APPENDIX C
OTHERS

Appendix C-1

Geo-Technical Conditions

APPENDIX C-1 GEO-TECHNICAL INVESTIGATION

C-1.1 General

In the Basic Design report, geo-technical characteristics were discussed mainly referring to the results of field investigation in the Feasibility Study. Data obtained through field investigations as of end of February supplemented previous data, which are the basis for design of foundation of facilities.

Using consolidated data and information as mentioned above, geo-technical characteristics at each premises of facility are discussed in this Appendix.

C-1.2 Methodology Applied

As mentioned in the Basic Design report, the methods applied for soil investigations correspond to GOST and SNiP . Raw data of test are attached to this report as *Annexes A to D*. Supplementary explanations on calculation method of bearing capacity including some formulas are made in this sub-section.

The standard penetration test is generally applied for soil investigations in J apan and other countries. This method is used to obtain the data on the geo-technical condition N-value with undisturbed sample. This method, however, is not applied in the Republic of Kazakhstan.

For the reference, converted N-value was calculated on the basis of the results of the static penetration test, since the method and equipment applied is same as the Dutch cone penetration test. In general, N-value is converted by using following formula:

$$qc = 4N$$

where, qc : static penetrate resistance (kgf/cm^2)

However, it is suggested that different coefficient should be applied depending on geological layers. In this report, following formulas are applied:

for clay layer : $qc = 3N$

for sandy layer : $qc = 4N$

Bearing capacity R_0 for the spread foundation is calculated in accordance with SNiP and is displayed in *Table 1*. The values are calculated under the condition of width b_0 = 1m and penetration depth d_0 = 2m. For the purpose of comparison, allowable bearing capacity (*qa*) is calculated using the result of static penetration test under the same condition with bearing capacity R_0. Formula applied is as follows:

$$qa = (1/40)*qc*B(1+Df/B)$$

where, Df (penetration depth): 2m

B (width of foundation): 1m

qc(static penetration resistance): ton/m^2

Mechanical properties are displayed in *Table 1 and Annex B for raw data.* In the column of Cohesion, Angle of internal friction and Deformation module, both of values obtained during Feasibility study in accordance with SNiP 2.02.02-83 and by tri-axial test during this study are displayed. For the design purpose, it is recommended to utilize the latter value, if two figures are obtained.

Investigation of ground corrosion activity was carried out in accordance with GOST 9.602-89 for steel and SNiP 2.03.11-85 for concrete. The level of soil aggressive impact on concrete by cement types and on steel are determined on the basis of the results of chemical analysis of soil moisture (*see Tables 3 and 4, Annex C for raw data*). Corrosion activity of soil is also investigated using dried soil sample (*see Table5*). Water aggressiveness to the concrete is determined on the basis of the results of chemical analysis of water samples (*see Annex D*).

C-1.3 Geo-technical Conditions of each Facility

(1) Water Treatment Plant (WTP)

1) General

The existing WTP constructed on the alluvial plain consisting of weathering Mesozoic crust, is located in the eastern part of the Astana city. The elevation of land varies from 351 to 354mASL inclining slightly from south to north. During the feasibility study, geo-technical investigations were carried out at six points in the premise of WTP. Furthermore, additional eight points were selected in order to obtain more detailed data on soil conditions. These points were determined taking into account the plan of facilities to be constructed. Locations of boring points and profiles are shown in *Figure 1* and *Figure 2(1)-(9)*, respectively.

2) Geo-Technical Conditions

Based on the results of investigations, geological unit in this area was classified into seven layers from the geo-technical point of view, which are (0 and 0^a) soil vegetation layer and sandy clay, (I) light arenaceous sandy clay, (II) dusty average coarseness sand, (III) polymictic loamy average coarseness sand, (IV) compact gravelly sand, (V) light dusty sandy clay, and (VI) clay (*see Table 1*). In this report, two surface layers are regarded as same

layer.

The sand layer composed of the layers from (II) to (IV), changes its faces gradually from place to place. On the other hand, sandy clay layer (I) is distributed in whole area of WTP (*see Figure 2(1) - (9)*). The groundwater level is mainly observed in the (I) sandy clay. The flow direction of groundwater is from south to north harmonizing with ground level. The level of groundwater in August 2000 is from 0.95 to 2.40mbgl. There is no significant seasonal groundwater fluctuation in this area. According to the SNiP 2.02.01-83 and 2.01.01-82, the depth of seasonal ground freezing is as follows: sandy clay-189cm, thin and dusty sand-230cm and sand of middle coarseness, coarse and gravelly-246cm.

Geo-technical characteristics of the soil and results of laboratory tests are summarized in *Tables 1 and 2*. Facilities to be constructed in the area are water-retaining structures and administration buildings. Depths of the foundation of water-retaining structures are between 3 and 10m from the designed ground level. The layers under the foundation of designed facilities are from layer (II) dusty average coarseness sand to layer (VI) clay. The layer (II) consisting of dusty average coarseness sand having insufficient bearing capacity is mainly distributed in northeastern part of WTP. Taking into account the results of static penetration test, it is also concluded that calculated bearing capacity is insufficient. Sand layers of (II) having insufficient bearing capacity and (III) which seem to be intercalated layer should not be regarded as bearing layer. Layer (IV) compact gravelly sand, which seems to be having enough capacity, is distributed in the southwest and northeast part of the WTP premises. Considering these conditions, layers from (IV) to (VI) can be considered as bearing layer. Depth to these bearing layers from the bottom of some designed facilities is more than three meters. Therefore, the pile foundation is recommended for these facilities.

As shown in Table 1, the layer (I) consisting of sandy clay cannot be regarded as having sufficient bearing capacity, even for the three floors administration building. In addition, sand layer distributing under the layer (I) does not have enough bearing capacity. Considering these conditions, pile foundation of which bearing layer is the layer (V) or (VI), is recommended.

3) Soil Corrosion Activity

According to the investigation for the ground corrosion activity, most of the level of corrosion activity to steel is more than medium (*see Table 3*). The Portland cement has a low aggression against SO_4 and Cl (*see Table 4*). Relatively high concentration of sulphate is observed in layer (I) and (II). Layers from (IV) to (VI) are classified as not aggressive to concrete (*see Annex C*). The result of corrosion activity of soil taken from excavations point

shows low to medium corrosive to portland cement (*see Table 5 and Figure 1 for location*).

Considering these conditions, it is recommended to take the relevant countermeasures against soil aggressive property to steel and portland cement.

(2) Sewerage Treatment Plant (STP)

1) General

The STP is located in the southwestern part of Astana city. The treated water is discharged into the Taldykol Lake located southward of the STP. The land of STP is almost flat and its elevation is around 343mASL. During the feasibility study, geo-technical investigations were carried out at seven points. Within the framework of this study, five points were selected on the basis of the plan of the facilities to be constructed in order to obtain more detailed information of the soil conditions of the area. Locations of these boring points and profiles are shown in *Figure 3* and *Figure 4 (1)-(9)*, respectively.

2) Geo-Technical Conditions

Based on the results of investigations, geological unit in this area was classified into seven layers in terms of the geo-technical point, which are (0 and 0^a) soil vegetation layer and sandy clay, (I) light arenaceous sandy clay, (II) loamy arenaceous sand, (III) polymictic average coarseness sand, (IV) polymictic coarse-grained sand, (V) light dusty gravelly sandy clay and (VI) light dusty clay (*see Table 1*). In this report, two surface layers are regarded as one layer.

The layer (I) consisting of arenaceous sandy clay is distributed in whole area. It is observed that the lower part of the layer (I) arenaceous sandy clay is gradually changed to the layer (II) loamy arenaceous sand from south to northe. Sand layers under the layer (II) loamy sand mainly composed of polimictic coarse-grained sand, are distributed throughout premises of STP. In the western part of premises (boring points are No.11, 15 and 16), the facies of upper part of sand layer is gradually changed from the layer (IV) polimictic coarse-grained sand to the layer (III) average coarseness sand. The intercalation of the layer (V) sandy clay including organic remains (flora) is also observed between two sand layers (III and IV). These indicate that the grain size of sand layer changes to finer in the western part of the premises.

The elevation of groundwater in each boring point is almost same. Considering the location of the Taldykol Lake, the groundwater within the premises of STP flows in the direction from north to south in general, with very gentle inclination. The groundwater table is observed as

GL. -0.95 to -2.63m in September 2000. There is no significant groundwater fluctuation in this area. According to the SNiP 2.02.02-83 and 2.01.01-82, the depths of seasonal ground freezing are as follows: sandy clay – 189cm, thin and dusty sands – 230cm and sands of middle coarseness, coarse and gravelly – 246cm.

Geo-technical characteristics of the soils and results of laboratory tests are summarized in *Tables 1 and 2*. Facilities to be constructed for STP are mainly water-basin structures. The depths of bottom of facilities vary between 2 and 10m from the designed ground level. The layers under the shallow foundation facility such as settlement tank are layer (I) light sandy clay or the layer (II) loamy sand. The calculated bearing capacities of these two layers are insufficient to bear such heavy structures. Furthermore, the results of static penetration test also reveal insufficient bearing capacity (refer to *Table 1*). In addition, considering the influence of frost heave, it is required to design the suitable foundation for the settlement tank. The layer under the deeper foundation facility such as the digester is the layer (VI) clay having sufficient bearing capacity. This layer is the Mesozoic strata and is regarded as basement of this area.

In case, the set of earth retaining wall is required for the construction of the deep foundatio facilities, the mechanical characteristics of layers above the layer (VI) clay should be taken into consideration.

3) Soil Corrosion Activity

According to the investigation for the ground corrosion activity, the level of corrosion activity to steel varies from low to high (s*ee Table 3*). Soils of this area have sulphate aggressive both low and high to all concrete types of portlandcement, and low aggressive to concrete of W4 type of slagportrandcement (*see Table 4*). High concentration of sulphate is observed in layer (0) surface soil (*see Annex C*). Even in the underlying layers (I), (IV) and (VI), level of corrosive is relatively high. The result of corrosion activity of soil taken from excavations point shows low corrosive to portland cement (*see Table 5, Figure 2 for location*). Considering these conditions, it is recommended to take the suitable countermeasure against corrosion. The classification of concrete W4, W6 and W8 is described in *Annex E*.

(3) Water Intake Tower

1) General

Vyacheslavsky Reservoir, which is the main source of water supply of Astana city, is located around 50km southeast from Astana city. A new water intake tower is designed about 100m

northeastward of the existing water intake. During the feasibility study, geo-technical investigations were carried out at three points. According to the results, the bearing capacity of the planned strata seems to be sufficient for supporting of the facility. In order to ensure the sufficiency and sequence including an inclination of bearing layer, additional two points were selected. Locations of boring points and profiles are shown in *Figure 5* and *Figure 6 (1) - (3)*, respectively.

2) Geo-Technical Conditions

Based on the results of investigations, the geological units of this area were classified into four layers, which are (I) light arenaceous sandy clay, (II) heavy arenaceous sandy clay with interlayer of fine sand, (III) loamy sand with weathering sandstone, (IV) weathered medium-grained sandstone.

From the geological point of view, the layer (II) sandy clay is considered as a part of layer (I) light arenaceous sandy clay (*see Figure 6 (1) - (3)*). The layer (III) loamy sand with weathering sandstone is regarded as a weathering part of layer (IV) sandstone. Elevations of groundwater at three boring points were almost the same as that of the reservoir water. According to the SNiP, the depth of seasonal ground freezing of sandy clay is 189cm.

Geo-technical characteristics of the soils and the results of laboratory tests are summarized in *Tables 1 and 2*. Thickness of the layer (I) light arenaceous sandy clay with intercalation of layer (II) is from 10 to 13m. Elevation of the bottom of layer (I) is around 386mASL. The thin layer (III) consisting of loamy sand with weathering sandstone is distributed between layer (I) and layer (IV). The layer (IV) consisting of Ordovician sandstone, which is considered as a basement rock in this area, has a sufficient bearing capacity. The elevation of top of the layer (IV) is around 385mASL plunging slightly into northeast.

Since the elevation of foundation of the facility is designed to reach to the layer (IV) with few meters of penetration depth, the earth pressure of layer (I) and (II) should be taken into consideration of facility designing.

3) Soil Corrosion Activity

According to the investigation for soil corrosion activity, the level of activity to steel varies from low to high (*see Table 3*). Soil moisture is not aggressive to all types of concretes (*see Table 4*). Concentration of sulphate of layer (I) and (II) is relatively low (see *Annex C*). Considering these conditions, suitable corrosion proofing against sulphate is recommended.

(4) River Crossing Point

1) General

River crossing point at Ishym river is situated on south of Astana city. The elevations of boring points are around 400mASL. Within the framework of this study, geo-technical investigation was carried out at two points located at both side of the river. Locations of these boring points and profiles are shown in *Figure 7* and *Figure 8*, respectively. River crossing point was shifted to north from original point. However, geological situation at shifted point can be considered similar to that of original point, because both points are located along the river.

2) Geo-Technical Conditions

Based on the results of investigations, geological unit in this area was classified into five layers in terms of geo-technical point, which are (0) soil vegetation layer, (I) dark-grey sandy loam, (II) brownish-grey sandy loam, (III) coarse grained sand and (IV) clayey loam. The layer (II) consisting of dark gray sandy loam is become thicker eastward, on the other hand, layer (III) consisting of brownish gray sandy loam is become thinner eastward. Top of the layer (IV) consisting of clay loam including crust of weathering sandstone is inclined from west to east.

Geo-technical characteristics of the soils and results of laboratory tests are summarized in *Tables 1 and 2*. Facilities to be constructed at Ishym river crossing point is invert siphon.

Physical and mechanical properties of layers of (IV) and (V) are measured during this study. These properties of the layer from (I) to (III) shown in tables are obtained from the other boring point along the Ishym river, which is located about 1km south from original point.

3) Soil Corrosion Activity

According to the investigation for ground corrosion activity, the level of corrosion activity to steel is low in shallow and high in deeper part (*see Table 3*). Aggressive impact on concrete varies from not aggressive to medium aggressive (*see Table 4*). Considering these conditions, suitable corrosion proofing for the facilities is required.

Table 1 Mechanical Properties and Calculated Bearing Capacity

Facility	Layer	Geological Description	Geological Time	Depth of layer base occurrence	Layer thickness	Cohesion		Angle of internal friction		Deformation module		Coefficient of lateral Pressure	Coefficient of Permeability k	Static penetrate resistance	Converted N-value	Allowable bearing capacity	Calculated resistance R_0
				m	m	1)kgf/cm^2	2)kgf/cm^2	1)degree	2)degree	1)kgf/cm^2	2)kgf/cm^2		m/day	kgf/cm^2		ton/m^2	1)ton/m^2
WATER TREATMENT PLANT	0	Soil vegetation layer	Q_{IV}	0.2 - 0.3	0.2 - 0.3	---	---	---	---	---	---		---	---	---	---	---
	0[a]	Sandy Clay, solid	Q_{IV}	0.3 - 1.0	0.3 - 1.0	---	---	---	---	---	---		---	---	---	---	---
	1	Sandy Clay, light, arenaceous	Q_{II-III}	1.7 - 3.4	1.4 - 3.2	**0.25**	**0.43**	**19**	**22**	**142**	**56**	**0.19**	**1)0.18**	**17 / 87**	**4 / 22**	**13 /65**	**25**
	2	Sand, average coarseness, dusty, polymictic	Q_{I-II}	2.8 - 6.5	1.1 - 2.0	**0.04**	---	**30**	---	**187**	---	---	**0.71**	**13**	**3**	**10**	**10**
	3	Sand, average coarseness, polymictic	Q_{I-II}	4.9 - 8.0	2.3 - 3.3	**0.02**	---	**38**	---	**253**	---	---	**0.70**	**45**	**11**	**34**	**40**
	4	Sand, gravelly, compact	Q_{I-II}	3.7 - 8.0	0.7 - 3.8	**0.01**	---	**40**	---	**309**	---	---	**2.56**	**60**	**15**	**45**	**50**
	5	Sandy Clay, light, dusty	Q_{I-II}	5.5 - 11.5	1.8 - 5.9	**0.25**	**0.71**	**19**	**19**	**160**	**63**	**0.16**	**1)0.18**	**33**	**9**	**25**	**25**
	6	Clay, dusty, yellow	Mz	---	---	**0.33**	**0.58**	**19**	**24**	**336**	**65**	**0.14**	---	**30 / (79)**	**8 / (20)**	**22 / (60)**	**70.5/106.5**
SEWERAGE TREATMENT PLANT	0	Soil vegetation layer	Q_{IV}	0.3	0.3	---	---	---	---	---	---	---	---	---	---	---	---
	0[a]	Sandy Clay, solid, low humid	Q_{IV}	0.5	0.5	---	---	---	---	---	---	---	---	---	---	---	---
	1	Sandy Clay, light, arenaceous	Q_{III-IV}	2.0 - 6.8	1.5 - 6.5	**0.3**	---	**22**	---	**214**	---	---	**1)0.18**	**12**	**3**	**9**	**24.5**
	2	Loamy Sand,, arenaceous	Q_{I-II}	3.5 - 6.0	1.5 - 3.0	**0.15**	---	**26**	---	**240**	---	---	**1)0.18**	**14 / (91)**	**3 / (23)**	**11 / (68)**	**20**
	3	Sand, average coarseness, polymictic	Q_{I-II}	5.5 - 8.8	1.5 - 2.8	**0.02**	---	**38**	---	**400**	---	---	**1.95**	**110**	**28**	**82**	**40**
	4	Sand, coarse-grained	Q_{I-II}	10.2 - 11.8	1.7 - 6.6	**0.01**	---	**40**	---	**400**	---	---	**27.1**	**104**	**26**	**77**	**50**
	5	Sandy Clay, light, dusty	Q_{I-II}	9.3	0.5	**0.42**	---	**25**	---	**305**	---	---	**1)0.18**	---	---	---	**29.5**
	6	Clay, light, dusty	Mz	---	---	**0.39**	**0.69**	**21**	**18**	**170**	**53**	**0.14**	---	**(28)**	**(9)**	**(21)**	**37**
WATER INTAKE	1	Sandy Clay, light, arenaceous	Q_{II-III}	13.5 - 15.8	10.6 - 13.5	**0.25**	**0.78**	**21**	**18**	**150**	**46**	**0.17**	**1)0.18**	**17 / 14**	**4**	**13 / 11**	**21**
	2	Sandy Clay, heavy, arenaceous	Q_{II-III}	7.3 - 7.5	3.6 - 4.3	**0.22**	**0.61**	**18**	**9**	**120**	**25**	**0.16**	**1)0.18**	**3**	**1**	**2**	**19**
	3	Loamy Sand	Mz	14.3 - 16.8	0.3 - 1.0	**0.48**	**0.71**	**24**	**28**	**210**	**37**	**0.19**	---	---	---	---	**30**
	4	Sandstone, medium-grained	O_1 ?	---	---	---	---	---	---	---	---	---	---	---	---	---	**100**
ISHYM RIVER CROSSING POINT	0	Soil vegetation layer	Q_{IV}	0.1 - 0.2	0.1 - 0.2	---	---	---	---	---	---	---	---	---	---	---	---
	1	Sandy Loam, heavy, dark-grey	Q_{III}	0.8 - 1.0	0.7 - 0.8	**(0.25)**	---	**(23)**	---	**(170)**	---	---	---	**40**	**10**	**30**	**(23)**
	2	Sandy Loam, brownish-grey	Q_{II-III}	1.8 - 5.3	1.0 - 4.3	**(0.13)**	---	**(24)**	---	**(100)**	---	---	---	**14**	**4**	**11**	**(24)**
	3	Sand, coarse-grained	Q_{I-II}	6.3 - 9.0	1.0 - 7.2	**(0.01)**	---	**(40)**	---	**(400)**	---	---	**41.1**	**18**	**5**	**14**	**(50)**
	4	Loam, light, dusty	Mz	---	---	---	**0.76**	---	**23**	---	**82**	**0.13**	---	**46**	**11**	**34**	---

Note: " 1) " means figure obtained during the Feasibility Study in accordance with SNiP 2.02.02-83
" 2) " means the figure obtained by tri-axial test in this study
" (figure)" means the figure obtained from only one sample

Table2 Physical Properties

Facility	Layer	Geological Description	Geological Time	Depth of layer base occurrence	Layer thickness	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation
				m	m	WL	WP	IP	W	IL	Ic	Gs(ρs)	ρ g/cm^3	ρd g/cm^3	e	Sr
WATER TREATMENT PLANT	0	Soil vegetation layer	Q_{IV}	0.2 - 0.3	0.2 - 0.3	---	---	---	---	---	---	---	---	---	---	---
	0[a]	Sandy Clay, solid	Q_{IV}	0.3 - 1.0	0.3 - 1.0	---	---	---	---	---	---	---	---	---	---	---
	1	Sandy Clay, light, arenaceous	Q_{II-III}	1.7 - 3.4	1.4 - 3.2	**25.1**	**14.5**	**10.6**	**15.4**	**-0.09**	**0.93**	**2.72**	**2.06**	**1.78**	**0.52**	**0.81**
	2	Sand, average coarseness, dusty, polymictic	Q_{I-II}	2.8 - 6.5	1.1 - 2.0	**27.3**	**13.6**	**13.8**	**20.8**	**0.53**	**0.47**	**2.71**	**2.23**	**1.85**	**0.47**	**1.20**
	3	Sand, average coarseness, polymictic	Q_{I-II}	4.9 - 8.0	2.3 - 3.3	---	---	---	**17.4**	---	---	**2.70**	**2.23**	**1.90**	**0.42**	**1.10**
	4	Sand, gravelly, compact	Q_{I-II}	3.7 - 8.0	0.7 - 3.8	---	---	---	---	**(0.28)**	**(0.72)**	**2.73**	**(2.16)**	**(1.83)**	**(0.47)**	**(1.01)**
	5	Sandy Clay, light, dusty	Q_{I-II}	5.5 - 11.5	1.8 - 5.9	**32.6**	**19.1**	**13.4**	**20.8**	**0.08**	**0.92**	**2.72**	**2.08**	**1.73**	**0.58**	**0.95**
	6	Clay, dusty, yellow	Mz	---	---	**41.8**	**26.0**	**15.8**	**23.5**	**-0.33**	**1.33**	**2.73**	**1.97**	**1.61**	**0.71**	**0.90**
SEWERAGE TREATMENT PLANT	0	Soil vegetation layer	Q_{IV}	0.3	0.3	---	---	---	---	---	---	---	---	---	---	---
	0[a]	Sandy Clay, solid, low humid	Q_{IV}	0.5	0.5	---	---	---	---	---	---	---	---	---	---	---
	1	Sandy Clay, light, arenaceous	Q_{III-IV}	2.0 - 6.8	1.5 - 6.5	**25.1**	**15.9**	**9.2**	**19.4**	**0.33**	**0.67**	**2.72**	**2.01**	**1.68**	**0.62**	**0.86**
	2	Loamy Sand,, arenaceous	Q_{I-II}	3.5 - 6.0	1.5 - 3.0	**20.6**	**15.4**	**5.2**	**21.3**	**1.12**	**-0.13**	**2.70**	**2.12**	**1.75**	**0.55**	**1.07**
	3	Sand, average coarseness, polymictic	Q_{I-II}	5.5 - 8.8	1.5 - 2.8	---	---	---	---	---	---	---	---	---	---	---
	4	Sand, coarse-grained	Q_{I-II}	10.2 - 11.8	1.7 - 6.6	---	---	---	---	---	---	**2.69**	---	---	---	---
	5	Sandy Clay, light, dusty	Q_{I-II}	9.3	0.5	**28.0**	**16.0**	**12.0**	**16.7**	**0.06**	**0.94**	**2.72**	**2.12**	**1.82**	**0.50**	**0.91**
	6	Clay, light, dusty	Mz	---	---	**46.3**	**22.7**	**23.6**	**24.5**	**0.03**	**0.97**	**2.72**	**2.01**	**1.63**	**0.70**	**0.95**
WATER INTAKE	1	Sandy Clay, light, arenaceous	Q_{II-III}	13.5 - 15.8	10.6 - 13.5	**32.8**	**18.4**	**14.4**	**22.7**	**0.3**	**0.7**	**2.71**	**1.99**	**1.62**	**0.68**	**0.92**
	2	Sandy Clay, heavy, arenaceous	Q_{II-III}	7.3 - 7.5	3.6 - 4.3	**33.9**	**19.4**	**14.6**	**25.6**	**0.44**	**0.56**	**2.72**	**2.04**	**1.62**	**0.68**	**1.02**
	3	Loamy Sand	Mz	14.3 - 16.8	0.3 - 1.0	**20.2**	**13.1**	**7.1**	**16.4**	**0.5**	**0.5**	**2.69**	**2.12**	**1.82**	**0.48**	**0.91**
	4	Sandstone, medium-grained	O_1?	---	---	---	---	---	---	---	---	---	---	---	---	---
ISHYM RIVER CROSSING POINT	1	Soil vegetation layer	Q_{IV}	0.1 - 0.2	0.1 - 0.2	---	---	---	---	---	---	---	---	---	---	---
	2	Sandy Loam, heavy, dark-grey	Q_{III}	0.8 - 1.0	0.7 - 0.8	***32**	***19**	***13**	***20**	***0.08**	***0.92**	***2.73**	***1.88**	***1.57**	***0.74**	***0.74**
	3	Sandy Loam, brownish-grey	Q_{II-III}	1.8 - 5.3	1.0 - 4.3	***25**	***18**	***7**	***19.6**	***0.23**	***0.77**	***2.70**	***1.86**	***1.55**	***0.74**	***0.72**
	4	Sand, coarse-grained	Q_{I-II}	6.3 - 9.0	1.0 - 7.2	---	---	---	**10.4**	---	---	**2.71**	---	---	---	---
	5	Loam, light, dusty	Mz	---	---	**30.9**	**17.0**	**14.0**	**18.8**	**0.19**	**0.89**	**2.71**	**2.07**	**1.75**	**0.57**	**0.9**

Note: " (figure)" means the data of a part of the formation, not particular figure of the formation.
" --- " means " not measured" .
" * " means that the data are from other boring points near the Ishym river which are located 1 km south from crossing point

