contractors to learn their views about Concrete Pressure Pipe relative to other pipe materials.

If you receive a market survey, please take the time to fill it out and return it to our market research firm, AWP Research. ACPPA performed an in depth market research program in 1993, which lead to a series of programs designed to respond to customers comments and suggestions.

Now, we are interested to know if we have made a difference. Your attention to completing the survey will be helpful to us. Should you not receive an ACPPA Market Survey, and wish to give your views, please call for your personal copy.



A specially manufactured 54-inch (1350 mm) diameter tapping saddle assembly was installed on the existing cast-in-place concrete aqueduct to provide for the interconnection with the new reservoir cells.

designed and manufactured in accordance with the AWWA Standards C304-92 and C301-92, and supplied by Hyprescon, Inc., of St. Eustache, Quebec.

The project contained several unique requirements for the pipe supplier. Pipe joint testing for each joint as the pipe was laid was necessary due to burial depth and construction speed. PCCP's special double-gasket testable joint was specified for this project to allow for immediate testing of each joint as the pipe was installed.

Special outlet saddles were needed to connect the new pipe to the 75-year old concrete aqueduct. In order to supply water to the two new reservoir cells, two custom fabricated saddles with 54-inch (1350 mm) diameter outlets were designed and constructed by the pipe supplier to tap into the existing 96-inch (2400 mm) aqueduct. The pipe supplier measured the aqueduct at the two connection sites and made a template for the saddle plate. In a manner similar to tapping Concrete Pressure Pipe, but without pressure, the saddle assembly was installed and an opening was cut into the aqueduct. The entire outlet was then completely encased in concrete. Several valve chambers were also installed to house the reservoir connection control valves.

The pipe and fittings for this project were shipped from Hyprescon's St-Eustache plant in Quebec by railcar to an offloading facility in the City of Winnipeg. The pipe was then transferred to trucks for the trip to the job site on the eastern outskirts of the city.

The trucks of pipe and fittings were unloaded and stored at the site by Nelson River Construction. Timing was of the essence and a concerted effort by the pipe supplier and the transport companies ensured that the shipments made it to the job site on time. Installation of the pipe and fittings began in June 1995 and was completed the following October.

According to Mr. Ed Kozera, Contract Administrator for Nelson River Construction, "The timely delivery of the Concrete Pressure Pipe was extremely well tailored to our construction schedule and allowed us to complete our work many months ahead of the project schedule."

Messrs. Jerry Comeau, Terry Whiteside and Chris Trupish of the City of Winnipeg were responsible for the design and specifications for the project.

Mr. Bob St. Goddard of the City of Winnipeg was the onsite representative who assisted in the coordination of pipe shipments with the contractor's installation schedule. In the spirit of partnering, an organized effort between the City of Winnipeg, Nelson River Construction, Inc. and Hyprescon, Inc., insured that enough pipe and fittings were on hand at all times to optimize the installation schedule.

Contributed by Karl Hartl
Hyprescon, Inc.

Concrete Pressure Pipe in Tunnel Installations

Tunneling is a necessary aspect of water pipeline construction. Tunnels are used to avoid obstacles such as mountains and rivers. Tunneling is also used to avoid open excavation which would affect traffic filled city streets or residential neighborhoods. In many urban areas, open excavation is costly and disruptive.

Because Concrete Pressure Pipe is so rugged and maintains its joint configuration, even when transmitting substantial forces, it is an ideal pipe material for tunnel installations.

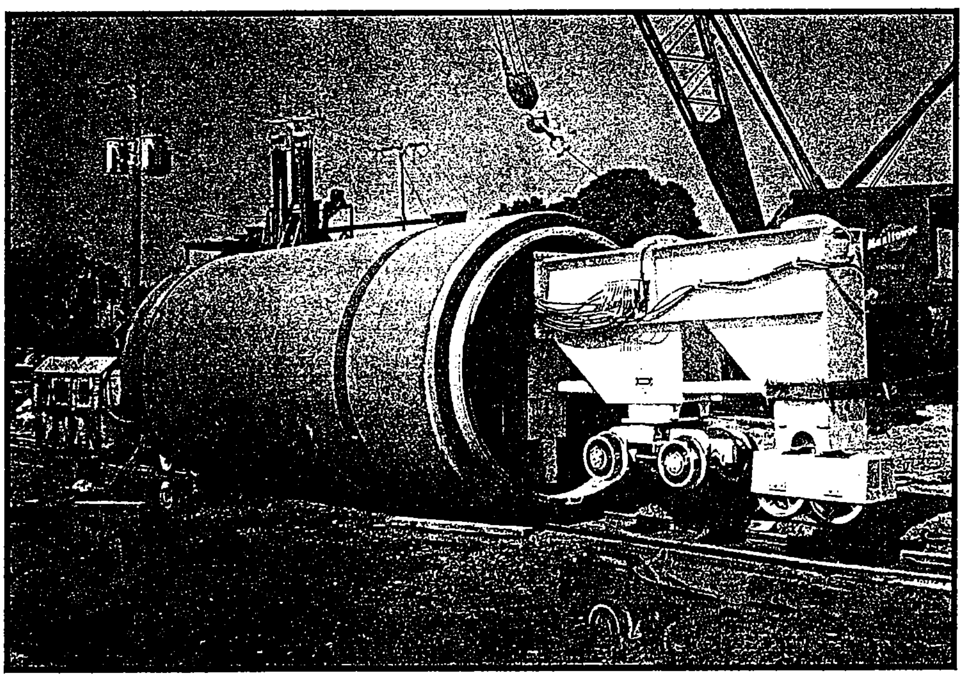
All four types of Concrete Pressure Pipe namely: Prestressed Concrete Lined Cylinder Pipe, Prestressed Concrete Embedded Cylinder Pipe, Bar-Wrapped Concrete Cylinder Pipe and Reinforced Concrete Cylinder Pipe assure leak-proof systems and are ideally suited for use in these tunnel applications.

Construction Methods

Construction methods for installing Concrete Pressure Pipe in tunnels varies with the size of the pipe, the length of the tunnel and the type of primary liner casing system used.

Installation of a 30-inch (750 mm) diameter Prestressed Concrete Cylinder Pipe through a steel casing under a roadway.

The liner casings are usually one of four types: steel liner plate, steel ribs and timber lagging, precast concrete segments or concrete pipe itself. There are two construction methods used to install the tunnel casing - tunneling or jacking. Each project requires individual evaluation by experienced engineers to determine the appropriate installation method to follow.



After tunnel excavation was completed, this unique pipe carrier was used to move each section of Prestressed Concrete Cylinder Pipe into position to complete the joint quickly, precisely and safely.

For smaller diameter pipe in short tunnels, such as those under a highway or a railroad, it is common practice to slide the Concrete Pressure Pipe through the liner.

Transporting or moving large pipe into or through the tunnel varies from a simple push-pull skidding arrangement, using hydraulic jacks or winches and cables, to special pipe carrying machines that not only transport the pipe but are capable of positioning and joining a section of pipe to the previously placed section.

Joint Testing

No pipe laying job is complete without testing the joint for leaks. Competitive pipe materials require filling the line with water and applying a pressure to test for leaks. Typically, that is accomplished after a considerable amount of pipeline has been placed into the tunnel. Should a leak occur, finding it is a major problem and correcting it is a larger one. With Concrete Pressure Pipe a double O-ring testable joint alternative gives the pipe laying contractor the assurance of watertight joints, immediately after make-up, and it takes only minutes to perform. In practice, the joint employs dual O-ring gaskets with an air test fitting installed between them, accessible from the interior of the pipe. Immediately after making the joint, the contractor connects an air line from a small air tank or pump to the test fitting and pressurizes the space between the gaskets. Any leakage is detected immediately. However the pressure is usually maintained for approximately five minutes. On the rare occasion that leakage takes place, the joint is disassembled and the gaskets are replaced.

Pipe Protection

If Concrete Pressure Pipe is to be pushed or pulled into the tunnel liner, care must be taken to protect the pipe from damage. Provision must also be made to protect the steel bell and spigot joint rings.

- Timber sections can be strapped to the exterior of each pipe to act as runners, with the liner surface lubricated, possibly with bentonite.

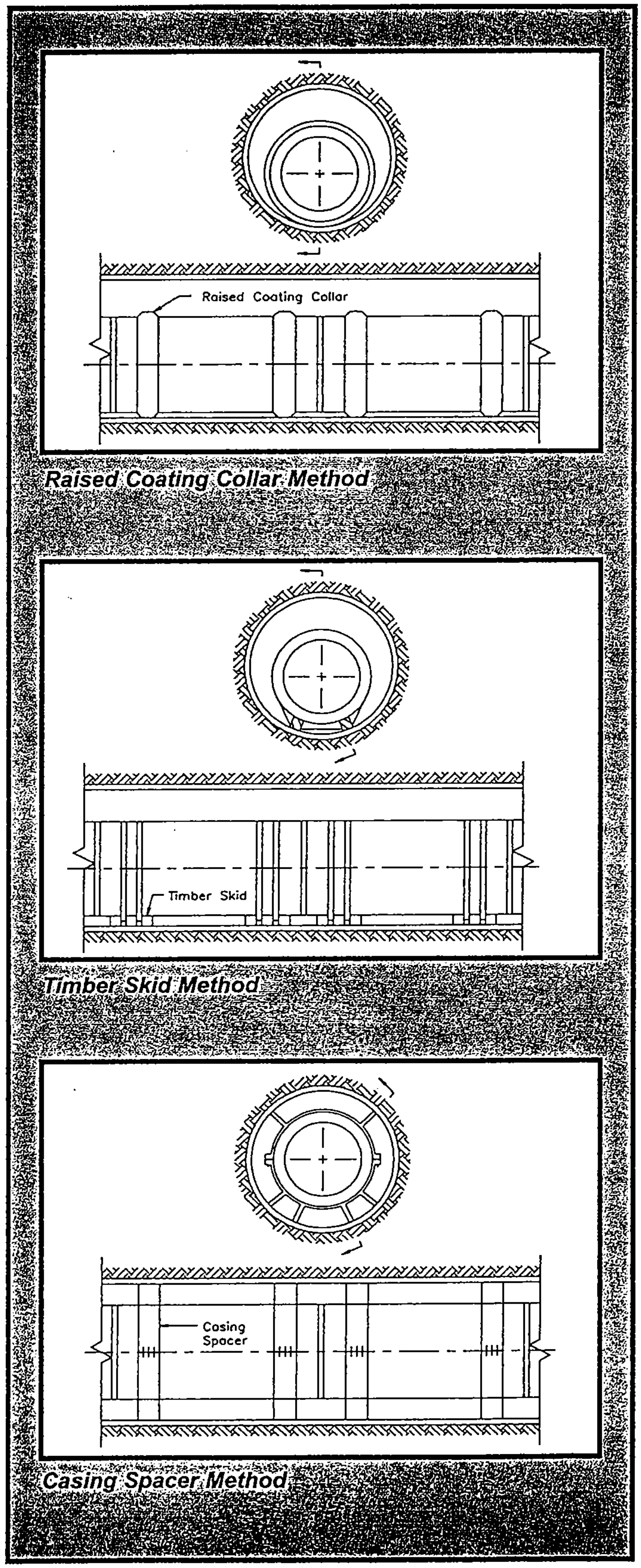
- For mortar-coated Concrete Pressure Pipe, an additional band of mortar can be applied to the exterior of the pipe, during manufacture, to act as a wearing surface.

- Exterior segmented bands, with plastic tipped steel ribs, called casing spacers, can be bolted together around the pipe at the job site. The ribs act as runners, reducing friction and protecting the pipe exterior from damage.

- In any push-pull installation, a lubricant, such as bentonite, may also be used on the tunnel casing system to reduce the sliding resistance.

- If pipe is to be pushed or pulled into the tunnel casing, the pipe ends must be protected from damage. That can be accomplished with timber cushions placed in the joints. Consult with the pipe manufacturer for details.

Regardless of the pipe installation method, if the annular space between the tunnel liner and the Concrete Pressure Pipe is not filled with portland cement mortar or grout, then joint protection must be applied, either by grouting the joints, painting or metalizing the steel joint rings, or by another joint protection system.



Methods of installing Concrete Pressure Pipe inside a casing.

Long-Term Pipe Support

Typically, the annular space between the Concrete Pressure Pipe and the tunnel liner is filled with portland cement mortar or grout. A bulkhead is used to retain the mortar or grout. It is placed in the annular space at each end of the section that is to be grouted to retain the mortar or grout. Provision must be made to prevent floatation of the pipe and to vent trapped air.

Grout may be delivered to the annular space through ports installed in the pipe walls during manufacturing, or by use of a grout placement line extended back to the remote bulkhead. The grout placement line is withdrawn as the grouting progresses.

Alternatively, the annular space may be filled with sand, or the pipe may be blocked, top and bottom as well as sides, to prevent its shifting in the tunnel.

