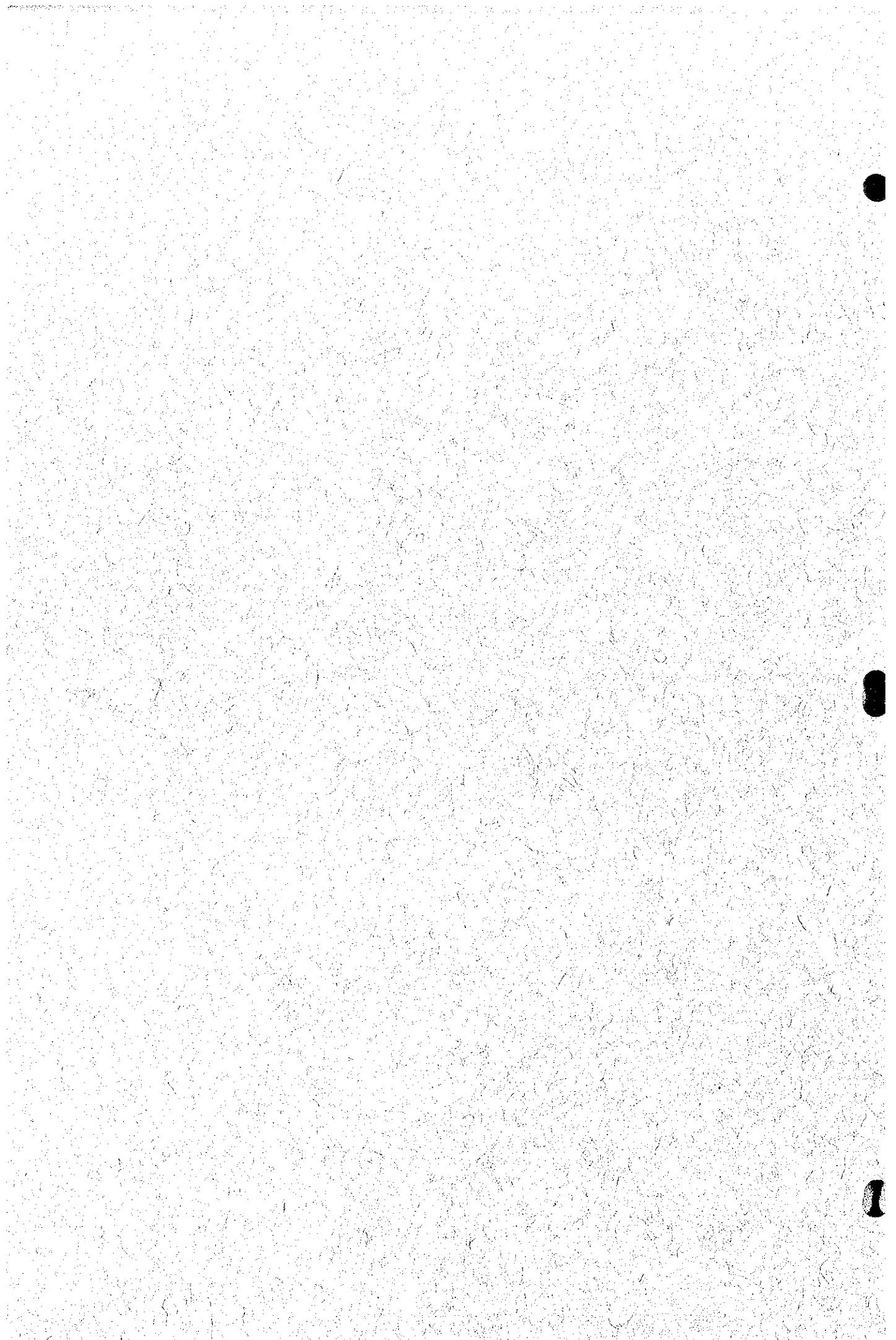


Chapter

WATER SOURCE DEVELOPMENT

7



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 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, surface water potential of major rivers was studied in terms of quantity (return period flow rate) and quality to provide information for LGU's future use, if necessary.

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 geological 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 salt 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 35,116 shallow wells, 894 deep wells and 100 developed springs in the province (functional sources). Majority of the wells is shallow wells. About 3% of these water sources are public facilities. Of the total existing wells, only 3 deep wells are not functional at present. In addition to the above sources, 34 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	591	329	45	965
b. Privately owned sources	34,525	565	55	35,145
c. Number of water sources	35,116	894	100	36,110
d. % share of different sources	97.2	2.5	0.3	100
2. Water sources with problems and non-functional wells				
a. Water quality problems*	17,558	0	0	17,558
b. Non-functional	0	3	0	3
3. Spring source information				
a. Undeveloped	-	-	0	0
b. Untapped	-	-	34	34

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

Young volcanic mountains, the most prominent of which is Mt. Matutum and classified as active volcano, constitute the central highlands of the province. The metamorphic rock units such as a sort of schist and quartzite of Cretaceous or older period are underlain by the sedimentary rocks of Mio-Pleistocene epoch. The andesite plug of Quaternary covers on Tertiary sedimentary rocks. The folds with limited magnitude appear to have conduits.

The Cotabato Cordillera is a WNW-ESE trending mountain range of moderate to high relief extending from Cotabato City to Sarangani Bay. The basement complex consists of metamorphic rocks of Middle Mesozoic era. The exposure is limited and might be concealed under Miocene rocks at the southeastern part of the Cotabato Cordillera. The rock units of sev-

eral ages are found in mountainous area. The youngest rock units are marine and terrestrial sediments of Plio-Pleistocene epoch in upstream area of Surallah, and volcanic rocks as andesite plug in Mt. Parker of Quaternary period.

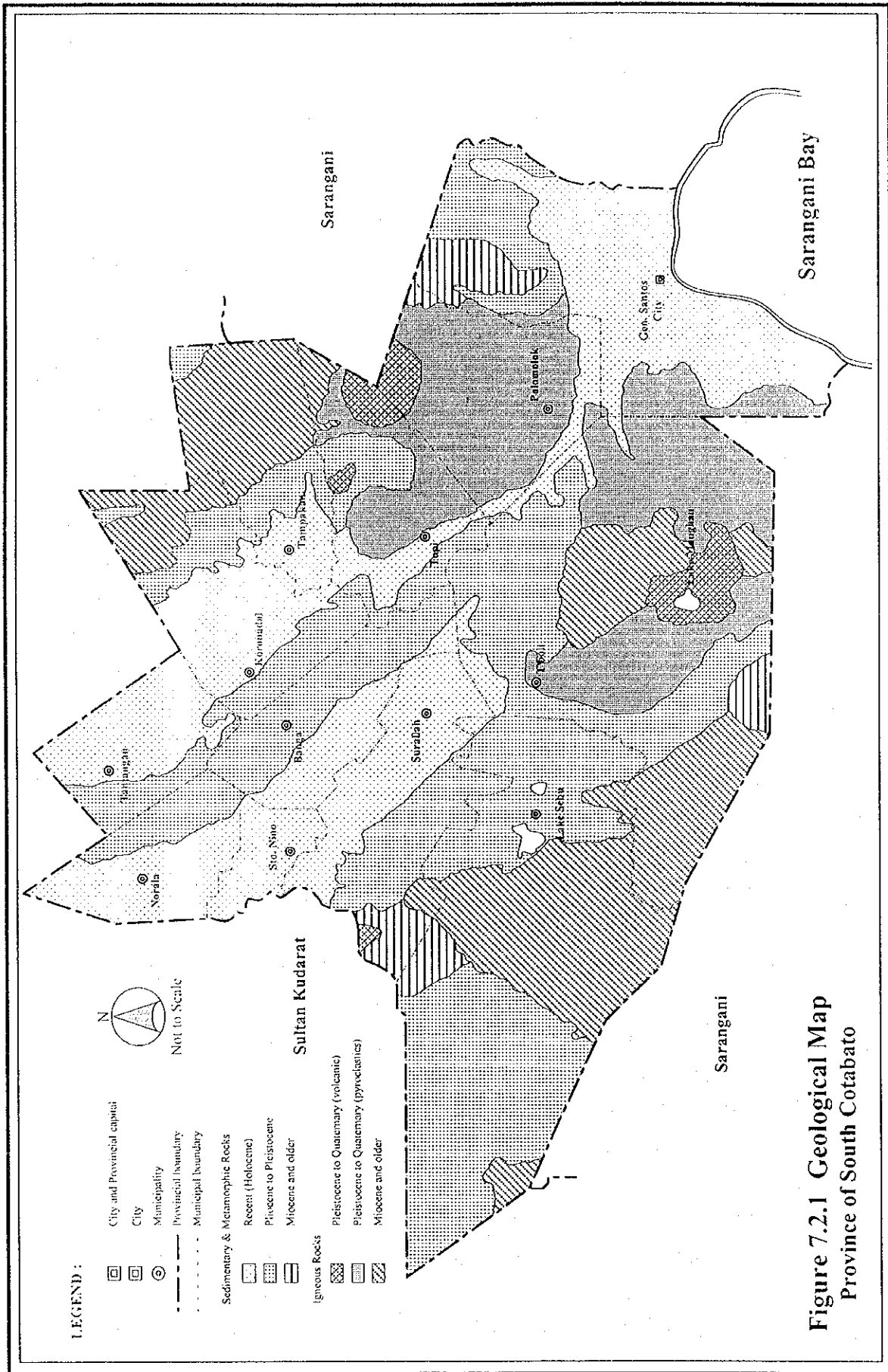
The Cotabato Basin is a broad alluvium-filled valley. The basement of this alluvial plain is formed by the strike faults in reef limestone sediments of Plio-Pleistocene epoch. Presently, the fault block Roxas Range with a length of 50 km and elevations of 700 m to 800m is in the central alluvial plain. The other alluvial deposits cover volcanic plain of Plio-Pleistocene epoch that is formed by Mt. Matutum and Mt. Parker, in the southeastern part of the province.

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. These are, from the oldest to the youngest, 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 considered the most important to groundwater 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 have impermeability. They are classified as aquicludes. The oldest formation is the basement complex in the Cotabato Cordillera that consists of piedmontite schist, quartzo-feldspathic schist, quartz, chlorite, epidote schist and amphibolite schist. The exposure is limited and might be concealed under Miocene rock units. The Cretaceous-Paleogene rocks consist of undifferentiated metamorphosed submarine flows, largely spilites and basalt intercalated with chert, marble and sediments. A batholithic mass of diorites as Neogene intrusive underlies the western part of the province, disposed parallel following the main Cotabato Cordillera. Small satellite bodies were also noted. The rock intrudes the older formation of the area and closely follows the distribution of the older rock types. It is usually medium to coarse grained with crude foliation in some portion.

Lower Miocene sedimentary rock, which units are thick sequences of conglomerate, wackes, shales and limestone associated with basic to intermediate flows and pyroclastics, is exposed throughout the whole extent of the province. In the south-southwest portion, the lower Miocene sedimentary rocks occur in narrow, irregular and discontinuous



**Figure 7.2.1 Geological Map
Province of South Cotabato**

patches overlying the older rocks. The rocks in this portion consist dominantly of conglomerate with minor wackes and limestone converted into a marbolized mass with crude schistosity. The formulation is intruded by diorite. A continuous belt also occurs in the northeast to southeast portion of the province fringing the arcuate or elbow configuration of the eastern part.

Upper Miocene sedimentary rock formulation, which is extensive as the lower Miocene sedimentary rocks, consists of interbedded conglomerate, sandstone and shale overlain by pyroclastics. In the southeastern part, the pyroclastics are represented by tuffaceous marl. The series is associated with slightly coralline to crystalline groundmass. The clastic member is basaltic in composition.

(2) Plio-Pleistocene Series

Sedimentary rocks of this series have various range of the permeability. This formulation overlaps the older sedimentary series and fringes the broad alluvial basin of Cotabato at the north as well as the Sarangani Bay area. The clastic member consists of tuffaceous sandstone and shale with few lenses of conglomerate. The sediments are usually folded especially at the western flank of the Allah River valley near Banga. Reef limestone fringing the rim of Sarangani Bay and Maitum-Banga area appears to rest unconformably on the older rocks and a portion of the volcanic plugs. The rocks are usually flat lying with minor inclinations. The unconfined and confined aquifer is leaky.