Table 3 Level of Ground Corrosion to the Carbon Steel

Facility	Well No.	Lab#	Depth of Sampling(m)	Geology	*)Anodized pipe weight losing(gr)	Corrosion level of ground activity
Water Treatment Plant	1	476	1.0-2.7	light dusty sandy clay	1.13	medium
	2	489	0.0-1.7	light dusty sandy clay	3.67	medium
	4	509	0.0-2.6	light dusty sandy clay	1.1	medium
	5	517	0.3-3.0	loamy sand	1.05	medium
	6	523	0.2-2.5	light arenaceous sandy clay	1.3	medium
	21	---	0.5-0.7	clay loam, hevy	N.A	high
	21	---	2.0-2.5	clay loam, light	N.A	high
	21	---	14-15	clay loam soid	N.A	high
	22	---	1.35-1.45	Clay loam, heavy pulverulent solid	N.A	high
	22	---	2.0-2.15	Clay loam, heavy pulverulent semisolid	N.A	high
	22	---	2.9-3.1	Clay, light pulverulent tight-plastic	N.A	high
	22	---	3.1-3.3	Clay loam, heavy pulverulent soft-plastic	N.A	high
	22	---	12-12.2	Clay loam, heavy pulverulent semisolid	N.A	high
	23	---	4.5-5.5	Clay, light pulverulent tight-plastic	N.A	high
	23	---	6.8-7.0	Clay, light pulverulent tight-plastic	N.A	high
	24	---	10.0-12.0	Clay, light pulverulent tight-plastic	N.A	high
	24	---	12.5-12.7	Clay, heavy pulverulent semisolid	N.A	high
	25	---	8.0-8.2	Coarse sand	N.A	low
	25	---	10.15-10.5	Clay, light pulverulent soft-plastic	N.A	high
	26	---	6.0-6.25	Clay, heavy semisolid	N.A	high
	27	---	5.0-6.0	Gravel sand	N.A	low
	27	---	7.0-7.2	Clay, light pulverulent solid	N.A	high
	28	---	7.0-8.0	Gravel sand	N.A	medium
	28	---	9.2-9.6	Clay, light pulverulent semisolid	N.A	high
Sewerage Treatment Plant	10	566	0.3-3.0	light, loam sandy clay	2.8	high
	11	573	0.3-3.0	light, loam sandy clay	4.29	high
	14	604	0.0-3.0	light, loam sandy clay	1.69	medium
	15	609	0.0-3.0	light, loam sandy clay	2.19	high
	29	---	10.0-11.0	Gravel sand	N.A	medium
	29	---	14-14.2	Clay heavy semisolid	N.A	high
	30	---	8.0-9.0	Gravel sand	N.A	low
	30	---	12.0-12.2	Clay, heavy semisolid	N.A	high
	31	---	7.0-8.0	Gravel sand	N.A	low
	31	---	13.0-13.2	Clay, heavy semisolid	N.A	high
	32	---	9.0-10.0	Gravel sand	N.A	medium
	32	---	12.5-12.7	Clay, heavy pulverulent semisolid	N.A	high
	33	---	8.0-9.0	Gravel sand	N.A	low
	33	---	12.0-12.2	Clay, heavy pulverulent tight-plastic	N.A	high
Water Intake Tower	7	533	0.3-3.0	light sandy clay	2.84	high
	8	543	0.0-4.5	heavy sandy clay	2.75	high
	9	548	0.0-3.0	light sandy clay	0.41	low
	36	---	0-3.2	Loam, dusty plastic	N.A	medium
	36	---	5-5.2	Clay, light, dusty, semi-hard	N.A	low
	36	---	8-8.2	Loam, heavy dusty, softy plastic	N.A	medium
	36	---	9.0-12.0	Loam, heavy, dusty, softly plastic	N.A	medium
	36	---	12-14.0	Loam, light,dusty softly plastic	N.A	low
	37	---	1.2-1.35	Clay, light, dusty	N.A	low
	37	---	3.2-3.4	Clay, light, dusty	N.A	medium
	37	---	6.0-12.7	Loam heavy dusty fluid plastic	N.A	medium
	37	---	12.7-14.6	Loam, light, arenaceous softly plastic	N.A	medium
Ishym River	34	---	6.4-7.0	Coarse sand	N.A	low
	34	---	10.2-10.4	Clay loam, light pulverulent tight-plastic	N.A	high
	35	---	5.3-6.3	Gravel sand	N.A	low
	35	---	7.0-8.0	Clay loam, light pulverulent semisolid	N.A	high

Note : result of chemcal analysis that is used for determination of corrosion level is displayed in Annex C

*) figures are obtained by method of weight losing in accordance with GOST 9.602-89

Table 4 Level of Aggressive Impact on Concrete and Ferroconcrete thinwalled Construction

	Lab. No.	No. of Well	Sampling interval (m)	level of aggressive impact on a ferroconcrete	Cement Type	Level of aggressive impact on concrete by cement types		
						W4	W6	W8
Water Treatment Plant	476	1	1.0 - 2.7	non	Portlandcement	**Low**	**Low**	non
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non
	489	2	0 - 1.7	**Low**	Portlandcement	**Low**	**Low**	non
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non
	496	3	0 - 1.5	non	Portlandcement	**Low**	non	non
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non
	517	5	0.3 - 3.0	non	Portlandcement	**Low**	non	non
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non
	523	6	1.0 - 1.2	**Low**	Portlandcement	**Low**	non	non
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non
Sewerage Treatment Plant	573	11	0.3 - 3.0	N.A	Portlandcement	**Low**	**Low**	**Low**
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non
	604	14	0 - 0.3	N.A	Portlandcement	**High**	**High**	**High**
					Slagportlandcement	**Low**	non	non
					Sulphate stable	non	non	non
	609	15	0 - 0.3	N.A	Portlandcement	**High**	**High**	**High**
					Slagportlandcement	**Low**	non	non
					Sulphate stable	non	non	non
Water Intake Tower	-	36	0 - 3.2	non	Portlandcement	non	non	non
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non
	-	36	9.0 - 12.0	**Low**	Portlandcement	non	non	non
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non
	-	37	1.2 - 1.35	**Low**	Portlandcement	non	non	non
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non
	-	37	3.2 - 3.4	**Low**	Portlandcement	non	non	non
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non
	-	37	12.7 - 14.6	**Low**	Portlandcement	non	non	non
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non
Ishym River	-	34	6.4 - 7.0	non	Portlandcement	**Low**	non	non
					Slagportlandcement	**Low**	non	non
					Sulphate stable	**Low**	non	non
	-	35	5.3 - 7.3	non	Portlandcement	**Medium**	**Medium**	**Low**
					Slagportlandcement	non	non	non
					Sulphate stable	non	non	non

Note: Level of aggressive is determined on the basis of the result of quality analysis of soil moisture

Table 5 Result of Soil Corrosion Analysis

Facilities	No.	Sampling Date	Sampling Depth(m)	SO_4^{2-}	Degree of corrosive of soil on concrete and ferroconcrete (SNiP 2.03.11-85 Corrosion Protection of Building Components))		
				mg/kg of soil	portland cement	Portland slag cement	Suphate resistant cement
Water Treatment Plant	1	25-Nov-02	2.9	0.04	non	non	non
	2	25-Nov-02	3.0	484	**Low**	non	non
	3	25-Nov-02	3.5	243	non	non	non
	4	27-Nov-02	3.4	749	**Medium**	non	non
Sewerage Treatment Plant	1	10-Oct-02	2.7	110	non	non	non
	2	7-Oct-02	3.3	440	**Low**	non	non
	3	7-Oct-02	2.8	243	non	non	non
along pipe in City	1	---	---	390	**Low**	non	non
	2	---	---	28	non	non	non
	3	---	---	3	non	non	non

Note: Lcation of sampling points are shown in Figure 1 for WTP, Figure 3 for STP and Figure 9 for pipe

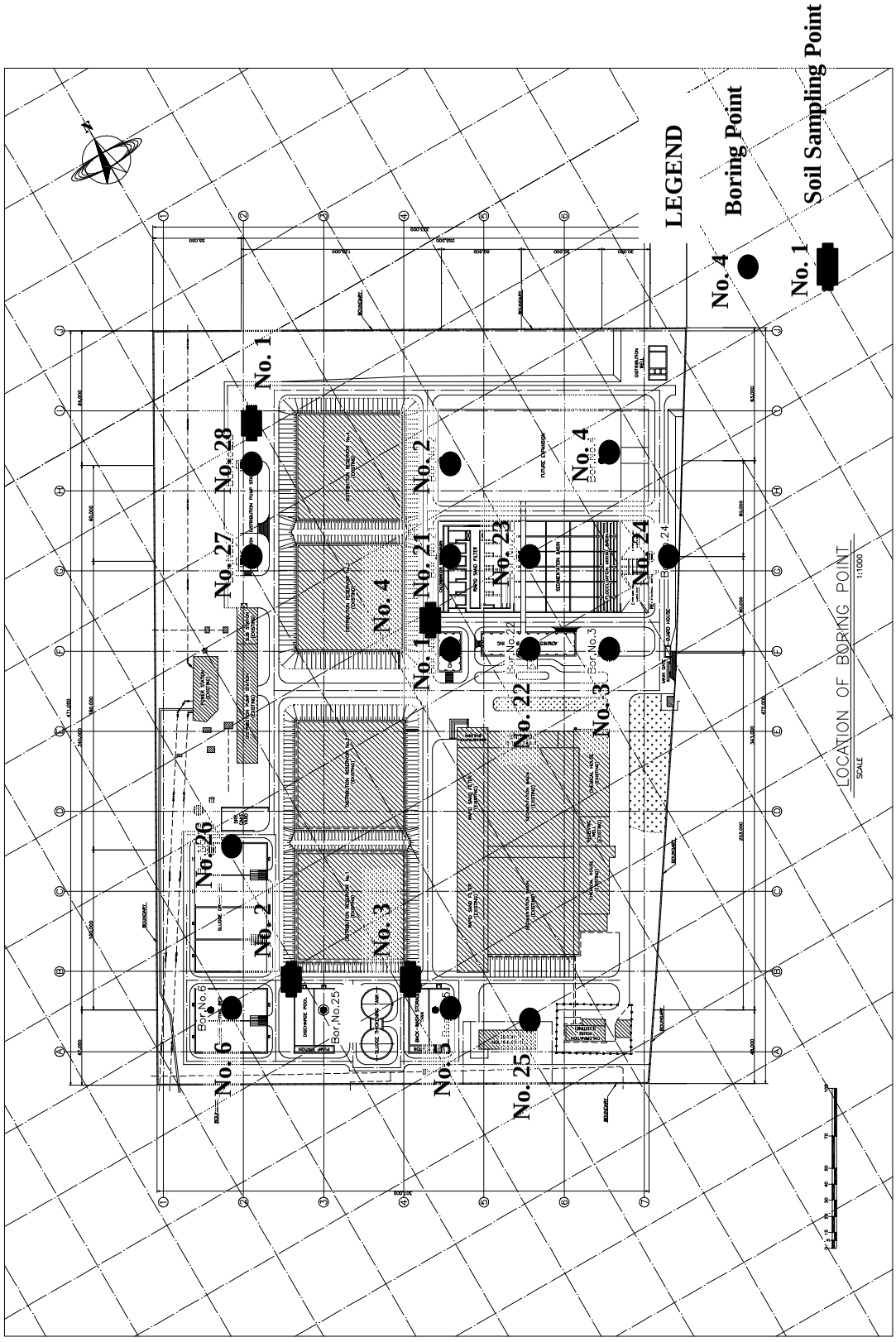

Figure 1 Location Map of Boring Points at Water Treatment Plant (WTP)

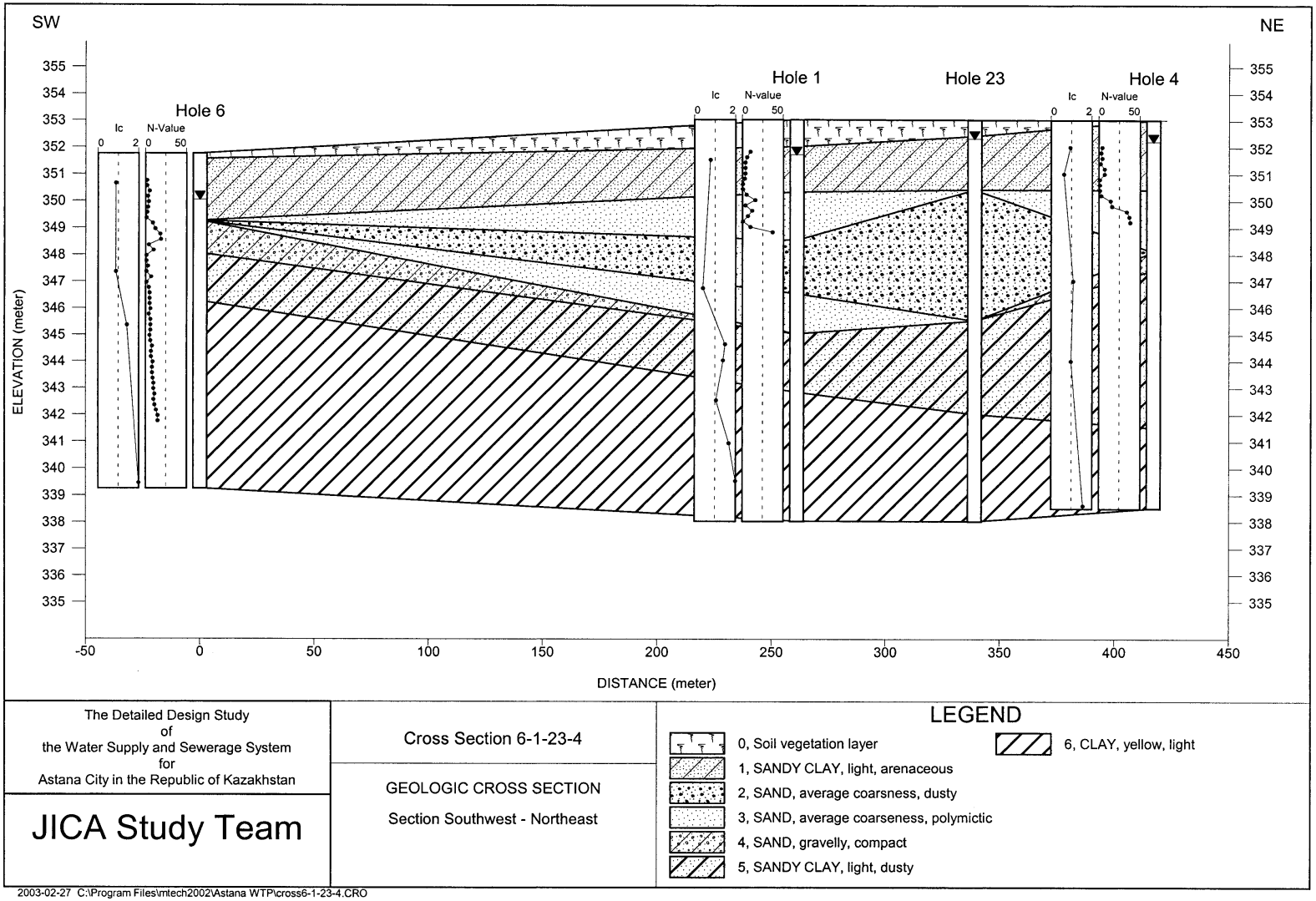

Figure 2(1) Geological Cross Section at Water Treatment Plant (1/9, Line No. 6-1-23-4)

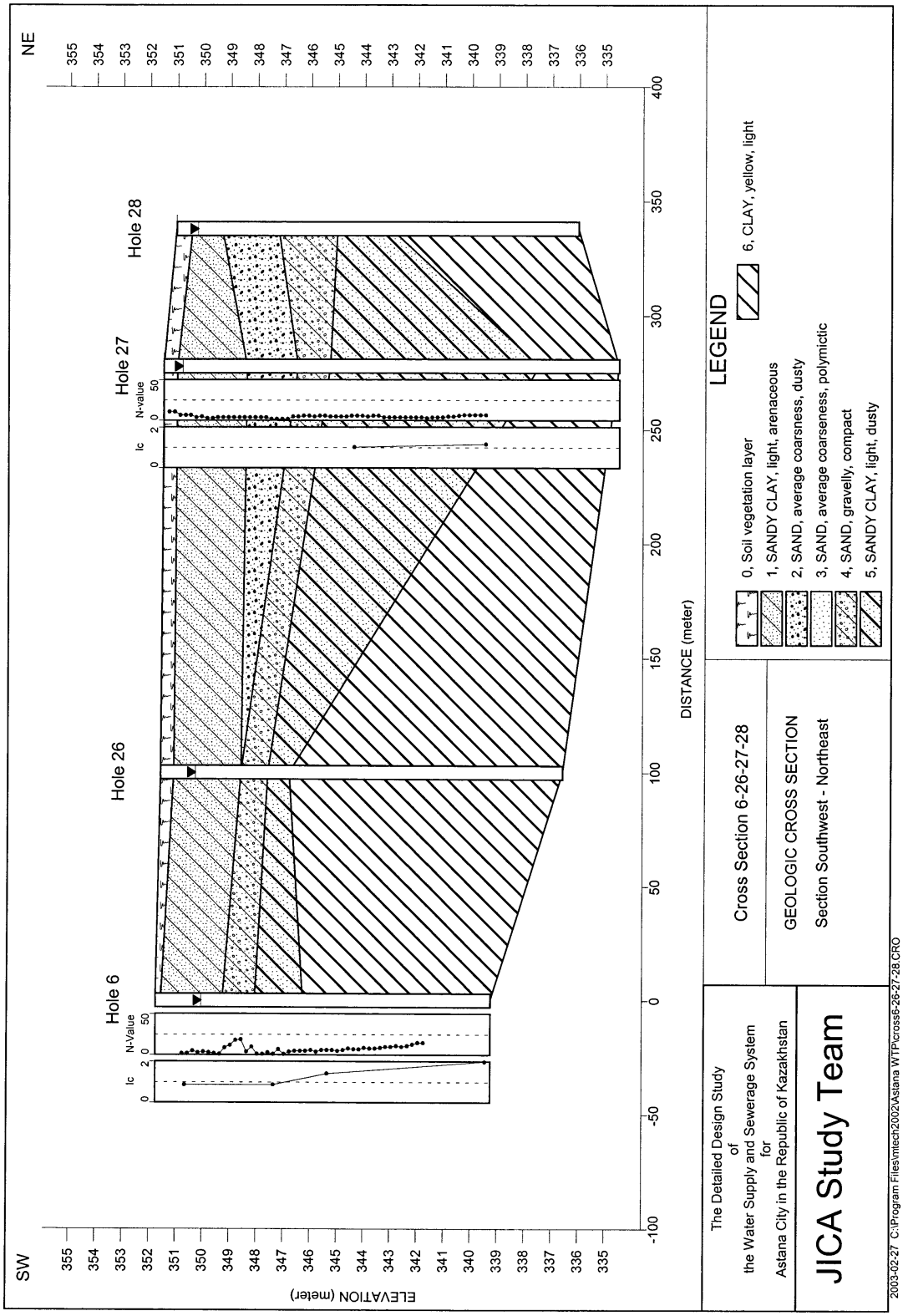

Figure 2(2) Geological Cross Section at Water Treatment Plant (2/9, Line No. 6-26-27-28)

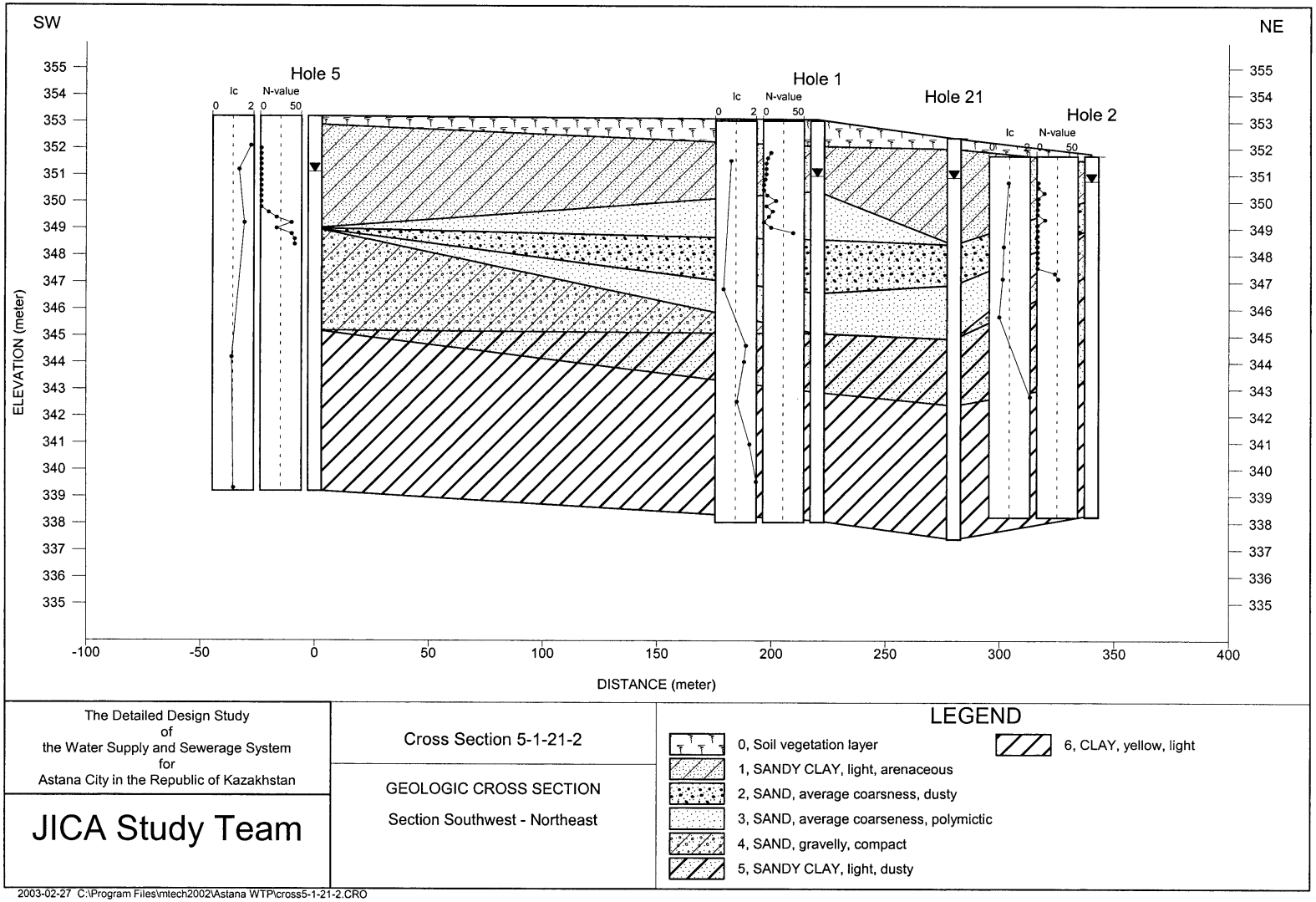

Figure 2(3) Geological Cross Section at Water Treatment Plant (3/9, Line No. 5-1-21-2)

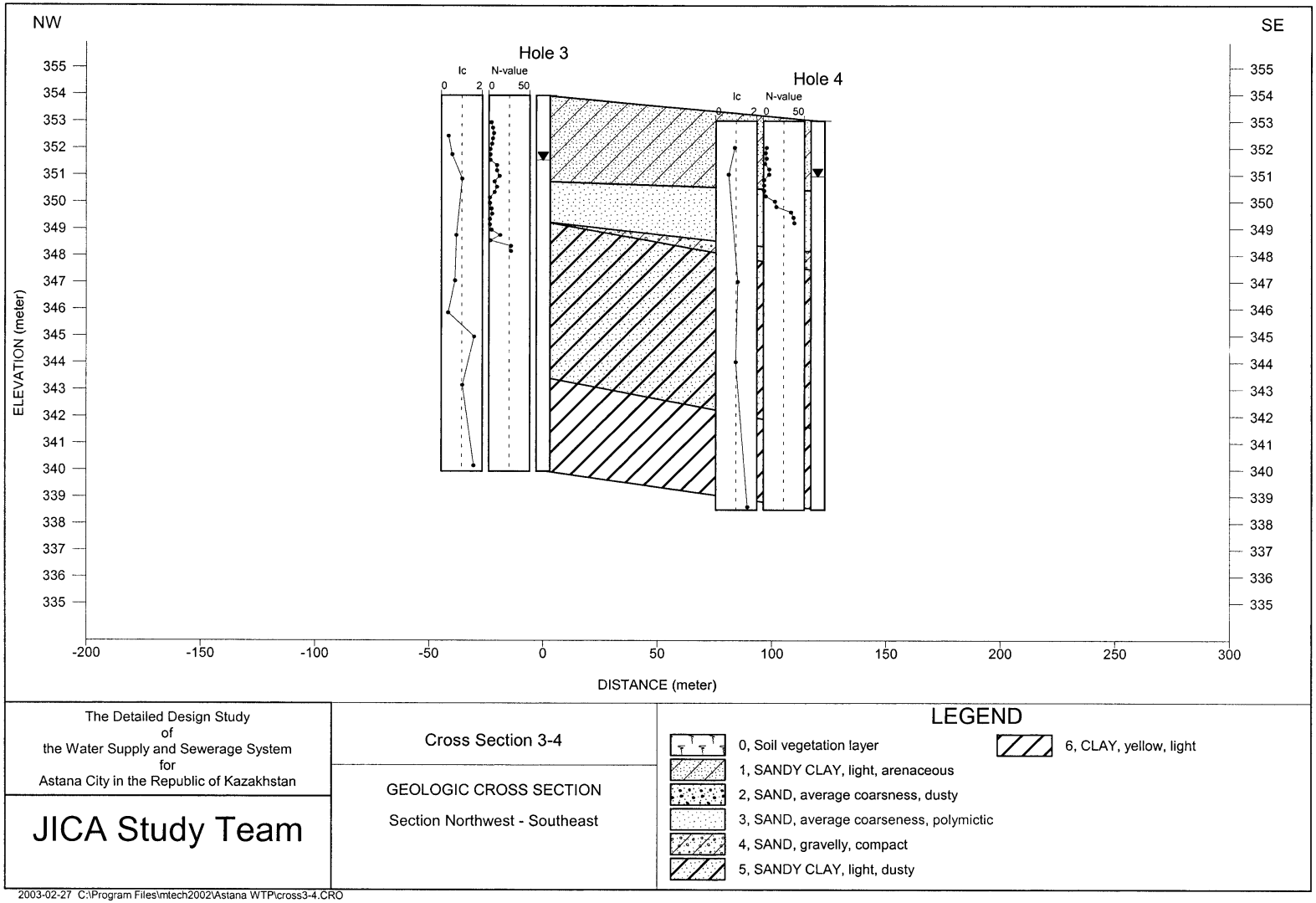

Figure 2(4) Geological Cross Section at Water Treatment Plant (4/9, Line No. 3-4)

