
CHAPTER TWO:

GEO-PHYSICAL ENVIRONMENT

2. GEO-PHYSICAL ENVIRONMENT

GEOGRAPHICAL LOCATION

2.1.1. BOUNDARY AND LOCATION

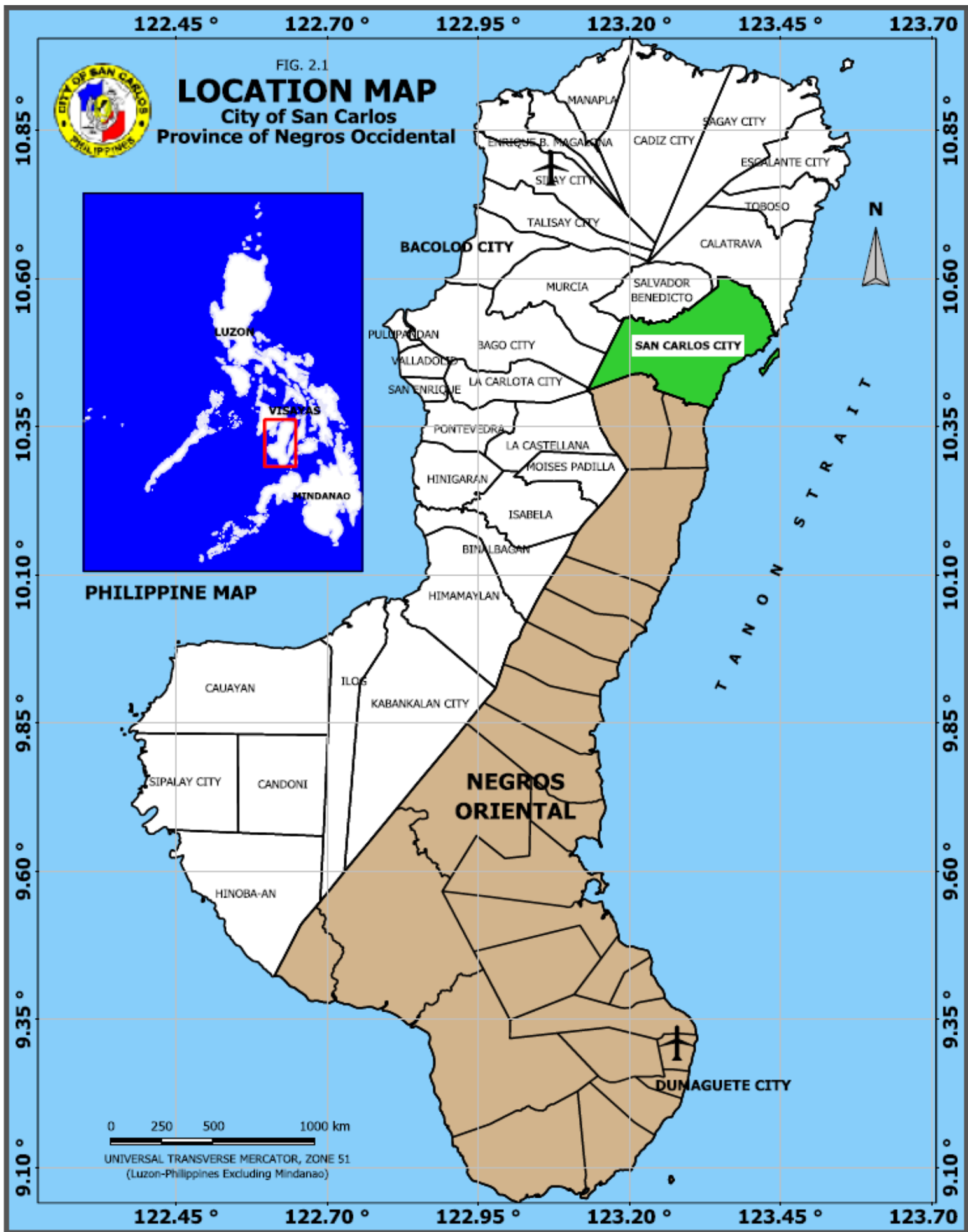
San Carlos City is located in the Province of Negros Occidental in the Western Visayas Region of the Philippines. The Western Visayas Region is characterized by wide stretches of rivers, coastal lowlands, and rugged hills and mountains, with predominantly rural areas providing for a variety of land uses. The region lies within two large inter-island water bodies; the Sibuyan and the Visayan Seas which include a number of bays and coves that provide good anchorages and potentially good port areas.

Negros Occidental is the “sister-province” of Negros Oriental located in the north western portion of Negros Island at the heart of the Philippine archipelago. Its land area is 7,926.10 square kilometers stretching some 372 kilometers from its northern tip at San Carlos, to its southern tip in Hinoba-an.

Negros Occidental has twelve component cities, apart from its highly urbanized provincial capital Bacolod City. San Carlos is one of the twelve component cities. San Carlos is located at 123°06'00" to 123°30'00" longitude and 10°36'00" to 10°22'00" latitude northeast of Negros. The Municipality of Calatrava defines its boundaries at the north, Municipality of Salvador Benedicto and City of Bago at the west, the Municipality of Vallehermoso (Negros Oriental) and City of Kanlaon at the south, and the 12 fathoms deep Tañon Strait at the east. The depth of Tañon Strait makes San Carlos an ideal location for port development and shipping facilities. **Figure 2.1** shows the Location Map of the City.

San Carlos City is a 2nd Class Component City with a total land area of 45,150 hectares and a population size of 129,981 (as of May 1, 2010). It has eighteen (18) barangays, of which fifteen (15) may be classified as urban and three (3) as rural. This classification follows Resolution No. 9 of the National Statistics Coordination Board (NSCB) dated October 13, 2003 which defines an urban place as:

- a. A barangay with a population of 5,000 or more;
- b. A barangay with at least one establishment having a minimum of 100 employees;
- c. A barangay with at least 5 establishments, each with a minimum of 10 employees and 5 or more facilities within a 2-km radius from the barangay hall;
- d. All barangays in the National Capital Region are automatically classified as urban;
- e. All highly urbanized cities will be subjected to criteria 1, 2 & 3 to determine which barangays are urban;
- f. All other barangays are considered rural.



The respective land areas of these barangays are shown in Table 2.1.

TABLE 2.1: LAND AREA BY BARANGAY (2013)

Barangay	Area (in hectares)	% of Total Area
URBAN AREAS		
Barangay I	162.32	0.36%
Barangay II	73.33	0.16%
Barangay III	9.60	0.02%
Barangay IV	19.51	0.04%
Barangay V	50.74	0.11%
Barangay VI	13.60	0.03%
Bagonbon	2,561.92	5.67%
Buluangan	4,682.16	10.37%
Codcod	8,622.84	19.10%
Guadalupe	4,654.61	10.31%
Palampas	5,254.51	11.64%
Prosperidad	3,357.87	7.44%
Punao	1,729.18	3.83%
Quezon	8,199.42	18.16%
Rizal	2,944.28	6.95%
Subtotal	42,335.88	93.77%
RURAL AREAS		
Ermita	176.21	0.39%
Nataban	2,392.45	5.30%
San Juan	245.46	0.54%
Subtotal	2,814.12	6.23%
Total Area	45,150.00	100%

Source: City Planning and Development Office, SCC

The City's Administrative Map is shown in **Figure 2.2**.

TOPOGRAPHY

2.2.1. TOPOGRAPHY AND SLOPE CLASSIFICATION

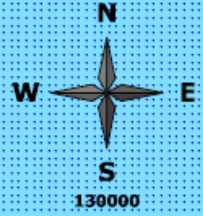
The topography of the City of San Carlos is predominantly level to undulating along the coastline and rolling to very steep along its north-western and south-western portions. Parts of Mount Kanlaon Volcano and the Balabag Mountain Ranges are within the jurisdiction of San Carlos. The Mount Kanlaon National Park, which has a geographical spread across Negros, reaches into the southwestern portion of the City. Mount Kanlaon National Park in Barangay Codcod has an elevation of 2,455 meters from the peak down, and is 1,800 meters above sea level. The City's Topographic Map is presented in **Figure 2.3**

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

10°36' N 10°31' N 10°27' N 10°23' N

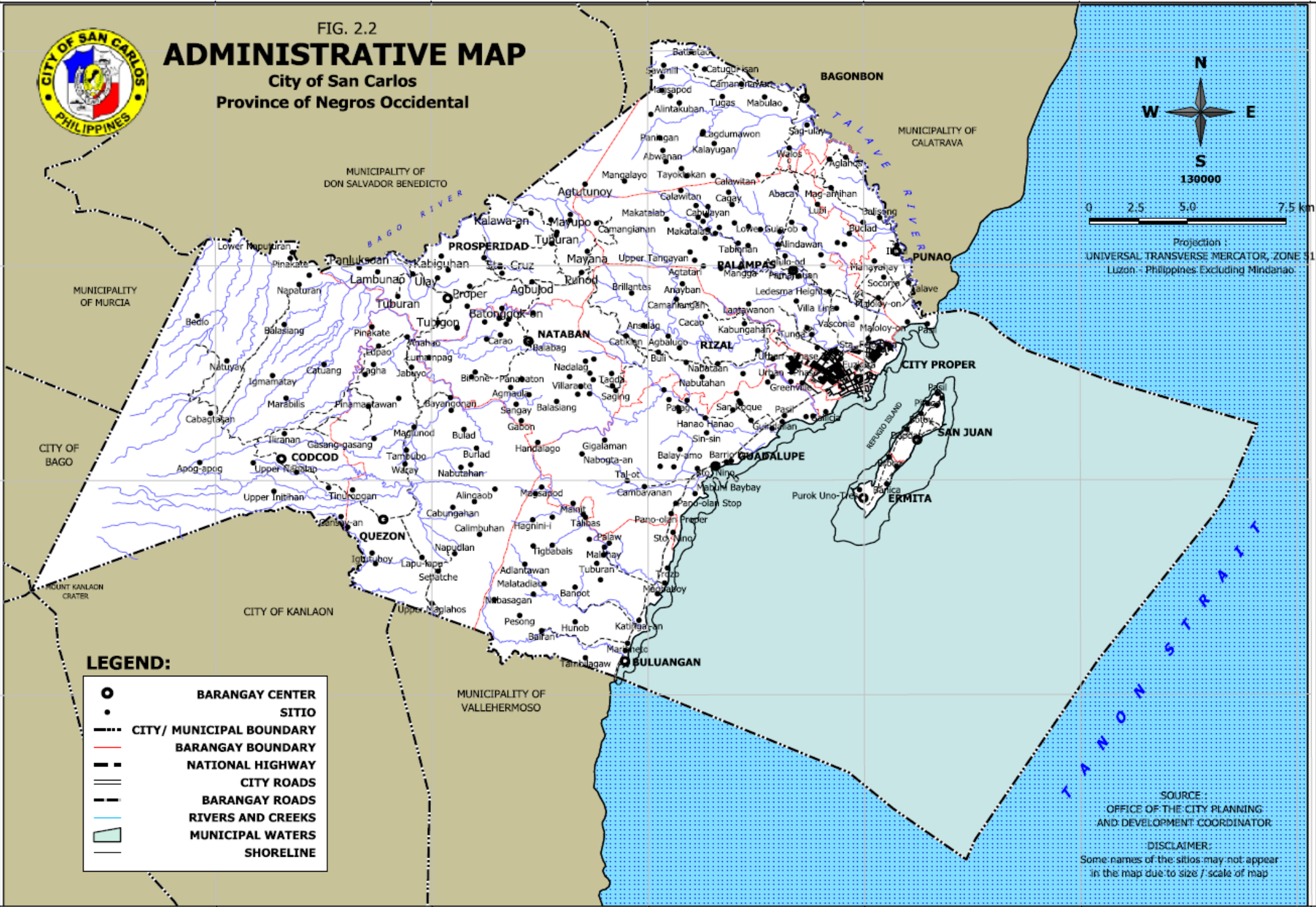


FIG. 2.2 ADMINISTRATIVE MAP City of San Carlos Province of Negros Occidental



0 2.5 5.0 7.5 km

Projection :
UNIVERSAL TRANSVERSE MERCATOR, ZONE 51
Luzon - Philippines Excluding Mindanao



