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WHITE TANKS FLOOD RETENTION STRUCTURE NO. 3

INLET IMPROVEMENTS

CONTRACT NO. FCD 93-47

FINAL CONCEPTUAL DESIGN REPORT

Prepared for

Flood Control District of Maricopa County

December 1994

Prepared by

AGK Engineers, Inc.
2255 North 44th Street, Suite 330
Phoenix, AZ 85008
(602) 244-2566

AGK Project No. 310.44

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AGK ENGINEERS, INC.

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INTRODUCTION

On June 7, 1994, AGK Engineers, Inc. was retained by the Flood Control District of Maricopa County to perform professional services in connection with the design of White Tanks Flood Retention Structure No. 3 Inlet Improvements. One of the project requirements is to prepare a *Conceptual Design Report* addressing the horizontal and vertical alignments of the proposed channel, channel lining alternatives, location and type of inlet and grade control structures, structures at roadway crossings, and cost estimates.

On September 5, 1994, AGK Engineers, Inc. submitted a *Preliminary Conceptual Design Report* to the Flood Control District of Maricopa County for review. After reviewing the report several comments were raised by the District. The most significant comment was a request to evaluate a channel designed for supercritical flow. A *Conceptual Design Addendum* was prepared and submitted on October, 1994 to addresses those comments. The changes and comments included in the Addendum and in a follow up memo are incorporated in this *Final Conceptual Design Report*.

The *Conceptual Design Report* and *Addendum* were prepared based on the information obtained from topographic maps with 2-foot contour intervals and supplemented by field survey. Refinement on alignments, structural dimensions, and elevations will be required during the design phase of this project.

This project was initially planned to be designed upon acceptance of the CDR, however, due to funding constraints, the District decided to forego preparation of construction documents at this time.

PROJECT LOCATION AND CHARACTERISTICS

White Tank Flood Retention Structure No. 3 (WTFRS #3) is located in the vicinity of Glendale Avenue and Jackrabbit Trail (see **Figure 1**). The structure was designed and constructed by the Soil Conservation Service in 1954 to provide flood protection to farmland and irrigation facilities in the downstream area.

Storm runoff from the east slope of the White Tank Mountains generally flows southeasterly to an existing earthen channel and thence southerly to WTFRS #3. The existing earthen channel is situated along the west bank of Beardsley Canal, with roadway crossings at Northern and Olive Avenues.

Between WTFRS #3 and Northern Avenue crossing, the existing channel is more or less prismatic with well-defined cross-section. The channel north of Northern Avenue is defined but remains natural without any improvement. While there is overland flow intercepting the channel from the northwest for virtually the entire length of its reach, three major lateral washes (Cholla Wash and two unnamed washes) concentrate much of the flow.

As presently located, the channel's downslope bank is the Beardsley Canal maintenance road. This bank has been overtopped a number of times by flood waters. The purpose of this improvement project is the upgrade of the channel and its related structures capable of intercepting the runoff generated from the 100-year event and conveying it to WTFRS #3.

The limits of this project are from the northeast entrance of WTFRS #3 to approximately 2000 feet north of Olive Avenue. Based on the characteristics of side inflow and roadway crossing (as shown on **Plate 1**), the project corridor was divided into the following five reaches:

Reach A	-	From WTFRS #3 to Northern Avenue
Reach B	-	From Northern Avenue to the confluence of Cholla Wash
Reach C	-	From the confluence of Cholla Wash to Olive Avenue
Reach D	-	From Olive Avenue to approximately 1200 feet north of Olive Avenue
Reach E	-	From north end of Reach D to project's north limit

DESIGN FLOWS

The 100-year peak discharges at various concentration points along the project corridor were estimated and documented in the *White Tank-Agua Fria Area Drainage Master Study* (**Reference 1**). The hydrology model from this study was revised by the District. These revisions included eliminating diversions along the Beardsley Canal, routing procedures, and revised loss parameters. The location of concentration points determined in the *ADMS* and the revised District model sometimes do not coincide with the ends of the channel reaches defined in this project. For this reason, the peak flows were adjusted on a prorated basis according to the drainage area size. The 100-year design flows adopted for this project are summarized as follows:

Channel Reach	100-year Design Flow (cfs)
A	8,480
B	7,770
C	3,230
D	3,050
E	1,130

DEVELOPMENT OF ALTERNATIVES

Because of large design flows, the unlined earthen channel alternative may require a channel width that is not economically feasible. Therefore, various lining alternatives were considered during this phase of the project. Commonly-used channel liners include at least the following types:

1. Unlined earthen channel
2. Plain riprap liner
3. Grouted riprap liner
4. Reno mattress (gabion basket) liner
5. Soil cement liner
6. Grass-lined channel
7. Concrete liner with vertical sidewalls
8. Concrete liner with sloped sidewalls

Because this list is rather lengthy, and in order to reduce the number of alternatives to a manageable number, a preliminary screening process was used. Elimination of the least desirable alternatives allows comparisons to focus on the more suitable ones. The preliminary screening was performed only to a level of detail sufficient to identify those alternatives that appear to be feasible and those that are clearly not feasible.

In studying channel lining alternatives for WTFRS #4 inlet improvements, Dibble & Associates (**Reference 2**) has demonstrated that the cost for Reno mattress liner is much higher than that for the plain or grouted riprap liners. The costs for the plain and grouted liners are compatible and the grouted riprap has a better hydraulic efficiency; therefore, the grouted riprap liner was selected among the three types of riprap group for further consideration in this project.

The soil cement liner and grass-lined channel were eliminated during the preliminary screening process due to constructability and maintenance concerns expressed by the C&O Division of the District.

The concrete liner with vertical sidewalls is economically feasible only in a reach where the right-of-way cost is exorbitant. Since the project corridor is in a fairly remote area with relatively low cost for right-of-way acquisition, this alternative was not chosen for further consideration.

As a result of the preliminary screening process, the following three alternatives were selected for more detailed evaluation:

Alternative 1	Unlined Earthen Channel
Alternative 2	Grouted Riprap Liner
Alternative 3	Concrete Liner with Sloped Sidewalls

These alternatives were based on subcritical flow. After concrete was selected as the preferred alternative, supercritical flow was evaluated for the concrete liner at the request of the District.

Characteristics of channel configuration for each of the alternatives are discussed in the following paragraphs.

Channel Capacities

At the conceptual design stage, channel capacities for various reaches were estimated using the Manning's Formula. Values of Manning's "n" for earthen and concrete lined channels were obtained from the *Drainage Design Manual for Maricopa County, Arizona, Volume II, Hydraulics* (**Reference 3**). Manning's "n" value for grouted riprap channel was selected from Chow's *Open-Channel Hydraulics* (**Reference 4**). The selected "n" values are summarized in **Table 1**.

Horizontal Alignment

For both subcritical and supercritical flow, the horizontal alignment of the new channel between WTFRS #3 and Northern Avenue basically follows the existing channel which includes a reverse curve. North of Northern Avenue, the east bank of the new channel matches the west side of the maintenance road of the Beardsley Canal.

For the reverse curve, a 1000-foot radius was used for the subcritical alternatives. For the supercritical alternatives, a minimum radius of 1300 feet is required as determined by methods outlined in *EM 1110-2-1601, Hydraulic Design of Flood Control Channels, July 1970* (see **Appendix L**). A 1500-foot radius was used for the design of the supercritical channel.

Channel Cross-sections

Standard trapezoidal cross-sections were used for all channel configurations. The side slopes for different types of channel liners are summarized in **Table 1**. Since the channel's east bank is adjacent to the maintenance road of Beardsley Canal, the top elevations of the maintenance road warrant a maximum depth of 11 feet. Since subcritical flow requires the use of several drop structures which are typically 3 feet high, the maximum upstream depth from the drop structure was limited to 8 feet. For the supercritical flow regime, however, drop structures are not required and the full 11 feet was used. Typical channel cross-sections are illustrated in **Figures 2** through **4**.

Hydraulic Parameters

Allowable flow velocities for lining alternatives are also shown in **Table 1**. The Froude number was restricted to less than 0.80 for subcritical flow and between 1.13 and 2.00 for supercritical flow. These parameters were used in order to avoid a potentially unstable condition with the possibility of wave formation typical of flow with a Froude number between .85 and 1.13 and hazardous conditions for Froude numbers higher than 2.00. Freeboard and superelevation values which are functions of flow depth and velocity, were computed using the formula contained in the *Drainage Design Manual for Maricopa County, Arizona, Volume II, Hydraulics* (**Reference 3**).

Hydraulic Computation

A spreadsheet program was developed to compute channel configurations for the three lining alternatives as well as for the supercritical alternative. The outputs from the spreadsheets are shown in **Appendices A** through **C2**. In computing channel configurations, parameters such as discharge, Manning's "n," and flow depth were fixed. Then, a maximum velocity was established using the *Drainage Design Manual* (**Reference 3**). These computations were verified by the output from the HEC-2 model, included in **Appendix I**.

For the subcritical alternatives, channel bottom width and longitudinal slope were solved for a given depth using the maximum permissible velocity. These maximum velocities were reduced in some cases (some in Alternative 2, and all of Alternative 3) to satisfy the Froude number criteria for stability ($F<0.80$)).

For the supercritical alternative, existing ground slope was used as the longitudinal slope. Channel bottom width was then solved for each chosen depth and the Froude number checked to insure it met the safety and stability criteria ($1.13 < F < 2$).

Freeboard, top width and additional channel geometric information were subsequently computed based on the solved sections.

Drop Structures

It was noted that the longitudinal slopes of all subcritical channel configurations were flatter than that of the existing channel profile. Therefore, drop structures were needed in all subcritical alternatives to establish the required channel grade. Drop structure height was limited to a maximum of three feet for safety reasons and as recommended in the *Drainage Design Manual* (**Reference 3**). The straight-drop type structure was selected for evaluation of the three different subcritical alternatives. Drop structures were sized according to the empirical formulas listed in French's *Open-Channel Hydraulics* (**Reference 5**). Details of drop structure sizing are presented in **Appendix F**. Modification of drop structure configuration may be required during the final design phase of this project. Particular attention will need to be paid to the hydrostatic pressures created at the drop structure.

No drop structures were required within the reaches for supercritical flow since the longitudinal slope closely follows the natural ground slope however some drop in elevation was required at the transitions to match energy levels between reaches.

Right-of-way

As shown in **Figures 2** through **5**, a 14-foot wide maintenance road is planned along the east bank of each alternative channel cross-section. Also, a 20-foot strip was allowed on the west bank for side ditch construction. Therefore, for cost comparison, the right-of-way width was assumed to be the channel top width plus 34 feet.

SUMMARY OF ALTERNATIVES

The configurations and characteristics of the three subcritical alternative and the supercritical alternative designs are presented in **Tables 2** through **5**. The thickness of riprap lining was estimated according to the method recommended by the U.S. Army Corps of Engineers (**Reference 6**). The thickness and reinforcement for the concrete channel were determined in accordance with the *Channel Lining Design Guidelines* prepared by ADOT (**Reference 7**).

TABLE 1
CHANNEL HYDRAULICS DESIGN SUMMARY

Channel Type	Side Slopes	Manning's "n"	Allowable Velocity (fps)
Unlined earthen channel	4:1	0.030	3.0
Grouted riprap liner	3:1	0.025	9.0
Concrete liner	2:1	0.015	15.0 *

* Guideline for simplified design. Higher velocity allowed with increased reinforcement

TABLE 2
UNLINED EARTHEN CHANNEL CHARACTERISTICS

CHANNEL CHARACTERISTICS	CHANNEL REACH				
	A	B	C	D	E
Design Flow (cfs)	8,480	7,770	3,230	3,050	1,130
Channel Slope (ft/ft)	0.00040	0.00040	0.00044	0.00044	0.00118
Flow Velocity (fps)	3.00	3.00	3.00	3.00	3.00
Bottom Width (ft)	492	449	174	163	141
Top Width at Water Surface (ft)	536	493	218	207	161
Flow Depth (ft)	5.50	5.50	5.50	5.50	2.5
Freeboard (ft)	1.41	1.41	1.41	1.41	1.00
Froude Number	0.23	0.23	0.24	0.24	0.35
Right-of-way Width (ft)	628	592	305	287	249
No. of Drop Structures	7	5	9	2	1
Reach Length (ft)	4,214	1,950	3,332	1,168	600

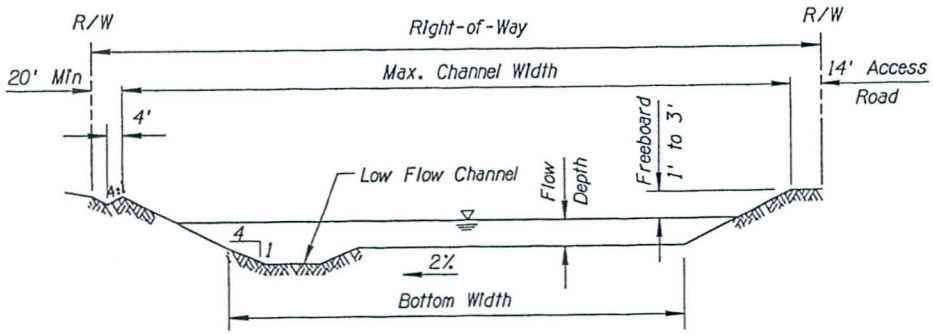

FIGURE 2. TYPICAL CROSS SECTION FOR UNLINED EARTHEN CHANNEL

TABLE 3
GROUTED RIPRAP CHANNEL CHARACTERISTICS

CHANNEL CHARACTERISTICS	CHANNEL REACH				
	A	B	C	D	E
Design Flow (cfs)	8,480	7,770	3,230	3,050	1,130
Channel Slope (ft/ft)	0.00270	0.00273	0.00328	0.00334	0.00452
Flow Velocity (fps)	9.00	9.00	9.00	9.00	6.8
Bottom Width (ft)	155	140	49	45	59
Top Width at Water Surface (ft)	188	174	82	79	74
Flow Depth (ft)	5.50	5.50	5.50	5.50	2.50
Freeboard (ft)	1.69	1.69	1.69	1.69	1.00
Froude Number	0.71	0.71	0.76	0.76	0.80
Right-of-way Width (ft)	278	521	168	157	160
No. of Drop Structures	4	3	5	1	0
Reach Length (ft)	4,214	1,950	3,332	1,168	600

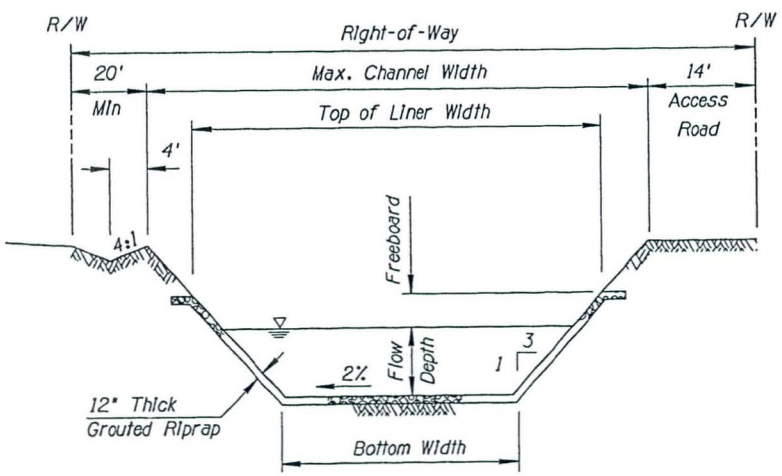

FIGURE 3. TYPICAL CROSS SECTION FOR GROUTED RIPRAP CHANNEL

TABLE 4
CONCRETE-LINED CHANNEL CHARACTERISTICS
(SUBCRITICAL)

CHANNEL CHARACTERISTICS	CHANNEL REACH				
	A	B	C	D	E
Design Flow (cfs)	8,480	7,770	3,230	3,050	1,130
Channel Slope (ft/ft)	0.00124	0.00125	0.00131	0.00132	0.00160
Flow Velocity (fps)	10.28	10.25	9.77	9.74	7.15
Bottom Width (ft)	139	127	49	46	53
Top Width at Water Surface (ft)	161	149	71	68	64
Flow Depth (ft)	5.50	5.50	5.50	5.50	2.70
Freeboard (ft)	1.8	1.8	1.7	1.7	1.00
Froude Number	0.80	0.80	0.80	0.80	0.80
Right-of-way Width (ft)	250	244	154	144	148
No. of Drop Structures	6	4	8	2	1
Reach Length (ft)	4,214	1,950	3,332	1,168	600

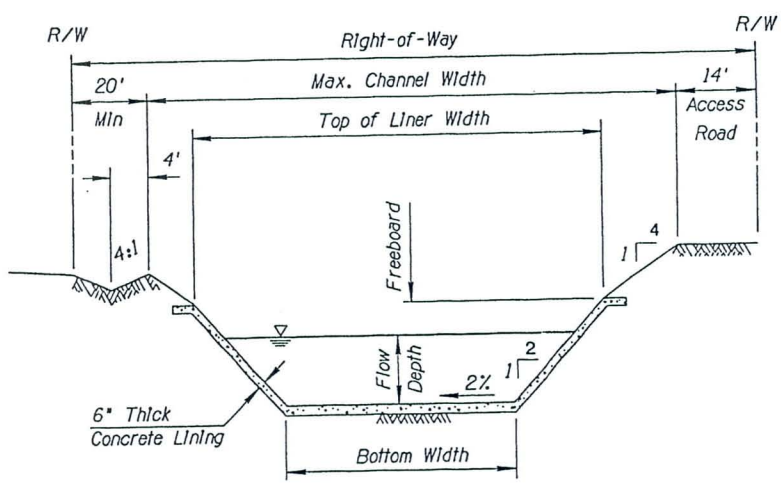

FIGURE 4. TYPICAL CROSS SECTION FOR SUBCRITICAL CONCRETE LINED CHANNEL

TABLE 5
CONCRETE-LINED CHANNEL CHARACTERISTICS
(SUPERCRITICAL)

CHANNEL CHARACTERISTICS	CHANNEL REACH				
	A	B	C	D	E
Design Flow (cfs)	8,480	7,770	3,230	3,050	1,130
Channel Slope (ft/ft)	0.00500	0.00640	0.00760	0.00570	0.00570
Flow Velocity (fps)	21.45	23.55	21.35	18.86	14.37
Bottom Width (ft)	42	33	8	9	12
Top Width at Water Surface (ft)	70	61	36	37	28
Flow Depth (ft)	7.0	7.0	7.0	7.0	4.0
Freeboard (ft)	3.54	3.90	3.52	3.13	2.00
Froude Number	1.596	1.786	1.826	1.592	1.501
Right-of-way Width (ft)	156	148	116	116	102
No. of Drop Structures	0	0	0	0	0
Reach Length (ft)	4,214	1,950	3,332	1,168	600

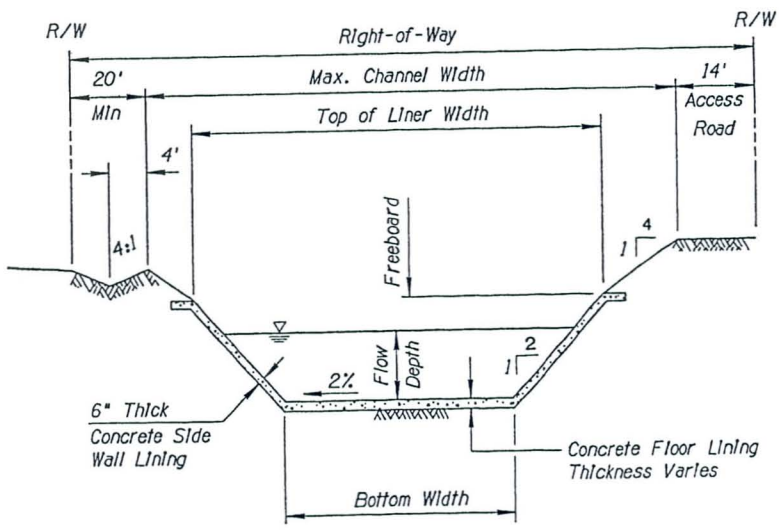

FIGURE 5. TYPICAL CROSS SECTION FOR SUPERCRITICAL CONCRETE LINED CHANNEL

EVALUATION OF ALTERNATIVES BY COST COMPARISON

The four alternative designs were evaluated in terms of their capital and O & M costs. The capital cost for each item was estimated by applying a unit cost to the required quantities of that particular item. Unit costs, as shown in **Table 6**, were derived from the recent construction bid prices on similar projects or from the estimated unit costs listed in **Reference 2**.

TABLE 6
ESTIMATED UNIT PRICES FOR CAPITAL COST

Item	Unit	Unit Cost
1. Excavation	CY	$ 3.00
2. Structural Excavation	CY	10.00
3. Concrete Lining (Reinforced)	CY	180.00
4. Grouted Riprap	CY	65.00
5. Structural Concrete	CY	300.00
6. 3-foot Drop Structure - Concrete	LF/ft width	250.00
7. 3-foot Drop Structure - Grouted Riprap	LF/ft width	351.00
8. 3-foot Drop Structure - Earthen	LF/ft width	275.00
9. 5-foot Drop Structure	LF/ft width	279.00
10. Right-of-Way	Ac	13,000.00
11. Fence	LF	10.00
12. Bridge crossing - Northern (Subcritical)	EA/ft width	2,659.00
13. Box Culvert Crossing - Olive (Subcritical)	EA/ft width	2,436.00
14. Bridge Crossing - Northern (Supercritical)	EA/ft width	2,659.00
15. Bridge Crossing - Olive (Supercritical)	EA/ft width	3,754.00
16. Inlet Structures (Subcritical)	EA/ft width	552.00
17. Outlet Structures (Subcritical)	EA/ft width	904.00
18. Inlet structure (Supercritical)	EA/ft width	831.00
19. Outlet Structure (Supercritical)	EA/ft width	2,766.00
20. Side inlet - Cholla	LS	339,453.00
21. Side inlet - Olive	LS	186,334.00
22. Maintenance of Earthen Channel (30 years)	LF	100.50
23. Maintenance of Riprap Channel (30 years)	LF	50.00
24. Maintenance of Concrete Channel (30 years)	LF	5.68

A cost per-foot width was estimated for channel drop structures, which included the costs for structural excavation and concrete work. The right-of-way cost was assumed to be a constant value regardless of the location in the project area. The O & M costs were obtained from the Contracts, Operation & Maintenance Division of the District. More details regarding the selection of unit costs are presented in **Appendix D.**

The total estimated capital and O & M costs for each alternative design are summarized in **Table 7.** Detailed cost estimates are included in **Appendices A** through **C2.** The excavation was calculated using the average end area method at a typical section within each reach. Channel fencing was assumed to be along the west side only. The costs for the bridge or culvert crossings were based upon the cost estimate of structures for a concrete lined channel alternative. From this cost, a unit cost per channel top width was developed and applied to each of the alternatives. The cost for the inlet (at the north end of the project) and the outlet (at FRS #3) was based on a unit cost per foot of width and was assumed to be the same for all three alternatives. The cost for the side inlets at Cholla Wash and immediately north of Olive were assumed to be the same for all alternatives.

These cost estimates include operation and maintenance costs for thirty years. These costs were based on simply multiplying the annual cost by thirty years. This was based on the assumption that the cost of securing funds (interest rate charge) would be equal to the current market interest rate (interest paid) for a safe investment.

Because the scope of this *Conceptual Design Report* is limited in the degree that specific construction costs can be identified, some components of the channel improvement could be further evaluated and reduced in cost during design. Based on preliminary observations, these items include: lining with shotcrete in lieu of cast-in-place concrete, drop structures, right-of-way, inlet and outlet structures, and side inlets. Some of the potential cost reductions for these items are discussed in the **Recommended Channel Improvement** section of this report and in **Appendix K.** Further value engineering should be performed during the design phases of this project, considering not only cost reduction, but the subsequent impact to risk assessment, liability, and future O & M costs.

These cost estimates include a contingency of 20% to allow for unforeseen components, changes in the design, and costs for engineering and construction inspection.

TABLE 7
COST COMPARISON FOR CHANNEL ALTERNATIVES

Channel Reach	Unlined Earthen Channel	Grouted Riprap Channel	Concrete Lined Channel (subcritical)	Concrete Lined Channel (supercritical)
A	5,781,017	4,163,407	4,189,647	2,269,954
B	4,894,586	2,988,162	2,895,591	1,673,530
C	2,495,052	2,020,803	1,772,844	1,088,248
D	1,574,650	1,062,864	1,011,685	820,968
E	369,118	291,927	292,124	142,777
TOTAL	**15,114,423**	**10,527,164**	**10,161,891**	**5,995,477**

RECOMMENDED CHANNEL IMPROVEMENT

Based on the results listed in **Table 7**, the supercritical concrete lined channel is the least-cost alternative for this project. It represents a savings of 41% over the next least-cost alternative, subcritical concrete. However; the supercritical channel will have peak flow velocities in excess of 20 feet per second. This condition creates significant additional safety risks and maintenance considerations. These issues were discussed during the preparation of this Concept Design Report and it was decided that a risk-cost analysis would be performed by the District to weigh the cost savings afforded by this alternative against the risk associated with high velocity supercritical flow.

For this reason, at this point, this report recommends that the subcritical concrete lined channel be constructed. However, we have included a design description and plan and profile sheets for the supercritical concrete lined channel in the next section entitled "**LEAST COST ALTERNATIVE**".

Recommended Channel Plan and Profile

The horizontal and vertical alignment of the "Recommended" WTFRS #3 inlet channel is shown on the 1" = 100' plan and profile sheets, contained in the overleaf pocket labeled "Recommended Alternative". In order to minimize right-of-way acquisition and follow the existing drainageway alignment, the horizontal alignment of the channel hugs the east limits of the project corridor. A key assumption was the joint use of the 60'-wide strip of property owned by Maricopa County Municipal Water Conservation District No. 1 between Northern and Olive Avenues. The effects of this assumption are discussed in the next section, **Right-of-Way**. The southern end of the proposed channel shows a reverse curve, which was included in order to keep the channel away from the toe of FRS #3 and to provide a more hydraulically compatible outlet.

The proposed profile, shown on the plan and profile sheets, illustrates the existing ground contours, the proposed channel invert and top of lining, and the designed hydraulic grade line and energy grade line for the channel. All of these considerations were used during the preparation of the *Conceptual Design Report* to determine the most cost-effective channel depth and the preferred location of the side inlets and drop structures. It was determined that the most economical channel flow depth, considering the downstream bank (Beardsley Canal Service Road), the increase in depth downstream from the drops, and the existing flowline, was 5.5 feet. This also considered the District's requirements for freeboard. Further refinement of the channel profile can be accomplished during the final design phase when additional cross section information and design refinements are incorporated into the project.

Right-of-Way

The required right-of-way for each reach is also indicated on the 1" = 100' plan and profile sheets. The minimum right-of-way width for each reach was estimated by evaluating the most critical cross section within that reach. A summary of the right-of-way width calculations for the selected alternative is included in **Appendix H.** Refinements of the actual right-of-way requirements will be made during the final design of this project. Right-of-way costs could be reduced if a variable right-of-way alignment was incorporated based on actual topographic conditions. Another option for reducing right-of-way requirements would be to acquire a floodway or temporary construction easement for portions of the improvements.

One key assumption for all three alternatives evaluated as part of this *Conceptual Design Report* was the joint use of the 60' right-of-way owned by the Maricopa County Municipal Water Conservation District No. 1, currently operating the Beardsley Canal. If an agreement cannot be reached, it is estimated that an additional 11 acres of right-of-way will be required. Also, the horizontal alignment north of Northern Avenue will have to be shifted 60 feet to the west, requiring a reverse curve south of Northern Avenue. This would result in an approximate increase of $150,000 to the project cost (see **Appendix H**).

One potential conflict was discovered during right-of-way research. The legal description prepared by Maricopa County Right-of-way Department infers a 300 feet wide right-of-way for the existing White Tanks FRS #3 inlet channel south of Northern Avenue. The legal description obtained from research lists a 250 feet wide right-of-way in this area. Based on review of records, District staff verified that the R/W width is 250 feet.

The cost estimates shown in this report could be further reduced by decreasing the right-of-way that needs to be purchased. Refinements in the right-of-way requirements can be finalized as part of the construction document preparation.

The right-of-way required by the project can be reduced in the following ways:

1. Joint use agreement for the 60-foot Beardsley canal right-of-way between Northern and Olive Avenues. This will result in about $140,000 savings to the District.

2. Obtaining temporary grading easements for construction of the west banks instead of purchasing the land.

3. Obtaining right-of-way that is not of consistent width, but varies according to the channel requirements. The cost estimates in this report are based on constant width equal to the maximum required within the reach.

Proposed Roadway Crossings

For initial comparison, reinforced concrete box culverts were sized for the roadway crossings at Northern and Olive Avenues based on the selected alternative, concrete lined channel. The sizing was based on an assumption of inlet control condition, using the nomograph contained in the *Drainage Design Manual* (**Reference 3**). Capacities and dimensions of concrete box culverts are shown in **Table 8**. Detailed computations are presented in **Appendix E.**

TABLE 8
CULVERT CONFIGURATIONS AT ROADWAY CROSSINGS

Location	Capacity (cfs)	Height (ft)	Culvert Arrangement	Total Span (ft)
Northern Avenue	7,770	8	Twelve 10′ x 8′ or Ten 12′ x 8′	130
Olive Avenue	3,350	8	Five 10′ x 8′	54

The proposed length of the culverts is 91′ 2", based upon the initial requirements of the Maricopa County Department of Transportation. Based on subsequent discussions with the County's Bridge Engineer, the overall length of the box culvert may be reduced to 68′. The actual required length of the box culvert will be determined during subsequent phases of the design.

The total span of culvert at each roadway crossing is compatible with the bottom width of the upstream and downstream channel reaches. Transitions into and out of these culverts were designed using a taper rate of 10:1, as required in **Reference 6.**

An evaluation of alternative roadway crossings was performed as part of the design concept process. From this analysis, three alternatives were developed for the Olive Avenue crossing and two alternatives were developed for the Northern Avenue crossing. A summary of these alternatives and the associated costs is shown below.

Northern Avenue	Cost
12 Channel 8 x 10′ Box Culvert	$ 413,000
4-Span Slab Bridge (Piers w/shafts)	$ 399,500
Olive Avenue	**Cost**
5 Channel 8 x 10′ Box Culvert	$ 181,500
Single Span Voided Slab Bridge	$ 199,000
2-Span Slab Bridge	$ 172,500

Based on the cost estimates and ease of constructability, a bridge is recommended at the Northern Avenue crossing. At the Olive Avenue crossing, the box culvert appears to have approximately the same cost as a 2-Span Slab Bridge, when considering possible additional design costs. However, it is most likely that 68′ long box, vs. 91′ could be installed. This would cause the box culvert to be cheaper, and we therefore, recommend the box be installed.

Drop Structure Locations

Generally, drop structures were placed upstream of the roadway crossings (culverts) to minimize the effect of backwater from hydraulic losses at the culvert inlet. Drop structures were also typically placed upstream of major side inlets to minimize potential backwater effect at the confluence with the main channel. The height of the drop structures was held at three feet in accordance with Flood Control District safety requirements. Based on sizing calculations, this three-foot drop required a sill downstream of the drop to force the hydraulic jump within the drop structure. In order to minimize construction costs and allow for low flows to pass through the drop structures, a raised curb type sill was included as part of the design. Openings in the curb sill were provided to allow for periodic maintenance and to encourage scouring.

The possibility of incorporating 5′ drop structures was evaluated. The advantage of 5′ drop structures was a reduction in the number of structures required, resulting in a potential cost savings of approximately $200,000 (See **Appendix K**) for the entire project.

Side Inlets

Major lateral washes generally inlet into the main channel at or above the channel flowline. Concrete lined channels were sized for these major side inlets in accordance with the estimated runoff obtained from the revised hydrology from a previous ADMS Study (**Reference 1**). Each concrete lined channel was extended upstream in the lateral wash to a location where it could smoothly match the existing stream cross section.

Sheet flows from the west would be collected in a shallow swale (as shown in **Figure 4**) and discharged to the main channel at the major side inlets, if possible, or at inlets spaced at approximately 500-foot intervals.

Sediment Transport

As part of the geotechnical investigation provided as part of this design concept process (see **Appendix J**), erosion potential for existing soils in the project area was evaluated. Threshold velocities for the soils are estimated to be between 0.75 to 2.5 feet per second. Because the velocity required for sediment erosion is so low, construction of any lined desilting or sedimentation basins would be ineffective.

Considering the low velocity required for soil erosion and sediment transport, the selected channel alternative was designed to allow sediment to pass through the channel. The sediment load carried by the runoff entering into the north and side inlets of the channel would be carried through the facility and deposited in the FRS #3 Structure. Transition for the inlets and outlet into FRS #3 were accomplished with gabion mats to provide a stable, yet flexible transition from the rigid concrete channel to the existing alluvial streambeds.

Subsidence

As part of the geotechnical investigation prepared for this project (see **Appendix J**). An evaluation for potential of subsidence in the project corridor was performed. Anticipated subsidence values at selected points along the project from the present to the year 2035 are as follows:

- 1.7 feet at Peoria Avenue
- 0.0 feet at Olive and Northern Avenue
- 0.0 to 1.4 feet at Glendale Avenue

Based on this information, the effects of subsidence should not be a major impact to this project. However, the potential of subsidence will be considered and incorporated into the design of the concrete lining, the expansion and crack control joints, the final channel grade, and the height and location of the drop structures.

Channel Access

According to the District's requirements, 14-foot wide access ramps were provided between drop structures for maintenance purposes. Ramp slopes were set at approximately 8%.

Water Surface Profiles by HEC-2

The HEC-2 input and output files for the proposed channel alignment and profiles are presented in **Appendix I.**

LEAST COST ALTERNATIVE

The supercritical concrete lined channel is the least cost alternative for this project. However, this alternative is not recommended at the time of this report. Please see the beginning of ***RECOMMENDED CHANNEL IMPROVEMENT*** for further discussion.

Least Cost Plan and Profile

The horizontal and vertical alignment of the "Least Cost" WTFRS #3 inlet channel is shown on the 1" = 100' plan and profile sheets, contained in the overleaf pocket labeled "Least Cost Alternative". In order to minimize right-of-way acquisition and follow the existing drainageway alignment, the horizontal alignment of the channel hugs the east limits of the project corridor. A key assumption was the joint use of the 60'-wide strip of property owned by Maricopa County Municipal Water Conservation District No. 1 between Northern and Olive Avenues. The affects of this assumption are the same as for the recommended channel alternatives and were discussed in the ***RECOMMENDED CHANNEL IMPROVEMENT***. The southern end of the proposed channel shows a reverse curve, which was included in order to keep the channel away from the toe of FRS #3 and to provide a more hydraulically compatible outlet. After the reverse curve, the channel was designed to change the flow from supercritical to subcritical flow regime by forcing an hydraulic jump. This is accomplished by widening the channel, flattening the slope, and installing a sill, creating a smooth transition into FRS #3.

The proposed profile, shown on the plan and profile sheets, illustrates the existing ground contours, the proposed channel invert and top of lining, and the designed hydraulic grade line and energy grade line for the channel. All this information was used during the preparation of the *Conceptual Design Report* to determine the most cost-effective channel depth and the preferred location of the side inlets and drop structures. It was determined that the most economical channel flow depth, considering the downstream bank (Beardsley Canal Service Road) and the existing flowline was 7 feet. This also considered the District's requirements for freeboard.

Further refinement of the channel profile can be accomplished during the final design phase when additional cross section information and design refinements are incorporated into the project.

Right-of-Way

The required right-of-way for each reach is also shown in the 1" = 100' plan and profile sheets. The same assumptions and considerations described in ***RECOMMENDED CHANNEL IMPROVEMENT*** also apply to the Least Cost Alternative.

Proposed Roadway Crossings

The cost of the bridges required for the supercritical channel is about the same or slightly higher as for the one use in the subcritical alternatives. For a supercritical channel the width of the channel is significantly reduced, but the cross-section under the roadway crossings is not significantly changed. For the subcritical alternatives, the bridge span was designed to match the bottom width of the channel allowing for vertical abutments. For supercritical flow, the bridge matches the top width, which increases the span by approximately 30 feet. At Olive Avenue, the same width single span bridge is required for both supercritical and subcritical channels.

Channel Transitions

Transitions were designed between reaches to smoothly change the geometry and to ensure enough energy is available in the upstream reach. The cost associated with these transitions was included in the unit costs for the channel or in the inlet and outlet unit costs. Any modifications of the transitions during the final design stage will need to be analyzed to ensure that they do not create losses greater than the available energy gradient differential at the transition.

Channel Access

For a supercritical flow channel, any change in the cross section may create a significant disturbance of the flow, this situation should be avoided if possible. For this reason, no access ramps were provided along the channel. Instead, access was assumed to be available at the inlet and outlet of the channel.

Other Considerations

Considerations regarding right-of-way, side inlets, sediment transport, subsidence, and water surface profiles are the same for both the Low Cost Alternative and the Recommended Alternative. Please refer to the discussion of these considerations in ***RECOMMENDED CHANNEL IMPROVEMENT***.

Water Surface Profiles by HEC-2

The HEC-2 input and output files for the proposed channel alignment and profiles are presented in **Appendix I**.

COST MITIGATION CONSIDERATIONS

At the request of the District, AGK Engineers evaluated additional options that could reduce the cost of the project. These options were presented to the District in a memorandum on November, 1994. A copy of this memorandum is included in **Appendix K**. Reduction of the design flow, reduction of lined freeboard, and revision of some cost estimates were analyzed, as well as dividing the project into two and three phases. Some of the unit costs presented in the memorandum have changed slightly since the memorandum was presented, but these changes are reflected in the tables included in this report.

REFERENCES

1. Flood Control District of Maricopa County, *White Tank - Agua Fria Area Drainage Master Study (ADMS)*, June, 1992.

2. Dibble & Associates, *Conceptual Design Report for White Tank Flood Retention Structure No. 4 Inlet Improvements*, Contract No. FCD 92-38, July, 1993.

3. Flood Control District of Maricopa County, *Drainage Design Manual for Maricopa County, Arizona, Volume II, Hydraulics*, September, 1992.

4. Chow, V.T., *Open Channel Hydraulics*, McGraw-Hill Book Company, New York, 1959.

5. French, R. H., *Open-Channel Hydraulics*, McGraw-Hill Book Company, New York, 1985.

6. U.S. Army Corps of Engineers, *Hydraulic Design of Flood Control Channels*, EM 1110-2-1601, July 1970.

7. Arizona Department of Transportation, *Channel Lining Design Guidelines*, February 1989.

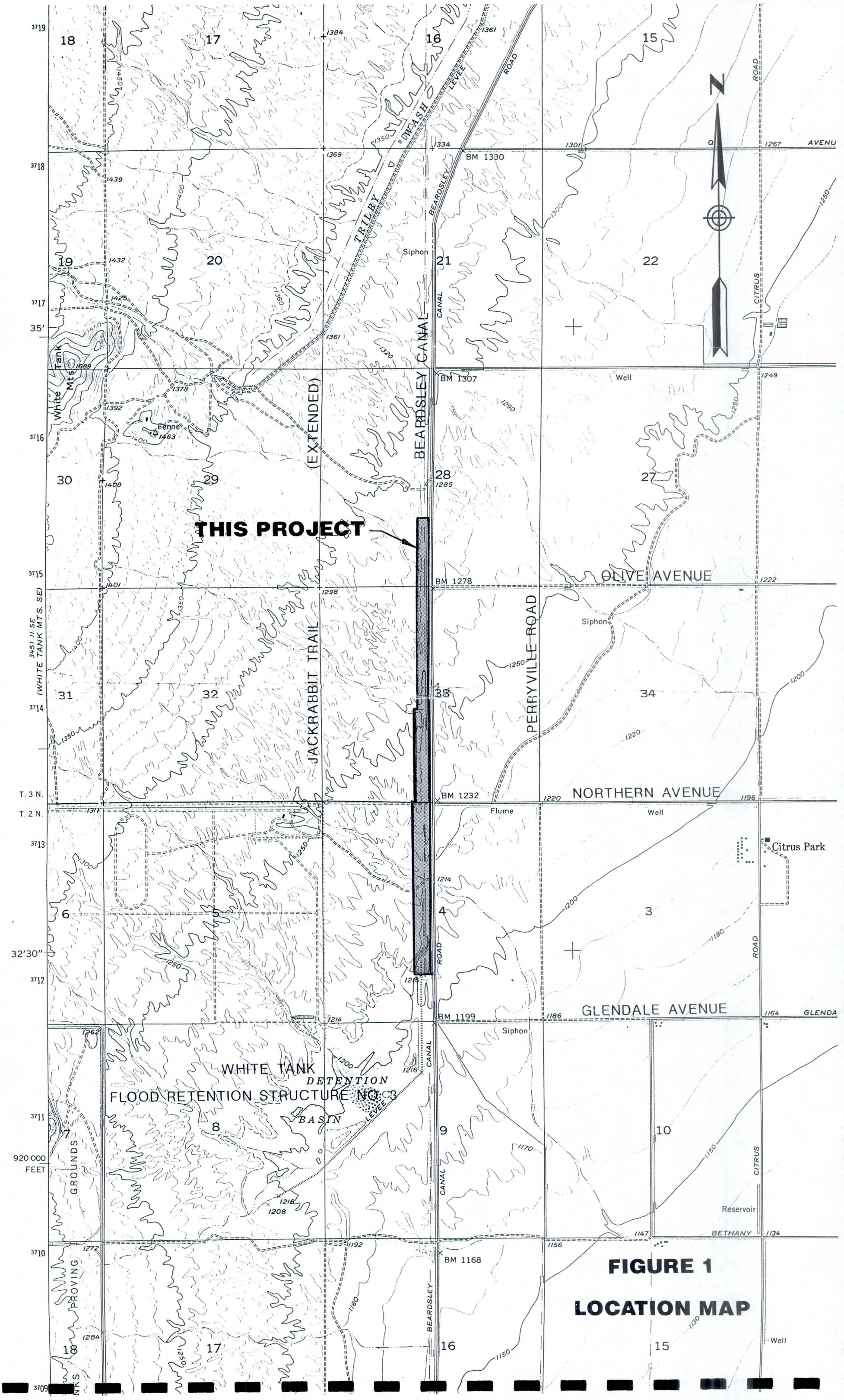

FIGURE 1

LOCATION MAP

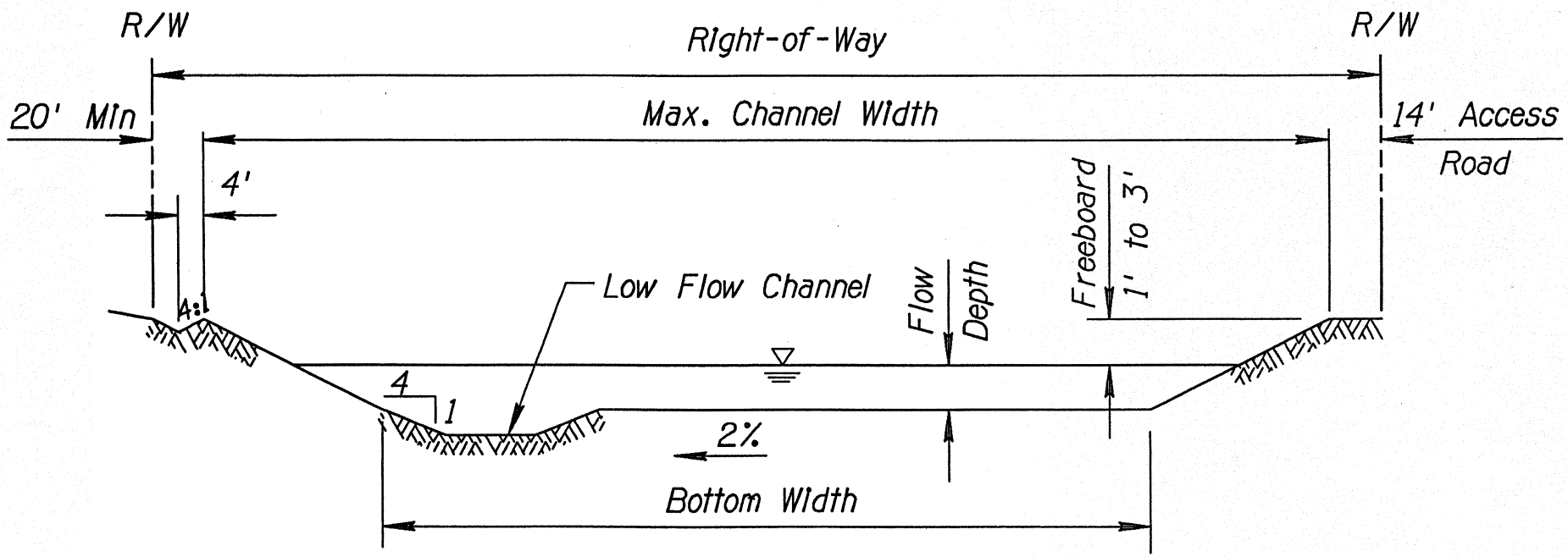

FIGURE 2. TYPICAL CROSS SECTION FOR UNLINED EARTHEN CHANNEL

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BY [illegible] DATE

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CLIENT FCDMC

JOB White Tanks JOB NO. 310 W4

The equations use in the spread sheet are shown in the next couple pages. the spread sheet use an optimization procedure to solve for the bottom width and the slope. the Froude # and velocity are optimize no to exide .8 and the maximum allowable velocity for the liner. A value of 0.8 was used for the limit to the Froude # the county's manual states the limit as .85 0.8 was use to prevent the flow from going on this unstable region on transitions and channel irregularities the equation used are common use equations and they can be found in any fluid book

The minimum depth was assumed to be flow depth + free-board (Y_c)

Because terrain does not match ground level the channel must be deeper in some areas than in other this differens is included as overexcavation

the slope of the overexcavation was assumed to be 3:1

excavation was calculated base on the average volume of channel excavation

Volume of liner was calculated as the minimum excavation volume minus volume of channel

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SHEET 2 OF 3
BY HMA DATE 7/20/94
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CLIENT FCDMC
JOB Cost Estimates spread sheet
JOB NO. 310.01

Column	Variable		Equation	Formula
A	Riprap D_{50}		Input	
* B	Computed Q		$\frac{1.486}{n} A R^{0.667} S^{0.5}$	$\frac{1.486}{I} K M^{0.6667} F^{0.5}$
* C	Error		$Q_{design} - Q_{calc}$	E - B
E	Qdesign	(Q_{des})	Input	
F	Slope	(S)	Input	
G	Bottom width	(B)	Input	
H	Side slopes	(m)	Input	
I	mannings n	(n)	Input	
J	flow depth	(Y)	Input	
K	flow area	(A)	$y(b+my)$	J * (G + H*J)
L	Wetted perimeter	(P)	$b + 2\sqrt{y^2+(my)^2}$	G + 2 * $\sqrt{(J*H)^2 + J^2}$
M	Hydraulic Radius	(R)	A/P	K/L
N	Velocity	(V)	Q/A	B/K
O	Top width	(T)	$B + 2(Ym)$	G + 2 * J * H
P	Froude No.	(F_n)	$\sqrt{Q^2T/32.2A^3}$	$\sqrt{B^2 * O/32.2 * K^3}$
Q	Free-board	(FB)	1 or $0.25\left(Y + \frac{V^2}{2(32.2)}\right)$	$0.25\left(J + \frac{N^2}{2(32.2)}\right)$ • MECO Mar 97
R	Channel depth	(Y_t)	$Y + FB$	Q + J
S	Min Top width	(T_{min})	$B + 2(Y_t m)$	G + 2(R * H)
t	Max Top width	(T_{max})	$B + 2(m \cdot Y_t + 30v)$	G + 2(H * (R + R5))
U	Existing channel area	(A_{exist})	Input	
V	min exc Area	(A_{cmin})	$(Y_t+t)((b+2t)+m(Y_t+t))$	(R+R6) * ((G+2*(R6)) + H * (R+R6))
W	Channel area	(A_{ch})	$Y_t(b+mY_t)$	R(G + H*R)

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SHEET 3 OF 3
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CLIENT FCDMC
JOB Wada tunnel JOB NO. 340 441

X	Max excavation area	(Aemax)	(Yt + Ob + L)((Zt + B) + m(Yt + Ob + L))	(R + R6)^R5 ((6 + Z R6) + H(R + R6))^R5
Y	Av. excavation area	(Aeav)	(Aemax + Aemin)/2	(X + Y)/2
Z	Liner Area	A_L	Aemin − Ach	(V − W)
AA	Road width	Wr	Input	
AB	R.O.W width	Wrow	Tmax + Wr	(AA + L)
AC	R.O.W Area	Arow	Wrw × L/43560	(AB)(R2)/43560
AD	R.O.W Cost	Costrow	Arow unit cost	(AC) + (E4)
AE	Drope cost		Tmin unit cost/width	(S)(H3)
AF	# of drops		Tbord / L(Sex − S)/Hd	@Rbord((R2)+(R3) − F)/(R4)
AG	Drop cost		(# of drops) (unit cost)	(AF)(AE)
AH	Crossing cost		Tmin (cost/unit)	S11 (H4)
AI	# of crossing		Input	
AJ	Crossing cost		# crossing (cost)	(AI) + AH
AK	excavation Volume		(Aeav − Aeins) L/27	Y − U (R2)/27
AL	Excav. cost		excavation volume (cost)	AK (E$5)
AM	Liner volume		A_L L/27	Z + (R2)/27
AN	Liner cost		Liner Vol(m)(Cost)	AM (E$6)
AO	Road cost		(L)(unit cost)	(R2) (H5)
AP	Fence		L (unit cost)	(R2) (H6)
AQ	Operation Maintenance		L unit cost	
AR	Total		AQ + AP + AO + AN + AL + AJ + AG + AD	

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SHEET 1 OF 1
BY HAM DATE 8-21-94
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CLIENT FCDMC
JOB White Tanks FRS # 3 Inlet JOB NO. 310.44

Free-board Requirements

$\frac{r_c}{B} > 3.0$

$\Delta Y = \frac{V^2 T}{g r_c}$

$r_c > (3.0)(140)$

$r_c > 420'$ use 500'

$r_c = 500$

$\Delta Y = \frac{(10.36)^2 (157.10)}{32.2 \ (500)}$

$\Delta Y = 1.05$ Ft ✓

Freeboard required at Curvature = 1.79 + 1.05
= 2.84' ✓

Minimun depth of channel at curvature = 5.5 + 2.84
= 8.34' 8', 4"

$r_c = 1000$

$\Delta Y = \frac{(10.32)^2 (157.10)}{32.2 \ (1000)} = 0.52$ ✓

= 0.52

Freeboard required = 1.79 + 0.52 = 2.31
Minimun depth of channel at curvature = 5.5 + 2.31
= 7.81 ✓

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 1 - EARTHEN - REACH A

250	Existing ROW width		$351.00	Drop cost/ft width		N/A	Side inlet cost		0.0057	Existing ground slope Se (ft/ft)				4214	Reach Length L (fT)		
$13,000	Land cost/acre		N/A	Crossing cost/ft widt		4	Bank slopes (H/1)		3	Drop height Hd (ft)				200	Existing channel Area		
$3.00	Earthwork/cy		$904.00	inlet\outlet cost/ft wi		N/A	Liner side slop ticknes		3.8	Max. overexcavation ov (ft)				50	Road and side ditch widt		
$0.00	Liner/cy		$10	fence/ft		$100.50	O-M Present Value/LF		0	Liner ticknes t (ft)				0	number of crossings		
Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
8480	0.00086	930	4	0.0300	3.00	2826.67	2.96	3.00	954	0.307	1.00	3785	3785	7499	5642	0	
8480	0.00071	794	4	0.0300	3.50	2826.67	3.44	3.00	822	0.285	1.00	3652	3652	6863	5257	0	
8480	0.00060	691	4	0.0300	4.00	2826.67	3.91	3.00	723	0.267	1.03	3579	3579	6414	4997	0	
8480	0.00051	610	4	0.0300	4.50	2826.67	4.37	3.00	646	0.253	1.16	3582	3582	6130	4856	0	
8480	0.00045	545	4	0.0300	5.00	2826.67	4.82	3.00	585	0.241	1.28	3585	3585	5906	4746	0	
8480	0.00040	492	4	0.0300	5.50	2826.67	5.26	3.00	536	0.230	1.41	3590	3590	5727	4659	0	
8480	0.00036	447	4	0.0300	6.00	2826.67	5.69	3.00	495	0.221	1.53	3596	3596	5582	4589	0	
8480	0.00033	409	4	0.0300	6.50	2826.67	6.11	3.00	461	0.213	1.66	3603	3603	5462	4532	0	
8480	0.00030	376	4	0.0300	7.00	2826.67	6.52	3.00	432	0.207	1.78	3610	3610	5363	4487	0	

Flow Depth Y (ft)	R.O.W. Additional Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
3.00	792.62	76.68	$996,819	$337,740	7	$2,364,180	N/A	$0	849354	$2,548,061	0.00	$0	$840,921	$42,140	$423,507	$8,658,754
3.50	660.02	63.85	$830,054	$291,196	7	$2,038,374	N/A	$0	789336	$2,368,007	0.00	$0	$717,432	$42,140	$423,507	$7,703,416
4.00	561.35	54.30	$705,961	$256,562	7	$1,795,935	N/A	$0	748616	$2,245,848	0.00	$0	$624,363	$42,140	$423,507	$7,005,305
4.50	485.83	47.00	$610,987	$230,055	7	$1,610,386	N/A	$0	726639	$2,179,918	0.00	$0	$551,574	$42,140	$423,507	$6,502,214
5.00	426.01	41.21	$535,763	$209,060	7	$1,463,421	N/A	$0	709502	$2,128,507	0.00	$0	$492,981	$42,140	$423,507	$6,103,582
5.50	377.62	36.53	$474,902	$192,074	7	$1,344,517	N/A	$0	695912	$2,087,735	0.00	$0	$444,713	$42,140	$423,507	$5,781,017
6.00	337.79	32.68	$424,813	$178,094	7	$1,246,659	N/A	$0	685006	$2,055,017	0.00	$0	$404,188	$42,140	$423,507	$5,515,589
6.50	304.55	29.46	$383,010	$166,427	8	$1,331,417	N/A	$0	676187	$2,028,561	0.00	$0	$369,620	$42,140	$423,507	$5,493,906
7.00	276.49	26.75	$347,719	$156,577	8	$1,252,618	N/A	$0	669029	$2,007,087	0.00	$0	$339,732	$42,140	$423,507	$5,295,363

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 1 - EARTHEN - REACH B

0	Existing ROW width	$351.00	Drop cost/ft width	$339,453.00	Side inlet cost	0.0079	Existing ground slope Se (ft/ft)	1950	Reach Length L (fT)
$13,000	Land cost/acre	$2,659.00	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	N/A	inlet\outlet cost/ft width	N/A	Liner side slop ticknes	5	Max. overexcavation ov (ft)	47.5	Road and side ditch width
$0.00	Liner/cy	$10	fence/ft	$100.50	O-M Present Value/LF	N/A	Liner ticknes t (ft)	1	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
7770	0.00086	851	4	0.0300	3.00	2590.00	2.96	3.00	875	0.307	1.00	3469	3469	7986	5728	0
7770	0.00071	726	4	0.0300	3.50	2590.00	3.43	3.00	754	0.285	1.00	3348	3348	7258	5303	0
7770	0.00060	632	4	0.0300	4.00	2590.00	3.90	3.00	664	0.268	1.03	3281	3281	6740	5010	0
7770	0.00052	558	4	0.0300	4.50	2590.00	4.36	3.00	594	0.253	1.16	3284	3284	6398	4841	0
7770	0.00045	498	4	0.0300	5.00	2590.00	4.80	3.00	538	0.241	1.28	3288	3288	6129	4709	0
7770	0.00040	449	4	0.0300	5.50	2590.00	5.24	3.00	493	0.231	1.41	3293	3293	5914	4603	0
7770	0.00036	408	4	0.0300	6.00	2590.00	5.67	3.00	456	0.222	1.53	3299	3299	5739	4519	0
7770	0.00033	372	4	0.0300	6.50	2590.00	6.08	3.00	424	0.214	1.66	3306	3306	5594	4450	0
7770	0.00030	342	4	0.0300	7.00	2590.00	6.48	3.00	398	0.207	1.78	3313	3313	5475	4394	0

Flow Depth Y (ft)	R.O.W. Additional Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
3.00	970.83	43.46	$564,982	$310,050	5	$1,550,250	339453	$2,348,783	399220	$1,197,661	0.00	$0	$0	$19,500	$195,975	$7,459,926
3.50	849.50	38.03	$494,372	$267,462	5	$1,337,310	339453	$2,026,158	368550	$1,105,650	0.00	$0	$0	$19,500	$195,975	$6,622,101
4.00	759.28	33.99	$441,867	$235,795	5	$1,178,973	339453	$1,786,262	347419	$1,042,256	0.00	$0	$0	$19,500	$195,975	$6,005,144
4.50	690.34	30.90	$401,745	$211,595	5	$1,057,976	339453	$1,602,938	335180	$1,005,541	0.00	$0	$0	$19,500	$195,975	$5,547,753
5.00	635.78	28.46	$369,996	$192,446	5	$962,231	339453	$1,457,875	325621	$976,863	0.00	$0	$0	$19,500	$195,975	$5,186,271
5.50	591.69	26.49	$344,337	$176,970	5	$884,851	339453	$1,340,637	318023	$954,069	0.00	$0	$0	$19,500	$195,975	$4,894,586
6.00	555.45	24.87	$323,245	$164,249	5	$821,246	339453	$1,244,269	311907	$935,720	0.00	$0	$0	$19,500	$195,975	$4,655,290
6.50	525.24	23.51	$305,667	$153,647	5	$768,236	339453	$1,163,953	306941	$920,823	0.00	$0	$0	$19,500	$195,975	$4,456,329
7.00	499.78	22.37	$290,850	$144,710	5	$723,551	339453	$1,096,251	302889	$908,667	0.00	$0	$0	$19,500	$195,975	$4,289,096

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 1 - EARTHEN - REACH C

0	Existing ROW width	$351.00	Drop cost/ft width	N/A	Side inlet cost	0.0082	Existing ground slope Se (ft/ft)	3332	Reach Length L (fT)
$13,000	Land cost/acre	N/A	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	N/A	inlet\outlet cost/ft widt	N/A	Liner side slop ticknes	5.25	Max. overexcavation ov (ft)	34	Road and side ditch width
$0.00	Liner/cy	$10	fence/ft	$100.50	O-M Present Value/LF	0	Liner ticknes t (ft)	0	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
3230	0.00089	347	4.0	0.030	3.00	1076.67	2.90	3.00	371	0.310	1.00	1452	1452	3551	2501	0
3230	0.00074	294	4.0	0.030	3.50	1076.67	3.34	3.00	322	0.289	1.00	1402	1402	3243	2323	0
3230	0.00063	253	4.0	0.030	4.00	1076.67	3.76	3.00	285	0.272	1.03	1376	1376	3027	2202	0
3230	0.00055	221	4.0	0.030	4.50	1076.67	4.17	3.00	257	0.258	1.16	1380	1380	2890	2135	0
3230	0.00049	195	4.0	0.030	5.00	1076.67	4.55	3.00	235	0.247	1.28	1386	1386	2785	2086	0
3230	0.00044	174	4.0	0.030	5.50	1076.67	4.91	3.00	218	0.238	1.41	1392	1392	2704	2048	0
3230	0.00040	155	4.0	0.030	6.00	1076.67	5.25	3.00	203	0.230	1.53	1398	1398	2641	2020	0
3230	0.00037	140	4.0	0.030	6.50	1076.67	5.57	3.00	192	0.223	1.66	1406	1406	2592	1999	0
3230	0.00035	126	4.0	0.030	7.00	1076.67	5.87	3.00	182	0.217	1.78	1414	1414	2554	1984	0

Flow Depth Y (ft)	R.O.W. Additional Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
3.00	454.89	34.80	$452,341	$132,990	8	$1,063,920	N/A	$0	283993	$851,979	0.00	$0	$0	$33,320	$334,866	$3,283,711
3.50	405.62	31.03	$403,347	$115,696	8	$925,570	N/A	$0	261952	$785,856	0.00	$0	$0	$33,320	$334,866	$2,979,551
4.00	369.45	28.26	$367,377	$103,000	8	$823,997	N/A	$0	247000	$741,001	0.00	$0	$0	$33,320	$334,866	$2,760,672
4.50	342.54	26.20	$340,620	$93,555	8	$748,441	N/A	$0	238823	$716,470	0.00	$0	$0	$33,320	$334,866	$2,608,460
5.00	321.61	24.60	$319,811	$86,210	9	$775,891	N/A	$0	232687	$698,061	0.00	$0	$0	$33,320	$334,866	$2,594,339
5.50	305.04	23.33	$303,328	$80,392	9	$723,528	N/A	$0	228056	$684,167	0.00	$0	$0	$33,320	$334,866	$2,495,052
6.00	291.72	22.31	$290,090	$75,719	9	$681,472	N/A	$0	224573	$673,718	0.00	$0	$0	$33,320	$334,866	$2,416,159
6.50	280.92	21.49	$279,347	$71,927	9	$647,344	N/A	$0	221990	$665,971	0.00	$0	$0	$33,320	$334,866	$2,353,018
7.00	272.09	20.81	$270,565	$68,827	9	$619,445	N/A	$0	220133	$660,398	0.00	$0	$0	$33,320	$334,866	$2,302,313

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 1 - EARTHEN - REACH D

0	Existing ROW width		$351.00	Drop cost/ft width		$186,334.00	Side inlet cost		0.0061	Existing ground slope Se (ft/ft)				1168	Reach Length L (fT)		
$13,000	Land cost/acre		$2,436.00	Crossing cost/ft width		4	Bank slopes (H/1)		3	Drop height Hd (ft)				200	Existing channel Area		
$3.00	Earthwork/cy		N/A	inlet\outlet cost/ft widt		N/A	Liner side slop ticknes		4.4	Max. overexcavation ov (ft)				34	Road and side ditch width		
$0.00	Liner/cy		$10	fence/ft		$100.50	O-M Present Value/LF		0	Liner ticknes t (ft)				1	number of crossings		
Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
3050	0.00089	327	4	0.03	3.00	1016.67	2.89	3.00	351	0.311	1.00	1372	1372	3028	2200	0	
3050	0.00074	276	4	0.03	3.50	1016.67	3.33	3.00	304	0.289	1.00	1325	1325	2777	2051	0	
3050	0.00063	238	4	0.03	4.00	1016.67	3.75	3.00	270	0.273	1.03	1301	1301	2603	1952	0	
3050	0.00055	208	4	0.03	4.50	1016.67	4.15	3.00	244	0.259	1.16	1305	1305	2497	1901	0	
3050	0.00049	183	4	0.03	5.00	1016.67	4.53	3.00	223	0.248	1.28	1310	1310	2416	1863	0	
3050	0.00044	163	4	0.03	5.50	1016.67	4.88	3.00	207	0.238	1.41	1316	1316	2353	1835	0	
3050	0.00041	145	4	0.03	6.00	1016.67	5.22	3.00	193	0.231	1.53	1323	1323	2306	1814	0	
3050	0.00038	130	4	0.03	6.50	1016.67	5.53	3.00	182	0.224	1.66	1330	1330	2269	1800	0	
3050	0.00035	117	4	0.03	7.00	1016.67	5.81	3.00	173	0.218	1.78	1339	1339	2241	1790	0	

Flow Depth Y (ft)	R.O.W. Additional Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
3.00	428.09	11.48	$149,222	$125,970	2	$251,940	186334	$874,253	86511	$259,534	0.00	$0	$0	$11,680	$117,384	$2,220,416
3.50	381.68	10.23	$133,043	$109,679	2	$219,358	186334	$761,192	80086	$240,259	0.00	$0	$0	$11,680	$117,384	$2,003,101
4.00	347.65	9.32	$121,181	$97,735	2	$195,469	186334	$678,295	75784	$227,352	0.00	$0	$0	$11,680	$117,384	$1,845,235
4.50	322.41	8.64	$112,383	$88,875	2	$177,750	186334	$616,808	73574	$220,721	0.00	$0	$0	$11,680	$117,384	$1,731,673
5.00	302.81	8.12	$105,553	$81,998	2	$163,996	186334	$569,081	71936	$215,809	0.00	$0	$0	$11,680	$117,384	$1,643,805
5.50	287.33	7.70	$100,156	$76,563	2	$153,126	186334	$531,360	70723	$212,169	0.00	$0	$0	$11,680	$117,384	$1,574,650
6.00	274.92	7.37	$95,832	$72,209	2	$144,418	186334	$501,144	69835	$209,504	0.00	$0	$0	$11,680	$117,384	$1,519,555
6.50	264.89	7.10	$92,334	$68,687	2	$137,374	186334	$476,700	69203	$207,608	0.00	$0	$0	$11,680	$117,384	$1,475,297
7.00	256.72	6.88	$89,486	$65,819	2	$131,637	186334	$456,793	68777	$206,332	0.00	$0	$0	$11,680	$117,384	$1,439,575

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 1 - EARTHEN - REACH E

0	Existing ROW width		$351.00	Drop cost/ft width		N/A	Side inlet cost		0.0061	Existing ground slope Se (ft/ft)				600	Reach Length L (fT)		
$13,000	Land cost/acre		N/A	Crossing cost/ft width		4	Bank slopes (H/1)		3	Drop height Hd (ft)				200	Existing channel Area		
$3.00	Earthwork/cy		$552.00	inlet\outlet cost/ft width		N/A	Liner side slop ticknes		5.8	Max. overexcavation ov (ft)				34	Road and side ditch width		
$0.00	Liner/cy		$10	fence/ft		$100.50	O-M Present Value/LF		0	Liner ticknes t (ft)				0	number of crossings		
Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1130	0.00221	245	4	0.03	1.50	376.67	1.46	3.00	257	0.437	1.00	638	638	2310	1474	0	
1130	0.00154	180	4	0.03	2.00	376.67	1.91	3.00	196	0.382	1.00	577	577	1897	1237	0	
1130	0.00118	141	4	0.03	2.50	376.67	2.34	3.00	161	0.345	1.00	541	541	1654	1098	0	
1130	0.00096	114	4	0.03	3.00	376.67	2.72	3.00	138	0.319	1.00	518	518	1497	1008	0	
1130	0.00082	94	4	0.03	3.50	378.00	3.08	3.00	122	0.299	1.00	504	504	1393	948	0	
1130	0.00072	78	4	0.03	4.00	376.00	3.39	3.00	110	0.286	1.03	494	494	1315	904	0	
1130	0.00065	66	4	0.03	4.50	378.00	3.67	3.00	102	0.274	1.16	502	502	1282	892	0	
1130	0.00060	55	4	0.03	5.00	375.00	3.90	3.00	95	0.267	1.29	504	504	1249	876	0	
1130	0.00056	46	4	0.03	5.50	374.00	4.09	3.00	90	0.261	1.41	509	509	1231	870	0	

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1.50	345.51	4.76	$61,868	$93,054	1	$93,054	N/A	$0	28308	$84,925	0.00	$0	$135,301	$6,000	$60,300	$529,739
2.00	284.73	3.92	$50,985	$71,721	1	$71,721	N/A	$0	23041	$69,123	0.00	$0	$99,544	$6,000	$60,300	$429,208
2.50	249.07	3.43	$44,599	$59,202	1	$59,202	N/A	$0	19950	$59,850	0.00	$0	$77,648	$6,000	$60,300	$369,118
3.00	225.96	3.11	$40,460	$51,090	1	$51,090	N/A	$0	17947	$53,841	0.00	$0	$62,683	$6,000	$60,300	$329,249
3.50	210.40	2.90	$37,675	$45,630	1	$45,630	N/A	$0	16628	$49,885	0.00	$0	$51,888	$6,000	$60,300	$301,654
4.00	198.68	2.74	$35,576	$41,516	1	$41,516	N/A	$0	15654	$46,961	0.00	$0	$43,056	$6,000	$60,300	$280,091
4.50	191.68	2.64	$34,323	$39,059	1	$39,059	N/A	$0	15371	$46,113	0.00	$0	$36,432	$6,000	$60,300	$266,673
5.00	185.68	2.56	$33,249	$36,953	1	$36,953	N/A	$0	15028	$45,085	0.00	$0	$30,360	$6,000	$60,300	$254,337
5.50	181.68	2.50	$32,532	$35,549	1	$35,549	N/A	$0	14885	$44,656	0.00	$0	$25,392	$6,000	$60,300	$245,315

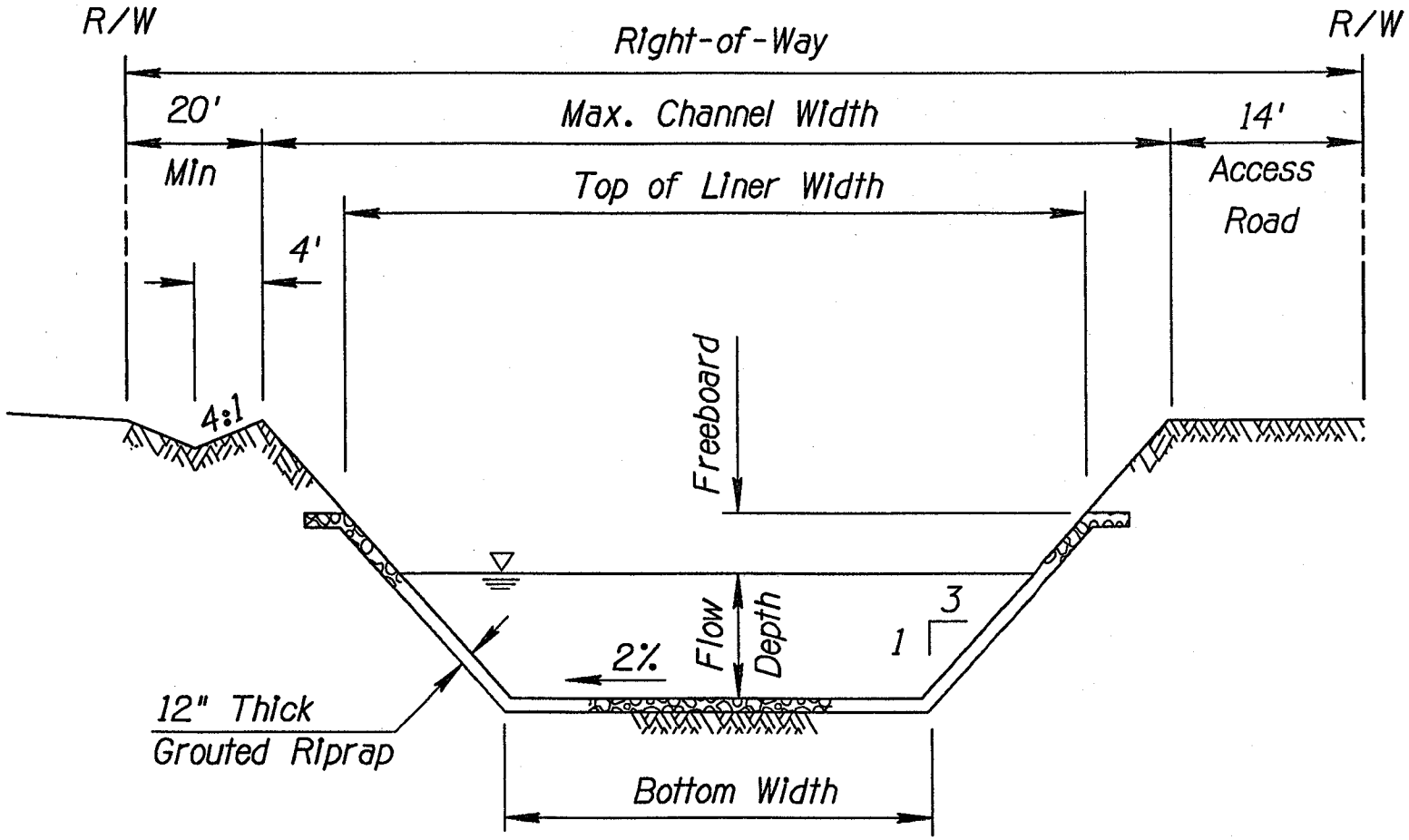

FIGURE 3. TYPICAL CROSS SECTION FOR GROUTED RIPRAP CHANNEL

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 2 - GROUTED RIPRAP - REACH A

250	Existing ROW width		$275.00	Drop cost/ft width		N/A	Side inlet cost		0.0057	Existing ground slope Se (ft/ft)				4214	Reach Length L (fT)		
$13,000	Land cost/acre		N/A	Crossing cost/ft width		4	Bank slopes (H/1)		3	Drop height Hd (ft)				200	Existing channel Area		
$3.00	Earthwork/cy		$904.00	inlet\outlet cost/ft width		1	Liner side slop ticknes		3.8	Max. overexcavation ov (ft)				50	Road and side ditch width		
$65.00	Liner/cy		$10	fence/ft		$50.00	O-M Present Value/LF		1	Liner ticknes t (ft)				0	number of crossings		
Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
8480	0.00376	227	3	0.025	4.00	957.58	3.79	8.86	251	0.800	1.30	1565	1291	2608	2087	261
8480	0.00338	196	3	0.025	4.50	942.22	4.20	9.00	223	0.771	1.44	1518	1269	2455	1986	233
8480	0.00300	173	3	0.025	5.00	942.22	4.59	9.00	203	0.737	1.56	1499	1268	2365	1932	215
8480	0.00270	155	3	0.025	5.50	942.22	4.97	9.00	188	0.708	1.69	1485	1268	2295	1890	200
8480	0.00247	139	3	0.025	6.00	942.22	5.32	9.00	175	0.684	1.81	1476	1270	2241	1858	188
8480	0.00227	125	3	0.025	6.50	942.22	5.66	9.00	164	0.663	1.94	1470	1272	2197	1834	179
8480	0.00212	114	3	0.025	7.00	942.22	5.97	9.00	156	0.645	2.06	1467	1276	2163	1815	171
8480	0.00199	103	3	0.025	7.50	942.22	6.26	9.00	148	0.629	2.19	1467	1281	2137	1802	164
8480	0.00188	94	3	0.025	8.00	942.22	6.53	9.00	142	0.615	2.31	1468	1286	2117	1792	159

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	89.62	8.67	$112,710	$71,286	3	$213,858	N/A	$0	294488	$883,464	40726.52	$2,647,224	$205,565	$42,140	$210,700	$5,178,794
4.50	61.92	5.99	$77,871	$63,668	3	$191,003	N/A	$0	278815	$836,446	36435.03	$2,368,277	$177,078	$42,140	$210,700	$4,684,219
5.00	43.23	4.18	$54,368	$58,529	4	$234,114	N/A	$0	270330	$810,989	33549.93	$2,180,746	$156,794	$42,140	$210,700	$4,427,822
5.50	28.35	2.74	$35,653	$54,436	4	$217,745	N/A	$0	263827	$791,482	31259.01	$2,031,835	$139,951	$42,140	$210,700	$4,163,407
6.00	16.32	1.58	$20,529	$51,129	5	$255,645	N/A	$0	258830	$776,491	29413.70	$1,911,891	$125,689	$42,140	$210,700	$4,011,702
6.50	6.49	0.63	$8,167	$48,426	5	$242,129	N/A	$0	255008	$765,025	27911.19	$1,814,227	$113,413	$42,140	$210,700	$3,834,962
7.00	0.00	0.00	$0	$46,197	5	$230,986	N/A	$0	252125	$756,376	26678.01	$1,734,071	$102,697	$42,140	$210,700	$3,692,364
7.50	0.00	0.00	$0	$44,348	5	$221,741	N/A	$0	250008	$750,024	25660.30	$1,667,920	$93,229	$42,140	$210,700	$3,582,905
8.00	0.00	0.00	$0	$42,808	5	$214,039	N/A	$0	248527	$745,580	24817.66	$1,613,148	$84,775	$42,140	$210,700	$3,492,458

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 2 - GROUTED RIP-RAP - REACH B

0	Existing ROW width	$275.00	Drop cost/ft width	$339,453.00	Side inlet cost	0.0079	Existing ground slope Se (ft/ft)	1950	Reach Length L (fT)
$13,000	Land cost/acre	$2,659.00	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	N/A	inlet\outlet cost/ft width	1	Liner side slop ticknes	5	Max. overexcavation ov (ft)	47.5	Road and side ditch width
$65.00	Liner/cy	$10	fence/ft	$50.00	O-M Present Value/LF	1	Liner ticknes t (ft)	1	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
7770	0.00377	208	3	0.0250	4.00	878.88	3.77	8.84	232	0.800	1.30	1441	1186	2739	2090	241
7770	0.00341	178	3	0.0250	4.50	863.33	4.17	9.00	205	0.774	1.44	1396	1165	2566	1981	216
7770	0.00303	158	3	0.0250	5.00	863.33	4.56	9.00	188	0.739	1.56	1379	1164	2465	1922	199
7770	0.00273	140	3	0.0250	5.50	863.33	4.93	9.00	173	0.711	1.69	1368	1165	2386	1877	186
7770	0.00250	126	3	0.0250	6.00	863.33	5.27	9.00	162	0.687	1.81	1360	1167	2324	1842	175
7770	0.00231	113	3	0.0250	6.50	863.33	5.59	9.00	152	0.666	1.94	1356	1170	2276	1816	167
7770	0.00216	102	3	0.0250	7.00	863.33	5.89	9.00	144	0.648	2.06	1354	1174	2238	1796	160
7770	0.00203	93	3	0.0250	7.50	863.33	6.16	9.00	138	0.633	2.19	1354	1179	2208	1781	154
7770	0.00192	84	3	0.0250	8.00	863.33	6.42	9.00	132	0.620	2.31	1356	1185	2185	1771	149

Flow Depth Y (ft)	R.O.W. Additional Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	327.04	14.64	$190,323	$65,874	3	$197,621	339453	$636,939	136500	$409,501	17424.47	$1,132,591	$0	$19,500	$97,500	$3,628,113
4.50	301.49	13.50	$175,453	$58,847	3	$176,541	339453	$568,995	128626	$385,879	15593.95	$1,013,606	$0	$19,500	$97,500	$3,332,313
5.00	284.55	12.74	$165,597	$54,190	3	$162,569	339453	$523,965	124373	$373,118	14385.50	$935,057	$0	$19,500	$97,500	$3,140,112
5.50	271.11	12.14	$157,772	$50,492	3	$151,475	339453	$488,209	121114	$363,342	13428.98	$872,884	$0	$19,500	$97,500	$2,988,162
6.00	260.28	11.65	$151,469	$47,513	4	$190,053	339453	$459,410	118610	$355,830	12661.40	$822,991	$0	$19,500	$97,500	$2,923,447
6.50	251.46	11.26	$146,337	$45,088	4	$180,353	339453	$435,962	116694	$350,082	12039.17	$782,546	$0	$19,500	$97,500	$2,822,080
7.00	244.22	10.93	$142,125	$43,098	4	$172,392	339453	$416,718	115248	$345,743	11531.14	$749,524	$0	$19,500	$97,500	$2,739,546
7.50	238.25	10.67	$138,650	$41,456	4	$165,823	339453	$400,838	114183	$342,550	11114.46	$722,440	$0	$19,500	$97,500	$2,672,105
8.00	233.30	10.44	$135,772	$40,096	4	$160,384	339453	$387,691	113436	$340,309	10772.01	$700,181	$0	$19,500	$97,500	$2,616,948

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 2 - GROUTED RIPRAP - REACH C

0	Existing ROW width	$275.00	Drop cost/ft width	N/A	Side inlet cost	0.0082	Existing ground slope Se (ft/ft)	3332	Reach Length L (fT)
$13,000	Land cost/acre	N/A	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	N/A	inlet\outlet cost/ft width	1	Liner side slop ticknes	5.25	Max. overexcavation ov (ft)	34	Road and side ditch width
$65.00	Liner/cy	$10	fence/ft	$50.00	O-M Present Value/LF	1	Liner ticknes t (ft)	0	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
3230	0.00389	82	3.0	0.025	4.00	377.70	3.51	8.55	106	0.800	1.28	649	519	1870	1260	116
3230	0.00379	67	3.0	0.025	4.50	362.59	3.80	8.91	94	0.800	1.43	623	504	1743	1183	105
3230	0.00354	57	3.0	0.025	5.00	358.89	4.06	9.00	87	0.780	1.56	616	502	1659	1138	98
3230	0.00328	49	3.0	0.025	5.50	358.89	4.30	9.00	82	0.757	1.69	617	506	1592	1104	94
3230	0.00309	42	3.0	0.025	6.00	358.89	4.50	9.00	78	0.739	1.81	619	510	1526	1073	91
3230	0.00294	36	3.0	0.025	6.50	358.89	4.67	9.00	75	0.724	1.94	623	515	1461	1042	89
3230	0.00282	30	3.0	0.025	7.00	358.89	4.81	9.00	72	0.712	2.06	629	521	1395	1012	88
3230	0.00273	25	3.0	0.025	7.50	358.89	4.93	9.00	70	0.702	2.19	635	527	1328	982	87
3230	0.00267	21	3.0	0.025	8.00	358.89	5.02	9.00	69	0.695	2.31	643	534	1260	951	86

