Chapter 7

WATER SOURCE DEVELOPMENT

7. WATER SOURCE DEVELOPMENT

7.1 General

The study on water source development covers the entire province in order to come up with water source potential exploitable mainly as domestic water supply. Emphasis is placed on groundwater availability due to its prevalent use and comparatively conservative development expected through the future in the jurisdiction of the provincial government. It is also advantageous to utilize groundwater for domestic water supply because of better quality and economical use. Nevertheless, with reference to river basin water resources management, surface water potential of major rivers was studied to provide information for the future use.

A "Groundwater Availability Map" was prepared, which identifies the areas with available potable water sources. The study has two major components: (1) interpretation of existing geologic and groundwater conditions and (2) preparation of Groundwater Availability Map to show groundwater potential areas under three categorized areas. Furthermore, standard well specifications by municipality were also established to reflect in the medium-term sector development plan.

The major data used in the study were obtained from concerned agencies (NAMRIA, BMGS, NWRB, LWUA, DPWH and PPDO) and supplemented by the information gathered through questionnaires from relevant local offices in the field (including spring inventories with verifications). The field information directly collected by the Study Team was also used to increase the accuracy of the Map. Among the information, the Geologic Map published by BMGS, the Water Resource Investigation Report and the Well Inventory Database of NWRB are essential for the analysis of geological characteristics, projection of high yielding area and possible area with saline water intrusion, and classification of groundwater potential areas, respectively (details are referred to Table 7.1.2, Data Report).

The Groundwater Availability Map may be used for provincial level master plan and feasibility study at present. However, recommendations on the required investigations were presented for specific areas with scope of survey, as reference for LGUs, to conduct these prior to D/D and construction work. Aside from the requirements, updating the map is a requisite to gain more information on prevailing groundwater conditions using the questionnaires prepared for the study. An annual review and updating of the database will enable the LGUs to implement water source development on a project site basis.

An overview on current groundwater use with the conditions is summarized in Table 7.1.1 (well data collected from each municipality are presented in Table 7.1.1, Water Source Information, Data Report). There are 11,459 shallow wells, 7,827 deep wells and 997 developed springs in the province (functional sources). More than half in the number of the wells is shallow wells. About 60% of these water sources are public facilities. Of the total existing wells, 2,741 shallow/deep wells are not functional at present. In addition to the above sources, 25 untapped springs are accounted.

Table 7.1.1 Existing Groundwater Sources in the Province

Category and Classification	Shallow Well	Deep Well	Spring	Total
1. Water source being availed				
a. Public sources	6,796	4,270	997	12,063
b. Privately owned sources	4,663	3,557	0	8,220
c. Number of water sources	11,459	7,827	997	20,283
d. % share of different sources	56%	39%	5%	100%
2. Water sources with problems and non-functional facilities				
a. Water quality problems*	3,438	0	0	3,438
b. Non-functional	1,205	1,536	72	2,813
3. Spring source information				
a. Undeveloped	-	-	1	1
b. Untapped	-	-	25	25

Note. 1: Number of water sources being availed at present including those with water quality problems.
2: Number of existing water sources with problems: being used, but with water quality problem/abandoned wells.
3: Number of springs availed, but not adequately protected; and those as candidate sources to be developed.
*: Assumed number of sources (unsafe category) based on the study on existing water supply facilities in Chapter 4.

7.2 Geology

The geographic features of Negros Occidental are represented by the volcanoes in the northwestern part, the alluvial fans in the western central plain and the undulating and rolling lands in the southern part. In the northwestern part of the province, volcanoes are prominent, namely Mt. Silay, Mt. Mandalagan and Mt. Canlaon. The first 2 mountains are classified as inactive volcanoes, while the remaining one is an active volcano. In the southern part of the province, the oldest geologic region is extensively distributed. Same geologic rock units are abruptly found in the northeastern and the southern sides of the volcanoes.

The geology and topography of the province are considerably affected by volcanic activity. Mt. Canlaon had undoubtedly played a leading role for the activity with several times of the

phreatic explosion in July 1997. The erosion of sediments from the higher lands and the violent eruptions had filled up the portions of the western and southern parts of the province. The mudflow carried much soil materials into the Guimaras Strait.

The present hills in the vicinity of La Castellana to San Carlos City are remnants of another volcanic activity. The rolling of heavy and coarse angular stones mixed with volcanic ash has formed such short and steep hills. The river water crossing the eastern alluvial fans carried volcanics with pre-deposited materials which had earlier been deposited to form landmass.

The upliftment of the western portion of the province within Recent times is indicated by the raised beaches near Pontevedra, the bluffs of Bacolod and the incised meandering stream in the volcanic and littoral plains. The remains of limestone formations are found at the summit and slopes of the hills and mountains of the province. Subsequently, mountain-making movements of tremendous force raised the rocks to great heights.

For the purpose of preparing the Groundwater Availability Map of the province, only rock units significant to groundwater storage and permeability are briefly described. The rock units in the province are classified into 3 main groups based on the geologic ages. In geologic age these are; the Miocene and Older Systems, the Plio-Pleistocene Series and Recent Deposits. The grouping of rock units is related to their potential as groundwater sources. The younger rocks are essential in groundwater development because of their porosity and permeability relative to the older rocks. The distribution of these rock groups is shown in Figure 7.2.1, Geological Map. Its geological features are described below.

(1) Miocene and Older Systems

Rock units of Miocene and older systems are impermeable, which are classified as aquicludes. Limestone of middle Miocene to early Pliocene epochs consists of mainly well bedded to massive coralline and fossiliferous limestone with lenses of marl and calcarenite. Apparently impervious to partly pervious outcrops of it is fairly cemented. Volcanic rocks of late Miocene to Pliocene epochs are made up of andesite and basalt lava, breccia and agglomerate flows and minor pyroclastic rocks. Such volcanic rocks are well compacted and cemented with impervious facies.

(2) Plio-Pleistocene Series

Sedimentary rocks of this series have various ranges of permeability. The clastic rocks of Plio-Pleistocene epochs consist of fair to well-compacted claystone, shale, silt stone

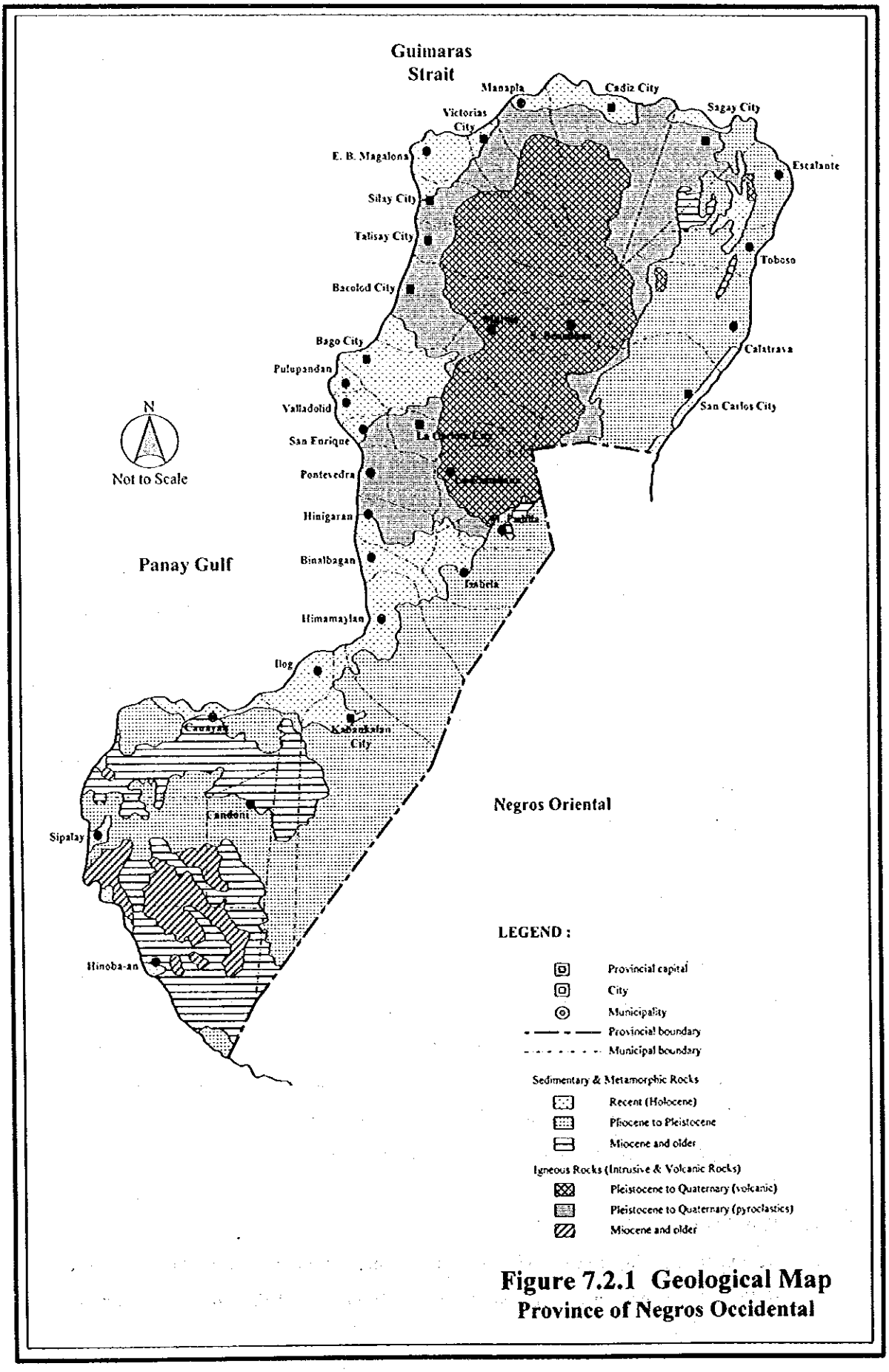

Figure 7.2.1 Geological Map
Province of Negros Occidental

and sandstone, in which thin beds and massive conglomerate bouldery deposits, impure limestone, tuffs and thin lenses of coal are found as the interposed rocks. Its terrain is almost flat to gently rolling with moderately and steeply slopping. This unit is inferred to underlie most of the Quaternary pyroclastic deposits at the lowlands. In the northern piedmont areas of volcanoes, most of this series are made up of basaltic fragmental and pyroclastic materials. Limestone of Plio-Pleistocene epochs are made up of coralline to marly limestone with conglomerate to sandy facies.

(3) Recent Deposits (Holocene Series)

Recent volcanic rock units consist of andesite and basalt lava, breccia and agglomerate flows, interbedded tuff and overlying poorly compacted pyroclastic deposits. It occurs in the volcanic centers. Terrain is moderately to very steeply sloping.

Recent pyroclastic deposits are made up of agglomerate, tuff, volcanic ash, minor lava flows, dikes and sills. Most of the pyroclastic deposits laid under the sea were obviously reworked to form tuffaceous shale, mudstone, siltstone, sandstone and conglomerate. Some of the pyroclastics were re-deposited by rivers to form similar sequence. Fragmental materials from the volcanic cones formed part of the fluvial deposits. The reworked pyroclastic deposits generally occur at lower elevation that show almost flat to undulating terrain. The terrestrial pyroclastic deposits and volcanic flows are found as the outcrops at higher elevation of precipitous slopes. The small mounds consist of volcanic boulders while the volcanic flows form knobs and hills around volcanic cones.

Recent alluvium as major aquifers in the coastal area is made up of clay, silt, sand, gravel and organic remains. Potential saturated thickness may be as thick as 10m or more. The average thickness of the unconfined and unconsolidated aquifer may not exceed 5m.

7.3 Groundwater Sources

7.3.1 Classification of Groundwater Availability

For planning purpose, the provincial area is divided into the following sub-areas in terms of groundwater availability.

(1) Solo shallow well area

Solo shallow well area is defined in this study as the area where only shallow well is available. These areas have water bearing rock formations extending not more than 20m in depth below the ground surface. Solo shallow well areas are usually located in allu-

vial, coastal plains and inland small basins, where recent unconsolidated materials overlie on the impervious rocks at shallow depth. The extent of completely solo shallow well area is limited, because most of the recent formations are thick or deposited on the Late Plio-Pleistocene series that usually have multiple aquifers located at greater depths.

(2) Deep well area

In deep well areas, the lower aquifers are located more than 20m below the ground surface. These areas could be found in portions underlain by the Plio-Pleistocene series and Recent formations. Most of these areas have several aquifers occurring at various depths. In this area, shallow wells can also be developed.

(3) Difficult area

This area is not suitable for well development. The areas under this category largely consist of rock formations older than Miocene epoch. The groundwater availability in the aforesaid rocks is very low and water is rarely released in the opened rock fractures. Springs are the common sources of water supply in these areas.

In addition to the above classification, potential areas to have high yielding deep aquifers are presented based on NWRB's geo-resistivity survey.

7.3.2 Groundwater Availability in the Province

The Groundwater Availability Map is presented in Figure 7.3.1. The major databases used in the preparation of the map were obtained from BMGS and NWRB. The methodology and study procedures with respective outputs are discussed in 7.3.2, Supporting Report.

Technical information on the wells by municipality is also shown in the Data Report. The groundwater development potential areas in the province for the future are summarized.

(1) Solo shallow well area

Solo shallow well areas in the province are limited. The development of shallow wells is, however, possible in the "Deep Well Area" (recent alluvium and beach deposits), where shallow aquifers usually occur.