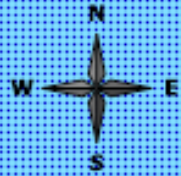
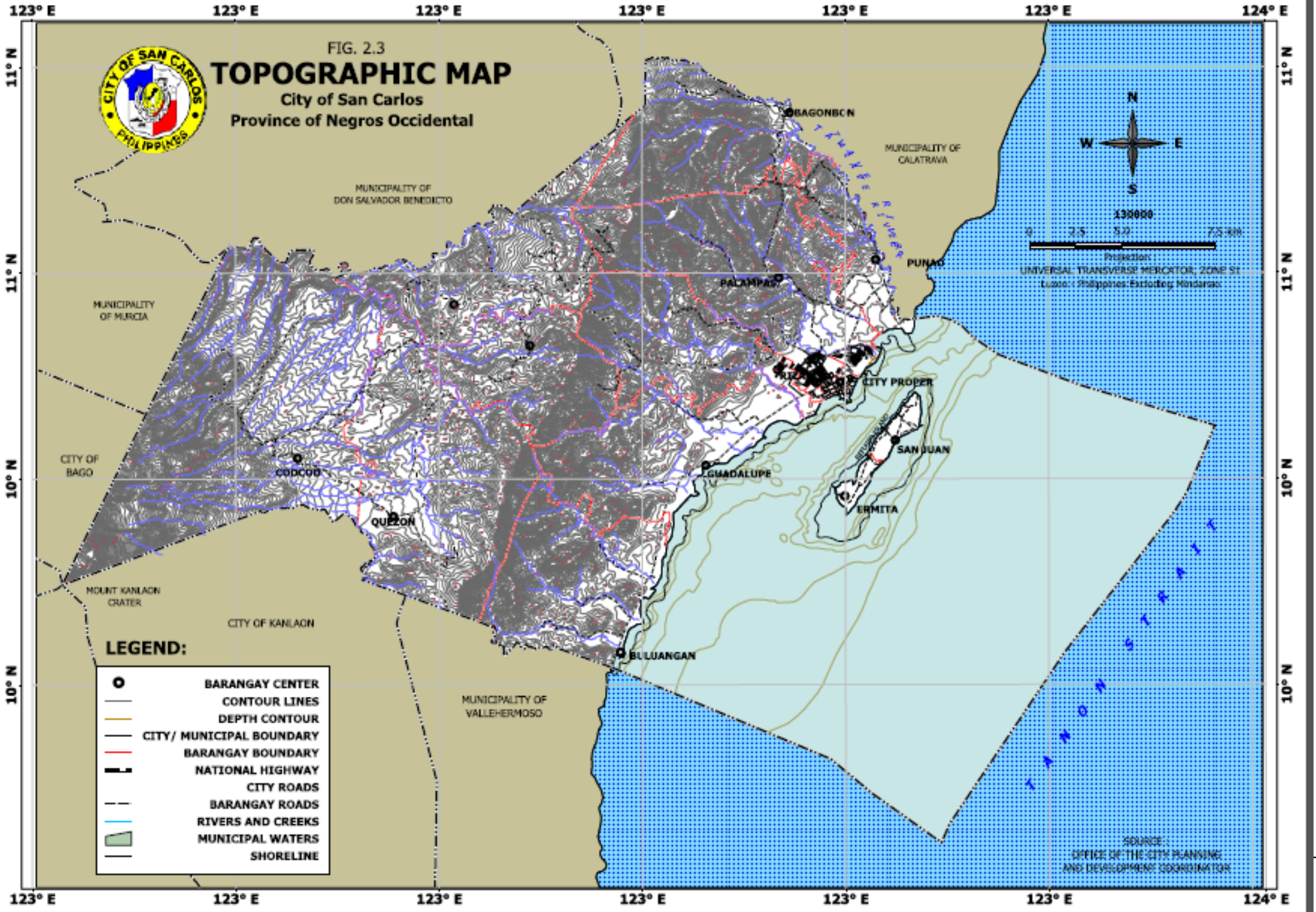
LEGEND:

- BARANGAY CENTER**
- SITIO**
- CITY/ MUNICIPAL BOUNDARY**
- BARANGAY BOUNDARY**
- NATIONAL HIGHWAY**
- CITY ROADS**
- BARANGAY ROADS**
- RIVERS AND CREEKS**
- MUNICIPAL WATERS**
- SHORELINE**

SOURCE:
OFFICE OF THE CITY PLANNING
AND DEVELOPMENT COORDINATOR

DISCLAIMER:
Some names of the sitios may not appear
in the map due to size / scale of map

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E



Projection:
 UNIVERSAL TRANSVERSE MERCATOR, ZONE 51
 UTM Zone: Philippines-Excluding Mindanao

SOURCE:
 OFFICE OF THE CITY PLANNING AND DEVELOPMENT COORDINATOR

Slopes of 0-8% are flatlands, considered irrigable and highly suitable for agriculture, urban, industrial, and other related uses. Slopes of 8-18% have higher variety of uses with potential for seasonal or permanent agricultural activities. Steeper slopes of 18-30% are considered marginal lands that may also be used for planting agricultural crops but may require more tillage. Slopes of 30-50% are suitable for forest trees, while those with greater than 50% slopes should be maintained as secondary growth forests.

Based on this slope profile, the City’s flatlands are found along the coastline, from barangay Buluangan up north to barangay Punao and on Refugio (Island. Slope gradually becomes steeper to the west of the National Highway that reaches the 18 – 30% range in barangays Quezon, Nataban, Prosperidad, Palampas and Bagonbon. Slope becomes gradual up to the valley portion of barangays Prosperidad, Nataban and Quezon that becomes almost flat again in many parts of barangay Codcod. Notable increases in slope may thereafter be observed going to the upper regions of Mount Kanlaon and along the City’s boundaries with the Municipality of Murcia and City of Bago. The area distribution of the City’s slope categories are presented in the table below while its Slope Map is presented in **Figure 2.4**.

TABLE 2.2: LAND AREA BY SLOPE CATEGORY (2013)

Slope Category	Area (has)	Share
Level to nearly level (0% to 3%)	2,958.11	6.55%
Undulating to rolling (3% to 8%)	1,209.17	2.68%
Rolling to moderately steep (8% to 18%)	15,066.75	33.37%
Gently sloping to undulating (18% to 30%)	3,856.63	8.54%
Steep (30% to 50%)	11,277.06	24.98%
Very Steep (50% and over)	10,782.28	23.88%
TOTAL	45,150.00	100.00%

Source: City Planning and Development Office, SCC

GEOLOGY

2.3.1. ROCK FORMATIONS

The geology of San Carlos City consists of Late Oligocene to Middle Miocene Clastic Rocks, Pliocene to Pleistocene Limestone and Recent Alluvium. Late Oligocene to Middle Miocene Clastic Rocks consists of hard cemented, partly calcareous and partly tuffaceous mudstone, claystone, shale, siltstone, sandstone, conglomerate, sandy limestone and intercalated lava, breccia and agglomerate flows, pyroclastics, dikes and sills. Unless sufficiently fractured or weathered, these rocks are very poorly permeable to impermeable so that they often act as barriers to groundwater flow. The rocky terrains are mildly to very steeply sloping. This type of geology can be found in the western part of the City (portions of Barangays Codcod, Quezon, Prosperidad, and Nataban). On the other hand, Refugio (Sipaway) Island’s geology is of Upper Miocene-Pliocene (Sedimentary & Metamorphic Rocks).

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

10°36' N

10°31' N

10°27' N

10°23' N

10°36' N

10°31' N

10°27' N

10°23' N



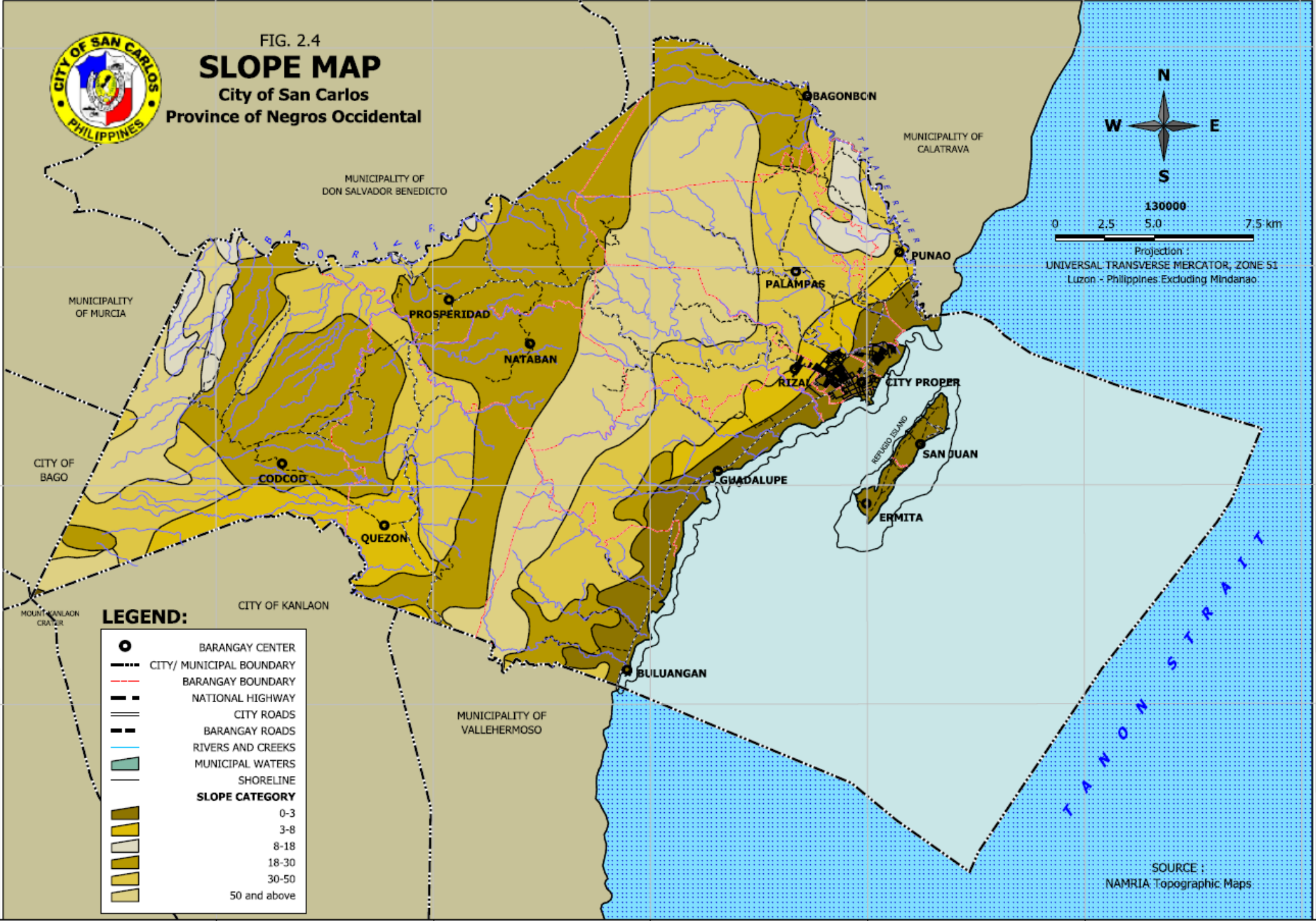
FIG. 2.4
SLOPE MAP
City of San Carlos
Province of Negros Occidental

N
W E
S

130000

0 2.5 5.0 7.5 km

Projection:
UNIVERSAL TRANSVERSE MERCATOR, ZONE 51
Luzon - Philippines Excluding Mindanao



LEGEND:

- BARANGAY CENTER
- CITY/ MUNICIPAL BOUNDARY
- BARANGAY BOUNDARY
- NATIONAL HIGHWAY
- CITY ROADS
- BARANGAY ROADS
- RIVERS AND CREEKS
- MUNICIPAL WATERS
- SHORELINE

SLOPE CATEGORY

- 0-3
- 3-8
- 8-18
- 18-30
- 30-50
- 50 and above

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

SOURCE:
NAMRIA Topographic Maps

The central part of the City is characterized by Pliocene to Pleistocene Limestone which is made up of coralline to marly limestone with conglomerate to sandy facies. Concentration of pelecypods, gastropods, coral fingers, coral heads and other megafossils are reported in some deposits. Its hills and ridges are characterized by very gently sloping to precipitous karstic terrain. This structure characterizes the valley portions of barangays Prosperidad, Nataban and Quezon. The upper highlands which go up to Mount Kanlaon is of Pliocene-Quaternary origin. The City's Geologic Map is shown in **Figure 2.5**.

