EXECUTIVE SUMMARY

A. PROJECT FACT SHEET

Name of Proponent	National Irrigation Administration (NIA) Region I - Pangasinan Irrigation Management Office
Office Address	Barangay Bayaoas, Urdaneta City, Pangasinan
Authorized Signatory/ Representative	Engr. Gaudencio M. de Vera, PIMO Division Manager A
Contact Details	Telefax No. (075) 632 2776; RIM OFFICE (075) 632 2776; PIMO - (075) 632 2775

EIA Preparer	Integrative Competitive Intelligence Asia, Inc. (ICI-Asia)
Address	Unit 3301 One Corporate Center, Meralco Avenue corner Julia Vargas Avenue, Ortigas Center, Pasig, Philippines
Contact Person	President V. Vargas, BSRIP SEIA Project Manager
Contact Details	pvvargas@ici-asia.com, (02) 7063292
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

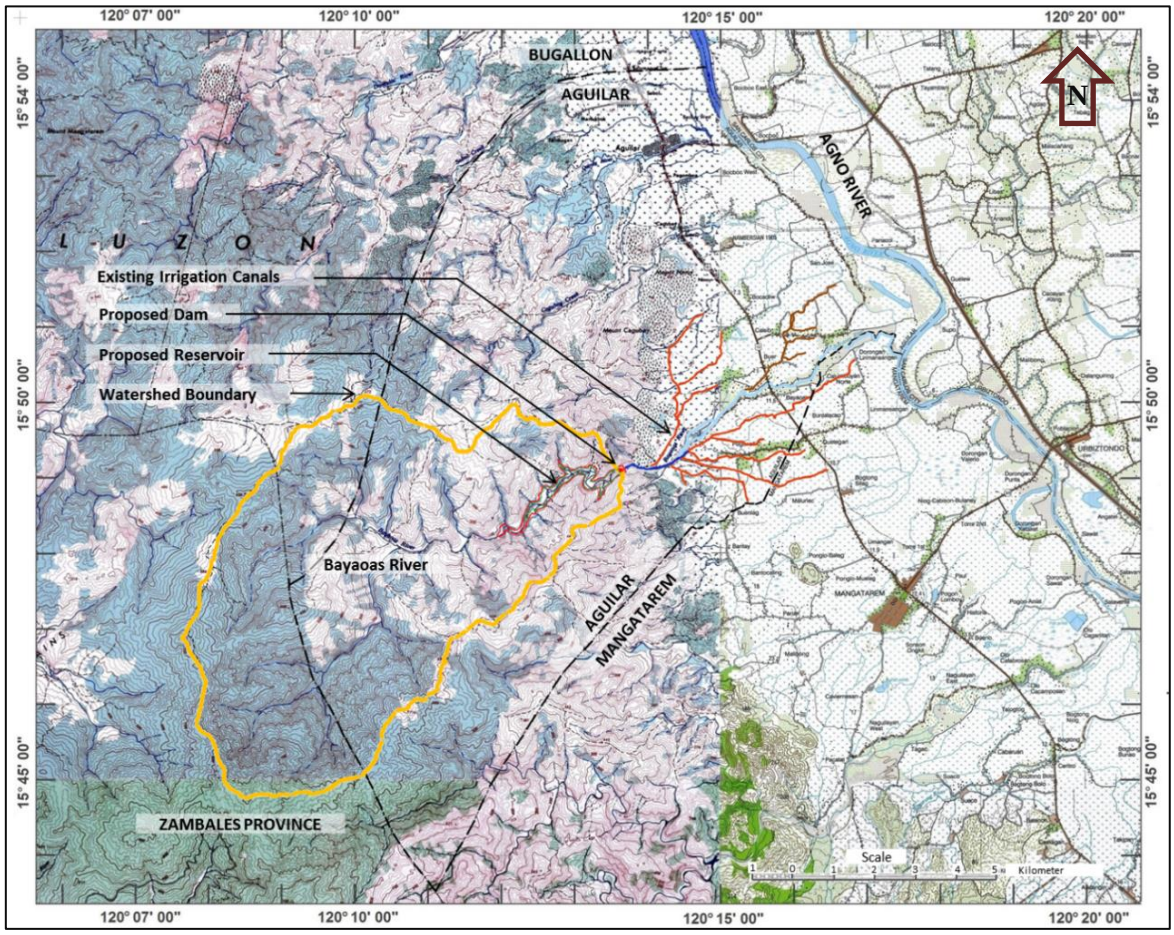

Figure ES-1. Municipal Location of the Proposed Project on a NAMRIA Topographic Map

