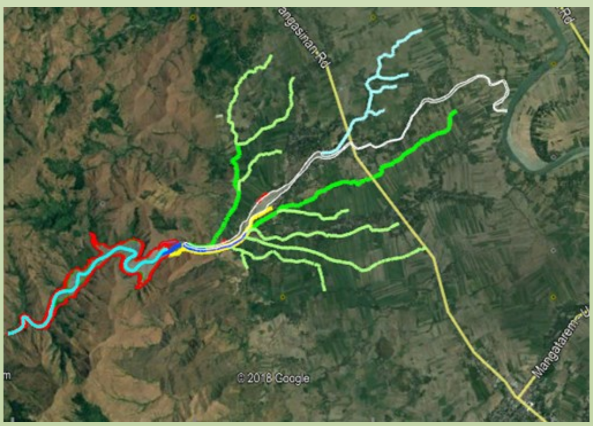
PROPOSED BAYAOAS SMALL RESERVIOR IRRIGATION PROJECT (BSRIP)

Aguilar, Pangasinan

Project Description for Scoping



Pangasinan Irrigation Management Office (PIMO)
NIA Region 1

prepared by

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NOTE: This material will be used as a reference material for the Public and Technical Scoping for setting the coverage or Terms of Reference of the conduct of an Environmental Impact Assessment (EIA) Study to be documented as Environmental Impact Statement (EIS) for BSRIP, under the requirements of DENR Administrative Order 2003-30, which is the Implementing Rules and Regulations of Presidential Decree (PD) 1586, Establishing an Environmental Impact Statement System including other Environmental Management Related Measures and for Other Purposes. This material will be posted at the website of the Environmental Management Bureau (EMB) for public disclosure.

1.0 BASIC PROJECT INFORMATION

Project Name	Bayaoas Small Reservoir Irrigation Project (BSRIP)
Project Location	Aguilar, Pangasinan, Philippines
Project Type	Dam and Irrigation System

Dam Reservoir Surface Area	103.79 ha (at extreme flood condition, 46.8-m high from river bed) 77.68 ha (at maximum operating level, 39.5-m high from river bed
Dam Reservoir Volume	18.03 million m^3 (at extreme flood condition level) 11.51 million m^3 (at maximum operating level)
Irrigation Service area	1,400 ha (existing, for improvements and repairs)
Project Technology	Zoned Embankment Gravity, closed supply canal with siphon crossing Bayaoas River, concrete closed and open main canals, concrete and earthen lateral canals
Major Physical Components of the Project	dam and appurtenances, new access road for dam, new main supply canal, connecting main canal of existing irrigation intakes, maintenance repair and improvement of segments of existing irrigation canals

Project/Investment Cost	P759.69 million (Indicative as of 2015)
Project Construction Period	3 years

Name of Proponent	National Irrigation Administration (NIA) Region I - Pangasinan Irrigation Management Office
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2.0 PROJECT DESCRIPTION

2.1 Project Location and Area

The Proposed Project covers a dam, river water reservoir, and improvements of the existing irrigation systems to be served. These will be located in Luzon, Administrative Region 1, Province of Pangasinan (**Figure 1**) and in the southern part of the Municipality of Aguilar (**Figure 2**). The municipality is bounded from the northwest and north by the Municipality of Bugallon, Pangasinan; to the east by San Carlos City, Pangasinan and Agno River; to the south by Municipality of Mangatarem; and to the southwest by Municipality of Sta. Cruz, Zambales. The dam and its reservoir is proposed to be located in a Public Forest at the southeastern part of Barangay Laoag, the western and largest barangay of Aguilar, (**Figure 3**), and to the west of Barangays Buer, Bayaoas and Pogonsili, based on the 2013-2022 Comprehensive Land Use Plan of the municipality.

In terms of natural features, the proposed area for the dam and reservoir is within Bayaoas River, a tributary of Agno River, at elevations 55 to 100 m of the northeastern part and largely open areas of Zambales Mountains, based on NAMRIA topographic map (**Figure 4**). A satellite image of the area is presented in **Figure 5**. The proposed dam is 7.3 km aerial distance, and 9.4 km channel distance from Agno River. The dam axis is located at WGS 84 geographic coordinates of 15º49'0.658"N, 120º13'43.371"E, or PRS92 geographic coordinates of 15º49'6.41"N, 120º13'38.576"E. A panoramic view of the dam site is presented in **Figure 6.** The mountain area of Bayaoas Watershed which covers the dam site is highly susceptible to landslide based on the mapping by the Mines and Geosciences Bureau (MGB). Parts of the watershed are covered under the Enhanced National Greening Program of the government.

The existing irrigation canal networks with separate intakes in Bayaoas River are largely located in five (5) barangays; namely, Pogonsili, Bayaoas, Buer, Calsib, and Bocacliw of the Municipality of Aguilar. Irrigation water may reach some rice farms in Barangay Niñoy. In addition, the networks extend in short segments in the northernmost barangays of Mangatarem, such as Malunec, Quetegan, Bunlalacao, and Calumboyan Norte, according to municipal boundary indicated in the NAMRIA topographic map. The area has low to moderate susceptibility to flooding or with less than 1.0 m flood height. It is inundated usually during prolonged and extensive heavy rainfall or extreme weather condition.

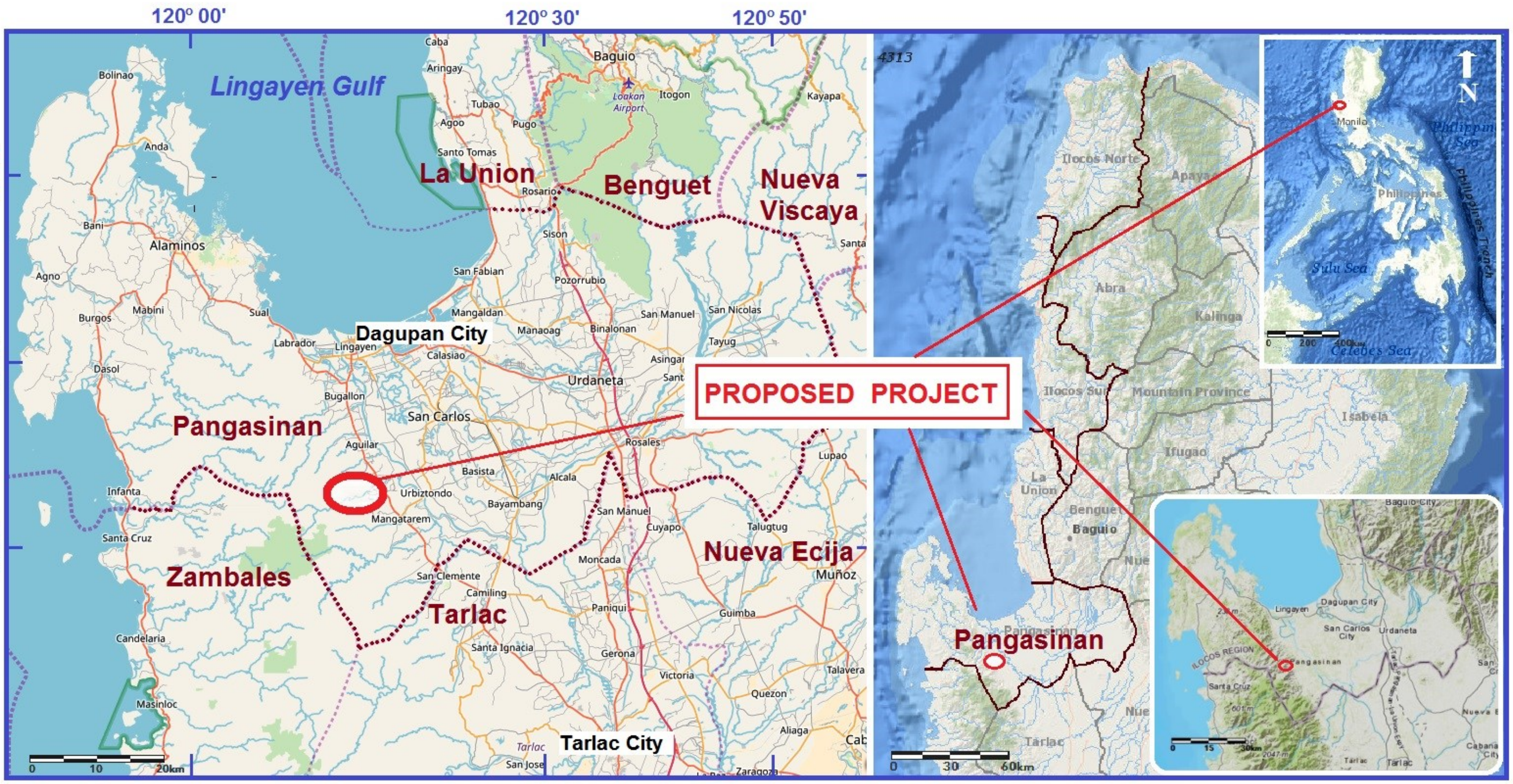


Figure 1. National, Regional and Provincial Location of the Proposed Project

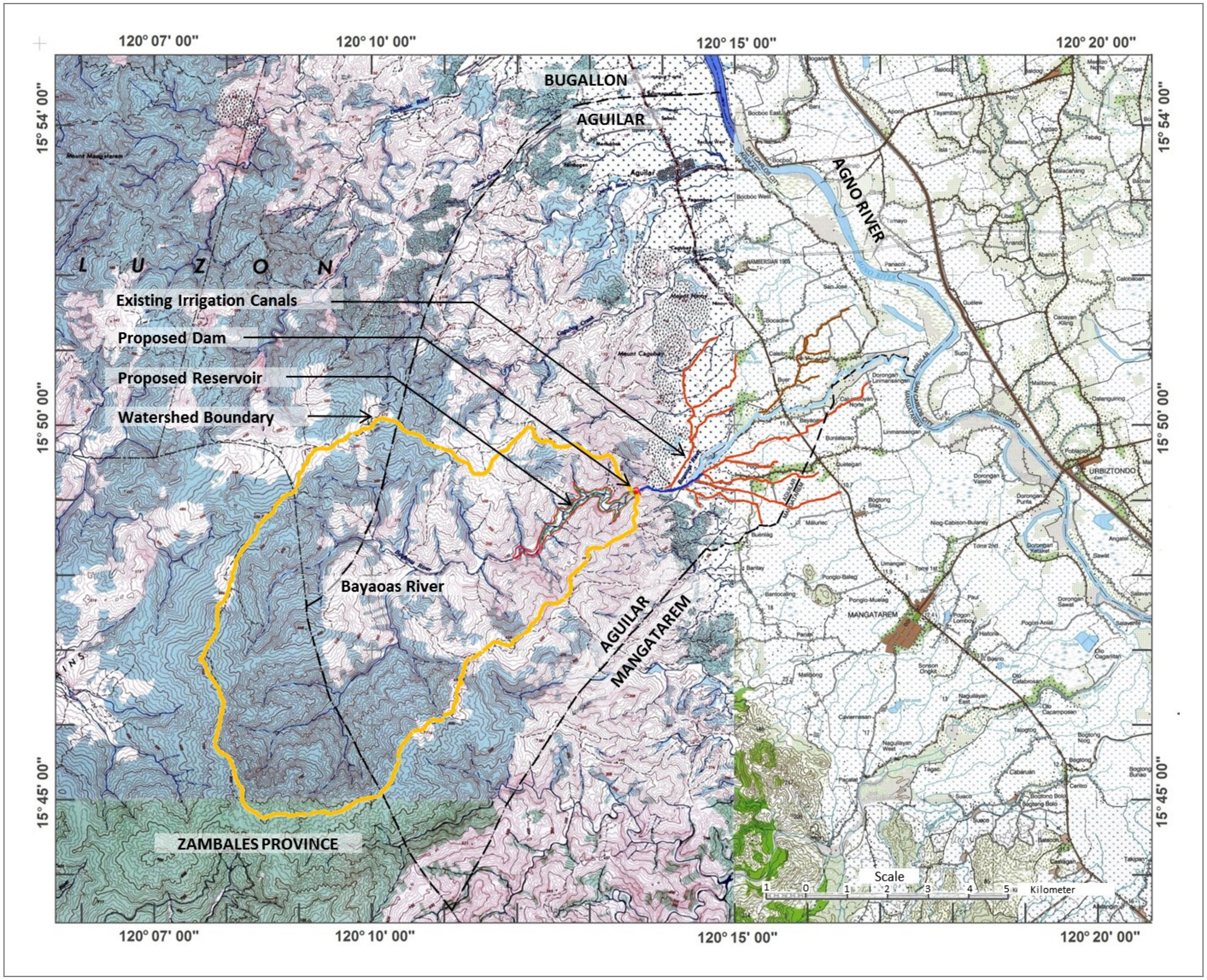


Figure 2. Municipal Location of the Proposed Project on NAMRIA Topographic Map

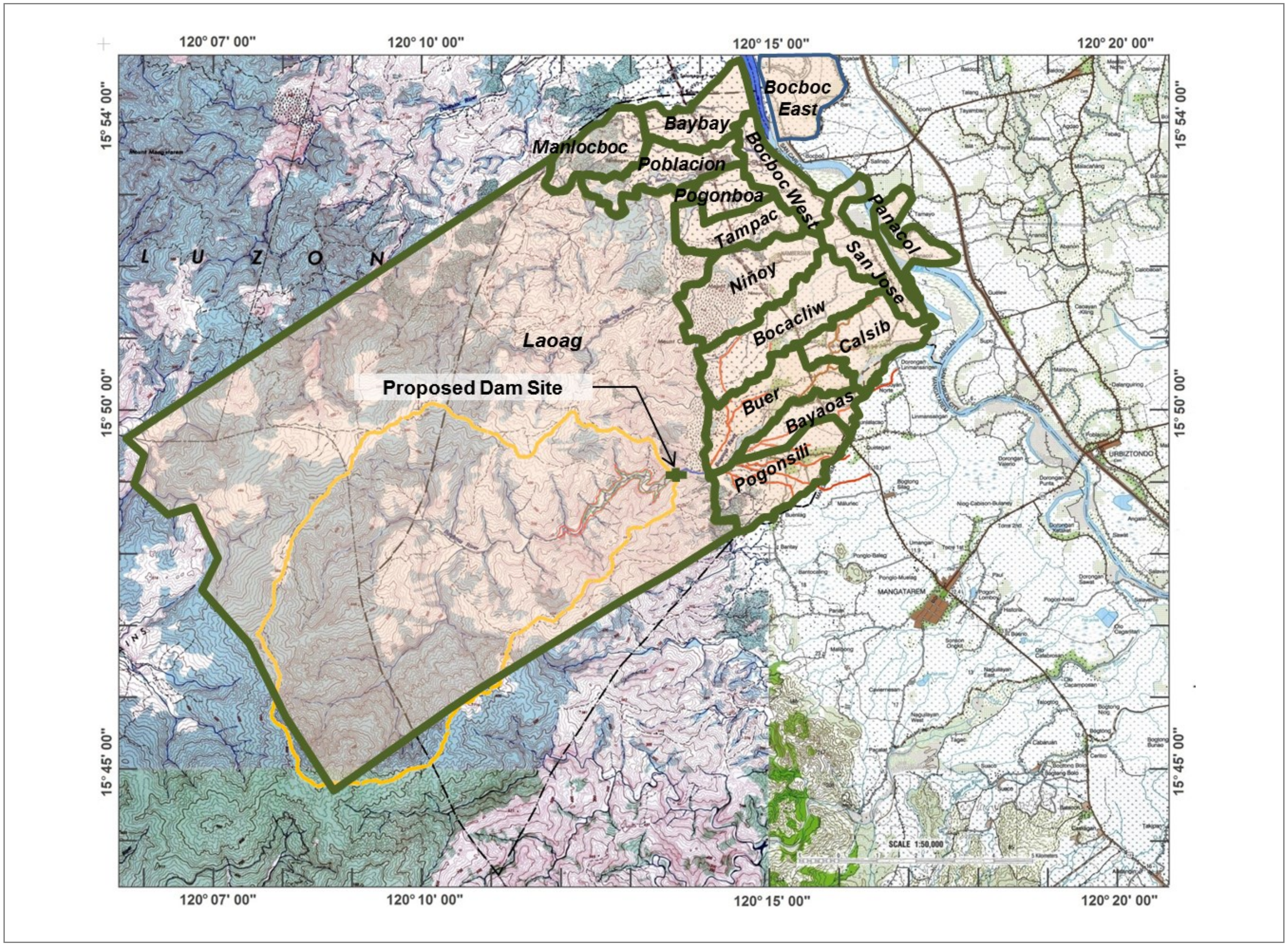


Figure 3. Plot of Barangay Boundaries of Municipality of Aguilar on NAMRIA Topographic Map (Source: Aguilar 2013-2022 CLUP). Note that the barangay boundaries do not add up to the municipal boundary in NAMRIA Map

