Republic of the Philippines
Department of Transportation and Communication

Republic of the Philippines
Preparatory Survey
for
New Bohol Airport Construction and
Sustainable Environment Protection Project

Final Report
Volume 2: Tourism, Water Supply, Sewerage and Individual Sewage Treatment

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Japan International Cooperation Agency (JICA)

Japan Airport Consultants, Inc. (JAC)
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Joint Venture


CEBU
CEBU CITY
MACTAN
BOHOL
PHILIPPINES MAP
BOHOL
Rajah Sikatuna National Park
Existing Airport
TAGBILARAN
PANGLAO
DAUIS
PANGLAO
PANGLAO
Proposed New Bohol Airport
PANGLAO MAP
BOHOL SEA

Table of Contents

Table of Contents

Chapter1. Current Status and Development Plan

Chapter2. Tourism Development

List of Illustrations

Chapter1. Current Status and Development Plan

Chapter2. Tourism Development

Chapter3. Water Supply Facilities at New Bohol Airport

Chapter4. Sewerage Development

Chapter5. Studies for Individual Sewage Treatment Facilities

List of Tabulations

Chapter1. Current Status and Development Plan

Chapter2. Tourism Development

Chapter3. Water Supply Facilities at New Bohol Airport

Chapter4. Sewerage Development

Chapter5. Studies for Individual Sewage Treatment Facilities

List of Abbreviations

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A

AAZ	**Aerodrome Advisory Zones**
AAGR	**Average Annual Growth Rate**
ABC	**A: Common Combustibles, B: Flammable Liquids & Gas, C: Live Electrical Equipment**
ACC	**Area Control Center**
ACB	**Ancillary Building**
ADB	**Asian Development Bank**
ADRM	**Airport Development Reference Manual**
AFP	**Armed Force of the Philippines**
AFTN	**Aeronautical Fixed Telecommunication Network**
A/G	**Air to Ground**
AGL	**Aeronautical Ground Light**
AHU	**Air-Handling Units**
AIS	**Aeronautical Information Service**
AIP	**Aeronautical Information Publication**
AMDS	**Airport Development Reference Manual**
AMHS	**ATS Message Handling System**
ANS	**Air Navigation Service**
APEC	**Asia-Pacific Economic Cooperation**
ATC	**Air Traffic Control**
ATZs	**Aerodrome Traffic Zones**
ATM	**Air Traffic Management**
ATS	**Air Traffic Service**
AUSAID	**Australian Agency for International Development**
AWOS	**Automated Weather Observing System**

B

BANGON	**Bohol Alliance of NGOs**
BBP	**Bohol Business Park**
BH	**Borehole**
BHS	**Baggage Handling System**
BIMP-EAGA	**Brunei, Indonesia, Malaysia and the Philippines – East ASEAN Growth Area**
BIR	**Bureau of Internal Revenue**
BMS	**Building Management System**
BMT	**BOHOL Marine Triangle**
BOHECO	**BOHOL Electric Cooperative Inc.**
BOD	**Biochemical Oxygen Demand**
BOI	**Board of Investment**
BOO	**Built – Own – and – Operate**
BOT	**Built – Operate – and – Transfer**
BSP	**Bangko Sentral ng Pilipinas**
BTO	**Built – Transfer – and – Operate**
BTO	**Bohol Tourism Office**
BWUI	**Bohol Water Utilities, Inc**

C

CAAP	**Civil Aviation Authority of Philippines**
CAO	**Contract- Add-and- Operate**
CAT	**Category**
CBR	**California Bearing Ratio**
CCO	**Command and Control Office**
CCPAP	**Coordinating Council of the Philippine Assistance Program**
CCR	**Constant Current Regulator**
CCTV	**Closed Circuit Television**

CFF	**Coral Reefs, Fisheries and Food Security**
CHB	**Concrete Hollow Block**
CI	**Conservation International**
CID	**Citizens Intelligence Division**
CIP	**Commercial Important Person**
CIQ	**Custom, Immigration, Quarantine**
CLUP	**Comprehensive land use plan**
CNC	**Certificate of Non-Coverage**
CNS	**Communication, Navigation, Surveillance**
COD	**Chemical Oxygen Demand**
CT	**Coral Triangle**
CTB	**Cargo Terminal Building**
CTI	**Coral Triangle Initiative**
CTRs	**Control Zones**
CWA	**Clean Water Act**

D

DAO	**DENR Administrative Order**
DBP	**Development Bank of the Philippines**
D/E	**Debt/Equity**
DENR	**Department of Environment and Natural Resources**
DFA	**Department of Foreign Affaires**
DGS	**Direct Government Subsidy**
DH	**Decision Height**
DME	**Distance Measuring Equipment**
DOF	**Department of Finance**
DOT	**Department of Tourism**
DOLE	**Department of Labor and Employment**
DOTC	**Department of Transportation and Communication**

DPWH	**Department of Public Works and Highways**
DSCR	**Debt Service Coverage Ratio**
DSRA	**Debt Service Reserve Account**
DTI	**Department of Trade and Industry**
DVOR	**Doppler Type VHF Omni-directional Radio Range**

E

ECC	**Environmental Clearance Certification**
EIA	**Environmental Impact Assessment**
EIAMD	**Environmental Impact Assessment Management Division**
EIRR	**Economic Internal Rate of Return**
EIS	**Environmental Impact Statement**
EMB	**Environmental Management Bureau**
EPS	**Electrical Pipe Shaft**
ESWM	**Ecological Solid Waste Management**

F

FAA	**Federal Aviation Administration**
FAARFIELD	**FAA Rigid and Flexible Iterative Elastic Layered Design**
FADS	**Fire Alarm Detection System**
FARMCs	**Fisheries and Aquatic Resources Management Councils**
FCU	**Fan Coil Unit**
F/D	**Flight Data**
FIC	**Facility In Charge**
FIDS	**Flight Information Display System**
FIR	**Flight Information Region**
FIRR	**Financial Internal Rate of Return**
FOBS	**Flight Observation**
FPE	**Foundation for Philippine Environment**
FS	**Feasibility Study**

FSS	**Flight Service Station**

G

GCR	**Greater Capital Region**
GDP	**Gross Domestic Product**
GFS	**Government Financial Statistics**
GIS	**Geographic Information System**
GOCC	**Government-Owned and Controlled Corporations**
GOJ	**Government of Japan**
GOP	**Government of the Philippines**
GS	**Glide Slope**
GPR	**Ground Penetrating Radar**
GRDP	**Gross Regional Domestic Product**
GRP	**Government of the Republic of the Philippines**
GTZ	**German Agency for Technical Cooperation**
GWL	**Ground Water Level**

H

HF	**High Frequency**

I

IAS	**Indicated Air Speed**
IATA	**International Air Transportation Association**
ICAO	**International Civil Aviation Organization**
ICB	**International Competitive Bidding**
ICC	**Investment Coordination Committee**
IEEC	**Initial Environmental Examination Checklist**
IEER	**Initial Environmental Examination Report**
IFR	**Instrument Flight Rule**
ILS	**Instrument Landing System**
IRR	**Implementing Rules and Regulations**

ITB	**Invitation to Bid**
IUCN	**International Union for Conservation of Nature**

<u>J</u>

JCAB	**Japan Civil Aviation Bureau**
JICA	**Japan International Cooperation Agency**

<u>L</u>

LAN	**Local Area Network**
LCC	**Low Cost Carriers**
LED	**Light Emitting Diode**
LGUs	**Local Government Units**
LLCR	**Loan Life Coverage Ratio**
LLZ	**Localizer**
LPDA	**Log Periodic Dipole Array**
LPG	**Liquefied Petroleum Gas**
LV	**Low Voltage**
LWUA	**Local Water Utilities Administration**

<u>M</u>

MC	**Management Contract**
MCIAA	**MACTAN-CEBU International Airport Authority**
MDA	**Minimum Descent Altitude**
MET	**Meteorological Equipment**
METAR	**Regular airport Weather Report**
MIAA	**Manila International Airport Authority**
MPDO	**Municipal Planning and Development Office**
MSL	**Mean Sea Level**
MWS	**Municipal Waterworks System**
MWSI	**Maynilad Water Service Inc.**

N

NAAQS	**National Ambient Air Quality Standards**
NAIA	**Ninoy Aquino International Airport**
NAPOCOR	**National Power Corporation**
NAVAID(s)	**Navigation Aid (s)**
NAWASA	**National Waterworks and Sewerage Authority**
NBSAP	**National Biodiversity Strategy and Action Plan**
NCCC	**National CTI Coordination Committee**
NCR	**National Capital Region**
NDB	**Non-Directional Beacon**
NEDA	**National Economic Development Authority**
NFPA	**National Fire Protection Association**
NGO	**Non-Governmental Organization**
NIPAS	**National Integrated Protected Area System**
NOTAM	**Notice to Airmen**
NPV	**Net Present Value**
NSCB	**National Statistical Coordination Board**
NSO	**National Statistics Office**
NSWMC	**National Solid Waste Management Commission**
NWRB	**National Water Resources Board**

O

ODA	**Official Development Assistance**
OJT	**On-the-job training**
OLS	**Obstacle Limitation Surface**
O/M	**Operation and Maintenance**

P

PAL	**Philippine Airlines**
PABX	**Private Automatic Branch Exchange**
PACAP	**Philippines Australia Community Assistance Program**
PALS	**Precision Approach Lighting System**
PANS	**Procedures for Air Navigation Services**
PANS/OPS	**PANS-Aircraft Operations**
PAPI	**Precision Approach Path Indicator**
PAU	**Primary Air-Handling Units**
PAWB	**Protected Area and Wildlife Bureau**
PBB	**Passenger Boarding Bridge**
PBN	**Performance Based Navigation**
PC	**Personnel Computer**
PCCP	**Portland Cement Concrete Pavement**
PCGRDP	**GRDP Per Capita**
PD	**Presidential Decree**
PDPFP	**Provincial Development and Physical Framework Plan**
PEIS	**Programmatic EIS**
PHILVOLCS	**Philippine Institute of Volcanology and Seismology**
PHO	**Provincial Health Office**
PIRR	**Project Internal Rate of Return**
PLC	**Programming Logic Controller**
PMO	**Project Management Office**
PNP	**Philippine National Police**
PNSDW	**Philippine National Standard for Drinking Water**
PPA	**Philippine Port Authority**
PPDO	**Provincial Planning and Development Office**
PPP	**Public Private Partnership**

PSC	**Public Sector Comparator**
PSFC	**Passenger Service Facility Charge**
PTA	**Philippines Tourism Authority**
PTB	**Passenger Terminal Building**
PTWG	**Provincial Technical Working Group**
PWS	**Provincial Waterworks System**

Q

QNH	**Altimeter sub-scale setting to obtain elevation when on the ground**
QFE	**Atmospheric pressure at aerodrome elevation**

R

RAP	**Resettlement Action Plan**
REDCOM	**Review and Development Committee**
REDL	**Runway Edge Light**
RENL	**Runway End Light**
RESA	**Runway End Safety Area**
RNAV	**Area Navigation**
ROO	**Rehabilitate – Own – and – Operate**
ROT	**Rehabilitate – Operate – and – Transfer**
ROW	**Right Of Way**
RPOA	**Regional Plan Of Action**
RTHL	**Runway Threshold Light**
RVR	**Runway Visual Range**
R/W	**Runway**
RWDC	**Rural Waterworks Development Corporation**
RX	**Receiver**

S

SARS	**Severe Acute Respiratory Syndrome**
SALS	**Simplified Approach Lighting System**

SEC	**Securities & Exchange Commission**
SPC	**Special Purpose Company**
SPECI	**Special Weather Report**
SPV	**Special Purpose Vehicle**
SSB	**Single Sideband**
SSS	**Social Security Service**
STAR	**Standard Terminal Approach Route**
STEP	**Special Terms for Economic Partnership**
STP	**Sewage Treatment Plant**

T

TB	**Treasury Bond**
T-DME	**Terminal DME**
TEDL	**Taxiway Edge Light**
TIEZA	**Tourism Infrastructure and Enterprise Zone Authority**
TMA	**Terminal Control Area**
TNC	**The Nature Conservancy**
TOC	**Toll Operation Certificate**
TRB	**Toll Regulatory Board**
TRCV	**Transceiver**
T/W	**Taxiway**
TWS	**Tagbilaran Waterworks System**
TX	**Transmitter**
TXGL	**Taxiway Guidance Sign**

U

UPS	**Uninterruptible Power Supply**
USAID	**U.S. Agency for International Development**
USEPA	**United States Environmental Protection Agency**
UTC	**Universal Time Coordinated**

V

VAT	**Value Added Tax**
VCCS	**Voice Communication Control System**
VFM	**Value For Money**
VFR	**Visual Flight Rules**
VHF	**Very High Frequency Range**
VIP	**Very Important Person**
VOR	**VHF Omni-directional Radio Range**
VRS	**Voice Recording System**
VSAT	**Very Small Aperture Terminal**

W

WB	**World Bank**
WBRL	**Wing Bar Light**
WC	**Working Capital**
WD	**Wind Direction**
WDPS	**Weather Data Processing System**
WDIL	**Wing Direction Indicator Light**
WECPNL	**Weighted Equivalent Continuous Perceived Noise Level**
WGS84	**World Geodetic System-84**
WHO	**World Health Organization**
WMO	**World Meteorological Organization**
WS	**Wind Speed**
WQMA	**Water Quality Management Areas**
WQMS	**Water Quality Management Section**
WRS	**Water Refill Station**
WWF	**World Wild Fund**
WWTP	**Wastewater Treatment Plant**

Chapter 1

Current Status and Development Plan

Table of Contents

Chapter 1. Current Status and Development Plan

1.1. Location

Bohol is one of the island provinces of the Philippines and is the 10th largest island of the archipelago. Bohol province forms part of Region IV of the Central Visayas Region, which consists of four (4) provinces. The area of Bohol province is 4,117sqkm.

There are 47 municipalities in Bohol. Tagbilaran City is the provincial capital and a primary gateway to Bohol. Tagbilaran City is 630 km away from Manila and 72 km away from Cebu. There is a small island, named Panglao, on the opposite shore of Tagbilaran City. Panglao island is the major tourist destination of Bohol and consists of two (2) municipalities, namely Dauis and Panglao.

The following figures show the location of Bohol.

Source: Wikipedia

Figure 1.1-1 Location of Bohol

Figure 1.1-2 shows the location of Tagbilaran City, Dauis and Panglao Municipalities, which are the target areas of the sewerage sector. Administration areas of these local governments are as follows:

Tagbilaran City	32.70 km^2
Dauis Municipality	44.57 km^2
Panglao Municipality	50.49 km^2

Source: Wikipedia

Figure 1.1-2 Location of Sewerage Survey Area

1.2. Natural Conditions

1.2.1. Climate and Rainfall

1) Climate

The climate type of the Bohol Province is classified as Type IV, characterized by rainfall more or less evenly distributed throughout the year. Intensification of the southeastern monsoon usually occurs from July to October. The 1971-2000 climatological records show a mean temperature of 27.7 degrees centigrade and a prevailing wind direction towards the northeast with an average speed of 2 miles per hour.

2) Rainfall

Based on 1971-2000 climatological records of the Tagbilaran weather station, the province has an average annual rainfall of 1,360.2 mm. Table 1.2-1 shows monthly rainfall during the last 10 years at the Tagbilaran weather station. The table shows that the rainfall amount for three months from February to April is relatively small and the average annual rainfall amount is 1,550.5 mm.

Table 1.2-1 Monthly Rainfall 2001-2010

Mon	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Monthly Ave 2001-2010
Jan	85.3	52.4	78.5	64.4	26.2	95.7	185.5	264.7	67.1	100.4	102.0
Feb	63.3	85.5	64.6	97.7	1.3	130.7	25.1	202.8	190.1	20.9	88.2
Mar	83.9	79.0	18.0	79.3	78.8	183.6	31.8	236.5	160.8	31.2	98.3
Apr	82.7	95.5	24.9	12.4	60.1	41.5	26.2	107.1	174.6	89.5	71.5
May	77.9	47.3	207.2	185.5	42.9	66.8	124.1	179.2	113.0	47.3	109.1
Jun	193.6	49.0	196.0	148.0	137.5	125.0	244.1	294.0	162.6	148.8	169.9
Jul	152.7	131.7	230.9	116.6	133.1	103.6	141.3	155.3	116.5	164.3	144.6
Aug	117.9	130.9	179.0	109.4	129.5	111.5	50.5	241.0	30.6	137.8	123.8
Sep	62.1	57.6	122.1	109.4	81.3	72.6	154.2	131.1	74.2	206.5	107.1
Oct	187.4	156.5	266.2	102.1	92.5	140.5	214.6	176.2	22.7	305.1	166.4
Nov	447.5	148.4	107.2	111.5	204.7	170.0	161.3	120.9	273.6	140.6	188.6
Dec	182.9	82.3	372.1	72.3	269.6	157.9	170.4	164.3	56.6	282.6	181.1
Total	1,737.2	1,116.1	1,866.7	1,208.6	1,257.5	1,399.4	1,529.1	2,273.1	1,442.4	1,675.0	1,550.5

Source: Philippine Atmospheric, Geophysical Astronomical Administration (PAGASA Tagbilaran)

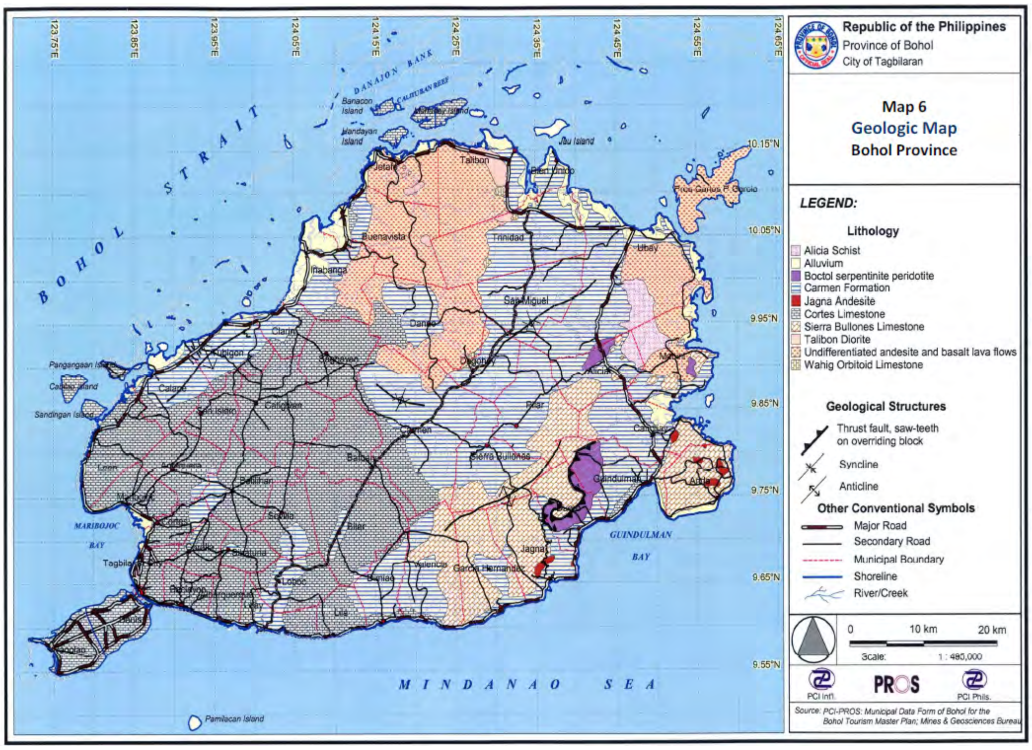
1.2.2. Geography

The island of Bohol is a predominantly sedimentary island developed from the magmatic mechanism of the southwest Philippine Plate. The soil depth is relatively thin ranging from a minimum of 24 cm to maximum of 30 cm. and most of the hills and ridges have meager to no soil cover. Therefore, most of the province’s land has a rapid drainage surface. The seven different geomorphologic land forms of the island province of Bohol are shown in Figure 1.2-1 .

The major part of Tagbilaran City consists of Maribojoc Limestone (98.4% of the city area). Limestone’s permeability is very high and exhibits numerous sinkholes, caves and caverns. The elevation of Tagbilaran City is mostly ranging from 10 to 50 meters above mean sea level.

Pangalo island comprises of flat coastal plains, limestone hills, limestone terraces, and sinkholes. A slightly rolling terrain could also be observed at various locations of the island. Its elevation gradually rises from 5 meters to about 30 meters above mean sea level, except a hilly terrain culminating to about 190 meters that exists in Dauis.

The coastal plains are vegetated with mangroves, coconuts and other natural vegetation. The limestone areas are covered with shrubs and grasses, whilst limestone terraces are generally vegetated with corn and legumes.



Source: PDPFP 2010-2015

Figure 1.2-1 Geologic Map

1.2.3. Water Resource

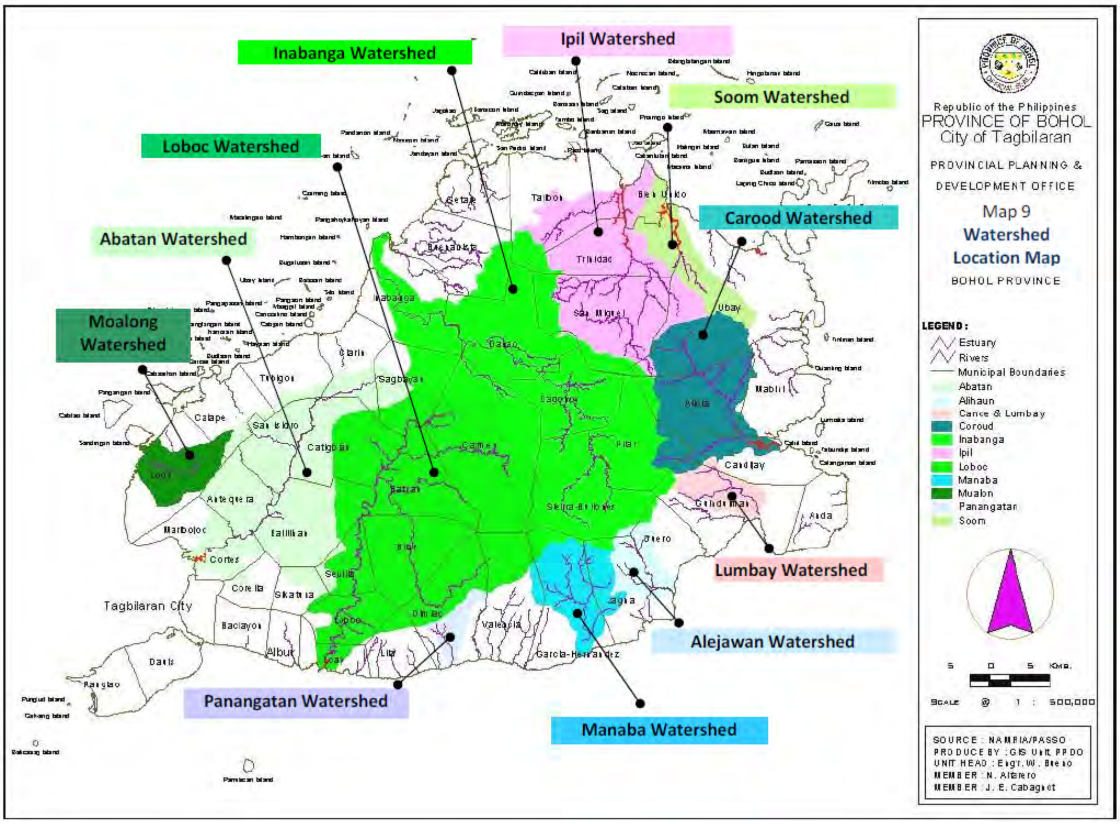
1) <u>River</u>

Bohol's water supply system for domestic, agricultural and industrial uses is mainly based on 2,224 springs, 59 rivers and 200 creeks. There are 22 rivers basins/watersheds that are valuable sources of water for drinking and irrigation1. However, there are no major rivers in Tagbilaran City nor on Panglao Island (Figure 1.2-2).

2) <u>Groundwater</u>

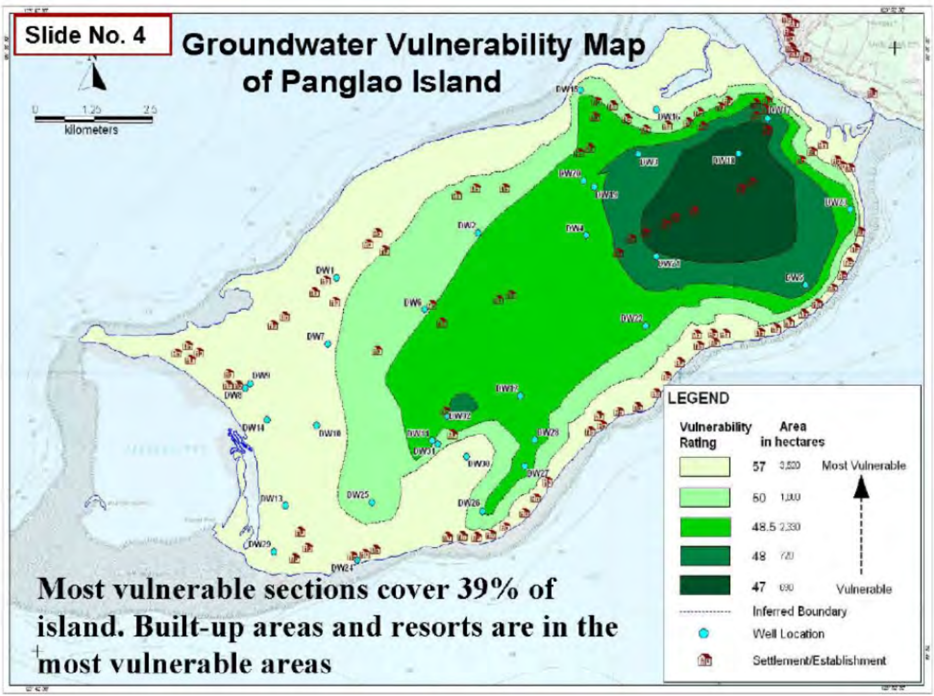
Groundwater resources are the major source of drinking water in Bohol. The survey of wells conducted by SWECO in 1999 revealed that the water for drinking does not satisfy the water quality standards for potability. Water quality problems are due to higher salinity content, excessive amounts of iron and manganese and bacteriological pollution. Water for home consumption is often prone to contamination due to inadequate sanitation practices and characteristics in limestone inherent substrate (karst).

In Panglao Island, the groundwater system is inherently vulnerable to contamination due to the permeable nature of the limestone formation. The most vulnerable sections cover 39% of the island's land area. The built-up areas and the tourist establishments are located in these sections. (refer to Figure 1.2-3)



Source: PDPFP 2010-2015

Figure 1.2-2 Watershed Location map in Bohol



Source: Panglao Island Assessment Report, June 2006

Figure 1.2-3 Status of Groundwater in Panglao Island

1.3. Socio-Economic Conditions

1.3.1. Population

The following table shows population and household by LGUs in Bohol province. Population of Tagbilaran City is dominant at 7.5% of the total population of the province. However, the population share of Dauis and Panglao Municipalities, where are the major tourism destination, are only 3.0% and 2.1%, respectively.

