Climate and Disaster Risk Assessment

Municipality of Alaminos Laguna

Climate and Disaster Risk Assessment

Municipality of Alaminos
Province of Laguna

December 2018

Republic of the Philippines
Province of Laguna
Municipality of Alaminos
OFFICE OF THE SANGGUNIANG BAYAN

EXCERPTS FROM THE MINUTES OF THE REGULAR SESSION OF THE SANGGUNIANG BAYAN OF ALAMINOS, LAGUNA HELD ON JULY 29, 2019 AT THE SANGGUNIAN SESSION HALL.

PRESENT:

HON. RUBEN D. ALVAREZ	Presiding Officer
HON. VICTOR L. MITRA	Councilor
HON. ARTEMIO C. MAMIIT, JR	Councilor
HON. MORRIS ALBERT S. MATIBAG	Councilor
HON. RAMMEL E. BANZUELA	Councilor
HON. DARWIN C. TOLENTINO	Councilor
HON. GORGONIO M. ABRIGO	Councilor
HON. CANDELAIA V. CALABIA	Councilor
HON. JACKLYN A. VILLANUEVA	Councilor SK,Chairman)
HON. LORENZO B. ZUNIGA, JR.	Councilor (ABC, Pres.)

ABSENT:

HON. BERNADETH V. ALVAREZ	Councilor

RESOLUTION NO. 60
Series of 2019

A RESOLUTION APPROVING AND ACKNOWLEDGING THE RESULTS OF THE CLIMATE CHANGE AND DISASTER RISK ASSESSMENT 2018.

WHEREAS, Section 16, Local Government Code of 1991 mandates local government unit to exercise the powers expressly granted those necessarily implied there from, as well as the powers necessary appropriate or incidental for its efficient and effective governance, and those which are essential to the promotion of the general welfare. Within the respective territorial jurisdiction local government units shall ensure and support, among other things the preservation and enrichment of culture, promote health and safety, enhance the right of the people to a balanced ecology, encourage and support the development of appropriate and self-prosperity and social justice, promote full employment among their residents, maintain peace and order, and preserve the comport and convenience of their inhabitants;

WHEREAS, Section 5 (e) of the IRR of RA 6975. The Department of the Interior and Local Government (DILG). As mandated by laws, shall vigorously pursue its mandate to establish and formulate plans, policies and programs to strengthen the technical fiscal and administrative capabilities of local governments;

WHEREAS, Section 2 (g) of RA 10121, or the Philippine Disaster Risk Reduction and climate change in the development processes such as policy formulation, socio economic agriculture, water, energy, health, education ,poverty reduction, land-use and urban planning, and public infrastructure and housing, among others;

WHEREAS, Republic Act No. 9729, or the Climate Change Act of 2009, as amended, also stipulated that it is the policy of the state to systematically integrate the concept of climate

change in various phases of policy formulation, development plans, poverty reduction strategies and other development tools and techniques by all agencies and intrumentalities of the government;

NOW, THEREFORE, upon motion of Coun. Gorgonio M. Abrigo and unanimously approved by All Members of the Body Present RESOLVED as it is Hereby Resolved to ratify the " Resolution approving and acknowledging the results of the Climate Change and Disaster Risk Assessment 2018.

ENACTED and APPROVED – July 29, 2019.

I Hereby Certify that this Resolution is true and correct.

NEMIA B. NONZONES
S.B. Secretary

ATTESTED BY:

RUBEN D. ALVAREZ
Presiding Officer and Mun.
Vice Mayor

APPROVED:

ELADIO M. MAGAMPON, M.D.
Municipal Mayor
8-5-19

Republic of the Philippines
Municipality of Alaminos
Province of Laguna

ATTY. LORETO M. MASA
Municipal Mayor

EXCERPT FROM THE MUNICIPAL DISASTER RISK REDUCTION AND MANAGEMENT PLAN FORMULATION WORKSHOP, HELD ON MAY 22-24, 2019 AT THE HANNAH'S GARDEN EVENT PLACE, SILANGAN ROAD, BARANGAY BUNGGO, CALAMBA, LAGUNA.

IN ATTENDANCE:

GLADYS D. THOMPSON	MA/MENRO
LEISURELLY A. BANZUELA	RHU – SANITARY OFFICER
EDEN C. GESMUNDO	MLGOO
MICHAEL B. BUNO, EnP.	MPDO
ENGR. FLORENTINO J. DESTACAMENTO	MUNICIPAL ENGINEER
CHRISTIAN V. SABINOSA	MDRRMO
IRENE O. BANAWA	MBO
JOSEFINA A. TOLOSA	TREASURY OFFICE
ARLENE M/ GARACHICO	MCR
JUANITA B. RIVERA	GSO
NEMIA B. MONZONES	SB SECRETARY
NORRIDI CARREON	MSWDO – SWO II
PAT PAOLO V TOLENTINO	PNP
FLORANTE GONZALES	ASSESSOR'S OFFICE STAFF
JOSE LIMBO Jr.	ACCOUNTING OFFICE STAFF
MORRIS H. SILVA	MDRRMO STAFF
LESTER CARAAN	DEPED - SDRRMC
JOSELITO M. ANGELES	DEPED
CONNIE SANTOS	KABALIKAT
NORIEL S. MAURICIO	SNEAKY
JAYSON ALIS	GMGI-KALASAG
ERLINDA A. LARUQUE	PHMI
ROCKY B. VILLANUEVA	MENRO STAFF
JOAN M. AGANA	MDRRMO STAFF
MORRIS H. SILVA	MDRRMO STAFF
MARIA CARMEN LOURDES M. BUNO	ADMIN. OFFICE STAFF

MDRRMC Resolution No. 03 - 2019

RESOLUTION ACKNOWLEDGING THE RESULTS OF THE CLIMATE CHANGE AND DISASTER RISK ASSESSMENT 2018.

WHEREAS, Section 16, Local Government Code of 1991 mandates local government unit to exercise the powers expressly granted, those necessarily implied therefrom, as well as powers necessary, appropriate, or incidental for its efficient and effective governance, and those which are essential to the promotion of the general welfare. Within their respective territorial jurisdictions, local government units shall ensure and support, among other things, the preservation and enrichment of culture, promote health and safety, enhance the right of the people to a balanced ecology, encourage and support the development of appropriate and self-reliant scientific and technological capabilities, improve public morals, enhance economic prosperity and social justice, promote full employment among their residents, maintain peace and order, and preserve the comfort and convenience of their inhabitants.

WHEREAS, Section 5(e) of the IRR of RA 6975. The Department of the Interior and Local Government (DILG), as mandated by laws, shall vigorously pursue its mandate to establish and formulate plans, policies and programs to strengthen the technical, fiscal and administrative capabilities of local governments.

WHEREAS, Paragraph (K), Article 182, Rule 23 of the IRR of RA 7160, The DILG shall, in coordination and consultation with NEDA and the leagues of LGUs, formulate the operational guidelines of the local development planning process.

WHEREAS, Section 106 of the RA 7160, the local government unit shall have a comprehensive multi-sectoral development plan to be initiated by its development council and approved by its Sanggunian. For this purpose, the development council at the provincial, city, municipal, or barangay level, shall assist the corresponding Sanggunian in setting the direction of economic and social development, and coordinating development efforts within its territorial jurisdiction.

WHEREAS, Paragraph (a)(1) of Section 109 of the RA 7160, The municipal development councils shall exercise the following functions, to formulate long-term, medium-term, and annual socio-economic development plans and policies.

WHEREAS, Section 2(g) of RA 10121, or the Philippine Disaster Risk Reduction and Management Act of 2010, emphasized the need to mainstream disaster risk reduction and climate change in development processes such as policy formulation, socioeconomic development planning, budgeting, and governance, particularly in the areas of environment, agriculture, water, energy, health, education, poverty reduction, land-use and urban planning, and public infrastructure and housing, among others.

WHEREAS, Republic Act No. 9729, or the Climate Change Act of 2009, as amended, also stipulated that it is the policy of the state to systematically integrate the concept of climate change in various phases of policy formulation, development plans, poverty reduction strategies and other development tools and techniques by all agencies and instrumentalities of the government.

WHEREFORE, premises considered on the presentation of Christian V. Sabinosa of the CDRA 2018 to the Municipal Disaster Risk Reduction and Management Council last May 22, 2019.

RESOLVED, in line with the objectives of RA 9729 and RA 10121, the Municipal Government of Alaminos Laguna through the MDRRMC, hereby acknowledges the results of the Climate Change and Disaster Risk Assessment 2018. Thus, the CDRA 2018 shall be recommended by the MDRRMC to Sangguniang Bayan for acknowledgement. The CDRA 2018 shall be used as baseline data for the formulation of the Municipal Disaster Risk Reduction and Management Plan.

RESOLVED FURTHER, that copies of this resolution be attached to the Climate Change and Disaster Risk Assessment 2018 and to the Sangguniang Bayan for their recognition and acknowledgement.

UNANIMOUSLY APPROVED: May 29, 2019

Republic of the Philippines
Municipality of Alaminos
Province of Laguna

ATTY. LORETO M. MASA
Municipal Mayor

I HEREBY CERTIFY, that the foregoing resolution was duly approved by the Municipal Disaster Risk Reduction and Management Council in a meeting held on May 29, 2019.

CHRISTIAN V. SABINOSA
MDRRMO III

Attested:

ATTY. LORETO M. MASA
Municipal Mayor, MDRRMC Chairman

Acknowledgement

The Climate Change and Disaster Risk Assessment of the Municipality of Alaminos was made possible through the active support and participation of the following:

Honorable ELADIO M. MAGAMPON, M.D., Local Chief Executive;
Honorable RUBEN ALVAREZ, Vice Mayor;

And also, the contribution of the former Local Chief Executive Atty. Loreto M. Masa.

The Municipal Officials, Department Heads composed of Mr. CORSENI R. SALCEDO, Municipal Administrator-Designate; ENGR. MICHAEL B. BUNO, Mun. Planning & Development Coordinator; CHRISTIAN V. SABINOSA, Municipal Disaster Risk Reduction and Management Officer; Ms. GLADYS D. THOMPSON, Municipal Agriculturist; Mr. CIRILO M. MISTA, Municipal Accountant; Ms. IRENE O. BANAWA, Municipal Budget Officer; Ms. JOSEFINA A. TOLOSA, Municipal Treasurer; Ms. ARLENE M. GARACHICO, Municipal Civil Registrar; MARISSA M. AGUILAR, Municipal Social Welfare & Development Officer; Mr. EULOGIO B. SANTILLAN, REA, Municipal Assessor; DR. VICTORIA JOSEFA F. BASILAN, Municipal Health Officer; NEMIA B MONZONES, Sanggunian g Bayan Sectretary; JANETH B. RIVERA, General Services Officer; Ms. Eden C. Gesmundo, OIC-MLGOO; PCPT SERAFIN T GAPUNUAN, Acting Chief of Police; SFO3 MELVIN R BUENAVENTURA, OIC-Fire Marshall;

And the former FSINSP JOEL A ELEFANTE; and PSINSP GLENN CUEVAS;

The Sangguniang Bayan Members of Alaminos namely: HON. LORELEI M. PAMPOLINA; HON. BERNADETE ALVAREZ; HON. NIKKI D. CASTILLO; HON. CANDELARIA V. CALABIA; HON. NOEL MONZONES; HON. LINO B. ZUÑIGA; HON. GEORGE ABRIGO; HON. JEYSON C. ABU; HON. ANGELO S. OBA (Acting LNB President); JACKLYN A. VILLANUEVA, SK Federation President.

The current members of the Municipal Development Council: Hon. EDUARDO R. BRIZ (Del Carmen); Hon. VICTOR L. MITRA (Palma); Hon. MEXICO VILLANUEVA (Poblacion I); Hon. ANGELO OBA (Poblacion II); Hon. ROMEO ANURAN (Poblacion III); Hon. BILLY BAUTISTA (Poblacion IV); Hon. ROMEO O. SAGARIO, JR., (San Andres); Hon. GREGORIO L. BERTO (San Agustin); Hon. CESAR VILLANUEVA (San Benito); Hon. LORENZO ZUÑIGA JR., (San Ildefonso); Hon. RONY H. PUJANES (San Juan); Hon. URBANO M. BALOG (San Gregorio); Hon. MARS V. LIBANG (San Miguel); Hon. EUSTAQUIO ABRIL., (San Roque); Hon. GREGORIA A. CATIPON (Sta. Rosa) and all the CSO, NGO members.

The Alaminos Water District headed by ENGR. EMILIANO CASTILLO; the Local School Board headed by the Department of Education District Supervisor, EDITHA V. RANA, and the group of professionals who provided us with technical assistance and exceptional service namely CHRISTIROSE JIREH R. BETIA, DANA MAE C JACOBO, MA. CHARIZ A. MONTERO and JOHN JOWARD A. MARTILLANA.

Sectoral data requirements were supplied by national government offices namely: The Land Management Bureau; Mines and Geosciences Bureau; Department of Interior and Local Government; Department of Public Works and Highways; Philippine Atmospheric, Geophysical and Astronomical Services Administration; Bureau of Soils and Water Management; Philippine Institute of Volcanology and Seismology; National Statistics Office; and Housing and Land Use Regulatory Board;

Above all, our sincerest gratitude and appreciation to all people of Alaminos who participated in all dialogues, consultations and profiling activities in all barangays who provided the essence for the direction of the municipality's development vision.

Table of Contents

List of Tables

List of Figures

List of Maps

CDRA Process

Mainstreaming Disaster Risk Reduction and Climate Change Adaptation in CLUP and CDP

The CLUP is an effective disaster risk reduction instrument. HLURB's Supplemental Guidelines on mainstreaming DRR/CCA in the CLUP (Figure 1) details how the Climate and Disaster Risk Assessment (CDRA) assesses the risks and vulnerabilities of exposed elements – people, settlements, production, protection and infrastructure areas associated with natural hazards and climate changes.

CDRA aims to establish risk and vulnerable areas by analyzing the hazard, exposure, sensitivity and adaptive capacities of the elements. The assessment identifies decision areas and zones that need to be addressed and generates information to provide an understanding of the existing conditions to planners and decision makers to identify and recommend mitigation measures and spatial policy interventions.

The CDRA covers both disaster risk assessment (DRA) and climate change vulnerability assessments (CCVA). These two processes have been established in the National Climate Change Action Plan. While the disaster risk assessment uses historical patterns in describing climate-related hazards, climate change adaptation establishes how a changing climate may influence the frequency and severity of these hazards so actions for mitigation can be designed to accommodate predicted changes. Pursuing a single approach will be beneficial to local government units since both DRA and CCVA look at the same geographical area. It will result in the identification of projects that address risks with an added level of safety to accommodate predicted changes in the climate.

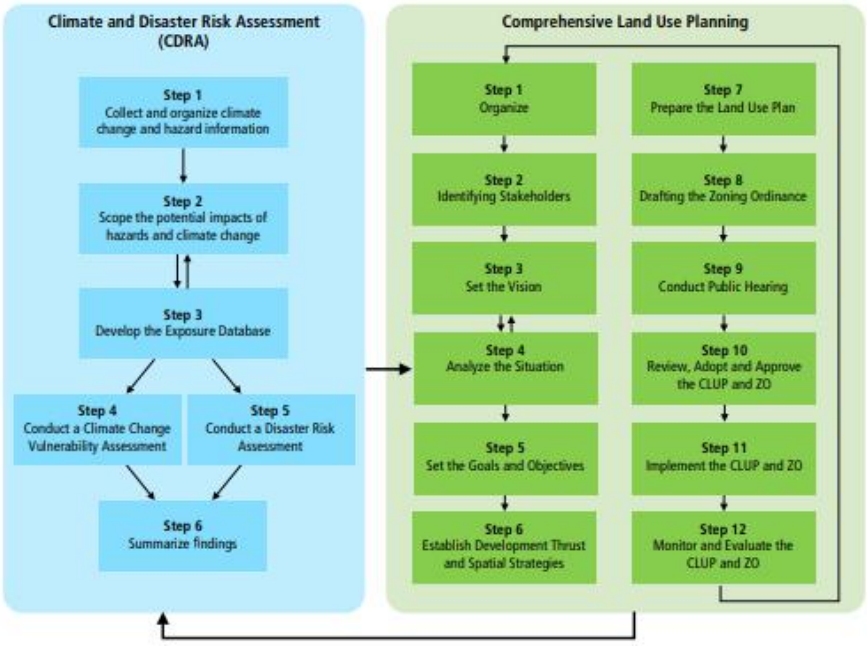


Figure 1: Framework for Mainstreaming Climate and Disaster Risks in the Comprehensive Land Use Plan

Climate and Disaster Risk Assessment (CDRA) Process

The climate and disaster risk assessment (CDRA) intends to determine the level of risks and vulnerabilities of areas and sectors in the municipality/city to climate related hazards and potential impacts of climate change and facilitate the identification of priority decision areas where the various interventions can be implemented.

The following is the standard six-step process of the conduct of the CDRA including a brief description of each step:

1. Collection and organization of climate change and hazard information which involves the gathering of climate change information and characterizing hazards that may affect the locality;
2. Scoping of potential impacts of hazards and climate change involves identifying key areas or sectors that may be affected by climate change and natural hazards and determining likely impacts (direct and indirect);
3. Development of exposure database include gathering baseline map and attribute data on exposure, vulnerability/ sensitivity and adaptive capacity as basis for the Climate Change Vulnerability Assessment (CCVA) and Disaster Risk Assessment (DRA);
4. Conduct of CCVA refers to the identification of vulnerable areas and sectors by analyzing exposure, sensitivity and adaptive capacity to the various climate stimuli;
5. Conduct of DRA includes identification of risk areas by analyzing hazard, exposure and vulnerability; and
6. Summarization of ¬findings involves identification of priority decision areas/sectors based on the combined level of risks and vulnerabilities, identification of risk management options, climate change adaptation and mitigation options

Glossary of Terms

Adaptation - In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate (IPCC 2012). The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (CC Act, 2009).

Adaptive Capacity - The ability of ecological, social or economic systems to adjust to climate change including climate variability and extremes, to moderate or offset potential damages and to take advantage of associated opportunities with changes in climate or to cope with the consequences thereof (CC Act, 2009). The combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities (IPCC, 2012).

Capacity - a combination of all strengths and resources available within a community, society or organization that can reduce the level of risk, or effects of a disaster. Capacity may include infrastructure and physical means, institutions, societal coping abilities, as well as human knowledge, skills and collective attributes such as social relationships, leadership and management. Capacity may also be described as capability (PDRRM Act 2010).

Climate Change - A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC, 2012). A Change in climate that can be identified by changes in the mean and/or variability of its properties and that persists for an extended period typically decades or longer, whether due to natural variability or as a result of human activity (CC Act, 2009). A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCC, 1992).

Climate extreme (extreme weather or climate event) - The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable. For simplicity, both extreme weather events and extreme climate events are referred to collectively as 'climate extremes'.

Climate Risk - Climate Risk refers to the product of climate and related hazards working over the vulnerability of human and natural ecosystems (CC Act, 2009).

Climate Variability - The variations in the average state and in other statistics of the climate on all temporal and spatial scales beyond that of individual weather events (CC Act, 2009). Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate at all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). See also Climate change (IPCC, 2012).

Coping capacity - The ability of people, organizations, and systems, using available skills, resources, and opportunities, to address, manage, and overcome adverse conditions (IPCC, 2012). The ability of people, organizations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters (UNISDR, 2009).

Contingency Planning - A management process that analyzes specific potential events or emerging situations that might threaten society or the environment and establishes arrangements in advance to enable timely, effective and appropriate responses to such events and situations (PDRRM Act, 2010).

Disaster - A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources (UN-ISDR, 2009). Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery (IPCC, 2012). A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. Disasters are often described as a result of the combination of: the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences, Disaster impacts may include loss of life, injury, disease and other negative effects on human, physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, Social and economic disruption and environmental degradation (PDRRM Act, 2010).

Disaster Prevention - The outright avoidance of adverse impacts of hazards and related disasters. It expresses the concept and intention to completely avoid potential adverse impacts through action taken in advance such as construction of dams or embankments that eliminate flood risks, land-use regulations that do not permit any settlement in high-risk ares, and seismic engineering designs that ensure the survival and function of a critical building in any likely earthquake (PDRRM Act, 2010).

Disaster Response - The provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected. Disaster response is predominantly focused on immediate and short-term needs and is sometimes called "disaster relief" (PDRRM Act, 2010).

Disaster Risk - The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period (UNISDR, 2009). The likelihood over a specified time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery (IPCC, 2012).

Disaster Risk Management - The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster (UNISDR, 2009). Processes for designing, implementing, and evaluating

strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development (IPCC, 2012).

Disaster Risk Reduction - The concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events (UNISDR, 2009). Denotes both a policy goal or objective, and the strategic and instrumental measures employed for anticipating future disaster risk; reducing existing exposure, hazard, or vulnerability; and improving resilience (IPCC, 2012) Disaster Risk Reduction and Management. The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster. Prospective disaster risk reduction and management refers to risk reduction and management activities that address and seek to avoid the development of new or increased disaster risks, especially if risk reduction policies are not put in place (PDRRM Act, 2010).

Disaster Mitigation - The lessening or limitation of the adverse impacts of hazards and related disasters. Mitigation measures encompass engineering techniques and hazard-resistant construction as well as improved environmental policies and public awareness (PDRRM Act, 2010).

Disaster Preparedness - The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the Impacts of likely, imminent or current hazard events or conditions. Preparedness action is carried out within the context of disaster risk reduction and management and aims to build the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response to sustained recovery. Preparedness is based on a sound analysis of disaster risk and good linkages with early warning systems, and includes such activities as contingency planning, stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information, and associated training and field exercises. These must be supported by formal institutional, legal and budgetary capacities (PDRRM Act, 2010).

Exposure - The presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected (IPCC, 2012). People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses (UNISDR, 2009). The degree to which the elements at risk are likely to experience hazard events of different magnitudes (PDRRM Act, 2010).

Hazard - A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR, 2009). The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources (IPCC, 2012). A threatening event, or the probability of occurrence of a potentially damaging phenomenon, within a given time period and area that may cause loss of life or injury, property damage, social and economic disruption or environmental degradation or a combination of these. (NEDA, 2008).

Mainstreaming - The integration of policies and measures that address climate change into development planning and sectoral decision making (CC Act, 2009).

Land-Use Planning - Land use planning refers to the rational and judicious approach of allocating available land resources to different land using activities, (e.g. agricultural, residential, industrial) and for different functions consistent with the overall development vision/goal of a particular locality. It entails the detailed process of determining the location and area of land required for the implementation of social and economic development, policies, plans, programs and projects. It is based on consideration of physical planning standards, development vision, goals and objective, analysis of actual and potential physical conditions of land and development constraints and opportunities (HLURB, 2006). The process undertaken by public authorities to identify, evaluate and decide on different options for the use of land, including consideration of long-term economic, social and environmental objectives and the implications for different communities and interest groups, and the subsequent formulation and promulgation of plans that describe the permitted or acceptable uses (UNISDR, 2009).

Retrofitting - Reinforcement or upgrading of existing structures to become more resistant and resilient to the damaging effects of hazards (UNISDR, 2009).

Risk - The combination of the probability of an event and its negative consequences (UNISDR, 2009). Risk is the expected losses (of lives, persons injured, property damaged and economic activity disrupted) due to a particular hazard for a given area and reference period. e unit of measure of risk could be number of fatality or value of damaged property. Risk is mathematically expressed as: Risk = Hazard x Elements at risk x Vulnerability (NEDA, 2007)

Risk Assessment - A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend (UNISDR, 2009). A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihood and the environment on which they depend. Risk assessments with associated risk mapping include: a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability including the physical, social, health, economic and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities in respect to likely risk scenarios (PDRRMC Act, 2010).

Mitigation - Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation, and technological hazards and to ensure the ability of at-risk communities to address vulnerabilities aimed at minimizing the impact of disasters. Such measures include, but are not limited to, hazard-resistant construction and engineering works, the formulation and implementation of plans, programs, projects and activities, awareness raising, knowledge management, policies on land-use and resource management, as well as the enforcement of comprehensive land-use planning, building and safety standards, and legislation (PDRRM Act, 2010). In the context of climate change, refers to human intervention to address anthropogenic emissions by sources and removals by sinks of all GHG, including ozone- depleting substances and their substitutes (IPCC, 2012). In the context of disaster and disaster risk, the lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability (IPCC, 2012).

Preparedness - The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions (UNISDR, 2009). Pre-disaster actions and measures being undertaken within the context of disaster risk reduction and management and are based on sound risk analysis as well as pre-disaster activities to avert or minimize loss of life and property such as, but not limited to, community organizing, training, planning, equipping, stockpiling, hazard mapping, insuring of assets, and public information and education initiatives. This also includes the development enhancement of an overall preparedness strategy, policy, institutional structure, warning and forecasting capabilities, and plans that define measures geared to help at-risk communities safeguard their lives and assets by being alert to hazards and taking appropriate action in the face of an Imminent threat or an actual disaster (PDRRM Act, 2010).

Resilience - The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions (IPCC, 2012). The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions (UNISDR, 2009).

Response - Any concerted effort by two (2) or more agencies, public or private, to provide assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected and in the restoration of essential public activities and facilities (PDRRM Act, 2010).

Post-Disaster Recovery - The restoration and improvement where appropriate, of facilities, livelihood and living conditions of disaster- affected communities, including efforts to reduce disaster risk factors, in accordance with the principles of "build back better"(PDRRM Act, 2010).

Prevention - The outright avoidance of adverse impacts of hazards and related disasters (UNISDR, 2009).

Recovery - The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster- affected communities, including efforts to reduce disaster risk factors (UNISDR, 2009).

Vulnerability - The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard (UNISDR, 2009). The propensity or predisposition to be adversely affected (IPCC, 2012). The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. Vulnerability may arise from various physical, social, economic, and environmental factors such as poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks (PDRRM Act, 2010). The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (CC Act, 2009).

Vulnerability Assessment - Systematic examination of impacts of climate change and disasters on natural and socio-economic systems (IPCC 2007). Vulnerability assessments

examine the underlying socioeconomic, institutional, and, to a lesser extent, political and cultural factors, that determine how people cope with climate hazards. Vulnerability assessments make use of indicators that can help identify and target vulnerable regions, sectors or populations, raise awareness, and be part of a monitoring strategy (Downing et. al. 2001).

Municipal Profile

Demographic Profile

Population Size and Projection

The municipality of Alaminos has a total population of 47,859 based on the 2015 Population Census (PSA, 2015) with a 1.92 growth rate (2010-2015). In the same year, Laguna has a population of 3,035,081 with 2.47 growth rate while Region IV-A has 14,414,774 population with 2.58 growth rate. Similar to many areas in the country, Alaminos' population, generally, increased over the years and will continue to increase in the next few years if the growth rate is maintained. The population is expected to reach 60,080 by 2027 and double in 36 years.

Population Composition

The 2015 Philippine Statistics Authority (PSA) population pyramid shows that the Alaminos has a broad base, where young dependents (0-14 years of age) make up 30 percent of the total population and old dependents (65 and above years of age) contribute 4.93 percent to the population. Population ages 15 to 64 or the productive age group shares 65.07 percent of the total population. The municipality of Alaminos has a total working age population of 33,503 or 65 percent of the total population. Refer to (Figure 2: Alaminos Population Pyramid.)

The reproductive age group (15-49 years of age) population make up 12,574, contributing about 26.27 percent in the total population in the municipality. The sex ratio shows that there are 101 males for every 100 females in the municipality.

In addition, the total number of differently abled person (DAPs) is 449, accounting for psychosocial, mental, hearing, visual, speech, learning, and orthopedic disabilities. Location of DAPs in the municipality is shown in (Map 1: Location Map of Differently-Abled Person.)

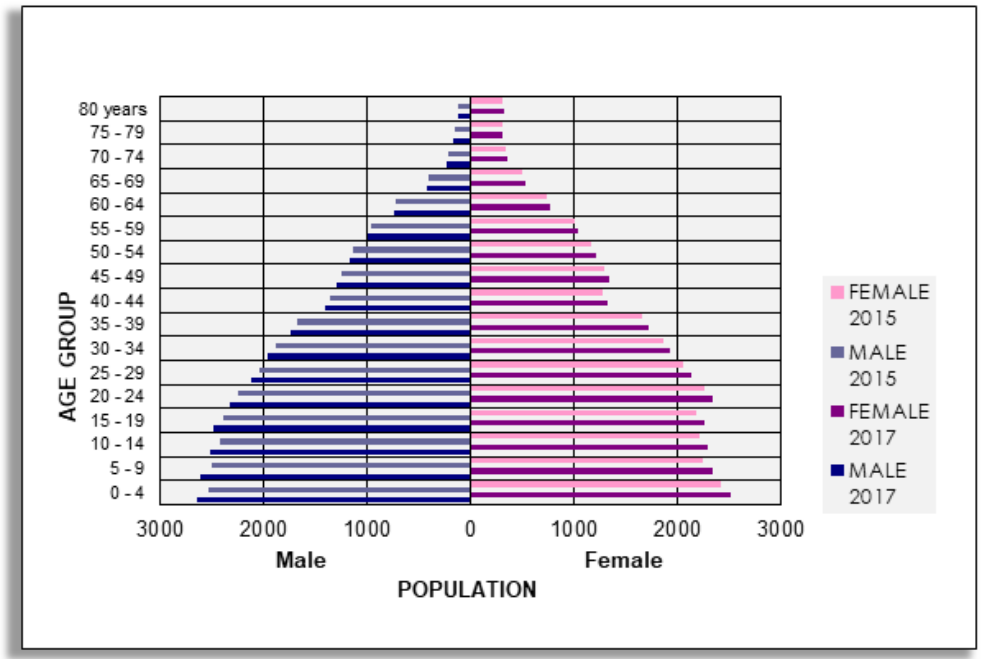
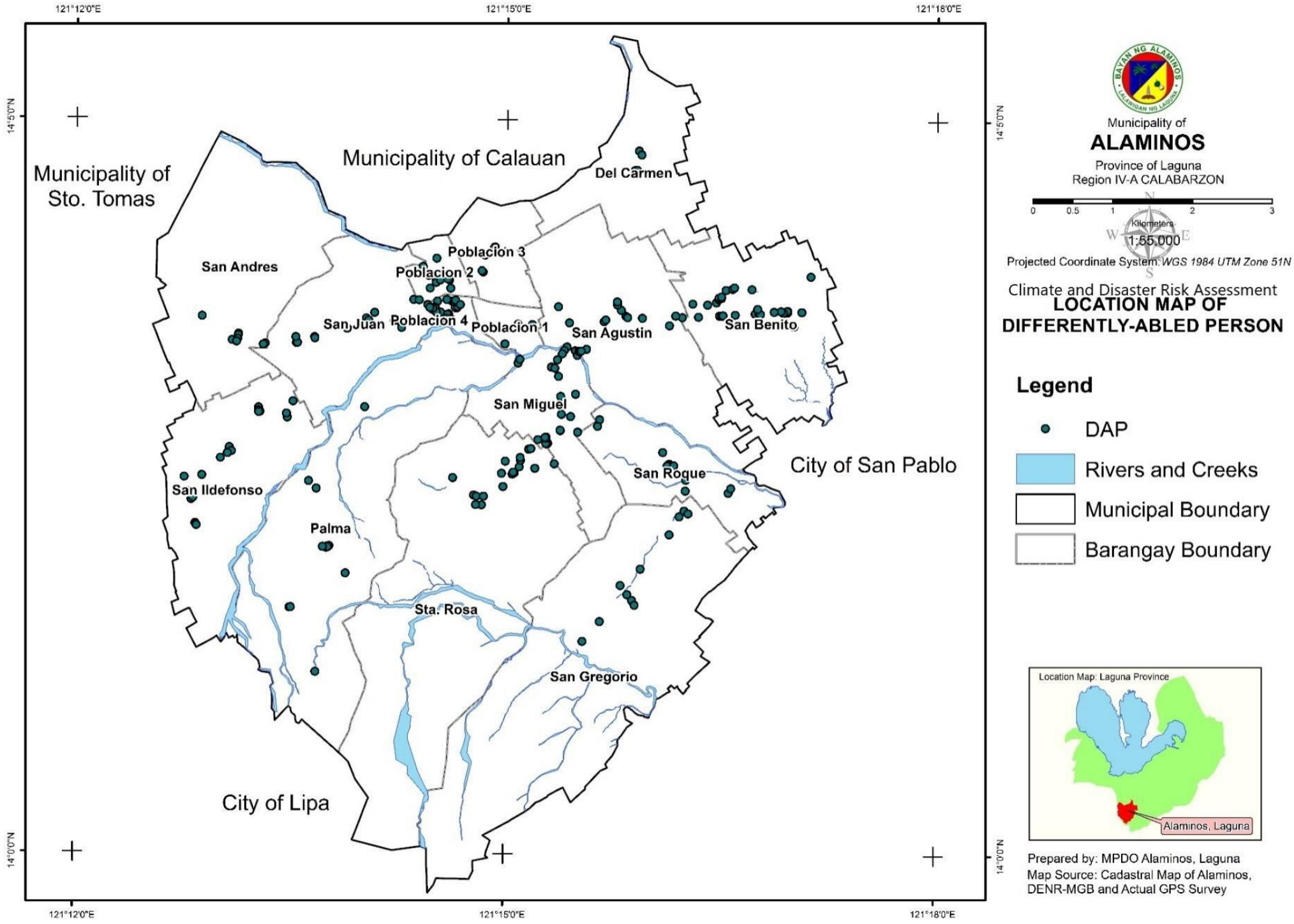


Figure 2: Alaminos Population Pyramid

Map 1: Location Map of Differently-Abled Person



Population Distribution

Six (6) barangays are classified as urban barangays based on the Philippine Statistics Authority's (PSA) new urban barangay definition of having more than 5,000 population. These area barangays Poblacion 1, Poblacion 2, Poblacion 3, Poblacion 4, San Agustin and San Benito. The urban population totals to 24,188 and contribute a 50.54 percent to the total population, while rural barangays comprise of barangays Del Carmen, Palma, San Andres, San Gregorio, San Ildefonso, San Juan, San Miguel, San Roque, and Santa Rosa, have a total rural population of 23,671 and contribute 49.46 percent to the total population.

The gross population density is at nine (9) persons per hectare, computed using the total land area of the municipality, while the net population density, computed using the total alienable and disposable land is at 10 persons per hectare. For the urban density, computed using total population and urban barangays' total land area, is at 23 per hectare, while the rural barangay density is computed at 5.51 persons per hectare. Population density map is shown in (Map 2)

Geographic Location

Alaminos is a heart-shaped mainland municipality in the Province of Laguna. It is located within 121° 12' 40.79" - 121° 17' 23.36" Longitude and 13° 59' 43.64" – 14° 5' 35.73" Latitude of the southern part of Laguna. It is bounded by the municipalities of Calauan in the north, San Pablo City in the east, Sto. Tomas, Batangas in the west, and Lipa City, Batangas in the south.
Alaminos is located 78 kilometers southward of Manila with an average travel time of two (2) hours and approximately 28 kilometers northward of Sta. Cruz, the provincial capital of Laguna with the travel time of one (1) hour. Location map of the municipality is shown in Map 3

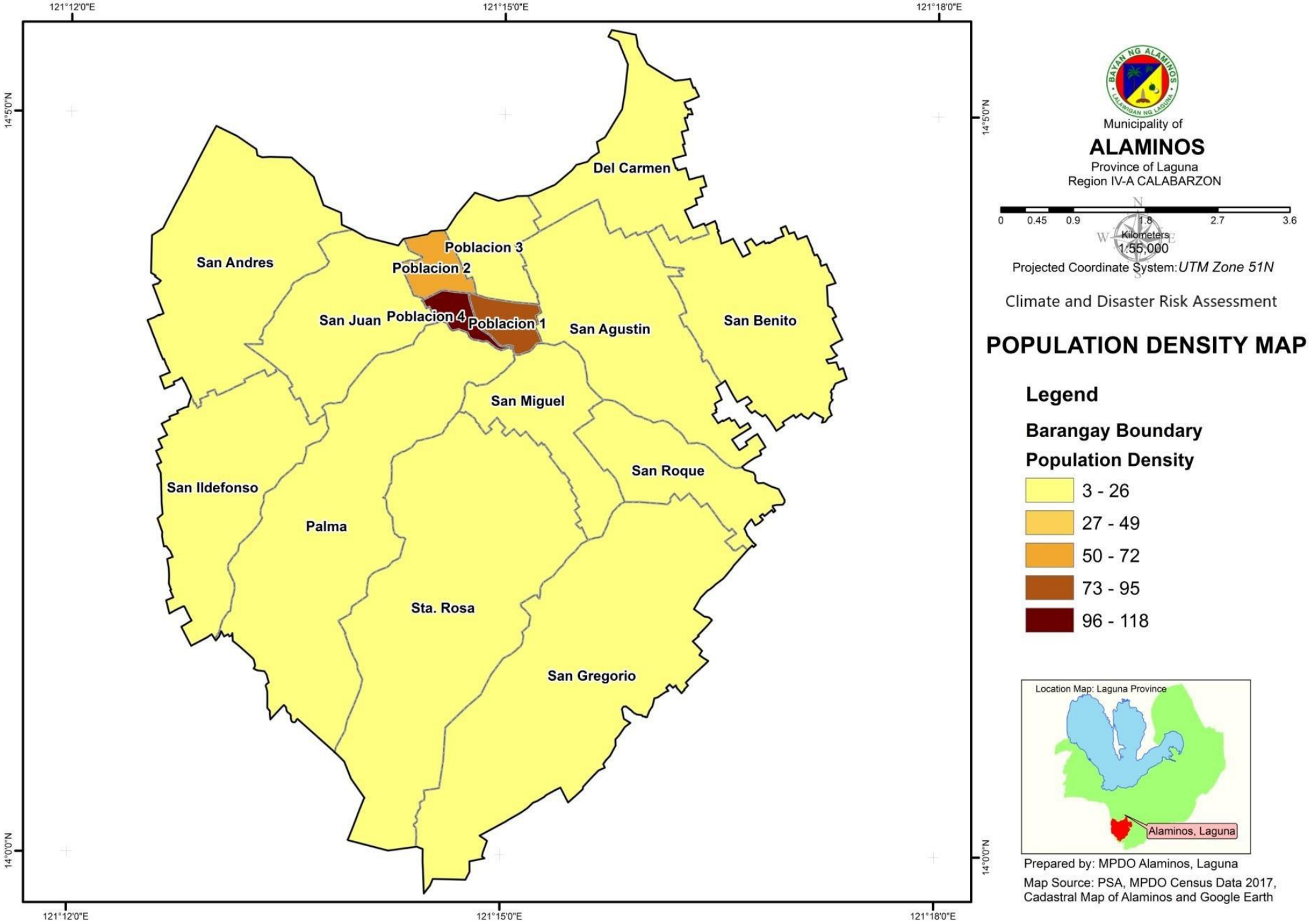
Physical Features and Environmental Conditions

Topography

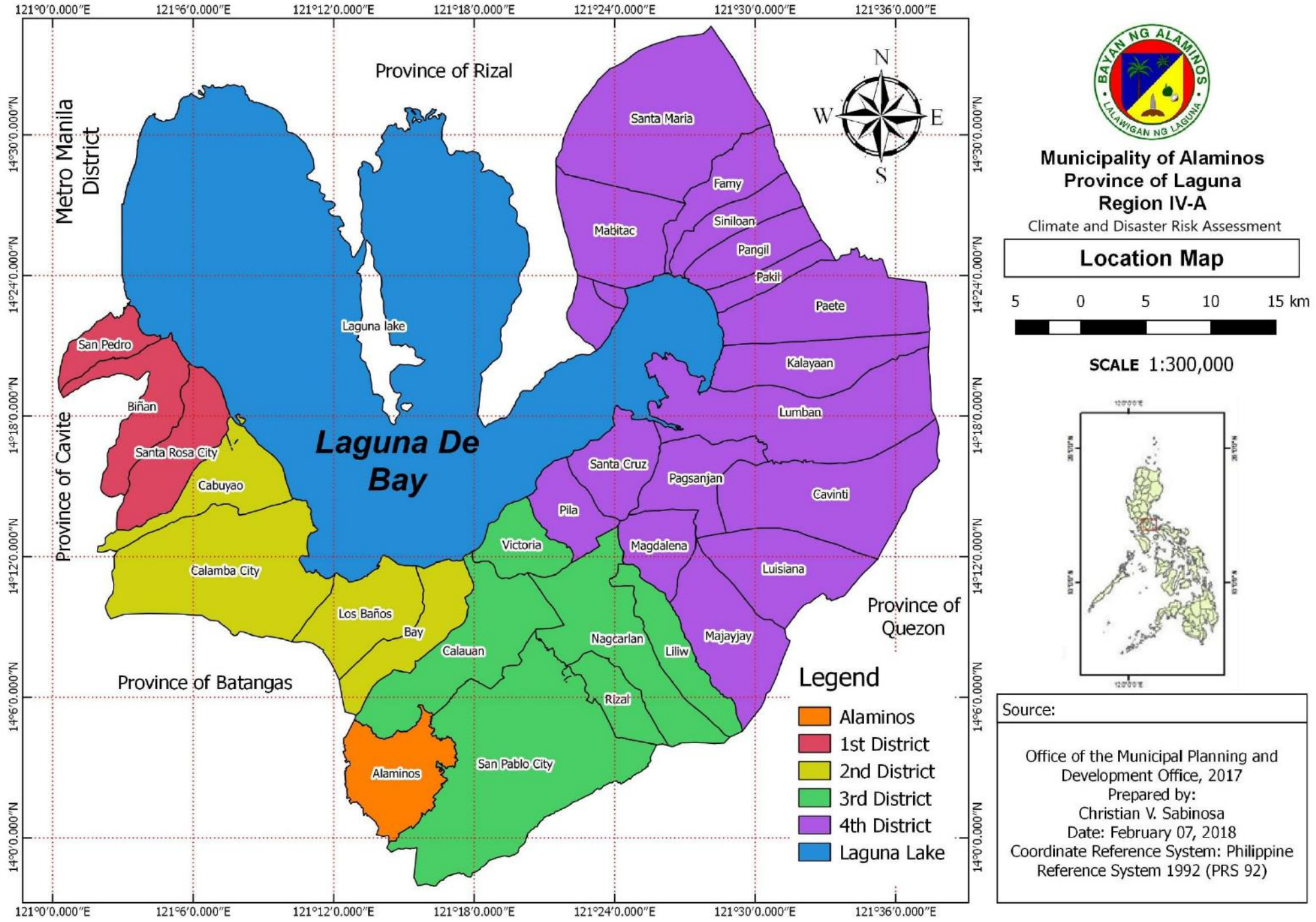
The municipality is relatively flat with a gently sloping topographic relief in the southern and southwestern portions where two (2) mountains and five (5) hills are situated. Slopes from zero (0) to 18 percent make up a total of 4,203.19 hectares of the total land area while the remaining 1,142.16 hectares are 18 percent and above slope (refer to Map 4).

Alaminos has four (4) soil types present - Lipa loam, Macolod, Macolod clay loam and mountain soils. Lipa loam is the dominant type of soil in the municipality, comprising a total of 2,942.51 hectares or 55.05 percent of the total land area. Alaminos also has parts made up of 229.16 hectares or 4.29 percent Macolod. These soil types are highly suitable for urban use, recreational use, agriculture, road, parking lots, and sewage disposal facilities (refer to Map 5).

Map 2: Population Density Map



Map 3: Location Map of Alaminos



Municipality of Alaminos
Province of Laguna
Region IV-A

Climate and Disaster Risk Assessment

Location Map

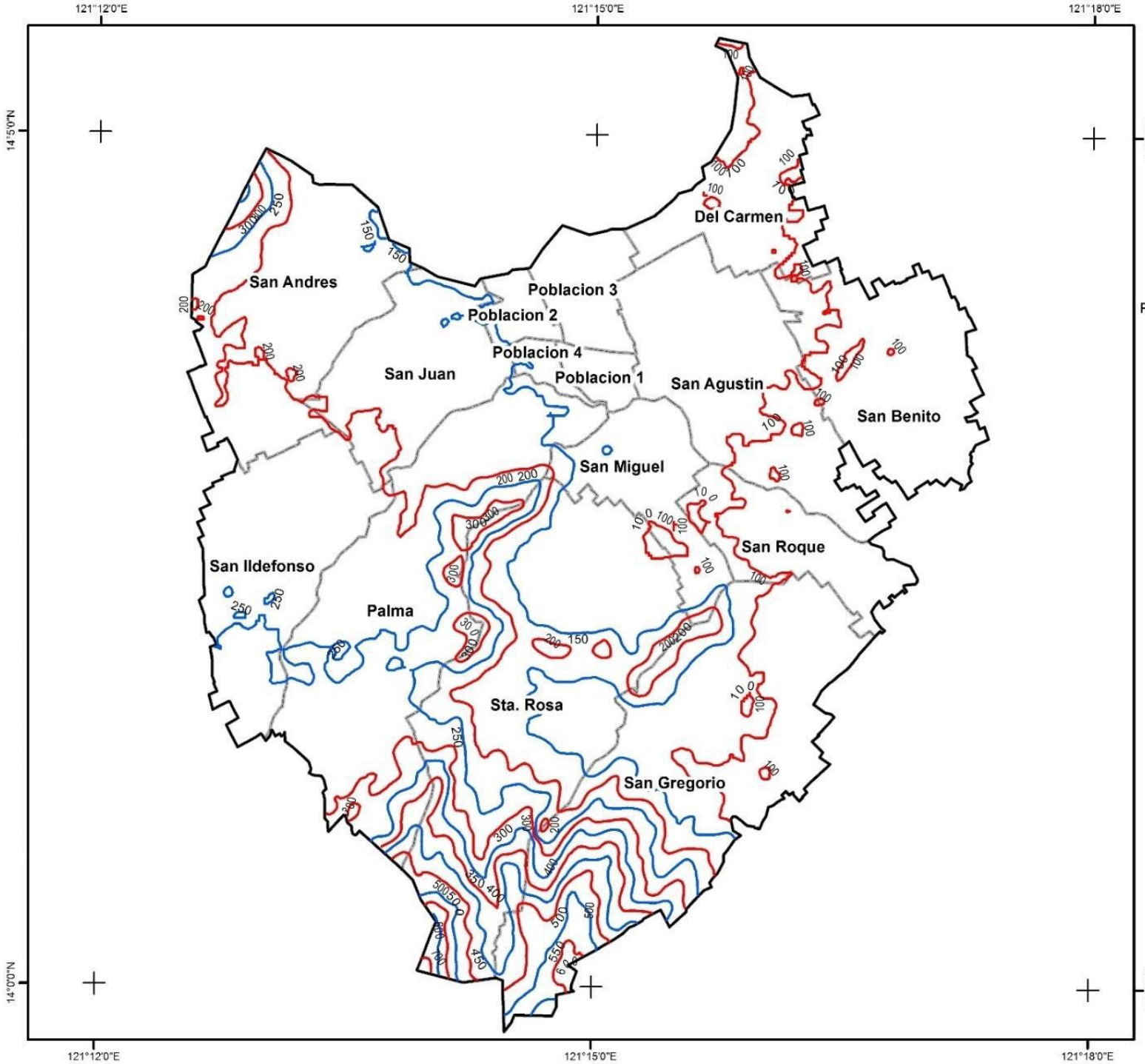
5 0 5 10 15 km

SCALE 1:300,000

Source:

Office of the Municipal Planning and Development Office, 2017
Prepared by:
Christian V. Sabinosa
Date: February 07, 2018
Coordinate Reference System: Philippine Reference System 1992 (PRS 92)

Map 4; Topographic Relief Map



Municipality of
ALAMINOS
Province of Laguna
Region IV-A CALABARZON

0 0.5 1 2 3
Kilometers
1:55,000

Projected Coordinate System: *WGS 1984 UTM Zone 51N*

Climate and Disaster Risk Assessment

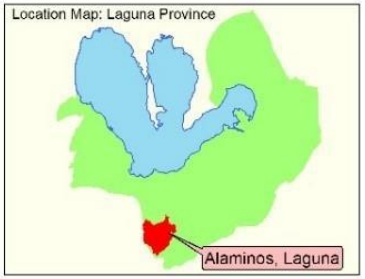
TOPOGRAPHIC RELIEF MAP

Legend

- 50m interval
- 100m interval

Base Map

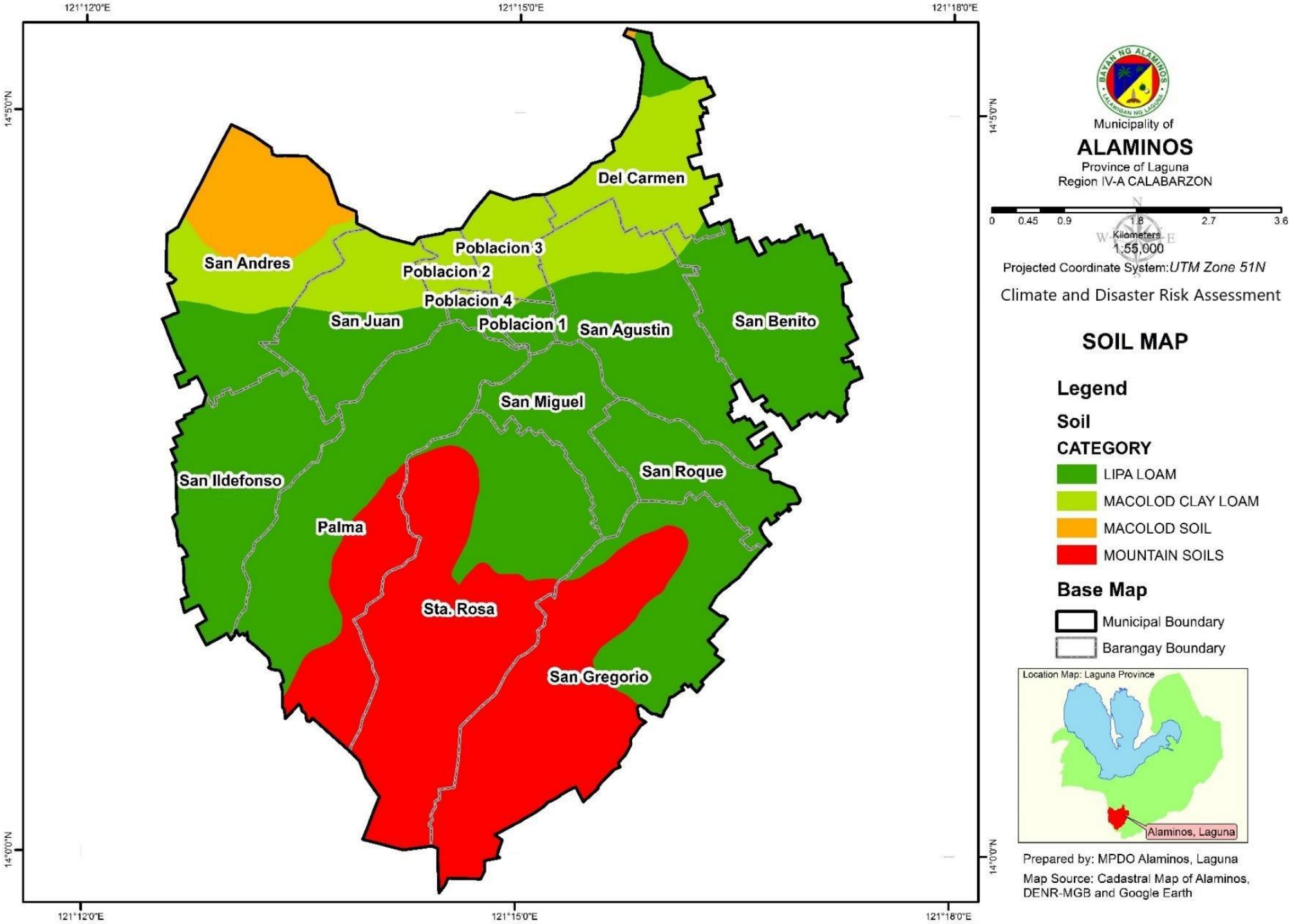
- Municipal Boundary
- Brgy Boundary



Prepared by: MPDO Alaminos, Laguna

Map Source: Cadastral Map of Alaminos, DENR-MGB, and Google Earth

Map 5: Soil Map



Hydro-geological features

The municipality of Alaminos falls under Type I and Type 3 of the Philippine Climate Corona Classification. Type 1 climate has two pronounce seasons, which is dry from November to April and wet during the rest of the year. While, Type 3 climate is characterized by having not very pronounced, relatively dry from November to April, and wet during the rest of the year. Alaminos has a significant rainfall most months, with a short dry season (refer to Map 6).

The driest month is February, with an average rainfall of 30 millimeters, while the warmest month of the year is May, with an average temperature of 28.0 degrees Celsius or 82.4 degrees Fahrenheit. January is considered the coldest month of the year with an average of 24.7 degrees Celsius or 76.46 degrees Fahrenheit.

Alaminos also experiences heavy rainfall from June to December. An average of 274.8 millimeters precipitation can be experienced in the month of October. The peak wind velocity is observed from February to May with a prevailing direction of northeast. Southwest wind is observed in the months of July and August.

Land Resource

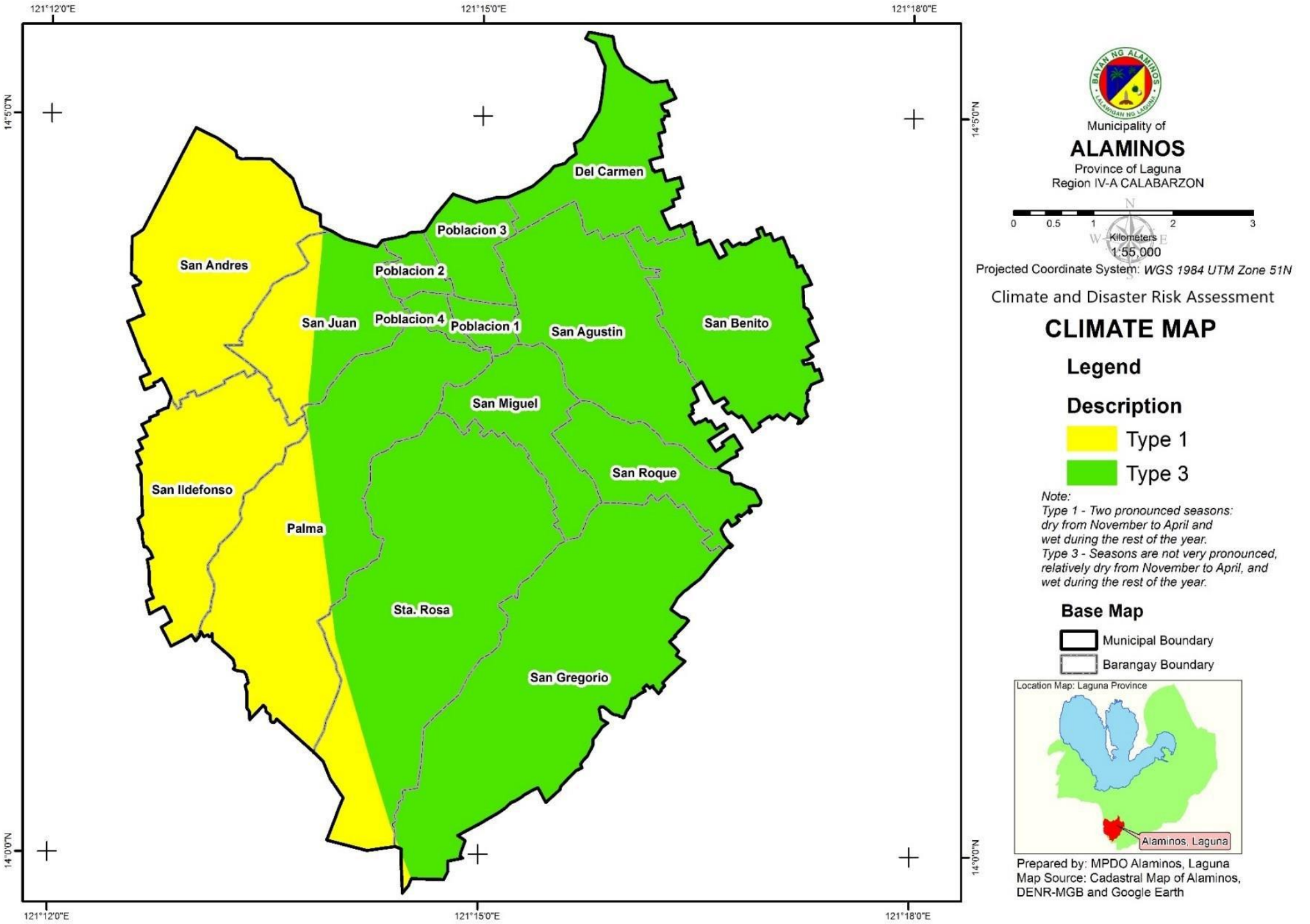
The total land area of the municipality is about 5,345.35 hectares. Alienable and disposable lands cover 5,202.38 hectares (97.33%) of the total land while forest reserve covers 142.97 hectares (2.67%). (Refer to Map 7: Land Classification Map). Alaminos has no critical/protected area as defined under Republic Act No. 7586, NIPAS Act of 1992. There are, however, areas that are locally proclaimed protected areas to maintain and preserve the natural condition to the greatest extent potential. These areas are located in barangays San Gregorio, Sta. Rosa and Palma.

Based from the 2017 Google Earth satellite imagery, the land cover of Alaminos consists of built-up, coconut with cropland mixed, annual crop, grassland, grassland and shrub land, other wooded grasslands, inland water body, open forest/mixed trees and rivers and creeks. Majority of the area is perennial crop such as coconut, lanzones, and rambutan, with a total area of 3,214.00 hectares or 60.12 percent, followed by open forest/mixed trees, built up, grassland and shrub land, annual crop, river and creeks, grassland, other wooded grasslands and inland water body with an area covers 893.26 hectares, 507.04 hectares, 361.00 hectares, 187.42 hectares, 125.47 hectares, 123.58 hectares, 23.14 hectares, and 0.439 hectares, respectively (refer to Map 8).

