

STORM DRAINAGE MASTER PLAN

FOR

TAMUNING - DEDEDO

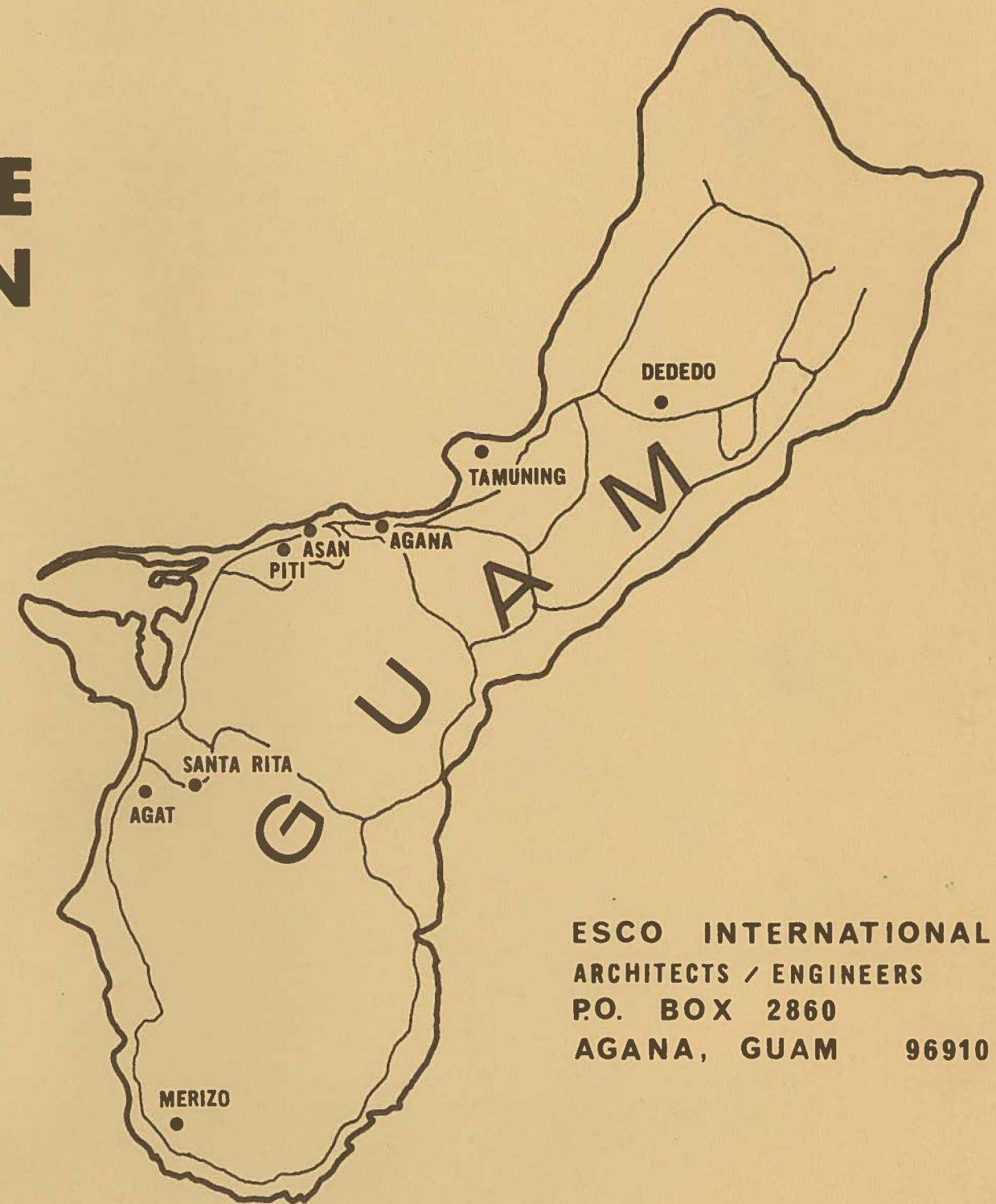
AGANA

ASAN

PITI

MERIZO

AGAT-SANTA RITA



ESCO INTERNATIONAL
ARCHITECTS / ENGINEERS
P.O. BOX 2860
AGANA, GUAM 96910

ESCO INTERNATIONAL ARCHITECTS / ENGINEERS

LOS ANGELES GUAM SAIPAN HONOLULU VIRGINIA BEACH

August 1970

Juan C. Tenorio
Director of Public Works
Government of Guam
Tumon, Guam

Dear Mr. Tenorio,

In accordance with an agreement made on October 16, 1968 between the Government of Guam and ESCO International, we hereby submit a report entitled, "Storm Drainage Master Plan."

This study is the result of hydrologic and hydraulic analysis performed while giving consideration to probable future land development. The proposed drainage system will provide comprehensive storm drain control for:

1. Tamuning — Dededo
2. Agana
3. Asan
4. Piti
5. Agat — Santa Rita
6. Merizo

Functional plans and estimate presented in this report for storm drainage improvements are based upon the best data now available; however, changes in land use, street improvements, utility locations, or information developed by more detailed studies require adjustments when final designs and plans are prepared.

We appreciate the opportunity to participate in the development of the territory of Guam. The cooperation and assistance of your office has been highly beneficial and gratifying.

Respectfully submitted,



Michael D. Flynn, P.E.
Manager, Guam Office

SUMMARY

The rapid growth of the municipal areas of the territory of Guam coupled with its pluvial climate necessitates the development of an adequate drainage system for the preservation of municipal and private property. It is essential that a comprehensive and orderly program of storm drainage facilities be provided to insure orderly future development within these areas.

The following objectives are set forth in order that this orderly development may be effected:

1. Provide a system of storm drain facilities based on rainfall resulting from the selected design storm that will:
 - A. Dispose of storm waters without damage to municipal or private property.
 - B. Permit normal business and traffic to continue.
 - C. Alleviate surface water flow as a nuisance to the public.
2. Provide a comprehensive plan which will insure maximum use of existing facilities, whenever available and adequate, and which will adapt to economical future development.

The plan establishes drainage systems for each of the six subject areas which will permit adequate disposal of storm water. Whenever possible, the natural course of drainage flow was adhered to. The proposed plans provide a general routing of all channels and covered drains, and provide for the accomplishment of the construction work in such order or procedure as may be required to afford the greatest relief to the greatest number of people consistent with good engineering practice.

The improvements are based upon ultimate requirements for capacity and a permanent type of construction. However, construction of all the units on this basis at the present time is not economically justified. Three proposals are presented for the accomplishments of the proposed constructions.

1. Underground conduits, where required, be constructed to ultimate capacity possibly under highway funds.
2. Open channels in unimproved areas be constructed permanently, possible with funds contributed by owners or developers of adjacent areas being served by the respective facility.
3. Open channels in areas, which have already reached their full design development, be constructed permanently, with funds from special assessment.

It is not contemplated that all storm drains in the report be installed immediately or concurrently. The drainage works proposed are considered to provide a pattern of flood protection which will facilitate orderly development of unimproved areas and sound redevelopment or renewal of improved areas.

"Sinks" of various sizes have been taken into consideration in this report. However it should be noted that these local depressions alone cannot, in most instances, contain the volume of storm water generated from large drainage areas.

The percolation rate in the Harmon-Dededo area is estimated at 1" in 5 minutes. Under this condition the "Sinks" are adequate for low rainfall intensity only. Consequently only major "Sinks" which cannot be economically developed should be retained.

HYDROLOGY AND HYDRAULICS

The method of hydrologic computation were based on the "Storm Drainage Standards and Design Criteria," a study prepared by Austin, Smith and Associates, Inc., Agana Guam, for the Government of Guam. The design storm or recurrence interval, run-off coefficient, time of concentration and rainfall intensity were computed as outlined in that report. The method of tabulation was devised by ESCO INTERNATIONAL for this report. The rational method of hydrologic calculation, as modified by Austin, Smith, was used in all the areas and lines studied, except in the case of Line F. Merizo, was used. All areas within the project boundaries were considered to be fully developed.

Nomographs, developed by the U.S. Public Road Administration, Washington, D. C., were used in sizing channels from bottom widths (b) of 2-20 feet. Channels, with (b) greater than 20 feet, were sized using HANDBOOK OF HYDRAULICS by King and Brater.

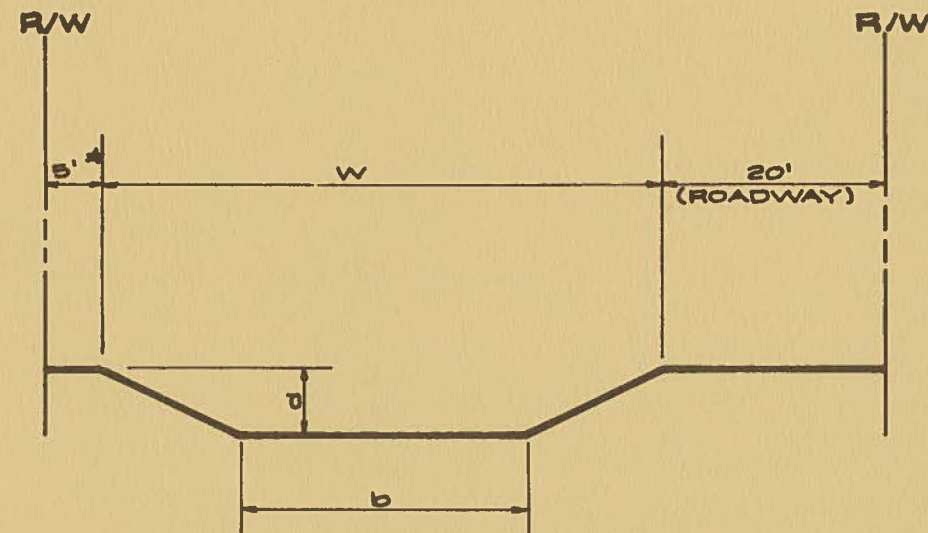
Rectangular channels (box) and trapezoidal channels were sized, allowing for a freeboard as outlined in Austin, Smith's Report. Pipes

were sized such that the friction slope is equal to the slope of the pipe, or stated differently, the pipe is just flowing full or nearly full. Pipes are used only on small areas, hence the reason for their flowing full.

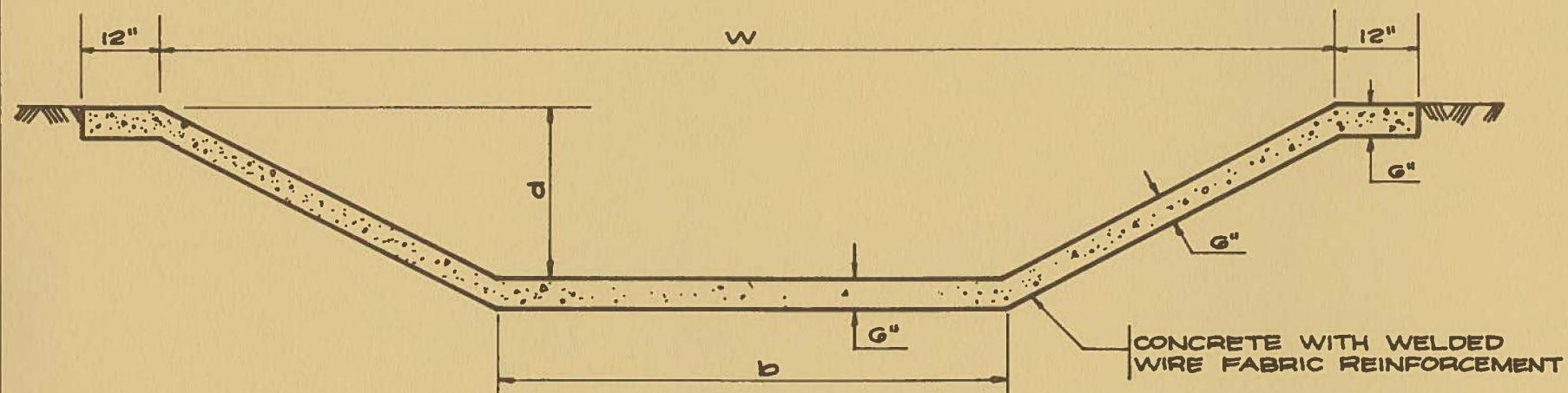
For the purposes of this report a trapezoidal channel section was used, however in the detail planning and preparation of final drawings other sections may be used as dictated by factors beyond our immediate control. Erosion control, velocity dissipators, debris guards, etc. are not included in this report.