Table 1.3-1 Population and Household by LGUs

Province/City/ Municipality	Total Population	% of Population Share	Number of House-holds	Average House-hold Size
Bohol	1,230,110	100.0	242,307	5.1
Tagbilaran City	92,297	7.5	18,045	5.1
Ubay	65,900	5.4	13,544	4.9
Talibon	59,274	4.8	11,481	5.1
Tubigon	44,434	3.6	8,965	5.0
Inabanga	43,331	3.5	8,755	4.9
Carmen	43,153	3.5	8,562	5.0
Loon	42,441	3.5	8,682	4.9
Dauis	36,525	3.0	6,982	5.2
Guindulman	32,355	2.6	6,598	4.9
Jagna	32,034	2.6	6,637	4.8
Candijay	31,183	2.5	5,951	5.2
Calape	29,786	2.4	6,236	4.8
Mabini	28,788	2.3	5,561	5.2
Valencia	28,043	2.3	5,020	5.6
Jetafe	27,852	2.3	5,230	5.3
Trinidad	27,580	2.2	5,544	5.0
Pilar	27,276	2.2	5,045	5.4
Buenavista	26,443	2.1	4,917	5.4
Sierra Bullones	26,398	2.1	4,874	5.4
Panglao	25,558	2.1	4,734	5.4
Pres. Carlos P. Garcia	25,118	2.0	4,654	5.4
Alicia	23,422	1.9	4,564	5.1
Bien Unido	23,412	1.9	4,454	5.3
Catigbian	23,333	1.9	4,429	5.3
San Miguel	22,199	1.8	4,387	5.1
Garcia Hernandez	21,308	1.7	4,330	4.9
Sagbayan	19,399	1.6	4,232	4.6
Clarin	18,871	1.5	4,004	4.7
Dagohoy	18,311	1.5	3,528	5.2
Maribojoc	18,113	1.5	3,904	4.6
Baclayon	18,015	1.5	3,546	5.1
Danao	17,716	1.4	3,174	5.6

Duero	17,254	1.4	3,502	4.9
Balilihan	17,131	1.4	3,381	5.1
Bilar	17,078	1.4	3,322	5.1
Anda	16,616	1.4	3,286	5.1
Loboc	16,299	1.3	3,031	5.4
Loay	15,881	1.3	3,150	5.0
Cortes	14,586	1.2	2,928	5.0
Antequera	14,357	1.2	3,098	4.6
Dimiao	14,187	1.2	2,894	4.9
Batuan	12,137	1.0	2,494	4.9
Sevilla	11,289	0.9	2,000	5.6
Lila	10,801	0.9	1,934	5.6
Alburquerque	9,644	0.8	1,964	4.9
San Isidro	9,176	0.7	1,954	4.7
Corella	7,471	0.6	1,534	4.9
Sikatuna	6,335	0.5	1,266	5.0

Source: 2007 Census, National Statistics Office

Population, land area and population density of Tabilaran City, Dauis and Panglao Municipalities are shown in Table1.3-2~ Table1.3-4.

Table 1.3-2 Population of Tagbilaran City in 2000 and 2007

Name of Brgy	Population in 2000 (NSO)	Population in 2007 (NSO)	Area (ha)	Population Density In 2007
1. Bool	3,361	4,929	348.8	14.1
2. Booy	6,736	7,896	146.4	53.9
3. Cabawan	798	1,550	267.3	5.8
4. Cogon	16228	17,266	204.4	84.5
5. Dao	5,808	6,772	443.7	15.3
6. Dampas	4,674	7,210	390.0	18.5
7. Manga	4,594	6,081	117.3	51.8
8. Mansasa	4,673	5,396	82.9	65.1
9. Poblacion I	3,203	3,323	25.9	128.3
10. Poblacion II	5,828	5,856	70.2	83.4
11. Poblacion III	6,234	6,511	70.7	92.1
12. San Isidro	3,776	4,500	429.4	10.5
13. Taloto	5,095	6,176	244.5	25.3
14. Tiptip	3,068	3,956	282.1	14.0
15. Ubujan	3,624	4,875	145.6	33.5
Total	77,700	92,297	3.270.2	28.2

Table 1.3-3 Population of Dauis Municipality in 2000 and 2007

Name of Brgy	Population in 2000 (NSO)	Population in 2007 (NSO)	Area (ha)	Population Density
1. Biking	2,615	2,631	544.89	4.8
2. Bingag	1,460	4,294	610.20	7.0
3. Catarman	3,318	4,152	369.00	11.3
4. Dao	891	923	564.25	1.6
5. Mayacabac	2,535	3,236	275.49	11.7
6. San Isidro	956	1,129	390.57	2.9
7. Songculan	3,000	3,422	394.60	8.7
8. Tabalong	2,664	4,027	350.22	11.5
9. Tinago	1,625	2,202	320.30	6.9
10. Totolan	3,626	4,834	238.10	20.3
11. Marivedes	2,033	2,818	304.40	9.3
12. Poblacion	2,297	2,857	95.50	29.9
Total	27,015	36,525	4,457.52	8.2

Table 1.3-4 Population of Panglao Municipality in 2000 and 2007

Name of Brgy	Population in 2000 (NSO)	Population in 2007 (NSO)	Area (ha)	Population Density
1. Bilisan	2,296	2,800	364.37	7.7
2. Danao	2,635	3,296	789.65	4.2
3. Doljo	2,483	2,984	109.88	27.2
4. Looc	1,765	2,135	254.11	8.4
5. Poblacion	3,870	4,608	287.15	16.0
6. Bolod	1,304	1,349	597.99	2.3
7. Libaong	1,161	1,558	423.37	3.7
8. Lourdes	816	1,053	377.39	2.8
9. Tangnan	2,582	3,046	682.87	4.5
10. Tawala	2,425	2,729	891.80	3.1
Protected Area (NIPAS)*			271.87	
Total	21,337	25,558	5,050	

*Mangroves area within the coastline of Barangay Danao, Poblacion and Doljo.

1.3.2. Economy and Industry

1) GRDP

The following shows GRDP growth rate and per capita GRDP of Bohol. The services sector including the tourism sector marks a higher figure than other sectors.

Table 1.3-5 GRDP of Bohol, 2004-2009

Indicator	2004	2005	2006	2007	2008	2009	Average
GRDP Growth Rates (%)	7.2	6.0	4.8	8.6	3.3	0.8	5.1
Agriculture	3.5	1.7	(5.3)	4.5	1.7	1.4	1.2
Industry	5.8	5.4	5.4	6.8	4.5	(2.2)	1.2
Services	8.8	7.2	6.5	10.2	2.9	2.1	6.3
Per Capita GRDP (in Pesos)	13,046	13,544	13,918	14,816	14,997	14,810	14,188
Employment Levels (in ‘000)	2,225	2,423	2,464	2,588	2,697	2,714	495
Agriculture	704	817	833	872	882	835	98
Industry	462	487	472	515	521	451	13
Services	1,059	1,119	1,159	1,201	1,295	1,428	384

Source: Central Visayas Regional Development Plan for 2011-2016

2) Industry

The economy of Bohol predominantly relies on agriculture, service sector (especially tourism) and home-based industries. The following figure shows the number of employed persons. In terms of the number of employed persons, employment in agriculture sector is dominant compared to service sectors in the whole of Bohol, though the employment in the service sector in urban areas is higher than the one in rural areas. This means almost half of the total employment in urban areas are engaged in the service sector.

Table 1.3-6 Employed Persons by Type of Industry from Primary Occupation, April 2003 ('000)

Province/City/Area	Agriculture	Industry	Service	Total
Philippines	11,155	4,859	14,404	30,418
Central Visayas (Region VII)	675	449	916	2,041
Urban	117	232	560	909
Rural	558	218	356	1,132
Bohol	165	89	141	395
(%)	41.8	22.5	35.7	100.0
Urban	30	16	46	91
(%)	33.0	17.6	50.5	100.0
Rural	135	73	96	304
(%)	44.4	24.0	31.6	100.0
Cebu	288	322	601	1,211
Urban	59	203	432	695
Rural	229	118	169	517
Negros Oriental	206	35	163	403
Siquijor	16	3	11	31

Source: NSO

The agriculture sector remains to be a major source of employment and livelihood in the province. The total land devoted for agricultural use is 273,950 hectares, approximately 66% of the total land area of the province. Meanwhile, the tourism industry is growing rapidly especially on Panglao Island.

3) Family income

The average income of a Boholano family is P77,291 (per capita income of P16,478) in the year 2000, based on the latest available provincial disaggregation of the Family Income and Expenditure Survey. This is an increase of 36% from the 1997 level of P56,940.

The average expenditure in 2000 for each Boholano family amounts to P66,907 (per capita expenditure of P14,364), denoting a 32% increase over the 1997 level of P50,754. Which shows that the average income of a Boholano family compared to the average annual expenditures in that same year is almost equal.

1.3.3. Health Status

1) Health Indicator

The health of Boholanos is generally improving along the years as shown by key health indicators.

Table 1.3-7 Key Health Indicators in Bohol

Key Health Indicators	2000	2006	2007	2008
Crude Birth Rate （per 1,000 population）	20.73	18.45	18.17	18.3
Percent Male		52%	52%	53%
Crude Death Rate （per 1,000 population）	4.04	4.34	4.94	4.79
Percent Male	56%	55%	58%	55%
Percent of Newborn with Low Birth Weight(<2500g)	15%	3%	5%	4%
Infant Mortality Rate（per 1,000 live birth）	11.14	9.3	14.15	8.98
Maternal Mortality Rate（per 100,000 live birth）	0.55	0.51	0.51	0.29
Proportion of Children 0~5years who died	5%	4%	10%	7%
Prevalence of underweight Children	-	17%	14%	13%
Pre-school Children	6%	10%	11%	9%
Percent Male			50.2%	49.7%
School Children（6～10years old）	14%	24%	16%	17%
Elementary/Pre-school	-	-	17.43%	17.87%
High School Students	-	-	12.57%	12.63%
Percent of Immunized Children	81%	72%	69%	69%
Percent of Households with Access to Safe Water Supply	43%	83%	77%	75%
Percent of Households with Access to Sanitary Toilet Facility	70%	88%	89%	85%
Health Insurance Coverage (PhilHealth)			35%	38%

Source: Provincial Health Office (PHO) Bohol

2) Water-borne diseases

Following Table shows the number of suspected cases of water-borne diseases reported from the hospital to the Provincial Health Office (PHO). The numbers of the cases are not confirmed by laboratory but are listed as suspicious cases.

Table 1.3-8 No. of Suspect Case by LGU in 2010

Name of Disease	Tagbilaran	Panglao	Dauis	Remarks
Cholera	0	0	0	
Typhoid	6	3	6	
Hepatitis A	0	0	0	
Diarrhea	-	-	-	No data
Dysentry	-	-	-	No data

Source: PHO of Bohol Province

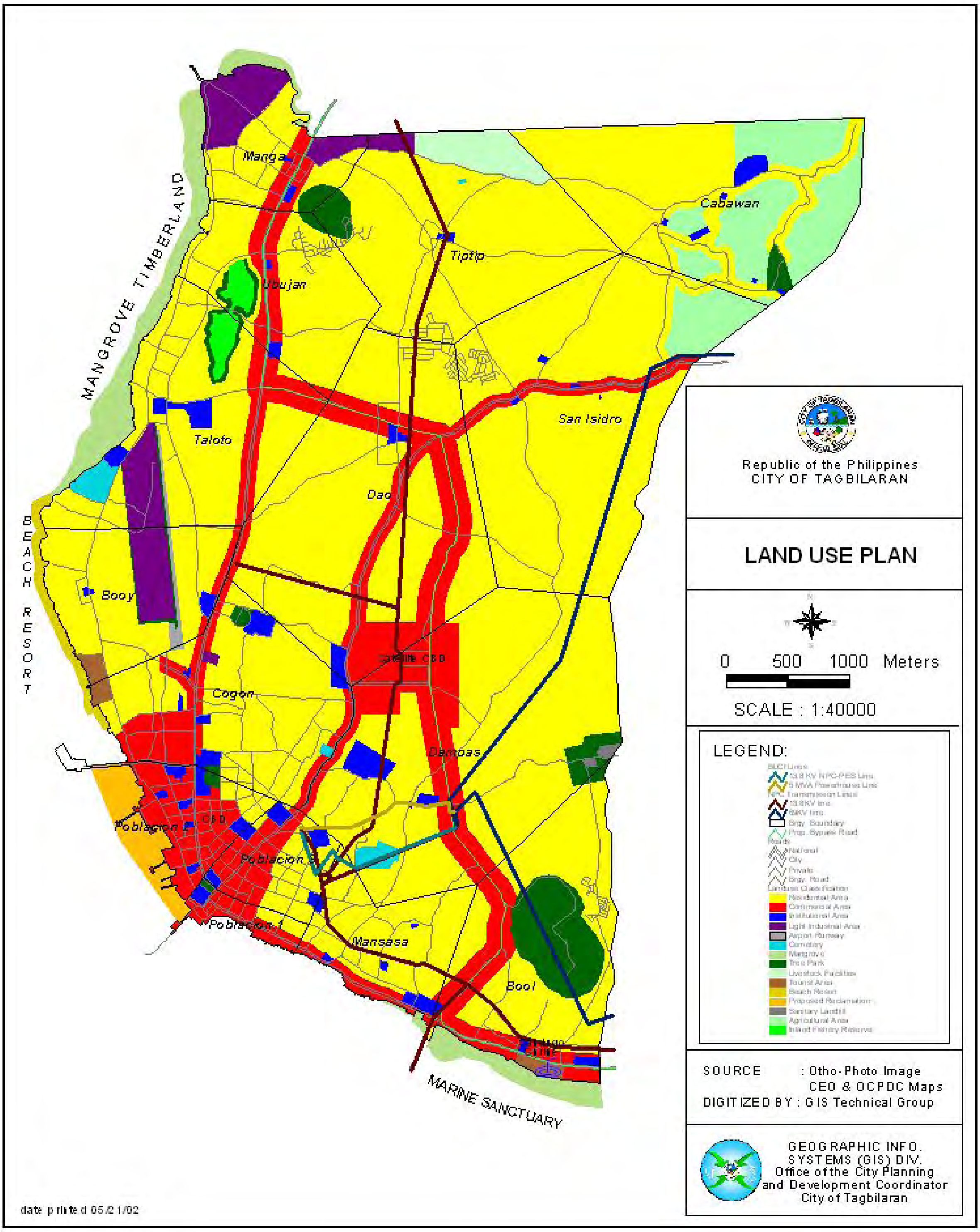
1.4. Infrastructure

1.4.1. Land Use

1) Tagbilaran City

The comprehensive Land Use Plan (CLUP) 2003-2013 has been already authorized as the zoning ordinance of Tagbilaran City. This ten-year plan has been revised in 2008, however, the revision is still in progress and is expected to be completed in 2012. So far there is no significant change from the original plan, one of the minor changes is the expansion of the commercial zoning. The map of land use is shown in the following figure.

Most of the area is designated as residential area (yellow). Commercial area (red) is mainly divided into two (2) areas, which are the Provincial Government Hall (Capital) area and the Tagbilaran City Hall area. The industrial area (purple) is located adjacent to Tagbilaran airport. There is a proposal for a plan of a Bohol Business Park in this industrial area.



Source: City of Tagbilaran

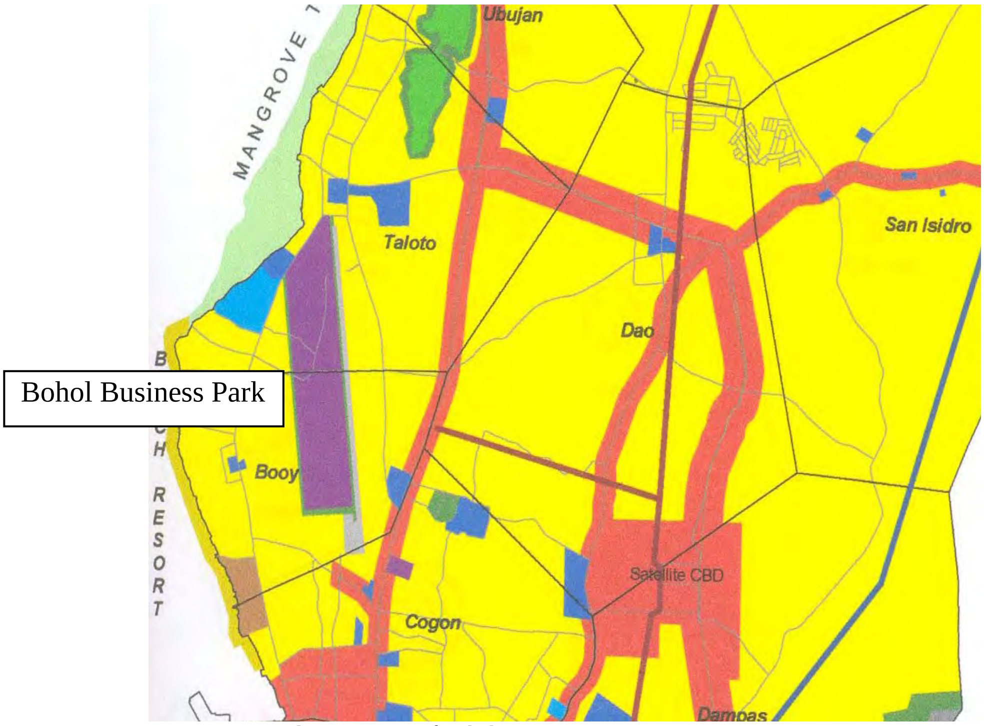
Figure 1.4-1 Land Use Map of Tagbilaran City

Bohol Business Park

The Bohol Business Park (BBP) is proposed for the development of high quality business areas and environmentally-friendly light industrial complex in the province. The BBP will be a site for mixed use, a complementary prime area for commercial, business office spaces, tourism and high-technology is provided to stimulate economic growth.

The BBP will be located in the current Tagbilaran airport area once its operations will be transferred to the New Bohol Airport on Panglao Island.

The site comprises of approximately 8.7 hectares of land located adjacent to lots classified as Light Industrial Area in the existing Land Use Plan of the City of Tagbilaran



Source: Provincial Government of Bohol

Figure 1.4-2 Location of Bohol Business Park

About 75% of the 8.7-hectare lot is owned by the Provincial Government of Bohol and the remaining area is owned by the Tagbilaran City Government and the Civil Aviation Authority of the Philippines (formerly the Air Transportation Office).

The BBP Development seeks to achieve the following:

- Development of a high quality and environmentally-sustaining business zone of local and regional significance that will enhance Bohol's economic competitiveness and business environment;
- Stimulate economic growth through investment placement, business development, job generation and employment;
- Increase Government income from taxes and related revenues thereby reducing IRA-dependency.

Regarding the project modes of implementation, the BBP can be developed through:

- Local Government undertaking and supported by the National Government, ODA facilities and Financial Institutions;
- Public-Private Partnerships such as Joint Ventures, Build-Operate-Transfer (BOT) and its

variants, Lease Arrangements and other applicable modes of counter-parting.

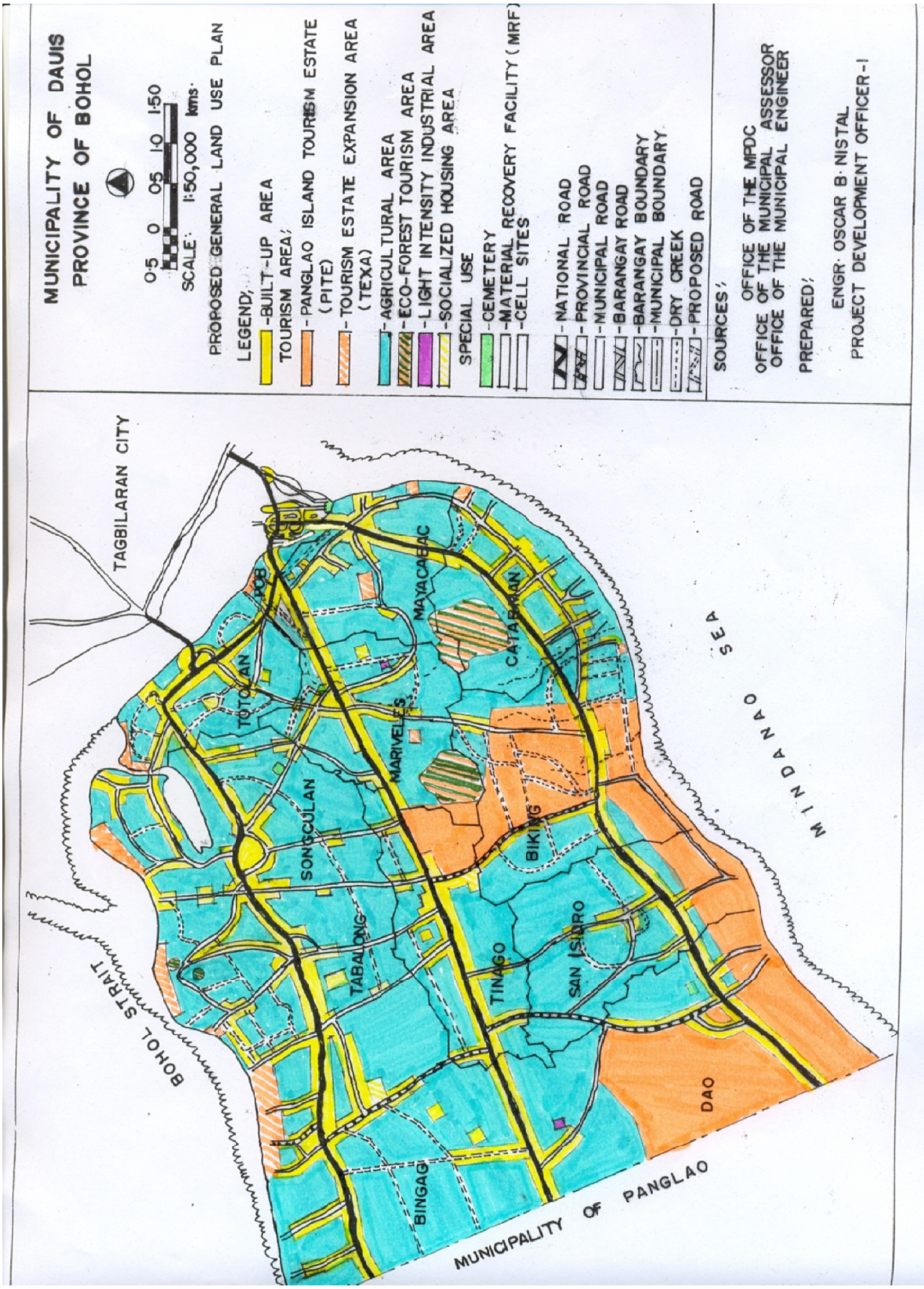
2) Dauis Municipality

There is a Comprehensive Land Use Plan (CLUP) 2000-2010 for Dauis Municipality, which already expired. Now Dauis Municipality is preparing a revised CLUP for the next decade. As of August 2011, the status of the progress is almost finalized. The following map shows a draft land use plan as of August 2011. The major changes from the previous one are i) A Tourism estate expansion area (orange shade) in the north, ii) An Eco-forest tourism area, which is to be reforested, and iii) Two (2) light intensity industries.

There is no sewerage system in the Municipality. Basically there are septic tanks; with a private company desludging septic tanks at hotels and others places. There is a hotel at Bolod beach named Flushing Meadow Resort & Playground, which has its own wastewater treatment plant.

Dauis Municipal Waterworks is supplying water to individual properties, including hotels. The Waterworks is supplying water from the Bohol Water Utilities, Inc. (BWUI.), however, insufficient water is a critical issue. Eight (8) Barangays out of 12 in the Municipality are served by the Waterworks.

In addition, the Municipal Government is preparing an environmental code because one of issues is that divers are damaging the coral reefs. Therefore the Government needs environmental management though increasing number of tourist is highly appreciated.



Source: Municipality of Dauis

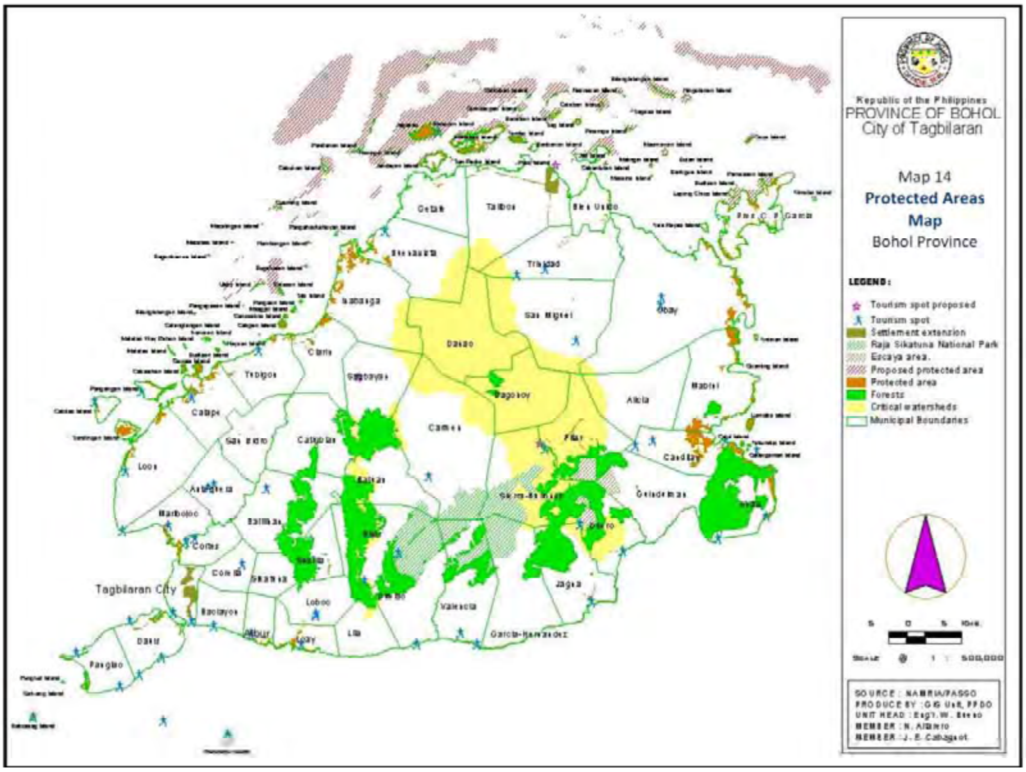
Figure 1.4-3 Land Use Map of Dauis Municipality

3) Panglao Municipality

There is no official CLUP for the Panglao Municipality. In 2003, a CLUP was prepared and almost approved, however the former Municipal Mayor at that time did not approve it because he opposed the new airport construction project in Panglao. Currently the Municipal Government is preparing a new CLUP with support from the Provincial Government.

4) Protected Area

The following figure shows the protected areas of Bohol. Bohol has a total of 75,766 hectares under protection as an initial component of the National Integrated Protected Area System (NIPAS Act or RA7586). All development within these areas shall follow the provisions embodied in the NIPAS Law.



Source: PDPFP 2010-2015

Figure 1.4-4 Protected Area Map

1.4.2. Solid Waste

1) Tagbilaran City

There is an open dump site in Barangay Dampas in Tagbilaran City. The City Government is operating a solid waste collection. Residents have to bring their waste to a collecting truck at a designated time, and on a specific location. Generated solid waste as well as desludge from the City and Dauis Municipality are dumped on the dumping site.

2) Dauis

There is no solid waste disposal site in the Dauis Municipality. The Municipal Government is operating solid waste collection. The Government allows only residual waste collected from material recovery facilities (MRF) in the Barangays, where residents bring their waste. The collection fee is free of charge. Generated residual waste is disposed to the open dumping site in Tagbilaran City.