The essential definition of shallow well is to develop an unconfined aquifer. However, it is difficult to classify an aquifer into confined or unconfined. In this study, therefore, the well classification was made referred to the well depth of 20m as the boundary. The

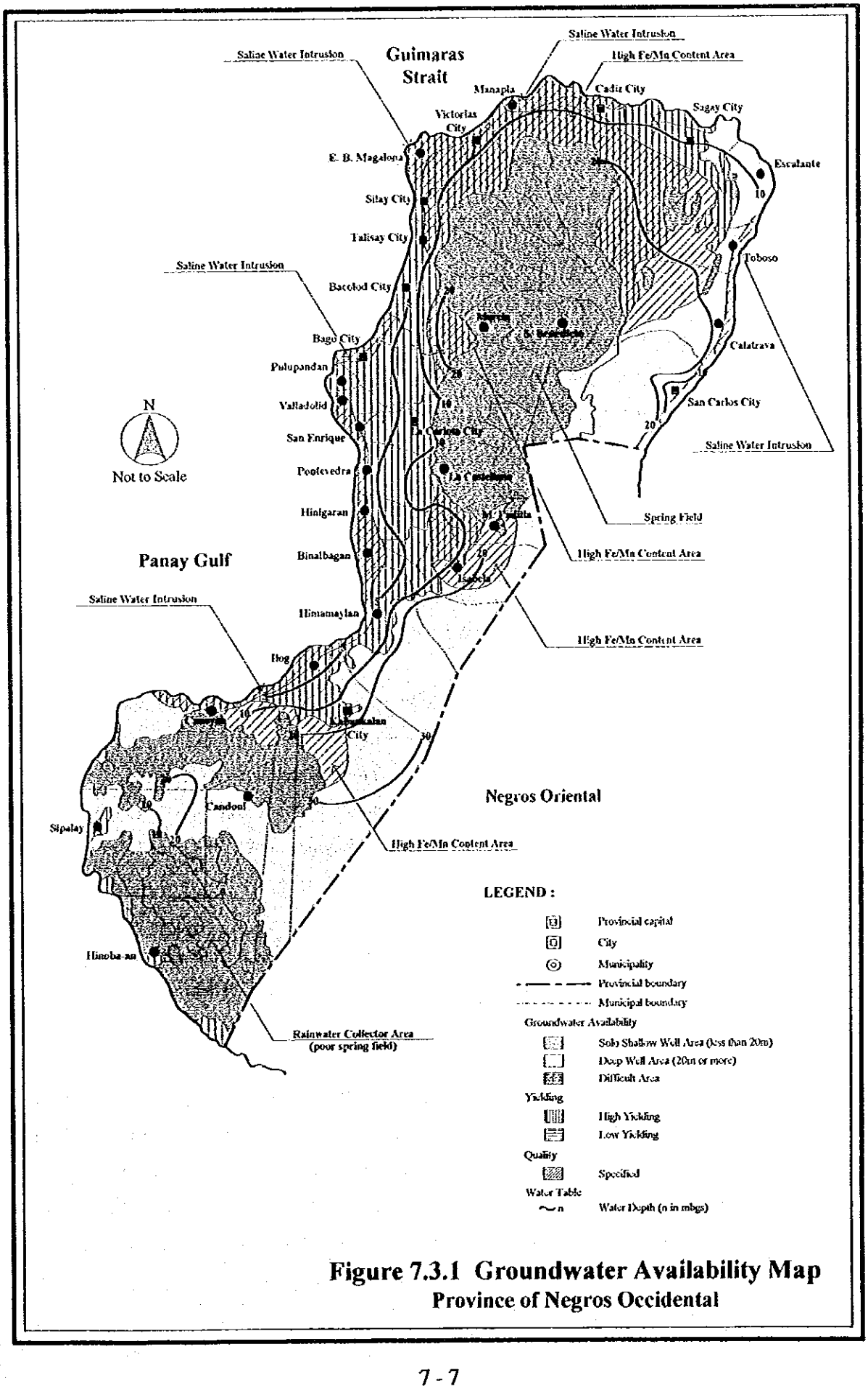

Figure 7.3.1 Groundwater Availability Map
Province of Negros Occidental

depths of shallow wells in the province were assumed ranging from 1.6 to 19.0m. The static water levels are from 0.5 to 11.0 mbgs and specific capacities from 0.1 to 6.4 lpsm.

(2) Deep well Area

The deep well area covers approximately 75% of the province, widely distributed in the surroundings of northwestern volcanoes and the central part of the province. The deep well area is composed of alluvial plains, piedmonts and rolling hills formed by sedimentary and volcanic rocks. The alluvial plain is made up of recent deposits of clay, silt, sand and gravel, which form a groundwater storage basin for some aquifers. The sedimentary formations of Plio-Pleistocene epoch consist of claystone, shale, siltstone, sandstone, conglomerate, limestone, tuffs and coal in the eastern fringe of the province. In the piedmont areas of volcanoes, volcanic rocks are made up of basaltic fragmental materials and pyroclastics.

Considering the geological formation, the alluvial plain and fan are categorized as a high potential area for deep well development. There is no low-yielding area in the province. In the deep well areas, the average depth of the existing deep wells is 31.9 m with an average water level of 7.3 mbgs. The average specific capacity is 2.1 lpsm.

In the southern mountain area formed by Plio-Pleistocene series, groundwater development has not yet been performed sufficiently due to limited demand, although enough spring sources exist in the barangay vicinity. The average depth of the deep wells was projected to be 40m in urban and 80m in rural area with static water levels ranging from 10 to 20 mbgs. The specific capacity of the wells may be enough for Level-II service.

(3) Difficult area

About 25% of the provincial area are classified as the difficult area to exploit groundwater, in which the volcanoes and the mountain system areas exist. These are located in the northwestern and southern portions of the province.

The geology is made up of (1) limestone of middle Miocene to early Pliocene epochs consisting of mainly well bedded to massive coralline and fossiliferous limestone and (2) volcanic rocks of late Miocene to Pliocene epochs comprising of andesite and basalt lava, breccia and agglomerate flows and pyroclastic rocks. These rocks and formations are in dense, massive and consolidated conditions and have impervious characteristics. Groundwater occurs only in fissures, fault fracture or cave zones.

7.3.3 Groundwater Quality

The water quality problem in deep wells is found in the piedmont areas of volcanoes and the western coast (details are referred to Table 7.3.2, Data Report). Major water quality problem is ironic groundwater and saline water intrusion. The results of water resources investigation for the province conducted by NWRB and the general information from DPWH-DEO and PPDO revealed these problem areas and are shown in the Groundwater Availability Map in Figure 7.3.1.

Among the water quality problems of the province, ironic water is serious with a high percentage of affected existing wells (nearly half of the numbers of deep wells) in populated area. The problem is extended to the northern piedmont area from the municipality of Calatrava to Bago City in the counterclockwise order. Groundwater with saline water intrusion is prevalent in most of western seashore of the province, extensively distributed in the central part.

7.4 Spring Sources

Spring is a natural outlet of groundwater at the ground surface. It occurs when water table intersects the ground surface, usually along the contacts of pervious and impervious rock formation and through rock features. Because of the intense fracturing, particularly older formation, and the presence of large solution openings in limestone, secondary permeability is induced to the rocks that favors spring development.

For the study, springs are categorized into developed, undeveloped and untapped springs. A developed spring is utilized with sanitary protection provided, otherwise it is classified as undeveloped spring, which is considered as unsafe water source. An untapped spring, as the name implies, is unutilized and flowing in its natural state.

Based on the inventory of water sources prepared throughout the study, the province has 997 developed springs currently serving the province. Such spring sources come out from the volcanoes and from the mountain system area in the northwestern and southern parts of the province. Of these springs, 60 have discharge rates of less than 2.0 lps (2.0 lps is enough for Level II water supply with service population of about 2,000 and can be applicable for small Level III water supply), while 5 springs exceed discharge rates of 2.0 lps. The other 932 developed springs have no data available on discharge rates at present. However, 223 springs of the total developed springs are utilized for Level II and Level III water supply services, especially in the volcano vicinities. Most of these springs are not dried up during a drought year

or dry season, though yields varying from 0.1 lps to 80 lps. The technical information of springs in each municipality is presented in Table 7.4.1 Existing Spring Sources, Supporting Report.

7.5 Surface Water Sources

The major surface water sources in the province are Himoga-an, Sicaba, Malogo, Napilas, Bago, Binalbagan, Hilabangan and Sipalay Rivers. The Ilog river is tributary of Hilabangan River. Most areas of the province belong to the Water Resource Region VI, while only the area of Hinoba-an falls on that of Region VII. There are 9 gauging stations at the major rivers in the province.

Surface water amount used in the province totaled to 59.5 m^3/sec according to the NWRB's water rights registration database as of March 1997. Of this usage, 67.4% of the water rights were registered for irrigation. The diversions for major flume, which are operated by the province and NIA, are located at Moises Padilla, the Binalbagan River; at Murcia, the Bago River; at Sipalay, the Sipalay River; and at Victorias City, the Malogo River, respectively. The province operates some communal irrigation systems in the northern part of the province, while in the southern part, NIA manages the systems. Other surface water rights are lodged with private companies for domestic, industrial and fisheries uses. For domestic water supply, several associations registered intake amount of 0.09 m^3/sec in a total for concerned subdivisions including those in the municipality of Sipalay. Intake amount of 16.5 m^3/sec (or 27.8% of total water rights in the province) is registered for industrial uses. The main consumer is Philex Mining Corporation taking water from Sipalay River since 1993.

Data on river flow including maintenance flow and water use of the major rivers/streams were obtained from available runoff records at the gauging stations (refer to Table 7.5.1, Supporting Report). The inflow to and the outflow from the respective municipalities are estimated as the exploitable potential of the major rivers in the province as shown in Table 7.5.2, Supporting Report.

Water quality analyses at selected rivers were conducted during this study. The examined water quality at each river meets the Class AA or A limitation of "DENR Fresh Water Quality Criteria". It is noted that mining activities on copper and gold are prevalent in the southern watersheds (municipality of Sipalay). These operations might have caused contamination to the surface water, but as of now surface water and soil in the vicinity of these mining sites have not yet surveyed by the regional DENR.

7.6 Future Development Potential of Water Sources

(1) Groundwater

Based on the study of existing water sources, groundwater is considered as a safe and more economical source for future water supply requirements of the province.

Shallow wells are the possible source for Level-I service. Considering the existing wells in the province, the potential aquifers for shallow wells occur between 1.6 to 19.0 mbgs. One disadvantage of shallow wells is the lowering of water level during dry season that reduces the discharge rate of the wells or disturbs the hand-pump operation. Another disadvantage is the usual high susceptibility of shallow aquifers to direct infiltration of surface pollutants.

In general, deep wells have better water quality and invariable yields when developed with appropriate technology. This depends if the wells tap to comparatively deeper aquifer. It reduces the hazards of groundwater pollution. In addition, lowering of static groundwater level does not affect the discharge rate and the hand-pump operation. In Recent deposits and Plio-Pleistocene series, good aquifers apparently occur from 20 mbgs to 150 mbgs in depth.

Additional wells can still be developed to meet future water supply demand of the province. For future planning purpose, the Groundwater Availability Map includes basic information for municipal groundwater development with the following information: well type, well yield, water quality and static water level. Aquifer formations are shown in Table 7.6.2, Supporting Report. The groundwater development potential in the province is shown in Table 7.6.1.

The well design with gravel placement is required for additional well development. However, the natural gravel packed well for Level-I water supply is also adaptable within limited areas in the province. The percentages of the natural gravel packed wells to the total potential number of wells to be developed in the expected municipality area are assumed in Table 7.6.3, Supporting Report. The construction ratio of natural gravel packed well to the total requirements of the province is assumed at merely 5%.

Most of the Level-I deep well facilities had been designed with well materials made of either galvanized iron, mild steel or low carbon steel. In the area where groundwater with acidic pH is observed, anti-metallic materials (polyvinyl chloride; PVC) for well

Table 7.6.1 Groundwater Development Potential in the Province

Area	Groundwater Development Potential	Water Quality	Area Feature
Northeastern to Central Mountain Range	This district is classified as deep well area. Majority of the existing sources is deep wells with depths of 50m or more. Deep well production capacity is slightly lower in this area than that in the northwestern coasts. Static water levels are 20 mbgs or lower. Shallow well is available only along the coastal area. Very few spring sources are found in this mountain range area.	Existence of high Fe contents in groundwater is reported in northern piedmont areas of volcanoes. The saline water intrusion presents in the western seashore area from Taboso to Calatrava.	This area covers the northeastern to the central-western part of the province consisting of nine (9) municipalities and two (2) cities from Sagay City to Ilog's mountainside. This mountain area consists of a main coastal range. The main range trends N-NE parallel the northeastern coast. The mountain range falls steeply to the east leaving a few coastal plains, the largest of which is the settlements of San Carlos City.
Northwestern Volcanoes	Volcanic mountain area is classified as difficult area. Piedmont area is classified as deep well area. Majority of the existing water sources is deep wells with depths of 30 to 150m with sufficient discharge for Level-III water supply. Shallow well is also available in the seashore. Static water levels are less than 30 mbgs depending on the distance from coast. There are numerous springs, the fields of which are located in the border belt between the deep well and the difficult areas.	The saline water intrusion is observed in most area of the western seashore. Spring is potable.	This district covers the northwestern to central-western part of the province consisting of thirteen (13) municipalities and eight (8) cities from Cadiz City to Ilog. The chain of volcanic peaks consists of 3 volcanoes. Mt. Canlaon is rather isolated from the two extinct volcanoes. The western plain is the wide and important strategic area of the island.
Southern Wide Level Land	More than half area of this district is classified as difficult area, while rests are deep well area in the inland valley and solo shallow well areas in the southern coast. Many rainwater collector facilities are found. Potential water source is spring, but it is limited and scattered. Fissure water can be hit locally with high production. Deep well is available in the valley bottom plain from Sipalay to Candoni with depths of 40m to 80m. Static water levels are about 10 mbgs to 20 mbgs. Shallow wells have a high productivity.	The high Fe content in groundwater and the saline water intrusion are reported in the mountain and the coastal areas of Cauayan, respectively. There are mining sites in this district, but water quality for drinking was not confirmed.	This district covers the southern part of the province consisting of four (4) municipalities from Cauayan to Hinobaan. The dominant topographical feature is a wide level land consisting of the hills in maturity stage and the valleys made by cycle of erosion. The coastal plains are narrow and very small.

casing pipes and screens, and anti-corrosive metals (stainless steel; SUS) for pump facility are required. However, the area where the deep well construction using PVC and SUS materials is applicable for the future plan could not be confirmed due to insufficient information available on the water quality examination. Therefore, the construction ratio of deep well using PVC and SUS materials to the total requirements of the province is assumed to be nil at present. Nevertheless, the expected municipality areas, in which there is a possibility to encounter low pH value (acidic) in groundwater, are projected as shown in Table 7.6.4, Supporting Report for the future study.