The following explanation is in order. The designation "Box: 3x2" means the section is of the rectangular variety with a concrete cover, having inside dimension of 3 feet wide and 2 feet high. The designation "Trap: 3x2" indicates a trapezoidal variety, having a bottom width (b) of 3 feet and a depth (d) of 2 feet. In all cases, trapezoidal channels have side slopes of 2 horizontal to 1 vertical. "RCP: 36" diameter" indicates a reinforced concrete pipe, having inside diameter of 36".

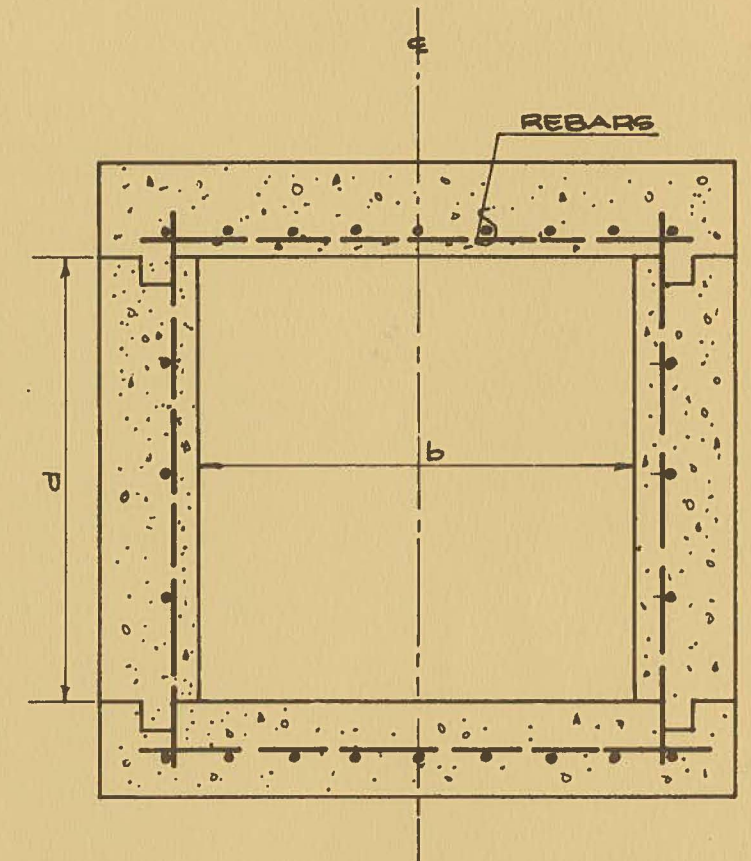
★ NOTE :
WHEREVER $W > 40'$, 20' ACCESS ROAD IS
REQUIRED ON EACH SIDE.



