3.5.1 Water Source

The La Tirana and the Pintados sources are located much closer to the service area than the Salar del Huasco source, hence, less transport, construction and maintenance cost is anticipated.

The average yield per well in Salar del Huasco is 40 l/sec while in La Tirana and Pintados is 55 l/sec. Therefore, the number of wells necessary to obtain the required quantity of water is less at La Tirana and Pintados (16 wells each) than at Salar del Huasco (22 wells).

In La Tirana and Pintados, the wells are located on a symmetrical grid 1.5 km x 1.5 km. Therefore, the construction activities are restricted to a limited area, resulting in a lower cost for construction and maintenance facilities and transport. But in the case of Salar del Huasco, the intake wells are spread in an area of 7.5 km x 2 km.

Owing to the increased number of wells and their locations, the Salar del Huasco source requires twice as long as intake pipelines than the other two sources. Therefore, the construction and maintenance cost of intake pipelines are much higher in Salar del Huasco than the other two sources. In addition, 21 junction tanks are required to collect water from the wells and transmit to the treatment works at the Salar del Huasco. This is an additional component of construction and maintenance cost, which do not occur in the other two sources.

The water in the La Tirana and the Pintados sources currently do not require any treatment unlike in the case of Salar del Huasco. In Salar del Huasco, a construction of a treatment plant is necessary for the removal of excess Fe and Mn.

Therefore, by considering all the above factors, the Pintados and the La Tirana sources are preferred to the Salar del Huasco source.

3.5.2 Water Transmission

The length of the transmission pipeline is very large in the case of Salar del Huasco, 157.7 km. It is about 2.5 times longer than the transmission line from La Tirana. Therefore, in Salar del Huasco, the cost of installation and maintenance of the pipelines is much higher than the other two cases. The Alternatives (1) and (2) are the most cheapest options; ie. transmission of water from La Tirana.

The Salar del Huasco source is located at a significantly higher altitude (+3,800 m MSL) than the service area (+95 m MSL). Therefore, the number of new break-pressure tanks required along the transmission pipeline is also high; at 20 sites.

Also, as it is necessary to cross a hilly area (+4,200 m MSL), two booster pumping stations are required between the treatment plant and the hill. However, as far as the other two sources are concerned, a maximum of 5 new break-pressure tanks and one booster pumping station are required. Therefore, the cost of facilities construction and maintenance is high in the case of Salar del Huasco.

Even though the intake power consumption is much lower in Salar del Huasco, the total power consumption for transmitting water to the service areas is much higher in this case than in the other two cases. The total power consumption is about two times higher than other Alternatives. Therefore, high operating cost would be required for the case of Salar del Huasco water source.

From the above discussion, it can be seen that it is not economical to extract water from the Salar del Huasco source and transmit to the service area. Therefore, the Salar del Huasco source will not be considered as a preferred alternative, hereafter. The following discussion will concentrate on the La Tirana and the Pintados sources, Alternatives (1)-(4), in order to select the most suitable transmission route. The transmission pipeline cost from La Tirana is comparatively lower than that of from Pintados. The cost of the installation of transmission/booster pumps and the construction of break-pressure tanks is the lowest in the alternative (1): from La Tirana. In Alternative (1), the raw water can be pumped from the collection tank to a tank located at the highest point of the pipeline without any booster pumps, while other three alternatives require a booster pumping station in between. Therefore, the transmission Alternative route (1) is less complicated than the other three alternatives, hence, less operational and maintenance problems. The total power consumption for extracting water from the wells and transmit to the desired location, is less in Alternatives (1) and (3).

3.5.3 Conclusion

The La Tirana water source is recommended to be the most suitable source to meet the future demand of the Iquique city. Furthermore, the Alternative (1) is recommended as the best transmission route to transmit the La Tirana water to Iquique city.

For the purpose of reference, a comparison table for five (5) alternatives, summarizing important parameters, is given in the following pages.

Comparison Table for Alternatives (1)-(5) to Iquique Water Supply

Common Conditions Applicable to All Alternatives
- Water Source : Groundwater
- Method of groundwater intake : Deep well and submergible pump
- Intake capacity: 738 l/sec (Daily maximum basis)
- Transmission capacity: 701 l/sec (")

Alternative	(1) Pampa-North La Tirana Route-1	(2) Pampa-North La Tirana Route-2	(3) Pampa-South Pintados Route-1	(4) Pampa-South Pintados Route-2	(5) Salar del Huasco
Location of Water source	La Tirana	La Tirana	Pintados	Pintados	Salar del Huasco
Ground Level of Water Source	+1,025 m	+1,025 m	+995 m	+995 m	+3,800 m
Length of Intake Pipeline	9,750 m (100%)	9,750 m (100%)	9,750 m (100%)	9,750 m (100%)	23,610 m 242%
Water Treatment	Not Required	Not Required	Not Required	Not Required	Required for Fe/Mn
Length of Transmission Pipeline up to Alto Hospicio	64,600 m (102%)	63,500 m (100%)	84,400 m (133%)	81,300 m (128%)	157,700 m (248%)
Construction Cost (M$: Million Peso)					
Well-Field Cost (Well/Pump Electricity/Pipeline)	M$4,336 (105%)	M$4,336 (105%)	M$4,142 (100%)	M$4,142 (100%)	M$5,548 (134%)
Transmission/Booster Pump Cost (Pump/Electricity/ House)	M$2,031 (100%)	M$3,620 (1,78%)	M$3,621 (178%)	M$3,092 (152%)	M$6,429 (317%)
Transmission Pipeline Cost (Pipeline/Pressure Relieve Valve)	M$29,081 (106%)	M$27,534 (100%)	M$36,891 (134%)	M$39,367 (143%)	M$63,468 (231%)
Tank Cost (Collection/Break-pressure/ Distribution)	M$1,373 (100%)	M$1,534 (112%)	M$1,447 (106%)	M$1,476 (108%)	M$2,179 (159%)
Treatment Plant Cost (For Mn/Fe)	0	0	0	0	M$12,360
Total Construction Cost	M$36,821 (100%)	M$37,024 (101%)	M$46,101 (125%)	M$48,077 (131%)	M$89,984l (244%)
Pump Power Required					
Total Head of Transmission/ Booster Pumps	125m (100%)	114 + 114 = 228 m (182%)	95 + 237 = 222 m (178%)	102 + 26 = 128 m (102%)	165 + 165 + 115 = 445 m (356%)
Power Consumption of Transmission/Booster Pumps	1,280 kw (1 step) (100%)	2,320 kw (2 steps) (181%)	2,260 kw (2 steps) (177%)	1,320 kw (2 steps) (103%)	4,540 kw (3 steps) (355%)
Power Consumption of Intake Pumps	981 kw (138%)	981 kw (138%)	738 kw (104%)	738 kw (104%)	713 kw (100%)
Total Power Consumption	2,16 kw (110%)	3,301 kw (160%)	2,998 kw (146%)	2,058 kw (100%)	5,253 kw (255%)

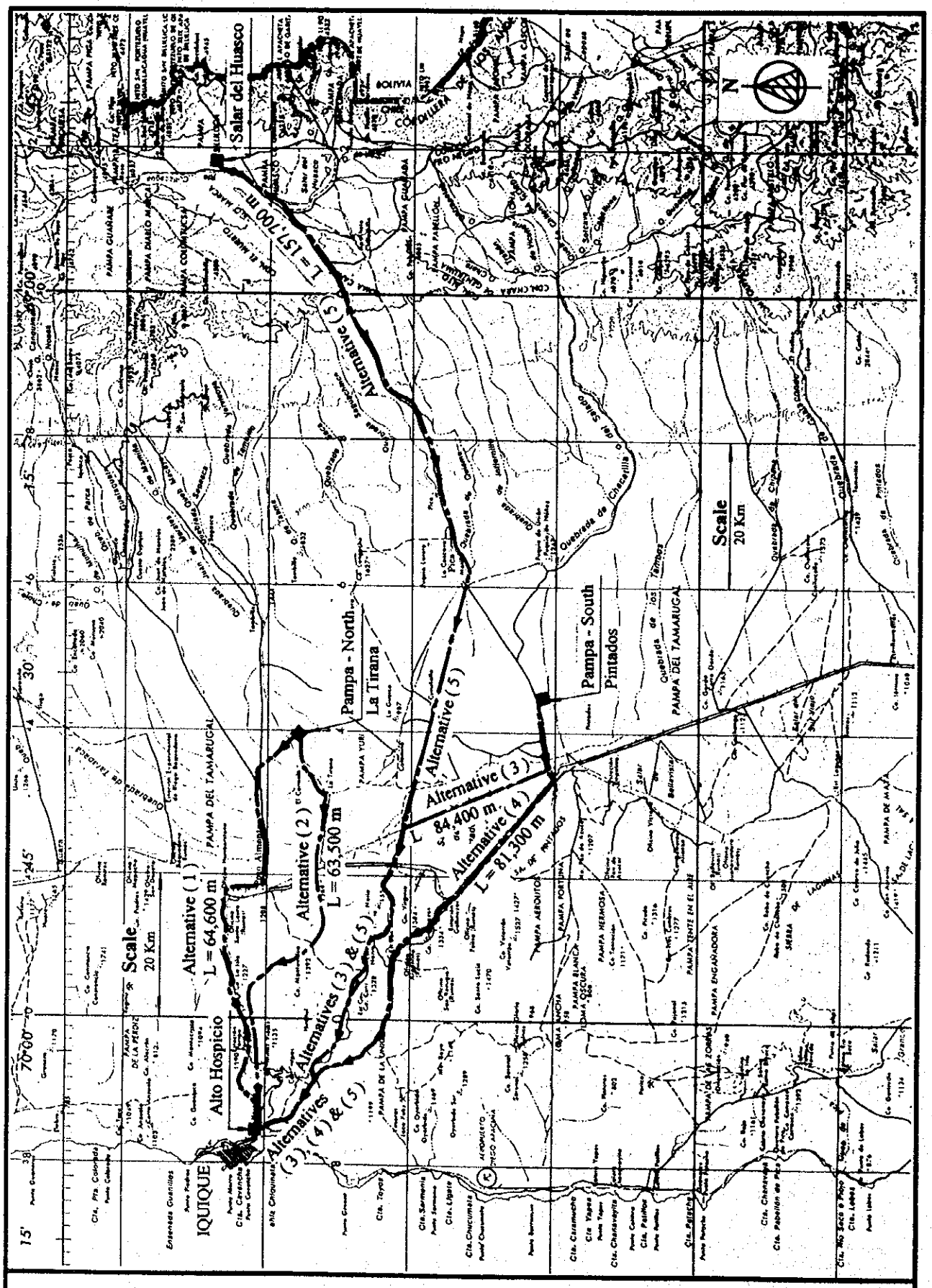

Fig. D-II, 3.1 Pipelines Alternatives (1) - (5) for Iquique Water Supply (from Water Sources to Alto Hospicio)

< Tuberías Alternativas (1) - (5) para el Abastecimiento de Aqua para Iquique (desde las Fuentes hasta Alto Hospicio) >

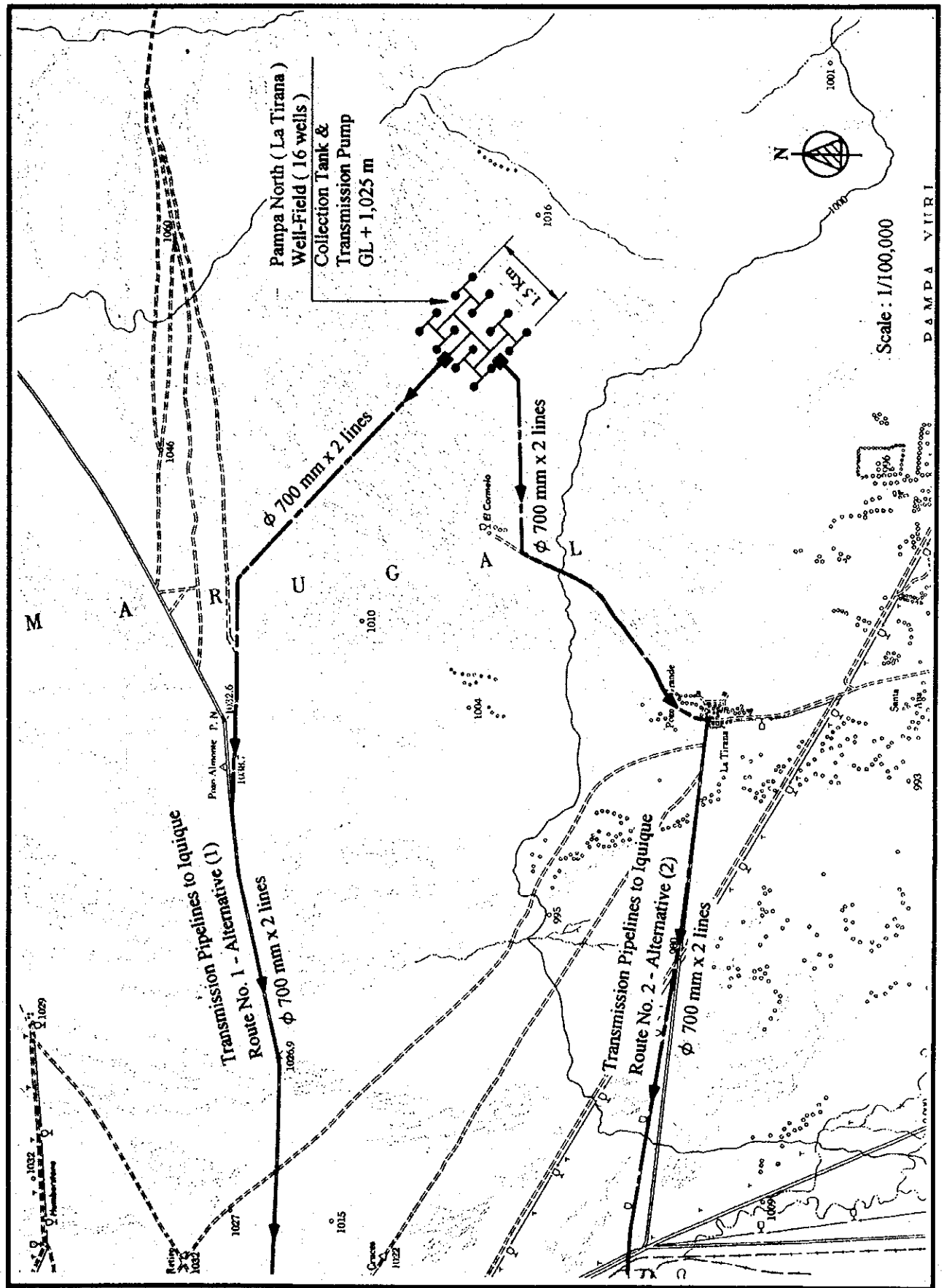

Fig. D-II,3.2 Well - Field of Pampa North (La Tirana) Water Source for Alternatives (1) & (2) to Iquique Water Supply

< Batería de Pozos Fuente de Agua Pampa Norte (La Tirana) para Alternativas (1) y (2), Abastecimiento de Agua Iquique

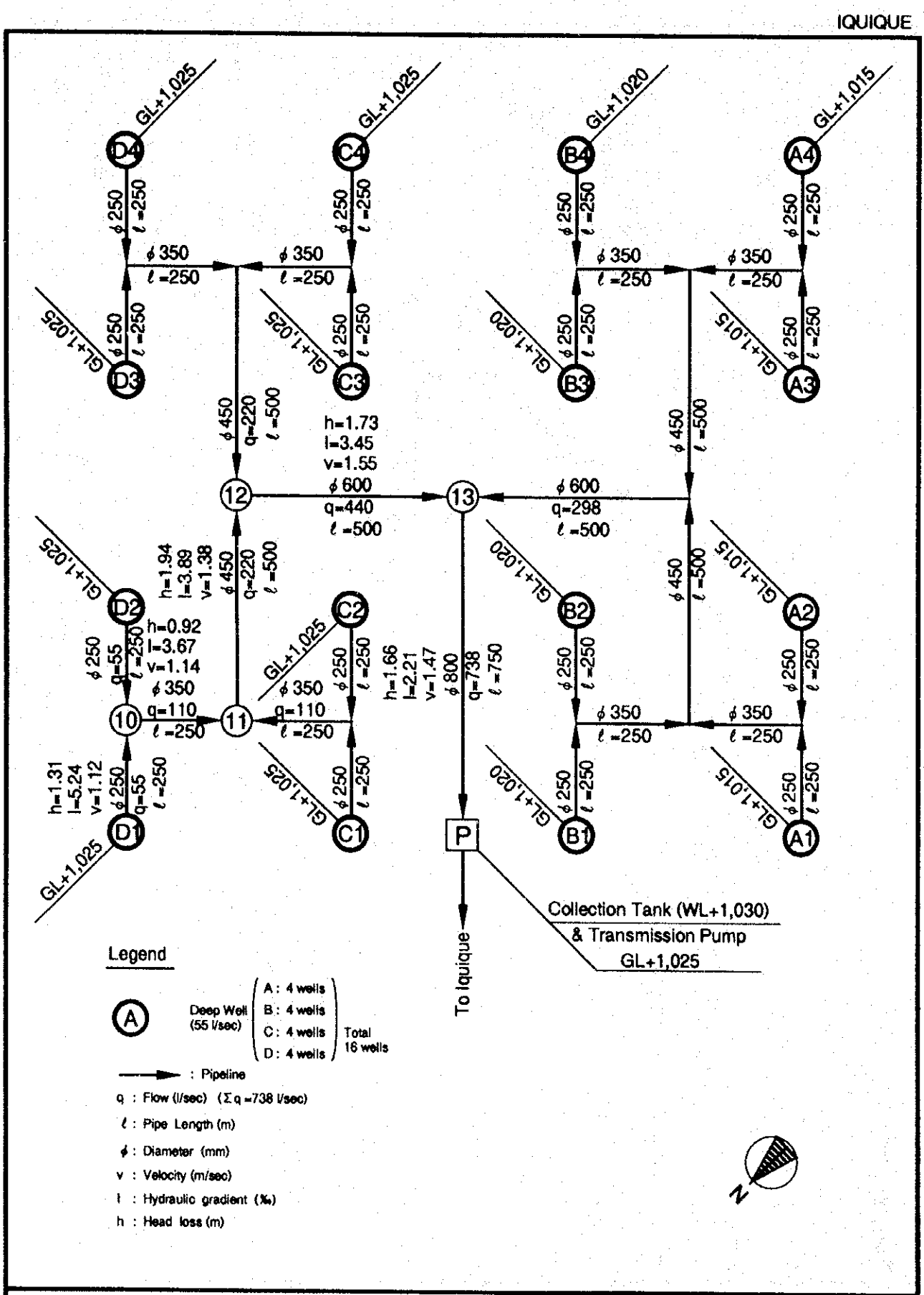

Fig. D-II, 3.3 Hydraulic Chart of Well-Field Pipelines at Pampa del Tamarugal-North (La Tirana)

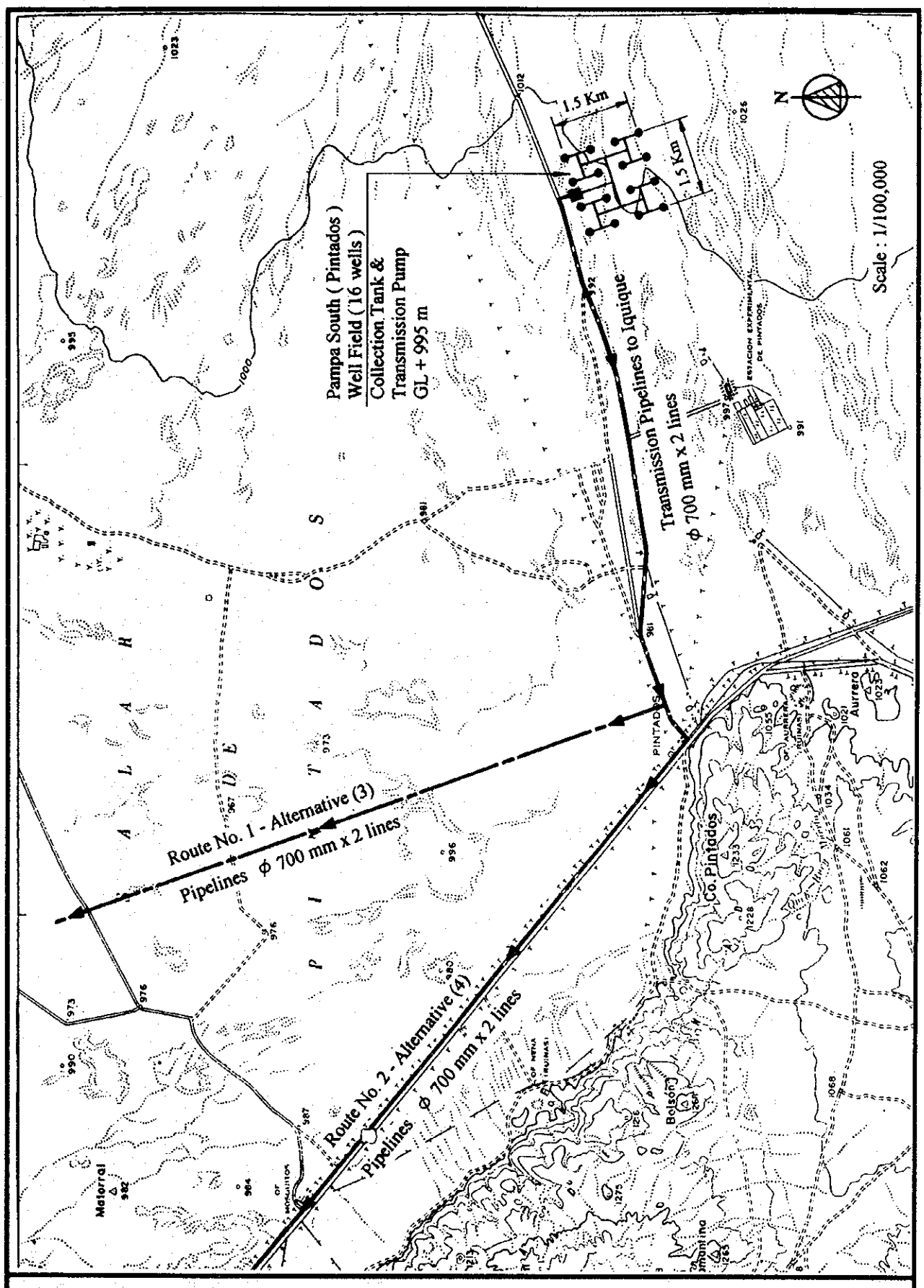

Fig. D-II,3.4 Well - Field of Pampa - South (Pintados) Water Source for Alternatives (3) & (4) to Iquique Water Supply

< Batería de Pozos Fuente de Agua Pampa Sur (Pintados) para Alternativas (3) y (4), Abastecimiento de Agua Iquique >