(2) Spring

A total of 25 untapped spring sources identified by the PSPT is listed in Table 7.6.5 Untapped Spring Source Identification, Supporting Report. The list includes detailed data on barangay name, owner, discharge rate in dry season, transmission line length and relative elevation between spring source and served area. Such springs are mainly located in the piedmont of volcanoes in the northwestern part of the province. Other areas have few untapped springs. Of these springs, 21 untapped springs with discharge rates ranging from 0.5 lps to 189.3 lps (actual data base) are generally applicable for Level-II water supply. Spring development potential in the province is shown in Table 7.6.5, Supporting Report.

(3) Surface Water

The potential surface water volume exploitable from major rivers for the use of domestic water supply was estimated by municipality. It was arranged in this calculation to ensure maintenance flow of the rivers under the drought flow in the 10-year return period with due consideration of the present water rights.

The calculation results are shown in Table 7.5.2, Supporting Report. In particular, municipalities situated in the Bago, Binalbagan and Ilog River basins are privileged to use larger amount of river water.

7.7 Water Source Development for Medium-Term Development Plan

For the preparation of the medium-term development plan in terms of water source development, standard specifications of wells by municipality were prepared. The parameters, such as: proportion of well type, well depth, static water level and specific capacity are shown in Table 7.7.1. These were established using the well information from NWRB and the province (detailed database is included in Table 7.1.1, Data Report), and the hydrogeological assess-

ment presented in Table 7.6.2, Supporting Report.

Groundwater source availability (well and spring) is reflected in Table 7.7.1 that was assumed based on water sources study considering the limited information on geology, topography, water sources inventory, etc. The groundwater source availability indicates the general profile of the different types of groundwater source available in the municipalities. Hence, the descriptions have no projected meaning on future development values of its groundwater source. Considering the present water sources utilization, the percentages of spring development compared with well development for the future demand of the entire province are studied in Chapter 8 of this report.

Shallow wells are currently used in some municipalities. The municipal areas are categorized into deep well and solo shallow well areas considering the on-going practices. The proportions (%) by deep well and shallow well area are determined with reference to groundwater development potential in the Groundwater Availability Map. Furthermore, well locations are assumed in terms of rural and urban areas by municipality using the classification of rural and urban barangays.

For municipalities without any well data, the well parameters are estimated using the data of adjoining towns, provided they have similar hydrogeologic features.

Table 7.7.1 Standard Specification of Wells by Municipality

Municipalities With Classification		Type	Proportion (%)	Standard Specification					Availability of Sources
				Depth Range (m)			SWL (m)	Sp. Cap. (lpsm)	
Bago City	Rural	SW	0	-	<D<	-	-	-	Good DW and Few SP
		DW	60	20.0	<D<	40.0	8	1.5	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	3	1.5	
Binalbagan	Rural	SW	0	-	<D<	-	-	-	Good DW and Poor SP
		DW	100	20.0	<D<	30.0	5	0.4	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	3	2.0	
Cadiz City	Rural	SW	0	-	<D<	-	-	-	Good DW and Rich SP
		DW	60	20.0	<D<	40.0	10	2.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	40.0	5	2.0	
Calatrava	Rural	SW	0	-	<D<	-	-	-	Fair DW and Rich SP
		DW	80	20.0	<D<	60.0	15	0.4	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	40.0	6	0.6	
Candoni	Rural	SW	0	-	<D<	-	-	-	Fair DW and Few SP
		DW	30	40.0	<D<	60.0	15	0.2	
	Urban	SW	0	-	<D<	-	-	-	
		DW	80	30.0	<D<	50.0	10	0.4	

Table 7.7.1 Standard Specification of Wells by Municipality

(cont'd)

Municipalities With Classification		Type	Proportion (%)	Standard Specification					Availability of Sources
				Depth Range (m)			SWL (m)	Sp. Cap. (lpsm)	
Cauayan	Rural	SW	10	12.0	<D<	18.0	5	0.2	Fair DW and Few SP
		DW	40	20.0	<D<	40.0	10	0.4	
	Urban	SW	0	-	<D<	-	-	-	
		DW	50	30.0	<D<	50.0	5	1.0	
E. B. Magalona	Rural	SW	0	-	<D<	-	-	-	Good DW and Few SP
		DW	70	30.0	<D<	50.0	15	2.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	5	2.0	
Escalante	Rural	SW	0	-	<D<	-	-	-	Fair DW and Few SP
		DW	90	30.0	<D<	50.0	15	0.6	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	40.0	5	1.0	
Himamaylan	Rural	SW	0	-	<D<	-	-	-	Good DW and Poor SP
		DW	100	20.0	<D<	40.0	10	1.5	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	5	2.0	
Hinigaran	Rural	SW	0	-	<D<	-	-	-	Good DW and Poor SP
		DW	100	20.0	<D<	40.0	8	1.5	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	3	2.0	
Hinoba-an	Rural	SW	10	12.0	<D<	18.0	5	0.2	Risky DW and Few SP
		DW	0	-	<D<	-	-	-	
	Urban	SW	50	12.0	<D<	18.0	5	0.2	
		DW	0	-	<D<	-	-	-	
Ilog	Rural	SW	0	-	<D<	-	-	-	Good DW and Few SP
		DW	60	20.0	<D<	40.0	8	2.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	5	2.0	
Isabela	Rural	SW	0	-	<D<	-	-	-	Fair DW and Few SP
		DW	100	40.0	<D<	80.0	15	0.6	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	30.0	<D<	70.0	10	1.0	
Kabankalan City	Rural	SW	0	-	<D<	-	-	-	Fair DW and Few SP
		DW	90	40.0	<D<	80.0	15	0.4	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	30.0	<D<	70.0	10	1.0	
La Carlota City	Rural	SW	0	-	<D<	-	-	-	Good DW and Rich SP
		DW	50	40.0	<D<	80.0	10	1.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	30.0	<D<	50.0	8	1.5	
La Castellana	Rural	SW	0	-	<D<	-	-	-	Risky DW and Rich SP
		DW	10	40.0	<D<	80.0	10	0.6	
	Urban	SW	0	-	<D<	-	-	-	
		DW	0	-	<D<	-	-	-	
Manapla	Rural	SW	0	-	<D<	-	-	-	Good DW and Rich SP
		DW	60	20.0	<D<	40.0	10	1.5	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	5	1.5	
Moises Padilla	Rural	SW	0	-	<D<	-	-	-	Fair DW and Rich SP
		DW	70	30.0	<D<	70.0	10	0.6	
	Urban	SW	0	-	<D<	-	-	-	
		DW	60	50.0	<D<	90.0	20	1.0	

Table 7.7.1 Standard Specification of Wells by Municipality

(cont'd)

Municipalities With Classification		Type	Proportion (%)	Standard Specification					Availability of Sources
				Depth Range (m)			SWL (m)	Sp. Cap. (lpsm)	
Murcia	Rural	SW	0	-	<D<	-	-	-	Good DW and Rich SP
		DW	10	40.0	<D<	80.0	25	1.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	30	50.0	<D<	90.0	30	1.5	
Pontevedra	Rural	SW	0	-	<D<	-	-	-	Good DW and Few SP
		DW	100	20.0	<D<	40.0	5	1.5	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	3	2.0	
Pulupandan	Rural	SW	0	-	<D<	-	-	-	Good DW and Poor SP
		DW	100	20.0	<D<	40.0	5	1.5	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	3	1.5	
Sagay City	Rural	SW	0	-	<D<	-	-	-	Good DW and Rich SP
		DW	90	20.0	<D<	70.0	5	2.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	50.0	3	3.0	
Salvador Benedicto	Rural	SW	0	-	<D<	-	-	-	Risky DW and Rich SP
		DW	0	-	<D<	-	-	-	
	Urban	SW	0	-	<D<	-	-	-	
		DW	0	-	<D<	-	-	-	
San Carlos City	Rural	SW	0	-	<D<	-	-	-	Fair DW and Few SP
		DW	80	30.0	<D<	80.0	10	0.4	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	50.0	5	0.8	
San Enrique	Rural	SW	0	-	<D<	-	-	-	Good DW and Few SP
		DW	100	20.0	<D<	40.0	5	2.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	3	2.0	
Silay City	Rural	SW	0	-	<D<	-	-	-	Good DW and Rich SP
		DW	30	20.0	<D<	40.0	10	2.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	5	3.0	
Sipalay	Rural	SW	10	12.0	<D<	18.0	3	1.0	Fair DW and Few SP
		DW	50	30.0	<D<	50.0	10	0.4	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	40.0	5	0.6	
Talisay City	Rural	SW	0	-	<D<	-	-	-	Good DW and Rich SP
		DW	20	40.0	<D<	70.0	15	2.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	30.0	<D<	50.0	10	3.0	
Toboso	Rural	SW	0	-	<D<	-	-	-	Fair DW and Few SP
		DW	90	40.0	<D<	80.0	10	0.6	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	30.0	<D<	50.0	10	1.0	
Valladolid	Rural	SW	0	-	<D<	-	-	-	Good DW and Poor SP
		DW	100	20.0	<D<	40.0	5	2.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	3	30	
Victorias City	Rural	SW	0	-	<D<	-	-	-	Good DW and Rich SP
		DW	50	20.0	<D<	40.0	10	2.0	
	Urban	SW	0	-	<D<	-	-	-	
		DW	100	20.0	<D<	30.0	5	3.0	

For the furtherance in collecting accurate information to design the concrete specifications of the planned wells, the following recommendations are made (details are referred to Chapter 7.7.1, Supporting Report). Prior to the detailed design or pre-construction stages, additional detailed groundwater investigations entailing the construction of test wells shall be conducted. The cities that fall on this group are Talisay, Bacolod and Bago. Table 7.7.2 summarizes these requirements.

Table 7.7.2 Detailed Groundwater Investigation Required

Municipality	Area	Investigation Activities and Specification
Cities of Talisay, Bacolod & Bago	Urban & Rural	Groundwater Database; log data, well structures, SWL, discharge and water quality (Fe, Mn, Ca, Mg, Cl, pH, etc.) Electric Prospecting; sounding depth of 200m at 30 points (interval distance between neighboring sounding points shall be about 1 km) in the entire fan and plain area Test Wells (monitoring wells) ; 3 test wells, depth of 150m to 200m (depending on the result of prospecting), diameter of 250 mm pumping test & periodical water quality monitoring (Fe, Mn, Ca, Mg, Cl, pH, etc.)

Groundwater development for water supply in urban areas (Level II and III systems) may require the construction of deep wells with larger casing diameter of 6 inches or more to ensure larger production rates. In these cases, short spacing intervals between the adjacent wells often cause the well interference due to the large lowering of pumping water level when the adjacent wells are operated simultaneously in a longer period. As the remedy of the problem pump-operation with excess electric consumption and deterioration of deep well life may be obliged. Thus, appropriate spacing interval and number of wells to be constructed per km^2 shall be considered. Table 7.7.1, Supporting Report presents reference information on spacing arrangements for planned wells.

Spring sources, proposed by barangay level, for future developments are shown in Table 7.6.4, Supporting Report. They shall also be investigated to confirm the development possibility in the following items: (1) location and type of spring sources, (2) fluctuation of discharge rates throughout the year, (3) distance from spring sources and proposed served areas, and (4) elevation differences between the two points.

The groundwater development using deep well is very risky in the southern mountain systems. Furthermore, spring inventories prepared by the PSPT for this study and the informa-

tion from the DPWH indicated that there are few untapped spring sources scattered in this area. Thus, improved rainwater collector (roof materials, reservoir with sand filtration and chlorination system) shall be promoted for the future rural water supply.

Chapter 8

FUTURE REQUIREMENTS IN WATER SUPPLY AND SANITATION IMPROVEMENT

8. FUTURE REQUIREMENTS IN WATER SUPPLY AND SANITATION IMPROVEMENT

8.1 General

Phased investments for provincial sector development, Medium-Term Investment (2001-2005) and Long-Term Development (2006-2010), are planned in almost the same manner as adopted in the 1998 Philippine National Development Plan (PNDP), the National Sector Master Plan (NSMP) and Updated Medium-Term Philippine Development Plan.

Targets of provincial service coverage for the two phases are established as percentages of beneficiaries or utilities to be served by sub-sector. Service coverage in the base year (1998) and national sector targets indicated in the National Sector Master Plan (NSMP) and the updated Medium-Term Philippine Development Plan, 1996 - 1998 (MTPDP) are the bases of the study. Sector targets which are not prescribed in the national plan; school and public toilets as well as sewerage are assumed based on the current conditions. In addition, preliminary discussions on solid waste management are included as a vital component of sanitation sector.

Projection of frame values by municipality is undertaken for respective sub-sectors; future population by urban and rural area, the number of student enrollment to public schools and the number of public utilities. Reference base figures for the study of framework are the 1995 Census of Population and Housing, the statistical data of the province and the information from relevant agencies. Municipal population by target year and the base year (1998) is estimated referring to the NSO population census results (past 3 census periods: 1980 - 1995), the 1995 Census-based Regional and Provincial Population projection prepared by NSO and the Provincial Physical Framework Plan/Comprehensive Provincial Land Use Plan.

Types of required facilities and their implementation criteria according to service level standards are referred to the NSMP and the NEDA Board Resolution No. 12 (s. 1995). Some planning conditions and assumptions not prescribed in the national plan are conferred to the relevant standards of sector agencies and provincial government. For sewerage requirements, the deficit in sanitation must first be addressed. Partial upgrading of on-site disposal to a sewerage system (off-site disposal) is envisaged in the final target year.

