

CHAPTER 11 INFRASTRUCTURE DEVELOPMENT MASTER PLAN

11.1 Water Supply

11.1.1 Basic Policy for Development

The problems in the potable water supply system of Managua in the face of current and future demands are outlined in Chapter 5.1. These problems are addressed by the following proposed projects. Other problems which are not mentioned in Chapter 5.1 are being addressed either in whole or partially by other projects funded by other international lenders. These projects are either currently being executed or are assumed to be starting in the early planning period, based on descriptions provided by *Empresa Nicaraguense de Acueductos y Alcantarillados Sanitarios* (ENACAL). The proposed projects identified for this master plan in some cases augment or depend on these outside activities.

This infrastructure portion of the master plan identifies the improvements in infrastructure to meet the minimum criteria for sustainable standard of living for the current population as well as its future growth. The output of this part identifies the needs on a macroscopic scale, allocating appropriate resources for improvements. The planning target year for this study is 2040. The overview of the problems, their causes, and rationale for developing the solutions are presented in Figure 11.1.1.

The United Nations recognizes that availability of safe, clean, and accessible drinking water is a basic human right. ENACAL serves Managua relatively well, in that a large fraction of the population has water for some hours of the day. But it needs some improvements.

The growth projected in this master plan could not be realized without sufficient water supply. In fact, a robust and dependable water supply can be used as encouragement and enticement for investment.

The basic policy for development of water supply is as follows:

- Increase the production and efficiency of the water supply system to ensure all users receive sufficient water 24 hours per day, and
- Ensure planning and resources are available to meet the future growth in the city to maintain the 24 hours per day standard for all new users.

Of the five priority projects described below, four projects pertain to the overall goal of sustainability, order, and opportunity; promoting planned and efficient development; and improving the resiliency in response to the rate of population growth as described in Chapter 8. The other projects directly result from the proposals of the distinct high-density sub-centers as indicated in Figure 9.2.1

11.1.2 Proposed Projects

Figure 5.1 above lists the rationale involved between the identification of the problems and the development of proposed solutions. As seen, these solutions include other projects that are currently being executed or planned.

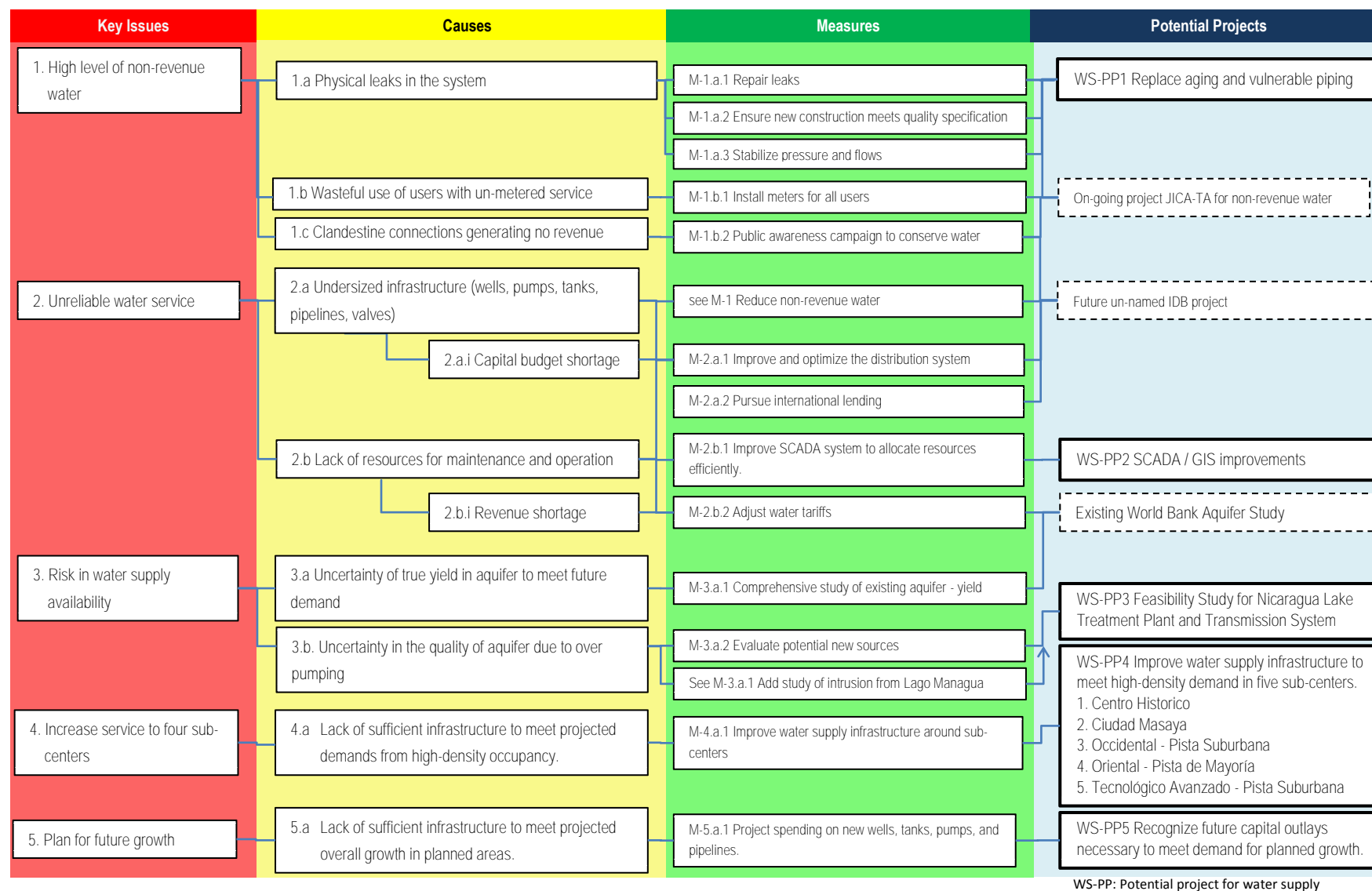


Figure 11.1.1 Fault Tree of Water Supply

(1) Old and Vulnerable Pipeline Replacement

The issue of non-revenue water is currently being addressed through a number of physical, regulatory, and administrative improvements. The current JICA technical assistance (JICA TA) project will address non-revenue water through physical improvements in selected areas. Also at the beginning phase of project formulation is a project to be funded by the Inter-American Development Bank (IDB) valued at up to USD 300 million.

One source of leaks that has not been addressed to date is the number of leaky asbestos-cement pipes, obsolete ductile iron pipes, and other vulnerable pipelines present in the northern areas of Managua. The ENACAL Department of Non-Revenue Water produced a table quantifying the length and diameters of pipes to be replaced. They identified over 115 km of pipes, with diameter ranging from 3 to 14 inches.

(2) Technical Assistance for SCADA/GIS Improvements

This problem has many causes and virtually any physical improvements to the distribution system will improve it. Both the JICA TA project and the unnamed proposed IDB project will include improvements to the capacity and efficiency of pumps, tanks, and pipes. The ongoing program of micro-sectorization will improve the operational control.

Another solution is the improvement in the operational knowledge and ability. These aspects can be improved with a well-developed SCADA system. A partial SCADA system is in place, but it should be completed to provide optimum data collection and control for the entire system.

Before designing the SCADA system, a better digital model of the water system is necessary. Much of the pipeline system is well defined in AutoCAD digital files, but ideally these should be converted to GIS to assist in the control and maintenance. Also, a detailed digital hydraulic model should be developed.

Hence, this proposed project is for improved SCADA and GIS systems. This project includes the conversion of the AutoCAD system into a complete GIS, development of a hydraulic model, and training and execution of the model for operational optimization. This project includes some field effort to monitor and measure over time to assist in calibrating the model, and other field work to confirm pipe connections.

(3) Nicaragua Lake Potable Water Treatment Plant and Transmission System

The water supply for Managua is finite. Hence, ENACAL recognizes that other sources must be identified. Managua Lake, through decades of receiving improperly treated industrial and domestic wastewater as well as typical urban runoff, is widely characterized as unsuitable drinking water source.

The most logical source therefore is Nicaragua Lake, located 35 km from Central Managua. Hence one of the proposed projects is the feasibility study to look at the alternatives in using Nicaragua Lake as a water supply source. This engineering project will identify treatment methods and locations of the

treatment facility, as well as study pipeline alignments and phasing, pumping characteristics, scheduling, and costs.

(4) Improve Water Supply Infrastructure to Meet the Demand in Five Sub-centers

The existing water system is generally below 100% compliance throughout the city. Urban planners are proposing to encourage the development of four large new mixed-use sectors and redevelop with higher density the existing downtown area. These developments would place up to 5,000 new users in a single spot. Given the deficiencies presently encountered in the water supply system, the water demands from such developments cannot be satisfied. Hence, improvements must be made to the systems in the areas around these proposed sub-centers.

This proposed project involves the improvement of the existing water distribution networks in the immediate areas surrounding the development areas. In this case, it is assumed that a new well would be installed at each area, with a minimum amount of piping to serve the facilities, and a storage tank at each site. It is possible that the costs for such improvements could be borne by private enterprise developers of the sites, which are designed and constructed to the specifications and in coordination with ENACAL.

(5) Accommodate Future Growth in Water Supply System

It is inevitable that the city will grow, and growth will require an expansion of the water supply system to satisfy the demands. The local networks for new development areas and barrios are generally constructed and paid for by the developers. Developers must pay a minimal fee to connect the new network in the barrio to the main water network. These costs are not (necessarily) borne by ENACAL. However, the growth in the city will definitely require additional capital expenditures from ENACAL to improve water production and distribution systems.

No detailed investigation of ENACAL's capital improvements planning was made. It should be recognized that future growth will require capital investment in the water system. The urban planners are projecting 400,000 new residents by 2040.

Much of the projected growth in water demand for Managua is projected to be met by reductions in the non-revenue water. However, this only applies to the water source, and does not necessarily account for geographic growth.

The project entitled "Recognize Future Capital Outlays Necessary to Meet the Demand for Planned Growth" is proposed to illustrate potential capital investment to meet the future growth. This is not a specific project per se, instead is a placemark to recognize that population growth requires a separate capital investment from ENACAL to meet the future scenario proposed here. Some of these values may be included in the contemplated IDB project.

11.2 Water Resources

11.2.1 Basic Policy for Development

Key issues described in Chapter 5.7 of this report shall be improved through some measures. The key issues, their causes and measures as well as the proposed projects composed of some measures on water resources in the study area are summarized in Figure 11.2.1. As described in the left side column of the figure, there are four key issues on water resources, i.e., i) contamination of water resources, ii) reduction of water recharge function in the basins, iii) deterioration of existing water source facilities, and iv) lack of alternative water source for future water demand. Causes of the key issues shown in the middle column of the figure are described in detail in Chapter 5.1 of this report. Measures shown in the next column in the figure are effective activities for each cause of key issues. Some measures do not become potential projects in this sector because they are already carried out by ongoing projects or will be studied by other sectors in this JICA study. Some measures are combined as “potential projects”.

11.2.2 Proposed Projects

The proposed projects for water resources are extracted for urban development as follows:

(1) Technical Assistance for Water Quality Improvement of Managua Lake

Managua Lake is one of the largest surface water resources in the country, but the water is significantly contaminated by heavy metals such as mercury, pesticide, and domestic wastewater. Water taken from the lake has a risk of contamination for use as tap water. Monitoring of water quality of Managua Lake and regulation of its contamination are essential to ensure safe water supply in Managua City.



WR-PP: Potential project for water resources

Source: JICA Study Team

Figure 11.2.1 Fault Tree of Water Resources in the Study Area

11.3 Sewerage and Wastewater Disposal

11.3.1 Basic Policy for Development

The expansion of the sewerage coverage is related to public health protection in addition to the improvement in quality of life of low-income people living in settlements and other urban areas. At the national level, the estimated urban sewerage coverage is 44%. The Government National Policy goal is to reach an urban coverage of 50% in 2020, and 64% in 2030. According to the Sewerage Master Plan for Managua-PMASM (reviewed in 2002), the coverage projected for 2015 is 68%, and it will reach 72% in 2020.

For the purpose of planning, ENACAL uses the statistical data from INIDE (2005 Census, adjusted biennially by means of household surveys). The results of the recent demographic survey (2016) by ALMA (Law 40261) found that the data differs by 330,000 inhabitants more than the projection of the last INIDE Census. Because the actual coverage is not clear, the JICA Study Team considers around 65% of sewerage coverage for Managua City.

ENACAL has prioritized human settlements and urban areas without sanitary sewer service. It has identified approximately 33,000 households (200,000 users) that are using on-site sanitation systems such as latrines, absorption wells, ditches, or stormwater drainage channels for excreta and graywater disposal. Around 1,761 households (almost 10,000 users) already have applied for new sewer service connections and they are on the waiting list since 2014 (to 2016).

The most relevant project related with water and sanitation systems at the urban level is “The Comprehensive Program of Sectoral Human Water and Sanitation of Nicaragua – PISASH”. It is a 20-year program, with its first phase directed to the improvement and expansion of potable water supply systems and sanitation in 19 cities and the preparation of portfolio of projects to benefit other 17 cities. Phase I of PISASH is being implemented by ENACAL with a total budget of USD 337 million, to be executed during the 2014-2019 period. The other five cities will be incorporated in its second phase. The participation of PISASH in the improvement and expansion of the sewerage system in Managua City is insignificant.

The Sewerage Master Plan for Managua City- PMASM (1998) identified 140 km of secondary collectors that are partially destroyed and without hydraulic capacity. Within the program of “Immediate Actions”, only 40 km out of the 140 km of collectors were renewed, leaving the other 100 km behind. At present, ENACAL has estimated a minimum of 120 km (10% of the total sewer length) should be rehabilitated, renewed, or reinforced. This action will allow ENACAL to reduce maintenance expenses, provide services to new users, and also improve the service for current users.

Since 2014, ENACAL has prepared a Program for Priority Works and Complementary Projects for the PMASM Plan Phase I. Three projects aim to complete the main sewerage infrastructure in Managua City, namely: (i) Complementary measures in the Managua Wastewater Treatment Plant-MWWTP, this component has the main objectives to a) complete the treatment facilities of the Plant, and b) achieve

the design capacity of 253,000 m³/day covering the treatment demand until 2030; (ii) Complete the Interceptor No. 2 (Phase 2); and (iii) Complete the collector “Y” (Phase 2). In this way, the connection of still unsewered urban areas to the existing infrastructure and expansion of coverage will be promoted.

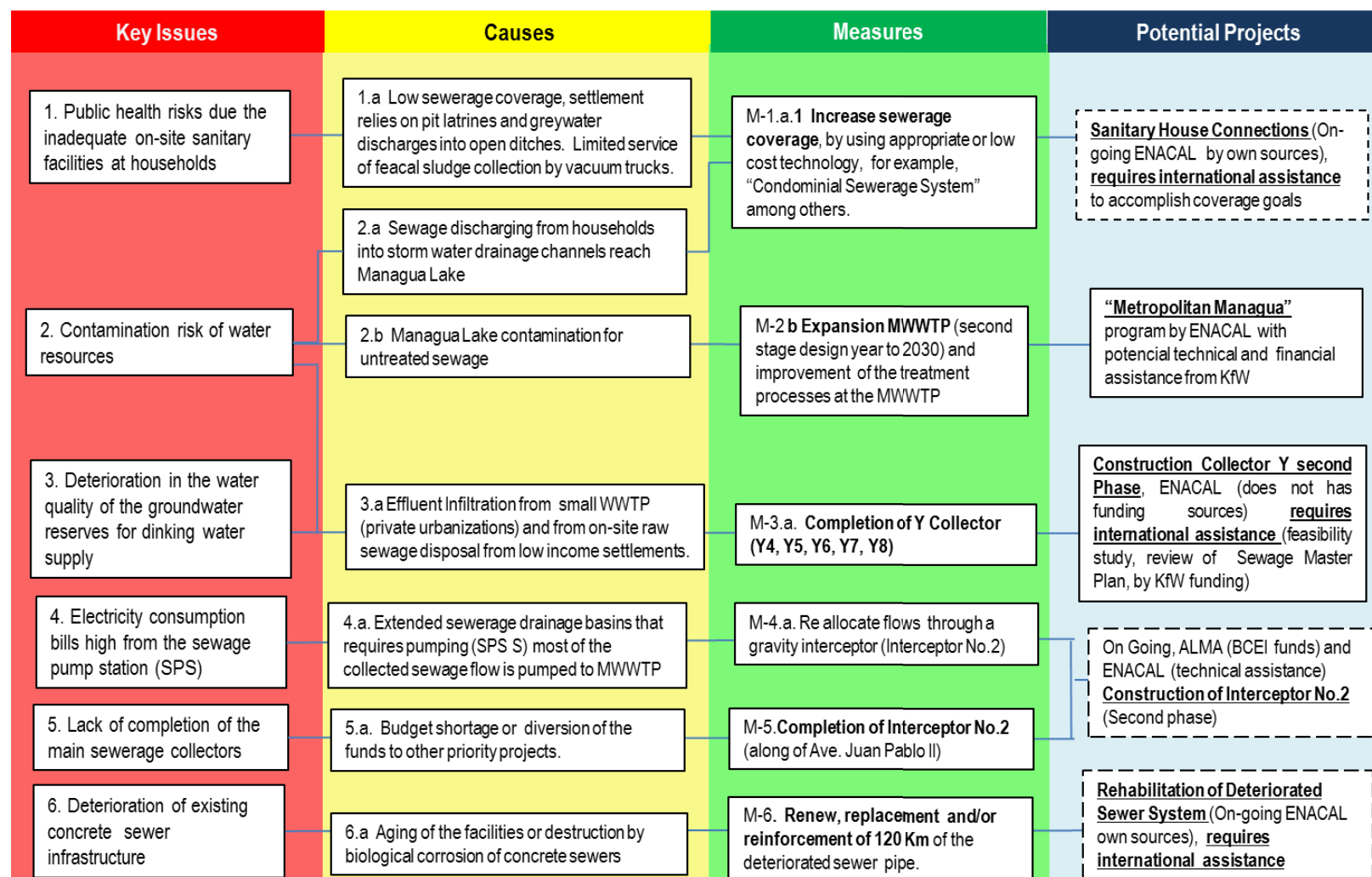
(1) Collector Y - Second Phase

This collector will contribute to the protection and conservation of watersheds in the southern part of Managua. In addition, it will reduce the risks of contamination of aquifers in the prioritized area of Ticuantepe and Veracruz, to be used as drinking water. The scope includes the supply and installation of 11.2 km of sewers to collect and drain the sewage from Jaguitas, Esquipulas, and Ticuantepe sectors. Also, the project will benefit a large number of neighbourhoods and low-income settlements that experience adverse health and environmental factors, which are necessary to be reversed and improved. Also, it will allow to directly connect the effluent, and decommission most of the small wastewater treatment facilities (27 WWTP).

(2) Interceptor No. 2 – Second Phase

Due to the growing upstream demand for sanitation, driven by the increasing population density, and in order to preserve public health as well as the environment, the implementation of this interceptor has been prioritized. It was also justified by the need to reduce the flow rate that converges in the existing collectors and main pumping station (EBAS-S), given that it shows signs of overloading and exceeding its design capacity. The interceptor will allow the drainage of sewage flow generated by more than 400,000 people. Recently, this project has been relaunched by ALMA because of the Plan for the Expansion and Remodeling of Juan Pablo II Avenue (the mentioned interceptor runs along that main avenue).

The third level of required projects is related with the Complementary Measures in the Wastewater Treatment Plant of Managua – MWWTP. The planned capacity of the plant for the year 2020 is 2.56 m³/sec; however, due to the planned expansion of the sewerage service connections, this component has as its main objective to complete the facilities of the treatment plant by 2030 and achieve the design capacity of 2.93 m³/sec.



Source: JICA Study Team

Figure 11.3.1 Fault Tree of Sewerage and Wastewater Disposal in the Study Area

11.3.2 Proposed Projects

As explained in Chapter 5.3, after analyzing the current status of sewerage and wastewater treatment in Managua City, five projects were identified and prioritized as written below.

The projects proposed for the improvement of the sanitary sewerage infrastructure include the construction of two primary collectors (Interceptor No. 2 and the second stage of the Y collector) that will give capacity to the system and allow the extension of coverage, and the reconstruction and reinforcement of deteriorated collectors. The master plan considers the development of five urban centers and the proposed projects are aligned with this development and aim to improve sanitation of the following: (i) East Service Center (Oriental Market), which has a very deteriorated sewage system and lack capacity and therefore requires renovation and expansion of the network; (ii) Masaya Center, which has a sewage system but needs extension of the collectors and capacity reinforcement; (iii) Advanced Knowledge Center which has no sewerage networks nearby and requires extension of new sewer trunks (increased coverage); (iv) Western Service Center which has some local sanitary sewers but require reinforcement and extension of new sewer trunks (increased coverage); and (v) Traditional and Heritage Center, which has an old sewer system that is broken and in very bad condition and thus requires renovation and reinforcement.

(1) Expansion of the Sewerage Coverage in Managua Project

The objective of this project is to improve the quality of life (protection of public health) of hundred thousand residents of settlements and other urban areas by extending the present sewerage coverage and increasing the treated wastewater effluent. The project components are: (i) Updating of the diagnostic (identification and verification of the number of housing); (ii) Enhancement of close coordination among the neighborhood leaders, ENACAL, and ALMA; (iii) Preparation of the feasibility study and final design (includes condominial systems and conventional); and (iv) Prioritization of the works, by phased implementation, starting from the highest impact sections of the city (the most populated communities and also those with higher health risks). The proposed project is divided into two phases. The first phase consists of an initial construction of 20,000 new sewer service connections between 2018 and 2020 (6,670 connection/yr) while the second phase will extend the coverage in the following five-year (2021 to 2025) period by constructing another 20,000 service connections (4,000 connection/yr). After the completion of this project, a sewerage coverage of 72% is expected. The estimated total cost is USD 66.4 million; USD 3.2 million for three years in the first phase and USD 33.2 million for the following five years. The financial source of the project has not been specified.

(2) Renewal and Improvement of Deteriorated Sewers Project

This sewer rehabilitation project aims to initiate the renewal, rehabilitation, and/or capacity reinforcement of the collectors that are damaged or have inadequate dimensions. Apart from reducing ENACAL's operation and maintenance costs due to frequent maintenance and repairs of damaged secondary sewers, these actions will result in improved service to the users. The components of the project are: (i) Updating of the diagnosis (CCTV inspection), (ii) Detailed design and preparation of the

technical dossier for tender and construction supervision, and (iii) Construction or rehabilitation of 120 km of sewers, which should start in 2018, at the rate of 40 km/yr, achieving the goal of 120 km in 2020. The total estimated cost is USD 13.6 million, but the financial source of the project has not been specified yet.

(3) Design Review and Construction of Collector Y - Second Phase Project

This project would allow the direct connection of sewerized urbanizations and unsewered settlements to the public sewerage system and lead the closure of 27 small WWTPs (that are not in compliance with the fecal coliform and nutrient quality standards). Additionally, this project will reduce the risk of contaminating the groundwater reserves for drinking water supply, located in the sub-basin III (South West) of Managua. The drainage basin of the existing sewage collector Y is composed of sub-basins Y4, Y5, Y6, Y7, and Y8. Sub-basins Y4 and Y5 can be drained by gravity into the existing collector Y (first phase); however, to drain sub-basins Y8, Y7, and Y6, it will require a pump station to convey the pressurized flow to the existing collector Y. The collector Y (second phase) has an estimated length of 11.2 km and diameter ranging from 200 mm to 500 mm, covering the neighborhood located south of Sabana Grande Road, the Jagüitas, Vera Cruz and Gotel Valley, and reaching Masaya's Road. The total estimated cost is USD 17.9 million, but the financial source of the project has not been defined yet.

(4) Design Review and Construction of Interceptor No. 2 – Second Phase Project

The project includes the construction of a gravity pipeline made of glass-reinforced plastic (GRP) (reinforced with fiberglass) with a length of 8.5 km and with diameter ranging from 900 mm to 1,200 mm. The line will have a maximum capacity of 2.13 m³/sec and allow to drain the wastewater generated by more than 400,000 people. The objective of the project is to release the flow pressure on Interceptor No. 1 by collecting the sewage flow generated in the southern part of the city (from Juan Pablo II Avenue to the South) which means reallocating the sewage flows through the new gravity flow Interceptor No. 2 (second span). At present, the extended sewerage drainage basins require pumping at EBAS-S to be conveyed to the MWWTP which results in high electricity bills (high operational cost).

A total of nine collectors are intercepted during conveyance, settling an equal number of boxes and Vortex-type flow regulating valves. The valves allow the passage of the maximum flow to the interceptor. If the flow rate is greater, excess flow continues downstream through the existing network. The implementation of these works has taken priority as there are growing upstream demand for sanitation in these areas due to the increase in population density and there is a need to reduce the flow rate that converges in the pumping station EBAS-S, given that it shows signs of overloading and exceeding its design capacity. The estimated construction cost is USD 13 million. This project originally had no financial source; however, the construction of Interceptor No. 2 – Second Phase will be included in the package of Rehabilitation and Remodeling of Juan Pablo II Avenue by ALMA.

(5) Complementary Measures in the Wastewater Treatment Plant of Managua – MWWTP.

Managua's WWTP (MWWTP) began its operations in 2009 having facilities to treat a design flow of 11 m³/sec, which corresponds to the first phase. This is being managed by BIWATER. In 2013, some improvements on the equipment were carried out to enhance the operation of the WWTP. The planning of the facilities considered to achieve an average capacity of 2.72 m³/sec in 2025. The estimated average influent flow is 1.8 m³/sec according to the actual coverage.

In May 2015, the German and Nicaraguan governments signed a loan agreement that put together a funding package of complementary measures for the MWWTP, amounting to EUR 6 million by KfW and EUR 0.6 million by the central government. The project will ensure that the treatment processes in the MWWTP will retain its efficiency up to 2030, and that the subsequent quality of treated wastewater discharged into Managua Lake (Xolotlan Lake) is acceptable to sustain the current ecological and environmental conditions. The project will be carried out in 3.5 years with the following four components: (i) Expansion and optimization of the treatment process, including the replacement of two primary sludge pumps, installation of two mechanical thickeners (GBP), construction of two additional secondary sedimentation tanks, construction of one additional primary settling tank, and construction of an aerated grit chamber; (ii) Construction of a co-generation plant based on biogas utilization including biogas micro-turbines, pre-treatment facilities, and a gasometer; (iii) Expansion of the solar drying capacity by equipping the sixth gallery with a Wendewolf system, and construction of an additional warehouse for the biosolids storage; and (iv) Consultancy service to support ENACAL to ensure proper implementation and efficient management of the project. According to the official information, once this biogas cogeneration plant operates, ENACAL will be able to save an electricity bill amounting to approximately USD 837,000 in 2018, and reaching USD 958,000 in 2025.

11.4 Flood Management

11.4.1 Basic Policy for Development

Key issues described in Chapter 5.7 of this report, their causes, measures, as well as the proposed projects composed of some measures on flood management in the study area are summarized in Figure 11.4.1. As described on the left side column of the figure, there are five key issues on flood management i.e.: i) shortage of flow capacity of *cauces*; ii) malfunction of flood management structures; iii) significant flood damage risk along *cauces*; iv) lack of prior information to evacuate when threaten with large floods; and v) reduction of rainwater storage and infiltration functions due to rapid urbanization. Causes of the key issues shown in the middle column of the figure are described in detail on Section 5.4 of this report. Measures shown in the next column in the figure are effective activities for each cause of key issues. Some measures do not automatically become proposed projects in this sector because they are already being carried out by ongoing projects or will be studied by other sectors in this JICA study. Especially, non-structural measures for flood management such as i) land use regulation in *cauces*, ii)

public emergency facilities, and iii) flood early warning system are described in Section 12.5 “Proposed Projects from Disaster Mitigation and Risk Management in Formulated Urban Development Master Plan in Managua City ” in this report. Some measures are combined as “potential projects”.

11.4.2 Proposed Projects

Three proposed projects for flood management are extracted for urban development as follows:

(1) Structural Improvement of Priority Cauces

Large-scale floods are likely caused when *cauces* (drainage canals) overflow. Fundamental data needed to study flood measures including existing flow capacity and probable maximum flood of each *cauce* are not available. Assessment of existing flow capacity of each *cauce* against probable floods will be the first step of the improvement works. It is expected that the study on master plan of flood drainage in Managua supported by IDB will contribute in understanding the current conditions.

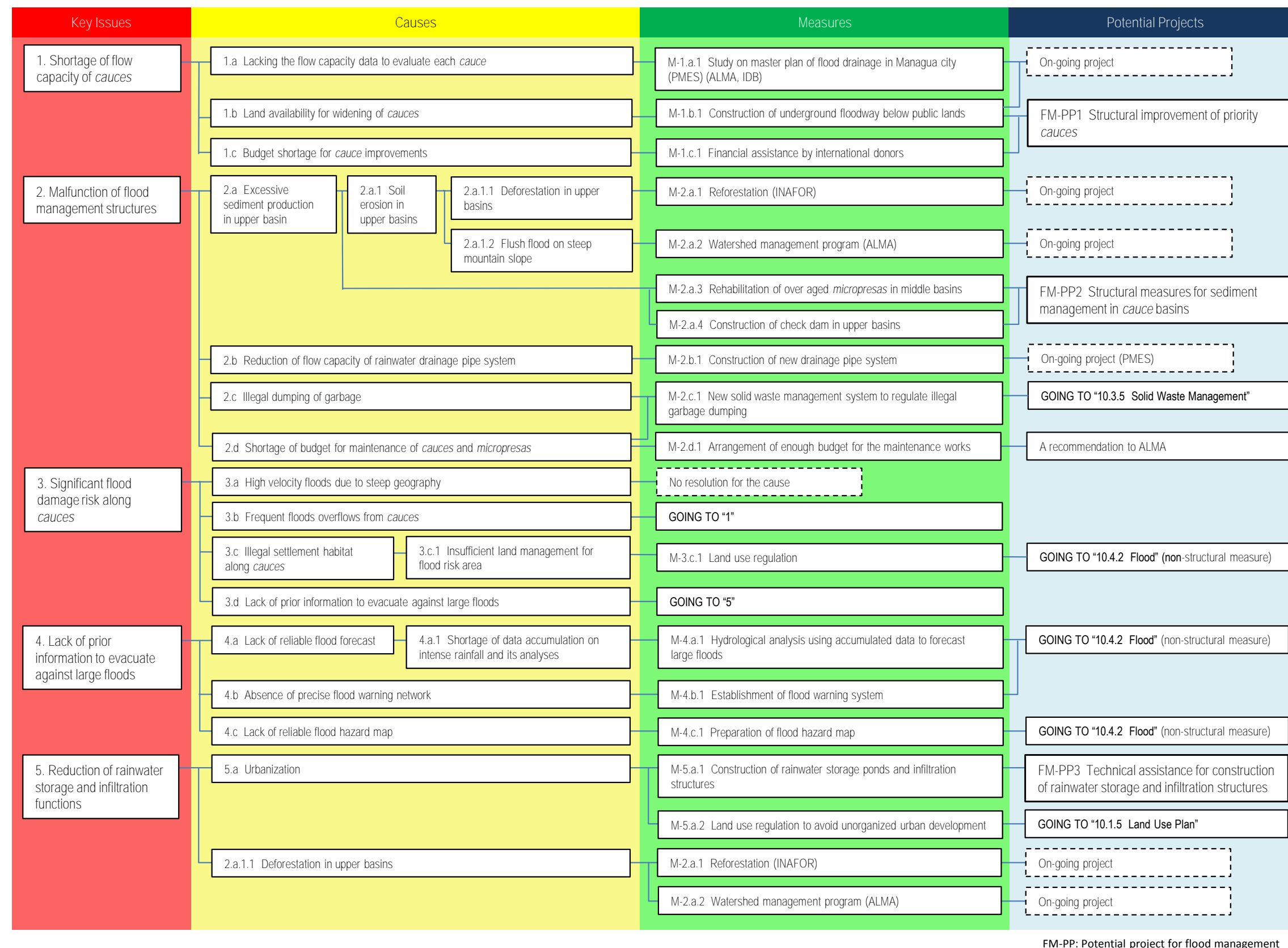
On the other hand, it is clarified that floods of *Cauce Oriental* often overflow causing significant damage on Pista Juan Pablo II Highway. The Drainage Section of ALMA considers that flood of *Cauce Oriental* is one priority issue of flood management in Managua. Improvement of flow capacity of the *cauce* is highly required to ensure safe traffic on the highway.

(2) Structural Measures for Sediment Management in *Cauce* Basins

Soil erosion from bare lands on upstream basins produces a large amount of sedimentation in *cauces* and *micropresas*, or small regulating dams. Sedimentation reduces the flow capacity of *cauces* and causes malfunction of *micropresas*. Reforestation and watershed management programs by INAFOR and ALMA are ongoing for reduction of excessive sediment production in the upper basin. However, sediment control, such as capture of excessive sediment and re-excavation of existing *micropresas*, is still required.

(3) Technical Assistance for Construction of Rainwater Storage and Infiltration Structures

Most of the urban areas are covered by concrete and asphalt except for limited gardens, public parks, and *micropresas* in the study area. Hence, rainwater does not infiltrate to the ground and discharges to lower land immediately. It is necessary to recover the function of rainwater storage and infiltration functions in the urban area. Furthermore, it is predicted that land use will be changed from free/green areas to urban areas in the future. Control of rainfall runoff rate, which is rapidly increasing, is important for flood risk management in Managua.



Source: JICA Study Team

Figure 11.4.1 Fault Tree of Flood Management in the Study Area

11.5 Solid Waste Management

11.5.1 Basic Policy for Development

Appropriate solid waste management is one of the important functions of urban development in keeping a safe and clean-living environment as well as ensuring that people's living is less burdensome to the environment. In order to realize the six development visions and slogan entitled "Sustainable, orderly, safe and opportunity for all" of this basic plan, securing an appropriate solid waste management is an important condition. Therefore, the basic policy for development of waste management is set as follows:

- Establishment of appropriate solid waste management.
- Promotion of 3Rs (reduce, reuse, and recycle).
- Adoption of a sustainable waste management system in the environment, society, economy, and technology.

Based on the basic policy described above, the direction for the solution of issues of this sector is shown below for the medium- and the long-term goal, respectively.

- Direction of goals in the medium term: A safe and hygienic living environment in the city will be secured by establishing appropriate waste management. Therefore, appropriate municipal solid waste management should be provided to all citizens during the medium term and it should be maintained.
- Direction of goals in the long term: An environmental friendly city which reduces the environmental impact by reducing waste generated and effectively utilizing resources through cooperation with the citizens and businesses will be aimed. The implementation of recycling, which has already been initiated by EMTRIDES, should be further promoted to allow reduction of waste disposal volume. Furthermore, it is necessary to promote reduction of waste generation through understanding and cooperation of citizens and businesses.

In addition, in the medium to long term, the optimal waste management system including possible adoption of a new treatment technology and/or private sector partnership in the future, should be considered from the aspects of environmental, societal, economic, and technological sustainability which is in line with the third basic policy. Furthermore, as basis for achieving and sustaining these goals, strengthening the capacity of policies, organizations, and individuals is indispensable.

11.5.2 Proposed Projects

In order to realize the city's vision that is currently planned, a comprehensive approach is needed to deal with the key issues on waste management as listed in Chapter 5.7. Causes, measures, and proposed projects are shown in Figure 11.5.1.