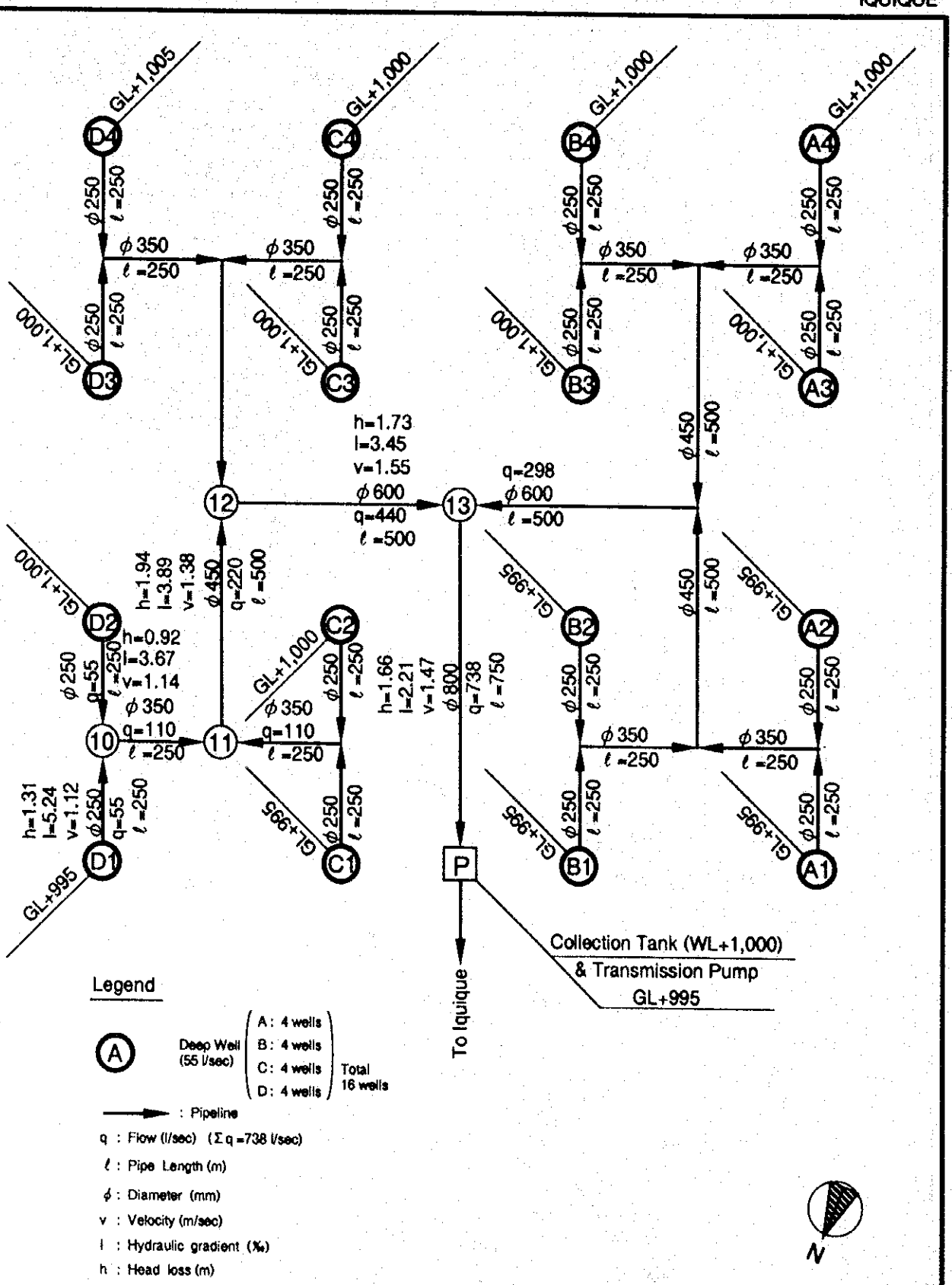

Fig. D-II, 3.5 Hydraulic Chart of Well-Field Pipelines at Pampa del Tamarugal-South (Pintados)

< Gráfico Hidráulico Cañerias de Conduccio'n de La Bateria de Pozos Pampa del Tamarugal - Sur (Pintados) >

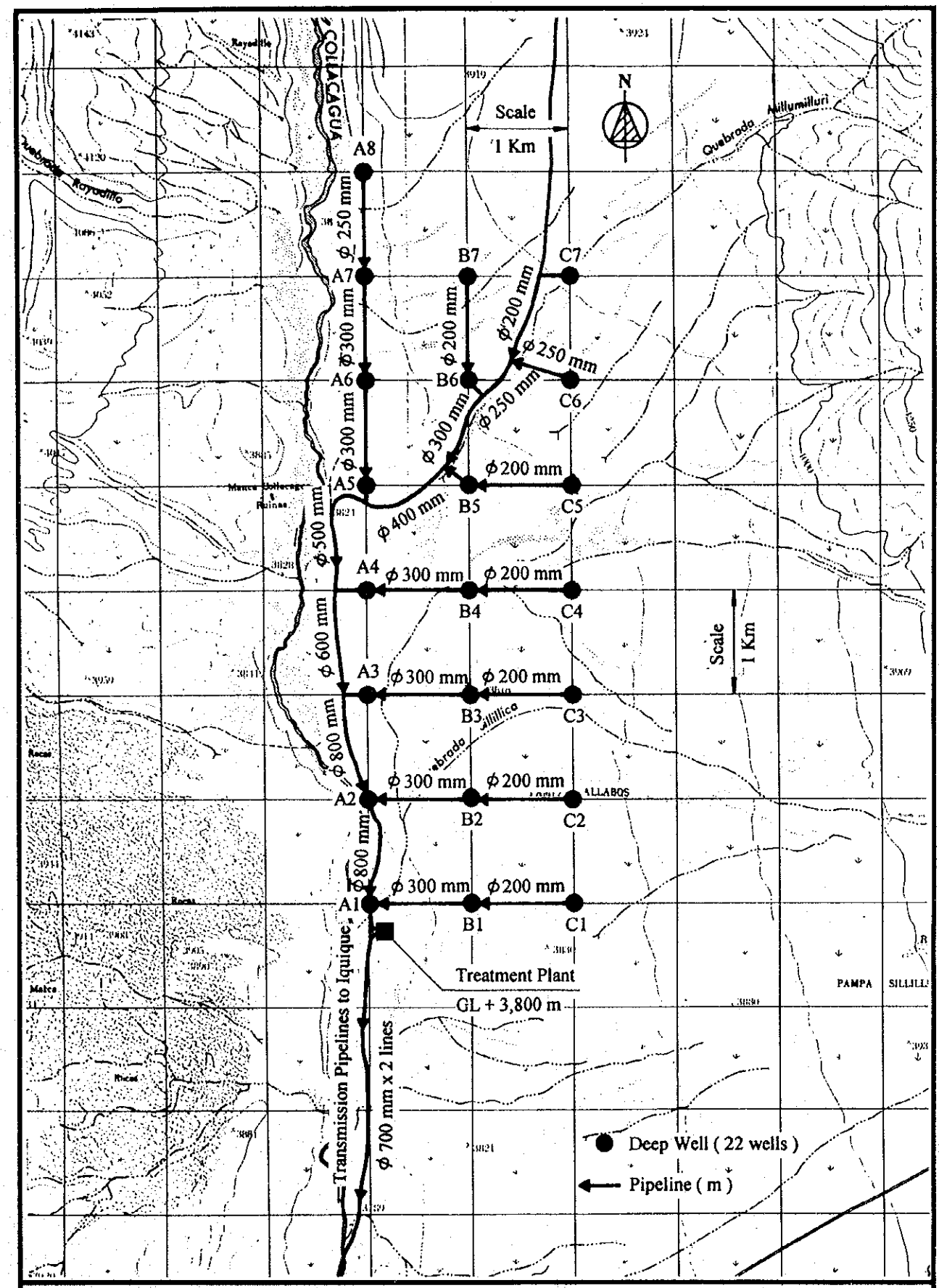

Fig. D-II,3.6 Well - Field of Salar del Huasco Water Source for Alternative (5) to Iquique Water Supply

< Batería de Pozos de la Fuente de Agua Salar del Huasco para la Alternativa (5) , Abastecimiento de Agua Iquique >

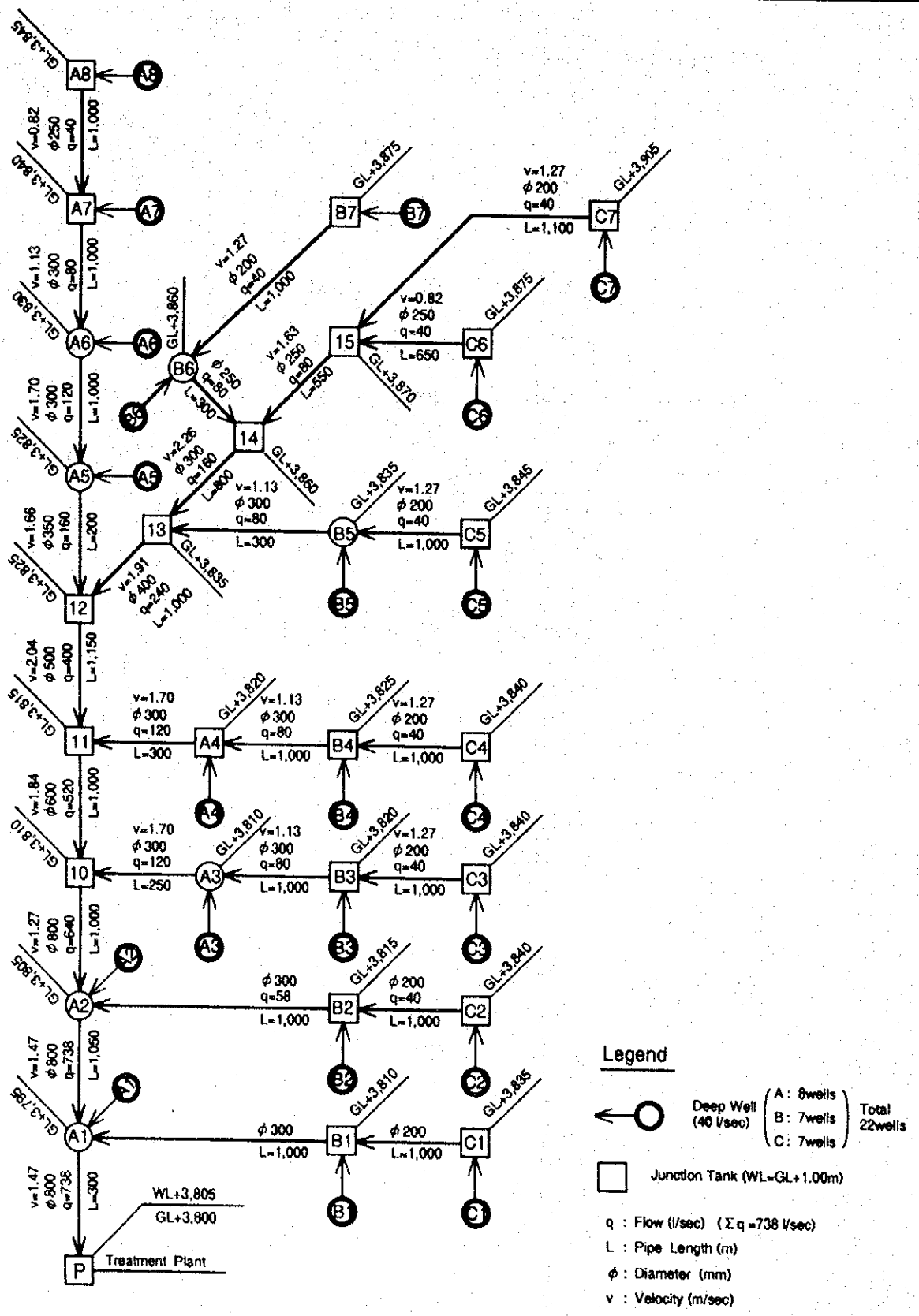

Fig. D-II, 3.7 Hydraulic Chart of Intake Pipelines for Salar del Huasco Well-Field

< Diagrama Hidraulico de la Obra de Toma de las Tuberias Para el Pozo Salar del Huasco >

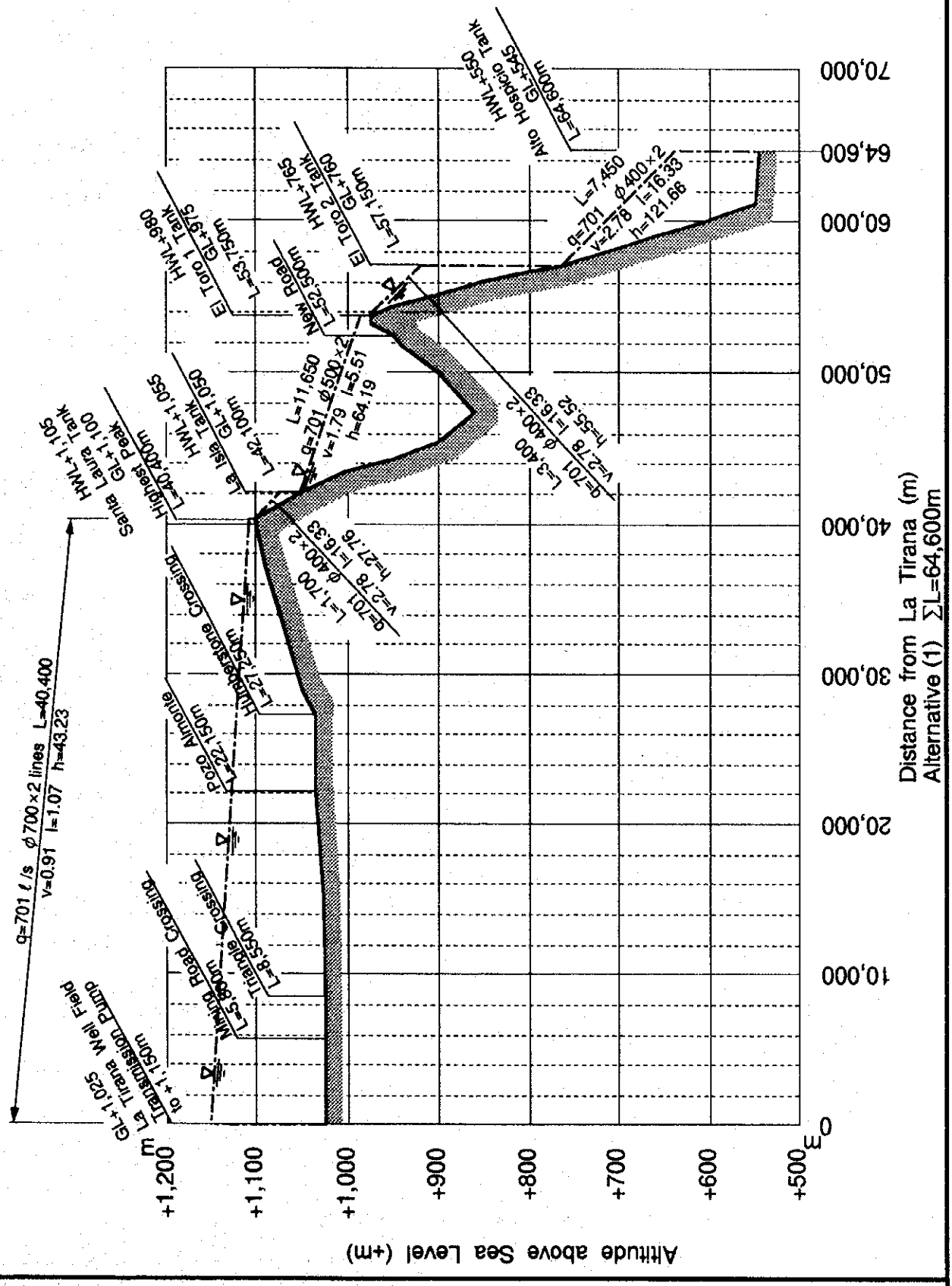

Fig. D - II, 3.8 Longitudinal Profile of Transmission Pipeline for Alternative (1) to Iquique Water Supply from Pampa - North (La Tirana) to Alto Hospicio (Route No.1)

< Perfil Longitudinal de la Cañeria de Conduccio'n para la Alternative (1) al Abastecimiento de Agua de Iquique desde Pampa - Norte (La Tirana) a Alto Hospicio (Ruta No.1) >

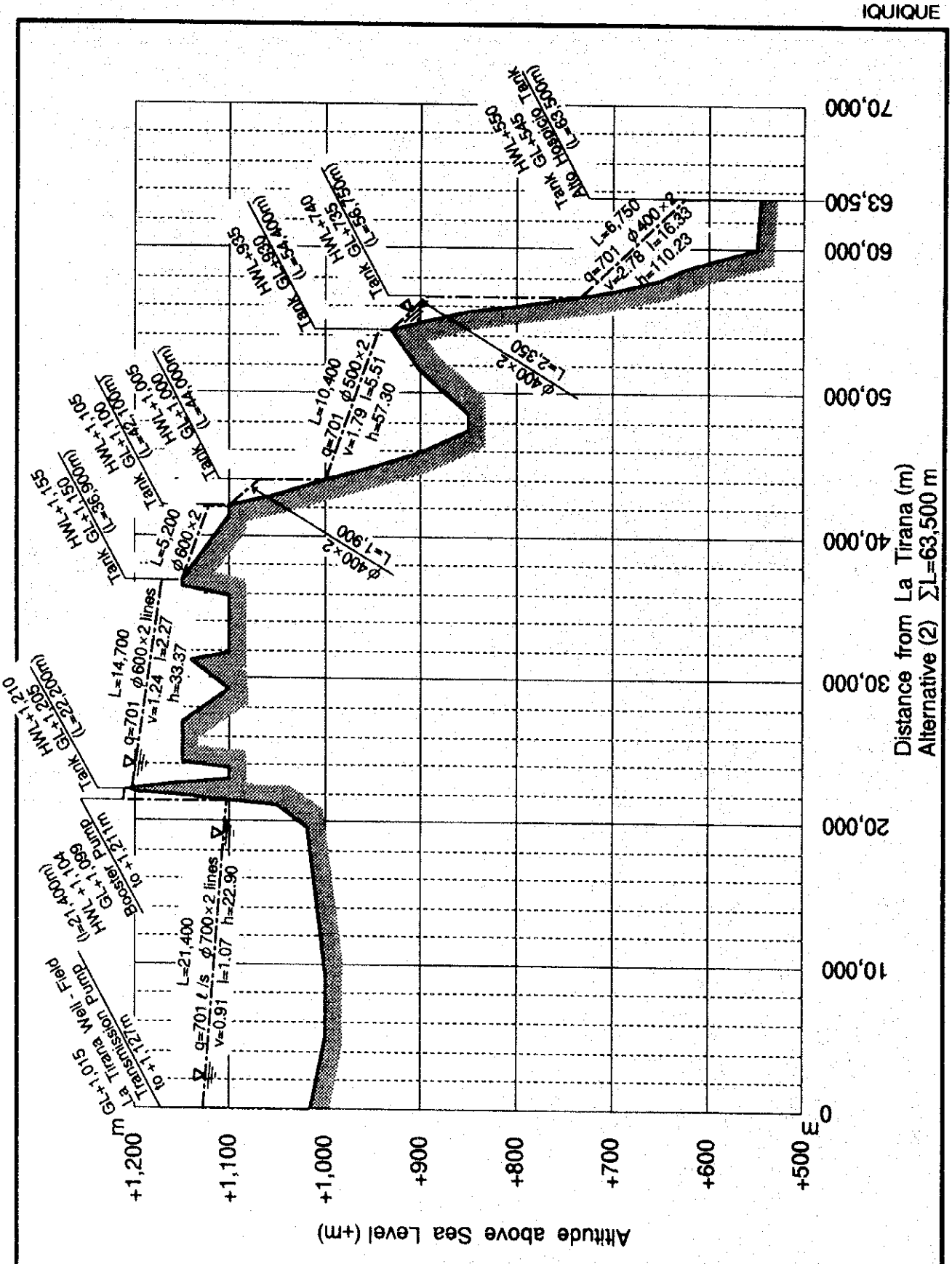

Fig. D-II, 3.9 Longitudinal Profile of Transmission Pipeline for Alternative (2) to Iquique Water Supply from Pampa - North (La Tirana) to Alto Hospicio (Route No.2)

< Perfil Longitudinal de la Cañeria de Conduccio'n para la alternative (2) al Abastecimiento de Agua de Iquique desde Pampa - Norte (La Tirana) a Alto Hospicio (Ruta N0.2) >

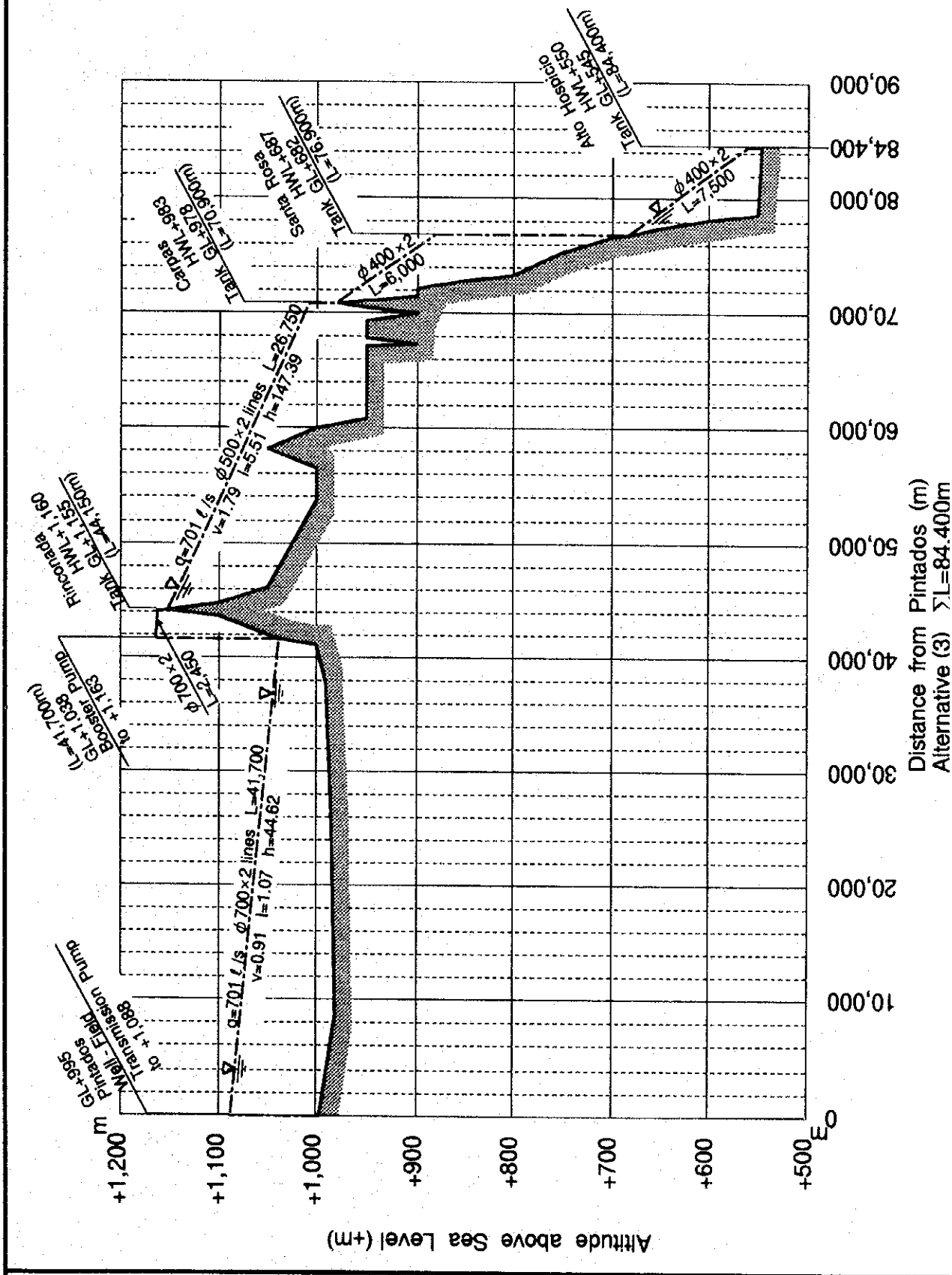

Fig. D-II, 3.10 Longitudinal Profile of Transmission Pipeline for Alternative (3) to Iquique Water Supply from Pampa - South (Pintados) to Alto Hospicio (Route No.1)

