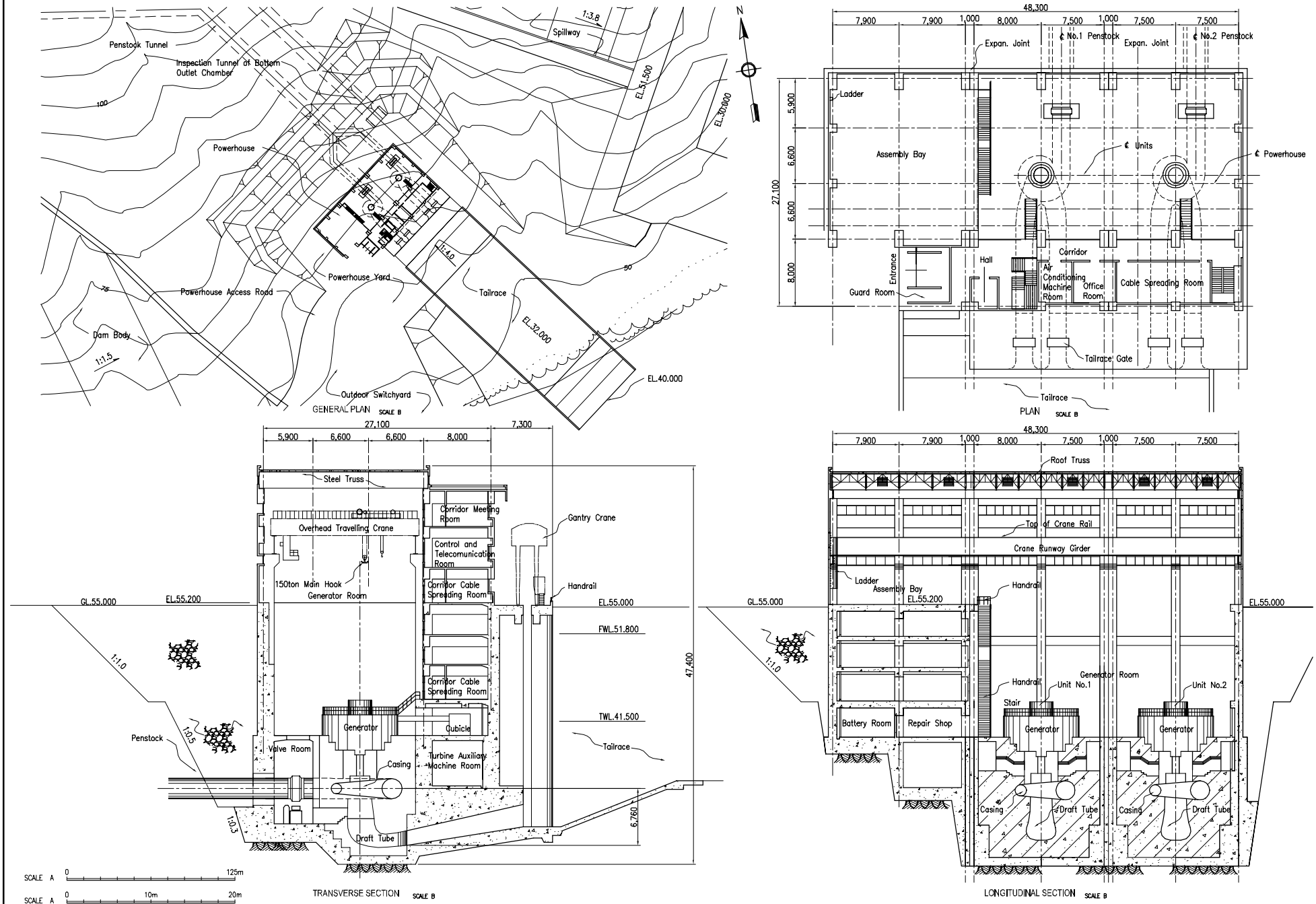


Figure 8.7 Plan, Profile and Section of Agos Powerhouse

CHAPTER IX CONSTRUCTION PLAN AND COST ESTIMATE

9.1 Conditions and Assumptions

9.1.1 Workable Days

Based on the annual rainfall data for 10-year period between 1991 and 2000, the annual total and monthly mean workable days for respective work activities are determined as follows:

Number of Workable Days

Work Activities	Annual Total	Monthly Mean
Excavation	271 days	23 days
Embankment	247 days	21 days
Structural Works	263 days	22 days
Pipe laying	263 days	22 days
Tunneling	304 days	25 days

The details of the rainfall records and the basis of the analysis in respect of the above are described in Annex J of Volume V.

9.1.2 Construction Materials

Rock materials for dam embankment and aggregate materials for concrete will be obtained from the proposed quarry site, approximately 1 km upstream from Agos Dam site. A part of excavated rock materials from spillway will also be utilized for dam embankment.

Construction materials other than the earth materials, such as cement, reinforcement steels, fuel, explosives and timbers, can be procured in the local market.

Steel pipes larger than 3 m diameter will be imported or a new pipe manufacturing plant may alternatively be established at the site, while the other small diameter pipes (less than 3.0 m) can be procured in the local market. Steel sheetpiles and H-beams to be used for trench excavation for steel pipe installation will also be imported.

9.1.3 Development Stage

The project will be executed in 3 stages, each comprising the following work components:

Stage 1: 1st Waterway from Kaliwa Low Dam to Water Treatment Plant, and Water Treatment Plant #1 and Waterway up to Service Reservoirs

Stage 2: Stage 2-1; Agos Dam and Water Treatment Plant #2
Stage 2-2; 2nd Waterway and Water Treatment Plant #3 & #4

The construction works will be procured through international and local competitive bidding for the packages varying by type of the project (either government project or BOT project) and also type of the construction works.

9.2 Construction Plan for Stage 1 Development

9.2.1 Kaliwa Low Dam and Intake

(1) Kaliwa Low Dam

The dam is designed as a temporary structure of random fill using the materials obtained from the intake and tunnel excavation works. The upper face of the dam is covered with impervious earth fill, which is also from the nearby excavation work. Top portion of the upstream face and the whole downstream face are protected with wood cribs filled with rocks to protect the face from damage caused by the overtopping of flow. The proposed plan is shown in Figure 7.2 in Chapter VII.

The dam body will be constructed in 2 steps: firstly the construction of sand flushing sluice and intake structures and secondary the embankment of dam body. At each stage, a temporary cofferdam will be built with earth embankment to make the work area dry. During the Step-1 period, the river flow is through the present river channel and during the Step-2 period, through a sand flush sluice constructed in the Step-1 period.