In estimating future requirements by municipality, additional population (or number of stu-

dents/public utilities) to be served by sub-sector is first calculated as a shortfall at target years in comparison between each target and its base year service coverage. In this regard, planned/on-going projects to be completed by respective base years are considered as part of existing services for each target year. Required number of facilities by sector component is then estimated corresponding to the said additional population (or number of students/public utilities) to be served. Rehabilitation work for Level I facilities limited to new deep wells to be constructed under PW4SP is taken into account. Generally, rehabilitation of deep wells and shallow wells constructed by means of conventional method is difficult.

Logistic support is considered as a minimum requirement of LGUs for community development and training, and other relevant activities along with the implementation of PW4SP. The types and number of well drilling/rehabilitation equipment and supporting vehicle for Level I facilities are also suggested as reference information. Also, minimum requirements for setting up a provincial laboratory to support drinking water quality surveillance and monitoring are described. This will include building, instrument/equipment and reagent/chemical requirements. The 1993 Philippine National Standards for Drinking Water (PNSDW) requires that initial examinations of water from newly constructed sources should first be undertaken before operation for public use and henceforth periodic examinations of these water supply sources/facilities.

Project priority for medium-term development is discussed entailing general criteria to identify specific projects. However, at the provincial level master plan, it is suggested that municipal priority ranking be used for allocation of provincial fund.

8.2 Targets of Provincial Sector Plan

Provincial sector targets for the years 2005 and 2010 are determined as the provincial average of the desirable minimum level for each sub-sector. Table 8.2.1 summarizes the target percentages to be served by sub-sector. Details by sub-sector are discussed in this subsection.

(1) Water supply

The base year (1998) service coverage was calculated as a total of 1998 figures and expected by planned/on-going projects scheduled to be completed by 1999. Table 8.2.2 shows service coverage for the planning purpose (details are referred to Supporting Report).

Table 8.2.1 Provincial Sector Targets

Sub-sector	Base Year Service Coverage	Phase I (2000-2004)		Phase II (2005-2010)	
Water Supply	Population Coverage (%)	Population Coverage (%)	Additional Population to be Served	Population Coverage (%)	Additional Population to be Served
Urban Water Supply	81	85	99,537	95	589,524
Rural Water Supply	73	78	182,846	93	289,440
Sanitation	Household Coverage (%)	Household Coverage (%)	Additional Households to be Served	Household Coverage (%)	Additional Households to be Served
Household Toilet					
Urban Area	80	80	13,383	93	89,030
Flush	8	25	10,687	50	80,299
Pour Flush	59	70	2,696	50	8,731
VIP/Dry	33	5	0	0	0
Rural Area	73	80	41,168	90	149,682
Flush	3	5	6,548	10	12,532
Pour Flush	48	75	33,661	85	136,194
VIP/Dry	48	20	959	5	956
School Toilet	Public School Student Coverage (%)	Public School Student Coverage (%)	Additional Public School Students to be Served	Public School Student Coverage (%)	Additional Public School Students to be Served
	39	60	138,700	90	214,541
Public Toilet	Public Utilities Coverage (%)	Public Utilities Coverage (%)	Additional Public Utilities with Sanitary Toilets	Public Utilities Coverage (%)	Additional Public Utilities with Sanitary Toilets
	92	100	62	100	47
Sewerage	Urban Population Coverage (%)	Not Applicable		Urban Population Coverage (%)	Urban Population to be Served
	0			50	453,137
Solid Waste	Urban Household Coverage (%)	Urban Household Coverage (%)	Additional Urban House-holds to be Served	Not Applicable	
	70	80	45,695		

Table 8.2.2 Estimation of Base Year Service Coverage of Water Supply

Name of Municipality	Area	Population (1998)	Population Served by 1998 Facilities				
			Level III	Level II	Level I	Total	Percentage Coverage
Bago City	Urban	31,401	5,724		16,988	22,712	72
	Rural	107,841	1,224	5,600	70,998	77,822	72
	Total	139,242	6,948	5,600	87,986	100,534	72
Binalbagan	Urban	25,124	7,680		13,577	21,257	85
	Rural	31,539	5,214	75	16,330	21,619	69
	Total	56,663	12,894	75	29,907	42,876	76
Cadiz City	Urban	35,329	32,767	550	1,350	34,667	98
	Rural	95,235	3,000	1,300	78,280	82,580	87
	Total	130,564	35,767	1,850	79,630	117,247	90
Calatrava	Urban	12,055	10,269		578	10,847	90
	Rural	58,972	2,346	2,500	47,616	52,462	89
	Total	71,027	12,615	2,500	48,194	63,309	89
Candoni	Urban	2,806		325	1,368	1,693	60
	Rural	14,575		2,025	7,070	9,095	62
	Total	17,381		2,350	8,438	10,788	62
Cauayan	Urban	22,680		4,450	8,268	12,718	56
	Rural	63,911	900	5,200	34,678	40,778	64
	Total	86,591	900	9,650	42,946	53,496	62
Enrique B. Magalona	Urban	30,366	3,500	75	20,240	23,815	78
	Rural	28,025	350		18,989	19,339	69
	Total	58,391	3,850	75	39,229	43,154	74
Escalante	Urban	37,146	5,523	125	28,683	34,331	92
	Rural	47,945	1,320	1,200	38,759	41,279	86
	Total	85,091	6,843	1,325	67,442	75,610	89
Himamaylan	Urban	32,115	4,986	550	22,920	28,456	89
	Rural	53,077	4,782	4,600	34,275	43,657	82
	Total	85,192	9,768	5,150	57,195	72,113	85
Hinigaran	Urban	13,109	948		6,722	7,670	59
	Rural	60,563	2,142	1,000	40,475	43,617	72
	Total	73,672	3,090	1,000	47,197	51,287	70
Hinoba-an (Asia)	Urban	16,355		175	10,960	11,135	68
	Rural	24,720		1,750	15,866	17,616	71
	Total	41,075		1,925	26,826	28,751	70
Ilog	Urban	27,123	1,200		17,295	18,495	68
	Rural	16,782		625	6,849	7,474	45
	Total	43,905	1,200	625	24,144	25,969	59
Isabela	Urban	11,140			7,020	7,020	63
	Rural	39,419		5,950	18,018	23,968	61
	Total	50,559		5,950	25,038	30,988	61
Kabankalan City	Urban	50,036	180	375	31,894	32,449	65
	Rural	98,089	13,782	5,800	30,848	50,430	51
	Total	148,125	13,962	6,175	62,742	82,879	56
La Carlota City	Urban	22,873	16,620	50	5,070	21,740	95
	Rural	33,931	9,360	1,500	15,375	26,235	77
	Total	56,804	25,980	1,550	20,445	47,975	84
La Castellana	Urban	21,730	2,958		11,477	14,435	66
	Rural	41,697		1,325	23,396	24,721	59
	Total	63,427	2,958	1,325	34,873	39,156	62
Manapla	Urban	9,572	4,278		4,557	8,835	92
	Rural	37,724		1,150	31,194	32,344	86
	Total	47,296	4,278	1,150	35,751	41,179	87
Moises Padilla	Urban	10,820	2,445	300	6,744	9,489	88
	Rural	21,079		1,075	14,748	15,823	75
	Total	31,899	2,445	1,375	21,492	25,312	79

Table 8.2.2 Estimation of Base Year Service Coverage of Water Supply

(cont'd)

Name of Municipality	Area	Population (1998)	Population Served by 1998 Facilities				
			Level III	Level II	Level I	Total	Percentage Coverage
Murcia	Urban	17,738	6,982	125	8,826	15,933	90
	Rural	40,765	888	4,775	26,968	32,631	80
	Total	58,503	7,870	4,900	35,794	48,564	83
Pontevedra	Urban	19,475	7,837		9,272	17,109	88
	Rural	24,726	4,534	425	13,520	18,479	75
	Total	44,201	12,371	425	22,792	35,588	81
Pulupandan	Urban	16,271	1,284		12,088	13,372	82
	Rural	10,059	762		8,318	9,080	90
	Total	26,330	2,046		20,406	22,452	85
Sagay City	Urban	50,250	13,030	840	25,272	39,142	78
	Rural	89,369	7,697	775	49,347	57,819	65
	Total	139,619	20,727	1,615	74,619	96,961	69
Salvador Benedicto	Urban						
	Rural	18,587		4,400	12,327	16,727	90
	Total	18,587		4,400	12,327	16,727	90
San Carlos City	Urban	28,943	13,585		11,837	25,422	88
	Rural	77,504	770	18,855	31,852	51,477	66
	Total	106,447	14,355	18,855	43,689	76,899	72
San Enrique	Urban	9,865			7,340	7,340	74
	Rural	11,801		325	8,211	8,536	72
	Total	21,666		325	15,551	15,876	73
Silay City	Urban	57,862	14,445		34,910	49,355	85
	Rural	71,515	2,917	4,525	43,813	51,255	72
	Total	129,377	17,362	4,525	78,723	100,610	78
Sipalay	Urban	21,546	1,410	100	16,136	17,646	82
	Rural	44,093	294	1,025	33,746	35,065	80
	Total	65,639	1,704	1,125	49,882	52,711	80
Talisay City	Urban	33,189	8,220	500	22,248	30,968	93
	Rural	38,914	42	500	29,324	29,866	77
	Total	72,103	8,262	1,000	51,572	60,834	84
Toboso	Urban	7,279	954	510	2,022	3,486	48
	Rural	34,201	936	1,725	23,361	26,022	76
	Total	41,480	1,890	2,235	25,383	29,508	71
Valladolid	Urban	21,066	1,610		17,937	19,547	93
	Rural	11,540		375	10,898	11,273	98
	Total	32,606	1,610	375	28,835	30,820	95
Victorias City	Urban	60,419	14,400		36,664	51,064	85
	Rural	23,889	3,480		13,926	17,406	73
	Total	84,308	17,880		50,590	68,470	81
Provincial Total	Urban	755,683	182,835	9,050	420,263	612,148	81
	Rural	1,372,087	66,740	80,380	849,375	996,495	73
	Total	2,127,770	249,575	89,430	1,269,638	1,608,643	76

The base year service coverage in urban area (81%) is higher than the updated MTPDP sector target (69%) for the year 1998, while rural area (73%) is slightly behind the sector target of 79%. As identified in Chapter 4, lower service coverage in rural area is considered to arise from existence of high percentage of underserved population.

For Phase I development, targets of service coverage for water supply by urban and rural area were set up considering the following conditions:

i) at least the existing service coverage shall be secured to meet population increase; and

ii) viable investment using available IRA to be allocated to water supply sector shall be considered.

Thus, the targets of 85% for urban and 78% for rural area, which are 4 - 5% increase from the existing service coverage, were established in the medium-term period.

Phase II targets are planned to increase urban and rural water supply coverage to 95% and 93%, respectively, as envisaged in the NSMP.

(2) Sanitation

1) Household toilets

As with water supply, the base year service coverage is calculated as shown in Table 8.2.3 reflecting any planned or on-going projects scheduled to be completed by 1999 (details are referred to Supporting Report).

The province has base year service coverage of 75%, which is well above the current national average coverage of 60%. Urban and rural area registers a level of 80% and 73%, respectively. These are well above the national average coverage. By type of sanitary toilet facility, the existing percentage composition to total households is as follows:

Type	Urban (%)	Rural (%)
Flush	8	3
Pour-flush	59	48
VIP latrine	33	48

To attain sufficiency and equitable access to basic services, provincial target of Phase I for both urban and rural household toilets is planned at 80%. This is equal to the existing urban service coverage of 80% that is pursued to lessen the gap of the coverage between the urban and rural areas and to achieve a balanced distribution of this basic facility as embodied in the PNDP. For Phase II, 93% as set by the NSMP is adopted for urban household toilets, while, 90% is arranged for rural household toilets.