B. EIA PROCESS DOCUMENTATION

B1. EIA Team

The EIA Study was conducted by a multidisciplinary team of specialists and consultants of the ICI-Asia, Inc., in coordination with PIMO staff (**Table ES-1**).

Table ES-1. EIA Study Team Composition

Name	Position/ Module
President V. Vargas	SEIA Project Manager
Vanderleaf C. Capalungan	Technical Team Leader, Integrator, Project Description, Land Classification and Use, Pedology, Water Quality, Air Module, Environmental Risk Assessment (ERA)
James Paul H. Esguerra	The People Module, Public Participation, Overall Reviewer
Napoleon D. Villanueva Jr.	Geology
Leizel G. de la Cruz	Terrestrial Flora
Myka S. Allam	Terrestrial Fauna
Silvino M.Lambino Jr.	Hydrology
Westly R. Rosario	Freshwater Ecology
Joseph V. Jovellanos	Right-of-Way
Joveil C. Jovenal	Research Assistant
Resty A. Alvarado	Research Assistant
Ian Midrick M. Delos Santos	Administrative Support
Francis B. Aquino	NIA SEIA Coordinator
Karl S. Geslani	NIA Support Staff
Dave M. Lagundi	NIA Support Staff

B2. EIA Study Schedule

The EIA started in August 2018 with the 2015 Feasibility Study Report to define the proposed Project for screening with the EMB EIA regulatory requirements. This was followed by compliation of environmental information in the FS usable for the EIA, with an initial impact assessment, in preparation for the IEC and initial perception survey done in September 24, 2018. Results were converted into a supporting document for the request for Public Scoping which was carried out on December 11, 2018. This was followed by a Project Briefing and Technical Scoping with EMB and EIA Review Committee (EIARC) on January 23, 2019. Thereafter, primary data gathering activities for the applicable modules were done. Together with the compiled data from the 2015 FS, government documents, and from internet searches, the primary data were used to prepare modular reports. They were integrated as basis for preparing the rest of sections of the EIS. The sequence of events is in compliance with the requirements of DAO 2017-15. **Table ES-2** shows the major EIA activities.

B3. EIA Study Area

The study area covered Bayaoas Watershed (for the proposed access road, dam site, area, reservoir), and the beneficiary irrigation canals in the barangays of Aguilar (Laoag, Bayaoas, Pogonsili, Buer, Calsib, Bocacliw, Niñoy), and Mangatarem (Quetegan, Bunlalacao, Linmansangan, Calomboyan Norte). Area covered by flora and fauna surveys covered farther upstream of the proposed reservoir.

Table ES-2. EIA Study Schedule

Date	Activity
August – September 2018	Preparation of Initial Project Description
August 14, 2018	Project Screening with NIA
September 24, 2018	Initial Perception Survey
September 24, 2018	IEC with the Barangay Residents
October 26, 2018	IEC for Pangasinan, Aguilar, Mangatarem LGUs
November 30, 2018	EMB Posting of Public Scoping
December 11, 2108	Public Scoping, Aguilar and Mangatarem
January 23, 2019	Project Briefing and Technical Scoping
February – May 2019	Primary Data Gathering and EIS Writing