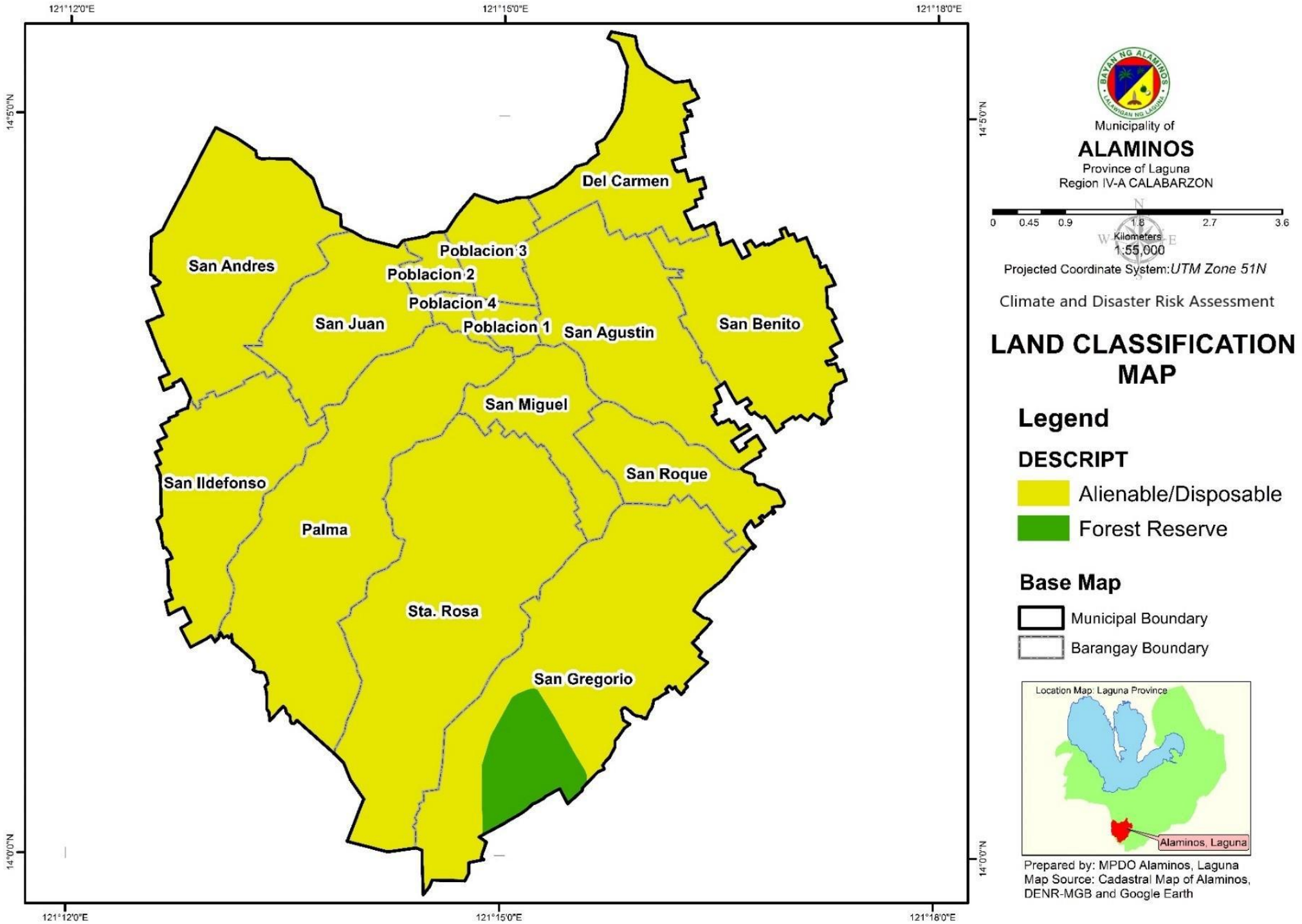
Water Resource

The municipality has six (6) major rivers and creeks – Tigas (Tigsa) river on the northern portion serving as boundary between Calauan and Alaminos, Tarac river in east (Camachile) river on the western portion, Kaquinkong (Viana) river centrally located and Onipa (Calaboa) river on the southern portion. River systems traversed from one location to another, as locals name it differently. In terms of its water quality classifications Class C and D Class. C is characterized as fishery water for the propagation and growth of fish and other aquatic resources, recreational water class II and industrial water Class I suitable for manufacturing processes after treatment, while Class D is for agriculture, irrigation, livestock, watering, and industrial water supply class II (refer to Map 9: River Systems Map).

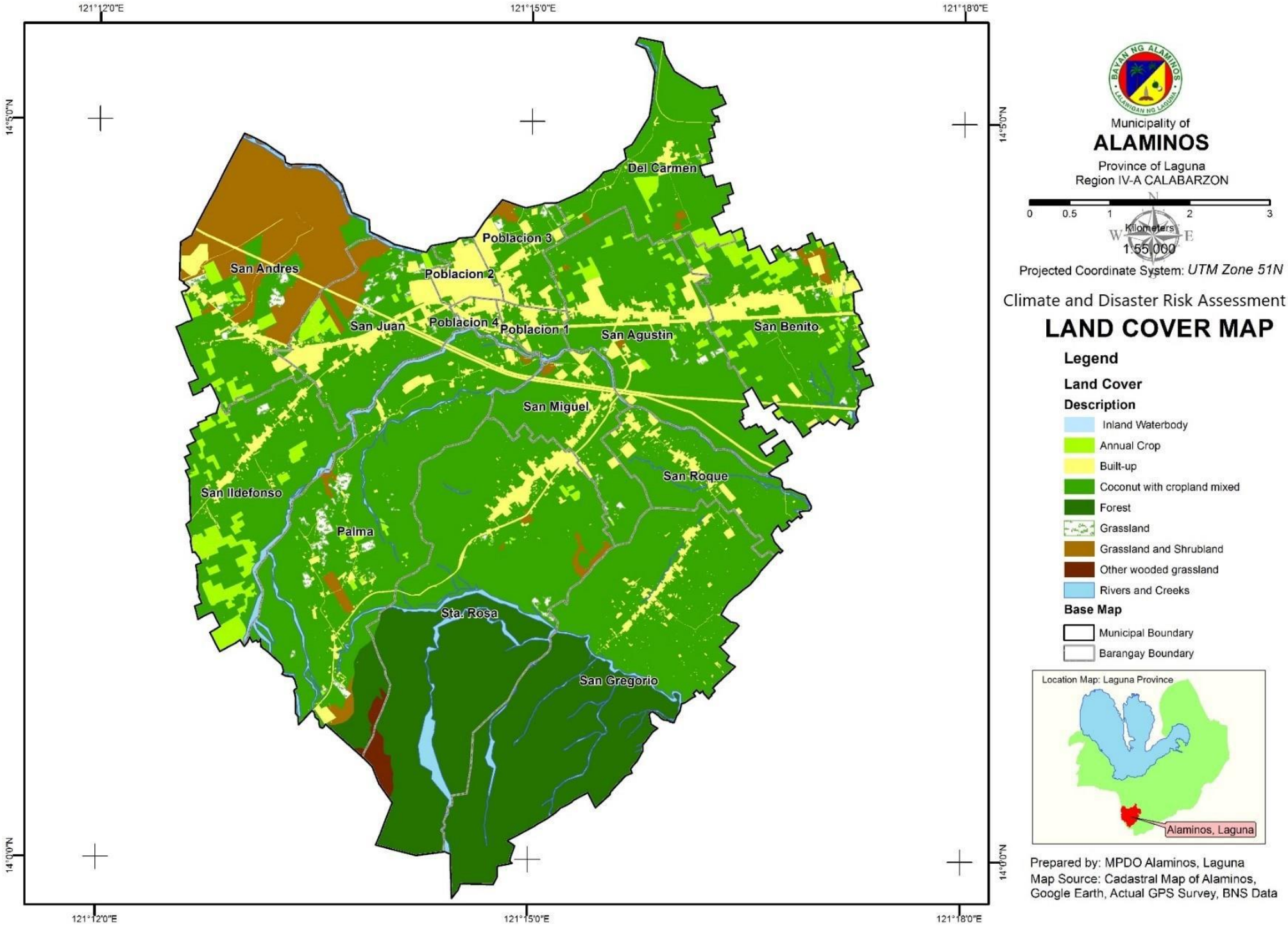
Map 6: Climate Map



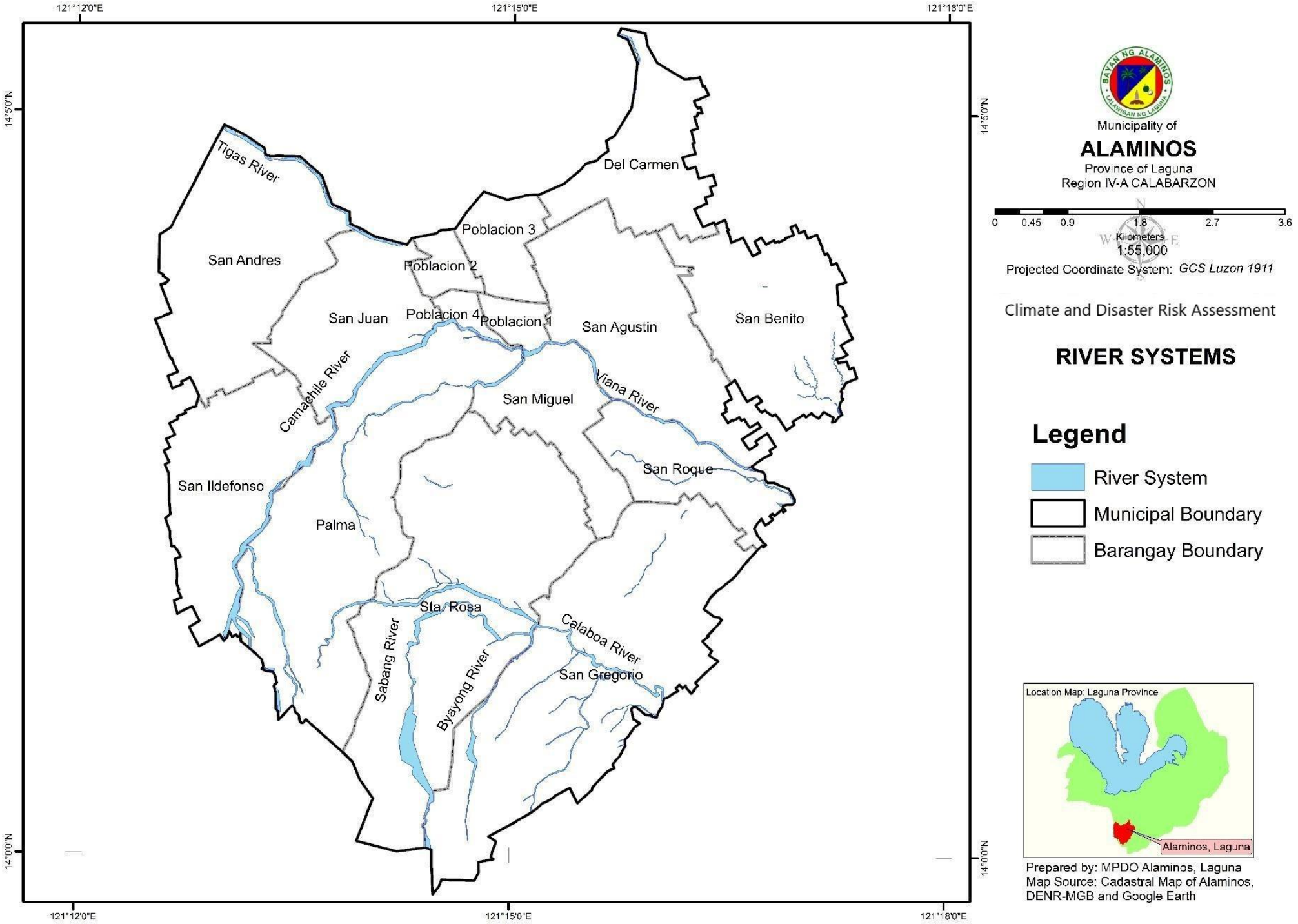
Map 7: Land Classification Map



Map 8: Land Cover Map



Map 9: River Systems Map



Existing Land Use and Land Use Trends

The predominant land use in Alaminos is agriculture, having a total land area of 3,488.98 hectares (65.27%), followed by forest area with 893.28 hectares (16.71%). Built up areas constitute to 537.51 hectares (10.06%). The existing land use of the municipality is shown in Map 10. From 2000 to 2017, the municipality's land use changed as it become more progressive and developed.

Infrastructure, Facilities and Utilities

Social services and facilities

There are various social services and facilities available in the municipality. Location of critical facilities is shown in Map 11.

Alaminos has a total of 19 elementary schools and 6 (six) high schools.

The Municipal Health Center is located in barangay Poblacion III. It can accommodate patients in the Poblacion area, as well as the patients from other barangays, which has no barangay health station, these includes barangays Poblacion1, Poblacion2, Poblacion4, Palma, Del Carmen, and San Roque. Alaminos has four (4) cemeteries and memorial parks. The privately-owned memorial parks include Alaminos Memorial Park, Inc., Roloma Memorial Park Corp., and Mulberry Garden Memorial Park. There is only one (1) government-owned cemetery or the Alaminos Public Cemetery, which has reached its capacity.

There are three (3) identified social welfare facilities in Alaminos. These are
1. Day Care Centers; each barangay has their own and are reported to have an acceptable and serviceable condition;
2. Senior Citizens Office which provide services such as Senior Citizen ID, purchase booklet for discounts, and financial assistance to persons over the age of 65; and
3. Differently-abled persons (DAP) or persons with disabilities (PWD) office.

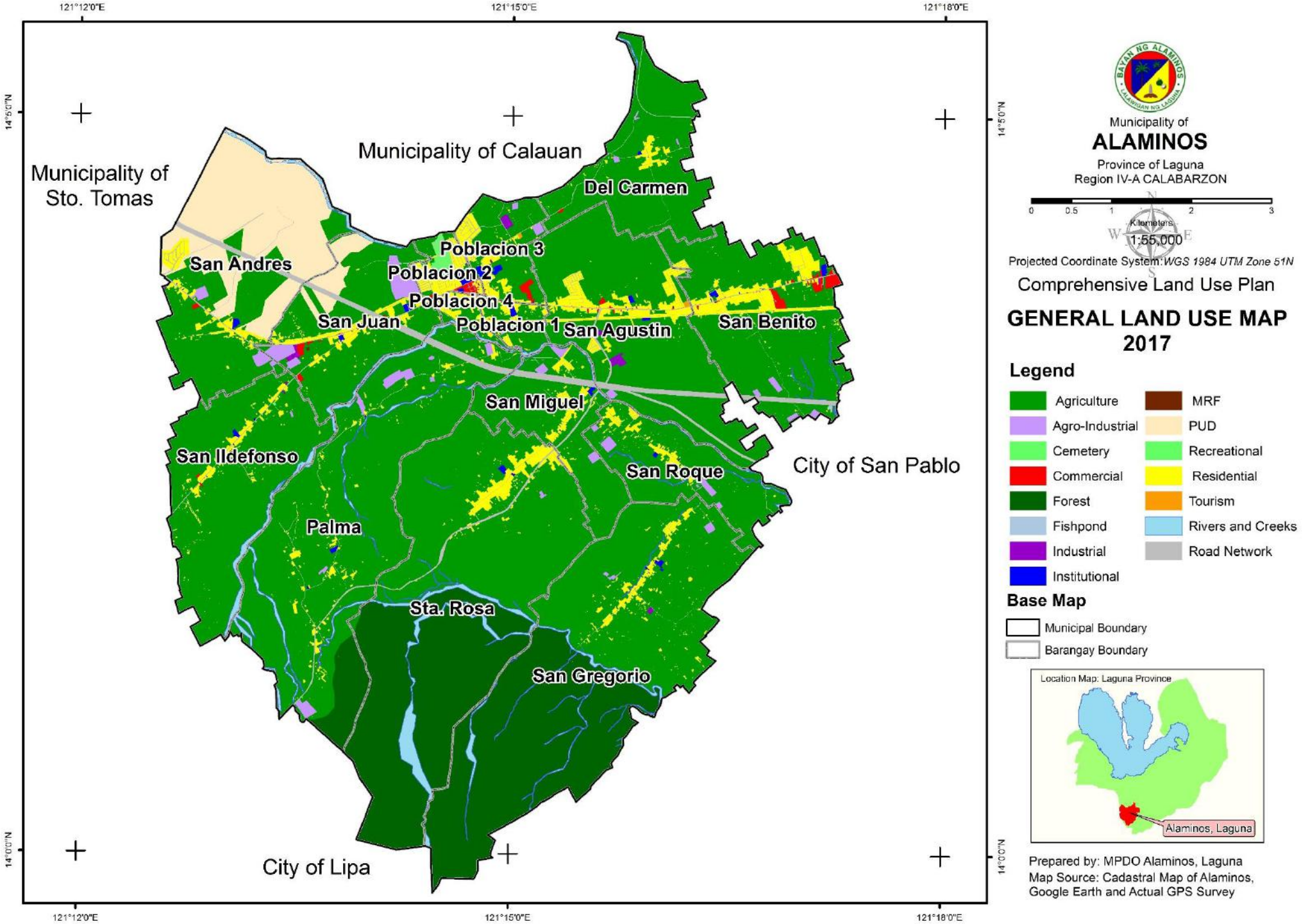
Both the senior citizens' office and DAP or PWD offices are located in the municipal hall of Alaminos.

There are 11,025 occupied housing units in the municipality. Alaminos has a 4.33:1 ratio of household population to occupied housing units. This ratio indicates that there are multiple households occupying single housing units.

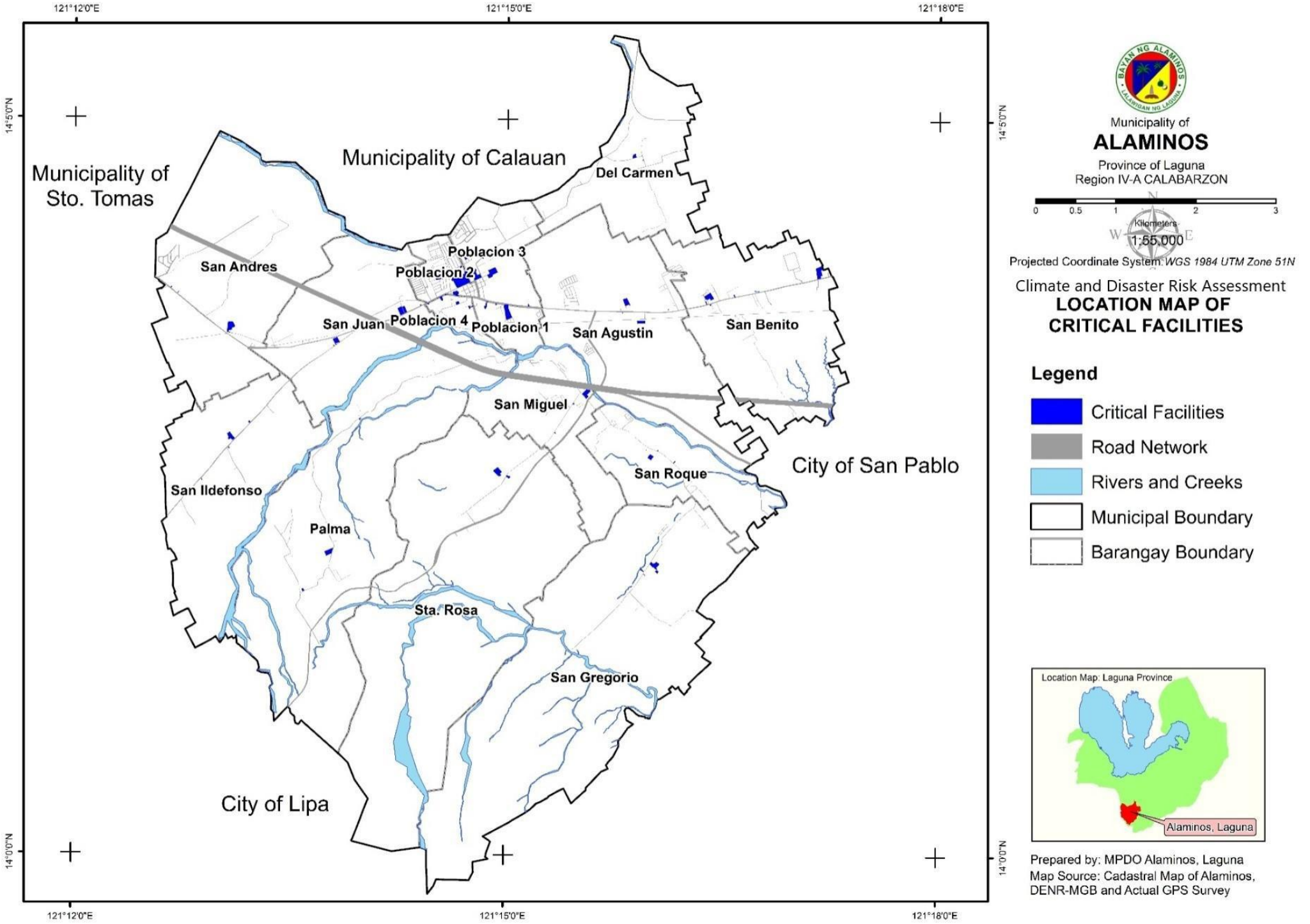
In terms of housing backlogs, there are 343 backlogs in Alaminos, where 76 percent comes from doubled up and unacceptable housing units. Alaminos has 249 identified informal settlers in the municipality, 136 of which belong to the urban barangays, and 133 settlers belong to the rural barangays. Barangays Poblacion3, Del Carmen, San Ildefonso, San Juan, and San Roque do not have an informal settler.

There are nine (9) identified subdivisions in the municipality, four (5) of them are considered socialized housing. These are, Lynville Homes Alaminos, Newborn Village, Sitio Maligaya, La Trenchera de Felimon Masa and Bella Vita. A total of 2,067 dwelling units are available as part of the socialized housing in these subdivisions. Those who are identified as socio-economically disadvantaged can avail these socialized housing units.

Map 10: Existing Land Use Map



Map 11: Location Map of Critical Facilities



The police station and fire station are located in barangay Poblacion 3, near the municipal hall. The police force needs to add two (2) more police officers in order to comply with the minimum standard. The fire force of Alaminos is below the minimum standard, there should be an additional of at least an additional of 12 more fire personnel in the municipality to meet the required population to firefighter ratio.

All barangays in the municipality have their own multipurpose covered courts, which are often used, as a venue for barangay events and activities and evacuation centers during disasters.

Power Supply

The main electricity Alaminos is the Manila Electric Company (MERALCO). In 2015, 10,475 households have electricity, and the remaining 2.98 percent of total households currently do not have electricity. Households that still do not have electricity are those identified as informal settlers.

Water Supply

In terms of water supply, three (3) barangays with 148 households are dependent on a hand pump or Level I water supply. These are barangays Poblacion I, San Agustin, and Sta. Rosa. Households from barangays Palma, San Gregorio, San Ildefonso, San Miguel, San Roque, and Sta. Rosa have 3,892 households relying on a communal water or Level II water source. Majority of the households in Alaminos use a Level III water supply for their daily needs. Alaminos Water District provides service for water supply in barangay Poblacion 1, Poblacion 2, Poblacion 3, Poblacion 4, Del Carmen, San Agustin, San Andres, San Benito, and San Juan.

Table 1: Water Service Providers

Water Service Provider	Level of Service	Connections
Alaminos Water District	Level 3	5,305
San Miguel Rural Waterworks Association	Mix of Levels 1 & 2	207
San Roque Waterworks Association	Mix of Levels 2 & 3	309
Sta. Rosa Waterworks	Level 3	658
Palma Waterworks Association	Mix of Levels 1 & 2	6
San Gregorio TALAGA (Tanglaw at Liwanag and Gabay) Multi-purpose cooperative	Level 3	650
San Ildefonso Water Association Inc.	Level 2	520

Source: NWRB Listang Tubig 2017

Transportation Networks

Similar to the province of Laguna, Alaminos is only accessible by land transportation. The transportation network is composed of roads, railways and footpaths. The municipality has a

total of 64.85 kilometers of road networks, which is mostly made of concrete (72%) or asphalt (28%).

One of the country's major roads is the Maharlika Highway (Pan-Philippines Highway), connecting the islands of Luzon, Visayas and Mindanao totaling to 3,517 kilometers in length. It is the principal transport backbone, forming the country's north–south backbone components. Maharlika highway also travelers in the municipality, thus a major contributor to vehicular air pollution.

In addition to road networks, the Philippine National Railway traverses in Alaminos, specifically in barangays San Andres, San Juan, Poblacion 1, Poblacion 4, San Agustin, and San Benito. However, these railways are no longer used as a form of transportation since the tracks are already paved and there are no facilities or services provided, and residents and the neighboring municipalities/cities use private vehicles, jeeps, tricycles, and buses as their main modes of transportation.

Communication Networks

The postal office operates in the municipal hall and its services include mailing and freight forwarding and delivery. There are also eight (8) freight services offered in the municipality, which are all privately owned. Internet is available in the municipality but with relatively slow connection, depending on the location and the service providers. The three (3) internet providers present in the municipality are PLDT-Smart, Converge and Globe. PLDT and Digitel offer telephone services, which is usually bundled with the internet connection.

For cellular network, Globe Telecommunication and Smart Communications are available and widely used for calling and messaging. Two (2) cable television service providers are present in Alaminos – Rustic Clear Cable Corporation and Telmarc Corporation located in barangay San Benito.

Waste Management and Facilities

All barangays except barangay Palma, Poblacion 1, and San Agustin have materials recovery facilities in Alaminos. However, two (2) of which are not functional. These are from barangays Del Carmen and San Gregorio. The 11 MRFs are considered beyond capacity due to improper use of these waste facilities. (Refer to Map 12: Location of Material Recovery Facilities).

Table 2: Material Recovery Facilities

Description	Type	Remarks
Municipal	Municipal	Operational
Barangay 1	Barangay	None
Barangay 2	Barangay	Operational
Barangay 3	Barangay	Operational
Barangay 4	Barangay	Operational
Del Carmen	Barangay	Not functional
Palma	Barangay	None
San Agustin	Barangay	None
San Andres	Barangay	Operational
San Benito	Barangay	Operational
San Gregorio	Barangay	Not functional

Description	Type	Remarks
San Ildefonso	Barangay	Operational
San Juan	Barangay	Operational
San Miguel	Barangay	Operational
San Roque	Barangay	Operational
Sta Rosa	Barangay	Operational

Source: MENRO 2018

Economic Structure

Primary Sector

The agriculture sector of Alaminos mainly focuses on fruit bearing trees. Fruit bearing trees in the municipality include mango, avocado, lanzones and rambutan, which are only available on a certain month in a year. Its dominant crops are lanzones, rambutan, papaya, banana, pineapple and coconut. Durian, avocado and santol trees are also present in the municipality.

As of 2018, there are 21 poultry farms, two (2) piggeries, one (1) goat farm and (3) fishing grounds. However, fishing grounds are not for commercial use.

Secondary Sector

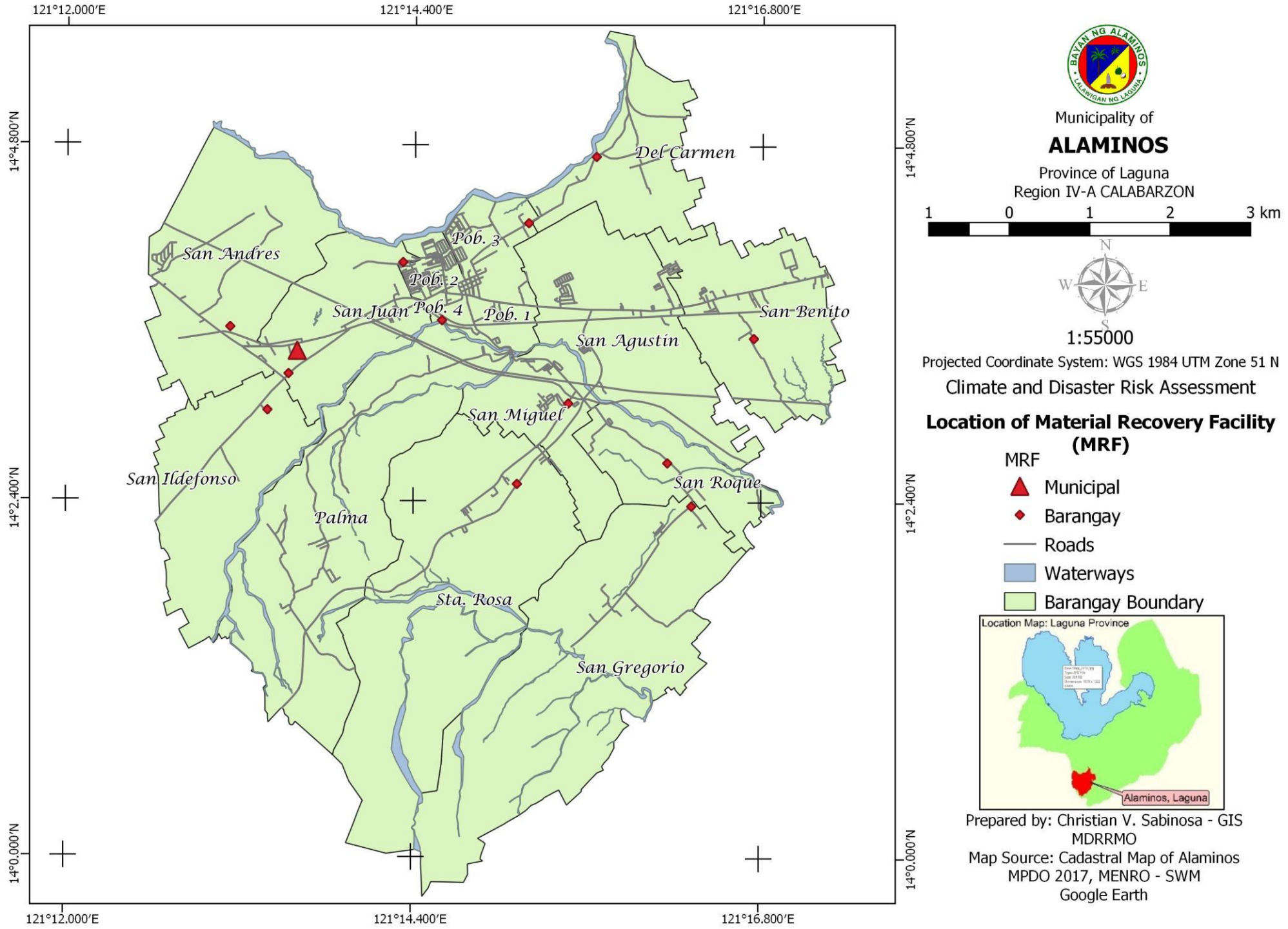
There are no mining and quarrying industries in the Alaminos. Other secondary industry sectors are present in the municipality. Gasoline stations are concentrated in barangay San Juan. There are seven (7) existing fuel depots located in the aforementioned barangay.

Tertiary Sector

Wholesale, retail trade, transportation, communication, finance and other business and personal services make up the commercial establishments in Alaminos. There are 470 commercial establishments with a total of 1,582 employees. These establishments are concentrated in urban barangays.

There are also light, medium and heavy industries in the municipality such as Jacksonville Creative Concept, Charise Sash Factory And Furniture, Carl Lou Furniture, Trichique Wood Creations classified as light industries; Kayumanggi (KTF) Tropical Food, Larcen Metal Works, Texin Inc., Joe-Vick's Buko Pie as medium industries; and Trinidy Steel Work, Reyes Nata De Coco, Pyro Buster Enterprise, Rastech Chemicals Manufacturing, Mega Southern Asphalt Mix Corp., and Meridian Nature-Tek Corp. as heavy industries. Some of these industries are considered pollutive industries and discharge large amounts of air, water, and solid pollutants. Non-pollutive industries on the other hand emit little or negligible amounts of these pollutants.

Map 12: Location of Material Recovery Facilities



Climate Change: Effects and Impacts

The Philippines ranks third among most countries at risk in the world because of vulnerability and susceptibility to natural hazards of its exposed population. This situation is further aggravated by climate change. Meteorological and meteorologically-induced hazards have intensified within the last decade, resulting in increased deaths and economic losses, especially in areas that are unprepared for such phenomena.

Climate Projections

The global climate is drastically changing due to both natural and human-induced influences. According to NASA, compelling evidences of rapid climate change include sea level rise of about 8 inches in the last century, global temperature rise of about 2.0 degrees Fahrenheit (1.1 degrees Celsius) since the late 19th century, warming of oceans of about 0.302 degrees Fahrenheit since 1969, shrinking ice sheets in Greenland and Antarctic, glacial retreat including in Alps, Himalayas, Andes, Rockies, Alaska and Africa, intense occurrence of extreme events, ocean acidification which started from the Industrial Revolution, and decreased snow cover mostly in Northern Hemisphere. Locally, the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) leads the undertaking of scientific and technological services in meteorology, hydrology, climatology, astronomy and other geophysical sciences to ensure protection from natural calamities.

Recently, PAGASA published a document about the projected changes of different climate variables for 2036 and 2065 under the medium-range emission scenario using the observed baseline in 1971-2000 at regional and provincial level. The different climate variables include temperature, rainfall, and frequency of extreme events, number of dry days and the number of days with rainfall of more than 200 mm.

According to the climate projections of PAGASA as presented in the succeeding table, that there will be an increase in the temperature in the municipality in all seasons in 2036 and 2065, the increase ranges from 1.0°C to 2.4°C. From the observed baseline of 25.0°C in the months of December, January and February, it is projected to increase to 26.0°C to 26.9°C in 2036 to 2050, according to the projected Seasonal Mean Temperature.

The same increasing trend applies to the months of March, April and May. From a baseline of 27.5°C reference, it is expected to increase of 1.0°C to 2.2°C. While for the months of June-July-August (JJA), with an observed baseline of 27.5°C, the expected increase in temperature ranges from 1.0°C to 2.4°C. It can be noted that, historically, the Philippines experienced the hottest or an increased in temperature during the months of March, April and May, however the projected seasonal mean temperature for the months of June, July and August shows a slightly higher temperature increase in the upper bound. Thus, potentially altering systems and processes in the province. Lastly, in the months of September, October and November, from 26.7°C baseline, it is projected to increase ranging from 1.0°C to 2.3°C.

Table 3. Projected Changes in Seasonal Temperature in the Mid-21st Century (2036-2065) for Laguna relative to 1971-2000

Season	Scenario	Range	Projected Change	
			Change in °C	Projected Seasonal Mean Temperature (°C)
December-January-February (DJF) Observed baseline = 25.0 °C	Moderate emission (RCP4.5)	Lower Bound	1.0	26.0
		Median Bound	1.2	26.2
		Upper Bound	1.6	26.6
	High Emission (RCP 8.5)	Lower Bound	1.1	26.1
		Median Bound	1.6	26.6
		Upper Bound	1.9	26.9
March-April-May (MAM) Observed baseline = 27.5 °C	Moderate emission (RCP4.5)	Lower Bound	1.0	28.5
		Median Bound	1.2	28.7
		Upper Bound	1.7	29.2
	High Emission (RCP 8.5)	Lower Bound	1.3	28.8
		Median Bound	1.6	29.1
		Upper Bound	2.2	29.7
June-July-August (JJA) Observed baseline = 27.5 °C	Moderate emission (RCP4.5)	Lower Bound	1.0	28.5
		Median Bound	1.3	28.8
		Upper Bound	1.8	29.3
	High Emission (RCP 8.5)	Lower Bound	1.3	28.8
		Median Bound	1.5	29.0
		Upper Bound	2.4	29.9
September-October-November (SON) Observed baseline = 26.7 °C	Moderate emission (RCP4.5)	Lower Bound	1.0	27.7
		Median Bound	1.1	27.8
		Upper Bound	1.9	28.6
	High Emission (RCP 8.5)	Lower Bound	1.4	28.1
		Median Bound	1.5	28.2
		Upper Bound	2.3	29.0

Source: PAGASA, 2018

On the other hand, the significant increase in rainfall is expected to happen in 2036 and more drastically in 2050. The next table shows that the months of December-January-February (DFJ) has the highest percentage of projected change in the seasonal rainfall which is 43.9 percent or 276 millimeters. It is also observable that in June-July-August (JJA) has a negative value for the rate of seasonal rainfall change which is -22.7 percent or negative 191.6 millimeters of rainfall amount. This means that, the projected value for the rainfall amount in JJA is less than the observed baseline which is 845 millimeters, which further emphasizes the changing weather conditions and patterns in the province.

The changes with the different climate factors will consequently affect the extremity of the likelihood and severity of hazards and natural calamities in the area. The changes in the seasonal rainfall may affect crop yield, prevalence of vermin and pests, cause disruption in the regular provision of economic and social services, among other.

Table 4. Projected Changes in Seasonal Rainfall in the Mid-21st Century (2036-2065) for Laguna relative to 1971-2000

Season	Scenario	Range	Projected Change		Projected Seasonal Rainfall Amount (mm)
			Percent	Rainfall amount (mm)	
December-January-February (DJF) Observed baseline = 629 mm	Moderate emission (RCP4.5)	Lower Bound	4.2	26.7	655.9
		Median	10.2	64.0	693.2
		Upper Bound	43.9	276.0	905.2
	High Emission (RCP 8.5)	Lower Bound	2.3	14.5	643.7
		Median	13.8	87.1	716.3
		Upper Bound	32.9	207.2	836.4
March-April-May (MAM) Observed baseline = 387 mm	Moderate emission (RCP4.5)	Lower Bound	-2.1	-8.3	378.5
		Median	12.6	48.6	435.4
		Upper Bound	24.8	95.8	482.6
	High Emission (RCP 8.5)	Lower Bound	-14.4	-55.8	331.0
		Median	-0.1	-0.5	386.3
		Upper Bound	28.3	109.4	496.2
June-July-August (JJA) Observed baseline = 845 mm	Moderate emission (RCP4.5)	Lower Bound	-22.7	-191.6	653.4
		Median	-14.3	-121.0	724.0
		Upper Bound	-2.1	-17.7	827.3
	High Emission (RCP 8.5)	Lower Bound	-20.9	-176.2	668.8
		Median	-11.0	-93.0	752.0
		Upper Bound	7.5	63.8	908.8
September-October-November (SON) Observed baseline = 1,067	Moderate emission (RCP4.5)	Lower Bound	-9.0	-96.2	970.3
		Median	-5.8	-61.8	1004.7
		Upper Bound	5.7	60.5	1127.0
	High Emission (RCP 8.5)	Lower Bound	-10.8	-115.5	951.0
		Median	1.4	14.6	1081.1
		Upper Bound	10.5	112.4	1178.9

Source: PAGASA, 2018

Impact Chain Analysis

In order to adapt and mitigate climate change impacts and reduce the risks of natural hazards, it is crucial to an in-depth and detailed study of the conditions of vulnerability that a particular area or locale of concern faces. This perspective can be gained by, firstly, dissecting the anatomy of the identified risks, from the hazards that create the conditions for these risks to exist, to the possible damaging effects or "impacts" they can have on society and the environment if they are not managed (or are simply too powerful to handle) and result into disaster events. Once the vulnerability elements have been identified, the next thing to do is to map out these elements into a visual cause and effect representation, with the hazards as cause and the impacts as effects.

The CDRA method makes use of Impact Chain Diagrams or Analysis to effectively illustrate the multifarious cause and effect relationships among the hazards, risks and the affected socio-economic and environmental elements in a particular place. These impact chains are fashioned so as to clearly show what can happen to the various social and economic, environment and infrastructure systems at play if a disaster would occur. By using Impact Chain Analysis, planners can determine the specific hazards of a place and what sectors are most at risk to these hazards based on the severity of projected impacts, which ultimately will give them the necessary information to make informed and tailor-fit mitigation measures for disaster preparedness in the areas of concern.

The figures below or flow charts show both positive and negative effects and impacts on settlements, production, protection and infrastructure areas. These effects and impacts were derived from the CDRA workshop 2018.

Settlements Development Area

Climate change influences the rate of precipitation and evaporation and the overall water cycle, groundwater, which is the usual source of household water, will be harder to maintain. An increase in temperature would also affect groundwater and if not replenished (via precipitation), it could lead to water shortage. (Refer to Figure 3. Potential impacts and effects of changes in seasonal temperature to settlements).

Increase in temperature also causes an increase in power and water consumption which leads to a higher demand in both electricity and water but with the chances of power and water shortage, prices of these services would increase and will be unaffordable for some. Aside from economic impacts, drought increases the likelihood of prevalence of diseases and pests for warm temperature is a favorable environment for pests and pathogens to proliferate which increases the risk of the residents to contract disease such as measles, food and water-borne diseases.

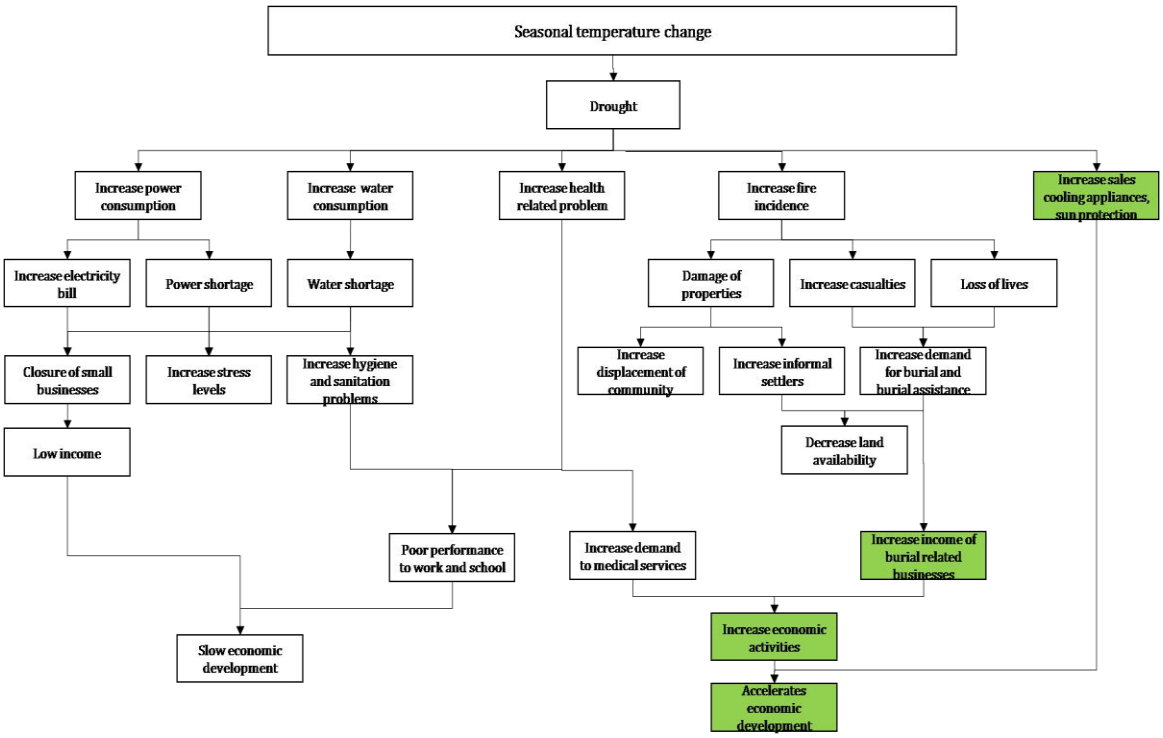


Figure 3. Potential impacts and effects of changes in seasonal temperature to settlements

The figure below shows the impact chain for increase in rainfall in urban areas. Landslide and flooding are a major concern in urban areas especially that most of the populace reside there. It can damage properties and infrastructures, cause overflow of canal/drainage, and loss of lives or higher morbidity rate. Damage in property increases road traffic and disrupt public and private transportation, it also delays delivery of goods and services.

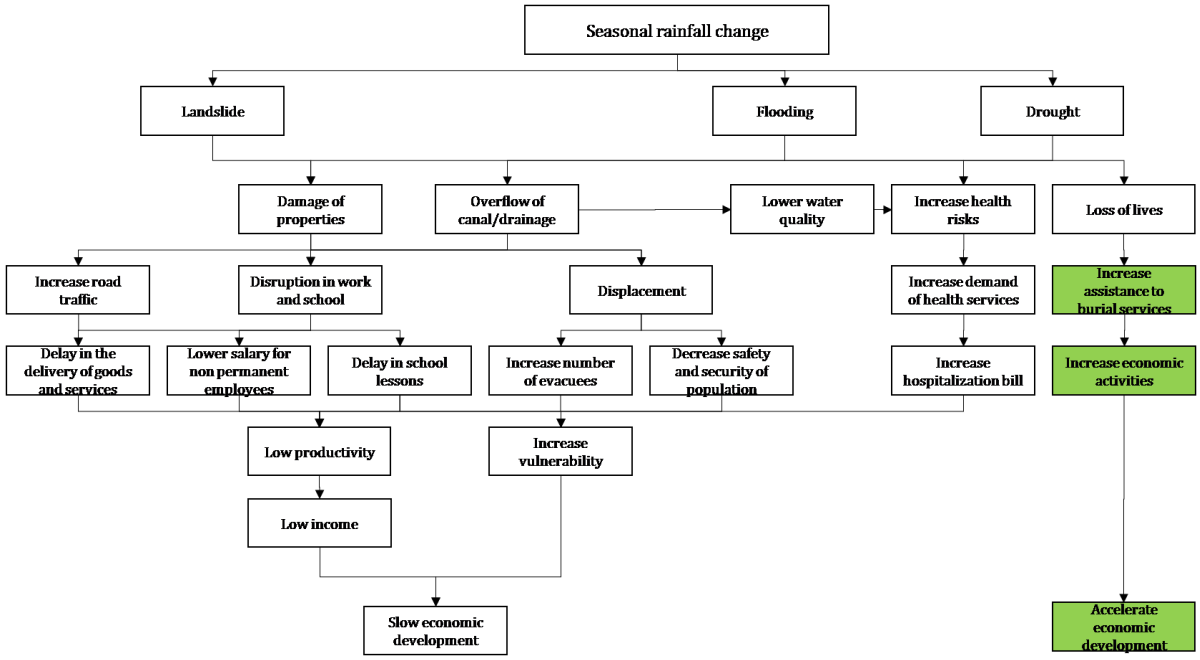


Figure 4. Potential impacts and effects of changes in seasonal rainfall to settlements

Production Development Area

The impacts of increasing temperature are showed in Figure 5. Drought is identified to be the only direct impact of increased temperature which may lead to reduced water recharge, reduced river flow, increased stress to crops and animals, and increased likelihood of new predators, pests, and pathogens. Currently, Alaminos is experiencing water interruptions and is said to have insufficient supply of water in some areas and an occurrence of drought may exacerbate the current situation which may occur on the months March-April-May since the expected rainfall is less and temperature may reach up to 29.7℃.

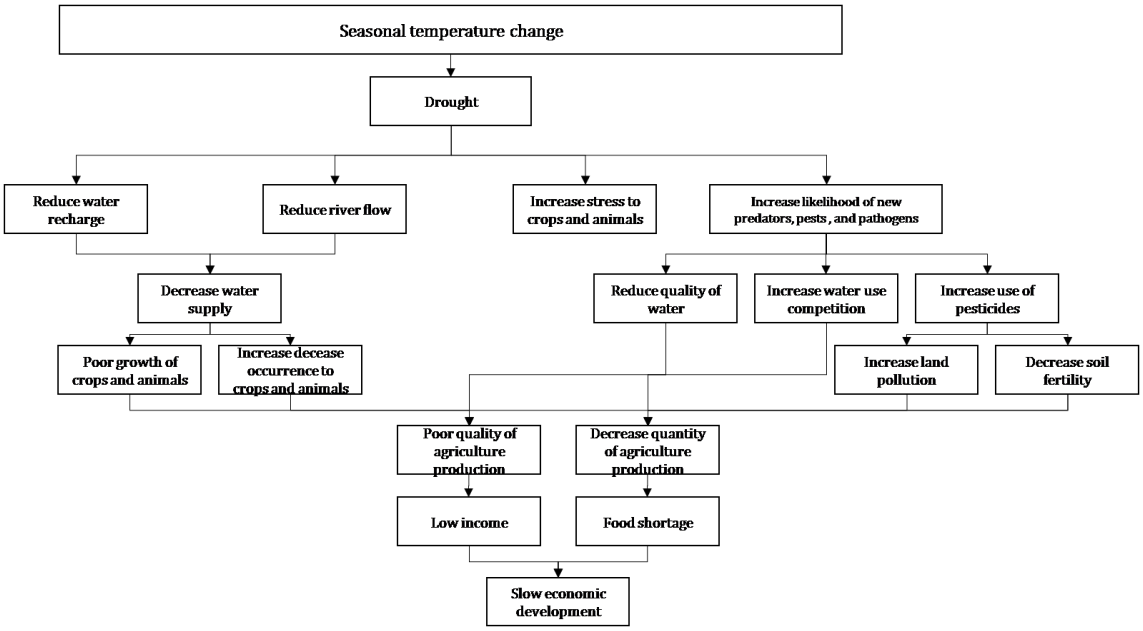


Figure 5. Potential impacts and effects of changes in seasonal temperature to production areas

Alaminos is known to have several poultry services and many residents are also dependent on crops such as lanzones, rambutan, and coconut. These livelihoods will largely be affected because drought reduces soil moisture content which results to poor quality of agriculture produce. Temperature also affects the growth pattern of crops and may adversely affect the productivity of the crops and trees.

Excessive rainfall could lead to landslide, flooding, increased diseases of crops and animals, and change in harvesting and planting cycle. These direct impacts would result to damage in agricultural areas and overflow of fishponds, it may also cause destruction of infrastructures such as farm to market roads. The months September-October-November is projected to have 1178.9 millimeter of rainfall, these could be the months when extreme rainfall could happen. Livelihood and food shortage are the major concern in case there would be intense rainfall (refer to Figure 6).

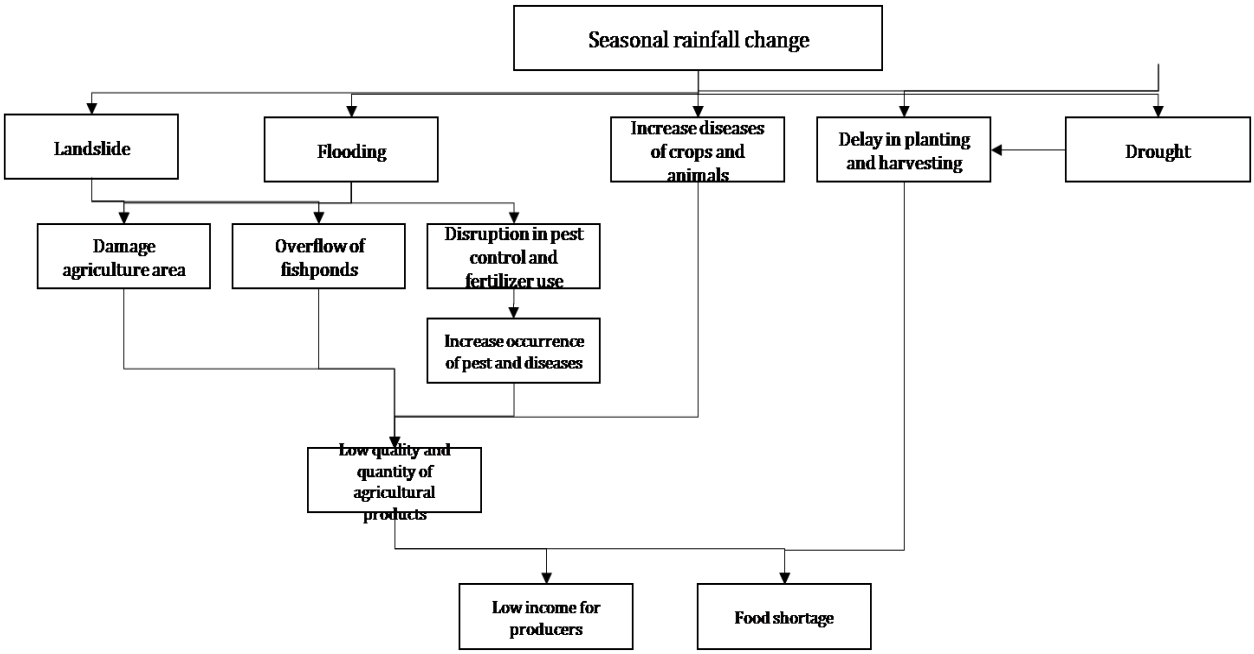


Figure 6. Potential impacts and effects of changes in seasonal rainfall to production areas

Protection Development Area

As shown in Figure 7, increased temperature means warmer temperature. This affects the moisture content of the soil and could even lead to drought. This reduces the speed of growth of the trees. Warm temperature increases the likelihood of insect outbreaks and invasive species; it reduces river flow and decreases water availability due to faster rate of evaporation. On the positive side, the warm temperature increases the concentration of carbon dioxide which promotes photosynthesis, thus, encourages forest growth. It decreases vulnerability and increases economic activity by reducing the occurrence and impact of hazards, improving forest production, and promotes biodiversity.

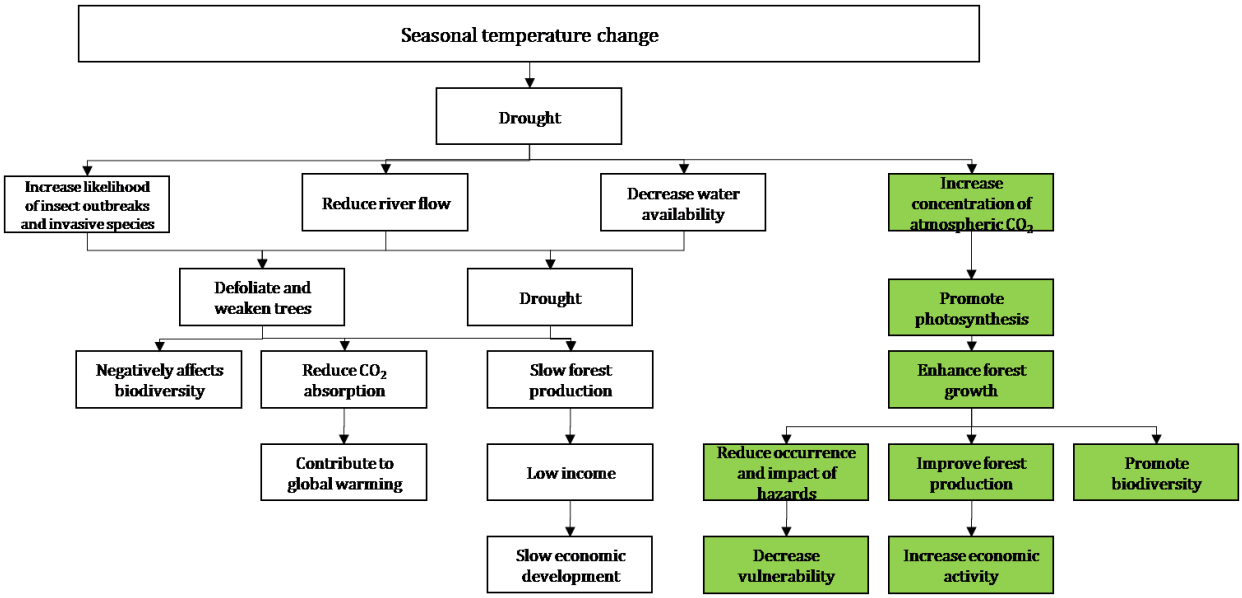


Figure 7. Potential impacts and effects of changes in seasonal temperature to protection areas

The figure below shows the increased rainfall leads to three direct impacts: increased break up of soil and water built up, overflow of rivers and creeks, and an increase of tree mortality. This could lead to soil erosion, landslide, flooding, and even reduced carbon dioxide absorption which inhibit the growth of seeds and seedlings, disturbance of species pattern, lower food availability, lower quality of water. Overall, the disruption of normal amount of rainfall and its increase affects biodiversity in a negative way.

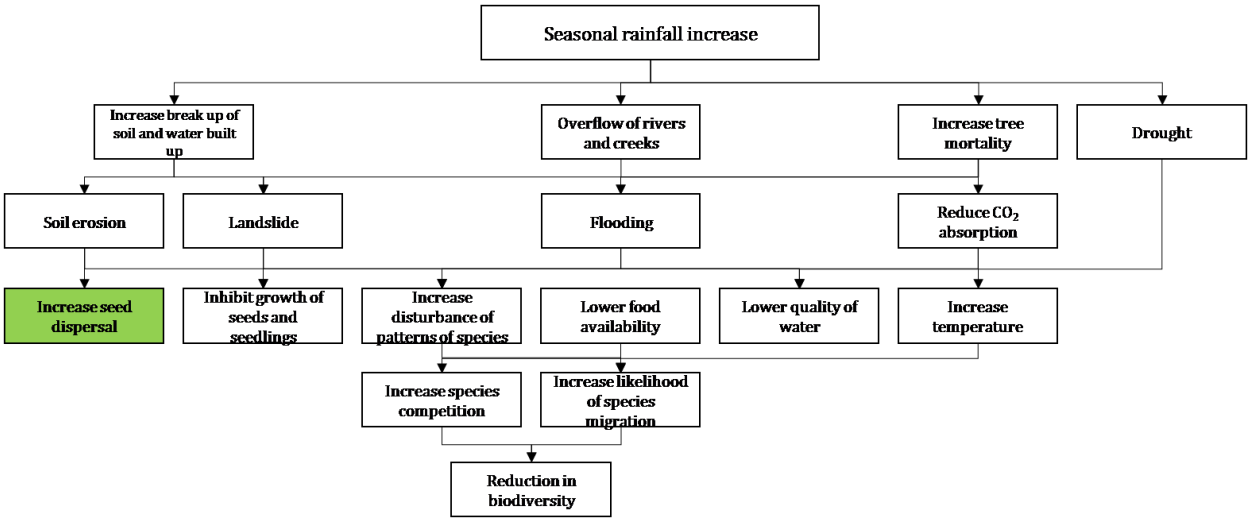


Figure 8. Potential impacts and effects of changes in seasonal rainfall to protection areas

Infrastructure Development Area

Changes in season temperature may lead to drought and affect the water and power supplies of the area, leading to an increase in demand and shortage of utilities. Increase in temperature also increases likelihood of infrastructure damage. As shown in the figure below:

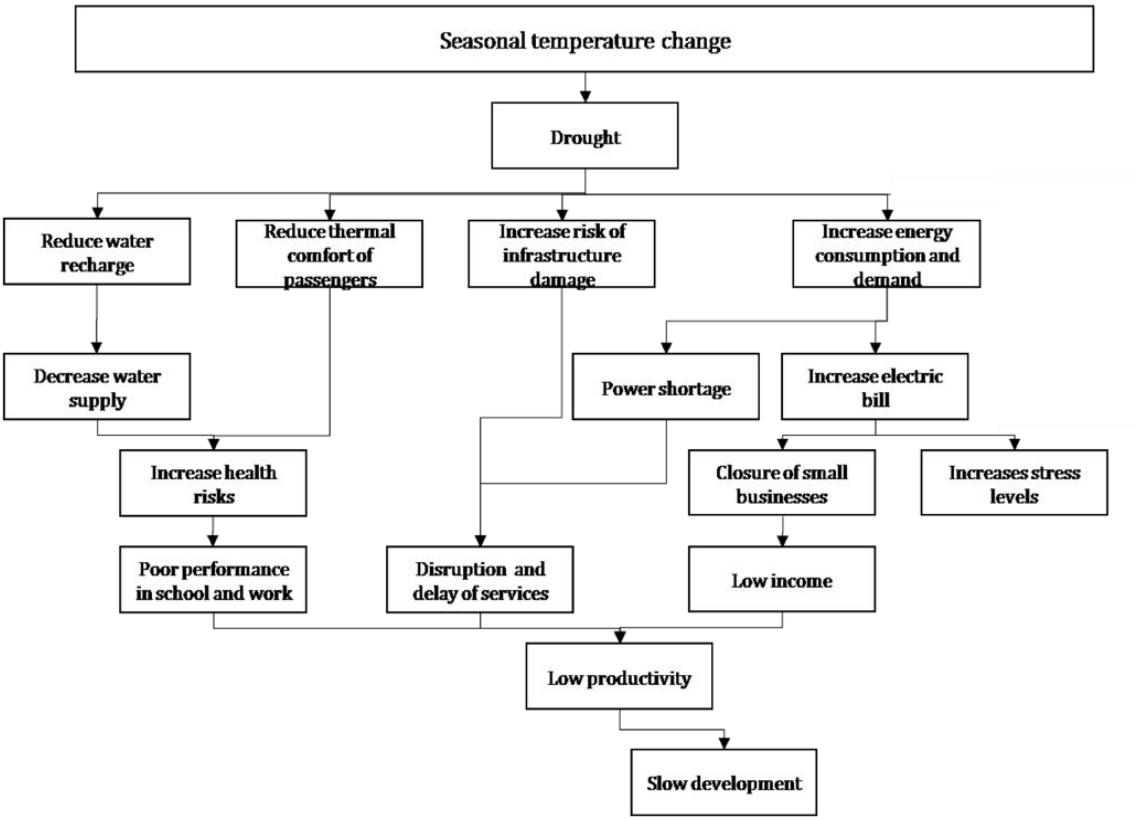


Figure 9: Potential impacts and effects of changes in seasonal temperature to infrastructures

Changes in rainfall may lead to landslide, flooding and also drought in the area. These hazards affect and damage the utility line networks, such as water, power, telecommunications and road and bridges, and overflow canals and drainage systems, potentially delaying deliver of goods and services, and flow of resources in the municipality. These potentials impacts affect both the population and production areas. As shown in the figure below:

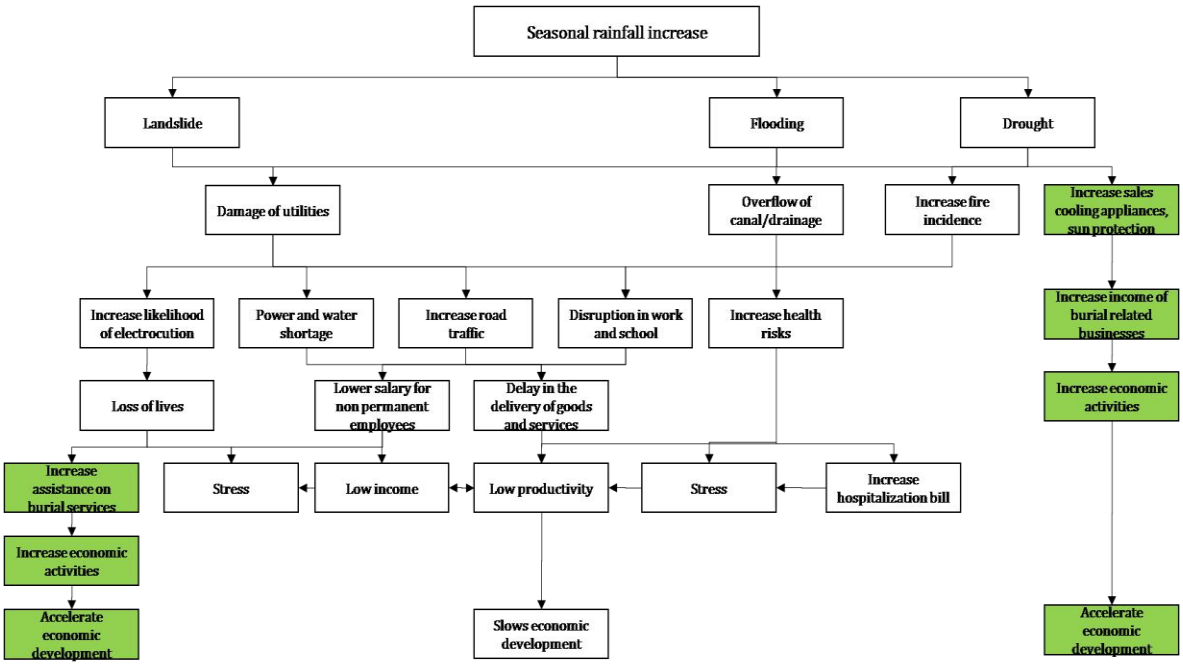


Figure 10. Potential impacts and effects of changes in seasonal rainfall to infrastructures

Disaster Risk Assessment

Historical information

Disaster events caused by natural hazards are becoming more and more frequent. It is important to record the damages and losses to better manage and reduce its effects and impacts to the community, its settlements and land. Historical data enables the government and other institutions to generate appropriate adaptation and mitigation measures.