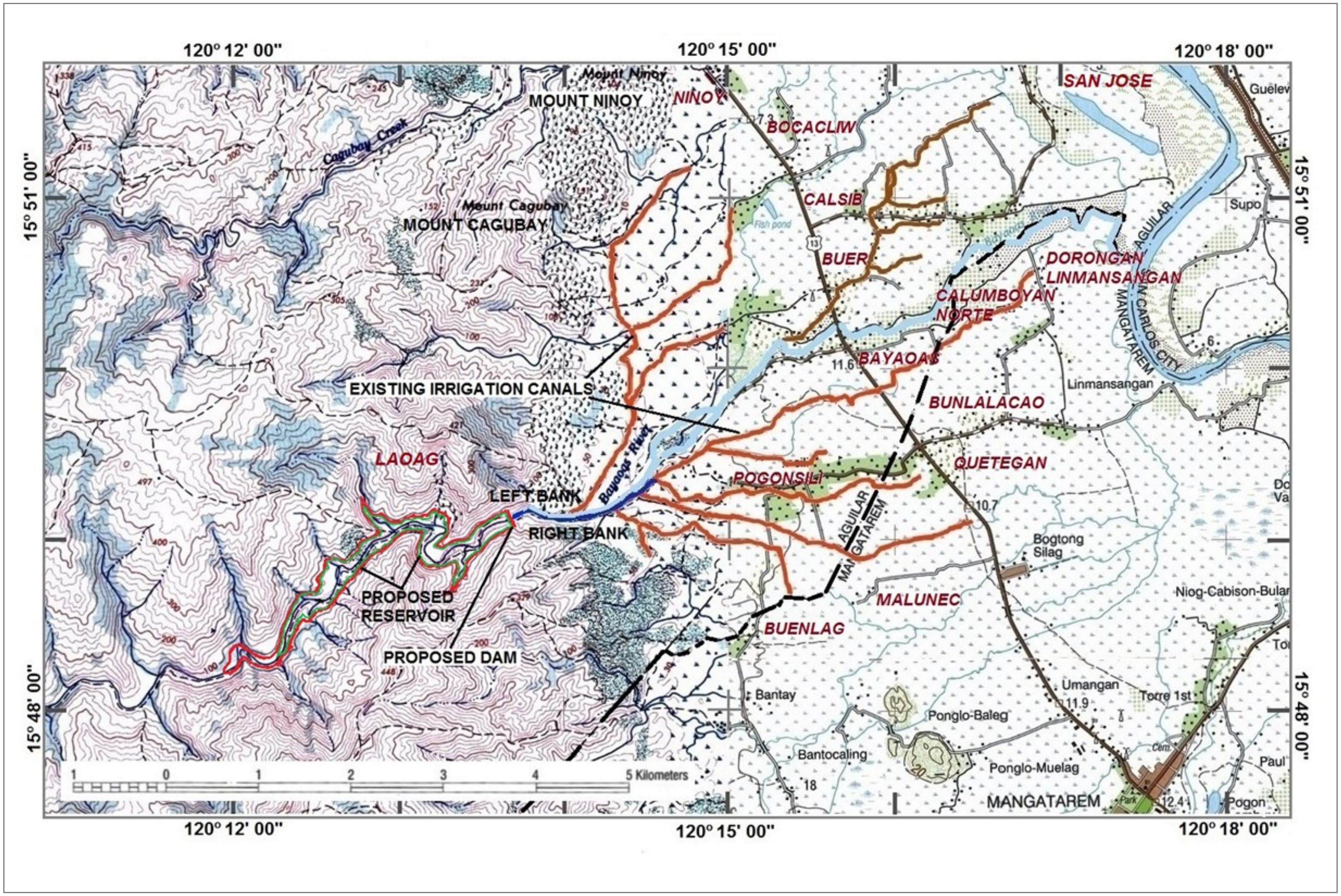


Figure 4. Closer View of the Location of the Proposed Project Showing the Potential Impact Barangays

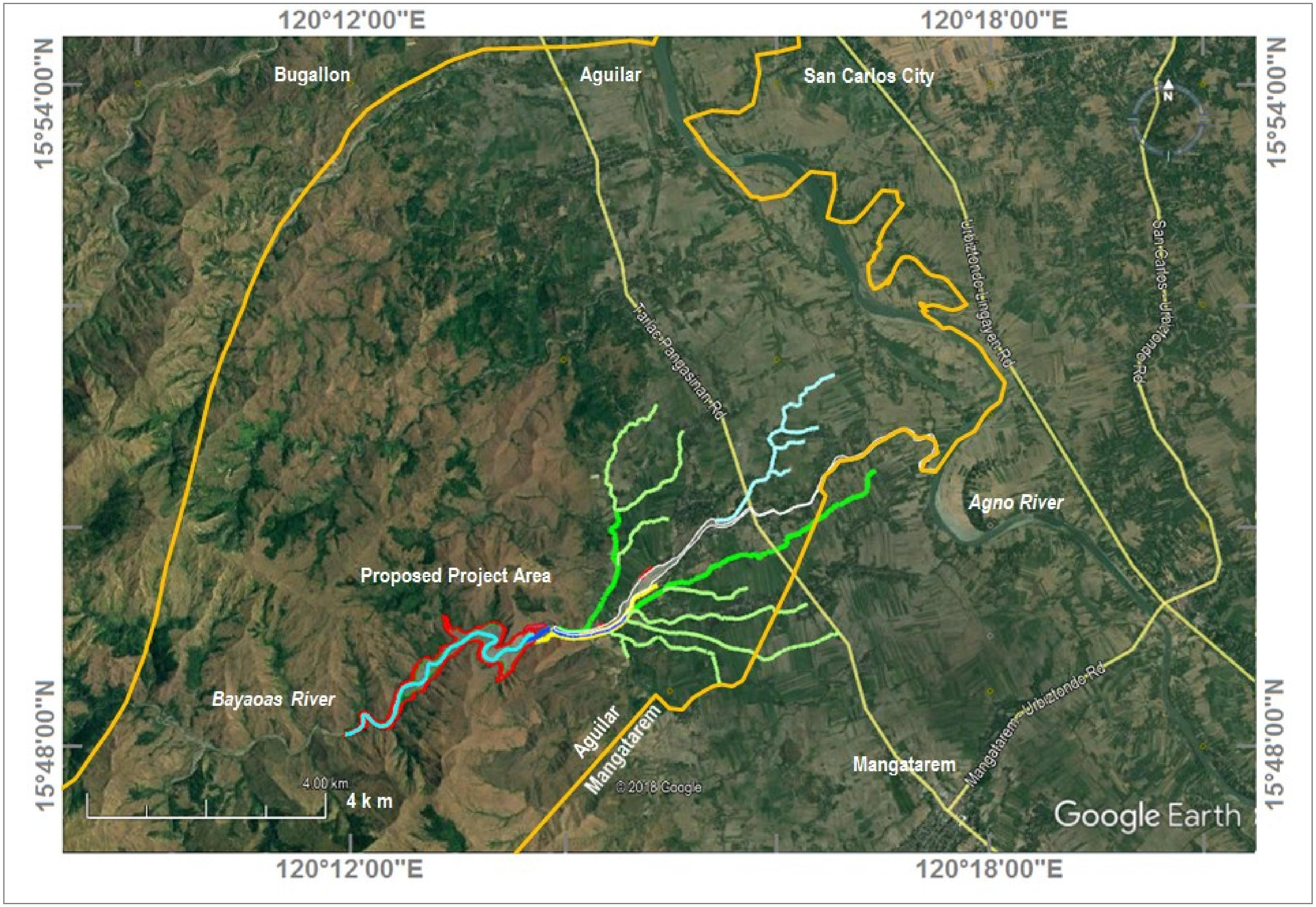


Figure 5. Satellite view of the location of the Proposed Project

Figure 6. Panoramic View of the damsite, Bayaoas River, and Left Bank Irrigation System taken from the Proposed Access Road Area (looking west)

The Proposed Project is accessible by land. The dam site is accessible from Tarlac-Pangasinan Road, either through Barangay Bayaoas in Aguilar, or Barangay Quetegan in Mangatarem. The Bayaoas (north) route consists of 2.4 km concrete road which converge just south of Baoyaoas River in Y-intersection with the 3.0 km concrete road of the Quetegan (south) route, which traverses Barangay Pogonsili. From the intersection, a new 3.0 km access road to dam site will be constructed parallel to Bayaoas River. The new access road will pass through lowland existing dirt road and orchard.

Table 1 shows the accessibility of the Bayaoas and Quetegan routes from Quezon City, Metro Manila (188 km) ; Urdaneta City, Pangasinan (55 km); Dagupan City, Pangsinan (36 km) and San Fernando City, La Union (109 km).

Table 1. Accessibility of the Project Site from different points of origin.

Origin	Destination	Distance, km	Approx Travel Time, hr	Road and Direction
Quezon City Hall, Metro Manila	Barangay. Quetegan, Mangatarem	188	4	Quezon Ave (SW), EDSA (NNW-W), NLEX-SCTEX-TPLEX (N), Paniqui-Ramos Road (W), Paniqui-Camiling Road(WNW), Tarlac-Pangasinan Road (WNW-NW)
Urdaneta City Town Hall	Barangay. Quetegan, Mangatarem	55	1.5	Calasiao-Urdaneta Road (W), Malasiqui-Urdaneta (SW), Malasiqui-Urdaneta (W), Basista-San Carlos (SE), Basista-Urbiztondo (SW), Mangataren-Urbiztondo (SW), Tarlac Pangasinan (NW)
Dagupan City, Town Hall	Barangay Bayaoas, Aguilar	36	1.5	Dagupan City Town Hall in AB Fernandez Avenue (W), Binmaley-Dagupan Regional Road (W-NW), Quibaol-Nansangaan Regional Hi-way (WSW), Tarlac-Pangasinan Road (S)
Dagupan City, Town Hall	Barangay Bayaoas, Aguilar	36	1.0	Dagupan to San Carlos City San Carlos to Aguilar
San Fernando City, La Union	Barangay Bayaoas, Aguilar	109	3.5	McArthur Hi-Way (S), Pangasinan-La Union Road (SSE-SSW-SW), Judge Jose Devenecia Extension (SW), Binmaley-Dagupan Regional Road (W-NW), Quibol-Nanansangan Regional Hi-way (WSW), Tarlac-Pangasinan Road (S)

2.2 Project Rationale

Water is used fice farming in the proposed area for land preparation, nursery, transplanting, and crop management, which are followed by drainage and harvesting. The main physical objective of the Proposed Project is to build a dam to impound the water of Bayaoas River with a necessary objective of improving the existing irrigation systems downstream. Based on the BSRIP 2015 Feasibility Study Report, the Proposed Project can provide dependable dry season supply of irrigation water from the present area of 200 ha to 1,238 ha. This is coupled by a significant increase in rice production from an estimated low of 2.5-3.6 ton/ha to a maximum 5.2 ton/ha, and from 5,013 tons/year to 13,718 tons/year, as presented in **Table 2.**

Table 2. Summary of Comparison Without the Project and with Project Scenarios

Crop	Present (2015)			Future with Project		
	Area ha	Yield Rate tons/ha	Total Yield tons	Area ha	Yield Rate tons/ha	Total Yield tons
Paddy Rice						
Dry Season						
Irrigated	200	3.2	640	1,238*	5.2	6,438
Wet Season						
Irrigated	710	3.6	2,556	1,400	5.2	7,280
Rainfed	640	2.8	1,792			
Third Crop						
Pump Irrigated	10	2.5	25			
Total			5,013			13,718
Corn						
Rainfed Dry Season	25	4.0	100			

Source: NIA, 2015. BSRIP Feasibility Study Report. p 4-6.

* Plus 162 ha in slightly elevated ricefields for adoption of pump irrigation with the available diverted surface water

The proposed area is part of agricultural area of 6,347.31 ha or 32.54% of the total land area of Aguilar. This is distributed as 3,605 ha for SAFDZ/NPAAD, 885 ha for lowland rainfed areas, and 1,857 has for upland (100 m and below) rainfed areas.[1]

By Republic Act No. 8435 otherwise known as the Agriculture and Fisheries Modernization Act of 1997, "Strategic Agriculture and Fisheries Development Zones (SAFDZ)" refers to the areas within the NPAAD identified for production, Agro-Processing and marketing activities to help develop and modernize, either the support of government, the agriculture and fisheries sectors in an environmentally and socio-cultural sound manner.