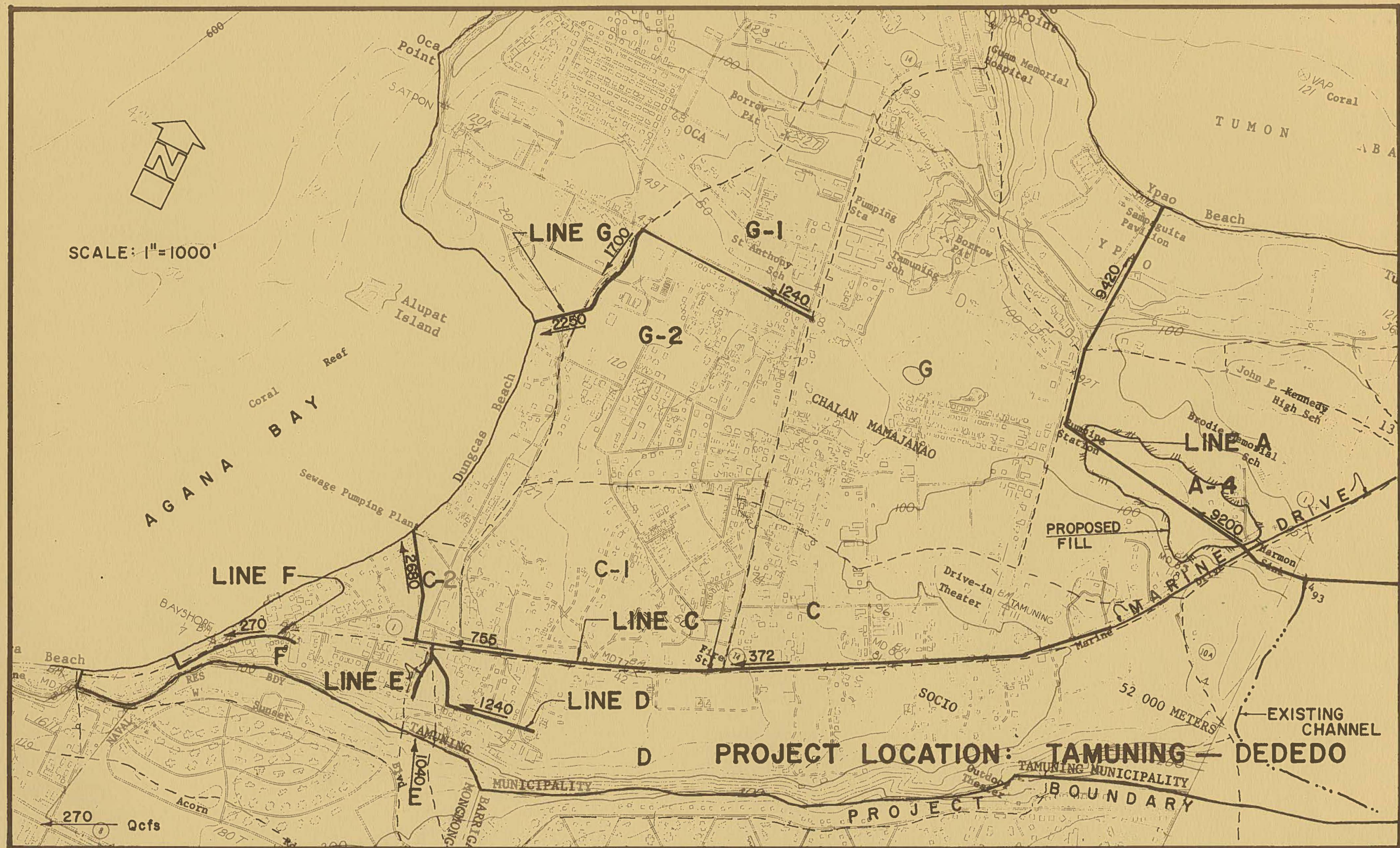
REAL ESTATE REQUIREMENT

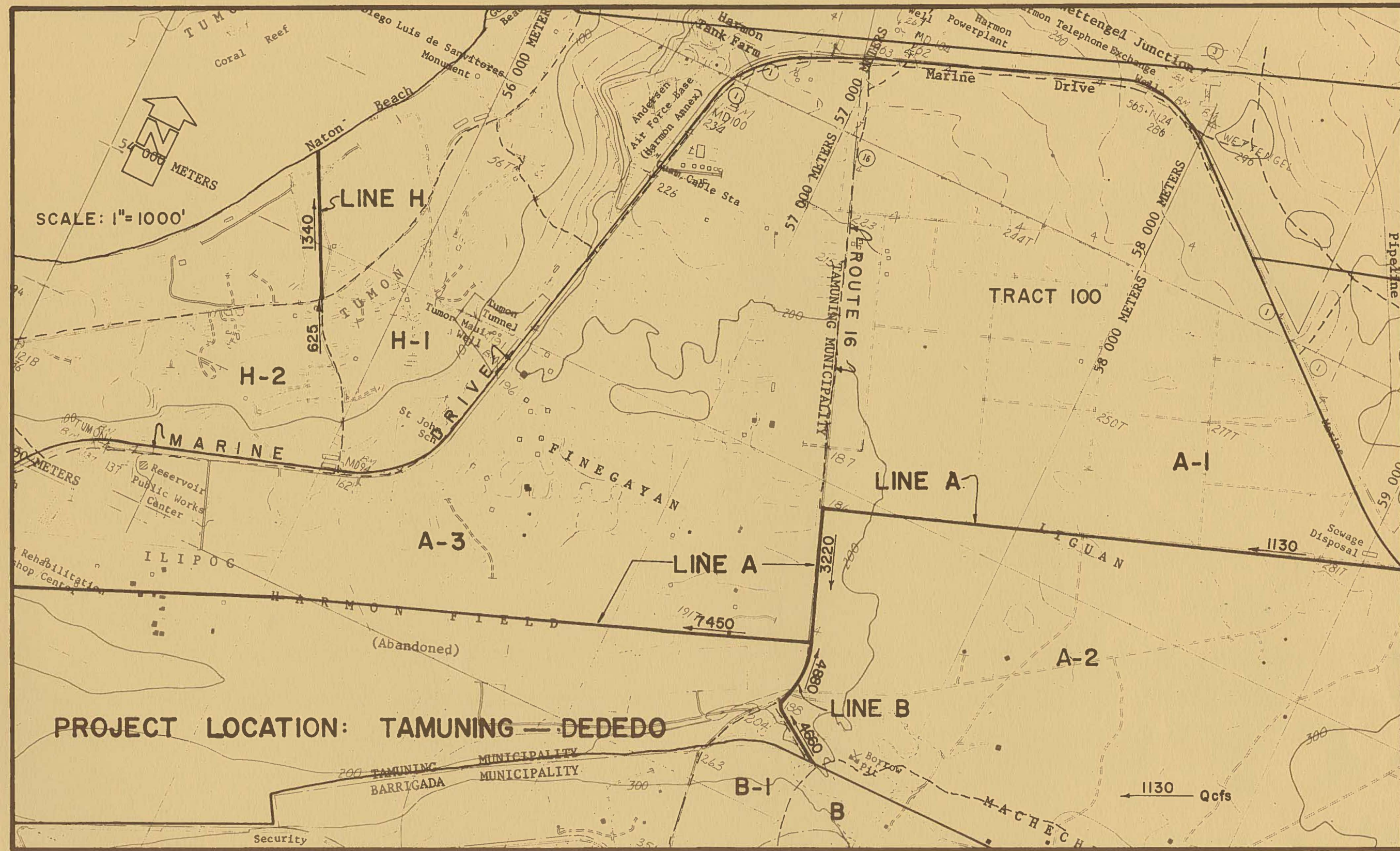


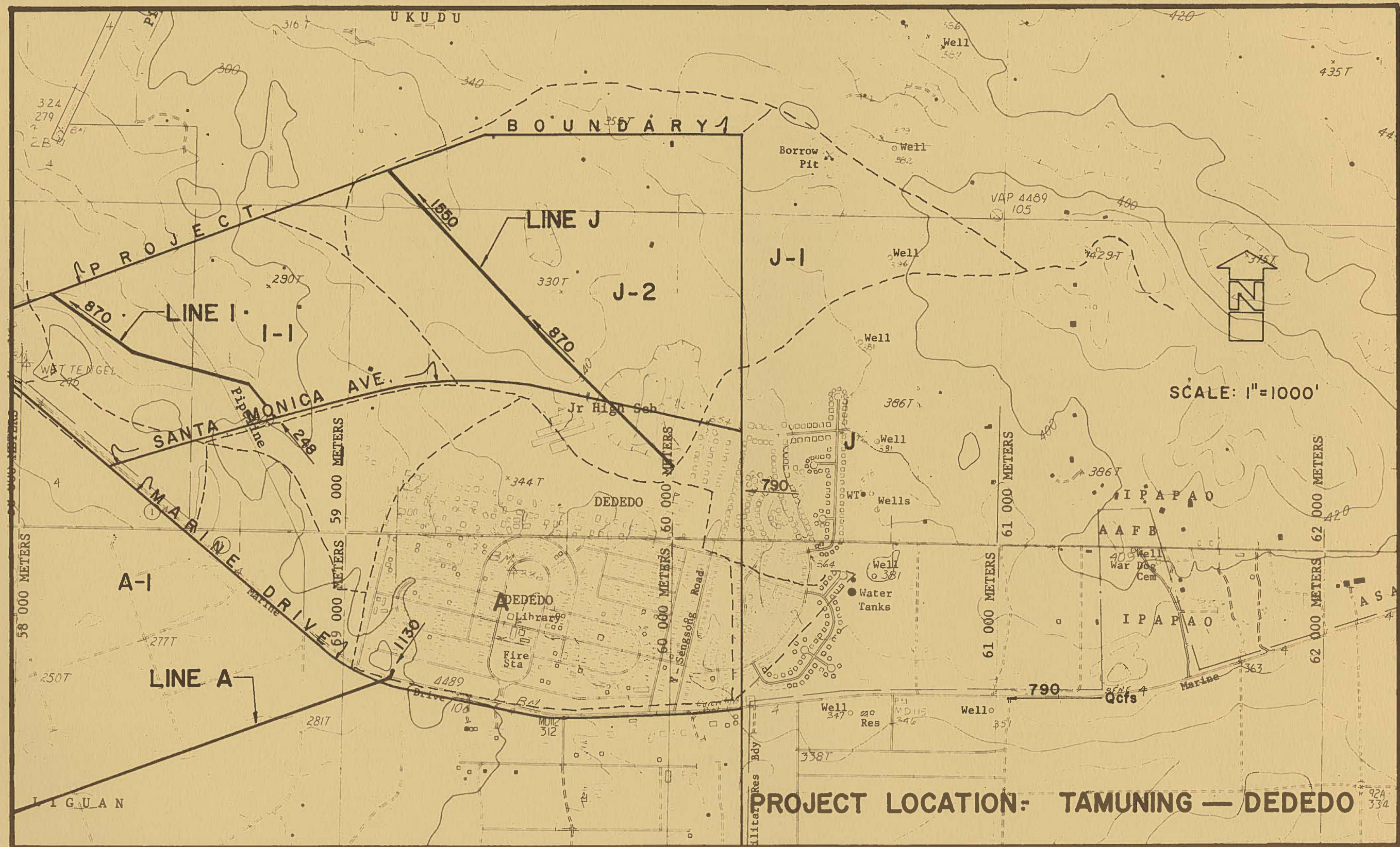
TYPICAL TRAPEZOIDAL CHANNEL SECTION

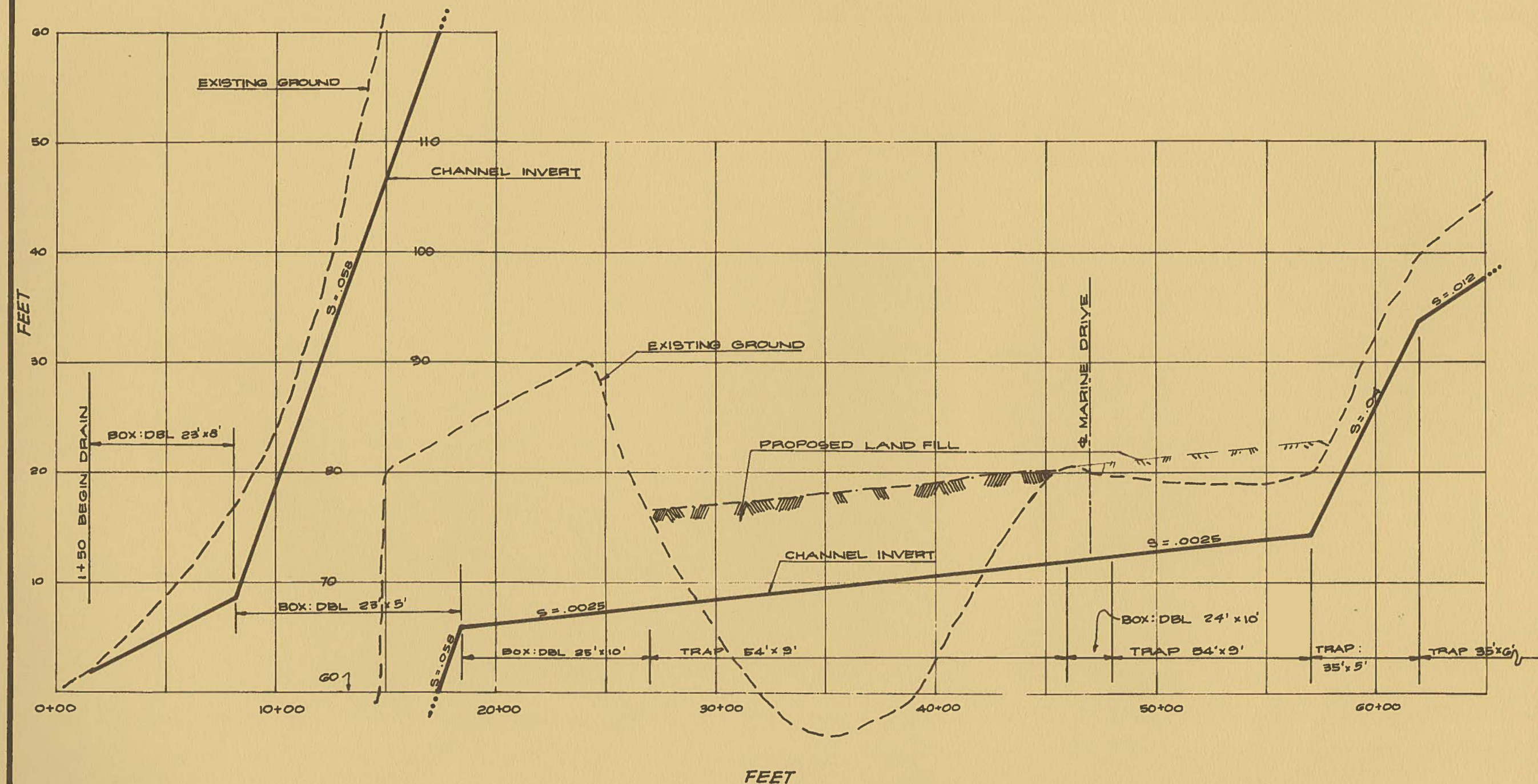