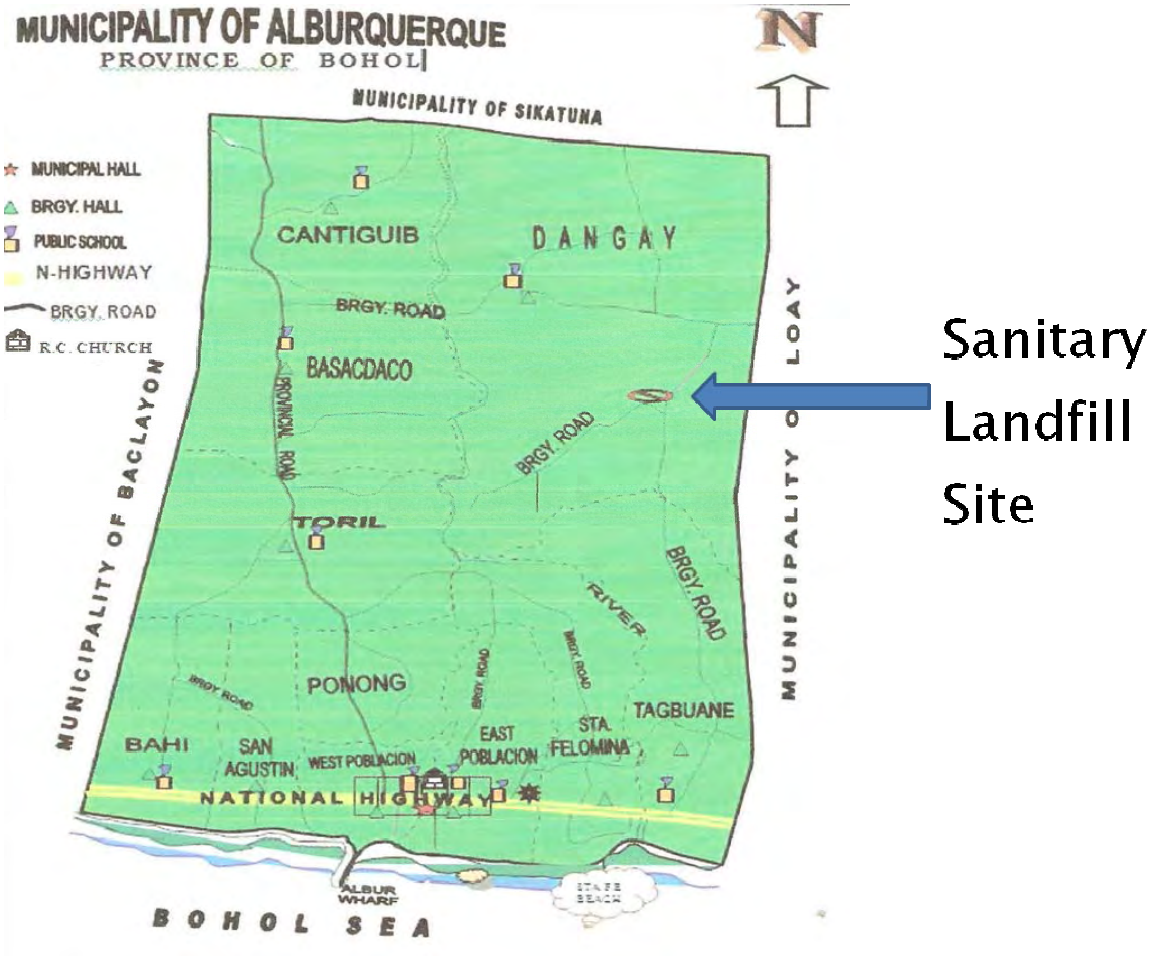
3) Panglao

There is an open dumping site at Barangay Lourdes in the Panglao Municipality. However the site is expected to be used for another 2 to 3 years due to its limited capacity. The service area of this open dumping site covers Poblacion and the hotel accommodation areas, solid waste of the other area is treated individually.

4) New Solid Waste Disposal Site

There is a sanitary landfill site in Alburquerque, however the site is still under construction. After the completion of phase 1 of the construction, in 2008, the construction worke were stopped due to no allocation of budget.

The Municipality of Alburquerque is located about 7 km east form Tagbilaran City. The site is located at 2 km north from the national highway, the area of the site is 7ha. The location of the site is shown in the following figure.



Source: Municipality of Alburquerque

Figure 1.4-5 Location of Sanitary Landfill Site

The site is designed to be used by the Metro Bohol Cluster, which consists of the following 11 local governments out of the 48 LGUs in the province; Albur, Baclayon, Balilihan, Corella, Cortes, Dauis, Lila, Loboc, Maribojoc, Panglao and Sikatuna.

The site allows only residual waste. This means a proper separation system, recycling system and collection system, including transferring stations, must be set up. After the completion of the entire construction, if at that time not yet established the set up of these systems will become an issue.

The historical background of this sanitary landfill site project is as follows. In 2002, the DENR-Environmental Management Board (EMB) together with the ESWM (Ecological Solid Waste Management)-PTWG (Provincial Technical Working Group) recommended dividing the province into 8 clusters. Each cluster was to search for 2 to 3 suitable sites for Sanitary Landfill. The Bohol Provincial Government entered into a Memorandum of Agreement (MOA) with the DENR and USAIDs for the Philippine Environmental Governance Project 1 with the overriding objective, namely for the improvement of environmental governance in the Province of Bohol in forestry, coastal resources and delivery of solid waste management services. The project owner is the former Philippine Tourism Authority (PTA), which is now named Tourism Infrastructure and Enterprise Zone Authority (TIEZA)

1.4.3. Road and others

The road network itself in Bohol is not a problem, however, the roads are basically very old. Therefore the road width is narrow and thickness of the pavement is thin. As a result, road improvement in terms of road width and pavement are issues for the future.

Electricity is supplied by undersea cable from Layte. Therefore, so far, power supply is not a problem. Urban drainage system is a problem especially in Tagbilaran City. Floods happen sometimes after and/or during heavy rain.

1.5. Provincial Development Physical Framework Plan

1.5.1. Review of Provincial Development Physical Framework Plan

1) Outline of PDPFP

The Provincial Development and Physical Framework Plan (PDPFP) is a proactive planning tool and a primary technical guide for the development of the province over five (5) years from 2010 to 2015. The specific objectives of the plan are to:

- Define the overall development framework for the province, as enshrined in its Vision, Mission, Goals and Strategies (VMGS);
- Provide the analytical basis for understanding existing conditions and identifying key development issues, goals, objectives and targets of the province;
- Translate the vision into strategies that can be implemented to attain the goals, objectives and targets;
- Identify programs and projects consistent with the strategies and which serve as inputs to the Provincial Development Investment Program (PDIP); and
- Provide a spatial/physical representation of the aforementioned plan components, where possible.

2) Issues and Challenges

The PDPFP clarifies major development issues and challenges of Bohol. Multi-sectoral development issues and challenges consists of six (6) elements as follows;

1. high poverty incidence,
2. population,
3. environmental,
4. transport and other infrastructure,
5. economic development, and
6. other major development.

The above issues are inter-related, since population growth and economic activities have created pressures on Bohol's environment and natural resources. On the other hand, tourism is considered as an economic development drive for the province. The following needs are to be addressed for the tourism sector:

- To upgrade and develop new tourism attractions and their corresponding support infrastructures,
- To integrate tourism packages towards the development of viable tourism circuits,
- To enhance tourism services, promote Bohol's new attractions and strengthen institutional linkages,
- To upgrade tourism data to assist planning and monitoring to include the review of the extent to which visitor arrivals are documented in both accredited and non-accredited tourism establishments as well as the magnitude of excursionists (visitors within the day) which could have a significant but unknown impact to the province's tourism industry.

In addition, sector-specific issues and challenges are indicated as follows;

1. environmental and natural resources management,
2. economic development,
3. social development,
4. development administration, and
5. infrastructure development.

3) Development Framework of Bohol

In the PDPFP, the Provincial Government commits to the following goals as enumerated under the main headings of:

1. Environmental Protection and Management,
2. Social Equity and Inclusion,
3. Local/Regional Economic Development and Strategic Wealth Creation,
4. Upholding Cultural Heritage and Boholano Values, and
5. Responsive, Transparent and Accountable Governance.

The following figure shows the concept of the development framework plan.

Source: PDPFP

Figure 1.5-1 Concept of Development Framework Plan

The Provincial Government sustains the following comprehensive strategies:

- Green Agri-based Economic Development
- Eco-cultural Tourism
- Public-Private Partnership

Green agri-based economic development and eco-cultural tourism are considered as the same strategy. It means that economic development is mainly achieved by eco-cultural tourism. At the same time, these strategies contribute to environmental protection.

4) New Airport in Panglao

A new airport construction project in Panglao is stated as a major provincial project in the PDPFP. It is expected that more tourists will come to Bohol when the new airport is constructed as well as the New Bohol Airport will have a positive economic impact. However the environmental impact caused by a growing number of tourists will have to be properly addressed. If more tourists will arrive at specific areas in Bohol, over-carrying capacity, insufficient water supply, increased environmental load and so on are of a concern. In addition, when the new airport is constructed, it will also have an impact on its environment, which will have to be properly addressed during the initial planning and construction period, of which examples are given throughout this report.

1.5.2. Issues to be Addressed

1) Environmental Conservation

One of the most critical issues is environmental conservation. There are numerous natural resources, such as beautiful ocean, coral reefs, the chocolate hills, tarsiers, Loboc River, other rivers and their riparian and mangrove forests. Apart from natural resources, there are historical and cultural heritages as tourism resources, therefore, for the purpose of sustainable regional development, these tourism resources must be conserved in the future.

2) Economic Development

Economic development is one of the most important issues as well. For the purpose of achieving economic development in Bohol Province, tourism development is one of the most effective drivers. Poverty alleviation is one of the critical issues in the province, especially in the rural areas. So far the benefit from the tourism sector is reaching only limited areas, where tourists visit, such as Panglao and Dauis Municipalities and Tagbilaran City.

3) Compatibility between Economic Development and Environmental Conservation

In general, above two (2) issues, namely environmental conservation and economic development, seem to be in conflict with each other. Through the promotion of tourism development, economic development can be achieved, however risks would be caused by negative environmental impact if appropriate measures are not taken.

Though the PDPFP indicates a necessity of eco tourism and agro tourism, it does not indicate the balance between economic development and environmental conservation. For the purpose of sustainable regional development, conservation and maintenance of tourism resources including natural environment of Bohol are indispensable. The economic development and environmental conservation must be kept in balance.

1.6. Strategic Concept for Future Development of Bohol

For the purpose of solving the above issues, two (2) strategic concepts for future development of Bohol are proposed. These strategic concepts can overcome the compatibility between two (2) contradicted issues.

1.6.1. Sustainable Regional Development (High-Quality Eco-tourism)

As described above, tourism sector is one of the most important industries for the future regional development and economic development of Bohol. The tourism resources of Bohol attracting tourists are beautiful and rich natural environment and abundance in leisure time and its feeling produced by the resources. Therefore quality eco-tourism concept, which achieves both tourism development and environmental conservation, can be an important strategic concept, which attracts tourists in Bohol in the future.

In general, mass tourism intends to receive many tourists, while it causes deterioration of tourism resources (especially natural environment), satisfaction level of tourists and expense in Bohol, and shortening of stay. In contrast, Cebu Island is characterized as mass tourism mainly for international tourism destination, the merit of Bohol tourism is beautiful and rich natural environment, which attracts tourists. For the differentiation from and synergy with Cebu Island, it is necessary to promote carrying capacity concept for the sustainable regional development. Even if limited number of tourists visit, and they stay longer with enjoying eco-tourism instead of short stay and sport tourism, it results in much revenue in Bohol.

It is necessary for longer stay, enjoying tranquil time in natural environment, and enjoying personal contact with local people and life, to improve the value added quality of accommodation, service level, food, and goods.

Tourism development by quality eco-tourism concept will contribute to sustainable environmental conservation. Because natural environment is the most important tourism resources in Bohol, beautiful and rich natural environment must be conserved and maintained as well as beautiful and sanitary townscape.

1.6.2. Decentralized Regional Development

"Decentralized regional development" means to develop tourist spots and attractions in all over Bohol while utilizing existing tourism and industrial resources and not concentrating urban and tourism functions in certain areas. Currently urban and tourism functions are limited in and concentrated use in Tagbiralan City, where the most urbanized area in Bohol, and Panglao Island, where attractive beach resorts are conveniently located.

Over viewing the whole of Bohol, there are many alternatives for tourism development. There have been already some trials of community-based tourism developments in Danao, Buenavista, Anda and Loboc Municipalities (for details refer to Chapter 2).

Different from the centralized tourism, decentralized regional development will contribute to a reduction and avoidance from the exceeding environmental load in partially concentrated areas. In addition, decentralized development will contribute to poverty alleviation in rural areas.

Chapter 2

Tourism Development

Table of Contents

Chapter 2. Tourism Development

2.1. Current Situation of Tourism Sector in Bohol

2.1.1. Bohol Tourism Overview

Bohol province is located, about 626km south of Manila, at the heart of the Central Visayas. It is composed of one large island, namely "Bohol Island", and numerous small islands such as "Panglao Island" and "Lapinig Island". Some noteworthy examples of Bohol's tourism would be its most unique and best known feature "Chocolate Hills" and "Tarsier", which can attract many domestic and foreign tourists. It is noted that other excellent examples are its beautiful and comfortable places, Panglao beach resorts and historical Spanish heritage sites consisting of archeological and religious monuments such as the Baclayon Church. Bohol has experienced a boom in tourism and tourist arrivals have been increasing rapidly and it is surely expected that this trend will continue.

Chocolate Hills | Tarsier | Panglao Beach | Baclayon Church

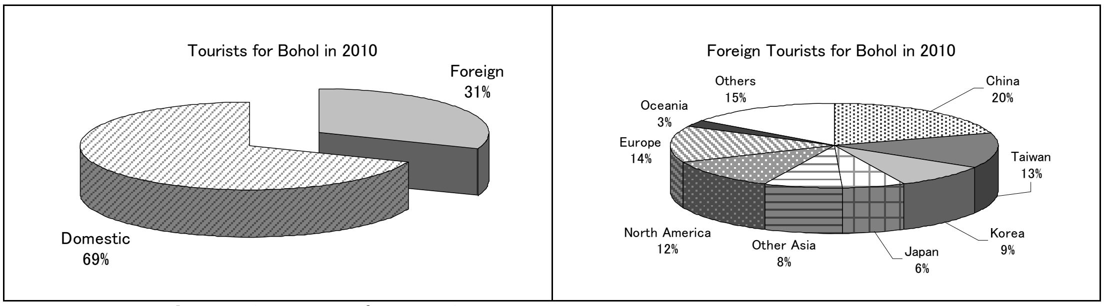
Source: JICA Study Team

Figure 2.1-1 Outstanding Tourism Resources of Bohol

2.1.2. Current Tourism Situations

1) <u>Tourist Arrivals</u>

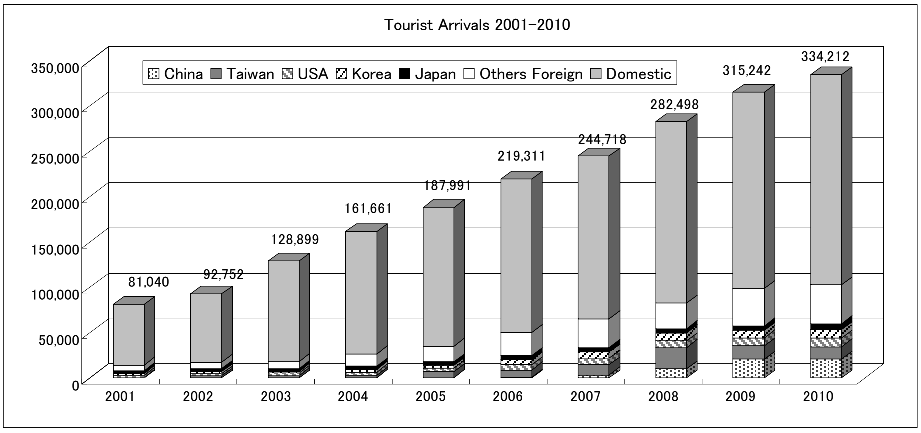
The annual volume of tourist arrivals in 2010 was approximately 330,000, 69 % of which were domestic tourists and 31 % were foreign tourists. Regarding the foreign tourist volume by country, the largest one is China with a 20% share of the total amount of foreign tourists, followed by Taiwan (13%), USA (12%), South Korea (9%) and Japan (6%).



Source: JICA Study Team (Data source from DOT)

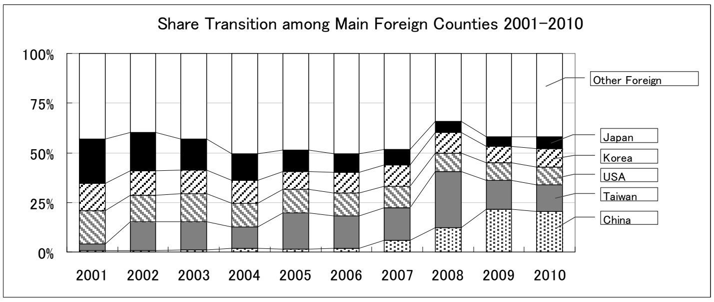
Figure 2.1-2 Tourist Arrivals by County in 2010

The annual tourist arrival growth rate in the last decade is approximately 15% based on the 80,000 arrivals in 2001. It should be noted that the annual growth rate of foreign arrivals in the same period is 22% which is a larger growth than the domestic tourist arrivals.



Source: JICA Study Team (Data source from DOT)

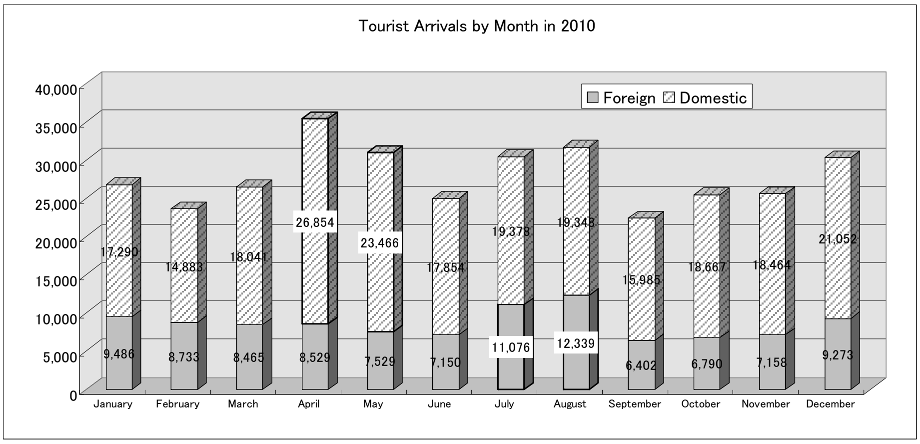
Figure 2.1-3 Tourist Arrivals Transition 2001-2010



Source: JICA Study Team (Data source from DOT)

Figure 2.1-4 Tourist Arrivals Share among Main Foreign Countries 2001-2010

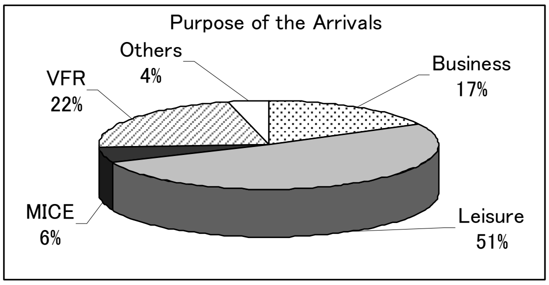
The arrival transition by month in 2010 shows that there were three peaks of arrival volumes throughout a year, as an illustration; April was the highest peak and September was the lowest.



Source: JICA Study Team (Data source from DOT)

Figure 2.1-5 Tourist Arrivals by Months in 2010

Regarding the purpose of the arrivals, “Leisure” is the main purpose which dominates more than 50% share, followed by “VFR (Visiting friends and relatives)” (22%), “Business” (17%) and “MICE (Meeting, Incentive, Convention and Exhibition)” (6%).



Source: BTO and JICA Study Team Survey

Figure 2.1-6 Purpose of Tourist Arrivals

2) Tourism Resources

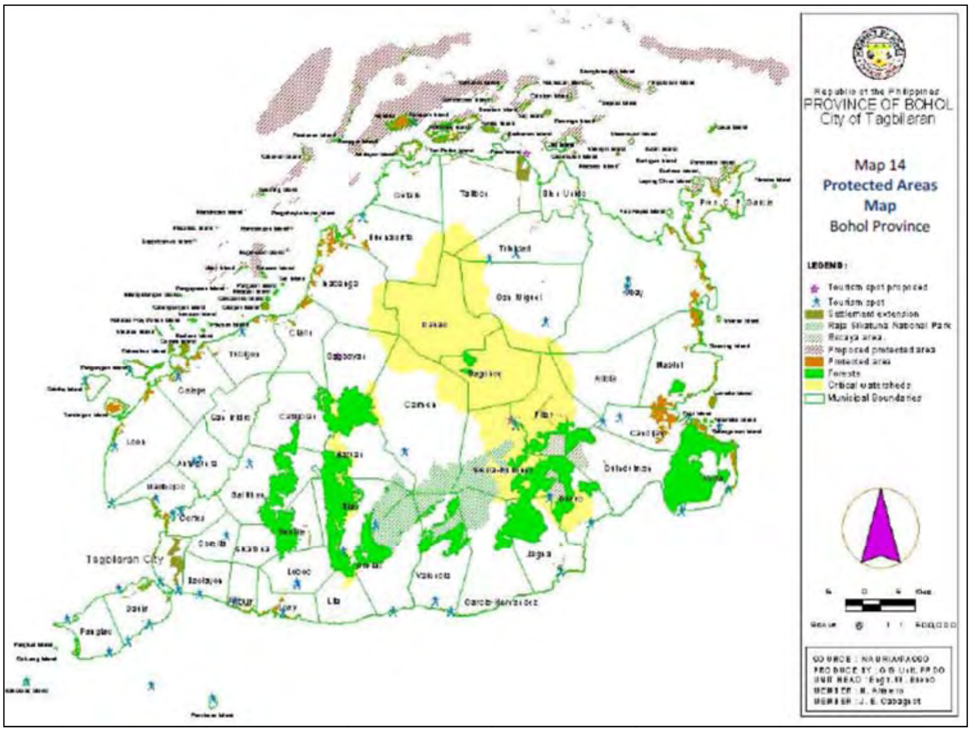
Natural Resources

In Bohol, there are five NIPAS (National Integrated Protected Area System) designated by DENR (Department of Environment and Natural Resources) to protect the natural resources, namely Rajah Sikatuna (10,451ha), Chocolate Hills (19,410 ha), Loboc (10,387ha), Alejawan-Cansuhay-Anibongan River (3,620ha) and a total 10 of Wilderness Areas and Mangrove Swamp Forest Reserves (8,772ha). It shows a characteristic that all types of natural resources, meaning terrestrial, terrestrial water and ocean water, are designated and protected as NIPAS’s in the provincial area.

Table 2.1-1 List of NIPAS

Name	Area
Rajah Sikatuna Protected Landscape (National Park)	10,451 ha
Chocolate Hills Natural Monument	19,410 ha
Loboc Watershed Forest Reserve	10,387 ha
Alejawan-Cansuhay-Anibongan River Watershed Forest Reserve	3,620 ha
Wilderness Areas (a total of 10 components)	2,092 ha
Mangrove Swamp Forest Reserve	8,772 ha

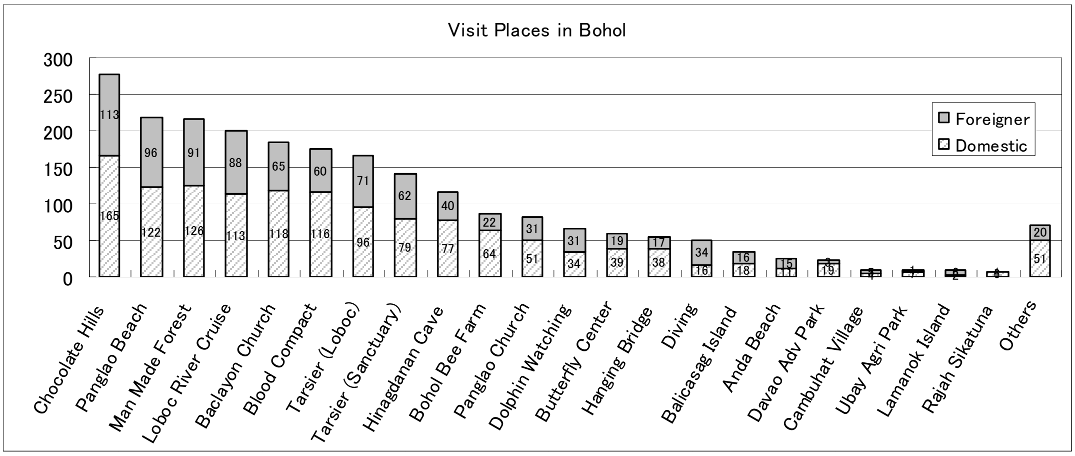
Source: PPDO



Source: PDPFP: Provincial Development & Physical Framework Plan (2010: Bohol Province)

Figure 2.1-7 Protected Areas Map

According to the result of the "Tourists Questionnaire Survey", some of the most major places tourists visited are the Chocolate Hills, Panglao Beach, Man Made Forest, Loboc River Cruises and Baclayon Church, which are almost all located along the axis running from the center of city of Tagbilaran to the Chocolate Hills. As a result, it is clear that currently the tourism base-area tends to concentrate only on Panglao Island and Tagbilaran City. The "Tourists Questionnaire Survey" was conducted by JICA Study Team in this study as the outline showed the next page and the result attached the appendix.



Source: JICA Study Team (Tourists Questionnaire Survey)

Figure 2.1-8 Tourists' Visit Places in Bohol

Table 2.1-2 Outline of the Survey

Survey Name	Tourist Questionnaire Survey	
Date of the Survey	Peak Season (May)	One day in weekday - 13th May 2011 (Friday) 8:00 – 17:00 (9 hour inc. lunch)
	Ordinary Season (July)	One day in weekend - 9th July 2011 (Saturday) 8:00 – 17:00 (9 hour inc. lunch) One day in weekday - 14th July 2011 (Thursday) 8:00 – 17:00 (9 hour inc. lunch)
Purpose of the Survey	To grasp information date of tourism sector	
Target Place	Tagbilaran Airport Tagbilaran Seaport Tubigon Seaport (only July) Ubay Seaport (only July) Jagna Seaport (only July)	
Method	Face to face individually	
Total Sample	390 Samples - 121 in May - 269 in July	
Questionnaires	- General Information (Nationality, Purpose, Accompanies, etc.) - Tourism Information (Staying Days, Place, Spending Money, etc.) - Trip Course (Itinerary, Hometown, etc.) - Visit Place, Activity in Bohol - About Eco-tourism - Opinion	

Source: JICA Study Team

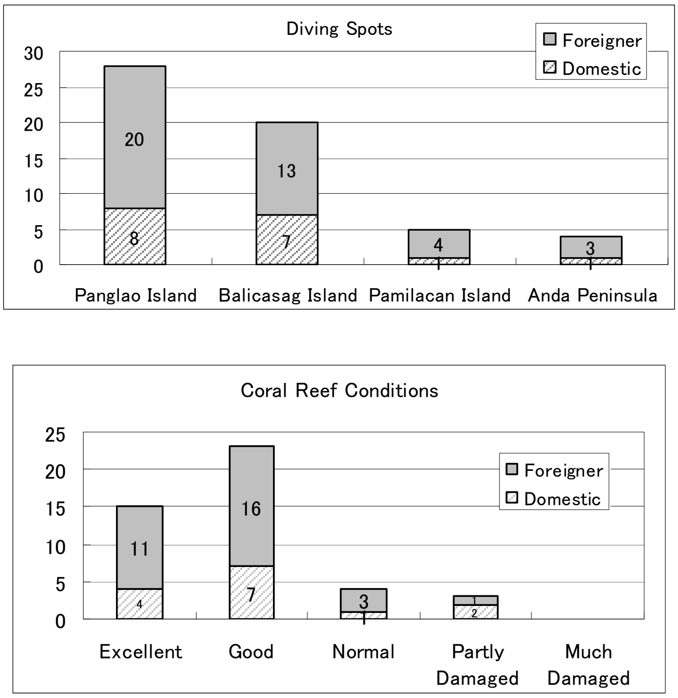
Tarsier

The Tarsier, which is one of the most attractive tourism resources of Bohol, lives mainly in the Southeast-Asia region. The “Philippines Tarsier” *(Scientific name: Tarsius syrichta)*, a species in the Tarsier family, lives not only in Bohol but also in Samar, Lyte and Mindanao and are now endangered, consequently, registered “NT (Near Threatened)” species in the Red List of IUCN (International Union for Conservation of Nature). The primary consideration should be that Bohol is the largest habitat for Philippines Tarsier to secure their sustainable existence for the future. According to the Tarsier sanctuary staff, the estimation of current population size is between 500 to 1,000 animals and, at the moment, they are only living in the south-west area of the Bohol Island. They are nocturnal creatures feeding on live insects etc. It is estimated that one animal needs one hectare habitat or more because they are basically solitary animals acting in isolation not in groups. For tourists, there are 6 or 7 souvenir shops, where one can watch and take pictures of Tarsiers along the road to Chocolate Hills, it is, however, illegal to keep Tarsiers in the such shops and cages. Now Local Government Units (LGU) are trying to eliminate this kind of business.