Table 5 shows the historical disaster information of the municipality of Alaminos from 1967 to 2014, derived from the several Climate and Disaster Risk Assessment (CDRA) Workshops.

Table 5. Historical disaster information of the municipality of Alaminos, Laguna

Year	Name	Type	Affected Areas/Barangay/Effect
1967	Welming	Super Typhoon	San Juan Poblacion 3 - affected by flashflood (knee-level)
1976	Taal Volcano Eruption	Ash Fall	Municipal wide
1990	No data	EIL	No data
1991	Mt. Pinatubo Eruption	Ash Fall	Municipal wide –damaged crops and trees
1995	Rosing	Super Typhoon	Poblacion 3 (San Pedro Ibaba)
2006	Milenyo	Typhoon	Sta. Rosa – damaged lanzones and rambutan San Miguel Poblacion IV San Benito San Roque San Gregorio – 300 affected families, damaged crops including banana and coconuts, 1 casualty
		RIL	Sta. Rosa
2009	Ondoy	Typhoon	San Roque – partially damaged houses
2013	Yolanda	Super Typhoon	Poblacion 2 – partial and totally damaged houses, ~200 houses partially damaged
2014	Glenda	Typhoon	San Miguel – 1 casualty, San Benito Poblacion 2 Poblacion 3 Sta. Rosa - damaged roofs Del Carmen San Ildefonso San Roque - 2 houses damaged Municipal wide - 1ater and power interruption for 2 weeks in all barangays
		Rain-Induced Landslide	Poblacion 1 - 190 partially damaged households San Miguel Sta. Rosa
2017	Maring	Typhoon	Municipal Wide – damaged trees San Benito – Affected families

Year	Name	Type	Affected Areas/Barangay/Effect
			Barangay 1 – Affected families
2018	Ompong	Typhoon	Municipal Wide – damaged trees

Source: CDRA workshop 2018, DENR, 2013

Susceptibility and Risk to Hazards

Hazard Susceptibility

According to DENR-MGB, Alaminos have five (5) natural hazards such as flooding, rain-induced landslide, ground shaking, earthquake-induced landslide and soil erosion. Table 6 shows the existing hazards per barangay in Alaminos. Similarly, stakeholders from workshops conducted identified similar hazard events and experiences, except for soil erosion. It is also noted that landslide occurrence was not determined whether it was rain or earthquake induced.

Table 6. Hazards in the Alaminos, Laguna

Barangay	Flood	Rain-Induced Landslide	Ground Shaking	Earthquake-Induced Landslide	Soil Erosion
Poblacion 1			✔		
Poblacion 2		✔	✔		✔
Poblacion 3			✔		✔
Poblacion 4			✔		
Del Carmen		✔	✔		✔
Palma		✔	✔	✔	✔
San Agustin	✔		✔		
San Andres		✔	✔	✔	✔
San Benito	✔		✔		
San Gregorio	✔	✔	✔	✔	✔
San Ildefonso		✔	✔		✔
San Roque	✔	✔	✔		
San Juan		✔	✔		✔
San Miguel		✔	✔	✔	
Sta. Rosa		✔	✔	✔	✔

Source: CDRA workshop, DENR, 2013

Flood Hazard

Flooding hazard in Alaminos is categorized as low, moderate and high susceptibility with a total land area of 126.03 hectares, 20.62 hectares, and 28.68 hectares, respectively. These are within the boundaries of barangays San Benito, San Roque, San Agustin, and San Gregorio (Table 7 and Map 13: Flood Hazard Map).

Its characteristic with relatively flat and Climate Type III which is characterized as relatively dry from November to April and wet during the rest of the year can trigger the flooding events. The presence of river and tributaries situated in barangays San Benito and San

Agustin can cause the occurrence of flooding in the area. In addition, the intensity of rainfall also contributes to flooding.

The table below shows the area of barangays exposed to flooding. Overall, the total area susceptible is 175.30 hectares (3.28 percent), and the remaining 5,170.05 hectares are considered not susceptible to flooding.

Table 7. Susceptibility of Alaminos, Laguna to flooding

Level	Barangay	Area per barangay (Ha)	Total Area (Ha)
Not Susceptible	Poblacion 1	43.61	5,170.05
	Poblacion 2	49.37	
	Poblacion 3	111.66	
	Poblacion 4	28.71	
	Del Carmen	257.93	
	Palma	725.36	
	San Agustin	412.97	
	San Andres	494.64	
	San Benito	265.85	
	San Gregorio	844.37	
	San Ildefonso	380.77	
	San Juan	287.32	
	San Miguel	199.89	
	Sta. Rosa	892.86	
	San Roque	174.75	
Low Susceptibility	San Benito	113.24	126.03
	San Agustin	12.79	
Moderate Susceptibility	San Agustin	5.16	20.62
	San Roque	15.46	
High Susceptibility	Del Carmen	0.07	28.68
	San Agustin	8.01	
	San Roque	7.56	
	San Gregorio	13.00	
		Total Area (Ha)	**Percentage to total land area**
Total area susceptible		175.30	3.28
Total area not susceptible		5,170.05	96.72
Total		5,345.35	100

Source: MPDO GIS computation 2017, DENR, 2013

Risk estimation

The risk estimation of flooding in the municipality is presented in Table 8. Although there are barangays that are not susceptible to flooding, there are other factors that contribute to the occurrence of the hazard in Alaminos, such as overflowing and clogged canals due to pollution, which is one of the identified problems in the area.

Likelihood of occurrence of a hazard is an estimated period of time a certain hazard event itself likely to repeat itself, usually expressed in years. Flooding in urban barangays are more likely to occur than flooding in rural barangays. These occurrences can be attributed to other

factors such as intensity of the rainfall, coupled with the presence of clogged canals --and pollution, no drainage system and the current land use in the area. On the other hand, barangays that are susceptible to flooding, as shown in Table 5, such as San Benito, San Roque, San Agustin, Del Carmen and San Gregorio, have an occasional to very rare return period.

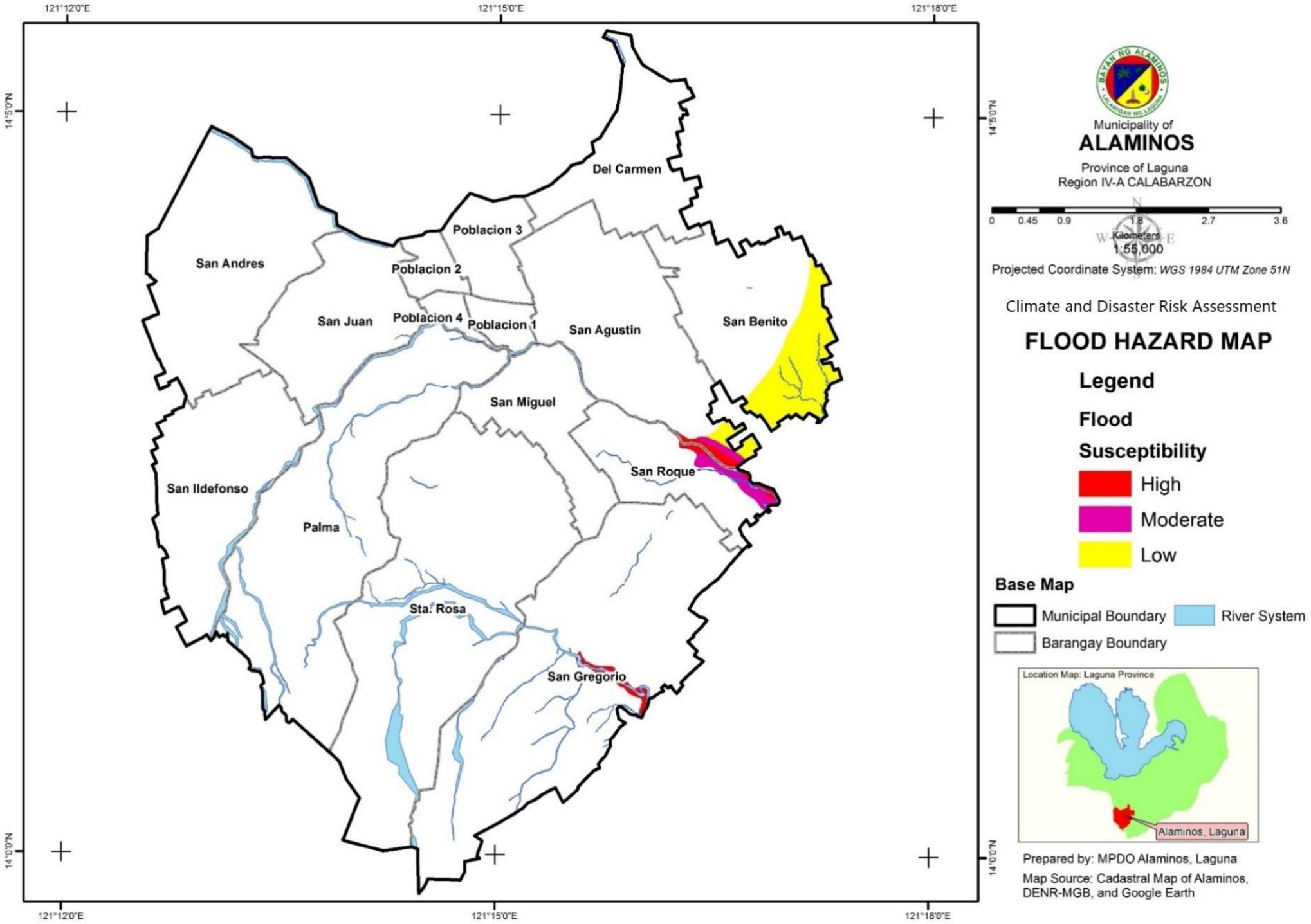
In terms of the severity of consequence, all barangays except barangay Poblacion 2 have low severity of consequence score. This means that elements – population, urban use areas, production areas, critical point facilities and lifeline utilities have a low effect. In the case of Alaminos, less than five (5) percent of its population are affected, less than five (5) percent of its residential structure are severely damaged and less than 10 percent of its non-residential structure are severely damaged, less than 10 percent of its production areas are affected and severely damaged, disruption of critical services is less than one (1) day and disruption of service of utilities does not last for more than one (1) day. For barangay Poblacion 2, five (5) to 10 percent of its population are affected, five (5) to 10 percent of its residential structure are severely damaged and 10 to 20 percent of its non-residential structure are severely damaged, 10 to 20 percent of its production areas are affected and severely damaged, disruption of critical services is less than three (3) days and disruption of service of utilities does not last for more than three (3) days.

Overall, the risk category for flooding in Alaminos shows barangays Poblacion 3, Del Carmen, Palma, San Agustin, San Andres, San Benito, San Gregorio, San Ildefonso, San Juan, San Miguel, and San Roque have low risk, while barangays Poblacion 1, Poblacion 4 and Sta. Rosa have moderate risk and only Poblacion 2 have high risk.

Table 8. Risk estimation and likelihood of occurrence to flooding in Alaminos, Laguna

Barangay	Likelihood of Occurrence Score	Severity of Consequence				Risk Score	Risk Category
		Very High	High	Mod	Low		
		4	3	2	1		
Poblacion 1	5				1	5	Moderate
Poblacion 2	6			2		12	High
Poblacion 3	4				1	4	Low
Poblacion 4	6				1	6	Moderate
Del Carmen	4				1	4	Low
Palma	1				1	1	Low
San Agustin	1				1	1	Low
San Andres	4				1	4	Low
San Benito	4				1	4	Low
San Gregorio	4				1	4	Low
San Ildefonso	2				1	4	Low
San Juan	2				1	4	Low
San Miguel	4				1	4	Low
San Roque	4				1	4	Low
Sta. Rosa	5			2		10	Moderate

Map 13: Flood Hazard Map



Rain-Induced Landslide Hazard

The geographic location, slope, elevation, soil and rainfall patterns are some of the factors that contribute to rain-induced landslides (RIL) in Alaminos. The total land area susceptible to RIL is 767.37 hectare (21.64%) of the total land area. About 462.05 hectares (13.02%) is classified as moderate susceptibility while low susceptibility has an area of 1,748.59 hectares or 49.32% (Refer to Table 9). Infrastructure, livelihood and lives of the people in these areas are at risk. Strict implementation of policies and regulations must be observed in these areas to reduce the vulnerabilities and negative impacts, if relocation is not an option for some areas in the municipality.

In terms of low susceptibility, barangay Palma has the highest area susceptible to rain induced landslide with 631.05 hectares while barangay Poblacion 3 is the least with less than one (1) percent of its area is susceptible. For moderately susceptible barangays, barangay Sta. Rosa is the most susceptible having a total of 190.80 hectares (3.57 percent) of its area, while barangay San Andres is the least with 70.53 hectares (1.32 percent) moderately susceptible. Among the 15 barangays, barangay San Gregorio has the largest area highly susceptible to RIL with 416.98 hectares at risk, followed by barangay Sta. Rosa with 324.08 hectares.

Overall, barangay San Gregorio is the most susceptible to RIL impacts having a total land area of 739.97 hectares exposed to RIL, while barangay Poblacion 3 is the least susceptible. Moreover, areas in barangays Sta. Rosa and San Miguel are possible landslide debris accumulation zone. This means that implementation of laws and regulations pertaining to this concern should be enhanced, such as no build zone.

On the other hand, a total of 2,326.64 hectares (43.53 percent) are not prone to rain-induced landslides. These areas are suitable for sector-specific development (refer to Table 9 and Map 14).

Changes of precipitation or amount of rainfall directly affect rain-induced hazards. It can be noted that the highest percentage of susceptibility occurs along rivers and riverbanks due to the soil type, existing land cover and land uses. Table 9 summarizes of level of susceptibility, locations, area and its percentage in Alaminos.

Table 9. Rain-Induced Landslide per Barangay of Alaminos, Laguna

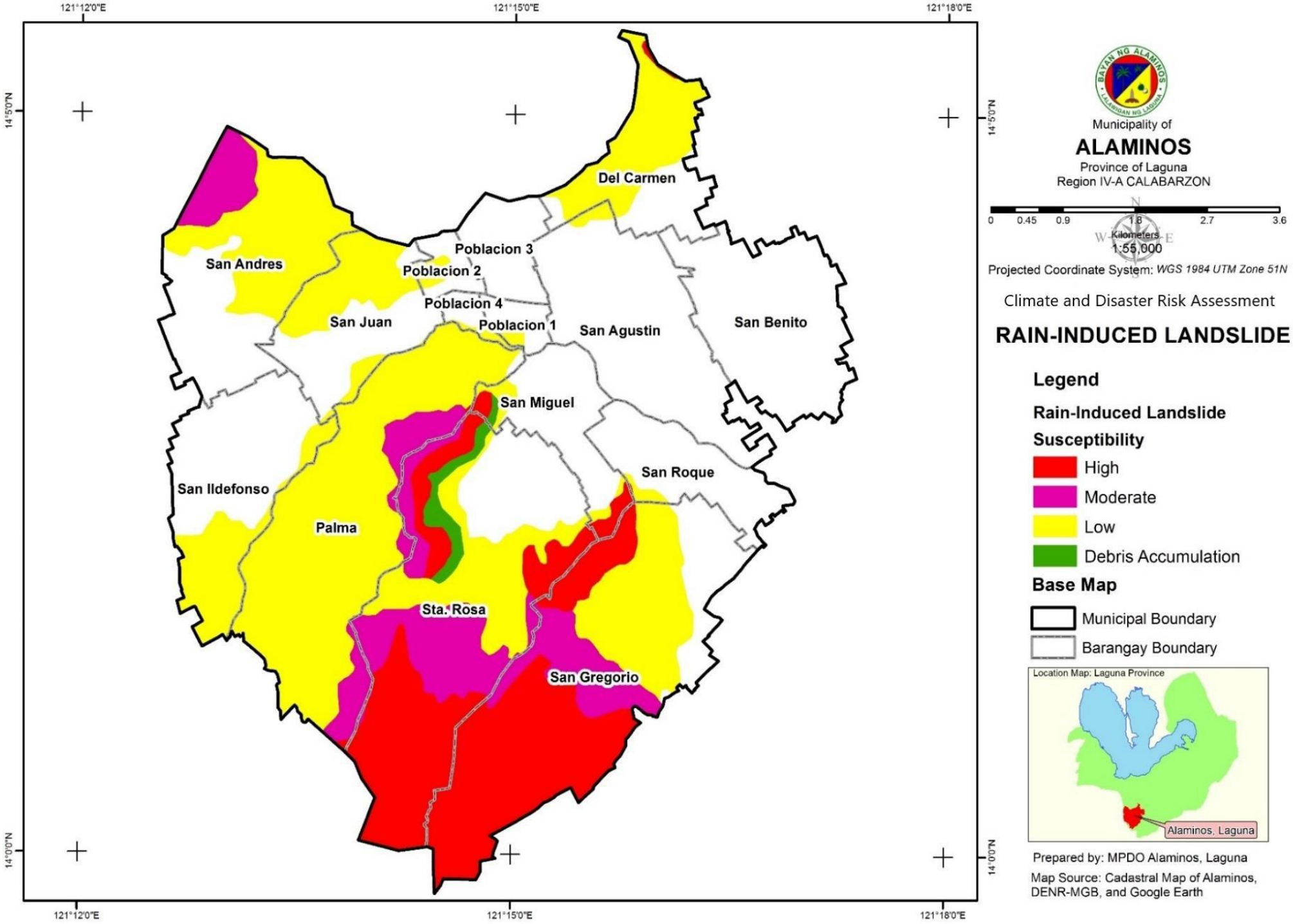
Level	Barangay	Area per barangay (Ha)	Total Area (Ha)	% Total
Not Susceptible	Del Carmen	86.81	2,326.64	43.53
	Palma	4.00		
	Poblacion 1	38.73		
	Poblacion 2	36.45		
	Poblacion 3	111.64		
	Poblacion 4	21.38		
	San Agustin	430.04		
	San Andres	187.00		
	San Benito	379.09		
	San Gregorio	117.41		
	San Ildefonso	254.93		
	San Juan	154.66		
	San Miguel	157.50		
	San Roque	189.81		

	Sta. Rosa	157.21		
Low Susceptibility	Del Carmen	168.15	1,748.59	14.36
	Palma	631.05		
	Poblacion 1	4.88		
	Poblacion 2	7.33		
	Poblacion 3	0.02		
	Poblacion 4	7.33		
	San Agustin	8.89		
	San Andres	237.11		
	San Gregorio	210.34		
	San Ildefonso	125.84		
	San Juan	132.66		
	San Miguel	18.45		
	San Roque	7.42		
	Sta. Rosa	183.51		
Moderate Susceptibility	San Andres	70.53	462.05	8.64
	Palma	88.07		
	San Gregorio	112.65		
	Sta. Rosa	190.80		
High Susceptibility	Palma	2.24	767.37	32.71
	Del Carmen	3.04		
	San Roque	0.53		
	San Gregorio	416.98		
	San Miguel	20.50		
	Sta. Rosa	324.08		
Landslide Debris Accumulation	San Miguel	3.44	40.70	0.76
	Sta. Rosa	37.26		

	Total Area (Ha)	**Percentage to total land area**
Total area susceptible	3,018.71	56.47
Total area not susceptible	2,326.64	43.53
Total	5,345.35	100

Source: MPDO GIS computation 2017, DENR, 2013

Map 14: Rain-induced Landslide Map



Earthquake-Induced Landslide Hazard

Due to the physical characteristics of Alaminos, which is relatively flat to gently sloping, 62.88 hectares (1.18%) of the total land area is susceptible to earthquake induced landslides (EIL). Portion of barangays San Andres, Palma, San Gregorio, San Miguel, and Sta. Rosa are exposed to earthquake-induced landslide, which is presented in Table 10. This kind of hazard resulted from ground shaking event (refer to Map 15: Earthquake-induced Landslide).

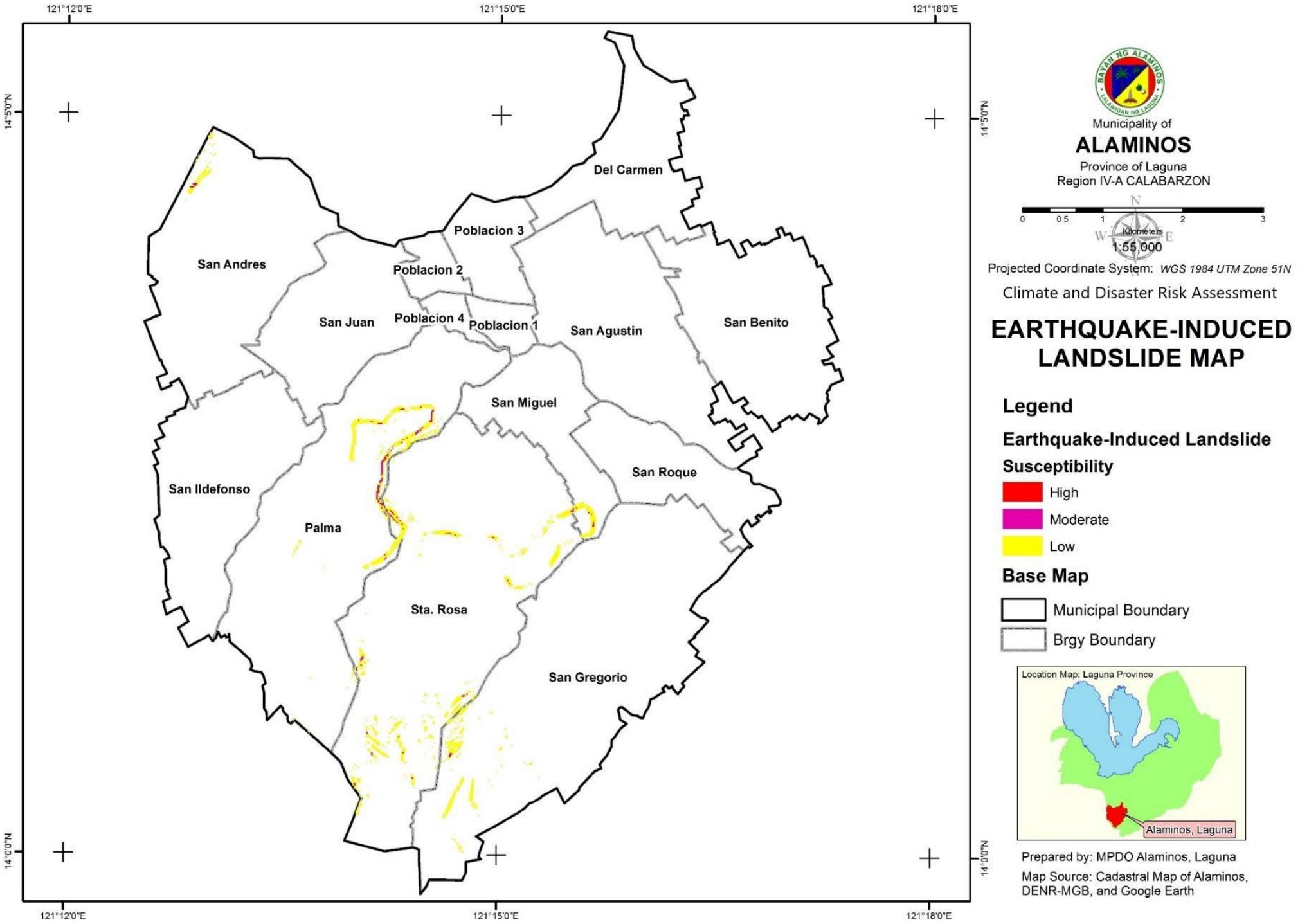
In terms of the level of susceptibility, 58.07 hectares (1.09%) of land has low susceptibility to EIL, while 4.62 hectares (0.09%) have moderate susceptibility. Only barangay Palma has high susceptibility to EIL having 0.19 (0.004%) hectare of its land exposed. Overall, barangay Sta. Rosa is the most susceptible to this hazard with a total of 26.59 hectares land exposed to EIL, while Poblacion 1, Poblacion 2, Poblacion 3, Poblacion 4, San Agustin, San Benito, Del Carmen, San Ildefonso, San Juan, and San Roque are not susceptible at all.

Table 10. Earthquake-Induced Landslide of Alaminos, Laguna

Level of Susceptibility	Barangay	Area (Ha)	Percentage to Total land area
Not Susceptible	Poblacion 1	43.61	98.82
	Poblacion 2	49.37	
	Poblacion 3	111.66	
	Poblacion 4	28.71	
	San Agustin	438.93	
	San Benito	379.09	
	Del Carmen	258	
	San Ildefonso	380.77	
	San Juan	287.32	
	San Roque	197.76	
Low Susceptibility	San Andres	2.77	1.09
	Palma	17.61	
	San Gregorio	9.07	
	San Miguel	3.59	
	Sta. Rosa	25.03	
Moderate Susceptibility	San Andres	0.27	0.09
	Palma	2.36	
	San Gregorio	0.15	
	San Miguel	0.28	
	Sta. Rosa	1.56	
High Susceptibility	San Andres	0.001	0.004
	Palma	0.19	
		Total Area (Ha)	**Percentage to total land area**
Total area susceptible		62.88	1.184
Total area not susceptible		5,282.47	98.82
Total		5,345.35	100

Source: MPDO GIS computation 2017, DENR-MGB, 2013

Map 15: Earthquake-induced Landslide



Risk Estimation

Table 11 shows the summary of likelihood of occurrence and risk scores for landslide in the municipality. Barangays Poblacion 2, Poblacion 3, Del Carmen, Palma, San Agustin, San Andres, San Benito, San Gregorio, San Ildefonso, San Juan and San Roque have a very rare of occurrence (every > 200 years) of RIL and EIL in their areas, while in barangays Poblacion 1 and San Miguel, RIL is a rare event, occurring every 100 to 200 years. RIL and EIL in barangay Poblacion 4 occurs every 30 to 100 years and barangay Sta. Rosa occurs every 3 to 10 years. Some barangays, as shown in Table 9 and Table 10, experience landslide but the likelihood varies from moderate to very rare return periods.

All barangays have low risk scores except barangay Sta. Rosa with moderate risk score. This means that five (5) to 10 percent of its population are affected, five (5) to 10 percent of its residential structure are severely damaged and 10 to 20 percent of its non-residential structure are severely damaged, 10 to 20 percent of its production areas are affected and severely damaged, disruption of critical services is less than three (3) days and disruption of service of utilities does not last for more than three (3) days. This result supports the susceptibility of the area in terms of landslide.

Table 11. Risk Estimation of Rain-induced landslide in Alaminos, Laguna

Barangay	Likelihood of Occurrence Score	Severity of Consequence				Risk Score	Risk Category
		Very High	High	Mod	Low		
		4	3	2	1		
Poblacion 1	2				1	2	Low
Poblacion 2	1				1	1	Low
Poblacion 3	1				1	1	Low
Poblacion 4	3				1	3	Low
Del Carmen	1				1	1	Low
Palma	1				1	1	Low
San Agustin	1				1	1	Low
San Andres	1				1	1	Low
San Benito	1				1	1	Low
San Gregorio	1				1	1	Low
San Ildefonso	1				1	1	Low
San Juan	1				1	1	Low
San Miguel	2				1	2	Low
San Roque	1				1	1	Low
Sta. Rosa	5			2		10	Moderate

Source: CDRA Workshop, 2018

Ground Shaking

Ground shaking is the most familiar effect of earthquake. The degree of impact depends on the intensity and magnitude and can be directly damaged the buildings and houses, roads, infrastructures.

In Alaminos setting, there are two (2) ground shaking category which are PEIS Intensity VII and VIII with total land area of 2358.30 hectares or 44.12% and 2987.05 or 55.88%, respectively (refer to Table 12, and Map 16: Ground Shaking Map).

Table 12. Ground Shaking Hazard of Alaminos, Laguna

Intensity Scale	Description	Barangay	Area (Ha)	Percentage to Total Land Area
Intensity I (Scarcely Perceptible)	Perceptible to people under favorable circumstance. Delicately balanced objects are disturbed slightly. Still Water in containers oscillates slowly	Not applicable. For presentation purposes only.		
Intensity II (Slightly Felt)	Felt by few individuals at rest indoors. Hanging objects swing slightly. Still Water in containers oscillates noticeably.			
Intensity III (Weak)	Felt by many people indoors especially in upper floors of buildings. Vibration is felt like one passing of a light truck. Dizziness and nausea are experienced by some people. Hanging objects swing moderately. Still water in containers oscillates moderately.			
Intensity IV (Moderately Strong)	Felt generally by people indoors and by some people outdoors. Light sleepers are awakened. Vibration is felt like a passing of heavy truck. Hanging objects swing considerably. Dinner, plates, glasses, windows and doors rattle. Floors and walls of wood framed buildings creak. Standing motor cars may rock slightly. Liquids in containers are slightly disturbed. Water in containers oscillates strongly. Rumbling sound may sometimes be heard.			
Intensity V (Strong)	Generally felt by most people indoors and outdoors. Many sleeping people are awakened. Some are frightened, some run outdoors. Strong shaking and rocking felt throughout building. Hanging objects swing violently. Dining utensils clatter and clink, some are broken. Small, light and unstable objects may fall or overturn. Liquids spill from filled open containers.			

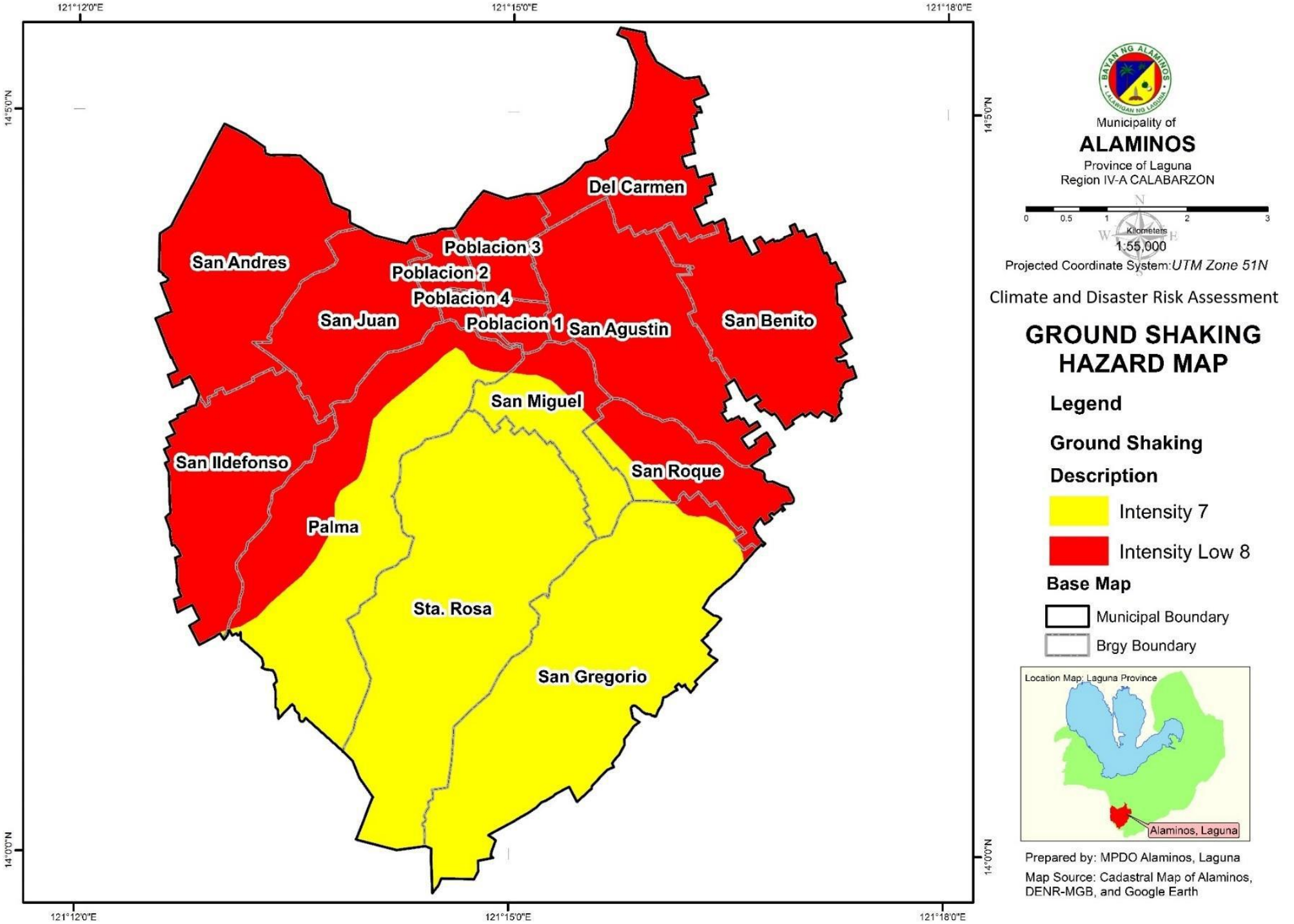
Intensity Scale	Description	Barangay	Area (Ha)	Percentage to Total Land Area
	Standing vehicles rock noticeably. Shaking of leaves and twigs of trees are noticeable.			
Intensity VI (Very Strong)	Many people are frightened; many run outdoors. Some people lose their balance. Motorists feel like driving in flat tires. Heavy objects or furniture move or may be shifted. Small church bells may ring. Wall plaster may crack. Very old or poorly built houses and man-made structures are slightly damaged though well-built structures are not affected. Limited rock falls and rolling boulders occur in hilly to mountainous areas and escarpments. Trees are noticeably shaken.			
Intensity VII (Destructive)	Most people are frightened and run outdoors. People find it difficult to stand in upper floors. Heavy objects and furniture overturn or topple. Big church bells may ring. Old or poorly built structures suffer considerably damage. Some well-built structures are slightly damaged. Some cracks may appear on dikes, fishponds, road surface and concrete hollow block walls. Limited liquefaction, lateral spreading and landslides are observed. Trees are shaken strongly.	Palma, San Miguel, Sta. Rosa, San Gregorio and San Roque	2,358.30	44.12
Intensity VIII (Very Destructive to Completely Devastating)	Numerous landslides and rock falls occur in mountainous and hilly areas Most buildings are totally damaged. Bridges and elevated concrete structures are toppled or destroyed. Massive landslides and liquefaction, large-scale subsidence and uplifting of landforms and many ground fissures are observed. Changes in river courses and	San Andres, San Juan, Poblacion 1, Poblacion 2, Poblacion 3, Poblacion 4, San Agustin,	2,987.05	55.88

Intensity Scale	Description	Barangay	Area (Ha)	Percentage to Total Land Area
	destructive seiches in large lake occur.	Del Carmen, San Benito, San Roque, San Miguel, Palma, and San Ildefonso		
Intensity IX (Devastating)	People are forcibly thrown to ground. Many cry and shake with fear. Most buildings are totally damaged. Bridges and elevated concrete structures are toppled or destroyed. Numerous utility posts, towers and monument are tilted, toppled or broken. Water sewer pipes are bent, twisted or broken. Landslides and liquefaction with lateral spreading and sandboils are widespread. The ground is distorted into undulations. Trees are shaken very violently with some toppled or broken. Boulders are commonly thrown out. River water splashes violently on slops over dikes and banks.	Not applicable. For presentation purposes only.		
Intensity X (Completely Devastating)	Practically all man-made structures are destroyed. Massive landslides and liquefaction, large-scale subsidence and uplifting of land forms and many ground fissures are observed. Changes in river courses and destructive seiches in large lakes occur. Many trees are toppled, broken and uprooted.			

	Total Area (Ha)	Percentage to Total Land Area
Total area susceptible	5,345.35	100
Total area not susceptible	0.00	0
Total	5,345.35	100

Source: PHIVOLCS Earthquake Intensity Scale (PEIS), MPDO GIS computation 2017, DENR-MGB, 2013

Map 16: Ground Shaking Map



Risk Estimation

For the risk analysis of ground shaking, the severity of consequence as shown in Table 13: Risk Estimation of Ground shaking in Alaminos, Laguna, shows that all barangays have low severity of consequence. In terms of risk score, all barangays have low risk scores except for barangay Palma. For the likelihood of occurrence, barangays have varying scores ranging from more every 3 to more than 200 years (moderate to very rare occurrence). The difference is attributed various answers from the workshop consultations in the municipality.

Table 13: Risk Estimation of Ground shaking in Alaminos, Laguna

Barangay	Likelihood of Occurrence Score	Severity of Consequence				Risk Score	Risk Category
		Very High	High	Mod	Low		
		4	3	2	1		
Poblacion 1	1				1	1	Low
Poblacion 2	1				1	1	Low
Poblacion 3	3				1	3	Low
Poblacion 4	3				1	3	Low
Del Carmen	3				1	3	Low
Palma	5				1	5	Moderate
San Agustin	4				1	4	Low
San Andres	4				1	4	Low
San Benito	1				1	1	Low
San Gregorio	3				1	3	Low
San Ildefonso	4				1	4	Low
San Juan	4				1	4	Low
San Miguel	1				1	1	Low
San Roque	4				1	4	Low
Sta. Rosa	4				1	4	Low

Source: CDRA Workshop, 2018

Soil Erosion

Soil erosion hazard have many factors to be consider such as slope, elevation and soil type and more importantly, the influence of water and wind that can create more damage on the soil erosion events.

In Alaminos, about 2,570.01 or 48.08 % of the total land area of the municipality experienced soil erosion hazard (refer to Map 17). These barangays are San Andres, San Juan, Poblacion 2, Poblacion 3, Del Carmen, San Ildefonso, Palma, Sta. Rosa, and San Gregorio (Refer to Table 14). Barangays Palma, San Gregorio and Sta. Rosa categorized as moderate susceptibility due to its geographical location, slope ranging 18 – 50 percent with an elevation of 286-728 meters above sea level. Moreover, the soil can also resist erosion have greatly affects the effect of high potential erosion.

Further, Macolod clay loam and Mountain soils are present in portion of barangays categorized as moderately susceptible that is in favor to have a good resistance to erosion. However, the extreme and intense rainfall can increase the speed surface runoff resulting to high sediment load, which is directly affect water bodies.

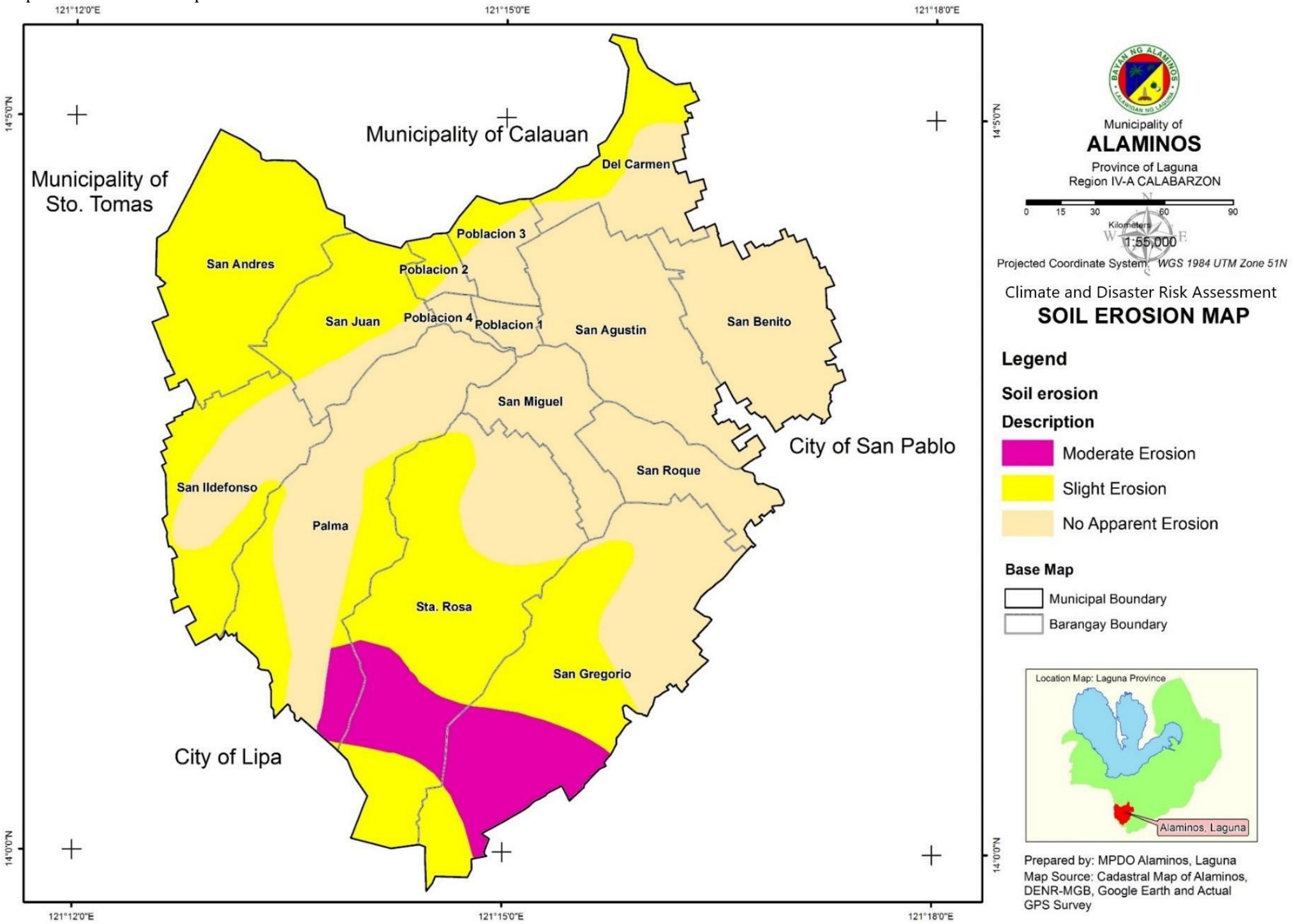
Table 14. Soil Erosion Hazard of Alaminos, Laguna

Erosion Susceptibility	Barangay	Area (Ha)	Total Area (Ha)	Percentage to Total Area Susceptible
No Apparent Erosion	Del Carmen	146.98	2775.34	51.92
	Palma	476.66		
	Poblacion 1	43.61		
	Poblacion 2	13.83		
	Poblacion 3	74.70		
	Poblacion 4	28.71		
	San Agustin	438.93		
	San Benito	379.09		
	San Gregorio	300.87		
	San Ildefonso	186.58		
	San Juan	75.82		
	San Miguel	199.89		
	San Roque	197.76		
	Sta. Rosa	211.94		
Slight Erosion	Del Carmen	111.04	2162.10	40.45
	Palma	200.86		
	Poblacion 2	35.57		
	Poblacion 3	36.96		
	San Andres	494.64		
	San Gregorio	336.32		
	San Ildefonso	194.19		
	San Juan	211.51		
	Sta. Rosa	541.03		
Moderate Erosion	Palma	47.88	407.91	7.63
	San Gregorio	220.19		
	Sta. Rosa	139.88		

	Total Area (Ha)	Percentage to total land area
Total area susceptible	5,345.35	100
Total area not susceptible	0	0
Total	5,345.35	100

Source: MPDO GIS computation 2017, DENR-MGB, 2013

Map 17: Soil Erosion Map



Multi-hazard

The Multi-hazard map was based on the identified five (5) hazards in the Municipality. Table 15 summarizes the area susceptible to hazards per barangay. Map 18 shows the multi-hazard exposure of Alaminos.

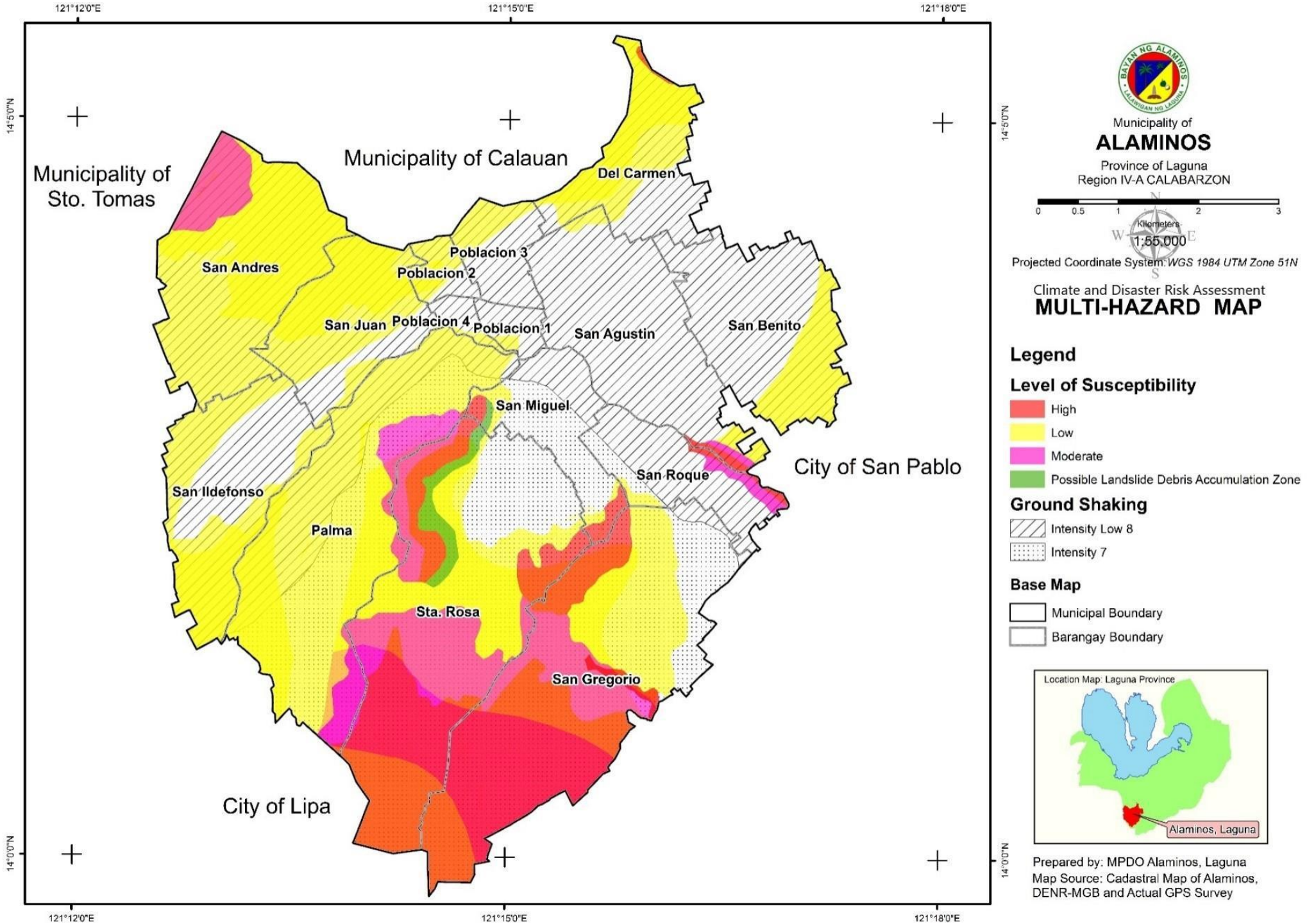
Only Barangay San Gregorio are susceptible to all hazards. And all barangays are susceptible to earthquake manifested by ground shaking. In barangay San Benito 30% of the area are susceptible to flooding. In barangay Palma, 99% are susceptible to rain-induced landslide. In terms of earthquake-induced landslide, 3% of barangay Palma and Sta.Rosa are susceptible. And 100% of San Andres are susceptible to soil erosion.

Table 15. Summary of Area Susceptible to Hazards per barangay in Alaminos, Laguna

Barangay	Land Area	Flood	RIL	Ground shaking	EIL	Soil Erosion
Palma	725.36	0.00	721.37	725.36	20.16	248.70
Poblacion 1	43.61	0.00	4.88	43.61	0.00	0.00
Poblacion 2	49.37	0.00	12.92	49.37	0.00	35.55
Poblacion 3	111.66	0.00	0.02	111.66	0.00	36.96
Poblacion 4	28.71	0.00	7.33	28.71	0.00	0.00
Del Carmen	258.00	0.07	171.19	258.00	0.00	111.04
San Agustin	428.93	25.96	8.89	428.93	0.00	0.00
San Andres	494.64	0.00	307.63	494.64	3.04	494.64
San Benito	379.09	113.24	0.00	379.09	0.00	0.00
San Gregorio	857.37	13.00	739.97	857.37	9.22	556.51
San Ildefonso	380.77	0.00	125.84	380.77	0.00	194.19
San Juan	287.32	0.00	132.66	287.32	0.00	211.51
San Miguel	199.89	0.00	42.39	199.89	3.88	0.00
San Roque	197.776	23.02	7.96	197.776	0.00	0.00
Santa Rosa	892.86	0.00	735.65	892.86	26.59	680.92

Source: MPDO GIS computation 2017, DENR-MGB, 2013

Map 18: Multi-Hazard Map



Exposure, Sensitivity, Adaptive Capacity and Vulnerability

Population

Population refers to the households' special location and number of potentially affected persons based on demographic characteristics. Population exposure refers to the spatial location and number of potentially affected persons exposed to a particular hazard.

The indicators used to measure the exposure and adaptive capacity for all hazard events in the municipality are as follows:

Table 16. Exposure and Adaptive Capacity Indicators used for the Population system in Alaminos, Laguna

Exposure	Adaptive Capacity
Affected Area Exposed Population Percentage of Exposed Area	Access to financial assistance Access to information Capacity and willingness to retrofit or relocate Government investments

Population Exposure to Hazards

In terms of flooding, only barangays San Gregorio and San Ildefonso have population exposed to flooding hazards, with 2.07 hectares and 0.10 hectares exposed, both with less than one percent of its population. In terms of the barangay area, barangays Del Carmen, San Agustin, San Gregorio, San Ildefonso, and San Roque have areas exposed to flooding. It shall be noted that areas that are exposed to flooding events shall adhere to local and national policies to mitigate and adapt to the impacts of the events.

Table 17 shows the summary of the population exposure to flooding events. (Map 19 shows the population exposed to flooding.)

Table 17. Population Exposure to Flood Events in Alaminos, Laguna

Barangay	Exposure		
	A	B	C
	Affected area	Exposed pop'n (Ha)	Exposure %
Poblacion 1	0.00	0.00	0.00
Poblacion 2	0.00	0.00	0.00
Poblacion 3	0.00	0.00	0.00
Poblacion 4	0.00	0.00	0.00
Del Carmen	0.07	0.00	0.00
Palma	0.00	0.00	0.00
San Agustin	25.96	0.00	0.00
San Andres	0.00	0.00	0.00
San Benito	0.00	0.00	0.00
San Gregorio	13.00	2.07	0.01
San Ildefonso	113.24	0.00	0.00
San Roque	23.02	0.10	0.00

San Juan	0.00	0.00	0.00
San Miguel	0.00	0.00	0.00
Sta Rosa	0.00	0.00	0.00

Source: CDRA Workshop, MPDO GIS Computation, 2018

As for RIL, barangays Palma having a 13.50 percent, Santa Rosa with 13.76 percent and have the highest percentage of its population exposed to RIL were San Gregorio with 13.84 percent, while barangays San Andres, Poblacion 3, and Del Carmen are not exposed and susceptible to this type of hazard. (refer to Table 18).

Map 20 shows population exposed to rain-induced landslide in the municipality.

Table 18. Population Exposure to RIL Events in Alaminos, Laguna

Barangay	Exposure		
	A	B	C
	Affected area	Exposed pop'n (in ha)	Exposure %
Poblacion 1	4.88	1.39	0.09
Poblacion 2	12.92	6.25	0.24
Poblacion 3	2.21	0.00	0.00
Poblacion 4	7.33	0.74	0.40
Del Carmen	171.19	7.30	3.20
Palma	721.37	15.33	13.50
San Agustin	8.89	0.00	0.00
San Andres	307.63	3.52	5.76
San Benito	0.00	0.00	0.00
San Gregorio	739.96	14.93	13.84
San Ildefonso	125.84	0.58	2.35
San Roque	7.96	0.00	0.15
San Juan	132.66	1.33	2.48
San Miguel	42.39	0.02	0.79
Sta Rosa	735.65	0.53	13.76

Source: CDRA Workshop, MPDO GIS Computation, 2018

Earthquake induced landslide only affect populations residing in barangays Palma, San Miguel and Sta. Rosa (refer to Table 16), in terms of percentage of population exposed, all barangays have an insignificant value or less than one (1) percent. Structures and materials used for houses must be in compliance with the National Building Code to ensure that the population is safe and sustain less damage to their properties. Map 21 presents the population exposed to EIL in the municipality.

Table 19. Population Exposure to EIL Events in Alaminos, Laguna

Barangay	Exposure		
	A	B	C
	Affected area	Exposed pop'n (in Ha)	Exposure %
Poblacion 1	0.00	0.00	0.00
Poblacion 2	0.00	0.00	0.00
Poblacion 3	0.00	0.00	0.00

Poblacion 4	0.00	0.00	0.00
Del Carmen	0.00	0.00	0.00
Palma	20.16	0.14	0.00
San Agustin	0.00	0.00	0.00
San Andres	3.04	0.00	0.00
San Benito	0.00	0.00	0.00
San Gregorio	9.22	0.00	0.00
San Ildefonso	0.00	0.00	0.00
San Roque	0.00	0.00	0.00
San Juan	0.00	0.00	0.00
San Miguel	3.88	0.03	0.00
Sta Rosa	26.59	0.06	0.00

Source: CDRA Workshop, MPDO GIS Computation, 2018

On the other hand, all barangays are affected by ground shaking (refer to Table 17). Barangay San Agustin has the highest area of population exposed to ground shaking with 41.59 hectares or 0.78 percent of its total population, followed by San Benito with 0.67 percent and Sta. Rosa with 0.49 percent of its population exposed to this hazard event. Map 22 shows population exposed to ground shaking.

Table 20. Population Exposure to Ground Shaking Events in Alaminos, Laguna

Barangay	Exposure		
	A	B	C
	Affected area	Exposed pop'n (in Ha)	Exposure %
Poblacion 1	10.94	10.94	0.20
Poblacion 2	19.22	19.22	0.36
Poblacion 3	22.50	22.50	0.42
Poblacion 4	11.76	11.76	0.22
Del Carmen	7.43	7.43	0.14
Palma	15.34	15.34	0.29
San Agustin	41.59	41.59	0.78
San Andres	19.37	19.37	0.36
San Benito	35.87	35.87	0.67
San Gregorio	17.95	17.95	0.34
San Ildefonso	14.76	14.76	0.28
San Roque	12.56	12.56	0.23
San Juan	20.83	20.83	0.39
San Miguel	14.95	14.95	0.28
Sta Rosa	26.25	26.25	0.49

Source: CDRA Workshop, MPDO GIS Computation, 2018

Population is also exposed to soil erosion, particularly in barangays San Juan and San Andres, being the barangays with the highest percentage of population exposed, having 0.37 percent and 0.36 percent, respectively (refer to Table 21 and Map 23). Barangays Poblacion 1, Poblacion 4, San Agustin, San Benito, San Roque, and San Miguel are not exposed to this type of hazard.

Table 21. Population Exposure to Soil Erosion in Alaminos, Laguna

Barangay	Exposure		
	A	B	C
	Affected area	Exposed pop'n (in Ha)	Exposure %
Poblacion 1	0.00	0.00	0.00
Poblacion 2	35.55	13.74	0.26
Poblacion 3	36.96	8.34	0.16
Poblacion 4	0.00	0.00	0.00
Del Carmen	111.04	0.70	0.01
Palma	248.70	0.47	0.01
San Agustin	0.00	0.00	0.00
San Andres	494.64	19.37	0.36
San Benito	0.00	0.00	0.00
San Gregorio	556.51	2.46	0.05
San Ildefonso	194.19	1.77	0.03
San Roque	0.00	0.00	0.00
San Juan	211.51	19.84	0.37
San Miguel	0.00	0.00	0.00
Sta Rosa	680.92	0.53	0.01

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 19 summarizes the degree of impact to hazard events of Alaminos. A degree of impact value of one (1) means that the estimated direct and indirect impacts are low to negligible and can be felt within a short period of time only. All barangays exposed to flooding, ground shaking, and EIL have low degree of impact, while some barangays exposed to RIL and soil erosion have a combination of degree of impact values of two (2) and three (3). A DOI value of two (2) means that the direct and indirect impacts are moderate in terms of number of fatalities and injuries, while a value of three (3) means that the estimated direct and indirect impacts in terms of number of fatalities and injuries are disastrous.