2.3.2 SOIL CLASSIFICATION

Soils in the City's mountainous areas are classified as Rough Mountainous Land while the valley of barangay Prosperidad and Nataban are of Guimbalaon Loam. On the other hand, the sloping portions of barangays Buluangan, Guadalupe, Rizal, Palampas and Punao are of Faraon Clay (steep phase) while most of the City's coastline is of Isabela Clay. Soils on Refugio (Sipaway) Island are of Faraon Clay. The area distribution of the City's soil composition is presented in the following table while its Soil Map is shown in **Figure 2.6**.

TABLE 2.3:- LAND AREA BY SOIL CLASSIFICATION (2013)

Geologic Structure	Area (has)	Share (%)
Faraon Clay	653.03	1.45%
Faraon Clay (Steep phase)	8,056.85	17.84%
Guimbalaon loam	6,479.20	14.35%
Hydrosol	196.40	0.43%
Isabela clay	3,338.36	7.39%
La Castellana Clay loam	759.72	1.68%
Rough Mountainous land	25,666.45	56.85%
Total	45,150.00	100.00%

Source: City Planning and Development Office, SCC

2.4 BAGO RIVER WATERSHED FOREST RESERVE

The western section of the City is part of the Bago River Watershed Forest Reserve (BRWFR) which, according to its Integrated Ecosystem Management Framework Plan (IEMF) for 2011 – 2030, "contains the largest expanses of forest left in the Visayas Region." The BRWFR has an area of about 83,020 hectares of which 61,296 hectares was proclaimed as a watershed forest reserve by virtue of Proclamation No. 604 dated June 28, 1990.

Approximately 10,606.55 hectares of Alienable & Disposable (A & D) lands and about 7,210.25 hectares of Forest lands in the City are covered by the BRWFR. The A & D lands are already considered Private lands while the Forest lands comprise those in the North Negros Natural Park (NNNP) and in the Mt. Kanlaon National Park (MKNP). The Bago Watershed Map is shown in **Figure 2.7**.

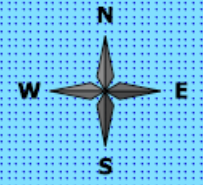
Based also on information from the IEMF, the estimated population within the BRWFR in year 2000 was 188,776. Those in the City were estimated to be about 25,448 or 13.5% of the total watershed population. The City's population within the watershed ranked third, next only to that of Bago City (92,468 or 49.1%) and the Municipality of Murcia (42,940 or 22.8%).

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

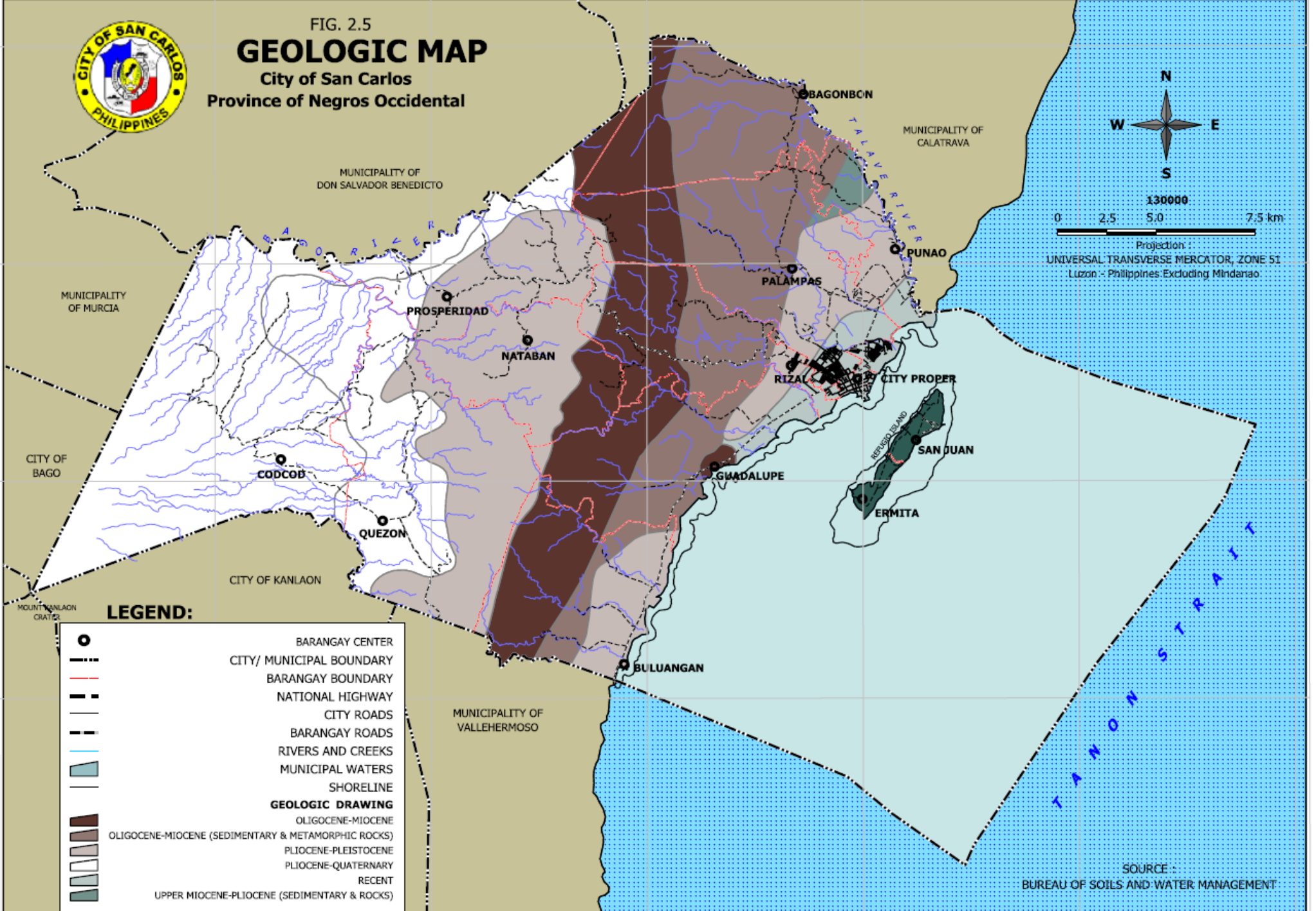
10°36' N
10°31' N
10°27' N
10°23' N



FIG. 2.5
GEOLOGIC MAP
City of San Carlos
Province of Negros Occidental



130000
0 2.5 5.0 7.5 km
Projection :
UNIVERSAL TRANSVERSE MERCATOR, ZONE 51
Luzon - Philippines Excluding Mindanao



LEGEND:

- BARANGAY CENTER
- CITY/ MUNICIPAL BOUNDARY
- BARANGAY BOUNDARY
- NATIONAL HIGHWAY
- CITY ROADS
- BARANGAY ROADS
- RIVERS AND CREEKS
- MUNICIPAL WATERS
- SHORELINE
- GEOLOGIC DRAWING**
- OLIGOCENE-MIOCENE
- OLIGOCENE-MIOCENE (SEDIMENTARY & METAMORPHIC ROCKS)
- PLIOCENE-PLEISTOCENE
- PLIOCENE-QUATERNARY
- RECENT
- UPPER MIOCENE-PLIOCENE (SEDIMENTARY & ROCKS)

SOURCE :
BUREAU OF SOILS AND WATER MANAGEMENT

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

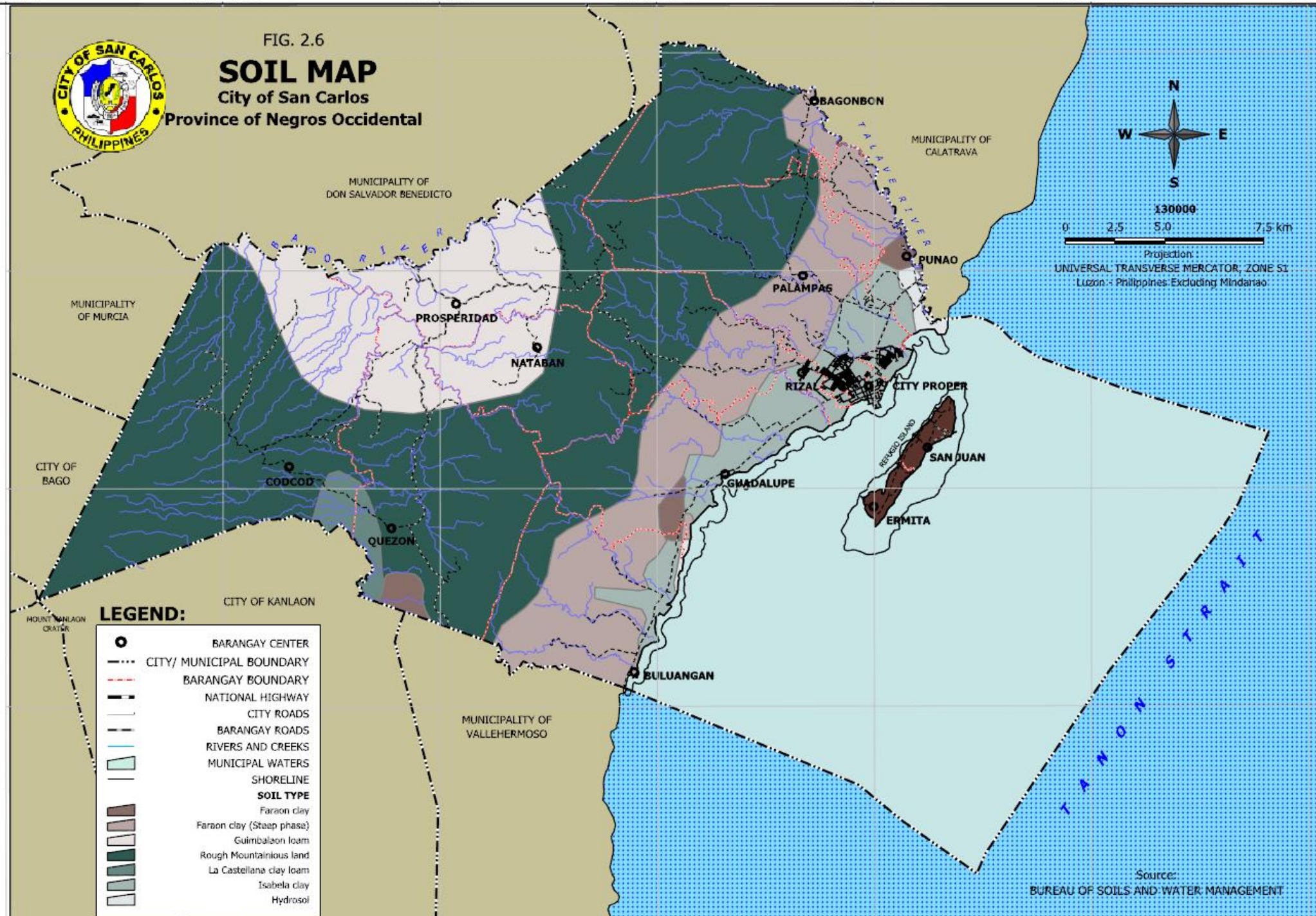
123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

10°36' N
10°31' N
10°27' N
10°23' N

10°36' N
10°31' N
10°27' N
10°23' N



FIG. 2.6
SOIL MAP
City of San Carlos
Province of Negros Occidental



130000
0 2.5 5.0 7.5 km
Projection:
UNIVERSAL TRANSVERSE MERCATOR, ZONE 52
Luzon - Philippines: Excluding Mindanao

LEGEND:

- BARANGAY CENTER
- CITY/ MUNICIPAL BOUNDARY
- BARANGAY BOUNDARY
- NATIONAL HIGHWAY
- CITY ROADS
- BARANGAY ROADS
- RIVERS AND CREEKS
- MUNICIPAL WATERS
- SHORELINE
- SOIL TYPE**
- Faraon clay
- Faraon clay (Steep phase)
- Guimbalaon loam
- Rough Mountainous land
- La Castellana clay loam
- Isabela clay
- Hydrosol

