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PROJECT DESCRIPTION
CHAPTER I

Bagtingon Small Reservoir Irrigation Project (BSRIP)

Barangay Bagtingon, Buenavista, Marinduque

1 Project Description

The National Irrigation Administration (NIA) is proposing to construct the Bagtingon Small Reservoir Irrigation Project (BSRIP) encompassing eight barangays in the Municipality of Buenavista particularly Barangays Bagtingon, Malbog, Caigangan, Daykitin, Uno, Dos, Tres, and Quatro. The project also covers Barangay Tabionan in the Municipality of Gasan.

NIA has been undertaking the Small Reservoir Irrigation Project (SRIP) under the Accelerated Irrigation Development Program of the Philippine Government. The implementation of SRIPs involves the construction of medium-sized dams and appurtenant structures to impound water during wet season mainly to provide year-round irrigation to farmlands of farmer beneficiaries in the rural areas. Additional benefits intended for SRIPs include flood control, aquaculture, hydropower, domestic water supply and recreational facilities.

Under the SRIP, the proposed project in the Municipalities of Buenavista and Gasan has been selected as one of the prioritized projects due to its technical location and availability of data (e.g. geologic and topographic) relevant to its construction.

The project aims to support the largely agricultural Province of Marinduque by addressing insufficient water for irrigation that will aid the agriculture sector to increase productivity (i.e. to extend farming seasons up to two to three cropping seasons annually).

The Geographic Innovations for Development Solutions, Inc. (GRIDs) was engaged by NIA to conduct the Environmental Impact Assessment (EIA) process and Environmental Compliance Certificate (ECC) application through the preparation of a Social Environmental Impact Assessment (SEIA).

Since the project site overlaps with a small part of the Marinduque Wildlife Sanctuary, NIA will need to apply for a Special Use Agreement in Protected Areas (SAPA) to be able to construct within MWS vicinity once the ECC is acquired. Moreover, right-of-way negotiations with private owners of lands overlapping with the project are also ongoing. NIA has reached an agreement with an initial number of 43 out of 47 landowners. NIA will proceed with the negotiations with the remaining landowners once their documentary requirements (i.e. proof of tenure) have been validated by NIA.

1.1 Project Location and Area

The proposed BSRIP is located in the Province of Marinduque, specifically the Municipalities of Buenavista and Gasan. Figure 1-1 shows the project's location. Meanwhile, the location of project components per barangay is detailed in Table 1-1.

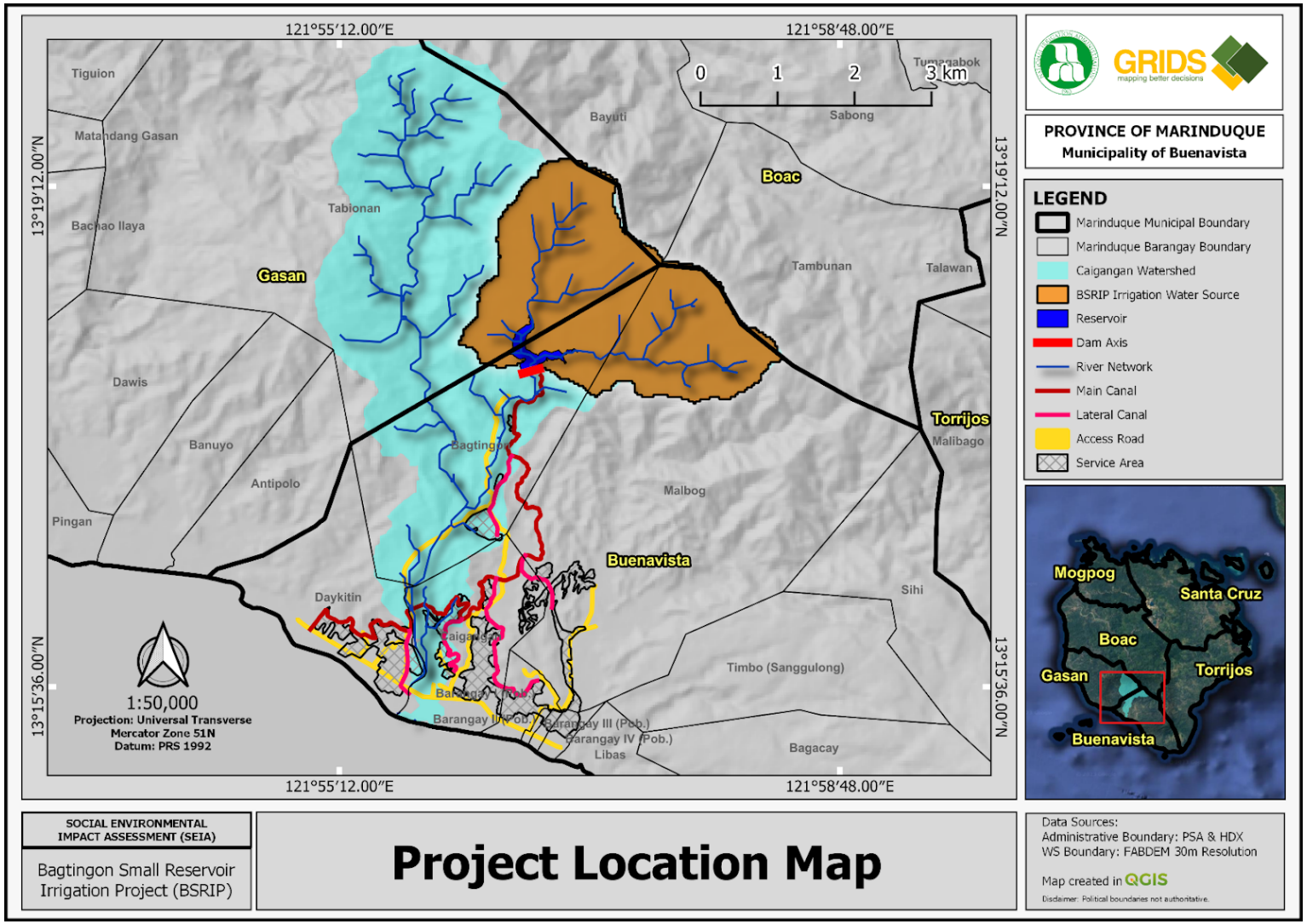


Figure 1-1 Project location map

There are eight project barangays in Municipality of Buenavista specifically Barangays Bagtingon, Daykitin, Caigangan, Uno, Dos, Tres, Quatro, and Malbog. Meanwhile, Barangay Tabionan is the only project site in the Municipality of Gasan.

The project's Irrigation Water Source (IWS) spans 765 ha in which 16.90 ha (2.21%) will be submerged by the project, The largest barangay covering the IWS is Barangay Malbog with a total area of 313.99 ha, while the Barangay with the smallest area coverage within IWS is Tambunan with only 3.26 ha. Additionally, around 9.15% or 11.86 ha of the reservoir is within Barangay Bagtingon.

The dam's specific location is at the northwestern part of Barangay Bagtingon, between 13° 17' 49" in the North latitude and 121° 56' 36.02" in the East longitude. The project aims to source water from the Caigangan Watershed and its associated rivers (i.e. Manlawanin and Subling Rivers) with a total area of 2,152 ha that falls under the jurisdiction of the local government units of Gasan and Buenavista. The proposed dam location is bounded from the North by the Municipality of Gasan, to the Northeast by the Municipality of Boac, to the South by the Municipality of Torrijos, and to the Tablas Strait in the Southwest.

Table 1-1 Summary of barangays covered by the project

Municipality	Barangay	Project Component/Facility
Buenavista	Bagtingon	IWS, Reservoir and service area
	Malbog	IWS, reservoir, and service area
	Caigangan, Daykitin, Uno, Dos, Tres, Quatro	Service area
Gasan	Tabionan	IWS

The project area encompasses the Marinduque Wildlife Sanctuary (MWS) which was declared as a Protected Landscape and Seascape under the NIPAS Act[1]. However, a survey conducted for the EIS identified that only about 8.54 ha (0.09%) of the total area of MWS (9, 791.19 ha) (Table 1-2) will be affected by the project. The affected portion is part of the area to be submerged by the proposed project specifically in Barangay Bagtingon in Buenavista and Barangay Tabionan in Gasan **(**Figure 1-1**)**. The project will not encompass the Municipality of Boac. Figure 1-2 shows the project's proximity to the MWS.

[1] RA 7986 or the Network of Integrated Protected Areas System

Table 1-2 List of barangays covered by the project IWS and reservoir

Municipality	Barangay	Area (ha)			
		BSRIP IWS		RESERVOIR	
		Within PA	Outside PA	Within PA	Outside PA
Boac	Bayuti	3.33	-	-	-
	Tambunan	3.26	-	-	-
Buenavista	Bagtingon	119.19	10.47	5.00	5.48
	Malbog	313.99	-	-	-
Gasan	Tabionan	312.93	0.03	3.54	0.03
TOTAL AREA		**752.69**	**10.50**	**8.54**	**5.52**

The proposed project will not overlap and is not located within close proximity with any cultural properties and declared National Historical Shrines across the host municipality. Specifically, the Immaculate Conception Cathedral Parish[2], a significant cultural property in Marinduque is approximately 19.93 km away from the project site as presented in Figure 1-3. Surveys and assessments in compliance with regulatory requirements were conducted ensuring that the project site will not overlap with significant historical or cultural features. The BSRIP was intentionally proposed to be located outside cultural properties and National Historic Sites to minimize potential impacts on the host community's rich historical heritage.

The project also does not overlap with an ancestral domain. As of 2018, there are no records of Certificate of Ancestral Domain Titles and Certificates (CADT and CADC) in the Province of Marinduque. Therefore, no indigenous peoples' groups will be affected by the project. The project also does not cover coastal, wetland, and Ramsar areas[3].