All barangays have low degree of impact score (1) in terms of flooding, earthquake-induced landslide and ground shaking, while rain-induced landslide and soil erosion have varying degree of impact scores.

Table 22. Degree of Impact of Population to Hazard events of Alaminos, Laguna

Barangay	Degree of Impact				
	Flood	RIL	EIL	Ground Shaking	Soil Erosion
Poblacion 1	1	1	1	1	1
Poblacion 2	1	1	1	1	1
Poblacion 3	1	1	1	1	1
Poblacion 4	1	1	1	1	1
Del Carmen	1	1	1	1	1
Palma	1	3	1	1	2
San Agustin	1	1	1	1	1
San Andres	1	2	1	1	3
San Benito	1	1	1	1	1

San Gregorio	1	3	1	1	3
San Ildefonso	1	1	1	1	2
San Roque	1	1	1	1	1
San Juan	1	1	1	1	2
San Miguel	1	1	1	1	1
Sta Rosa	1	3	1	1	3

Source: CDRA Workshop

Population Adaptive Capacity to Hazards

Four indicators were used to assess the adaptive capacity of the municipality. Access to financial assistance include the five (5) percent disaster risk reduction and management (DRRM) and gender and development (GAD) fund is utilized; 4Ps for beneficiaries, Cash for Work; calamity loan for Govt employees; Financial assistance such as micro-financing, credit cooperatives, banks. All barangays have access to these financial assistances.

In the same way, all barangays have access to information, such as cellphone, radio, television, mega phone; Earthquake Drill conducted every quarter, presence of Early Warning System such as siren and rain gauge; IEC; flyers and maps about CCA-DRR distributed to barangays.

On the other hand, all barangays have no capacity to retrofit however households are willing to relocate if government will provide incentives and other subsidies.

The municipality have investments on the following: rescue vehicle, command center and equipment (e.g. 2-way radio communication ,equipment); produce IEC related to extension programs; with current CDP and CLUP (mainstreamed CCA-DRR); LGU has existing partnership with SUC for technology transfer, in which all barangays can use and access.

Table 23. Adaptive Capacity of Population to Hazard events of Alaminos, Laguna

Barangay	Adaptive Capacity			
	Access to financial assistance (%)	Access to information (%)	Capacity and willingness to retrofit or relocate (%)	Government investments (%)
Poblacion 1	100	100	0	100
Poblacion 2	100	100	0	100
Poblacion 3	100	100	0	100
Poblacion 4	100	100	0	100
Del Carmen	100	100	0	100
Palma	100	100	0	100
San Agustin	100	100	0	100
San Andres	100	100	0	100
San Benito	100	100	0	100
San Gregorio	100	100	0	100
San Ildefonso	100	100	0	100
San Roque	100	100	0	100
San Juan	100	100	0	100
San Miguel	100	100	0	100
Sta Rosa	100	100	0	100

Source: CDRA Workshop

Population Vulnerability to Hazards

Table 24 below summarizes the vulnerability ratings of Alaminos in terms of its population and hazards. Vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. All urban barangays have low vulnerability ratings while urban barangays have a combination of low and moderate vulnerability ratings. Barangays Palma, San Andres, San Gregorio, San Ildefonso, San Juan, and Sta. Rosa have moderate vulnerability ratings in terms of RIL and soil erosion.

Low vulnerability ratings in these areas can be attributed to low exposure to hazards of the population of Alaminos.

Table 24. Vulnerability Ratings of Population to Hazard events of Alaminos, Laguna using Exposure and Adaptive Capacity indicators

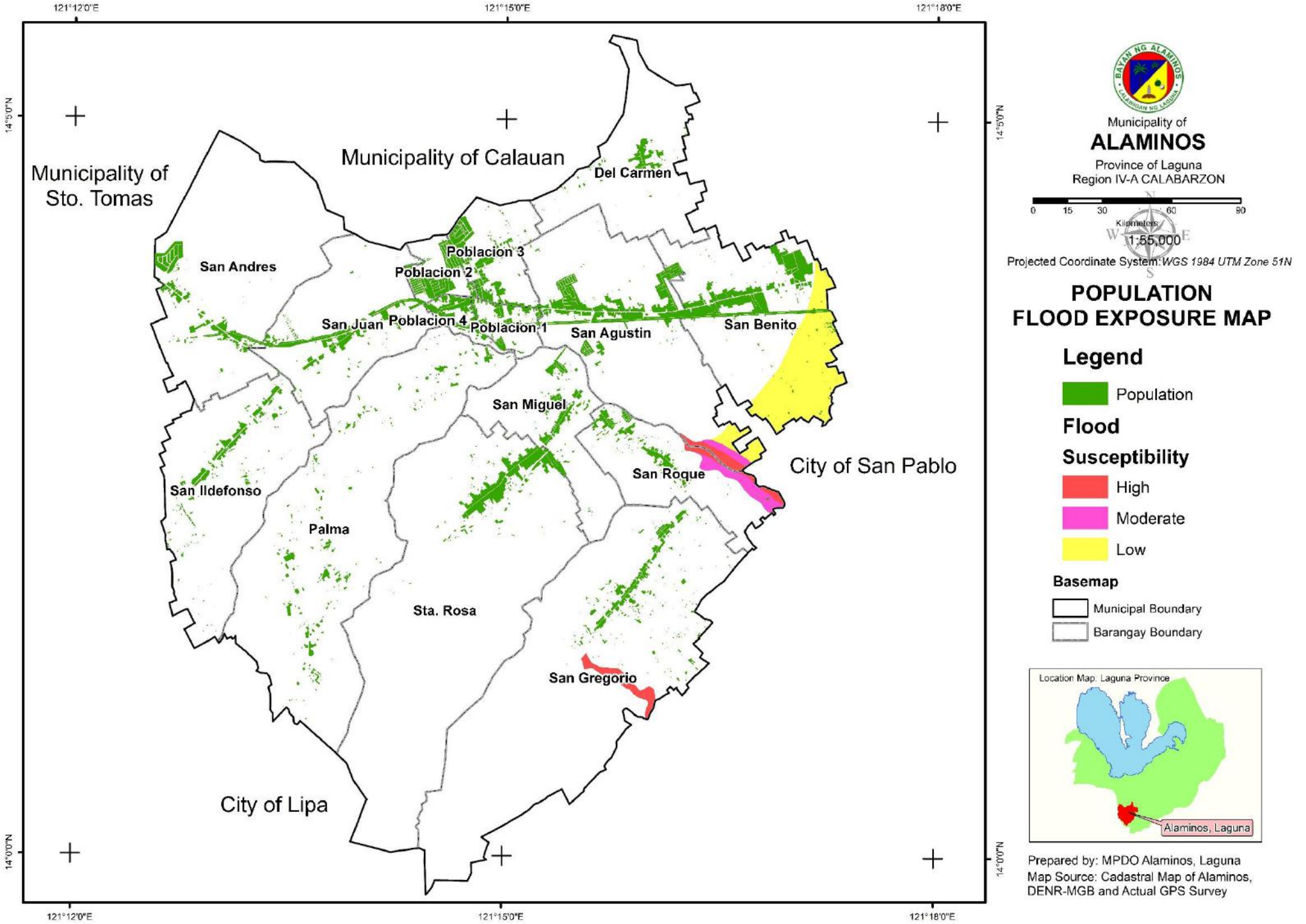
Barangay	Vulnerability				
	Flood	RIL	EIL	Ground Shaking	Soil Erosion
Poblacion 1	Low	Low	Low	Low	Low
Poblacion 2	Low	Low	Low	Low	Low
Poblacion 3	Low	Low	Low	Low	Low
Poblacion 4	Low	Low	Low	Low	Low
Del Carmen	Low	Low	Low	Low	Low
Palma	Low	Moderate	Low	Low	Moderate
San Agustin	Low	Low	Low	Low	Low
San Andres	Low	Moderate	Low	Low	Moderate
San Benito	Low	Low	Low	Low	Low
San Gregorio	Low	Moderate	Low	Low	Moderate
San Ildefonso	Low	Low	Low	Low	Moderate
San Roque	Low	Low	Low	Low	Low
San Juan	Low	Low	Low	Low	Moderate
San Miguel	Low	Low	Low	Low	Low
Sta Rosa	Low	Moderate	Low	Low	Moderate

Source: CDRA Workshop, MPDO GIS Computation, 2018

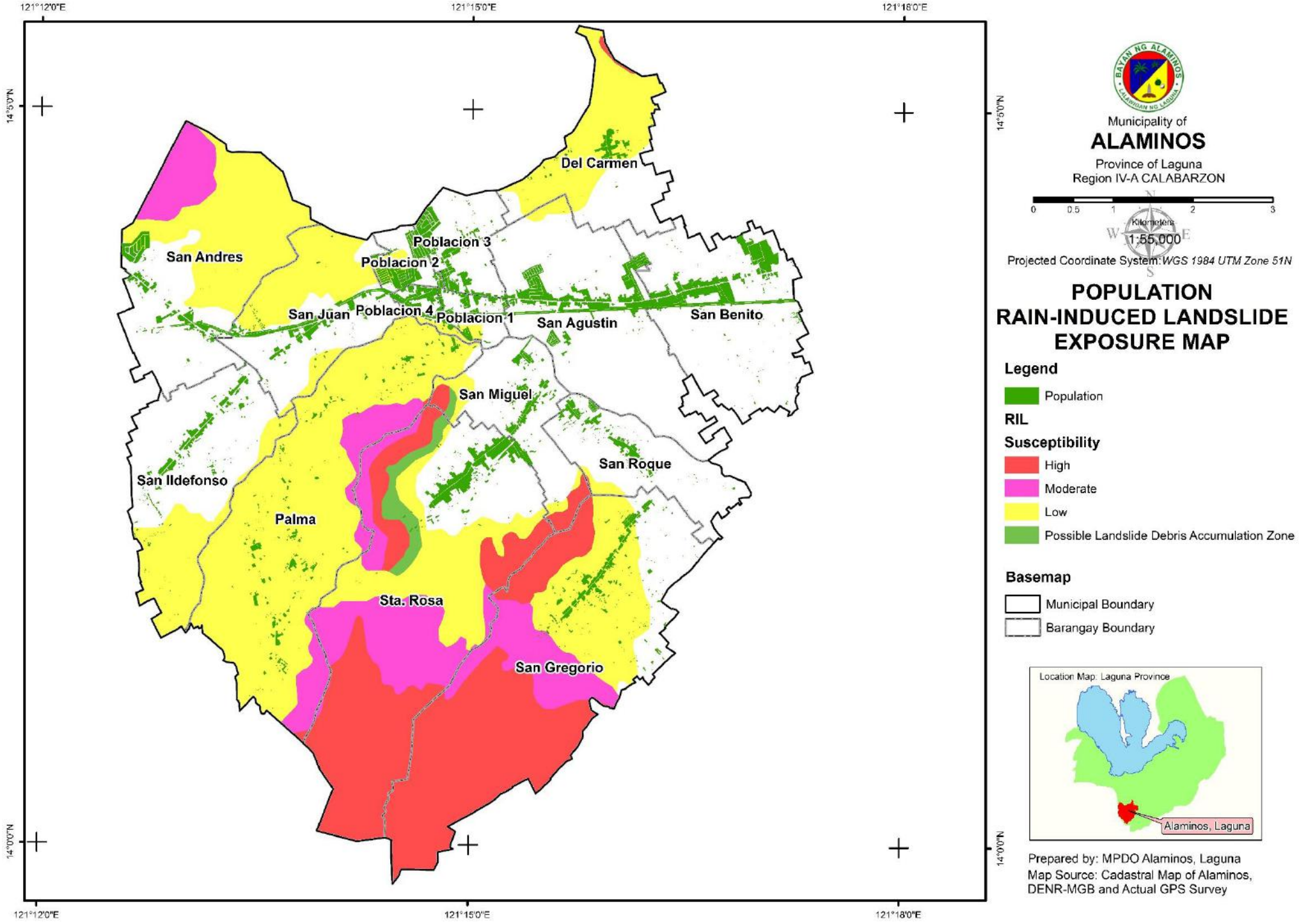
Refer to:

Map 24: Population Vulnerability to Flooding
Map 25: Population Vulnerability to Rain-induced Landslide
Map 26: Population Vulnerability to Earthquake-induced Landslide
Map 27: Population Vulnerability to Ground Shaking
Map 28: Population Vulnerability to Soil Erosion

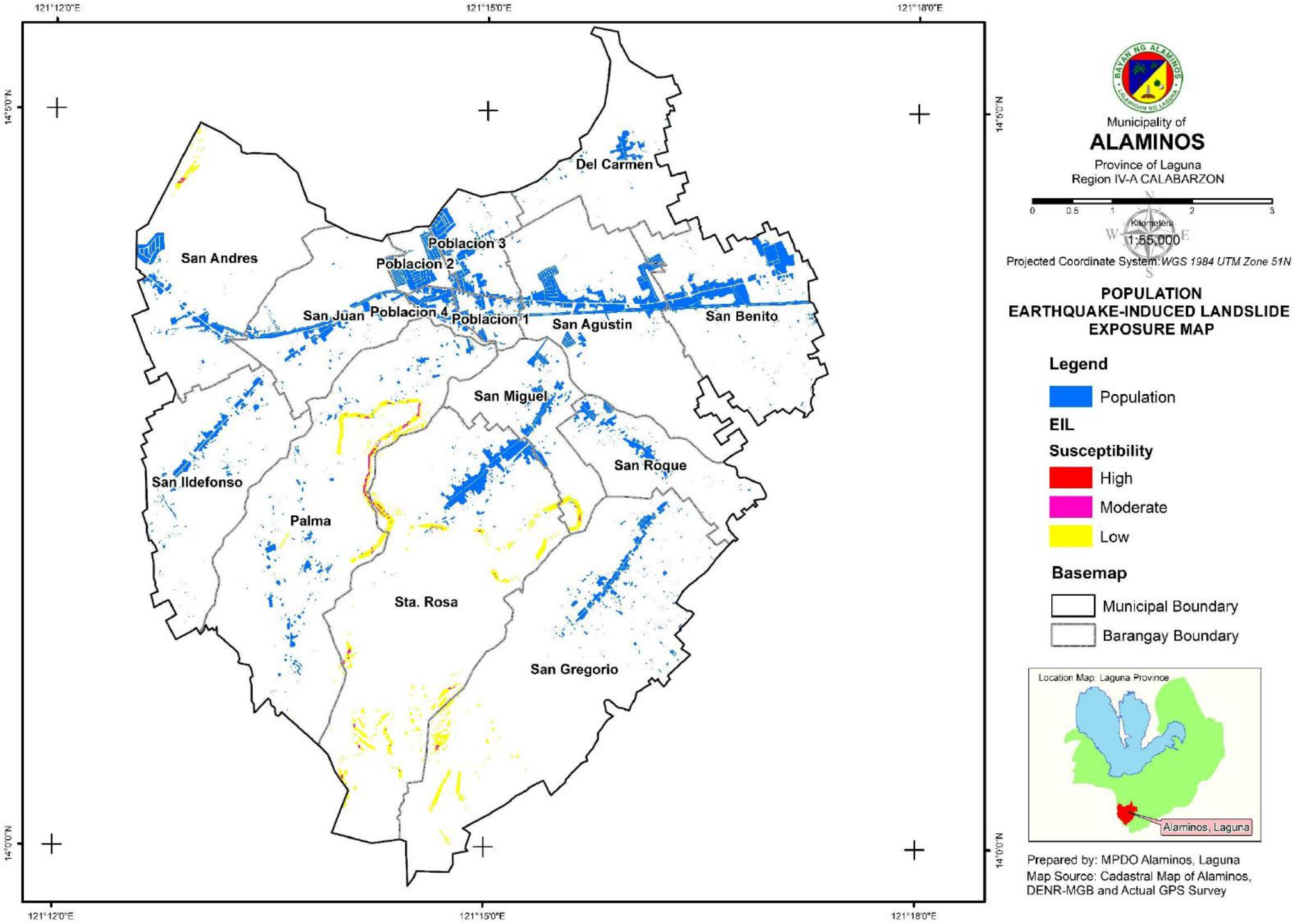
Map 19: Population Flood Exposure Map



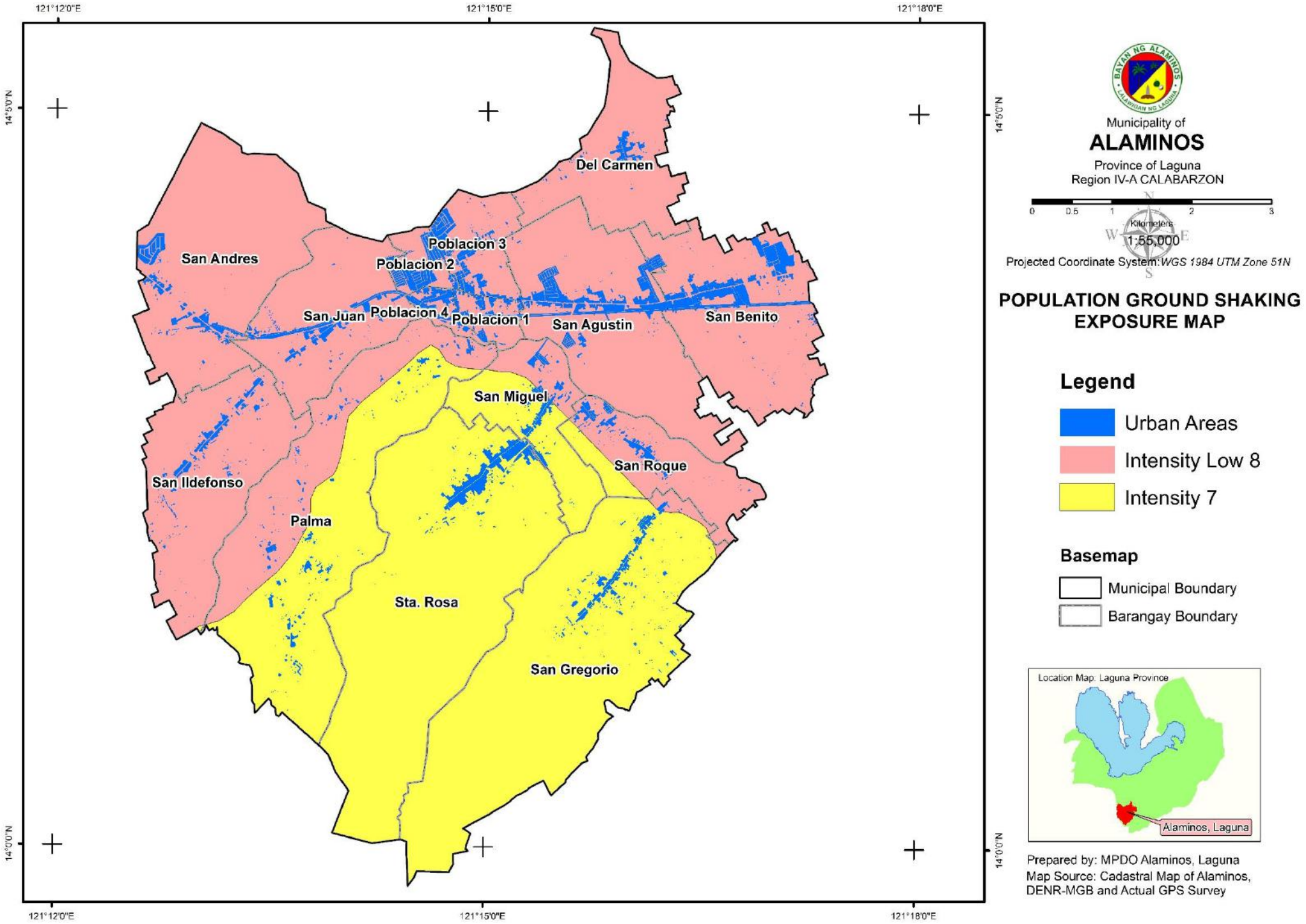
Map 20: Population Rain-induced Landslide Exposure Map



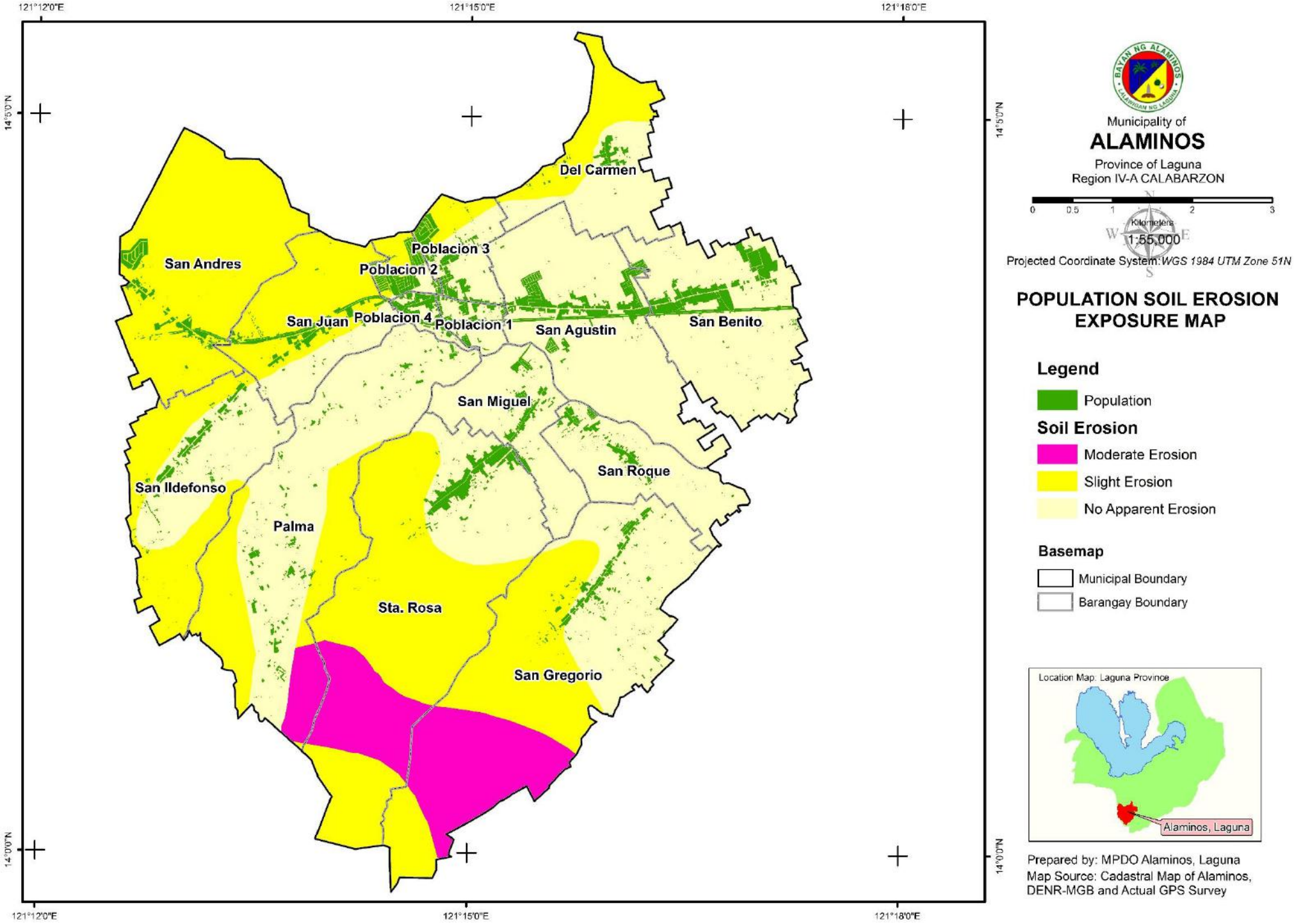
Map 21: Population Earthquake-induced Landslide Exposure Map



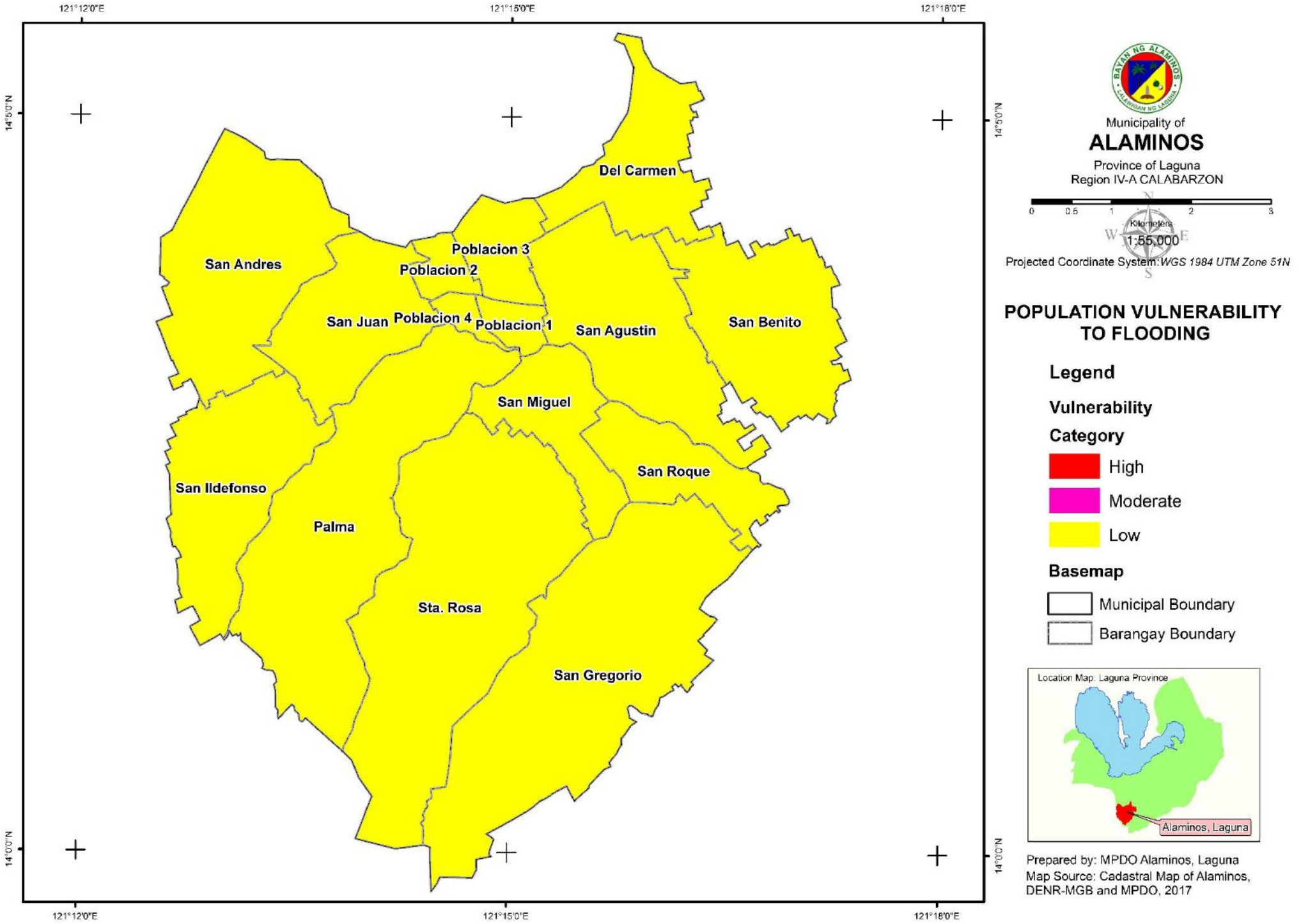
Map 22: Population Ground Shaking Exposure Map



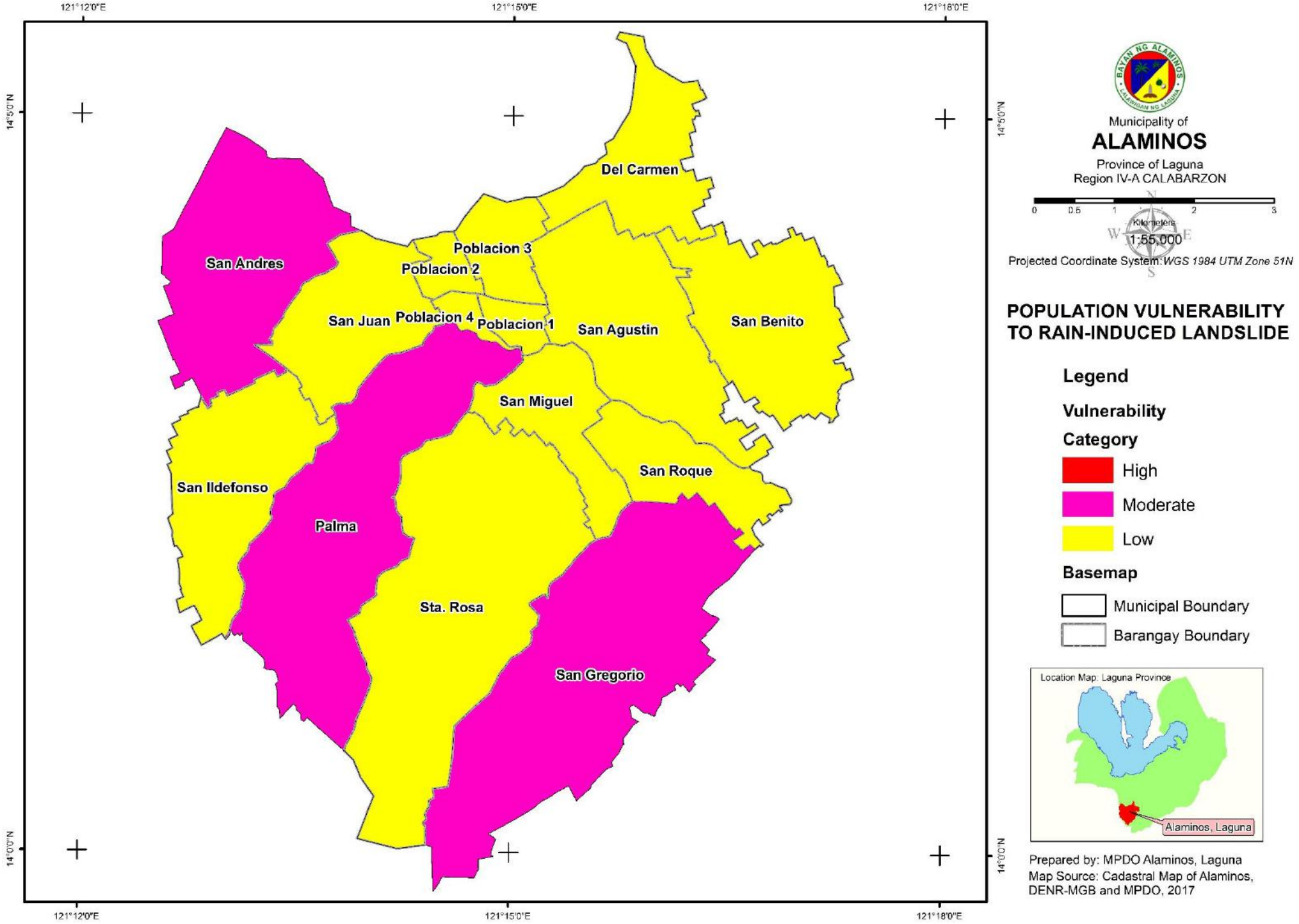
Map 23: Population Soil Erosion Exposure Map



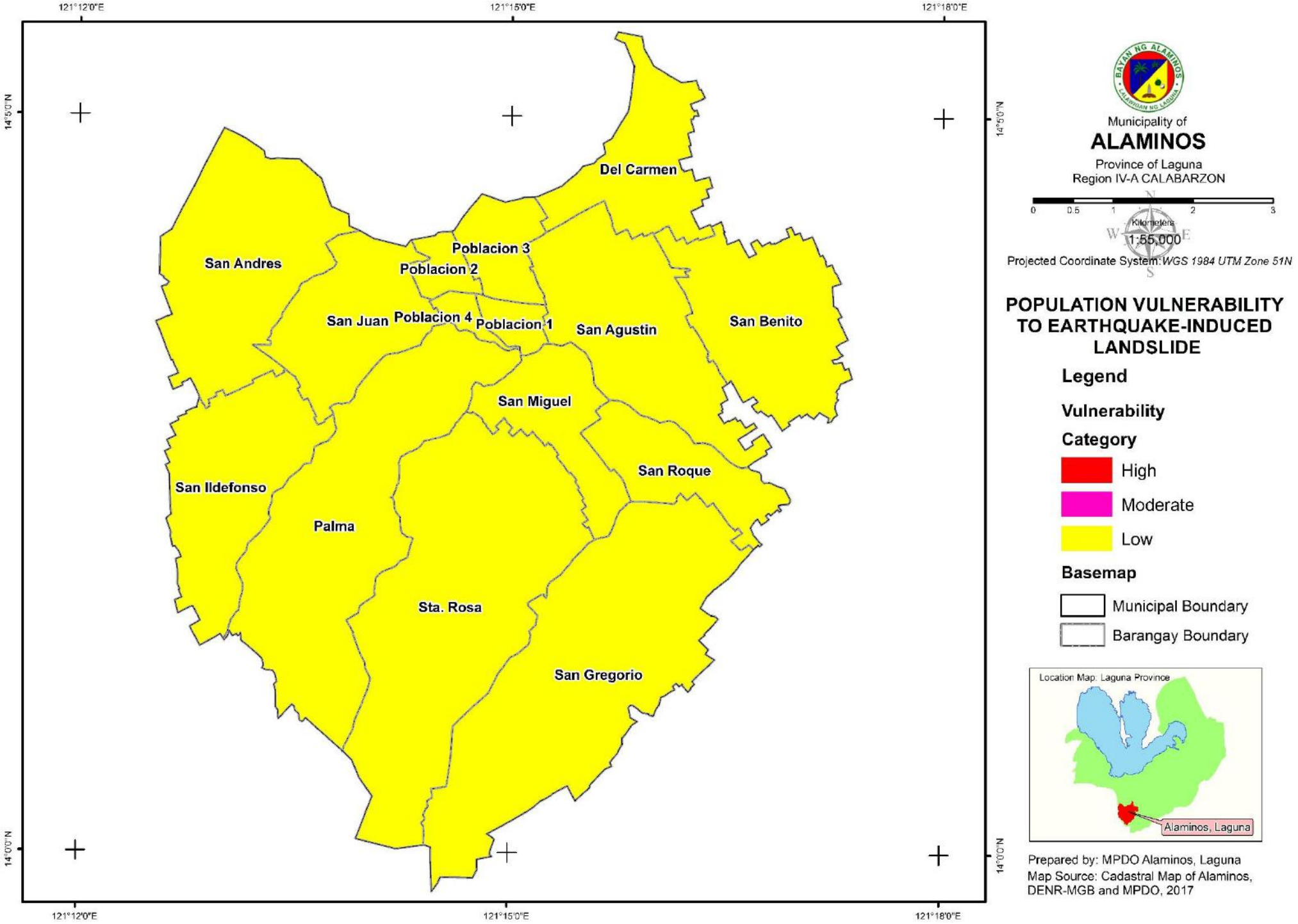
Map 24: Population Vulnerability to Flooding



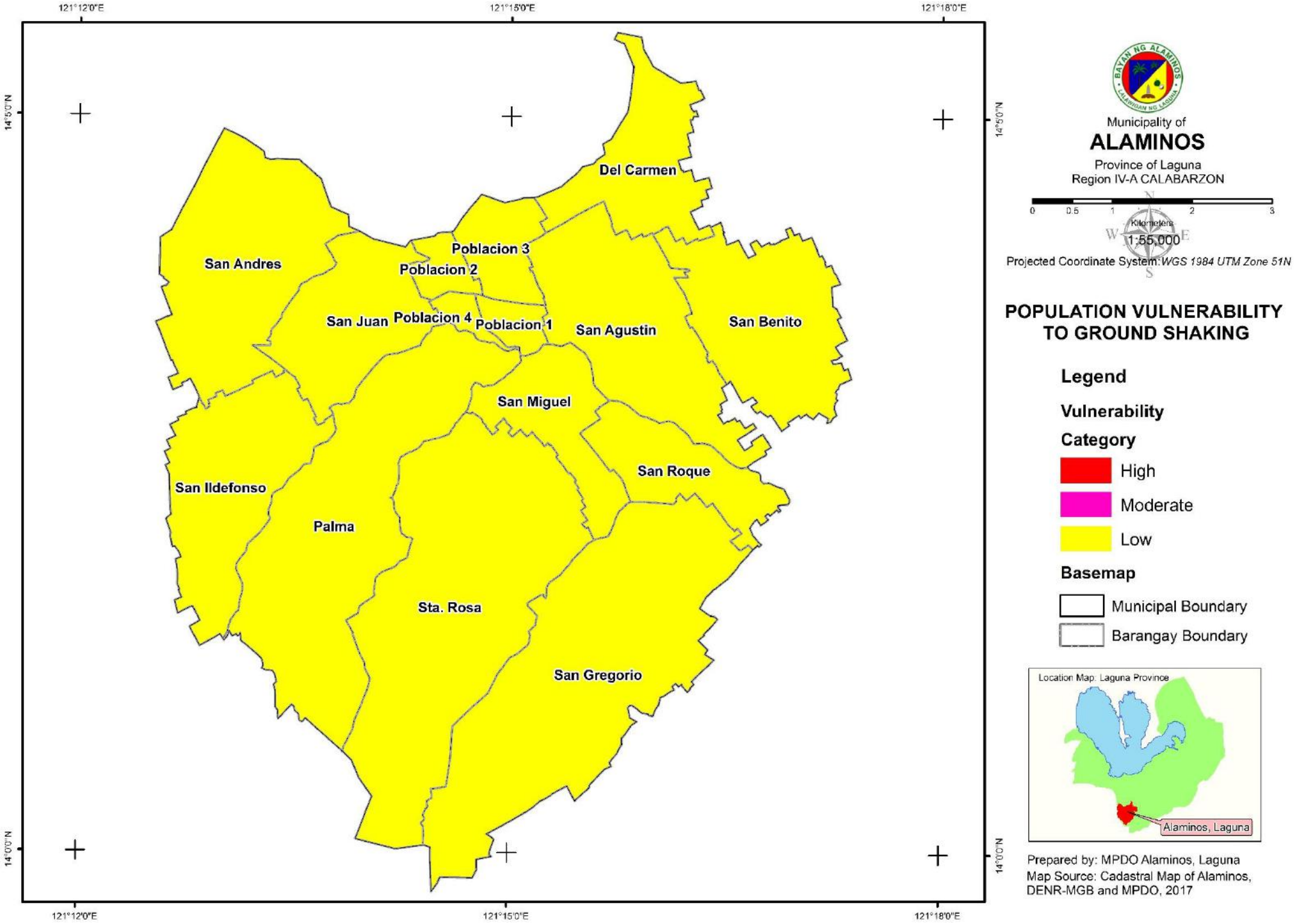
Map 25: Population Vulnerability to Rain-induced Landslide



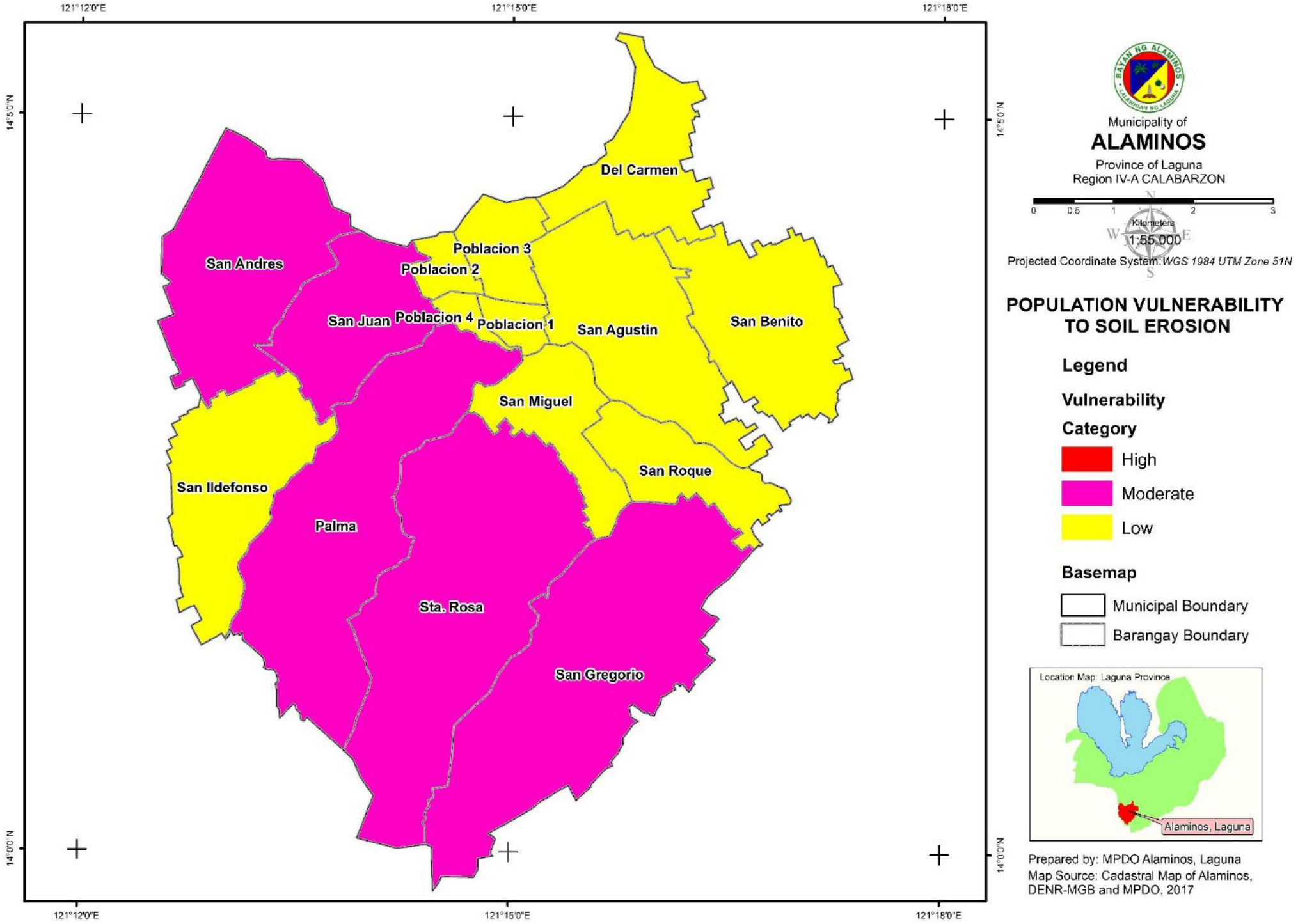
Map 26: Population Vulnerability to Earthquake-induced Landslide



Map 27: Population Vulnerability to Ground Shaking



Map 28: Population Vulnerability to Soil Erosion



Critical Facilities

Critical facilities include elementary schools, day care centers, government offices such as barangay and municipal halls, health centers, police stations, fire stations, transport terminals, among others. These facilities provide key socio-economic support services. Table 22 shows the indicators used for assessing the exposure and adaptive capacity of the municipality. Due to limited information, only the following indicators were used.

Table 25. Exposure and Adaptive Capacity Indicators used for Critical Facilities in Alaminos, Laguna

Exposure	Adaptive Capacity
Facility Type Area in Square Meters	Capacity and willingness to retrofit Available alternative structures Government Investments Available Alternative Sites

Critical Facilities Exposure to Hazards

In terms of degree of impact, flooding, RIL, EIL and soil erosions have a value of one (1), while ground shaking has a value of three (3). A value of one (1) has a low degree of impact, which means that the estimated direct and indirect impacts are low to negligible and can be felt within a short period of time. While critical point facilities with a value of three (3) means that the estimated direct and indirect impacts in terms of property damage will be disastrous given the extent of exposure and current sensitivity of the system. The high degree of impact for ground shaking can be attributed to the materials used, age of the buildings and location.

Table 23 shows the exposure and degree of impact on critical point facilities in the municipality.

Table 26. Flood Exposure and Degree of impact on critical point facilities in Alaminos, Laguna

Barangay	Exposure			Degree of Impact score
	A	B	C	
	Facility Type	Name	Area (Sq.M)	
Poblacion 1	Chapel	Poblacion 1 Chapel	199	1
Poblacion 1	Chapel	Poblacion 1 Chapel	100	1
Poblacion 1	Church	Munting Kawan	83	1
Poblacion 1	Day Care Center and Barangay Hall	Poblacion 1 Day Care Center and Barangay Hall	130	1
Poblacion 1	Elementary School	Cresmat Learning Center	1,452	1
Poblacion 1	Government Office	Quezon Farmers' Office	365	1
Poblacion 2	Vocational School and Senior High School	KCD Technical Institute	3,200	1
Poblacion 2	Barangay Hall	Poblacion 2 Barangay Hall	202	1
Poblacion 2	Chapel	Poblacion 2 Chapel	178	1

Barangay	Exposure			Degree of Impact score
	A	B	C	
	Facility Type	Name	Area (Sq.M)	
Poblacion 2	Senior Citizen Building	Barangay 2 Senior Citizen	203	1
Poblacion 2	Elementary and Secondary School	Alaminos Elementary School and Alaminos National High School	27,423	1
Poblacion 3	Church	Municipal Church	5,860	1
Poblacion 3	Barangay Hall	Poblacion 3 Barangay Hall	38	1
Poblacion 3	Municipal Building	Alaminos Municipal Building	2,875	1
Poblacion 3	Rural Health Unit Building	Alaminos Rural Health Building	229	1
Poblacion 3	Police Station	Alaminos Municipal Police Station	151	1
Poblacion 3	Government Office	Philippine Coconut Authority Provincial Official	9,263	1
Poblacion 3	Elementary and Secondary School	St. Paul Learning School	469	1
Poblacion 3	Pre-School*	Palm Valley International School	1,710	1
Poblacion 3	Elementary, Secondary, College School	Marcelino Fule Memorial College	10,046	1
Poblacion 3	Church	Mosque	212.64	1
Poblacion 4	Water District	Alaminos Water District	301	1
Poblacion 4	Church	Church of Christ	163	1
Poblacion 4	Church	Ang Dating Daan Church	162	1
Poblacion 4	Church	Jesus is the Lord Church	290	1
Poblacion 4	Pre-School	Reymarie's Pre-School	1,020	1
Poblacion 4	Chapel	Poblacion 4 Chapel	44.5	1
Poblacion 4	Day Care and Barangay Hall	Poblacion 4 Day Care and Barangay Hall	122	1
Poblacion 4	Chapel	Poblacion 4 Chapel	1,387	1
Poblacion 4	Pre-School and Elementary School	Marantha Christian School	1,515	1
Del Carmen	Chapel	Del Carmen Chapel	77.12	1
Del Carmen	Elementary School	Del Carmen Elementary School	1647.32	1
Palma	Barangay Hall	Palma Barangay Hall	130.14	1
Palma	Chapel	Palma Chapel	300.95	1

Barangay	Exposure			Degree of Impact score
	A	B	C	
	Facility Type	Name	Area (Sq.M)	
Palma	Chapel	Palma Chapel	740.13	1
Palma	Elementary School	Palma Elementary School	5185.13	1
San Agustin	Others	East PAC Base	25.34	1
San Agustin	Chapel	San Agustin Chapel	185.96	1
San Agustin	Health Center	San Agustin Health Center	537.26	1
San Agustin	Barangay Hall	San Agustin Barangay Hall	116.84	1
San Agustin	Elementary School	San Agustin Elementary School	6422.05	1
San Agustin	Secondary School	Buenaventura Fandialan Integrated National Highschool	3842.89	1
San Andres	Senior Citizen Building	San Andres Senior Citizen	45.3	1
San Andres	Barangay Hall	San Andres Barangay Hall	127	1
San Andres	Elementary School	San Andres Elementary School	8,404	1
San Andres	Chapel	San Andres Chapel	225	1
San Andres	***	KALK	135	1
San Benito	Day Care Center	San Benito Day Care Center	116.89	1
San Benito	Barangay Hall	San Benito Barangay Hall	143.93	1
San Benito	Church	Iglesia ni Cristo	382.32	1
San Benito	Chapel	San Benito Chapel	512.13	1
San Benito	Government Office	Land Transportation Office - Provincial	10446.95	1
San Benito	Elementary School	San Benito Elementary School	5125.41	1
San Gregorio	Barangay Hall	San Gregorio Barangay Hall	156.86	1
San Gregorio	Chapel	San Gregorio Chapel	523.25	1
San Gregorio	Elementary School	Demesa Elementary School	5492.13	1
San Ildefonso	Church	Iglesia ni Cristo	621	1
San Ildefonso	Barangay Hall	San Juan Barangay Hall	143	1
San Ildefonso	Elementary School	San Ildefonso Elementary School	3,497.46	1

Barangay	Exposure			Degree of Impact score
	A	B	C	
	Facility Type	Name	Area (Sq.M)	
San Ildefonso	Water Station	San Ildefonso Water Station	33.20	1
San Roque	Barangay Hall	San Roque Barangay Hall	304.6	1
San Roque	Chapel	San Roque Chapel	139.36	1
San Roque	Elementary School	San Roque Elementary School	2850.55	1
San Juan	Chapel	San Juan - Our Lady of the Pillar Chapel	88	1
San Juan	Chapel	San Juan Chapel	87.3	1
San Juan	Barangay Hall	San Juan Barangay Hall	136	1
San Juan	Church	Mormons	4,231	1
San Juan	Church	Iglesia ni Cristo	2,082	1
San Juan	Church	Kingdom Hall of Jehovah Witness	600	1
San Juan	Outpost	West PAH Base	125	1
San Juan	Elementary School	San Juan Elementary School	3,946	1
San Miguel	Chapel	San Miguel Chapel	109.64	1
San Miguel	Chapel	San Pedro Calungsod Parish	618.42	1
San Miguel	Barangay Hall	San Miguel Barangay Hall	357.44	1
San Miguel	Elementary School	San Miguel Elementary School	4855.37	1
Sta Rosa	Barangay Hall	Sta Rosa Barangay Hall	290.63	1
Sta Rosa	Elementary School	Sta Rosa Elementary School	5792.71	1
Sta Rosa	Chapel	Sta Rosa Chapel	292.98	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 27. Rain-induced Landslide Exposure and Degree of impact on critical point facilities in Alaminos, Laguna

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Poblacion 1	Chapel	Poblacion 1 Chapel	199	1
Poblacion 1	Chapel	Poblacion 1 Chapel	100	1
Poblacion 1	Church	Munting Kawan	83	1

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Poblacion 1	Day Care Center and Barangay Hall	Poblacion 1 Day Care Center and Barangay Hall	130	1
Poblacion 1	Elementary School*	Cresmat Learning Center	1,452	1
Poblacion 1	Government Office	Quezon Farmers' Office	365	1
Poblacion 2	Vocational School and Senior High School	KCD Technical Institute	3,200	1
Poblacion 2	Barangay Hall	Poblacion 2 Barangay Hall	202	1
Poblacion 2	Chapel	Poblacion 2 Chapel	178	1
Poblacion 2	Senior Citizen Building	Barangay 2 Senior Citizen	203	1
Poblacion 2	Elementary and Secondary School	Alaminos Elementary School and Alaminos National High School	27,423	1
Poblacion 3	Church	Municipal Church	5,860	1
Poblacion 3	Barangay Hall	Poblacion 3 Barangay Hall	38	1
Poblacion 3	Municipal Building	Alaminos Municipal Building	2,875	1
Poblacion 3	Rural Helath Unit Building	Alaminos Rural Health Building	229	1
Poblacion 3	Police Station	Alaminos Municipal Police Station	151	1
Poblacion 3	Government Office	Philippine Coconut Authority Provincial Official	9,263	1
Poblacion 3	Elementary and Secondary School	St. Paul Learning School	469	1
Poblacion 3	Pre-School*	Palm Valley International School	1,710	1
Poblacion 3	Elementary Secon dary College School	Marcelino Fule Memorial College	10,046	1
Poblacion 3	Church	Mosque	212.64	1
Poblacion 4	Water District	Alaminos Water District	301	1
Poblacion 4	Church	Church of Christ	163	1
Poblacion 4	Church	Ang Dating Daan Church	162	1

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Poblacion 4	Church	Jesus is the Lord Church	290	1
Poblacion 4	Pre-School	Reymarie's Pre-School	1,020	1
Poblacion 4	Chapel	Poblacion 4 Chapel	44.5	1
Poblacion 4	Day Care and Barangay Hall	Poblacion 4 Day Care and Barangay Hall	122	1
Poblacion 4	Chapel	Poblacion 4 Chapel	1,387	1
Poblacion 4	Pre-School and Elementary School	Marantha Christian School	1,515	1
Del Carmen	Chapel	Del Carmen Chapel	77.12	1
Del Carmen	Elementary School	Del Carmen Elementary School	1647.32	1
Palma	Barangay Hall	Palma Barangay Hall	130.14	1
Palma	Chapel	Palma Chapel	300.95	1
Palma	Chapel	Palma Chapel	740.13	1
Palma	Elementary School	Palma Elementary School	5185.13	1
San Agustin	***	East PAC Base	25.34	1
San Agustin	Chapel	San Agustin Chapel	185.96	1
San Agustin	Health Center	San Agustin Health Center	537.26	1
San Agustin	Barangay Hall	San Agustin Barangay Hall	116.84	1
San Agustin	Elementary School	San Agustin Elementary School	6422.05	1
San Agustin	Secondary School	Buenaventura Fandialan Integrated National Highschool	3842.89	1
San Andres	Senior Citizen Building	San Andres Senior Citizen	45.3	1
San Andres	Barangay Hall	San Andres Barangay Hall	127	1
San Andres	Elementary School	San Andres Elementary School	8,404	1
San Andres	Chapel	San Andres Chapel	225	1
San Andres	Others	KALK	135	1
San Benito	Day Care Center	San Benito Day Care Center	116.89	1
San Benito	Barangay Hall	San Benito Barangay Hall	143.93	1
San Benito	Church	Iglesia ni Cristo	382.32	1
San Benito	Chapel	San Benito Chapel	512.13	1

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
San Benito	Government Office	Land Transportation Office - Provincial	10446.95	1
San Benito	Elementary School	San Benito Elementary School	5125.41	1
San Gregorio	Barangay Hall	San Gregorio Barangay Hall	156.86	1
San Gregorio	Chapel	San Gregorio Chapel	523.25	1
San Gregorio	Elementary School	Demesa Elementary School	5492.13	1
San Ildefonso	Church	Iglesia ni Cristo	621	1
San Ildefonso	Barangay Hall	San Juan Barangay Hall	143	1
San Ildefonso	Elementary School	San Ildefonso Elementary School	3,497.46	1
San Ildefonso	Water Station	San Ildefonso Water Station	33.20	1
San Roque	Barangay Hall	San Roque Barangay Hall	304.6	1
San Roque	Chapel	San Roque Chapel	139.36	1
San Roque	Elementary School	San Roque Elementary School	2850.55	1
San Juan	Chapel	San Juan - Our Lady of the Pillar Chapel	88	1
San Juan	Chapel	San Juan Chapel	87.3	1
San Juan	Barangay Hall	San Juan Barangay Hall	136	1
San Juan	Church	Mormons	4,231	1
San Juan	Church	Iglesia ni Cristo	2,082	1
San Juan	Church	Kingdom Hall of Jehovah Witness	600	1
San Juan	Outpost	West PAH Base	125	1
San Juan	Elementary School	San Juan Elementary School	3,946	1
San Miguel	Chapel	San Miguel Chapel	109.64	1
San Miguel	Chapel	San Pedro Calungsod Parish	618.42	1
San Miguel	Barangay Hall	San Miguel Barangay Hall	357.44	1
San Miguel	Elementary School	San Miguel Elementary School	4855.37	1
Sta Rosa	Barangay Hall	Sta Rosa Barangay Hall	290.63	1
Sta Rosa	Elementary School	Sta Rosa Elementary School	5792.71	1

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Sta Rosa	Chapel	Sta Rosa Chapel	292.98	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 28. Earthquake-induced Landslide Exposure and Degree of impact on critical point facilities in Alaminos, Laguna

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Poblacion 1	Chapel	Poblacion 1 Chapel	199	1
Poblacion 1	Chapel	Poblacion 1 Chapel	100	1
Poblacion 1	Church	Munting Kawan	83	1
Poblacion 1	Day Care Center and Barangay Hall	Poblacion 1 Day Care Center and Barangay Hall	130	1
Poblacion 1	Elementary School*	Cresmat Learning Center	1,452	1
Poblacion 1	Government Office	Quezon Farmers' Office	365	1
Poblacion 2	Vocational School and Senior High School	KCD Technical Institute	3,200	1
Poblacion 2	Barangay Hall	Poblacion 2 Barangay Hall	202	1
Poblacion 2	Chapel	Poblacion 2 Chapel	178	1
Poblacion 2	Senior Citizen Building	Barangay 2 Senior Citizen	203	1
Poblacion 2	Elementary and Secondary School	Alaminos Elementary School and Alaminos National High School	27,423	1
Poblacion 3	Church	Municipal Church	5,860	1
Poblacion 3	Barangay Hall	Poblacion 3 Barangay Hall	38	1
Poblacion 3	Municipal Building	Alaminos Municipal Building	2,875	1
Poblacion 3	Rural Health Unit Building	Alaminos Rural Health Building	229	1
Poblacion 3	Police Station	Alaminos Municipal Police Station	151	1
Poblacion 3	Government Office	Philippine Coconut Authority Provincial Official	9,263	1

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Poblacion 3	Elementary and Secondary School	St. Paul Learning School	469	1
Poblacion 3	Pre-School*	Palm Valley International School	1,710	1
Poblacion 3	Elementary Secondary College School	Marcelino Fule Memorial College	10,046	1
Poblacion 3	Church	Mosque	212.64	1
Poblacion 4	Water District	Alaminos Water District	301	1
Poblacion 4	Church	Church of Christ	163	1
Poblacion 4	Church	Ang Dating Daan Church	162	1
Poblacion 4	Church	Jesus is the Lord Church	290	1
Poblacion 4	Pre-School	Reymarie's Pre-School	1,020	1
Poblacion 4	Chapel	Poblacion 4 Chapel	44.5	1
Poblacion 4	Day Care and Barangay Hall	Poblacion 4 Day Care and Barangay Hall	122	1
Poblacion 4	Chapel	Poblacion 4 Chapel	1,387	1
Poblacion 4	Pre-School and Elementary School	Maranatha Christian School	1,515	1
Del Carmen	Chapel	Del Carmen Chapel	77.12	1
Del Carmen	Elementary School	Del Carmen Elementary School	1647.32	1
Palma	Barangay Hall	Palma Barangay Hall	130.14	1
Palma	Chapel	Palma Chapel	300.95	1
Palma	Chapel	Palma Chapel	740.13	1
Palma	Elementary School	Palma Elementary School	5185.13	1
San Agustin	***	East PAC Base	25.34	1
San Agustin	Chapel	San Agustin Chapel	185.96	1
San Agustin	Health Center	San Agustin Health Center	537.26	1
San Agustin	Barangay Hall	San Agustin Barangay Hall	116.84	1
San Agustin	Elementary School	San Agustin Elementary School	6422.05	1
San Agustin	Secondary School	Buenaventura Fandialan	3842.89	1