Earthworks will be carried out using bulldozer, backhoe, wheel loader, compaction roller, dump truck, while concrete for sand flush sluice/channel will be placed by means of crane with skip and concrete pump.

(2) Intake Structure

The intake structure, consisting of 2 nos. of water intake and gate shaft (one is for the 1st waterway and the other for the 2nd waterway), will be constructed on the right side of the dam body in order to feed water to conveyance tunnel (Tunnel No.1).

The whole framework structure of intake, i.e. 2 intakes, will be constructed under this 1st stage period (Stage 1), since the area is flooded once the Agos Dam is impounded. The work includes the full installation of the 1st intake equipment including gates, hoist and stoplogs, while for the 2nd intake only the framework structure and a part of Tunnel No.1 (some 30 m in length) will be constructed.

9.2.2 Kaliwa – Taytay 1st Waterway

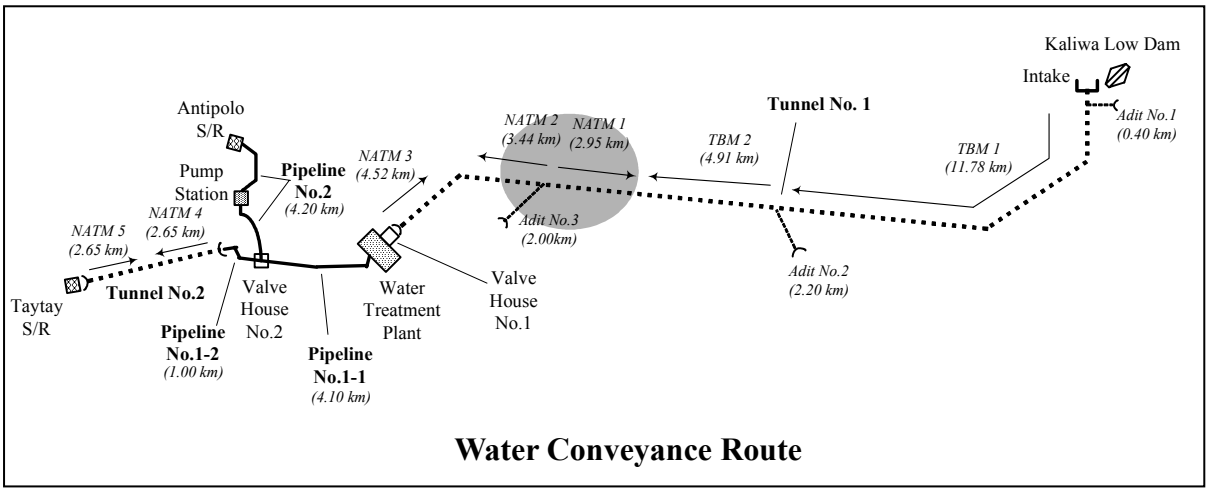
(1) General

The 1st waterway is planned to transfer water from Kaliwa Low Dam to service reservoirs at Antipolo and Taytay. The general plan and profile of the waterway are shown in Figure 7.1 in Chapter VII.

Raw water taken at Kaliwa Low Dam is transferred to water treatment plant through a 27.5 km long tunnel with 3.5 m diameter (Tunnel No.1), and the water treated at the water treatment plant will then be conveyed to the respective

reservoirs through pipelines and a tunnel (Tunnel No.2). The construction period is planned to be 5 years in total.

A schematic layout is shown below together with indication of the lengths and the proposed plan of tunneling work.



Water Conveyance Route

(2) Tunnel No.1

Since the Tunnel No.1 is the most critical activities out of the 1st waterway construction works, the tunneling method by using Tunnel Boring Machine (TBM) is planned for the longest possible sections so that the earliest completion can be achieved.

Tunnel No. 1 is planned to have 5 excavation faces by providing 3 access adits. Based upon the available geological information at this stage, it is planned that about 16.7 km out of 27.6 km is driven by TBM while the rest of the tunnel is constructed by New Austrian Tunneling Method (NATM) with shotcrete and rock-bolt supporting. The 3 adits will also be excavated by NATM.

Typical tunnel section is a circular shape with 3.5m in finished diameter for both the TBM and NATM sections.

The progress rate of tunneling by TBM is expected to be 400 m/month (although it may be rather conservative figure) based on the available geological information and the actual progress records in the Umiray-Angat Tunnel that attained a progress of 540 m/month. The progress rate in NATM sections is expected to be 130 m/month based on the available geological information and cycle-time analysis.

Approximately 450,000 m^3 of tunnel muck will be produced from the tunnel excavation. The majority of the muck will be disposed to the nearby spoil bank of the respective work adit portals, while some will be used for internal temporary access roads at the site.

Upon the completion of the tunnel excavation, concrete lining of 350-mm thickness will then be executed. Progress rate of concrete lining with use of telescopic forms is estimated to be 1,000 m/month.

According to the geological information available at this stage, the tunnel will encounter fault zones at several locations. In order to reduce the ingress water and/or improve the ground conditions, auxiliary measures such as forepoling grouting will be carried out during the course of tunnel excavation.

(3) Valve House No.1

Valve House No.1 is constructed at the western end of Tunnel No.1 in order to control the quantity of water flowing into water treatment plant from Tunnel No.1.

Quantities of earthworks and concrete works are calculated at 74,000 m^3 and 3,700 m^3, respectively. In this construction stage (Stage 1), three butterfly valves and three sleeve valves are planned to be installed.

(4) Morong Water Treatment Plant – 1st Development

The Morong water treatment plant is planned to be constructed in 2 stages: a half area in this Stage1 (for accommodating two plant units: #1 unit to be installed in Stage 1 and #2 unit in Stage 2-1) and the remaining half area in Stage 2-2 (for #3 and #4 units).

The elevation of the area ranges from EL. 90-100 m in the relatively flat areas to EL. 120 m on the hilltops. The area consists of a mixture of fruits plantation, paddy field, uncultivated land and hilly areas with about 25 housings at scattered locations. The plan envisages acquiring a total land of about 110 ha including earth disposal area. The Stage 1 work will be constructed in the area of about 60 ha.

Earthworks to provide a 60 ha land require some 4 millions m^3 of cut and fill. Many kinds of heavy machinery such as 44 ton bulldozer with ripper, 10 m^3 class wheel loader, 3 m^3 class backhoe (or larger), and 46 ton dump truck will be employed to deal with 4 million m^3 earthworks within a limited construction period. In order to dispose the surplus excavated materials, spoil bank is planned at the nearby locations.

