Technical Analysis of the Deepening of the Atlantic Entrance to Drafts of 41.5', 46', and 50'

Autoridad del Canal de Panamá

Dredging Division

Canal Capacity Projects Division

March 2003

TABLE OF CONTENTS

TECHNICAL ANALYSIS
DEEPENING OF THE ATLANTIC ENTRANCE TO DRAFTS OF 41.5', 46', AND 50'

GENERAL DESCRIPTION OF THE STUDY

Among major components of the Panama Canal Expansion Study are the deepening and widening of the Canal navigational channels, which include the Atlantic and Pacific entrances, Gatun Lake and Gaillard Cut. The deepening of Canal navigational channels will allow the navigation of ships larger than the current Panamax size through the waterway.

This study covers the technical analysis for deepening the Atlantic Entrance navigation channel under three options as shown in the following table:

THREE SCENARIOS PROPOSED FOR ATLANTIC ENTRANCE DEEPENING

Draft	New Design Channel Bottom (PLD)	Water Depth (MLWS)
41.5'	-46.88'	-46.5'
46'	-51.38'	-51'
50'	-55.38'	-55'

Actual navigation channel bottom elevation: -44.9' PLD

Table 1. Atlantic Entrance Deepening Scenarios

The deepening to a draft of 41.5' consists of dredging the Atlantic Entrance navigational channels from station -2K+700, that is 1.7 km north of the Atlantic Entrance breakwater, to the north end of Gatun Locks. Refer to Appendix No. 1 for a sketch of the Panama Canal Atlantic Entrance. On the other hand, the dredging for the deepening to drafts of 46' and 50' begins also at station – 2K+700 but ends at station 9K+000, near the old third set of locks excavation of 1939.

The deepening for a draft of 41.5' is intended for the existing Canal, provided that either the sills in some of the Canal lock chambers are lowered or the minimum operation water level in Miraflores Lake is raised to obtain at least 2 feet of under-keel clearance (UKC), required to accommodate ships with a draft of 41.5 ft. If the Miraflores Lake minimum operation water level is not increased, the sills at the south end of Pedro Miguel locks and the north end of Gatun locks should

be lowered to ensure the 2 feet under-keel clearance (UKC) for ships with 41.5 ft of draft. At present the sills in Canal locks chambers provide a minimum of 2 feet UKC for Panamax ships with a 39.5' draft; therefore, to allow ships with an increased draft of 41.5', the locks chamber sills must be cut lower to restore the minimum UKC. The ACP is studying this possibility of increasing the Miraflores Lake minimum operation water level or modifying the above-mentioned lock chamber sills to allow the navigation of 41.5' draft Panamax ships. So far, no decision has been made on this matter. Refer to Appendix No. 2, which shows the sill elevations for Panama Canal locks.

Separate from the deepening for a draft of 41.5', deepening for drafts of 46' and 50' falls under the Panama Canal Expansion Study. If the new locks are built, the Canal navigational channels will require dredging to allow the safe navigation of deeper-draft Post-Panamax vessels.

ATLANTIC ENTRANCE TIDAL VARIATIONS

a. Unlike the Pacific Entrance large tidal range, the Atlantic Entrance has a small tidal range, as shown in the Panama Canal Clearance Diagram in Appendix No. 2. The extreme high-water tide is at +1.85 ft (0.56 m) PLD, and the extreme low-water tide is at –1.25 ft (-0.38 m), resulting in a 3.10 ft (0.94 m) of tidal variation.

b. The Panama Canal Clearance Diagram shows the locks chambers, lake, and tidal elevations referenced to precise level datum (PLD), which is a reference line used by ACP to measure all Canal elevations. This PLD is close to the Pacific and Atlantic mean sea level.

c. The reaches of ACP dredges and the drilling and blasting boat have enough capacity to perform the proposed Atlantic Entrance deepening at any tide level, as shown in the following table:

ACP DREDGES UNDERWATER REACH IN FEET FOR ATLANTIC ENTRANCE DEEPENING TO 50' DRAFT

All figures in feet

REACH	High Tide	Mean Sea Level	Mean Low Water
Required for 50' draft	**59.23**	**57.58**	**57**
Dipper dredge RMC	**60**	**60**	**60**
Cutter suction MINDI	**72**	**72**	**72**
MINDI spuds	**83**	**83**	**83**
D&B barge THOR	**75**	**75**	**75**
D&B barge THOR spuds	**58**	**58**	**58**
New D&B barge	**85**	**85**	**85**
New D&B barge spuds	**80**	**80**	**80**

Notes: ACP equipment complies with minimum requirement for proposed Atlantic entrance deepening.

Table 2. Underwater Reach for ACP Dredges

d. If the drill-boat is required to drill and blast a –44.9' PLD channel bottom at a high tide of 1.85' PLD, the spuds are required to anchor in 46.75 feet of water depth; therefore, the drill-boat THOR complies with this reach requirement because it has a maximum anchoring capacity of 58 feet under the water line. The previous table shows that 59.23 feet is required for a 50'-draft scenario; however, this figure reflects the condition when the channel bottom is at –55.38' PLD.

DREDGING VOLUMES

DREDGING PARAMETERS

a. The parameters used to estimate the dredging volumes in deepening the Atlantic Entrance for drafts of 41.5', 46', and 50', respectively, were the following:

ATLANTIC ENTRANCE DEEPENING PARAMETERS (all figures in feet)

Draft	Existing Design Channel Bottom (PLD)	Proposed New Design Channel Bottom (PLD)	Dredging Tolerance Elevation (PLD)
41.5'	-44.9	-46.88	-48.88
46'	-44.9	-51.38	-53.38
50'	-44.9	-55.38	-57.38

Notes:

1. All elevations are referred to Panama Canal Precise Level Datum (PLD), which is close to mean sea level.

Table 3. Atlantic Entrance Deepening Parameters

b. To obtain the new design channel bottom, the ACP dredges require a minimum of 2' of dredging tolerance as shown in the above table.

c. For the Atlantic entrance, the dredging volume includes an over-swing of about 25' outside of each navigational channel prism line and up to the dredging tolerance line. Under the 41.5' draft scenario, the over-swing of 25' is also applied, but from station 9K+900 to 10K+750 the over-swing is 10' due to the area instability and space restrictions. These over-swing parameters were advised by the master-in-charge of ACP cutter suction dredge, according to his experience in dredging the Atlantic entrance.

d. To estimate the dredging volume, it was assumed that the Atlantic entrance navigation channel width is already 650'. ACP is projecting for this fiscal year 2003 or next fiscal year 2004 to augment the Atlantic entrance navigation channel's present width from 575' to 650'. In 1995, the Atlantic entrance channel was dredged (widened) 75' to the west to obtain a channel width of 575'.

e. Refer to Appendix No. 3 for an Atlantic entrance deepening cross sectional view of the deepening at the three levels.

DREDGING VOLUME ESTIMATES

a. ACP Survey Branch estimated the dredging volumes by using the civil engineering application software HYPACK, and the digital bathymetry updated to August 2002. Please refer to Appendix No. 4 for bathymetric charts.

b. The following table shows a summary of dredging volumes required at the Atlantic Entrance for drafts of 41.5', 46', and 50'. For more details, please refer to Appendix Nos. 1 and 5.

TOTAL DREDGING VOLUME IN m^3

VOLUME	41.5' Draft	46' Draft	50' Draft
Dredging	**983,402**	**3,007,359**	**6,008,686**
Dredging Tolerance	**759,280**	**1,650,505**	**1,591,139**
TOTAL	**1,742,682**	**4,657,864**	**7,599,825**

1. Dredging for 41.5' draft ends at the north end of Gatun locks
2. Dredging to drafts of 46' and 50' ends at 1.9 km north of Gatun locks north end.
3. Dredging volume includes an over-swing of 25' outside the navigation channel prism lines for 46' and 50' draft scenario. The over-swing for 41.5' is 25' for areas north to the station 9K+900, and 10' for areas south to this station.

Table 4. Total Dredging Volume

c. The deepening to 41.5' starts at station No. –2K+700, that is 1.7 km north of Atlantic entrance breakwater, to station 10K+750 close to the north end of Gatun locks approach wall soft nose. Dredging for the levels of 46' and 50' draft starts also at station –2K+700, and finishes at station No. 8K+800, close to the 1939 third locks excavation.

d. The above dredging volume contemplates an over-swing of 25', or 10' when applicable, outside the prism line of each navigational channel; a tactic that delays the drifting of side slopes material into the deepest section of the channel and renders the desired design channel bottom.

e. Appendixes Nos.1 and 5 reflect the dredging volume by a set of stations. The Atlantic entrance navigational channels were divided into this set of stations in order to determine the amount of dredging material required for its disposal at the different designated disposal sites available near this entrance.

PERCENTAGE ESTIMATE OF MEDIUM TO HARD AND SOFT MATERIAL

a. There is no information, such as seismic profiles, about the geophysical conditions of the Atlantic entrance navigational channel to determine the location of medium to hard and soft material.

b. According to ACP experience in dredging the Atlantic entrance, there are two types of material found in the Atlantic entrance marine sub-bottom: Atlantic muck and Gatun formation.

c. The Atlantic muck has an OC-1 to OC-2 (overburden consistency), while the Gatun formation can be RH-1 to RH-2; although, RH3 material could be found. Appendix No. 6 contains more geologic information on Atlantic entrance marine sub-bottom material.

d. The ACP cutter suction dredge master-in-charge pointed out that medium to hard material can be found in the areas located between stations 7K+700 to 9K+900, that is 2,200 meters of navigation channel, in the case of 41.5' draft deepening. For 46' and 50' draft scenarios, the deepening ends at station 8K+800; consequently, the dredge might find 1,100 meters (7K+700 to 8K+800) of navigation channel with medium to hard material. Refer to Appendix No. 1 for location.

e. The following table shows the percentage of medium to hard material that could be found in the Atlantic entrance navigation channel:

ATLANTIC ENTRANCE NAVIGATION CHANNEL PERCENTAGE ESTIMATE OF MEDIUM TO HARD MATERIAL

DRAFT	Total Area (m^2)	Areas in stations that medium to hard material could be found	Net areas with medium to hard material (m^2)	Estimated percentage of areas with medium to hard material
41.5 ft	2,840,865	7k+700 to 9k+900	458,420	16%
46 ft	2,448,155	7k+700 to 8k+900	229,210	9%
50 ft	2,448,155	7k+700 to 8k+900	229,210	9%

Notes:

1. The 41.5' draft deepening ends at the north end of Gatun locks; the 46' and 50' draft deepening ends near the 1939 third set of locks excavation

2. The percentage of areas with medium to hard material is less for 46' and 50' drafts than 41' draft because the deepening ends more to the south in this last draft scenario.

Table 5. Atlantic Entrance Estimate of Dredging Material Hardness

DREDGING TIME FRAME

GENERAL PARAMETERS

a. ACP has two dredges for Canal navigation channel maintenance and capital dredging: the cutter suction dredge MINDI and the dipper dredge RIALTO M. CHRISTENSEN (RMC or CHRISTENSEN). Nevertheless, due to Atlantic entrance marine sub-bottom geologic conditions, the cutter suction dredge MINDI has proven to be effective and efficient for deepening as well as for widening the navigation channel of this entrance. Therefore, it is assumed that either one or two cutter suction dredges similar to the MINDI, or with better productivity, could execute the Atlantic entrance deepening at drafts 41.5', 46', and 50'.

b. The MINDI's historical performance and the opinion of its master-in-charge concerning dredge productivity in the Atlantic entrance were used to estimate the time required to accomplish the new proposed deepening of this entrance.

c. Two scenarios were analyzed to determine the time frame of Atlantic entrance deepening for 41.5', 46', and 50' draft:

    a. Cutter suction dredge productivity same as MINDI's
    b. Cutter suction dredge productivity 1.5 times of MINDI's

d. Also, two schemes were analyzed under each productivity scenario:

    a. One cutter suction dredge executing the dredging
    b. Two cutter suction dredges executing the dredging

e. As per ACP dredging needs and availability of resources, one of the cutter suction dredges could be the MINDI, and the other cutter suction dredge could be a new one that ACP is planning the acquire.

f. The average time frame to execute a dredging task takes into account one month of preventive maintenance each year and six months of dry dock overhaul every 5 years for each dredge. However, since the time frame of the Atlantic entrance for each of the three deepening scenarios is less than 5 years each, it was assumed that dredge dry dock overhaul would be performed before or after deepening the Atlantic entrance navigation channel.

g. The Atlantic entrance deepening will delay the required maintenance dredging cycle, that is, maintenance re-scheduling and consequently

represents dredging cost savings to ACP. The last maintenance cycle performed in the Atlantic entrance was in 1995.

h. Average productivity of ACP dredges includes out-of-service time such as emergency repairs.

i. The current work schedule for ACP dredges is 24 hours a day, 7 days a week, and will continue as required for future dredging work. However, the effective working time for the MINDI in the Atlantic entrance is estimated at 12.5 hours per day.

j. Appendix No. 7 contains a summary of the MINDI historical performance. Following is a summary of the MINDI's productivity, which only reflects channel widening and maintenance:

ACP CUTTER SUCTION DREDGE "MINDI" PRODUCTION IN THE ATLANTIC ENTRANCE FROM OCT. '94 TO FEB. '96

Production	Bank cubic meters per hour	Bank cubic meters per day	Bank cubic meters per week
Least	408	5,100	35,700
Average	824	10,300	**72,100**
Greatest	1,523	19,038	133,263

Table 6. Cutter Suction Dredge MINDI Production, Atlantic Entrance

DREDGING TIME FRAME ESTIMATE

a. Based on historical records from 1994 through 1996, the MINDI has an individual average productivity of approximate 72,100 m^3 per week in the Atlantic entrance. However, the MINDI or any other cutter suction dredge will be dredging deeper design channel bottoms than it has dredged previously, and might encounter more vessel traffic than in 1996. Therefore, a meeting was held on November 20, 2002, with the masters-in-charge of the MINDI, and it was agreed that 30,000 m^3 per week for medium to hard material, and 60,000 m^3 per week for soft material would be better deepening productivity rates for estimating the time frame for dredging the Atlantic entrance for drafts of 41.5', 46', and 50'.

b. According to the most recent dredging project in the Atlantic entrance in 1996, ACP has estimated that the MINDI can remove the medium to hard material in the Atlantic entrance with almost no drilling and blasting; therefore, assuming that no blasting will be required, the MINDI productivity would be 25,000 m^3 per week instead of 30,000 m^3 for medium to hard material.

c. A Gantt chart was used to plan the dredging activities in the Atlantic entrance under the different scenarios. The charts show the dredges' preventive maintenance schedules as well as their dredging activity for each of the dredging options. As in any other project, this dredging program might change to conform to ACP needs.

Scenario No. 1: Cutter suction dredge productivity same as MINDI's

a. Appendix No. 8 contains in detail the time frame calculation for the 3 deepening scenarios with one and two dredge schemes, assuming that the dredge productivity is same as MINDI's.

b. Appendixes Nos. 10 and No. 11 contain the Gantt Chart for the 3 proposed deepening scenarios under the one-dredge and two-dredge schemes, respectively, assuming the dredge productivity same as MINDI's.

c. The time frame required to complete the three proposed deepenings in the Atlantic entrance for scenario No. 1 is summarized as follows:

TOTAL DURATION ESTIMATE FOR DREDGING OPERATION
Assuming that cutter suction dredge production is same as MINDI's

DRAFT	Dredging volume (m^3)	Estimated percentage of areas with medium to hard material	Dreges Quantity	Dredges average productiviy (m^3/week)		Total duration (y = years; m = months)
				Medium to hard material	Soft material	
41.5 ft	1,742,682	16%	1	25,000	60,000	1y
			2	25,000	60,000	8m
46 ft	4,657,864	9%	1	25,000	60,000	2y - 2m
			2	25,000	60,000	1y - 2m
50 ft	7,599,825	9%	1	25,000	60,000	3y - 5m
			2	25,000	60,000	1y - 11m

Notes:

1. All dredges are cutter suction type.

2. Estimated total duration includes overhaul, preventive maintenance, emergency repairs, crew relief, dredge mobilization and traffic interferences.

3. The 41.5' draft deepening ends at the north end of Gatun locks: the 46' and 50' draft deepening ends near the 1939 third set of locks excavation

Table 7. Dredging Operations Time Estimate

Scenario No.2: Cutter suction productivity is 50% more than of MINDI's

a. Appendix No. 9 contains in detail the time frame calculation for the 3 deepening scenarios with one- and two-dredge schemes, assuming that one of the two dredges' productivity is same as MINDI's and the other's is 1.5 times of the MINDI.

b. Appendix No. 12 and No. 13 contain the Gantt Chart for the 3 proposed deepening scenarios under the one-dredge, and two-dredge schemes, assuming that one of the dredges' productivity is 50% more than MINDI's.

c. The time frame required to complete the three proposed deepenings in the Atlantic entrance for scenario No. 2 is summarized as follows:

TOTAL DURATION ESTIMATE FOR DREDGING OPERATION

Assuming that one of the cutter suction dredges production is 1.5 times of MINDI's

DRAFT	Dredging volume (m^3)	Estimated percentage of areas with medium to hard material	Dreges Quantity	Dredges average productiviy (m^3/week)		Total duration (y = years; m = months)
				Medium to hard material	Soft material	
41.5 ft	1,742,682	16%	1	37,500	90,000	9m
			2	31,250	75,000	6m
46 ft	4,657,864	9%	1	37,500	90,000	1y - 6m
			2	31,250	75,000	11m
50 ft	7,599,825	9%	1	37,500	90,000	2y - 5m
			2	31,250	75,000	1y - 6m

Notes:

1. All dredges are cutter suction type.

2. Under the 2-dredge scheme, one of the cutter suction is assumed to be the MINDI or similar while the other one is assumed to have a productivity 1.5 times of MINDI's. Therefore the average productivity is 31,250 m3 per wk (37,500 and 25,000 m3 per wk

3. Estimated total duration includes overhaul, preventive maintenance, emergency repairs, crew relief, dredge mobilization and traffic interferences.

4. The 41.5' draft deepening ends at the north end of Gatun locks; the 46' and 50' draft deepening ends near the 1939 third set of locks excavation

Table 8. Dredging Time Estimate Totals

DREDGING COSTS

GENERAL PARAMETERS

a. The MINDI operation costs were used as a baseline to estimate the operational costs of cutter suction dredges in dredging the Atlantic entrance navigation channels,

b. The MINDI operation costs for fiscal years 1995, 1996, 1997 and 1998 were reviewed and are shown in Appendix No. 14. Included are operation costs for availability, labor, overhead, and auxiliary equipment support. Dredging Division overhead was estimated at 12%.

c. The yearly cost indexes for channels and canals, developed and revised on September 30, 2002, by the US Army Corps of Engineers (USACE), were used to convert to 2002 dollars the ACP dredges' average cost of operation for fiscal years 1995, 1996, 1997, and 1998, and may be seen in Appendix No. 15. As shown in that appendix, the average inflation rate used for fiscal years 1995 through 2002 is 1.023.

d. The dredges' availability, fuel cost, and auxiliary support costs were converted to 2002 dollars using a conversion factor of 1.023. This conversion factor was not applied to ACP dredges' labor costs because labor costs were estimated at the maximum step for each employee wage-category effective on January 3, 1999, and have not been increased since. In other words, the labor costs are estimated at 2002 dollars.

e. The dredges' availability costs were averaged, based on 270 days of operation a year, to account for maintenance, overhaul, and emergency repairs.

ACP DREDGES OPERATION AND UNIT COSTS

a. The following table shows a summary of the MINDI estimated hourly costs for a maximum discharge pumping distance of 3 kms. For more calculation details, refer to Appendixe No. 14.

ACP CUTTER SUCTION DREDGE MINDI COST

	MINDI's productivity
Discharge Pumping Distance	**3 km**
Availability cost ($ per hour)	781
Labor cost ($ per hour)	624
Indirect Cost ($ per hour)	75
Fuel cost ($ per hour)	233
Support equipment cost ($ per hour)	439
TOTAL COST ($ per hour)	**2,153**
TOTAL COST ($ per week)	**351,866**

Table 9. Dredge MINDI Costs

b. For an average productivity of 25,000 and 60,000 m^3 per week for hard-to-medium and soft material, respectively, and for an average increased productivity to 50% each, dredging unit costs are as follows:

DREDGING UNIT COST

DREDGE	Cost per week ($)	Estimated production per week (m^3)		Unit cost ($/$m^3$)	
		Medium to hard material	Soft material	Medium to hard material	Soft material
MINDI	351,866	25,000	60,000	**14.07**	**5.86**
DREDGE W/ 50% Productivity increase	351,866	37,500	90,000	**9.38**	**3.91**

Table 10. Dredging Unit Costs

TOTAL DREDGING COST TO PROVIDE DRAFTS OF 41.5', 46', and 50'

Scenario No. 1: Cutter suction dredge, productivity same as MINDI's

a. Assuming that cutter suction dredge productivity is same as MINDI's, and using the aforementioned unit costs, the dredging cost per set of stations is shown in Appendix No. 8, and the total cost for each of the three levels of dredging for 1- and 2-dredge schemes is as follows:

ATLANTIC ENTRANCE TOTAL DREDGING COST FOR EACH OF THE 3 DEEPENING SCENARIOS

Assuming that cutter suction dredge production is same as MINDI's

DRAFT	Dredging volume (m^3)	Estimated percentage of areas with medium to hard material	Unit cost ($/$m^3$)		Total Dredging Cost for 1- or 2 dredge scenario ($)
			Medium to hard material	Soft material	
41.5 feet	1,742,682	16%	14.07	5.86	16,270,604
46 feet	4,657,864	9%	14.07	5.86	35,462,210
50 feet	7,599,825	9%	14.07	5.86	56,827,569

Notes: 1. The 41.5' draft deepening ends at the north end of Gatun locks.

2. The 46' and 50' draft deepening ends near the 1939 excavation for a third set of Atlantic side locks.

3. Total dredging cost only reflects the operational activities.

Table 11. Total Dredging Costs Total Dredging Costs with One or Two Dredges, Working at 100% Current Capacity

b. The operation cost for the proposed deepening is the same for 1- and 2-dredge scenarios since the productivity for 1 or 2 dredges is assumed to be the same as MINDI's, and consequently the costs are the same. Nevertheless, the dredging activity time frame under the 2-dredge scheme is shorter than for the 1-dredge.

Scenario No.2: Cutter suction productivity is 50% more than the MINDI's

a. Assuming that one of the cutter suction dredge's productivity is 1.5 times of the MINDI's, and using the aforementioned unit costs, the dredging cost per set of stations is shown in Appendix No. 9, and the total cost for each of the three levels of dredging for 1- and 2-dredge scenarios is as follows:

ATLANTIC ENTRANCE TOTAL DREDGING COST FOR EACH OF THE 3 DEEPENING SCENARIOS

Assuming that one of the dredge's production is 1.5 times of MINDI's

DRAFT	Dredging volume (m^3)	Estimated % of areas with medium to hard material	Unit cost ($/m^3$)				Total Dredging Cost ($)	
			Medium to hard material		Soft material		Only One Dredge	MINDI & Additional Dredge
			MINDI	New dredge	MINDI	New dredge		
41.5 feet	1,742,682	16%	14.07	9.38	5.86	3.91	10,850,418	12,791,222
46 feet	4,657,864	9%	14.07	9.38	5.86	3.91	23,653,684	28,699,534
50 feet	7,599,825	9%	14.07	9.38	5.86	3.91	37,905,388	46,006,609

Notes: 1. The 41.5' draft deepening ends at the north end of Gatun locks.
2. The 46' and 50' draft deepening ends near the 1939 excavation for a third set of Atlantic side locks.
3. Total dredging costs only reflects the operational activities.

Table 12. Total Dredging Costs with Two Dredges, One Working at 150% Current Capacity

b. Contrary to the scenario of dredge productivity the same as the MINDI's, the scenario of 1.5 times the MINDI's productivity operational costs are different for 1- and 2-dredge scheme. The 2-dredge scheme assumes the operational costs of a cutter suction dredge similar to the MINDI with its usual productivity, and an additional cutter suction dredge with 1.5 times the MINDI's productivity. The 1-dredge scheme assumes the operational costs of one cutter suction dredge with 1.5 times the MINDI's productivity.

DRILLING & BLASTING (D&B) ACTIVITY

a. According to ACP experience in dredging the Atlantic entrance navigation channels, very little D&B is required. For example, there was no need for D&B during the most recent dredging activity performed in the Atlantic entrance navigation channel for widening to 75' on the west side of the channel, executed from 1994 through 1996. The ACP cutter suction dredge MINDI was able to remove the material without any fragmentation assistance from the ACP drill-boat THOR.

b. Although there are no official records of the drill-boat THOR blasting the area of the Atlantic entrance, the THOR master-in-charge recalls that, in the early 1990s, D&B was performed for few days in an area close to the west prism line across from the MINE Dock, buoy (13). Refer to Appendix No. 1 for the Atlantic entrance plan view sketch.

c. The MINDI's master-in-charge identified the areas blasted by the THOR in the early 1990s as sites that might again require D&B before proper dredging can be performed.

d. Based on the previous facts, ACP estimated that if D&B might be required in the Atlantic entrance navigation channels to permit proper dredging, the costs for D&B activity would not surpasse $2 million.

DISPOSAL SITES FOR DREDGING MATERIAL

GENERAL PARAMETERS

a. The Atlantic entrance navigation channel deepening, including the 2' of over-dredging and 10' to 25' of over-swing, will require disposal of the following dredging material volumes:

- Deepening for 41.5' draft: 1.74 M m^3
- Deepening for 46' draft: 4.7 M m^3
- Deepening for 50' draft: 7.6 M m^3

b. The remaining capacities of the disposal sites at the Atlantic entrance to receive material have been estimated using mean low water for the aquatic sites. Refer to Appendix No. 1 for a map of disposal site locations at the Atlantic entrance.

c. Following are disposal sites at the Atlantic entrance that are available to accommodate dredging material:

- Northwest breakwater disposal site: This is an underwater site located outside of the west Cristobal breakwater, and has an area of 1.29 km^2. The remaining capacity has been estimated around 14.9 M m^3.

- Northeast breakwater disposal site: This is an underwater site located outside of the east Cristobal breakwater, and has an area of 1.17 km^2. The remaining capacity of this site has not been estimated. A study is required to determine whether this is a feasible site for accommodating the dredging material, as it is located adjacent to the Cristobal port's navigation channel and the deposited material could drift into this channel.

- Limon Bay disposal site: This is an underwater site located in Limon Bay, to the south of anchorage area "B" and to the west of anchorage area "C". The Limon Bay disposal site would be a space required for a project to expand the Atlantic entrance anchorage area; therefore, it is not recommended to be used for depositing dredging material.

- Limon Bay south disposal site: This is an underwater site located south of Limon Bay and north of Sherman site. It has been used to deposit dredging material, but the area is shallow; therefore it is not recommended to add more dredging material to the site. Also, water flowing from the Gatun Lake spillway requires unfettered access to Limon Bay, as shown in Appendix No. 16.

- Fan dumping area: This site is proposed for depositing material dredged by a cutter suction dredge and is located south of the designated Limon Bay disposal site. It can hold up to a maximum of 10 M m^3, and it could be an ideal site if Telfers Island will not be available to receive dredging material.

- Sherman site: This is an overland site located west of the Atlantic entrance navigation channel. The ACP received this site in 1999 from ARI in exchange for Telfers Island (ARI is the Panama governmental agency in charge of former US military base areas). The Sherman site has 665 hectares and its total capacity has not been estimated. It contains three designated disposal sites, known as Gatun Approach No.1, No.2, and No.3, located along the west bank of the Atlantic entrance, adjacent to Limon Bay to the north,the Gatun Highway and Loma Borracha to the east and the old Atlantic French canal excavation to the south.and the sites have remaining capacities of 273K. 261.5K, and 152.5K m^3 , respectively. Refer to Appendix Nos. 1 and 16 for location sketches of the Sherman site disposal sites. With the acquisition of the entire Sherman site, ACP can move dredging material that has been deposited at the Gatun Approach disposal sites, on the west side up to the area designated for the Gatun spillway floodwater, over to the Sherman site. In this way, the Gatun Approach disposal sites can be cleared for receiving more material. The Sherman site is adjacent to areas protected by ANAM (the Panama agency for environment protection), and contains large forested areas, as shown in Appendix No. 16; therefore, an environmental impact study (EIS) is highly recommended before depositing any dredging material there.

- Davis site: This is an overland site located at the corner between the Gatun Approach reach and the 1939 Third Locks excavation, also north of the Davis landing facilities. It has an area of 47,713 m^2 and a remaining capacity of 60.5 K m^3, which can be increased up to 183.6 K m^3; however, its use as a disposal site should be rejected due to its proximity to the proposed new Post-Panamax locks construction area.

- 1939 Third locks construction area: This is an underwater site located to the south of the Atlantic entrance and to the east of Gatun Locks. It has been used as a disposal site for dredging material from Atlantic entrance dredging activities; however, it should be rejected as a disposal site because it is also a potential site for future new Post-Panamax locks.

- Telfers Island: This is an overland site located to the east of Atlantic entrance navigation channels, it has a dike, and it can accommodate 3.7 M m^3 of material. However, the Canal only has 28 hectares after transferring 213 hectares to ARI in exchange for the Sherman site in 1999. A permission from ARI to fill the existing diked area will benefit both

agencies, as ACP will have an additional place to put material, and ARI will acquire a level landfill for future industrial or other development.

d. According to the above Atlantic entrance disposal site descriptions and their availability, the dredging material from station 2K+700 to 2K+000 could be deposited in northwest breakwater disposal site; from station 2K+000 to 6K+800, in Limon Bay; and from station 6K+800, in the Sherman site.

e. As pointed out earlier, before proceeding with any dredging activity in the Atlantic entrance, an environmental impact study is required to further assess the different disposal options. The only exception for the EIS would be for Telfers Island, as it is already designated for receiving Atlantic entrance dredging material.

SUMMARY

Scenario No. 1: Cutter suction dredge productivity same as the MINDI's

a. In summary, the total dredging volume, required dredging equipment, time frame, and costs of deepening the Atlantic entrance navigation channels for the three options **without any contingency factor** and assuming that the Atlantic entrance channel bottom is at –44.9' PLD under scenario No. 1 are as follows:

DRAFT	Dredging volume (m^3)	No. of dredges	Total duration (years-months)	Dredging cost ($)	Drilling & Blasting cost ($)	Total Cost ($)
41.5 ft	1,742,682	1 2	1 y 8 m	16,270,604	2,000,000	**18,270,604**
46 ft	4,657,864	1 2	2y - 2m 1y -2m	35,462,210	2,000,000	**37,462,210**
50 ft	7,599,825	1 2	3y - 5m 1y - 11m	56,827,569	2,000,000	**58,827,569**

Notes: 1. The 41.5' draft deepening ends at the north end of Gatun locks.

2. The 46' and 50' draft deepening ends near the 1939 excavation for a third set of Atlantic side locks.

3. The cost does not contemplate any equipment investment.

Table 13. Summary for Scenario No. 1

Scenario No.2: Cutter suction productivity is 50% more than the MINDI's

a. In summary, the total dredging volume, required dredging equipment, time frame, and costs of deepening the Atlantic entrance navigation channels for the three options **without any contingency factor** and assuming that the Atlantic entrance channel bottom is at –44.9' PLD under scenario No. 2 are as follows:

Table 14. Summary for Scenario No. 2

SUMMARY OF VOLUME, AREAS, DURATION, EQUIPMENT, AND COST TO DEEPENING THE ATLANTIC ENTRANCE NAVIGATION CHANNELS

Assuming that one dredge production is same as MINDI's, and additional dredge production is 1.5 times of MINDI's

DRAFT	Dredging volume (m^3)	No. of dredges	Total duration (years-months)	Dredging cost ($)	Drilling & Blasting cost ($)	Total Cost ($)
41.5 ft	1,742,682	1	9m	10,850,418.00	2,000,000	**12,350,418**
		2	6m	12,791,222.00		**14,791,222**
46 ft	4,657,864	1	1y - 6m	23,653,684.00	2,000,000	**25,653,684**
		2	11m	28,699,534.00		30,699,534
50 ft	7,599,825	1	2y - 5m	37,905,388.00	2,000,000	**39,905,388**
		2	1y - 6m	46,006,609.00		**48,006,609**

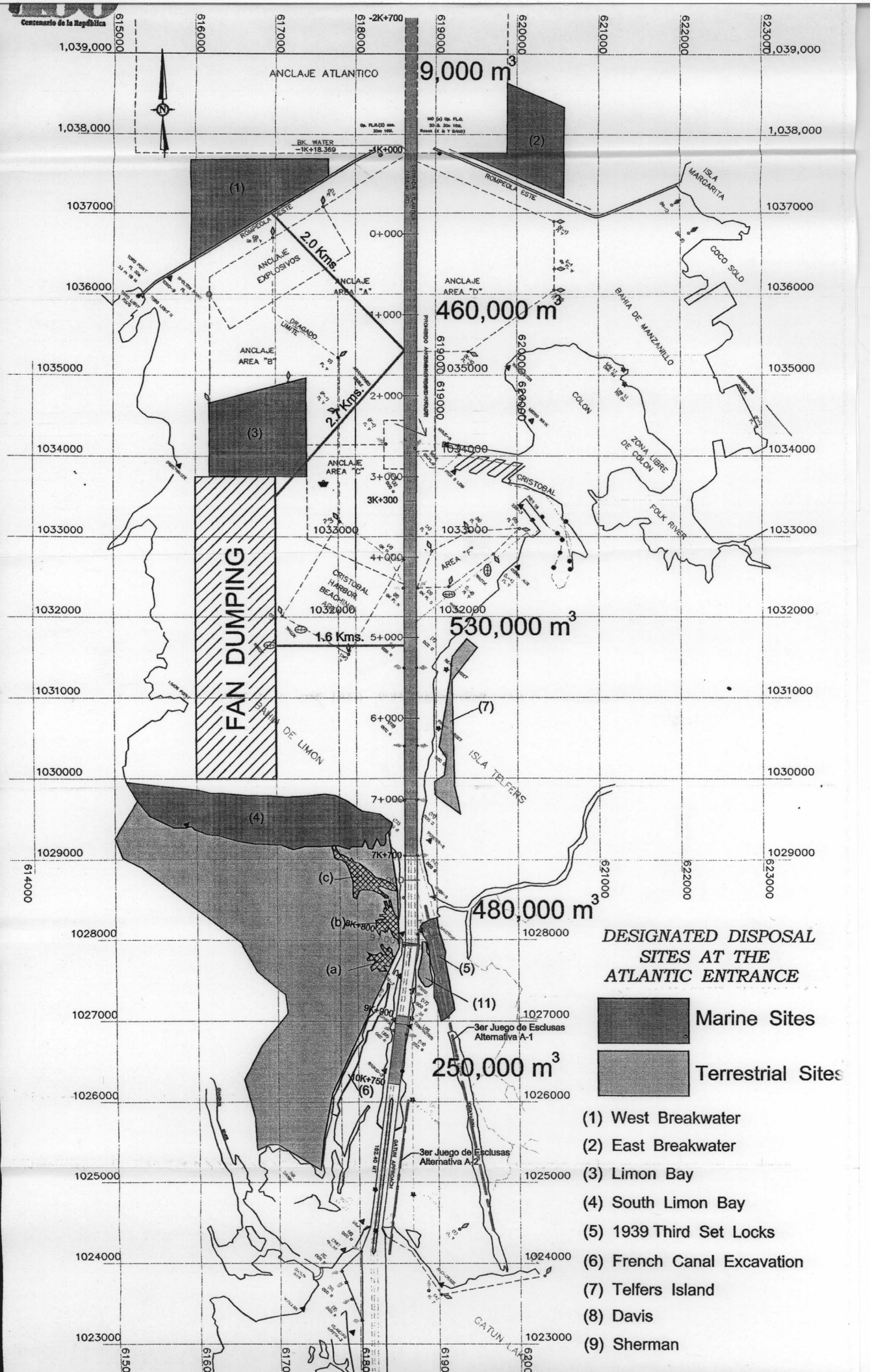
Notes: 1. The 41.5' draft deepening ends at the north end of Gatun locks.