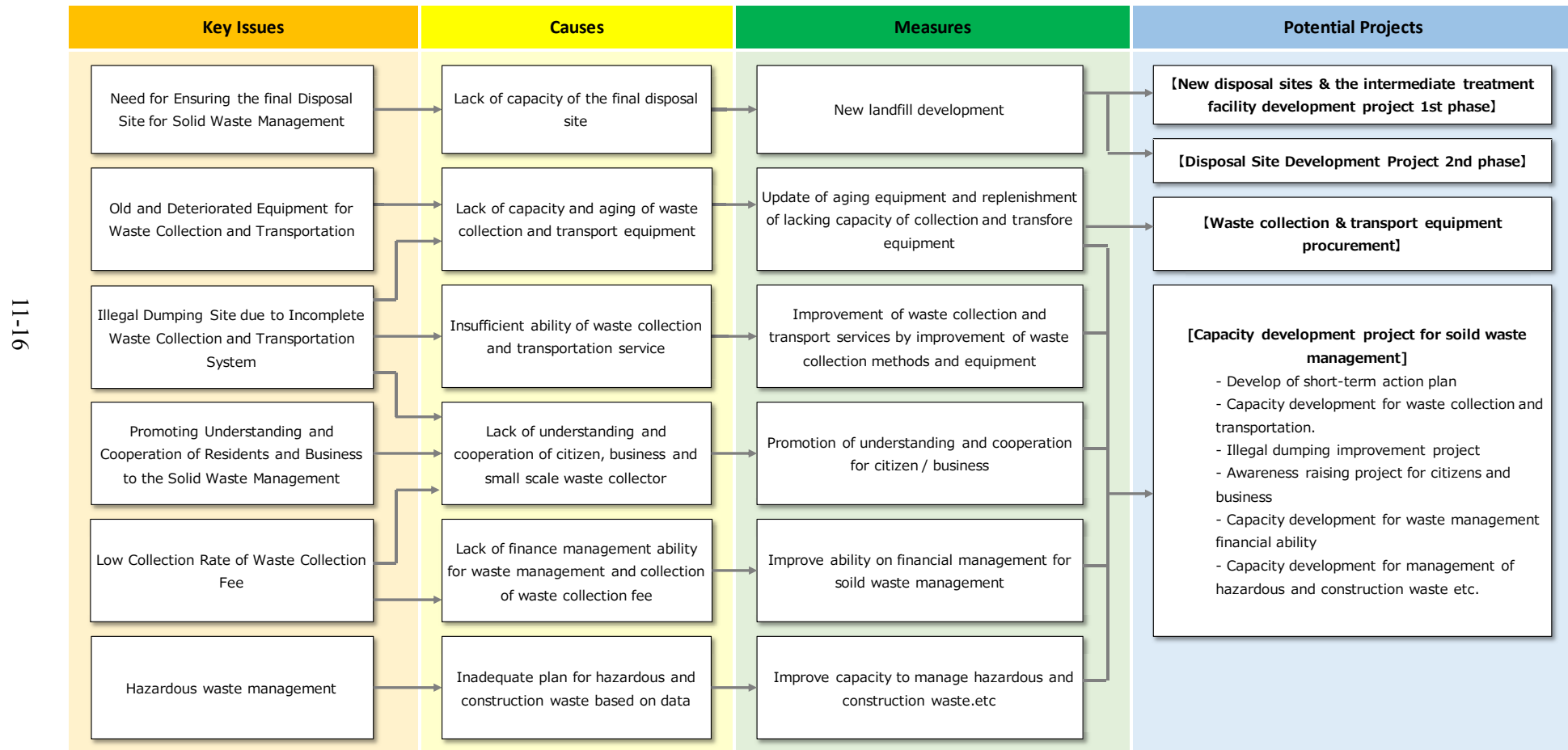


Figure 11.5.1 Fault Tree of Solid Waste Management

(1) New Sanitary Landfill and Intermediate Treatment Facility Development Project (Phase 1)

From the estimation of waste amount based on population and economic data in the future, the current landfill site is expected to be full in 2020 if the current waste management system is to be maintained without any upgrading, as shown in Chapter 5. Also, it is expected to be full by 2024, even in the case where a waste-to-energy project based on the private concession method which ALMA is considering with a private enterprise is to take place (ALMA will reportedly make a decision on whether to proceed with this concession in July 2017)¹. Securing a final disposal site is an urgent issue in any case, as it is the most important factor for establishing appropriate solid waste management. Given the time needed for the construction work of a final disposal site (at least six years from the feasibility study to construction), the development project for a new final disposal site should be started immediately. Upon the development of a final disposal site, the adoption of sustainable intermediate treatment technology to reduce the final disposal volume and to promote recycling to achieve long-term goals is a necessary condition. A development plan for the final disposal site should therefore include intermediate treatment facilities for recycling such as sorting and composting facilities depending on the result of the adoption of the waste-to-energy project through private concession method, which is currently under consideration.

Based on the above, development of a final disposal site and intermediate treatment facilities for waste volume covering up to 2030 including development of a plan will be implemented as the first phase.

1) Formulation of a regional final disposal site plan

The regional sanitary landfill plan proposed in the "Solid Waste Management Strategic Plan of Managua City (2010)" supported by UNHABITAT should be developed including the consideration of management organization with neighbouring municipality and its feasibility. The future solid waste management system should include intermediate treatment that would enable improvement of revenue from recycling while also achieving the reduction of the amount of final disposal. As described in the "Solid Waste Management Strategic Plan of Managua City", the utilization of existing mechanical biological treatment facilities (sorting and composting facilities) in AQUA LINKA final disposal site should be considered. A large-scale transportation facility would also be needed at the existing final disposal site for this purpose.

2) Development of new final disposal sites and intermediate treatment facilities

A new sanitary landfill site and intermediate treatment facilities will be constructed by implementing the above regional final disposal site plan.

¹ In the case where the waste-to-energy project through the private concession method fails, the sustainability of waste management services including final disposal would be put at risk. ALMA must brace itself for contract management capacity for taking such risk into consideration.

(2) Capacity Development Project for Solid Waste Management

In order to solve the issues identified, a project aiming at improving the organizational and individual capacity of the department in-charge of solid waste management should be carried out. This soft component project will be implemented in harmony with the infrastructure development mentioned above. This project consists of six components as follows:

1) Review of existing plans and development of a short-term action plan

A short-term action plan (including facility maintenance plan) will be developed based on the review of “Managua City Solid Waste Comprehensive Management Strategic Plan (UNHABITAT: 2010)” and “*Plan de Desarrollo del municipio de MANAGUA plan*”.

2) Capacity development for collection and transportation

The current waste collection method is inefficient. It could not collect waste on a fixed time because collection is conducted during the rush hours, and also encounters frequent trouble/problem in door-to-door collection and collection equipment. Waste collection method should be improved according to the characteristics of the collection area by introducing the following: for example, nighttime collection to avoid traffic jam in the rush hours; station collection method by segregation at the source in a newly developed housing area; and appropriate collection method in areas where vehicles could not enter. It is also necessary to reconsider the transport method from the five transport stations existing in the city. In addition, the number of necessary equipment according to the waste collection and transportation system employed should be calculated periodically and must be procured as planned. Appropriate waste collection also contributes to the closure of illegal dumping sites. For this purpose, a waste collection method including segregation at source appropriate to the regional characteristics should be considered based on the current status survey, and it should be integrated into and implemented under the waste collection plan covering the promotion of cooperation of citizens, businesses, and small-scale waste collectors shown in the next section. Through these activities, the capacity development for waste collection and transportation services will be achieved.

3) Improvement project against illegal dumping

Improvement of illegal dumping will be aimed through adoption of efficient solid waste collection method and updating/adding collection equipment as mentioned above. In parallel, it is also important to implement awareness-raising project listed in the next paragraph in a collaborative manner because understanding and cooperation among the citizens, businesses, and small-scale waste collectors who create illegal dumping sites are indispensable. To prevent illegal dumping, in addition to periodic inspection by ALMA, cooperation with the police and reporting system by citizen, community, and NGO should also be considered.

4) Awareness-raising project for citizens and businesses

Promotion of understanding and cooperation among citizens, businesses, and small-scale waste collectors is indispensable as one of the measures against illegal dumping, either into the dumping sites already existing in many areas of the city or into the open channels, as well as against the low collection rate of waste collection fee and 3R promotion. Therefore, awareness-raising program will be planned and implemented. In addition, as environmental education is practiced in many countries, it is desirable that environmental education with the aim of awareness raising and practicing of 3Rs in school be implemented. A stepwise and continuous environmental education program that is not transient should be planned for that.

5) Capacity development for financial management for waste management.

Improvement of tax revenues related to solid waste management is aimed at revising waste collection fee, which has not been revised since 1993, and improving fee collection method. In order to revise any official fees such as waste collection fee, diet approval is required and therefore sufficient study and consideration are necessary. In this project component, it is necessary to accurately grasp the data at each stage of solid waste management such as collection, treatment, and disposal from residents and businesses. Furthermore, the new waste collection fee will be reviewed based on the calculation of the unit price necessary for ensuring appropriate solid waste management including maintenance costs and replenishment costs of future facilities and equipment. In addition, a more efficient fee collection method shall be considered to raise the low fee collection rate.

6) Capacity development for management of hazardous and construction waste

Basically, MARENA is the responsible organization for hazardous waste management. It is expected that hazardous waste management will gradually be strengthened at the national level through "special bill for integrated waste management and hazardous and non-hazardous solid waste" which will be approved at the national level in the future. However, in order to solve the problems of batteries and fluorescent lights disposed by houses and small businesses, action of Managua City, which carries out the actual waste management, is necessary. Management of waste such as construction waste, although not hazardous, also needs to be considered along with city development. Therefore, current status survey, analysis, and planning for management of such type of waste are also targeted.

(3) Equipment for Collection and Transportation Procurement Project

Appropriate waste collection and transportation are important in securing a safe living environment. To eliminate waste from the living environment without delay, improvement of waste collection and transporting capacity will be aimed at. The following two points need to be implemented during the medium term in parallel to the review of waste collection system proposed above:

- Update and replenishment of aged waste collection equipment

- Replenishment of transportation equipment

(4) Sanitary Landfill Development Project (Second Phase)

A final disposal site and an intermediate treatment facility for waste volume over the period from 2031 to 2040 will be developed as the second phase.

11.6 Proposed Projects from Infrastructure Part

Table 11.6.1 List of Proposed Projects for Urban Development

Project Name	Objectives	Implementation Organization	Project Component	Cost (USD)
Replace Aging and Vulnerable Piping	<ul style="list-style-type: none"> Reduce the leaks and non-revenue water, which in turn maximize water resources and save money for ENACAL and the country. Strengthen the reliability of the water system against seismic events and other potential damage to the water system. 	ENACAL	<ul style="list-style-type: none"> Perform engineering to develop plans and specifications, including refining pipe locations. Allow to have a contract to construct the replacement of piping. 	USD 13 million
SCADA/GIS Improvements	Create an accurate digital map of the network, install data acquisition instruments and transmitters, purchase computers and hardware to operate the system, and purchase and be trained in the software to utilize the system competently.	ENACAL, ALMA ENACAL: Planning ALMA: Project Management	<p>GIS:</p> <ul style="list-style-type: none"> Procure suitable equipment to perform field verification Employ field technicians to investigate precise locations of pipes and valves. Analyze and adjust field data to create accurate GIS system. <p>SCADA</p> <ul style="list-style-type: none"> Employ consultant to design and implement the system Procure instruments, gauges, transmitters, receivers, converters, and communication equipment, including flowmeters, pressure gauges, valve positioning detectors, etc. 	USD 20 million
Feasibility Study for Nicaragua Lake Potable Water Treatment Plant and Transmission	Study and engineer a system of water treatment and transmission from Nicaragua Lake.	ENACAL ENACAL: Planning	<p>Engineering project to study the long-term water supply demands in light of restricted and degraded groundwater supply. Assess options to treat and deliver water from Nicaragua Lake.</p> <ul style="list-style-type: none"> Field investigations 	USD 5 million

Project Name	Objectives	Implementation Organization	Project Component	Cost (USD)
System			<ul style="list-style-type: none"> Desktop study 	
Improve Water Supply Infrastructure to Meet High-density Demand in Five Sub-centers	Ensure that these proposed high-density areas have sufficient water supply to encourage development.	Private	<ul style="list-style-type: none"> Investigation and design. An engineer must evaluate the real requirements for each sub-center, evaluate the existing water supply, then identify and design the required improvements for the area. Construct a new well Construct a new larger-diameter pipeline in the vicinity Construct a new water storage tank. 	USD 20 million
Recognize Future Capital Outlays Necessary to Meet Demand for Planned Growth	Create a solvent financial entity that is able to respond adequately to new infrastructure requirements to meet future demands.	ENACAL Division/Department in-charge: Finance	<ul style="list-style-type: none"> Adjust water tariffs Create capital improvement fund Ensure future projects including accommodations for growth 	USD 20 million
Project on Technical Assistance for Water Quality Improvement of Managua Lake	<p>To monitor the water quality in Managua Lake.</p> <p>To regulate water contamination in Managua Lake</p>	CIRA/UNAN (<i>Centro para la Investigación en Recursos Acuáticos de Nicaragua/ Universidad Nacional Autónoma de Nicaragua</i>), MARENA, MINSA (<i>Ministerio de Salud</i>), ENACAL	<ul style="list-style-type: none"> Review of the JICA study results in 2014 for water quality evaluation on Managua Lake Data and information collection and their analyses Establishment of water quality monitoring system Procurement of water quality test installments Preparation of guidelines for regulation of water contamination Capacity development of responsible staffs 	USD 5 million
Design Review and Construction of Collector Y Second Phase Project	<p>Groundwater protection: Its fundamental objective is to minimize the risks of contamination of the Managua aquifer by collecting sewage from the rapid population growth area.</p> <p>Elimination of almost 27 little wastewater treatment facilities built by the developers and administrated by the residents.</p>	ENACAL – Direction of Project and Investment; Direction of Environmental Issues; General Direction of Operations; Department of Sewerage and	<p>The second phase is composed of the so called sub-basins Y4, Y5, Y6, Y7, and Y8. Sub-basins Y4 and Y5 can drain by gravity into the collector Y (first phase); however, to drain sub-basins Y8, Y7, and Y6, it will be necessary to have a pump station to convey the pressurized flow to the existing collector Y.</p> <p>The <i>Collector “Y” Second Phase</i>, has an estimated length of 11.2 km, covering the neighborhoods located south of</p>	USD 17.9 million

Project Name	Objectives	Implementation Organization	Project Component	Cost (USD)
		Wastewater Treatment Plant Managua	Sabana Grande Road, the Jagüitas, Vera Cruz, and Gotel Valley, reaching Masaya's Road.	
Design Review and Construction of Interceptor No. 2 – Second Phase	Release of the flow pressure on Interceptor No.1, by collecting the sewage flow generated in the southern part of the city (from Juan Pablo II Ave. to the south)	ENACAL: Direction of Project and Investment; Direction of Environmental Issues	The upstream span of Interceptor No.2, is 8.5-km length and diameters ranged between ø 900-mm and ø 1,200-mm (reinforced fiberglass pipe - GRP). For a maximum flow of 2.13 m³/sec. It has already detailed design (DD), however the design should be reviewed and the bidding documents be updated. Also, it includes, nine vortex valves at the interception point of the other main collectors.	USD 14.42 million
Expansion of the Sewerage Coverage in Managua Project	<ul style="list-style-type: none"> To extend the present sewerage coverage and treated wastewater. Improve the quality of life (protection of public health) of hundred thousand residents of settlements and other urban areas. 	ENACAL: Direction of Projects and Investment; Direction of Environmental Issues	Update of diagnostic (identification and verification of the number of housing). Close coordination of ENACAL and neighborhood leaders. Preparation of the feasibility study and final design (includes condominial and conventional systems). Prioritization of the works. Phased implementation starting from the highest impact (the most populated and communities with the greatest health risk.).	USD 66.4 million
Renewal and Improvement of Deteriorated Sewers	Renewal, rehabilitation and/or capacity reinforcement of the collectors that are damaged or have inadequate dimensions. Reduce the costs of operation and maintenance of damaged systems. To improve the service to the user.	ENACAL: Direction of Project and Investment; Direction of Operations	Update of diagnosis (CCTV inspection) Detailed design and technical dossier for tender and construction supervision Construction or rehabilitation of 120 km sewers	USD 13.6 million
Additional Measures to Increase the Treatment Capacity of the Managua	Complete the facilities of the plant according to the master plan design, to reach 2.93 m³/sec of treatment capacity, to cover the requirements of the year 2030.	ENACAL – Direction of Project and Investment; Direction of Environmental Issues	The facilities required in the second phase consists of one aerated grit chamber and degreaser, three primary settling tanks, two secondary settling tanks, two trickling filters, one anaerobic digester; two vessels of solar drying, and one sludge mechanical dewatering unit.	USD 14.12 million

Project Name	Objectives	Implementation Organization	Project Component	Cost (USD)
WWTP		General Direction of Operations; Department of Sewerage and Wastewater Treatment Plant Managua		
Structural Improvement of Priority <i>Cauces</i> Project	To improve flow capacity of priority <i>cauce</i>	Drainage Section in ALMA	<ul style="list-style-type: none"> Review of the master plan of flood drainage in Managua City Selection of facilities to be improved Design of improvement works Construction works 	USD 30 million
Project on Structural Measures for Sediment Management in <i>Cauce</i> Basins	<p>To rehabilitate overaged <i>micropresas</i> in the middle basin</p> <p>To construct and check dams in the upper basin to capture excessive sediment</p>	Drainage Section in ALMA	<ul style="list-style-type: none"> Data and information collection Preparation of sediment management plan Selection of rehabilitation sites and new sediment control sites Design works for the rehabilitation including re-excavation and structural improvement of existing <i>micropresas</i> Design works for the construction including new <i>micropresas</i> in upper basins and in sub-centers² Construction works Procurement of maintenance machineries Capacity development of responsible staffs to maintain the structures 	USD 50 million
Project on Technical Assistance for Construction of Rainwater Storage and Infiltration	To construct rainwater storage ponds and infiltration structures in the urban area	Drainage Section in ALMA	<ul style="list-style-type: none"> Data and information collection Selection of pilot project sites including rainwater infiltration pavement on the parking lot and pedestrian road, rainwater infiltration box and drainage pipe, and underground rainwater storage pond 	USD 5 million

² Function of new *micrompresas* constructed in the subcenters is temporary storage of rainwater within the area to reduce flood volume.

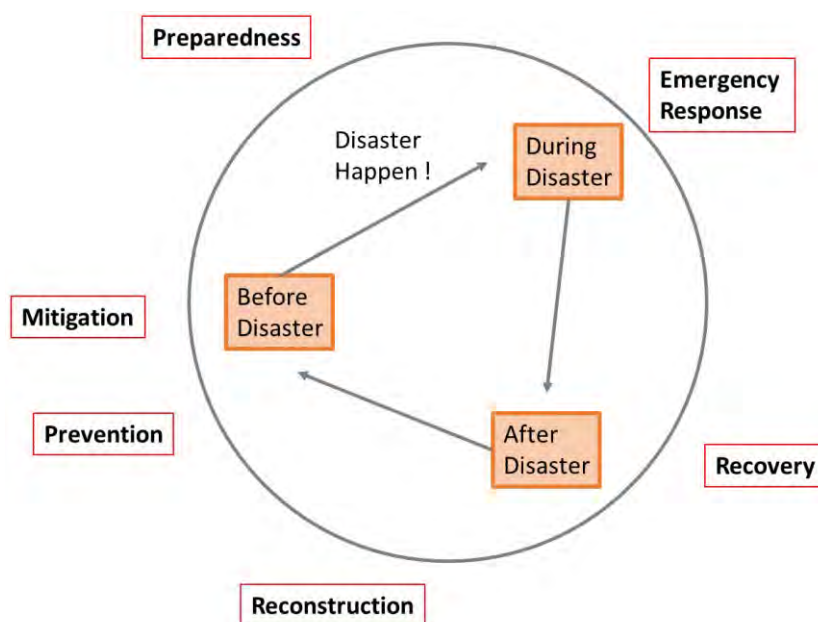
Project Name	Objectives	Implementation Organization	Project Component	Cost (USD)
Structures			<ul style="list-style-type: none"> Design works Construction works Capacity development of responsible staffs 	
New Sanitary Landfill and Intermediate Treatment Facility Development Project (Phase 1)	To improve solid waste management infrastructure to cope with the increase in waste volume due to population growth and economic activity expansion (Phase 1)	ALMA Directorate General for Public Cleaning, EMTRIDES	<ul style="list-style-type: none"> Development of regional disposal site plan (including other municipality) Development of a new disposal site Development of an intermediate treatment facility (within the existing final disposal site: Acahualinca) Development of a large-scale transportation facility (within the existing final disposal site: Acahualinca) 	USD 72 million
Capacity Development for Solid Waste Management Project	Improvement of hygienic living environment of the citizen by capacity development for waste management	ALMA L.P, EMTREDE, ALMA Environmental management department, District office	<ul style="list-style-type: none"> Review of the existing plans and development of a short-term action plan Capacity development for collection and transportation Improvement project against illegal dumping Awareness raising project for citizens and businesses Capacity development on financial ability for waste management Capacity development on management of hazardous and construction waste 	USD 6 million
Equipment for Collection and Transportation Procurement Project	Improvement of collecting and transporting capacity by updating aged equipment	ALMA Directorate General for Public Cleaning, EMTRIDES	<ul style="list-style-type: none"> Procurement of waste collection and transportation equipment Construction of transportation station facilities and procurement of equipment 	USD 18 million
Sanitary Landfill Development Project (Second Phase)	To improve solid waste management infrastructure to cope with the increase in waste volume due to population growth and economic activity expansion (Phase 2)	ALMA Directorate General for Public Cleaning, EMTRIDES	<ul style="list-style-type: none"> Development of sanitary landfill site (second phase) Development of intermediate treatment facility (second phase) 	USD 50 million

Source: JICA Study Team

CHAPTER 12 DISASTER MITIGATION AND RISK MANAGEMENT PLAN

12.1 Basic Approach in Disaster Risk Reduction Management (DRRM) for Managua City

Prevention, mitigation, preparedness, emergency response, recovery, and reconstruction are the major components of the disaster risk reduction management cycle. The continuous process of the disaster management cycle as shown in Figure 12.1.1 was examined for the basic approach in disaster risk reduction management.



Source: JICA study team

Figure 12.1.1 Disaster Management Cycle

- **Prevention/Mitigation** : Minimizing the effects of a disaster
(Structural measures, land use planning, public education)
- **Preparedness** : Planning how to respond
(Contingency plan for emergency, emergency training, building warning system)
- **Emergency Response** : Efforts to minimize the hazards created by a disaster
(Search and rescue, emergency relief, temporary shelter, evacuation center, grants, medical care)
- **Recovery** : Returning the community to its normal state through short-term plans
(Recovery of life-support system, building temporary housing, health program including counselling)

- **Reconstruction** : Returning the community to its normal state through long-term plans
(Reconstruction of public infrastructure and houses)

In the Sendai Framework for Disaster Risk Reduction 2015-2030, the goal is defined as “to prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that will prevent and reduce hazard exposure and vulnerability to disaster, and increase preparedness for response and recovery, and thus strengthen resilience”. Furthermore, there are four priorities for action, namely, Priority 1: Understanding disaster risk, Priority 2: Strengthening disaster risk governance to manage disaster risk, Priority 3: Investing in disaster risk reduction for resilience, and Priority 4: Enhancing disaster preparedness for effective response, and to «Build Back Better» in recovery, rehabilitation and reconstruction.

As mentioned above, prevention/mitigation and preparedness, which are measures done before a disaster, shall be given more focus. Climate Change Adaptation (CCA) should also be given more focus in this project.

12.2 Basic Development Policy and Vision of Managua City with DRRM

The urban planning of Managua City shall be formulated based on the foregoing basic approach with well-balanced structural and non-structural measures in the DRRM.

In general, the DRRM for structural measures shall be formulated based on the design criteria created for different magnitudes of different natural disasters. For instance, for flood mitigation structural measures in Managua City, crossing structures on river channel (cauce) are designed against a flood with a probability of 1 in 25 years. Then, safety against flood with the design flood probability will be ensured once the flood mitigation structures are constructed in accordance with the said design criteria, which will function well for reducing hazard magnitude. However, there is a likelihood of natural disaster beyond the design criteria. In case of natural disaster beyond the capacity of the structural and non-structural measures, then it is important to mitigate or control the damages, which will happen by reducing the vulnerability of the structures.

Although stepwise improvements of structural measures are indispensable, these measures still cannot control the disasters completely. Thus, well-balanced structural and non-structural measures with an effective disbursement of investment taking into account marginal capacity of structural measures will be required in the DRRM.

A vision is a single keyword or a sentence that describes the ultimate goal. One of the basic development visions of the Managua Urban Master Plan (PDUM) would be “Resilient city against disaster which shall be supported by well-balanced structural and non-structural measures in the DRRM”.

12.3 Well-balanced Structural and Non-Structural Measures in the DRRM

12.3.1 Structural Measures in the DRRM

Managua City proposed some structural measures in its Annual Investment Plan in 2016. Referring to the measures, Table 12.3.1 shows the required structural measures for earthquake, flood, and landslide for Managua City.

Table 12.3.1 Required Structural Measures for Earthquake, Flood, and Landslide for Managua City

Disaster	Required Structural Measures	Remarks
Earthquake	Adaptation of Simple and Economic Techniques to Strengthen the Existing Structures Adoption of New Earthquake-Resistant Buildings/Structures	
Flood	River Channel Improvement (e.g., Increase of Flow Capacity of Existing Channel by Change in Section, Concreting, Dredging including Cleaning of Solid Waste, Extension of New Channel) Development of Retarding Basin (e.g., Dredging of Existing Facilities, Construction of Additional <i>Micropresa</i> , etc.)	
Landslide	Soil Erosion Control (e.g., Bonas Program) Afforestation/Reforestation	

Source: JICA Study Team

12.4 Non-structural Measures in DRRM

Required non-structural measures in the DRRM for Managua City are also considered as shown in the following:

- Establishment of a permanent office/staff for disaster management and preparation of program
- Update of the hazard map and proper dissemination to citizens for understanding the community-based DRRM system
- Land use regulation in *cauces*, *micropresa*, and high-risk areas
- Improvement of public emergency facilities for disaster preparedness
- Development of emergency transportation network
- Development/upgrade of disaster forecasting and warning system
- Environmental consideration including solid waste management
- Assessment of earthquake resistance of existing buildings, and study on improvement for earthquake-resistant buildings

In March 2017, there were discussions and comments on the above measures given by the Technical Working Group III: Disaster Prevention, as follows:

- All the measures are required for Managua City.
- Project components of some measures need to be revised.
- Cost and phasing plan are subject to change later.

- PDC No.6 renamed as “Project for Study, Design and Installation of the Flood Early Warning System for the Urban Area of Managua City”, proposed by INETER, was agreed including project component, phasing, and cost.
- An additional PDC No.9 named as “Project for Improvement of Earthquake Disaster Prevention and Warning System”, proposed by INETER, was agreed including project component, phasing, and cost.

12.5 Proposed Projects for Disaster Mitigation and Risk Management in the Formulated Urban Development Master Plan in Managua City

It is noted that the proposed projects for flood and landslide were studied under “Flood Management”, and there are three projects that were proposed. Of these, two structural measures were recommended, i.e., “ Structural Improvement of Priority *Cauces* Project”, and “ Project on Structural Measures for Sediment Management in *Cauce* Basin. It is also noted that the structural measures for earthquake described in the foregoing table (Adaptation of Simple and Economic Techniques to Strengthen Existing Structures, and Adoption of New Earthquake-Resistant Buildings/Structures) are assumed to be implemented after the proposed projects for non-structural measures in PDC No. 8 and PDC No. 9, as shown below, are undertaken.

Based on the above, the proposed projects on disaster mitigation and risk management in the formulated urban development master plan in Managua City are shown in Table 12.5.1.

Table 12.5.1 Proposed Projects for Disaster Mitigation and Risk Management in the Formulated Urban Development Master Plan in Managua City

											CS\$1=US\$		0.0338 (as of March 15, 2017)			
No.	Project Title	Type of Measures	Sector			Executing Agency	Related Agencies	Phase/ Cost	Short Term (- 2020)	Middle Term (2021-2030)	Long Term (2031-2040)	Total Cost (Mil. US\$)	Budget of ALMA Expected (Mil. US\$)	Remarks		
1	Project for Establishment of Permanent Office/Staff for Disaster Management and Preparation of Program	Structural Measures				ALMA	SINAPRED, etc.	Phase	○					3 Mil. C\$/year/each District estimated by ALMA		
		Non-Structural Measures	○	○	○			Cost (Mil. US\$)	2.1			2.1	2.1			
2	Project for Update of Hazard Map and Dissemination to Citizen for Understanding /Community Based Disaster Risk Reduction Management System	Structural Measures				INETER/SINAPRED/ALMA	-	Phase	○	○	○			0.5 Mil. C\$/year/each District estimated by ALMA		
		Non-Structural Measures	○	○	○			Cost (Mil. US\$)	0.4	1.2	1.2	2.7	2.7			
3	Project for Land Use Regulation in Cause, Micropresa and High Risk Area	Structural Measures				ALMA	SINAPRED, etc.	Phase	○	○	○			Relocation cost, estimated by ALMA		
		Non-Structural Measures		○	○			Cost (Mil. US\$)	10	20	40	70	7			
4	Project for Improvement of Public Emergency Facilities for Disaster Preparedness	Structural Measures				ALMA	SINAPRED, etc.	Phase	○					Like "Civic Core" in Japan		
		Non-Structural Measures	○	○	○			Cost (Mil. US\$)	1			1				
5	Project for Development of Emergency Transportation Network	Structural Measures				ALMA	SINAPRED, etc.	Phase	○							
		Non-Structural Measures	○	○	○			Cost (Mil. US\$)	1			1				
6	Project for Study, Design and Installation of the Flood Early Warning System for the Urban Area of Managua City	Structural Measures				INETER	ALMA, SINAPRED, etc.	Phase	○					TOR prepared by INETER and finalized by TWG To be proposed to IDB by ALMA		
		Non-Structural Measures		○	○			Cost (Mil. US\$)	1.5			1.5				
7	Project for Consideration on Environment including Solid Waste Management	Structural Measures				ALMA	SINAPRED, etc.	Phase	○	○				to be implemented under proposed "Project for Consideration of Environment including Solid Waste Management"		
		Non-Structural Measures		○	○			Cost (Mil. US\$)	4	2		6				
8	Project for Assessment of Earthquake Resistance for Existing Buildings, and Study on Improvement for Earthquake-Resistant Buildings	Structural Measures				ALMA	SINAPRED, etc.	Phase	○							
		Non-Structural Measures	○					Cost (Mil. US\$)	1			1				
9	Project for Improvement of Earthquake Disaster Prevention and Warning System	Structural Measures				INETER	ALMA, SINAPRED, etc.	Phase	○					TOR prepared by INETER and finalized by TWG		
		Non-Structural Measures	○					Cost (Mil. US\$)	1			1				

Source: JICA Study Team

The background, objectives, and components of the above projects are described below. Project Detail Charts (PDCs) for the above projects are attached in Appendix 5.

Table 12.5.2 List of Proposed Projects for Urban Development

Project Name	Objective	Implementing Organization	Project Component	Cost (USD)
Project for the Establishment of a Permanent Office and Staff for Disaster Management with Training Program	To establish permanent office and staff for disaster management, and to prepare a training program for COMUPRED of ALMA and CODIPRED of District Offices I-VII of ALMA	COMUPRED of ALMA and CODIPRED of District Offices I-VII of ALMA	(1) Study on selection of office (location) of District Offices I-VII of ALMA, and method of establishment of office (by repair or new construction) as a permanent office for disaster management (2) Study on appointment of permanent staff for disaster management (3) Preparation of training program (3-1) Preparation of training program (3-2) Capacity building for permanent staff	USD 2.1 million
Project for the Update of the Hazard Map and Proper Dissemination to Citizens for Understanding the Community-based Disaster Risk Reduction Management System	To update the hazard map and to disseminate it to citizens for their understanding/To establish community-based disaster risk reduction management system for COMUPRED of ALMA and CODIPRED of District Offices I-VII of ALMA	Directorate of Hydrology of INETER, Directorate of Territorial Organization in SINAPRED, and the Directorate of Urban Planning of ALMA,	(1) Update of hazard map and dissemination to citizens for their understanding (1-1) Update of hazard map (1-2) Dissemination to citizens for their understanding (2) Community-based disaster risk reduction management system (2-1) Community-based disaster risk reduction management system	USD 2.7 million
Project for Land Use Regulation in <i>Cauce</i> , <i>Micropresa</i> and High-risk Areas	To assist in the preparation of the regulation in <i>cauce</i> , <i>micropresa</i> and high-risk areas, and/or relocation, and improvement.	Organization in SINAPRED, Directorate of Territorial Organization in SINAPRED	(1) To assist in the preparation of the regulation in <i>cauce</i> , <i>micropresa</i> and high-risk areas, and/or relocation, and improvement. (2) Relocation of families along <i>cauce</i> , <i>micropresa</i> and high-risk areas	USD 70 million
Project for the Improvement of Public Emergency Facilities for Disaster Preparedness	To improve public emergency facilities for disaster preparedness	Directorate of Urban Planning, COMUPRED and CODIPRED of District Offices I-VII of ALMA	(1) Study on selection of emergency base (like civic core in Japan, see attachment) (2) Study on improvement of emergency evacuation areas (open space and building) (2-1) Improvement of emergency evacuation areas (open space and building) (2-2) Capacity building for permanent staff	USD 1 million

Project Name	Objective	Implementing Organization	Project Component	Cost (USD)
Project for the Development of Emergency Transportation Network	To develop emergency transportation network	Organization in SINAPRED, and the Directorate of Territorial Organization in SINAPRED	(1) To study the development of emergency road transport network (1-1) Establishment of emergency road transport network (1-2) Dissemination of emergency road transport network (2) To study the development of emergency air and water transportation network (2-1) Establishment of emergency air and water transport network (2-2) Dissemination of emergency air and water transport network (3) To study the development of signboards and lights during nighttime in the emergency transportation network (3-1) Preparation of signboards and lights (3-2) Capacity building for operation	USD 1 million
Project for the Study, Design and Installation of Flood Early Warning System for the Urban Area of Managua City	Design the integrated early warning system for floods, within the southern subbasin of Lake Managua (urban area of Managua), according to the main axes of operation of the SATs (Surveillance, Forecast, Communication and Response).	Directorate of Hydrology of INETER, Directorate of Territorial Organization in SINAPRED, and Directorate of Urban Planning of ALMA	1. Densify the hydrometeorological surveillance network: It is intended to increase the network of satellite hydrometeorological stations considering 1 station per 20 km ² , for a total of approximately 40 stations; It was found that 18 stations are already installed in Managua; thus, 22 new stations are to be installed. 2. Creation of the Hydrometeorological Information System (hydrometeorological database): this component includes the creation of a system to store all the information generated by the different meteorological models (e.g., radar), hydrological as well as all the information generated for Managua City that will serve as input for different studies 3. Flood Hazard Studies: This component consists of maps of flood hazards at critical sites in the previously identified urban area. 4. Institutional Strengthening (requirement): a fundamental component that will allow to be efficient in hydrometeorological surveillance; for this, it is required to hire personnel to perform	USD 1.5 million

Project Name	Objective	Implementing Organization	Project Component	Cost (USD)
			continuous shifts because of the addition of the Hydrometeorological Forecast Center and/or the Hydrometeorological Operations Center.	
Project for Environmental Consideration including Solid Waste Management	To develop education to the local residents (this Project will be implemented under the proposed "Project for Environmental Consideration including Solid Waste Management").	Organization in SINAPRED and the Directorate of Territorial Organization in SINAPRED	(1) To consider the environment including solid waste management	USD 6 million
Project for the Assessment of Earthquake Resistance of Existing Buildings, and Study on Improvement for Earthquake-resistant Buildings	To improve the situation of the buildings against earthquake in ALMA	Organization in SINAPRED and the Directorate of Territorial Organization in SINAPRED	(1) Assessment of earthquake resistance of existing buildings (2) Study on improvement for earthquake-resistant buildings	USD 1 million
Improvement of Earthquake Disaster Prevention and Warning System	To improve disaster prevention and warning system	INETER / Organization in SINAPRED/ALMA, Directorate of Hydrology of INETER, Directorate of Territorial Organization in SINAPRED, and the Directorate of Urban Planning of ALMA	(1) Strengthen the earthquake prevention and warning system (1-1) Study and propose a system for prevention and warning for extreme local earthquakes in Managua City (1-2) Acquisition and installation of 25 seismic stations in Managua City (1-3) Articulation of the system of stations to the Seismic Central via router/radio (1-4) Elaboration of software for the real-time monitoring of Managua City (1-5) Design of the communication protocol for warnings and recommendation for alerts	

12.5.1 Establishment of the Permanent Office and Staff for Disaster Management and Training Program

(1) Background

SINAPRED has a permanent office and staff for disaster management and training program. However, the COMUPRED of ALMA and CODIPRED of District Offices I-VII of ALMA do not have permanent offices and staff for disaster management and training program, which resulted in insufficient operation and management of the disaster management cycle. Besides, some buildings of the district offices of ALMA are not structurally safe since they are non-resistant structures against earthquake, and so it will not fully function as an emergency base.



Source: JICA Study Team

**Figure 12.5.1 Operation Center of
SINAPRED**

Accordingly, the establishment of a permanent office/staff for disaster management and the preparation of program would be necessary for COMUPRED of ALMA and CODIPRED of District Offices I-VII of ALMA.