B4. EIA Methodology

Basically, the EIA followed the topics and methodology for the baseline and impact assessment stipulated in the Technical and Screening Form (**Annex ES-1**), the Revised Procedural Manual for DAO 2003-30 and DAO 2017-15. Applicable methodologies or approaches were applied for Project Description, Land Classification and Use, Geology, Pedology, Terrestrial Flora, Terrestrial Fauna, Hydrology, Water Quality, Freshwater Ecology, Climate and Meteorology, Air Quality, Noise, and People. Data and information for the Project Description, land classification and use, geology, pedology and hydrology were compiled from existing 2015 Feasibility Study for BSRIP. Many data including maps on natural environment were obtained government websites (e.g. NAMRIA, DENR, EMB, FMB, BMB, MGB, PHIVOLCS, Manila Observatory, PhilRice, PAGASA,). Documents related to the Bayaoas Watershed like on the National Greening Program, were made available from DENR CENRO Dagupan. A number of maps for land and water modules were obtained from DENR-R1 Development of Climate-Responsive Integrated Master Plan for Agno River Basin, Comprehensive Report on the Studies Conducted (Phase 1), which situates the condition of BSRIP with the Agno River Basin. Secondary data for The People Module were obtained from CLUP of Aguilar, CLUP of Mangatarem, NCIP, PSA, NSO, LMB, PhilAtlas, Pangasinan LGU, among others. Other websites contain supplemental information from literature for the various modules.

Primary data on natural environment were obtained by sampling of soil, terrestrial flora, terrestrial fauna, river eater, groundwater, freshwater organisms, air quality (TSP), noise. Methodology, maps and photos for the sampling of the natural environment are provided in each section. Primary data on people module were botaied from IEC, perception survey, key informant interviews, and focus group discussions.

The Google Earth Pro was used in map development and analysis of the project and environment characteristics, planning the primary data gathering and impact assessment. As possible, the results of the baseline data were compared the established regulation (RA 9275 Clean Water Act, RA 8749 Clean Air Act, PD 984), and criteria (like International Union for Conservation of Nature (IUCN) Red List of Threatened Species 2016 and DENR Administrative Order No 01 of 2007 “Establishing the National List of Threatened Philippine Plant and Their Categories). Computational techniques were applied for terrestrial flora diversity analysis, Bayaoas River flow, reservoir simulation, flood simulation, and noise attenuation by distance from source.

B5. Public Participation

In accordance with DAO 2017-15, various stakeholders participated in a number of activities,, including the following:

	Activity	Date	No. of Participants
1.	Initial Perception Survey	September 24, 2018	49
2.	1st IEC, with the AGuilar Barangay Residents	September 24, 2018	50
3.	2nd IEC/KII for Pangasinan, Aguilar, Mangatarem LGUs	October 26, 2018	9
4.	3rd IEC, houset- to-house with Barangay Bayaoas Residents	October 27, 2018	30,
5.	Public Scoping, Aguilar and Mangatarem	December 11, 2108	70
6.	Perception Surveys and FGDs (Aguilar and Mangatarem)	April 22-25, 2019	145

The public participation activities included the local residents from Aguilar and Mangatarem and respective municipal and provincial representatives. Communication tools used include slides, form, leaflets and tarpaulin.

A copy of the Initial Perception Survey Report is provided in **Annex-ES-2** and the Information Education and Communication Report in **Annex ES-3.** These were undertaken under the initiative of the proponent to introduce the project by inviting a number of stakeholders for the IEC, and the IPS. The IEC was meant to introduce the project to the community. While so, some community members were already raising issues about the project. These reports were filed with the request for Public Scoping, Technical Scoping, and became part of the material for the FGD. The Public Scoping Report is presented in **Annex ES-4**.

The most recurring concerns identified were possible flooding, dam breakage, watershed management, and reduction in supply of water. These issues became the focal themes across a number of target barangays were the issues were most felt, through Focus Group Discussions, with guide questions provided in **Annex ES-5.** A summary of the key points from the FGDs was included in the People Module, along with the results of the Socio-Economic Survey, which also included a Perception Survey. A listing of the key variables of the survey is provided. In general, both the Initial Perception Survey and the Perception Survey have socio-demographic data, though the latter is more extensive, and more nuanced. The discussions on the socio-economic survey and perception focused on key elements discussed in this EIA Module.