Upon the completion of site formation works, structural works will then be carried out at every location of the site. The water treatment plant consists of many structures including receiving well, mixing chamber, flocculation basin, sedimentation basin, rapid sand filter, clear water basin, sludge thickening tank, and sludge drying bed. The concrete will be produced at and transported from a central batching plant installed at the site.

At the locations where the structural works have been completed, the mechanical and the electrical works will then be done accordingly.

(5) Pipelines

Embedded pipelines will be installed for the length of 5.1 km in total between the water treatment plant and Tunnel No.2 (main pipeline) and 4.1 km between Valve House No.2 and Antipolo Service Reservoir (branch pipeline). The diameter is 3.4-3.3 m for the main pipeline and 1.6 m for the branch pipeline, respectively.

The installation of pipes requires the excavation of a trench which is as deep as 6.6 m. The work will require the use of steel sheetpile walling with strut supports in the sections of lowland area where soft silt-clay layers are dominant. It is expected that sheetpiling be needed for some 60 % of the total length of the pipelines to be installed. The rest of the pipeline will be installed after the open cut excavation without sheetpiling.

Following the trench excavation, steel pipes of each 9m (or 6m) long segment will then be installed in position by a 150-ton class capacity crawler crane. Each steel pipe will be connected properly by the internal welding method.

Upon the completion of the pipe installation, backfill with adequate compaction will be executed and sheetpile coffer-wall then removed. However, one side of the sheetpile wall will be left in-situ without extraction, which would be used later as a wall for the 2nd pipeline construction.

Similar construction method will be adopted for the 1.6m diameter pipeline. It is estimated that the sheetpiling be needed for some 20 % section of the total length of the pipeline.

(6) Tunnel No.2

Tunnel No.2 (5.3 km long) will be constructed by NATM taking into account varying geological conditions foreseen for this tunnel.

As discussed in Section 4.4, limestone mass and confined groundwater are anticipated at the eastern half of this tunnel. In order to reduce ingress water and/or improve ground conditions, auxiliary measures including forepoling method will be carried out during the course of tunnel excavation.

The progress rate of tunnel construction by NATM is expected to be 80m/month. The tunnel is to be excavated by 2 fronts from both portals at Teresa and Taytay.

Upon the completion of the tunnel excavation, concrete lining will be applied with steel lining in partial sections. The gap between the tunnel-excavated surface and steel pipe will be filled with concrete.

(7) Service Reservoirs

At the Stage 1, a reservoir of 180,000 m^3 storage capacity will be constructed at Taytay and a 30,000 m^3 reservoir at Antipolo. The reservoir is of reinforced concrete construction for both the sites.

The construction work will be initiated with site clearance and site formation work by using bulldozer, backhoe, compaction roller and dump truck. Following the site formation work, structural works and equipment installation works will then be done using crawler/truck crane and concrete pump. The conventional construction methods will be adopted for all the works.

(8) Pump House

The proposed work is a conventional type of construction. Since soft silt-clay layer overlies a part of the site, the pump house needs to be built on pile foundation. The

excavation for building foundation will require a proper drainage arrangement in view of the location in paddy fields at the foot of hills.

9.3 Construction Plan for Stage 2-1 Development

9.3.1 Agos Dam

(1) General

Agos Dam with power generation facilities is constructed just downstream of the confluence of the Kanan and Kaliwa Rivers, about 20 km upstream of the river mouth of the Agos River. Acquisition of lands and re-settlement of the affected households will have to be completed before the commencement of the construction works.

During the construction works, various temporary facilities such as the employer's offices, contractor's site offices and camps, aggregate/concrete plant, rock quarry, stockpile area, spoil bank, etc. will be built. A preliminary layout plan of the temporary facilities at the Agos Dam site is shown in Figure 9.1.

By the time when Agos Dam is completed, trees in the reservoir-impounding area are to be thoroughly cut and removed in order to avid the deterioration of reservoir water after the impoundment.

Total construction period covering both the dam and hydropower plant is planned to be nearly 6 years in total.

(2) River Diversion Work

Prior to the main dam construction, the river flow is to be diverted through 2 diversion tunnels of 10-m diameter, built one each on the both banks. The length of the diversion tunnels is 1,589 m on the right bank and 772 m on the left bank, respectively. The layout plan is shown in Figure 8.1 in Chapter VIII.

Two upstream cofferdams will be constructed; one each on the Kanan River and Kaliwa River. In order to balance the water levels of the ponds created upstream of the cofferdams, one connecting tunnel (water balance tunnel) with 6-m internal diameter is also to be constructed. The tunnel is planned to be unlined. The length of the tunnel is about 372 m.

The diversion tunnels will be excavated by NATM using 3-boom hydraulic wheel jumbo, side dump wheel loader, backhoe, and dump truck. Construction of the tunnels is on the critical path of the project and hence the earliest completion is a prerequisite requirement. Taking into account the progress rate and the length of the tunnels, 4 sets of tunneling plants are planned for this work. Two sets will be used for the right bank diversion tunnel, one each at the inlet and outlet portals, while the remaining 2 sets will be allocated for the left bank diversion tunnel and connecting tunnel.

The monthly progress rate of tunnel excavation is expected to be 80 m/month based on the available geological information, plants capacity, and cycle time analysis.

The temporary support for excavated tunnel will be made by means of shotcrete and rock bolts. Concrete lining work will follow the tunnel excavation works accordingly. The tunnel wall and crown concrete will be placed at first by a circular travelling form to allow concurrent work with excavation work. Invert concrete will be placed separately afterward.

Upon the completion of 3 tunnels in about 13 months time, upstream and downstream cofferdams will then be constructed to divert the river flow into the diversion tunnels.

In order to avoid seepage through dam body and to prevent piping phenomenon, the upper face of the both cofferdams will be covered with impervious materials. Slurry wall with 800mm thickness will be constructed at the upstream toe of both upstream cofferdams to prevent water seepage under the cofferdams.

An access road to the proposed quarry site will be constructed upon the completion of the cofferdam embankment.

(3) Main Dam

The proposed dam is a concrete face rockfill dam (CFRD) laid out as shown in Figures 8.1 and 8.2 in Chapter VIII.

Upon the completion of site clearance, excavation for dam foundation will then be executed from higher portion toward lower portion, while the earthworks at the lowest portion needs to await the diversion of river flow. Sufficient dewatering system is to be established and maintained during the course of the excavation for the lowest portion (at upstream toe of the dam) since the considerable amount of underground water ingress is anticipated through the upstream riverbed. The excavation at this portion is to be executed in the relatively dry period, i.e. between February and September.