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	190.13	14.54	$189,063	$58,205	5	$291,025	N/A	$0	130775	$392,324	14295.90	$929,234	$0	$33,320	$166,600	$2,401,879
4.50	178.67	13.67	$177,672	$52,868	5	$264,341	N/A	$0	121294	$363,883	12908.24	$839,036	$0	$33,320	$166,600	$2,213,822
5.00	172.16	13.17	$171,200	$48,855	5	$244,275	N/A	$0	115725	$347,176	12130.32	$788,471	$0	$33,320	$166,600	$2,101,251
5.50	167.89	12.84	$166,949	$45,301	5	$226,507	N/A	$0	111608	$334,823	11627.76	$755,804	$0	$33,320	$166,600	$2,020,803
6.00	164.70	12.60	$163,779	$41,730	6	$250,378	N/A	$0	107703	$323,108	11259.41	$731,861	$0	$33,320	$166,600	$2,002,855
6.50	162.35	12.42	$161,441	$38,096	6	$228,578	N/A	$0	103919	$311,756	10994.29	$714,629	$0	$33,320	$166,600	$1,939,588
7.00	160.66	12.29	$159,757	$34,370	6	$206,223	N/A	$0	100190	$300,570	10810.29	$702,669	$0	$33,320	$166,600	$1,882,966
7.50	159.49	12.20	$158,595	$30,529	6	$183,176	N/A	$0	96469	$289,406	10691.19	$694,927	$0	$33,320	$166,600	$1,831,229
8.00	158.75	12.14	$157,859	$26,556	6	$159,334	N/A	$0	92719	$278,156	10624.81	$690,612	$0	$33,320	$166,600	$1,783,058

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 2 - GROUTED RIPRAP - REACH D

0	Existing ROW width	$275.00	Drop cost/ft width	$186,334.00	Side inlet cost	0.0061	Existing ground slope Se (ft/ft)	1168	Reach Length L (fT)
$13,000	Land cost/acre	$2,436.00	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	N/A	inlet\outlet cost/ft width	1	Liner side slop ticknes	4.4	Max. overexcavation ov (ft)	34	Road and side ditch width
$65.00	Liner/cy	$10	fence/ft	$50.00	O-M Present Value/LF	1	Liner ticknes t (ft)	1	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
3050	0.00390	77	3	0.025	4.00	357.77	3.48	8.53	101	0.800	1.28	617	493	1175	896	111
3050	0.00381	63	3	0.025	4.50	343.74	3.76	8.87	90	0.800	1.43	594	478	1105	849	100
3050	0.00359	53	3	0.025	5.00	338.89	4.02	9.00	83	0.784	1.56	586	476	1069	828	94
3050	0.00334	45	3	0.025	5.50	338.89	4.24	9.00	78	0.761	1.69	587	479	1053	820	91
3050	0.00315	38	3	0.025	6.00	338.89	4.43	9.00	74	0.744	1.81	590	484	1043	816	88
3050	0.00300	33	3	0.025	6.50	338.89	4.60	9.00	72	0.729	1.94	594	489	1038	816	86
3050	0.00289	27	3	0.025	7.00	338.89	4.73	9.00	69	0.718	2.06	600	495	1037	819	85
3050	0.00281	23	3	0.025	7.50	338.89	4.83	9.00	68	0.709	2.19	607	501	1040	823	84
3050	0.00274	18	3	0.025	8.00	338.89	4.91	9.00	66	0.702	2.31	614	509	1045	830	84

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	178.34	4.78	$62,164	$30,012	1	$30,012	186334	$265,854	30121	$90,362	4795.28	$311,693	$0	$11,680	$58,400	$1,219,800
4.50	167.67	4.50	$58,446	$27,079	1	$27,079	186334	$239,875	28082	$84,247	4343.04	$282,298	$0	$11,680	$58,400	$1,138,032
5.00	161.36	4.33	$56,248	$25,345	1	$25,345	186334	$224,513	27146	$81,437	4079.13	$265,143	$0	$11,680	$58,400	$1,090,919
5.50	157.45	4.22	$54,884	$24,270	1	$24,270	186334	$214,984	26818	$80,453	3918.69	$254,715	$0	$11,680	$58,400	$1,062,864
6.00	154.57	4.14	$53,879	$23,476	1	$23,476	186334	$207,957	26667	$80,000	3802.68	$247,174	$0	$11,680	$58,400	$1,042,679
6.50	152.47	4.09	$53,149	$22,900	1	$22,900	186334	$202,854	26656	$79,967	3720.84	$241,854	$0	$11,680	$58,400	$1,028,565
7.00	151.00	4.05	$52,635	$22,495	1	$22,495	186334	$199,263	26759	$80,278	3665.84	$238,280	$0	$11,680	$58,400	$1,019,238
7.50	150.02	4.02	$52,294	$22,226	1	$22,226	186334	$196,882	26959	$80,876	3632.33	$236,102	$0	$11,680	$58,400	$1,013,753
8.00	149.45	4.01	$52,094	$22,068	1	$22,068	186334	$195,484	27240	$81,720	3616.27	$235,058	$0	$11,680	$58,400	$1,011,405

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 2 - GROUTED RIPRAP - REACH E

0	Existing ROW width	$275.00	Drop cost/ft width	N/A	Side inlet cost	0.0061	Existing ground slope Se (ft/ft)	600	Reach Length L (fT)
$13,000	Land cost/acre	N/A	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	$552.00	inlet\outlet cost/ft width	1	Liner side slop ticknes	5.8	Max. overexcavation ov (ft)	34	Road and side ditch width
$65.00	Liner/cy	$10	fence/ft	$50.00	O-M Present Value/LF	1	Liner ticknes t (ft)	0	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1130	0.00517	133	3	0.025	1.50	206.54	1.45	5.47	142	0.800	1.00	510	352	1504	1007	149
1130	0.00477	85	3	0.025	2.00	181.74	1.86	6.22	97	0.800	1.00	395	282	1127	761	104
1130	0.00445	52	3	0.025	2.70	161.43	2.35	7.00	68	0.800	1.00	319	232	882	600	75
1130	0.00436	43	3	0.025	3.00	155.68	2.52	7.26	61	0.800	1.00	299	220	822	561	68
1130	0.00425	32	3	0.025	3.50	148.60	2.75	7.60	53	0.800	1.10	284	210	764	524	61
1130	0.00419	24	3	0.025	4.00	143.75	2.92	7.86	48	0.800	1.24	279	208	734	507	57
1130	0.00416	18	3	0.025	4.50	140.45	3.04	8.05	45	0.800	1.38	277	208	719	498	55
1130	0.00414	13	3	0.025	5.00	138.26	3.12	8.17	43	0.800	1.51	279	209	714	496	54
1130	0.00414	8	3	0.025	5.50	136.88	3.17	8.26	41	0.800	1.64	283	213	715	499	54

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1.50	228.59	3.15	$40,932	$40,753	0	$0	N/A	$0	17932	$53,797	3311.17	$215,226	$73,522	$6,000	$30,000	$503,372
2.00	183.27	2.52	$32,817	$28,289	0	$0	N/A	$0	12468	$37,405	2307.62	$149,995	$46,848	$6,000	$30,000	$363,678
2.70	154.29	2.13	$27,627	$20,319	0	$0	N/A	$0	8892	$26,677	1668.63	$108,461	$28,532	$6,000	$30,000	$272,756
3.00	147.29	2.03	$26,375	$18,395	0	$0	N/A	$0	8016	$24,048	1515.34	$98,497	$23,676	$6,000	$30,000	$250,315
3.50	139.95	1.93	$25,061	$16,378	0	$0	N/A	$0	7204	$21,613	1356.61	$88,180	$17,641	$6,000	$30,000	$226,193
4.00	135.78	1.87	$24,312	$15,228	0	$0	N/A	$0	6812	$20,435	1268.37	$82,444	$13,213	$6,000	$30,000	$211,685
4.50	133.37	1.84	$23,881	$14,566	0	$0	N/A	$0	6628	$19,885	1219.45	$79,264	$9,776	$6,000	$30,000	$202,568
5.00	132.11	1.82	$23,656	$14,220	0	$0	N/A	$0	6587	$19,762	1196.00	$77,740	$6,984	$6,000	$30,000	$196,969
5.50	131.62	1.81	$23,569	$14,087	0	$0	N/A	$0	6647	$19,942	1189.81	$77,338	$4,630	$6,000	$30,000	$193,774

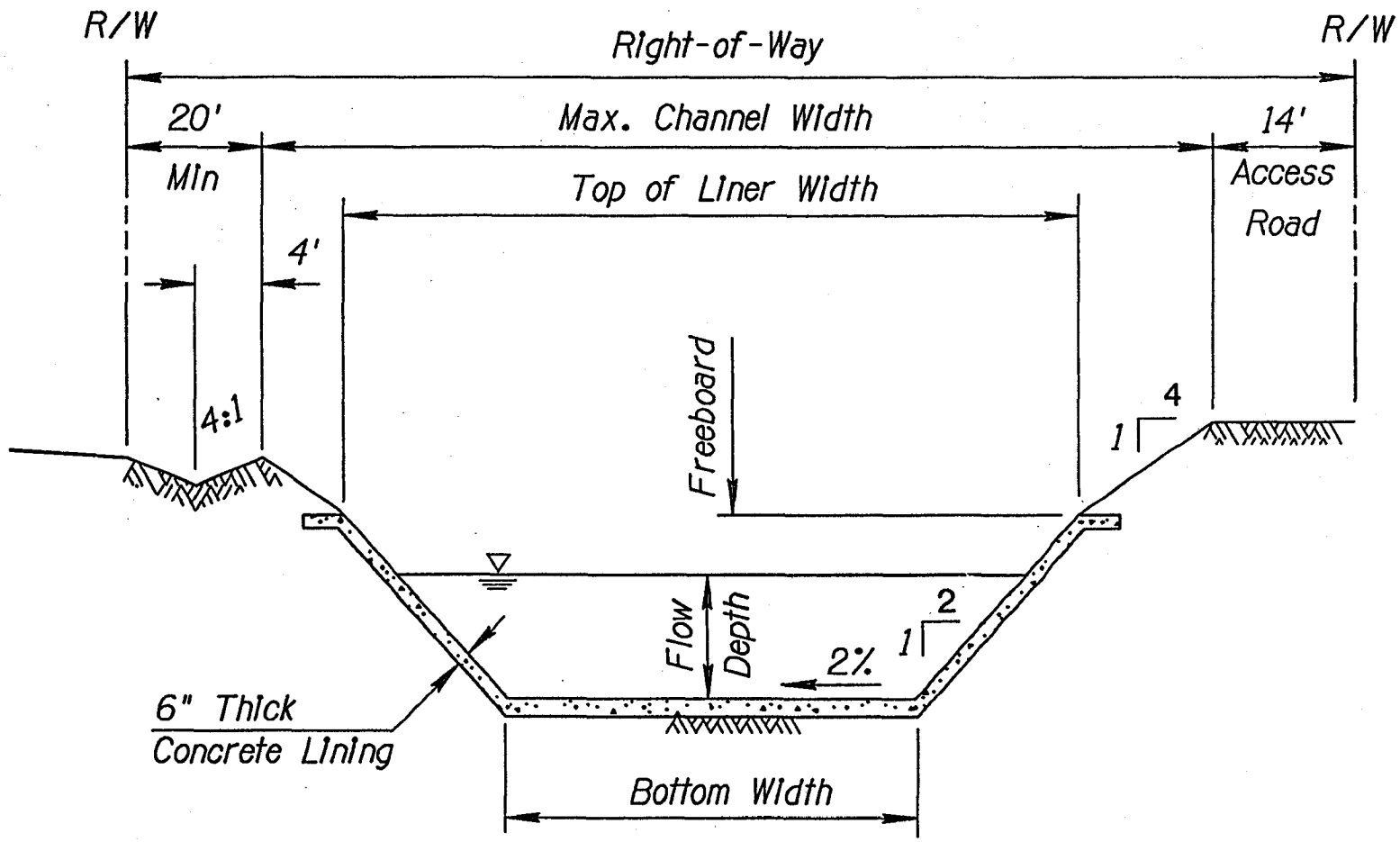

FIGURE 4. TYPICAL CROSS SECTION FOR SUBCRITICAL CONCRETE LINED CHANNEL

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 3A - CONCRETE/SUBCRITICAL - REACH A

250	Existing ROW width	$250.00	Drop cost/ft width	N/A	Side inlet cost	0.0057	Existing ground slope Se (ft/ft)	4214	Reach Length L (fT)
$13,000	Land cost/acre	N/A	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	$904.00	inlet\outlet cost/ft width	0.5	Liner side slop ticknes	3.8	Max. overexcavation ov (ft)	50	Road and side ditch width
$180.00	Liner/cy	$10	fence/ft	$5.68	O-M Present Value/LF	0.5	Liner ticknes t (ft)	0	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
8480	0.00135	229	2	0.015	4.00	949.61	3.84	8.93	245	0.800	1.31	1406	1274	2416	1911	127
8480	0.00131	191	2	0.015	4.50	900.11	4.26	9.42	209	0.800	1.47	1326	1212	2200	1763	109
8480	0.00127	162	2	0.015	5.00	859.36	4.66	9.87	182	0.800	1.63	1263	1161	2036	1649	96
8480	0.00124	139	2	0.015	5.50	825.21	5.04	10.28	161	0.800	1.78	1211	1119	1908	1560	86
8480	0.00122	121	2	0.015	6.00	796.35	5.40	10.65	145	0.800	1.94	1170	1085	1807	1488	78
8480	0.00120	106	2	0.015	6.50	771.77	5.73	10.99	132	0.800	2.09	1136	1056	1726	1431	72
8480	0.00118	93	2	0.015	7.00	751.07	6.03	11.29	121	0.800	2.24	1109	1033	1662	1385	67
8480	0.00117	83	2	0.015	7.50	732.62	6.30	11.57	113	0.800	2.40	1086	1014	1608	1347	63
8480	0.00116	74	2	0.015	8.00	717.01	6.55	11.83	106	0.800	2.54	1068	999	1566	1317	60

Flow Depth Y (ft)	R.O.W. Additional Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	81.04	7.84	$101,919	$62,660	6	$375,961	N/A	$0	267064	$801,193	19754.88	$3,555,879	$207,380	$42,140	$23,936	$6,130,089
4.50	45.30	4.38	$56,975	$53,726	6	$322,356	N/A	$0	243979	$731,937	16990.39	$3,058,270	$172,687	$42,140	$23,936	$5,289,960
5.00	18.78	1.82	$23,623	$47,096	6	$282,576	N/A	$0	226210	$678,631	14945.12	$2,690,122	$146,332	$42,140	$23,936	$4,664,830
5.50	0.00	0.00	$0	$42,044	6	$252,266	N/A	$0	212232	$636,695	13392.48	$2,410,646	$125,690	$42,140	$23,936	$4,189,647
6.00	0.00	0.00	$0	$38,121	6	$228,728	N/A	$0	201094	$603,282	12192.03	$2,194,565	$109,135	$42,140	$23,936	$3,842,141
6.50	0.00	0.00	$0	$35,027	6	$210,162	N/A	$0	192138	$576,415	11250.23	$2,025,042	$95,583	$42,140	$23,936	$3,567,933
7.00	0.00	0.00	$0	$32,569	6	$195,413	N/A	$0	184983	$554,949	10506.90	$1,891,242	$84,339	$42,140	$23,936	$3,350,423
7.50	0.00	0.00	$0	$30,566	6	$183,395	N/A	$0	179046	$537,139	9905.63	$1,783,014	$74,745	$42,140	$23,936	$3,173,242
8.00	0.00	0.00	$0	$28,949	6	$173,697	N/A	$0	174317	$522,950	9424.96	$1,696,494	$66,558	$42,140	$23,936	$3,030,928

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 3A - CONCRETE/SUBCRITICAL - REACH B

0	Existing ROW width	$250.00	Drop cost/ft width	$339,453.00	Side inlet cost	0.0079	Existing ground slope Se (ft/ft)
$13,000	Land cost/acre	$2,659.00	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)
$3.00	Earthwork/cy	N/A	inlet\outlet cost/ft widt	0.5	Liner side slop ticknes	5	Max. overexcavation ov (ft)
$180.00	Liner/cy	$10	fence/ft	$5.68	O-M Present Value/LF	0.5	Liner ticknes t (ft)

1950	Reach Length L (fT)
200	Existing channel Area
47.5	Road and side ditch width
1	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
7770	0.00135	210	2	0.0150	4.00	871.37	3.83	8.92	226	0.800	1.31	1292	1170	2548	1920	117
7770	0.00131	175	2	0.0150	4.50	826.34	4.24	9.40	193	0.800	1.47	1220	1113	2312	1766	101
7770	0.00128	148	2	0.0150	5.00	789.33	4.64	9.84	168	0.800	1.63	1162	1068	2134	1648	89
7770	0.00125	127	2	0.0150	5.50	758.39	5.01	10.25	149	0.800	1.78	1116	1030	1997	1556	80
7770	0.00123	110	2	0.0150	6.00	732.31	5.35	10.61	134	0.800	1.94	1079	999	1888	1484	73
7770	0.00121	96	2	0.0150	6.50	710.17	5.67	10.94	122	0.800	2.09	1049	974	1802	1426	67
7770	0.00119	85	2	0.0150	7.00	691.27	5.96	11.24	113	0.800	2.24	1025	954	1734	1379	63
7770	0.00118	75	2	0.0150	7.50	675.08	6.22	11.51	105	0.800	2.39	1006	937	1678	1342	60
7770	0.00117	67	2	0.0150	8.00	661.17	6.46	11.75	99	0.800	2.54	990	924	1634	1312	57

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	318.58	14.26	$185,399	$57,770	4	$231,078	339453	$614,437	124215	$372,644	8435.01	$1,518,301	$0	$19,500	$11,076	$3,950,267
4.50	286.00	12.80	$166,442	$49,626	4	$198,505	339453	$527,824	113097	$339,292	7269.98	$1,308,597	$0	$19,500	$11,076	$3,492,827
5.00	261.87	11.72	$152,397	$43,593	4	$174,370	339453	$463,650	104602	$313,805	6409.67	$1,153,740	$0	$19,500	$11,076	$3,153,589
5.50	243.52	10.90	$141,717	$39,005	4	$156,019	339453	$414,854	97968	$293,903	5758.17	$1,036,471	$0	$19,500	$11,076	$2,895,591
6.00	229.30	10.26	$133,443	$35,450	4	$141,800	339453	$377,046	92720	$278,160	5255.88	$946,058	$0	$19,500	$11,076	$2,695,843
6.50	218.12	9.76	$126,934	$32,654	4	$130,616	339453	$347,307	88531	$265,594	4863.12	$875,362	$0	$19,500	$11,076	$2,539,010
7.00	209.21	9.37	$121,754	$30,429	4	$121,715	339453	$323,639	85173	$255,518	4552.80	$819,503	$0	$19,500	$11,076	$2,414,589
7.50	202.07	9.05	$117,595	$28,642	4	$114,568	339453	$304,637	82477	$247,432	4305.79	$775,042	$0	$19,500	$11,076	$2,315,162
8.00	196.29	8.79	$114,233	$27,198	4	$108,791	339453	$289,274	80320	$240,959	4108.19	$739,473	$0	$19,500	$11,076	$2,235,311

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 3A - CONCRETE/SUBCRITICAL - REACH C

0	Existing ROW width	$250.00	Drop cost/ft width	N/A	Side inlet cost	0.0082	Existing ground slope Se (ft/ft)	3332	Reach Length L (fT)
$13,000	Land cost/acre	N/A	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	N/A	inlet\outlet cost/ft width	0.5	Liner side slop ticknes	5.25	Max. overexcavation ov (ft)	34	Road and side ditch width
$180.00	Liner/cy	$10	fence/ft	$5.68	O-M Present Value/LF	0.5	Liner ticknes t (ft)	0	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
3230	0.00139	85	2.0	0.015	4.00	370.79	3.61	8.71	101	0.800	1.29	564	505	1230	897	54
3230	0.00136	70	2.0	0.015	4.50	354.08	3.94	9.12	88	0.800	1.45	539	485	1140	839	48
3230	0.00134	58	2.0	0.015	5.00	340.76	4.23	9.48	78	0.800	1.60	521	471	1075	798	44
3230	0.00132	49	2.0	0.015	5.50	330.04	4.48	9.79	71	0.800	1.75	507	460	1027	767	41
3230	0.00131	42	2.0	0.015	6.00	321.38	4.70	10.05	66	0.800	1.89	498	453	992	745	38
3230	0.00130	35	2.0	0.015	6.50	314.38	4.88	10.27	61	0.800	2.03	492	448	967	729	37
3230	0.00129	30	2.0	0.015	7.00	308.73	5.03	10.46	58	0.800	2.17	488	445	949	719	36
3230	0.00129	26	2.0	0.015	7.50	304.17	5.15	10.62	56	0.800	2.31	487	443	937	712	35
3230	0.00129	22	2.0	0.015	8.00	300.49	5.24	10.75	54	0.800	2.45	487	444	930	708	34

Flow Depth Y (ft)	R.O.W. Additional Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	181.88	13.91	$180,858	$26,469	8	$211,753	N/A	$0	85989	$257,967	6687.22	$1,203,700	$0	$33,320	$18,926	$2,287,829
4.50	169.48	12.96	$168,527	$23,369	8	$186,953	N/A	$0	78910	$236,731	5941.12	$1,069,402	$0	$33,320	$18,926	$2,056,631
5.00	160.55	12.28	$159,647	$21,137	8	$169,093	N/A	$0	73767	$221,300	5409.08	$973,634	$0	$33,320	$18,926	$1,891,104
5.50	154.00	11.78	$153,133	$19,499	8	$155,990	N/A	$0	70008	$210,024	5023.71	$904,268	$0	$33,320	$18,926	$1,770,793
6.00	149.13	11.41	$148,296	$18,283	8	$146,263	N/A	$0	67275	$201,826	4742.41	$853,635	$0	$33,320	$18,926	$1,682,719
6.50	145.50	11.13	$144,690	$17,376	8	$139,009	N/A	$0	65330	$195,990	4537.34	$816,721	$0	$33,320	$18,926	$1,618,387
7.00	142.80	10.92	$142,004	$16,701	8	$133,608	N/A	$0	64002	$192,007	4389.34	$790,082	$0	$33,320	$18,926	$1,571,936
7.50	140.81	10.77	$140,018	$16,202	8	$129,614	N/A	$0	63162	$189,485	4284.70	$771,246	$0	$33,320	$18,926	$1,539,130
8.00	139.36	10.66	$138,575	$15,839	8	$126,712	N/A	$0	62715	$188,144	4213.68	$758,462	$0	$33,320	$18,926	$1,516,966

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 3A - CONCRETE/SUBCRITICAL - REACH D

0	Existing ROW width		$250.00	Drop cost/ft width		$186,334.00	Side inlet cost		0.0061	Existing ground slope Se (ft/ft)					1168	Reach Length L (fT)	
$13,000	Land cost/acre		$2,436.00	Crossing cost/ft widt		4	Bank slopes (H/1)		3	Drop height Hd (ft)					200	Existing channel Area	
$3.00	Earthwork/cy		N/A	inlet\outlet cost/ft wid		0.5	Liner side slop ticknes		4.4	Max. overexcavation ov (ft)					34	Road and side ditch width	
$180.00	Liner/cy		$10	fence/ft		$5.68	O-M Present Value/LF		0.5	Liner ticknes t (ft)					1	number of crossings	
Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Are Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
3050	0.00140	80	2	0.015	4.00	350.92	3.59	8.69	96	0.800	1.29	535	478	1056	796	52	
3050	0.00137	66	2	0.015	4.50	335.31	3.92	9.10	84	0.800	1.45	512	460	982	747	46	
3050	0.00134	55	2	0.015	5.00	322.90	4.20	9.45	75	0.800	1.60	495	447	929	712	42	
3050	0.00133	46	2	0.015	5.50	312.97	4.44	9.75	68	0.800	1.74	483	437	890	687	39	
3050	0.00132	39	2	0.015	6.00	304.96	4.64	10.00	63	0.800	1.89	475	431	862	668	37	
3050	0.00131	33	2	0.015	6.50	298.53	4.82	10.22	59	0.800	2.03	469	426	842	656	36	
3050	0.00130	28	2	0.015	7.00	293.37	4.95	10.40	56	0.800	2.17	467	424	828	647	34	
3050	0.00130	24	2	0.015	7.50	289.23	5.06	10.55	54	0.800	2.31	466	423	819	642	34	
3050	0.00130	20	2	0.015	8.00	285.91	5.15	10.67	52	0.800	2.44	466	424	814	640	33	

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	170.10	4.56	$59,294	$25,226	2	$50,451	186334	$245,798	25761	$77,284	2236.53	$402,576	$0	$11,680	$6,634	$1,248,061
4.50	158.50	4.25	$55,249	$22,324	2	$44,649	186334	$217,529	23664	$70,993	1992.20	$358,595	$0	$11,680	$6,634	$1,141,995
5.00	150.17	4.03	$52,344	$20,242	2	$40,483	186334	$197,234	22148	$66,444	1818.63	$327,354	$0	$11,680	$6,634	$1,066,210
5.50	144.08	3.86	$50,222	$18,719	2	$37,439	186334	$182,403	21049	$63,148	1693.56	$304,840	$0	$11,680	$6,634	$1,011,240
6.00	139.58	3.74	$48,654	$17,595	2	$35,190	186334	$171,446	20261	$60,783	1602.85	$288,513	$0	$11,680	$6,634	$971,081
6.50	136.25	3.65	$47,493	$16,762	2	$33,524	186334	$163,329	19713	$59,138	1537.34	$276,721	$0	$11,680	$6,634	$941,823
7.00	133.79	3.59	$46,635	$16,147	2	$32,294	186334	$157,337	19352	$58,057	1490.66	$268,318	$0	$11,680	$6,634	$920,748
7.50	131.99	3.54	$46,009	$15,698	2	$31,395	186334	$152,957	19141	$57,424	1458.28	$262,490	$0	$11,680	$6,634	$905,908
8.00	130.71	3.50	$45,561	$15,376	2	$30,753	186334	$149,828	19051	$57,154	1436.98	$258,656	$0	$11,680	$6,634	$895,920

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 3A - CONCRETE/SUBCRITICAL - REACH E

0	Existing ROW width	$250.00	Drop cost/ft width	N/A	Side inlet cost	0.0061	Existing ground slope Se (ft/ft)	600	Reach Length L (fT)
$13,000	Land cost/acre	N/A	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	$552.00	inlet\outlet cost/ft width	0.5	Liner side slop ticknes	5.8	Max. overexcavation ov (ft)	34	Road and side ditch width
$180.00	Liner/cy	$10	fence/ft	$5.68	O-M Present Value/LF	0.5	Liner ticknes t (ft)	0	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1130	0.00171	86	2	0.015	2.00	179.89	1.90	6.28	94	0.800	1.00	329	276	1031	680	50
1130	0.00162	60	2	0.015	2.50	163.34	2.28	6.92	70	0.800	1.00	277	236	843	560	38
1130	0.00159	53	2	0.015	2.70	158.35	2.42	7.14	64	0.800	1.00	263	224	792	528	35
1130	0.00152	34	2	0.015	3.50	143.94	2.89	7.85	48	0.800	1.11	232	200	671	452	27
1130	0.00150	27	2	0.015	4.00	138.13	3.11	8.18	43	0.800	1.26	225	195	635	430	25
1130	0.00149	21	2	0.015	4.50	133.94	3.28	8.44	39	0.800	1.40	221	192	613	417	24
1130	0.00149	16	2	0.015	5.00	130.90	3.40	8.63	36	0.800	1.54	220	191	600	410	23
1130	0.00149	12	2	0.015	5.50	128.70	3.48	8.78	34	0.800	1.67	221	192	594	407	22
1130	0.00149	9	2	0.015	6.00	127.24	3.53	8.88	33	0.800	1.81	223	194	592	407	22

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
2.00	178.34	2.46	$31,935	$24,486	1	$24,486	N/A	$0	10669	$32,007	1103.99	$198,718	$47,440	$6,000	$3,408	$412,793
2.50	154.74	2.13	$27,708	$18,584	1	$18,584	N/A	$0	8005	$24,014	844.34	$151,980	$33,306	$6,000	$3,408	$318,001
2.70	148.45	2.04	$26,582	$17,012	1	$17,012	N/A	$0	7283	$21,850	775.52	$139,593	$29,394	$6,000	$3,408	$292,607
3.50	132.98	1.83	$23,812	$13,145	1	$13,145	N/A	$0	5594	$16,781	608.45	$109,521	$18,837	$6,000	$3,408	$229,806
4.00	127.97	1.76	$22,915	$11,893	1	$11,893	N/A	$0	5115	$15,345	556.17	$100,110	$14,646	$6,000	$3,408	$209,180
4.50	124.77	1.72	$22,342	$11,092	1	$11,092	N/A	$0	4827	$14,481	523.95	$94,310	$11,462	$6,000	$3,408	$195,714
5.00	122.74	1.69	$21,978	$10,584	1	$10,584	N/A	$0	4669	$14,006	504.71	$90,849	$8,931	$6,000	$3,408	$186,907
5.50	121.50	1.67	$21,756	$10,274	1	$10,274	N/A	$0	4602	$13,806	494.28	$88,970	$6,845	$6,000	$3,408	$181,271
6.00	120.83	1.66	$21,636	$10,108	1	$10,108	N/A	$0	4606	$13,819	490.18	$88,233	$5,082	$6,000	$3,408	$177,944

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 3B - CONCRETE/SUPERCRITICAL - REACH A

250	Existing ROW width		$250.00	Drop cost/ft width		N/A	Side inlet cost		0.005	Existing ground slope Se (ft/ft)				4214	Reach Length L (fT)		
$13,000	Land cost/acre		N/A	Crossing cost/ft width		4	Bank slopes (H/1)		3	Drop height Hd (ft)				200	Existing channel Area		
$3.00	Earthwork/cy		$2,766.00	inlet\outlet cost/ft width		0.5	Liner side slop ticknes		3	Max. overexcavation ov (ft)				50	Road and side ditch width		
$180.00	Liner/cy		$10	fence/ft		$5.68	O-M Present Value/LF		0.583	Liner ticknes t (ft)				0	number of crossings		
Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	Min. Top Width Tmin (ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
8480	0.00500	118	2	0.015	4.00	505.15	3.71	16.79	134	1.525	2.09	142.66	795	1351	1119	83
8480	0.00500	97	2	0.015	4.50	474.80	4.07	17.86	115	1.546	2.36	123.96	757	1246	1042	72
8480	0.00500	80	2	0.015	5.00	450.99	4.40	18.80	100	1.562	2.62	110.69	728	1170	986	64
8480	0.00500	68	2	0.015	5.50	432.12	4.69	19.62	90	1.574	2.87	101.05	706	1115	945	58
8480	0.00500	58	2	0.015	6.00	417.06	4.94	20.33	82	1.584	3.10	93.93	689	1074	915	54
8480	0.00500	49	2	0.015	6.50	404.99	5.17	20.94	75	1.591	3.33	88.61	678	1044	893	51
8480	0.00500	42	2	0.015	7.00	395.32	5.36	21.45	70	1.596	3.54	84.62	670	1022	877	48
8480	0.00500	37	2	0.015	7.50	387.57	5.52	21.88	67	1.599	3.73	81.61	664	1007	867	47
8480	0.00500	32	2	0.015	8.00	381.39	5.65	22.23	64	1.601	3.92	79.35	662	997	860	45

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	0.00	0.00	$0	$35,666	0	$0	N/A	$0	143392	$430,176	12889.81	$2,320,166	$327,181	$42,140	$23,936	$3,772,318
4.50	0.00	0.00	$0	$30,991	0	$0	N/A	$0	131441	$394,324	11176.89	$2,011,840	$266,949	$42,140	$23,936	$3,287,027
5.00	0.00	0.00	$0	$27,672	0	$0	N/A	$0	122725	$368,174	9957.48	$1,792,347	$221,827	$42,140	$23,936	$2,938,108
5.50	0.00	0.00	$0	$25,262	0	$0	N/A	$0	116313	$348,940	9069.02	$1,632,423	$186,889	$42,140	$23,936	$2,681,193
6.00	0.00	0.00	$0	$23,482	0	$0	N/A	$0	111600	$334,801	8410.39	$1,513,870	$159,071	$42,140	$23,936	$2,488,580
6.50	0.00	0.00	$0	$22,154	0	$0	N/A	$0	108171	$324,513	7916.01	$1,424,881	$136,382	$42,140	$23,936	$2,342,223
7.00	0.00	0.00	$0	$21,155	0	$0	N/A	$0	105733	$317,199	7541.87	$1,357,536	$117,484	$42,140	$23,936	$2,229,954
7.50	0.00	0.00	$0	$20,402	0	$0	N/A	$0	104075	$312,225	7257.59	$1,306,367	$101,447	$42,140	$23,936	$2,143,336
8.00	0.00	0.00	$0	$19,838	0	$0	N/A	$0	103040	$309,121	7041.73	$1,267,511	$87,610	$42,140	$23,936	$2,076,380

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 3B - CONCRETE/SUPERCRITICAL - REACH B

0	Existing ROW width		$250.00	Drop cost/ft width		$339,453.00	Side inlet cost		0.0064	Existing ground slope Se (ft/ft)				1950	Reach Length L (fT)		
$13,000	Land cost/acre		$2,659.00	Crossing cost/ft width		4	Bank slopes (H/1)		3	Drop height Hd (ft)				200	Existing channel Area		
$3.00	Earthwork/cy		N/A	inlet\outlet cost/ft width		0.5	Liner side slop ticknes		3	Max. overexcavation ov (ft)				47.5	Road and side ditch width		
$180.00	Liner/cy		$10	fence/ft		$5.68	O-M Present Value/LF		0.667	Liner ticknes t (ft)				1	number of crossings		
Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	Min. Top Width Tmin (ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	0	14	15	16	17
7770	0.00640	95	2	0.0150	4.00	413.49	3.65	18.79	111	1.719	2.37	120.85	689	1178	979	78
7770	0.00640	78	2	0.0150	4.50	389.84	3.99	19.93	96	1.740	2.67	106.30	659	1096	919	68
7770	0.00640	64	2	0.0150	5.00	371.50	4.29	20.92	84	1.756	2.95	96.09	637	1038	876	61
7770	0.00640	54	2	0.0150	5.50	357.15	4.55	21.76	76	1.768	3.21	88.79	622	997	846	55
7770	0.00640	46	2	0.0150	6.00	345.87	4.77	22.47	70	1.777	3.46	83.48	611	967	824	52
7770	0.00640	39	2	0.0150	6.50	336.98	4.96	23.06	65	1.782	3.69	79.60	603	947	809	49
7770	0.00640	33	2	0.0150	7.00	330.00	5.12	23.55	61	1.786	3.90	76.75	599	933	800	46
7770	0.00640	28	2	0.0150	7.50	324.53	5.25	23.94	58	1.788	4.10	74.67	597	924	794	45
7770	0.00640	24	2	0.0150	8.00	320.29	5.35	24.26	56	1.788	4.28	73.17	597	920	792	44

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	192.35	8.61	$111,942	$30,214	0	$0	339453	$321,353	56257	$168,770	5623.11	$1,012,161	$0	$19,500	$11,076	$2,381,106
4.50	177.80	7.96	$103,472	$26,575	0	$0	339453	$282,651	51915	$155,745	4897.12	$881,481	$0	$19,500	$11,076	$2,152,053
5.00	167.59	7.50	$97,531	$24,023	0	$0	339453	$255,510	48824	$146,473	4381.05	$788,588	$0	$19,500	$11,076	$1,989,758
5.50	160.29	7.18	$93,279	$22,196	0	$0	339453	$236,081	46621	$139,863	4005.22	$720,940	$0	$19,500	$11,076	$1,872,231
6.00	154.98	6.94	$90,192	$20,870	0	$0	339453	$221,977	45068	$135,203	3726.40	$670,752	$0	$19,500	$11,076	$1,785,784
6.50	151.10	6.76	$87,933	$19,900	0	$0	339453	$211,654	44002	$132,006	3516.62	$632,991	$0	$19,500	$11,076	$1,721,535
7.00	148.25	6.64	$86,276	$19,188	0	$0	339453	$204,081	43310	$129,931	3357.18	$604,292	$0	$19,500	$11,076	$1,673,530
7.50	146.17	6.54	$85,066	$18,668	0	$0	339453	$198,553	42911	$128,733	3235.24	$582,343	$0	$19,500	$11,076	$1,637,668
8.00	144.67	6.48	$84,194	$18,294	0	$0	339453	$194,572	42744	$128,231	3141.78	$565,520	$0	$19,500	$11,076	$1,611,056

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 3B - CONCRETE/SUPERCRITICAL - REACH C

0	Existing ROW width	$250.00	Drop cost/ft width	N/A	Side inlet cost	0.0076	Existing ground slope Se (ft/ft)	3332	Reach Length L (fT)
$13,000	Land cost/acre	N/A	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	N/A	inlet\outlet cost/ft width	0.5	Liner side slop ticknes	4	Max. overexcavation ov (ft)	34	Road and side ditch width
$180.00	Liner/cy	$10	fence/ft	$5.68	O-M Present Value/LF	0.667	Liner ticknes t (ft)	0	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	Min. Top Width Tmin (ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	0	14	15	16	17
3230	0.00760	34	2.0	0.015	4.00	166.72	3.23	18.88	50	1.864	2.38	59.22	297	647	497	37
3230	0.00760	27	2.0	0.015	4.50	160.30	3.43	19.64	45	1.874	2.62	55.11	291	624	481	34
3230	0.00760	21	2.0	0.015	5.00	155.77	3.58	20.21	41	1.878	2.84	52.50	289	610	473	32
3230	0.00760	17	2.0	0.015	5.50	152.61	3.69	20.63	39	1.879	3.03	50.86	288	603	469	30
3230	0.00760	13	2.0	0.015	6.00	150.48	3.77	20.92	37	1.878	3.20	49.88	290	600	469	29
3230	0.00760	10	2.0	0.015	6.50	149.10	3.82	21.11	36	1.874	3.36	49.36	292	602	471	29
3230	0.00760	8	2.0	0.015	7.00	151.27	3.89	21.35	36	1.826	3.52	49.69	301	613	482	29
3230	0.00760	5	2.0	0.015	7.50	147.97	3.87	21.28	35	1.864	3.63	49.26	301	611	481	28
3230	0.00760	2	2.0	0.015	8.00	147.97	3.87	21.28	34	1.857	3.76	49.53	306	618	487	28

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	125.22	9.58	$124,515	$14,804	0	$0	N/A	$0	36623	$109,868	4533.95	$816,111	$0	$33,320	$18,926	$1,323,287
4.50	121.11	9.26	$120,433	$13,778	0	$0	N/A	$0	34718	$104,154	4156.70	$748,205	$0	$33,320	$18,926	$1,230,045
5.00	118.50	9.06	$117,833	$13,124	0	$0	N/A	$0	33665	$100,994	3903.46	$702,624	$0	$33,320	$18,926	$1,168,435
5.50	116.86	8.94	$116,201	$12,714	0	$0	N/A	$0	33198	$99,595	3731.56	$671,681	$0	$33,320	$18,926	$1,127,667
6.00	115.88	8.86	$115,227	$12,469	0	$0	N/A	$0	33152	$99,457	3615.10	$650,718	$0	$33,320	$18,926	$1,101,178
6.50	115.36	8.82	$114,715	$12,340	0	$0	N/A	$0	33418	$100,255	3537.74	$636,794	$0	$33,320	$18,926	$1,084,812
7.00	115.69	8.85	$115,042	$12,422	0	$0	N/A	$0	34768	$104,303	3529.35	$635,283	$0	$33,320	$18,926	$1,088,248
7.50	115.26	8.82	$114,613	$12,315	0	$0	N/A	$0	34616	$103,849	3461.20	$623,015	$0	$33,320	$18,926	$1,072,467
8.00	115.53	8.84	$114,878	$12,381	0	$0	N/A	$0	35463	$106,389	3449.87	$620,977	$0	$33,320	$18,926	$1,073,388

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 3B - CONCRETE/SUPERCRITICAL - REACH D

0	Existing ROW width	$250.00	Drop cost/ft width	$186,334.00	Side inlet cost	0.0057	Existing ground slope Se (ft/ft)	1168	Reach Length L (fT)
$13,000	Land cost/acre	$3,754.00	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	N/A	inlet\outlet cost/ft width	0.5	Liner side slop ticknes	4	Max. overexcavation ov (ft)	34	Road and side ditch width
$180.00	Liner/cy	$10	fence/ft	$5.68	O-M Present Value/LF	0.583	Liner ticknes t (ft)	1	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	Min. Top Width Tmin (ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	0	14	15	16	17
3050	0.00570	38	2	0.015	4.00	184.23	3.29	16.56	54	1.580	2.06	62.31	304	662	506	36
3050	0.00570	30	2	0.015	4.50	176.67	3.51	17.26	48	1.590	2.28	57.39	297	633	487	33
3050	0.00570	24	2	0.015	5.00	171.26	3.67	17.81	44	1.595	2.48	54.18	293	616	475	31
3050	0.00570	19	2	0.015	5.50	167.40	3.80	18.22	41	1.597	2.66	52.09	292	606	469	30
3050	0.00570	15	2	0.015	6.00	164.71	3.90	18.52	39	1.597	2.83	50.78	292	601	467	29
3050	0.00570	12	2	0.015	6.50	162.90	3.96	18.72	38	1.595	2.99	50.00	294	600	468	28
3050	0.00570	9	2	0.015	7.00	161.75	4.00	18.86	37	1.592	3.13	49.63	298	602	471	28
3050	0.00570	6	2	0.015	7.50	161.13	4.03	18.93	36	1.587	3.27	49.55	302	607	476	28
3050	0.00570	4	2	0.015	8.00	160.92	4.03	18.95	36	1.582	3.39	49.69	307	613	482	28

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency) ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
4.00	128.31	3.44	$44,727	$15,578	0	$0	186334	$233,924	13225	$39,674	1546.38	$278,349	$0	$11,680	$6,634	$961,586
4.50	123.39	3.31	$43,010	$14,347	0	$0	186334	$215,437	12403	$37,210	1419.20	$255,457	$0	$11,680	$6,634	$906,914
5.00	120.18	3.22	$41,891	$13,544	0	$0	186334	$203,379	11913	$35,740	1335.29	$240,353	$0	$11,680	$6,634	$871,213
5.50	118.09	3.17	$41,164	$13,023	0	$0	186334	$195,551	11654	$34,962	1279.87	$230,377	$0	$11,680	$6,634	$848,043
6.00	116.78	3.13	$40,705	$12,694	0	$0	186334	$190,614	11561	$34,682	1243.93	$223,908	$0	$11,680	$6,634	$833,470
6.50	116.00	3.11	$40,437	$12,501	0	$0	186334	$187,717	11592	$34,775	1221.76	$219,917	$0	$11,680	$6,634	$824,992
7.00	115.63	3.10	$40,305	$12,407	0	$0	186334	$186,306	11718	$35,153	1209.60	$217,728	$0	$11,680	$6,634	$820,968
7.50	115.55	3.10	$40,277	$12,387	0	$0	186334	$186,003	11918	$35,755	1204.93	$216,887	$0	$11,680	$6,634	$820,284
8.00	115.69	3.10	$40,328	$12,423	0	$0	186334	$186,548	12180	$36,540	1205.98	$217,076	$0	$11,680	$6,634	$822,168

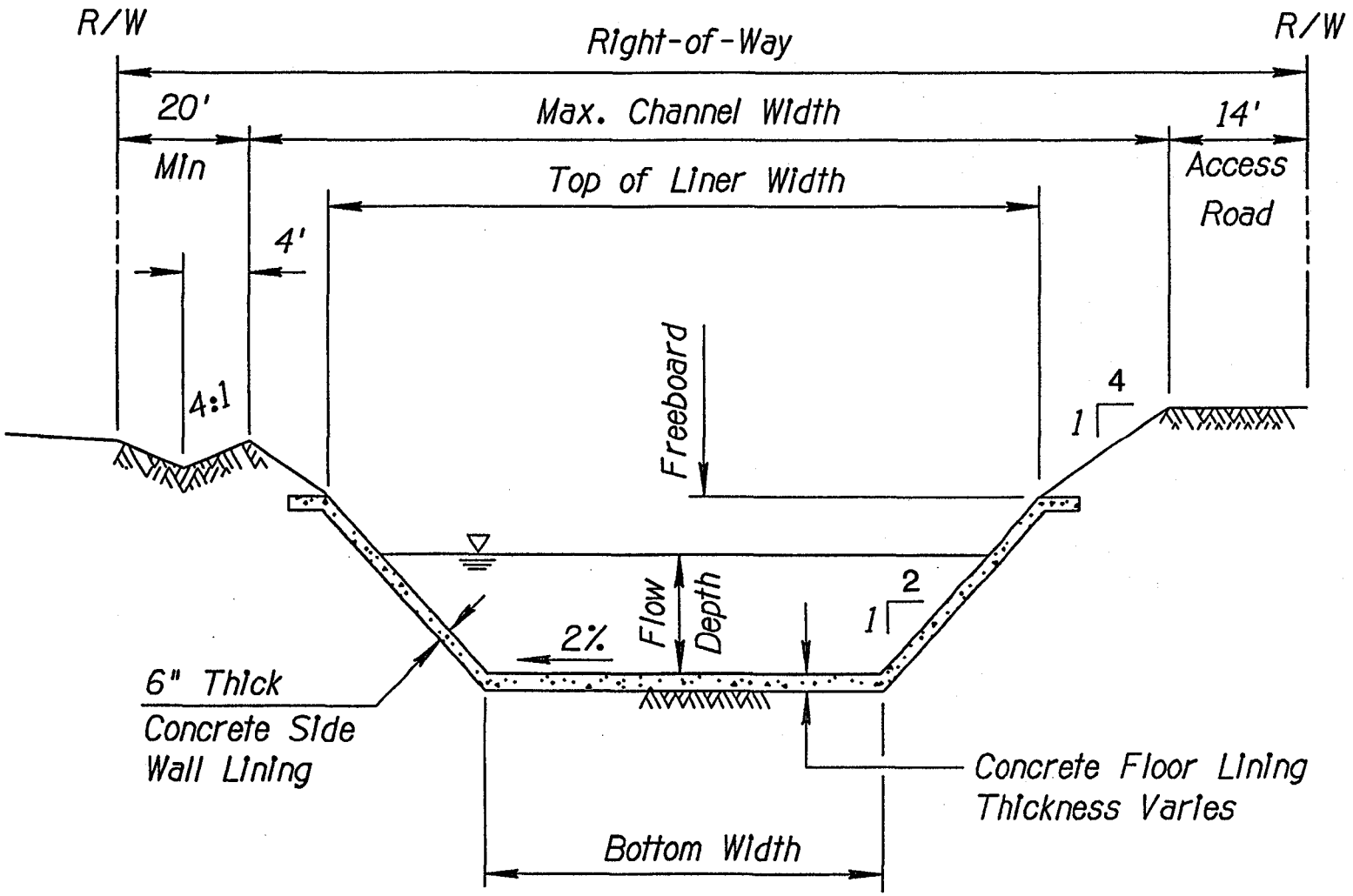

FIGURE 5. TYPICAL CROSS SECTION FOR SUPERCRITICAL CONCRETE LINED CHANNEL

WHITE TANKS FRS#3 INLET IMPROVEMENTS - ALTERNATIVE No. 3B - CONCRETE/SUPERCRITICAL - REACH E

0	Existing ROW width	$250.00	Drop cost/ft width	N/A	Side inlet cost	0.0057	Existing ground slope Se (ft/ft)	600	Reach Length L (fT)
$13,000	Land cost/acre	N/A	Crossing cost/ft width	4	Bank slopes (H/1)	3	Drop height Hd (ft)	200	Existing channel Area
$3.00	Earthwork/cy	$831.00	inlet\outlet cost/ft width	0.5	Liner side slop ticknes	4	Max. overexcavation ov (ft)	34	Road and side ditch width
$180.00	Liner/cy	$10	fence/ft	$5.68	O-M Present Value/LF	0.5	Liner ticknes t (ft)	0	number of crossings

Design Flow Q (cfs)	Design Slope S (ft/ft)	Bottom Width B (ft)	Side Slopes m (H/V)	Manning's n	Flow Depth Y (ft)	Flow Area A (ft^2)	Hydraulic Radius R (ft)	Flow Velocity V (ft/sec)	Top Width T (ft)	Froude No. Fn	Free-bord fb (ft)	X-sec. min. exc. A Aemin (ft^3/ft)	X-sec Chan Area Ach (ft^3/ft)	X-sec. Max. Area Aemax (ft^3/ft)	X-sec. Av. Area Aeav (ft^3/ft)	Liner Area Al (ft^3/ft)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1130	0.00570	47	2	0.015	2.00	101.27	1.82	11.16	55	1.444	2.00	255	219	569	412	32
1130	0.00570	31	2	0.015	2.50	91.05	2.14	12.41	41	1.475	2.00	212	182	474	343	26
1130	0.00570	27	2	0.015	2.70	88.20	2.24	12.81	38	1.483	2.00	201	172	449	325	24
1130	0.00570	16	2	0.015	3.50	80.99	2.55	13.95	30	1.500	2.00	175	149	391	283	20
1130	0.00570	12	2	0.015	4.00	78.66	2.66	14.37	28	1.501	2.00	167	142	373	270	19
1130	0.00570	8	2	0.015	4.50	77.32	2.73	14.62	26	1.499	2.00	162	138	363	263	19
1130	0.00570	5	2	0.015	5.00	76.64	2.77	14.74	25	1.494	2.09	163	138	362	263	19
1130	0.00570	3	2	0.015	5.50	76.42	2.78	14.79	25	1.487	2.22	167	142	366	267	19
1130	0.00570	1	2	0.015	6.00	76.52	2.77	14.77	25	1.480	2.35	172	146	373	272	19

Flow Depth Y (ft)	R.O.W. Additional W Wrow (ft)	R.O.W. Area Arow (acres)	R.O.W. Cost ($)	Drop Cost/drop ($/drop)	Number of Drops	Drop Cost ($)	Side Inlet Cost ($)	Crossings Cost	Exavation Volume (cyr)	Excavation Cost ($)	Liner Volume (cyr)	Liner Cost ($)	Inlet/ Outlet Cost ($)	Fence Cost ($)	O/M Cost ($)	Total Cost (with 20% Contingency ($)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
2.00	128.64	1.77	$23,034	$15,659	0	$0	N/A	$0	4714	$14,142	716.94	$129,050	$38,755	$6,000	$3,408	$257,267
2.50	115.42	1.59	$20,668	$12,355	0	$0	N/A	$0	3177	$9,530	572.73	$103,091	$26,111	$6,000	$3,408	$202,568
2.70	112.07	1.54	$20,067	$11,516	0	$0	N/A	$0	2782	$8,346	536.50	$96,570	$22,658	$6,000	$3,408	$188,459
3.50	104.14	1.43	$18,648	$9,535	0	$0	N/A	$0	1847	$5,542	452.65	$81,476	$13,413	$6,000	$3,408	$154,185
4.00	101.67	1.40	$18,205	$8,916	0	$0	N/A	$0	1559	$4,677	427.76	$76,997	$9,694	$6,000	$3,408	$142,777
4.50	100.18	1.38	$17,939	$8,545	0	$0	N/A	$0	1392	$4,175	413.89	$74,501	$6,799	$6,000	$3,408	$135,386
5.00	99.70	1.37	$17,853	$8,426	0	$0	N/A	$0	1395	$4,186	411.70	$74,105	$4,427	$6,000	$3,408	$131,976
5.50	99.79	1.37	$17,869	$8,447	0	$0	N/A	$0	1486	$4,458	415.96	$74,872	$2,405	$6,000	$3,408	$130,814
6.00	100.14	1.38	$17,931	$8,535	0	$0	N/A	$0	1607	$4,821	423.12	$76,161	$627	$6,000	$3,408	$130,738

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SHEET 1 OF 1
BY HAP DATE 6/20/94
CHECK MJB DATE 8/26/94

CLIENT FCDMC
JOB White Tanks Unit Price
JOB NO. 310.44

Compiled from Dibble's WTFRS #4 Inlet improvements

Item description	ADOT	RS MEANS	Dibble's
Excavation	0.80 $/cy – 5.00 $/cy		3.00 $/cy
Riprap	36.00 $/cy – 28 $/cy	18.60 $/ton – 32.60 $/cy	40 $/cy
Reno Mattress	43.00 $/cy – 43.00 $/cy	41.00 $/sy – 123 $/cy	90 $/cy 3.40 $/SF
Grouted Rip-rap 1'	32.00 $/cy – 57.00 $/cy	100 $/cy	65 $/cy
Soil Cement 11% Cement		32.12 $/cy *	30.00 $/cy
Cement	78.00/ton > 29.40/cy		
Soil cement	15.00/cy		
Shotcrete (6" Reinf)	2.00 $/sf – 3.50 $/sf		2.80 $/sf 75 $/cy
Concrete			
concrete	$200/cy –		
steel	$0.35/lb –		
Floor (6" reinf)			2.8 $/sf
vertical ≥ 4'			18.00 $/sf
vertical > 4			15.00 $/sf
Right of way			$13,000/Acre
fence			$10/ft

* 12% cement mix.

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SHEET 1 OF 1
BY HDD DATE 8/7/94
CHECK MJB DATE 9.2.94
CLIENT FCDMC
JOB White Tanks FRS #3 Inlet JOB NO. 310.44

Cost of Maintenance

Earth 17700/mile/yr (Duke Yeager FCDMC)

cost = 17700/5280

= 3.35/LF/yr

assuming interest rate is same as loan interest then the maintenance cost for standard 30 yr live of project is

(3.35)(30) = 100.5/LF

Concrete 1000/mile (Duke Yeager FCDMC)

cost = 1000/5280

= 0.189

Present worth (0.189)(30) = 5.68 $/LF

Grouted rip-rap the district don't have an estimated for grouted rip rap but Mr Yeager state that is more than concrete and since the cost of the grouted riprap channel is already higher than concrete this cost is irrelevant therefore a cost equal to that of concrete was use.

Present worth 5.68

TABLE B

WHITE TANKS FLOOD RETENTION STRUCTURE #4 INLET CHANNEL — JOB 9302

D PROJECT NO. 92-38 — PRICESUM

UNIT PRICE SUMMARY

EM O.	DESCRIPTION	BASE UNIT PRICE	UNIT	ESTIMATING UNIT PRICE	UNIT
1	EXCAVATION	$3.00	CY	$3.00	CY
2	PLAIN RIPRAP LINER	$40.00	CY	$2.22	SF
3	RENO MAT (GABION) LINER	$90.00	CY	$3.40	SF
4	GROUTED RIPRAP LINER	$65.00	CY	$2.40	SF
5	SOIL-CEMENT LINER (4:1)	$30.00	CY	$1.11	SF
6	SOIL-CEMENT LINER (2:1)	$30.00	CY	$4.00	SF
7	SHOTCRETE LINER	$150.00	CY	$2.80	SF $25.00/SY
8	CONCRETE LINER (RET.WALLS)	$200.00	CY (CONC.)	$18.00	LF (4' HIGH)
		$0.35	LB (STEEL)	$15.00	LF (12' HIGH)
9	DROP STRUCTURES				
	A. IN EARTH CHANNEL	$400.00	LF	$400.00	LF
	B. IN RIPRAP CHANNEL	$405.00	LF	$405.00	LF
	C. IN RENO MAT CHANNEL	$215.00	LF	$215.00	LF
	D. IN GROUTED RIPRAP CHANNEL	$330.00	LF	$330.00	LF
	E. IN SOIL-CEM (4:1) CHANNEL	$475.00	LF	$475.00	LF
	F. IN SOIL-CEM (2:1) CHANNEL	$450.00	LF	$450.00	LF
	G. IN SHOTCRETE CHANNEL	$325.00	LF	$325.00	LF
	H. IN CONCRETE CHANNEL	$270.00	LF	$270.00	LF
10	FENCE AND GATES	NA	NA	$10.00	LF
11	RIGHT-OF-WAY	NA	NA	$13,500.00	ACRE

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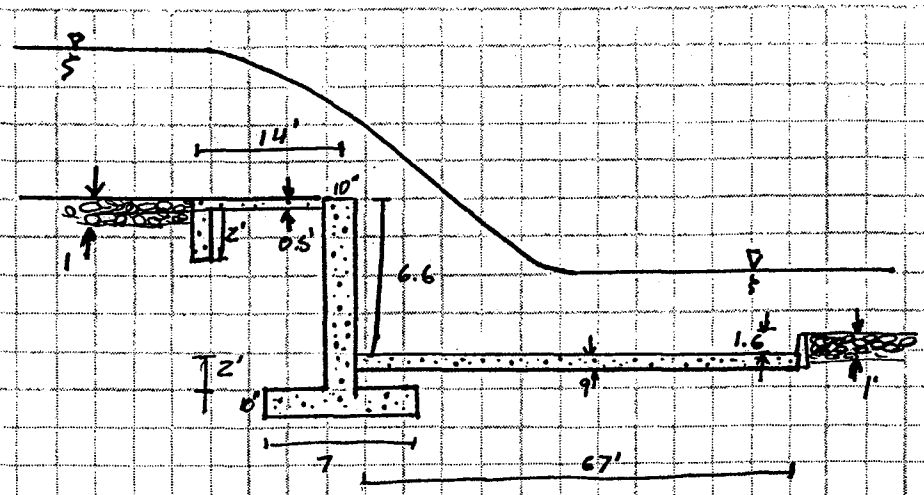
SHEET 1 OF 2
BY AAA DATE 8/5/94
CHECK _____ DATE _____

CLIENT FCDMC
JOB White tank @ Rip Rap drop (Grouted) cost
JOB NO. 310.44



Volume of Concret

Spillway (7+6.6)(0.83) = 11.29 ft²/LF

Upstream App. (14)(0.5) = 7.00 ft²/LF

Downstream Basin (0.75)(67) = 50.25 ft²/LF

Total = 68.53 ft²/LF
= 2.54 cy/LF

Cost 2.54 cy/LF @ $200/cy = $507.69/LF

Excavation and Backfill

Basin excess excavation as compared to channel 1.6 + 0.75 − 1 = 1.35 ft

Volume (1.35)(67') = 90 ft³/LF = 3.3 cy/LF

Spillway 0.5(6.6)(6.6) + 4(6.6) + 0.5(2)(2) + (3)(2) = 56 ft³/LF = 2.1 cy/LF

Cost Basin 3.3 cy/LF @ $3/cy = $10/LF

Cost Spillway 2.1 cy/LF @ 10/cy = $21/LF

Rip-Rap Replaced by concrete Volume

(70)(1) + (14)(1) = 110 ft³/LF

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SHEET 2 OF 2
BY HAA DATE 8/5/94
CHECK _____ DATE _____

CLIENT FCDMC
JOB Grouted Rip-Rap Channel drop structure cost
JOB NO. _____

cost saving 4.07 cy/LF @ $65/cy = $264/LF

Total cost

concrete $507.69/LF

Excavation and Backfill $31.0/LF

Rip-Rap -$-275.0/LF

$275/LF

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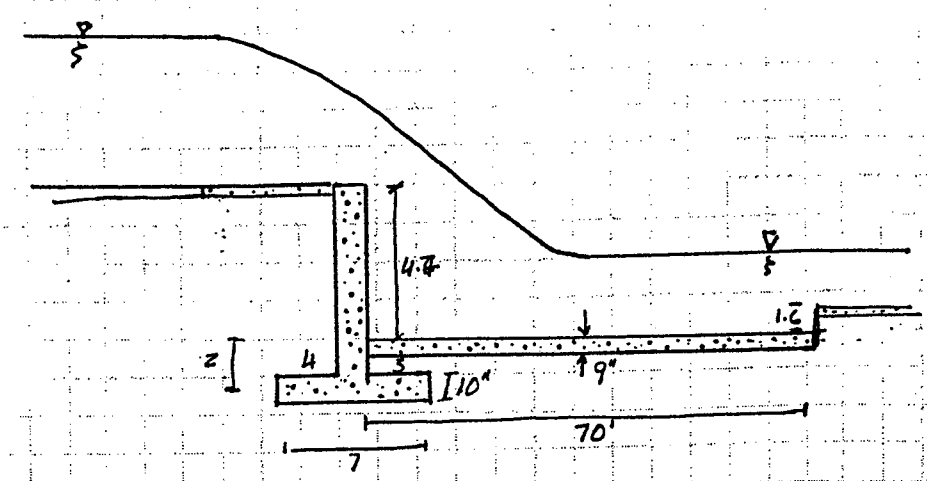
SHEET ____ OF ____
BY HBA DATE 8/4/94
CHECK ____ DATE ____

CLIENT FCDMC
JOB White Tanks #3 drop Cost on Concrete Channel JOB NO. 310.44



For a concrete lined channel no upstream apron is required and the downstream apron tickness is increase from 6" to 9"

Volume of Concrete

Spillway $(7 + 6.7)(0.83)$ $= 11.4$ ft²/LF

Basin $(0.75 - 0.5)(70)$ $= 17.5$ ft²/LF
Basin t − channel

Total 28.87 ft²/LF

Cost 1.07 CY/LF @ \$200/CY = \$213.9/LF

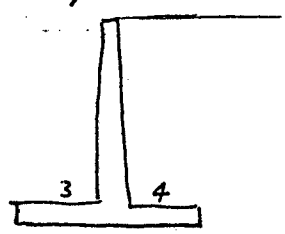
Excavation / Backfill

Spillway $0.5(6.7)(6.7) + 4(6.7) + 0.5(2)(2) + (3)(2)$ $= 57.2$ ft³/LF
$= 2.12$ CY/LF

Cost 2.12 CY/LF @ \$10/CY = \$21.2/LF

Basin $(1.6 + 0.25)(70)$ $= 129.5$ ft³/LF
4.80 CY/LF

Cost 4.80 CY/LF @ \$3/CY = \$14.39/LF



Total cost

$213.9 + 21.2 + 14.39$ $\boxed{\approx \$250/LF}$

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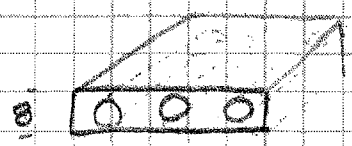
SHEET 1 OF 1
BY HAA DATE 9/30/94
CHECK MJB DATE 10/5/94
CLIENT FCDMC
JOB White Tanks FRS #3 Inlet Imp. JOB NO. 310.44

Unit cost for reinforce concrete liner

Concrete cost $180/cy

Steel $0.35 lb

Assuming 8" thickness for bottom and 6" for the side slopes (V>20)



Longitudinal ratio of reinforcement to x-sec concrete = 0.30%

Traverse ratio " " " = 0.30%

assuming #4 $A_s = 0.2\ in^2$

$A_c = 0.2/0.003 = 66.6\ in^2$

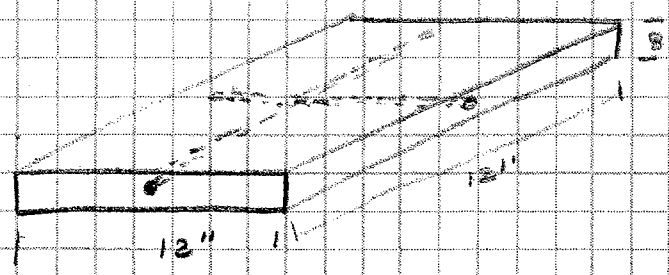
Spacing $= 66.6/8" = 8.32$

assuming #5 $A_s = 0.31$

$A_c = 0.31/0.003 = 103.3\ in^2$

Spacing $= 103.3/8 = 12.91$

use #5 @ 12"



$W_s/cy = (2')(1.043\ lb/ft)\ \frac{12"}{8"}(27) = 81\ lb/cy$

Cost of liner $= \$180/cy + (\$0.35)(81) \approx \$210/cy$

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BY: HAA DATE: 29-Aug-94
CHECK: DATE:

PROJECT: White Tanks
LOCATION: Northern Av.

JOB NO. 310.44

HYDROLOGIC AND CHANNEL INFORMATION

MEAN STREAM VELOCITY = 13
MAX. STREAM VELOCITY = 15

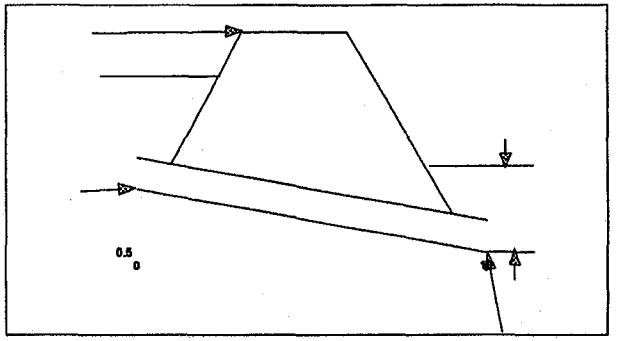
n= 0.015

Q1 = 706 TW1 = 5.5
Q2 = TW2 =

Q1 = DESIGN DISCHARGE, SAY Q25
Q2 = CHECK DISCHAQRGE, SAY Q50 OR Q100

SKETCH

STATION:
EL. = 1271.7
AHW 8
EL. = 1224.03



So = 0.001 EL. = 1223.95
L = 90 TW = 5.5

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	H	W	HEAD WATER COMPUTATION										HW CONT.	V OUT	COST	COMENTS
				INLET CONT		OUTLET CONTROL HW=H+ho-LSo											
				HW/D	HW	Ke	H	dc	(dc+D)/2	TW	ho	LSo	HW				
chart #				ch-1													
(Q 100-yr flow)/12	706	8	10	1.00	8.00	0.5	2.06	5.37	6.68	5.50	5.50	0.08	7.48	8.00	inlet		HW ok

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SHEET _____ OF _____

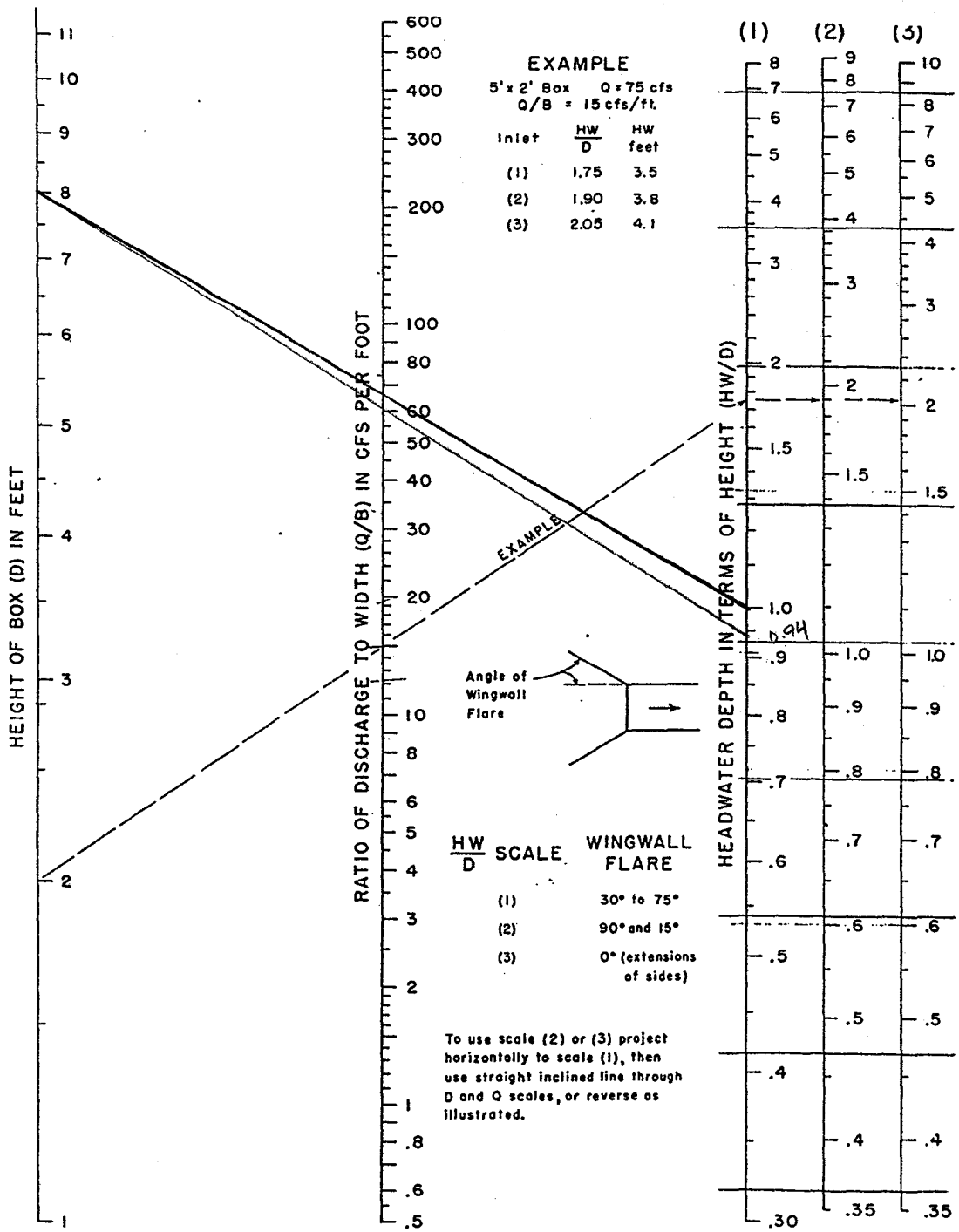
BY JAB DATE 8/5/94

CHECK MJB DATE 9.2.94

CLIENT FCDMC

JOB Culvert at Olive Av. White Tanks

JOB NO. 310.44



Q/B = 67 cfs

Nathar

Q ~~[illegible]~~ = 777

B = 7770/67

B = 116

12 8' x 10' ✓

HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

ACK ENGINEERS, INC.
2255 N. 44th St. Phoenix, AZ · Phone (602) 244-2566

BY: HAA DATE: 29-Aug-94
CHECK: DATE:
JOB NO. 310.44

PROJECT: White Tanks
LOCATION: Northern Av.

HYDROLOGIC AND CHANNEL INFORMATION

MEAN STREAM VELOCITY = 13
MAX. STREAM VELOCITY = 15

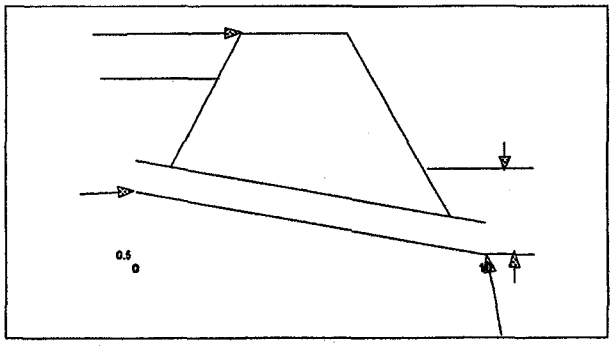
n= 0.015

Q1 = 706 TW1 = 5.5
Q2 = TW2 =

Q1 = DESIGN DISCHARGE, SAY Q25
Q2 = CHECK DISCHAQRGE, SAY Q50 OR Q100

SKETCH

STATION:
EL. = 1271.7
AHW 8
EL. = 1224.03



So = 0.001 EL. = 1223.95
L = 90 TW = 5.5

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	H	W	HEAD WATER COMPUTATION										HW CONT.	V OUT	COST	COMENTS
				INLET CONT		OUTLET CONTROL HW=H+ho-LSo											
				HW/D	HW	Ke	H	dc	dc+D/2	TW	ho	LSo	HW				
chart #				ch-1													
(Q 100-yr flow)/12	706	8	10	1.00	8.00	0.5	2.06	5.37	6.68	5.50	5.50	0.08	7.48	8.00	inlet		HW ok

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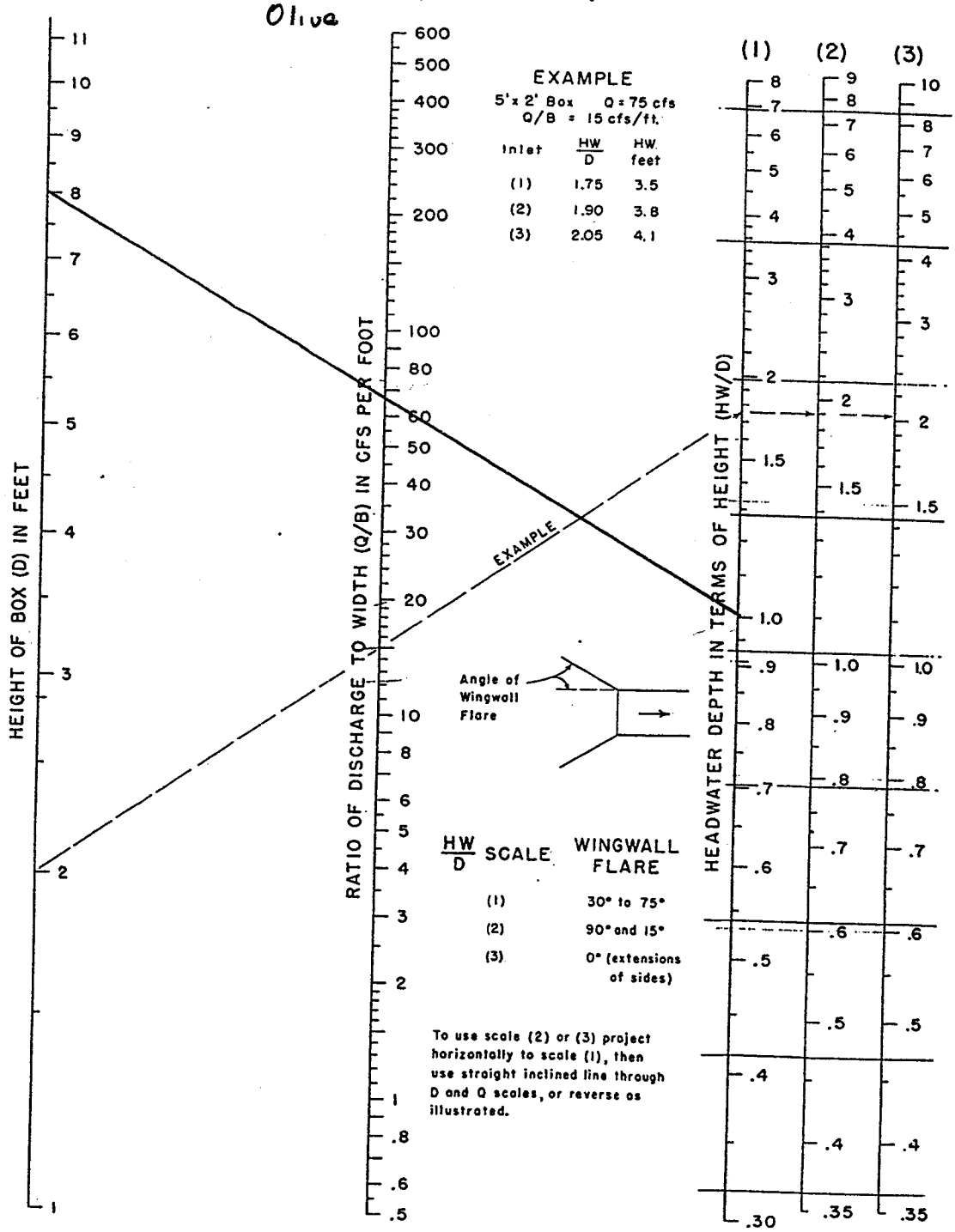
SHEET _____ OF _____
BY HAA DATE 8.5.94
CHECK MJB DATE 9.2.94

CLIENT FCDMC
JOB Culvert at ~~Northern~~ Olive Ave White Tanks
JOB NO. 310.44



Q/B = 67 cfs/ft

Q Olive = 3350

B = 3350/67
B = 50 ft ✓

5 8'x10' Box culverts

1267

HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

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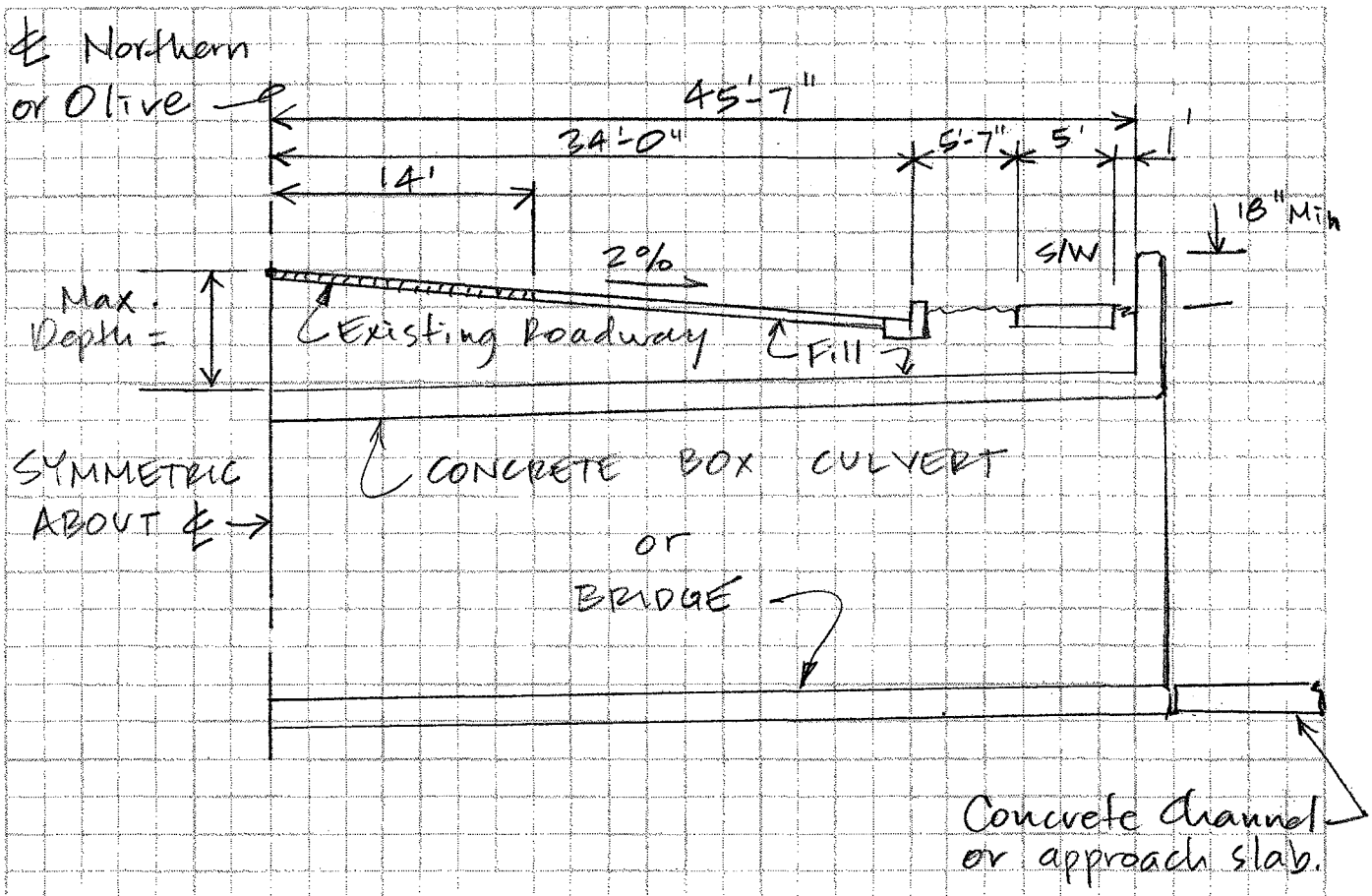
SHEET 1 OF 3
BY MJB DATE 8·24·94
CHECK _____ DATE _____

CLIENT FCD Maricopa Cty
JOB White Tanks #3 - Inlet
JOB NO. 310.44



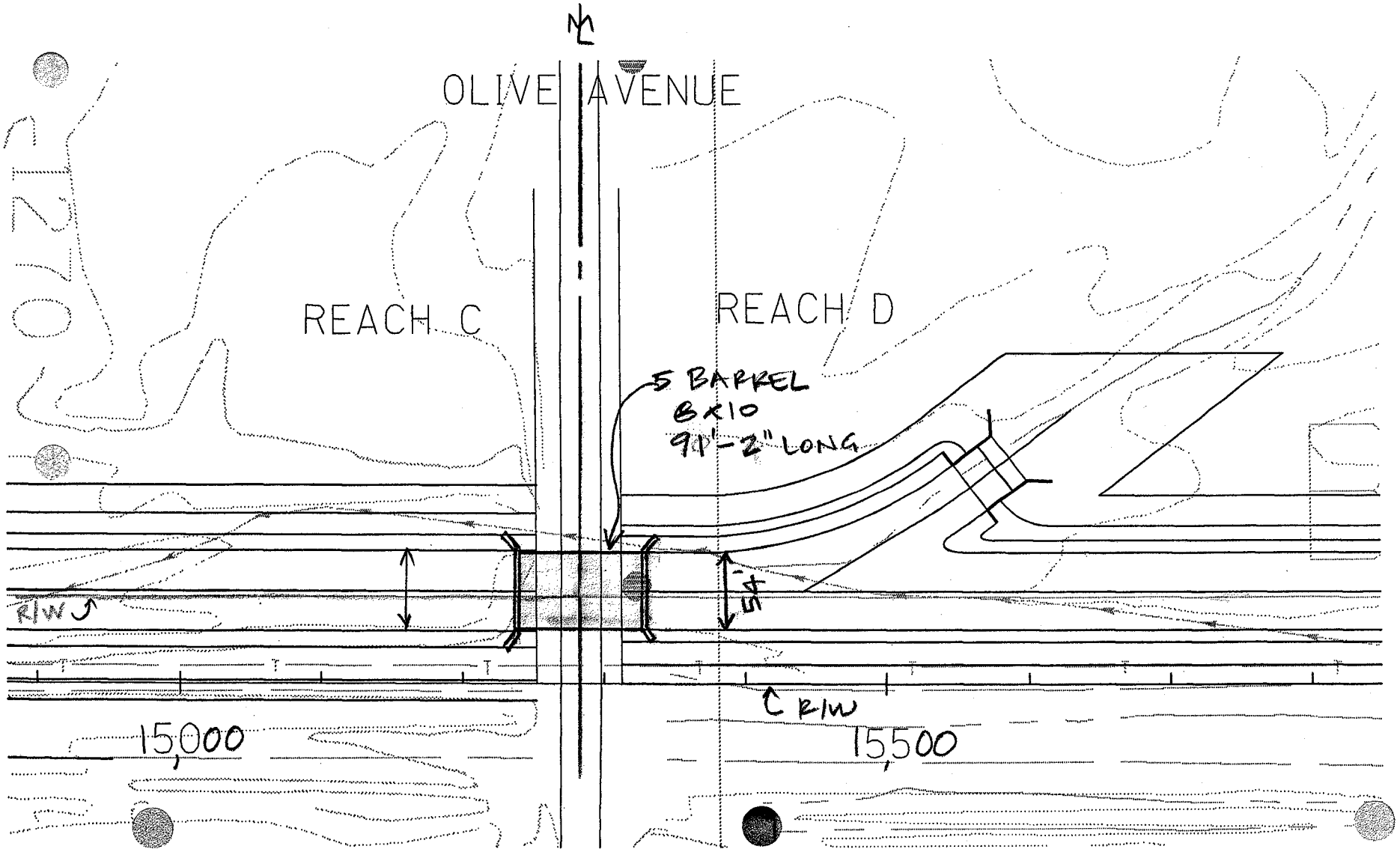
NOTES:

1). Concrete Box @ Olive is 5 barrel 8'x10'. Total Width = 5x10+4'± = 54'±

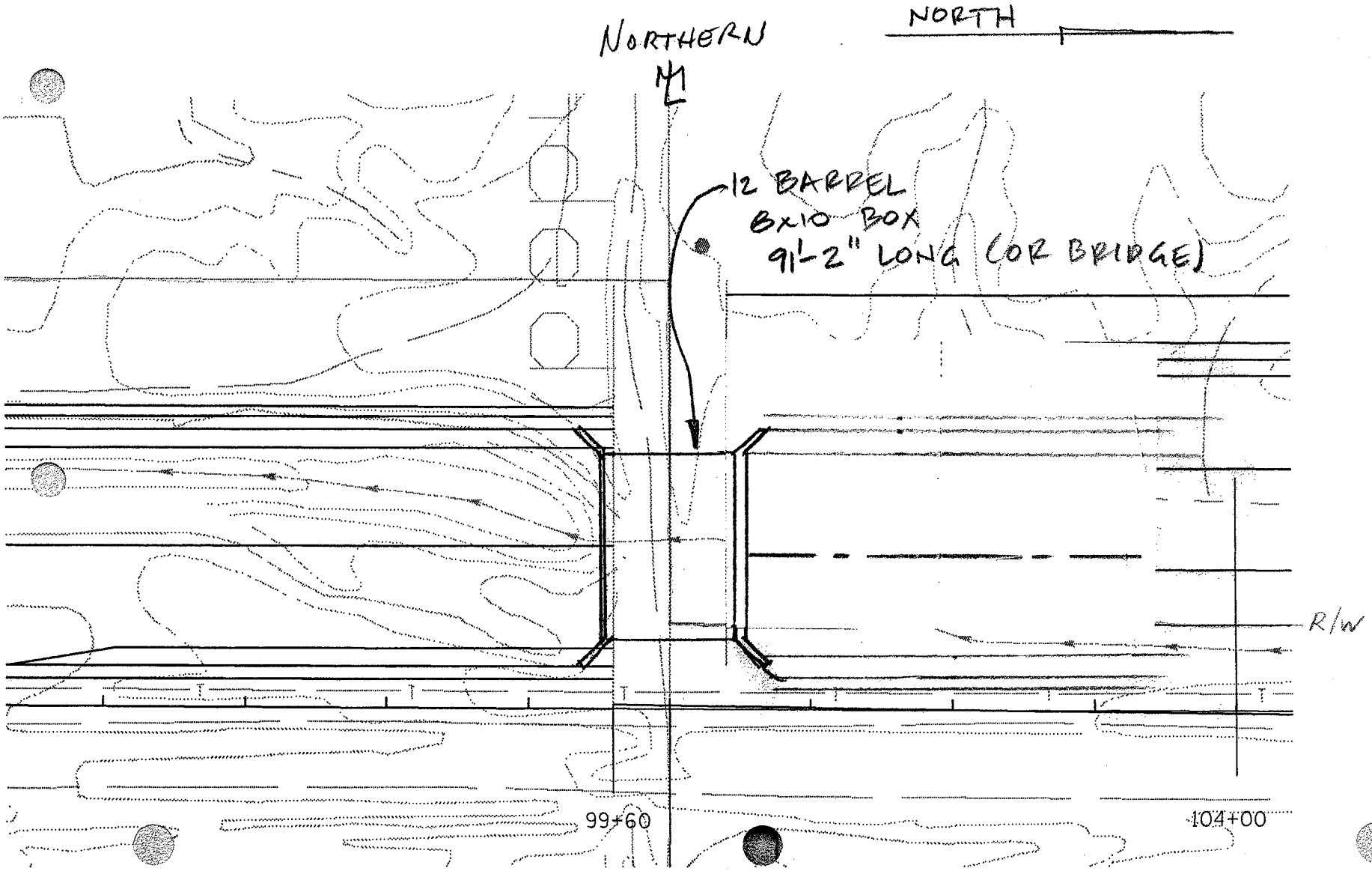
2). Concrete Box @ Northern is 12 barrel 8'x10'. Total Width = 12x10+11'± = 131'±

STRAIGHT BOX
(ASSUME WE JOINTLY USE CANAL R/W)

NORTH



Sht. 2 of 3


NORTHERN
NORTH
12 BARREL
8x10 BOX
91'-2" LONG (OR BRIDGE)
R/W
99+60
104+00

Sht. 2 of 3

ACK ENGINEERS, INC.
2255 N. 44th St. • Phoenix, Az. 85008 • Phone (602) 244-2566

SHEET 1 OF 1
BY [illegible] DATE 9-1-94
CHECK MJB DATE 9.2.94

CLIENT FCDMC
JOB White Tanks FRS #3 JOB NO. 310.44

Crossing Cost for Olive Av. and Norther Av. where estimated to be

Box at Olive = 181500
Bridge at Northern = 399500

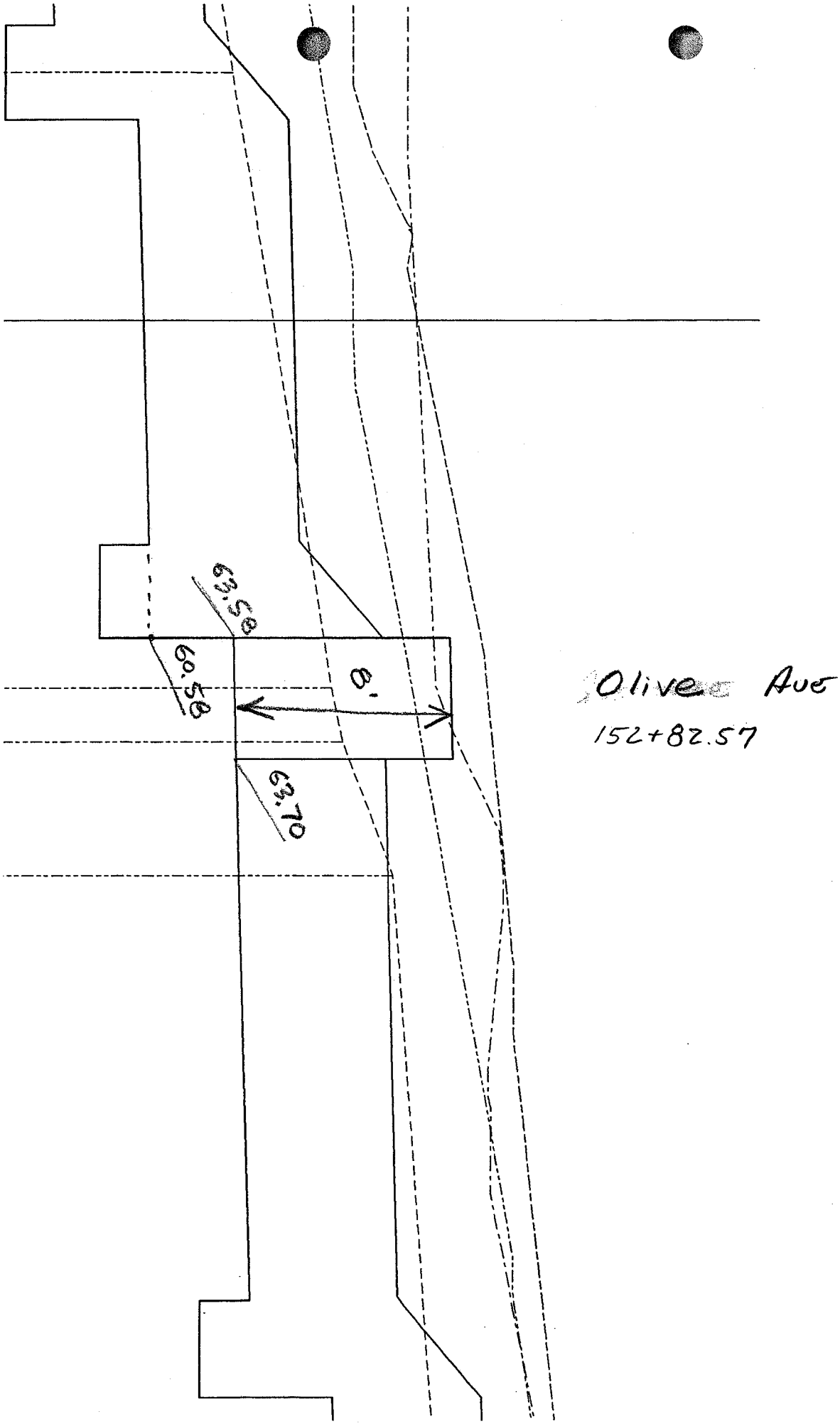
these cost where based on the peppered alternative (Concrete, 5.5 ft depth) To be able to apply this cost to other deep and channel configurations these cost where converted to cost per unit top width.