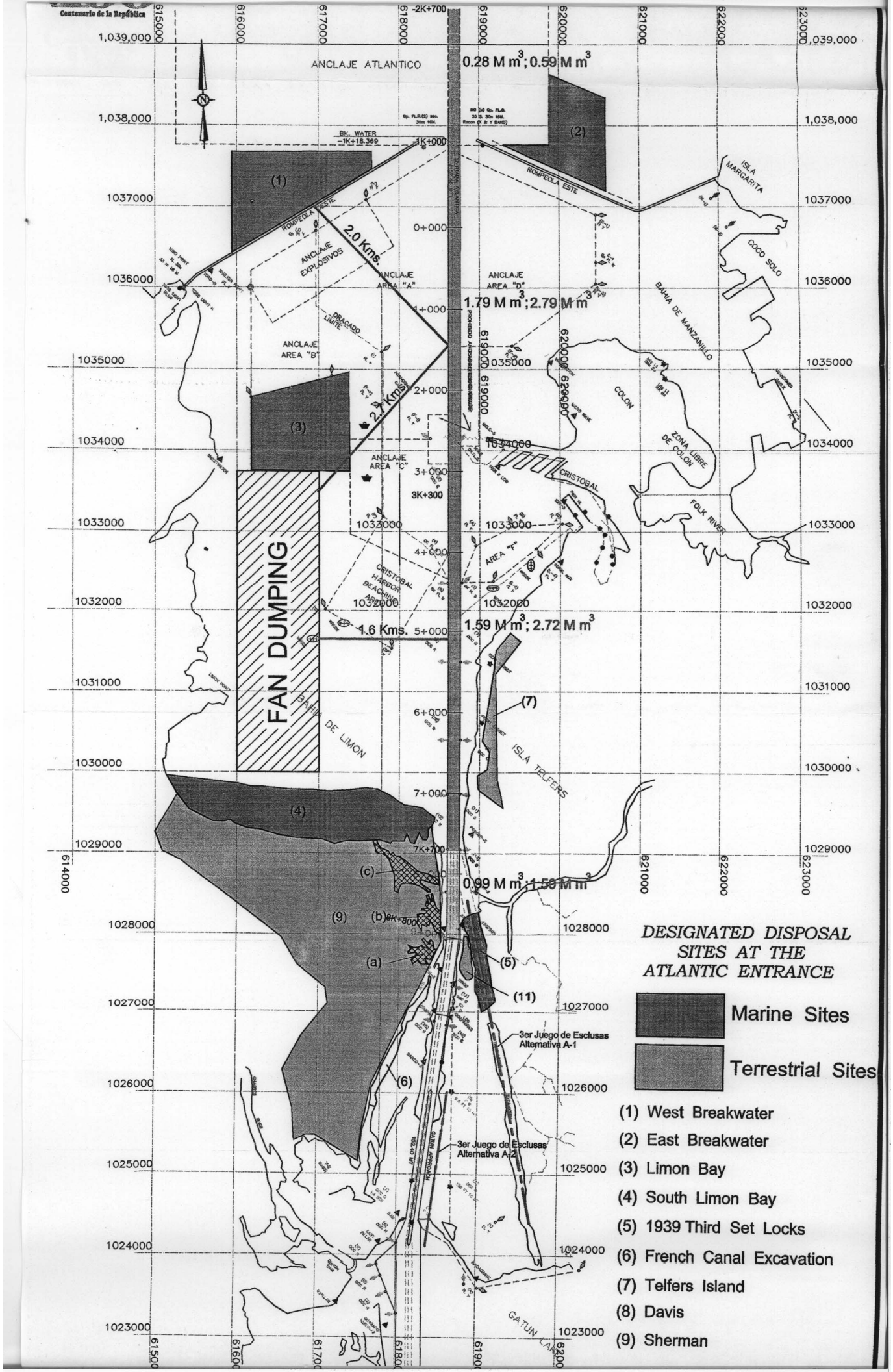
2. The 46' and 50' draft deepening ends near the 1939 third set of Atlantic side locks excavation.

3. The cost does not contemplate any equipment investment.

APPENDIX No. 1

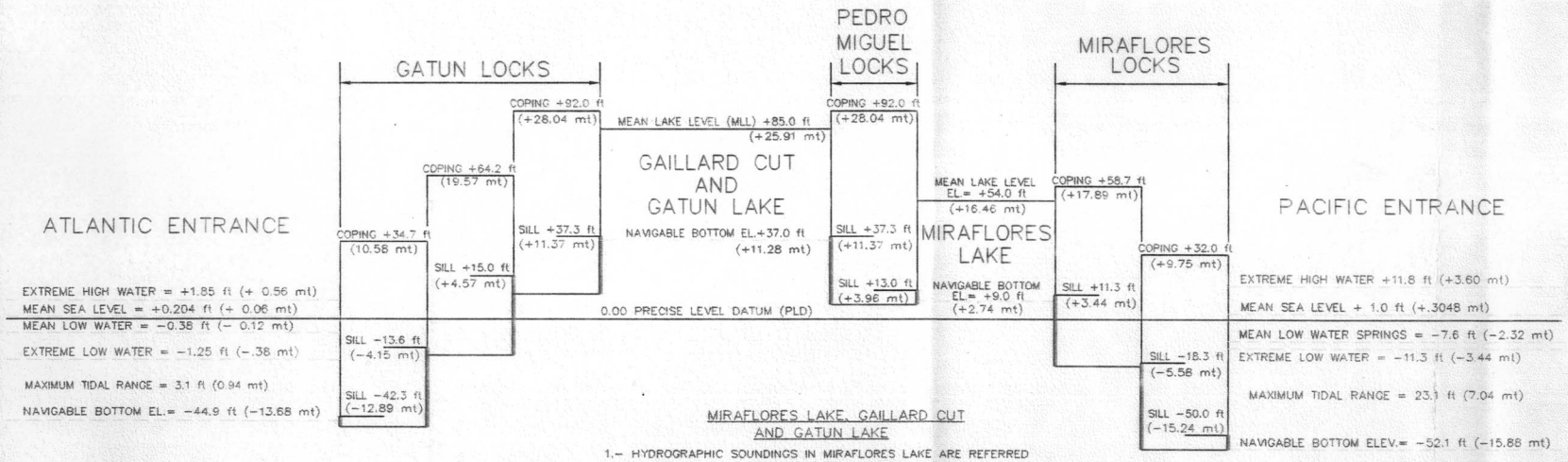
Panama Canal Atlantic Entrance Sketch


ANCLAJE ATLANTICO
9,000 m3
460,000 m3
530,000 m3
480,000 m3
250,000 m3
(1)
(2)
(3)
(4)
(5)
(6)
(7)
(11)
(a)
(b)
(c)
ROMPEOLA ESTE
ROMPEOLA OESTE
2.0 Kms.
2.7 Kms.
1.6 Kms.
ANCLAJE EXPLOSIVOS
ANCLAJE AREA "A"
ANCLAJE AREA "B"
ANCLAJE AREA "C"
ANCLAJE AREA "D"
DRAGADO LIMITE
FAN DUMPING
BAHIA DE LIMON
ISLA TELFERS
ISLA MARGARITA
COCO SOLO
BAHIA DE MANZANILLO
COLON
ZONA LIBRE DE COLON
CRISTOBAL
FOLK RIVER
CRISTOBAL HARBOR BEACHING AREA
AREA "F"
3K+300
7K+700
8K+800
9K+900
10K+750
-2K+700
-1K+000
0+000
1+000
2+000
3+000
4+000
5+000
6+000
7+000
3er Juego de Esclusas Alternativa A-1
3er Juego de Esclusas Alternativa A-2
GATUN LAKE
DESIGNATED DISPOSAL SITES AT THE ATLANTIC ENTRANCE
Marine Sites
Terrestrial Sites
(1) West Breakwater
(2) East Breakwater
(3) Limon Bay
(4) South Limon Bay
(5) 1939 Third Set Locks
(6) French Canal Excavation
(7) Telfers Island
(8) Davis
(9) Sherman


Centenario de la República
ANCLAJE ATLANTICO
0.28 M m³; 0.59 M m³
(1)
(2)
ROMPEOLA ESTE
ISLA MARGARITA
2.0 Kms.
ANCLAJE EXPLOSIVOS
ANCLAJE AREA "A"
ANCLAJE AREA "D"
1.79 M m³; 2.79 M m³
COCO SOLO
BAHIA DE MANZANILLO
ANCLAJE AREA "B"
(3)
2.7 Kms.
COLON
ZONA LIBRE DE COLON
ANCLAJE AREA "C"
CRISTOBAL
FOLK RIVER
FAN DUMPING
CRISTOBAL HARBOR BEACHING AREA
1.6 Kms.
1.59 M m³; 2.72 M m³
BAHIA DE LIMON
(7)
ISLA TELFERS
(4)
(c)
0.99 M m³; 1.56 M m³
(9)
(b)
(a)
(5)
(11)
3er Juego de Esclusas Alternativa A-1
(6)
3er Juego de Esclusas Alternativa A-2
GATUN LAKE
DESIGNATED DISPOSAL SITES AT THE ATLANTIC ENTRANCE
Marine Sites
Terrestrial Sites
(1) West Breakwater
(2) East Breakwater
(3) Limon Bay
(4) South Limon Bay
(5) 1939 Third Set Locks
(6) French Canal Excavation
(7) Telfers Island
(8) Davis
(9) Sherman

APPENDIX No. 2

Panama Canal Clearance Diagram



ATLANTIC ENTRANCE

1.- THE DATUM FOR TIDAL ELEVATIONS AND HYDROGRAPHIC CHARTS AT ATLANTIC ENTRANCE IS "MEAN LOW WATER" WHICH IS -0.38 ft (-0.12 mt) PLD

2.- "MEAN LOW WATER" IS THE AVERAGE OF ALL LOW TIDE

MIRAFLORES LAKE, GAILLARD CUT AND GATUN LAKE

1.- HYDROGRAPHIC SOUNDINGS IN MIRAFLORES LAKE ARE REFERRED TO "MEAN LAKE LEVEL" WHICH IS +54.0 ft (+16.46 mt) PLD

2.- HYDROGRAPHIC SOUNDINGS IN GAILLARD CUT AND GATUN LAKE ARE REFERRED TO "MEAN LAKE LEVEL" WHICH IS +85.0 ft (+25.91 mt) PLD

3.- MAXIMUM NAVIGABLE DEPTH IS CONTROLLED BY DEPTH OF WATER OVER SILL AT SOUTH END OF PEDRO MIGUEL LOCKS

PACIFIC ENTRANCE

1.- THE DATUM FOR TIDAL ELEVATIONS AND HYDROGRAPHIC CHARTS AT PACIFIC ENTRANCE IS "MEAN LOW WATER SPRINGS" WHICH IS -7.6 ft (-2.32 mt) PLD

2.- "MEAN LOW WATER SPRINGS" IS THE AVERAGE OF LOW WATERS AT TIME OF SPRING TIDE

NOTE:

1.- TIDAL DATA IS BASED ON HYDROGRAPHIC RECORDS FROM 1902 TO 1972

2.- CLEAR NAVIGABLE DEPTH WILL BE MAINTAINED TO NAVIGABLE BOTTOM ELEVATIONS BY MAINTENANCE DREDGING

3.- ALL ELEVATIONS ARE REFERRED TO PRECISE LEVEL DATUM (PLD)

JOB SAFETY DEPENDS ON YOU

NOTE:
THIS DRAWING SUPERSEDES DWG. No. 6120-30A AND DWG. No.6120-30B

M 6120- 30 C

REV.	DATE:	DESCRIPTION	BY CHK'D	REVWD	APPR'D
MC AC	7/99 7-05 96	NAVIGABLE BOTTOMS NOTES POSSITIONS	RC RC	J.R	R.S.F

PANAMA CANAL COMMISSION

ENGINEERING AND INDUSTRIAL SERVICES
ENGINEERING DIVISION
BALBOA HEIGHTS, REPUBLIC OF PANAMA

THE PANAMA CANAL CLEARANCE DIAGRAM

SCALE: NOT TO SCALE

DATE: JULY 28, 1999

DRAWN: M. R. CARRIZO
CARTOGRAPHIC SECTION

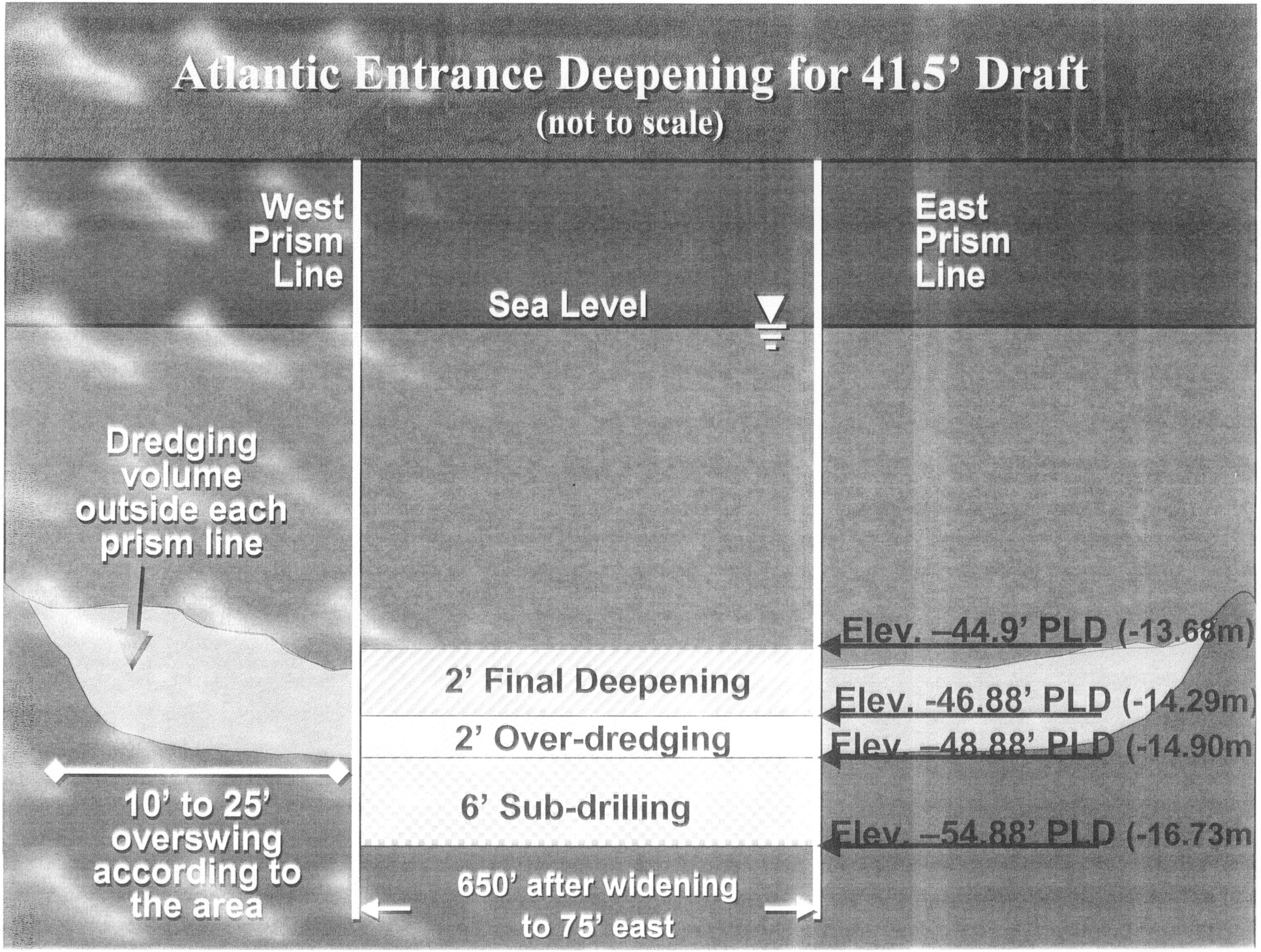
CHECKED: R. CASTILLO
SUPERVISOR, CARTOGRAPHIC SECTION

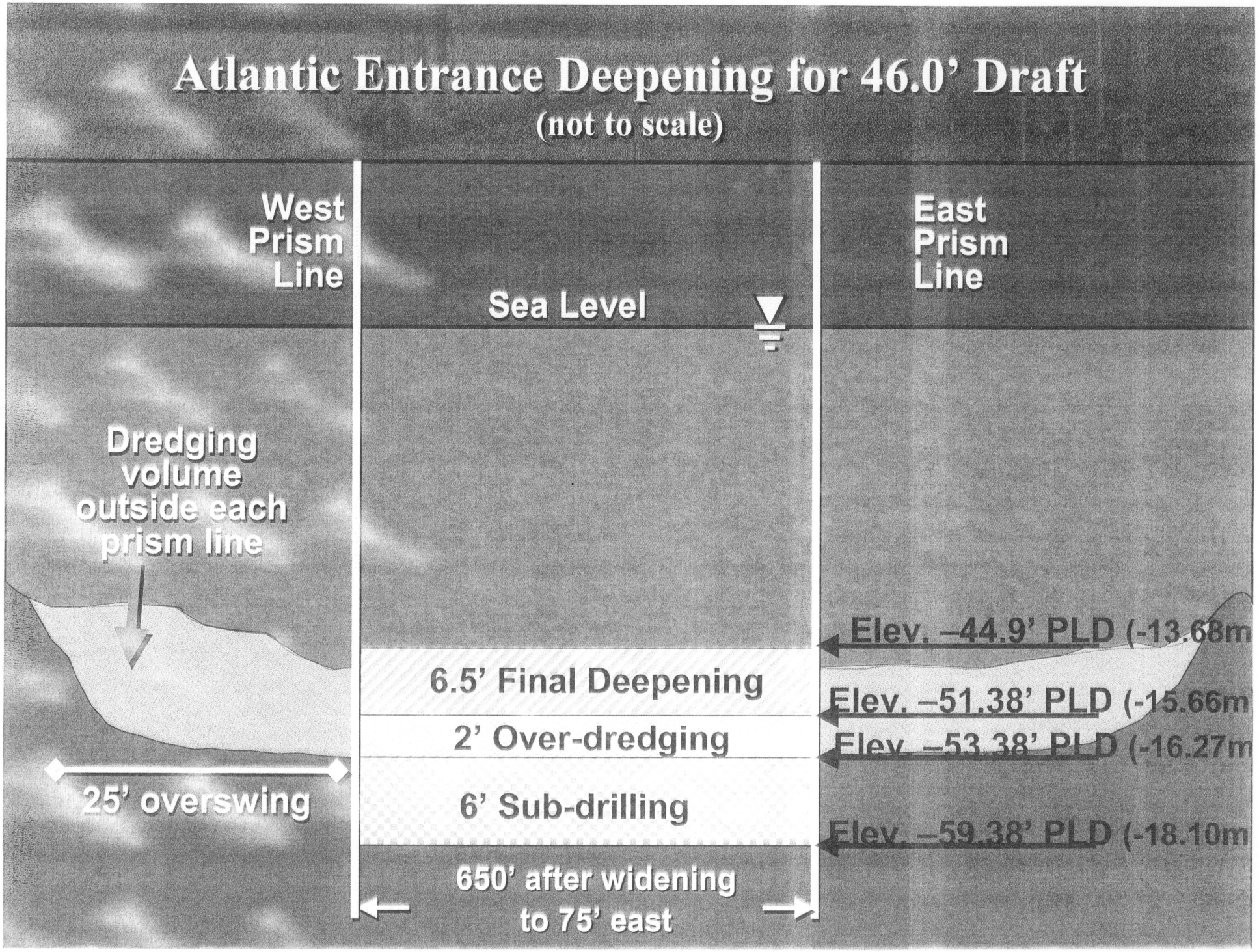
SUBMITTED: _____
MANAGER, SURVEYS BRANCH

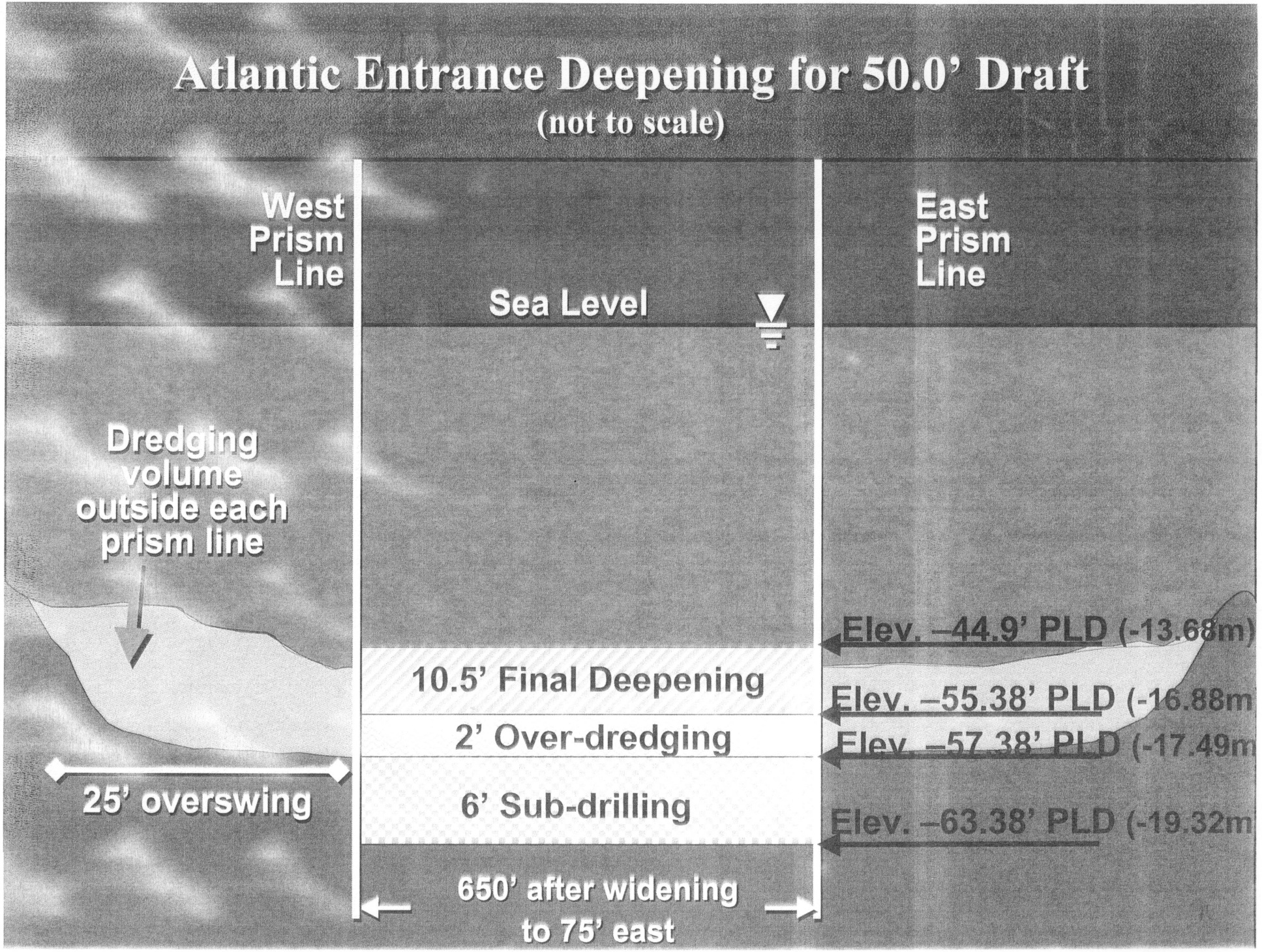
APPROVED: _____
MANAGER, ENGINEERING DIVISION

APPENDIX No. 3

Atlantic Entrance Cross Sectional Views for the Three Deepening Scenarios

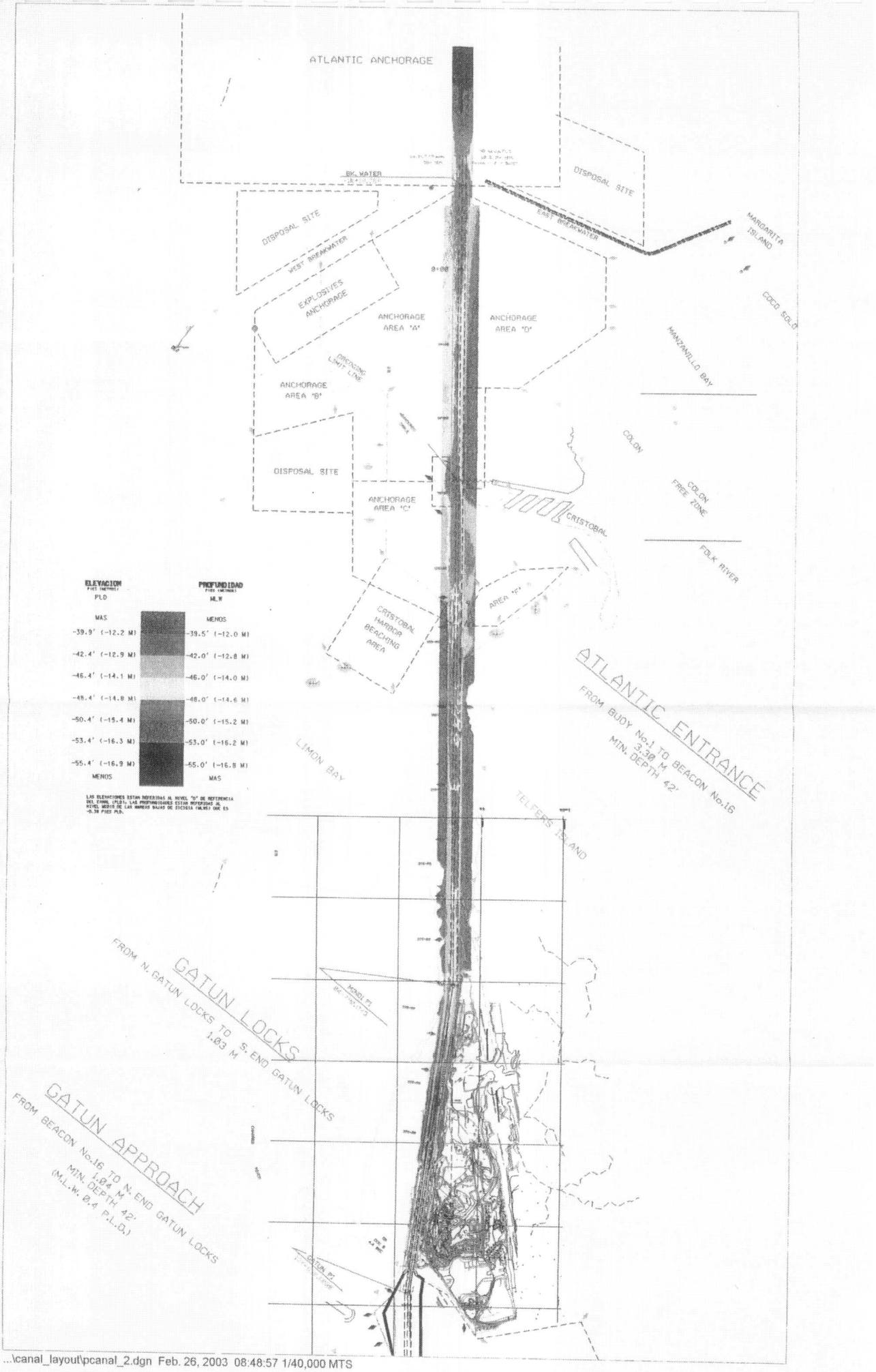

Atlantic Entrance Deepening for 41.5' Draft
(not to scale)
West Prism Line
Sea Level
East Prism Line
Dredging volume outside each prism line
Elev. –44.9' PLD (-13.68m)
2' Final Deepening
Elev. -46.88' PLD (-14.29m)
2' Over-dredging
Elev. –48.88' PLD (-14.90m
6' Sub-drilling
Elev. –54.88' PLD (-16.73m
10' to 25' overswing according to the area
650' after widening to 75' east

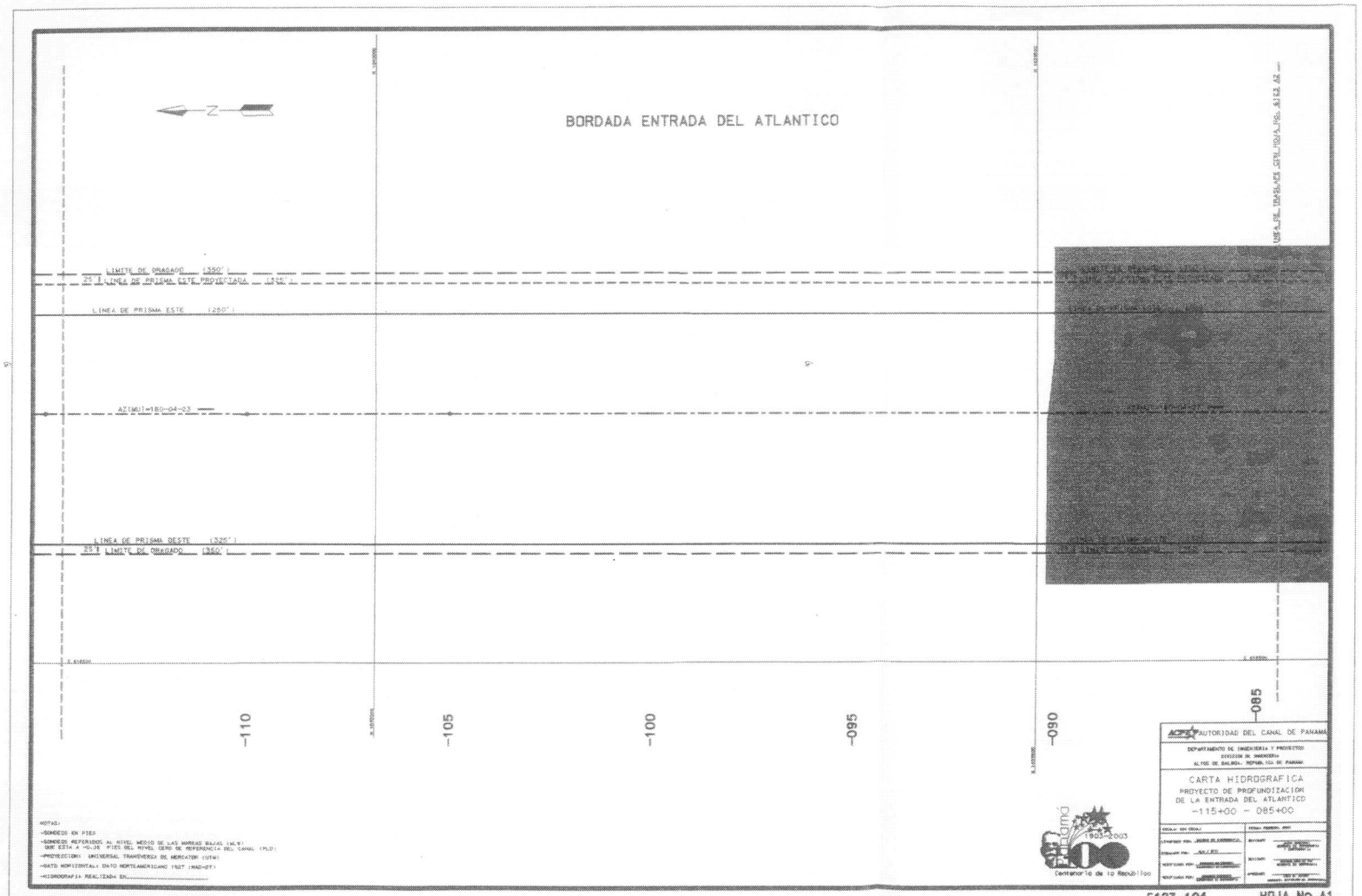

Atlantic Entrance Deepening for 46.0' Draft
(not to scale)
West Prism Line
Sea Level
East Prism Line
Dredging volume outside each prism line
25' overswing
6.5' Final Deepening
2' Over-dredging
6' Sub-drilling
650' after widening to 75' east
Elev. –44.9' PLD (-13.68m
Elev. –51.38' PLD (-15.66m
Elev. –53.38' PLD (-16.27m
Elev. –59.38' PLD (-18.10m