Applications

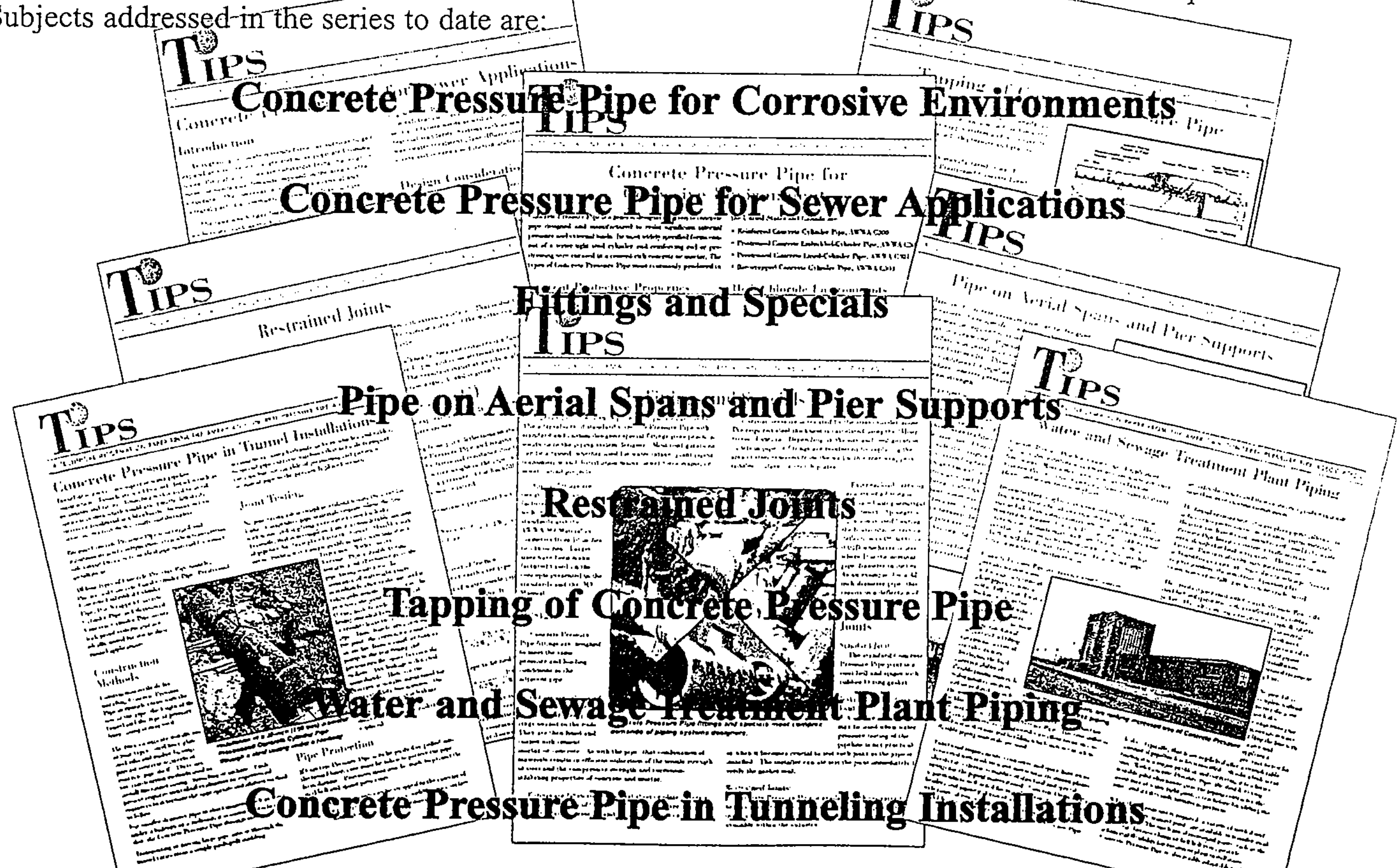
There are many successful applications of Concrete Pressure Pipe installed in tunnels. Concrete Pressure Pipe is manufactured with concrete supporting the compressive loads, and reinforcing steel resisting the tensile loads.

Whether the pipeline must traverse a river, pass under city streets or be placed under railroad or highway embankments, Concrete Pressure Pipe can be designed and manufactured to take the loads of installation, and still perform for a lifetime.

TIPS

A TECHNICAL INFORMATION PAPER FROM THE AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION

There are eight technical publications now available from the *American Concrete Pressure Pipe Association*. Subjects addressed in the series to date are:



Concrete Pressure Pipe for Corrosive Environments

Concrete Pressure Pipe for Sewer Applications

Fittings and Specials

Pipe on Aerial Spans and Pier Supports

Restrained Joints

Tapping of Concrete Pressure Pipe

Water and Sewage Treatment Plant Piping

Concrete Pressure Pipe in Tunneling Installations

For a free copy of these publications, please call or write the *American Concrete Pressure Pipe Association*.

New *Pipe* Projects

California - Ameron International Corp. will supply 12,400 feet of 36" Concrete Cylinder Pipe for the City of Sacramento's Franklin Blvd. Water Transmission Main. Syblon-Reid Company of Folsom will install the pipe.

California - Eastern Municipal Water District has awarded Ameron International Corp. a contract for nearly 24,000 feet of 30" and 54" Concrete Cylinder Pipe for a water reclamation project in Lake Elsinore, California. Spiess Construction of Santa Maria, California will install the pipe.

California - The Imperial Irrigation District in California's Imperial Valley has awarded a contract to Ameron International Corp. for supply of over 18,000 ft. of 45" Concrete Cylinder Pipe for a water interceptor system. Kenko, Inc. of Minneapolis will install the pipe. Bookman-Edmonston are the Engineers.

Illinois - Lake County Public Works awarded a contract to Walsh Construction for the Northeast Interceptor-Sewer. Cretex Pressure Pipe will supply 4,428 ft. of 48"; 35,355 ft. of 20-42" Concrete Cylinder Pipe. Engineers are Rezek, Henry, Meisen Heimer & Gende.

Michigan - Cretex Pressure Pipe will supply 5,665 ft. of 30" Prestressed Concrete Cylinder Pipe for the 14 Mile Road Watermain owned by Southeastern Oakland County Water Authority. The contract was awarded to Dan's Excavating. The Engineers are Hubbell, Roth & Clark.

Ontario - The City of York has awarded a contract to Lafarge Pressure Pipe for supply of 2,065 ft. of 20" Prestressed Concrete Cylinder Pipe for a trunk watermain. Drainstar Construction will install the pipe.

Ontario - Lafarge Pressure Pipe will supply 6,860 ft. of 24" Prestressed Concrete Cylinder Pipe for the Pugsley/Bayview Avenue project in the Town of Richmond Hill. Mardave Construction will install the pipe. Mitchell Pound Braddock are the Engineers.

Ontario - The Regional Municipality of Waterloo has awarded a contract to Sierra Construction for the Fischer Hallman Road Project. Lafarge Pressure Pipe will supply 1,435 ft. of 24" Prestressed Concrete Cylinder Pipe for a trunk watermain.

Ontario - Lafarge Pressure Pipe will supply 2,047 ft. of 30" Prestressed Concrete Cylinder Pipe for the Brittannia Road Project in the City of Mississauga. F.C.M. Construction will install the pipe. Region of Peel is the Engineer.

Oregon - The City of Portland, Oregon has specified Ameron International's Concrete Cylinder Pipe for its Parkrose Water Supply System. S-2 Constructors will install 10,220 ft. of 36" and 48" diameter pipe for this contract, engineered by Black & Veatch of Lake Oswego.

Texas - Nueces River Authority awarded a contract to Pate & Pate Enterprises for the Texana Supply Line between Lake Texana and Corpus Christi. Gifford-Hill-American, Inc's Victoria and Grand Prairie plants will supply 105 miles of Concrete Cylinder Pipe. Engineers are HD&R Engineering.

Texas - Upper Trinity Regional Water District awarded a contract to Wright Construction Company for treated water supply line in Lewisville, Texas. Gifford-Hill-American, Inc. will supply 27,735 ft. of 24" Concrete Cylinder Pipe. Alan Plummer & Associates are the Engineers.

Texas - The City of Southlake awarded a contract to Wright Construction Company Southlake,Texas. Gifford-Hill-American, Inc. will supply 7,500 ft. of 20" Concrete Cylinder Pipe. Cheatham & Associates are the Engineers.

Texas - Gifford-Hill-American, Inc. will supply 4,370 ft. of 20" Concrete Cylinder Pipe for a treated water supply in Carrolton, Texas. Murray Construction Company will install the pipe. Black & Veatch are the Engineers.

Texas - The Tarrant Regional Water District awarded a contract to H.B. Zachry Company for the Benbrook Connection Project. Gifford-Hill-American, Inc. will supply 43,500 ft. of 90" Prestressed Concrete Cylinder Pipe. Freese & Nichols, Inc. are the Engineers.

Case Histories

Send us your Concrete Pressure Pipe case histories and we will help you share them with your colleagues in the water industry. Simply provide a manuscript (limited to 2000 words), photographs and useful quotes to:

David P. Prosser, P.E.
American Concrete Pressure Pipe Association
11800 Sunrise Valley Drive
Suite 309
Reston, VA 20191

Not all manuscripts will be printed and the editor reserves the right to make selections and revisions.

American Concrete Pressure Pipe Association Member Companies

Ameron International Corp.
10681 Foothill Boulevard, Suite 450
Rancho Cucamonga, CA 91730-3857
(909) 944-4100
FAX: (909) 944-4112

Cretex Pressure Pipe, Inc.
P.O. Box 67
South Beloit, IL 61080
(815) 389-4800
FAX: (815) 389-4825

Gifford-Hill-American, Inc.
P.O. Box 569470
Dallas, TX 75356-9470
(972) 262-3600
FAX: (972) 264-6236

Hyprescon, Inc.
699 Industrial Boulevard
St. Eustache, Quebec J7R 6C3
(514) 623-2200
FAX: (514) 623-3308

Lafarge Pressure Pipe
Lafarge Construction Materials
5387 Bethesda Road
Stouffville, Ontario L4A 7X3
(905) 640-5151
FAX: (905) 640-5154

Price Brothers Company
P.O. Box 825
Dayton, OH 45401
(937) 226-8700
FAX: (937) 226-8840

Vianini Pipe, Inc.
P.O. Box D
Somerville, NJ 08876
(908) 469-2900
FAX: (908) 534-5011

Editor
David P. Prosser, P.E.
(703) 391-9135
FAX: (703) 391-9136

AMERICAN
CONCRETE
PRESSURE PIPE
ASSOCIATION

11800 Sunrise Valley Drive
Suite 309
Reston, VA 20191

TIPS

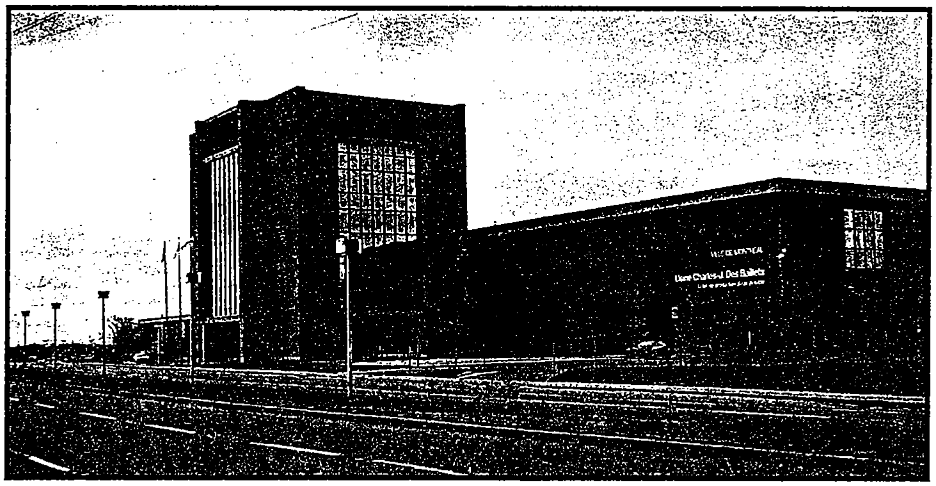
A TECHNICAL INFORMATION PAPER FROM THE AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION

Water and Sewage Treatment Plant Piping

Concrete Pressure Pipe has a wide range of applications beyond water distribution and transmission mains and sewer force mains. Many water and wastewater utilities use Concrete Pressure Pipe in pumping stations, water treatment plants, and sewage treatment plants.

Treatment plants employed in water and sewage systems are designed to treat a broad spectrum of water in-flows. These may include fresh water, sanitary sewage, and a wide range of industrial wastewater. Concrete Pressure Pipe, with its dense concrete core, is particularly well suited for use in these installations. In sewage treatment plants, chances are that the flow will already have been carried by a concrete pipe before it reaches the treatment plant.

Concrete Pressure Pipe is commonly used to convey partially treated water and sewage in treatment plant piping systems as well as fully treated water discharging from the plant. The rigid nature of Concrete Pressure Pipe eliminates the need for elaborate lateral support in backfilling operations, a critical consideration in developing the load carrying ability of flexible piping materials. Substantial economies will be realized through the use of conventional bedding and backfilling procedures normally specified for the installation of Concrete Pressure Pipe. The ring stiffness of Concrete Pressure Pipe provides excellent resistance to localized deflections and buckling which may occur when flexible piping materials are used.



Water treatment plants are making increased use of Concrete Pressure Pipe for their process piping.