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
		Integrated National Highschool		
San Andres	Senior Citizen Building	San Andres Senior Citizen	45.3	1
San Andres	Barangay Hall	San Andres Barangay Hall	127	1
San Andres	Elementary School	San Andres Elementary School	8,404	1
San Andres	Chapel	San Andres Chapel	225	1
San Andres	***	KALK	135	1
San Benito	Day Care Center	San Benito Day Care Center	116.89	1
San Benito	Barangay Hall	San Benito Barangay Hall	143.93	1
San Benito	Church	Iglesia ni Cristo	382.32	1
San Benito	Chapel	San Benito Chapel	512.13	1
San Benito	Government Office	Land Transportation Office - Provincial	10446.95	1
San Benito	Elementary School	San Benito Elementary School	5125.41	1
San Gregorio	Barangay Hall	San Gregorio Barangay Hall	156.86	1
San Gregorio	Chapel	San Gregorio Chapel	523.25	1
San Gregorio	Elementary School	Demesa Elementary School	5492.13	1
San Ildefonso	Church	Iglesia ni Cristo	621	1
San Ildefonso	Barangay Hall	San Juan Barangay Hall	143	1
San Ildefonso	Elementary School	San Ildefonso Elementary School	3,497.46	1
San Ildefonso	Water Station	San Ildefonso Water Station	33.20	1
San Roque	Barangay Hall	San Roque Barangay Hall	304.6	1
San Roque	Chapel	San Roque Chapel	139.36	1
San Roque	Elementary School	San Roque Elementary School	2850.55	1
San Juan	Chapel	San Juan - Our Lady of the Pillar Chapel	88	1
San Juan	Chapel	San Juan Chapel	87.3	1
San Juan	Barangay Hall	San Juan Barangay Hall	136	1
San Juan	Church	Mormons	4,231	1

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
San Juan	Church	Iglesia ni Cristo	2,082	1
San Juan	Church	Kingdom Hall of Jehovah Witness	600	1
San Juan	Outpost	West PAH Base	125	1
San Juan	Elementary School	San Juan Elementary School	3,946	1
San Miguel	Chapel	San Miguel Chapel	109.64	1
San Miguel	Chapel	San Pedro Calungsod Parish	618.42	1
San Miguel	Barangay Hall	San Miguel Barangay Hall	357.44	1
San Miguel	Elementary School	San Miguel Elementary School	4855.37	1
Sta Rosa	Barangay Hall	Sta Rosa Barangay Hall	290.63	1
Sta Rosa	Elementary School	Sta Rosa Elementary School	5792.71	1
Sta Rosa	Chapel	Sta Rosa Chapel	292.98	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 29. Ground Shaking Exposure and Degree of impact on critical point facilities in Alaminos, Laguna

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Poblacion 1	Chapel	Poblacion 1 Chapel	199	3
Poblacion 1	Chapel	Poblacion 1 Chapel	100	3
Poblacion 1	Church	Munting Kawan	83	3
Poblacion 1	Day Care Center and Barangay Hall	Poblacion 1 Day Care Center and Barangay Hall	130	3
Poblacion 1	Elementary School*	Cresmat Learning Center	1,452	3
Poblacion 1	Government Office	Quezon Farmers' Office	365	3
Poblacion 2	Vocational School and Senior High School	KCD Technical Institute	3,200	3
Poblacion 2	Barangay Hall	Poblacion 2 Barangay Hall	202	3
Poblacion 2	Chapel	Poblacion 2 Chapel	178	3
Poblacion 2	Senior Citizen Building	Barangay 2 Senior Citizen	203	3

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Poblacion 2	Elementary and Secondary School	Alaminos Elementary School and Alaminos National High School	27,423	3
Poblacion 3	Church	Municipal Church	5,860	3
Poblacion 3	Barangay Hall	Poblacion 3 Barangay Hall	38	3
Poblacion 3	Municipal Building	Alaminos Municipal Building	2,875	3
Poblacion 3	Rural Helath Unit Building	Alaminos Rural Health Building	229	3
Poblacion 3	Police Station	Alaminos Municipal Police Station	151	3
Poblacion 3	Government Office	Philippine Coconut Authority Provincial Official	9,263	3
Poblacion 3	Elementary and Secondary School	St. Paul Learning School	469	3
Poblacion 3	Pre-School*	Palm Valley International School	1,710	3
Poblacion 3	Elementary Secondary College School	Marcelino Fule Memorial College	10,046	3
Poblacion 3	Church	Mosque	212.64	3
Poblacion 4	Water District	Alaminos Water District	301	3
Poblacion 4	Church	Church of Christ	163	3
Poblacion 4	Church	Ang Dating Daan Church	162	3
Poblacion 4	Church	Jesus is the Lord Church	290	3
Poblacion 4	Pre-School	Reymarie's Pre-School	1,020	3
Poblacion 4	Chapel	Poblacion 4 Chapel	44.5	3
Poblacion 4	Day Care and Barangay Hall	Poblacion 4 Day Care and Barangay Hall	122	3
Poblacion 4	Chapel	Poblacion 4 Chapel	1,387	3
Poblacion 4	Pre-School and Elementary School	Maranatha Christian School	1,515	3
Del Carmen	Chapel	Del Carmen Chapel	77.12	3
Del Carmen	Elementary School	Del Carmen Elementary School	1647.32	3

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Palma	Barangay Hall	Palma Barangay Hall	130.14	3
Palma	Chapel	Palma Chapel	300.95	3
Palma	Chapel	Palma Chapel	740.13	3
Palma	Elementary School	Palma Elementary School	5185.13	3
San Agustin	Others	East PAC Base	25.34	3
San Agustin	Chapel	San Agustin Chapel	185.96	3
San Agustin	Health Center	San Agustin Health Center	537.26	3
San Agustin	Barangay Hall	San Agustin Barangay Hall	116.84	3
San Agustin	Elementary School	San Agustin Elementary School	6422.05	3
San Agustin	Secondary School	Buenaventura Fandialan Integrated National Highschool	3842.89	3
San Andres	Senior Citizen Building	San Andres Senior Citizen	45.3	3
San Andres	Barangay Hall	San Andres Barangay Hall	127	3
San Andres	Elementary School	San Andres Elementary School	8,404	3
San Andres	Chapel	San Andres Chapel	225	3
San Andres	Others	KALK	135	3
San Benito	Day Care Center	San Benito Day Care Center	116.89	3
San Benito	Barangay Hall	San Benito Barangay Hall	143.93	3
San Benito	Church	Iglesia ni Cristo	382.32	3
San Benito	Chapel	San Benito Chapel	512.13	3
San Benito	Government Office	Land Transportation Office - Provincial	10446.95	3
San Benito	Elementary School	San Benito Elementary School	5125.41	3
San Gregorio	Barangay Hall	San Gregorio Barangay Hall	156.86	3
San Gregorio	Chapel	San Gregorio Chapel	523.25	3
San Gregorio	Elementary School	Demesa Elementary School	5492.13	3
San Ildefonso	Church	Iglesia ni Cristo	621	3
San Ildefonso	Barangay Hall	San Juan Barangay Hall	143	3

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
San Ildefonso	Elementary School	San Ildefonso Elementary School	3,497.46	3
San Ildefonso	Water Station	San Ildefonso Water Station	33.20	3
San Roque	Barangay Hall	San Roque Barangay Hall	304.6	3
San Roque	Chapel	San Roque Chapel	139.36	3
San Roque	Elementary School	San Roque Elementary School	2850.55	3
San Juan	Chapel	San Juan - Our Lady of the Pillar Chapel	88	3
San Juan	Chapel	San Juan Chapel	87.3	3
San Juan	Barangay Hall	San Juan Barangay Hall	136	3
San Juan	Church	Mormons	4,231	3
San Juan	Church	Iglesia ni Cristo	2,082	3
San Juan	Church	Kingdom Hall of Jehovah Witness	600	3
San Juan	Outpost	West PAH Base	125	3
San Juan	Elementary School	San Juan Elementary School	3,946	3
San Miguel	Chapel	San Miguel Chapel	109.64	3
San Miguel	Chapel	San Pedro Calungsod Parish	618.42	3
San Miguel	Barangay Hall	San Miguel Barangay Hall	357.44	3
San Miguel	Elementary School	San Miguel Elementary School	4855.37	3
Sta Rosa	Barangay Hall	Sta Rosa Barangay Hall	290.63	3
Sta Rosa	Elementary School	Sta Rosa Elementary School	5792.71	3
Sta Rosa	Chapel	Sta Rosa Chapel	292.98	3

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 30. Soil Erosion Exposure and Degree of impact on critical point facilities in Alaminos, Laguna

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Poblacion 1	Chapel	Poblacion 1 Chapel	199	1
Poblacion 1	Chapel	Poblacion 1 Chapel	100	1

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Poblacion 1	Church	Munting Kawan	83	1
Poblacion 1	Day Care Center and Barangay Hall	Poblacion 1 Day Care Center and Barangay Hall	130	1
Poblacion 1	Elementary School*	Cresmat Learning Center	1,452	1
Poblacion 1	Government Office	Quezon Farmers' Office	365	1
Poblacion 2	Vocational School and Senior High School	KCD Technical Institute	3,200	1
Poblacion 2	Barangay Hall	Poblacion 2 Barangay Hall	202	1
Poblacion 2	Chapel	Poblacion 2 Chapel	178	1
Poblacion 2	Senior Citizen Building	Barangay 2 Senior Citizen	203	1
Poblacion 2	Elementary and Secondary School	Alaminos Elementary School and Alaminos National High School	27,423	1
Poblacion 3	Church	Municipal Church	5,860	1
Poblacion 3	Barangay Hall	Poblacion 3 Barangay Hall	38	1
Poblacion 3	Municipal Building	Alaminos Municipal Building	2,875	1
Poblacion 3	Rural Helath Unit Building	Alaminos Rural Health Building	229	1
Poblacion 3	Police Station	Alaminos Municipal Police Station	151	1
Poblacion 3	Government Office	Philippine Coconut Authority Provincial Official	9,263	1
Poblacion 3	Elementary and Secondary School	St. Paul Learning School	469	1
Poblacion 3	Pre-School*	Palm Valley International School	1,710	1
Poblacion 3	Elementary Secondary College School	Marcelino Fule Memorial College	10,046	1
Poblacion 3	Church	Mosque	212.64	1
Poblacion 4	Water District	Alaminos Water District	301	1
Poblacion 4	Church	Church of Christ	163	1
Poblacion 4	Church	Ang Dating Daan Church	162	1

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Poblacion 4	Church	Jesus is the Lord Church	290	1
Poblacion 4	Pre-School	Reymarie's Pre-School	1,020	1
Poblacion 4	Chapel	Poblacion 4 Chapel	44.5	1
Poblacion 4	Day Care and Barangay Hall	Poblacion 4 Day Care and Barangay Hall	122	1
Poblacion 4	Chapel	Poblacion 4 Chapel	1,387	1
Poblacion 4	Pre-School and Elementary School	Marantha Christian School	1,515	1
Del Carmen	Chapel	Del Carmen Chapel	77.12	1
Del Carmen	Elementary School	Del Carmen Elementary School	1647.32	1
Palma	Barangay Hall	Palma Barangay Hall	130.14	1
Palma	Chapel	Palma Chapel	300.95	1
Palma	Chapel	Palma Chapel	740.13	1
Palma	Elementary School	Palma Elementary School	5185.13	1
San Agustin	***	East PAC Base	25.34	1
San Agustin	Chapel	San Agustin Chapel	185.96	1
San Agustin	Health Center	San Agustin Health Center	537.26	1
San Agustin	Barangay Hall	San Agustin Barangay Hall	116.84	1
San Agustin	Elementary School	San Agustin Elementary School	6422.05	1
San Agustin	Secondary School	Buenaventura Fandialan Integrated National Highschool	3842.89	1
San Andres	Senior Citizen Building	San Andres Senior Citizen	45.3	1
San Andres	Barangay Hall	San Andres Barangay Hall	127	1
San Andres	Elementary School	San Andres Elementary School	8,404	1
San Andres	Chapel	San Andres Chapel	225	1
San Andres	Others	KALK	135	1
San Benito	Day Care Center	San Benito Day Care Center	116.89	1
San Benito	Barangay Hall	San Benito Barangay Hall	143.93	1
San Benito	Church	Iglesia ni Cristo	382.32	1

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
San Benito	Chapel	San Benito Chapel	512.13	1
San Benito	Government Office	Land Transportation Office - Provincial	10446.95	1
San Benito	Elementary School	San Benito Elementary School	5125.41	1
San Gregorio	Barangay Hall	San Gregorio Barangay Hall	156.86	1
San Gregorio	Chapel	San Gregorio Chapel	523.25	1
San Gregorio	Elementary School	Demesa Elementary	5492.13	1
San Ildefonso	Church	Iglesia ni Cristo	621	1
San Ildefonso	Barangay Hall	San Juan Barangay Hall	143	1
San Ildefonso	Elementary School	San Ildefonso Elementary School	3,497.46	1
San Ildefonso	Water Station	San Ildefonso Water Station	33.20	1
San Roque	Barangay Hall	San Roque Barangay Hall	304.6	1
San Roque	Chapel	San Roque Chapel	139.36	1
San Roque	Elementary School	San Roque Elementary School	2850.55	1
San Juan	Chapel	San Juan - Our Lady of the Pillar Chapel	88	1
San Juan	Chapel	San Juan Chapel	87.3	1
San Juan	Barangay Hall	San Juan Barangay Hall	136	1
San Juan	Church	Mormons	4,231	1
San Juan	Church	Iglesia ni Cristo	2,082	1
San Juan	Church	Kingdom Hall of Jehovah Witness	600	1
San Juan	Outpost	West PAH Base	125	1
San Juan	Elementary School	San Juan Elementary School	3,946	1
San Miguel	Chapel	San Miguel Chapel	109.64	1
San Miguel	Chapel	San Pedro Calungsod Parish	618.42	1
San Miguel	Barangay Hall	San Miguel Barangay Hall	357.44	1
San Miguel	Elementary School	San Miguel Elementary School	4855.37	1
Sta Rosa	Barangay Hall	Sta Rosa Barangay Hall	290.63	1

Barangay	Exposure			Degree of impact score
	A	B	C	
	Facility Type	Name	Area (Sq. M)	
Sta Rosa	Elementary School	Sta Rosa Elementary School	5792.71	1
Sta Rosa	Chapel	Sta Rosa Chapel	292.98	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Critical Facilities Adaptive Capacity to Hazards

All barangays have no capacity to retrofit however households are willing to relocate, if it is subsidized by the government. On the other hand, barangays have available alternative sites, structures to use in case of any damage or disruption of services. These alternative sites include schools, barangay hall, and day care centers. In addition, the LGU have infrastructure programs such as construction of canal, barangay rural health.

Table 31. Adaptive Capacity of Critical Point Facilities to Hazard events of Alaminos, Laguna

Barangay	Adaptive Capacity			
	Capacity and willingness to retrofit (%)	Available alternative structures (Yes or No)	Government investments (%)	Available Alternative Sites (Yes or No)
Poblacion 1	0	Yes	100	Yes
Poblacion 2	0	Yes	100	Yes
Poblacion 3	0	Yes	100	Yes
Poblacion 4	0	Yes	100	Yes
Del Carmen	0	Yes	100	Yes
Palma	0	Yes	100	Yes
San Agustin	0	Yes	100	Yes
San Andres	0	Yes	100	Yes
San Benito	0	Yes	100	Yes
San Gregorio	0	Yes	100	Yes
San Ildefonso	0	Yes	100	Yes
San Roque	0	Yes	100	Yes
San Juan	0	Yes	100	Yes
San Miguel	0	Yes	100	Yes
Sta Rosa	0	Yes	100	Yes

Source: CDRA Workshop

Critical Facilities Vulnerability to Hazards

In terms of vulnerability ratings, only ground shaking has a moderate vulnerability rating, while all barangays have low vulnerability ratings in flooding, RIL, EIL and soil erosion. This low vulnerability can be attributed to low exposure, sensitivity and high adaptive capacity of facilities to hazards.

Table 29 below summarizes the vulnerability ratings of Alaminos in terms of its critical point facilities and hazards.

Table 32. Vulnerability Ratings of Critical Point Facilities to Hazard events of Alaminos, Laguna using Exposure and Adaptive Capacity indicators

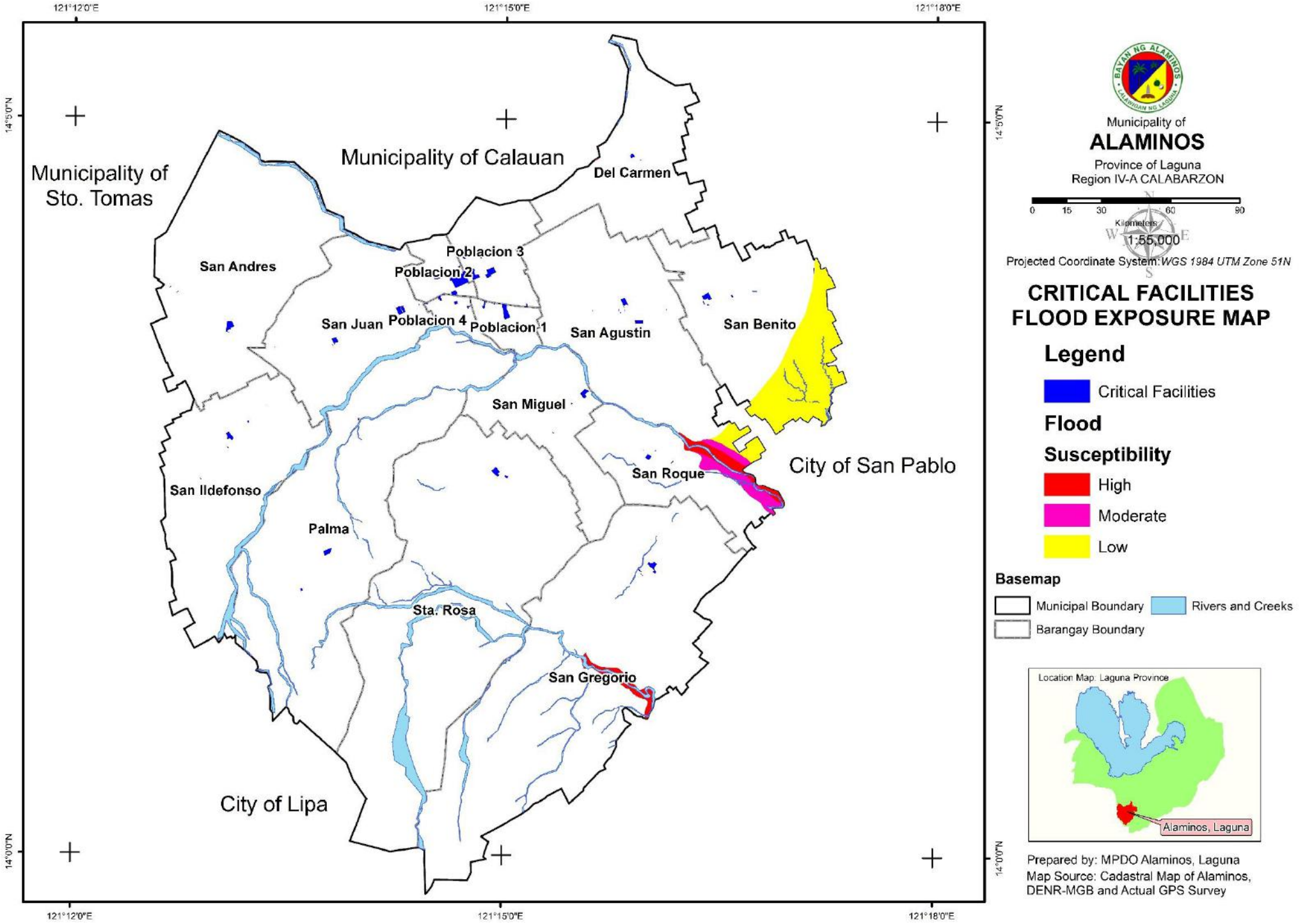
Barangay	Vulnerability				
	Flood	RIL	EIL	Ground Shaking	Soil Erosion
Poblacion 1	Low	Low	Low	Moderate	Low
Poblacion 2	Low	Low	Low	Moderate	Low
Poblacion 3	Low	Low	Low	Moderate	Low
Poblacion 4	Low	Low	Low	Moderate	Low
Del Carmen	Low	Low	Low	Moderate	Low
Palma	Low	Low	Low	Moderate	Low
San Agustin	Low	Low	Low	Moderate	Low
San Andres	Low	Low	Low	Moderate	Low
San Benito	Low	Low	Low	Moderate	Low
San Gregorio	Low	Low	Low	Moderate	Low
San Ildefonso	Low	Low	Low	Moderate	Low
San Roque	Low	Low	Low	Moderate	Low
San Juan	Low	Low	Low	Moderate	Low
San Miguel	Low	Low	Low	Moderate	Low
Sta Rosa	Low	Low	Low	Moderate	Low

Source: CDRA Workshop, MPDO GIS Computation, 2018

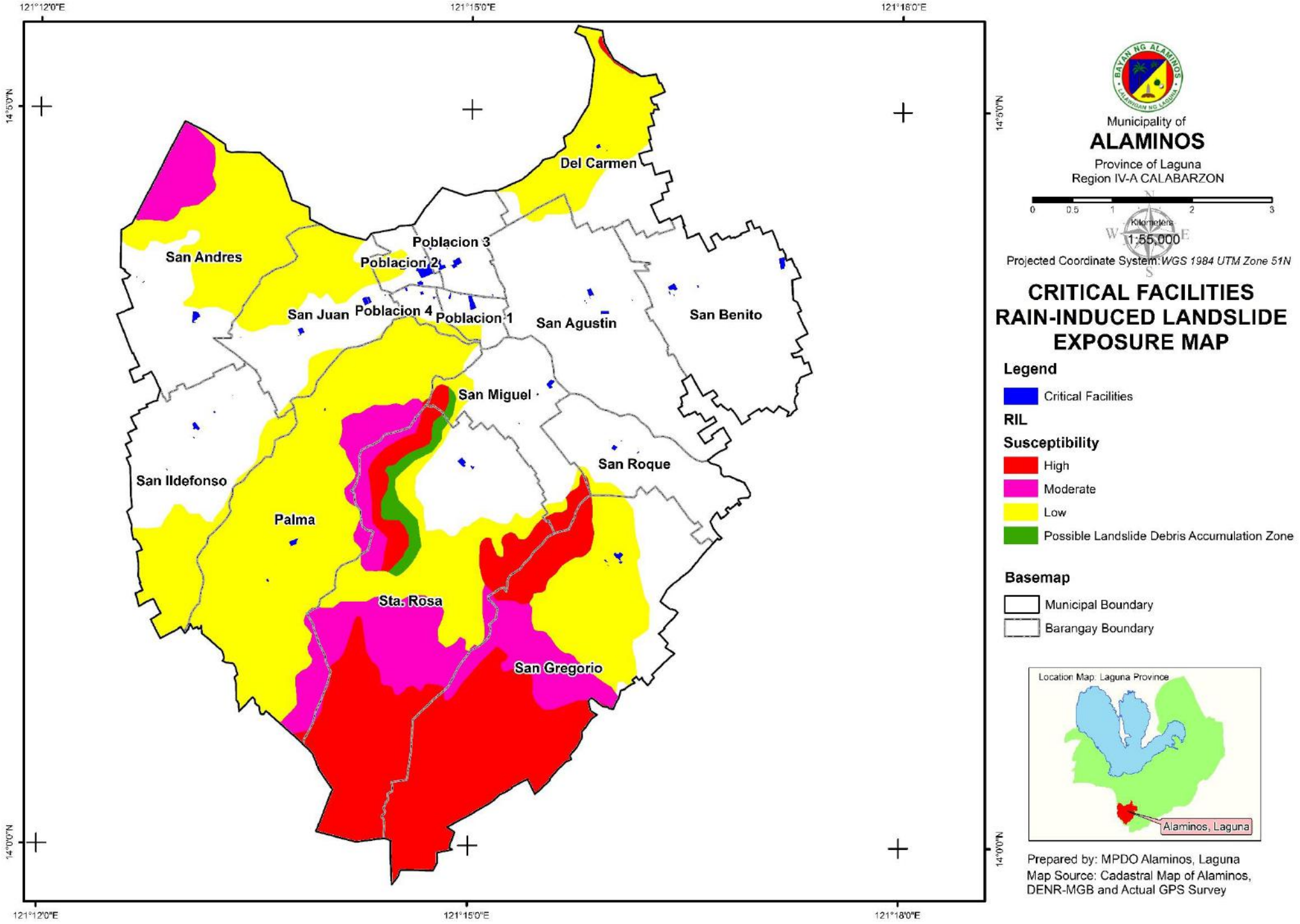
Refer to the maps below for the exposure and vulnerability to hazards:

Map 29: Critical Facilities Flood Exposure Map
Map 30: Critical Facilities Rain-induced Landslide Exposure Map
Map 31: Critical Facilities Earthquake-induced Landslide Exposure Map
Map 32: Critical Facilities Ground Shaking Exposure Map
Map 33: Critical Facilities Soil Erosion Exposure Map
Map 34: Critical Facilities Vulnerability to Flooding
Map 35: Critical Facilities Vulnerability to Rain-induced Landslide
Map 36: Critical Facilities Vulnerability to Earthquake-induced Landslide
Map 37: Critical Facilities Vulnerability to Ground Shaking
Map 38: Critical Facilities Vulnerability to Soil Erosion

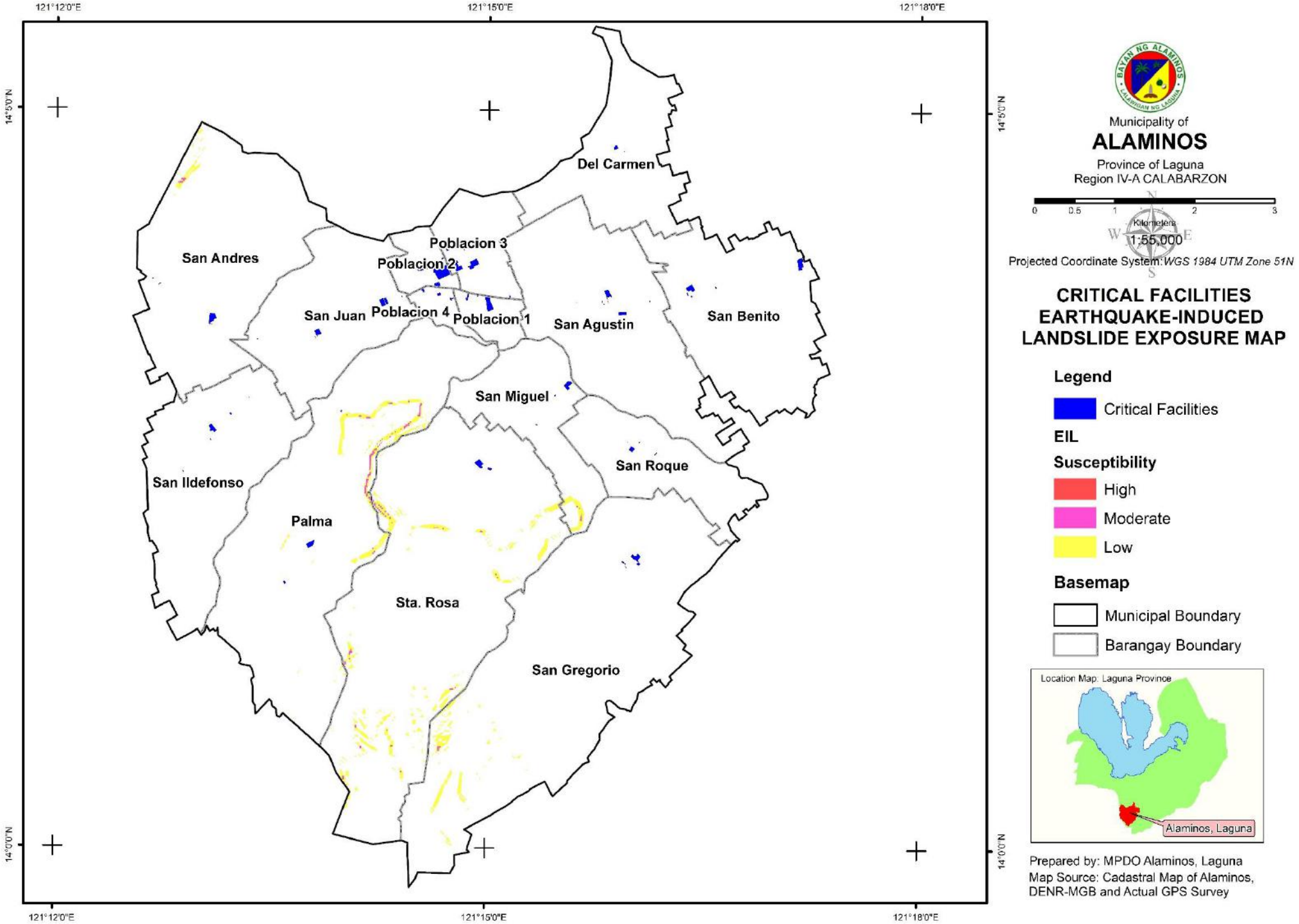
Map 29: Critical Facilities Flood Exposure Map



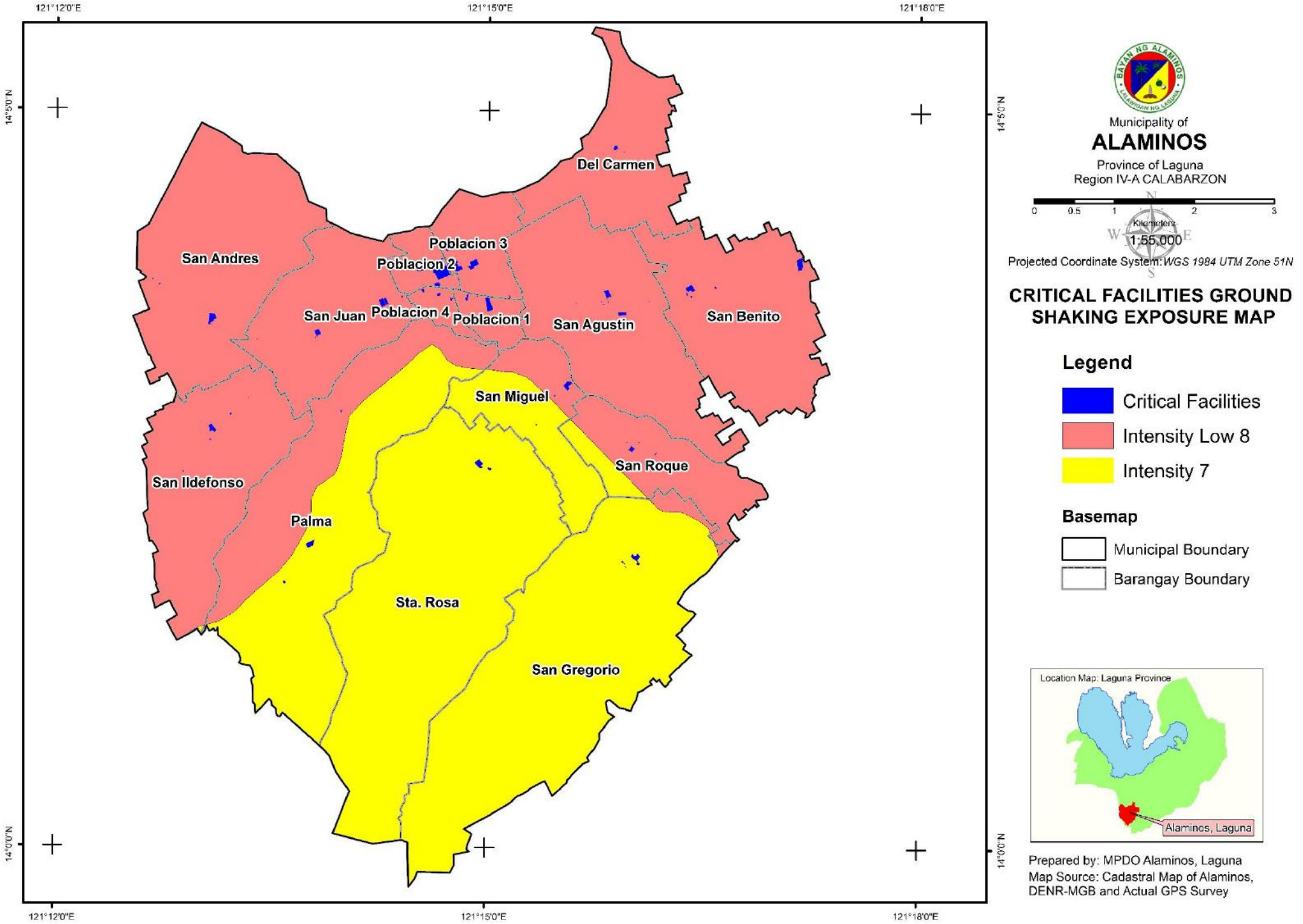
Map 30: Critical Facilities Rain-induced Landslide Exposure Map



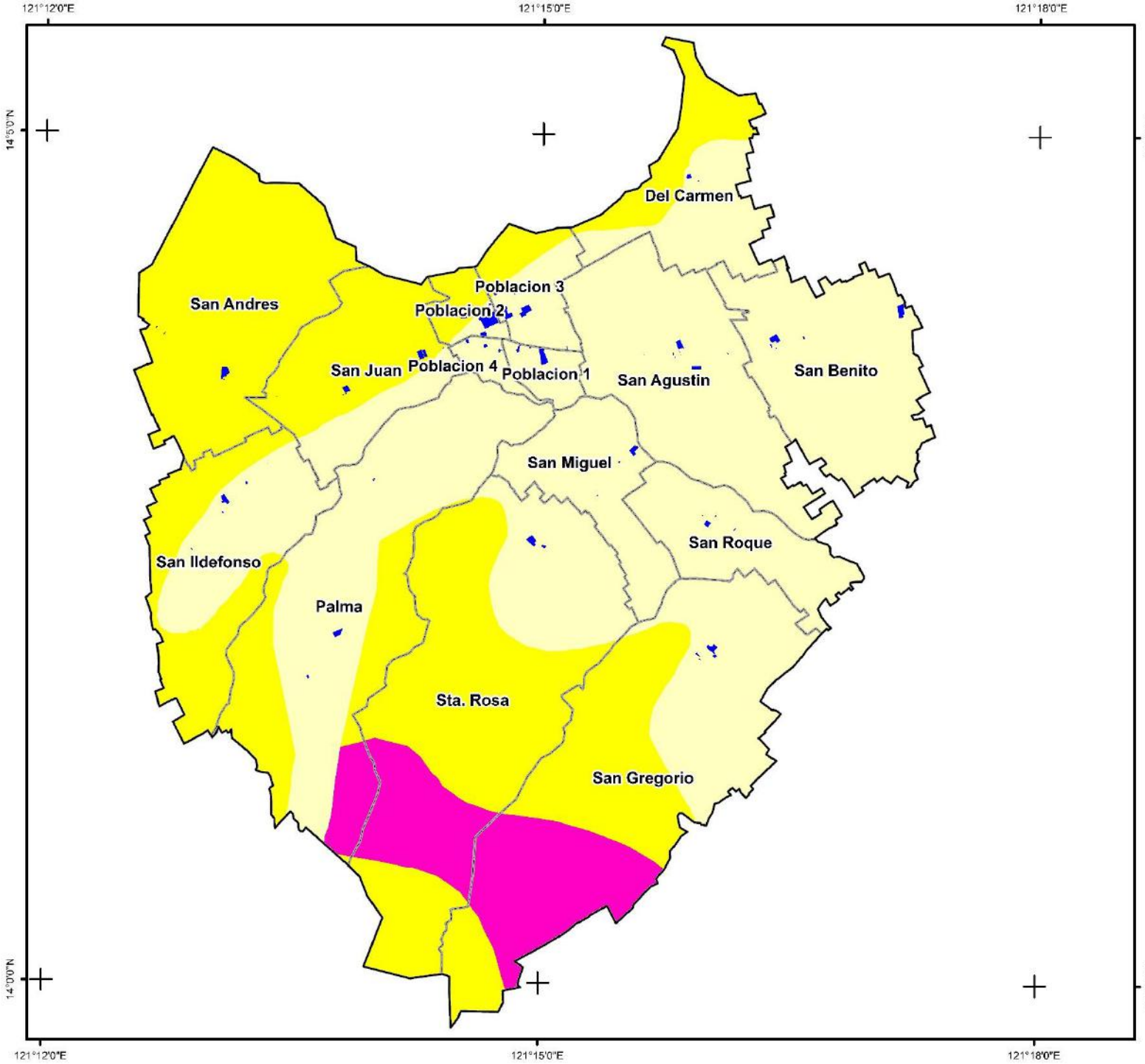
Map 31: Critical Facilities Earthquake-induced Landslide Exposure Map



Map 32: Critical Facilities Ground Shaking Exposure Map



Map 33: Critical Facilities Soil Erosion Exposure Map



Municipality of
ALAMINOS
Province of Laguna
Region IV-A CALABARZON

0 0.5 1 2 3
Kilometers
1:55,000

Projected Coordinate System: *WGS 1984 UTM Zone 51N*

CRITICAL FACILITIES SOIL EROSION EXPOSURE MAP

Legend

- Critical Facilities

Soil Erosion

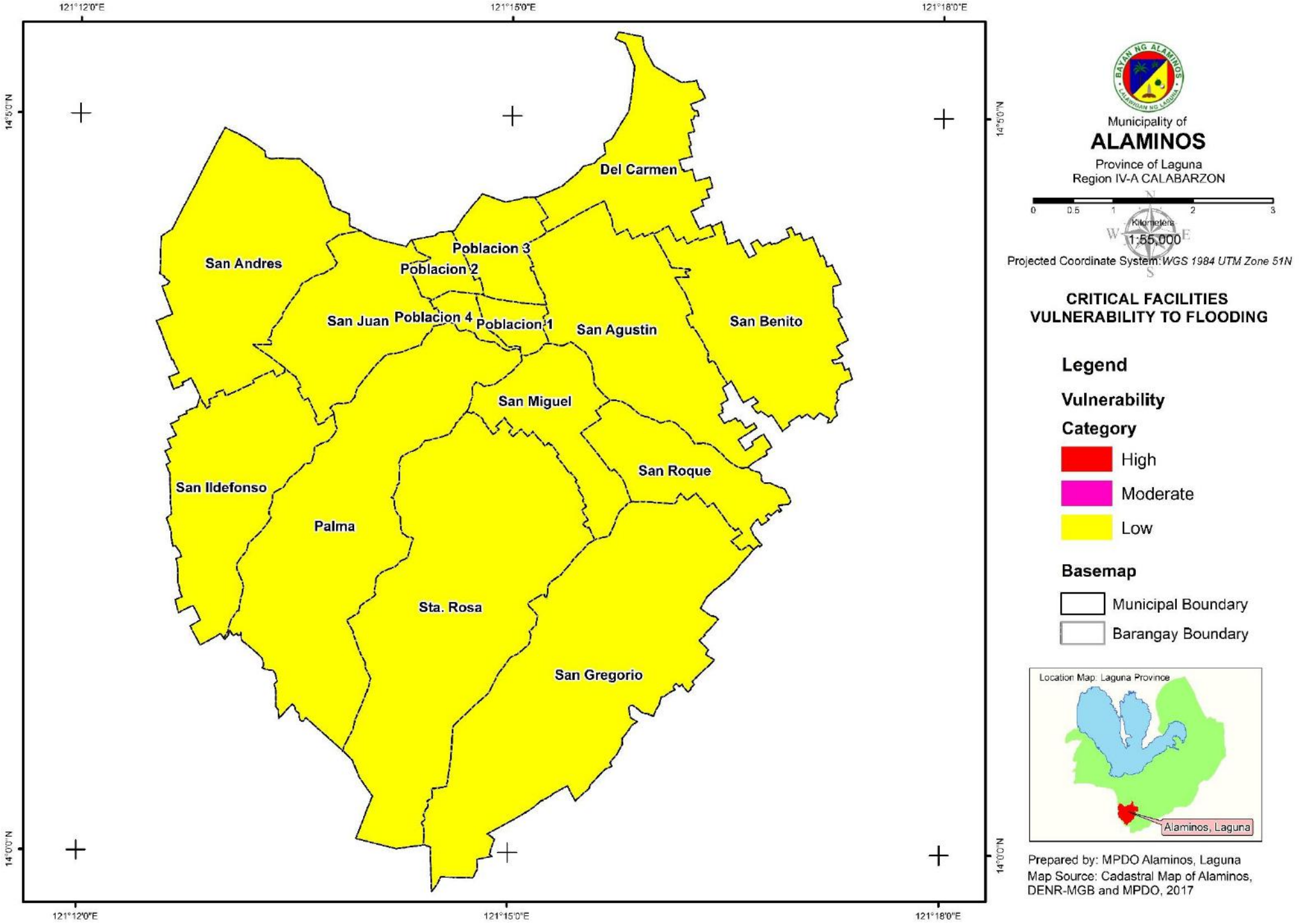
- Moderate Erosion
- Slight Erosion
- No Apparent Erosion

Basemap

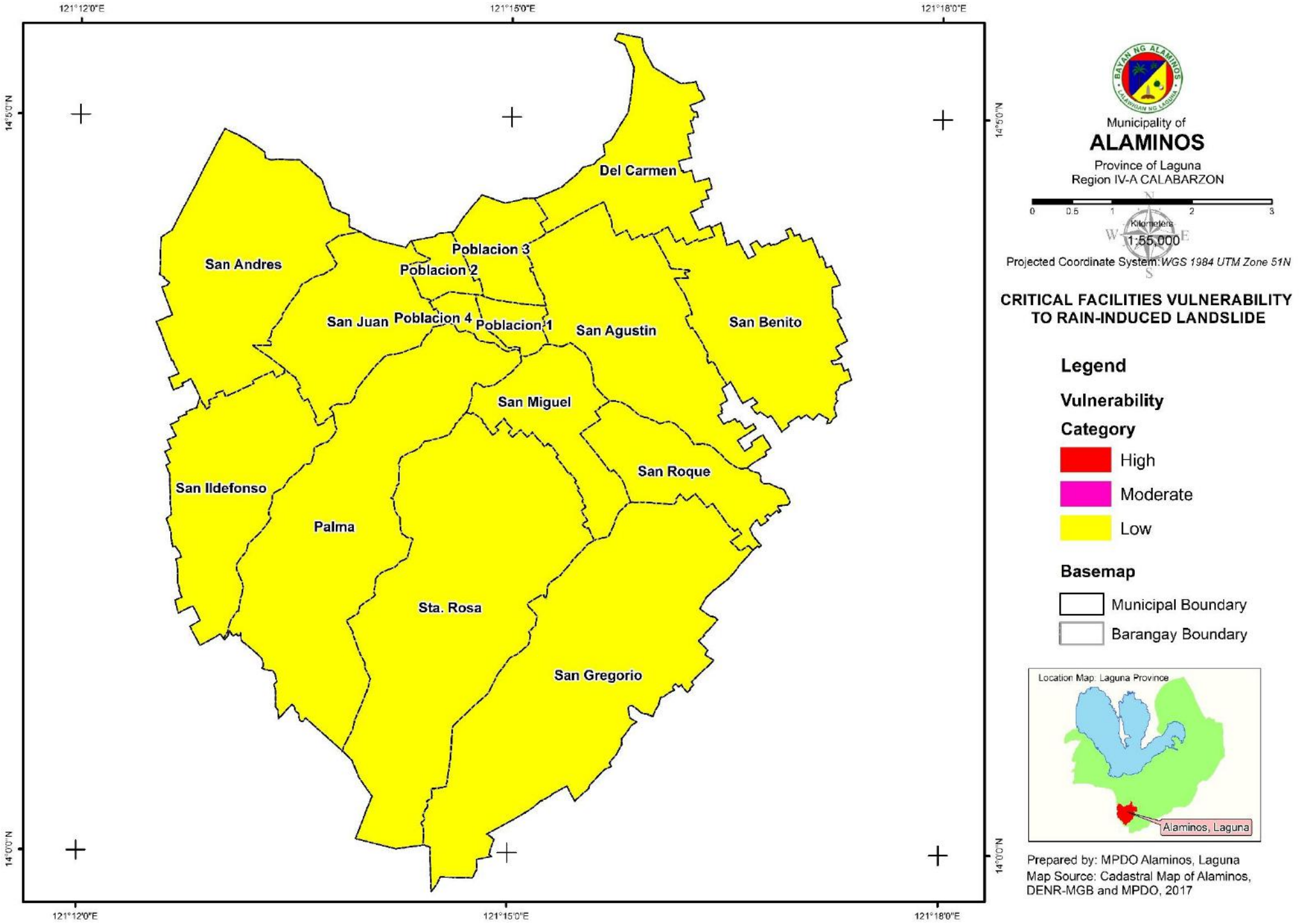
- Municipal Boundary
- Barangay Boundary

Prepared by: MPDO Alaminos, Laguna
Map Source: Cadastral Map of Alaminos, DENR-MGB and Actual GPS Survey

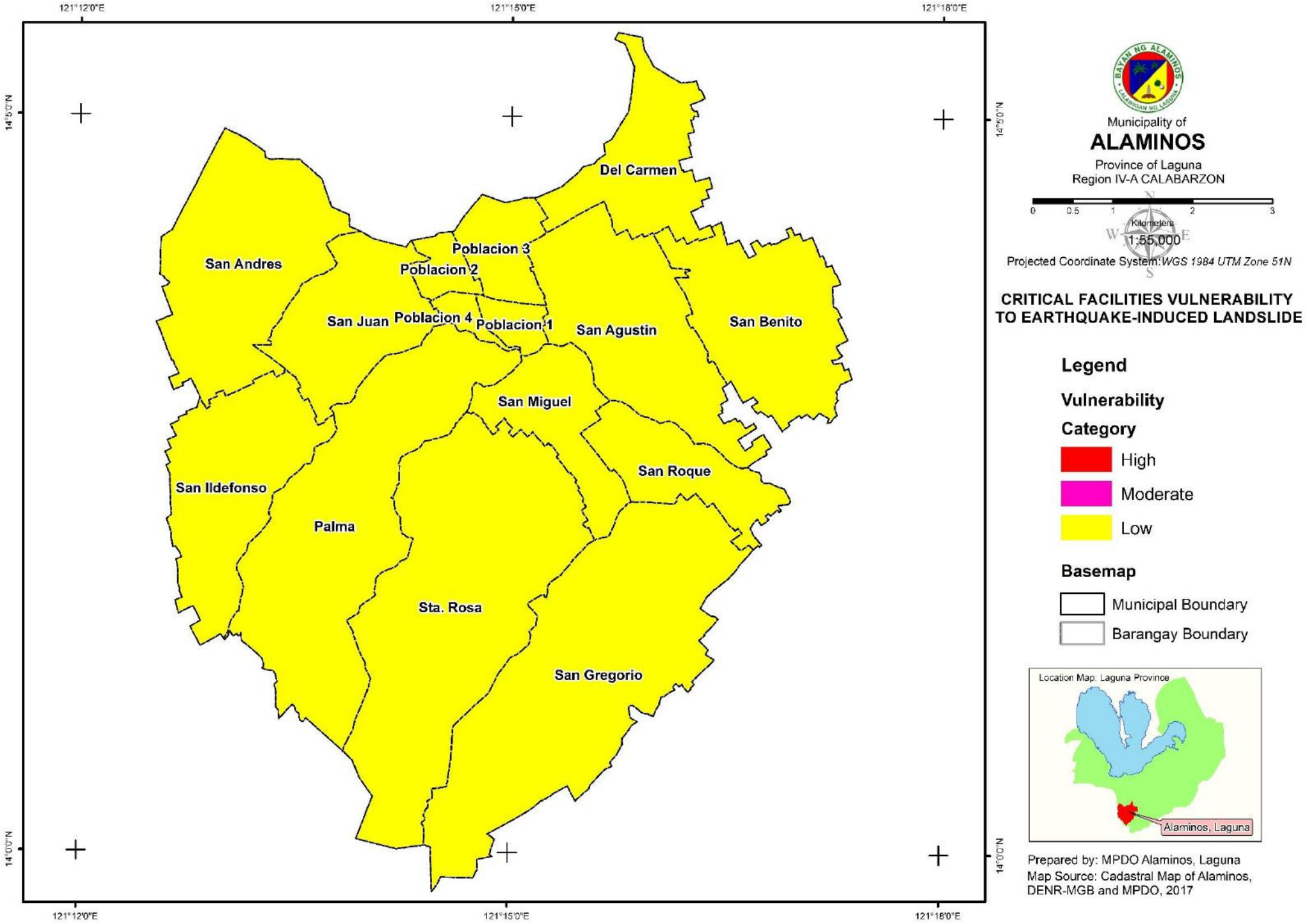
Map 34: Critical Facilities Vulnerability to Flooding



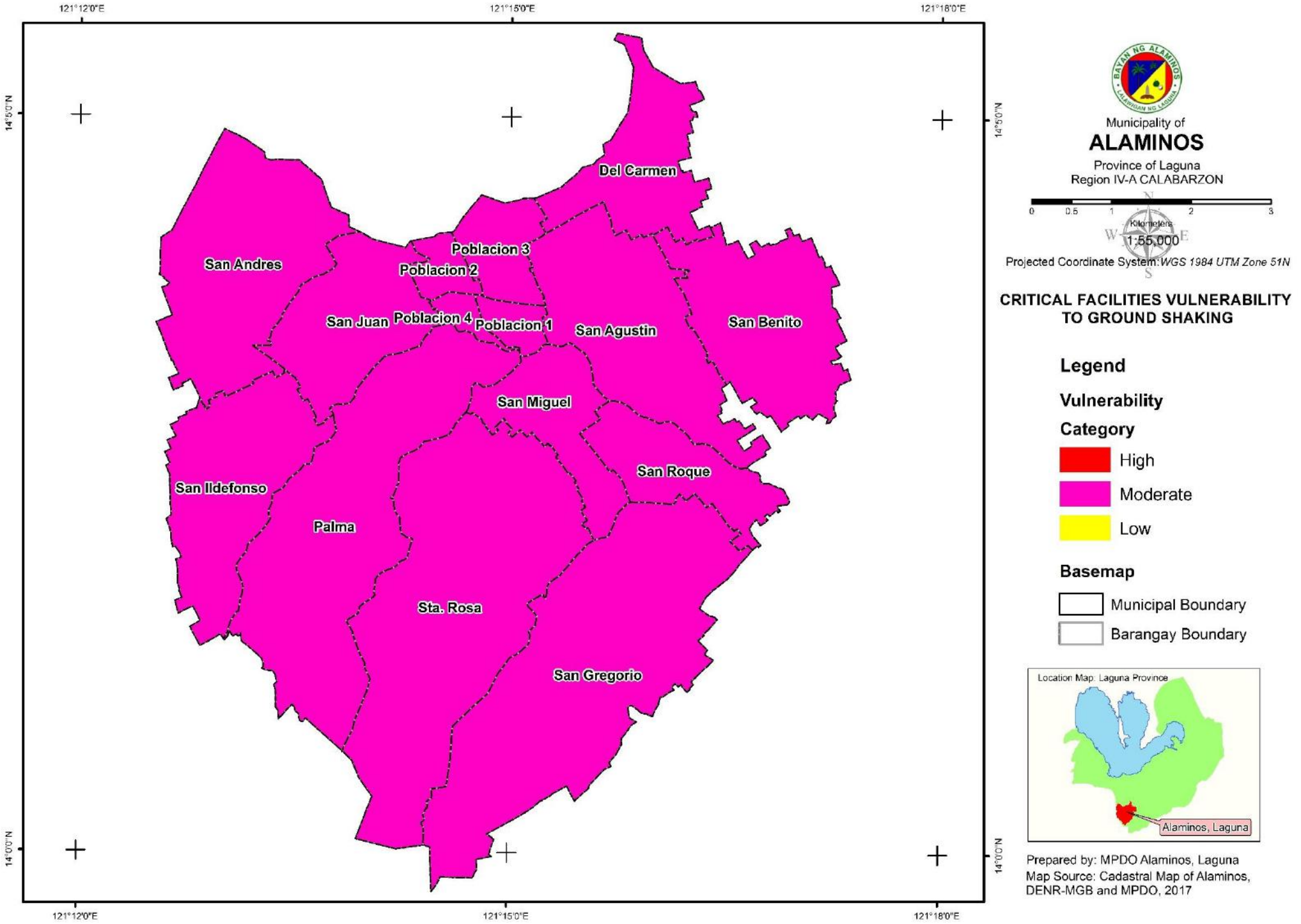
Map 35: Critical Facilities Vulnerability to Rain-induced Landslide



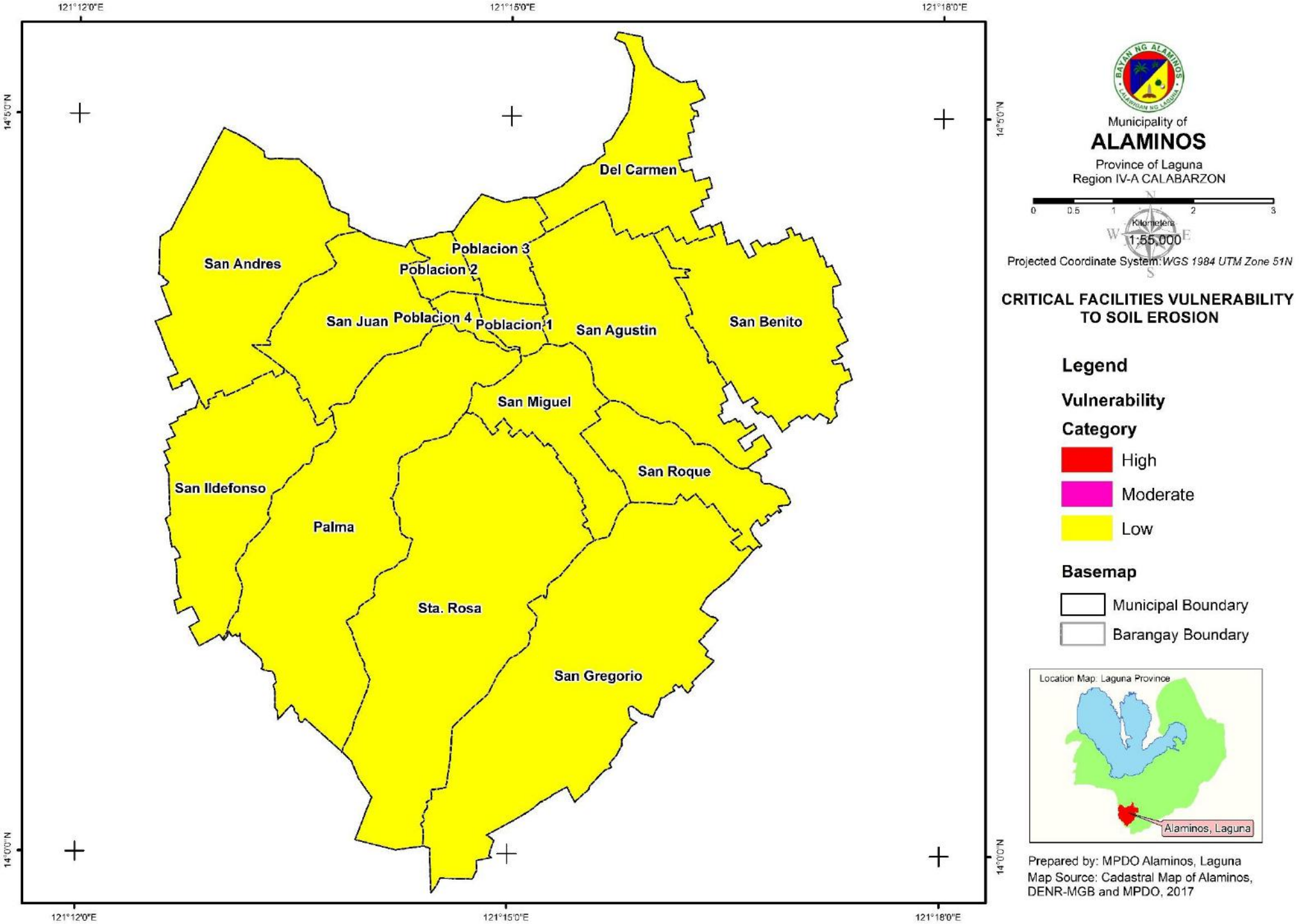
Map 36: Critical Facilities Vulnerability to Earthquake-induced Landslide



Map 37: Critical Facilities Vulnerability to Ground Shaking



Map 38: Critical Facilities Vulnerability to Soil Erosion



Production Area

Production areas pertain to natural resource areas utilized for crop, fisheries, and forestland production. In the case of the municipality, only crop production is applicable and therefore used for this assessment. Coconut with cropland mixed is used as the dominant crop of the municipality.

Table 33. Exposure and Adaptive Capacity Indicators used for Production Areas in Alaminos, Laguna

Exposure	Adaptive Capacity
Area by Dominant Crop Exposed Area Exposure %	Access to financing Alternative Livelihood Government Extension Program Government Infrastructure Programs

Production Area Exposure to Hazards

Barangays San Agustin, San Benito, Del Carmen, San Gregorio, and San Roque have production areas exposed to flooding. With barangay San Benito having the highest percentage of area exposed with 0.308 percent of its total production area.

Table 34. Flooding Exposure and Degree of impact on Production Areas in Alaminos, Laguna

Barangay	Exposure			Degree of Impact
	A	B	C	
	Area by Dominant Crop (Ha)	Exposed Area (Ha)	Exposure (%)	
Poblacion 1	27.376313	0.00	0.00	1
Poblacion 2	8.79	0.00	0.00	1
Poblacion 3	74.577	0.00	0.00	1
Poblacion 4	12.048	0.00	0.00	1
Del Carmen	244.568	0.052	0.00021	2
Palma	663.83	0.00	0.00	3
San Agustin	369.815	23.29	0.063	3
San Andres	452.632	0.00	0.00	3
San Benito	319.192	98.25	0.308	3
San Gregorio	879.815	3.68076	0.0042	3
San Ildefonso	349.067	0.00	0.00	2
San Roque	172.319	19.94	0.116	2
San Juan	225.667	0.00	0.00	2
San Miguel	165.481	0.00	0.00	1
Sta Rosa	839.004	0.00	0.00	3

Source: CDRA Workshop, MPDO GIS Computation, 2018

In terms of RIL, barangays Poblacion 4, Del Carmen, San Ildefonso, San Juan and Sta Rosa are top five barangays with the highest percentage of its production area exposed to this type of hazard.