[2] Within the Roman Catholic Diocese of Boac

[3] https://doe.gov.ph/eicc/list-identified-ancestral-domain-ads-region

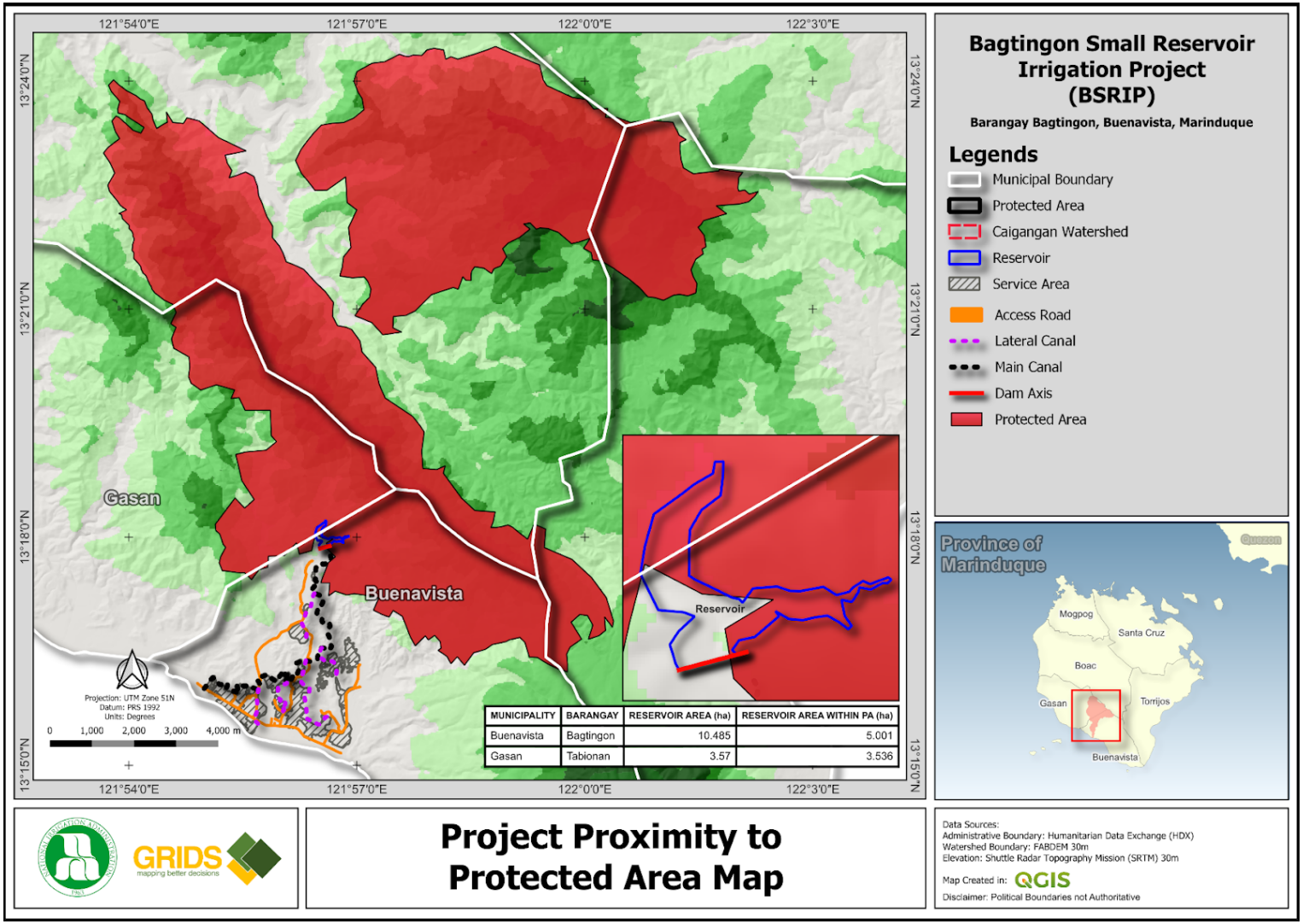


Figure 1-2 Project proximity to Protected Area

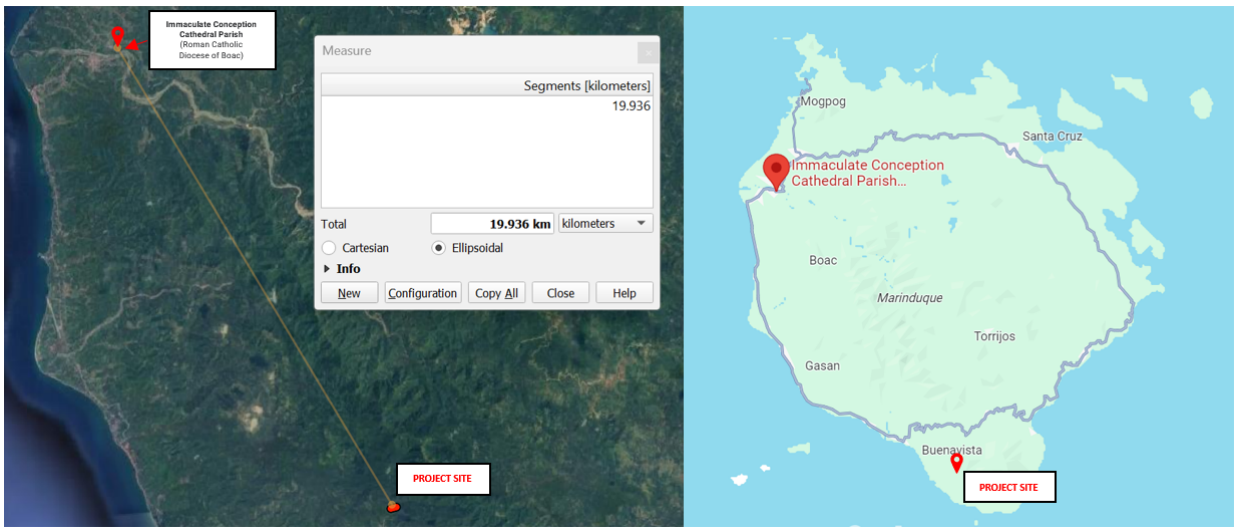


Figure 1-3 Relative distance of the project site from any significant cultural property

1.1.1 Service Area and Features

The project can irrigate a service area of 226 ha during dry and wet seasons. The intended beneficiaries of the project are the eight barangays in Buenavista namely the barangays of: Bagtingon, Caigangan, Daykitin, Malbog, Uno, Dos, Tres, and Quatro as shown previously in Figure 1-1.

Currently, around 50% of the potential 226 ha of the potential service area is planted with paddy rice under rainfed condition during the wet season while the remaining areas are classified as grasslands. Due to unavailability of water supply, the areas planted with rice during the wet season are left idle during the dry season. High value crops are also irregularly cultivated within relatively small areas or at a backyard level during dry and wet seasons.

The annual cropping intensity at present condition is relatively low since the majority of the area is vacant during the dry season. This is due to the low irrigation intensity brought about by unreliable irrigation water sources. The table below (Table 1-3) provides the area and coordinates of the project's main and lateral canals and their corresponding service areas. Meanwhile, Figure 1-4 illustrated the general layout of the project's irrigation canals.

Table 1-3 Geographic coordinates of main and lateral canal and its corresponding total service area

Main Canal			
Turn Out	**Station**	**Coordinates**	**Area**
	Sta. 0+876	13°17'29.48"N, 121°56'26.77"E	0.78
	Sta. 0+993	13°17'25.80"N, 121°56'26.50"E	0.39
	Sta. 4+375	13°16'19.97"N, 121°56'13.15"E	4.15
	Sta. 5+345	13°16'11.22"N, 121°56'7.10"E	6.03
	Sta. 5+550	13°16'13.04"N, 121°56'1.73"E	2.62
	Sta. 6+103	13°16'10.40"N, 121°55'49.59"E	4.33

	Sta. 7+320	13°16'1.73"N, 121°55'26.35"E	12.56
	Sta. 7+810	13°15'59.22"N, 121°55'21.77"E	9.03
	Sta. 8+545	13°16'9.62"N, 121°55'6.25"E	7.96
Lateral A			
Turn Out	**Station**	**Coordinates**	**Area**
	Sta. 0+509	13°17'0.55"N, 121°56'19.11"E	1.42
end canal			12.5
Lateral B			
Turn Out	**Station**	**Coordinates**	**Area**
	Sta. 0+320	13°16'22.18"N, 121°56'32.82"E	0.62
			0.92
			2.42
	Sta. 0+367.40	13°16'20.75"N, 121°56'34.87"E	3.06
	Sta. 0+485.40	13°16'21.37"N, 121°56'37.71"E	5.77
	Sta. 0+674	13°16'18.14"N, 121°56'42.64"E	3.20
			12.72
existing canal			26.00
Lateral C			
Turn Out	**Station**	**Coordinates**	**Area**
	Sta. 0+529.89	13°16'7.81"N, 121°56'13.41"E	17.76
			8.77
	Sta. 0+806.89	13°16'0.61"N, 121°56'21.51"E	10.65
	Sta. 1+507	13°15'40.67"N, 121°56'17.75"E	14.27
end canal			15.76
Lateral D			
Turn Out	**Station**	**Coordinates**	**Area**
	Sta. 0+470	13°15'50.51"N, 121°55'55.36"E	2.91
end canal			3.38
Lateral E			
Turn Out	**Station**	**Coordinates**	**Area**
	Sta. 0+345	13°15'47.12"N, 121°55'40.63"E	16.33
			6.66
end canal			13.03
TOTAL AREA			**226.00**

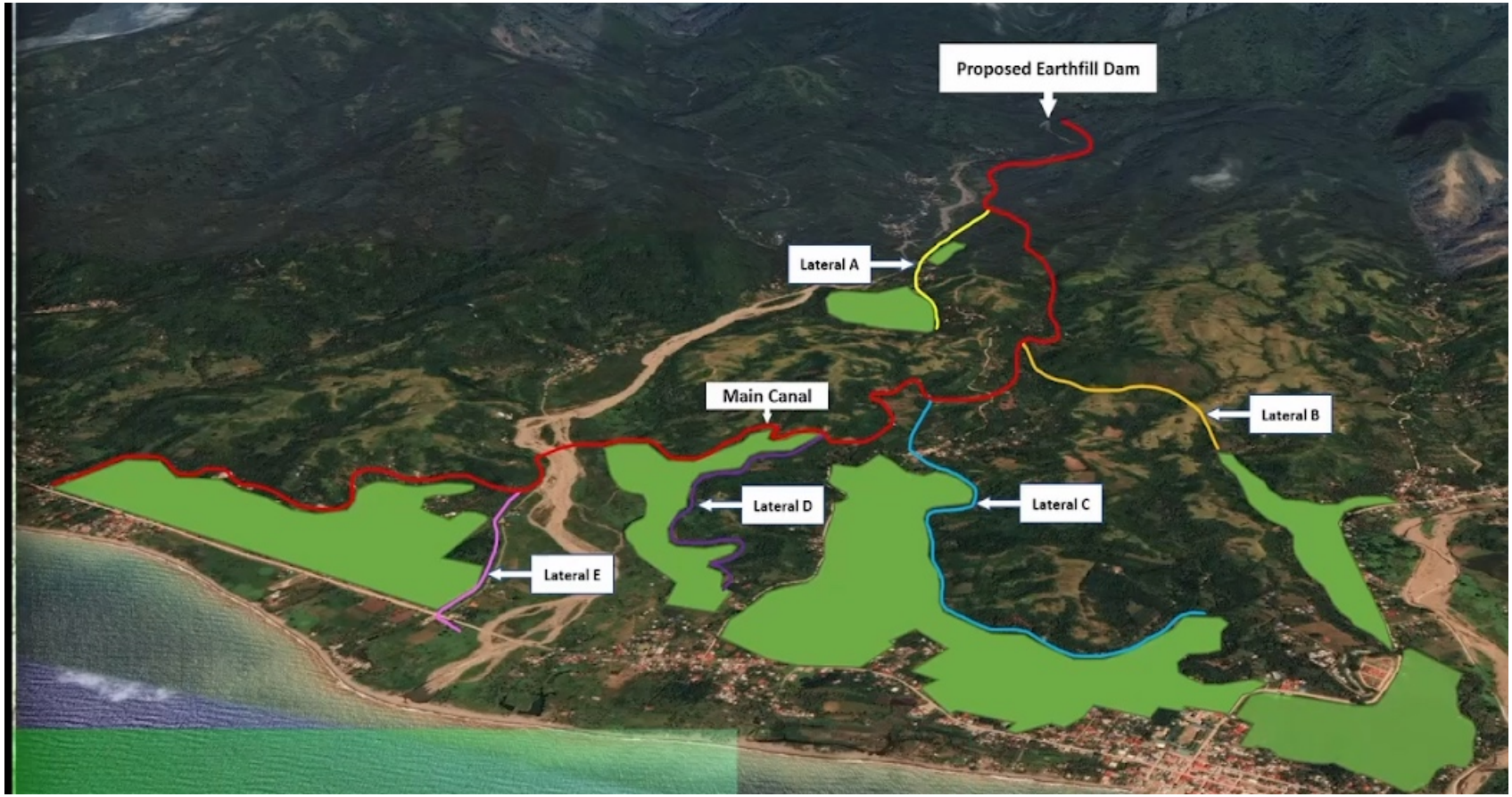


Figure 1-4 General layout of irrigation canals

1.1.2 Accessibility

The proposed dam location of BSRIP is situated in the northwestern portion of Buenavista. The proposed dam axis is accessible by any type of land vehicles, preferably four-wheeled automobiles from a nearest parking spot followed by trekking. It takes about eight (8) hours to travel from Manila to Buenavista (3-hour ferry trip included) and roughly another hour from the town proper to the proposed project site.