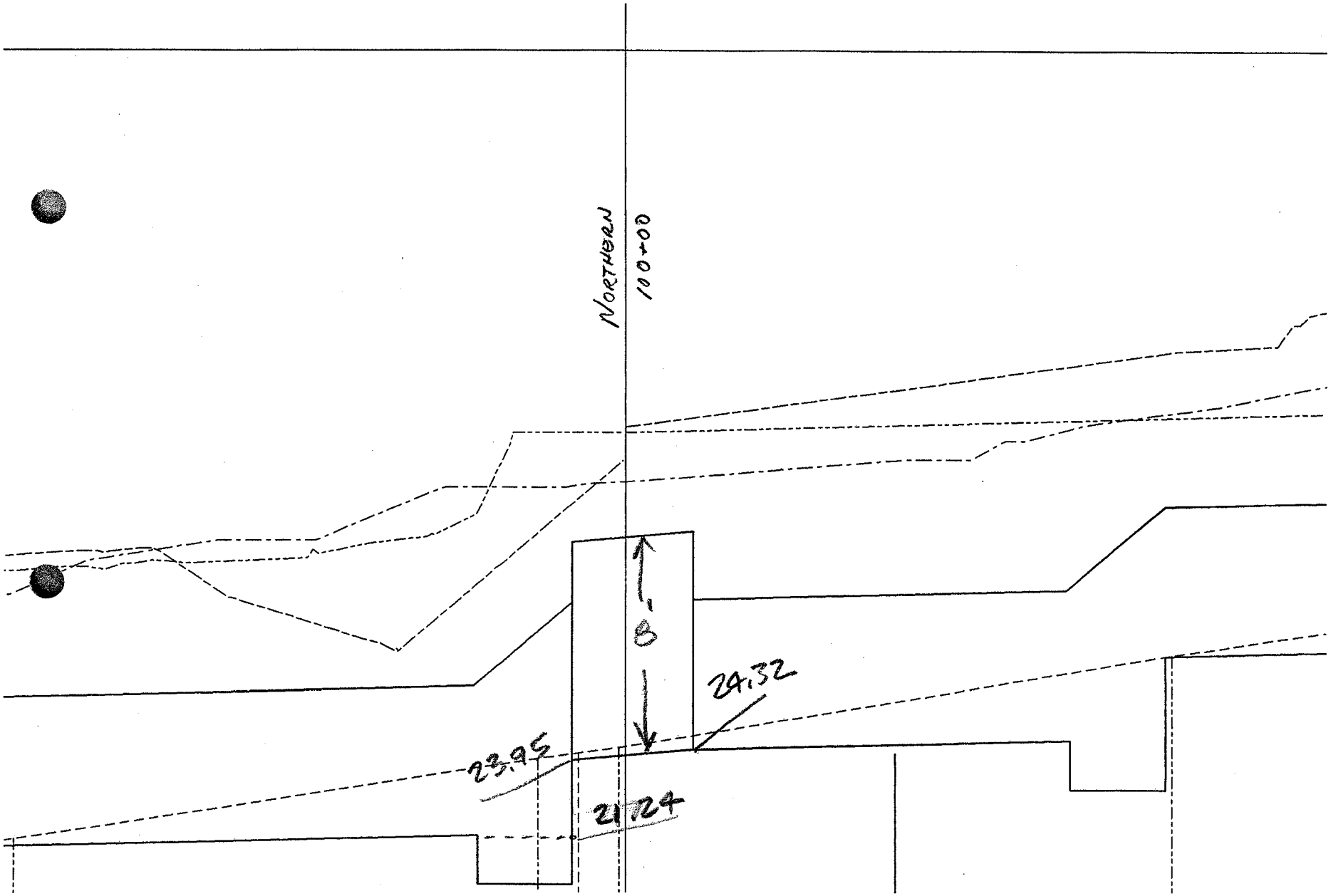
the top width use in the estimate are (width at top or liner)

Olive Av. = 74.51
Northern Av. = 150.27

Cost/ft at Olive Av = 181500/74.51 = 2436 ✓

Cost/ft at Norther Av = 399500/151 = 2659 ✓


63.50
60.50
8'
63.70
Olive Ave
152+82.57


NORTHERN
100+00
8
24.32
23.95
21.24

ACK ENGINEERS, INC.
2255 N. 44th St. • Phoenix, Az. 85008 • Phone (602) 244-2566

SHEET 1 OF 1
BY [illegible] DATE 9-1-94
CHECK MJB DATE 9.2.94
CLIENT FCDMC
JOB White Tanks FRS #3 JOB NO. 310.44

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Cost/ft at Norther Av = 399500/151 = 2659 ✓

AGK ENGINEERS, INC.
2255 N. 44th Street Suite
PHOENIX, ARIZONA 85008

(602) 244-2566
Fax (602) 244-8947

LETTER OF TRANSMITTAL

INCA Engineers, Inc.

DATE 8-24-94	JOB NO. 310.94
ATTENTION C.G.	
RE: White Tanks FRS #3	

ARE SENDING YOU ☐ Attached ☐ Under separate cover via _____ the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications

☐ Copy of letter ☐ Change order ☐ _____

OPIES	DATE	NO.	DESCRIPTION
1	8-24-94	5	Box layout & profile
1	8-18-94	—	Geotechnical Report
1	8-23-94		Memo from 8-22-94

SE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval

☒ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution

☐ As requested ☐ Returned for corrections ☐ Return _____ corrected prints

☐ For review and comment ☐ _____

☐ FOR BIDS DUE _____ 19 _____ ☐ PRINTS RETURNED AFTER LOAN TO US

MARKS Please review this information & give us your comments. We would also like a cost estimate for boxes at both crossings and a bridge at Northern. Please return estimates by Aug. 31, 1994.

You are hereby authorized to proceed with this work per your proposal for this project. We will forward agreement for execution shortly.

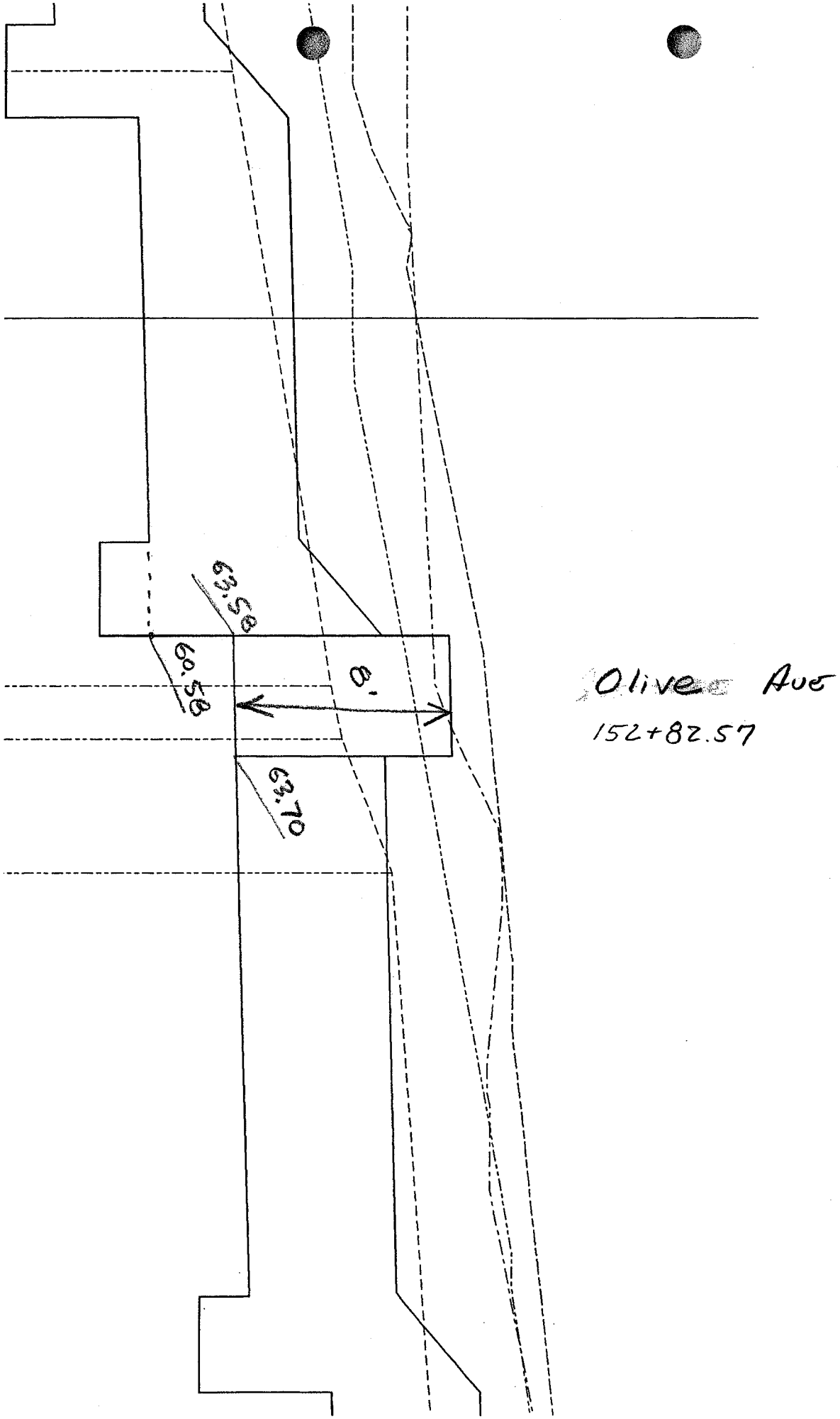
PY TO _____

SIGNED: Michael J. Bo

40% Pre-Consumer Content • 10% Post-Consumer Content

CT 240 NEBS Inc. Groton, Mass. 01471

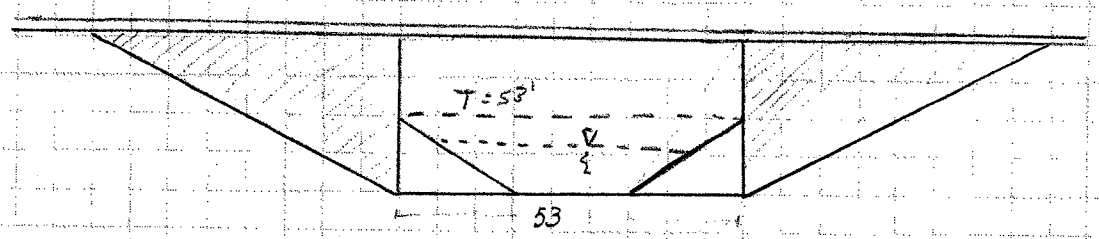
If enclosures are not as noted, kindly notify us at once.


63.50
60.50
8.
63.70
Olive Ave
152+82.57

ACK ENGINEERS, INC.
2255 N. 44th St. Suite 220 • Phoenix, Az. 85008 • Phone (602) 244-2566

SHEET 1 OF 1
BY HDA DATE 9/29/94
CHECK MJB DATE 10.5.94
CLIENT FCDMC
JOB White Tanks FRS # Inlet Imp.
JOB NO. 410.44

Olive Av
For supercritical flow single span to minimize obstruction



the same bridge can be used for supercritical flow

Inca estimate 199000

cost/unit Top width = 199000/53

= $3754/unit top width

APPENDIX F – METAL REINFORCEMENT INFORMATION

As an aid to users of the ACI Building Code, information on sizes, areas, and weights of various metal reinforcement is presented.

ASTM STANDARD REINFORCING BARS

Bar size	U.S. customary			Metric		
	Nominal diameter, in.	Nominal area, sq in.	Nominal weight, lb per ft	Nominal diameter, mm	Nominal area, mm^2	Nominal mass, kg/m
# 3	0.375	0.11	0.376	9.52	71	0.560
4	0.500	0.20	0.668	12.70	129	0.994
5	0.625	0.31	1.043	15.88	200	1.552
6	0.750	0.44	1.502	19.05	284	2.235
7	0.875	0.60	2.044	22.22	387	3.042
8	1.000	0.79	2.670	25.40	510	3.973
9	1.128	1.00	3.400	28.65	645	5.060
10	1.270	1.27	4.303	32.26	819	6.404
11	1.410	1.56	5.313	35.81	1006	7.907
14	1.693	2.25	7.650	43.00	1452	11.38
18	2.257	4.00	13.600	57.33	2581	20.24

ASTM STANDARD PRESTRESSING TENDONS

Type*	U.S. customary			Metric		
	Nominal diameter, in.	Nominal area, sq in.	Nominal weight, lb per ft	Nominal diameter, mm	Nominal area, mm^2	Nominal mass, kg/m
Seven-wire strand (Grade 250)	1/4 (0.250)	0.036	0.12	6.35	23	0.179
	5/16 (0.313)	0.058	0.20	7.95	37	0.298
	3/8 (0.375)	0.080	0.27	9.52	52	0.402
	7/16 (0.438)	0.108	0.37	11.12	70	0.551
	1/2 (0.500)	0.144	0.49	12.70	93	0.729
	(0.600)	0.216	0.74	15.24	139	1.101
Seven-wire strand (Grade 270)	3/8 (0.375)	0.085	0.29	9.52	55	0.432
	7/16 (0.438)	0.115	0.40	11.12	74	0.595
	1/2 (0.500)	0.153	0.53	12.70	99	0.789
	(0.600)	0.215	0.74	15.24	139	1.101
Prestressing wire	0.192	0.029	0.098	4.88	18.7	0.146
	0.196	0.030	0.10	4.98	19.4	0.149
	0.250	0.049	0.17	6.35	32	0.253
	0.276	0.060	0.20	7.01	39	0.298
Prestressing bars (smooth)	3/4	0.44	1.50	19.05	284	2.232
	7/8	0.60	2.04	22.22	387	3.036
	1	0.78	2.67	25.40	503	3.973
	1 1/8	0.99	3.38	28.58	639	5.030
	1 1/4	1.23	4.17	31.75	794	6.206
	1 3/8	1.48	5.05	34.92	955	7.515
Prestressing bars (deformed)	5/8	0.28	0.98	15.88	181	1.458
	3/4	0.42	1.49	19.05	271	2.217
	1	0.85	3.01	25.40	548	4.480
	1 1/4	1.25	4.39	31.75	806	6.535
	1 3/8	1.56	5.56	34.92	1006	8.274

*Availability of some tendon sizes should be investigated in advance.

L K ENGINEERS, INC.
2255 N. 44th St. Phoenix, Az. 85008 • Phone (602) 244-2566

TO: FILE

FROM: MJB

JOB: White Tanks

JOB NO.: 310.44

DATE: 10.3.94

MEMORANDUM

Call from C.G. @ INCA

He has reviewed our fax of Fri. 9.30.94
He came up with a new bridge which is a Voided Slab design. Add Concrete topping 3"-4".
$45.00 / S.F. is cost / unit area. This is higher. 100' x 92' = $415,000
Old cost = $399,000

Total cost for structure is almost the same as before, just a little higher.

MARICOPA COUNTY
FLOOD CONTROL DISTRICT

OLIVE & NORTHERN AVENUE STRUCTURES PRELIMINARY COST ESTIMATES

Registered Professional Engineer (Structural)
CERTIFICATE NO.
26023
CHIDAMBARAM
GNANASAMBANTHAN
Date Signed 8/31/94
ARIZONA, U.S.A.

WHITE TANKS NO. 3 FRS
INLET IMPROVEMENTS
CONTRACT FCD 93-47

INCA ENGINEERS, INC.

INCA ENGINEERS INC.

August 31, 1994

AGK Engineers
2255 North 44th Street, Suite 330
Phoenix, AZ 85008

ATTN: **Mr. Michael J. Bonar, P.E.**

RE: **White Tanks FRS #3; INCA #693901**

Dear Mike,

We have reviewed the information provided to us regarding the structures at Olive Avenue and Nothern Avenue for the above mentioned project. We do not have the preliminary geotechnical information and therefore the foundation quantities are based on our engineering judgement.

Based on our discussions on August 25, 1994, evaluation of the data provided to us and our preliminary cost estimate, we recommend the following:

Olive Avenue Structure

Cost comparisons were made between a five-barrel 8' x 10' culvert, a single-span precast, prestressed voided slab bridge and a two-span cast-in-place reinforced concrete slab bridge. Our preliminary cost estimates for these three options are:

- Five-barrel 8' x 10' box culvert = $181,500
- Single-span voided slab bridge = $199,000
- Two-span slab bridge = $172,500

The construction and maintenance of the two-span bridge is easier than that of the box culvert. Also, due to the relative economy, we recommend the two-span slab bridge at this location.

Northern Avenue Structure

Cost comparisons were made between a 12-barrel 8' x 10' box culvert and a four-span cast-in-place reinforced concrete slab bridge with piers supported on drilled shafts. Our preliminary cost estimates for these two options are:

- 12 barrel 8' x 10' box culvert = $413,000
- Four-span slab bridge = $399,500

1702 East Highland Avenue, Suite 207 Phoenix, AZ 85016 (602) 277-8161 (FAX) 277-8163

INCA ENGINEERS INC.

Mr. Michael J. Bonar, P.E.
AGK Engineers
White Tanks FRS #3; INCA #693901
August 31, 1994

We recommend the four-span bridge option at this location due to the following reasons:

- Easier to construct and maintain.
- Better scour control for the structure.
- More economical than the box culvert option.

The quantities/cost estimate calculations along with backup data have been attached herewith. If you have any questions, please feel free to call me.

Sincerely,

INCA Engineers, Inc.

C. Gnanasambanthan, P.E.
Project Manager

Registered Professional Engineer (Structural)
CERTIFICATE NO.
26023
CHIDAMBARAM
GNANASAMBANTHAN
Date Signed 8/31/94
ARIZONA, U.S.A.

INCA ENGINEERS INC.

Sheet No 0 of 11

Job Number 693901

TITLE WHITE WATER TANKS #3

SUBJECT OLIVE & NORTHERN AVE. STRUCTURES

MADE BY CG DATE 8/25/94 CHECKED BY JL DATE 8/31/94

REFERENCES/ASSUMPTIONS

A. 5-Barrel 8'x10' Box Culvert:

1. Box culvert dimensions, concrete, steel and excavation quantities from ADOT (Structures section) standard drawings, 1992 edition

2. Unit costs are based on ADOT "Construction Costs".

B. 12-Barrel 8'x10' Box culvert:

1. Quantities are based on the 5-barrel 8x10 box culverts ($^{12}/_{5} \times 12$)

2. Unit costs are based on ADOT "Construction Costs".

C. 4-Span Bridge structure:

1. Superstructure dimensions and concrete qty. from ADOT (Structures section) standard drawings, 1992 edition.

2. Steel Qty. based on CALTRANS' Estimate guide.

3. Unit costs are based on ADOT "Construction Cost".

D. General:

1. Contingency factor from CALTRANS' Estimate guide.

INCA ENGINEERS INC.

Sheet No 1 of 11

Job Number 693901

TITLE WHITE WATER TANKS #3

SUBJECT OLIVE AVE. BOX STRUCTURE

MADE BY CG DATE 8/25/94 CHECKED BY JL DATE 8/31/94

Proposed Structure: 5 Barrel - 8' high × 10' span ; 91'-2" long.

Width = $5 \times 10' + 6 \times \frac{11''}{12} = 55.5'$

QUANTITIES

(per ADOT Std. Dwg. B-02.50, B-02.70, B-04.20, B-04.40 & B-05.10): Concrete & Steel

Barrel : Concrete = 5.641 cy/ft × 91.2 = 514.5 cy

Steel = 808 lbs/ft × 91.2 = 73690 lbs.

Outlet wings (assume 2:1 embankment slope):

Concrete = 20.88 + 4 × 2.51 = 30.9 cy.

(20.88: for 1 barrel; 2.51: for every add'l barrel)

Steel = 1354 + 4 × 220 = 2234 lbs.

Inlet wings : Concrete = 16.25 + 4 × 1.4 = 21.9 cy

Steel = 943 + 4 × 130 = 1463 lbs.

Total Concrete = 567.3 cy.

Total Steel = 77387 lbs.

(Per ADOT Std. Dwg. B-19.50): Struc. Excavation & Backfill

$A = 55.5' + \frac{8''}{12} + 1.5' \times 2 = 59.17'$

$B = 91.2 + 4\left(8' + \frac{10\frac{1}{2}''}{12} + \frac{12\frac{1}{2}''}{12}\right) = 130.87'$

INCA ENGINEERS INC.

Sheet No 2 of 11

Job Number 693901

TITLE WHITE WATER TANKS #3

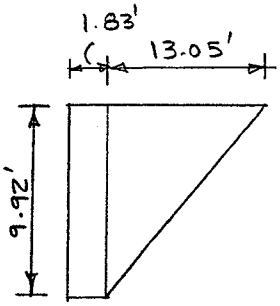
SUBJECT OLIVE AVE. BOX STRUCTURE

MADE BY CG DATE 8/25/94 CHECKED BY JL DATE 8/31/94

Excavation = $(59.17 \times 130.87 \times 9.92)/27$ = 2884 cy.

Backfill = $\left(\frac{1}{2} \times 13.05 \times 9.92 + 1.83 \times 9.92\right) \times (91.2 + 2 \times 9.92)/27$

= 341 cy.



COST ESTIMATE

Concrete	=	567.3 × \$180/cy	=	102,114
Steel	=	77.387 × \$0.35/lb	=	27,086
Excavation	=	2884 × \$6/cy	=	17,304
Backfill	=	341 × \$14/cy	=	4,774
		Sub total	=	151,277
		Add 20% cont.	=	30,255
		Total	=	\$ 181,532

For initial estimate purposes, say \$ 181,500

INCA ENGINEERS INC.

Sheet No 3 of 11

Job Number 693901

TITLE WHITE WATER TANKS #3

SUBJECT OLIVE AVE. BRIDGE ALTERNATIVE

MADE BY CG DATE 8/26/94 CHECKED BY JL DATE 8-31-94

BRIDGE STRUCTURE

Spans : Single span, 52' center to center of abtments

Superstructure type : Precast, Prestressed Voided Slabs.

Abutment fdn : 3'-ϕ Drilled shafts

COST ESTIMATE

Voided slabs = 23 × \$80/ft × 52	=	95,680
Topping concrete (3") = $\frac{3''}{12} \times \frac{52}{27} \times 91.2 \times \$180/cy$	=	7904
Steel (topping) = 100 lbs/cy × 44 × \$0.35/lb	=	1540
Abutment concrete (per Northern Ave. Bridge)	=	24,318
Abutment steel (per Northern Ave. Bridge)	=	4,729
Drilled shafts = 2 × 5 × 25 × \$60/ft	=	15,000
Excavation = 185 × \$6/cy	=	1,110
Backfill = 31 × \$14/cy	=	434
Subtotal	=	150,715
Add 10% (slope paving etc.)	=	15072
Add 20% cont.	=	33,158
Total	=	198,945

For initial estimate purposes, say \$199,000

INCA ENGINEERS INC.

Sheet No 4 of 11

Job Number 693901

TITLE WHITE WATER TANKS #3

SUBJECT OLIVE AVE. BRIDGE STRUCTURE

MADE BY CG DATE 8/26/94 CHECKED BY JL DATE 8-31-94

BRIDGE STRUCTURE

Spans : 2 span ; 27' x 2

Bridge length (℄ to ℄ abt.) = 54'

Superstructure type : C.I.P. concrete slab

Pier type : Concrete wall.

Foundation : 3'ϕ drilled shafts.

QUANTITIES

Superstructure : Concrete = $\left[\left(54 + 2\times\frac{8''}{12}\right)\times 91.2 \times \frac{15''}{12} + 8' \times \frac{5''}{12} \times 91.2\right] \times \frac{1}{27} = 244.9$ cy.

Steel = $13\ \text{lb}/\text{ft}^2 \times 91.2 \times \left(54 + 2\times\frac{8''}{12}\right) = \underline{65{,}599\ \text{lbs.}}$

Pier wall : Concrete = $\frac{194.6^*}{3} = \underline{64.9\ \text{cy.}}$

Steel = $\frac{15{,}565^*}{3} = \underline{5188\ \text{lbs.}}$

Foundation cap : Concrete = $\frac{121.6^*}{3} = \underline{40.5\ \text{cy.}}$

Steel = $\frac{14592^*}{3} = \underline{4864\ \text{lbs.}}$

Abutments : Concrete = $\underline{135.1\ \text{cy.}^*}$

Steel = $\underline{13{,}510\ \text{lbs.}^*}$

Drilled shafts = $\frac{450^*}{3} = \underline{150\ \text{ft}}$

* FROM NORTHERN AVE. BRIDGE QTY.

INCA ENGINEERS INC.

Sheet No 5 of 11

Job Number 693901

TITLE WHITE WATER TANKS #3

SUBJECT OLIVE AVE. BRIDGE STRUCTURE

MADE BY CG DATE 8/26/94 CHECKED BY JL DATE 8-31-94

* Northern Ave. Bridge Qty.

Structural Excavation = $185^{*} + \frac{366^{*}}{3}$ = 307 cy.

Structural Backfill = $31^{*} + \frac{172^{*}}{3}$ = 88 cy.

COST ESTIMATE

Concrete	=	485.4 × $180/cy	=	87372
Steel	=	89,161 × $0.35/cy	=	31206
Drilled Shafts	=	150 × $60/ft	=	9000
Excavation	=	307 × $6/cy	=	1842
Backfill	=	88 × $14/cy	=	1232
		Subtotal	=	130,652
		Add 10% (Slope paving, etc.)	=	13065
		Add 20% contin.	=	28743
		Total	=	172,460

For initial estimate purposes, say $172,500

INCA ENGINEERS INC.

Sheet No 6 of 11
Job Number 693901

TITLE WHITE WATER TANKS #3
SUBJECT NORTHERN AVE. BOX STRUCTURE
MADE BY CG DATE 8/25/94 CHECKED BY JL DATE 8-31-94

Proposed Structure : 12 Barrel - 8' high x 10' span ; 91'-2" Long.

Width = $12 \times 10 + 11 \times \frac{11''}{12} = 130.1'$

QUANTITIES

Concrete & Steel

Barrel : Concrete = $13.54\ cy/_{ft} \times 91.2$ = 1234.8 cy.

Steel = $1939.\ lb/_{ft} \times 91.2$ = 176,855 lbs.

Outlet Wings : Concrete = $20.88 + 11 \times 2.51$ = 48.5 cy

Steel = $1354 + 11 \times 220$ = 3774 lbs.

Inlet Wings : Concrete = $16.25 + 11 \times 1.4$ = 31.7 cy

Steel = $943 + 11 \times 130$ = 2373 lbs.

Total concrete = 1315 cy.

Total steel = 183,002 lbs.

Structural Excavation & Backfill

$A = 130.1' + \frac{8''}{12} + 1.5' \times 2 = 133.8'$

$B = 91.2 + 4\left(8' + \frac{10\frac{1}{2}''}{12} + \frac{12\frac{1}{2}''}{12}\right) = 130.87'$

Excavation = $(133.8 \times 130.87 \times 9.92)/_{27}$ = 6434 cy

Backfill (Same as before) = 341 cy

INCA ENGINEERS INC.

Sheet No 7 of 11

Job Number 693901

TITLE WHITE WATER TANKS #3

SUBJECT NORTHERN AVE. BOX STRUCTURE

MADE BY CG DATE 8/25/94 CHECKED BY JL DATE 8-31-94

COST ESTIMATE

Concrete	=	1315 x $ 180/cy	=	236,700
Steel	=	183,002 x $ 0.35/lbs	=	64,050
Excavation	=	6434 x $ 6/cy	=	38,604
Backfill	=	341 x $ 14/cy	=	4,774
		Sub total	=	344,128
		Add 20% cont.	=	68,825
		Total	=	$ 412,953

For initial estimate purposes, say $ 413,000

INCA ENGINEERS INC.

Sheet No 8 of 11
Job Number 693901

TITLE WHITE WATER TANKS # 3
SUBJECT NORTHERN AVE. BRIDGE ALTERNATIVE
MADE BY CG DATE 8/26/94 CHECKED BY JL DATE 8-31-94

BRIDGE STRUCTURE

Spans : 4-Span ; 28.5', 2×35', 28.5'

Bridge length (℄ abt. to ℄ abt.) = 127'-0"

Superstructure type : C.I.P concrete slab

Pier type : Concrete wall.

Foundation : 3' ϕ drilled shafts.

QUANTITIES

Superstructure : Concrete $= \left[\left(127 + 2\times\frac{8''}{12}\right)\times 91.2 \times \frac{17.5''}{12} + 3\times 8'\times\frac{5''}{12}\times 91.2\right]\times\frac{1}{27} = \underline{666 \text{ cy}}$

Steel $= 13 \text{ lb}/\text{ft}^2 \times 91.2 \times \left(127 + 2\times\frac{8''}{12}\right) = \underline{152{,}152 \text{ lbs.}}$

Pier Walls : Concrete $= 3\left(91.2 \times 1.5 \times 12.8'\right)/27 = \underline{194.6 \text{ cy.}}$

$(8' + 2' + 10\tfrac{1}{2}'' + 2')$

8' — op'ng; 2' — below gnd.; 10½" + 2' — to maintain same rdwy profile.

Steel $= 80 \text{ lbs}/\text{cy} \times 194.6 = \underline{15{,}565 \text{ lbs.}}$

Foundation Cap : Concrete $= 3(3\times 4\times 91.2)/27 = \underline{121.6 \text{ cy.}}$
(assume 3' deep × 4' wide)

Steel $= 120 \text{ lbs}/\text{cy} \times 121.6 = \underline{14{,}592 \text{ lbs.}}$

INCA ENGINEERS INC.

Sheet No 9 of 11

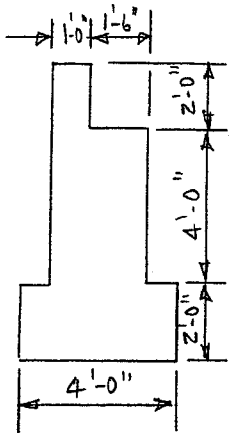
Job Number 693901

TITLE WHITE WATER TANKS #3

SUBJECT NORTHERN AVE. BRIDGE ALTERNATIVE

MADE BY CG DATE 8/26/94 CHECKED BY JL DATE 8-31-94

Abutments :



concrete $= 2\left(1\times2 + 2.5\times4 + 2\times4\right)\times\frac{91.2}{27}$

$= \underline{135.1 \text{ cy.}}$

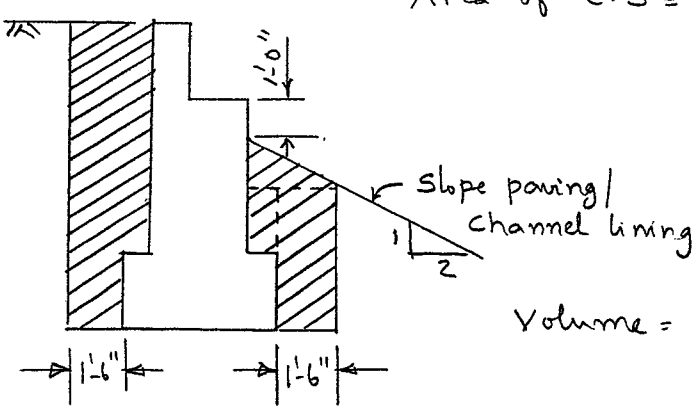
Steel $= 100 \text{ lbs/cy} \times 135.1 = \underline{13{,}510 \text{ lbs.}}$

Drilled Shafts : $3 \times 5 \times 30 = \underline{450'}$

spaced ~ 20' o/c

Structural Excavation :

Abutments :



Area of C.S $= 1.5\times8 + 0.75\times8 + 1.5\times3.875$

$+ 0.75\times1.875 + \frac{1}{2}\times2.25\times1.125$

$= 26.5 \text{ ft}^2.$

Volume $= 26.5\times\frac{(91.2+3)}{27}\times2 = \underline{185 \text{ cy.}}$

INCA ENGINEERS INC.

Sheet No 10 of 11

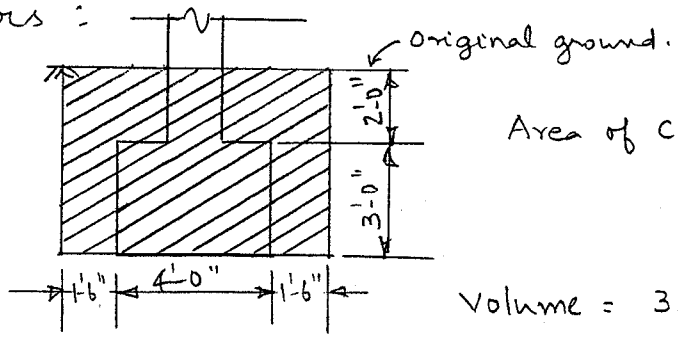
Job Number 693901

TITLE WHITEWATER TANKS #3

SUBJECT NORTHERN AVE. BRIDGE ALTERNATIVE

MADE BY CG DATE 8/26/94 CHECKED BY JL DATE 8-31-94

Piers :



Area of C.S = (4 + 3)(3 + 2)

= 35 ft².

Volume = 35 (91.2 + 3) × 3/27

= 366 cy.

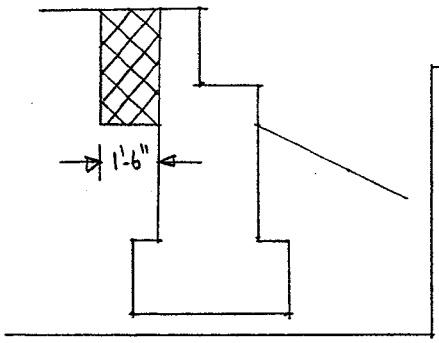
∴ Total Excavation = 185 + 366 = 551 cy.

Structure Backfill :

Abutments :

Area = 1.5 × 3 = 4.5 ft²

Volume = $\frac{4.5 \times 91.2 \times 2}{27}$ = 31 cy.

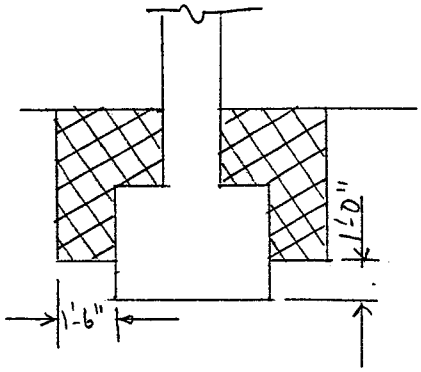


Piers :

Area of C.S

= 1.5 × 4 × 2 + 1.25 × 2 × 2

= 17 ft²



Volume = 17 × 91.2 × 3/27

= 172 cy.

∴ Total backfill = 31 + 172 = 203 cy.

INCA ENGINEERS INC.

Sheet No 11 of 11

Job Number 693901

TITLE WHITE WATER TANKS #3

SUBJECT NORTHERN AVE. BRIDGE ALTERNATIVE

MADE BY CG DATE 8/26/94 CHECKED BY JL DATE 8-31-94

COST ESTIMATE

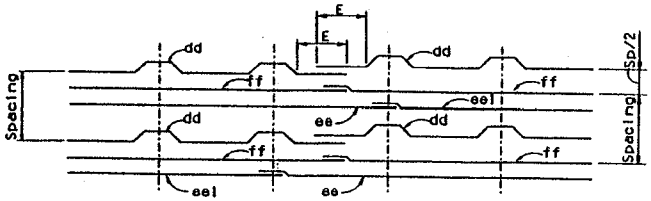
Concrete	=	1117.3 x $180/cy	=	201,114
Steel	=	195,819 x $0.35/lb	=	68,537
Drilled shaft	=	450 x $60/ft	=	27,000
Excavation	=	551 x $6/cy	=	3,306
Backfill	=	203 x $14/cy	=	2,842
		Subtotal	=	302,799
		Add 10% (slope paving etc.)	=	30,279
		Add 20% cont.	=	66,616
		Total	=	399,694

For initial estimate purposes, say $399,500

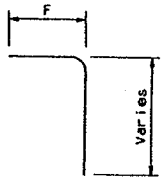
TABLE I
0'-10' FILL

Span "S"	Height "H"	Top Slab "T"	Walls "W"	aa Spacing	aa Length	bb Spacing	bb Length	cc Number +	dd Bar Size	dd Spacing	dd Length	dd A	dd B	dd C	dd D	dd E	ee & eel Bar Size	ee & eel Spacing	ee Length	eel Length	ff Bar Size	ff Spacing	ff Length	gg Number +	hh Bar Size	hh Spacing	hh Length	hh F
6'	3'	9½"	8"	12"	4'-4	12"	8'-9	108	5	14"	17'-9	4'-7	2'-7	6½"	3'-1	2'-2	5	14"	20'-9	14'-1	5	14"	17'-6	40	4	7"	5'-1	2'-5
	4'	9½"	8"	12"	5'-4	12"	10'-9	120	5	14"	17'-9	4'-7	2'-7	6½"	3'-1	2'-2	5	14"	20'-9	14'-1	5	14"	17'-6	40	4	7"	5'-7	2'-5
	5'	9½"	8"	12"	6'-4	12"	12'-9	120	5	14"	17'-9	4'-7	2'-7	6½"	3'-1	2'-2	5	14"	20'-9	14'-1	5	14"	17'-6	40	4	7"	6'-1	2'-5
	6'	9½"	8"	12"	7'-4	12"	14'-9	132	5	14"	17'-9	4'-7	2'-7	6½"	3'-1	2'-2	5	14"	20'-9	14'-1	5	14"	17'-6	40	4	7"	6'-7	2'-5
	7'	9½"	8"	12"	8'-4	12"	16'-9	144	5	13"	17'-9	4'-7	2'-7	6½"	3'-1	2'-2	5	13"	20'-9	14'-1	5	13"	17'-6	40	4	6½"	7'-1	2'-5
8'	3'	9½"	9"	12"	4'-4	12"	8'-9	108	6	14"	23'-2	6'-1	3'-8	6½"	4'-2	2'-10	6	14"	27'-0	18'-3	6	14"	22'-9	60	6	7"	5'-6	2'-6
	4'	9½"	9"	12"	5'-4	12"	10'-9	120	6	14"	23'-2	6'-1	3'-8	6½"	4'-2	2'-10	6	14"	27'-0	18'-3	6	14"	22'-9	60	6	7"	6'-0	2'-6
	5'	9½"	9"	12"	6'-4	12"	12'-9	120	6	14"	23'-2	6'-1	3'-8	6½"	4'-2	2'-10	6	14"	27'-0	18'-3	6	14"	22'-9	60	6	7"	6'-6	2'-6
	6'	9½"	9"	12"	7'-4	12"	14'-9	132	6	14"	23'-2	6'-1	3'-8	6½"	4'-2	2'-10	6	14"	27'-0	18'-3	6	14"	22'-9	60	6	7"	7'-0	2'-6
	7'	9½"	9"	12"	8'-4	12"	16'-9	144	6	13"	23'-2	6'-1	3'-8	6½"	4'-2	2'-10	6	13"	27'-0	18'-3	6	13"	22'-9	60	5	6½"	7'-6	2'-6
	8'	9½"	9"	12"	9'-4	12"	18'-9	144	6	13"	23'-2	6'-1	3'-8	6½"	4'-2	2'-10	6	13"	27'-0	18'-3	6	13"	22'-9	60	6	6½"	8'-0	2'-6
10'	3'	10½"	11"	12"	4'-6	12"	9'-2	108	7	17"	28'-8	7'-7	4'-8	7½"	5'-2	3'-6	6	17"	33'-6	22'-7	7	17"	28'-8	100	6	8½"	6'-1	3'-0
	4'	10½"	11"	12"	5'-6	12"	11'-2	120	7	17"	28'-8	7'-7	4'-8	7½"	5'-2	3'-6	6	17"	33'-6	22'-7	7	17"	28'-8	100	6	8½"	6'-7	3'-0
	5'	10½"	11"	12"	6'-6	12"	13'-2	120	6	12"	28'-8	7'-7	4'-8	7½"	5'-2	3'-6	5	12"	33'-6	22'-7	6	12"	28'-8	100	5	6"	6'-8	2'-8
	6'	10½"	11"	12"	7'-6	12"	15'-2	132	6	12"	28'-8	7'-7	4'-8	7½"	5'-2	3'-6	5	12"	33'-6	22'-7	6	12"	28'-8	100	5	6"	7'-2	2'-8
	7'	10½"	11"	12"	8'-6	12"	17'-2	144	7	15"	28'-8	7'-7	4'-8	7½"	5'-2	3'-6	5	15"	33'-6	22'-7	7	15"	28'-8	100	6	7½"	7'-9	2'-8
	8'	10½"	11"	12"	9'-6	12"	19'-2	144	7	15"	28'-8	7'-7	4'-8	7½"	5'-2	3'-6	5	15"	33'-6	22'-7	7	15"	28'-8	100	6	7½"	8'-3	2'-8
	9'	10½"	11"	12"	10'-6	12"	21'-2	156	7	15"	28'-8	7'-7	4'-8	7½"	5'-2	3'-6	6	15"	33'-6	22'-7	7	15"	28'-8	100	6	7½"	8'-9	2'-8
	10'	10½"	11"	12"	11'-6	12"	23'-2	168	7	14"	28'-8	7'-7	4'-8	7½"	5'-2	3'-6	5	14"	33'-6	22'-7	7	14"	28'-8	100	6	7"	9'-3	2'-8
12'	8'	12½"	13"	12"	9'-10	12"	20'-0	144	7	13"	34'-4	9'-1	5'-6	9½"	6'-2	4'-1	5	13"	40'-0	27'-0	7	13"	34'-4	130	6	6½"	8'-7	2'-10
	9'	12½"	13"	12"	10'-10	12"	22'-0	156	8	16"	34'-4	9'-1	5'-6	9½"	6'-2	4'-1	5	16"	40'-0	27'-0	8	16"	34'-4	130	6	8"	9'-1	2'-10
	10'	12½"	13"	12"	11'-10	12"	24'-0	168	8	16"	34'-4	9'-1	5'-6	9½"	6'-2	4'-1	5	16"	40'-0	27'-0	8	16"	34'-4	130	6	8"	9'-7	2'-10
	11'	12½"	13"	12"	12'-10	12"	26'-0	168	7	12"	34'-4	9'-1	5'-6	9½"	6'-2	4'-1	4	12"	40'-0	27'-0	7	12"	34'-4	130	6	6"	10'-1	2'-10
	12'	12½"	13"	12"	13'-10	12"	28'-0	180	7	12"	34'-4	9'-1	5'-6	9½"	6'-2	4'-1	5	12"	40'-0	27'-0	7	12	34'-4	130	6	6"	10'-7	2'-10

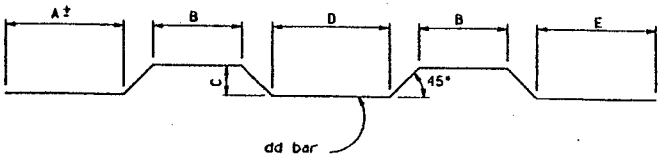
+Total number of bars in the cross-section.



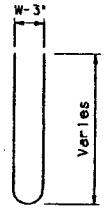
REINFORCING BAR PLACING DIAGRAM



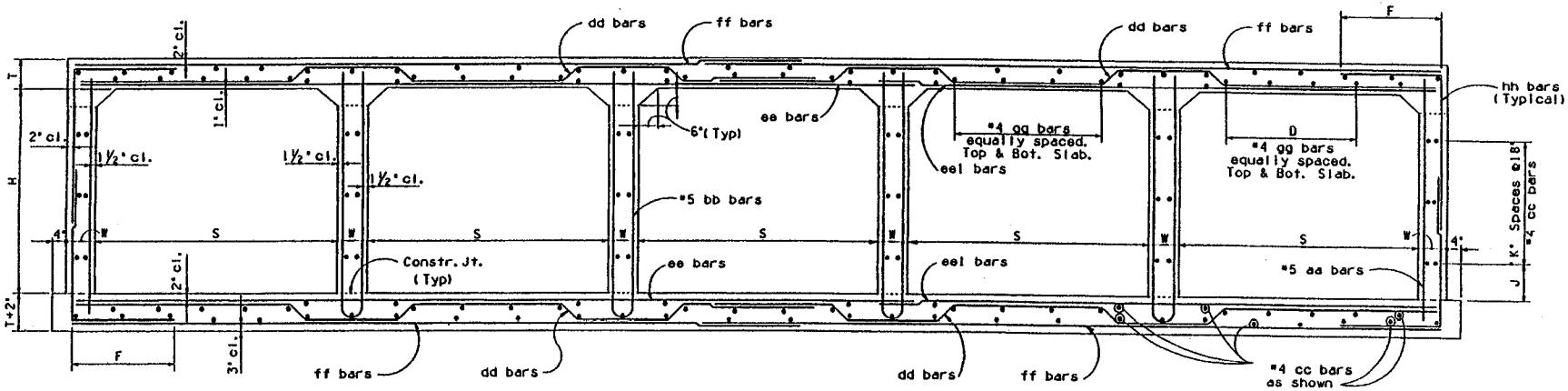
hh bar



BENDS



bb bar



Height "H"	"J" Dim.	"K" Spaces
3'	9"	1
4'	3"	2
5'	12"	2
6'	9"	3
7'	3"	4
8'	12"	4
9'	9"	5
10'	3"	6
11'	12"	6
12'	9"	7

TYPICAL SECTION

NOTE:
See B-02.55 for Tables II thru V.
See B-01.10 for General Notes and Miscellaneous Details.
See B-02.70 for Quantities.

DESIGN APPROVED
J.D. Dunn
APPROVED FOR DISTRIBUTION
T.D. Bryant, Jr.

ARIZONA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
STANDARD DRAWINGS

FIVE BARREL
BOX CULVERT

REVISION 7-88

STANDARD NO. B-02.50

CADD FILENAME= BFA
VIEW NAME=

DOUBLE BARREL

Span 'S'	Height 'H'	Table I Concrete C.Y.	Table I Reinf. Steel Lbs.	Table II Concrete C.Y.	Table II Reinf. Steel Lbs.	Table III Concrete C.Y.	Table III Reinf. Steel Lbs.	Table IV Concrete C.Y.	Table IV Reinf. Steel Lbs.	Table V Concrete C.Y.	Table V Reinf. Steel Lbs.
6'	3	1.172	172.1	1.039	167.5	1.172	177.7	1.305	190.0	1.437	187.7
	4	1.246	183.8	1.113	179.2	1.246	189.8	1.379	202.3	1.511	199.0
	5	1.320	191.6	1.187	187.0	1.320	197.8	1.453	210.7	1.585	206.3
	6	1.394	203.3	1.261	198.7	1.394	209.8	1.527	223.0	1.659	225.1
	7	1.468	224.5	1.335	210.5	1.468	221.8	1.601	235.4	1.734	237.5
8'	3	1.475	261.6	1.590	236.4	1.762	253.5	1.991	256.6	2.221	242.2
	4	1.558	274.9	1.673	248.5	1.845	265.8	2.075	268.9	2.304	253.5
	5	1.642	284.3	1.756	256.5	1.928	274.1	2.158	277.3	2.387	280.5
	6	1.725	297.6	1.840	268.5	2.012	286.5	2.241	289.6	2.471	292.8
	7	1.808	301.3	1.923	280.5	2.095	298.9	2.325	302.0	2.554	305.2
	8	1.892	337.1	2.006	304.5	2.178	307.2	2.408	310.3	2.637	313.5
10'	3	1.965	296.9	2.250	303.7	2.606	325.7	2.891	329.2	3.176	354.8
	4	2.067	310.0	2.352	333.8	2.708	337.8	2.993	341.2	3.278	367.1
	5	2.168	318.4	2.453	323.2	2.810	345.8	3.095	349.3	3.380	375.4
	6	2.270	330.7	2.555	353.9	2.912	357.8	3.197	361.3	3.481	387.8
	7	2.372	355.9	2.657	365.9	3.013	369.9	3.298	373.3	3.583	400.2
	8	2.474	364.9	2.759	373.9	3.115	377.9	3.400	381.3	3.685	408.5
	9	2.576	394.3	2.861	385.9	3.217	389.9	3.502	393.4	3.787	420.8
	10	2.678	410.1	2.963	398.0	3.319	401.9	3.604	405.4	3.889	434.4
12'	8	3.282	456.2	3.708	458.6	4.219	465.8	4.644	495.8	5.070	505.6
	9	3.403	453.7	3.828	471.6	4.339	477.5	4.765	509.1	5.190	519.0
	10	3.523	466.4	3.949	484.6	4.459	523.2	4.885	522.4	5.311	532.3
	11	3.643	523.5	4.069	491.1	4.580	532.5	5.005	536.9	5.431	541.6
	12	3.764	537.7	4.189	538.3	4.700	545.8	5.126	542.1	5.551	584.6

TRIPLE BARREL

Span 'S'	Height 'H'	Table I Concrete C.Y.	Table I Reinf. Steel Lbs.	Table II Concrete C.Y.	Table II Reinf. Steel Lbs.	Table III Concrete C.Y.	Table III Reinf. Steel Lbs.	Table IV Concrete C.Y.	Table IV Reinf. Steel Lbs.	Table V Concrete C.Y.	Table V Reinf. Steel Lbs.
6'	3	1.687	237.6	1.493	231.1	1.687	244.7	1.882	261.0	2.076	262.9
	4	1.786	252.8	1.592	246.3	1.786	260.2	1.980	276.8	2.175	277.6
	5	1.885	262.6	1.690	256.1	1.885	270.3	2.079	287.2	2.274	287.0
	6	1.984	277.8	1.789	271.3	1.984	285.7	2.178	303.0	2.372	305.8
	7	2.082	305.2	1.888	286.5	2.082	301.2	2.277	318.8	2.471	321.5
8'	3	2.135	358.1	2.303	330.0	2.557	356.4	2.894	360.3	3.231	344.1
	4	2.246	374.9	2.415	348.2	2.668	372.2	3.005	376.1	3.343	358.8
	5	2.357	386.3	2.526	358.4	2.779	382.6	3.116	386.5	3.454	391.2
	6	2.468	403.0	2.637	373.8	2.890	398.4	3.227	402.3	3.565	407.0
	7	2.579	415.4	2.748	389.3	3.001	414.2	3.338	418.0	3.676	422.8
	8	2.690	453.3	2.859	420.9	3.112	424.6	3.450	428.5	3.787	433.2
10'	3	2.851	430.6	3.271	433.3	3.795	464.5	4.215	469.1	4.635	503.4
	4	2.987	446.4	3.406	472.5	3.931	479.9	4.351	484.5	4.771	519.2
	5	3.122	459.1	3.542	458.3	4.067	490.0	4.487	494.7	4.906	529.7
	6	3.258	474.9	3.678	500.0	4.203	505.5	4.622	510.1	5.042	545.4
	7	3.394	504.9	3.814	515.5	4.338	520.9	4.758	525.6	5.178	561.2
	8	3.530	516.0	3.950	525.6	4.474	531.1	4.894	535.7	5.314	571.6
	9	3.666	556.8	4.085	541.0	4.610	546.5	5.030	551.1	5.450	587.4
	10	3.801	574.5	4.221	556.5	4.746	562.0	5.166	566.6	5.585	604.3
12'	8	4.703	646.9	5.330	643.6	6.083	662.3	6.711	695.8	7.338	705.2
	9	4.863	649.1	5.491	660.0	6.244	677.5	6.871	711.7	7.499	722.0
	10	5.024	665.2	5.651	676.4	6.404	726.5	7.032	728.4	7.659	738.7
	11	5.184	733.7	5.812	695.0	6.565	737.9	7.192	745.0	7.820	750.2
	12	5.345	752.3	5.972	745.4	6.725	754.7	7.353	764.1	7.980	806.9

FOUR BARREL

Span 'S'	Height 'H'	Table I Concrete C.Y.	Table I Reinf. Steel Lbs.	Table II Concrete C.Y.	Table II Reinf. Steel Lbs.	Table III Concrete C.Y.	Table III Reinf. Steel Lbs.	Table IV Concrete C.Y.	Table IV Reinf. Steel Lbs.	Table V Concrete C.Y.	Table V Reinf. Steel Lbs.
6'	3	2.203	305.2	1.947	295.8	2.203	313.9	2.459	334.3	2.715	340.3
	4	2.326	323.8	2.070	314.4	2.326	332.8	2.582	353.5	2.838	358.4
	5	2.450	335.7	2.193	326.3	2.450	345.0	2.706	366.0	2.962	369.9
	6	2.573	354.3	2.317	344.9	2.573	363.9	2.829	385.2	3.085	388.5
	7	2.697	388.1	2.440	363.5	2.697	382.8	2.953	404.4	3.209	407.7
8'	3	2.794	465.8	3.017	431.4	3.351	461.5	3.797	466.4	4.242	447.4
	4	2.933	486.0	3.156	450.3	3.490	480.7	3.936	485.6	4.381	465.6
	5	3.072	499.5	3.295	462.5	3.629	493.2	4.075	498.1	4.520	504.1
	6	3.211	518.8	3.434	481.3	3.768	512.4	4.213	517.3	4.659	523.3
	7	3.350	541.0	3.573	500.2	3.907	531.6	4.352	536.5	4.798	542.5
	8	3.489	581.0	3.712	539.7	4.046	544.2	4.491	549.1	4.937	555.0
10'	3	3.737	542.2	4.291	564.9	4.985	605.5	5.539	611.2	6.094	655.6
	4	3.907	561.5	4.461	615.2	5.154	624.3	5.709	630.1	6.263	674.8
	5	4.076	578.5	4.631	595.5	5.324	636.5	5.879	642.3	6.433	687.3
	6	4.246	597.7	4.801	648.2	5.494	655.4	6.048	661.2	6.603	706.5
	7	4.416	632.1	4.970	667.1	5.664	674.3	6.218	680.0	6.773	725.7
	8	4.586	645.2	5.140	679.3	5.833	686.5	6.388	692.2	6.942	738.2
	9	4.755	698.3	5.310	698.2	6.003	705.4	6.558	711.1	7.112	757.4
	10	4.925	717.3	5.480	717.1	6.173	724.9	6.727	730.0	7.282	777.8
12'	8	6.123	819.9	6.953	831.8	7.948	860.9	8.778	895.4	9.607	907.0
	9	6.324	826.6	7.153	851.6	8.149	879.5	8.978	915.6	9.808	927.2
	10	6.524	846.1	7.354	871.4	8.349	931.2	9.179	935.8	10.008	947.3
	11	6.725	926.2	7.555	901.1	8.550	944.7	9.379	954.4	10.209	960.8
	12	6.926	947.3	7.755	954.2	8.751	964.9	9.580	938.5	10.409	1032.1

FIVE BARREL

Span 'S'	Height 'H'	Table I Concrete C.Y.	Table I Reinf. Steel Lbs.	Table II Concrete C.Y.	Table II Reinf. Steel Lbs.	Table III Concrete C.Y.	Table III Reinf. Steel Lbs.	Table IV Concrete C.Y.	Table IV Reinf. Steel Lbs.	Table V Concrete C.Y.	Table V Reinf. Steel Lbs.
6'	3	2.718	369.1	2.400	364.3	2.718	386.4	3.036	411.2	3.354	421.8
	4	2.866	391.1	2.548	386.3	2.866	408.7	3.184	433.9	3.502	443.4
	5	3.014	405.1	2.697	400.3	3.014	423.0	3.332	448.5	3.650	457.0
	6	3.163	427.1	2.845	422.3	3.163	445.3	3.480	471.1	3.798	475.1
	7	3.311	467.6	2.993	444.3	3.311	467.6	3.629	493.7	3.947	497.7
8'	3	3.454	567.4	3.731	535.9	4.146	573.2	4.700	578.9	5.253	557.7
	4	3.621	591.0	3.898	558.1	4.313	595.9	4.866	601.5	5.420	579.3
	5	3.788	606.6	4.064	572.4	4.479	610.5	5.033	616.1	5.586	623.2
	6	3.954	630.2	4.231	594.7	4.646	633.1	5.200	638.8	5.753	645.8
	7	4.121	661.4	4.398	617.0	4.813	655.7	5.366	661.4	5.920	668.4
	8	4.288	702.8	4.564	664.8	4.979	670.3	5.533	676.0	6.086	683.0
10'	3	4.623	685.6	5.140	705.8	6.174	756.5	6.863	763.1	7.552	820.4
	4	4.827	708.3	5.516	768.0	6.378	778.8	7.067	785.4	7.756	843.0
	5	5.030	730.0	5.720	741.9	6.581	793.0	7.271	799.6	7.960	857.6
	6	5.234	752.6	5.923	806.5	6.785	815.3	7.474	821.9	8.164	880.2
	7	5.438	792.7	6.127	828.8	6.989	837.6	7.678	844.2	8.367	902.8
	8	5.641	808.0	6.331	843.1	7.192	851.9	7.882	858.5	8.571	917.4
	9	5.845	872.4	6.534	865.4	7.396	874.2	8.085	880.8	8.775	940.1
	10	6.049	894.1	6.738	887.7	7.600	896.5	8.289	903.1	8.978	963.9
12'	8	7.544	1025.0	8.575	1031.1	9.815	1072.9	10.844	1109.2	11.876	1122.1
	9	7.784	1037.5	8.816	1054.4	10.053	1095.0	11.085	1132.8	12.116	1145.7
	10	8.025	1060.4	9.057	1077.6	10.294	1150.9	11.326	1156.4	12.357	1169.3
	11	8.266	1151.9	9.297	1120.8	10.535	1166.5	11.566	1177.1	12.598	1184.9
	12	8.507	1176.3	9.538	1178.5	10.776	1190.1	11.807	1227.3	12.838	1269.7

SIX BARREL

Span 'S'	Height 'H'	Table I Concrete C.Y.	Table I Reinf. Steel Lbs.	Table II Concrete C.Y.	Table II Reinf. Steel Lbs.	Table III Concrete C.Y.	Table III Reinf. Steel Lbs.	Table IV Concrete C.Y.	Table IV Reinf. Steel Lbs.	Table V Concrete C.Y.	Table V Reinf. Steel Lbs.
6'	3	3.234	431.8	2.854	415.4	3.234	439.6	3.613	467.0	3.993	481.4
	4	3.406	457.2	3.027	440.9	3.406	465.3	3.786	493.0	4.166	506.4
	5	3.579	473.3	3.200	457.0	3.579	481.7	3.959	509.7	4.338	522.1
	6	3.752	498.8	3.372	482.4	3.752	507.4	4.132	535.7	4.511	541.3
	7	3.925	545.3	3.545	507.9	3.925	533.1	4.305	561.8	4.684	567.3
8'	3	4.114	679.4	4.445	609.6	4.941	650.2	5.602	656.3	6.264	634.1
	4	4.308	706.4	4.639	635.3	5.135	676.2	5.797	682.4	6.458	659.1
	5	4.503	724.0	4.834	651.7	5.330	692.9	5.991	699.1	6.653	709.0
	6	4.697	751.1	5.028	677.4	5.524	718.9	6.186	725.1	6.847	735.1
	7	4.892	790.1	5.222	703.1	5.719	745.0	6.380	751.2	7.042	761.1
	8	5.086	834.3	5.417	756.6	5.913	761.7	6.575	767.8	7.236	777.8
10'	3	5.509	816.5	6.333	801.8	7.363	857.8	8.187	864.3	9.011	926.5
	4	5.747	842.6	6.571	873.6	7.601	883.5	8.425	890.0	9.249	952.6
	5	5.984	868.7	6.808	843.3	7.838	899.9	8.663	906.4	9.487	969.3
	6	6.222	894.7	7.046	916.3	8.076	925.6	8.900	932.1	9.724	995.3
	7	6.460	939.5	7.284	942.1	8.314	951.3	9.138	957.8	9.962	1021.3
	8	6.697	956.9	7.521	958.4	8.551	967.7	9.376	974.2	10.200	1038.0
	9	6.935	1032.7	7.759	984.1	8.789	993.4	9.613	999.9	10.437	1064.1
	10	7.173	1056.3	7.997	1009.9	9.027	1019.8	9.851	1025.6	10.675	1091.3
12'	8	8.964	1208.2	10.198	1172.8	11.677	1220.8	12.911	1257.4	14.144	1270.0
	9	9.245	1225.6	10.478	1199.5	11.958	1246.3	13.192	1284.4	14.425	1297.1
	10	9.526	1252.0	10.759	1226.2	12.239	1305.6	13.472	1311.4	14.706	1324.1
	11	9.807	1354.6	11.040	1277.5	12.520	1323.3	13.753	1334.3	14.987	1341.0
	12	10.088	1382.5	11.321	1339.2	12.801	1350.3	14.034	1395.4	15.267	1440.3

NOTE:

Quantities shown in tables are per lin. foot of culvert length.

DESIGN APPROVED

APPROVED FOR DISTRIBUTION

ARIZONA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
STANDARD DRAWINGS

CULVERT QUANTITIES

REVISION

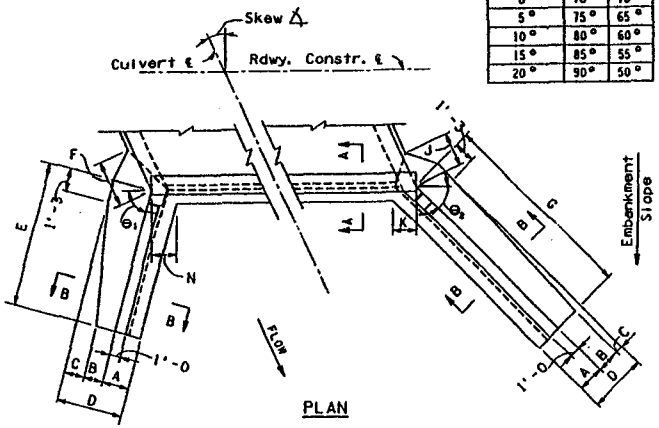
STANDARD NO. B-02.70

DRAWN
CHECKED

1 2 3 4

CADD FILENAME: 3FA
VIEW NAME:

Skew ∡	θ_1	θ_2
0°	70°	70°
5°	75°	65°
10°	80°	60°
15°	85°	55°
20°	90°	50°



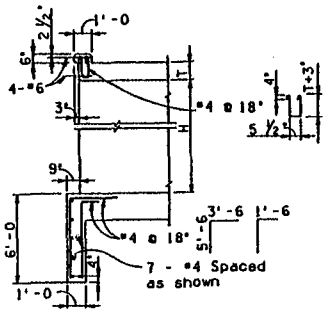
2 : 1 Slope Dimensions	Skew ∡	0°					5°					10°					15°					20°				
	Height H	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'
	A	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4
	B	1'-4	1'-5	1'-6	1'-7	1'-8	1'-4	1'-5	1'-6	1'-7	1'-8	1'-4	1'-5	1'-6	1'-7	1'-8	1'-4	1'-5	1'-6	1'-7	1'-8	1'-4	1'-5	1'-6	1'-7	1'-8
	C	1'-10	2'-2	2'-6	3'-0	3'-8	1'-11	2'-3	2'-7	3'-2	3'-10	1'-11	2'-4	2'-8	3'-3	4'-0	2'-0	2'-5	2'-9	3'-5	4'-1	2'-1	2'-6	2'-10	3'-6	4'-3
	D	5'-2	5'-8	6'-2	6'-10	7'-8	5'-3	5'-9	6'-3	7'-0	7'-10	5'-3	5'-10	6'-4	7'-1	8'-0	5'-4	5'-11	6'-5	7'-3	8'-1	5'-5	6'-0	6'-6	7'-4	8'-3
	E	14'-6	16'-0	17'-6	19'-0	20'-6	14'-0	15'-6	17'-0	18'-6	20'-0	14'-0	15'-6	17'-0	18'-6	20'-0	13'-6	15'-0	16'-6	18'-0	19'-6	13'-6	15'-0	16'-6	18'-0	19'-6
	F	3'-9	4'-3	4'-10	5'-7	6'-6	3'-10	4'-5	4'-11	5'-9	6'-9	3'-10	4'-6	5'-0	5'-11	6'-11	4'-0	4'-7	5'-2	6'-1	7'-1	4'-1	4'-9	5'-3	6'-2	7'-3
	G	14'-6	16'-0	17'-6	19'-0	20'-6	14'-6	16'-6	18'-0	19'-6	21'-0	15'-0	17'-0	18'-6	20'-0	22'-0	15'-6	17'-6	19'-0	21'-0	22'-6	16'-6	18'-6	20'-0	22'-0	23'-6
	J	3'-9	4'-3	4'-10	5'-7	6'-6	3'-10	4'-5	4'-11	5'-9	6'-9	3'-10	4'-6	5'-0	5'-11	6'-11	4'-0	4'-7	5'-2	6'-1	7'-1	4'-1	4'-9	5'-3	6'-2	7'-3
	K	1'-10½	1'-11¾	2'-0⅝	2'-1½	2'-2½	1'-10½	1'-11¾	2'-0½	2'-1⅝	2'-2¾	1'-10½	1'-11¾	2'-0⅝	2'-2	2'-3⅛	1'-11	2'-0¼	2'-1½	2'-2⅝	2'-3⅞	1'-11¾	2'-1⅛	2'-2⅝	2'-3¾	2'-5
	L	2'-3	2'-7	2'-10	3'-2	3'-5	2'-4	2'-7	2'-10	3'-2	3'-5	2'-2	2'-5	2'-8	2'-11	3'-3	2'-4	2'-7	2'-10	3'-1	3'-4	2'-4	2'-7	2'-10	3'-1	3'-4
	M	2'-3	2'-7	2'-10	3'-2	3'-5	2'-6	2'-7	2'-11	3'-3	3'-7	2'-7	2'-8	3'-1	3'-5	3'-6	2'-9	2'-11	3'-3	3'-6	3'-10	2'-9	3'-0	3'-5	3'-8	4'-1
	N	1'-10½	1'-11¾	2'-0⅝	2'-1½	2'-2½	1'-10½	1'-11½	2'-0½	2'-1½	2'-2⅝	1'-10½	1'-11¾	2'-0⅝	2'-1⅝	2'-2⅞	1'-11¾	2'-0¼	2'-1½	2'-2⅝	2'-3⅝	2'-0	2'-1	2'-2	2'-3	2'-4

4 : 1 Slope Dimensions	Skew ∡	0°					5°					10°					15°					20°				
	Height H	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'
	A	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4
	B	1'-4	1'-5	1'-6	1'-7	1'-8	1'-4	1'-5	1'-6	1'-7	1'-8	1'-4	1'-5	1'-6	1'-7	1'-8	1'-4	1'-5	1'-6	1'-7	1'-8	1'-4	1'-5	1'-6	1'-7	1'-8
	C	1'-8	2'-0	2'-4	2'-10	3'-6	1'-9	2'-1	2'-5	2'-11	3'-6	1'-9	2'-1	2'-5	2'-11	3'-7	1'-9	2'-1	2'-5	3'-0	3'-8	1'-10	2'-2	2'-6	3'-0	3'-8
	D	5'-0	5'-6	6'-0	6'-8	7'-6	5'-1	5'-7	6'-1	6'-9	7'-6	5'-1	5'-7	6'-1	6'-9	7'-7	5'-1	5'-7	6'-1	6'-10	7'-8	5'-2	5'-8	6'-2	6'-10	7'-8
	E	22'-6	25'-0	27'-6	30'-0	32'-6	22'-0	24'-6	27'-0	29'-6	32'-0	22'-0	24'-0	26'-6	29'-0	31'-6	21'-6	24'-0	26'-6	29'-0	31'-0	21'-6	24'-0	26'-6	29'-0	31'-0
	F	3'-6	4'-1	4'-7	5'-4	6'-4	3'-8	4'-2	4'-9	5'-5	6'-4	3'-8	4'-2	4'-9	5'-5	6'-5	3'-8	4'-2	4'-9	5'-7	6'-6	3'-9	4'-3	4'-10	5'-7	6'-6
	G	22'-6	25'-0	27'-6	30'-0	32'-6	23'-0	25'-6	28'-0	30'-6	33'-0	23'-6	26'-0	28'-6	31'-0	34'-0	24'-0	27'-0	29'-6	32'-0	35'-0	25'-0	28'-0	30'-6	33'-6	36'-0
	J	3'-6	4'-1	4'-7	5'-4	6'-4	3'-8	4'-2	4'-9	5'-5	6'-4	3'-8	4'-2	4'-9	5'-5	6'-5	3'-8	4'-2	4'-9	5'-7	6'-6	3'-9	4'-3	4'-10	5'-7	6'-6
	K	1'-10½	1'-11¾	2'-0⅝	2'-1½	2'-2½	1'-10½	1'-11½	2'-0½	2'-1⅝	2'-2¾	1'-10½	1'-11½	2'-0⅝	2'-2	2'-3⅛	1'-11	2'-0¼	2'-1½	2'-2⅝	2'-3⅞	1'-11¾	2'-1⅛	2'-2⅝	2'-3¾	2'-5
	L	3'-9	4'-2	4'-7	5'-0	5'-5	3'-9	4'-2	4'-8	4'-11	5'-4	3'-8	4'-2	4'-6	4'-11	5'-4	3'-9	4'-1	4'-6	4'-10	5'-4	3'-8	4'-1	4'-5	4'-10	5'-4
	M	3'-9	4'-2	4'-7	5'-0	5'-5	3'-10	4'-3	4'-9	5'-2	5'-7	4'-0	4'-5	4'-11	5'-4	5'-8	4'-2	4'-6	5'-0	5'-6	5'-11	4'-3	4'-8	5'-3	5'-8	6'-2
	N	1'-10½	1'-11¾	2'-0⅝	2'-1½	2'-2½	1'-10½	1'-11½	2'-0½	2'-1½	2'-2⅝	1'-10½	1'-11½	2'-0⅝	2'-1⅝	2'-2⅞	1'-11¾	2'-0¼	2'-1½	2'-2¾	2'-3⅝	2'-0	2'-1	2'-2	2'-3	2'-4

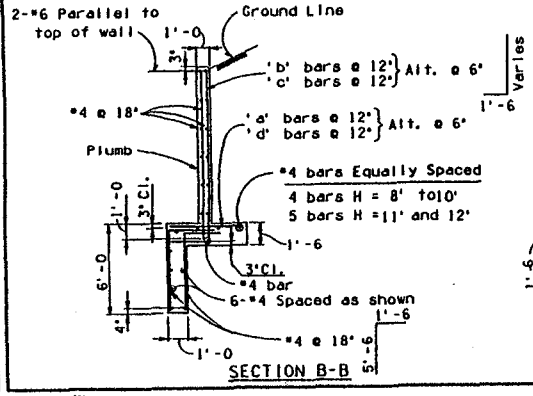
6 : 1 Slope Dimensions	Skew ∡	0°	5°	10°	15°	20°
	Height H	8'	8'	8'	8'	8'
	A	2'-0	2'-0	2'-0	2'-0	2'-0
	B	1'-4	1'-4	1'-4	1'-4	1'-4
	C	1'-8	1'-8	1'-8	1'-9	1'-9
	D	5'-0	5'-0	5'-0	5'-1	5'-1
	E	28'-0	27'-6	27'-0	27'-0	27'-0
	F	3'-6	3'-6	3'-6	3'-8	3'-8
	G	28'-0	28'-0	29'-0	29'-6	30'-6
	J	3'-6	3'-6	3'-6	3'-8	3'-8
	K	1'-10½	1'-10½	1'-10½	1'-11	1'-11½
	L	4'-8	4'-8	4'-8	4'-7	4'-7
	M	4'-8	4'-10	4'-11	5'-0	5'-2
	N	1'-10½	1'-10½	1'-10½	1'-11½	2'-0

	Height H	'c' Bars: Short Wing Skew ∡ 0°	5°	10°	15°	20°	Long Wing Skew ∡ 0°	5°	10°	15°	20°	Dim 'X'	'd' Bars: Short Wing 0° to 10°	15° & 20°	Long Wing 0° to 20°
2 : 1 Slope	8'	2-#5	2-#5	2-#5	-	-	2-#5	2-#5	2-#5	3-#5	3-#5	2'-0	-	-	-
	9'	4-#5	4-#5	4-#5	3-#5	2-#5	4-#5	4-#5	5-#5	5-#5	3'-0		-	-	-
	10'	6-#6	6-#6	5-#6	5-#6	4-#6	6-#6	7-#6	7-#6	8-#6	4'-3		-	-	-
	11'	8-#7	8-#7	7-#7	6-#7	6-#7	8-#7	9-#7	9-#7	10-#7	6'-9		5-#6	4-#6	5-#6
	12'	9-#7	8-#7	7-#7	6-#7	6-#7	9-#7	9-#7	9-#7	10-#7	6'-9		8-#6	6-#6	8-#6
4 : 1 Slope	9'	6-#5	6-#5	5-#5	4-#5	3-#5	6-#5	6-#5	6-#5	7-#5	7-#5	3'-0	-	-	-
	10'	10-#5	10-#5	9-#5	8-#5	7-#5	10-#5	10-#5	11-#5	11-#5	12-#5	4'-0	-	-	-
	11'	14-#6	14-#6	13-#6	12-#6	12-#6	14-#6	15-#6	15-#6	16-#6	17-#6	5'-3	9-#6	8-#6	10-#6
	12'	14-#7	14-#7	13-#7	12-#7	11-#7	14-#7	14-#7	15-#7	16-#7	17-#7	6'-9	13-#6	12-#6	15-#6

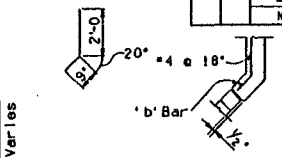
• 'd' bars alternate with 'a' bars at high end of wall.