Source:
BUREAU OF SOILS AND WATER MANAGEMENT

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

122°54' E

123°00' E

123°06' E

123°12' E

123°18' E

123°24' E

123°30' E

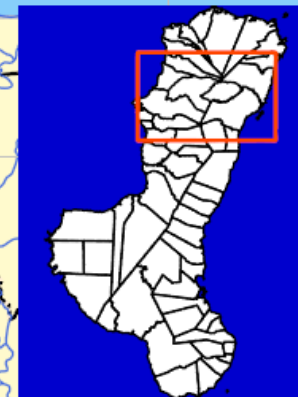
FIG. 2.7

BAGO WATERSHED MAP

City of San Carlos
Province of Negros Occidental



SCALE: 1: 200000



10°43' N

10°43' N

10°37' N

10°37' N

10°31' N

10°31' N

10°25' N

10°25' N

10°20' N

10°20' N

LEGEND

- CITY/MUNICIPAL BOUNDARY
- BARANGAY BOUNDARY
- RIVERS AND CREEKS
- RIVER BOUNDARIES
- BAGO WATERSHED
- MUNICIPAL WATERS
- SAN CARLOS CITY AREA

Source:

PROVINCIAL ENVIRONMENT MANAGEMENT OFFICE

0 7.5 15 30 KM

UNIVERSAL TRANSVERSE MERCATOR, ZONE 51
Luzon-Philippines Excluding Mindanao

122°54' E

123°00' E

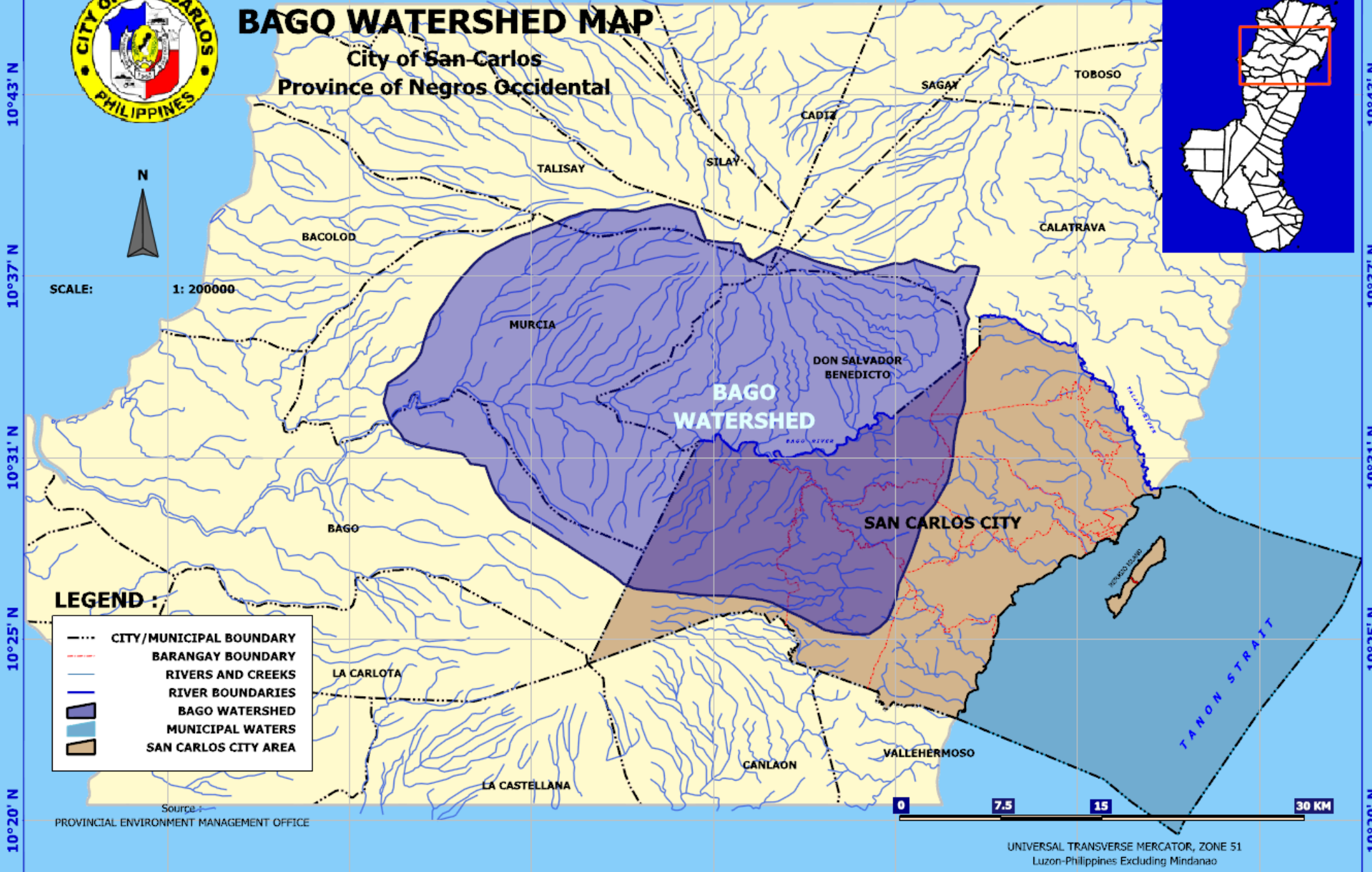
123°06' E

123°12' E

123°18' E

123°24' E

123°30' E



The Department of Environment and Natural Resources (DENR), through the Protected Area Management Board (PAMB), performs general administrative functions over the watershed in accordance with the NIPAS Act of 1992. The Bago River Watershed Forest Reserve Management Council (BWFRMC), on the other hand, provides “direction and guidance to all conservation and development initiatives to ensure the sustainability of the ecological, socio-cultural and economic functions of the watershed area.” The BWFRMC is composed of the “DENR Regional Executive Director, the Provincial Governor, the seven Mayors with political jurisdiction within the watershed area and ten other members representing various stakeholders.”

2.5 LAND RESOURCES

2.5.1 LAND CLASSIFICATION

Almost forty-four per cent (44%) of the total land area of San Carlos amounting to some 20,068 hectares is classified as forestland. This includes the NNNP and the MKNP. Alienable and disposable (A&D) lands account for about 25,082 hectares or 55.55% of the total land area. The area breakdown of A & D A D Forestlands is presented in the table below while the City’s Land Classification Map is illustrated in **Figure 2.8**.

TABLE 2.4: LAND CLASSIFICATION (2013)

LAND CLASSIFICATION	AREA (hectares)	Percent
Alienable and disposable lands	25,082.00	55.55%
Classified forestland	20,068.00	44.45%
• NNNP	(12,938.00)	(28.66%)
• MKNP	(7,130.00)	(15.79%)
TOTAL	45,150.00	100.00%

Source: City Planning and Development Office, SCC

2.5.2 LAND USE

General Land Use Pattern

On the overall, the general land use pattern of the City is characterized by the predominance of vast agricultural lands at the valley of the MKNP and NNNP, along the coastline and on Refugio (Sipaway) Island. Forest lands are the next prevalent and are distinctly evident on the upland portions of the MKNP at the west and on NNNP at the center of the City. The main built-up area is at the City Proper, along the coast, which hosts a variety of mixed urban uses. From here, settlements may be observed along major roads and at the barangay centers.

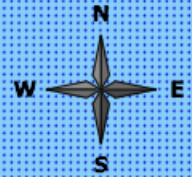
The City’s Existing Land Use Map is presented in **Figure 2.9** while the distribution of land uses is presented in the following table:

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

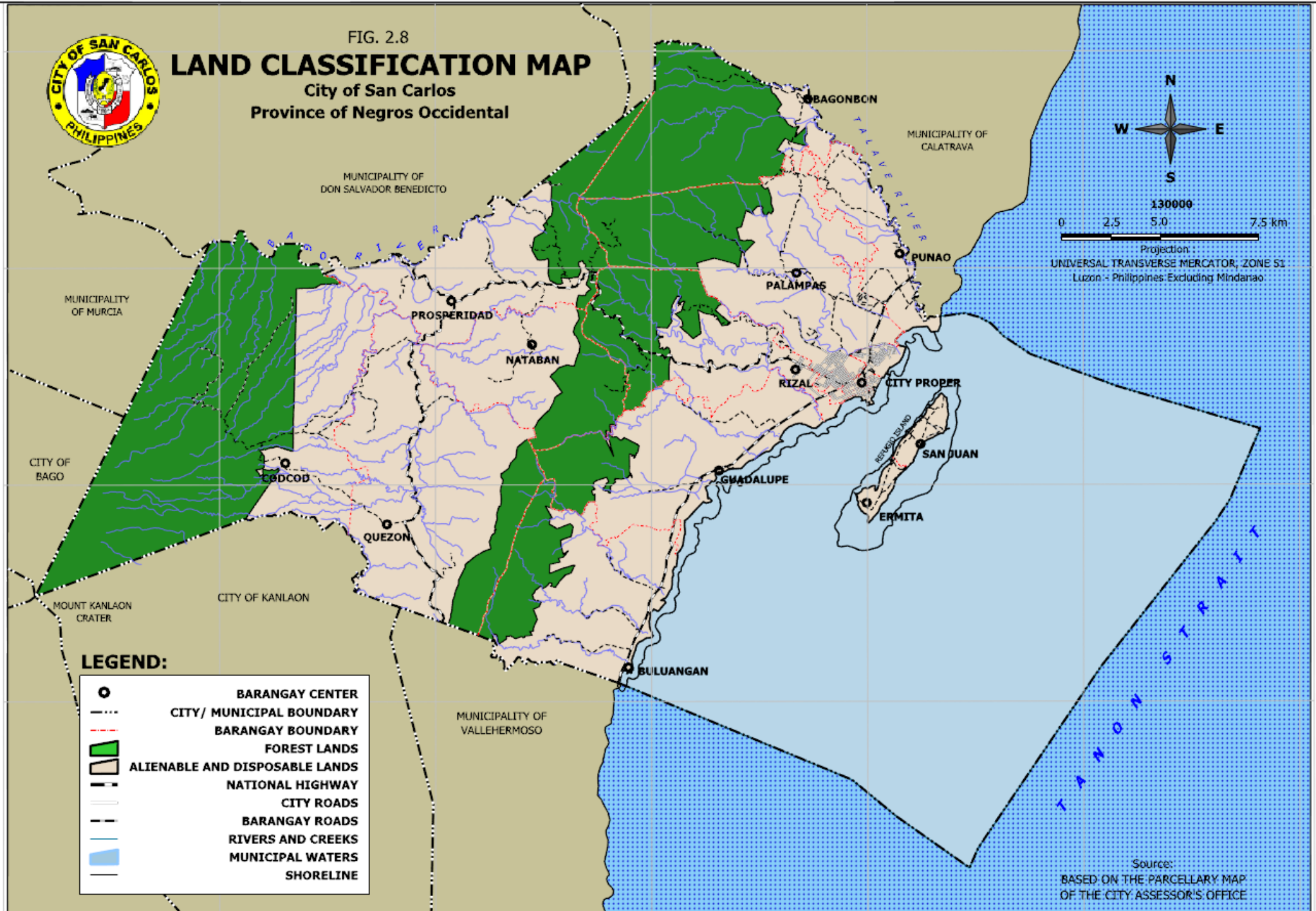
10°36' N 10°31' N 10°27' N 10°23' N



FIG. 2.8 LAND CLASSIFICATION MAP City of San Carlos Province of Negros Occidental



130000
0 2.5 5.0 7.5 km
Projection :
UNIVERSAL TRANSVERSE MERCATOR, ZONE 51
Luzon - Philippines, Excluding Mindanao



LEGEND:

	BARANGAY CENTER
	CITY/ MUNICIPAL BOUNDARY
	BARANGAY BOUNDARY
	FOREST LANDS
	ALIENABLE AND DISPOSABLE LANDS
	NATIONAL HIGHWAY
	CITY ROADS
	BARANGAY ROADS
	RIVERS AND CREEKS
	MUNICIPAL WATERS
	SHORELINE