The excavation will be executed using bulldozer with ripper, backhoe, loader, and dump truck. The rock excavation will be done in combination with blasting method.

In parallel with the excavation operation at the damsite, the proposed quarry site (approximately 1 km from damsite) is to be developed and be made available by the time when embankment for dam body is commenced.

The dam embankment volume is estimated at about 13,000,000 m^3 in total. The materials for the embankment will be obtained from the proposed quarry site and partly from the spillway excavation. It is anticipated that 50% of the excavated rock from spillway be reused for dam embankment.

The embankment work will be carried out using heavy machines such as bulldozer for spreading and vibrating roller for compaction. Some 400,000 m^3 of rockfill per month will have to be embanked in order to achieve the scheduled completion.

The face slab concrete will be placed with slip form. Concrete is delivered to the dam site by agitator trucks from a batching plant and further conveyed to the placing location by concrete chute, crane with skip or concrete pump. The slip

form will move at a travelling speed of 1.5 m/hr and the concrete will continuously be placed without making any horizontal joint once the work operation is started. The face slab concrete work will be carried out in 3 to 4 stages for the whole surface of the dam.

(4) Spillway

Spillway is located on the left side bank of the main dam.

Excavation work will be commenced from the higher portion to downward direction along the chuteway with bench cut method. The excavation work for both earth and rock (about 9,000,000 m^3 in total) will be carried out using various heavy machines such as bulldozer, backhoe, crawler drill and dump truck in combination with blasting operation (for rock portion). The selected rock materials from the spillway excavation are partly used for dam embankment as stated above. Rock quantity expected to be usable for dam embankment is about 4,300,000 m^3, while the rest will be hauled to the spoil bank.

Concrete work for the spillway construction, i.e. fore-bay structure, overflow weir, chuteway and plunge pool walls, will be done by combination of various equipment including fixed type tower crane, crawler/truck crane and concrete pump.

Electrical and Mechanical works including radial gates (11m(h)x14m(w)x4nos.) and stoplogs will be carried out upon the completion of structural works.

Plunge pool will be excavated to the designated level after the left side diversion tunnel is closed and the downstream cofferdam is relocated to further downstream by about 300m. Closure of the left side diversion tunnel is to be done at the beginning of the dry season to allow the plunge pool construction to be executed in the relatively dry period. During the course of excavation, proper dewatering system is to be established and maintained since a considerable amount of seepage water is anticipated.

(5) Hydropower Facilities

The hydropower plant and switchyard will be constructed at the toe of the Agos Dam. The works for power facilities consisting of intake structure, gate shaft, headrace tunnel, penstock line and powerhouse will be carried out in parallel with the main dam embankment and spillway construction.

Following the excavation works, concrete works for powerhouse substructure will be carried out using the same equipment used for the spillway construction. Installation of overhead travelling crane in the powerhouse superstructure will be a milestone event for the succeeding installation of generating equipment.

9.3.2 Water Treatment Plant - Installation of Unit #2

During the construction of the Agos Dam, an additional unit of water treatment plant is installed at the adjacent area of Unit #1 installed under the Stage 1. Since the site formation work is planned to be completed in the Stage 1, the work involved at this stage is limited to the structural and mechanical works for the Unit #2.

9.4 Construction Plan for Stage 2-2 Development

In order to double the water supply capacity, the 2nd waterway will be constructed in the Stage 2-2. The alignment of the 2nd waterway is in parallel with the existing 1st waterway.

(1) Waterway Intake

As described in Subsection 9.2.1 before, the structural works for the 2nd waterway are planned to be constructed in the Stage 1. The works carried out in this stage are mechanical works (installation of gates, hoists, stoplogs and trashracks) and the associated electrical works.

All the mechanical works are to be installed and fixed at proper positions using crawler/truck crane. A crane with skip will handle the associated concrete work.

(2) Tunnel No.1

The same tunneling method (TBM and NATM) as proposed for the 1st tunnel will be adopted for the 2nd stage tunneling as well. The tunneling work in this Stage 2-2 could be carried out with a more confidence compared with the case of the 1st tunnel, since the tunnel geology will have been clarified in detail through the experience in the 1st tunnel.

The existing access adits, namely Adit No.1, Adit No.2, and Adit No.3 used in the Stage 1, will also be utilized for the 2nd stage construction, with necessary repairs and/or reinforcement of damaged portions that has taken place during the elapse of time since the Stage 1. The construction period of the 2nd tunnel could be reduced by about 1 year because of the immediate access to the tunnel site through the existing adits.

(3) Valve House No.2

Since all the civil works will have already been completed in Stage 1, installation of valves and associated equipment for the 2nd waterway will be carried out in this stage.

(4) Water Treatment Plant – 2nd Development

The plant will be expanded to double the production capacity by accommodating Unit #3 and #4. The work is almost same as conducted in the Stage1. The site formation work involves cut-and-fill of about 6,800,000 m^3 for the expansion of the plant area by 50 ha.

Plan units #3 and #4 will be installed in 2 successive stages at interval of 3 years.

(5) Pipelines

The pipelines will be laid in parallel with the 1st stage pipeline in principle. At the locations where sheetpile coffer walling will have been applied in the 1st stage construction, the distance between the pipes (edge to edge) will be the same as the diameter of the pipes laid. In the sections where the open cut excavation will have been applied in the 1st stage construction, the distance between the pipes (edge to edge) will be about 10 m.

(6) Tunnel No.2

The 2nd tunnel will be excavated in parallel with the 1st tunnel in the upstream part. The distance between the 2 tunnels is 20 m. The tunnel in the downstream part is aligned so as to take a shortest length to the proposed outlet site in the Taytay Service Reservoir.

A faster progress of the tunneling is expected since the work could be arranged with advance knowledge of in-situ geology obtained through the experience in the 1st tunnel.

(7) Service Reservoirs and Pump House

The construction work at this stage is virtually the expansion of facilities by building structures similar to those built under the Stage 1. The work will use the same method as adopted in the Stage 1 work.

9.5 Construction Schedule

Construction schedule of the proposed project was worked in consideration of required duration of each work activity, sequence of the works, progress rates, seasonal constraints (weather and river flow conditions) and availability of construction resources.

The proposed schedule is shown in a bar chart form in Figure 9.2. The detailed programs for tunnels and Agos Dam are presented in Annex J of Volume V.

9.6 Construction Cost Estimate

9.6.1 Conditions and Assumptions

The project cost was estimated based on the following conditions and assumptions:

(1) The project cost is composed of Foreign Currency (F.C.) portion and Local Currency (L.C.) portion. The estimated cost is expressed in US dollar (US$) for both the foreign and local currency portions.