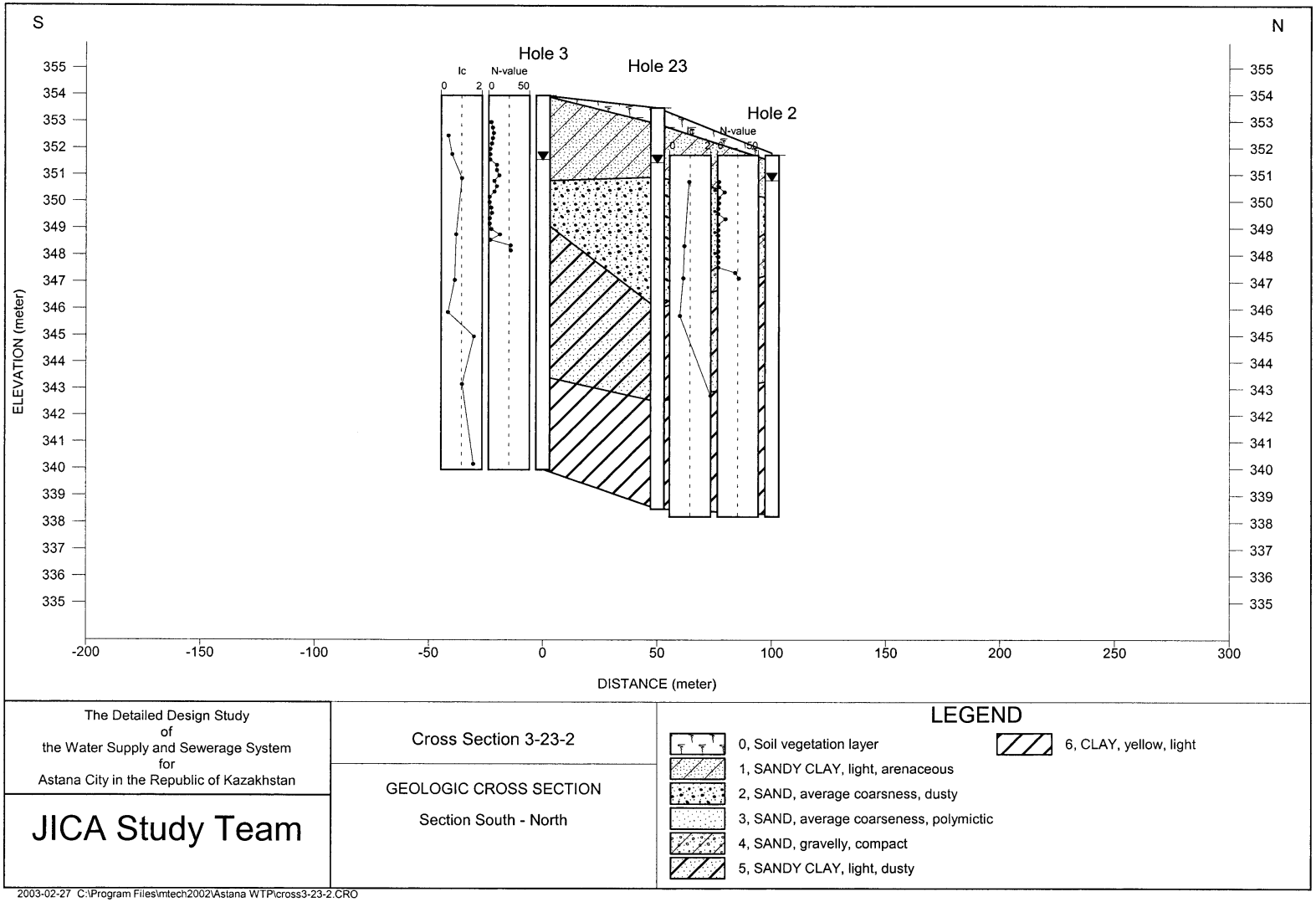

Figure 2(5) Geological Cross Section at Water Treatment Plant (5/9, Line No. 3-23-2)

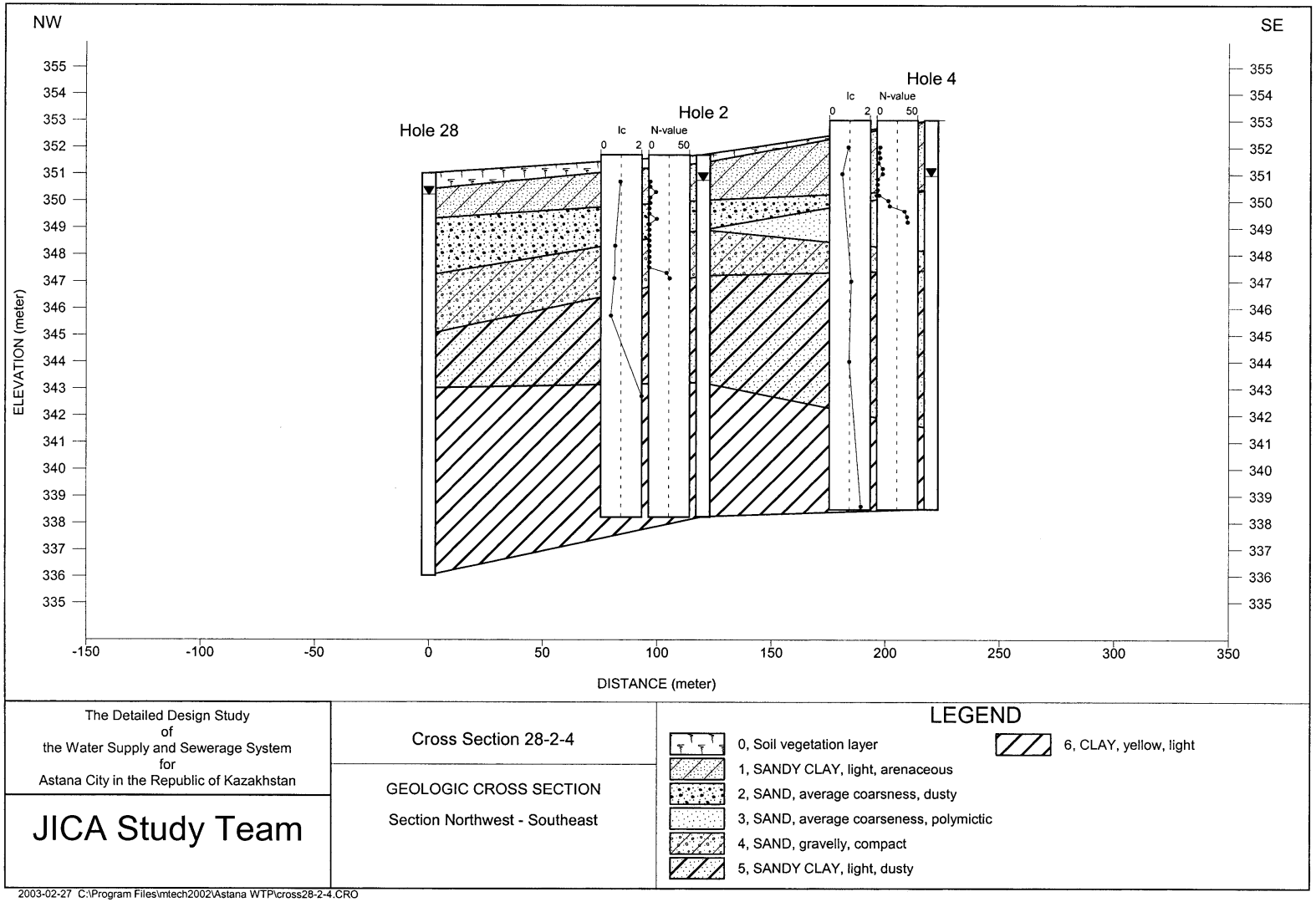

Figure 2(6) Geological Cross Section at Water Treatment Plant (6/9, Line No. 28-2-4)

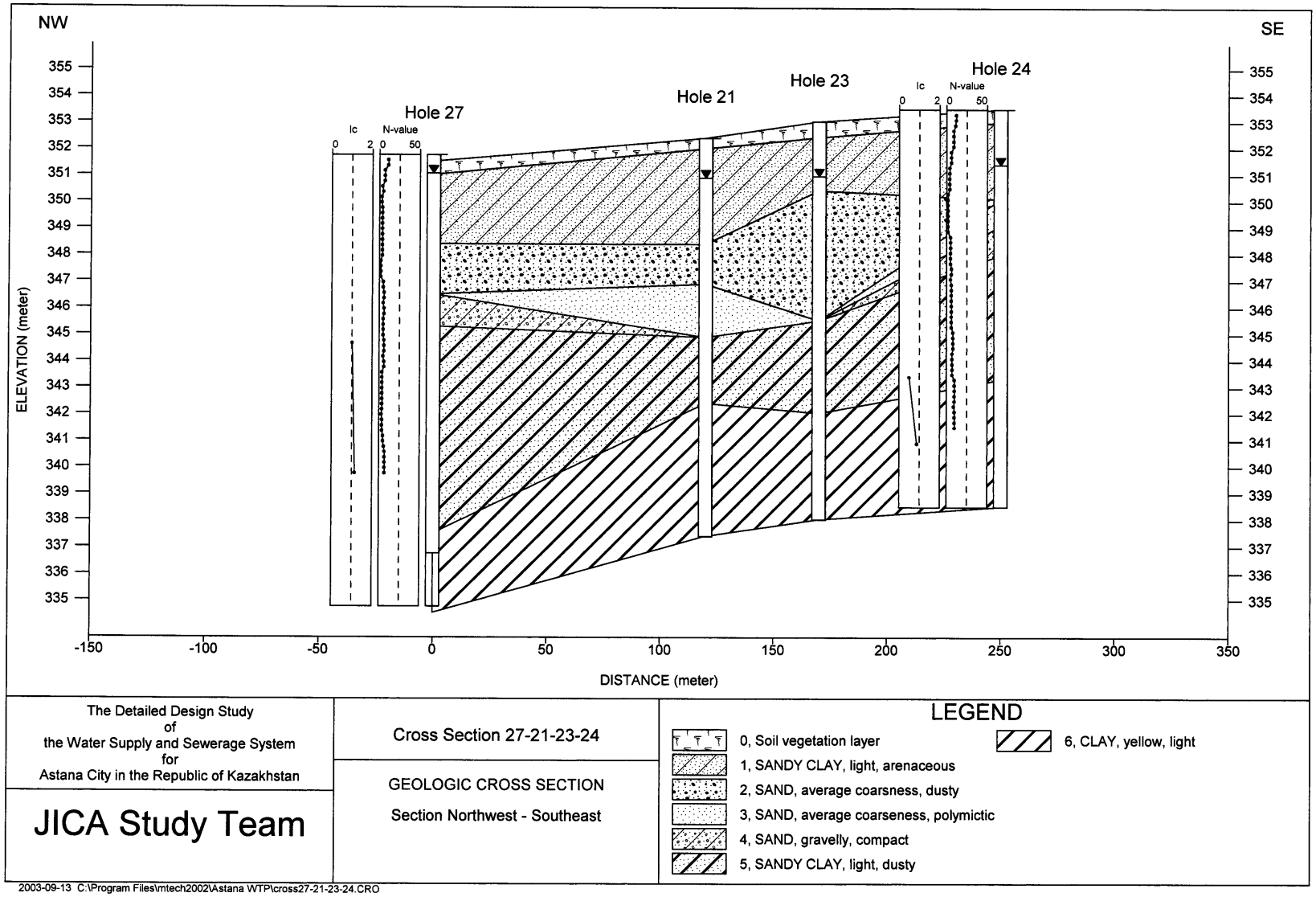

Figure 2(7) Geological Cross Section at Water Treatment Plant (7/9, Line No. 27-21-23-24)

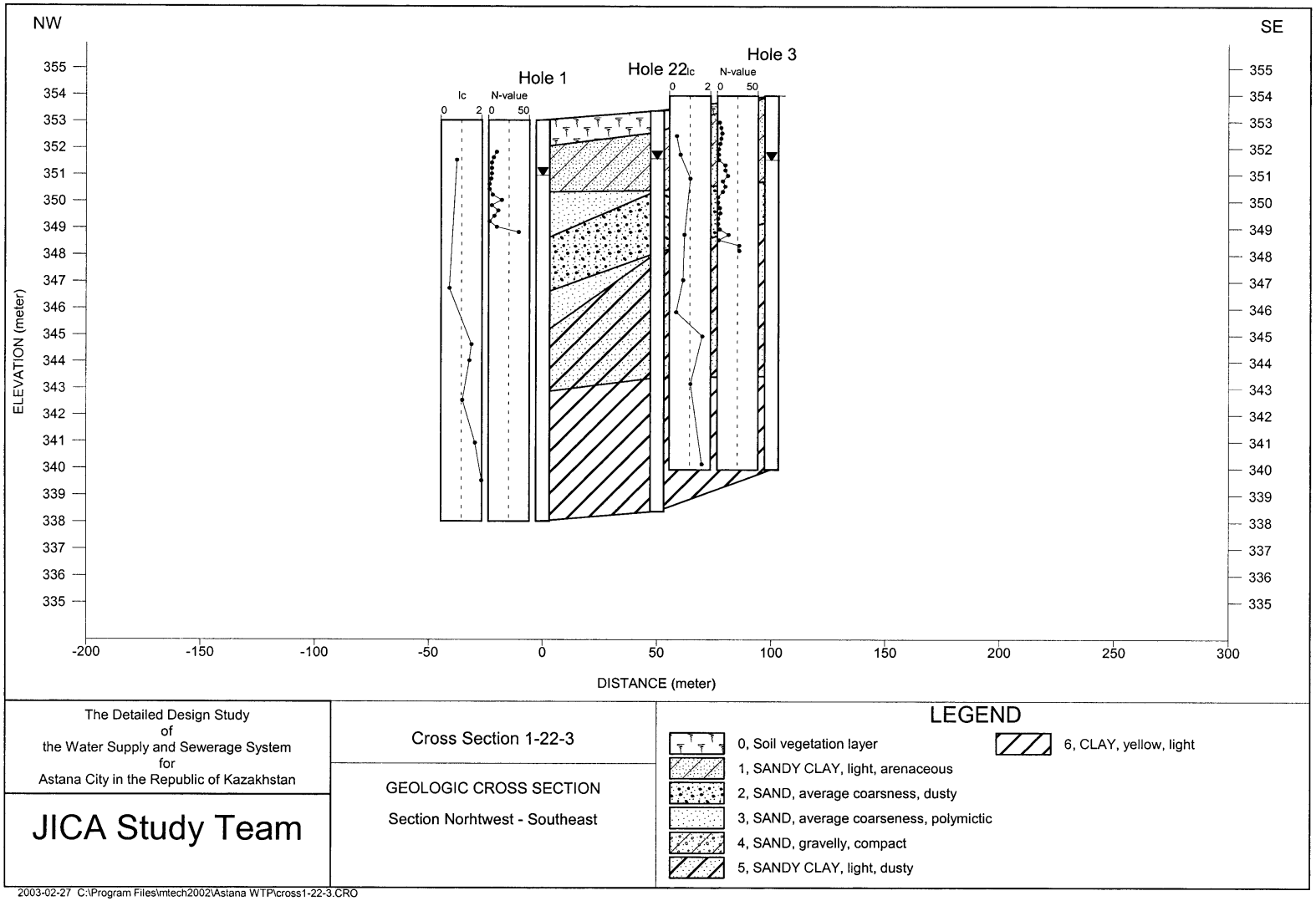

Figure 2(8) Geological Cross Section at Water Treatment Plant (8/9, Line No. 1-22-3)

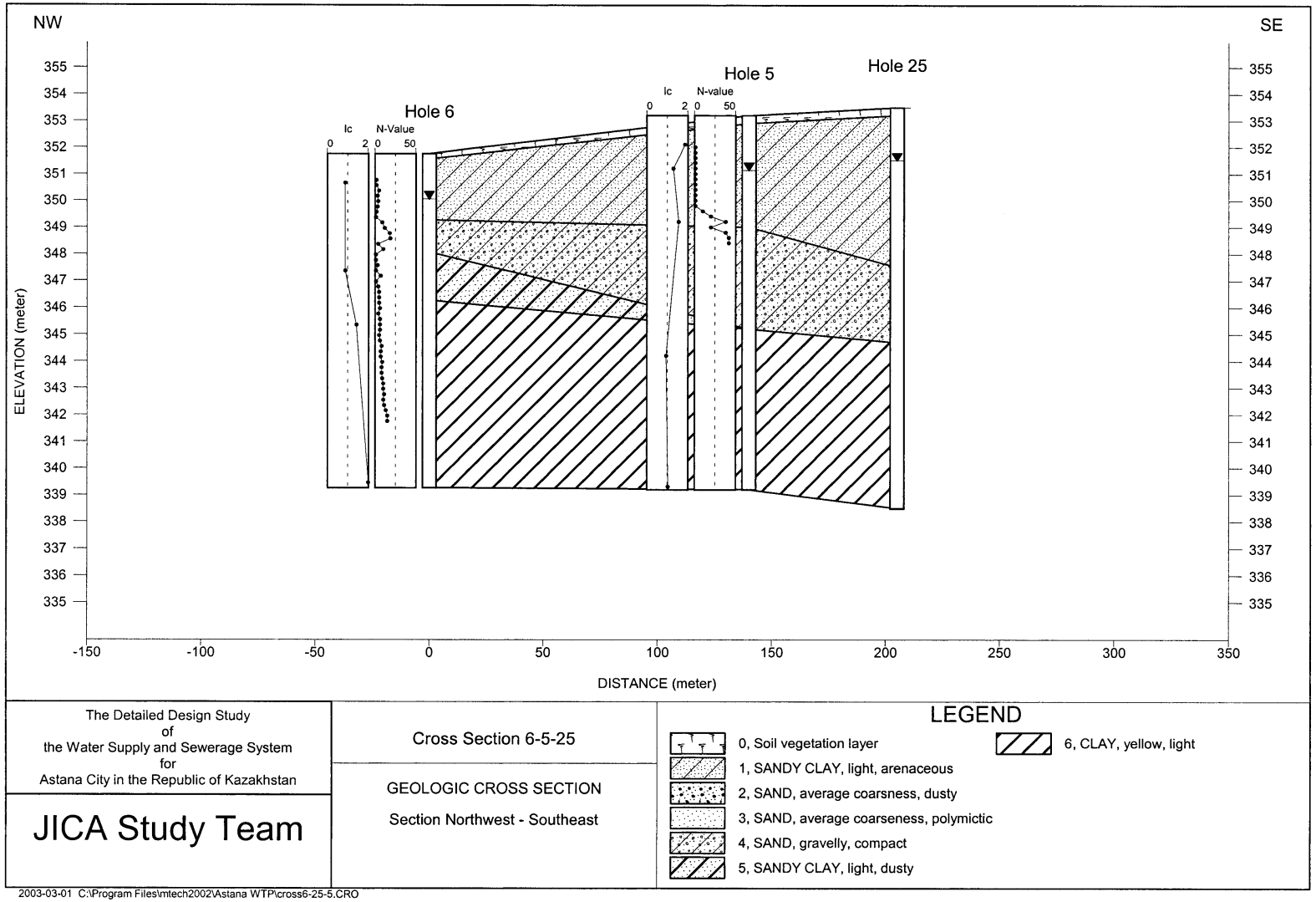

Figure 2(9) Geological Cross Section at Water Treatment Plant (9/9, Line No. 6-5-25)

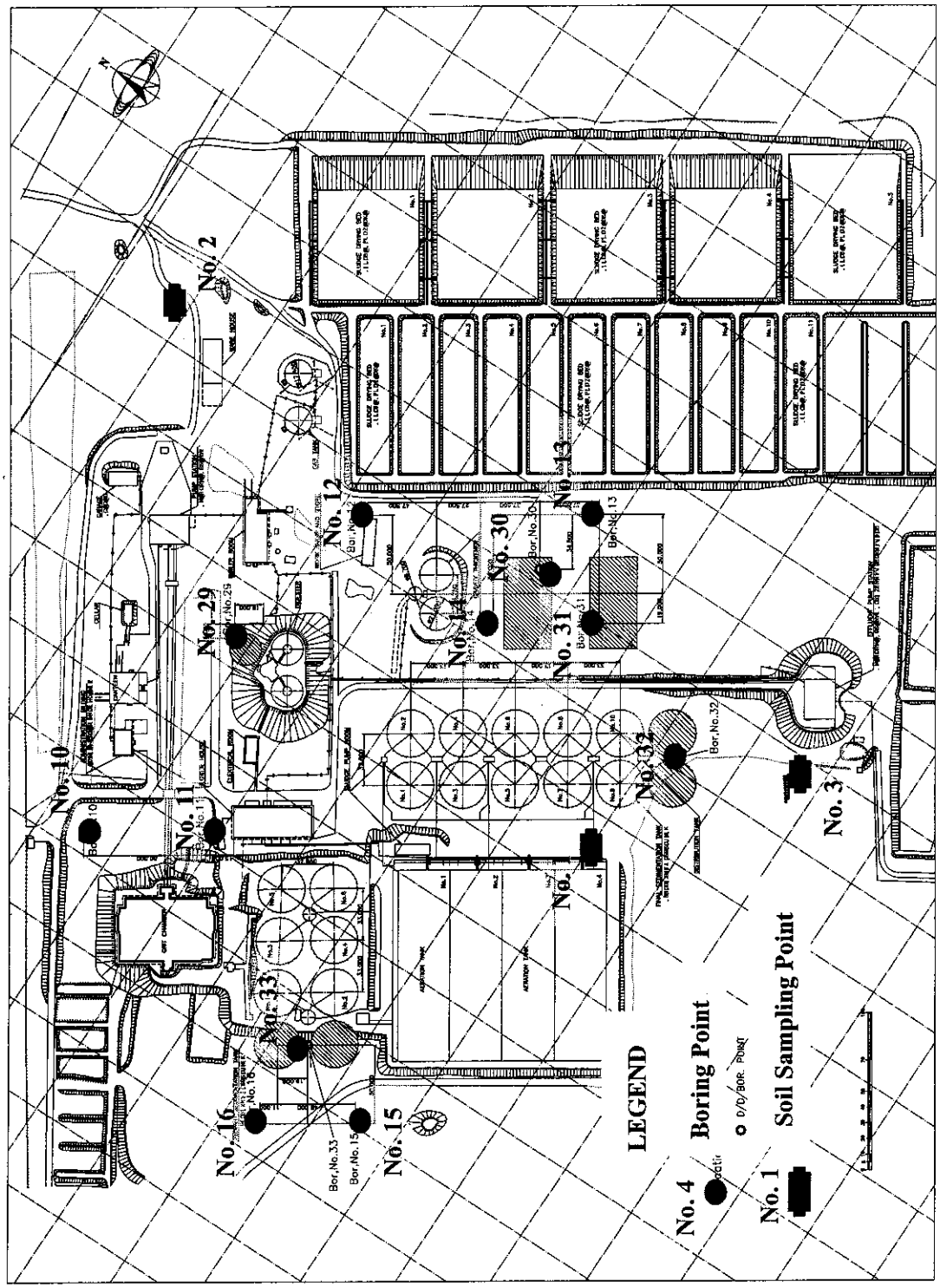

Figure 3 Location Map of Boring Points at Sewerage Treatment Plant (STP)

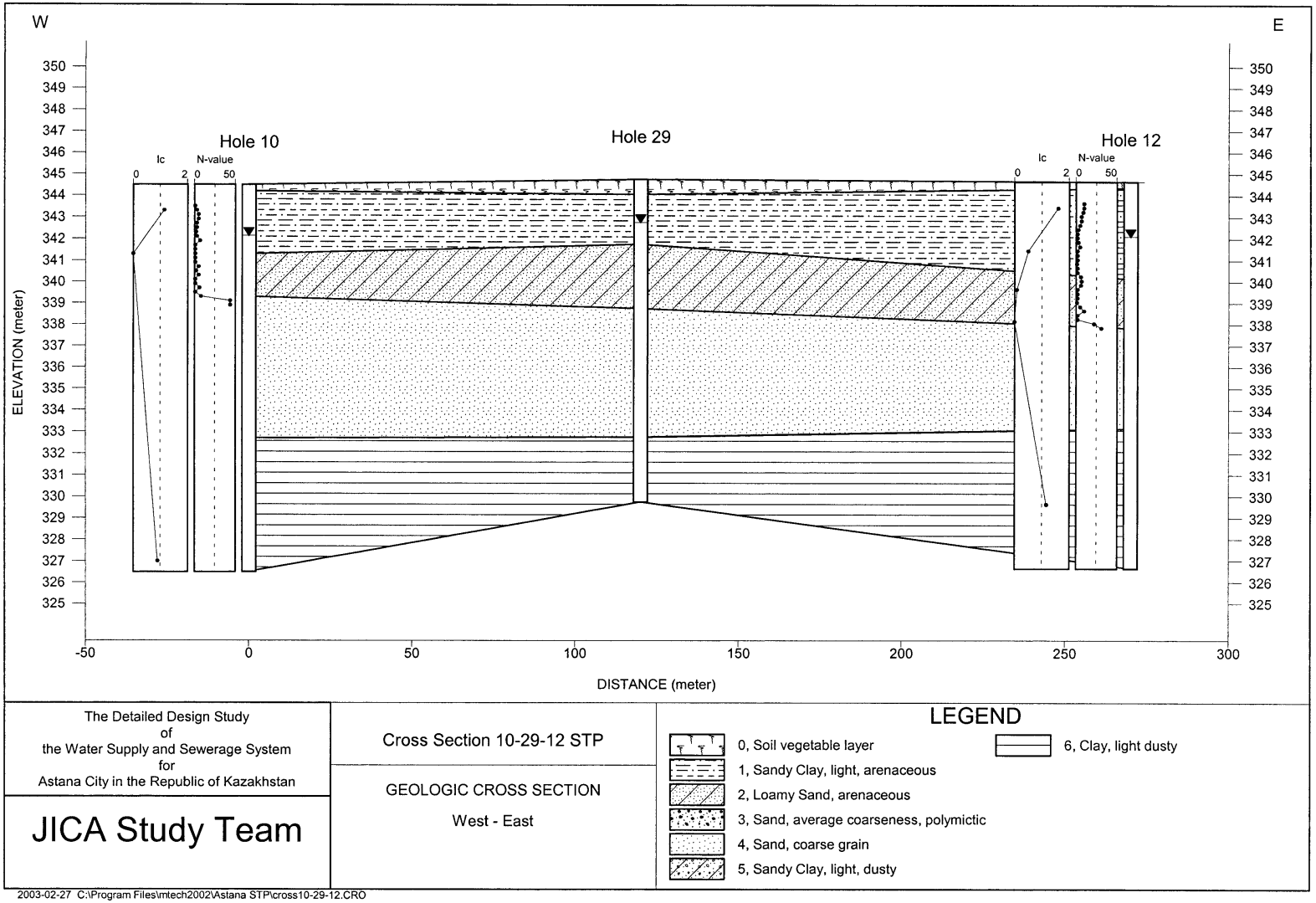

Figure 4 (1) Geological Cross Section at Sewerage Treatment Plant (1/9, Line No. 10-29-12)