Table 35. Rain-Induced Landslide Exposure and Degree of impact on Production Areas in Alaminos, Laguna

Barangay	Exposure			Degree of Impact
	A	B	C	
	Area by Dominant Crop (Ha)	Exposed Area (Ha)	Exposure (%)	
Poblacion 1	27.38	3.214	0.117	
Poblacion 2	8.79	0.614	0.070	
Poblacion 3	74.58	0.022	0.0003	1
Poblacion 4	12.05	4.050	0.336	1
Del Carmen	244.57	158.42	0.648	1
Palma	663.83	675.178	1.017	1
San Agustin	369.2	8.883	0.024	3
San Andres	452.632	290.679	0.642	3
San Benito	319.192	0.039	0.0001	3
San Gregorio	879.815	896.708	1.0192	3
San Ildefonso	349.067	113.084	0.324	2
San Roque	172.319	7.958	0.046	3
San Juan	225.667	115.3	0.511	1
San Miguel	165.481	41.4	0.250	1
Sta Rosa	839.004	741.414	0.884	2

Source: CDRA Workshop, MPDO GIS Computation, 2018

On the other hand, all urban barangays are not exposed to earthquake induced landslide, however, barangays Palma, San Andres, San Gregorio, San Miguel and Sta Rosa have areas exposed to EIL, with barangays Palma and Sta. Rosa having the highest percentage among all barangays.

Table 36. Earthquake-Induced Landslide Exposure and Degree of impact on Production Areas in Alaminos, Laguna

Barangay	Exposure			Degree of Impact
	A	B	C	
	Area by Dominant Crop (Ha)	Exposed Area (Ha)	Exposure (%)	
Poblacion 1	27.376	0.00	0.00	1
Poblacion 2	8.79	0.00	0.00	1
Poblacion 3	74.577	0.00	0.00	1
Poblacion 4	12.048	0.00	0.00	1
Del Carmen	244.568	0.00	0.00	2
Palma	663.83	19.879	0.030	3
San Agustin	369.815	0.00	0.00	3
San Andres	452.632	3.04	0.007	3

San Benito	319.192	0.00	0.00	2
San Gregorio	879.815	8.891	0.010	3
San Ildefonso	349.067	0.00	0.00	2
San Roque	172.3187	0.00	0.00	1
San Juan	225.667	0.00	0.00	2
San Miguel	165.481	3.852	0.023	2
Sta Rosa	839.004	24.848	0.030	3

Source: CDRA Workshop, MPDO GIS Computation, 2018

In terms of ground shaking exposure, all barangays are exposed to this type of hazard.

Table 37. Ground Shaking Exposure and Degree of impact on Production Areas in Alaminos, Laguna

Barangay	Exposure			Degree of Impact
	A	B	C	
	Area by Dominant Crop (Ha)	Exposed Area (Ha)	Exposure (%)	
Poblacion 1	27.376313	27.376313	1.00	1
Poblacion 2	8.79	8.79	1.00	1
Poblacion 3	74.577	74.577	1.00	1
Poblacion 4	12.048	12.048	1.00	1
Del Carmen	244.568	244.568	1.00	1
Palma	663.83	663.83	1.00	1
San Agustin	369.815	369.815	1.00	1
San Andres	452.632	452.632	1.00	1
San Benito	319.192	320.665	1.005	1
San Gregorio	879.815	879.815	1.00	1
San Ildefonso	349.067	349.067	1.00	1
San Roque	172.319	172.318	0.999	1
San Juan	225.667	225.667	1.00	1
San Miguel	165.481	165.481	1.00	1
Sta Rosa	839.004	839.004	1.00	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 38. Soil Erosion Exposure and Degree of impact on Production Areas in Alaminos, Laguna

Barangay	Exposure			Degree of Impact
	A	B	C	
	Area by Dominant Crop (Ha)	Exposed Area (Ha)	Exposure (%)	
Poblacion 1	27.376	0.00	0.00	1
Poblacion 2	8.79	8.059	0.917	1
Poblacion 3	74.577	24.015	0.322	1

Poblacion 4	12.048	0.00	0.00	1
Del Carmen	244.568	106.193	0.434	2
Palma	663.83	243.183	0.366	3
San Agustin	369.815	0.00	0.00	3
San Andres	452.632	452.632	1.00	3
San Benito	319.192	0.00	0.00	2
San Gregorio	879.815	601.659	0.684	3
San Ildefonso	349.067	182.011	0.521	3
San Roque	172.319	0.00	0.00	1
San Juan	225.667	157.279	0.697	3
San Miguel	165.481	0.00	0.00	1
Sta Rosa	839.004	658.213	0.785	3

Source: CDRA Workshop, MPDO GIS Computation, 2018

For the degree of impact, only ground shaking has a value of one (1) or low. This means that the estimated damage to property is low to negligible. In terms of other hazards, barangays Poblacions 1 to 4 have a low DOI value. This low value is attributed to these barangays having very low crop production areas. For other barangays, there is a combination of high and moderate estimated direct and indirect damage to property/production areas, particularly barangays Sta. Rosa, San Gregorio, Palma, San Agustin, and San Andres, since these barangays have high estimated direct and indirect damage to its production areas. Mitigation and adaptation measure must be strengthened in these areas to reduce impact of damage to flooding, RIL, EIL and soil erosion.

Production Area Adaptive Capacity to Hazards

Table 39. Adaptive Capacity on Hazard events in Production Areas in Alaminos, Laguna

Barangay	Adaptive Capacity			
	Access to financing (%)	Alternative Livelihood (%)	Government Extension Program (%)	Government Infrastructure Programs (%)
Poblacion 1	100	60	100	100
Poblacion 2	100	65	100	100
Poblacion 3	100	65	100	100
Poblacion 4	100	65	100	100
Del Carmen	100	60	100	100
Palma	100	65	100	100
San Agustin	100	60	100	100
San Andres	100	60	100	100
San Benito	100	60	100	100
San Gregorio	100	60	100	100
San Ildefonso	100	60	100	100
San Roque	100	30	100	100
San Juan	100	60	100	100
San Miguel	100	85	100	100

Sta Rosa	100	90	100	100

Source: CDRA Workshop, MPDO GIS Computation, 2018

Production Area Vulnerability to Hazards

In terms of flooding, rail-induced landslide, soil erosion and earthquake-induced landslide, Alaminos has a combination of low and moderate vulnerability ratings, while in terms of ground shaking, the municipality has a low vulnerability rating. Table 40 below summarizes the vulnerability ratings of Alaminos in terms of its production area and hazards.

Table 40. Vulnerability Ratings of Production Areas to Hazard events of Alaminos, Laguna using Exposure and Adaptive Capacity indicators

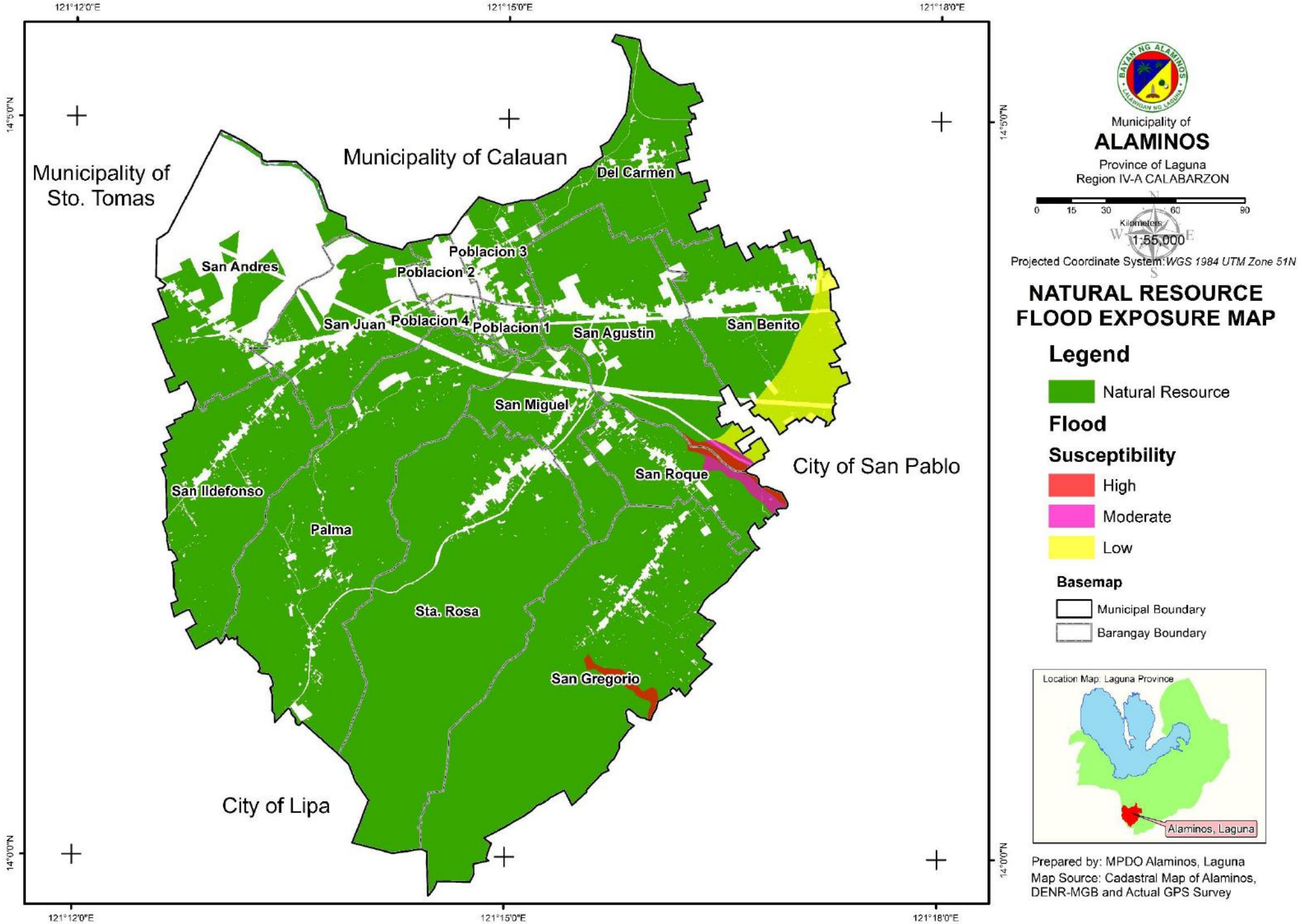
Barangay	Vulnerability				
	Flood	RIL	EIL	Ground Shaking	Soil Erosion
Poblacion 1	Low	Low	Low	Low	Low
Poblacion 2	Low	Low	Low	Low	Low
Poblacion 3	Low	Low	Low	Low	Low
Poblacion 4	Low	Low	Low	Low	Low
Del Carmen	Low	Low	Moderate	Low	Low
Palma	Moderate	Moderate	Moderate	Low	Moderate
San Agustin	Moderate	Moderate	Moderate	Low	Moderate
San Andres	Moderate	Moderate	Moderate	Low	Moderate
San Benito	Moderate	Low	Low	Low	Low
San Gregorio	Moderate	Moderate	Moderate	Low	Moderate
San Ildefonso	Low	Low	Low	Low	Moderate
San Roque	Low	Low	Low	Low	Low
San Juan	Low	Low	Low	Low	Moderate
San Miguel	Low	Low	Low	Low	Low
Sta Rosa	Moderate	Moderate	Moderate	Low	Moderate

Source: CDRA Workshop, MPDO GIS Computation, 2018

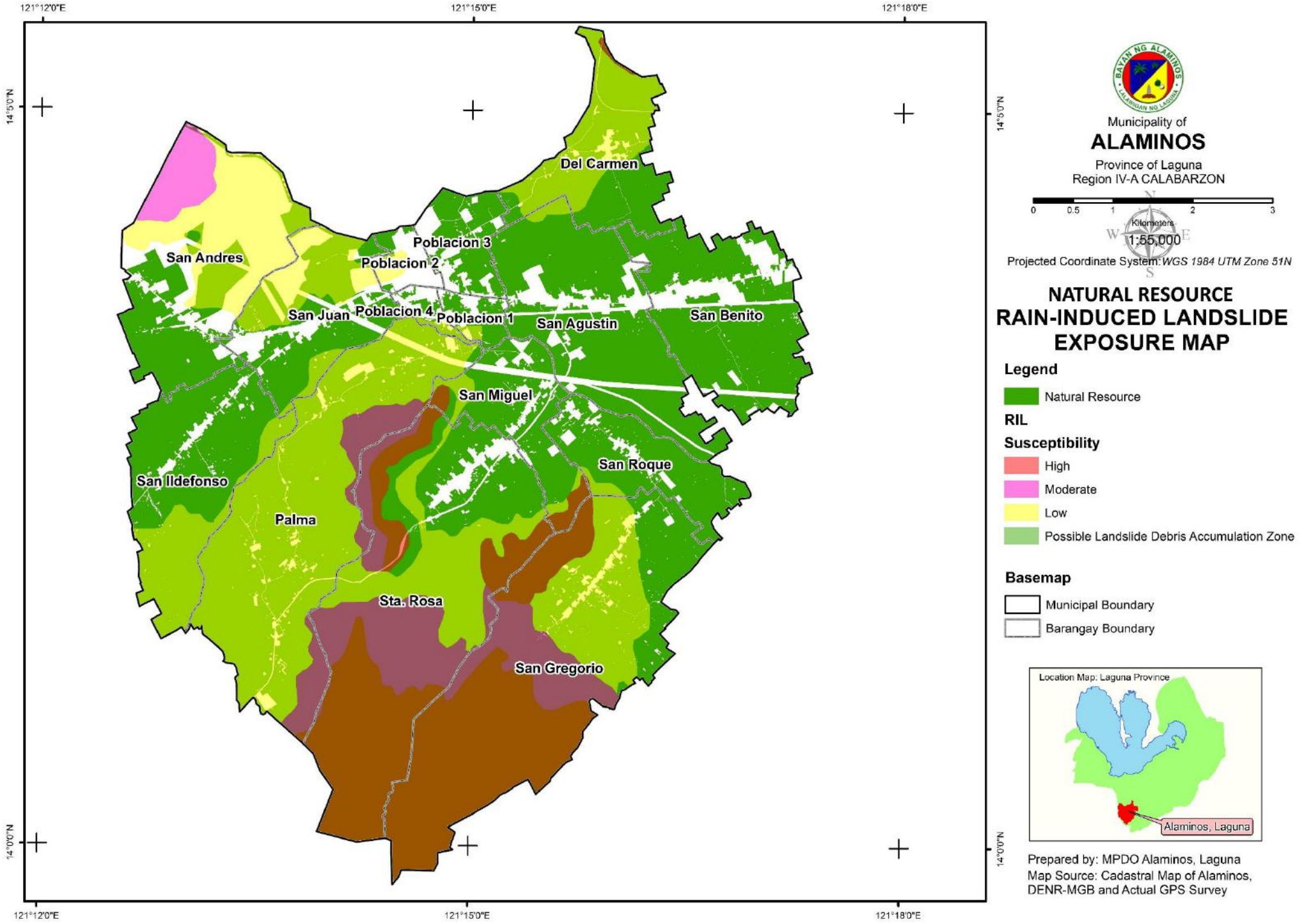
Refer to the maps below for the exposure and vulnerability of natural resource areas:

Map 39: Natural Resource Flood Exposure Map
Map 40: Natural Resource Rain-induced Landslide Exposure Map
Map 41: Natural Resource Earthquake-induced Landslide Exposure Map
Map 42: Natural Resource Ground Shaking Exposure Map
Map 43: Natural Resource Soil Erosion Exposure Map
Map 44: Natural Resource Vulnerability to Flooding
Map 45: Natural Resource Vulnerability to Rain-induced Landslide
Map 46: Natural Resource Vulnerability to Earthquake-induced Landslide
Map 47: Natural Resource Vulnerability to Ground Shaking
Map 48: Natural Resource Vulnerability to Soil Erosion

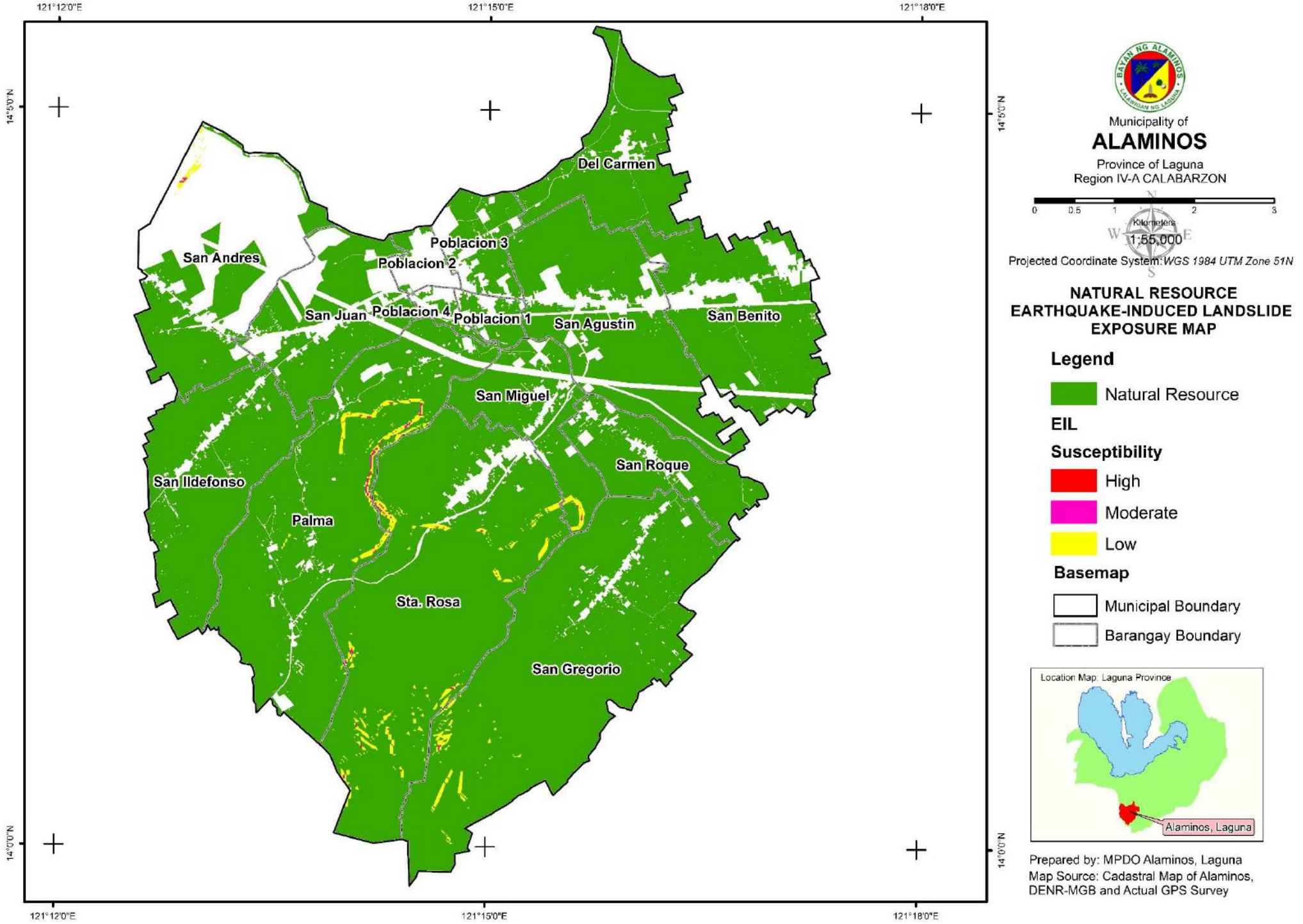
Map 39: Natural Resource Flood Exposure Map



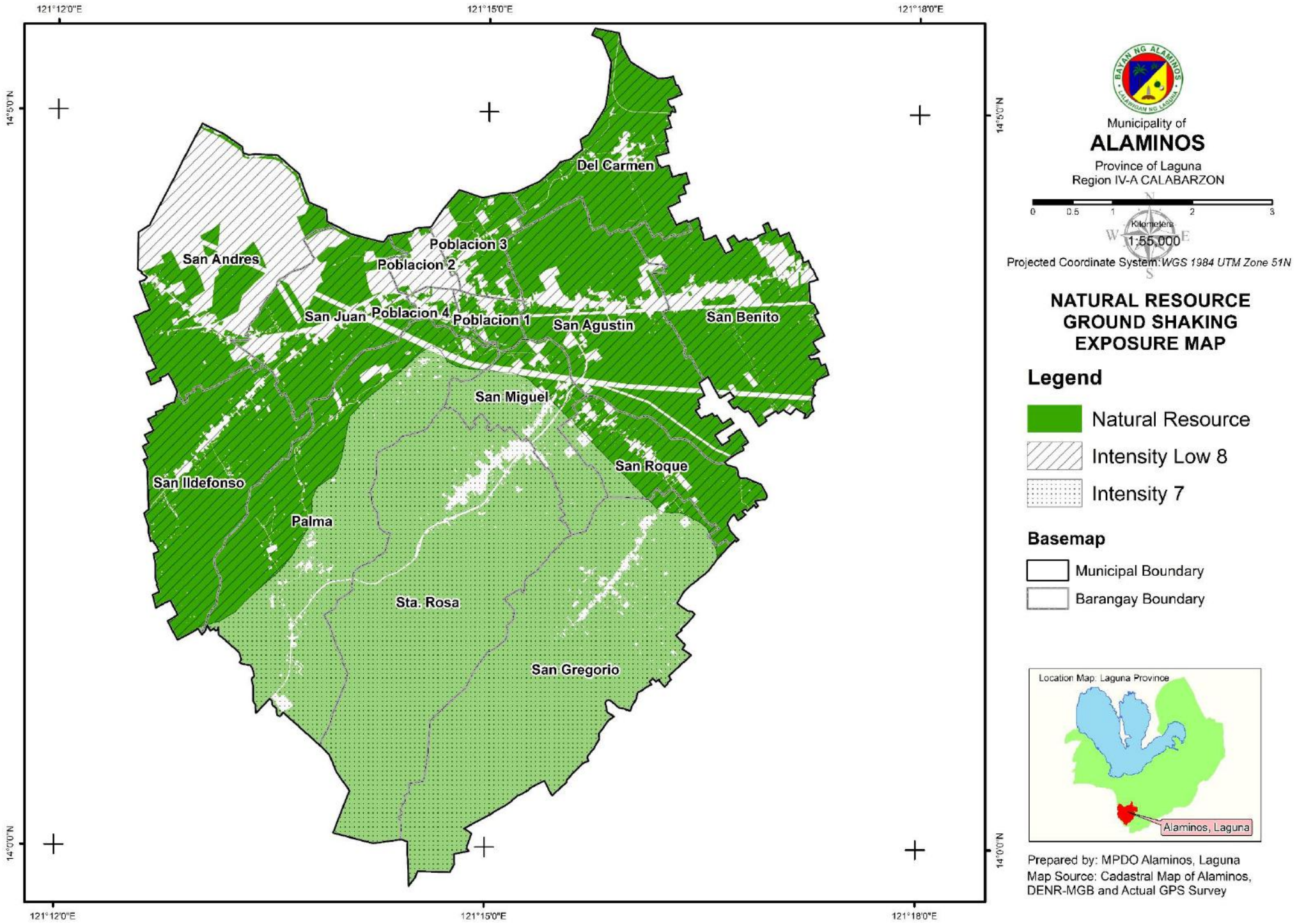
Map 40: Natural Resource Rain-induced Landslide Exposure Map



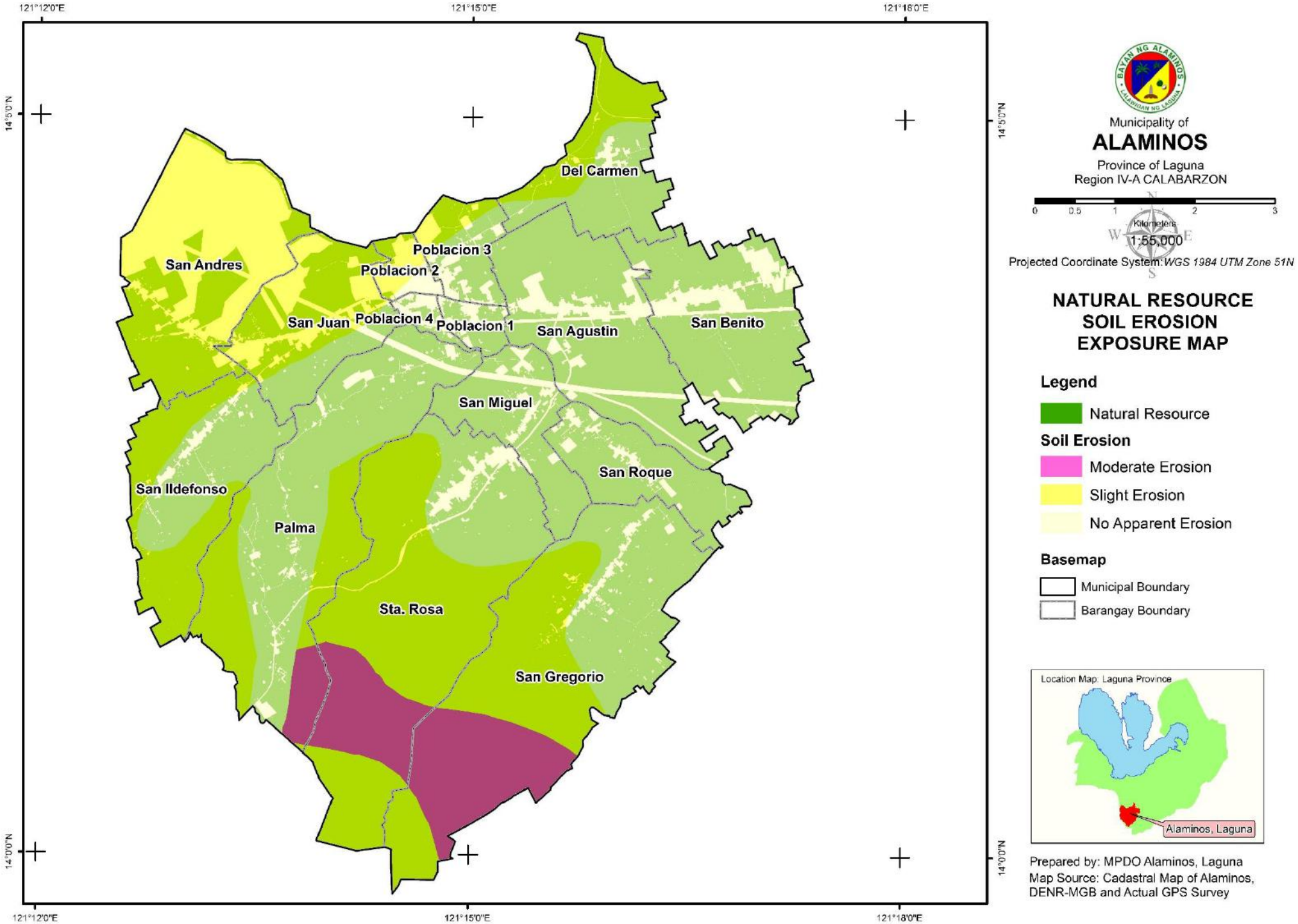
Map 41: Natural Resource Earthquake-induced Landslide Exposure Map



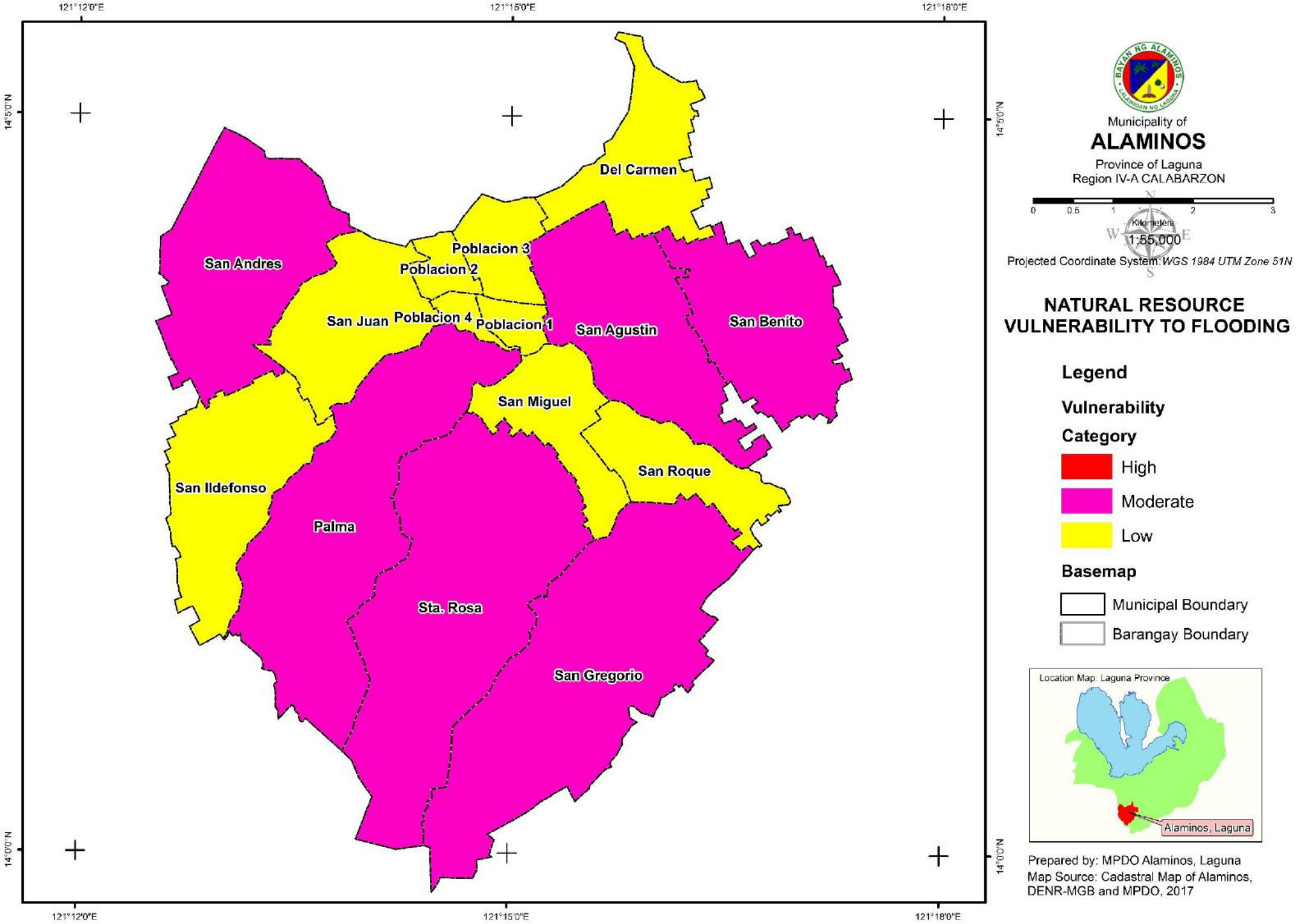
Map 42: Natural Resource Ground Shaking Exposure Map



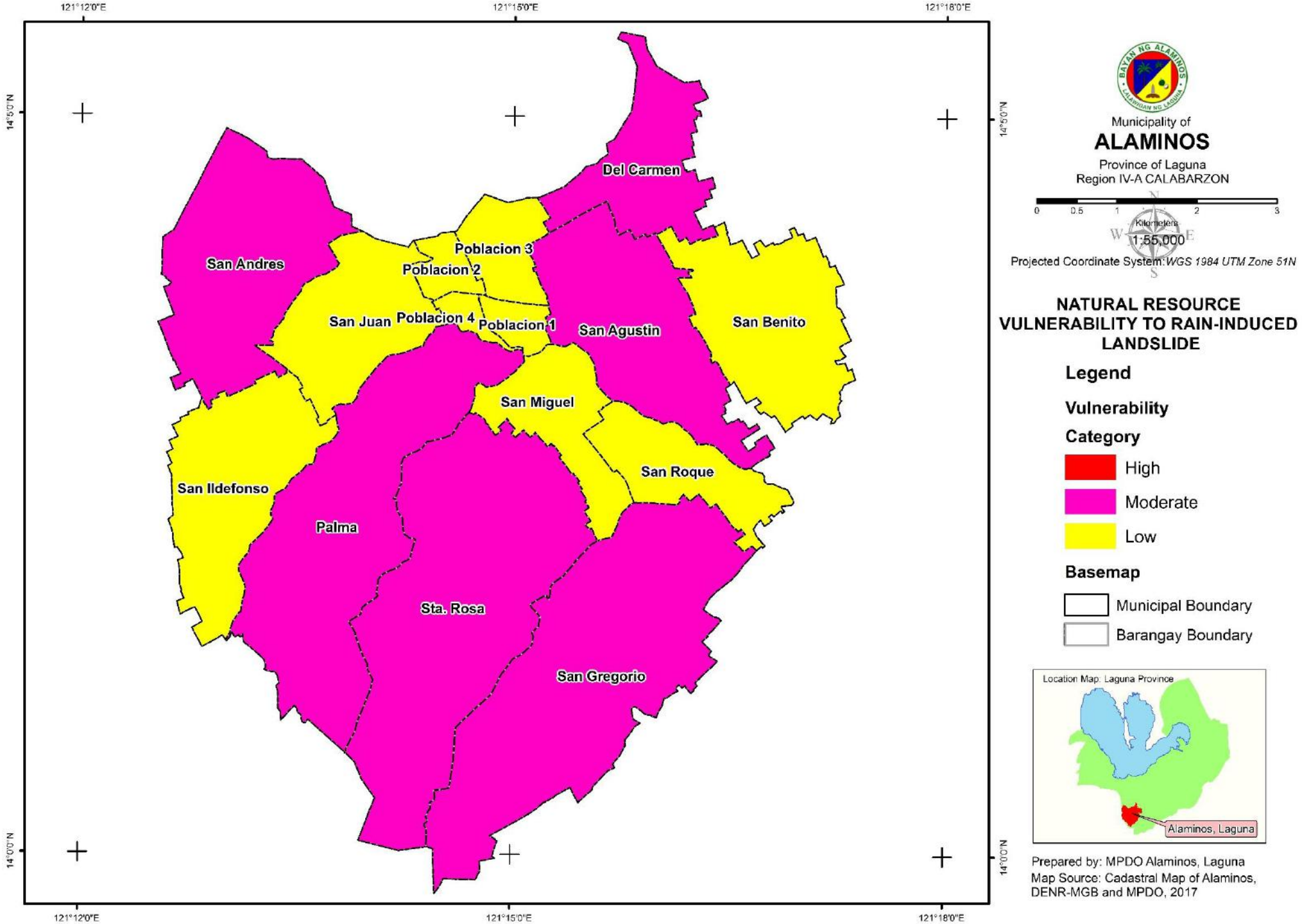
Map 43: Natural Resource Soil Erosion Exposure Map



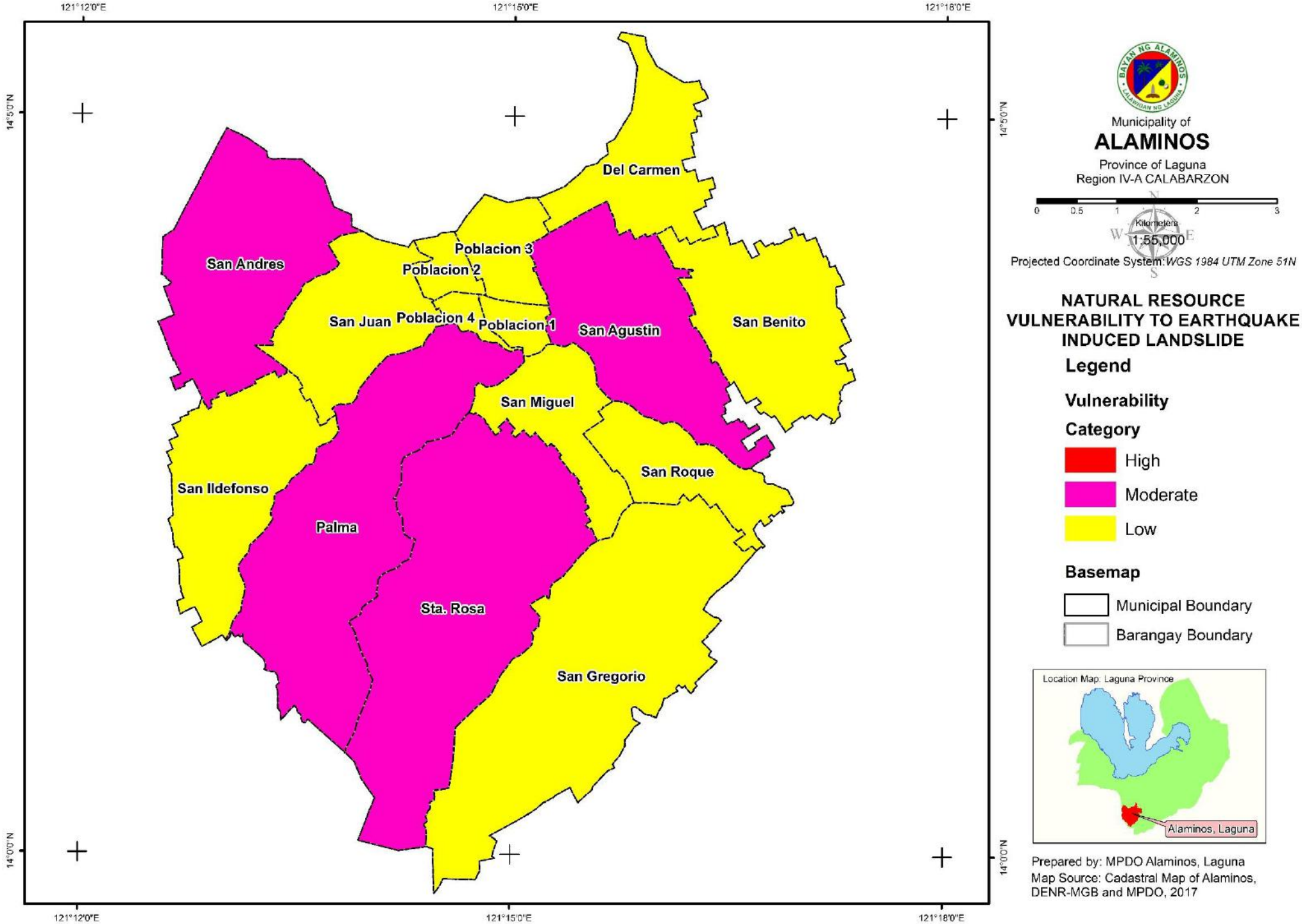
Map 44: Natural Resource Vulnerability to Flooding



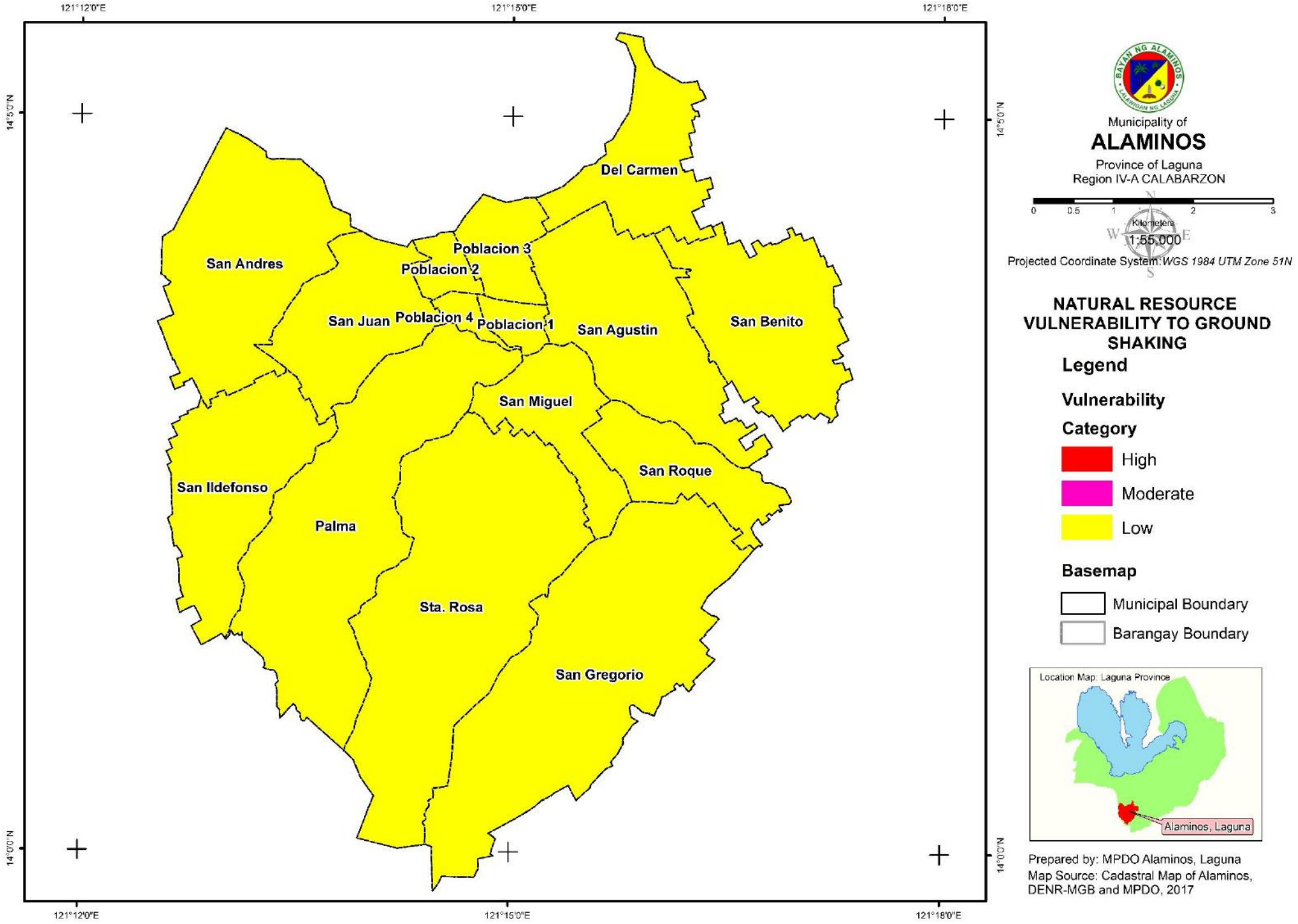
Map 45: Natural Resource Vulnerability to Rain-induced Landslide



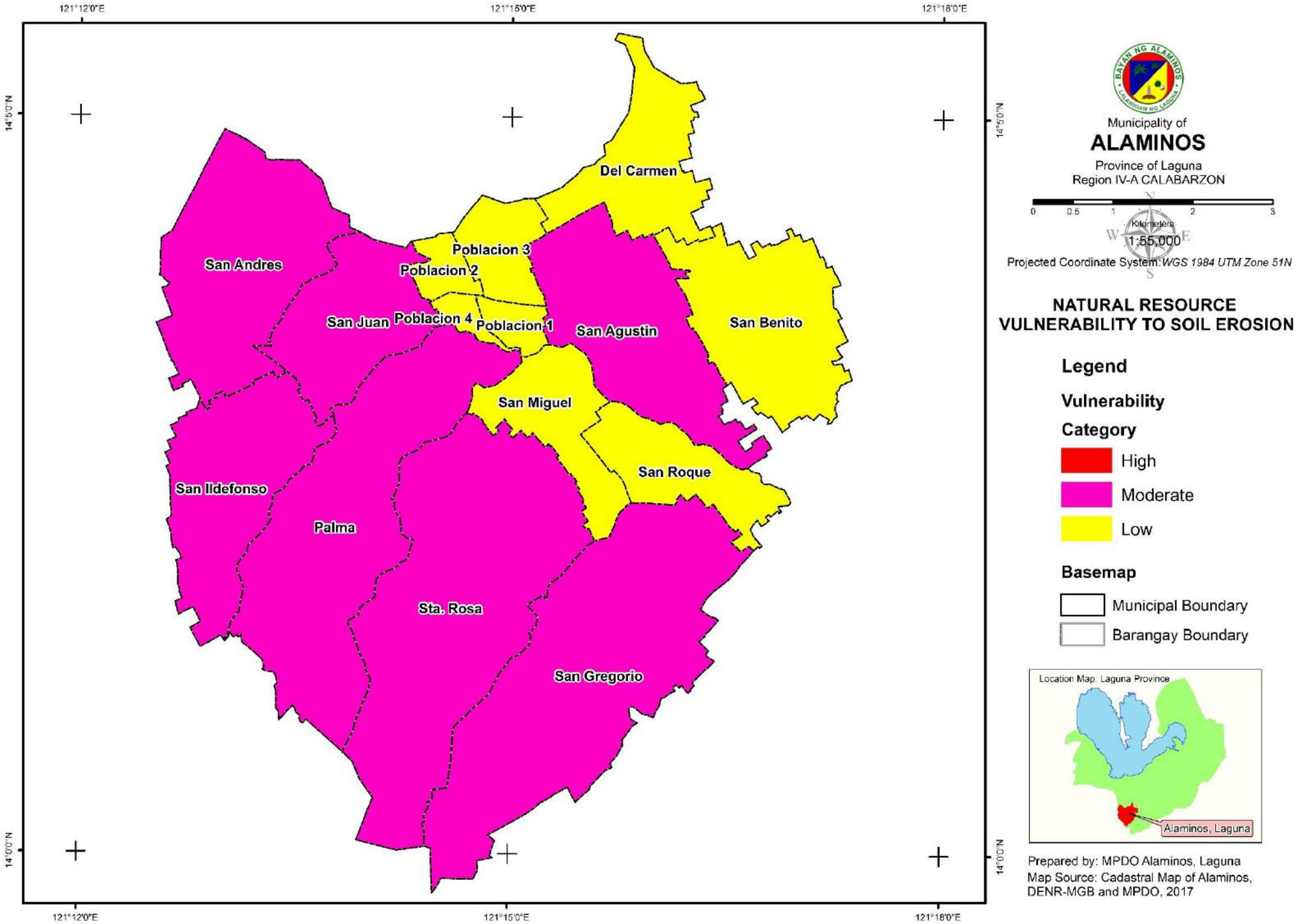
Map 46: Natural Resource Vulnerability to Earthquake-induced Landslide



Map 47: Natural Resource Vulnerability to Ground Shaking



Map 48: Natural Resource Vulnerability to Soil Erosion



Lifeline Utilities

Lifeline utilities include the transportation, water distribution, drainage and power distribution networks. These utilities are considered as assets and the LGU must ensure delivery of these lifeline services. Due to limited data, Alaminos only used transportation networks in the assessment. The maps (starting on page 127) show the transportation networks exposed to various hazards.

Table 41. Exposure and Adaptive Capacity Indicators used for the Lifeline Utilities in Alaminos, Laguna

Exposure	Adaptive Capacity
Road Length in Kilometers Exposed Length in Kilometers Value of exposed Lifeline	Government Infrastructure related investment Available redundant systems (roads)

Lifeline Utilities Exposure to Hazards

Among the hazards, ground shaking is the only hazard with a high degree of impact, while the remaining four (4) hazards – flooding, RIL, EIL and soil erosion varies from DOI values one (1) to two (2). For flooding, 3.55 kilometers of roads are exposed, particularly in barangays San Agustin, San Benito and San Roque. The total road length exposed for other hazards are 36.63 kilometers, 117.57 kilometers, 0.13 kilometers, and 39.72 kilometers, for RIL, ground shaking, EIL and soil erosion, respectively.

Table 42. Flood Exposure and Degree of impact on Lifeline Utilities in Alaminos, Laguna

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Poblacion 1	Francisco Fule	Municipal	0.16	0	0	1
Poblacion 1	Medina	Municipal	0.01	0	0	1
Poblacion 1	Gen. Malvar	Municipal	0.01	0	0	1
Poblacion 1	Maharlika	National	0.89	0	0	1
Poblacion 1	Jose Rizal	Municipal	0.01	0	0	1
Poblacion 1	PNR	Barangay	0.76	0	0	1
Poblacion 1	Alaminos Bypass	National	0.09	0	0	1
Poblacion 1	Private	Private	1.08	0	0	1
Poblacion 1	Socorro Fule	Barangay	0.26	0	0	1
Poblacion 1	Palma	Barangay	0.01	0	0	1
Poblacion 2	Gen. Malvar	Municipal	0.19	0	0	1
Poblacion 2	Lt. de Villa	Municipal	0.14	0	0	1
Poblacion 2	Jose Rizal	Municipal	0.30	0	0	1
Poblacion 2	Daniel Fandiño	Municipal	0.34	0	0	1
Poblacion 2	Apolinario Mabini	Municipal	0.17	0	0	1
Poblacion 2	Villanueva	Municipal	0.49	0	0	1
Poblacion 2	Baylon	Municipal	0.16	0	0	1

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Poblacion 2	Private	Private	9.37	0	0	1
Poblacion 2	Juan Luna	Municipal	0.17	0	0	1
Poblacion 3	Medina	Municipal	0.28	0	0	1
Poblacion 3	Gen. Malvar	Municipal	0.00	0	0	1
Poblacion 3	Jose Rizal	Municipal	0.27	0	0	1
Poblacion 3	Daniel Fandiño	Municipal	0.32	0	0	1
Poblacion 3	Baylon	Municipal	0.11	0	0	1
Poblacion 3	Private	Private	4.99	0	0	1
Poblacion 3	San Pedro I	Municipal	0.34	0	0	1
Poblacion 3	Juan Luna	Municipal	0.15	0	0	1
Poblacion 3	San Pedro II	Municipal	0.67	0	0	1
Poblacion 3	Del Carmen	Barangay	0.54	0	0	1
Poblacion 3	Limao Road	Provincial	0.51	0	0	1
Poblacion 3	Schultz	Municipal	0.10	0	0	1
Poblacion 4	Francisco Fule	Municipal	0.79	0	0	1
Poblacion 4	Jose Fule	Municipal	0.47	0	0	1
Poblacion 4	Marcelino Fule Diversion Route	Municipal	0.82	0	0	1
Poblacion 4	Kalye Putol	Municipal	0.15	0	0	1
Poblacion 4	Lt. de Villa	Municipal	0.01	0	0	1
Poblacion 4	Maharlika	National	0.62	0	0	1
Poblacion 4	PNR Road	Barangay	0.55	0	0	1
Poblacion 4	Daniel Fandiño	Municipal	0.00	0	0	1
Poblacion 4	Mabini	Municipal	0.00	0	0	1
Poblacion 4	Alaminos Bypass	National	0.02	0	0	1
Poblacion 4	Villanueva Street	Municipal	0.01	0	0	1
Poblacion 4	Private	Private	0.06	0	0	1
Poblacion 4	Socorro Fule	Barangay	0.00	0	0	1
Poblacion 4	PNR Road	Barangay	0.00	0	0	1
Del Carmen	Private	Private	2.80	0	0	1
Del Carmen	Del Carmen	Barangay	2.05	0	0	1
Del Carmen	Del Carmen - San Crispin	Provincial	0.39	0	0	1
Del Carmen	Philippine National Railway	National Railway	1.60	0	0	1
Palma	Alaminos Bypass	National	0.01	0	0	1
Palma	Private	Private	2.74	0	0	1
Palma	South Luzon TR4	National	1.18	0	0	1
Palma	Alaminos - Lipa	National	2.01	0	0	1
Palma	Palma Barangay	Barangay	8.63	0	0	1

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Palma	Alaminos - San Pablo By-Pass	National	1.16	0	0	1
San Agustin	Maharlika	National	1.81	0	0	1
San Agustin	PNR Road	Barangay	1.81	0	0	1
San Agustin	Private	Private	5.81	0	0	1
San Agustin	South Luzon TR4	National	1.66	0	0	1
San Agustin	Alaminos - Lipa	National	1.13	0	0	1
San Agustin	San Agustin	Barangay	0.18	0	0	1
San Agustin	Alaminos - San Pablo By-Pass	National	2.24	0.62	46500000	2
San Andres	Maharlika	National	1.41	0	0	1
San Andres	PNR Road	Barangay	1.03	0	0	1
San Andres	Private	Private	5.35	0	0	1
San Andres	South Luzon TR4	National	1.78	0	0	1
San Andres	San Andres - San Juan	Provincial	0.51	0	0	1
San Benito	Maharlika	National	1.86	0.21	3100380	1
San Benito	PNR Road	Barangay	1.83	0.29	432582	1
San Benito	Private	Private	3.78	0.57	8530245	1
San Benito	South Luzon TR4	National	1.19	0.99	14820465	1
San Benito	San Benito	Barangay	0.72	0	0	1
San Benito	San Benito - Sta. Veronica	Provincial	1.60	0.66	9964740	1
San Gregorio	Private	Private	1.69	0	0	1
San Gregorio	San Gregorio	Barangay	2.29	0	0	1
San Gregorio	San Gregorio - Santiago 1	Provincial	1.09	0	0	1
San Ildefonso	Private	Private	0.63	0	0	1
San Ildefonso	San Andres - San Juan Road	Provincial Road	0.15	0	0	1
San Ildefonso	Sto.Tomas - Alaminos	Provincial	2.39	0	0	1
San Juan	Marcelino Fule Diversion Route	Municipal	0.10	0	0	1
San Juan	Maharlika	National	2.29	0	0	1
San Juan	PNR Road	Barangay	1.59	0	0	1
San Juan	Private Roads	Private	2.24	0	0	1
San Juan	South Luzon TR4	National	1.66	0	0	1
San Juan	Sto.Tomas - Alaminos	Provincial	1.02	0	0	1
San Juan	San Juan	Barangay	0.23	0	0	1

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
San Juan	Alaminos - San Pablo By-Pass	National	0.58	0	0	1
San Juan	PNR Road	Barangay	0.00	0	0	1
San Miguel	Alaminos Bypass	Barangay	1.13	0	0	1
San Miguel	Private	Private	3.21	0	0	1
San Miguel	South Luzon TR4	National	1.04	0	0	1
San Miguel	Alaminos - Lipa	National	0.93	0	0	1
San Miguel	San Miguel	Barangay	2.11	0	0	1
San Miguel	Alaminos - San Pablo By-Pass	National	1.09	0	0	1
San Roque	Private	Private	1.08	0	0	1
San Roque	San Roque	Barangay	1.88	0	0	1
San Roque	Sta. Veronica, SPC	Barangay	0.43	0.21	3150000	3
Sta. Rosa	Private	Private	0.65	0	0	1
Sta. Rosa	Alaminos - Lipa	National	3.03	0	0	1
Sta. Rosa	Sta. Rosa	Barangay	1.28	0	0	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 43. Rain-Induced Landslide Exposure and Degree of impact on Lifeline Utilities in Alaminos, Laguna

Barangay		Exposure				Degree of impact score
	Road/ Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Poblacion 1	Francisco Fule	Municipal	0.16	0.161411	2421165	1
Poblacion 1	Medina Street	Municipal	0.01	0	0	1
Poblacion 1	Gen. Malvar	Municipal	0.01	0	0	1
Poblacion 1	Maharlika	National	0.89	0	0	1
Poblacion 1	Jose Rizal Street	Municipal	0.01	0	0	1
Poblacion 1	PNR Road	Barangay	0.76	0	0	1
Poblacion 1	Alaminos Bypass	National	0.09	0.013118	196770	1
Poblacion 1	Private Roads	Private	1.08	0.262289	3934335	1
Poblacion 1	Socorro Fule	Barangay	0.26	0	0	1
Poblacion 1	Palma	Barangay	0.01	0	0	1
Poblacion 2	Gen. Malvar	Municipal	0.19	0	0	1
Poblacion 2	Lt. de Villa	Municipal	0.14	0	0	1
Poblacion 2	Jose Rizal	Municipal	0.30	0	0	1
Poblacion 2	Daniel Fandiño	Municipal	0.34	0	0	1

Barangay		Exposure				Degree of impact score
	Road/ Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Poblacion 2	Mabini	Municipal	0.17	0	0	1
Poblacion 2	Villanueva	Municipal	0.49	0	0	1
Poblacion 2	Baylon Street	Municipal	0.16	0	0	1
Poblacion 2	Private Roads	Private	9.37	3.65597	54839550	1
Poblacion 2	Juan Luna	Municipal	0.17	0	0	1
Poblacion 3	Medina Street	Municipal	0.28	0	0	1
Poblacion 3	Gen. Malvar	Municipal	0.00	0	0	1
Poblacion 3	Jose Rizal	Municipal	0.27	0	0	1
Poblacion 3	Daniel Fandiño	Municipal	0.32	0	0	1
Poblacion 3	Baylon Street	Municipal	0.11	0	0	1
Poblacion 3	Private Roads	Private	4.99	0	0	1
Poblacion 3	San Pedro I	Municipal	0.34	0	0	1
Poblacion 3	Juan Luna	Municipal	0.15	0	0	1
Poblacion 3	San Pedro II	Municipal	0.67	0	0	1
Poblacion 3	Del Carmen	Barangay	0.54	0	0	1
Poblacion 3	Limao	Provincial	0.51	0	0	1
Poblacion 3	Schultz Street	Municipal	0.10	0	0	1
Poblacion 4	Francisco Fule	Municipal	0.79	0.303499	4552485	1
Poblacion 4	Jose Fule	Municipal	0.47	0	0	1
Poblacion 4	Diversion	Municipal	0.82	0.227029	3405435	1
Poblacion 4	Kalye Putol	Municipal	0.15	0	0	1
Poblacion 4	Lt. de Villa	Municipal	0.01	0	0	1
Poblacion 4	Maharlika	National	0.62	0	0	1
Poblacion 4	PNR Road	Barangay	0.55	0	0	1
Poblacion 4	Daniel Fandiño	Municipal	0.00	0	0	1
Poblacion 4	Mabini	Municipal	0.00	0	0	1
Poblacion 4	Alaminos Bypass Road	National	0.02	0.019731	295965	1
Poblacion 4	Villanueva	Municipal	0.01	0	0	1
Poblacion 4	Private Roads	Private	0.06	0	0	1
Poblacion 4	Socorro Fule	Barangay	0.00	0	0	1
Poblacion 4	PNR Road	Barangay	0.00	0	0	1
Del Carmen	Private Roads	Private	2.80	1.700748	25511220	1
Del Carmen	Del Carmen	Barangay	2.05	1.87618	28142700	1
Del Carmen	Del Carmen - San Crispin	Provincial	0.39	0.38611	5791650	3
Del Carmen	Philippine National Railway	National Railway	1.60	1.60	24000000.00	1
Palma	Alaminos Bypass	National	0.01	0	0	1

Barangay		Exposure				Degree of impact score
	Road/ Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Palma	Private Roads	Private	2.74	2.71	40650000	2
Palma	South Luzon TR4	National	1.18	1.072317	16084755	1
Palma	Alaminos - Lipa	National	2.01	2.012628	30189420	1
Palma	Palma	Barangay	8.63	8.54785	128217750	1
Palma	Alaminos - San Pablo By-Pass	National	1.16	1.088679	81650925	1
San Agustin	Maharlika	National	1.81	0	0	1
San Agustin	PNR Road	Barangay	1.81	0	0	1
San Agustin	Private Roads	Private	5.81	0	0	1
San Agustin	South Luzon TR4	National	1.66	0	0	1
San Agustin	Alaminos - Lipa	National	1.13	0	0	1
San Agustin	San Agustin	Barangay	0.18	0	0	1
San Agustin	Alaminos - San Pablo By-Pass	National	2.24	0	0	1
San Andres	Maharlika	National	1.41	0	0	1
San Andres	PNR Road	Barangay	1.03	0	0	1
San Andres	Private Roads	Private	5.35	3.06	45904350.00	1
San Andres	South Luzon TR4	National	1.78	1.62	243000000	2
San Andres	San Andres - San Juan Road	Provincial	0.51	0	0	1
San Benito	Maharlika Highway	National	1.86	0	0	1
San Benito	PNR Road	Barangay	1.83	0	0	1
San Benito	Private Roads	Private	3.78	0	0	1
San Benito	South Luzon TR4	National	1.19	0	0	1
San Benito	San Benito	Barangay	0.72	0	0	1
San Benito	San Benito - Sta. Veronica Road	Provincial	1.60	0	0	1
San Gregorio	Private Roads	Private	1.69	1.287013	19305195	1
San Gregorio	San Gregorio	Barangay	2.29	1.912636	28689540	2
San Gregorio	San Gregorio - Santiago 1	Provincial	1.09	0.913885	13708275	1
San Ildefonso	Private Roads	Private	0.63	0	0	1
San Ildefonso	San Andres - San Juan Road	Provincial	0.15	0	0	1
San Ildefonso	Sto.Tomas - Alaminos Road	Provincial	2.39	0	0	1