As shown in Table 1-4, the route involves navigating through Boac - Mogpog - Santa Cruz - Torrijos Rd and Boac Byp Rd to Boac - Gasan - Torrijos Rd from Port of Balanacan in Mogpog, Marinduque with a 49.3 km. travel distance. Furthermore, accessibility extends to the project host municipality and service areas, with distance ranging from 3.5 – 10.8 km., equivalent to travel time of approximately 9 – 26 mins. This convenient accessibility underscores the project's logistical feasibility and connectivity to key areas within the region. Figure 1-5 provides an illustration of the road networks surrounding the host communities.

Table 1-4 Accessibility of the proposed damsite from different points of origin

Origin	Distance (Km)	Approx. Travel Time	Road & Direction
Port of Balanacan Mogpog, Marinduque	49.3	1 hr. & 25 mins.	Head east on Mogpog - Balanacan Port Rd (9.7 km) Turn right onto Boac - Mogpog - Santa Cruz - Torrijos Rd/Marinduque Circumferential Rd/Rizal St (3.0 km) Take Boac Byp Rd to Boac - Gasan - Torrijos Rd/Marinduque Circumferential Rd (4.4 km) Turn right onto Boac - Gasan - Torrijos Rd/Marinduque Circumferential Rd (27.4 km) Turn left (4.5 km) Slight right (300 m)
Municipal Hall of Buenavista	10.8	26 mins.	Head north on Bagacay Barangay Rd (3.8 km) Slight right onto Buenavista - Lipata - Dampulan - Tigwi Rd (1.0 km) Continue onto Boac - Gasan - Torrijos Rd/Marinduque Circumferential Rd (1.2 km) Turn right (4.5 km) Slight right (300 m)
Barangay Caigangan, Buenavista	3.5	9 mins.	Head northeast (3.2 km) Slight right (300 m)
Barangay Daykitin, Buenavista	10.3	22 mins.	Head southwest toward Boac - Gasan - Torrijos Rd/Marinduque Circumferential Rd (1.7 km) Turn left onto Boac - Gasan - Torrijos Rd/Marinduque Circumferential Rd (3.8 km) Turn left (4.5 km) Slight right (300 m)

Origin	Distance (Km)	Approx. Travel Time	Road & Direction
Barangay Malbog, Buenavista	9.1	21 mins.	Head south toward Boac - Gasan - Torrijos Rd/Marinduque Circumferential Rd (1.3 km) Turn right onto Boac - Gasan - Torrijos Rd/Marinduque Circumferential Rd (3.1 km) Turn right (4.5 km) Slight right (300 m)
Barangay Uno, Buenavista	4.3	11 mins.	Head northeast (4.0 km) Slight right (300 m)
Barangay Dos, Buenavista	5.9	14 mins.	Head southwest toward Sadiwa (190 m) Turn right onto Boac - Gasan - Torrijos Rd/Marinduque Circumferential Rd (950 m) Turn right (4.5 km) Slight right (300 m)
Barangay Tres, Buenavista	7.4	18 mins	Head north (160 m) Turn right (450 m) Turn right toward Boac - Gasan - Torrijos Rd/Marinduque Circumferential Rd (16 m) Turn right onto Boac - Gasan - Torrijos Rd/Marinduque Circumferential Rd (1.9 km) Turn right (4.5 km) Slight right (300 m)
Barangay Quatro, Buenavista	6.7	16 mins.	Head southwest on Boac - Gasan - Torrijos Rd/Marinduque Circumferential Rd toward Sadiwa (1.9 km) Turn right (4.5 km) Slight right (300 m)

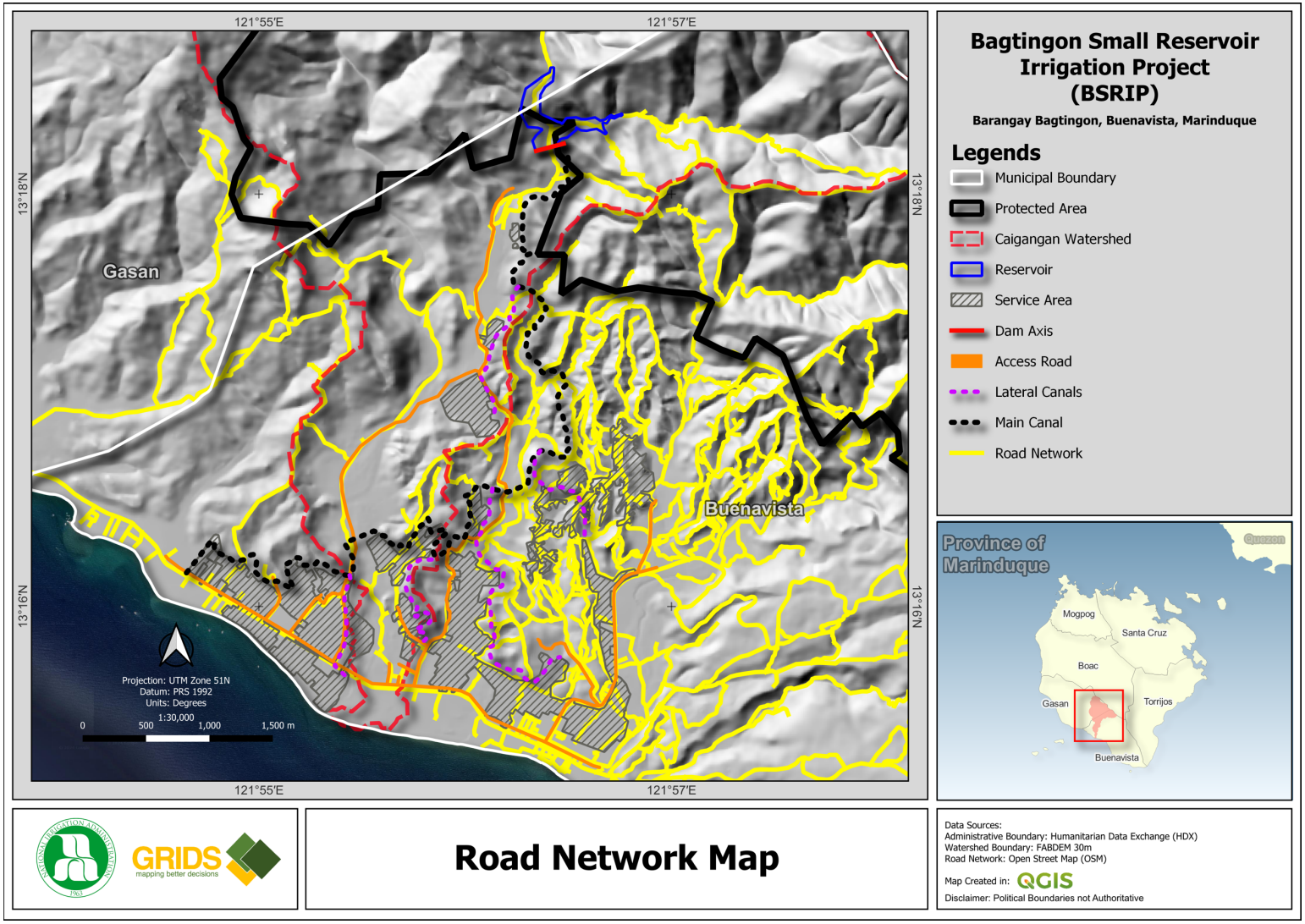


Figure 1-5 Road network to the project site

1.1.3 Delineation of Primary and Secondary Impact Areas

Annex 3 of DENR Memorandum Circular 2010-14 outlines the guidelines in determining Direct and Indirect Impact Areas (DII and IIA). The DIA encompasses the areas where all project facilities are proposed to be constructed and where all operations are intended to take place. The DIA also incorporates the mixing or buffer zone areas marked by a point or isopleths where ambient standards and/or guidelines are met. The IIA, on the other hand, extends from the outer boundary of the mixing or buffer zone to the point or area where the baseline environmental quality is calculated or monitored to be met. The socio-cultural IIA shall be determined based on the area of influence of the biophysical IIA. Additionally, DAO 2017-05 provided guidelines on defining DIA concerning impacts on land, water, air, and people. In compliance with the previously mentioned guidelines, the direct and indirect impact areas of the proposed BSRIP were defined and are detailed as below:

Direct Impact Areas

- Dam site and reservoir areas
- Access road to the dam site
- Service area covers the existing and new area where improvements/facilities/irrigation canals and new facilities will be constructed

The DIAs are composed of the Municipalities of Buenavista (Barangays Bagtingon, Daykitin, Caigangan, Uno, Dos, Tres, Quatro, and Malbog) and Gasan (Barangay Tabionan) in the Province of Marinduque.

Indirect Impact Areas

- Immediate vicinity of the dam site and reservoir
- Transport Route
- Drain areas downstream the service area

Foreseen impacts on land include submersion of areas that will be covered by the reservoir and habitat disturbance of fauna as a result of tree-cutting activities. In terms of foreseen water impacts, the project is expected to affect water bodies that will overlap with project components, specifically the reservoir and canals that will traverse Caigangan River. Potential disturbance of settlements and properties may also occur within and/or near the proposed facilities. Resource competition, in-migration, and threats to public health and safety are also among the likely socio-economic impacts of the project in the host barangays.

1.2 Project Rationale

The nationwide implementation of the Small Reservoir Irrigation Project (SRIP) is one of the major undertakings of the National Irrigation Administration under the Accelerated Irrigation Development Program of the national government. SRIPs are multi-oriented projects which require the construction of medium-sized dams and appurtenant structures to impound water during wet season for the primary purpose of providing year-round irrigation to farmlands in the rural areas. Other benefits that can be derived from SRIPs include flood control, aquaculture, hydropower, domestic water supply and recreational facilities.

The proposed Bagtingon SRIP has been selected as one of the priority projects located in Buenavista, Marinduque. The selection was based on the technical soundness of the dam location, and the project's readiness as to the availability of the geologic data and topographic maps and the equitable regional distribution.

1.2.1 Regional and Provincial Context

The MIMAROPA Region composed of the Provinces of Mindoro (Oriental and Occidental), Marinduque, Romblon, and Palawan is mainly an agriculture, fishing, and ecotourism economy. It is one of the producers of the Philippines' major export products such as rice, banana, coconut, cashew, and papaya (NIA MIMAROPA, n.d[4]). The Province of Marinduque also considers agriculture, fishery and livestock as its primary economic activity. Its main agricultural products also include banana, corn, root tubers, and green leafy vegetables (2020 Marinduque Brief Socio-Economic Profile, n.d)[5].