For the IEC, details of the sample size and profile of participants is in the IEC Report, likewise for the IPS. For the Initial Perception Survey, a small number of respondents was targeted (n=30) was used, but as implemented used n =50. For the socio-economic survey and perception survey, the sample size was set at 90% confidence level with and a margin of error of 10%. The required minimum sample size for beneficiary/ affected barangays of 67 for Mangatarem and 63 for Aguilar (=130 respondents). The sample size for the actual survey was 145.

C. EIA SUMMARY

C1. Summary of Project Alternatives Considered for Siting, Technology Selection/Operation and Design

The alternatives are guided mainly by the objectives of collecting and distributing sufficiently dependable irrigation water to rice fields in the project area. Bayaoas River is the only river present in the area that can reasonably provide irrigation water by gravity to the target existing irrigation systems. The proposed dam of choice is basically due to the abundance of rock and earth fill materials in the area. Generically, the trapezoidal cross section along the river segment of an embankment dam has an impermeable clay core, with upstream and downstream protective filter zones and outer shells.

Siting of water source from the downstream Agno River would require costly pumping, or long right-of-way for piping of water at higher elevation of the river. Basically, the technology adopted for the siting of the water source uses gravity which is more economical in the long term than the use of pumps. This also requires a water reservoir. One siting and technology alternative is the construction of lined multiple lowland reservoirs on 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. A dam may be an embankment dam or concrete dam that the construction of the latter is more costly.

C2. Summary of Main Impacts and Residual Effects After Applying Mitigation

Land Classification and Use. The proposed dam site and reservoir are located in the general area of wooded grassland forest reserve. However, its location along the river channel is identified as alienable and disposable land by Aguilar CLUP 2013-2022. The footprint partly overlaps with the Enhanced National Greening Project in the area. The proposed access road starts from titled agricultural areas with patches of trees, avoiding built up areas. The proposed site is not located in any of the following: protected area, key biodiversity area (KBA), tenurial instrument, IP area, mining tenement, volcanic activities, tested significant groundwater, flood prone area (for the dam site). The proposed area is within Petroleum Service Contract Area of the Department of Energy (DOE). The location of dam site and reservoir is within the channel of water body (Bayaoas River), which is highly susceptible to landslide, with critical slopes, and frequently visited or hard hit by typhoon, but not prone to flood. The potential quarry site is an old quarry site.

The proposed Project would therefore cause partial conversion of NGP area to dam and reservoir area, and from the titled private land to right-of-way for the new access road to dam site. These would however provide ease for NGP activities due to improved access and water supply. Additional benefit includes opportunity for flood control, buffer area for KBA, fishery industry, tourism, educational tour, and increase frequency and volume of water supply during the dry season, with consequent increase in rice production.

Geology/Geomorphology. The proposed dam is located in the rugged topography in the northeastern part of Zambales Mountain consisting of Ophiolite Complex an east-dipping complete sequence of oceanic crust and mantle material, generally sound and massive rock, consisting of a series of basic to ultrabasic or ultramafic rocks. It is a mineral district of chromium, nickel, platinum, copper, and gold. The nearest active fault is the East Zambales Fault which is about 3.7 km east of the dam site. The maximum credible earthquake (MCE) is 7.4 for East Zambales Fault, based on possible surface rupture length. In consideration of the East Zambales Fault, the estimated PGA for the dam design by deterministic approach is

0.21g which is equivalent to PEIS VII, and already considered in the conceptual design of the dam.

The dam site has shear zones and two northwest trending vertical faults are located approximately 75 meters downstream and 500 meters upstream of the proposed dam. A more detailed geotechnical investigation will be done for detailed engineering design of the proposed Project. At the dam site, the joint systems within the rocks are generally tight and are filled with secondary alteration such as quartz and calcite. The nature of the joints and a lack of through-going structures suggest no problem regarding water seepage. The dam site is highly susceptible to landslide. The dam site provides sufficient quantity and good quality construction materials. The dam would prevent the natural channel replenishment of earth materials downstream. The service areas or the rice farms are located in alluvial plains with high susceptibility to liquefaction.