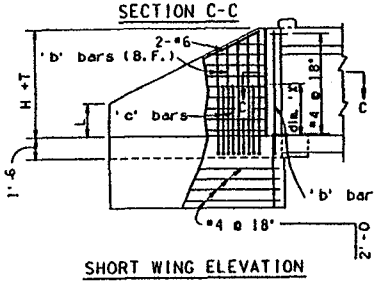
SECTION A-A



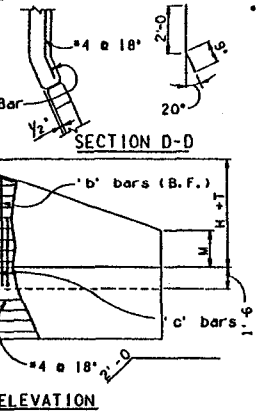
SECTION B-B



SECTION C-C



SHORT WING ELEVATION



SECTION D-D

LONG WING ELEVATION

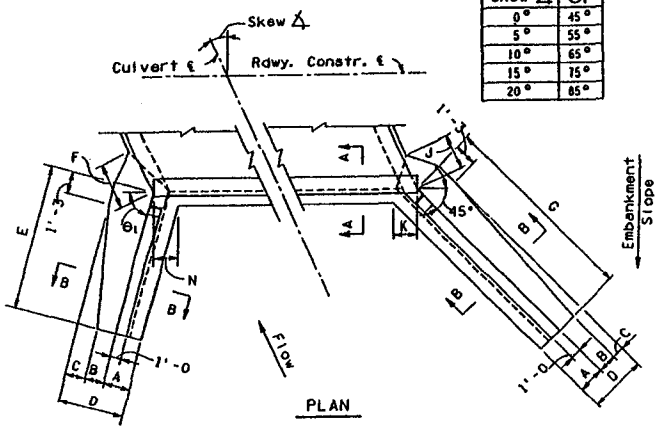
Height H	'a' bars	'b' bars
8'	#5	#5
9'	#5	#5
10'	#6	#5
11'	#5	#5
12'	#6	#6

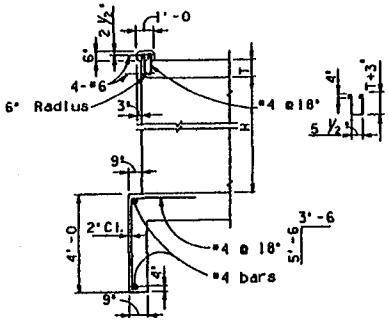
NOTE :

For General Notes and Miscellaneous Details see B-01.10.
For Headwall Quantities see B-05.10, B-05.20 and B-05.30.

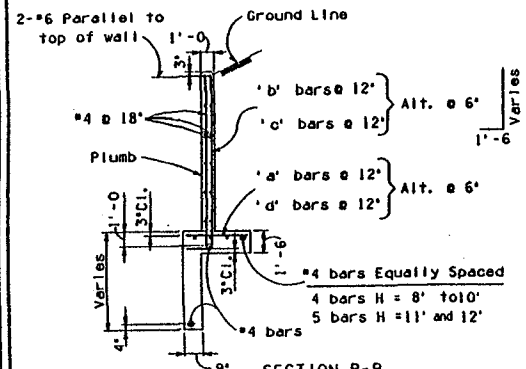
DESIGN APPROVED	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS		REVISION 7-88
APPROVED FOR DISTRIBUTION	OUTLET WINGS CULVERT HEIGHT 8' to 12' SKEW 0° to 20°		STANDARD NO. B-04.20

Skew ∡	θ_1
0°	45°
5°	55°
10°	65°
15°	75°
20°	85°

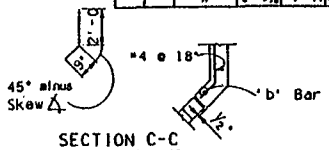




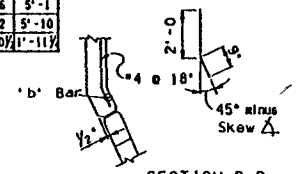
SECTION A-A



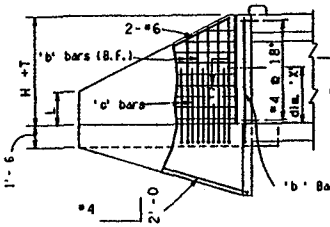
SECTION B-B



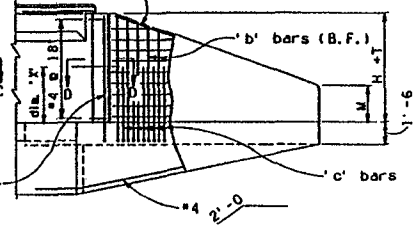
SECTION C-C



SECTION D-D



SHORT WING ELEVATION



LONG WING ELEVATION

	Skew ∡	0°					5°					10°					15°					20°				
	Height H	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'
2 : 1 Slope Dimensions	A	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4
	B	1'-4	1'-5	1'-6	1'-9	1'-11	1'-4	1'-5	1'-6	1'-7	1'-9	1'-4	1'-5	1'-6	1'-7	1'-8	1'-4	1'-5	1'-6	1'-7	1'-8	1'-4	1'-5	1'-6	1'-7	1'-8
	C	2'-2	2'-7	3'-0	3'-6	4'-2	2'-2	2'-7	3'-0	3'-8	4'-4	2'-2	2'-7	3'-0	3'-8	4'-5	2'-2	2'-7	3'-0	3'-8	4'-5	2'-2	2'-7	3'-0	3'-8	4'-5
	D	5'-6	6'-1	6'-8	7'-6	8'-5	5'-6	6'-1	6'-8	7'-6	8'-5	5'-6	6'-1	6'-8	7'-6	8'-5	5'-6	6'-1	6'-8	7'-6	8'-5	5'-6	6'-1	6'-8	7'-6	8'-5
	E	13'-0	14'-6	16'-0	17'-0	18'-6	12'-6	14'-0	15'-6	16'-6	18'-0	12'-6	13'-6	15'-0	16'-6	18'-0	12'-6	14'-0	15'-0	16'-6	18'-0	13'-0	14'-6	15'-6	17'-0	18'-6
	F	4'-8	5'-4	6'-1	7'-1	8'-3	4'-7	5'-4	6'-0	7'-1	8'-3	4'-7	5'-3	5'-11	7'-0	8'-2	4'-6	5'-2	5'-10	6'-10	8'-0	4'-4	5'-0	5'-8	6'-8	7'-9
	G	13'-0	14'-6	16'-0	17'-0	18'-6	13'-6	15'-0	16'-6	18'-0	19'-6	14'-6	16'-0	17'-6	19'-0	20'-6	15'-0	17'-0	18'-6	20'-0	22'-0	16'-0	18'-0	19'-6	21'-6	23'-6
	J	4'-8	5'-4	6'-1	7'-1	8'-3	4'-7	5'-4	6'-0	7'-1	8'-3	4'-7	5'-3	5'-11	7'-0	8'-2	4'-6	5'-2	5'-10	6'-10	8'-0	4'-4	5'-0	5'-8	6'-8	7'-9
	K	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝
	L	4'-6	4'-11	5'-5	6'-1	6'-6	3'-11	4'-4	4'-9	5'-4	5'-8	3'-5	3'-11	4'-3	4'-7	4'-11	3'-0	3'-4	3'-10	4'-1	4'-4	2'-7	2'-10	3'-4	3'-7	3'-10
	M	4'-6	4'-11	5'-5	6'-1	6'-6	4'-3	4'-9	5'-3	5'-8	6'-2	3'-11	4'-5	4'-11	5'-4	5'-10	3'-9	4'-1	4'-6	5'-0	5'-3	3'-5	3'-8	4'-2	4'-6	4'-9
	N	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝	1'-11	2'-0¼	2'-1½	2'-2⅝	2'-3⅞	1'-10½	1'-11¾	2'-0½	2'-1⅝	2'-2¾	1'-10½	1'-11½	2'-0½	2'-1½	2'-2⅝	1'-11½	2'-0¼	2'-1½	2'-2⅝	2'-3⅞

	Skew ∡	0°					5°					10°					15°					20°				
	Height H	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'	8'	9'	10'	11'	12'
4 : 1 Slope Dimensions	A	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4	2'-0	2'-1	2'-2	2'-3	2'-4
	B	1'-8	1'-11	2'-2	2'-5	2'-8	1'-6	1'-9	2'-0	2'-3	2'-6	1'-5	1'-8	1'-11	2'-2	2'-4	1'-4	1'-6	1'-9	1'-11	2'-2	1'-4	1'-5	1'-6	1'-8	1'-10
	C	1'-6	1'-8	1'-10	2'-3	2'-9	1'-8	1'-10	2'-0	2'-5	2'-11	1'-9	1'-11	2'-1	2'-6	3'-1	1'-10	2'-1	2'-3	2'-9	3'-3	1'-10	2'-2	2'-6	3'-0	3'-7
	D	5'-2	5'-8	6'-2	6'-11	7'-9	5'-2	5'-8	6'-2	6'-11	7'-9	5'-2	5'-8	6'-2	6'-11	7'-9	5'-2	5'-8	6'-2	6'-11	7'-9	5'-2	5'-8	6'-2	6'-11	7'-9
	E	17'-0	19'-0	21'-0	23'-0	25'-0	17'-6	19'-6	21'-0	23'-0	25'-0	18'-0	19'-6	21'-6	23'-6	25'-6	18'-6	20'-6	22'-6	24'-6	26'-6	20'-0	22'-0	24'-0	26'-6	28'-6
	F	4'-2	4'-9	5'-4	6'-3	7'-4	4'-2	4'-9	5'-4	6'-3	7'-4	4'-1	4'-8	5'-3	6'-2	7'-3	4'-0	4'-7	5'-2	6'-1	7'-1	3'-11	4'-5	5'-0	5'-11	6'-11
	G	17'-0	19'-0	21'-0	23'-0	25'-0	18'-6	20'-6	22'-6	24'-6	26'-6	19'-6	22'-0	24'-0	26'-0	28'-6	21'-6	23'-6	26'-0	28'-6	30'-6	23'-6	26'-0	28'-6	31'-0	34'-0
	J	4'-2	4'-9	5'-4	6'-3	7'-4	4'-2	4'-9	5'-4	6'-3	7'-4	4'-1	4'-8	5'-3	6'-2	7'-3	4'-0	4'-7	5'-2	6'-1	7'-1	3'-11	4'-5	5'-0	5'-11	6'-11
	K	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝
	L	6'-1	6'-8	7'-4	8'-0	8'-8	5'-6	6'-1	6'-9	7'-4	7'-11	5'-0	5'-8	6'-2	6'-9	7'-3	4'-7	5'-1	5'-8	6'-2	6'-8	4'-1	4'-7	5'-1	5'-6	6'-0
	M	6'-1	6'-8	7'-4	8'-0	8'-8	5'-10	6'-5	7'-1	7'-9	8'-5	5'-7	6'-2	6'-10	7'-6	8'-0	5'-3	5'-11	6'-6	7'-0	7'-8	4'-11	5'-6	6'-0	6'-7	7'-1
	N	2'-0⅞	2'-2⅞	2'-3¾	2'-5⅞	2'-6⅝	1'-11	2'-0¼	2'-1½	2'-2⅝	2'-3⅞	1'-10½	1'-11¾	2'-0½	2'-1⅝	2'-2¾	1'-10½	1'-11½	2'-0½	2'-1½	2'-2⅝	1'-11½	2'-0¼	2'-1½	2'-2⅝	2'-3⅞

	Skew ∡	0°	5°	10°	15°	20°
	Height H	8'	8'	8'	8'	8'
6 : 1 Slope Dimensions	A	2'-0	2'-0	2'0	2'-0	2'-0
	B	1'-11	1'-10	1'-9	1'-8	1'-6
	C	1'-2	1'-3	1'-4	1'-5	1'-7
	D	5'-1	5'-1	5'-1	5'-1	5'-1
	E	19'-6	20'-0	21'-0	22'-0	24'-0
	F	4'-1	4'-0	4'-0	3'-11	3'-9
	G	19'-6	21'-0	22'-6	24'-6	27'-6
	J	4'-1	4'-0	4'-0	3'-11	3'-9
	K	2'-0⅞	2'-0⅞	2'-0⅞	2'-0⅞	2'-0⅞
	L	6'-9	6'-4	5'-11	5'-6	5'-1
	M	6'-9	6'-7	6'-5	6'-2	5'-10
	N	2'-0⅞	1'-11	1'-10½	1'-10½	1'-11½

Height H	'a' bars	'b' bars
8'	#5	#5
9'	#6	#5
10'	#6	#5
11'	#6	#5
12'	#6	#6

	Height H	'c' Bars: Short Wing Skew ∡ 0°	5°	10°	15°	20°	Long Wing Wall	Dim 'X'	'd' Bars: Short Wing 0° to 10°	15° & 20°	Long Wing 0° to 20°
2 : 1 Slope	8'	3-#5	3-#5	2-#5	2-#5	-	3-#5	2'-0	-	-	-
	9'	5-#5	4-#5	3-#5	3-#5	2-#5	5-#5	3'-0	-	-	-
	10'	8-#6	7-#6	6-#6	5-#6	4-#6	8-#6	4'-3	3-#5	-	3-#5
	11'	11-#7	10-#7	9-#7	7-#7	6-#7	11-#7	6'-9	6-#5	5-#5	6-#5
	12'	11-#7	10-#7	9-#7	7-#7	6-#7	11-#7	6'-9	9-#7	7-#6	9-#7
4 : 1 Slope	9'	7-#5	6-#5	6-#5	5-#5	4-#5	7-#5	3'-0	-	-	-
	10'	12-#5	11-#5	10-#5	9-#5	8-#5	12-#5	4'-0	-	-	-
	11'	18-#7	17-#7	16-#7	15-#7	14-#7	18-#7	6-3	11-#5	6-#5	11-#5
	12'	18-#7	17-#7	16-#7	15-#7	14-#7	18-#7	6'-3	11-#6	11-#6	11-#6

* 'd' bars alternate with 'a' bars at high end of wall.

NOTE :

For General Notes and Miscellaneous Details see B-01.10.
For Headwall Quantities see B-05.10, B-05.20 and B-05.30.

DESIGN APPROVED

APPROVED FOR DISTRIBUTION

ARIZONA
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
STANDARD DRAWINGS

INLET WINGS
CULVERT HEIGHT 8' to 12'
SKEW 0° to 20°

REVISION

STANDARD NO.
B-04.40

INLET WINGS

Span	Hgt.	0°Skew Conc. C.Y. 1 Bbl.	0°Skew Conc. C.Y. Δc	0°Skew Steel lbs. 1 Bbl.	0°Skew Steel lbs. Δs	5°Skew Conc. C.Y. 1 Bbl.	5°Skew Conc. C.Y. Δc	5°Skew Steel lbs. 1 Bbl.	5°Skew Steel lbs. Δs	10°Skew Conc. C.Y. 1 Bbl.	10°Skew Conc. C.Y. Δc	10°Skew Steel lbs. 1 Bbl.	10°Skew Steel lbs. Δs	15°Skew Conc. C.Y. 1 Bbl.	15°Skew Conc. C.Y. Δc	15°Skew Steel lbs. 1 Bbl.	15°Skew Steel lbs. Δs
6'	3'	3.81	.86	276	80	3.66	.87	271	80	3.73	.88	281	81	3.81	.89	284	83
	4'	5.18	.86	376	80	5.00	.87	357	80	5.07	.88	356	81	5.16	.89	368	83
	5'	6.52	.86	452	80	6.59	.87	457	80	6.65	.88	468	81	6.75	.89	470	83
	6'	8.26	.86	552	80	8.34	.87	570	80	8.28	.88	564	81	8.67	.89	570	83
	7'	10.26	.86	774	80	10.18	.87	740	80	10.25	.88	763	81	10.52	.89	735	83
8'	3'	4.11	1.13	318	105	3.95	1.14	311	106	4.02	1.15	322	107	4.11	1.17	332	109
	4'	5.47	1.13	397	105	5.29	1.14	380	106	5.37	1.15	381	107	5.47	1.17	400	109
	5'	6.81	1.13	477	105	6.88	1.14	482	106	6.95	1.15	493	107	7.06	1.17	499	109
	6'	8.56	1.13	604	105	8.64	1.14	620	106	8.58	1.15	617	107	8.98	1.17	633	109
	7'	10.55	1.13	791	105	10.48	1.14	773	106	10.55	1.15	788	107	10.83	1.17	767	109
	8'	15.95	1.13	892	105	15.73	1.14	909	106	16.04	1.15	922	107	16.18	1.17	935	109
10'	3'	4.41	1.40	358	130	4.25	1.41	352	131	4.33	1.43	362	132	4.42	1.45	365	135
	4'	5.77	1.40	440	130	5.59	1.41	422	131	5.68	1.43	424	132	5.78	1.45	437	135
	5'	7.11	1.40	521	130	7.18	1.41	526	131	7.26	1.43	539	132	7.37	1.45	538	135
	6'	8.86	1.40	651	130	8.94	1.41	667	131	8.88	1.43	664	132	9.29	1.45	675	135
	7'	10.86	1.40	840	130	10.78	1.41	822	131	10.86	1.43	837	132	11.14	1.45	811	135
	8'	16.25	1.40	943	130	16.04	1.41	961	131	16.35	1.43	974	132	16.50	1.45	981	135
	9'	19.48	1.40	1210	130	19.29	1.41	1182	131	19.36	1.43	1195	132	19.99	1.45	1225	135
	10'	23.08	1.40	1412	130	22.84	1.41	1435	131	22.95	1.43	1431	132	23.30	1.45	1439	135
12'	8'	16.59	1.69	972	156	16.36	1.69	991	157	16.71	1.71	1004	159	16.86	1.74	1007	162
	9'	19.82	1.69	1240	156	19.63	1.69	1205	157	19.71	1.71	1226	159	20.35	1.74	1258	162
	10'	23.42	1.69	1442	156	23.18	1.69	1465	157	23.24	1.71	1454	159	23.66	1.74	1473	162
	11'	27.28	1.69	1828	156	27.16	1.69	1852	157	27.49	1.71	1865	159	28.02	1.74	1882	162
	12'	32.13	1.69	2526	156	32.03	1.69	2498	157	32.41	1.71	2518	159	33.16	1.74	2480	162

Span	Hgt.	20°Skew Conc. C.Y. 1 Bbl.	20°Skew Conc. C.Y. Δc	20°Skew Steel lbs. 1 Bbl.	20°Skew Steel lbs. Δs	25°Skew Conc. C.Y. 1 Bbl.	25°Skew Conc. C.Y. Δc	25°Skew Steel lbs. 1 Bbl.	25°Skew Steel lbs. Δs	30°Skew Conc. C.Y. 1 Bbl.	30°Skew Conc. C.Y. Δc	30°Skew Steel lbs. 1 Bbl.	30°Skew Steel lbs. Δs	35°Skew Conc. C.Y. 1 Bbl.	35°Skew Conc. C.Y. Δc	35°Skew Steel lbs. 1 Bbl.	35°Skew Steel lbs. Δs
6'	3'	4.00	.92	302	85	4.11	.95	303	88	4.23	1.00	320	93	4.44	1.05	332	98
	4'	5.38	.92	391	85	5.61	.95	405	88	5.76	1.00	417	93	5.94	1.05	423	98
	5'	7.00	.92	487	85	7.14	.95	503	88	7.39	1.00	523	93	7.83	1.05	550	98
	6'	8.80	.92	585	85	9.08	.95	608	88	9.44	1.00	637	93	9.80	1.05	654	98
	7'	10.96	.92	764	85	11.28	.95	790	88	11.67	1.00	821	93	12.11	1.05	857	98
8'	3'	4.31	1.21	352	112	4.43	1.25	356	116	4.57	1.31	367	121	4.80	1.38	386	128
	4'	5.69	1.21	423	112	5.93	1.25	438	116	6.10	1.31	444	121	6.30	1.38	458	128
	5'	7.31	1.21	520	112	7.47	1.25	532	116	7.73	1.31	551	121	8.19	1.38	586	128
	6'	9.12	1.21	649	112	9.41	1.25	674	116	9.78	1.31	698	121	10.16	1.38	723	128
	7'	11.28	1.21	798	112	11.61	1.25	824	116	12.02	1.31	849	121	12.48	1.38	893	128
	8'	16.76	1.21	948	112	17.40	1.25	1016	116	17.75	1.31	1037	121	18.60	1.38	1086	128
10'	3'	4.63	1.49	388	139	4.76	1.55	395	144	4.92	1.62	412	150	5.16	1.71	456	188
	4'	6.01	1.49	462	139	6.27	1.55	480	144	6.45	1.62	492	150	6.67	1.71	531	188
	5'	7.64	1.49	560	139	7.81	1.55	576	144	8.08	1.62	593	150	8.56	1.71	659	188
	6'	9.44	1.49	691	139	9.75	1.55	720	144	10.13	1.62	750	150	10.53	1.71	800	188
	7'	11.60	1.49	843	139	11.95	1.55	866	144	12.37	1.62	899	150	12.85	1.71	973	188
	8'	17.10	1.49	996	139	17.76	1.55	1067	144	18.12	1.62	1094	150	18.99	1.71	1169	188
	9'	20.60	1.49	1273	139	21.30	1.55	1334	144	21.76	1.62	1371	150	22.69	1.71	1429	188
	10'	24.00	1.49	1497	139	24.76	1.55	1641	144	25.72	1.62	1714	150	26.76	1.71	1806	188
12'	8'	17.48	1.79	1034	196	18.15	1.86	1104	204	18.52	1.95	1130	213	19.42	2.06	1179	265
	9'	20.99	1.79	1312	196	21.70	1.86	1362	204	22.16	1.95	1407	213	23.12	2.06	1440	265
	10'	24.38	1.79	1526	196	25.15	1.86	1678	204	26.13	1.95	1751	213	27.18	2.06	1817	265
	11'	29.01	1.79	1938	196	29.83	1.86	2111	204	30.66	1.95	2193	213	32.29	2.06	2334	265
	12'	34.22	1.79	2581	196	35.14	1.86	2714	204	36.25	1.95	2828	213	37.74	2.06	2988	265

Span	Hgt.	40°Skew Conc. C.Y. 1 Bbl.	40°Skew Conc. C.Y. Δc	40°Skew Steel lbs. 1 Bbl.	40°Skew Steel lbs. Δs	45°Skew Conc. C.Y. 1 Bbl.	45°Skew Conc. C.Y. Δc	45°Skew Steel lbs. 1 Bbl.	45°Skew Steel lbs. Δs
6'	3'	4.71	1.13	341	105	4.97	1.22	369	113
	4'	6.32	1.13	449	105	6.80	1.22	484	113
	5'	8.20	1.13	574	105	8.75	1.22	597	113
	6'	10.30	1.13	681	105	11.07	1.22	747	113
	7'	12.88	1.13	900	105	13.61	1.22	956	113
8'	3'	5.09	1.48	398	137	5.38	1.60	429	149
	4'	6.70	1.48	485	137	7.22	1.60	523	149
	5'	8.59	1.48	611	137	9.17	1.60	635	149
	6'	10.68	1.48	753	137	11.49	1.60	823	149
	7'	13.27	1.48	937	137	14.03	1.60	995	149
	8'	19.50	1.48	1150	137	21.19	1.60	1247	149
10'	3'	5.48	1.83	476	201	5.80	1.99	510	217
	4'	7.10	1.83	569	201	7.64	1.99	607	217
	5'	8.98	1.83	697	201	9.59	1.99	722	217
	6'	11.08	1.83	842	201	11.91	1.99	913	217
	7'	13.67	1.83	1029	201	14.46	1.99	1088	217
	8'	19.92	1.83	1240	201	21.64	1.99	1338	217
	9'	23.99	1.83	1531	201	25.67	1.99	1633	217
	10'	28.34	1.83	1961	201	30.18	1.99	2070	217
12'	8'	20.37	2.20	1236	334	22.13	2.38	1348	361
	9'	24.45	2.20	1537	334	26.16	2.38	1643	361
	10'	28.79	2.20	1968	334	30.67	2.38	2080	361
	11'	34.32	2.20	2460	334	36.40	2.38	2678	361
	12'	39.97	2.20	3103	334	43.12	2.38	3421	361

OUTLET WINGS

Span	Hgt.	0°Skew Conc. C.Y. 1 Bbl.	0°Skew Conc. C.Y. Δc	0°Skew Steel lbs. 1 Bbl.	0°Skew Steel lbs. Δs	5°Skew Conc. C.Y. 1 Bbl.	5°Skew Conc. C.Y. Δc	5°Skew Steel lbs. 1 Bbl.	5°Skew Steel lbs. Δs	10°Skew Conc. C.Y. 1 Bbl.	10°Skew Conc. C.Y. Δc	10°Skew Steel lbs. 1 Bbl.	10°Skew Steel lbs. Δs	15°Skew Conc. C.Y. 1 Bbl.	15°Skew Conc. C.Y. Δc	15°Skew Steel lbs. 1 Bbl.	15°Skew Steel lbs. Δs
6'	3'	5.98	1.55	467	135	5.98	1.56	468	135	6.19	1.58	475	137	6.07	1.61	464	140
	4'	7.72	1.55	574	135	7.71	1.56	574	135	7.96	1.58	592	137	8.00	1.61	600	140
	5'	9.61	1.55	707	135	9.80	1.56	713	135	9.90	1.58	716	137	9.94	1.61	724	140
	6'	11.75	1.55	807	135	11.94	1.56	826	135	12.23	1.58	852	137	12.37	1.61	871	140
	7'	14.08	1.55	976	135	14.29	1.56	981	135	14.63	1.58	1050	137	14.77	1.61	1040	140
8'	3'	6.50	2.02	525	177	6.51	2.03	525	178	6.73	2.05	534	180	6.61	2.09	536	184
	4'	8.25	2.02	613	177	8.24	2.03	613	178	8.50	2.05	632	180	8.55	2.09	654	184
	5'	10.14	2.02	746	177	10.34	2.03	753	178	10.44	2.05	756	180	10.49	2.09	779	184
	6'	12.28	2.02	877	177	12.48	2.03	896	178	12.78	2.05	924	180	12.93	2.09	958	184
	7'	14.62	2.02	1016	177	14.84	2.03	1021	178	15.18	2.05	1091	180	15.33	2.09	1095	184
	8'	20.30	2.02	1278	177	20.18	2.03	1256	178	20.48	2.05	1270	180	20.72	2.09	1316	184
10'	3'	7.06	2.51	589	220	7.06	2.52	589	221	7.29	2.55	598	223	7.19	2.59	586	228
	4'	8.80	2.51	679	220	8.80	2.52	679	221	9.06	2.55	696	223	9.13	2.59	707	228
	5'	10.70	2.51	814	220	10.90	2.52	821	221	11.01	2.55	825	223	11.07	2.59	834	228
	6'	12.84	2.51	947	220	13.04	2.52	967	221	13.35	2.55	996	223	13.51	2.59	1016	228
	7'	15.18	2.51	1088	220	15.40	2.52	1094	221	15.75	2.55	1165	223	15.91	2.59	1155	228
	8'	20.88	2.51	1354	220	20.77	2.52	1332	221	21.08	2.55	1346	223	21.32	2.59	1378	228
	9'	24.31	2.51	1530	220	24.44	2.52	1560	221	24.89	2.55	1567	223	25.17	2.59	1584	228
	10'	27.99	2.51	1830	220	28.14	2.52	1827	221	28.65	2.55	1860	223	28.94	2.59	1872	228
12'	8'	21.47	2.98	1385	264	21.36	2.99	1377	265	21.68	3.02	1386	268	21.93	3.08	1427	274
	9'	24.90	2.98	1576	264	25.04	2.99	1606	265	25.49	3.02	1614	268	25.78	3.08	1634	274
	10'	28.58	2.98	1876	264	28.74	2.99	1873	265	29.25	3.02	1898	268	29.55	3.08	1922	274
	11'	32.86	2.98	2175	264	33.17	2.99	2235	265	33.71	3.02	2243	268	34.51	3.08	2285	274
	12'	37.72	2.98	2866	264	38.11	2.99	2849	265	39.17	3.02	2890	268	39.56	3.08	2968	274

Span	Hgt.	20°Skew Conc. C.Y. 1 Bbl.	20°Skew Conc. C.Y. Δc	20°Skew Steel lbs. 1 Bbl.	20°Skew Steel lbs. Δs	25°Skew Conc. C.Y. 1 Bbl.	25°Skew Conc. C.Y. Δc	25°Skew Steel lbs. 1 Bbl.	25°Skew Steel lbs. Δs	30°Skew Conc. C.Y. 1 Bbl.	30°Skew Conc. C.Y. Δc	30°Skew Steel lbs. 1 Bbl.	30°Skew Steel lbs. Δs	35°Skew Conc. C.Y. 1 Bbl.	35°Skew Conc. C.Y. Δc	35°Skew Steel lbs. 1 Bbl.	35°Skew Steel lbs. Δs
6'	3'	6.31	1.65	485	143	6.58	1.71	495	149	6.73	1.79	520	156	7.05	1.90	538	165
	4'	8.28	1.65	619	143	8.56	1.71	630	149	8.74	1.79	651	156	8.96	1.90	658	165
	5'	10.26	1.65	734	143	10.44	1.71	752	149	10.78	1.79	786	156	11.40	1.90	824	165
	6'	12.66	1.65	882	143	12.86	1.71	890	149	13.31	1.79	933	156	13.79	1.90	956	165
	7'	15.17	1.65	1077	143	15.54	1.71	1107	149	16.02	1.79	1151	156	16.58	1.90	1192	165
8'	3'	6.87	2.15	559	189	7.16	2.23	570	196	7.34	2.34	582	204	7.68	2.47	616	216
	4'	8.84	2.15	674	189	9.14	2.23	686	196	9.35	2.34	694	204	9.60	2.47	717	216
	5'	10.82	2.15	789	189	11.02	2.23	804	196	11.39	2.34	829	204	12.05	2.47	883	216
	6'	13.23	2.15	970	189	13.45	2.23	979	196	13.93	2.34	1010	204	14.43	2.47	1049	216
	7'	15.74	2.15	1126	189	16.13	2.23	1163	196	16.65	2.34	1195	204	17.23	2.47	1253	216
	8'	21.49	2.15	1360	189	22.12	2.23	1389	196	22.50	2.34	1412	204	23.53	2.47	1479	216
10'	3'	7.46	2.67	610	235	7.77	2.77	625	243	7.97	2.89	851	254	8.36	3.06	702	298
	4'	9.43	2.67	728	235	9.76	2.77	744	243	9.99	2.89	765	254	10.27	3.06	806	298
	5'	11.42	2.67	845	235	11.64	2.77	863	243	12.04	2.89	895	254	12.72	3.06	973	298
	6'	13.82	2.67	1029	235	14.07	2.77	1041	243	14.57	2.89	1085	254	15.11	3.06	1143	298
	7'	16.34	2.67	1187	235	16.75	2.77	1221	243	17.30	2.89	1268	254	17.91	3.06	1350	298
	8'	22.11	2.67	1424	235	22.76	2.77	1456	243	23.17	2.89	1492	254	24.23	3.06	1579	298
	9'	26.06	2.67	1632	235	26.75	2.77	1756	243	27.25	2.89	1801	254	28.38	3.06	1872	298
	10'	29.90	2.67	1935	235	30.52	2.77	2086	243	31.65	2.89	2178	254	32.88	3.06	2283	298
12'	8'	22.74	3.17	1406	311	23.40	3.29	1516	323	23.83	3.44	1545	337	24.93	3.64	1614	397
	9'	26.68	3.17	1694	311	27.40	3.29	1808	323	27.92	3.44	1855	337	29.08	3.64	1908	397
	10'	30.52	3.17	1998	311	31.16	3.29	2148	323	32.32	3.44	2232	337	33.58	3.64	2319	397
	11'	35.56	3.17	2344	311	36.27	3.29	2614	323	37.22	3.44	2703	337	39.12	3.64	2869	397
	12'	40.87	3.17	3045	311	42.02	3.29	3250	323	43.24	3.44	3372	337	44.93	3.64	3552	397

Span	Hgt.	40°Skew Conc. C.Y. 1 Bbl.	40°Skew Conc. C.Y. Δc	40°Skew Steel lbs. 1 Bbl.	40°Skew Steel lbs. Δs	45°Skew Conc. C.Y. 1 Bbl.	45°Skew Conc. C.Y. Δc	45°Skew Steel lbs. 1 Bbl.	45°Skew Steel lbs. Δs
6'	3'	7.43	2.03	555	177	7.82	2.20	598	191
	4'	9.53	2.03	696	177	10.21	2.20	751	191
	5'	11.89	2.03	855	177	12.63	2.20	897	191
	6'	14.47	2.03	995	177	15.50	2.20	1086	191
	7'	17.60	2.03	1252	177	18.52	2.20	1328	191
8'	3'	8.11	2.64	636	231	8.55	2.86	683	251
	4'	10.21	2.64	757	231	10.94	2.86	815	251
	5'	12.58	2.64	916	231	13.38	2.86	961	251
	6'	15.16	2.64	1092	231	16.25	2.86	1187	251
	7'	18.30	2.64	1314	231	19.27	2.86	1393	251
	8'	24.62	2.64	1556	231	26.70	2.86	1688	251
10'	3'	8.83	3.27	739	318	9.33	3.54	781	344
	4'	10.93	3.27	865	318	11.72	3.54	917	344
	5'	13.30	3.27	1027	318	14.16	3.54	1066	344
	6'	15.88	3.27	1205	318	17.04	3.54	1295	344
	7'	19.03	3.27	1430	318	20.06	3.54	1503	344
	8'	25.31	3.27	1670	318	27.51	3.54	1797	344
	9'	29.95	3.27	2000	318	31.98	3.54	2125	344
	10'	34.73	3.27	2463	318	36.92	3.54	2595	344
12'	8'	26.11	3.89	1684	475	28.32	4.21	1833	513
	9'	30.70	3.89	2024	475	32.79	4.21	2165	513
	10'	35.48	3.89	2488	475	37.73	4.21	2632	513
	11'	41.50	3.89	3018	475	43.95	4.21	3268	513
	12'	47.51	3.89	3690	475	51.16	4.21	4049	513

NOTES :

All quantities are for headwalls of barrels shown in Table No. 1 (0-10' Fill).

Quantities are shown for single barrel culvert only.

Multi-barrel culvert headwall quantities are obtained by adding, for each additional barrel, Δs and Δc to the inlet and outlet quantities.

NOTATIONS :

Δc = Inlet or outlet concrete quantity per additional barrel.

Δs = Inlet or outlet steel quantity per additional barrel.

DESIGN APPROVED

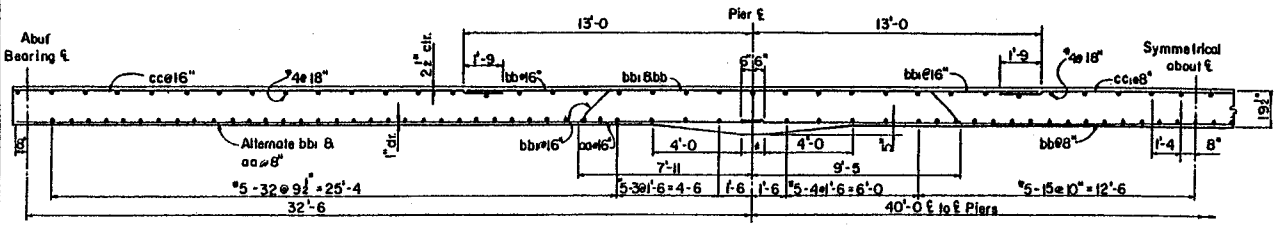
APPROVED FOR DISTRIBUTION

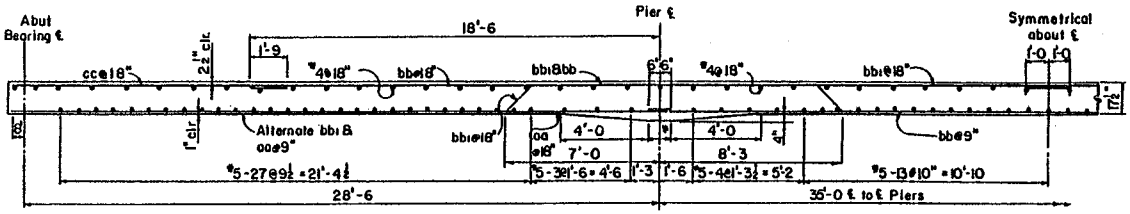
ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS

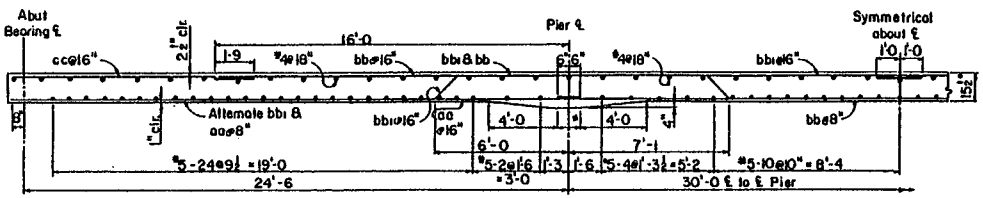
HEADWALL QUANTITIES 2 : 1 SLOPE

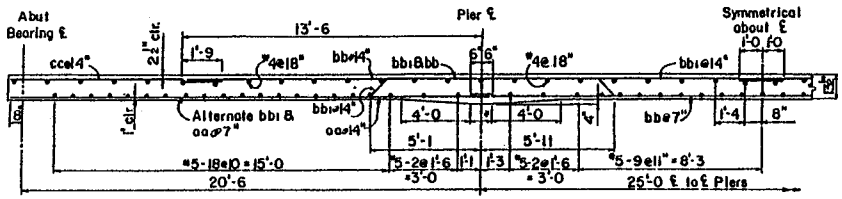
REVISION 7-88

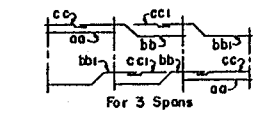
STANDARD NO. B-05.10

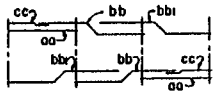


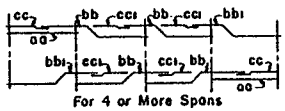




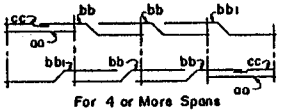




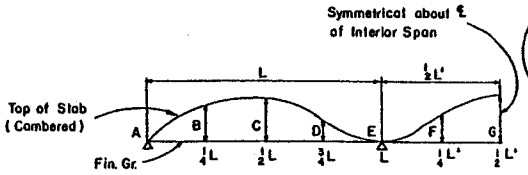




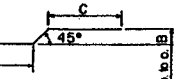
SLAB STEEL PLACING DIAGRAM
For 32½-40 Span Length



SLAB STEEL PLACING DIAGRAM
For 28½-35, 24½-30 & 20½-25 Span Lengths



DEAD LOAD CAMBER DIAGRAM
NO SCALE



STEEL LIST

Span Lgths	Mark	Size	Bend	Lgth	Bend Dimensions A	B	C
32'-6, 40'-0	aa	10	str	33'-9			
	bb	10		54'-0	31'-1	1'-4	21'-2
	bb1	10		46'-9	25'-3	1'-4	19'-8
	cc	6	str	22'-0			
	cc1	4	str	17'-6			
28'-6, 35'-0	aa	10	str	29'-9			
	bb	10		54'-6	27'-3	1'-2	25'-8
	bb1	10		48'-3	22'-2	1'-2	24'-5
	cc	6	str	12'-6			
24'-6, 30'-0	aa	9	str	25'-9			
	bb	9		47'-0	23'-5	1'-0	22'-2
	bb1	9		41'-6	19'-2	1'-0	21'-1
	cc	6	str	11'-0			
20'-6, 25'-0	aa	8	str	21'-9			
	bb	8		39'-6	19'-7	10"	18'-8
	bb1	8		35'-0	16'-1	10"	17'-10
	cc	6	str	9'-6			

GENERAL NOTES:

See Project Drawings for cross section of deck slab, roadway width, curbs, railings, and foundations.
Minimum length of bridge shall be 3 spans. For additional length intermediate spans equal to the center span shall be added.
Construction - Standard Specifications Ariz. Dept. of Transportation Edition of 1982, revised to date.
Design - A.A.S.H.O. Specifications for Highway Bridges 1973.

Dead Load - Dead Load includes allowance of 25 pounds per square foot for future wearing surface.
Loading Class - HS20-44
Load Distribution - E = 4.0 + .06S (S taken as effective end span length)
Stresses -
Class S concrete f'_c = 4,500 psi; f_c = 1,400 psi
Reinforcing steel shall conform to ASTM Spec. A615.
Bar sizes #6 and smaller shall be Gr. 40 or Gr. 60; f_s = 20000 psi
Bar sizes #7 and larger shall be Grade 60; f_s = 24000 psi

Curbs and/or sidewalk shall be poured to grade after falsework has been struck.
Dimensions shall not be scaled from drawings.
Haunch dimension normal to centerline of bent.
Forms shall be cambered for dead load deflection, vertical curvature, form deflection and falsework settlement. Camber figures given in plans are for dead load only.

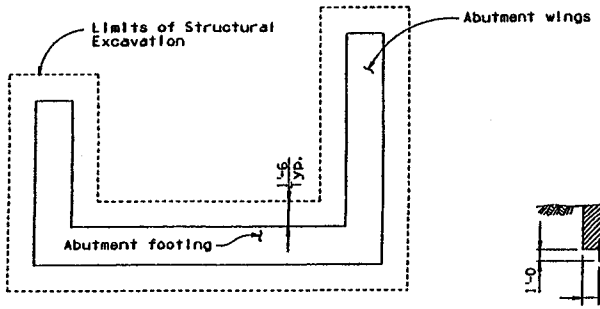
DEAD LOAD CAMBER

L	L'	A	B	C	D	E	F	G
32'-6	40'-0	0"	1/8"	3/32"	3/32"	0"	1/8"	3/32"
28'-6	35'-0	0"	1/8"	3/32"	3/32"	0"	1/8"	3/32"
24'-6	30'-0	0"	1/8"	3/32"	1/16"	0"	3/32"	3/32"
20'-6	25'-0	0"	1/32"	1/32"	1/32"	0"	1/32"	1/32"

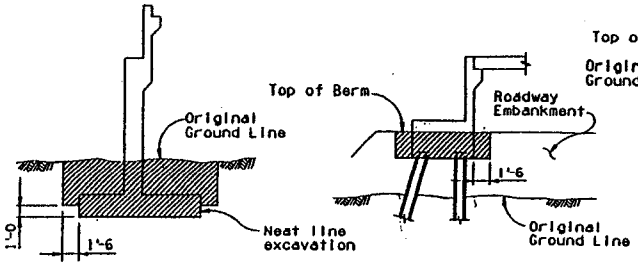
* Dimension varies. See Project Drawings for dimension and Special Pier Details.

DESIGN APPROVED K. C. Buchler	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS		REVISION 10-86
APPROVED FOR DISTRIBUTION E. K. Smalley	CONTINUOUS SPAN SLAB HS20-44 LOADING		STANDARD NO. B-09.10

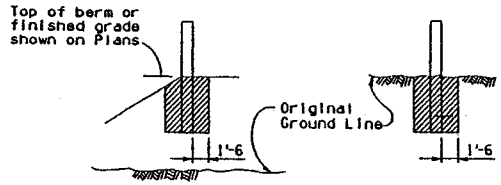
DESIGNED	JEBL, HW	12-72	⑥ Change notes & clearances
DRAWN			⑤ Change Reinf. Note
CHECKED			
	WEB	2-82	
	CK	10-86	



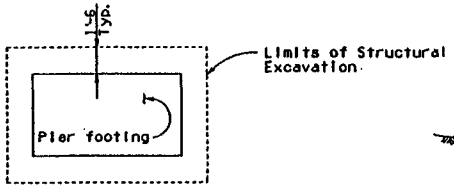
TYPICAL ABUTMENT FOOTING PLAN



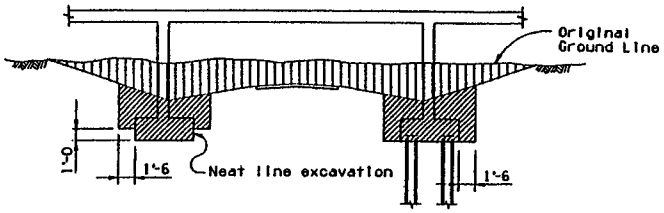
TYPICAL ABUTMENT SECTIONS

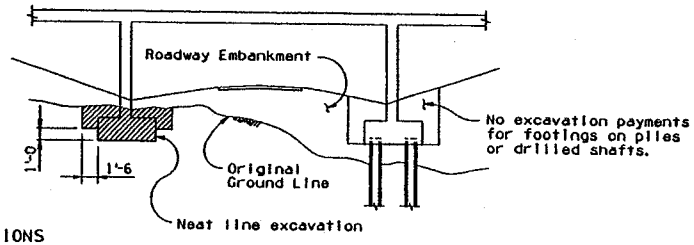


WINGWALLS

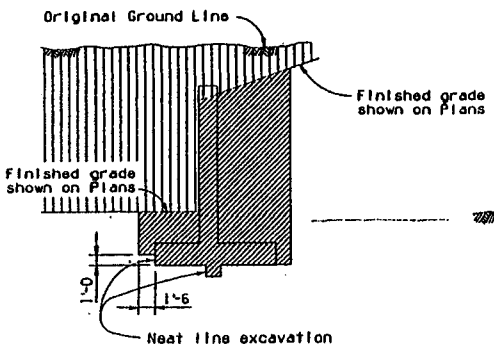


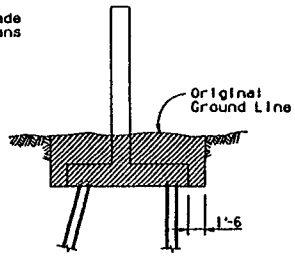
TYPICAL PIER FOOTING PLAN

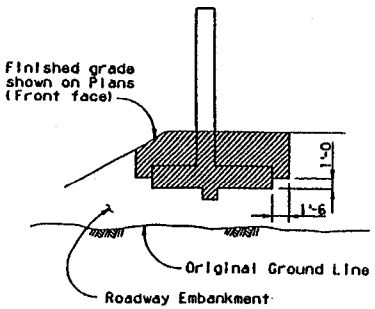




TYPICAL PIER ELEVATIONS







TYPICAL RETAINING WALL SECTIONS

NOTES

Indicates Structural Excavation

Indicates Roadway Excavation

For any footing on piles or drilled shafts do not use neat line excavation.

For structure foundations above original ground line, construct roadway embankment to top of berm or finished grade before strucural excavation is made.

If no roadway excavation or embankment is involved, structural excavation shall be measured from the original ground line.

Top of berm shall mean the top of berm or elevation at point of intersection between front face and slope.

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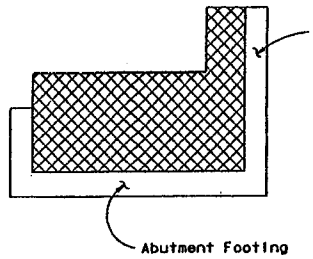
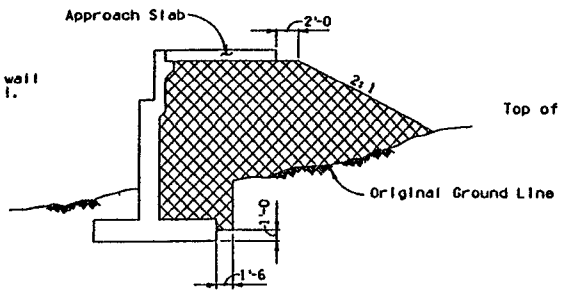
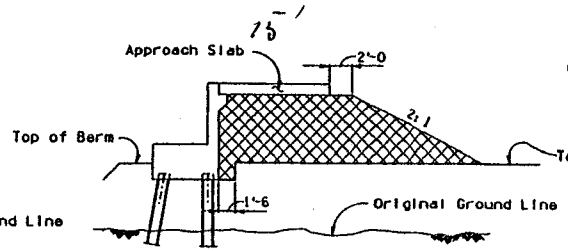
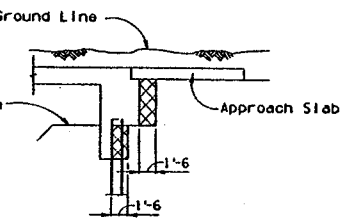
VIEW NAME=



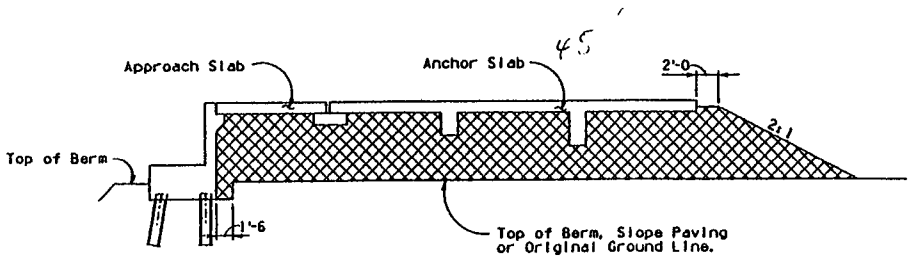
TYPICAL ABUTMENT FOOTING PLAN



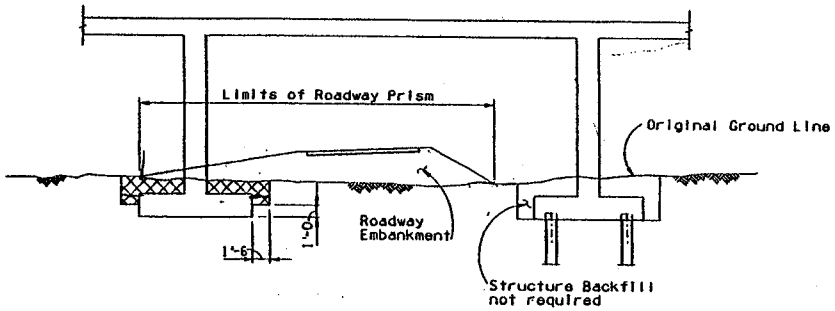




TYPICAL ABUTMENT SECTIONS WITH APPROACH SLABS

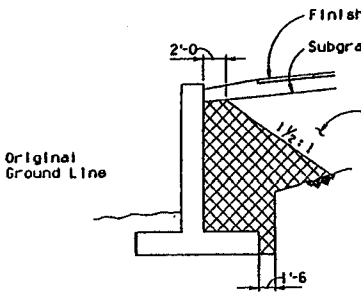


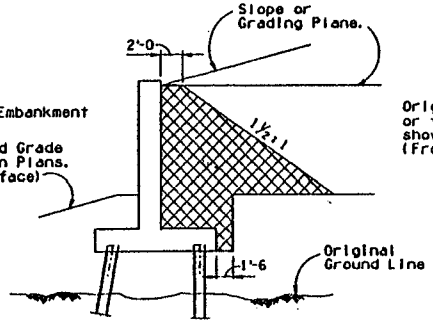
TYPICAL ABUTMENT SECTION WITH APPROACH SLAB AND ANCHOR SLAB

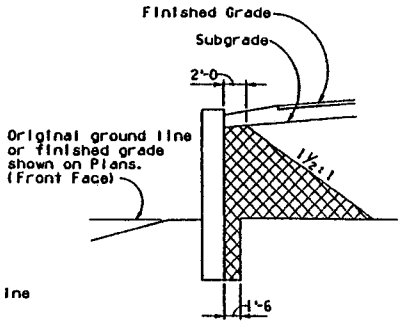


TYPICAL PIER ELEVATION

NOTE: Structure Backfill is required for piers only when the pier falls within the roadway prism.







TYPICAL WALL SECTIONS

NOTE: Structure Backfill is required only when the wall falls within the roadway prism.

NOTE:

Indicates Structure Backfill.

Roadway Prism shall be the distance between points of intersection of Roadway Embankment and Original Ground Line.

"Top of Berm" shall mean the top of berm or elevation at point of intersection between front face and slope.

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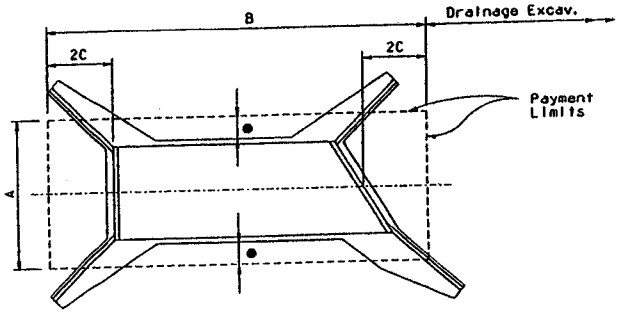
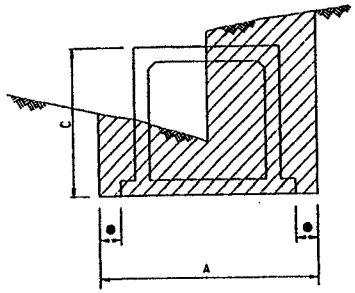
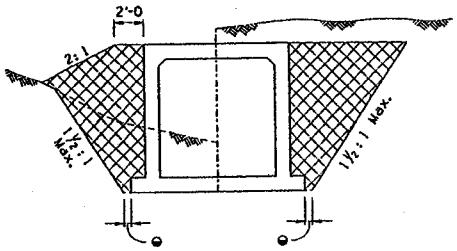
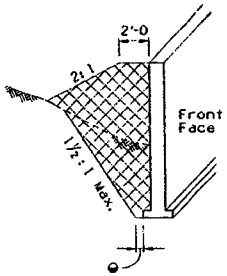


PLAN



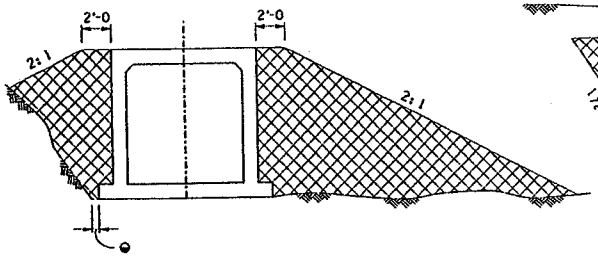
SECTION



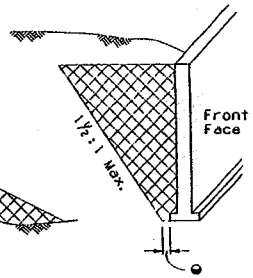


STRUCTURAL EXCAVATION - PAYMENT LIMITS

Note: Payment limits shown include structural excavation for headwalls, cutoffwalls, wingwalls, end sections, etc.



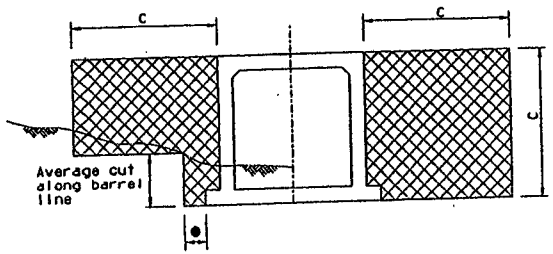
SECTION

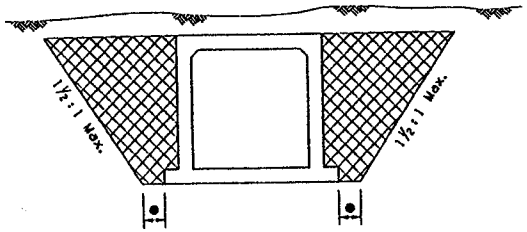


END VIEW WING OF BOX CULVERT

STRUCTURE BACKFILL - PLACEMENT

Note: Placement of structure backfill behind headwalls and wingwalls shall be the same as around structures.





STRUCTURE BACKFILL - MEASUREMENT

Note: Computation of structure backfill quantities is based on the area of a typical installation times (the total length of structure plus 2H). No measurement is necessary for wing arms. Use H for box extensions on each end extended.

LEGEND

A = Width
B = Length
C = Height of barrel or headwall without cutoff wall.
● 6" Max. in rock and trench, 1'-6 max. all others
◉ 6" Min. in rock and trench, 1'-6 min. all others

Indicates Structural Excavation
Indicates Structure Backfill

	DESIGN APPROVED	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS	REVISION
	APPROVED FOR DISTRIBUTION	STRUCTURAL EXCAVATION & STRUCTURE BACKFILL FOR R.C.B. CULVERTS	STANDARD NO. B-19.50

					DATE
					DATE 6-8
					DESCRIPTION OF REVISIONS
					NO.
					1
					2
					3
					4
					5
DESIGN					
DRAWN					
CHECKED					

Revised Estimates

It is the responsibility of the Design Section Leader and Project Engineer to advise all interested parties as successive estimates are made during the development of a project.

Submittal and Retention of Quantity Calculations

Quantity calculations are to be submitted to the Cost Estimates Section along with Estimate Summary sheets. Calculations for Marginal (Blue Sheet) Estimates are retained in the Cost Estimates Section until the contract is awarded, at which time they are forwarded to the RE Pending File for the Structure Rep's use during the course of construction.

Escalation Factor

Structure estimates are prepared on the basis of prices which are valid on the day the estimate is made. As part of their procedure in developing their planning program, the Districts periodically apply an escalation factor, according to the cost index, to these estimates as necessary to cover inflation.

Mobilization Factor

Structure estimates generally include an item for mobilization. The value of this item is estimated at 10% of the total cost of bid items. If a particular kind or size of a project does not require a separate item for mobilization, the unit price for one (or more) of the major items of work is inflated to cover the contractors cost for mobilization.

Contingency Factors

A contingency factor is added to all estimates to cover the costs of unforeseen design changes and the uncertainty of early quantity estimates.

Planning Estimates	25%	Contingency
General Plan Estimates	20%	Contingency ← USE
Marginal Estimate – Final PS&E	5%	Contingency

Stage Construction

It is sometimes necessary to build a bridge in stages. The most common case is replacing a bridge on existing alignment. This will increase the cost about 25% and the construction time about 75%. The plans must show the width of each stage and indicate how traffic is to be handled.

Bar Reinforcement /CY of Concrete for Various Bridge Parts

The following are approximate quantities of Bar Reinforcement per cubic yard of concrete. Use for Planning and General Plan Estimates only.

Deck slab on prestressed or steel girders ..... 225 lbs/cy

Bent Caps ..... 150 lbs/cy

Single column bents ..... 450 lbs/cy (285-545 variation)

Multiple column bents ..... 225 lbs/cy (95-350 variation)

Piers and walls of simulated closed end abutments ..... 80 lbs/cy

Footings ..... 150-200 lbs/cy

End diaphragm abutments ..... 80 lbs/cy

Cantilever and strutted abutments ..... Design Charts

Retaining walls ..... Standard Plans

Seat Type Abutments

- Skews < 15° ..... 90 lbs/cy
- Skews 15° to 45° ..... 100 - 140 lbs/cy

Bar Reinforcement/Ft² of Deck Area

- Cast-In-Place Reinforced Slab ..... 13 lbs/Ft²

Note: See "Sources of Quantities for Standard Details" shown on page 11-49.

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BY AAA. DATE 8/3/94

CHECK _____ DATE _____

CLIENT FCDMC

JOB White Tanks Drop Structure JOB NO. 310.44

Calculation for the drop structures follow the methodology described on "Open-Channel Hydraulics, Ven Te Chow", "SCS Engineering Handbook sec 11" and "Open-Channel Hydraulics, Richard H. French"

Calculate weir width req

$$Q = C W_f \left(Y_n + \frac{V_a^2}{2g}\right)^{1.5}$$ (SCS NEH 11)

Coefficient $C = 3.386$ for Cippoletti weir

solving for free flow width W_f

Free flow width $W_f = \dfrac{Q}{C\left(Y_n + \frac{V_a^2}{2g}\right)^{1.5}}$

Upstream Head $H1 = Y_n + \frac{V_a^2}{2g}$ upstream Head = normal depth + Velocity head (upstream channel)

Drop Number $D_n = \dfrac{(Q/W_f)^2}{(32.2)(H^3)}$ where H is the drop Height. (Chow)

Sequent depth $Y_s = 1.66\, D_n^{0.27}\, H$ (Chow)

If $Y_s < H$ free flow
If $Y_s > H$ the Jump is submerged (NEH 11)

If submerge the width of the weir needs to be adjusted to compensate for the decrease of Capacity under submerged condition

using figure 3.4 (NEH 11)

a capacity reduction factor can be obtained for the particular submergence Ratio (H_2/H_1)

Submerged unit flow $q_s = (Q/W_f)\,R$

Submerged Width $W_s = Q/q_s$

W_s is the minimun weir width required to prevent water from backin up in the upstream channel. the actual width (W) can be equal or greater than W_s.

For the New actual width (W) a new D_n is needed

$$D_n = \frac{(Q/W)}{(32.2)\,H^3}$$

and the dimentions of the structure are obtaine from these equations:

Length of Jet $L_J = 4.30\,D_n^{0.27}\,H$

→ Length of Jump $L_s = 6.9\,(Y_s)$

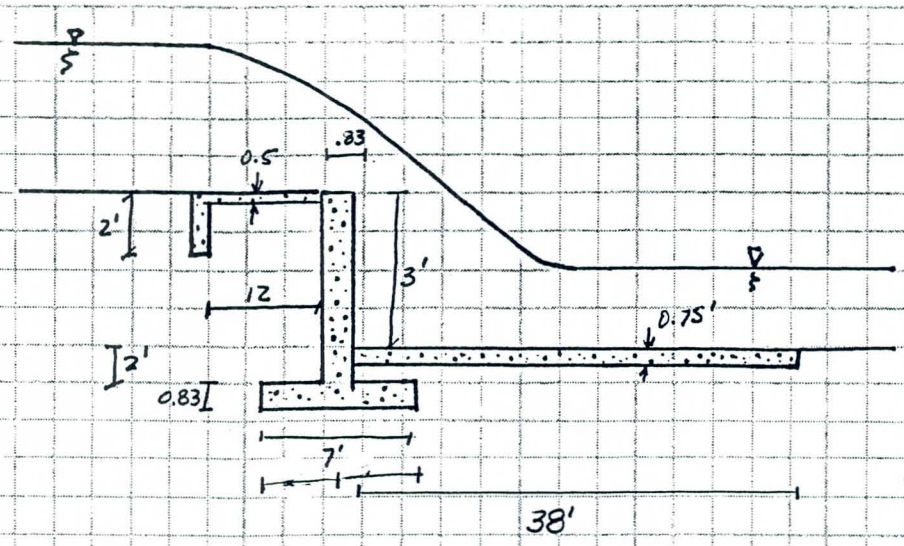
Length of Basin $L_B = L_J + L_s$

Sequent depth $Y_s = (1.66)\,D_n^{0.27}\,H$

Depth of Jet $Y_J = (0.54)\,D_n^{0.425}\,H$

CLIENT FCDMC

JOB White Tanks #3 drop on Earthen channel (cost) JOB NO. 310.44



Volume of Concrete

upsteam apr. (12' + 2)(0.5)

= 7 SF/ft

Spillway (7' + 5)(0.83)

= 9.96 SF/ft

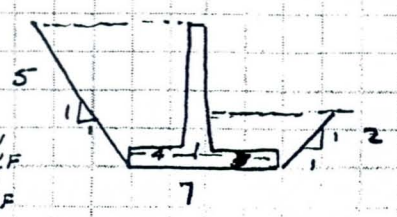
basin (38)(0.75)

= 28.5 SF/ft

Total = 45.46 SF/ft

Cost = 1.68 CY/LF @ $200/CY = $336/LF (200/CY structural, $150/CY non struc

Volume of Excavation/Backfill



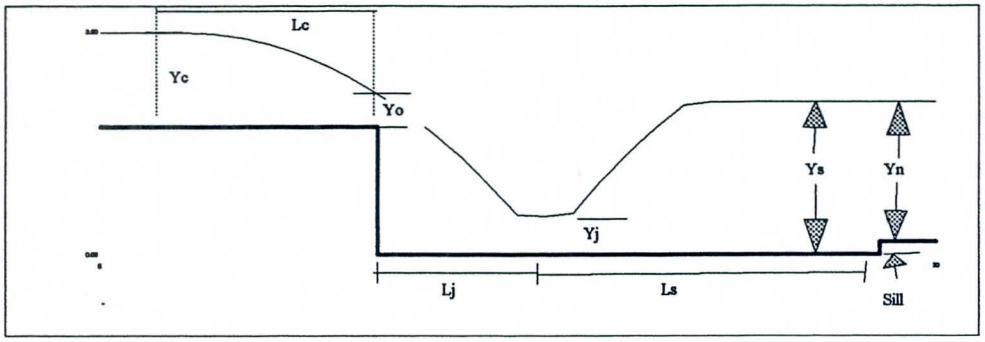
0.5(5)(5) + (4)(5) + 0.5(2)(2) + (3)(2) = 40 ft³/LF
= 1.5 CY/LF

cost 1.5 CY/ft @ $10/CY = $ 15/LF

Total Cost = 336/LF + 15/LF = $351/LF

Drop Structure Worksheet

Project	White Tanks	**Design**	HAA
Project #	310.44	**Check**	
Location	WTFRS#3 / Northern, Earthen channel	**Date**	17-Dec-94



	Upstream Channel		Dowstream Channel		
Flow	Q =	8480			
Y normal	Yn =	5.50	Yn =	5.50	
Velocity	Va =	3.00			
Yn + Hv	H1 =	5.64	H2 =	2.99	
	Weir crest width				
Coef.	C =	3.100	H2/H1 =	0.53	
width	Wf =	204.24	R =	0.95	(fig 3.4)
drop heigth	H =	3.00	qf =	41.52	
Drop #	Dn =	1.98	qs =	39.44	
Y seq.	Ys =	5.99	Ws =	214.99	
	Subm.	YES			
Min. width	W min =	214.99			
Width	W =	490.00			
	Drop dimentions				
Y crit.	Yc =	2.10			
Y at drop	Yo =	1.47			
drop #	Dn =	0.34			
L jet	Lj =	9.59			
Y superc.	Yj =	1.03			
Y seq.	Ys =	3.73			
L jump	Ls =	25.77			
L basin	Lb =	35.36			
L upstream	Lc =	11.28			
	Sill =	0.00			

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SHEET 5 OF 10
BY SDA DATE 8/3/94
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CLIENT FCDMC
JOB White Tank FRS#3 Inlet - Reach A. - Earthen
JOB NO. 310.44

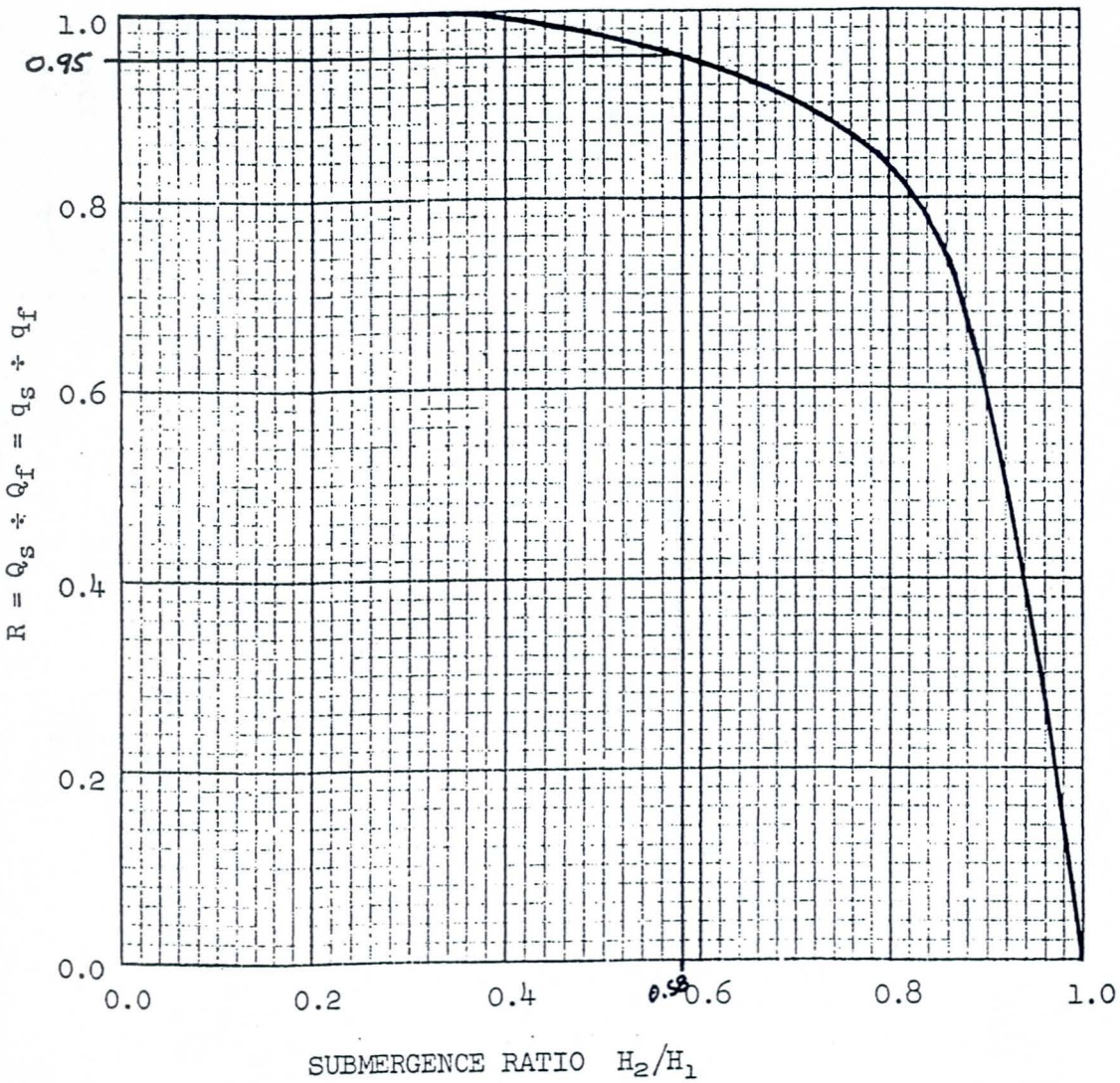
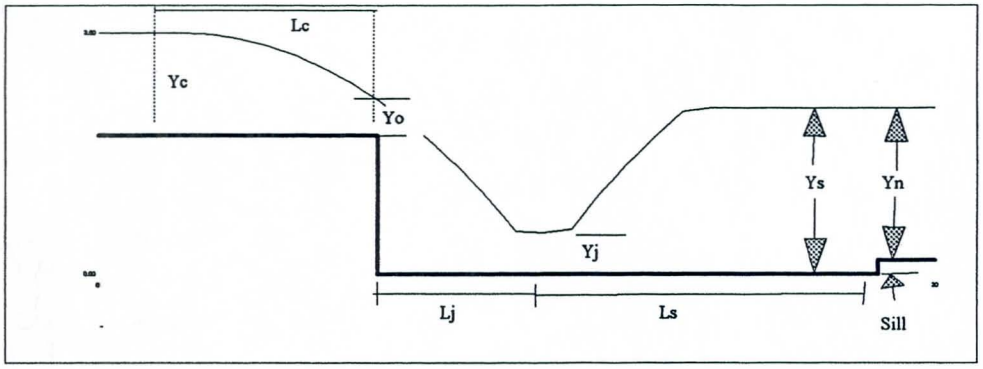


FIGURE 3.4

Project	White Tanks #3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Northern / Cholla, Earthen channel	**Date**	17-Dec-94



	Upstream Channel			Dowstream Channel		
Flow	Q =	7770				
Y normal	Yn =	5.50		Yn =	5.50	
Velocity	Va =	3.00				
Yn + Hv	H1 =	5.64		H2 =	2.99	
	Weir crest width					
Coef.	C =	3.100		H2/H1 =	0.530	
width	Wf =	187.14		R =	0.950	(fig 3.4)
drop heigt	H =	3.00		qf =	41.52	
Drop #	Dn =	1.98		qs =	39.44	
Y seq.	Ys =	5.99		Ws =	196.99	
	Subm.	YES				
Min. width	W min =	196.99				
Width	W =	450.00				
	Drop dimentions					
Y crit.	Yc =	2.10				
Y at drop	Yo =	1.47				
drop #	Dn =	0.34				
L jet	Lj =	9.58				
Y superc.	Yj =	1.03				
Y seq.	Ys =	3.73				
L jump	Ls =	25.74				
L basin	Lb =	35.32				
L upstrea	Lc =	11.28				
	Sill =	0.00				

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SHEET 7 OF 10
BY [illegible] DATE 8/4/94
CHECK _____ DATE _____

CLIENT FCDMC
JOB White Tanks FRS #3 Inlet - Reach B - Earthen
JOB NO. 310.44

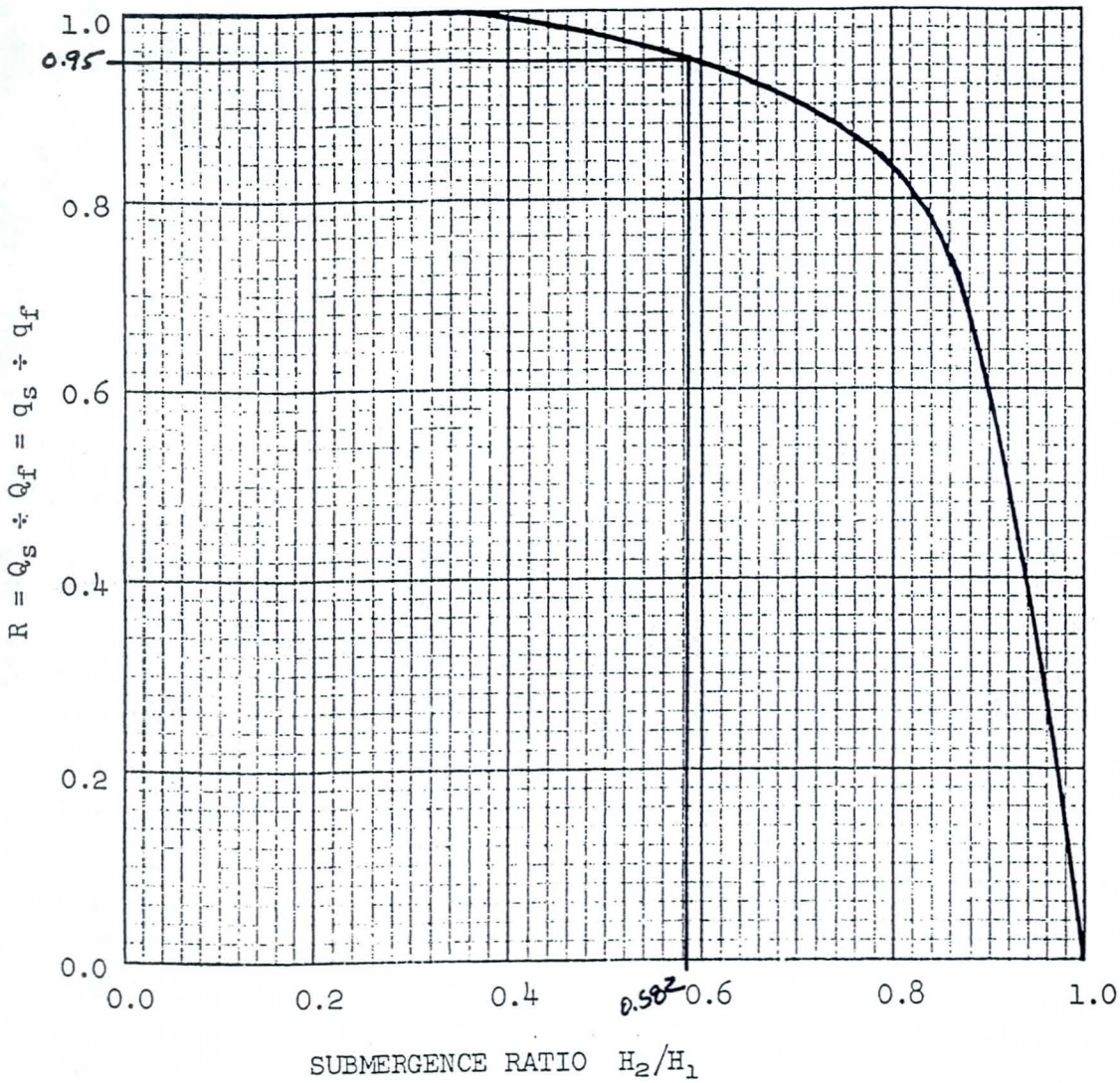
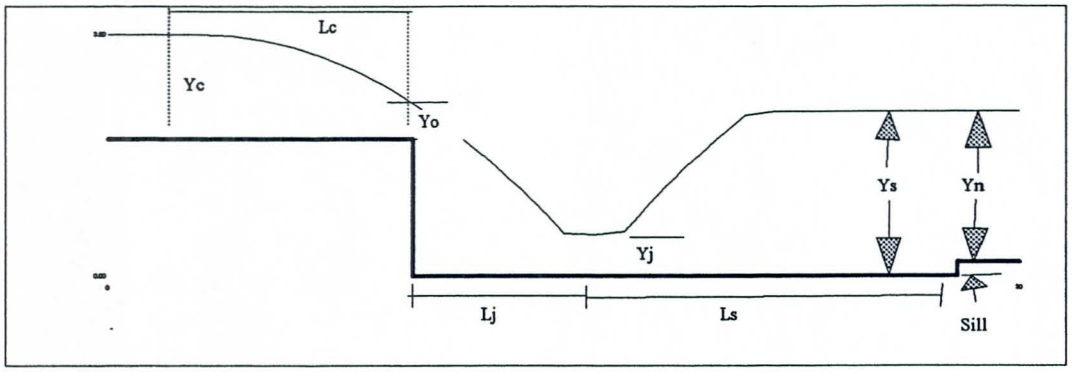


FIGURE 3.4

Project	White Tanks #3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Cholla Wash to Olive Av.	**Date**	17-Dec-94



	Upstream Channel			Dowstream Channel		
Flow	Q =	3230				
Y normal	Yn =	5.50		Yn =	5.50	
Velocity	Va =	3.00				
Yn + Hv	H1 =	5.64		H2 =	2.61	
	Weir crest width					
Coef.	C =	3.10		H2/H1 =	0.46	
width	Wf =	87.91		R =	0.97	(fig 3.4)
drop heigt	H =	3.00		qf =	36.74	
Drop #	Dn =	1.55		qs =	35.64	
Y seq.	Ys =	5.61		Ws =	90.63	
	Subm.	YES				
Min. width	W min =	25.00				
Width	W =	190.00				
	Drop dimentions					
Y crit.	Yc =	2.20				
Y at dop	Yo =	1.54				
drop #	Dn =	0.33				
L jet	Lj =	9.50				
Y superc.	Yj =	1.01				
Y seq.	Ys =	3.70				
L jump	Ls =	25.52				
L basin	Lb =	35.02				
L upstrea	Lc =	11.28				
	Sill =	0.00				