1.2.2 Municipal Context

At the municipal level, Buenavista is also a largely agricultural community since around 71% of its land area is suitable for crop production (2020 Buenavista Land Use Plan, p.36). It is projected that in 2024, around 38 percent (2,292 individuals) of the 5,926 total labor force are agricultural workers. Coconut and rice are the two major crops with a total land area of 3,812 ha and 144.63 ha, respectively (2020 Buenavista Land Use Plan, p.14[6]). Likewise, the Municipality of Gasan also includes coconut as one of its major agricultural products. In fact, the Department of Trade and Industry (DTI) deemed that coconut-based products will be Gasan's "Own Town, One Product"[7]. Fishing is also a main economic activity in Gasan.

Local farmers reported that a relatively low yield per hectare (around 1.55 ton/ha) is due to lack of adequate water for irrigation, poor crop management practices, and lack and/or untimely application of agricultural inputs (e.g. fertilizers and pesticides) considered as essential components in high agricultural yield (ibid, p.5-3). Other threats to agriculture include rising demand for residential and commercial lands (i.e. decrease in agricultural lands), and low productivity and farm income among people engaged in agriculture.

As of 2020, there are two existing irrigation systems in Buenavista, specifically Bagtingon and Malbog Communal Irrigation Systems (CISs). However, due to lack of rainfall within their proximity, these systems were not able to irrigate their intended service areas (2020 BSRIP Feasibility Report, p.5-1). Similarly, the farmers added that the inability to have a second and third cropping seasons in a year contribute to the challenges that the agricultural sector is currently facing.

The Bagtingon Small Reservoir Irrigation Project (SRIP) aims to address mainly the concern for lack of irrigation system in the areas. It is in line with the Philippine Development Plan (PDP) 2017-2022 goals of ensuring the sustainability of government efforts to improve the productivity of the agriculture, forestry, and fisheries (AFF) sector.

Based on the BSRIP 2020 Feasibility Study Report, the proposed project can provide a dependable supply of irrigation water during the dry season, from the present area of 56 ha to 226 ha. Projection also shows a significant increase in rice production from an estimated low of

[4] https://region4b.nia.gov.ph/content/overview

[5] https://region4b.nia.gov.ph/content/overview

[6] Based on the Socio-economic and Physical Profile (Municipality of Buenavista) as reported in the 2020 Bagtingon BSRIP Feasibility Report, p.5-1

[7] One Town One Product is a DTI program that assists local government units in developing local products and services.

3.5 mt/ha to a maximum of 5.0 mt/ha, and from 196 mt/year to 1,505 mt/year, as presented in Table 1-5.

Table 1-5 Summary of Comparison Between the Present (Without-the-Project) and Future (With-the Project) Scenarios on Rice Production

Description	Area (Ha)	Yield (Mt/Ha)	Yield (Cavan/Ha)	Production (Mt/Year)
WITHOUT-THE-PROJECT				
WET SEASON				
Irrigated	68	4.0	80	272
Rained	52	3.0	60	156
Upland Rice	55	1.0	20	55
DRY SEASON				
Irrigated	56	3.5	70	196
TOTAL				679 (13,680 cavans/year)
WITH-THE-PROJECT				
WET SEASON				
Irrigated	226	4.5	90	1,354.50
DRY SEASON				
Irrigated	226	5.0	100	1,505.00
TOTAL				**2,859.50 (57,190 cavans/year)**

Source: BSRIP 2020 Feasibility Study Report

1.3 Project Alternatives

This section comprises the criteria for siting, technology, and dam design that were considered for the Bagtingon SRIP. As a background, the proposed project is included in the nationwide implementation of the SRIP, one of the major undertakings of NIA under the Accelerated Plan which require the construction of medium-sized dams and appurtenant structures.

The Small Reservoir Irrigation Project-Project Management Office (SRIP-PMO) is responsible for identifying potential sites for SRIPs all over the country. Specifically, SRIP-PMO investigates, surveys, and conducts feasibility studies of candidate projects and construction of pipeline projects qualified for implementation. The SRIP-PMO has considered 30 project sites around the Philippines for SRIP-Phase 1 (i.e. inventory and revalidation). Only 20 of these sites proceeded to Phase 2 or the continuation/completion of the feasibility study. Among the 20 sites, Bagtingon SRIP was selected as a priority project. The general criteria for the selection are: a) technical soundness of the dam location; b) availability of geologic data and topographic maps; and c) equitable regional distribution (Bagtingon SRIP Scoping and Public Consultation Report, p.2).

For Bagtingon, geologic data and relevant information on hazards were available. Specifically, there were no potential earthquake generators (e.g. fault lines) within the 100 km radius from the dam site. The nearest fault line is around 4.8 km away which is the Central Marinduque Fault. Consequently, there were no earthquakes recorded within the vicinity of the host Barangay Bagtingon. The site also has a low susceptibility to earthquake- and rain-induced landslides as well as flooding. There have been no historical records of the eruption of Mount Malindig, which is 10.3 km away but still the nearest volcano from the project site.

Project-specific identification and selection of alternatives were mostly based on the capacity of the project area in collecting and distributing sufficient irrigation water to nearby agricultural areas. More details on project alternatives are provided in the succeeding section.

1.3.1 Siting

The current dam site for the proposed Bagtingon SRIP was selected based on the following criteria (BSRIP Feasibility Report, p. 6-2):

- Capacity to catch and/or store more rainfall
- Number of settlers/ population around the area to lessen disturbance of settlers and/or resettlement during project implementation

For the project's feasibility study, there were three options for the dam sites, all of which were inspected and studied (Table 1-6).

Table 1-6 Location of site alternatives for Bagtingon SRIP

Dam site	Latitude	Longitude	Drainage area (km^2)
1	13°17'53.56"N	121°56'34.40"E	7.60
2	13°17'49.00"N	121°56'36.02"E	7.65
3	13°17'39.31"N	121°56'31.43"E	8.07

Source: Bagtingon SRIP Feasibility Report

Among the three site options, Dam Site 2 met the aforementioned siting criteria. The proposed dam site will be constructed across the Bagtingon River. The final dam axis will be about 100 m downstream from the confluence of Bagtingon River and Tipo River.

1.3.2 Dam Type

In general, dams that will be built under the Philippine SRIP are medium- or intermediate- sized embankment dams. For comparison, this section will discuss the differences between an embankment dam and a concrete dam. A concrete dam requires a higher cost than an embankment. The proposed project will be an earth filled, medium-sized zoned embankment dam that will be built around 28 m in height.

Below is a more detailed comparison of the two types of dam:

Table 1-7 Differences between an embankment and concrete dam types

Criteria	Embankment	Concrete
Dam design	Used to block streams through relatively narrow gorges	Preferred to control rivers and/or streams passing through wide valleys
Permeability	Relatively weak in tensile strength unless reinforced with embedded steel bars	Much more permeable and thus have less resistance to deterioration and disturbance by flowing water
Cost	Relatively higher due to required construction materials such as concrete and steel bars	Relatively cheaper because of the following: • Can utilize soil or rockfill available near the dam site • Has the ability to adapt to deformity caused by movements in its foundation

Criteria	Embankment	Concrete
Dam size	Usually utilized for large dams	Usually utilized for small to medium dams

Reference: The modern dam, Britannica, n.d [8]

Other factors considered for preliminary options for facility siting and development design are the following (Bagtingon SRIP Scoping and Public Consultation Report, p. 18):

- The embankment slopes should be stable under all kinds of conditions during the construction and operation phases.
- The spillway and outflow parts slopes should be stable under the operational phase.
- The water in the reservoir and the wall of the embankment should not overstress the foundation.
- The foundation must be water tight. If there will be a fissure, pressure grouting should be immediately done.
- The seepage flow through the foundation, embankment, and abutments should be properly controlled to prevent sloughing, piping, or material removal.
- The height of the dam should be enough to avoid overtopping by waves and als include allowance for settlement of embankment and foundation.
- The spillway and the outflow parts should be enough to avoid overtopping and ensure hydrological safety of the dam.
- The spillway should safeguard the hydrological safety of the dam.
- The hydrology of the river should fully impound the reservoir in a certain period of time. The water flow during the dry season should be enough to sustain the reservoir.
- The catchment area should not be too degraded.

In terms of general environmental considerations, the list below were examined for selecting project alternatives:

1. Reservoir surface area – Areas that will be inundated by the reservoir will reflect the span of environmental and social impacts resulting from project implementation.

2. Length of River Impounded - The project considered potential impacts of the project and conservation measures to aquatic and riparian biodiversity that will be affected by the reservoir

3. Biomass flooded – Also factored in was the amount of greenhouse gases that will be released once flooded vegetation emits methane and carbon dioxide.

These were considered because flooded vegetation will release ample amount of greenhouse gas methane and carbon dioxide.

1.3.3 No Project Scenario

Under no project scenario, the proposed project will not be implemented and its main purpose (i.e. to supply the agricultural sector's irrigation water needs) will not be met. The no project scenario will result in no environmental impacts. However, the project area's potential to be an essential source of water for nearby communities will not be explored if the project will not proceed.

[8] *https://www.britannica.com/technology/dam-engineering/The-modern-dam*

The development and operation of the project in the area has the potential to enhance the economic growth of the host municipalities especially since the project is part of a national development agenda.

1.4 Project Components

The proposed SRIP aims to utilize the water resource potential of the Caigangan Watershed for irrigation purposes. The BSRIP was proposed to be able to provide a sufficient supply of irrigation water to some agricultural areas in Barangays Bagtingon, Daykitin, Caigangan, Uno, Dos, Tres, Quatro, and Malbog all in the municipality of Buenavista. It involves the construction of a dam and its appurtenant structures across the Tipo River in Barangay Bagtingon. This could store about 102 meters of water at Normal Water Surface Elevation.

The main components that are relevant to the project ECC application are the following:

- The main dam
- Spillway structure
- Outlet works (irrigation and diversion outlet)
- Main and lateral canals and associated structures
- Access roads

1.4.1 Indicative dam attributes and appurtenant structures

Below is the summary of features and performance specification of Bagtingon SRIP is presented in Table 1-8. Each component will be discussed in detail in the following sections below.