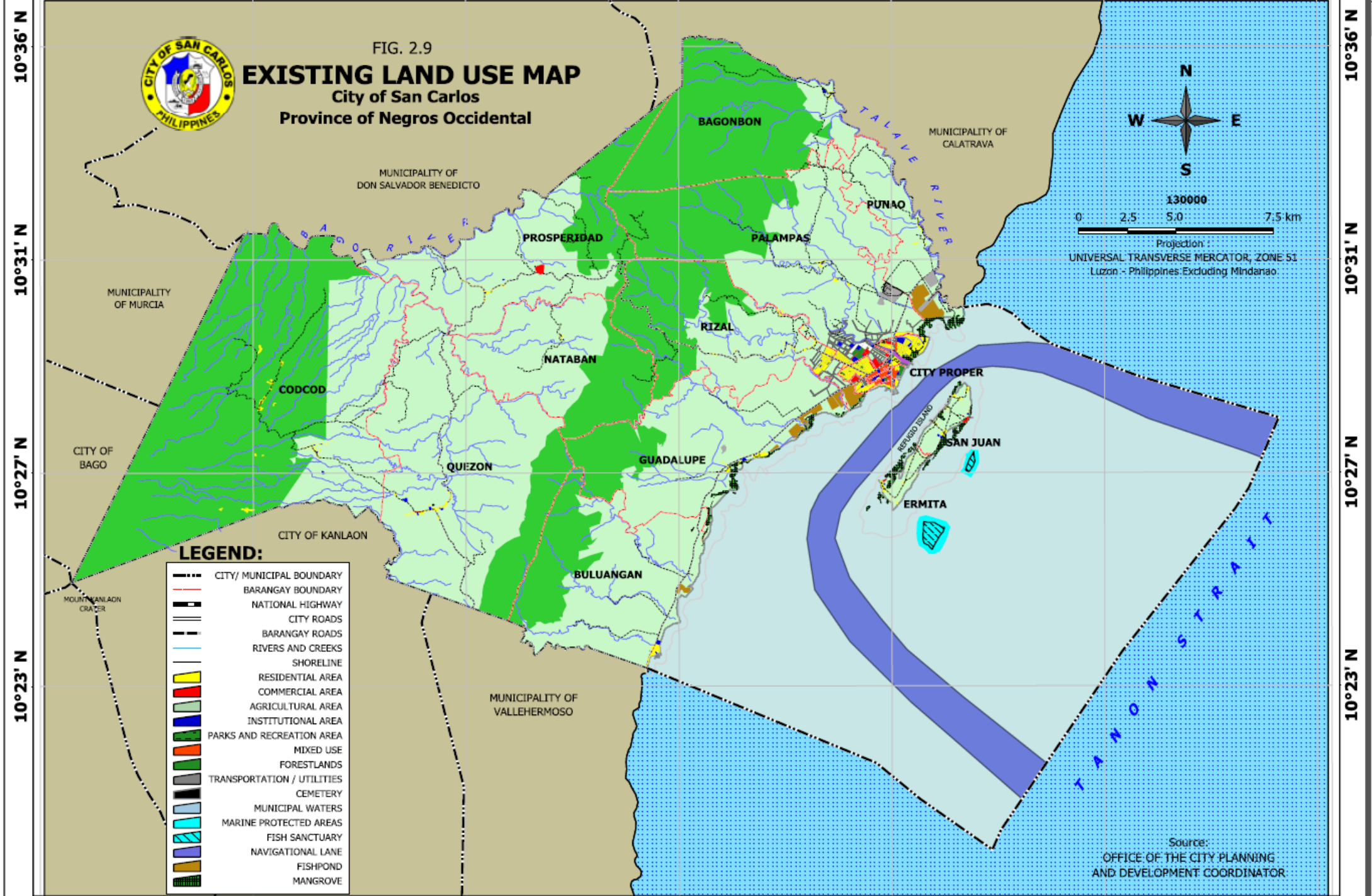
Source:
BASED ON THE PARCELLARY MAP
OF THE CITY ASSESSOR'S OFFICE

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

10°36' N
10°31' N
10°27' N
10°23' N

10°36' N
10°31' N
10°27' N
10°23' N

23°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E



23°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

TABLE 2.5: AREAS OF EXISTING LAND USES (2013)

Land Use	Area (has)	Share (%)
Commercial Area	44.25	0.10%
Residential Area	206.95	0.46%
Institutional Area	35.81	0.08%
Socialized Housing Area	9.32	0.02%
Parks and Recreation Area	37.81	0.08%
Idle Land (vacant)	246.82	0.55%
Cemetery	6.65	0.01%
Public Transport Terminal	1.75	0.00%
SCC Port	4.49	0.01%
Heavy Industrial	16.17	0.04%
Cell Site	0.28	0.00%
Built-Up Area - upland barangays	24.70	0.05%
Special Economic Zone (Bio-ethanol)	24.69	0.05%
Agricultural Area	23,688.17	52.47%
Forest Land	20,068.00	44.45%
Fishpond	210.79	0.47%
Mangrove (inland)	92.00	0.20%
Roads	431.35	0.96%
Sub-total (Land Area)	45,150.00	100.00%
Mangrove (water)	113.00	0.42%
Marine Protected Area/ Fish Sanctuary	193.15	0.71%
Navigational Lane	4,298.67	15.83%
Municipal Waters (open)	22,550.53	83.04%
Sub-total (Municipal Waters Area)	27,155.35	100.00%
Total Area – Land and Municipal Water Area	54,310.70	

Note: Areas still subject to reconciliation

Built-Up and Production Areas

- Urban Settlement Areas

The Poblacion (consisting of Barangays I, II, III, IV, V and VI) is the City's major urban settlement area. Having an aggregate land area of about 641.26 hectares, Poblacion represents about 1.4% of the City's total land area. Settlement expansion follows a westward direction towards Barangays Rizal and Palampas, and in a northeast and southwest direction following the National Road. These areas may collectively be called as the City's urban core.

Commercial and institutional uses are most prevalent in the old City center, comprising Barangays III, IV and VI. Residential expansion is evident in Barangay I, II and Rizal. Barangay Palampas is also experiencing urban growth anchored on the City Hall and the City's new central business district.

The existing land use map of the City Proper is presented in **Figure 2.10**.

123°24' E

123°25' E

123°25' E

123°26' E

N



1:12000



EXISTING URBAN LAND USE MAP (CITY PROPER)

City of San Carlos
Province of Negros Occidental

TO CALATRAVA

TO BACOLOD

BARANGAY
PALAMPAS

BARANGAY
1

BARANGAY
RIZAL

BARANGAY
2

BARANGAY
4

BARANGAY
3

BARANGAY
5

BARANGAY
6

LEGEND :

	CITY BOUNDARY
	BARANGAY BOUNDARY
	NATIONAL HIGHWAY
	PROPOSED LONG TERM BYPASS ROAD
	SHORELINE
	RESIDENTIAL
	COMMERCIAL
	INSTITUTIONAL
	RIVERS AND CREEKS
	INDUSTRIAL
	MIXED USE
	PARKS AND RECREATION
	IDLE LAND
	TRANSPORTATION / UTILITIES
	POND
	CEMETERY
	SOCIALIZED HOUSING - FOR GOVT. EMPLOYEES
	SOCIALIZED HOUSING - HOMELOT PROGRAM
	CELL SITE

0 1.25 2.50 <5 km

UNIVERSAL TRANSVERSE MERCATOR, ZONE 51
Philippines - Excluding Mindanao

Source :
OFFICE OF THE CITY PLANNING
AND DEVELOPMENT COORDINATOR

123°24' E

123°25' E

123°25' E

123°26' E

10°30' N

10°29' N

10°29' N

10°30' N

10°29' N

10°29' N

- Rural Settlement Areas

Minor settlements are scattered in the lowland barangays outside of Poblacion. These are observably clustered and wedged between the National Road and the coastline. Notable clusters are found in the barangay centers of Buluangan and Guadalupe as well as in the eastern coastal portion of Punao.

Settlement clusters may also be found along the coastline of Refugio (Sipaway) Island, such as in barangay San Juan at the east and barangay Ermita at the west.

Upland settlement areas are, on the other hand, sporadically located along farm to market roads. Settlement concentrations may be found in the northern barangay centers of Bagonbon, Punao and Palampas. Significant clusters are also found in the western barangays of Prosperidad and Nataban as well as in the southwestern barangays of Codcod and Quezon. Small settlements may also be found within the Protection Forest areas. These are located in areas served by old logging roads.

Per the IEMF, settlements within the BRWFR reportedly “occupy the A & D lands that are titled to private individuals.” It was further reported in the IEMF that about 42.21 hectares of land, with about 18 farmer beneficiaries, within the watershed have reportedly been included in the Comprehensive Agrarian Reform Program (CARP).

- Agricultural Areas

Agricultural areas characterize most of the lower portions of barangays Prosperidad, Codcod, Quezon and Nataban. These areas are also found along the coastline in barangays Buluangan, Guadalupe, Rizal, Palampas, Punao and a small portion of Bagonbon. Sugarcane is the most commonly planted crop and is planted in about 50% of lands in barangays Punao, Palampas, Rizal, Guadalupe, Buluangan and Quezon. Corn, rice and some fruits and vegetables are only marginally produced and may mainly be found in barangay Quezon and Codcod.

- Fisheries

Fisheries production areas are found in the City’s Municipal Waters and inland along the coastal area. There are three (3) identified major fishing grounds along Tañon Strait found in the areas around Refugio (Sipaway) Island and off the coast of barangays Punao and Buluangan.

Fishponds may be found along the coastal areas of barangays Guadalupe, Rizal and Punao.

- Special Economic Zone

The City Government has established a 400 hectare Economic Zone in barangay Palampas. Approved by the Philippine Economic Zone Authority (PEZA), the ecozone hosts the first Bio-Ethanol Plant in the country that is currently being operated and managed by San Carlos Bio-Energy Inc. The project is targeted to supply approximately 10% of petroleum requirements in the Philippines through the production of 30 million liters of ethanol each year. Full-blown operation in ethanol production started in 2009 and mega-watts of renewable energy is currently being co-generated. The plant is powered by sugarcane by-products, bagasse and other renewable fuels.

An 18 mega-watts capacity San Carlos City Bio-Mass power plant is also being developed in the said ecozone.

- Tourism

The City has various tourism sites and resources. These include the coastal resources of Refugio (Sipaway) Island, the “lake” in barangay Buluangan, mountain view and resort in barangays Prosperidad and Nataban, forest park in barangay Codcod and Peoples’ Park in Barangay 3.

- Mining

There are no significant mining activities in the City. Only commercial sand and gravel quarrying activities are being done at certain portions of rivers such as Talave, Gigalaman, Ando-on and Palampas. Other small scale quarrying activities include that for limestone in barangays Palampas and Guadalupe, rock phosphate in barangay Palampas and ordinary earth materials in barangay Nataban.

Protection Areas

The City’s Protection Areas are those categorized as NIPAS Areas (**Figure 2.11**) including its declared Strategic Agriculture and Fisheries Development Zones (SAFDZ).

- NIPAS Areas

There are several areas in the City that are considered protected under the NIPAS Act. These include the Forest Reservation Areas (MKNP and NNNP), SAFDZ, Tañon Strait, Marine Protected Areas and Fish Sanctuary.

- Forest Reservation Areas

Mount Kanlaon National Park and North Negros Natural Park

Per the BRWFR IEMF 2011-2030, the MKNP and NNNP “support the largest expanses of forest left in the Visayas Region.” These two natural parks belong to the Western Visaysa Biogeographic Zone (WVBZ) and are composed of “three terrestrial rainforest habitat types such as lowland, mid-montane and mossy forests.” It was further reported in the IEMF that these natural parks “still harbor pristine and natural habitats with a unique assemblage of flora and fauna, many of which are endemic to Panay and Negros Island as well as the WVBZ.”

The MKNP is situated at the central portion of Negros Island and falls within the jurisdictions of Negros Occidental and Negros Oriental. It was declared as a protected area by virtue of Republic Act 9154 of 2001 or the NIPAS Act. This was after it had already been proclaimed as a natural park through Presidential Proclamation No. 1005 dated May 8, 1997. The MKNP is centered on the peak of Mount Kanlaon which forms the common boundaries of four cities, namely San Carlos, Bago, La Carlota and Kanlaon. The portion of MKNP within San Carlos is at the City’s southwest in Barangays Codcod and Prosperidad has an area of about 2,165 hectares.