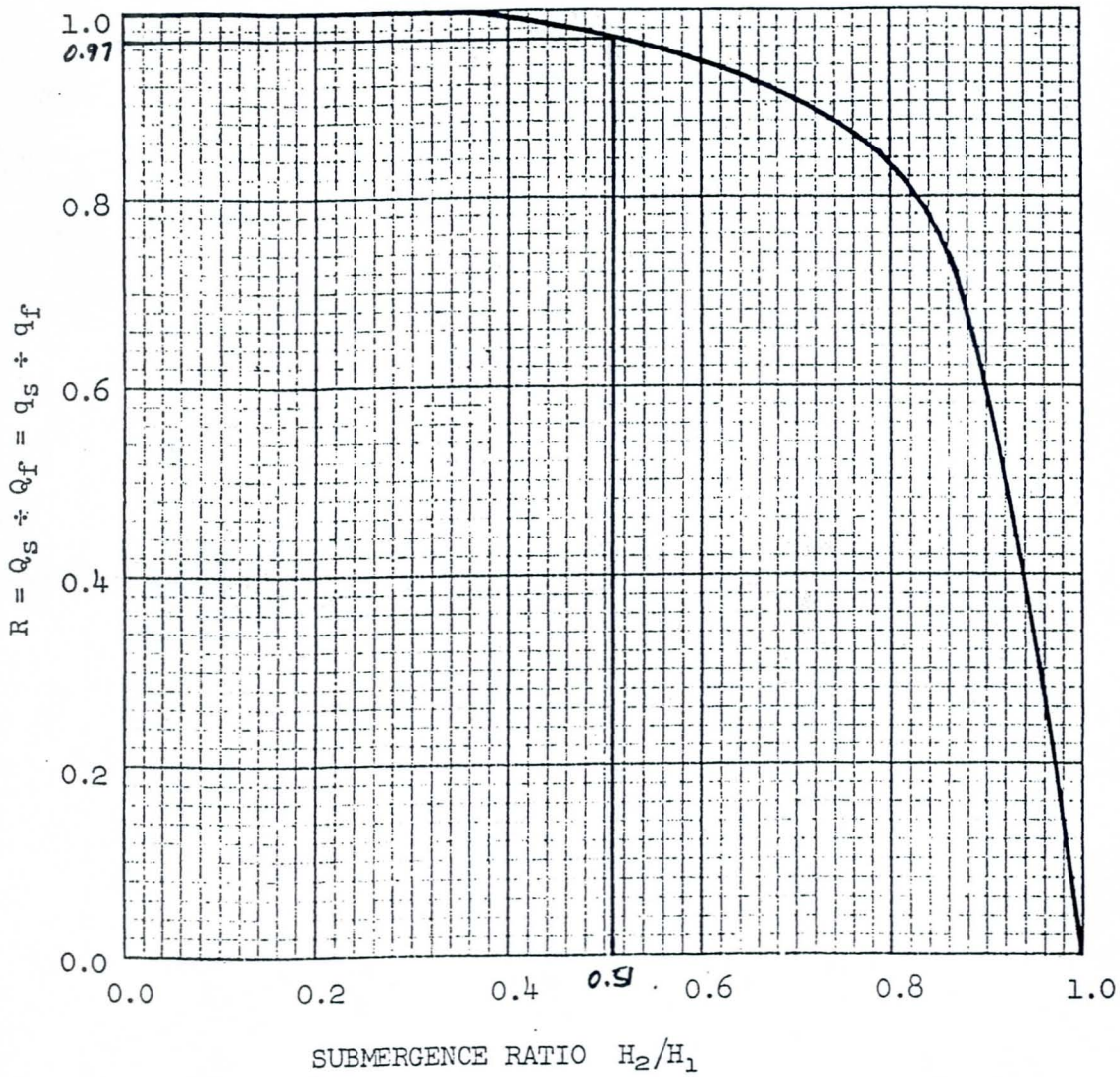
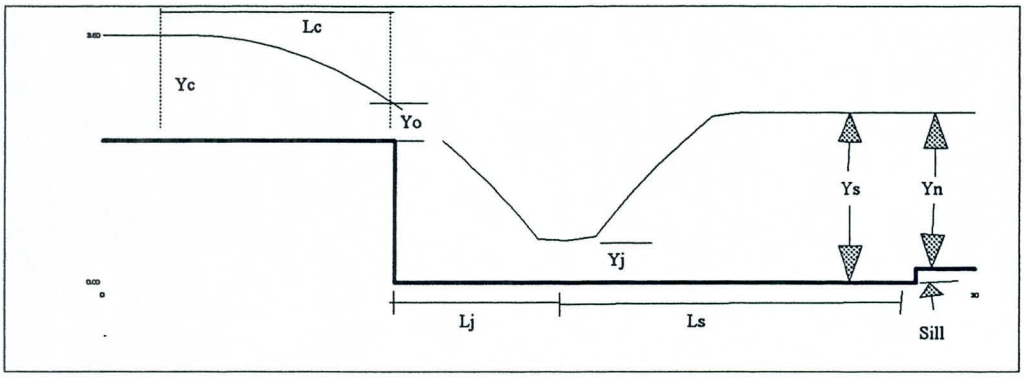

1.0
0.97
0.8
0.6
0.4
0.2
0.0
R = Qs ÷ Qf = qs ÷ qf
0.0
0.2
0.4
0.5
0.6
0.8
1.0
SUBMERGENCE RATIO H2/H1

FIGURE 3.4

Drop Structure Worksheet

Project	White Tanks #3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Upstrem from Olive	**Date**	17-Dec-94



	Upstream Channel			Dowstream Channel	
Flow	Q =	3050			
Y normal	Yn =	5.50		Yn =	5.50
Velocity	Va =	3.00			
Yn + Hv	H1 =	5.64		H2 =	2.99
	Weir crest width				
Coef.	C =	3.10		H2/H1 =	0.53
width	Wf =	73.46		R =	0.95 (fig 3.4)
drop heigt	H =	3.00		qf =	41.52
Drop #	Dn =	1.98		qs =	39.44
Y seq.	Ys =	5.99		Ws =	77.33
	Subm.	YES			
Min. width	W =	77.33			
Width	W =	180.00			
	Drop dimentions				
Y crit.	Yc =	2.21			
Y at dop	Yo =	1.55			
drop #	Dn =	0.33			
L jet	Lj =	9.48			
Y superc.	Yj =	1.01			
Y seq.	Ys =	3.69			
L jump	Ls =	25.48			
L basin	Lb =	34.96			
L upstrea	Lc =	11.28			
	Sill =	0.00			

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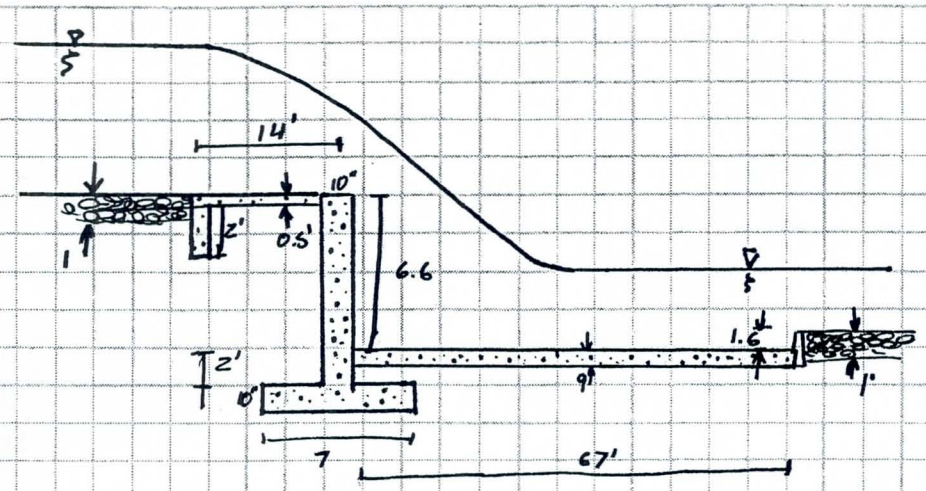
SHEET 1 OF 2
BY AAA DATE 8/5/94
CHECK _____ DATE _____
CLIENT FCDMC
JOB White tank Rip Rap drop (Grouted) cost
JOB NO. 310.44



Volume of Concret

Spillway (7+6.6)(0.83) = 11.29 ft²/LF

upstream App. (14)(0.5) = 7.00 ft²/LF

Downstream Basin (0.75)(67) = 50.25 ft²/LF

Total = 68.53 ft²/LF
= 2.54 cy/LF

Cost 2.54 cy/LF @ $200/cy = $507.69/LF

(structural and non structural concrete)
$300/cy 150/cy

Excavation and Backfill

Basin excess excavation as compared to channel 1.6 + 0.75 − 1 = 1.35 ft

Volume (1.35)(67') = 90 ft³/LF = 3.3 cy/LF

Spillway 0.5(6.6)(6.6) + 4(6.6) + 0.5(2)(2) + (3)(2) = 56 ft³/LF = 2.1 cy/LF

Cost Basin 3.3 cy/LF @ $3/cy = $10/LF

Cost Spillway 2.1 cy/LF @ 10/cy = $21/LF

Rip-Rap Replaced by concrete Volume

(70)(1) + (14)(1) = 110 ft³/LF
= 4.07 cy/LF

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CHECK _____ DATE _____

CLIENT FCDMC

JOB Grouted Rip-Rap Channel drop structure cost

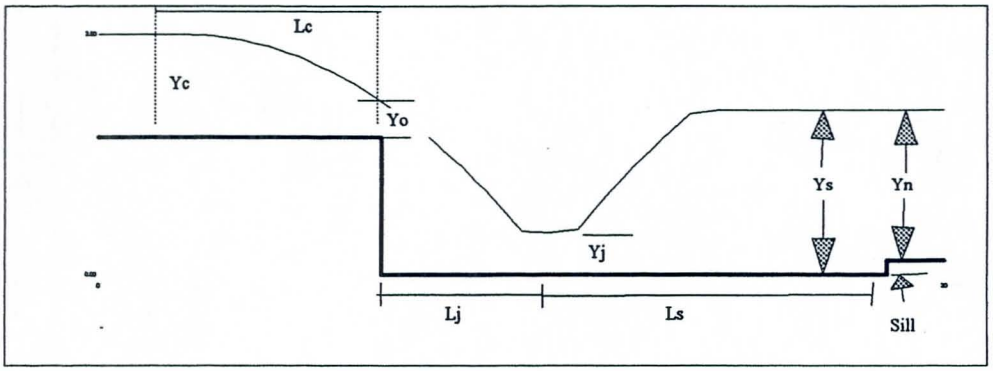
JOB NO. _____

cost saving 4.07 cy/LF @ $65/cy = $264/LF

Total cost

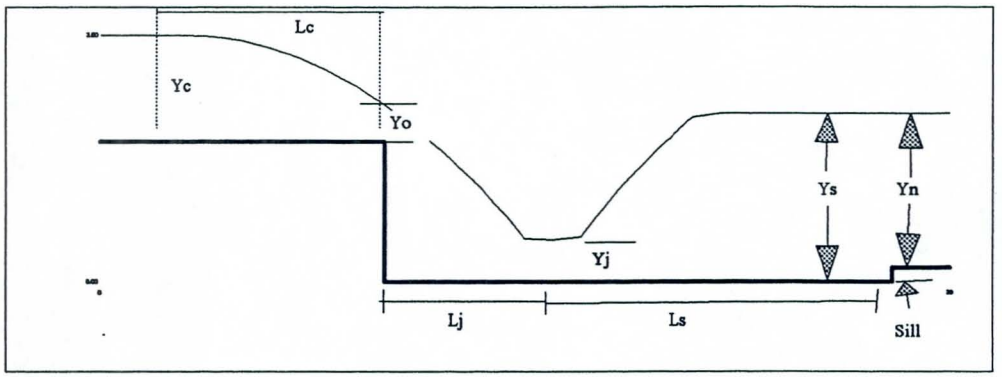
concrete	$ 507.69/LF
Excavation and Backfill	$ 31.0/LF
Rip-Rap	- $ -275.0/LF
	$ 275 /LF

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	WTFRS #3/Northern - GROU. RIP-RAP	**Date**	17-Dec-94



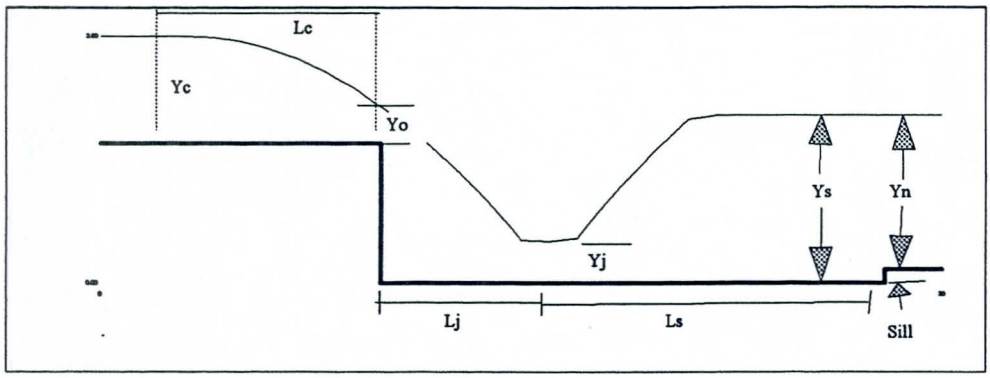
	Upstream Channel			Dowstream Channel		
Flow	Q =	8480				
Y normal	Yn =	5.50		Yn =	5.50	
Velocity	Va =	9.00				
Yn + Hv	H1 =	6.76		H2 =	3.94	
	Weir crest width					
Coef.	C =	3.10		H2/H1 =	0.58	
width	Wf =	155.71		R =	0.99	(fig 3.4)
drop heigt	H =	3.00		qf =	54.46	
Drop #	Dn =	3.41		qs =	53.91	
Y seq.	Ys =	6.94		Ws =	157.29	
	Subm.	YES				
Min. width	W =	157.29				
Width	W =	150.00				
	Drop dimentions					
Y crit.	Yc =	4.61				
Y at drop	Yo =	3.23				
drop #	Dn =	3.68				
L jet	Lj =	18.53				
Y superc.	Yj =	2.82				
Y seq.	Ys =	7.08				
L jump	Ls =	48.84				
L basin	Lb =	67.36				
L upstrea	Lc =	13.52				
	Sill =	1.58				

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	NORTHERN / CHOLLA - GRO. RIP-RAP	**Date**	17-Dec-94



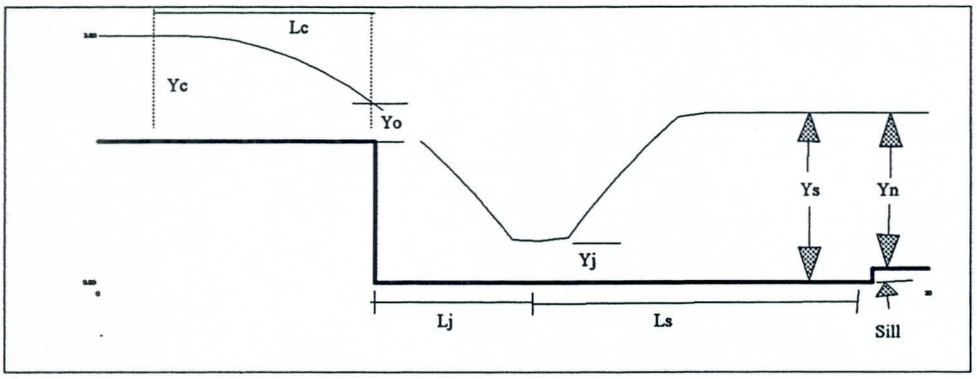
	Upstream Channel		Dowstream Channel		
Flow	Q =	7770			
Y normal	Yn =	5.50	Yn =	5.50	
Velocity	Va =	9.00			
Yn + Hv	H1 =	6.76	H2 =	3.94	
	Weir crest width				
Coef.	C =	3.10	H2/H1 =	0.58	
width	Wf =	142.68	R =	0.99	(fig 3.4)
drop heigt	H =	3.00	qf =	54.46	
Drop #	Dn =	3.41	qs =	53.91	
Y seq.	Ys =	6.94	Ws =	144.12	
	Subm.	YES			
Min. width	W =	144.12			
Width	W =	140.00			
	Drop dimentions				
Y crit.	Yc =	4.56			
Y at dop	Yo =	3.19			
drop #	Dn =	3.54			
L jet	Lj =	18.34			
Y superc.	Yj =	2.77			
Y seq.	Ys =	7.01			
L jump	Ls =	48.35			
L basin	Lb =	66.69			
L upstrea	Lc =	13.52			
	Sill =	1.51			

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	CHOLLA/OLIVE GROU. RIP-RAP	**Date**	17-Dec-94



	Upstream Channel			Dowstream Channel		
Flow	Q =	3230				
Y normal	Yn =	5.50		Yn =	5.50	
Velocity	Va =	9.00				
Yn + Hv	H1 =	6.76		H2 =	3.94	
	Weir crest width					
Coef.	C =	3.10		H2/H1 =	0.58	
width	Wf =	59.31		R =	0.99	(fig 3.4)
drop heigt	H =	3.00		qf =	54.46	
Drop #	Dn =	3.41		qs =	53.91	
Y seq.	Ys =	6.94		Ws =	59.91	
	Subm.	YES				
Min. width	W =	59.91				
Width	W =	60.00				
	Drop dimentions					
Y crit.	Yc =	4.53				
Y at dop	Yo =	3.17				
drop #	Dn =	3.33				
G\reaC	Lj =	18.03				
Y superc.	Yj =	2.70				
Y seq.	Ys =	6.89				
L jump	Ls =	47.56				
L basin	Lb =	65.59				
L upstrea	Lc =	13.52				
	Sill =	1.39				

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	UPSTREAM OLIVE - GROU. RIP-RAP	**Date**	17-Dec-94



	Upstream Channel			Dowstream Channel		
Flow	Q =	3050				
Y normal	Yn =	5.50		Yn =	5.50	
Velocity	Va =	9.00				
Yn + Hv	H1 =	6.76		H2 =	3.94	
	Weir crest width					
Coef.	C =	3.10		H2/H1 =	0.58	
width	Wf =	56.01		R =	0.93	(fig 3.4)
drop heigt	H =	3.00		qf =	54.46	
Drop #	Dn =	3.41		qs =	50.65	
Y seq.	Ys =	6.94		Ws =	60.22	
	Subm.	YES				
Min. width	W =	60.22				
Width	W =	60.00				
	Drop dimentions					
Y crit.	Yc =	4.56				
Y at dop	Yo =	3.19				
drop #	Dn =	2.97				
L jet	Lj =	17.46				
Y superc.	Yj =	2.57				
Y seq.	Ys =	6.68				
L jump	Ls =	46.11				
L basin	Lb =	63.57				
L upstrea	Lc =	13.52				
	Sill =	1.18				

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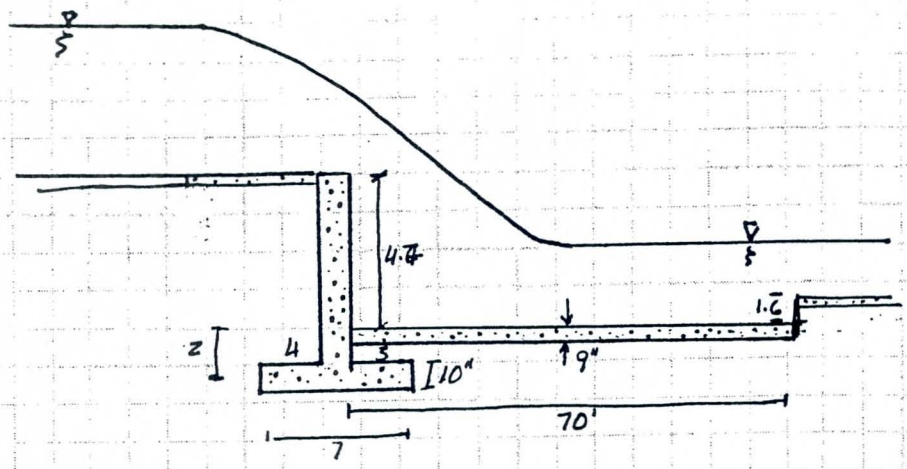
CLIENT FCDMC

JOB White Tanks #3 drop Cost on Concrete Channel JOB NO. 310.44



For a concrete lined channel no upstream apron is required and the downstream apron tickness is increase from 6" to 9"

Volume of Concrete

Spillway $(7+6.7)(0.83)$ $= 11.4\ ft^2/LF$

Basin $(0.75-0.5)(70)$ $= 17.5\ ft^2/LF$

Basin t – channel

Total $28.87\ ft^2/LF$

Cost $1.07\ CY/LF$ @ \$200/cy $= \$213.9/LF$ (\$300/cy For structural \$150/cy For non structural)

Excavation /Backfill

Spillway $0.5(6.7)(6.7) + 4(6.7) + 0.5(2)(2) + (3)(2) = 57.2\ ft^3/LF$
$= 2.12\ CY/LF$

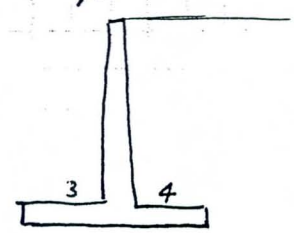
Cost $2.12\ CY/LF$ @ \$10/cy $= \$21.2/LF$

Basin $(1.6+0.25)(70)$ $= 129.5\ ft^3/LF$
$= 4.80\ CY/LF$

Cost $4.80\ CY/LF$ @ \$3/cy $= \$14.39/LF$

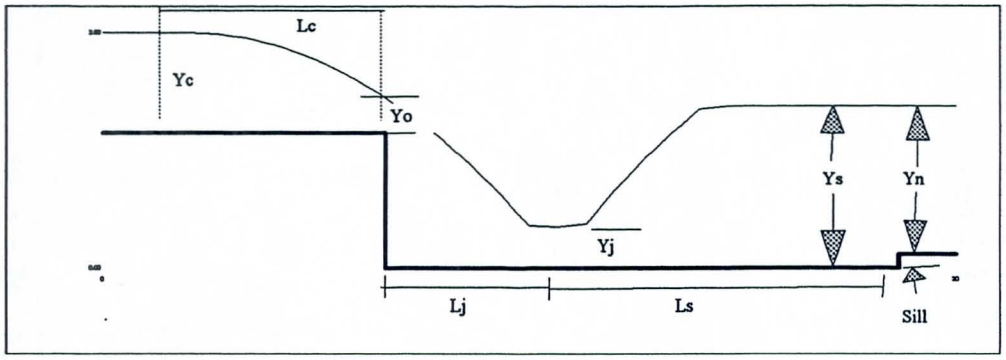
Total cost

$213.9 + 21.2 + 14.39$ $\boxed{\approx \$250/LF}$



Drop Structure Worksheet

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	WTFRS # 3 to Northern - Concrete	**Date**	17-Dec-94



	Upstream Channel			Dowstream Channel		
Flow	Q =	8480				
Y normal	Yn =	5.50		Yn =	5.50	
Velocity	Va =	10.36				
Yn + Hv	H1 =	7.17		H2 =	4.27	
	Weir crest width					
Coef.	C =	3.10		H2/H1 =	0.60	
width	Wf =	142.58		R =	0.92	(fig 3.4)
drop heigt	H =	3.00		qf =	59.47	
Drop #	Dn =	4.07		qs =	54.72	
Y seq.	Ys =	7.27		Ws =	154.98	
	Subm.	YES				
Min. width	W =	154.98				
Width	W =	150.00				
	Drop dimentions					
Y crit.	Yc =	4.62				
Y at dop	Yo =	3.23				
drop #	Dn =	3.68				
L jet	Lj =	18.53				
Y superc.	Yj =	2.82				
Y seq.	Ys =	7.08				
L jump	Ls =	48.84				
L basin	Lb =	67.36				
L upstrea	Lc =	14.33				
	Sill =	1.58				

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SHEET 3 OF 6
BY HAA DATE 8/4/94
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CLIENT FCDMC
JOB White Tanks #3 WTFRS#3 to Northern (Concrete)
JOB NO. _____

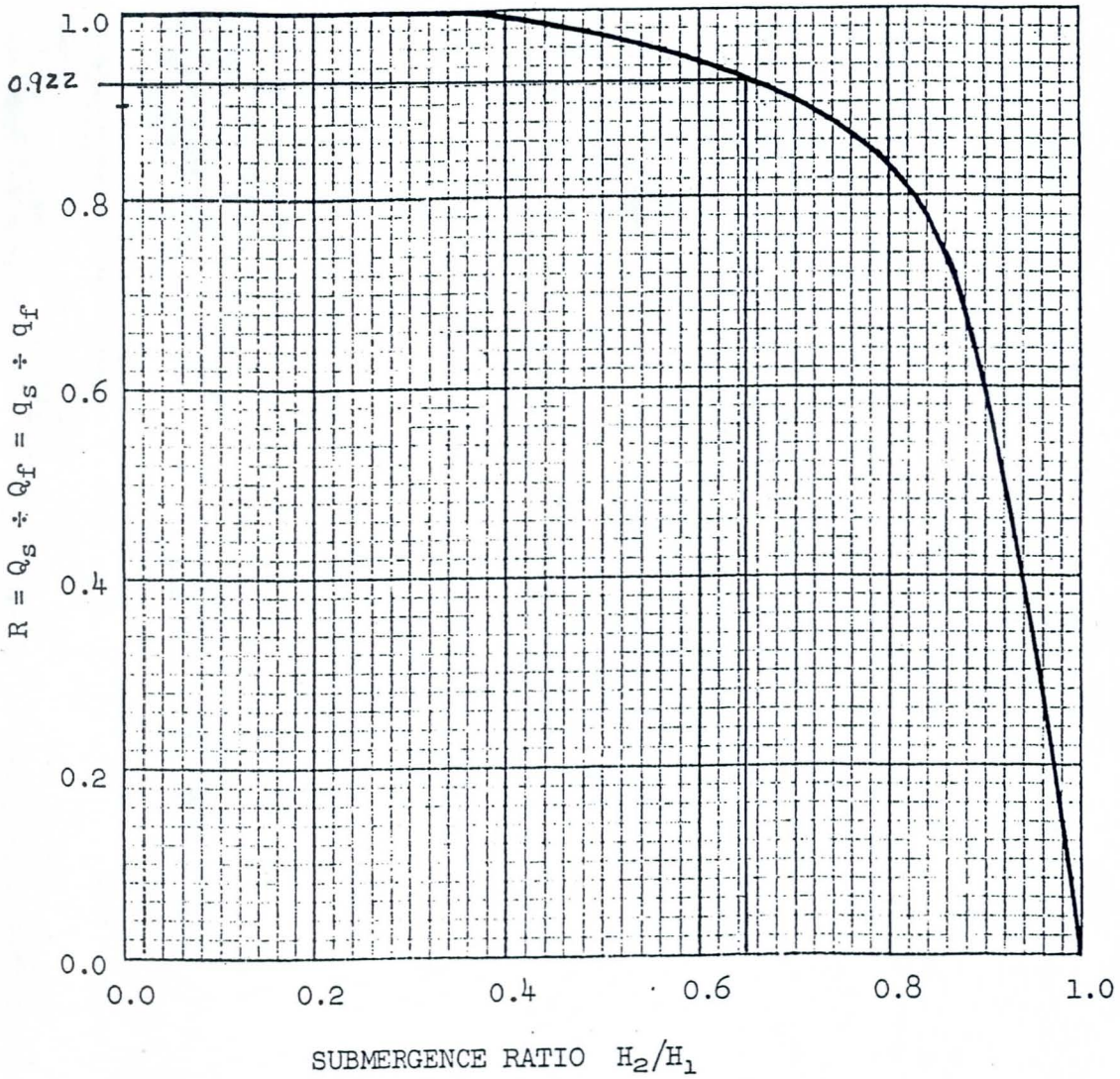
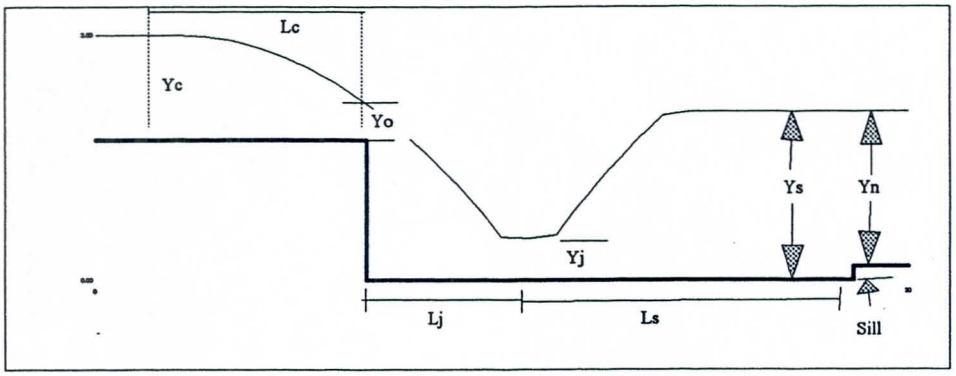


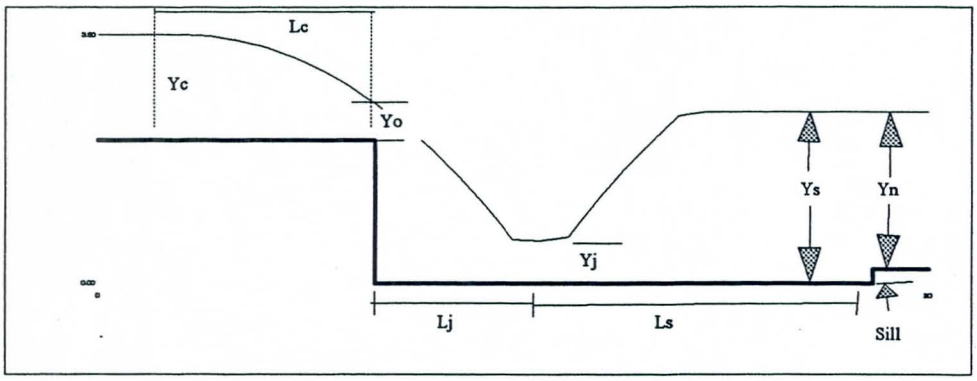
FIGURE 3.4

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Northern to Cholla Concrete	**Date**	17-Dec-94



	Upstream Channel			Dowstream Channel		
Flow	Q =	7770				
Y normal	Yn =	5.50		Yn =	5.50	
Velocity	Va =	10.34				
Yn + Hv	H1 =	7.16		H2 =	4.27	
	Weir crest width					
Coef.	C =	3.10		H2/H1 =	0.60	
width	Wf =	130.82		R =	0.93	(fig 3.4)
drop heigt	H =	3.00		qf =	59.39	
Drop #	Dn =	4.06		qs =	55.24	
Y seq.	Ys =	7.27		Ws =	140.67	
	Subm.	YES				
Min. width	W =	140.67				
Width	W =	140.00				
	Drop dimentions					
Y crit.	Yc =	4.79				
Y at dop	Yo =	3.35				
drop #	Dn =	3.54				
L jet	Lj =	18.34				
Y superc.	Yj =	2.77				
Y seq.	Ys =	7.01				
L jump	Ls =	48.35				
L basin	Lb =	66.69				
L upstrea	Lc =	14.32				
	Sill =	1.51				

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Cholla to Olive - Concrete	**Date**	17-Dec-94

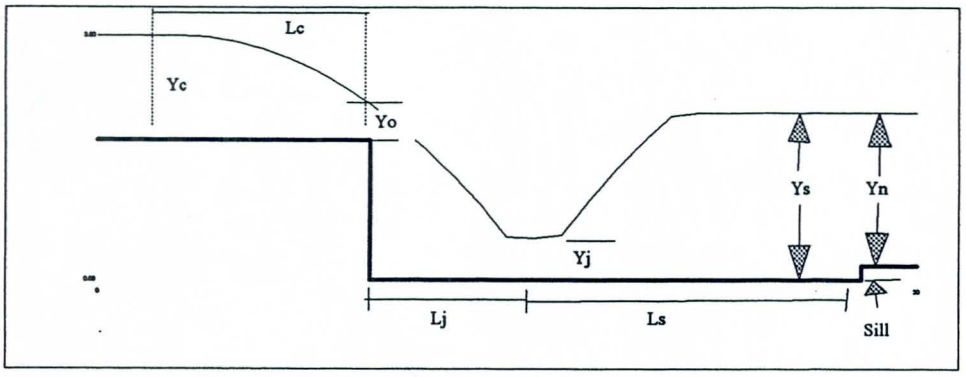


	Upstream Channel		Dowstream Channel		
Flow	Q =	3230			
Y normal	Yn =	5.50	Yn =	5.50	
Velocity	Va =	10.20			
Yn + Hv	H1 =	7.12	H2 =	4.23	

	Weir crest width				
Coef.	C =	3.10	H2/H1 =	0.59	
width	Wf =	54.89	R =	0.93	(fig 3.4)
drop heigt	H =	3.00	qf =	58.84	
Drop #	Dn =	3.98	qs =	54.72	
Y seq.	Ys =	7.23	Ws =	59.03	
	Subm.	YES			
Min. width	W =	59.03			
Width	W =	60.00			

	Drop dimentions	
Y crit.	Yc =	4.72
Y at dop	Yo =	3.30
drop #	Dn =	3.33
L jet	Lj =	18.03
Y superc.	Yj =	2.70
Y seq.	Ys =	6.89
L jump	Ls =	47.56
L basin	Lb =	65.59
L upstrea	Lc =	14.23
	Sill =	1.39

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Upstream from Olive - Concrete	**Date**	17-Dec-94



			Upstream Channel	Dowstream Channel		
Flow	Q	=	3050			
Y normal	Yn	=	5.50	Yn =	5.50	
Velocity	Va	=	9.99			
Yn + Hv	H1	=	7.05	H2 =	4.18	
			Weir crest width			
Coef.	C	=	3.10	H2/H1 =	0.59	
width	Wf	=	52.56	R =	1.00	(fig 3.4)
drop heigt	H	=	3.00	qf =	58.03	
Drop #	Dn	=	3.87	qs =	58.03	
Y seq.	Ys	=	7.18	Ws =	52.56	
	Subm.		YES			
Min. width	W	=	52.56			
Width	W	=	53.00			
			Drop dimentions			
Y crit.	Yc	=	4.95			
Y at dop	Yo	=	3.47			
drop #	Dn	=	3.81			
L jet	Lj	=	18.71			
Y superc.	Yj	=	2.86			
Y seq.	Ys	=	7.15			
L jump	Ls	=	49.31			
L basin	Lb	=	68.02			
L upstrea	Lc	=	14.10			
	Sill	=	1.65			

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SHEET 1 OF 2
BY HAA DATE 9/30/94
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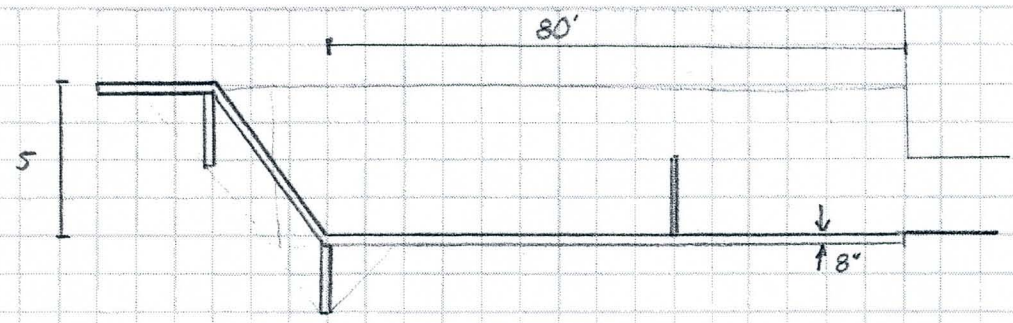
CLIENT FCDMC
JOB White Tanks FRS #3 Inlet Imp
JOB NO. 310.44



Basin Apron

$V = \frac{(0.667)(80)}{27} = 1.97$ CY/ft of width

Cost = (1.97 CY/ft) @ 210/cy = \$415/ft

$V_{channel} = \frac{(0.5)(80)}{27} = 1.48$

Cost channel = 1.48 cy/ft @ \$150/cy = 222 ✓

Cost = 415 − 222 = **\$192/ft** ✓

Inclined Apron

$L = \sqrt{10^2 + 5^2} = 11.2$ ft

$V = \frac{(11.2)(0.5)}{27} = 0.207$ cy/ft

Cost = (0.207) @ \$210/cy = \$43.5/ft

$V_{channel} = \frac{(0.5)(10)}{27} = 0.81$ cy/ft

Cost channel = (0.81) @ \$150/cy = \$27.8 cy

Cost = 43.5 − 27.8 = **\$15.8/ft**

Sill $V = \frac{(2.6)(0.667)}{27} = 0.064$

cost = (0.064) @ \$210/cy = **\$13.5/ft**

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BY UDA DATE 7/30/94

CHECK MJB DATE 10.5.94

CLIENT FCDMC

JOB White Tank FRS #3 Inlet Imp

JOB NO. 310 44

Cut out walls

$$V = \frac{(0.5)(2)}{(27)} = 0.037 \text{ cy/ft}$$

two walls $(0.037)(2) = 0.074$

Cost 0.074 cy/ft @ \$210/cy = \$15.6/ft

Extra liner required

assume $\frac{2(80' \times 7' \times 0.5)}{27} = 20.74 \text{ cy}$

20.74 cy @ \$210 cy = \$4356

Cost = \$4356 / 140 ft = \$31/ft

Excavation and backfill

$$\text{Volume} = \frac{(2)(11)+(2)(4)}{27} = 1.1 \text{ cy/ft}$$

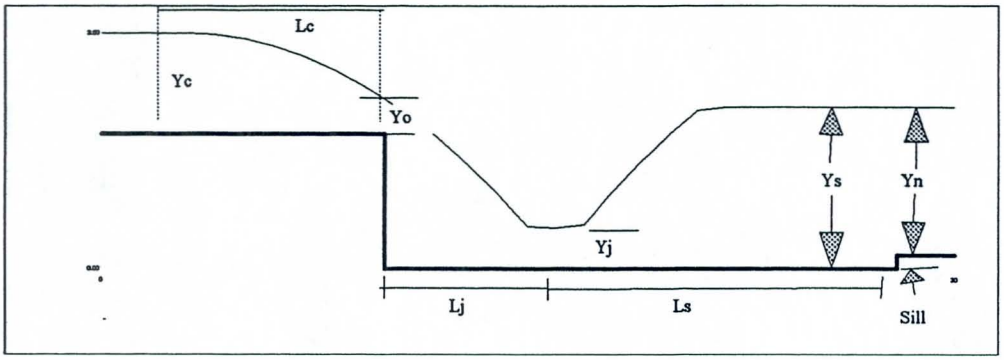
1.1 @ \$10/cy = \$11/ft

total cost = 192 + 16 + 13 + 16 + 31 + 11

= \$279/ft

Drop Structure Worksheet

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	WTFRS # 3 to Northern - Concrete	**Date**	30-Sep-94

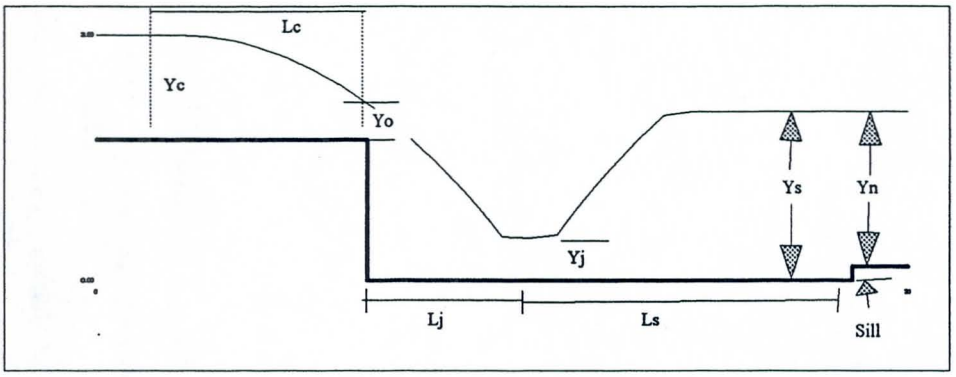


	Upstream Channel			Dowstream Channel		
Flow	Q =	8480				
Y normal	Yn =	5.50		Yn =	5.50	
Velocity	Va =	10.28				
Yn + Hv	H1 =	7.14		H2 =	2.99	
	Weir crest width					
Coef.	C =	3.10		H2/H1 =	0.42	
width	Wf =	143.35		R =	0.99	(fig 3.4)
drop heigt	H =	5.00		qf =	59.16	
Drop #	Dn =	0.87		qs =	58.27	
Y seq.	Ys =	7.99		Ws =	145.53	
	Subm.	YES				
Min. width	W =	145.53				
Width	W =	140.00				

	Drop dimentions	
Y crit.	Yc =	4.62
Y at dop	Yo =	3.23
drop #	Dn =	0.91
L jet	Lj =	20.95
Y superc.	Yj =	2.60
Y seq.	Ys =	8.09
L jump	Ls =	55.86
L basin	Lb =	76.81
L upstrea	Lc =	14.28
	Sill =	2.59

Drop Structure Worksheet

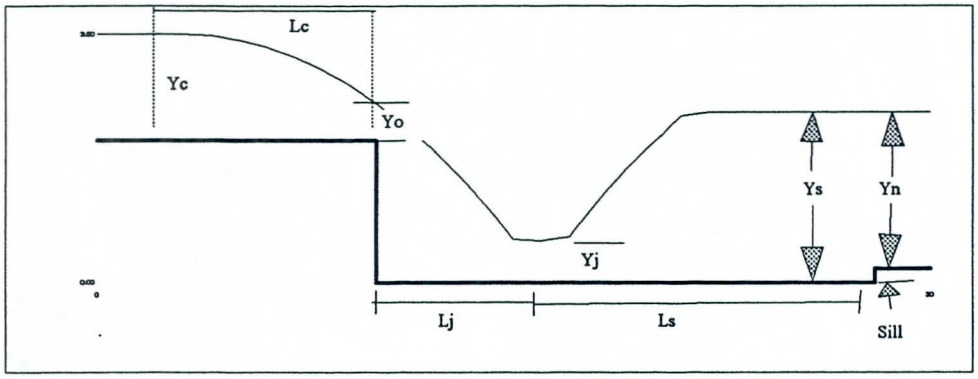
Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Northern to Cholla Concrete	**Date**	30-Sep-94



	Upstream Channel			Dowstream Channel	
Flow	Q =	7770			
Y normal	Yn =	5.50		Yn =	5.50
Velocity	Va =	10.25			
Yn + Hv	H1 =	7.13		H2 =	2.98
	Weir crest width				
Coef.	C =	3.10		H2/H1 =	0.42
width	Wf =	131.61		R =	0.99 (fig 3.4)
drop heigt	H =	5.00		qf =	59.04
Drop #	Dn =	0.87		qs =	58.15
Y seq.	Ys =	7.98		Ws =	133.62
	Subm.	YES			
Min. width	W =	133.62			
Width	W =	130.00			
	Drop dimentions				
Y crit.	Yc =	4.79			
Y at dop	Yo =	3.35			
drop #	Dn =	0.89			
L jet	Lj =	20.80			
Y superc.	Yj =	2.57			
Y seq.	Ys =	8.04			
L jump	Ls =	55.45			
L basin	Lb =	76.25			
L upstrea	Lc =	14.26			
	Sill =	2.54			

Drop Structure Worksheet

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Cholla to Olive - Concrete	**Date**	30-Sep-94



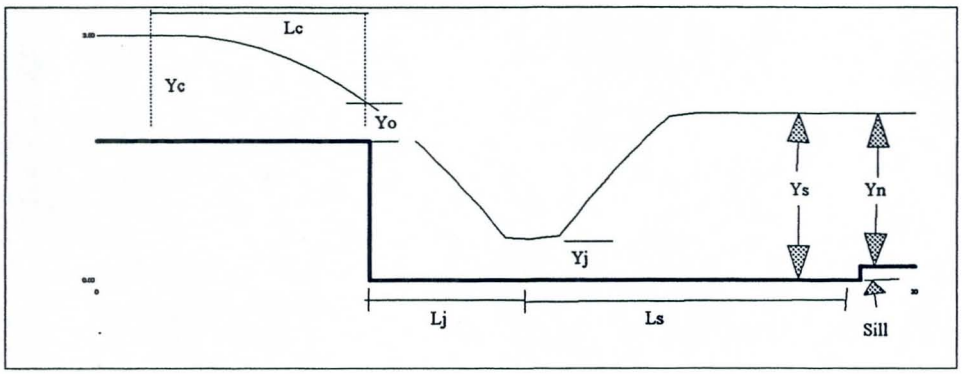
	Upstream Channel		Dowstream Channel	
Flow	Q =	3230		
Y normal	Yn =	5.50	Yn =	5.50
Velocity	Va =	9.79		
Yn + Hv	H1 =	6.99	H2 =	2.85

	Weir crest width				
Coef.	C =	3.10	H2/H1 =	0.41	
width	Wf =	56.40	R =	0.99	(fig 3.4)
drop heigt	H =	5.00	qf =	57.27	
Drop #	Dn =	0.81	qs =	56.70	
Y seq.	Ys =	7.85	Ws =	56.97	
	Subm.	YES			
Min. width	W =	56.97			
Width	W =	60.00			

	Drop dimentions	
Y crit.	Yc =	4.72
Y at dop	Yo =	3.30
drop #	Dn =	0.72
L jet	Lj =	19.62
Y superc.	Yj =	2.35
Y seq.	Ys =	7.60
L jump	Ls =	52.41
L basin	Lb =	72.03
L upstrea	Lc =	13.98
	Sill =	2.10

Drop Structure Worksheet

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Upstream from Olive - Concrete	**Date**	30-Sep-94



	Upstream Channel			Dowstream Channel	
Flow	Q =	3050			
Y normal	Yn =	5.50		Yn =	5.50
Velocity	Va =	9.75			
Yn + Hv	H1 =	6.98		H2 =	2.84
	Weir crest width				
Coef.	C =	3.10		H2/H1 =	0.41
width	Wf =	53.40		R =	0.99 (fig 3.4)
drop heigt	H =	5.00		qf =	57.12
Drop #	Dn =	0.81		qs =	56.55
Y seq.	Ys =	7.84		Ws =	53.94
	Subm.	YES			
Min. width	W =	53.94			
Width	W =	53.00			
	Drop dimentions				
Y crit.	Yc =	4.95			
Y at dop	Yo =	3.47			
drop #	Dn =	0.82			
L jet	Lj =	20.37			
Y superc.	Yj =	2.49			
Y seq.	Ys =	7.87			
L jump	Ls =	54.33			
L basin	Lb =	74.70			
L upstrea	Lc =	13.95			
	Sill =	2.37			

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SHEET 1 OF 2
BY PAA DATE 9-2/94
CHECK MJB DATE 9.2.94

CLIENT FCDMC
JOB WTFRS #3 Inlet
JOB NO. 310.44

Cholla wash inlet

Gabions

Area = 23000 ft^2
Volume = (23000)(2) = 46000 /27
= 1704 cy

Cost = 1704 cy @ $90/cy = $153,333

Grouted Rip Rap

Area = 48000 ft^2
Volume = 48000 ft^3 /27
= 1778 cy

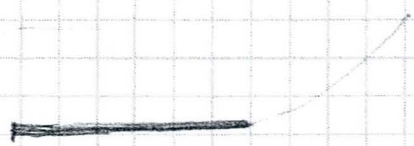
Cost 1778 cy @ $65/cy = $115,570

Concrete

Area = 8000 ft^2
Volume = 4000 ft^3/27
= 148 cy

Cost 148 cy @ $150/cy = $22,200

Wall (between main flow & Cholla Side inflow)



L = 300'
t = 0.75
h = 8'
Volume = 1800 ft^3/27
= 67 cy

Cost 67 cy @ $350/cy = $23450

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BY HDA DATE 9-2-94

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CLIENT FCDMC

JOB WT FRS #3 Inlet

JOB NO. 310.44

Earthwork

average excavation depth 4'

area to excavate = 56000 ft²

Volume = (56000)(4) = 224,000 / 27

= 8297 cy

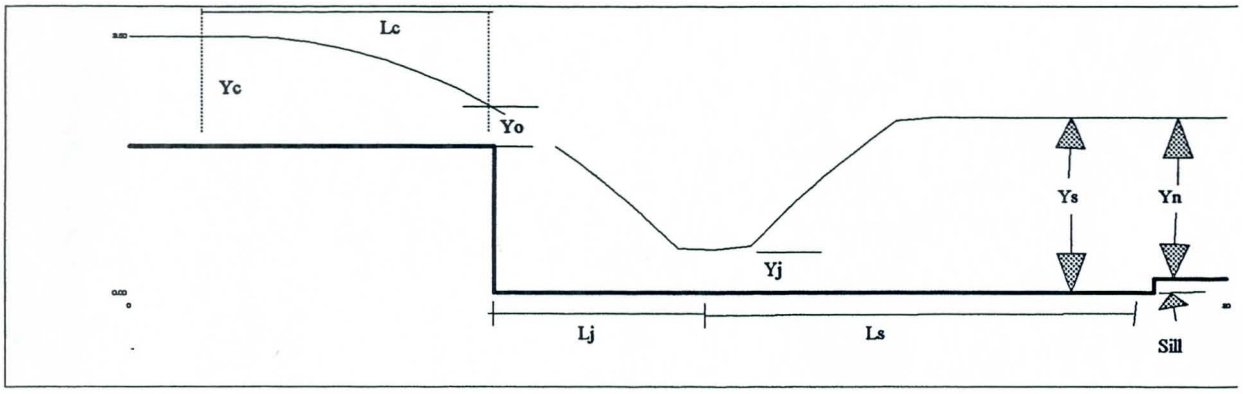
Cost = 8297 cy @ $ 3.00/cy

= $24900

Total cost = 153333
115570
22200
23450
24900
$ 339453 ✓

Drop Structure Worksheet

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Cholla Wash inlet	**Date**	29-Aug-94



	Upstream Channel			Dowstream Channel		
Flow	Q =	5265				
Y normal	Yn =	5.50		Yn =	5.50	
Velocity	Va =	15.00				
Yn + Hv	H1 =	8.99		H2 =	5.74	
	Weir crest width					
Coef.	C =	3.10		H2/H1 =	0.64	
width	Wf =	62.97		R =	0.93	(fig 3.4)
drop heigt	H =	3.00		qf =	83.61	
Drop #	Dn =	8.04		qs =	77.76	
Y seq.	Ys =	8.74		Ws =	67.71	
	Subm.	YES				
Min. width	W =	67.71				
Width	W =	62.00				
	Drop dimentions					
Y crit.	Yc =	6.07				
Y at dop	Yo =	4.25				
drop #	Dn =	8.29				
L jet	Lj =	23.23				
Y superc.	Yj =	3.98				
Y seq.	Ys =	8.82				
L jump	Ls =	60.83				
L basin	Lb =	84.06				
L upstrea	Lc =	17.99				
	Sill =	3.32				

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BY HOA DATE 9-1-94
CHECK MUB DATE 9.2.94

CLIENT FCDMC
JOB White tanks FRS#3 Inlet JOB NO. 310.44

Outlet into WTFRS #3

Gabion

W = 320
L = 50
D = 2'

Volume = (320)(50)(2)

= 32000 ft³ / 27 ft³/cy

= 1185 cy

cost of Gabion 1185 @ $90 cy = $106,666 ✓

Concrete

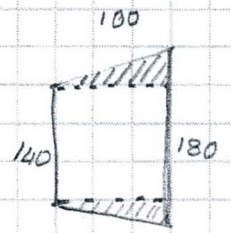
W_{max} = 180 maximum width of structure
W_{min} = 140 minimum width of structure

L = 100' length of concrete transition

Extra concrete required at floor of transition = (180-140) 100/2 (0.6)

= 1200 ft³ / 27

= 44 cy



Extra concrete required at walls of transition

$W_{min} = \sqrt{8^2 + 12^2} = 14.4$ ft

$W_{max} = \sqrt{8^2 + 32^2} = 33$ ft

(33 - 14.4)(100)(0.6) = 1116 ft³/27

= 41 cy

Total additional concrete = (41 + 44) = 85 cy
total concrete cost 85 cy @ $150/cy = $12,750 ✓

Earth work 1185 cy for gabions ✓

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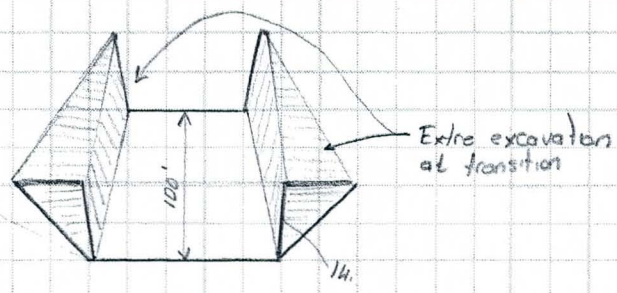
CHECK MJB DATE 9.2.94

CLIENT FCDMC

JOB White Tanks FRS #3 Inlet.

JOB NO. 310.44



total are at downstream = $[180 + (4)(8)]8$
$= 1696\ ft^3$

total area of channel $[140 + (1.5)(8)]8$

$= 1216\ ft^3$

assuming a average x-sec 2/3 from upstream end

extra excavation area at downstream = $1696 - 1216 = 480\ ft^3$
extra excavation area at upstream = 0

Average area $2/3\ (480) = 320\ ft^3$

Volume $= (320)(100) = 32000\ ft^3/27$

$= 1185\ cy$

Total excavation Volume $= 1185 + 1185$

$= 2370\ cy$

total excavation cost = 2370 cy @ \$3.00/cy = \$7111

$\boxed{\text{Total cost of structure} = \$126,500}$

Cost/ft width $(126500)/140 = \$904/ft$ ✓

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BY HAA DATE 8/18/94

CHECK MJB DATE 9.6.94

CLIENT FCDMC

JOB White Tanks JOB NO. 310.44

Inlet at wash upstream from Olive Av.

$Q = 2800$ cfs (ADMS flow from areas 1 and 2)

$Q = C L H^{1.5}$ assuming a weir coefficient $C \approx 3$ and 1' of head

$2800 = 3 L 1^{1.5}$

$L = 2800/3$

$= 930$ ft

Required 930 ft weir at 1' of head

Inlet at Cholla Wash

$Q = 5265$ cfs (Adms flow from areas 8 and 10)

assumming a weir coefficient $C \approx 3.0$ and 1' of head

5265 cfs $= 3 L 1^{1.5}$

$L = 5265/3$

$= 1755$ ft.

Conclusion - A weir is Impractical!

WEIR LENGTH AND HEAD REQUIREMENTS

Project White Tanks FRS # 3 inlet
Project # 310.44
Location Wash upstream from Olive Av.

Design HAA
Check
Date 18-Aug-94

C = 3
Q = 2800 HEC 1 RCP 2 (2757)

L	H
100	4.43
150	3.38
200	2.79
250	2.41
300	2.13
350	1.92
400	1.76
450	1.63
500	1.52
550	1.42
600	1.34
650	1.27
700	1.21
750	1.16
800	1.11
850	1.06
900	1.02
950	0.99
1000	0.96

$Q = C L H^{1.5}$

WEIR LENGTH AND HEAD REQUIREMENTS

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Wash upstream from Olive Av.	**Date**	18-Aug-94

C = 3
Q = 2800

$Q = C L H^{1.5}$

L	H
100	4.43
150	3.38
200	2.79
250	2.41
300	2.13
350	1.92
400	1.76
450	1.63
500	1.52
550	1.42
600	1.34
650	1.27
700	1.21
750	1.16
800	1.11
850	1.06
900	1.02
950	0.99

WEIR LENGTH AND HEAD REQUIREMENTS

Project	White Tanks FRS # 3 inlet	**Design**	HAA
Project #	310.44	**Check**	
Location	Wash upstream from Olive Av.	**Date**	18-Aug-94

C = 3
Q = 2800

$Q = C L H^{1.5}$

L	H
100	4.43
150	3.38
200	2.79
250	2.41
300	2.13
350	1.92
400	1.76
450	1.63
500	1.52
550	1.42
600	1.34
650	1.27
700	1.21
750	1.16
800	1.11
850	1.06
900	1.02
950	0.99

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BY HAA DATE 9/1/94

CHECK _____ DATE _____

CLIENT FCDMC

JOB White tanks FRS #3 Inlet JOB NO. 310.04

Baffle Apron Drop @ Inlet North of Olive

Q = 2800 cfs

assuming a 7 ft depth upstream and 5 ft/sec velocity

$A = Q/V$

$= 2800/5$
$= 560 \text{ ft}^2$

$B = 560/7$

$= 80 \text{ ft}$ use 80'

$q = 2800/80 = 35 \text{ cfs/ft}$

$V_c = \sqrt[3]{(32.2)(35)}$

$= 10.4$

$V_c/2 = 10.4/2 = 5.2$

entrance velocity $= 5 < 5.2$ ok

Inlet lenght $\underline{(2)(5) = 10 \text{ ft}}$ L_1 ←

$d_c = V_2^2/32.2 = 3.33 \text{ ft}$

Block height $h_b = 0.9 d_c = \underline{3 \text{ ft}}$

Block width and spacing W

$W_{max} = 1.5 h_b = (1.5)(3) = 4.5$
$W_{min} = h_b = 3$

dry 4' 3" $= \underline{4.25}$ W_{block} ←

width of partial block $= [80 - (18)(4.25)]/2 = 1.75 \text{ ft}$

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BY HAA DATE 9-1-94

CHECK _____ DATE _____

CLIENT FCDMC

JOB WT FRS #3 Inlet JOB NO. 310.44

select Top block tickness >8 <10 9"

sill height

$$h_s = (d_1 + h_{v1}) - (d_c + h_{vc}) - 0.5(h_{vc} - h_{v1})$$

$$h_v = \frac{v^2}{2g} = \frac{5^2}{(2)(32.2)} = 0.39$$

$$h_{vc} = \frac{(10.4)^2}{2(32.2)} = \quad = 1.68$$

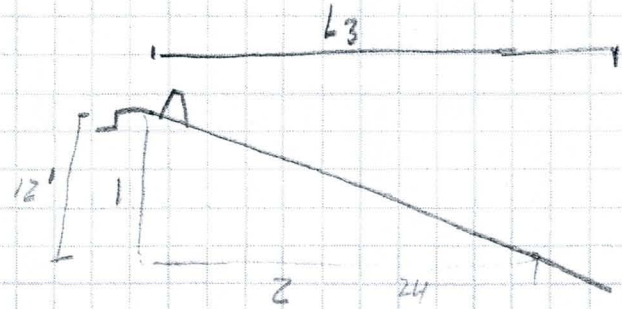
$$h_s = (7 + 0.39) - (3.33 + 1.68) - 0.5(1.68 - 0.39)$$

$$\underline{= 1.74}$$

hs

slope distance between blocks

$$S = 2h_b \text{ min} = 2(3) = 6 \text{ min}$$



$$L_s = (5)(6) = 30'$$

$$L_3 = 2\sqrt{L_s^2/5} = 26.8$$

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CLIENT FCDMC

JOB WTFRS # 3 Inlet JOB NO. 310.44

$h_1 = d_1 + 1$

$= 7 + 1 = 8$ ft

$h_3 = 3h_0$
$= (3)(3) = 9$

$M_1 = 1.5h_1 + C_1$ $C_1 = 3$ @ figure 7-2

$M_1 = (1.5)(8) + 3$

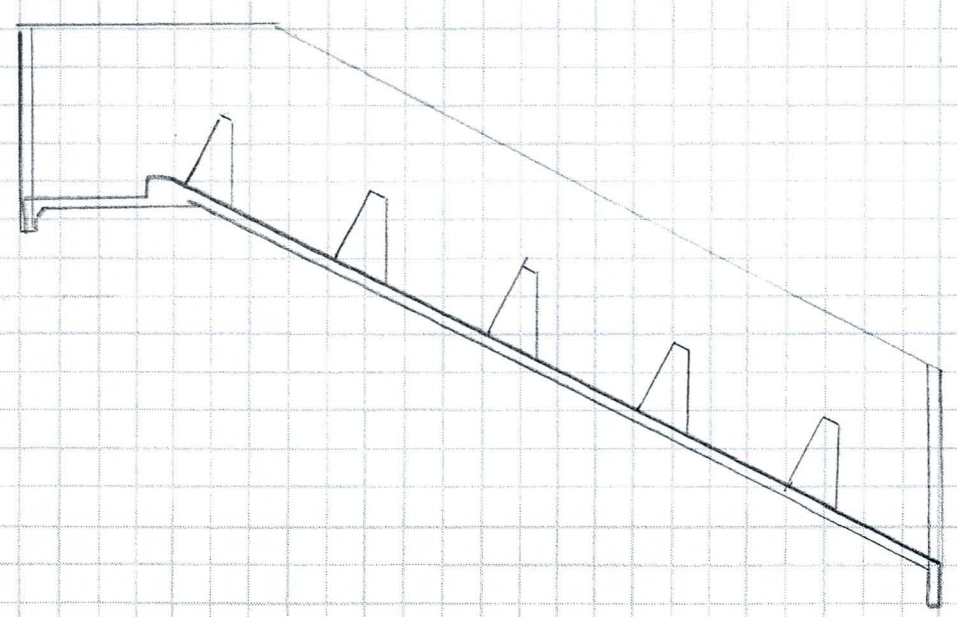
$= 15$

$M_3 = 1.5h_3' + C_3$ $C_3 = 3$

$1.5\left(\frac{h_3}{\cos\theta}\right) + C_3$

$= 1.5\ \frac{9}{0.8944} + 3$

$= 18$ ft



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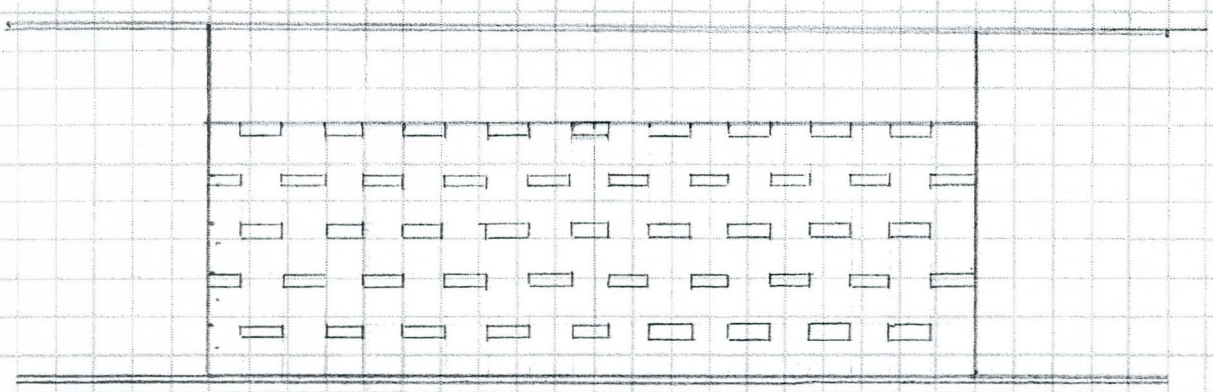
BY HAA DATE 9-2-94

CHECK _____ DATE _____

CLIENT FCDMC

JOB WTFRS #3 Inlet

JOB NO. 310.44



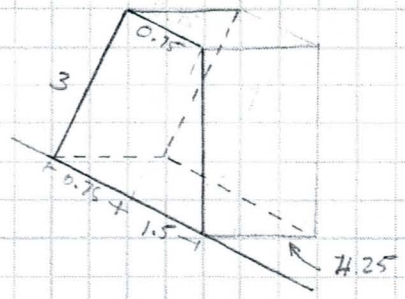
BEGIN COST ESTIMATE

assuming apron and wall to be 9" thick (0.75')

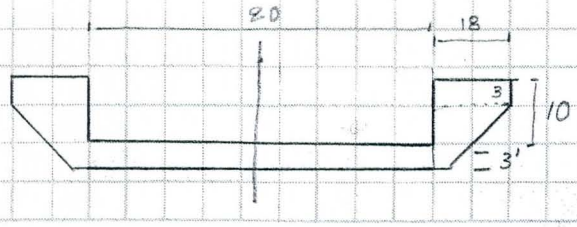
Volume of Concrete

Shute Apron = 80 x 30 x 0.75 = 1800 ft³/27 = 67 cy
Shute wall = 2(26.8)(9)(0.75) = 361 ft³/27 = 13 cy
Inlet Apron = 10 x 80 x 0.75 = 600 ft³/27 = 22 cy
Inlet walls = 2(10)(8)(0.75) = 120 ft³/27 = 5 cy

blocks = 43 [(3)(0.75) + ½(1.5)(3)] 4.25
= 822 ft³/27 = 30 cy



Inlet wing walls = [(3)(18) + (40)3 + ½(7)(18)] 2 = 474 ft³/27 = 18
Outlet wings = 18



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BY HAA DATE 12-94

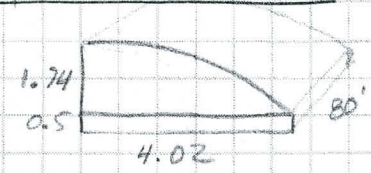
CHECK _____ DATE _____

CLIENT FCDMC

JOB WTFRS #3 Intel JOB NO. 310.44

Volume of Conc. (Cont'd.)

Sill



$\theta = 26° 34'$ $\frac{\pi}{180} = 0.4637$

$$\text{Area} = \left[\tfrac{1}{2}(4.02)(1.74) + (0.5)(4.02) + \tfrac{1}{8}(0.4637 - \sin 0.4637)(18)^2\right] 80$$

$= 1920 \text{ ft}^3/27$

$= 71 \text{ cy}$

Total volume of concrete = 244 cy

Cost of concrete 244 cy @ \$350/cy = \$85400

Gabions

Area = 7300 ft²

Volume = 7300 (2) = 14600 ft³/27

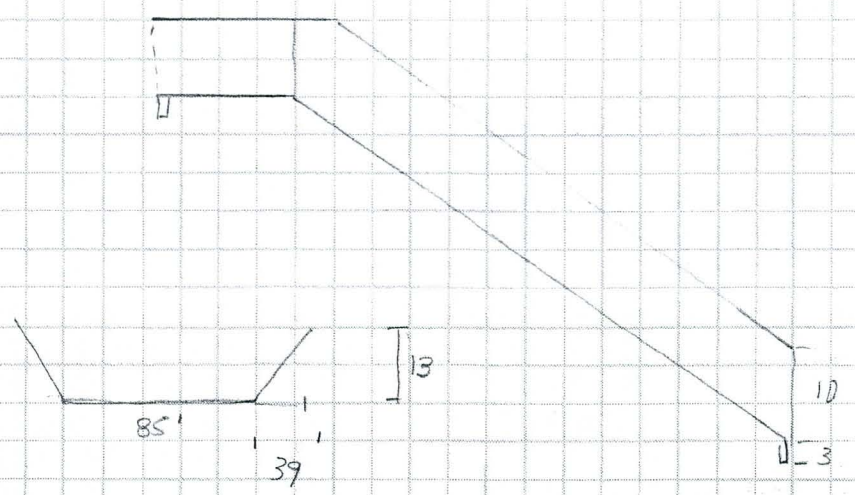
= 541 cy

Cost = 541 cy @ \$90/cy = 48690

Earthwork

Gabion excavation 541 cy

assuming structure top at ground level and 3:1 slopes



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BY HAA DATE 9-2-94

CHECK _____ DATE _____

CLIENT FCDMC

JOB WTFRS #3 Inlet

JOB NO. 310.44

Area = (85)(13) + (39)(13)

= 1612 ft²

Volume = 1612 (27 + 10)

= 59321 ft³/27

= 2,197 cy

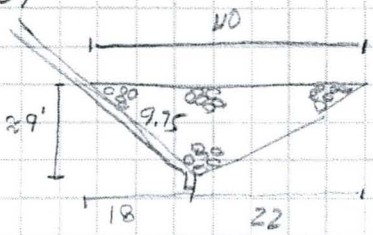
Cost 2197 cy @ $3.00/cy = $6590

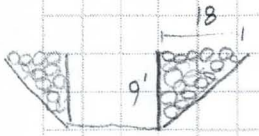
Rip-Rap

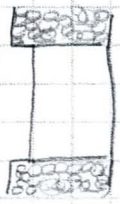
Volume = [(40)(9)/2] 80

= 14400 ft³/27

= 533 cy







= (18)(9)(27)

= 4374/27 ft³/cy

= 162 cy

total rip-rap volume = 700 cy

Cost 700 cy @ $40/cy = $27800

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BY JAA DATE 9-2-94

CHECK _____ DATE _____

CLIENT FCDMC

JOB WTFRS #3 INlet JOB NO. 310-44

Channel Transition

Area of concrete = 8800

Volume = (8800)(0.5)
= 4400/27 = 163 cy

Cost 163 cy @ $150/cy = $24444

Total cost 85400
48690
27800
24444
$186334

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SHEET 1 OF 1
BY HAA DATE 9-1-94
CHECK MJB DATE 9.2.94

CLIENT FCDMC
JOB White Tanks FRS #3 Inlet
JOB NO. 310.44

Inlet structure at upstream end of project

Gabions L = 50
W = 60'
t = 2

Volume of gavions = (50)(60)(2) = 6000 ft³/27
= 230 cy

cost = 230 cy @ $90/cy = $20700

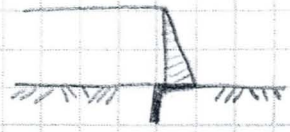
Earth work

assuming need to excavate full area of channel for 100 ft before aligning with existing channel

V = [53 + (1.5)(8)] 8 (100)
= 52000 ft³ /27
= 1.926

cost 1926 cy @ $3.00/cy = $5780

concrete wing wall end cut of wall



cut off wall (53)(3)(0.67) = 106 ft³/27
3.94 cy

wing wall = (8)(20)(0.67) = 107 ft³/27
= 3.97

total concrete 3.94 + 3.97 = 7.91 cy

Cost of concrete 7.91 cy @ $350 cy = $2770

Total cost = $29250 ✓

cost/ft width = (29250)/53 = $552/ft

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BY HAA DATE 9/30/94

CHECK MJB DATE 10.5.94

CLIENT DCDMC

JOB White Tanks FRS #3 Inlet Imp. JOB NO. 310.444

Outlet cost Supercritical Alternative

W_{max} = 180 ft

W_{min} = 75

L = 250 ft

Extra concrete required at floor of transition

$Y = (180 - 75)(250)/2\ (0.58)$

$= 7612\ ft^3$

$= 282\ cy$

Extra concrete at walls

$W_{min} = \sqrt{8^2 + 12^2} = 14.4\ ft$

$W_{max} = \sqrt{8^2 + 32^2} = 33\ ft$

$Y = (33 - 14)(250)(0.5)$

$= 2325\ ft^3$

$= 88\ cy$

Sill assume 100 ft sill 2 ft height and 8" wide

$Y = \frac{(100)(2)(0.667)}{27} = 4.9\ cy$

Total concrete = 4.9 + 88 + 282 = 374.9

Cost 375 cy @ $210/cy = $78729

Extra excavation

total area downstream $[180 + (4)(8)]8 = 1696$

total area channel $[75 + (1.5)(8)]8 = 696$

assuming av. x-sec 2/3 from downstream end

extra excavation upstream $1697 - 696 = 1000\ ft^3$
extra excavation downstream $0\ ft^3$

Average area $= 2/3\ (1000) = 667\ ft^3$

Volume $= \frac{(667)(250)}{27} = 6175\ cy$

Gabions Volume and Cost

Same as subcritical

$V = 1185\ cy$
$\$ = 106666$

Earthwork

$V = 6175 + 1185$
$= 7360\ cy$

Cost 7360 cy @ \$3.0/cy = \$22080

Total cost

22080
106666
78729
\$207475

Cost/ft $= 207475/75$
$= \$2766.3/ft$ ✓

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SHEET 1 OF 1
BY HAA DATE 9/30/94
CHECK MJB DATE 10.5.94
CLIENT FCDMC
JOB White Tanks
JOB NO. 310 44

Inlet structure

Cost the same as subcritical

$552/ft

add cost of one drop to put channel at right depth

$279/ft

Total cost = 552 + 279

= $831/ft ✓

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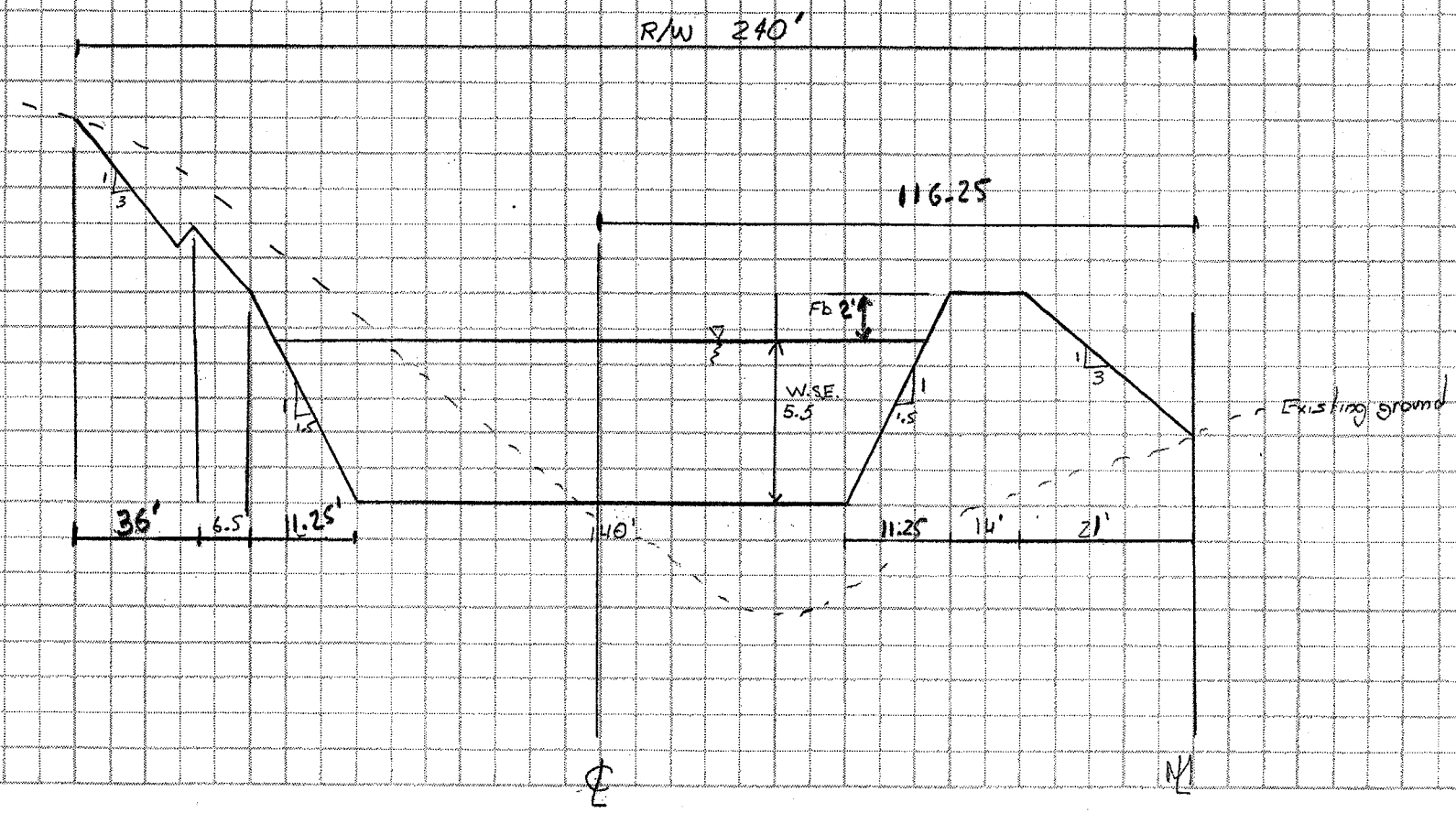
CLIENT FCDMC
JOB White tanks R/W determination

SHEET 1 OF 5
BY AAA DATE 8/5/94
CHECK MJB DATE 9.2.94
JOB NO. 310.44

Reach A the most critical section located at Sta 77+00

equivalent overexcavation [(6.5)+(21)]/2/3 = 4.6'



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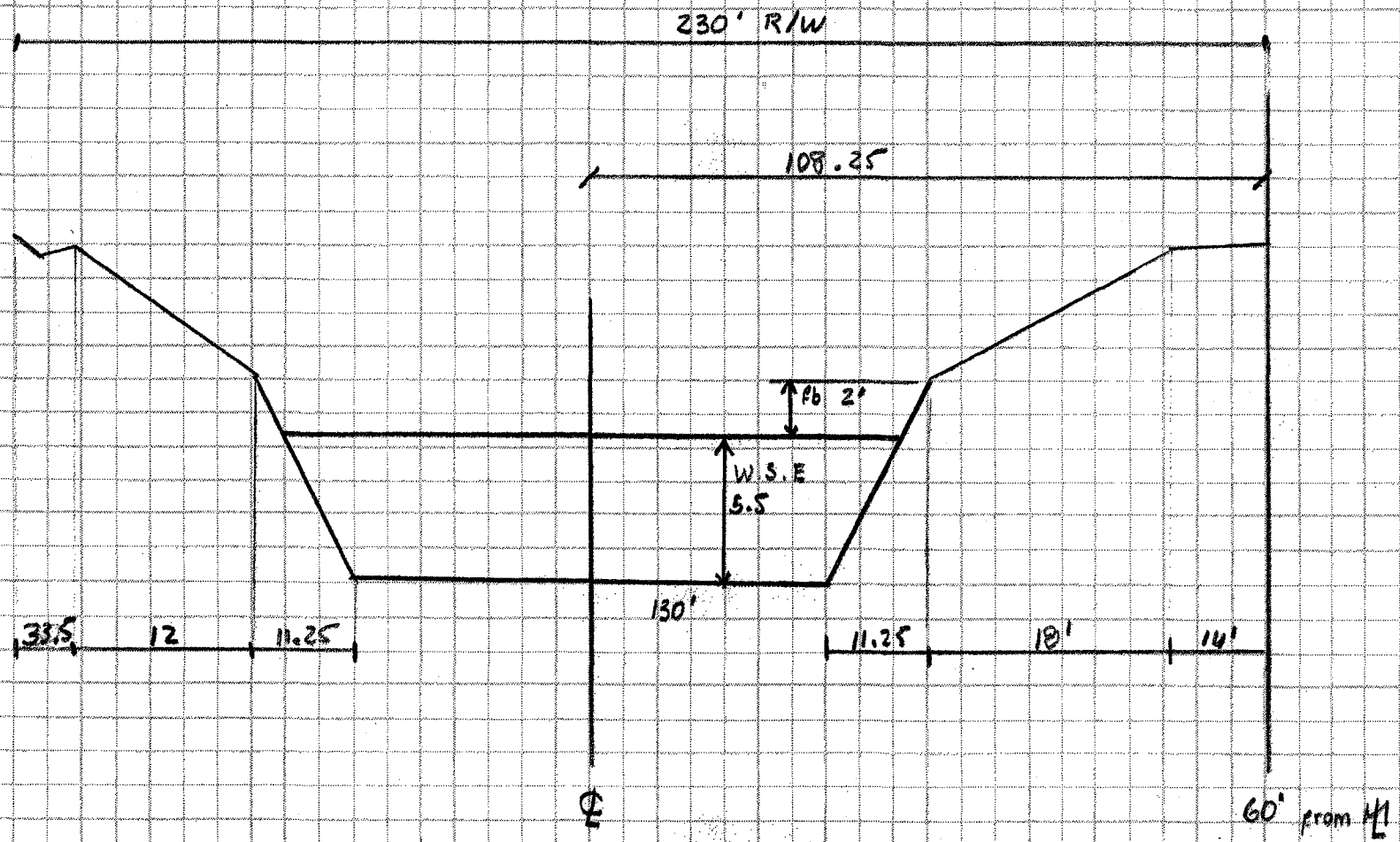
CLIENT FCDMC
JOB White Tanks R/W determination

SHEET 2 OF 5
BY [illegible] DATE 8/5/94
CHECK MJB DATE 9.2.94
JOB NO. 310.44

Reach B the most critical section located at sta 120+00

equivalent overexcavation (12 + 18)/2/3 = 5'



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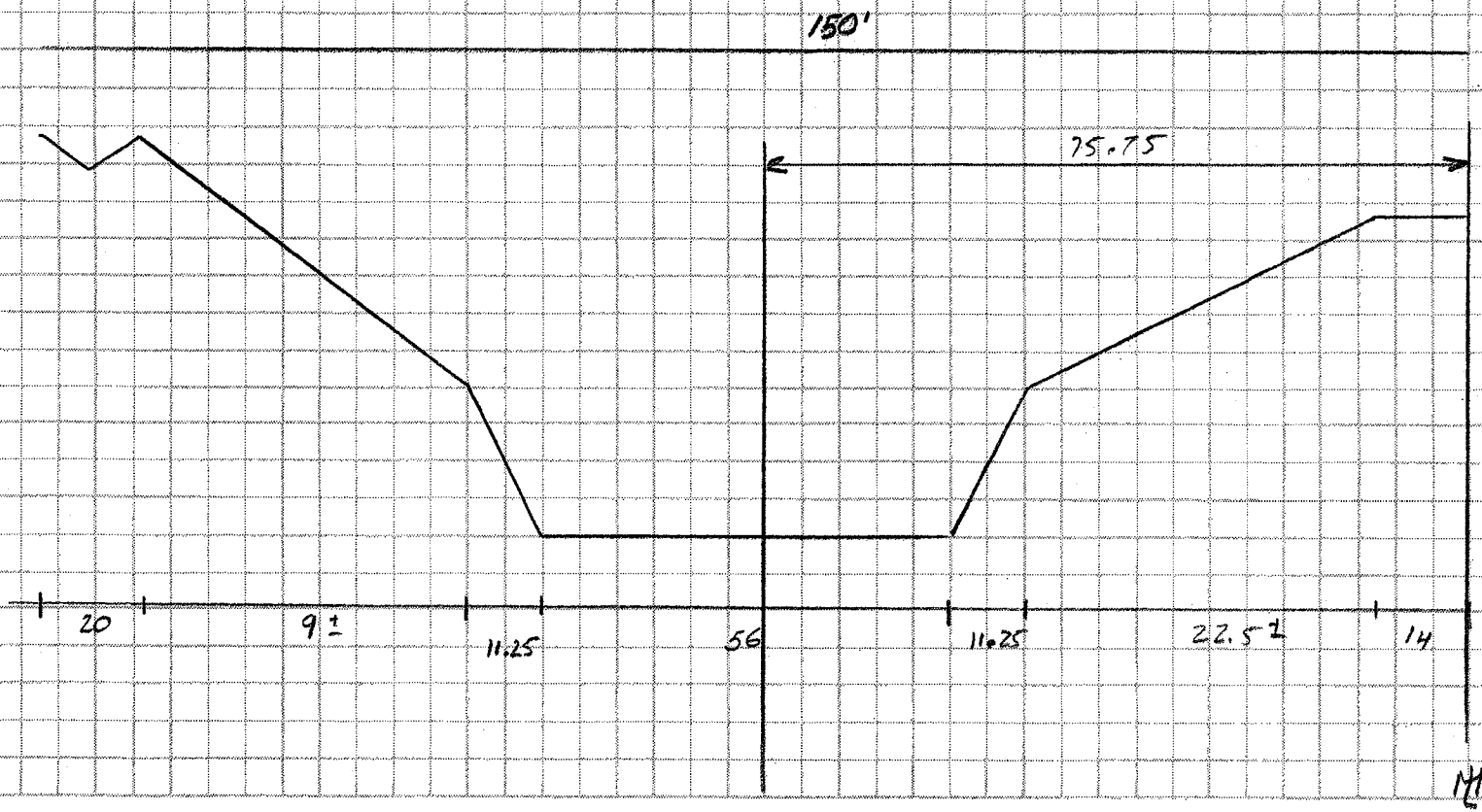
CLIENT FCDMC
JOB White Tank R/W