Table 1-8 Summary of features and performance specification of BSRIP

Project Data & Features		
Details	**Units**	**Dimensions/ Features**
A. Main Dam		
Dam Type		Zoned Embankment Dam
Hazard Classification		PHRC - 3
Maximum Dam Height	m	27.93
Dam Crest Length	m	226.65
Dam Crest Width (Earth)	m	9.00
Dam Crest Elevation	m	108.00
Riverbed Elevation	m	80.07
Reservoir Area	has	16.90
Watershed Area	km^2	7.65
Maximum Water Surface Water Elevation	m	105.51
Normal Water Surface Water Elevation	m	102.00
Minimum Water Surface Water Elevation	m	93.50
Inflow Design Flood (Q = 200yr)	m^3/sec	310.77
Active Storage Capacity	mcm	0.64
Dead Storage Capacity	mcm	0.28
Total Storage Capacity	mcm	0.93
B. Spillway Structure		
Type of spillway		Ungated
Height of spillway (ogee)	m	1.00
Crest Length (effective)	m	25.00
Crest Elevation	m	102.00

Shape of Chute Section		Rectangular
Length of Chute Section	m	242.00
Width of Chute Section	m	25.00
Energy Dissipator (Stilling Basin)		Type II (USBR)
Shape of Stilling Basin		Rectangular
Length of Stilling Basin	m	27.00
Length of Riprap (Boulder)		78.00
Bottom Width of Stilling Basin	m	25.00
Elevation of Stilling Basin	m	73.00
Shape of Exit Channel		Rectangular
C. Outlet Works (Diversion & Irrigation Outlet		
Main Canal	km	8.78
Lateral Canal	km	6.49
Design Discharge (Q = 10yr)	m^3/sec	125.18
Type of Intake		Intake tower with trashrack
Size of Pipe Diameter	m	2.70 (Diversion), 0.90 (Outlet)
Length of Outlet Works	m	189.40
Water Surface at inlet	m	94.50
Water Surface at the Start of Main Canal	m	82.30
Diversion Outlet (Energy Dissipator)		Impact - Type
D. Main Canal, Lateral Canal, And Canal Structures		
Main Canal	km	8.86
Main Canal Structures	units	9
Lateral A	km	1.184
Lateral B	km	0.973
Lateral C	km	2.334
Lateral D	km	0.905
Lateral E	km	1.180
Lateral Canal Structures	units	4
E. Access Road To Damsite		
Access Road	km	1.48

The project envisages the construction of a 27.93 m dam at 108 m elevation, and the impounded water will be used to provide irrigation water for about 226 ha of agricultural lands of Buenavista. The proposed dam is a zoned embankment and earth-filled type. It will be constructed along a selected portion of the Bagtingon River. The dam will be 9 m wide.

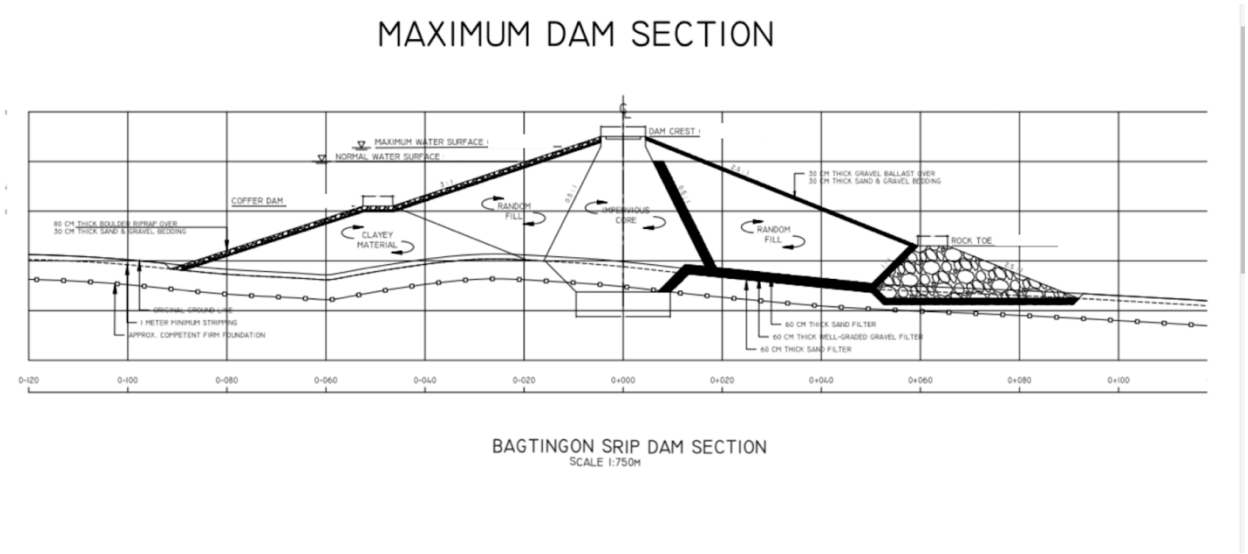


Figure 1-6 Bagtingon SRIP Dam Section (NIA Bagtingon SRIP Feasibility Study, 2020)
Note: Provided for visualization purposes only, updated specifications for the project is provided in Table 1-1 above.

The design of the dam aims to meet the following criteria: :

- The dam foundation will be able to withstand the loads exerted by the dam
- The dam will be able to resist the combination of anticipated loads.

The dam axis is located at geographic coordinates 13° 17' 49" in the North latitude and 121° 56' 36.02" in the East longitude. It will be about 100 m downstream from the confluence of rivers Bagtingon and Tipo. It is located around south-southwest and downstream of the reservoir and north-northeast of Barangay Bagtingon relative to the project's irrigation water source (Figure 1-1).

The dam's reservoir will span 16.90 ha with a maximum water surface elevation of 105.51 m while the watershed area is 7.65 km^2.Total storage capacity is 0.93 mcm.

1.4.2 Spillway

The spillway is designed with a return period of a 100-year flood, which is 138.17 m^3 per second. It will be located at the right bank of the river facing downstream.

The spillway will be ungated since said design is cost effective and requires a small number of personnel. It will have a rectangular chute section with length of 242 m and a Type II (USBR) energy dissipation/ stilling basin.

1.4.3 Main Lateral Canals and Associated Structures

The main canal is 8.78 km long while the lateral canal is about 6.49 km. The diversion conduit is designed to protect against a 10-year flood of 125.18 m^3/sec design flood. The outlet works include an inlet tower with trashrack. The diversion outlet (energy dissipator) will be an impact-type. The Main Canals and Laterals were conveniently designed along existing roadways to minimize the construction of service roads. A canal service road along the right bank of the Main Canal provides access to the service areas.

1.4.4 Access road

A 1.48 km access road will be constructed to give way to the damsite and will cover the host barangays in the Municipality of Buenavista.

1.4.5 Other supporting facilities

Aside from the abovementioned major components, supporting facilities for the projects are also characterized in this section.

1.4.5.1 Workers Accommodation and Offices

As of the field visit conducted for this report, NIA currently has a staff house located in nearby Barangay Dila in the Municipality of Buenavista. It currently has three rooms and will accommodate NIA staff during project development. At the onset of construction, contractors will provide field offices, staff quarters, and workshops within the project area. The accommodation shall comply with the minimum requirements set by the Department of Labor and Employment (DOLE) for a suitable living accommodation for workers and will contain the following[9]:

- Adequate supply of safe drinking water
- Adequate sanitation facilities for washing
- Separate sanitary, washing, and sleeping facilities for all gender, as appropriate
- Other workers' welfare facilities as may be required in compliance with Occupational Safety and Health standards and other applicable guidelines

1.4.5.2 Pollution Control Facilities/ Measures

During its operation phase, the Bagtingon SRIP will not produce a significant amount of waste. Air emissions are expected to be present in small quantities due to project vehicles accessing the facility. Maintenance and domestic activities will likewise produce small amounts of miscellaneous wastes. NIA will develop and implement an Environmental Management System with policies and procedures on handling, storing, and transporting wastes of various nature that will be generated during project implementation. The Proponent will also secure permits related to handling wastes. More details on the project's waste management activities are detailed in the Section 2.1.1.3.

1.5 Process/ Technology

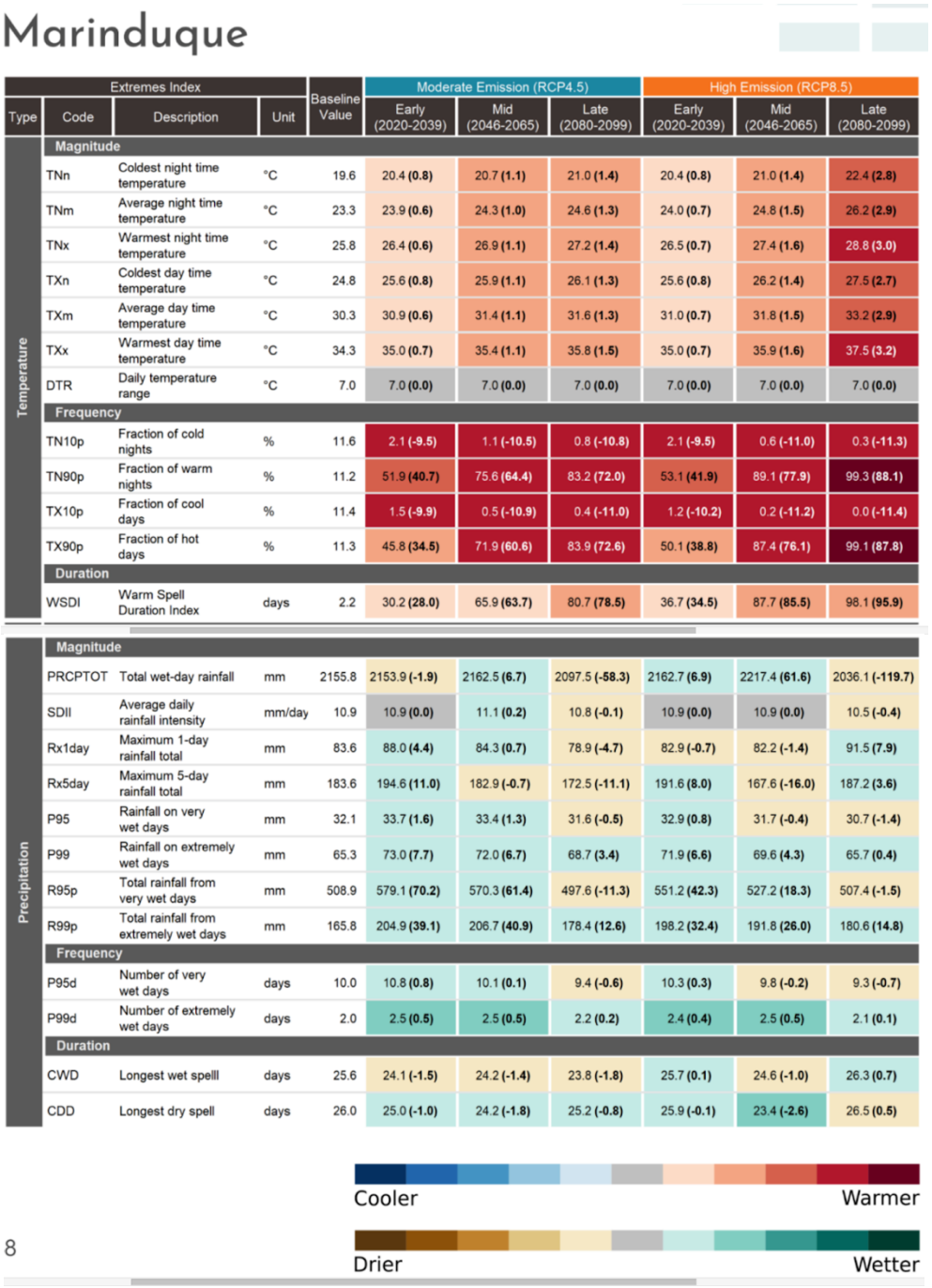
The proposed Bagtingon SRIP is an earth-filled embankment dam. It will be a semi-permeable structure that can deform slightly to lessen its resistance to flowing water during water impounding in its reservoir. It will have a spillway that acts as the passage for surplus water over or around the dam when the reservoir is full. This is an important safety feature of dams to ensure flow of water so dams will not be overtopped and will not fail. Canals provide a pathway to lead the impounded water from the reservoir to its intended beneficiaries (i.e. agricultural fields for irrigation purposes).