(2) The local currency component covers the cost of locally available materials including cement, reinforcement steel, fuel, explosives and local labors. The cost of imported machinery for mechanical and electrical works and depreciation of construction equipment are allocated to the foreign currency portion.

(3) The price level of the estimate is as at June 2002 and the exchange rate used in the estimate is US$ 1.0 = Philippine Peso 52.0.

(4) Competent contractors selected through international competitive bidding (ICB) and local competitive bidding (LCB) will undertake the construction works.

The unit prices of the works are determined by referring to the prevailing unit costs of labors, construction materials and equipment in principle. The allocation of F.C. and L.C. is made by applying an assumed percentage for each type of the work based on the latest bidding information for the similar projects in the Philippines and the other Asian countries.

9.6.2 Method of Cost Estimate

The cost estimate for respective cost categories is made by the following manner:

(1) Preparatory Works

Preparatory works include the construction of new access road to the site, existing road improvement, construction plant including batching plant and quarry plant, offices, base camps, power supply system, water supply system, and all other necessary preparatory works required for proceeding with the main works.

The construction cost for the new access roads and existing road improvement are estimated by unit price method based on the lengths measured on 1:50,000 map. The cost of other preparatory works is estimated on a lump sum basis at 12 % of the cost of the main works.

(2) Civil Works

Construction cost of the civil works including earthworks, structural works, tunneling works, pipe laying, etc. is estimated by unit price method based on the quantities measured from the preliminary design drawings.

(3) Metal Works and Electrical Equipment

For the metal works such as gate, penstock and valve, the unit price estimating method is applied. The weight of steel structures is estimated based on principal dimensions proposed in preliminary designs.

For the power plant equipment and other electrical works, estimate on lump sum basis is applied based on the empirical cost formula taking account of various parameters such as design head, discharge, capacity, dimensions, etc. The recent bidding data for the similar works are also referred to in determining the respective unit prices or lump sum cost.

(4) Land Acquisition and Resettlement

Land acquisition and resettlement cost is estimated by unit price method taking into account the quantities revealed in the EIA study discussed in the Chapter V.

(5) Engineering and Administration Cost

The cost for engineering service for detailed design, procurement of the works, and construction supervision is estimated at 5.0% of the total of construction cost and land acquisition/resettlement cost.

Administration expense of the executing agency is estimated at 2.5% of the total cost of construction cost and land acquisition/resettlement cost.

(6) Physical Contingency

Physical contingency is estimated at 15 % of the total cost of above items.

(7) Tax

Local tax imposed on the project cost is estimated at 10 % of the above total cost, covering both the foreign currency portion and local currency portion.

(8) Price Contingency

Price contingency is estimated applying the assumed annual price escalation rates of 2.0 % and 3.0 % for foreign currency portion and local currency portion, respectively.

9.6.3 Total Project Cost

The total project cost is estimated at US$ 2,543 million equivalent (equivalent to PhP 132.2 billion), comprising foreign currency portion of US$ 1,599 million (PhP 83.1 billion) and local currency portion of US$ 944 million (PhP 49.1 billion). The details of the estimated project cost for each implementation stage is shown in Tables 9.1 and 9.2.

Estimated Total Project Cost

Description	FC (10^6US$)	LC (10^6US$)	Total (10^6US$)
Construction Cost	917	482	1,399
Engineering Service	46	24	70
Administration Expense	23	12	35
Physical Contingency	148	78	226
Price Contingency	352	288	640
Tax	113	60	173
Total	1,599	944	2,543

9.6.4 Annual Disbursement Schedule

The annual disbursement schedule is worked out based on the estimated project cost and construction time schedule as follows:

Summary of Annual Disbursement Schedule

(Unit: 10^6 US$)

Year	Stage 1	Stage 2-1	Stage 2-2	Total
2005	5			5
2006	7	1		9
2007	9	1		10
2008	9	3		12
2009	77	3		79
2010	141	3		144
2011	165	64		229
2012	169	174		343
2013	107	152		258
2014		141	2	142
2015		251	58	310
2016		190	143	332
2017			179	179
2018			173	173
2019			98	98
2020			0	0
2021			109	109
2022			111	111
Total	690	982	871	2,543

Note: The above annual costs include price contingency and tax.

Table 9.1 Project Cost Summary

Description	F.C. (US$)	L.C. (US$ equiv.)	Total (US$ equiv.)
Stage 1 Kaliwa Low Dam + 1st Waterway			
(1) Kaliwa Low Dam + 1st Waterway (excluding WTP #1)			
Land Acquisition & Resettlement excluding WTP #1	0	20,970,525	20,970,525
Kaliwa Low Dam (Temporary)	8,846,139	7,219,177	16,065,316
Waterway to Valve House No.1	123,157,716	40,292,011	163,449,727
Valve House No.1	2,377,927	1,102,818	3,480,745
Waterway from WTP to Reservoi	75,991,207	28,563,732	104,554,939
Sub-total for (1)	210,372,988	98,148,264	308,521,252
(2) Water Treatment Plant #1			0
Land Acquisition & Resettlement for WTP #1 and #2	0	2,556,516	2,556,516
Waterway Facility (WTP #1)	67,793,676	33,983,004	101,776,681
Sub-total for (2)	67,793,676	36,539,521	104,333,197
TOTAL for Stage 1	278,166,664	134,687,785	412,854,449
Stage 2-1 Agos Dam + WTP #2			
(1) Agos Dam			
Land Acquisition & Resettlement	0	16,702,920	16,702,920
Agos Dam	236,686,200	153,611,623	390,297,823
Agos Hydropower Facility	54,417,488	10,970,794	65,388,282
Sub-total for (1)	291,103,688	181,285,336	472,389,024
(2) Water Treatment Plant #2 + Service Reservoirs #2	47,769,758	26,113,283	73,883,041
TOTAL for Stage 2-1	338,873,446	207,398,619	546,272,065
Stage 2-2 Kaliwa Angono 2nd Waterway + WTP #3 & #4			
(1) 2nd Waterway (excluding WTP #3)			
Land Acquisition & Resettlement excluding WTPs	0	6,265,486	6,265,486
Kaliwa Low Dam (Temporary)	239,652	159,768	399,420
Waterway to Valve House No.1	100,288,106	34,273,271	134,561,376
Valve House No.1	1,239,235	137,693	1,376,928
Waterway from WTP to Reservoi	63,448,980	24,938,261	88,387,241
Sub-total for (1)	165,215,973	65,774,478	230,990,451
(2) Water Treatment Plant #3			
Land Acquisition & Resettlement for WTP #3 & #4	0	3,931,064	3,931,064
Waterway Facility	66,694,307	36,715,879	103,410,186
Sub-total for (2)	66,694,307	40,646,943	107,341,250
(3) Water Treatment Plant #4 + Service Reservoir #4	68,219,974	34,159,294	102,379,268
TOTAL for Stage 2-2	300,130,254	140,580,715	440,710,969
A. Total Construction Cost including Land Acquisition and Resettlement	**917,170,364**	**482,667,119**	**1,399,837,483**
B. Engineering Service (A x 5.0%)	**45,858,518**	**24,133,356**	**69,991,874**
C. Administration Expense (A x 2.5%)	**22,929,259**	**12,066,678**	**34,995,937**
D. Physical Contingency ((A+B+C) x 15%)	**147,893,721**	**77,830,073**	**225,723,794**
TOTAL PROJECT COST at 2002 Price	**1,133,851,863**	**596,697,226**	**1,730,549,088**
E. Tax ((A+B+C+D) x 10%)	**113,385,186**	**59,669,723**	**173,054,909**
F. Price Contingency	**351,835,550**	**287,865,450**	**639,701,000**
TOTAL FUND REQUIREMENT *	**1,599,072,599**	**944,232,398**	**2,543,304,997**