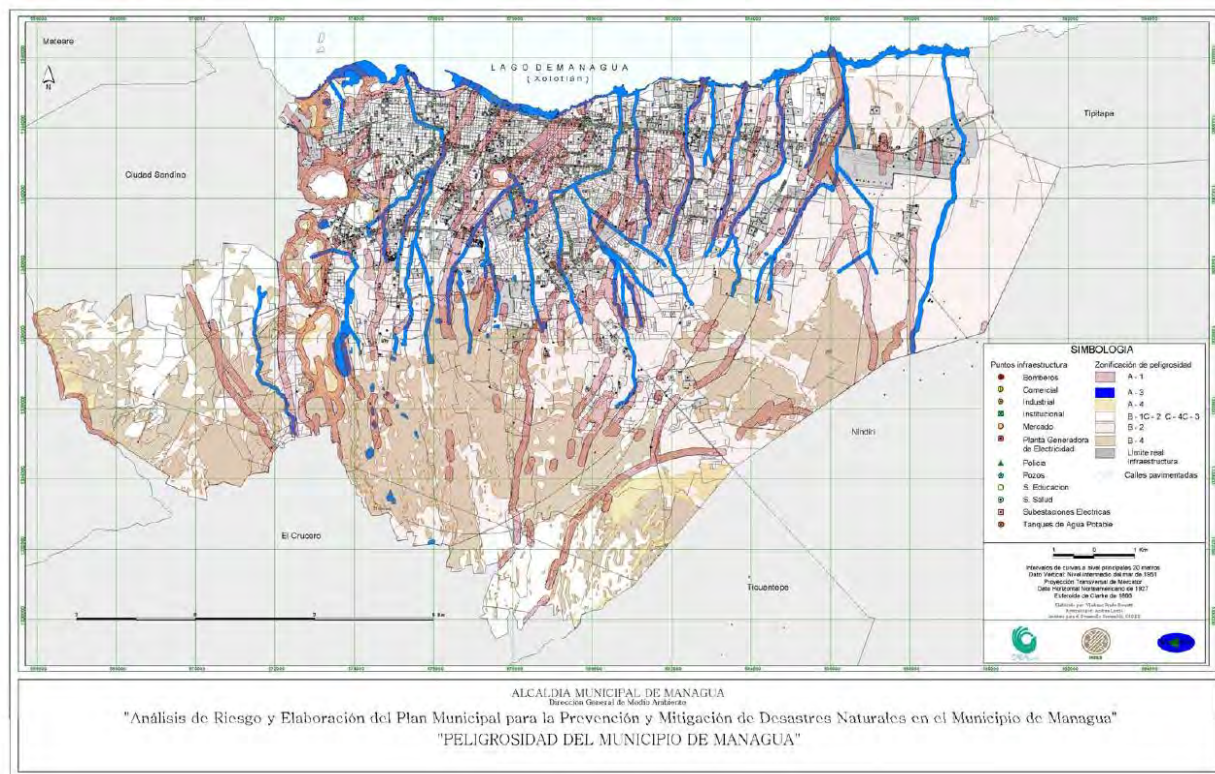
(2) Objectives

The objectives of the project are to establish a permanent office and staff for COMUPRED of ALMA and CODIPRED of District Offices I-VII of ALMA for disaster management and to prepare training programs for these staff. Organization related to SINAPRED will be a relevant agency for this objective.

12.5.2 Update of Hazard Map and Dissemination to Citizens for Their Understanding of the Community-based Disaster Risk Reduction Management System

(1) Background

A joint working group consisting of an organization related to SINAPRED, INETER, and ALMA updated the hazard potential map using three-level classification (A, B, and C) as shown in Figure 12.5.2.



Source: ALMA, prepared in 2016

Figure 12.5.2 Hazard Potential Map with Three-level Classification (A, B, and C) for Seismic, Volcano, Flood, and Landslide

Hazardous Area A – High Risk

In these areas, the safety of life and property is directly threatened which affects urban development. Severe restrictions shall be applied for urban development and it is necessary to assess the vulnerability of the existing infrastructures.

Hazardous Area B – Medium Risk

In these areas, it is necessary to take mitigation measures and parameters for adequate design and risk assessment. Partial restrictions shall be applied.

Hazardous Area C – Low or Non-existent Risk

In these areas, the phenomenon only presents residual danger and is relatively “negligible”. Existing standards shall be applied.

The map shown above shall be updated from time to time or when necessary.

Table 12.5.3 General Characteristics of the Hazardous Areas of Managua City

Disaster	Hazardous Area A – High Risk	Hazardous Area B – Medium Risk	Hazardous Area C – Low or Non-existent Risk
Seismic	A1- Areas near proven and suspected faults (100 m), volcanic slopes, sloping areas, evidence and instability of land.	B1- Rest of the city	None
Volcanic	None	B2- Areas subject to combination of different danger	C2- Areas subject to volcanic danger
Flood	A3- Areas near <i>cauce</i> , <i>micropresa</i> , under 42 m s.n.m., subject to registered historical floods	None	C3- Rest of the city
Landslide	A4- Areas with high risk of landslide and areas of active landslide, registered in the INETER inventory	B4- Areas of medium susceptibility to landslide	C4- Rest of the city

Source: ALMA

Furthermore, the dissemination to citizens for their understanding seems not enough. Accordingly, more efforts will be necessary to disseminate information on what does hazard mean, where are the hazard areas, when do hazard areas become dangerous, who are responsible for the measures for the hazard areas, why is it necessary, and how will it be done. Then, community-based disaster risk reduction management (DRRM) system will be established. Thus, this program will be included in the master plan.

(2) Objectives

The objectives of the project are to update the hazard map, to disseminate it to citizens for their understanding, and to establish a community-based DRRM system for COMUPRED of ALMA and CODIPRED of District Offices I-VII of ALMA.

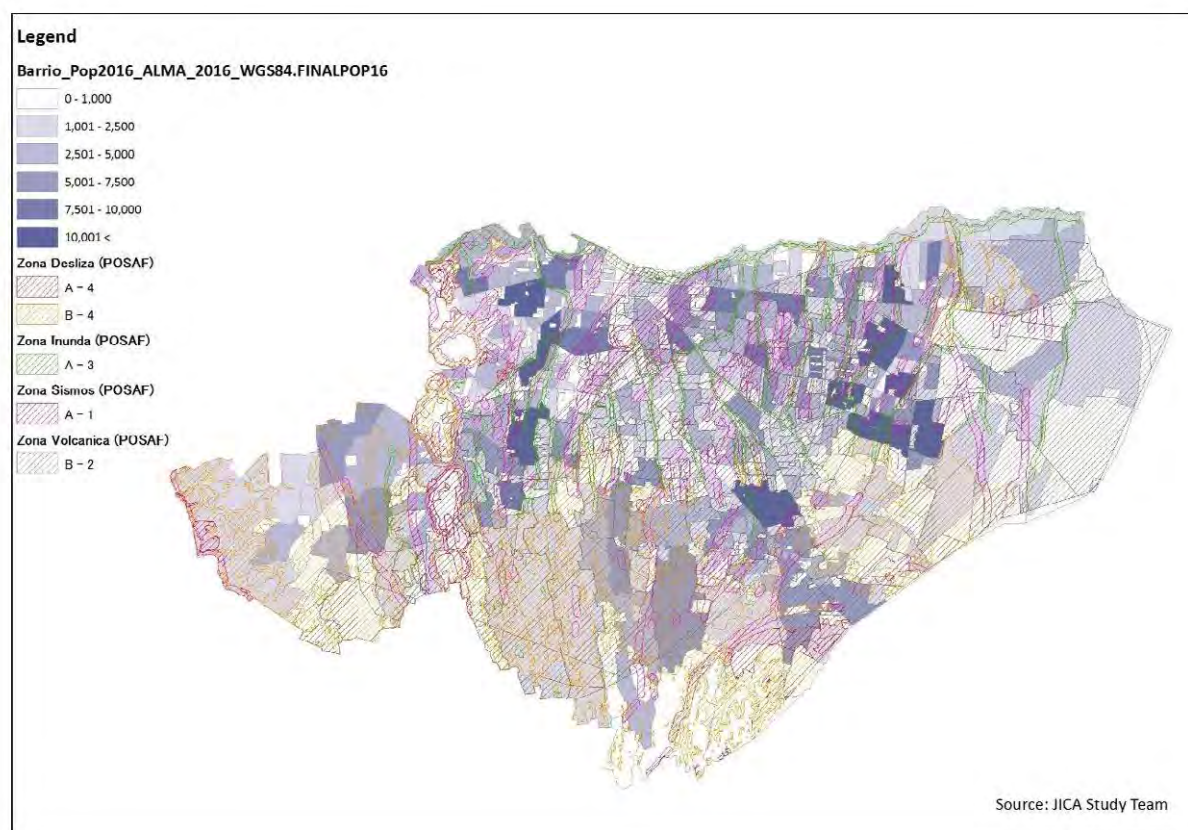
12.5.3 Land Use Regulation in *Cause*, *Micropresa*, and High-risk Areas

(1) Background

As previously described, Managua City sets land use regulation where the area from the edge of a river channel with a width of 5 m (in case of concrete lining channel) and 7 m (in case of natural channel) is restricted to be used for any purpose due to a minimum required margin space based on the memorandum in February 2002. Furthermore, Managua City is going to set a similar regulation for those along the retarding basin with a width of 10 m based on the agreement drafted in 2009.

However, there are many areas in the city where such regulation does not apply due to illegal settlement and improper management of land.

The following Figure 12.5.3 shows the population distribution in the hazard areas. Appropriate land use regulation and/or relocation and improvement of these areas will be required.



Source: ALMA

Figure 12.5.3 Population Distribution in the Hazard Areas

(2) Objectives

The objectives of the project are to assist in the preparation of the regulation in *cauce*, *micropresa*, and high-risk areas, and/or relocation and improvement.

12.5.4 Improvement of Public Emergency Facilities for Disaster Preparedness

(1) Background

The following three public emergency facilities for disaster risk reduction management are considered:

(1) Emergency Operation Center, (2) Emergency Base, and (3) Emergency Evacuation Area.

1) Emergency Operation Center

Specific organization related to SINAPRED will function as the nationwide emergency operation center, while COMUPRED of ALMA will act as a key office/center for Managua City.

2) Emergency Base (like Civic Core in Japan)

The emergency base will be a building for relocation and information center in an emergency situation, while in a normal condition, it will be utilized for educational purposes/ dissemination of information about disaster preparedness to citizens for their understanding, ceremony and any other events. The related agencies have been making efforts on education and dissemination

to citizens through their programs such as disaster drill (conducted 4 times a year); however, more public education and disaster awareness programs are required to achieve disaster preparedness, which needs not only a place but also a program for the schools and related agencies.

From the above, ALMA is considering to propose in the master plan an emergency base like the Civic Core in Niigata, Japan, which is to be provided in each district.

3) Emergency Evacuation Area (Open Space and Building)

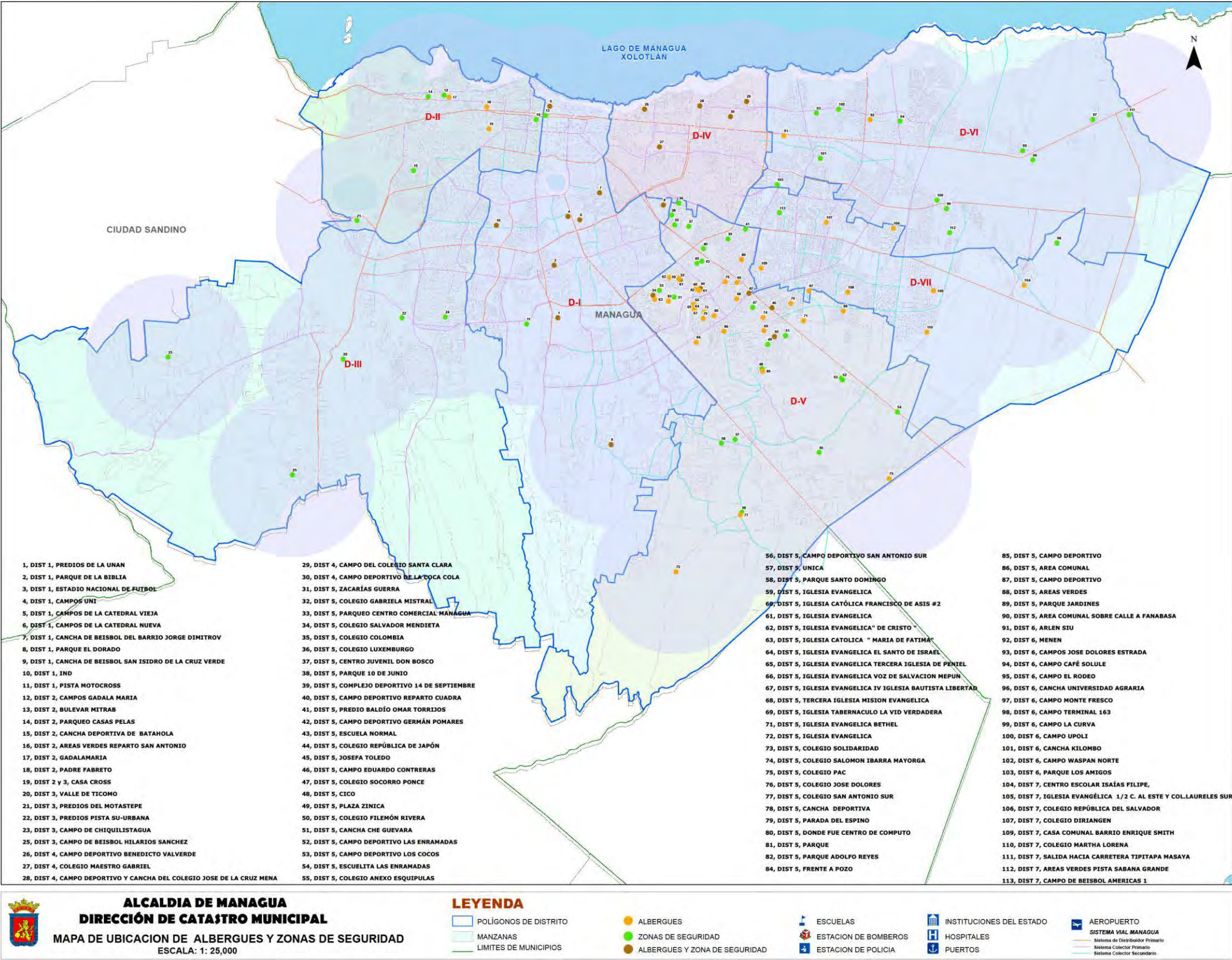
Open spaces, such as parks, school grounds, and football areas, would be one of the emergency areas which will be equipped with the requisites for use in the event of a disaster. It shall be utilized not only as an escape destination but also as a base for rescue, relief and temporary housing, while the buildings (shelter) would be one of the emergency areas which will be equipped with water supply facilities and toilet for temporary use of the dislocated families.

The emergency area shall be: (i) along the main arterial road, (ii) in the vicinity of the hazard area, and (iii) nearer to the city center and sub-centers. The time required for escape/evacuation is quite limited when disaster occurs. Thus, a place having a higher elevation, and/or safer space shall be provided along the escape road.

The locations and the number of emergency evacuation areas shall be planned taking into account the population distribution in the danger area, the escape road network, the distance from the houses, and possible distance for escape on foot, which is assumed at about 2 km radius (30 minutes at a walking speed of 1 m/sec on average among the aged, handicapped, and children). If the existing emergency evacuation area is located outside the houses with such distance, an additional emergency evacuation area shall be planned. The disaster management map in Figure 12.5.4 was prepared by ALMA. A more integrated map shall be prepared.

(2) Objectives

The objective of the project is to improve the public emergency facilities for disaster preparedness.



Source: ALMA

Figure 12.5.4 Disaster Management Map

12.5.5 Development of Emergency Transportation Network

(1) Background

Emergency transportation network shall be provided for smooth activities in an emergency situation such as escape, rescue, and relief of citizens by relevant government agencies. The escape transportation network plays an important role for providing a route for the citizens to escape from a disaster or to go to a safer place before a disaster, while the rescue and relief transportation network will be utilized to provide immediate treatment, and supply relief goods and materials for the dislocated families after a disaster.

The emergency road transport network shall form a belt line linking the city center, new sub-centers, emergency operation center, emergency base, emergency evacuation areas, airport, and seaport. The most effective route with the shortest distance to and from the above areas shall be analyzed by each district.

The emergency air and water transportation network shall be assigned at the existing airport and seaport, but a heliport at the rooftop of the emergency operation center or emergency base shall be developed in the future.

Signboards and lights will also be provided during nighttime in the emergency transportation network.

The evacuation road map in Figure 12.5.5 was prepared by ALMA in January 2017, but a more integrated map shall be prepared in the near future.

(2) Objectives

The objective of the project is to develop the emergency transportation network.

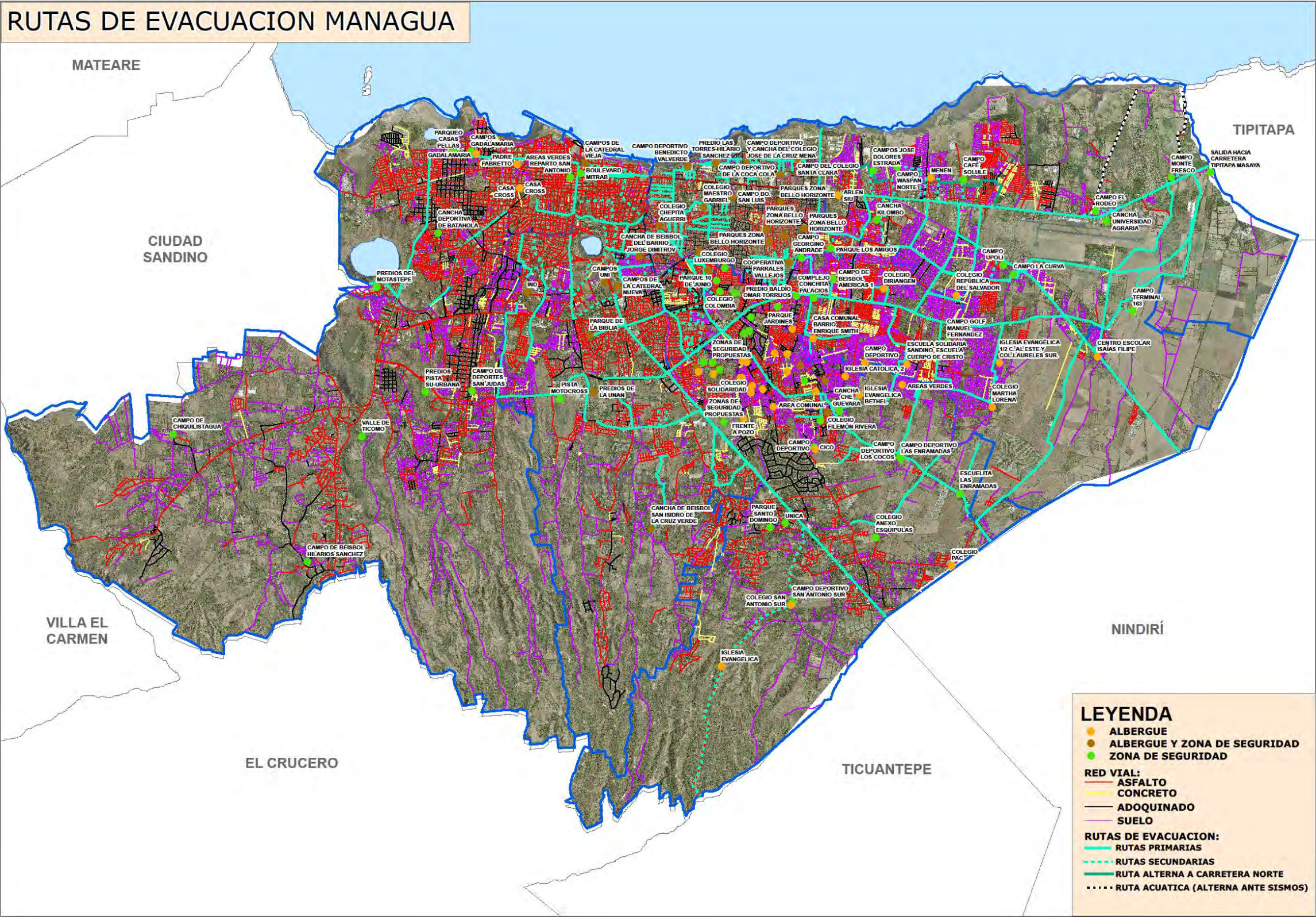


Figure 12.5.5 Evacuation Road Map

12.5.6 Study, Design, and Installation of the Flood Early Warning System for the Urban Area of Managua City

(1) Background

Since the flood damages caused by Hurricane Mitch (1998) were serious in this country, concerned agencies made efforts to implement prevention and mitigation measures, especially in the areas with high-risk population.

The works related to the flood early warning systems were first carried out in order to prevent damages to the life and assets of the people. The INETER, through the General Directorate of Water Resources, DGRH, focused its efforts on the establishment of early warning systems for floods, community-based systems, and other automatic (real-time monitoring) systems with economic and technical supports from international cooperation.

Managua City is habitually affected by floods; therefore, INETER considered the installation of a system of early warning for flood whose function is the monitoring of precipitation and runoff.

(2) Objectives

The objective of the project is to design an integrated early warning system for floods, within the southern subbasin of Lake Managua (urban area of Managua), according to the main axes of operation of the SATs (Surveillance, Forecast, Communication and Response).

12.5.7 Environmental Consideration including Solid Waste Management

(1) Background

One of the causes of flooding from the river channel are the garbage/solid waste inside the channel and *micropresa* dumped by local residents. Annual maintenance cost spent by ALMA for the removal of these garbage/solid waste from the channel and *micropresa* is huge. Accordingly, education of the local residents to consider this issue as part of the environment is also very important.

(2) Objectives

The objective of the project is to develop education of the local residents. This project will be implemented under the proposed "Project for Environmental Consideration including Solid Waste Management".

12.5.8 Assessment of Earthquake Resistance of Existing Buildings, and Study on Improvement for Earthquake-resistant Buildings

(1) Background

There are still many buildings in Managua City that are unsafe structurally against earthquake. Some buildings of the district office of ALMA are also not structurally safe since they are old and non-resistant structures against earthquake, which will not fully function as an emergency base. Therefore, some study and improvement through structural and non-structural measures are important. Therefore, this project was proposed to grasp the current situation of the buildings and to find a way for improvement against earthquake.

(2) Objectives

The objective of the project is to improve the situation of the buildings against earthquake in ALMA.

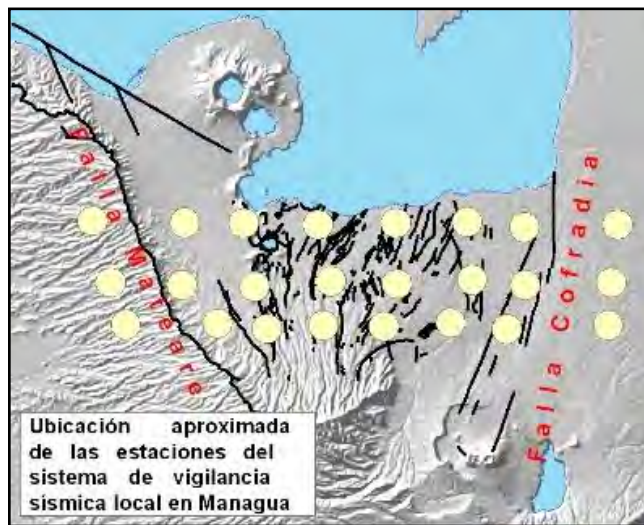
12.5.9 Improvement of the Earthquake Disaster Prevention and Warning System

(1) Background

Managua, from recent historical times (postcolonial), has experienced seismic events, but not necessarily large earthquakes, that have caused an increasing damage to both humans and infrastructures. With the current localization error of earthquakes and the high density of faults in the urban area, it is difficult to say what geological fault is the generator of the local telluric events. In addition, the low density of seismic stations could not help define the mechanism of rupture of these earthquakes. The densification of seismic stations would solve these two issues and real-time seismic monitoring would allow to locate the premonitory earthquakes of a larger earthquake. Residents of Managua mentioned that before the destructive earthquakes of 1972, they already felt earthquakes. Instrumentally, it would be possible to record many earthquakes of low magnitude, even imperceptible to the population and to graph the epicenters in the geological faults map of Managua to identify which fault has been activated within days before the occurrence of some moderate event. In addition, the mechanisms of rupture would be defined, which, for the most part, would be repetitive for the same fault.

(2) Objectives

The objective of the project is to improve the earthquake disaster prevention and warning system.



Source: JICA Study Team

Figure 12.5.6 Approximate Location of Seismic Monitoring System

CHAPTER 13 ACTION PLAN FOR IMPLEMENTATION OF URBAN DEVELOPMENT MASTER PLAN

13.1 Overview

13.1.1 Overall Urban Development Master Plan

An urban development master plan is considered to be the making of an orderly sequence of action that will lead to the achievement of a stated goal or goals of the city. In the case of this project, the objective is to formulate the urban development master plan of Managua, which is composed broadly of: (i) urban development program, (ii) transport development program, (iii) infrastructure development program, and (iv) disaster management program. The first two components are closely related to one another, as the changes in land use shall be affected by the transportation system the city has in the future and vice versa.

13.1.2 Overview of Proposed Projects

As a result of the analysis of the current situation, future demand forecast, and the visions and scenarios of the future Managua City, the JICA Study Team and the Alcaldia de Managua (ALMA) have discussed and proposed the potential projects that are necessary to solve the issues and realize the visions of the master plan (MP) with respect to the sectors considered in the MP. The proposed projects are categorized into sectoral programs. Table 13.1.1 lists the proposed projects and Table 13.1.2 shows the implementation schedule.

Table 13.1.1 List of All Proposed Projects

Program	Sub-sector	No	Code	Project Name	Total Cost (USD in Million)	Implementing Institution
Urban Development	Urban Planning	1	UD-1	Urban Planning Capacity Building Project	1.43	ALMA
		2	UD-2	New CBD Development Project in Metropolitan Urban Sub-center	1231	ALMA, Private
		3	UD-3	Residential Zone Redevelopment Project	1666.5	Private
		4	UD-4	Urban Park Development Project	265	ALMA
		5	UD-5	Public Awareness Project for Compact City Planning	0.025	ALMA
		6	UD-6	Revision of Address System Project	2.3	ALMA
Transport Development	Capacity Development	7	CD-1	Transport Planning/Traffic Management Capacity Building Project	2	ALMA
	Road Development	8	RD-1	Overpass and Intersections Project	306.9	ALMA, National Police
		9	RD-2	Road Improvement and Road Extension Project	944.3	ALMA, MTI
		10	RD-3	New Bypass Project	677.2	ALMA, MTI
	Public Transport	12	PT-1	Urban Public Bus Reorganization Project	41.2	ALMA, IRTRAMMA
		13	PT-2	Intercity Bus Terminal Project	51.3	MTI
		14	PT-3	Urban Mass Transit Project (Masaya Line (AGT))	732	ALMA, MTI
		15	PT-4	Urban Mass Transit Project (Suburbana Line (AGT))	791	ALMA, MTI
		16	PT-5	Urban Mass Transit Project (Pan-American Line (LRT))	653	ALMA, MTI
		17	PT-6	Urban Mass Transit Project (Juan Pablo II Line (BRT))	216	ALMA, MTI
		18	TM-1	Increase in Value of Car Permit Tax	0	ALMA, MTI
	Traffic Management	19	TM-2	Panels with Street Name Project	19	ALMA
		20	TM-3	Underground Parking Project	30	ALMA
		21	TM-4	Studies for the Concessions of Two Parking Sites	0.2	ALMA, Private
		22	TM-5	Studies on Traffic and Parking Project	0.2	ALMA
		23	TM-6	Traffic Management Project	30.3	ALMA
Infrastructure Development	Water Supply	24	WS-1	Technical Assistance for SCADA/GIS Improvements	20	ALMA
		25	WS-2	Feasibility Study for Lago Nicaragua Treatment Plant and Transmission System	5	ENACAL, ALMA
		26	WS-3	Improve Water Supply Infrastructure to Meet Demand in Five "Sub-centers"	20	ENACAL
		27	WS-4	Old and Vulnerable Pipeline Replacement Project	13	Private
		28	WS-5	Accommodate Future Growth in Water Supply System Project	20	ENACAL
	Water Resource	29	WR-1	Technical Assistance for Water Quality Improvement of Managua Lake	5	ENACAL
	Sewerage and Wastewater Disposal	30	SW-1	Expansion of the Sewerage Coverage in Managua Project	66.4	CIRA, UNAN, MARENA, MINSA, ENACAL
		31	SW-2	Renewal and Improvement of Deteriorated Sewers	13.6	ENACAL
		32	SW-3	Design Review and Construction of Collector Y Second Phase Project	17.9	ENACAL
		33	SW-4	Design Review and Construction of Interceptor 2 – Second Phase	14.42	ENACAL
		34	SW-5	Additional Measures to Increase the Treatment Capacity of the WWTP Managua	15.74	ENACAL
	Solid Waste Management	35	WM-1	New Sanitary Landfill and Intermedia Treatment Facility Development Project (Phase 1)	72	ENACAL
		36	WM-2	Capacity Development for Solid Waste Management Project	6	ALMA, EMTRIDE

		37	WM-3	Equipment for Collection and Transportation Procurement Project	18	ALMA, EMTRIDE
		38	WM-4	Sanitary Landfill Development Project (Phase 2)	50	ALMA, EMTRIDE
Disaster Management	Disaster Management	39	DM-1	Project for Establishment of Permanent Offices and Staff for Disaster Management with Training Program	2.1	ALMA, EMTRIDE
		40	DM-2	Project for Update of Hazard Map and Dissemination to Citizen for Understanding/ Community-based Risk Reduction Management System	2.7	SINAPRED
		41	DM-3	Project for Land Use Regulation in Cause, Micropresa, and High Risk Area	70	INETER, SINAPRED, ALMA
		42	DM-4	Project for Improvement of Public Emergency Facilities for Disaster Preparedness	1	SINAPRED
		43	DM-5	Project for Development of Emergency Transportation Network	1	SINAPRED
		44	DM-6	Project for Study, Design, and Installation of the Flood Early Warning System for the Urban Area of Managua City	1.5	SINAPRED
		45	DM-7	Project for Consideration on Environment including Solid Waste Management	6	SINAPRED
		46	DM-8	Project for Assessment of Earthquake Resistance for Existing Buildings, and Study on Improvement for Earthquake-Resistant Buildings	1	SINAPRED
		47	DM-9	Project for Improvement of Earthquake Disaster Prevention and Warning System	1	INETER, SINAPRED, ALMA
	Flood Management	48	FM-1	Structural Improvement of Priority Cauces Project	30	ALMA
		49	FM-2	Project on Structural Measures for Sediment Management in Cauce Basins	50	ALMA
		50	FM-3	Project on Technical Assistance for Construction of Rainwater Storage and Infiltration Structures	5	ALMA
Total					8,189.2	

Source: JICA Study Team

Note: Project cost is rough estimation including land acquisition cost.

Table 13.1.2 Implementation Schedule of All Proposed Projects

No	Code	Short Term				Middle Term										Long Term									
		2017	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Project starting in the Short term																									
1	UD-1																								
2	UD-2																								
3	UD-3																								
5	UD-5																								
6	UD-6																								
7	CD-1																								
11	RD-4																								
8	RD-1																								
16	PT-5																								
17	PT-6																								
12	PT-1																								
15	PT-4																								
18	TM-1																								
21	TM-4																								
22	TM-5																								
23	TM-6																								
24	WS-1																								
27	WS-4																								
30	SW-1																								
31	SW-2																								
32	SW-3																								
33	SW-4																								
34	SW-5																								
35	WM-1																								
36	WM-2																								
37	WM-3																								
39	DM-1																								
40	DM-2																								
41	DM-3																								
42	DM-4																								
43	DM-5																								
44	DM-6																								
45	DM-7																								
46	DM-8																								
47	DM-9																								
48	FM-1																								
49	FM-2																								
Projects starting in the Middle term																									
13	PT-2																								
14	PT-3																								
19	TM-2																								
20	TM-3																								
25	WS-2																								
26	WS-3																								
28	WS-5																								
29	WR-1																								
50	FN-3																								
Projects starting in the Long term																									
4	UD-4																								
10	RD-3																								

Source: JICA Study Team

Table 13.1.3 shows the allocation of the cost to each implementing institution and by the period. The total investment cost of all the proposed projects is USD 8,641 million, and the investment cost allocated to ALMA is USD 5,009 million for the total MP period.

Table 13.1.3 Allocation of Cost to Implementing Institutions

Sector		Implementing Institution	Short	Middle	Long	Total
Urban Development	Urban Planning	ALMA	3.8	90.0	265.0	358.8
		Private	0.0	1696.5	1111.0	2807.5
Transport Development	Capacity Development	ALMA	2.0	0.0	0.0	2.0
	Road Development	ALMA	713.1	1033.3	633.8	2380.3
	Public Transport	ALMA	44.2	984.6	928.7	1957.5
		Private	0.0	260.7	266.3	527.0
	Traffic Management	ALMA	10.7	61.6	7.4	79.7
Infrastructure Development	Water Supply	Other	33.0	25.0	20.0	78.0
	Water Resource	Other	0.0	5.0	0.0	5.0
	Sewerage and Wastewater Disposal	Other	94.9	33.2	0.0	128.1
	Solid Waste Management	ALMA	7.0	139.0	0.0	146.0
Disaster	Disaster Management	Other	22.0	23.1	41.1	86.3
	Flood Management	ALMA	80.0	5.0	0.0	85.0
Total			1010.57	4357.02	1010.6	8641.1
Average per Year			252.64125	435.702	252.6	360.0
Total Cost of ALMA			860.76	2313.50	1834.9	5009.3
Average per Year			215.18875	231.35	183.5	208.7

Source: JICA Study Team

13.1.3 Selecting Criteria for Priority Projects

(1) Prioritization of the Proposed Projects

As analyzed in Chapter 7, the possible estimated budget of ALMA during the MP period is USD 1,345 million in case of low level investment and USD 2,153 million in case of a more intensive investment. Due to such financial constraint, the proposed projects need to be prioritized in the implementation phase. In order to consider the priority of projects, the proposed projects shall be evaluated according to the following criteria. As a result of the evaluation projects, the priority projects will be selected, which shall be implemented with higher priority among the proposed projects during the period of MP. The priority projects should be ideally carried out mainly in the short term during the MP period to fill the gaps between the current supply and demand as a result of population and economic growth in Managua City. The other projects which are not selected as priority projects shall be re-considered in the timing of the commencement of implementation according to the availability of finance or shall be implemented if extra funding is available.

(2) Evaluation and Selecting Criteria for Priority Projects

Table 13.1.4 and Table 13.1.5 summarize the criteria for selecting the priority projects. In order to rank the proposed projects quantitatively and select the priority projects from all the proposed projects, the following criteria, composed of eight items in the four categories, shall be used. The four categories include the compliance with the macro development strategy, the social and natural environmental impact, the economic indicators, and the implementation factors, in order to express general benefit and importance of the projects. Each criterion shall be assessed by three levels according to the respective measurements as listed in Table 13.1.4. The proposed projects and the importance of each project have been discussed and examined in each technical working group (TWG). The criteria of Development Strategy and Implementation Indicators are scored in an objective way. The criteria of Social and Natural Environment Impact and Economic Indicators are scored by respective experts in a qualitative manner based on the estimation of cost and effect of the projects. The proportion of total score is shown in Table 13.1.5. The proportion is determined based on the discussions in the Socio-economic (Finance) TWG, where the scores are basically allocated equally to the criteria, and “socio-economic benefit” and “urgency of the project” are given extra 10 points (in total 20 points for each) because these are crucially important factors of a project. The projects, which scored high in the overall points in the above criteria, shall be selected as priority projects.

Table 13.1.4 Criteria for Selecting Priority Projects

Category	Criteria	Description	Evaluation
Development Strategy	Compliance with the National/Sector Development Vision	The objectives of the project complied with the national development vision such as the Human Development Plan and the sectorial plan in each sector.	<p>High: The project has the same component or objective with the existing development strategy or plan.</p> <p>Middle: The project has similar or related components or objective with the existing development strategy or plan.</p> <p>Low: The components or objectives of the project are not mentioned in any existing development strategy or plan.</p>

	Compliance with the Implementing Institution or ALMA's Development Vision	The objectives of the project complied with the existing development vision or development plan of the implementing institution such as ALMA or other ministries.	Same as above.
Social and Natural Environment Impact	Social Environment Impact	The social environment impact is the impact of the project on social living conditions of the citizens such as resettlement (negative impact), or improvement of living conditions, safety, welfare or citizen satisfaction (positive impact).	High: The project has a sound amount of positive impact compared with the total project cost. Middle: The project has no impact or neutral impact. Low: The project has a certain level of negative impact.
	Natural Environmental Impact	The natural environment impact is the impact of the project on the natural environment such as the environmental protection and mitigation of environmental damage (positive impact), or the environmental disruption such as the cut-over of green area (negative impact).	Same as above.
Economic Indicators	Cost Efficiency	The cost efficiency is related to the result of the project which is converted from the inputs or cost of the project to maximize these inputs. It can be represented by the ratio of the number of person or household which would be impacted by the project and project cost.	High: The cost per benefited person is low. Middle: The cost per benefited person is middle. Low: The cost per benefited person is high.
	Socio-economic Benefit	The amount of impact of the project, is ideally expressed in a monetary quantification such as	High: The benefit generated by the project is significant and necessary

		the benefit to the impacted people from the infrastructure project or the reduction of social and economic cost from the traffic improvement project.	for the future urban planning. Middle: The benefit generated by the project is moderate. Low: The benefit generated by the project is low or little direct benefit.
Implementation Indicators	Urgency of the Project (timing of the implementation)	The urgency of the project is measured by the timing of the launching of the project including the commencement of the feasibility study for middle- or long-term project.	High: The project starts in the short term. Middle: The project starts in the middle term. Low: The project starts in the long term.
	ALMA's Involvement	The extent of ALMA's involvement, if the project owner is ALMA, the involvement is high. If neither the implementation institution nor the regulating institution is not ALMA, then ALMA's involvement shall be evaluated to be low.	High: ALMA is the implementation institution. Middle: ALMA is one of the implementation institutions or the regulatory institutions. Low: ALMA is not involved in the project.