Climate change aspects such as temperature and precipitation influence future irrigation requirements. Thus , it is essential to consider future scenarios relative to the project's life. PAGASA has conducted a study to estimate possible changes to the climate under different emission scenarios from 2020-2099. Figure 1-7 below shows temperature and precipitation

[9] From DOLE Department Order No. 198 (Series of 2018) Implementing Rules and Regulations of RA 11058 presentation (https://www.peza.gov.ph/sites/default/files/oshirrprimer.pdf)

factors during moderate and high greenhouse gas emission scenarios for the Province of Marinduque.

Based on the figure below, the only consistent factor in both emission scenarios is the daily temperature range. However, for all temperature scenarios, there is a continual increase. It also shows that the warm spell duration index will dramatically increase from the baseline of 2.2 days to a minimum of 30.2 in the moderate emissions scenario and a minimum of 36.7 days in the high emissions scenario. This means that longer dry spells will result in the increased need for more irrigation sources to supplement the water needs of the agriculture sector.



Extremes Index				Baseline Value	Moderate Emission (RCP4.5)			High Emission (RCP8.5)		
Type	Code	Description	Unit		Early (2020-2039)	Mid (2046-2065)	Late (2080-2099)	Early (2020-2039)	Mid (2046-2065)	Late (2080-2099)
Temperature	**Magnitude**									
	TNn	Coldest night time temperature	°C	19.6	20.4 (0.8)	20.7 (1.1)	21.0 (1.4)	20.4 (0.8)	21.0 (1.4)	22.4 (2.8)
	TNm	Average night time temperature	°C	23.3	23.9 (0.6)	24.3 (1.0)	24.6 (1.3)	24.0 (0.7)	24.8 (1.5)	26.2 (2.9)
	TNx	Warmest night time temperature	°C	25.8	26.4 (0.6)	26.9 (1.1)	27.2 (1.4)	26.5 (0.7)	27.4 (1.6)	28.8 (3.0)
	TXn	Coldest day time temperature	°C	24.8	25.6 (0.8)	25.9 (1.1)	26.1 (1.3)	25.6 (0.8)	26.2 (1.4)	27.5 (2.7)
	TXm	Average day time temperature	°C	30.3	30.9 (0.6)	31.4 (1.1)	31.6 (1.3)	31.0 (0.7)	31.8 (1.5)	33.2 (2.9)
	TXx	Warmest day time temperature	°C	34.3	35.0 (0.7)	35.4 (1.1)	35.8 (1.5)	35.0 (0.7)	35.9 (1.6)	37.5 (3.2)
	DTR	Daily temperature range	°C	7.0	7.0 (0.0)	7.0 (0.0)	7.0 (0.0)	7.0 (0.0)	7.0 (0.0)	7.0 (0.0)
	Frequency									
	TN10p	Fraction of cold nights	%	11.6	2.1 (-9.5)	1.1 (-10.5)	0.8 (-10.8)	2.1 (-9.5)	0.6 (-11.0)	0.3 (-11.3)
	TN90p	Fraction of warm nights	%	11.2	51.9 (40.7)	75.6 (64.4)	83.2 (72.0)	53.1 (41.9)	89.1 (77.9)	99.3 (88.1)
	TX10p	Fraction of cool days	%	11.4	1.5 (-9.9)	0.5 (-10.9)	0.4 (-11.0)	1.2 (-10.2)	0.2 (-11.2)	0.0 (-11.4)
	TX90p	Fraction of hot days	%	11.3	45.8 (34.5)	71.9 (60.6)	83.9 (72.6)	50.1 (38.8)	87.4 (76.1)	99.1 (87.8)
	Duration									
	WSDI	Warm Spell Duration Index	days	2.2	30.2 (28.0)	65.9 (63.7)	80.7 (78.5)	36.7 (34.5)	87.7 (85.5)	98.1 (95.9)
Precipitation	**Magnitude**									
	PRCPTOT	Total wet-day rainfall	mm	2155.8	2153.9 (-1.9)	2162.5 (6.7)	2097.5 (-58.3)	2162.7 (6.9)	2217.4 (61.6)	2036.1 (-119.7)
	SDII	Average daily rainfall intensity	mm/day	10.9	10.9 (0.0)	11.1 (0.2)	10.8 (-0.1)	10.9 (0.0)	10.9 (0.0)	10.5 (-0.4)
	Rx1day	Maximum 1-day rainfall total	mm	83.6	88.0 (4.4)	84.3 (0.7)	78.9 (-4.7)	82.9 (-0.7)	82.2 (-1.4)	91.5 (7.9)
	Rx5day	Maximum 5-day rainfall total	mm	183.6	194.6 (11.0)	182.9 (-0.7)	172.5 (-11.1)	191.6 (8.0)	167.6 (-16.0)	187.2 (3.6)
	P95	Rainfall on very wet days	mm	32.1	33.7 (1.6)	33.4 (1.3)	31.6 (-0.5)	32.9 (0.8)	31.7 (-0.4)	30.7 (-1.4)
	P99	Rainfall on extremely wet days	mm	65.3	73.0 (7.7)	72.0 (6.7)	68.7 (3.4)	71.9 (6.6)	69.6 (4.3)	65.7 (0.4)
	R95p	Total rainfall from very wet days	mm	508.9	579.1 (70.2)	570.3 (61.4)	497.6 (-11.3)	551.2 (42.3)	527.2 (18.3)	507.4 (-1.5)
	R99p	Total rainfall from extremely wet days	mm	165.8	204.9 (39.1)	206.7 (40.9)	178.4 (12.6)	198.2 (32.4)	191.8 (26.0)	180.6 (14.8)
	Frequency									
	P95d	Number of very wet days	days	10.0	10.8 (0.8)	10.1 (0.1)	9.4 (-0.6)	10.3 (0.3)	9.8 (-0.2)	9.3 (-0.7)
	P99d	Number of extremely wet days	days	2.0	2.5 (0.5)	2.5 (0.5)	2.2 (0.2)	2.4 (0.4)	2.5 (0.5)	2.1 (0.1)
	Duration									
	CWD	Longest wet spelll	days	25.6	24.1 (-1.5)	24.2 (-1.4)	23.8 (-1.8)	25.7 (0.1)	24.6 (-1.0)	26.3 (0.7)
	CDD	Longest dry spell	days	26.0	25.0 (-1.0)	24.2 (-1.8)	25.2 (-0.8)	25.9 (-0.1)	23.4 (-2.6)	26.5 (0.5)

Figure 1-7 Climate change scenarios (moderate and high emission scenarios) (PAGASA)[10]

[10] https://www.pagasa.dost.gov.ph/climate/climate-change/dynamic-downscaling

1.5.1 Pollution Control and Waste Management System

1.5.1.1 Water supply and power generation system

The proposed Bagtingon SRIP aims to use the water resource potential of the Caigangan Watershed for irrigation purposes. The project's implementation aims to provide water supply to agricultural areas in some parts of the Municipality of Buenavista. Other water needs such as surface water for operation activities aside from irrigation will be sourced from the Bagtingon River.

The power requirement for the project is estimated around 2,000 KWh and is planned to be sourced from the Marinduque Electric Cooperative (MARELCO). Using light-emitting diode (LED) lights and lighting during nighttime is also proposed to save an estimate of 500 KWh for the project.

1.5.1.2 Solid waste

Construction activities are expected to result in manageable accumulation of solid wastes such as excavated soil, rubble, concrete, rocks, debris, and other spoils. The excavated materials can be used as backfill for the canal embankment and service areas. To mitigate environmental impacts due to solid waste, the following will be implemented:

- Prevent waste at source by effective and efficient design of permanent and temporary works and relevant execution
- Development and implementation of a waste management plan in accordance with solid waste management laws and regulations
- Separate and appropriate disposal, storage, and handling of waste per type of solid wastes (general and hazardous)
- Reusing and/or recycling materials as appropriate; Recyclable waste can be sold to accredited scrap buyers/ recyclers
- Cut trees and overburden shall be disposed of in designated areas, away from water bodies to avoid siltation of nearby river and creeks

Pollution control measures and waste management mechanisms shall be implemented in accordance with relevant local regulations and national laws such as the Republic Act (RA) 8749 (Philippine Clean Air Act), RA 9003 (Ecological Solid Waste Management Act of 2000), and RA 9275 (Philippine Clean Water Act).

1.5.1.3 Wastewater/ liquid waste

Non-solid waste such as human waste, wastewater, and used oils are also expected to be present during construction.

Septic tanks or portable toilets will be installed on-site during construction. Wastewater from every facility will be treated. Untreated human waste will not be allowed to pass any water course that will affect downstream the water quality, aquatic environment, and health of nearby communities. Inceptor traps will be used in water courses to prevent contamination of water during accidental spills. Contained waste and used oil will be collected by a certified collection entity nearby the project area. Organic waste may be treated through composting.

1.5.1.4 Air pollutants

Accumulation of dust during construction is also expected during project development. Activities such as transport of materials, removal of vegetation, stockpiling of excavated earth materials and debris will increase the accumulation of dust around the project site. During the peak of construction, access roads and other dust generating facilities will be frequently sprayed with

water. Stockpiles will be covered as appropriate. Moreover, vehicles used for materials transport will undergo emission testing to mitigate increased vehicular emission.

Foreseen wastes to be generated from project implementation are also summarized below.

Table 1-9 Summary of wastes to be generated by the project

Project phase	Activities/ Environmental Aspects	Types of Wastes	Estimated daily generation rate	Built-in Pollution Control Measures
Pre-construction	Not applicable (NA)	NA	NA	NA
Construction	Generation of: • Construction solid waste • Domestic solid waste	Construction wastes such as excavated earth materials, removed trees and other vegetation, debris, rubble, concrete and other spoils	• Variable for construction waste • 40.8 kg for domestic waste	• Prevent waste at source • Implementation of waste management plan • Proper disposal, handling, and transport of all kinds of waste • Reusing and recycling of wastes as appropriate
	Generation of wastewater	Domestic wastewater from NIA and contractor workers	Around 10.2 m^3	Construction of multiple-chambered septic tank or portalets which will undergo periodic cleaning and maintenance Treatment of wastewater Composting of organic wastes
	Generation of emission gases	Carbon dioxide, NOx SOx from construction equipment	Variable	Dust generating activities will be frequently sprayed with water Covering of stockpiles Vehicle emission testing
Operation	Generation of wastewater	Domestic wastewater from permanent workers	About 1,000 lt	Periodic maintenance of septic tank Treatment of wastewater

Project phase	Activities/ Environmental Aspects	Types of Wastes	Estimated daily generation rate	Built-in Pollution Control Measures
	Generation of domestic solid waste	Solid waste generated by permanent workers (may be comprised of office disposals such as paper, plastics, and cartons)	About 4 kg	Implementation of waste management plan Proper disposal, handling, and transport of all kinds of waste Reusing and recycling of wastes as appropriate
Abandonment	NA	NA	NA	NA

1.6 Project Size

The project proposes the construction of a 27.93 m-high zoned embankment dam at the riverbed with an elevation of 80.07 m. The crest length of the dam is 226.65 m at an elevation of 108 masl. At its maximum water capacity, the water is estimated to extend 400 m upstream of Manlawanin and 300 m upstream of Subling, reckoned from the dam axis level. The impounded water will be used to provide irrigation water for about 226 ha of agricultural lands in eight barangays. It is located just a few meters downstream from the confluence of the Manlawanin and Subling Rivers which is eventually called the Caigangan River as it approaches the Tablas Strait.