Table 8.2.3 Base Year Service Coverage of Household Toilets

Name of Municipality/ City	Area	1998		Households and Population Using Sanitary Toilets								
				Number of Households					Service Coverage (%)			
		Population	HHs	Flush	Pour Flush	VIP/Dry	Total	Population	Flush	Pour Flush	VIP/Dry	Total
Bago City	Urban	31,401	6,016	362	3,709	1,417	5,488	28,575	6	62	24	91
	Rural	107,841	20,580	25	11,101	6,833	17,959	93,822		54	33	87
	Total	139,242	26,596	387	14,810	8,250	23,447	122,397	1	56	31	88
Binalbagan	Urban	25,124	4,731	455	1,740	1,287	3,482	18,592	10	37	27	74
	Rural	31,539	5,917	155	1,354	2,373	3,882	20,816	3	23	40	66
	Total	56,663	10,648	610	3,094	3,660	7,364	39,408	6	29	34	69
Cadiz City	Urban	35,329	7,066	1,480	1,314	2,493	5,287	26,497	21	19	35	75
	Rural	95,235	18,244	2,548	4,620	3,536	10,704	56,189	14	25	19	59
	Total	130,564	25,310	4,028	5,934	6,029	15,991	82,686	16	23	24	63
Calatrava	Urban	12,055	2,506	86	1,131	677	1,894	9,162	3	45	27	76
	Rural	58,972	11,890	18	2,421	6,194	8,633	43,050		20	52	73
	Total	71,027	14,396	104	3,552	6,871	10,527	52,212	1	25	48	73
Candoni	Urban	2,806	531		250	179	429	2,273		47	34	81
	Rural	14,575	2,704		552	1,552	2,104	11,369		20	57	78
	Total	17,381	3,235		802	1,731	2,533	13,642		25	54	78
Cauayan	Urban	22,680	4,295	86	2,057	1,371	3,514	18,598	2	48	32	82
	Rural	63,911	11,813	148	5,639	3,805	9,592	51,768	1	48	32	81
	Total	86,591	16,108	234	7,696	5,176	13,106	70,366	1	48	32	81
Enrique B.	Urban	30,366	5,784	9	2,214	1,372	3,595	18,827		38	24	62
	Rural	28,025	5,050		1,542	1,488	3,030	16,815		31	29	60
	Total	58,391	10,834	9	3,756	2,860	6,625	35,642		35	26	61
Escalante	Urban	37,146	7,241	50	2,364	3,965	6,379	32,689	1	33	55	88
	Rural	47,945	9,383		2,269	5,135	7,404	37,877		24	55	79
	Total	85,091	16,624	50	4,633	9,100	13,783	70,566		28	55	83
Himamaylan	Urban	32,115	5,839	175	3,155	748	4,078	22,481	3	54	13	70
	Rural	53,077	9,650	261	3,476	2,812	6,549	36,093	3	36	29	68
	Total	85,192	15,489	436	6,631	3,560	10,627	58,574	3	43	23	69
Hinigaran	Urban	13,109	2,375	348	745	720	1,813	9,963	15	31	30	76
	Rural	60,563	11,215	850	3,527	3,915	8,292	44,817	8	31	35	74
	Total	73,672	13,590	1,198	4,272	4,635	10,105	54,780	9	31	34	74
Hinoba-an	Urban	16,355	3,145	8	1,504	1,249	2,761	14,393		48	40	88
	Rural	24,720	4,629	7	2,043	2,002	4,052	21,754		44	43	88
	Total	41,075	7,774	15	3,547	3,251	6,813	36,147		46	42	88
Ilog	Urban	27,123	5,156		4,382		4,382	23,055		85		85
	Rural	16,782	3,227		2,676		2,676	13,930		83		83
	Total	43,905	8,383		7,058		7,058	36,985		84		84
Isabela	Urban	11,140	2,193	129	1,746	97	1,972	10,026	6	80	4	90
	Rural	39,419	7,480	65	5,448	295	5,808	30,747	1	73	4	78
	Total	50,559	9,673	194	7,194	392	7,780	40,773	2	74	4	80
Kabankalan	Urban	50,036	9,081	281	2,384	5,925	8,590	47,535	3	26	65	95
	Rural	98,089	17,642	64	4,649	9,575	14,288	79,453		26	54	81
	Total	148,125	26,723	345	7,033	15,500	22,878	126,988	1	26	58	86
La Carlota	Urban	22,873	4,244	449	3,413	59	3,921	21,044	11	80	1	92
	Rural	33,931	6,378	71	4,987	157	5,215	27,824	1	78	2	82
	Total	56,804	10,622	520	8,400	216	9,136	48,868	5	79	2	86
La Castellana	Urban	21,730	4,131	100	1,652	1,133	2,885	15,211	2	40	27	70
	Rural	41,697	8,160	6	2,577	2,851	5,434	27,937		32	35	67
	Total	63,427	12,291	106	4,229	3,984	8,319	43,148	1	34	32	68
Manapla	Urban	9,572	1,820	143	776	334	1,253	6,605	8	43	18	69
	Rural	37,724	6,986	481	2,313	1,969	4,763	25,653	7	33	28	68
	Total	47,296	8,806	624	3,089	2,303	6,016	32,258	7	35	26	68

Table 8.2.3 Base Year Service Coverage of Household Toilets

(Cont'd)

Name of Municipality/ City	Area	1998		Households and Population Using Sanitary Toilets								
				Number of Households					Service Coverage (%)			
		Population	HHs	Flush	Pour Flush	VIP/Dry	Total	Population	Flush	Pour Flush	VIP/Dry	Total
Moises Pa-	Urban	10,820	2,143	19	855	541	1,415	7,142	1	40	25	66
	Rural	21,079	4,038		1,022	1,558	2,580	13,491		25	39	64
	Total	31,899	6,181	19	1,877	2,099	3,995	20,633		30	34	65
Murcia	Urban	17,738	3,471	84	1,201	1,011	2,296	11,708	2	35	29	66
	Rural	40,765	7,780	74	2,619	2,253	4,946	26,090	1	34	29	64
	Total	58,503	11,251	158	3,820	3,264	7,242	37,798	1	34	29	64
Pontevedra	Urban	19,475	3,826	93	2,471	475	3,039	15,386	2	65	12	79
	Rural	24,726	4,719	22	2,332	1,101	3,455	18,050		49	23	73
	Total	44,201	8,545	115	4,803	1,576	6,494	33,436	1	56	18	76
Pulupandan	Urban	16,271	3,129	30	845	1,681	2,556	13,343	1	27	54	82
	Rural	10,059	1,992	33	820	902	1,755	8,852	2	41	45	88
	Total	26,330	5,121	63	1,665	2,583	4,311	22,195	1	33	50	84
Sagay City	Urban	50,250	9,499	1,582	2,455	4,381	8,418	44,723	17	26	46	89
	Rural	89,369	17,558	620	3,146	9,850	13,616	69,708	4	18	56	78
	Total	139,619	27,057	2,202	5,601	14,231	22,034	114,431	8	21	53	81
Salvador	Urban											
	Rural	18,587	3,547		2,359	463	2,822	14,870		67	13	80
	Total	18,587	3,547		2,359	463	2,822	14,870		67	13	80
San Carlos	Urban	28,943	5,697	592	2,813	1,264	4,669	23,734	10	49	22	82
	Rural	77,504	15,721	16	5,587	7,180	12,783	62,779		36	46	81
	Total	106,447	21,418	608	8,400	8,444	17,452	86,513	3	39	39	81
San Enrique	Urban	9,865	1,897	206	1,176	95	1,477	7,695	11	62	5	78
	Rural	11,801	2,218	163	1,139	323	1,625	8,615	7	51	15	73
	Total	21,666	4,115	369	2,315	418	3,102	16,310	9	56	10	75
Silay City	Urban	57,862	10,735		9,117	49	9,166	49,183		85		85
	Rural	71,515	13,622		3,750	2,028	5,778	30,037		28	15	42
	Total	129,377	24,357		12,867	2,077	14,944	79,220		53	9	61
Sipalay	Urban	21,546	4,136	456	1,518	1,597	3,571	18,530	11	37	39	86
	Rural	44,093	8,335	822	2,850	1,655	5,327	28,220	10	34	20	64
	Total	65,639	12,471	1,278	4,368	3,252	8,898	46,750	10	35	26	71
Talisay City	Urban	33,189	6,508	872	3,000	993	4,865	24,892	13	46	15	75
	Rural	38,914	7,541		163	4,755	4,918	25,295		2	63	65
	Total	72,103	14,049	872	3,163	5,748	9,783	50,187	6	23	41	70
Toboso	Urban	7,279	1,441	20	800	244	1,064	5,387	1	56	17	74
	Rural	34,201	6,477	42	1,509	3,180	4,731	24,967	1	23	49	73
	Total	41,480	7,918	62	2,309	3,424	5,795	30,354	1	29	43	73
Valladolid	Urban	21,066	4,163	75	2,458	380	2,913	14,747	2	59	9	70
	Rural	11,540	2,241	13	1,279	174	1,466	7,501	1	57	8	65
	Total	32,606	6,404	88	3,737	554	4,379	22,248	1	58	9	68
Victorias City	Urban	60,419	11,530	1,491	5,054	2,430	8,975	47,127	13	44	21	78
	Rural	23,889	4,457	115	1,751	1,572	3,438	18,395	3	39	35	77
	Total	84,308	15,987	1,606	6,805	4,002	12,413	65,522	10	43	25	78
Provincial Total	Urban	755,683	144,329	9,681	68,299	38,167	116,147	609,123	7	47	26	80
	Rural	1,372,08	261,194	6,619	91,520	91,486	189,625	996,784	3	35	35	73
	Total	2,127,77	405,523	16,300	159,819	129,653	305,772	1,605,907	4	39	32	75

The existing composition of the 3 facility types serves as an indicator in the distribution for Phase I, while for Phase II, VIP and sanitary pit privy/latrine (dry-type) is phased-out.

2) School toilets

The base year service coverage of public school students is shown in Table 8.2.4 counting expected coverage of any planned or on-going projects scheduled to be completed by 1999 (details are referred to Supporting Report).

Base year service coverage is 39% applying the standard number of public school students to be served by one (1) unit of toilet facility. The low level is due to a large number of unsanitary or absence of facilities.

In the absence of national targets for school toilets, the existing level of service coverage is the base in setting up the targets. It is expected that all new construction of school-buildings will entail sanitary toilets enabling the coverage to increase on a high level. For Phase I and II, 60% and 90% are set, respectively.

Table 8.2.4 Base Year Service Coverage of Public School Toilets and Public Toilets

Name of Municipality/City	Public School Toilets			Public Toilets		
	Total Number of Public School Students (1998)	Std. No. of Public School Student that can be Served by Base Year (1998) Sanitary Toilets	Service Coverage (%)	Number of Public Utilities with Toilets in 1998	Number of Public Utility with Sanitary Toilets in Base Year (1998)	Service Coverage (%)
Bago City	32,768	13,600	42	36	36	100
Binalbagan	13,743	8,320	61	9	9	100
Cadiz City	30,176	7,600	25	44	44	100
Calatrava	16,888	7,960	47	28	22	79
Candoni	5,344	1,040	19	6	6	100
Cauayan	20,387	6,280	31	19	17	89
Enrique B. Magalona	12,481	2,320	19	2	2	100
Escalante	19,209	7,920	41	8	8	100
Himamaylan	21,392	10,280	48	12	12	100
Hinigaran	16,694	14,120	85	3	3	100
Hinoba-an (Asia)	11,666	4,480	38	2		
Ilog	10,249	2,640	26	6	6	100
Isabela	11,729	10,240	87	10	10	100
Kabankalan City	33,994	6,840	20	42	28	67
La Carlota City	15,075	7,920	53	20	20	100
La Castellana	15,170	15,170	100	15	15	100
Manapla	9,889	4,520	46	8	6	75
Moises Padilla	7,058	5,160	73	8	8	100
Murcia	13,542	3,360	25	6	6	100
Pontevedra	10,354	760	7	6	6	100
Pulupandan	4,956	4,800	97	8	8	100
Sagay City	27,980	3,880	14	34	24	71
Salvador Benedicto	3,707					
San Carlos City	24,352	5,840	24	45	45	100
San Enrique	4,237	1,640	39	4	4	100
Silay City	22,627	4,040	18	34	34	100
Sipalay	15,405	6,160	40	14	14	100
Talisay City	15,535	6,240	40	5	5	100
Toboso	10,158	3,440	34	4	4	100
Valladolid	6,241	480	8	8	8	100
Victorias City	19,695	12,040	61	22	22	100
Provincial Total	482,701	189,090	39	468	432	92

3) Public toilets

The base year service coverage considering expected additional coverage by 1999 is shown in Table 8.2.4 (details are referred to Supporting Report).

Almost all-existing public utilities are served with at least one sanitary toilet giving 92% coverage. This can be attributed by the fact that almost all public utilities (mostly public markets) are provided with sanitary toilet facilities.

Without national targets as of now, the indicator in setting up provincial targets would be the existing level of coverage. Accordingly, 100% coverage for both Phase I and Phase II are assumed.

(3) Sewerage

Given the non-existence of sewerage systems in any municipality at the present time, this plan does not consider the service during Phase I. For Phase II, a target of 50% coverage was applied to urban population of municipalities with more than 10,000 urban population provided by Level III water supply systems.

(4) Solid waste

The municipal level data in 1998 on the number of households served by the municipal refuse collection revealed that the current practice is concentrated to urban areas. The base year service coverage for urban area by municipality is reflected in Table 8.2.5.

About 25% of the total households in the province relied on municipal refuse collection using trucks or 75% urban household coverage. These municipalities have a total of 69 units of collection truck.

No national targets have yet been set. However, considering the present level of coverage, 80% urban household coverage is applied for the medium-term period (2001-2005).

Table 8.2.5 Base Year Service Coverage of Municipal Solid Waste System in 1998

Name of Municipality/City	Total No. of Households	No. of Urban Households	No. of Households Served	Coverage of Households (%)	Coverage of Urban Households (%)
Bago City	26,596	6,016	1,894	7	31
Binalbagan	10,648	4,731	1,930	18	41
Cadiz City	25,310	7,066	10,622	42	100
Calatrava	14,396	2,506	759	5	30
Candoni	3,235	531	935	29	100
Cauayan	16,108	4,295	500	3	12
Enrique B. Magalona	10,834	5,784	1,036	10	18
Escalante	16,624	7,241	1,507	9	21
Himamaylan	15,489	5,839	4,800	31	82
Hinigaran	13,590	2,375	2,178	16	92
Hinoba-an (Asia)	7,774	3,145	288	4	9
Ilog	8,383	5,156			
Isabela	9,673	2,193	1,843	19	84
Kabankalan City	26,723	9,081	3,550	13	39
La Carlota City	10,622	4,244	5,914	56	100
La Castellana	12,291	4,131	3,229	26	78
Manapla	8,806	1,820	1,447	16	80
Moises Padilla	6,181	2,143	767	12	36
Murcia	11,251	3,471	1,300	12	37
Pontevedra	8,545	3,826	1,006	12	26
Pulupandan	5,121	3,129	1,980	39	63
Sagay City	27,057	9,499	9,950	37	100
Salvador Benedicto	3,547				
San Carlos City	21,418	5,697	8,149	38	100
San Enrique	4,115	1,897			
Silay City	24,357	10,735	17,000	70	100
Sipalay	12,471	4,136	226	2	5
Talisay City	14,049	6,508	5,662	40	87
Toboso	7,918	1,441	600	8	42
Valladolid	6,404	4,163	2,209	34	53
Victorias City	15,987	11,530	9,939	62	86
Provincial Total	405,523	144,329	101,220	25	70

8.3 Projection of Frame Values

8.3.1 Population Projection

Future population for all municipalities by urban and rural areas was projected for the target years of 2005 and 2010 together with the present population in 1998 as a planning base year.