Source: JICA Study Team

Table 13.1.5 Scoring Chart for the Evaluation of Projects

Criteria		Score				Sub-Total
		Total	0%	50%	100%	
Development Strategy	Compliance with National/Sector Development Vision	10	Low	Middle	High	20
	Compliance with Implementing Institution or ALMA's Development Vision	10				
Social and Natural Environment Indicators	Social Environment Impact	10	Low (Negative)	Middle (Middle or None)	High (Positive)	20
	Natural Environmental Impact	10				
Economic Indicators	Cost Efficiency	10	Low	Middle	High	30
	Socio-Economic Benefit	20				
Implementation Indicators	Urgency of the project (timing of implementation)	20	Long (-2040)	Middle (-2030)	Short (-2020)	30
	ALMA's Involvement	10	Low	Middle	High	
Total		100				

Source: JICA Study Team

The criteria are chosen in order to compare projects of the different sectors in a coherent and objective manner as much as possible. In addition, the detailed studies such as a feasibility study or project design have not been conducted at this MP formulation phase. Therefore, the project proposals shall be evaluated with the data and estimations to the current situation and the qualitative assessment is applied. However, in case of sector specific planning or more detailed examination phase, more specific criteria and quantitative or numerical assessment shall be applied such as the assessment done in the Comprehensive Transportation Plan in the Municipality of Managua in the Republic of Nicaragua (PITRAVI, 1999).

Ideally, economic impact should be evaluated in the quantitative monetary value. For example, in case of a transport project, the economic indicators such as economic internal return rate (EIRR), economic net present value (ENPV), and/or the ratio of benefit and cost (B/C) are used to measure the effectiveness of the project by comparing its cost and benefit. However, monetary quantification of the output of the project is problematic in many cases because the result and impact are difficult to be placed in a monetary term in most public services. In such cases, cost efficiency could be alternatively evaluated in terms of the ratio to indicate the volume of outcome of the project per cost, such as the number of people/household who would be benefited from the project, i.e., the number of children who can attend the school and the number of additional households served with electricity per thousand dollars invested.

(3) Evaluation Results and Priority Projects

The result of evaluation of all proposed projects is shown in Table 13.1.6 below. Considering the budget constraint of ALMA as analyzed in Chapter 7 and the total investment cost of the proposed projects, the projects which mark the score over 70 shall be selected as the priority project in order to make the package of priority projects at the manageable budget volume. The total investment cost of selected priority projects is USD 5,615 million and the investment cost of ALMA is USD 2,111 million in total. The cost and financial plan of the priority projects will be analyzed in Section 13.3 below.

Table 13.1.6 Scoring and Result of the Evaluation of Proposed Projects

No.		Development Strategy		Social and Natural Environment Impact		Economic Indicators		Implementation Indicators		Total Score (100)	Priority Project
		National/ Sector	Implementatio n Institution's Development Vision	Social Environment Impact	Natural Environment Impact	Cost Efficiency	Socio- Economic Benefit	Timing of Implementatio n	ALMA's Involvement		
1	UD-1	5	10	5	5	5	20	20	10	80	x
2	UD-2	10	10	10	5	5	10	20	10	80	x
3	UD-3	5	10	10	5	5	20	10	5	70	x
4	UD-4	5	10	5	0	5	10	0	10	45	
5	UD-5	5	10	5	5	5	10	20	10	70	x
6	UD-6	5	5	5	5	5	10	20	10	65	
7	CD-1	10	0	5	5	5	20	20	10	75	x
8	RD-1	10	10	10	5	0	10	20	10	75	x
9	RD-2	10	10	5	5	0	10	20	10	70	x
10	RD-3	10	10	5	5	0	20	10	10	70	x
11	RD-4	10	10	5	5	0	20	0	5	55	
12	PT-1	5	10	5	10	10	20	20	10	90	x
13	PT-2	10	10	0	10	10	20	20	0	80	x
14	PT-3	10	10	5	5	0	20	20	5	75	x
15	PT-4	10	10	5	5	0	20	10	5	65	
16	PT-5	10	10	5	5	0	20	10	5	65	
17	PT-6	10	10	5	5	10	20	20	5	85	x
18	TM-1	5	5	5	5	10	20	0	10	60	
19	TM-2	0	0	5	10	10	10	10	10	55	
20	TM-3	10	5	10	10	5	10	10	5	65	
21	TM-4	10	10	10	5	5	20	20	10	90	x
22	TM-5	10	10	10	5	5	20	20	10	90	x
23	TM-6	5	10	5	5	10	20	20	10	85	x

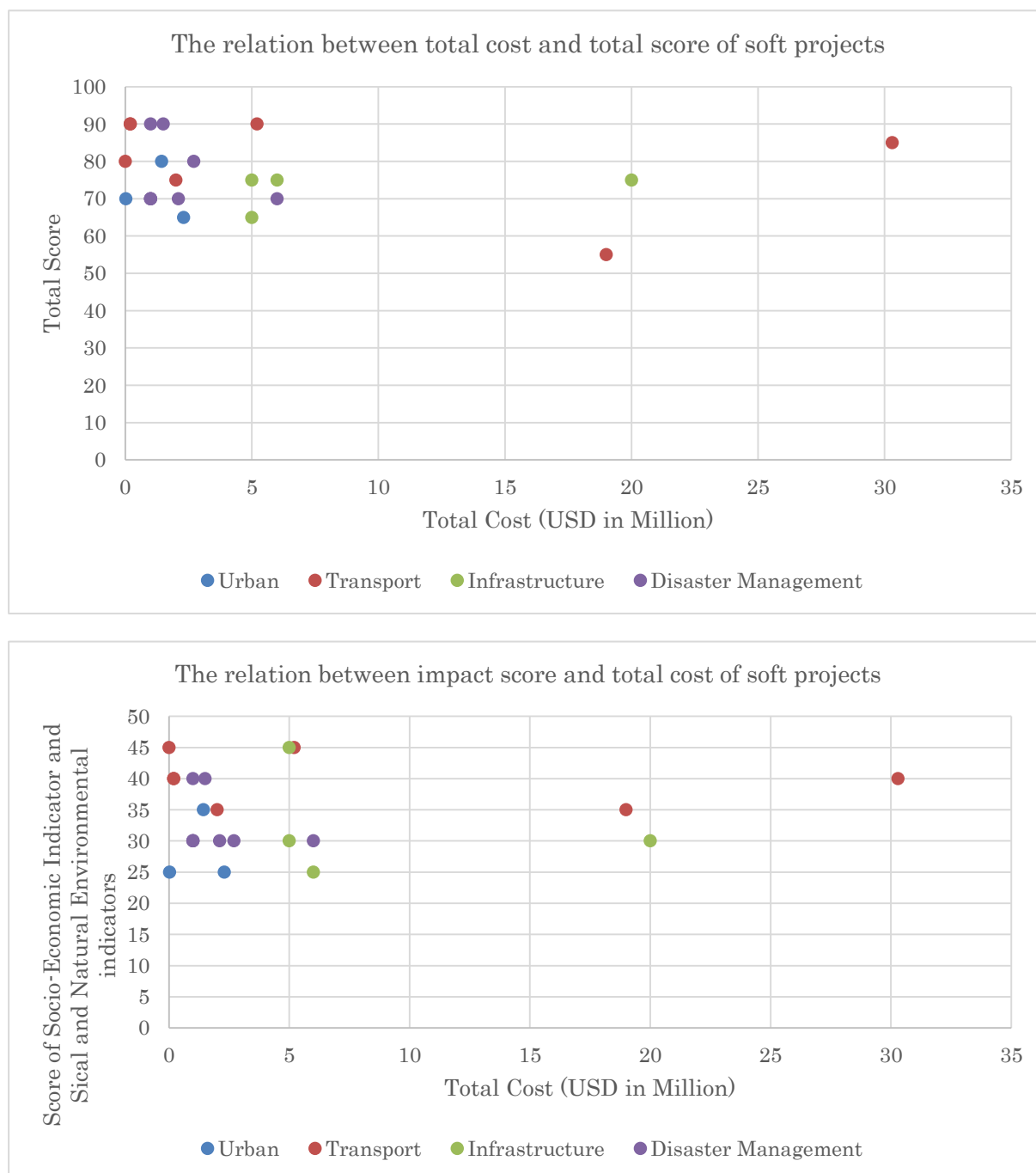
		Development Strategy		Social and Natural Environment Impact		Economic Indicators		Implementation Indicators			
No.		National/ Sector	Implementatio n Institution's Development Vision	Social Environment Impact	Natural Environment Impact	Cost Efficiency	Socio- Economic Benefit	Timing of Implementatio n	ALMA's Involvement	Total Score (100)	Priority Project
		High: 10 Mid: 5 Low: 0	High: 10 Mid: 5 Low: 0	High (Positive): 10 Mid (None): 5 Low (Negative): 0	High (Positive): 10 Mid (None): 5 Low (Negative): 0	High: 10 Mid: 5 Low: 0	High: 20 Mid: 10 Low: 0	Short: 20 Mid: 10 Long: 0	High: 10 Mid: 5 Low: 0		
24	WS-1	5	10	10	5	5	10	20	10	75	x
25	WS-2	10	10	10	5	5	10	10	5	65	x
26	WS-3	0	10	10	5	0	20	10	0	55	
27	WS-4	10	10	5	10	10	20	20	0	85	x
28	WS-5	5	10	10	5	10	10	10	0	60	
29	WR-1	10	5	10	10	5	20	10	5	75	x
30	SW-1	10	10	10	10	0	20	20	0	80	x
31	SW-2	5	10	10	5	5	20	20	0	75	x
32	SW-3	5	10	10	10	0	10	20	0	65	
33	SW-4	5	10	10	5	10	20	20	5	85	x
34	SW-5	10	10	5	10	5	20	20	0	80	x
35	WM-1	10	10	0	5	5	20	20	10	80	x
36	WM-2	10	10	5	5	5	10	20	10	75	x
37	WM-3	10	10	5	5	10	20	20	10	90	x
38	WM-4	10	10	0	0	5	20	10	10	65	
39	DM-1	10	10	5	5	10	10	20	0	70	x
40	DM-2	10	10	5	5	10	10	20	10	80	x
41	DM-3	10	10	5	5	5	10	20	0	65	
42	DM-4	10	10	5	5	10	10	20	0	70	x
43	DM-5	10	10	5	5	10	10	20	0	70	x
44	DM-6	10	10	5	5	10	20	20	10	90	x
45	DM-7	10	10	5	5	10	10	20	0	70	x
46	DM-8	10	10	5	5	10	10	20	0	70	x
47	DM-9	10	10	5	5	10	20	20	10	90	x
48	FM-1	10	10	5	5	10	10	20	10	80	x
49	FM-2	10	0	5	0	0	10	20	10	55	
50	FM-3	10	0	5	10	10	10	10	10	65	

Source: JICA Study Team

The relations between the projects and their scores (according to sector, type, and total cost of the projects) are examined in the following charts. The charts plot the relationship between total cost and total score of the projects according to the type of project and whether the project is non-structural project (soft project) such as capacity building, study, or improvement in the operation, or structural development project (hard project) such as construction or physical development project. The result

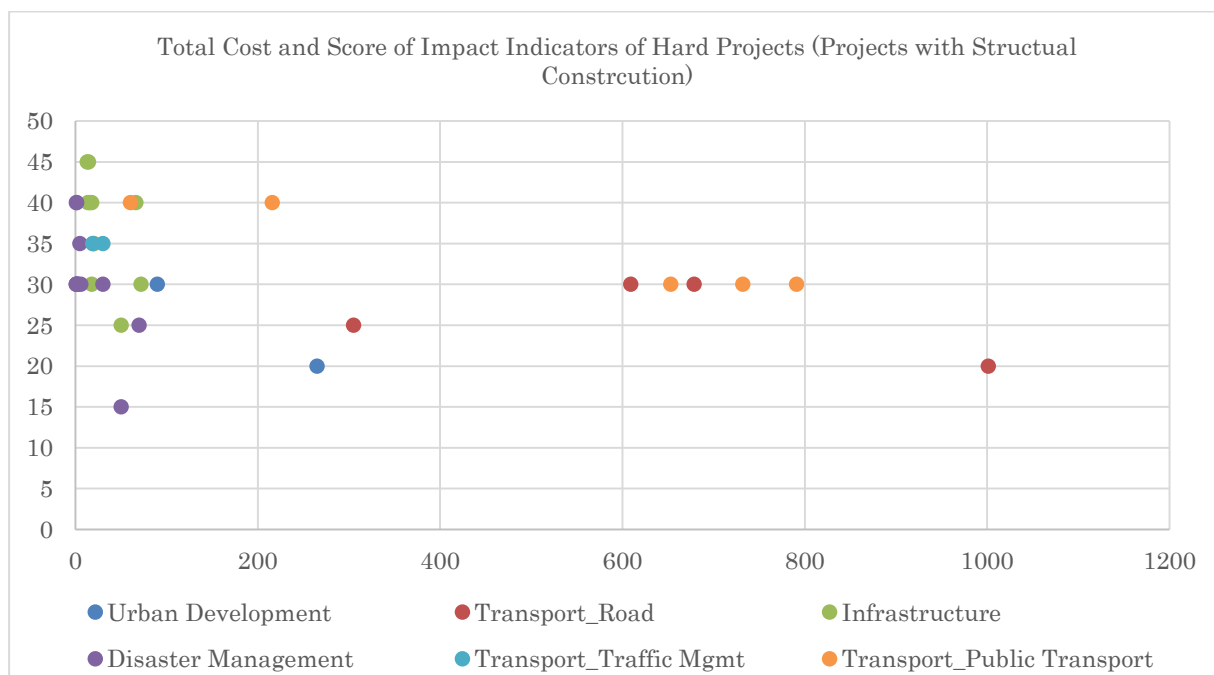
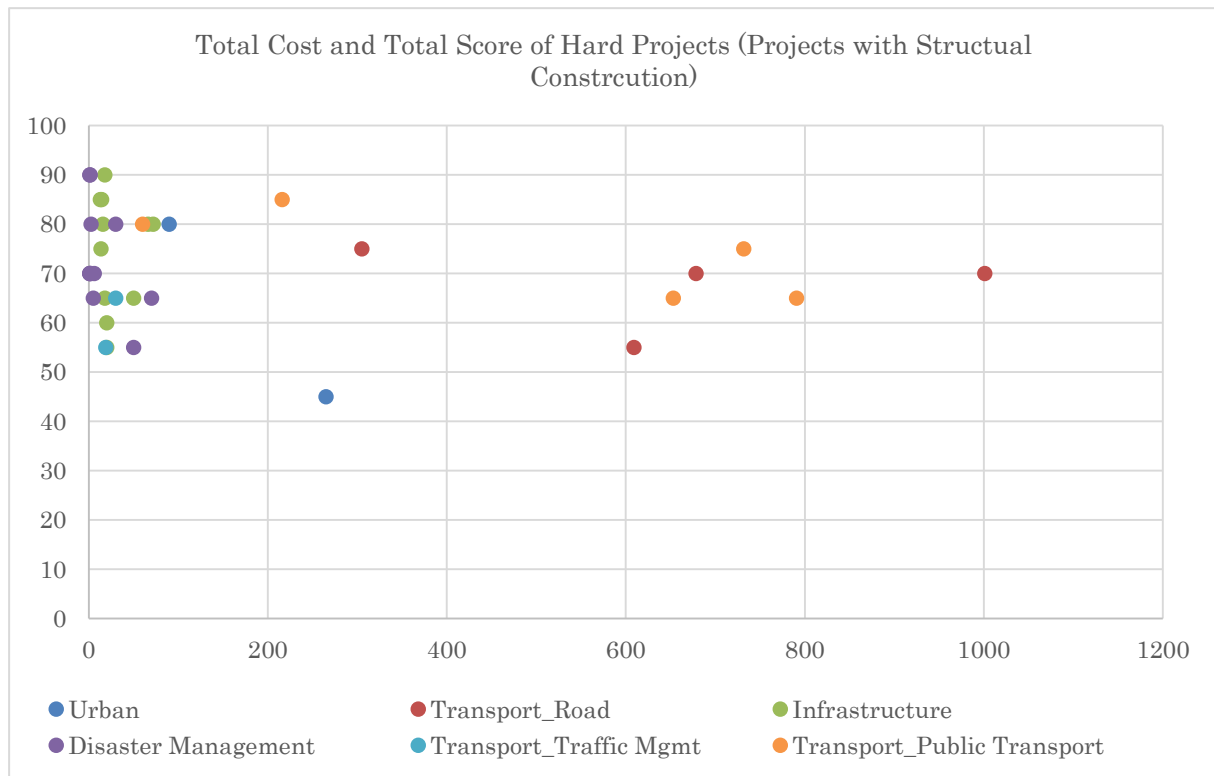
shows that the disaster management projects generally mark high score, which may be attributed that the political priority of disaster mitigation is regarded high and the total costs are generally at the lower level compared with projects of other sectors.

The characteristics of transportation and infrastructure projects are the high scores in the score of impact indicators (sum of the social and natural environmental indicators and socio-economic indicators scores), which indicate the benefits of the projects. This result represents that Managua City has issues in transport and utility infrastructures, which are not efficient or sufficient compared with the demands. Therefore, the improvement might largely benefit the citizens of Managua City.



Source: JICA Study Team

Figure 13.1.1 Relation between Total Cost and Score (Soft Projects)



Source: JICA Study Team

Figure 13.1.2 Relation between Total Cost and Score (Hard Projects)

As a result of the above evaluation, the priority projects are selected as listed in Table 13.1.7. The MP proposes 37 priority projects among 50 total proposed projects.

Table 13.1.7 List of Priority Projects

Program	Pj No.	Pj. Code.	Project Name
Urban Development Program	2	UD-2	New CBD Development Project in Metropolitan Urban Sub-center
	3	UD-3	Residential Zone Redevelopment Project
	5	UD-5	Public Awareness Project for Compact City Planning
	6	UD-6	Revision of Address System Project
Transport Development Program	7	CD-1	Transport Planning/Traffic Management Capacity Building Project
	8	RD-1	Overpass and Intersections Project
	9	RD-2	Road Improvement and Road Extension Project
	10	RD-3	New Bypass Project
	12	PT-1	Urban Public Bus Reorganization Project
	13	PT-2	Intercity Bus Terminal Project
	14	PT-3	Urban Mass Transit Project (Masaya Line (AGT))
	17	PT-6	Urban Mass Transit Project (Juan Pablo II Line (BRT))
	21	TM-4	Studies for the Concessions of Two Parking Sites
	22	TM-5	Studies on Traffic and Parking Project
Infrastructure Development Program	23	TM-6	Traffic Management Project
	24	WS-1	Technical Assistance for SCADA/GIS Improvements
	25	WS-2	Feasibility Study for Lago Nicaragua Treatment Plant and Transmission System
	26	WS-3	Improve Water Supply Infrastructure to Meet Demand in Five "Sub-centers"
	27	WS-4	Old and Vulnerable Pipeline Replacement Project
	29	WR-1	Technical Assistance for Water Quality Improvement of Managua Lake
	30	SW-1	Expansion of the Sewerage Coverage in Managua Project
	32	SW-2	Renewal and Improvement of Deteriorated Sewers
	33	SW-4	Design Review and Construction of Interceptor 2 – Second Phase
	34	SW-5	Additional Measures to Increase the Treatment Capacity of the WWTP Managua
Disaster Management Program	35	WM-1	New Sanitary Landfill and Intermedia Treatment Facility Development Project (Phase 1)
	36	WM-2	Capacity Development for Solid Waste Management Project
	37	WM-3	Equipment for Collection and Transportation Procurement Project
	39	DM-1	Project for Establishment of Permanent Offices and Staff for Disaster Management with Training Program
	40	DM-2	Project for Update of Hazard Map and Dissemination to Citizen for Understanding/ Community-based Risk Reduction Management System
	42	DM-4	Project for Improvement of Public Emergency Facilities for Disaster Preparedness
	43	DM-5	Project for Development of Emergency Transportation Network
	44	DM-6	Project for Study, Design and Installation of the Flood Early Warning System for the Urban Area of Managua City
	45	DM-7	Project for Consideration on Environment including Solid Waste Management
	46	DM-8	Project for Assessment of Earthquake Resistance for Existing Buildings and Study on Improvement for Earthquake-resistant Buildings
	47	DM-9	Project for Improvement of Earthquake Disaster Prevention and Warning System
	48	FM-1	Structural Improvement of Priority Causes Project

Source: JICA Study Team

13.2 Proposal for Action Plan

It is necessary to have solid action plans in the implementation of priority projects to achieve the visions of Managua City in 2040. Certain sets of priority projects shall be grouped together as a policy package to achieve the same objective in the development of Managua City. The policy package shall be implemented in parallel to maximize the impact of each project and the whole program of such projects. Three policy packages of the priority projects are proposed along with the concepts of Managua City Development, namely: (i) **Sustainable and Attractive City Development Program**, (ii) **Accessible and Economically Active City Program**, and (iii) **Resilient and Socially Equitable City Program**.

Policy Packages for the Urban Development Master Plan of Managua City

- (i) **Sustainable and Attractive City Development Program**: Managua is located on green slopes of hills going towards the lake. Managua has to be maintained and regulated properly as a city attractive to the citizens as well as to the visitors in consideration of its environmental sustainability.
- (ii) **Accessible and Economically Active City Program**: As the capital and largest urban city of Nicaragua, Managua is and will be an economically active city with flourishing economic activities which will be supported by effective and efficient transportation system providing accessibility for all the residents and visitors.
- (iii) **Resilient and Socially Equitable City Program**: Managua, which experienced heavy earthquake in the 1970s and is basically vulnerable to natural disasters, will transform a resilient city in preparation for natural disasters and make a socially equitable city.

13.2.1 Package 1: Sustainable and Attractive City Development Program

This package is consisted of capacity building, promotion of appropriate land use, and improvement of urban environment project. Private funding is essential for urban improvement project because regional development such as construction of shopping building and new company building contribute to hiring and economic activity. Therefore, what ALMA should do is to take action for promoting proper land use and attracting private resource by using publicity and other social platforms.

The present land use zoning scheme is old because its norm has not been updated for a long time and it should be updated as soon as possible to enforce this MP properly. Although a series of TWG meetings and on-the-job training (OJT) for geographic information system (GIS) operation as one of the capacity building activities had been carried out through this MP study, capacity development of ALMA staff is important and necessary in for acting new zoning scheme. Urban development is closely related to road and transport projects; therefore, capacity development is needed not only for urban sector but also for road transport sector in order to make close coordination. These actions should be taken in the earlier stage.

In parallel to the above actions, publicity for growing citizen and private-sector interest regarding urban development should be done. These actions should be continued to long term. It is desirable to promote urban densification by early stage of middle term.

Action plan of Package 1 is shown in Figure 13.2.1. Action Plan 1 is very important in promoting future urban development and this action should be conducted as soon as possible.

13.2.2 Package 2: Accessible and Economically Active City Program

This package consists of improvement of traffic condition and road infrastructure, introduction of mass transportation, and development of new central business district (CBD) project. Future traffic demand is very high, and if necessary action for traffic problem is not taken, traffic condition will become worse. Existing road capacity is mostly limited; therefore, introduction of mass transportation is important for future traffic movement in Managua City.

New road construction including outer ring road which is implemented by the Ministry of Transport and Infrastructure (*Ministerio de Transporte e Infraestructura*: MTI) takes time. In short term, road improvement and traffic management measures, which can be implemented in less time compared with the new road construction project, should be conducted in mitigating traffic congestion and maintaining existing road function. Road improvement measures include construction of exclusive lane for mass transportation.

Mass transportation should introduce the timing of development of new CBD. CBD becomes a core for several activities and ensuring accessibility among CBDs and the surrounding area by mass transportation is essential. Mass transportation has a role of connection between CBD and district center and mass transportation improves people and economic activities.

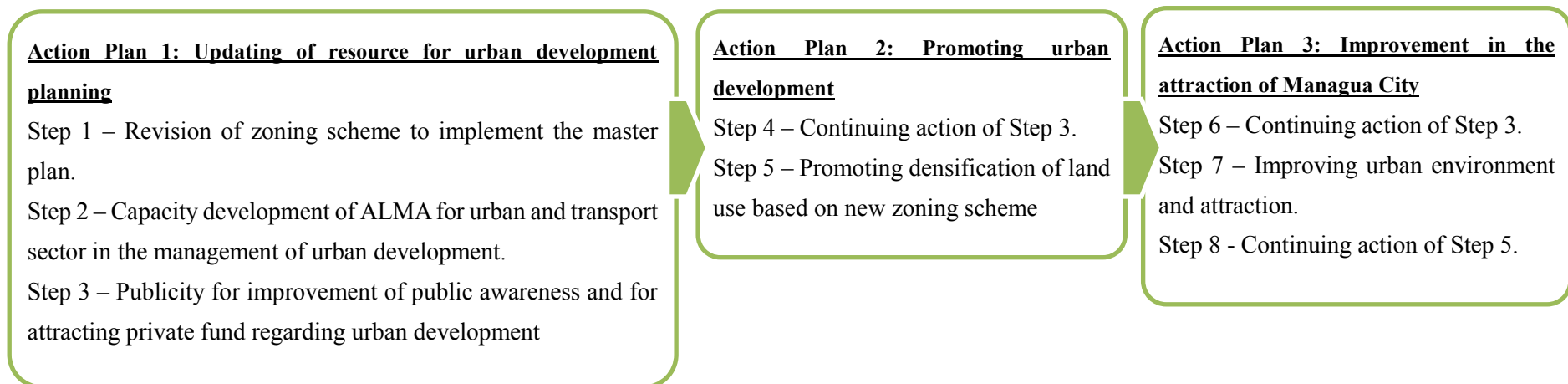
13.2.3 Package 3: Resilient and Socially Equitable City Program

This package consists of infrastructure project of each sector and disaster prevention project.

Many infrastructures related to water supply, water resource, and sewerage have problems such as old facilities, lack of capacity for satisfying demand, low quality, etc. These issues need to be addressed or provide improvement to ensure quality of life in Managua City. Therefore, updating existing facilities as a project should be conducted in short term and construction project should be started after the short-term project. Regarding solid waste management, capacity of sanitary landfill will be full in the near future. Therefore, new sanitary landfill and intermediate treatment facility development project should be conducted in short term.

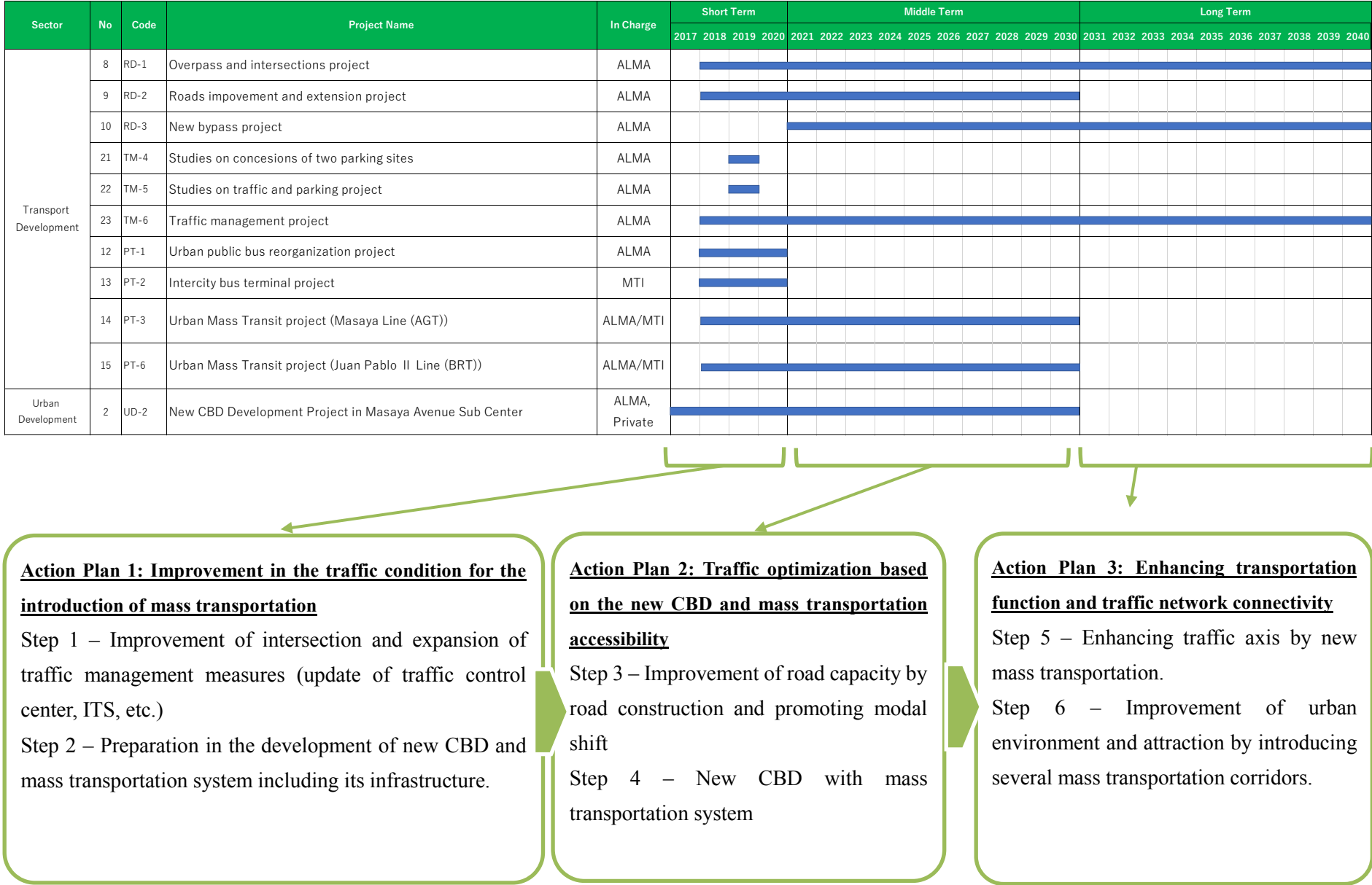
In disaster management, the national government (SINAPRED) and ALMA have some tools, resources, and programs of disaster prevention such as staff of permanent office, hazard map, etc. Managua City has suffered from earthquake and flooding and ALMA should have more resources related to disaster management. Therefore, several short-term projects for updating and utilizing existing resources are needed.

Sector	No	Code	Project Name	In Charge	Short Term				Middle Term										Long Term									
					2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Transport Development	7	TD-1	Transport Planning/Traffic Management Capacity Building Project	ALMA	<div></div>																							
Urban Development	1	UD-1	Urban Planning Capacity Building Project	ALMA	<div></div>																							
	3	UD-3	Residential Zone Redevelopment Project	ALMA/ Private	<div></div>																							
	5	UD-5	Public Awareness Project for Compact City Planning	ALMA	<div></div>																							



Source: JICA Study Team

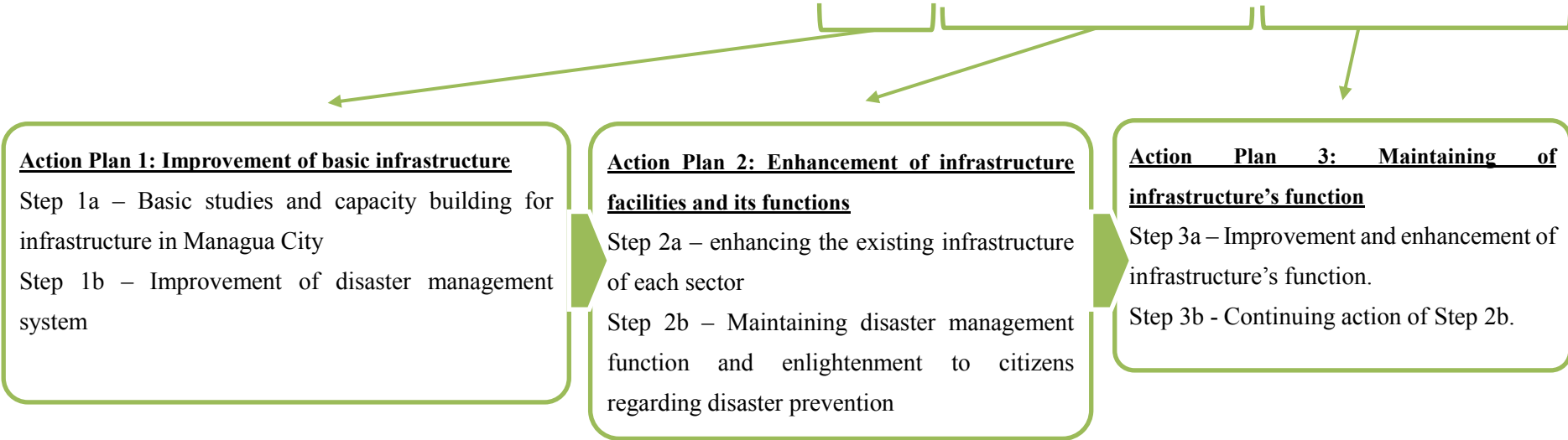
Figure 13.2.1 Action Plan for Package 1 (Sustainable and Attractive City Development Program)



Source: JICA Study Team

Figure 13.2.2 Action Plan for Package 2 (Accessible and Economically Active City Program)

Sector	No	Code	Project Name	In Charge	Short Term					Middle Term										Long Term														
					2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040						
Infrastructure Development	24	WS-1	Technical Assistance for SCADA/GIS improvements	ENACAL/ALMA																														
	25	WS-2	Feasibility Study for Lago Nicaragua Treatment Plant & Transmission System	ENACAL																														
	27	WS-4	Old and Vulnerable Pipeline Replacement Project	ENACAL																														
	29	WR-1	Project on Technical Assistance for Water Quality Improvement of Managua Lake	ENACAL etc.																														
	30	SW-1	Expansion of the Sewerage Coverage in Managua Project	ENACAL																														
	31	SW-2	Renewal and Improvement of Deteriorated Sewers	ENACAL																														
	33	SW-4	Design Review and Construction of Interceptor 2 – Second Phase	ENACAL																														
	34	SW-5	Additional Measures to Increase the Treatment Capacity of the WWTP Managua	ENACAL																														
	35	WM-1	New Sanitary landfill & intermedia treatment facility development project (phase 1)	ALMA																														
	36	WM-2	Capacity development for solid waste management project	ALMA																														
	37	WM-3	Equipment for collection & transportation procurement project	ALMA																														
Disaster Management	39	DM-1	Project for Establishment of Permanent Offices and Staff for Disaster Management with Training Program	ALMA																														
	40	DM-2	Project for Update of Hazard Map and Dissemination to Citizen for Understanding/ Community Based Risk Reduction Management System	SINAPRED /INETER /ALMA/ect.																														
	42	DM-4	Project for Improvement of Public Emergency Facilities for Disaster Preparedness	ALMA																														
	43	DM-5	Project for Development of Emergency Transportation Network	ALMA																														
	44	DM-6	Project for Study, Design and Installation of the Flood Early Warning System for the Urban Area of Managua City	INETER																														
	45	DM-7	Project for Consideration on Environment including Solid Waste Management	ALMA																														
	46	DM-8	Project for Assessment of Earthquake Resistance for Existing Buildings, and Study on Improvement for Earthquake-Resistent Buildings	ALMA																														
	47	DM-9	Project for Improvement of Earthquake Disaster Prevention and Warning System	INETER																														
	48	FM-1	Structural Improvement of Priority Cauces Project	ALMA																														



Source: JICA Study Team

Figure 13.2.3 Action Plan for Package 3 (Resilient and Socially Equitable City Program)

13.2.4 Implementation Institutions

Table 13.2.1 shows the implementation and regulating institutions and divisions/departments of respective institutions in relation to the priority projects. The priority projects should be implemented in coordination with these relevant institutions.