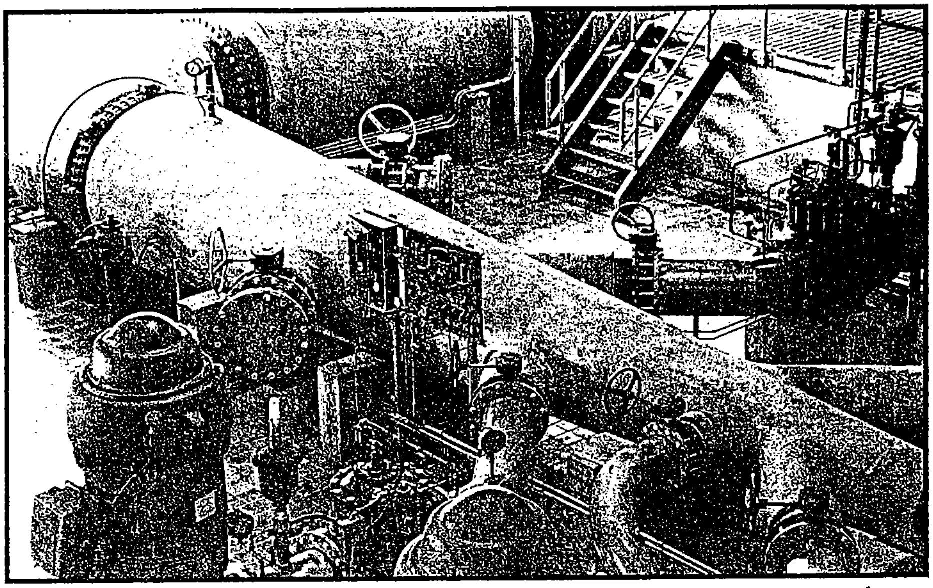
Functional requirements, economics and space limitations associated with modern water and sewage treatment plants also dictate extreme versatility of standard and special fittings for the piping material used. Concrete Pressure Pipe is particularly well suited for installation in the distribution headers and piping galleries of all types of plants. With a wide range of tees, wyes, elbows and reducer sections available, the customizing ability of Concrete Pressure Pipe provides the owners and their engineers a product that will meet their most exacting requirements.

The humid environments of many plant piping galleries can induce atmospheric corrosion of ferrous piping materials. However, the humid environment is well suited to Concrete Pressure Pipe because concrete actually increases in strength with that kind of exposure. The use of Concrete Pressure Pipe may also eliminate the expense of dehumidifying equipment. Since the concrete pipe does not require painting, the initial cost of painting plus maintenance of metallic piping systems can be saved.

The standard joint used with Concrete Pressure Pipe is the steel bell and spigot ring with a confined O-ring rubber gasket. This self-centering joint provides ample flexibility for normal settlement experienced in yard piping installations around treatment plants.

No pipe job is complete without testing the joint for leaks. Competitive pipe materials require filling the line with water and applying a pressure to test for leaks. Typically, that is accomplished after a considerable amount of pipeline has been installed. Should a leak occur, finding it is a major problem and correcting it is a larger one. With Concrete Pressure Pipe, the double O-ring testable joint alternative gives the piping contractor the assurance of water-tight joints, even before backfilling the pipe, and it takes only minutes to perform.

When thrust restraint is required, a variety of welded and mechanically restrained joints are available to transfer axial thrust forces. The mechanical restrained joints, such as the snap-ring, harness clamp or bell-bolt type, provide additional flexibility for treatment plant installations. Concrete Pressure Pipe is also readily adaptable to the



Concrete Pressure Pipe header and integral piping lead to a treated-water reservoir.

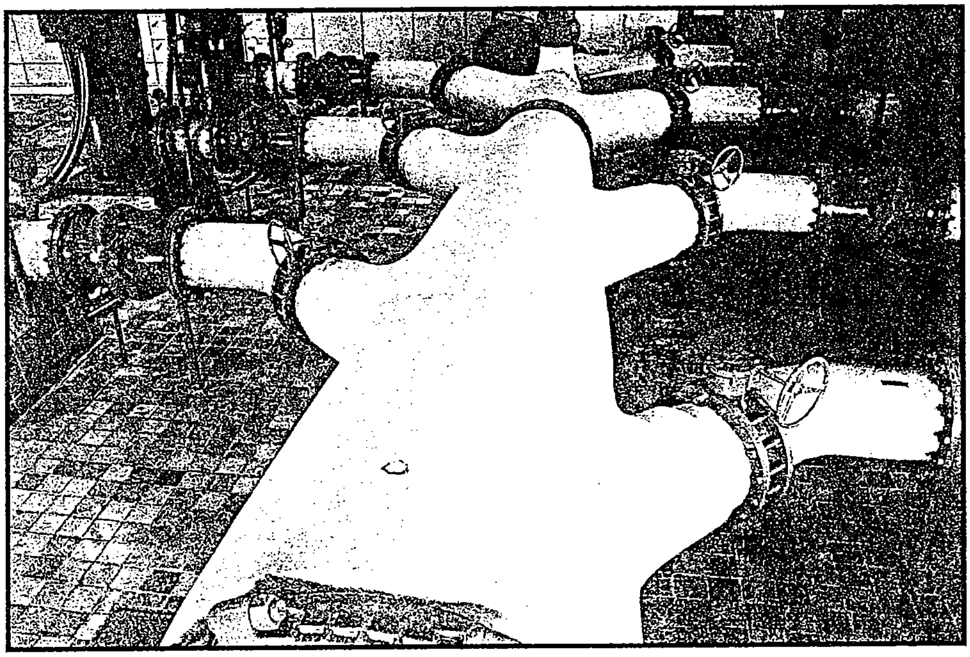
Prestressed Concrete Cylinder Pipe

(PCCP) is furnished under AWWA Standard C301. Two general types are manufactured: lined cylinder pipe with a steel cylinder lined with concrete and embedded cylinder pipe with a steel cylinder embedded in concrete. Both types are wrapped with high-strength steel prestressing wire to develop a predetermined residual compression in the concrete and steel core. The entire pipe is then coated with a cement-rich mortar for protection of the prestressing wire.

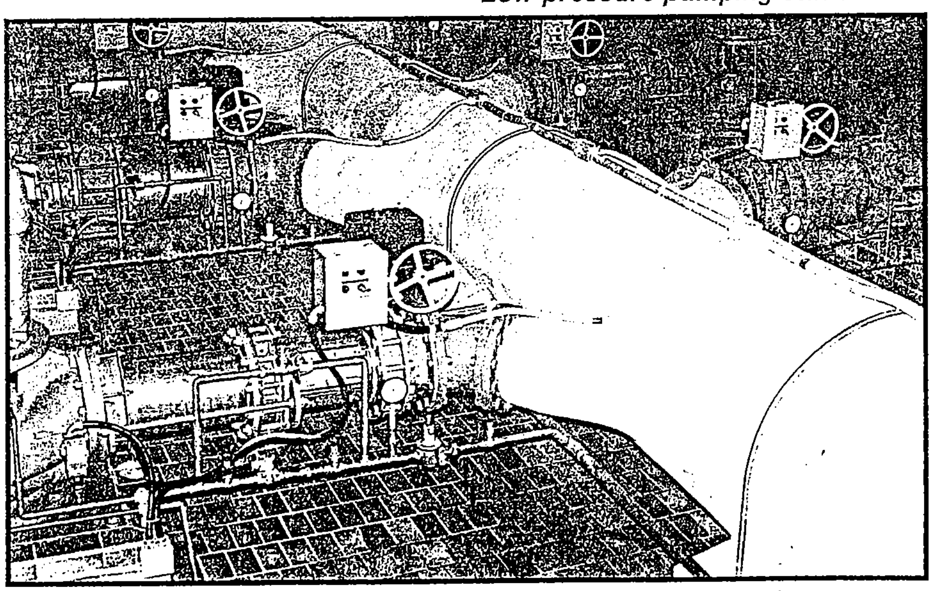
mechanical couplings frequently used to join valves and pumping equipment in treatment plants.

The corrosion inhibiting properties of mortar-coated Concrete Pressure Pipe are well known in the waterworks field. The cement-rich mortar coating and concrete places the steel components of the pipe into a passive state, protecting it from corrosion. The alkaline environment provided by the coating yields a pH value of approximately 12.5 around the steel.

Concrete Pressure Pipe is specified in accordance with American Water Works Association (AWWA) standards.



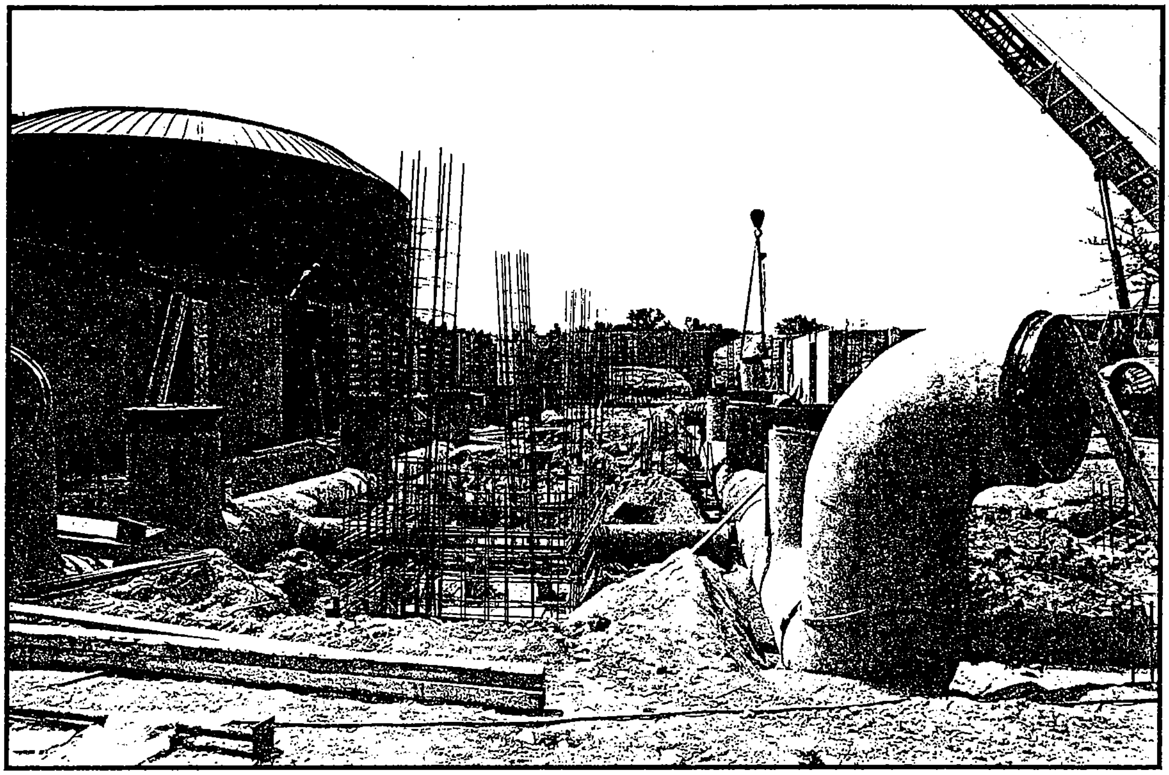
Low-pressure pumping station header in the a water treatment plant.



Concrete Pressure Pipe manifold in a high-head pumping plant.

Bar-Wrapped Concrete Cylinder Pipe

(CCP) is furnished under AWWA Standard C303. Manufactured mainly in Canada and the western and southwestern United States, CCP contains a fabricated steel cylinder with welded joint rings attached. It is lined with cement or mortar, wrapped with a mild steel bar and then coated with a cement-rich mortar.



Thirty-six and 42-inch diameter Concrete Pressure Pipe installed during construction of this pumping plant.

Reinforced Concrete Cylinder Pipe

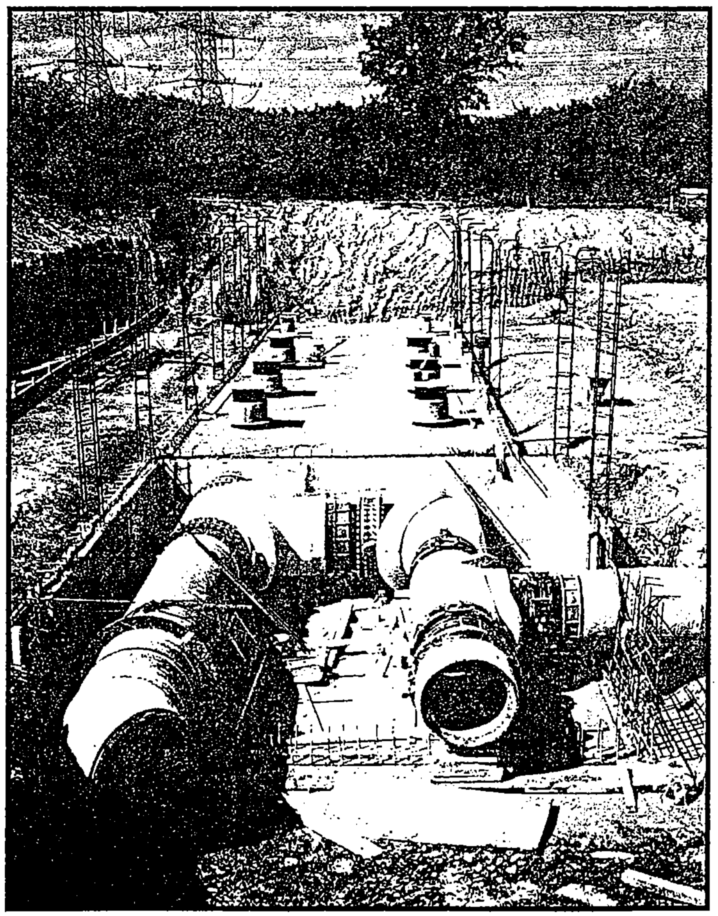
(RCCP) is furnished in accordance with AWWA Standard C300. Again, manufacture starts with the steel cylinder with joint rings attached, followed by placement, with the steel reinforcement, into a form. Concrete is then cast within the form to create the pipe.

Summary

Concrete Pressure Pipe has a proven track record in treatment plant installations in both the United States and Canada. Its excellent long-term hydraulic characteristics and corrosion resistance combine to provide extremely low maintenance and operations costs.

Whether the requirement is for 10-inch (254 mm) or 144-inch (6400 mm) diameter pipe or larger, one or more types of Concrete Pressure Pipe are readily available to match the design requirements. These pipes will handle pressures from a vacuum condition to over 400 psi (2760 kPa). A full range of standard and special fittings are available for solving even the most complex piping problems.