"Network of Protected Areas for Agricultural and Agro-industrial Development (NPAAD)" refers to agricultural areas identified by the Department through the Bureau of Soils and Water Management in coordination with the National Mapping and Resources Information Authority in order to ensure the efficient utilization of land for agriculture and Agro-industrial development

[1] Source: 2013-2022 Aguilar CLUP, pp. 62, 64

and promote sustainable growth. The NPAAD covers all irrigated areas, all irrigable lands already covered by irrigation projects with firm funding commitments; all alluvial plain land highly suitable for agriculture whether irrigated or not; agro-industrial crop lands or lands presently planted to industrial crops that support the viability of existing agricultural infrastructure and agro-based enterprises, highlands, areas located at an elevation of five hundred (500) meters or above and have the potential for growing semi temperate and high-value crops; all agricultural lands that are ecological fragile, the conversion of which will result in serious environmental degradation, and mangrove areas and fish sanctuaries.

2.2.1 Current Situation on Rice Farm Irrigation

Based on BSRIP 2015 Feasibility Study Report (Chapter 3), the arable area is primarily cultivated to rice and corn crops. The area is around 1,400 ha, which is distributed as follows: as about 700 ha to the north (left bank), and 700 ha to the south (right bank) of Bayaoas River. The irrigation canals were indigenously constructed, as such they benefitted from local knowledge, and BSRIP project provides the complementary technical knowledge for it

Two irrigation intakes are in the left (north) bank (for Don Queron CIS and Buer-Calsib CIS), and four in the right (south) bank (for Patapaya CIS, Pogonsili CIS, and Quetegan). In consultation with the irrigators associations, field validation will be done on the names and location of intakes as the FS also mentions Cali-Baro and Bayaoas Irrigation Systems in the right bank.

Table 2 shows a summary of the use arable lands in the dry and wet season, while the **Table 3** expands such summary by location. The areas will also be validated with the farmers, starting at the pre-construction stage. **Figures 7 and 8** provide visualization of these areas on maps.

During the dry season, the mean decadal (10 days) daily discharge of Bayaoas River water is 1.36 m^3/s in November down to 0.16 m^3/s in March, taken from 1983 to 2007 daily streamflow data of the Bureau of Research and Standard of DPWH (with missing data). In this season, only around 200 ha or 14.3% of the total arable area are irrigated by gravity and planted with rice. Additional 10.0 ha for rice and 25.0 ha for corn are supported by pumping water from nearby creeks, ponds or shallow tube wells. This leaves an idle land of 1,165 ha or 58.2% of arable land. Rice production in irrigated area is 3.2 ton/ha. A third crop by pumping yields an average of only 2.5 t/ha. The reason for the low productivity include (i) insufficient supply of irrigation water due to the low flowrate of Bayaoas River during dry season, (ii) frequent repairs, and (iii) low amount and untimely application of fertilizer and other farm inputs.

During the wet season irrigated areas increases to 1,350 ha. This includes the increase of irrigated areas by existing communal irrigation system to around 710 ha or 50.7% due to the increase in water flowrate in Bayaos River. The rainfed areas total 640 ha or 45.7% of the total arable area. An area of around 50 ha is flooded. Rice yield stands 3.6 ton/ha for irrigated areas and 2.8 t/ha for rainfed areas.

Table 2. Summary use of arable lands in the dry and wet seasons

Arable Land	Dry Season Area (ha)	Dry Season Percent of Arable Land	Wet Season Area (ha)	Wet Season Percent of Arable Land
Rainfed Paddy Rice			640	45.7
Irrigated Paddy Rice	200	14.3	710	50.7
Pump-irrigated Paddy Rice, 3rd crop	10	0.7		
Corn	25	1.8		
Fallow/Idle (flooded)	1,165	83.2	(50)	3.6
Total	1,400	100.0	1,400	100.0

Source: NIA, 2015. BSRIP Feasibility Study Report. p 3-8

Table 3. Use of arable land by location in the dry and wet seasons by location (in hectare)

Location with Respect to Bayaoas River	Dry Season					Wet Season			
	Paddy Rice Irrigated	Paddy Rice Pump Irrigated, 3rd crop	Corn	Fallow	Total	Irrigated	Rainfed	Flooded	Total Area
A. Left (north) Bank									
Don Queron CIS	25	5		258	288	150	138		288
Calsib CIS (NIA)	125	5		132	262	200	62		262
Other Areas				150	150		100	50	150
Subtotal	150	10		540	700	350	300	50	700
B. Right (south) Bank									
Patapaya CIS	15			35	50	50			50
Pogonsili CIS	25			395	420	190	230		420
Quetegan	10		25	195	230	120	110		230
Subtotal	50		25	625	700	360	340		700
Total	200	10	25	1,165	1,400	710	640	50	1,400

Source: NIA, 2015. BSRIP Feasibility Study Report. p 3-9

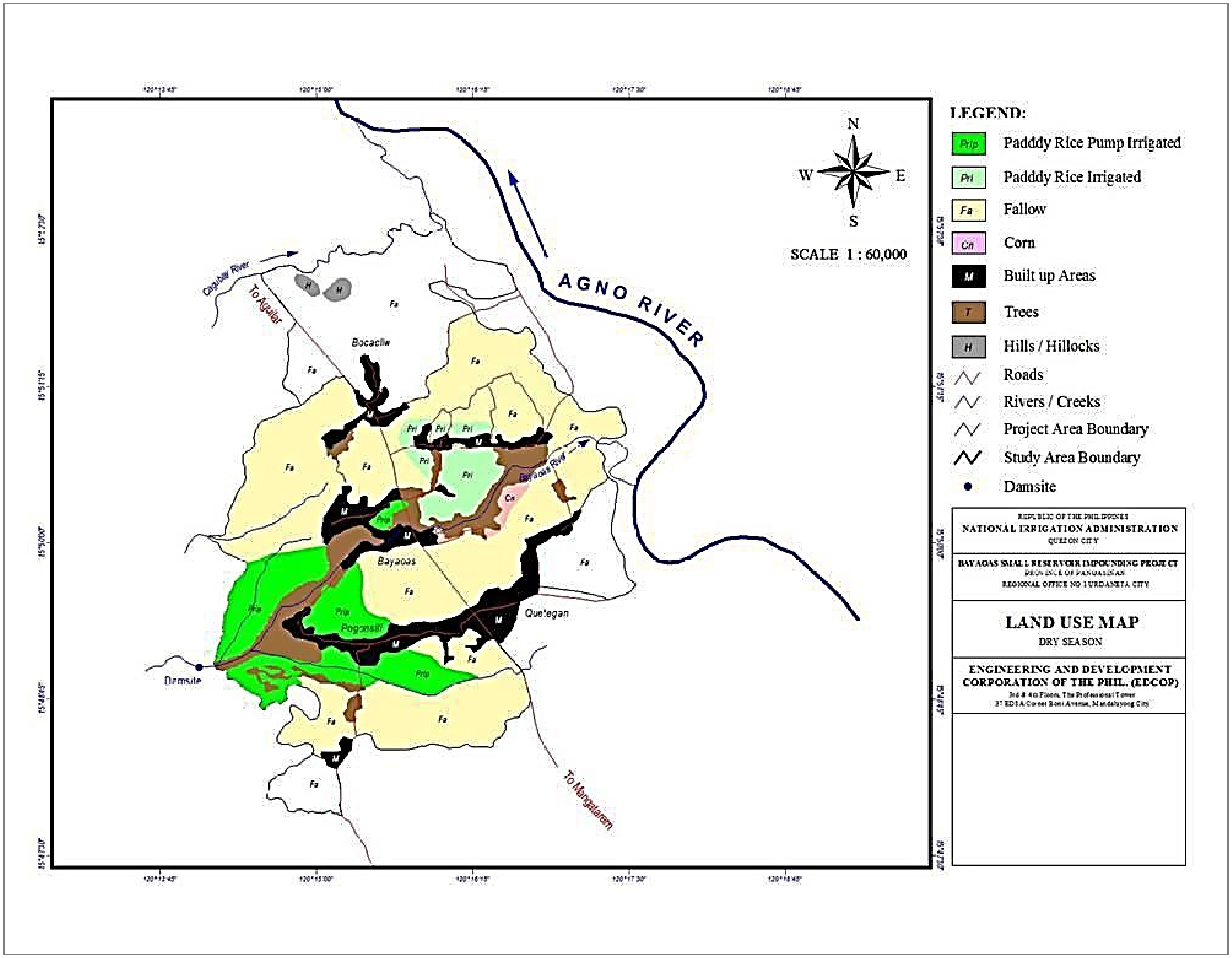


Figure 7. Land Use Map (Dry Season)

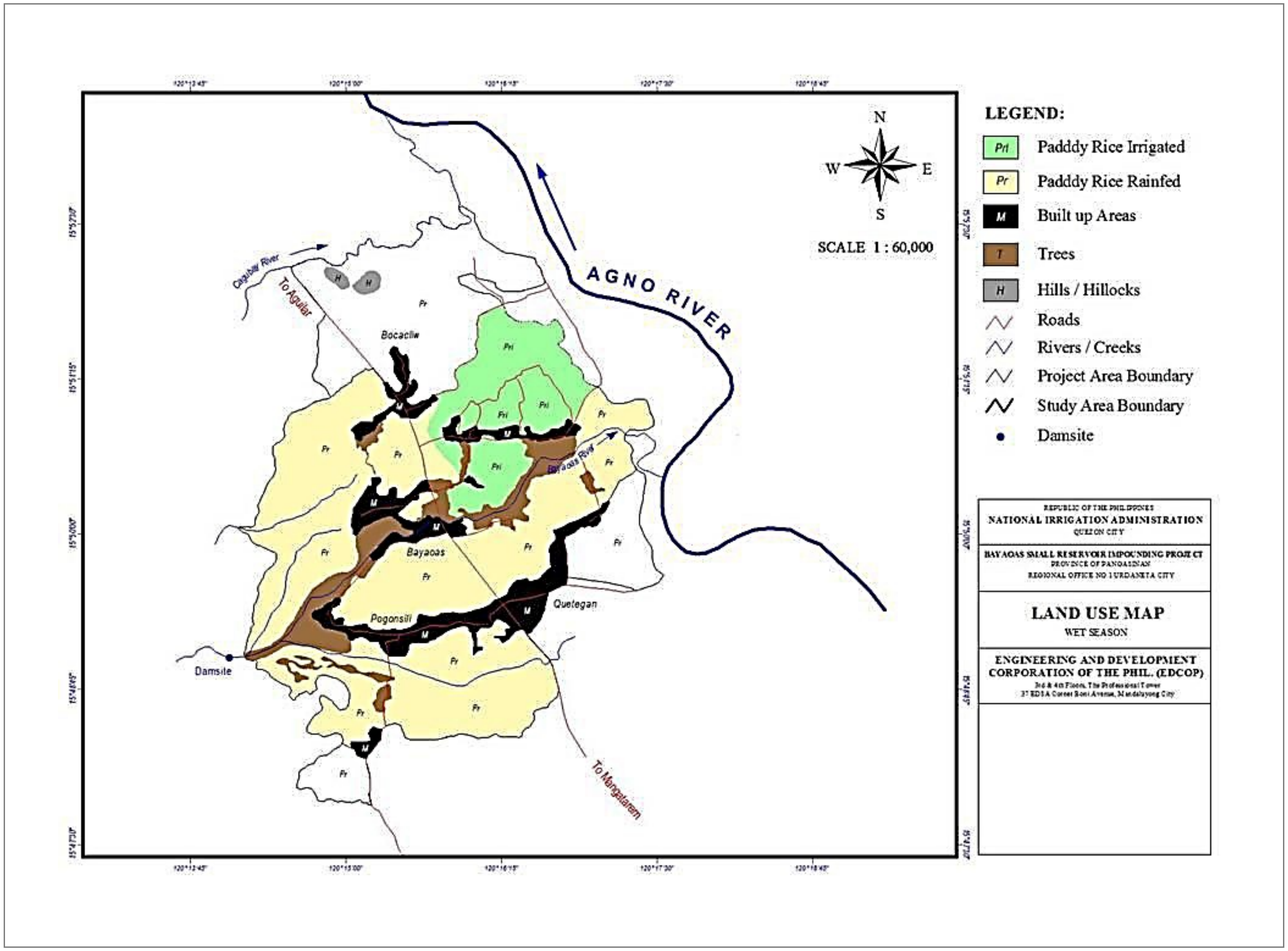


Figure 8. Land Use Map (Wet Season)

2.2.2 Future Scenarios with the Proposed Project

With dependable irrigation water from the reservoir at 2.4 m^3/s or 2.1 L/s/ha, and with improvements in the irrigation canals, the BSRIP 2015 Feasibility Study shows a potential, irrigation of 1,238 ha (with 162 ha as idle), during the dry season, and the whole 1,400 ha during the wet season. Paddy yield is expected to increase 5.2 t/ha in both for a total annual paddy rice production increase from 5,013 tons to 13,718 tons, or a potential net increase of 8,715 tons.

For the cropping pattern in dry season, paddy rice transplanting would be in the 3rd week of October to 3rd week of November and harvesting from 1st week of February to 1st week of March. The wet season paddy rice transplanting would be from 2nd week of June to 2nd week of July and harvesting from 3rd week of September to 3rd week of October. Terminal drainage will occur ten (10) days before harvest for both wet and dry season.

Labor requirements would be 82 person-days in the dry season and 79 person-days in the wet season. In addition, the present labor requirement of 116.1 thousand person-days annually is expected increase to about 210.4 thousand person-days with the project scenario due to increase in cropping intensity from 113% to 188%. With the projected available farm labor of 749 thousand person-days, there would still be a surplus labor of 538.6 thousand person-days.

The Proposed Project would eventually contribute to the provincial, regional and national efforts in rice production. As of 2017, Pangasinan has a service area of 110,553 ha or 63.11% of potential irrigable area of 175,180.29 (**Table 4**). In 2014, Pangasinan contributed 65% of the total rice production in Region 1.[2]

The Department of Agriculture reports that the country's rice production in 2017 is a record high of 19.28 million metric tons. In 2018, the target production is projected to stand at 20 million metric tons of palay or 12.9 million metric tons of rice.[3]

Table 4. Status of Irrigation Development Based on Inventory as of December 31, 2017

Attribute	Pangasinan	Region 1	National
Estimated Total Irrigable Area, Ha (3% Slope Land)	175,180.29	264,491.00	3,128,631.00
Service Area, Ha			
National Irrigation System	31,280.00	61,499.44	867,902.74
Communal Irrigation System	32,262.00	57,519.40	563,230.28
Private Irrigation System	16,325.00	20,788.45	184,869.79
Other Government Agency Assisted	30,686.00	50,575.83	171,983.68
Total of Service Area	110,553.00	190,383.12	1,887,986.49
% of Irrigable Areas	63.11	71.98	60.35
Total remaining area to be developed	64,627.29	74,107.88	1,240,644.51

Source: http://www.nia.gov.ph/sites/default/files/pdf_reader/CY2017_status-of-irrigation-development.pdf

2 Source: http://pangasinan.gov.ph/wp-content/uploads/2014/02/Region1.jpg.
3 Source: http://www.pna.gov.ph/articles/1042884

2.2.3 Induced Benefits

Induced benefits (positive impacts) from BSRIP on agricultural economy include opportunities for increase in agricultural labor, improved agricultural commerce, aquatic industry, improved access to upland greening projects, education and recreation such as boating and fishing.