(3) Recent Deposits (Holocene Series)

Quaternary volcanic is represented by the Mt. Parker and the Mt. Matutum volcanoes that consist of andesitic igneous rock with occasional dacitic phases. It covers a more or less symmetrical distribution around the core of the two mountains. The andesite is usually gray and porphyritic. The rock formation surrounds the volcanic plugs and consists of a thick of agglomerates, ash flows and associated pyroclastic rocks. Tuffaceous shale is interbedded with pyroclastic pile, which is andesitic in composition. The recent deposits cover a broad area at the north where the southern extension of the Cotabato Basin is located. Wide alluvial plain fringes the Sarangani Bay area. The deposit consists of unconsolidated gravel, beach and swamp deposits and raised coral reefs. The unconfined and confined aquifer is leaky.

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) Shallow well area

Shallow well area is defined in this study as area where solo shallow well is available. These areas have water bearing rock formations extending not more than 20m in depth from the ground surface. Shallow well areas are usually located in alluvial and coastal plains, where recent unconsolidated materials overlies impervious rocks at shallow depth. The extent of completely 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 from the ground level. These areas could be found in portions underlain by the Plio-Pleistocene series and Recent formations. Most of these areas have more than one aquifer occurring at various depths. Areas where both shallow and deep wells could be developed are categorized as deep well areas.

(3) Difficult area

These are areas 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 usually 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 also 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 database 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.

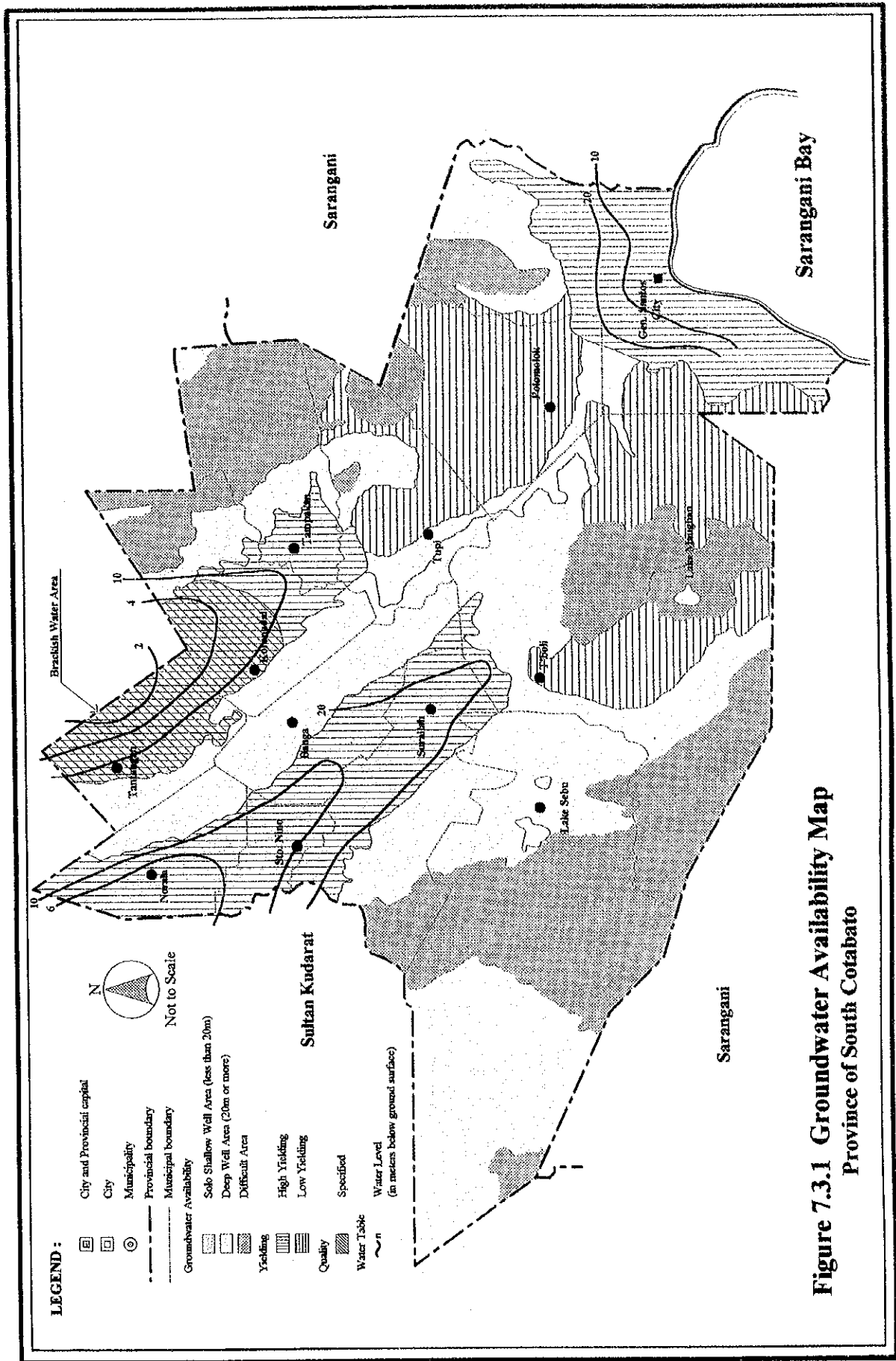


Figure 7.3.1 Groundwater Availability Map
Province of South Cotabato

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 below.

(1) Shallow well area

The province has no solo shallow well area. The development of shallow wells is, however, possible in the "Deep Well Area" (recent alluvium and beach deposits), where shallow aquifers usually occur. The shallow wells in the province are driven to an average depth of 12m (6m to 18m). These wells have average static water level of 3 mbgs (1m to 5m) and average specific capacity of 0.5 lpsm (0.2 lpsm to 0.9 lpsm).

(2) Deep well Area

The deep well area covers approximately 75% of the province, widely distributed in northwestern to southeastern part of the province. The deep well area is composed of alluvial plain and low hills made of sedimentary rocks. The alluvial plain is composed of recent deposits of clay, silt, sand, and gravel, which forms a groundwater storage basin for some aquifers. While, the sedimentary formation of Plio-Pleistocene epoch consist of reef limestone, sandstone, conglomerate and pyroclastics in the southwestern and north-eastern parts of the province.

Considering the geological formation, the alluvial plain is categorized as a high potential area for deep well development, while the pyroclastics of Plio-Pleistocene epoch are classified as a low-yielding area for deep well development. In alluvial plain, the average depth of the existing deep wells is 80m with an average water level of 10 mbgs. The average specific capacity is 3.5 lpsm.

In the volcanic sediment area made of Plio-Pleistocene series, groundwater development is not performed yet due to the sufficient spring sources and limited population. When deep well development becomes necessary in this area, the average depth of the planned deep wells would probably be 60m with an average water level of 20 mbgs. However, the specific capacity will be good for only Level-I service.

(3) Difficult area

About 25% of the provincial area are classified as a difficult area to exploit groundwater, in which the cordillera mountainous areas belong. These are located in the western and northern portions of the province.

The geology is made up of 1) metamorphic rocks of Cretaceous period to Paleocene epoch, 2) well-compacted sediments of Oligocene to Miocene epoch including sandstone, siltstone and conglomerate, and 3) volcanic and igneous rocks of Oligocene to Miocene epoch. These rocks and formations are in dense, massive and consolidated conditions and have impervious characteristics. Groundwater occurs only in fissures or fault fracture zones.

7.3.3 Groundwater Quality

There is water quality problem in both shallow and deep wells in northern area of the province (details are referred to Table 7.3.2, Data Report). Major water quality problem is brackish water. This area is distributed along the national highway of the northwestern alluvial plain. 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, brackish water is the most serious with a high percentage of affected existing wells (more than half of the numbers of shallow and deep wells) in populated area. The problem is extended to most of the areas in the municipalities of Koronadal and Tantangan. Groundwater with chloride content is believed to be remnants of the blockaded seawater due to the neritic sedimentation of Plio-Pleistocene epoch.

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 100 developed springs currently serving the province, which come out from high mountain areas

in the northeastern and southwestern parts, and from the range area in the central part of the province. Of these springs, 99 have discharges of less than 2.8 lps, while only one yields with 6.7 lps. Most of these springs are not dried up during a drought year with yields varying from 0.2 lps to 6.7 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 Silway and Mindanao Rivers. The Allah, Banga and Buluan rivers are tributaries of the Mindanao River. There are 5 stream gauging stations at the major rivers in the province and 2 other stations in the provinces of Sarangani and Sultan Kudarat.

Surface water use in the province totaled to 74.6 m³/sec according to the NWRB's water rights registration database as of March 1997. Of this usage, 99.6% of the water rights were registered for irrigation. The diversions for major flume, which are operated by NIA, are located in General Santos City at the Silway River, in Surallah at the Allah River, and in Banga and Norala at the Banga River. Other surface water rights are lodged to waterworks and private companies for domestic and industrial users. For domestic water supply, a private company had registered a 0.04 m³/sec intake amount at the Buluan River for the subdivision development in Polomolok and Tupi in 1988.

Data on river flow together with 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 streams were conducted during this study. The examined water quality analysis at each stream meets the Class A limitation of "DENR Fresh Water Quality Criteria". It is noted that mining activities on gold and copper are prevalent at the Allah and Buluan stream watersheds in the municipalities of Lake Sebu and Tampakan. These operations have caused contamination of the surface water by heavy metals such as mercury solution.

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 5 to 20 mbgl. One disadvantage of shallow wells is the lowering of water level during dry season that reduces the discharge of the wells. 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 groundwater level does not affect the discharge, since usual confinement of deep aquifer rises water level above the aquifers. In Recent deposits and Plio-Pleistocene series, good aquifers apparently occur from 30m to 150m 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 in the expected municipality area are assumed in the Supporting Report. The construction ratio of natural gravel packed well to the total requirements of the province is probably summed at more than 10%.

(2) Spring

A total of 34 untapped spring sources for future development are listed in Table 7.6.3 Untapped Spring Source Identification, Supporting Report. The list includes detailed

Table 7.6.1 Groundwater Development Potential in the Province

Area	Groundwater Development Potential	Water Quality	Area Feature
Mt. Matutum & Piedmont	<p>The potential water source is developed by springs in the northern area and is developed by deep wells in southern piedmont. Deep wells have limited production with depths of 30 m to 80 m and water levels of 10 m to 40 mbgs. The water level is easily affected upon the precipitation amount.</p> <p>The spring is only available source for water supply in this area. The spring fields are widely distributed. However, most of eyes are located in lower elevation area than that of populated.</p> <p>The deep well development is generally risky in terms of quality and quantity. The groundwater potential areas are located in the western part of this area where limited reef limestone and sporadic terrace gravel deposits are observed. Probably the deep well depth is 50 m or more depending on the water level.</p>	<p>The groundwater quality both spring and deep well is potable.</p> <p>The Ca and Mg contents are observed in limestone area, while the Fe and Mn contents are distributed in volcanic area.</p>	<p>This area covers northern part of Polomolok and Tupi, and entire Tampakan. The form of Mt. Matutum is classified as stratovolcano with its piedmont radius of about 20 km.</p> <p>This area, with elliptical shape of 20 km and 80 km, covers an upstream part of the Cotabato Cordillera. The southwestern part of Surallah and T'boli, and entire Lake Sebu are belonging to. Mt Parker, classified as active volcano, is located in the southeast end of this cordillera.</p>
Cotabato Cordillera with Mt. Parker	<p>Groundwater is major potential source for this area in term of quantity. The aquifer thickness in the alluvial plain is estimated about 150 m to 80 m adopted by the lithologic log of existing deep wells. The static water levels are shallower (5 mbgs) in downstream area and deeper (20 mbgs) in upstream area. The reef limestone formation, which is underlain by the alluvium deposits, is one of the influential productive aquifer. Presently, some of the free flowing deep wells with depths of more than 120 m can be seen in Banga area.</p> <p>Spring sources are also possible in lower piedmont of the fault block Roxas Range. This spring source probably comes from the recharge area of Tupi and or Surallah. The number of spring sources is limited but some of their discharges are strong as 100 lps or more.</p>	<p>The groundwater quality has different characters in each area divided by the fault block Roxas Range in the central alluvial plain. The quality in southwestern area is potable while the brackish water is observed in downstream side of the Buluan River in Koronadal and Tantangan.</p>	<p>This area is a part of the Cotabato Basin, which covers eight municipalities along the R-5 national highway. The alluvial plain with maximum width of 30 km and length of 55 km is formed by the Buluan and the Banga Rivers, which are tributaries of the Mindanao River.</p>
Northwest Alluvial Plain	<p>The majority of water source is developed by deep wells exclusive in area of higher piedmont, where water sources are developed by springs. The thickness of the aquifer in the alluvial plain is 200m or more according to electric prospecting survey performed by the NWRC in early 1980. The static water levels are generally 40 mbgs in upstream area and shallower in order to the elevation until General Santos City.</p>	<p>The groundwater quality, developed as deep wells and springs, is potable.</p>	<p>This area is formed as alluvial fan with width of 31 km and length of 22 km, which area covers a part of Polomolok and entire General Santos City. The Silway River is flowing through this area. The highest elevation is 450 m and the slope until Sarangani Bay is averaged.</p>
Southeast Alluvial Fan			

data on barangay name, owner, discharge rate in dry season, transmission line length and elevation difference between spring source and served area. Such springs are mainly located in the Cotabato Cordillera and piedmont of the Roxas Range. Other areas have few untapped springs. Discharge rates of the springs are generally small ranging from 0.1 lps to 6.0 lps. Spring development potential in the province is shown in Table 7.6.1, Supporting Report.