For further information regarding the application of this amazingly versatile piping product in your treatment plant projects, contact any member of the American Concrete Pressure Pipe Association.



Concrete Pressure Pipe is installed during pumping plant construction.

American Concrete Pressure Pipe Association Member Companies

Ameron International Corp.
10681 Foothill Boulevard, Suite 450
Rancho Cucamonga, CA 91730-3857
(909) 944-4100
FAX: (909) 944-4112

Cretex Pressure Pipe, Inc.
P.O. Box 67
South Beloit, IL 61080
(815) 389-4800
FAX: (815) 389-4825

Gifford-Hill-American, Inc.
P.O. Box 569470
Dallas, TX 75356-9470
(972) 262-3600
FAX: (972) 264-6236

Hyprescon, Inc.
699 Industrial Boulevard
St. Eustache, Quebec J7R 6C3
(514) 623-2200
FAX: (514) 623-3308

Lafarge Pressure Pipe
Lafarge Construction Materials
P.O. Box 1420
Stouffville, Ontario L4A 8A3
(905) 640-5151
FAX: (905) 640-5154

Price Brothers Company
P.O. Box 825
Dayton, OH 45401
(513) 226-8700
FAX: (513) 226-8840

Vianini Pipe, Inc.
P.O. Box D
Somerville, NJ 08876
(908) 269-2900
FAX: (908) 534-5011

American Concrete Pressure Pipe Association
11800 Sunrise Valley Drive, Suite 309
Reston, Virginia 20191
(703) 391-9135, fax (703) 391-9136

TIPS

A TECHNICAL INFORMATION PAPER FROM THE AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION

Concrete Pressure Pipe in Tunnel Installations

Tunneling is a necessary aspect of water pipeline construction. Tunnels are used to avoid obstacles such as mountains and rivers. Tunneling is also used to avoid open excavation which would affect traffic filled city streets or residential neighborhoods. In many urban areas, open excavation is costly and disruptive.

Because Concrete Pressure Pipe is so rugged and maintains its joint configuration, even when transmitting substantial forces, it is an ideal pipe material for tunnel installations.

All four types of Concrete Pressure Pipe namely; Prestressed Concrete Lined Cylinder Pipe, Prestressed Concrete Embedded Cylinder Pipe, Bar-Wrapped Concrete Cylinder Pipe and Reinforced Concrete Cylinder Pipe assure leak-proof systems and are ideally suited for use in these tunnel applications.

Installation of a 30-inch (750 mm) diameter Prestressed Concrete Cylinder Pipe through a steel casing under a roadway.

Construction Methods

Construction methods for installing Concrete Pressure Pipe in tunnels varies with the size of the pipe, the length of the tunnel and the type of primary liner casing system used.

The liner casings are usually one of four types: steel liner plate, steel ribs and timber lagging, precast concrete segments or concrete pipe itself. There are two construction methods used to install the tunnel casing - tunneling or jacking. Each project requires individual evaluation by experienced engineers to determine the appropriate installation method to follow.

For smaller diameter pipe in short tunnels, such as those under a highway or a railroad, it is common practice to slide the Concrete Pressure Pipe through the liner.

Transporting or moving large pipe into or through the tunnel varies from a simple push-pull skidding arrangement, using hydraulic jacks or winches and cables, to special pipe carrying machines that not only transport the pipe but are capable of positioning and joining a section of pipe to the previously placed section.

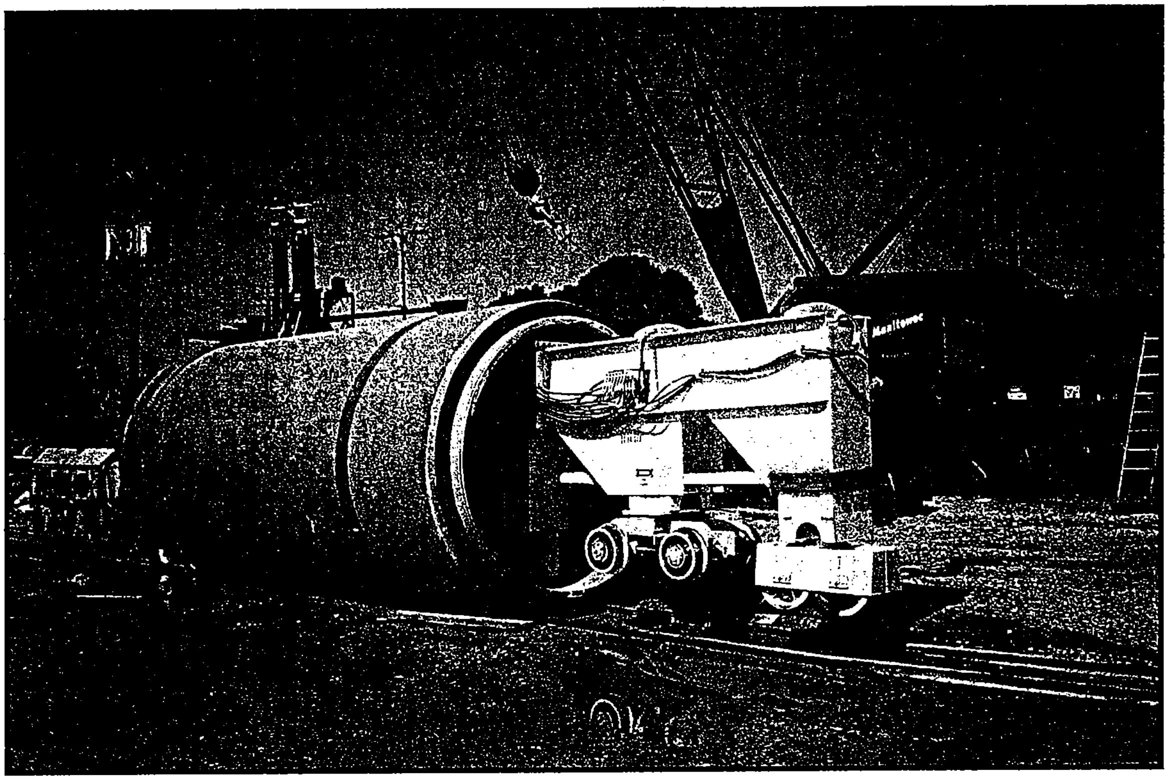
Joint Testing

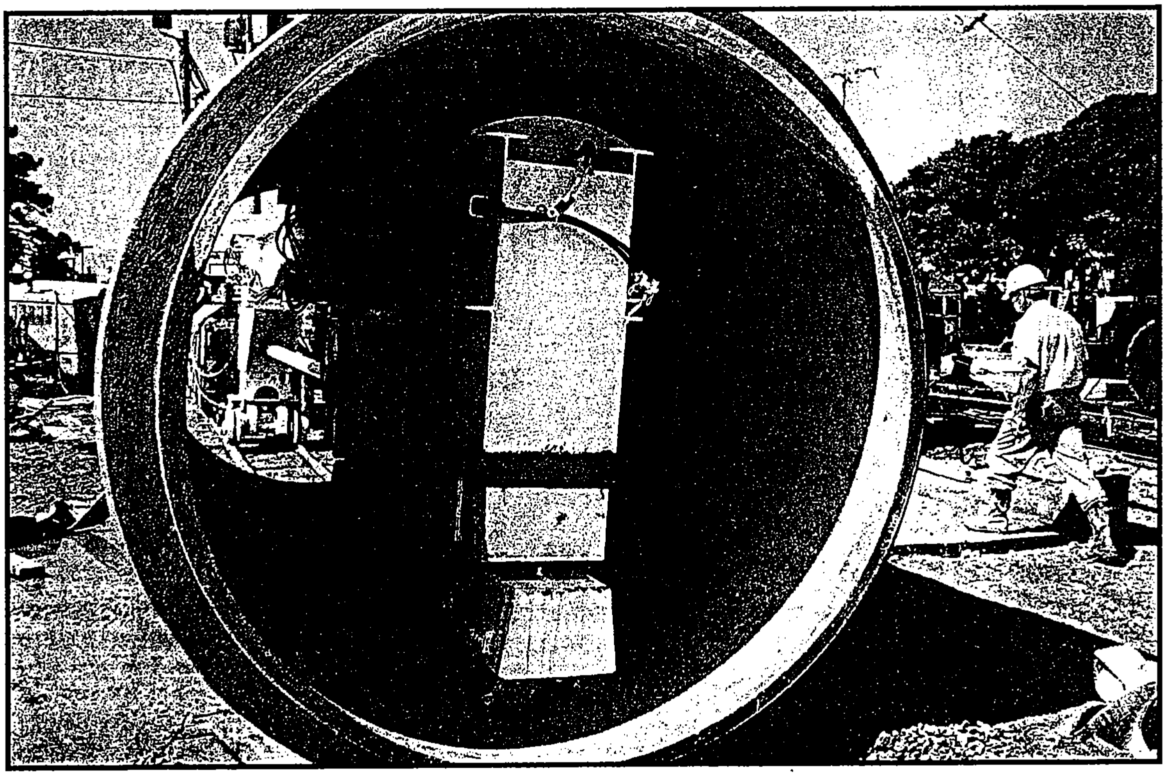
No pipe laying job is complete without testing the joint for leaks. Competitive pipe materials require filling the line with water and applying a pressure to test for leaks. Typically, that is accomplished after a considerable amount of pipeline has been placed into the tunnel. Should a leak occur, finding it is a major problem and correcting it is a larger one. With Concrete Pressure Pipe a double O-ring testable joint alternative gives the pipe laying contractor the assurance of watertight joints immediately after make-up, and it takes only minutes to perform. In practice, the joint employs dual O-ring gaskets with an air test fitting installed between them, accessible from the interior of the pipe. Immediately after making the joint, the contractor connects an air line from a small air tank or pump to the test fitting and pressurizes the space between the gaskets. Any leakage is detected immediately. However the pressure is usually maintained for approximately five minutes. On the rare occasion that leakage takes place, the joint is disassembled and the gaskets are replaced.

Pipe Protection

If Concrete Pressure Pipe is to be pushed or pulled into the tunnel liner, care must be taken to protect the pipe from damage. Provision must also be made to protect the steel bell and spigot joint rings.

- Timber sections can be strapped to the exterior of each pipe to act as runners, with the liner surface lubricated, possibly with bentonite.





After tunnel excavation is completed, this unique pipe carrier was used to move each section of Prestressed Concrete Cylinder Pipe into position to complete the joint quickly, precisely, and safely. These pictures show how the front end of the carrier passes through the pipe before lifting and moving it.

- For mortar-coated Concrete Pressure Pipe, an additional band of mortar can be applied to the exterior of the pipe, during manufacture, to act as a wearing surface.
- Exterior segmented bands, with plastic tipped steel ribs, called casing spacers, can be bolted together around the pipe at the job site. The ribs act as runners, reducing friction and protecting the pipe exterior from damage.
- In any push-pull installation, a lubricant, such as bentonite, may also be used on the tunnel casing system to reduce the sliding resistance.
- If pipe is to be pushed or pulled into the tunnel casing, the pipe ends must be protected from damage. That can be accomplished with timber cushions placed in the joints. Consult with the pipe manufacturer for details.

Regardless of the pipe installation method, if the annular space between the tunnel liner and the Concrete Pressure Pipe is not filled with portland cement or grout, then joint protection must be applied, either by grouting the joints, painting or metalizing the steel joint rings, or by another joint protection system.

Long-Term Pipe Support

Typically, the annular space between the Concrete Pressure Pipe and the tunnel liner is filled with portland cement grout. A bulkhead is used to retain the mortar or grout. It is placed in the annular space at each end of the section that is to be grouted. Provision must be made to prevent floatation of the pipe and to vent trapped air.

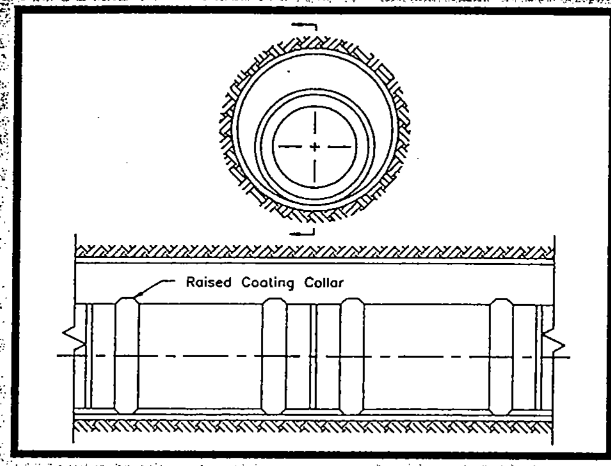
Grout may be delivered to the annular space through ports installed in the pipe walls during manufacturing, or by use of a grout placement line extended back to the remote bulkhead. The grout placement line is withdrawn as the grouting progresses.

Alternatively, the annual space may be filled with sand, or the pipe may be blocked, top and bottom as well as sides, to prevent its shifting in the tunnel.

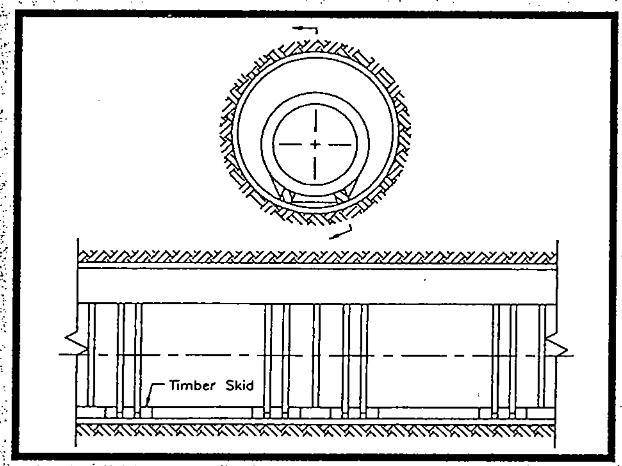
Applications

There are many successful applications of Concrete Pressure Pipe installed in tunnels. Concrete Pressure Pipe is manufactured with concrete bearing the compressive loads, and reinforcing steel bearing the tensile loads.