The future regional and provincial population has been projected by the NSO, while the projections at municipal levels were not available during the study. The future population of LGUs was therefore projected (details are included in the Supporting Report). Available information for the study at present is as follows:

NSO population census results from 1980 to 1995

1995 Census-based Regional and Provincial Population Projection prepared by the NSO

- Provincial Physical Framework Plan/Comprehensive Provincial Land Use Plan (1993-2002) prepared by the Provincial Office

(1) 1995 Census-Based Regional and Provincial Population Projections: NSO

The NSO conducted regional and provincial projections for the period 1995-2020. The assumptions take into account future trends in the demographic processes of fertility, mortality and migration required by the cohort-component method for projecting population. The 1995 Population Census was used as the basis for the projection.

In the regional population projection, the subject region for this study; Region VI is classified as the medium-sized region (at least 5 million but less than 10 million by year 2000). The following are the result of projection for the region and the province of Negros Occidental in 2000, 2005 and 2010.

Table 8.3.1 Regional and Provincial Population Projection by NSO

Year		1980	1990	1995	2000	2005	2010
Region VI	Population	4,525,615	5,393,333	5,756,623	6,328,671	6,890,447	7,428,329
	Growth Rate	-	1.77%	1.31%	1.91%	1.72%	1.51%
Negros Occidental	Population	1,930,301	2,256,908	2,425,941	2,627,178	2,910,028	3,131,450
	Growth Rate	-	1.58%	1.45%	1.95%	1.72%	1.48%

Note: Average annual growth rates: geometric growth rate
Population of the province as of Sep. 1, 1995 was 2,434,186 (1995 Census)

In the past development, annual growth rates of the region and province between 1990 and 1995 decreased compared with those of previous census period. The change of growth rate for the region was larger (from 1.77% to 1.31%) than that of the province (from 1.58% to 1.45%). The NSO, however, adopted almost same growth rates for the region and province for its projection. Thus, the growth rates of the region with 5-year interval between 1995 and 2010 are assumed at 1.91%, 1.72% and 1.51%, respectively. Likewise, those of the province are assumed at 1.95%, 1.72% and 1.48%.

(2) The Land Use Plan: Province of Negros Occidental (Planning period 1993-2002)

The population projection on the provincial total and component municipalities together with the regional population was made with a base year 1990. The population for the year 2002 was projected using a uniform growth rate between 1990 and 2002 referring to the experience from 1980 to 1990 (census years).

In comparison between Land Use Plan and NSO's projection for year 2002, there is no significant difference both in regional and provincial population.

On the other hand, regarding the projected municipal population in 1995, that of twenty (20) out of 32 municipalities/cities including Bacolod City is higher than that of NSO with a range of 0.3% to 70%. While that of remaining twelve (12) municipalities is lower with a range of -0.3% to -36%.

Thus, future projection shall be made using 1995 census results as a base year. While, the regional and provincial population projected by the NSO may be adopted in this PW4SP, since there is not so much difference from the population projected in the Land Use Plan.

(3) Population Projection of the Province

The following conditions are considered in the population projection.

Regional and Provincial Population

For the regional and provincial population in the study, the projection conducted by NSO shall be adopted. Table 8.3.2 shows the projected population of the region VI and component provinces.

Table 8.3.2 Projected Population by the NSO

Province	Census Population	Projected Population/Growth Rate					
		Population			Average Annual Growth Rate		
	1995	1998	2005	2010	1995-2000	2000-2005	2005-2010
Aklan	408,949	432,359	487,839	528,072	1.84%	1.72%	1.60%
Antique	430,363	455,051	512,755	554,797	1.84%	1.69%	1.59%
Capiz	622,034	657,975	742,312	801,742	1.86%	1.71%	1.55%
Guimaras	126,034	133,422	150,680	162,774	1.88%	1.72%	1.56%
Iloilo	1,743,302	1,847,328	2,086,833	2,249,494	1.91%	1.72%	1.51%
Negros Occidental	**2,425,941**	**2,573,658**	**2,910,028**	**3,131,450**	**1.95%**	**1.72%**	**1.48%**
Region VI	5,756,623	6,099,793	6,890,447	7,428,329	1.91%	1.72%	1.51%

Source: NSO
Note: Population of the province as of Sep.1, 1995 was 2,434,186 (1995 Census)

Municipal Population

1) The total population of the province in 1998, 2005 and 2010 was fixed.
2) Municipal population for short/medium-term target years (1998 and 2005) is estimated using the recorded growth rates between 1990 and 1995. The municipal population estimated initially is adjusted in proportion to the population size of each municipality to the total provincial population, to meet the above mentioned provincial population fixed for the years 1998 and 2005. In this adjustment, 1995 population was fixed for the municipality of Ilog to avoid negative growth.

In addition, for the municipalities of Bacolod City, Calatrava, Salvador Benedicto,

San Carlos and Silay City, the growth rates adopted in the Land Use Plan were applied in consideration of the current local situation.

For the year 2010 in the long-term, it is assumed that the tendency of population growth of respective municipalities will be stable reflecting the experiences in the past long term between 1980 and 1995. Thus, experienced growth rate between 1980 and 1995 by municipality is firstly applied to project 2010 population from the year 2005. Then, the municipal population initially estimated is adjusted in the same manner mentioned above. Table 8.3.3 presents census results (1980, 1990 and 1995) and projected population of the municipalities.

Table 8.3.3 Census results and Projected Population of Municipalities

Municipal-ity/City	Census Result					Projected Population/Growth Rate								
	Populatrion			GR		1998			2005			2010		
	1980	1990	1995	1990-1995	1980-1995	Population		GR	Population		GR	Population		GR
						Initial	Adjust.		Initial	Adjust.		Initial	Adjust.	
Bago City	99,631	122,717	132,338	1.52%	1.91%	138,469	139,242	1.71%	153,902	155,141	1.60%	170,538	168,773	1.70%
Binalbagan	49,428	51,968	54,664	1.02%	0.67%	56,348	56,663	1.20%	60,483	60,970	1.10%	63,051	62,398	0.42%
Cadiz City	129,632	119,707	125,943	1.02%	-0.19%	129,839	130,564	1.21%	139,406	140,528	1.10%	140,528	140,528	0.00%
Calatrava	58,163	60,214	69,902	3.03%	1.23%	70,633	71,027	0.53%	72,367	72,949	0.43%	77,560	76,757	1.02%
Candoni	10,831	16,546	17,004	0.55%	3.05%	17,285	17,381	0.73%	17,958	18,103	0.63%	21,049	20,822	2.84%
Cauayan	70,017	81,005	84,159	0.77%	1.23%	86,110	86,591	0.95%	90,849	91,571	0.85%	97,362	96,355	1.02%
Enrique B.	44,411	48,846	54,421	2.19%	1.36%	58,067	58,391	2.37%	67,553	68,096	2.27%	72,870	72,116	1.15%
Escalante	71,239	72,681	79,928	1.92%	0.77%	84,619	85,091	2.11%	96,662	97,440	2.09%	101,250	100,202	0.56%
Himamaylan	70,467	80,905	83,268	0.58%	1.12%	84,719	85,192	0.76%	88,203	88,913	0.66%	94,000	93,027	0.91%
Hinigaran	54,717	68,704	71,519	0.81%	1.80%	73,263	73,672	0.99%	77,500	78,123	0.89%	85,418	84,534	1.59%
Hinoba-an (Asia)	45,819	40,773	40,819	0.02%	-0.77%	40,847	41,075	0.21%	40,911	41,240	0.10%	41,240	41,240	0.00%
Ilog	38,956	46,588	43,905	-1.18%	0.80%	43,905	43,905	0.00%	43,905	43,905	0.00%	45,691	45,218	0.59%
Isabela	39,704	46,999	49,019	0.85%	1.41%	50,278	50,559	1.04%	53,344	53,773	0.93%	57,686	57,089	1.20%
Kabankalan City	92,109	126,872	139,282	1.88%	2.80%	147,303	148,125	2.07%	167,862	169,213	1.97%	194,222	192,212	2.58%
La Carlota City	45,812	56,290	56,414	0.04%	1.49%	56,489	56,804	0.23%	56,663	57,119	0.12%	61,223	60,589	1.19%
La Castellana	44,864	54,277	59,620	1.90%	1.91%	63,075	63,427	2.08%	71,936	72,515	1.98%	79,724	78,899	1.70%
Manapla	40,524	40,095	44,301	2.02%	0.60%	47,034	47,296	2.20%	54,083	54,518	2.10%	56,162	55,581	0.39%
Moises Padilla	22,916	30,740	31,350	0.39%	2.11%	31,722	31,899	0.58%	32,607	32,869	0.47%	36,488	36,141	1.90%
Murcia	45,162	50,396	55,128	1.81%	1.34%	58,178	58,503	2.00%	65,967	66,498	1.89%	71,068	70,332	1.13%
Pontevedra	33,258	40,036	42,443	1.17%	1.64%	43,956	44,201	1.36%	47,700	48,084	1.26%	52,156	51,616	1.35%
Pulupandan	24,824	22,977	24,932	1.65%	0.03%	26,184	26,330	1.84%	29,355	29,591	1.73%	29,591	29,591	0.00%
Sagay City	99,118	112,649	128,374	2.65%	1.74%	138,844	139,619	2.84%	166,716	168,057	2.73%	183,189	181,293	1.53%
Salvador Bene-	0	13,331	17,635	5.76%	#DIV/0!	18,484	18,587	1.77%	20,628	20,794	1.66%	22,812	22,576	1.66%
San Carlos City	91,627	105,649	101,429	-0.81%	0.68%	105,856	106,447	1.62%	116,951	117,892	1.53%	121,955	120,692	0.47%
San Enrique	14,662	19,237	20,649	1.43%	2.31%	21,545	21,666	1.62%	23,792	23,983	1.51%	26,883	26,604	2.10%
Silay City	111,131	100,944	122,748	3.99%	0.67%	128,659	129,377	1.77%	143,581	144,736	1.66%	149,614	148,065	0.45%
Sipalay	51,264	61,828	63,960	0.68%	1.49%	65,274	65,639	0.87%	68,447	68,998	0.76%	74,279	73,511	1.28%
Talisay City	53,624	63,232	68,401	1.58%	1.64%	71,703	72,103	1.77%	80,041	80,685	1.67%	87,504	86,599	1.42%
Toboso	36,415	34,611	38,623	2.22%	0.39%	41,250	41,480	2.41%	48,096	48,483	2.30%	49,444	48,932	0.18%
Valladolid	21,728	29,712	31,380	1.10%	2.48%	32,425	32,606	1.29%	35,002	35,284	1.18%	39,883	39,470	2.23%
Victorias City	55,959	69,828	78,283	2.31%	2.26%	83,840	84,308	2.50%	98,388	99,180	2.39%	110,923	109,735	2.05%
Study Area	1,668.01	1,890.34	2,031.84	1.45%	1.32%	2,116.20	2,127.76	1.55%	2,330.84	2,349.35	1.46%	2,515.35	2,491.50	1.18%
Bacolod City	262,415	362,825	402,345	2.09%	2.89%	443,416	445,891	3.45%	556,268	560,775	3.38%	646,634	639,941	2.68%
province	1,930.42	2,253.17	2,434.18	1.56%	1.56%	2,559.61	2,573.65	1.87%	2,887.14	2,910.02	1.80%	3,161.99	3,131.45	1.48%

Note: Growth rates in 1998, 2005 and 2010 were calculated using geometric formula.

Population by Urban and Rural Area

1) Past population development

With regards to the ratio of the urban population of the study area to the total population, the averages in 1980 and 1990 were 26.8% and 35.2%, respectively. While it maintained almost same percentage (35.5%) in 1995. The average growth rate of 4.05% (1980 - 1990) decreased to 1.60% in 1995. With regard to rural population, the growth rates as the provincial average were 0.03% (1980 - 1990) and 1.37% (1990 - 1995).

2) Projection of urban and rural population for the years 1998, 2005 and 2010

Urban population by municipality for the target years was at first projected and rural population was calculated to meet aforementioned total population fixing the urban population. In the projection of municipal urban population, the following are assumed by short/medium-term and long-term.

Short/Medium-term target: 1998 and 2005

The share of urban population in 1995 in terms of the profile of urban population to total population by municipality were basically adopted, assuming that the latest profile will not change drastically in short/medium-term period.

Long-term target: 2010

For the long-term projection, the recorded growth rates of urban population between 1980 and 1995 may be applied for the municipal population in 2010, assuming that the tendency of urban population will be stable reflecting the experiences in the past long period.

However, for the municipalities of Pulunpandan and Toboso, the present share of urban population to total population was applied to avoid negative population growth. Likewise, the same modification was made for the following municipalities having considerably higher growth rates (more than 5%) of urban population between 1980 and 1995: Calatrava, Canayan, E.B. Magalona, Himamaylan, Hinobaan, Ilog, Kabankalan, Moises Padilla, Valladolid and Victorias.

Under the above assumptions, provincial average share of urban population for the year 2010 arrived at 36.8%, slightly higher than the figure (35.2%) in 1995. Table 8.3.4 presents projected urban and rural population. The growth rates and shares on rural population are calculated using estimated rural population.