(3) Surface Water

The potential surface water volume exploitable at 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 Allah River basin are privileged to use larger amount of river water.

There is potential surface water source at the Crater Lake Maughan of Mt. Parker. The mountain is believed to be an active volcano. This volcanic lake has a diameter of about 2km, a water level of 1,800 masl and a depth of 2,000m. The storage volume of this lake is roughly estimated at (as a conical form) about 2.1 billion m³.

As a preliminary concept (details are referred to the Supporting Report), available water may be between 100 lps and 200 lps (service population: 50,000-170,000 persons). When other purposes of the water use are considered such as for irrigation, the available amount for the water supply must be discounted.

For future planning of the water supply, a detailed hydrologic investigation should be conducted. The study should entail a material balance of the system considering water recharge, storage, runoff, influent or effluent seepage, etc. In addition to the study on the bathymetry of the Lake Maughan, the following field measurements should be conducted.

- Echo Sounding to prepare the bathymetric map
- Water Quality & Temperature Log; to confirm the influent or effluent at the bottom of the lake
- Runoff & Rainfall to prepare the basic characteristics

Aside from the utilization of the lake-water, the following are to be taken into account. In the eastern piedmont area of Mt. Parker, where the transmission pipeline might be laid for wide-area water supply using the lake water, several large-scale springs exist. These spring sources may also supplemented the lake water with technical countermeasures (pressure reducing reservoirs, etc).

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 data base is included in Table 7.1.1, Data Report), and the hydrogeological assessment presented in Table 7.6.2, Supporting Report.

The water source availability (ratio between wells to springs) by municipality 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. These ratios indicate the general profile of the different types of groundwater source available in the municipalities. Therefore, the figures of ratio 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 shallow well areas considering the on-going practices. The proportions (%) of shallow and deep wells 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.

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 municipalities that fall on this group are Koronadal and Banga. Table 7.7.2 summarizes the requirements.

Table 7.7.1 Standard Specification of Wells by Municipality

Municipalities with Classification	Type	Proportion (%)	Standard Specification			Ratio (%) Well:Spring	
			Depth Range (m)	SWL (m)	Sp. Cap. (lpsm)		
Banga	Rural	-	-	<D<	-	-	90:10
	DW	100	30	<D<	60	20	
	Urban	-	-	<D<	-	-	-
	DW	100	60	<D<	120	20	2.0
Koronadal	Rural	-	-	<D<	-	-	-
	DW	90	20	<D<	50	10	0.5
	Urban	-	-	<D<	-	-	-
	DW	100	50	<D<	150	10	1.5
Lake Sebu	Rural	-	-	<D<	-	-	-
	DW	40	50	<D<	100	40	0.3
	Urban	-	-	<D<	-	-	-
	DW	100	90	<D<	120	40	0.5
Norala	Rural	-	-	<D<	-	-	-
	DW	100	20	<D<	50	5	0.5
	Urban	-	-	<D<	-	-	-
	DW	100	50	<D<	100	5	2.0
Polomolok	Rural	-	-	<D<	-	-	-
	DW	90	50	<D<	80	40	0.2
	Urban	-	-	<D<	-	-	-
	DW	100	90	<D<	120	40	1.0
Santo Nino	Rural	-	-	<D<	-	-	-
	DW	100	20	<D<	50	10	0.5
	Urban	-	-	<D<	-	-	-
	DW	100	50	<D<	100	10	2.0
Surallah	Rural	-	-	<D<	-	-	-
	DW	90	30	<D<	60	20	0.5
	Urban	-	-	<D<	-	-	-
	DW	100	60	<D<	120	20	2.0
T'boli	Rural	-	-	<D<	-	-	-
	DW	60	50	<D<	70	40	0.1
	Urban	-	-	<D<	-	-	-
	DW	100	80	<D<	100	40	0.5
Tampakan	Rural	-	-	<D<	-	-	-
	DW	30	30	<D<	60	20	0.5
	Urban	-	-	<D<	-	-	-
	DW	100	60	<D<	120	20	1.5
Tantangan	Rural	-	-	<D<	-	-	-
	DW	100	20	<D<	50	5	0.5
	Urban	-	-	<D<	-	-	-
	DW	100	50	<D<	150	5	1.5
Tupi	Rural	-	-	<D<	-	-	-
	DW	80	40	<D<	60	30	0.2
	Urban	-	-	<D<	-	-	-
	DW	100	70	<D<	90	30	1.0

Table 7.7.2 Detailed Groundwater Investigation Required

Municipality	Area	Investigation Activities and Specification
Koronadal	Urban Area	Test Wells; Two deep wells depth of 100 m and 150 m, diameter of 250 mm and well screen of 25 m and 40 m target aquifers: confined un-consolidated deposits Installation of Test; Pumping Test & Water Quality Examination Time Draw-down with maximum discharge of 2,500 m ³ /day Recovery Test Water Quality Examination to include of Cl
Banga	Urban Area	Test Wells; One deep well depth of 180 m, diameter of 250 mm and well screen of 45 m target aquifers: limestone formation (fissure water) Installation of Test; Pumping Test & Water Quality Examination Time Draw-down with maximum discharge of 2,500 m ³ /day Recovery Test Water Quality Examination to include of Ca, Mg and Cl

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. This is a solution to the problem on pump-operation with excess electric consumption and deterioration of deep well life. Thus, appropriate spacing interval and number of wells to be constructed per km² 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 7.6.3, 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.

Chapter

**FUTURE REQUIREMENTS IN WATER
SUPPLY AND SANITATION IMPROVEMENT**

8



8. FUTURE REQUIREMENTS IN WATER SUPPLY AND SANITATION IMPROVEMENT

8.1 General

Phased investments for provincial sector development are planned in almost the same manner as adopted in the 1998 Philippine National Development Plan (PNDP) and the National Sector Master Plan (NSMP), Medium-Term Investment covering the years 1999 to 2003 and Long-Term Development covering the period 2004 to 2010.

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 (1997) 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 that 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. Provincial population by target year and the base year (1997) is estimated referring to the NSO population census results (1980, 1990 and 1995), the 1995 Census-based National and Regional Population projection prepared by NSO and the Provincial Physical Framework Plan/Comprehensive Provincial Land Use Plan. While, the population distribution to urban and rural areas prepared by NSO in 1995 is modified to meet actual conditions in the classification of the areas.

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 students/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 2003 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 sub-section.

(1) Water supply

The base year service coverage in urban area (63%) is lower than the updated MTPDP sector target (68.8%) for the year 1998, likewise rural area (56%) is far behind the sector target of 79%. As identified in Chapter 4, the lower service coverage in rural area is

Table 8.2.1 Provincial Sector Targets

Sub-sectors	Existing Service Coverage	Phase I (1999-2003)		Phase II (2004-2010)	
		Population Coverage (%)	Population Coverage (%)	Additional Population to be Served	Population Coverage (%)
Water Supply	Population Coverage (%)	Population Coverage (%)	Additional Population to be Served	Population Coverage (%)	Additional Population to be Served
<i>Urban Area</i>	63	65	31,703	95	227,620
<i>Rural Area</i>	56	58	64,274	93	243,378
Sanitation	Household Coverage (%)	Household Coverage (%)	Additional Households to be Served	Household Coverage (%)	Additional Households to be Served
<i>Household Toilet</i>					
<i>Urban Area</i>	75	85	13,790	93	29,156
Flush	1	20	8,500	50	28,515
Pour Flush	81	75	3,622	50	641
VIP/San. latrine	18	15	1,668	0	0
<i>Rural Area</i>	63	75	28,833	93	61,130
Flush	0	10	4,193	15	5,960
Pour Flush	66	75	24,640	85	55,170
VIP/San. latrine	34	15	0	0	0
<i>School Toilet</i>	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
	64	80	51,914	90	47,243
<i>Public Toilet</i>	Public Utilities Coverage (%)	Public Utilities Coverage (%)	Additional Public Utilities with Sanitary Toilets	Public Utilities Coverage (%)	Additional Public Utilities with Sanitary Toilets
	97	100	10	100	14
<i>Sewerage</i>	Urban Population Coverage (%)	Not Applicable		Urban Population Coverage (%)	Urban Population to be Served
	0			50	161,339
<i>Solid Waste</i>	Urban Household Coverage (%)	Urban Household Coverage (%)	Additional Urban Households to be Served	Not Applicable	
	21	90	34,069		

Table 8.2.2 Estimation of Base Year Service Coverage of Water Supply

Name of Municipality	Area	Population (1997)	Population Served by 1997 facilities				Percentage Coverage
			Level III	Level II	Level I	Total	
Banga	Urban	12,926			9,699	9,699	75
	Rural	56,274		1,008	28,693	29,701	53
	Total	69,200		1,008	38,392	39,400	57
Koronadal (Capital)	Urban	64,071	2,930		36,016	38,946	61
	Rural	57,643	3,700	500	33,343	37,543	65
	Total	121,714	6,630	500	69,359	76,489	63
Lake Sebu	Urban	8,362			2,406	2,406	29
	Rural	45,654		5,654	19,015	24,669	54
	Total	54,016		5,654	21,421	27,075	50
Norala	Urban	26,584	11,105		9,351	20,456	77
	Rural	14,695		450	9,946	10,396	71
	Total	41,279	11,105	450	19,297	30,852	75
Polomolok	Urban	51,028	28,993		10,196	39,189	77
	Rural	47,703	13,987	5,184	8,179	27,350	57
	Total	98,731	42,980	5,184	18,375	66,539	67
Santo Niño	Urban	14,894			8,292	8,292	56
	Rural	17,908		600	10,089	10,689	60
	Total	32,802		600	18,381	18,981	58
Surallah	Urban	24,229	2,436		13,023	15,459	64
	Rural	40,209	2,271	5,944	18,183	26,398	66
	Total	64,438	4,707	5,944	31,206	41,857	65
Tampakan	Urban	9,972			4,956	4,956	50
	Rural	19,322		5,040	8,580	13,620	70
	Total	29,294		5,040	13,536	18,576	63
Tantangan	Urban	9,170			5,013	5,013	55
	Rural	22,351		1,740	11,799	13,539	61
	Total	31,521		1,740	16,812	18,552	59
T'Boli	Urban	13,894		2,060	2,825	4,885	35
	Rural	52,422	2,165	7,074	5,759	14,998	29
	Total	66,316	2,165	9,134	8,584	19,883	30
Tupi	Urban	10,015	1,750		3,778	5,528	55
	Rural	37,867	2,000	10,808	8,537	21,345	56
	Total	47,882	3,750	10,808	12,315	26,873	56
Provincial Total	Urban	245,145	47,214	2,060	105,555	154,829	63
	Rural	412,048	24,123	44,002	162,123	230,248	56
	Total	657,193	71,337	46,062	267,678	385,077	59

caused by difficulty in water source development due to lower availability of ground water sources.

For Phase I development, targets of service coverage for water supply are established to maintain the current service coverage in both urban and rural area. Sixty five percent

(65%) and 58% is adopted for urban and rural area, respectively. 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 1998 (details are referred to Supporting Report).

The province has base year service coverage of 67%, which is a little above the current national average coverage of 60%. Urban area registers a level of 75% that is well above the national average coverage. Rural area however, has only 63% owing to the presence of numerous unsanitary facilities. By type of sanitary toilet facility, the existing percentage composition to total households is as follows:

<u>Type</u>	<u>Urban (%)</u>	<u>Rural (%)</u>
Flush	1	0
Pour-flush	81	66
VIP latrine	18	34

To attain sufficiency and equitable access to basic services, provincial target of Phase I for urban household toilets is planned at 85%, while, for rural household toilets, 75% is projected. This is equal to the existing urban service coverage of 75% that is pursued to lessen the gap of the coverage between the urban and rural areas and therefore 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 both urban and rural household toilets.