Atlantic Entrance Deepening for 50.0' Draft
(not to scale)
West Prism Line
Sea Level
East Prism Line
Dredging volume outside each prism line
Elev. –44.9' PLD (-13.68m)
10.5' Final Deepening
Elev. –55.38' PLD (-16.88m
2' Over-dredging
Elev. –57.38' PLD (-17.49m
25' overswing
6' Sub-drilling
Elev. –63.38' PLD (-19.32m
650' after widening to 75' east

APPENDIX No. 4

Atlantic Entrance Navigation Channel
Bathymetry


ATLANTIC ANCHORAGE
BK. WATER
DISPOSAL SITE
DISPOSAL SITE
WEST BREAKWATER
EAST BREAKWATER
MARGARITA ISLAND
EXPLOSIVES ANCHORAGE
ANCHORAGE AREA "A"
ANCHORAGE AREA "D"
COCO SOLO
DREDGING LIMIT LINE
MANZANILLO BAY
ANCHORAGE AREA "B"
DISPOSAL SITE
COLON
ANCHORAGE AREA "C"
COLON FREE ZONE
CRISTOBAL
FOLK RIVER
AREA "F"
CRISTOBAL HARBOR BEACHING AREA
ELEVACION
PLD
PROFUNDIDAD
M.L.W.
MAS
MENOS
-39.9' (-12.2 M)
-39.5' (-12.0 M)
-42.4' (-12.9 M)
-42.0' (-12.8 M)
-46.4' (-14.1 M)
-46.0' (-14.0 M)
-48.4' (-14.8 M)
-48.0' (-14.6 M)
-50.4' (-15.4 M)
-50.0' (-15.2 M)
-53.4' (-16.3 M)
-53.0' (-16.2 M)
-55.4' (-16.9 M)
-55.0' (-16.8 M)
MENOS
MAS
LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS BAJAMAR BAJAS DE SIZIGIA (MLWS) QUE ES -0.38 PIES PLD.
ATLANTIC ENTRANCE
FROM BUOY No.1 TO BEACON No.16
3.30 M
MIN. DEPTH 42'
LIMON BAY
TELFERS ISLAND
GATUN LOCKS
FROM N. GATUN LOCKS TO S. END GATUN LOCKS
1.03 M
GATUN APPROACH
FROM BEACON No.16 TO N. END GATUN LOCKS
1.84 M
MIN. DEPTH 42'
(M.L.W. @.4 P.L.D.)
...\canal_layout\pcanal_2.dgn Feb. 26, 2003 08:48:57 1/40,000 MTS



6123-104 HOJA No A1

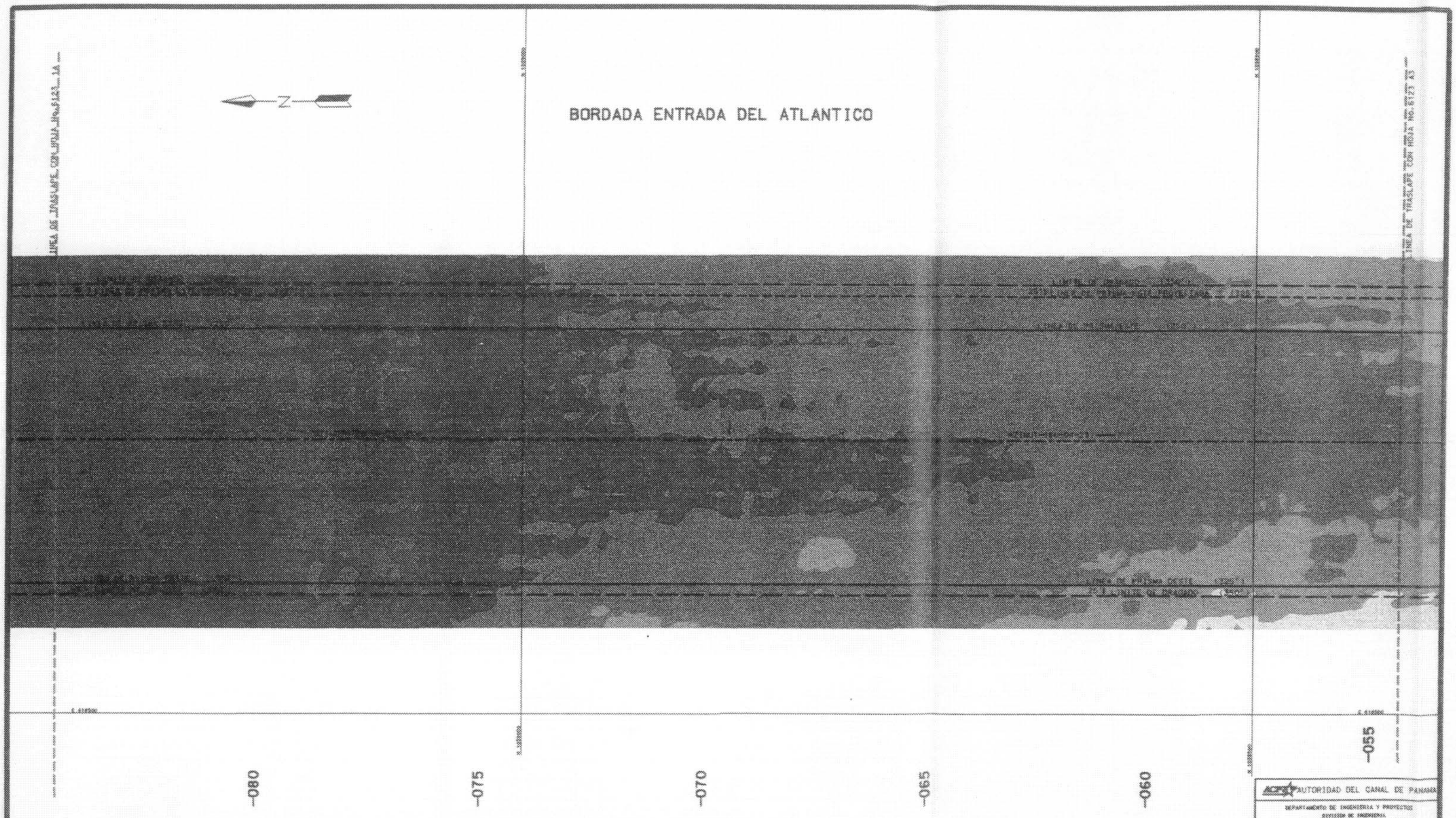
ELEVACION
PIES (METROS)
PLD

PROFUNDIDAD
PIES (METROS)
MLW

MAS	MENOS
-39.9' (-12.2 M)	-39.5' (-12.0 M)
-42.4' (-12.9 M)	-42.0' (-12.8 M)
-46.4' (-14.1 M)	-46.0' (-14.0 M)
-48.4' (-14.8 M)	-48.0' (-14.6 M)
-50.4' (-15.4 M)	-50.0' (-15.2 M)
-53.4' (-16.3 M)	-53.0' (-16.2 M)
-55.4' (-16.9 M)	-55.0' (-16.8 M)
MENOS	MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD), LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SICIGIA (MLWS) QUE ES -0.38 PIES PLD.

...\6123_104_a1.dgn Feb. 13, 2003 12:23:56



NOTAS:
-SONDEOS EN PIES
-SONDEOS REFERIDOS AL NIVEL MEDIO DE LAS MAREAS BAJAS (MLW) QUE ESTA A -0.38 PIES DEL NIVEL CERO DE REFERENCIA DEL CANAL (PLD)
-PROYECCION: UNIVERSAL TRANSVERSA DE MERCATOR (UTM)
-DATO HORIZONTAL: DATO NORTEAMERICANO 1927 (NAD-27)
-HIDROGRAFIA REALIZADA EN_______________

Panamá 1903-2003
Centenario de la República

AUTORIDAD DEL CANAL DE PANAMA
DEPARTAMENTO DE INGENIERIA Y PROYECTOS
DIVISION DE INGENIERIA
ALTOS DE BALBOA, REPUBLICA DE PANAMA

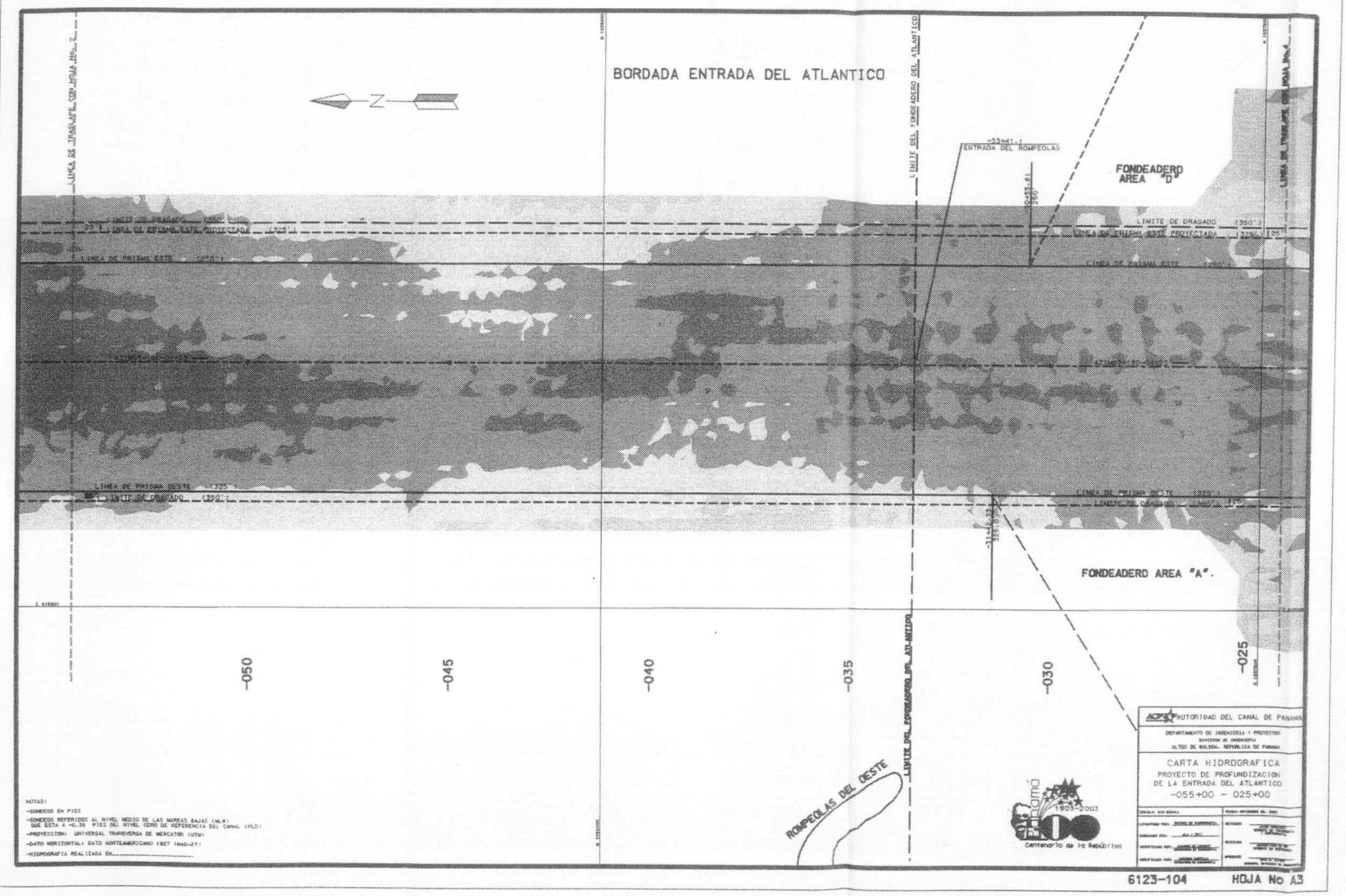
CARTA HIDROGRAFICA
PROYECTO DE PROFUNDIZACION
DE LA ENTRADA DEL ATLANTICO
-085+00 - 055+00

6123-104 HOJA No A2

ELEVACION PIES (METROS) PLD	PROFUNDIDAD PIES (METROS) MLW
MAS	MENOS
-39.9' (-12.2 M)	-39.5' (-12.0 M)
-42.4' (-12.9 M)	-42.0' (-12.8 M)
-46.4' (-14.1 M)	-46.0' (-14.0 M)
-48.4' (-14.8 M)	-48.0' (-14.6 M)
-50.4' (-15.4 M)	-50.0' (-15.2 M)
-53.4' (-16.3 M)	-53.0' (-16.2 M)
-55.4' (-16.9 M)	-55.0' (-16.8 M)
MENOS	MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "O" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SICIGIA (MLWS) QUE ES -0.38 PIES PLD.

123_104_a2.dgn Feb. 13, 2003 13:17:33



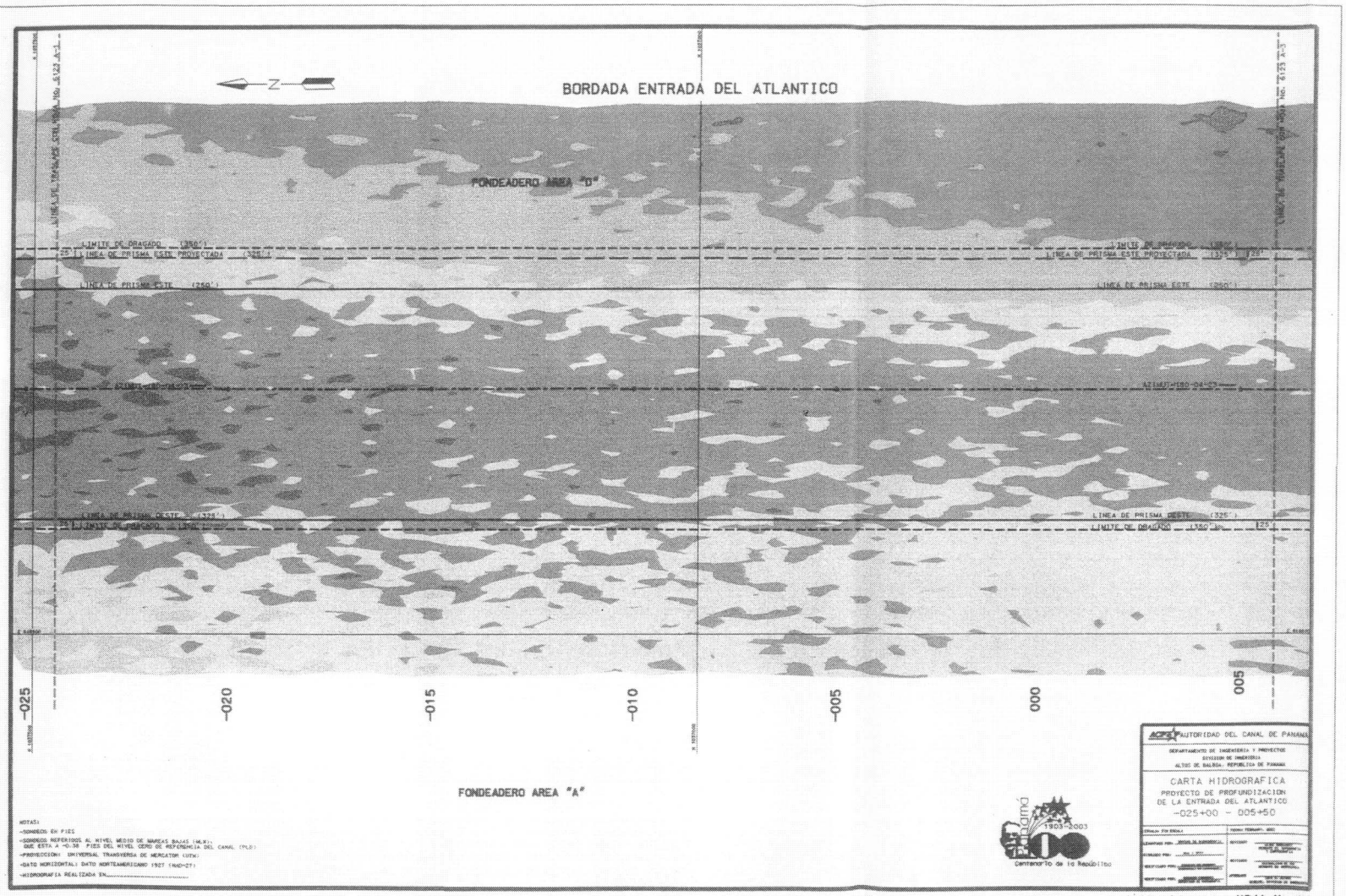
ELEVACION
PIES (METROS)
PLD

PROFUNDIDAD
PIES (METROS)
MLW

MAS	MENOS
-39.9' (-12.2 M)	-39.5' (-12.0 M)
-42.4' (-12.9 M)	-42.0' (-12.8 M)
-46.4' (-14.1 M)	-46.0' (-14.0 M)
-48.4' (-14.8 M)	-48.0' (-14.6 M)
-50.4' (-15.4 M)	-50.0' (-15.2 M)
-53.4' (-16.3 M)	-53.0' (-16.2 M)
-55.4' (-16.9 M)	-55.0' (-16.8 M)
MENOS	MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SIZIGIA (MLWS) QUE ES -0.38 PIES PLD.

123_104_a3.dgn Feb. 13, 2003 13:52:13



ELEVACION
PIES (METROS)
PLD

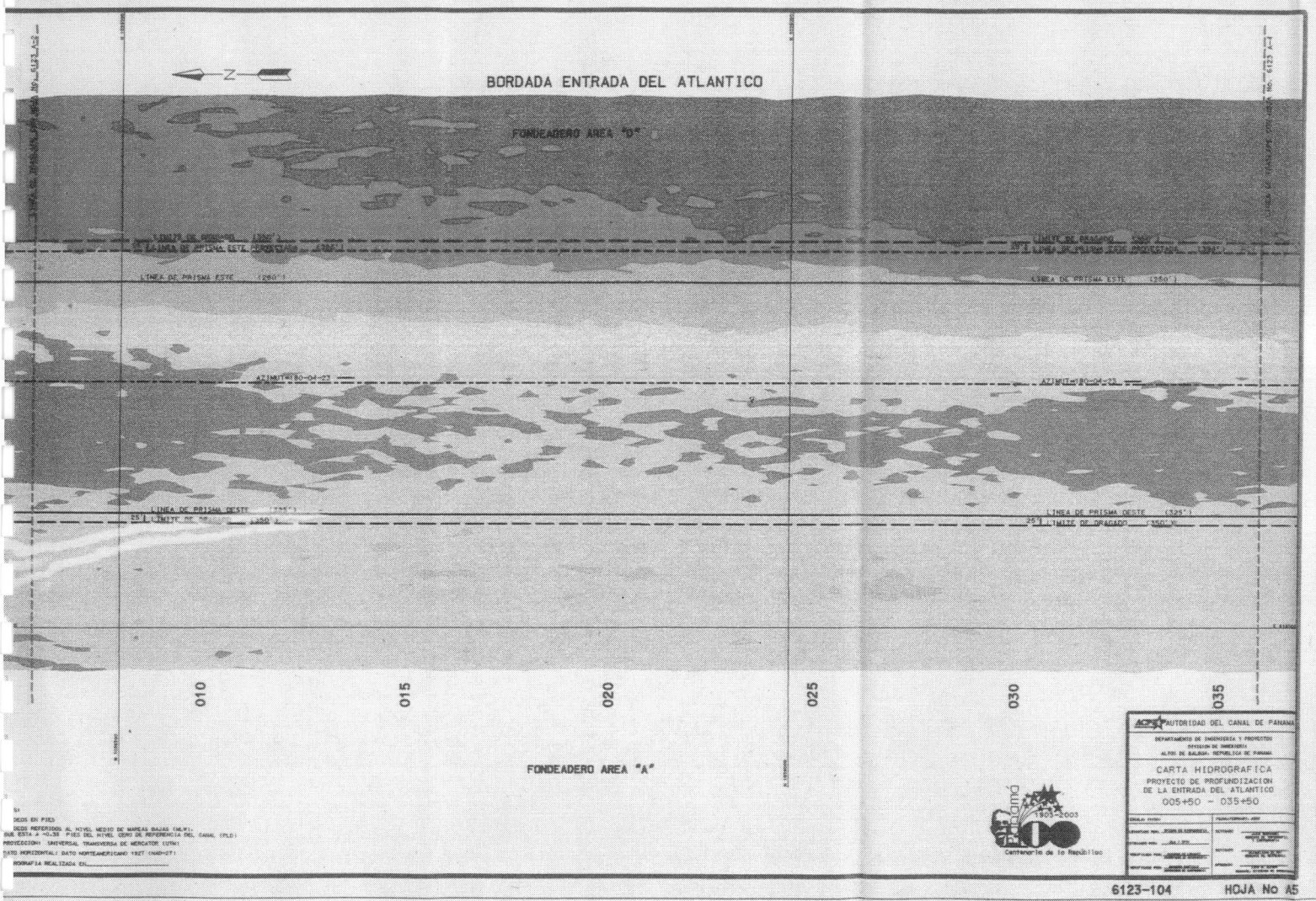
PROFUNDIDAD
PIES (METROS)
MLW

MAS	MENOS
-39.9' (-12.2 M)	-39.5' (-12.0 M)
-42.4' (-12.9 M)	-42.0' (-12.8 M)
-46.4' (-14.1 M)	-46.0' (-14.0 M)
-48.4' (-14.8 M)	-48.0' (-14.6 M)
-50.4' (-15.4 M)	-50.0' (-15.2 M)
-53.4' (-16.3 M)	-53.0' (-16.2 M)
-55.4' (-16.9 M)	-55.0' (-16.8 M)
MENOS	MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "D" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SIZIGIA (MLWS) QUE ES -0.38 PIES PLD.

6123-104 HOJA No A4

23_104_a4.dgn Feb. 14, 2003 07:44:00



ELEVACION PIES (METROS) PLD

MAS

-39.9' (-12.2 M)

-42.4' (-12.9 M)

-46.4' (-14.1 M)

-48.4' (-14.8 M)

-50.4' (-15.4 M)

-53.4' (-16.3 M)

-55.4' (-16.9 M)

MENOS

PROFUNDIDAD PIES (METROS) MLW

MENOS

-39.5' (-12.0 M)

-42.0' (-12.8 M)

-46.0' (-14.0 M)

-48.0' (-14.6 M)

-50.0' (-15.2 M)

-53.0' (-16.2 M)

-55.0' (-16.8 M)

MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SICIGIA (MLWS) QUE ES -0.38 PIES PLD.

AUTORIDAD DEL CANAL DE PANAMA

DEPARTAMENTO DE INGENIERIA Y PROYECTOS

DIVISION DE HIDROGRAFIA

ALTOS DE BALBOA, REPUBLICA DE PANAMA

CARTA HIDROGRAFICA

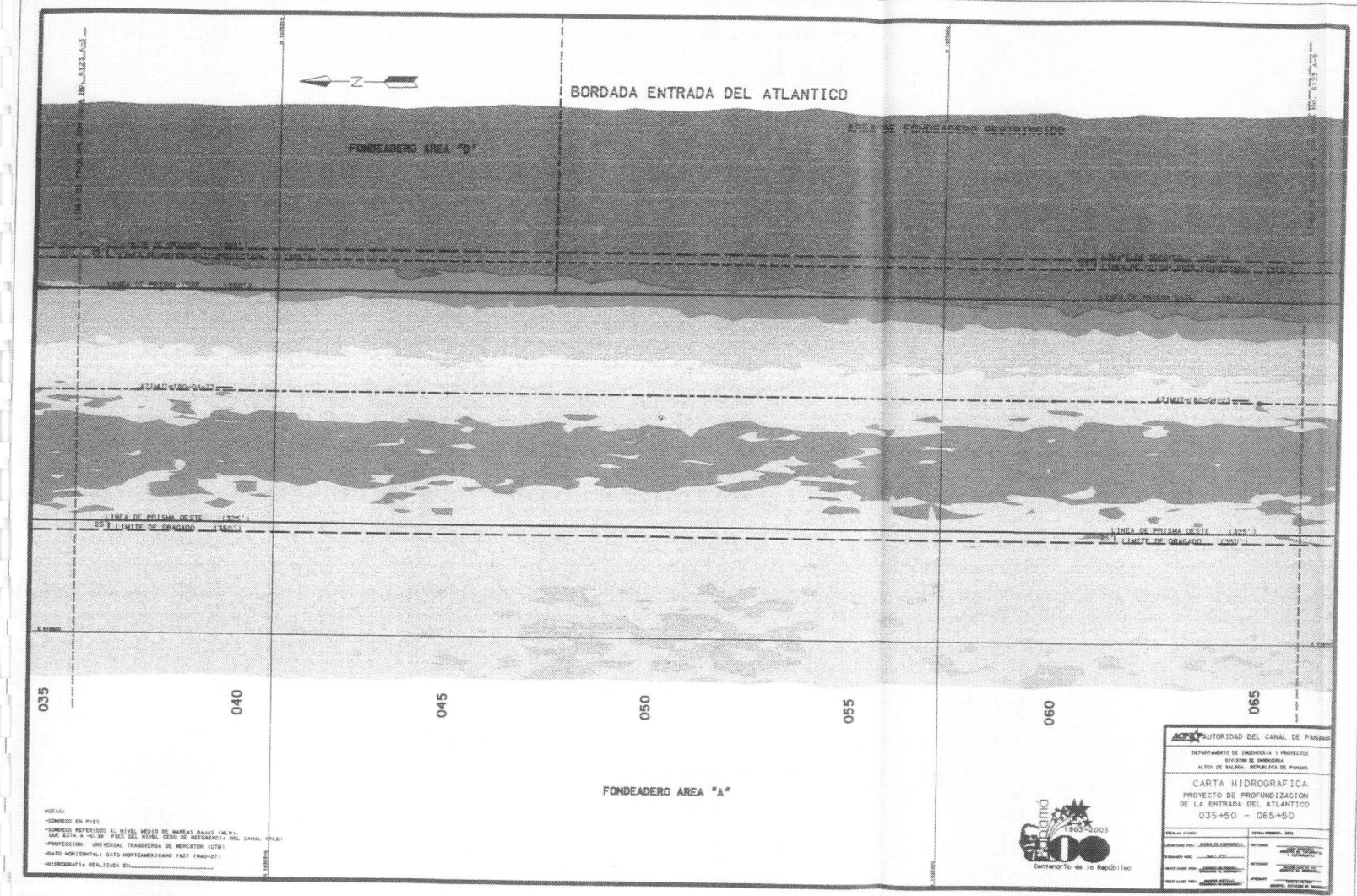
PROYECTO DE PROFUNDIZACION DE LA ENTRADA DEL ATLANTICO

005+50 - 035+50

1903-2003 Centenario de la República

6123-104 HOJA No A5

4_a5.dgn Feb. 14, 2003 08:00:52



AUTORIDAD DEL CANAL DE PANAMA

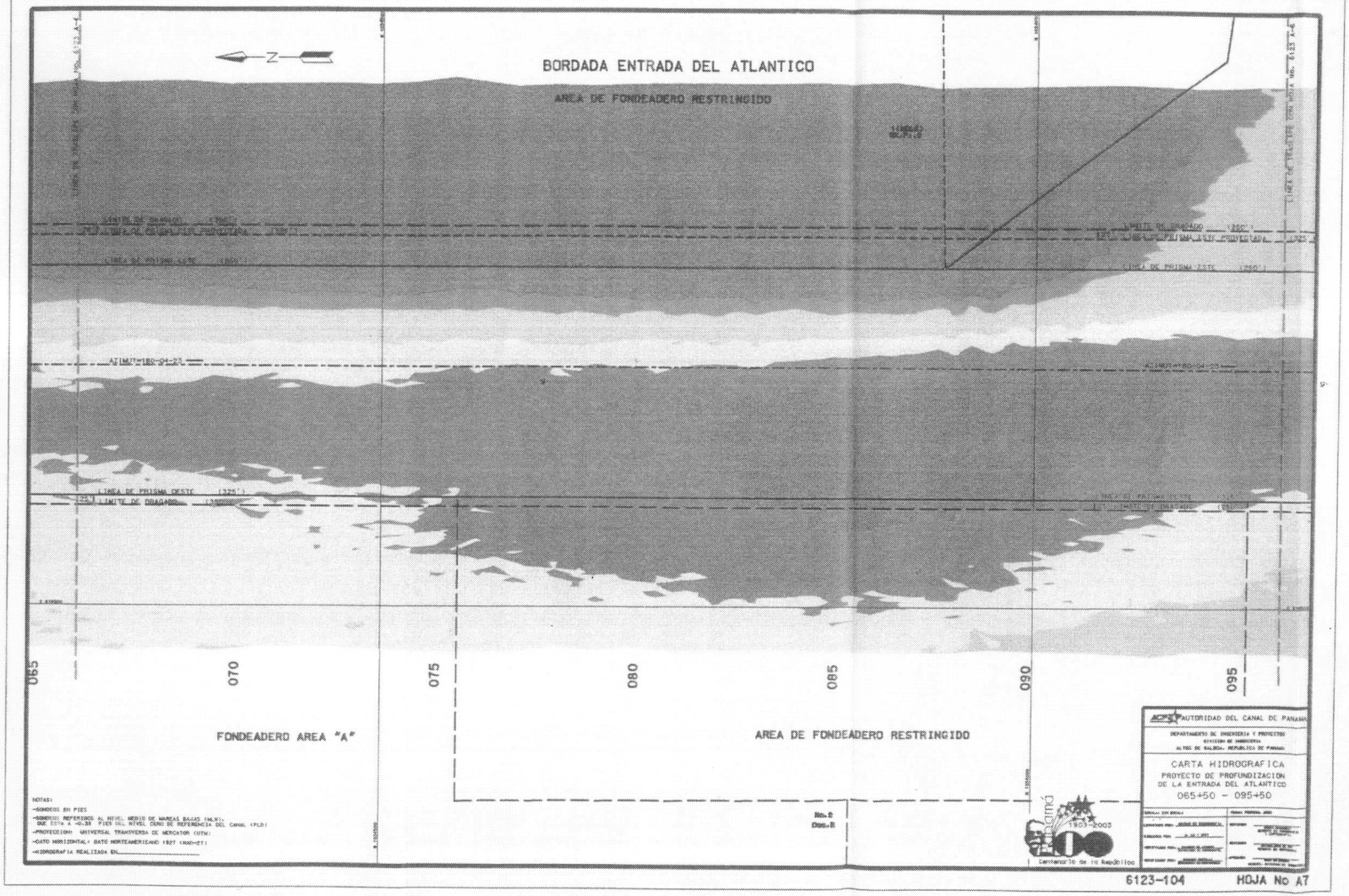
DEPARTAMENTO DE INGENIERIA Y PROYECTOS
DIVISION DE INGENIERIA
ALTOS DE BALBOA, REPUBLICA DE PANAMA

CARTA HIDROGRAFICA
PROYECTO DE PROFUNDIZACION
DE LA ENTRADA DEL ATLANTICO
035+50 - 065+50

ELEVACION PIES (METROS) PLD		PROFUNDIDAD PIES (METROS) MLW
MAS		MENOS
-39.9' (-12.2 M)		-39.5' (-12.0 M)
-42.4' (-12.9 M)		-42.0' (-12.8 M)
-46.4' (-14.1 M)		-46.0' (-14.0 M)
-48.4' (-14.8 M)		-48.0' (-14.6 M)
-50.4' (-15.4 M)		-50.0' (-15.2 M)
-53.4' (-16.3 M)		-53.0' (-16.2 M)
-55.4' (-16.9 M)		-55.0' (-16.8 M)
MENOS		MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SICIGIA (MLWS) QUE ES -0.38 PIES PLD.