* Based on a proposed implementation schedule. Excluding interest during construction

Table 9.2 Construction Cost Summary (1/2)

Stage 1 Kaliwa Low Dam + 1st Waterway	F.C.	L.C.	TOTAL
1 Kaliwa Low Dam + 1st Waterway (excluding WTP #1)			
(1) Land Acquisition & Resettlement excluding WTP #1			
Land Acquisition	0.0	6,260,125.0	6,260,125.0
Resettlement and Compensation	0.0	14,710,400.0	14,710,400.0
Sub-total for (1)	0.0	20,970,525.0	20,970,525.0
(2) Kaliwa Low Dam (Temporary)			
Preparatory Works	1,671,014.9	1,255,626.1	2,926,641.0
Kaliwa Low Dam	3,966,391.0	3,429,734.0	7,396,125.0
Intake Structure	3,208,733.0	2,533,817.0	5,742,550.0
Sub-total for (2)	8,846,138.9	7,219,177.1	16,065,316.0
(3) Waterway to Valve House no.1			
Preparatory Works	13,838,326.7	4,745,572.6	18,583,899.3
Tunnel No.1	109,319,389.2	35,546,438.6	144,865,827.8
Sub-total for (3)	123,157,715.9	40,292,011.2	163,449,727.1
(4) Valve House No.1			
Preparatory Works	270,849.3	128,873.4	399,722.7
Valve House Portion	1,887,347.0	779,273.0	2,666,620.0
Tailrace Portion	219,730.5	194,672.0	414,402.5
Sub-total for (4)	2,377,926.8	1,102,818.4	3,480,745.2
(5) Waterway from WTP to Reservoir			
Preparatory Works	8,921,379.3	3,580,042.8	12,501,422.1
Pipeline No.1-1 (3.4m dia., 4.1km)	14,865,605.0	3,713,163.9	18,578,768.9
Pipeline No.1-2 (3.3m dia., 1.0km)	3,523,902.6	856,605.1	4,380,507.7
Valve House No.2	879,907.8	477,208.4	1,357,116.2
Pipeline No.2 (1.6m dia., 4.2km)	5,256,619.0	1,264,170.0	6,520,789.0
Surge Tank	17,194.8	23,167.2	40,362.0
Pumping Station #1 & #2 (80MLD)	10,521,727.9	3,107,370.1	13,629,098.0
Antipolo Service Reservoir #1 & #2 (30,000 m3)	1,654,962.5	1,433,382.6	3,088,345.1
Tunnel No.2	20,439,312.5	6,241,662.5	26,680,975.0
Taytay Service Reservoir #1 (180,000 m3)	9,910,595.2	7,866,960.1	17,777,555.3
Sub-total for (5)	75,991,206.7	28,563,732.4	104,554,939.2
Total for 1	**210,372,988.3**	**98,148,264.1**	**308,521,252.4**
2 Water Treatment Plant #1			
(1) Land Acquisition & Resettlement for WTP #1 and #2			
Land Acquisition	0.0	2,435,096.0	2,435,096.0
Resettlement and Compensation	0.0	121,420.4	121,420.4
Sub-total for (1)	0.0	2,556,516.4	2,556,516.4
(2) Waterway Facility			
Preparatory Works	7,424,322.4	3,748,179.1	11,172,501.5
Water Treatment Plant #1 (910 MLD)	60,369,353.7	30,234,825.4	90,604,179.1
Sub-total for (2)	67,793,676.1	33,983,004.5	101,776,680.6
Total for 2	**67,793,676.1**	**36,539,520.9**	**104,333,197.0**
TOTAL for Stage 1	**278,166,664.4**	**134,687,785.0**	**412,854,449.4**
Stage 2-1 Agos Dam + WTP #2			
1 Agos Dam			
(1) Land Acquisition & Resettlement			
Land Acquisition	0.0	4,098,028.8	4,098,028.8
Resettlement and Compensation	0.0	12,604,890.7	12,604,890.7
Sub-total (1)	0.0	16,702,919.5	16,702,919.5
(2) Agos Dam			
Preparatory Works	29,869,079.3	22,642,796.4	52,511,875.7
Agos Dam			
Diversion Works	51,626,278.0	19,121,432.0	70,747,710.0
Main Dam	53,305,395.0	40,255,930.0	93,561,325.0
Landslide Protection Measures	3,900,000.0	2,600,000.0	6,500,000.0
Rock Quarry for Dam Embankment	35,287,344.1	23,524,896.1	58,812,240.1
Spillway	62,698,103.6	45,466,568.4	108,164,672.0
Sub-total (2)	236,686,200.0	153,611,622.8	390,297,822.8
(3) Agos Hydropower Facility			
Preparatory Works	5,830,445.2	1,175,442.2	7,005,887.3
Intake Structure	819,341.6	200,787.4	1,020,129.0
Headrace Tunnel	741,004.0	315,766.0	1,056,770.0
Penstock Line	5,211,437.0	2,219,778.0	7,431,215.0
Powerhouse	1,260,336.0	1,551,759.0	2,812,095.0
Tailrace	553,476.0	706,189.0	1,259,665.0
Switchyard	378,507.4	253,078.5	631,585.9
Hydromechanical and Hydroelectric Works			0.0
Hydromechanical works	2,225,300.0	392,700.0	2,618,000.0
Hydroelectrical Work	37,397,641.1	4,155,293.5	41,552,934.5
Sub-total (3)	54,417,488.2	10,970,793.6	65,388,281.7
Total for 1	**291,103,688.1**	**181,285,335.9**	**472,389,024.0**
2 Water Treatment Plant #2 + Service Reservoir #2			
Preparatory Works	5,118,188.3	2,797,851.8	7,916,040.1
Water Treatment Plant #2 (Expansion 910 MLD)	36,160,243.3	17,053,355.5	53,213,598.8
Taytay Service Reservoir #2 (180,000 m3)	6,491,326.2	6,262,075.8	12,753,402.0
Total for 2	**47,769,757.8**	**26,113,283.1**	**73,883,040.9**
TOTAL for Stage 2-1	**338,873,446.0**	**207,398,619.0**	**546,272,064.9**