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.

Table 8.2.3 Base Year Service Coverage of Household Toilets

Name of Municipality	Area	1997										
		Population		HHs		Number of Households			Households and Population Using Sanitary Toilets			
		Population	HHs	Flush	Pour Flush	VIP/Dry	Total	Population	Flush	Pour Flush	VIP/Dry	Total
Banga	Urban	12,926	2,596	33	2,265	178	2,476	12,280	1	87	7	95
	Rural	56,274	10,927	15	5,523	3,024	8,562	43,894		51	28	78
	Total	69,200	13,523	48	7,788	3,202	11,038	56,174		58	24	82
Koronadal (Capital)	Urban	64,071	13,432	247	8,486	576	9,309	44,209	2	63	4	69
	Rural	57,643	11,325	12	6,050	1,883	7,945	40,351		53	17	70
	Total	121,714	24,757	259	14,536	2,459	17,254	84,560	1	59	10	70
Lake Sebu	Urban	8,362	1,679	2	601	468	1,071	5,352		36	28	64
	Rural	45,654	9,186		1,017	1,970	2,987	15,066		11	21	33
	Total	54,016	10,865	2	1,618	2,438	4,058	20,418		15	22	37
Norala	Urban	26,584	5,142	20	2,898	1,072	3,990	20,736		56	21	78
	Rural	14,695	2,706	11	1,687	421	2,119	11,463		62	16	78
	Total	41,279	7,848	31	4,585	1,493	6,109	32,199		58	19	78
Polomolok	Urban	51,028	10,288	72	7,273	1,286	8,631	42,864	1	71	13	84
	Rural	47,703	9,263	42	4,768	1,540	6,350	32,916		51	17	69
	Total	98,731	19,551	114	12,041	2,826	14,981	75,780	1	62	14	77
Santo Niño	Urban	14,894	2,826	13	1,550	609	2,172	11,469		55	22	77
	Rural	17,908	3,392	6	2,085	451	2,542	13,431		61	13	75
	Total	32,802	6,218	19	3,635	1,060	4,714	24,900		58	17	76
Surallah	Urban	24,229	4,760	30	2,901	842	3,773	19,141	1	61	18	79
	Rural	40,209	8,010	12	4,480	1,464	5,956	29,755		56	18	74
	Total	64,438	12,770	42	7,381	2,306	9,729	48,896		58	18	76
Tampakan	Urban	9,972	1,833	3	1,037	287	1,327	7,180		57	16	72
	Rural	19,322	3,781	15	1,438	965	2,418	12,367		38	26	64
	Total	29,294	5,614	18	2,475	1,252	3,745	19,547		44	22	67
Tantangan	Urban	9,170	1,757	12	1,034	140	1,186	6,236	1	59	8	68
	Rural	22,351	4,109	7	1,754	984	2,745	14,976		43	24	67
	Total	31,521	5,866	19	2,788	1,124	3,931	21,212		48	19	67
T'boli	Urban	13,894	2,757	3	484	771	1,258	6,392		18	28	46
	Rural	52,422	10,381	9	1,485	2,444	3,938	19,921		14	24	38
	Total	66,316	13,138	12	1,969	3,215	5,196	26,313		15	24	40
Tupi	Urban	10,015	2,007	64	1,053	269	1,386	6,911	3	52	13	69
	Rural	37,867	7,254	28	3,066	2,019	5,113	26,507		42	28	70
	Total	47,882	9,261	92	4,119	2,288	6,499	33,418	1	44	25	70
Provincial Total	Urban	245,145	49,077	499	29,582	6,498	36,579	182,770	1	60	13	75
	Rural	412,048	80,334	157	33,353	17,165	50,675	260,647		42	21	63
	Total	657,193	129,411	656	62,935	23,663	87,254	443,417	1	49	18	67

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 1998 (details are referred to Supporting Report).

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

Name of Municipality	Public School Toilets			Public Toilets		
	Total Number of Public School Students (1997)	Std. No. of Public School Student that can be Served by Base Year (1997) Sanitary Toilets	Service Coverage (%)	Number of Public Utilities with Toilets in 1997	Number of Public Utility with Sanitary Toilets in Base Year (1997)	Service Coverage (%)
Banga	13,129	11,560	88	4	4	100
Koronadal(Capital)	28,941	21,160	73	10	10	100
Lake Sebu	7,169	400	6			
Norala	10,171	6,200	61	2	1	50
Polomolok	20,148	15,080	75	6	6	100
Santo Niño	9,364	8,640	92	3	3	100
Surallah	16,445	8,480	52	5	5	100
Tampakan	7,737	4,520	58	2	2	100
Tantangan	6,487	5,360	83	1	1	100
T'Boli	10,063	4,000	40	1	1	100
Tupi	13,037	6,480	50	4	4	100
Provincial Total	142,691	91,880	64	38	37	97

Base year service coverage is 64% applying the standard number of public school students to be served by 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, 80% and 90% are set, respectively.

3) Public toilets

The base year service coverage considering expected additional coverage by 1998 is shown in Table 8.2.4 (details are referred to Supporting Report). All existing public utilities are served with at least one sanitary toilet giving 100% coverage. This can be attributed by the fact that 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 1997 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.

Table 8.2.5 Base Year Service Coverage of Municipal Solid Waste System in 1997

Name of Municipality	Total No. of Households	No. of Urban Households	No. of Households Served	Coverage of Households (%)	Coverage of Urban Households (%)
Banga	13,523	2,596	712	5	27
Koronadal(Capital)	24,757	13,432	5,338	22	40
Lake Sebu	10,865	1,679			
Norala	7,848	5,142	849	11	17
Polomolok	19,551	10,288	1,936	10	19
Santo Niño	6,218	2,826	365	6	13
Surallah	12,770	4,760	630	5	13
Tampakan	5,614	1,833	126	2	7
Tantangan	5,866	1,757			
T'Boli	13,138	2,757			
Tupi	9,261	2,007	150	2	7
Provincial Total	129,411	49,077	10,106	8	21

About 8% of the total households in the province relied on municipal refuse collection using trucks or a 21% urban household coverage. These municipalities have a total of 9 units of collection truck.

No national targets have yet been set. However, considering the present level of coverage, a 90% urban household coverage is applied for the medium-term period (1999-2003). This is on the assumption that the LGUs will rigorously pursue the national program on solid waste management.

8.3 Projection of Frame Values

8.3.1 Population Projection

Future population for all municipalities by urban and rural area was projected for the target years 2003 and 2010 together with the present population in 1997 as the planning base year.

The regional population in the future is published by the NSO, while the projection at the provincial and municipal levels were not available during the time of this study. The future population of LGUs was therefore projected (details are included in the Supporting Report).

Available information for this study at present is as follows:

- NSO population census results in 1980, 1990 and 1995
- 1995 Census-based National and Regional Population Projection prepared by the NSO
- Provincial Physical Framework Plan/Comprehensive Provincial Land Use Plan (1993-2002)

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

The NSO projected the regional population 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, Regions X and XI are classified as medium-sized regions. The following are the result of the projection for the two regions in 2000, 2005 and 2010.

Table 8.3.1 Regional Population Projection

Year		1980	1990	1995	2000	2005	2010
Region X	Population	2,758,985	3,509,753	3,938,252	4,441,739	4,955,545	5,465,272
	Growth rate	-	2.44 %	2.33 %	2.44 %	2.21 %	1.98 %
Region XI	Population	3,346,803	4,458,829	5,052,730	5,749,821	6,456,464	7,146,889
	Growth rate	-	2.91 %	2.53 %	2.62 %	2.35 %	2.05 %

(2) Provincial Physical Framework Plan/Comprehensive Provincial Land Use Plan: Planning period 1993-2002

The population projection on the provincial total and the component municipalities was made with 1990 as the base year. 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). Minor arrangements on the municipal growth rates were made to meet the provincial average growth rate (about 2.99%).

Comparing the census and the projected population in 1995, the provincial population based on census result was about 7% lower than the projected. Regarding the municipal census population in 1995, about half of the municipalities is lower comparing with the projected figures (maximum of 10 %). While, the remaining municipalities are higher with a range of 0-50 %. In addition, since the growth rates of Lake Sebu and T'boli from 1990 to 1995 are considerably different from the projected, future projection shall be made using the 1995 census results as base year.

(3) Population Projection of the Province

The following conditions are considered/assumed in the population projection.

Provincial Population

- 1) The growth rates experienced by province/municipalities from 1990 to 1995 are basically adopted for the projection of medium-term target years (1997-2003). However, the provincial population was first determined by applying the growth rate from 1990 to 1995 (2.86%) before finalization of the municipal population and their growth rates. The base year for the projection is 1995 using census results.
- 2) For the long-term projection from 2004 to 2010, the population ratios of the province to the regional total population were assumed considering past experience. The range of population ratios of the provincial population to the regional population (from 1980 to 1995 and projected year 2002 in the Land Use Plan) considered the correlation with other component provinces in the region and the projected regional population. The following are the population ratios of the province to the region both in the past and the projected.

<u>Year</u>	<u>1980</u>	<u>1990</u>	<u>1995</u>	<u>2002</u>	<u>2003</u>	<u>2010</u>
Province	401,705	539,428	621,155	768,360	778,345	901,057
Region	3,346,803	4,458,829	5,052,730	6,032,322	6,173,575	7,146,889
P/R (%)	12.00	12.10	12.29	12.74	12.61	12.61

The population ratios of the province from 1980 to 1990 were about 12%, while the 1995 census results showed a higher figure of 12.29 %. The population ratio of the province between 12-13 % may be taken into account throughout the future. The provincial ratio of 12.61 % is adopted for the year 2010 to determine the 2010 provincial population (estimated growth rate is 2.11%, while the regional rate from 2000-2005 is assumed at 2.05%). The projected population for the years 1997, 2003 and 2010 are shown below.

<u>Year</u>	<u>Population</u>	<u>Growth Rate</u>
1995	621,155	Census result
1997	657,193	2.86 % (growth rate from 1990 to 1995)
1998	778,345	2.86 % (growth rate from 1990 to 1995)
1999	901,057	2.11 % (estimated from projected population)

Municipal population

- 1) The total population of the province by target year is fixed.
- 2) The growth rates of respective municipalities for the years 1997 and 2003 are determined referring to the development experienced between 1990 and 1995. The municipal population for the respective target years was finally adjusted according to the initially calculated population size to meet the fixed provincial population. Accordingly, the growth rates of municipalities were modified. Table 8.3.2 presents the calculation results under the above conditions/assumptions.

Table 8.3.2 Municipal Population Projection

<u>Municipality</u>	<u>Annual Growth Rate (%)</u>			<u>Population (person)</u>				
	<u>'80-'90</u>	<u>Land Use</u>	<u>'90-'95</u>	<u>1995</u>	<u>1997</u>	<u>Estimated G.R</u>	<u>2003</u>	<u>Estimated G.R</u>
Banga	2.31	2.47	2.19	66,571	69,200	1.96	76,232	1.71
Koronadal	3.04	3.03	1.69	118,231	121,714	1.46	130,238	1.22
Lake Sebu	3.68	3.46	6.75	47,617	54,016	6.51	77,331	6.25
Norala	1.87	2.08	2.22	39,688	41,279	1.98	45,553	1.74
Polomolok	4.19	3.77	1.50	96,274	98,731	1.27	104,438	1.02
Sto. Nino	3.78	3.52	1.31	32,103	32,802	1.08	34,318	0.84
Surallah	2.46	2.58	2.59	61,509	64,438	2.35	72,664	2.11
Tampakan	3.52	3.36	2.05	28,256	29,294	1.82	32,016	1.57
Tantangan	1.72	1.95	2.66	30,044	31,521	2.43	35,701	2.18
T'boli	2.33	2.48	10.86	54,206	66,316	10.61	119,093	10.34
Tupi	3.19	3.13	1.54	46,656	47,882	1.31	50,761	1.06
Province	2.99	2.99	2.86	621,155	657,193	2.86	778,345	2.86

Note: 1995 population is census result.

Regarding the municipal population for the year 2010 in the long-term, it is assumed that the trend of the population growth of the respective municipalities between 1990 and 2002, which is considered in the Land Use Plan, will be realized in line with land use plan of the province. Thus, the projected growth rates for the year 2002 by municipality in the Land Use Plan are first applied to project the 2010 population from the year 2003. Then, 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 year 2010 (901,057 persons). Table 8.3.3 shows the study process results and the projected population by municipality for the year 2010 and the adjusted growth rates.