Generically, the brochure of the Bureau of Soils and Water Management claims that small water impounding project (SWIP) is more than providing irrigation to marginal upland areas. Multiple uses have been outlined, as follows:

i. provides water for supplemental irrigation, domestic purposes and livestock production in critical, less accessible upland areas and isolated, vulnerable resource-poor communities;

ii. enhances upland productivity with strong sense of responsibility among farmers while ensuring environmental sustainability;

iii. facilitates inland fish production through the culture of freshwater fish, shrimps, eels and other native freshwater species;

iv. contributes in combating local malnutrition problems and helps in alleviating poverty in the uplands;

v. serves as strategic small-scale upland structure of flood prevention and control in high rainfall areas to ensure whole-year round agricultural production, and for soil and water conservation in areas with distinct wet and dry seasons to increase cropping intensity and enhance crop diversification;

vi. enhances and facilitates recharging of groundwater and spring sources for domestic and other uses;

vii. provides other environmental impacts such as maintaining important habitat for wildlife and biodiversity, thus, augmenting government efforts in protecting our environment; and

viii. provides recreational facilities as swimming and picnic grounds for local rural communities.

The long-term benefits of SWIPs to the environmental and ecological stability are flood control, reduced soil erosion/sedimentation and water moisture conservation through agro-forestry development in the watershed.

2.3 Project Alternatives

Project alternatives for BSRIP under the Philippine EIS system refers to project siting, development design, process/technology selection, and resource utilization. In terms of technical, commercial, social and natural environmental aspects, such alternatives are guided mainly by the objectives of collecting and distributing sufficiently dependable irrigation water to rice fields in the project area.

2.3.1 Siting of Source of Irrigation Water Supply

Bayaoas River is the only river present in the area that can provide irrigation water by gravity. Aside from Bayaoas River, the alternative supply of irrigation water includes the groundwater and Agno River Water which are below the level of the irrigated fields. The use of groundwater and Agno River would be less technically, commercially, socially and environmentally feasible. For example, these sources would require pumps and larger storage facilities, which are more expensive in the long term. There is much uncertainty on the available groundwater volume for a 2.1 L/s/ha of water requirement. This would also cause significant groundwater draw down during the dry season. Agno River is 6.6 km away and about 37 m lower than the highest elevation irrigable areas.

2.3.2 Technology Selection/Operation Processes

Basically, the technology adopted for the siting of the water source is gravity which is more economical in the long term than the use of pumps that will use liquid fuels which emit greenhouse gases during combustion.

2.3.3 Siting of Water Reservoir

Harnessing of Bayaoas River would involve construction of water reservoir. One alternative is the construction of lined multiple lowland reservoirs in the left (north) bank and right (south) bank of Bayaoas higher than the rice fields. However, this would also require a diversion dam and vast tract of private lands. For 1,238 ha of ricefield to be irrigated in 50 days at 2.1 L/s/ha, the volume of water to be stored should be 11,231,136 m^3, without buffer for evapotranspiration. Thus, for a 3-meter deep reservoir, this would require a land area about 3,743,712 m^2 or 374 ha.

Siting of dam in Bayaoas River is site-specific for the covered existing irrigation systems. The proposed location of the dam has the following advantages: (i) the optimum location for collecting the required large amount of water in the watershed, (ii) closest to the irrigation systems of larger area, and (iii) in narrow channel for stability and minimum construction materials. Further upstream would mean longer supply canal and longer access road that will add to the cost of the project. Moving downstream would mean larger area and higher cost of the dam.

2.3.4 Dam Type and Design

A dam may be an embankment (earth or rock fill) dam or concrete dam (gravity, arch and buttress), the latter requires a higher cost of construction. The proposed dam is an embankment dam basically due to the abundance of rock and earth fill materials in the area. Generically, the trapezoidal cross section along the river segment (bank view) of an embankment dam has an impermeable clay core, with upstream and downstream protective filter zones and outer shells. The impermeable core prevents water from seeping through the dam. The filter serves as transition and cushion in-between zones to prevent the loss of fines in the central core. The shell provides stability for the dam.

Table 5 shows the attributes of two alternative dams. The proposed dam is a 48.4-m high (93.9 masl) zone embankment type, with central clay core, with fine/coarse/fine filter, with random fill outer shell 1, and rockfill outer shell 2. The random fill outer shell 1 and rock-filled outer shell 2 represent the sequence of an onsite available material from soil to rock level. The dam height is inclusive of a normal freeboard of 8.90 meters, broken down as 7.30 m for 1000-year flood surcharge, 0.60 m for wave due to wind, and 1.00 m for minimum freeboard. The maximum normal operating height is at 85 masl or 39.5 m from the river bed of 45.5 masl.

The alternative dam is 35-m high (80.5 masl) zone embankment type, with central clay core, with fine/coarse/fine filter, with random fill outer shell, and a rock toe downstream. The height only considers a 100-year design flood. The minimum freeboard provided is only 2.85 meters, enough to protect against wave run-up. The crest of the dam is also cambered to a maximum of 1.5 meters to allow for foundation settlement.

Table 5. Bayaoas Dam Attributes

Dam Attributes	Proposed Dam	Alternate Dam
Dam Height (meter)	48.40	35.0
Dam Type	Zone Embankment	Zoned Embankment
Clay Core	Central Clay Core	Central Clay Core
Filter	fine/coarse/fine upstream and downstream embankment filters	fine/coarse downstream embankment filter
Outer shell 1	Random fill	Random fill
Outer shell 2	U/S and D/S rockfill	none
Rock Toe	None	Rockfill

On the issue of dam safety, a slope stability analysis was conducted for the two alternative outer shell materials but with similar height of 48.4 m (at 93.90 m top elevation) **(Figures 9 and 10).** Results show a higher safety of factor for the proposed type, even under an earthquake condition. The indicative dam has an upstream and downstream slopes of 1.00 V : 2.60 H to effect a dam base of 264 m from upstream to downstream. The alternative dam has an upstream slope of 1.00 V : 3.00 H downstream slope of 1.00 V : 2.65 H, and base of around 285 m. Note that the indicative dam with 21-m shorter base would require lesser volume of materials.

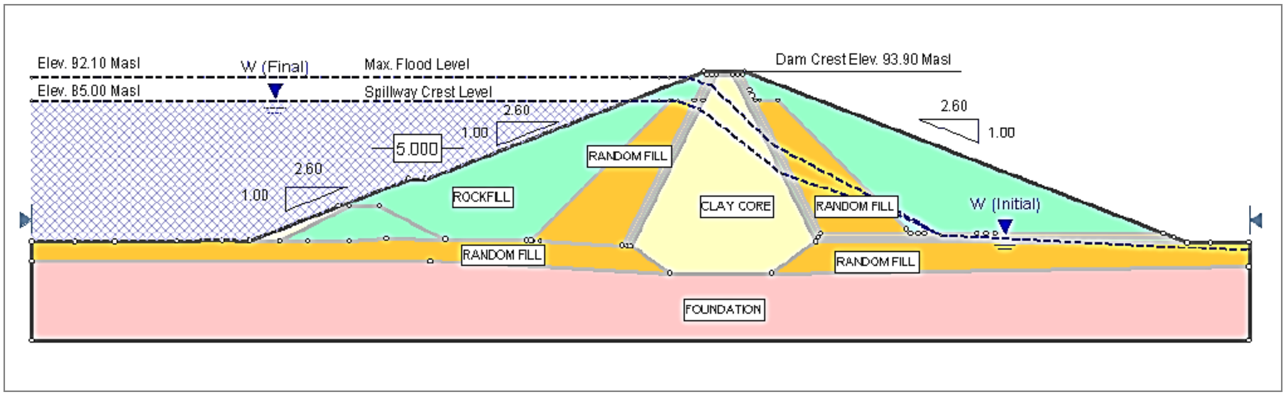


Figure 9. Embankment Section of Proposed Indicative Dam

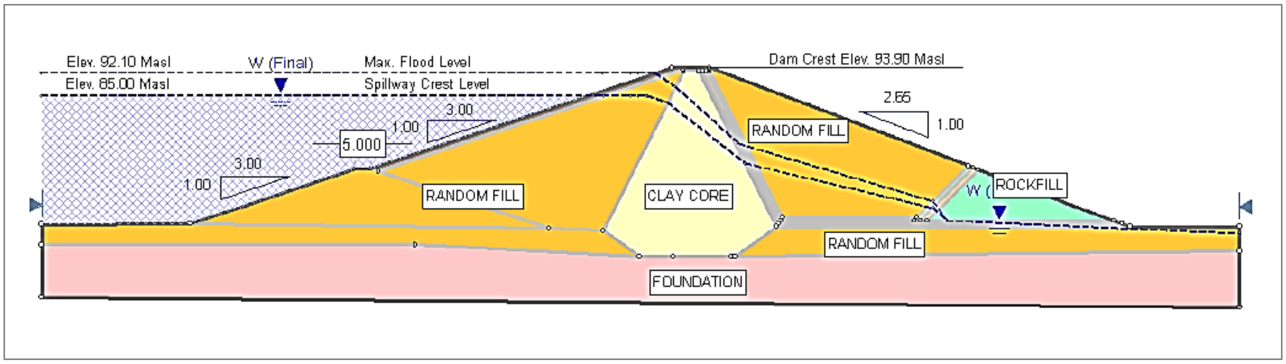


Figure 10. Embankment Section of Alternative Dam

The slope stability analysis was done using RocScience Slide software, which requires material properties, loading conditions, peak ground acceleration, and seismic coefficient among others. The material properties used in the stability analyses are listed in **Table 6**. The 45 kPa and 20-degree friction angle for the clay core and unit weights were adopted. All other properties were based on triaxial test and generally accepted material properties established in other similar dam projects elsewhere. **Table 7** shows loading conditions and corresponding widely accepted minimum factors of safety were adopted in the stability analyses.

From the seismic hazard analysis under the earthquake condition, the peak ground acceleration corresponding to the maximum credible earthquake (MCE) was placed at 0.21g. For the earthquake loading, a seismic coefficient of 0.5 PGA/g was derived from pseudo-static analysis which is generally acceptable for preliminary design. Here, the seismic forces acting on the dam is expressed by a static horizontal force expressed as product of the seismic coefficient and the weight of the potential sliding mass in the dam body. Unacceptable deformation is avoided with this value of seismic coefficient, as long as the factor of safety is above 1.0.

Table 6. Properties of Dam Materials

Material	Cohesion (kPa)	Friction Angle (degree)	Bulk Unit Weight (kN/m^3)	Saturated Unit Weight (kN/m^3)
Clay Core	45	20	17	19
Fine filter	0	35	23	24
Coarse filter	0	45	23	24
Random fill	20	25	20	22
Boulder rip-rap	45	20	17	19
Foundation	0	35	23	24
Rockfill	0	40	28	28

Table 7. Stability Analyses Criteria on Loading Conditions

Loading Conditions (LC)		Minimum Factor of Safety	Slope
LC1	Steady state seepage with max. storage pool	1.5	Downstream
LC2	Partial rapid drawdown (from max. storage pool to min. storage pool)	1.2	Upstream
LC3	Storage Pool (with earthquake)	1.2	Downstream and upstream

A summary of the computed factors of safety (FoS) is given in **Table 8,** which shows the slopes of the indicative dam meet the minimum factor of safety for LC1 and LC3 (with earthquake loading), as compared with the slopes (original) of the alternative dam materials. The latter would meet the minimum factor of safety by revising the upstream slope to 1.0 V : 2.00 H, and downstream slope to 1.0 V : 2.65 H.

Table 8. Computed Factors of Safety, Bayaoas SRIP

Loading Condition	Factor of Safety (FoS)					
	EDCOP Study		NIA FS (original slopes)		NIA FS (revised slopes)	
	DS	US	DS	US	DS	US
LC1	1.571		1.467		1.652	
LC2		1.638		1.678		1.698
LC3	1.203	1.218	1.117	1.199	1.209	1.207

2.3.5 Design of Headworks

The headworks refer the structure that will supply water to the left (north) and right (south) banks irrigation system. The present proposal is the installation of the supply canal from the dam located at the right bank, with a siphon towards the left bank (Don Queron CIS).

The alternative as presented in an earlier feasibility study is a diversion dam about 900 meters below the storage dam, is just about below the current intake of the Don Queron CIS (Left Main Canal). The proposed diversion weir is ogee-shaped, 60 meters long. The reasons for not adopting this alternative are the following

i. the estimated construction cost of the structure, as designed, including the intakes to the left and right main canal at 2015 prices is P43.3 million, higher than the P22.9 million of proposed scheme;

ii. the left bank is unstable with loose materials, and would require for anchorage and protection features such as spur dikes, gabions, higher depth of cut-off walls, steel sheet piles, etc. that will increase further the development cost; and

iii. the earlier design only considers an 850 m^3/sec 100-year flood discharge, in contrast to the current estimate of 1,318 m^3/sec 100-year flood that adds a safety factor.

2.4 Project Physical Components

The initial working location of the dam is a plot on Google Earth Satellite map presented in **Figure 11,** which is based on the dam site development plan in **Figure 12** taken from 2015 BSRIP 2015 Feasibility Study. The Proposed Project will consist of the following (with indicative dimensions and areas in **Table 4)**:

i. impounding dam and appurtenances,
ii. water reservoir,
iii. interface main supply canal from dam to irrigation intakes,
iv. new access road to dam,
v. siphon crossing to Bayaoas River,
vi. connecting main canals for the existing intakes in the right (south) bank of Bayaoas River,
vii. improvements existing irrigation canals which may involve widening, realignment deviation, grade correction and thresher weir installation to be identified during the detailed engineering design stage of the project,
viii. associated supporting areas to be identified for construction are temporary facilities, coffer dam, quarry sites, and spoil disposal areas, and

Table 4. Indicative Spatial Requirements for the Proposed Project Physical Components.