The proposed spillway of the dam is located on the right bank of the river facing downstream. The width of the spillway is 136.93 m throughout its length of 192 m. The inlet portion is a straight ungrated ogee crest type, 1.00 m in height; a guide portion of the rectangular chute type, and a 32-m long energy dissipater of the USBR-Type II stilling basin. The spillway is designed with a return period of a 100-year flood, which is 138.17 m^3 per second.

The outlet work structure shall also serve as the diversion conduit during construction. The regulating portion will be located between the downstream end of the conduit and the energy dissipater and the irrigation water is directly discharged into the irrigation canal. The drainage network includes the construction of near-farm drains to provide conveyance of excess irrigation water and runoff discharges into existing waterways.

The Main Canal will deliver water requirements to an area of 226 ha. A corresponding 8.78 km length of the Main Canal and 6.49 km of Laterals will deliver the water requirement for its service areas in barangays of Bagtingon, Daykitin, Caigangan, Uno, Dos, Tres, Quatro, and Malbog. The Main Canals and Laterals conveniently designed along existing roadways greatly minimized the construction of service roads. A canal service road of 1.48 km along the right bank of the Main Canal provides access to the service areas.

1.7 Development Plan, Description of Project Phases and Corresponding Timeframes

1.7.1 Pre-construction Phase

The pre-construction phase will mostly involve acquiring the required permits, certifications, and acquisition on the proposed project site. At this stage, NIA has an ongoing process in terms of negotiating agreements with landowners for the project's right-of-way (ROW). In fact, NIA has signed Permit to Enter and To Construct Forms for Bagtingon SRIP's ROW for the project's dam site, canals (main and lateral), and access roads. As of writing, an initial number of 22 landowners are estimated to be affected by the project through its land acquisition. More information on the project's ROW acquisition is discussed in the People Module of this EIS (Section 2.4).

The Proponent is also applying for a Special Use Agreement in Protected Areas (SAPA) in coordination with the Protected Area Management Board (PAMB) since the part of the project footprint overlaps with the Marinduque Wildlife Sanctuary. Other pre-construction activities include but are not limited to the following:

- Preparation of construction contract documents for the main works
- Processing of other various permits and licenses, as applicable
- Sourcing of construction materials, manpower, and other construction components/facilities

1.7.2 Construction phase

The construction of Bagtingon SRIP in Buenavista, Marinduque is scheduled for three (3) years. This is in line with the established criteria by SRIP that a dam with a height of more than 15 m shall have a construction period of three (3) dry seasons. The major components in the project are dam, spillway, and outlet works.

Upon completion of the preparatory works especially in survey and Right-of-way (ROW) negotiations, the construction of the civil works shall then proceed. Each major component shall have a separate construction crew and heavy equipment. The sequence activities for each major component in relation to the others are discussed as follows:

Dam – The clearing, grubbing, and stripping shall start before the onset of the rainy season. The core trench excavation shall follow simultaneously. The river section shall be continued as the last stretch. Upon attaining the design elevation, the trench channel section, drilling, and grouting shall immediately follow. The start of this activity shall fall at the start of the rainy season and should be finished at the end of the first year.

Embankment activities shall start at the right abutment where the drilling and grouting have been completed. Upon completion of the concreting works and other activities at the outlet, the embankment shall continue at the right abutment, and slope towards the river.

In January of the 3rd year, the original flow of the river shall be diverted to the outlet works. All other components such as the intake tower, value house, and stilling basin should be completed by then. Likewise, the cofferdam crest elevation at 27.50 m should have been completed. The closure dam shall be constructed during this month and continued up to the crest elevation of the dam until the last quarter of the third year.

Spillway – The foundation excavation and channel formation for the spillway shall start simultaneously with the dam core trench excavation in the third quarter of the first year of construction. The preparatory works such as filter drain, anchor bars, reinforcing bars, and formworks hall follow immediately after attaining the designed channel floor elevations.

The concreting of the spillway chute down to the stilling basin should be given priority and should be finished before the start of the rainy season in the second quarter of the 2nd year. This is to avoid the problem of dewatering.

Outlet Works – The foundation excavation for the pipe conduit shall also start in first quarter of the 1st year. The preparatory works should be ready for the start of concreting of the pipe conduit. Simultaneous activities shall be undertaken at the intake tower, valve house, and stilling basin. River diversion shall be conducted in first quarter of the 3rd year, so it is of prime importance that the activities at the outlet works be finished beforehand.

Irrigation Drainage – The construction of the irrigation and drainage facilities shall start immediately after having cleared ROW and also after having completed the construction drawings. The irrigation and drainage component is expected to be finished in 4th quarter of the 3rd year, in time for the test run and completion of the project within the prescribed duration of 3 years.

Utility Requirements- During the construction phase, the estimated demand for power and water utilities are specific in the table below:

Table 1-10 Estimated utility requirements for Bagtingon SRIP

Utilities	Estimated demand/ consumption (Total)	Source	Projected amount from source specified
Power/electricity	45 KWh	MARELCO	14,800 KWh
	420KWh	Cummins Diesel Generator Set	750KWh
Water	5 cu.m./day	Banlawanin Spring	4,994.78 cu.m./day
	5 cu.m./day	Bagtingon River	15,898,464 cu.m./day

Source: NIA Project updates during public scoping

1.7.3 Operation Phase

1.7.3.1 Dam operation

The operation of the reservoir, dam, and its appurtenant structures includes a series of works before normal use. These are works to be done prior to the initial storage, from the end of the full storage to the steady behavior onwards. These preparatory works or inspection works must confirm that the dam, spillway, and outlet works are completed and/or sufficiently functioning.

Besides the operational preparations, the other works include the release of water from the reservoir for irrigation and other purposes and the emergency release of excess water during periods of heavy rains and anticipated flooding.

1.7.3.2 Dam maintenance

The reservoir, dam and its appurtenant structures have to be well maintained to keep the facilities functioning, as long as possible. Any damage or breach to these facilities should be prevented to protect the people from dangerous deluge/overflow. The maintenance works of the dam are divided into three (3) categories, which are as follows:

- **Routine Works** – These include the routine inspection of the dam, its appurtenant structures, and vicinities to check leakage, seepage, and shrinkage or deformation of the dam body and record the data gathered from the dam instrumentation and seepage weir.
- **Periodic Works** – These include the removal of floating obstacles around the control gates/valves, repair and refilling of undulation of dam crest and slopes, and the moving or cutting of shrubs and grasses on dam slopes.
- **Emergency Repairs** – These are the repairs needed to the damaged facilities and structures caused by unusual weather or geological disturbance like very strong rains, big floods, or devastating earthquakes.

1.7.3.3 Operation of the irrigation system

The operation of the irrigation system refers to the appropriate adjustment and proper utilization of the facilities, which includes the proper distribution of the irrigation water at the turnout and division boxes and the prevention of the water overtopping the canals and ditches.

1.7.3.4 Maintenance of the irrigation system

The maintenance works of the irrigation system are also divided into three (3) categories similar to the dam maintenance which are as follows:

- **Routine Works** – These works include the cutting of grasses at the canals and ditches particularly at the inner section prior to regular irrigation.
- **Periodic Works** - These works include the repairs of the canals and ditches, removal of silt inside the canal prism, removal of debris in the canals and other structures, and repair of upstream and downstream transition and projection works of structures. The work should be done before the start or after the cropping season, that is, during the pre-irrigation or post-irrigation stage.
- **Emergency Repairs** – These are the repairs which may include partial breach or break of canals and ditches due mainly to the overtopping of excessive water supply and collapse of cross drains, road crossings, etc. caused by unusual weather or geological disturbance like very strong rains, floods, or devastating earthquakes.

Utilities for the operation phase- The power source intended for the project's operation phase is also MARELCO. Estimated demand is around 2,000 KWh. NIA proposes to use LED lights during night time to save at least 500 KWh of electricity.

The Bagtingon River will also be the surface water source for the project's operation phase. Estimated demand is yet to be determined but likely would be minimal and mostly for domestic activities of the project's workers. There is minimal waste foreseen to be produced during the operation phase. However, NIA will implement a Waste Management Plan to list procedures and processes related to handling various types of wastes.

1.7.4 Abandonment Phase

Upon the completion of Bagtingon SRIP, the operation and maintenance of the dam and its appurtenant structures, and irrigation facilities shall be the responsibility of NIA – MIMARO Irrigation Management Office (IMO) with technical assistance from NIA – Central Office.

The concerned parties shall also be responsible for the implementation of environmental measures in their respective areas of concern. However, this will be conducted in consultation with relevant experts and stakeholders in accordance with best practices and local regulatory requirements.

1.8 Workforce Requirements

The breakdown of required workforce per relevant project phase is provided in Table 1-11 and Table 1-12 below. To lessen the socio-economic impact of influx of migrant workers and potential resource competition, NIA will prioritize hiring of qualified locals for all the project stages in compliance with RA 6685[11].

Specifically, the project will aim to hire at least 50% of the unskilled and 30% of skilled workers from the bonafide residents of the project's host municipality. Moreover, the project will allow equal hiring opportunities for both men and women. A 9710 or the Magna Carta of Women Act highlights women's right to decent employment. Thus, the project will target that women make up at least 20% of the project workforce. The project site does not overlap with an ancestral domain of an indigenous people's group. However, qualified indigenous peoples from outside the host communities will be considered for employment for the project.

1.8.1 Construction phase

For the construction phase, the projected number of workers that will be employed is about 214 employees. Additional workforce will be hired, as needed during the operation. The workforce will mainly be composed of five sections:

- Office Engineering
- Field Engineering
- Administrative
- Provincial Management
- Support Staff

The table below shows the exact number allocated per section while Figure 1-8 shows the Bagtingon SRIP Construction Management and Engineering Supervision Organizational Chart.