Coral Reefs

In Bohol, four coral reefs are still in good condition with large-scale spreads, namely the Bohol marine triangle (Alona-Balicasag-Pamilacan) area, the Cabilao reef area, the Danajon double barrier reef area, and the Anda reef area; these are obviously popular spots for diving. Although damages of coral reefs by diving activities are not so serious until now, but it could become a serious problem due to rapidly increasing diving tourism.

According to the result of the Tourists Questionnaire Survey, the most major diving spots are Panglao Island, followed by Balicasag Island. All tourists who enjoyed diving in Bohol answered that current coral conditions were excellent, good or normal.



Source: JICA Study Team (Tourists Questionnaire Survey)

Figure 2.1-9 Visited Diving Spots and Coral Reef Conditions

Regarding Bohol's coral reefs, Siliman University in Negros Island carried out a survey for grasping the current conditions and to propose a sustainable capacity of Balicasag coral reef, a few years ago. In this proposal, the maximum user volume (diving and snorkeling) should be less than 5,000 – 6,000 persons per one site per year, it is, however, estimated that more than 21,000 persons, meaning three times more than the maximum volume, are currently using one site in Balicasag in one year.

In some famous spots for coral reefs such as Apo Island, south of Negros, a system of a "Sanctuary Fee" has been introduced and now operates with in the Philippines. In fact, a similar system was introduced in Panglao Island several years ago, however it has been canceled after a three weeks trial period because of strong oppositions by diving shops due to a dispute on how to use this fee.

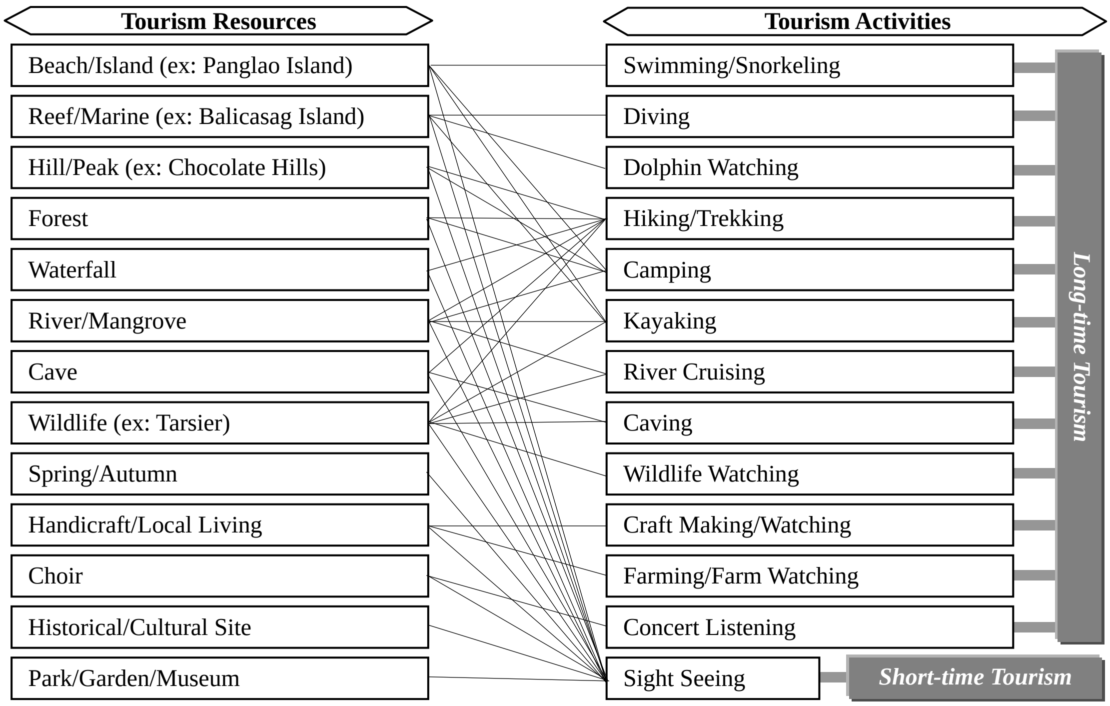
Source: JICA Study Team

Figure 2.1-10 Tourism Resources Map

3) Tourism Characteristics

It can be said that Cebu's tourism is a kind of "Mass Tourism" which can accept a very large volume of tourists through its international airport. In contrast, Bohol appeals to "Eco Tourism" for its appeal for typical and attractive natural resources, such as the Chocolate Hills and Tarsiers. However, at the moment, Bohol's tourism seems not to be real "Eco Tourism." Eco tourism should be based on the principles of "Sustainability," "Biodiversity Conservation," "Community and Stakeholder Participation," "Local Economic Benefits" and "Quality of Visitor Experience" according to "Biodiversity Conservation and Ecotourism Framework Plan of Bohol." Current tourism style of Bohol as mentioned below would not contribute such principles of eco tourism.

All existing tourism resources can easily become short-time tourism resources which are not able to keep tourists to stay in Bohol for a long time. However, it would be more difficult if these tourism resources make long-time resources without any plans, efforts, or creative ideas by all people and organizations concerned. It is very important that all existing tourism resources connect to long-time resources to keep tourists staying in Bohol a longer time.



Source: JICA Study Team

Figure 2.1-11 Tourism Resources and Activities in Bohol

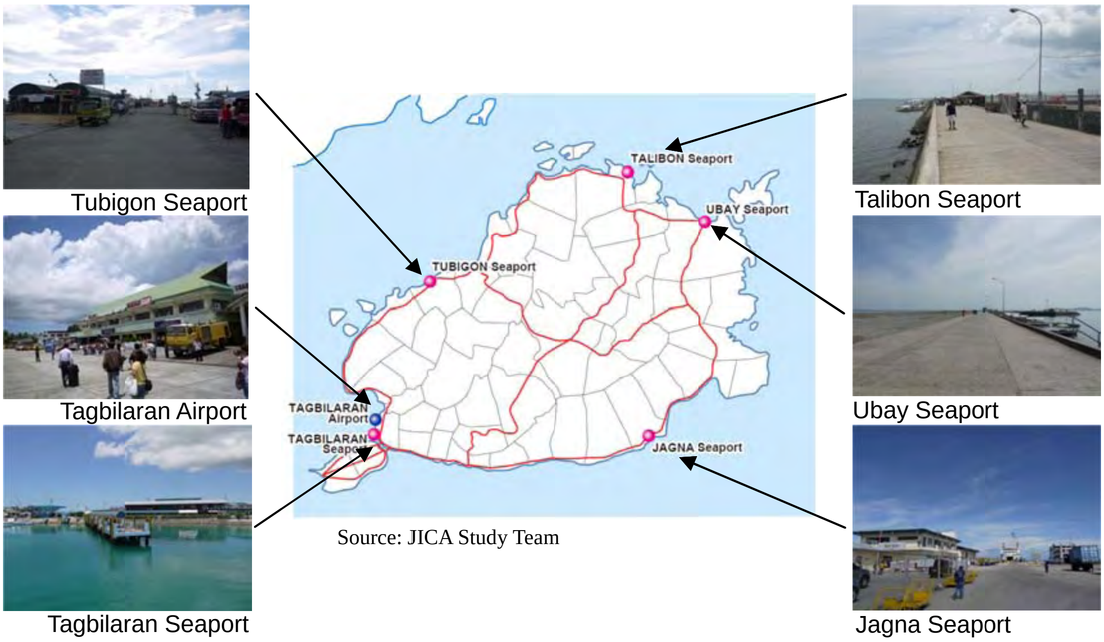
In addition, the accessibility of information related to tourism is currently insufficient; hence ordinary tourists are not able to easily access the full amount of tourist information other than via an aggressive method by drivers at the airport or seaports. It is likely that such kind of tours are "Mass Tourism", just going through the main tourist spots within a short time, respectively in half a day or at maximum one day, even though "one day" tourists to Bohol are few, most tourists do stay in Bohol at least one night.

2.1.3. Tourism Industry

1) Gateways (Airport and Seaports)

The main gateways of Bohol are consists of one airport and five seaports, namely Tagilaran Airport, Tagbiralan Seaport, Tubigon Seaport, Talibon Seaport, Ubay Seaport and Jagna Seaport.

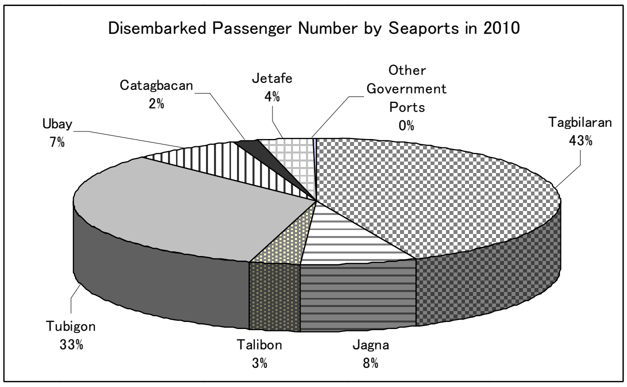
The annual throughput of tourists through these gateways is approximately 280,000 tourist at the airport (2009) and 1,960,000 tourists at the combined seaports (2010).



Source: JICA Study Team

Figure 2.1-12 Location of an Airport and main Seaports

Looking at the share among the main seaports Tagbilaran (43%) and Tubigon (33%) dominate with a combined share of about 80%, followed by smaller shares of Jagna (8%) and Ubay (7%). Many foreign tourists tend to use Tagbilaran Seaport and Tubigon Seaport., not other seaports.



Source: JICA Study Team

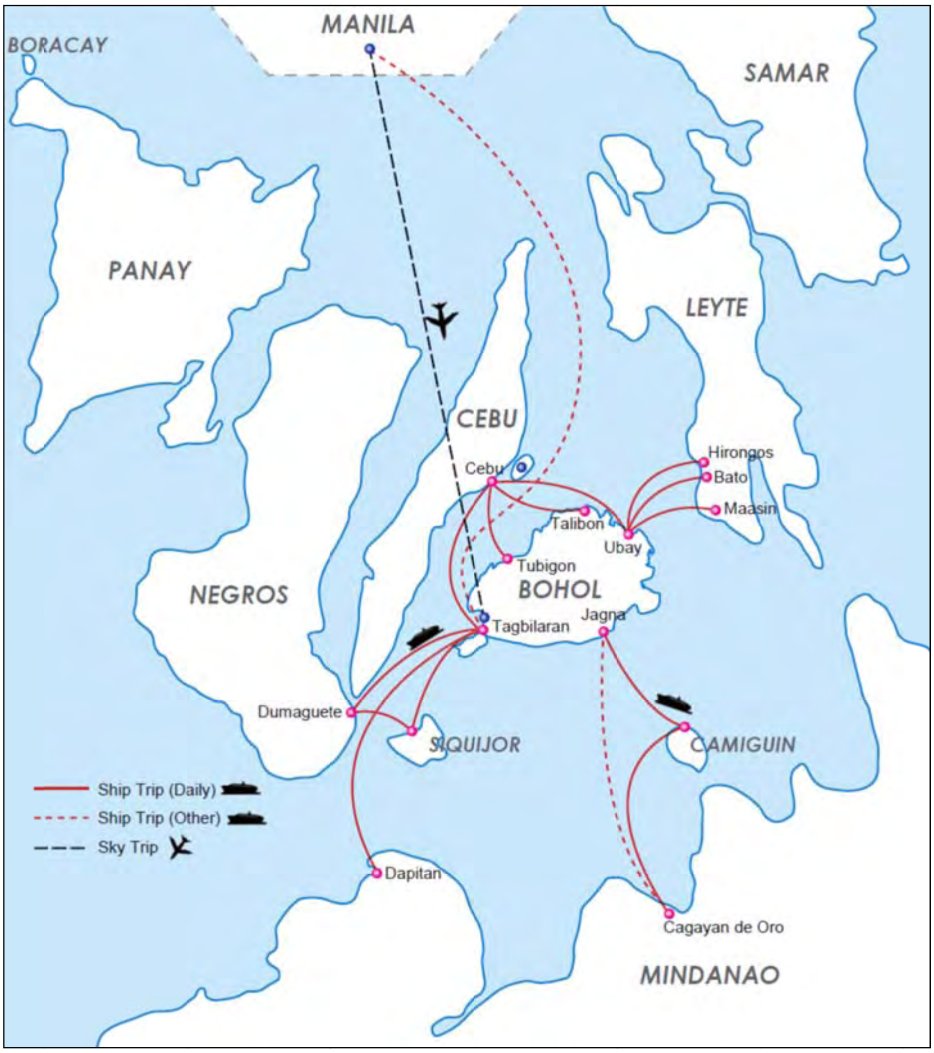
Figure 2.1-13 Usage Share of Seaports

Trip routes from main seaports are as below. Only Cebu, Dumaguete (Negros) and Siquijor are within two hours reach from Tablilaran Seaport.

Table 2.1-3 Shipping Destinations from Bohol Seaports

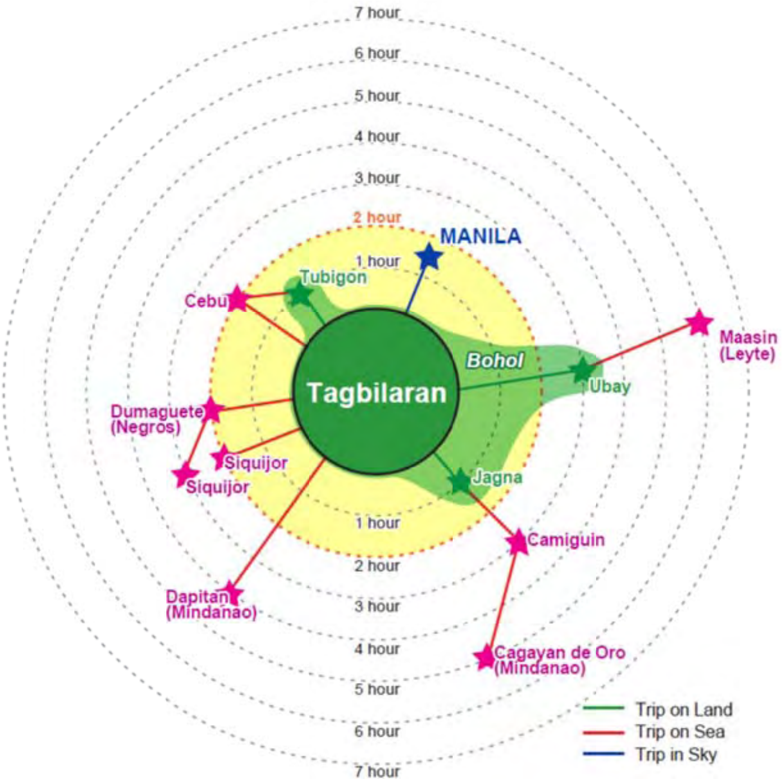
Bohol Seaport	Destinations	Frequency (daily)	Travel Time	Ave.Fee (peso)	Total Daily Capacity (One way) (Rough Estimation)
Tagbilaran	Cebu	15 ships	2 hours	460	4,000 persons/ day
	Negros (Du)	2	2 hours	680	600 persons/ day
	Mindanao (Da)	1+	4 hours	950	300 persons/ day
	Siquijor	1+	2 hours	520	700 persons/ day
	Manila	(1/week)	27 hours	1,320	(200 persons/ week)
Tubigon	Cebu	16-19	1.5 hours	200	2,000 persons/ day
Talibon	Cebu	2	2 hours	300	200 persons/ week
Ubay	Leyte (Ma etc.)	3	3 hours	220	700 persons/ day
	Cebu	1	5 hours	250	300 persons/ day
Jagna	Camiguin	1	2 hours	550	300 persons/ day
	Mindanao (Ca)	1+	4 hours	900	300 persons/ day

Source: JICA Study Team



Source: JICA Study Team

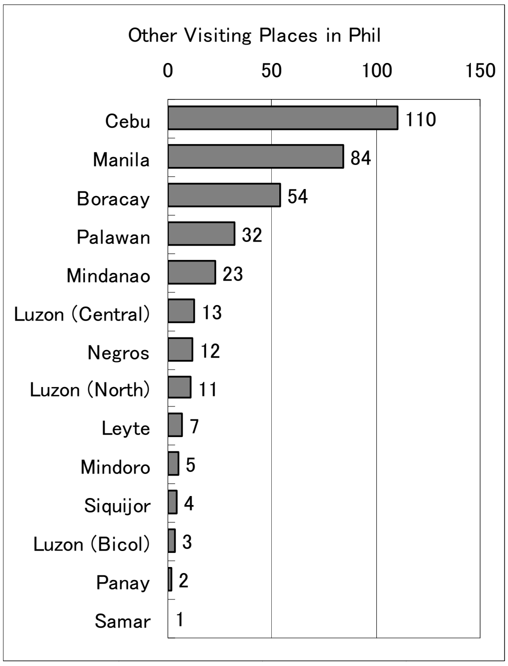
Figure 2.1-14 Destination Map



Source: JICA Study Team

Figure 2.1-15 Time versus Distance Map

According to the result of the Tourists Questionnaire Survey, many tourists visit as well other islands and cities such as Cebu, Manila, Boracay and Palawan in addition to Bohol. It is noted that more than one third of all tourists visiting Bohol also visit Cebu.

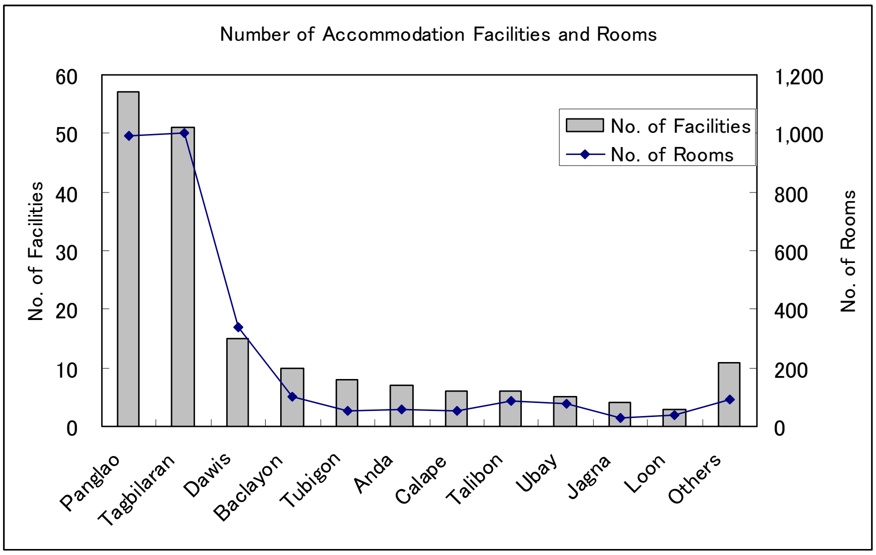


Source: JICA Study Team (Tourists Questionnaire Survey)

Figure 2.1-16 Other Visiting Places in Philippines

2) Tourism Facility

In Bohol, the total number of accommodation facilities is 202 with a combined total of 3,107 rooms; occupation rates are estimated to be approximately 70%. The accommodation facilities are mainly located on Panglao Island and in Tagbilaran City.



Source: JICA Study Team (PPDO data)

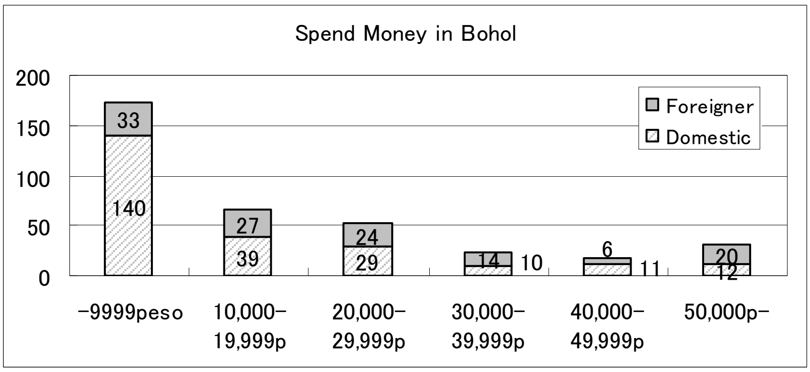
Figure 2.1-17 Number of Accommodation Facilities and Rooms

According to the result of the Tourists Questionnaire Survey, on average, tourists stayed for 3.78 nights and spent a total cost of 19,219 peso during their stay in Bohol.

Table 2.1-4 Stay Nights and Spend Money in Bohol

Stay Nights in Average	Spend Money in Average
3.78 nights	19,219 peso

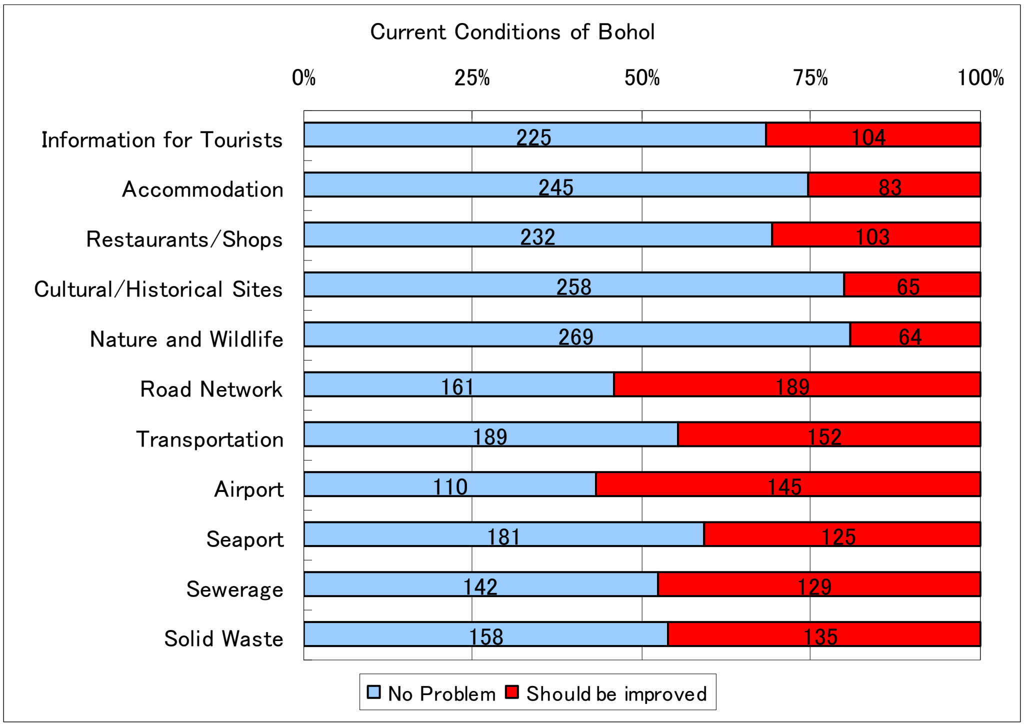
Source: JICA Study Team (Tourists Questionnaire Survey)



Source: JICA Study Team (Tourists Questionnaire Survey)

Figure 2.1-18 Spend Money in Bohol

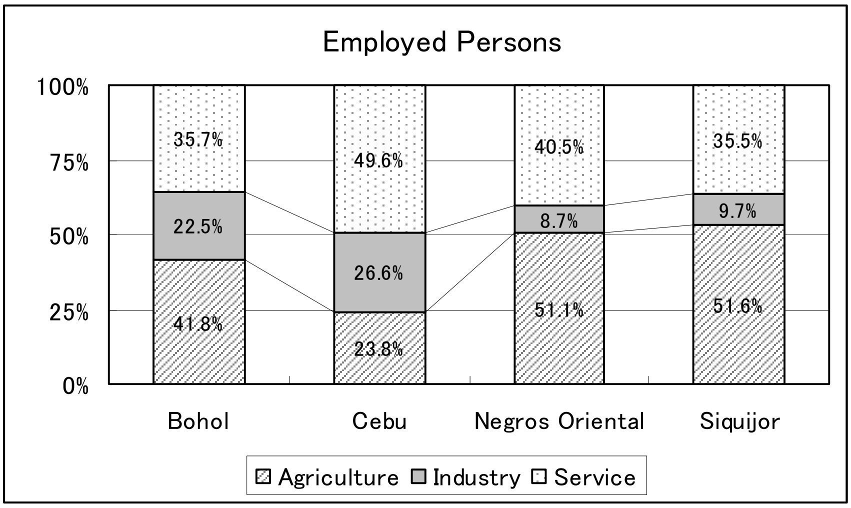
The result of the Tourists Questionnaire Survey also shows that tourists' satisfaction regarding the current airport in comparison with other infrastructure conditions, such as the seaports, is very low.



Source: JICA Study Team (Tourists Questionnaire Survey)

Figure 2.1-19 Tourists' Satisfaction of Current Infrastructure Conditions

Regarding the industrial structure (employee's volume) of Bohol, primary (agriculture) industry is 41.8%, secondary industry is 22.5% and tertiary (service) industry is 35.7%. In comparison with Cebu, of which the primary industry stands at 23.8%, Bohol's primary industry is still more active.



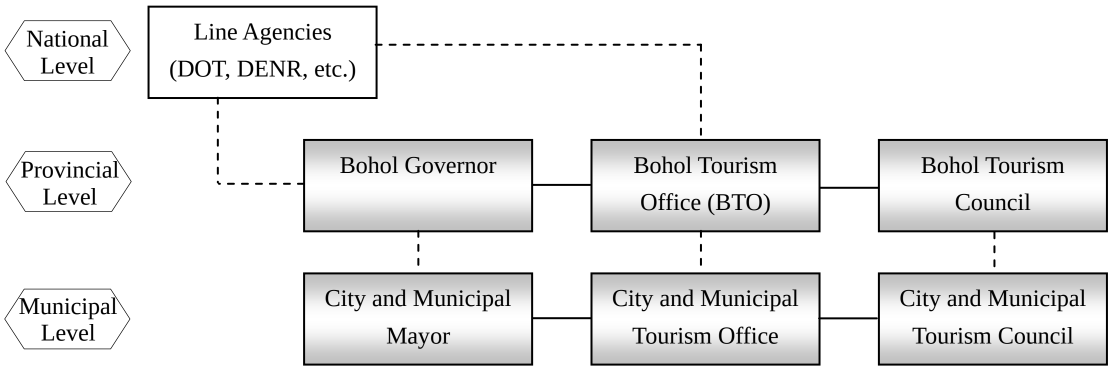
Source: JICA Study Team (Date Source from PDPFP)

Figure 2.1-20 Industrial Structure

2.1.4. Organizations and Regulations

1) <u>Organization and Human Resources</u>

One of the most important organizations related to the Bohol tourism sector is BTO (Bohol Tourism Office) which belongs to the SEEM (Social, Economic, Development and Environment Management) Cluster in the Bohol Province. Currently the Bohol Tourism Office has a staff of 13. The PPDO (Provincial Planning Department Office) plays a role in the comprehensive planning of the Bohol Province. Figure 2.1-21 shows the Bohol local government's institutional arrangement for tourism. Tourism councils are private entities, the memberships of which usually comprise of 60% private entities and 40% government representatives. The councils help to organize the local tourism industry into a cohesive organization that promotes the growth of the sector and the area.