Barangay	Exposure					Degree of impact score
	Road/ Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
San Juan	Marcelino Fule Diversion Route	Municipal	0.10	0	0	1
San Juan	Maharlika	National	2.29	0	0	1
San Juan	PNR Road	Barangay	1.59	0.015256	228840	1
San Juan	Private Roads	Private	2.24	0.015256	228840	1
San Juan	South Luzon TR4	National	1.66	0.605955	90893250	1
San Juan	Sto.Tomas - Alaminos Road	Provincial	1.02	0	0	1
San Juan	San Juan	Barangay	0.23	0	0	1
San Juan	Alaminos - San Pablo By-Pass	National	0.58	0.022588	1694100	1
San Juan	PNR Road	Barangay	0.00	0	0	1
San Miguel	Alaminos Bypass Road	National	1.13	0	0	1
San Miguel	Private Roads	Private	3.21	0	0	1
San Miguel	South Luzon TR4	National	1.04	0	0	1
San Miguel	Alaminos - Lipa	National	0.93	0	0	1
San Miguel	San Miguel	Barangay	2.11	0	0	1
San Miguel	Alaminos - San Pablo By-Pass	National	1.09	0	0	1
San Roque	Private Roads	Private	1.08	0	0	1
San Roque	San Roque	Barangay	1.88	0	0	1
San Roque	Sta. Veronica, SPC	Barangay	0.43	0	0	1
Sta. Rosa	Private Roads	Private	0.65	0.058889	883335	1
Sta. Rosa	Alaminos - Lipa	National	3.03	1.48	22200000	3
Sta. Rosa	Sta. Rosa	Barangay	1.28	0	0	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 44. Earthquake-Induced Landslide Exposure and Degree of impact on Lifeline Utilities in Alaminos, Laguna

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Poblacion 1	Francisco Fule	Municipal	0.16	0.00	0.00	1
Poblacion 1	Medina Street	Municipal	0.01	0.00	0.00	1
Poblacion 1	Gen. Malvar	Municipal	0.01	0.00	0.00	1

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Poblacion 1	Maharlika	National	0.89	0.00	0.00	1
Poblacion 1	Jose Rizal	Municipal	0.01	0.00	0.00	1
Poblacion 1	PNR Road	Barangay	0.76	0.00	0.00	1
Poblacion 1	Alaminos Bypass	Barangay	0.09	0.00	0.00	1
Poblacion 1	Private Roads	Private	1.08	0.00	0.00	1
Poblacion 1	Socorro Fule	Barangay	0.26	0.00	0.00	1
Poblacion 1	Palma	Barangay	0.01	0.00	0.00	1
Poblacion 2	Gen. Malvar	Municipal	0.19	0.00	0.00	1
Poblacion 2	Lt. de Villa Street	Municipal	0.14	0.00	0.00	1
Poblacion 2	Jose Rizal Street	Municipal	0.30	0.00	0.00	1
Poblacion 2	Daniel Fandiño	Municipal	0.34	0.00	0.00	1
Poblacion 2	Mabini	Municipal	0.17	0.00	0.00	1
Poblacion 2	Villanueva	Municipal	0.49	0.00	0.00	1
Poblacion 2	Baylon Street	Municipal	0.16	0.00	0.00	1
Poblacion 2	Private Roads	Private	9.37	0.00	0.00	1
Poblacion 2	Juan Luna	Municipal	0.17	0.00	0.00	1
Poblacion 3	Medina Street	Municipal	0.28	0.00	0.00	1
Poblacion 3	Gen. Malvar	Municipal	0.00	0.00	0.00	1
Poblacion 3	Jose Rizal Street	Municipal	0.27	0.00	0.00	1
Poblacion 3	Daniel Fandiño	Municipal	0.32	0.00	0.00	1
Poblacion 3	Baylon Street	Municipal	0.11	0.00	0.00	1
Poblacion 3	Private Roads	Private	4.99	0.00	0.00	1
Poblacion 3	San Pedro I Street	Municipal	0.34	0.00	0.00	1
Poblacion 3	Juan Luna Street	Municipal	0.15	0.00	0.00	1
Poblacion 3	San Pedro II Street	Municipal	0.67	0.00	0.00	1
Poblacion 3	Del Carmen	Barangay	0.54	0.00	0.00	1
Poblacion 3	Barangay 3 - Limao Road	Provincial	0.51	0.00	0.00	1
Poblacion 3	Schultz Street	Municipal	0.10	0.00	0.00	1
Poblacion 4	Francisco Fule	Municipal	0.79	0.00	0.00	1
Poblacion 4	Jose Fule	Municipal	0.47	0.00	0.00	1
Poblacion 4	Diversion Route	Municipal	0.82	0.00	0.00	1
Poblacion 4	Kalye Putol	Municipal	0.15	0.00	0.00	1
Poblacion 4	Lt. de Villa Street	Municipal	0.01	0.00	0.00	1
Poblacion 4	Maharlika	National	0.62	0.00	0.00	1
Poblacion 4	PNR Road	Barangay	0.55	0.00	0.00	1
Poblacion 4	Daniel Fandiño	Municipal	0.00	0.00	0.00	1
Poblacion 4	Apolinario Mabini	Municipal	0.00	0.00	0.00	1
Poblacion 4	Alaminos Bypass	National	0.02	0.00	0.00	1
Poblacion 4	Villanueva Street	Municipal	0.01	0.00	0.00	1

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Poblacion 4	Private Roads	Private	0.06	0.00	0.00	1
Poblacion 4	Socorro Fule	Barangay	0.00	0.00	0.00	1
Poblacion 4	PNR Road	Barangay	0.00	0.00	0.00	1
Del Carmen	Private Roads	Private	2.80	0.00	0.00	1
Del Carmen	Del Carmen Barangay Road	Barangay	2.05	0.00	0.00	1
Del Carmen	Del Carmen - San Crispin Road	Provincial	0.39	0.00	0.00	1
Del Carmen	Philippine National Railway	National Railway	1.60	0.00	0.00	1
Palma	Alaminos Bypass	National	0.01	0.00	0.00	1
Palma	Private Roads	Private	2.74	0.00	0.00	1
Palma	South Luzon TR4	National	1.18	0.00	0.00	1
Palma	Alaminos - Lipa	National	2.01	0.00	0.00	1
Palma	Palma	Barangay	8.63	0.00	0.00	1
Palma	Alaminos - San Pablo By-Pass	National	1.16	0.00	0.00	1
San Agustin	Maharlika	National	1.81	0.00	0.00	1
San Agustin	PNR Road	Barangay	1.81	0.00	0.00	1
San Agustin	Private Roads	Private	5.81	0.00	0.00	1
San Agustin	South Luzon TR4	National R	1.66	0.00	0.00	1
San Agustin	Alaminos - Lipa City Road	National	1.13	0.00	0.00	1
San Agustin	San Agustin	Barangay	0.18	0.00	0.00	1
San Agustin	Alaminos - San Pablo By-Pass	National Road	2.24	0.00	0.00	1
San Andres	Maharlika	National	1.41	0.00	0.00	1
San Andres	PNR Road	Barangay	1.03	0.00	0.00	1
San Andres	Private Roads	Private	5.35	0.00	0.00	1
San Andres	South Luzon TR4	National	1.78	0.00	0.00	1
San Andres	San Andres - San Juan Road	Provincial	0.51	0.00	0.00	1
San Benito	Maharlika	National	1.86	0.00	0.00	1
San Benito	PNR Road	Barangay	1.83	0.00	0.00	1
San Benito	Private Roads	Private	3.78	0.00	0.00	1
San Benito	South Luzon TR4	National	1.19	0.00	0.00	1
San Benito	San Benito	Barangay	0.72	0.00	0.00	1
San Benito	San Benito - Sta. Veronica Road	Provincial	1.60	0.00	0.00	1
San Gregorio	Private Roads	Private	1.69	0.00	0.00	1
San Gregorio	San Gregorio	Barangay	2.29	0.00	0.00	1

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
San Gregorio	San Gregorio - Santiago 1	Provincial	1.09	0.00	0.00	1
San Ildefonso	Private Roads	Private	0.63	0.00	0.00	1
San Ildefonso	San Andres - San Juan	Provincial	0.15	0.00	0.00	1
San Ildefonso	Sto.Tomas - Alaminos Road	Provincial	2.39	0.00	0.00	1
San Juan	Diversion Route	Municipal	0.10	0.00	0.00	1
San Juan	Maharlika	National	2.29	0.00	0.00	1
San Juan	PNR Road	Barangay	1.59	0.00	0.00	1
San Juan	Private Roads	Private	2.24	0.00	0.00	1
San Juan	South Luzon TR4	National	1.66	0.00	0.00	1
San Juan	Sto.Tomas - Alaminos Road	Provincial	1.02	0.00	0.00	1
San Juan	San Juan	Barangay	0.23	0.00	0.00	1
San Juan	Alaminos - San Pablo By-Pass	National	0.58	0.00	0.00	1
San Juan	PNR Road	Barangay	0.00	0.00	0.00	1
San Miguel	Alaminos Bypass	National	1.13	0.00	0.00	1
San Miguel	Private Roads	Private	3.21	0.00	0.00	1
San Miguel	South Luzon TR4	National	1.04	0.00	0.00	1
San Miguel	Alaminos - Lipa	National	0.93	0.00	0.00	1
San Miguel	San Miguel	Barangay	2.11	0.00	0.00	1
San Miguel	Alaminos - San Pablo By-Pass	National	1.09	0.00	0.00	1
San Roque	Private Roads	Private	1.08	0.00	0.00	1
San Roque	San Roque	Barangay	1.88	0.00	0.00	1
San Roque	Sta. Veronica SPC	Barangay	0.43	0.00	0.00	1
Sta. Rosa	Private Roads	Private	0.65	0.00	0.00	1
Sta. Rosa	Alaminos - Lipa	National	3.03	0.13	1950000	1
Sta. Rosa	Sta. Rosa	Barangay	1.28	0.00	0.00	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 45.Ground shaking Exposure and Degree of impact on Lifeline Utilities in Alaminos, Laguna

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Poblacion 1	Francisco Fule	Municipal	0.16	0.16	2421167.44	3
Poblacion 1	Medina Street	Municipal	0.01	0.01	96103.62	3

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Poblacion 1	Gen. Malvar	Municipal	0.01	0.01	83891.71	3
Poblacion 1	Maharlika	National	0.89	0.89	13329034.42	3
Poblacion 1	Jose Rizal	Municipal	0.01	0.01	155094.86	3
Poblacion 1	PNR Road	Barangay	0.76	0.76	11372840.40	3
Poblacion 1	Alaminos Bypass	Barangay	0.09	0.09	1403676.51	3
Poblacion 1	Private Roads	Private	1.08	1.08	16152647.82	3
Poblacion 1	Socorro Fule	Barangay	0.26	0.26	3934329.73	3
Poblacion 1	Palma	Barangay	0.01	0.01	105093.31	3
Poblacion 2	Gen. Malvar	Municipal	0.19	0.19	2814596.93	3
Poblacion 2	Lt. de Villa Street	Municipal	0.14	0.14	2095822.52	3
Poblacion 2	Jose Rizal Street	Municipal	0.30	0.30	4460241.88	3
Poblacion 2	Daniel Fandiño	Municipal	0.34	0.34	5038328.38	3
Poblacion 2	Mabini	Municipal	0.17	0.17	2493340.14	3
Poblacion 2	Villanueva	Municipal	0.49	0.49	7368912.30	3
Poblacion 2	Baylon Street	Municipal	0.16	0.16	2384009.28	3
Poblacion 2	Private Roads	Private	9.37	9.37	140538598.30	3
Poblacion 2	Juan Luna	Municipal	0.17	0.17	2494233.40	3
Poblacion 3	Medina Street	Municipal	0.28	0.28	4134476.08	3
Poblacion 3	Gen. Malvar	Municipal	0.00	0.00	36321.85	3
Poblacion 3	Jose Rizal Street	Municipal	0.27	0.27	4117329.09	3
Poblacion 3	Daniel Fandiño	Municipal	0.32	0.32	4792132.25	3
Poblacion 3	Baylon Street	Municipal	0.11	0.11	1674811.85	3
Poblacion 3	Private Roads	Private	4.99	4.99	74865837.73	3
Poblacion 3	San Pedro I Street	Municipal	0.34	0.34	5122934.45	3
Poblacion 3	Juan Luna Street	Municipal	0.15	0.15	2283876.95	3
Poblacion 3	San Pedro II	Municipal	0.67	0.67	10025802.54	3
Poblacion 3	Del Carmen	Barangay	0.54	0.54	8027008.67	3
Poblacion 3	Barangay 3 - Limao Road	Provincial	0.51	0.51	7706624.18	3
Poblacion 3	Schultz Street	Municipal	0.10	0.10	1466619.18	3
Poblacion 4	Francisco Fule	Municipal	0.79	0.79	11923685.51	3
Poblacion 4	Jose Fule	Municipal	0.47	0.47	7032873.81	3
Poblacion 4	Diversion Route	Municipal	0.82	0.82	12290470.01	3
Poblacion 4	Kalye Putol	Municipal	0.15	0.15	2230609.72	3
Poblacion 4	Lt. de Villa Street	Municipal	0.01	0.01	109930.82	3
Poblacion 4	Maharlika	National	0.62	0.62	9281949.87	3
Poblacion 4	PNR Road	Barangay	0.55	0.55	8230928.96	3
Poblacion 4	Daniel Fandiño	Municipal	0.00	0.00	21556.26	3
Poblacion 4	Mabini	Municipal	0.00	0.00	66626.48	3
Poblacion 4	Alaminos Bypass	National	0.02	0.02	1479812.37	3
Poblacion 4	Villanueva Street	Municipal	0.01	0.01	110676.71	3
Poblacion 4	Private Roads	Private	0.06	0.06	914821.13	3
Poblacion 4	Socorro Fule	Barangay	0.00	0.00	5378.38	3
Poblacion 4	PNR Road	Barangay	0.00	0.00	709.86	3

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Del Carmen	Private Roads	Private	2.80	2.80	42005340.30	3
Del Carmen	Del Carmen	Barangay	2.05	2.05	30710646.37	3
Del Carmen	Del Carmen - San Crispin Road	Provincial	0.39	0.39	5791647.58	3
Del Carmen	Philippine National Railway	National Railway	1.60	1.60	24049309.50	3
Palma	Alaminos Bypass	National	0.01	0.01	92026.39	3
Palma	Private Roads	Private	2.74	2.74	41071870.44	3
Palma	South Luzon TR4	National	1.18	1.18	17651533.16	3
Palma	Alaminos - Lipa	National	2.01	2.01	30189418.19	3
Palma	Palma	Barangay	8.63	8.63	129484401.66	3
Palma	Alaminos - San Pablo By-Pass	National	1.16	1.16	17440687.67	3
San Agustin	Maharlika	National	1.81	1.81	27224636.34	3
San Agustin	PNR Road	Barangay	1.81	1.81	27119107.67	3
San Agustin	Private Roads	Private	5.81	5.81	87174805.04	3
San Agustin	South Luzon TR4	National R	1.66	1.66	248912138.78	3
San Agustin	Alaminos - Lipa	National	1.13	1.13	17022019.05	3
San Agustin	San Agustin	Barangay	0.18	0.09	1313872.32	3
San Agustin	Alaminos - San Pablo By-Pass	National Road	2.24	2.24	168169555.99	3
San Andres	Maharlika	National	1.41	1.41	21124120.94	3
San Andres	PNR Road	Barangay	1.03	1.03	15486848.42	3
San Andres	Private Roads	Private	5.35	5.35	80251815.58	3
San Andres	South Luzon TR4	National	1.78	1.78	26665004.42	3
San Andres	San Andres - San Juan Road	Provincial	0.51	0.51	7605640.76	3
San Benito	Maharlika	National	1.86	1.86	27973696.79	3
San Benito	PNR Road	Barangay	1.83	1.83	27426217.19	3
San Benito	Private Roads	Private	3.78	3.78	56700063.49	3
San Benito	South Luzon TR4	National	1.19	1.19	17849802.74	3
San Benito	San Benito	Barangay	0.72	0.20	3063338.90	3
San Benito	San Benito - Sta. Veronica Road	Provincial	1.60	1.60	23975830.46	3
San Gregorio	Private Roads	Private	1.69	1.69	25310904.46	3
San Gregorio	San Gregorio	Barangay	2.29	2.29	34383850.58	3
San Gregorio	San Gregorio - Santiago 1	Provincial	1.09	1.09	16404111.38	3
San Ildefonso	Private Roads	Private	0.63	0.63	9478341.83	3
San Ildefonso	San Andres - San Juan	Provincial	0.15	0.15	2277394.33	3
San Ildefonso	Sto.Tomas - Alaminos Road	Provincial	2.39	2.39	35776894.35	3
San Juan	Diversion Route	Municipal	0.10	0.10	1498232.35	3
San Juan	Maharlika	National	2.29	2.29	34389355.55	3

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
San Juan	PNR Road	Barangay	1.59	1.59	23833934.41	3
San Juan	Private Roads	Private	2.24	2.24	33550940.16	3
San Juan	South Luzon TR4	National	1.66	1.66	24901059.49	3
San Juan	Sto.Tomas - Alaminos Road	Provincial	1.02	1.02	15292290.66	3
San Juan	San Juan	Barangay	0.23	0.23	3450000.00	3
San Juan	Alaminos - San Pablo By-Pass	National	0.58	0.58	43224485.55	3
San Juan	PNR Road	Barangay	0.00	0.00	709.86	3
San Miguel	Alaminos Bypass	National	1.13	1.13	16973334.87	3
San Miguel	Private Roads	Private	3.21	3.21	48198579.70	3
San Miguel	South Luzon TR4	National	1.04	1.04	15573246.13	3
San Miguel	Alaminos - Lipa	National	0.93	0.93	13991124.37	3
San Miguel	San Miguel	Barangay	2.11	0.15	2208816.22	3
San Miguel	Alaminos - San Pablo By-Pass	National	1.09	1.09	82033013.99	3
San Roque	Private Roads	Private	1.08	1.08	16178854.54	3
San Roque	San Roque	Barangay	1.88	1.77	26485902.64	3
San Roque	Sta. Veronica SPC	Barangay	0.43	0.43	6402979.75	3
Sta. Rosa	Private Roads	Private	0.65	0.65	9796265.32	3
Sta. Rosa	Alaminos - Lipa	National	3.03	3.03	45430141.49	3
Sta. Rosa	Sta. Rosa	Barangay	1.28	1.08	16243492.37	3

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 46. Soil Erosion Exposure and Degree of impact on Lifeline Utilities in Alaminos, Laguna

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Poblacion 1	Francisco Fule	Municipal	0.16	0	0	1
Poblacion 1	Medina Street	Municipal	0.01	0	0	1
Poblacion 1	Gen. Malvar	Municipal	0.01	0	0	1
Poblacion 1	Maharlika	National	0.89	0	0	1
Poblacion 1	Jose Rizal	Municipal	0.01	0	0	1
Poblacion 1	PNR Road	Barangay	0.76	0	0	1
Poblacion 1	Alaminos Bypass	Barangay	0.09	0	0	1
Poblacion 1	Private Roads	Private	1.08	0	0	1
Poblacion 1	Socorro Fule	Barangay	0.26	0	0	1
Poblacion 1	Palma	Barangay	0.01	0	0	1
Poblacion 2	Gen. Malvar	Municipal	0.19	0	0	1
Poblacion 2	Lt. de Villa Street	Municipal	0.14	0	0	1
Poblacion 2	Jose Rizal Street	Municipal	0.30	0	0	1

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Poblacion 2	Daniel Fandiño	Municipal	0.34	0	0	1
Poblacion 2	Mabini	Municipal	0.17	0	0	1
Poblacion 2	Villanueva	Municipal	0.49	0.256843	3852645	2
Poblacion 2	Baylon Street	Municipal	0.16	0	0	1
Poblacion 2	Private Roads	Private	9.37	8.341308	125119620	2
Poblacion 2	Juan Luna	Municipal	0.17	0	0	1
Poblacion 3	Medina Street	Municipal	0.28	0	0	1
Poblacion 3	Gen. Malvar	Municipal	0.00	0	0	1
Poblacion 3	Jose Rizal Street	Municipal	0.27	0	0	1
Poblacion 3	Daniel Fandiño	Municipal	0.32	0	0	1
Poblacion 3	Baylon Street	Municipal	0.11	0	0	1
Poblacion 3	Private Roads	Private	4.99	3.433082	51496230	2
Poblacion 3	San Pedro I Street	Municipal	0.34	0	0	1
Poblacion 3	Juan Luna Street	Municipal	0.15	0	0	1
Poblacion 3	San Pedro II	Municipal	0.67	0	0	1
Poblacion 3	Del Carmen	Barangay	0.54	0	0	1
Poblacion 3	Barangay 3 - Limao Road	Provincial	0.51	0.338841	5082615	2
Poblacion 3	Schultz Street	Municipal	0.10	0	0	1
Poblacion 4	Francisco Fule	Municipal	0.79	0	0	1
Poblacion 4	Jose Fule	Municipal	0.47	0	0	1
Poblacion 4	Diversion Route	Municipal	0.82	0	0	1
Poblacion 4	Kalye Putol	Municipal	0.15	0	0	1
Poblacion 4	Lt. de Villa Street	Municipal	0.01	0	0	1
Poblacion 4	Maharlika	National	0.62	0	0	1
Poblacion 4	PNR Road	Barangay	0.55	0	0	1
Poblacion 4	Daniel Fandiño	Municipal	0.00	0	0	1
Poblacion 4	Mabini	Municipal	0.00	0	0	1
Poblacion 4	Alaminos Bypass	National	0.02	0	0	1
Poblacion 4	Villanueva Street	Municipal	0.01	0	0	1
Poblacion 4	Private Roads	Private	0.06	0	0	1
Poblacion 4	Socorro Fule	Barangay	0.00	0	0	1
Poblacion 4	PNR Road	Barangay	0.00	0	0	1
Del Carmen	Private Roads	Private	2.80	1.166694	17500410	2
Del Carmen	Del Carmen	Barangay	2.05	0	0	1
Del Carmen	Del Carmen - San Crispin Road	Provincial	0.39	1.113724	16705860	1
Del Carmen	Philippine National Railway	National Railway	1.60	1.603287	24049305	2
Palma	Alaminos Bypass	National	0.01	0	0	1

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
Palma	Private Roads	Private	2.74	0.447384	6710760	2
Palma	South Luzon TR4	National	1.18	0	0	1
Palma	Alaminos - Lipa	National	2.01	0.354867	5323005	2
Palma	Palma	Barangay	8.63	0.020032	300480	1
Palma	Alaminos - San Pablo By-Pass	National	1.16	0	0	1
San Agustin	Maharlika	National	1.81	0	0	1
San Agustin	PNR Road	Barangay	1.81	0	0	1
San Agustin	Private Roads	Private	5.81	0	0	1
San Agustin	South Luzon TR4	National R	1.66	0	0	1
San Agustin	Alaminos - Lipa	National	1.13	0	0	1
San Agustin	San Agustin	Barangay	0.18	0	0	1
San Agustin	Alaminos - San Pablo By-Pass	National Road	2.24	0	0	1
San Andres	Maharlika	National	1.41	1.408275	21124125	2
San Andres	PNR Road	Barangay	1.03	1.032457	15486855	2
San Andres	Private Roads	Private	5.35	5.350121	80251815	2
San Andres	South Luzon TR4	National	1.78	1.777667	26665005	2
San Andres	San Andres - San Juan Road	Provincial	0.51	0.507043	7605645	2
San Benito	Maharlika	National	1.86	0	0	1
San Benito	PNR Road	Barangay	1.83	0	0	1
San Benito	Private Roads	Private	3.78	0	0	1
San Benito	South Luzon TR4	National	1.19	0	0	1
San Benito	San Benito	Barangay	0.72	0	0	1
San Benito	San Benito - Sta. Veronica Road	Provincial	1.60	0	0	1
San Gregorio	Private Roads	Private	1.69	0.458823	6882345	2
San Gregorio	San Gregorio	Barangay	2.29	0.438694	6580410	2
San Gregorio	San Gregorio - Santiago 1	Provincial	1.09	0	0	1
San Ildefonso	Private Roads	Private	0.63	0.631889	9478335	1
San Ildefonso	San Andres - San Juan	Provincial	0.15	0.151826	2277390	2
San Ildefonso	Sto.Tomas - Alaminos Road	Provincial	2.39	0.567016	8505240	2
San Juan	Diversion Route	Municipal	0.10	0	0	1
San Juan	Maharlika	National	2.29	2.194748	32921220	2
San Juan	PNR Road	Barangay	1.59	1.554767	23321505	2
San Juan	Private Roads	Private	2.24	2.236729	33550935	2
San Juan	South Luzon TR4	National	1.66	1.303808	195571200	2

Barangay	Exposure					Degree of impact score
	Street Name	Road Class	Road Length (Km)	Exposed Length (Km)	Value of exposed Lifeline (PhP)	
San Juan	Sto.Tomas - Alaminos Road	Provincial	1.02	1.019486	15292290	2
San Juan	San Juan	Barangay	0.23	0.229	3435000	2
San Juan	Alaminos - San Pablo By-Pass	National	0.58	0.203465	3051975	2
San Juan	PNR Road	Barangay	0.00	0	0	1
San Miguel	Alaminos Bypass	National	1.13	0	0	1
San Miguel	Private Roads	Private	3.21	0	0	1
San Miguel	South Luzon TR4	National	1.04	0	0	1
San Miguel	Alaminos - Lipa	National	0.93	0	0	1
San Miguel	San Miguel	Barangay	2.11	0	0	1
San Miguel	Alaminos - San Pablo By-Pass	National	1.09	0	0	1
San Roque	Private Roads	Private	1.08	0	0	1
San Roque	San Roque	Barangay	1.88	0	0	1
San Roque	Sta. Veronica SPC	Barangay	0.43	0	0	1
Sta. Rosa	Private Roads	Private	0.65	0.058889	883335	2
Sta. Rosa	Alaminos - Lipa	National	3.03	1.525526	22882890	2
Sta. Rosa	Sta. Rosa	Barangay	1.28	0	0	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Lifeline Utilities Adaptive Capacity to Hazards

Table 47: Adaptive Capacity on Hazard events in Lifeline Facilities in Alaminos, Laguna

Barangay	Adaptive Capacity	
	Government Infrastructure Related Investment (%)	Available Redundant Systems (%)
Poblacion 1	85	50
Poblacion 2	90	55
Poblacion 3	87	53
Poblacion 4	85	50
Del Carmen	75	49
Palma	80	55
San Agustin	97	59
San Andres	90	50
San Benito	90	55
San Gregorio	75	48
San Ildefonso	95	50
San Roque	100	50
San Juan	95	55
San Miguel	85	52

Sta Rosa	82	50

Source: CDRA Workshop, MPDO GIS Computation, 2018

Lifeline Utilities Vulnerability to Hazards

All barangays have low vulnerability scores for all identified hazard events. The table below summarizes the vulnerability ratings of Alaminos in terms of its lifeline utilities and hazards

Table 48. Vulnerability Ratings of Lifeline Utilities to Hazard events of Alaminos, Laguna using Exposure and Adaptive Capacity indicators

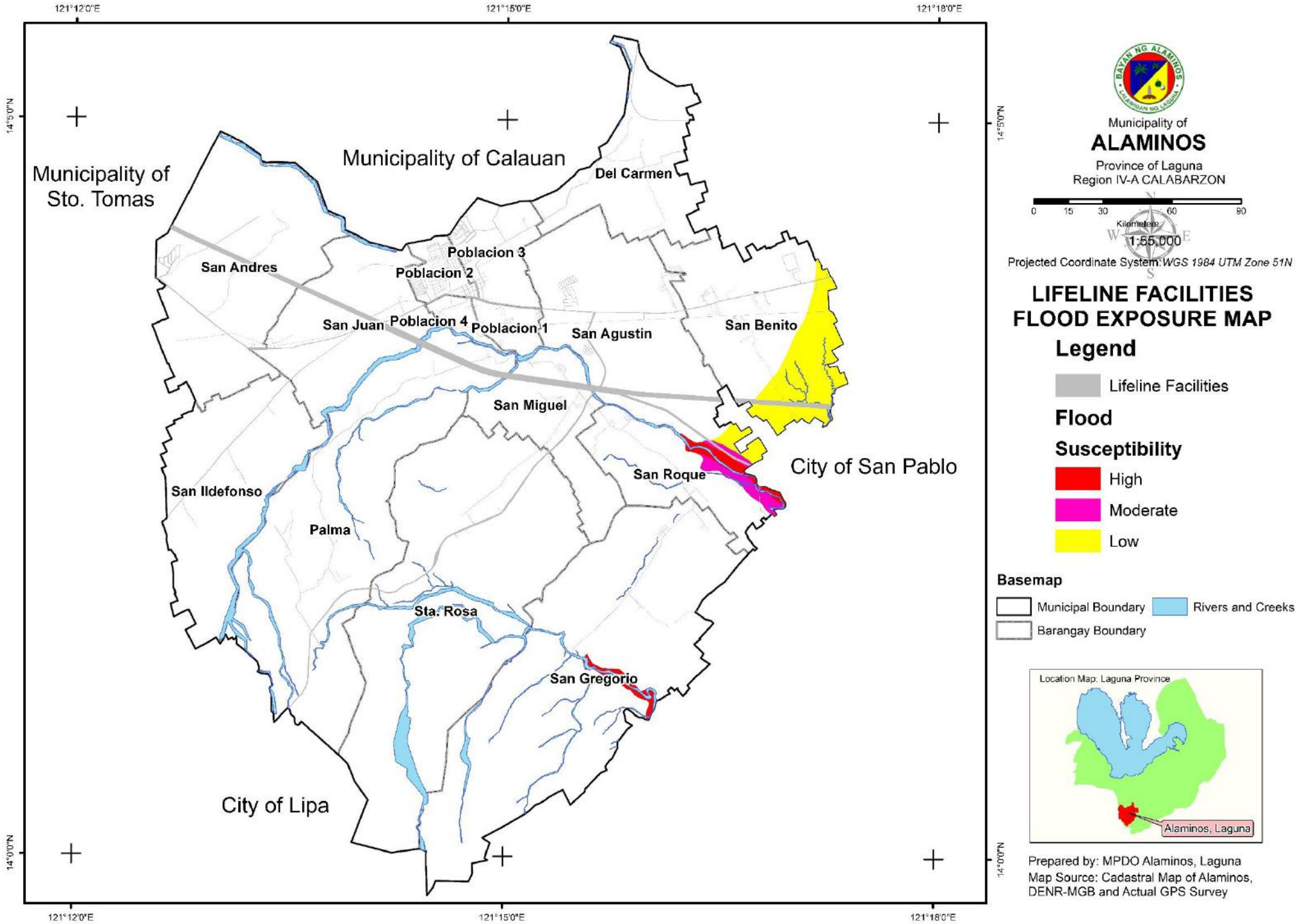
Barangay	Vulnerability				
	Flood	RIL	EIL	Ground Shaking	Soil Erosion
Poblacion 1	Low	Low	Low	Low	Low
Poblacion 2	Low	Low	Low	Low	Low
Poblacion 3	Low	Low	Low	Low	Low
Poblacion 4	Low	Low	Low	Low	Low
Del Carmen	Low	Low	Low	Low	Low
Palma	Low	Low	Low	Low	Low
San Agustin	Low	Low	Low	Low	Low
San Andres	Low	Low	Low	Low	Low
San Benito	Low	Low	Low	Low	Low
San Gregorio	Low	Low	Low	Low	Low
San Ildefonso	Low	Low	Low	Low	Low
San Roque	Low	Low	Low	Low	Low
San Juan	Low	Low	Low	Low	Low
San Miguel	Low	Low	Low	Low	Low
Sta Rosa	Low	Low	Low	Low	Low

Source: CDRA Workshop, MPDO GIS Computation, 2018

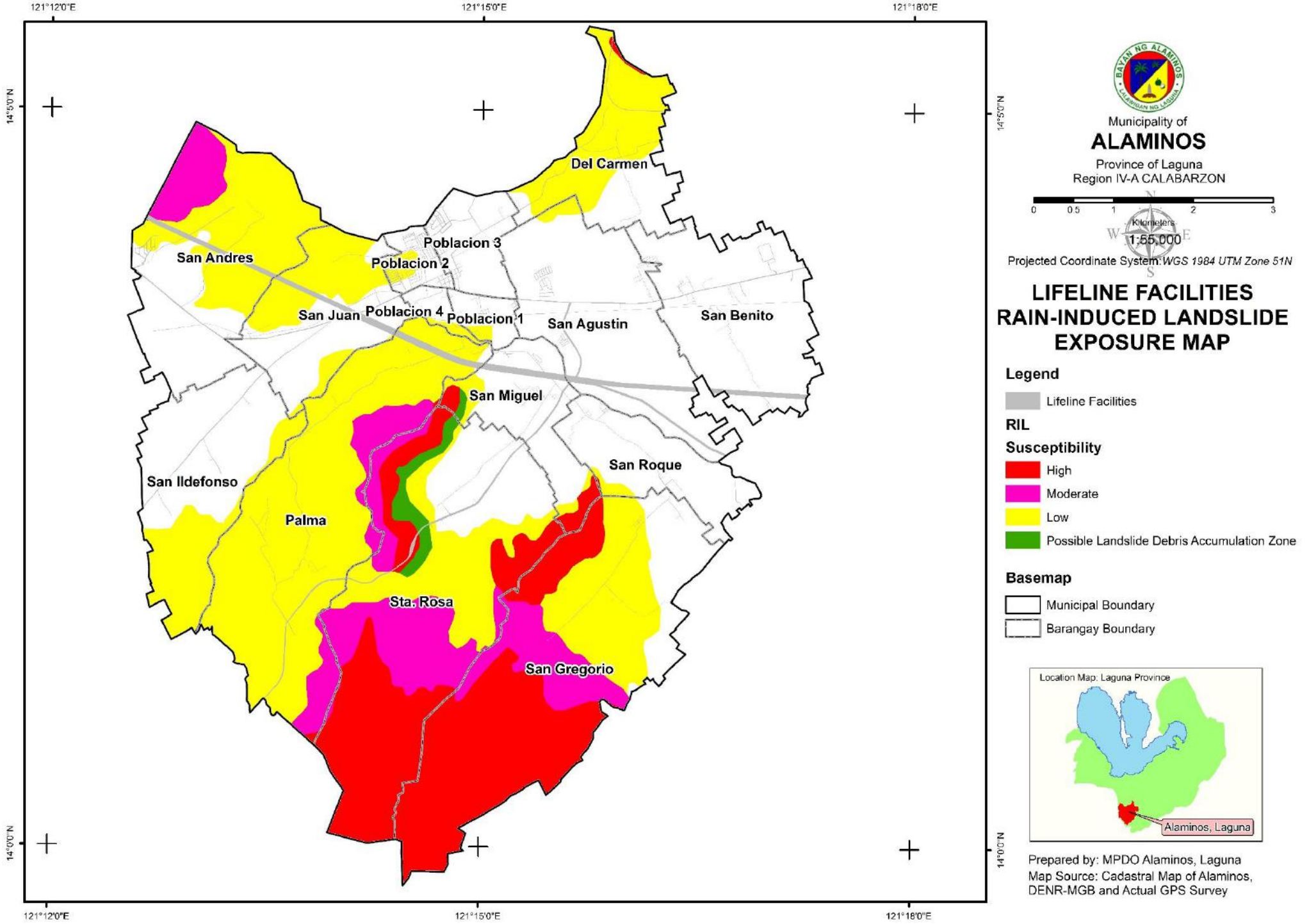
Refer to the maps below:

Map 49: Lifeline Facilities Flood Exposure Map
Map 50: Lifeline Facilities Rain-induced Landslide Exposure Map
Map 51: Lifeline Facilities Earthquake-induced Landslide Exposure Map
Map 52: Lifeline Facilities Ground Shaking Exposure Map
Map 53: Lifeline Facilities Soil Erosion Exposure Map
Map 54: Lifeline Facilities Vulnerability to Flooding
Map 55: Lifeline Facilities Vulnerability to Rain-induced Landslide
Map 56: Lifeline Facilities Vulnerability to Earthquake-induced Landslide
Map 57: Lifeline Facilities Vulnerability to Ground Shaking
Map 58: Lifeline Facilities Vulnerability to Soil Erosion

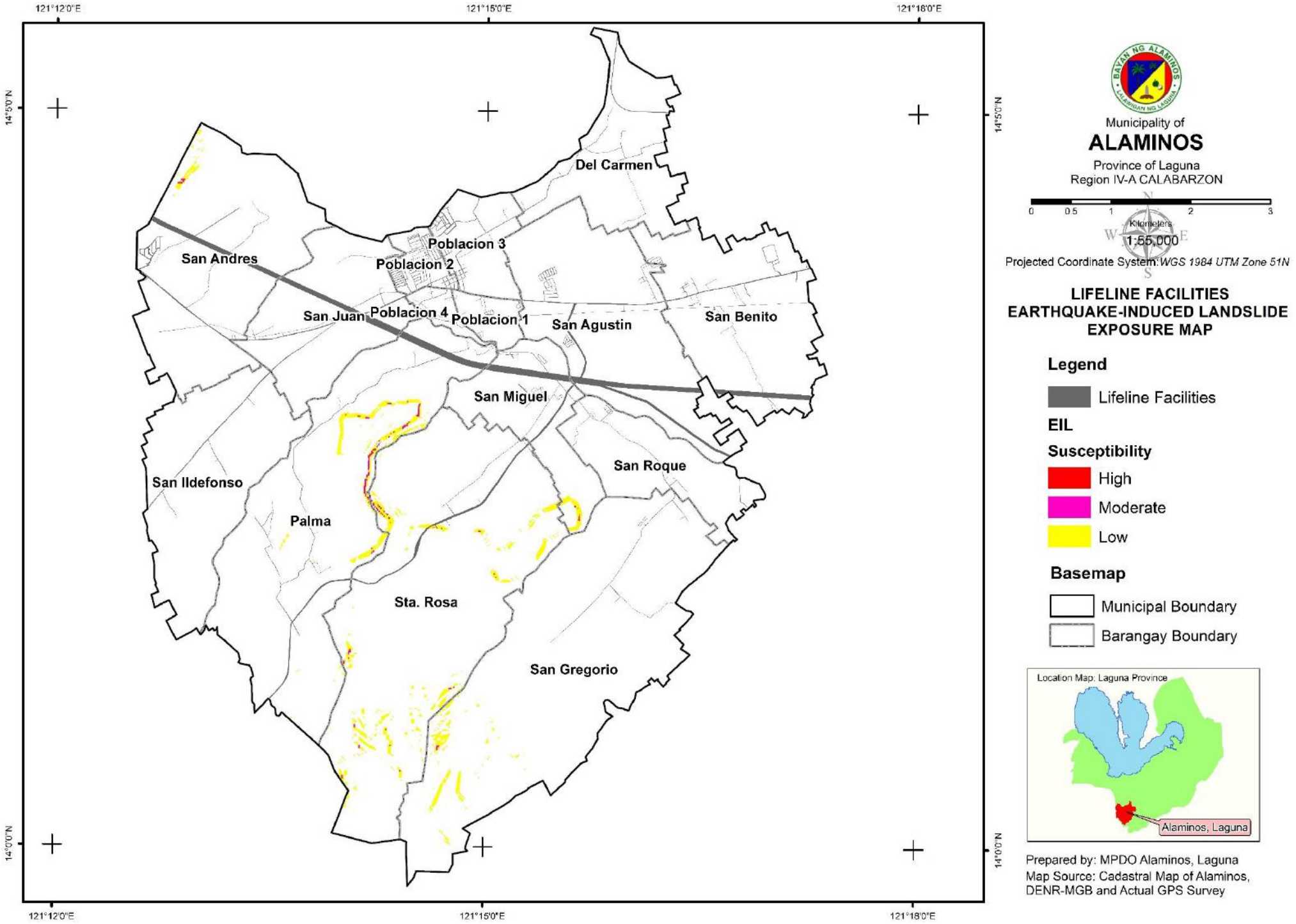
Map 49: Lifeline Facilities Flood Exposure Map



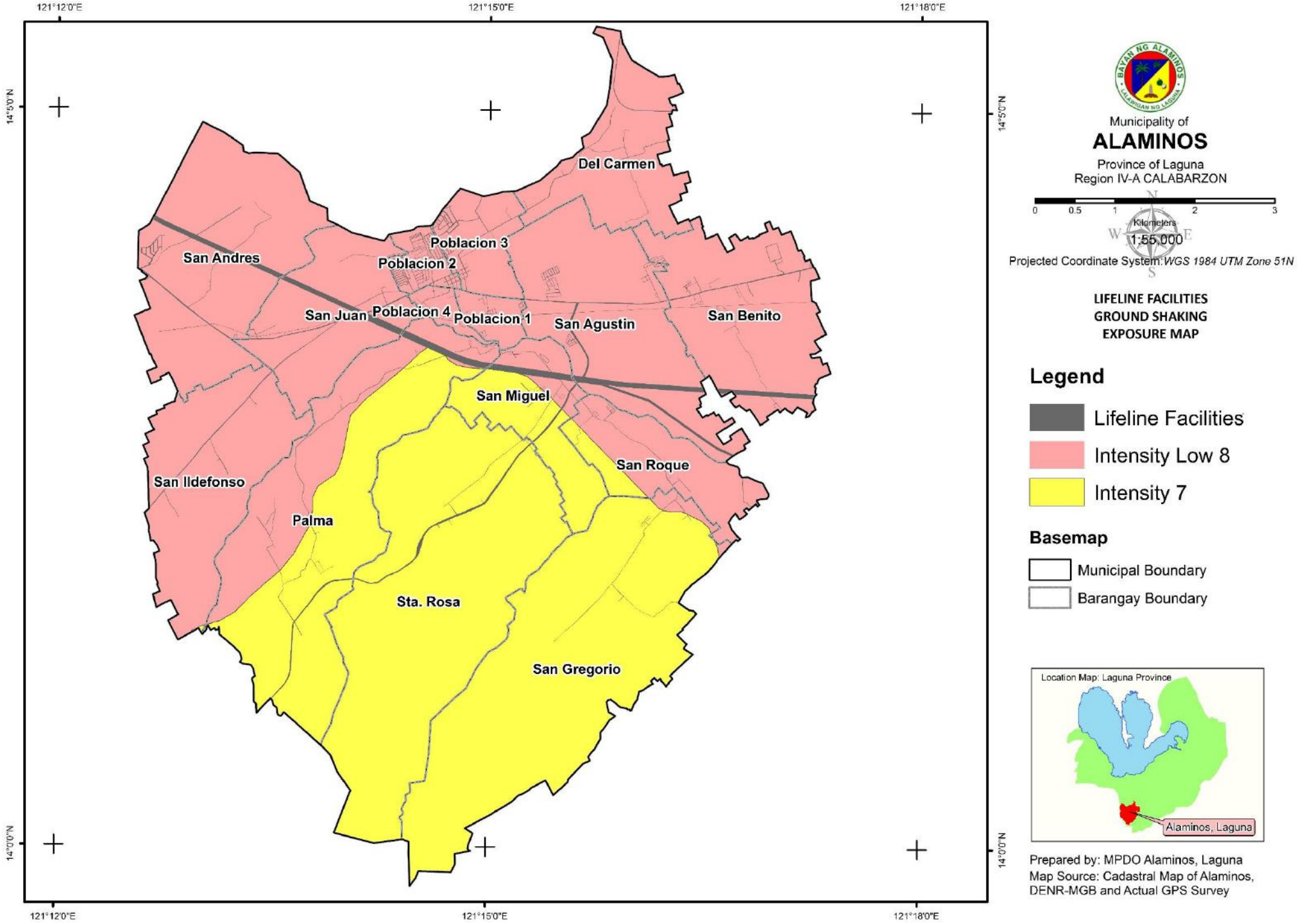
Map 50: Lifeline Facilities Rain-induced Landslide Exposure Map



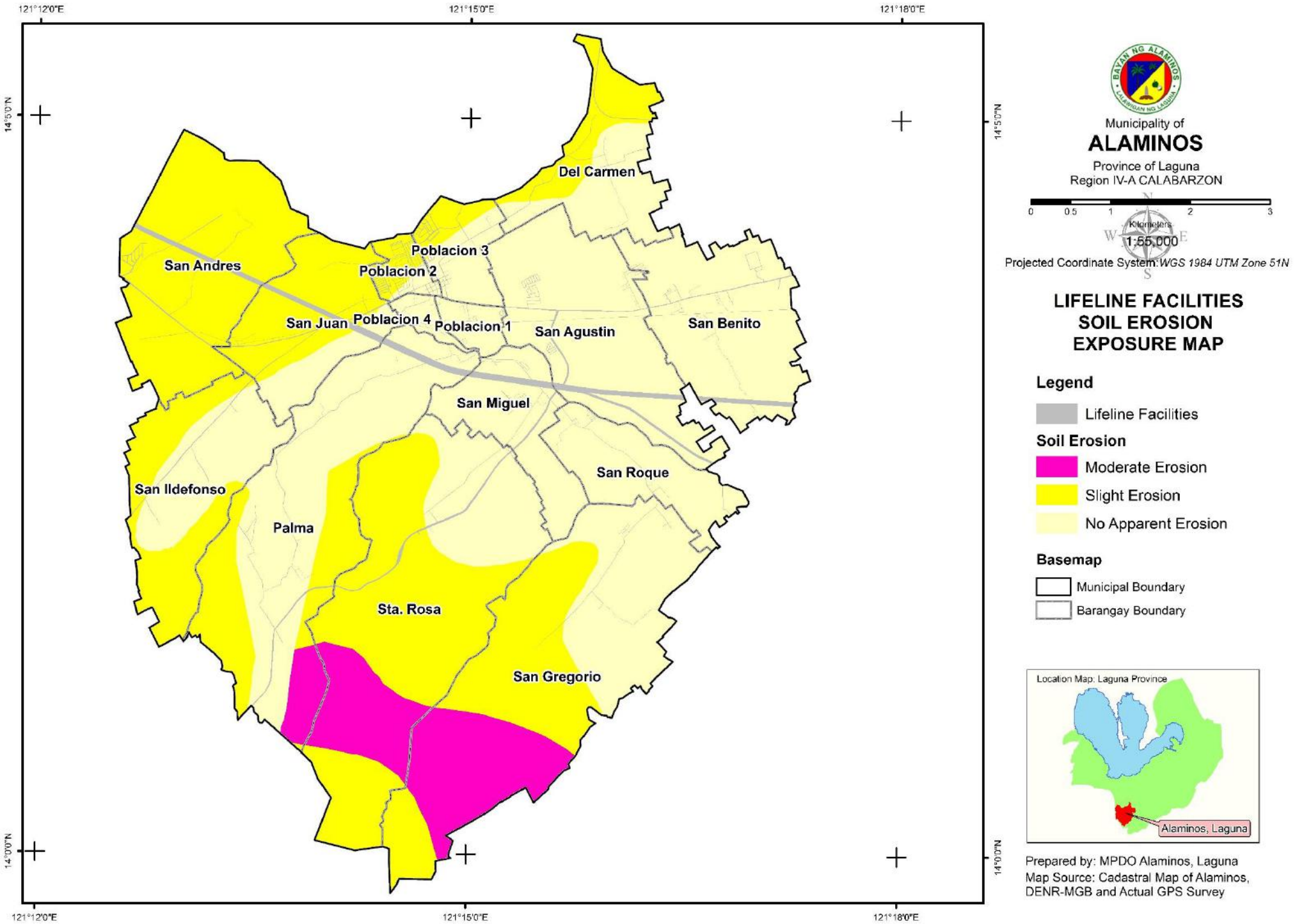
Map 51: Lifeline Facilities Earthquake-induced Landslide Exposure Map



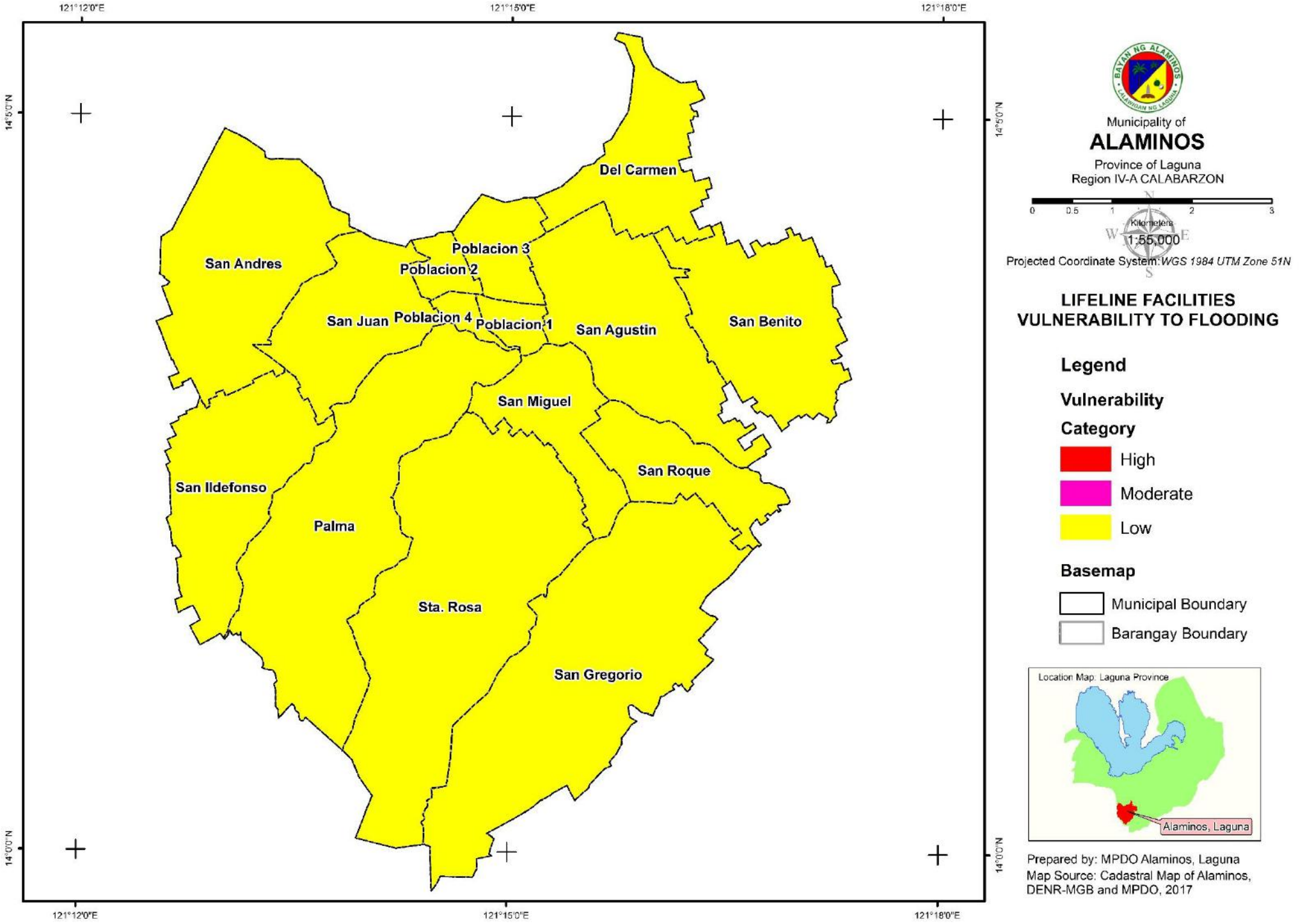
Map 52: Lifeline Facilities Ground Shaking Exposure Map



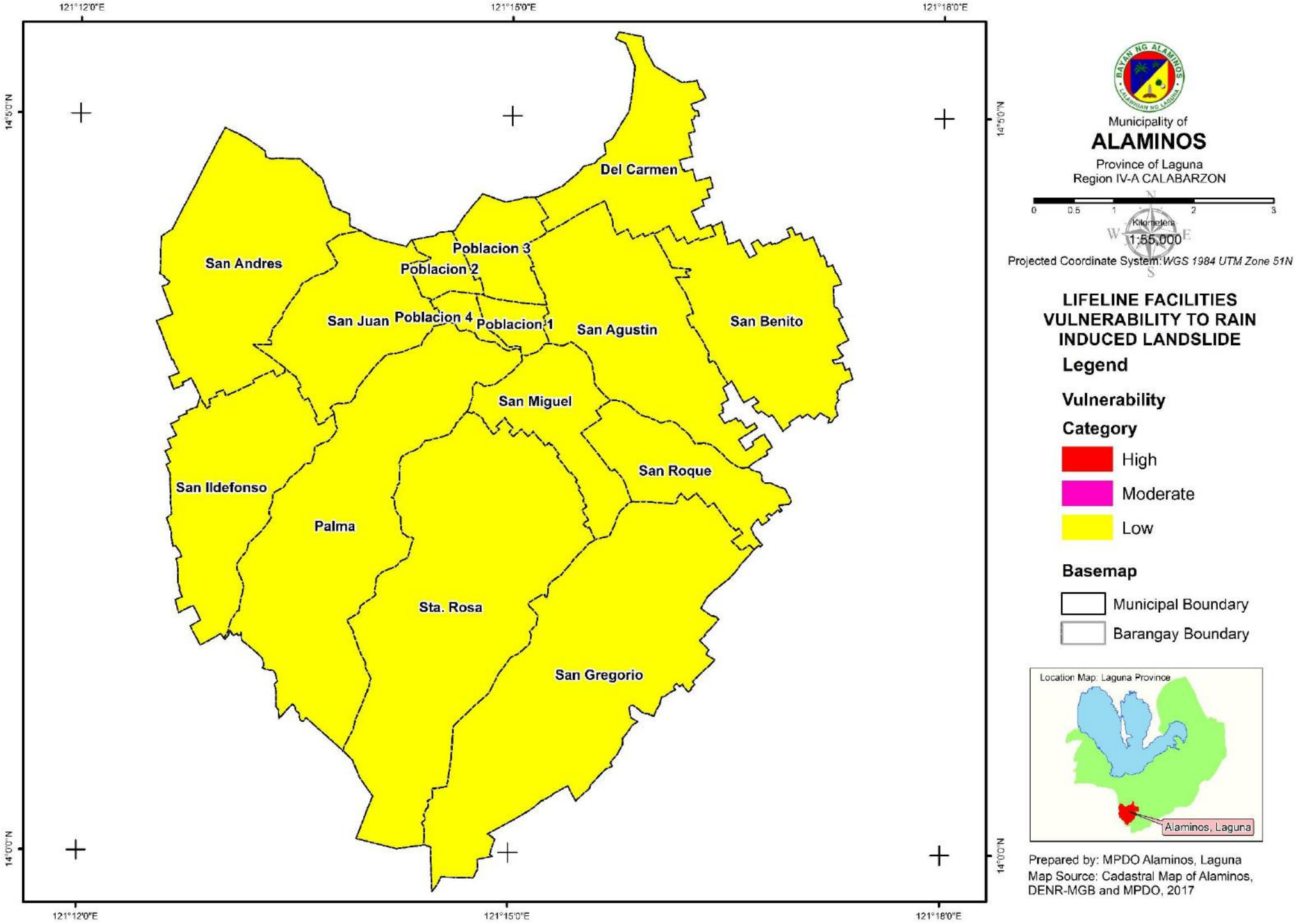
Map 53: Lifeline Facilities Soil Erosion Exposure Map



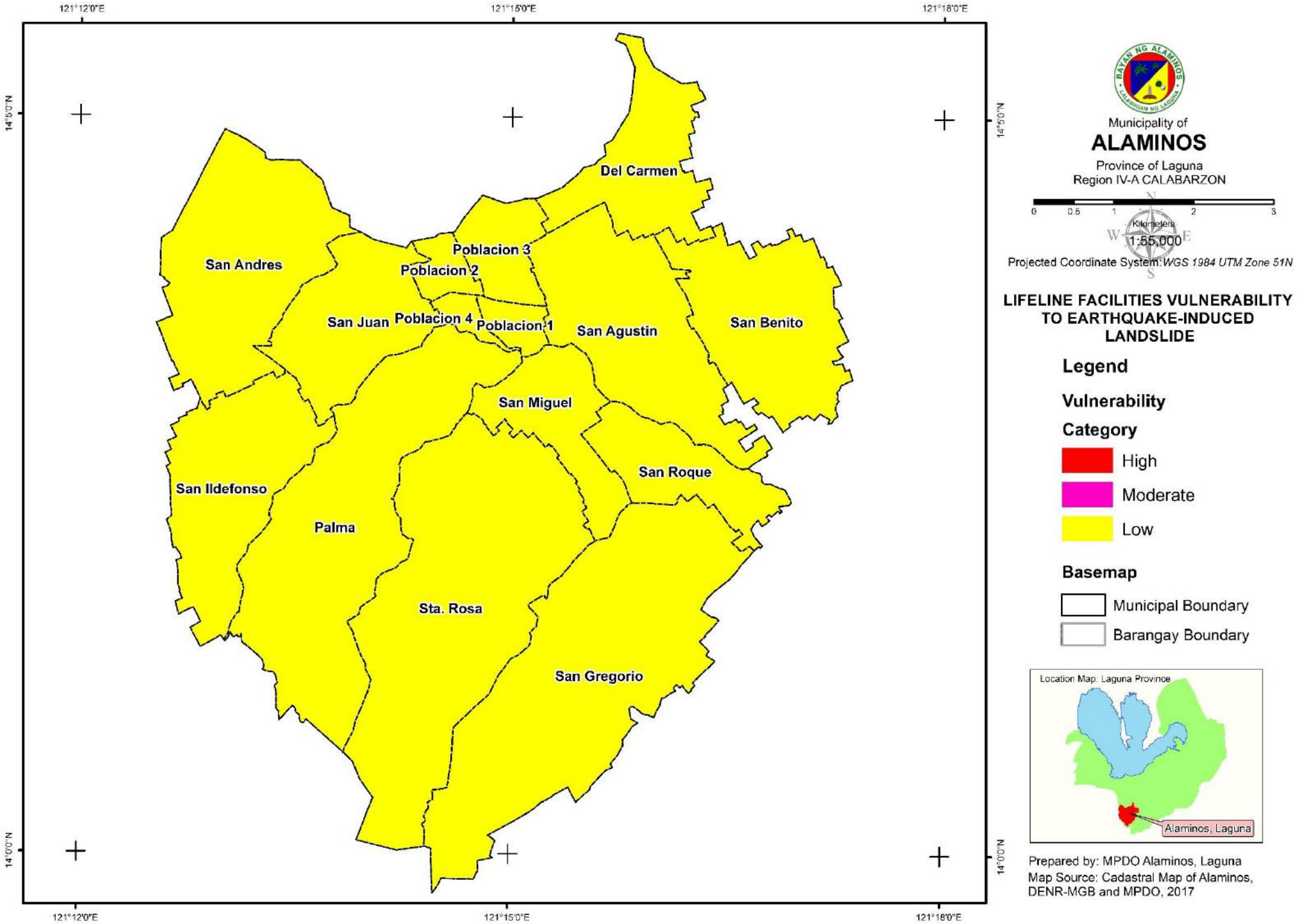
Map 54: Lifeline Facilities Vulnerability to Flooding



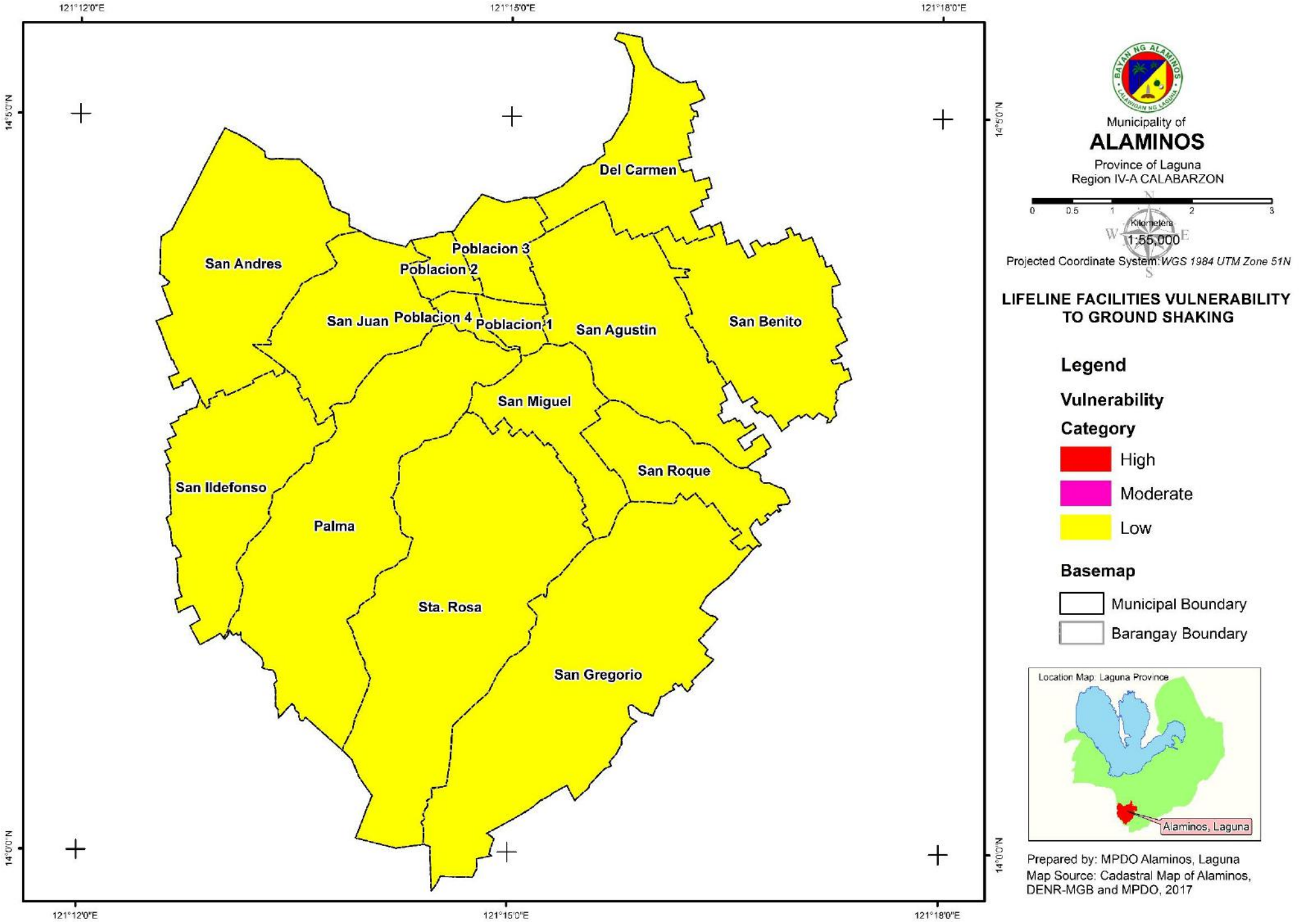
Map 55: Lifeline Facilities Vulnerability to Rain-induced Landslide



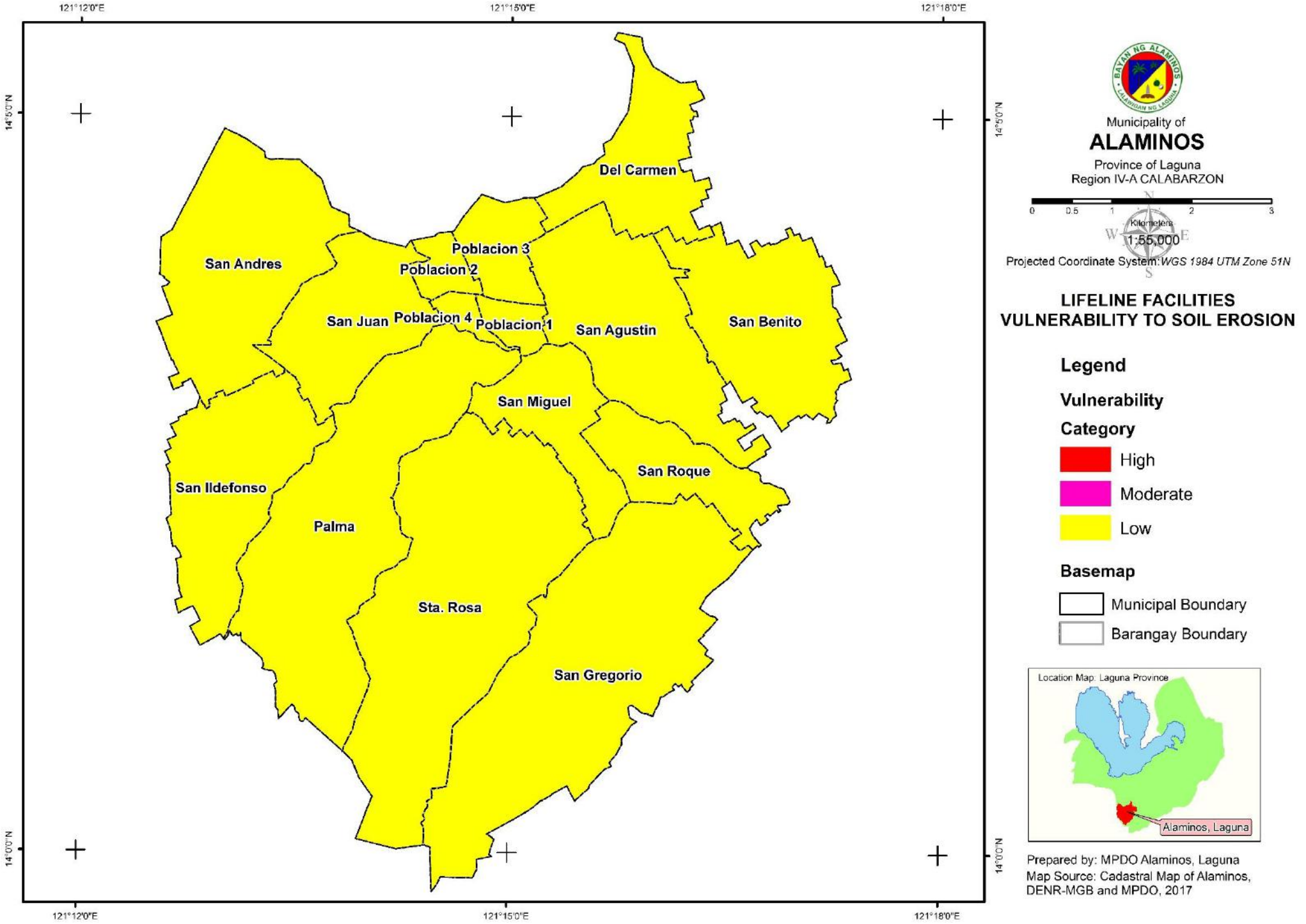
Map 56: Lifeline Facilities Vulnerability to Earthquake-induced Landslide



Map 57: Lifeline Facilities Vulnerability to Ground Shaking



Map 58: Lifeline Facilities Vulnerability to Soil Erosion



Urban System

Urban use areas pertain to the built environment currently utilized for residential, commercial, industrial, tourism, sanitary waste management facilities, cemeteries, and other land uses.