Table 8.3.4 Population Projection by Urban and Rural Area:1998, 2005 and 2010

	Municipality/City	1998		2005			2010			
		Total	Urban/ Rural	Total	Urban/ Rural	Share (%)	Total	Urban/ Rural	G.R. (%)	Share (%)
Urban Area	Bago City	139,242	31,401	155,141	34,986	22.6%	168,773	35,810	0.47%	21.2%
	Binalbagan	56,663	25,124	60,970	27,034	44.3%	62,398	28,097	0.77%	45.0%
	Cadiz City	130,564	35,329	140,528	38,026	27.1%	140,528	42,042	2.03%	29.9%
	Calatrava	71,027	12,055	72,949	12,381	17.0%	76,757	13,027	1.02%	17.0%
	Candoni	17,381	2,806	18,103	2,922	16.1%	20,822	2,938	0.11%	14.1%
	Cauayan	86,591	22,680	91,571	23,984	26.2%	96,355	25,237	1.02%	26.2%
	E B Magalona	58,391	30,366	68,096	35,413	52.0%	72,116	37,503	1.15%	52.0%
	Escalante	85,091	37,146	97,440	42,537	43.7%	100,202	51,519	3.91%	51.4%
	Himamaylan	85,192	32,115	88,913	33,518	37.7%	93,027	35,069	0.91%	37.7%
	Hinigaran	73,672	13,109	78,123	13,901	17.8%	84,534	14,587	0.97%	17.3%
	Hinobaan	41,075	16,355	41,240	16,421	39.8%	41,240	16,421	0.00%	39.8%
	Ilog	43,905	27,123	43,905	27,123	61.8%	45,218	27,934	0.59%	61.8%
	Isabela	50,559	11,140	53,773	11,848	22.0%	57,089	12,356	0.84%	21.6%
	Kabankalan	148,125	50,036	169,213	57,160	33.8%	192,212	64,929	2.58%	33.8%
	La Carlota	56,804	22,873	57,119	23,000	40.3%	60,589	23,631	0.54%	39.0%
	La Castellana	63,427	21,730	72,515	24,844	34.3%	78,899	29,350	3.39%	37.2%
	Manapla	47,296	9,572	54,518	11,034	20.2%	55,581	11,549	0.92%	20.8%
	Moises Padilla	31,899	10,820	32,869	11,149	33.9%	36,111	12,249	1.90%	33.9%
	Murcia	58,503	17,738	66,498	20,162	30.3%	70,332	29,212	7.70%	41.5%
	Pontevedra	44,201	19,475	48,084	21,185	44.1%	51,616	26,411	4.51%	51.2%
	Pulupandan	26,330	16,271	29,591	18,286	61.8%	29,591	18,286	0.00%	61.8%
	Sagay	139,619	50,250	168,057	60,485	36.0%	181,293	61,637	0.38%	34.0%
	S. Benedicto	18,587	0	20,794	0	0.0%	22,576	0	0.00%	0.0%
	San Carlos City	106,447	28,943	117,892	32,055	27.2%	120,692	34,306	1.37%	28.4%
	San Enrique	21,666	9,865	23,983	10,920	45.5%	26,604	13,582	4.46%	51.1%
	Silay City	129,377	57,862	144,736	64,731	44.7%	148,065	73,714	2.63%	49.8%
	Sipalay	65,639	21,546	68,998	22,649	32.8%	73,511	24,275	1.40%	33.0%
	Talisay	72,103	33,189	80,685	37,139	46.0%	86,599	39,354	1.17%	45.4%
	Toboso	41,480	7,279	48,483	8,508	17.5%	48,932	8,587	0.18%	17.5%
	Valladolid	32,606	21,066	35,284	22,796	64.6%	39,470	25,501	2.27%	64.6%
	Victorias	84,308	60,419	99,180	71,077	71.7%	109,775	78,670	2.05%	71.7%
	Study Area	**2,127,767**	**755,684**	**2,349,253**	**837,276**	**35.6%**	**2,491,509**	**917,784**	**1.85%**	**36.8%**
Rural Area	Bago City	139,242	107,841	155,141	120,154	77.4%	168,773	132,963	2.05%	78.8%
	Binalbagan	56,663	31,539	60,970	33,936	55.7%	62,398	34,301	0.21%	55.0%
	Cadiz City	130,564	95,235	140,528	102,503	72.9%	140,528	98,486	-0.80%	70.1%
	Calatrava	71,027	58,972	72,949	60,568	83.0%	76,757	63,730	1.02%	83.0%
	Candoni	17,381	14,575	18,103	15,181	83.9%	20,822	17,884	3.33%	85.9%
	Cauayan	86,591	63,911	91,571	67,587	73.8%	96,355	71,117	1.02%	73.8%
	E B Magalona	58,391	28,025	68,096	32,684	48.0%	72,116	34,613	1.15%	48.0%
	Escalante	85,091	47,945	97,440	54,903	56.3%	100,202	48,684	-2.38%	48.6%
	Himamaylan	85,192	53,076	88,913	55,395	62.3%	93,027	57,958	0.91%	62.3%
	Hinigaran	73,672	60,563	78,123	64,222	82.2%	84,534	69,947	1.72%	82.7%
	Hinobaan	41,075	24,720	41,240	24,820	60.2%	41,240	24,820	0.00%	60.2%
	Ilog	43,905	16,782	43,905	16,782	38.2%	45,218	17,284	0.59%	38.2%
	Isabela	50,559	39,419	53,773	41,924	78.0%	57,089	44,734	1.31%	78.4%
	Kabankalan	148,125	98,089	169,213	112,054	66.2%	192,212	127,283	2.58%	66.2%
	La Carlota	56,804	33,931	57,119	34,119	59.7%	60,589	36,958	1.61%	61.0%
	La Castellana	63,427	41,697	72,515	47,671	65.7%	78,899	49,549	0.78%	62.8%
	Manapla	47,296	37,724	54,518	43,484	79.8%	55,581	44,032	0.25%	79.2%
	Moises Padilla	31,899	21,079	32,869	21,720	66.1%	36,111	23,862	1.90%	66.1%
	Murcia	58,503	40,764	66,498	46,335	69.7%	70,332	41,120	-2.36%	58.5%
	Pontevedra	44,201	24,727	48,084	26,898	55.9%	51,616	25,205	-1.29%	48.8%
	Pulupandan	26,330	10,059	29,591	11,305	38.2%	29,591	11,305	0.00%	38.2%
	Sagay	139,619	89,369	168,057	107,572	64.0%	181,293	119,656	2.15%	66.0%
	S. Benedicto	18,587	18,587	20,794	20,794	100.0%	22,576	22,576	1.66%	100.0%
	San Carlos City	106,447	77,503	117,892	85,837	72.8%	120,692	86,386	0.13%	71.6%
	San Enrique	21,666	11,801	23,983	13,063	54.5%	26,604	13,023	-0.06%	48.9%
	Silay City	129,377	71,515	144,736	80,005	55.3%	148,065	74,351	-1.46%	50.2%
	Sipalay	65,639	44,093	68,998	46,349	67.2%	73,511	49,235	1.22%	67.0%
	Talisay	72,103	38,914	80,685	43,546	54.0%	86,599	47,244	1.64%	54.6%
	Toboso	41,480	34,201	48,483	39,975	82.5%	48,932	40,345	0.18%	82.5%
	Valladolid	32,606	11,540	35,284	12,488	35.4%	39,470	13,969	2.27%	35.4%
	Victorias	84,308	23,889	99,180	28,103	28.3%	109,775	31,106	2.05%	28.3%
	Study Area	**2,127,767**	**1,372,083**	**2,349,253**	**1,511,977**	**64.4%**	**2,491,509**	**1,573,725**	**0.80%**	**63.2%**

8.3.2 School Enrollment Projection

From the 1995 total population of the province, the number of children who would be enrolling in elementary and high school levels for all municipalities is derived.

School age population is extrapolated from the NSO age group classification of 5-9, 10-14 and 15-19 years old bracket by municipality. The age group for the elementary level is from 6 to 13 years, while that for the high school level is from 14 to 17 years. The percentages of school age population for the target years are based on the existing composition or structure of the 1995 population.

From the school age population, the number of children who would attend either private or public school, by target year is computed using the projected participation rate. The participation rate by target year varies depending on the socio-economic condition of the province. Generally, an improved economy will result to a higher participation rate. For the province, an increase in the participation rate in both private and public schools is foreseen by year 2010.

The number of public school students by target year is then derived from the projected number of children who will attend school. A participation rate for public school enrollment is established based on the existing participation rate of public school students to the total school age population. Based on the projection, an increase of 2% from the 1998 rate is foreseen in 2005 and another increase of 4% from the 2005 rate in 2010 (details are referred to Table 8.3.6, Supporting Report). It should be noted that some municipalities had participation rate in 1998 of over 100%, an indication that a number of school enrollees are over-aged.

Table 8.3.2 shows the projected number of public school students by municipality, by target year. About 546,300 and 602,000 public school students are estimated to enroll for years 2005 and 2010, respectively.

8.3.3 Projection of the Number of Public Utilities

The number of public utilities (limited to public markets and bus/jeepney terminals) by target year is projected in urban areas for all municipalities. The provincial physical framework plan and the provincial comprehensive development plan serve as references in the projection. Bus or jeepney terminals are considered in major transport routes of the province.

A total of 62 public utilities are planned for construction by year 2005 and another 47 by year 2010. Refer to Table 8.3.5 for the number of public utilities by municipality by target year (details are referred to Supporting Report).

8.3.4 Planning Area and its Projected Population for Sewerage

Urban areas with more than 10,000 population provided by Level III water supply systems in 2010 serve as the planning area. Population in the area is considered as the potential population to be served.

Twenty-seven (27) municipalities/cities with a total urban population of about 453,100 are considered (refer to Table 8.5.4).

Table 8.3.5 Projected Public School Enrollment and Number of Public Utilities by Municipality

Name of Municipality/City	Number of Public School Student			Number of Public Utilities		
	1998	2005	2010	1998	2005	2010
Bago City	32,768	37,500	43,062	21	23	24
Binalbagan	13,743	15,227	16,449	7	9	10
Cadiz City	30,176	33,043	34,987	12	12	14
Calatrava	16,888	16,618	19,670	9	10	11
Candoni	5,344	5,079	5,534	3	3	5
Cauayan	20,387	22,894	25,507	4	5	7
Enrique B. Magalona	12,481	9,907	11,445	2	3	3
Escalante	19,209	26,760	26,143	5	7	8
Himamaylan	21,392	23,206	25,628	9	11	11
Hinigaran	16,694	18,249	20,908	2	4	5
Hinoba-an (Asia)	11,666	11,598	10,987	4	5	6
Ilog	10,249	10,662	10,980	4	5	7
Isabela	11,729	12,995	14,608	3	3	5
Kabankalan City	33,994	41,409	47,037	19	20	22
La Carlota City	15,075	14,273	15,140	9	9	10
La Castellana	15,170	17,460	20,114	9	9	11
Manapla	9,889	11,498	12,454	3	4	5
Moises Padilla	7,058	4,273	5,216	4	4	7
Murcia	13,542	20,702	18,910	7	8	10
Pontevedra	10,354	11,768	13,334	3	3	6
Pulupandan	4,956	5,932	6,303	9	9	11
Sagay City	27,980	35,090	40,377	16	16	18
Salvador Benedicto	3,707	3,856	4,591	1	2	4
San Carlos City	24,352	28,882	31,210	17	18	20
San Enrique	4,237	4,982	5,873	2	2	3
Silay City	22,627	25,640	28,103	4	6	8
Sipalay	15,405	16,424	18,592	6	6	9
Talisay City	15,535	17,629	20,034	2	4	4
Toboso	10,158	12,219	13,018	4	5	5
Valladolid	6,241	7,033	8,391	6	7	7
Victorias City	19,695	23,508	27,465	10	10	13
Provincial Total	482,701	546,316	602,070	216	242	289

8.3.5 Number of Households to be Served by Municipal Solid Waste Collection System

The number of urban households in 2005 is the potential households for the planning (refer to Table 8.3.5, Supporting Report).

8.4 Types of Facilities and Implementation Criteria

In principle, types of facilities and their implementation criteria as prescribed in the NSMP and the NEDA Board Resolution No. 12 (s. 1995) are adopted to this PW4SP.

8.4.1 Water Supply

The following are the major conditions and assumptions applied to urban and rural water supply, which are intended as a guide for the implementation of sector projects.

(1) Urban water supply

Prevailing situation of urban water supply in each municipality was firstly reviewed mainly focusing on existing water sources and magnitude of service coverage. Planned/on-going projects for concerned municipalities were also studied and reflected in the planning, with due attention to merging of municipalities into an integrated water supply system. Potential water source for future development was then evaluated based on the study results in Chapter 7, taking into account the possibility to utilize untapped spring sources. Recommendations arising from these studies were also incorporated as overall development strategy.

Aforementioned studies were carried out by the following sequence:

Review of existing water supply systems and water sources;
Review of planned/on-going projects;
Establishment of planning conditions covering service level, utilization of existing facilities, water sources, and number of systems; and
Recommendations for overall development strategy.

Table 8.4.1 presents summary of the study results by municipality.

Table 8.4.1 Summary of Urban Water Supply Development by Municipality/City

Municipality	Existing Condition	On-going/Planned Project	Water Source Availability	Future Requirements
Bago City	There exists one WD which utilizes spring and well sources. There is an on-going project financed by DANIDA for the expansion of the existing system.	DANIDA assisted project is on-going	DW; high yield (salinity in the coastal area) SP; scattered & far from populated area (potable) Future development; DW	Expansion of the existing system using deep wells
Binalbagan	There exists one WD which utilizes well sources.		DW; high yield (salinity in the coastal area) SP; scatter & far from populated area Future development; DW	Expansion of the existing system using deep wells
Cadiz City	There are one each of WD and WWs. The WD uses deep well and spring sources, while deep wells by the WWs. The development of spring source funded by DANIDA is under way.	DANIDA assisted project is on-going	DW; high yield (salinity in the coastal area & ironic problem in the hilly area) SP; scattered & far from populated area (potable) Future development; DW/spring	Expansion of the existing system using deep wells/spring sources
Calatrava	There exists one WWs, water source of which is spring. The expansion of the existing system is under way.	On-going expansion project using Land Bank loan	DW; normal yield (potable) SP; scattered & far from populated area (potable) Future development; SP/DW	Expansion of the existing system using spring sources.
Candoni	There exists no Level III system.		DW; normal yield (potable) SP; scattered &limited yield (potable) Future development; SP/DW	A new system is necessary using spring source or deep well.
Cauayan	There exists no Level III system	Plan for Level III funded locally	DW; normal yield (salinity in the coastal area) SP; scatter & far from populated area Future development; DW/spring	A new system is necessary using spring source or deep well. Merging with Ilog and Kabankalan City may be studied.
Enrique B. Magalona	There exists one WWs, water source of which is deep well. Some barangays near the seashore are suffering from salt water intrusion.		DW; high yield (salinity in the coastal area & ironic problem in the hillside) SP; scattered & far from populated area (potable) Future development; DW/spring	Expansion of the existing system using deep well/spring sources.
Escalante	There are one each of WD and WWs, both of which utilize spring and deep well.	Plan for Level III assisted by CDF	DW; normal yield (ironic problem in the hills) SP; scatter & far from populated area Future development; DW/spring	Expansion of the existing system using deep well/spring sources
Himamaylan	There exists one WD which utilizes well sources.	Plan for Level III funded locally	DW; high yield (salinity in the coastal area) SP; scatter & far from populated area Future development; DW/spring	Expansion of the existing system using deep well/spring sources.