6123-104 HOJA No A6



ELEVACION
PIES (METROS)
PLD

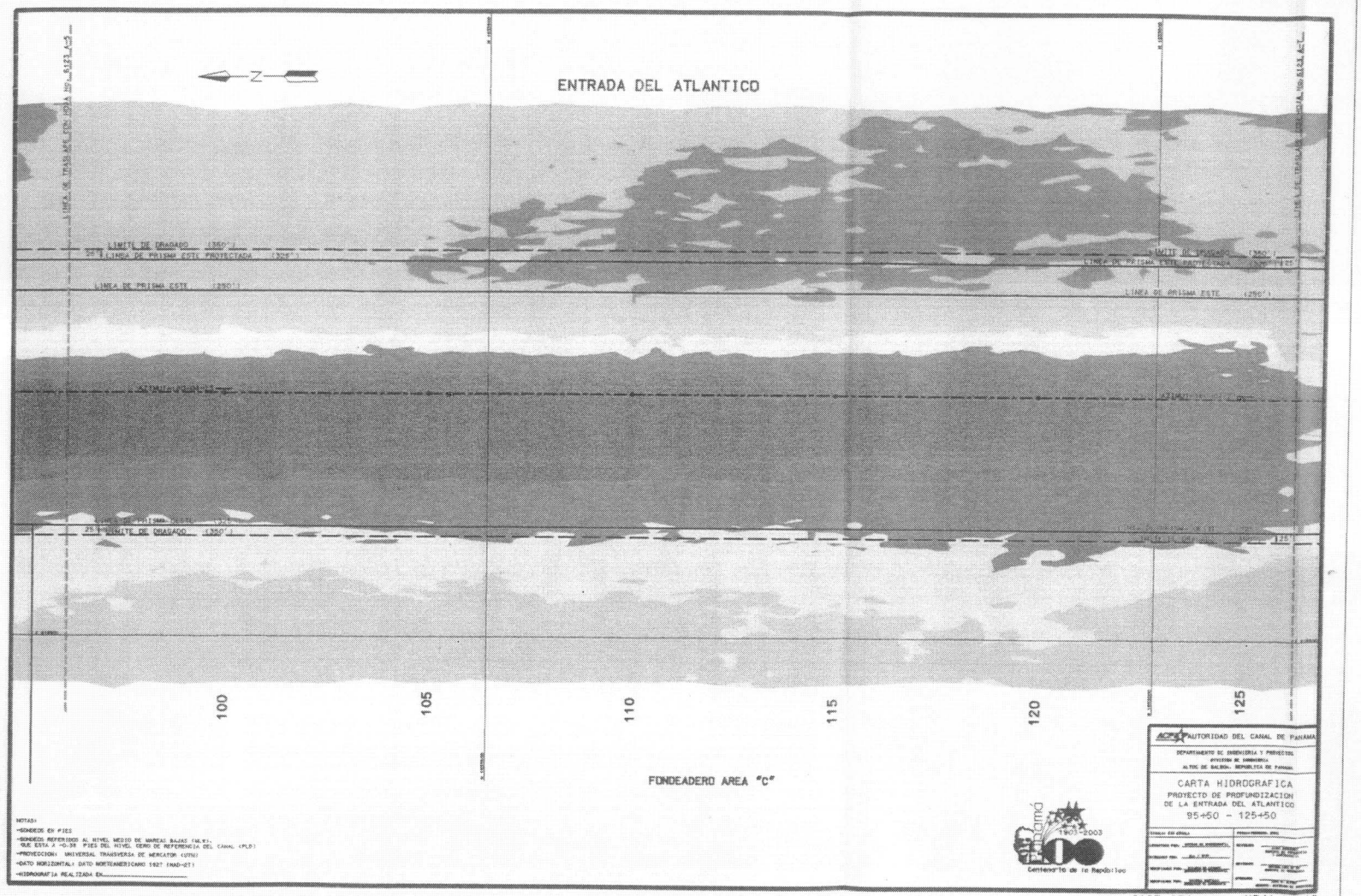
PROFUNDIDAD
PIES (METROS)
MLW

MAS	MENOS
-39.9' (-12.2 M)	-39.5' (-12.0 M)
-42.4' (-12.9 M)	-42.0' (-12.8 M)
-46.4' (-14.1 M)	-46.0' (-14.0 M)
-48.4' (-14.8 M)	-48.0' (-14.6 M)
-50.4' (-15.4 M)	-50.0' (-15.2 M)
-53.4' (-16.3 M)	-53.0' (-16.2 M)
-55.4' (-16.9 M)	-55.0' (-16.8 M)
MENOS	MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SIZIGIA (MLWS) QUE ES -0.38 PIES PLD.

6123-104 HOJA No A7

..\6123_104_a7.dgn Feb. 14, 2003 10:00:07



NOTAS:
- SONDEOS EN PIES
- SONDEOS REFERIDOS AL NIVEL MEDIO DE MAREAS BAJAS (MLW), QUE ESTA A -0.38 PIES DEL NIVEL CERO DE REFERENCIA DEL CANAL (PLD)
- PROYECCION: UNIVERSAL TRANSVERSA DE MERCATOR (UTM)
- DATO HORIZONTAL: DATO NORTEAMERICANO 1927 (NAD-27)
- HIDROGRAFIA REALIZADA EN_____

AUTORIDAD DEL CANAL DE PANAMA
DEPARTAMENTO DE INGENIERIA Y PROYECTOS
DIVISION DE INGENIERIA
ALTOS DE GALERA, REPUBLICA DE PANAMA

CARTA HIDROGRAFICA
PROYECTO DE PROFUNDIZACION
DE LA ENTRADA DEL ATLANTICO
95+50 - 125+50

1903-2003 Centenario de la República

6123-104 HOJA No A8

ELEVACION PIES (METROS) PLD

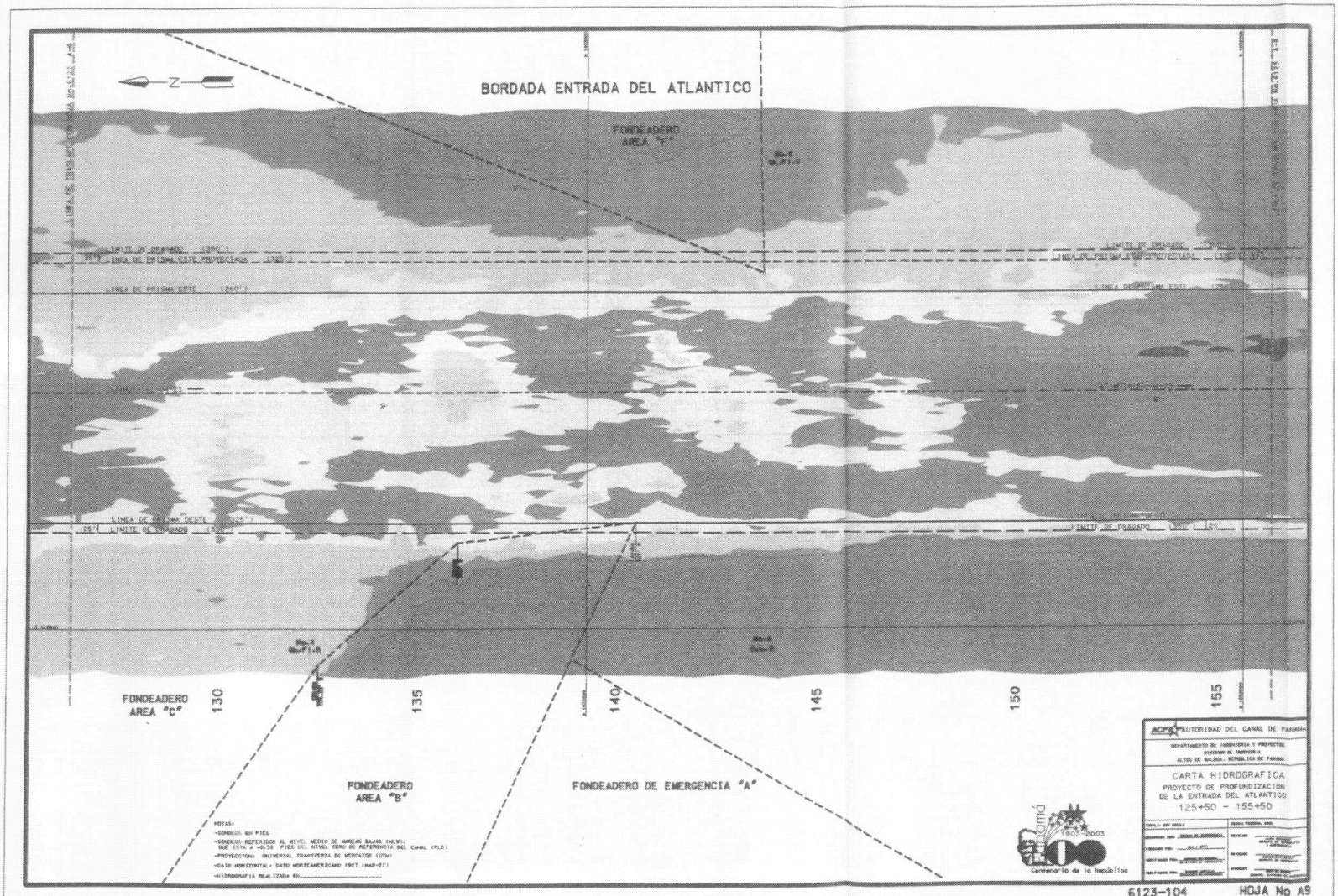
MAS
-39.9' (-12.2 M)
-42.4' (-12.9 M)
-46.4' (-14.1 M)
-48.4' (-14.8 M)
-50.4' (-15.4 M)
-53.4' (-16.3 M)
-55.4' (-16.9 M)
MENOS

PROFUNDIDAD PIES (METROS) MLW

MENOS
-39.5' (-12.0 M)
-42.0' (-12.8 M)
-46.0' (-14.0 M)
-48.0' (-14.6 M)
-50.0' (-15.2 M)
-53.0' (-16.2 M)
-55.0' (-16.8 M)
MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SIZIGIA (MLWS) QUE ES -0.38 PIES PLD.

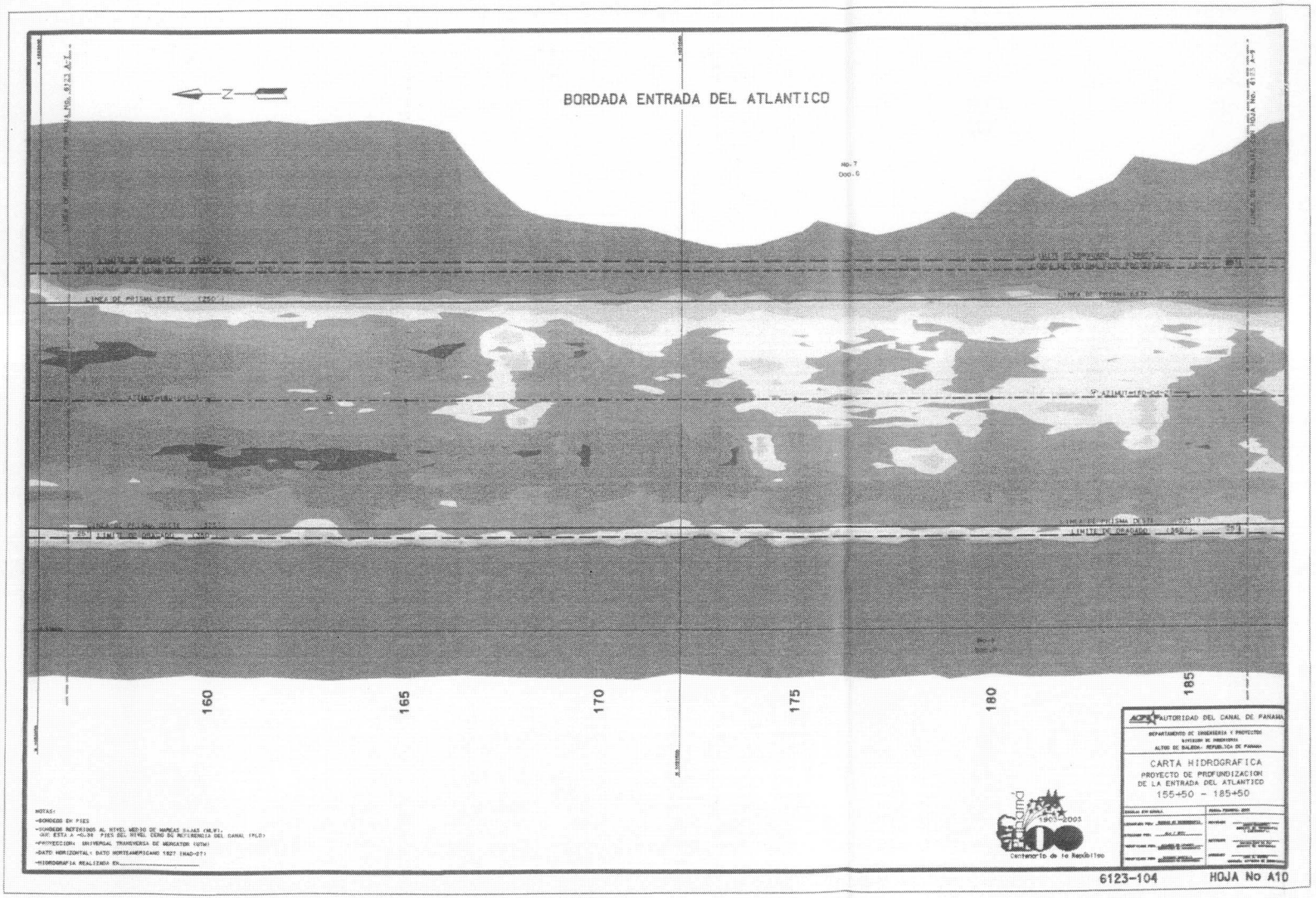
\6123_104_a8.dgn Feb. 14, 2003 10:36:36



ELEVACION PIES (METROS) PLD	PROFUNDIDAD PIES (METROS) MLW
MAS	MENOS
-39.9' (-12.2 M)	-39.5' (-12.0 M)
-42.4' (-12.9 M)	-42.0' (-12.8 M)
-46.4' (-14.1 M)	-46.0' (-14.0 M)
-48.4' (-14.8 M)	-48.0' (-14.6 M)
-50.4' (-15.4 M)	-50.0' (-15.2 M)
-53.4' (-16.3 M)	-53.0' (-16.2 M)
-55.4' (-16.9 M)	-55.0' (-16.8 M)
MENOS	MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SIZIGIA (MLWS) QUE ES -0.38 PIES PLD.

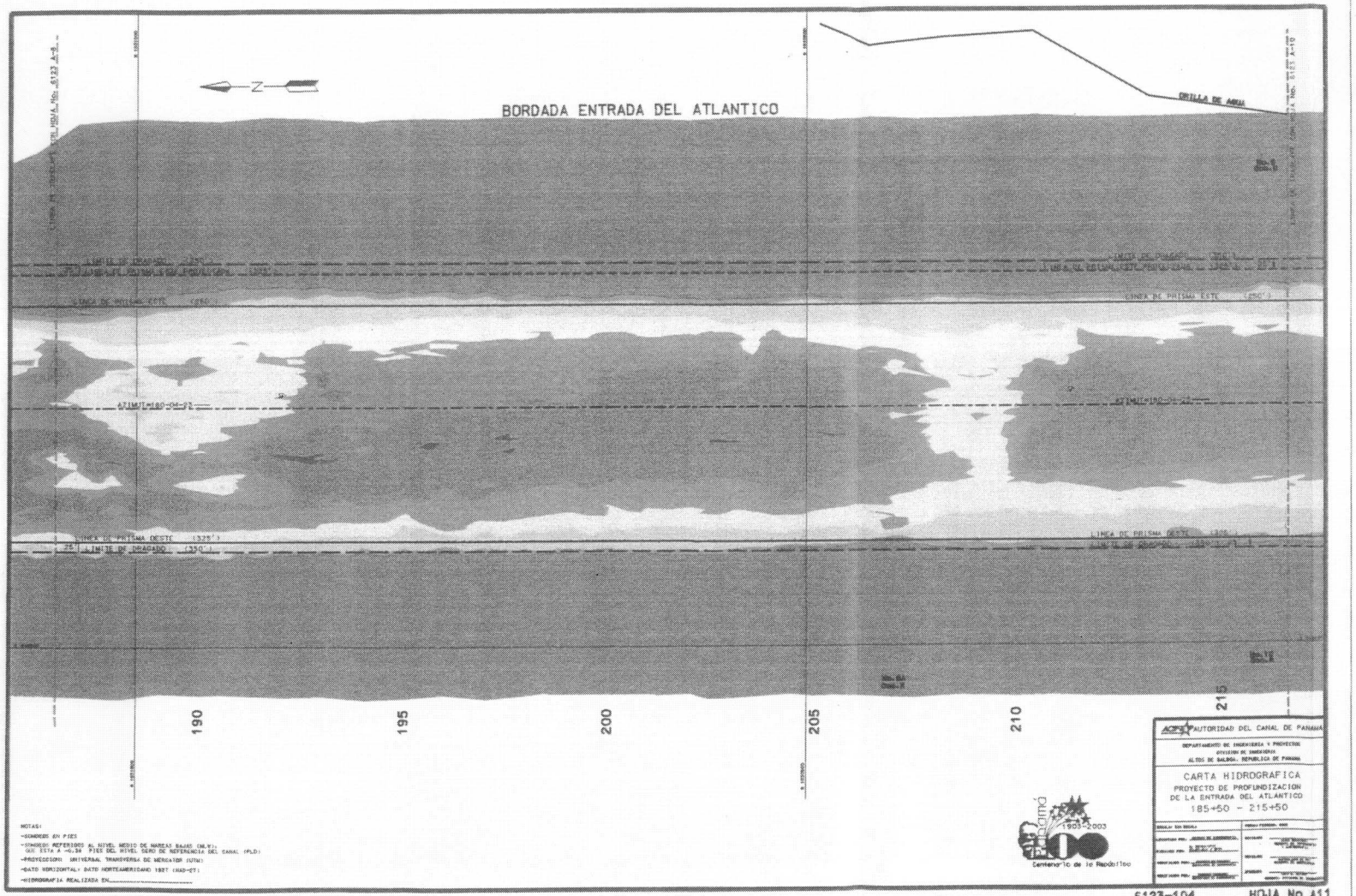
..\6123_104_a9.dgn Feb. 14, 2003 12:09:51



ELEVACION PIES (METROS) PLD	PROFUNDIDAD PIES (METROS) MLW
MAS	MENOS
-39.9' (-12.2 M)	-39.5' (-12.0 M)
-42.4' (-12.9 M)	-42.0' (-12.8 M)
-46.4' (-14.1 M)	-46.0' (-14.0 M)
-48.4' (-14.8 M)	-48.0' (-14.6 M)
-50.4' (-15.4 M)	-50.0' (-15.2 M)
-53.4' (-16.3 M)	-53.0' (-16.2 M)
-55.4' (-16.9 M)	-55.0' (-16.8 M)
MENOS	MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD), LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SIZIGIA (MLWS) QUE ES -0.50 PIES PLD.

6123_104_a10.dgn Feb. 14, 2003 14:16:13

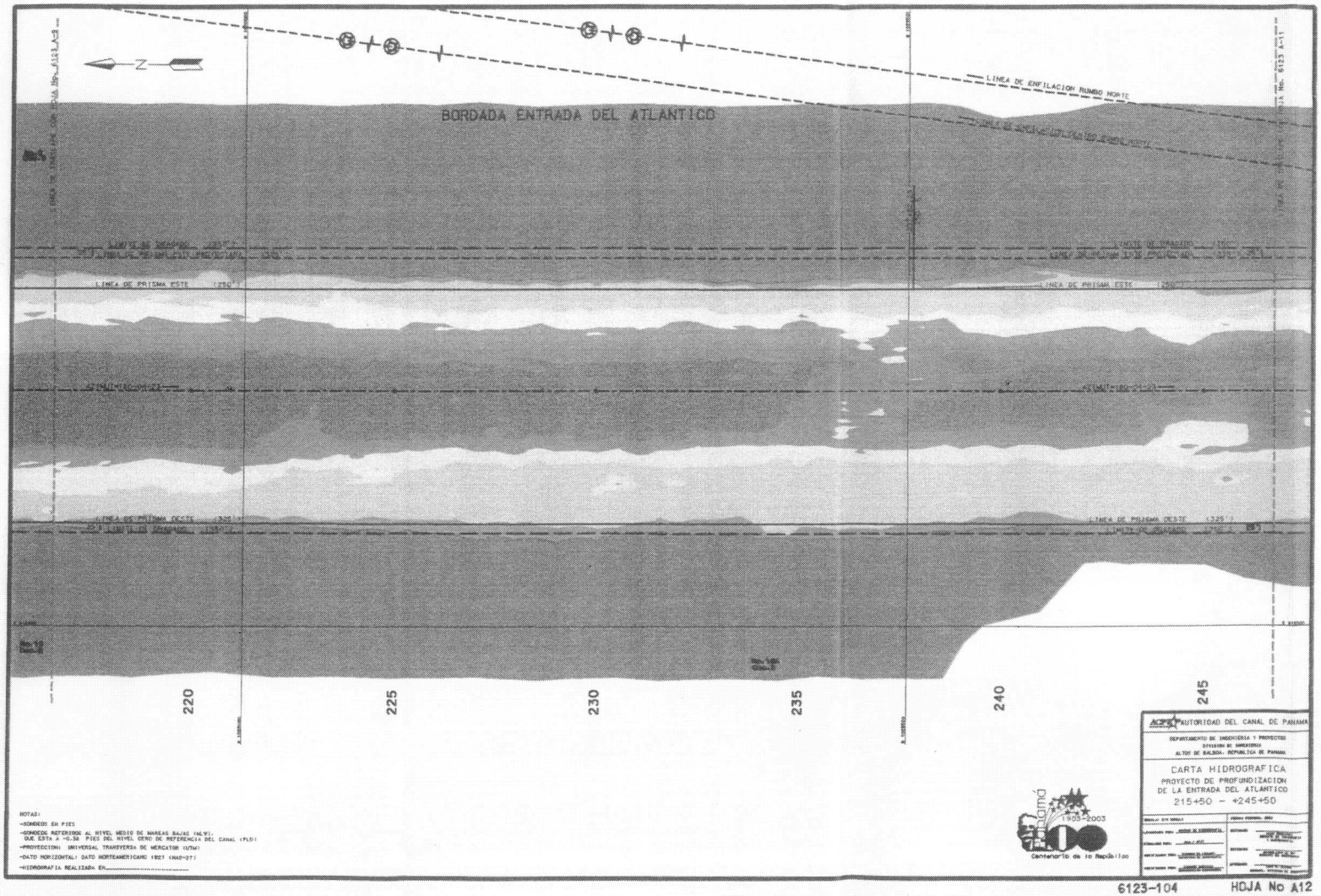


6123-104 HOJA No A11

ELEVACION PIES (METROS) PLD	PROFUNDIDAD PIES (METROS) MLW
MAS	MENOS
-39.9' (-12.2 M)	-39.5' (-12.0 M)
-42.4' (-12.9 M)	-42.0' (-12.8 M)
-46.4' (-14.1 M)	-46.0' (-14.0 M)
-48.4' (-14.8 M)	-48.0' (-14.6 M)
-50.4' (-15.4 M)	-50.0' (-15.2 M)
-53.4' (-16.3 M)	-53.0' (-16.2 M)
-55.4' (-16.9 M)	-55.0' (-16.8 M)
MENOS	MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SIZIGIA (M.W.S) QUE ES -0.38 PIES PLD.

6123_104_a11.dgn Feb. 14, 2003 14:47:58



NOTAS:
-SONDEOS EN PIES
-SONDEOS REFERIDOS AL NIVEL MEDIO DE MAREAS BAJAS (NLW), QUE ESTA A -0.38 PIES DEL NIVEL CERO DE REFERENCIA DEL CANAL (PLD)
-PROYECCION: UNIVERSAL TRANSVERSA DE MERCATOR (UTM)
-DATO HORIZONTAL: DATO NORTEAMERICANO 1927 (NAD-27)
-HIDROGRAFIA REALIZADA EN_____

Panamá 1903-2003 Centenario de la República

AUTORIDAD DEL CANAL DE PANAMA
DEPARTAMENTO DE INGENIERIA Y PROYECTOS
DIVISION DE HIDROGRAFIA
ALTOS DE BALBOA, REPUBLICA DE PANAMA

CARTA HIDROGRAFICA
PROYECTO DE PROFUNDIZACION
DE LA ENTRADA DEL ATLANTICO
215+50 - +245+50

6123-104 HOJA No A12

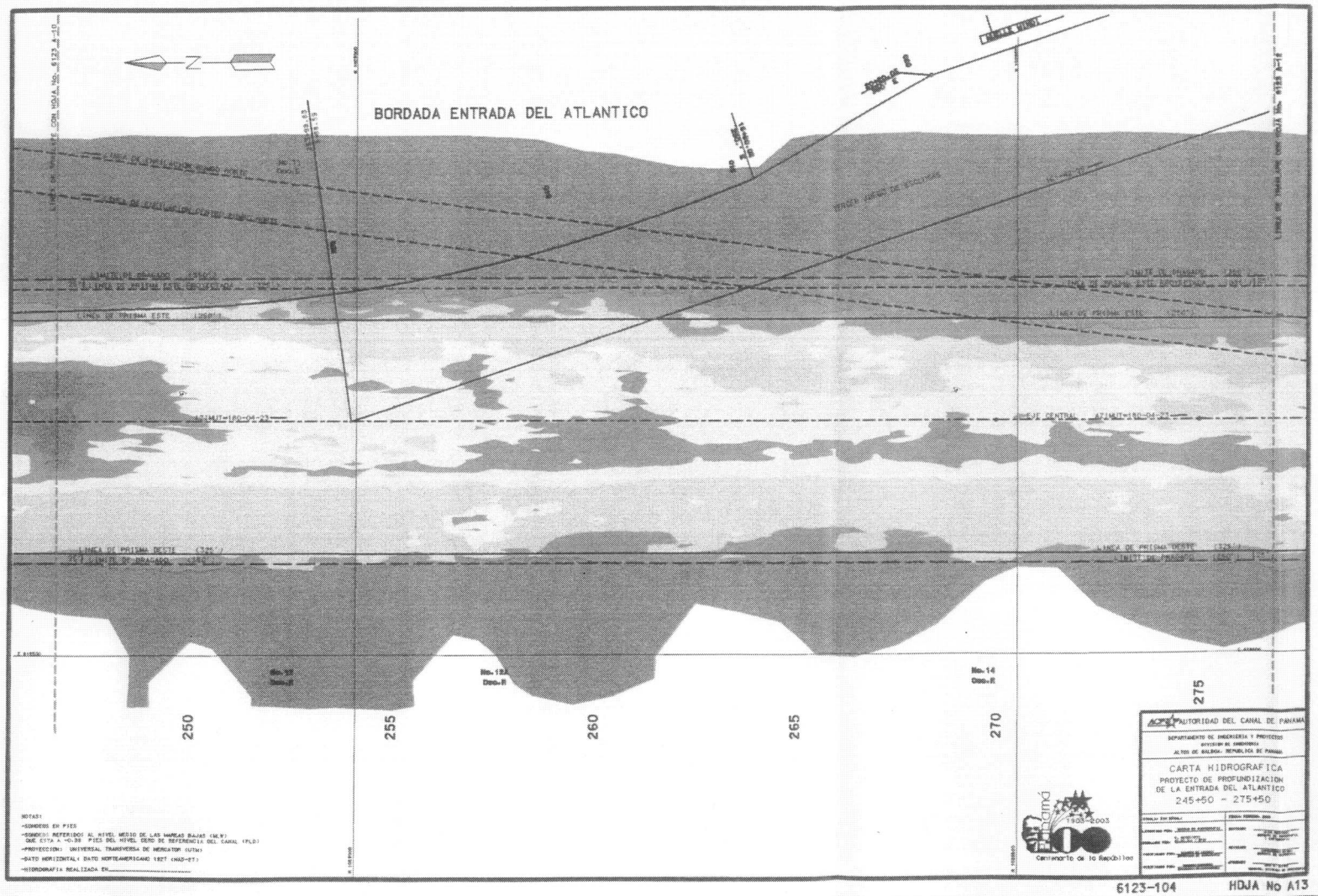
ELEVACION
PIES (METROS)
PLD

MAS	MENOS
-39.9' (-12.2 M)	-39.5' (-12.0 M)
-42.4' (-12.9 M)	-42.0' (-12.8 M)
-46.4' (-14.1 M)	-46.0' (-14.0 M)
-48.4' (-14.8 M)	-48.0' (-14.6 M)
-50.4' (-15.4 M)	-50.0' (-15.2 M)
-53.4' (-16.3 M)	-53.0' (-16.2 M)
-55.4' (-16.9 M)	-55.0' (-16.8 M)
MENOS	MAS

PROFUNDIDAD
PIES (METROS)
MLW

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SIZIGIA (MLWS) QUE ES -0.38 PIES PLD.

6123_104_a12.dgn Feb. 17, 2003 09:45:12



ELEVACION
PIES (METROS)
PLD

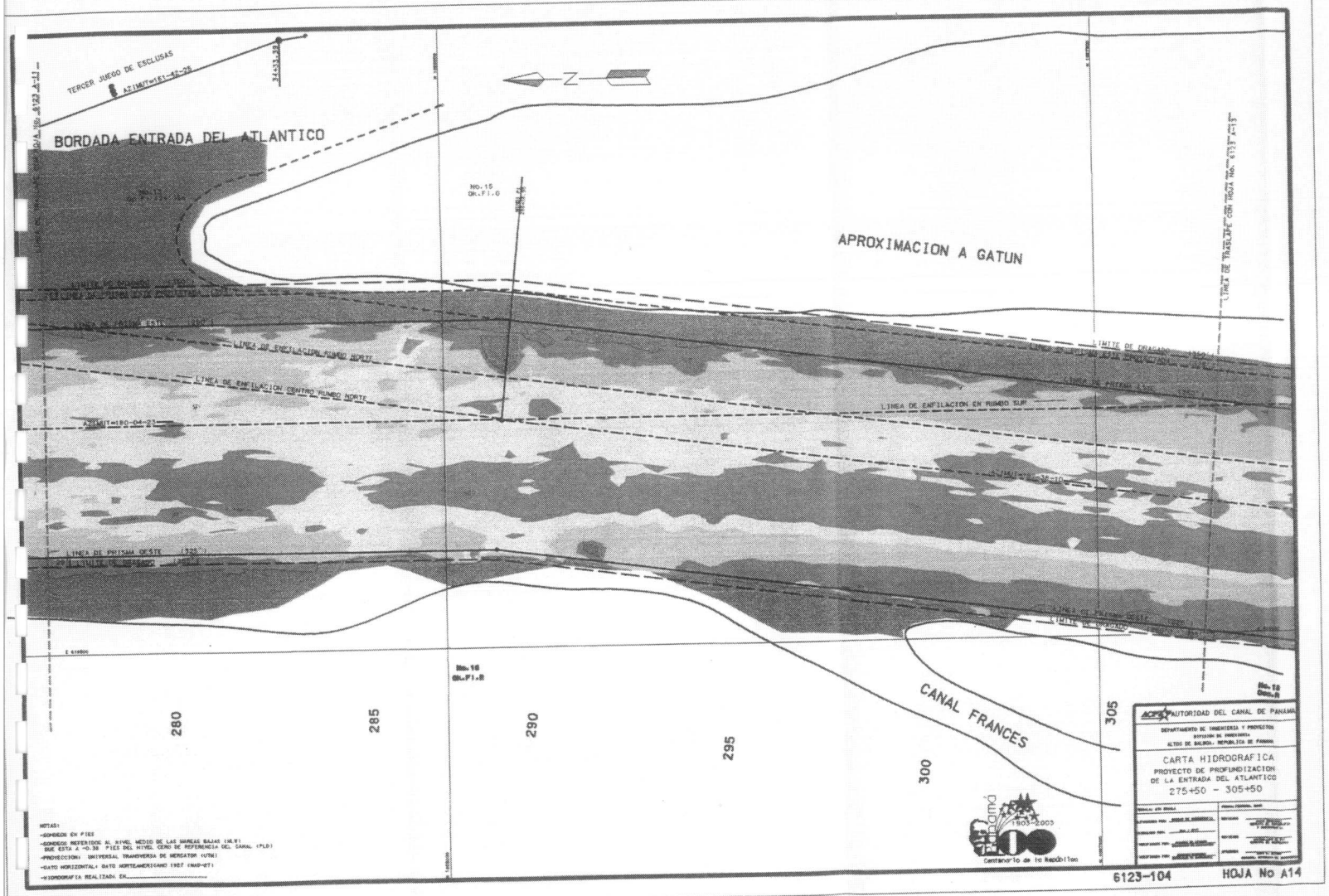
MAS
-39.9' (-12.2 M)
-42.4' (-12.9 M)
-46.4' (-14.1 M)
-48.4' (-14.8 M)
-50.4' (-15.4 M)
-53.4' (-16.3 M)
-55.4' (-16.9 M)
MENOS

PROFUNDIDAD
PIES (METROS)
MLW

MENOS
-39.5' (-12.0 M)
-42.0' (-12.8 M)
-46.0' (-14.0 M)
-48.0' (-14.6 M)
-50.0' (-15.2 M)
-53.0' (-16.2 M)
-55.0' (-16.8 M)
MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SICIGIA (MLWS) QUE ES -0.38 PIES PLD.