Source: JICA Study Team (Date Source from Sustainable Tourism Management Plan for the Central Philippines)

Figure 2.1-21 Bohol Government Institutional Arrangements for Tourism

There is a system of registered tour guides in Philippines and currently 70 tour guides are registered in Bohol (2009). To be an accredited tour guide, the following three steps must be followed, as shown in Table 2.1-5.

Table 2.1-5 Required Steps to be a Tour Guide

Steps	Contents
Step 1	One must undergo and pass the panel screening for the Basic Tour Guiding Training Course by the Department of Tourism (DOT) and should submit the following required documents: - Duly accomplished application form from DOT secretariat - Certified true copy of Transcript of Records - Copy of diploma as proof of finishing a 4 year course - Certificate of good health issued by government physician - 1 pc. 2x2 recent I.D. photo - Birth certificate
Step 2	The Basic Tour Guiding Training Course includes: - 25-day training at least - Oral and written examinations - Mock tour - Graduates of the course should likewise finish a 120-hour on-the-job training with DOT accredited tour operator's tour guide
Step 3	Accreditation

Source: JICA Study Team (Data source from BTO)

Regarding the central government, the DOT (Department of Tourism) and DENR (Department of Environment and Natural Resources) have responsibilities for the tourism sector, though almost all government departments are affected to a greater or lesser degree by the policy decisions and actions. DOT has a regional office in Cebu and the office dispatches one officer to the Tagbilaran seaport in Bohol.

Additionally, the following key NGO's are involved in tourism in the Central Philippines;

Table 2.1-6 List of NGO's

Abb.	Name
PRRCFI	Philippine Reef and Rainforest Conservation Foundation Inc.
NFEFI	Negros Forest and Ecological Foundation
PRRM	Philippine Rural Reconstruction Movement
CI	Conservation International (Philippines)
WWF	Worldwide Fund for Nature (Philippines)
HF	Haribon Foundation
WBCP	Wild Bird Club of Philippines
CCCI	Coral Vay Conservation Inc.

Source: Sustainable Tourism Management Plan for the Central Philippines

2) Relevant Plans and Policies

On a national level, the "National Ecotourism Strategy (2002)" was formulated with a principle of "Ecotourism for the Philippines". In this strategy, Bohol is listed as one of the 32 "Key Ecotourism Sites", of which six sites are located in Visaya region.

On a provincial level, the "Provincial Development and Physical Framework Plan (2010-2015)" was formulated with a vision of "Green Bohol !" and three strategies being "Green Agri-based Economic Development", "Eco-Cultural Tourism" and "Public-Private Partnership".

According to the Bohol Tourism Office, the "Biodiversity Conservation and Ecotourism Framework Plan of Bohol (2006-2015)" has little effect on Bohol's on-going tourism programs. Additionally, the "Tourism Master Plan on the Tourism Clusters of Bohol Province" has been formulated, but not yet received Congressional approval. Consequently, Bohol's tourism programs are in progress without any official plans.

Table 2.1-7 List of Relevant Policies and Plans

Level	Name
International	Global Agenda 21
	Agenda 21 for Travel and Tourism
	United Unions Commission of Sustainable Development
	Commission on International Treaties and Agreements
National	EO111 – Guidelines for Ecotourism Development in Philippines
	Republic Act 7586 or NIPAS Act for Protected Area
	PD 705 – Revised Forestry Code of the Philippines – 1975
	PD 856 – Code on Sanitation of Philippines of 1975
	PD 1067 – Water Code of the Philippines – 1976
	Philippines Agenda 21 of 1990
	PD 1152 – Philippine Environment Code- 1977
	PD 1586 – Environmental Impact Assessment System of 1978
	1987 Philippine Constitution
	The Medium Term Philippine Development Plan 1999-2004
	Sustainable Tourism Development Framework
	Tourism Master Plan for 1991-2010
	Republic Act 8371 or the Indigenous Peoples Rights Act
	Joint DENR-DOT Memorandum Circular – Guidelines for Ecotourism Development
	DENR Memorandum Circular – Guidelines for Ecological Destination Development and Management in the Philippines
	Republic Act 7160 – Local Government Code of 1991
	Republic Act 6969 – Toxic and Hazardous Wastes Control Act of 1990
	Republic Act 7076 – Small Scale Mining Law
	Republic Act 7942 – Philippines Mining At of 1995
	Executive Order 247 – The Bio-prospecting of Biological and Genetic Resources of 1996
	Republic Act 8550 – Revised Fishery Code of 1998
	Republic Act 8749 – Clean Air Act of 1999
	Republic Act 9003 – Solid Waste Management Act
	Republic Act 9072 – Cave and Cave Resources Management and Protection Act of 2001
	Republic Act 9147 – Wildlife Resources Conservation and Protection Act of 2001
	Republic Act 9275 – Philippine Clean Water Act of 2004
Provincial	Bohol Environmental Code of 1998
	Executive Order No.02 – Banning the extraction of sand and gravel within protected areas and environmentally critical areas
	Executive Order No. 13 – Enforcing the salvage zone, sanitation laws and demolition of structures along the shorelines
	Bohol Agenda 21 of 1999
	Medium Term Development Plan CY 2004-2009 (Bohol Province)
	Bohol Integrated Development Plan (DOT 2002)
	Provincial Tourism Sketch Plan (1998)
	Central Visayas Tourism Master Plan (1997)
	Bohol Eco-Tourism Development Framework (1997)
	Panglao Island Tourism Development Plan (1995)
	Area Plan for Panglao Island (1991)

Source: Biodiversity Conservation and Ecotourism Framework Plan of Bohol 2006-2015

According to BTO, priority development projects in 2011 are the “Product Development and Assistance”, “Tourism Marketing and Promotions”, “Office Facilities and Staff Capacity Enhancement”, “Management Information System” and the “Provincial Tourism Council Administration”. Based on the above, it is reasonable to assume that the Bohol tourism focuses on development related to product, capacity and information.

Table 2.1-8 Priority Development Projects of 2011

Rank	Program/Project/Activity Description
1st	Product Development and Assistance Program a) Community Tourism Assistance Program b) Tourism and Related Establishments Standardization Program
2nd	Tourism Marketing and Promotions
3rd	Office Facilities and Staff Capacity Enhancement Programs
4th	Management Information System Program
5th	Provincial Tourism Council Programs and Administration
6th	Tourism Services
7th	Policy Standards Development
8th	EMS (Environment Management System) Support Program

Source: BTO Information

The Bohol province is divided into five tourism clusters to aim further tourism development, taking advantage of their regional characteristics and regional strengths.

For Panglao Island, the “Tourism Development Guidelines” has been formulated as shown in the Table 2.1-9.

Table 2.1-9 Table of Contents of Panglao Island Tourism Development Guidelines

Rule	Titles
Rule Ⅰ	Concepts and Definitions
Rule Ⅱ	Administration
Rule Ⅲ	Requirement for the Development of All Types of Establishment
Rule Ⅳ	Development Guidelines
Rule Ⅴ	Tourism Development Guidelines
Rule Ⅵ	Physical Development Guidelines
Rule Ⅶ	Social Development Guidelines
Rule Ⅷ	Transitory Provision

Source: Panglao Island Tourism Development Guidelines

2.1.5. Over-Use Problems of Balicasag Island and Alona Beach

Balicasag Island is the one of the most famous spots of the beautiful coral reefs in the Philippines, the number of divers and snorkelers are therefore rapidly increasing. Especially snorkel use is a bigger potential problem of over-use, from viewpoint of carrying capacity, because the volume of snorkelers is not required to be limited, but they are not educated or trained of how to use the coral reefs unlike divers. Additionally, Alona Beach in Panglao Island has more serious problems of over capacity of tourists, buildings of inadequate status and other inadequate structures built along the beach.

Source: Bohol Map (Bohol Tourism Office)

Figure 2.1-22 Location of Balicasag Island Alona Beech

1) Outline of Balicasag Island

Balicasag Island has an area of 25 ha and is located 10 km from Panglao Island. The island is surrounded by pure white beaches without any piers. Coral reefs surrounding the island are renowned spots for divers. As there are no regular ships to the island, tourist should hire boats at Alona Beach which take about 45 minutes to reach the island.. The island has one resort hotel, one school, one church, 134 households and has a population of 740 persons.

2) Coral Reefs

Six (6) main diving spots surround the island, namely “Marine Sanctuary”, “Turtle Point”, “Diver’s Heaven”, “Black Forest”, “Royal Garden” and Cathedral”. Of which, Marine Sanctuary can be enjoyed not only by diving but also by snorkeling. In the peak season from March to May, more than 100 boats come to the island and its surrounding areas with many divers and snorkelers enjoying the beautiful coral reefs.

Regarding Bohol’s coral reefs, Siliman University in Negros Island carried out a survey for grasping the current conditions and to propose a sustainable capacity of Balicasag coral reef in 2005 and 2006. In this proposal, the maximum user volume (diving and snorkeling) should be less than 5,000 – 6,000 persons per one site per year, it is, however, estimated that already more than 21,000 persons, meaning three times more than the maximum volume, are using one site in Balicasag in one year. The target sites of the survey were “Marine Sanctuary”, “Diver’s Heaven” and “Black Forest”.

In Panglao Municipality, a “Environmental Usage Fee (Sanctuary Fee)” was introduced a few years ago to collect 100 Pesos from a diver and 50 Pesos from a snorkeler for one day entry fee, it was, however, canceled by oppositions of local peoples and shops. On the other hand, in Apo Island next to Negros, under management by Siliman University a similar system is ongoing by collecting 500 Pesos from each diver and 350 Pesos from each snorkeler for one day entry fee.

3) Dolphin Watching

Around Balicasag Island and Pamilacan Island, tourists can also enjoy "Dolphin Watching" during the time from 6 to 8 o'clock in the morning by means of hiring boat at a cost of 2,000 Pesos per person. The dolphins can appear in schools of more than a 100 dolphins and sometimes they can be enjoyed in company of a whale.

4) One Resort Hotel

"Balicasag Island Dive Resort" is the only hotel on Balicasag Island, it has 20 cottages and 2 family rooms. The main purpose for visiting the hotel seems to be for the purpose of diving, therefore the visitors tend to be repeaters and they provide 80% of the hotel's annual occupancy, meaning 2,000 persons. The hotel has been launched in 1989 and was renewed in 2006. The hotel has an area of 1.5ha and is managed by TIEZA (Tourism Infrastructure and Enterprise Zone Authority).

5) Problems and Issues

Diving and snorkeling are gradually becoming a problem of over-use around Balicasag Island and Alona Beach. Snorkel-use has a bigger problem especially in the peak season because more than 100 snorkelers are grouping together at the same time at same place. Additionally the fact that snorkelers do not need to be educated, trained and registered makes the problem more serious, in contrast, divers-use could be limiting due to the required training and registration system which carries a much higher cost. All this will lead to an increase of the snorkelers' bad behavior such as tramping, kicking or stepping on the coral or even collecting the coral. According to major opinions from the divers who have been continuously visited around the area , the status of the coral reefs in Balicasag Island still seem to be in a good condition similar as before, however in contrast, one coral reef in Alona Beach seems to be much worse than before.

With the dolphin watching around Balicasag Island, more than 30 boats with big engine noise levels rush toward the schools of dolphins during their surface floating time. When boats approach the dolphins closely, the dolphins tend to go down under the water surface level. Consequently, the watching activities disturb the dolphins' natural swimming habit. In the peak season of April and May, the number of boats seems to increase to more than 50 boats, it can be assumed that over capacity has already been reached.

Inland of Balicasag Island, recently the problem of a growing number of residents is likely to appear. The Original 20 households have recently grown to a current of 134 households. It shall cause nature pollutants such as sewerage, solid waste or cutting trees. Also the island has a land responsibility (ownership) problem among the Navy, Coastal Guard, TIEZA or Panglao Municipality. Therefore Bohol Province tries to coordinate these organizations.

On the other hand, Alona Beach has more serious problems of over capacity of tourists and buildings of inadequate status and other inadequate structures built along the beach.

According to the laws and regulations, buildings should be set back 20m from the coastal line, however many buildings such as restaurants and shops are illegally built beyond the regulated line.

View of Balicasag Island

View of Balicasag Resort Hotel

Houses in Balicasag Island: households in the island are gradually increasing

Dolphin Watching: boats rush to floating dolphins and sometimes disturb them

Many boats in Alona Beech: for diving and snorkeling, boats wait for visitors while floating

Alona Beach: buildings have been built too close to the coastal line

Source: JICA Study Team

Figure 2.1-23 Views and Problems of Balicasag Island and Alona Beach

2.1.6. Trials for Community-Based Tourism Development

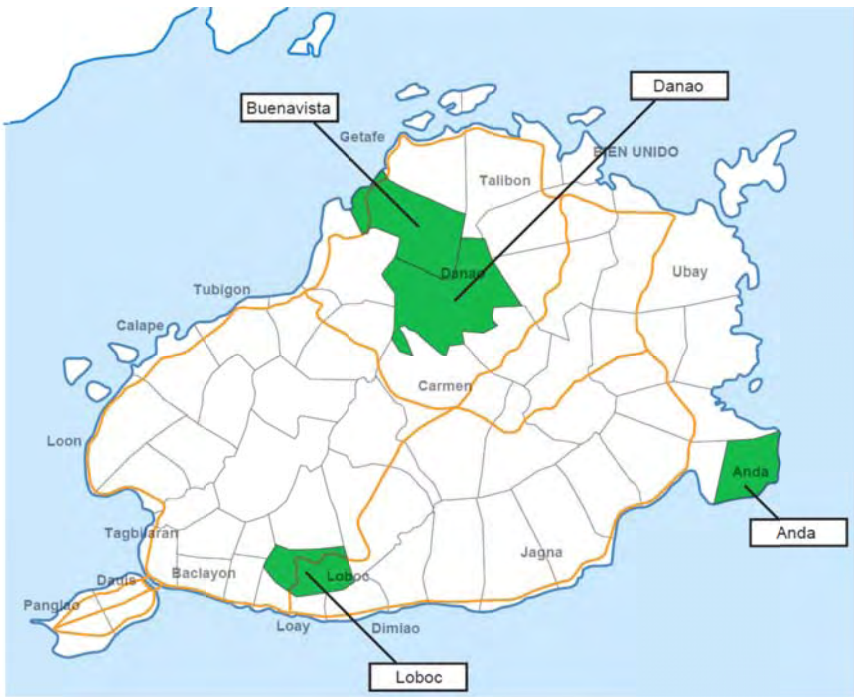
Not only Panglao and Tagbilaran but also other municipalities are managing to utilize their tourism resources by means of development of community-based tourism with strengthening of their local characteristics. Bohol Province has just started to promote a concept of "One Town One Attraction" hence community-based tourism development shall progress in all municipalities in Bohol in the future.

In this study, four (4) examples of community-based tourism are introduced as follows; in Danao, Buenavista, Anda and Loboc. It is expected that these examples will more and more lead the development of community-based tourism and develop the "One Town One Attraction" concept..

Table 2.1-10 Four Examples of Community-Based Tourism

Municipality	Tour Name	Characteristics
Danao	Danao Adventure Park	A tour that one of the poorest municipalities created one of the most attractive spots.
Buenavista	Cambuhat Village Eco-Tour	A tour which can enjoy learning local farming and eating local farm products and oysters.
Anda	Lamanok Island Eco-cultural Mystic Experience Tour	A tour which introduces local nature and historical culture through local fisheries.
Loboc	Loboc River Cruise	A tour which utilizes characteristics of local people who love music and instruments.

Source: JICA Study Team



Source: JICA Study Team

Figure 2.1-24 Locations of Four Examples Municipalities

1) Example in Danao Municipality

"Danao Adventure Park", a large-scale adventure site, is funded and operated by Danao Municipality. It has an area of 60ha and many activities such as "Plunge", "Caving", "Zipline", etc. From 2009 when it opened, many tourists visited here and now an annual number of visitors counts stands at 60.000 persons. Many domestic students visit here during their educational tours to enjoy stimulating experiences, because Bohol is originally one of the most famous destinations of educational tours in Philippines. Initial cost for construction was 12 million peso and the earning in 2009 was 17 million Pesos, in 2010 their earning was 32 million Pesos. Although there are only eight (8) accommodation rooms currently, the Park has plans to expand its accommodation and restaurant facilities.

Danao was in fact one of the poorest municipalities in Bohol in 2003, for the purpose to improve its condition, this adventure site was constructed to create new employment especially for the poor and to develop the local economy. Now the Park employs approximately 100 staff. At the site, visitors can enjoy "Caving" at one of the three caves. It takes one and a half hours for the easiest cave tour, the more challenging cave tours require a much longer time. The concept of a maximum carrying capacity for caving was introduced, now the maximum volume of users is regulated to 20 people per cave per day.


"Plunge"


"Caving"


Reception and Restaurant

Source: JICA Study Team

Figure 2.1-25 Example of "Danao Adventure Park"

2) Example in Buenavista Municipality

Buenavista is located at the north part of Bohol Island where it takes a travel time of two (2) hours by car to reach Buenavista from Tagbilaran City. Buenavista is famous for oyster farming and the "Cambuhat Village Eco-Tour" is in operation now which takes approximately 3-4 hours. This tour is a package of a river cruise, observing oyster farming, lunch including oyster cuisine and a cultural dance show, which cost 650 Pesos per person. Obviously the main sales point of this tour is the oysters, which visitors can enjoy observing and eating. The number of visitors is increasing from 100-200 persons/year at the time of opening to 800 persons/year currently, Koreans, Americans and Japanese form the majority of the foreign visitors. According to an operative manager, 1,000 persons/year is the maximum carrying capacity of the Eco-Tour.

In 1999, a Peoples' Organization was organized and the tour has been launched from 2000. Now the tour is operated by the Joint Project of Peoples' Organization and the LGU. The LGU started to support the tour in 2005 with the construction of two rest facilities, which are located at each the start-place and the destination-place. Additionally from 2008 a LGU staff has been dispatched in support of the business management.


River Cruise

Oyster Farming

Cultural Dance Show

Source: JICA Study Team

Figure 2.1-26 Example of "Cambuhat Village Eco-Tour"

3) Example in Anda Municipality

Anda is located on a peninsula at the south-east part of Bohol Island and has beautiful white sandy beaches and coral reefs, so called "The second Panglao". Anda has the potential to be one of the biggest tourism destinations, and now with the construction of a circumferential -road around the island tourists can arrive here within 2 hours from Tagbilaran. In 2006 the local fishermen' organization (BAFIAS) started the preparation of the "Lamanok Island Eco-cultural Mystic Experience Tour" it was launched in 2010. In the tour, visitors can enjoy beautiful landscapes of mangroves, small islands and historical remains. The number of visitors seems to increase gradually although exact numbers are unknown as only recently the counting of visitors has started. Concerning the share of visitors, domestic visitors dominate with 60% and foreign visitors stands at 40%. The tour costs 275 Pesos including a tour guide and a river cruise.

The tour started under the support framework of "Philippine Australia Community Assistance Program (PACAP)" for the purpose of developing local tourism and economy as well as maintaining local resources and in support of poverties. This assistance program was finished in 2009, following which the BAFIAS operates the tour supported by the LGU. The LGU supports, among others the construction of pedestrian wood decks, employment of staffs for site management, appeal and advertisement of the tour, education and training of staffs.

Lamanok Island

Wood Deck in Mangrove

A Tour Guide

Source: ANDA Homepage (left), JICA Study Team (center and right)

Figure 2.1-27Example of "Lamanok Island Tour"

4) Example in Loboc Municipality

Loboc is located along the way to the Chocolate Hills, it takes less than one hour from Tagbilaran City by car. "Loboc River Cruise" is a very popular tour to serve lunch for tourists who visit the Chocolate Hills. In the cruise, tourists can enjoy buffet style lunch or dinner, and a one hour river cruise. During the cruise, tourists also enjoy entertainment of singing and dancing by local dressed ladies. The cruise operates everyday and costs 300 Pesos per person for lunch or 450 Pesos per person for dinner.

Onlyat the dinner cruise on Friday and Saturday, tourists can enjoy the "Loboc Youth Band" after the cruise in a small concert hall next to pier by paying an additional 100 Pesos. The band's members seem to be mainly composed of junior high-school and high school students and they play saxophones, flutes, trumpets, oboes and so on. The band entices the tourists for one and a half hours with sophisticated movements similar to a marching band.

In fact, Loboc Municipality is famous as the "Music Capital" of Bohol. Originally local people love music and playing instruments. It can be said that Loboc makes the maximum use of its local characteristic and strength in combination with a good location to attract tourists.

River Cruise Entertainment

River Cruise Entertainment

Loboc Youth Band

Source: JICA Study Team

Figure 2.1-28 Example of "Loboc River Cruise"

2.2. Suggested Direction toward Sustainable Tourism Development in Bohol

2.2.1. Planning Issues

1) Mitigating Environmental Impacts against Rapidly Increasing Tourists and Securing Tourism Resources with Sustainability

1. Transition to Real "Eco-Tourism"

It is necessary to make a transition from the current "short-time-hopping-tourism" to real "Eco-Tourism" and "Agri-Tourism" to increase the tourists' satisfaction. Additionally, it will be more effective to be a high-quality island by means of formulation of good landscape with taking care of natural environment conservation.

2. Breakaway from Current Sole Tourism Base-area

It is necessary to break away from over-concentration of tourism base-areas in Panglao Island and Tagbilaran City only; hence decentralization of tourism base-areas should be accelerated by means of creation and enhancement of attractive and characteristic new tourism base-areas such as at Anda and Calape.

2) Differentiating Bohol Tourism Style from Cebu's International Tourism Island and Strengthening Bohol's Linkages with Neighboring Islands

1. Transition to Real "Eco-Tourism"

It is necessary to make a differentiation between the "Mass-Tourism" style of Cebu and the "Eco-Tourism" / "Agri-Tourism" style of Bohol in order to attract a larger number of tourists. For the above, it is strongly recommended to make a comfortable atmosphere through local people's hospitality and their closeness.

2. Breakaway from Current Sole Tourism Axis

It is necessary to break away from over-concentration of the tourism axis of Tagbilaran-Cebu only, hence establishment of new tourism axes linking Bohol with other neighboring islands such as Negros and Mindanao, including the southern area of Cebu. In addition, it is recommended that current main axis of Tagbilaran-Cebu is transferred to Tubigon-Cebu.

2.2.2. Proposal of Tourism Development Visions and Directions

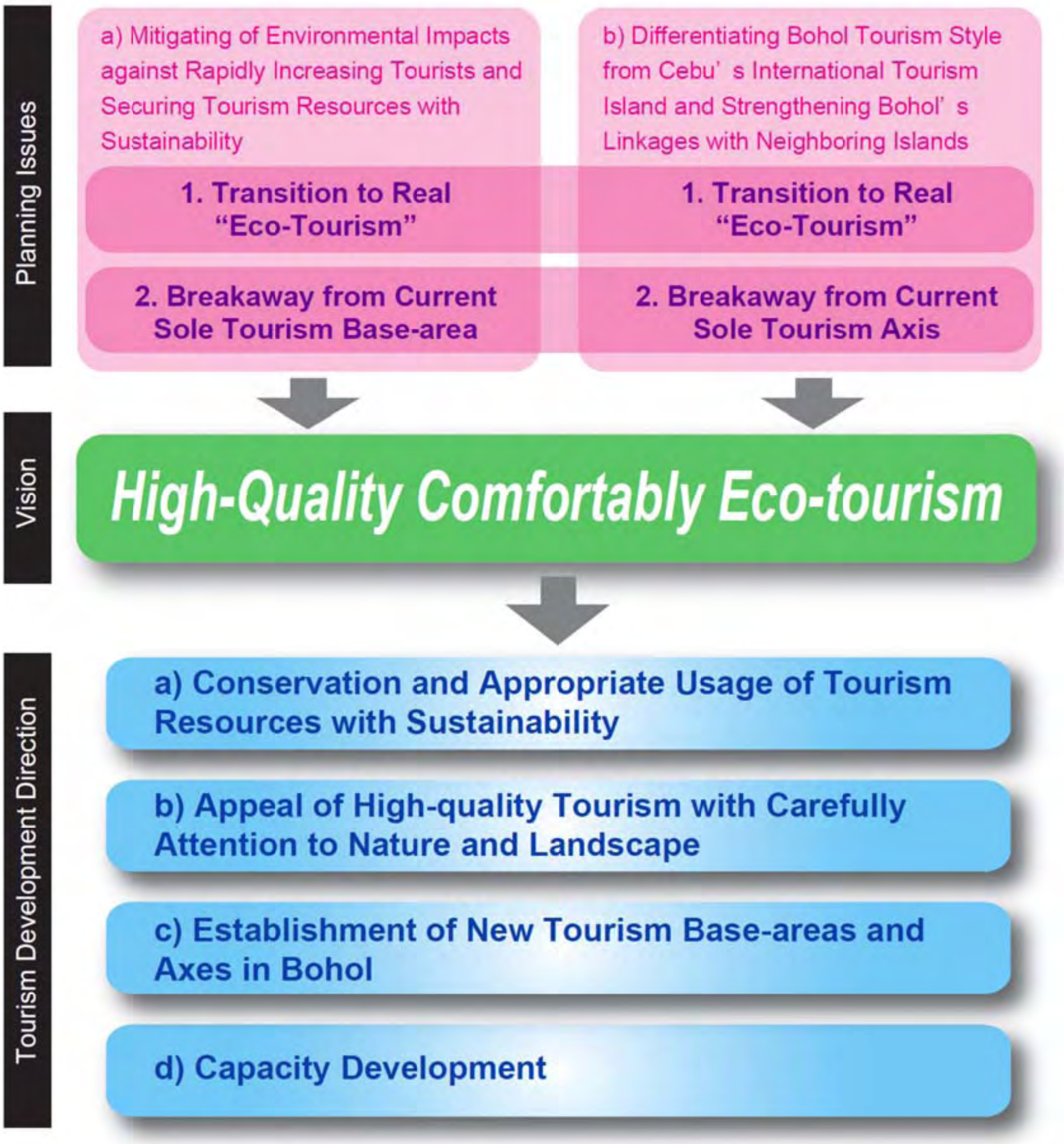
The Bohol province established "Green Bohol!" for a future vision in the Provincial Development and Physical Framework Plan (PDPFP) and emphasized "Bohol has it all!" which means they can correspond to any tourist needs' in the "Tourism Master Plan on the Tourism Clusters of Bohol Province."

Bohol province has a "Bohol Eco-tourism Vision" as below, which was formulated in 2003 and revised for the 2011 "Bohol Pre-Tourism Summit Conference."

Bohol as the country's prime eco-cultural tourist destination where visitors experience and learn from its distinct beauty and culture nurtured by a community committed to environmental, cultural and economic sustainability while meeting global tourism standards.