Table 8.3.3 Municipal Population for the Year 2010 and Growth Rates

Municipality	Pop. Projection using G.R in Land Use Plan				2010 Pop. Projection	
	2003 Pop.	Growth Rate(%)	2010 Pop.	Percent	Population	Growth Rate(%)
Banga	76,232	2.47	90,431	9.5	85,490	1.65
Koronadal	130,238	3.03	160,504	16.8	151,735	2.21
Lake Sebu	77,331	3.46	98,121	10.3	92,760	2.63
Norala	45,553	2.08	52,614	5.5	49,739	1.26
Polomolok	104,438	3.77	135,319	14.2	127,926	2.94
Sto. Nino	34,318	3.52	43,721	4.6	41,333	2.69
Surallah	72,664	2.58	86,848	9.1	82,103	1.76
Tampakan	32,016	3.36	40,350	4.2	38,145	2.53
Tantangan	35,701	1.95	40,869	4.3	38,636	1.14
T'boli	119,093	2.48	141,371	14.8	133,648	1.66
Tupi	50,761	3.13	62,983	6.6	59,542	2.31
Province	778,345	2.99	953,129	100.0	901,057	2.11

Notes: 2010 population by municipality is calculated proportionally distributing 901,057 persons to 11 municipalities.

N.A: Not Applicable Growth rate: 2003-2010

Population by urban and rural area

In the Land Use Plan, the urban/rural population by municipality for the year 2002 is projected with 1990 as the base year. The annual growth rate of the urban population for the year 2002 by municipality is estimated referring to the experience from 1980 to 1990 and the future land use plan. The provincial average growth rate is modified at 4.25% from 4.95% (growth rate of 1980-1990). The rural population by municipality is estimated as the balance between the total population and the urban population. The average growth rate of the province is estimated at about half of the urban area (2.24%).

Urban and rural population by municipality was studied considering the 1995 census results and the estimated figures in the Land Use Plan.

1) Past population development

With regard to the urban population of the province to the total population, the provincial averages in 1980 and 1990 were 28.9% and 34.9%, while it increased to 37.8% in 1995. The provincial average growth rate of 4.95% between 1980 and 1990 was slightly reduced to 4.51% in 1995.

Rural population by municipality has been slightly reduced with a provincial average growth rate of 1.93 % from 1990 to 1995.

2) Projection of urban and rural population for the years of 1997, 2003 and 2010

Urban population by municipality for the target years was first projected and the ru-

ral population was calculated to meet the aforementioned total population by smoothing the urban population. In the projection of municipal urban population, the following are assumed by short/medium-term and long-term purpose.

- Short/Medium-term target: 1997 and 2003
- Updated census results in 1995 are applied in terms of the share of urban population to total population by municipality.
- Long-term target: 2010
- The growth rate of the urban population by municipality, which is used for the projection in the year 2002 in the Land Use Plan, is employed with 2003 as the base year. It is anticipated that the share between the urban and the rural population will be regulated to meet the land use plan in the long-term period.

Under the above assumptions, the provincial average share of the urban population for the year 2010 was arrived at 40.9%, higher than the figures in 1995 (37.8%) and in 1990 (34.9%). Table 8.3.4 presents the 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: 1997, 2003 and 2010

Municipality	1997			2003			2010				
	Total	Urban/ Rural	Share (%)	Total	Urban/ Rural	Share (%)	Total	Urban/ Rural	G.R. (%)	Share (%)	
Urban Area	Banga	69,200	12,926	18.7	76,232	14,240	18.7	85,490	17,147	2.69	20.1
	Koronadal	121,714	64,072	52.6	130,238	68,559	52.6	151,735	92,490	4.37	61.0
	Lake Sebu	54,016	8,361	15.5	77,331	11,971	15.5	92,760	16,020	4.25	17.3
	Norala	41,279	26,584	64.4	45,553	29,336	64.4	49,739	33,010	1.70	66.4
	Polomolok	98,731	51,028	51.7	104,438	53,977	51.7	127,926	75,396	4.89	58.9
	Sto. Nino	32,802	14,894	45.4	34,318	15,583	45.4	41,333	20,853	4.25	50.5
	Surallah	64,438	24,229	37.6	72,664	27,322	37.6	82,103	39,325	5.34	47.9
	Tampakan	29,294	9,972	34.0	32,016	10,899	34.0	38,145	13,205	2.78	34.6
	Tantangan	31,521	9,170	29.1	35,701	10,386	29.1	38,636	14,286	4.66	37.0
	T'boli	66,316	13,894	21.0	119,093	24,952	21.0	133,648	33,752	4.41	25.3
	Tupi	47,882	10,015	20.9	50,761	10,618	20.9	59,542	12,926	2.85	21.7
Province	657,193	245,146	37.3	778,345	277,842	35.7	901,057	368,410	4.11	40.9	
Rural Area	Banga	69,200	56,274	81.3	76,232	61,992	81.3	85,490	68,343	1.40	79.9
	Koronadal	121,714	57,643	47.4	130,238	61,680	47.4	151,735	59,245	-0.57	39.0
	Lake Sebu	54,016	45,654	84.5	77,331	65,360	84.5	92,760	76,741	2.32	82.7
	Norala	41,279	14,695	35.6	45,553	16,217	35.6	49,739	16,729	0.45	33.6
	Polomolok	98,731	47,703	48.3	104,438	50,460	48.3	127,926	52,530	0.58	41.1
	Sto. Nino	32,802	17,908	54.6	34,318	18,735	54.6	41,333	20,479	1.28	49.5
	Surallah	64,438	40,209	62.4	72,664	45,342	62.4	82,103	42,778	-0.83	52.1
	Tampakan	29,294	19,322	66.0	32,016	21,117	66.0	38,145	24,940	2.41	65.4
	Tantangan	31,521	22,351	70.9	35,701	25,315	70.9	38,636	24,350	-0.55	63.0
	T'boli	66,316	52,421	79.0	119,093	94,141	79.0	133,648	99,896	0.85	74.7
	Tupi	47,882	37,866	79.1	50,761	40,143	79.1	59,542	46,616	2.16	78.3
Province	657,193	412,047	62.7	778,345	500,503	64.3	901,057	532,647	0.89	59.1	

Note: Large population growth and higher shares of rural area in the municipalities of Lake Sebu and T'boli from 1995 to 2003 decrease provincial urban share from 37.8 % (1995) to 35.7 % (2003).

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 average increase of 4% from the 1997 rate is foreseen in 2003 and another increase of 2% from the 2003 rate in 2010 (details are referred to Table 8.3.8, Supporting Report). It should be noted that the public school participation rate in 1997 was quite low, at 77%.

Table 8.3.5 shows the projected number of public school students by municipality, by target year. About 178,130 and 210,829 public school students are estimated to enroll for years 2003 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.

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

Name of Municipality	Number of Public School Student			Number of Public Utilities		
	1997	2003	2010	1997	2003	2010
Banga	13,129	16,142	19,310	4	4	4
Koronadal (Capital)	28,941	28,337	33,014	10	10	13
Lake Sebu	7,169	15,511	19,935		2	5
Norala	10,171	11,411	12,460	2	3	3
Polomolok	20,148	25,210	30,880	6	8	11
Santo Niño	9,364	9,189	10,485	3	3	3
Surallah	16,445	18,805	21,247	5	5	6
Tampakan	7,737	8,857	10,553	2	3	3
Tantangan	6,487	7,679	8,864	1	2	3
T'Boli	10,063	23,605	28,382	1	2	4
Tupi	13,037	13,384	15,699	4	5	6
Provincial Total	142,691	178,130	210,829	38	47	61

A total of 9 public markets, bus/jeepney terminals and parks/playgrounds are planned for construction by year 2003 and another 14 by the 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.

Five (5) municipalities with a total urban population of about 236,897 are considered (refer to Table 8.5.5).

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

The number of urban households in 2003 is the potential households for the planning (refer to Table 8.3.7, Supporting Report).

8.4 Types of Facilities and Implementation Criteria

In principle, the 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 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 first 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.

The aforementioned studies were carried out in the following sequence:

- Review of existing water supply systems and water sources (details are referred to Supporting Report);
- 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 a summary of the study results by municipality.

1) Review of existing water supply systems and water sources

Majority of the existing Level III systems in urban areas is utilizing deep well sources. The municipalities of Koronadal, Norala, Polomolok, Surallah and Tupi are served by WDs.

Currently, 6 out of the total 11 municipalities, namely: Banga, Lake Sebu, Sto. Nino, Tampakan, Tantangan and T'Boli have no Level III system in their urban areas. These areas are presently served by Level II systems and/or Level I facilities.

Population served by Level III systems range from about 1,800 persons in Tupi to 29,000 persons in Polomolok. The average size of served population is about 9,400 persons.

Table 8.4.1 Summary of Urban Water Supply by Municipality

Municipality	Existing Condition	Future Requirements	Water Source Availability	On-going/Planned Project
Banga	No Level III exists at present. Requests by many municipalities on the establishment of WDs were made to LWUA, but not yet realized as of now.	Individual new system shall be developed.	Deep well (good potential)	None
Koronadal	Existing WD covers only 5% of urban population and applying loan to LWUA for expansion of the system. The number of deep wells shall be increased to augment water source. Current water supply problems are the delay of system expansion.	System expansion with augmentation of water source	Deep well (good potential, but possibility of brackish water)	None
Lake Sebu	No Level III exists at present. They can use shallow wells and demand of Level III service is low at present. LGUs will extend service to indigenous people.	An individual system shall be constructed	There exist springs (many untapped springs are identified, but located in remote and discharge rate is small for Level III). Wells may also be used.	Apply for "Urban Water Supply, DILG"
Norala	Existing WD covers 42% of urban population. But, the charge collection ratio is high. They need to expand the system with augmentation of wells. Gravity flow may be possible for the distribution system.	System expansion with augmentation of water source	Deep well (good potential)	None
Polomolok	Existing WD covers about 57% of urban population.	System expansion with augmentation of water source.	Deep well (but low yielding) Test balling shall be conducted before project implementation.	Expansion of the system is planned with deepwell. Utilization of lake water at Maughan lake is under study.
Sto. Nino	No Level III exists at present.	An individual system shall be constructed.	No spring source exists, thus deep wells may be used.	None
Surallah	Many Level II systems exist (deep wells). There is a WD, which needs to expand the system. New urban development (agri-industry) has been proceeded with a water supply.	System expansion with augmentation of water source	Deep well (good potential)	None
Tampakan	No Level III exists at present. While there are many Level II systems	An individual system shall be constructed	Deep well (good potential)	None
Tantangan	No Level III exists at present. Brackish water is common in use of groundwater. Many Level II systems are operated using spring source. They also use public deep wells.	An individual system shall be constructed	Deep well (good potential)	None
TBoli	No Level III exists at present.	An individual system shall be constructed.	It is difficult to develop deep wells. Spring sources at Barangay Kematu may be utilized as a water source, although transmission line is very long from spring sources (15 Km) to service area.	None
Tupi	Existing WD covers 17% of urban population.	System expansion with augmentation of water source	Untapped springs shall be used.	None

2) Review of planned/on-going projects

At present, there is no particular planned/on-going project for municipalities in the province. However, the province will apply for the urban water supply project which is coordinated by the DILG. The study on the utilization of lake water at Lake Maughan was recently commenced.

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, in general, 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 to exclude from being implemented Level I and II facilities in urban area as individual cases in the future.

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 assumed 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 viewpoint 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.

Water source development study revealed that some of the municipalities in the planning area have high potential for spring development. Among various untapped spring sources identified during the course of PW4SP preparation, the untapped sources located in the municipalities of Lake Sebu and T'Boli are con-

sidered to have favorable conditions for use in Level III service.

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 is 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 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) for the long-term is considered. Integrated management systems shall also be sought. Conditions to be studied include; water source availability, willingness by concerned municipalities and technical study on cost recovery/economical construction.

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

- Norala and Sto Nino
- Surallah and Banga
- Koronadal and Tampakan

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

With regard to water source development, spring sources in Lake Sebu and T'boli may be fully used for Level III systems and deep wells for other municipalities. The study results on the utilization of lake water at Lake Maughan, as a potential source for the future, shall be considered in the implementation of the PW4SP.

(2) Rural water supply

1) Service level

Level I systems (deep and shallow wells) are generally planned for rural areas where houses are scattered. In the PW4SP, public investment for Level I facilities covers 30% of the total number of required facilities, considering the existing share of population served between public (7%) and private facilities (93%).

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 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 the 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, the application of an iron removal facility is recommended. The standard structure of an 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%. This takes into account the existing percentage of developed springs (6%) among public Level I facilities as safe water sources.