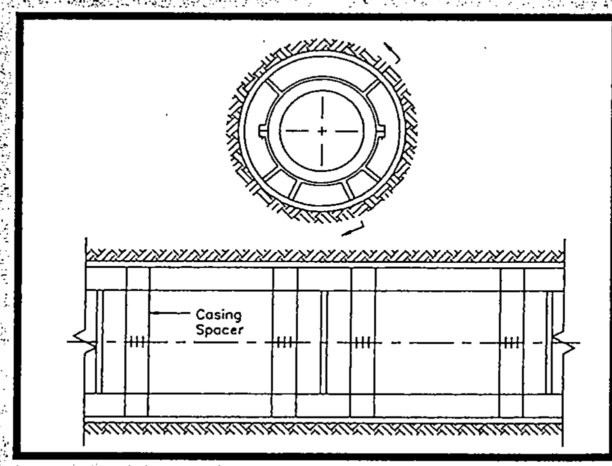
Whether the pipeline must traverse a river, pass under city streets or be placed under railroad or highway embankments, Concrete Pressure Pipe can be designed and manufactured to take the loads of installation, and still perform for a lifetime.



Raised Coating Collar Method



Timber Skid Method



Casing Spacer Method

Methods of installing Concrete Pressure Pipe inside a casing.

American Concrete Pressure Pipe Association
Member Companies

Ameron International Corp.
10681 Foothill Boulevard, Suite 450
Rancho Cucamonga, CA 91730-3857
(909) 944-4100
FAX: (909) 944-4112

Cretex Pressure Pipe, Inc.
P.O. Box 67
South Beloit, IL 61080
(815) 389-4800
FAX: (815) 389-4825

Gifford-Hill-American, Inc.
P.O. Box 569470
Dallas, TX 75356-9470
(972) 262-3600
FAX: (972) 264-6236

Hyprescon, Inc.
699 Industrial Boulevard
St. Eustache, Quebec J7R 6C3
(514) 623-2200
FAX: (514) 623-3308

Lafarge Pressure Pipe
Lafarge Construction Materials
P.O. Box 1420
Stouffville, Ontario L4A 8A3
(905) 640-5151
FAX: (905) 640-5154

Price Brothers Company
P.O. Box 825
Dayton, OH 45401
(513) 226-8700
FAX: (513) 226-8840

Vianini Pipe, Inc.
P.O. Box D
Somerville, NJ 08876
(908) 269-2900
FAX: (908) 534-5011

American Concrete Pressure Pipe Association
11800 Sunrise Valley Drive, Suite 309
Reston, Virginia 20191
(703) 391-9135, fax (703) 391-9136

TIPS

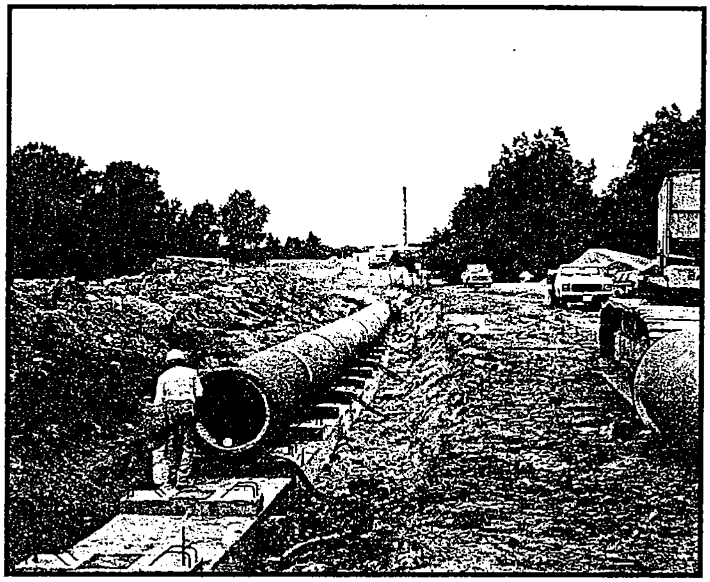
A TECHNICAL INFORMATION PAPER FROM THE AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION

Pipe on Aerial Spans and Pier Supports

Installations of Concrete Pressure Pipe can be designed for a wide variety of site-specific conditions. Aerial installations may be required to cross over an obstacle such as a roadway or stream bed. Pipeline alignment may require installation in unstable or low-strength soils, such as swamp or river bottom silts. These are among the most difficult local conditions for pipeline design. It is in those applications where Concrete Pressure Pipe is able to exhibit its superior beam strength.

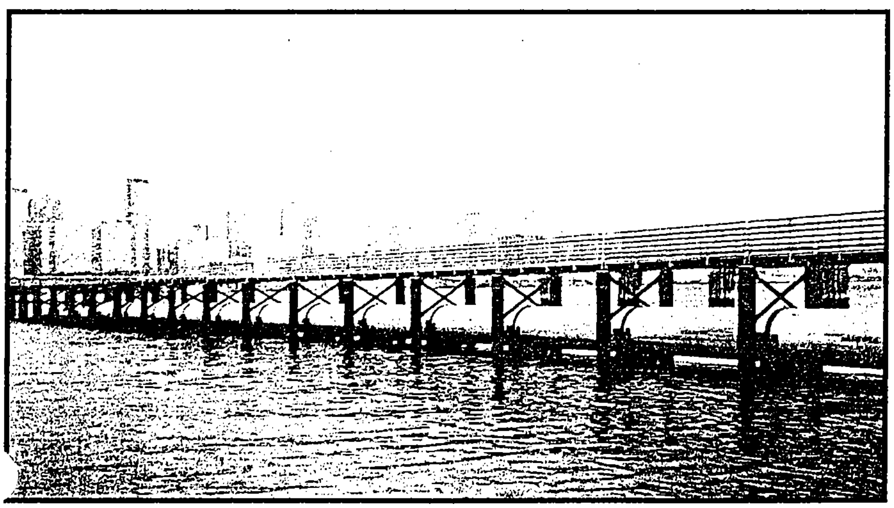
When a pipe project must pass through low-strength soils, the design engineer must first determine if the soil can be stabilized by removing a portion and replacing it with higher strength and stabilizing materials. If that is found to be insufficient and where more traditional foundation designs are not practicable, selection of foundation reinforcement by use of piles may provide the design solution. Bearing piles are the most common, extending below the weak soil layer to stronger strata such as firm soil or bed rock below. Bearing piles are particularly useful when there is a risk of the upper soil strata being eroded by fast moving water currents. The other most commonly used type of pile is the tension pile, so named because its resistance to load derives from frictional resistance between the pile surface and the surrounding soil. Batter piles are designed to carry lateral loading and may be of either bearing or tension pile type.

The best type of pier support for a given location often is a compromise of engineering preference to cost and availability. Supports can range from shaped concrete support saddles to pile driven timber, concrete or steel supported systems.



36-inch Concrete Pressure Pipe installation on a grade support beam built atop a pile foundation crossing a land-fill site

There are basically two types of pier supported systems. The supports can be placed under the joints of the pipe, forming a simply supported beam, or they can be placed within the span of the pipe, to form a pinned cantilever type structure. The latter is usually preferred since supports can be strategically placed in order to balance the positive and negative bending moments that develop in the pipe. Use of the pinned cantilever support system also provides the advantage of reducing stresses in the steel cylinder to approximately one-half of those created in a simply supported system. The point where the positive and negative longitudinal bending moments are balanced can be located by deriving the equations for the maximum positive longitudinal bending moments between the supports and the maximum negative longitudinal bending moments at the supports and then equating them to each other.



54-inch sewer outfall on pile foundation with wood saddles.

Design of pile foundations must rely upon careful foundation investigation. Considerations are: the depth of firm soil or rock; characteristics of the upper soil strata; actual vertical load to be carried and application of any lateral loading to the foundation. Such information provides data to determine the required pile depth, spacing and type of pipe support required. While pile foundations may be costly, they may also offer the only solution to being able to construct a project in the desired location. (Design of Concrete Pressure Pipe for support on piers is detailed in the AWWA M9 Manual, Chapter 10.)

Design of pipe on piers, whether the joint support system or cantilever system is used, must consider all of the live and dead loads typically included in normally buried pipe. Design must also accommodate expansion and contraction of the pipe and any resulting forces at the joints. Additionally, aerial installations must include applicable wind loads. However, the design calculation must address that, between the piers, there is no support for the pipe.

The standard O-ring joint provides joint flexibility to allow for movement resulting from expansion and contraction. The forces created by expansion and contraction, plus any other forces which may exist, can be resisted by design and installation of pipe support anchorage systems. Supplemental anchorage should be provided at intermediate points in long, multiple-joint, aerial spans.

There are other design parameters which may need consideration. If the pipeline is to be buried under heavy loads, the shear strength of the joint must be investigated during the design phase. Also, in above ground and aerial installations, consideration must be given to environmental conditions. Therefore, pipelines should have a seal coat of light-colored paint applied to protect the pipe from environmental deterioration.

The degree of total differential settlement at the piers should be held to less than 1/2-inch in order to minimize stresses in the pipe, especially in simply supported pier structures. If settlement does occur in a simply supported pier structure, gaps may occur between the pipe joint and the support which can increase the bending moments in the pipe.

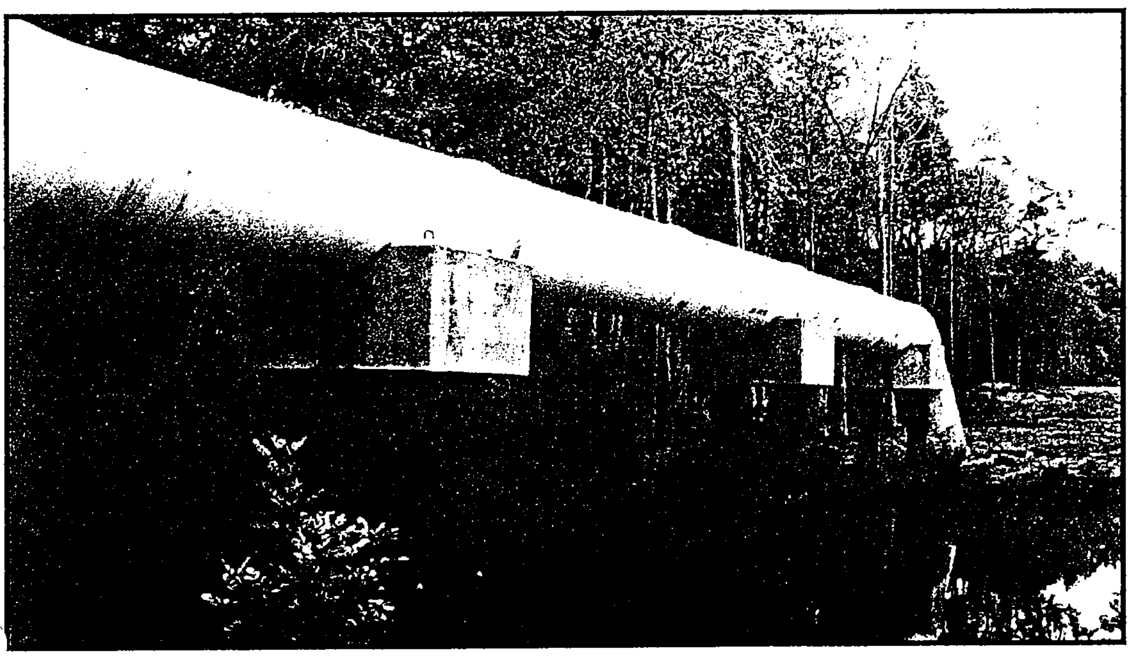
The pipe supports at the top of the pier or pile bent can range from a simple two-point support (wood chocks) on each side of the pipe, to a reinforced concrete saddle. The type of support and its area of contact with the pipe have a large influence on the circumferential moments in the pipe wall and therefore upon the load carrying capacity of the pipe. Wide cradles with large support angles provide the best support.

The pipe span length is also a major cost factor. The fewer the number of supports, the lower the overall project cost and the greater the horizontal clearances for objects such as highways, rivers, etc. Many aerial installations have utilized multiple pipe spans which have been welded together in order to form long rigid spans on the order of 60-feet.

Timber piles are the simplest type, but are often limited in load capacity and are generally less than 50-feet in length. In low swampy areas they are advantageous since they may be used without preservative treatment if they will always be wet.

Precast and prestressed concrete piles can be custom designed and engineered for a project for both length and load and thus offer many advantages. The main disadvantage to concrete piles is their weight, but this can be overcome where long piles are required by splicing shorter sections together.

H-piles are also widely used since they too can be designed to carry a wide range of loads and can be joined to form almost any length. They are very rugged and can penetrate very difficult materials by simple reinforcement of the end tip.