6123_104_a13.dgn Feb. 17, 2003 10:18:15



ELEVACION
PIES (METROS)
PLD

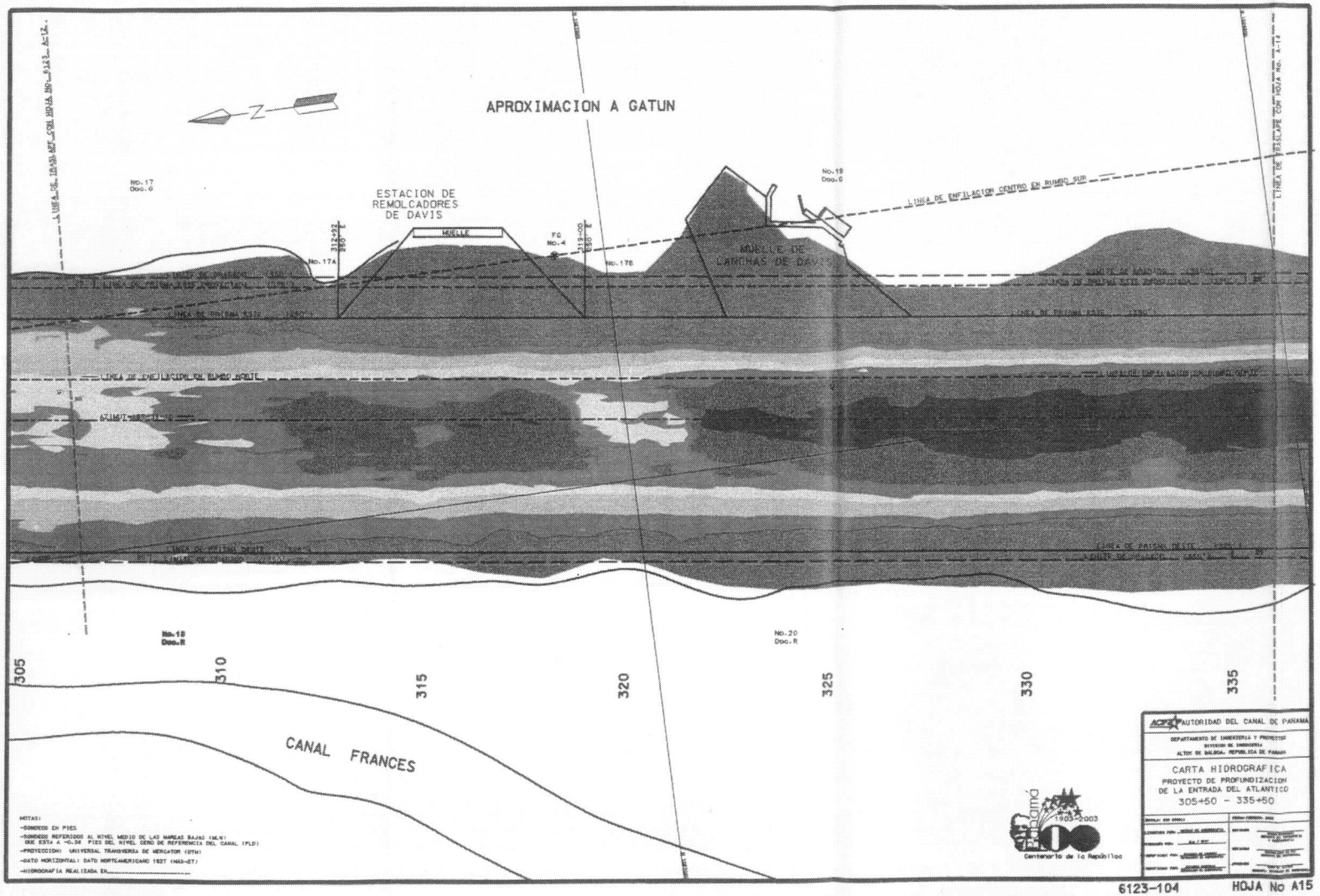
MAS
-39.9' (-12.2 M)
-42.4' (-12.9 M)
-46.4' (-14.1 M)
-48.4' (-14.8 M)
-50.4' (-15.4 M)
-53.4' (-16.3 M)
-55.4' (-16.9 M)
MENOS

PROFUNDIDAD
PIES (METROS)
MLW

MENOS
-39.5' (-12.0 M)
-42.0' (-12.8 M)
-46.0' (-14.0 M)
-48.0' (-14.6 M)
-50.0' (-15.2 M)
-53.0' (-16.2 M)
-55.0' (-16.8 M)
MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SIZIGIA (MLWS) QUE ES -0.38 PIES PLD.

123_104_a14.dgn Feb. 17, 2003 12:57:15



ELEVACION
PIES (METROS)
PLD

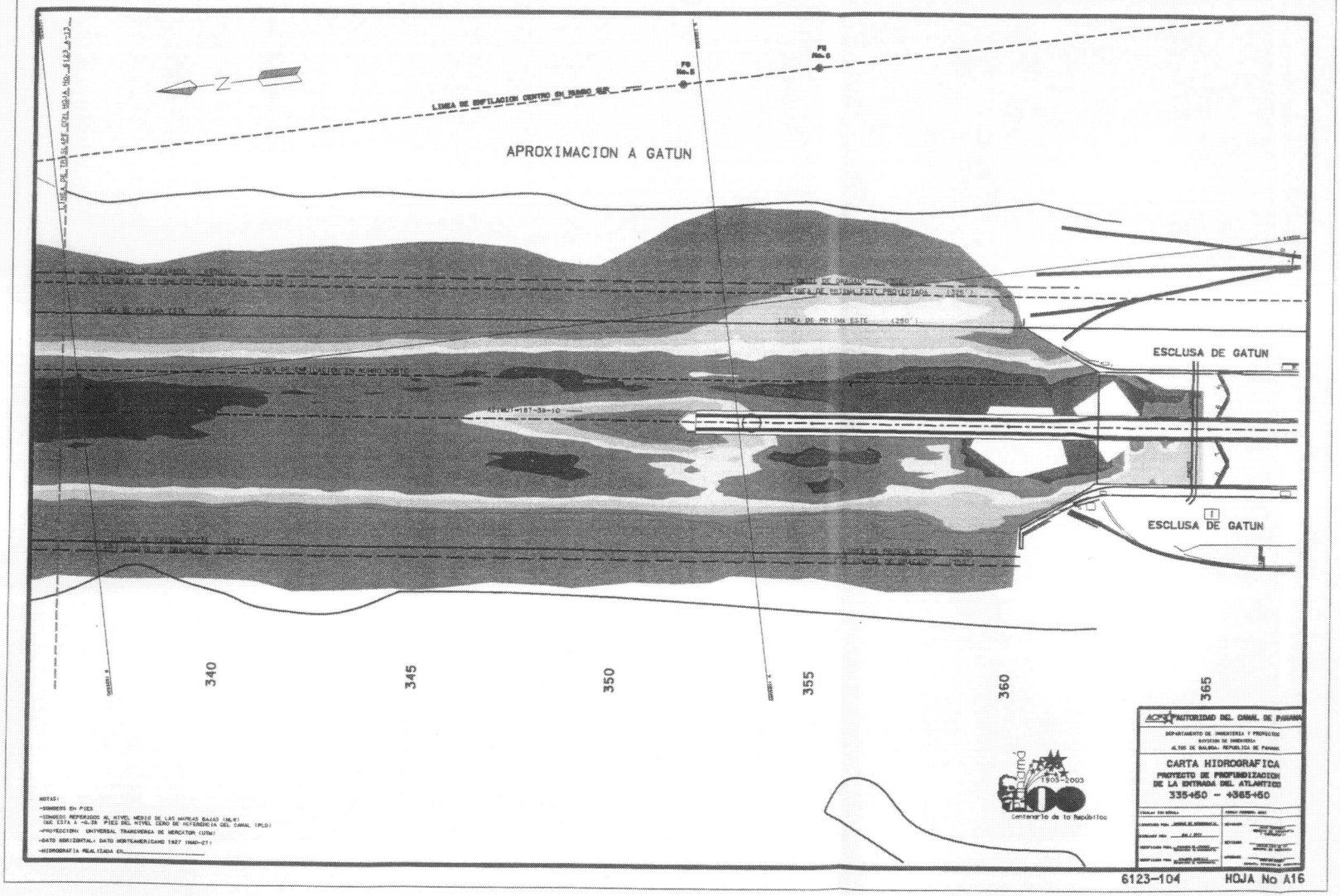
MAS
-39.9' (-12.2 M)
-42.4' (-12.9 M)
-46.4' (-14.1 M)
-48.4' (-14.8 M)
-50.4' (-15.4 M)
-53.4' (-16.3 M)
-55.4' (-16.9 M)
MENOS

PROFUNDIDAD
PIES (METROS)
MLW

MENOS
-39.5' (-12.0 M)
-42.0' (-12.8 M)
-46.0' (-14.0 M)
-48.0' (-14.6 M)
-50.0' (-15.2 M)
-53.0' (-16.2 M)
-55.0' (-16.8 M)
MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SICIGIA (MLWS) QUE ES -0.30 PIES PLD.

6123_104_a15.dgn Feb. 18, 2003 09:47:13



ELEVACION
PIES (METROS)
PLD

PROFUNDIDAD
PIES (METROS)
MLW

MAS	MENOS
-39.9' (-12.2 M)	-39.5' (-12.0 M)
-42.4' (-12.9 M)	-42.0' (-12.8 M)
-46.4' (-14.1 M)	-46.0' (-14.0 M)
-48.4' (-14.8 M)	-48.0' (-14.6 M)
-50.4' (-15.4 M)	-50.0' (-15.2 M)
-53.4' (-16.3 M)	-53.0' (-16.2 M)
-55.4' (-16.9 M)	-55.0' (-16.8 M)
MENOS	MAS

LAS ELEVACIONES ESTAN REFERIDAS AL NIVEL "0" DE REFERENCIA DEL CANAL (PLD). LAS PROFUNDIDADES ESTAN REFERIDAS AL NIVEL MEDIO DE LAS MAREAS BAJAS DE SICIGIA (MLWS) QUE ES -0.38 PIES PLD.

6123_104_a16.dgn Feb. 13, 2003 14:50:58

APPENDIX No. 5

Atlantic Entrance Dredging Volumes for 41.5', 46', and 50' draft

ATLANTIC ENTRANCE DREDGING VOLUME FOR 41.5' DRAFT

STATIONS	Dredging Volume from -44.8' to -46.88' PLD (m^3)	Overdredge Volume from -46.88' to -48.88' PLD (m^3)	Total Dredging Volume from -44.8' to -48.88' PLD (m^3)
STA(-2K+700 to -1K+000)	128	9,330	9,458
STA(-1K+000 to 3K+300)	212,992	246,542	459,534
STA(3K+300 to 7K+700)	290,357	245,393	535,750
STA(7K+700 to 9K+900)	280,901	202,417	483,318
STA(9K+900 to 10K+750)	199,024	55,598	254,622
TOTAL	**983,402**	**759,280**	**1,742,682**

ATLANTIC ENTRANCE DREDGING VOLUME FOR 46' DRAFT

STATIONS	Dredging Volume from -44.8' to -51.38' PLD (m^3)	Overdredge Volume from -51.38' to -53.38' PLD (m^3)	Total Dredging Volume from -44.8' to -53.38' PLD (m^3)
STA(-2K+700 to -1K+000)	90,020	188,475	278,495
STA(-1K+000 to 3K+300)	1,082,584	708,056	1,790,640
STA(3K+300 to 7K+700)	1,067,959	525,992	1,593,951
STA(7K+700 to 8K+800)	766,796	227,982	994,778
TOTAL	**3,007,359**	**1,650,505**	**4,657,864**

ATLANTIC ENTRANCE DREDGING VOLUME FOR 50' DRAFT

STATIONS	Dredging Volume from -44.8' to -55.38' PLD (m^3)	Overdredge Volume from -55.38' to -57.38' PLD (m^3)	Total Dredging Volume from -44.8' to -57.38' PLD (m^3)
STA(-2K+700 to -1K+000)	379,229	206,462	585,691
STA(-1K+000 to 3K+300)	2,219,422	572,659	2,792,081
STA(3K+300 to 7K+700)	2,165,139	559,643	2,724,782
STA(7K+700 to 8K+800)	1,244,896	252,375	1,497,271
TOTAL	**6,008,686**	**1,591,139**	**7,599,825**

APPENDIX No. 6

Atlantic Entrance Navigation Channel Marine Sub-bottom Geological Information

AUTORIDAD DEL CANAL DE PANAMA
Engineering Division - Geotechnical Branch

ATLANTIC MUCK

Introduction:
It is widely distributed in the Gatun Lake area between the north shore of the lake and Gamboa. Hills of the Gatun formation protrude through the black muck surface, representing islands completely surrounded by swamp and estuarine sediments. Muck deposits over 200 feet were found in some of the old borings in the area of Gatun dam. It comprises the Chagres, Trinidad and Gatun River valleys, with associated inland and coastal swamp areas.

Land Form:
The topography is of slight relief and is essentially the product of progressive sedimentation, as contrasted with the erosion processes involved in adjacent areas.

Origin:
In a relatively recent geological period, the land surface was higher than at present and the larger rivers of the Atlantic slope cut deep valleys. A period of subsidence followed, causing a reduction in the velocity of the streams, particularly along their lower courses, with resulting deposition of stream-borne silt and vegetable debris. Periodic encroachments of the sea resulted in brackish water conditions and a mingling of stream-borne clay, silt and vegetable matter with marine sediments. The latest geologic movement in the Atlantic coastal area raised the surfaces of the swampy estuary channels and tidal flats a few feet above sea level. The formation resulting from these processes of deposition is known as the Atlantic muck in the Gatun and neighboring areas.

Engineering Properties:
The muck deposits are uniformly soft and weak. They are composed predominantly of silt-sized sediments, and in their natural state of occurrence have very high moisture content. The depositional environment varied locally so that four facies are recognizable:

1. The border phase is adjacent to the contact with older formations and consists of gray to blue-gray silty clay.
2. The phase deposited in brackish marine areas contains an abundance of mollusk shells in an organic black silt matrix.
3. The swamp deposit portion of the formation is composed largely of black, very fine-grained organic materials, wood and other semi decayed vegetable substances intermixed with silt.
4. A soft, light gray or yellow-gray, weak, plastic, probably fluvial clay overlying the organic deposits.

The four facies intergrades laterally, and sandy lenses are present locally. The bedding is essentially horizontal. The surface of this formation was raised to its present position in late Pleistocene time.

Laboratory Tests:
Material obtained at 28 meters depth from core boring MHD-2, drilled at the Industrial Division of the ACP, at Mt. Hope, to the South of Cristobal, was taken to the soils lab for testing purposes. The index properties of the material, according to the UCS classification are as follows:

1. According to the UCS, the material is an MH (elastic sandy silt)
2. LL = 84
3. PI = 32
4. SG = 2.69
5. e = 2.3
6. $\gamma sat = 1434\ kg/m^3$
7. $\gamma dry = 848\ kg/m^3$
8. Consistency: OC-1 to OC-3 – Very soft to medium high consistency.

Adapted from
1947 -Isthmian Canal Studies
By Paulina Franceschi S.
26 July 2000

AUTORIDAD DEL CANAL DE PANAMA
Engineering Division - Geotechnical Branch

GATUN FORMATION

The type region of Gatun formation extends from Gatun Lake near Gatun northward to Mount Hope, near Colon. The base and the top of this formation are not exposed in the type region. It extends from the Atlantic entrance to one mile north of Puma Island in the Gatun Lake.

The formation has a thickness greater than 425 meters, as evidenced by core borings that have reached such depths, without reaching the base of the formation. In the Canal Area, the formation consists of massive, remarkably uniform beds of sandstone, siltstone, conglomerate and tuff medium soft to medium hard (RH-2 to RH-3); the formation is fairly strong, but soft enough to be excavated with ease. Most of the sandstone is fine-grained, and the sandstone and siltstone are variably calcareous, and somewhat tuffaceous. The tuff is almost invariably very fine-grained, and forms light colored outcrops in excavations. Fine-grained sandstones are interbedded with fine-textured volcanic tuffs and occasional thin conglomerate beds.

The formation is very fossiliferous, containing well-preserved mega- and microfossils of Miocene age. The massive, uniform beds of this formation represent uniform conditions of deposition, attaining thickness in excess of 100 feet.

The formation is not very jointed, being the material massive, except for the tuff beds, which are moderately jointed.

Adapted from
Stewart & Stewart
By Pastora Franceschi S.
1986

APPENDIX No. 7

ACP cutter suction dredge MINDI historical performance in the Atlantic Entrance

MINDI PRODUCTION AT ATLANTIC ENTRANCE

(0CT' 94 TO FEB' 96)

Appendix No. 7

DATE	RUN TIME (HOURS)	ADVANCE (ft)	VOLUME BCY	VOLUME BCM	BCM PER WEEK	AVERAGE PIPELINE	AVERAGE BCM/HR	PROJECT	DREDGE EQUIPMENT
OCT.94	407	7,785	528,287	403,273	87,821	5,762	992	ATL. ENT. Widening.	MINDI
NOV.94	426	4,765	660,283	504,033	104,743	5,828	1,183	ATL. ENT. Widening.	MINDI
DEC.94	333	1,475	252,077	192,425	51,183	5,362	578	ATL. ENT. Widening.	MINDI
JAN.95	68	205	36,400	27,786	**36,098**	5,250	408	ATL. ENT. Widening.	MINDI
FEB.95	361	1,875	261,182	199,376	48,871	4,202	552	ATL. ENT. Widening.	MINDI
MAR.95	117	400	64,870	49,519	37,347	3,533	422	ATL. ENT. Widening.	MINDI
JUN.95	42	1,020	83,000	63,359	[redacted]	3,366	1,523	ATL. ENT. Widening.	MINDI
NOV.95	110	4,570	194,433	148,422	119,632	4,777	1,351	ATL. ENT. Widening.	MINDI
FEB.96	177	4,598	185,622	141,697	71,049	6,790	802	ATL. ENT. Widening.	MINDI

LEAST [redacted]

MEAN	71,049
AVERAGE	76,849
STDEV	36,733
MAX	134,898

868
415

JAN.95	265	2,300	286,644	218,812	73 180	4,100	826	GATT. APP.	MINDI
MAR.95	265	1,260	212,029	161,854	54,088	3,889	611	GATT. APP.	MINDI
APR.95	335	1,300	186,835	142,622	**37,746**	2,666	426	GATT. APP.	MINDI
MAY.95	404	2,645	419,248	320.036	70,091	3,237	792	GATT. APP.	MINDI
JUN.95	154	2,235	259,518	198,106	[redacted]	5,375	1,288	GATT. APP.	MINDI
NOV.95	190	1,690	155,879	118,992	55,509	5,111	627	GATT. APP.	MINDI
DEC.95	345	4,750	503,608	384,434	98,809	8,220	1,116	GATT. APP.	MINDI
JAN.96	364	1,505	235,967	180,127	43,762	3,205	494	GATT. APP.	MINDI
FEB.96	163	2,570	179,097	136,715	74,193	9,780	838	GATT. APP.	MINDI

MEAN	70,091
AVERAGE	69,049
STDEV	24,956
MAX	114,059

780
282

DATE	RUN TIME (HOURS)	ADVANCE (ft)	VOLUME BCY	VOLUME BCM	BCM PER WEEK	AVERAGE PIPELINE	AVERAGE BCM/HR	PROJECT	DREDGE EQUIPMENT
OCT.94	407	7,785	528,287	403,273	87,821	5,762	992	ATL. ENT. Widening.	MINDI
NOV.94	426	4,765	660,283	504,033	104,743	5,828	1,183	ATL. ENT. Widening.	MINDI
DEC.94	333	1,475	252,077	192,425	51,183	5,362	578	ATL. ENT. Widening.	MINDI
JAN.95	68	205	36,400	27,786	**36,098**	5,250	408	ATL. ENT. Widening.	MINDI
FEB.95	361	1,875	261,182	199,376	48,871	4,202	552	ATL. ENT. Widening.	MINDI
MAR.95	117	400	64,870	49,519	37,347	3,533	422	ATL. ENT. Widening.	MINDI
JUN.95	42	1,020	83,000	63,359	[redacted]	3,366	1,523	ATL. ENT. Widening.	MINDI
NOV.95	110	4,570	194,433	148,422	119,632	4,777	1,351	ATL. ENT. Widening.	MINDI
FEB.96	177	4,598	185,622	141,697	71,049	6,790	802	ATL. ENT. Widening.	MINDI
JAN.95	265	2,300	286,644	218,812	73,180	4,100	826	GATT. APP.	MINDI
MAR.95	265	1,260	212,029	161,854	54,088	3,889	611	GATT. APP.	MINDI
APR.95	335	1,300	186,835	142,622	**37,746**	2,666	426	GATT. APP.	MINDI
MAY.95	404	2,645	419,248	320,036	70,091	3,237	792	GATT. APP.	MINDI
JUN.95	154	2,235	259,518	198,106	[redacted]	5,375	1,288	GATT. APP.	MINDI
NOV.95	190	1,690	155,879	118,992	55,509	5,111	627	GATT. APP.	MINDI
DEC.95	345	4,750	503,608	384,434	98,809	8,220	1,116	GATT. APP.	MINDI
JAN.96	364	1,505	235,967	180,127	43,762	3,205	494	GATT. APP.	MINDI
FEB.96	163	2,570	179,097	136,715	74,193	9,780	838	GATT. APP.	MINDI

MEAN	70,570
AVERAGE	72,949
STDEV	30,728
MAX	134,898
MIN	36,098

824
347

APPENDIX No. 8

Atlantic Entrance Deepening for 41.5', 46', and 50' Draft Calculations

Assuming that Cutter Suction Dredge Productivity is same as ACP Cutter Suction Dredge MINDI

Atlantic Entrance Deepening for 41.5' Draft Calculation

Scheme No. 1: One Cutter Suction Dredge
Scheme No. 2: Two Cutter Suction Dredges

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 41.5 FT - 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev. 21)

1	B	C	D	E	F	G
2	REACHES	AREA AND VOLUME - DRAFT 41.5'				
3		Dredging Volume from -44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	D&B from -44.88 to -54.88 PLD(mts^2)	% Drilling & Blasting Required	Net Area for D&B - 44.88´to -54.88' PLD (mts2)
4	ATLANTIC ENTRANCE					
5	STA(-2k+700 @ -1k+000)	128	9,330	362,712	0%	0
6	STA(-1k+000 @ 3k+300)	212,992	246,542	917,449	0%	0
7	STA(3k+300 @ 7k+700)	290,357	245,393	938,784	0%	0
8	STA(7k+700 @ 9k+900)	280,901	202,417	458,420	0%	0
9	STA(9k+900 @ 10k+750)	199,024	55,598	163,500	0%	0
10	TOTAL	983,402	759,280	2,840,865		0

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 41.5 FT - 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev. 21)

Celda: C3
Comentario: The dredging volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software.

Celda: F3
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to the percentage of drilling and blasting(Col. F).

DREDGING VOLUME AND DURATION BY REACH
DRAFT 41.5'- 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev.21)

1	B	C	D	E	F	G	H	I	J	K	L	M	N
2	**REACHES**	**VOLUME - DRAFT 41.5' (m^3)**			Hard & Medium Material Estimated Percentage	Hard and medium material volume (mts^3)	Soft material volume (mts^3)	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3/WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from 44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	[illegible] ENTRANCE												
5	**STA(-2k+700 @ -1k+000)**	128	9,330	9,458	0%	0	9,458	New Dredge	25,000	60,000	0	0.2	0.2
6	**STA(-1k+000 @ 3k+300)**	212,992	246,542	459,534	0%	0	459,534	New Dredge	25,000	60,000	0	8	8
7	**STA(3k+300 @ 7k+700)**	290,357	245,393	535,750	0%	0	535,750	New Dredge	25,000	60,000	0	9	9
8	**STA(7k+700 @ 9k+900)**	280,901	202,417	483,318	100%	483,318	0	New Dredge	25,000	60,000	19	0	19
9	**STA(9k+900 @ 10k+750)**	199,024	55,598	254,622	100%	254,622	0	New Dredge	25,000	60,000	10	0	10
10	TOTAL	**983,402**	**759,280**	**1,742,682**		**737,940**	**1,004,742**				30	17	**46**

DREDGING VOLUME AND DURATION BY REACH
DRAFT 41.5'- 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev.21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in thy canal.

Celda: G2
Comentario: Hard and [illegible] material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: Average historical value provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Survey Branch .

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch .

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING COST
DRAFT 41.5' - 25,000 m3/wk
(Basic=1 dredge; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K
2	REACHES	VOLUME - DRAFT 41.5' (m^3)			Available Dredge	Hard and medium material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from -44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Material	Soft material	
4	ALTERNATIVE									
5	STA(-2k+700 @ -1k+000)	128	9,330	9,458	New Dredge	0	9,458	$14.07	$5.86	$55,424
6	STA(-1k+000 @ 3k+300)	212,992	246,542	459,534	New Dredge	0	459,534	$14.07	$5.86	$2,692,869
7	STA(3k+300 @ 7k+700)	290,357	245,393	535,750	New Dredge	0	535,750	$14.07	$5.86	$3,139,495
8	STA(7k+700 @ 9k+900)	280,901	202,417	483,318	New Dredge	483,318	0	$14.07	$5.86	$6,800,284
9	STA(9k+900 @ 10k+750)	199,024	55,598	254,622	New Dredge	254,622	0	$14.07	$5.86	$3,582,532
10	**TOTAL**	**983,402**	**759,280**	**1,742,682**						**$16,270,604**
11										

DREDGING COST
DRAFT 41.5' - 25,000 m3/wk
(Basic=1 dredge; without drilling)
(rev. 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: I2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition, and prepared by the Canal Capacity Pr[illegible]s Division.

Celda: J2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therfore the formula used was equal to=(Col.G*Col.I + Col.H*Col.J)

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 41.5 FT - 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G
2	REACHES	AREA AND VOLUME - DRAFT 41.5'				
3		Dredging Volume from -44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	D&B from -44.88 to -54.88 PLD(mts^2)	% Drilling & Blasting Required	Net Area for D&B 44.88'to -54.88' PLD (mts2)
4	[illegible]					
5	STA(-2k+700 @ -1k+000)	128	9,330	362,712	0%	0
6	STA(-1k+000 @ 3k+300)	212,992	246,542	917,449	0%	0
7	STA(3k+300 @ 7k+700)	290,357	245,393	938,784	0%	0
8	STA(7k+700 @ 9k+900)	280,901	202,417	458,420	0%	0
9	STA(9k+900 @ 10k+750)	199,024	55,598	163,500	0%	0
10	TOTAL	983,402	759,280	2,840,865		0

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 41.5 FT - 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev. 21)

Celda: C3
Comentario: The dredging volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software.

Celda: F3
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to the percentage of drilling and blasting(Col. F)

DREDGING VOLUME AND DURATION BY REACH
DRAFT 41.5'- 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev.21)

1	B	C	D	E	F	G	H	I	J	K	L	M	N
2	REACHES	VOLUME - DRAFT 41.5' (m^3)			Hard & Medium Material Estimated Percentage	Hard and medium material volume (mts^3)	Soft material volume (mts^3)	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3/WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from 44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	[redacted]												
5	**STA(-2k+700 @ -1k+000)**	128	9,330	9,458	0%	0	9,458	Dredge No 1	25,000	60,000	0	0.2	0.2
6	**STA(-1k+000 @ 3k+300)**	212,992	246,542	459,534	0%	0	459,534	Dredge No 2	25,000	60,000	0	8	8
7	**STA(3k+300 @ 7k+700)**	290,357	245,393	535,750	0%	0	535,750	Dredge No 2	25,000	60,000	0	9	9
8	STA(7k+700 @ 9k+900)	280,901	202,417	483,318	100%	483,318	0	Dredge No 1	25,000	60,000	19	0	19
9	S 9k+900 @ 10k+750)	199,024	55,598	254,622	100%	254,622	0	Dredge No 1	25,000	60,000	10	0	10
10	TOTAL	**983,402**	**759,280**	**1,742,682**		**737,940**	**1,004,742**				30	17	**30**

DREDGING VOLUME AND DURATION BY REACH
DRAFT 41.5'- 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev.21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in thy canal.

Celda: G2
Comentario: Hard and medium material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: Average historical value provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Survey Branch

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch .

Celda: F3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING COST
DRAFT 41.5' - 25,000 m3/wk
(2 dredge=Mindi; without drilling)
(rev. 21)

	B	C	D	E	F	G	H	I	J	K
1										
2	REACHES	VOLUME - DRAFT 41.5' (m^3)			Available Dredge	Hard and medium material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from -44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Material	Soft material	
4	ATLANTIC RANGE									
5	STA(-2k+700 @ -1k+000)	128	9,330	9,458	Dredge No 1	0	9,458	$14.07	$5.86	$55,424
6	STA(-1k+000 @ 3k+300)	212,992	246,542	459,534	Dredge No 2	0	459,534	$14.07	$5.86	$2,692,869
7	STA(3k+300 @ 7k+700)	290,357	245,393	535,750	Dredge No 2	0	535,750	$14.07	$5.86	$3,139,495
8	STA(7k+700 @ 9k+900)	280,901	202,417	483,318	Dredge No 1	483,318	0	$14.07	$5.86	$6,800,284
9	STA(9k+900 @ 10k+750)	199,024	55,598	254,622	Dredge No 1	254,622	0	$14.07	$5.86	$3,582,532
10	TOTAL	**983,402**	**759,280**	**1,742,682**						**$16,270,604**
11										

DREDGING COST
DRAFT 41.5' - 25,000 m3/wk
(2 dredge=Mindi; without drilling)
(rev. 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: I2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition, and prepared by the Canal Capacity Projects Division.

Celda: K2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therfore the formula used was equal to=(Col G*Col.I + Col.H*Col.J).

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

Atlantic Entrance Deepening for 46'Draft Calculation

Scheme No. 1: One Cutter Suction Dredge
Scheme No. 2: Two Cutter Suction Dredges

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46'- 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev.21)

1	B	C	D	E	F	G
2	**REACHES**	**AREA AND VOLUME - DRAFT 46'**				
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	D&B from -44.88' to -59.38'(mts^2)	% Drilling & Blasting Required	Net Area for D&B - 44.88' to -59.38 PLD (mts2)
4	[illegible]					
5	**STA(-2k+700 @ -1k+000)**	90,020	188,475	362,712	0%	0
6	**STA(-1k+000 @ 3k+300)**	1,082,584	708,056	917,449	0%	1
7	**STA(3k+300 @ 7k+700)**	1,067,959	525,992	938,784	0%	0
8	**STA(7k+700 @ 8k+800)**	766,796	227,982	229,210	0%	0
9	**TOTAL**	3,007,359	1,650,505	2,448,155		0

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46'- 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev.21)

Celda: C3
omentario: The dredging volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software.

Celda: F3
omentario: Percentages based on MIND: Captain dredging experience in the canal

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to value of drilling and blasting(Col. F).

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46'- 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K	L	M	N
2	REACHES	VOLUME - DRAFT 46' (m^3)			Hard and Medium Material Estimated Percentage	Hard and medium material volume (m^3)	Soft material volume (m^3)	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3/ WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	ATLANTIC ENTRANCE												
5	**STA(-2k+700 @ -1k+000)**	90,020	188,475	278,495	0%	0	278,495	Dredge No 1	25000	60,000	0	5	5
6	**STA(-1k+000 @ 3k+300)**	1,082,584	708,056	1,790,640	0%	0	1,790,640	Dredge No 1	25000	60,000	0	30	30
7	**STA(3k+300 @ 7k+700)**	1,067,959	525,992	1,593,951	0%	0	1,593,951	Dredge No 1	25000	60,000	0	27	27
8	**STA(7k+700 @ 8k+800)**	766,796	227,982	994,778	100%	994,778	0	Dredge No 1	25000	60,000	40	0	40
9	TOTAL	3,007,359	1,650,505	**4,657,864**		**994,778**	**3,663,086**						**101**

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46'- 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev. 21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G2
Comentario: Hard and medium material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: Average historical value provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Survey Branch .

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch .

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING COST TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46' - 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K
2	REACHES	VOLUME - DRAFT 46' (m^3)			Available Dredge	Hard and medium hard material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Hard Material	Soft material	
4	ATLANTIC ENTRANCE									
5	STA(-2k+700 @ -1k+000)	90,020	188,475	278,495	Dredge No 1	0	278,495	$14.07	$5.86	$1,631,981
6	STA(-1k+000 @ 3k+300)	1,082,584	708,056	1,790,640	Dredge No 1	0	1,790,640	$14.07	$5.86	$10,493,150
7	STA(3k+300 @ 7k+700)	1,067,959	525,992	1,593,951	Dredge No 1	0	1,593,951	$14.07	$5.86	$9,340,553
8	STA(7k+700 @ 8k+800)	766,796	227,982	994,778	Dredge No 1	994,778	0	$14.07	$5.86	$13,996,526
9	TOTAL	**3,007,359**	**1,650,505**	**4,657,864**						**$35,462,210**
10										

DREDGING COST TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46' - 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev. 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: I2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition.

Celda: K2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therefore the formula used was equal to=(Col G*Col.I + Col.H*Col.I)

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46'- 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev.21)

1	B	C	D	E	F	G
2	**REACHES**	**AREA AND VOLUME - DRAFT 46'**				
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	D&B from -44.88' to -59.38'(mts^2)	% Drilling & Blasting Required	Net Area for D&B - 44.88' to -59.38' PLD (mts2)
4						
5	**STA(-2k+700 @ -1k+000)**	90,020	188,475	362,712	0%	3
6	**STA(-1k+000 @ 3k+300)**	1,082,584	708,056	917,449	0%	0
7	**STA(3k+300 @ 7k+700)**	1,067,959	525,992	938,784	0%	0
8	**STA(7k+700 @ 8k+800)**	766,796	227,982	229,210	0%	0
9	**TOTAL**	3,007,359	1,650,505	2,448,155		0

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46'- 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev.21)

Celda: C3
omentario: The dredging volume was estimated by the Survey Branch in December 2002. and includes an overswing of 25 feet at each side of the canal.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software.