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 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 the 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 upstream of large rivers in alluvial fans and alluvial plains. The aerial proportion will be worked out between those areas where the application of gravel-packed and natural gravel pack wells with reference to the condition of the province.

Modification needs of riser pipe diameter according to the water level of deep wells:

The standard specification 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, currently used in the Philippines has an operational experience of up to 40m in pumping water level, the diameter of riser pipe shall be adjusted between 1" to 2-1/2" 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.

5) Rehabilitation

Rehabilitation of existing Level I wells is not considered, since most of the existing 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.

8.4.2 Sanitation

The conditions and assumptions are established for the different sanitation components to serve as guides in the implementation of projects.

(1) Household toilets

Three types of sanitary toilet facilities for individual houses are considered for Phase I; flush, pour-flush and VIP/sanitary pit privy (dry-type). While for Phase II, flush and pour-flush are planned considering the improvement of living standard.

The type of toilet facilities is dependent on the existing or planned service level of water supply in the community. In urban and rural areas with Level I or II water supply facili-

ties, only pour-flush and/or VIP are considered, while in urban areas with Level III water supply systems, flush type toilets requiring a piped water connection are included. Isolated rural areas where there is dearth of water supply, sanitary pit privy (dry type) is considered.

(2) School toilets

Standard service level currently used by DECS (40 students per unit facility) is employed for both phases.

The standard toilet facility (1 building) with 5 units of toilet bowl to serve for 200 students is adopted for the planning purpose, which is modified from FW4SP design to provide a shallow well as a water source.

(3) Public toilets

As a minimum requirement, at least 1 sanitary toilet facility is assumed to be provided for respective utilities: public market and bus/jeepney terminal.

The FW4SP standard design with 6-units of toilet bowl for the market is adopted. In this design, it is assumed that water supply will be tapped from the existing system, hence an elevated water tank is provided.

8.4.3 Urban Sewerage

The commencement of staged implementation of the sewerage program is planned in Phase II for the limited urban area (50% of urban population served by Level III system for the municipalities with urban population of more than 10,000). It is practical to start the program fully using the existing facilities to allow for lower initial investment cost than starting at once a conventional sewerage system (refer to Figure 8.4.3 Staged Improvement in Sewage Collection Method, Supporting Report).

Low cost off-site technologies such as small-bore sewer for collection of effluent from septic tank are to be adopted. Improvement of sewage collection method may be gradually achieved from combined sewer to separate sewerage system.

Sewage treatment facilities may range from community scale septic tank or Imhoff tank to aerated lagoon systems and to a more advanced treatment process such as oxidation ditch.

For this PW4SP, aerated lagoons are assumed as a representative treatment facility for planning purpose. Daily average wastewater quantity is assumed to be 100L per capita per day.

8.4.4 Solid Waste

In terms of facility requirements, this PW4SP only studied the number of refuse collection trucks required for the year 2003. A rated capacity of 5m³ truck/vehicle is considered for calculation of required units of truck. Disposal of solid waste shall be studied in detail through investigations, F/S and D/D. Unit solid waste generation for urban area is assumed to be 0.418kg per capita per day.

8.5 Service Coverage by Target Year

8.5.1 Water Supply

The service coverage in terms of population to be served by target year was estimated by urban and rural area by municipality. The service coverage in rural area was further subdivided by service level (Level I & Level II) to finally come up with physical requirements.

Base figures applied to estimate the future service coverage and the additional population to be served are:

- provincial sector targets,
- population projection by target year, and
- base year service coverage (served population) by existing facilities.

Future requirements in terms of additional population to be served were then estimated by urban (Level III) and rural (Level I & II) area by municipality as a shortfall to meet the population to be served in each target year. The population served in the base year is adopted as the population served in the target year, when the former population exceeds the population to be served in the target year/s. The manner of calculation is specifically presented by phase.

(1) Phase I requirements

Additional service coverage was estimated as a shortfall of the population to be served in Phase I comparing with the population served in base year. In this connection, existing facilities both in urban and rural areas are assumed to be utilized during the Phase I period.

The utilization of untapped springs for Level II systems was given priority during Phase I period for rural water supply. At the time of this plan preparation, 27 untapped springs in 3 municipalities were identified.

(2) Phase II requirements

Additional service coverage was estimated as a shortfall of the population to be served in Phase II comparing with the population served in Phase I. In this regard, existing facilities in rural area were assumed to be utilized through the two Phases, while urban population served by Level I and II facilities in base year was assumed to be absorbed by Level III service during Phase II period.

Table 8.5.1 presents the service coverage by target year and by level of service as well as the additional population to be served (details are referred to Supporting Report).

Through Phase I development, approximately 96,000 persons in the province will be served by additional water supply services, of which 31,700 persons or 33% of the total will be urban population and 64,300 persons or 67% will be rural population..

For Phase II period, a total of 471,000 persons, of which 227,600 persons or 48% in urban area and 243,400 persons or 52% in rural area, will be further benefited by water supply services. This additional service coverage in urban area includes the upgrade of service level for 107,600 persons served by Level I and II facilities in 1997.

8.5.2 Sanitation

(1) Household toilets

The service coverage (number of households to be served) by different types of sanitary facility is estimated by urban and rural area by municipality for the years 2003 and 2010.

The future service coverage and additional households to be served are estimated to meet the provincial targets using the number of household served in the base year and the number of households in target years.

Additional number of households to be served by different type of facility by urban and rural area by municipality is the shortfall of the number of households to be served in target years comparing with either that in base year or in Phase I (details are referred to Supporting Report). However, when the number of households to be served in target

Table 8.5.1 Population to be Served by Target Year (Water Supply)

Name of Municipality	Area	Phase I Coverage (2003)												Phase II Coverage (2010)											
		Total Population			Service Coverage			Additional Population to be Served			Total Population			Service Coverage			Additional Population to be Served								
		Level III	Level II	Level I	Level III	Level II	Level I	Level III	Level II	Level I	Level III	Level II	Level I	Level III	Level II	Level I	Level III	Level II	Level I	Level III	Level II	Level I	Total		
																								Total	Total
Banga	Urban	14,240		9,699		9,699														15,171			15,171		
	Rural	61,992	3,583	32,372	2,575	3,670	2,575	3,670	6,254	6,254	6,254	3,583	61,072	64,655						69,521	3,583	61,072	28,700		
	Total	76,232	3,583	42,071	45,654	6,254	3,679	2,575	3,679	6,254	6,254	15,171	79,826	83,490	15,171	79,826	15,171			83,490	3,583	61,072	28,700		
Koronadal (Capital)	Urban	68,559	8,547	36,016	44,563	5,617	36,875	75,881	5,617	5,617	5,617	36,016	75,881	75,881	67,334					71,860	500	62,650	29,287		
	Rural	61,679	3,700	33,343	37,543							33,343	37,543	37,543	37,543					71,860	500	62,650	29,287		
	Total	130,238	12,247	69,359	82,106	5,617	36,875	75,881	5,617	5,617	5,617	69,359	75,881	75,881	75,881	67,334				142,711	1,000	141,711	58,574		
Lake Sebu	Urban	11,971	5,375	2,406	7,781	5,375	8,449	4,701	13,240	5,375	14,359	13,641	14,103	58,810	72,913	8,266				14,103	14,103	58,810	35,004		
	Rural	65,360	14,103	23,806	37,909	8,449	4,701	13,240	5,375	14,359	13,641	14,103	58,810	72,913	8,266					14,103	14,103	58,810	35,004		
	Total	77,331	18,478	26,212	45,690	13,824	9,402	26,640	10,750	28,725	28,000	28,000	72,913	87,823	16,532					28,506	28,506	117,723	70,008		
Norsala	Urban	29,336	11,105	9,351	20,456	5,375	8,449	4,701	13,240	5,375	14,359	13,641	14,103	58,810	72,913	8,266				14,103	14,103	58,810	35,004		
	Rural	16,217	450	9,946	10,396							9,946	10,396	10,396	10,396					17,707	450	16,457	6,072		
	Total	45,553	11,555	19,297	30,852	5,375	8,449	4,701	13,240	10,750	28,725	28,000	28,506	69,206	83,309	16,532				32,413	450	31,963	31,076		
Polomoiok	Urban	53,977	28,993	10,196	39,189	1,837	18,768	1,837	18,768	1,837	18,768	17,830	17,830	15,993						49,739	30,430	16,018	6,072		
	Rural	50,461	13,987	10,096	29,267	1,917	1,917	1,917	1,917	1,917	1,917	17,830	17,830	15,993						66,117	62,811	62,811	33,818		
	Total	104,438	42,980	20,292	68,456	3,754	3,834	3,834	3,834	3,834	3,834	35,768	35,768	31,986						115,856	95,622	125,625	40,690		
Santo Nino	Urban	15,583	1,837	8,292	10,129	1,837	18,768	1,837	18,768	1,837	18,768	17,830	17,830	15,993						18,768	17,830	17,830	15,993		
	Rural	18,735	600	10,266	10,866	1,837	1,837	1,837	1,837	1,837	1,837	17,830	17,830	15,993						30,872	29,328	29,328	24,592		
	Total	34,318	1,837	18,558	21,095	3,674	3,674	3,674	3,674	3,674	3,674	35,660	35,660	31,986						49,640	58,656	58,656	49,184		
Surallah	Urban	27,322	4,736	13,023	17,759	2,300	2,300	2,300	2,300	2,300	2,300	17,830	17,830	15,993						30,872	29,328	29,328	24,592		
	Rural	45,342	2,271	18,183	26,398	1,77	1,77	1,77	1,77	1,77	1,77	17,830	17,830	15,993						30,872	29,328	29,328	24,592		
	Total	72,664	7,007	31,206	44,157	4,077	4,077	4,077	4,077	4,077	4,077	35,660	35,660	31,986						61,744	58,656	58,656	49,184		
Taupakan	Urban	10,899	2,128	4,956	7,084	2,128	2,128	2,128	2,128	2,128	2,128	17,830	17,830	15,993						30,872	29,328	29,328	24,592		
	Rural	21,117	600	8,380	13,620	2,128	2,128	2,128	2,128	2,128	2,128	17,830	17,830	15,993						30,872	29,328	29,328	24,592		
	Total	32,016	1,228	13,336	20,704	4,256	4,256	4,256	4,256	4,256	4,256	35,660	35,660	31,986						61,744	58,656	58,656	49,184		
Tantangan	Urban	10,386	1,738	5,013	6,751	1,738	1,738	1,738	1,738	1,738	1,738	17,830	17,830	15,993						30,872	29,328	29,328	24,592		
	Rural	25,315	1,740	12,943	14,683	1,144	1,144	1,144	1,144	1,144	1,144	17,830	17,830	15,993						30,872	29,328	29,328	24,592		
	Total	35,701	3,478	17,956	21,434	2,882	2,882	2,882	2,882	2,882	2,882	35,660	35,660	31,986						61,744	58,656	58,656	49,184		
T'boli	Urban	24,952	1,334	2,825	16,219	1,334	1,334	1,334	1,334	1,334	1,334	17,830	17,830	15,993						30,872	29,328	29,328	24,592		
	Rural	94,141	2,165	9,599	42,838	54,602	54,602	54,602	54,602	54,602	54,602	17,830	17,830	15,993						30,872	29,328	29,328	24,592		
	Total	119,093	3,499	12,424	59,057	59,934	59,934	59,934	59,934	59,934	59,934	35,660	35,660	31,986						61,744	58,656	58,656	49,184		
Tupi	Urban	10,618	3,124	3,778	6,902	1,374	1,374	1,374	1,374	1,374	1,374	17,830	17,830	15,993						30,872	29,328	29,328	24,592		
	Rural	40,143	2,000	10,808	10,475	2,383	2,383	2,383	2,383	2,383	2,383	17,830	17,830	15,993						30,872	29,328	29,328	24,592		
	Total	50,761	5,124	14,586	21,378	4,766	4,766	4,766	4,766	4,766	4,766	35,660	35,660	31,986						61,744	58,656	58,656	49,184		
Provincial Total	Urban	277,843	78,917	2,060	105,555	186,532	31,703	13,549	50,725	64,274	57,551	330,660	330,660	243,378						306,537	227,620	227,620	227,620		
	Rural	500,502	24,123	57,551	212,848	294,522	243,378	243,378	243,378	243,378	243,378	330,660	330,660	243,378						537,900	456,226	456,226	456,226		
	Total	778,345	103,040	59,611	318,403	481,054	31,703	13,549	50,725	95,977	90,057	661,320	661,320	486,756						844,437	683,846	683,846	683,846		

year/s is less than or equal to that in base year, no additional number of households to be served is counted.