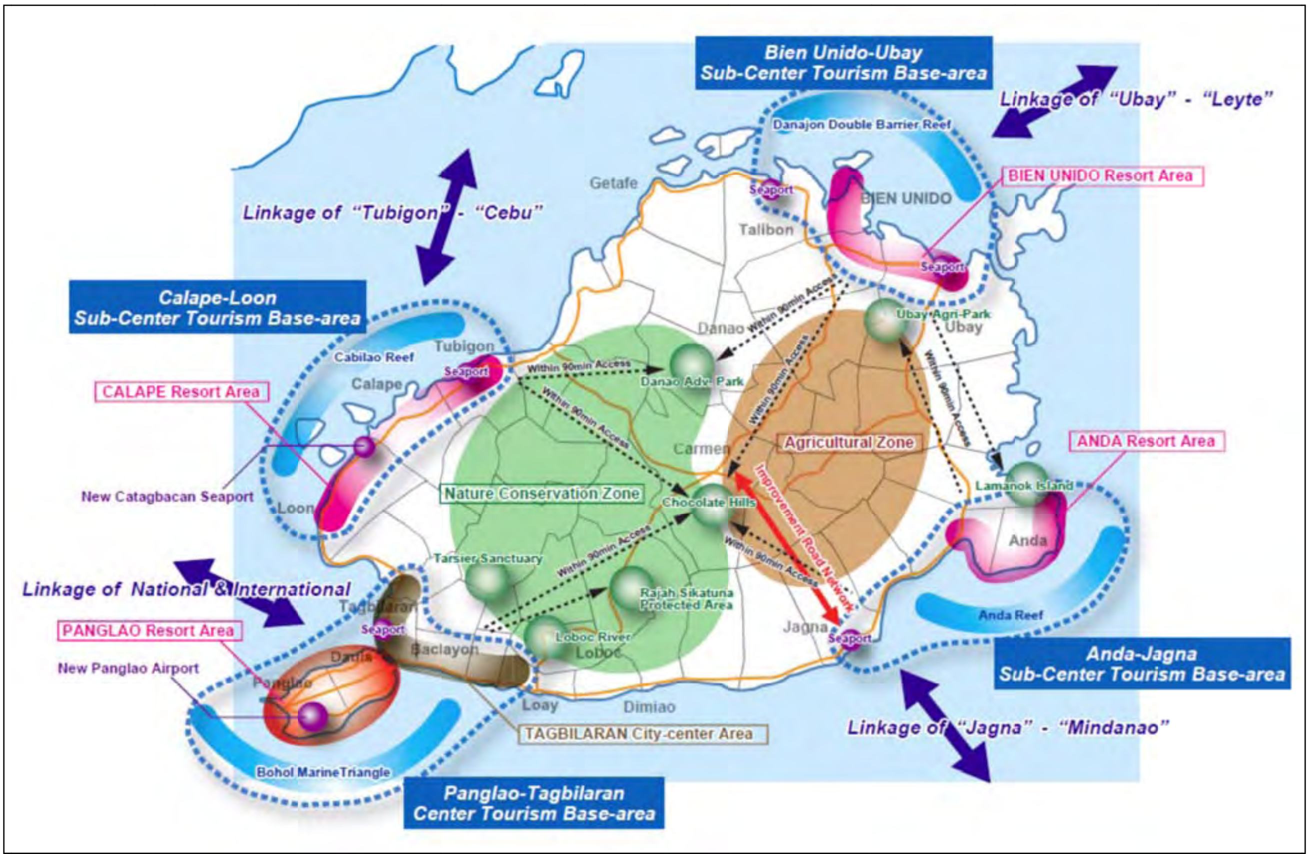
In this study, it proposes a "High-Quality Comfortably Eco-Tourism" as a tourism development vision, based on the planning issues and Bohol Eco-tourism Vision mentioned above.

Bohol still has good nature and atmosphere tourists can enjoy and be relax, on the other hand local people are getting realize environmental change caused by tourists increase rapidly. Therefore, it can be said that now is a good opportunity to establish Bohol's Eco-tourism. To respond to tourists increase tendency it is important to establish a system or a mechanism to implement the vision, "High-Quality Comfortably Eco-Tourism" by means of conducting tourism development programs as followings. This must achieve tourism development with good balance even if the new Bohol Airport will be constructed.



Source: JICA Study Team

Figure 2.2-1 Relationship Diagram of Planning Issue, Vision, and Direction



Source: JICA Study Team

Figure 2.2-2 Proposed Bohol Tourism Development Direction Image

Source: JICA Study Team

Figure 2.2-3 Proposed New Tourism Base-areas

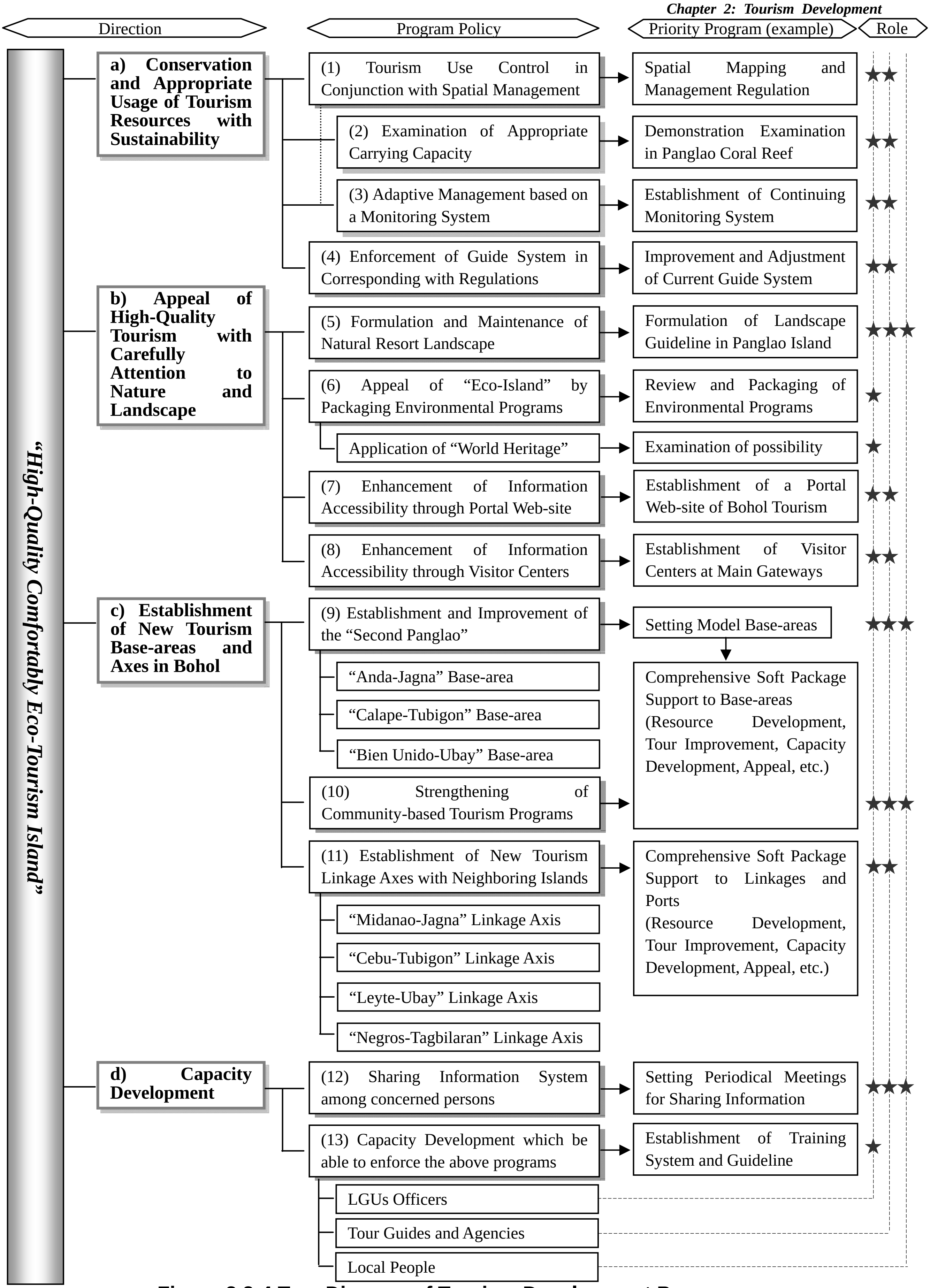


Figure 2.2-4 Tree Diagram of Tourism Development Programs

2.3. Proposal of Tourism Development Programs

Based on the diagram of the tourism development visions and directions as shown in Figure 2.2-4, some programs should be carried out as following indications and examples.

2.3.1. Conservation and Appropriate Usage of Tourism Resources with Sustainability

(1) Tourism Use Control in Conjunction with Spatial Management System

Bohol Province formulated the "Provincial Development & Physical Framework Plan (2010-2015)" to set a framework of a future land use plan for the whole Bohol. Based on the provincial framework, each municipality formulates a "Comprehensive Land Use Plan (CLUP)" on local level. Normally these land use plans indicate comprehensive directions of land use, such as urban use (residential, industrial and commercial), agricultural use, forestry use and so on. The plans cover both public lands and private lands to regulate and control development activities and building uses.

For the achievement of sustainable tourism development, tourism use control, both its volume and method, should work with spatial management system regulated by CLUP, to take a balance between tourism development and nature conservation. This spatial management system for tourism use control will have tourism use zoning which will correspond to rules and regulations of tourism use as shown in Table 2.3-2. The system should consider nature conditions, characteristics and methods of how tourists use the zones and how nature should be conserved and managed. For examples, regulation can be applied by the zones as follows;

- ✓ (Example 1) In the zone which is required to conserve nature strictly, although tourism use must be basically prohibited, limited tourism use shall be allowed, such as only for one month use, only for tourists accompanying a registered guide, only for 50 persons per day and so on, depending on nature conditions thorough the monitoring.
- ✓ (Example 2) In the zone which is better to conserve nature followed example 1, tourism use shall be basically allowed but limited use depending on nature conditions. In the case of nature conditions getting worth, tourism use shall be prohibited for required period.
- ✓ (Example 3) In the zone which is important habitat for rare wildlife species, tourism use must be limited depending on wildlife activities such as their transferring, breeding, feeding and so on.
- ✓ (Example 4) In the zone which is utilized for fisheries shall be restricted fishing methods and/or fishery catches volume in harmony with biodiversity and wildlife habitat.
- ✓ (Example 5) In the zone which is needed to mitigate environmental impact and risk, lecture shall be imposed by a guide.

To operate a spatial management system above, it is important that system links with "Usage

Control Management with a Maximum Carrying", "Adaptive Management with a Monitoring System", "Enforced Guide System" as one package program,

For the introduction of this spatial management system, the "Sustainable Environmental Manage Project in Northern Palawan" commenced in 2006 by a Yen-loan, should be referred to, as shown in Figure 2.3-1.

Table 2.3-1 Program Scheduling (1)

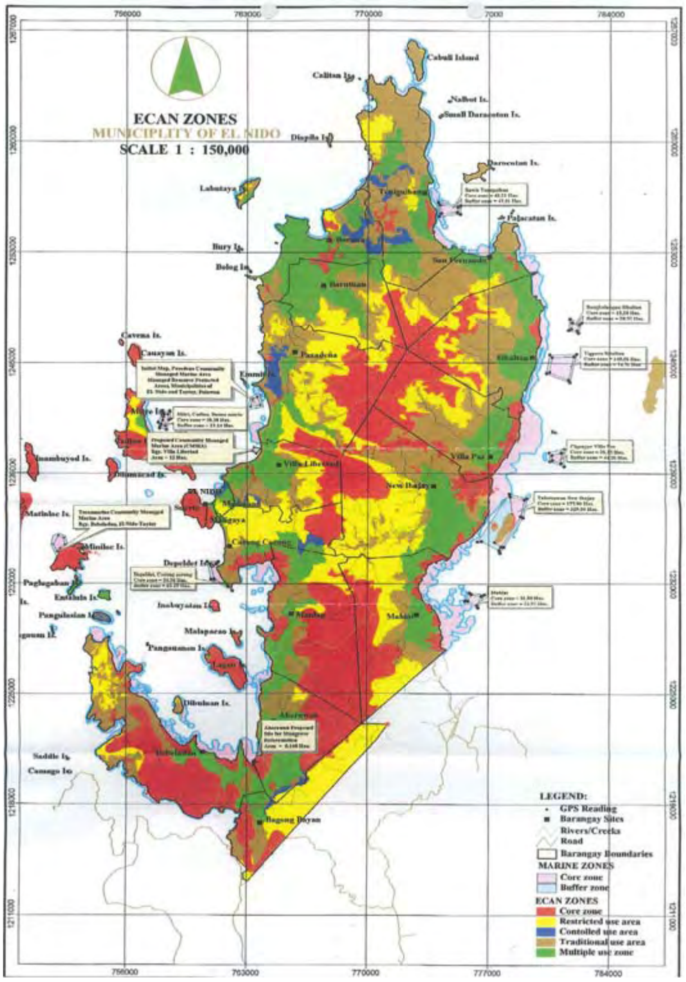
Term	Detailed Programs
Short-term	- Formulating land use (tourism use) zoning and mapping - Establishing rules and regulations corresponding the zoning
Middle and Long term	- Operating and improving the system based on PDCA - Diffusing the system to local people and tourists

Source: JICA Study Team

Table 2.3-2 Concept of Spatial Management Zoning and Regulation (Image)

Zone	Core Ⅰ Zone	Core Ⅱ Zone	Buffer Ⅰ Zone	Buffer Ⅱ Zone	Urbanized Zone
Recreation Opportunity Spectrum	Primitive	Semi-Primitive	Roaded Natural	Rural	Urban
Main Land Use	Forest and Grassland Area			Agricultural and Forestry Area	Urbanized Area
Nature Conditions	Natural	Semi-natural	Secondary-natural		Artificial
Importance for Wildlife	Very Important Habitat	Important Habitat	Buffer Habitat of Core Zone	Fringe Habitat of Buffer	(No importance)
Utilization for Ecotourism	(Prohibition in use)	Wild Nature Experience	Recreation Nature Experience	Agriculture and Forestry Experience	Training and Study Experience
Frequency for Ecotourism Use	(Prohibition in use)	Limited Use by Approval	Normal Use for Ecotourism		Living Use
Facilities for Ecotourism	No Facility	Trail only	Trail, Sign, Explanation Board		Education and Visitor Center
Accompanying Guide	(Prohibition in use)	Indispensability of Accompanying Guide	Accompanying Guide if want		

Source JICA Study Team



Source: Sustainable Environmental Manage Project in Northern Palawan

Figure 2.3-1 ECAN Zoning Map in Northern Palawan (Example)

(2) Examination of Appropriate Carrying Capacity

Definition of "Carrying Capacity" in this study: the maximum number of people and/or the tourism use method (high-quality tourism such as eco-tourism and agri-tourism) that may visit a tourist destination at the same time, without causing destruction of the physical, economic, socio-cultural environment and an unacceptable decrease in the quality of visitors' satisfaction.

It should be considered to keep a proper maximum carrying capacity of Bohol with the current growing volumes of both tourists and population. Especially on Panglao Island, tourism use may continue to excessively expand and new hotels and buildings may also construct due to its attractive white beach resorts and its easy accessibility.

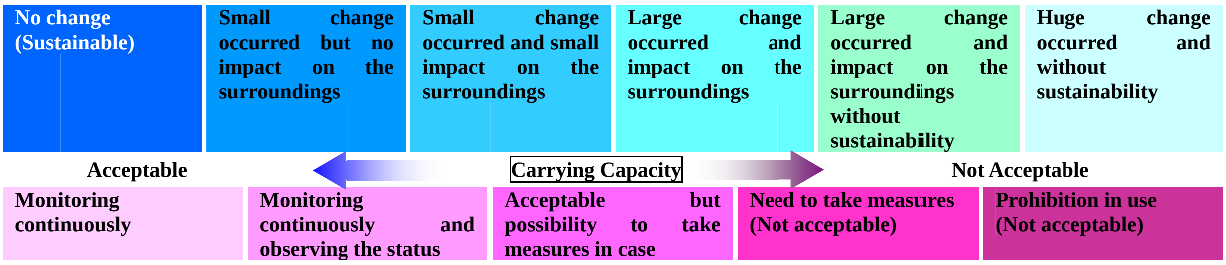
For avoiding and mitigating excessive concentration of use, it is necessary to introduce a "Usage Control Management" system based on a concept of "Maximum Carrying Capacity" especially on Panglao Island, as well as to accelerate decentralization of base-area of tourism as shown in Figure 2.3-2. What is especially important in the immediate future is to control the marine area of Panglao Island where over-use problems are appearing, such as at Balicasag Isand and Alona Beach. This system should be applied mainly to the usage of diving, snorkeling, dolphin watching and beach resort as soon as possible similar to the whale watching example as shown in Figure 2.3-3. The system may be also in relation with goals and policies of Coral Triangle Initiative (CTI), to be set in the future, such as when maximum carrying capacity is set. Additionally, it is recommended to examine and introduce a similar concept of “Sanctuary Fee” for entry into the island or a regulation of limited hotel rooms for construction hotel on the island in order to avoid and mitigate over concentration of tourists’ number in Panglao Island. In the middle or long term, in some major tourism facilities such as Chocolate Hills, the system should also be introduced, because the physical spaces of these tourist facilities for tend to be limited.

In Balicasag Island, the Siliman University in Negros carried out a survey of maximum carrying capacity a few years ago. This survey can be referred to examine further steps as shown in Figure 2.3-4.

Table 2.3-3 Program Scheduling (2)

Term	Detailed Programs
Short-term	- Conducting demonstration experiment in marine area of Panglao
Middle and Long term	- Operating and improving the system based on PDCA - Introducing the system in other areas and facilities

Source: JICA Study Team

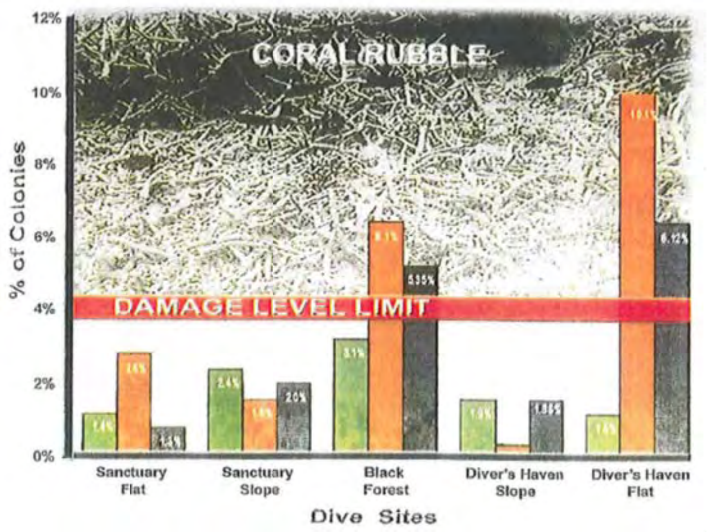


Source: “Tourism city planning and engineering” revised by JICA Study Team

Figure 2.3-2 Concept of Spatial Management based on Carrying Capacity (Image)

Source: DENR, DA-BFAR, DOT, Ocean Park Conservation Foundation , WWF-Phil

Figure 2.3-3 Guidelines for Dolphin Watching (Example)



Source: Report of "Balicasag Island recent findings and management options"

Figure 2.3-4 Average Percent of Coral Colonies damaged by Divers in Balicasag Island (Example)

(3) Adaptive Management based on a Monitoring System

For aiming sustainable usage of tourism resources, it is necessary to apply an "Adaptive Management" concept which means managing the natural environment flexibly with carefully observing change of nature conditions based on results of a monitoring process. It is important to understand and show clearly a change of tourism resource quantitatively through the monitoring process.

Currently, a technical cooperation project is conducting collecting tourism statistics, accordingly comprehensive data are being gathered on a national level. However on a local level, data seems not to be sufficient to understand conditions of nature environment conservation and usage.

At first, monitoring sites will be set up in some areas where over-use problems are appearing, the monitoring should be conducted continuously. At the monitoring sites, it is required to monitor the problems that each site is having, such as water quality, air quality, vegetation, wildlife habitat, etc. As noted above, the adaptive management should be conducted to understand the change of tourism resources through continuous and periodical monitoring.

Regarding the methods of monitoring, it is recommended to introduce easy and economical methods with cooperation of tour guides and people's organizations as much as possible to avoid large budget and many labors to perform the monitoring.

Table 2.3-4 Program Scheduling (3)

Term	Detailed Programs
Short-term	- Setting pilot monitoring sites and methods - Conducting pilot monitoring and gathering data
Middle and Long term	- Establishing monitoring system in the whole province - Operating and improving the system based on PDCA

Source: JICA Study Team

(4) Enforcement of Guide System in Corresponding with Regulations

The current "Tour Guide" system in Philippines has already been established with submitting required documents, undertaking training course and passing examination by DOT. Seventy (70) tour guides are registered in the whole Bohol as of 2009, also in addition they are required continuing education and renewal of their license, hence this system secures high-quality guides. As the current system mainly targets knowledge of tourism resources and technique of explanation, it can be said that at the moment knowledge related to environmental conservation and sustainable tourism development is not enough developed. Additionally, it seems to be insufficient that current system is not able to take care of marine areas where many problems of over-use are appearing, as the system mainly focuses on terrestrial areas.

It is necessary to renew the current guide system by adding requirements of environmental conservation knowledge and to establish a new system which has corresponding regulations between usage control zoning and an accompanied guide system as an example shown in Table 2.3-6. For example; for some areas, which are damaged by tourism usage, it may be prohibited to enter without being accompanied by a registered guide.

Also it is recommended to establish a further marine guide system in addition to the current terrestrial guide system. It is reasonable that concerned people such as diving trainers and boat owners take a training course and an examination at minimum level in order to improve manner of snorkelers and other tourists.

Table 2.3-5 Program Scheduling (4)

Term	Detailed Programs
Short-term	- Improving training course of current guide system - Establishing additional marine guide system
Middle and Long term	- Establishing accompanied guide to usage control zone - Operating and improving the system based on PDCA

Source: JICA Study Team

Table 2.3-6 Regulation for Proper Using in Ogasawara Islands (Example)

Items	Minami Island (in Ogasawara Island)	Sekimon Area, Haha Island (in Ogasawara Island)
Route	No entry other than permitted route	No entry other than permitted route
Maximum Time for Use	Maximum 2 hours	(No restriction)
Maximum Tourist number per one day	100 persons (up to 15 persons at same time)	50 persons (up to 5 persons at same time)
Restrictions	No entry period (3 months in a year)	No entry to caves even on the permitted route
Maximum Tourist Number per one tour guide	15 persons	5 persons

Source: "Eco-Tourism (Ministry of Environment)"

Tourists are prohibited to enter this island without accompanying registered tour guide.

Tour guide bring tourists only inside pedestrian ways between two poles.

Tourists are prohibited to enter this island without accompanying registered tour guide.

Structural methods are sometimes effective to mitigate impacts on nature conditions

Source: JICA Study Team

Figure 2.3-5 Tour Guides System and Structural Method (Example)

2.3.2. Appeal of High-Quality Tourism with Carefully Attention to Nature and Landscape

(5) Formulation and Maintenance of Natural Resort Landscape

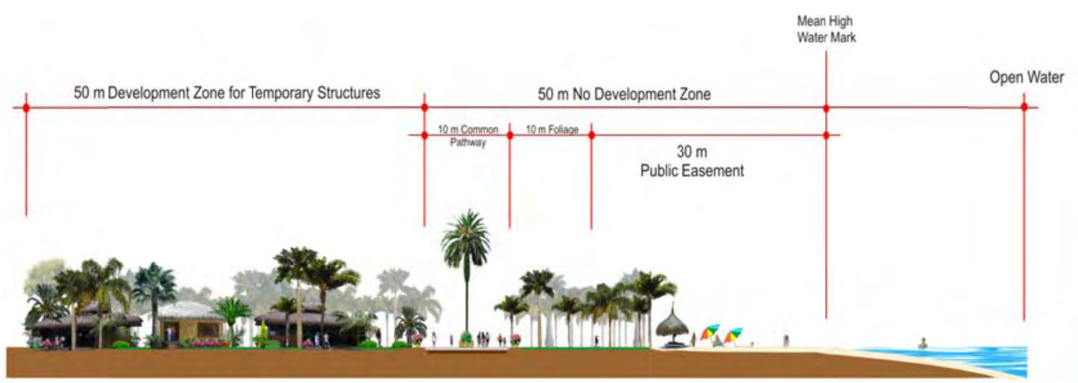
Panglao Island still has a calm and comfortable atmosphere and resort hotels look like hiding in trees and greens because of few middle or high buildings and less pressure by artificial structures. This atmosphere contrasts markedly with Mactan Island in Cebu which has many high rise hotels and developed urban areas. However even on Panglao Island, six stories hotel is currently under-construction and plans for hotel constructions seem to be on-going. An important point to emphasize is that the comfortable atmosphere of Alona Beach, the renowned public beaches rapidly being lost because the current regulation that artificial structure must be set back from the coastal line is not followed strictly.

It is necessary to preserve and maintain current the calm and comfortable atmosphere of Panglao Island which differs from Mactan Island, before rapid development starts which could be triggered by the new airport construction. To achieve this, a "Landscape Guideline" should be formulated and enacted to regulate location, height, volume, design, color of buildings and sign boards, and greenery direction. For example, Bali Island in Indonesia can be referred to which introduced the regulation of height of buildings as lower than one of its coconut trees.

Table 2.3-7 Program Scheduling (5)

Term	Detailed Programs
Short-term	- Formulating a landscape guideline in Panglao Island - Operating the guideline (regulation, leading and instruction)
Middle and Long term	- Formulating a landscape guideline in the whole province - Securing legal regulation of the guideline

Source: JICA Study Team



Source: "Eco-Tourism Development Plan for Panglao Island"

Figure 2.3-6 Site Selection of Resort Zone Delineation (Image)

(6) Appeal of "Eco-Island" by Packaging Environmental Programs

Appealing to an "Eco-tourism Island" must contribute to enhance a better image of Bohol tourism. It is necessary to make comprehensive efforts related to environmental consideration such as wildlife, energy, solid waste, water resources, landscape, environmental education, and so on. By means of a website, it should be promoted to appeal to environmental efforts not only by governmental plans, policies and programs, but also by any advanced efforts conducted by hotels, restaurants, people's organizations and NGO's. Additionally, it is recommended that a "Top Runner" system, in which backward companies need to follow advanced ones, should be introduced with support measures for advanced private sector in order to accelerate self-improvement.

"Chocolate Hills" appears to have a possibility to resister for the "World Heritage" of UNESCO which has a large potential not only to raise tourists volumes, but also to improve its quality as a tourism site, therefore it is recommended to examine the possibility and apply of the World Heritage, if possible.

Table 2.3-8 Program Scheduling (6)

Term	Detailed Programs
Short-term	- Gathering and Making database of environmental policies and efforts - Appealing the efforts through a portal website - Examining a possibility of register for "World Heritage" status
Middle and Long term	- Introducing support measures based on a "Top Runner" system

Source: JICA Study Team

(7) Enhancement of Information Accessibility through Portal Website

Currently there is no comprehensive website to transmit Bohol's tourism information to the wide world. In addition tourists who have just arrived at the airport or seaports may feel it is difficult to obtain tourism information, as there is no information center and then tourists are surrounded and caught by many taxi drivers with their high pressured selling method.

Therefore it is necessary to establish a "Portal Website" to provide easy access for everyone to proper information and to connect to multiple information between tourists' needs and municipalities' strengths for further promotion of the trials of "One Town One Attraction". In the portal website, tourists can make reservation for tours from all over the world with the posting of municipalities' tours. It will greatly assist municipalities which do not have enough appeal methods of their own. The Portal Website will work as a bridge between community-based tours and international tourists.