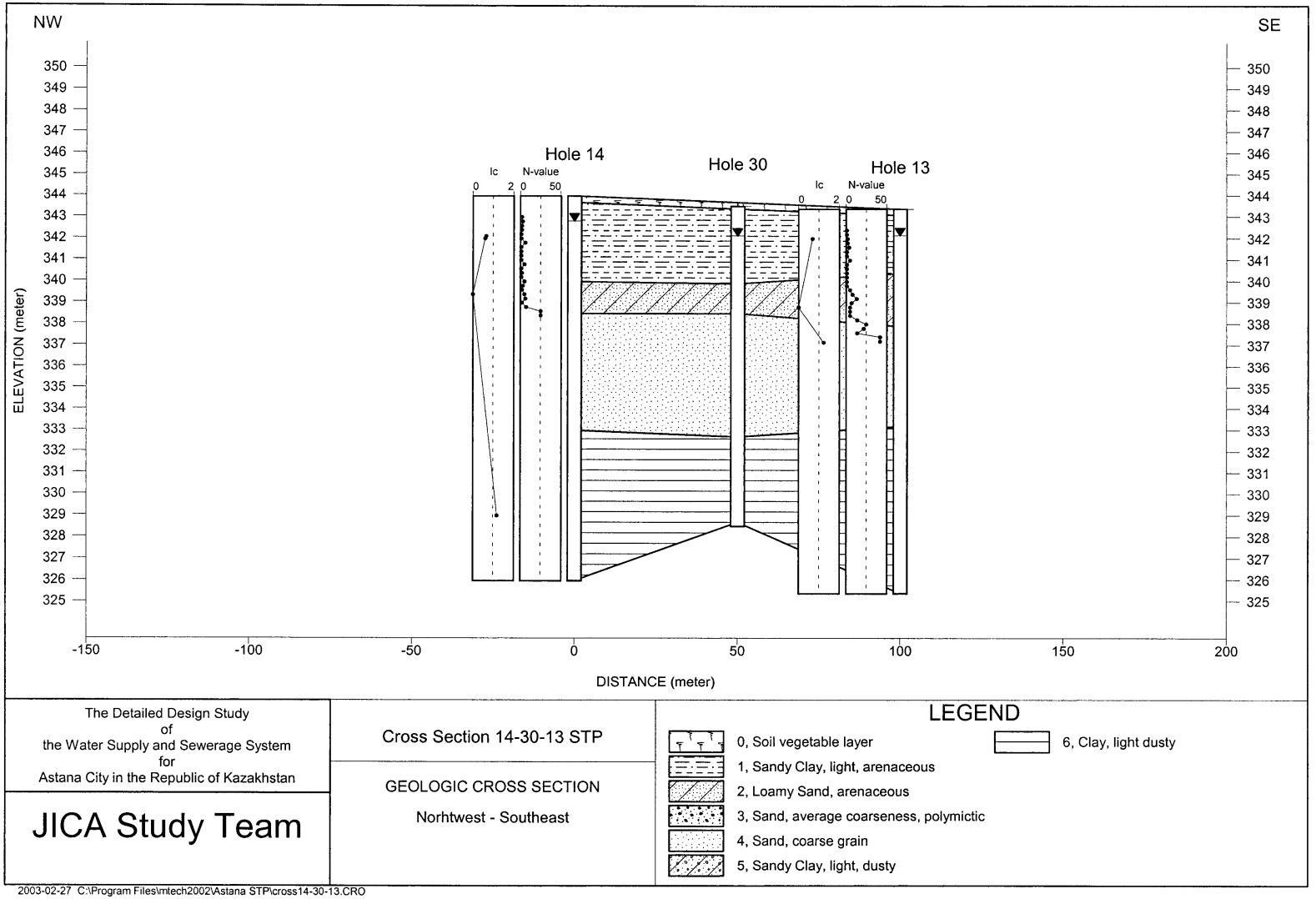

Figure 4(2) Geological Cross Section at Sewerage Treatment Plant (2/9, Line No. 14-30-13)

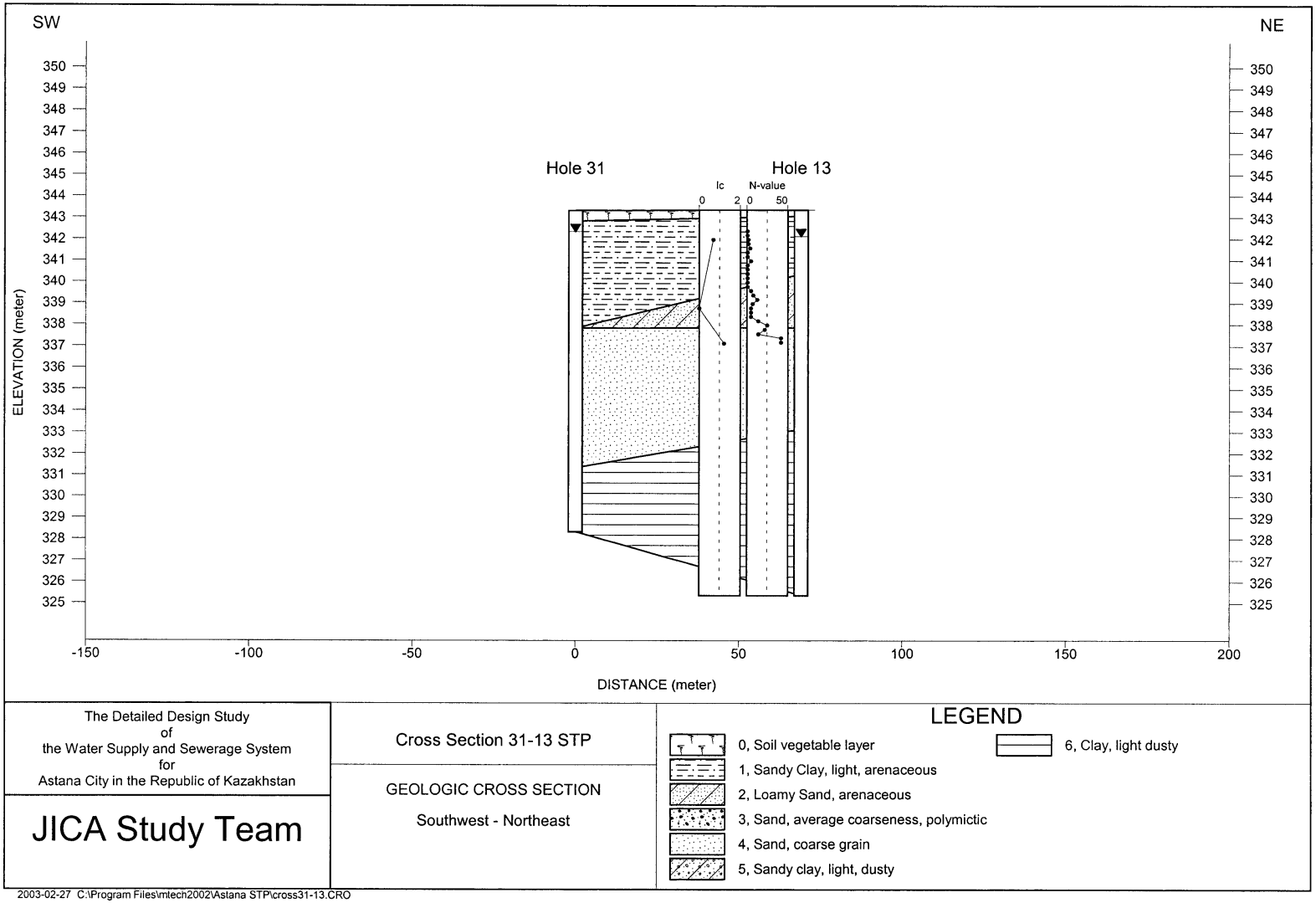

Figure 4(3) Geological Cross Section at Sewerage Treatment Plant (3/9, Line No. 31-13)

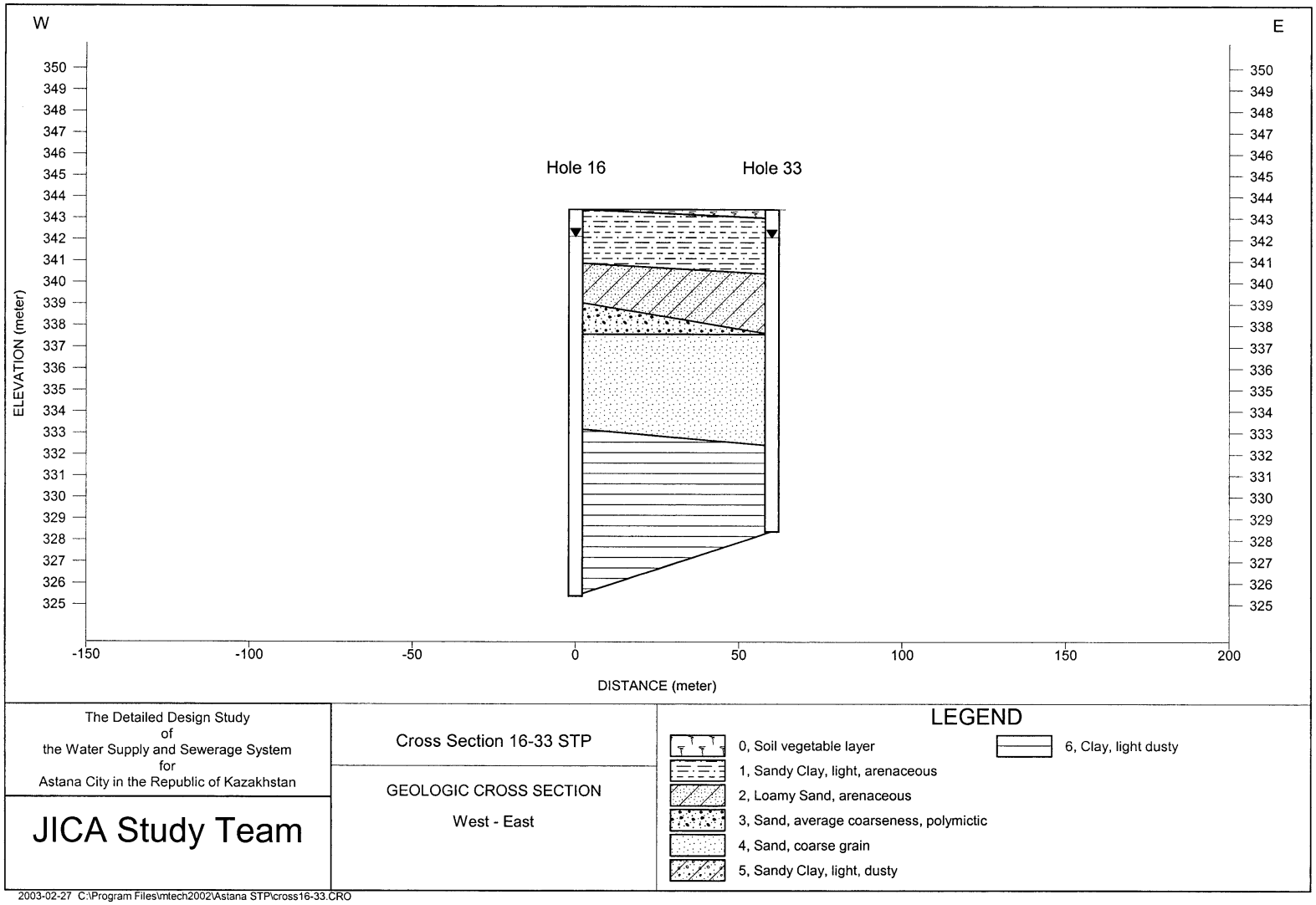

Figure 4(4) Geological Cross Section at Sewerage Treatment Plant (4/9, Line No. 16-33)

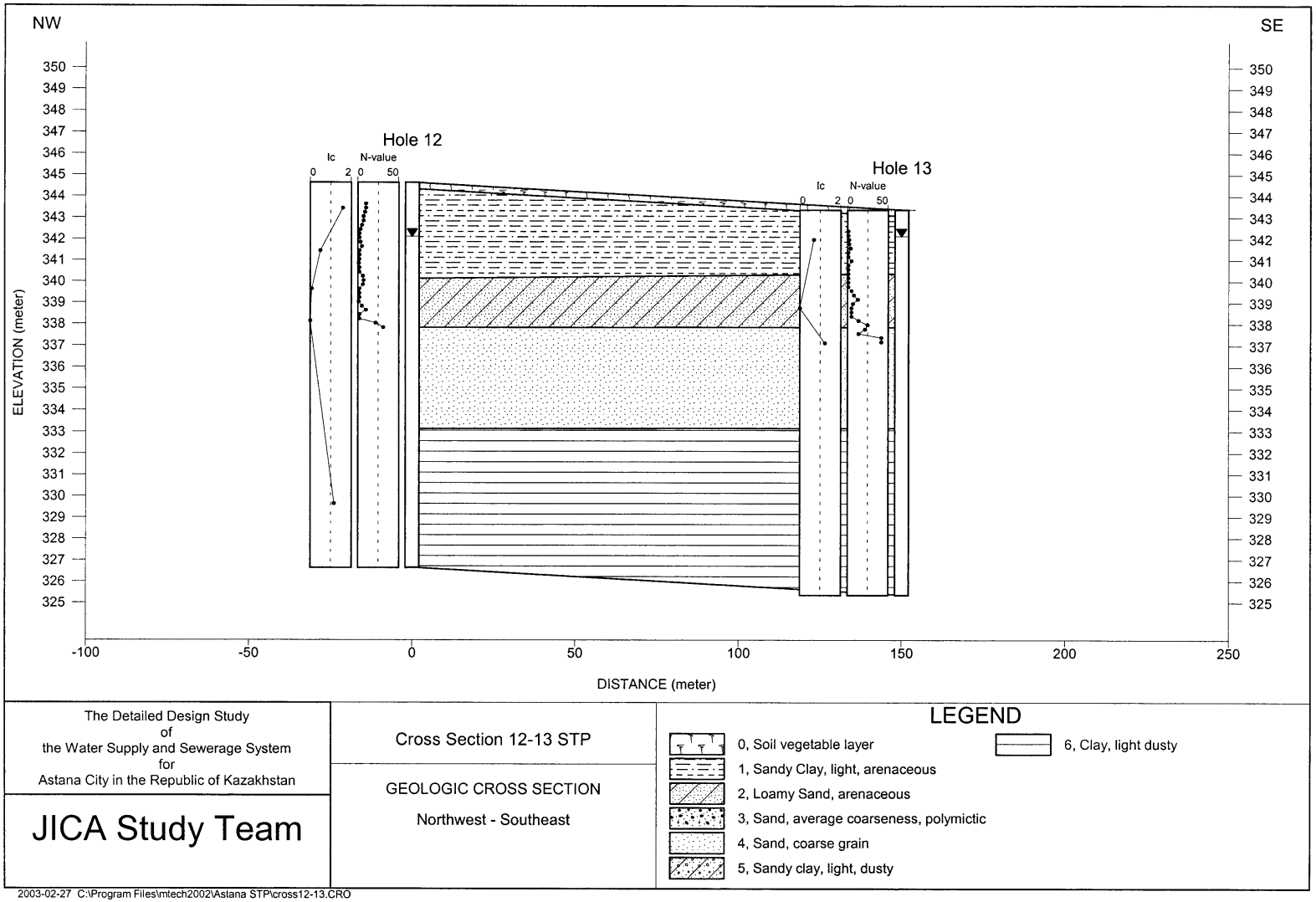

Figure 4(5) Geological Cross Section at Sewerage Treatment Plant (5/9, Line No. 12-13)

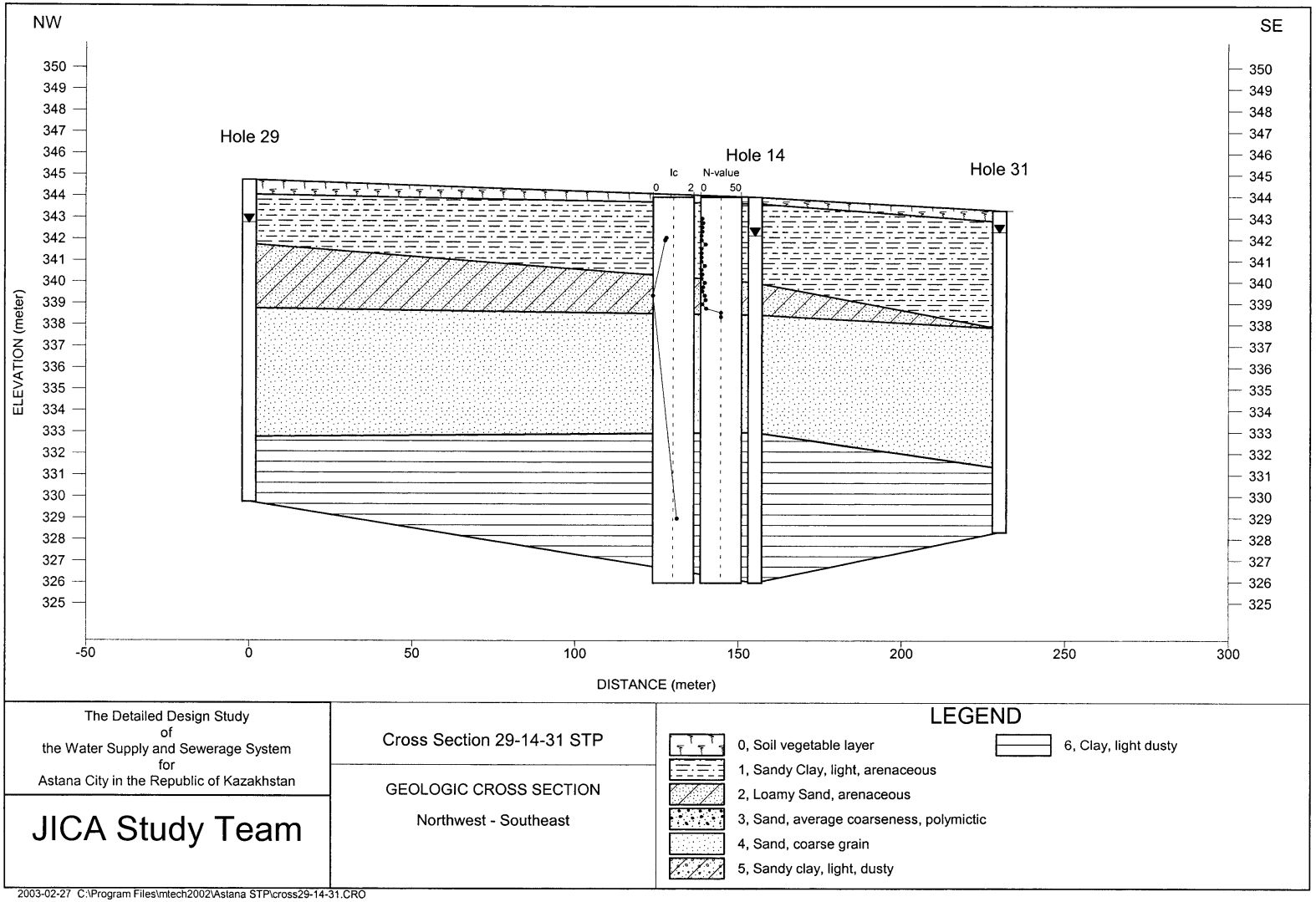

Figure 4(6) Geological Cross Section at Sewerage Treatment Plant (6/9, Line No. 29-14-31)

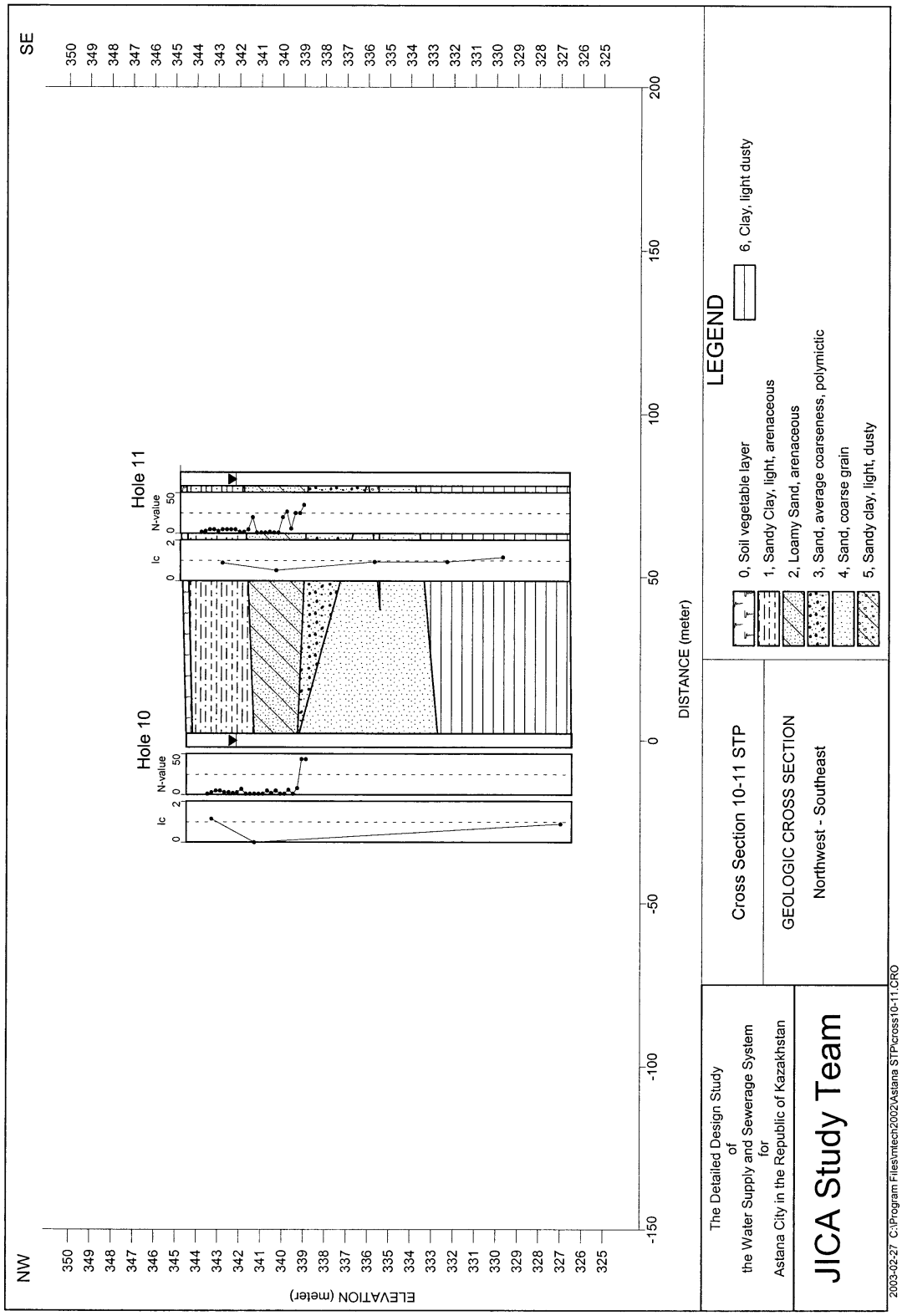

Figure 4(7) Geological Cross Section at Sewerage Treatment Plant (7/9, Line No. 10-11)