In the determination of the number of households to be served by flush type toilet, when the number of households to be served in the target year is higher than in base year, the target coverage is applied with conditions. When the target coverage is higher than Level III water supply coverage, the latter coverage is adopted, while on the other case, the target coverage is applied. In cases where the target coverage is less than that in base year, the base year coverage is adopted.

For Phase I, any type of existing sanitary facilities both in urban and rural areas is to be utilized during Phase I period. For Phase II, water-sealed toilet facilities in Phase I both in urban and rural areas are to be utilized.

The projected number of served households at the end of the Phase I period is 120,640. Additional households to be served totaled to 42,623, of which 32% is urban households and 68% is rural households. While at the end of Phase II period, the number of served households are 209,495 with an additional households to be served at 90,286. Table 8.5.2 provides the number of households to be served by target year for urban and rural areas by municipality.

(2) School toilets

The service coverage or the number of public school students to be served is estimated by municipality for the years 2003 and 2010.

The future service coverage and additional number of students to be served are estimated using the number of students served in the base year, the number of students in target years and the provincial sector targets.

Additional number of students to be served by municipality is the shortfall of the number of students to be served in targets comparing with either that in base year or in Phase I (details are referred to Supporting Report). However, when the number of students to be served in target/s is less than or equal to the base year, no additional number of households to be served is considered.

The existing facilities are to be utilized during Phase I period, while the facilities in Phase I are to be utilized during Phase II period.

Table 8.5.2 Additional Number of Households to be Served by Target Year (Household Toilets)

Name of Municipality	Area	Phase I Coverage (2003)						Phase II Coverage (2010)										
		No. of Served Households			Add'l. No. of Households to be Served			No. of Served Households			Add'l. No. of Households to be Served							
	Total Households	Flush	Pour Flush	VIP/Dry	Total	Flush	Pour Flush	VIP/Dry	Total	Flush	Pour Flush	VIP/Dry	Total	Flush	Pour Flush	VIP/Dry	Total	
Banga	Urban	2,859	33	2,072	371	2,476	193	193	3,992	1,857	1,485	371	3,713	1,824				1,824
	Rural	12,032	15	7,659	1,354	9,028	2,136	2,136	17,330	15	14,794	1,354	16,163	7,135				7,135
Koroaadal (Capital)	Urban	14,896	48	9,731	1,725	11,504	193	193	2,329	1,872	1,629	1,725	19,876	1,824				8,959
	Rural	14,373	2,443	7,941	1,833	12,217	2,196	1,257	3,453	19,969	9,286	7,452	1,833	18,571	6,843			6,843
Lake Sebu	Urban	12,118	909	6,817	1,363	9,089	897	767	1,664	17,965	2,506	12,838	1,363	16,707	1,597			7,618
	Rural	26,491	3,352	14,758	3,196	21,306	3,093	407	5,117	37,934	11,792	20,290	3,196	35,278	8,440	6,021		14,461
Norala	Urban	2,404	409	1,328	306	2,043	407	727	1,134	3,590	1,670	1,363	306	3,339	1,261	35		1,296
	Rural	13,151	8,384	1,479	9,863	7,367	7,367	18,112	18,112	23,190	1,670	18,112	1,785	21,567	1,261	8,400		8,365
Potomolok	Urban	15,555	409	9,712	1,785	11,906	407	8,094	8,501	23,190	1,670	18,112	1,785	21,567	1,261	8,400		9,661
	Rural	5,674	965	3,135	723	4,823	945	237	1,182	8,008	3,724	3,000	723	7,447	2,759			2,759
Santo Niño	Urban	2,957	503	1,633	377	2,513	490	85	206	4,427	111	3,770	336	4,117	1,877			1,877
	Rural	3,548	6	2,256	399	2,661	171	171	1,388	12,435	3,735	6,770	1,059	15,264	2,759	1,877		4,636
Surallah	Urban	6,505	509	3,889	776	5,174	490	254	744	10,333	2,188	6,546	776	9,610	1,679	2,757		4,436
	Rural	5,368	913	2,966	684	4,563	883	65	948	7,718	3,589	2,905	684	7,178	2,676			2,676
Tampakan	Urban	9,032	677	5,081	1,016	6,774	665	601	1,266	12,808	1,787	9,108	1,016	11,911	1,110	4,027		5,137
	Rural	14,400	1,590	8,047	1,700	11,337	1,548	666	2,214	20,526	5,376	12,013	1,700	19,089	3,786	4,027		7,813
Tantangan	Urban	2,003	341	1,107	255	1,703	338	70	408	3,246	1,510	255	3,019	1,169	147			1,316
	Rural	4,132	15	2,619	465	3,099	1,181	118	1,181	6,290	15	5,370	465	5,850	2,751			2,751
T'Boiti	Urban	6,135	356	3,726	720	4,802	338	251	1,589	9,556	1,525	6,624	720	8,869	1,169	2,898		4,067
	Rural	1,990	338	1,100	254	1,692	326	114	506	2,810	1,307	1,052	254	2,613	969			969
Tupi	Urban	4,653	7	2,959	524	3,490	1,205	1,205	6,849	7	5,839	524	6,370	2,880				2,880
	Rural	6,643	345	4,059	778	5,182	326	1,271	1,711	9,659	1,314	6,891	778	8,983	969	2,880		3,849
Provincial Total	Urban	4,951	842	2,735	631	4,208	839	2,251	3,090	7,000	3,255	2,624	631	6,510	2,413			2,413
	Rural	18,642	1,398	10,487	2,097	13,982	1,389	9,002	10,391	26,412	2,165	20,301	2,097	24,563	767	9,814		10,581
Total	Urban	23,593	2,240	13,322	2,728	18,190	2,228	1,125	13,481	33,412	5,420	23,925	2,728	31,073	3,180	9,814		12,994
	Rural	2,128	362	1,176	271	1,809	298	123	423	3,114	1,448	1,177	271	2,896	1,086	1		1,087
Total	Urban	7,690	577	4,326	865	5,768	549	1,260	1,809	11,772	1,642	8,441	865	10,948	1,065	4,115		5,180
	Rural	9,818	939	5,502	1,136	7,577	847	1,383	2,232	14,886	3,090	9,618	1,136	13,844	2,151	4,116		6,267
Provincial Total	Urban	55,589	8,999	31,205	7,093	47,297	8,500	3,622	13,790	80,668	37,514	30,415	7,093	75,022	28,515	641		29,156
	Rural	97,788	4,350	57,993	11,000	73,343	4,193	24,040	28,833	144,596	10,310	113,163	11,000	134,473	5,960	55,170		61,130
Total	Urban	153,377	13,349	89,198	18,093	120,640	12,693	28,262	42,623	225,264	47,824	143,578	18,093	209,495	34,475	55,811		90,286

The projected number of served students at the end of Phase I period is 142,505. The additional students to be served are 51,914. While at the end of Phase II period, the projected number of served students are 189,748 with an additional students to be served at 47,243.

Table 8.5.3 summarizes the number of public school students to be served by target year.

Table 8.5.3 Add'l. Number of Public School Student to be Served by Target Year (School Toilets)

Name of Municipality	Phase I Coverage (2003)			Phase II Coverage (2010)		
	Total No. of Public School Student	Std. No. of Public School Student to be Served	Add'l. No. of Public School Student to be Served	Total No. of Public School Student	Std. No. of Public School Students to be Served	Add'l. No. of Public School Student to be Served
Banga	16,142	12,914	1,354	19,310	17,379	4,465
Koronadal	28,337	22,670	1,510	33,014	29,713	7,043
Lake Sebu	15,511	12,409	12,009	19,935	17,942	5,533
Norala	11,411	9,129	2,929	12,460	11,214	2,085
Polomolok	25,210	20,168	5,088	30,880	27,792	7,624
Santo Niño	9,189	7,351		10,485	9,437	2,086
Surallah	18,805	15,044	6,564	21,247	19,122	4,078
Tampakan	8,857	7,086	2,566	10,553	9,498	2,412
Tantangan	7,679	6,143	783	8,864	7,978	1,835
T'Boli	23,605	18,884	14,884	28,382	25,544	6,660
Tupi	13,384	10,707	4,227	15,699	14,129	3,422
Provincial Total	178,130	142,505	51,914	210,829	189,748	47,243

(3) Public toilets

The service coverage of public utilities with sanitary toilet facility by municipality is estimated for the years 2003 and 2010.

The future service coverage and additional coverage are estimated using the existing number of public utilities with sanitary toilets in the base year, the number of public utilities in target years, and provincial sector targets.

The additional number of public utilities with sanitary toilets needed by municipality is the shortfall of the number of public utilities in target year comparing with either the existing coverage or Phase I coverage (details are referred to Supporting Report).

The existing sanitary facilities are to be utilized during Phase I period. The facilities in Phase I are to be utilized during Phase II period.

The number of served public utilities at the end of Phase I period is 47. The additional public utilities to be served are 9. While at the end of Phase II period, the number of

served public utilities are 61 with an additional public utilities to be served at 14. Table 8.5.4 summarizes the additional number of public utilities to be served by municipality by target year.

Table 8.5.4 Additional Number of Public Utilities with Sanitary Toilets by Target Year

Name of Municipality	Type	Phase I Coverage (2003)		Phase II Coverage (2010)	
		Add'l. No. of Public Utility with Sanitary Toilets	No. of Public Utility with Sanitary Toilets	Add'l. No. of Public Utility with Sanitary Toilets	No. of Public Utilities with Sanitary Toilets
Banga	Public Market		1		1
	Bus/Jeepney Terminal		1		1
	Parks/Playground		2		2
	Total		4		4
Koronadal (Capital)	Public Market		4	1	5
	Bus/Jeepney Terminal		2	1	3
	Parks/Playground		4	1	5
	Total		10	3	13
Lake Sebu	Public Market	1	1	1	2
	Bus/Jeepney Terminal	1	1	1	2
	Parks/Playground			1	1
	Total	2	2	3	5
Noralala	Public Market		1		1
	Bus/Jeepney Terminal		1		1
	Parks/Playground	1	1		1
	Total	2	3		3
Polomotok	Public Market	1	2	1	3
	Bus/Jeepney Terminal	1	2	1	3
	Parks/Playground		4	1	5
	Total	2	8	3	11
Santo Niño	Public Market		1		1
	Bus/Jeepney Terminal		1		1
	Parks/Playground		1		1
	Total		3		3
Surallah	Public Market		2		2
	Bus/Jeepney Terminal		1	1	2
	Parks/Playground		2		2
	Total		5	1	6
Tampakan	Public Market		1		1
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground		1		1
	Total	1	3		3
Tantangan	Public Market		1		1
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground			1	1
	Total	1	2	1	3
T'boli	Public Market		1	1	2
	Bus/Jeepney Terminal	1	1		1
	Parks/Playground			1	1
	Total	1	2	2	4
Tupi	Public Market		2		2
	Bus/Jeepney Terminal	1	1	1	2
	Parks/Playground		2		2
	Total	1	5	1	6
Provincial Total	Public Market	2	17	4	21
	Bus/Jeepney Terminal	6	13	5	18
	Parks/Playground	1	17	5	22
	Total	9	47	14	61

8.5.3 Urban Sewerage

The service coverage in 2010 (Phase II) is estimated for the municipalities with population of more than 10,000 in urban area provided by Level III water supply. It is assumed that half of the population in the area/s is to be served by the sewerage systems. Table 8.5.5 shows the population to be served in Phase II.

Table 8.5.5 Population to be Served by Urban Sewerage in Phase II

Name of Municipality	Urban Population in 2010	Level III Water Supply Coverage	Population to be Served
Koronadal (Capital)	79,875	75,881	39,938
Norala	32,032	30,430	16,016
Polomolok	66,117	62,811	33,059
Surallah	30,872	29,328	15,436
T'Boli	28,001	26,601	14,001
Provincial Total	236,897	225,051	118,450

8.5.4 Solid Waste

Future requirements in the sub-sector are studied giving priority to urban area for the Phase I. Staged improvement for the rural area shall be studied in the future.

Service coverage in Phase I was assumed at 90% with reference to the present service coverage of 21% in urban area. Additional service coverage in Phase I is calculated as a shortfall of target coverage in Phase I comparing with current service coverage. Table 8.5.6 presents the additional service coverage for Phase I in the urban area.