Physical Component	Indicative areas
1. Dam Site	17 ha (approx 550 m x 310 m with dam site access road area) 6.63 ha for dam; 2.71 ha for spillway
2. Dam Water Reservoir Surface Area	104 ha (at dam maximum flood conditionl)
3. New Main Supply Canal from Dam to Main Irrigation Intakes	0.024 ha (462 m x 2 m)
4. New Access Road to Dam Crest	2.4 ha (3.0 km x 8 m)
5. Siphon Crossing Bayaoas River	0.006 ha (80 m x 0.8)
6. New Left Main Canal Construction	0.13 ha (353 m barrel long x 1 m wide + 950 m CHB long x 1 m wide)
7. New Right Main Canal Construction	0.18 ha (250 m barrel long x 1.3 m wide +1.1 km CHB long x 1.3 m wide)
8. Main Canal Access Road	to be identified in the future
9. Construction Temporary Facilities	to be determined
10. Construction Batching Plant	to be determined
11. Quarry Site	to be determined
12. Earth Spoil Disposal Area	to be determined
13. Existing irrigation canals for repair and improvement	to be determined (variable within the network)

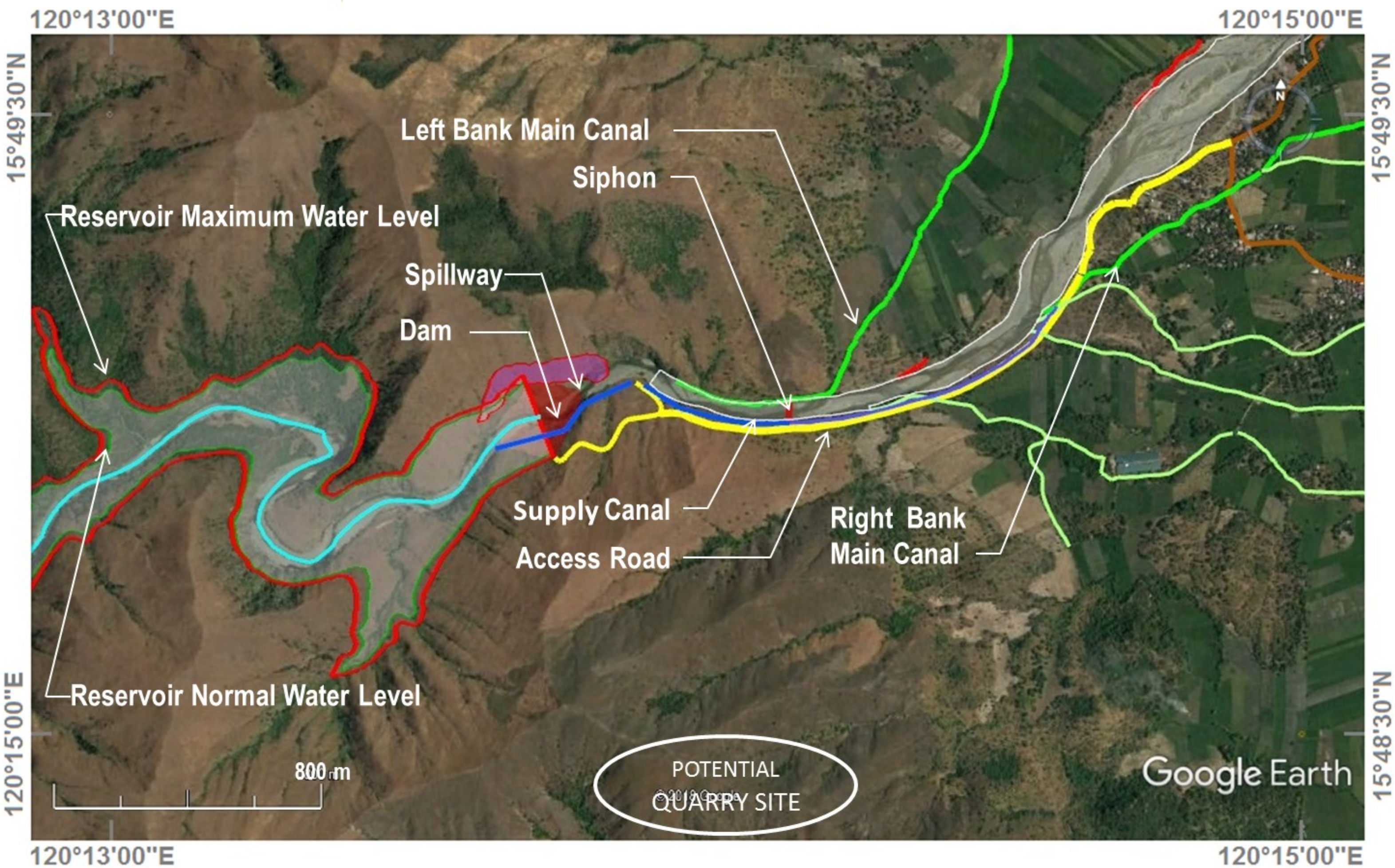


Figure 11. Conceptual development layout of BSRIP on satellite image

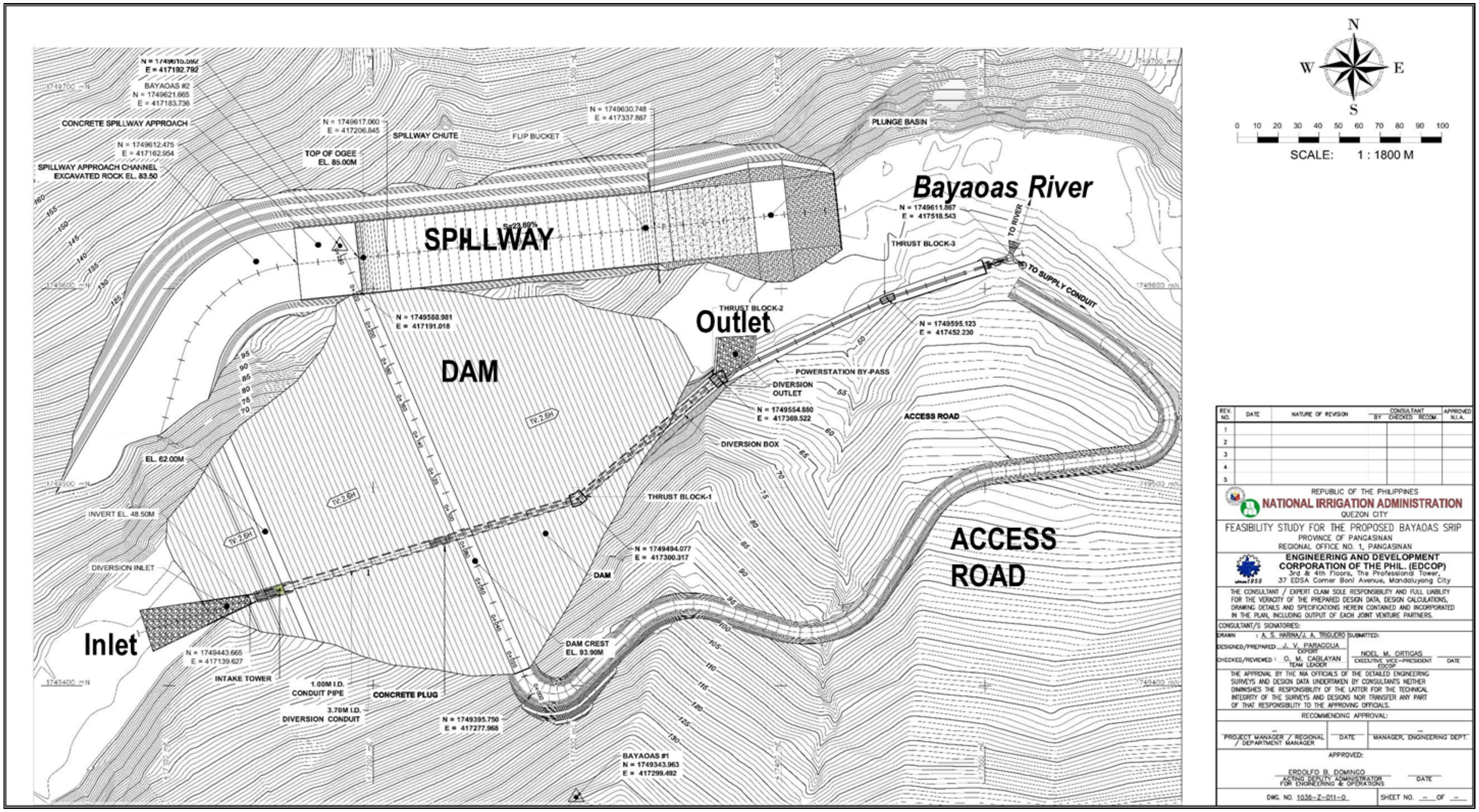


Figure 12. Engineering version of damsite development layout. Source 2015 BSRIP FS.

2.4.1 Indicative Dam Attributes and Appurtenant Structures

The dam will have the following attributes and structures which are discussed in detailed in the BSRIP 2015 FS Report:

i. dam type,
ii. dam dimensions (height, core trench width, widths of the crest and top of core),
iii. dam slope stability analysis (material properties, loading conditions),
iv. spillway and appurtenances (approach channel, control structure, chute, flip bucket and plunge basin),
v. diversion conduit and cofferdam,
vi. outlet works and its appurtenances (intake shaft, outlet pipe and stilling pool, and
vii. dam instrumentation.

2.4.1.1 Dam Type

The typical section of the recommended dam type is shown on **Figure 13**. The complete dam attributes are given in **Table 5.**

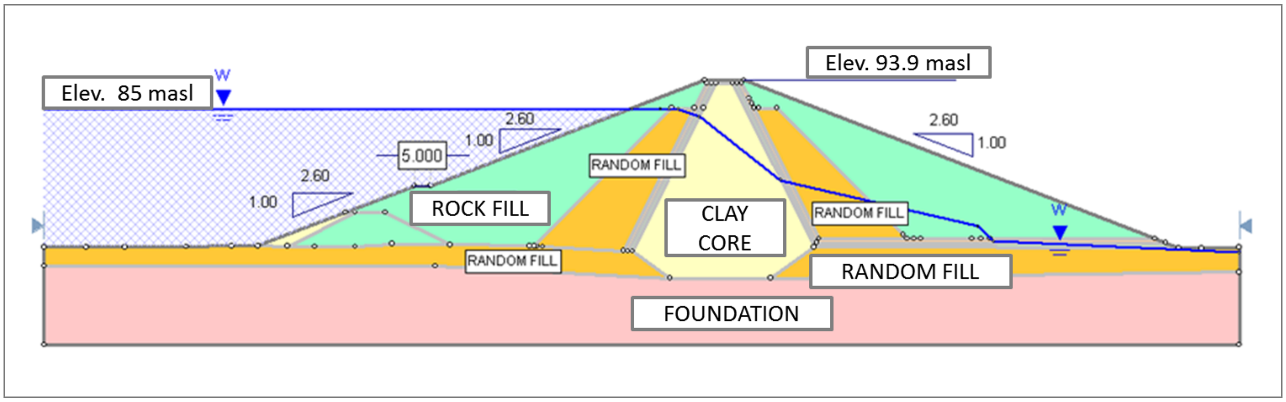


Figure 13. Typical Section of Embankment Dam

Table 5. BSRIP Dam Attributes

Dam Attributes	Description
Dam Height from River Bed	48.40 meter (93.9 masl elevation)
Maximum Operating Level from River Bed	39.50 meter (85 masl elevation)
Dam Type	Zone Embankment
Clay Core	Central Clay Core
Filter	U/S and D/S – fine/coarse/fine filter
Outer shell 1	Random fill
Outer shell 2	U/S and D/S rockfill
Rock Toe	None

U/S – upstream embankment; D/S= downstream embankment

The recommended dam is a zoned embankment type (central impervious core supported by a more pervious material). However, the supporting shell will be made of zones of rock fill and random material. This type of dam was considered primarily because:

i. there will be large volume of rockfill from excavations along the spillway, or if needed, quarry areas in the vicinity of the dam location; and

ii. a rock fill supporting shell will mean steeper outer slopes (refer to the stability analysis conducted) compared to a random fill supporting shell thereby requiring lesser volume of materials.

2.4.1.2 Dam Dimensions

Dam Height. The crest of the dam or top of the dam without camber is set at elevation 93.90 masl, about 48.40 meters above riverbed elevation of 45.50 meters, measured from topographic survey.

The normal water surface is set at 85.0 masl (or 39.5 m from river bed) to provide a normal freeboard of 8.90 meters, broken down as 7.30 m for 1000-year flood surcharge, 0.60 m for wave due to wind, and 1.00 m for minimum freeboard. It was assumed that earthquake will not occur at the same time as the 1,000-year flood. Note that the 8.90-meter freeboard due to flood governs.

Widths of the Crest. With reference to the USBR criteria as a function of the height of the dam, the will have a width of 8 meters, which is also enough for traffic access.

Impervious Core. The impervious core will have top width of 5 meters to meet the construction requirements. The impervious core will have a 1.0V:0.5H slopes extending to about 1 meter below the crest. At the centerline of the dam crest, the core will also have a positive cutoff to bedrock level 11.5 meters below the riverbed. The bottom will have a width of about 30 meters with sides sloping of 1V:1.4H to provide adequate contact with the rock foundation but also accounting for the loss of head as the water travels vertically through the foundation. Three lines of grout curtains with spacing of 6 meters will be provided for the rock foundation to control seepage.

Water Conduit Diameter. Within the upstream face of the dam, river water will pass through a 1.00 m inside diameter intake tower at 62.2 masl then down to a 3.7-m diameter conduit.

2.4.1.3 Spillway and Appurtenances

A spillway is the structure where excess water flows when the reservoir is full. The spillway is located at 85 masl of the true left abutment (northside) adjacent to the embankment dam. It is about 36-meter wide to accommodate a 1000-year flood. The recommended scheme consists of an approach channel, an overflow ogee crest, a chute terminating with a flip bucket, and a plunge basin.

The spillway alignment is situated as near the mountain slope as possible to minimize excavations. As a result however, the upper 9 meters of the right wall (which is above the max. normal water level at 85 masl is immediately adjacent to the embankment dam. This height is selected as the threshold for situating the alignment so that the joint between the concrete wall and the dam embankment will only be exposed to water pressure during flood events thereby lessening the risk of unwanted seepage. The foundation of the right side wall of the spillway is founded on firm rock.

2.4.1.4 Cofferdam

Coffer dam is a temporary structure built upstream from a dam to prevent stream flow around the excavation for a dam, minimizing the downstream flow of excavated earth materials. Eventually, the cofferdams will become integral part of the main dam. The design of the coffer day will depend on the gaging station records from 1983 to 2007, which showed a maximum peak discharge of 258 m^3/s in 1988. A gauged river hydrograph analysis showed the 5-year peak discharge of 652 m^3/s, inclusive of the base flow.