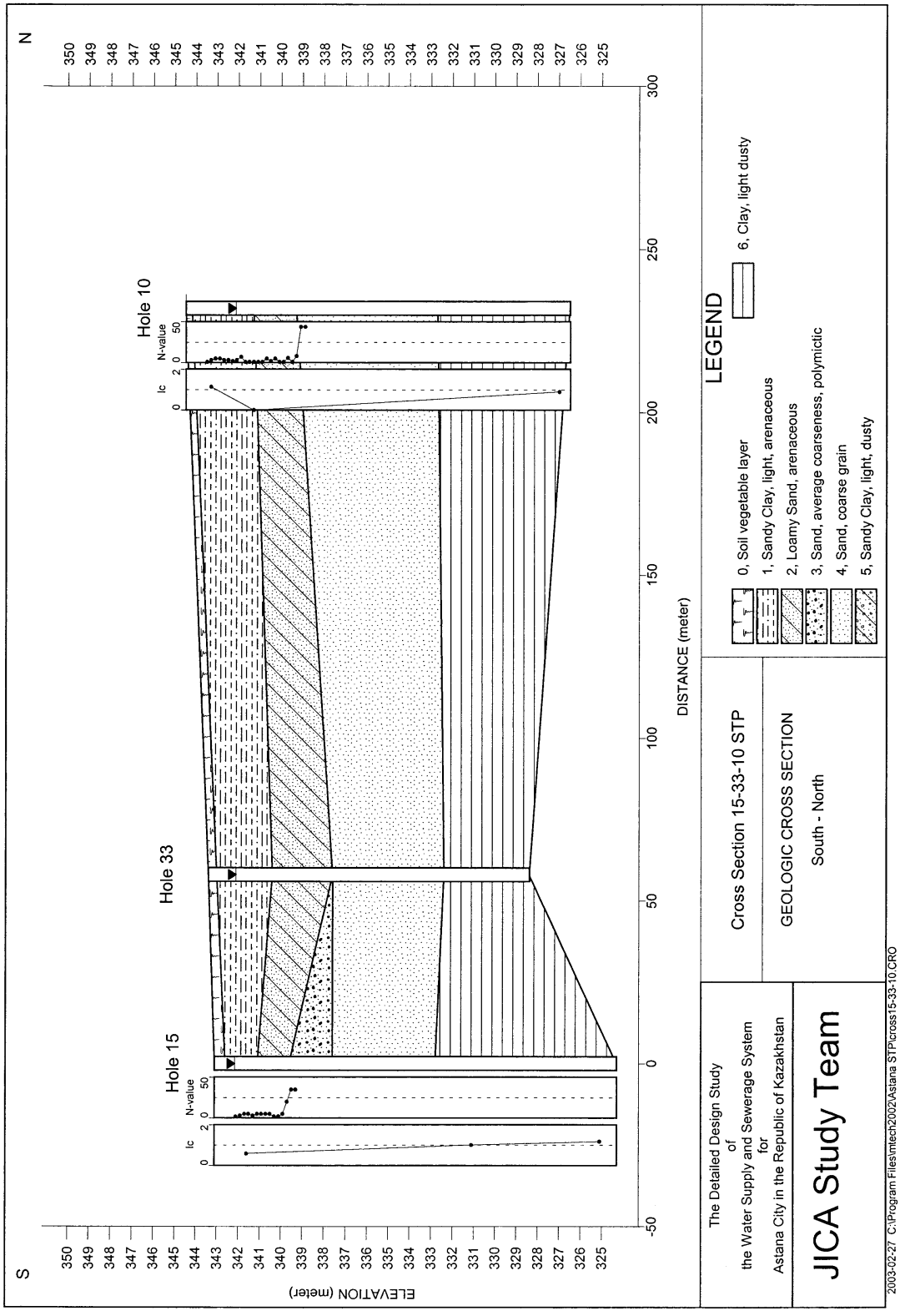

Figure 4(8) Geological Cross Section at Sewerage Treatment Plant (8/9, Line No. 15-33-10)

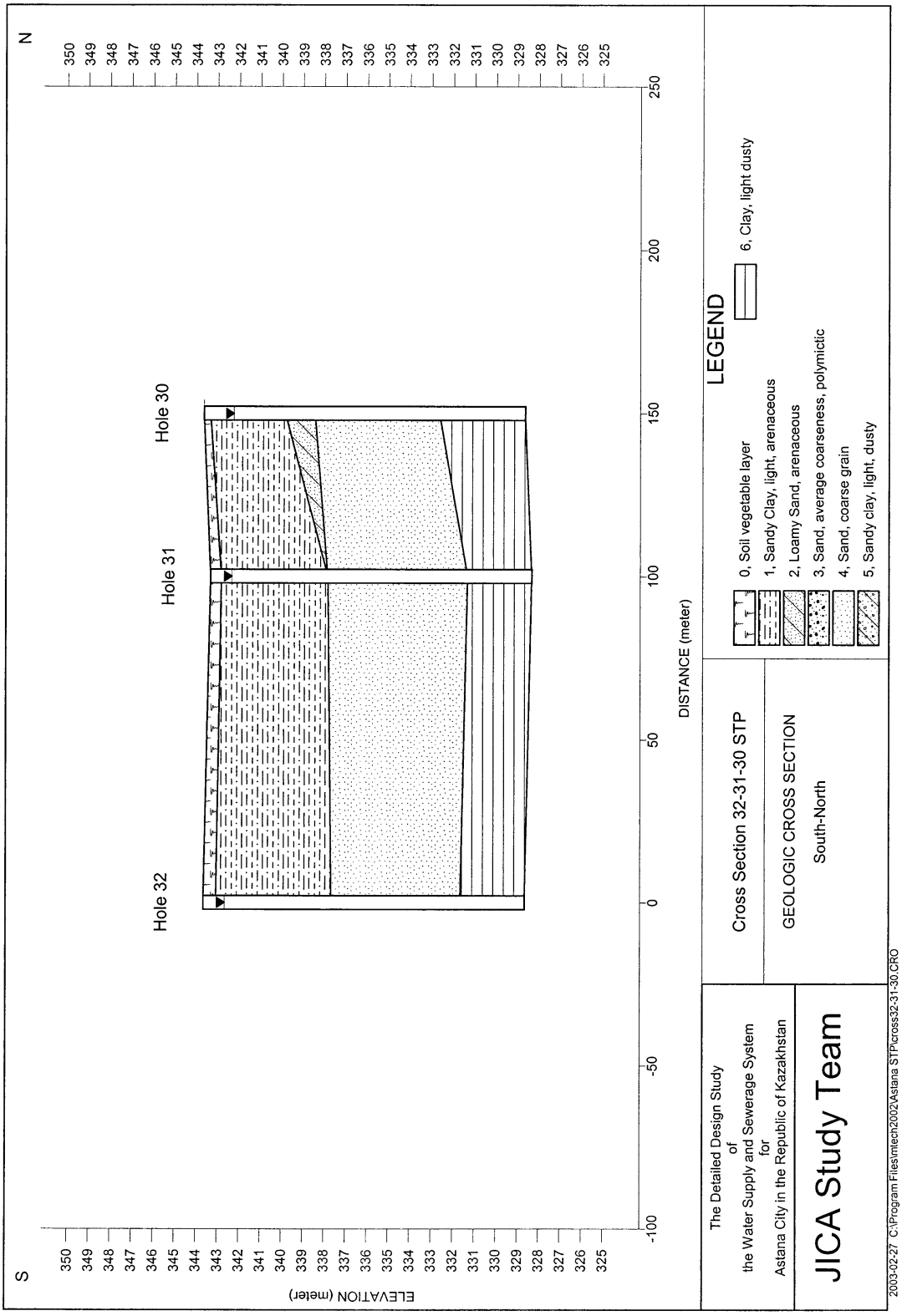

Figure 4(9) Geological Cross Section at Sewerage Treatment Plant (9/9, Line No. 32-31-30)

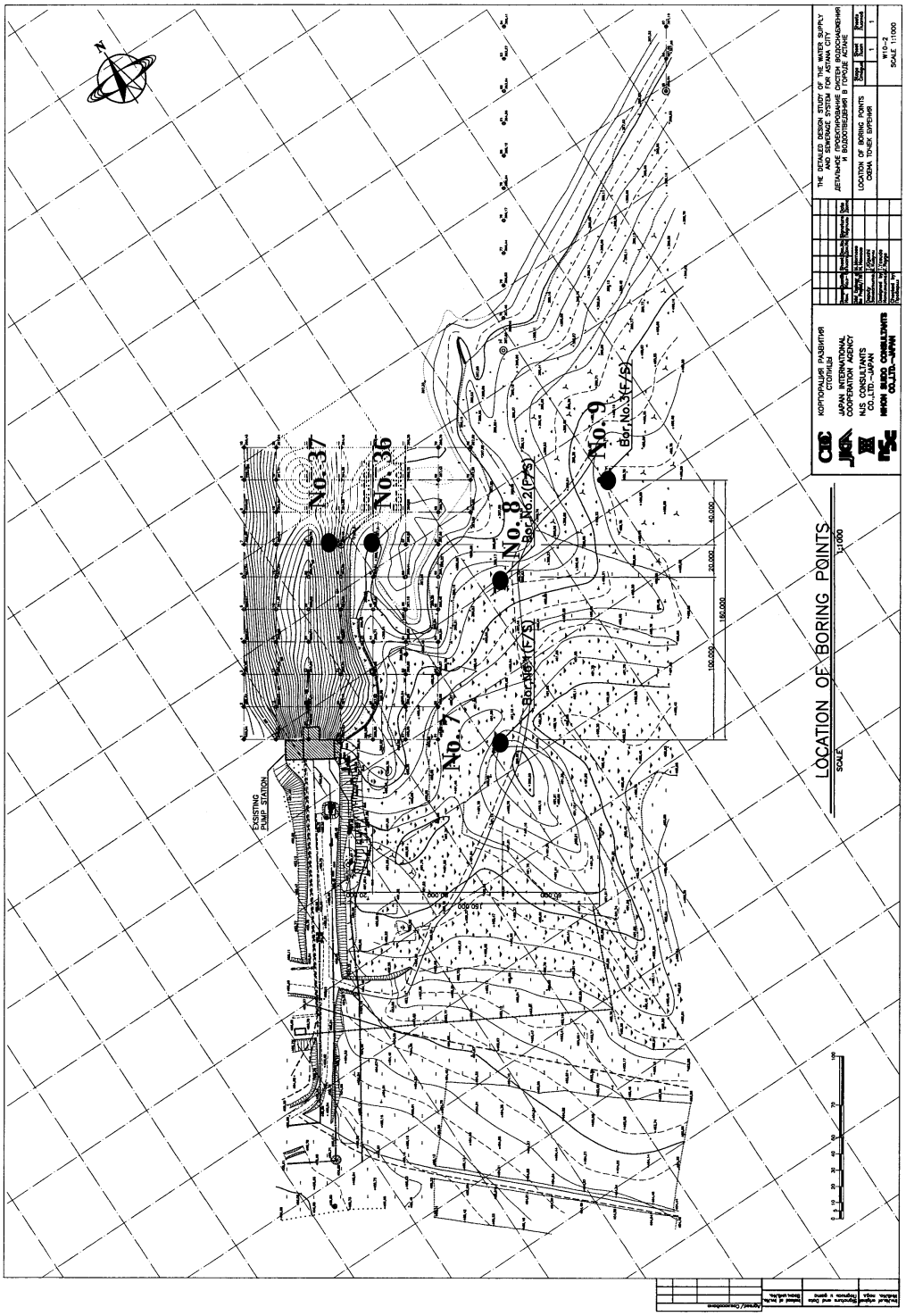

Figure 5 Location Map of Boring Points at Water Intake (Vyacheslavsky Reservoir)

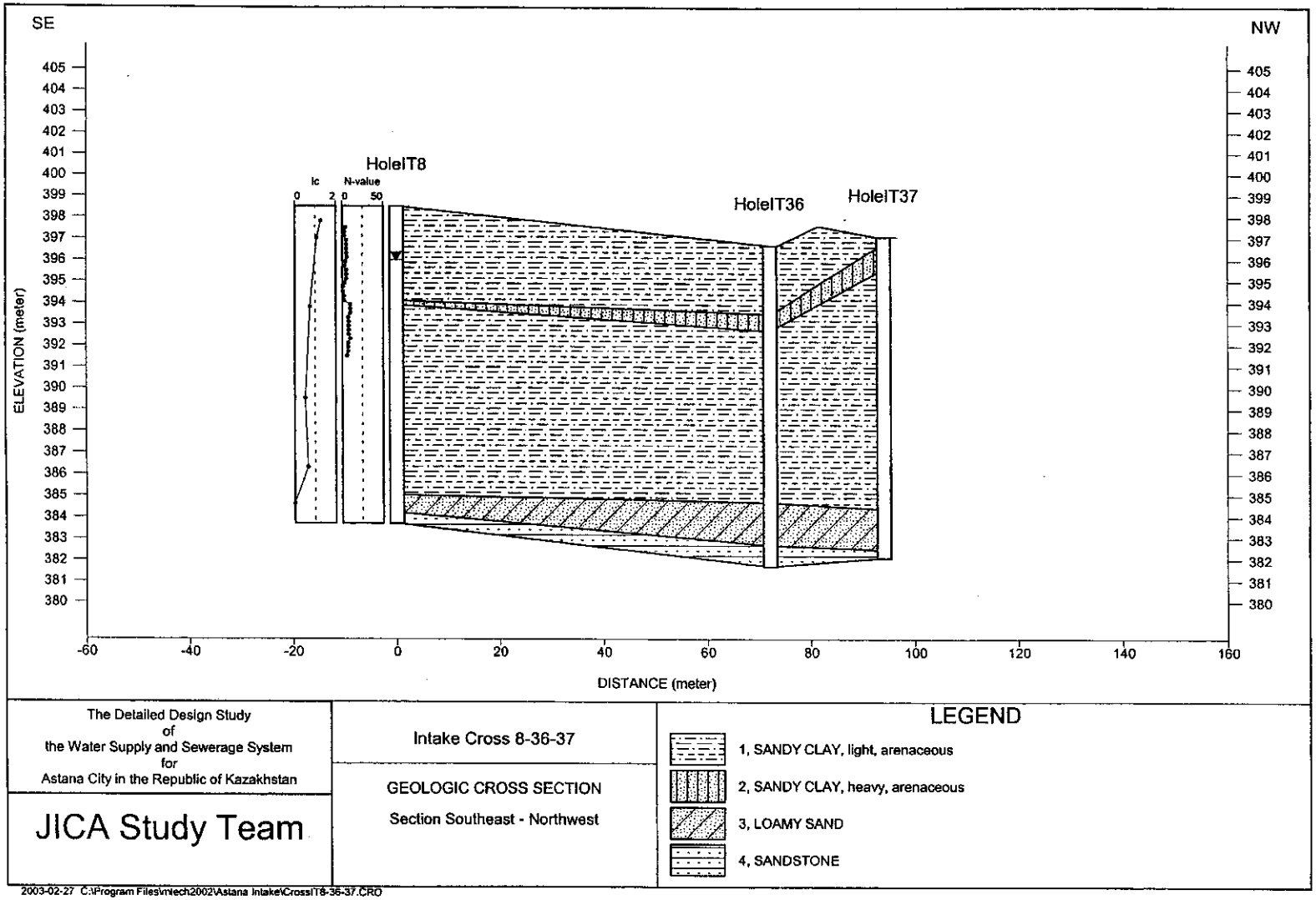

Figure 6 (1) Geological Cross Section at Water Intake Tower (1/3, Line No. 8-36-37)

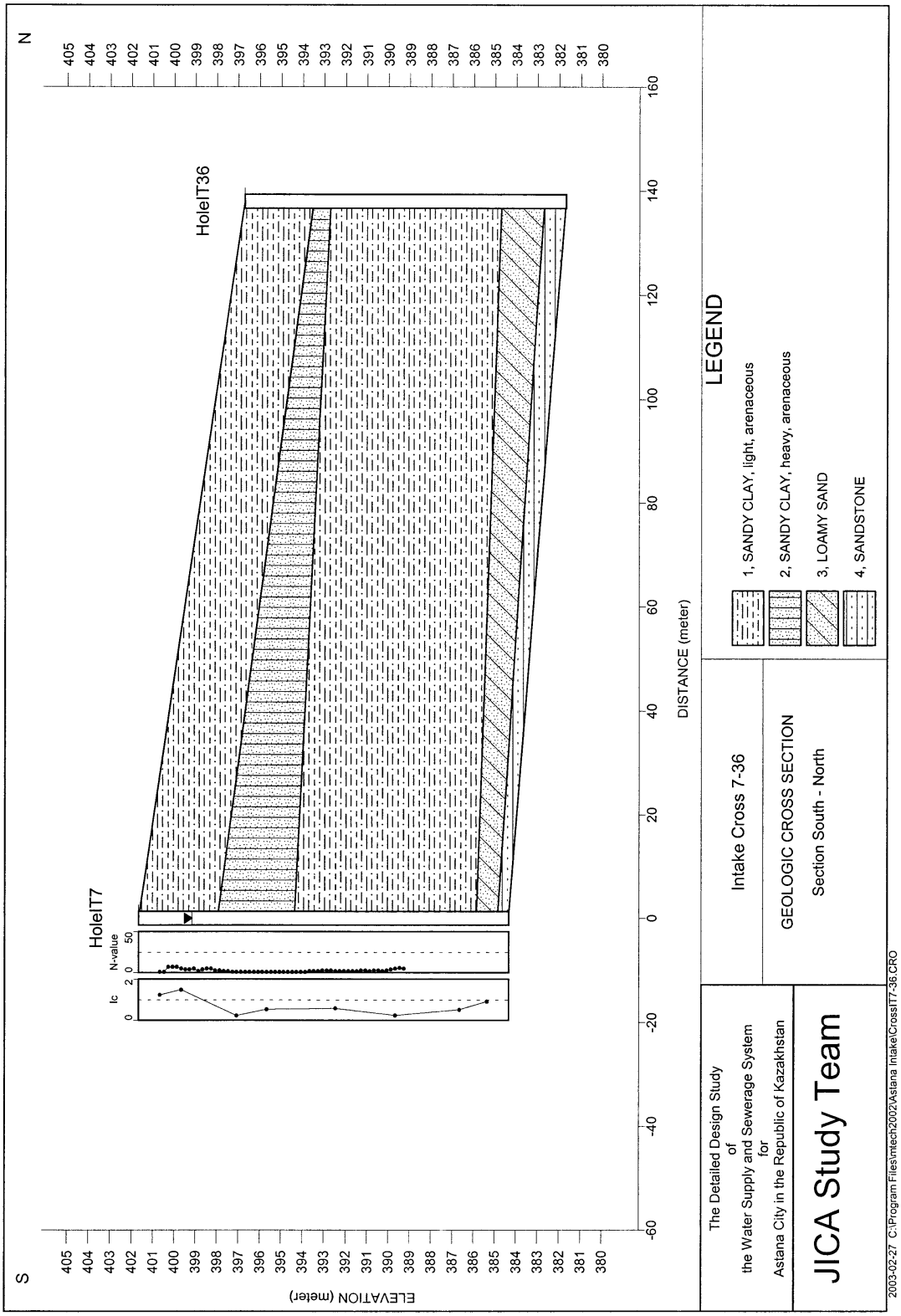

Figure 6(2) Geological Cross Section at Water Intake Tower (2/3, Line No. 7-36)

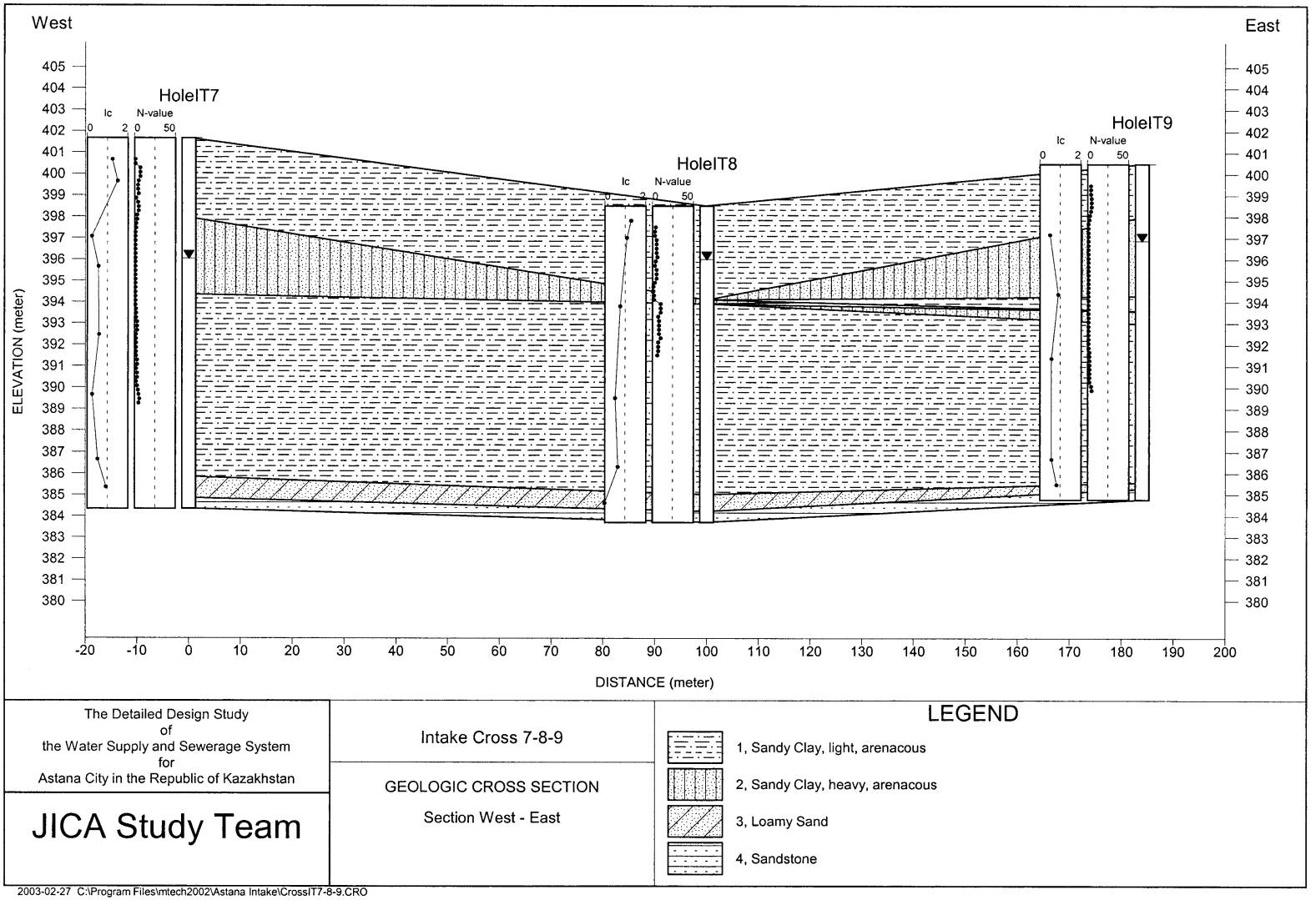

Figure 6(3) Geological Cross Section at Water Intake Tower (3/3, Line No. 7-8-9)

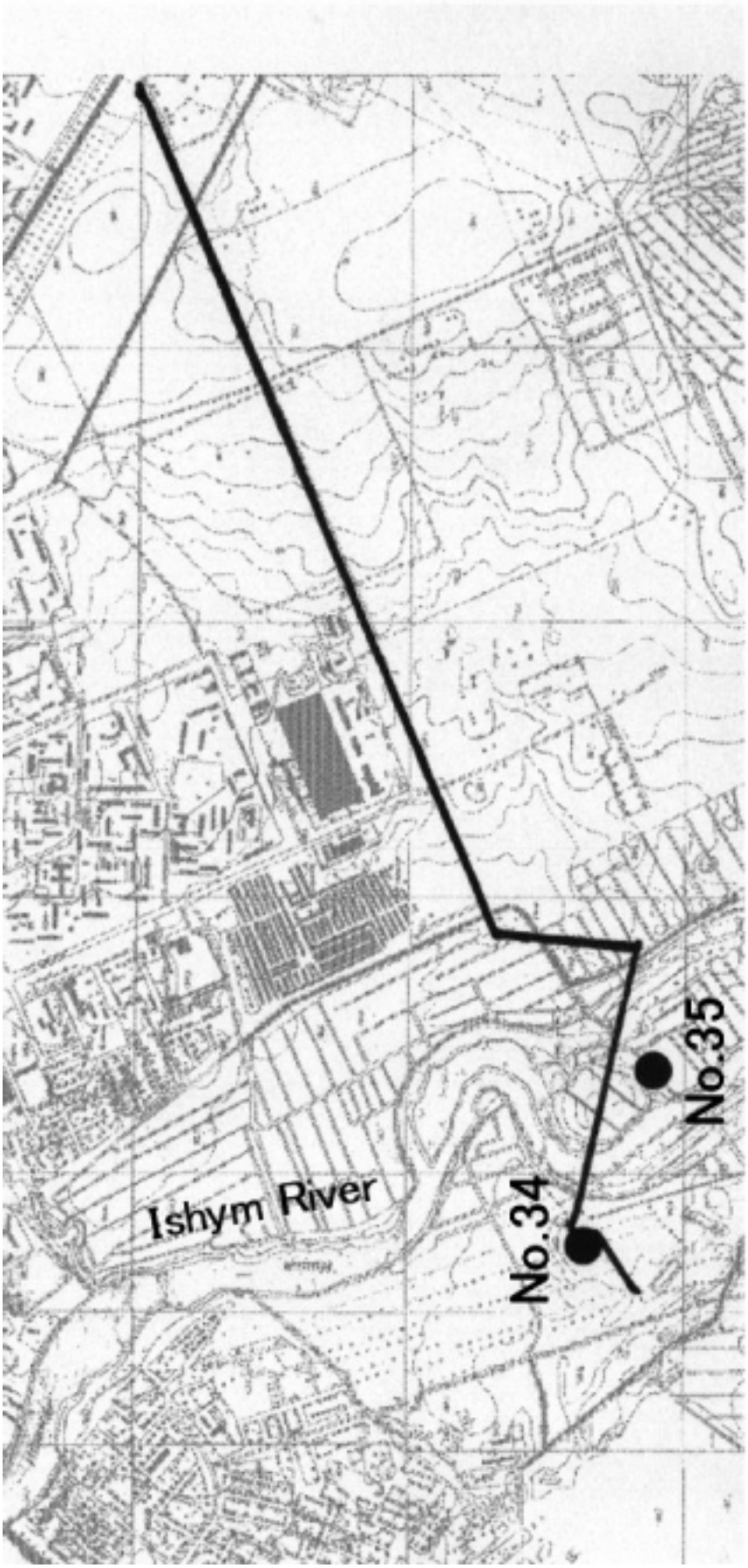

Figure 7 Location Map of Boring Points at Ishym River

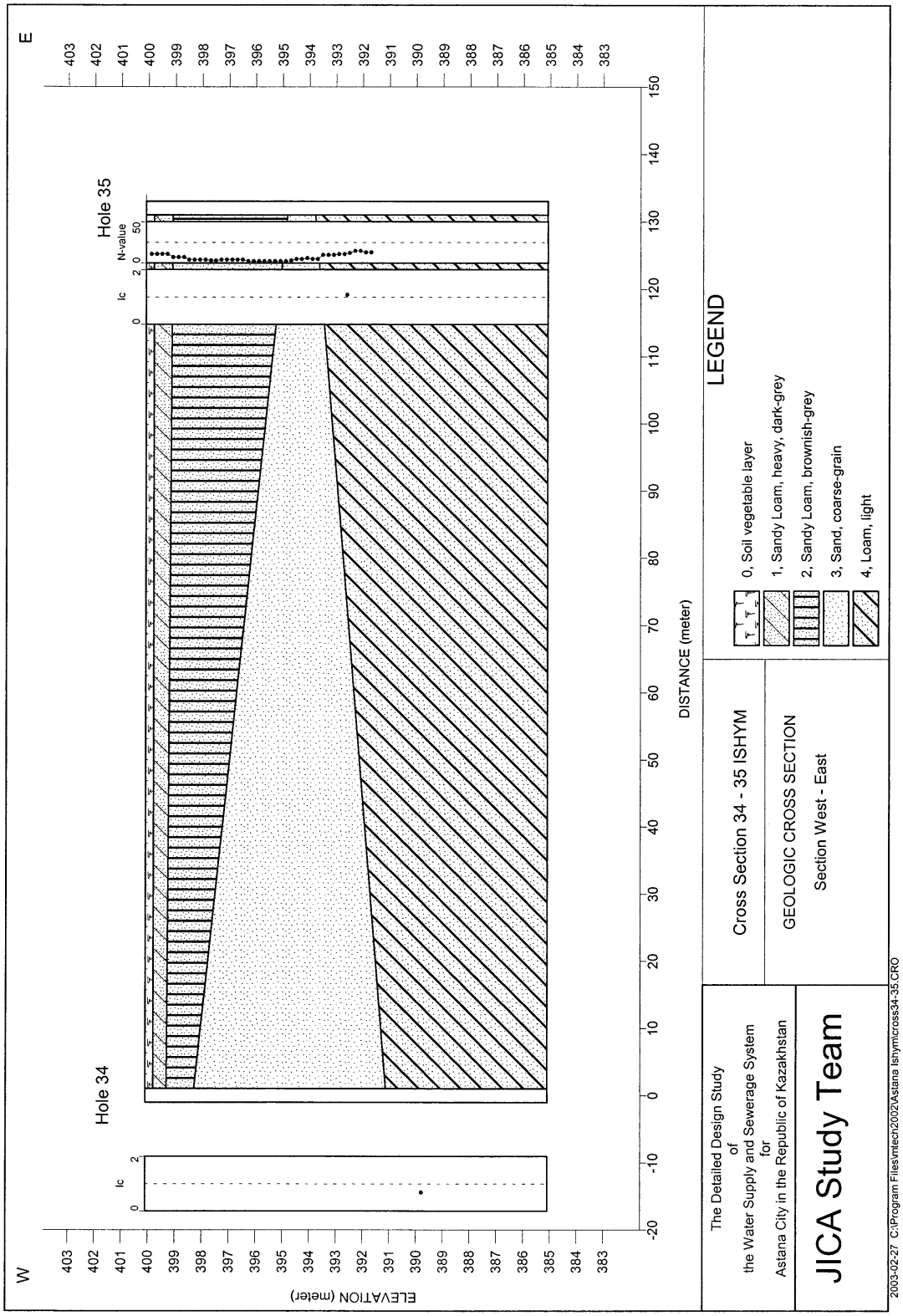

Figure 8 Geological Cross Section at Ishym River (1/1 Line No. 34-35)