Pedology. The project site has an upland or mountainous Alaminos series soil, where the dam and reservoir are located, and the lowland San Manuel series soil where rice fields are located. In between them is the intermediate upland Alaminos Series, formed on moderately dissected residual fan terrace located near and along foot slopes of hills and mountain. They are characteristically fine loamy and fine clayey ranging from fine sandy loam to clay which is well suited to a wide range of climatically adopted agricultural crops. Majority of the soils have moderate depth to deep solum thus indicating a greater water holding capacity. The soils are moderately weak granular, sub-angular and angular blocky structures. The soil in the project area is considered medium fertility based on pH, cationic exchange capacity (CEC) and the content of organic matter (OM) or nitrogen source, phosphorus, and potassium. Addition of nutrients is recommended to increase crop production.

The upland soil is recorded as having severe soil erosion, although the banks of Bayaoas River at the damsite appear stable and the channel is dominated by sand, gravel, cobbles and boulders. Excavation of soil during the dam construction would cause severe soil erosion during the wet season. The physical nature of the proposed Project would not cause significant deterioration of soil quality, although measures to prevent oil and fuel spillages will be put in place during construction. Soil fertility in the rice field decreases with the increase in the frequency of planting to two seasons in most areas, and this would require the addition of fertilizers. The additional use of banned non-biodegradable pesticides would pose a risk of accumulation of pesticide residues on rice soils.

Terrestrial Flora. The flora environment in the project site was grouped as upland where the dam and reservoir are located, and the lowland where the ricefields are located. The dam site and reservoir is located in wooded grassland northeast of the Key Biodiversity Area (KBA) of the Zambales mountain and site for the continuing implementation of the National Greening Program (NGP) with different kinds of trees are planted by 10 operators mostly based in the Municipality in Aguilar. The lowland flora within the proposed road route is sparse of economically valuable trees. On the conservation status, 17 from the 59-species identified are listed under the IUCN (2-Critically endangered (1-Endangered, 9-Least Concerned and 5-Vulnerable), while only three species are categorized under DAO-2017-11, two of which are threatened species, and one is vulnerable).

The vegetative layers exhibited low species richness based on Shannon-Wiener H' biodiversity index: 0.65 in the canopy, 0.43 in the understorey, and 0.72 in the groundcover. The Pielou's (J') Evenness Index measured 0.45 or moderate in the canopy, 0.38 or moderate in the understory, and 0.55 or high in the groundcover. Incidence of grassfire was noted in the area, which will be considered in the project design, construction, and operations. In preparation for the construction works, a thorough inventory of the trees will be done together with the NGP operators and DENR CENRO Dagupan. At the minimum, lost trees will be replaced according DENR Memorandum Order 2012-05 "Uniform

Replacement Ratio for Cut or Relocated Trees. The overall impact mitigation and monitoring on the flora will be part of the Watershed Management Plan for the proposed Project, which will be prepared with the stakeholders.

Terrestrial Fauna. The terrestrial fauna covered in this study were amphibians, reptiles, birds and mammals. The survey covered three areas from the proposed access road, to dam site and further upstream of the maximum reservoir level, for about 10 km channel segment of Bayaoas River at elevations 330-150 masl. Recorded were 11 species of herpetofauna (amphibians, and reptiles), 19 of avifauna (birds) and 7 of mammals (mouse, rat, bat, dee, pig). The species are not classified as Threatened and/or Endangered. There were endemic and native species ranging from Least Concern to Near Threatened and low in abundance and biodiversity.

An existing threat to wildlife is the recurrence of grass fire causing habitat destruction and limits the forest to regenerate and grow despite efforts to nurture trees in the area. Illegal wildlife hunting for bushmeat and livelihood also limits the increase in wildlife population. Loss of species is unlikely to occur since most of the recorded species are endemic and/or native, mostly of least concern and widespread within Zambales Mountain Range. Mitigation measures would include replacement tree planting and continuing support to the national greening program. A wildlife conservation program will be put in place, in coordination with the various stakeholders.