Celda: F3
omentario: Percentages based on MINDI Captain dredging experience in the canal

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to value of drilling and blasting(Col. F).

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46'- 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K	L	M	N
2	REACHES	VOLUME - DRAFT 46' (m^3)			Hard and Medium Material Estimated Percentage	Hard and medium material volume (m^3)	Soft material volume (m^3)	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3/ WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	ATLANTIC ENTRANCE												
5	**STA(-2k+700 @ -1k+000)**	90,020	188,475	278,495	0%	0	278,495	Dredge No 1	25000	60,000	0	5	5
6	STA(**-1k+000 @ 3k+300**)	1,082,584	708,056	1,790,640	0%	0	1,790,640	Dredge No 2	25000	60,000	0	30	30
7	STA(**3k+300 @ 7k+700**)	1,067,959	525,992	1,593,951	0%	0	1,593,951	Dredge No 2	25000	60,000	0	27	27
8	**STA(7k+700 @ 8k+800)**	766,796	227,982	994,778	100%	994,778	0	Dredge No 1	25000	60,000	40	0	40
9	**TOTAL**	**3,007,359**	**1,650,505**	**4,657,864**		**994,778**	**3,663,086**						**56**

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46'- 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev. 21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G2
Comentario: Hard and medium material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: Average historical value provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Survey Branch .

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch .

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING COST TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46' - 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K
2	**REACHES**	**VOLUME - DRAFT 46' (m^3)**			Available Dredge	Hard and medium hard material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Hard Material	Soft material	
4	ATLANTIC ENTRANCE									
5	**STA(-2k+700 @ -1k+000)**	90,020	188,475	278,495	Dredge No 1	0	278,495	$14.07	$5.86	$1,631,981
6	**STA(-1k+000 @ 3k+300)**	1,082,584	708,056	1,790,640	Dredge No 2	0	1,790,640	$14.07	$5.86	$10,493,150
7	**STA(3k+300 @ 7k+700)**	1,067,959	525,992	1,593,951	Dredge No 2	0	1,593,951	$14.07	$5.86	$9,340,553
8	**STA(7k+700 @ 8k+800)**	766,796	227,982	994,778	Dredge No 1	994,778	0	$14.07	$5.86	$13,996,526
9	TOTAL	**3,007,359**	**1,650,505**	**4,657,864**						**$35,462,210**
10										

DREDGING COST TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46' - 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev. 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: I2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition.

Celda: K2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therefore the formula used was equal to=(Col G*Col.I + Col.H*Col.J).

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

Atlantic Entrance Deepening for 50' Draft Calculation

Scheme No. 1: One Cutter Suction Dredge
Scheme No. 2: Two Cutter Suction Dredges

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev. 21)

1	B	C	D	E	F	G
2	**REACHES**	**AREA AND VOLUME - DRAFT 50'**				
3		Dredging Volume from -44.88' to -55.38' PLD (mts3)	Overdredge Volume from -55.38' to -57.38' PLD (mts3)	D&B from -44.88 to -63.38(mts^2)	% Drilling & Blasting Required	Net Area for D&B -44.88'to -63.38' PLD (mts2)
4						
5	**STA(-2k+700 @ -1k+000)**	379,229	206,462	362,712	0%	0
6	**STA(-1k+000 @ 3k+300)**	2,219,422	572,659	917,449	0%	0
7	**STA(3k+300 @ 7k+700)**	2,165,139	559,643	938,784	0%	0
8	**STA(7k+700 @ 8k+800)**	1,244,896	252,375	229,210	0%	0
9	**TOTAL**	6,008,686	1,591,139	2,448,155		0

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev. 21)

Celda: C3
Comentario: The dredging volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software.

Celda: F3
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to the value o drilling and blasting requiered(Col. F).

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev.21)

1	B	C	D	E	F	G	H	I	J	K	L	M	N
2	REACHES	VOLUME - DRAFT 50' (m^3)			Hard Material Estimated Percentage	Hard and medium material volume	Soft material volume	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3 / WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from -44.88' to -55.38' PLD (mts3)	Overdredge Volume from -55.38' to -57.38' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	[redacted]												
5	**STA(-2k+700 @ -1k+000)**	379,229	206,462	585,691	0%	0	585,691	Dredge No 1	25,000	60,000	0	10	10
6	**STA(-1k+000 @ 3k+300)**	2,219,422	572,659	2,792,081	0%	0	2,792,081	Dredge No 1	25,000	60,000	0	47	47
7	**STA(3k+300 @ 7k+700)**	2,165,139	559,643	2,724,782	0%	0	2,724,782	Dredge No 1	25,000	60,000	0	45	45
8	STA(7k+700 @ 8k+800)	1,244,896	252,375	1,497,271	100%	1,497,271	0	Dredge No 1	25,000	60,000	60	0	60
9	**TOTAL**	**6,008,686**	1,591,139	**7,599,825**		**1,497,271**	**6,102,554**				60	102	**162**

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev.21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G2
Comentario: Hard and medium material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: Average historical value provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Geothechnical Section .

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING COST ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K
2	REACHES	VOLUME - DRAFT 50' (m^3)			Available Dredge	Hard and medium material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from 44.88' to -55.38' PLD (mts3)	Overdredge Volume from -55.38' to -57.38' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Material	Soft material	
4	ATLANTIC ENTRANCE									
5	**STA(-2k+700 @ -1k+000)**	379,229	206,462	585,691	Dredge No 1	0	585,691	$14.07	$5.86	$3,432,149
6	**STA(-1k+000 @ 3k+300)**	2,219,422	572,659	2,792,081	Dredge No 1	0	2,792,081	$14.07	$5.86	$16,361,595
7	**STA(3k+300 @ 7k+700)**	2,165,139	559,643	2,724,782	Dredge No 1	0	2,724,782	$14.07	$5.86	$15,967,223
8	**STA(7k+700 @ 8k+800)**	1,244,896	252,375	1,497,271	Dredge No 1	1,497,271	0	$14.07	$5.86	$21,066,603
9	**TOTAL**	**6,008,686**	**1,591,139**	**7,599,825**						**$56,827,569**
10										

DREDGING COST ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(Basic=1 dredge; without drilling)
(rev. 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: I2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition, and prepared by the Canal Capacity Projects Division.

Celda: K2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therfore the formula used was equal to=(Col G*Col.I + Col.H*Col.J).

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G
2	REACHES	AREA AND VOLUME - DRAFT 50'				
3		Dredging Volume from -44.88' to -55.38' PLD (mts3)	Overdredge Volume from -55.38' to -57.38' PLD (mts3)	D&B from -44.88 to -63.38(mts^2)	% Drilling & Blasting Required	Net Area for D&B -44.88'to -63.38' PLD (mts2)
4	ATLANTIC ENTRANCE					
5	STA(-2k+700 @ -1k+000)	379,229	206,462	362,712	0%	0
6	STA(-1k+000 @ 3k+300)	2,219,422	572,659	917,449	0%	0
7	STA(3k+300 @ 7k+700)	2,165,139	559,643	938,784	0%	0
8	STA(7k+700 @ 8k+800)	1,244,896	252,375	229,210	0%	0
9	TOTAL	6,008,686	1,591,139	2,448,155		0

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev. 21)

Celda: C3
Comentario: The dredging volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software.

Celda: F3
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to the value of drilling and blasting requiered(Col. F).

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev.21)

1	B	C	D	E	F	G	H	I	J	K	L	M	N
2	REACHES	VOLUME - DRAFT 50' (m^3)			Hard Material Estimated Percentage	Hard and medium material volume	Soft material volume	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3 / WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from -44.88' to -55.38' PLD (mts3)	Overdredge Volume from -55.38' to -57.38' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	ATLANTIC ENTRANCE												
5	**STA(-2k+700 @ -1k+000)**	379,229	206,462	585,691	0%	0	585,691	Dredge No 1	25,000	60,000	0	10	10
6	**STA(-1k+000 @ 3k+300)**	2,219,422	572,659	2,792,081	0%	0	2,792,081	Dredge No 2	25,000	60,000	0	47	47
7	**STA(3k+300 @ 7k+700)**	2,165,139	559,643	2,724,782	0%	0	2,724,782	Dredge No 2	25,000	60,000	0	45	45
8	**STA(7k+700 @ 8k+800)**	1,244,896	252,375	1,497,271	100%	1,497,271	0	Dredge No 1	25,000	60,000	60	0	60
9	TOTAL	**6,008,686**	**1,591,139**	**7,599,825**		**1,497,271**	**6,102,554**				60	102	**92**

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev.21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G2
Comentario: Hard and medium material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: Average historical value provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Geothechnical Section .

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING COST ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K
2	REACHES	VOLUME - DRAFT 50' (m^3)			Available Dredge	Hard and medium material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from 44.88' to -55.38' PLD (mts3)	Overdredge Volume from -55.38' to -57.38' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Material	Soft material	
4	ATLANTIC ENTRANCE									
5	**STA(-2k+700 @ -1k+000)**	379,229	206,462	585,691	Dredge No 1	0	585,691	$14.07	$5.86	$3,432,149
6	**STA(-1k+000 @ 3k+300)**	2,219,422	572,659	2,792,081	Dredge No 2	0	2,792,081	$14.07	$5.86	$16,361,595
7	**STA(3k+300 @ 7k+700)**	2,165,139	559,643	2,724,782	Dredge No 2	0	2,724,782	$14.07	$5.86	$15,967,223
8	STA(**7k+700 @ 8k+**800)	1,244,896	252,375	1,497,271	Dredge No 1	1,497,271	0	$14.07	$5.86	$21,066,603
9	TOTAL	**6,008,686**	**1,591,139**	**7,599,825**						**$56,827,569**
10										

DREDGING COST ATLANTIC ENTRANCE
DRAFT 50' - 25,000 m3 / wk
(2 dredge=Mindi; without drilling)
(rev. 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: I2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition, and prepared by the Canal Capacity Projects Division.

Celda: J2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therfore the formula used was equal to=(Col G*Col I + Col.H*Col J).

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

APPENDIX No. 9

Atlantic Entrance Deepening for 41.5', 46', and 50' Draft Calculations

Assuming One of the Cutter Suction Dredges Productivity is 1.5 times ACP Cutter Suction Dredge MINDI

Atlantic Entrance Deepening for 41.5' Draft Calculation

Scheme No. 1: One Cutter Suction Dredge
Scheme No. 2: Two Cutter Suction Dredges

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 41.5 FT
(1 dredge=1.5 Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G
2	REACHES	AREA AND VOLUME - DRAFT 41.5'				
3		Dredging Volume from -44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	D&B from -44.88 to -54.88 PLD(mts^2)	% Drilling & Blasting Required	Net Area for D&B - 44.88´to -54.88' PLD (mts2)
4	ATLANTIC ENTRANCE					
5	STA(-2k+700 @ -1k+000)	128	9,330	362,712	0%	0
6	STA(-1k+000 @ 3k+300)	212,992	246,542	917,449	0%	0
7	STA(3k+300 @ 7k+700)	290,357	245,393	938,784	0%	0
8	STA(7k+700 @ 9k+900)	280,901	202,417	458,420	0%	0
9	STA(9k+900 @ 10k+750)	199,024	55,598	163,500	0%	0
10	TOTAL	983,402	759,280	2,840,865		0

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 41.5 FT
(1 dredge=1.5 Mindi; without drilling)
(rev. 21)

Celda: C3
Comentario: The dredging volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the cana.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software.

Celda: F3
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to the percentage of drilling and blasting(Col. F).

DREDGING VOLUME AND DURATION BY REACH
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 41.5'
(1 dredge=1.5 Mindi; without drilling)
(rev. 21)

	B	C	D	E	F	G	H	I	J	K	L	M	N
2	REACHES	VOLUME - DRAFT 41.5' (m^3)			Hard & Medium Material Estimated Percentage	Hard and medium material volume (mts^3)	Soft material volume (mts^3)	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3/WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from 44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	ATLANTIC ENTRANCE												
5	**STA(-2k+700 @ -1k+000)**	128	9,330	9,458	0%	0	9,458	New Dredge	37,500	90,000	0	0.1	0.1
6	**STA(-1k+000 @ 3k+300)**	212,992	246,542	459,534	0%	0	459,534	New Dredge	37,500	90,000	0	5	5
7	**STA(3k+300 @ 7k+700)**	290,357	245,393	535,750	0%	0	535,750	New Dredge	37,500	90,000	0	6	6
8	**STA(7k+700 @ 9k+900)**	280,901	202,417	483,318	100%	483,318	0	New Dredge	37,500	90,000	13	0	13
9	**STA(9k+900 @ 10k+750)**	199,024	55,598	254,622	100%	254,622	0	New Dredge	37,500	90,000	7	0	7
10	**TOTAL**	**983,402**	**759,280**	**1,742,682**		**737,940**	**1,004,742**				20	11	**31**

DREDGING VOLUME AND DURATION BY REACH
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 41.5'
(1 dredge=1.5 Mindi; without drilling)
(rev. 21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in thy canal.

Celda: G2
Comentario: Hard and medium material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: New dredge productivity = 1.5 Mindi average historical value, provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Survey Branch .

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch .

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING COST
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 41.5'
(1 dredge= 1.5 Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K
2	REACHES	VOLUME - DRAFT 41.5' (m^3)			Available Dredge	Hard and medium material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from -44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Material	Soft material	
4	ATLANTIC ENTRANCE									
5	STA(-2k+700 @ -1k+000)	128	9,330	9,458	New Dredge	0	9,458	$9.38	$3.91	$36,981
6	STA(-1k+000 @ 3k+300)	212,992	246,542	459,534	New Dredge	0	459,534	$9.38	$3.91	$1,796,778
7	STA(3k+300 @ 7k+700)	290,357	245,393	535,750	New Dredge	0	535,750	$9.38	$3.91	$2,094,783
8	STA(7k+700 @ 9k+900)	280,901	202,417	483,318	New Dredge	483,318	0	$9.38	$3.91	$4,533,523
9	STA(9k+900 @ 10k+750)	199,024	55,598	254,622	New Dredge	254,622	0	$9.38	$3.91	$2,388,354
10	TOTAL	**983,402**	**759,280**	**1,742,682**						**$10,850,418**
11										

DREDGING COST
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 41.5'
(1 dredge= 1.5 Mindi; without drilling)
(rev. 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: I2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition, and prepared by the Canal Capacity Projects Division.

Celda: K2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therfore the formula used was equal to=(Col G*Col.I + Col.H*Col.J).

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 41.5 FT
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G
2	REACHES	AREA AND VOLUME - DRAFT 41.5'				
3		Dredging Volume from -44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	D&B from -44.88 to -54.88 PLD(mts^2)	% Drilling & Blasting Required	Net Area for D&B - 44.88´to -54.88' PLD (mts2)
4	ATLANTIC ENTRANCE					
5	STA(-2k+700 @ -1k+000)	128	9,330	362,712	0%	0
6	STA(-1k+000 @ 3k+300)	212,992	246,542	917,449	0%	0
7	STA(3k+300 @ 7k+700)	290,357	245,393	938,784	0%	0
8	STA(7k+700 @ 9k+900)	280,901	202,417	458,420	0%	0
9	STA(9k+900 @ 10k+750)	199,024	55,598	163,500	0%	0
10	TOTAL	983,402	759,280	2,840,865		0

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 41.5 FT
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev. 21)

Celda: C3
Comentario: The dredging volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software.

Celda: F3
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to the percentage of drilling and blasting(Col. F).

DREDGING VOLUME AND DURATION BY REACH
DRAFT 41.5'
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev.21)

1	B	C	D	E	F	G	H	I	J	K	L	M	N
2	REACHES	VOLUME - DRAFT 41.5' (m^3)			Hard & Medium Material Estimated Percentage	Hard and medium material volume (mts^3)	Soft material volume (mts^3)	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3/WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from 44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	ATLANTIC ENTRANCE												
5	**STA(-2k+700 @ -1k+000)**	128	9,330	9,458	0%	0	9,458	Dredge No 1	37,500	90,000	0	0.1	0.1
6	**STA(-1k+000 @ 3k+300)**	212,992	246,542	459,534	0%	0	459,534	Dredge No 2	25,000	60,000	0	8	8
7	**STA(3k+300 @ 7k+700)**	290,357	245,393	535,750	0%	0	535,750	Dredge No 2	25,000	60,000	0	9	9
8	**STA(7k+700 @ 9k+900)**	280,901	202,417	483,318	100%	483,318	0	Dredge No 1	37,500	90,000	13	0	13
9	**STA(9k+900 @ 10k+750)**	199,024	55,598	254,622	100%	254,622	0	Dredge No 1	37,500	90,000	7	0	7
10	**TOTAL**	**983,402**	**759,280**	**1,742,682**		**737,940**	**1,004,742**				20	17	**20**

DREDGING VOLUME AND DURATION BY REACH
DRAFT 41.5'
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev.21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in thy canal.

Celda: G2
Comentario: Hard and medium material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: Average historical value provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Survey Branch .

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch .

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D

DREDGING COST
DRAFT 41.5'
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev. 21)

	B	C	D	E	F	G	H	I	J	K
1										
2	REACHES	VOLUME - DRAFT 41.5' (m^3)			Available Dredge	Hard and medium material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from -44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Material	Soft material	
4	ATLANTIC ENTRANCE									
5	**STA(-2k+700 @ -1k+000)**	128	9,330	9,458	Dredge No 1	0	9,458	$9.38	$3.91	$36,981
6	**STA(-1k+000 @ 3k+300)**	212,992	246,542	459,534	Dredge No 2	0	459,534	$14.07	$5.86	$2,692,869
7	**STA(3k+300 @ 7k+700)**	290,357	245,393	535,750	Dredge No 2	0	535,750	$14.07	$5.86	$3,139,495
8	STA(7k+700 @ 9k+900)	280,901	202,417	483,318	Dredge No 1	483,318	0	$9.38	$3.91	$4,533,523
9	STA(9k+900 @ 10k+750)	199,024	55,598	254,622	Dredge No 1	254,622	0	$9.38	$3.91	$2,388,354
10	TOTAL	**983,402**	**759,280**	**1,742,682**						**$12,791,222**
11										

DREDGING COST
DRAFT 41.5'
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev. 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: J2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition, and prepared by the Canal Capacity Projects Division.

Celda: K2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therfore the formula used was equal to=(Col G*Col.I + Col.H*Col.J).

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

Atlantic Entrance Deepening for 46'Draft Calculation

Scheme No. 1: One Cutter Suction Dredge
Scheme No. 2: Two Cutter Suction Dredges

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 46'
(1 dredge=1.5 Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G
2	**REACHES**	**AREA AND VOLUME - DRAFT 46'**				
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	D&B from -44.88' to -59.38'(mts^2)	% Drilling & Blasting Required	Net Area for D&B 44.88' to -59.38' PLD (mts2)
4						
5	**STA(-2k+700 @ -1k+000)**	90,020	188,475	362,712	0%	
6	**STA(-1k+000 @ 3k+300)**	1,082,584	708,056	917,449	0%	0
7	**STA(3k+300 @ 7k+700)**	1,067,959	525,992	938,784	0%	
8	**STA(7k+700 @ 8k+800)**	766,796	227,982	229,210	0%	
9	**TOTAL**	3,007,359	1,650,505	2,448,155		0

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 46'
(1 dredge=1.5 Mindi; without drilling)
(rev. 21)

Celda: C3
Comentario: The dredging volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software.

Celda: F3
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to value of drilling and blasting(Col. F).

DREDGING VOLUME AND DURATION - ATLANTIC ENTRANCE
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 46'
(1 dredge=1.5 Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K	L	M	N
2	REACHES	VOLUME - DRAFT 46' (m^3)			Hard and Medium Material Estimated Percentage	Hard and medium material volume (m^3)	Soft material volume (m^3)	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3/ WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	ATLANTIC ENTRANCE												
5	STA(**-2k+700 @ -1k+000**)	90,020	188,475	278,495	0%	0	278,495	Dredge No 1	37,500	90,000	0	3	3
6	STA(**-1k+000 @ 3k+300**)	1,082,584	708,056	1,790,640	0%	0	1,790,640	Dredge No 1	37,500	90,000	0	20	20
7	**STA(3k+300 @ 7k+700)**	1,067,959	525,992	1,593,951	0%	0	1,593,951	Dredge No 1	37,500	90,000	0	18	18
8	**STA(7k+700 @ 8k+800)**	766,796	227,982	994,778	100%	994,778	0	Dredge No 1	37,500	90,000	27	0	27
9	**TOTAL**	**3,007,359**	**1,650,505**	**4,657,864**		**994,778**	**3,663,086**						**67**

DREDGING VOLUME AND DURATION - ATLANTIC ENTRANCE
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 46'
(1 dredge=1.5 Mindi; without drilling)
(rev. 21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G2
Comentario: Hard and medium material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: Average historical value provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Survey Branch .

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch .

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING COST - ATLANTIC ENTRANCE
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 46'
(1 dredge=1.5 Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K
2	REACHES	VOLUME - DRAFT 46' (m^3)			Available Dredge	Hard and medium hard material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Hard Material	Soft material	
4	ATLANTIC ENTRANCE									
5	**STA(-2k+700 @ -1k+000)**	90,020	188,475	278,495	Dredge No 1	0	278,495	$9.38	$3.91	$1,088,915
6	**STA(-1k+000 @ 3k+300)**	1,082,584	708,056	1,790,640	Dredge No 1	0	1,790,640	$9.38	$3.91	$7,001,402
7	**STA(3k+300 @ 7k+700)**	1,067,959	525,992	1,593,951	Dredge No 1	0	1,593,951	$9.38	$3.91	$6,232,348
8	**STA(7k+700 @ 8k+800)**	766,796	227,982	994,778	Dredge No 1	994,778	0	$9.38	$3.91	$9,331,018
9	TOTAL	**3,007,359**	**1,650,505**	**4,657,864**						**$23,653,684**
10										

DREDGING COST - ATLANTIC ENTRANCE
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 46'
(1 dredge=1.5 Mindi; without drilling)
(rev. 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: I2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition.

Celda: K2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therefore the formula used was equal to=(Col G*Col.I + Col.H*Col.J).

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46'
(2 dredge = Mindi + 1.5Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G
2	**REACHES**	**AREA AND VOLUME - DRAFT 46'**				
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	D&B from -44.88' to -59.38'(mts^2)	% Drilling & Blasting Required	Net Area for D&B -44.88' to -59.38' PLD (mts2)
4						
5	**STA(-2k+700 @ -1k+000)**	90,020	188,475	362,712	0%	
6	**STA(-1k+000 @ 3k+300)**	1,082,584	708,056	917,449	0%	
7	**STA(3k+300 @ 7k+700)**	1,067,959	525,992	938,784	0%	0
8	**STA(7k+700 @ 8k+800)**	766,796	227,982	229,210	0%	
9	**TOTAL**	3,007,359	1,650,505	2,448,155		

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
DRAFT 46'
(2 dredge = Mindi + 1.5Mindi; without drilling)
(rev. 21)

Celda: C3
Comentario: The dredging volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software.

Celda: F3
Comentario: Percentages based on MINDI Captain dredging experience in the canal

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to value of drilling and blasting(Col. F).

DREDGING VOLUME AND DURATION - ATLANTIC ENTRANCE
DRAFT 46'
(2 dredge = Mindi + 1.5Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K	L	M	N
2	REACHES	VOLUME - DRAFT 46' (m^3)			Hard and Medium Material Estimated Percentage	Hard and medium material volume (m^3)	Soft material volume (m^3)	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3/ WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	ATLANTIC ENTRANCE												
5	STA(-2k+700 @ -1k+000)	90,020	188,475	278,495	0%	0	278,495	Dredge No 1	37,500	90,000	0	3	3
6	STA(-1k+000 @ 3k+300)	1,082,584	708,056	1,790,640	0%	0	1,790,640	Dredge No 2	25,000	60,000	0	30	30
7	STA(3k+300 @ 7k+700)	1,067,959	525,992	1,593,951	0%	0	1,593,951	Dredge					
	50% Dredge No 1			796,976	0%	0	796,976	Dredge No1	37,500	90,000	0	9	9
	50% Dredge No 2			796,976	0%	0	796,976	Dredge No2	25,000	60,000	0	13	13
8	STA(7k+700 @ 8k+800)	766,796	227,982	994,778	100%	994,778	0	Dredge No 1	37,500	90,000	27	0	27
9	TOTAL	**3,007,359**	**1,650,505**	**4,657,864**		**994,778**	**3,663,086**						**43**

DREDGING VOLUME AND DURATION - ATLANTIC ENTRANCE
DRAFT 46'
(2 dredge = Mindi + 1.5Mindi; without drilling)
(rev. 21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G2
Comentario: Hard and medium material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: Average historical value provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Survey Branch .

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch .

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING COST - ATLANTIC ENTRANCE
DRAFT 46'
(2 dredge = Mindi + 1.5Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K
2	REACHES	VOLUME - DRAFT 46' (m^3)			Available Dredge	Hard and medium hard material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from -44.88' to -51.38' PLD (mts3)	Overdredge Volume from -51.38' to -53.38' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Hard Material	Soft material	
4	ATLANTIC ENTRANCE									
5	**STA(-2k+700 @ -1k+000)**	90,020	188,475	278,495	Dredge No 1	0	278,495	$9.38	$3.91	$1,088,915
6	**STA(-1k+000 @ 3k+300)**	1,082,584	708,056	1,790,640	Dredge No 2	0	1,790,640	$14.07	$5.86	$10,493,150
7	**STA(3k+300 @ 7k+700)**	1,067,959	525,992	1,593,951	Dredge	0				
	50% Dredge No 1				Dredge No 1		796,976	$9.38	$3.91	$3,116,174
	50% Dredge No 2				Dredge No 2		796,976	$14.07	$5.86	$4,670,276
8	**STA(7k+700 @ 8k+800)**	766,796	227,982	994,778	Dredge No 1	994,778	0	$9.38	$3.91	$9,331,018
9	TOTAL	**3,007,359**	**1,650,505**	**4,657,864**						**$28,699,534**
10										

DREDGING COST - ATLANTIC ENTRANCE
DRAFT 46'
(2 dredge = Mindi + 1.5Mindi; without drilling)
(rev. 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: I2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition.

Celda: K2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therefore the formula used was equal to=(Col G*Col.I + Col H*Col.J).

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

Atlantic Entrance Deepening for 50' Draft Calculation

Scheme No. 1: One Cutter Suction Dredge
Scheme No. 2: Two Cutter Suction Dredges

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
NEW DREDGE PRODUCTION = 1.5 MINDI
DRAFT 50'
(1 dredge=1.5 Mindi; without drilling)
(REV.- 21)

1	B	C	D	E	F	G
2	REACHES	AREA AND VOLUME - DRAFT 50'				
3		Dredging Volume from -44.88' to -55.38' PLD	Overdredge Volume from -55.38' to -57.38'	D&B from -44.88 to -63.38(mts^2)	% Drilling & Blasting Required	Net Area for D&B -44.88'to -63.38' PLD (mts2)
4	ATLANTIC ENTRANCE					
5	TA(-2k+700 @ -1k+000)	379,229	206,462	362,712	0%	0
6	TA(-1k+000 @ 3k+300)	2,219,422	572,659	917,449	0%	0
7	STA(3k+300 @ 7k+700)	2,165,139	559,643	938,784	0%	0
8	STA(7k+700 @ 8k+800)	1,244,896	252,375	229,210	0%	0
9	TOTAL	6,008,686	1,591,139	2,448,155		0

PCL XL error

Subsystem: TEXT

Error: FontUndefinedNoSubstituteFound - OTTAndale Mono

Operator: SetFont

Position: 1008

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 41.5 FT
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G
2	REACHES	AREA AND VOLUME - DRAFT 41.5'				
3		Dredging Volume from -44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	D&B from -44.88 to -54.88 PLD(mts^2)	% Drilling & Blasting Required	Net Area for D&B - 44.88 to -54.88' PLD (mts2)
4	ATLANTIC ENTRANCE					
5	STA(-2k+700 @ -1k+000)	128	9,330	362,712	0%	0
6	STA(-1k+000 @ 3k+300)	212,992	246,542	917,449	0%	0
7	STA(3k+300 @ 7k+700)	290,357	245,393	938,784	0%	0
8	STA(7k+700 @ 9k+900)	280,901	202,417	458,420	0%	0
9	STA(9k+900 @ 10k+750)	199,024	55,598	163,500	0%	0
10	TOTAL	983,402	759,280	2,840,865		0

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 41.5 FT
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev. 21)

Celda: C3
Comentario: The dredging volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software

Celda: F3
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to the percentage of drilling and blasting(Col. F).

DREDGING VOLUME AND DURATION BY REACH
DRAFT 41.5'
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev.21)

1	B	C	D	E	F	G	H	I	J	K	L	M	N
2	REACHES	VOLUME - DRAFT 41.5' (m^3)			Hard & Medium Material Estimated Percentage	Hard and medium material volume (mts^3)	Soft material volume (mts^3)	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3/WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from 44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	AVANTO ENTRANCE												
5	**STA(-2k+700 @ -1k+000)**	128	9,330	9,458	0%	0	9,458	Dredge No 1	37,500	90,000	0	0.1	0.1
6	**STA(-1k+000 @ 3k+300)**	212,992	246,542	459,534	0%	0	459,534	Dredge No 2	25,000	60,000	0	8	8
7	**STA(3k+300 @ 7k+700)**	290,357	245,393	535,750	0%	0	535,750	Dredge No 2	25,000	60,000	0	9	9
8	**STA(7k+700 @ 9k+900)**	280,901	202,417	483,318	100%	483,318	0	Dredge No 1	37,500	90,000	13	0	13
9	**STA(9k+900 @ 10k+750)**	199,024	55,598	254,622	100%	254,622	0	Dredge No 1	37,500	90,000	7	0	7
10	TOTAL	**983,402**	**759,280**	**1,742,682**		**737,940**	**1,004,742**				20	17	**20**

DREDGING VOLUME AND DURATION BY REACH
DRAFT 41.5'
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev.21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in thy canal.

Celda: G2
Comentario: Hard and medium material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: Average historical value provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Survey Branch .

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch .

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING COST
DRAFT 41.5'
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev. 21)

1	B	C	D	E	F	G	H	I	J	K
2	REACHES	VOLUME - DRAFT 41.5' (m^3)			Available Dredge	Hard and medium material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from -44.88' to -46.88' PLD (mts3)	Overdredge Volume from -46.88' to -48.88' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Material	Soft material	
4	ATLANTIC ENTRANCE									
5	STA(-2k+700 @ -1k+000)	128	9,330	9,458	Dredge No 1	0	9,458	$9.38	$3.91	$36,981
6	STA(-1k+000 @ 3k+300)	212,992	246,542	459,534	Dredge No 2	0	459,534	$14.07	$5.86	$2,692,869
7	STA(3k+300 @ 7k+700)	290,357	245,393	535,750	Dredge No 2	0	535,750	$14.07	$5.86	$3,139,495
8	STA(7k+700 @ 9k+900)	280,901	202,417	483,318	Dredge No 1	483,318	0	$9.38	$3.91	$4,533,523
9	STA(9k+900 @ 10k+750)	199,024	55,598	254,622	Dredge No 1	254,622	0	$9.38	$3.91	$2,388,354
10	TOTAL	**983,402**	**759,280**	**1,742,682**						**$12,791,222**
11										

DREDGING COST
DRAFT 41.5'
(2 dredge=Mindi + 1.5Mindi; without drilling)
(rev. 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: I2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition, and prepared by the Canal Capacity Projects Division.

Celda: K2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therfore the formula used was equal to=(Col G*Col.I + Col.H*Col.J).

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50'
(2 dredge= Mindi + 1.5Mindi; without drilling)
(REV.- 21)

1	B	C	D	E	F	G
2	REACHES	AREA AND VOLUME - DRAFT 50'				
3		Dredging Volume from -44.88' to -55.38' PLD (mts3)	Overdredge Volume from -55.38' to -57.38' PLD (mts3)	D&B from -44.88 to -63.38(mts^2)	% Drilling & Blasting Required	Net Area for D&B -44.88'to -63.38' PLD (mts2)
4	ATLANTIC ENTRANCE					
5	STA(-2k+700 @ -1k+000)	379,229	206,462	362,712	0%	0
6	STA(-1k+000 @ 3k+300)	2,219,422	572,659	917,449	0%	0
7	STA(3k+300 @ 7k+700)	2,165,139	559,643	938,784	0%	0
8	STA(7k+700 @ 8k+800)	1,244,896	252,375	229,210	0%	0
9	TOTAL	6,008,686	1,591,139	2,448,155		0

DREDGING VOLUME TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50'
(2 dredge= Mindi + 1.5Mindi; without drilling)
(REV.- 21

Celda: C3
Comentario: The dredging volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: D3
Comentario: The overdredge volume was estimated by the Survey Branch in December 2002, and includes an overswing of 25 feet at each side of the canal.

Celda: E3
Comentario: Reach area is calculated using AUTOCAD software.

Celda: F3
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G3
Comentario: Drilling and Blasting net area for each reach was calculated by multiplying the area of each reach (Col. E) by the percentage of hard material, according to the value of drilling and blasting requiered(Col. F).