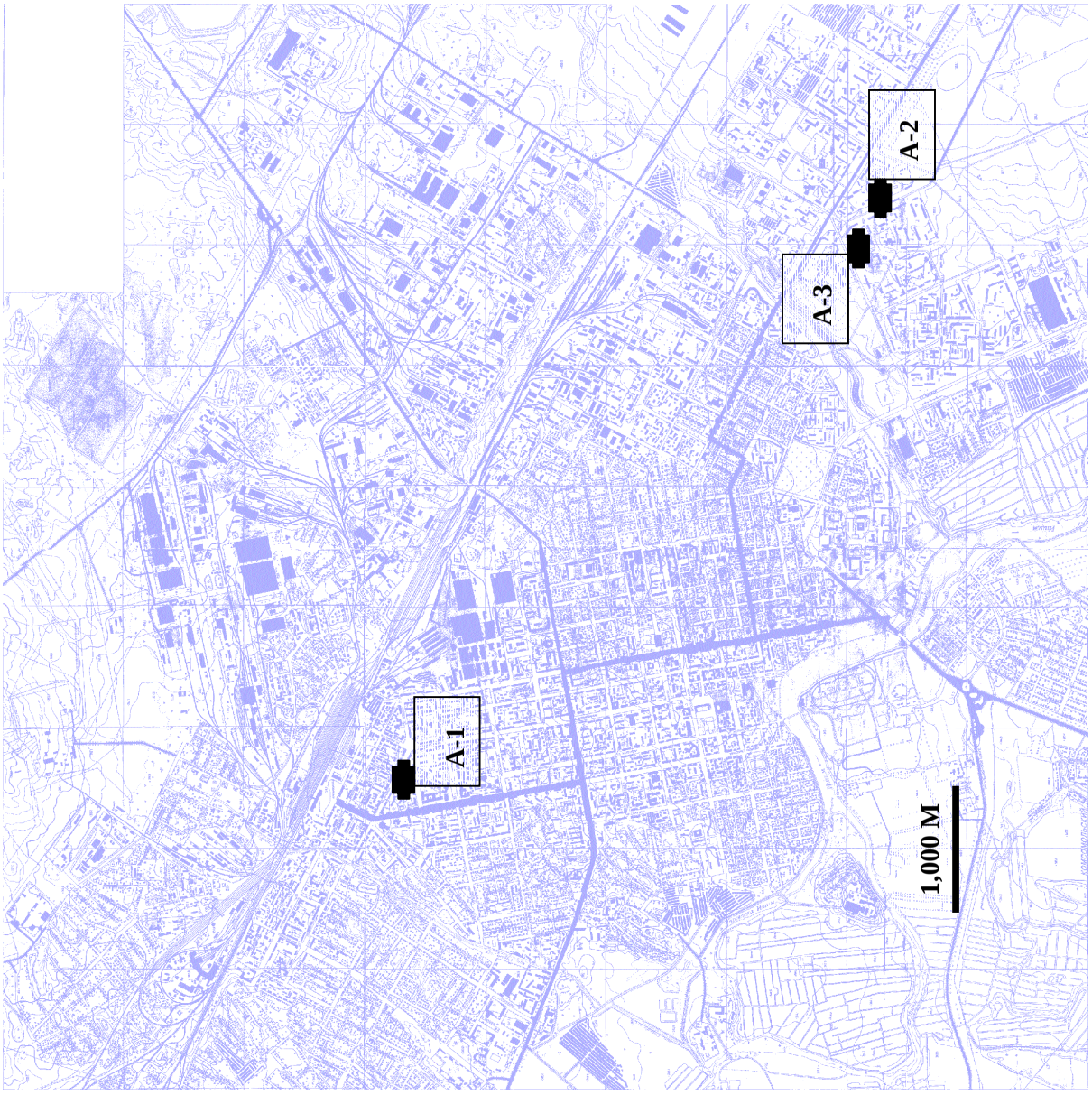

Figure 9 Location Map of Soil Sample Taken for Corrosion Test

Annex A(1) Result of Test for Physical Properties (WTP)

			Grain Size														Plastisity %						Solidity						
Lob. No.	Hole No.	Depth of Sampling	> 70	70-40	40-20	20-10	10-5	5-2	2.0-0.25	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.005	0.25-0.05	< 0.05	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index (relative water content)	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation	Coefficient of Permeability	Geology
		m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm								g/cm^3	g/cm^3			m/day	
																	WL	WP	IP	W	IL	Ic	Gs(ρ s)	ρ	ρ d	e	Sr	k	
475	1	1.5	0	0	0	0	0	0	6.7	0	0	0	0	0	16.7	76.7	28	16	12	19	0.225	0.775	2.72	2.037	1.716	0.585	0.869	-	light dusty sandy clay
476	1	1.0-2.7	0	0	0	3	3	2	11	0	0	0	0	0	26	55	22	14	8	-	-1.75	-	2.72	-	-	-	-	-	
477	1	3.0-4.5	0	0	0	4	2	5	0	9	23	14	24	3	0	16	-	-	-	-	-	-	2.7	-	-	-	-	0.6	middle coarseness sand
478	1	5.0-6.0	0	0	0	0	1	2	0	3	12	27	26	2	0	27	-	-	-	-	-	-	2.7	-	-	-	-	0	dusty sand
479	1	6.0-6.5	0	0	0	0	0	0	0	1	17	30	17	1	0	34	-	-	-	-	-	-	2.7	-	-	-	-	0.5	dusty sand
480	1	6.0-6.5	0	0	0	0	0	0	23.3	0	0	0	0	0	20	56.7	28	17	11	24	0.586	0.409	2.72	2.355	1.907	0.426	1.497	-	light sandy clay
481	1	7.5	0	0	0	1.5	6.5	10	0	4	13.5	22	16.5	1.5	0	24.5	-	-	-	17	-	-	2.7	2.229	1.899	0.422	1.112	-	middle coarseness sand
482	1	8.4	0	0	13.5	6	7	13	26.5	0	0	0	0	0	11.5	22.5	24	17	7	14	-0.495	1.5	2.7	2.171	1.912	0.412	0.8866	-	dust gravelly sandy loam
483	1	9	0	0	0	0	11	15	20	0	0	0	0	0	14	40	27	17	10	13	-0.403	1.4	2.72	2.158	1.91	0.424	0.8319	-	light gravelly dusty sandy clay
484	1	10.5	0	0	0	0	0	0	10	0	0	0	0	0	6.7	83.3	42	25	17	24	-0.06	1.059	2.73	1.949	1.572	0.737	0.8886	-	heavy dusty sandy clay
485	1	12.0-12.2	0	0	0	0	0	0	6.7	0	0	0	0	0	6.7	86.7	41	30	11	23	-0.678	1.682	2.72	1.973	1.61	0.689	0.8898	-	light dusty sandy clay
486	1	13.5	0	0	0	0	0	0	10	0	0	0	0	0	23.3	66.7	32	24	8	16	-1.04	2.038	2.72	2.151	1.86	0.463	0.9208	-	light dusty sandy clay
487	2	1	0	0	0	0	0	0	6.7	0	0	0	0	0	23.3	70	26	15	11	16	0.045	0.955	2.72	2.105	1.822	0.493	0.8555	-	light dusty sandy clay
488	2	1.7-2.5	0	0	0	0	0	5	0	1	11	30	33	2	0	18	-	-	-	-	-	-	-	-	-	-	-	1.22	dusty sand
489	2	0.0-1.7	0	0	0	0	0	0	16.7	0	0	0	0	0	16.7	66.7	34	24	10	-	-	-	-	-	-	-	-	-	light dusty sandy clay
490	2	2.8-4.0	0	0	0	12	13	15	0	4	9	10	15	5	0	17	-	-	-	-	-	-	-	-	-	-	-	-	gravelly sand
491	2	3.4	0	0	0	0	0	0	43.3	0	0	0	0	0	16.7	40	22	16	6	18	0.276	0.717	2.7	2.157	1.833	0.473	1.008	-	sandy loam
492	2	4.0-4.3	0	0	0	2	2	11	0	7	36	16	8	2	0	16													coarse sand
493	2	4.5-4.7	0	0	0	4	2	3	8	0	0	0	0	0	17	66	30	17	13	21	0.334	0.669	2.73	2.086	1.719	0.588	0.9908	-	heavy dusty sandy clay
494	2	6	0	0	0	0	0	0	3.3	0	0	0	0	0	3.3	93.3	32	22	10	27	0.502	0.5	2.72	2.088	1.644	0.655	1.122	-	light dusty sandy clay
495	2	9	0	0	0	0	0	0	16.7	0	0	0	0	0	13.3	70	35	28	7	17	-1.52	2.529	2.7	1.987	1.694	0.594	0.7877	-	dust sandy loam
496	3	1.5	0	0	0	0	0	0	23.3	0	0	0	0	0	33.3	43.3	22	15	7	20	0.65	0.357	2.7	2.173	1.818	0.485	1.087	-	sandy loam
497	3	2.2	0	0	0	0	0	0	10	0	0	0	0	0	46.7	43.3	24	15	9	19	0.464	0.533	2.72	2.083	1.748	0.556	0.9374	-	light sandy clay
498	3	3.0-3.2	0	0	0	0	0	0	13.3	0	0	0	0	0	43.3	43.3	21	15	6	15	-0.018	1.017	2.7	2.096	1.824	0.48	0.8376	-	sandy loam
499	3	3.2-4.7	0	0	0	0	0	2	0	3	19	19	30	5	0	22	-	-	-	-	-	-	-	-	-	-	-	0.42	dusy sand
500	3	5.2	0	0	0	6	3	6	18	0	0	0	0	0	16	51	30	19	11	22	0.262	0.736	2.72	2.052	1.684	0.616	0.9667	-	light dusty sandy clay with gravel
501	3	6.5-7.2	0	0	0	0	0	0	16.7	0	0	0	0	0	13.3	70	35	21	14	26	0.332	0.664	2.73	2.045	1.627	0.677	1.034	-	heavy dusty sandy clay
501	3	6.5-7.2	0	0	0	0	0	4	0	4	35	25	9	1	0	22	-	-	-	-	-	-	-	-	-	-	-	-	middle coarseness sand
502	3	8.0-8.2	0	0	0	13	4.5	6	15.5	0	0	0	0	0	11	50	24	15	9	21	0.667	0.333	2.72	2.163	1.787	0.522	1.095	-	light gravelly dusty sandy clay
503	3	9	0	0	0	1	7	16	27	0	0	0	0	0	11	38	21	14	7	10	-0.61	1.61	2.7	2.301	2.097	0.287	0.9139	-	dust sandy loam with gravel
504	3	10.5-11.0	0	0	0	0	0	0	6.7	0	0	0	0	0	3.3	90	51	33	18	33	-0.029	1.028	2.74	1.89	1.432	0.914	0.9741	-	light dusty clay
505	3	13.7-14.0	0	0	0	0	0	0	10	0	0	0	0	0	10	80	38	25	13	17	-0.586	1.585	2.73	2.05	1.746	0.563	0.8428	-	heavy dusty sandy clay

Note : These data are obtained during the Feasibility Study

" - " : not measured

Annex A(1) Result of Test for Physical Properties (WTP)

			Grain Size														Plastisity %						Solidity							
Lob. No.	Hole No.	Depth of Sampling	> 70	70-40	40-20	20-10	10-5	5-2	2.0-0.25	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.005	0.25-0.05	< 0.05	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index (relative water content)	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation	Coefficient of Permeability	Geology
		m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm								g/cm^3	g/cm^3			m/day	
																	WL	WP	IP	W	IL	Ic	Gs(ρ s)	ρ	ρ d	e	Sr	k	
			Grain Size														Plastisity %						Solidity							
Lob. No.	Hole No.	Depth of Sampling	> 70	70-40	40-20	20-10	10-5	5-2	2.0-0.25	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.005	0.25-0.05	< 0.05	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index (relative water content)	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation	Coefficient of Permeability	Geology
		m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm								g/cm^3	g/cm^3			m/day	
																	WL	WP	IP	W	IL	Ic	Gs(ρ s)	ρ	ρ d	e	Sr	k	
507	4	1	0	0	0	0	0	0	10	0	0	0	0	0	16.7	73.3	27	15	12	15.7	0.054	0.942	2.72	1.964	1.698	0.602	0.7076	-	light dusty sandy clay
508	4	2	0	0	0	0	0	0	16.7	0	0	0	0	0	16.7	66.7	27	15	12	19.4	0.366	0.633	2.72	1.917	1.606	0.694	0.7599	-	
509	4	0.0-2.6																											
510	4	2.6-4.5	0	0	0	0	0	0	0	0	1	58	22	1	0	18	-	-	-	-	-	-	-	-	-	-	-	0.8	middle coarseness sand
511	4	4.9-5.6	0	0	0	3.5	6.5	18	0	10	20	15	5	8.5	0	13.5	-	-	-	-	-	-	-	-	-	-	-	-	gravelly sand
512	4	6	0	0	0	0	0	0	16.7	0	0	0	0	0	26.7	56.7	28	18	10	17.2	-0.079	1.08	2.72	2.06	1.758	0.547	0.8553	-	light sandy clay
513	4	9	0	0	0	0	0	0	6.7	0	0	0	0	0	3.3	90	48	34	14	34.3	0.019	0.979	2.73	1.909	1.421	0.921	1.016	-	heavy dusty sandy clay
514	4	14.2-14.5	0	0	0	0	0	0	3.3	0	0	0	0	0	3.3	93.3	41	30	11	23.8	-0.564	1.564	2.72	1.913	1.545	0.76	0.8512	-	light dusty sandy clay
515	5	1.0-1.2	0	0	0	0	0	0	36.7	0	0	0	0	0	26.7	36.7	20	15	5	10.6	-0.879	1.88	2.7	1.918	1.734	0.557	0.5139	-	sandy loam
516	5	2	0	0	0	2	3	5	26	0	0	0	0	0	31	33	19	14	5	12.5	-0.297	1.3	-	-	-	-	-	-	sandy loam
517	5	0.3-3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
518	5	4	0	0	0	11	8	18	21	0	0	0	0	0	9	33	21	15	6	11	-0.661	1.667	2.7	1.952	1.758	0.536	0.5563	-	dust sandy loam with gravel
519	5	4.5-8.0	0	0	0	14	7	16	0	5	14	12	7	6	0	19	-	-	-	-	-	-	-	-	-	-	-	-	
520	5	9	0	0	0	0	0	0	6.7	0	0	0	0	0	6.7	86.7	43	32	11	32.6	0.058	0.945	2.72	1.892	1.426	0.907	0.9784	-	light dusty sandy clay
521	5	13.8-14.0	0	0	0	0	0	0	10	0	0	0	0	0	3.3	86.7	43	32	11	31.7	-0.03	1.027	2.72	1.908	1.449	0.877	0.982	-	light dusty sandy clay
522	6	1.0-1.2	0	0	0	0	0	0	26.7	0	0	0	0	0	20	53.3	21	15	6	15.7	0.121	0.883	2.7	2.062	1.782	0.515	0.8239	-	dust sandy loam
523	6	0.2-2.5	0	0	0	0	2	3	21	0	0	0	0	0	30	44	30	16	14	-	-1.14	-	2.73	-	-	-	-	-	heavy sandy clay
524	6	2.5-3.7	0	0	0	0	5	24	0	11	20	15	7	12	0	6	-	-	-	-	-	-	-	-	-	-	-	2.56	gravelly sand
525	6	4.3-4.5	0	0	0	0	0	0	3.3	0	0	0	0	0	6.7	90	37	21	16	23	0.128	0.875	2.73	2.039	1.657	0.647	0.9718	-	heavy dusty sandy clay
526	6	6.2-6.5	0	0	0	0	0	0	26.7	0	0	0	0	0	6.7	66.7	41	30	11	25.4	-0.417	1.418	2.72	1.918	1.529	0.779	0.8875	-	light dusty sandy clay
527	6	12.2-12.4	0	0	0	0	0	0	23.3	0	0	0	0	0	33.3	43.3	41	30	11	16.3	-1.24	2.245	2.72	2.066	1.776	0.532	0.8358	-	light sandy clay

Note : These data are obtained during the Feasibility Study

" - " : not measured

Annex A(2) Result of Test for Physical Properties (WTP)

			Grain Size														Plastisity %						Solidity						
Lob. No.	Hole No.	Depth of Sampling	> 70	70-40	40-20	20 - 10	10 - 5	5.0-2.0	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.05	0.05-0.01	0.01-0.005	< 0.005	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index (relative water content)	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation	Coefficient of Permeability	Geology
		m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm								g/cm^3	g/cm^3			m/day	
																	WL	WP	IP	W	IL	Ic	Gs(ρ s)	ρ	ρ d	e	Sr	k	
	21	0.5-0.7	0	0	0	0	0	0	0.3	3.1	16.7	15.8	6.7	21.8	8.2	27.4	29	13	17	18	0.3	0.69	2.71	2.02	1.71	0.58	0.83	-	Clay loam, heavy pulverulent tight-
	21	2-2.5	0	0	0	0	0	0	0	1.1	11.8	24.3	25.8	7	5.5	24.5	22	10	12	16	0.5	0.5	2.68	2.13	1.83	0.47	0.93	-	Clay loam, light pulverulent tight-
	21	14-15	0	0	0	0	0	0	0	0.2	2.3	11.7	16.1	26	15	28.7	33	19	14	10	-0.6	1.59	2.68	1.95	1.77	0.52	0.52	-	Clay loam, heavy pulverulent solid
	22	1.35-1.45	0	0	0	0	0	0.9	1.2	6.5	20.8	21.2	12.6	10.5	3.5	22.8	25	11	13	10	0.11	1.114	2.7	2.2	2	0.35	0.76	-	Clay loam, heavy pulverulent solid
	22	2-2.15	0	0	0	0	0	0	0	2.4	11.1	17.2	16.1	14.8	5	33.4	25	10	15	11	0.05	0.945	2.72	2.17	1.95	0.39	0.77	-	Clay loam, heavy pulverulent
	22	2.9-3.1	0	0	0	0	0	0	0	0.9	4.4	8	20.2	20.6	8.3	37.6	34	12	22	19	0.31	0.693	2.72	2.05	1.73	0.57	0.89	-	Clay, light pulverulent tight-plastic
	22	3-3.3	0	0	0	0	0	0	0.4	3	11.8	21.4	19.8	17.5	5	21.1	23	10	13	17	0.52	0.484	2.72	2.11	1.8	0.51	0.9	-	Clay loam, heavy pulverulent soft-
	22	12-12.2	0	0	0	0	0	0	0	0.4	0.8	6.4	12.7	38.4	9.4	31.9	37	20	17	21	0.05	0.952	2.76	2	1.65	0.67	0.88	-	Clay loam, heavy pulverulent
	23	4.5-5.5	0	0	0	0	1.3	5.9	3.4	8	12.4	2.9	5.7	17.9	9.4	33.1	31	13	18	22	0.48	0.514	2.72	-	-	-	-	-	Clay, light pulverulent tight-plastic
	23	6.8-7.0	0	0	0	0	0	0	0	0.4	2.9	3.7	4.4	24.2	15.3	49.1	36	15	20	21	0.28	0.718	2.74	2.08	1.72	0.59	0.97	-	Clay, light pulverulent tight-plastic
	24	10-10.2	0	0	0	0	0	1.6	0.7	1.9	10.9	14.6	6.9	15	11.2	37.2	31	12	19	22	0.49	0.497	2.72	2.07	1.7	0.6	0.88	-	Clay, light pulverulent tight-plastic
	24	12.5-12.7	0	0	0	0	0	1	0.5	0.7	1.4	1.9	3.5	7.5	13.4	70.1	53	17	36	22	0.12	0.879	2.72	2.15	1.77	0.54	1.08	-	Clay, heavy pulverulent semisolid
	25	8-8.2	0	0	0	17.2	13.7	15	7.7	14.7	22.7	5.6	0.6	0.8	0.5	1.5	-	-	-	5	-	-	2.72	-	-	-	-	67.5	Coarse sand
	25	10.15-10.5	0	0	0	0	0	0.6	0	0.4	0.8	4.1	10.9	27.5	16.3	39.4	46	25	22	37	0.59	0.405	2.72	1.85	1.35	1.02	1	-	Clay, light pulverulent soft-plastic
	26	6-6.25	0	0	0	0	0	0	0	0	0.4	1.2	5.8	28.9	20.5	43.2	50	23	27	26	0.13	0.868	2.78	1.97	1.56	0.79	0.93	-	Clay, heavy semisolid
	27	5.0-6.0	0	0	0	7.7	17.4	26.7	10.5	16.2	15.6	2	0.5	1	0.7	1.7	-	-	-	4	-	-	2.77	-	-	-	-	39.8	Gravel sand
	27	7.0-7.2	0	0	0	0	0	0	0	0.3	0.5	1.1	4.6	29.9	19.9	43.7	46	23	23	22	-0.02	1.017	2.78	2.03	1.66	0.67	0.92	-	Clay, light pulverulent solid
	27	12	0	0	0	0	0	0	0	0	0.3	2.9	5.5	33	21.5	36.8	41	22	19	19	-0.16	1.16	2.71	2.02	1.7	0.59	0.87	-	Clay loam, heavy pulverulent solid
	28	7.0-8.0	0	0	0	4	12.9	22.1	11.4	20	20.2	4.4	0.6	1.4	0.6	2.4	-	-	-	8	-	-	2.74	-	-	-	-	32.8	Gravel sand
	28	9.2-9.6	0	0	0	0	0	0	0	0	0.8	5.8	10.1	27	17.6	38.7	44	20	24	23	0.13	0.869	2.77	1.95	1.58	0.75	0.97	-	Clay, light pulverulent semisolid

Note: These data are obtained during this Study

" - " : not measured

Annex A(3) Result of test for Physical Properties (STP)