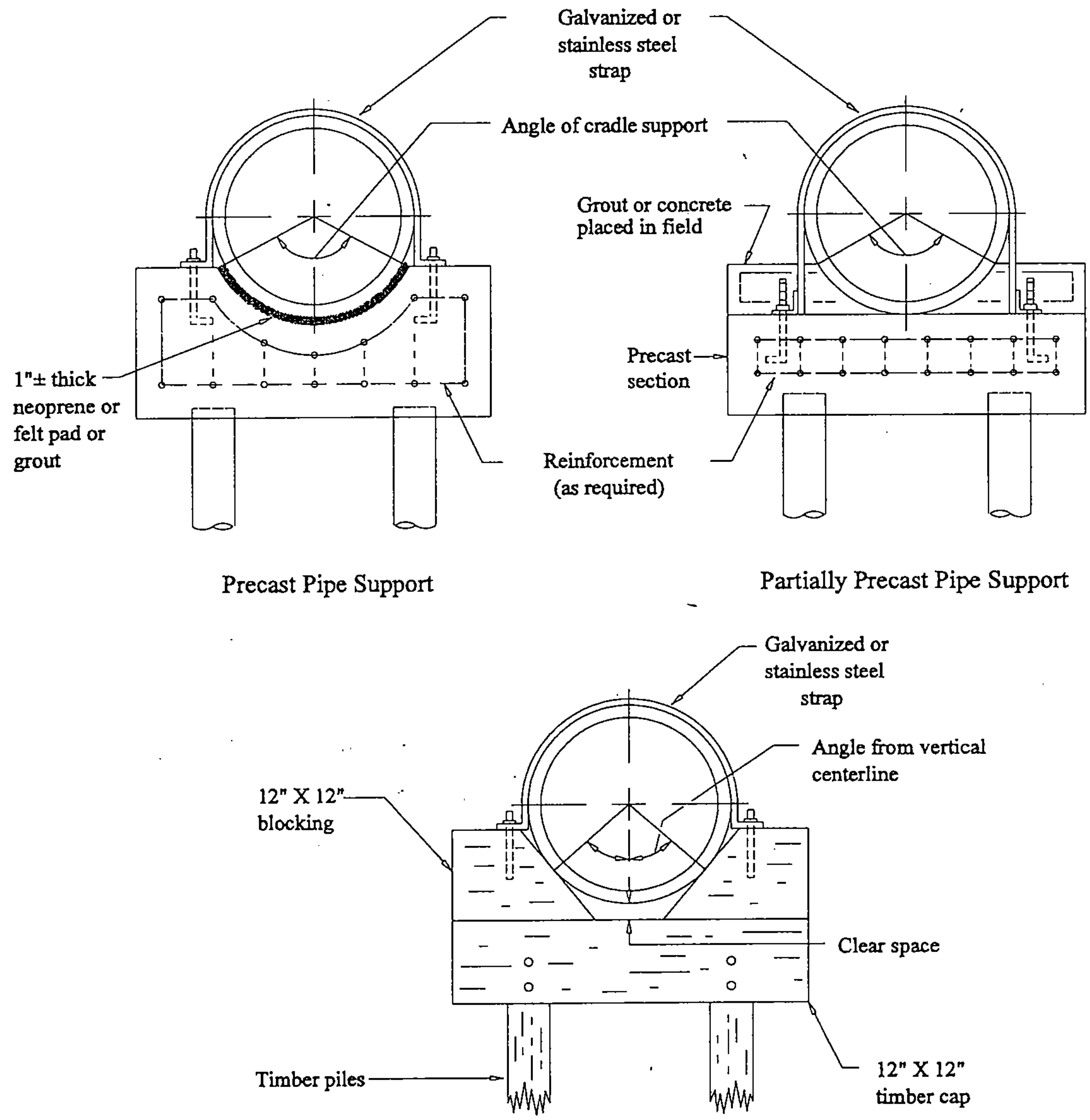
48-inch diameter Concrete Pressure Pipe supported by pile bents with concrete pipe cap.

Pier supported Concrete PressurePipe installations have ranged from buried structures passing through unstable soils and subacqueous installations to aerial crossings over highways, canals, rivers and existing structures. Concrete Pressure Pipe is available in nominal lengths ranging from 16 to 40 feet and can be welded together to form longer spans where required.

For further information on this subject or other data on Concrete Pressure Pipe, please contact one or more of the following members of the American Concrete Pressure Pipe Association.

References

1. AWWA Manual M-9, Concrete Pressure Pipe, Second Edition, 1995.
2. Hunt, Hal W., "Piles - Tips On Their Use Under Water Supply Structure," Water and Sewage Works, October, 1974.
3. Sowers, George B. and George F., "Introductory Soil Mechanics and Foundations," Macmillan Publishing Company, 1970.



Two Point Support
(Not Recommended For C303 Pipe)

American Concrete Pressure Pipe Association
Member Companies

Ameron, Inc.
10681 Foothill Boulevard, Suite 450
Rancho Cucamonga, CA 91730-3857
(909) 944-4100
FAX: (909) 944-4112

Cretex Pressure Pipe, Inc.
P.O. Box 67
South Beloit, IL 61080
(815) 389-4800
FAX: (815) 389-4825

Gifford-Hill-American, Inc.
P.O. Box 569470
Dallas, TX 75356-9470
(214) 262-3600
FAX: (214) 264-6236

Hyprescon, Inc.
699 Industrial Boulevard
St. Eustache, Quebec J7R 6C3
(514) 623-2200
FAX: (514) 623-3308

Lafarge Pressure Pipe
Lafarge Construction Materials
P.O. Box 1420
Stouffville, Ontario L4A 8A3
(905) 640-5151
FAX: (905) 640-5154

Price Brothers Company
P.O. Box 825
Dayton, OH 45401
(513) 226-8700
FAX: (513) 226-8840

Vianini Pipe, Inc.
P.O. Box D
Somerville, NJ 08876
(908) 269-2900
FAX: (908) 534-5011

American Concrete Pressure Pipe Association
8618 Westwood Center Drive, #105
Vienna, Virginia 22812
(703) 893-4350

TIPS

A TECHNICAL INFORMATION PAPER FROM THE AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION

Restrained Joints

Water and wastewater pipelines, when operating or under static pressure, will experience unbalanced thrust forces in the system as fluid flow is altered by change in direction or velocity. Such forces, if not adequately restrained could cause the pipeline to move and disengage at the joints. Thrust forces occur at elbows, wyes, tees, reducers, bulkheads and operating values. Since most water lines operate at relatively low velocities, the dynamic force is insignificant and is usually ignored when computing the thrust forces to be restrained.

Problem

There are two methods generally used to resist the unbalanced thrust forces in a pressurized pipeline. One method is to restrain the joints and the other is to use a concrete thrust block behind the elbows, tees, wyes, or bulkheads or concrete thrust collars on pipe adjacent to the fitting. Although use of concrete thrust blocks is common, it may not be the best engineering design because they depend not only upon the soil bearing capacity of the in situ material behind the block but the proper field construction as well. Future underground construction may disturb the soil behind the thrust block thus allowing the block to move at a later date and therefore become ineffective. In some instances, the reaction due to thrust may be so high that the size of the thrust block required would be impractical, particularly in congested urban areas. Unstable soil conditions may require an impractically large sized thrust block.

Restrained joints provide a completely engineered system that in most cases results in the most practical application. A buried pipeline system when pressurized, will cause thrust forces at most fittings in the pipe system. The thrust can be offset with sufficient external pipe-wall frictional resistance by tying together the pipeline joints. The number of pipe joints to be restrained is determined by the frictional resistance of the pipe against the soil. The resistance is calculated by evaluating the weight of the soil reacting on the top and bottom of the pipe, the pipe weight, and the water weight in the pipe multiplied by a coefficient of friction between the pipe and soil. Values for coefficient of friction vary from 0.25 to 0.50 depending on the type of soil. A design value of 0.3 is typical. Compacting the soil around the pipe can increase the effectiveness of the coefficient of friction. In identical soils, the coefficient of friction on concrete pipe with mortar coating will be greater than on pipe made with a smooth exterior surface. That is due to the roughness of the exterior surface of the mortar-coated concrete pressure pipe.

The thrust at bulkheads, tees and reducers is a function of internal pressure P (psi) and cross sectional area A (in^2) at the pipe joint. The resultant thrust at an elbow also includes the deflection angle, Δ, and is given by:

$$T = 2\,PA\,\sin\left(\frac{\Delta}{2}\right)$$

where T, thrust, is expressed as pounds of force when P is in psi and A is in square inches.

Thrust resulting from joint deflections in standard lengths of Concrete Pressure Pipe and lengths of beveled pipe is restrained by frictional resistance due to the dead weight of the pipe, water weight in the pipe, and earth load as well as the bearing pressure of the backfill. Additional restraint is usually not required.

The frictional resistance per linear foot of pipe against the soil is equal to:

$$\frac{\text{Frictional Resistance}}{\text{Ft. of Pipe}} = f\,(2W_e + W_p + W_w)$$

where:

f = coefficient of friction
W_e = weight of earth over pipe, lbs./ft.
W_w = weight of water inside pipe, lbs./ft.
W_p = weight of pipe, lbs./ft.

The length of pipe L to be tied to each leg of the bend is calculated as:

$$L = \frac{PA\,\sin(\Delta/2)}{f(2W_e + W_p + W_w)}$$

The length of pipe to be tied to a bulkhead is:

$$L = \frac{PA}{f(2W_e + W_p + W_w)}$$

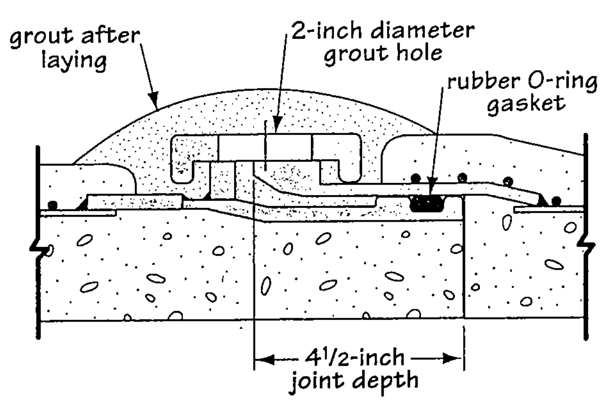
Thrust at in-line fittings such as valves, reducers or internal test plugs can be restrained by the friction on the downstream pipe transmitted by compression through the grouted joints and restraining of joints is usually not required. Thrust at downward turning vertical elbows is resisted by the dead weight of the pipe, water weight in the pipe and earth load on the pipe. If that is not adequate to resist the thrust, then the elbow must be restrained to adjoining pipe sufficiently to resist the uplifting force. Thrust at upward turning vertical elbows can be restrained in the same manner as horizontal elbows.

There are two general types of restrained joints: (1) field welded joints and (2) mechanically restrained joints. The field welded joint is rigid and must be welded by the skip-weld method to prevent overheating and burning of the pipe joint gasket, if a gasket is used. It is preferable to avoid more than three or four joints welded in a row to prevent development of a continuous rigid beam of 80' to 100' long. In the unlikely event of a pipe bedding failure, such as washout, the unsupported span may exceed the inherent beam strength of the pipe.

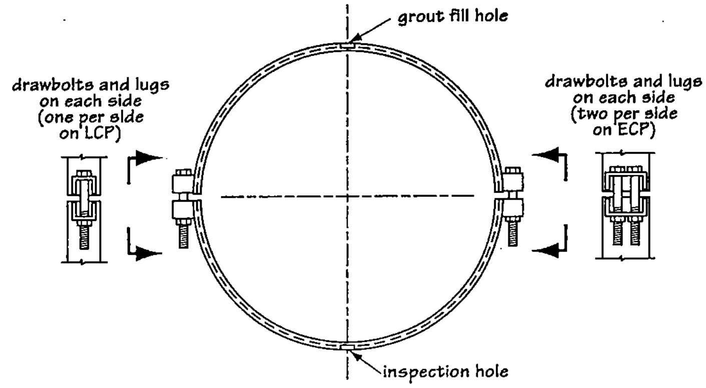
There are two types of field welded joints: (1) exterior field welded joints and (2) interior field welded joints. The exterior field weld involves the use of a mild steel filler rod between the bell flare and the shank of the spigot. The leading edge of the bell is welded to the steel rod and the shank of spigot is welded to the steel rod. The interior field weld is made by welding the leading edge of the spigot to the bell. The proximity of the rubber gasket (if used) to the internal weld may cause it to burn, therefore, the weld should be made fully circumferential and watertight.

Pipe and fitting joints can also be tied together with mechanical restraints. There are three types of mechanically restrained joints:

- Clamp type, which come in two semi-circular halves bolted together in the field;
- Bell Bolt types with a series of set screws tapped around the circumference of the bell and set behind the spigot groove after the joint is home;
- Snap Ring type which has a snap ring recessed in the bell and tightened behind the spigot groove after the joint is home.



Clamp-type restrained joint applied to lined-cylinder pipe.



Clamp-type restrained joint ring.

All of these restrained joint systems provide a positive bearing action, rather than a friction type action, to allow not only for transmitting longitudinal force through the steel cylinder but also for allowing the pipeline to adjust to minor trench settlement.

The maximum thrust force at the fitting is transmitted to the adjoining pipe cylinders through the joint rings. In concrete cylinder pipe (C300, C301 and C303), the steel cylinder is used to transmit the longitudinal forces from the joint rings at one end to the joint rings at the other end. Therefore, the cylinder must be of sufficient thickness to withstand the thrust and remain within the allowable tensile stresses of 13,500 psi at working pressure and 17,000 psi at field test pressure. The maximum cylinder thickness would be in the pipe adjacent to the fitting. Cylinder thickness is reduced as the thrust dissipates further from the fitting. In non-cylinder concrete pipe (C302), the longitudinal thrust force would be transmitted through the longitudinal reinforcement. A restrained joint system must dissipate the thrust force over a particular length dependent upon frictional resistance of the pipe against the soil.