< Perfil Longitudinal de la Cañeria de Conduccio'n para la Alternative (3) al Abastecimiento de Agua de Iquique desde Pampa - Sur (Pintados) a Alto Hospicio (Ruta No.1) >

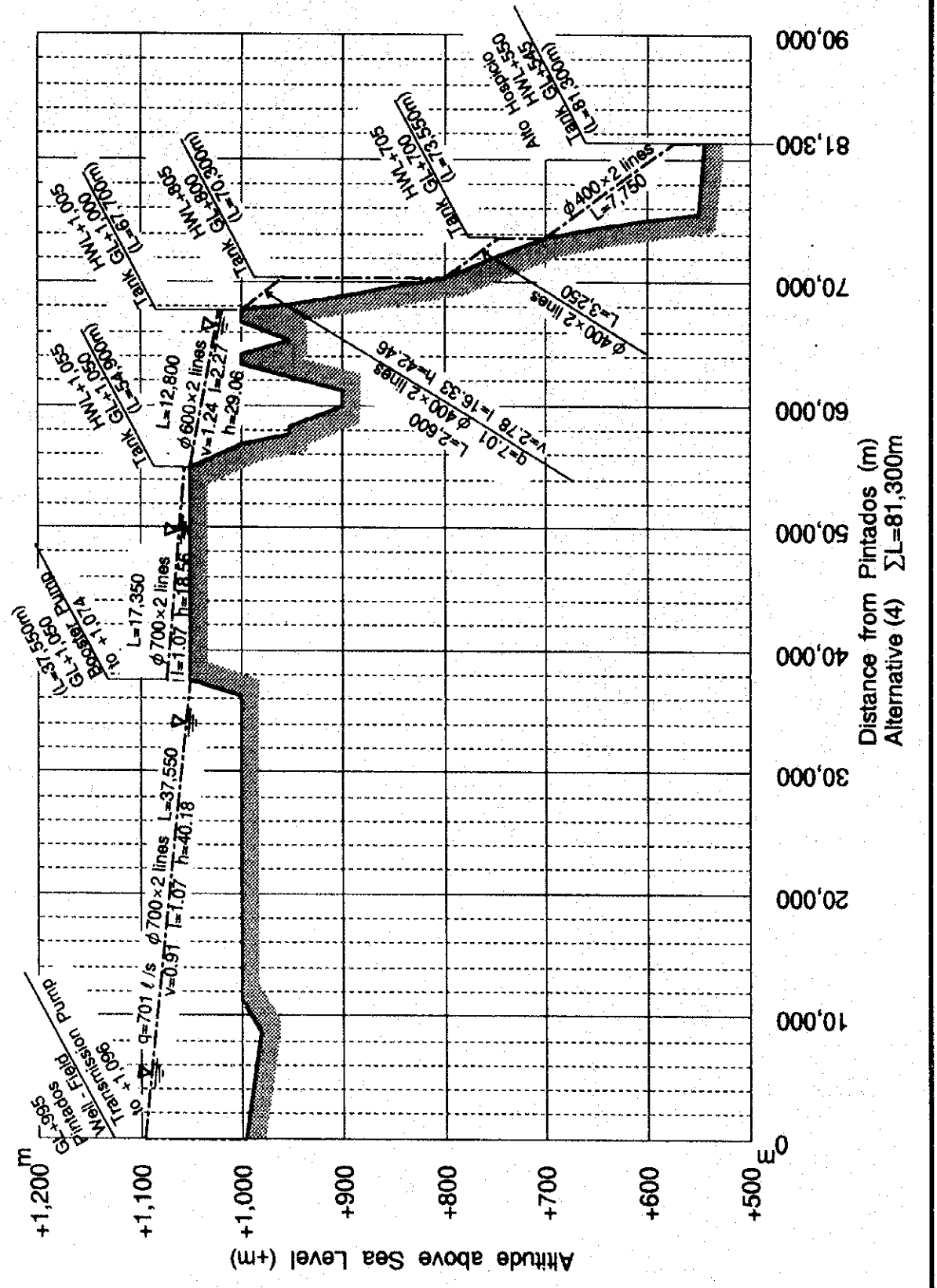

Fig. D-II, 3.11 Longitudinal Profile of Transmission Pipeline for Alternative (4) to Iquique Water Supply from Pampa - South (Pintados) to Alto Hospicio (Route No.2)

< Perfil Longitudinal de la Cañeria de Conduccio'n para la Alternative (4) al Abastecimiento de Agua de Iquique desde Pampa - Sur (Pintados) a Alto Hospicio (Ruta No.2) >

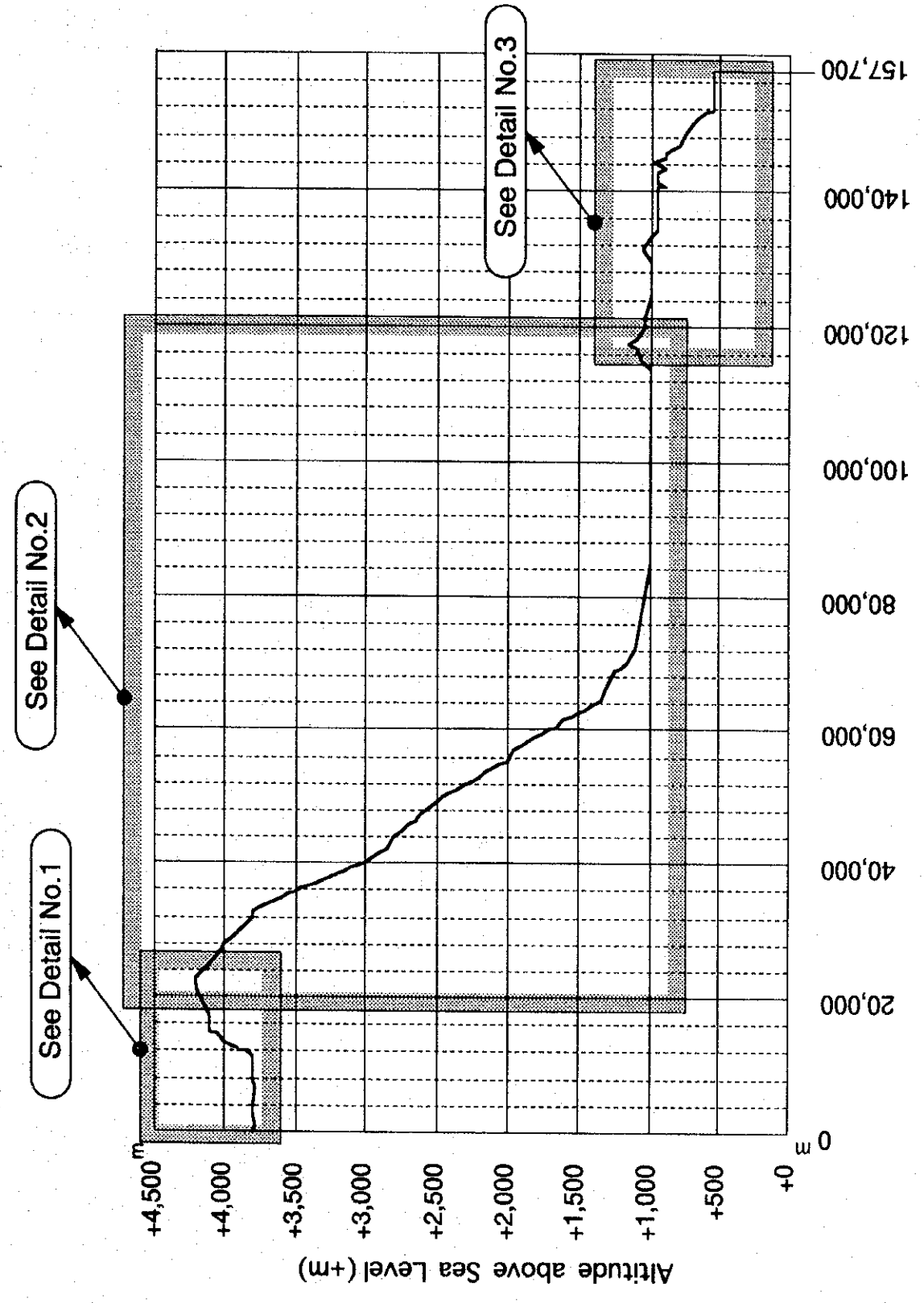

Fig. D-II, 3.12 Longitudinal Profile of Transmission Pipeline for Alternative (5) to Iquique Water Supply from Salar del Huasco to Alto Hospicio

< Perfil Longitudinal de la Cañeria de Conduccio'n para la Alternative (5) al Abastecimiento de Agua de Iquique desde Salar del Huasco a Alto Hospicio >

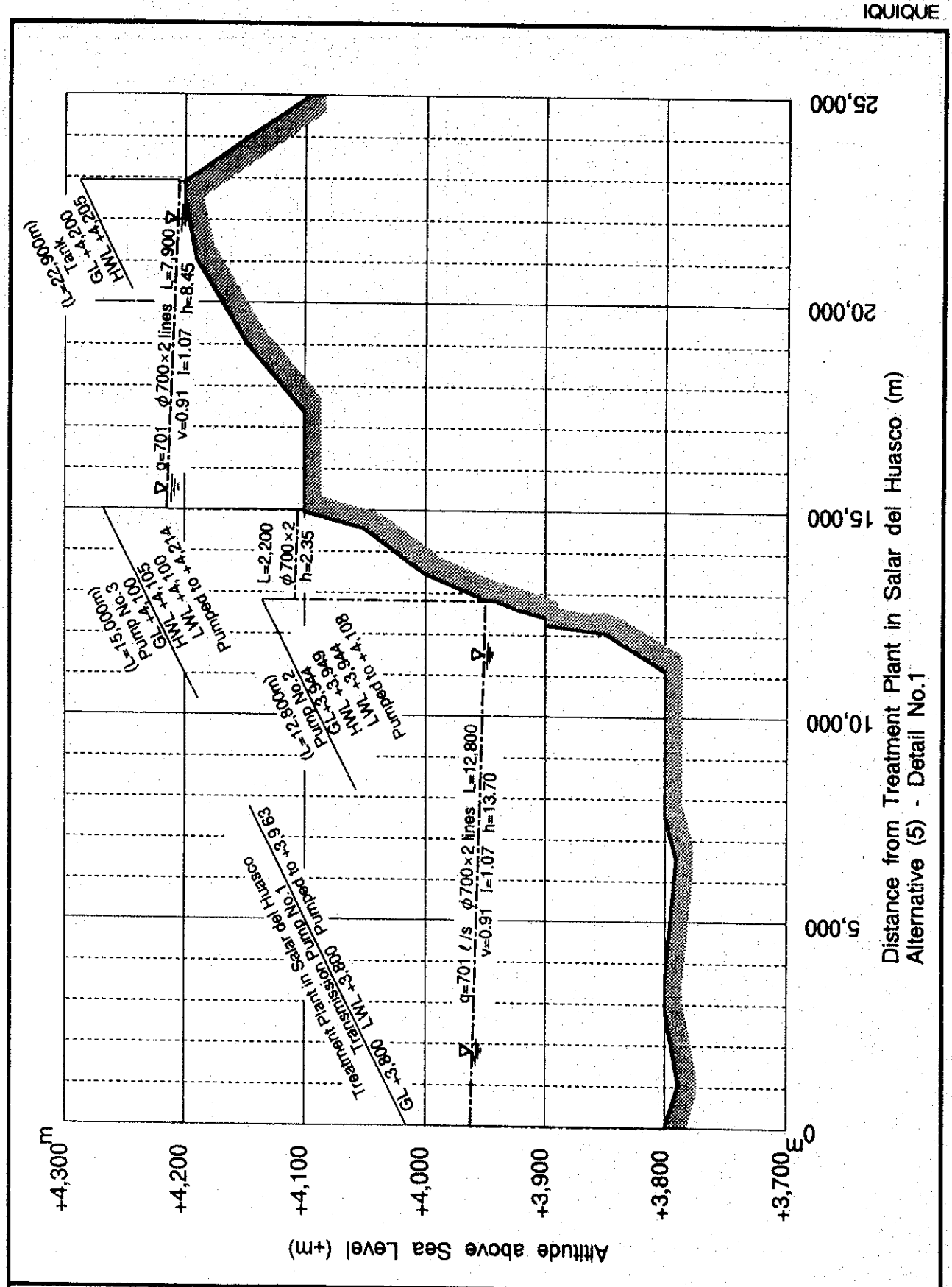

Fig. D-II, 3.13 Longitudinal Profile of Transmission Pipeline for Alternative (5) - Detail No.1 to Iquique Water Supply from Salar del Huasco to Alto Hospicio

< Perfil Longitudinal de la Cañeria de Conduccio'n para la Alternative (5) - Detalle No.1 al Abastecimiento de Agua de Iquique desde el Salar del Huasco hasta Alto Hospicio >

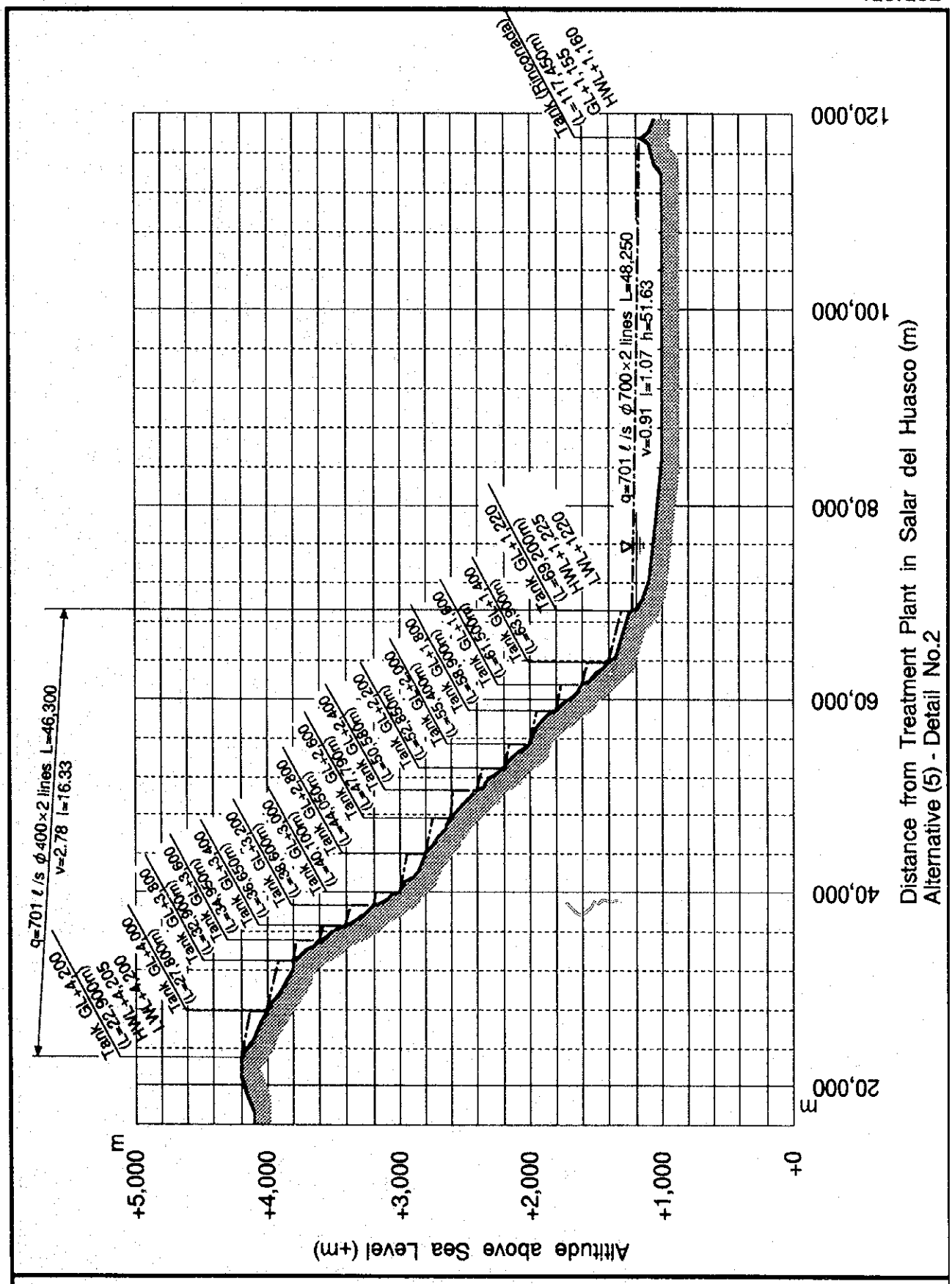

Fig. D-II, 3.14 Hydraulic Profile of Transmission Pipeline for Alternative (5) - Detail No.2 to Iquique Water Supply from Salar del Huasco to Alto Hospicio

< Perfil Longitudinal de la Cañeria de Conduccio'n para la Alternative (5) - Detalle No.2 al Abastecimiento de Agua de Iquique desde el Salar del hasta Alto Hospicio >

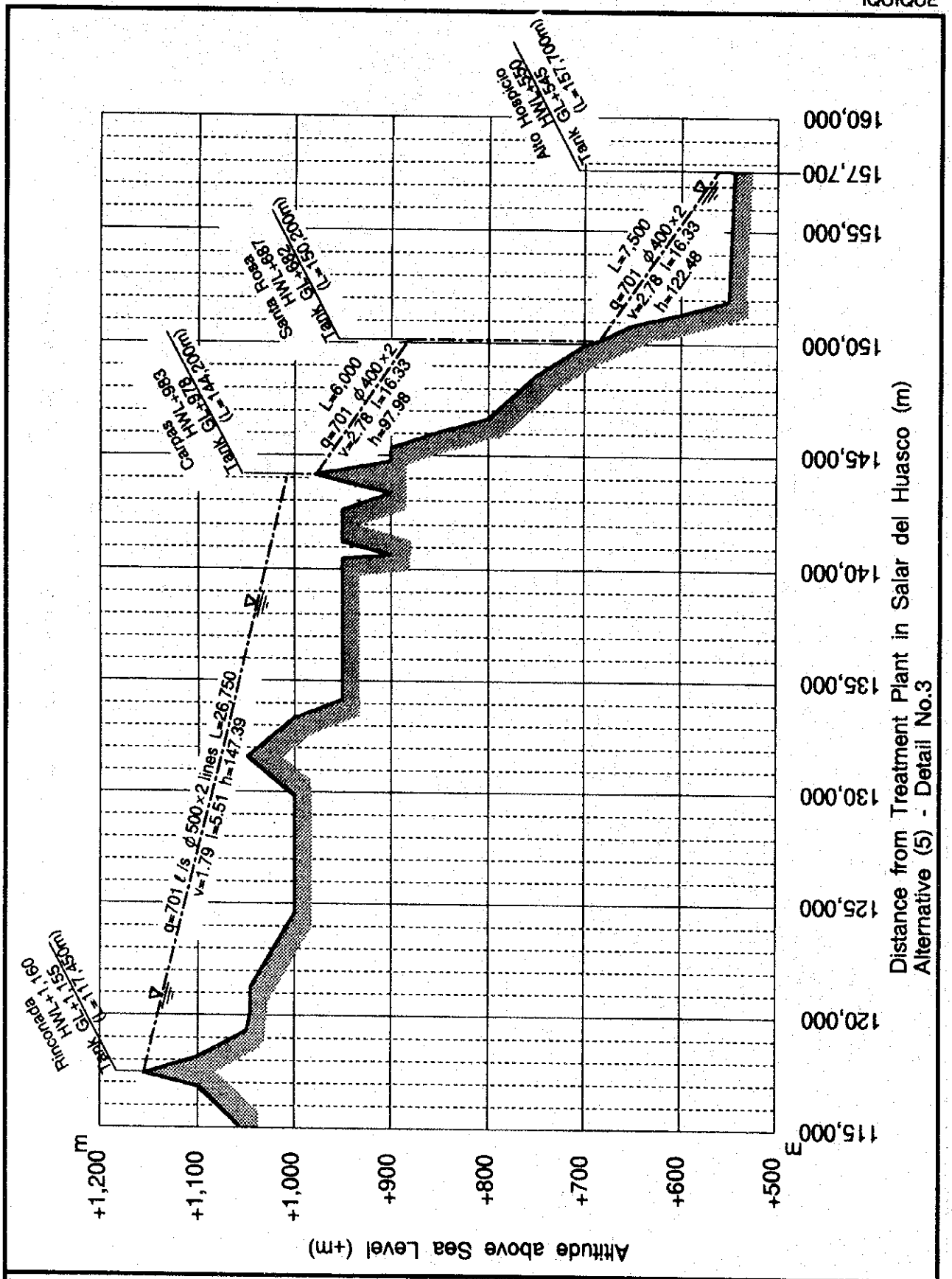

Fig. D-II, 3.15 Longitudinal Profile of Transmission Pipeline for Alternative (5) - Detail No.3 to Iquique Water Supply from Salar del Huasco to Alto Hospicio

< Perfil Longitudinal de la Cañeria de Conduccio'n para la Alternative (5) - Detalle N0.3 al Abastecimiento de Agua de Iquique desde el Salar del Huasco hasta Alto Hospicio >