TYPICAL BOX SECTION



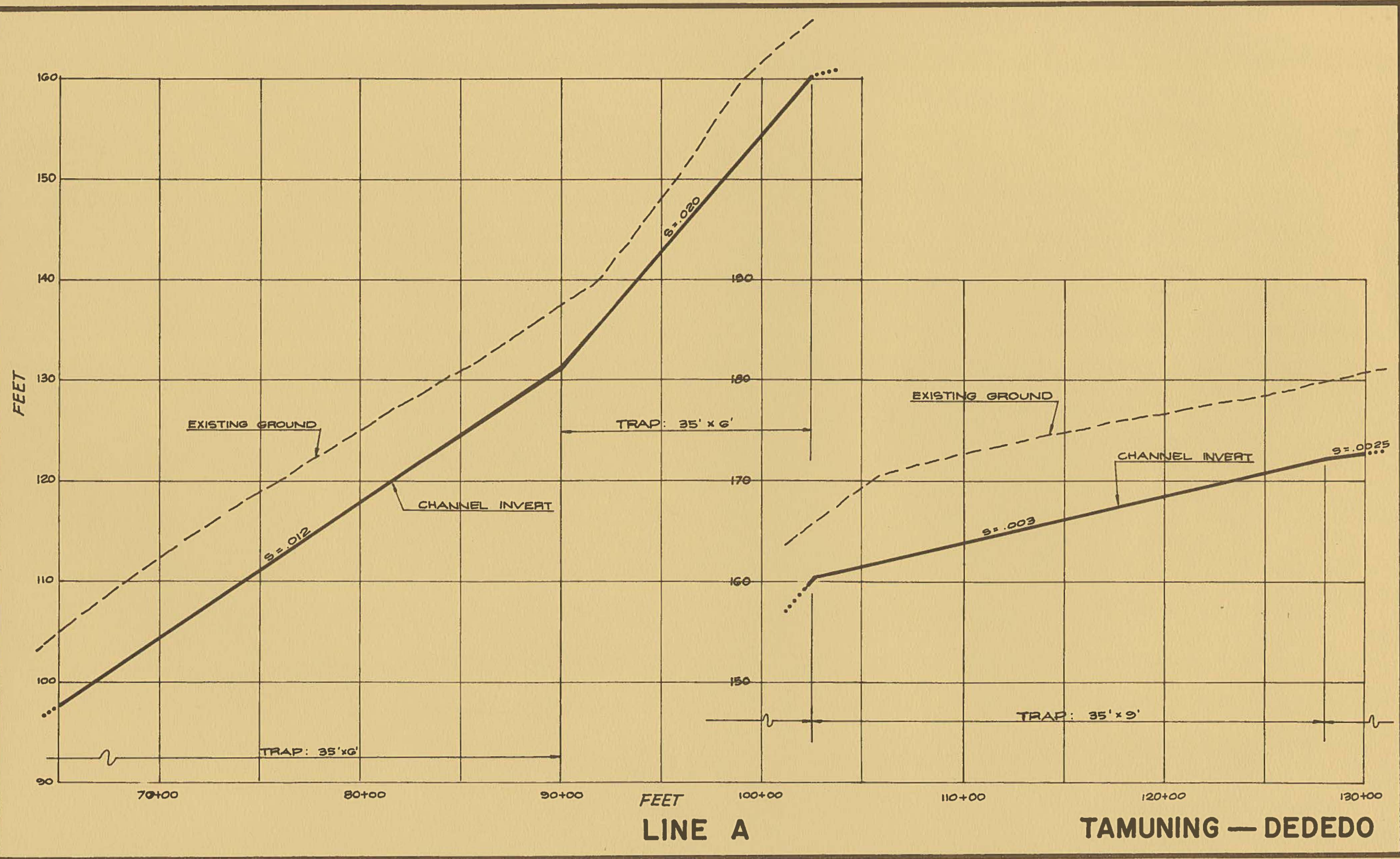


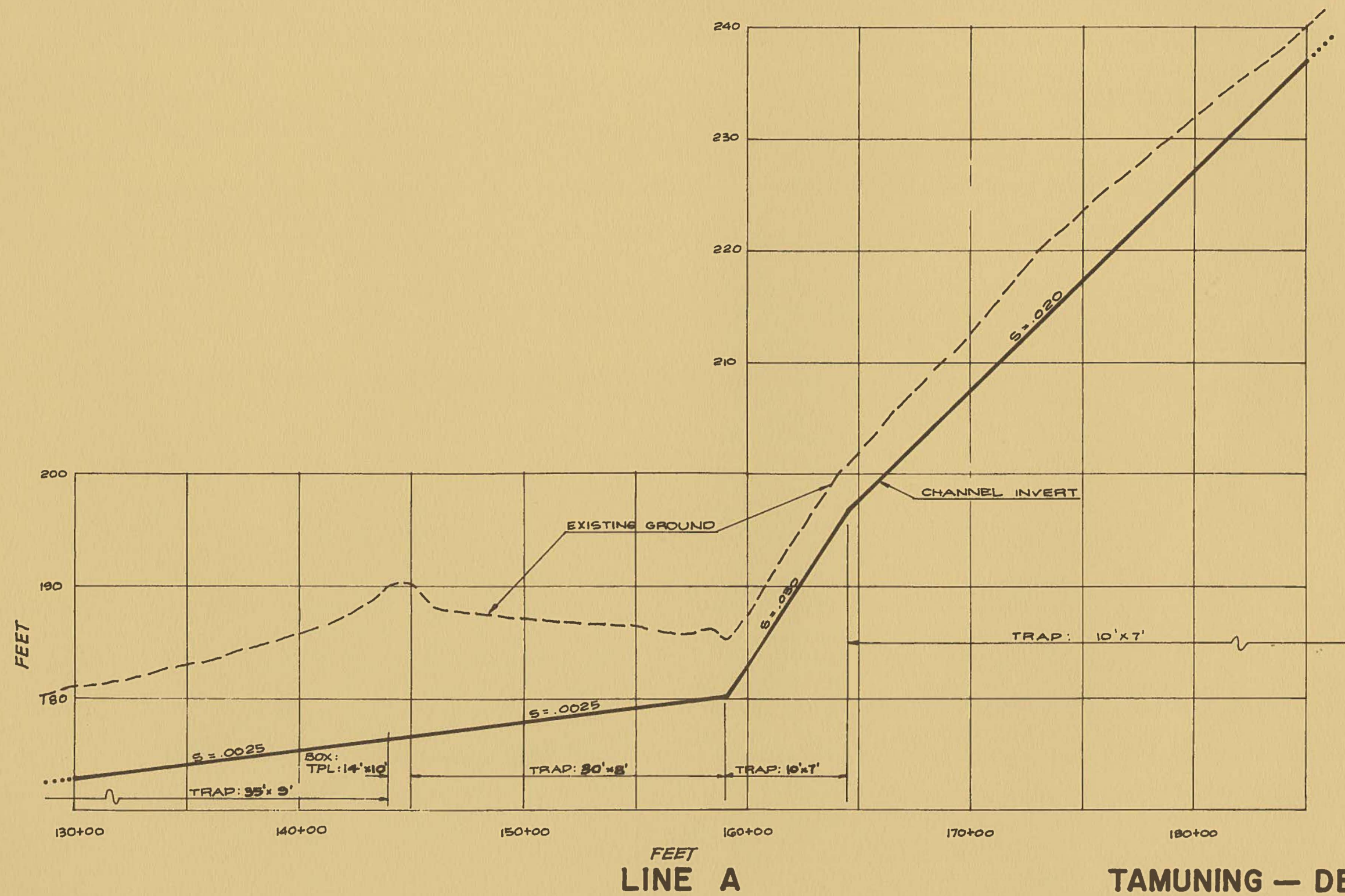


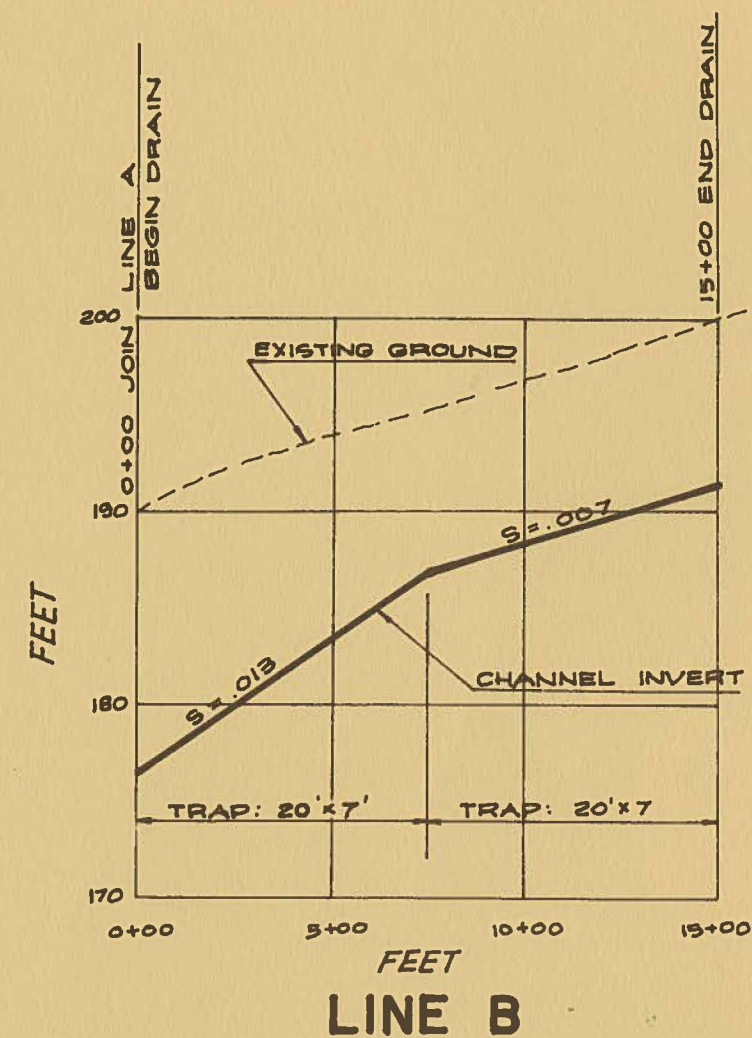
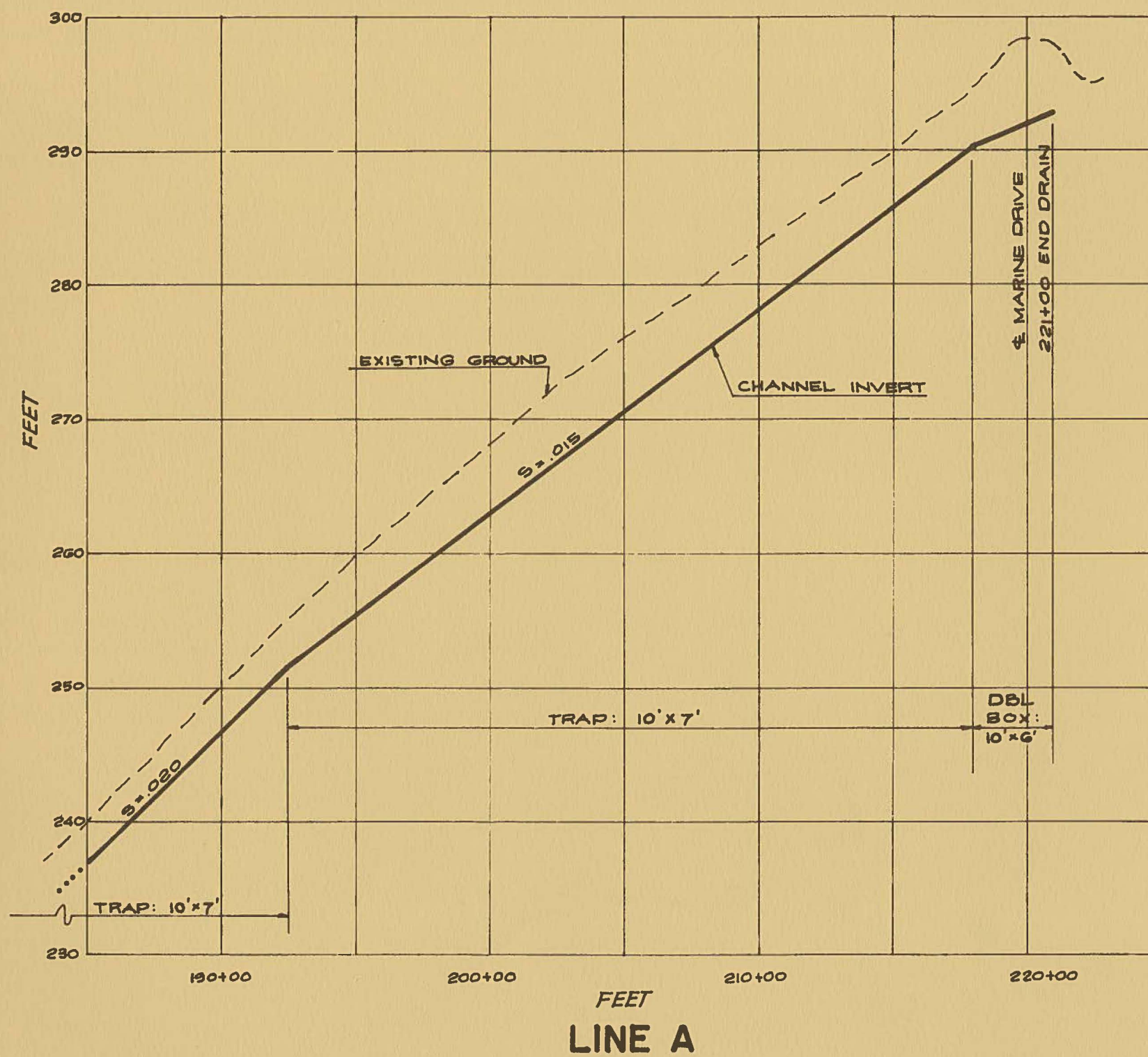