SHEET 3 OF 5
BY [illegible] DATE 8/5/94
CHECK MJB DATE 9.12.94
JOB NO. 310.44

Reach C Most critical section at Sta

equivalent overexcavation (9 + 22.5)/2/3 = 5.25



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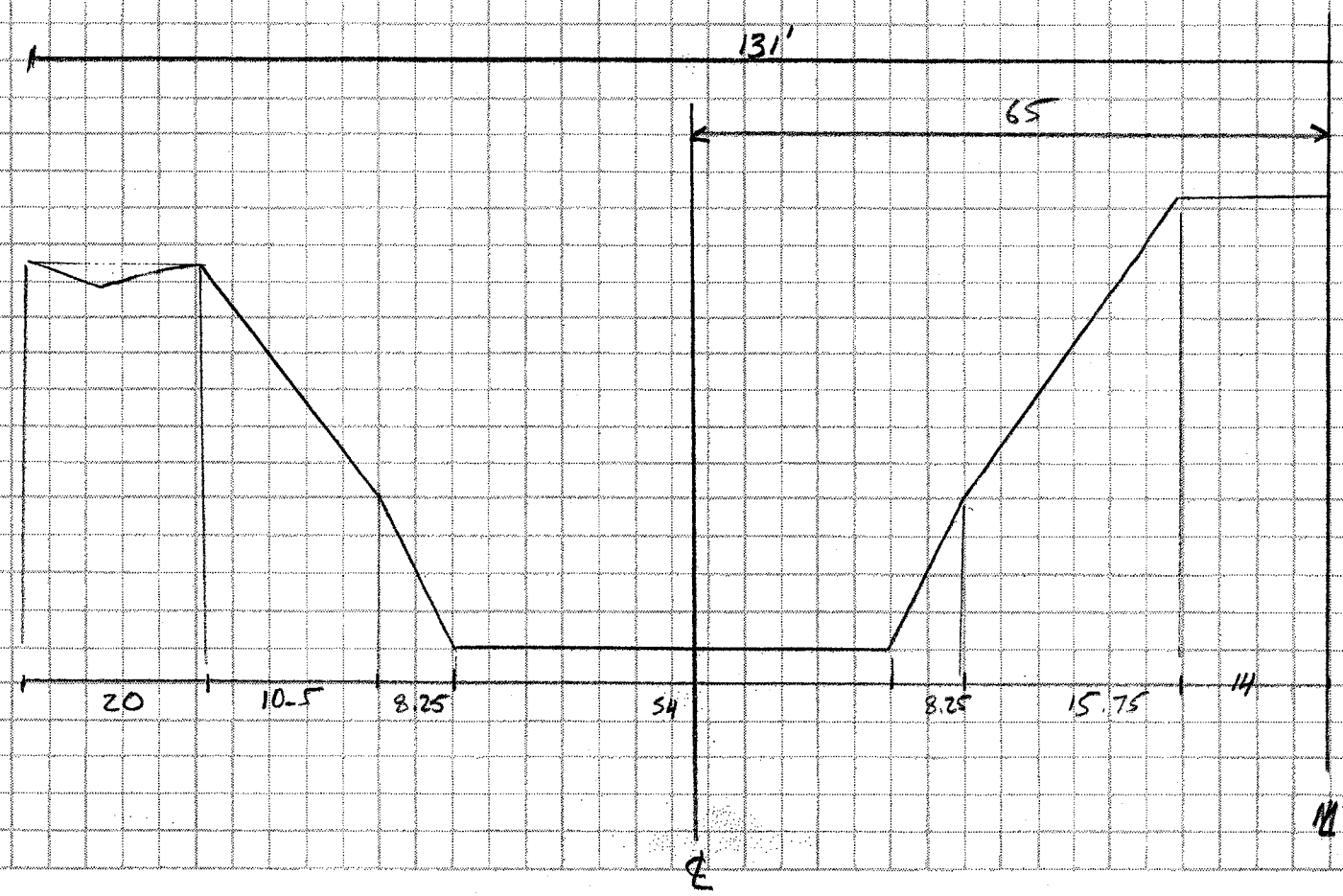
CLIENT FCDMC
JOB White Tank FRS #3 Inlet

SHEET 4 OF 5
BY [illegible] DATE 8/5/94
CHECK MJB DATE 9.2.94
JOB NO. 310.04

Reach D most critical section at sta 165+00

Equivalent overexcavation $(10.5 + 15.75)/2/3 = 4.4$



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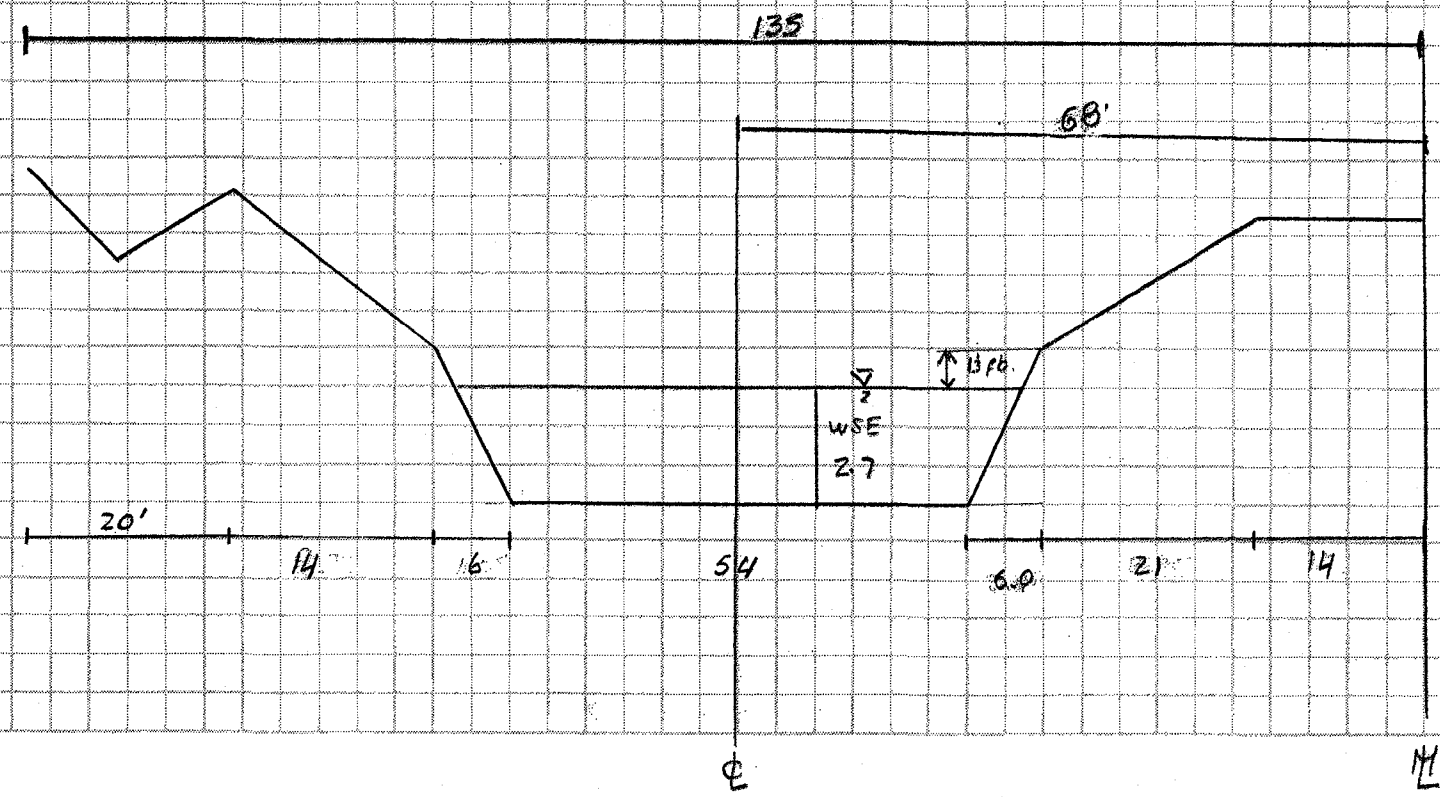
CLIENT FCDMC
JOB White Tank R/W

SHEET 5 OF 5
BY HDA DATE 8/5/94
CHECK MJB DATE 9.2.94
JOB NO. 310.44

Reach E most critical section at sta 167+00 at downstream End

Equivalent overexcavation (14+21)/2/3 = 5.8



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BY [illegible] DATE 9/4/94

CHECK MJB DATE 9.4.94

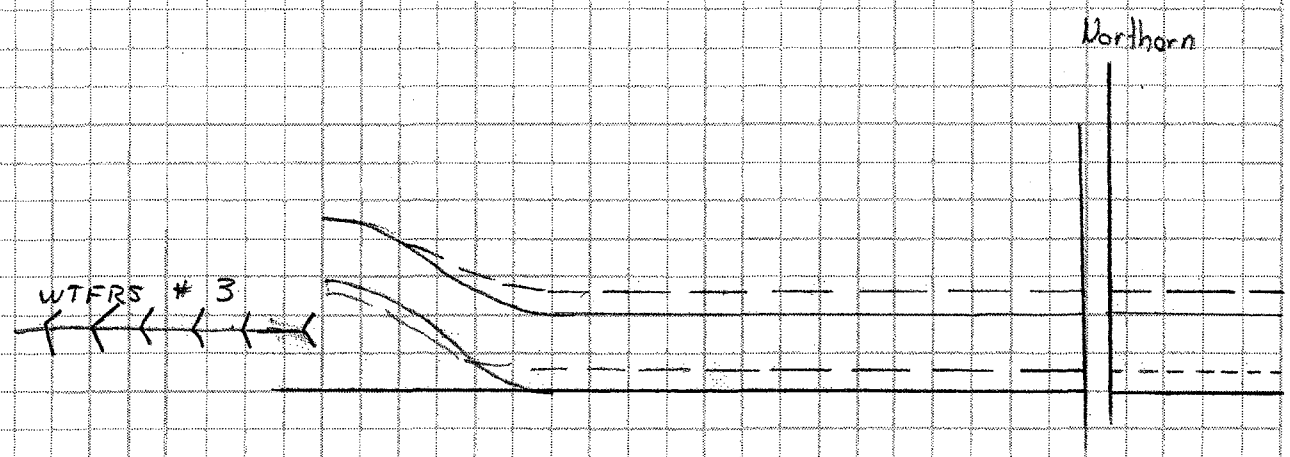
CLIENT FCDMC

JOB White Tank FRS #3 JOB NO. 310.44

Cost of agreement with Maricopa County Municipal WCD #1

Reach A

Alignment at "Reach B" displace 60' west forcing alignment of reach A 60' west downstream from culvert



the required R.O.W for this Reach is 240' all withing the 250' district property. w/ Alignment change the canal would be 50' off district property requiring purchase of 2590' x 50'

129500 ft² / 43560

= 2.97 acres Add'l. R/W for Reach A

also downstream from Olive av. additional R.O.W. would be required to accomodate a reverse curve that will realigne the chanal the additional R.O.W. was estimated to be 500' x 60' = 30000

30000 ft² / 43560

= 0.69 acres Add'l. R/W for Reaches D & E

$Cost_{A,D,E}$ = (0.69)+(2.97) @ $13000/acre = $47601

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BY HBM DATE 9/4/94

CHECK MJB DATE 9.4.94

CLIENT FCDMC

JOB White Tanks FRS #3 JOB NO. 310.44

The R.O.W cost for reach B and C where calculated assumming the 60" R.O.W. of the Maricopa County Municipal W.C.D #1 would need to be purchase

If and agreement is reach purchasing wouldn't be necesary resulting an Considerable saving.

	length	Area (ft²)	Area (Acres)	Savings
Reach B	(1950)(60)	117000	2.69 (13000)	34917
Reach C	(3332)(60)	199920	4.59 (13000)	59664

total B-C $59664 + $34917 = $93861

total A, D $47601

Total Cost $\Delta_{A \to E}$ = $141462

10.94 acres

58+08.41 to 99+55.00

Reach A

Description	Supercritical	Subcritical
Overexcavation	3	3.8
Depth	10.5	7.3
Side slope channel	2	2
Side slope bank	4	4
Bottom width	40	140
Road width	20	20
Swale width	30	30.4
R.W.	0	0
Road	20	20
Top of liner	32	35.2
Bottom of channel	53	49.8
CL	73	119.8
Bottom of channel	93	189.8
Top of liner	114	204.4
Swale	126	219.6
R.W.	156	250

99+55.00

Reach B

Description	Supercritical	Subcritical
Overexcavation	3	5
Depth	11.1	7.3
Side slope channel	2	2
Side slope bank	4	4
Bottom width	30	130
Road width	20	20
Swale width	27.6	30.8
R.W.	0	0
Road	20	20
Top of liner	32	40
Bottom of channel	54.2	54.6
CL	69.2	119.6
Bottom of channel	84.2	184.6
Top of liner	106.4	199.2
Swale	118.4	219.2
R.W.	146	250

Reach C

Description	Supercritical	Subcritical
Overexcavation	4	5.25
Depth	10.7	7.3
Side slope channel	2	2
Side slope bank	4	4
Bottom width	10	50
Road width	14	14
Swale width	20	20
R.W.	0	0
Road	14	14
Top of liner	30	35
Bottom of channel	51.4	49.6
CL	56.4	74.6
Bottom of channel	61.4	99.6
Top of liner	82.8	114.2
Swale	98.8	135.2
R.W.	118.8	155.2

Reach D

STA 152 + 37.57 to 164 + 50

Description	Supercritical	Subcritical
Overexcavation	4	4.4
Depth	10.2	7.3
Side slope channel	2	2
Side slope bank	4	4
Bottom width	10	46
Road width	14	14
Swale width	20.2	20
R.W.	0	0
Road	14	14
Top of liner	30	31.6
Bottom of channel	50.4	46.2
CL	55.4	69.2
Bottom of channel	60.4	92.2
Top of liner	80.8	106.8
Swale	96.8	124.4
R.W.	117	144.4

Reach E

164+50 to 167+00

Description	Supercritical	Subcritical
Overexcavation	4	5.8
Depth	6	3.5
Side slope channel	2	2
Side slope bank	4	4
Bottom width	12	60
Road width	14	14
Swale width	20	20
R.W.	0	0
Road	14	14
Top of liner	30	37.2
Bottom of channel	42	44.2
CL	48	74.2
Bottom of channel	54	104.2
Top of liner	66	111.2
Swale	82	134.4
R.W.	102	154.4

```
*********************************************
*  HEC-2 WATER SURFACE PROFILES             *
*                                           *
*  Version   4.6.2;  May 1991               *
*                                           *
*  RUN DATE    16DEC94    TIME   15:12:34   *
*********************************************
```

```
****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*          (916) 756-1104              *
****************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

THIS RUN EXECUTED 16DEC94 15:12:34

```
************************************
HEC-2 WATER SURFACE PROFILES

Version   4.6.2;  May 1991
************************************

T1 WHITE TANKS #3 FLOOD RETENTION STRUCTURE INLET CHANNEL
T2 DESIGN CONCEPT REPORT
T3      CHANNEL IMPROVEMENT      100-YR FLOWS

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

              2                                                           8480      1204.8

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

    -1                                                            -1        7

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

    100                 105                 120                 150

NC      .04       .04       .04       .1        .3
QT        1      8480

    Downstream from channel outlet
    WSE = 1204.8 ft.  from ADMS model modified to reflect new flow (Q=8480cfs)

X1     5490        23      9785     10065
GR     1210      9775      1206      9785      1204      9825      1202      9890      1200      9935
GR     1198      9980    1197.7     10000      1198     10015      1200     10030      1202     10040
GR     1204     10055      1206     10065      1206     10165      1204     10245      1202     10255
GR     1200     10275    1199.4     10285      1200     10300      1202     10315      1204     10340
GR     1206     10480      1208     10615      1210     10655

    Begining of Channel Outlet transition

X1     5786                                   264.54    264.54    264.54                         2.1
CI    10000      1200   265.015         4         4                -200

X1     5816                                       30        30        30                        .87
CI    10000    .00124    30.015         3         3                -180
```

```
X1    5846                                    30        30        30                  .87
CI   10000    .00124    30.015        2        2                  -150

X1    5876                                    30        30        30                  .87
CI   10000    .00124    30.015      1.5      1.5                  -140
 End of Transition

NC    .015      .015      .015       .1       .3
X1    5900         7      9914    10086       24        24        24                .14136
CI                                                                .01
GR    1210      9906      1208     9914     1200      9930      1200     10000      1200      10070
GR    1208     10086      1210    10094

X1    6000                                   100       100       100                 .124

X1    6100                                   100       100       100                 .124
 Drop structure
X1    6200                                   100       100       100                 .124
X1    6201                                     1         1         1                2.769

X1    6300                                    99        99        99                 .124

X1    6400                                   100       100       100                 .124

X1    6500                                   100       100       100                 .124

X1    6600                                   100       100       100                 .124

X1    6700                                   100       100       100                 .124
 Drop structure
X1    6800                                   100       100       100                 .124
X1    6801                                     1         1         1                2.703
```

X1	6900	99	99	99	.124
X1	7000	100	100	100	.124
X1	7100	100	100	100	.124
X1	7200	100	100	100	.124
X1	7300	100	100	100	.124
X1	7400	100	100	100	.124
X1	7500	100	100	100	.124
X1	7600	100	100	100	.124
X1	7700	100	100	100	.124
X1	7800	100	100	100	.124
X1	7900	100	100	100	.124
X1	8000	100	100	100	.124
X1	8100	100	100	100	.124
X1	8200	100	100	100	.124
Drop structure					
X1	8250	50	50	50	.062
X1	8251	1	1	1	2.703

X1	8300	49	49	49	.062
X1	8400	100	100	100	.124
X1	8500	100	100	100	.124
Drop Structure					
X1	8550	50	50	50	.062
X1	8551	1	1	1	2.466
X1	8600	49	49	49	.062
X1	8700	100	100	100	.124
Drop Structure					
X1	8800	100	100	100	.124
X1	8801	1	1	1	2.698
X1	8900	99	99	99	.124
X1	9000	100	100	100	.124
X1	9100	100	100	100	.124
X1	9200	100	100	100	.124
X1	9300	100	100	100	.124
Drop structure					
X1	9350	50	50	50	.062
X1	9351	1	1	1	2.698

X1	9400				49	49	49		.062	
X1	9500				100	100	100		.124	
X1	9600				100	100	100		.124	
X1	9700				100	100	100		.124	
X1	9800				100	100	100		.124	
X1	9900				100	100	100		.124	
X1	9954				54	54	54		.062	
NC	.015	.015	.015							
X1	9955	20	9930	10070	1	1	1		-2.21	
X3	10							1234.5	1234.5	
GR	1234.5	9880	1234.5	9920	1223.95	9930	1223.95	9940	1223.95	9970
GR	1223.9	9980	1223.95	9989	1223.95	9990	1223.95	9992	1223.95	9994
GR	1223.9	9995	1223.95	10005	1223.95	10006	1223.95	10008	1223.95	10010
GR	1223.9	10011	1223.95	10020	1223.95	10070	1236	10080	1236.5	10230
NC	.015	.015	.015							
QT	1	7770								
SC	12.015	.5	3	0	8	10	90	8.1	1222.11	1221.74
X1	10045	13	9940	10080	90	90	90		-2.21	
X2			2		1234.5					
X3	10							1234.5	1234.5	
BT	12	9886	1234.5	1234.5	9909	1234.5	1234.5	9916	1234.5	1234.5
BT	9928	1234.5	1234.5	9940	1234.5	1228.3	9940	1234.5	1232.32	10080
BT	1238	1232.3	10080	1238	1228.3	10115	1238	1238	10145	1238
BT	1238	10200	1237	1237	10280	1239	1239			
GR	1234.5	9886	1234.5	9909	1233.75	9916	1232.1	9928	1228.32	9940
GR	1224.3	9940	1224.3	10080	1228.3	10080	1232.1	10092	1238	10115
GR	1238	10145	1237	10200	1239	10280				
X1	10100	5	9936	10064	55	55	55			
GR	1230.2	9920	1222.179	9936	1222.179	10000	1222.179	10064	1230.179	10080

X1	10200	100	100	100	.125
Drop structure					
X1	10300	100	100	100	.125
X1	10301	1	1	1	2.52
Drop structure					
X1	10400	100	100	100	.125
X1	10401	1	1	1	2.71
X1	10500	99	99	99	.125
X1	10600	100	100	100	.125
Drop Structure					
X1	10700	100	100	100	.125
X1	10701	1	1	1	2.615
X1	10800	99	99	99	.125
X1	10900	100	100	100	.125
X1	11000	100	100	100	.125
X1	11100	100	100	100	.125
Drop Structure					
X1	11200	100	100	100	.125
X1	11201	1	1	1	3.005
X1	11300	99	99	99	.125

```
X1    11400                                   100       100       100                .125

X1    11500                                   100       100       100                .125
  Drop Structure
X1    11600                                   100       100       100                .125
X1    11601                                     1         1         1                  3

X1    11700                                    99        99        99                .125

X1    11800                                   100       100       100                .125

X1    11900                                   100       100       100                .125
  Drop structure
   CHOLLA WASH CONFLUENCE
X1    11950                                    50        50        50               .0625

QT        1      3230
X1    11951         5      9975     10025         1         1         1
GR   1249.3      9959   1241.29      9975   1241.29     10000   1241.29     10025   1249.29     10041

X1    12000                                    49        49        49               .0655

X1    12100                                   100       100       100                .131

X1    12200                                   100       100       100                .131

X1    12300                                   100       100       100                .131

X1    12400                                   100       100       100                .131

X1    12500                                   100       100       100                .131
```

X1	12600	100	100	100	.131
X1	12700	100	100	100	.131
X1	12800	100	100	100	.131
X1	12900	100	100	100	.131
X1	13000	100	100	100	.131
X1	13100	100	100	100	.131
X1	13200	100	100	100	.131
X1	13300	100	100	100	.131
Drop structure					
X1	13400	100	100	100	.131
X1	13401	1	1	1	3.0015
X1	13500	99	99	99	.131
Drop structure					
X1	13600	100	100	100	.131
X1	13601	1	1	1	2.997
X1	13700	99	99	99	.131
X1	13800	100	100	100	.131
X1	13900	100	100	100	.131
Drop structure					

X1	13950	50	50	50	.0655
X1	13951	1	1	1	2.9715
X1	14000	49	49	49	.0655
X1	14100	100	100	100	.131
X1	14200	100	100	100	.131
X1	14300	100	100	100	.131
X1	14400	100	100	100	.131
X1	14500	100	100	100	.131
Drop structure					
X1	14550	50	50	50	.0655
X1	14551	1	1	1	3.006
X1	14600	49	49	49	.0655
X1	14700	100	100	100	.131
X1	14800	100	100	100	.131
Drop structure					
X1	14850	50	50	50	.0655
X1	14851	1	1	1	3.007
X1	14900	49	49	49	.0655
X1	15000	100	100	100	.131

```
X1    15100                                100       100       100                .131

X1    15200                                100       100       100                .131

Drop structure

X1    15236                                 36        36        36               .04716

X1    15237      12      9972     10028     1         1         1                 -2.44
X3       10                                                          1275.6      1275.6
GR    1275.7    9910      1274      9970  1274.2      9972   1263.58     9972    1263.58     10025
GR    1274.2   10028      1272     10050    1274     10200      1276    10440       1278     10530
GR    1279.5   10720      1280     10910

QT        1    3050
SC    5.015      .5         3         0     8        10        90       8.1    1261.199   1261.08

X1    15327      14      9972     10028    90        90        90                 -2.501
X2                          2    1274.7  1275.9
X3       10                                                          1275.9      1275.9
BT       14    9910      1277      1277  9940   1276.63   1276.63     9968      1276.5     1275.5
BT     9972  1276.5   1267.58      9972 1276.59    1271.7     10028  1276.2      1271.7      10028
BT   1276.2  1267.5     10055    1276.2 1276.2     10085    1276.1  1276.1       10100     1275.9
BT   1275.9   10300    1276.1    1276.1  10500    1277.3    1277.3   10530        1278       1278
BT   10720   1279.5    1279.5
GR     1277    9910    1274.7      9940 1274.0      9968   1267.58     9972      1263.7       9972
GR   1263.7   10028    1267.7     10028 1272.3     10055    1273.2  10085      1274.3      10100
GR   1275.3   10300      1277     10500   1278     10530    1279.5  10720

X1    15400       5     9977     10023    73        73        73                 -2.5
GR    1271.8    9961  1263.796     9977 1263.796  10000  1263.796    10023   1271.796      10039

X1    15500                                100       100       100                .132

X1    15600                                100       100       100                .132

Drop structure

X1    15650                                 50        50        50               .066

X1    15650                                  1         1         1                  3
```

```
X1    15700                                    49        49        49                .066

X1    15800                                   100       100       100                .132

X1    15900                                   100       100       100                .132

X1    16000                                   100       100       100                .132
  Drop structure
X1    16050                                    50        50        50                .066
X1    16051                                     1         1         1               2.4845

X1    16100                                    49        49        49                .066

X1    16200                                   100       100       100                .132

X1    16300                                   100       100       100                .132

X1    16400                                   100       100       100                .132
  Drop structure
X1    16450                                    50        50        50                .066
QT        1      1130
X1    16451         5      9973     10027         1         1         1
GR   1275.1      9957   1271.18      9973   1271.18     10000   1271.18     10027    1275.1     10043

X1    16500                                    49        49        49                 .08

X1    16600                                   100       100       100                 .16
  Drop structure
X1    16650                                    50        50        50                 .08
X1    16651                                     1         1         1               2.6705
```

X1	16700	49	49	49	.08
Drop structure					
X1	16800	100	100	100	.16
X1	16801	1	1	1	2.71813
X1	16900	99	99	99	.16
Drop structure					
X1	16950	50	50	50	.08
X1	16951	1	1	1	2.434
X1	17000	49	49	49	.205
X1	17100	100	100	100	.410

CHANNEL IMPROVEMENT

SUMMARY PRINTOUT TABLE 105

	SECNO	CWSEL	HL	OLOSS	TOPWID	QLOB	QCH	QROB
	9954.000	1226.65	.07	.00	161.74	.00	8480.00	.00
*	9955.000	1226.56	.00	.23	140.00	.00	8480.00	.00
*	10045.000	1230.13	1.87	.00	140.00	.00	7770.00	.00
	10100.000	1230.14	.02	.00	159.82	262.83	7243.55	263.62
	15236.000	1265.85	.05	.00	71.06	176.98	2875.78	177.24
*	15237.000	1265.97	.00	.21	54.36	.00	3230.00	.00
*	15327.000	1268.77	1.19	.00	56.00	.00	3050.00	.00
	15400.000	1268.86	.03	.01	76.27	245.98	2557.90	246.12

CHANNEL IMPROVEMENT

SUMMARY PRINTOUT TABLE 120

	SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
	5490.000	1204.80	1205.45	6.60	53.18	7.10	433.01	.00	.01	9785.00	1206.00	10065.00	1206.00
*	5786.000	1205.10	1205.90	7.29	7.00	5.10	318.25	10000.00	200.00	9785.00	1208.10	10132.40	1208.10
	5816.000	1204.83	1206.05	8.92	11.13	4.79	266.52	10000.00	180.00	9785.00	1208.97	10116.80	1208.97
*	5846.000	1204.66	1206.72	11.55	19.56	4.58	207.65	10000.00	150.00	9785.00	1209.84	10094.53	1209.84
*	5876.000	1204.90	1207.14	12.00	19.85	4.79	182.77	10000.00	140.00	9785.00	1210.71	10085.90	1210.71
	5900.000	1205.55	1207.23	10.40	13.00	5.41	161.63	.00	.01	9914.00	1208.14	10086.00	1208.14
	6000.000	1205.71	1207.36	10.31	12.65	5.45	161.80	.00	.01	9914.00	1208.27	10086.00	1208.27
	6100.000	1205.84	1207.49	10.31	12.65	5.45	161.81	.00	.01	9914.00	1208.39	10086.00	1208.39
	6200.000	1205.97	1207.62	10.31	12.64	5.45	161.81	.00	.01	9914.00	1208.51	10086.00	1208.51
*	6201.000	1208.01	1210.25	12.01	20.50	4.72	158.90	.00	.01	9914.00	1211.28	10086.00	1211.28
	6300.000	1208.71	1210.46	10.63	13.95	5.30	161.18	.00	.01	9914.00	1211.41	10086.00	1211.41
	6400.000	1208.88	1210.60	10.52	13.50	5.35	161.39	.00	.01	9914.00	1211.53	10086.00	1211.53
	6500.000	1209.03	1210.74	10.48	13.31	5.38	161.48	.00	.01	9914.00	1211.65	10086.00	1211.65
	6600.000	1209.21	1210.87	10.35	12.82	5.43	161.72	.00	.01	9914.00	1211.78	10086.00	1211.78
	6700.000	1209.34	1211.00	10.34	12.77	5.44	161.74	.00	.01	9914.00	1211.90	10086.00	1211.90
	6800.000	1209.47	1211.13	10.33	12.73	5.45	161.77	.00	.01	9914.00	1212.03	10086.00	1212.03
*	6801.000	1211.45	1213.69	12.01	20.49	4.73	158.90	.00	.01	9914.00	1214.73	10086.00	1214.73
	6900.000	1212.15	1213.91	10.64	13.96	5.30	161.18	.00	.01	9914.00	1214.85	10086.00	1214.85
	7000.000	1212.33	1214.05	10.53	13.51	5.35	161.38	.00	.01	9914.00	1214.98	10086.00	1214.98
	7100.000	1212.48	1214.18	10.48	13.31	5.38	161.48	.00	.01	9914.00	1215.10	10086.00	1215.10
	7200.000	1212.65	1214.32	10.36	12.83	5.43	161.71	.00	.01	9914.00	1215.23	10086.00	1215.23
	7300.000	1212.79	1214.45	10.34	12.78	5.44	161.74	.00	.01	9914.00	1215.35	10086.00	1215.35
	7400.000	1212.92	1214.58	10.33	12.73	5.45	161.76	.00	.01	9914.00	1215.47	10086.00	1215.47
	7500.000	1213.05	1214.70	10.31	12.67	5.45	161.79	.00	.01	9914.00	1215.60	10086.00	1215.60

SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
7600.000	1213.18	1214.83	10.30	12.61	5.46	161.82	.00	.01	9914.00	1215.72	10086.00	1215.72
7700.000	1213.31	1214.96	10.28	12.55	5.47	161.85	.00	.01	9914.00	1215.85	10086.00	1215.85
7800.000	1213.44	1215.08	10.27	12.50	5.47	161.88	.00	.01	9914.00	1215.97	10086.00	1215.97
7900.000	1213.57	1215.21	10.26	12.46	5.48	161.90	.00	.01	9914.00	1216.09	10086.00	1216.09
8000.000	1213.70	1215.33	10.25	12.43	5.48	161.92	.00	.01	9914.00	1216.22	10086.00	1216.22
8100.000	1213.83	1215.46	10.25	12.41	5.48	161.93	.00	.01	9914.00	1216.34	10086.00	1216.34
8200.000	1213.95	1215.58	10.24	12.40	5.49	161.94	.00	.01	9914.00	1216.47	10086.00	1216.47
8250.000	1214.01	1215.64	10.24	12.39	5.49	161.94	.00	.01	9914.00	1216.53	10086.00	1216.53
* 8251.000	1215.96	1218.20	12.00	20.44	4.73	158.91	.00	.01	9914.00	1219.23	10086.00	1219.23
8300.000	1216.48	1218.32	10.88	15.01	5.19	160.72	.00	.01	9914.00	1219.29	10086.00	1219.29
8400.000	1216.73	1218.47	10.59	13.76	5.32	161.27	.00	.01	9914.00	1219.42	10086.00	1219.42
8500.000	1216.88	1218.61	10.55	13.60	5.34	161.34	.00	.01	9914.00	1219.54	10086.00	1219.54
8550.000	1216.96	1218.68	10.52	13.48	5.36	161.40	.00	.01	9914.00	1219.60	10086.00	1219.60
* 8551.000	1218.79	1221.03	12.02	20.55	4.72	158.88	.00	.01	9914.00	1222.07	10086.00	1222.07
8600.000	1219.33	1221.16	10.87	14.94	5.19	160.75	.00	.01	9914.00	1222.13	10086.00	1222.13
8700.000	1219.57	1221.31	10.59	13.75	5.32	161.27	.00	.01	9914.00	1222.26	10086.00	1222.26
8800.000	1219.72	1221.45	10.55	13.59	5.34	161.35	.00	.01	9914.00	1222.38	10086.00	1222.38
* 8801.000	1221.80	1224.04	12.02	20.55	4.72	158.88	.00	.01	9914.00	1225.08	10086.00	1225.08
8900.000	1222.50	1224.26	10.63	13.93	5.30	161.19	.00	.01	9914.00	1225.20	10086.00	1225.20
9000.000	1222.68	1224.40	10.52	13.48	5.35	161.40	.00	.01	9914.00	1225.33	10086.00	1225.33
9100.000	1222.83	1224.53	10.47	13.30	5.38	161.48	.00	.01	9914.00	1225.45	10086.00	1225.45
9200.000	1223.00	1224.67	10.35	12.83	5.43	161.71	.00	.01	9914.00	1225.57	10086.00	1225.57
9300.000	1223.13	1224.80	10.34	12.77	5.44	161.74	.00	.01	9914.00	1225.70	10086.00	1225.70
9350.000	1223.20	1224.86	10.33	12.74	5.44	161.76	.00	.01	9914.00	1225.76	10086.00	1225.76
* 9351.000	1225.18	1227.42	12.01	20.48	4.73	158.90	.00	.01	9914.00	1228.46	10086.00	1228.46
9400.000	1225.71	1227.55	10.88	14.97	5.19	160.74	.00	.01	9914.00	1228.52	10086.00	1228.52

	SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
	9500.000	1225.96	1227.70	10.59	13.76	5.32	161.27	.00	.01	9914.00	1228.64	10086.00	1228.64
	9600.000	1226.11	1227.84	10.55	13.60	5.34	161.34	.00	.01	9914.00	1228.77	10086.00	1228.77
	9700.000	1226.29	1227.98	10.41	13.05	5.40	161.61	.00	.01	9914.00	1228.89	10086.00	1228.89
	9800.000	1226.43	1228.11	10.39	12.97	5.41	161.64	.00	.01	9914.00	1229.02	10086.00	1229.02
	9900.000	1226.57	1228.24	10.37	12.89	5.43	161.68	.00	.01	9914.00	1229.14	10086.00	1229.14
	9954.000	1226.65	1228.31	10.34	12.78	5.44	161.74	.00	.01	9914.00	1229.20	10086.00	1229.20
*	9955.000	1226.56	1229.00	12.54	19.65	4.87	140.00	.00	.01	9930.00	1221.74	10070.00	1221.74
*	10045.000	1230.13	1230.87	6.89	3.23	8.04	140.00	.00	.01	9940.00	1226.11	10080.00	1226.09
	10100.000	1230.14	1230.89	7.10	3.23	7.97	159.82	.00	.01	9936.00	1222.18	10064.00	1222.18
	10200.000	1230.16	1230.93	7.20	3.38	7.86	159.42	.00	.01	9936.00	1222.30	10064.00	1222.30
	10300.000	1230.18	1230.97	7.31	3.54	7.75	159.00	.00	.01	9936.00	1222.43	10064.00	1222.43
*	10301.000	1229.69	1231.97	12.27	19.25	4.74	146.94	.00	.01	9936.00	1224.95	10064.00	1224.95
	10400.000	1230.36	1232.17	10.97	13.33	5.28	149.09	.00	.01	9936.00	1225.07	10064.00	1225.07
*	10401.000	1232.53	1234.80	12.27	19.25	4.74	146.95	.00	.01	9936.00	1227.78	10064.00	1227.78
	10500.000	1233.19	1235.00	10.98	13.39	5.28	149.06	.00	.01	9936.00	1227.91	10064.00	1227.91
	10600.000	1233.35	1235.14	10.89	13.03	5.32	149.24	.00	.01	9936.00	1228.03	10064.00	1228.03
	10700.000	1233.49	1235.27	10.87	12.94	5.33	149.28	.00	.01	9936.00	1228.16	10064.00	1228.16
*	10701.000	1235.52	1237.79	12.27	19.24	4.74	146.95	.00	.01	9936.00	1230.77	10064.00	1230.77
	10800.000	1236.18	1237.99	10.99	13.40	5.28	149.06	.00	.01	9936.00	1230.90	10064.00	1230.90
	10900.000	1236.34	1238.13	10.89	13.03	5.32	149.23	.00	.01	9936.00	1231.02	10064.00	1231.02
	11000.000	1236.48	1238.26	10.87	12.94	5.33	149.27	.00	.01	9936.00	1231.15	10064.00	1231.15
	11100.000	1236.62	1238.39	10.85	12.86	5.34	149.32	.00	.01	9936.00	1231.27	10064.00	1231.27
	11200.000	1236.75	1238.52	10.82	12.76	5.36	149.36	.00	.01	9936.00	1231.40	10064.00	1231.40
*	11201.000	1239.15	1241.42	12.26	19.21	4.74	146.96	.00	.01	9936.00	1234.40	10064.00	1234.40
	11300.000	1239.80	1241.62	10.99	13.41	5.28	149.05	.00	.01	9936.00	1234.53	10064.00	1234.53
	11400.000	1239.97	1241.76	10.90	13.05	5.32	149.23	.00	.01	9936.00	1234.65	10064.00	1234.65

	SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
	11500.000	1240.11	1241.89	10.87	12.96	5.33	149.27	.00	.01	9936.00	1234.78	10064.00	1234.78
	11600.000	1240.25	1242.02	10.85	12.87	5.34	149.31	.00	.01	9936.00	1234.90	10064.00	1234.90
*	11601.000	1242.65	1244.92	12.27	19.23	4.74	146.95	.00	.01	9936.00	1237.90	10064.00	1237.90
	11700.000	1243.31	1245.12	10.99	13.41	5.28	149.06	.00	.01	9936.00	1238.03	10064.00	1238.03
	11800.000	1243.47	1245.26	10.89	13.04	5.32	149.23	.00	.01	9936.00	1238.15	10064.00	1238.15
	11900.000	1243.61	1245.39	10.87	12.95	5.33	149.27	.00	.01	9936.00	1238.28	10064.00	1238.28
	11950.000	1243.68	1245.45	10.85	12.88	5.34	149.31	.00	.01	9936.00	1238.34	10064.00	1238.34
*	11951.000	1246.07	1248.21	12.14	18.64	4.78	69.13	.00	.01	9975.00	1241.29	10025.00	1241.29
	12000.000	1246.55	1248.33	11.11	14.00	5.19	70.73	.00	.01	9975.00	1241.36	10025.00	1241.36
	12100.000	1246.72	1248.47	11.02	13.65	5.23	70.88	.00	.01	9975.00	1241.49	10025.00	1241.49
	12200.000	1246.87	1248.61	10.99	13.51	5.25	70.94	.00	.01	9975.00	1241.62	10025.00	1241.62
	12300.000	1247.02	1248.74	10.94	13.33	5.27	71.02	.00	.01	9975.00	1241.75	10025.00	1241.75
	12400.000	1247.16	1248.88	10.91	13.22	5.28	71.07	.00	.01	9975.00	1241.88	10025.00	1241.88
	12500.000	1247.30	1249.01	10.89	13.12	5.29	71.12	.00	.01	9975.00	1242.01	10025.00	1242.01
	12600.000	1247.44	1249.14	10.87	13.05	5.30	71.15	.00	.01	9975.00	1242.14	10025.00	1242.14
	12700.000	1247.57	1249.27	10.85	13.00	5.30	71.17	.00	.01	9975.00	1242.27	10025.00	1242.27
	12800.000	1247.71	1249.40	10.85	12.97	5.30	71.19	.00	.01	9975.00	1242.40	10025.00	1242.40
	12900.000	1247.84	1249.53	10.84	12.96	5.30	71.19	.00	.01	9975.00	1242.53	10025.00	1242.53
	13000.000	1247.97	1249.66	10.84	12.96	5.30	71.19	.00	.01	9975.00	1242.67	10025.00	1242.67
	13100.000	1248.09	1249.79	10.85	12.98	5.30	71.18	.00	.01	9975.00	1242.80	10025.00	1242.80
	13200.000	1248.22	1249.92	10.85	13.00	5.30	71.17	.00	.01	9975.00	1242.93	10025.00	1242.93
	13300.000	1248.35	1250.05	10.86	13.01	5.29	71.17	.00	.01	9975.00	1243.06	10025.00	1243.06
	13400.000	1248.48	1250.18	10.86	13.03	5.29	71.16	.00	.01	9975.00	1243.19	10025.00	1243.19
*	13401.000	1250.97	1253.11	12.14	18.64	4.78	69.13	.00	.01	9975.00	1246.19	10025.00	1246.19
	13500.000	1251.59	1253.31	10.94	13.33	5.26	71.03	.00	.01	9975.00	1246.32	10025.00	1246.32
	13600.000	1251.75	1253.44	10.86	13.03	5.29	71.16	.00	.01	9975.00	1246.45	10025.00	1246.45

	SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
*	13601.000	1254.23	1256.37	12.14	18.63	4.78	69.13	.00	.01	9975.00	1249.45	10025.00	1249.45
	13700.000	1254.84	1256.57	10.96	13.41	5.26	70.99	.00	.01	9975.00	1249.58	10025.00	1249.58
	13800.000	1255.00	1256.70	10.88	13.09	5.29	71.13	.00	.01	9975.00	1249.71	10025.00	1249.71
	13900.000	1255.13	1256.83	10.87	13.06	5.29	71.15	.00	.01	9975.00	1249.84	10025.00	1249.84
	13950.000	1255.20	1256.90	10.87	13.05	5.29	71.15	.00	.01	9975.00	1249.91	10025.00	1249.91
*	13951.000	1257.66	1259.80	12.14	18.63	4.79	69.13	.00	.01	9975.00	1252.88	10025.00	1252.88
	14000.000	1258.14	1259.92	11.11	14.00	5.19	70.73	.00	.01	9975.00	1252.95	10025.00	1252.95
	14100.000	1258.31	1260.06	11.02	13.65	5.23	70.88	.00	.01	9975.00	1253.08	10025.00	1253.08
	14200.000	1258.46	1260.20	10.99	13.52	5.25	70.94	.00	.01	9975.00	1253.21	10025.00	1253.21
	14300.000	1258.61	1260.33	10.94	13.34	5.27	71.02	.00	.01	9975.00	1253.34	10025.00	1253.34
	14400.000	1258.75	1260.46	10.91	13.22	5.28	71.07	.00	.01	9975.00	1253.47	10025.00	1253.47
	14500.000	1258.89	1260.60	10.89	13.12	5.29	71.12	.00	.01	9975.00	1253.60	10025.00	1253.60
	14550.000	1258.96	1260.66	10.87	13.05	5.30	71.15	.00	.01	9975.00	1253.67	10025.00	1253.67
*	14551.000	1261.46	1263.59	12.14	18.62	4.79	69.13	.00	.01	9975.00	1256.67	10025.00	1256.67
	14600.000	1261.93	1263.71	11.11	14.02	5.19	70.73	.00	.01	9975.00	1256.74	10025.00	1256.74
	14700.000	1262.10	1263.85	11.02	13.66	5.23	70.88	.00	.01	9975.00	1256.87	10025.00	1256.87
	14800.000	1262.25	1263.99	10.98	13.48	5.25	70.96	.00	.01	9975.00	1257.00	10025.00	1257.00
	14850.000	1262.33	1264.06	10.95	13.37	5.26	71.00	.00	.01	9975.00	1257.06	10025.00	1257.06
*	14851.000	1264.86	1266.99	12.14	18.64	4.78	69.13	.00	.01	9975.00	1260.07	10025.00	1260.07
	14900.000	1265.33	1267.11	11.10	13.98	5.19	70.74	.00	.01	9975.00	1260.14	10025.00	1260.14
	15000.000	1265.50	1267.25	11.02	13.63	5.23	70.89	.00	.01	9975.00	1260.27	10025.00	1260.27
	15100.000	1265.65	1267.39	10.98	13.50	5.25	70.95	.00	.01	9975.00	1260.40	10025.00	1260.40
	15200.000	1265.80	1267.52	10.94	13.33	5.27	71.02	.00	.01	9975.00	1260.53	10025.00	1260.53
	15236.000	1265.85	1267.57	10.92	13.24	5.28	71.06	.00	.01	9975.00	1260.58	10025.00	1260.58
*	15237.000	1265.97	1268.38	12.46	23.92	4.83	54.36	.00	.01	9972.00	1271.76	10028.00	1271.76
*	15327.000	1268.77	1269.57	7.20	4.23	7.57	56.00	.00	.01	9972.00	1265.08	10028.00	1265.20

	SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
	15400.000	1268.86	1269.61	7.35	3.70	7.56	76.27	.00	.01	9977.00	1261.30	10023.00	1261.30
	15500.000	1268.87	1269.65	7.49	3.93	7.45	75.78	.00	.01	9977.00	1261.43	10023.00	1261.43
	15600.000	1268.90	1269.70	7.61	4.13	7.34	75.37	.00	.01	9977.00	1261.56	10023.00	1261.56
	15650.000	1268.91	1269.73	7.67	4.24	7.28	75.15	.00	.01	9977.00	1261.63	10023.00	1261.63
*	15650.000	1269.47	1271.61	12.19	18.46	4.84	65.37	.00	.01	9977.00	1264.63	10023.00	1264.63
	15700.000	1269.93	1271.72	11.18	13.99	5.24	66.94	.00	.01	9977.00	1264.69	10023.00	1264.69
	15800.000	1270.10	1271.86	11.09	13.65	5.28	67.08	.00	.01	9977.00	1264.82	10023.00	1264.82
	15900.000	1270.25	1272.00	11.06	13.53	5.29	67.14	.00	.01	9977.00	1264.96	10023.00	1264.96
	16000.000	1270.40	1272.14	11.03	13.42	5.31	67.19	.00	.01	9977.00	1265.09	10023.00	1265.09
	16050.000	1270.47	1272.20	11.00	13.32	5.32	67.23	.00	.01	9977.00	1265.15	10023.00	1265.15
*	16051.000	1272.48	1274.62	12.20	18.51	4.84	65.36	.00	.01	9977.00	1267.64	10023.00	1267.64
	16100.000	1272.95	1274.74	11.17	13.97	5.24	66.95	.00	.01	9977.00	1267.70	10023.00	1267.70
	16200.000	1273.12	1274.88	11.08	13.63	5.28	67.09	.00	.01	9977.00	1267.84	10023.00	1267.84
	16300.000	1273.26	1275.01	11.05	13.51	5.30	67.15	.00	.01	9977.00	1267.97	10023.00	1267.97
	16400.000	1273.41	1275.15	11.02	13.40	5.31	67.19	.00	.01	9977.00	1268.10	10023.00	1268.10
	16450.000	1273.48	1275.22	11.00	13.31	5.32	67.24	.00	.01	9977.00	1268.17	10023.00	1268.17
	16451.000	1275.07	1275.36	4.55	3.45	3.89	85.76	.00	.01	9973.00	1271.18	10027.00	1271.18
	16500.000	1275.08	1275.38	4.65	3.69	3.82	85.18	.00	.01	9973.00	1271.26	10027.00	1271.26
	16600.000	1275.10	1275.43	4.84	4.19	3.68	84.10	.00	.01	9973.00	1271.42	10027.00	1271.42
	16650.000	1275.11	1275.46	4.95	4.48	3.61	83.55	.00	.01	9973.00	1271.50	10027.00	1271.50
*	16651.000	1276.44	1277.46	8.36	23.92	2.26	72.49	.00	.01	9973.00	1274.17	10027.00	1274.17
	16700.000	1276.79	1277.57	7.35	15.87	2.54	74.76	.00	.01	9973.00	1274.25	10027.00	1274.25
	16800.000	1276.94	1277.74	7.41	16.25	2.53	74.62	.00	.01	9973.00	1274.41	10027.00	1274.41
*	16801.000	1279.39	1280.41	8.35	23.90	2.27	72.49	.00	.01	9973.00	1277.13	10027.00	1277.13
	16900.000	1279.86	1280.63	7.27	15.32	2.57	74.97	.00	.01	9973.00	1277.29	10027.00	1277.29
	16950.000	1279.95	1280.70	7.21	14.92	2.58	75.13	.00	.01	9973.00	1277.37	10027.00	1277.37

	SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
*	16951.000	1282.07	1283.09	8.35	23.90	2.27	72.49	.00	.01	9973.00	1279.80	10027.00	1279.80
*	17000.000	1282.27	1283.29	8.35	23.86	2.27	72.50	.00	.01	9973.00	1280.01	10027.00	1280.01
*	17100.000	1282.68	1283.70	8.35	23.86	2.27	72.50	.00	.01	9973.00	1280.42	10027.00	1280.42

CHANNEL IMPROVEMENT

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	5490.000	.00	.00	.00	1197.70	8480.00	1204.80	1203.55	1205.45	53.18	6.60	1310.97	1162.88
*	5786.000	265.00	.00	.00	1200.00	8480.00	1205.10	1203.71	1205.90	7.00	7.29	1284.59	3205.16
	5816.000	30.00	.00	.00	1200.04	8480.00	1204.83	1204.06	1206.05	11.13	8.92	1018.34	2542.19
*	5846.000	30.00	.00	.00	1200.07	8480.00	1204.66	1204.66	1206.72	19.56	11.55	763.37	1917.49
*	5876.000	30.00	.00	.00	1200.11	8480.00	1204.90	1204.90	1207.14	19.85	12.00	718.04	1903.41
	5900.000	24.00	.00	.00	1200.14	8480.00	1205.55	1204.85	1207.23	13.00	10.40	815.39	2351.51
	6000.000	100.00	.00	.00	1200.27	8480.00	1205.71	1204.99	1207.36	12.65	10.31	822.59	2384.32
	6100.000	100.00	.00	.00	1200.39	8480.00	1205.84	1205.11	1207.49	12.65	10.31	822.67	2384.68
	6200.000	100.00	.00	.00	1200.51	8480.00	1205.97	1205.24	1207.62	12.64	10.31	822.81	2385.31
*	6201.000	1.00	.00	.00	1203.28	8480.00	1208.01	1208.01	1210.25	20.50	12.01	706.03	1873.02
	6300.000	99.00	.00	.00	1203.41	8480.00	1208.71	1208.13	1210.46	13.95	10.63	797.48	2270.64
	6400.000	100.00	.00	.00	1203.53	8480.00	1208.88	1208.25	1210.60	13.50	10.52	805.77	2307.95
	6500.000	100.00	.00	.00	1203.65	8480.00	1209.03	1208.37	1210.74	13.31	10.48	809.46	2324.60
	6600.000	100.00	.00	.00	1203.78	8480.00	1209.21	1208.50	1210.87	12.82	10.35	819.06	2368.20
	6700.000	100.00	.00	.00	1203.90	8480.00	1209.34	1208.63	1211.00	12.77	10.34	820.09	2372.88
	6800.000	100.00	.00	.00	1204.03	8480.00	1209.47	1208.75	1211.13	12.73	10.33	821.03	2377.20
*	6801.000	1.00	.00	.00	1206.73	8480.00	1211.45	1211.45	1213.69	20.49	12.01	706.17	1873.59
	6900.000	99.00	.00	.00	1206.85	8480.00	1212.15	1211.58	1213.91	13.96	10.64	797.34	2270.02
	7000.000	100.00	.00	.00	1206.98	8480.00	1212.33	1211.70	1214.05	13.51	10.53	805.63	2307.32
	7100.000	100.00	.00	.00	1207.10	8480.00	1212.48	1211.82	1214.18	13.31	10.48	809.35	2324.15
	7200.000	100.00	.00	.00	1207.23	8480.00	1212.65	1211.95	1214.32	12.83	10.36	818.82	2367.12
	7300.000	100.00	.00	.00	1207.35	8480.00	1212.79	1212.07	1214.45	12.78	10.34	819.93	2372.16
	7400.000	100.00	.00	.00	1207.47	8480.00	1212.92	1212.20	1214.58	12.73	10.33	820.95	2376.84
	7500.000	100.00	.00	.00	1207.60	8480.00	1213.05	1212.32	1214.70	12.67	10.31	822.18	2382.43

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
7600.000	100.00	.00	.00	1207.72	8480.00	1213.18	1212.45	1214.83	12.61	10.30	823.42	2388.10
7700.000	100.00	.00	.00	1207.85	8480.00	1213.31	1212.57	1214.96	12.55	10.28	824.59	2393.43
7800.000	100.00	.00	.00	1207.97	8480.00	1213.44	1212.70	1215.08	12.50	10.27	825.62	2398.12
7900.000	100.00	.00	.00	1208.09	8480.00	1213.57	1212.82	1215.21	12.46	10.26	826.45	2401.92
8000.000	100.00	.00	.00	1208.22	8480.00	1213.70	1212.94	1215.33	12.43	10.25	827.10	2404.91
8100.000	100.00	.00	.00	1208.34	8480.00	1213.83	1213.07	1215.46	12.41	10.25	827.57	2407.08
8200.000	100.00	.00	.00	1208.47	8480.00	1213.95	1213.19	1215.58	12.40	10.24	827.91	2408.61
8250.000	50.00	.00	.00	1208.53	8480.00	1214.01	1213.25	1215.64	12.39	10.24	828.11	2409.52
* 8251.000	1.00	.00	.00	1211.23	8480.00	1215.96	1215.96	1218.20	20.44	12.00	706.61	1875.47
8300.000	49.00	.00	.00	1211.29	8480.00	1216.48	1216.02	1218.32	15.01	10.88	779.07	2188.51
8400.000	100.00	.00	.00	1211.42	8480.00	1216.73	1216.14	1218.47	13.76	10.59	800.90	2286.03
8500.000	100.00	.00	.00	1211.54	8480.00	1216.88	1216.26	1218.61	13.60	10.55	803.94	2299.69
8550.000	50.00	.00	.00	1211.60	8480.00	1216.96	1216.32	1218.68	13.48	10.52	806.16	2309.73
* 8551.000	1.00	.00	.00	1214.07	8480.00	1218.79	1218.79	1221.03	20.55	12.02	705.47	1870.66
8600.000	49.00	.00	.00	1214.13	8480.00	1219.33	1218.85	1221.16	14.94	10.87	780.23	2193.64
8700.000	100.00	.00	.00	1214.26	8480.00	1219.57	1218.97	1221.31	13.75	10.59	801.10	2286.92
8800.000	100.00	.00	.00	1214.38	8480.00	1219.72	1219.10	1221.45	13.59	10.55	804.11	2300.48
* 8801.000	1.00	.00	.00	1217.08	8480.00	1221.80	1221.80	1224.04	20.55	12.02	705.43	1870.50
8900.000	99.00	.00	.00	1217.20	8480.00	1222.50	1221.93	1224.26	13.93	10.63	797.77	2271.96
9000.000	100.00	.00	.00	1217.33	8480.00	1222.68	1222.04	1224.40	13.48	10.52	806.08	2309.37
9100.000	100.00	.00	.00	1217.45	8480.00	1222.83	1222.17	1224.53	13.30	10.47	809.69	2325.67
9200.000	100.00	.00	.00	1217.57	8480.00	1223.00	1222.29	1224.67	12.83	10.35	818.98	2367.84
9300.000	100.00	.00	.00	1217.70	8480.00	1223.13	1222.42	1224.80	12.77	10.34	820.03	2372.62
9350.000	50.00	.00	.00	1217.76	8480.00	1223.20	1222.48	1224.86	12.74	10.33	820.68	2375.58
* 9351.000	1.00	.00	.00	1220.46	8480.00	1225.18	1225.18	1227.42	20.48	12.01	706.19	1873.67
9400.000	49.00	.00	.00	1220.52	8480.00	1225.71	1225.24	1227.55	14.97	10.88	779.72	2191.38

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
9500.000	100.00	.00	.00	1220.64	8480.00	1225.96	1225.36	1227.70	13.76	10.59	800.95	2286.21
9600.000	100.00	.00	.00	1220.77	8480.00	1226.11	1225.49	1227.84	13.60	10.55	803.98	2299.86
9700.000	100.00	.00	.00	1220.89	8480.00	1226.29	1225.61	1227.98	13.05	10.41	814.50	2347.48
9800.000	100.00	.00	.00	1221.02	8480.00	1226.43	1225.74	1228.11	12.97	10.39	816.02	2354.38
9900.000	100.00	.00	.00	1221.14	8480.00	1226.57	1225.86	1228.24	12.89	10.37	817.62	2361.65
9954.000	54.00	.00	.00	1221.20	8480.00	1226.65	1225.93	1228.31	12.78	10.34	819.93	2372.16
* 9955.000	1.00	.00	.00	1221.69	8480.00	1226.56	1226.56	1229.00	19.65	12.54	676.00	1913.22
* 10045.000	90.00	1234.50	.00	1222.09	7770.00	1230.13	.00	1230.87	3.23	6.89	1127.45	4324.21
10100.000	55.00	.00	.00	1222.18	7770.00	1230.14	1226.94	1230.89	3.23	7.10	1146.33	4321.81
10200.000	100.00	.00	.00	1222.30	7770.00	1230.16	1227.05	1230.93	3.38	7.20	1130.50	4228.96
10300.000	100.00	.00	.00	1222.43	7770.00	1230.18	1227.17	1230.97	3.54	7.31	1113.60	4130.50
* 10301.000	1.00	.00	.00	1224.95	7770.00	1229.69	1229.69	1231.97	19.25	12.27	651.94	1770.95
10400.000	100.00	.00	.00	1225.07	7770.00	1230.36	1229.82	1232.17	13.33	10.97	731.51	2128.00
* 10401.000	1.00	.00	.00	1227.78	7770.00	1232.53	1232.53	1234.80	19.25	12.27	651.97	1771.10
10500.000	99.00	.00	.00	1227.91	7770.00	1233.19	1232.66	1235.00	13.39	10.98	730.43	2123.03
10600.000	100.00	.00	.00	1228.03	7770.00	1233.35	1232.78	1235.14	13.03	10.89	736.86	2152.83
10700.000	100.00	.00	.00	1228.16	7770.00	1233.49	1232.90	1235.27	12.94	10.87	738.39	2159.95
* 10701.000	1.00	.00	.00	1230.77	7770.00	1235.52	1235.52	1237.79	19.24	12.27	652.01	1771.26
10800.000	99.00	.00	.00	1230.90	7770.00	1236.18	1235.65	1237.99	13.40	10.99	730.34	2122.61
10900.000	100.00	.00	.00	1231.02	7770.00	1236.34	1235.77	1238.13	13.03	10.89	736.77	2152.41
11000.000	100.00	.00	.00	1231.15	7770.00	1236.48	1235.89	1238.26	12.94	10.87	738.32	2159.61
11100.000	100.00	.00	.00	1231.27	7770.00	1236.62	1236.02	1238.39	12.86	10.85	739.92	2167.08
11200.000	100.00	.00	.00	1231.40	7770.00	1236.75	1236.14	1238.52	12.76	10.82	741.64	2175.07
* 11201.000	1.00	.00	.00	1234.40	7770.00	1239.15	1239.15	1241.42	19.21	12.26	652.33	1772.66
11300.000	99.00	.00	.00	1234.53	7770.00	1239.80	1239.28	1241.62	13.41	10.99	730.09	2121.43
11400.000	100.00	.00	.00	1234.65	7770.00	1239.97	1239.40	1241.76	13.05	10.90	736.50	2151.14

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	11500.000	100.00	.00	.00	1234.78	7770.00	1240.11	1239.52	1241.89	12.96	10.87	738.09	2158.51
	11600.000	100.00	.00	.00	1234.90	7770.00	1240.25	1239.65	1242.02	12.87	10.85	739.72	2166.15
*	11601.000	1.00	.00	.00	1237.90	7770.00	1242.65	1242.65	1244.92	19.23	12.27	652.13	1771.81
	11700.000	99.00	.00	.00	1238.03	7770.00	1243.31	1242.78	1245.12	13.41	10.99	730.22	2122.02
	11800.000	100.00	.00	.00	1238.15	7770.00	1243.47	1242.90	1245.26	13.04	10.89	736.66	2151.91
	11900.000	100.00	.00	.00	1238.28	7770.00	1243.61	1243.02	1245.39	12.95	10.87	738.25	2159.27
	11950.000	50.00	.00	.00	1238.34	7770.00	1243.68	1243.09	1245.45	12.88	10.85	739.52	2165.21
*	11951.000	1.00	.00	.00	1241.29	3230.00	1246.07	1246.07	1248.21	18.64	12.14	284.96	748.15
	12000.000	49.00	.00	.00	1241.36	3230.00	1246.55	1246.15	1248.33	14.00	11.11	313.09	863.14
	12100.000	100.00	.00	.00	1241.49	3230.00	1246.72	1246.27	1248.47	13.65	11.02	315.77	874.35
	12200.000	100.00	.00	.00	1241.62	3230.00	1246.87	1246.40	1248.61	13.51	10.99	316.79	878.63
	12300.000	100.00	.00	.00	1241.75	3230.00	1247.02	1246.53	1248.74	13.33	10.94	318.22	884.60
	12400.000	100.00	.00	.00	1241.88	3230.00	1247.16	1246.66	1248.88	13.22	10.91	319.13	888.47
	12500.000	100.00	.00	.00	1242.01	3230.00	1247.30	1246.80	1249.01	13.12	10.89	319.90	891.69
	12600.000	100.00	.00	.00	1242.14	3230.00	1247.44	1246.93	1249.14	13.05	10.87	320.50	894.22
	12700.000	100.00	.00	.00	1242.27	3230.00	1247.57	1247.06	1249.27	13.00	10.85	320.91	895.98
	12800.000	100.00	.00	.00	1242.40	3230.00	1247.71	1247.19	1249.40	12.97	10.85	321.15	896.97
	12900.000	100.00	.00	.00	1242.53	3230.00	1247.84	1247.32	1249.53	12.96	10.84	321.22	897.26
	13000.000	100.00	.00	.00	1242.67	3230.00	1247.97	1247.45	1249.66	12.96	10.84	321.17	897.08
	13100.000	100.00	.00	.00	1242.80	3230.00	1248.09	1247.58	1249.79	12.98	10.85	321.05	896.57
	13200.000	100.00	.00	.00	1242.93	3230.00	1248.22	1247.71	1249.92	13.00	10.85	320.91	895.98
	13300.000	100.00	.00	.00	1243.06	3230.00	1248.35	1247.84	1250.05	13.01	10.86	320.77	895.36
	13400.000	100.00	.00	.00	1243.19	3230.00	1248.48	1247.97	1250.18	13.03	10.86	320.64	894.81
*	13401.000	1.00	.00	.00	1246.19	3230.00	1250.97	1250.97	1253.11	18.64	12.14	284.95	748.09
	13500.000	99.00	.00	.00	1246.32	3230.00	1251.59	1251.11	1253.31	13.33	10.94	318.27	884.82
	13600.000	100.00	.00	.00	1246.45	3230.00	1251.75	1251.24	1253.44	13.03	10.86	320.66	894.91

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	13601.000	1.00	.00	.00	1249.45	3230.00	1254.23	1254.23	1256.37	18.63	12.14	285.01	748.32
	13700.000	99.00	.00	.00	1249.58	3230.00	1254.84	1254.37	1256.57	13.41	10.96	317.57	881.91
	13800.000	100.00	.00	.00	1249.71	3230.00	1255.00	1254.50	1256.70	13.09	10.88	320.15	892.75
	13900.000	100.00	.00	.00	1249.84	3230.00	1255.13	1254.63	1256.83	13.06	10.87	320.41	893.85
	13950.000	50.00	.00	.00	1249.91	3230.00	1255.20	1254.69	1256.90	13.05	10.87	320.48	894.15
*	13951.000	1.00	.00	.00	1252.88	3230.00	1257.66	1257.66	1259.80	18.63	12.14	285.02	748.36
	14000.000	49.00	.00	.00	1252.95	3230.00	1258.14	1257.74	1259.92	14.00	11.11	313.11	863.20
	14100.000	100.00	.00	.00	1253.08	3230.00	1258.31	1257.86	1260.06	13.65	11.02	315.76	874.31
	14200.000	100.00	.00	.00	1253.21	3230.00	1258.46	1257.99	1260.20	13.52	10.99	316.77	878.55
	14300.000	100.00	.00	.00	1253.34	3230.00	1258.61	1258.12	1260.33	13.34	10.94	318.19	884.49
	14400.000	100.00	.00	.00	1253.47	3230.00	1258.75	1258.25	1260.46	13.22	10.91	319.10	888.33
	14500.000	100.00	.00	.00	1253.60	3230.00	1258.89	1258.39	1260.60	13.12	10.89	319.88	891.62
	14550.000	50.00	.00	.00	1253.67	3230.00	1258.96	1258.45	1260.66	13.05	10.87	320.46	894.07
*	14551.000	1.00	.00	.00	1256.67	3230.00	1261.46	1261.46	1263.59	18.62	12.14	285.08	748.59
	14600.000	49.00	.00	.00	1256.74	3230.00	1261.93	1261.53	1263.71	14.02	11.11	312.97	862.63
	14700.000	100.00	.00	.00	1256.87	3230.00	1262.10	1261.65	1263.85	13.66	11.02	315.66	873.87
	14800.000	100.00	.00	.00	1257.00	3230.00	1262.25	1261.78	1263.99	13.48	10.98	317.09	879.87
	14850.000	50.00	.00	.00	1257.06	3230.00	1262.33	1261.85	1264.06	13.37	10.95	317.89	883.25
*	14851.000	1.00	.00	.00	1260.07	3230.00	1264.86	1264.86	1266.99	18.64	12.14	284.95	748.09
	14900.000	49.00	.00	.00	1260.14	3230.00	1265.33	1264.93	1267.11	13.98	11.10	313.24	863.75
	15000.000	100.00	.00	.00	1260.27	3230.00	1265.50	1265.05	1267.25	13.63	11.02	315.88	874.82
	15100.000	100.00	.00	.00	1260.40	3230.00	1265.65	1265.18	1267.39	13.50	10.98	316.87	878.96
	15200.000	100.00	.00	.00	1260.53	3230.00	1265.80	1265.31	1267.52	13.33	10.94	318.23	884.67
	15236.000	36.00	.00	.00	1260.58	3230.00	1265.85	1265.36	1267.57	13.24	10.92	318.97	887.78
*	15237.000	1.00	.00	.00	1261.14	3230.00	1265.97	1265.97	1268.38	23.92	12.46	259.20	660.44
*	15327.000	90.00	1275.90	1274.70	1261.20	3050.00	1268.77	.00	1269.57	4.23	7.20	423.88	1482.89

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	15400.000	73.00	.00	.00	1261.30	3050.00	1268.86	1266.14	1269.61	3.70	7.35	462.70	1585.51
	15500.000	100.00	.00	.00	1261.43	3050.00	1268.87	1266.27	1269.65	3.93	7.49	453.38	1538.88
	15600.000	100.00	.00	.00	1261.56	3050.00	1268.90	1266.40	1269.70	4.13	7.61	445.73	1500.92
	15650.000	50.00	.00	.00	1261.63	3050.00	1268.91	1266.47	1269.73	4.24	7.67	441.61	1480.60
*	15650.000	1.00	.00	.00	1264.63	3050.00	1269.47	1269.47	1271.61	18.46	12.19	269.76	709.90
	15700.000	49.00	.00	.00	1264.69	3050.00	1269.93	1269.54	1271.72	13.99	11.18	295.69	815.34
	15800.000	100.00	.00	.00	1264.82	3050.00	1270.10	1269.67	1271.86	13.65	11.09	298.11	825.40
	15900.000	100.00	.00	.00	1264.96	3050.00	1270.25	1269.80	1272.00	13.53	11.06	298.99	829.09
	16000.000	100.00	.00	.00	1265.09	3050.00	1270.40	1269.93	1272.14	13.42	11.03	299.86	832.69
	16050.000	50.00	.00	.00	1265.15	3050.00	1270.47	1269.99	1272.20	13.32	11.00	300.59	835.77
*	16051.000	1.00	.00	.00	1267.64	3050.00	1272.48	1272.48	1274.62	18.51	12.20	269.54	709.01
	16100.000	49.00	.00	.00	1267.70	3050.00	1272.95	1272.55	1274.74	13.97	11.17	295.85	816.01
	16200.000	100.00	.00	.00	1267.84	3050.00	1273.12	1272.68	1274.88	13.63	11.08	298.28	826.12
	16300.000	100.00	.00	.00	1267.97	3050.00	1273.26	1272.81	1275.01	13.51	11.05	299.14	829.71
	16400.000	100.00	.00	.00	1268.10	3050.00	1273.41	1272.94	1275.15	13.40	11.02	299.97	833.16
	16450.000	50.00	.00	.00	1268.17	3050.00	1273.48	1273.01	1275.22	13.31	11.00	300.67	836.08
	16451.000	1.00	.00	.00	1271.18	1130.00	1275.07	1273.45	1275.36	3.45	4.55	271.86	608.36
	16500.000	49.00	.00	.00	1271.26	1130.00	1275.08	1273.53	1275.38	3.69	4.65	265.77	588.23
	16600.000	100.00	.00	.00	1271.42	1130.00	1275.10	1273.68	1275.43	4.19	4.84	254.64	551.98
	16650.000	50.00	.00	.00	1271.50	1130.00	1275.11	1273.76	1275.46	4.48	4.95	248.93	533.64
*	16651.000	1.00	.00	.00	1274.17	1130.00	1276.44	1276.44	1277.46	23.92	8.36	143.23	231.05
	16700.000	49.00	.00	.00	1274.25	1130.00	1276.79	1276.52	1277.57	15.87	7.35	163.75	283.65
	16800.000	100.00	.00	.00	1274.41	1130.00	1276.94	1276.68	1277.74	16.25	7.41	162.47	280.28
*	16801.000	1.00	.00	.00	1277.13	1130.00	1279.39	1279.39	1280.41	23.90	8.35	143.27	231.14
	16900.000	99.00	.00	.00	1277.29	1130.00	1279.86	1279.55	1280.63	15.32	7.27	165.66	288.72
	16950.000	50.00	.00	.00	1277.37	1130.00	1279.95	1279.64	1280.70	14.92	7.21	167.11	292.57

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	16951.000	1.00	.00	.00	1279.80	1130.00	1282.07	1282.07	1283.09	23.90	8.35	143.28	231.16
*	17000.000	49.00	.00	.00	1280.01	1130.00	1282.27	1282.27	1283.29	23.86	8.35	143.35	231.33
*	17100.000	100.00	.00	.00	1280.42	1130.00	1282.68	1282.68	1283.70	23.86	8.35	143.35	231.33

CHANNEL IMPROVEMENT

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	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	5490.000	8480.00	1204.80	.00	.00	.00	433.01	.00
*	5786.000	8480.00	1205.10	.00	.30	.00	318.25	265.00
	5816.000	8480.00	1204.83	.00	-.27	.00	266.52	30.00
*	5846.000	8480.00	1204.66	.00	-.17	.00	207.65	30.00
*	5876.000	8480.00	1204.90	.00	.25	.00	182.77	30.00
	5900.000	8480.00	1205.55	.00	.65	.00	161.63	24.00
	6000.000	8480.00	1205.71	.00	.16	.00	161.80	100.00
	6100.000	8480.00	1205.84	.00	.13	.00	161.81	100.00
	6200.000	8480.00	1205.97	.00	.13	.00	161.81	100.00
*	6201.000	8480.00	1208.01	.00	2.04	.00	158.90	1.00
	6300.000	8480.00	1208.71	.00	.70	.00	161.18	99.00
	6400.000	8480.00	1208.88	.00	.18	.00	161.39	100.00
	6500.000	8480.00	1209.03	.00	.15	.00	161.48	100.00
	6600.000	8480.00	1209.21	.00	.17	.00	161.72	100.00
	6700.000	8480.00	1209.34	.00	.13	.00	161.74	100.00
	6800.000	8480.00	1209.47	.00	.13	.00	161.77	100.00
*	6801.000	8480.00	1211.45	.00	1.98	.00	158.90	1.00
	6900.000	8480.00	1212.15	.00	.70	.00	161.18	99.00
	7000.000	8480.00	1212.33	.00	.18	.00	161.38	100.00
	7100.000	8480.00	1212.48	.00	.15	.00	161.48	100.00
	7200.000	8480.00	1212.65	.00	.17	.00	161.71	100.00
	7300.000	8480.00	1212.79	.00	.13	.00	161.74	100.00
	7400.000	8480.00	1212.92	.00	.13	.00	161.76	100.00
	7500.000	8480.00	1213.05	.00	.13	.00	161.79	100.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
7600.000	8480.00	1213.18	.00	.13	.00	161.82	100.00
7700.000	8480.00	1213.31	.00	.13	.00	161.85	100.00
7800.000	8480.00	1213.44	.00	.13	.00	161.88	100.00
7900.000	8480.00	1213.57	.00	.13	.00	161.90	100.00
8000.000	8480.00	1213.70	.00	.13	.00	161.92	100.00
8100.000	8480.00	1213.83	.00	.13	.00	161.93	100.00
8200.000	8480.00	1213.95	.00	.13	.00	161.94	100.00
8250.000	8480.00	1214.01	.00	.06	.00	161.94	50.00
8251.000	8480.00	1215.96	.00	1.94	.00	158.91	1.00
8300.000	8480.00	1216.48	.00	.52	.00	160.72	49.00
8400.000	8480.00	1216.73	.00	.25	.00	161.27	100.00
8500.000	8480.00	1216.88	.00	.15	.00	161.34	100.00
8550.000	8480.00	1216.96	.00	.08	.00	161.40	50.00
8551.000	8480.00	1218.79	.00	1.83	.00	158.88	1.00
8600.000	8480.00	1219.33	.00	.54	.00	160.75	49.00
8700.000	8480.00	1219.57	.00	.25	.00	161.27	100.00
8800.000	8480.00	1219.72	.00	.15	.00	161.35	100.00
8801.000	8480.00	1221.80	.00	2.07	.00	158.88	1.00
8900.000	8480.00	1222.50	.00	.70	.00	161.19	99.00
9000.000	8480.00	1222.68	.00	.18	.00	161.40	100.00
9100.000	8480.00	1222.83	.00	.15	.00	161.48	100.00
9200.000	8480.00	1223.00	.00	.17	.00	161.71	100.00
9300.000	8480.00	1223.13	.00	.13	.00	161.74	100.00
9350.000	8480.00	1223.20	.00	.07	.00	161.76	50.00
9351.000	8480.00	1225.18	.00	1.98	.00	158.90	1.00
9400.000	8480.00	1225.71	.00	.53	.00	160.74	49.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
9500.000	8480.00	1225.96	.00	.25	.00	161.27	100.00
9600.000	8480.00	1226.11	.00	.15	.00	161.34	100.00
9700.000	8480.00	1226.29	.00	.18	.00	161.61	100.00
9800.000	8480.00	1226.43	.00	.14	.00	161.64	100.00
9900.000	8480.00	1226.57	.00	.14	.00	161.68	100.00
9954.000	8480.00	1226.65	.00	.08	.00	161.74	54.00
* 9955.000	8480.00	1226.56	.00	-.08	.00	140.00	1.00
* 10045.000	7770.00	1230.13	.00	3.57	.00	140.00	90.00
10100.000	7770.00	1230.14	.00	.01	.00	159.82	55.00
10200.000	7770.00	1230.16	.00	.02	.00	159.42	100.00
10300.000	7770.00	1230.18	.00	.02	.00	159.00	100.00
* 10301.000	7770.00	1229.69	.00	-.49	.00	146.94	1.00
10400.000	7770.00	1230.36	.00	.67	.00	149.09	100.00
* 10401.000	7770.00	1232.53	.00	2.17	.00	146.95	1.00
10500.000	7770.00	1233.19	.00	.66	.00	149.06	99.00
10600.000	7770.00	1233.35	.00	.17	.00	149.24	100.00
10700.000	7770.00	1233.49	.00	.14	.00	149.28	100.00
* 10701.000	7770.00	1235.52	.00	2.03	.00	146.95	1.00
10800.000	7770.00	1236.18	.00	.66	.00	149.06	99.00
10900.000	7770.00	1236.34	.00	.17	.00	149.23	100.00
11000.000	7770.00	1236.48	.00	.14	.00	149.27	100.00
11100.000	7770.00	1236.62	.00	.14	.00	149.32	100.00
11200.000	7770.00	1236.75	.00	.14	.00	149.36	100.00
* 11201.000	7770.00	1239.15	.00	2.39	.00	146.96	1.00
11300.000	7770.00	1239.80	.00	.66	.00	149.05	99.00
11400.000	7770.00	1239.97	.00	.17	.00	149.23	100.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
11500.000	7770.00	1240.11	.00	.14	.00	149.27	100.00
11600.000	7770.00	1240.25	.00	.14	.00	149.31	100.00
* 11601.000	7770.00	1242.65	.00	2.40	.00	146.95	1.00
11700.000	7770.00	1243.31	.00	.66	.00	149.06	99.00
11800.000	7770.00	1243.47	.00	.17	.00	149.23	100.00
11900.000	7770.00	1243.61	.00	.14	.00	149.27	100.00
11950.000	7770.00	1243.68	.00	.07	.00	149.31	50.00
* 11951.000	3230.00	1246.07	.00	2.39	.00	69.13	1.00
12000.000	3230.00	1246.55	.00	.47	.00	70.73	49.00
12100.000	3230.00	1246.72	.00	.17	.00	70.88	100.00
12200.000	3230.00	1246.87	.00	.15	.00	70.94	100.00
12300.000	3230.00	1247.02	.00	.15	.00	71.02	100.00
12400.000	3230.00	1247.16	.00	.14	.00	71.07	100.00
12500.000	3230.00	1247.30	.00	.14	.00	71.12	100.00
12600.000	3230.00	1247.44	.00	.14	.00	71.15	100.00
12700.000	3230.00	1247.57	.00	.13	.00	71.17	100.00
12800.000	3230.00	1247.71	.00	.13	.00	71.19	100.00
12900.000	3230.00	1247.84	.00	.13	.00	71.19	100.00
13000.000	3230.00	1247.97	.00	.13	.00	71.19	100.00
13100.000	3230.00	1248.09	.00	.13	.00	71.18	100.00
13200.000	3230.00	1248.22	.00	.13	.00	71.17	100.00
13300.000	3230.00	1248.35	.00	.13	.00	71.17	100.00
13400.000	3230.00	1248.48	.00	.13	.00	71.16	100.00
* 13401.000	3230.00	1250.97	.00	2.49	.00	69.13	1.00
13500.000	3230.00	1251.59	.00	.61	.00	71.03	99.00
13600.000	3230.00	1251.75	.00	.16	.00	71.16	100.00

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	13601.000	3230.00	1254.23	.00	2.49	.00	69.13	1.00
	13700.000	3230.00	1254.84	.00	.60	.00	70.99	99.00
	13800.000	3230.00	1255.00	.00	.16	.00	71.13	100.00
	13900.000	3230.00	1255.13	.00	.13	.00	71.15	100.00
	13950.000	3230.00	1255.20	.00	.07	.00	71.15	50.00
*	13951.000	3230.00	1257.66	.00	2.47	.00	69.13	1.00
	14000.000	3230.00	1258.14	.00	.47	.00	70.73	49.00
	14100.000	3230.00	1258.31	.00	.17	.00	70.88	100.00
	14200.000	3230.00	1258.46	.00	.15	.00	70.94	100.00
	14300.000	3230.00	1258.61	.00	.15	.00	71.02	100.00
	14400.000	3230.00	1258.75	.00	.14	.00	71.07	100.00
	14500.000	3230.00	1258.89	.00	.14	.00	71.12	100.00
	14550.000	3230.00	1258.96	.00	.07	.00	71.15	50.00
*	14551.000	3230.00	1261.46	.00	2.50	.00	69.13	1.00
	14600.000	3230.00	1261.93	.00	.47	.00	70.73	49.00
	14700.000	3230.00	1262.10	.00	.17	.00	70.88	100.00
	14800.000	3230.00	1262.25	.00	.15	.00	70.96	100.00
	14850.000	3230.00	1262.33	.00	.08	.00	71.00	50.00
*	14851.000	3230.00	1264.86	.00	2.53	.00	69.13	1.00
	14900.000	3230.00	1265.33	.00	.48	.00	70.74	49.00
	15000.000	3230.00	1265.50	.00	.17	.00	70.89	100.00
	15100.000	3230.00	1265.65	.00	.15	.00	70.95	100.00
	15200.000	3230.00	1265.80	.00	.15	.00	71.02	100.00
	15236.000	3230.00	1265.85	.00	.06	.00	71.06	36.00
*	15237.000	3230.00	1265.97	.00	.11	.00	54.36	1.00
*	15327.000	3050.00	1268.77	.00	2.80	.00	56.00	90.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
15400.000	3050.00	1268.86	.00	.09	.00	76.27	73.00
15500.000	3050.00	1268.87	.00	.02	.00	75.78	100.00
15600.000	3050.00	1268.90	.00	.02	.00	75.37	100.00
15650.000	3050.00	1268.91	.00	.01	.00	75.15	50.00
* 15650.000	3050.00	1269.47	.00	.56	.00	65.37	1.00
15700.000	3050.00	1269.93	.00	.46	.00	66.94	49.00
15800.000	3050.00	1270.10	.00	.17	.00	67.08	100.00
15900.000	3050.00	1270.25	.00	.15	.00	67.14	100.00
16000.000	3050.00	1270.40	.00	.15	.00	67.19	100.00
16050.000	3050.00	1270.47	.00	.08	.00	67.23	50.00
* 16051.000	3050.00	1272.48	.00	2.01	.00	65.36	1.00
16100.000	3050.00	1272.95	.00	.47	.00	66.95	49.00
16200.000	3050.00	1273.12	.00	.17	.00	67.09	100.00
16300.000	3050.00	1273.26	.00	.15	.00	67.15	100.00
16400.000	3050.00	1273.41	.00	.14	.00	67.19	100.00
16450.000	3050.00	1273.48	.00	.08	.00	67.24	50.00
16451.000	1130.00	1275.07	.00	1.59	.00	85.76	1.00
16500.000	1130.00	1275.08	.00	.01	.00	85.18	49.00
16600.000	1130.00	1275.10	.00	.02	.00	84.10	100.00
16650.000	1130.00	1275.11	.00	.01	.00	83.55	50.00
* 16651.000	1130.00	1276.44	.00	1.32	.00	72.49	1.00
16700.000	1130.00	1276.79	.00	.35	.00	74.76	49.00
16800.000	1130.00	1276.94	.00	.15	.00	74.62	100.00
* 16801.000	1130.00	1279.39	.00	2.45	.00	72.49	1.00
16900.000	1130.00	1279.86	.00	.46	.00	74.97	99.00
16950.000	1130.00	1279.95	.00	.09	.00	75.13	50.00

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	16951.000	1130.00	1282.07	.00	2.12	.00	72.49	1.00
*	17000.000	1130.00	1282.27	.00	.21	.00	72.50	49.00
*	17100.000	1130.00	1282.68	.00	.41	.00	72.50	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