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

10°36' N

10°31' N

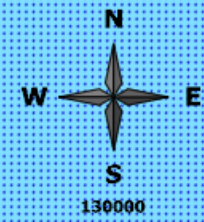
10°27' N

10°23' N

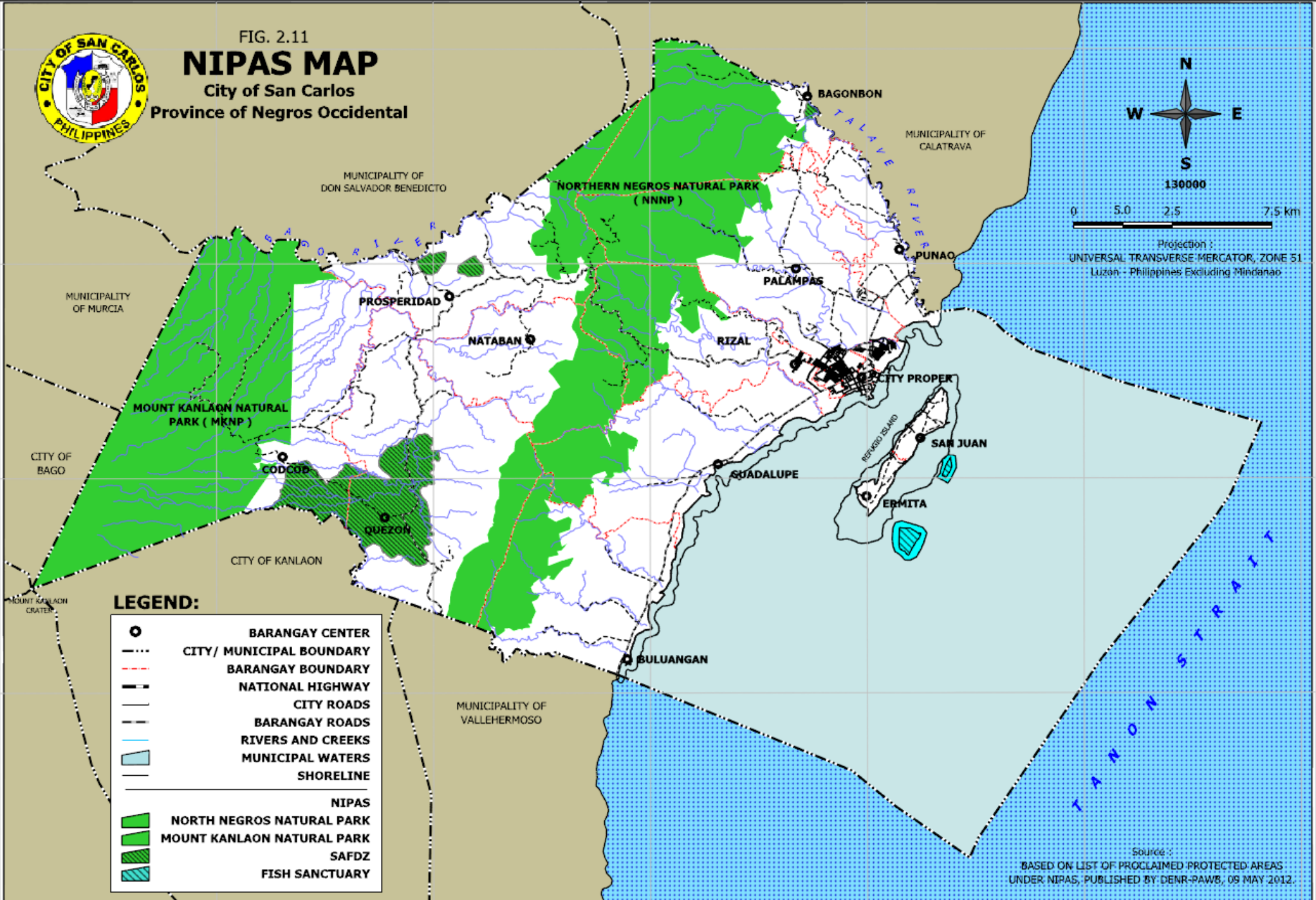
123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E



FIG. 2.11 NIPAS MAP City of San Carlos Province of Negros Occidental



Projection :
UNIVERSAL TRANSVERSE MERCATOR, ZONE 51
Luzon - Philippines Excluding Mindanao



LEGEND:

	BARANGAY CENTER
	CITY/ MUNICIPAL BOUNDARY
	BARANGAY BOUNDARY
	NATIONAL HIGHWAY
	CITY ROADS
	BARANGAY ROADS
	RIVERS AND CREEKS
	MUNICIPAL WATERS
	SHORELINE
	NIPAS
	NORTH NEGROS NATURAL PARK
	MOUNT KANLAON NATURAL PARK
	SAFDZ
	FISH SANCTUARY

Source :
BASED ON LIST OF PROCLAIMED PROTECTED AREAS
UNDER NIPAS, PUBLISHED BY DENR-PAWB, 09 MAY 2012.

The NNNP, on the other hand, was proclaimed as a natural park by virtue of Presidential Proclamation No. 895 in August 2005. It falls within the jurisdiction of the cities of San Carlos, Calatrava, Silay, and Don Salvador Benedicto. The NNNP covers about 7,235 hectares of the City and is located at its central portion.

Land Use Pattern

Citing a 2002 satellite image analysis, it was reported in the IEMF 2011 - 2030 that some of the remaining old growth forests of the BRWFR may be found at the uppermost slopes of MKNP and NNFP. The extent of the forest cover in the watershed has been detrimentally affected by intensive logging operations up to the 1980s. Other detrimental activities that have been reported include the conversion of forest areas for sugar cane production, “kaingin” or shifting cultivation and game fowl farming. The previous timberlands are now predominantly brushland areas and a significant portion of the watershed “consists of second growth forests, reforestation species, shrub vegetation, production timber and grasses.” Agricultural lands may also be found on slopes and valleys between MKNP and NNNP.

Stewardship Contracts

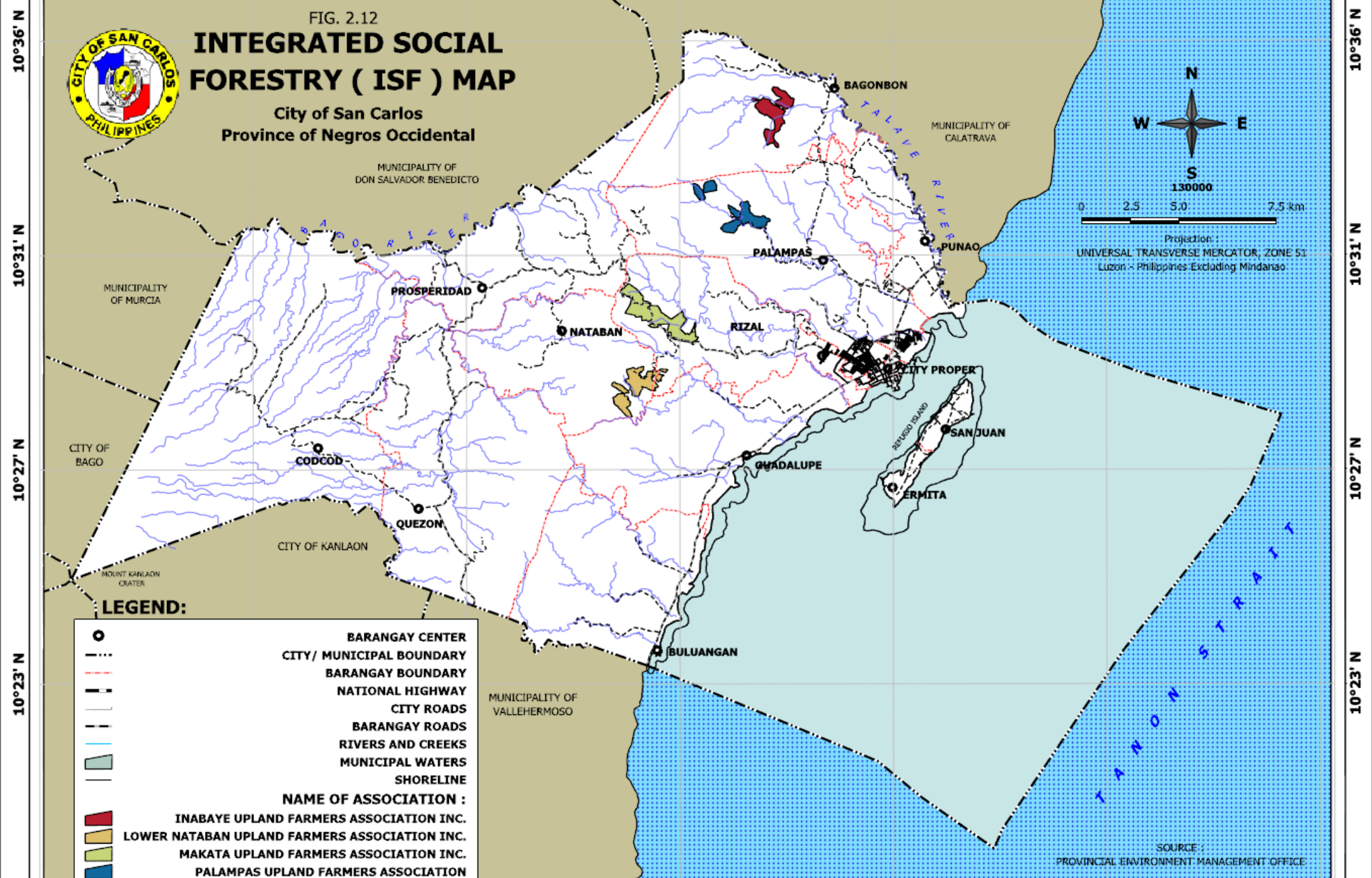
There are also lands under stewardship contracts administered either by the DENR’s Community Environmental and Natural Resources Office (CENRO) or by the Provincial Environment Management Office (PEMO). Within the City, a Community-based Forest Management (CBFM) agreement between the DENR and a people’s organization with 48 beneficiaries may be found in barangay Bagonbon (49.030 has.). The CBFM “is a production sharing agreement between the DENR and the participating people’s organization (POs) for a period of 25 years and is renewable for another 25 years. It aims to provide tenurial security and incentives to develop, utilize and manage specific portions of forest lands (DENR Administrative Order No. 96-29).”

Integrated Social Forestry Agreements, on the other hand, have been implemented in barangays Nataban (272.70 has.), Rizal (317 has.) and Palampas (144 has). The ISF “features the provision of land security tenure through the awarding of Certificate of Stewardship Contracts (CSCs). A CSC is awarded to individual households or families actually occupying or tilling portions of forest lands pursuant to LOI 1260 for a period of 25 years and is renewable for another 25 years.” Per the IEFM, the number of CSCs issued are 165 in Nataban, 173 in Rizal and 38 in Palampas. A map showing the location of ISFs is presented in **Figure 2.12**.

Indigenous Peoples

The population of Indigenous Peoples (IPs) was estimated at 575 with most of them living in Barangay Codcod. Most of them belong to the Bukidnon ethnic group while others are Aetas and Negritos. The most notable sources of income are being farm tenants, farming, honeybee production and laborers. Those residing in Barangay Codcod have already reportedly lodged applications for Certificates of Ancestral Domain Titles (CADT) with the National Commission on Indigenous Peoples (NCIP) and Protected Area Community-Based Management Agreement with the DENR. The following table presents information on the number and location of IPs in the City.

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E



123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

TABLE 2.6: NUMBER AND LOCATION OF INDIGENOUS PEOPLES (2013)

Location	Population	Source of Income	Ethnicity	Tenurial Instrument
Brgy. Codcod Iliranan Apog-apog Cabagtasán	380	Farm Tenant Farming Laborers	Bukidnon	Applicant of CADT with NCIP
Brgy. Codcod Cabagtasán	180	Farming laborer	Bukidnon	Applicant of PACBRMA with DENR
Brgy. Prosperidad Punod Agtotony Mayana	85	Farming	Bukidnon	None
Brgy. Rizal Brillantes	45	Farming	Bukidnon	None
Brgy. Bagonbon Nangka Buli Alasiis Pagbatangan	30	Farming	Aeta/Negríto /Bukidnon	None
Brgy. Nataban	35	Farming	Aeta/Negríto /Bukidnon	None
Total	755			

Source: City Planning and Development Office, SCC

- Tañon Strait Protected Seascape

Tañon Strait was declared a Protected Area, under the category of Protected Seascape, by virtue of Presidential Proclamation 1234 dated May 27, 1998. The strait is located between the islands of Cebu and Negros and is known as an area abundant with dolphins, whales and other marine species. The entire municipal waters of the City are part of this Protected Seascape.

- Marine Protected Areas and Fish Sanctuaries

The City Council has declared two Marine Protected Areas and Fish Sanctuaries off the eastern coast of barangays San Juan and Ermita.

- Non-NIPAS Areas

These are areas that are yet un-proclaimed by law, presidential decree, presidential proclamation or executive order as part of the NIPAS Areas. Per the National Physical Framework Plan 2001 - 2030, these areas should nonetheless be given equal importance, as in NIPAS Areas, in terms of conservation and protection.

- Reserved second growth forests

Most areas having slopes of greater than 50% are within the MKNP and NNNP, except for those at the upper portion of barangays Rizal and Palampas.