Table 13.2.1 Implementation Institutions

Activity		Implementing Institutions	Division/Department	National / Municipal
Urban Planning	Regulation	ALMA	General Directorate of Environment and Town Planning	Municipal (Support)
	Facility	ALMA	General Directorate of Environment and Town Planning	Municipal (Support)
	Parks	ALMA	General Direction of Projects (Building) and Direction of Ornament (Building and Maintenance) *Nationals Institutions and Ministries	Municipal
Road	Regulation	MTI	Dir. General de Vialidad División general de Planificación	National
	National Road	MTI	Dir. General de Vialidad División general de Planificación	National
	Municipal Road	ALMA	Dir. General de Proyectos, Dir. General de Infraestructura	Municipal
Intersections	Regulation	National Police	Departamento de Ingeniería de Tráfico	National
		ALMA	Dir. General de Proyectos, Dir. General de Infraestructura	Municipal
	Operation	National Police	Departamento de Ingeniería de Tráfico	National
		ALMA	Dir. General de Proyectos, Dir. General de Infraestructura	Municipal
Transportation (Communal Transit)	Regulation	ALMA	IRTRAMMA	Municipal Company
	Operation	Private Companies	-	Private
Rain Water (Drainage)	Regulation	ALMA	Drainage and Infrastructure Sector	Municipal/ National
		ENACAL	Planning	
	Collection	ALMA	Drainage and Infrastructure Department	Municipal
Solid Waste Management	Regulation	ALMA	General Directorate of Environment and Town Planning	Municipal
	Collection	ALMA	Dir. General de Limpieza Publica	Specific Direction / Municipal
			EMTRIDES	

	Management	ALMA	EMTRIDE	Municipal Company
Environment	Regulation	ALMA	General Directorate of Environment and Town planning	Municipal
	Management	ALMA	General Directorate of Environment and Town Planning	National / Municipal
Disaster Management	Regulation	SINAPRED	Directorate of Territorial Organization	National
		ALMA	Directorate of Urban Planning	Municipal
	Administration	SINAPRED	Directorate of Territorial Organization	National / Municipal
		ALMA	Directorate of Urban Planning	
		related sector org.	-	
Water	Regulation	ENACAL	Operations – Managua, Department of Non-revenue Water	National
	Generation (Treatment)	ENACAL	Planning	National
	Distribution	ENACAL	Planning, Project/Construction Supervision	National
		ALMA	Project Management	Municipal
Sewerage	Regulation	ENACAL	Direction of Project, Sewerage system of Managua	National
	Collection	ENACAL	Direction of Project and Investment, Direction of Environment, General direction of Operation, Department of Sewerage and Wastewater Treatment Plant Managua	National
	Purification	BIWATER	-	Private

Source: JICA Study Team

13.3 Financial Plan for Accomplishing Action Plan

13.3.1 Overview of the Project Investment

Table 13.3.1 shows the total investment cost of priority projects by each sector and implementation institution in each period. Table 13.3.2 also suggests the investment cost of priority projects by each package. Total investment cost for all priority projects is USD 5,615 million which is approximately NIO 158,358 million. It is expected that some of the urban development and transport development projects will be implemented by the private sector in the form of individual private investment or public-private partnership (PPP) scheme. The expected total private investment amount in the MP is USD 3,334.5 million (NIO 94,003 million) which accounts for 59.3% of the total investment, while public investment is USD 2,280.5 million (NIO 64,268 million).

Table 13.3.1 Allocation of Cost to Implementing Institutions (USD in Million)

Sector		Implementing Institution	Short	Middle	Long	Total
Urban Development	Urban Planning	ALMA	1.5	90.0	0.0	91.5
		Private	0.0	1696.5	1111.0	2807.5
Transport Development	Capacity Development	ALMA	2.0	0.0	0.0	2.0
	Road Development	ALMA	185.0	508.7	653.8	1347.4
	Public Transport	ALMA	44.2	454.3	15.0	513.5
		Private	0.0	260.7	266.3	527.0
	Traffic Management	ALMA	10.7	12.6	7.4	30.7
Infrastructure Development	Water Supply	Other	33.0	5.0	0.0	38.0
	Water Resource	Other	0.0	5.0	0.0	5.0
	Sewerage and Wastewater Disposal	Other	77.0	33.2	0.0	110.2
	Solid Waste Management	ALMA	7.0	89.0	0.0	96.0
Disaster	Disaster Management	Other	12.0	3.1	1.1	16.3
	Flood Management	ALMA	30.0	0.0	0.0	30.0
Total			402.3	3158.1	2054.6	5615.0
Average per Year			100.6	315.8	205.5	234.0
Total Cost of ALMA			280.4	1154.6	676.2	2111.1
Average per Year			70.1	115.5	67.6	88.0

Source: JICA Study Team

Table 13.3.2 Cost Schedule of Policy Packages (USD in Million)

Package	Program	Total Cost	Investment Cost Schedule							
			Public				Private			
			Short	Middle	Long	Total	Short	Middle	Long	Total
1	Urban Development	1668.0	1.5	0.0	0.0	1.5	0.0	555.5	1111.0	1666.5
	Transport Development	2	2.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0
	Package 2 Total	1670.0	3.5	0.0	0.0	3.5	0.0	555.5	1111.0	1666.5
2	Transport Development	2418.6	239.9	975.6	676.1	1891.6	0.0	260.7	266.3	527.0
	Urban Development	1231.0	0.0	90.0	0.0	90.0	0.0	1141.0	0.0	1141.0
	Package 2 Total	3649.6	239.9	1065.1	676.2	1978.2	0.0	1401.7	266.3	1668.0
3	Infrastructure Development	249.2	117.0	132.2	0.0	249.2	0.0	0.0	0.0	0.0
	Disaster Management	46.2	42.0	3.1	1.1	46.2	0.0	0.0	0.0	0.0
	Package 3 Total	295.4	158.9	135.3	1.1	295.4	0.0	0.0	0.0	0.0
Grand-total		5615.0	401.3	1200.4	677.3	2280.5	0.0	1957.2	1377.3	3334.5

Source: JICA Study Team

13.3.2 Financial Capacity of ALMA

As the financial capacity of ALMA has been examined in Chapter 7 to realize the implementation of priority projects which are to be funded by ALMA, it is necessary to intensively invest its infrastructure investment project budget in the priority projects and also obtain external finance to fill the shortage, especially in the short and middle term. Specifically, in the short term, ALMA needs to reconsider the

financial plan to adjust MP projects and seek for external finance to implement all priority projects. In the middle term, the necessary cost per year (in average) will be the largest, although the necessary cost will be lower than the financial capacity of ALMA in the long term provided that ALMA's revenue growth is stable. Therefore, ALMA may need to seek for external finance to fill the financial gap in the middle term as well as in the short term.

13.3.3 Financial Plan for Each Package

The financial and investment plan will be examined by each policy package in the following sections.

The budget allocation on each implementing institution will be examined in Section 13.3.3.

(1) Package 1

Table 13.3.3 Cost Schedule of Package 1

Package No.	Project No.	Project Code	Total Cost	Cost by Implementation Stage						Implementation Institution
				Public			Private			
				Short	Middle	Long	Short	Middle	Long	
1	7	TD-1	2.0	2.0	-	-	-	-	-	ALMA
	1	UD-1	1.5	1.5	-	-	-	-	-	ALMA
	3	UD-3	1,666.5	-	-	-	-	555.5	1,111.0	ALMA, Private
	5	UD-5	0.025	0.025	-	-	-	-	-	ALMA
	Total		1,670.025	3.5	0.0	0.0	0.0	555.5	1,111.0	

Source: JICA Study Team

Package 1 will be implemented by ALMA and the private sector. The funding for capacity development project (TD-1 and UD-1) is expected to come from international assistance. The residential zone redevelopment project (UD-3) is expected to be implemented mainly by the initiative of private investment. To promote private investment for the residential zone redevelopment project, the pilot project is included in the urban planning capacity building project. The budget for the public awareness project (UD-5), which is USD 0.025 million in the short term, could be incurred by ALMA's own budget of the urban planning division.

The revision of zoning and subcenter development is necessary to prevent urban sprawl and realize the densification to transform Managua City to a compact city. Total built-up area without densification case in 2040 is estimated at 20,210 ha and the same with densification case is estimated at 14,282 ha. Thus, the difference or the area to be saved from urban sprawl would be 6,000 ha approximately. Considering capital expenditure of ALMA related to the urban infrastructure construction and maintenance project (including district projects), waste management, and traffic management in 2016, the urban management costs is almost NIO 213,000 per ha. The densification could save approximately NIO 1,267 million (USD 45 million) of urban management cost per year in terms of current prices and standards of urban services.

(2) Package 2

Table 13.3.4 Cost Schedule of Package 2

Package No.	Project No.	Project Code	Total Cost	Cost by Implementation Stage						Implementation Institution
				Public			Private			
				Short	Middle	Long	Short	Middle	Long	
2	8	RD-1	242.8	32.5	128.6	81.7	-	-	-	ALMA
	9	RD-2	485.7	152.5	296.2	37	-	-	-	ALMA
	10	RD-3	619	0.0	83.9	535.1	-	-	-	ALMA
	21	TM-4	0.2	0.2	-	-	-	-	-	ALMA
	22	TM-5	0.2	0.2	-	-	-	-	-	ALMA
	23	TM-6	30.3	10.3	12.6	7.4	-	-	-	ALMA
	12	PT-1	41.2	41.2	-	-	-	-	-	ALMA
	13	PT-2	51.3	-	36.3	15	-	-	-	MTI
	14	PT-3	732	2	417.9	-	-	104.1	208.3	ALMA/MTI, Private
	17	PT-6	216	1	-	-	-	156.6	58.0	ALMA/MTI, Private
	2	UD-2	1231	-	90	-	-	1,141.0	-	ALMA, Private
	Total		3,649.6	238.9	1,065.1	676.2	0.0	1,401.7	266.3	

Source: JICA Study Team

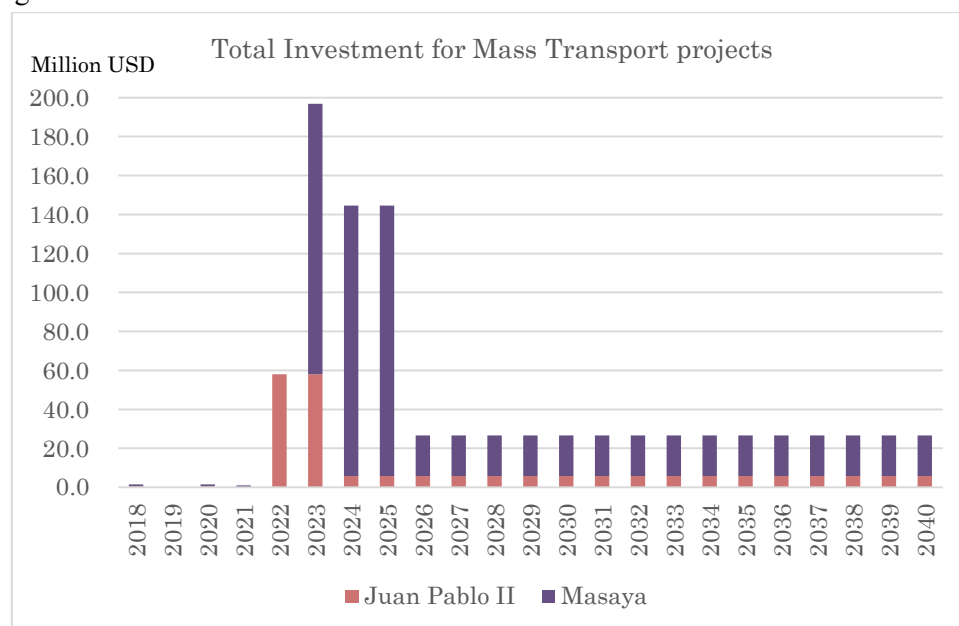
Most of the projects in package 2 are the urban transport development projects, which need large capital investment. Especially road development projects (RD-1-3) and mass transit projects (PT 3 and 6) require high construction costs. With respect to the road development projects (RD-1-3), the road development projects include numerous routes as shown in Chapter 10. The routes, which will become the priority projects, are selected from all the routes based on consistency with the major road axes. Among all the routes proposed in the original road development projects, A3, A4, A5, A6, A7, A9, M1, M2, M3, M17, I31, and N2 are eliminated in the priority projects¹.

The priority projects shall be implemented by ALMA possibly with MTI for the mass transit projects. In addition, external funding and private investment should be utilized to realize these projects. The mass transit projects could be expected to have stable revenue after the commencement of operation so it could utilize the PPP scheme. The investment schedule by year for mass transit project of Juan Pablo II Line and Masaya Avenue Line is shown in Figure 13.3.1.

The estimation of revenue based on the demand forecast is USD 41 million in 2030, USD 36 million in 2040 for Masaya Avenue Line and USD 42 million in 2030 and USD 32 million in 2040 for Juan Pablo II Line. Projected cost and revenue suggest the possibility of build-operate-transfer (BOT) scheme for Juan Pablo II Line. In this case, the construction and operation would be implemented by the private sector. With regard to Masaya Avenue Line, it is expected that the construction would be implemented by the public sector and the operation could be delegated to the private sector in the form of operation concession. Otherwise, the private sector could implement both construction and operation with the subsidy for the construction from the national or municipal government. The road development projects

¹ The routes are listed in Table 10.4.6 in Chapter 10.

shall be implemented by ALMA's own fund and external finance such as loan from multi-lateral or bilateral organization.



Source: JICA Study Team

Figure 13.3.1 Total Investment for Mass Transit Project by Year (USD in Million)

With regard to the urban development project in this package (UD-2), the new CBD development shall be implemented to promote economic growth based on the improved traffic conditions which will optimize private commercial activities. The initial survey for the new CBD development project would be included in the capacity building project (UD-1). The succeeding development to expand CBD development would be invested by the private sector in this package. The public transportation development, the update of land use zoning system, and other relevant regulations are the prerequisite to promote commercial investment and urban development with the initiative of the private sector.

(3) Package 3

Table 13.3.5 Cost Schedule of Package 3

Package No.	Project No.	Project Code	Total Cost	Cost by Implementation Stage						Implementation Institution
				Public			Private			
				Short	Middle	Long	Short	Middle	Long	
3	24	WS-1	20.0	20.0	-	-	-	-	-	ENACAL/ALMA
	25	WS-2	5.0	-	5.0	0.0	-	-	-	ENACAL
	27	WS-4	13.0	13.0	0.0	0.0	-	-	-	ENACAL
	29	WR-1	5.0	0.0	5.0	0.0	-	-	-	ENACAL etc.
	30	SW-1	66.4	33.2	33.2	0.0	-	-	-	ENACAL
	31	SW-2	13.6	13.6	0.0	0.0	-	-	-	ENACAL
	33	SW-4	14.4	14.4	0.0	0.0	-	-	-	ENACAL
	34	SW-5	15.7	15.7	0.0	0.0	-	-	-	ENACAL
	35	WM-1	72.0	2.0	70.0	0.0	-	-	-	ALMA
	36	WM-2	6.0	4.0	2.0	0.0	-	-	-	ALMA
	37	WM-3	18.0	1.0	17.0	0.0	-	-	-	ALMA
	39	DM-1	2.1	2.1	0.0	0.0	-	-	-	ALMA
	40	DM-2	2.7	0.4	1.1	1.1	-	-	-	INETER/ALMA/etc
	42	DM-4	1.0	1.0	0.0	0.0	-	-	-	ALMA
	43	DM-5	1.0	1.0	0.0	0.0	-	-	-	ALMA
	44	DM-6	1.5	1.5	0.0	0.0	-	-	-	INETER
	45	DM-7	6.0	4.0	2.0	0.0	-	-	-	ALMA
	46	DM-8	1.0	1.0	0.0	0.0	-	-	-	ALMA
	47	DM-9	1.0	1.0	0.0	0.0	-	-	-	INETER
	48	FM-1	30.0	30.0	0.0	0.0	-	-	-	ALMA
	Total			295.5	158.9	135.3	1.1	0.0	0.0	0.0

Source: JICA Study Team

The infrastructure development projects are mainly implemented by ALMA using its own budget. In contrast, the water and drainage projects are mainly implemented by the Nicaraguan Water and Sewerage Enterprise (*Empresa Nicaraguense de Acueductos y Alcantarillados Sanitarios*: ENACAL). The financial capacity of ENACAL is limited as analyzed in the next section. Therefore, the external financial support would be required to implement these projects. Private investment is not expected in this package.

The necessity of disaster mitigation is strongly recognized among the relevant stakeholders in Managua City. According to the news article of La Prensa², the heavy rain affected 2,000 families in 60 barrios and communities in 2015 when Managua City experienced a recorded heavy rain. In 2010, the news article of El Nuevo Diario reported that NIO 40 million was spent every year to clean up the riverbeds and drainage systems³. The garbage in the channel and drainage system due to illegal dumping caused overflow of rain water. The infrastructure development and disaster mitigation should be implemented jointly to effectively reduce the damage from flood.

²“Afectaciones en toda Managua por intensa lluvia”, 3 June 2015, La Prensa

³ “Managua desnuda y sin protección”, 13, June 2010, El Nuevo Diario

13.3.4 Budget Allocation

Table 13.3.6 categorizes the implementation institutions of priority projects and respective cost allocation. In addition to ALMA, the major implementation institution is ENACAL for water and drainage projects. In addition to the public investment, the private investment is expected in the commercial development and in the form of PPP. It is necessary to analyze and examine the possibility of funding resource according to the implementing institutions or stakeholders that could provide finance for the MP projects.

Table 13.3.6 Investment Cost by Funding Institutions

Funding Institutions	Package			Implementation Stage			Yearly Average Cost			Total Cost
	1	2	3	Short	Mid	Long	Short	Mid	Long	
ALMA	TD-1, UD-1, UD-2, UD-3, UD-5	RD-1, RD-2, RD-3, TM-4, TM-5, TM-6, PT-1, PT-3, PT-6, UD-2	WM-1, WM-2, WM-3, DM-1, DM-2, DM-4, DM-5, DM-7, DM-8, FM-1	290.3	1,158.0	677.0	97.1	115.8	67.7	2,125.4
ENACAL	-	-	WS-1, WS-2, WS-4, WR-1, SW-1, SW-2, SW-4, SW-5	110.0	38.2	0	36.7	3.8	0.0	148.2
Private Investment	-	PT-1, PT-3, PT-6, UD-2	-		1,957.2	1,377.3	0.0	195.7	137.7	3,334.5
Others	-	PT-2	DM-6, DM-9	2.5	5.0	0.0	0.8	0.5	0.0	7.5
Total				402.5	3158.4	2054.3	134.2	315.8	205.4	5615.5

Source: JICA Study Team

(1) ALMA

As discussed in Chapter 7, ALMA has its mid-term financial plan until 2021 and long-term development plan until 2028. The foreseen budget is allocated to the projects in these plans. As shown in Table 13.3.7, some of the priority projects of transport and disaster management projects are compatible with the projects in the development plan of ALMA. The approximate total budget is USD 61 million for the period from 2018 to 2021, and this budget could be utilized for the MP projects.

Table 13.3.7 Projects in the Development Plan of ALMA and the Central Government

Sector		Name of Project in ALMA's Development Plan	Priority Project in MP	Year (ALMA's Development Plan)	Budget (NIO)
Sector	Sub-sector				
Transport	Road Development	Villa Fontana Roundabout	Overpass and Intersections Project; Cod: I25	2018	60,000,000
	Traffic Management	Installation of traffic lights	Overpass and Intersections Project; and Traffic Management	2019	50,000,000

	Road Development	Enlargement and substitution of Av. Bolívar Section: Rigoberto Roundabout	Road Improvement and Extension; Cod: M9	2019	120,000,000
		Enlargement and substitution of Av. Bolívar Section: Rigoberto Roundabout	Road Improvement and Extension; Cod: M9	2019	120,000,000
		Overpass ENEL Central	Overpass and Intersections Project	2019	300,000,000
		Enlargement Road Sabana Grande / Rubenia / Road El Mayoreo	Road Improvement and Extension ; Cod: M10	2020	231,160,915
		Construction of Roundabout Iván Montenegro	Overpass and Intersections Project; Cod: I5	2020	65,000,000
		Extension of Pista Jean Paul Genie to neighborhoods 18 de Mayo and La Fuente	New Bypass Project; Cod: N8	2021	300,000,000
		Construction of Roundabout Villa Progreso	Overpass and Intersections Project; Cod: I22	2021	70,000,000
	Public Transport	Intercity Bus Terminal	Intercity bus Reorganization Project	2021	82,000,000
	Traffic Management	Traveler Information System	Project related: Panels with Street Name; Traffic Management	2021	27,249,450
	Total Budget				1,425,410,365
Disaster Mitigation and Risk Management	Flood Management	Improvement of Cauce Portezuelo 1 Etapa	Structural Improvement of Priority Cauces Project	2018	24,000,000
		Improvement of Cauce Villa Dignidad 1 Etapa	Structural Improvement of Priority Cauces Project	2018	30,000,000
		Improvement of Cauce Los Duartes	Structural Improvement of Priority Cauces Project	2018	60,000,000
		Improvement of Cauce Villa Dignidad 2 Etapa	Structural Improvement of Priority Cauces Project	2019	40,000,000
		Expansion of the Storm Drainage Network	Structural Improvement of Priority Cauces Project	2020	24,484,725
		Improvement of Cauce Jocote Dulce	Structural Improvement of Priority Cauces Project	2021	40,000,000
		Expansion of the Storm Drainage Network	Structural Improvement of Priority Cauces Project	2021	80,000,000
	Total Budge				298,484,725
Grand-total				1,723,895,090	
(Grand-total in USD)				61,131,032	

Source: JICA Study Team

(2) IRTRAMMA

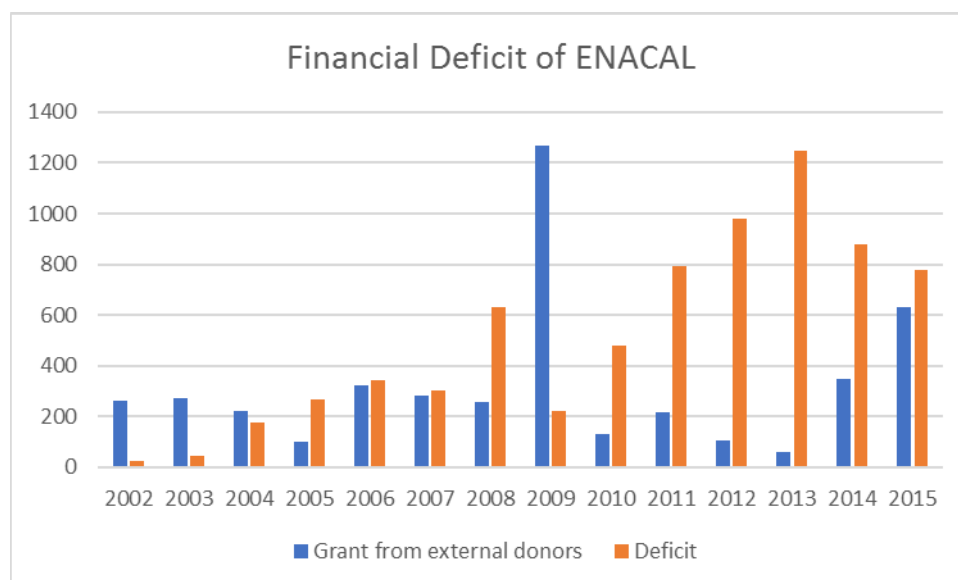
The income of IRTRMMA in 2016 was NIO 29,157,705 (approximately USD 1.03 million) which are mainly from the permissions, fines, and fares. IRTRMMA's own income covers its operational expenditures; however, it does barely have the financial capacity to implement large investment projects. The transfer from ALMA and other external resource or any additional income source is necessary to implement new development project.

(3) EMTRIDE

EMTRIDE has two-major financial resources: one is their own income from service tax and sales of materials and the other is budget transfer from ALMA. Approximately 70% of the revenue of EMTRIDE depends on the transfer from ALMA. Moreover, its own revenue is mostly spent on the operational cost only. Therefore, ALMA might need to finance the investment projects seeking for external finance.

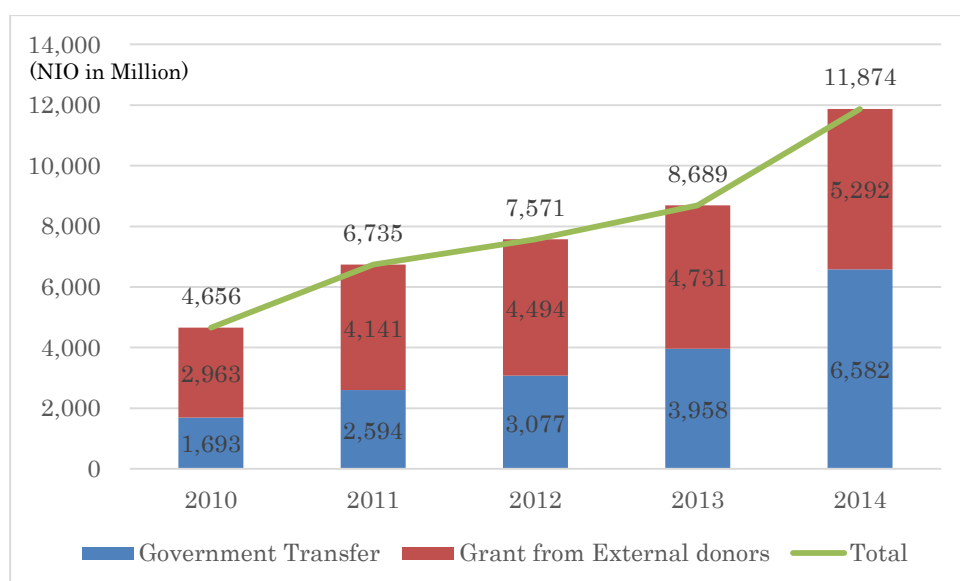
(4) ENACAL

ENACAL has experienced a large deficit every year and the amount of the deficit depends on the amount of the grant fund provided by external donors. According to JICA Study (2016), the total revenue covers only 56-69% of the total expenditure of ENACAL for the period of 2010 to 2014. The operation and investment of ENACAL largely depend on the transfer from the central government and grant from external donors. The projects proposed in PDUM also need to be funded by such grant from the central government or external donors.



Source: ENACAL and JICA Study Team

Figure 13.3.2 Financial Deficit of ENACAL

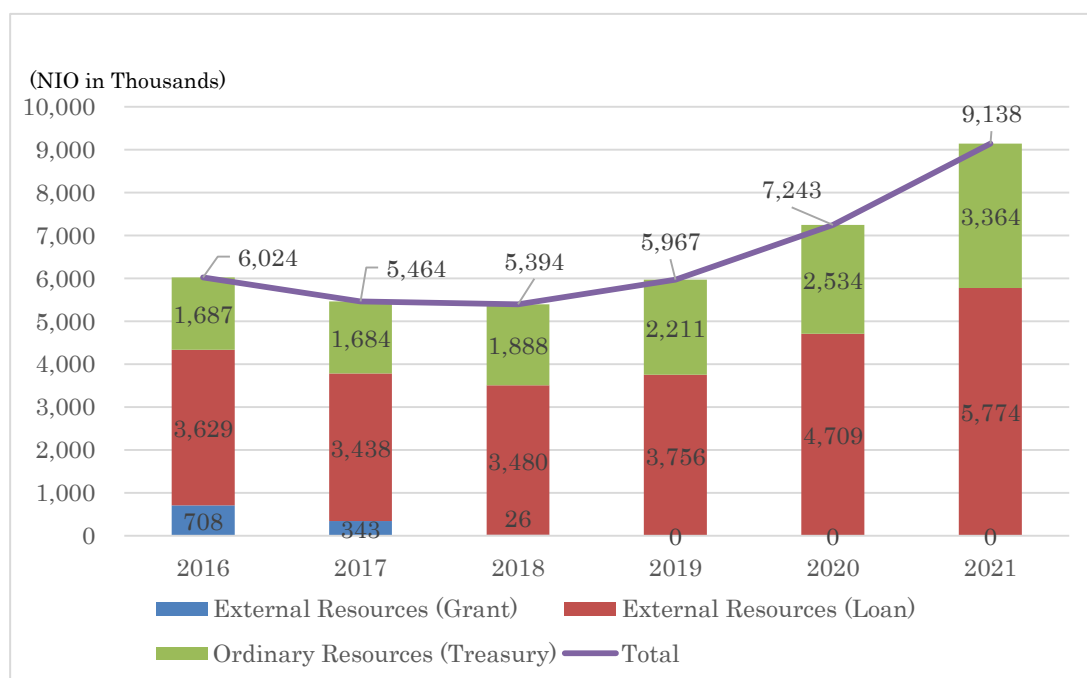


Source: ENACAL and JICA Study Team

Figure 13.3.3 Financial Support to ENACAL

(5) MTI

The budget of MTI also depends on the external donors especially for the large infrastructure projects. Its own resource is expected to increase; however, the expected own budget is NIO 3,364,000 (approximately USD 120 million), and the external resource (loan) is expected to be NIO 5,774,000 (approximately USD 163 million) in 2021. Therefore, MP projects, which shall be implemented by MTI, might need to find external loans as funding sources.



Source: MTI and JICA Study Team

Figure 13.3.4 Budget Framework of Capital Expenditure of MTI

13.3.1 Measures to Fill the Financial Gaps

ALMA's budget is not sufficient to implement all priority projects by itself especially for the transport projects which requires large initial investment. Although the external finance is essential to realize the implementation of priority projects, there are other several measures to fill the financial gap by strengthening the financial capacity of ALMA itself and promoting private sector involvement.

(1) Amend the tax decree to increase the tax rate

One of the financial issues of the revenue structure of ALMA is that the municipal tax rates are fixed by the National Law and ALMA does not have the discretion to increase tax rates.

The tax rate is specified in the National Law. It is necessary to take required procedure to amend the tax decree and increase the tax rate. However, the current tax rate is kept being low, so the increase to the reasonable level will bring additional revenue to ALMA. The increase in car permission tax is proposed as the proposed project in the transport sector. If the increase in car permission tax is implemented as proposed, the annual revenue collection from the revised car permission tax is estimated as USD 3 million in 2018-2020, USD 9 million in 2021-2030, and USD 22.5 million in 2031-2040.

(2) Improve financial viability of some projects by increasing service charge (transport, water, waste, etc.)

As pointed out in Chapter 10, some of the service charges such as bus toll are also kept at the low level and subsidies are provided by the national government. The service charge could be raised gradually to a financially viable but acceptable level.

(3) Private investment

To realize the visions and future development of Managua City, the participation of the private sector is expected in both entire private investment and the public-private partnership (PPP). Although entire private investment shall be limited to the financially viable project, the development of the commercial and residential areas in the subcenter is expected to be implemented by the private sector.

13.3.2 PPP Opportunities for Infrastructure Investment

The National Legislature has recently enacted the Law on PPP in Nicaragua (Ley No. 935/2016/Ley de Asociacion Publico Privada). This new law enables the participation of private entities in investments in national strategic projects. The enforcement body of this new law is the Ministry of Finance and Public Credit (*Ministerio de Hacienda y Credito Publico*: MHCP).

Before the enactment of the PPP Law in Nicaragua, there were limited cases of private participation in Nicaragua. The common forms of these private participation cases at ALMA are concessions. The concessions have been granted to private entities to manage certain roads; however, other options of PPP, such as BOT or build-own-operate (BOO) schemes, have not been available yet. In the national level, there are cases of more intensive private participations in some sectors such as electricity generation and distribution.

PPP is more suitable to large-scale projects and revenue-generating projects. The enactment of this new PPP Law could trigger a large flow of private investment into Managua's infrastructure development projects. Since it has just been enacted, continuous monitoring of the PPP implementation process is required.

CHAPTER 14 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

14.1 Environmental Administration and Legal Framework

14.1.1 Administration Framework for EIA

(1) Central EIA authority

The environmental impact assessment (EIA) system is administered by the central office of the Ministry of Environment and Natural Resources (*Ministerio del Ambiente y los Recursos Naturales*: MARENA) under the General Office of Environmental Quality.

The General Office of Environmental Quality (*Dirección General de Calidad Ambiental*: DGCA) should comply with all the functions that were assigned in the Presidential Decree 76-2006, to be described later, concerning environmental assessment, among which are as follows:

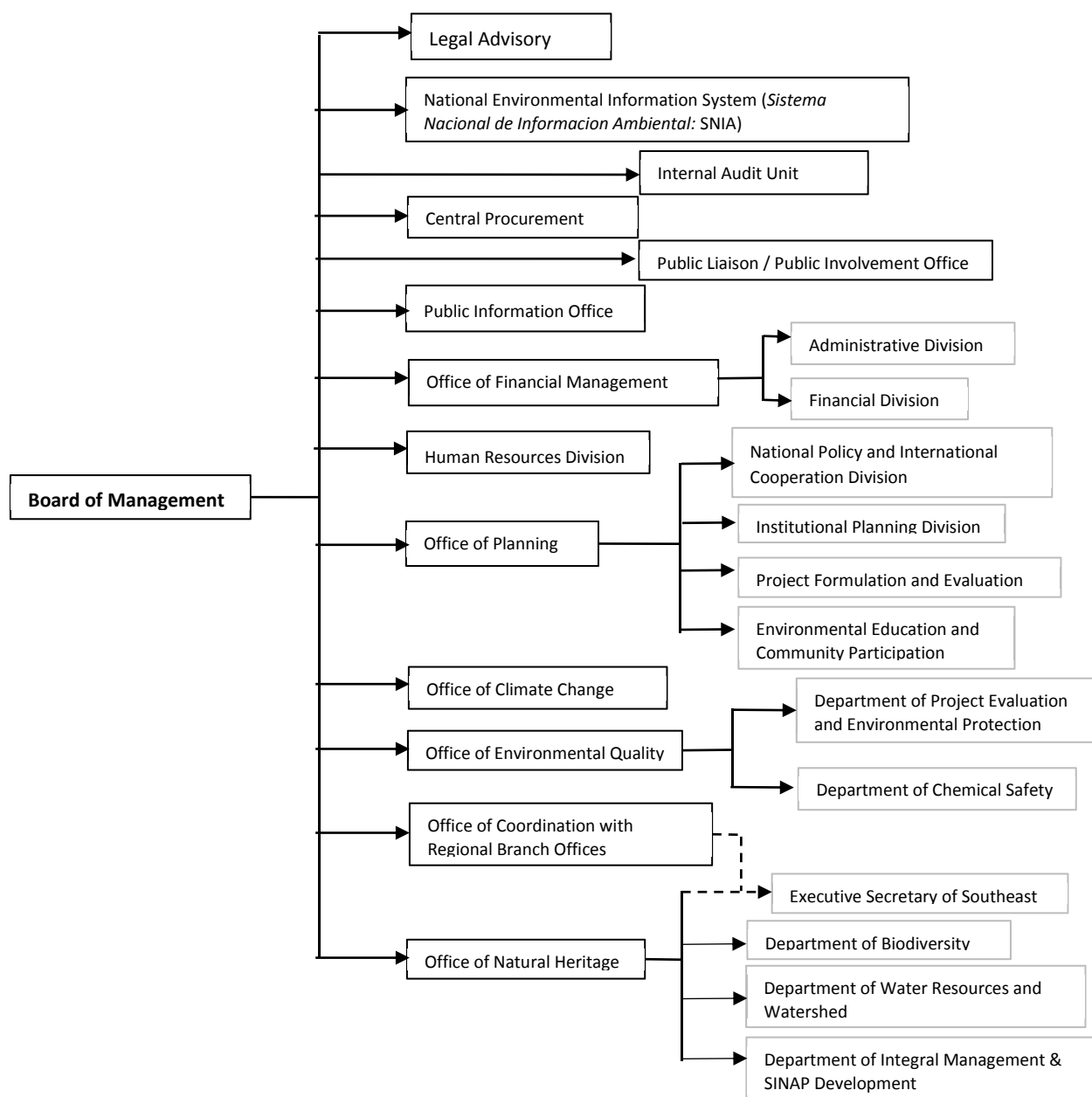
- 1) Establish the national registry of environmental assessment including registration of environmental consultants;
- 2) To promote, assess and train in the different governmental sectors of the country in the application of strategic environmental assessment (SEA) and elaborate instruments for the formulation and execution of plans and programs for environmental management;
- 3) To facilitate the coordination of relationships between the different environmental management units of the government on both sectorial and municipal levels including entities that do not have mandates on this subject.

The MARENA was founded in 1979. It was formerly known as the Nicaraguan Institute of Natural Resources and the Environment (*Instituto Nicaragüense de Recursos Naturales y del Ambiente*: IRENA). The following are the major departments within MARENA:

1. Legal Advisory,
2. National Environmental Information System (*Sistema Nacional de Información Ambiental*: SNIA),
3. Internal Audit Unit,
4. Central Procurement Unit,
5. Public Liaison / Public Involvement Office,
6. Public Information Office,
7. Office of Financial Management,
8. Office of Planning,
9. Human Resources Division,
10. Office of Climate Change,
11. Office of Environmental Quality,
12. Office of Natural Heritage, and
13. Office of Coordination with regional offices.

Source: <http://www.marena.gob.ni/index.php/conocenos/organigrama>

Figure 14.1.1 shows the organization chart of MARENA.