Hydrology. The proposed Project is within Bayaoas River Catchment which is one of the subwatershed or tributaries out of 19 of the Agno River Basin in the central plains of Region 1. The river system is dendritic, 4th stream order, and has a drainage area of 79.15 km2. The drainage area upstream of the proposed dam is 64 km2. The river channel measures 25.9 km long from Agno River (at 3 masl), going southwest and south at the headwaters in Sta Cruz Zambales (at maximum 840 masl). The longitudinal slope of the channel is low at the proposed reservoir. The river bed width varies and wide about 30 m at 180 masl upstream of the proposed reservoir to 250 m maximum at the lowland.

From the 2015 Feasibility Study (FS) Report for the proposed Project, the estimated mean monthly flow at the damsite is from the lowest 0.34 m^3/s in March to the highest 12.41 m^3/s in August. The observed peak flow ranged 18 to 258 m^3/s. In consideration of the climate projection for Panagasinan, the recommended design flood is 1,321.61 m^3/sec (100-year return period), while the check flood is 1,819.08 m^3/sec (1,000-year return period). At flood condition for a 100-year return period and reaching the 36 m wide and 6 m high spillway, estimates showed a water depth of 48.8 m at the dam axis, 103.79 ha water surface area, and 18.03 million m^3 water stored. The damsite would serve as a flood control measure, provide significant irrigation water during dry season, and reduce pumping frequency of groundwater for irrigation.

Uplands have rocks without any known significant groundwater, largely untested, while the lowland have rocks with limited potential, to moderate permeability. The damsite is not susceptible to flood, but the lowland have low to very high flood susceptibility. The area is susceptible to drought.

Water Quality. The surface water Bayaoas River has good water quality at the uninhabited dam site area but with lower quality down the irrigated and populated area. Quarrying activities along the river did not show significant increase in total suspended particulates due to low flow, ponding and absence of significant soil sediment. (A groundwater sample from a shallow 3-year old tube well in a residential area in Barangay Bayaoas exhibited low quality exceeding relevant water quality guidelines for Class C waters.)Construction's main impact will be limited to significant but temporary increases in total suspended solids in Bayaoas River. The use of Coffer dam is one measure to avoid excessive soil erosion.

During the operation phase, water quality of the reservoir will be different from other segments of Bayaoas River, which may arise from thermal stratification and nutrient enrichment in the water column of the reservoir. This will be monitored. The increase in frequency irrigation water supply would lead to an increase frequency in the use of fertilizers and pesticides. A continual IEC shall be implemented, plus spot-check monitoring of groundwater quality.

Freshwater Ecology. This study involved the determination of the distribution and abundance of the organisms in the food chain such as floating and drifting planktons (phytoplankton and zooplankton), bottom dwelling macrobenthos, and mobile fishes. Five baseline sampling sites were established in the dry season of February and March, 2019 along a 4-km shallow channel length Bayaoas River from the proposed dam site (uninhabited) down to the intake area of the Buer-Calsib irrigation system (populated area). The four lowland sampling sites are expected to become highly disturbed by the presence of quarrying activities, maintenance of channel barriers to divert irrigation water, sustenance fishing, inputs from agricultural and domestic activities. The potential significant impact during the construction phase of the proposed Project on freshwater ecology along Bayaoas River would be limited at the damsite, decreasing downstream. During the project operations phase, a new ecology would develop in the reservoir, which will be continually monitored.

Climate and Meteorology. The proposed Project is located in an area with Type 1 climate characterized as having two pronounced dry season in November to April and wet season during the rest of the year, with August as the rainiest month. April is the hottest month, while January is the coolest month. Prevailing winds is south and southeast at an average of 2 m/s. The strongest was 56 m/s from WNW direction on October 11, 1974. The project area is high risk to typhoon, about 5 cyclones in 3 years. Under a medium range scenario on climate change projection, Pangasinan would experience temperature increase, and rainfall decrease in March, April and May and increase in the rest of the year. Such rainfall projections were already incorporated in the dam design. Greenhouse gas (GHG) emissions would not appear to be significant from the temporary construction equipment. However, the GHG sequestration capacity of the dam and reservoir area would decrease due to submersion of vegetation. This calls for replacement tree planting as a mitigating measure. Emissions of methane from reservoir might happen but which adverse new emissions shall be offset by avoided emissions from decommissioned of diesel-pumps used for irrigation during dry season.