Table 49. Exposure and Adaptive Capacity Indicators used for Urban Systems in Alaminos, Laguna

Exposure	Adaptive Capacity
Land Use Category Area Exposure Area in Hectares Percentage of Area Exposed	Government regulations Capacity and willingness to retrofit Available alternative sites Government Investments

Urban System Exposure to Hazards

For this assessment, most of the built-up areas are concentrated in urban barangays. All urban barangays have low degree of impact score for all identified hazards. This means that the estimated direct and indirect damage to property is low to negligible. For the percentage of exposed area, only barangay San Benito has built up areas exposed, with 0.05 percent. For RIL, barangays Poblacions 1, 2, and 4 have exposed built up areas, with barangay Poblacion 2 having the highest percentage among the six (6) barangays with 1.33 percent. All areas exposed to ground shaking.

Table 50. Flood Exposure and Degree of impact on Urban System in Alaminos, Laguna

Barangay	Exposure				Degree of impact score
	Land Use Category	Area (Ha)	Exposure Area (Ha)	Exposure (%)	
Poblacion 1	ISF	0.151	0	0	1
Poblacion 2	ISF	0.261786	0	0	1
Poblacion 4	ISF	0.597	0	0	1
Poblacion 1	Residential	10.939818	0	0	1
Poblacion 2	Residential	19.219608	0	0	1
Poblacion 3	Residential	22.500327	0	0	1
Poblacion 4	Residential	11.758157	0	0	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 51. Rain-Induced Landslide Exposure and Degree of impact on Urban System in Alaminos, Laguna

Barangay	Exposure				Degree of impact score
	Land Use Category	Area (Ha)	Exposure Area (Ha)	Exposure (%)	
Poblacion 1	ISF	0.151	0.032	0.211	1
Poblacion 2	ISF	0.261786	0.261	1	1
Poblacion 4	ISF	0.597	0.597	1	1
Poblacion 1	Residential	10.939818	1.390	0.127	1

Poblacion 2	Residential	19.219608	6.251	0.325	1
Poblacion 3	Residential	22.500327	0	0	1
Poblacion 4	Residential	11.758157	0.7444	0.063	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 52. Earthquake-Induced Landslide Exposure and Degree of impact on Urban System in Alaminos, Laguna

Barangay	Exposure				Degree of impact score
	Land Use Category	Area (Ha)	Exposure Area (Ha)	Exposure (%)	
Poblacion 1	ISF	0.151	0	0	1
Poblacion 2	ISF	0.261786	0	0	1
Poblacion 4	ISF	0.597	0	0	1
Poblacion 1	Residential	10.939818	0	0	1
Poblacion 2	Residential	19.219608	0	0	1
Poblacion 3	Residential	22.500327	0	0	1
Poblacion 4	Residential	11.758157	0	0	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 53. Ground Shaking Exposure and Degree of impact on Urban System in Alaminos, Laguna

Barangay	Exposure				Degree of impact score
	Land Use Category	Area (Ha)	Exposure Area (Ha)	Exposure (%)	
Poblacion 1	ISF	0.151	0.151	1	1
Poblacion 2	ISF	0.261786	0.261786	1	1
Poblacion 4	ISF	0.597	0.597	1	1
Poblacion 1	Residential	10.939818	10.939817	0.999	1
Poblacion 2	Residential	19.219608	19.219608	1	1
Poblacion 3	Residential	22.500327	22.500327	1	1
Poblacion 4	Residential	11.758157	11.758158	1.0004	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Table 54. Soil Erosion Exposure and Degree of impact on Urban System in Alaminos, Laguna

Barangay	Exposure				Degree of impact score
	Land Use Category	Area (Ha)	Exposure Area (Ha)	Exposure (%)	
Poblacion 1	ISF	0.151	0	0	1
Poblacion 2	ISF	0.261786	0.261786	1	1
Poblacion 4	ISF	0.597	0	0	1
Poblacion 1	Residential	10.939818	0	0	1
Poblacion 2	Residential	19.219608	13.74218	0.715	1
Poblacion 3	Residential	22.500327	8.339871	0.371	1
Poblacion 4	Residential	11.758157	0	0	1

Source: CDRA Workshop, MPDO GIS Computation, 2018

Urban System Adaptive Capacity to Hazards

Indicators used to assess the adaptive capacity of barangays include - Government regulations such as presence of Zoning Ordinance or other ordinances related, capacity and willingness to retrofit, availability of alternative sites and government investments.

Available alternative sites for evacuation such schools, barangay hall, covered courts, day care centers are also present in the municipality. Government Investments such as rescue vehicle, command center and equipment (e.g.2-way radio communication equipment); produce IEC related to extension programs; with current CDP and CLUP (mainstreamed CCA-DRR); LGU has existing partnership with SUC for technology transfer contribute to the high score of barangays.

Table 55. Adaptive Capacity to Hazards for Urban System in Alaminos, Laguna

Barangay	Adaptive Capacity			
	Government regulations (%)	Capacity and willingness to retrofit (%)	Available alternative sites (%)	Government investments (%)
Poblacion 1	100	100	100	100
Poblacion 2	100	100	100	100
Poblacion 3	100	100	100	100
Poblacion 4	100	100	100	100
Del Carmen	100	100	100	100
Palma	100	100	0	100
San Agustin	100	100	0	100
San Benito	100	100	0	100

Source: CDRA Workshop, MPDO GIS Computation, 2018

Urban System Vulnerability to Hazards

All urban barangays have low vulnerability ratings in terms of flooding, ground shaking and earthquake-induced landslide, rain-induced landslide and soil erosion.

Table 56 table below summarizes the vulnerability ratings of Alaminos in terms of its population and hazards

Table 56. Vulnerability Ratings of Urban Systems to Hazard events of Alaminos, Laguna using Exposure and Adaptive Capacity indicators

Barangay	Vulnerability				
	Flood	RIL	EIL	Ground Shaking	Soil Erosion
Poblacion 1	Low	Low	Low	Low	Low
Poblacion 2	Low	Low	Low	Low	Low
Poblacion 3	Low	Low	Low	Low	Low
Poblacion 4	Low	Low	Low	Low	Low
San Agustin	Low	Low	Low	Low	Low
San Benito	Low	Low	Low	Low	Low

Source: CDRA Workshop, MPDO GIS Computation, 2018

Refer to the maps below:

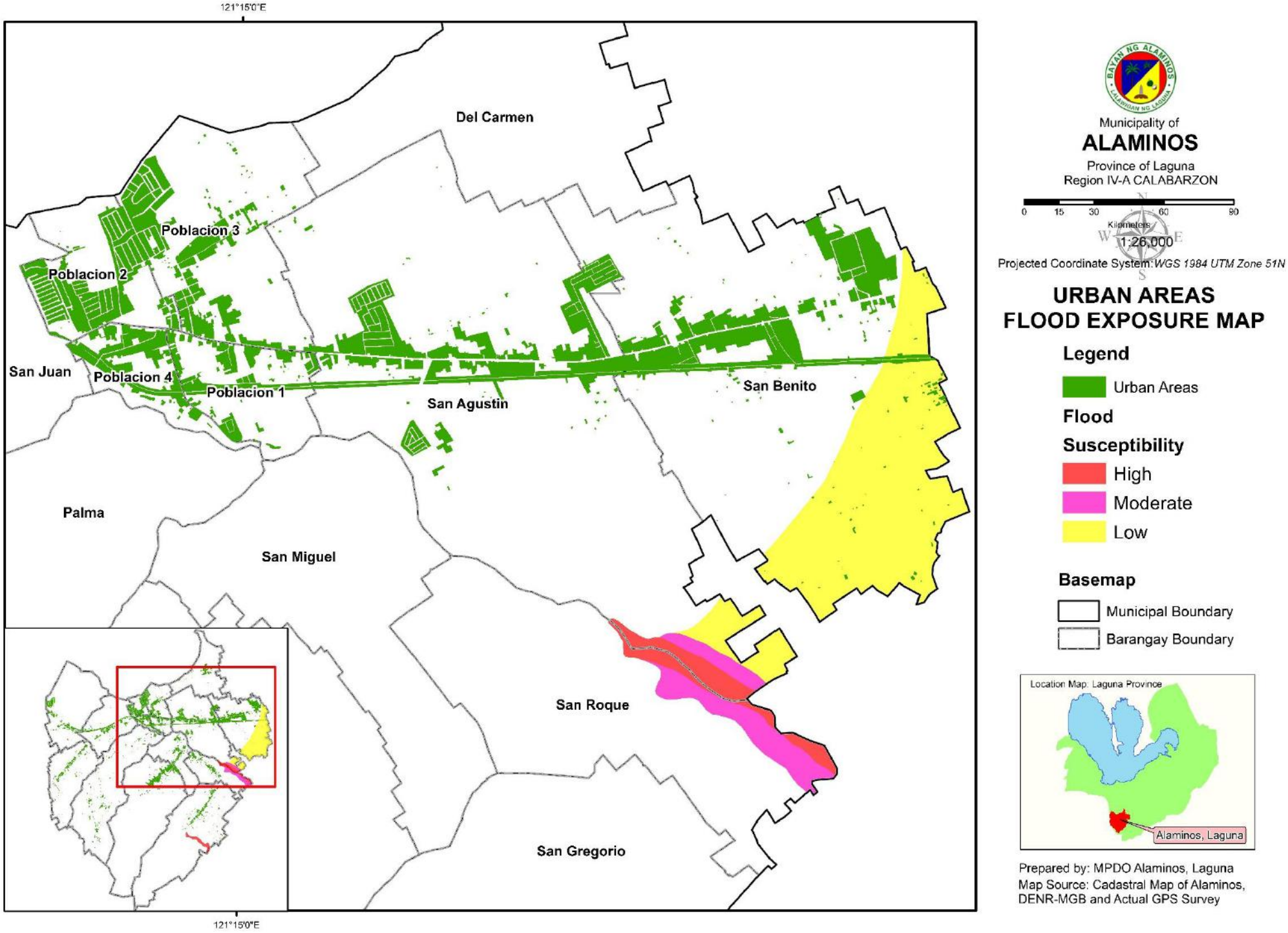
Urban Areas Exposure Maps:

Map 59: Urban Areas Flood Exposure Map
Map 60: Urban Areas Rain-induced Landslide Exposure Map
Map 61: Urban Areas Earthquake-induced Landslide Exposure Map
Map 62: Urban Areas Ground Shaking Exposure Map
Map 63: Urban Areas Soil Erosion Exposure Map

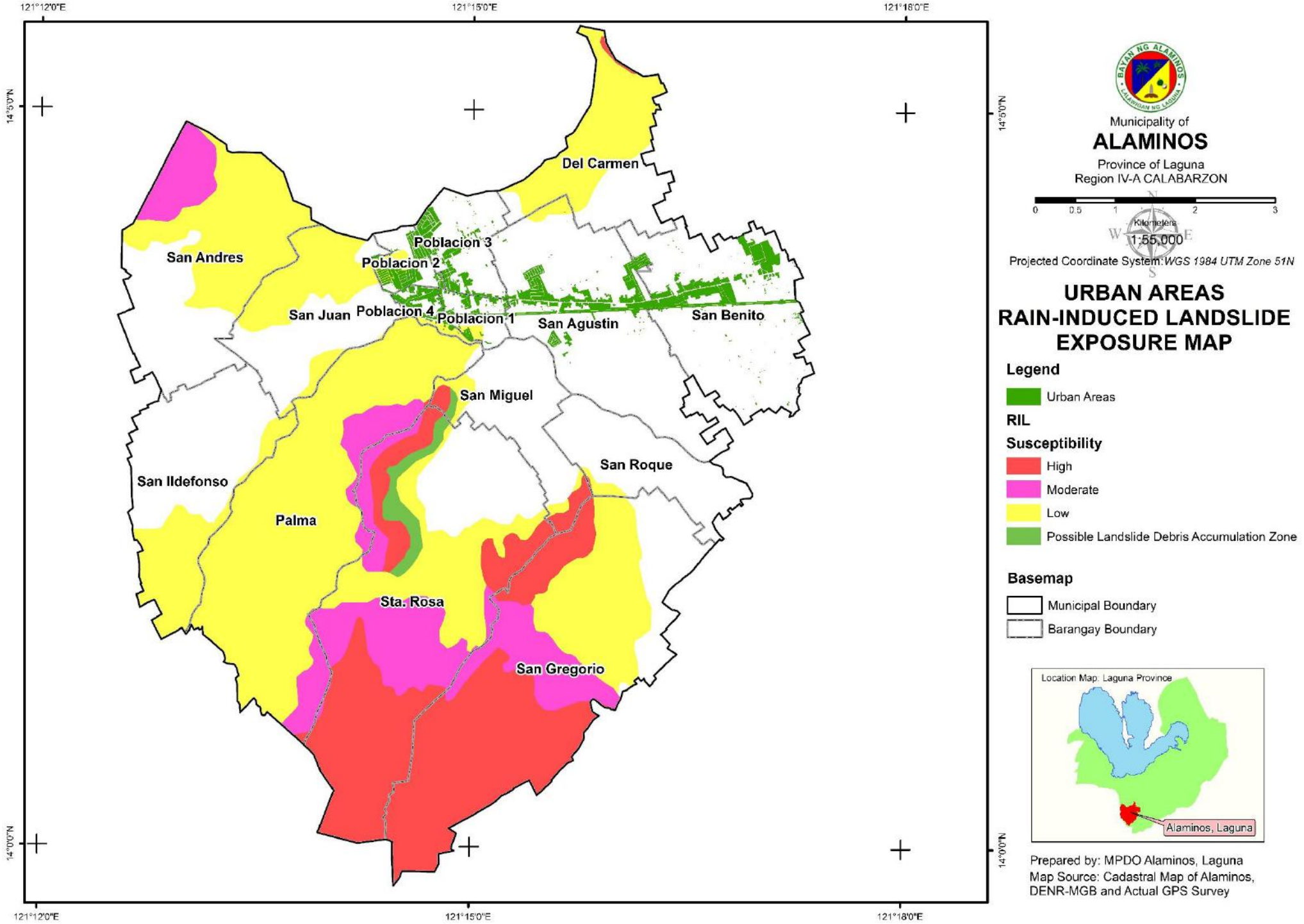
Urban Areas Vulnerability Maps:

Map 64: Urban Areas Vulnerability to Flooding
Map 65: Urban Areas Vulnerability to Rain-induced Landslide
Map 66: Urban Areas Vulnerability to Earthquake-induced Landslide
Map 67: Urban Areas Vulnerability to Ground Shaking
Map 68: Urban Areas Vulnerability to Soil Erosion

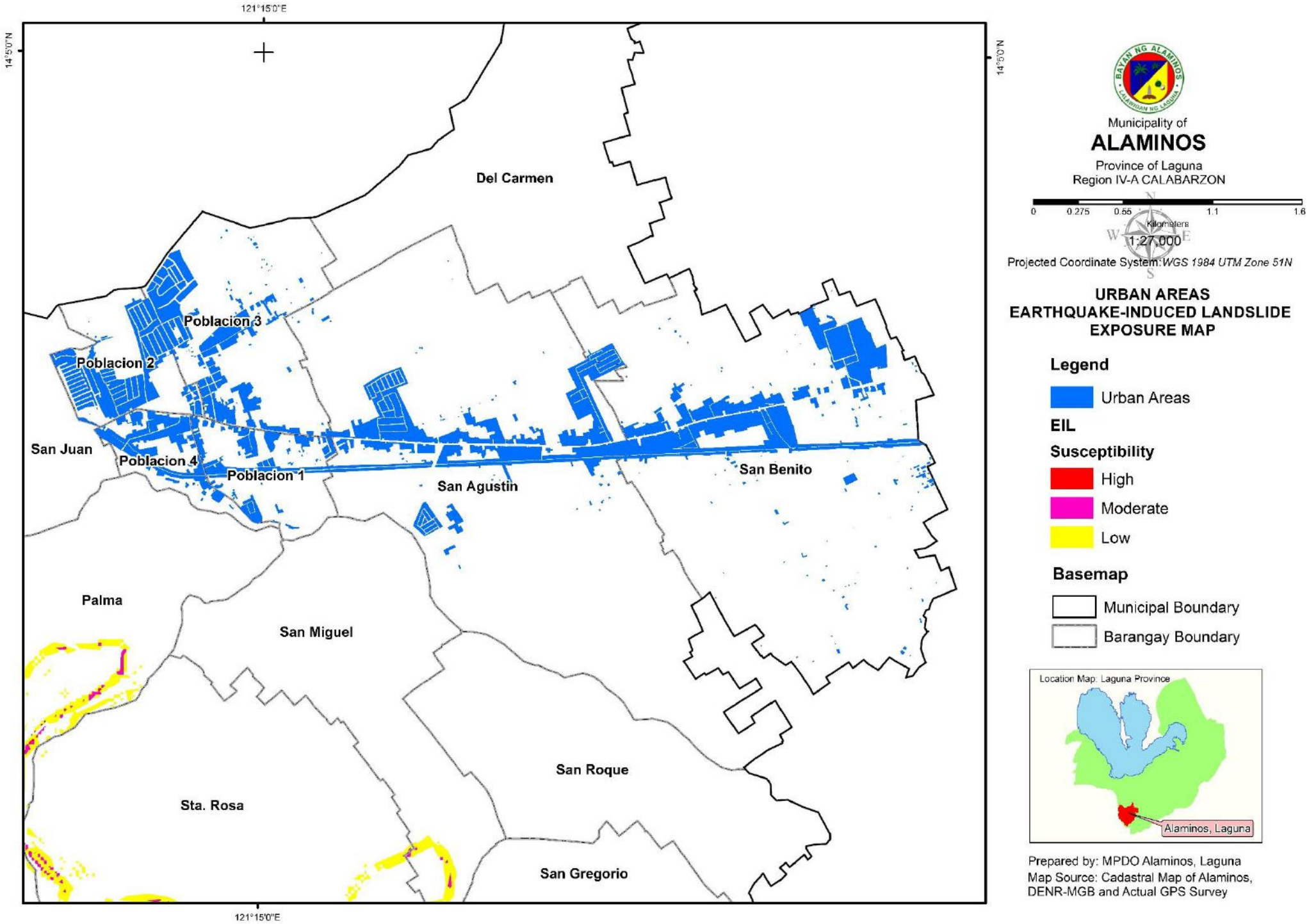
Map 59: Urban Areas Flood Exposure Map



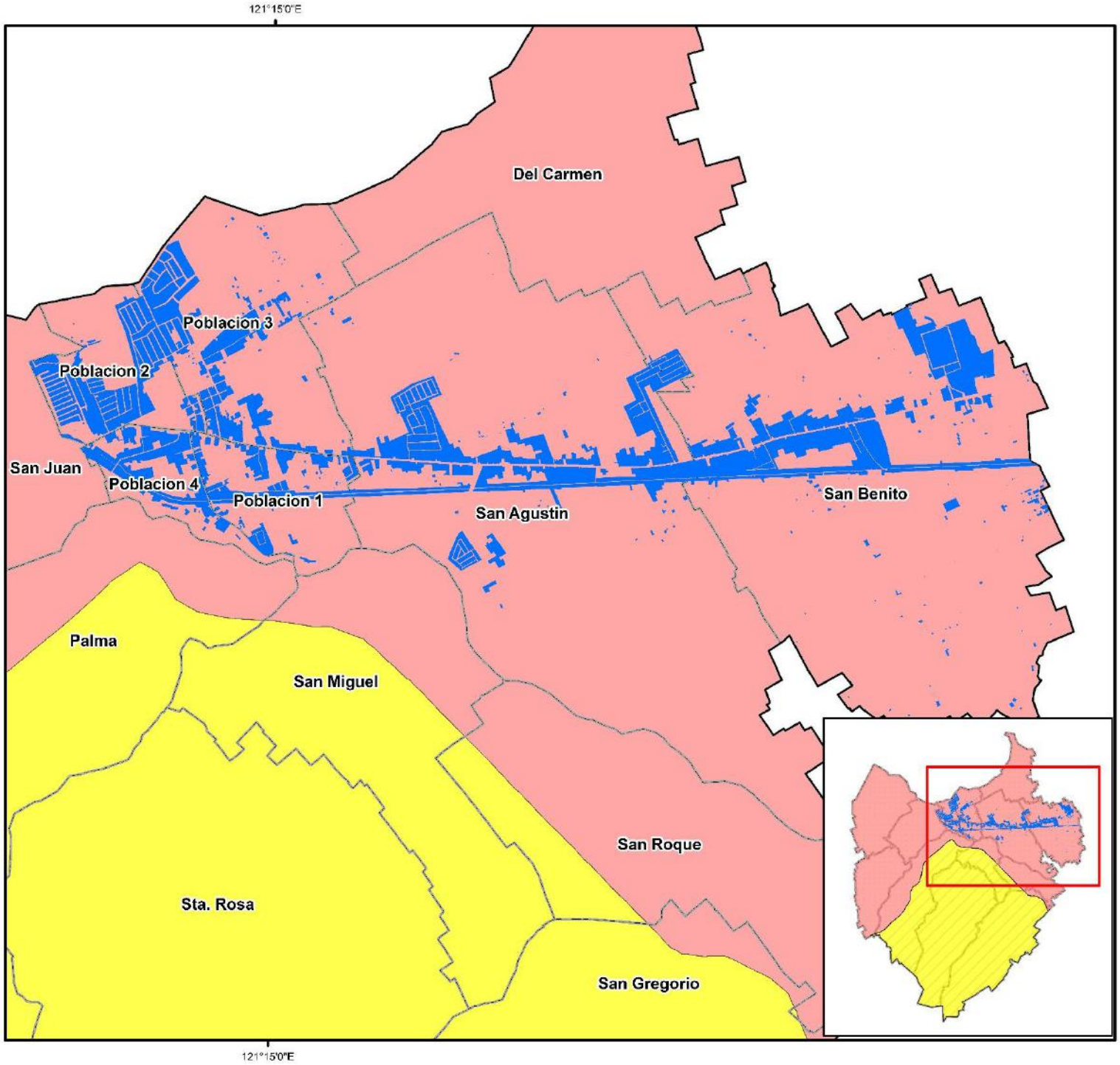
Map 60: Urban Areas Rain-induced Landslide Exposure Map



Map 61: Urban Areas Earthquake-induced Landslide Exposure Map



Map 62: Urban Areas Ground Shaking Exposure Map



Municipality of
ALAMINOS
Province of Laguna
Region IV-A CALABARZON

0 0.25 0.5 1 1.5
Kilometers
1:27,000

Projected Coordinate System: *WGS 1984 UTM Zone 51N*

URBAN AREAS GROUND SHAKING EXPOSURE MAP

Legend

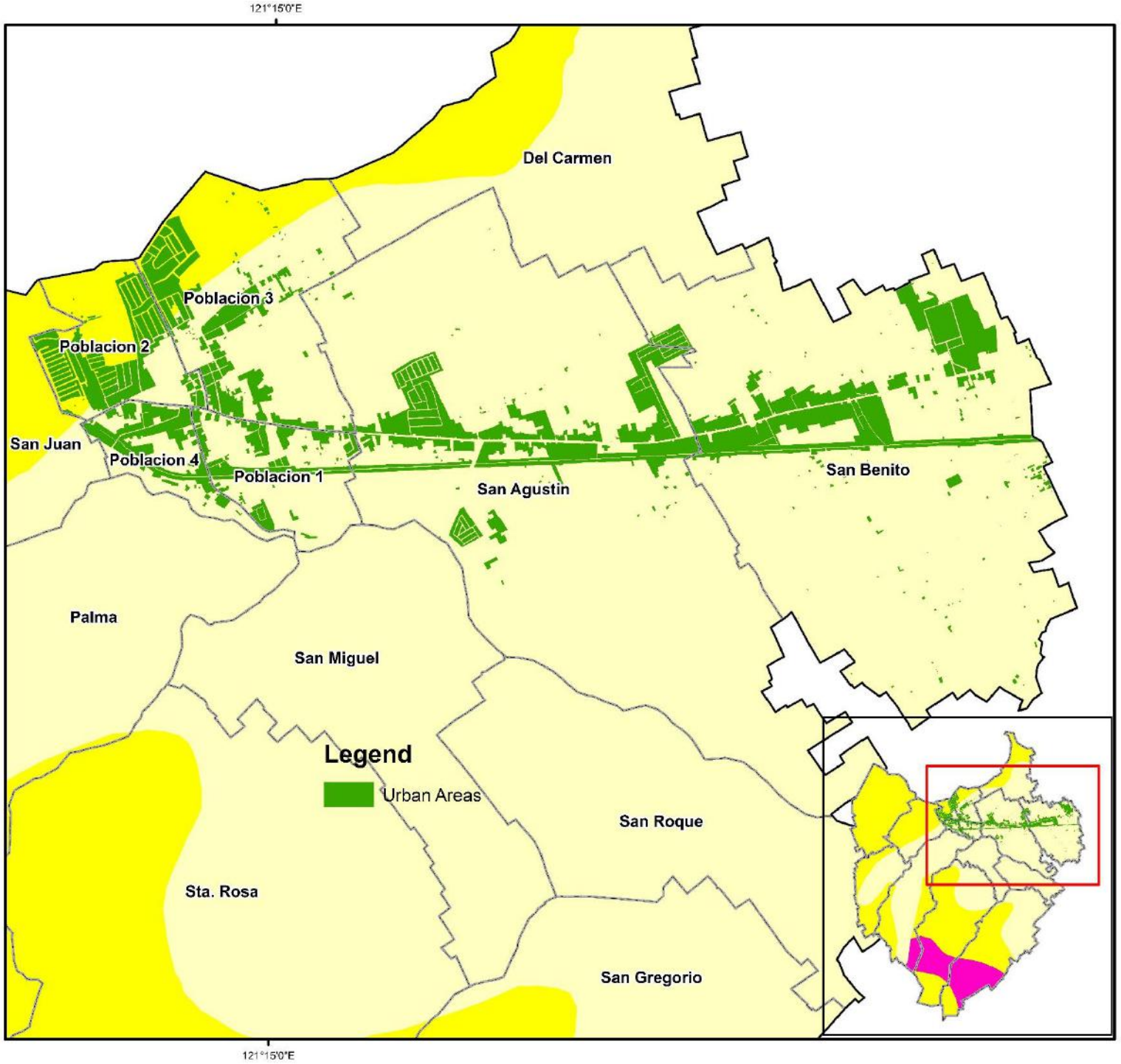
- Urban Areas
- Intensity Low 8
- Intensity 7

Basemap

- Municipal Boundary
- Barangay Boundary

Prepared by: MPDO Alaminos, Laguna
Map Source: Cadastral Map of Alaminos, DENR-MGB and Actual GPS Survey

Map 63: Urban Areas Soil Erosion Exposure Map



Municipality of
ALAMINOS
Province of Laguna
Region IV-A CALABARZON

0 0.25 0.5 1 1.5
Kilometers
1:26,907

Projected Coordinate System: *WGS 1984 UTM Zone 51N*

URBAN AREAS SOIL EROSION EXPOSURE MAP

Legend

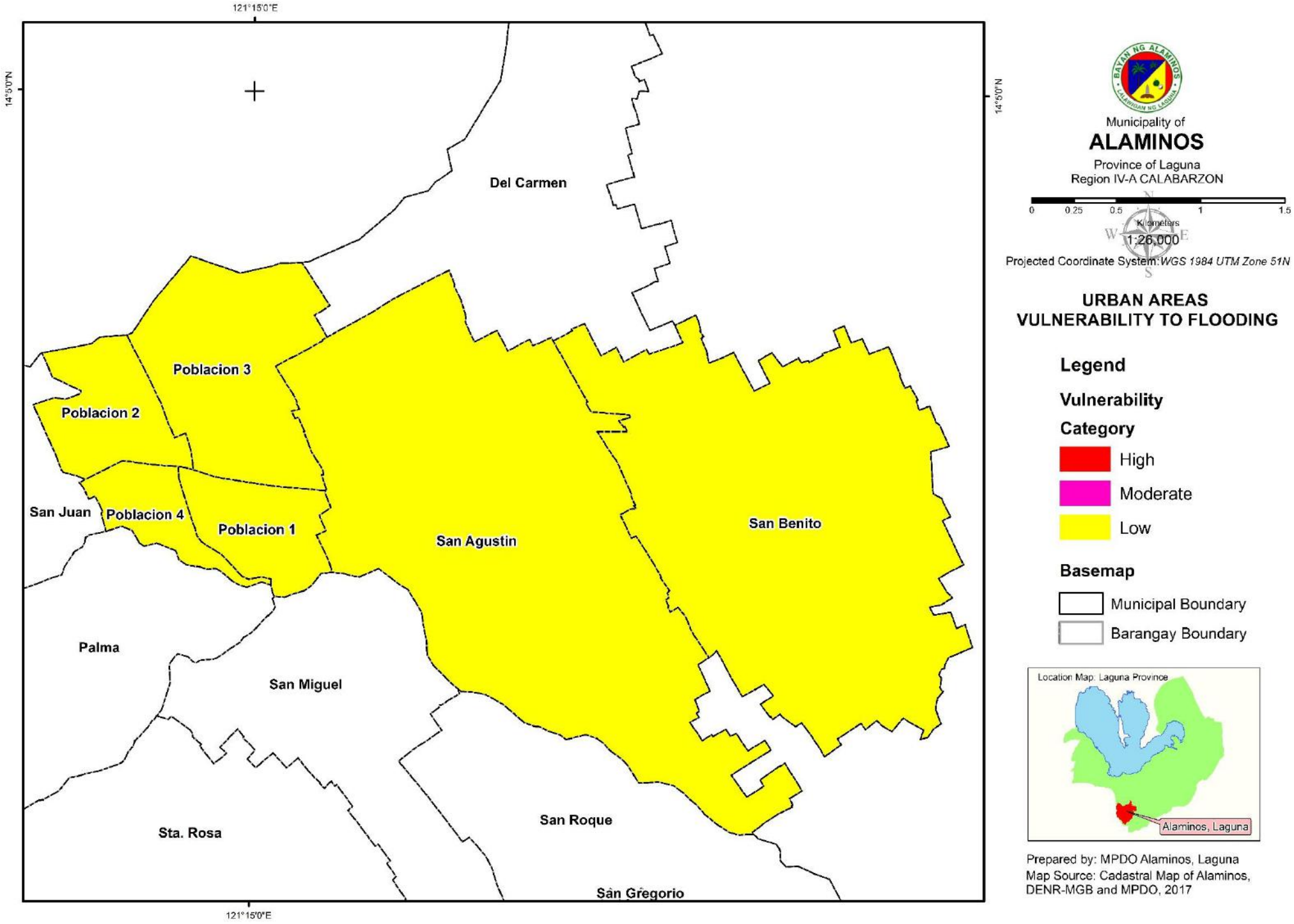
- Urban Areas
- Moderate Erosion
- Slight Erosion
- No Apparent Erosion

Basemap

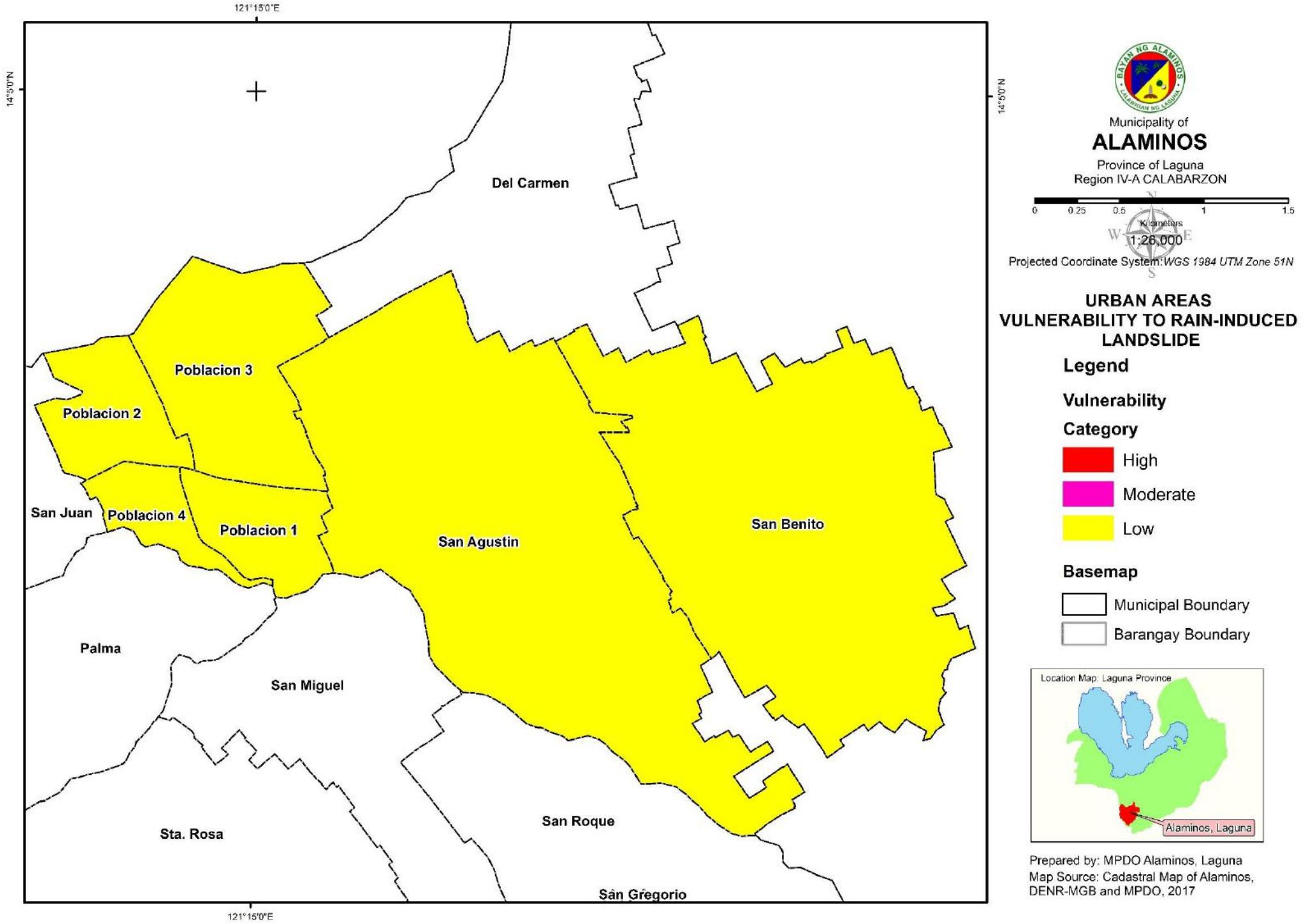
- Municipal Boundary
- Barangay Boundary

Prepared by: MPDO Alaminos, Laguna
Map Source: Cadastral Map of Alaminos, DENR-MGB and Actual GPS Survey

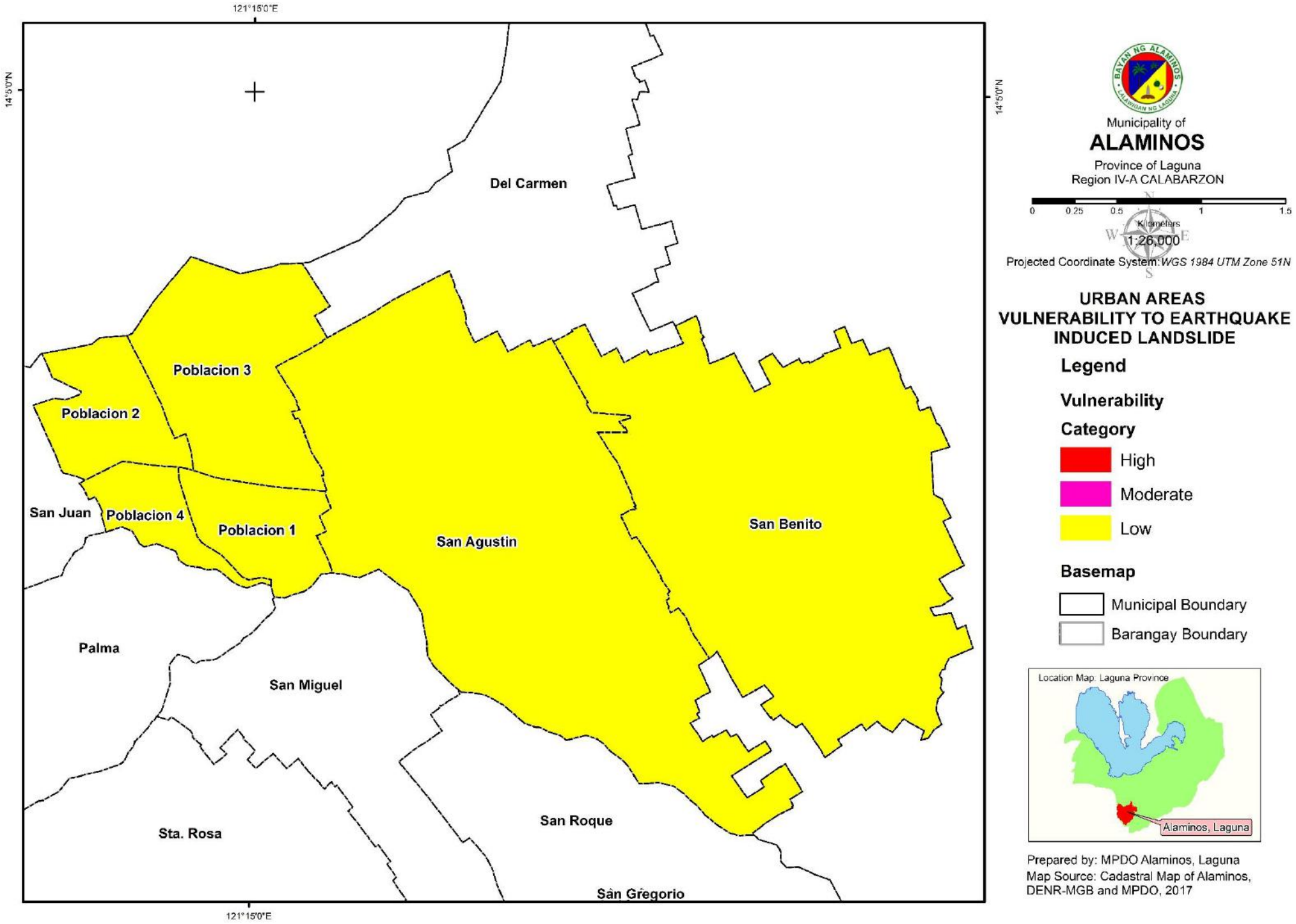
Map 64: Urban Areas Vulnerability to Flooding



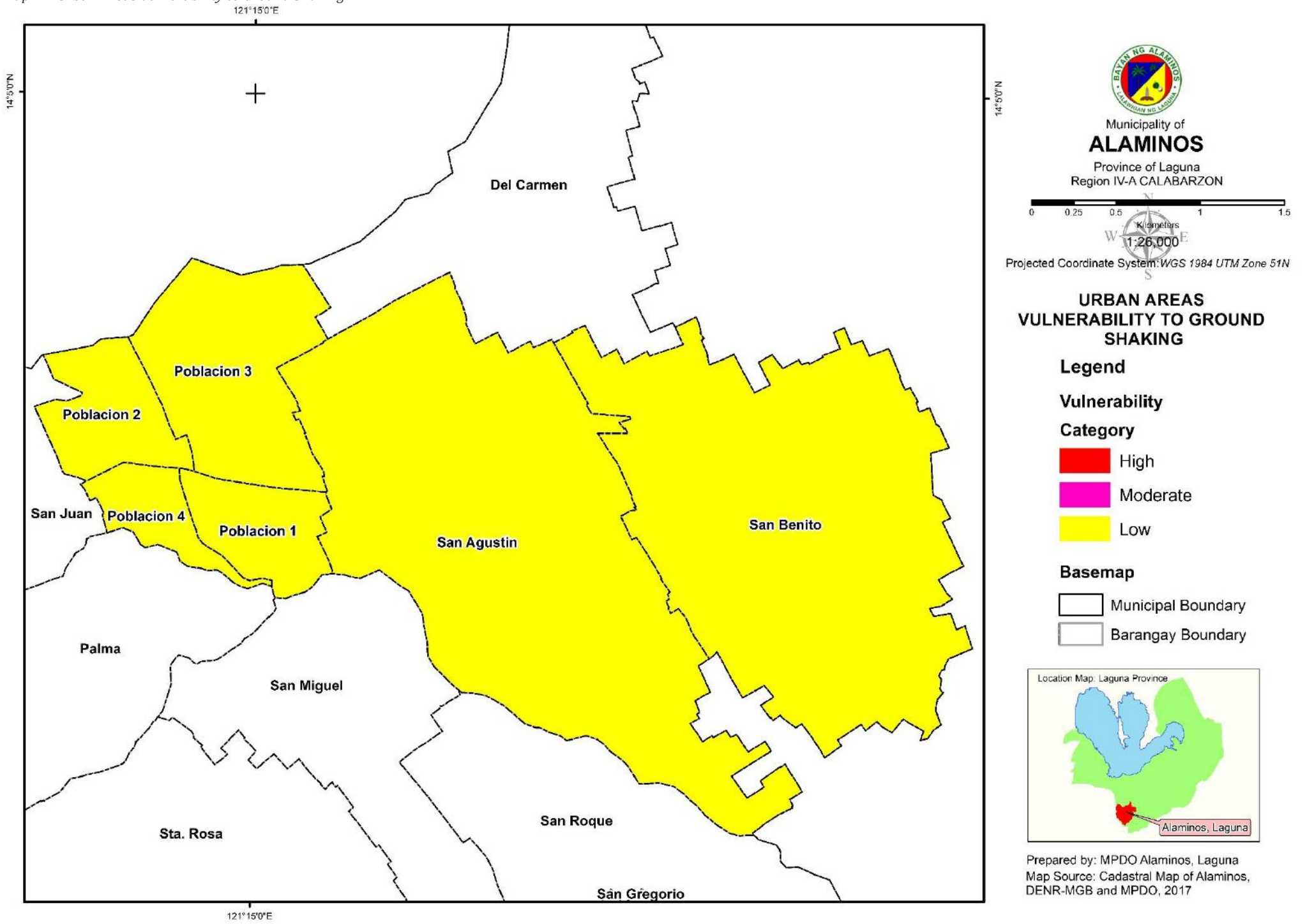
Map 65: Urban Areas Vulnerability to Rain-induced Landslide



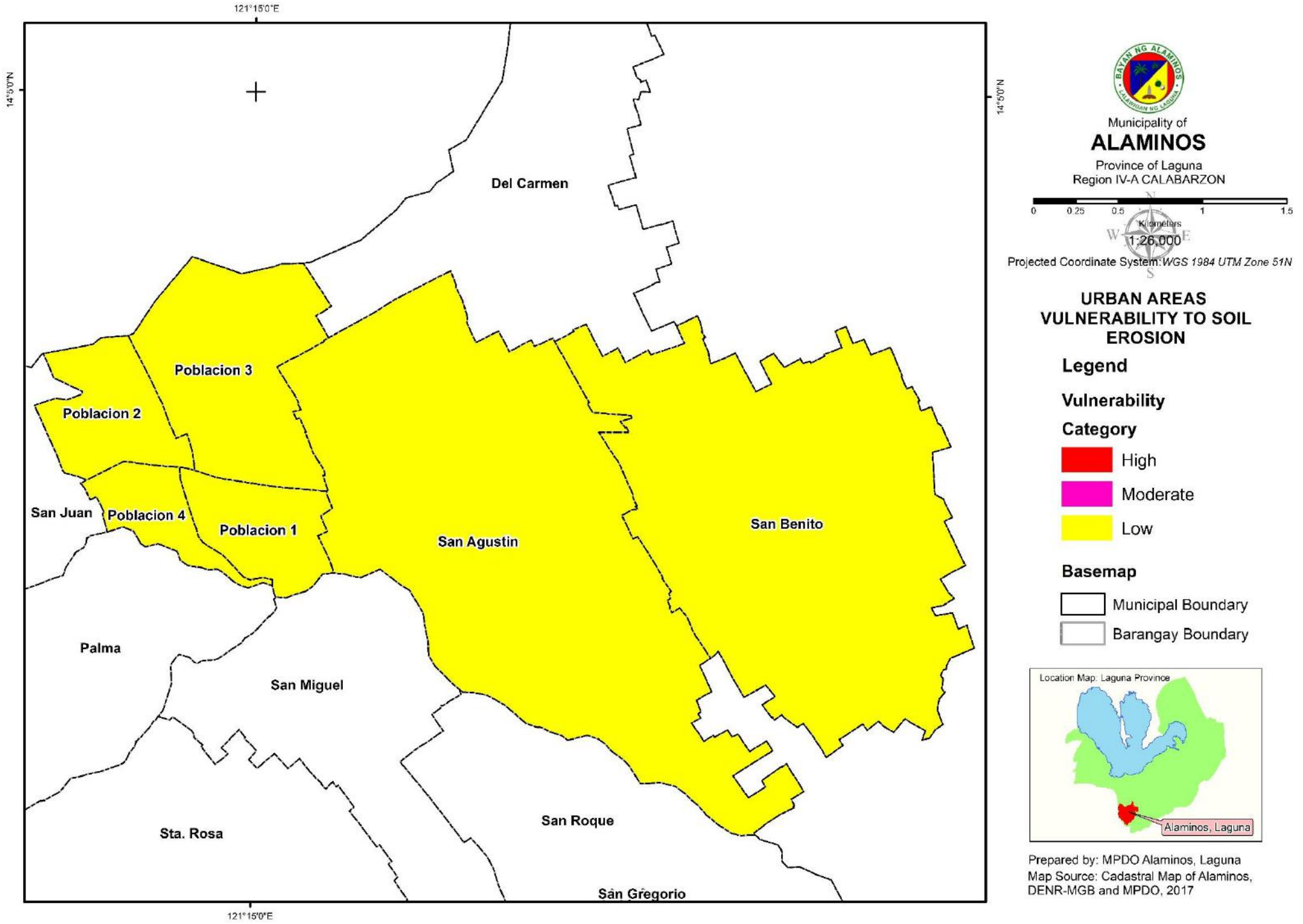
Map 66: Urban Areas Vulnerability to Earthquake-induced Landslide



Map 67: Urban Areas Vulnerability to Ground Shaking



Map 68: Urban Areas Vulnerability to Soil Erosion



Strategies and Policies

Policies

Settlements Development Area

The general policy for settlements is that built up areas are located in an area free from natural and other hazards, accessible to basic services and public utilities to enhance its overall well-being.

It is also necessary to ensure compliance to policies and guidelines related to the settlements development such as but not limited to PD 1096: National Building Code, PD 1067: Water Code, PD 957: Subdivision and Condominium Buyers' Protective Decree, PD 1216: Open space in residential subdivisions, BP 220: Socialized and Economic Housing, RA 7279: Urban Development and Housing Act, BP 344: Accessibility law, RA 9904: Magna Carta for Homeowners and Homeowners Associations, RA 10121: Philippine Disaster Risk Reduction and Management Act of 2010, RA 11023: An Act Authorizing the Issuance of Free Patents to Residential lands, PD 953: Requiring the planting off trees and penalizing unauthorized cutting, destruction of trees and vegetation, PD 825: Anti-littering, PD 856: Sanitation Code, RA 10884: Balanced Housing Program Amendments Act, PD 1185: Philippine Fire Code and HLURB Guidelines Volume 2, and zoning ordinance. General Residential Zone, Residential 1 Zone, and Residential 2 Zone are under this category.

Production Development Area

As a general policy, location of these production areas shall be to provide the population the optimum ease of availing goods and services they require to achieve quality life, such as employment areas without compromising the environmental quality of area for development.

Compliance to policies and other regulations such as but limited to RA 7160: Local Government Code, RA 1224, PD 856: Sanitation Code, PD 1096: National Building Code, and BP 344: Accessibility law, RA 6977: Magna Carta for Small Enterprises, PD 856: Sanitation Code, and PD 1185: Philippine Fire Code, PD 1152: Philippine Environmental Code, RA 10066: National Heritage Act of 2009, and RA 9593: Tourism Act, DOE Circulars Nos. 2003-11-010 and 2006-02-0002 and the zoning ordinance. Zones under production development area are (a) Agricultural Zone, (b) Agri-Industrial Zone, (c) General Commercial Zone, (d) Commercial 1 Zone, (e) Commercial 2 Zone, (f) Industrial 1 Zone, (g) Industrial 2 Zone, and (h) Tourism Zone.

Protection Development Area

Areas that are locally proclaimed protected areas, inland water bodies, and ground water resources shall be preserved, and conserved. No other development shall be seen in the area, buffer zones and easements shall be observed and strictly enforced. The zones under this category include (a) Forest Zone, and (b) Buffer Zones.

In addition, strict implementation of the Manila Bay Mandamus, Republic Act No. 8749 - Philippine Clean Air Act, Republic Act No. 9003 – Ecological Solid Waste Management Act and Republic Act (R.A.) No. 9275 - Philippine Clean Water Act.

Infrastructure Development Area

Policies related to public services and utilities such as but not limited RA 6541: National Building Code and its IRR of 2004, RA 7718: BOT Law, BP 344: Accessibility Law, RA 9003: Ecological Solid Waste Management Act, RA 10121: Disaster risk reduction and management Act, RA 9729: Climate change Act, HLURB guidelines Volume 2, and zoning ordinance. General Institutional Zone, Cemetery/Memorial Park Zone, Parks and Recreation Zone, Utilities, Transportation and Services Zone are included in this category.

Past and Current Programs, Projects and Activities

1. Disaster Prevention and Mitigation
    a. Rehabilitation of Open Dumpsite (Climate Change Adaptation and Mitigation)
2. Disaster Prevention
    a. Municipal Emergency Response Mobilization
    b. Continuous training to all stakeholders
    c. DRRM Equipment and Supplies
    d. Capacity development of DRRM personnel
    e. Early Warning System
    f. Information Dissemination Campaign
    g. Mainstreaming Climate Change Adaptation and Disaster Risk Reduction and Management in development planning
3. Disaster Response
4. Disaster Recovery and Rehabilitation

Proposed Programs, Projects and Activities

Some of the proposed projects include:

1. Formulation of 5-year MDRRM PLAN
2. Formulation of Municipal Climate Change Action Plan
3. Organization of Alaminos Laguna Emergency Response Team (ALERT)
4. Establishment of Community-Based Monitoring System (CBMS)
5. Establishment of Alaminos MDRRMO - Emergency Operation Center (EOC)
6. Establishment of Incident Command System (ICS)
7. Procurement of Early Warning System (EWS)
8. Establishment of Alaminos Evacuation Center
9. Conduct of Rapid Damage Assessment and Needs Analysis (RDANA)
10. Emergency Medical Services (EMS)
11. Camp Coordination and Camp Management (CCCM)
12. Establishment of Data Management for the Dead and Missing (MDM)
13. Generate Alaminos Hazard Maps
14. Formulation of Community-Based Disaster Risk Reduction and Management Plan
15. Disaster Resiliency Information Campaign (IEC)
16. Procurement of EMS Emergency Transport Vehicle
17. Integration of Build Back Better in Recovery, Rehabilitation and Reconstruction
18. Relocation of Critically Situated Families
19. Conduct of Environmental Rehabilitation and Clean-Up
20. Formulation of MDRRMO Contingency Plan
21. Conduct of DRRM Drills
22. Conduct of Manila Bay Ridge-to-Reef Approach Workshops