Source: <http://www.marena.gob.ni/index.php/conocenos/organigrama>

Figure 14.1.1 Organization Chart of MARENA

(2) Other Key Governmental Organizations Involved in EIA

- 1) Environmental Sectorial Units (from different ministries). Consulted during the decision-making stage of the projects in categories I and II (to be described later) along with other functions as members of the inter-institutional commission (see functions of these).
- 2) Territorial Representatives of MARENA. Consulted during the decision-making stage of the project in categories I and II, along with other functions as members of the inter-institutional commission (see functions of these).
- 3) Municipal Governments. Consulted during the decision-making stage of the project in

Categories I and II, along with other functions as members of the inter-institutional commission. Functions of Department of Environment and Urban Planning of ALMA is described later

- 4) Regional Council in Autonomous Regions. Consulted during the decision-making stage of the project in categories I and II, along with other functions as members of the inter-institutional commission. These can also dictate an exemption to the requirement of an environmental impact study as stipulated in Article 12, in the Regulation on the EIA.
- 5) Inter-institutional Commissions for Environmental Assessment. Made up of representatives of different environmental administrative units of autonomous entities, municipal governments, the Secretary of Natural Resources and the Environment (*Secretaria de Recursos Naturales y el Ambiente*: SERENA), universities, and territorial representatives of MARENA. The functions of this commission are stipulated in Article 11, in the EIA Regulation as follows:
 - a. Give support to MARENA or SERENA in the elaboration of the corresponding terms of reference to be used,
 - b. Participate in consultation meetings with the project employer and his interdisciplinary team of professionals selected by him to elaborate the environmental impact study,
 - c. Participate and dictate criteria after reviewing the documentation and information that is required for an environmental assessment,
 - d. Participate in the team that makes field investigation.
 - e. Provide the necessary information and coordinate related organization or support for the environmental feasibility study that MARENA or SERENA dictates.
 - f. Participate in the final revision on the technical solutions and offer support on the administrative resolution for granting or not granting the environmental permit.

In addition to the above, the Department of Environment and Urban Planning of Managua City (hereinafter referred to as ALMA or short for *Alcaldia de Managua*) is the significant environmental stakeholder within this urban development master plan study, and major functions and outlines of the organizations are described separately in the following subsections.

(3) Department of Environment and Urban Planning of ALMA

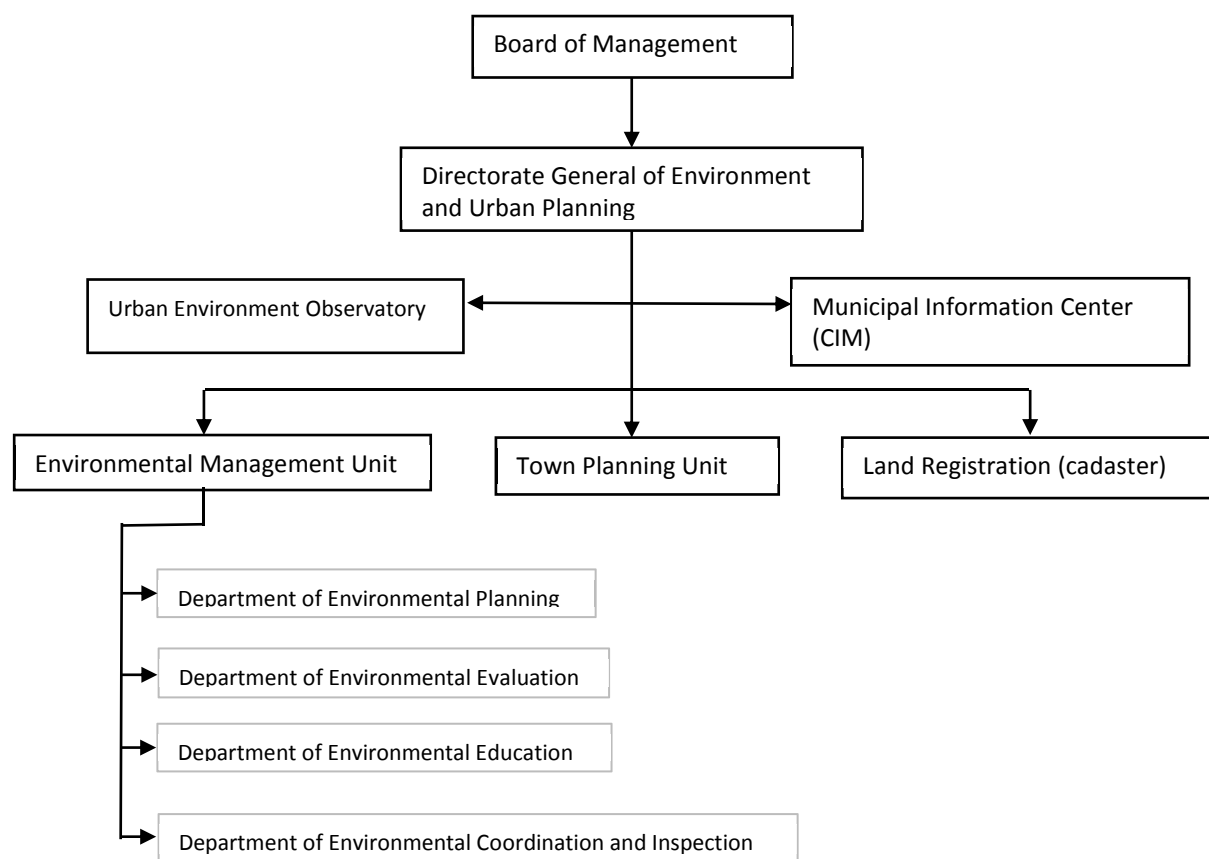
The ALMA has the Directorate of Environment and Urban Planning, consisting of the following major units (see Figure 14.1.2):

1. Environmental Management Unit,
2. Town Planning Unit, and
3. Land Registration Unit (cadaster).

Source: <http://www.managua.gob.ni/index.php?s=1004>

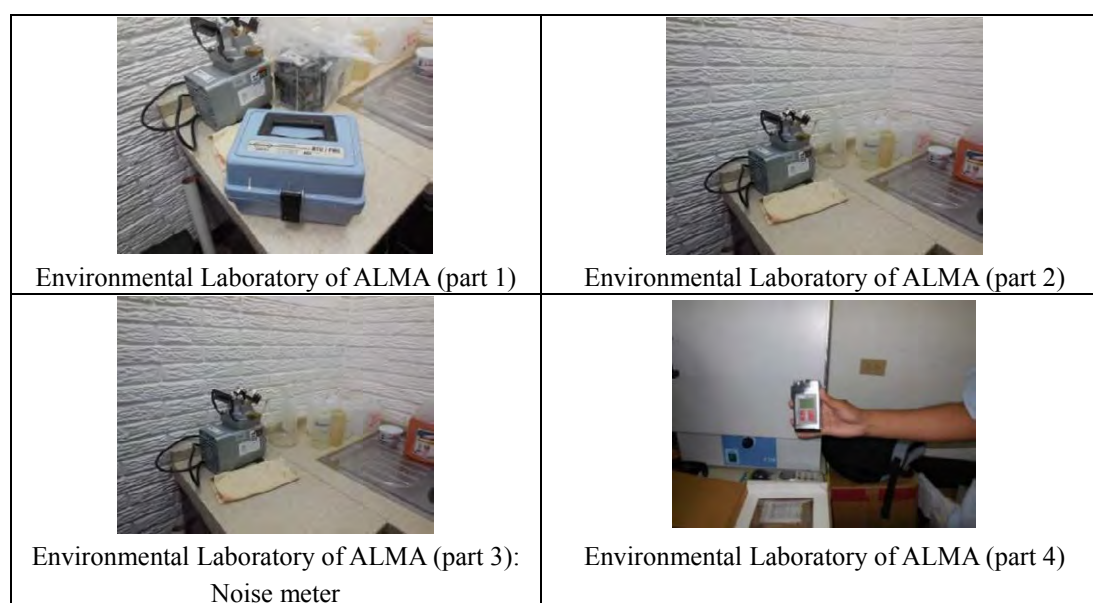
As shown in Figure 14.1.2, the environmental management unit belongs to the General Directorate of Environment and Urban Planning, and is responsible for the comprehensive urban environmental management such as the management of the watershed including the reforestation, wetlands, the water quality of Managua Lake, and urban noise. Currently, this unit has approximately 30 full-time staff.

In 2009, the Department of Environmental Coordination and Inspection (two permanent staff are working, see Figure 3) was established under the environmental management unit; and then, several environmental field surveys such as roadside noise, air quality, and water quality test for the effluents from factories were initiated. It is noted that no long-term environmental monitoring activity with fixed monitoring points were conducted yet, and on-site ad-hoc environmental surveys are conducted at requests and/or complaints from Managua citizens. As will be described later, the EIA examinations for any development projects, categorized as Categories I, II, and III, are conducted by MARENA. This department of ALMA is mainly conducting environmental surveys for the environmental permit application for small-scale development activities and/or effluent discharges of small-sized factories.



Source: http://www.managua.gob.ni/modulos/documentos/1_Organigramas2016.pdf

Figure 14.1.2 Organization Chart of Department of Environment and Urban Planning of ALMA



Source: JICA Study Team

Figure 14.1.3 Department of Environmental Coordination and Inspection of ALMA

14.1.2 Legal Framework

There are several important legal codes and/or regulations for the proposed urban development MP study (see Table 14.1.1).

Table 14.1.1 Major Legal Codes and/or Regulations for PDUM

	Relevant Law and/or Regulations
General Issues	a. Constitution of Nicaragua b. Law No. 40, Law on Municipalities and their Reforms.
Disaster Prevention and Public Health	c. Law No. 337, Law Creating the National System of Prevention, Mitigation and Disaster Care. d. Law No. 837, Law of the General Fire Department of Nicaragua. j. Special Law for the Promotion of Housing Construction and Access to Social Interest Housing, Law 677. k. General Law on Health, Law 423. m. General Law on Occupational Health and Safety, Law 618.
Cultural and Patrimonial Conservation	l. Law on Protection to the Cultural Patrimony of the Nation (Decree 1142).
Environmental Governance and Clearance	e. Law on Environmental Permit Regulation and Environmental Impact Assessment" (Decree 45-94). f. Law No. 217, General Law on Environment and Natural Resources and its Regulations. g. Law on Conservation, Promotion, and Sustainable Development of the Forestry Sector, Law 462. h. Veda Law for the Cut, Harnessing, and Commercialization of the Forest Resource, Law 585. i. General Law of National Waters and its Regulations, Law 620. o. Penal Code, Law 641. p. Environmental Assessment System (Decree 76-2006).
Waste Disposal	q. Nicaraguan Obligatory Technical Standard for the Management, Treatment and Final Disposal of Non-Hazardous Solid Waste (NTON 05-014-01). r. Nicaraguan Obligatory Technical Standard for the Handling, Treatment and Final Disposal of Hazardous Solid Waste (NTON 05-015-01).
Public Involvement	n. Law on Citizen Participation, Law 475.

Brief descriptions of each legal codes and/or regulations, listed in this table, are described separately as follows,

a. Constitution of Nicaragua: The Constitution of Nicaragua establishes principles, rights, and obligations of all Nicaraguans, giving guidelines for the sustainable development of the environment and natural resources. Article 60 institutes that all Nicaraguans have the right to live in a healthy environment and that the state has the obligation to preserve, conserve, and rescue the environment and natural resources. The management of natural resources is based on Article 102, which establishes, among other aspects, that "natural resources are national patrimony and imposes on the State the legal power to regulate and control their use and use". Article 150 institutes one of the powers of the President of the Republic to "prepare the decree and put into effect the State of Emergency provided for by this Constitution and send the decree to the National Assembly for ratification within a term not longer than 45 days".

b. Law No. 40, Law on Municipalities and their Reforms. This law determines that the municipalities are legal entities of public law, with full capacity to acquire rights and contract obligations. Part of their powers under Article 7, Paragraph 5 to establish municipal emergency committees, which in

coordination and with the support of the National Emergency Committee, draw up a plan that defines responsibilities of each institution and organizes and directs the defense of the community in case of natural disasters. Article 34, Paragraph 25, regarding one of the responsibilities of the mayor, institutes the authorization of directing of the municipal emergency committee and promoting the integration of the people within the organization of civil defense, which according to Law 337 is called the Committee Municipal Prevention, Mitigation, and Disaster Assistance.

c. Law No. 337, Law Creating the National System of Prevention, Mitigation and Disaster Care.

The law regulates inter-agency actions at different levels prior to the state of emergency with the purpose of reducing risks, having an effective and timely response to emergencies and disasters, as well as for the rehabilitation and reconstruction of areas affected by a disaster; even through the integration requires public and private efforts. It proposes that a common support organization for the higher directorate of all ministries, the Technical Units of Links for Disasters (*Unidades Técnicas de Enlaces para Desastres* UTED), shall exist in order to achieve the goals and objectives of the National System for Prevention, Mitigation and Attention to Disasters (*Sistema Nacional para la Prevención, Mitigación y Atención de Desastre*: SINAPRED).

This instrument is considered as a good normative and institutional framework, which harmoniously integrates all levels of the governmental sector, having a good organizational capacity and defining their attributions. Article 8 determines main functions of the entities that make up SINAPRED, including the preparation of risk analysis, prevention, mitigation, preparation, response, rehabilitation, and reconstruction before, during, and after a disaster. Article 23 clearly defines that the state of disaster can only be declared by the President of the Republic through an Executive Decree, in addition establishes what is necessary to define the state of disaster.

d. Law No. 837, Law of the General Fire Department of Nicaragua. It establishes the general legal norms, rules, and guidelines that govern the operation of the General Fire Department of Nicaragua, Ministry of the Interior, for the provision of services related to the prevention of fire and relevant special risks, fire suppression, search, rescue, and preservation of the environment.

e. Law of Environmental Permit Regulation and Environmental Impact Assessment" (Decree 45-94). This regulation institutes that MARENA is the organization what grant the environmental permit, which is the mandatory official document for the implementation of either of public or private projects, works or activities, national or foreign investment, during its pre-investment phase, construction, extension, rehabilitation or reconversion, that may lead to deterioration of the environment or natural resources. Basically, all project owners must obtain environmental permits prior to their construction.

f. Law No. 217, General Law on Environment and Natural Resources and its Regulations. This law institutes the legal framework for the rational and sustainable use (i.e., the conservation, protection,

improvement, and restoration) of the environment and the natural resources, which is stated in the Constitution. Article 51 defines that the President of the Republic, and/or the President of the Autonomous Regional Councils of the Atlantic Coast and/or of the Municipal Councils, may declare an environmental emergency zone(s) due to the occurrence of a disaster.

It should be noted that this environmental law institutes a fundamental aspect of "the precautionary principle", which will prevail over any others in the public and private management of the environment. The State shall take preventive measures even in the case wherein any negative impact or negative environmental consequences occur due to any actions or omissions with no proper scientific evidence nor justification.

g. Law of Conservation, Promotion and Sustainable Development of the Forestry Sector, Law 462.

This law aims to establish the legal regime for the conservation, development, and sustainable development of the forest-sector resources; and is a fundamental basis for the forest management of the natural forest, the promotion of plantations, protection, conservation, and restoration of forest areas.

h. Veda Law for the Cut, Harnessing and Commercialization of the Forest Resource, Law 585. It establishes the ban on cutting, harvesting, and commercialization of mahogany, cedar, mangrove, and other important tree species throughout the national territory, which may be renewable for ten years.

i. General Law of National Waters and its Regulations, Law 620. It establishes the institutional and legal framework for the administration, conservation, development, use, sustainable, equitable and preservation in quantity and quality of all water resources in the country, whether surface, underground, residual and of any nature while guaranteeing the protection of other natural resources, ecosystems, and the environment. It creates and defines the functions and powers of the institutions responsible for the administration of the water sector, and duties and rights of users while guaranteeing citizen participation in the resources management. Article 32 of the regulations dictates, based on the criteria of the Nicaraguan Institute of Territorial Studies (*Instituto Nicaragüense de Estudios Territoriales*: INETER) and SINAPRED, the declarations of zones of high risk to flood will be made, which must be approved by the President of the Republic. Article 6 institutes the right of indigenous peoples throughout the national territory and the ethnic communities of the Atlantic Coast for their use and enjoyment of waters within their communal lands.

j. Special Law for the Promotion of Housing Construction and Access to Social Interest Housing, Law 677. This law was published in May 2009, and institutes that all housing projects must comply with the recommendations issued by SINAPRED, in addition to reduce damage risks to be caused by disasters. Article 32 institutes that both SINAPRED and the Urban and Rural Housing Institute (*Instituto de Vivienda Urbana y Rural*: INVUR) will order that all housing protection measures shall be envisaged in housing projects in case of any possible future disasters.

k. General Law of health, Law 423. This law was published in May 2002 and institutes obligations of users to participate and cooperate with public authorities for the prevention and resolution of problems caused by disasters (Article 9). Article 66 dictates that it is the Ministry of Health (*Ministerio de Salud: MINSA*) to dictate technical standards in relation to the pampering standards that must be met in order to guarantee the user an appropriate level of care, including during disasters.

l. Law on Protection of the Cultural Patrimony of the Nation (Decree 1142). The law institutes that the cultural heritage must be protected by the State with proper legal system that guarantee its conservation and avoidance of its moving outside of the country. It establishes that they are considered as important cultural goods from the aspects of a) paleontological, b) archaeological, c) historical, d) artistic, and/or e) urban or rural groups, and institutes that these cultural goods are under the protection and protection of the State.

This law specifies the duty that any person who finds or has knowledge of the existence of paleontological or archaeological properties shall inform the nearest municipality.

m. General Law on Occupational Health and Safety, Law 618. This law establishes the set of minimum provisions that, in matters of occupational health and safety, the State, employers and workers must develop in the workplace through the promotion, intervention, monitoring, and establishing actions to protect workers in the performance of their duties.

n. Law on Citizen Participation, Law 475. This law is important and guarantees mechanisms and criteria in order to exercise adequate communication between the entities of the state and citizens to be involved; and establish a space of feedback that will improve the efficiency and transparency of the process for the project implementation.

o. Penal Code, Law 641. This law incorporates a chapter on environmental crimes. The incorporation of environmental crimes into ordinary criminal legislation is a significant advance in the efficient protection of the environment and natural resources.

p. Environmental Assessment System (Decree 76-2006). The Environmental Assessment System, Decree 76-2006, includes two important components, the SEA and the environmental assessment of works, projects, industries, and activities. The SEA aims to evaluate the policies, plans, and/or projects of national significance. In relation to the evaluation of works, projects, industries, and activities; establish different categories according to the complexity of the same; and determining the procedures that must be fulfilled. Article 12, "National Emergency Activities, Works, and Projects", which states: "For reasons of force majeure, such as projects designed to mitigate disasters or projects of national interest or national security that respond to situations of national emergency and classified in any of the environmental categories, the Ministry of the Environment and Regional Councils may issue an

exceptional resolution of environmental impact study and may give urgent procedure for projects or activities that require an environmental impact study or an environmental assessment, upon request of the National System of Prevention and Mitigation of Disasters, through its executive secretary or the Ministry of Defense with proper statements such as ". It is very important to establish the simple and clear procedure to define and dictate what an exception resolution is.

q. Nicaraguan Obligatory Technical Standard for the Management, Treatment and Final Disposal of Non-Hazardous Solid Waste (NTON 05-014-01). This regulation covers the treatment of non-hazardous solid wastes, or combinations of wastes that do not cause immediate or potential danger to human health or other living species. Among the non-hazardous wastes are household, commercial, institutional, market waste, and street garbage for sweeping. It establishes the technical and environmental criteria that must be met within implementation of any projects and/or activities in order to protect the health environment.

r. Nicaraguan Obligatory Technical Standard for the Handling, Treatment and Final Disposal of Hazardous Solid Waste (NTON 05-015-01). Hazardous waste, according to regulations, are those that are in any physical states, contain significant amounts of substances that may present a danger to the life and health of living organisms when released into the environment or if they are handled incorrectly due to their characteristic that may be corrosive, toxic, poisonous, reactive, explosive, inflammable, biologically harmful, infectious, irritant, or any other characteristics that represent a danger to human health, quality of life, environmental resources or ecological balance. In case of emergency, key indicators to prevent greater accidents and/or disastrous situations shall be considered.

14.1.3 Environmental Impact Assessment and Approval Process

(1) EIA Process in Nicaragua

According to Nicaraguan law, MARENA is the agency responsible for managing the EIA system, among other tasks. In addition, Article 11 of the General Law on the Environment and Natural Resources (Law No. 217) lists environmental permits and EIA among the environmental management instruments; Article 5 of said law defines EIA as the management instrument used to estimate, predict, and control the environmental effects of a specific activity or project.

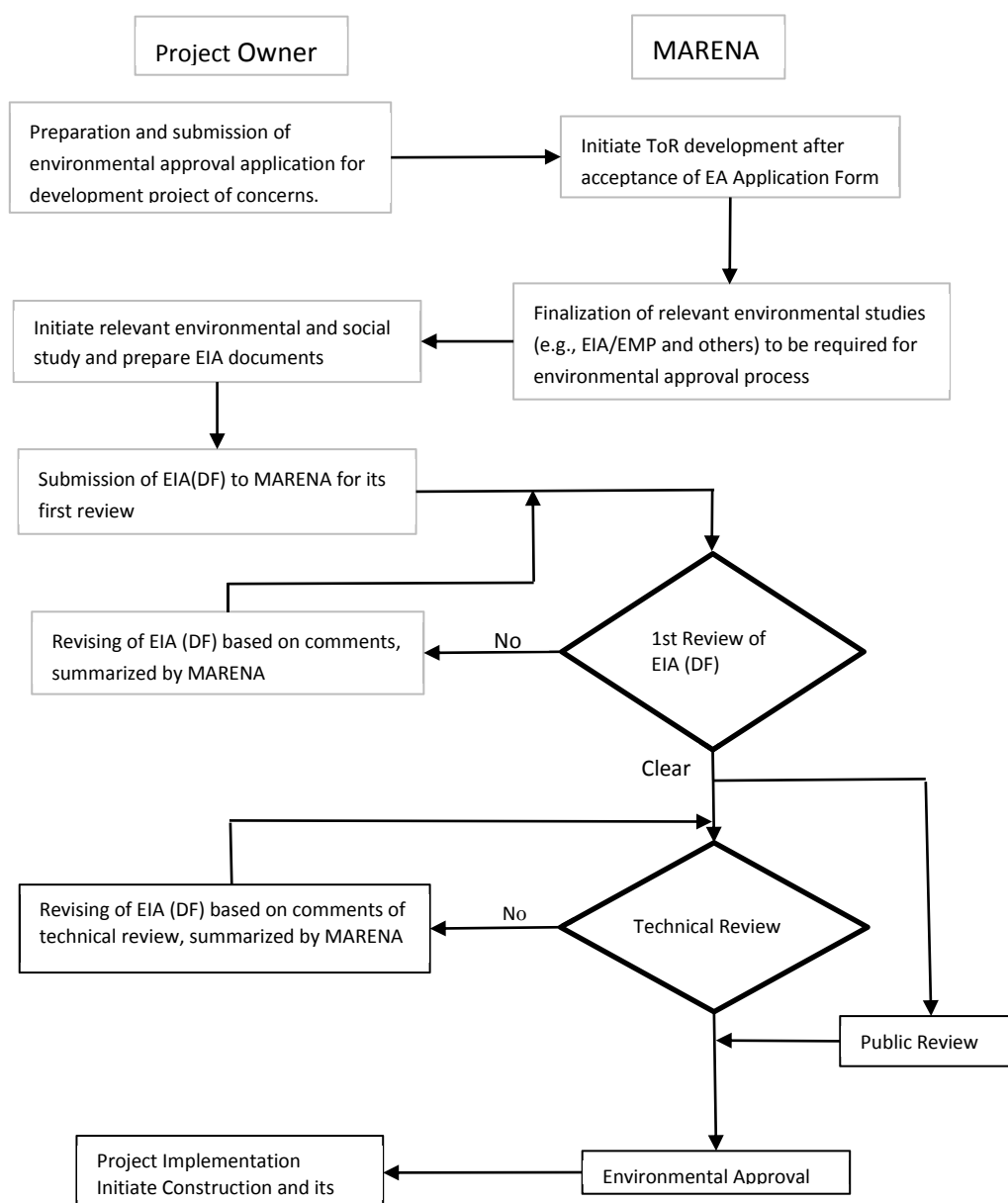
In Nicaragua, EIA is the primary instrument for managing the implications of projects, works, and activities that could damage the environment or impact on the natural resources. The EIA has been conducted in Nicaragua since 1994 (Decree 45-94) but the current environmental assessment system was enacted in 2006 by Decree No 76–2006. This decree divides activities and projects with potential environmental impacts into four categories, specifying whether an EIA or an environmental management program (EMP) is required, and allocates the responsibility to evaluate the EIAs to specific agencies (see Table 14.1.2).

Table 14.1.2 EIA Categories by Projects Expected Environmental Impacts

Category	Characteristics	EIA/EMP Required	Responsible Agencies
Environmental Category I	Projects, works, and activities considered special projects for their national, bi-national, or regional importance; for their economic and social implications; and for their potentially high environmental impact.	EIA	MARENA's Central Office (through the General Directorate of Environmental Quality (<i>Dirección General de Calidad Ambiental</i> : DGCA) in coordination with sectoral environmental units MARENA's
Environmental Category II	Projects, works, and activities with potentially high environmental impact.	EIA	Same as above (but with SERENAs rather than MARENA responsible for the EIA of activities and projects in the South Atlantic Autonomous Region (<i>Región Autónoma dea Atlantico Sur</i> : RAAS) and the North Atlantic Autonomous Region (<i>Región Autónoma dea Atlantico Norte</i> : RAAN).
Environmental Category III	Projects, works, and activities with potentially moderate environmental impact.	EMP	MARENA's delegations in coordination with sectoral environmental units and municipal authorities; SERENA's delegations in the case of the RAAS and RAAN.
Low Impact	Projects, works, and activities with potentially low environmental impact.	N/A	Municipal authorities.

Source: JICA Study Team

Figure 14.1.4 shows the flowchart of the environmental approval process (EIA) in Nicaragua. Table 14.1.3 summarizes the timeline information of the technical review process, one of key components within the entire environmental approval process for each environmental category.



Source: JICA Study Team

Figure 14.1.4 Flowchart of Environmental Approval Process in Nicaragua

Table 14.1.3 Timeline for Technical Review

Category	Time of Environmental Approval Process
Environmental Category I	The MARENA has a minimum term of 120 working days to a maximum term of 240 working days for its technical review and to grant its corresponding resolution for the projects of environmental category I. This term can be interrupted by way of a notification until the required information is completed.
Environmental Category II	The MARENA and the regional councils of the autonomous regions have a maximum term of ten working days to review the preliminary documents received for the projects in environmental category II; and in case there is a need for more information, this will be required in accordance with the ToR. Upon receipt of this additional information, the ten-working day term will be reinstated. Furthermore, MARENA and the regional councils of autonomous regions have a maximum term of 120 working days for its

	technical review and to grant the corresponding resolution for the projects of environmental category II. This term can be interrupted by way of a notification until the required information is completed.
Environmental Category III	There is a maximum term of 30 working days for its technical review and to grant the corresponding resolution for the projects of environmental category III.

Source: JICA Study Team

(2) Environmental Categorization in Japan

Figure 14.1.4 summarizes the list of major infrastructure development projects subject to EIA in Japan.

Table 14.1.4 List of Major Projects Subject to EIA in Japan (Excerpt)

Project Type	Class-1 Project (EIA is always required.)	Class-2 Project (The necessity of EIA is judged by project.)
1. Road National expressway Metropolitan expressway National roads Large-scale forest road	All 4 lanes or more 4 lanes or more, 10 km or longer 2 lanes or more, 20 km or longer	4 lanes or more, 7.5 km - 10 km 2 lanes or more, 15 km - 20 km
2. River dam, weir diversion channel, and lake-related development	Reservoir area: 100 ha or larger Area of land alteration: 100 ha or larger	Reservoir area: 75 ha - 100 ha Area of land alteration: 75 ha - 100 ha
3. Railway Shinkansen (super express train) Railway and track	All Length: 10 km or longer	Length: 7.5 km - 10 km
4. Airport	Runway 2,500 m or longer	Runway 1,875 m - 2,500 m
5. Waste disposal site	Area: 30 ha or larger	Area: 25 ha - 30 ha
6. Landfill and reclamation	Area: exceeding 50 ha	Area: 40 ha - 50 ha
7. Land readjustment project	Area: 100 ha or larger	Area: 75 ha - 100 ha
8. New residential area development project	Area: 100 ha or larger	Area: 75 ha - 100 ha
9. Industrial estate development project	Area: 100 ha or larger	Area: 75 ha - 100 ha
10. New town infrastructure development project	Area: 100 ha or larger	Area: 75 ha - 100 ha
11. Distribution center complex development project	Area: 100 ha or larger	Area: 75 ha - 100 ha
12. Residential or industrial land development by specific organizations	Area: 100 ha or larger	Area: 75 ha - 100 ha

(Source: Ministry of Environment, Government of Japan, www.env.go.jp/en/laws/policy/assess/)

14.1.4 Environmental Monitoring

The objective is to look after and control the level of environmental performance. It consists of monitoring and controlling the implementation of mitigating measures and conditions established in the environmental permit or the environmental assessment program. This vigilance and control will be carried out by authorities as summarized in Table 14.1.5.

Table 14.1.5 Environmental Monitoring

Category	Monitoring Activities
Projects in Environmental Category I	Corresponds to territorial delegations from MARENA and SERENAS from autonomous regional councils in coordination with inter-institutional commission for environmental assessment on special projects.
Projects in Environmental Category II	Corresponds to the territorial delegations from MARENA and/or SERENAS from autonomous regional councils in coordination with environmental assessment units and municipalities.
Projects in Environmental Category III	Corresponds to the territorial delegations from MARENA and/or SERENAS from autonomous regional councils, in coordination with environmental assessment municipal units and corresponding sectorial units. If autonomous regions are involved, monitoring and control will be executed by petitions that determine respective autonomous region regime in coordination with territorial delegations from MARENA.

Source: JICA Study Team

14.1.5 Public Participation

The system for environmental assessment considers that the informed public should participate at all levels. In the autonomous regions, the project should be developed taking into account the customs and traditions of the general public.

As stipulated in Article 33, in the Presidential Decree 76-2006, MARENA should establish special norms that regulate public consultation in the procedures of the environmental assessment based on the following guiding principles:

1. The principal of proactive inclusion, in which all public persons and decision makers are involved in the process; and
2. The principal of shared responsibility, where the State and the general public unite forces in a strategic alliance to prevent and alleviate a negative impact on the environment by agreeing on joint decisions.

14.1.6 Strategic Environmental Assessment (SEA)

Currently, no specific laws nor regulations regarding SEA are in effect in Nicaragua (note: MARENA is preparing for the draft law for the specific SEA implementation, personal communication with MARENA, 2016). However, Article 13 of Decree No. 76-2006, specifies that any plan and/or program of the national, bi-national, or regional level, to be categorized into following categories, shall conduct a relevant SEA study.

1. Sectoral National Development Plans and Programs,
2. National Land Use Plans or Programs,
3. Administrative Development Plans,
4. Regional Plans and Programs, and
5. Land Use and Urban Development Plans.

14.1.7 Environmental Standards

Table 14.1.6 summarizes major environmental standards implemented in Nicaragua. In general, there is no significant gap between Nicaraguan environmental standards and other developed nations such as Japan (e.g., 55 – 60 dBA for daytime noise standards and 40 – 50 dBA for night time ones in Japan).

Table 14.1.6 Major Environmental Standards of Nicaragua

Item	Unit	Criteria	
Air Quality			
SPM	µg/m ³	75	
PM10	µg/m ³	150	
CO	Ppm	9	
Water Quality		Type Category1A	Type Category1B
pH	-	6 - 8.5	6 - 8.5
SS	mg/L	-	-
Turbidity	UNT	< 5	< 250
BOD	mg/L	< 2	< 5
Noise (LeqA)			Designated Construction Activities
	dB (A)	65 (daytime) 45 (night time)	70
Vibration		Designated factories	Designated Construction Activities
	dB	N/A	

Note: In Nicaragua, environmental standards are created by either of MARENA or Ministry of Transport and Infrastructure (*Ministerio de Transporte e Infraestructura*: MTI). No environmental standards for effluent discharge due to construction activities exist. In Nicaragua, the following six categories are for the implementation of the water quality standard depending on the purpose of the water usage:

Type 1: Water quality standards for household and/or industrial uses (Category 1A) and for the simplified sewerage treatment (Category 1B),

Type 2: Agricultural purpose,

Type 3: Coastal areas,

Type 4: Beaches and/or swimming pools,

Type 5: Industrial use without important water use, and

Type 6: Maritime navigation and/or hydropower.

14.2 Current Environmental Status of Managua

14.2.1 Introduction

The current major environmental issues of Managua can be addressed through following three main topics: (i) the southern watershed system, (ii) Managua Lake, and (iii) the urban environment of the capital city. Brief summary of current environmental status for each item are summarized in the following section.

14.2.2 Southern Watershed Group

About 22 km south of the capital, the land rises to from 55 EL-m at the lakefront of Managua Lake to 926 EL-m in the area known as the southern watershed group, consisting of Sub watersheds I – IV (i.e., Cuenca I – IV).

Figure 14.2.1 shows current conditions around the highland area of this watershed region. Although a vast water-recharge forest still exist there, partial deforestations of this watershed area are still ongoing. These watersheds have been deforested due to both agricultural activities such as cattle and coffee, and the human need for firewood. This leads to a rapid erosion and/or loss of retention capacity of the area; thus, resulting in inundation in the downstream urban areas in Managua. Also, the run-off water passes through on its way to the lake, carrying huge quantities of sediment, and then, rapid sedimentation in the Managua Lake.

As environmental mitigation measures, several reforestation and/or agro-forestry development, consisting of fruit trees with wide canopies that protect the soil from erosion due to rainfall are being implemented by several governmental organizations such as the National Forestry Institute (*Instituto Nacional Forestal*: INAFOR) and the Department of Environment and Urban Planning of ALMA. These compound efforts would improve environmental quality while still allowing production, taking advantage of the nearby market for agricultural products.

 <p>Grassland at the starting point of Cuenca II and III</p>	 <p>Roadside view at the starting point of Cuenca II and III</p>
 <p>Water Recharge Forest (towards Concepcion)</p>	 <p>Roadside view of trunk road (Cuenca II)</p>
 <p>Livestock Farming (Cuenca II)</p>	 <p>Agricultural Farm (Cuenca II)</p>

Source: JICA Study Team

Figure 14.2.1 Current Natural and Social Conditions of Southern Watershed Region

14.2.3 Managua Lake

(1) Lake Morphology

The Managua is located at the lake southern shoreline of Managua Lake (also known as Lake Xolotlán, lake surface area $\approx 1,042 \text{ km}^2$, approximately 65 km long x 25 km wide, averaged depth $\approx 9.5 \text{ m}$, maximum depth $\approx 20 \text{ m}$). This lake is located in the middle of the great rift valley connecting Golfo de Fonseca (northwest) and the Nicaragua Lake (southeast). The water surface level of Managua Lake rises significantly during the periods of the heavy rainfall (average surface water level $\approx 37 \text{ EL-m}$).

(2) Lake Flood and Hydrology

There are several tributaries running into Managua Lake from surrounding mountainous area, and its downstream discharge to the Lake Nicaragua is done via the Tipitapa River located at the southeast of the Managua Lake.

Basically, the entire watershed system of the Managua Lake consists of two sub systems: (i) Northern Watershed System, and (ii) Southern Watershed System; and most of major tributaries running into the lake exist within northern watershed subsystem.

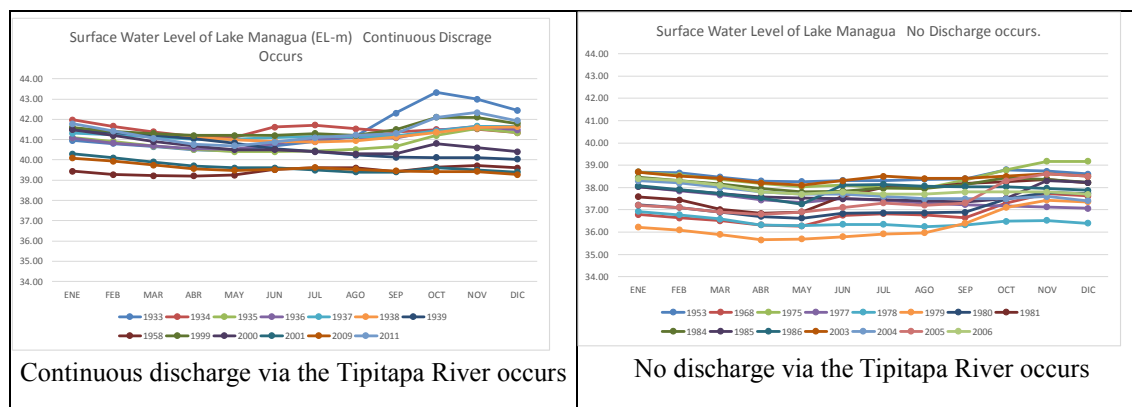
Discharge of the Managua Lake through the Tipitapa River occurs when the surface water level of the Managua Lake becomes higher than 39.19 EL-m. Otherwise, no discharge occurs from the Managua Lake. In general, this no-discharge situation tends to occur during the dry season. However, different dry-season situations sometime occur at the lake within El Niño events (see Table 14.2.1 and Figure 14.2.2), and the continuous discharge occurred for several years in the past.