LINE A

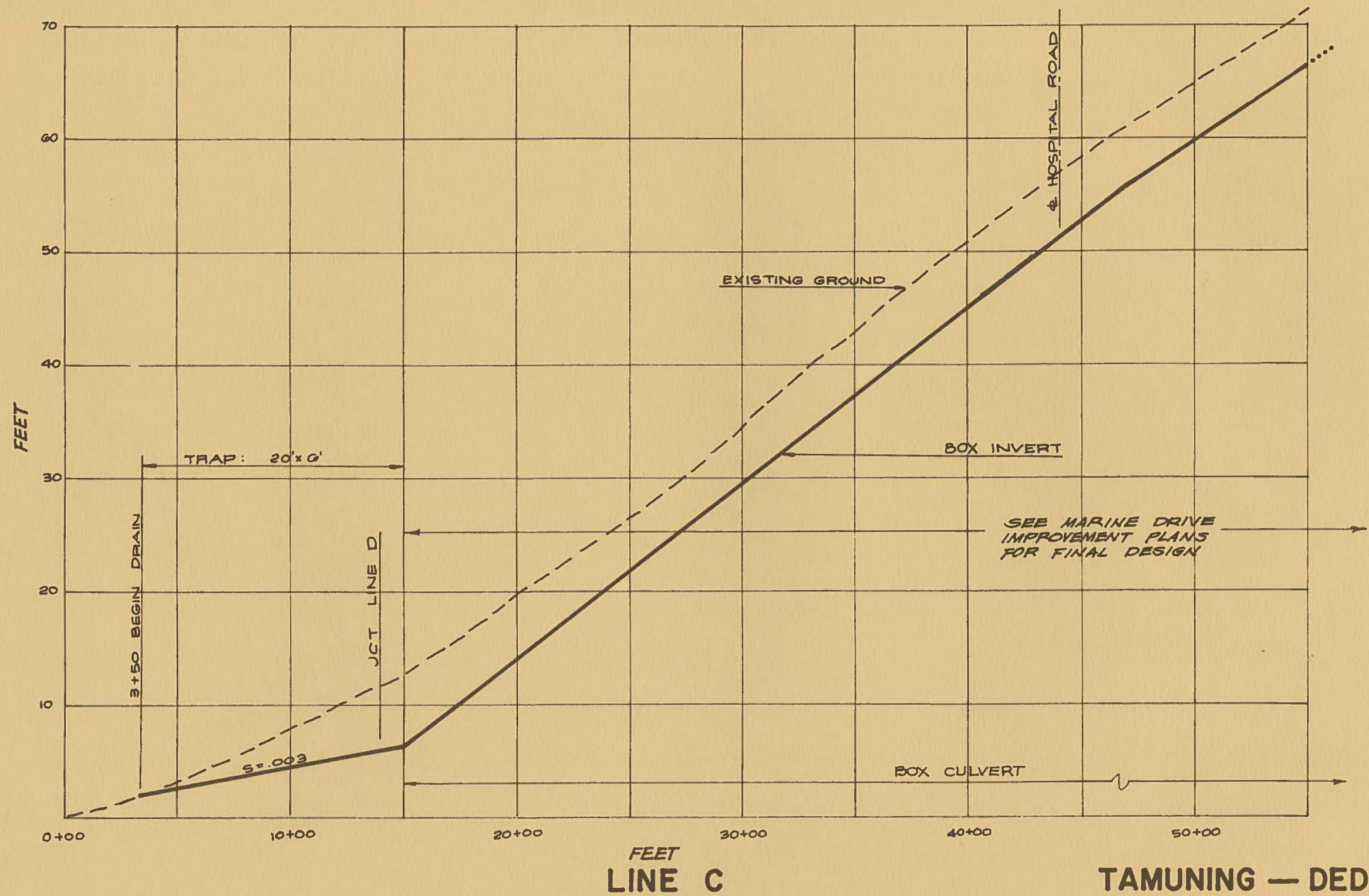
TAMUNING — DEDEDO

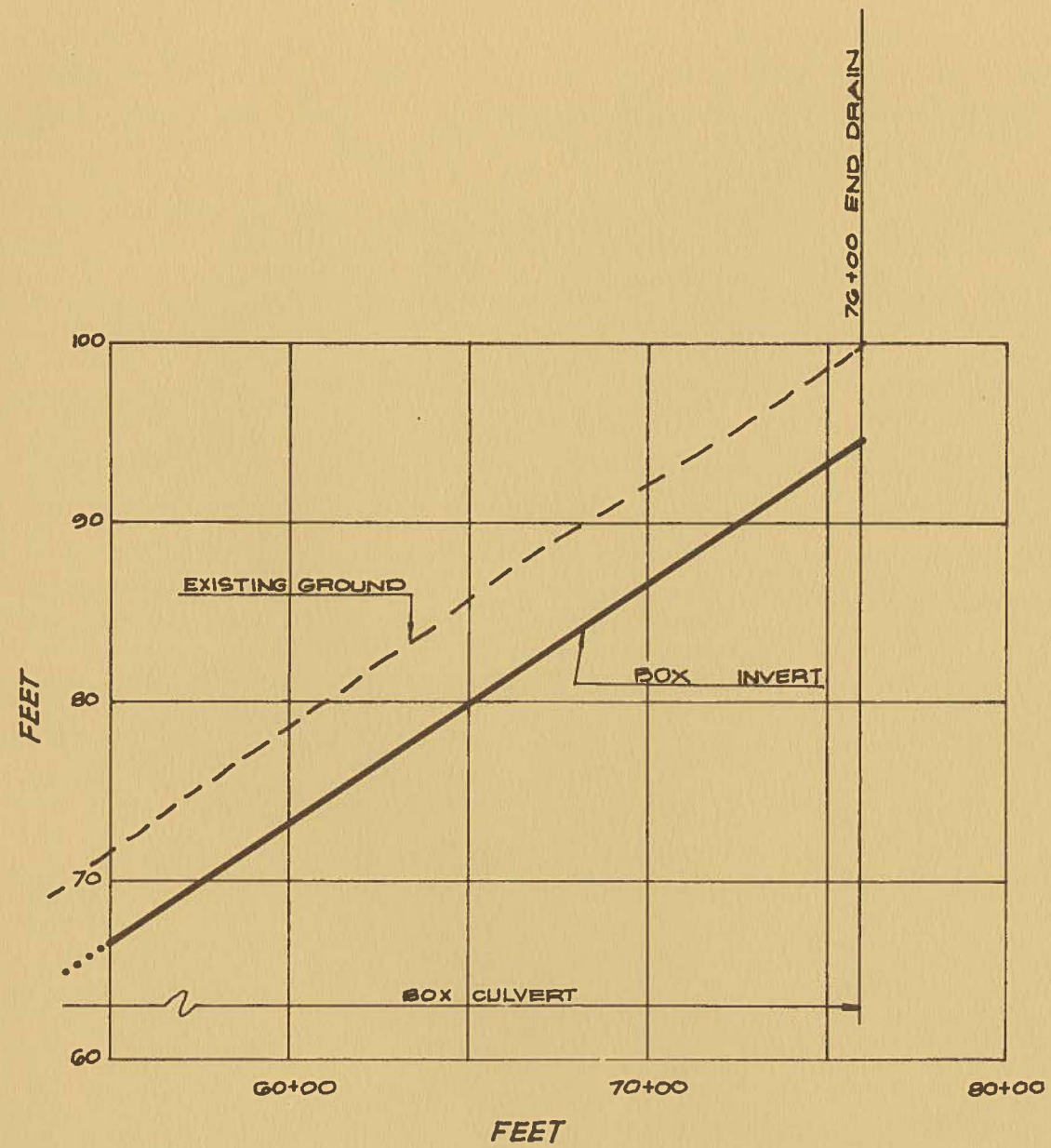




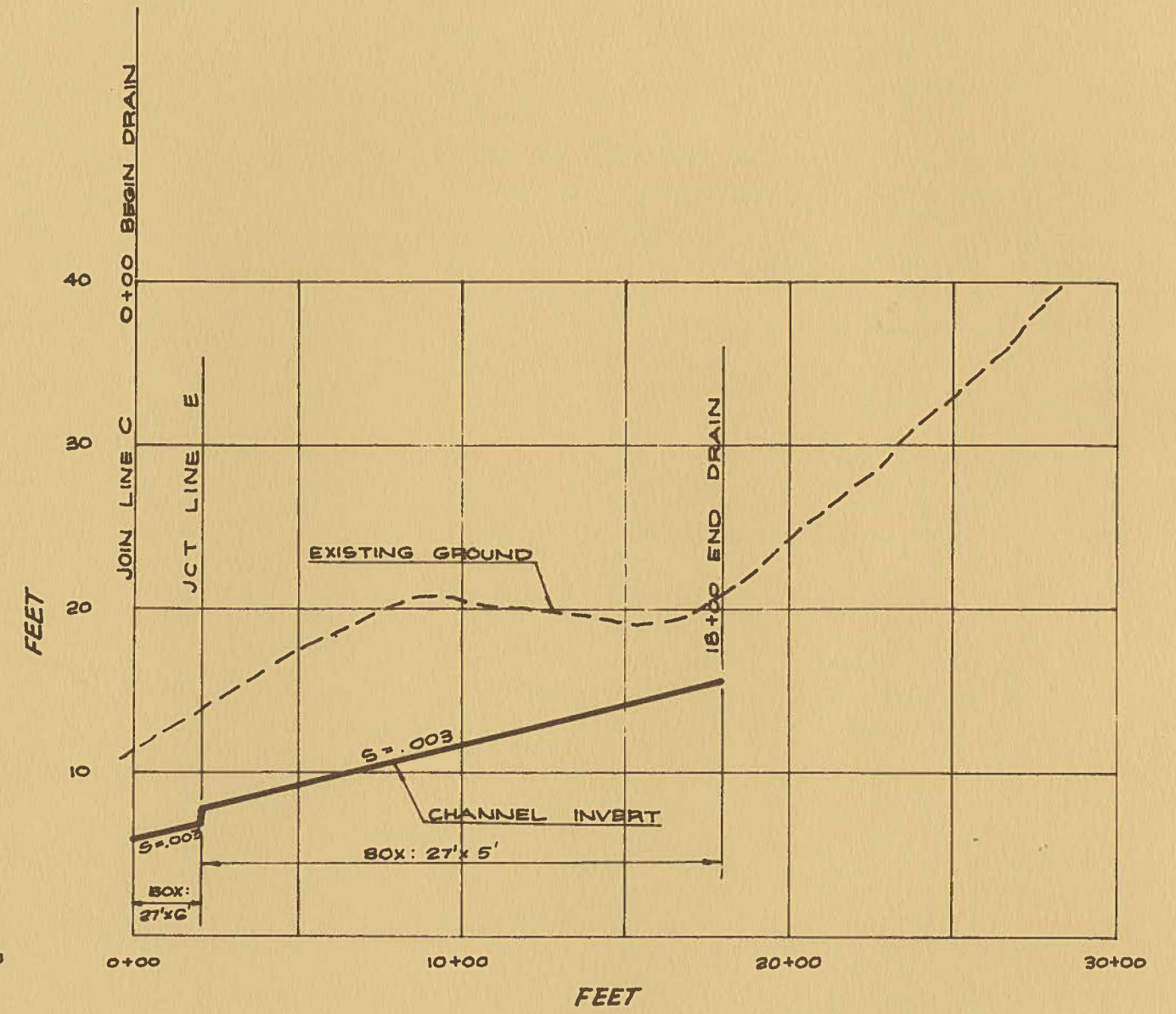


TAMUNING — DEDEDO



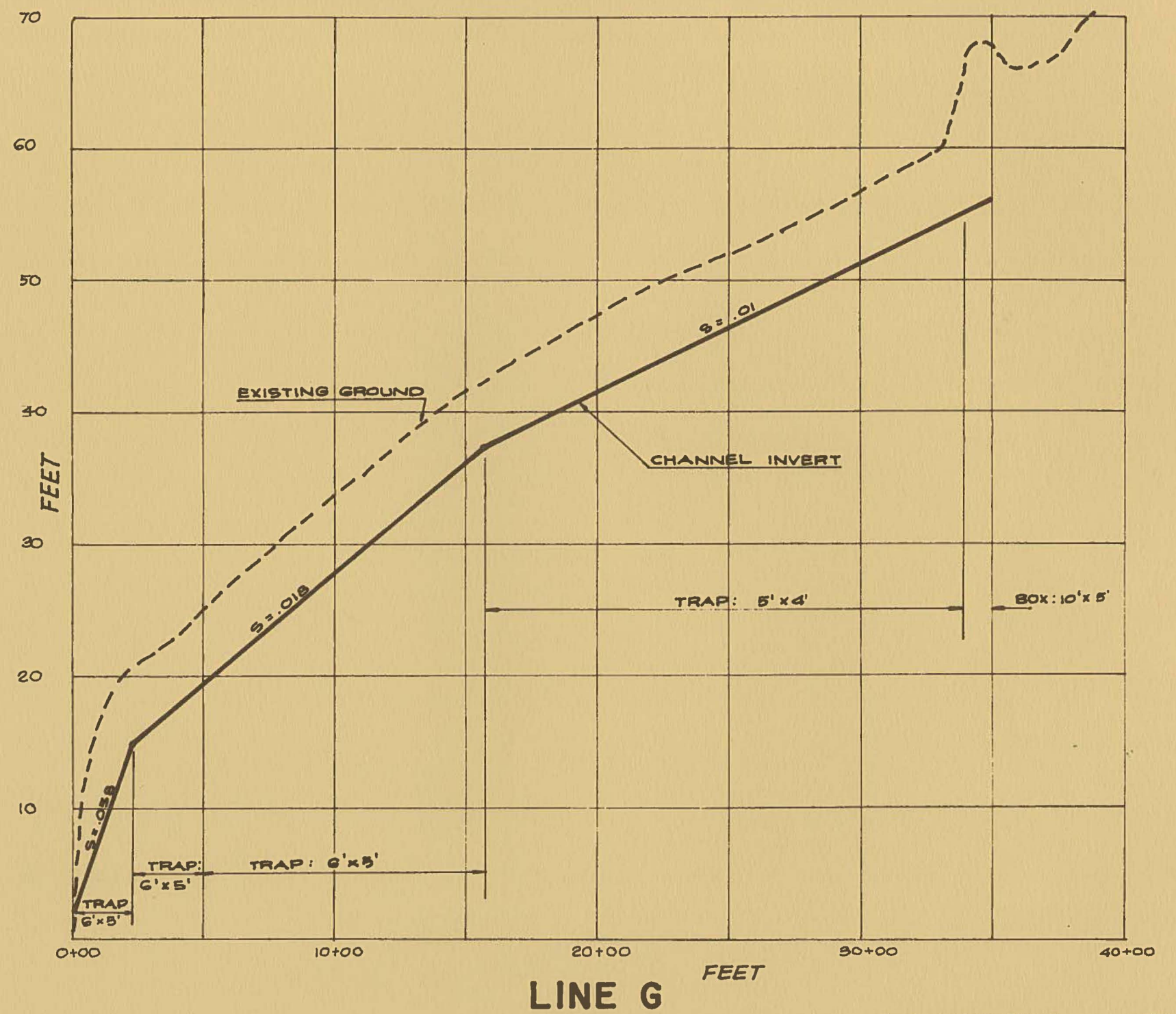
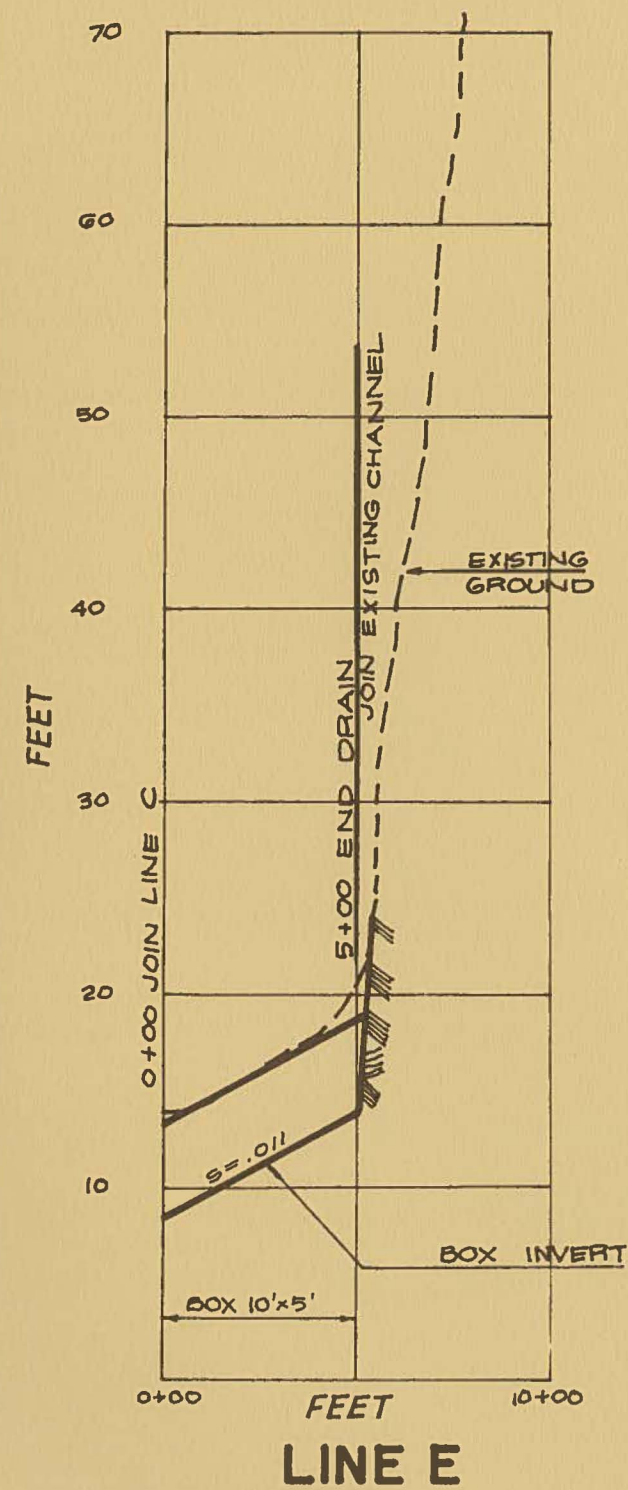