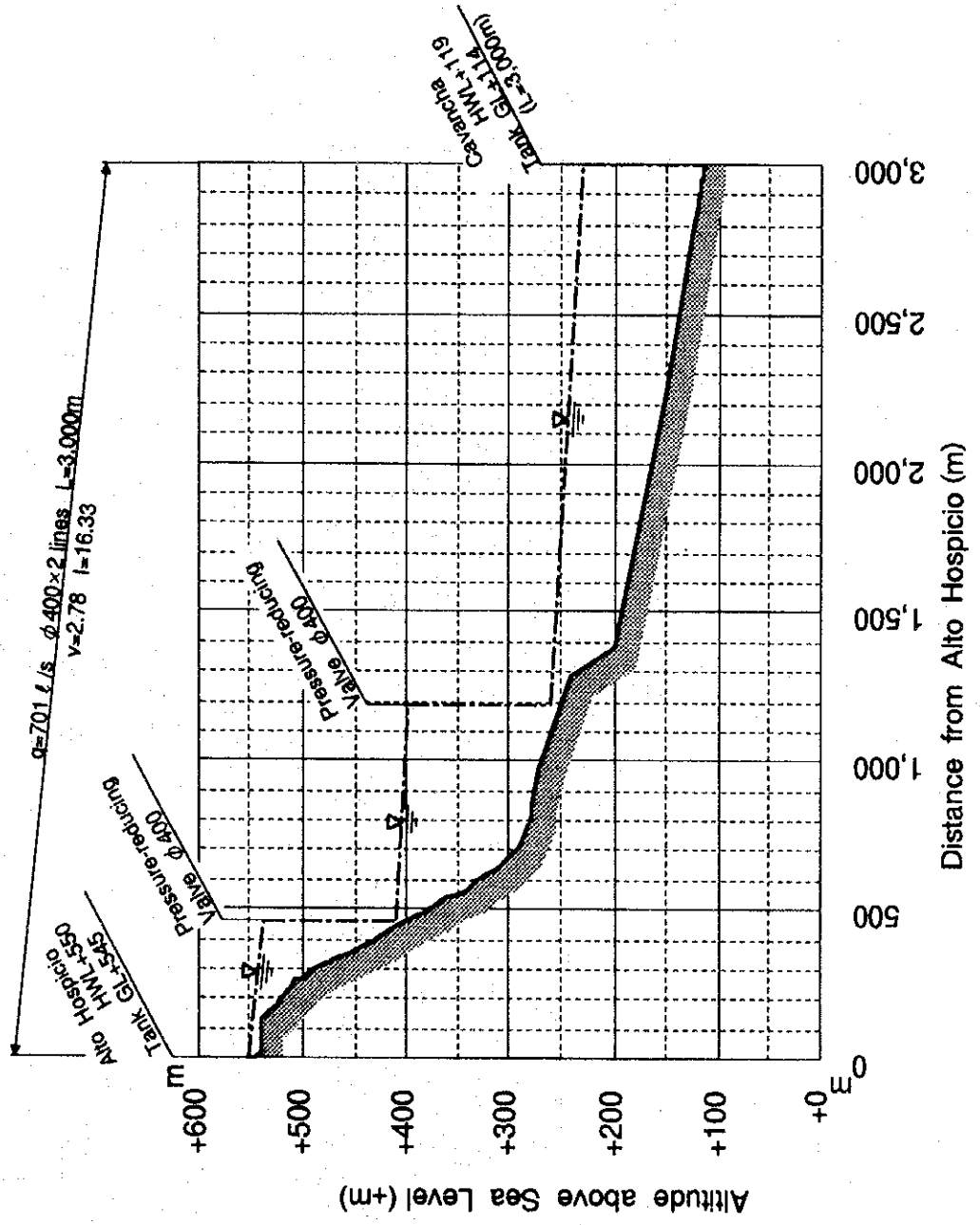

Fig. D-II, 3.16 Longitudinal Profile of Transmission Pipeline for Alternatives (1) - (5) to Iquique Water Supply (from Alto Hospicio to Cavancha)

< Perfil Longitudinal de la Cañeria de Conduccio'n para las Alternativas (1) -(5) al Abastecimiento de Agua de Iquique (desde Alto Hospicio a Cavancha) >

Note:
This drawing shows the case of Transmission Pump Station for Alternative (1) - Iquique

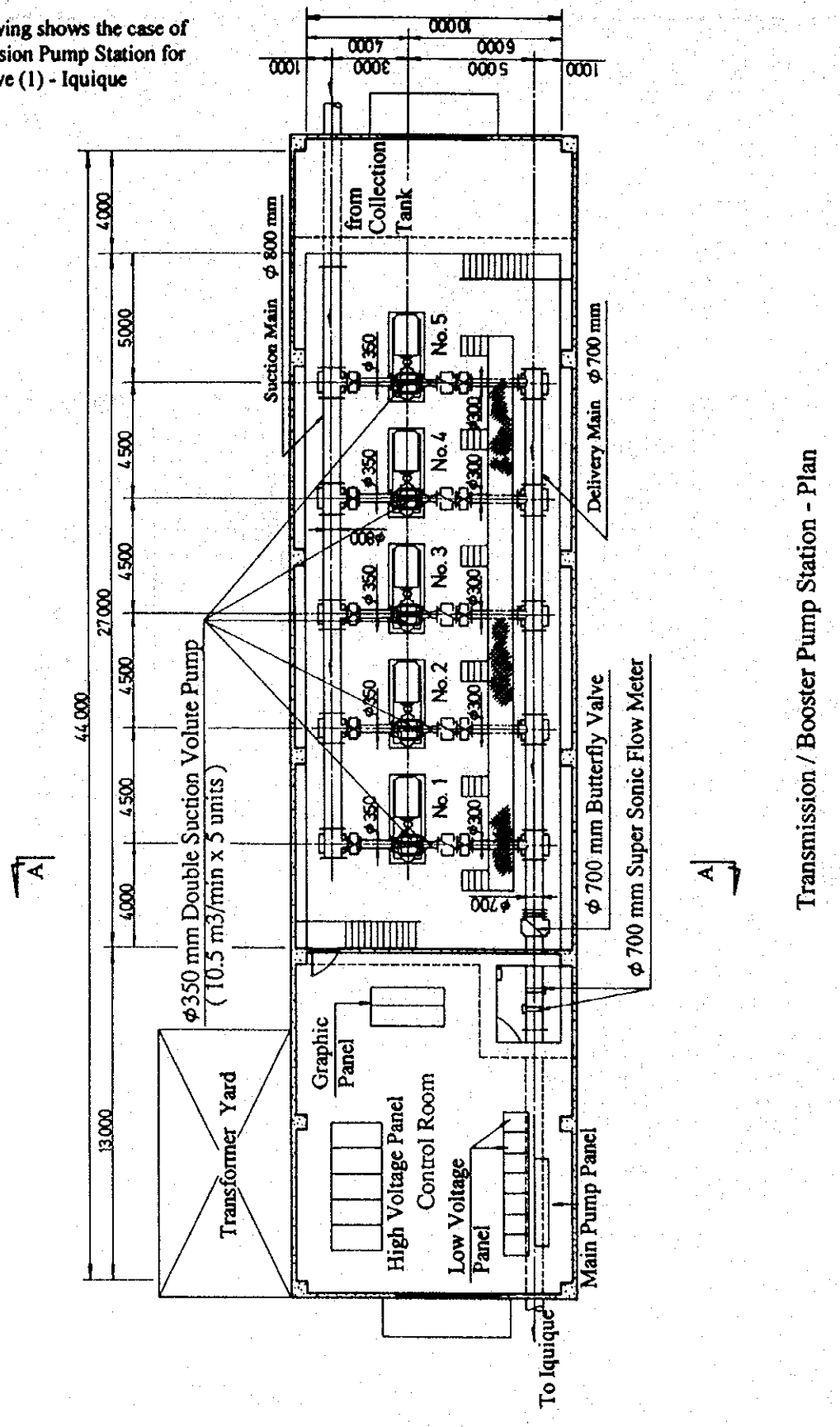

Fig. D-II, 3.17 Typical Layout of Transmission/Booster Pump Station - Plan

< Distribución Típica de la Planta Elevadora de Impulsión/Conducción - Planta >

Note:
This drawing shows the case of
Transmission Pump Station for
Alternative (1) - Iquique

Transmission / Booster Pump Station - Elevation

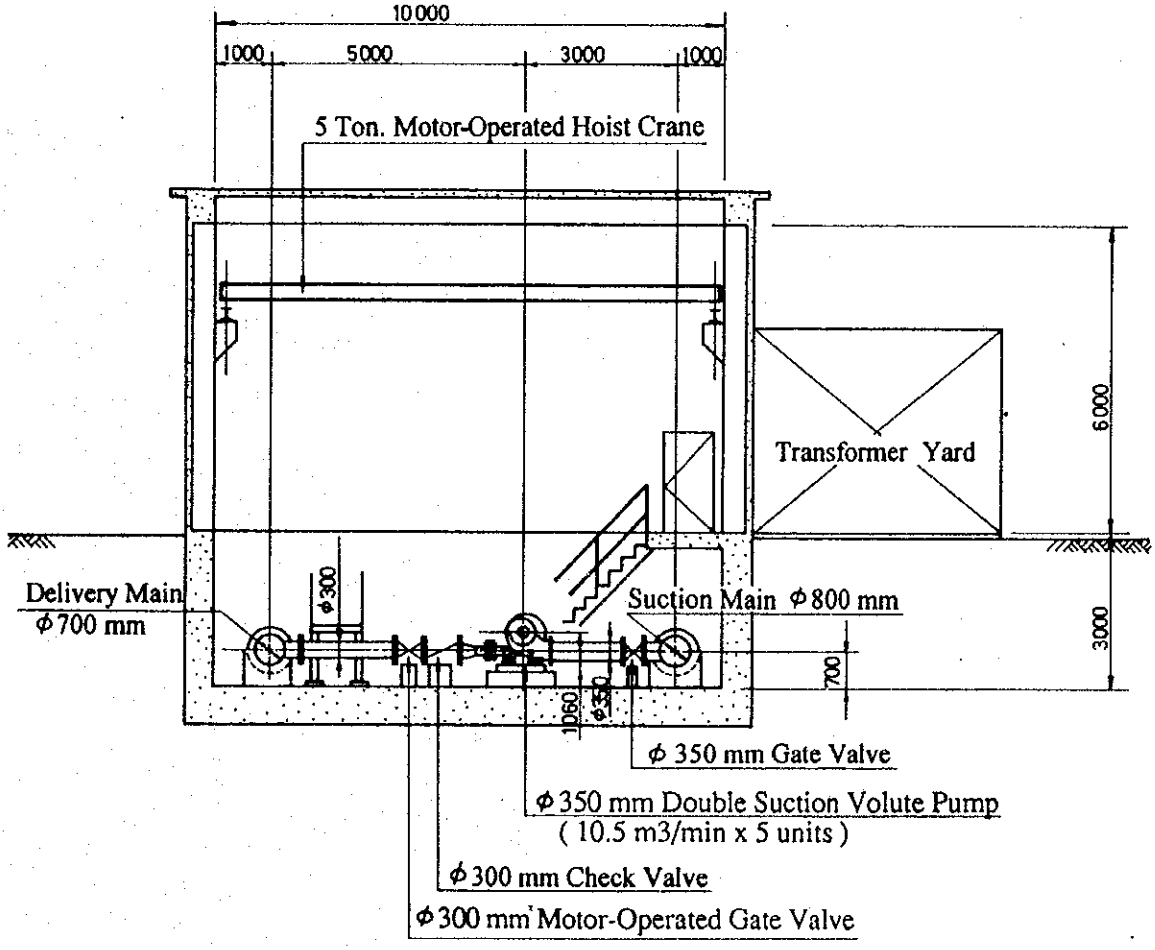

Fig. D-II, 3.18 Typical Layout of Transmission/Booster Pump Station - Elevation

< Distribución Típica de la Planta Elevadora de Impulsión/Conducción - Elevación >

CHAPTER IV. PLANNING OF FIRST-STAGE DEVELOPMENT

4.1 General

In order to meet the increasing water demand of the Iquique city due to the population growth, it is proposed to develop the water sources in the near future. The foregoing Chapter dealt with the potential water sources, transmission routes and cost incurred on each alternative. As discussed in Section 3.5, the groundwater in the La Tirana water source and the transmission route No.1, from La Tirana to Alto Hospicio: Alternative (1), are the most suitable water source and the most economical route to transfer water to the Iquique city.

It is planned to develop the water source in two stages. The first stage is targeted for the year 2005, while the second stage is targeted for the year 2015. During the first-stage, the construction of 8 wells, and laying of the transmission pipelines including the construction of related structures will be carried out. In the second-stage, further 8 wells will be developed within the same well field and a duplication transmission pipeline will be installed, along the Stage-1 pipeline, including the construction of related structures. The first-stage construction work is planned to commence in 1997 and finish in 1998. The project will be commissioned in 1999.

4.2 Capacity

The daily maximum and the daily average demand by the year 2005 are estimated as 369 l/sec and 284 l/sec, respectively, on the production basis (See Tables D-II, 2.1 and 2.2).

4.3 Water Source

The groundwater in the La Tirana well field in the Pampa del Tamarugal area, located about 60 km east to the Iquique city, is selected as the most suitable source to meet the future water requirement of the Iquique city. In the first stage, 8 deep wells, including 1 on standby, with a discharge capacity of 55 l/sec each, are planned to develop. The wells are located at 500 m apart, on a grid of 1,500 m x 500 m. The average depth of a well is about 200 m. Each well is equipped with a submersible pump of 55 l/sec discharge capacity and a pump head of 76-81 m. (See Fig. D-II, 4.10 for typical cross-sectional details of a well structure and for details of intake pumps.)

The quality of the water in the La Tirana source is within the acceptable levels of the Chilean Drinking Water Quality Standard 409. Therefore, the water can be served

to the customers without any specific treatment. Disinfection will be carried out in the distribution tanks at Cavancha prior to serving the customers. However, the land is reserved within the well field, for the construction of a future treatment plant, if necessary, due to uncertainties related to the possible deterioration of quality in future. Fig. D-II, 4.9 shows the area reserved for the future treatment plant.

4.4 Water Transmission

The proposed transmission pipeline runs along the existing local road and Highway from La Tirana well-field to Cavancha distribution tank. Four tanks of Santa Launa, La Isla, El Toro 1 El Toro 2 and Alto Hospicio are provided on route for pressure-break. The route of the pipeline is shown in Figs. D-II, 4.1, D-II, 4.2, D-II, 4.3, D-II, 4.4, D-II, 4.5, D-II, 4.6 and D-II, 4.7. The longitudinal profile of the pipeline is shown in Fig. D-II, 4.8. The hydraulic calculation of the pipeline is shown in Table D-II, 4.1.

The water extracted from the wells is first transmitted to a collection tank located within the well field. The tank is served as a temporary storage and has a capacity of 1,250 m^3. The 5,750 m long intake pipelines within the well field, from the wells up to the collection tank, are of Asbestos Cement and the diameters vary from 250 mm to 800 mm. The layout of the well field is shown in Fig. D-II, 4.9.

The water is then pumped to the Santa Laura tank (capacity 1,250 m^3) located at the highest peak (+1,100 m MSL) of the transmission pipeline by the transmission pumps located in the La Tirana pumping station. The pumping station is equipped with 3 transmission pumps, of 175 l/sec capacity and a 125 m pump head each, including 1 pump on standby. Also, provision is allowed in the pumping station to house the second stage pumps (2 Nos.). The transmission pumps are of double-suction volute type. Total power requirement for the first stage pumps is 840 KW. The power required for both stages to operate the intake pumps and the transmission pumps can be obtained from the local power supply company, ELIQSA. The layout of the collection tank and transmission pumps are shown in Fig. D-II, 4.11. The pumping station is illustrated in Figs. D-II, 4.12 and 4.13.

The transmission pipelines are of Ductile Cast Iron (DIP) and the diameters vary from 700 mm to 400 mm. The majority of the pipelines run along the existing highways or local roads. The construction of new access road (4.0 m wide and 5,800 m long) is required from the well field to the existing local road (See, Fig. D-II, 4.14 for the access road and Fig. D-II, 4.15 for the maintenance road in the well

field). Between Alto Hospicio and Cavancha, the proposed pipeline will follow the existing pipelines. The 700 mm dia. pumping pipeline is 40,400 m long, and the gravity flow pipelines are 27,200 m long and the diameters vary from 500 mm to 400 mm.

The water flows by gravity from the Santa Laura tank to a transmission tank at Alto Hospicio (+545 m MSL) via three break-pressure tanks, of 250 m^3 capacity each. The break-pressure tanks are located at strategically important locations for the purpose of reducing the operating pressure within the transmission mains to acceptable levels. They are the La Isla tank at 1,050 m MSL (L=42,100 m), the El Toro-1 tank at +975 m MSL (L=53,750 m) and the El Toro-2 tank at +760 m MSL (L=57,150 m).

The gravity pipeline between the Santa Laura tank and the La Isla tank is 400 mm in dia. and 1,700 m long. The pipeline between the La Isla tank and the El Toro-1 tank is 11,650 m long and 500 mm in dia. The pipelines between the El Toro-1 and the El Toro-2 tanks, and the El Toro-2 and the Alto Hospicio tanks are 400 mm in dia. and 3,400 m and 7,450 m in length, respectively. The Alto Hospicio tank has a capacity of 1,250 m^3 and serves as a transmission tank as well as a break-pressure tank.

The elevation difference between the Alto Hospicio tank and the distribution tanks at Cavancha is about 430 m and, therefore, the water can flow by gravity between the tanks. However, due to site constraints, break-pressure tanks will not be constructed along this pipeline to reduce the pressure within the mains to acceptable levels. Therefore, two pressure-reducing valves are provided to reduce the operating pressure within the mains. They are located at L=65,060 m and L=65,790 m.

The pipeline from the Alto Hospicio tank to the distribution tanks at Cavancha is 3,000 m long and 400 mm in diameter. There are two distribution tanks at Cavancha, of 7,500 m^3 capacity each, with a 12 hours, storage. All tanks are made of reinforced concrete and are circular in shape.

Fig. D-II, 4.16 shows the typical cross-section of the pipe installation, Fig. D-II, 4.17 shows the structural specifications of the proposed tanks, Fig. D-II, 4.18 shows the layout of Alto Hospicio tank and Fig. D-II, 4-19 shows the layout of Cavancha distribution tank.

It is necessary to acquire land for the development of the well field and the construction of tanks, except for Alto Hospicio and Cavancha tanks. At Alto

Hospicio and Cavancha, new tanks will be constructed at the same sites where there are tanks for present water supply. Easement is required for the installation of transmission pipelines along the roads.

4.5 Construction Cost

The total construction cost for the first stage development is Chilean Peso $ 20,238,224,000. The summary of cost estimation is presented below. The amount indicated are in Chilean Peso, as of March 1994.

- Well-field development.....	$2,295,144,000
- Transmission pumps	$1,510,912,000
- Transmission pipeline	$14,680,499,000
- Tanks	$686,225,000
- Distribution Networks	$765,546,000
- Electric Transmission Line	$158,000,000
	Total = $20,096,320,000

Refer Table D-II, 4.2 for break down of cost for above items.

4.6 Implementation Schedule

The first stage development is targeted to meet the water demand up to 2005. The implementation schedule for the first stage development is given below:

- Detailed design : 1996
- Construction : 1997 - 98 (in two years)
- Commissioning : 1999

Note:
Second Stage Schedule
- Targeted year : 2015
- Construction : 2004 - 05 (in two years)
- Commissioning : 2006

4.7 Operation and Maintenance Cost

The operation and maintenance (O&M) cost for the first stage development is composed of electric power cost, chemicals cost, personnel expenditure, repairing and replacement cost for water supply facilities as of September 1994. O&M cost is summarized below.