Table 8.5.6 Additional Number of Urban HHs to be Served by Municipal Solid Waste System in Phase I

Name of Municipality	No. of Urban Households Served in the Base Year	Phase I Coverage (2003)		
		No. of Urban Households	Urban Households Coverage	Add'l. No. of Urban Households to be Served
Banga	712	2,596	2,337	1,625
Koronadal (Capital)	5,338	13,432	12,089	6,751
Lake Sebu		1,679	1,512	1,512
Norala	849	5,142	4,628	3,779
Polomolok	1,936	10,288	9,260	7,324
Santo Niño	365	2,826	2,544	2,179
Surallah	630	4,760	4,284	3,654
Tampakan	126	1,833	1,650	1,524
Tantangan		1,757	1,582	1,582
T'Boli		2,757	2,482	2,482
Tupi	150	2,007	1,807	1,657
Provincial Total	10,106	49,077	44,175	34,069

8.6 Facilities, Equipment and Rehabilitation to Meet the Target Services

8.6.1 Water Supply

(1) Required facilities

Water supply facilities required by service level were estimated by urban and rural area by municipality based on the additional service coverage by target year and summarized in Table 8.6.1 (details are referred to Supporting Report).

Urban water supply:

Physical requirements of Level III systems were estimated as the number of required house connections. Mode of project indicates whether future urban water supply will be implemented as expansion of existing system or construction of a new system. The number of water sources was also estimated based on the water source evaluation results in Chapter 7.

Rural water supply:

Physical requirements of Level II systems were estimated as the number of systems and number of communal faucets, while that of Level I facilities were first estimated as the number of wells with classification of deep and shallow wells. Deep wells were further subdivided in terms of three different standard depths based on the water source evaluation results.

Furthermore, as for Level I facilities, in this PW4SP, 30% of the total required facilities will be implemented by public (LGUs) and 10% of these public Level I facilities will be allocated to spring development.

(2) Rehabilitation

Rehabilitation requirements were estimated as 10% of the total number of deep wells to be constructed under PW4SP. Rehabilitation work will be mainly redevelopment of wells by means of air surging, while minor repair of concrete apron and hand pump will be undertaken by respective beneficiary organizations.

(3) Equipment

Logistic support:

For rural water supply development, 1 unit each or set of the following equipment was considered necessary for the provincial government to conduct various activities of PW4SP implementation;

Table 8.6.1 Water Supply Facilities Required by Target Year

Name of Municipality	Phase I (2003) Requirements											Phase I (2010) Requirements						
	Urban Water Supply (Level III)					Rural Water Supply						Urban WS (Level III)			Rural Water Supply			
	Mode of Project	No. of Add'l Deep Wells	No. of HHs Connection	Level II		Level I			No. of Add'l Deep Wells	No. of HHs Connection	Level I							
				No. of System	No. of Communal Faucets	Number of Deep Wells		No. of Shallow Wells			Number of Deep Wells		Number of Deep Wells		No. of Shallow Wells			
		40 m		80 m		120 m		Sub-total		40 m		80 m		120 m		Sub-total		
Banga	N/A			5	100	48			48					479			479	
Koronadal (Capital)	Expansion	1	1,178											441			441	
Lake Sebu	New	1	1,079	19	340		26		26	38	64	2	2,067		234		2,301	
Norala	N/A												4,831	102		102		
Polomolok	N/A							23	23	2	25	5	8,455	424		424		
Santo Niño	New	1	349			2			2		2	3	3,998	169		169		
Surallah	Expansion	1	452									4	6,148	320		320		
Tampakan	New	1	391	4								2	2,552	49		49		
Tantangan	New	1	333			14			14		14	2	2,235	180		180		
T'boli	Expansion	2	2,249	5	100	294		294	294	195	489	2	3,817	437		437		
Tupi	Expansion	1	275			20			20	5	25	2	2,177	274		274		
Provincial Total	Exp. - 4	9	6,306	33	540	378	49	427	427	240	667	36	56,907	2,451	658	3,109	953	4,062
	New - 4																	

Transportation- service vehicle
Office equipment- computer with printer, typewriter, mimeo machine, scanning machine and copier
Field equipment- sound system, tape recorder and tools for maintenance

For urban water supply, no hardware was considered.

Well drilling and rehabilitation equipment:

As a reference information, necessary types and number of well drilling and rehabilitation equipment were studied considering the existing equipment of sector agencies in the province.

During Phase I, a total of 118 Level I deep wells shall be newly constructed by public (LGUs) and 10% of these deep wells shall be rehabilitated annually. Although there are huge requirements, only 1 unit each of percussion (8") and rotary (6") type drilling rig are operational at DPWH-DEO in the province.

Therefore, 1 set of drilling rig (medium size percussion type) together with 1 set of well rehabilitation equipment, 1 unit of support vehicle for well rehabilitation and 1 unit of service truck for deep well construction shall be mobilized/procured either by the private sector or LGUs (details are referred to Supporting Report).

Selection of well drilling machine

An appropriate type of well drilling machine with its specifications shall be selected after comprehensive study on the technical requirements, local capability in O&M of the machine and cost effectiveness.

From the technical viewpoint, geological conditions in the province allow for the use of either rotary or percussion type drilling machine (no rock drilling is expected). While, in view of economical and O&M experience on the machine in the local area, a percussion type is recommendable. Although, the rotary type machine is quite effective to reduce construction period under soft soil condition, special training on mud-circulation, handling manner, etc. are required together with additional equipment and materials as compared with percussion type. The drilling speed of the percussion type is rather slow, but has advantages in drilling boulder and cobble formations.

One (1) unit of truck mounted percussion drilling machine was considered to be procured in the long-term development period.

(4) Laboratory

Instrument/Equipment and Other Laboratory Accessory:

The provincial government will need at least 3 sets of instrument/equipment in order to ensure regular water quality monitoring and surveillance activities for the entire province. The distribution would be in 3 strategic municipalities where provincial/municipal hospitals are located. These are at the provincial hospital in Koronadal, and at the municipal hospitals of Polomolok and Sto. Nino.

The laboratory equipment requirement for the provincial hospital is designed to upgrade the existing facilities so as to cover efficiently the municipalities of Tampakan, Tantonagan and Banga. The 2 new laboratories will cover the remaining municipalities. The following are the requirements:

Item	Unit	Provincial Laboratory	Supplemental Laboratory	
		Upgrading of PHO Laboratory	Polomolok	Sto. Nino
1. Instrument/Equipment				
Turbidity meter	set	1	1	1
Color meter	set	1	1	1
pH/Residual chlorine checker	set	1	1	1
Incubator	set	0	1	1
Refrigerator	set	0	1	1
Sterilizer	set	1	1	1
Portable water quality testing kit	set	1	1	1
Electric stove	set	0	1	1
Range hood	set	1	1	1
2. Glassware/Chemical	set	1	1	1
3. Accessory				
Sink	set	0	1	1
Working table	set	0	1	1
Shelf	set	0	1	1
Office desk	set	0	1	1
Chair	set	0	1	1
File cabinet	set	1	1	1

Note: 0 = existing

1 = required number

8.6.2 Sanitation

This sub-section refers to physical requirements by target year covering household, school and public toilet facilities. Table 8.6.2 presents the required sanitation facilities by target year. Rehabilitation for the sanitation facilities is considered as part of recurrent cost.

(1) Household toilets

Future requirements in the number of household toilets by different type for urban and rural areas were estimated based on the additional households to be served by type of facility both for urban and rural areas by target year (details are referred to Supporting Report).

(2) School toilets

The future requirements in the number of toilet facilities were estimated based on the standard number of students to be served by a 5-unit standard facility and the additional students to be served by target year (details are referred to Supporting Report).

Total required facilities were further broken down into urban and rural areas by applying the percentage share of urban and rural population.

(3) Public toilets

Future requirements in the number of toilet facilities were estimated based on the additional number of toilets for public markets and bus/jeepney terminals located in urban areas (details are referred to Supporting Report).

8.6.3 Urban Sewerage and Solid Waste

Physical requirements for the sewerage facilities are not discussed in this sub-section. Further study shall be conducted in the future.

As reference information, the number of refuse collection trucks is estimated for the urban area in Phase I. Eleven (11) additional units of truck are required to meet assumed service coverage as reflected in Table 8.6.3.

Table 8.6.2 Sanitation Facilities Required by Target Year

Name of Municipality	Phase I (2003) Requirements															Phase II (2010) Requirements														
	Urban Sanitation							Rural Sanitation								Urban Sanitation							Rural Sanitation							
	No. of Households				No. of Public Toilets			No. of Households				No. of Public Toilets				No. of Households				No. of Public Toilets				No. of Households						
	Pour Flush	VIP/ Dry	Total	No. of Public Sch. Toilets	Public Market	Bus/ Jeepney Terminal	Parks/ Playground	Flush	Pour Flush	VIP/ Dry	Total	No. of Public Sch. Toilets	Public Market	Bus/ Jeepney Terminal	Parks/ Playground	Flush	Pour Flush	VIP/ Dry	Total	No. of Public Sch. Toilets	Public Market	Bus/ Jeepney Terminal	Parks/ Playground	Flush	Pour Flush	VIP/ Dry	Total	No. of Public Sch. Toilets		
Banga		193	193	1				2,136	767	2,903	6				1,824	1,824	1,824	1,824	4						7,135	7,135	7,135	71		
Koronadal (Capital)	2,196	1,257	3,453	4			897	767	1,664	4					6,843	6,843	6,843	6,843	19	1	1	1	1,597	6,021	7,618	70				
Lake Sebu	407	727	1,134	9	1	1		7,367	7,367	51	51				1,261	35	1,296	1,296	4	1	1	1		8,365	8,365	76				
Norala	945	237	1,182	9	1	1		206	206	5	5				2,759	2,759	2,759	2,759	7					1,877	1,877	20				
Pobomolok	1,778	102	1,880	13	1	1		693	744	1,437	12				5,836	286	6,122	6,122	20	1	1	1	1,421	5,600	7,021	67				
Santo Niño	490	83	573					171	171	171					1,679	172	1,851	1,851	5					2,585	2,585	26				
Surallah	883	65	948	12				665	601	1,266	20				2,676		2,676	2,676	8			1	1,110	4,027	5,137	60				
Tampakan	338	70	408	4		1		1,181	1,181	8	8				1,169	147	1,316	1,316	4					2,751	2,751	31				
Tamtungan	326	66	392					1,205	1,205	3	3				969		969	969	3			1		2,880	2,880	28				
T'boli	839	2,251	3,090	16				1,389	9,002	10,391	59				2,413		2,413	2,413	7	1	1	1	767	9,814	10,581	101				
Tupi	298	123	421	4		1		549	1,260	1,809	17				1,086	1	1,087	1,087	4					1,065	4,115	5,180	56			
Provincial Total	8,500	3,622	12,122	72	3	6	1	41,933	24,640	66,573	185				28,515	641	29,156	29,156	85	4	5	5	5,960	55,170	61,130	606				

Table 8.6.3 Number of Refuse Collection Trucks Required in Phase I

Name of Municipality	Additional Urban Households to be Served	Estimated Daily Amount of Refuse to beGenerated, (Kg)	Number of Collection Truck Required
Banga	1,625	680	1
Koronadal (Capital)	6,751	2,822	1
Lake Sebu	1,512	633	1
Norala	3,779	1,580	1
Polomolok	7,324	3,062	1
Santo Niño	2,179	911	1
Surallah	3,654	1,528	1
Tampakan	1,524	638	1
Tantangan	1,582	662	1
T'Boli	2,482	1,038	1
Tupi	1,657	693	1
Provincial Total	34,069	14,247	11

8.7 Identification of Priority Projects for Medium-Term Development Plan

In general, the present service coverage by municipality with reference to the target coverage indicates the direction of development effort for implementing PW4SP with municipal priorities.

Specific projects shall be selected subject to detailed studies and will not be discussed in the provincial master plan. In addition, pertinent information to identify priority projects is not available both at provincial and municipal level during this PW4SP preparation, except some future expansion work for WDs.

The general criteria for identifying priority projects as guide for implementing the PW4SP are summarized below.

The first level of priority should be given to projects with positive feasibility studies and identified funding. Next level of priority should be given to projects with positive feasibility studies, although no funding source has been identified. The third level should be for which feasibility study has been conducted. Within each level, if funds were insufficient, a ranking could be carried out applying some factors, such as willingness to pay, water-related diseases status and per capita cost. Under the above-mentioned conditions, the implementors should prepare a list of projects.

Due attention shall be paid on the importance of integrated development of relevant sub-sectors to maximize the effects and benefits through simultaneous implementation of water supply and sanitation projects. On a municipal level priority, synthetic evaluation of sector components for concerned municipalities (which is studied in the financial arrangements, Chapter 11) may be used for implementation arrangements.