LINE C

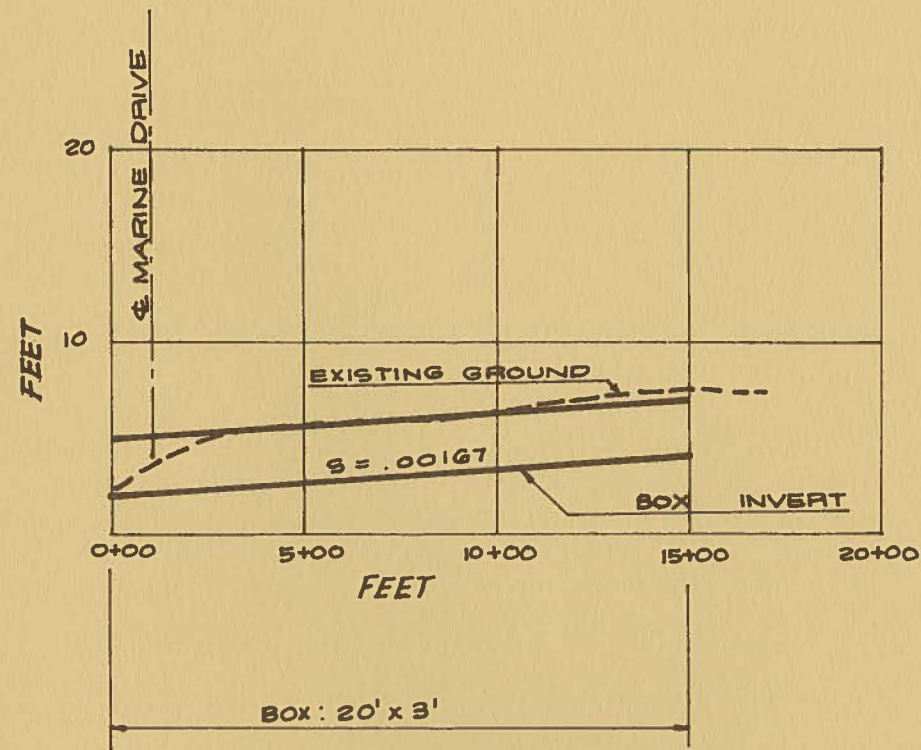


LINE D

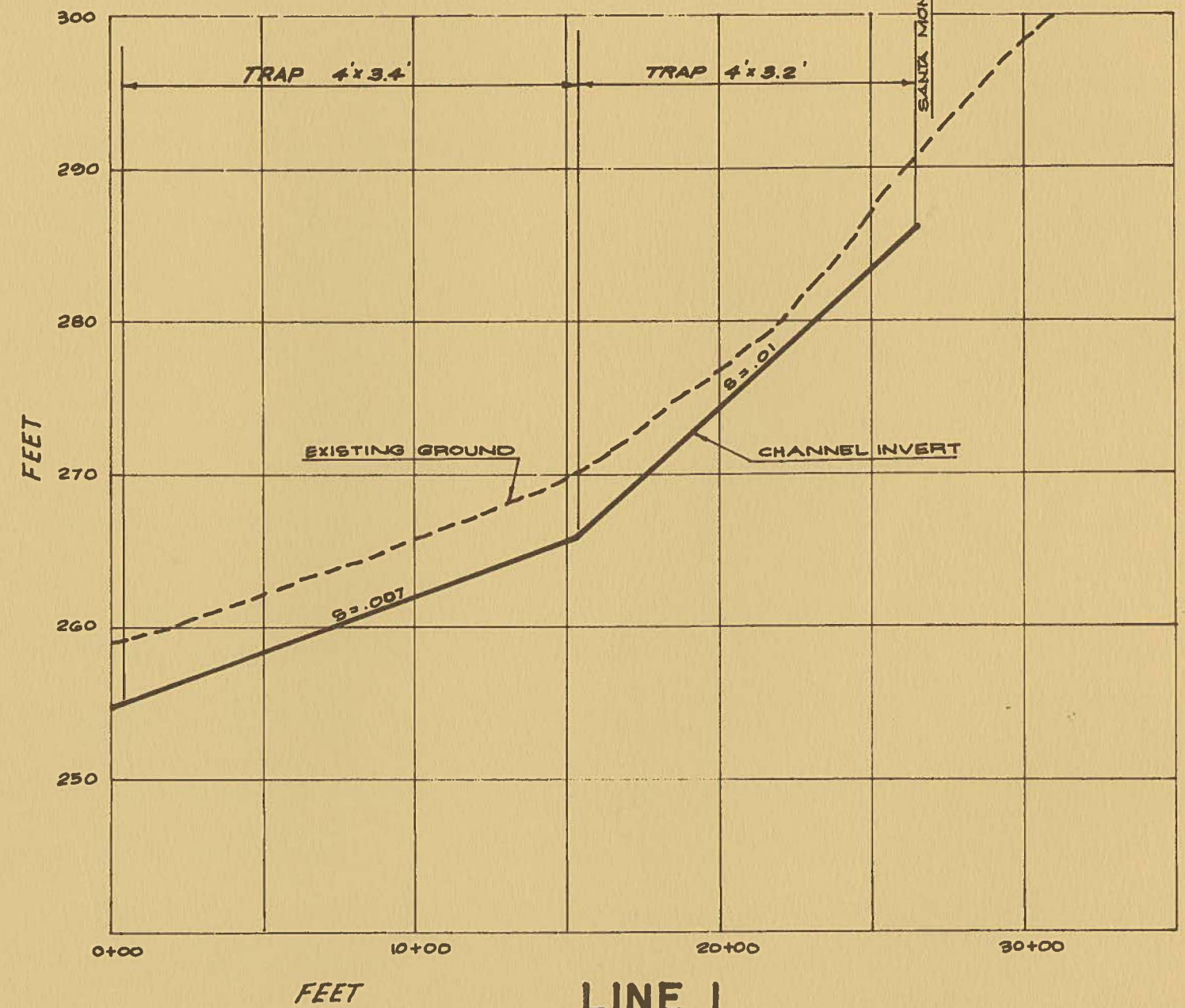
TAMUNING — DEDEDO



TAMUNING — DEDEDO

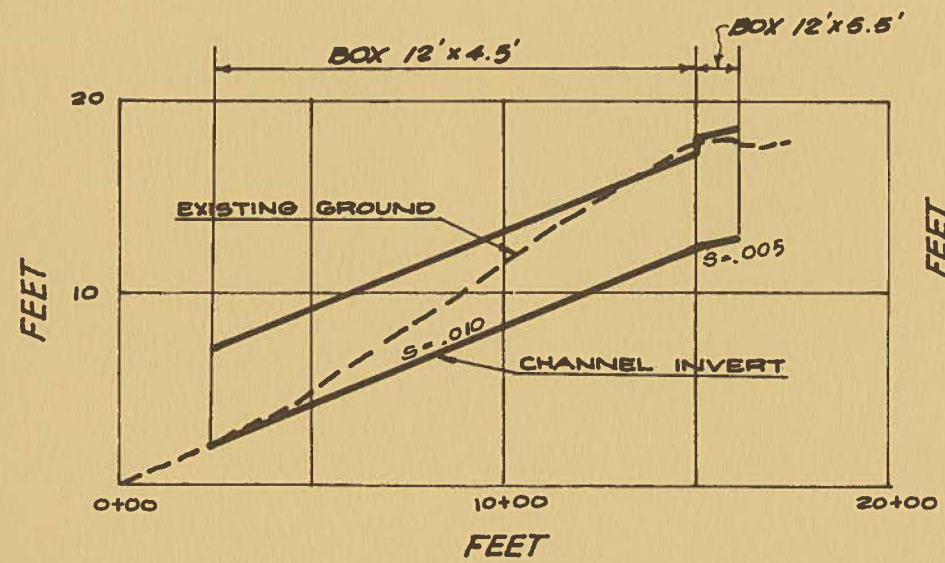


LINE F

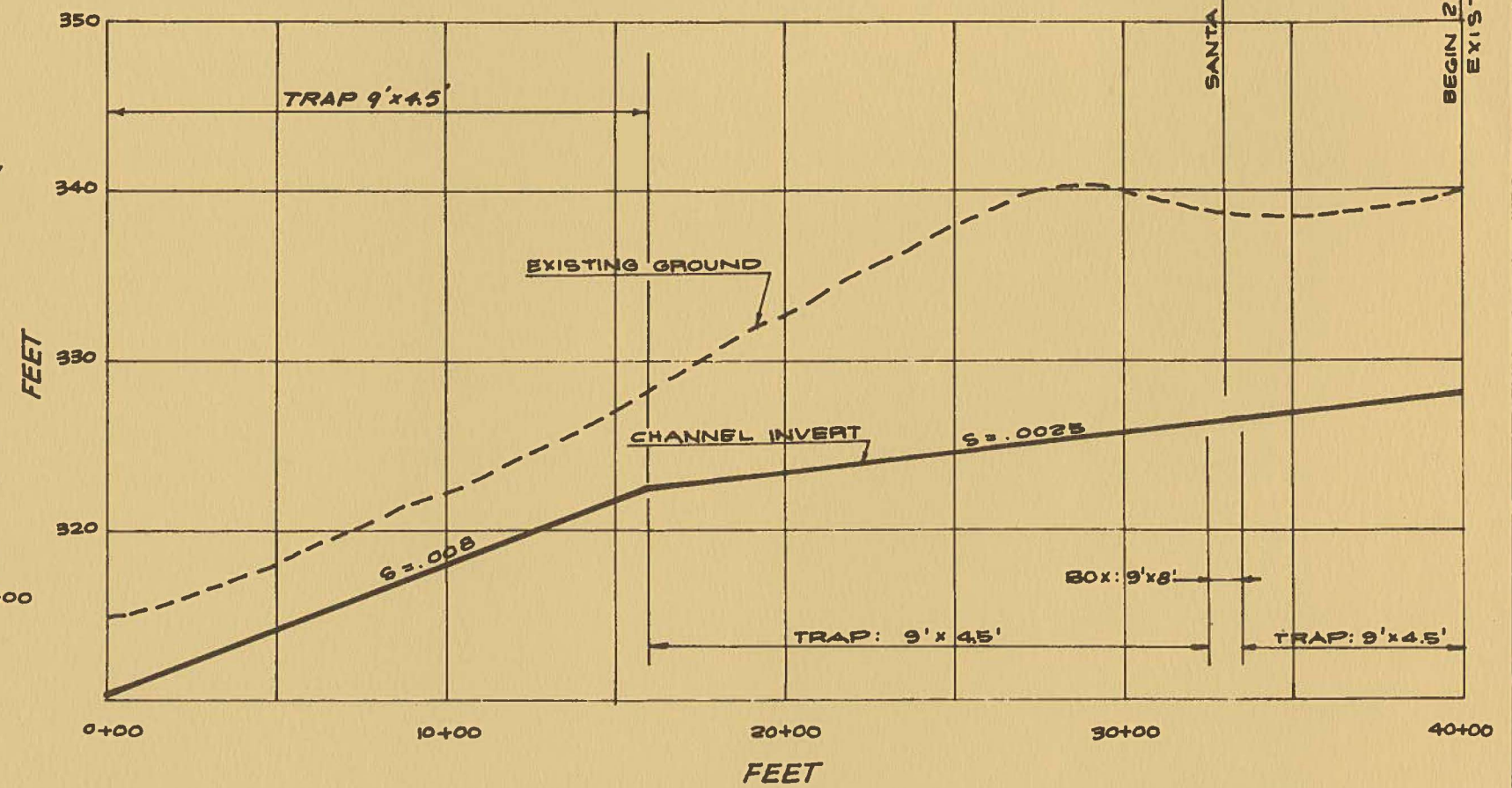


LINE I

TAMUNING — DEDEDO



LINE H



LINE J

TAMUNING — DEDEDO

DRAINAGE TABULATION

TAMUNING - DEDEDO

LINE No.	DRAINAGE AREA			C	CA	ΣCA	I	Q I ΣCA (CFS)	SLOPE S (FT/FT)	n	Qn	TYPE SIZE	L (FT)	V (FT)	t _c (MIN.)	REMARKS
	NUMBER	ACRES	TOTAL ACRES													
A	A	202	-	.75	151	-	7.5	1130							23.0	Across Marine Dr.
									.010	.013	15	DBL.Box 10x6	300	9	4.8	
									.015	.013	15	Trap 10 x 7	2600	9	4.6	
									.020	.013	15	Trap 10 x 7	2800	10	.8	
									.030	.013	15	Trap 10 x 7	550	12	33.5	
	A-1	460	662	.75	345	496	6.5	3220							47.0	Vertical Walls
									.0025	.013	42	Trap 30 x 8	100	10		
	A-2	550	1212	.70	385	881	6.4	5650								
	B, B-1	6730	7940	.50	1680	2561	2.9	7450 *							240.0	Across Route 16
									.0025	.013	97	TPL Box 14x10	250	15	1.9	
									.0025	.013	97	Trap 35 x 9	1800	16	2.4	
									.0030	.013	97	Trap 35 x 9	2500	17	.6	
									.0200	.013	97	Trap 35 x 6	1250	30	2.0	
									.012	.013	97	Trap 35 x 6	2800	25	.2	
									.040	.013	97	Trap 35 x 5	500	40	247.4	
															1.1	
B	A-3	960	9460	.75	720	3281	2.8	9200	.0025	.013	120	Trap 54 x 9	900	14	.5	Across Marine Dr.
									.0025	.013	120	DBL.Box 24x10	200	9	2.3	
	A-4	150	9610	.55	83	3364	2.8	9420	.0025	.013	120	Trap 54 x 9	1900	14	251.3	
									.0025	.013	122	DBL.Box 25x10	850	-		
									.055	.013	122	DBL.Box 23 x5	1050	-		
									.010	.013	122	DBL.Box 23 x8	700	-		Discharge @ Tumon Bay
	B	6450	-	.50	1610	-	2.9	4660							240	
									.007	.013	60	Trap 20 x 7	750	12	241	*Use R=.50 in view
									.013	.013	63	Trap 20 x 7	750	14		of local depres-
																sions and storage
																areas available

DRAINAGE TABULATION

TAMUNING — DEDEDO

LINE No.	DRAINAGE AREA			C	CA	ΣCA	I	Q I ΣCA (CFS)	SLOPE S (FT/FT)	n	Qn	TYPE SIZE	L (FT)	V (FT)	t _c (MIN.)	REMARKS
	NUMBER	ACRES	TOTAL ACRES													
C	C	100	100	.60	60	-	6.2	372							15	Hosp.Rd.@MarineDr.
	C-1	100	200	.60	60	120	6.3	755							18,40	(See Marine Dr.
	D	286	486	.60	172	292	6.2	1810							37	Improvement Plans
	E	246	732	.55	135	427	6.2	2650							41	for Design)
	C-2	10	742	.60	6	433	6.2	2680	.003	.013	35	Trp. 20 x 6	1300	18		
D	D	286	-	.70	200	-	6.2	1240							40	