(See Table D-II, 4.3 for more details)

Summary of O&M Cost
(First Stage of Iquique Water Supply Scheme)

(Unit : Chilean Peso)

Year	Electric Power	Chemicals	Personnel	Repairing & Replacement	Total
1999	188,014,000	4,686,714	11,520,000	355,711,060	559,931,774
2000	196,410,000	4,893,099	11,520,000	355,711,060	568,534,159
2001	204,890,000	5,104,358	11,520,000	355,711,060	577,225,418
2002	213,541,000	5,320,493	11,520,000	355,711,060	586,092,553
2003	219,562,000	5,470,000	11,520,000	355,711,060	592,263,060
2004	231,435,000	5,765,764	11,520,000	355,711,060	604,431,824
2005	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2006	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2007	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2008	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2009	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2010	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2011	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2012	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2013	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2014	240,683,000	5,996,524	11,520,000	1,563,233,060	1,821,432,584
2015	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2016	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2017	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2018	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2019	240,683,000	5,996,524	11,520,000	2,351,111,060	2,609,310,584
2020	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2021	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2022	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2023	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2024	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2025	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2026	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2027	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2028	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2029	240,683,000	5,996,524	11,520,000	1,563,233,060	1,821,432,584
2030	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584

(Note) : - Cost : as of September 1994
- Cost without Value Added Tax (IVA)
- Foreign exchange rate (as of March 1994) :
  US$ 1.00 = Chile Peso : $ 435.00
  US$ 1.00 = Japanese Yen : $ 110.00
  Japanese Yen 1.00 = Chile Peso : $ 3.955

Table D-II, 4.1 Hydraulic Calculations for Transmission Pipelines (First Stage for Iquique)

Transmission Pipeline From La Tirana Well Field to Cavancha/Iquique

Total Length: L= 67,600 m

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Point (Accumulated Distance)	Altitude above Sea Level	Distance between Two Points	Flow Q	Pipe Dia.	V	I	H	Dynamic Water Level
(m)	(+m)	(m)	(l/s)	(mm)	(m/s)	(x10*-3)	(m)	(+m)
0	+1,025	0						+1,025.00
(Transmission Pump Station: GL=+1,025, LWL=+1,025, HWL=+1,030)								+1,153.00
40,400	+1,100	40,400	369	700	0.96	1.18	47.67	+1,105.33
(Santa Laura Tank: GL=+1,100, LWL=+1,100, HWL=+1,105)								+1,105.33
42,100	+1,050	1,700	369	400	2.93	17.95	30.52	+1,074.48
(La Isla Tank: GL=+1,050, LWL=+1,050, HWL=+1,055)								+1,074.48
53,750	+975	11,650	369	500	188	6.05	70.48	+979.52
(El Toro-1 Tank: GL=+975, LWL=+975, HWL=+980)								+975.00
57,150	+760	3,400	369	400	2.93	17.59	61.03	+913.97
(El Toro-2 Tank: GL=+760, LWL=+760, HWL=+765)								+760.00
64,600	+545	7,450	369	400	2.93	17.95	133.73	+626.27
(Alto Hospicio Tank: GL=+545, LWL=+545, HWL=+550)								+545.00
65,060	+400	460	369	400	2.93	17.95	8.26	+536.74
(Pressure-reducing valve)								+410.00
65,790	+250	730	369	400	2.93	17.95	13.10	+396.90
(Pressure-reducing valve)								+260.00
67,600	+114	1,810	369	400	2.93	17.95	32.49	+227.51
(Cavancha Tank: GL=+114, LWL=+114, HWL=+119)								+119.00

Pipe Distance from La Tirana Well Field to Cavancha/Iquique

Diameter	Distance
700 mm	40,400 m
500 mm	11,650 m
400 mm	15,550 m
Total =	67,600 m

Table D-II, 4.2 Construction Cost for First Stage - Iquique Water Supply Scheme

Summary

	Item	Amount (Peso:$)
(A)	Well-Field ..... (at La Tirana)	$2,295,144,000
(B)	Transmission Pumps ..... (at la Tirana Well-Field)	$1,510,912,000
(C)	Transmission Pipeline ..... from La Tirana to Cavancha/Iquique)	$14,680,499,000
(D)	Tanks ..... (Transmission/ Break-pressure / Distribution Tanks)	$686,225,000
(E)	Distribution Networks.....	$765,546,000
(F)	Electric Transmission Line.....	$158,000,000
Grand Total (A+B+C+D+E+F).....		$20,096,326,00

(Note): - Cost : as of March 1994
- Cost without Value Added Tax (IVA)
- Foreign exchange rate (as of March 1994):
  US$1.00 = Chile Peso: $435.00
  US$1.00 = Japanese Yen: \110.00
  Japanese Yen 1.00 = Chile Peso: $3.955

Table D-II, 4.2' Construction Cost for First Stage - Iquique Water Supply Scheme

(Note): - Cost : as of March 1994
- Cost without Value Added Tax (IVA)
- Foreign exchange rate (as of March 1994):
US$1.00 = Chile Peso: $435.00
US$1.00 = Japanese Yen: \110.00
Japanese Yen 1.00 = Chile Peso: $3.955

	Item	Q'ty	Unit Price ($)	Amount ($)
(A)	Well Field (at La Tirana)			
1	Deep wells			
1.1	Construction of deep well (12" x 200 m depth, screen: 80 m)	8 wells	70,629,000	565,032,000
1.2	Pump house 5.5 m x 4.0 m	8 Nos.	2,200,000	17,600,000
			Sub Total =	$582,632,000
2.	Pump (Submersible pump with motor, column pipe, electric cables, base plate, water level indicator, check valve gate valves,flow meter, station pipes) Q= 55 l/sc = 3.30 m^3/min, Dia= 150 mm			
2.1	Pump (79 m, 75 kw)	3 Nos.	79,100,000	237,300,000
2.2	Pump (74 m, 70 kw)	5 Nos.	77,518,000	387,590,000
2.3	Electrical facilities for the above (Including pump control panel, transformer, telemeter transfer panel, uninterrupted power supply)	8 units	37,572,500	300,580,000
			Sub Total =	$925,470,000
3.	Power transmission line, including power cable, control cable for telemeter, wooden pole, insulator, etc.	1 lot		183,908,000
			Sub Total =	$183,908,000
4.	Pipelines (ACP) within the well-field (Materials and Installation cost)			
4.1	800 mm ACP	750 m	113,689	85,267,000
4.2	600 mm ACP	1,000 m	70,208	70,208,000
4.3	450 mm ACP	1,000 m	53,491,000	53,491,000
4.4	350 mm ACP	1,000 m	36,545	36,545000
4.5	250 mm ACP	2,000 m	19,749	39,498,000
			Sub Total =	$285,009,000

	Item	Q'ty	Unit Price ($)	Amount ($)
5.	Valves in well-field			
5.1	Valve 800 mm (Butterfly)	1 No.	18,382,000	18,382,000
5.2	Valve 600 mm (")	2 Nos.	12,859,000	25,718,000
5.3	Valve 350 mm (Sluice)	4 Nos.	2,968,000	11,872,000
			Sub Total =	$55,972,000
6.	Roads and others			
6.1	Access road (w= 4.0 m) to the well-field	5,800 m	4,942	28,664,000
6.2	Maintenance road (w=4.0 m) within the well-field	4,500 m	4,942	22,239,000
6.3	Asphalt pavement for the above (50 m x 4.0 m)	1,000 m^2	1,271	1,271,000
6.4	Boundary fence (h= 2.0 m)	4,900 m	18,589	91,086,000
6.5	Entrance gate	1 No.		791,000
			Sub Total =	$144,051,000
7.	Miscellaneous Works			118,102,000
Total of (A)				$2,295,144,000
(B)	Transmission Pumps			
1.	Transmission Pumps (350 mm x 10.5m^3/min x 125 m x 420 kw x 5 units)			
1.1	Mechanical equipment including transmission pump with motor, suction valve, delivery valve, check valve	3 units	114,695,000	344,085,000
1.2	Accessories for the above including header pipe, valve, flow meter, station pipes, overhead electrical crane, etc.	1 lot		278,432,000
1.3	Sub station (11 kv / 3,500 kvA) including incoming panel, receiving panel, transformer	1 lot		375,725,000
1.4	Electricl equipment including transmissionpump control panel, intake pump feeder panel, low voltage panel, cables	1 lot		292,670,000

	Item	Q'ty	Unit Price ($)	Amount ($)
1.5	Pump house construction 44 m x 10 m x 10 m (h)	1 lot		220,000,000
Total of (B)				$1,510,912,000
(C)	Transmission Pipeline (from La Tirana to Cavancha/Iquique)			
1.	Pipeline (DIP) from La Tirana to Alto Hospicio (Materials and Installation cost)			
1.1	700 mm DIP	40,400 m	266,537	10,768,094,000
1.2	500 mm DIP	11,650 m	157,154	1,830,844,000
1.3	400 mm DIP	12,550 m	113,741	1,427,450,000
1.4	Preessure reducing valve: 400 mm (with a strainer)	3 Nos.	64,902,000	194,706,000
1.5	Highway crossing work	3 sites	5,000,000	15,000,000
1.6	Asphalt pavement restoratin	9,398 m^2	1,271	11,945,000
			Sub Total =	$14,248,039,000
2.	Pipeline (DIP) from Alto Hospicio to Cavancha (Materials and Installation cost)			
2.1	400 mm DIP	3,000 m	113,741	341,223,000
2.2	Pressure-reducing valve: 400 mm	3 Nos.	27,404,000	82,212,000
2.3	Highway crossing work	1 site	5,000,000	5,000,000
2.4	Railway crossing work	1 site	2,000,000	2,000,000
2.5	Concrete anchor blocks	30 Nos.	67,500	2,025,000
			Sub Total =	$432,460,000
Total of (C)				$14,680,499,000
(D)	Tanks (Collectin/Transmission/Break-pressure/Distribution Tanks) (RC: Reinforced Concrete)			
1.	Tanks (Between La Tirana and Alto Hospicio)			
1.1	1,250 m^3 tank	3 Nos.	54,000,000	162,000,000
1.2	250 m^3 tank	3 Nos.	14,575,000	43,725,000
1.3	Miscellaneous works			2,000,000
2.	Distribution Tanks (at Cavancha)			
2.1	7,500 m^3 tank	2 Nos.	239,250,000	478,500,000
Total of (D)				$686,225,000

Item	Q'ty	Unit Price ($)	Amount ($)
(E) Distribution Networks			
1. Distribution Network	21,873	35,000	765,546,000
Total of (E)			$765,546,000
(F) Electric Transmission Line			
1. High voltage (23 kv) electric power line from Pozo Almonte Substation/ELIQSA	20 km	7,900,000	158,000
Total of (F)			$158,000,000
Grand Tiotal (A+B+C+D+E+F) ..... (First Stage for Iquique Water Supply			$20,096,326,000

Table D-II, 4.3 Operation and Maintenance Cost for First Stage
- Iquique Water Supply System
(Water Source : Groundwater in La Tirana)

Summary

[Unit : Chilean Peso]

Year	Electric Power	Chemicals	Personnel	Repairing & Replacement	Total
1999	188,014,000	4,686,714	11,520,000	355,711,060	559,931,774
2000	196,410,000	4,893,099	11,520,000	355,711,060	568,534,159
2001	204,890,000	5,104,358	11,520,000	355,711,060	577,225,418
2002	213,541,000	5,320,493	11,520,000	355,711,060	586,092,553
2003	219,562,000	5,470,000	11,520,000	355,711,060	592,263,060
2004	231,435,000	5,765,764	11,520,000	355,711,060	604,431,824
2005	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2006	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2007	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2008	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2009	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2010	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2011	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2012	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2013	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2014	240,683,000	5,996,524	11,520,000	1,563,233,060	1,821,432,584
2015	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2016	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2017	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2018	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2019	240,683,000	5,996,524	11,520,000	2,351,111,060	2,609,310,584
2020	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2021	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2022	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2023	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2024	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2025	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2026	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2027	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584
2028	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584

2029	240,683,000	5,996,524	11,520,000	1,563,233,060	1,821,432,584
2030	240,683,000	5,996,524	11,520,000	355,711,060	613,910,584

(Note) : - Cost : as of September 1994
- Cost without Value Added Tax (IVA)
- Foreign exchange rate (as of March 1994) :
  US$ 1.00 = Chile Peso : $ 435.00
  US$ 1.00 = Japanese Yen : $ 110.00
  Japanese Yen 1.00 = Chile Peso : $ 3.955

Table D-II, 4.3' Operation and Maintenance Cost for First Stage
- Iquique Water Supply System
(Water Source : Groundwater in La Tirana)

(Note) : - Cost : as of September 1994
- Cost without Value Added Tax (IVA)
- Foreign exchange rate (as of March 1994) :
US$ 1.00 = Chile Peso : $ 435.00
US$ 1.00 = Japanese Yen : $ 110.00
Japanese Yen 1.00 = Chile Peso : $ 3.955

[A] Electric Power Consumption Cost

Annual electric power consumption (Y-kw) cost of maximum water demand year (2005) is estimated as shown below.
(Daily Maximum = 369 l/s, Daily Average = 283.8 l/s)
Intake Pumps = 370 kw / day (Daily Average)
Transmission Pumps = 545 kw (Daily Average)
Total = 370 + 546 = 916 kw /day (Daily Average)
Y-kw = 916 kw /day x 24 hr/day x 365 day x $30 /kwh
= 240,683,000 $ / Year (year 2005)

Annual electric power consumption from 1999 to 2030 is shown below.

Year	Yearly Production Capacity (m^3/Year)	Yearly Electric Power Consumption Cost ($ / Year)	Remarks
1999	6,991,531	188,014,000	Start of Operation
2000	7,303,738	196,410,000	
2001	7,619,098	204,890,000	
2002	7,940,765	213,541,000	
2003	8,164,670	219,562,000	
2004	8,606,174	231,435,000	
2005	8,949,917	240,683,000	Maximum Consumption
2006	8,949,917	240,683,000	
2007	8,949,917	240,683,000	
2008	8,949,917	240,683,000	
2009	8,949,917	240,683,000	
2010	8,949,917	240,683,000	

2011	8,949,917	240,683,000
2012	8,949,917	240,683,000
2013	8,949,917	240,683,000
2014	8,949,917	240,683,000
2015	8,949,917	240,683,000
2016	8,949,917	240,683,000
2017	8,949,917	240,683,000
2018	8,949,917	240,683,000
2019	8,949,917	240,683,000
2020	8,949,917	240,683,000
2021	8,949,917	240,683,000
2022	8,949,917	240,683,000
2023	8,949,917	240,683,000
2024	8,949,917	240,683,000
2025	8,949,917	240,683,000
2026	8,949,917	240,683,000
2027	8,949,917	240,683,000
2028	8,949,917	240,683,000
2029	8,949,917	240,683,000
2030	8,949,917	240,683,000

[B] Chemicals Cost

Annual chemicals consumption cost from 1999 to 2030 is shown below.

[Unit : Chilean Peso]

Year	Water Flow Rate Daily Maximum (l / sec)	Water Flow Rate Daily Average (l / sec)	Chlorine	Total
1999	288.4	221.8	4,686,714	4,686,714
2000	301.1	231.6	4,893,099	4,893,099
2001	314.1	241.6	5,104,358	5,104,358
2002	327.4	251.8	5,320,493	5,320,493
2003	336.6	258.9	5,470,000	5,470,000
2004	354.8	272.9	5,765,764	5,765,764
2005	369.0	283.8	5,996,524	5,996,524
2006	369.0	283.8	5,996,524	5,996,524
2007	369.0	283.8	5,996,524	5,996,524
2008	369.0	283.8	5,996,524	5,996,524

2009	369.0	283.8	5,996,524	5,996,524
2010	369.0	283.8	5,996,524	5,996,524
2011	369.0	283.8	5,996,524	5,996,524
2012	369.0	283.8	5,996,524	5,996,524
2013	369.0	283.8	5,996,524	5,996,524
2014	369.0	283.8	5,996,524	5,996,524
2015	369.0	283.8	5,996,524	5,996,524
2016	369.0	283.8	5,996,524	5,996,524
2017	369.0	283.8	5,996,524	5,996,524
2018	369.0	283.8	5,996,524	5,996,524
2019	369.0	283.8	5,996,524	5,996,524
2020	369.0	283.8	5,996,524	5,996,524
2021	369.0	283.8	5,996,524	5,996,524
2022	369.0	283.8	5,996,524	5,996,524
2023	369.0	283.8	5,996,524	5,996,524
2024	369.0	283.8	5,996,524	5,996,524
2025	369.0	283.8	5,996,524	5,996,524
2026	369.0	283.8	5,996,524	5,996,524
2027	369.0	283.8	5,996,524	5,996,524
2028	369.0	283.8	5,996,524	5,996,524
2029	369.0	283.8	5,996,524	5,996,524
2030	369.0	283.8	5,996,524	5,996,524

[Chemical cost of maximum water demand year (2005) on 1 st Stage]

Chlorine = 0.369 m^3/s * 86,400 * 365 day * 0.001 kg/m^3
* @ 1.54 US$/kg * 435 $/US$

[C] Personnel Expense

The kind of water works and number of persons for O&M of intake facilities and treatment plant is assumed as follows.

	Kind of Works	Number of Persons
1	Wells & Pumping Station	6
2	Pipeline & Tanks	2
	Total	8

[D] Repairing and Replacement Cost

Annual repairing and replacement cost is composed of repairing and replacement cost for intake facilities, transmission and distribution facilities. Annual repairing cost and life spans for replacement of equipment are as follows.

	Kind of Facilities	Repairing Cost (% of Construction Cost)	Life Spans for Replacement (Year)
1	Intake and Transmission Facilities		
1.1	Wells and Intake Pumps	1.0	15
1.1	Pipeline	2.0	40
1.2	Equipment	1.0	20
2	Distribution Facilities		
2.1	Pipeline	2.0	40

The details of these cost are shown in next tables.

Annual Repairing and Replacement Cost of Intake Facility and Transmission Pipeline in Iquique
-- for First Stage

[Unit : Chilean Peso]

Year	Water Rate Daily Maximum (l / sec)	Water Rate Daily Average (l / sec)	Intake and Transmission Facilities		Distribution	Total
			Repairing Cost	Replacement Cost	Repairing Cost	
1999	288.4	221.8	340,400,060	0	15,311,000	355,711,060
2000	301.1	231.6	340,400,060	0	15,311,000	355,711,060
2001	314.1	241.6	340,400,060	0	15,311,000	355,711,060
2002	327.4	251.8	340,400,060	0	15,311,000	355,711,060
2003	336.6	258.9	340,400,060	0	15,311,000	355,711,060
2004	354.8	272.9	340,400,060	0	15,311,000	355,711,060
2005	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2006	398.5	306.5	340,400,060	0	15,311,000	355,711,060
2007	428.8	329.8	340,400,060	0	15,311,000	355,711,060
2008	460.0	353.8	340,400,060	0	15,311,000	355,711,060
2009	491.8	378.3	340,400,060	0	15,311,000	355,711,060
2010	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2011	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2012	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2013	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2014	369.0	283.8	340,400,060	1,207,522,000	15,311,000	1,563,233,060
2015	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2016	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2017	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2018	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2019	369.0	283.8	340,400,060	1,995,400,000	15,311,000	2,351,111,060
2020	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2021	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2022	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2023	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2024	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2025	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2026	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2027	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2028	369.0	283.8	340,400,060	0	15,311,000	355,711,060
2029	369.0	283.8	340,400,060	1,207,522,000	15,311,000	1,563,233,060
2030	369.0	283.8	340,400,060	0	15,311,000	355,711,060

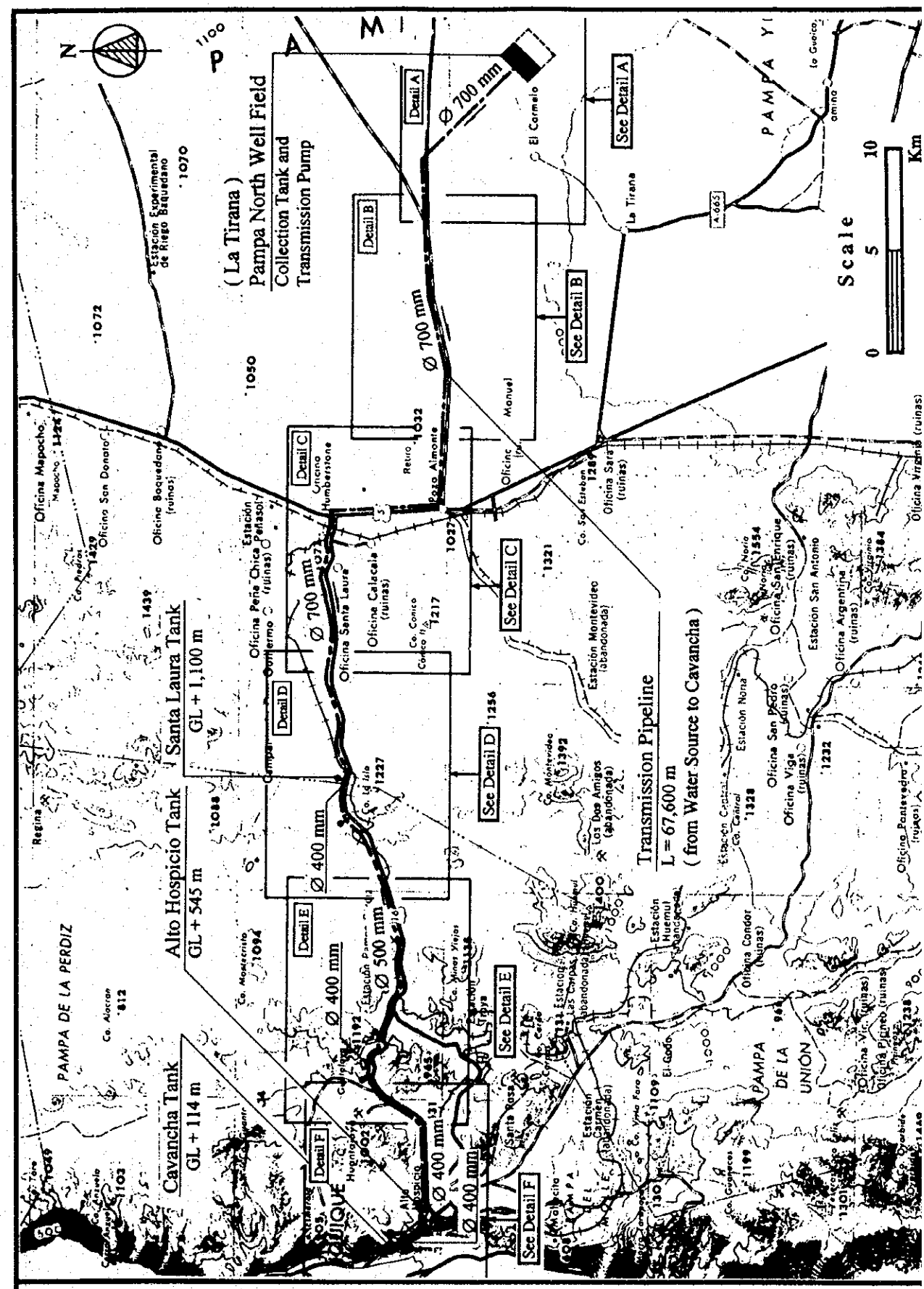

Fig. D-II, 4.1 Proposed Transmission Pipeline for Iquique Water Supply, from La Tirana to Cavancha

< Cañería de Conducción Propuesta para Abastecimiento de Iquique, desde La Tirana a Cavancha >

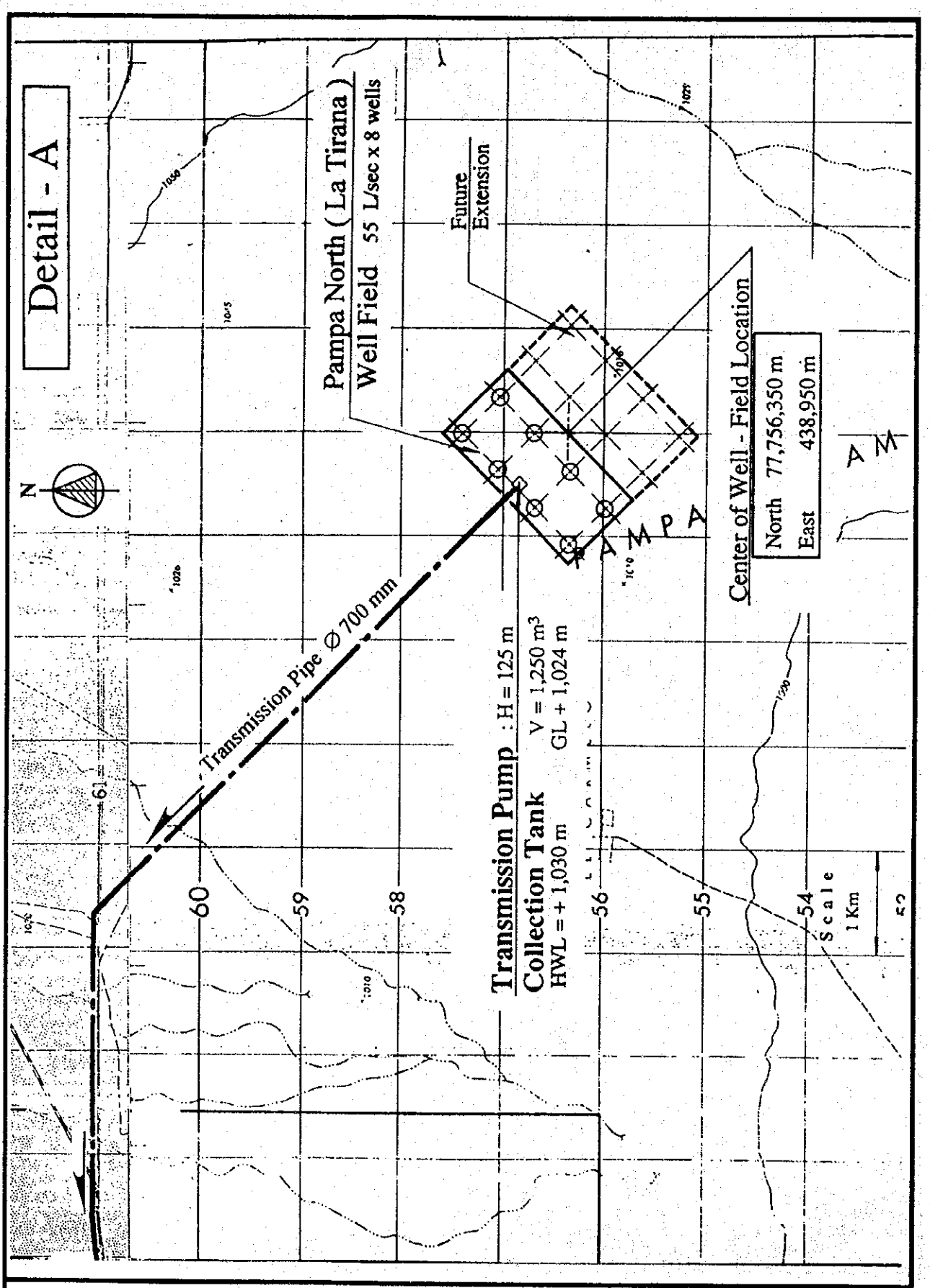

Fig. D-II, 4.2 Proposed Transmission Pipeline for Iquique Water Supply, Detail - A