```
WARNING SECNO=   5786.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=   5846.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   5846.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=   5876.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   5876.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=   6201.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   6201.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=   6801.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   6801.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=   8251.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   8251.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=   8551.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   8551.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=   8801.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   8801.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=   9351.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   9351.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=   9955.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   9955.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

WARNING SECNO=  10045.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=  10301.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  10301.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  10401.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  10401.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  10701.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  10701.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  11201.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  11201.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  11601.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  11601.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  11951.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  11951.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  13401.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  13401.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY
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CAUTION SECNO=  13601.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  13601.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  13951.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  13951.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  14551.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  14551.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  14851.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  14851.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  15237.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  15237.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

WARNING SECNO=  15327.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=  15650.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  15650.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  16051.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  16051.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  16651.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  16651.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  16801.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  16801.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  16951.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  16951.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  17000.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  17000.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=  17100.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  17100.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY
```

```
*********************************************
*  HEC-2 WATER SURFACE PROFILES             *
*                                           *
*  Version   4.6.2;  May 1991               *
*                                           *
*  RUN DATE    16DEC94    TIME   12:05:37   *
*********************************************
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****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*          (916) 756-1104              *
****************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X       X     X            X     X
X     X  X       X                        X
XXXXXXX  XXXX    X          XXXXX    XXXXX
X     X  X       X                  X
X     X  X       X     X            X
X     X  XXXXXXX  XXXXX             XXXXXXX
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THIS RUN EXECUTED 16DEC94 12:05:37

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************************************
HEC-2 WATER SURFACE PROFILES

Version   4.6.2;  May 1991
************************************

T1      WHITE TANKS F.R.S. #3 INLET
T2      DESIGN CONCEPT REPORT
T3      CHANNEL IMPROVEMENTS (SUPERCRITICAL)  100-YR FLOWS

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ
              2                 1        -1                         1130     1283

J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE
    -1                                                      -1       7

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

    100       105      120      150

J6  IHLEQ     ICOPY    SUBDIV   STRTDS   RMILE
    1

  UPSTREAM X-SEC.  (NATURAL CHANNEL)

 REACH E

NC     .015      .015      .015       .1        .3
QT        1      1130
X1    17000         7        82      118    17.73     17.73     17.73
GR     1286        82  1283.966       86  1279.966        94  1279.966       100  1279.966       106
GR     1284       114   1285.97      118

X1    16982                                 82.27     82.27     82.27                -1.504

X1    16900                                   100       100       100                -.4689

X1    16800                                   100       100       100                -.5699

X1    16700                                   100       100       100                -.5699

X1    16600                                   100       100       100                -.5699

X1    16500                                    25        25        25                -.5699
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X1    16475                                  50        50        50              -.1425

 REACH D

QT        1    3050
X1    16425       7      74.6     125.4       25        25        25              1.686
GR   1279.1    74.6    1275.9        81   1268.9        95   1268.90       100   1268.9       105
GR   1275.9     119    1279.1     125.4

X1    16400                                 100       100       100              -.1425

X1    16300                                 100       100       100              -.5699

X1    16200                                 100       100       100              -.5699

X1    16100                                 100       100       100              -.5699

X1    16000                                 100       100       100              -.5699

X1    15900                                 100       100       100              -.5699

X1    15800                                 100       100       100              -.5699

X1    15700                                 100       100       100              -.5699

X1    15600                                 100       100       100              -.5699

X1    15500                                 100       100       100              -.5699

X1    15400                                 100       100       100              -.5699

X1    15300                               37.43     37.43     37.43              -.5732

X1    15262                                  50        50        50              -.2133

 REACH C

QT        1    3230
X1    15212       7      73.8     126.2    12.57     12.57     12.57              -.837
GR   1272.6    73.8    1268.95        81  1261.95        95  1261.95       100  1261.95       105
GR   1268.9     119    1272.65     126.2

X1    15200                                 100       100       100             -.09545

X1    15100                                 100       100       100              -.7594

X1    15000                                 100       100       100              -.7594
```

X1	14900	100	100	100	-.7594
X1	14800	100	100	100	-.7594
X1	14700	100	100	100	-.7594
X1	14600	100	100	100	-.7594
X1	14500	100	100	100	-.7594
X1	14400	100	100	100	-.7594
X1	14300	100	100	100	-.7594
X1	14200	100	100	100	-.7594
X1	14100	100	100	100	-.7594
X1	14000	100	100	100	-.7594
X1	13900	100	100	100	-.7594
X1	13800	100	100	100	-.7594
X1	13700	100	100	100	-.7594
X1	13600	100	100	100	-.7594
X1	13500	100	100	100	-.7594
X1	13400	100	100	100	-.7594
X1	13300	100	100	100	-.7594
X1	13200	100	100	100	-.7594
X1	13100	100	100	100	-.7594
X1	13000	100	100	100	-.7594
X1	12900	100	100	100	-.7594
X1	12800	100	100	100	-.7594
X1	12700	100	100	100	-.7594
X1	12600	100	100	100	-.7594

```
X1    12500                                   100       100       100              -.7594
X1    12400                                   100       100       100              -.7594
X1    12300                                   100       100       100              -.7594
X1    12200                                   100       100       100              -.7594
X1    12100                                   100       100       100              -.7594
X1    12000                                    25        25        25              -.7594
X1    11975                                    50        50        50              -.1898
REACH B

RT        1     7770
X1    11925        7      61.8     138.2        25        25        25              -1.814
GR   1246.0     61.8   1241.99        70   1234.99        84   1234.99       100   1234.99       116
GR     1242      130    1246.1     138.2
X1    11900                                   100       100       100               -.16
X1    11800                                   100       100       100               -.64
X1    11700                                   100       100       100               -.64
X1    11600                                   100       100       100               -.64
X1    11500                                   100       100       100               -.64
X1    11400                                   100       100       100               -.64
X1    11300                                   100       100       100               -.64
X1    11200                                   100       100       100               -.64
X1    11100                                   100       100       100               -.64
X1    11000                                   100       100       100               -.64
X1    10900                                   100       100       100               -.64
X1    10800                                   100       100       100               -.64
X1    10700                                   100       100       100               -.64
X1    10600                                   100       100       100               -.64
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X1    10500                                   100       100       100              -.64

X1    10400                                   100       100       100              -.64

X1    10300                                   100       100       100              -.64

X1    10200                                   100       100       100              -.64
  EXPANTION BEGIN

X1    10100                                    54        54        54              -.64

X1    10046        7      60.8     139.2        1         1         1           -.0676
GR   1232.3     60.8   1228.22        71  1221.22        85   1221.22       100 1221.22       117
GR   1228.2      131    1232.3     139.2
  BRIDGE AND PIER AND EXPANCION END

X1    10045       11      60.8     139.2       45        45        45             -.074
GR   1232.3     60.8   1228.22        71  1221.22        85   1221.22        99    1235        99
GR    1235      100      1235       101  1221.22       101   1221.22       117 1228.22       131
GR   1232.3    139.2

X1    10000                                    44        44        44             -.325

X1     9956       11        59       141        1         1         1            .0064
GR   1231.0       59   1227.57        66  1220.57        81   1220.57        99    1235        99
GR    1235      100      1235       101  1220.57       101   1220.57       120 1227.57       134
GR    1231      141
  PIER END
  REACH A -  BRIDGE OUTLET

QT       1     8480
X1    9955        7      56.8     143.2       55        55        55
GR   1231.0     56.8   1227.57        64  1220.57        78   1220.57       100 1220.57       122
GR   1227.5      134   1231.07     143.2

X1     9900                                   100       100       100           -.2772

X1     9800                                   100       100       100            -.504

X1     9700                                   100       100       100            -.504

X1     9600                                   100       100       100            -.504

X1     9500                                   100       100       100            -.504

X1     9400                                   100       100       100            -.504

X1     9300                                   100       100       100            -.504
```

X1	9200	100	100	100	-.504
X1	9100	100	100	100	-.504
X1	9000	100	100	100	-.504
X1	8900	100	100	100	-.504
X1	8800	100	100	100	-.504
X1	8700	100	100	100	-.504
X1	8600	100	100	100	-.504
X1	8500	100	100	100	-.504
X1	8400	100	100	100	-.504
X1	8300	100	100	100	-.504
X1	8200	100	100	100	-.504
X1	8100	100	100	100	-.504
X1	8000	100	100	100	-.504
X1	7900	100	100	100	-.504
X1	7800	100	100	100	-.504
X1	7700	100	100	100	-.504
X1	7600	100	100	100	-.504
X1	7500	100	100	100	-.504
X1	7400	100	100	100	-.504
X1	7300	100	100	100	-.504
X1	7200	100	100	100	-.504
X1	7100	100	100	100	-.504
X1	7000	100	100	100	-.504
X1	6900	100	100	100	-.504

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X1     6800                                    100       100       100                -.504
X1     6700                                    100       100       100                -.504
X1     6600                                    100       100       100                -.504
X1     6500                                    100       100       100                -.504
X1     6400                                    100       100       100                -.504
X1     6300                                    100       100       100                -.504
X1     6200                                    100       100       100                -.504
X1     6100                                    100       100       100                -.504
X1     6000                                     50        50        50                -.504
Outlet tranc.

X1     5950                                     50        50        50                -.252
X1     5900        5        36       164         1         1         1
GR   1207.3       36  1200.347        50  1200.347       100  1200.347       150  1207.347       164
X1     5901                                      1         1         1                   3
X1     5902                                      1         1         1               -3.25
```

CHANNEL IMPROVEMENTS (SU

SUMMARY PRINTOUT TABLE 120

	SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
*	17000.000	1284.89	1286.61	10.54	24.40	4.92	31.60	.00	.01	82.00	1286.00	118.00	1285.97
*	16982.000	1282.04	1286.26	16.49	83.85	3.58	26.27	.00	.01	82.00	1284.50	118.00	1284.47
	16900.000	1281.71	1285.49	15.60	71.87	3.72	26.85	.00	.01	82.00	1284.03	118.00	1284.00
	16800.000	1281.28	1284.72	14.89	63.17	3.85	27.36	.00	.01	82.00	1283.46	118.00	1283.43
	16700.000	1280.78	1284.06	14.54	59.17	3.92	27.62	.00	.01	82.00	1282.89	118.00	1282.86
	16600.000	1280.22	1283.46	14.43	57.92	3.94	27.71	.00	.01	82.00	1282.32	118.00	1282.29
	16500.000	1279.66	1282.88	14.40	57.61	3.94	27.73	.00	.01	82.00	1281.75	118.00	1281.72
	16475.000	1279.54	1282.72	14.31	56.60	3.97	27.80	.00	.01	82.00	1281.60	118.00	1281.57
*	16425.000	1277.91	1282.35	16.91	42.75	7.32	39.27	.00	.01	74.60	1280.79	125.40	1280.79
	16400.000	1277.72	1282.23	17.04	43.63	7.28	39.14	.00	.01	74.60	1280.64	125.40	1280.64
	16300.000	1277.06	1281.77	17.41	46.20	7.19	38.75	.00	.01	74.60	1280.07	125.40	1280.07
	16200.000	1276.42	1281.28	17.69	48.25	7.11	38.46	.00	.01	74.60	1279.50	125.40	1279.50
	16100.000	1275.79	1280.78	17.91	49.89	7.06	38.24	.00	.01	74.60	1278.93	125.40	1278.93
	16000.000	1275.18	1280.26	18.09	51.21	7.02	38.07	.00	.01	74.60	1278.36	125.40	1278.36
	15900.000	1274.58	1279.73	18.23	52.28	6.98	37.93	.00	.01	74.60	1277.79	125.40	1277.79
	15800.000	1273.97	1279.20	18.36	53.31	6.94	37.80	.00	.01	74.60	1277.22	125.40	1277.22
	15700.000	1273.38	1278.66	18.44	53.97	6.92	37.72	.00	.01	74.60	1276.65	125.40	1276.65
	15600.000	1272.79	1278.11	18.51	54.51	6.91	37.66	.00	.01	74.60	1276.08	125.40	1276.08
	15500.000	1272.21	1277.56	18.57	54.95	6.89	37.60	.00	.01	74.60	1275.51	125.40	1275.51
	15400.000	1271.63	1277.01	18.61	55.32	6.88	37.56	.00	.01	74.60	1274.94	125.40	1274.94
	15300.000	1271.04	1276.45	18.66	55.67	6.87	37.52	.00	.01	74.60	1274.37	125.40	1274.37
	15262.000	1270.85	1276.23	18.62	55.34	6.90	37.56	.00	.01	74.60	1274.16	125.40	1274.16
	15212.000	1267.34	1275.58	23.02	94.49	6.23	35.02	.00	.01	73.80	1271.76	126.20	1271.81
	15200.000	1267.26	1275.44	22.95	93.68	6.24	35.07	.00	.01	73.80	1271.67	126.20	1271.72

SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
15100.000	1266.59	1274.43	22.46	88.42	6.33	35.42	.00	.01	73.80	1270.91	126.20	1270.96
15000.000	1265.89	1273.49	22.12	84.78	6.40	35.67	.00	.01	73.80	1270.15	126.20	1270.20
14900.000	1265.18	1272.61	21.87	82.29	6.44	35.85	.00	.01	73.80	1269.39	126.20	1269.44
14800.000	1264.46	1271.75	21.67	80.25	6.48	36.01	.00	.01	73.80	1268.63	126.20	1268.68
14700.000	1263.71	1270.93	21.56	79.16	6.49	36.09	.00	.01	73.80	1267.87	126.20	1267.92
14600.000	1262.98	1270.12	21.45	78.07	6.52	36.18	.00	.01	73.80	1267.11	126.20	1267.16
14500.000	1262.23	1269.33	21.39	77.44	6.53	36.23	.00	.01	73.80	1266.35	126.20	1266.40
14400.000	1261.48	1268.55	21.34	76.97	6.54	36.27	.00	.01	73.80	1265.59	126.20	1265.64
14300.000	1260.72	1267.78	21.32	76.78	6.54	36.28	.00	.01	73.80	1264.83	126.20	1264.88
14200.000	1259.96	1267.01	21.30	76.57	6.54	36.30	.00	.01	73.80	1264.07	126.20	1264.12
14100.000	1259.22	1266.24	21.26	76.22	6.55	36.33	.00	.01	73.80	1263.31	126.20	1263.36
14000.000	1258.46	1265.47	21.26	76.17	6.55	36.33	.00	.01	73.80	1262.55	126.20	1262.60
13900.000	1257.70	1264.71	21.25	76.12	6.55	36.33	.00	.01	73.80	1261.80	126.20	1261.85
13800.000	1256.94	1263.95	21.25	76.08	6.55	36.34	.00	.01	73.80	1261.04	126.20	1261.09
13700.000	1256.18	1263.19	21.24	76.03	6.56	36.34	.00	.01	73.80	1260.28	126.20	1260.33
13600.000	1255.42	1262.43	21.24	76.00	6.56	36.35	.00	.01	73.80	1259.52	126.20	1259.57
13500.000	1254.66	1261.67	21.24	75.98	6.56	36.35	.00	.01	73.80	1258.76	126.20	1258.81
13400.000	1253.90	1260.91	21.24	75.97	6.56	36.35	.00	.01	73.80	1258.00	126.20	1258.05
13300.000	1253.15	1260.15	21.24	75.96	6.56	36.35	.00	.01	73.80	1257.24	126.20	1257.29
13200.000	1252.39	1259.39	21.23	75.95	6.56	36.35	.00	.01	73.80	1256.48	126.20	1256.53
13100.000	1251.63	1258.63	21.23	75.94	6.56	36.35	.00	.01	73.80	1255.72	126.20	1255.77
13000.000	1250.87	1257.87	21.23	75.94	6.56	36.35	.00	.01	73.80	1254.96	126.20	1255.01
12900.000	1250.11	1257.11	21.23	75.93	6.56	36.35	.00	.01	73.80	1254.20	126.20	1254.25
12800.000	1249.35	1256.35	21.23	75.94	6.56	36.35	.00	.01	73.80	1253.44	126.20	1253.49
12700.000	1248.59	1255.59	21.23	75.93	6.56	36.35	.00	.01	73.80	1252.68	126.20	1252.73
12600.000	1247.83	1254.83	21.23	75.94	6.56	36.35	.00	.01	73.80	1251.92	126.20	1251.97

SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
12500.000	1247.07	1254.07	21.23	75.93	6.56	36.35	.00	.01	73.80	1251.16	126.20	1251.21
12400.000	1246.31	1253.31	21.23	75.93	6.56	36.35	.00	.01	73.80	1250.40	126.20	1250.45
12300.000	1245.55	1252.55	21.23	75.93	6.56	36.35	.00	.01	73.80	1249.64	126.20	1249.69
12200.000	1244.79	1251.79	21.23	75.94	6.56	36.35	.00	.01	73.80	1248.89	126.20	1248.94
12100.000	1244.03	1251.03	21.23	75.93	6.56	36.35	.00	.01	73.80	1248.13	126.20	1248.18
12000.000	1243.27	1250.27	21.23	75.94	6.56	36.35	.00	.01	73.80	1247.37	126.20	1247.42
11975.000	1243.08	1250.08	21.24	75.96	6.56	36.35	.00	.01	73.80	1247.18	126.20	1247.23
* 11925.000	1240.07	1249.48	24.61	71.67	6.90	59.57	.00	.01	61.80	1244.19	138.20	1244.29
11900.000	1239.92	1249.28	24.55	71.22	6.91	59.61	.00	.01	61.80	1244.03	138.20	1244.13
11800.000	1239.33	1248.53	24.35	69.54	6.95	59.79	.00	.01	61.80	1243.39	138.20	1243.49
11700.000	1238.72	1247.81	24.19	68.26	6.99	59.93	.00	.01	61.80	1242.75	138.20	1242.85
11600.000	1238.10	1247.11	24.08	67.38	7.01	60.03	.00	.01	61.80	1242.11	138.20	1242.21
11500.000	1237.48	1246.41	23.98	66.63	7.03	60.12	.00	.01	61.80	1241.47	138.20	1241.57
11400.000	1236.86	1245.73	23.90	66.02	7.05	60.19	.00	.01	61.80	1240.83	138.20	1240.93
11300.000	1236.24	1245.06	23.84	65.54	7.06	60.25	.00	.01	61.80	1240.19	138.20	1240.29
11200.000	1235.61	1244.40	23.79	65.17	7.07	60.29	.00	.01	61.80	1239.55	138.20	1239.65
11100.000	1234.98	1243.74	23.76	64.88	7.08	60.33	.00	.01	61.80	1238.91	138.20	1239.01
11000.000	1234.34	1243.09	23.73	64.66	7.09	60.35	.00	.01	61.80	1238.27	138.20	1238.37
10900.000	1233.70	1242.44	23.72	64.62	7.08	60.36	.00	.01	61.80	1237.63	138.20	1237.73
10800.000	1233.07	1241.79	23.69	64.37	7.09	60.39	.00	.01	61.80	1236.99	138.20	1237.09
10700.000	1232.43	1241.14	23.69	64.36	7.09	60.39	.00	.01	61.80	1236.35	138.20	1236.45
10600.000	1231.80	1240.49	23.67	64.18	7.10	60.41	.00	.01	61.80	1235.71	138.20	1235.81
10500.000	1231.15	1239.85	23.67	64.21	7.10	60.41	.00	.01	61.80	1235.07	138.20	1235.17
10400.000	1230.51	1239.21	23.67	64.18	7.10	60.41	.00	.01	61.80	1234.43	138.20	1234.53
10300.000	1229.88	1238.56	23.65	64.02	7.11	60.43	.00	.01	61.80	1233.79	138.20	1233.89
10200.000	1229.24	1237.92	23.65	64.07	7.10	60.42	.00	.01	61.80	1233.15	138.20	1233.25

SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
10100.000	1228.60	1237.28	23.65	64.06	7.10	60.42	.00	.01	61.80	1232.51	138.20	1232.61
10046.000	1228.26	1236.93	23.62	63.97	7.11	60.55	.00	.01	60.80	1232.23	139.20	1232.23
10045.000	1228.72	1236.72	22.70	74.69	7.58	60.61	.00	.01	60.80	1232.23	139.20	1232.23
10000.000	1228.43	1236.37	22.62	74.02	7.61	60.70	.00	.01	60.80	1231.90	139.20	1231.90
9956.000	1227.02	1235.92	23.93	89.50	6.45	63.71	.00	.01	59.00	1231.01	141.00	1231.01
9955.000	1226.89	1235.90	24.09	69.55	6.32	67.55	.00	.01	56.80	1231.00	143.20	1231.07
9900.000	1226.68	1235.45	23.77	66.93	6.39	67.81	.00	.01	56.80	1230.72	143.20	1230.79
9800.000	1226.28	1234.70	23.28	62.99	6.49	68.22	.00	.01	56.80	1230.22	143.20	1230.29
9700.000	1225.88	1233.99	22.85	59.65	6.60	68.60	.00	.01	56.80	1229.71	143.20	1229.78
9600.000	1225.45	1233.34	22.55	57.42	6.66	68.86	.00	.01	56.80	1229.21	143.20	1229.28
9500.000	1225.00	1232.73	22.31	55.66	6.72	69.08	.00	.01	56.80	1228.71	143.20	1228.78
9400.000	1224.54	1232.14	22.12	54.27	6.77	69.26	.00	.01	56.80	1228.20	143.20	1228.27
9300.000	1224.07	1231.57	21.97	53.22	6.81	69.40	.00	.01	56.80	1227.70	143.20	1227.77
9200.000	1223.60	1231.02	21.86	52.45	6.83	69.51	.00	.01	56.80	1227.19	143.20	1227.26
9100.000	1223.12	1230.48	21.78	51.88	6.86	69.59	.00	.01	56.80	1226.69	143.20	1226.76
9000.000	1222.63	1229.95	21.72	51.46	6.87	69.64	.00	.01	56.80	1226.19	143.20	1226.26
8900.000	1222.15	1229.42	21.64	50.93	6.90	69.72	.00	.01	56.80	1225.68	143.20	1225.75
8800.000	1221.64	1228.91	21.65	50.98	6.89	69.71	.00	.01	56.80	1225.18	143.20	1225.25
8700.000	1221.16	1228.40	21.59	50.62	6.91	69.76	.00	.01	56.80	1224.67	143.20	1224.74
8600.000	1220.64	1227.89	21.60	50.68	6.90	69.75	.00	.01	56.80	1224.17	143.20	1224.24
8500.000	1220.15	1227.38	21.57	50.47	6.91	69.78	.00	.01	56.80	1223.67	143.20	1223.74
8400.000	1219.63	1226.87	21.59	50.60	6.90	69.77	.00	.01	56.80	1223.16	143.20	1223.23
8300.000	1219.14	1226.36	21.56	50.40	6.91	69.80	.00	.01	56.80	1222.66	143.20	1222.73
8200.000	1218.64	1225.85	21.54	50.29	6.92	69.81	.00	.01	56.80	1222.15	143.20	1222.22
8100.000	1218.12	1225.35	21.57	50.44	6.90	69.79	.00	.01	56.80	1221.65	143.20	1221.72
8000.000	1217.63	1224.84	21.54	50.25	6.92	69.82	.00	.01	56.80	1221.15	143.20	1221.22

	SECNO	CWSEL	EG	VCH	10*KS	DEPTH	TOPWID	CLSTA	BW	STCHL	XLBEL	STCHR	RBEL
	7900.000	1217.15	1224.33	21.51	50.05	6.93	69.85	.00	.01	56.80	1220.64	143.20	1220.71
	7800.000	1216.62	1223.83	21.55	50.32	6.91	69.81	.00	.01	56.80	1220.14	143.20	1220.21
	7700.000	1216.13	1223.32	21.52	50.12	6.92	69.84	.00	.01	56.80	1219.63	143.20	1219.70
	7600.000	1215.64	1222.81	21.50	49.98	6.94	69.86	.00	.01	56.80	1219.13	143.20	1219.20
	7500.000	1215.10	1222.31	21.54	50.26	6.91	69.81	.00	.01	56.80	1218.63	143.20	1218.70
	7400.000	1214.62	1221.80	21.51	50.05	6.93	69.85	.00	.01	56.80	1218.12	143.20	1218.19
	7300.000	1214.12	1221.30	21.49	49.95	6.94	69.86	.00	.01	56.80	1217.62	143.20	1217.69
	7200.000	1213.60	1220.80	21.53	50.16	6.92	69.83	.00	.01	56.80	1217.11	143.20	1217.18
	7100.000	1213.12	1220.29	21.48	49.85	6.94	69.88	.00	.01	56.80	1216.61	143.20	1216.68
	7000.000	1212.60	1219.79	21.51	50.05	6.93	69.85	.00	.01	56.80	1216.11	143.20	1216.18
	6900.000	1212.10	1219.28	21.50	50.01	6.93	69.85	.00	.01	56.80	1215.60	143.20	1215.67
	6800.000	1211.59	1218.78	21.52	50.12	6.92	69.84	.00	.01	56.80	1215.10	143.20	1215.17
	6700.000	1211.10	1218.28	21.50	49.96	6.94	69.86	.00	.01	56.80	1214.59	143.20	1214.66
	6600.000	1210.58	1217.77	21.52	50.14	6.92	69.83	.00	.01	56.80	1214.09	143.20	1214.16
	6500.000	1210.08	1217.27	21.51	50.08	6.93	69.84	.00	.01	56.80	1213.59	143.20	1213.66
	6400.000	1209.57	1216.77	21.53	50.18	6.92	69.83	.00	.01	56.80	1213.08	143.20	1213.15
	6300.000	1209.09	1216.26	21.50	49.98	6.94	69.86	.00	.01	56.80	1212.58	143.20	1212.65
	6200.000	1208.56	1215.76	21.53	50.17	6.92	69.83	.00	.01	56.80	1212.07	143.20	1212.14
	6100.000	1208.08	1215.25	21.49	49.94	6.94	69.86	.00	.01	56.80	1211.57	143.20	1211.64
	6000.000	1207.56	1214.75	21.52	50.15	6.92	69.83	.00	.01	56.80	1211.07	143.20	1211.14
	5950.000	1207.32	1214.49	21.49	49.95	6.94	69.86	.00	.01	56.80	1210.81	143.20	1210.88
*	5900.000	1203.46	1213.66	25.63	161.64	3.11	112.50	.00	.01	36.00	1207.30	164.00	1207.35
*	5901.000	1207.86	1212.47	17.25	46.33	4.51	118.10	.00	.01	36.00	1210.30	164.00	1210.35
*	5902.000	1203.47	1212.07	23.53	123.14	3.38	113.55	.00	.01	36.00	1207.05	164.00	1207.10

CHANNEL IMPROVEMENTS (SU

SUMMARY PRINTOUT TABLE 150

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
* 17000.000	.00	.00	.00	1279.97	1130.00	1284.89	1284.89	1286.61	24.40	10.54	107.23	228.75
* 16982.000	17.73	.00	.00	1278.46	1130.00	1282.04	1283.39	1286.26	83.85	16.49	68.53	123.40
16900.000	82.27	.00	.00	1277.99	1130.00	1281.71	1282.92	1285.49	71.87	15.60	72.44	133.29
16800.000	100.00	.00	.00	1277.42	1130.00	1281.28	1282.35	1284.72	63.17	14.89	75.90	142.18
16700.000	100.00	.00	.00	1276.85	1130.00	1280.78	1281.77	1284.06	59.17	14.54	77.71	146.90
16600.000	100.00	.00	.00	1276.28	1130.00	1280.22	1281.20	1283.46	57.92	14.43	78.31	148.48
16500.000	100.00	.00	.00	1275.71	1130.00	1279.66	1280.63	1282.88	57.61	14.40	78.47	148.88
16475.000	25.00	.00	.00	1275.57	1130.00	1279.54	1280.49	1282.72	56.60	14.31	78.97	150.20
* 16425.000	50.00	.00	.00	1270.59	3050.00	1277.91	1279.15	1282.35	42.75	16.91	180.31	466.49
16400.000	25.00	.00	.00	1270.44	3050.00	1277.72	1279.05	1282.23	43.63	17.04	178.95	461.73
16300.000	100.00	.00	.00	1269.87	3050.00	1277.06	1278.44	1281.77	46.20	17.41	175.20	448.74
16200.000	100.00	.00	.00	1269.30	3050.00	1276.42	1277.87	1281.28	48.25	17.69	172.39	439.10
16100.000	100.00	.00	.00	1268.73	3050.00	1275.79	1277.30	1280.78	49.89	17.91	170.27	431.82
16000.000	100.00	.00	.00	1268.16	3050.00	1275.18	1276.73	1280.26	51.21	18.09	168.63	426.23
15900.000	100.00	.00	.00	1267.59	3050.00	1274.58	1276.16	1279.73	52.28	18.23	167.34	421.84
15800.000	100.00	.00	.00	1267.02	3050.00	1273.97	1275.59	1279.20	53.31	18.36	166.13	417.73
15700.000	100.00	.00	.00	1266.45	3050.00	1273.38	1275.02	1278.66	53.97	18.44	165.37	415.17
15600.000	100.00	.00	.00	1265.88	3050.00	1272.79	1274.45	1278.11	54.51	18.51	164.76	413.12
15500.000	100.00	.00	.00	1265.31	3050.00	1272.21	1273.88	1277.56	54.95	18.57	164.27	411.44
15400.000	100.00	.00	.00	1264.74	3050.00	1271.63	1273.31	1277.01	55.32	18.61	163.86	410.08
15300.000	100.00	.00	.00	1264.17	3050.00	1271.04	1272.73	1276.45	55.67	18.66	163.47	408.77
15262.000	37.43	.00	.00	1263.96	3050.00	1270.85	1272.52	1276.23	55.34	18.62	163.84	410.00
15212.000	50.00	.00	.00	1261.11	3230.00	1267.34	1269.91	1275.58	94.49	23.02	140.29	332.29
15200.000	12.57	.00	.00	1261.02	3230.00	1267.26	1269.84	1275.44	93.68	22.95	140.74	333.71

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
15100.000	100.00	.00	.00	1260.26	3230.00	1266.59	1269.08	1274.43	88.42	22.46	143.78	343.50
15000.000	100.00	.00	.00	1259.50	3230.00	1265.89	1268.32	1273.49	84.78	22.12	146.04	350.79
14900.000	100.00	.00	.00	1258.74	3230.00	1265.18	1267.55	1272.61	82.29	21.87	147.66	356.07
14800.000	100.00	.00	.00	1257.98	3230.00	1264.46	1266.79	1271.75	80.25	21.67	149.04	360.57
14700.000	100.00	.00	.00	1257.22	3230.00	1263.71	1266.03	1270.93	79.16	21.56	149.80	363.04
14600.000	100.00	.00	.00	1256.46	3230.00	1262.98	1265.27	1270.12	78.07	21.45	150.57	365.56
14500.000	100.00	.00	.00	1255.70	3230.00	1262.23	1264.51	1269.33	77.44	21.39	151.02	367.04
14400.000	100.00	.00	.00	1254.94	3230.00	1261.48	1263.75	1268.55	76.97	21.34	151.36	368.15
14300.000	100.00	.00	.00	1254.18	3230.00	1260.72	1262.99	1267.78	76.78	21.32	151.50	368.62
14200.000	100.00	.00	.00	1253.42	3230.00	1259.96	1262.23	1267.01	76.57	21.30	151.65	369.11
14100.000	100.00	.00	.00	1252.66	3230.00	1259.22	1261.47	1266.24	76.22	21.26	151.91	369.97
14000.000	100.00	.00	.00	1251.90	3230.00	1258.46	1260.71	1265.47	76.17	21.26	151.95	370.09
13900.000	100.00	.00	.00	1251.15	3230.00	1257.70	1259.95	1264.71	76.12	21.25	151.98	370.21
13800.000	100.00	.00	.00	1250.39	3230.00	1256.94	1259.19	1263.95	76.08	21.25	152.02	370.32
13700.000	100.00	.00	.00	1249.63	3230.00	1256.18	1258.43	1263.19	76.03	21.24	152.05	370.44
13600.000	100.00	.00	.00	1248.87	3230.00	1255.42	1257.67	1262.43	76.00	21.24	152.08	370.51
13500.000	100.00	.00	.00	1248.11	3230.00	1254.66	1256.91	1261.67	75.98	21.24	152.09	370.56
13400.000	100.00	.00	.00	1247.35	3230.00	1253.90	1256.15	1260.91	75.97	21.24	152.10	370.58
13300.000	100.00	.00	.00	1246.59	3230.00	1253.15	1255.39	1260.15	75.96	21.24	152.11	370.61
13200.000	100.00	.00	.00	1245.83	3230.00	1252.39	1254.63	1259.39	75.95	21.23	152.11	370.63
13100.000	100.00	.00	.00	1245.07	3230.00	1251.63	1253.88	1258.63	75.94	21.23	152.12	370.66
13000.000	100.00	.00	.00	1244.31	3230.00	1250.87	1253.12	1257.87	75.94	21.23	152.12	370.66
12900.000	100.00	.00	.00	1243.55	3230.00	1250.11	1252.36	1257.11	75.93	21.23	152.12	370.67
12800.000	100.00	.00	.00	1242.79	3230.00	1249.35	1251.60	1256.35	75.94	21.23	152.12	370.66
12700.000	100.00	.00	.00	1242.03	3230.00	1248.59	1250.84	1255.59	75.93	21.23	152.12	370.67
12600.000	100.00	.00	.00	1241.27	3230.00	1247.83	1250.08	1254.83	75.94	21.23	152.12	370.66

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
12500.000	100.00	.00	.00	1240.51	3230.00	1247.07	1249.32	1254.07	75.93	21.23	152.12	370.67
12400.000	100.00	.00	.00	1239.75	3230.00	1246.31	1248.56	1253.31	75.93	21.23	152.12	370.67
12300.000	100.00	.00	.00	1238.99	3230.00	1245.55	1247.80	1252.55	75.93	21.23	152.12	370.67
12200.000	100.00	.00	.00	1238.24	3230.00	1244.79	1247.04	1251.79	75.94	21.23	152.12	370.66
12100.000	100.00	.00	.00	1237.48	3230.00	1244.03	1246.28	1251.03	75.93	21.23	152.12	370.67
12000.000	100.00	.00	.00	1236.72	3230.00	1243.27	1245.52	1250.27	75.94	21.23	152.12	370.66
11975.000	25.00	.00	.00	1236.53	3230.00	1243.08	1245.33	1250.08	75.96	21.24	152.11	370.61
* 11925.000	50.00	.00	.00	1233.18	7770.00	1240.07	1243.03	1249.48	71.67	24.61	315.74	917.78
11900.000	25.00	.00	.00	1233.02	7770.00	1239.92	1242.90	1249.28	71.22	24.55	316.44	920.69
11800.000	100.00	.00	.00	1232.38	7770.00	1239.33	1242.25	1248.53	69.54	24.35	319.13	931.78
11700.000	100.00	.00	.00	1231.74	7770.00	1238.72	1241.61	1247.81	68.26	24.19	321.23	940.45
11600.000	100.00	.00	.00	1231.10	7770.00	1238.10	1240.97	1247.11	67.38	24.08	322.71	946.57
11500.000	100.00	.00	.00	1230.46	7770.00	1237.48	1240.33	1246.41	66.63	23.98	324.00	951.92
11400.000	100.00	.00	.00	1229.82	7770.00	1236.86	1239.69	1245.73	66.02	23.90	325.05	956.28
11300.000	100.00	.00	.00	1229.18	7770.00	1236.24	1239.05	1245.06	65.54	23.84	325.89	959.79
11200.000	100.00	.00	.00	1228.54	7770.00	1235.61	1238.41	1244.40	65.17	23.79	326.55	962.51
11100.000	100.00	.00	.00	1227.90	7770.00	1234.98	1237.77	1243.74	64.88	23.76	327.06	964.65
11000.000	100.00	.00	.00	1227.26	7770.00	1234.34	1237.13	1243.09	64.66	23.73	327.46	966.31
10900.000	100.00	.00	.00	1226.62	7770.00	1233.70	1236.48	1242.44	64.62	23.72	327.53	966.61
10800.000	100.00	.00	.00	1225.98	7770.00	1233.07	1235.85	1241.79	64.37	23.69	327.98	968.45
10700.000	100.00	.00	.00	1225.34	7770.00	1232.43	1235.20	1241.14	64.36	23.69	328.00	968.55
10600.000	100.00	.00	.00	1224.70	7770.00	1231.80	1234.57	1240.49	64.18	23.67	328.32	969.87
10500.000	100.00	.00	.00	1224.06	7770.00	1231.15	1233.92	1239.85	64.21	23.67	328.27	969.68
10400.000	100.00	.00	.00	1223.42	7770.00	1230.51	1233.28	1239.21	64.18	23.67	328.32	969.87
10300.000	100.00	.00	.00	1222.78	7770.00	1229.88	1232.64	1238.56	64.02	23.65	328.60	971.07
10200.000	100.00	.00	.00	1222.14	7770.00	1229.24	1232.01	1237.92	64.07	23.65	328.52	970.73

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
10100.000	100.00	.00	.00	1221.50	7770.00	1228.60	1231.36	1237.28	64.06	23.65	328.53	970.76
10046.000	54.00	.00	.00	1221.15	7770.00	1228.26	1231.04	1236.93	63.97	23.62	328.91	971.50
10045.000	1.00	.00	.00	1221.15	7770.00	1228.72	1231.29	1236.72	74.69	22.70	342.35	899.09
10000.000	45.00	.00	.00	1220.82	7770.00	1228.43	1230.94	1236.37	74.02	22.62	343.50	903.12
9956.000	44.00	.00	.00	1220.58	7770.00	1227.02	1229.80	1235.92	89.50	23.93	324.64	821.32
9955.000	1.00	.00	.00	1220.57	8480.00	1226.89	1229.74	1235.90	69.55	24.09	352.08	1016.85
9900.000	55.00	.00	.00	1220.29	8480.00	1226.68	1229.47	1235.45	66.93	23.77	356.73	1036.50
9800.000	100.00	.00	.00	1219.79	8480.00	1226.28	1228.97	1234.70	62.99	23.28	364.26	1068.49
9700.000	100.00	.00	.00	1219.28	8480.00	1225.88	1228.46	1233.99	59.65	22.85	371.14	1097.99
9600.000	100.00	.00	.00	1218.78	8480.00	1225.45	1227.95	1233.34	57.42	22.55	376.03	1119.09
9500.000	100.00	.00	.00	1218.28	8480.00	1225.00	1227.44	1232.73	55.66	22.31	380.09	1136.68
9400.000	100.00	.00	.00	1217.77	8480.00	1224.54	1226.93	1232.14	54.27	22.12	383.40	1151.12
9300.000	100.00	.00	.00	1217.27	8480.00	1224.07	1226.43	1231.57	53.22	21.97	385.99	1162.38
9200.000	100.00	.00	.00	1216.76	8480.00	1223.60	1225.92	1231.02	52.45	21.86	387.94	1170.95
9100.000	100.00	.00	.00	1216.26	8480.00	1223.12	1225.42	1230.48	51.88	21.78	389.40	1177.35
9000.000	100.00	.00	.00	1215.76	8480.00	1222.63	1224.91	1229.95	51.46	21.72	390.48	1182.08
8900.000	100.00	.00	.00	1215.25	8480.00	1222.15	1224.41	1229.42	50.93	21.64	391.88	1188.21
8800.000	100.00	.00	.00	1214.75	8480.00	1221.64	1223.90	1228.91	50.98	21.65	391.77	1187.72
8700.000	100.00	.00	.00	1214.24	8480.00	1221.16	1223.40	1228.40	50.62	21.59	392.72	1191.92
8600.000	100.00	.00	.00	1213.74	8480.00	1220.64	1222.90	1227.89	50.68	21.60	392.55	1191.17
8500.000	100.00	.00	.00	1213.24	8480.00	1220.15	1222.39	1227.38	50.47	21.57	393.11	1193.64
8400.000	100.00	.00	.00	1212.73	8480.00	1219.63	1221.89	1226.87	50.60	21.59	392.78	1192.18
8300.000	100.00	.00	.00	1212.23	8480.00	1219.14	1221.38	1226.36	50.40	21.56	393.32	1194.54
8200.000	100.00	.00	.00	1211.72	8480.00	1218.64	1220.88	1225.85	50.29	21.54	393.61	1195.82
8100.000	100.00	.00	.00	1211.22	8480.00	1218.12	1220.38	1225.35	50.44	21.57	393.19	1193.98
8000.000	100.00	.00	.00	1210.72	8480.00	1217.63	1219.87	1224.84	50.25	21.54	393.70	1196.23

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
7900.000	100.00	.00	.00	1210.21	8480.00	1217.15	1219.37	1224.33	50.05	21.51	394.26	1198.67
7800.000	100.00	.00	.00	1209.71	8480.00	1216.62	1218.86	1223.83	50.32	21.55	393.52	1195.44
7700.000	100.00	.00	.00	1209.20	8480.00	1216.13	1218.36	1223.32	50.12	21.52	394.06	1197.81
7600.000	100.00	.00	.00	1208.70	8480.00	1215.64	1217.86	1222.81	49.98	21.50	394.44	1199.50
7500.000	100.00	.00	.00	1208.20	8480.00	1215.10	1217.35	1222.31	50.26	21.54	393.68	1196.12
7400.000	100.00	.00	.00	1207.69	8480.00	1214.62	1216.85	1221.80	50.05	21.51	394.25	1198.63
7300.000	100.00	.00	.00	1207.19	8480.00	1214.12	1216.34	1221.30	49.95	21.49	394.51	1199.80
7200.000	100.00	.00	.00	1206.68	8480.00	1213.60	1215.84	1220.80	50.16	21.53	393.96	1197.36
7100.000	100.00	.00	.00	1206.18	8480.00	1213.12	1215.34	1220.29	49.85	21.48	394.80	1201.04
7000.000	100.00	.00	.00	1205.68	8480.00	1212.60	1214.83	1219.79	50.05	21.51	394.26	1198.67
6900.000	100.00	.00	.00	1205.17	8480.00	1212.10	1214.33	1219.28	50.01	21.50	394.37	1199.16
6800.000	100.00	.00	.00	1204.67	8480.00	1211.59	1213.82	1218.78	50.12	21.52	394.07	1197.84
6700.000	100.00	.00	.00	1204.16	8480.00	1211.10	1213.32	1218.28	49.96	21.50	394.50	1199.76
6600.000	100.00	.00	.00	1203.66	8480.00	1210.58	1212.82	1217.77	50.14	21.52	394.02	1197.62
6500.000	100.00	.00	.00	1203.16	8480.00	1210.08	1212.31	1217.27	50.08	21.51	394.16	1198.26
6400.000	100.00	.00	.00	1202.65	8480.00	1209.57	1211.81	1216.77	50.18	21.53	393.90	1197.09
6300.000	100.00	.00	.00	1202.15	8480.00	1209.09	1211.30	1216.26	49.98	21.50	394.44	1199.50
6200.000	100.00	.00	.00	1201.64	8480.00	1208.56	1210.80	1215.76	50.17	21.53	393.93	1197.24
6100.000	100.00	.00	.00	1201.14	8480.00	1208.08	1210.30	1215.25	49.94	21.49	394.55	1199.95
6000.000	100.00	.00	.00	1200.64	8480.00	1207.56	1209.79	1214.75	50.15	21.52	393.98	1197.47
5950.000	50.00	.00	.00	1200.38	8480.00	1207.32	1209.54	1214.49	49.95	21.49	394.53	1199.87
* 5900.000	50.00	.00	.00	1200.35	8480.00	1203.46	1206.17	1213.66	161.64	25.63	330.83	666.99
* 5901.000	1.00	.00	.00	1203.35	8480.00	1207.86	1209.16	1212.47	46.33	17.25	491.70	1245.86
* 5902.000	1.00	.00	.00	1200.10	8480.00	1203.47	1205.90	1212.07	123.14	23.53	360.44	764.17

CHANNEL IMPROVEMENTS (SU

SUMMARY PRINTOUT TABLE 150

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
* 17000.000	1130.00	1284.89	.00	.00	1.89	31.60	.00
* 16982.000	1130.00	1282.04	.00	-2.84	.00	26.27	17.73
16900.000	1130.00	1281.71	.00	-.33	.00	26.85	82.27
16800.000	1130.00	1281.28	.00	-.44	.00	27.36	100.00
16700.000	1130.00	1280.78	.00	-.50	.00	27.62	100.00
16600.000	1130.00	1280.22	.00	-.55	.00	27.71	100.00
16500.000	1130.00	1279.66	.00	-.57	.00	27.73	100.00
16475.000	1130.00	1279.54	.00	-.11	.00	27.80	25.00
* 16425.000	3050.00	1277.91	.00	-1.64	.00	39.27	50.00
16400.000	3050.00	1277.72	.00	-.18	.00	39.14	25.00
16300.000	3050.00	1277.06	.00	-.66	.00	38.75	100.00
16200.000	3050.00	1276.42	.00	-.64	.00	38.46	100.00
16100.000	3050.00	1275.79	.00	-.63	.00	38.24	100.00
16000.000	3050.00	1275.18	.00	-.61	.00	38.07	100.00
15900.000	3050.00	1274.58	.00	-.60	.00	37.93	100.00
15800.000	3050.00	1273.97	.00	-.61	.00	37.80	100.00
15700.000	3050.00	1273.38	.00	-.59	.00	37.72	100.00
15600.000	3050.00	1272.79	.00	-.59	.00	37.66	100.00
15500.000	3050.00	1272.21	.00	-.58	.00	37.60	100.00
15400.000	3050.00	1271.63	.00	-.58	.00	37.56	100.00
15300.000	3050.00	1271.04	.00	-.58	.00	37.52	100.00
15262.000	3050.00	1270.85	.00	-.19	.00	37.56	37.43
15212.000	3230.00	1267.34	.00	-3.51	.00	35.02	50.00
15200.000	3230.00	1267.26	.00	-.08	.00	35.07	12.57

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
15100.000	3230.00	1266.59	.00	-.67	.00	35.42	100.00
15000.000	3230.00	1265.89	.00	-.70	.00	35.67	100.00
14900.000	3230.00	1265.18	.00	-.72	.00	35.85	100.00
14800.000	3230.00	1264.46	.00	-.72	.00	36.01	100.00
14700.000	3230.00	1263.71	.00	-.75	.00	36.09	100.00
14600.000	3230.00	1262.98	.00	-.73	.00	36.18	100.00
14500.000	3230.00	1262.23	.00	-.75	.00	36.23	100.00
14400.000	3230.00	1261.48	.00	-.75	.00	36.27	100.00
14300.000	3230.00	1260.72	.00	-.76	.00	36.28	100.00
14200.000	3230.00	1259.96	.00	-.76	.00	36.30	100.00
14100.000	3230.00	1259.22	.00	-.75	.00	36.33	100.00
14000.000	3230.00	1258.46	.00	-.76	.00	36.33	100.00
13900.000	3230.00	1257.70	.00	-.76	.00	36.33	100.00
13800.000	3230.00	1256.94	.00	-.76	.00	36.34	100.00
13700.000	3230.00	1256.18	.00	-.76	.00	36.34	100.00
13600.000	3230.00	1255.42	.00	-.76	.00	36.35	100.00
13500.000	3230.00	1254.66	.00	-.76	.00	36.35	100.00
13400.000	3230.00	1253.90	.00	-.76	.00	36.35	100.00
13300.000	3230.00	1253.15	.00	-.76	.00	36.35	100.00
13200.000	3230.00	1252.39	.00	-.76	.00	36.35	100.00
13100.000	3230.00	1251.63	.00	-.76	.00	36.35	100.00
13000.000	3230.00	1250.87	.00	-.76	.00	36.35	100.00
12900.000	3230.00	1250.11	.00	-.76	.00	36.35	100.00
12800.000	3230.00	1249.35	.00	-.76	.00	36.35	100.00
12700.000	3230.00	1248.59	.00	-.76	.00	36.35	100.00
12600.000	3230.00	1247.83	.00	-.76	.00	36.35	100.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
12500.000	3230.00	1247.07	.00	-.76	.00	36.35	100.00
12400.000	3230.00	1246.31	.00	-.76	.00	36.35	100.00
12300.000	3230.00	1245.55	.00	-.76	.00	36.35	100.00
12200.000	3230.00	1244.79	.00	-.76	.00	36.35	100.00
12100.000	3230.00	1244.03	.00	-.76	.00	36.35	100.00
12000.000	3230.00	1243.27	.00	-.76	.00	36.35	100.00
11975.000	3230.00	1243.08	.00	-.19	.00	36.35	25.00
* 11925.000	7770.00	1240.07	.00	-3.01	.00	59.57	50.00
11900.000	7770.00	1239.92	.00	-.15	.00	59.61	25.00
11800.000	7770.00	1239.33	.00	-.59	.00	59.79	100.00
11700.000	7770.00	1238.72	.00	-.60	.00	59.93	100.00
11600.000	7770.00	1238.10	.00	-.62	.00	60.03	100.00
11500.000	7770.00	1237.48	.00	-.62	.00	60.12	100.00
11400.000	7770.00	1236.86	.00	-.62	.00	60.19	100.00
11300.000	7770.00	1236.24	.00	-.63	.00	60.25	100.00
11200.000	7770.00	1235.61	.00	-.63	.00	60.29	100.00
11100.000	7770.00	1234.98	.00	-.63	.00	60.33	100.00
11000.000	7770.00	1234.34	.00	-.63	.00	60.35	100.00
10900.000	7770.00	1233.70	.00	-.64	.00	60.36	100.00
10800.000	7770.00	1233.07	.00	-.63	.00	60.39	100.00
10700.000	7770.00	1232.43	.00	-.64	.00	60.39	100.00
10600.000	7770.00	1231.80	.00	-.63	.00	60.41	100.00
10500.000	7770.00	1231.15	.00	-.64	.00	60.41	100.00
10400.000	7770.00	1230.51	.00	-.64	.00	60.41	100.00
10300.000	7770.00	1229.88	.00	-.63	.00	60.43	100.00
10200.000	7770.00	1229.24	.00	-.65	.00	60.42	100.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
10100.000	7770.00	1228.60	.00	-.64	.00	60.42	100.00
10046.000	7770.00	1228.26	.00	-.33	.00	60.55	54.00
10045.000	7770.00	1228.72	.00	.46	.00	60.61	1.00
10000.000	7770.00	1228.43	.00	-.30	.00	60.70	45.00
9956.000	7770.00	1227.02	.00	-1.40	.00	63.71	44.00
9955.000	8480.00	1226.89	.00	-.13	.00	67.55	1.00
9900.000	8480.00	1226.68	.00	-.21	.00	67.81	55.00
9800.000	8480.00	1226.28	.00	-.40	.00	68.22	100.00
9700.000	8480.00	1225.88	.00	-.40	.00	68.60	100.00
9600.000	8480.00	1225.45	.00	-.44	.00	68.86	100.00
9500.000	8480.00	1225.00	.00	-.45	.00	69.08	100.00
9400.000	8480.00	1224.54	.00	-.46	.00	69.26	100.00
9300.000	8480.00	1224.07	.00	-.47	.00	69.40	100.00
9200.000	8480.00	1223.60	.00	-.48	.00	69.51	100.00
9100.000	8480.00	1223.12	.00	-.48	.00	69.59	100.00
9000.000	8480.00	1222.63	.00	-.49	.00	69.64	100.00
8900.000	8480.00	1222.15	.00	-.48	.00	69.72	100.00
8800.000	8480.00	1221.64	.00	-.51	.00	69.71	100.00
8700.000	8480.00	1221.16	.00	-.48	.00	69.76	100.00
8600.000	8480.00	1220.64	.00	-.51	.00	69.75	100.00
8500.000	8480.00	1220.15	.00	-.49	.00	69.78	100.00
8400.000	8480.00	1219.63	.00	-.52	.00	69.77	100.00
8300.000	8480.00	1219.14	.00	-.49	.00	69.80	100.00
8200.000	8480.00	1218.64	.00	-.50	.00	69.81	100.00
8100.000	8480.00	1218.12	.00	-.52	.00	69.79	100.00
8000.000	8480.00	1217.63	.00	-.49	.00	69.82	100.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
7900.000	8480.00	1217.15	.00	-.49	.00	69.85	100.00
7800.000	8480.00	1216.62	.00	-.53	.00	69.81	100.00
7700.000	8480.00	1216.13	.00	-.49	.00	69.84	100.00
7600.000	8480.00	1215.64	.00	-.49	.00	69.86	100.00
7500.000	8480.00	1215.10	.00	-.53	.00	69.81	100.00
7400.000	8480.00	1214.62	.00	-.49	.00	69.85	100.00
7300.000	8480.00	1214.12	.00	-.49	.00	69.86	100.00
7200.000	8480.00	1213.60	.00	-.52	.00	69.83	100.00
7100.000	8480.00	1213.12	.00	-.48	.00	69.88	100.00
7000.000	8480.00	1212.60	.00	-.52	.00	69.85	100.00
6900.000	8480.00	1212.10	.00	-.50	.00	69.85	100.00
6800.000	8480.00	1211.59	.00	-.51	.00	69.84	100.00
6700.000	8480.00	1211.10	.00	-.49	.00	69.86	100.00
6600.000	8480.00	1210.58	.00	-.52	.00	69.83	100.00
6500.000	8480.00	1210.08	.00	-.50	.00	69.84	100.00
6400.000	8480.00	1209.57	.00	-.51	.00	69.83	100.00
6300.000	8480.00	1209.09	.00	-.49	.00	69.86	100.00
6200.000	8480.00	1208.56	.00	-.52	.00	69.83	100.00
6100.000	8480.00	1208.08	.00	-.48	.00	69.86	100.00
6000.000	8480.00	1207.56	.00	-.52	.00	69.83	100.00
5950.000	8480.00	1207.32	.00	-.24	.00	69.86	50.00
5900.000	8480.00	1203.46	.00	-3.86	.00	112.50	50.00
5901.000	8480.00	1207.86	.00	4.40	.00	118.10	1.00
5902.000	8480.00	1203.47	.00	-4.38	.00	113.55	1.00