			Grain Size														Plastisity %						Solidity						
Lob. No.	Hole	Depth of Sampling	> 70	70-40	40-20	20-10	10-5	5-2	2.0-0.25	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.005	0.25-0.05	< 0.05	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index (relative water content)	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation	Coefficient of Permeability	Geology
		m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm								g/cm^3	g/cm^3			m/day	
																	WL	WP	IP	W	IL	Ic	Gs(ρ s)	ρ	ρ d	e	Sr	k	
565	10	1.1-1.3	0	0	0	0	0	0	20.3	0	0	0	0	0	43.3	36.3	22	14	8	13	-0.155	1.15	2.72	1.913	1.696	0.604	0.575	-	light sandy clay
566	10	0.3-3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
567	10	3.2	0	0	0	0	0	0	15	0	0	0	0	0	47.7	37.3	23	16	7	23	0.996	0.0	2.7	2.061	1.676	0.611	1.015	-	arenaceous loamy sand
568	10	5.2-8.4	0	0	0	9.5	3.5	9.5	0	6	24.5	15.5	17	2.5	0	12	-	-	-	-	-	-	-	-	-	-	-	2.41	coarse sand
569	10	8.5-11.8	0	0	0	6.5	11.5	27	0	11	17.5	8	8	1.5	0	9	-	-	-	-	-	-	-	-	-	-	-	3.09	gravelly sand
570	10	17.5	0	0	0	0	0	0	7	0	0	0	0	0	18.3	74.7	58	27	31	30	0.098	0.903	2.74	1.878	1.444	0.897	0.917	-	heavy clay
572	11	2	0	0	0	0	0	0	12	0	0	0	0	0	30	58	25	16	9	17	0.111	0.889	2.72	1.847	1.579	0.723	0.6395	-	light sandy clay
573	11	0.3-3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	
574	11	4.5	0	0	0	0	0	0	20	0	0	0	0	0	50.3	29.7	20	16	4	18	0.481	0.525	2.7	2.283	1.936	0.395	1.226	-	arenaceous loamy sand
575	11	4.0-6.0	0	0	0	0	0.5	2	0	2	22.5	36	19.5	2	0	15.5	-	-	-	-	-	-	-	-	-	-	-	1.75	average coarseness sand
576	11	6.0-8.8	0	0	0	2	3.5	13.5	0	4.5	18.5	19.5	22.5	3	0	13	-	-	-	-	-	-	-	-	-	-	-	1.82	light gravelly dusty sandy clay
577	11	8.8-9.3	0	0	0	0	8.5	20.3	22.1	0	0	0	0	0	9.4	39.7	28	16	12	17	0.06	0.942	2.72	2.121	1.817	0.497	0.9149	-	light gravelly dusty sandy clay
578	11	9.3-11.0	0	0	0	3.5	8.5	17	0	6.5	16.5	18	17.5	1.5	0	11	-	-	-	-	-	-	-	-	-	-	-	1.01	gravelly sand
579	11	12.5	0	0	0	0	6.7	0	21	0	0	0	0	0	43	29.3	19	12	7	12	0.05	0.943	2.7	2.214	1.97	0.37	0.9003	-	light sandy clay
580	11	15.0-15.2	0	0	0	0	1	3.2	13.1	0	0	0	0	0	32.1	50.6	20	14	6	13	-0.161	1.167	2.7	2.181	1.93	0.399	0.8816	-	dust sandy loam
588	12	1.2	0	0	0	0	0	0	10.3	0	0	0	0	0	51	38.7	25	18	7	14	-0.603	1.6	2.7	1.818	1.598	0.69	0.5393	-	arenaceous loamy sand
589	12	3.0-3.3	0	0	0	0	0	0	5	0	0	0	0	0	43.7	51.3	26	18	8	22	0.497	0.5	2.72	2.034	1.668	0.631	0.9473	-	light sandy clay
590	12	5	0	0	0	0	0	0	3.7	0	0	0	0	0	22.7	73.7	25	15	10	24	0.92	0.08	2.72	2.022	1.628	0.671	0.9811	-	light gravelly dusty sand clay
591	12	6.5	0	0	0	0	0	0	5.3	0	0	0	0	0	22.3	72.3	27	15	12	28	1.049	-0.05	2.72	2.005	1.572	0.731	1.027	-	
592	12	4.4-6.0	0	0	0	6	8.5	20.1	0	8.1	17.6	9.5	12.4	3.6	0	14.3	-	-	-	-	-	-	-	-	-	-	-	-	gravelly sand
593	12	7.0-9.5	0	0	0	0	2.1	23.1	0	13.5	29.3	10.8	8.8	4.7	0	7.7	-	-	-	-	-	-	-	-	-	-	-	8.97	
594	12	9.5-11.5	0	0	0	0	3	26	0	17.6	25.7	8.6	7.6	2.9	0	8.6	-	-	-	-	-	-	-	-	-	-	-	-	
595	12	15	0	0	0	0	3.1	6.1	12.4	0	0	0	0	0	15.9	62.5	45	27	18	24	-0.169	1.167	2.74	1.936	1.562	0.754	0.8704	-	light dusty clay
596	13	1.3-1.5	0	0	0	0	0	0	14.1	0	0	0	0	0	46.4	39.5	23	15	8	18	0.311	0.688	2.72	2.137	1.818	0.496	0.9595	-	light sandy clay
597	13	4.5-4.8	0	0	0	0	0	0	10.3	0	0	0	0	0	42	47.7	20	15	5	21	1.132	-0.14	2.7	2.004	1.661	0.626	0.8918	-	arenaceous loamy sand
598	13	5.5	0	0	0	0	3.9	10.1	0	9	38.4	15.9	11	3.6	0	8.1	-	-	-	-	-	-	-	-	-	-	-	-	coarse sand
599	13	7.6-10.2	0	0	0	0	8.4	25.4	0	11.5	20.7	12.5	10.7	3.2	0	7.6	-	-	-	-	-	-	-	-	-	-	-	-	gravelly sand
600	13	12.5	0	0	0	0	0	6.4	10	0	0	0	0	0	26.6	57	43	25	18	21	-0.23	1.228	2.74	2.059	1.703	0.609	0.9393	-	light dusty clay

Note: These data are obtained during the Feasibility Study

" - " : not measured

Annex A(3) Result of test for Physical Properties (STP)

			Grain Size														Plastisity %						Solidity						
Lob. No.	Hole	Depth of Sampling	> 70	70-40	40-20	20-10	10-5	5-2	2.0-0.25	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.005	0.25-0.05	< 0.05	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index (relative water content)	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation	Coefficient of Permeability	Geology
		m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm								g/cm^3	g/cm^3			m/day	
																	WL	WP	IP	W	IL	Ic	Gs(ρs)	ρ	ρd	e	Sr	k	
602	14	1.8-2.0		0	0	0	0	0	9.3	0	0	0	0	0	46.3	44.3	24	15	9	18	0.344	0.656	2.72	2.14	1.812	0.501	0.9829	-	light sandy clay
603	14	2		0	0	0	0	0	13.3	0	0	0	0	0	36	50.7	15	15	10	19	0.384	-0.38	2.72	2.098	1.766	0.541	0.9478	-	
604	14	0.0-3.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
605	14	4.6-4.7		0	0	0	0	0	9	0	0	0	0	0	52.3	38.7	20	15	5	23	1.653	-0.66	2.7	2.11	1.712	0.577	1.088	-	arenaceous loamy sand
606	14	7.0-11.0		0	0	2.4	11.9	32.2	0	8.7	16.8	9	7.8	3	0	8.2	-	-	-	-	-	-	-	-	-	-	-	1.41	gravelly sand
607	14	15		0	0	0	0	4.3	13.7	0	0	0	0	0	22.7	59.3	45	29	16	26	-0.189	1.188	2.73	1.937	1.537	0.776	0.9142	-	heavy dusty sandy clay
608	15	1.5		0	0	0	0	0	8	0	0	0	0	0	42.7	49.3	29	18	11	23	0.413	0.591	2.72	2.049	1.672	0.626	0.9787	-	light sandy clay
609	15	0.0-3.0		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
610	15	3.5-4.5		0	0	0	2.3	2	0	1.1	9.9	38.7	31.4	2.9	0	11.7	-	-	-	-	-	-	-	-	-	-	-	2.07	average caarseness sand
611	15	4.5-5-5		0	0	0	0	10.9	0	6.6	24.4	23	23.5	3.8	0	7.8	-	-	-	-	-	-	-	-	-	-	-	-	
612	15	5.5-8.0		0	0	1.5	4.3	26.9	0	13.1	24.7	13.2	10.3	2.5	0	3.5	-	-	-	-	-	-	-	-	-	-	-	-	gravelly sand
613	15	8.0-10.3		0	0	0	5.9	25.5	0	12.5	27.2	13.7	10.2	2.8	0	2.2	-	-	-	-	-	-	-	-	-	-	-	14.3	
614	15	12		0	0	0	0	0	5.7	0	0	0	0	0	20.7	73.7	26	13	13	13	-0.012	1.015	2.73	2.267	2.009	0.359	0.9776	-	heavy dusty sandy clay
615	15	18		0	0	0	0	0	3.3	0	0	0	0	0	13.3	83.3	65	35	30	30	-0.172	1.173	2.74	1.89	1.456	0.882	0.9268	-	heavy clay
616	16	3.2		0	0	0	0	0	7.3	0	0	0	0	0	54.3	38.3	20	15	5	22	1.353	-0.36	2.7	2.163	1.777	0.52	1.13	-	arenaceous loamy sand
617	16	4.5-5.8		0	0	0	2.2	7.5	0	4.8	16.2	19.3	22.2	6.3	0	21.5	-	-	-	-	-	-	-	-	-	-	-	-	fine sand
618	16	5.8-8.0		0	0	5.6	11.7	18.2	0	8.4	21.8	15.7	10.9	2.9	0	4.7	-	-	-	-	-	-	-	-	-	-	-	-	gravelly sand
619	16	8.0-10.2		0	0	3.8	14.3	34.7	0	8.7	10.5	7.9	8	6.2	0	5.9	-	-	-	-	-	-	-	-	-	-	-	-	gravel soil
620	16	15		0	0	0	0	0	4.7	0	0	0	0	0	19.3	76	65	33	32	40	0.209	0.791	2.74	1.895	1.356	1.02	1.066	-	heavy clay

Note: These data are obtained during the Feasibility Study

" - " : not measured

Annex A(4) Result of test for Physical Properties (STP)

			Grain Size														Plastisity %						Solidity						
Lob. No.	Hole	Depth of Sampling	> 70	70-40	40-20	20 - 10	10 - 5	5.0-2.0	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.05	0.05-0.01	0.01-0.005	< 0.005	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index (relative water content)	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation	Coefficient of Permeability	Geology
		m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm								g/cm^3	g/cm^3			m/day	
																	WL	WP	IP	W	IL	Ic	Gs(ρ s)	ρ	ρ d	e	Sr	k	
	29	10-11	0	0	0	6.4	14.3	31.1	12.5	12.8	12.7	6.3	0.1	1	0.7	2.1	-	-	-	4	-	-	2.68	-	-	-	-	58.2	Gravel sand
	29	14-14.2	0	0	0	0	0	0	0	0.3	0.2	0.5	3.9	15.6	17.1	62.4	51	21	30	27	0.21	0.789	2.74	1.98	1.56	0.76	0.98	-	Clay heavy semisolid
	30	8.0-9.0	0	0	0	6.2	10.3	25	13.8	21.6	18.8	2.8	0.8	0.3	0.1	0.3	-	-	-	3	-	-	2.7	-	-	-	-	57.8	Gravel sand
	30	12-12.2	0	0	0	0	0	0	0.1	0.1	0.3	0.6	3.1	14.1	14.9	66.8	50	21	30	26	0.18	0.819	2.7	1.99	1.58	0.71	0.99	-	Clay, heavy semisolid
	31	7.0-8.0	0	0	0	6.4	11.4	21.5	12.2	24.8	19.3	3.1	0.5	0.2	0.2	0.4	-	-	-	4	-	-	2.7	-	-	-	-	45.6	Gravel sand
	31	13-13.2	0	0	0	0	0.3	0.8	0.5	0.8	1.2	1.2	7.3	5.3	13.5	69.1	53	19	33	23	0.11	0.892	2.73	2.07	1.68	0.63	0.99	-	Clay, heavy semisolid
	32	9.0-10.0	0	0	0	6.9	10.7	21.8	12.3	21.6	19.2	3.4	1.3	0.3	0.6	1.9	-	-	-	3	-	-	2.7	-	-	-	-	39.2	Gravel sand
	32	12.5-12.7	0	0	0	0	0.2	0.2	0.2	0.3	0.6	1.6	4.2	20.7	9.2	62.8	51	20	31	27	0.22	0.785	2.72	1.98	1.56	0.74	0.99	-	Clay, heavy pulverulent semisolid
	33	8.0-9.0	0	0	0	7.9	12.4	29.4	15	20.7	10.2	3.2	0.1	0.5	0.2	0.4	-	-	-	3	-	-	2.68	-	-	-	-	65.7	Gravel sand
	33	12-12.2	0	0	0	0	0.4	2.2	0.6	1.4	8.9	4.9	5.5	9.8	7	59.3	57	22	35	32	0.29	0.71	2.68	1.92	1.46	0.84	1.02	-	Clay, heavy pulverulent tight-
	34	6.4-7.0	0	0	0	8	12.5	14.9	9.6	25	24.3	4.3	0.1	0.4	0.3	0.6	-	-	-	9	-	-	2.7	-	-	-	-	33.9	Coarse sand
	34	10.2-10.4	0	0	0	0	0	0.9	0.8	2.6	5	8.9	9.5	25.8	14.2	32.3	35	20	15	25	0.3	0.693	2.73	1.97	1.58	0.73	0.92	-	Clay loam, light pulverulent tight-
	35	5.3-6.3	0	0	0	4.7	12.5	25.7	15.4	21.8	10.7	3.6	0.7	2	0.7	2.2	-	-	-	12	-	-	2.71	-	-	-	-	48.2	Gravel sand
	35	7.0-8.0	0	0	0	0	2.1	1.1	0.8	3	16.9	22.5	10.1	23.5	5.9	14.1	27	14	13	13	0.08	1.079	2.69	2.17	1.92	0.4	0.87	-	Clay loam, light pulverulent

Note: These data are obtained during this Study

" - " : not measured

Annex A(5) Result of Test for Physical Properties (Water Intake)

			Grain Size														Plastisity %						Solidity						
Lob. No.	Hole	Depth of Sampling	> 70	70-40	40-20	20-10	10-5	5-2	2.0-0.25	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.005	0.25-0.05	< 0.05	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index (relative water content)	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation	Coefficient of Permeability	Geology
		m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm								g/cm^3	g/cm^3			m/day	
																	WL	WP	IP	W	IL	Ic	Gs(ρs)	ρ	ρd	e	Sr	k	
531	7	1	0	0	0	0	0	0	17.7	0	0	0	0	0	25.3	57	40	25	15	21.3	-0.25	1.247	2.73	1.706	1.407	0.94	0.617	-	heavy dusty sandy clay
532	7	2	0	0	0	0	0	0	15.7	0	0	0	0	0	34.3	50	36	24	12	18	-0.501	1.5	2.72	1.774	1.504	0.809	0.6046	-	light sandy clay
534	7	0.3-3.0	0	0	0	0	0	0	4.7	0	0	0	0	0	44	51.3	32	20	12	18.4	-0.137	1.133	2.72	1.675	1.415	0.922	0.5417	-	
535	7	4.5-5.0	0	0	0	0	0	0	14	0	0	0	0	0	33.3	52.7	31	20	11	28.4	0.762	0.236	2.72	2.019	1.572	0.73	1.058	-	
536	7	6	0	0	0	0	0	0	15	0	0	0	0	0	31	54	33	19	14	25.3	0.449	0.55	2.73	2.062	1.646	0.658	1.048	-	heavy sandy clay
537	7	9.0-9.5	0	0	0	0	0	0	4.7	0	0	0	0	0	15.7	79.7	33	20	13	25.3	0.411	0.592	2.73	2.076	1.656	0.649	1.066	-	heavy dusty sandy clay
538	7	12	0	0	0	0	0	0	6.3	0	0	0	0	0	16.3	77.3	32	19	13	28.7	0.745	0.254	2.73	2.047	1.591	0.716	1.093	-	
539	7	15	0	0	0	0	0	0	2.7	0	0	0	0	0	11	86.3	33	20	13	26.2	0.48	0.523	2.73	2.034	1.611	0.695	1.031	-	
540	7	15.8-16.8	0	0	0	4.2	1.6	2.9	16.8	0	0	0	0	0	24.8	49.8	24	17	7	17.5	0.067	0.929	2.7	2.168	1.846	0.463	1.019	-	dust sandy loam
541	8	0.6-0.8	0	0	0	0	0	0	13.7	0	0	0	0	0	36.3	50	34	20	14	16	-0.286	1.286	2.73	1.832	1.58	0.728	0.5996	-	heavy sandy clay
542	8	1.4-1.6	0	0	0	0	0	0	13	0	0	0	0	0	31.7	55.3	35	20	15	18.7	-0.086	1.087	2.73	1.894	1.595	0.711	0.7183	-	
544	8	4.7	0	0	0	0	0	0	13.3	0	0	0	0	0	32.7	54	36	19	17	23.2	0.246	0.753	2.73	2.066	1.677	0.628	1.008	-	
545	8	9	0	0	0	0	0	0	15	0	0	0	0	0	30	55	35	20	15	27.3	0.488	0.513	2.73	2.02	1.586	0.721	1.035	-	
546	8	12.0-12.3	0	0	0	0	0	0	13.7	0	0	0	0	0	32.7	53.7	36	23	13	27.6	0.351	0.646	2.73	2.013	1.578	0.73	1.031	-	
547	8	13.5-14.3	0	0	0	0	0	2.3	24.4	0	0	0	0	0	27.7	45.6	21	16	5	21.6	1.114	-0.12	2.7	2.099	1.727	0.564	1.033	-	dust sandy clay
549	9	3.2-3.4	0	0	0	0	0	0	10	0	0	0	0	0	26.7	63.3	31	20	11	25.6	0.512	0.491	2.72	2.011	1.601	0.699	0.9972	-	light dusty sandy clay
550	9	6.0-6.2	0	0	0	0	0	0	9	0	0	0	0	0	23	68	33	20	13	21.3	0.1	0.9	2.73	2.105	1.735	0.573	1.014	-	heavy dusty sandy clay
551	9	9.0-9.2	0	0	0	0	0	0	3	0	0	0	0	0	4.7	92.3	30	18	12	23.3	0.442	0.558	2.72	2.097	1.7	0.6	1.057	-	light dusty sandy clay
552	9	13.7-13.9	0	0	0	0	0	0	3.3	0	0	0	0	0	6.7	90	31	19	12	24.2	0.432	0.567	2.72	2.082	1.676	0.622	1.057	-	
553	9	15	0	0	0	0	3.7	2.8	19	0	0	0	0	0	29	45.6	21	14	7	15.3	0.193	0.814	2.7	2.077	1.801	0.499	0.8298	-	dust sandy clay

Note: These data are obtained during the Feasibility Study

" - " : not measured

Annex A(6) Result of test for Physical Properties (Water Intake)

			Grain Size														Plastisity %						Solidity						
Lob. No.	Hole	Depth of Sampling	> 70	70-40	40-20	20 - 10	10 - 5	5.0-2.0	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.05	0.05-0.01	0.01-0.005	< 0.005	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index (relative water content)	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation	Coefficient of Permeability	Geology
		m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm								g/cm^3	g/cm^3			m/day	
																	WL	WP	IP	W	IL	Ic	Gs(ρ s)	ρ	ρ d	e	Sr	k	
	36	0-3.2	0	0	0	0	0	0	0.5	12.5	52.5	9.5	3	7.4	2.8	11.8	17.5	12.3	5.2	15.7	0.65	0.346	2.67	2.14	1.85	0.44	0.95	-	Loam, dusty plastic
	36	5-5.2	0	0	0	0	0	0		1.1	5.8	9.6	5.6	16.6	13.3	48	38.2	15.8	22.4	20.6	0.21	0.786	2.68	2.10	1.74	0.54	1.02	-	Clay, light, dusty, semi-hard
	36	8-8.2	0	0	0	0	0	0	0.1	0.1	1.2	3.5	12.4	40.2	9.1	33.4	29.3	13.6	15.7	24.1	0.67	0.331	2.68	2.03	1.64	0.63	1.03	-	Loam, heavy dusty, softy plastic
	36	9-12	0	0	0	0	0	0	1.1	4.2	14.1	12.9	9.5	8.6	9.7	39.9	31.0	13.6	17.4	25.2	0.67	0.333	2.69	2.07	1.65	0.63	1.08	-	Loam, heavy, dusty, softly plastic
	36	12-14	0	0	0	0	1.2	3.7	5.3	20.7	30.2	9.1	4.1	8.1	4	13.6	19.0	9.7	9.3	15.2	0.59	0.409	2.67	2.09	1.81	0.48	0.85	-	Loam, light,dusty softly plastic
	37	1.2-1.35	0	0	0	0	0	0	0.4	1.6	6.5	8.5	8	13.2	11.8	50	41.6	17.8	23.8	27.2	0.39	0.605	2.71	1.98	1.56	0.74	1.00	-	Clay, light, dusty
	37	3.2-3.4	0	0	0	0	0	0	0.4	1.6	6.1	11.4	9.7	14	5.8	51	36.1	14.1	22.0	21.9	0.35	0.645	2.71	2.09	1.71	0.58	1.02	-	Clay, light, dusty
	37	6.0-12.7	0	0	0	0	0	0	0	0.4	2.7	5.4	15.9	32	11.6	32	28.0	12.6	15.4	25.3	0.82	0.175	2.7	2.02	1.61	0.68	1.00	-	Loam heavy dusty fluid plastic
	37	12.7-14.6	0	0	0	1.5	8.4	18	9.2	21.3	19.7	5.9	2	5.4	3	5.6	15.9	8.6	7.3	12.4	0.52	0.479	2.68	2.15	1.91	0.4	0.83	-	Loam, light, arenaceous softly plastic

Note: These data are obtained during this Study

" - " : not measured

Annex A(7) Result of test for Physical Properties (Ishym River)

			Grain Size														Plastisity %						Solidity						
Lob. No.	Hole	Depth of Sampling	> 70	70-40	40-20	20 - 10	10 - 5	5.0-2.0	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.05	0.05-0.01	0.01-0.005	< 0.005	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index (relative water content)	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation	Coefficient of Permeability	Geology
		m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm								g/cm^3	g/cm^3			m/day	
																	WL	WP	IP	W	IL	Ic	Gs(ρ s)	ρ	ρ d	e	Sr	k	
	34	6.4-7.0	0	0	0	8	12.5	14.9	9.6	25	24.3	4.3	0.1	0.4	0.3	0.6	-	-	-	9	-	-	2.7	-	-	-	-	33.9	Coarse sand
	34	10.2-10.4	0	0	0	0	0	0.9	0.8	2.6	5	8.9	9.5	25.8	14.2	32.3	35	20	15	25	0.3	0.693	2.73	1.97	1.58	0.73	0.92	-	Clay loam, light pulverulent tight-
	35	5.3-6.3	0	0	0	4.7	12.5	25.7	15.4	21.8	10.7	3.6	0.7	2	0.7	2.2	-	-	-	12	-	-	2.71	-	-	-	-	48.2	Gravel sand
	35	7.0-8.0	0	0	0	0	2.1	1.1	0.8	3	16.9	22.5	10.1	23.5	5.9	14.1	27	14	13	13	0.08	1.079	2.69	2.17	1.92	0.4	0.87	-	Clay loam, light pulverulent

Note: These data are obtained during this Study
" - " : not measured

Annex A(8) Result of Test for Physical Properties (Along the Ishym River)

			Grain Size														Plastisity %						Solidity						
Lob. No.	Hole	Depth of Sampling	>70	70-40	40-20	20-10	10-5	5-2	2.0-0.25	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.005	0.25-0.05	<0.05	Liquid Limit	Plastic Limit	Plasticity Index	Natural Water Content	Liquidity Index (relative water content)	Consistency Index	Specific gravity of soil particle	Wet Density	Dry Density	Void Ratio	Degree of Saturation	Coefficient of Permeability	Geology
		m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm								g/cm^3	g/cm^3			m/day	
																	WL	WP	IP	W	IL	Ic	Gs(ρs)	ρ	ρd	e	Sr	k	
631	19	1.5							3.7	-	-	-	-	-	17	79.3	32	19	13	20	0.077	0.923	2.73	1.883	1.569	0.739	0.7367	-	Sandy Clay, heavy, dusty
632	19	0.3-3.0																											
633	19	4.5-6.0					1.4	1.2	-	1.2	9.8	22	43.3	3	0	18.1												1.97	Sand, fine grained
634	19	6.0-8.0				2.4	12.2	20.9	-	9	22.6	12.4	13.7	1.2	0	5.7													Sand, coarse grained
635	19	8.0-10.4				3.8	10.7	22.3	-	8.1	21.3	13.3	11.7	1.9	0	7.2													
636	20	3							3.3	-	-	-	-	-	32	64.7	25	18	7	19.6	0.229	0.771	2.70	1.86	1.554	0.737	0.720		Sandy Loam, dusty
637	20	6.7-8.5				2	5.3	16.9	-	8.1	23.8	15.3	15.8	2.7	0	10.3													Sand, coarse grained
638	20	8.5-10.4				3	2.8	7.3	-	6.4	24.4	22	21.3	2.2	0	10.8												2.3	Sand, average coarseness

Note: These data are obtained during the Feasibility Study

" - " : not measured

Annex B Result of Test for Mechanical Properties

Facility	Well No.	Interval of sampling, m	Layer	Coefficient of lateral pressure	Angle of internal friction	Cohesion			Deformation Module	
				β	ϕ	S, MPa	kgf/cm^2	tonf/m^2	E, MP a	kgf/cm^2
Water Treatment Plant	21	0.5 - 0.7	1	0.15	25	0.02	0.20	2.04	5.5	56
	22	1.35 - 1.45	1	0.2	22	0.04	0.41	4.08	5.9	60
	22	2 - 2.15	1	0.15	15	0.05	0.51	5.10	5.9	60
	22	2.9 - 3.1	1	0.24	28	0.04	0.41	4.08	5.2	53
	22	3 - 3.3	1	0.23	20	0.06	0.61	6.12	4.8	49
		Average		**0.19**	**22**	**0.04**	**0.43**	**4.28**	**5.5**	**56**
	23	6.8 - 7	5	0.2	12	0.08	0.82	8.16	4.8	49
	24	10 - 10.2	5	0.1	10	0.06	0.61	6.12	5.5	56
	27	7 - 7.2	5	0.12	30	0.06	0.61	6.12	2.2	22
	27	12 -12.2	5	0.2	23	0.08	0.82	8.16	12.3	125
		Average		**0.16**	**19**	**0.07**	**0.71**	**7.14**	**6.2**	**63**
	21	14 - 15	6	0.2	29	0.07	0.71	7.14	8.6	88
	22	12 - 12.2	6	0.1	16	0.06	0.61	6.12	4.6	47
	24	12.5 - 12.7	6	0.15	29	0.04	0.41	4.08	10.1	103
	25	10.15 - 10.5	6	0.17	18	0.03	0.31	3.06	3.8	39
	26	6 - 6.25	6	0.1	24	0.05	0.51	5.10	6.9	70
	28	9.2 - 9.6	6	0.1	25	0.09	0.92	9.18	4.1	42
		Average		**0.14**	**24**	**0.06**	**0.58**	**5.78**	**6.4**	**65**
Sewerage Treatment Plant	29	14 - 14.2	6	0.16	24	0.08	0.82	8.16	6.7	68
	30	12 - 12.2	6	0.1	15	0.09	0.92	9.18	3.1	32
	31	13 - 13.2	6	0.1	14	0.06	0.61	6.12	4.6	47
	32	12.5 - 12.7	6	0.12	15	0.08	0.82	8.16	5.9	60
	33	12 - 12.2	6	0.2	24	0.03	0.31	3.06	5.5	56
		Average		**0.14**	**18**	**0.07**	**0.69**	**6.93**	**5.2**	**53**
Ishym River	34	10.2 - 10.4	4	0.16	26	0.04	0.41	4.08	4.8	49
	35	7 - 8	4	0.1	19	0.11	1.12	11.22	11.2	114
		Average		**0.13**	**23**	**0.08**	**0.76**	**7.65**	**8.0**	**82**
Water Intake Tower	36	0 - 3.2	1	0.2	33	0.09	0.92	9.18	3.9	40
	36	5 - 5.2	1	0.2	10	0.1	1.02	10.20	11	112
	36	8 - 8.2	1	0.1	22	0.04	0.41	4.08	3.4	35
	36	9.0 - 12.0	1	0.16	14	0.07	0.71	7.14	3.1	32
	37	3.2 - 3.4	1	0.15	10	0.07	0.71	7.14	2.9	30
	37	6.0 - 12.7	1	0.23	---	0.09	0.92	9.18	2.6	27
		Average		**0.17**	**18**	**0.08**	**0.78**	**7.82**	**4.48**	**46**
	37	1.2 - 1.35	2	0.16	9	0.06	0.61	6.12	2.5	25
				0.16	**9**	**0.06**	**0.61**	**6.12**	**2.5**	**25**
	36	12.0 - 14.0	3	0.18	29	0.04	0.41	4.08	3.6	37
	37	12.7 - 14.6	3	0.2	27	0.1	1.02	10.20	3.6	37
		Average		**0.19**	**28**	**0.07**	**0.71**	**7.14**	**3.6**	**37**