- Mangroves

Mangroves may be found in patches along the coastline and around Refugio (Sipaway) Island.

- Buffer strips

Buffer strips are identified in accordance with the provisions of the Water Code of the Philippines, i.e., 1) the banks of rivers and streams and the shores of the seas and lakes throughout their entire length within a zone of three (3) meters in urban areas, twenty (20) meters in agricultural areas and forty (40) meters in forest areas.

- Strategic Agriculture and Fisheries Development Zone

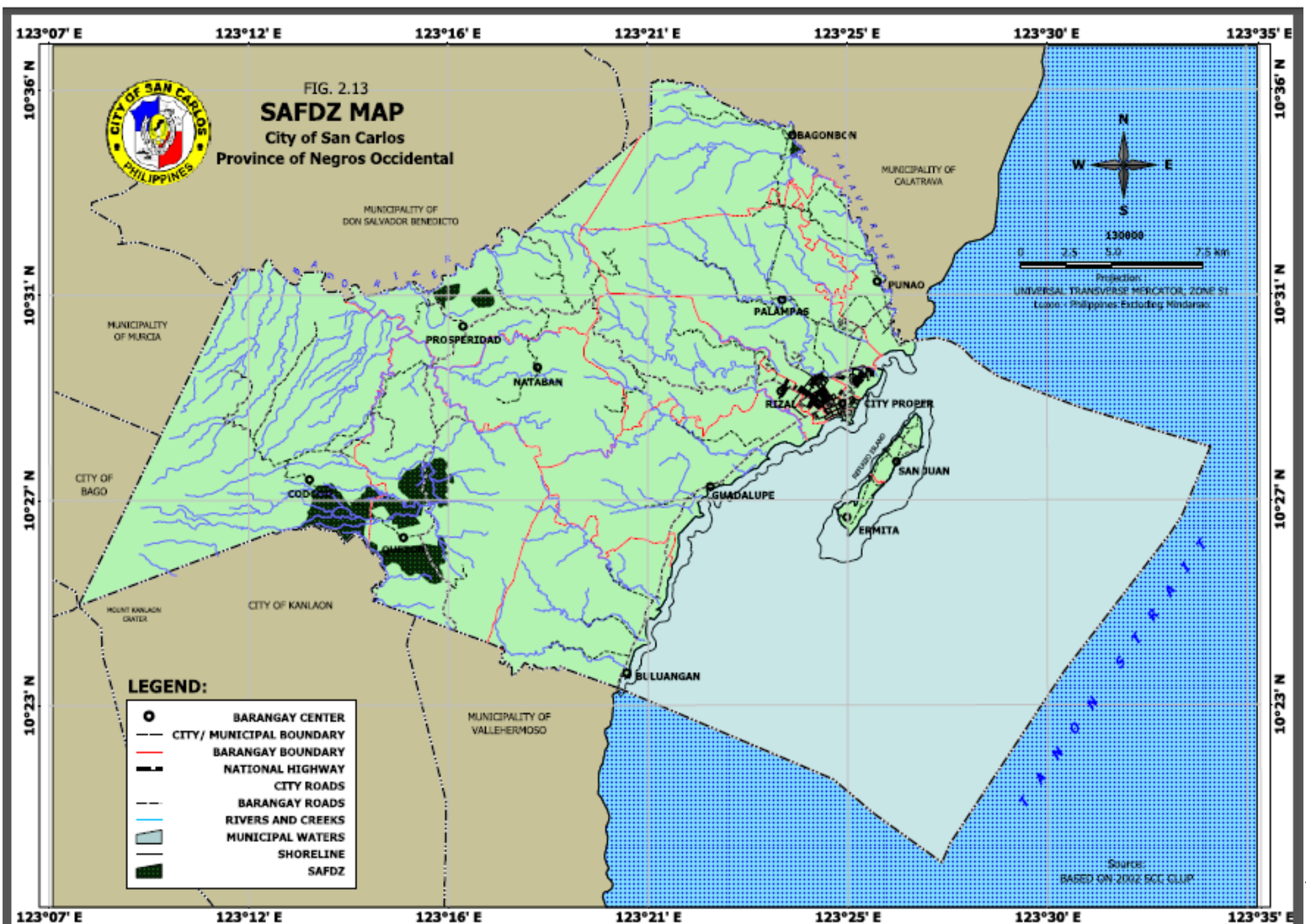
The City's declared Strategic Agriculture and Fisheries Development Zone (SAFDZ) is located in barangays Quezon and Codcod, as shown on **Figure 2.13 SAFDZ Map**.

2.6 COASTAL RESOURCES

2.6.1 MUNICIPAL FISHING GROUNDS

Fish production in the City is generally categorized into two, namely, aquaculture and marine. Aquaculture production is the production of fish and its related culture from brackish water fishpond

and freshwater fishpond. Most fishponds are located in barangays Guadalupe, Rizal and Punao where the major produce are bangus and prawns.



Major fish species caught in the City's Municipal Waters are tuna, mackerel, anchovy, grouper, parrot fish and rabbit fish. Marine fish production is basically of the subsistence type although some local fisherfolk sell their surpluses in the City's public market. In year 2012, a total of 1,256 fisherfolk were registered with the Fisheries & Coastal Resources Management Division of the City Agriculturist Office. As per record, using the Catch per Unit Effort (CPUE), the Daily Fish Catch is 0.33 kg/man/hr.

City Ordinance No. 180 Series of 1996 regulates fishing operations in and at the vicinity of the City's territorial waters. The highlights of this ordinance are the ban on commercial fishing within the municipal waters, unless otherwise allowed by the City government, and the prohibition on the use of drift gill nets within seven kilometers of the City's territorial waters.

2.5.1 MANGROVES, SEA GRASSES AND SEaweEDS

Mangroves may be found along the main shoreline of the City and on Refugio (Sipaway) Island. The dominant mangrove species that were recorded include bungalow, pagatpat and bakauan. Portions of mangrove forests (facing San Carlos City) on Refugio (Sipaway) Island provide shelter and food for migrating and endemic birds. There are at least 35 bird species reported in the area by PENRO-DENR. Cognizant of the importance of birds and bats to the overall ecology and tourism potential of Refugio (Sipaway) Island, the City has passed Ordinance No. 111 series of 1992 which prohibits the hunting or catching of birds and bats within the vicinity of the island.

Realizing the importance of mangroves, the City government has funded mangrove reforestation projects since 1995. To date, almost 400 hectares have been planted in Barangay I, San Juan, Ermita, and Punao with an average survival rate of 75%.

Section 23 of City Ordinance 192 S. 1997 prohibits cutting of mangroves for any purpose, fish farms, dumping of agricultural, manufacturing and solid wastes, and the shooting and hunting of birds in areas designated as mangrove zones. In the same light, Section 94 of RA 8550 prohibits the conversion of mangroves into fishponds or for any other purposes. However, the City allows fishpond establishment in denuded areas which have been zoned as suited for such an activity.

Seagrasses are nursery grounds and permanent habitats to certain fishes, economically important shellfish, eels, and crabs. They serve as food for fishes and other marine life forms and hold sediment that prevents siltation to corals. According to the 1994 Reconnaissance Survey and Evaluation Report of the PENRO-DENR, different marine organisms such as seagrass and seaweeds were spotted on Refugio (Sipaway) Island. They were seen in patches specifically in areas facing San Carlos City. Four seagrass species were identified on the island which includes *Halophila ovalis*, *Enhalus acoroides*, *Cymodocea rotundata* and *Halodule pinifolia*. On the other hand, there were 10 seaweed species recorded namely: *Turbanaria recurrences*, *Sargassum sp.*, *Chlorodesmis sp.*, *Ulva reticulata*, *Enteromorpha intestinales*, *Caulerpa taxopolia*, *Chaetomorpha crassa*, *Chondrococcus sp.*, *Hypnea sp.*, and *Actinotrichia fragilis*.

2.5.2 CORAL REEFS

In year 2012, live coral cover on the reef near Refugio (Sipaway) Island was estimated at 36.37% near barangay Ermita and 35.38% near barangay San Juan. This is a significant improvement from the respectively estimated 25.33% and 27.50% live cover observed in 2002 near the two barangays.

TABLE 2.7: LIVE CORAL COVER

Source of Observation	Year	Ermita	San Juan
Silliman University	2002	25.33%	27.50%
BFAR	2003	35.20%	35.20%
SCC Survey Team	2008	44.35%	51.67%
	2010	31.25%	52.38%
	2011	44.38%	44.38%
	2012	36.37%	35.38%

Source: Fisheries & Coastal Resources Management, City Agriculturist Office (2012)

2.7 FRESHWATER RESOURCES

2.7.1 SURFACE WATER RESOURCES

There are eight (8) major rivers in the City. These are the Talave, Palampas, Andoon, Gignalman, Mainit, Katingal-an, Sta. Cruz and Buluangan Rivers. The Talave and Palampas rivers and their tributaries emanate from the western slopes of the forest reserve area and drain to Tañon Strait. On the other hand, the Sta. Cruz and Bulungan rivers originate from the western slope of Mt. Kanlaon and also drains towards Tañon Strait.

2.7.2 GROUND WATER RESOURCES

The City Government, in coordination with the German Technical Cooperation (GTZ), commissioned a study of the groundwater potential in the City in 2009. This focused on the eight (8) major rivers and the catchment area of barangay Prosperidad. The study's findings indicate that "the most important rock formations for possible groundwater development" in the City are "found extensively in the flat alluvial plains near the coastline..."

Aquifers in the coastal and river deposits (coastal segments of barangays Punao, Rizal, Guadalupe, Poblacion, Buluangan) are made up of clay, silt, sand, gravel and organic remains. Potential saturated thickness during the rainy season may be as thick as ten (10) meters. The average thickness of the unconfined unconsolidated aquifer may not exceed five (5) meters. Most of its water discharges to surface drainage and to the air through plants and trees. There is a high possibility of encountering salt water if wells will be dug in these areas. The City's Groundwater Map is presented in **Figure 2.14**.

2.8 CLIMATE

San Carlos City, typical to other Negros island LGUs, belongs to Type III climate based on the Modified Coronas Classification of Philippine climate. Type III climate has "no very pronounced maximum rain period with a dry season lasting only from one to three months, either during the period from December to February or from March to May." The Climate Map of the Philippines is shown on **Figure 2.15**.