Table 2.3-9 Program Scheduling (7)

Term	Detailed Programs
Short-term	- Establishing a "Portal Website" of Bohol tourism sector - Examining appeal strategy as an "Eco-tourism Island" - Appealing the trial of "One Town One Attraction"
Middle and Long term	- Establishing a reservation system through the website - Making database of tourism resources archives - Disclosing the results of monitoring timely

Source: JICA Study Team


Wildlife Habitat Condition


Vegetation Condition


Tourists Using Condition

Source: Website of e-Tanzawa

Figure 2.3-7 Monitoring Database System on Website (Example)

(8) Enhancement of Information Accessibility through Visitor Centers

There is no visitor's center to supply comprehensive information for tourists even at neither the airport nor the seaports. This means that tourists cannot access good information efficiently without a portal website. Currently tourists may visit an office space of BTO (Bohol Tourism Office) which is located next to the provincial capital hall, however the space and function of this facility is not sufficient. The other option for tourists is to ask information at receptions of the hotel where they stay.

It is necessary to set up "Visitor Centers" which are able to supply comprehensive information and to give useful advice to tourists. In short-term, it may be difficult to construct a new visitor center facility , therefore it is better to secure required spaces in existing buildings at good locations and transfer functions as the visitor center with supplying of staffs, PC's, panels, brochures and so on. In the future, visitor centers should be constructed in good locations such as gateways and/or city centers.

Table 2.3-10 Program Scheduling (8)

Term	Detailed Programs
Short-term	- Transferring functions of visitor center
Middle and Long term	- Constructing visitor centers - Constructing information centers

Source: JICA Study Team

In a visitor center, information such as pamphlets and brochure is prepared.

A manned counter is also important to provide advice to tourists.

Source: JICA Study Team

Figure 2.3-8 Visitor Centers in Japan (Example)

2.3.3. Establishment of New Tourism Base-areas and Axes in Bohol

(9) Establishment and Improvement of the "Second Panglao"

Regarding tourism usage, its focal issue is how to break away from over-concentration on Panglao Island and in Tagbilaran City. For transferring tourist functions to Anda, namely "the second Panglao", Calape and Bienunido, supporting measures should be undertaken to accelerate the decentralization of the current sole tourism base-area and the formulation of new tourism base-areas. Additionally it is important to combine these new base-areas with surrounding areas to enhance their attractiveness.

- ✓ "Anda-Jagna" New Base Area (namely "First Class Resort")
- ✓ "Calape-Tubigon" New Base Area (namely "Light Hearted Resort")
- ✓ "Bien Unido-Ubay" New Base Area (namely "Private Hideaway Resort")
- ✓ "Panglao-Tagbilaran" New Base Area (namely "Central Major Resort")

Table 2.3-11 Program Scheduling (9)

Term	Detailed Programs
Short-term	- Setting new model base areas - Supporting comprehensive soft packaging (resource development, community-based tour improvement, capacity development, appeal, etc.)
Middle and Long term	- Applying usage control management same as Panglao - Formulating landscape guidelines same as Panglao

Source: JICA Study Team

(10) Strengthening of Community-based Tourism Programs

It is necessary to promote "Eco-Tourism" with vigorous community powers through accelerating "One Town One Attraction". This will also contribute to the decentralization of tourism usage apart from over-concentration only on Panglao-Tagbilaran. In order to spread out the current community-based trials, which are being conducted in Danao, Buenavista, Anda and Loboc, towards -for example- the whole province, comprehensive package supports are needed for all municipalities. With using the municipalities' strengths, tour development should be carried to create attractive "Eco-Tours", "Agri-Tours" and "Cultural-Tours" in all municipalities. The current community-based tours are still not sophisticated and nor very attractive, it is recommended to take care of these attractions to strengthen them in the viewpoint of foreign tourists and to advice how to improve the tours. In addition attractive souvenirs should be developed which can benefit the local economy.

Table 2.3-12 Program Scheduling (10)

Term	Detailed Programs
Short-term	- Supporting comprehensive soft packaging (resource developments, community-based tour improvements, capacity developments, appeals, etc.)
Middle and Long term	- Brushing up the community-based tours - Making long-term tours by promoting linkage with tours

Source: JICA Study Team

(11) Establishment of New Tourism Linkage Axes with Neighboring Islands

One of the characteristics of Bohol is that it is located at center of Central Visayas and that it has short-time accessibilities from the neighboring islands such as Cebu, Leyte, Mindanao and Negros. It is necessary to strengthen the linkages with neighboring islands for improving the whole of the attractiveness of the Central Visayas. It will lead to the increase of tourists and will develop the tourism sector and local economy. For strengthening the linkages, improvement of not only the ports but also access roads between ports and major tourism spots is be required.

- ✓ "Mindanao-Jagna" Linkage Axis
- ✓ "Cebu-Tubigon" Linkage Axis
- ✓ "Leyte-Ubay" Linkage Axis
- ✓ "Negros-Tagbilaran" Linkage Axis

Table 2.3-13 Program Scheduling (11)

Term	Detailed Programs
Short-term	- Supporting comprehensive soft packaging (cooperative support with model base-areas, etc.)
Middle and Long term	- Strengthening function of ports as gateways to neighboring islands - Improving accessibilities for providing access inside Bohol

Source: JICA Study Team

2.3.4. Capacity Development

(12) Sharing Information System among concerned persons

Though Tourism Councils have been set up in the province at each LGUs, it can be said that it is not sufficient to share and exchange information concerning tourism sector for the whole of Bohol. It is necessary to make and establish a system to increase sharing and promoting further exchange information and by certain methods such as to hold “Bohol Tourism Summits” more periodical.

Table 2.3-14 Program Scheduling (12)

Term	Detailed Programs
Short-term	- Setting a periodical opportunity to share information - Establishing a website system to share information
Middle and Long term	- Establishing comprehensive system to share information

Source: JICA Study Team

(13) Capacity Development which be able to enforce the above programs

It is necessary to establish training and enhancement systems to secure conducting programs written above. Targets shall be officers of province and LGUs, tour guides, tour agents, tourism concerned persons and local people including people’s organizations, The system should be divided into categorized targets. Additionally, guidelines and newsletters should be issued to guide local and concerned people.

Table 2.3-15 Program Scheduling (13)

Term	Detailed Programs
Short-term	- Establishing a system of training and edification - Making guidelines for concerned people and local people - Issuing and distributing newsletters to local people - Guidance by the webpage
Middle and Long term	- Conducting the system of training and enhancement continuously

Source: JICA Study Team

2.4. Proposal of a Priority Package Program

In previous section, Chapter 2.3, examples of tourism development programs indicated with categorized in items of (1) to (13). In these examples, a priority package program is proposed as below. It is expected that this priority package program will be done by JICA technical cooperation framework with focusing on Panglao Island as main target area.

A Priority Package Program for Sustainable Tourism Development

Goal	To establish an improved framework for the conservation and appropriate use of tourism resources under the concept of "carrying capacity", targeting on Panglao Island.	
Contents	**1) Establishment of Bohol's Implementation Organizations** i. To review and analyze current conditions of stakeholders ii. To establish "Regional Liaison Committee (tentative name)", which has roles to consider and decide directions of management and to promote liaison and coordination iii. To establish "Scientific Council (tentative name)", which has roles to provide necessary advices from viewpoints of scientific knowledge **2) Commencement and Continuance of a Monitoring System** i. To commence monitoring surveys in cooperation with relevant organizations to grasp environmental conditions and the number of tourists, and to examine the maximum carrying capacity ii. To operate monitoring system which consists mainly of collecting survey results and analyzing those results **3) Set of Goals and Policies for Sustainable Tourism Development and Establishment of Adaptive Management System** i. To set goals and policies for sustainable tourism development by Bohol's implementation organizations ii. To formulate tourism usage control methods in conjunction with existing CLUPs iii. To operate PDCA cycle, namely "Adaptive Management System" based on the results and analysis of monitoring to be conducted **4) Pilot Trials of Usage Control based on a Maximum Carrying Capacity** i. To set study areas and initial figures of carrying capacity in each study area ii. To conduct pilot trials to control the maximum number of tourists in study areas, and to review and modify proper figures of carrying capacity by feedbacks based on the monitoring results **5) Enforcement of Guide System for Tourism Usage Control** i. Improve the training course for the current guide system ii. Introduce a new guide system in marine areas as well as the current system in terrestrial areas **6) Capacity Development for Officials and Relevant Players** i. Formulate and conduct training programs for officials and relevant players ii. Prepare administrative guidelines for officials' use	
Implementation Organizations	Management Bodies	Administrative agencies that conduct the management. It may consist of Province of Bohol DOT (Department of Tourism), etc.
	Regional Liaison Committee (tentative name)	It has roles to consider and decide directions of management and to promote liaison and coordination. It may consist of members of existing committees, such as tourism, hotel, fishery, tour guide, diving shop, restaurant and commercial with management bodies.
	Scientific Council (tentative name)	It has roles to provide necessary advices from viewpoints of scientific knowledge. It may consist of members of researchers from university and institution, relevant NGO representatives, tour guides and other persons who have special knowledge.

Schedule	Two Years

Items	Period (2 Years)
1) Establishment of Bohol's Implementation Organizations	
2) Commencement and Continuance of a Monitoring System	
3) Set of Goals and Policies for Sustainable Tourism Development and Establishment of Adaptive Management Syste	
4) Pilot Trials of Usage Control based on a Maximum Carrying Capacity	
5) Enforcement of Guide System for Tourism Usage Control	
6) Capacity Development for Officials and Relevant Players	

Source: JICA Study Team

Chapter 3

Water Supply Facilities at New Bohol Airport

Table of Contents

Chapter 3. Water Supply Facilities at New Bohol Airport

3.1. Existing Water Supply System

3.1.1. Population in Survey Area

The population in the survey area is as shown in Population in the Survey Area.

Table 3.1-1 Population in the Survey Area

Population Census	Tagbilaran Municipality	Dauis Municipality	Panglao Municipality
2000	77,700	27,015	21,337
2007	92,297 (Growth Rate from public statistics: 3.6%)	36,525	25,558

Source: NSO and NSCB (2012)

According to the Bohol Integrated Water Supply Master Plan (the M/P), the water supply expansion project is supposed to supply water to Tagbilaran, Dauis and Panglao municipalities with Loboc River as the water source situated at approximately 20km east of the site. The Feasibility Study (F/S) is under preparation in 2012 and its details are not yet finalized. The M/P sets the water supply target year at 2035 with the development of a new water source.

3.1.2. Water Supply Situation in the Target Areas

1) Tagbilaran City

Tagbilaran City is one of the major port cities facing the Straits of Cebu and the Mindanao Sea. Surrounded by coral reefs, the city is a popular tourist destination including Panglao Island and receives many tourists throughout the year. Due to the increasing influx of tourists, the spread of waterborne diseases has become a likely event in recent years. Therefore, the policy implementation requires an urgent attention for an adequate supply of safe drinking water.

The population of Tagbilaran City is 92,297 (Census 2007), growth rate of public statistics is 3.6% (census 2007) and the increase rate of population is 3.6%. The increase in water demand by urban growth is not negligible. Water supply in Tagbilaran City is managed by Bohol Water Utilities, Inc. (BWUI) and Tagbilaran City Waterworks System (TCWS).

a) BWUI

BWUI supplies water to 59,300 out of 68,744 water supply population in the area in charge in 2011. The population served is 86%. The water consumption per capita is 268L/cap/day. BWUI directly supplies water to the southeastern area of Tagbilaran. It also supplies water for production to a part of TCWS and part of Panglao Island. The pump capacity at the water source is 23,487m3/day (operation for 20 hours) in March 2012. The water source is groundwater (shallow-well site borehole) in Corella. The water from this source is stored in the distribution tanks R6 in Dampas (2,000m3 = 1,000m3 x 2 tanks). The water is supplied to Tagbilaran and Dauis municipalities through these tanks. Most pumps are operated approximately 20 hours a day. The uncounted for water (UFW) with BWUI is 23%.

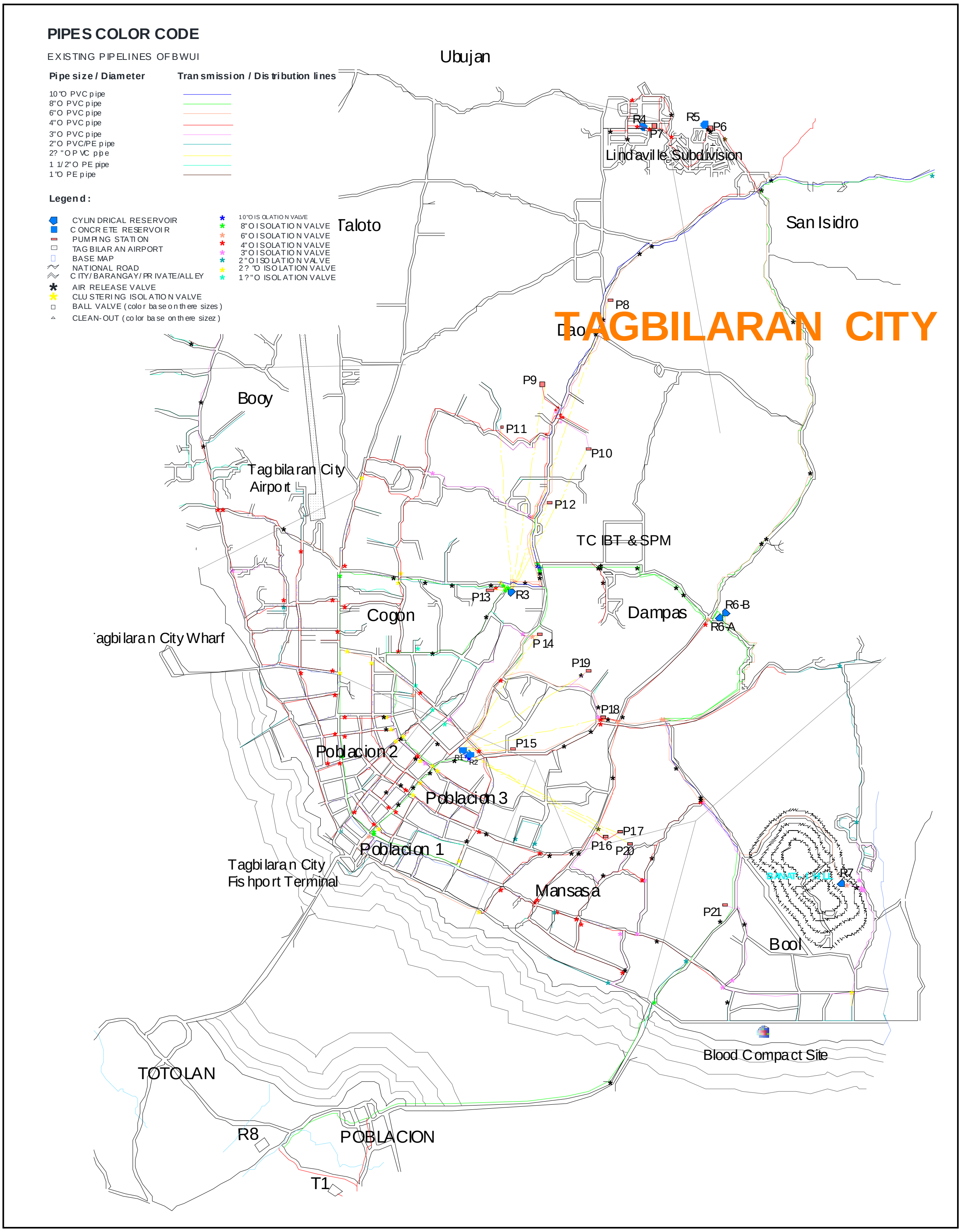
The water consumption in March (the summer season) 2012 is 20,753m3/day and 268 l/day/cap. (including 2,500m3/day for Dauis Municipality). There is still an excess of 2,743m3/day for use since the water yield is 23,487m3/day. The planned water demand for the new airport is 420m3/day, which is around 2% of the total water supply by BWUI. The diameter of transmission pipes is 200mm. These existing pipes have a capacity to increase water transmission to the new airport (based on the questionnaires to BWUI). These pipes will be shared to transmit water to the new airport. The existing pipelines of BWUI and the facility disposition are as shown in Figure 3.1-1 and Figure 3.1-5 respectively.

BWUI supplies water to 59,300 out of 68,744 water supply population in the area in charge in 2011. The population served is 86%. The water consumption per capita is 268L/cap/day. BWUI directly supplies water to the southeastern area of Tagbilaran. It also supplies water for production to a part of TCWS and part of Panglao Island.

b) TCWS

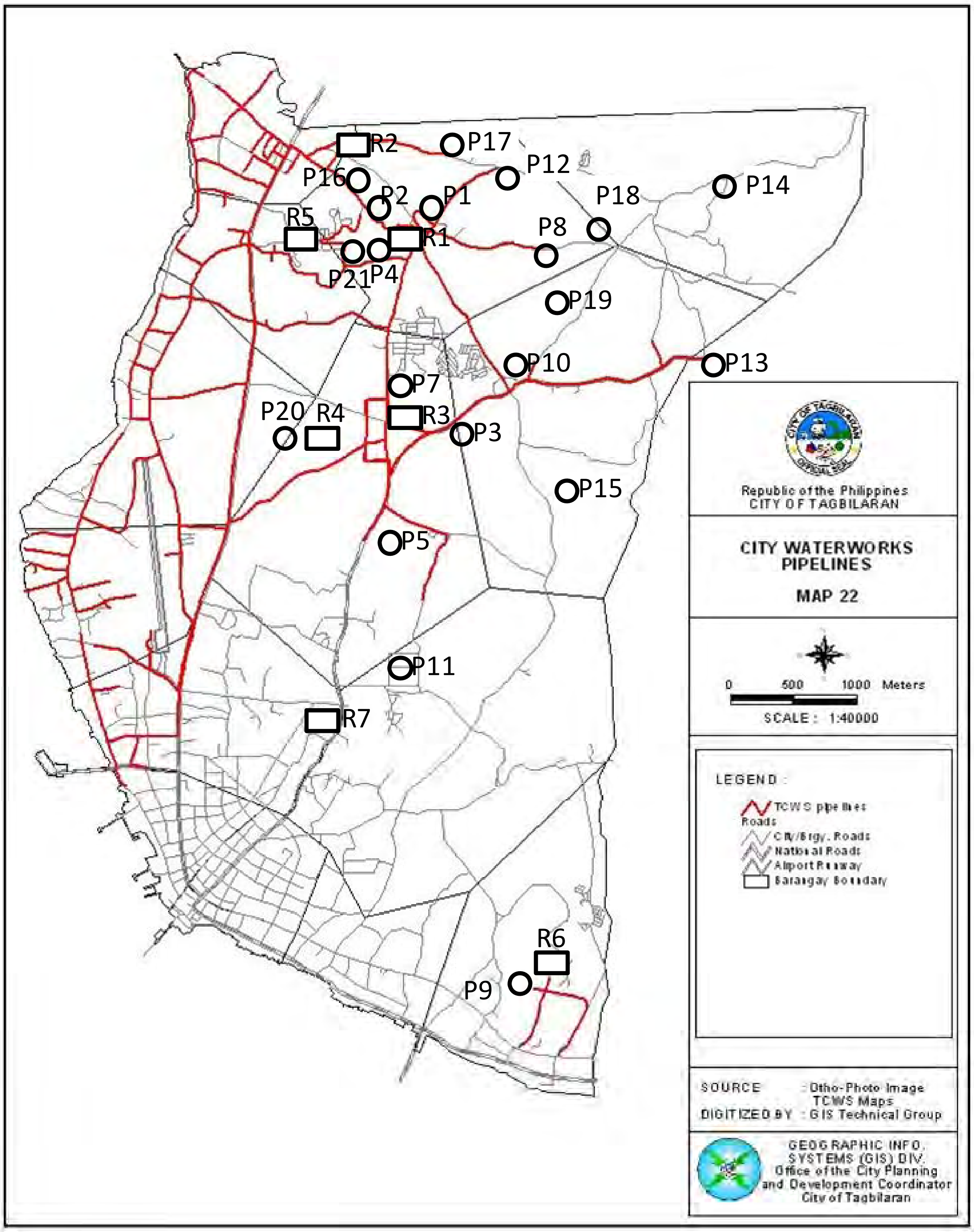
TCWS supplies water to 24,000 of water supply population in the area in 2010. The population served is 75%. The water consumption rate per capita is 140L/cap/day. TCWS directly supplies water to the northwestern area in Tagbilaran.

The pump capacity at the water source is 5,435m3/day in 2010. The water source is a borehole located in a barangay in Tagbilaran. BWUI also covers part of the TCWS supply area in the bordering areas between TCWS and BWUI. A new water source with groundwater is difficult to develop. The water supply amount is 4,632m3/day and 140 l/day/cap. from its own water source in 2011. UFW of TCWS is 25%. The existing pipelines of TCWS are as sketched in Figure 3.1-2.



Source: JICA Study Team

Figure 3.1-1 Existing Facilities and Pipeline of BWUI in TAGBILARAN CITY



Source: City of Tagbilaran

Figure 3.1-2 Existing Pipeline of TCWS

2) Panglao Island

The municipalities in Panglao Island depend on the groundwater for their water sources. The wells are artesian or boring wells with varying depths of a few dozens to 100m. The geological feature includes eroded limestone to be porous sponge that allows rainwater to penetrate the ground.

The network of distribution pipelines in each municipality is not covering suburban areas. Majority of the residents in the non-served areas purchase water from other houses connected to water supply at 1-2PhP/10L plastic container. Other residents may have personal boreholes or receive water distributed by truck at large resort hotels.

a) DAUIS

Water is supplied to 22,330 out of 45,735 water supply population in Dauis in March 2012. The population served is 49% and the water consumption per capita is 70L/cap/day.

The yield of the well in barangay is limited to 396m3/day. Together with 2,500m3/day supplied from the BWUI network, the total water supply capacity is 2,896 m3/day. The water from BWUI is supplied from 2 distribution tanks (T1=GL approx. 25m, T5= GL approx. 60m). The water is pumped up at R6 distribution tank in Tagbilaran in order to transmit water to an elevated tank. Therefore, the possible water supply amount is determined by the transmission pump capacity. The operation time of the pump is about 20 hours and the water is supplied almost 24hours. The water supply amount in March 2012 is 2,728m3/day covering 4,466 households. The development of a new water source in this area is difficult due also to salinization (based on a questionnaire to the Dauis Department of Water).

BWUI plans to receive water at the lower tank T1 by gravity fed system, and to pump up from the lower tank T1 to the higher tank for the future. This system is economically site stable because pressurization to the higher tank is partial (based on a questionnaire to BWUI). The main facility disposition in Dauis is shown in Figure 3.1-3.

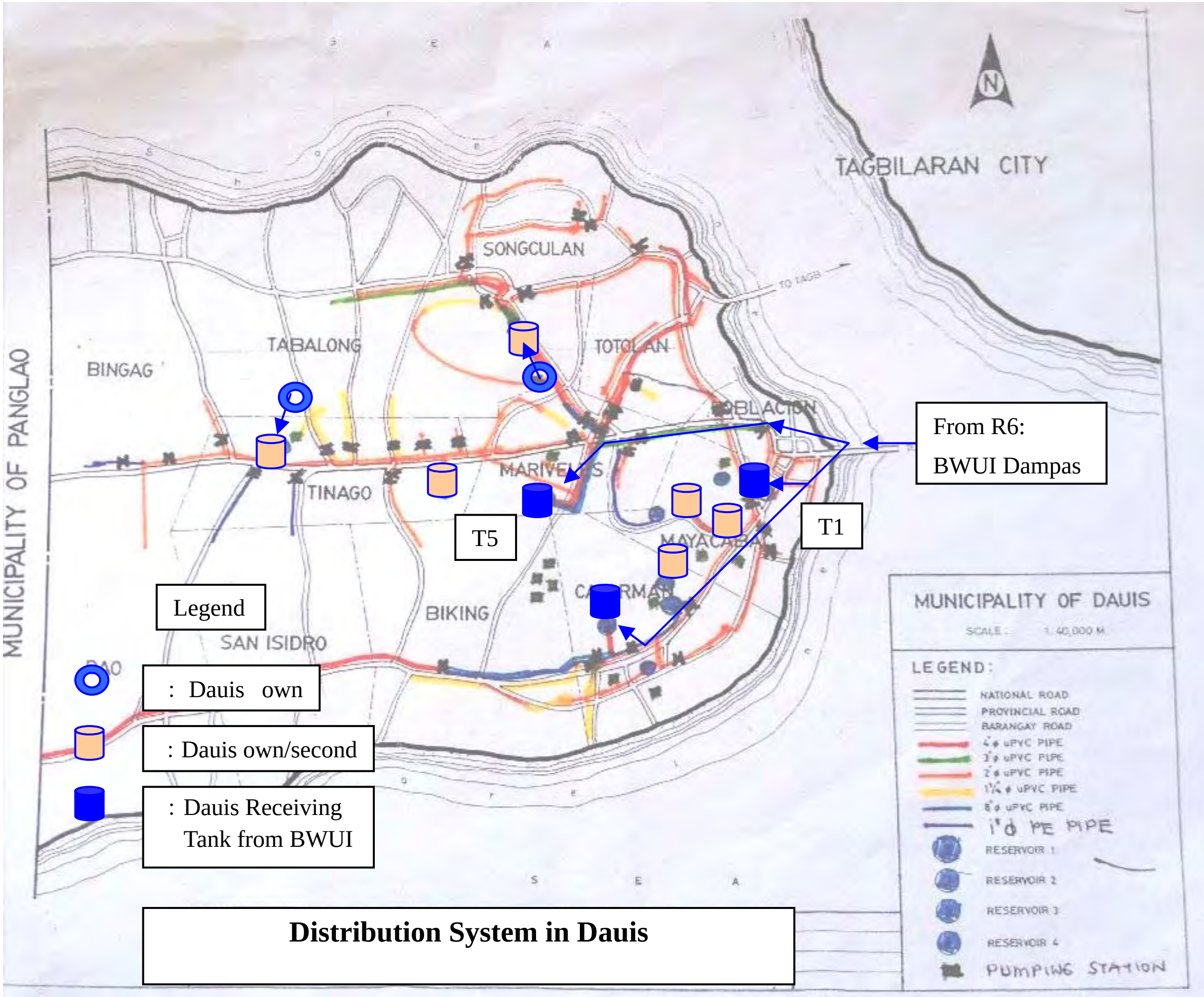


Figure 3.1-3 Existing Water Pipeline in Dauis

b) PANGLAO

Water is supplied to 18,580 out of 27,241 water supply population in Panglao in 2010. The population served is 68% and the water consumption per capita is 70L/cap/day (based on a questionnaire to Panglao water department).

The water source in the coastal area in Panglao is slightly salty and is not used for drinking. The water from a well on the island is filtrated by RO membrane or charcoal filter, and bottled for sale. Bottled water is widely consumed. The price of 20L bottled water is 20PhP.

Bacterial contamination from the surface of the ground sometimes occurs. In such a case, water is treated with chlorine by dissolving bleach mix into the distribution tank. The injection quantity of chlorine is 50kg/3months (6,210PhP/50kg). The existing pipelines in Panglao are as shown in Figure 3.1-4.