Table 8.4.1 Summary of Urban Water Supply Development by Municipality/City (Cont'd)

Municipality	Existing Condition	On-going/Planned Project	Water Source Availability	Future Requirements
Hinigaran	There exists one WWs managed by LGU, which utilizes well sources.		-ditto-	-ditto-
Hinoba-an (Asia)	There exist no Level III systems.	Plan for Level III funded locally	DW; risky & only shallow well SP; scattered & far from populated area (potable) Future development; SP or radial well	A new system is necessary using spring source or radial well.
Ilog	There exists one WD which utilizes spring source. The water source capacity is not sufficient.		DW; high yield (salinity in the coastal area) SP; scattered & far from populated area (potable) Future development; DW	Expansion of the existing system using deep well sources
Isabela	There exist no Level III systems.	Plan for Level III funded locally	DW; high yield (ironic problem) SP; many springs near populated area Future development; SP	A new system is necessary using spring source.
Kabankalan City	There exists one WD which utilizes spring and deep well sources.	Expansion plan to cover BRY Tabugon	DW; normal to high yield (ironic problem in the hills) SP; scattered & far from service area Future development; DW/spring	Expansion of the existing system using spring/deep well sources; Merging with Ilog, Cauayan and Himamaylan may be studied.
La Carlota City	There exists one WD which utilizes spring and deep well sources.		DW; high yield (potable) SP; many near populated area Future development; SP	Expansion of the existing system using spring sources.
La Castellana	There exists one WD which utilizes spring source.		DW; high yield (ironic problem) SP; many near populated area Future development; SP	Expansion of the existing system using spring sources.
Manapla	There exists one WD which utilizes deep well source.		DW; high yield (salinity in the coastal area & ironic problem in the hills) SP; scattered & far from populated area (potable) Future development; DW	Expansion of the existing system using deep well sources
Moises Padilla	There exists one WWs, water source of which is spring.		DW; normal yield (ironic problem) SP; many near populated area Future development; SP	Expansion of the existing system using spring sources
Murcia	There exists one WWs, water source of which is spring and deep well.		DW; high yield (ironic problem) SP; many near populated area Future development; SP	Expansion of the existing system using spring sources; Merging into BACIWA may be studied.

Table 8.4.1 Summary of Urban Water Supply Development by Municipality/City (Cont'd)

Municipality	Existing Condition	On-going/Planned Project	Water Source Availability	Future Requirements
Pontevedra	There exists one WD which utilizes spring source.		DW; high yield (salinity in the coastal area) SP; scattered & far from populated area Future development; DW	Expansion of the existing system using deep well sources; Merging with Valladolid, San Enrique and Pulupandan may be studied.
Pulupandan	There exists one WWs, water source of which is deep well. The service is not enough due to deterioration of water source facilities.		DW; high yield (salinity in the coastal area) SP; scattered & far from populated area Future development; DW	Expansion of the existing system using deep well sources; Merging with Bago City WD may be studied.
Sagay City	There are one each of WD and WWs, both of which utilize spring and deep well.		DW; high yield (ironic problem in the hills) SP; scattered & far from populated area (potable) Future development; DW	Expansion of the existing system using deep well sources
Salvador Benedicto	There exists no Level III system. Only Level II systems are used.	Plan of Level III to be funded by CDF	DW; risky SP; many near populated area Future development; SP	A new system is necessary using spring source.
San Carlos City	There exists one WWs, water source of which is spring and deep well. Other barangays out of the WWs service area are served by Level II systems.		DW; normal yield (potable) SP; scattered & far from populated area (potable) Future development; DW	Expansion of the existing system using deep well sources; Improvement of existing Level II shall be considered.
San Enrique	There exists no Level III system.		DW; high yield (salinity in the coastal area) SP; scattered & far from populated area (potable) Future development; DW	A new system is necessary using deep well source. Merging into La Carlota City WD may be studied.
Silay City	There exists one WD which utilizes deep well source.	Foreign assisted project is on-going	DW; high yield (salinity in the coastal area & ironic problem in the hills) SP; scattered & far from populated area (potable) Future development; DW	Expansion of the existing system using deep well sources; Ozonization treatment is considered in use of river water Merging with Victorias city, Talisay City and Bacolod City may be studied.
Sipalay	There exists one WWs, water source of which is spring.		DW; normal to high yield (potable) SP; scattered & far from populated area (potable) Future development; DW and/or SP	Expansion of the existing system using spring/deep well sources

Table 8.4.1 Summary of Urban Water Supply Development by Municipality/City (Cont'd)

Municipality	Existing Condition	On-going/Planned Project	Water Source Availability	Future Requirements
Talisay City	There exists one WD which utilizes deep well source.	On-going expansion project assisted by DANIDA	DW; high yield (salinity in the coastal area & ironic problem in the hills) SP; scattered & far from populated area (potable) Future development; DW	Expansion of the existing system using deep well sources; Merging with Bago City, Bacolod City and Silay City may be studied.
Toboso	There exists one WWs, water source of which is spring .	Plan for Level III funded locally	DW; normal yield (salinity in the coastal area) SP; scattered & far from populated area (potable) Future development; SP	Expansion of the existing system using spring sources
Valladolid	There exists one WWs which utilizes deep well source.		DW; high yield (salinity in the coastal area) SP; scattered & far from populated area (potable) Future development; DW	Expansion of the existing system using deep well; Merging into La Carlota City WD may be studied.
Victorias City	There exists one WD which utilizes deep well source.	Plan for Level III funded locally	DW; high yield (salinity in the coastal area & ironic problem in the hills) SP; scattered & far from populated area (potable) Future development; DW	Expansion of the existing system using deep well sources

1) Review of existing water supply systems and water sources

The municipalities/cities of Bago, Binalbagan, Cadiz, Escalante, Himamaylan, Hinigaran, Ilog, Kabankalan, La Carlota, La Castellana, Manapla, Pontevedra, Sagay, Silay, Talisay and Valladolid are served by WDs.

Population served by existing Level III systems range from about 1,200 persons at Lopez Sugar Corp. in Sagay City to 32,000 persons at Cadiz City WD. The average size of served population is about 14,400. Majority of the existing Level III systems in urban area is utilizing deep well/spring sources.

The remaining 6 municipalities such as Candoni, Cauayan, Hinoba-an, Isabela, Salvador Benedicto and San Enrique, out of the total 31 municipalities/cities, have no Level III system in their urban areas and are presently served by Level II systems and/or Level I facilities.

2) Review of planned/on-going projects

At present, Bago City WD, Cadiz City WD and Talisay City WD undertake expansion/water source development projects financially assisted by DANIDA. The municipalities of Escalante and Salvador Benedicto have plans of expansion/new creation of Level III systems assisted by CDF. Calatrava has on-going expansion project using Land Bank loan. Other municipalities/city such as Cauayan, Himamaylan, Hinoba-an, Isabela, Toboso and Victorias have plans of expansion/creation of Level III systems as locally funded projects.

3) Establishment of planning conditions

a. Service level

It shall be noted that a national policy for urban water supply is a Level III system, as the most suitable measure. Therefore, for the investment needs of the sector development, it is assumed in this PW4SP that underserved or unserved urban population at present and in the future will be provided with individual house connections. However, it does not intend in the future to exclude, as individual cases, Level I and II facilities from being implemented in urban area.

b. Utilization of existing facilities

The existing Level I and II facilities are considered to be utilized during the Phase I period. However, the population served by these facilities is to be absorbed by Level III service in Phase II.

c. Water sources

Possibility/availability to utilize surface water and groundwater (spring and deep well) is evaluated as potential water sources for water supply development.

From the viewpoints of cost effectiveness and easy O&M of water supply system, utilization of spring sources is given due priority in the course of urban water supply planning. Application of deep wells for water source is regarded as the second priority in principle. Surface water is, on the other hand, not adopted at this moment, because of large capital investment requirements and complexity of surface water treatment.

d. Number of systems

In principle, one (1) Level III system is considered for urban area of every municipality. In the municipalities with an existing Level III system/s, the expansion of the system was first considered. In case of no existence of Level III system/s, a new system was recommended. Existing plan/s on the development of Level III/WD are also taken into account to determine the respective systems of the municipalities.

Possibility and necessity to merge service area of some neighboring municipalities to an urban water supply system were also studied from the viewpoint of:

water source constraints, and

economical development/scale merit of water supply system by cost reduction of water source development and other common facilities as well as O&M cost/minimized number of technical staff.

Any rural barangay/s being served by an existing urban Level III system are considered to continue throughout the future.

e. Rehabilitation

Rehabilitation of existing and future facilities is assumed to be undertaken by the operating bodies.

4) Overall development strategy

Expansion of the existing system/s was planned for those with WD/Level III, while creation of the system is considered for those without systems at present.

Merging of municipal systems (physical arrangement) in the long-term is considered. Integrated management systems shall also be sought. Conditions to be studied in-

clude; water source availability, willingness by concerned municipalities and technical study on cost recovery/economic construction.

The following WDs/municipalities may be studied for the integration both in physical and management systems.

- Kabankalan City WD, Cauayan, Himamaylan and Ilog
- Bago City WD, Pontevedra, Pulupandan, San Enrique and Valladolid
- La Carlota City WD and San Enrique
- Bacolod City WD, Silay, Talisay and Victorias
- Murcia and Bacolod City WD

Integration of small Level III systems for operation and management shall be sought, although these systems are currently managed individually.

Some municipalities have high potential for spring development due to the presence of a number of untapped spring sources favorable for urban water supply that were identified during the course of PW4SP preparation. However, a detailed survey to ensure appropriate development of spring sources shall be conducted in the implementation of the projects.

(2) Rural water supply

1) Service level

Level I systems (deep well/shallow well/developed spring) are generally planned for rural areas where houses are scattered. In the PW4SP, public investment for Level I facilities covers 50% of the total number of required facilities, considering the existing share between public (53%) and private facilities (47%).

Level II systems are considered where houses are clustered and suitable untapped spring is available.

Service level standards are set forth as 15 households per source for Level I and 5 households per communal faucet for Level II, as defined in the national plan.

Application of Level III systems in rural areas may be considered in a case to case basis during actual implementation.

2) Utilization of existing facilities

The existing facilities/systems in all service levels are considered to be utilized throughout the future.

3) Water source

For Level I facilities, deep well construction is given priority wherever applicable considering safety against possible contamination and stable water supply. Standard specifications of shallow and deep wells are summarized in Table 8.4.2 based on the water source evaluation results presented in Chapter 7. Conventional construction method (driven well) may be employed under favorable substrata or hydrogeological conditions. The standard structure of wells in application of "open-hole drilling and gravel pack" is presented in Figure 8.4.1, Supporting Report. In addition to this, for deep well with high iron content, application of iron removal facility is recommended. The standard structure of iron removal facility is presented in Figures 8.4.2 (a) and 8.4.2 (b), Supporting Report.

Spring development is also included in Level I planning by adopting its share of 10% referring to study results of water source development presented in Chapter 7.

For Level II systems, a total of 16 untapped springs suitable for water supply purpose are considered. Identified untapped springs are presented in Table 7.4.1, Supporting Report.

Table 8.4.2 Standard Specifications of Level I Wells

Specification	Shallow Well	Deep Well
Construction Method	Open-hole drilling and gravel pack	
Casing Diameter	50mm	100mm
Borehole Diameter	150mm	200mm
Ranges of Well Depth	Standard Depth	
0 - 20m	20m	Not Applicable
21 - 50m	Not Applicable	40m
51 - 100m	Not Applicable	80m
101 - 150m	Not Applicable	120m

Profile between gravel packed well and natural gravel packed well for Level I water supply:

The open-hole drilling method is employed for the well construction to ensure yield of ground water from adequate aquifer in provision of proper screen location and

specifications. The conventional "cased-hole driven well" shall be used only in cases where well specifications are established in the specified area with sufficient information on the hydrogeological condition including existence of natural gravel at the expected aquifer.

It is important to study the potential areas to adopt natural gravel method, which can perform the same level of function as gravel-packed wells. Such areas are usually limited to the upper stream of larger rivers in alluvial fans and alluvial plains. The arial proportion between those in application of gravel-packed and natural gravel pack wells will be worked out referring to the condition of the province.

Modification needs of riser pipe diameter according to the water level of deep wells:
The standard specification of riser pipe of deep well hand pump is set with a diameter of 2-1/2 inch in the plan. However, water level of the deep wells may range between 20m and around 40m, depending on the aquifer conditions.

Although the Malawi type deep well pump with a cylinder that is currently used in the Philippines has operation experience up to 40 m in pumping water level, the diameter of riser pipe must be adjusted between 1" to 2-1/2" in order to lower required power at the pump handle (calculating required power under the specific pumping water level).

For Level II systems, only untapped springs suitable for water supply purpose are considered. Identified untapped springs are presented in Table 7.4.1, Supporting Report.

4) Number of systems/facilities

The number of Level I wells and spring development is estimated based on the service level standard; while the number of Level II systems coincides with the number of untapped springs having an estimated discharge of 2.0 lps. or more.

5) Rehabilitation

Rehabilitation of existing Level I wells is not considered, since most of the wells constructed by driving method is not suitable for rehabilitation to recover their functions. However, minor repair work for hand-pump and concrete apron is a requisite.