	E	246	532	.70	172	372	6.0	2230	.003	.013	16	Box 27 x 5	1600	9.8	43	
									.003	.013	29	Box 27 x 6	200			
E	E	246	-	.65	160	-	6.5	1040							37	
									.011	.013	13	Box 10 x 5	500			
F	F	57	-	.65	37	-	7.3	270							15	
									.00167	.013	4	Box 20 x 3	1500			
G	G	230	-	.70	161	-	7.7	1240							20	
									.01	.013	16	Box 10 x 5	100	17	2	
									.01	.013	16	Trap 6 x 4	1800	23		
	G-1	95	326	.70	66	227	7.5	1700							22	
	G-2	108	434	.70	76	303	7.4	2250							23	
									.018	.013	22	Trap 6 x 5	1100	23		
H									.018	.013	29	Trap 6 x 5	250	20		
									.058	.013	29	Trap 6 x 5	250	20		
	H	115		.70	80		7.8	625							20	
	H-1	132	247	.70	92	172	7.8	1340	.005	.013	8	Box 12 x 4.5	100	12	20	
									.010	.013	17	Box 12 x 5.5	1250	18		

DRAINAGE TABULATION

TAMUNING—DEDEDO

[illegible]

COST ESTIMATE
TAMUNING - DEDEDO

Line A

Fence	198,500
Real Estate	160,820
Concrete	2,517,750
Excavation	<u>544,700</u>

Total for Line A	\$3,421,770
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Line B

Fence	15,000
Real Estate	13,000
Concrete	75,960
Excavation	<u>32,230</u>

Total for Line B	\$ 136,190
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Line C

Fence	11,500
Real Estate	19,270
Concrete	328,310
Excavation	<u>32,000</u>

Total for Line C	\$ 391,080
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Line D

Fence	-
Real Estate	4,860
Concrete	198,600
Excavation	<u>18,660</u>

Total for Line D	\$ 222,120
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Line E

Fence	-
Real Estate (Easement)	2,000
Concrete	36,750
Excavation	<u>1,850</u>

Total for Line E	\$ 40,600
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Line F

Fence	-
Real Estate (Easement)	3,000
Concrete	112,500
Excavation	<u>8,330</u>

Total for Line F	\$ 123,830
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Line G

Fence	35,000
Real Estate	7,500
Concrete	136,800
Excavation	<u>30,400</u>

Total for Line G	\$ 209,700
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Line H

Fence	-
Real Estate	1,620
Concrete	130,650
Excavation	<u>8,150</u>

Total for Line H	\$ 140,420
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COST ESTIMATE

TAMUNING - DEDEDO

Line I

Fence	26,000
Real Estate	9,620
Concrete	72,150
Excavation	<u>8,420</u>

Total for Line I	\$ 116,190
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Line J

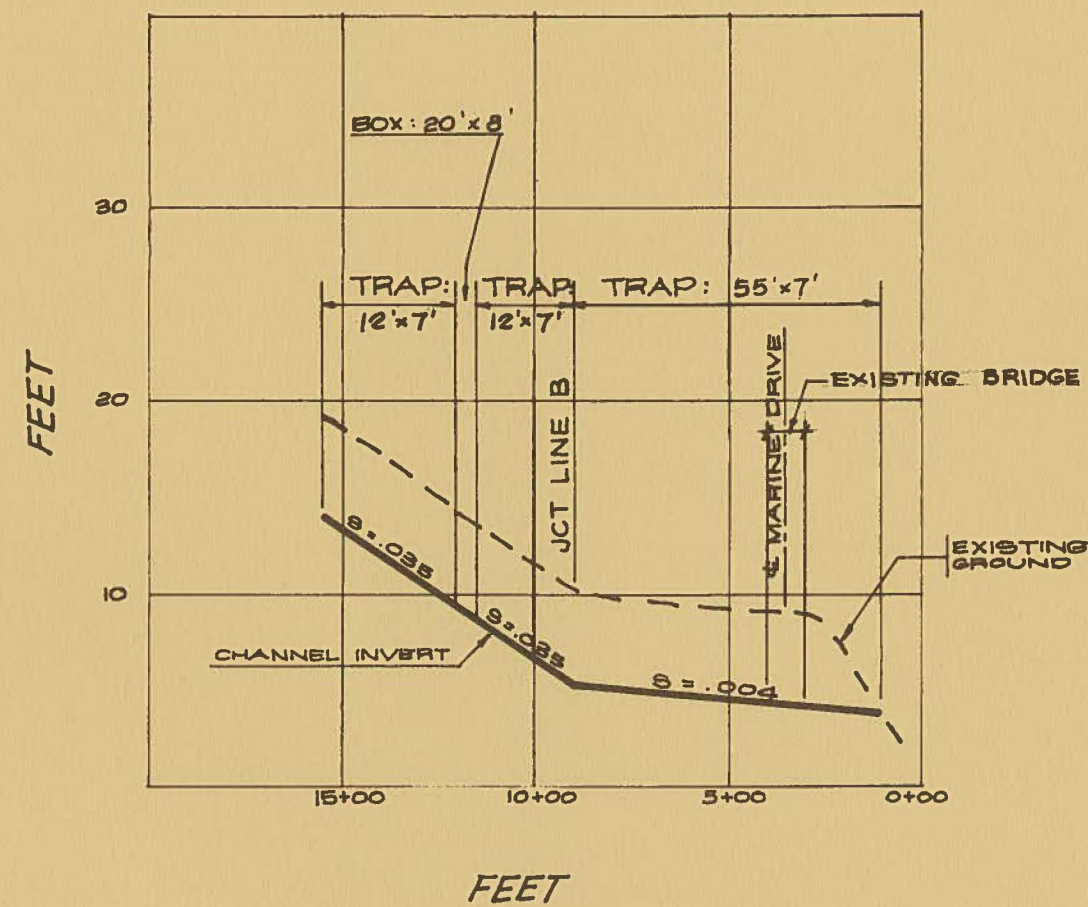
Fence	40,000
Real Estate	18,800
Concrete	172,050
Excavation	30,000