Table 9.2 Construction Cost Summary (2/2)

Stage 2-2 Kaliwa-Angono 2nd Waterway + WTP #3 & #4			
1 2nd Waterway (excluding WTP #3)			
(1) Land Acquisition & Resettlement excluding WTPs			
Land Acquisition	0.0	5,977,163.0	5,977,163.0
Resettlement and Compensation	0.0	288,322.5	288,322.5
Sub-total for (1)	0.0	6,265,485.5	6,265,485.5
(2) Kaliwa Low Dam (Temporary)			
Kaliwa Low Dam	239,652.0	159,768.0	399,420.0
Sub-total for (2)	239,652.0	159,768.0	399,420.0
(3) Waterway to Valve House No.1			
Preparatory Works	10,745,154.2	3,672,136.2	14,417,290.3
Tunnel No.1	89,542,951.4	30,601,134.7	120,144,086.1
Sub-total for (3)	100,288,105.6	34,273,270.9	134,561,376.4
(4) Valve House No.1			
Preparatory Works	132,775.2	14,752.8	147,528.0
Valve House Portion	1,069,200.0	118,800.0	1,188,000.0
Tailrace Portion	37,260.0	4,140.0	41,400.0
Sub-total for (4)	1,239,235.2	137,692.8	1,376,928.0
(5) Waterway from WTP to Reservoir			
Preparatory Works	6,798,105.0	2,671,956.5	9,470,061.5
Pipeline No.1-1 (3.4m dia., 4.1km)	12,217,715.6	3,245,889.3	15,463,604.9
Pipeline No.1-2 (3.3m dia., 1.0km)	2,568,812.2	686,615.5	3,255,427.7
Pipeline No.2 (1.6m dia., 4.2km)	4,504,079.6	1,114,888.7	5,618,968.3
Surge Tank	17,194.8	23,167.2	40,362.0
Pumping Station (installation of additional pumps)	4,771,525.4	842,033.9	5,613,559.3
Antipolo Service Reservoir #3 (Expansion 30,000 m3 x 2 units)	2,968,351.3	2,699,345.9	5,667,697.2
Tunnel No.2 (Steel lined; 3.4m dia., 5.7km)	20,439,312.5	6,241,662.5	26,680,975.0
Taytay Service Reservoir #3 (Expansion 180,000 m3)	9,163,883.7	7,412,701.3	16,576,585.0
Sub-total for (5)	63,448,980.2	24,938,260.7	88,387,240.9
Total for 1	**165,215,973.0**	**65,774,477.9**	**230,990,450.9**
2 Water Treatment Plant #3			
(1) Land Acquisition & Resettlement for WTP #3 & #4			
Land Acquisition	0.0	2,406,250.0	2,406,250.0
Resettlement and Compensation	0.0	1,524,814.4	1,524,814.4
Sub-total for (1)	0.0	3,931,064.4	3,931,064.4
(2) Waterway Facility			
Preparatory Works	7,145,818.6	3,933,844.1	11,079,662.8
Water Treatment Plant #3 (Expansion 910 MLD)	59,548,488.5	32,782,034.5	92,330,523.0
Sub-total for (2)	66,694,307.1	36,715,878.7	103,410,185.8
Total for 2	**66,694,307.1**	**40,646,943.1**	**107,341,250.2**
3 Water treatment Plant #4 + Service Reservoir #4			
Waterway Facility			
Preparatory Works	7,309,282.9	3,659,924.3	10,969,207.2
Water Treatment Plant #4 (Expansion 910 MLD)	35,276,349.3	16,847,917.7	52,124,267.0
Pumping Station (Expansion 340 MLD)	15,091,847.0	3,679,438.1	18,771,285.1
Antipolo Service Reservoir #4 (Expansion 30,000 m3 x 3 units)	4,141,067.0	3,725,802.4	7,866,869.4
Taytay Service Reservoir #4 (Expansion 180,000 m3)	6,401,427.5	6,246,211.3	12,647,638.8
Total for 3	**68,219,973.8**	**34,159,293.8**	**102,379,267.6**
TOTAL for Stage 2-2	**300,130,253.9**	**140,580,714.8**	**440,710,968.6**
GRAND TOTAL	**917,170,364.2**	**482,667,118.8**	**1,399,837,483.0**