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50'
(2 dredge= Mindi + 1.5 Mindi; without drilling)
(REV.-21)

1	B	C	D	E	F	G	H	I	J	K	L	M	N
2	REACHES	VOLUME - DRAFT 50' (m^3)			Hard Material Estimated Percentage	Hard and medium material volume	Soft material volume	AVAILABLE DREDGES	DREDGE PRODUCTIVITY (M^3 / WEEK)		Duration (weeks)		TOTAL DURATION (weeks)
3		Dredging Volume from -44.88' to -55.38' PLD (mts3)	Overdredge Volume from -55.38' to -57.38' PLD (mts3)	Dredging Total Volume (mts^3)					Hard and Medium Material	Soft Material	Hard and Medium Material	Soft Material	
4	ATLANTIC ENTRANCE												
5	**STA(-2k+700 @ -1k+000)**	379,229	206,462	585,691	0%	0	585,691	Dredge No 1	37,500	90,000	0	7	7
6	**STA(-1k+000 @ 3k+300)**	2,219,422	572,659	2,792,081	0%	0	2,792,081	Dredge No 2	25,000	60,000	0	47	47
7	**STA(3k+300 @ 7k+700)**	2,165,139	559,643	2,724,782	0%	0	2,724,782	Dredge					
	50% Dredge No 1			1,362,391	0%	0	1,362,391	Dredge No 1	37,500	90,000	0	15	15
	50% Dredge No 2			1,362,391	0%	0	1,362,391	Dredge No 2	25,000	60,000	0	23	23
8	**STA(7k+700 @ 8k+800)**	1,244,896	252,375	1,497,271	100%	1,497,271	0	Dredge No 1	37,500	90,000	40	0	40
9	**TOTAL**	**6,008,686**	**1,591,139**	**7,599,825**		**1,497,271**	**6,102,554**				40	91	**69**

DREDGING VOLUME AND DURATION TO DEEPEN ATLANTIC ENTRANCE
DRAFT 50'
(2 dredge= Mindi + 1.5 Mindi; without drilling)
(REV.-21)

Celda: F2
Comentario: Percentages based on MINDI Captain dredging experience in the canal.

Celda: G2
Comentario: Hard and medium material volume was estimated by multipling column E by column F.

Celda: H2
Comentario: Soft material volume was estimated by the difference of column E minus column G.

Celda: J2
Comentario: Average historical value provided by Operations Branch of Dredging Division.

Celda: L2
Comentario: Duration was calculated by dividing the volume of hard or soft material by the corresponding productivity.

Celda: N2
Comentario: Total duration is the sum of column L plus column M.

Celda: C3
Comentario: Value imported from spreadsheet 1, column C; corresponding to the dredging volume calculated by the Geothechnical Section .

Celda: D3
Comentario: Value imported from spreadsheet 1, column D; corresponding to the dredging volume calculated by the Survey Branch.

Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

DREDGING COST ATLANTIC ENTRANCE
DRAFT 50'
(2 dredge= Mindi + 1.5Mindi; without drilling)
(REV.- 21)

1	B	C	D	E	F	G	H	I	J	K
2	REACHES	VOLUME - DRAFT 50' (m^3)			Available Dredge	Hard and medium material volume	Soft material volume	DREDGING UNIT COST		TOTAL COST BY REACH
3		Dredging Volume from 44.88' to -55.38' PLD (mts3)	Overdredge Volume from -55.38' to -57.38' PLD (mts3)	Dredging Total Volume (m^3)				Hard and Medium Material	Soft material	
4	ATLANTIC ENTRANCE									
5	STA(-2k+700 @ -1k+000)	379,229	206,462	585,691	Dredge No 1	0	585,691	$9.38	$3.91	$2,290,052
6	STA(-1k+000 @ 3k+300)	2,219,422	572,659	2,792,081	Dredge No 2	0	2,792,081	$14.07	$5.86	$16,361,595
7	STA(3k+300 @ 7k+700)	2,165,139	559,643	2,724,782	Dredge	0				
	50% Dredge No 1				Dredge No 1	0	1,362,391	$9.38	$3.91	$5,326,949
	50% Dredge No 2				Dredge No 2	0	1,362,391	$14.07	$5.86	$7,983,611
8	STA(7k+700 @ 8k+800)	1,244,896	252,375	1,497,271	Dredge No 1	1,497,271	0	$9.38	$3.91	$14,044,402
9	TOTAL	**6,008,686**	**1,591,139**	**7,599,825**						**$46,006,609**
10										

DREDGING COST ATLANTIC ENTRANCE
DRAFT 50'
(2 dredge= Mindi + 1.5Mindi; without drilling)
(REV.- 21)

Celda: G2
Comentario: Value imported from spreadsheet 2, column G.

Celda: H2
Comentario: Value imported from spreadsheet 2, column H.

Celda: I2
Comentario: Dredging unit costs were estimated based on equipment production related to the submarine soil geologic condition, and prepared by the Canal Capacity Projects Division.

Celda: K2
Comentario: Total cost by reach is equal to the product of the volume of hard or soft material by the corresponding unit price. Therfore the formula used was equal to=(Col G*Col.I + Col.H*Col.J).

Celda: C3
Comentario: Value imported from spreadsheet 1, column C.

Celda: D3
Comentario: Value imported from spreadsheet 1, column D.

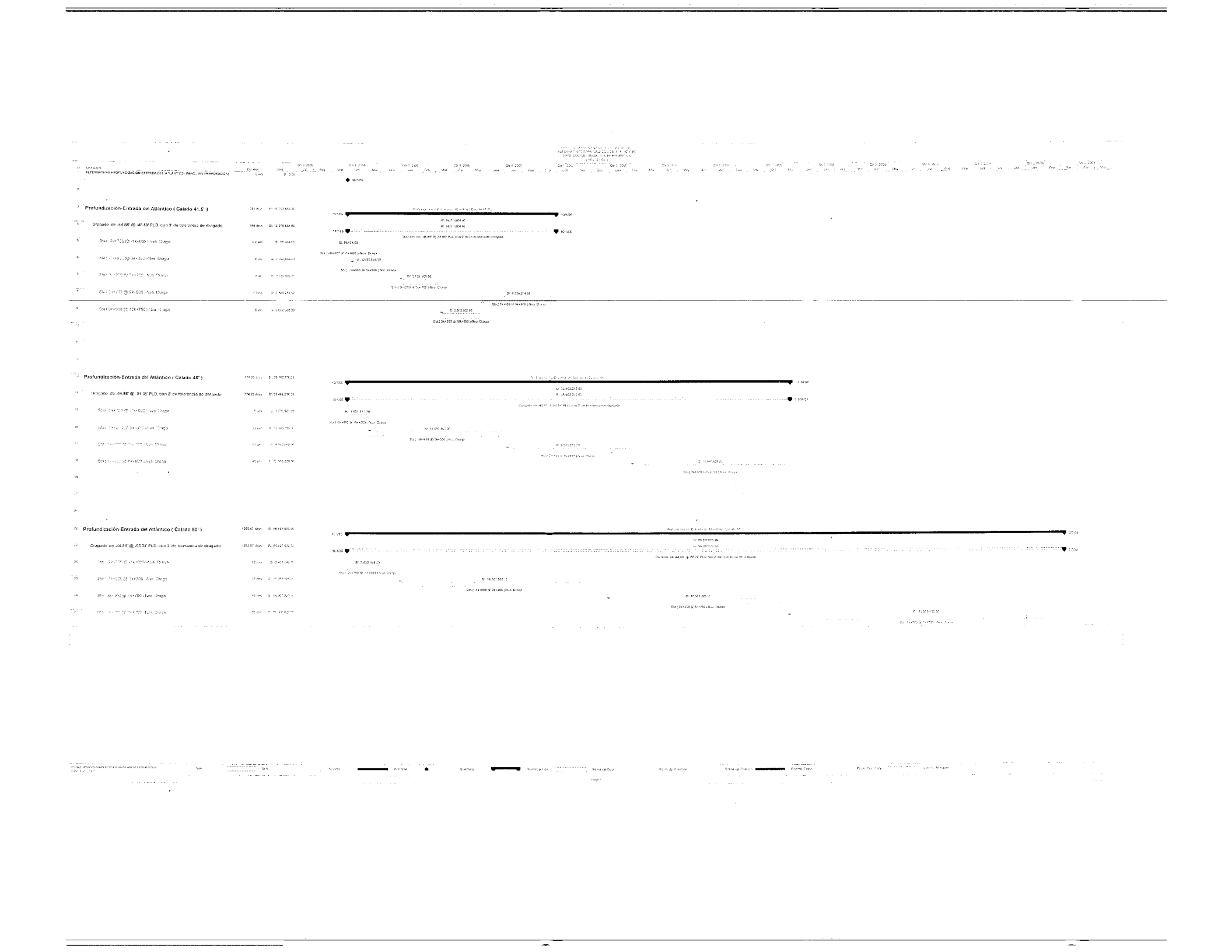
Celda: E3
Comentario: The Total dredging volume is the sum of column C plus column D.

APPENDIX No. 10

Atlantic Entrance Deepening for 41.5', 46', and 50' Draft Gantt Chart

One Cutter Suction Dredge Scenario

Cutter Suction Dredge Productivity = MINDI's


ALTERNATIVA4-PROFUNDIZACIÓN ENTRADA DEL ATLANTICO (MANT. SIN PERFORADEN)
Profundización-Entrada del Atlántico (Calado 41.5')
Dragado de -44.88' @ -45.58' PLD, con 2' de tolerancia de dragado
Profundización-Entrada del Atlántico (Calado 45')
Dragado de -44.88' @ -51.38' PLD, con 2' de tolerancia de dragado
Profundización-Entrada del Atlántico (Calado 50')
Dragado de -44.88' @ -55.38' PLD, con 2' de tolerancia de dragado

APPENDIX No. 11

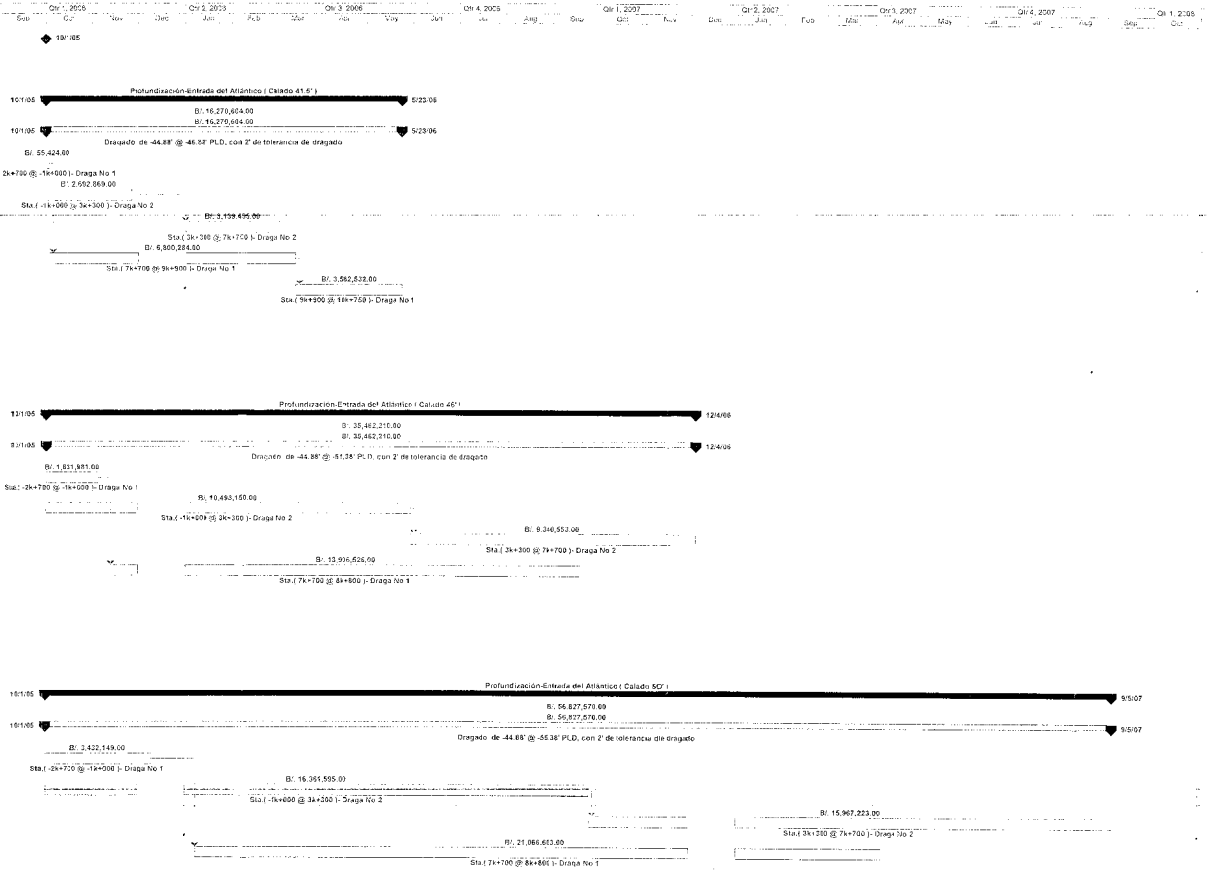
Atlantic Entrance Deepening for 41.5', 46', and 50' Draft Gantt Chart

Two-Cutter Suction Dredge Scenario

Cutter Suction Dredge Productivity = MINDI's

PROFUNDIZACION ENTRADA DEL ATLANTICO
ALTERNATIVAS PARA CALADOS DE 41.5', 45' Y 50'
PRODUCCION = MINDI, BAGCO + 2 DRAGAS SIN PERFORACION
(REV. 21-JUY)

ID	Task Name	Duration	Cost
1	ALTERNATIVAS-PROFUNDIZACIÓN ENTRADA DEL ATLÁNTICO - (MINDI, SIN PERFORACIÓN)	0 wks	B/. 0.00
2			
3	**Profundización-Entrada del Atlántico (Calado 41.5')**	234.82 days	B/. 16,270,604.00
4	Dragado de -44.88' @ -46.88' PLD, con 2' de tolerancia de dragado	234.82 days	B/. 16,270,604.00
5	Sta.(-2k+700 @ -1k+000)- Draga No 1	0.2 wks	B/. 55,424.00
6	Sta.(-1k+000 @ 3k+300)- Draga No 2	8 wks	B/. 2,592,869.00
7	Sta.(3k+300 @ 7k+700)- Draga No 2	9 wks	B/. 3,159,495.00
8	Sta.(7k+700 @ 9k+900)- Draga No 1	19 wks	B/. 6,800,284.00
9	Sta.(9k+900 @ 10k+750)- Draga No 1	10 wks	B/. 3,562,532.00
10			
11			
12			
13	**Profundización-Entrada del Atlántico (Calado 45')**	429.83 days	B/. 35,462,210.00
14	Dragado de -44.88' @ -51.38' PLD, con 2' de tolerancia de dragado	429.83 days	B/. 35,462,210.00
15	Sta.(-2k+700 @ -1k+000)- Draga No 1	5 wks	B/. 1,831,981.00
16	Sta.(-1k+000 @ 3k+300)- Draga No 2	30 wks	B/. 10,493,150.00
17	Sta.(3k+300 @ 7k+700)- Draga No 2	27 wks	B/. 9,346,553.00
18	Sta.(7k+700 @ 8k+800)- Draga No 1	40 wks	B/. 13,996,526.00
19			
20			
21			
22	**Profundización-Entrada del Atlántico (Calado 50')**	764.83 days	B/. 56,827,579.00
23	Dragado de -44.88' @ -55.38' PLD, con 2' de tolerancia de dragado	764.83 days	B/. 56,827,579.00
24	Sta.(-2k+700 @ -1k+000)- Draga No 1	10 wks	B/. 3,422,149.00
25	Sta.(-1k+000 @ 3k+300)- Draga No 2	67 wks	B/. 16,361,595.00
26	Sta.(3k+300 @ 7k+700)- Draga No 2	45 wks	B/. 15,967,223.00
27	Sta.(7k+700 @ 8k+800)- Draga No 1	69 wks	B/. 21,066,603.00



Project: Alternativas-Profundizacion de entrada del Atlantico
Date: Mar 19 08

Task | Split | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | Rolled Up Split | External Tasks | Project Summary | External Milestone | Deadline | External Milestone | Progress

Page 1

APPENDIX No. 12

Atlantic Entrance Deepening for 41.5', 46', and 50' Draft Gantt Chart

One-Cutter Suction Dredge Scenario

Cutter Suction Dredge Productivity = 1.5 MINDI's

	Task Name	Duration	Cost
1	PROFUNDIZACION ENTRADA DEL ATLANTICO - (1.5MINDI, SIN PERFORACIÓN)	0 days	$/. 0.00
2			
3	**Profundización-Entrada del Atlántico (Calado 41.5')**	260 days	B/. 10,850,419.00
4	**Dragado de -44.88' @ -46.88' PLD, con 2' de tolerancia de dragado**	260 days	B/. 10,850,419.00
5	Sta (-2k+700 @ -1k+000)-Nva. Draga	31 days	B/. 36,981.00
6	Sta (-1k+000 @ 3k+300)-Nva. Draga	6 days	B/. 1,796,778.00
7	Sta (3k+300 @ 7k+700)-Nva. Draga	8 days	B/. 2,094,783.00
8	Sta (7k+700 @ 9k+900)-Nva. Draga	13 days	B/. 4,533,523.00
9	Sta (9k+900 @ 10k+750)-Nva. Draga	7 days	B/. 2,388,354.00
10			
11			
12	**Profundización-Entrada del Atlántico (Calado 46')**	542.42 days	B/. 23,653,683.00
13	**Dragado de -44.88' @ -51.38' PLD, con 2' de tolerancia de dragado**	542.42 days	B/. 23,653,683.00
14	Sta (-2k+700 @ -1k+000)-Nva. Draga	1 days	B/. 7,588,915.00
15	Sta (-1k+000 @ 3k+300)-Nva. Draga	23 days	B/. 7,601,402.00
16	Sta (3k+300 @ 7k+700)-Nva. Draga	14 days	B/. 6,232,348.00
17	Sta (7k+700 @ 8k+800)-Nva. Draga	27 days	B/. 1,331,018.00
18			
19			
20	**Profundización-Entrada del Atlántico (Calado 50')**	862.25 days	B/. 37,905,389.00
21	**Dragado de -44.88' @ -55.38' PLD, con 2' de tolerancia de dragado**	862.25 days	B/. 37,905,389.00
22	Sta (-2k+700 @ -1k+000)-Nva. Draga	1 days	B/. 2,250,052.00
23	Sta (-1k+000 @ 3k+300)-Nva. Draga	31 days	B/. 10,617,037.00
24	Sta (3k+300 @ 7k+700)-Nva. Draga	20 days	B/. 10,653,896.00
25	Sta (7k+700 @ 8k+800)-Nva. Draga	45 days	B/. 11,044,402.00

APPENDIX No. 13

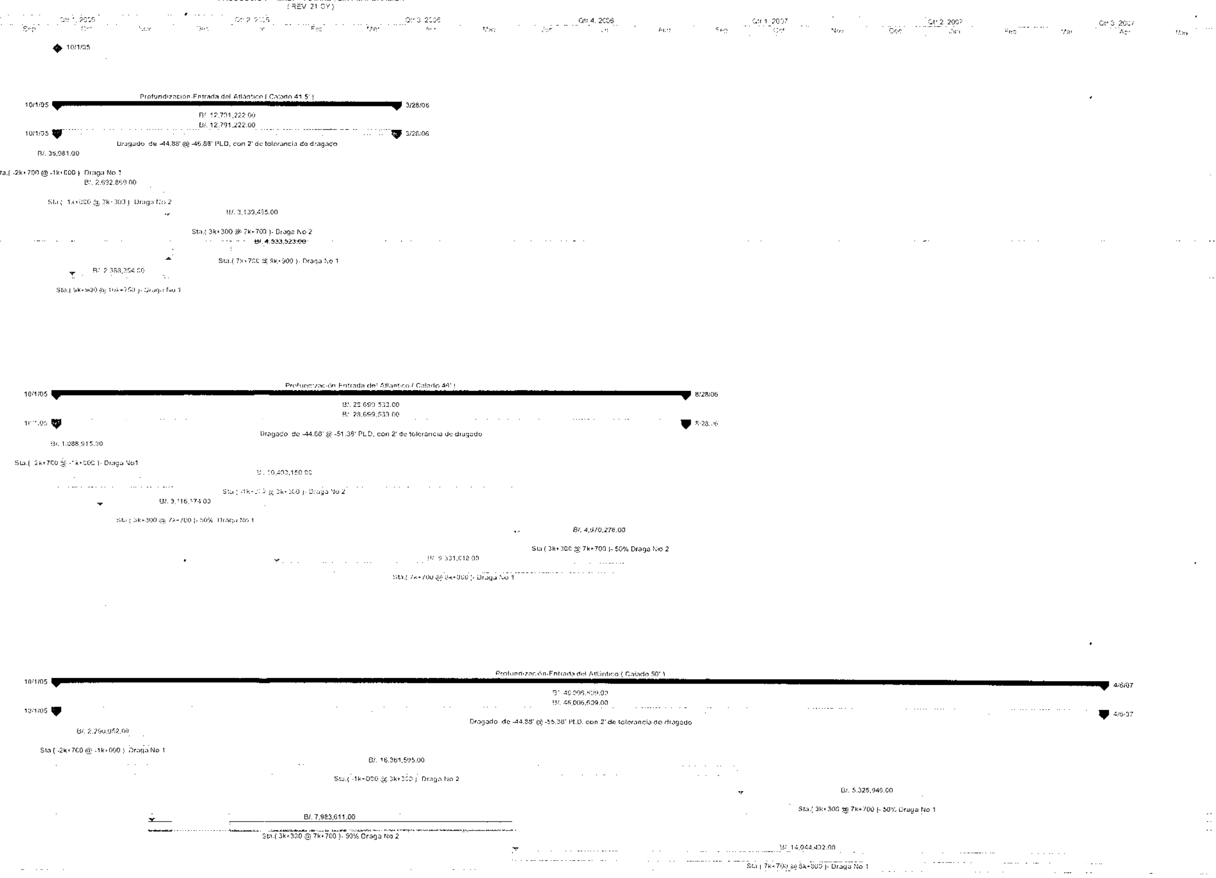
Atlantic Entrance Deepening for 41.5', 46', and 50' Draft Gantt Chart

Two-Cutter Suction Dredge Scenario

Cutter Suction Dredge Productivity = 1.5 MINDI's

PROFUNDIZACIÓN ENTRADA DEL ATLÁNTICO
ALTERNATIVAS PARA CALADOS DE 41.5', 46' Y 50'
PRODUCCIÓN = MINDI + 1.5 MINDI, SIN PERFORACIÓN
(REV. 21 CY)

ID	Task Name	Duration	Cost
1	ALTERNATIVAS-PROFUNDIZACIÓN ENTRADA DEL ATLÁNTICO - (MINDI + NVA. DRAGA, SIN PERF.)	0 wks	B/. 0.00
2			
3	**Profundización-Entrada del Atlántico (Calado 41.5')**	178.42 days	B/. 12,791,222.00
4	**Dragado de -44.88' @ -46.88' PLD, con 2' de tolerancia de dragado**	178.42 days	B/. 12,791,222.00
5	Sta (-2k+700 @ -1k+000)- Draga No 1	[illegible]	[illegible]
6	Sta.(-1k+000 @ 3k+300)- Draga No 2	[illegible]	[illegible]
7	Sta (3k+300 @ 7k+700)- Draga No 2	[illegible]	[illegible]
8	Sta (7k+700 @ 9k+900)- Draga No 1	[illegible]	[illegible]
9	Sta (9k+900 @ 10k+750)- Draga No 1	[illegible]	[illegible]
10			
11			
12			
13	**Profundización-Entrada del Atlántico (Calado 46')**	331.42 days	B/. 28,699,533.00
14	**Dragado de -44.88' @ -51.38' PLD, con 2' de tolerancia de dragado**	331.42 days	B/. 28,699,533.00
15	Sta (-2k+700 @ -1k+000)- Draga No1	[illegible]	[illegible]
16	Sta (-1k+000 @ 3k+300)- Draga No 2	[illegible]	[illegible]
17	Sta (3k+300 @ 7k+700)- 50% Draga No 1	[illegible]	[illegible]
18	Sta.(3k+300 @ 7k+700)- 50% Draga No 2	[illegible]	[illegible]
19	Sta (7k+700 @ 8k+800)- Draga No 1	[illegible]	[illegible]
20			
21			
22			
23	**Profundización-Entrada del Atlántico (Calado 50')**	552.67 days	B/. 46,006,609.00
24	**Dragado de -44.88' @ -55.38' PLD, con 2' de tolerancia de dragado**	552.67 days	B/. 46,006,609.00
25	Sta (-2k+700 @ -1k+000)- Draga No 1	[illegible]	[illegible]
26	Sta (-1k+000 @ 3k+300)- Draga No 2	47 wks	[illegible]
27	Sta (3k+300 @ 7k+700)- 50% Draga No 1	15 wks	B/. 5,325,940.00
28	Sta (3k+300 @ 7k+700)- 50% Draga No 2	23 wks	B/. 7,983,611.00
29	Sta (7k+700 @ 8k+800)- Draga No 1	40 wks	B/. 14,044,432.00



APPENDIX No. 14

ACP Cutter Suction Dredge MINDI Costs

DREDGING RATES OF THE "MINDI"

Inflation Factor Conversion	1.023	
Division Overhead	12%	

		Total Costs		Marginal Costs
Hourly Cost for Availability	$	781		n.a.
Hourly Cost for Labor		624		624
Indirect Costs relating to Labor		75		75
Average Hourly Cost of Fuel		233		233
Support for 3 small tugboats		344 /1		344
Guard or Passenger Boat Support		81 /1		81
Hydrographic Launches Support (5 days a week - day shift)		15		
Sub-total for Support		439		439
Total	**$**	**2,153**	**$**	**1,371**
Cost by Shift				
Cost for Availability for 8 hours	$	6,251		n.a.
Cost of Labor for 8 hours		5,591		5,591
Fuel Consumption for 8 hours		1,399		1,399
Support for 8 hours		3,514		3,514
Total Cost by Shift	**$**	**16,756**		**10,504**
Daily Cost				
Cost for Availability		18,754		n.a.
Labor Cost		16,774		16,774
Fuel Consumption		4,196		4,196
Support		10,542		10,542
Total Daily Cost	**$**	**50,267**		**$31,512**
Weekly Cost				
Cost for Availability		131,281		n.a.
Labor Cost		117,421		117,421
Fuel Consumption		29,370		29,370
Support		73,794		73,794
Total Weekly Cost	**$**	**351,866**		**$220,585**

Estimated Excavated Volumes by Week (Cubic Meters in Bank)

Productivity a	**25,000**
Productivity b	**37,500**
Productivity c	**60,000**
Productivity d	**90,000**

Cost of Cubic Meter in Bank		
Productivity a	**$14.07**	**$8.82**
Productivity b	**$9.38**	**$5.88**
Productivity c	**$5.86**	**$3.68**
Productivity d	**$3.91**	**$2.45**

"MINDI" DREDGE

Overhead	12%
Employee Benefits	38%
Night Shift Differential	10%
Complementary Sunday	25%
Overtime	50%

DAY SHIFT

On Deck Department:	Grade	No.	Hourly Rate	Total Hourly Rate	Annual Rate	With Benefits Annually	5 hours weekly with benefits annually	8 hours overtime weekly with benefits annually
Captain in charge	FE-17	1	$ 34.21	$ 34.21	$ 71,157	$ 98,211	$ 18,414	$ 29,463
Welder	MG-10	3	17.56	52.68	109,574	151,235	28,356	45,370
Seaman	MG-07	1	6.96	6.96	14,477	19,981	3,746	5,994
Laborer	MG-03	1	5.75	5.75	11,960	16,507	3,095	4,952
Subtotal		**6**		**$ 99.60**	**207,168**	**285,933**	**53,612**	**85,780**
Engine Department:								
Chief Engineer	ME-16	1	$ 32.02	$ 32.02	$ 66,602	$ 91,924	$ 17,236	$ 27,577
Deputy Chief Engineer	ME-15	1	29.99	29.99	62,379	86,096	16,143	25,829
Engineer	ME-14	1	28.15	28.15	58,552	80,813	15,153	24,244
Electrician	FE-11	1	24.35	24.35	50,648	69,904	13,107	20,971
Machinist	MG-10	1	17.56	17.56	36,525	50,412	9,452	15,123
Nautical engine mechanic	MG-10	2	17.56	35.12	73,050	100,823	18,904	30,247
Electrical Equipment Repairer	MG-09	1	11.12	11.12	23,130	31,923	5,986	9,577
Subtotal		**8**		**178.31**	**370,885**	**511,895**	**95,980**	**153,569**
Staff at Dredged Material Disposal Sites								
Leader	ML-10	1	$ 19.31	$ 19.31	$ 40,165	$ 55,435	$ 10,394	$ 16,631
Helpers	MG-05	2	6.23	12.46	25,917	35,770	6,707	10,731
Subtotal		**3**		**31.77**	**66,081.60**	**91,205.82**	**17,101.09**	**27,361.75**
TOTAL- DAY SHIFT CREW		**14**		**$ 309.68**	**644,134**	**889,034**	**166,694**	**266,710**
ROTATION CREW								
On-deck Department:								
Dredge Operator	FE-14	1	$ 28.15	$ 28.15	$ 58,552	$ 80,813	$ 15,153	$ 24,244
Dredge Officer	FE-11	1	24.35	24.35	50,648	69,904	13,107	20,971
Dredge Seaman Leader	ML-08	1	9.74	9.74	20,259	27,962	5,243	8,389
Winch Operator	MG-08	2	8.25	16.50	34,320	47,368	8,882	14,211
Dredge Seaman	MG-07	7	6.96	48.72	101,338	139,866	26,225	41,960
Subtotal		**12**		**$ 127.46**	**265,117**	**365,914**	**68,609**	**109,774**
Engine Department:								
Dredge Engineer	ME-14	1	$ 28.15	$ 28.15	$ 58,552	$ 80,813	$ 15,153	$ 24,244
Dredge Engineer	ME-11	1	$ 24.35	24.35	50,648	69,904	13,107	20,971
Oiler	MG-08	2	8.25	16.50	34,320	47,368	8,882	14,211
Subtotal		**4**		**$ 69.00**	**143,520**	**198,086**	**37,141**	**59,426**
Staff at Dredged Material Disposal Sites								
Tractor Operators	MG-10	2	$ 17.56	$ 35.12	$ 73,050	$ 100,823	$ 18,904	$ 30,247
Helper	MG-08	2	8.25	16.50	34,320	47,368	8,882	14,211
Subtotal				**$ 51.62**	**107,370**	**148,192**	**27,786**	**44,457**
TOTAL- ROTATION CREW		**16**		**$ 248.08**	**516,006**	**712,192**	**133,536**	**213,658**
TOTAL - 4 ROTATION CREWS					**2,064,026**	**2,848,768**	**534,144**	**854,630**
TOTAL - 5 ROTATION CREWS					**2,580,032**	**3,560,960**		
TOTAL WITH 4 CREWS, 1 DAY SHIFT AND OVERTIME							**3,904,496**	**4,859,143**
							446	555
TOTAL WITH 5 CREWS 1 DAY SHIFT AND NO OVERTIME						**4,449,994**		
						508		

Total Average Rate with cargo - 4 rotation crews and 8 hours of overtime weekly for each crew

Monday to Friday	660.01	
Saturday	474.79	
Sunday	593.49	
Total Average Hourly Rate	**$ 624.05**	**5,466,664**

Total Average Rate with cargo - 5 rotation crews and 1 hour of overtime weekly

Monday to Friday	645.15	
Saturday	497.34	
Sunday	621.67	
Total Average Hourly Rate	**$ 620.68**	**5,437,166**

1/ There are 5 steps in the hourly wage grade, and the last step was used

2/ Employee benefits were included at 38.02% of the average hourly wages

3/ Included in the average hourly wages were 10% for night differential, 25% for complementary Sunday, and 50% for overtime.

4/ Eight hours of weekly overtime were included for each crew

Appendix No.14 C
Updated on March 20, 2001

Dredging Division - Mindi Suction Dredge

Division
12% Overhead
(applied to
labor)

Costs	FY 1995 Actual	FY 1996 Actual	FY 1997 Actual	FY 1998 Actual	Yearly Estimate	
Labor	$ -	$ -	$ -	$ -	-	
Supplies/Materials (excluding fuel)	905,333	676,442	1,232,400	1,038,000	963,044	
Supplies/Materials for Disposal Sites			58,000	313,000	185,500	
Other Direct Expenses	1,328,672	1,612,966			1,470,819	
General Maintenance	531,943	310,300	1,180,000	852,000	718,561	
Indirect Maintenance CC 556					79,200	1/
Equipment Maintenance at Disposal Sites			32,000	88,000	60,000	
Overhaul Expenses	328,029	691,217	1,571,000		863,415	
Depreciation	508,597	491,390	544,654	601,226	536,467	2/
Maintenance at Disposal Sites						
Maritime Insurance					72,837	3/
Total	$3,602,574	$ 3,782,315	$ 4,618,054	$ 2,892,226	$ 4,949,842	

Total Annual Estimate	$	4,949,842
Number of Available Days		270
Daily Cost for Availability without crew (demand)	$	18,333
Hourly Cost for Availability without crew (demand)	$	764

	Inter-Divisional	Capital (with Division overhead)	Commercial (w/RGG)
Hourly Cost for Availability	$ 764	$ 764	$ 1,039
Stand-by or day crew, hourly	$ 310	$ 347	$ 472
Total Hourly Cost for Availability	**$ 1,074**	**$ 1,111**	**$ 1,511**
Hourly Cost for Availability	$ 764	$ 764	$ 1,039
Operations Crew - hourly cost	$ 624	$ 699	$ 951
Hourly Cost of Fuel	$ 228 4/	$ 228	$ 310
Hourly Cost of Operation (without support equipment)	**$ 1,616**	**$ 1,691**	**$ 2,299**
Support of 3 small tugboats	$ 319 5/	$ 336	$ 457
Guard or Passenger Support Boat	$ 73	$ 79	$ 107
Hydrography Support Launches (5 days a week - day shift)	$ 14	$ 15	$ 20
Hourly Cost of Operation (with support equipment)	**$ 2,022**	**$ 2,120**	**$ 2,883**

Rate for Mobilization

Hourly Cost for Availability (without crew)	$ 764	$ 764	$ 1,039
Hourly Cost of Operations Crew	$ 624	$ 699	$ 951
Hourly Cost of Pilot (required to move dredge)	$ 45	$ 51	$ 69
Cost of a large tugboat to move the dredge	$ 332	$ 354	$ 482
Cost of a small tugboat to move the dredge	$ 106	$ 112	$ 152
Cost of a mid-size tugboat to move pipes and pontoons	$ 202	$ 217	$ 295
Cost of a small tugboat to move pipes and pontoons	$ 106	$ 112	$ 152
Total Hourly Rate for Mobilization	**$ 2,180**	**$ 2,309**	**$ 3,140**

1/ Distribution of Support of "other 550" of 556 was based on the equitable assignment of the 5 largest equipment of the central cost system.