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

10°36' N

10°31' N

10°27' N

10°23' N

10°36' N

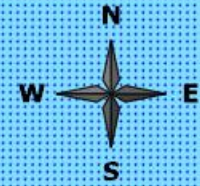
10°31' N

10°27' N

10°23' N

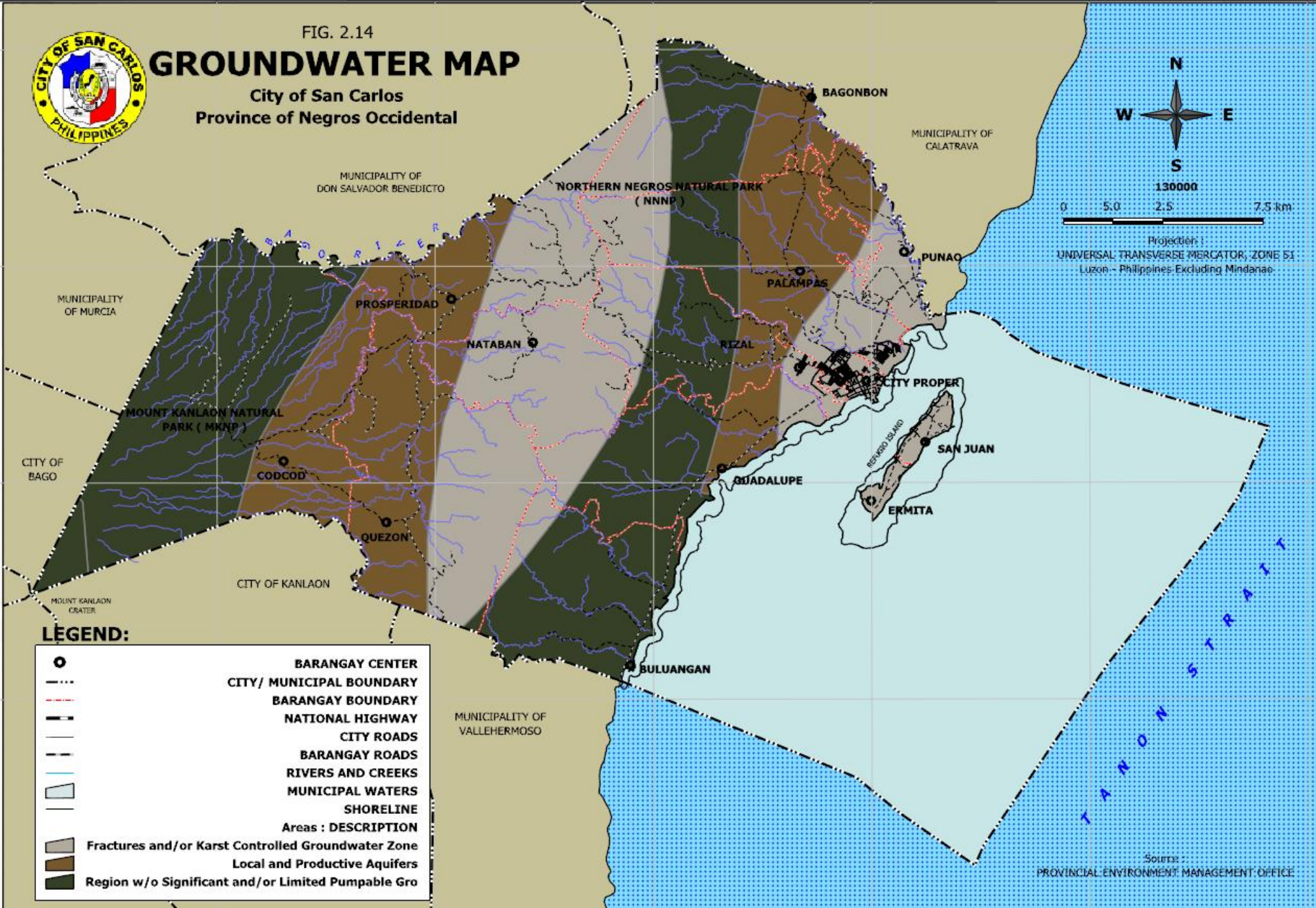


FIG. 2.14 GROUNDWATER MAP City of San Carlos Province of Negros Occidental



130000
0 5.0 2.5 7.5 km

Projection:
UNIVERSAL TRANSVERSE MERCATOR, ZONE 51
Luzon - Philippines Excluding Mindanao



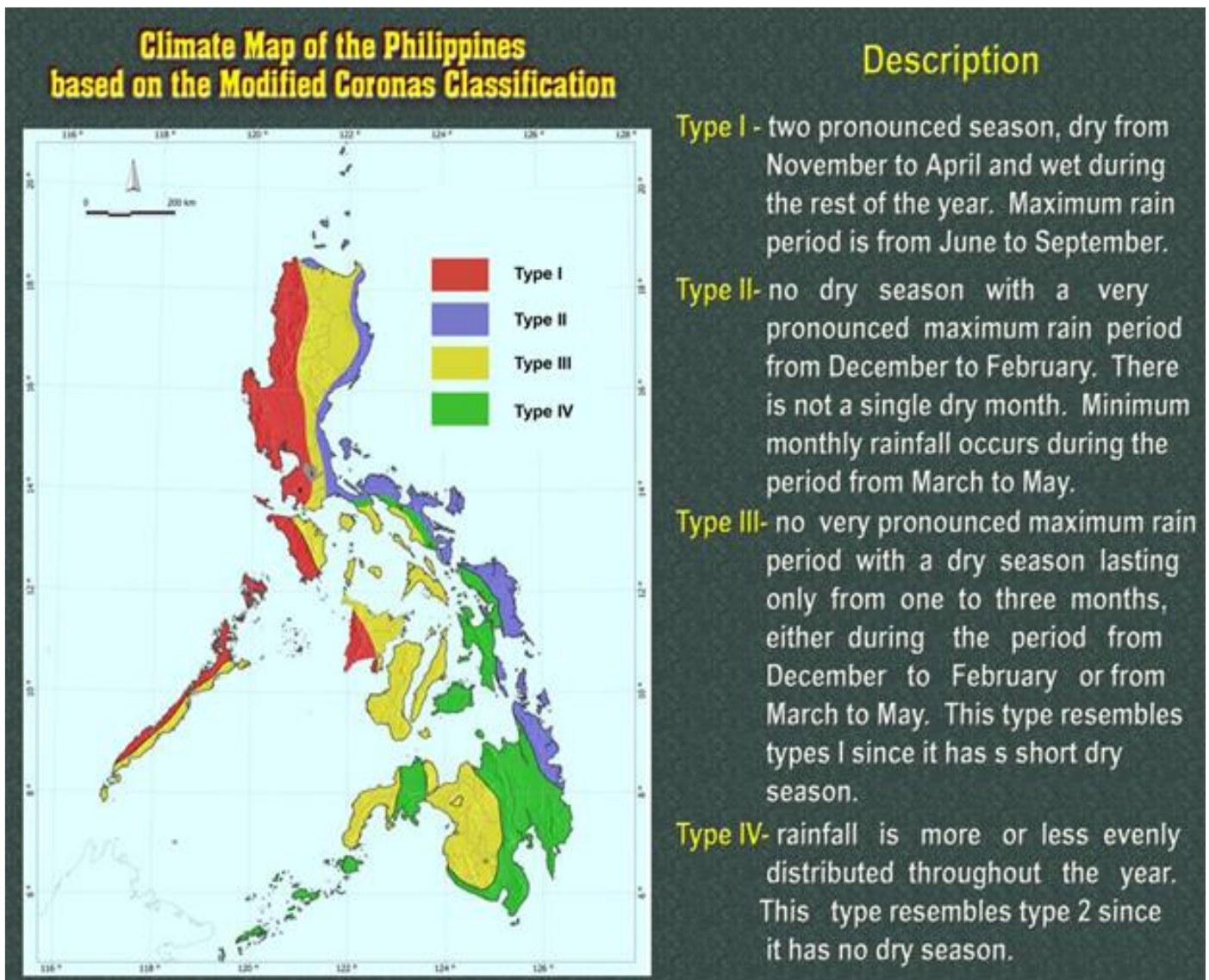
LEGEND:

- BARANGAY CENTER
- CITY/ MUNICIPAL BOUNDARY
- BARANGAY BOUNDARY
- NATIONAL HIGHWAY
- CITY ROADS
- BARANGAY ROADS
- RIVERS AND CREEKS
- MUNICIPAL WATERS
- SHORELINE
- Areas : DESCRIPTION**
- Fractures and/or Karst Controlled Groundwater Zone
- Local and Productive Aquifers
- Region w/o Significant and/or Limited Pumpable Gro

Sources:
PROVINCIAL ENVIRONMENT MANAGEMENT OFFICE

123°07' E 123°12' E 123°16' E 123°21' E 123°25' E 123°30' E 123°35' E

Fig. 2.15
Climate Map of the Philippines



Source: DOST – PAG-ASA

San Carlos City relatively enjoys good weather throughout the year. It lies within a zone where an average of one cyclone hits directly every year. However, it can be affected by other cyclones that pass in nearby areas. The map showing the frequency of tropical cyclones in the Philippines is shown in **Figure 2.16**.

2.9 NATURAL HAZARDS/CONSTRAINTS

Certain locations in the City are vulnerable to natural hazards. The City's Geohazard Map is presented in **Figure 2.17** and the hazards are briefly discussed below.

2.9.1 AREAS WITH CRITICAL SLOPES

These areas are defined as lands with slopes of 50% or more. These are mostly found in the highland areas of barangays Codcod, Prosperidad, Nataban, Rizal, Buluangan and Bagonbon.

2.9.2 LANDSLIDE-PRONE AREAS

Areas identified as highly susceptible to landslide include the upland portions of all mainland barangays. These are mostly located within the MKNP and NNNP.

2.9.3 AREAS PRONE TO VOLCANIC ACTIVITY

The nearest active volcano to San Carlos City is Mt. Kanlaon. Eruption history of this volcano based on the rock record shows that the volcano can have a major eruption. These major eruptions can bring about lava flows and airfall tephra with ballistic projectiles. Subsequent mudflows or lahars can develop after these events.

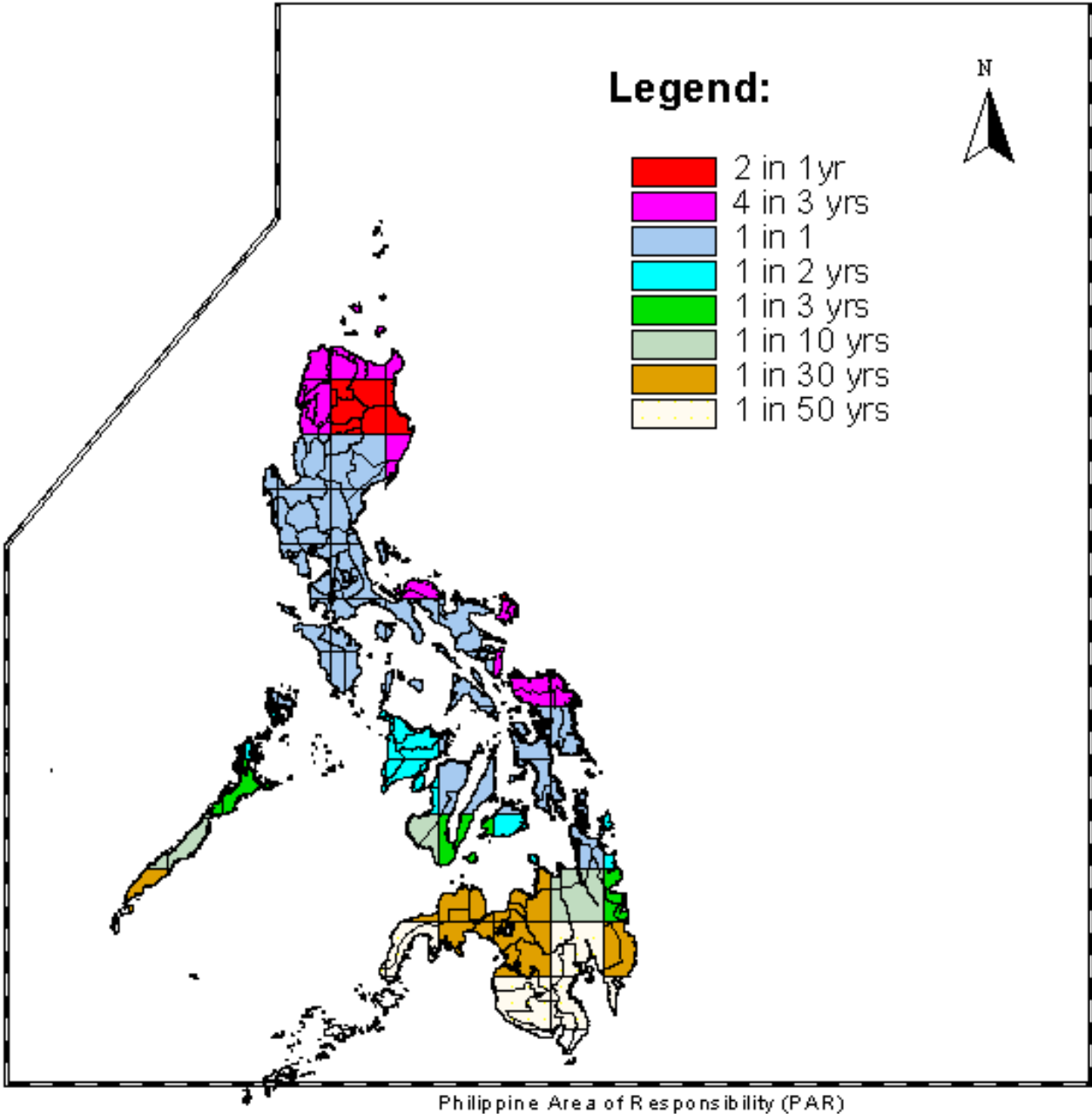
Based on the distribution of older volcanic deposits from past eruptions, the eruptions have been towards the south and south-west. As for the river systems that drain the slopes of Mt. Kanlaon, these potential lahar systems move towards that west and away from San Carlos City. The most probable adverse effect of a major eruption from Mt. Kanlaon would be airfall tephra should the eruption occur during the south-west monsoon, which falls on the months of June to October.

A significant portion of barangay Codcod was determined to be prone to volcanic and related hazards.

2.9.4 TIDAL ZONE

The entire Refugio (Sipaway) Island has been identified as a Tidal Zone that is exposed to wave action.

Fig. 2.16
Frequency of Tropical Cyclones in the Philippines



Source: PAGASA, 2013