2.4.1.5 Outlet Works and its Appurtenances

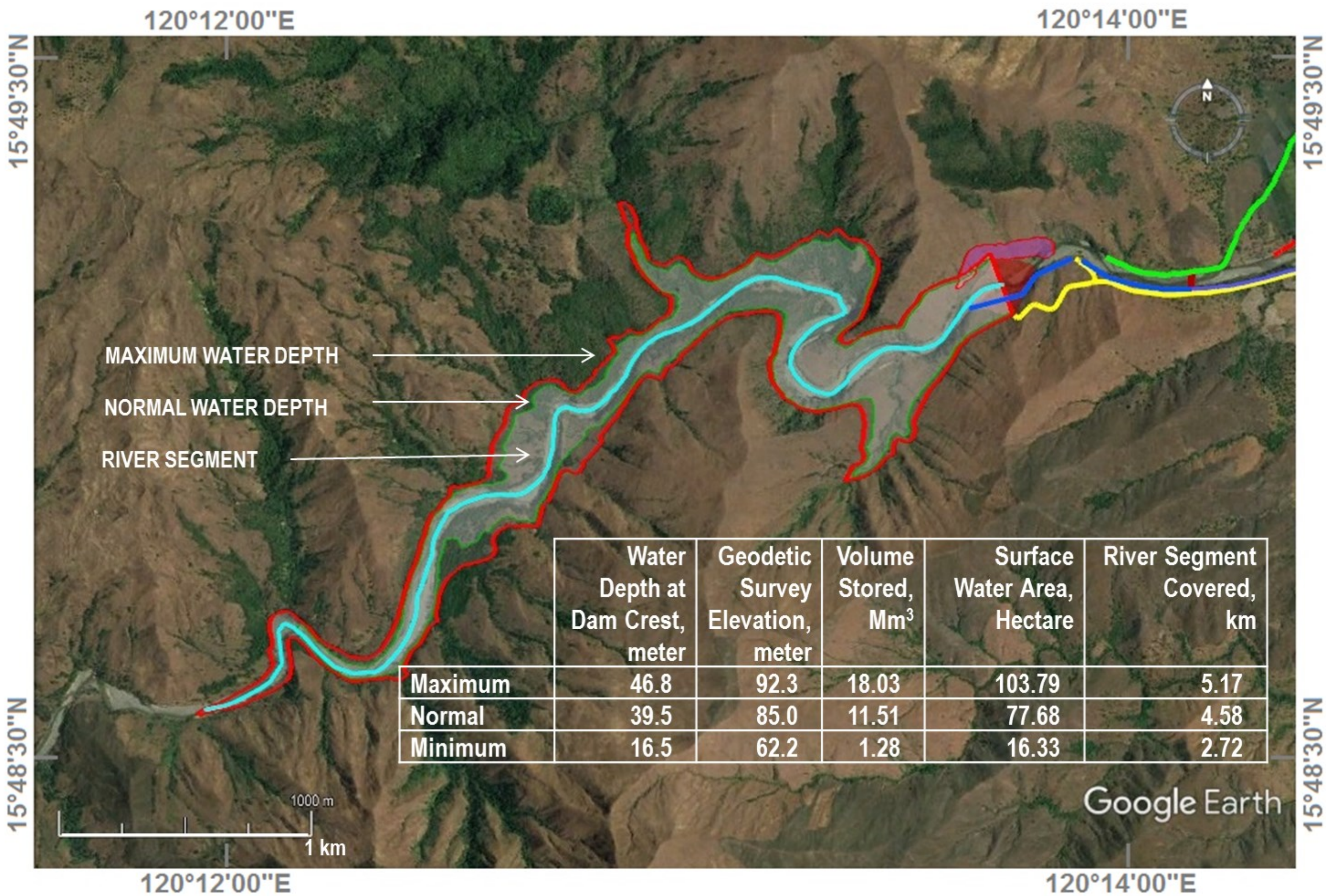
The outlet works are located at the right bank. They include the diversion conduit as access for inspection, a vertical intake shaft with a bellmouth inlet, an outlet pipe with upstream and downstream control valves, and a stilling pool which will also serve as a junction box to the irrigation supply conduit. A bypass channel provided at the stilling pool will enable diversion of water back to the Bayaoas River to satisfy irrigation requirements of the Calsib CIS and environmental requirements.

2.4.1.5 Dam Instrumentation

Minimum dam instrumentation shall be installed to include piezometer surface measuring points and permanent benchmark.

2.4.2 River Water Reservoir

The reservoir indicative covered area, maximum water depth, normal operating water depth and river segment of the reservoir is shown in **Figure 14.** The maximum water depth (red line) is a flood condition that would be at 92.3 masl or 46.8 m high from the dam crest river bed (45.5 masl) , with volume stored of 18.03 million m^3 and surface area of 104 ha, covering about 5.17 km of upstream segment of Bayaoas River. The normal (maximum) operating water depth (green line) would be at 85 masl (also the floor level the spillway ogee) or 39.5 m from the dam crest river bed, with volume stored of 11.51 million m^3 and surface area of 78 ha covering about 4.58 km of upstream segment of the river. The minimum level at 62 masl, would be at 16.5 m deep from the dam crest river bed, with volume stored of 1.28 million m^3, and surface area of 16 ha, covering about 2.72 km of the upstream segment of the river. Additional information on elevation is presented in **Table 6.** The relationship of reservoir surface area and cumulative capacity with respect to reservoir surface water elevation is shown in **Table 7**. The difference in volume between the maximum normal operating level at 85 mas and the minimum operating level at 62 masl is 10.23 million m^3 for the irrigation and environmental flow.



	Water Depth at Dam Crest, meter	Geodetic Survey Elevation, meter	Volume Stored, Mm^3	Surface Water Area, Hectare	River Segment Covered, km
Maximum	46.8	92.3	18.03	103.79	5.17
Normal	39.5	85.0	11.51	77.68	4.58
Minimum	16.5	62.2	1.28	16.33	2.72

Figure 14. Close-up view of the BSRIP Reservoir

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Table 6. Reservoir Data

Reservoir Water Level	Water Depth m	Volume Stored million m^3	Surface Water Area Ha	Length of Bayaoas River Segment, km	Ground Survey Elevation m	Google Earth Elevation, m	NAMRIA Map Elevation m
Maximum	46.8	18.03	103.79	5.17	92.3	107	102
Normal	39.5	11.51	77.68	4.58	85.0	99	94
Minimum	16.5	1.28	16.33	2.72	62.2	77	72

Note: Dam river bed elevation is 45.3 m by ground survey; 47 m in Google Earth; and 55 m in NAMRIA topographic map.

Table 7. Reservoir surface area and cumulative capacity by reservoir surface water elevation

Reservoir Surface water Elevation, masl	Area, ha	Cumulative capacity million m^3
45.5	0	0
50	2.79	62.85
60	11.79	791.48
70	32.01	2,981.16
80	60.84	7,623.36
90	94.52	15,391.37
100	134.84	26,859.81
110	181.73	42,688.39
120	231.36	63,342.70
130	280.13	88,917.29
140	336.63	119,755.62

To test the capacity of the reservoir, the BSRIP 2015 FS Report also presents a simulation of reservation operation under decadal (10 days) accounting of reservoir inflows and releases including potential evaporation and other losses at the reservoir (10% of evaporation). The simulation was set to meet the requirements for irrigation water diversions through gravity. This involves the computation of changes in stored water using basic continuity or conservation of volume equation for a reservoir taking into account the relationship of the elevation versus storage volume and surface area. The dead storage determined based on sedimentation rate and normal water surface elevations to be assumed and determined were used.

The following operations criteria were set:

i. Maximum annual shortage should be less than 25% of average annual demand;
ii. Maximum cumulative shortage for ten (10) consecutive years should be less than 50% of the average annual demand.
iii. Reservoir reliability should not be less than 95%.
iv. Shortage should not be exhibited in three (3) successive years.
v. Allowable carryover storage should not be higher than 24 months.

The following cases were in effect in the simulation:

i. Spillage occurs when the water level reaches the maximum operating level.

ii. Water is drawn within the active reservoir storage when water level is above the minimum water level.

iii. When the reservoir is below the minimum operating level: inflow is utilized to replenish the deficit first; secondly, excess inflow, if any, is used to satisfy irrigation demand; and, thirdly, storage to increase water level but not higher than the normal water surface.

The simulation covered 1961-2013 stream flow data, and varying the normal water surface elevations from 80 to 85 masl. The result of the 85 masl run is presented in **Table 8**, which shows conformance with all of the operations criteria.

Table 8. Results of Reservoir Operation Simulation @ 85 masl

1.	Simulation Period	1961-2013
2.	Number of decades	1908
3.	River Bed Elevation	45.49 masl
4.	Irrigated Rice Area during Wet Season	1,400 ha
5.	Irrigated Rice Area during Dry Season	1,238
6.	Ending Storage at Maximum Water Level of 85 masl	11.507 million m^3
7.	Ending Storage at Minimum Water Level of 62.25 masl	1.284 million m^3
8.	Frequency of Spills	529 or 28%
9.	Frequency of Deficit	24
10.	Reliability	98%
11.	Maximum Annual Deficit	3.860 million m^3 or 15% of diversion requirement
12.	Maximum Cumulative Shortage: 10 successive years	9.660 million m^3 or 37% diversion requirement
13.	Maximum Number of Decades (10 days) reservoir is full every year	15
14.	Minimum Number of Decades (10 days) reservoir is full every year	5
15.	Maximum Carry-over period	10 months
16.	Number of 3 successive years with deficit	0
17.	Number of times storage below minimum	0

Source: BSRIP 2015 FS Report. Chapter 7

2.4.3 Access Road

Access to the dam site would either be from barangay Quetegan, Mangatarem or from barangay Bayaoas, Aguilar. The Quetegan route starts from the national highway then on westward direction along the concrete barangay road going to Pogonsili. The Bayaoas route is also from the national highway just south of the Bayaoas Bridge then traversing the barangay road alongside the Bayaoas river then to Pogonsili. The two routes converge to a Y-shape intersection somewhere at Pogonsili, thus the Quetegan and Bayaoas routes is 2.4 kilometers and 2.7 kilometers respectively.

To illustrate the areal coverage of the new access road to the damsite, the starting point is set at the intersection of the Quetegan and Bayaoas barangay roads. The example access road negotiates an existing cart track/trail on a south-westerly direction of about 0.9 kilometer then to a westerly direction of about 1.6 kilometers, then it will connect to a 0.5 kilometer new section leading to the main dam crest. The proposed access road length is about 3.0 kilometers. The development cost of this new access road was included in the project cost estimate.

The exact location and length will be determined during the detailed engineering design stage of the project. The stated location and distance of road alignment is just an estimate which is acceptable for site-specific environmental impact assessment. An order of magnitude of earth spoil would be adequate as a basis of locating the spoil disposal site and additional access road. Significant volume of earth spoil may be generated. Spoil disposal site would just be nearby to the south. Soil was estimated to be 2 meters deep. Cut-and-fill is expected to be done during road construction.

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2.4.2 Covered Irrigation Canal Network

The covered irrigable area is 1,400 ha of ricefields, however only 1,238 ha could be served during the dry season. The remaining 162 ha that could not be irrigated in the dry season is projected to be idle. There are existing canal networks within the area which farmers traditionally use but most are indigenously constructed. The same canal alignments were mostly adopted in the BSRIP 2015 FS Report, but repair and improvements have to be undertaken to effectively improve the conveyance of irrigation water to the rice paddies. An annotated closer view of the irrigation network is presented in **Figure 15.**

The proposed irrigation network shall involve the following activities:

i. Construction of a main supply canal from the outlet works of the reservoir, traversing along the right bank of Bayaoas River with a length of about 461.70 meters. The scheme along this segment is to provide a cut and cover by installing a 1.30 meters x 1.30 meters box conduit to accommodate the total irrigation discharge requirement of 2.427 m^3/sec. Manholes will be installed at 30 meters interval for operation and maintenance.

ii. Construction of a 1.00m. x 1.00m barrel along left main canal with a length of about 353 meters, and vertical lining (CHB sidewalls) with a length of about 950 meters. The total length of the left main canal would be about 2.40 km, serving an area of 438 hectares. Three laterals take off from the left main canal.

iii. Construction of a 1.30m x 1.30m barrel along right main canal with a length of about 250 meters, and vertical lining (CHB sidewalls) with a length of about 1.10 km. The total length of the right main canal would be about 6.30 km serving an area of 717 hectares. The existing canal runs to a stretch of about 6.20 km that needs to be improved, because the canal prism is already deformed and could not accommodate the discharge requirement. Three laterals take off from the Right Main Canal. The lateral canals also need to be improved. Existing canals are Lateral A with length of 2.60 km, Lateral B with 3.90 km and Lateral C with 1.40 km.

iv. Construction of a 0.80m x 0.80 section siphon crossing Bayaoas River to supply the irrigation discharge requirement of the Left Main Canal. The siphon will convey a discharge of 0.921 m^3/sec.

v. Construction of turnouts, pipe crossings and other conveyance and control structures along the main canals and laterals.

vi. Construction of on-farm and drainage facilities.

Distribution of irrigation water is by gravity. The water duty used in the delivery of irrigation water is, 2.10 liters/sec/hectare, normally required during the months of May and June, where rainfalls seldom occur. At the initial segments of the right and left main canal including the supply canal, cut and cover structures (conduits) were provided as these stretches traverse slopes and side of hills. Manholes are provided at strategic points, intended for the operation and maintenance.

Vertical linings are also considered which normally connect at the outlet of these conduits. Grouted riprap on some canal stretches was considered with the abundance of potential source of stones at the vicinity of the site. This is to ensure delivery of irrigation water to the last lateral of the main canals controlling the effect of losses on the delivery of irrigation water. These losses include among others, percolation and seepages that will lead to wastage. All conveyance and control structures are hydraulically designed as free flowing except for siphons. All structures shall have a concrete mix of 211kg/cm^2.

Farm drains shall be provided to discharge floodwater or run-off from irrigation into the existing creeks. Good drainage will facilitate removal of excess water during rains and prevent water logging that would be damaging to the rice crops resulting to poor yields Drainage discharges were derived from Gumbel method, to determine the design discharges for paddy fields with 100 mm flood retained. Based on the land classification and soil investigation, the lowland area are deep, fine loamy soils with good internal drainage, with fair to good external (or surface) drainage, subject to moderate flooding. The upland with fine clayey soils have poor internal drainage but good surface drainage.

Construction of maintenance access road to the Left Main Canal may be considered in the future.