Table 1-11 Workforce requirements for Bagtingon SRIP for the construction phase

Expertise	No. of workforce required
Project manager	1
Office Engineering Section	
Chief	1
-Cost/Estimate	3
-Design	3
-Planning	1
-Drafting	3
Field Engineering Section	
Chief	1
-Construction	150
-Equipment	25
-Survey	5

[11] An Act Requiring Private Contractors To Whom National, Provincial, City And Municipal Public Works Projects Have Been Awarded Under Contract To Hire At Least Fifty Percent Of The Unskilled And At Least Thirty Percent Of The Skilled Labor Requirements To Be Taken From The Available Bona Fide Residents In The Province, City Or Municipality In Which The Projects Are To Be Undertaken, And Penalizing Those Who Fail To Do So

Expertise	No. of workforce required
-Materials	5
Administrative Section	
Chief	1
Admin Officer	1
Finance	3
Procurement	1
Personnel	2
Provincial Management Office	
SRIP Task Force	1
Resident Engineer	1
Officer Engineer	1
Material and Testing Engineer	1
Construction Engineer	1
Geologist	1
Support Staff	
Clerk/Data encoder	1
Laboratory Technician	1
Driver Mechanic	1

Source: BSRIP Feasibility Report

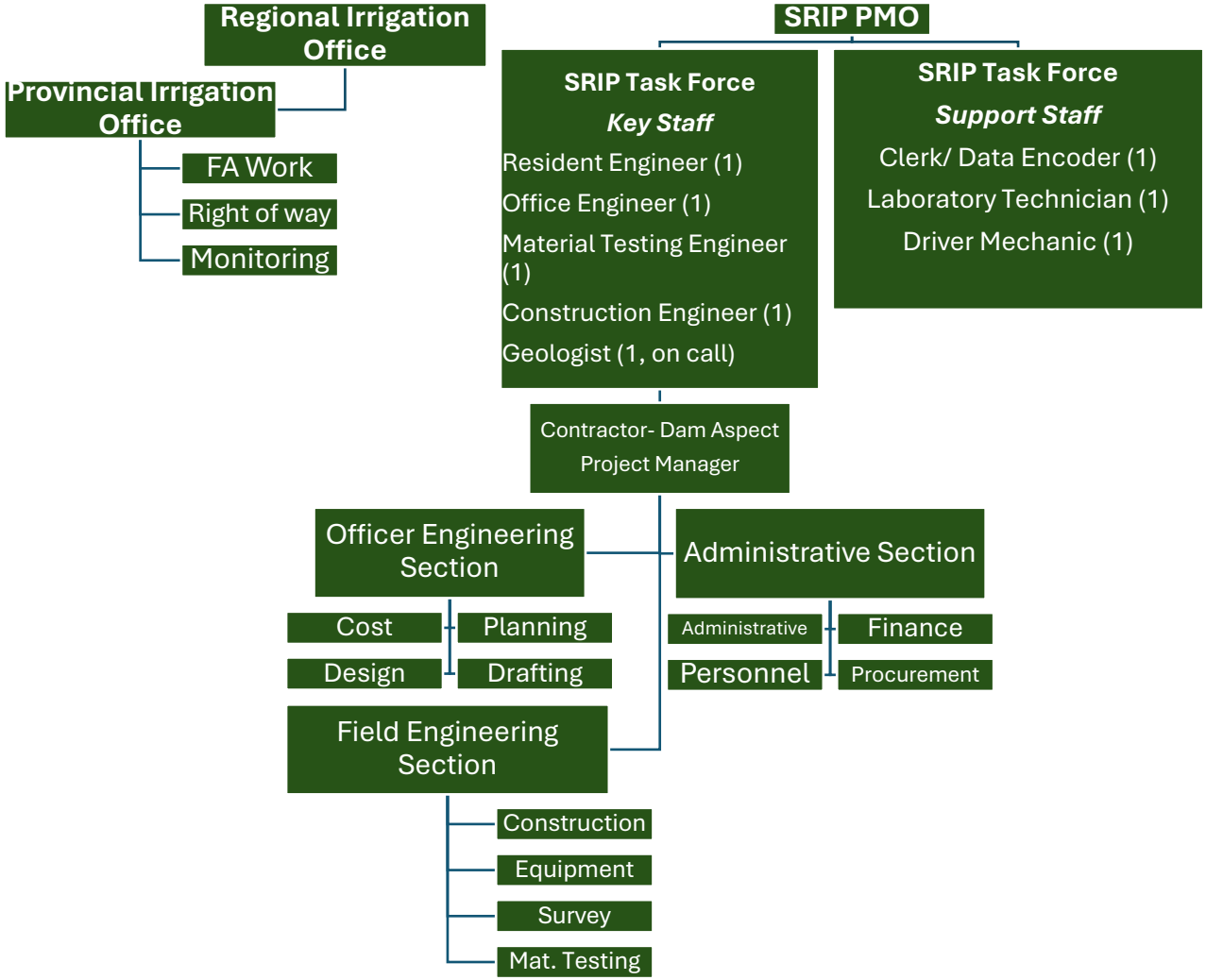


Figure 1-8 Organizational chart for Bagtingon SRIP

1.8.2 Operation Phase

The required workforce will significantly decrease for the operation phase. Per the table below, at least 6 staff will be required.

Table 1-12 Workforce requirements for Bagtingon SRIP for the operation phase

Expertise	No. of workforce required
Project engineer	1
Material engineer	1
Safety officer	1
Foreman	3

1.8.3 Project Cost

The Project is scheduled to be completed in three years and full agricultural development is expected to be attained after the dam construction and other appurtenant facilities. The proposed Bagtingon – Small Reservoir Irrigation Project will cost Nine Hundred Ninety Million Pesos (Php 990,000,000.00). Table 1-13 details the cost allocated for the project.

Table 1-13 Project cost allocation

Detailed Breakdown Of Current Year Program				
Direct Cost		**Field Office**	**Central Office**	**Total**
1	Civil Works	₱ 115,120,069.09	₱ 739,505,709.83	₱ 854,625,778.92
2	Institutional Development Program	₱ 15,279,444.01		₱ 15,279,444.01
3	Construction Survey	₱ 8,391,338.47		₱ 8,391,338.47
4	Parcellary Mapping / Survey	₱ 3,568,512.00		₱ 3,568,512.00
5	Land Acquisition & Resettlement Plan	₱ 33,999,633.34		₱ 33,999,633.34
6	Procurement of Equipment & Vehicle			₱ -
7	Permits & Clearances	₱ 4,282,866.20		₱ 4,282,866.20
8	Safety and Health	₱ 41,448.12		₱ 41,448.12
9	Contingencies	₱ 2,281,683.15	₱ 67,529,295.79	₱ 69,810,978.94
TOTAL DIRECT COST		**₱ 182,964,994.38**	**₱ 807,035,005.62**	**₱ 990,000,000.00**

Table 1-14 Project schedule

Item No.	Description	No. of Calendar Days	2023				2024				2025				2026			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
I.	**CIVIL WORKS**																	
A.	**CONTRACT WORKS**																	
1.0	**PRE-CONSTRUCTION**																	
1.1	Temporary Works, Construction Plant, Mobilization of Construction Equipment and Demobilization Works																	
	a. Mobilization/ Demobilization	60.00																
	b. Temporary Facilities	30.00																
1.2	Clearing & Grubbing (Including Disposal AHD= 3.00 km)	30.00																
1.3	Diversion & Care of River During Construction & Unwatering of Foundation	1,102.00																
1.4	Access Road																	
	a. Aggregate Base Course	30.00																
	b. Aggregate Sub-base Course	30.00																
2.0	**DAM AREA**																	
2.0	Excavation and Foundation preparation																	
	a. Common	139.00																
	b. Rock	139.00																
2.1	Overhaul (Waste Disposal) AHD= 3.00 kms.	139.00																
2.2	Drilling & Grouting																	
	a. Drilling (Non-Coring)	70.00																
	b. Standpipe	21.00																
	c. Pressure Grouting	44.00																
	d. Checkhole (Core Drilling)	30.00																
	e. Water Pressure Test	42.00																

Item No.	Description	No. of Calendar Days	2023				2024				2025				2026			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
2.3	Dam Embankment																	
	a. Test Fill	130.00																
	b. Impervious Clay	393.00																
	c. Random Fill	363.00																
	d. Filter Drain																	
	d.1. Sand	200.00																
	d.2. Gravel	200.00																
	e. Gravel Bedding	163.00																
	f. Boulder Riprap	163.00																
	g. Rock Toe	200.00																
	h. Grass Sodding	163.00																
2.4	Concrete Structures, 211 kg/cm2, Class "A"	30.00																
2.5	Reinforcing Steel Bars (all sizes grade 40)	30.00																
2.6	Dam Instrumentation																	
	a. Furnish and Installation (Breakdown of item on separate sheet. See sample)	30.00																
	b. Surface Measuring Point (SMP)	30.00																
	c. Bench Mark	30.00																
	d. Seepage Monitoring Weir	30.00																
2.7	Miscellaneous Metal Works & Materials																	
	a. Railing																	
	a.1. Guard Railing, G.I. Pipe 50cmØ (Dam Crest)	30.00																
	a.2. Stair Railing, G.I. Pipe 50cmØ (Stair)	30.00																
	b. Rock Toe Drain Pipe	200.00																
2.8	Roads (Dam Crest)																	
	a. Aggregate Base Course	30.00																

Item No.	Description	No. of Calendar Days	2023				2024				2025				2026			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	b. Aggregate Sub-base Course	30.00																
3.0	**SPILLWAY AREA**																	
3.1	Excavation and Foundation Preparation																	
	a. Common	254.00																
	b. Rock	254.00																
3.2	Overhaul (Waste Disposal) AHD= 3.00 kms.	254.00																
3.3	Filling and Backfilling	242.00																
3.4	Concrete Structures, 211 kg/cm2, Class "A"	320.00																
3.5	Reinforcing Steel Bars (all sizes)																	
	a. Grade 40	290.00																
	b. Grade 60	290.00																
3.6	Concrete Joints and Joint Materials																	
	a. PVC Waterstop (230mm width)	320.00																
	b. Joint Sealant	320.00																
	c. Joint Filler (Bituminous Type)	320.00																
3.7	Filter Drain																	
	a. Sand	175.00																
	b. Gravel	175.00																
3.8	Grouted Riprap	175.00																
3.9	Anchor Bars, 25mmØ x 1.50m	320.00																
3.10	Miscellaneous Metal Works & Materials																	
	a. Perforated PVC Pipe, 100mmØ Sch 40	320.00																
	b. PVC Pipe, 50mmØ Sch 40	320.00																
	c. Dowel Bar, 20mmØ x 750mm Long, Plain Bar	320.00																
	d. Dowel Bar, 16mmØ x 800mm Long, Plain Bar	320.00																
	e. Ladder Rung, 25mmØ Plain Bar	320.00																

Item No.	Description	No. of Calendar Days	2023				2024				2025				2026			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	f. Guard Railing, G.I. Pipe 75cmØ (Dam Crest)	320.00																
	g. G.I. Pipe 25cmØ (Spillway Drain)	320.00																
4.0	**OUTLET WORKS (Diversion and Irrigation)**																	
4.1	Excavation and Foundation preparation																	
	a. Common	150.00																
	b. Rock	150.00																
4.2	Overhaul (Waste Disposal) AHD= 3.00 kms.	150.00																
4.3	Filling and Backfilling																	
	a. From Excavated Materials	150.00																
	b. Impervous Clay	150.00																
	c. Random Fill	150.00																
4.4	Concrete Structure																	
	a. 21.0 Mpa, Class "A"	220.00																
	b. 7.0 Mpa, Lean Concrete	220.00																
4.5	Reinforcing Steel Bars (all sizes)																	
	a. Grade 40	201.00																
	b. Grade 60	201.00																
4.6	Concrete Joints and Joint Materials																	
	a. PVC Waterstop (230mm width)	220.00																
	b. Joint Sealant	220.00																
	c. Joint Filler (Bituminous Type)	220.00																
4.7	Miscellaneous Metal Works & Materials																	
	a. Trash Racks																	
	a.1. 3.10m x 1.25m	60.00																
	a.2. 2.40m x 1.25m	60.00																
	b. Steel Frame, 4.40m x 3.20m with Manhole	60.00																

Item No.	Description	No. of Calendar Days	2023				2024				2025				2026			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
	c. Fabrication, Supply, Delivery and Installation of Steel Pipes, Reducer Pipes, Flanges, bolts, nuts, washer and other accessories to complete the works including Non-Destructive Test (NDT)	60.00																
4.8	Gate Valve and Butterfly Valves																	
	a. Gate Valve 900mmØ, Gear Reduction w/ bypass valve	60.00																
	b. Butterfly Valve 900mmØ, Gear Reduction w/ bypass valve	60.00																
	c. Dresser Coupling 900mmØ	60.00																
B.	HEALTH & SAFETY	1,162.00																
1	BASIC PERSONAL PROTECTIVE EQUIPMENT																	