After calculating pipe length to be tied to a fitting, designers must assure that tied pipe lengths have sufficient continuous longitudinal steel reinforcement to transmit thrust forces. The maximum thrust force for which the longitudinal steel in the pipe adjacent to a bend must be designed is determined by:

$$F_y = PA\left(\frac{5.43\Delta + 0.063\Delta^2}{1000}\right) \quad \text{for } 0 < \Delta \leq 90°$$

$$F_y = PA \quad \text{for } \Delta > 90°$$

where:

F_y = force for which the longitudinal steel in the pipe adjacent to a bend must be designed, in pounds;

P = internal pressure, in pounds per square inch;

A = pressurized cross-sectional area within the pipe's steel cylinder for cylinder pipe, or within the pipe barrel for noncylinder pipe, in square inches; and

Δ = bend deflection angle, in degrees.

Thrust diminishes from a maximum value at the fitting to zero a distance L from the fitting. Therefore, longitudinal reinforcement can be prorated within the pipe length on a straight line basis. The required longitudinal steel reinforcement at any location within the tied distance L can be determined as follows:

$$A_{yt} = \frac{PA(5.43\Delta + 0.063\Delta^2)}{f_s\ 1000}\left(\frac{L-\ell}{L}\right) \quad \text{for bends with } 0<\Delta\leq 90°$$

$$A_{yt} = \frac{PA}{f_s}\left(\frac{L-\ell}{L}\right) \quad \text{for bends with } \Delta>90° \text{ and bulkheads}$$

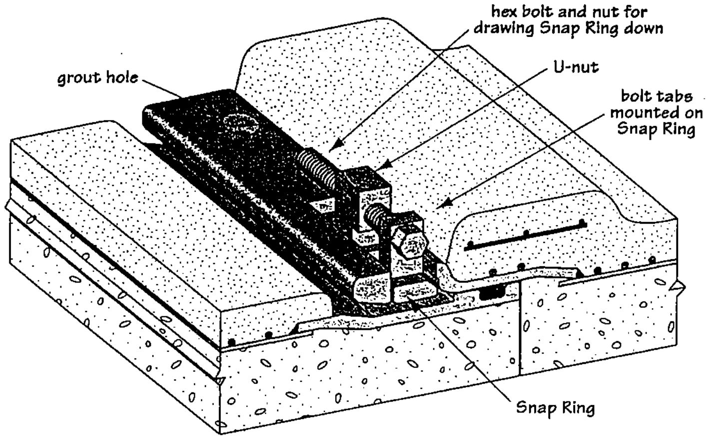
where:

A_{yt} = cross sectional area of longitudinal steel reinforcement requirement at a distance from the fitting, in square inches;
L = length of pipe required to be tied to each leg of a bend or to a fitting in feet;
ℓ = distance from fitting (within length L), in feet;
f_s = allowable tensile stress in longitudinal steel, in pounds per square inch, not to exceed 13,500 at working pressure or 17,000 at test pressure;

and all other variables are as previously defined.

There are other uses of restrained joints. In laying pipe down a steep slope the joints may be restrained in order to prevent pipe from sliding downhill and opening the joints. When laying pipe across a river or in unstable soil, it may be desirable to restrain the joints to prevent them from opening due to excessive settlement.

Subaqueous installation of intake and outfall lines may require longer lengths of pipe to save on installation costs. In such cases, standard pipe lengths can be shop welded at the plant to make longer lengths. That would reduce the number of joints that the contractor needs to make under water. Another consideration for longer length pipe would be installing pipe on piles. Shop welding standard lengths

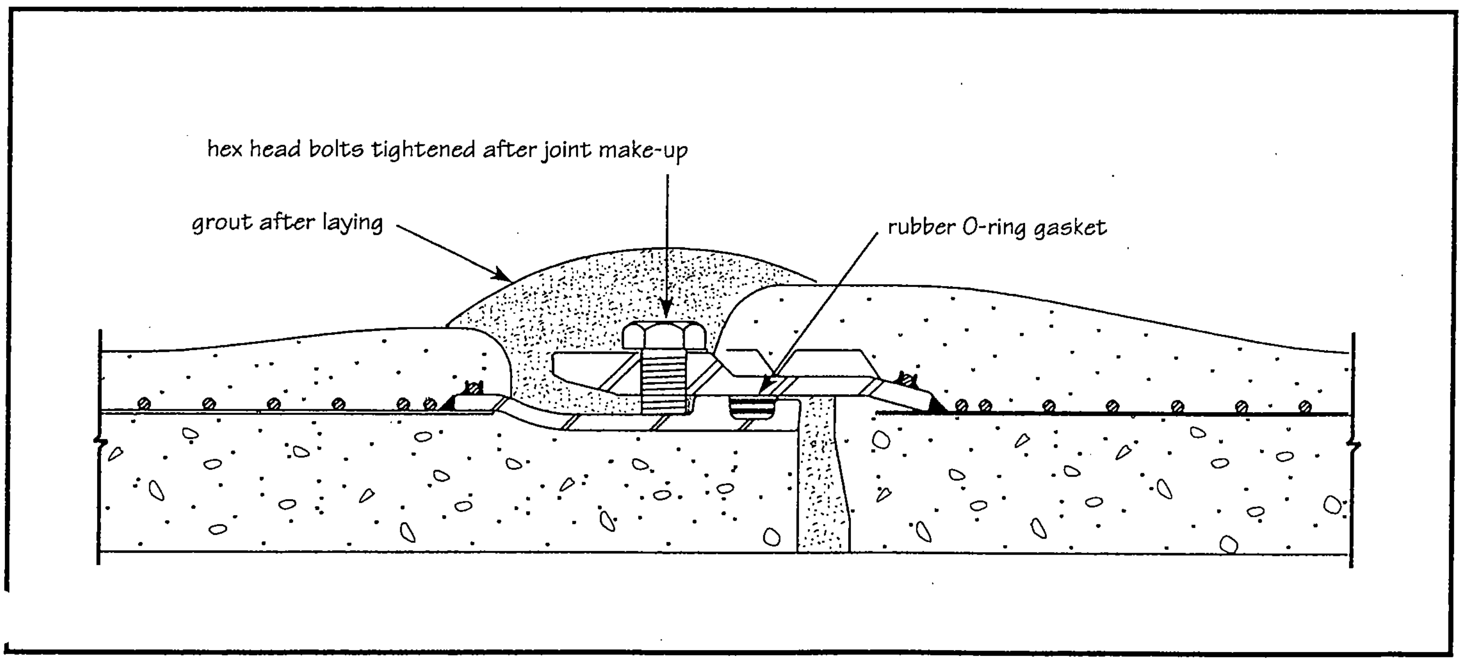


Snap Ring type restrained joint applied to lined-cylinder Concrete Pressure Pipe.

together with a full circumferential weld would provide a pipe able to span longer lengths. Thus reducing construction costs by eliminating pile bents.

Summary

Concrete Pressure Pipe provides the pipeline and system designer considerable freedoms and opportunities to produce the optimum system capabilities. Your Concrete Pressure Pipe supplier provides customized engineering plans to aid in system design and construction. Contact them for design specifications, construction and operations assistance.



Bell bolt type restrained joint applied to lined-cylinder Concrete Pressure Pipe.

American Concrete Pressure Pipe Association
Member Companies

Ameron, Inc.
10681 Foothill Boulevard, Suite 450
Rancho Cucamonga, CA 91730-3857
(909) 944-4100
FAX: (909) 944-4112

Cretex Pressure Pipe, Inc.
P.O. Box 67
South Beloit, IL 61080
(815) 389-4800
FAX: (815) 389-4825

Gifford-Hill-American, Inc.
P.O. Box 569470
Dallas, TX 75356-9470
(214) 262-3600
FAX: (214) 264-6236

Hyprescon, Inc.
699 Industrial Boulevard
St. Eustache, Quebec J7R 6C3
(514) 623-2200
FAX: (514) 623-3308

Lafarge Pressure Pipe
Lafarge Construction Materials
P.O. Box 1420
Stouffville, Ontario L4A 8A3
(905) 640-5151
FAX: (905) 640-5154

Price Brothers Company
P.O. Box 825
Dayton, OH 45401
(513) 226-8700
FAX: (513) 226-8840

Vianini Pipe, Inc.
P.O. Box D
Somerville, NJ 08876
(908) 269-2900
FAX: (908) 534-5011

American Concrete Pressure Pipe Association
8618 Westwood Center Drive, #105
Vienna, Virginia 22812
(703) 893-4350

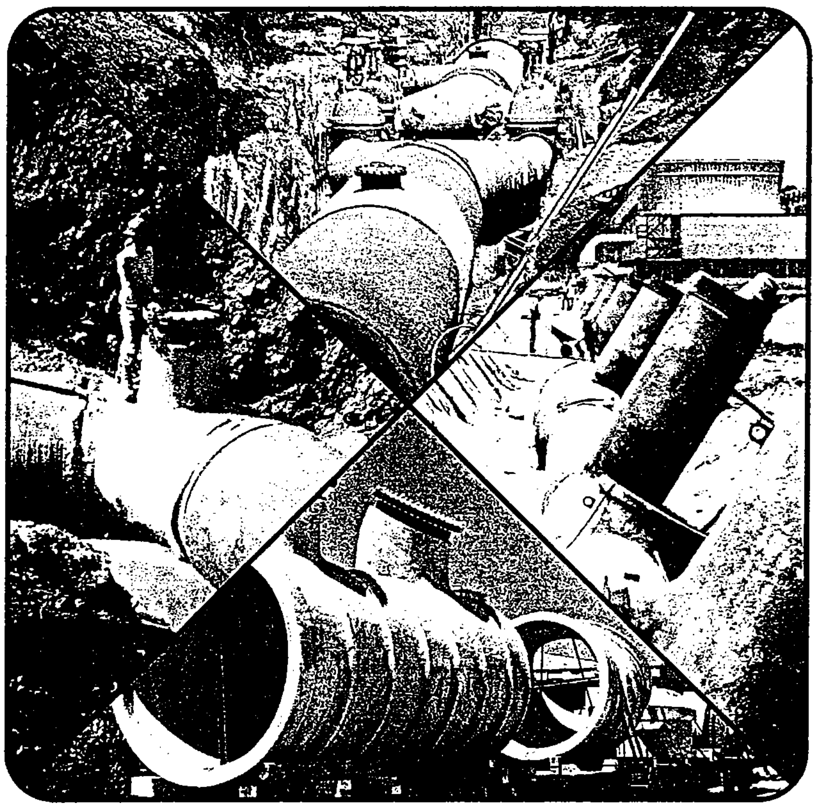
TIPS

A TECHNICAL INFORMATION PAPER FROM THE AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION

Fittings and Specials

Pipeline projects often require a complicated geometry. The adaptability of standard Concrete Pressure Pipe with standard and custom designed special fittings gives practical solutions to the piping system designer. Most configurations can be attained, whether used for water intake, plant piping, transmission and distribution mains, sewer force mains, or sewer outfall projects.

Special fittings are designed and manufactured in accordance with the AWWA standards and the AWWA M9 Manual in diameters from 10 inches to 144 inches. Larger sizes have been manufactured based on the concepts presented in the standards and the M9 Manual.



Concrete Pressure Pipe fittings and specials meet complex demands of piping systems designers.

Design

Concrete Pressure Pipe fittings are designed to meet the same pressure and loading conditions as the adjacent pipe.

Fittings are fabricated from welded steel sheet or plate, with steel joint rings welded to the ends. They are then lined and coated with cement mortar or concrete. As with the pipe, that combination of materials results in efficient utilization of the tensile strength of steel and the compressive strength and corrosion-inhibiting properties of concrete and mortar.

Fittings are fabricated from steel sheet or plate having a minimum thickness of 0.1345 in. (10 Ga.), and are designed for both internal pressure and for external load capacity.

Internal pressure is resisted by the steel cylinder alone. The required steel thickness is calculated using the "Hoop Stress" formula. Depending on the size and configuration, outlets in pipe or fittings are reinforced by replacing the area of steel removed from the wall with either wrappers, saddles, collars, or crotch plates.

External load carrying capacity of a fitting is calculated using semirigid pipe theory. Splanger's equation is used limiting the horizontal or vertical deflection to $D^2/4000$, or 0.02D whichever is less; where D is the nominal pipe diameter in inches. As an example, for a 42-inch diameter pipe, this results in a deflection of approximately 1 percent.

Joints

Standard Joint:

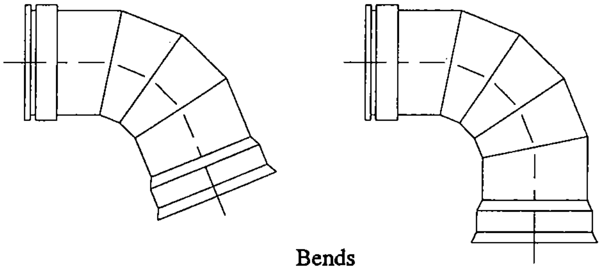
The standard Concrete Pressure Pipe joint is a steel bell and spigot with rubber O-ring gasket.

Testable Double Gasket Joint:

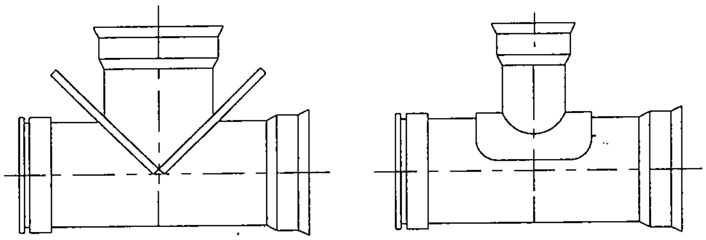
A double gasket joint may be used when water pressure testing of the pipeline is not practical, or when it becomes crucial to test each joint as the pipe is installed. The installer can air-test the joint immediately to verify the gasket seal.