Total for Line J	\$ 260,850
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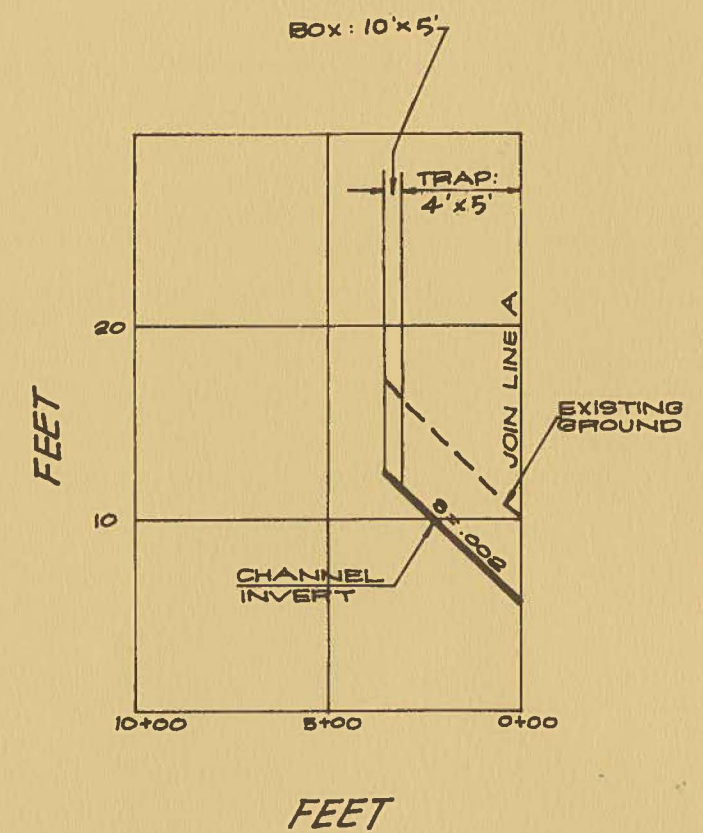
Sub-Total	5, 062, 750
10% Contingencies	<u>506, 270</u>

Construction Costs	5, 569, 020
10% Engineering & Inspection	<u>556, 900</u>

Total	\$6, 125, 920
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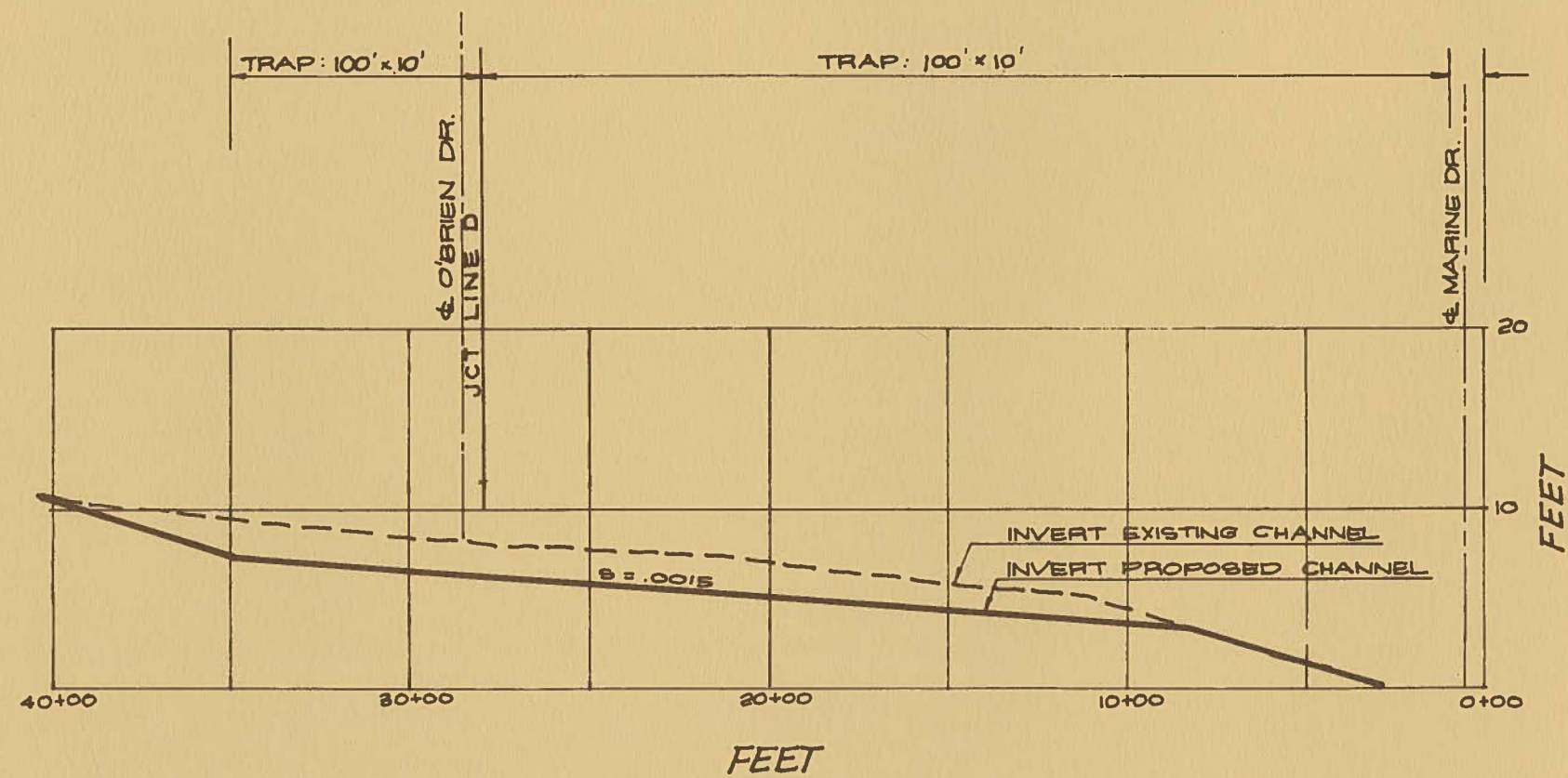


LINE A



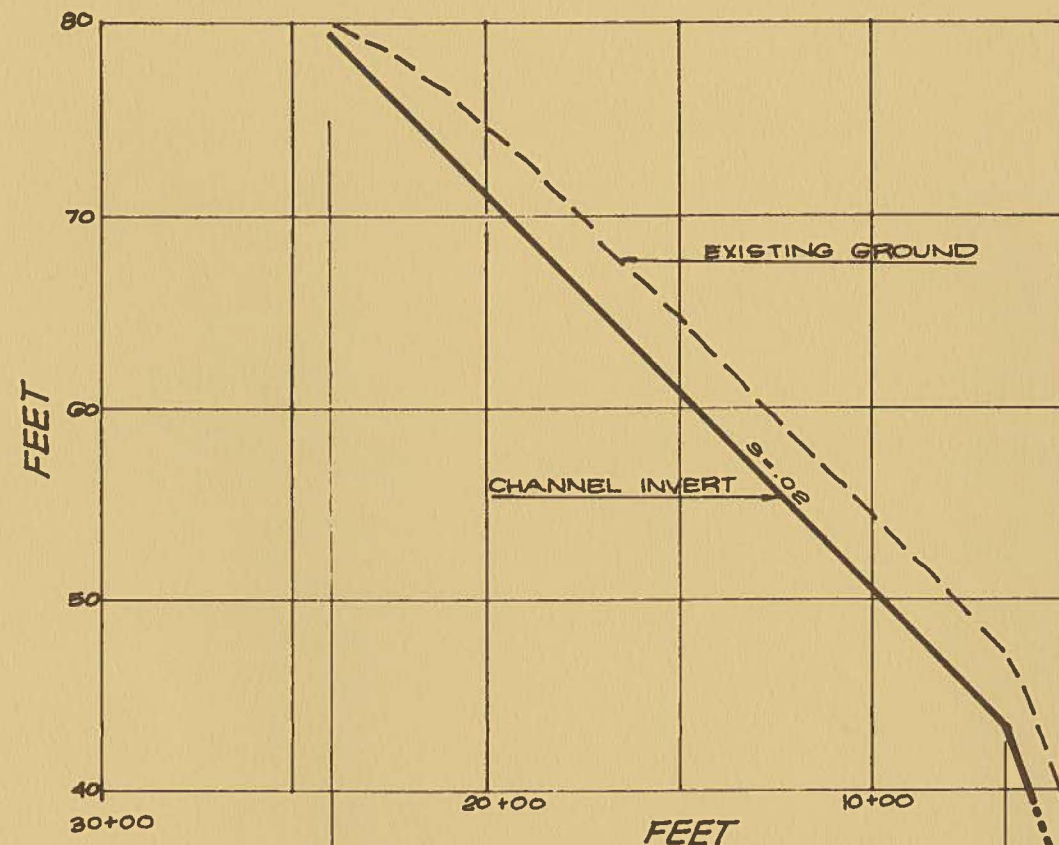
LINE B

AGANA



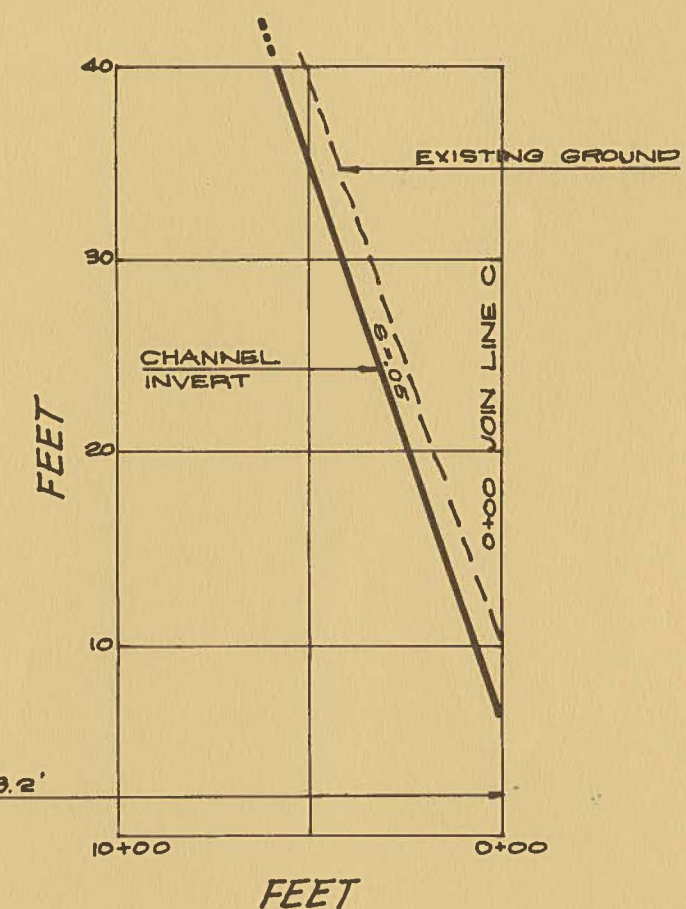
LINE C

AGANA



TRAP 5'x3.5'

TRAP 5'x3.2'



LINE D

AGANA

DRAINAGE TABULATION

AGANA

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