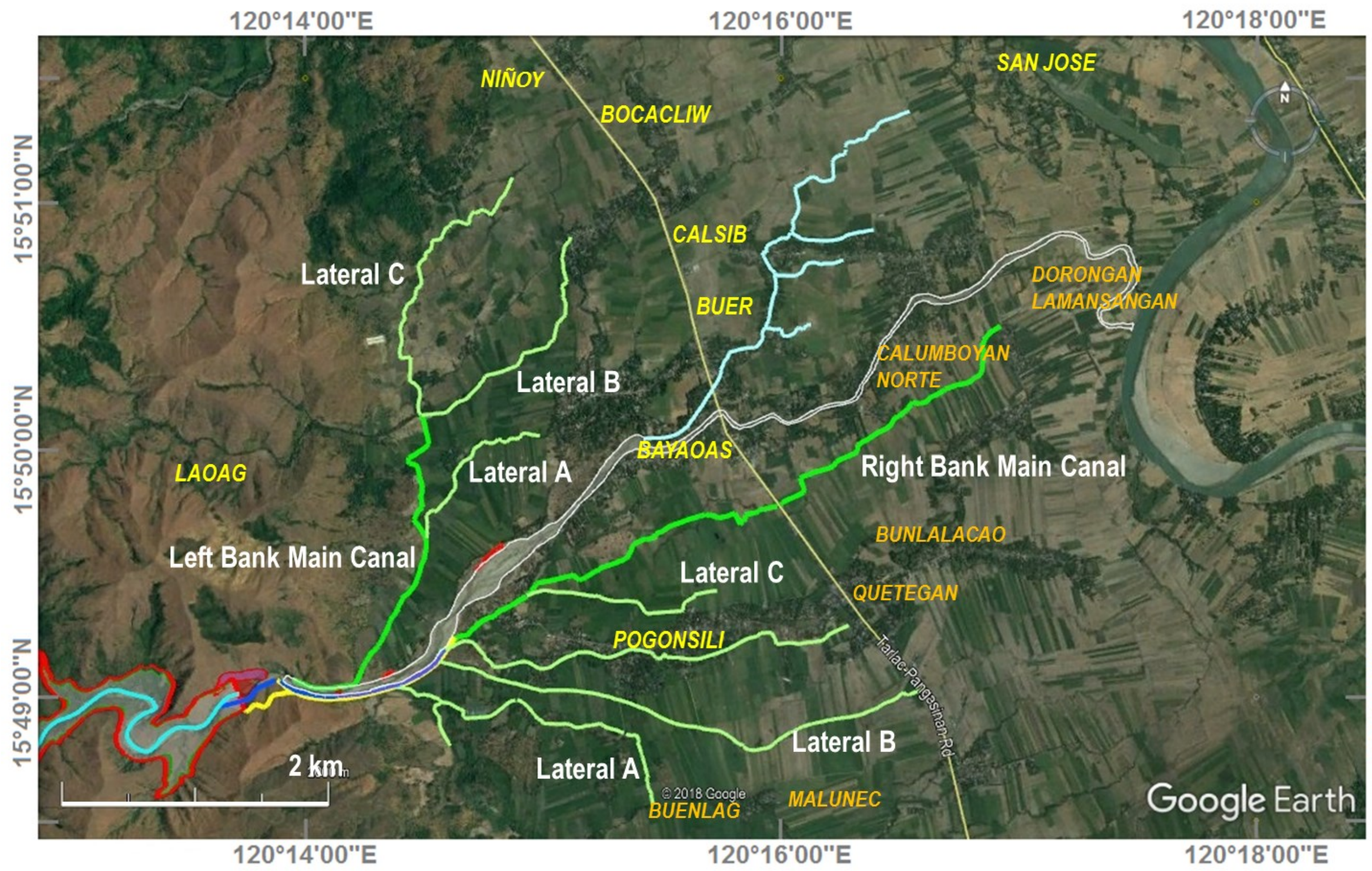

Figure 15. BSRIP Irrigation canal network for improvement, and covered and neighboring barangays in Aguilar (in yellow text) and Mangatarem (in gold text)

2.5 Project Phases and Timetable

Under favorable conditions, the Proposed Project will be completed in four (4) years from the pre-construction, construction and operation phases **(Figure 16**). Pre-construction activities, allotted for one-year will include arrangements with the farmers and landowners, surveying, right-of-way acquisition, and government permitting. Construction of the dam and improvements in irrigation facilities will be done in parallel.

Timing and sequencing of construction activities will dependent on weather conditions. The area is dry from November to April and wet during the rest of the year. For example, critical activities such as concreting of outlet works and spillway and placement of impervious core materials and random fill for dam embankment should only be done during the driest months of the year. For the irrigation facilities, the first two to four (2-4) months shall be allotted to survey and profiling of canal locations.

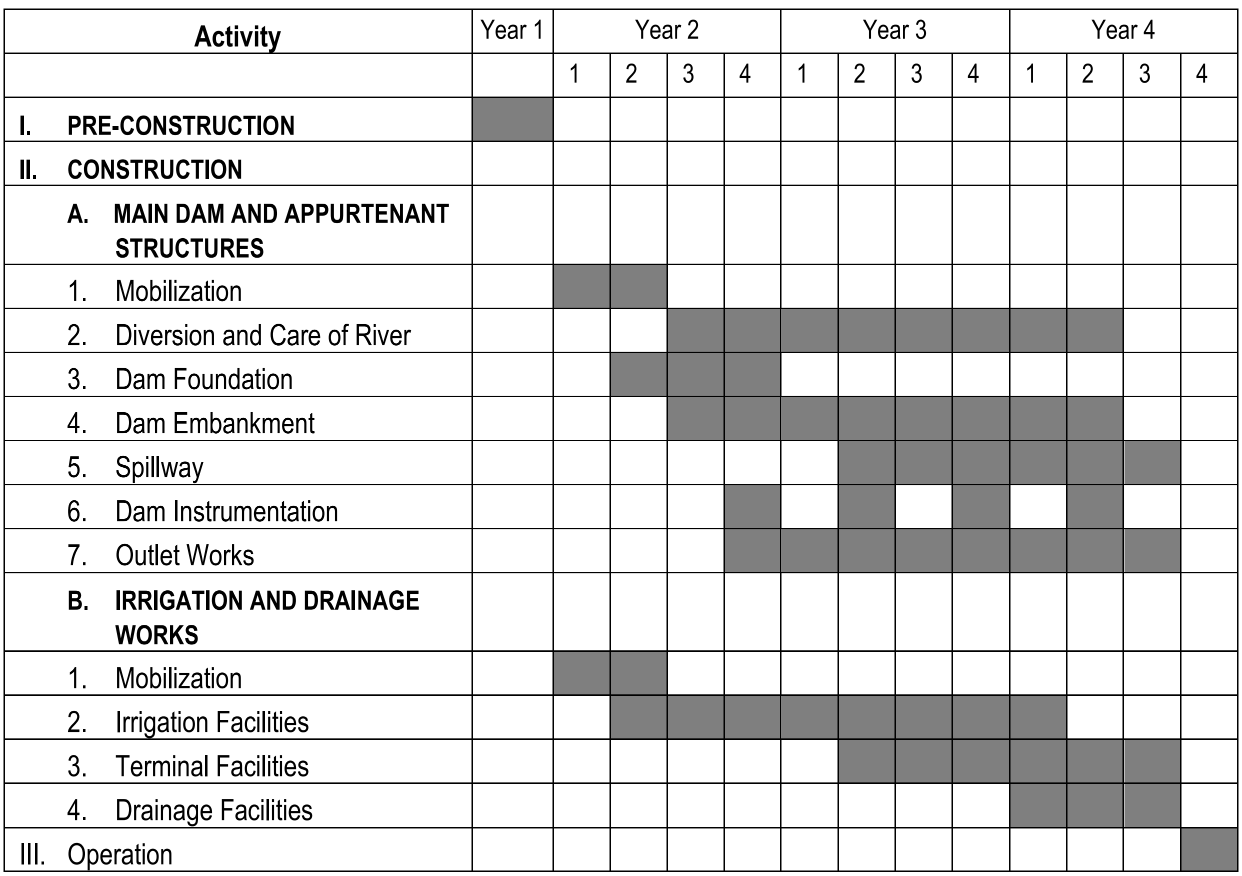

Figure 16. Project Timetable

2.6 Project Implementation Arrangement

2.6.1 Construction

The proposed construction organization will be patterned from the existing set-up of the implementing management office, SRIP-PMO of the NIA Central Office. A task force will be formed that will handle and supervise the construction which consists of a Resident Engineer, Office Engineer, Material Testing Engineer, Construction Engineer and Geologist (on call basis), complemented with support staff (**Figure 17**). The Pangasinan Provincial Irrigation Management Office (PIMO) together with the Regional Irrigation Office 1 (RIO) will supervise all construction activities and the Environmental and Institutional aspects of the project.

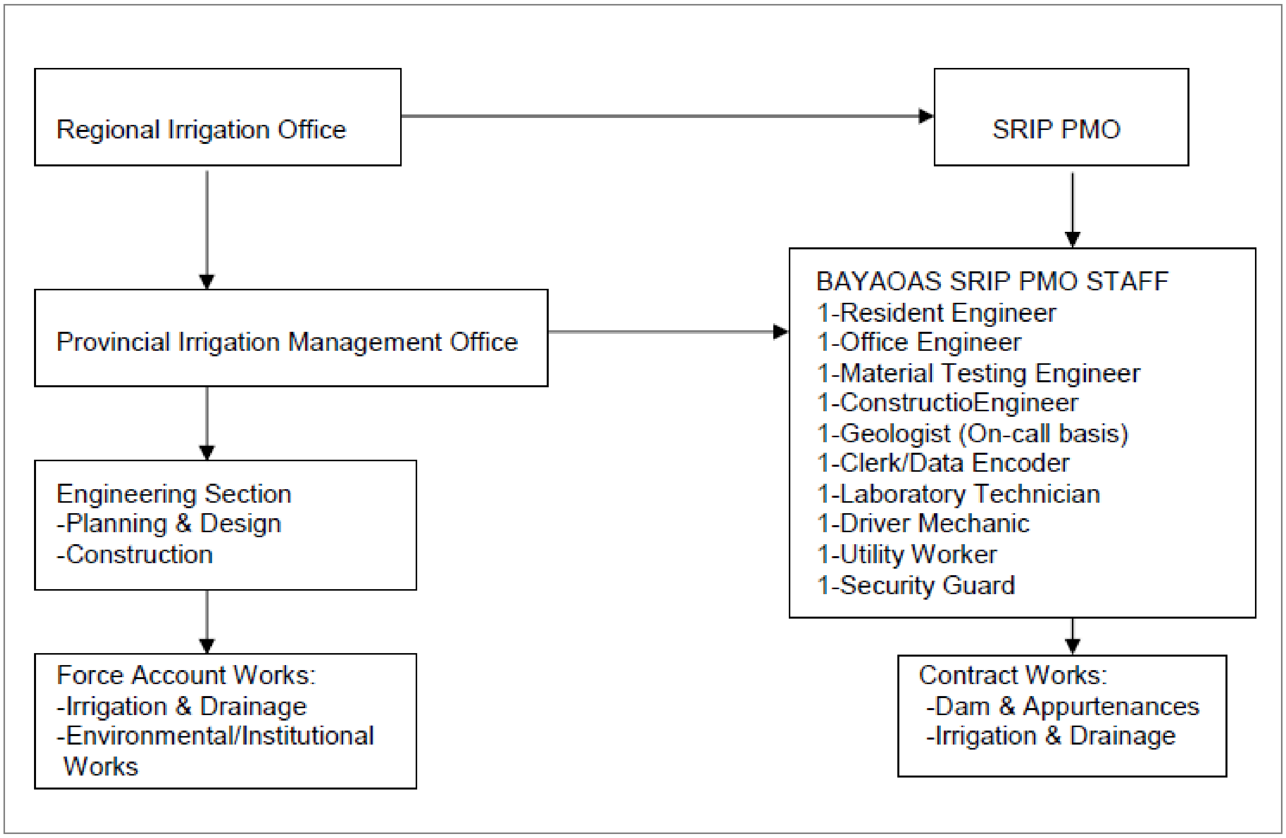

Figure 17. Organization for Project Implementation and Construction Supervision

2.6.2 Operation and Maintenance

Upon completion of the Bayaoas SRIP, the entire project will be turned over to the Pangasinan Provincial Irrigation Management Office (PIMO). Under the direction and supervision of the Regional Irrigation Office, the operation and maintenance of the dam and its appurtenant structures will be the responsibility of the Pangasinan PIMO, while the operation and maintenance of the irrigation facilities will be performed by the Irrigators Associations with technical assistance from NIA-PIMO.

The operation and maintenance of the irrigation system will be a joint responsibility of NIA and the irrigators associations. The Dam and Reservoir, the Diversion Dams and Main Canals will be managed by the PIMO. The laterals and secondary facilities shall be turned over to the IA, under contract maintenance. The IAs will therefore be strengthened by giving them the whole package of IA development training programs on capability building in systems O & M, including financial management.

Figure 18 shows the PIMO organization for O & M. Bayaoas SRIP shall be lodged under one (1), of the four (4) O & M Sections under the PIMO.

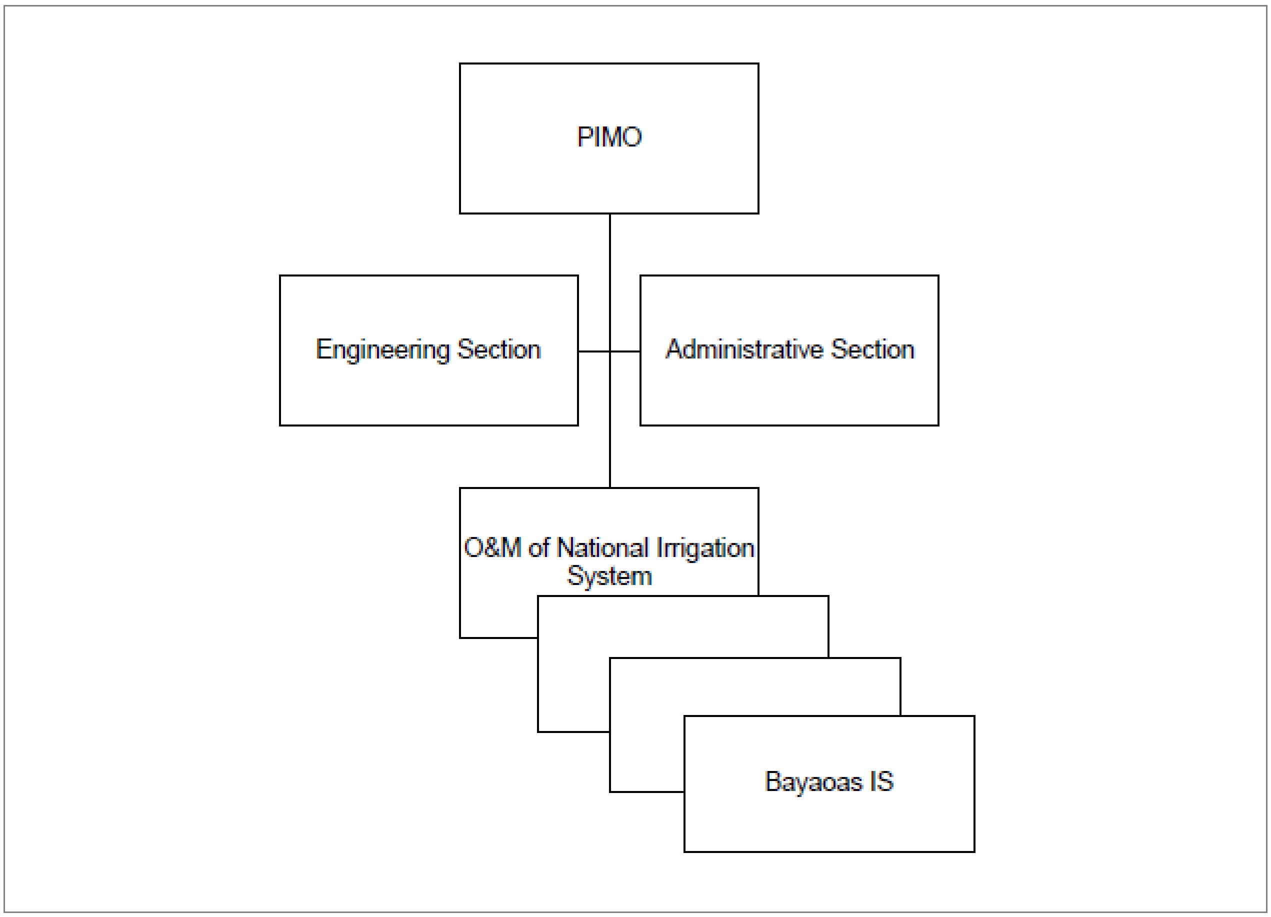

Figure 18. Pangasinan Irrigation Management Office Organization

Under the NIA Memorandum Circular 15 series of 2009, there is an Irrigation Management Transfer Program of NIA. The IAs shall be developed to gradually progress from Model 1 Contract to Model 4 Contract. The IMT Program aims to completely transfer to the IA the management of the entire system with NIA retaining only monitoring and evaluation function and extend periodic technical assistance whenever requested by the IA. The sharing of responsibilities in O & M under the different Models (Model 1 to Model 4) are provided in the circular.