SUMMARY OF ERRORS AND SPECIAL NOTES

```
CAUTION SECNO=  17000.000  PROFILE=  1  CRITICAL DEPTH ASSUMED

WARNING SECNO=  16982.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=  16425.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=  11925.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   5900.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=   5901.000  PROFILE=  1  WSEL ASSUMED BASED ON MIN DIFF
CAUTION SECNO=   5901.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=   5902.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
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GEOTECHNICAL INVESTIGATION REPORT
DESIGN SERVICES FOR THE WHITE TANKS
NO. 3 FRS INLET IMPROVEMENTS
CONTRACT FCD 93-47
MARICOPA COUNTY, ARIZONA

RECEIVED
AUG 19 1994
AGK ENGINEERS, INC.

Submitted To:

AGK Engineers, Inc.
2255 North 44th Street
Suite 300
Phoenix, Arizona 85008

Submitted By:

AGRA Earth & Environmental, Inc.
Phoenix, Arizona

Registered Professional Engineer (Civil)
CERTIFICATE NO.
18682
MICHAEL L.
RUCKER
Date Signed 8-18-94
ARIZONA, U.S.A.

18 August 1994

AGRA Job No. E94-167

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18 August 1994
AGRA Job No. E94-167

AGK Engineers, Inc.
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Suite 300
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Attention: **Samuel E. Kao, Ph.D., P.E.**
Vice President

Gentlemen:

RE: DESIGN SERVICES FOR THE WHITE TANKS
NO. 3 FRS INLET IMPROVEMENTS
CONTRACT FCD 93-47
MARICOPA COUNTY, ARIZONA

Our Geotechnical Investigation Report on the referenced project is herewith submitted. The report includes the results of exploratory drilling, test pit excavation, laboratory testing and a subsidence study. Presented in the report are recommendations for excavation and channel slope stability, preliminary design criteria for bridge and box culverts, and preliminary subsidence estimates.

Should any questions arise concerning our recommendations, please do not hesitate to call us.

Respectfully submitted,
AGRA Earth & Environmental, Inc.

Norman H. Wetz, P.E.
Senior Geotechnical Engineer

And

Michael L. Rucker, P.E.
Senior Engineer
Engineering Geophysics

Reviewed by:

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klp/94J-3/8-18-94

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Discussion & Recommendations	3
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APPENDICES

Appendix A - Field Investigation
Appendix B - Laboratory Testing

AGRA
Earth & Environmental

1.0 INTRODUCTION

This report is submitted pursuant to the performance of a geotechnical investigation performed by AGRA Earth & Environmental, Inc. (AGRA E&E) of the White Tanks No. 3 Inlet Improvements. The purpose of this investigation was to examine the subsurface profile along the 2.5 mile alignment of the proposed channel. This information has been used to develop recommendations concerning excavation, slope stability and erosion protection of the channel. A further objective of the investigation was to provide preliminary recommendations for bridge or box culvert foundations at the Olive and Northern Avenues crossings of the channel. Data and recommendations concerning future ground subsidence for the design of the channel also are presented.

2.0 PROJECT DESCRIPTION

Details of the project were provided to us by Samuel E. Kao, Ph.D., P.E., and Michael J. Bonar, P.E., both of AGK Engineers, Inc. (AGK). It is understood that a storm water diversion channel, approximately 2 1/2 miles in length, will be constructed parallel to and just west of the existing Beardsley Canal between Peoria and Glendale Avenues. The channel may be earthen lined or lined with concrete, soil-cement, gabions or shotcrete. Depending on the type of lining system utilized, drop structures may be required at several locations along the alignment to control stream velocities. Storm flows from three main intersecting washes will enter the channel; side channel drop structures may be required at these locations. Bridges or multiple barrel box culverts also will be required for channel crossings at Olive Avenue and Northern Avenue. The proposed channel will discharge to an existing retention area named White Tanks No. 3. An earthen channel is in place near the White Tanks No. 3 retention area, however, this channel will require upgrading to conform with the new channel.

3.0 INVESTIGATION

3.1 SUBSURFACE INVESTIGATION

3.1.1 BACKHOE TEST PITS

Exploratory test pits were excavated with a Case 580K backhoe at eight locations along the alignment. The test pits were advanced to a depths of 13 1/2 to 16 feet below existing grade. Excavation of the test pits was directed and continuously observed by our field engineer, Mark A.R. Keyes, G.I.T. Mr. Keyes prepared geotechnical logs of the pits which are presented in Appendix A of this report. Bulk samples of soils were retrieved from the various pits and were transported to our laboratory for testing.

3.1.2 EXPLORATORY BORINGS

Borings were performed at four locations with a truck-mounted CME-75 drill rig advancing 6 5/8-inch diameter hollow stem auger. Borings were completed at two locations at each of the

Northern Avenue and the Olive Avenue crossings to depths of about 50 feet below existing grade. Standard penetration testing and sampling in accordance with ASTM D1586 were performed at selected intervals in the borings. Drilling of the borings was directed by Steven C. Wilson, P.G. of this firm. Geotechnical logs of the auger borings are presented in Appendix A along with a site plan showing the boring and test pit locations.

3.2 LABORATORY TESTING

Index tests (moisture content, dry density, Atterberg limits and grain-size distribution) were performed on selected drive samples and bulk samples recovered from the borings and test pits. Moisture content and dry density values are presented on the boring logs. Grain-size distribution and Atterberg limit test results are presented in Appendix B.

4.0 PROJECT SETTING & GEOTECHNICAL PROFILE

4.1 PROJECT SETTING

The project is located just west of the Beardsley Canal and the terrain is relatively undisturbed desert growth consisting of creosote, cacti and grass with some desert trees near the side drainages. There is an existing earthen channel near the south end of the project. Northern and Olive Avenues are existing two-lane paved highways.

4.2 GEOTECHNICAL PROFILE

The soils encountered at the site consist of alluvial fan deposits with localized stream alluvium deposits. Lenticular deposits of sandy and clayey silts and silty sand and sand with varying amounts of gravel were encountered throughout the depths of the investigation.

The borings at Northern Avenue (Borings 3 and 4) encountered sandy silt, gravelly silt and sandy clay from the surface to depths of 14 to 19 feet below existing grade. These soils vary from soft to moderately firm near the surface and become very firm with depth. Lenticular deposits of silt, sand and gravel mixtures and clayey silt underly the surface stratum and extend to the full depth of these borings. These soils generally are weakly cemented and vary from firm to hard.

The borings at Olive Avenue (Borings 8 and 9) encountered sandy silt, clayey silt, sandy clay, clayey sand, silty sand and gravelly sand from the surface to depths of about 22 feet below existing grade. The upper 7 feet is roadway fill that is very loose to loose and moderately firm. The soils from 7 to 22 feet are very firm to hard. Gravelly sand and silty sand and gravel were encountered from 22 to about 50 feet below existing grade. These soils are dense to very dense or hard.

4.3 GROUNDWATER & SOIL MOISTURE CONDITIONS

No free groundwater was encountered in the test pits or borings. Soil moisture contents were relatively low throughout the extent of the investigations. Based on Arizona Department of Water Resources (ADWR) data on existing wells in the general area, the regional groundwater table is at a depth of about 400 feet below existing site grades.

5.0 DISCUSSION & RECOMMENDATIONS

5.1 BRIDGES, BOX CULVERTS & DROP STRUCTURES

The soils near the surface at the two roadway crossings are moisture sensitive and will settle with substantial moisture increases. Concrete lining the bottom of the channel will assist in mitigating moisture infiltration and preventing scour. Preliminary safe soil bearing pressures of 2,000 pounds per square foot (psf) to 4,000 psf may be used to estimate the size of footings for drop structures and bridges. Footings for drop structures should extend at least 5 feet below channel grade. Minimum elevations of 1,215 feet and 1,254 feet are recommended for spread-type footings at the Northern and Olive Avenues crossings, respectively. The Northern Avenue crossing is more susceptible to settlement than the Olive Avenue crossing. A review of the above bearing values are recommended when loads and type of structure have been determined in order to estimate potential settlements.

The use of drilled, cast-in-place concrete piers will greatly reduce the risk of settlement, especially at the Northern Avenue crossing. Drilled piers should extend at least 30 feet below the scour elevation. Once channel grades, scour elevations and structure type are determined, capacities of drilled piers can be developed. Some to considerable caving of the more granular soils should be anticipated during the construction of drilled piers.

Due to the rigid nature of box culvert structures, box culverts are feasible for use at the two roadway crossings. Design pressures for box culverts can be provided once the size and configuration of the structures are determined.

5.2 EROSION

Threshold velocities (velocity of water which will cause erosion of soils) for the soils as given by Vanoni (1975)* vary from 0.75 to 2.5 feet per second. The lower threshold velocities apply where sands and silts are encountered and the higher threshold velocities apply to materials that contain gravels. Due to the lenticular nature of the soils, finer grained soils will be encountered in significant portions of the slopes and bottoms of the proposed channel.

---

*References are listed at the end of this report.

Thus, it appears that some type of erosion protection will be needed for the channel. The several alternatives which appear to be technically feasible for the project include the following:

- Concrete lined channels will provide a positive treatment of erosion. This treatment will also assist in preventing scour at bridge locations. The concrete liner can be placed with a slip form paver, or it can be placed as gunite or shotcrete.

- Riprap can be used to prevent erosion. The size and thickness of the required riprap will depend on the flow velocities of the channel. A geotextile filter fabric will be required between the riprap and the native soils. Where lower velocity flows are anticipated, gravel or small cobble-sized materials may be acceptable to mitigate erosion.

- Soil-cement is feasible for the project. Materials are present along the channel alignment that will be acceptable for soil-cement. However, the lenticular nature of the soils will require careful sorting or establishing specific borrow areas during construction. Cement contents of 7 to 8 percent are estimated for the more granular deposits encountered during the investigation. Cement contents will increase to about 10 to 12 percent if significant quantities of silt are used. An 8-foot wide thickness for the slopes of the channels and a 1-foot thickness on the bottoms of the channels are recommended.

5.3 EXCAVATIONS & SLOPES

It is estimated that mass excavations for the channel can be made with conventional earth-moving equipment.

Permanent cut slopes in the channel should be no steeper than 2H:1V (horizontal to vertical). Where rounded riprap materials are used, the slopes will need to be flattened to 2 1/2H:1V. If soil-cement is used with an 8 foot wide thickness on the slopes, the cut slopes can be steepened to 1H:1V.

5.4 SUBSIDENCE & EARTH FISSURING

5.4.1 GEOLOGIC & HYDROLOGIC SETTING

The project alignment lies nearby and adjacent to the eastern flank of the White Tank Mountains. Based on available geologic studies of the area, depths to bedrock along the alignment were estimated. Brown and Pool (1989) interpret a zone of block faulting of the metamorphic and granite rocks of the White Tank Mountains downward into the alluvial Salt River Valley east of the project alignment. A profile along Bethany Home Road (Brown and Pool, 1989) indicates this zone is about 1 mile east of the project alignment. Interpreted

depths to bedrock, and estimated saturated alluvium thicknesses for 1948, 1967 and 1991 along the project alignment (and north and south of the alignment) are presented in Table 1.

According to records for wells in the vicinity (ADWR, 1994), groundwater levels along the project alignment fell rapidly in the period of 1948 to the late 1960s. Groundwater elevations in 1948 were at about 1,000 feet above mean sea level in the project vicinity. By the late 1960s, the groundwater elevations in the vicinity of Olive, Peoria and Northern Avenues had fallen about 200 feet, and at Glendale Avenue had fallen about 130 feet. By the early 1990s, groundwater levels had recovered slightly between Northern and Peoria Avenues and fallen perhaps an additional 30 feet at Glendale Avenue.

5.4.2 SUBSIDENCE

Estimates of future subsidence along the project alignment, based on several groundwater level scenarios, are provided in Figure 1. Subsidence information for the site area in the form of level surveys at the Beardsley Canal is available for the years 1948, 1967 and 1981. A new survey for the canal is in progress. When the results of that survey become available, subsidence estimates will be reviewed and updated, if necessary.

Using 1948 elevations as initial conditions, measured subsidence along the project alignment is available for the years 1967 and 1981 (SHB, 1982). In addition, the Maricopa County Flood Control District (MCFCD) provided subsidence data and groundwater elevation changes for the period of 1923 to 1991 for the area surrounding Luke Air Force Base. This data was developed by the U.S. Geological Survey (USGS) and was presented in the form of provisional contour maps. It has not been formally released in report form by the USGS. The project site lies just to the west of the contour mapping, and about 0.5 mile west of the westernmost subsidence data for the 1923 to 1991 period. Subsidence data from these sources is presented in Figure 1.

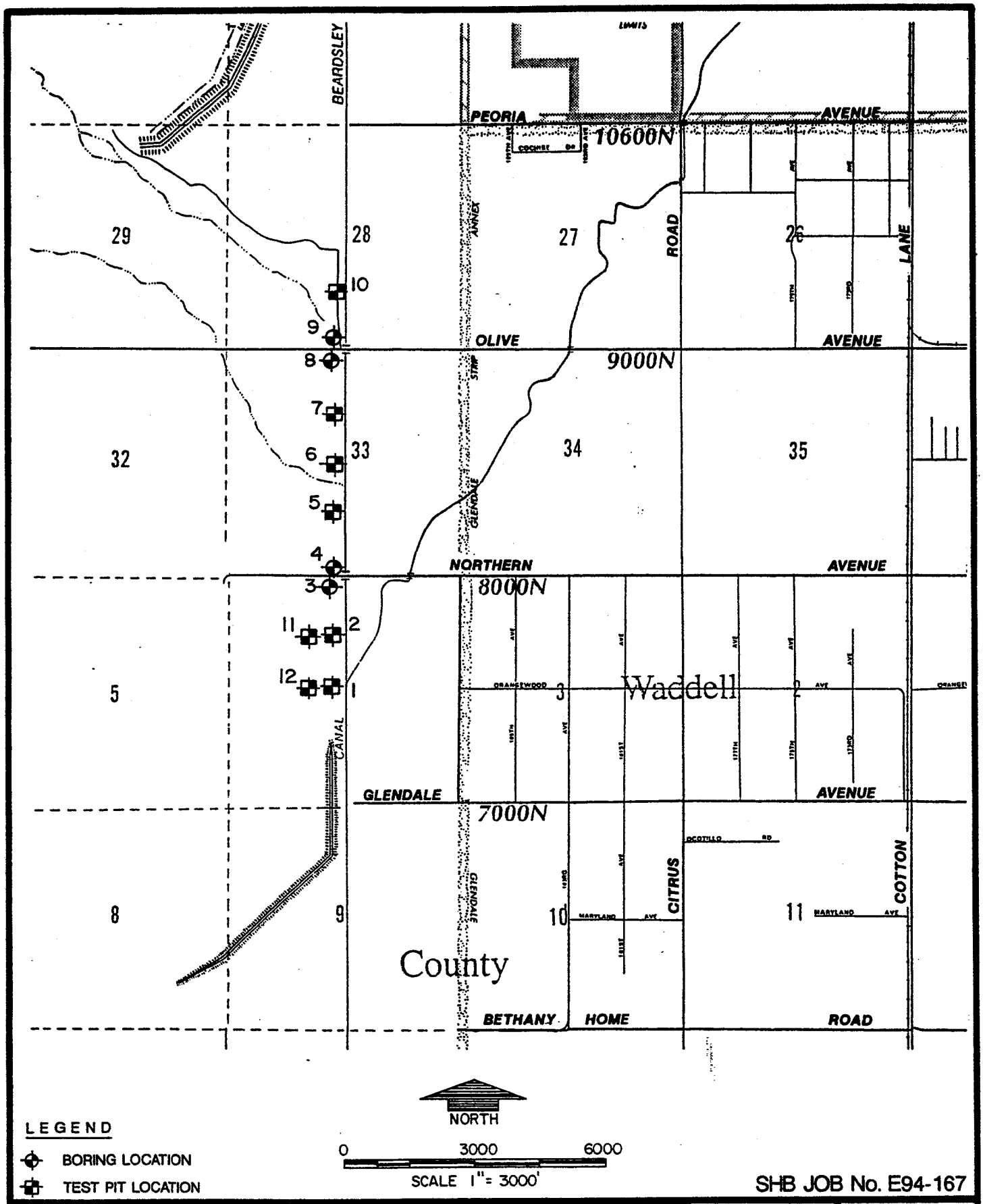
Historic subsidence profiles along the project alignment are relatively complex, and may be influenced by both groundwater decline and the varying depth to bedrock. Maximum historic subsidence along the project alignment appears to have been on the order of 5 feet or less in the vicinity of Peoria Avenue. Historic subsidence appears to have been considerably less in the vicinity of Olive and Northern Avenues, as groundwater declines appear to have reached the relatively shallow bedrock in this area. Historic subsidence has increased southward from Northern Avenue toward Glendale Avenue.

A complex modeling analysis of subsidence along the project alignment is not warranted at this time. Groundwater and bedrock conditions at the site are complex and information concerning them is uncertain. For prediction purposes, time-dependent mechanics of the secondary consolidation (or compaction) aspects of subsidence are poorly documented or understood. As shown in Figure 1, the rate of subsidence at the Beardsley Canal between 1967 and 1981 appeared to equal or be greater than the rate of subsidence between 1948 and 1967, even though the groundwater level drop was considerably less or even rising. New

TABLE 1
Estimated Saturated Alluvium Thicknesses & Water Level Drop

Year	Estimated Thickness of Saturated Alluvium above Bedrock & (Approximate Groundwater Level Drop, 1948 - year), feet		
	Cactus Road	Olive Avenue, (Water Level @ Olive & Peoria Avenues)	Bethany Home Road, (Water Level @ Glendale Avenue)
1948	720	210	660
1967	530 (190)	30 (180)	540 (120)
1981	630 (90)	0 (250)	510 (150)
1991	590 (130)	0 (230)	500 (160)

Note: Groundwater levels are based on nearest relevant well data (ADWR, 1994) for locations about 1 mile east of the Beardsley Canal alignment at Peoria and Olive Avenues and on the Beardsley Canal alignment at Cactus Road and Glendale Avenue.



LEGEND

BORING LOCATION

TEST PIT LOCATION

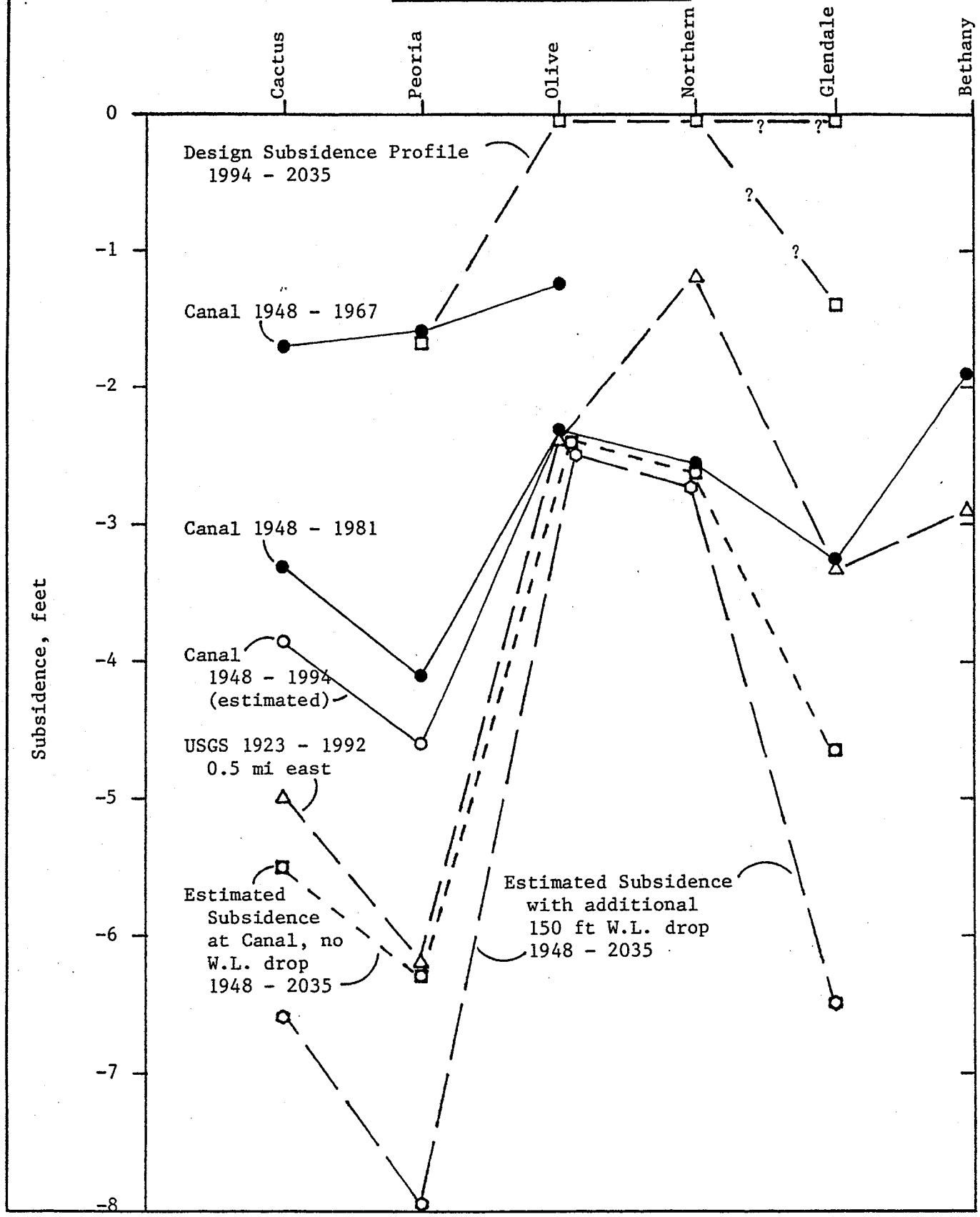
SHB JOB No. E94-167

SITE PLAN SHOWING APPROXIMATE BORING AND TEST PIT LOCATIONS

A-5

FIGURE 1

Historic & Estimated
Future Subsidence Profiles



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Computed by: Ckd. by:
Date 8-18-94 Page 1 of 1

survey data will provide additional time-dependent subsidence information for the period of 1981 to 1994 and establish new subsidence rates based on relatively stable groundwater levels over an extended time period.

Subsidence rates as a function of groundwater level decline are listed in Table 2 based on available information. Subsidence rates at the location of the canal and for the western limit of the USGS data, about 0.5 mile east of the canal, are presented. Subsidence rates in terms of foot of subsidence per foot of groundwater level decline, based on these data, were then estimated for use in predicting future subsidence.

Similar total subsidence magnitudes based on nearby USGS data for 1923 to 1992 and Beardsley Canal subsidence data for 1948 to 1981 may indicate that subsidence along the southern portion of the project between Olive and Glendale Avenues is substantially complete. This is consistent with evidence of relatively shallow bedrock in that area. A resumption of groundwater decline could affect the southern end of the project in the vicinity of Glendale Avenue.

Simplified estimates of future subsidence, based on the information in Table 2, are presented in Figure 1. Two scenarios were considered. A likely scenario includes groundwater levels approximately at present levels. A conservative case scenario includes groundwater levels dropping about 150 feet from their present levels. This would represent a resumption of groundwater withdrawal at approximately the historic rate between 1948 and the present. Since the project is within an Arizona Department of Water Resources Active Management Area, the second scenario is unlikely. A third scenario could include a rise of groundwater levels. However, because the elastic component of the subsidence available for rebound is considerably smaller in magnitude, perhaps 5 to 10 percent of the consolidation or compaction component (Carpenter, 1987), this scenario is not relevant.

Considering the factors discussed above, and assuming the most likely scenario of stable groundwater levels, a preliminary recommended design subsidence profile for the project was estimated. This estimate may need to be revised when the 1994 elevation and subsidence survey is completed. The anticipated subsidence values at selected points along the project from the present to the year 2035 are as follows:

- 1.7 feet at Peoria Avenue.
- 0.0 feet at Olive and Northern Avenues.
- 0.0 to 1.4 feet at Glendale Avenue.

The profile plotted in Figure 1 assumes a linear relationship between these points.

5.6.3 EARTH FISSURING

Earth fissuring is present in the project vicinity. The Fenne Knoll fissure, located 0.5 mile west of the project alignment at Peoria Avenue, was investigated by this firm as part of the

TABLE 2
Subsidence Rates as a Function of Water Level Drop

Street	1948 - 1991 Water Level Change, feet	Subsidence, feet 1923 - 1992 0.5 Mi East, 1948 - 1981 @ Canal	Subsidence, Foot per Foot of Water Level Decline	Estimated Subsidence Rate at Beardsley Canal, Foot per Foot of Water Level Decline
Cactus Road	130 190 max	5 approx 3.31 @ Canal	0.039 - 0.026 0.026 - 0.017	0.021
Peoria Avenue	230 250 max	6.2 4.09 @ Canal	0.027 -0.025 0.018 -0.016	0.017
Olive Avenue	210 to bedrock	2.4 2.30 @ Canal	0.011 or stopped	0.011 or 0
Northern Avenue	210 to bedrock	1.2 2.55 @ Canal	0.006 - 0.012 or stopped	0.012 or 0
Glendale Avenue	160	3.3 3.25 @ Canal	0.021 - 0.020	0.020

Note: Subsidence was assumed to have been negligible before 1948, similar to subsidence behavior near Apache Junction, Arizona (Carpenter, 1987).

Increased subsidence rates at 0.5 mile east of project alignment at some locations can be explained. Bedrock becomes deeper to the east. Therefore, the thickness of compressible alluvium increases to the east with a corresponding increase in subsidence rate. For example, the saturated alluvium thickness increases about 33 percent 0.5 mile east of the canal at Cactus Road. Additional subsidence reported by the USGS through 1992 at that location may include time-dependent consolidation. At Cactus Road, subsidence of 3.31 feet multiplied by 1.33 (additional alluvium thickness) results in 4.4 feet by 1981 at 0.5 mile east of the canal. USGS reported about 5 feet at that location by 1992, an additional 0.6 foot over the 1981 subsidence with little change in groundwater level. Lacking better information, this 0.6 foot for a saturated alluvium thickness of 800 feet over 11 years is a reasonable estimate of time-dependent consolidation. At the canal alignment at Cactus Road and Olive Avenue, the time dependent subsidence since 1981 is estimated at 0.041 foot per year.

Similar subsidence magnitudes between 1923-1992 USGS data and 1948-1981 data from Olive Avenue south may indicate that subsidence above shallow bedrock is substantially complete. Northern Avenue is an anomaly. There is insufficient information available to verify what is occurring along Northern Avenue.

McMicken Dam Restoration Study (SHB, 1982). This fissure is oriented north-south, parallel to the project alignment, and had a mapped length of about 2,000 feet in 1981.

A reconnaissance of this fissure and the project area in the vicinity of Olive Avenue was made by Michael L. Rucker, P.E. of this firm on July 20, 1994. This fissure was still clearly active and displayed lineal collapse features, surface erosion and zones of piping. Additionally, concentrations of animal borrows and small drainages in the general fissure orientation were observed toward the south. These features blended into more general drainage features that turned to the southeast between Peoria and Olive Avenues. Unusual drainage features observed included small slot features in the drainage and dendritic patterns of headward erosion, extending about 6 to 20 feet from the sides of the drainage, which appeared to be of very recent origin. This unusual drainage crossed the Beardsley Canal about 1,000 feet south of Olive Avenue.

As demonstrated by the nearby Fenne Knoll fissure, the geologic and hydrologic setting in the vicinity of Olive Avenue and the Beardsley Canal is conducive to the formation of earth fissures. The apparent shallow bedrock is adjacent to alluvium in an area where considerable groundwater drawdown has occurred. Relatively large differences in subsidence rate and magnitude have occurred over a relatively short distance and may continue, with resulting large horizontal tensile forces developing in the overlying alluvium. If not already present, the formation of fissure or fissures crossings the project alignment should be anticipated. Should such fissuring be identified, appropriate mitigation can be implemented to inhibit or prevent erosion or piping induced failures.

REFERENCES

Arizona Department of Water Resources (ADWR), 1994, Water Level Files, March 24.

Brown, J.R., and Pool, D.R., 1989, Hydrogeology of the Western Part of the Salt River Valley Area, Maricopa County, Arizona, U.S. Geological Survey Water-Resources Investigations Report 88-4202, Prepared in Cooperation with the Arizona Department of Water Resources, Salt River Project, and Municipal Water User's Association, Tucson, Arizona.

Carpenter, M.C., 1987, Water-Level Declines, Land Subsidence, and Specific Compaction near Apache Junction, South-Central Arizona, U.S. Geological Survey Water Resources Investigations Report 86-4071, Tucson, Arizona, January.

Sergent, Hauskins & Beckwith Geotechnical Engineers, Inc. (SHB), 1982, McMicken Dam Restoration Study, Maricopa County, report prepared for Maricopa County Flood Control District, July 27.

Vanoni, V.A., 1975, Sedimentation Engineering, ASCE Manuals and Reports on Engineering Practice, No. 54, pg. 102.

APPENDIX A

FIELD INVESTIGATION

AGRA
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TEST DRILLING EQUIPMENT & PROCEDURES

DESCRIPTION OF SUBSURFACE EXPLORATION METHODS

Auger Boring Drilling through overburden soils is performed with 6 5/8" O.D., 3 1/4" I.D. hollow stem auger or 4 1/2" solid stem continuous flight auger. Carbide insert teeth are normally used on bits so they can penetrate soft rock or very strongly cemented soils. A CME-55 or CME-75 truck-mounted drill rig is used to advance the auger. The drill rigs are powered with six-cylinder Ford industrial engines capable of delivering about 7,000 to 8,400 foot-pounds torque to the drill spindle. The spindle is advanced with twin hydraulic rams capable of exerting 16,000 to 20,000 pounds downward force.

Generally, refusal to penetration of the auger is adopted as top of the SGC or river-run material, which normally requires other techniques for penetration. Grab samples or auger cuttings may be taken as necessary. Standard penetration tests or 2.42" diameter ring samples are taken in conjunction with the auger borings as needed, with the sampling interval and type being indicated on the boring logs.

Hammer Drill Drilling with the Hammer drill is accomplished with a Drill Systems AP1000 drill rig advancing a double-walled drive casing with a link-belt 180 diesel pile driving hammer, having a rated energy of 8,100 foot-pounds per blow. Where noted on the boring log, the hammer is equipped with a supercharger which can boost the energy to approximately 12,000 foot-pounds per blow. The supercharger is used only in portions of the boring where blow counts are relatively high. Cuttings are removed with compressed air by a reverse circulation process, and are collected in a cyclone from which grab samples are obtained. The drive casing is either 9" O.D. by 6" I.D. or 6 5/8" O.D. by 4" I.D. and employs an expendable bit of slightly larger diameter than the O.D. of the casing. Hammer blows required to advance the drive casing are recorded in 1′ increments, as noted on the boring logs. Standard penetration tests or 2.42" diameter ring samples taken are noted on the boring logs.

Odex System The Odex (overburden drilling with the eccentric method) system, also referred to as the DTH (down-the-hole hammer) system, consists of a pneumatic-rotary percussion down-the-hole hammer operating at the bottom being drilled through a 5" diameter steel casing. The eccentric button percussion bit overreams the boreholes and allows advancement of the casing. The same compressed air or air-detergent (foam) mixture that operates the hammer also serves to expel the cuttings from the borehole, where they can be collected as grab samples. Retraction of the eccentric drill bit allows removal of the hammer from the center of the casing to facilitate standard penetration testing (ASTM D1586) where noted on the boring logs.

Schramm Rotadrill The Schramm T64H truck-mounted drill rig is a top drive rotary rig capable of up to 85,500 inches/pounds of torque with a pulldown capacity of 35,000 lbs. Drilling is performed with either 4", or larger, diameter Tricone roller bits or 4" to 6" diameter down-the-hole hammer. Cutting removal is facilitated by compressed air or air/water mixtures and collected in a cyclone. Where noted on the boring logs, grab samples of the cuttings were collected. When casing is required to stabilize the borehole, an Aardvark drill through casing hammer is utilized, permitting simultaneous drilling and driving of the casing. Casing penetration is recorded on the boring logs in feet per minute. Standard penetration, 2.42" diameter ring samples, Shelby tubes, pitcher tube or Denison samples taken are noted on the boring logs.

Sampling Procedures Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 test procedure. In many cases, 2" O.D., 1 3/8" I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140-pound, 30-inch free fall drop hammer required to advance the samplers in 6-inch increments. However, in stratified soils, driving resistance is sometimes recorded in 2- or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per 6 inches on the boring logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587), pitcher samplers, Denison samplers or continuous CME samplers. Where samples of rock are required, they are obtained by NQ diamond core drilling (ASTM D2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings. Also, representative samples are obtained from the cuttings from the hammer and Schramm drill rig.

Boring Records Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares the boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487), with appropriate group symbols being shown on the boring logs.

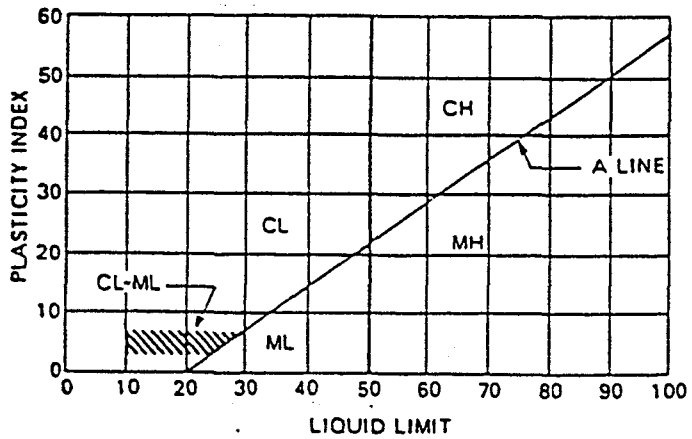
UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified by the Unified Soil Classification system on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" Corp of Engineers, US Army Technical Memorandum No. 3-357 (Revised April 1960) or ASTM Designation: D2487-66T.

MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
					GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 seive)			SW	Well graded sands, gravelly sands.
					SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS (Limits plot below "A" line & hatched zone on plasticity chart)	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)			ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CLAYS (Limits plot above "A" line & hatched zone on plasticity chart)	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)			CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

NOTE: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the plasticity chart to have double symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to ¾ in.
Fine gravel	¾ in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per 0.3 meter (foot) is obtained by the ASTM D1586 procedure using 5.1 centimeter (2-inch) O.D., 3.5 centimeter (1 3/8-inch) I.D. samplers.

1. Relative Density. Terms for description of relative density of cohesionless, uncemented sands and sand-gravel mixtures.

N	Relative Density
0-4	Very loose
5-10	Loose
11-30	Medium dense
31-50	Dense
50+	Very dense

2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several centimeters with fist.
3-4	Soft	Easily penetrated several centimeters with thumb.
5-8	Medium stiff	Can be penetrated several centimeters with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16-30	Very stiff	Readily indented with thumbnail.
30+	Hard	Indented only with difficulty by thumbnail.

3. Relative Firmness. Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

N	Relative Firmness
0-4	Very soft
5-8	Soft
9-15	Moderately firm
16-30	Firm
31-50	Very firm
50+	Hard

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST PIT NO. TP-1

JOB NO. E94-167 DATE 6-22-94

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION 120' west of canal ROW
ELEVATION 1209.3'
DATUM Valco Surveying

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		SM	slightly moist loose	**SILTY SAND**, some gravel, predominantly fine to medium grained, subangular to subrounded, weakly lime cemented, nonplastic to low plasticity, brown
			D			slightly moist	**SANDY SILT**, weakly lime cemented, low plasticity, brown note: trace of gravel from 1' to 4' with increasing gravel content with depth
5					ML	moderately firm	
10							
			D			slightly moist	**SILTY SAND & GRAVEL**, trace of predominantly small cobbles, well graded subangular to subrounded sand & gravel, weakly lime cemented, nonplastic to low plasticity, brown
					GW-GM		
15							Stopped Backhoe at 15'
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
U - 3" O.D. 2.42" I.D. Tube Sample

AGRA EARTH & ENVIRONMENTAL, INC

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST PIT NO. TP-2

JOB NO. E94-167 DATE 6-22-94

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION 80' west of canal ROW
ELEVATION 1212.2'
DATUM Valco Surveying

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		SM	slightly moist	**SILTY SAND**, some gravel, predominantly medium grained subangular to subrounded, nonplastic to low plasticity, brown
			D		ML	slightly moist	**SANDY SILT**, predominantly fine grained gravel, weakly lime cemented, low plasticity, brown
5							
					GM	slightly moist	**SILTY GRAVEL**, some sand, weakly lime cemented, subangular to subrounded, weakly lime cemented, low plasticity, brown
						slightly moist	**GRAVELLY SILT**, weakly to moderately lime cemented, low plasticity, brown
10					ML		
			D				
							Stopped Backhoe at 13'6"
15							
20							
25							

SAMPLE TYPE

B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
U - 3" O.D. 2.42" I.D. Tube Sample

AGRA EARTH & ENVIRONMENTAL, INC

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST BORING NO. 3

JOB NO. E94-167 DATE 6-23-94

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1232.8'
DATUM Valco Surveying

Depth in Feet	Drill Rate Min/Ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0									slightly moist	**SANDY SILT**, some clay, predominantly fine to medium grained sand, some lime, low to medium plasticity, brown
								ML	moderately firm	note: roadway fill from 0 to 8'
5				S	17-9-6					
									moist	**SANDY CLAY**, weakly lime cemented, medium plasticity, brown
10				S	7-9-32		14.1	CL	very firm	
15				S	9-9-14				slightly moist	**SILTY SAND & GRAVEL**, some cobbles below 16', well graded subangular to subrounded sand & well graded gravel, low plasticity to nonplastic, brown
								SM/GM	medium dense to dense	
20				S	14-20-21					
25				S	16-34-50/5"			ML	slightly moist	**SANDY SILT**, weakly to moderately lime cemented, low plasticity, brown
									hard	
30				S	9-19-15		3.2			**SAND & GRAVEL**, some cobbles, well graded, subangular to subrounded, weakly lime cemented, nonplastic, light brown
								GW	slightly moist	
35				S	13-43-23				dense	note: some thin clayey silt lenses up to 1" thick below 34'6"
40				S	12-14-16			ML	slightly moist to moist, firm	**CLAYEY SILT**, weakly lime cemented, medium plasticity, dark brown note: some interbedded gravelly sand lenses
45				S	20-25-31					**SILTY SAND & GRAVEL**
								GM	slightly moist	
					19-36-48				hard	
50				S						

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
C - California tube Sample
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
PR - Poor Recovery

AGRA EARTH & ENVIRONMENTAL INC.

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST BORING NO. 3

JOB NO. E94-167 DATE 6-23-94

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1232.8'
DATUM Valco Surveying

Depth in Feet	Drill Rate Min/Ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50										**SILTY SAND & GRAVEL**, occasional small cobbles, predominantly fine to medium grained sand, well graded gravel, weakly lime cemented, low plasticity, brown note: decreasing gravel content with depth
55										
60										Stopped Auger at 49'6" Stopped Sampler at 51'
65										
70										
75										
80										
85										
90										
95										
100										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

C - California tube Sample
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
PR - Poor Recovery

AGRA EARTH & ENVIRONMENTAL INC.

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST BORING NO. 4

JOB NO. E94-167 DATE 6-22-94

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1234.6'
DATUM Valco Surveying

Depth in Feet	Drill Rate Min/Ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	21-9-9				slightly moist to moist	FILL **SANDY SILT**, trace of fine grained gravel, some clay, low plasticity, brown
								ML		
5				S	3-3-3				firm to soft	
10				S	21-19-20		10.6		moist	**SANDY TO GRAVELLY SILT**, some to considerable clay, weakly cemented, low to medium plasticity, brown
								ML	very firm	
15				S	17-19-21					note: decreasing sand & gravel with depth
20				S	16-18-18				slightly moist	**SILTY SAND**, some gravel, predominantly medium grained, angular, weakly cemented, nonplastic, light brown to brown
25				S	12-21-31				very firm to hard	
								SM		
30				S	17-25-32					
35				S	23-31-50/5"		3.3			
40				S	12-14-19				moist	**CLAYEY SILT**, weakly cemented, low plasticity, brown
									very firm to hard	note: sand & gravel lens at 45'
45				S	32-50/4"			ML		
50				S	18-33-42					

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

C - California tube Sample
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
PR - Poor Recovery

AGRA EARTH & ENVIRONMENTAL INC.

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST BORING NO. 4

JOB NO. E94-167 DATE 6-22-94

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1234.6'
DATUM Valco Surveying

Depth in Feet	Drill Rate Min/Ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50										
										Stopped Auger at 49'6" Stopped Sampler at 51'
55										
60										
65										
70										
75										
80										
85										
90										
95										
100										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

C - California tube Sample
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
PR - Poor Recovery

AGRA EARTH & ENVIRONMENTAL INC.

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST PIT NO. TP-5

JOB NO. E94-167 DATE 6-22-94

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION 50' west of canal ROW
ELEVATION 1242.4'
DATUM Valco Surveying

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist	**SANDY SILT**, trace of predominantly fine grained gravel, weakly lime cemented, low plasticity, brown
			D	5.5	ML		
5							
			D		ML	slightly moist	**SANDY SILT**, some predominantly fine grained gravel, weakly lime cemented, low plasticity, brown
10							
			D		GM	slightly moist	**SILTY SAND & GRAVEL**, trace of predominantly small cobbles, well graded, subangular to subrounded, weakly lime cemented, nonplastic to low plasticity, brown
15							
							Stopped Backhoe at 16'
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
U - 3" O.D. 2.42" I.D. Tube Sample

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST PIT NO. TP-6

JOB NO. E94-167 DATE 6-22-94

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION 75' west of canal ROW
ELEVATION 1246.5'
DATUM Valco Surveying

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					GM	slightly moist	**SILTY SAND & GRAVEL**, predominantly fine to medium grained subangular to subrounded sand, predominantly fine grained subangular to subrounded gravel, nonplastic to low plasticity, brown note: small cobble lense from 1' to 1'6"
5					ML	slightly moist	**SANDY SILT**, weakly lime cemented, low plasticity, brown note: some gravel lenses below 4'
10			D	3.7	SP-SM	slightly moist	**SILTY SAND**, considerable gravel & some cobbles, predominantly fine to medium grained subangular to subrounded sand, predominantly well graded angular gravel, moderately lime cemented, nonplastic, light brown
15			D		ML	slightly moist to moist	**SANDY SILT**, some predominantly fine grained gravel, weakly lime cemented, low plasticity, brown
20							Stopped Backhoe at 15'6"
25							

SAMPLE TYPE

B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
U - 3" O.D. 2.42" I.D. Tube Sample

AGRA EARTH & ENVIRONMENTAL, INC

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST PIT NO. TP-7

JOB NO. E94-167 DATE 6-22-94

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION 50' west of canal ROW
ELEVATION 1253.7'
DATUM Valco Surveying

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D	2.7	GM	slightly moist	**SILTY SAND & GRAVEL**, occasional small cobbles, weakly lime cemented, nonplastic, brown
5					SM	slightly moist	**SILTY SAND**, some predominantly fine grained gravel & occasional cobble, well graded subangular to subrounded sand, weakly lime cemented, low plasticity, brown
10							
15			D		GM	slightly moist to moist	**SILTY SAND & GRAVEL**, occasional cobbles, well graded subangular to subrounded sand & predominantly fine grained gravel, weakly lime cemented, low plasticity, brown
20							Stopped Backhoe at 15'6"
25							

SAMPLE TYPE

B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
U - 3" O.D. 2.42" I.D. Tube Sample

AGRA EARTH & ENVIRONMENTAL, INC

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST BORING NO. 8

JOB NO. E94-167 DATE 6-22-94

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1276.0'
DATUM Valco Surveying

Depth in Feet	Drill Rate Min/Ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	9-6-6				moist moderately firm	FILL SANDY SILT, some clay, trace of fine grained gravel, low plasticity, brown
								ML		
5				S	6-6-6					
								ML	moist	CLAYEY SILT, trace of fine grained sand, moderately lime cemented, low plasticity, brown
10				S	20-37-50/4"				hard	
									slightly moist	GRAVELLY SAND, trace of silt, well graded subangular to angular sand, predominantly fine grained angular gravel, weakly to moderately lime cemented, nonplastic, light brown
15				S	25-50/4"			SW	hard	
20				S	21-33-47		12.0	CL	slightly moist hard	SANDY CLAY, weakly lime cemented, medium plasticity, brown
25				S	19-23-23				slightly moist to moist	GRAVELLY SAND, well graded, subangular to subrounded, nonplastic, brown
30				S	18-19-23			SW	dense to very dense	
35				S	45-50/3"		7.8			
40				S	23-38-38					
45				S	30-41-45					
50				S	31-50/5"					

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

C - California tube Sample
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
PR - Poor Recovery

AGRA EARTH & ENVIRONMENTAL INC.

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST BORING NO. 8

JOB NO. E94-167 DATE 6-22-94

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1276.0'
DATUM Valco Surveying

Depth in Feet	Drill Rate Min/Ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50										Stopped Auger at 49'6" Sampler refused at 50'4"
55										
60										
65										
70										
75										
80										
85										
90										
95										
100										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

C - California tube Sample
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
PR - Poor Recovery

AGRA EARTH & ENVIRONMENTAL INC.

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST BORING NO. 9

JOB NO. E94-167 DATE 6-22-94

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1275.7'
DATUM Valco Surveying

Depth in Feet	Drill Rate Min/Ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	13-5-4				slightly moist to moist	FILL **SILTY SAND**, some fine grained gravel, some lime, low plasticity, brown
								SM		
5				S	2-2-2				loose to very loose	
10				S	8-6-50/5"		8.4	SC	moist very dense	**CLAYEY SAND**, predominantly fine to medium grained sand, angular to subangular, predominantly fine grained gravel, moderately lime cemented, low plasticity, brown note: coarse grained gravel from 13' to 14'
15				S	18-20-37					
20				S	20-25-18			ML	moist very firm	**CLAYEY SILT**, trace of sand, weakly lime cemented, medium plasticity, brown
25				S	33-34-37		2.8		slightly moist hard	**SILTY SAND & GRAVEL**, predominantly fine grained angular gravel, weakly lime cemented, nonplastic, light brown to brown note: lens of clayey silt at 40' & 47' note: some coarse grained gravel at 45'
30				S	20-22-27		3.1			
								GM		
35				S	50-50/4"					
40				S	45-50/4"					
45				S	27-33-32					
50				S	13-28-50/5"					

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

C - California tube Sample
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
PR - Poor Recovery

AGRA EARTH & ENVIRONMENTAL INC.

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST BORING NO. 9

JOB NO. E94-167 DATE 6-22-94

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV. 1275.7'
DATUM Valco Surveying

Depth in Feet	Drill Rate Min/Ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50										
										Stopped Auger at 49'6" Sampler refused at 50'11"
55										
60										
65										
70										
75										
80										
85										
90										
95										
100										

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

C - California tube Sample
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
PR - Poor Recovery

AGRA EARTH & ENVIRONMENTAL INC.

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST PIT NO. TP-10

JOB NO. E94-167 DATE 6-22-94

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION 30' west of canal ROW
ELEVATION 1283.6'
DATUM Valco Surveying

Depth in Feet	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					slightly moist	**SANDY SILT grading to SILTY CLAY**, some sand, trace of gravel, weakly lime cemented, low plasticity, brown note: considerable gravel below 7'
		D	4.6			
				CL-ML		
5						
10				GM	slightly moist	**SILTY SAND & GRAVEL**, occasional cobbles, predominantly coarse grained subangular to subrounded gravel, weakly lime cemented, low plasticity, brown
				ML	slightly moist	**GRAVELLY SILT**, weakly lime cemented, low plasticity, brown
15		D	2.7	SM-SC	slightly moist	**SILTY SAND & GRAVEL**, some clay & cobbles, well graded, subangular to subrounded, weakly lime cemented, low plasticity, brown
20						Stopped Backhoe at 16'6"
25						

SAMPLE TYPE

B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
U - 3" O.D. 2.42" I.D. Tube Sample

AGRA EARTH & ENVIRONMENTAL, INC

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST PIT NO. TP-11

JOB NO. E94-167 DATE 6-22-94

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION 70' west of road (channel)
ELEVATION 1212.5'
DATUM Valco Surveying

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist	**SILTY SAND**, occasional cobbles, predominantly well graded subangular to subrounded sand & gravel, weakly lime cemented, nonplastic, brown
			D	3.2			
					SW-SM		
5							
						slightly moist	**SANDY SILT**, trace of gravel, weakly lime cemented, low plasticity, brown
10					ML		
			D				
15							
							Stopped Backhoe at 16'
20							
25							

SAMPLE TYPE

B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
U - 3" O.D. 2.42" I.D. Tube Sample

AGRA EARTH & ENVIRONMENTAL, INC

PROJECT No.3 FRS Inlet Improvement

LOG OF TEST PIT NO. TP-12

JOB NO. E94-167 DATE 6-22-94

GROUNDWATER		
DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580K
LOCATION 90' west of west road edge
ELEVATION 1205.2'
DATUM Valco Surveying

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	D		GP	slightly moist	**SAND & GRAVEL**, some silt, predominantly fine grained gravel, predominantly medium to coarse grained sand, nonplastic, brown
		X			ML		
					SM		
		X	D	15.1		slightly moist	**SANDY SILT**, weakly lime cemented, low plasticity, brown
5		X			ML		
						slightly moist to moist	**SILTY SAND**, trace of gravel, predominantly fine to medium grained, subangular to subrounded, weakly lime cemented, low plasticity to nonplastic, brown
10						moist	**SANDY SILT**, trace of gravel, weakly lime cemented, low plasticity, brown
					GM	moist	**SILTY SAND & GRAVEL**, occasional cobbles, predominantly fine to medium grained sand & predominantly fine grained gravel, weakly lime cemented, low plasticity, brown
15		X	D				
20							Stopped Backhoe at 16'
25							

SAMPLE TYPE

B - Undisturbed Block Sample.
D - Disturbed Bulk Sample.
U - 3" O.D. 2.42" I.D. Tube Sample

AGRA EARTH & ENVIRONMENTAL, INC

APPENDIX B

LABORATORY TESTING

AGRA
Earth & Environmental

AGRA Earth & Environmental

TABULATION OF TEST RESULTS

Job No. E94-167
W/O 1

HOLE NO	DEPTH	UNIFIED CLASS	L.L.	P.I.	SIEVE ANALYSIS-ACCUM % PASSING #200	#100	#50	#40	#30	#16	#10	#8	#4	.25"	.375"	.5"	LAB NO
					.75"	1"	1.5"	2"	2.5"	3"	3.5"	4"	6"	8"	10"	12"	
4	34.5'-35.9'	SM	NV	NP	21	28	37	43	50	66	74	76	83	88	94	97	
					100												4-167-8
8	19.5'-21'	CL	49	26	58	67	75	78	81	89	95	96	99	100			4-167-17
9	9.5'-10.9'	SC	28	10	48	52	57	59	62	69	75	76	82	83	86		
					87	100											4-167-26
9	24.5'-26'	GM	NV	NP	12	16	22	25	28	35	40	42	48	52	59	67	
					73	82	100										4-167-29
3	9.5'-11'	CL	42	18	75	83	89	92	94	98	99	99	100				4-167-36
TP-5	3'-5'	ML	30	7	84	89	92	93	95	97	99	99	100				4-167-51
TP-6	7'-10'	SP-SM	NV	NP	7.0	10	16	21	26	38	47	49	56	59	63	65	
					69	72	77	83	87		94	100					4-167-54
TP-7	0'-4'	GM	27	3	19	24	27	30	32	39	46	48	56	59	64	68	
					75	80	88	91	94	100							4-167-56
TP-10	2'-6'	CL-ML	29	7	81	88	91	92	93	96	98	98	99	99	100		4-167-58
TP-10	14'-16.5'	SM-SC	27	7	19	23	29	33	38	50	61	63	72	75	81	85	
					91	94	97	100									4-167-59
TP-11	1'-4'	SW-SM	NV	NP	9.3	13	24	35	47	71	80	82	88	90	92	93	
					95	96	98	100									4-167-60
TP-12	4'-6'	ML	31	8	71	78	83	86	89	95	98	98	100				4-167-63

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TO: FCDMC

FROM: H.A. Aristizabal

JOB: FCDMC - White Tanks FDC 93-47

JOB NO.: 310.44

DATE: Nov 1, 1994

MEMORANDUM

Reference: White Tanks Flood Retaining Structure No. 3 Improvements Conceptual Design Report: Addendum

In response to the letter we received from the District on October 21, 1994, we have prepared the following analysis and cost estimates.

COST ESTIMATES (Revised per letter of October 21, 1994)

Lowest Cost per Addendum to DCR (Dated October 1994)
Supercritical flow - 5-feet depth $7,665,216

Option No. 1
Supercritical flow - 7-feet depth **$6,254,886**
Seven-foot depth was chosen as the most economical section. The cost estimate spread-sheet shows the cost still can be reduced by increasing depth, but the spread sheet was developed based on a 5.5-foot flow depth, the further away from this depth, the more chance there is of underestimating the cost. Enough contingency was included in the cost estimates that the 7-foot depth cost is realistic but approaches the point of diminishing return.

Option No. 2
Mixed Flow - 7-foot supercritical & 5.5 subcritical **$7,618,001**
This option represents supercritical flow upstream from Northern Avenue and subcritical flow through Northern Avenue and downstream. Cost does not justify reversing the channel to supercritical downstream from the crossing and back to subcritical before the reverse curve. The savings obtained from the supercritical flow are minimized by the required structures. This option also assumes unreinforced concrete in the subcritical channel with a unit cost of $150 CY.

ADDITIONAL COST MITIGATION CONSIDERATIONS

1. Revise the hydrology parameters used in the HEC-1 model and perhaps find some way to lower the design flows.

2. Change the design storm frequency to a lesser frequency event.

3. Concrete liner could be placed to an elevation less than the required freeboard, perhaps one foot above the water surface elevation. The remainder of the freeboard could be left unprotected, realizing that damage to the channel may occur during a 100-year storm, but since the channel is below grade, no significant flooding or failure will occur. For the east side of the channel, it may be desirous to line the full freeboard to protect the Beardsley Canal or it could be built to the one foot freeboard level and extended in the future. For the 7-foot supercritical channel, the cost savings would be:

Liner to one foot of freeboard, both sides	$ 519,606
Liner to one foot west, full freeboard east	$ 259,803

4. The side inlets cost estimate is $525,787. This value was based on a depth of 8-feet below grade, the cost for an 11-foot depth (7-feet supercritical channel and freeboard) would increase slightly, but enough allowance was made on the side inlet structures estimates that the cost can be reduced by $26,000

5. The project can be divided into two or three phases as follows:
   a). Two Phase: Phase One--from WTFRS#3 to Cholla Wash confluence, and Phase Two--upstream from Cholla Wash confluence.

Phase One cost	$4,134,971
Phase Two cost	$2,119,914

   b). Three Phase: Phase One--from WTFRS#3 to downstream from Northern Avenue Bridge, Phase Two--from downstream of Northern Avenue Bridge to downstream from Olive Avenue Bridge, and Phase Three--upstream from Olive Avenue

Phase One cost	$2,636,547
Phase Two cost	$2,942,686
Phase Three cost	$ 675,653

These phase costs are based on Option No. 1, Supercritical flow through the entire channel and 7-foot flow depth in Reaches A-D and 4-foot depth in Reach E.

WHITE TANKS FRS # 3 INLET IMPROVEMENTS

Cost Comparison for Different Depths

Prepared By AGK Engineers, Inc. October 1, 1994

Depth (ft)	ROW Cost ($)	Excavation Cost ($)	Drop Cost ($)	Liner Cost ($)	Inlet/outlet Cost ($)	Fence Cost ($)	Side inlet Cost ($)	Crossing Cost ($)	Total Cost + 20% cont. ($)
Supercritical flow									
5.0	$286,747	$664,850	$0	$4,110,945	$244,606	$112,640	$525,787	$442,105	$7,665,216
5.5	$278,571	$635,055	$0	$3,678,376	$199,524	$112,640	$525,787	$418,137	$7,017,709
6.0	$274,027	$616,970	$0	$3,470,922	$169,992	$112,640	$525,787	$401,646	$6,686,381
6.5	$270,060	$603,637	$0	$3,319,079	$139,626	$112,640	$525,787	$390,433	$6,433,515
7.0	$268,016	$596,998	$0	$3,207,764	$118,153	$112,640	$525,787	$383,047	$6,254,886
7.5	$266,876	$594,495	$0	$3,126,650	$100,146	$112,640	$525,787	$378,502	$6,126,115
8.0	$266,501	$595,652	$0	$3,068,500	$84,699	$112,640	$525,787	$376,111	$6,035,866
Mixed flow									
Mixed flow *	$268,016	$963,463	$195,413	$3,765,030	$134,938	$112,640	$525,787	$383,047	$7,618,001
1ft of lined freeboardon both sides									
5.0	$286,747	$664,850	$0	$3,745,613	$244,606	$112,640	$525,787	$442,105	$7,226,818
5.5	$278,571	$635,055	$0	$3,386,949	$199,524	$112,640	$525,787	$418,137	$6,667,996
6.0	$274,027	$616,970	$0	$3,131,729	$169,992	$112,640	$525,787	$401,646	$6,279,349
6.5	$270,060	$603,637	$0	$2,925,647	$139,626	$112,640	$525,787	$390,433	$5,961,396
7.0	$268,016	$596,998	$0	$2,774,759	$118,153	$112,640	$525,787	$383,047	$5,735,280
7.5	$266,876	$594,495	$0	$2,658,764	$100,146	$112,640	$525,787	$378,502	$5,564,652
8.0	$266,501	$595,652	$0	$2,569,304	$84,699	$112,640	$525,787	$376,111	$5,436,832
1ft of lined freebord on one side, fully lined on other									
5.0	$286,747	$664,850	$0	$3,928,279	$244,606	$112,640	$525,787	$442,105	$7,446,017
5.5	$278,571	$635,055	$0	$3,532,663	$199,524	$112,640	$525,787	$418,137	$6,842,852
6.0	$274,027	$616,970	$0	$3,301,325	$169,992	$112,640	$525,787	$401,646	$6,482,865
6.5	$270,060	$603,637	$0	$3,122,363	$139,626	$112,640	$525,787	$390,433	$6,197,455
7.0	$268,016	$596,998	$0	$2,991,262	$118,153	$112,640	$525,787	$383,047	$5,995,083
7.5	$266,876	$594,495	$0	$2,892,707	$100,146	$112,640	$525,787	$378,502	$5,845,383
8.0	$266,501	$595,652	$0	$2,818,902	$84,699	$112,640	$525,787	$376,111	$5,736,349
Phasing Alternatives (Based on supercritical - 7' deep)									
phase a,1	$84,917	$434,181	$0	$2,218,838	$108,905	$61,640	$339,453	$197,875	$4,134,971
phase a,2	$183,099	$162,817	$0	$988,926	$9,248	$51,000	$186,334	$185,172	$2,119,914
phase b,1	$0	$308,020	$0	$1,540,182	$108,905	$42,140	N/A	$197,875	$2,636,547
phace b,2	$209,708	$249,855	$0	$1,415,230	$0	$52,820	$339,453	$185,172	$2,942,686
phase b,3	$58,309	$39,122	$0	$252,351	$9,248	$17,680	$186,334	$0	$675,653

NOTE: For reach "E" depths from 2 to 5 were used

* 5.5' Subcritical flow in reach A. Surecritical 7' in reaches B-D and $' in reach E

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SHEET _____ OF _____
BY HAA DATE 9/29/94
CHECK _____ DATE _____

CLIENT FCDMC
JOB White Tanks FRS #3 Inlet imp.
JOB NO. 310.44

$r_{min} = \frac{4 V^2 T}{g y}$ (EM 1110-2-1601)

Reach A
$V = 17.87$
$T = 127$
$y = 4$

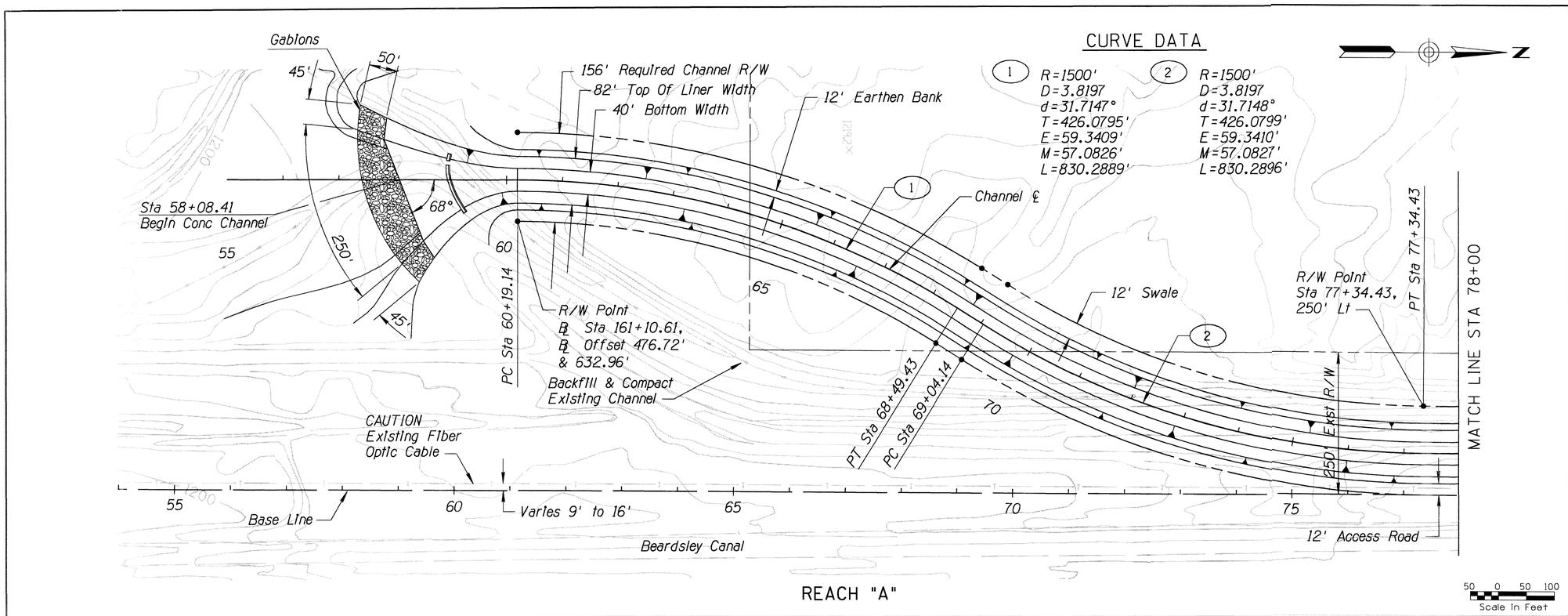
$r_{min} = \frac{4 (17.87)^2 (127)}{32.2 (4)}$

$= 1260$ ft ← min. Radius

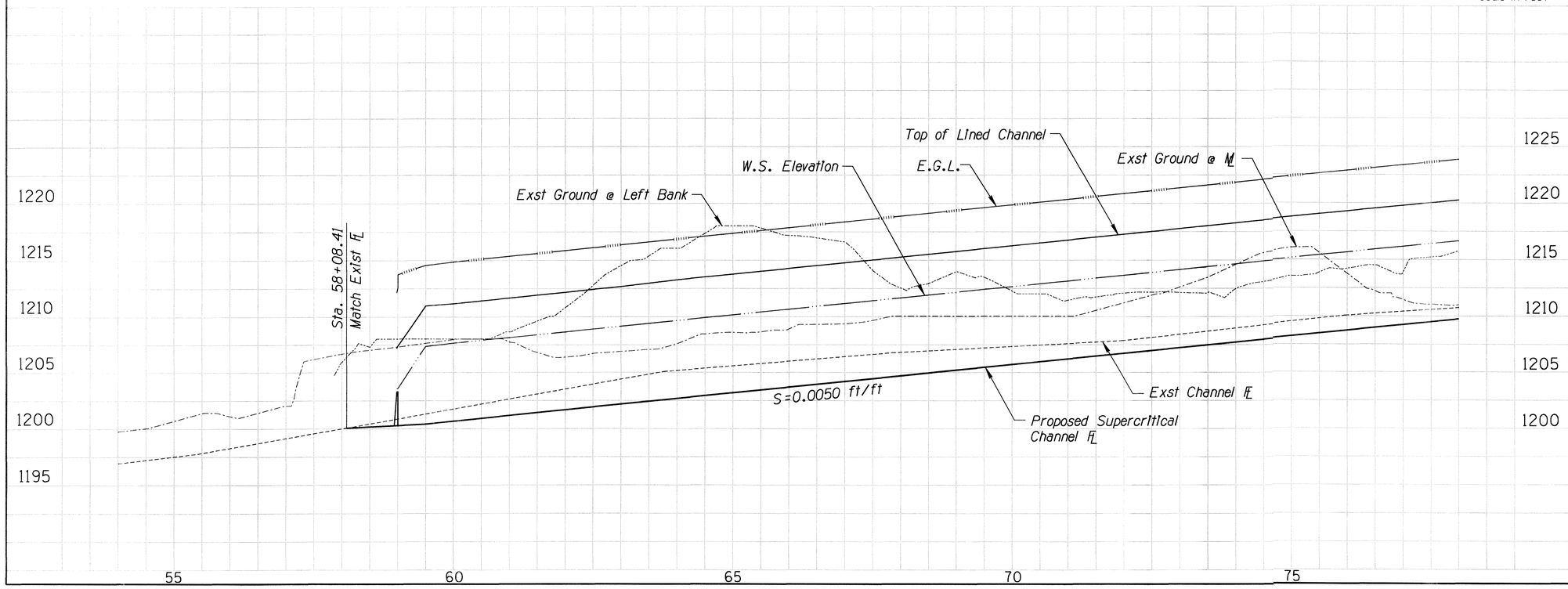
$\Delta y = C \frac{V^2 T}{g r}$

$= (1) \frac{(17.87)^2 (127)}{(32.2)(1260)}$

$= 1'$ ← superelevation



REACH "A"



LEAST COST ALTERNATIVE DESIGN CONCEPT

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS NO. 3 FLOOD RETENTION STRUCTURE INLET IMPROVEMENTS CONCEPTUAL DESIGN REPORT

		BY	DATE
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	H.A.A.	12/17/94
	DRAWN	J.C.C.	12/17/94
	CHECKED	M.J.B./S.E.K.	12/17/94

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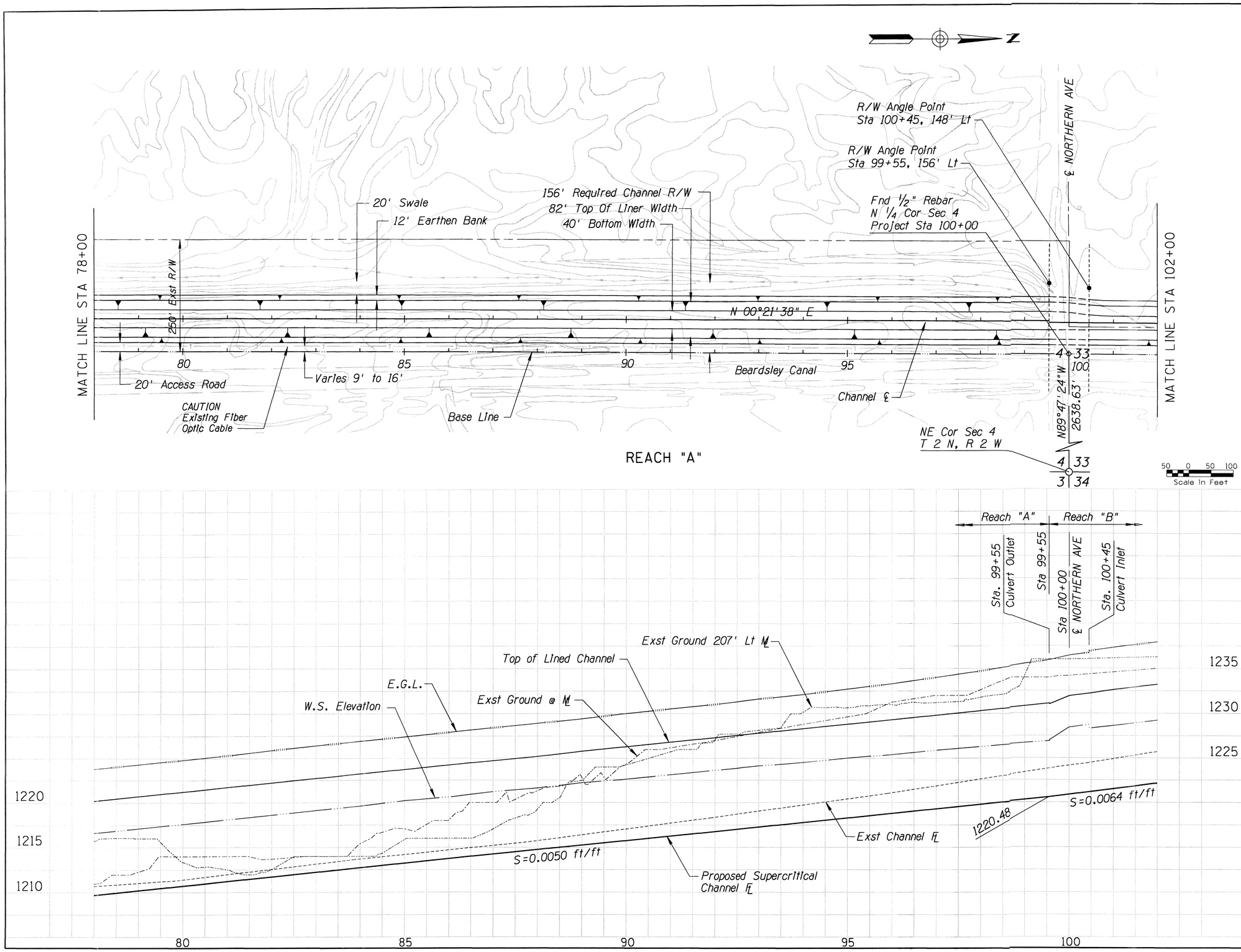
SHEET 1 OF 5



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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
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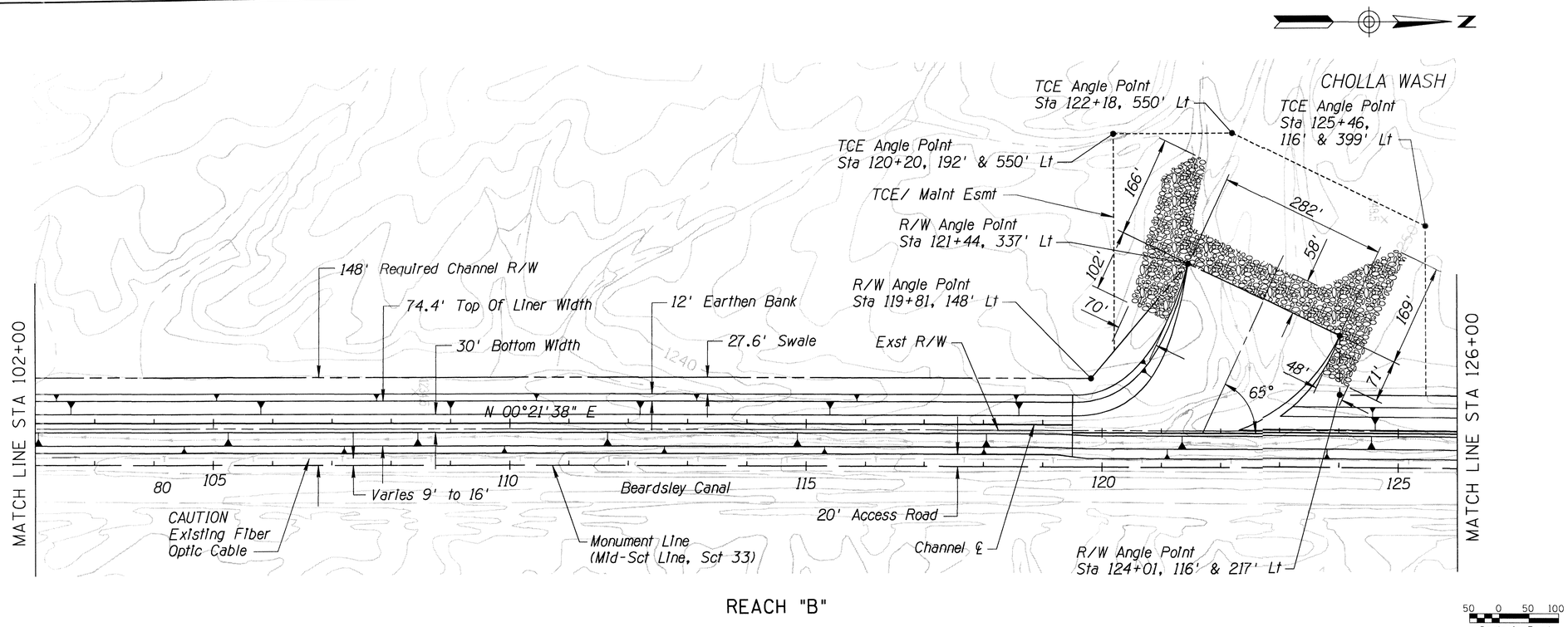
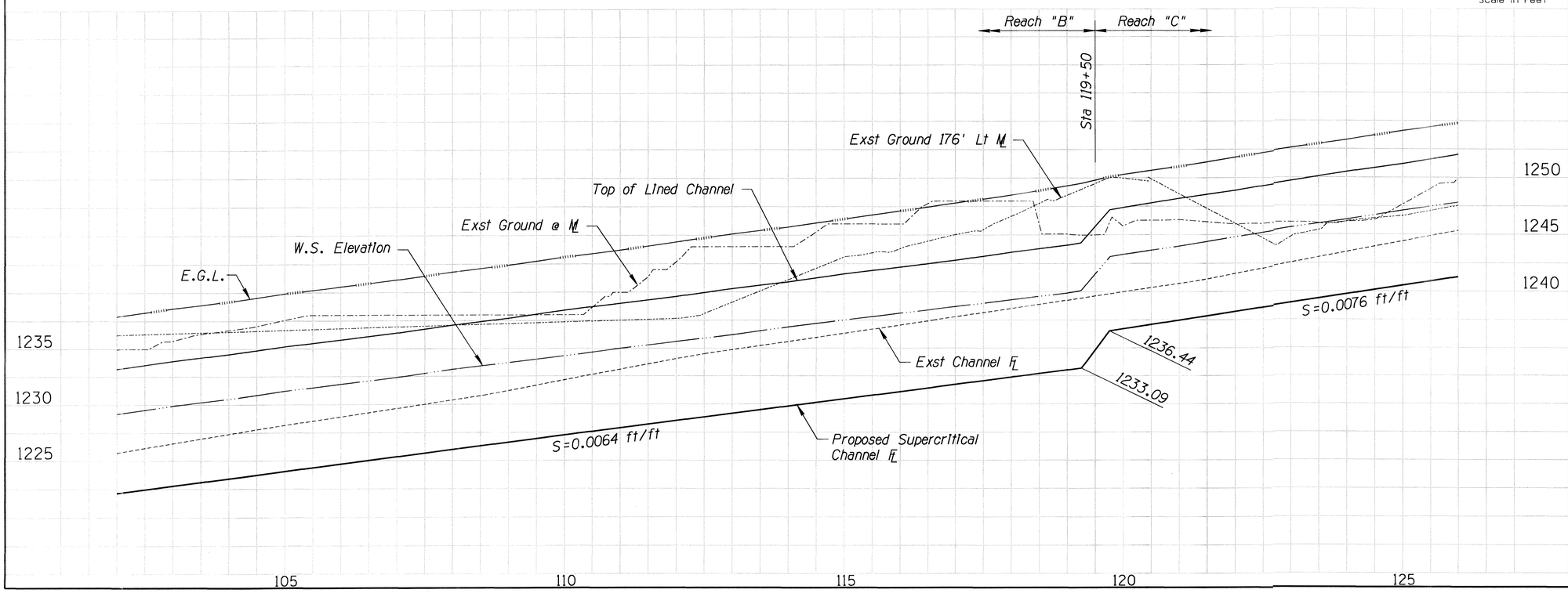
SHEET 2 OF 5



REACH "B"

50 0 50 100
Scale In Feet



LEAST COST ALTERNATIVE DESIGN CONCEPT

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
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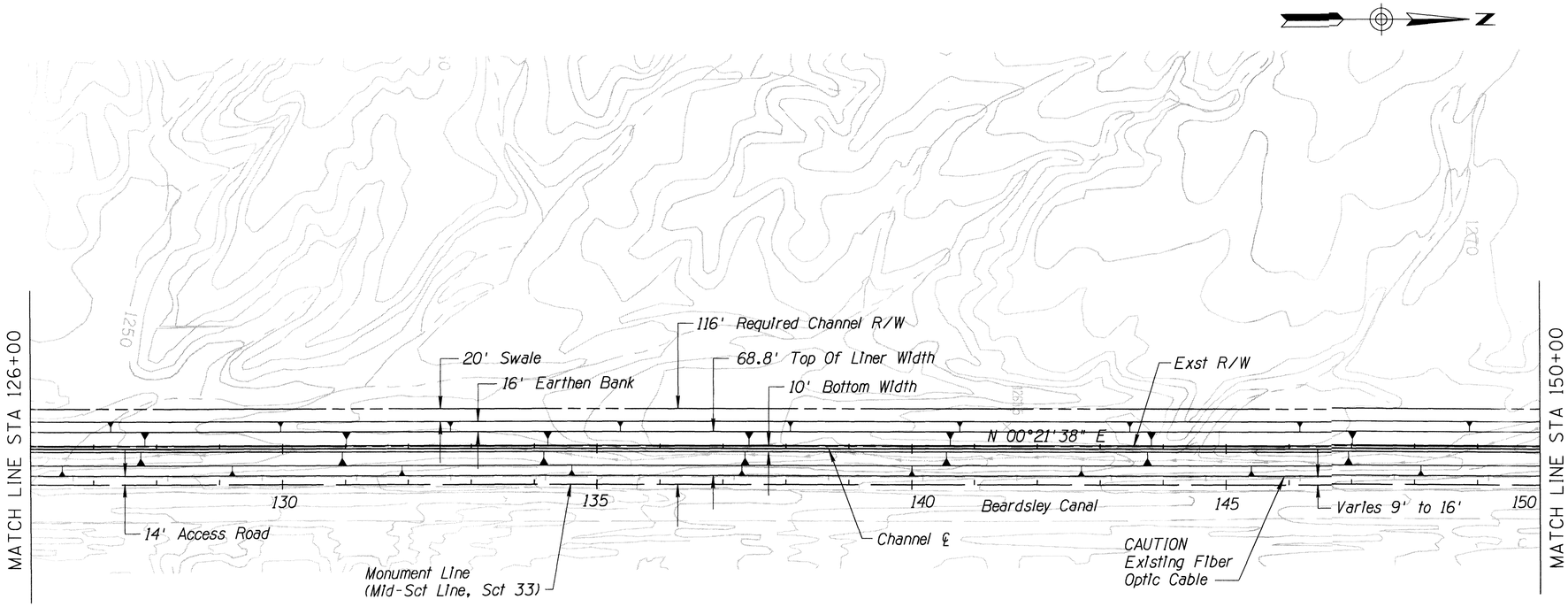
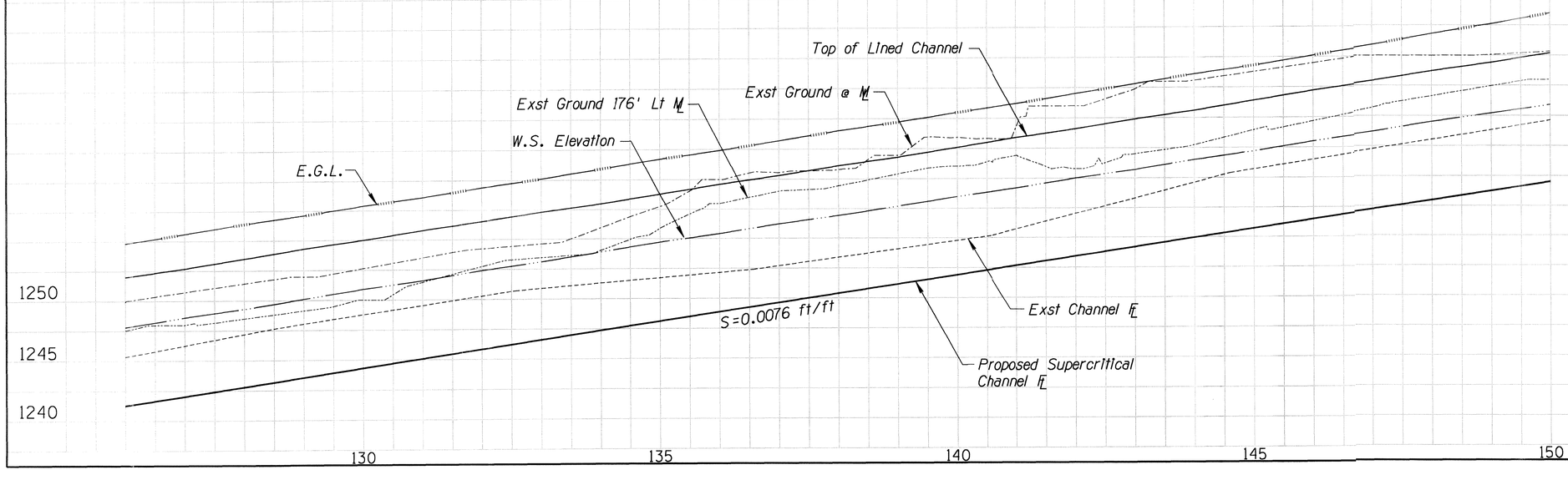
SHEET 3 OF 5



REACH "C"

50 0 50 100
Scale In Feet



LEAST COST ALTERNATIVE DESIGN CONCEPT

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FLOOD CONTROL DISTRICT
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WHITE TANKS NO. 3 FLOOD RETENTION
STRUCTURE INLET IMPROVEMENTS
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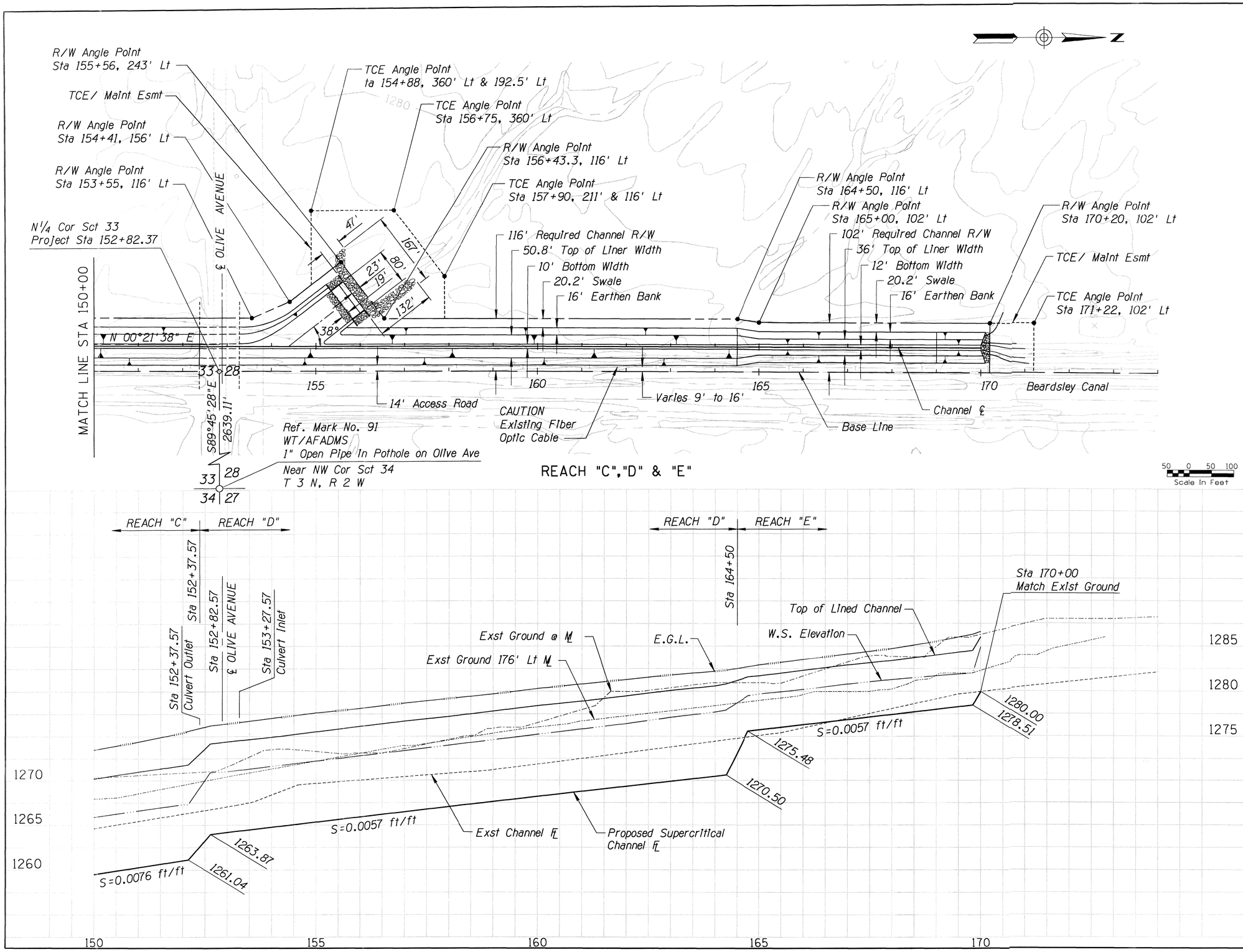
SHEET 4 OF 5



LEAST COST ALTERNATIVE DESIGN CONCEPT

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FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS NO. 3 FLOOD RETENTION
STRUCTURE INLET IMPROVEMENTS
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DRAWN	J.C.C.	12/17/94
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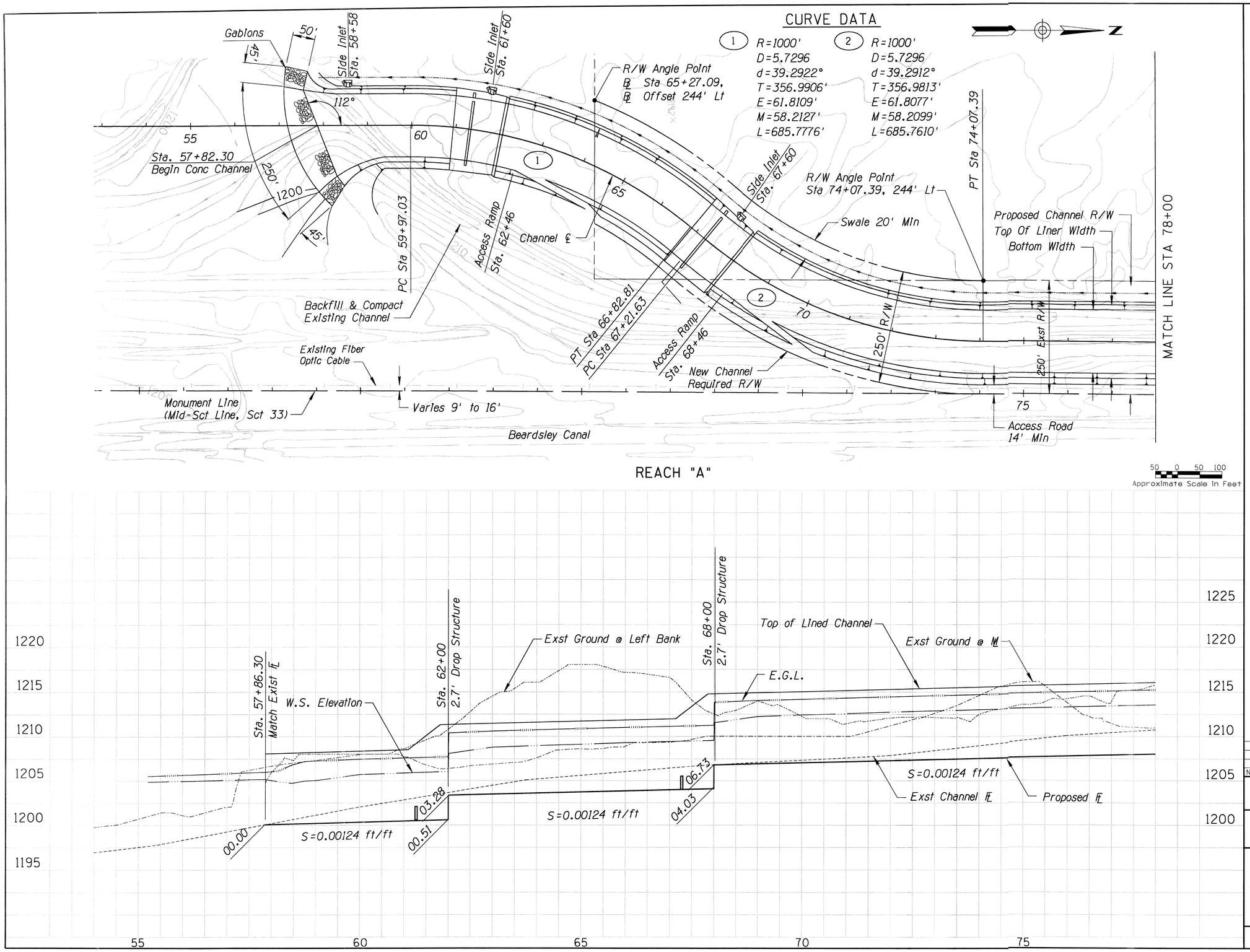
SHEET 5 OF 5



RECOMMENDED ALTERNATIVE DESIGN CONCEPT

NO.	REVISION	BY	DATE
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1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS NO. 3 FLOOD RETENTION STRUCTURE INLET IMPROVEMENTS CONCEPTUAL DESIGN REPORT

		BY	DATE
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	H.A.A.	12/17/94
	DRAWN	J.C.C./V.P.	12/17/94
	CHECKED	M.J.B./S.E.K.	12/17/94

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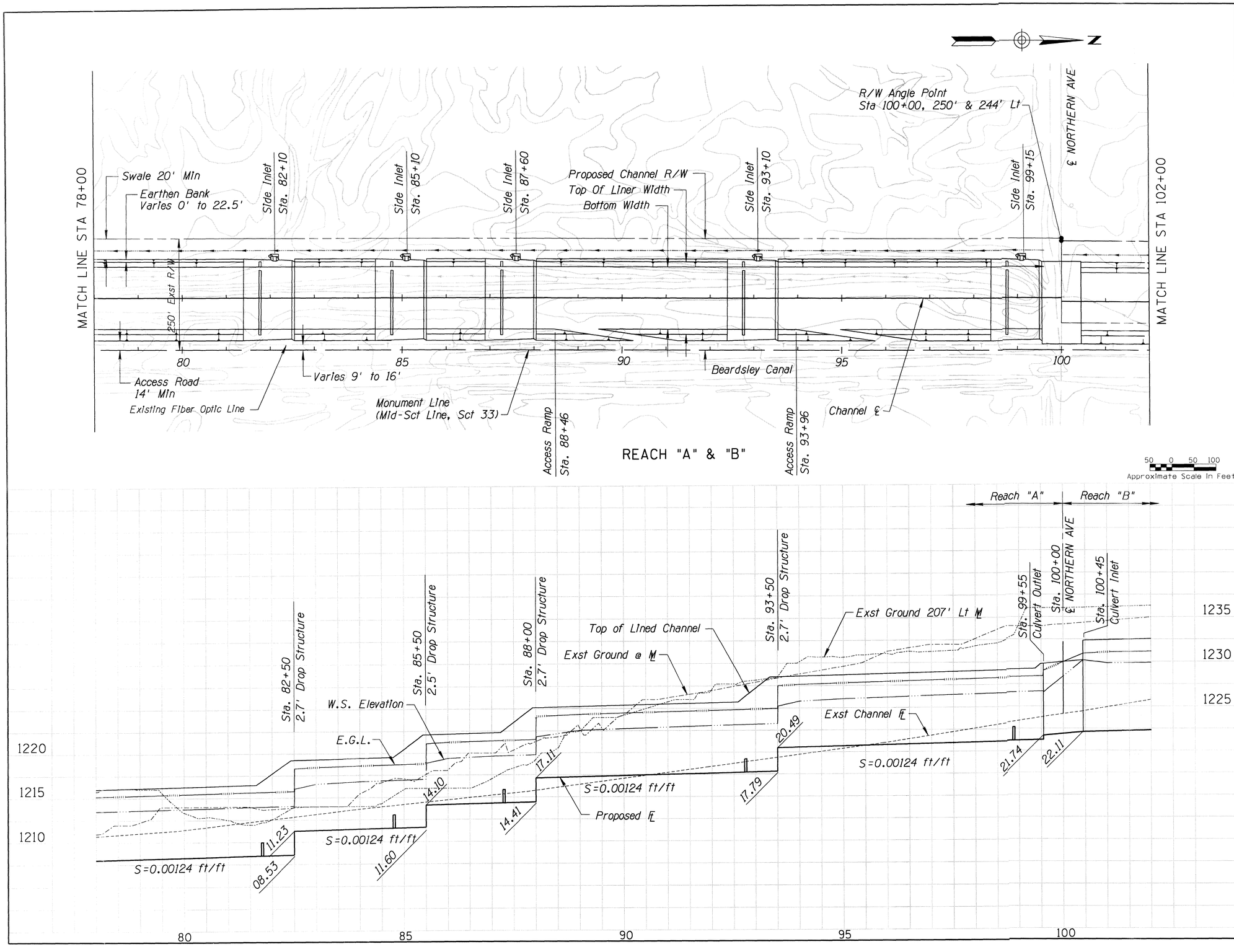
SHEET 1 OF 5



RECOMMENDED ALTERNATIVE DESIGN CONCEPT

NO.	REVISION	BY	DATE
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FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS NO. 3 FLOOD RETENTION
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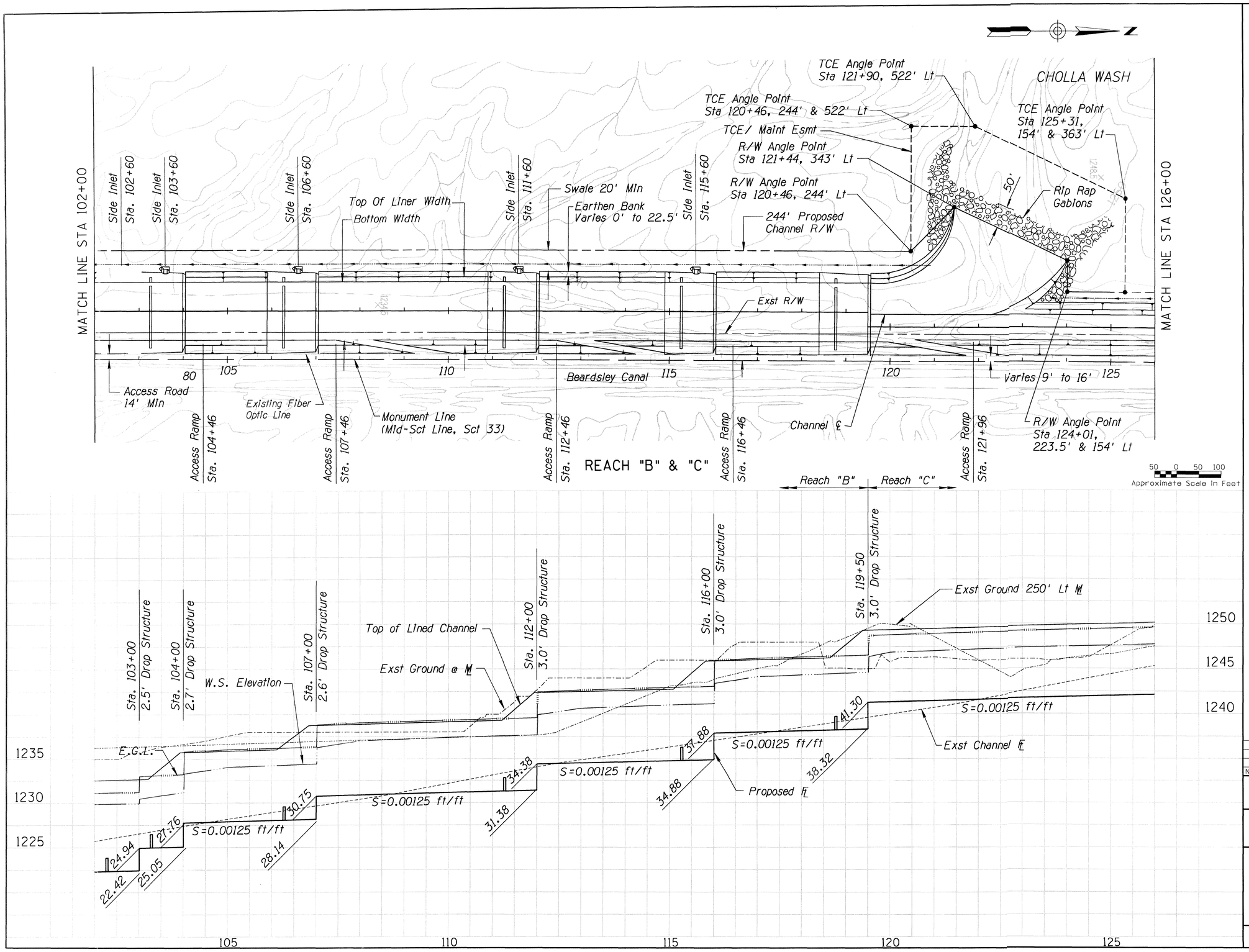
STA 78+00.00 TO 102+00.00

SHEET 2 OF 5



RECOMMENDED ALTERNATIVE DESIGN CONCEPT

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS NO. 3 FLOOD RETENTION STRUCTURE INLET IMPROVEMENTS CONCEPTUAL DESIGN REPORT

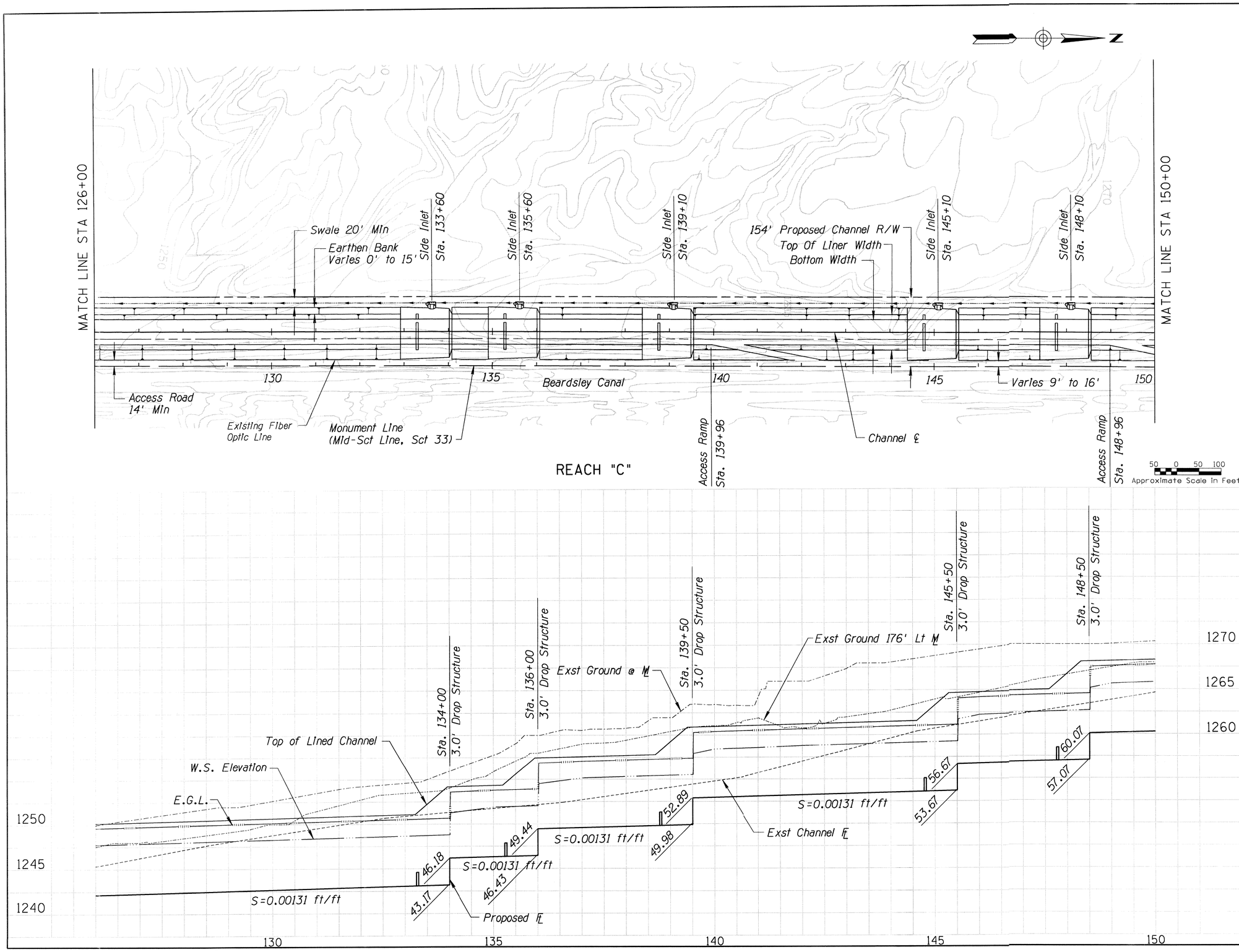
PRELIMINARY NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	H.A.A.	12/17/94
DRAWN	J.C.C./V.P.	12/17/94
CHECKED	M.J.B./S.E.K.	12/17/94

ENGINEERS, INC.
2255 NORTH 44TH STREET, SUITE 330
PHOENIX, ARIZONA 85008
TELEPHONE (602) 244-2566

PLAN & PROFILE
STA 102+00.00 TO 126+00.00

SHEET 3 OF 5



RECOMMENDED
ALTERNATIVE
DESIGN CONCEPT

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS NO. 3 FLOOD RETENTION
STRUCTURE INLET IMPROVEMENTS
CONCEPTUAL DESIGN REPORT

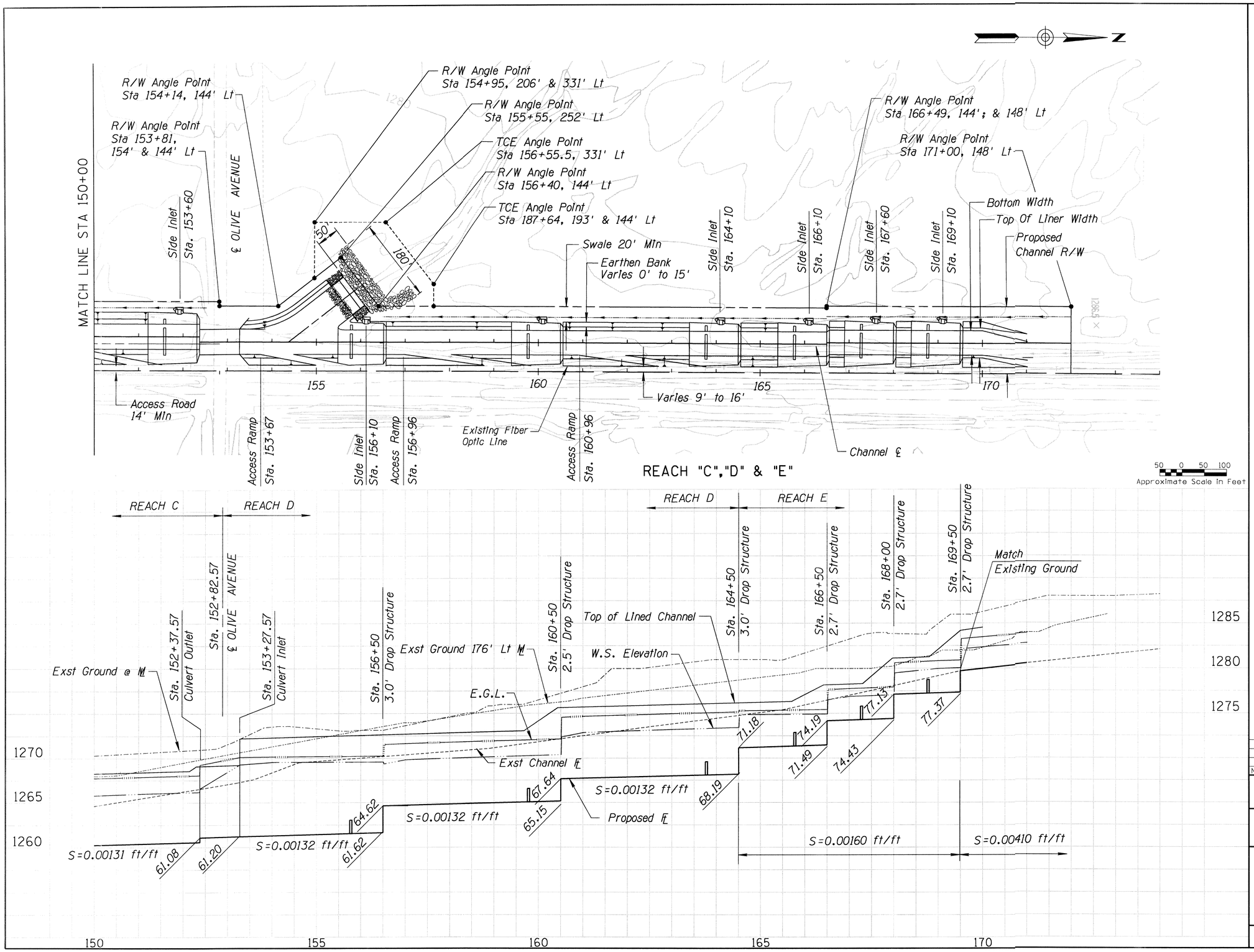
PRELIMINARY
NOT FOR
CONSTRUCTION

	BY	DATE
DESIGNED	H.A.A.	12/17/94
DRAWN	J.C.C./V.P.	12/17/94
CHECKED	M.J.B./S.E.K.	12/17/94

CAK ENGINEERS, INC.
2255 NORTH 44TH STREET, SUITE 330
PHOENIX, ARIZONA 85008
TELEPHONE (602) 244-2566

PLAN & PROFILE
STA 126+00.00 TO 150+00.00

SHEET 4 OF 5



RECOMMENDED ALTERNATIVE DESIGN CONCEPT

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS NO. 3 FLOOD RETENTION STRUCTURE INLET IMPROVEMENTS CONCEPTUAL DESIGN REPORT

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CAK ENGINEERS, INC.
2255 NORTH 44TH STREET, SUITE 330
PHOENIX, ARIZONA 85008
TELEPHONE (602) 244-2566

PLAN & PROFILE
STA 150+00.00 TO 174+00.00

SHEET 5 OF 5