Restrained Joints:

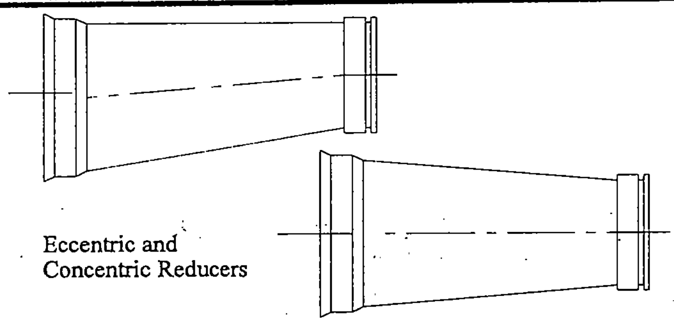
Concrete Pressure Pipe is available with restrained joints to avoid construction of thrust blocks during pipeline installation. Different types of restrained joints are available within the industry.



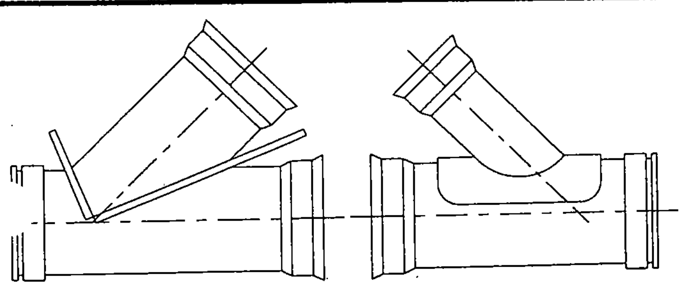
Bends



Tees



Eccentric and
Concentric Reducers



Wyes

Welded Joints:

There are two systems for welding the joints of Concrete Pressure Pipe:

Standard - Regular bell and spigot joints can be welded either from the outside or from the inside. Due to limited working space in small diameter pipe, welding from the inside is seldom performed on pipe with a diameter of less than 36 inches.

Spilt Sleeve - A split sleeve can be welded to plain steel ends. This system is mostly used for closures. Welded joints and split sleeves provide some flexibility in the adjustment of fittings on site. On smaller size pipe, a flexible welded joint is also available.

Plain Steel Ends:

When a Concrete Pressure Pipe fitting connects to another type of pipe or a structure, a plain steel end can be supplied at the required outside diameter.

Flanges:

Flanges for any class or any drilling pattern can be installed on a Concrete Pressure Pipe fitting. The most common flange specification for the waterworks industry is AWWA Standard C-207.

Others:

Concrete Pressure Pipe fittings can connect to most pipe materials using adapters available from the Concrete Pressure Pipe manufacturer. Any machined special end can be supplied to fit with couplings whether they are plain, grooved or shouldered.

Outlets

Small outlets serve many purposes, such as service connections and air release valves. Threaded outlets (3/4" to 3" dia.) can be installed on a straight pipe or fitting.

Larger size outlets can be fabricated at required locations on straight pipe or fittings with any of the pipe ends described earlier.

Two very interesting features of Concrete Pressure Pipe fittings are the availability of fabricated outlets at required angles, thus eliminating the need for an additional separate fitting, and making outlets tangent to the pipe for drain and blow-off purposes.

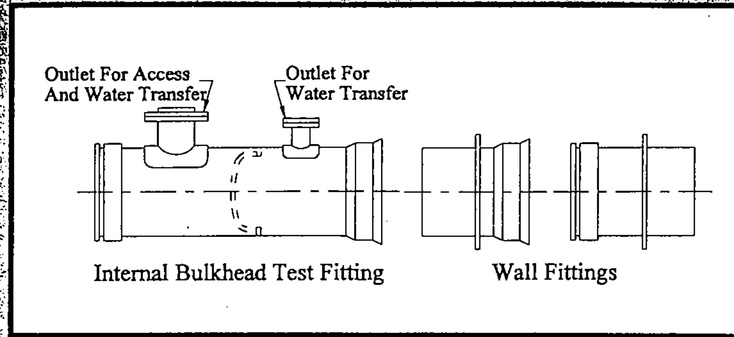
Bulkheads

Dished and flat bulkheads are available with outlets for filling, draining and for air relief.

Internal bulkheads are also available in sizes where access for removal is available. They are useful for isolating a section of pipeline during initial testing.

lve Chambers:

Valve chambers are the best example of the versatility of Concrete Pressure Pipe fittings. Wall pieces can be anchored in the concrete walls with a thrust flange, which also serves as a water stop. Drains and air vents can be achieved by a simple tangent outlet. Flanges or any special end can be used to connect to valves or special couplings. Special outlets can be supplied for installation of equipment or connection to other lines. All of the features above can generally be achieved on two compact wall pieces.

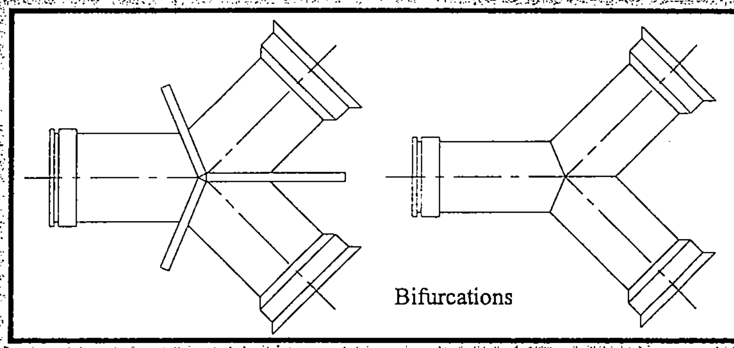


Internal Bulkhead Test Fitting Wall Fittings

Custom Made Fittings

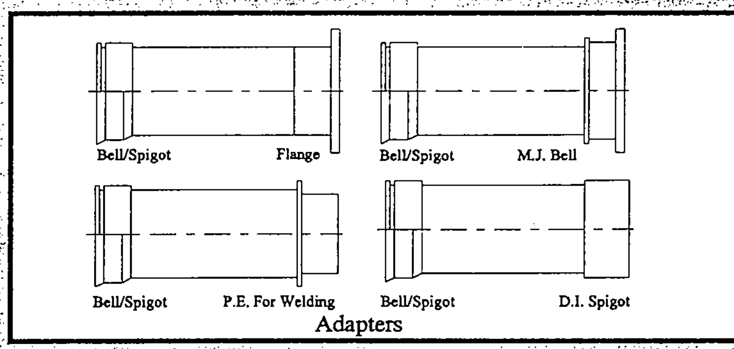
Special fittings are custom made. The size and length of required tees, elbows, reducers, and other fittings, can be adjusted to fit complex layouts.

If necessary, many features such as special ends, reducers, outlets, and wall flanges, can be combined into the same fitting. By so doing, the number of joints is reduced, thus simplifying installation, minimizing space requirements, and lowering overall project costs.



Bifurcations

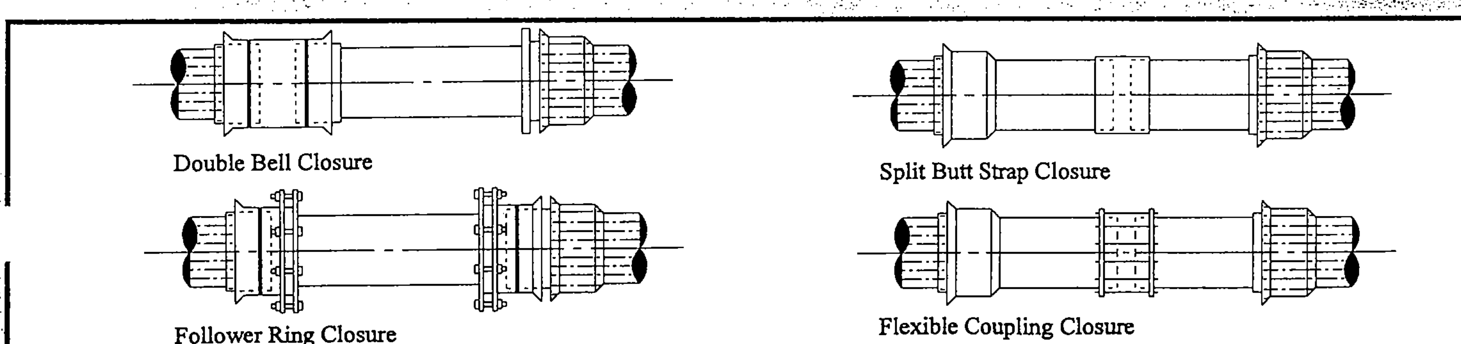
Special fittings for field adjustments may be nforeseen at the time that the project is on the drawing ard. However, different types and sizes of fittings are available for most situations. Also, in stock, are closure assemblies for urgent replacement of existing pipe sections.



Adapters

Technical Assistance

Each Concrete Pressure Pipe manufacturer has a catalogue depicting standard dimensions for common fittings and joint types. The dimensions assist the designer in determining the length of standard fittings or specials as available from the manufacturer. Also, manufacturers' technical representatives are available to assist the designer in developing the most effective pipe system layout.



American Concrete Pressure Pipe Association
Member Companies

Ameron, Inc.
10681 Foothill Boulevard, Suite 450
Rancho Cucamonga, CA 91730-3857
(909) 944-4100
FAX: (909) 944-4112

Cretex Pressure Pipe, Inc.
P.O. Box 67
South Beloit, IL 61080
(815) 389-4800
FAX: (815) 389-4825

Gifford-Hill-American, Inc.
P.O. Box 569470
Dallas, TX 75356-9470
(214) 262-3600
FAX: (214) 264-6236

Hyprescon, Inc.
699 Industrial Boulevard
St. Eustache, Quebec J7R 6C3
(514) 623-2200
FAX: (514) 623-3308

Lafarge Pressure Pipe
Lafarge Construction Materials
P.O. Box 1420
Stouffville, Ontario L4A 8A3
(905) 640-5151
FAX: (905) 640-5154

Price Brothers Company
P.O. Box 825
Dayton, OH 45401
(513) 226-8700
FAX: (513) 226-8840

Vianini Pipe, Inc.
P.O. Box D
Somerville, NJ 08876
(908) 269-2900
FAX: (908) 534-5011

American Concrete Pressure Pipe Association
8618 Westwood Center Drive, #105
Vienna, Virginia 22812
(703) 893-4350

SUPPORTING DOCUMENTS FOR COMMENT NO. 6

Mr. Barre/2429

CELMN-ED-HD

12 Feb 97

MEMORANDUM FOR C/Plng Div

SUBJECT: Jefferson Parish Feasibility Study - Alternative No. 3B for East Bank

1. Enclosed herein are the stages associated with each storage area for Alternative No 3B (Encl. 1). This alternative is in addition to the authorized Southeast Louisiana Project (SELA) and consists of slope paving the canals from top of bank down to elevation 6.0' cairo datum and placing rip-rap in the remaining section.

2. Different from SELA, Elmwood Pumping Station is to be increased 1800 cfs instead of 2400 cfs and Duncan Pumping Station is to be increased 1200 cfs where in SELA no increase in capacity is necessary. It is more beneficial to the overall plan to split the pumping capacity in this manner.

3. Enclosure No. 2 is the hydraulic design data to be used to develop representative cost estimates for the subject alternative.

4. Point of Contact is Clyde J. Barré, ext 2429.

THIBODEAUX
CELMN-ED-HD

2 Encls
as

W. EUGENE TICKNER
Chief, Engineering Division

LAURENT
CELMN-ED-H

CELMN-ED
TICKNER

CF (w/encls)
CELMN-ED-SP (Anderson)
CELMN-ED-FS (Bonanno)
CELMN-ED-TM (Jolissant)

JEFFERSON PARISH URBAN FLOOD CONTROL PLAN
PERTINENT DESIGN DATA

PLAN NAME	PUMP CAPACITY INCREASE (CFS)	CHANNEL IMPROVEMENT LENGTH (TYPE & FT)	BOTTOM WIDTH (FT)	SIDE SLOPE V:H	CHANNEL INVERT (FT NGVD)	AVG. T.O.B. ELEVATION (FT NGVD)
Plan JE-3B						
Elmwood Canal	1800					
Soniat Canal						
Reach 24 - A		SR - 2071	45	1:3	-7.9	2.1
Reach 24 - B		CF - 1510	28		-8.4	1.6
Reach 24 - C		SR - 839	45	1:3	-8.9	1.1
Reach 24 - D		CF - 2223	28		-9.4	0.6
Reach 24 [1]						
Reach 25 [2]		SR - 176	55	1:2	-14.2	-0.4
Reach 25 [1]						
Reach 36		SR - 7175	69	1:3	-17.6	-5.4
Duncan Canal	1200					
Reach 43		SR - 1425	21	1:3	-17.7	-5.4
Reach 44		SR - 2323	57	1:3	-17.9	-5.4
Reach 45		SR - 1748	56	1:3	-18.1	-5.4
Reach 46		SR - 2323	59	1:3	-18.4	-5.4
Reach 47		SR - 1823	75	1:3	-18.6	-5.4
Reach 48		SR - 984	80	1:3	-18.9	-5.4

SR = Slope Pave and Rip-Rap; **CF** = Concrete Flume; **V** = Vertical; **H** = Horizontal; **T.O.B.** = Top of Bank

[1] See drawings from BCG for details on length, invert, and top of bank.

[2] The modified trapezoidal channel has 4.0' vertical walls from the invert then slopes to the indicated T.O.B.