Annex C Results of Chemical Analysis of Soil Moisture (2/7)

Facility	Lab	Boring No.	Formation	Sampling Interval (m)	pH	Ion Content %/m·mol/100g of soil							Contents %			salting level	Content mg/kg		note about aggressivity absense or aggression factor
													easily dissolving	Gypsum	Total				
						CO_3	HCO_3	Cl	SO4	Ca	Mg	Na	Salt				chlorides	sulphates	
Water Treatment Plant	476	1	1	1-2.7	-	0.00	0.08	0.01	0.07	0.01	0.02	0.03	0.18	-0.01	0.17	Non-saline	310	672	SO4
						0.00	1.34	0.40	1.40	0.60	1.25	1.29							
	480	1	2	6-6.5	-	0.00	0.05	0.01	0.03	0.01	0.01	0.01	0.1	0.06	0.16	Non-saline	221	288	not aggressive
						0.00	0.88	0.42	0.60	0.65	0.90	0.35							
	489	2	1	1-1.7	-	0.00	0.12	0.04	0.07	0.01	0.02	0.05	0.24	-0.01	0.23	Non-saline	538	704	Cl, SO4
						0.00	1.90	1.02	1.47	0.45	1.75	2.19							
	496	3	1	0-1.5	-	0.00	0.03	0.01	0.06	0.02	0.01	0.01	0.12	0.01	0.13	Non-saline	265	576	SO4
						0.00	0.44	0.34	1.20	0.85	0.55	0.58							
	497	3	1	1.5-2.2	-	0.00	0.03	0.01	0.05	0.01	0.01	0.01	0.11	0.03	0.14	Non-saline	262	480	not aggressive
						0.00	0.52	0.40	1.00	0.60	0.85	0.47							
	509	4	1	0-2.6	-	0.00	0.03	0.02	0.04	0.02	0.01	0.01	0.11	0.05	0.16	Non-saline	308	352	not aggressive
						0.00	0.56	0.62	0.73	0.80	0.75	0.36							
	517	5	1	0.3-3.0	-	0.00	0.04	0.01	0.05	0.01	0.01	0.03	0.13	0.02	0.15	Non-saline	270	512	SO4
						0.00	0.72	0.40	1.07	0.50	0.45	1.24							
	523	6	1	1-1.2	-	0.00	0.11	0.04	0.05	0.01	0.01	0.07	0.23	0.02	0.25	Non-saline	541	544	Cl, SO4
						0.00	1.78	1.14	1.13	0.70	0.50	2.85							
	BD	21	1	0.5-0.7	9.2	0.03	0.12	0.03	0.09	0.01	0.00	0.10	0.32	0	0.38	Non-saline	273	878	
						1.10	1.10	0.77	1.83	0.40		4.20							
	BD	21	1	1.0-2.5	8.5	0.01	0.07	0.004	0.04	0.004	0.00	0.04	0.15	0	0.17	Non-saline	36	384	
						0.44	1.10	0.10	0.80	0.20		1.76							
	BD	21	6	14-15	8.2	0.01	0.05	0.014	0.015	0.002	0.00	0.032	0.10	0	0.12	Non-saline	138	148	
						0.22	0.77	0.39	0.31	0.10		1.40							
	BD	22	1	1.35-1.45	8.3	0.00	0.054	0.021	0.057	0.012	0.00	0.047	0.142	0	0.191	Non-saline	206	571	
							0.88	0.58	1.19	0.60		2.05							
	BD	22	1	2-2.15	8.9	0.015	0.034	0.009	0.113	0.03	0.00	0.042	0.127	0.06	0.238	Non-saline	85	1132	
						0.22	0.55	0.24	2.36	1.50		1.82							
	BD	22	1	2.9-3.1	9.0	0.00	0.027	0.007	0.092	0.014	0.005	0.033	0.138	0.018	0.178	Non-saline	67	917	
							0.44	0.19	1.91	0.70	0.40	1.43							
	BD	22	2	3.1-3.3	8.7	0.00	0.027	0.007	0.048	0.014	0.006	0.007	0.055	0.017	0.109	Non-saline	67	485	
							0.44	0.19	1.01	0.70	0.50	0.31							
	BD	22	6	12-12.2	8.3	0.00	0.034	0.009	0.012	0.004	0.000	0.019	0.062	0	0.078	Non-saline	85	125	
							0.55	0.24	0.26	0.20		0.84							
	BD	23	2	4.5-5.5	8.1	0.00	0.040	0.017	0.122	0.006	0.002	0.072	0.235	0	0.259	Non-saline	170	1219	
							0.66	0.48	2.54	0.30	0.20	3.14							
	BD	23	5	6.8-7.0	8.3	0.00	0.047	0.026	0.015	0.006	0.002	0.029	0.09	0	0.125	Non-saline	256	154	
							0.77	0.72	0.32	0.30	0.20	1.27							
	BD	24	5	10-10.2	7.8	0.00	0.020	0.004	0.024	0.006	0.001	0.012	0.042	0	0.067	Non-saline	36	240	

Annex C Results of Chemical Analysis of Soil Moisture (3/7)

Facility	Lab	Boring No.	Formation	Sampling Interval (m)	pH	Ion Content %/m·mol/100g of soil							Contents %			salting level	Content mg/kg		note about aggressivity absense or aggression factor
													easily dissolving	Gypsum	Total				
						CO_3	HCO_3	Cl	SO4	Ca	Mg	Na	Salt				chlorides	sulphates	
Water Treatment Plant							0.33	0.10	0.50	0.30	0.10	0.51							
	BD	24	6	12.5-12.7	8.2	0.00	0.040	0.007	0.020	0.008	0.000	0.020	0.047	0	0.095	Non-saline	71	197	
							0.64	0.20	0.41	0.40		0.87							
	BD	25	4	8.0-8.2	7.6	0.00	0.020	0.002	0.015	0.008	0.001	0.004	0.018	0.004	0.049	Non-saline	18	149	
							0.33	0.05	0.31	0.40	0.10	0.19							
	BD	25	6	10.15-10.5	8.1	0.004	0.034	0.017	0.015	0.006	0.001	0.025	0.078	0	0.102	Non-saline	170	154	
						0.13	0.55	0.48	0.32	0.30	0.10	1.08							
	BD	26	6	6-6.25	7.6	0.00	0.013	0.014	0.036	0.010	0.002	0.013	0.048	0.02	0.088	Non-saline	138	365	
							0.22	0.39	0.76	0.50	0.20	0.57							
	BD	27	4	5.0-6.0	8.2	0.004	0.027	0.005	0.005	0.006	0.001	0.009	0.033	0	0.057	Non-saline	50	53	
						0.12	0.44	0.14	0.11	0.30	0.10	0.39							
	BD	27	5	7-7.2	8.1	0.003	0.020	0.009	0.017	0.004	0.002	0.014	0.053	0	0.069	Non-saline	85	173	
						0.10	0.33	0.24	0.36	0.20	0.20	0.62							
	BD	28	5	7.0-8.0	8.1	0.00	0.040	0.014	0.050	0.010	0.001	0.013	0.07	0	0.083	Non-saline	138	48	
							0.66	0.39	0.10	0.50	0.10	0.55							
	BD	28	6	9.2-9.6	7.9	0.00	0.020	0.009	0.012	0.008	0.001	0.007	0.03	0	0.057	Non-saline	85	125	

Annex C Results of Chemical Analysis of Soil Moisture (4/7)

Facility	Lab	Boring No.	Formation	Sampling Interval (m)	pH	Ion Content %/m·mol/100g of soil							Contents %			salting level	Content mg/kg		note about aggressivity absense or aggression factor
						CO_3	HCO_3	Cl	SO4	Ca	Mg	Na	easily dissolving Salt	Gypsum	Total		chlorides	sulphates	
WASTE WATER TREATMENT PLANT	566	10	1	1.1-1.3	-	0.00	0.05	0.02	0.03	0.01	0.01	0.01	0.11	0.07	0.18	Non-saline	298	256	not aggressive
						0.00	0.74	0.66	0.53	0.70	0.65	0.58							
	573	11	1	0.3-3.0	-	0.00	0.03	0.03	0.09	0.03	0.01	0.03	0.19	-0.04	0.15	Non-saline	507	864	Cl, SO4
						0.00	0.54	0.82	1.80	1.35	0.70	1.11							
	604	14	0	0-0.3	-	0.00	0.09	0.07	0.31	0.02	0.01	0.18	0.64	-0.44	0.2	Non-saline	1486	3104	Cl, SO4
						0.00	1.46	2.00	6.47	1.00	1.00	7.93							
	609	15	0	0-0.3	-	0.00	0.04	0.06	0.31	0.01	0.01	0.16	0.57	-0.44	0.13	Non-saline	1336	3072	Cl, SO4
						0.00	0.60	1.60	6.40	0.50	1.00	7.10							
	BD	29	4	10.0-11.0	8	0.00	0.020	0.002	0.043	0.014	0.004	0.006	0.037	0.025	0.089	Non-saline	18	398	
							0.33	0.05	0.83	0.70	0.30	0.27							
	BD	29	6	14-14.2	7.6	0.00	0.013	0.046	0.038	0.008	0.005	0.035	0.115	0.013	0.145	Non-saline	461.5	384	
							0.22	1.30	0.80	0.40	0.40	1.53							
	BD	30	4	8.0-9.0	7.6	0.003	0.027	0.010	0.015	0.006	0.000	0.019	0.06	0	0.08	Non-saline	103	163	
						0.10	0.44	0.29	0.31	0.30		0.84							
	BD	30	6	12-12.2	7.2	0.00	0.020	0.055	0.043	0.006	0.001	0.054	0.055	0	0.179	Non-saline	547	427	
							0.33	1.54	0.89	0.30	0.10	2.36							
	BD	31	4	7.0-8.0	7.6	0.00	0.027	0.009	0.017	0.006	0.000	0.019	0.054	0	0.078	Non-saline	85	173	
							0.44	0.24	0.36	0.30		0.84							
	BD	31	6	13-13.2	8	0.00	0.013	0.033	0.028	0.006	0.000	0.032	0.089	0	0.112	Non-saline	326.6	378	
							0.22	0.92	0.58	0.30		1.43							
	BD	32	4	9.0-10.0	8.5	0.01	0.027	0.007	0.031	0.006	0.001	0.018	0.068	0	0.091	Non-saline	67	307	
						0.22	0.44	0.19	0.64	0.30	0.10	0.77							
	BD	32	6	12.5-12.7	8	0.00	0.013	0.041	0.021	0.002	0.001	0.004	0.11	0	0.118	Non-saline	412	211	
							0.22	1.16	0.44	0.10	0.10	1.74							
	BD	33	4	8.0-9.0	8	0.00	0.020	0.020	0.020	0.020	0.020	0.020	0.01	0	0.034	Non-saline	18	38	
							0.33	0.05	0.08	0.30	0.10	0.06							
	BD	33	6	12-12.2	8	0.00	0.027	0.034	0.009	0.002	0.002	0.030	0.096	0	0.104	Non-saline	341	91	

Annex C Results of Chemical Analysis of Soil Moisture (5/7)

Facility	Lab	Boring No.	Formation	Sampling Interval (m)	pH	Ion Content %/m·mol/100g of soil							Contents %			salting level	Content mg/kg		note about aggressivity absense or aggression factor
													easily dissolving	Gypsum	Total				
						CO_3	HCO_3	Cl	SO4	Ca	Mg	Na	Salt				chlorides	sulphates	
Water Intake Tower	533	7	1	0.3-3.0	-	0.00	0.08	0.01	0.04	0.02	0.01	0.01	0.13	0.05	0.18	Non-saline	195	384	not aggressive
						0.00	1.38	0.28	0.80	1.10	0.90	0.46							
	543	8	1	0-4.5	-	0.00	0.05	0.01	0.03	0.01	0.01	0.01	0.09	0.06	0.15	Non-saline	171	288	not aggressive
						0.00	0.80	0.28	0.60	0.40	0.65	0.63							
	548	9	1	0-3.0	-	0.00	0.04	0.01	0.04	0.01	0.00	0.02	0.1	0.05	0.15	Non-saline	203	384	not aggressive
						0.00	0.64	0.30	0.80	0.55	0.40	0.79							
	BD	36	1	0-3.2	7.8	0.00	0.018	0.0017	0.017	0.010	0.0012	0.0025	0.013	0	0.0504	Non-saline	17	171	
							0.30	0.048	0.356	0.50	0.10	0.409							
	BD	36	1	5-5.2	8.1	0.00	0.037	0.0034	0.026	0.0178	0.0037	0.001	0.0373	0	0.157	Non-saline	34	256	
							0.60	0.097	0.533	0.89	0.30	0.042							
	BD	36	1	8-8.2	8.1	0.00	0.031	0.005	0.0071	0.008	0.0024	0.0045	0.0178	0	0.058	Non-saline	51	71	
							0.50	0.145	0.147	0.40	0.20	0.196							
	BD	36	1	9.0-12	8.1	0.00	0.043	0.0017	0.0021	0.0100	0.0037	0.0001	0.0202	0	0.0607	Non-saline	17	21	
							0.70	0.048	0.044	0.50	0.30	0.002							
	BD	36	3	12.0-14.0	7.8	0.00	0.024	0.0017	0.0084	0.0060	0.0024	0.0028	0.015	0	0.0452	Non-saline	17	81	
							0.40	0.05	0.17	0.30	0.20	0.12							
	BD	37	2	1.2-1.35	9.1	0.00	0.05	0.002	0.01	0.01	0.0012	0.013	0.0508	0	0.083	Non-saline	170	134	
							0.80	0.05	0.21	0.40	0.10	0.56							
	BD	37	1	3.2-3.4	8	0.00	0.043	0.0051	0.010	0.010	0.0012	0.013	0.0478	0	0.0804	Non-saline	52	101	
							0.70	0.145	0.211	0.40	0.10	0.56							
	BD	37	1	6.0-12.7	7.8	0.00	0.024	0.0017	0.021	0.008	0.0012	0.0091	0.033	0	0.0652	Non-saline	17	213	
							0.40	0.048	0.444	0.40	0.10	0.396							
	BD	37	3	12.7-14.6	7.8	0.00	0.018	0.0034	0.019	0.006	0.0024	0.0068	0.0317	0	0.0558	Non-saline	34	190	
							0.30	0.097	0.395	0.30	0.20	0.296							
Ishym River	BD	34	3	6.4-7	8.4	0.00	0.020	0.002	0.026	0.006	0.001	0.012	0.043	0	0.067	Non-saline	18	299	
							0.33	0.05	0.54	0.3	0.1	0.52							
	BD	34	4	10.2-10.4	9.1	0.003	0.020	0.010	0.003	0.004	0.001	0.001	0.036	0	0.052	Non-saline	103	34	
						0.1	0.33	0.29	0.07	0.2	0.1	0.49							
	BD	35	3	5.3-6.3	7.8	0.003	0.036	0.007	0.072	0.024	0.004	0.021	0.079	0.044	0.169	Non-saline	67	720	
						0.1	0.55	0.19	1.5	1.2	0.3	0.9							
	BD	35	4	7.0-8.0	7.8	0	0.040	0.012	0.006	0.004	0.0	0.019	0.07	0	0.086	Non-saline	117	62	
							0.66	0.33	0.13	0.2		0.84							

Annex D Results of Chemical Analysis of Water (6/7)

Facility	Borehole No.	Unit	Cation						Anion					pH	Carbonic acid, corrosive	Content of organic substances	Mineralization	Hardness, mg-equiv/dm^2			Corrosive activity of water to cable cover made of		Corrosive activity of water to							
																		Total	Corbonate	Non-carbonate			Concrete of W4 type					Reinforcement of ferroconcrete construction at	
																												permanent immersion	periodical wetting
			Ca^{2+}	Mg^{+}	Na^{+}	K^{+}	Fe^{3+}	NH_4^{+}	HCO_3^{-}	Cl^{-}	SO_4^{2-}	NO_3^{-}	NO_2^{-}		mg/dm^3	mg/dm^3	mg/dm^3				Lead	Aluminium	HCO_3	Mg	NH_4	Na+K	SO_4	Cl	
Water Treatment Plant	21	mg	72	47	495	1.2	0.84	< 0.1	695	145	643	0.6	< 0.01	7.4	1.4	0.72	1852	7.4	7.4	-	L	H	x	x	x	x	x	x	S
		mg-equiv.	3.6	3.8	21.5	0.03	0.05		11.4	4.1	13.4	0.01																	
		%mg-equiv.	12.4	13.1	74.2	0.1	0.2		39.4	14.2	46.4	0.6																	
	22	mg	148	125	223	1.6	< 0.1	0.72	427	170	764	0.01		7.3	1.1	0.21	1648	17.9	7	10.9	L	H	x	x	x	x	x	x	S
		mg-equiv.	7.4	10.5	9.7	0.04		0.04	7	4.8	15.9	< 0.01																	
		%mg-equiv.	26.7	37.9	35	0.2		0.2	253	17.3	0.01																		
	23	mg	132	115	186	0.8	< 0.1	< 0.1	537	110	602	5	< 0.01	7.5	< 1.1	1.24	1415	16	8.8	7.2	L	H	x	x	x	x	x	x	S
		mg-equiv.	6.6	9.4	8.1	0.02			8.8	3.1	12.6	0.081																	
		%mg-equiv.	27.4	39	33.6				35.8	12.6	51.3	0.3																	
	24	mg	140	130	261	1.6	< 0.1	0.18	561	170	720	5	< 0.01	7.5	< 1.1	0.207	1705	17.6	9.2	8.4	L	H	x	x	x	x	x	x	M
		mg-equiv.	7	10.6	11.4	0.04		0.1	9.2	4.8	15	0.081																	
		%mg-equiv.	24.1	36.5	39.3	0.1			31.7	16.5	51.5	0.3																	
	25	mg	120	61	138	1.9	0.48	< 0.1	477	219	145	< 0.5	< 0.01	7.7	< 1.1	0.21	925	11	7.8	3.2	L	H	x	x	x	x	x	x	S
		mg-equiv.	6	5	6	0.05	0.26		7.8	6.2	3																		
		%mg-equiv.	34.7	28.9	34.7	0.2	1.5		45.9	36.5	17.6																		
	26	mg	100	42	388	0.8	< 0.1	< 0.1	551	393	264	< 0.5	< 0.01	7.5	< 1.1	0.72	1463	8.4	8.4	-	L	H	x	x	x	x	x	x	M
		mg-equiv.	5	3.4	16.9	0.02			9	11.1	5.5																		
		%mg-equiv.	19.8	13.4	66.8				35.2	43.3	21.5																		
	27	mg	88	66	340	1.2	0.48	< 0.1	747	216	304	< 0.5	1.16	7.3	< 1.1	1.76	1390	9.8	9.8	-	L	H	x	x	x	x	x	x	M
		mg-equiv.	4.4	5.4	14.8	0.03	0.26		12.2	6.1	6.3		0.025																
		%mg-equiv.	17.7	21.7	59.5	0.1	1		49.6	24.8	25.6																		
	28	mg	112	88	964	1.2	0.4	< 0.1	709	583	1265	< 0.5	< 0.01	7.5	< 1.1	4.34	3368	12.8	11.6	1.2	L	H	x	x	x	x	M	x	M
		mg-equiv.	5.6	7.2	42	0.03	0.02		11.6	16.4	26.4																		
		%mg-equiv.	10.2	13.1	76.6	0.1			21.3	30.1	48.6																		

Annex D Results of Chemical Analysis of Water (7/7)

Facility	Borehole No.	Unit	Cation						Anion					pH	Carbonic acid, corrosive	Content of organic substances	Mineralization	Hardness, mg-equiv/dm^2			Corrosive activity of water to cable cover made of		Corrosive activity of water to							
																							Concrete of W4 type					Reinforcement of ferroconcrete construction at	
																												permanent immersion	periodical wetting
			Ca^{2+}	Mg^{+}	Na^{+}	K^{+}	Fe^{3+}	NH_4^{+}	HCO_3^{-}	Cl^{-}	SO_4^{2-}	NO_3^{-}	NO_2^{-}		mg/dm^3	mg/dm^3	mg/dm^3	Total	Corbonate	Non-carbonate	Lead	Aluminium	HCO_3	Mg	NH_4	Na+K	SO_4	Cl	
Sewerage Treatment Plant	29	mg	160	245	931	0.4	< 0.1	< 0.1	1175	1202	738	< 0.5	0.46																
		mg-equiv.	8	20	41	0.01			19.3	33.9	15.4		0.1	7.2	< 1.1	5.38	3864	28	19.3	8.7	L	H	x	x	x	x	x	x	M
		%mg-equiv.	11.6	29	59.4				28.1	49.4	22.5																		
	30	mg	140	271	830	0.4	0.1	< 0.1	979	1205	720	< 0.5	< 0.01																
		mg-equiv.	7	22	36	0.01	0.01		16.1	33.9	15			7.2	< 1.1	3.83	3656	29	16.1	12.9	L	H	x	x	x	x	x	x	M
		%mg-equiv.	10.8	33.8	55.4				24.8	52.2	23																		
	31	mg	120	184.8	1247	1.5	< 0.1	0.18	1456	1120	970	< 0.5	< 0.01																
		mg-equiv.	6	15.4	54.2	0.04		0.01	23.9	31.5	20.2			7.3	< 1.1	4.86	4374	21.4	21.4	-	L	H	x	x	x	x	x	x	M
		%mg-equiv.	7.9	20.4	71.6	0.1			31.6	41.7	26.7																		
	32	mg	168	105	900	17.6	0.48	0.18	967	872	776	< 0.5	< 0.01																
		mg-equiv.	8.4	8.6	39	0.45	0.03	0.01	15.9	24.6	16.2			7.3	< 1.1	10.55	3322	17	15.9	1.1	L	H	x	x	x	x	x	x	M
		%mg-equiv.	14.9	15.2	69	0.8	0.1		28	43.4	28.6																		
	33	mg	76	127	794	0.8	< 0.1	5.4	808	539	983	36.2	0.6																
		mg-equiv.	3.8	10.4	35	0.02		0.3	13.2	15.2	20.5	0.58	0.013	7.5	-	2.79	2963	14.2	13.2	1	L	H	x	x	x	x	x	x	M
		%mg-equiv.	7.7	21	70.7			0.6	26.7	30.7	41.4	1.2																	
Ishym River	34	mg	156	53	48	5.4	< 0.1	0.82	470	229	4.8	< 0.5	< 0.01																
		mg-equiv.	7.8	4.4	2.1	0.14		0.05	7.7	6.5	0.1			7.2	1.1	0.72	966	12.2	7.7	4.5	L	H	x	x	x	x	x	x	S
		%mg-equiv.	53.8	30.4	14.5	1		0.3	53.8	45.5	0.7																		
	35	mg	265	84	229	5.5	< 0.1	0.56	549	592	226	< 0.5	< 0.01																
		mg-equiv.	13.2	7	10	0.14		0.03	9	16.7	4.7			7.4	< 1.1	42.1	1677	20.2	9	11.2	L	H	x	x	x	x	x	x	M
		%mg-equiv.	43.5	23	32.9	0.5		0.1	29.6	54.9	15.5																		

Note: " x " means " not corrosive" , " L " means " low corrosive" , " S " means " slightly corrosive" , " M " means " medium corrosive" , " H " means " high corrosive"

Annex E Concrete Permeability Attributes

Conventional signs of a concrete permeability attribute	Direct		Indirect	
	Concrete type according to its water-proof ability	Filtration ratio, cm/s (at moisture equilibrium), K_f	Water absorption, % by weight	Water-cement proportion, not larger than
N – concrete of normal permeability	W4	from 2×10^{-9} to 7×10^{-9}	from 4.7 to 5.7	0.6
L – concrete of low permeability	W6	from 6×10^{-10} to 2×10^{-9}	from 4.2 to 4.7	0.55
V – concrete of very low permeability	W8	from 1×10^{-10} to 6×10^{-10}	up to 4.2	0.45

Note: 1. Filtration ratio and concrete type according to its water-proof ability should be defined by GOST 12730.5-84; concrete water-absorption – by GOST 12730.3-78

2. Water-absorption and water-cement proportion attributes (given in table 1) are referred to hard concrete. Light concrete water-absorption should be defined by multiplying of the values from table 1 by the coefficient, equal to the ratio of hard concrete medium density to light concrete medium density. Water-cement proportion of light concrete should be defined by multiplying of the value given in table 1 by 1.3.

3. Further on in the text, the value of concrete permeability is given according to the water-proof ability attribute.

Source: USSR(1986) SNiP 2.03.11-85 Protection from corrosion for building construction