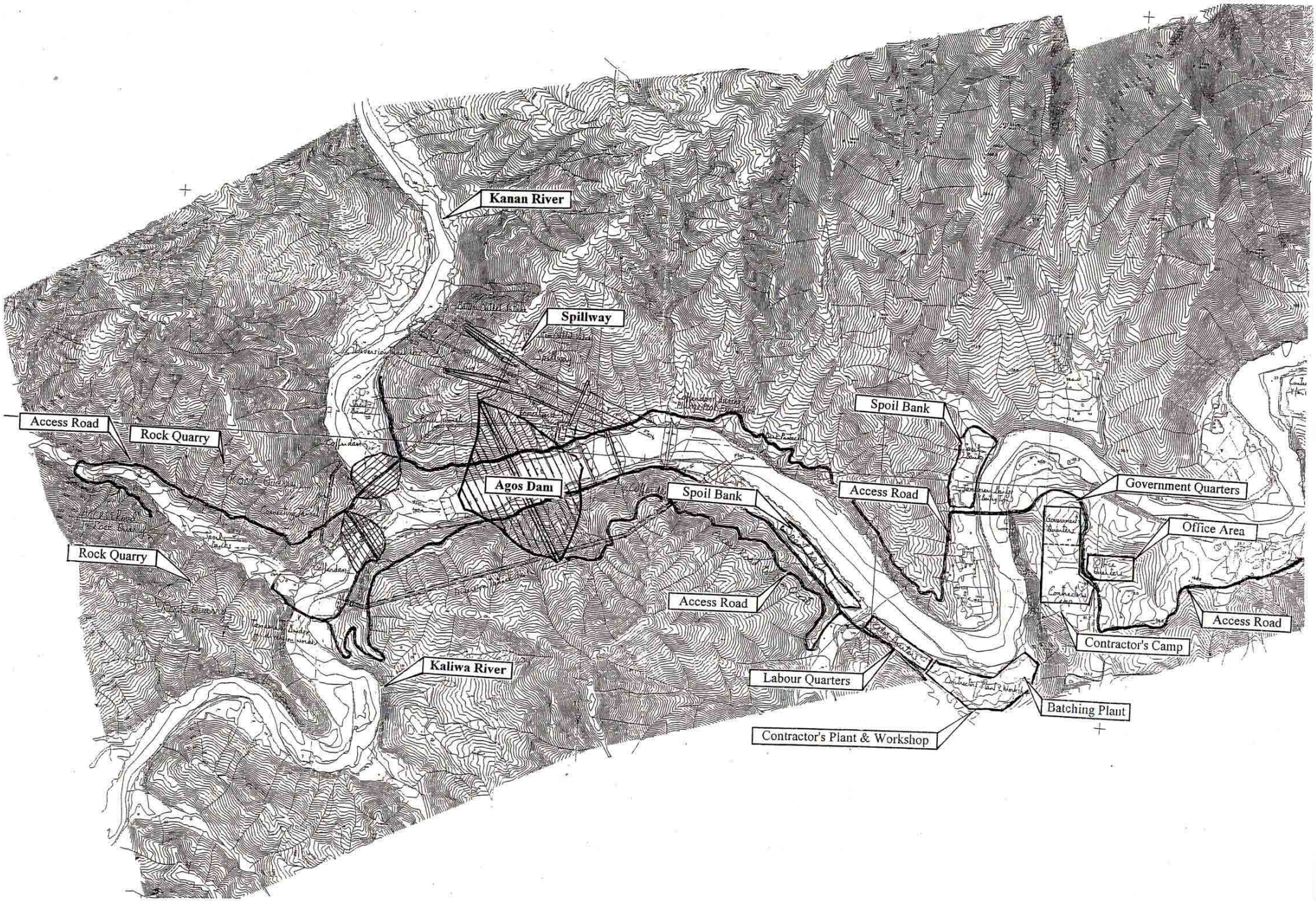


Figure 9.1 Proposed Location Plan for Temporary Facilities

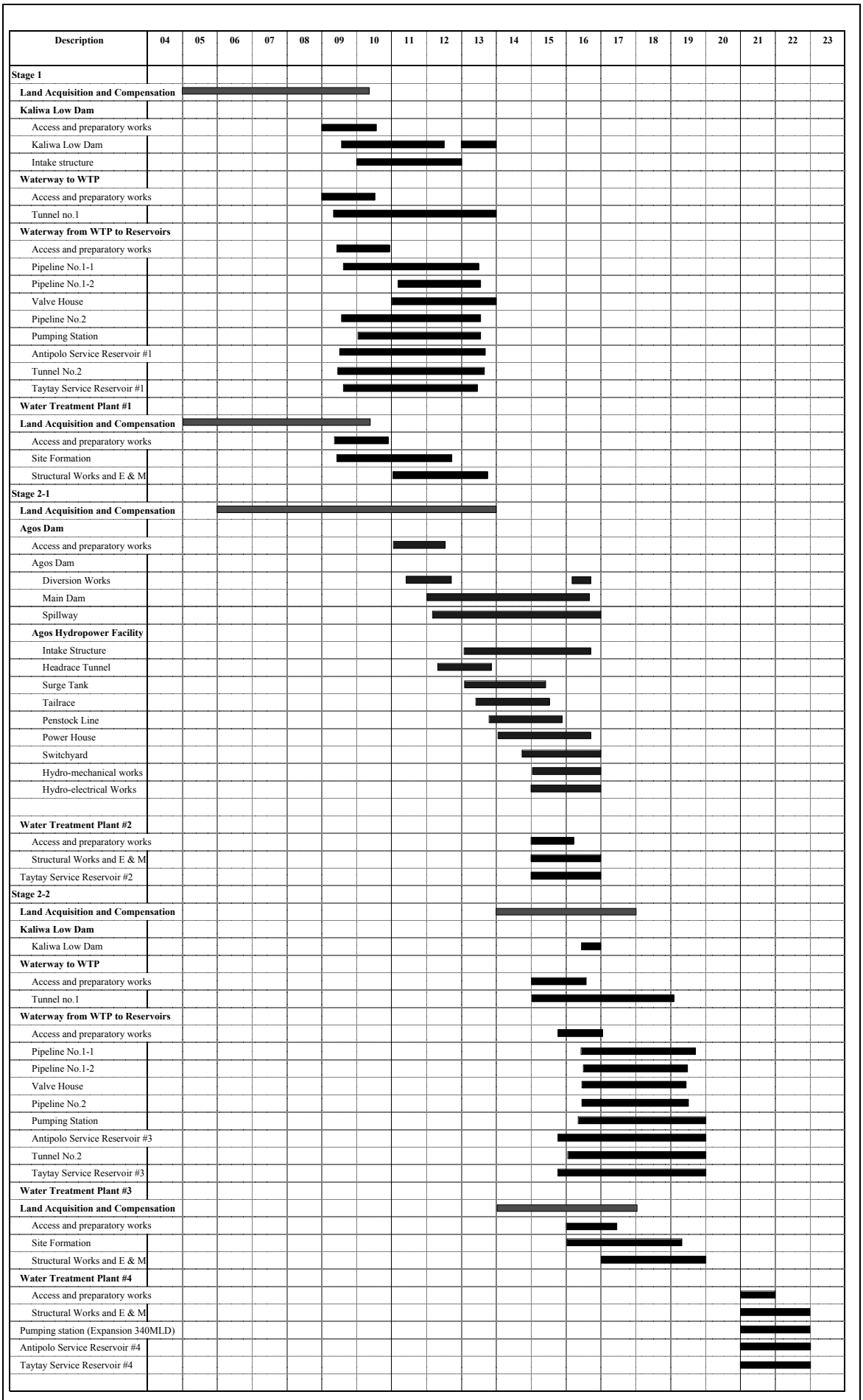


Figure 9.2 Construction Schedule