For such a scheme, an institutional development will be implemented for the irrigators associations, as in those NIA-assisted irrigator association in Calsib. The plan will involve: reorganizing the IAs; retraining the IA officers and members on the various aspects of their business operating system management, and mobilization of resources to improve their financial standing; and linking them to extension and credit services.

This will encourage IAs to duly register with the government either with the Securities and Exchange Commission (SEC), Cooperative Development Authority (CDA) and other entities to obtain its legal personality. This will provide the IAs to a legal personality to enter into contracts with government and private institutions. NIA has a policy to enlist the participation of farmers, in project planning, implementation and operation and maintenance of the irrigation system. An example of organization for the AIs is presented in **Figure 19**.

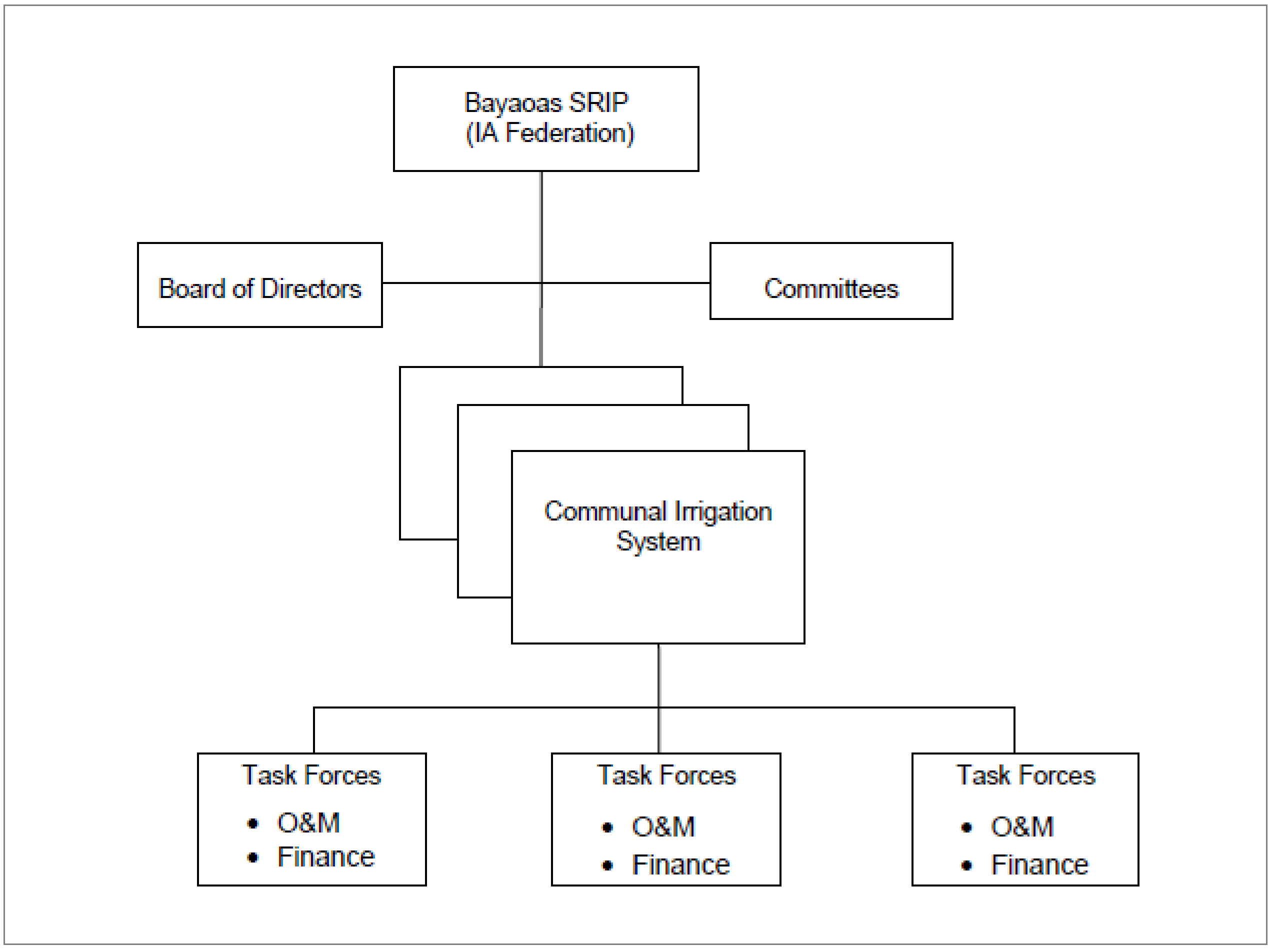

Figure 19. Irrigators Association (IA) Organization

3.0 SCREENING OF ENVIRONMENTAL ASPECTS, IMPACTS AND RISKS

The screening of environmental aspects, impacts and risks is used for focusing, leveling and endpoints of the more relevant information for the EIS **(Table 8).** This is also used in the listing of the stakeholders for public participation.

During pre-construction, no physical activity will be done, although the idea of the having the Proposed Project at the implementation stage may raise concerns from the community. This will be addressed by the continuing IEC and dialogues down to family level of the areas to be affected, and implementation of a grievance mechanism.

During construction, leading environmental aspect will be traffic to the proposed dam site for the project vehicle and equipment through the narrow road of Barangay Bayaoas and Pogonsili, with concerns on traffic, accidents, noise and vehicular emissions. The construction of new road to dam site will pass through private properties of Barangay Pogonsili and would involve surface clearing and earth excavation and concreting. This would cause removal of vegetation, increase in noise, excessive dust emissions during dry periods, increase soil erosion during rainy period with increase in the total suspended solids in Bayaoas River. There is a risk of heavy equipment damaging the poorly constructed road segment. There is also a risk of spillage of the fuels and oil at the equipment staging or maintenance area.

Such clearing, earth excavation and equipment staging works will also be done at the damsite and quarry areas of greater magnitude and longer period. The damsite and quarry areas are located in Barangay Laoag and will be far from residential areas of Barangay Bayaoas and Pogonsili, but within the greening projects of the communities affecting the planted trees. Increase in the soil erosion and total suspended solids may still happen during dry period causing the browning of Bayaoas River. The cofferdam to be constructed would significant siltation. The dam site is considered highly susceptible to landslide.

Improvements in the irrigation system would not cause significant impact by each site of work inasmuch the existing alignments of the irrigation canals will be the work area. Prior arrangements with the farmers will be done should there be cases of water supply interruption.

The locations mentioned will be the direct impact areas and the neighboring areas will be the indirect impact areas.

During the operation stage, irrigation waters will be supplied even during the dry season and impacts include the increase frequency of fertilizers and agro-chemicals that would affect the groundwater. The environmental risk is dam failure that would cause flashfloods.

In the Municipality of Aguilar, the direct impact area stakeholders are Barangays Laoag, Pogonsili, Bayaoas, Buer, Calsib and Bocacliw In the Muncipality of Mangatarem, the direct impact areas for the improvements of irrigation canals, if there would be are Barangay Malunec and Calomboyan Norte. The neighboring barangays as indirect impact areas in Aguilar are Barangay Niñoy and San Jone; in Aguilar, Barangay Buenlac, Quetegan, Bunlalacao and Dorongan Lamansangan.

As a guide, the following stakeholders were listed:

Department of Environment and Natural Resources
Community Environment and Natural Resources, Dagupan City
DENR Environmental Management Bureau (EMB)
Department of Agriculture (DA)
Bureau of Soils and Water Management (BSWM)
Forest Management Bureau (FMB)
Biodiversity Management Bureau (BMB)
Department of Public Works and Highways (DPWH)
Pangasinan Provincial Government
Aguilar, Pangasinan Local Government Units
Mangatarem, Pangasinan Local Government Units
PAGASA, PHIVOLCS, NAMRIA, Mines and Geosciences Bureau
Aguilar and Mangatarem Pangasinan Irrigators Associations, and farmers
Academe, Churches, Non-Government Organizations, People's Organizations
Media and other organizations and individuals

Table 8. BSRIP Screening of Environmental Aspects, Impacts and Risks

Project Activities	Land	Water	Air	People	Measures
1. **ROW acquisition** for proposed access roads to dumpsite, access irrigation canals, staging area, basecamp, quarry site, spoil disposal site	change in land use from agriculture, idle to built up area			loss of property, income in the proposed access road [No displacement of local residents] induced settlement at road side	
2. **Land Use Permit /Authority** Acquisition for the dumpsite, irrigation canals, staging area, basecamp, quarry site, spoil disposal site					
3. **Construction of Dam and Support Facilities**					
3.1. Piloting and land clearing in the construction of access road, staging area, basecamp, quarry site, spoil disposal site and dam	loss of vegetation disturbance to wildlife top soil removal increase in soil erosion potential	Increase in TSS and browning of Bayaoas river especially during rainy season	insignificant, localized increase in criteria pollutants and noise from the operation of heavy equipment		Collection of cut wood for use Replacement planting
3.2. Earth excavations by heavy equipment along the proposed access road, staging area, basecamp, quarry site, spoil disposal site and dam	Change in the location of foot trails top soil removal increase in soil erosion potential	Increase in TSS and browning of Bayaoas River especially during rainy season	Intermittent sudden and localized increase in TSP during dry season insignificant, localized increase in criteria pollutants and noise from the operation of heavy equipment		Immediate hauling of excavated materials to spoil disposal area
3.3. Disposal of excavated	localized change in	Increase in TSS of	Intermittent sudden		Spoil disposal area to

Project Activities	Land	Water	Air	People	Measures
materials to spoil disposal area	slope and topography increase in soil erosion potential	Bayaoas River	and localized increase in TSP during dry season		have soil erosion control measures
3.4. Quarrying Works as source of rocks for the dam	increase in soil erosion potential	Increase in TSS of Bayaoas River	Intermittent sudden and localized increase in TSP during dry season		Siting of quarry area away from water body provision of soil erosion control measure until closure
3.5. Stockpiling of construction concreting materials (gravel and sand)	Increase in soil erosion	Increase in TSS of Bayaoas River	Increase in TSP		
3.6. Filling of rock materials at dam site	increase in soil erosion potential reduction of land area for wildlife in the area submersion of trees	Increase in TSS of Bayaoas River Increase in water level of Bayaoas River upstream of damsite	Intermittent sudden and localized increase in TSP during dry season		use of cofferdam
3.7. Concreting of Dam	reduction of land area for wildlife in the area Increase in the local solid waste	Intermittent water coloration temporary disruption in irrigation water supply due to water diversion			prior arrangements with farmers
4. Repairs and improvements of Existing Irrigation Canals					
4.1. Quarrying works as source of gravel and sand [from Bayaoas River ?]	increase in soil erosion potential	Increase in TSS of Bayaoas River	Intermittent sudden and localized increase in TSP during dry season		Siting of quarry area away from water body provision of soil erosion control measure until closure
4.2. Stockpiling of construction				temporary non-use	siting of stockpile in an

Project Activities	Land	Water	Air	People	Measures
concreting materials (gravel and sand)				of land by land owner	idle land
4.3. Concreting of Irrigation canal	reduction of land area for wildlife in the area Increase in the local solid waste	Intermittent water coloration		temporary disruption in irrigation water supply due to water diversion	prior arrangements with farmers
5. Operations of Construction Support Facilities					
5.1. Operation of Batching Plant	increase in soil erosion potential	Increase in TSS of Bayaoas River	Intermittent sudden and localized increase in TSP during dry season		Provision of soil erosion control measures
5.2. Use of unpaved access road beside Bayaoas River	increase in littered soil along paved road during rainy season	Increase in TSS of Bayaoas River during rainy season	Intermittent localized increase in TSP during dry season Intermittent and localized increase in noise level	Intermittent reduction in traffic flow, risk of road accident	provision of tire wash area, Use of water spray during dry season. Implementation of traffic safety plan
5.3. Use of generator at dam site			Localized increase in criteria pollutants and noise		
5.4. Onsite Refueling of vehicles		risk of fuel spillage			Compliance with RA 6969
5.5. Onsite maintenance of heavy equipment at dam site	Increase in the local solid waste	risk of waste oil loading into Bayaoas River			Compliance with RA 6969 and RA 9275
5.6. Use of Basecamp at dam site	Increase in the local solid waste	insignificant increase in human sewage loading into Bayaoas			Compliance with RA 9003 and RA 9275
6. Demobilization Works	increase in solid wastes			risk of road accidents	Compliance with RA 9003; Implementation

Project Activities	Land	Water	Air	People	Measures
					of traffic safety plan
7. Operations					
7.1. Maintenance of dam reservoir water level	decrease in the land area for wildlife, localized migration of wildlife Opportunity for local tourism	Opportunity for fisheries industry increase in fish population		Additional income from fishery projects and local tourism	[risk of dam collapse]
7.2. Supply of water to irrigation networks	Increase in the frequency of land for rice production change in the ecology during dry season	competition in water use Increase in loading of fertilizers, insecticides, pesticides		Increase in the income local income	
7.3. Dam site office use	Increase in the local solid waste	insignificant increase in human sewage loading into Bayaoas			
7.4. Use of dam reservoir for fish culture		increase in fish population		additional income	
7.5. Use of dam site for tourism, educational tour				additional income	