< Cañería de Conducción Propuesta para Abastecimiento de Iquique, Detalle - A >

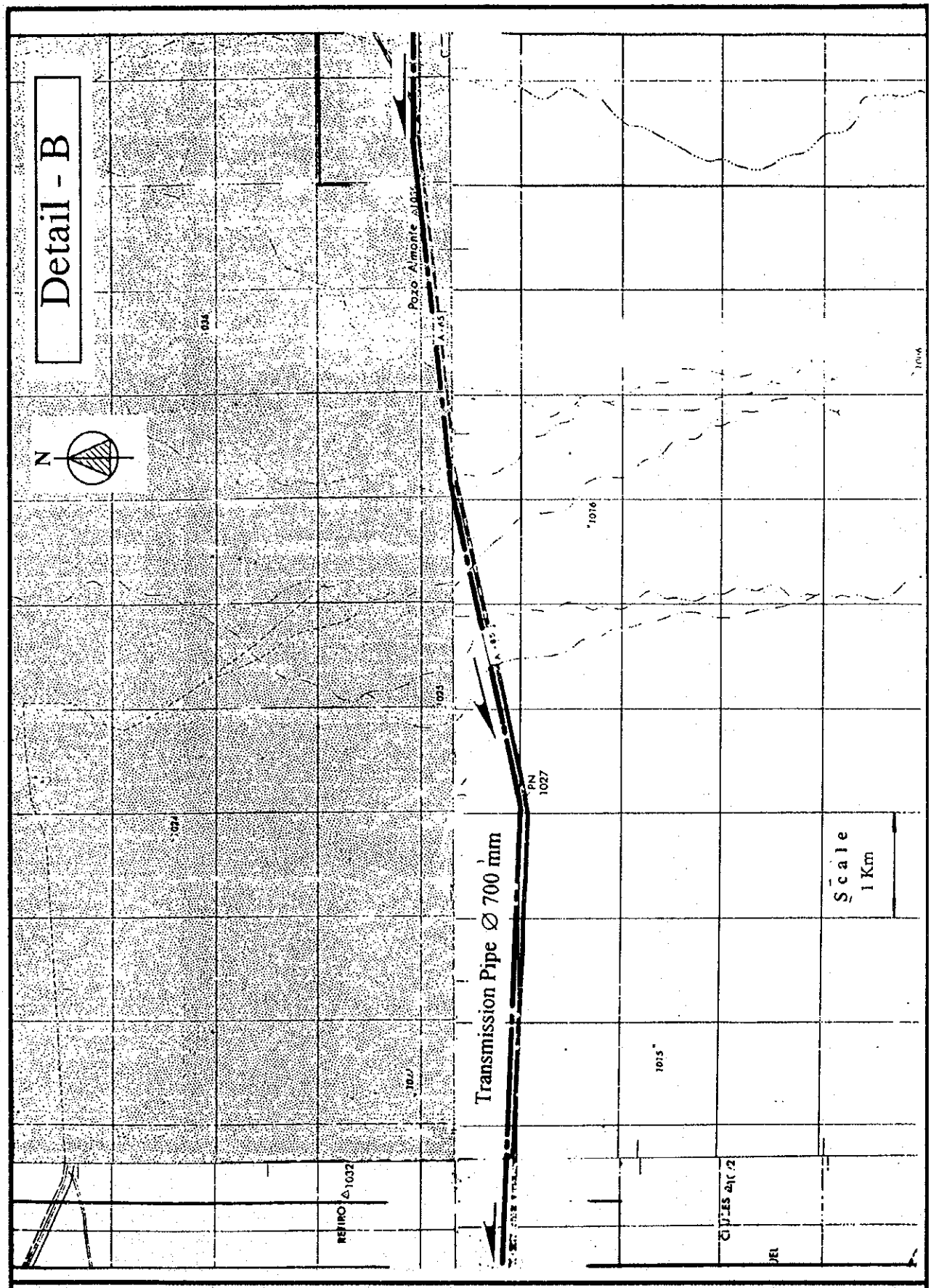

Fig. D-II, 4.3 Proposed Transmission Pipeline for Iquique Water Supply, Detail - B

< Cañería de Conducción Propuesta para Abastecimiento de Iquique, Detalle - B >

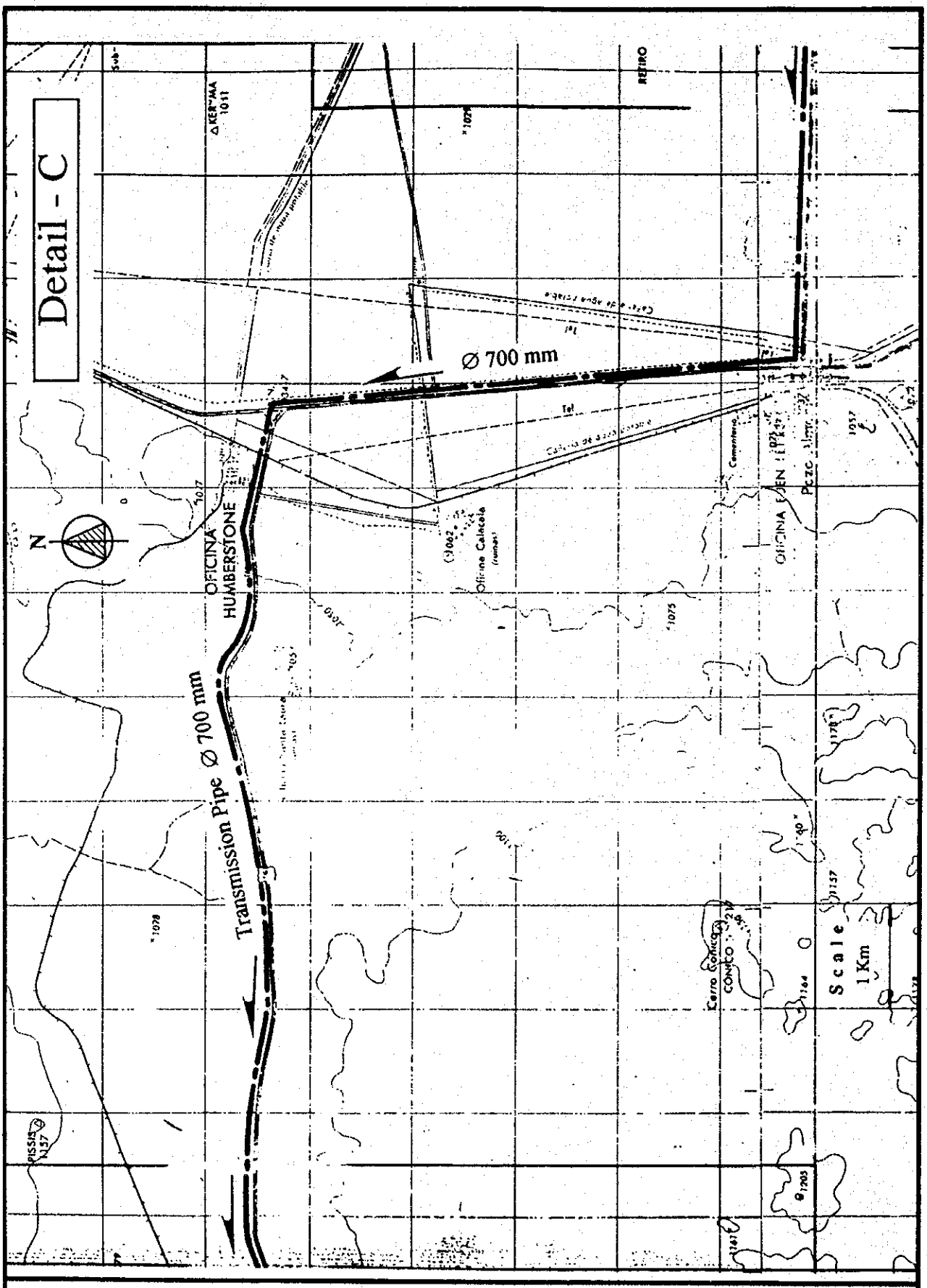

Fig. D-II, 4.4 Proposed Transmission Pipeline for Iquique Water Supply, Detail - C

< Cañería de Conducción Propuesta para Abastecimiento de Iquique, Detalle - C >

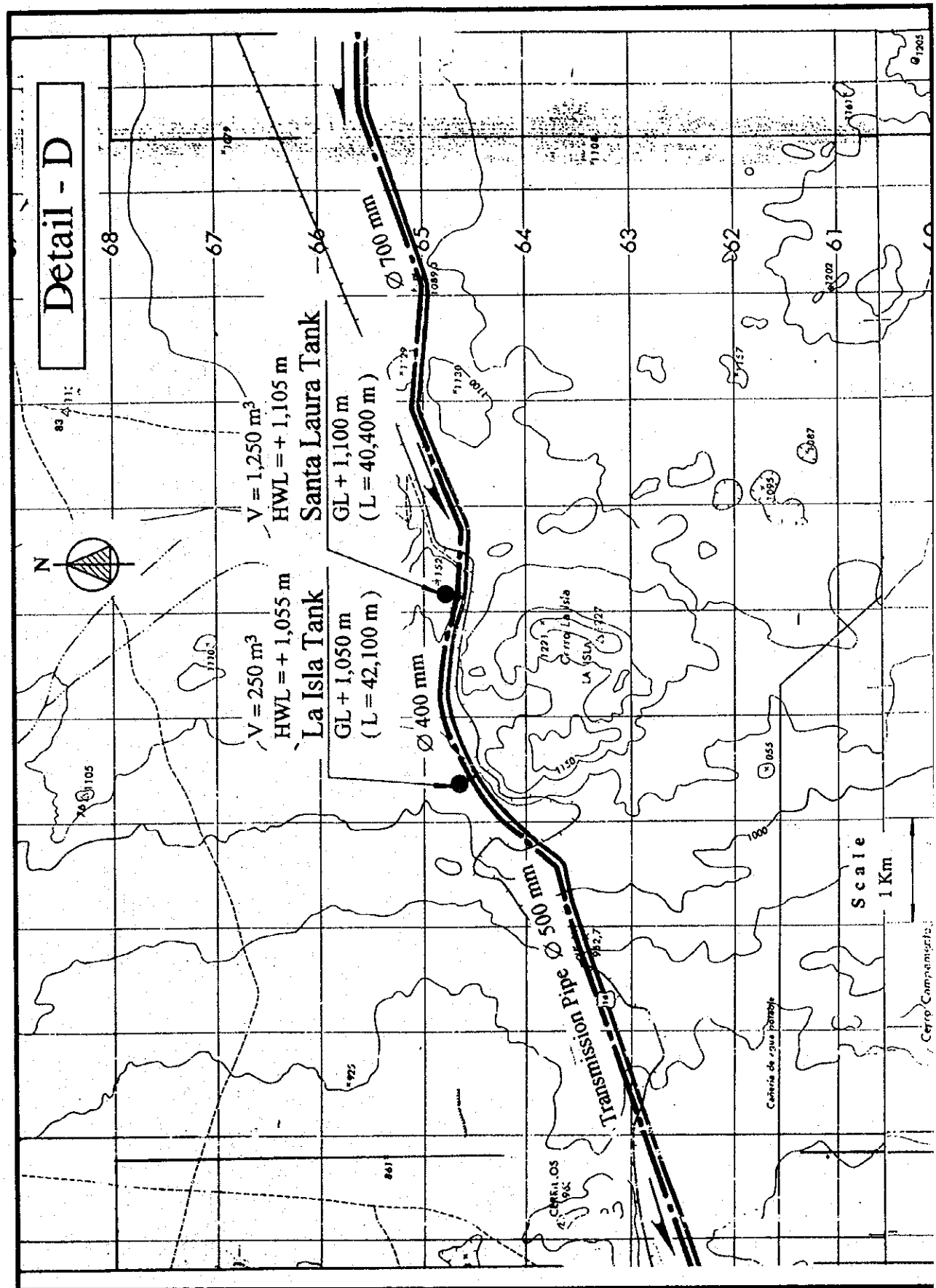

Fig. D-II, 4.5 Proposed Transmission Pipeline for Iquique Water Supply, Detail - D

< Cañería de Conducción Propuesta para Abastecimiento de Iquique, Detalle - D>

THE STUDY ON THE DEVELOPMENT OF WATER RESOURCES IN NORTHERN CHILE | JICA

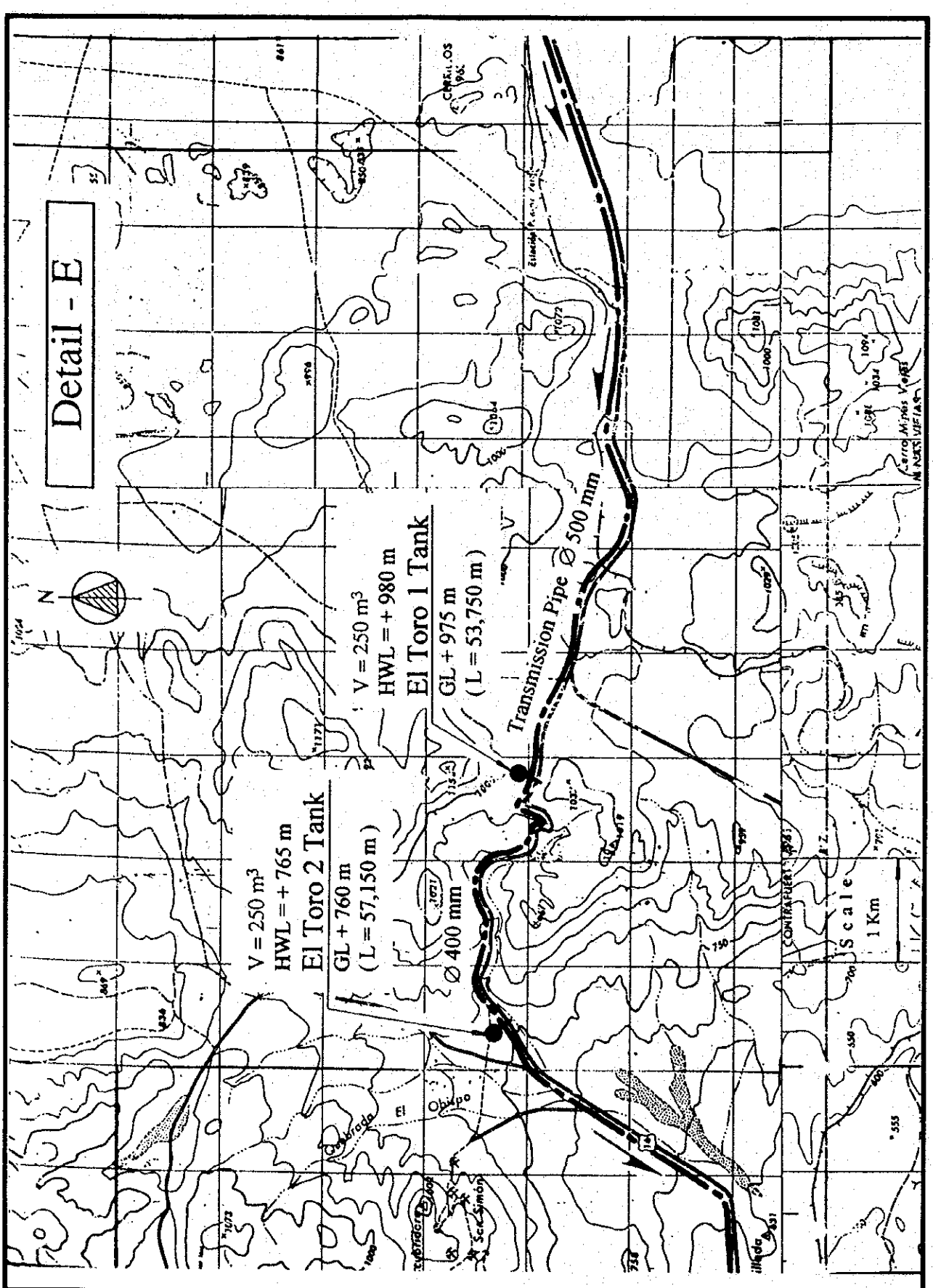

Fig. D-II, 4.6 Proposed Transmission Pipeline for Iquique Water Supply, Detail - E

< Cañería de Conducción Propuesta para Abastecimiento de Iquique, Detalle - E>

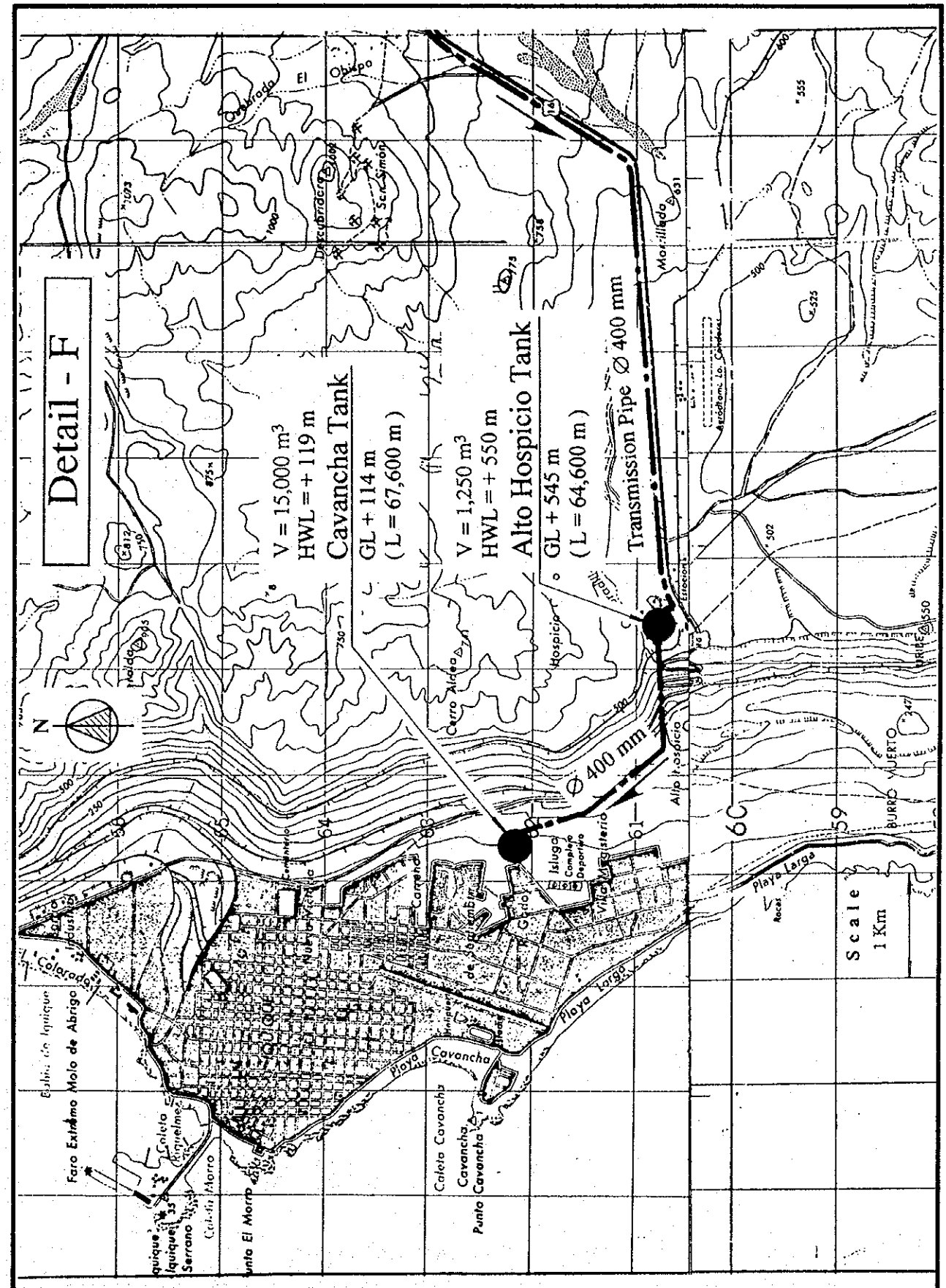

Fig. D-II, 4.7 Proposed Transmission Pipeline for Iquique Water Supply, Detail - F