Table 14.2.1 Summary of Surface Water Level of Managua and its Discharge for the last 87 years (1928 -2014)

Surface Water Level Condition		Numbers of Years
Monthly average water level < 39.19 EL-m (no discharge)	Completely No Flow	15
	Completely No Flow (data missing)	8
	Partially Occur	20
	Partially Occur (data missing)	4
Monthly averaged water level > 39.19 EL-m (discharge occur)	No Data Missing	13
	Data Missing	3

Note that relevant lake surface water level records are provided by INETER. No data is available for following years: 1947 – 1952 (6 years), 1954 – 1957 (4 years), 1960 – 1962 (3 years), 1973 and 1988 – 1997 (10 years).

Source: JICA Study Team



Note that the discharge via the Tipitapa River occurs when the surface water level of Managua Lake becomes higher than 39.19 EL-m. The figure on the left shows the time variation of the water surface level when continuous discharge occur throughout the year. The figure on the right shows the time variation of the water surface level when no discharge occur throughout the year.

Source: JICA Study Team

Figure 14.2.2 Time Variation of the Monthly-Average Surface Water Level of Managua Lake

The highest water level was recorded during the flooding on October 1933 (monthly average surface water level = 43.33 EL-m). In 1998, the lake water level rose by 3 m within five days during Hurricane Mitch (the total amount of the rainfall was approximately 1,900 mm during those five days), destroying the homes of many who lived on its lake shoreline (monthly average surface water level of Managua Lake in November = 42.00 EL-m). An even higher flooding occurred in September/October 2010 (41.72 and 42.66 EL-m in September and October, respectively). Since then, the city has prohibited residential use of the most flood-prone areas, those with the elevation below 42.76 meters above sea level.

After passing from the southern watershed group through Managua, the rainwater drains into Managua Lake, dumping everything it carries with it into the lake water. The rate of sedimentation per square unit of watershed is very high due to the recent deforestation and erosion of the southern watershed system (INETER, personal communication, 2017).

(3) Flora/Fauna

About 20 fish species and crocodiles are found in Managua Lake, and inland fishery is still on-going at certain areas of this lake.

(4) Other Lake-related Environmental Concerns

a. Lake Pollution (Direct Impact)

As mentioned earlier, run-off rainwater passing through the Managua, also carry most of the city's solid waste into the lake. In the 1970s, the lake became a cheap dumping ground for Managua's sewage and dozens of industries that sprang up on its shores. Since the city had no sewage treatment plant at that time, the lake received approximately 130,000 m³ per day of raw sewage (according to 1985 statistics). The different industries discharge a myriad of wastes into the water. One of the worst offenders is

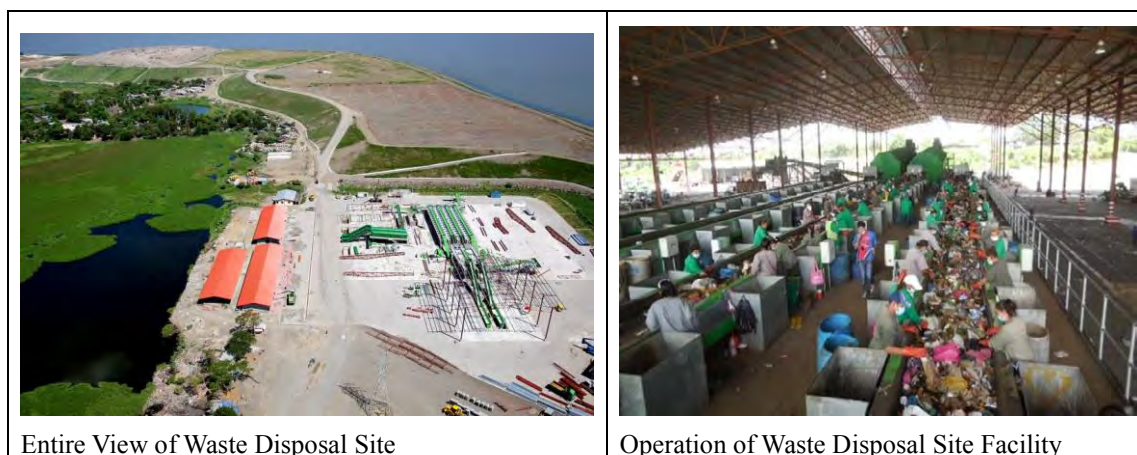
Penwalt Corporation, which releases mercury into the lake; it is estimated that between 1968 and 1981, that company discharged 40 tons of mercury into the lake without proper treatment.

Organic mercury, discharged from the lakeside factory still exist within the lake bottom sediment. Currently, the development of appropriate environmental mitigation program (the health care program for the lake-side community people included) are ongoing by the Center for Research in Aquatic Resources of Nicaragua of the National Autonomous University of Nicaragua (*Centro para la Investigación en Recursos Acuáticos de Nicaragua de la Universidad Nacional Autónoma de Nicaragua*: UNAN-CIRA) with the technical assistance of National Institute for Minamata Disease, Japan.

As mentioned earlier, the lake has no stable outlet except during rainy years when the lake water level is high enough to drain down to the Tipitapa River and then the outlet is reached into the downstream Lake Nicaragua. Otherwise, pollutants reaching Managua Lake will be trapped, accumulated, and will be concentrated therein.

Due to the magnitude of the local lake water hydrodynamics (turbulence), the lake self-purifies its water therein, decomposing organic matters to some extent. But the decomposition of heavy metals such as organic mercury and arsenic cannot be achieved rapidly and thus remain therein.

In 2008, the operation of the final waste disposal site that was moved to the lake shoreline started (see Figure 14.2.3), and the municipal sewerage plant began its operation (approximately 40% – 50 % of the total amount of city-wide sewerage is to be treated) in 2009. After the two facilities started operating, it was reported that pollutant loading into the Managua Lake was reduced considerably, leading to the improvement of the entire water quality of the Managua Lake. Several water quality measurements were conducted in order to grasp the effects of sewerage plant operation.



Entire View of Waste Disposal Site

Operation of Waste Disposal Site Facility

Source: JICA Study Team

Figure 14.2.3 Photo Records of Lakeside Final Waste Disposal Site

b. Lake Pollution (Indirect Impact)

The lake also threatens some portions of Managua's water supply system for water pollution located near the lake due to its local geological permeable character. Basically, local groundwater flow is running from highland area to the Managua Lake. However, when the water level of the Managua Lake becomes higher than nearby groundwater levels, the lake water starts to infiltrate into the aquifer and the flow direction of the local lakeside groundwater is reversed. As a result, it sometimes causes local flooding at basement of nearby buildings and/or houses (INETER, personal communication, 2016). By the same token, when the water level in the Asososca Reservoir drops below a certain height, the Managua Lake's water that may contain certain amounts of toxins leaches towards it through those aquifers.

14.2.4 The Urban Environment of the Capital City

The Managua features three smaller crater lakes or lagoons within city limits (see Figure 14.2.4). The most centrally located is the Tiscapa Lagoon (protected as Tiscapa Lagoon Natural Reserve), located in the south of the old downtown and was formed approximately 10,000 years ago. The Asososca Lagoon, located at the beginning of Southern Highway close to the connection with the New Highway to León, is Managua's most important source of drinking water. The Nejapa Lagoon, south of Asososca Lagoon, is also along the Southern Highway.

Due to those geological features, no physical discharge occurs at those lagoons. In general, water qualities of those lagoons are in good condition compared with those of the Managua Lake. The Asososca Lagoon is one of the important water reservoirs in Managua. Recently, occurrence of some portions of the city sewerage (household effluents from illegal settlers' communities included) discharging into both Tiscapa and Nejapa Lagoons during rainy seasons is becoming one of important environmental issues. Periodical water quality monitoring at those lagoons are conducted and some of those water quality monitoring results are attached in Appendix 4.

According to Department of Environment and Urban Planning of ALMA, there are two environmentally important areas in Managua beside those three lagoons mentioned above, namely, (i) Sabana Groundwater Pumping Area, and (ii) Chiquilistagua Revegetation Area in the south-west of Managua. No strict legal protection system is established and several infrastructure and/or housing construction projects are ongoing in the two environmentally important areas.

As mentioned earlier, Managua boasts vast amount of forest at its mountainous watershed area. It is reported that several mammals, such as foxes, armadillos, rabbits, pakas, deer, coyotes, bobcat, various rodents and reptiles (e.g., iguana, lizards, and snakes), and birds thrive as the local fauna. The local flora is also diverse due to both complex local climate, geographical features around Managua, and 71 species of 37 families have been confirmed. By altitude, it is reported that 24 species of 28 genera in the middle of Managua (altitude 400 EL - m ~ 600 EL - m) and vegetation of 35 species of 32 genera, 26 families in the high altitude (altitude 600 m ~ 800 m) therein (MARENA, personal communication, 2015).



Source: JICA Study Team

Figure 14.2.4 Crater Lakes and Important Groundwater Pumping Area

In the past, several urban environmental monitoring surveys such as urban air quality survey were conducted across Managua. Some of those survey results are summarized in Appendix 4.

14.3 Household Interview Survey (Environmental and Social Aspects)

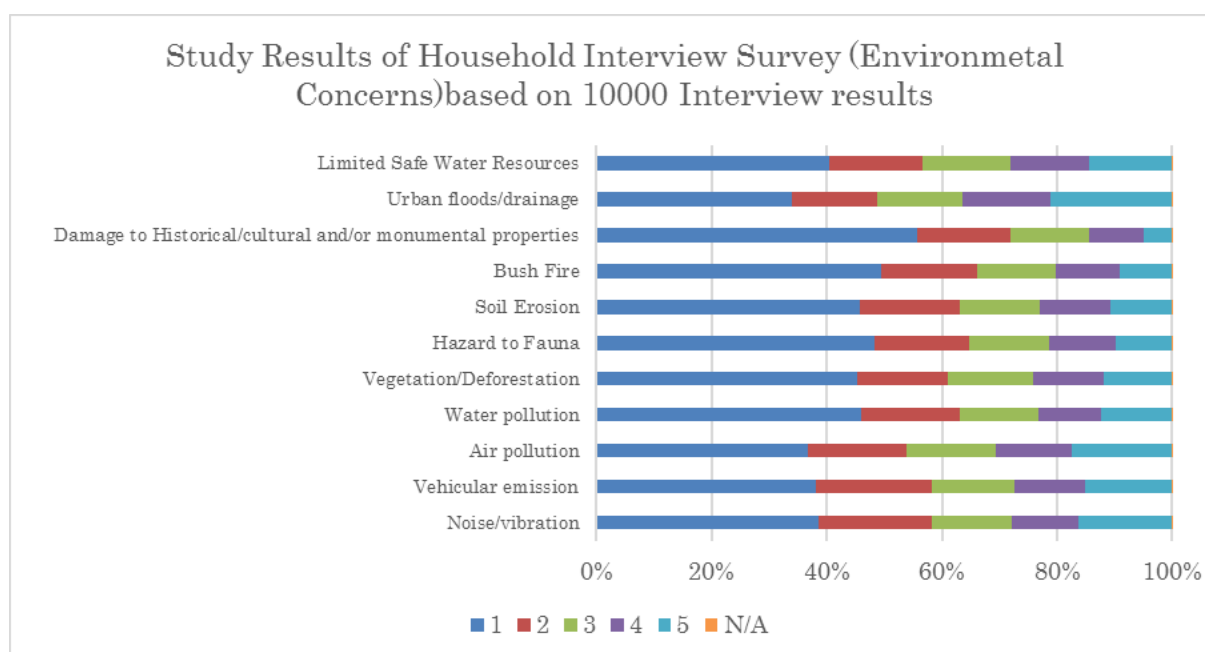
14.3.1 Introduction

Within this PDUM study, household interview survey was conducted in 2016, and 10,000 households returned PDUM-related questionnaire-based survey results (see Chapter 4 for more detailed descriptions for this household interview surveys). Within this survey, four environmental and social concerns-related questions are incorporated, and those survey results are explained in the following sections.

14.3.2 Survey Results

- (1) Questionnaire 1: What are the current main environmental concerns or issues of Managua regarding the urban development?

This question asks interviewees to evaluate the individual importance for 11 environmental issues (“1” for “Less Significant” whereas “5” for “Major Issue and/or Important”). Figure 14.3.1 shows the survey results. From Figure 14.3.1, it is found that most interviewees think the importance and/or individual priority regarding environmental items, listed in the survey, are not high. Even for questionnaire’s result regarding urban flooding/drainage, results shows that about 40% of interviewees place high importance whereas about 50% of them do not. This indicates that they may be satisfied with the current urban environmental condition, or most of them do not have proper understanding of current local environmental conditions.

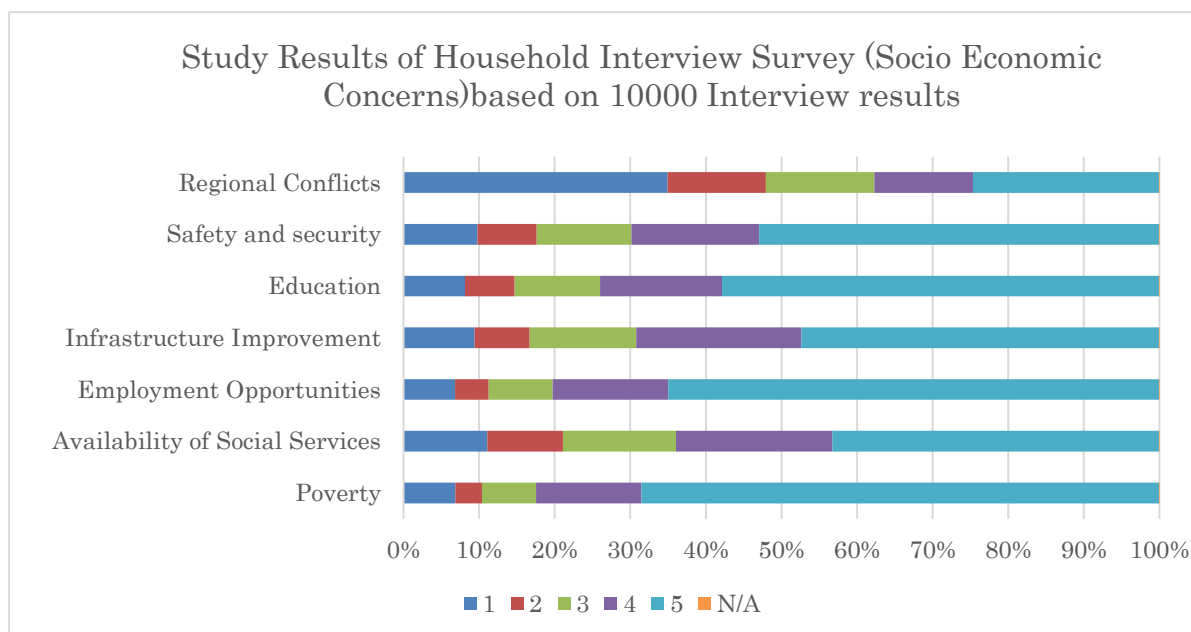


Note that “1” for “less important” while “5” for “Major Important” for its evaluation.
Source: JICA Study Team

Figure 14.3.1 Survey Results Regarding “What are the current main environmental concerns or issues of Managua regarding the urban development?”

- (2) What are the current main socio-economic concerns regarding the urban development of Managua?

This question asks interviewees to evaluate the individual importance for seven socio-economic-related issues (“1” for “Less Significant” whereas “5” for “Major Issue and/or Important”). Figure 14.3.2 shows the survey results. From Figure 14.3.2, it is found that most of interviewees think individual importance and/or priority regarding socio-economic items are relatively high compared with the previous question.



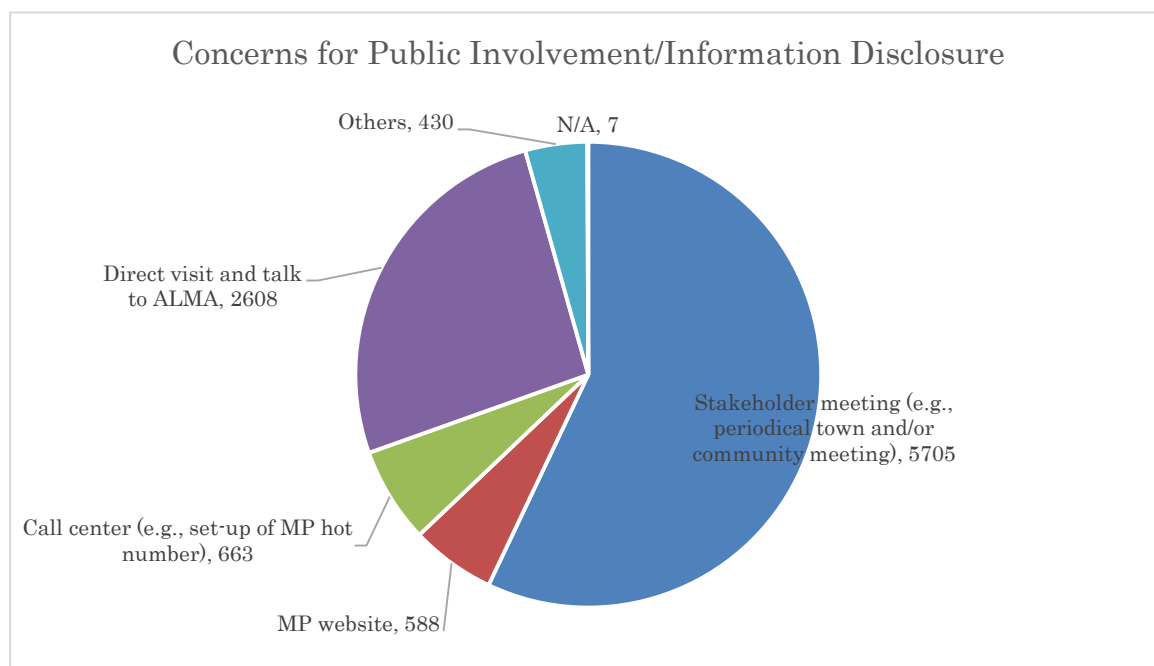
Note that “1” for “less important” whereas “5” for “Major Important” for its evaluation.

Source: JICA Study Team

Figure 14.3.2 Survey Results regarding “What are the current main socio-economical concerns regarding the urban development of Managua?”

- (3) Information disclosure and public involvement program regarding the PDUM is to be initiated soon. Which procedures do you prefer to express your concerns and/or opinions (multiple answers)?

This question asks interviewees their preferences for the constructive public involvement (PI) and information disclosure for the proposed PDUM study. Figure 14.3.3 shows the survey results. From Figure 14.3.3, it is found that about 58% of interviewees prefer to have PI option via the stakeholder meeting and/or community meeting-based approach. Also, about 20 % of interviewees prefer to have direct contact to ALMA for the PDUM study. It is noted that a participatory MP development approach that would conduct a series of stakeholder meetings and relevant focal group meetings across the city is established in order to collect public comments and/or opinions from various stakeholders while disseminating relevant M/P-related information within this PDUM study (see Section 14.4 for more detailed descriptions of the public involvement established within this study).

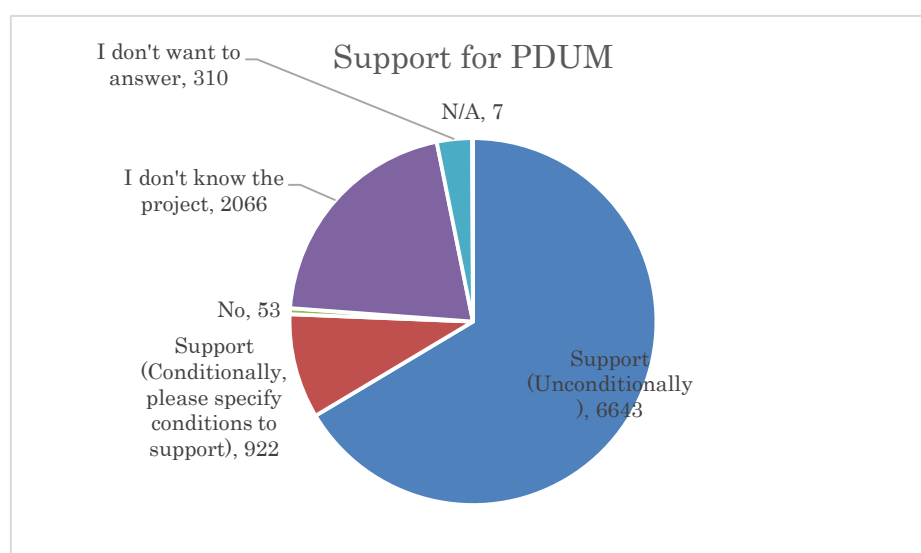


Source: JICA Study Team

Figure 14.3.3 Survey Results Regarding “Information disclosure and public involvement program regarding the PDUM is to be initiated soon. Which procedures you prefer to express your concerns and/or opinions?”

(4) Do you support the ongoing Managua Urban Development MP study?

This question asks interviewees how they regard the proposed PDUM study. Figure 14.3.4 shows this survey results. From Figure 14.3.4, it is found that most of interviewees support the proposed PDUM study whereas about 20 % of them do not know the PDUM project.

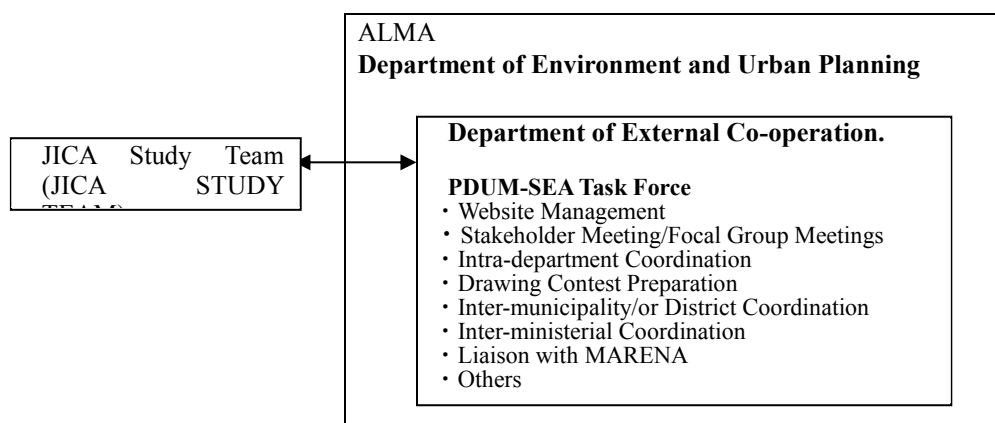


Source: JICA Study Team

Figure 14.3.4 Survey Results Regarding “Do you support on-going Managua Urban Development MP study?”

14.4 Strategic Environmental Assessment

The entire SEA process, to be implemented within PDUM is “stakeholder meeting”- centered (or participatory) SEA, and its main objective is to assess the suitable urban development alternative by sharing PDUM-related information and establishing consensus among various stakeholders through a series of stakeholder meetings. To achieve a smooth implementation of this SEA, a new ad-hoc group, named as the “PDUM-SEA Task Force”, is established within the Department of External Co-operation of ALMA (see Figure 14.4.1). The main role of this newly created group is to supervise all SEA process with relevant technical assistances of the JICA study team. Also, this group establish liaisons with MARENA, relevant governmental organizations, universities, schools, and international development partners including JICA, NGOs, and key stakeholders. Public relation program, which is one of the key components of this SEA process, is also developed and implemented by this group with technical supports from JICA study team. PDUM and SEA website is developed within the ALMA’s website in order to precipitate relevant information disclosure of PDUM study. The operation of this PDUM and SEA website is organized by this group under the supervision of Department of Environment and Urban Planning. Also, a drawing contest regarding the PDUM, one of key public relation events, targets for the education-sector as well as the young generation of Managua citizen, is organized. More detailed descriptions of the website and the drawing contest are summarized later.



Source: JICA Study Team

Figure 14.4.1 SEA Implementation Framework

14.5 Stakeholder Meeting and Public Involvement

14.5.1 Introduction

The stakeholder meeting is one of important parts of this SEA-related technical assistance study for PDUM. According to the discussion between ALMA and the JICA study team, held in May 2016, it was agreed that multiple stakeholder meetings for different social tiers such as (i) city-wide general meeting consisting of government officials, university, private companies, and NGOs, and (ii) local stakeholder

meetings at each district (seven districts in total) and several neighbouring municipalities (two municipalities such as Tipitapa and Sandino are selected since those two cities' urban growth are significant compared with other surrounding municipalities). Based on these discussions, a comprehensive stakeholder meeting program was developed for the SEA study of PDUM (see Table 14.5.1). It is noted that the 3rd round of the stakeholder meeting and focal group meetings are to be held on April and May of 2017. Besides, PDUM workshop that would present the final plan of PDUM that would reflect all comments and/or suggestions of PDUM is to be held later. Contents of stakeholder meeting and its focal group meeting are described in following section, separately.

Table 14.5.1 Summary of Stakeholder Meeting for PDUM

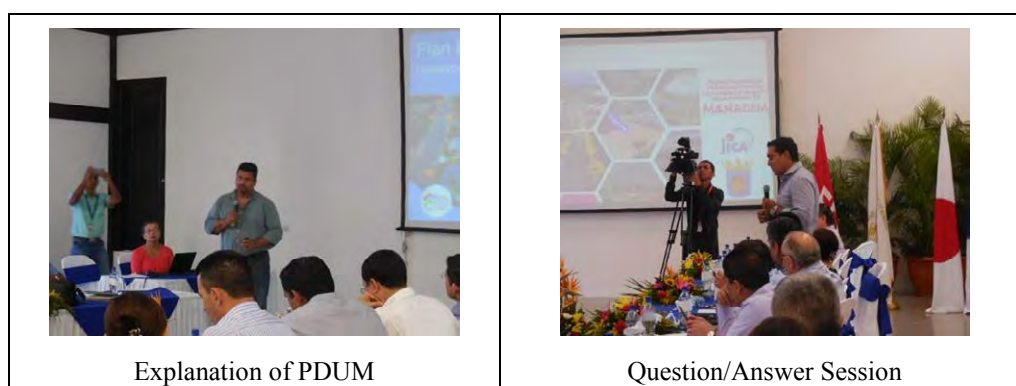
	Schedule	Purpose
Stakeholder Meeting (three times)	June 15, 2016	Explain current urban issues and outline of PDUM
	Dec 01, 2016	Explain visions of urban development and development alternatives
	April 28, 2017	Explain progress of MP study for consensus building among stakeholders.
Focal Meeting Group (three rounds)	June 2016 – August 2016	Current urban issues and PDUM outline
	Jan 2017 – Feb 2017	Vision of urban development and development alternatives
	May 2017 – June 2017	Explain contents of MP (D/F) for consensus building among stakeholders
Workshop (once)	June 22, 2017	Presentation of MP (Final)

Source: JICA Study Team

14.5.2 1st Stakeholder Meeting

Figure 14.5.1 shows the program outline and photo records of the first stakeholder meeting. In total, 80 people attended. Within this meeting, firstly, the project outlines of PDUM and the schedule of its public involvement throughout the entire study period were explained. After these presentations, question and answer session followed.

1. Registration	13:30-14:00
2. Opening Remark	14:00 -14:20
3. Explanation of Study Outline of PDUM	14:20 - 15:00
4. Questions and Answer Session	15:00 - 15:50
5. Closing Remark	15:50 - 16:00
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Overview of first Stakeholder Meeting</p> </div> <div style="text-align: center;">  <p>Opening Remarks by the Mayor</p> </div> </div>	



Source: JICA Study Team

Figure 14.5.1 Program Outline and Photo Records of 1st Stakeholder Meeting (held on June 15, 2016)

14.5.3 First Round of Focal Group Meeting

Table 14.5.2 summarizes the schedule of the first round of the focal group meetings, held at Districts 1 -7 and Tipitapa and Sandino Municipalities. Figure 14.5.2 shows photo records of the first campaign of the focal group meeting.

Table 14.5.2 Summary of Focal Group Meeting (1st Round)

	District No./ Municipality	Date and Time	Venue	Total Number of Participants
1	District 1	June 29, 2016 9:00- 11:00	RUCFA Auditorium	24
2	District 2	June 30, 2016 10:00 -12:00	Seminar Room District II	32
3	District 3	July 06, 2016 10:00-12:00	ALMA – Miguel la Reynaga auditorium	28
4	District 4	July 01, 2016 10:00 – 12:00	Seminar Room district IV	35
5	District 5	June 07, 2016 9:00-11:00	Seminar Room of IAC , District V	34
6	District 6	July 05, 2016 14:00 – 16:00	Seminar Room German Hospital	38
7	District 7	July 05, 2016 9:00 – 11:00	Seminar Room District VII	25
8	Sandino and Tipitapa	Aug 12, 2016 9:00 – 12:00	INIFOM	14

Source: JICA Study Team





Source: JICA Study Team

Figure 14.5.2 Photo Records of 1st Round of Focal Group Meeting

14.5.4 2nd Stakeholder Meeting

Figure 14.5.3 shows the program outline and photo records of the second stakeholder meeting. In total, 54 people attended. Within this meeting, firstly, the study progresses of PDUM, in particular, review of the 1st stakeholder meeting and focal group meetings and pros and cons of several future urban development strategies such as the creation of new urban subcenters were explained. After these presentations, question and answer session followed.

1. Registration	13:30-14:00
2. Opening Remark	14:00 -14:20
3. Explanation of Study Progress of PDUM	14:20 - 15:00
4. Questions and Answer Session	15:00 - 15:50
5. Closing Remark	15:50 - 16:00



Source: JICA Study Team

Figure 14.5.3 Program Outline and Photo Records of 2nd Stakeholder Meeting (held on December 01, 2016)

14.5.5 Second Round of Focal Group Meeting

Table 14.5.3 summarizes the schedule of the first round of the focal group meetings, held at Districts 1-7 and Tipitapa and Sandino Municipalities. Figure 14.5.4 shows photo records of the second round of the focal group meeting.

Table 14.5.3 Summary of Focal Group Meeting (2nd Round)

	District No./ Municipality	Date and Time	Venue	Total Number of Participants
1	District 1	February 03, 2017 14:30 – 16:00	Sala de conferencia, Parque Japonés	27
2	District 2	January 12, 2017 14:00 – 16:00	Auditorium of Nacional Police District 2	24
3	District 3	January 25, 2017 10:00 – 11:10	ALMA Miguel la Reynaga auditorium, Managua	25
4	District 4	January 20, 2017 10:00 – 12:00	Seminar Room of District 4	21
5	District 5	January 25, 2017 10:00-12:00	Seminar Room of IAC, District 5	32
6	District 6	January 26, 2017 15:00 – 17:00	Seminar Room of District 6	39
7	District 7	January 31, 2017 09:00 – 11:00	Seminar Room of District 7	35
8	Sandino and Tipitapa	February 09, 2017 14:00 – 16:00	INIFOM	11

Source: JICA Study Team



Source: JICA Study Team

Figure 14.5.4 Photo Records of 2nd Round of Focal Group Meeting

14.5.6 3rd Stakeholder Meeting

Figure 14.5.5 shows the program outline and photo records of the third stakeholder meeting. In total, 48 people attended. Within this meeting, firstly, review of the 1st and 2nd stakeholder meetings and focal group meetings were explained. Then, the study progresses of PDUM, such as the future urban planning/land use and public transport system were explained. After these presentations, question and answer session followed.

1. Registration	8:30-9:00
2. Opening Remark	9:00 -9:20
3. Explanation of Study Progress of PDUM	9:20 - 11:00
4. Questions and Answer Session	11:00 - 11:50
5. Closing Remark	11:50 - 12:00

 <p>Overview of Third Stakeholder Meeting</p>	 <p>Opening Remarks by the Mayor</p>
 <p>Explanation of PDUM</p>	 <p>Question/Answer Session</p>

Source: JICA Study Team

Figure 14.5.5 Program Outline and Photo Records of 3rd Stakeholder Meeting (held on April 28, 2017)

14.5.7 Third Round of Focal Group Meeting

Table 14.5.4 summarizes the schedule of the first round of the focal group meetings, held at Districts 1-7 and Tipitapa and Sandino Municipalities. Figure 14.5.6 shows photo records of the second round of the focal group meeting.

Table 14.5.4 Summary of Focal Group Meeting (3rd Round)

	District No./ Municipality	Date and Time	Venue	Total Number of Participants
1	District 1	May 26, 2017 14:00 – 16:00	Sala de conferencia, Parque Japonés	17
2	District 2	May 12, 2017	Auditorium of Nacional Police	14

		14:00 – 16:30	District 2	
3	District 3	May 19, 2017 14:00 – 16:10	ALMA Miguel la Reynaga auditorium, Managua	16
4	District 4	May 10, 2017 9:00 – 11:00	Seminar Room of District 4	33
5	District 5	May 09, 2017 10:00-11:30	Seminar Room of IAC, District 5	33
6	District 6	May 23, 2017 16:00 – 17:00	Seminar Room of District 6	50
7	District 7	May 18, 2017 09:00 – 11:00	Seminar Room of District 7	20
8	Sandino and Tipitapa	June 07, 2017 16:00 – 17:00	INIFOM	13

Source: JICA Study Team



District 1



District 2



District 3



District 4



District 5



District 6



Source: JICA Study Team

Figure 14.5.6 Figure Photo Records of 3rd Round of Focal Group Meeting

14.5.8 MP Workshop

As listed in Table 14.5.1, MP Workshop was held on June 22, 2017 at Auditorium Miguel Larreynaga of ALMA. Figure 14.5.1 shows photo records of this workshop. In total, 45 people attended, and workshop started at 10:00 am and adjourned at the noon. Within this, draft final of PDUM was explained, and then question and answer session was followed.



Source : JICA study team

Figure 14.5.7 Photo Records of MP Workshop (held on June 22, 2017)

Box below summarizes key comments, obtained from participants.

INETER: In order to implement PDUM, it is necessary to conduct coherent monitoring all the times, taking into account unforeseen and upcoming changes which may be significant and/or drastic for the citizen. It is necessary that the development plans, proposed within this PDUM, shall be slow and needs a lot of commitment and consensus from all stakeholders. Also in order to implement a good disaster management, it is necessary to prepare a hazard map in a scale 1:5000

MTI: Ms. Rosa Rodriguez from Road Transport Department, firstly congratulated the team and commented the proposed PDUM as excellent. Secondly she advised that it should take into account people from rural areas that come to the city with their products to sell in the oriental market and others within the bus terminals relocation.


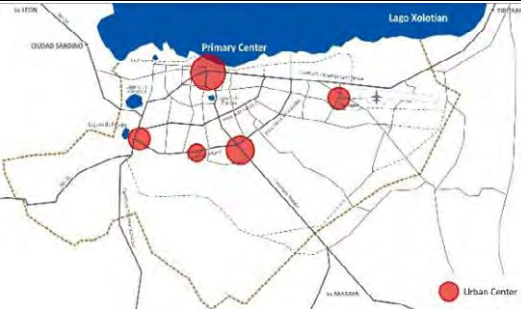
MARENA: MARENA stress out the importance of land use control, in particular, expansion of agricultural zones. It is important that this rule of thumb shall be abided within in the implementation of PDUM.


14.6 Analysis on Planning Alternatives (structure plan)

(1) Outline

Table 14.6.1 summarizes three development structure alternatives strategies, proposed within this PDUM study. It is noted that several land use strategies that would control a city-wide future population density are to be implemented in conjunction with the implementation of PDUM (see Table 14.6.2). In order to conduct an evaluation of five proposed development structure alternative strategies, following two matrices, (i) Compound Matrix, and (ii) Risk and Opportunity Matrix, are developed.



Table 14.6.1 Summary of Proposed Development Structure Alternative Plan

Structure Plan	Image of Structure	Characteristics
STR-1 CBD One core system (mono core)		Only one strong nuclei which develops and there is no existence or important function in other centers. By establishing new urban core, it is expected to have orderly urban movement to some extents and would have severe traffic congestions and resultant degradation of the roadside air quality and noise/vibration environment around newly created urban core.
STR-2 Sub-center system (poly nucleated development)		There is no dominating single settlement; all nodes of the polycentric network have the same relevance of "spatial participation". Future traffic congestions and resultant roadside air quality and noise/vibration environment degradations around the primary and sub centers would be alleviated to some extent, compared with "STR-1".

Structure Plan	Image of Structure	Characteristics
STR-3 No core nor sub-center system (present trend)		Regarded as “No Action” plan. City will grow and expand as it is. No harmonized orders such as urban transport, land use, settlement, protection of environmental reserves nor others is to be introduced. As a result, future urban condition will be more chaotic and in disorder.

Source: JICA Study Team

Table 14.6.2 Land Use strategies to control city-wide population densification

Scenario 1: Without densification	Scenario 2: With densification and protection of reserved area
	

Source: JICA Study Team

The compound matrix, mentioned above, is used, principally to evaluate individual PPPs (Policy, Plan and Program) against a range of environmental criteria, which serve as indicators of the existing environmental and social conditions. This approach was used for the SEA study of Kumashi Urban Development Master Plan Study, conducted in Ghana (JICA, 2013). Basically, this evaluation is conducted, regarding four sub-categories such as (i) natural resources, (ii) socio-cultural, (iii) economic, and (iv) institutional ones. Table 14.6.3 summarizes evaluation factors.