Air Quality. The proposed Project is located in a rural agricultural and woody grassland area with good air quality. The increase in total suspended particulates (TSP) is the main air quality issue for the proposed project and only during earthmoving activities at the construction phase of the proposed access road near a low density populated area. High dust emission will be mitigated by avoidance of earthmoving activities during high wind conditions, water sprinkling, and reduced speed of vehicles in unpaved roads in residential areas.

Noise. The baseline noise levels for the proposed Project were measured together with TSP measurements. On the average, noise levels located in low populated area measured were within respective standards in the morning, daytime, evening and nighttime. Noise sources were people, vehicles and animals. The increase in noise levels in populated areas would be felt only during the construction phase of the project. Nighttime operation and excessive use of vehicle horns, and vehicle accelerations will avoided near residential areas. Significant noise levels will occur at the damsite during construction driving away the wildlife which may return after construction

The People. The proposed Project will be located in a rural setting. The proposed dam and reservoir will be located in upland in Barangay Laoag, Aguilar, with no residential area, but visited by the operators of the National Greening Program. The immediate receipients of irrigation waters will be the ricefarms eastward in the following barangays: Bayaoas, Pongonsili, Buer, Calsib, Bocacliw and Niñoy, all in the Municipality of Aguilar, a third class municipality. Farther east will be the Barangays Quetegan, Bunlalacao, Linmansangan, and Calomboyan Norte of the Municipality of Mangatarem, a first class municipality

Various stakeholders participated in a number of activities in the EIA process. A number of activities were undertaken under to introduce the project to various stakeholders for the IEC, and the IPS. Community members early on raised issues about the project, without yet understanding the technical details of the project, which documented and informed the FGDs. The FGD themes were the following: possible flooding, dam breakage, watershed management, and reduction in supply of water. FGDs were conducted across target barangays were the issues were most felt. The socio-economic, and perception survey, subsequently conducted, showed a general appreciation of project benefit for the farmers. While rather few perceived possible flooding risk, flooding itself, flooding from dam breakage, these were perceived to be not likely to happen. When probed for the need to be relocated given the risks, and the need for support, the respondents generally declined the need for relocation, and support for relocation. Nonetheless, specific monitoring programs shall be put into place for ascertaining proper maintenance, state of health of the dam and the various parts of the irrigation system.

C3. Risk and Uncertainties Relating to the Findings and Implications for Decision Making

Three risks or uncertainties were identified from upstream to downstream: (i) nature and emergence of a reservoir ecology; (ii) dam failure with flash flood; and (iii) equitable distribution of irrigation water supply to farmers. The nature of ecology of the reservoir is difficult to predict but be likely similar to the other dams in the Philippines which is a tropical country. The dam design allows continuous flow and shall not induce population growth of disease-causing organisms. The dam would serve as a flood control measure during the rainy season. It would also serve as a water source for the NGP operations in the area, and prevention of wide-area grass fire.

Dam failure is a major issue raised by the residents. In the FS, a simplified worst-case simulation model for an instantaneous dam collapse at maximum operating setup estimates flash flood occurrence downstream with about 1.6 m flood over the banks of Bayaoas River. Literature shows a low chance of dam collapse for earth-filled dams and is not instantaneous. There is no record yet of dam collapse in the Philippines. A detailed simulation study would be part of the preparedness program to be formulated with the residents.

Lastly, the equitable distribution of irrigation water supply is not raised as a major issue by the communities, but it would be important to consider it as uncertainty as a change in farming practices and in the absence of an existing federation of irrigators association. This could cause negative perceptions among the farmers. NIA will ensure preventive measure from the start.