< Cañería de Conducción Propuesta para Abastecimiento de Iquique, Detalle - F >

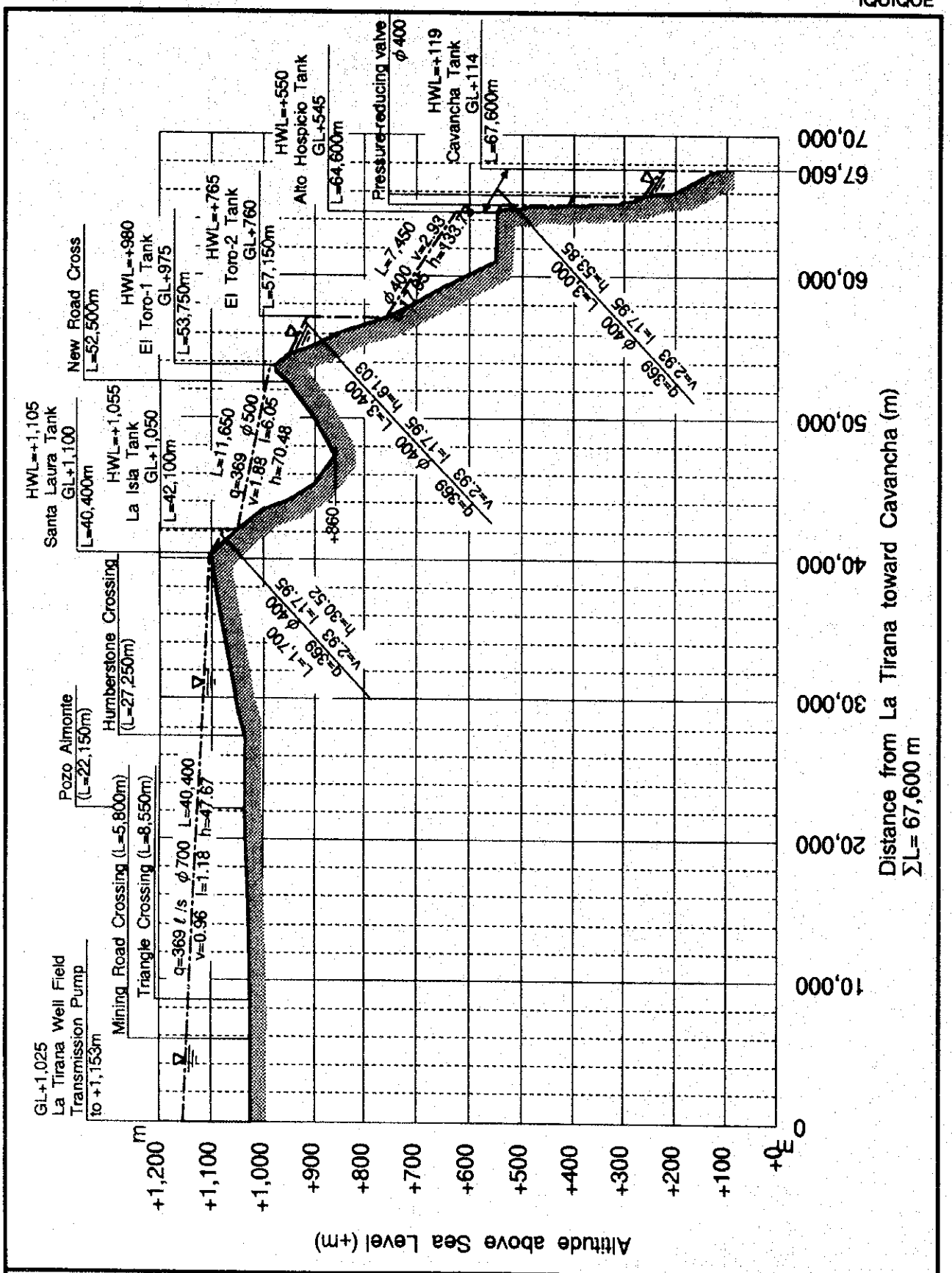

Fig. D-II, 4.8 Longitudinal Profile of Proposed Transmisson Pipeline for Iquique Water Supply from Pampa - North (La Tirana) to Cavancha

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< Perfil Longitudinal de la Conduccio'n Propuesta para el Abastecimiento de Agua de Iquique desde Pampa-Norte (La Tirana) a Cavancha >

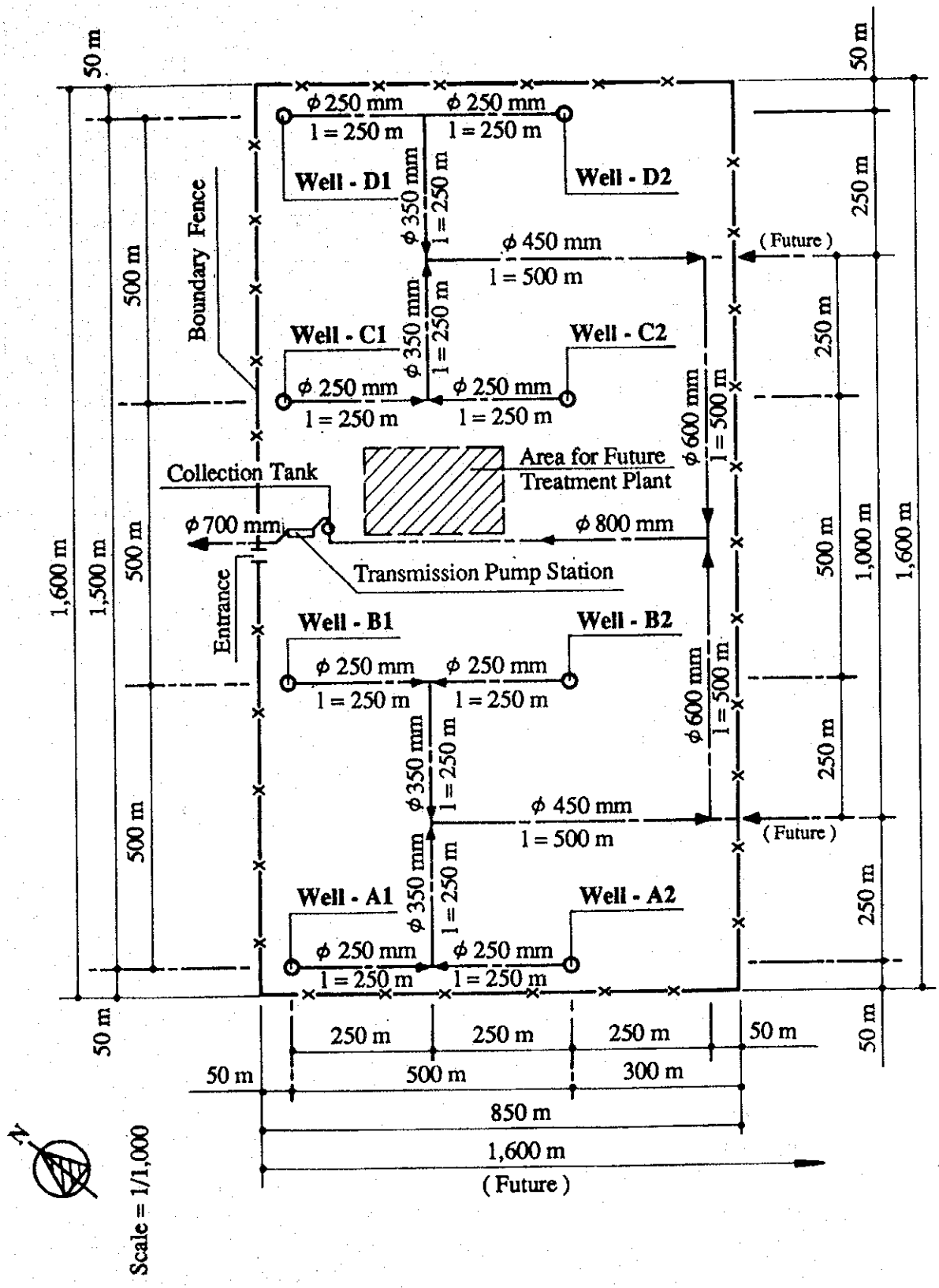
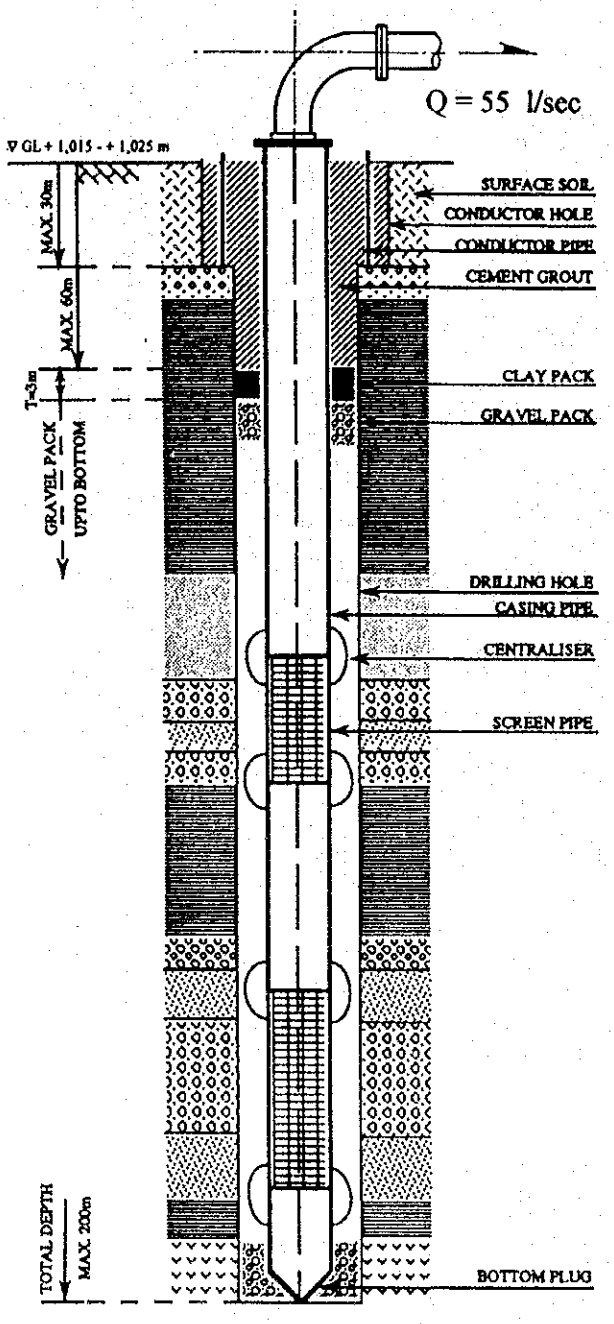


Fig. D-II, 4.9 Layout of La Tirana Well Field (1st - Stage)

< Distribución de la Batería de Pozos de La Tirana (1ª - Etapa) >

Well Structure



HOLE DIAMETER
CONDUCTOR : 558.8mm (22")
DRILLING : 444.5mm (17-1/2")
PIPE DIAMETER
CONDUCTOR : 508.0mm (20")
SCREEN : 318.5mm (12")
CASING : 318.5mm (12")

List of Wells and Intake Pumps

(1st Stage / Iquique)

Well No.	Ground Level	Well Depth	Well Yield	Pump Power
A1	+ 1,015 m	200 m	55 l/sec	75 Kw
A2	+ 1,015 m	200 m	55 l/sec	75 Kw
B1	+ 1,020 m	200 m	55 l/sec	70 Kw
B2	+ 1,020 m	200 m	55 l/sec	75 Kw
C1	+ 1,025 m	200 m	55 l/sec	70 Kw
C2	+ 1,025 m	200 m	55 l/sec	70 Kw
D1	+ 1,025 m	200 m	55 l/sec	70 Kw
D2	+ 1,025 m	200 m	55 l/sec	70 Kw
	Total Pump Power = (8 pums)			575 Kw

(Note)

- Type of Pump : Submersible motor pump

Fig. D-II, 4.10 Deep Wells for La Tirana Well Field

< Pozos para la Batería de Pozos La Tirana>

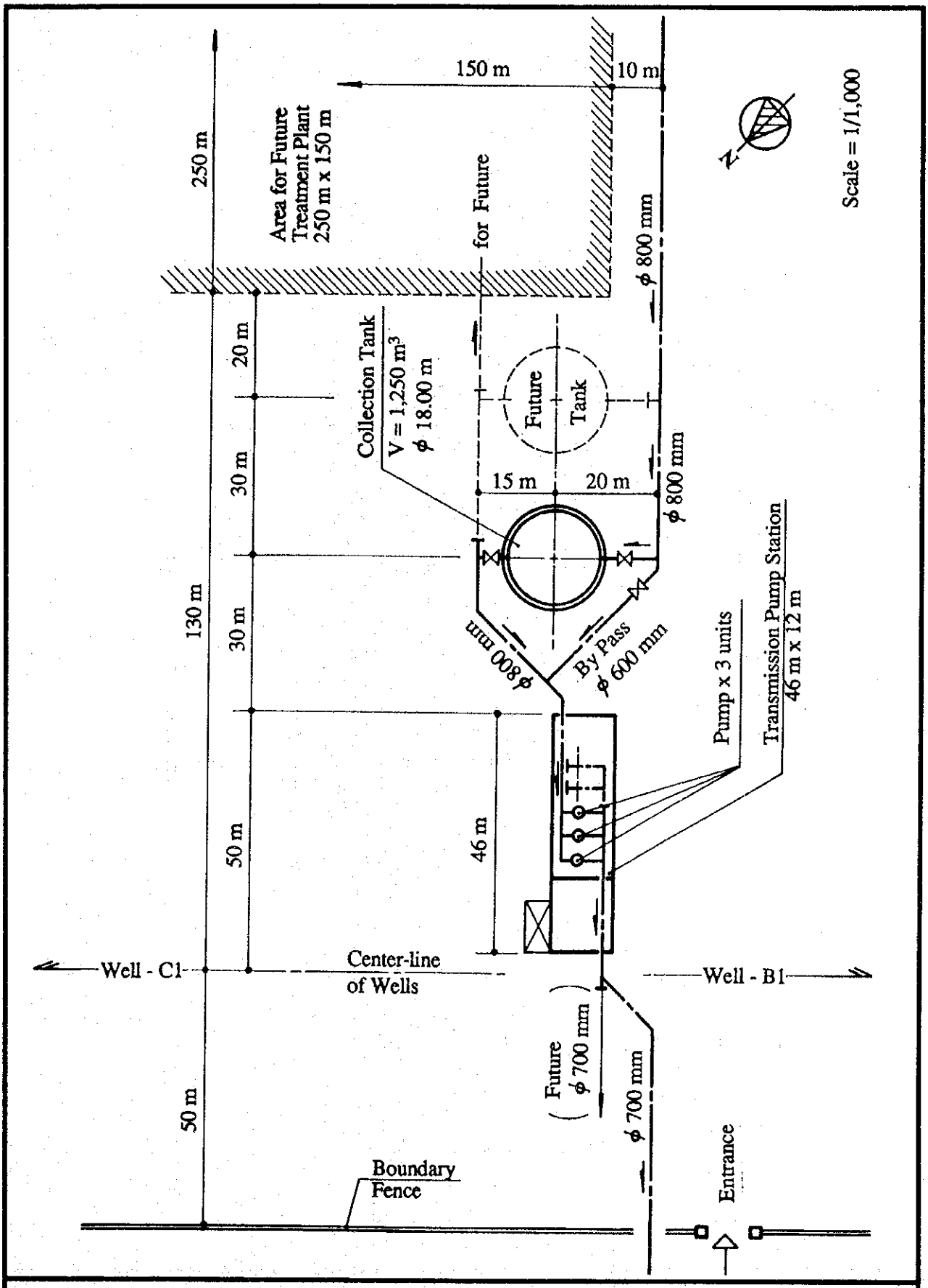


Fig. D-II, 4.11 Layout of Collection Tank and Pump Station

< Distribución del Estanque Colector y Planta Elevadora >

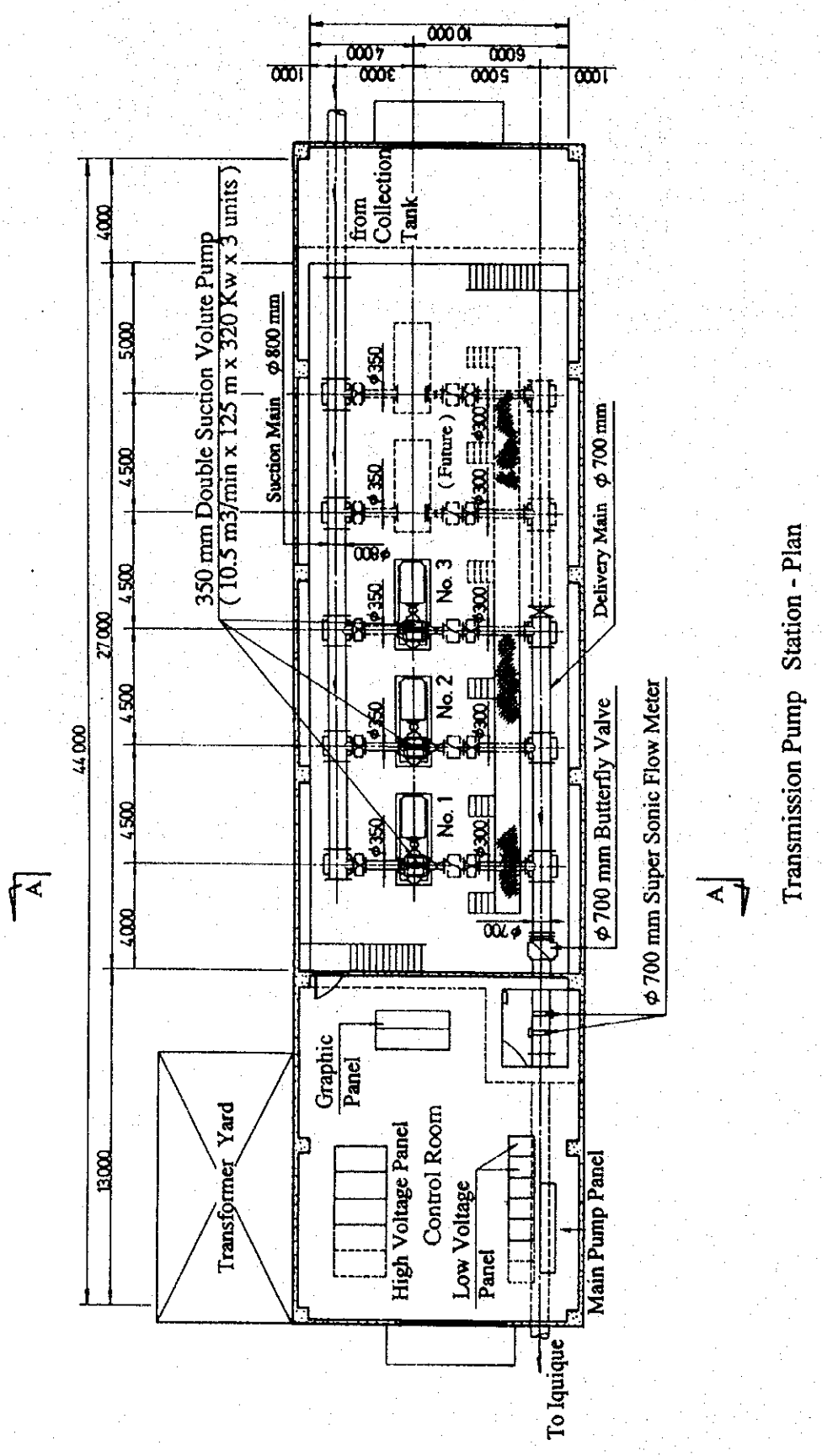


Fig. D-II, 4.12 Transmission Pump Station Proposed in La Tirana Well Field - Plan

< Planta Elevadora de Conducción Propuesta en la Batería de Pozos en La Tirana - Planta >

Transmission Pump Station - Elevation

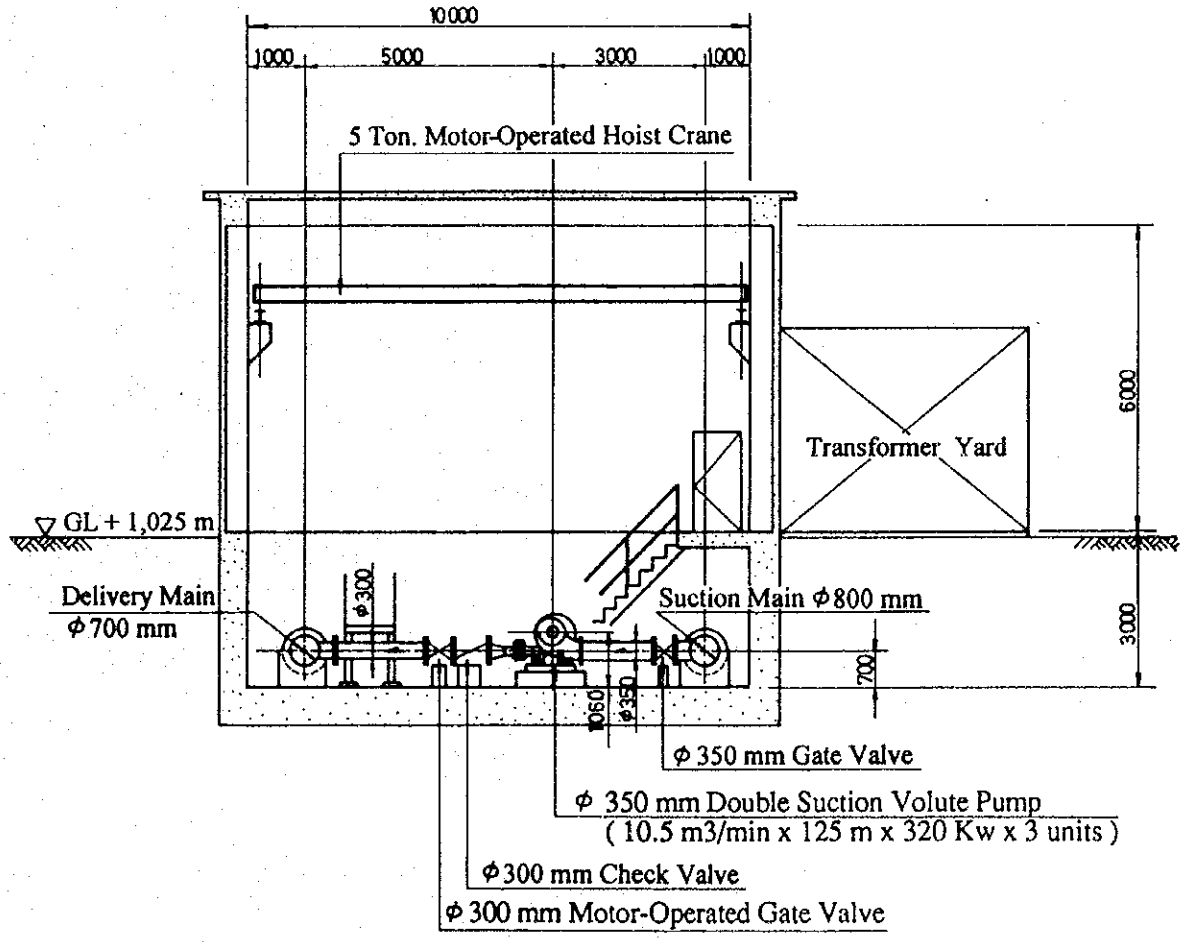
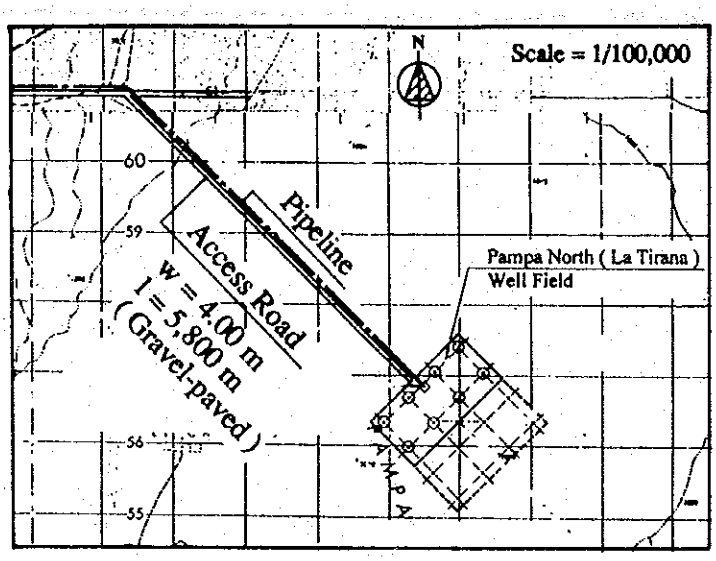