Environmental risk and opportunities matrix, also, mentioned earlier, helps to assess the potential risks and opportunities associated with each individual PPPs, so that remedial and/or mitigation measures for the risk can be proposed and factored in the design of the PPP. Within this SEA study, a similar methodology, used in Ghana, is used, reflecting the site-specific features across the study area.

Table 14.6.3 Evaluation Factors for SEA (draft)

Natural Resources	Socio-Cultural	Economic	Institutional
Water Pollution Erosion Deforestation Ecosystem Conservation Flood	Waste Management Traffic Congestions Noise/Vibration Air Quality Illegal settlement Improvement of Safety and Amenity Land Litigation	Unemployment Poor Accessibility to market/or Business Districts. Poor Road Network Low Income	Urban Development Control Urban Development Promotion System (Private Sector) Public Participation/public awareness Information Disclosure System

Source: JICA Study Team

(2) Compound Matrix

Table 14.6.4 summarizes the compound matrix of each development structure alternative, summarized in Table 14.6.1 and Table 14.6.2. Specific negative risk, associated with the implementation of each development structure alternative, is summarized in following section.

As summarized in this table, by implementing STR-1, a new urban core center, never existed since last severe earthquake event occurred in 1972, is going to be established. It is expected that this new core will play a vital function as CBD of Managua, and then, an orderly urban movement of the urban transport is to be created eventually. Also, high-rise, multi-storying buildings such as tower complex is to be constructed across this new urban core center. Those building complex, sometime, provide “building valley phenomenon” that would trap vehicle emissions inside of urban core area for a longer time, cause the local air quality degradation, and may cause health problems such as asthma for vulnerable people such as small children and/or elderly people eventually.

By implementing STR-2, certain amounts of alleviation of traffic congestions and the improvement of related roadside environment are expected to occur although several infrastructure developments shall be conducted around the current suburb areas of Managua. More detailed pros and cons of each development structure alternatives are summarized, using the risk and opportunity matrix in next section.

No positive impact can be recognized for STR-3 scenario (i.e., “No Action” Plan”, and current city traffic congestion and its resultant roadside environmental conditions such as the air quality and noise are getting worse.

Table 14.6.4 Compound Matrix for Selected Development Structure Alternatives

	Natural Resources					Socio-Cultural Issues							Economic Issues			Institutional				
Evaluation Factors	Water body pollution	Erosion	Deforestation	Ecosystem Conservation	Flooding	Waste Management	Traffic Congestion	Noise/Vibration	Air Quality	Illegal settlement	Improvement of Urban Safety and Amenity	Land encroachment	High unemployment	Poor accessibility to markets/or business district due to traffic jams	Poor road network	Low Income	Urban Development Control	Urban Development Promotion System (Private Sector)	Public Participation/public awareness	Information Disclosure System
STR-1	?	?	?	?	?	-	-	-	-	?	?	?	?	+	+	0	+	+	+	+
STR-2	?	?	?	?	?	-	-	-	-	?	?	?	?	+	+	0	+	+	+	+
STR-3	-	-	-	-	-	-	-	-	-	-	-	-	?	-	-	0	-	-	?	?
Note																				
	+	: Likely to be Positive																		
	-	: Likely to be Negative																		
	0	: Likely to be Neutral																		
	?	: Uncertain																		

Source: JICA Study Team

(3) Risk and Opportunity Matrix

Table 14.6.5 summarizes the environmental risk and opportunity matrix for selected development structure alternatives, summarized in Table 14.6.1 and Table 14.6.2. As summarized in this table, each development structure alternative has its own advantage and disadvantage of its implementation, and preparation of relevant environmental and social management plan or program would be essential to make implementations of those options environmentally and socially sound ones. In “Do-nothing scenario (i.e., STR-3, listed in Table 14.6.5)”, it would be obvious that current county-wide issues such as disorganized land use conditions, traffic congestion, illegal settlement, improper waste treatment system, deforestation and other will not be changed (most likely to be worsened).

From the urban development and management points of views, potential advantages to lessen the difficulties for implementation of urban development and/or improvement programs in future would be significant. Besides, it can be expected that chronic shortage of basic infrastructure facilities such as waste disposal sites, one of important current urban issues, would be solved by the implementation of PDUM. It is noted that temporal environmental degradations would be inevitable within construction activities due to its implementation. It would be beneficial to prepare mid-term or long-term comprehensive regional management plans or strategies for the implementation of future urban development program, based on any development structure alternatives (i.e., STR-2, listed in Table 14.6.5). More specific environmental and social program shall be developed after specific development projects including relevant construction plans are delineated.

Table 14.6.5 Environmental Risk and Opportunity Matrix for Selected Development Structure Alternative

Development Structure Alternative	Anticipated Risk	Proposed Mitigation/Implementation Guideline
STR-1	<ul style="list-style-type: none"> • Future local traffic congestion/crowdedness and resultant roadside air quality and noise/vibration environment would be observed around the newly established urban core center (i.e., CBD) after its establishment. • Increased risk of temporal traffic jams during new urban center construction period. • Increased risk of building valley effect (to be described later) across new urban center. • Increased risk of heat island effect across new urban center. • Increased human activity pressure on Tiscapa Lagoon protection area (located near to new core center). • Increased risk of temporal stoppage of urban services due to massive destruction of single urban center in case of severe future earthquake event. 	<ul style="list-style-type: none"> • Need to establish organized comprehensive urban development program covering from land use, transport, social safety and services, and environment as well as relevant capacity development while establishing integrity with regional development plan, mentioned above. • Need to develop a city-wide, long-term urban environmental and social monitoring and management program covering from social safety and services, and environment, on particular, local environment for new core center to check the interaction between PDUM implementation and urban environment periodically. • Need to establish relevant capacity development before starting relevant environmental monitoring and management program.
STR-2	<ul style="list-style-type: none"> • Compared with STR-1, congestion and crowdedness, to be observed at CBD and several sub-core centers would be 	<ul style="list-style-type: none"> • Need to establish organized comprehensive regional development

	<p>alleviated.</p> <ul style="list-style-type: none"> • Increased risk of temporal traffic jams during new sub-center construction period. • Increased risk of building valley effect (to be described later) across new urban sub centers. • Increased risk of heat island effect across new urban sub-centers. • Possibilities in that newly developed sub-center would become new pollution source exist, but possible intensity and/or the order of the magnitude of future negative impacts of each sub-center and residential area would be lessened compared with STR-1 due to the wider organized distribution of future population. • Risk of reduction of open spaces such as green, wetland and forest areas would be increased due to construction of new sub-centers, compared with STR-1. 	<p>plan covering from basic infrastructure (e.g., transport network, adequate water supply, sewerage, waste management, power supply to other basic social services (e.g., school, medical center, market and others) while establishing integrity with regional development plan, mentioned above.</p> <ul style="list-style-type: none"> • Need to establish city-wide, long-term comprehensive environmental and social monitoring and management program covering from social safety and services, and environment for each sub-center. • Need to establish relevant capacity development before starting relevant environmental monitoring and management program.
STR-3	<ul style="list-style-type: none"> • More worsened and disorganized land use across entire city area and resultant traffic congestion, illegal settlement, waste dumping, deforestation and others. • More urban traffic congestion, and resultant loss of business opportunities, more disorganized traffic safety, worsened roadside environment such as noise, vibration and air quality, and deterioration of urban amenity and environmental quality. • Difficulties for implementation of urban development and/or improvement programs in future remain. • Worsened chronic shortage of basic infrastructure facilities (e.g., construction of new waste disposal sites). • Difficulties to implement city-wide environmental and social management programs in future remain. • Possible future urban amenity degradation due to mass exodus of population to suburb areas (e.g., Detroit, USA). 	<ul style="list-style-type: none"> • Need to establish organized comprehensive regional development plan covering from basic infrastructure (e.g., transport network, adequate water supply, sewerage, waste management, power supply to other basic social services (e.g., school, medical center, market and others) while establishing integrity with regional development plan, mentioned above. • Need more organized operation of regional transport network, water supply and waste management system due to the increase of collective residential areas and sub-centers. • Need to develop a city-wide, long-term urban environmental monitoring and management program to check the interaction between on-going urban development activities and urban environment periodically.

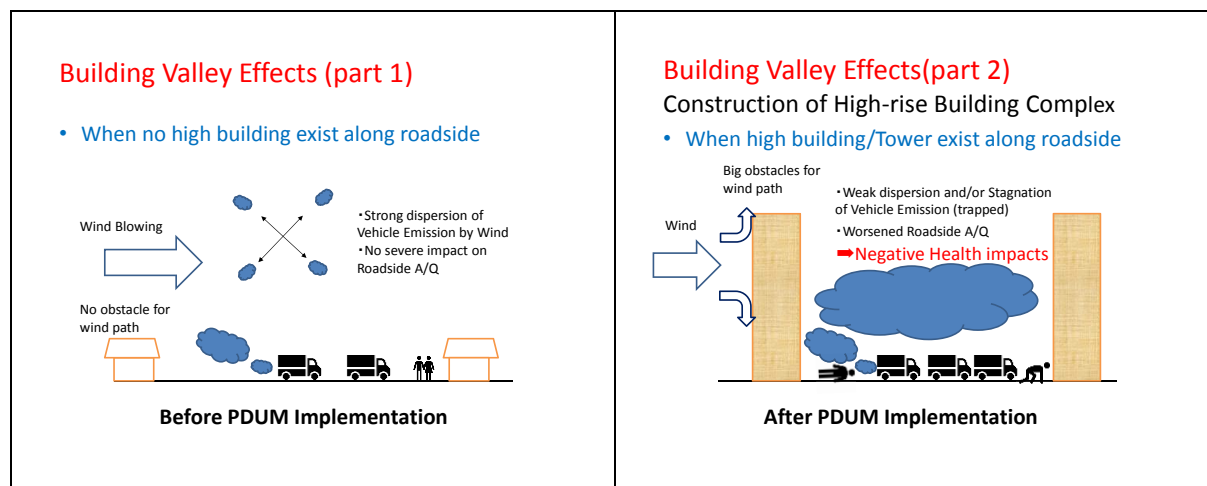
Source: JICA Study Team

(4) PDUM-related Key Environmental Concerns

No matter which developing alternatives and/or scenarios of future Managua, discussed earlier, are to be implemented for the future urban development, it can be said that there will be sets of high-rise building complex at both future urban core or sub-centers with increased urban traffic volumes circulating therein. As a result, the local vegetation cover at those urban core center and sub-centers would be decreased due to those development activities and the coverage of the asphalt and/or mortar pavements on the ground surface of those local areas would be increased.

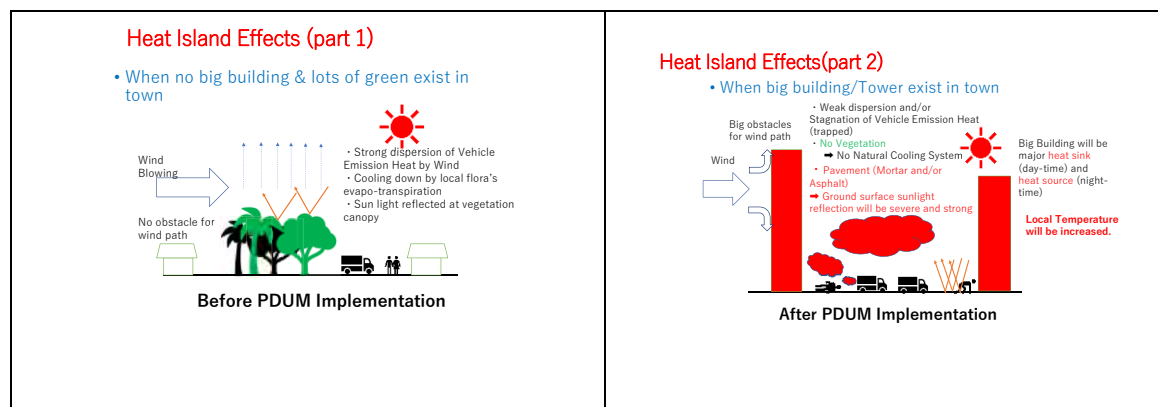
Then, under those situations without proper mitigation measures, several new urban environmental concerns such as “building valley effects” and resultant local urban air quality degradation (see Figure 14.6.1) and/or “heat island effects” and resultant local urban temperature hike (see Figure 14.6.2) may be raised due to the implementation of PDUM. The mechanism and the relevant mitigation methods and/or policies for those “building valley effect” and “heat island effect” in urban areas are discussed through a series of the technical working group sessions between JICA study team and Department of Environment and Urban Planning of ALMA. Common understanding and the importance of a city-wide environmental monitoring (to be discussed later) to monitor those “building valley effect” and “heat island effect” are shared between JICA study team and Department of Environment and Urban Planning

of ALMA. It is noted that as the implementation of PDUM goes on, there will be other types of future urban environmental and social issues such as the wastewater treatment, waste disposal system, water resources conservation, disaster prevention and others. Those topics are addressed within this main report, separately. Besides, those topics are discussed between JICA study team and ALMA within a series of relevant technical working group (TWG) sessions (see Chapter 1 for more detailed descriptions of the TWG classification). In this Chapter, the possible urban air quality degradation due to the implementation of PDUM without proper environmental mitigation nor management programs are of concerns.



Source: JICA Study Team

Figure 14.6.1 Schematic Diagram of “Building Valley Effect”



Source: JICA Study Team

Figure 14.6.2 Schematic Diagram of “Heat Island Effect”

(5) Preparation of Urban Environmental Monitoring

A discussed earlier, it would be inevitable to have an either of “building valley effect” or “heat island effect” as the implementation of PDUM goes on. Relevant mitigation measures and its monitoring shall be prepared, and then, implemented within a long-term framework. Main objectives of this urban environmental monitoring are summarized as follows,

Objectives:

1. Provide information that would enable more accurate prediction of impacts associated with development plan of concerns.
2. Warning of anticipate adverse impacts or sudden changes
3. Provide immediate warning
4. Provide information which could be used to control the timing, location and level of impact.
5. Effectiveness evaluation of the implemented mitigation measures.
6. Provide information which could be used to verify predicted impacts and thus validate impact-prediction techniques.

By establishing and implementing proper urban environmental monitoring, relevant data accumulations is expected to occur, and that would increase the validity of the entire citywide environmental management framework. Basically, there are following two environmental monitoring scheme project manager shall consider,

Monitoring Scheme

1. Comprehensive Environmental Monitoring Program:

- ➡ Set of activities which provide chemical, physical, geological, biological, and other environmental, social, or health data required by environmental managers.

2. Targeted Monitoring program:

- ➡ This could include elements related to environmental media (air, surface, and/or groundwater; soil; and noise), biological features (plant, animals, and habitats), visual resources, social impacts, and human health.

Key topics regarding the monitoring scheme of the proposed urban environmental monitoring system, to be required for the PDUM implementation and other detailed issues such as the parameters to be monitored, are discussed through a series of the technical working group sessions between JICA study team and Department of Environment and Urban Planning of ALMA.

14.7 Integration of Public Comments into the Master Plan

Based on stakeholder meetings, held during SEA study of PDUM, three (3) city-wide public consultations and twenty four (24) focal group meetings are conducted across Managua and two neighbouring cities such as Sandino and Tipitapa to precipitate constructive information dissemination of PDUM study, encourage the citizens to contribute and share their desired aspirations in the development of the city (see Sections 8.4 and 8.5 for more detailed descriptions).

The purpose of the consultations is to share information of the current city situation, challenges and opportunities as well as contents of PDUM, to have sectoral discussions with various stakeholders, and then, to consolidate the study consensus further. Within the forum, validity of development options were discussed in order to build consensus and agreements for selected priority programs and projects. In order to encourage more interactive deliberations and to gain more insights into sectoral issues, thematic working group discussions were organized, and more sector-specific discussions were conducted at each district. Table 14.7.1 and Table 14.7.2 summarize major findings and remarks, commonly found within each discussion (25 comments, obtained from two stakeholder meetings as well as 104 comments, obtained two rounds of focal group meetings, as of March 2017). It is noted that those findings and remarks, mentioned above, are incorporated into PDUM.

Table 14.7.1 Major PDUM Remarks and/or Comments (Stakeholder Meetings)

	Type of Comments	# of Counting
Urban Infrastructure and Land Use		

1	Improve and extend city-wide infrastructure	4
2	Upgrading/renovate water supply and sewerage system	1
3	Harmonize with other on-going projects	1
4	Proper land use and balanced densification	1
5	Land use and disaster management	1
6	NMV inside of city	1
7	Need city core center	1
8	Need to have more multi-story housing complexes	3
Public Involvement		
9	Information sharing and common understanding of PDUM among stakeholder	1
Institutional		
10	Need to have public awareness workshop and/or campaign for living in multi-story housing complexes	1
11	Improve and/or update land-use-related legal framework	2
12	Set up an inter-institutional committee to regulate urban land use, including private sector.	1
13	Improvement of city service network	2
14	Easy access to land-use related information	1
Hydrology and Environment		
15	Fair and sustainable use of the water resources and aquifer.	1
16	Precaution with the protection of the soil cover	1
17	Conservation of lagoons and Lake Managua	1
Market		
18	Need to improve functions of Oriental Market	1
Total		25

Note; 1st stakeholder meeting held on June 15, 2016, and 2nd on 1st December 2016.

Source: JICA Study Team

Table 14.7.2 Major PDUM Remarks and/or Comments (Focal Group Meetings)

	Type of Comments	# of counting
Urban Infrastructure and Land Use		
1	Public Health and sufficient hospital facilities	3
2	Importance of a rapid urban transport system such as train or BRT between Tipitapa/Ciudad Sandino, Granada/Ticuantepé	4
3	Upgrading of public transport system (bus)	4
4	Improve and secure the safety of international bus terminal	1
5	Relocation of bus terminal	1
6	Traffic congestion	6
7	Improvement of traffic signal	1
8	Sufficient parking spaces	2
9	Amenity of townscape	1
10	Improvement of power grid system	1
11	Improve and extend city-wide infrastructure such as urban road network	3
12	Upgrading/renovate water supply and sewerage system	4
13	Upgrading/renovate waste disposal system	2
14	Harmonize with other on-going projects	1
15	Coordinated urban infrastructure development among various sectors (e.g., MTI and ENACAL)	1
16	Set up Exclusive lanes for ambulances and fire trucks	1
17	Need to have more multi-story housing complexes	2
18	Urban floods and appropriate drainage	3
19	Relocation of industrial complex from Managua to suburban areas	1

20	NMV inside of city	2
Public Involvement		
21	Need to discuss comprehensive environmental issues among various sector, in particular, schools and communities	3
22	Importance of constructive public involvement	6
23	Information sharing and common understanding of PDUM among stakeholder	1
Institutional		
24	Proper Land Use and balanced densification	1
25	Need to have public awareness workshop and/or campaign for less-polluted Managua while promoting recycling to reduce public landfills for future Managua	1
26	Secure the urban safety (drivers included)	4
27	Strict legal enforcement on drunken drivers	1
28	Need proper traffic educations for drivers	1
29	Strict legal enforcement	4
30	Invalidating environmental certificates, already approved for the business operation of companies, illegally established in residential areas.	2
31	Strict legal enforcement regarding the local land use	3
32	Necessity of new address coding system	1
33	Need to have public awareness workshop and/or campaign for living in multi-story housing complexes	1
34	Need to incorporate comprehensive disaster management	3
35	Improvement of city service network in conjunction with sub center	2
36	Importance of education	4
37	Appropriate taxi services and fare system	2
Hydrology and Environment		
38	Need to address climate change-related issue	1
39	Illegal tree cutting and resultant rapid sedimentation	1
40	Illegal waste dumping and rapid sedimentation	2
41	Pay attentions to district-specific environmental and disaster-prevention issues	2
42	Fair and sustainable use of the water resources and aquifer.	4
43	Conservation of green areas, environmental protection	2
Market		
44	Need to improve functions of Oriental Market	6
45	Need to improve functions of major markets in Managua	2
Total		104

Note; 1st FGM held on June - August, 2016, and 2nd on January-February 2017.

Source: JICA Study Team

14.8 Website Development and Management

14.8.1 Introduction

The website for PDUM is developed within the website of ALMA (its domain name is <https://www.managua.gob.ni/2017/04/04/plan-maestro-para-el-desarrollo-urbano-del-municipio-de-managua/>) in collaboration with the Department of Information and Technology of ALMA. The main objectives of this website development are the following: (i) to promote public participation, (ii) to provide opportunities for the general public and key stakeholders to learn the master plan formulation, (iii) to educate the general public about the master plan development process (i.e., support for the empowerment) and provide opportunities for citizenry participation during the master plan formulation process, and (iv) to obtain feedback from the general public and key stakeholders. Those feedbacks will be integrated within the master plan formulation process.

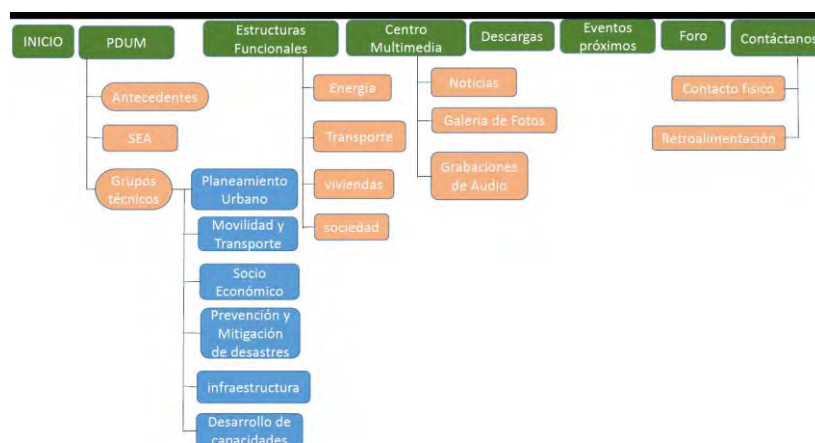
The website development is part of the strategies for strengthening public participation in the formulation of PDUM. This is alongside public advertisement in the newspapers, television and other suitable media. It is noted the prototype of this website has been developed but not starts its full-scale operation, yet (Note: PDUM website operation has been started in April 2017).

14.8.2 Content

Basically, this website contains the following features:

1. Outline of the entire MP Study,
2. Relevant information regarding the proposed MP Study (e.g., material of Technical Working Group),
3. Interim, Progress, Draft Final, and Final Report,
4. Stakeholder and focal group program (e.g., notice of date, venue, and others),
5. Question and answers session,
6. List of past question and answer session with attendance list,
7. Drawing Contest program (notice of date, venue, and others), and
8. Others.

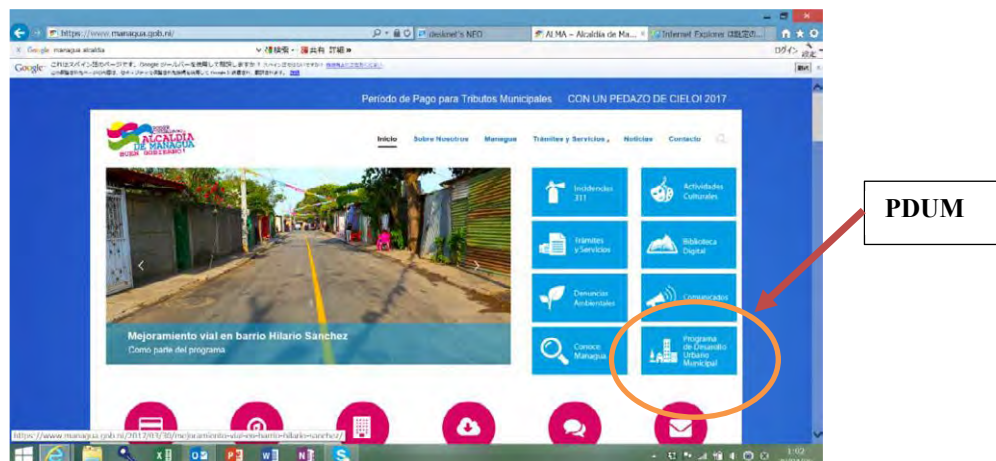
Figure 14.8.1 shows the website outline and architecture, developed for this master plan study. Throughout this website, the following three goals were established, including: (i) comprehensive information disclosure, (ii) learning opportunity, and (iii) constructive interaction between ALMA and the general public.



Source: JICA Study Team

Figure 14.8.1 Website Architecture

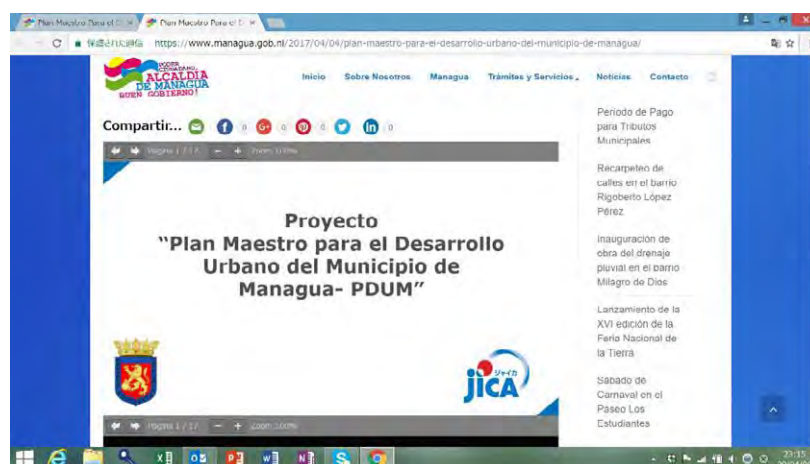
Figure 14.8.2 shows the frontpage image of the developed website for this integrated urban development MP Study. It is noted that all questions and/or comments, obtained through this website are received by the PDUM website management task group, and then, some of them are passed forward to relevant sections and/or specialists for more detailed examination as well as appropriate response preparations.



(a) Frontpage of ALMA's website



(b) 1st Slide of PDUM-SEA



(c) Introduction Page of PDUM

Source: JICA Study Team

Figure 14.8.2 FrontPage of the Website of PDUM

14.8.3 Website Operation Framework and Policy

The website will be operated by the PDUM Secretariat with support from the JICA study team (see Table 14.8.1).

Table 14.8.1 Website Operation Policy (draft)

	Task/Activity	Frequency of Task/Activity
1	Contents Collection	Daily
2	Content Approval	Weekly
3	Website/Content Updating	Weekly
4	Question and Answer (Website)	Daily
5	Minutes of Meeting of Public Meetings	Promptly after the meeting

Source: JICA Study Team

14.9 PDUM-related Drawing Contest

14.9.1 Introduction

PDUM-related drawing contest was conducted at the conference hall of Japan Garden, Managua, on April 20, 2017. Main purpose of this PDUM-related drawing contest is to (i) disseminate on-going PDUM study for the younger generation of Managua citizen, who will play main roles in various social and economic and relevant activities in Managua, and (ii) to encourage a constructive involvement of the younger generation through the education-sector within the on-going PDUM study.

On March 24, 2017, preliminary meeting with the group of directors of elementary schools (1st – 6th Grades) and high schools (7th – 10th Grades), located in Managua, was held at the Ministry of Education (MoE) to explain the outline of on-going PDUM and the objectives of the PDUM-related drawing contest (see Figure 14.9.1).

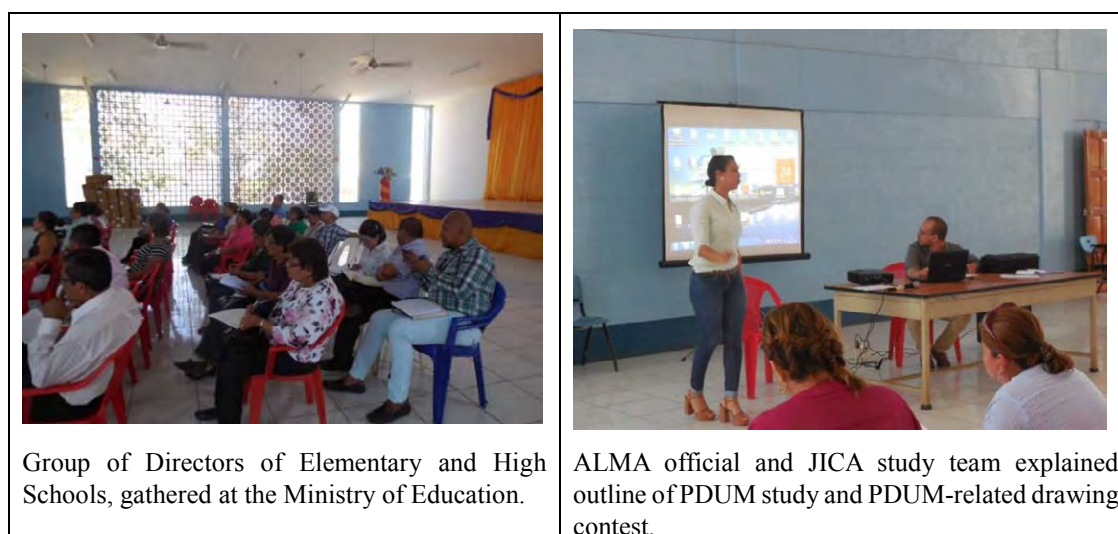


Figure 14.9.1 Preliminary Discussion between ALMA and Directors of Elementary and High Schools in Managua, held on March 24, 2017

Source: JICA Study Team

After this meeting, school representative selection for this drawing contest was conducted at each school, and then, selected students at each school, participated the PDUM-related drawing contest on April 18, 2017.

14.9.2 Outline of Contest

Figure 14.9.1 summarizes the outline of PDUM-related drawing contest, held on April 18, 2017 at the conference hall of Japan Garden, Managua. In total, 110 people (80 students, 24 teachers and 6 MoE staff) participated to this drawing contest. Photo records of this drawing contest are summarized in Figure 14.9.2.

Table 14.9.1 Outline of PDUM-related Drawing Contest

Time	Agenda	
9:00 – 9:10 am	Welcoming and opening Remark	Ms Karen Bonilla, PDUM Project Manager
9:10 – 9:20 am	Explanation of Objective and Contest Methodology	Ms Reyna Rueda, Secretary of the City Council
9:20 – 11:00 am	Drawing Preparation	All Students
11:00 – 11:40 am	Cultural performance/ Review and Evaluation of all Drawing/Refreshment	
11:40 – 12:00 am	Award ceremony, Delivery of certificates	
12:00 – 12:10 pm	Overall comment	Mr Hirohito Takata, JICA Nicaragua Representative
	Closing words	Ms Juana Cecila Vargas, Director General of Planning, ALMA

Source: JICA Study Team



Source: JICA Study Team

Figure 14.9.2 Photo Records of PDUM-related Drawing Contest

14.10 Conclusions and Recommendations

14.10.1 Conclusions

Followings are major remarks and/or findings obtained within this environmental study,

- (1) Currently, urban development activities such as the construction of new roads and residential complex in Managua are gaining momentum, and some of those activities tend to encroach several important ecological systems such as lagoons, water recharge area such as Sabana and highland vegetation. So, it is important to introduce some orders in the future city-wide urban development activities in order to establish the harmony and/or integrity between those developments of city infrastructure facilities and the conservation of ecologically critical areas.
- (2) Strategic environmental assessment (SEA) is conducted within this PDUM study in order to assess the pros and cons of proposed development structure alternatives (namely, STR-1, STR-2 and STR-3, respectively, see Table 14.6.1). From this assessment, it is found that it would be difficult to establish the harmony between future development activities under STR-3 development scenario and the management and/or conservation ones (i.e., No core nor sub-center system (Do-nothing scenario)).
- (3) On the other hand, under development scenarios such as STR-1 (i.e., CBD One core system (mono core)) and STR-2 (i.e., Sub-center system (poly nucleated development)), there are some possibilities to introduce some orders in future city-wide development activities that would be able to reconcile with relevant management policies such as the conservation of ecologically important areas in Managua. However, it is noted that it is likely to have new urban environmental concerns such as the building valley effects and/or heat island effects in the course of future city-wide development activities based on either of STR-1 and/or STR-2.
- (4) SEA methodology, implemented within this PDUM study, is “stakeholder-centered”, participatory one. Three rounds of the stakeholder meeting (SHM, city-wide) and related focal group meeting (FGM, for districts and key neighboring cities such as Tipitapa and Sandino) programs are developed in order to encourage constructive public involvement and information dissemination of PDUM study. It is noted that 2nd round of both SHM and FGM are completed as of April 21, 2017. More than 100 comments regarding the PDUM are collected through those SHM and FGM activities, and are feedbacked within PDUM as much as possible. Besides, a website for PDUM and its SEA is developed within the ALMA’s homepage in order to precipitate the interaction between ALMA and Managua citizens and to make the PDMU participatory one. PDUM-related drawing contest is conducted on April 18, 2017 in order to encourage the involvement of young generation of Managua population, that would play vital role in various activities of near-future Managua. 80 elementary and high school students participated and competed by drawings of future Managua city.

14.10.2 Recommendation

Followings are recommendations for the implementation of PDUM,

- (1) As the city-wide urban infrastructure development activities go on based on the proposed PDUM, it is likely to have severe local traffic congestions around the proposed urban core centers due to city-wide future traffic volume increases to be occurred under either of STR-1 or STR-2 development scenario, and resultant degradation of the roadside environmental conditions such as noise/vibration and air quality. To avoid any serious environmental cases, it would be imperative to establish a long-term urban environmental monitoring system that would monitor the entire urban environment as well as water bodies such as groundwater, lagoons and Lake Managua. By establishing and implementing proper urban environmental monitoring, relevant data accumulations is expected to occur, and that would increase the validity of the entire citywide environmental management framework. This would also lead to set-up of a city-wide environmental database that would become a basis for the diagnosis of city-wide environmental condition.
- (2) Another serious urban environmental issue, to be arisen through the course of the further urbanization would be a heat island effect. There are several mitigation measures to alleviate this heat island effect as well as the building valley effect, mentioned above at the same time. One of most effective measure is to configured a proper land-use regulation that would keep local wind-path that would sweep away the vehicular emission gas as well as exhaust heat, emitted from vehicles and building facilities. In particular, it is important to secure certain amounts of vegetation and/or forest area that would keep the local water movement cycle at the normal and stable condition.
- (3) Constructive public involvement (PI) plays a vital role as the PDUM goes on, and successful PDUM implementation will be guaranteed after a broad consensus of the masterplan among entire citizen is established. Within this PDUM study, several prototype communication processes between ALMA and Managua citizen such as PDUM/SEA website as well as PDUM enlightenment events such as the drawing contests are developed. This kind of process shall be enhanced, elaborated and well-supervised periodically by both ALMA and JICA Study Team for further improvement of PDUM.

CHAPTER 15 CONCLUSION AND RECOMMENDATION

15.1 Conclusion

The urban development master plan for Managua City has been formulated by the Alcaldia de Managua (ALMA) in cooperation with the Japan International Cooperation Agency (JICA). This master plan will be respected and used as a guideline for the development of Managua until the target year of 2040. In the course of time, when the master plan needs to be updated and modified, ALMA should do so in compliance with the principles established in the original master plan.

ALMA will be responsible for implementing the master plan and all relevant donors are recommended to streamline their assistance to ALMA along the master plan.

The capacity development of ALMA staff has been done throughout the master plan study. The effort should be continued after the study.

15.2 Recommendations

The following are recommendations for each of the main fields of the master plan:

(1) Urban Planning

With regard to urban planning, the urgent need is to put the land use plan into actual zoning regulations. ALMA shall review the existing zoning scheme and introduce a new zoning scheme in compliance with the land use plan adopted in the master plan. In the meantime, the present scheme will be revised to encourage densification along the main corridors. For this purpose, the existing zoning scheme, which is complex with a number of parameters, should be simplified. Control of density in the zoning scheme, which adds to the complexity, should be eliminated.

ALMA's capacity for urban planning has to be improved and relevant donors are recommended to consider assistance to this effect.

With regard to the city center planning, including the Traditional and Heritage Center, planning by IDB and metropolitan sub-center in this master plan has to be implemented. ALMA should prepare to build a coordination platform with the participation of stakeholders including the private sectors.

With regard to the Oriental Market, an improvement plan needs to be formulated in view of improving mobility, resilience, and stopping uncontrolled expansion.

(2) Transport Planning

With regard to the public transport solutions proposed for the medium term, ALMA should start to carry out necessary preparatory actions. For the automated guideway transit (AGT) in Carretera a Masaya Line and the bus rapid transit (BRT) in Juan Pablo II Line, pre-investment studies need to be started in the short term.

At present, no specific body in charge of transport planning exists in ALMA. The relevant organization needs to coordinate as to establish an integrated body.

To realize the transport system in line with the city concept, both infrastructure and non-physical measures such as traffic management or regulations must be implemented.

In addition, when the proposed road transport project in this master plan is implemented, it is desirable to clarify the demarcation for the implementation among relevant organizations such as ALMA, MTI, and IRTRAMMA based on the discussion and coordination.

(3) Infrastructure Planning

For the planning of infrastructures such as water supply, water resources, sewerage, solid waste management, flood management, and disaster prevention, the policies adopted in this master plan shall be respected and more detailed study and planning, for which assistance by donors is recommended, should be carried out by ALMA.