2/ The depreciation includes the dredge and its improvements, its auxiliary equipment, the discharge pipes and pontoons, as well a 4 tractors.

3/ The cost of maritime insurance paid by ACP in 2000 was proportionately allocated to all insured floating equipment.

4/ Usage of 290 gallons/hour, 42 gallons/barrel, $33/barrel.

5/ One CHAME class and two ULUA types

APPENDIX No. 15

Yearly Cost Indexes for Channels & Canal

And

Consumer Price Index

YEARLY COST INDEXES FOR CHANNEL & CANALS

SOURCE: U.S. CORPS OF ENGINEERS (USACE)

FISCAL YEARS	YEARLY COSTS	YEARLY PERCENTAGE CHANGE
1995	470.64	
1996	482.90	0.026
1997	492.16	0.019
1998	503.55	0.023
1999	516.11	0.025
2000	526.72	0.021
2001	536.03	0.018
2002 [2]	550.03	0.026
LAST 8-YEAR AVERAGE		**0.023**

Notes:

1. Fiscal year correspond the period from October 1 to September 30
2. Forecasted data developed based on US Office of Management and Budget projections.

Consumer Price Index (CPI) Conversion Factors to Convert to 2001 Dollars
Using the CPI-U-X1 series, which applies the CPI used starting 1983 to 1950-1982
Should be used when exact comparisons are needed between years during the period since 1950

To convert dollars of a year to 2001 dollars, **divide** the dollar amount
of that year by the conversion factor (CF) for that year
For example, $1000 dollars of 1953 = $6135 dollars of 2001 ($1000 / 0.163)

Year	CF	Year	CF	Year	CF	Year	CF	Year	CF	Year	CF
1950	0.148	1960	0.182	1970	0.233	1980	0.465	1989	0.700	1999	0.941
1951	0.160	1961	0.184	1971	0.243	1981	0.509	1990	0.738	2000	0.972
1952	0.163	1962	0.185	1972	0.251	1982	0.540	1991	0.769	2001	**1.000**
1953	0.164	1963	0.188	1973	0.267	CPI-U = CPI-U-X1		1992	0.792	2002	1.018
1954	0.165	1964	0.190	1974	0.293	1983	0.562	1993	0.816	2003	1.042
1955	0.164	1965	0.193	1975	0.317	1984	0.587	1994	0.837	2004	1.067
1956	0.167	1966	0.199	1976	0.335	1985	0.608	1995	0.861	2005	1.093
1957	0.172	1967	0.205	1977	0.357	1986	0.619	1996	0.886	2006	1.120
1958	0.177	1968	0.213	1978	0.381	1987	0.641	1997	0.906	2007	1.147
1959	0.178	1969	0.223	1979	0.418	1988	0.668	1998	0.920	2008	1.176

CPI is CPI-U-X1, which applies the post-1982 CPI methods to the period 1950 to 1982.
By definition, CPI-U-X1 equals CPI-U starting in 1983, so the conversion factors are the same.
2000 conversion factors use the final 2000 year-to-year CPI (172.2). Conversion factors for 2001-2008 use the average of inflation estimates by the Office of Management and Budget and the Congressional Budget Office.
It is recommended that numbers be **rounded** to **no more than three decimal places**,
for example, $6135 in the example at the top of this page becomes $6140

Note: To reverse the process, that is, to determine what a 2000-dollar figure would be in the dollars of another year, simply **multiply** the 2001 figure by the conversion factor of that year. For example, $1000 2001 dollars would be $148 in 1950 ($1000 x 0.148 = 148), again rounded to 3 decimal places ($148).

The 1983 changes reduced the inflation rate by changing the way costs of home ownership are measured.
For reference, the following lists yearly inflation rate 1970 to 1985 using the CPI and the CPI-U-X1 series, which applies the 1983 measure to the period 1950 to 1982.

	CPI	CPI-U-X1	CPI Inflation	X1 Inflation	Difference (CPI minus X1)
1970	38.8	41.3	5.7	4.8	0.9
1971	40.5	43.1	4.4	4.4	0.0
1972	41.8	44.4	3.2	3.0	0.2
1973	44.4	47.2	6.2	6.3	-0.1
1974	49.3	51.9	11.0	10.0	1.0
1975	53.8	56.2	9.1	8.3	0.8
1976	56.9	59.4	5.8	5.7	0.1
1977	60.6	63.2	6.5	6.4	0.1
1978	65.2	67.5	7.6	6.8	0.8
1979	72.6	74.0	11.3	9.6	1.7
1980	82.4	82.3	13.5	11.2	2.3
1981	90.9	90.1	10.3	9.5	0.8
1982	96.5	95.6	6.2	6.1	0.0
1983	99.6	99.6	3.2	4.2	-1.0

Starting 1983, CPI = CPI-U-X1, but comparing changes between 1982 and 1983 price levels in CPI and CPI-U-X1 results in different rates of inflation for 1983.

TABLE A-2, YEARLY COST INDEXES BY CWBS FEATURE CODE
Base Year 1967 = 100

CWBS - FEATURE CODES	Wt %	FY68 Oct 67 - Sep 68	FY69 Oct 68 - Sep 69	FY70 Oct 69 - Sep 70	FY71 Oct 70 - Sep 71	FY72 Oct 71 - Sep 72	FY73 Oct 72 - Sep 73	FY74 Oct 73 - Sep 74	FY75 Oct 74 - Sep 75	FY76 Oct 75 - Sep 76	FY77 Oct 76 - Sep 77
02 RELOCATIONS	5%	105.52	112.79	118.78	134.70	146.50	153.85	167.31	193.03	206.77	218.70
03 RESERVOIRS	5%	104.95	115.82	126.39	146.60	161.77	167.43	175.64	201.34	215.69	226.15
04 DAMS	15%	104.99	112.21	121.16	132.02	142.58	149.41	165.26	186.45	203.20	214.55
05 LOCKS	2%	104.91	111.93	119.92	132.69	143.03	150.04	167.12	190.30	201.75	213.78
06 FISH & WILDLIFE FACILITIES	5%	104.72	112.28	120.22	132.70	143.52	150.83	171.27	193.50	205.30	216.70
07 POWER PLANT	10%	104.79	111.26	119.72	128.54	135.78	141.26	159.74	185.20	194.61	206.65
08 ROADS, RAILROADS & BRIDGES	10%	105.52	112.79	118.78	134.70	146.50	153.85	167.31	193.03	206.77	218.70
09 CHANNELS & CANALS	3%	105.43	112.16	120.51	132.28	141.12	146.21	161.64	186.46	202.12	212.28
10 BREAKWATER & SEAWALLS	5%	104.83	111.42	118.88	127.05	136.29	141.06	158.76	188.03	201.26	213.56
11 LEVEES & FLOODWALLS	5%	105.31	112.16	120.69	132.30	143.87	149.31	166.79	190.35	204.98	216.62
12 NAVIGATION PORTS & HARBORS	10%	104.36	109.78	116.39	127.54	135.81	143.73	162.24	189.32	204.99	220.93
13 PUMPING PLANT	5%	104.83	112.17	119.75	131.73	141.94	149.36	170.45	190.49	202.61	215.84
14 RECREATION FACILITIES	5%	104.83	112.17	119.75	131.73	141.94	149.36	170.45	190.49	202.61	215.84
15 FLOODWAY CONTROL & DIVERSION STRUCTURE	2%	104.72	112.28	120.22	132.70	143.52	150.83	171.27	193.50	205.30	216.70
16 BANK STABILIZATION	2%	105.08	111.41	118.87	128.79	138.40	143.26	160.28	176.63	190.48	200.18
17 BEACH REPLENISHMENT	2%	106.12	113.34	123.12	136.97	149.55	154.85	167.00	188.41	204.97	214.59
18 CULTURAL RESOURCE PRESERVATION	2%	104.83	112.17	119.75	131.73	141.94	149.36	170.45	190.49	202.61	215.84
19 BUILDINGS, GROUNDS & UTILITIES	5%	104.83	112.17	119.75	131.73	141.94	149.36	170.45	190.49	202.61	215.84
20 PERMANENT OPERATING EQUIPMENT	2%	104.83	112.17	119.75	131.73	141.94	149.36	170.45	190.49	202.61	215.84
COMPOSITE INDEX (WEIGHTED AVERAGE)	100%	104.98	112.09	119.92	132.17	142.49	149.16	166.25	189.80	203.43	215.68
YEARLY PERCENTAGE CHANGE			*6.8%*	*7.0%*	*10.2%*	*7.8%*	*4.7%*	*11.5%*	*14.2%*	*7.2%*	*6.0%*

Note: FY indicates data developed based on OMB projections.*

TABLE A-2, YEARLY COST INDEXES BY CWBS FEATURE CODE
Base Year 1967 = 100

CWBS - FEATURE CODES	Wt %	FY78 Oct 77 - Sep 78	FY79 Oct 78 - Sep 79	FY80 Oct 79 - Sep 80	FY81 Oct 80 - Sep 81	FY82 Oct 81 - Sep 82	FY83 Oct 82 - Sep 83	FY84 Oct 83 - Sep 84	FY85 Oct 84 - Sep 85	FY86 Oct 85 - Sep 86	FY87 Oct 86 - Sep 87
02 RELOCATIONS	5%	239.50	260.37	280.18	306.16	327.40	340.86	349.51	355.43	358.36	366.32
03 RESERVOIRS	5%	243.39	261.77	285.56	315.28	346.62	365.07	375.29	381.95	386.61	394.55
04 DAMS	15%	234.29	254.47	277.12	302.42	323.67	334.76	344.25	350.47	352.94	358.99
05 LOCKS	2%	233.87	254.13	276.11	301.87	323.21	334.84	343.82	348.28	350.35	356.84
06 FISH & WILDLIFE FACILITIES	5%	238.15	260.08	280.32	304.02	322.75	332.91	342.38	347.18	348.99	354.63
07 POWER PLANT	10%	222.75	241.68	266.35	294.48	314.76	324.11	333.16	337.53	341.85	348.65
08 ROADS, RAILROADS & BRIDGES	10%	239.50	260.37	280.18	306.16	327.40	340.86	349.51	355.43	358.36	366.32
09 CHANNELS & CANALS	3%	230.44	249.44	276.52	306.57	333.45	346.07	354.42	358.24	362.93	371.71
10 BREAKWATER & SEAWALLS	5%	232.34	252.07	280.18	311.09	336.64	347.98	355.31	361.66	366.25	374.63
11 LEVEES & FLOODWALLS	5%	235.94	256.08	280.75	308.97	333.68	346.21	354.99	359.69	362.50	370.28
12 NAVIGATION PORTS & HARBORS	10%	236.08	264.25	312.54	348.37	372.04	369.17	379.93	376.98	369.85	358.99
13 PUMPING PLANT	5%	235.78	257.20	277.60	302.25	320.13	330.82	341.06	346.12	347.33	353.35
14 RECREATION FACILITIES	5%	235.78	257.20	277.60	302.25	320.13	330.82	341.06	346.12	347.33	353.35
15 FLOODWAY CONTROL & DIVERSION STRUCTURE	2%	238.15	260.08	280.32	304.02	322.75	332.91	342.38	347.18	348.99	354.63
16 BANK STABILIZATION	2%	217.80	236.77	262.55	290.13	312.93	324.76	333.55	342.96	349.49	358.71
17 BEACH REPLENISHMENT	2%	231.77	249.67	273.04	299.95	327.10	342.33	351.39	358.74	365.02	373.80
18 CULTURAL RESOURCE PRESERVATION	2%	235.78	257.20	277.60	302.25	320.13	330.82	341.06	346.12	347.33	353.35
19 BUILDINGS, GROUNDS & UTILITIES	5%	235.78	257.20	277.60	302.25	320.13	330.82	341.06	346.12	347.33	353.35
20 PERMANENT OPERATING EQUIPMENT	2%	235.78	257.20	277.60	302.25	320.13	330.82	341.06	346.12	347.33	353.35
COMPOSITE INDEX (WEIGHTED AVERAGE)	100%	234.58	255.68	280.71	308.09	329.87	340.21	349.63	354.31	356.24	361.43
YEARLY PERCENTAGE CHANGE		*8.8%*	*9.0%*	*9.8%*	*9.8%*	*7.1%*	*3.1%*	*2.8%*	*1.3%*	*0.5%*	*1.5%*

Note: FY indicates data developed based on OMB projections.*

TABLE A-2, YEARLY COST INDEXES BY CWBS FEATURE CODE
Base Year 1967 = 100

CWBS - FEATURE CODES	Wt %	FY88 Oct 87 - Sep 88	FY89 Oct 88 - Sep 89	FY90 Oct 89 - Sep 90	FY91 Oct 90 - Sep 91	FY92 Oct 91 - Sep 92	FY93 Oct 92 - Sep 93	FY94 Oct 93 - Sep 94	FY95 Oct 94 - Sep 95	FY96 Oct 95 - Sep 96	FY97 Oct 96 - Sep 97
02 RELOCATIONS	5%	380.42	394.57	402.95	411.27	422.37	440.44	454.26	463.84	473.27	486.24
03 RESERVOIRS	5%	407.44	420.33	435.31	447.08	457.13	467.07	477.72	490.54	502.77	511.08
04 DAMS	15%	371.82	385.00	393.91	402.98	410.31	422.71	435.37	450.08	460.21	470.29
05 LOCKS	2%	371.05	383.63	390.92	398.73	405.85	418.00	430.98	445.65	454.94	464.50
06 FISH & WILDLIFE FACILITIES	5%	367.96	379.94	386.38	394.22	402.07	416.83	430.89	444.68	454.33	466.15
07 POWER PLANT	10%	360.93	376.54	387.78	398.99	406.50	416.04	425.62	438.32	445.08	451.66
08 ROADS, RAILROADS & BRIDGES	10%	380.42	394.57	402.95	411.27	422.37	440.44	454.26	463.84	473.27	486.24
09 CHANNELS & CANALS	3%	383.49	400.61	415.58	427.22	437.81	449.00	459.60	470.64	482.90	492.16
10 BREAKWATER & SEAWALLS	5%	385.55	405.23	422.20	435.04	446.15	457.62	467.96	478.33	490.36	499.73
11 LEVEES & FLOODWALLS	5%	384.15	400.02	410.71	419.99	429.95	441.84	453.83	467.41	477.68	486.21
12 NAVIGATION PORTS & HARBORS	10%	367.45	381.27	396.89	401.41	407.73	419.08	422.73	434.64	451.45	463.22
13 PUMPING PLANT	5%	369.45	383.14	386.75	392.35	399.07	410.63	424.91	439.72	445.58	454.99
14 RECREATION FACILITIES	5%	369.45	383.14	386.75	392.35	399.07	410.63	424.91	439.72	445.58	454.99
15 FLOODWAY CONTROL & DIVERSION STRUCTURE	2%	367.96	379.94	386.38	394.22	402.07	416.83	430.89	444.68	454.33	466.15
16 BANK STABILIZATION	2%	368.75	380.82	392.20	402.54	412.09	423.49	433.89	446.05	457.20	465.43
17 BEACH REPLENISHMENT	2%	383.51	399.48	414.03	425.67	438.77	451.27	460.91	474.09	487.28	495.55
18 CULTURAL RESOURCE PRESERVATION	2%	369.45	383.14	386.75	392.35	399.07	410.63	424.91	439.72	445.58	454.99
19 BUILDINGS, GROUNDS & UTILITIES	5%	369.45	383.14	386.75	392.35	399.07	410.63	424.91	439.72	445.58	454.99
20 PERMANENT OPERATING EQUIPMENT	2%	369.45	383.14	386.75	392.35	399.07	410.63	424.91	439.72	445.58	454.99
COMPOSITE INDEX (WEIGHTED AVERAGE)	100%	374.45	388.68	398.34	406.78	415.22	427.83	439.45	452.31	462.16	472.17
YEARLY PERCENTAGE CHANGE		*3.6%*	*3.8%*	*2.5%*	*2.1%*	*2.1%*	*3.0%*	*2.7%*	*2.9%*	*2.2%*	*2.2%*

Note: FY indicates data developed based on OMB projections.*

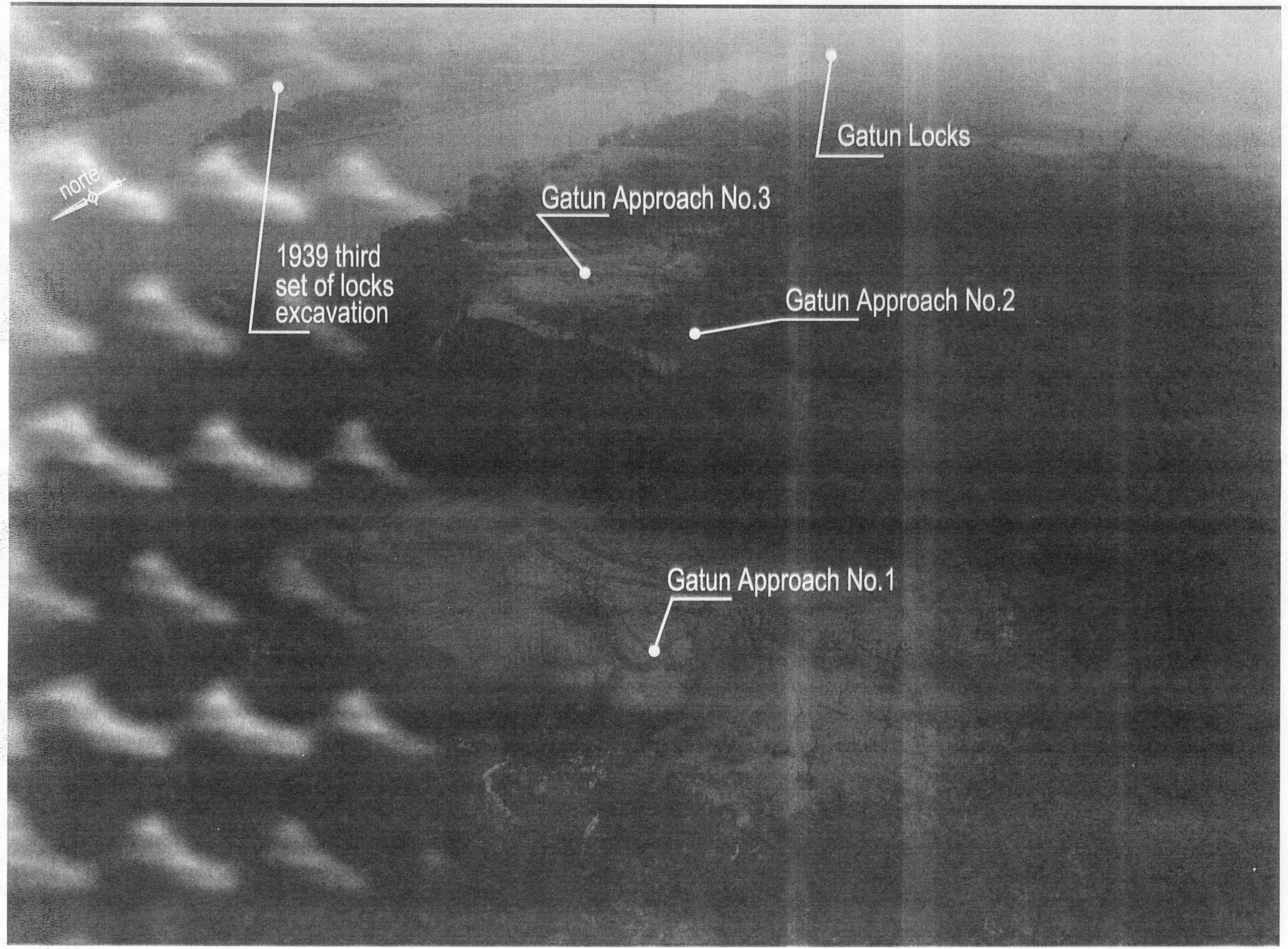
TABLE A-2, YEARLY COST INDEXES BY CWBS FEATURE CODE
Base Year 1967 = 100

CWBS - FEATURE CODES	Wt %	FY98 Oct 97 - Sep 98	FY99 Oct 98 - Sep 99	FY00 Oct 99 - Sep 00	FY01 Oct 00 - Sep 01	FY02* Oct 01 - Sep 02	FY03* Oct 02 - Sep 03	FY04* Oct 03 - Sep 04	FY05* Oct 04 - Sep 05	FY06* Oct 05 - Sep 06	FY07* Oct 06 - Sep 07
02 RELOCATIONS	5%	490.26	501.14	507.97	513.30	526.95	541.17	555.79	570.79	586.20	602.03
03 RESERVOIRS	5%	521.42	540.51	552.38	568.09	583.83	599.60	615.79	632.41	649.49	667.02
04 DAMS	15%	479.06	488.39	496.78	503.96	515.89	529.82	544.12	558.81	573.90	589.40
05 LOCKS	2%	472.47	480.10	488.88	495.43	507.88	521.59	535.68	550.14	564.99	580.25
06 FISH & WILDLIFE FACILITIES	5%	472.75	481.62	488.90	494.06	506.03	519.69	533.72	548.13	562.93	578.13
07 POWER PLANT	10%	458.96	465.38	472.73	479.63	489.52	502.74	516.31	530.25	544.57	559.27
08 ROADS, RAILROADS & BRIDGES	10%	490.26	501.14	507.97	513.30	526.95	541.17	555.79	570.79	586.20	602.03
09 CHANNELS & CANALS	3%	503.55	516.11	526.72	536.03	550.39	565.25	580.51	596.18	612.28	628.81
10 BREAKWATER & SEAWALLS	5%	510.50	520.83	527.86	534.68	548.77	563.59	578.80	594.43	610.48	626.96
11 LEVEES & FLOODWALLS	5%	495.99	503.35	512.62	518.66	532.71	547.10	561.87	577.04	592.62	608.62
12 NAVIGATION PORTS & HARBORS	10%	457.55	465.45	500.23	504.84	504.07	517.67	531.65	546.01	560.75	575.89
13 PUMPING PLANT	5%	459.40	460.16	468.05	472.18	483.50	496.55	509.96	523.73	537.87	552.39
14 RECREATION FACILITIES	5%	459.40	460.16	468.05	472.18	483.50	496.55	509.96	523.73	537.87	552.39
15 FLOODWAY CONTROL & DIVERSION STRUCTURE	2%	472.75	481.62	488.90	494.06	506.03	519.69	533.72	548.13	562.93	578.13
16 BANK STABILIZATION	2%	476.48	489.61	501.50	513.00	527.35	541.59	556.21	571.23	586.65	602.49
17 BEACH REPLENISHMENT	2%	507.09	521.89	532.71	543.21	562.57	577.76	593.36	609.38	625.83	642.73
18 CULTURAL RESOURCE PRESERVATION	2%	459.40	460.16	468.05	472.18	483.50	496.55	509.96	523.73	537.87	552.39
19 BUILDINGS, GROUNDS & UTILITIES	5%	459.40	460.16	468.05	472.18	483.50	496.55	509.96	523.73	537.87	552.39
20 PERMANENT OPERATING EQUIPMENT	2%	462.01	460.16	468.05	472.18	483.50	496.55	509.96	523.73	537.87	552.39
COMPOSITE INDEX (WEIGHTED AVERAGE)	100%	478.10	486.21	497.07	503.52	514.80	528.70	542.98	557.64	572.69	588.16
YEARLY PERCENTAGE CHANGE		*1.3%*	*1.7%*	*2.2%*	*1.3%*	*2.2%*	*2.7%*	*2.7%*	*2.7%*	*2.7%*	*2.7%*

Note: FY indicates data developed based on OMB projections.*

APPENDIX No. 16

Atlantic Entrance Disposal Sites


norte
1939 third
set of locks
excavation
Gatun Locks
Gatun Approach No.3
Gatun Approach No.2
Gatun Approach No.1


ÁREA PARA DEPÓSITO DE MATERIAL DRAGADO JUNTO
A LA CARRETERA QUE CONDUCE A FORT SHERMAN
616,000
617,000
618,000
1,030,000
1,029,000
1,028,000
1,027,000
1,026,000
1,025,000
N
0
300
600
Escala: 1:15,000

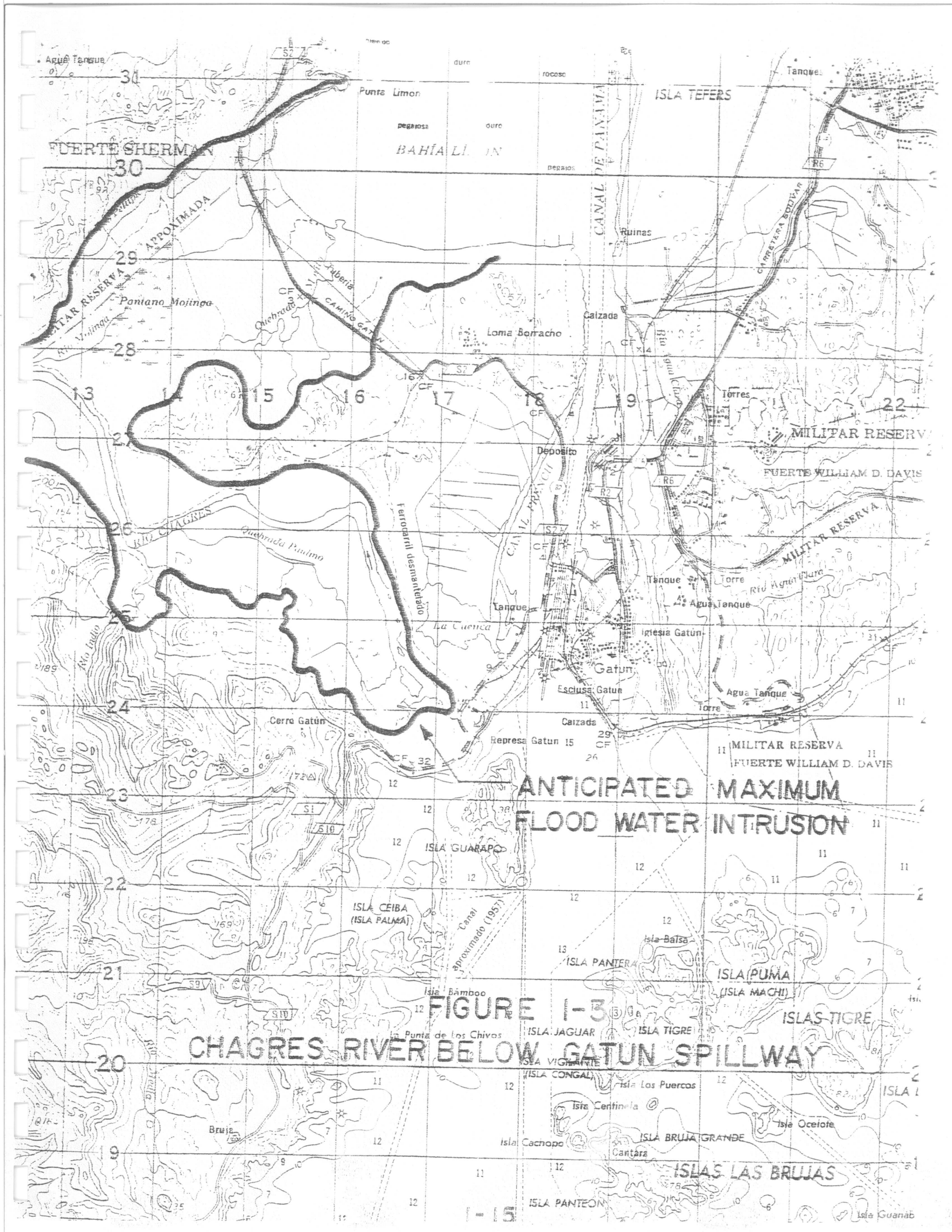
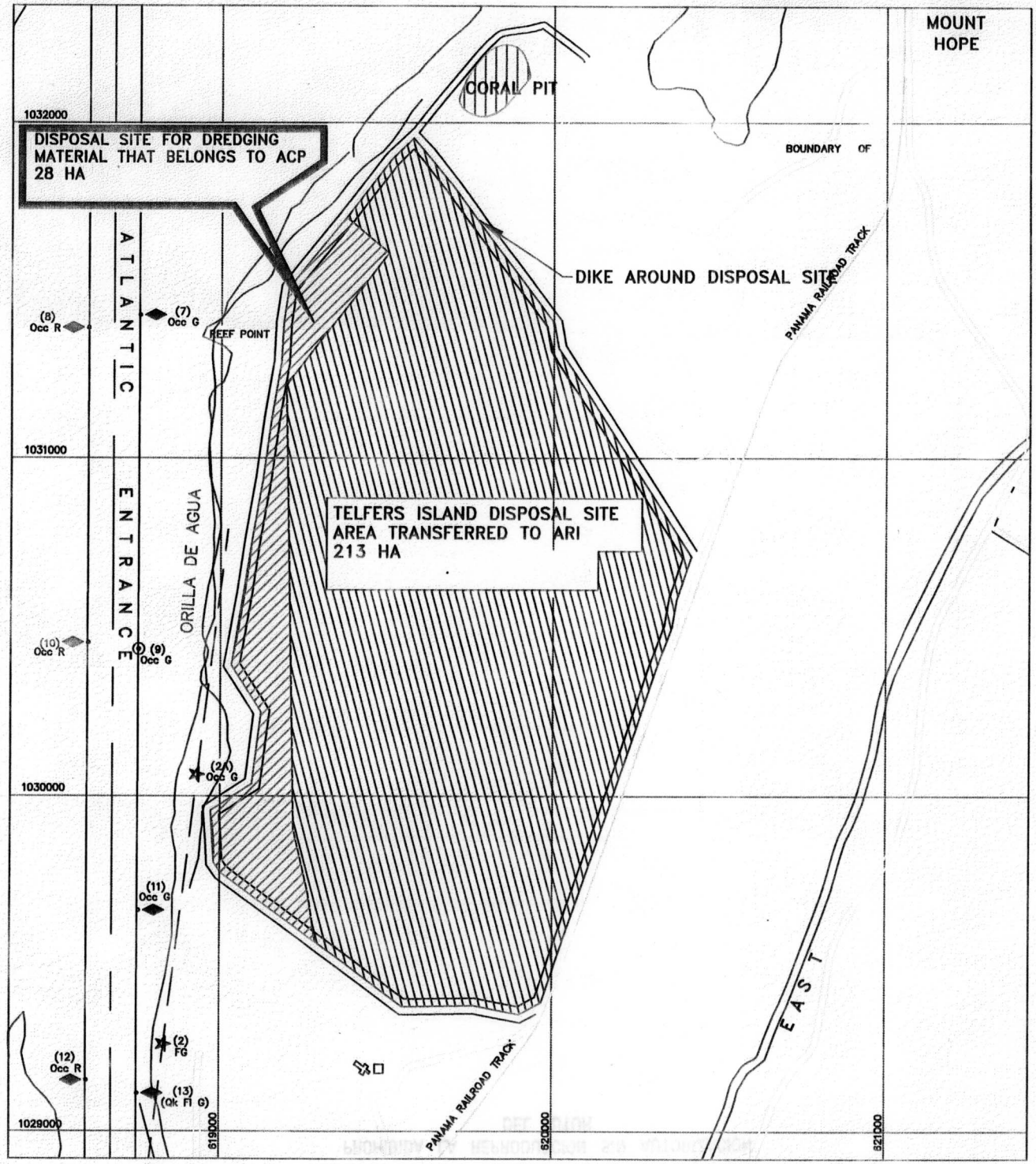


FIGURE I-3

CHAGRES RIVER BELOW GATUN SPILLWAY


MOUNT HOPE
CORAL PIT
1032000
DISPOSAL SITE FOR DREDGING MATERIAL THAT BELONGS TO ACP
28 HA
BOUNDARY OF
DIKE AROUND DISPOSAL SITE
PANAMA RAILROAD TRACK
ATLANTIC ENTRANCE
(8) Occ R
(7) Occ G
REEF POINT
1031000
ORILLA DE AGUA
TELFERS ISLAND DISPOSAL SITE
AREA TRANSFERRED TO ARI
213 HA
(10) Occ R
(9) Occ G
(2A) Occ G
1030000
(11) Occ G
(2) FG
(12) Occ R
(13) (Qk Fl G)
1029000
619000
620000
621000
PANAMA RAILROAD TRACK
EAST