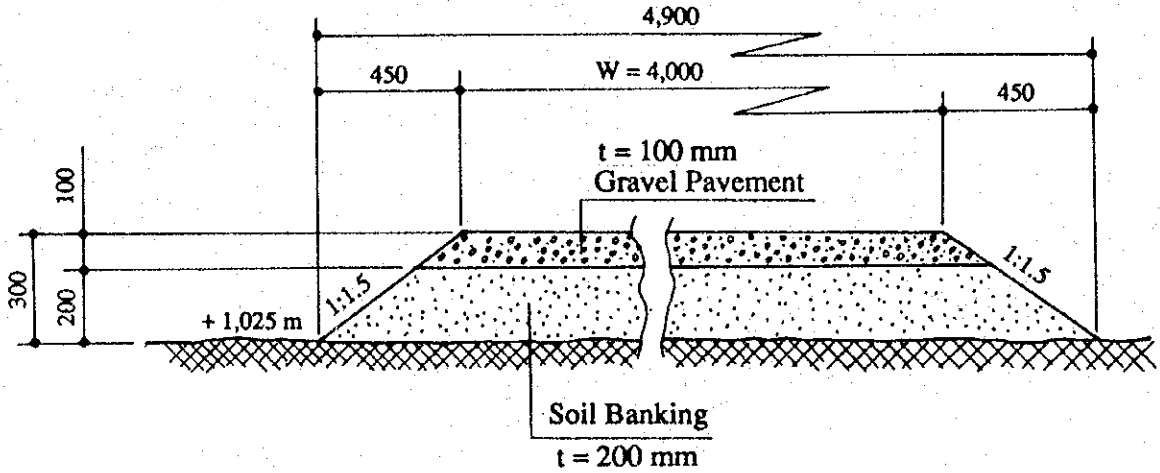
Fig. D-II, 4.13 Transmission Pump Station Proposed in La Tirana Well Field - Elevation

< Planta Elevadora de Conducción Propuesta en la Batería de Pozos de La Tirana - Elevación >

Location Map of Access Road



Access Road - Section



Turn Out - Plan

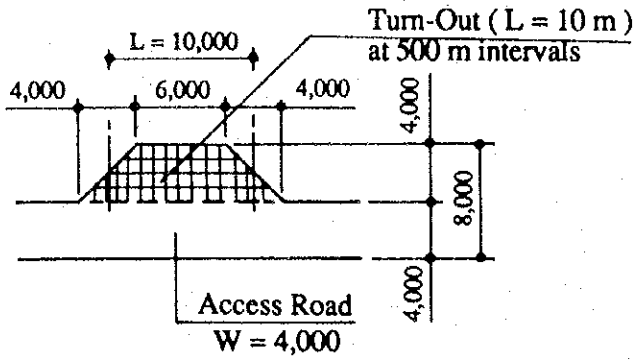
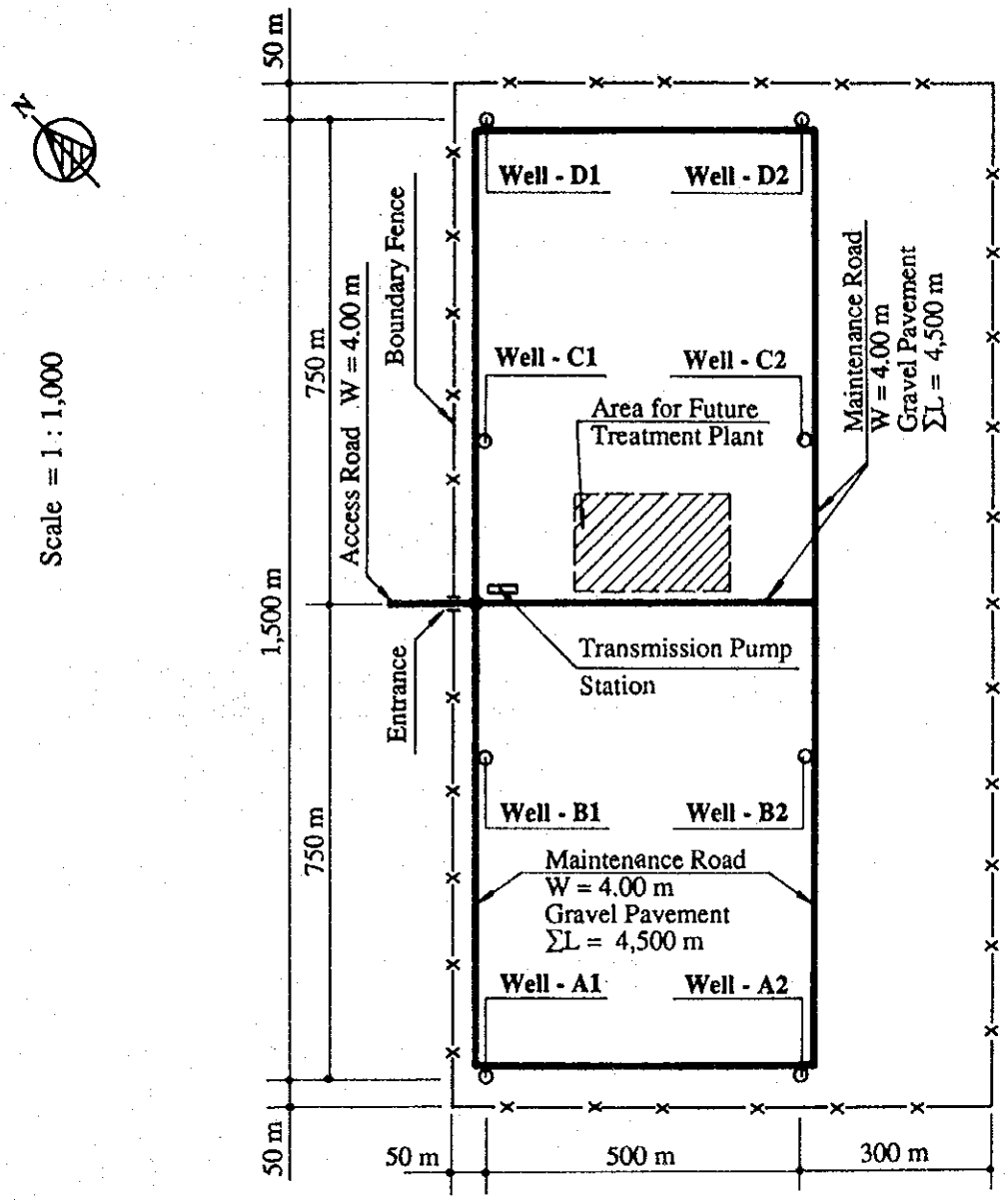


Fig. D-II, 4.14 Access Road to La Tirana Well Field

< Carretera de Acceso a la Batería de Pozos de La Tirana >



Maintenance Road - Section

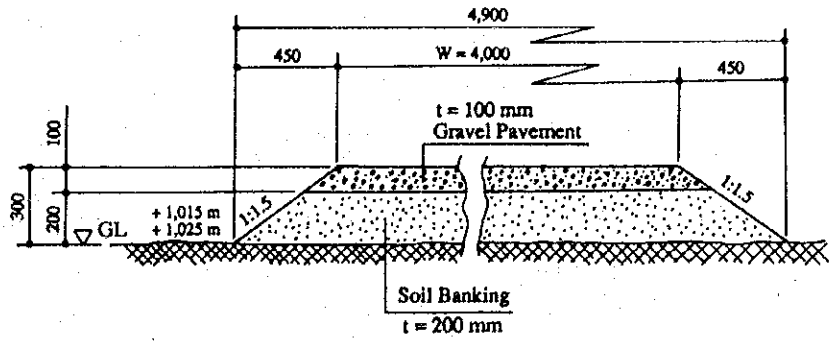


Fig.D-II, 4.15 Maintenance Road in the La Tirana Well Field (1st - Stage)

< Camino de Servicio en la Batería de Pozos La Tirana (1ª - Etapa) >

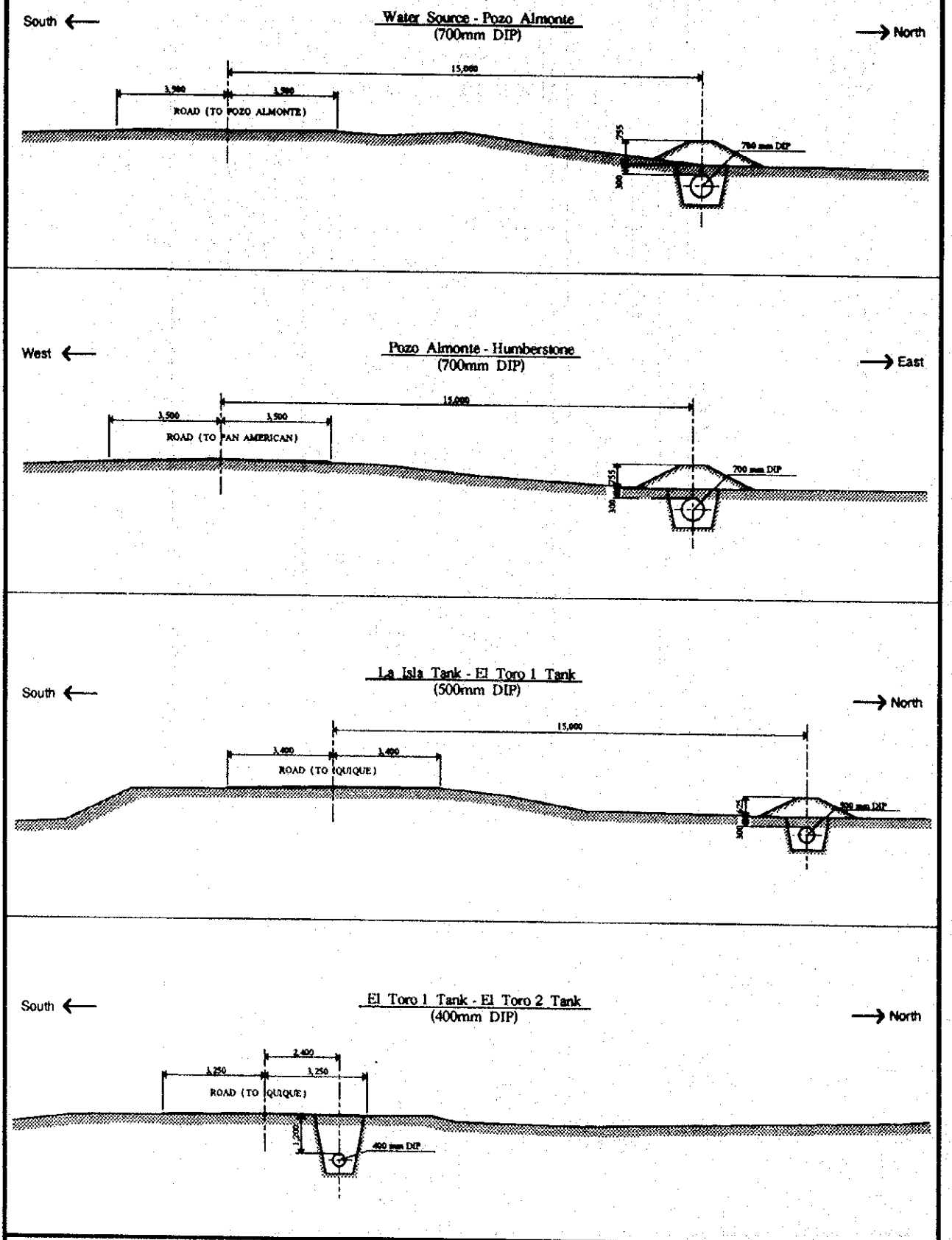
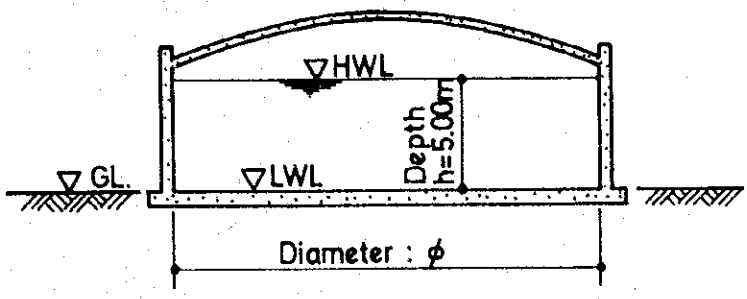


Fig. D - II, 4.16 Typical Cross Section of Pipe Inatallation for Iquique
< Sección Tipica Transversal de los Tubos para Iquique >

Tank Structure
(Reinforced Concrete)



List of Tanks (from La Tirana to Cavancha)

Name of Tank		La Tirana Collection Tank	Santa Laura Tank	La Isla Tank	El Toro 1 Tank	El Toro 2 Tank	Alto Hospicio Tank	Cavancha Tank
Distance from La Tirana (m)		0 m	40,400 m	42,100 m	53,750 m	57,150 m	64,600 m	67,600 m
Purpose		Collection	Transmi-ssion	Break - Presure	Break - Presure	Break - Presure	Transmi-ssion	Distribu-tion
Storage Hours		1 hour	1 hour	10 min	10 min	10 min	1 hour	12 hours
GL (+ m)		+ 1,025	+ 1,100	+1,050	+ 975	+ 760	+ 545	+ 114
HWL (+m)		+ 1,030	+ 1,105	+ 1,055	+ 980	+ 765	+ 550	+ 119
LWL (+ m)		+ 1,025	+ 1,100	+ 1,050	+ 975	+ 760	+ 545	+ 114
Capacity of Tank Unit		1,250 m^3	1,250 m^3	250 m^3	250 m^3	250 m^3	1,250 m^3	7,500 m^3
Diameter (ϕ)		18.0 m	18.0 m	8.0 m	8.0 m	8.0 m	18.0 m	43.8 m
Water Depth (h)		5.0 m	5.0 m	5.0 m	5.0 m	5.0 m	5.0 m	5.0 m
Pipe Diameter	Inlet	800 mm	700 mm	400 mm	500 mm	400 mm	400 mm	400 mm
	Outlet	800 mm	400 mm	500 mm	400 mm	400 mm	400 mm	(700 mm)
Number of Tank Unit to be Constructed in 1st - Stage		1 unit	1 unit	1 unit	1 unit	1 unit	1 unit	2 units
Total Tank Capacity in 1st - Stage		1,250 m^3	1,250 m^3	250 m^3	250 m^3	250 m^3	1,250 m^3	15,000m^3

Fig. D-II, 4.17 Tanks Proposed for Iquique Water Supply

< Estanques Propuestos para el Abastecimiento de Agua de Iquique >

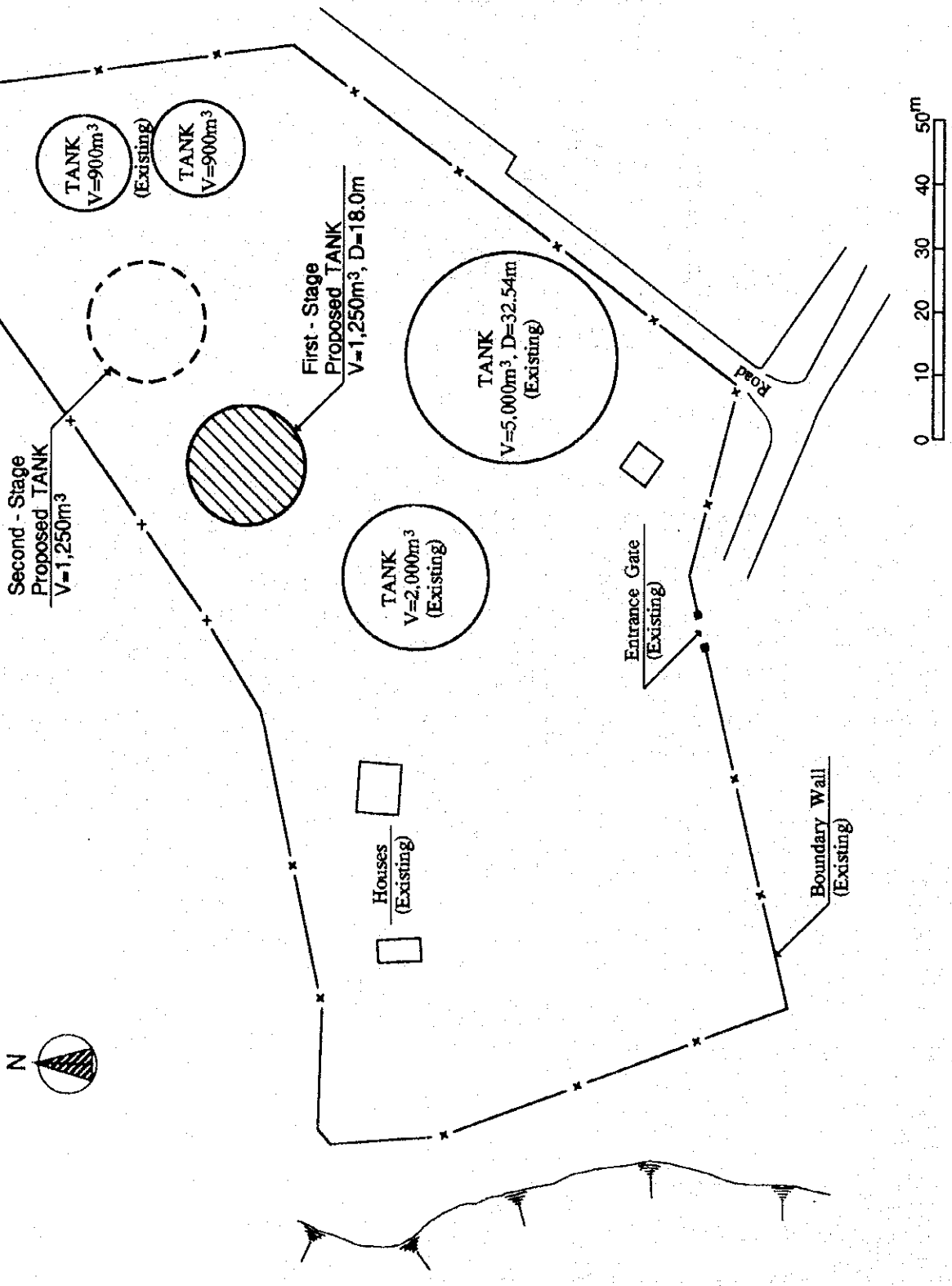


Fig. D - II, 4.18 Tanks in Alto Hospicio
< Tanque en Alto Hospicio >

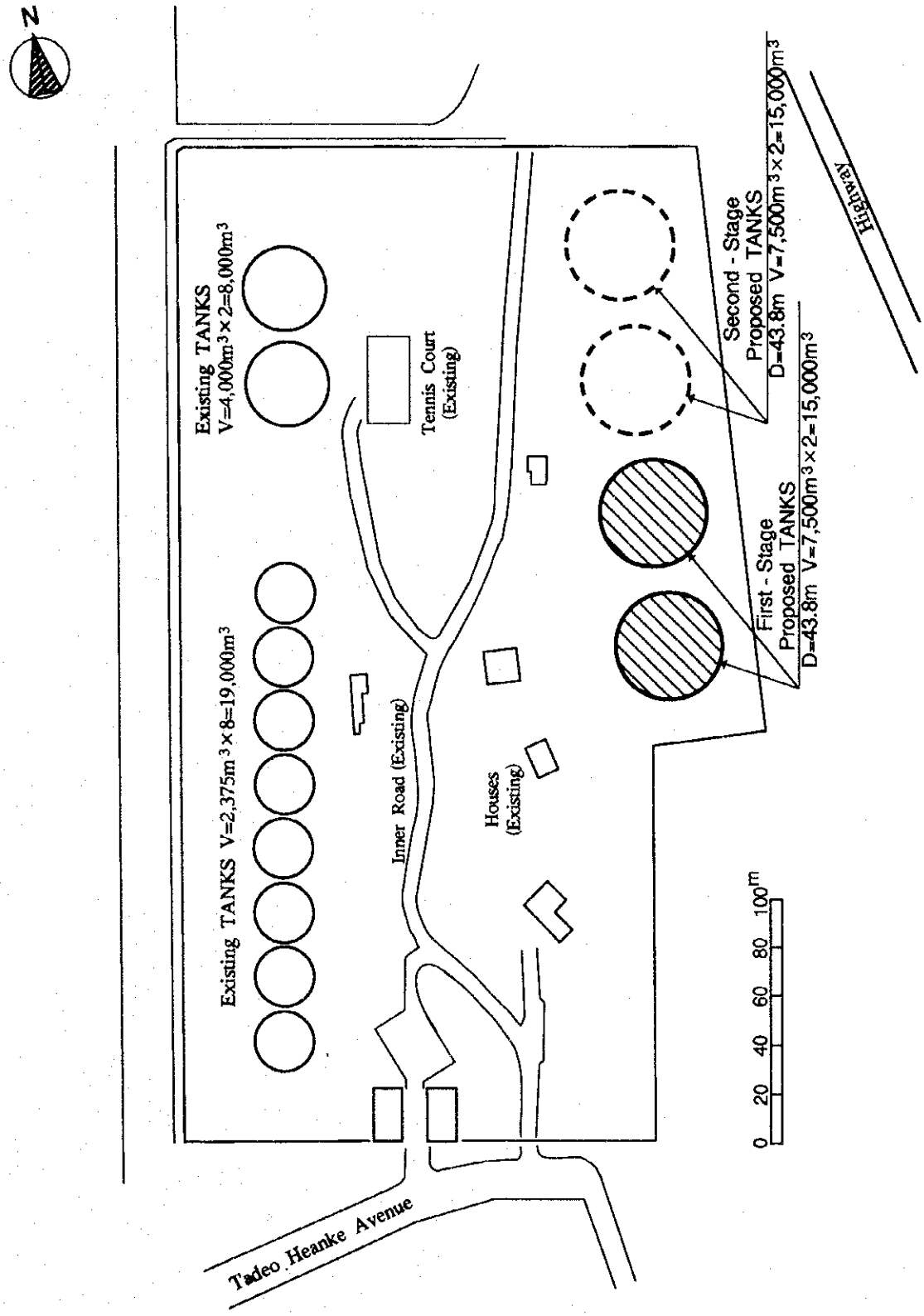


Fig. D - II, 4.19 Distribution Tanks in Cavancha
< Distribución de Tanques en Cavancha >