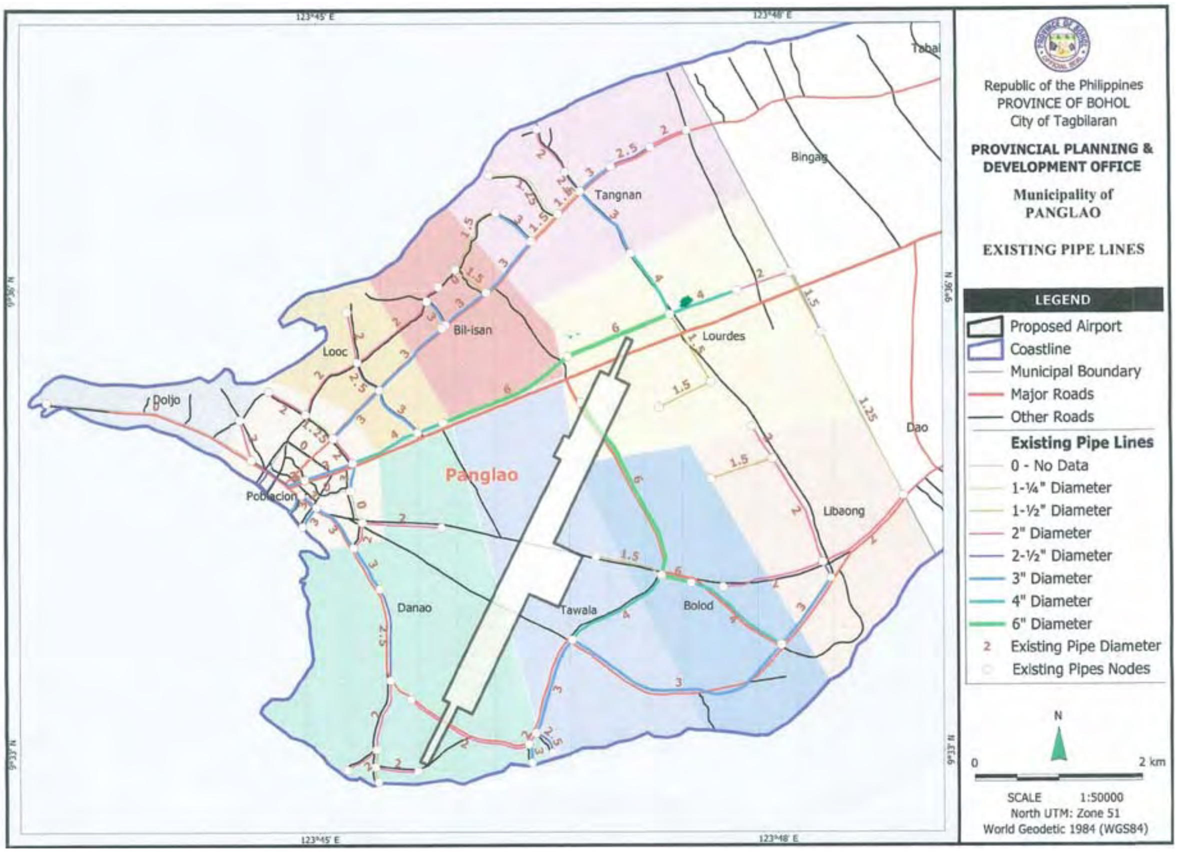


Figure 3.1-4 Existing Water Pipeline in Panglao

3) Water Demand in the Area

The water supply capacity of BWUI will be deficient as of 2014. However, since water supply per person is 268L/cap/day (cf. Tokyo: 240L/cap/day), which is rather large, an immediate water shortage is unlikely to occur. Water supply capacities of TCWS and Dauis are estimated to be deficient as of 2016 and 2014 respectively. Dauis expects to receive more water from BWUI. The total amount of water supply capacity is estimated to be deficient as of 2014; therefore, an expansion of 10,000m3 by BWUI needs to be pursued as planned. The timing of receiving water at the airport needs solid coordination to meet the inauguration of the airport planned in 2016.

a) Method of estimation: Linear Formula (by the Least Squares Method)
b) Rate of Non-Revenue Water is interpolated in the range of 0.5 to 1%,
c) Load Factor (=85%, Daily Average Water Supply Amount/Daily Maximum Water Supply Amount, in Dauis; 70% is adopted in the waterworks record in2012)

* Yellow column in the table: there is no actual data, interpolated estimates from the past data.

* Blue column: estimated value in the future.

The situation and estimation of water supply in each city/municipality is as shown in Table 3.1-2.

Table 3.1-2 The Situation and Estimation of Water Supply in Each City/Municipality (1/2)

Year \ Particular		Population in supply area	Water Supplied Population	Population Served	Service Connection	Water Consumption per capita (L/cap/day)	Water Supply Amount (m^3/day)		Water Production (m^3/day)	UFW	Water Source	Remarks
							Revenue Water Amount	Daily Water Supply			Pump Capacity (m^3/day)	
1.Tagbilaran (BWUI)												
	2003	-	-	-	-	-	10,070	-	14,295	30%	17,278	
	2004	-	-	-	-	-	11,225	-	16,400	32%	18,560	
	2005	-	53,000	-	-	240	12,700	-	17,310	27%	19,420	
	2006	-		-	10,878	-	13,478	-	17,757	24%	19,640	
	2007	-		-	11,126	-	14,507	-	18,329	21%	20,828	
	2008	-		-	11,363	-	14,978	-	19,489	23%	22,047	
	2009	-		-	11,978	-	15,116	-	19,917	24%	21,500	
	2010	65,449	58,700	90%	11,850	267	15,689	-	20,274	23%	22,337	
	2011	68,774	59,300	86%	11,978	268	15,908	-	20,660	23%	23,580	
	2012	68,068	59,900	88%	12,358	-	16,076	-	20,753	23%	23,487	March
Eatimate value	2013	68,750	60,500	88%	12,594	-	18,114	-	23,223	22%	23,580	
	2014	69,432	61,100	88%	12,831	-	18,901	-	23,926	21%	33,580	+10,000m^3 Water to Pump Capacity
	2015	69,326	61,700	89%	13,068	-	19,689	-	24,611	20%	33,580	
	2016	70,000	62,300	89%	13,305	-	20,476	-	25,280	19%	33,580	
	2017	70,674	62,900	89%	13,541	-	21,264	-	25,932	18%	33,580	
	2018	71,348	63,500	89%	13,778	-	22,051	-	26,568	17%	33,580	
	2019	71,222	64,100	90%	14,015	-	22,839	-	27,189	16%	33,580	
	2020	71,889	64,700	90%	14,252	-	23,627	-	27,796	15%	33,580	
	2025	71,758	65,300	91%	15,436	-	27,564	-	31,683	13%	33,580	
2.Tagbilaran (TCWS)												
Measured value	2004	27,352	20,202	74%	3,616	-	2,678	-	3,151	33%	3,851	
	2005	28,632	21,280	74%	3,857	181	3,859	-	4,540	32%	5,240	
	2005	30,632	22,602	74%	4,086	-	4,399	-	5,175	31%	5,875	
	2005	30,632	22,754	74%	4,182	-	4,176	-	4,913	30%	5,613	
	2005	30,632	22,466	73%	4,235	-	4,361	-	5,130	29%	5,830	
	2005	30,632	23,110	75%	4,246	-	3,171	-	3,730	28%	4,430	
	2010	31,551	23,803	75%	4,333	142	3,389	4,620	3,987	27%	4,600	
	2011	31,551	24,363	77%	4,415	-	3,464	4,632	4,075	25%	5,435	
	2012	31,551	24,875	79%	4,512	-	4,253	-	5,003	24%	5,435	March
Eatimate value	2013	32,634	25,387	78%	4,592	-	4,346	5,644	5,113	23%	5,435	
	2014	33,091	25,898	78%	4,672	-	4,439	5,691	5,222	22%	5,435	
	2015	33,547	26,410	79%	4,751	-	4,532	5,737	5,332	21%	5,435	
	2016	34,004	26,922	79%	4,831	-	4,625	5,782	5,442	20%	5,435	Shortage
	2017	34,460	27,434	80%	4,911	-	4,719	5,825	5,551	19%	5,435	
	2018	34,917	27,945	80%	4,991	-	4,812	5,868	5,661	18%	5,435	
	2019	35,373	28,457	80%	5,070	-	4,905	5,910	5,770	17%	5,435	
	2020	35,830	28,969	81%	5,150	-	4,998	5,950	5,880	16%	5,435	
	2025	38,112	31,527	83%	5,549	-	5,464	-	6,428	-	5,435	

Source: Questionnaire Response from each Water Corporation, Bohol Government HP

Table 3.1-2 The Situation and Estimation of Water Supply in Each City/Municipality (2/2)

Particular / Year		Population in supply area	Water Supplied Population	Population Served	Service Connection	Water Consumption per capita (L/cap/day)	Water Supply Amount (m^3/day)		Water Production (m^3/day)	UFW	Water Source	Remarks
							Revenue Water Amount	Daily Water Supply			Pump Capacity (m^3/day)	
3.Dauis Municipality												
	2003	29,423	11,990	41%	-	-	602	1,003	860	40%	1,010	
	2004	30,247	13,680	45%	-	-	964	1,606	1,377	40%	1,527	
	2005	31,094	15,160	49%	3,032	-	1,077	1,766	1,539	39%	1,689	-
	2006	31,965	15,940	50%	-	-	1,089	1,785	1,556	39%	1,706	
	2007	32,860	17,310	53%	-	-	1,151	1,856	1,644	38%	1,794	
	2008	33,780	18,350	54%	-	-	1,248	2,013	1,783	38%	1,933	
	2009	34,726	19,405	56%	-	-	1,276	2,026	1,823	37%	1,973	
	2010	35,698	20,580	58%	4,116	67	1,383	2,150	1,976	36%	2,126	Bulk Water from BWUI: 1,532m^3
	2011	43,724	21,970	50%	4,396	-	1,864	2,868	2,663	35%	2,813	-
	2012	45,735	22,330	49%	4,466	-	1,800	2,728	2,760	34%	2,896	March Water Source in Dauis:396m^3/20h operation Bulk Water from BWUI:
Eatimate value	2013	42,654	24,574	58%	-	-	1,944	2,901	2,776	33%	2,896	
	2014	43,996	25,772	59%	-	-	2,084	3,065	2,978	32%	2,896	Shortage
	2015	45,339	26,970	59%	-	-	2,229	3,230	3,184	31%	2,896	
	2016	46,682	28,168	60%	-	-	2,376	3,395	3,395	30%	2,896	
	2017	48,024	29,366	61%	-	-	2,527	3,559	3,610	29%	2,896	
	2018	49,367	30,564	62%	-	-	2,681	3,724	3,830	28%	2,896	
	2019	50,709	31,762	63%	-	-	2,839	3,888	4,055	27%	2,896	
	2020	52,052	32,960	63%	-	-	2,999	4,053	4,285	26%	2,896	
	2025	58,765	38,950	66%	-	-	3,755	4,876	5,364	23%	2,896	
4.Panglao Municipality												
	2007	23,416	15,946	68%	3,328	66	1,046	-	-	-	2,017	
	2010	27,241	18,580	68%	3,522	-	-	1,705	-	-	-	
	2011	27,928	-	-	3,827	-	-	1,926	-	-	-	
	2012	28,631	-	-	-	-	-	-	-	-	-	March

Source: Questionnaire Response from each Water Corporation, Bohol Government HP

Table 3.1-3 Total Water Source

Items	Year	Amount of water (m^3/day)		Remarks
		Water production (supplied water)	Capacity of water source	
Actual data	2003	14,541	17,674	
	2004	19,797	22,807	
	2005	22,096	25,056	
	2006	23,178	25,911	
	2007	23,488	26,837	
	2008	24,865	28,273	
	2009	23,893	26,326	
	2010	24,507	27,333	
	2011	24,981	29,411	
	2012	26,016	29,318	
Estimation	2013	28,612	29,411	
	2014	29,626	39,411	Amount of water source is developed to 10,000m^3/day
	2015	30,627	39,411	
	2016	31,616	39,411	
	2017	32,593	39,411	
	2018	33,559	39,411	
	2019	34,515	39,411	
	2020	35,461	39,411	
	2025	40,975	39,411	Amount of water source will run sort

Source: JICA Study team

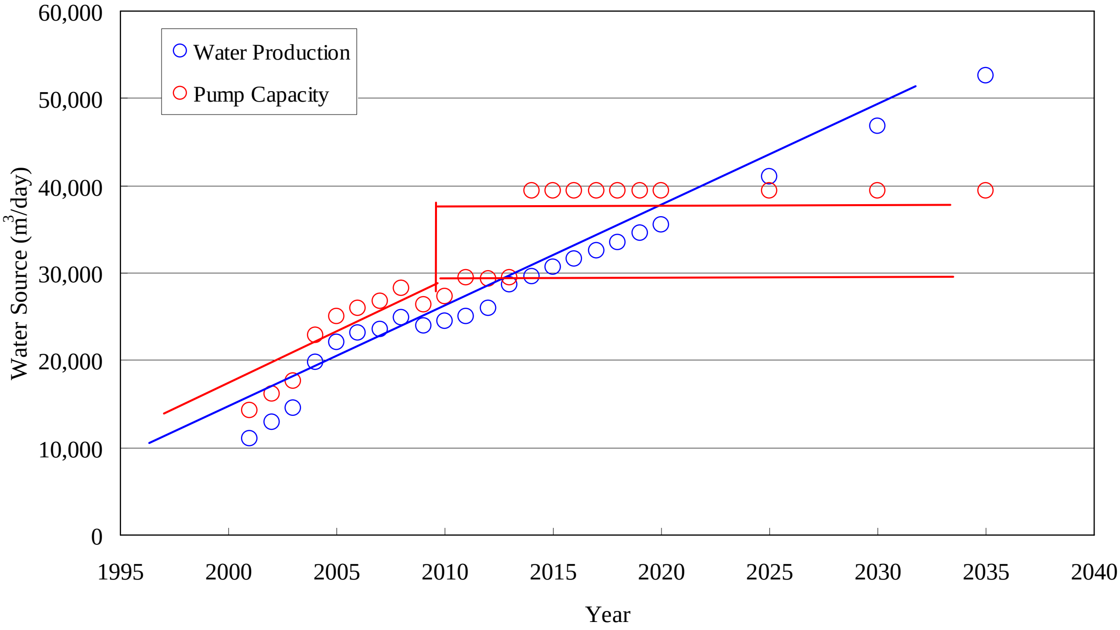


Figure 3.1-5 Estimation of Total Water Source

Except for Dauis of which population served is 49%, other municipalities cover more than 70-80% which is the target rate in the Philippines. The rate of population served is expected to improve according to an estimate. Population has grown in all areas, and the present population growth rate is larger than the forecast in the M/P. Therefore, it is predicted that water demand continues to increase. The groundwater development at the area along the shore in the circumference of Tagbilaran is a challenge because of the water salinization of wells.

Given the population growth and increase of the service population rate in Tagbilaran and Dauis in the future, it is necessary that water sources and water supply are improved in all areas. However, there is still a spring water source at the Abatan River in Cortes which is on going project (surface water taken from a spring water next to the river) to cover the increase of water demand in Tagbilaran and Dauis as well as at the new airport (see 3.1.3-6). According to the above demand estimation, this water source development scheme can supply water until 2025.

According to the Water Code, the development of new water sources is decided by the committee, taking into account the impact on the environment such as salinization, etc. Development of a new water source on the island is difficult since it may induce salinization.

4) Water Tariff

Water tariff in each municipality is shown in Table 3.1-4. All municipalities apply a progressive tariff system.

The water tariff of BWUI is 30.5PhP/m3 for the use of more than 31m3/month regardless of tariff classification. On the other hand, the water rate in Dauis is 40-50PhP/m3 for the use of more than 26m3/month because of the additional operational expense after receiving water from BWUI.

Table 3.1-4 Water Tariff in Each Municipality

Particulars	Consumption (m^3)	Residential (PhP/m^3)	Institutional (PhP/m^3)	Commercial (PhP/m^3)
1. BWUI				
Usage Rate	(basic rate) Up to 10	60.00	60.00	60.00
	11-20	10.75	10.75	10.75
	21-30	13.75	13.75	13.75
	31<	30.50	30.50	30.50
2. TCWS				
Usage Rate	(basic rate) Up to 10	56.00	56.00	20.00
	11-20	6.20	6.20	20.00
	21-30	7.00	7.00	20.00
	31-40	8.00	8.00	20.00
	41-50 51-60 61-70 71-100	9.00-10.00 11.00 12.00 14.00	9.00-10.00 11.00 12.00 14.00	20.00
	101<	20.00	20.00	20.00
3. Dauis				
Usage Rate	1-5	16.00	16.00	
	6-10	17.00	18.00	
	11-20	18.00	20.00	
	21-30	20.00	25.00	
	31<	22.00	30.00	
	Up to 25			30
	26-50			40
	51<			50
4. Panglao				
Usage Rate	(basic rate) up to 5	30.00	60.00	60.00
	6<	9.00	20.00	18.00

Source: Records of Each Water-Supply Corporation

a) Supply of drinking water other than piped water connection

The rate of population served is 70 to 80% except for 49% of Dauis. This is not particularly low compared to the national target. The residents or commercial entities in the non-served areas find water by the following methods.

In the non-served areas of these 3 municipalities, water from a well in the area is filtrated by RO membrane or charcoal filter, and bottled for sale by 20litters. Bottled water is widely consumed among the residents. The residents in the areas without pipelines go to other houses in other areas to buy water. The unit price of water seems low in both cases, but in total it is far more expensive than the piped water. Table 3.1-5 shows how people get water.

Table 3.1-5 Supply of Drinking Water (Interview at Waterworks Agency)

Status	Method	Price	Abstract
Direct connection of public water to residential house:			
Water sharing from nearby public water	10 litters Container tank	1-2PhP/tank	Water is allocated for a fee from the house covered with public water service.
Bottled water	20 litters Bottle	20PhP	Each of the six (6) companies in Panglao Municipality produces $2m^3$/day of bottled water. The water sources are individual well sites; the water is treated with reverse osmosis membrane and charcoal filter.
Hotel:			
Water truck / Private well	10t Truck	800PhP/m^3	There are dozens of hotels around Alona Beach in Panglao Municipality. Some of the hotels have their own private wells but almost all water sources of wells in this area get saline water. The water sources by Panglao Waterworks also have water salinity.

3.1.3. Condition of Water Supply Facilities for New Airport

1) <u>Planning of Water Source</u>

Initially, there was a suggestion that water can be sourced from private wells on the island for the new airport. However, the usage of these wells was seen as risky as a heavy demand for the airport may cause salinity of surrounding wells.

For this reason, water for the new airport is to be sourced from BWUI. In the design of the airport, the water demand at the airport will be 383m3/day at maximum. Including 10% of loss, which is estimated to be lost in the transmission of 14km from the intake to the airport, the water demand rate of 420m3/day will be applied.

The water demand for the new airport is 420m3/day and this is about 2% of 21,000m3/day, the total maximum water supply amount by BWUI in 2012. The total water supply capacity by BWUI in March (the summer season) in 2012 is 23,487m3/day and the water supply amount is 20,753m3/day. The margin of daily supply is 13%, which is 3,000m3/day.

2) Condition of Related Facilities

The existing water supply facilities of BWUI for the new airport are a well located in Corella to the north of Tagbilaran, a water pump and a distribution tank in Dampas as well as water transmission pipes installed from there up to Dauis: (PVC D200mm).

Sources of Six Wells in Collera: - Amount of Water Source: 8,700m^3/day (pump capacity) - Production Volume: 6,900m^3/day - Transmission Flow Rate: 6,400m^3/day (including water supply to Dauis) Transmission pipe of water source from Corella is pumped up by submerged pump in the wall. Pipe Diameter from Corella to Dampas is 250mm. - There is a margin of 2,300m^3/day in the water source in this area including for the transportation to Dauis.
1) Capacity of R6 Tank (reservoir) in Dampas: Capacity of R6 tank (reservoir) in Dampas: 1,000 x 2 basins = 2,000m^3 (retention time is 6.2 hours) Retention time of the R6 tank is 6.2 hours. This capacity satisfies the standard of 6 hours to stabilize hourly change of the demand. In addition, Dauis Waterworks has been receiving of water in the existing tank in the city with a sufficient storage capacity. (retention time of 12 hours storage)
2) Transmission Pump: - Current operation capacity of each pump is estimated at 120m^3/h. - Simultaneous operation will allow supply of sufficient amount of water to the airport with functional operation. - Transmission pump at R6 reservoir in Dampas: the capacity is more than 2,400m^3/day (alternately one pump operation) - Current operating time in summer season in this year (in March) is 17.3 hours/day. Two pumps have been installed in parallel, which are alternately available for 24 hours a day.
3) Transmission Pipe: Transmission pipe pumped up at Dampas, supplying water to Dauis Pipe Diameter from Corella to Dampas is 200mm. Current flow rate to Dauis is around 2,500m^3/day.

Source: JICA Study team

Repair of pump leakage of these facilities are conducted in a timely manner. For this reason it is determined that the related system can continue stable water supply.

a) BWUI R6 Water Pump Actual Use

The water pump is placed at the highest point of the transmission pipes. This is causing overloaded operation. In principle, water pumps need to be placed at lower points to secure boost pressure.

Table 3.1-6 R6 Water Pump Actual Use

	Rating	Actual	Remarks
Capacity	$104m^3/h$	Approx. $120m^3/h$	Upper maximum: $120m^3/h$
Pump Head	111m	Approx. 80m	The pump head becomes below 80m at actual operation, which is the limit of cavitation. The use of multiple pumps with adequate capacity will normalize the problem (less energy loss).

Source: BWUI

b) BWUI Operation and Maintenance of Existing Facilities

After its transformation to a corporate company, BWUI has made managerial efforts to turn its operation from red to black (Financial details are unpublished).

- Replacement of old pipes
- Leakage repair (concerted efforts to repair in the beginning. Currently, it is reduced to once a week)
- Repair of pump failure
- Limit to water supply at elevated areas (the city is roughly rolling. The water supply was limited in the recklessly developed areas)

Owing to these efforts, currently, 85% of the population served is recorded and keeps stable financial operation. There is a strong organizational capacity to maintain the necessary facilities and keep a good water supply system. The human resources of BWUI are summarized in Table 3.1-7. There are 4 engineers and 25 operational staff. These personnel are in charge of operation and maintenance, repair and design. The actual repair works are outsourced in accordance of needs.

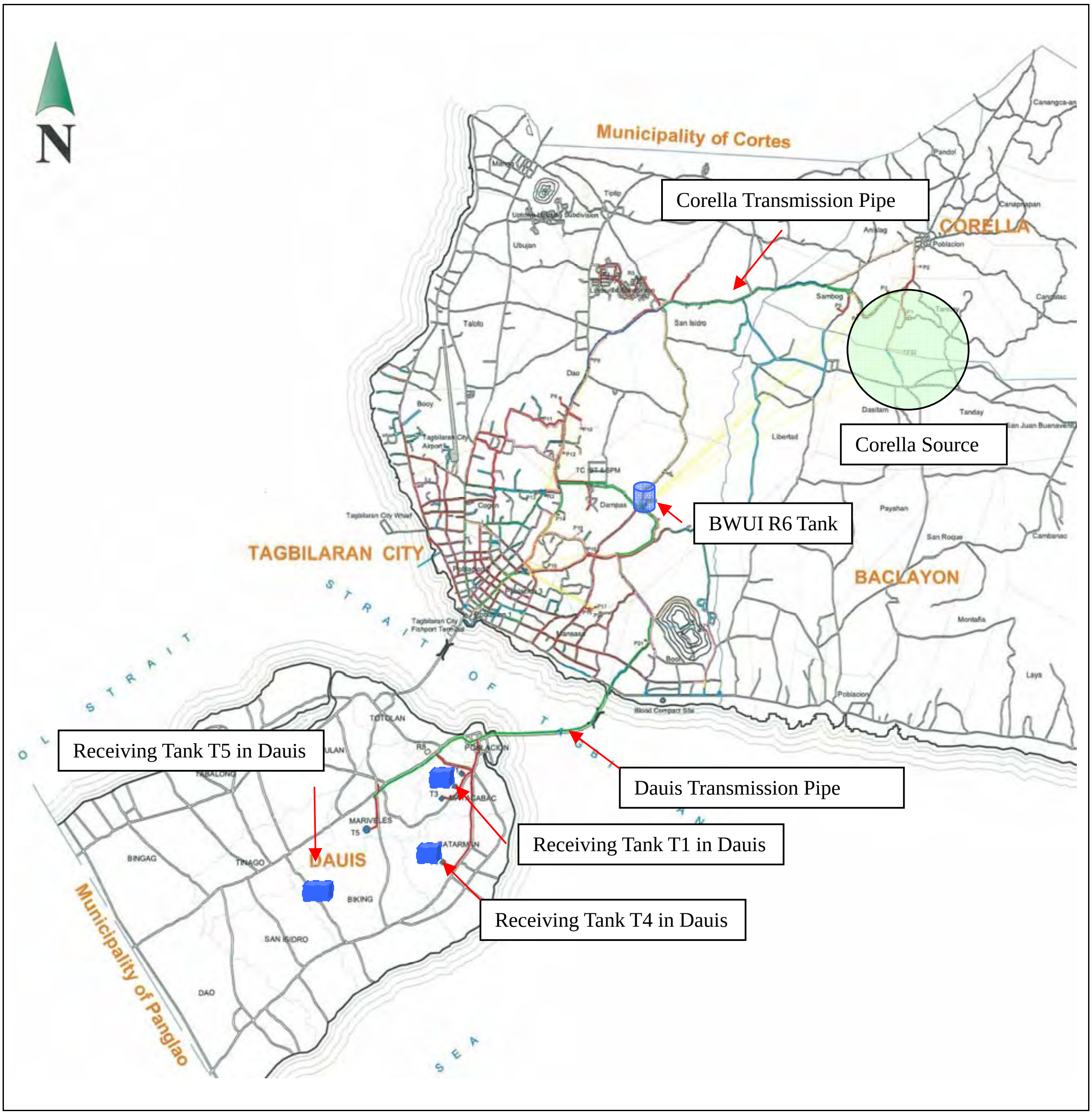
Table 3.1-7 Human Resources at BWUI

Personnel	Filled-up	Vacancies
Office of GM	3	0
Operation	25	2
Finance/Admin	23	2
Engineering	4	0
Water Quality	4	1

Source: BWUI

c) Existing facility related in Bohol-Panglao

The existing facilities required for water supply from Bohol Island to the new airport are as shown in Figure 3.1-6.



Source: BWUI

Figure 3.1-6 Existing Facilities in Bohol-Panglao

Photographs of related existing facilities from water source of Corella to Dauis

Bohol Island and Panglao Island, Corellasouse-R6 Tank-D200mmTranssmission pipe about 6km-Dauis

BWUI well at Corella P1(deep well hypochlorite injected total six wells, transporting water to R6)

BWUI R6 reservoir (tank) (supply water from Corella) Cap. 1,000m^3 x 2 tanks = 2,000m^3

R6: transmission pump, supply water to Dauis, h=111m x 2 pumps

Maintenance of R6 Transmission pump at BWUI Dampas

BWUI Dauis T1: receiving water from R6: Q=200m^3

Laboratory for water quality test at BWUI

Well in Panglao Municipality

	
Water Division at Dauis Municipality	Bottle water company in Panglao Municipality-Reverse osmosis membrane facility ($2m^3$/day production)

3) Tank Capacity and Retention Time

Table 3.1-8 shows the tank capacity at each utility. The retention time in the tank of BWUI is 4.3 hours, which is slightly lower than the retention time of 5 to 6 hours that make a peak cut of hourly maximum flow rate possible. Therefore, a decrease of water pressure may occur at the pipe end starting at the late afternoon.

However, BWUI is currently preparing an expansion plan with its own funds. Once this expansion plan is completed, a stable water supply for all water users becomes possible and other utility water tanks will have sufficient retention time.

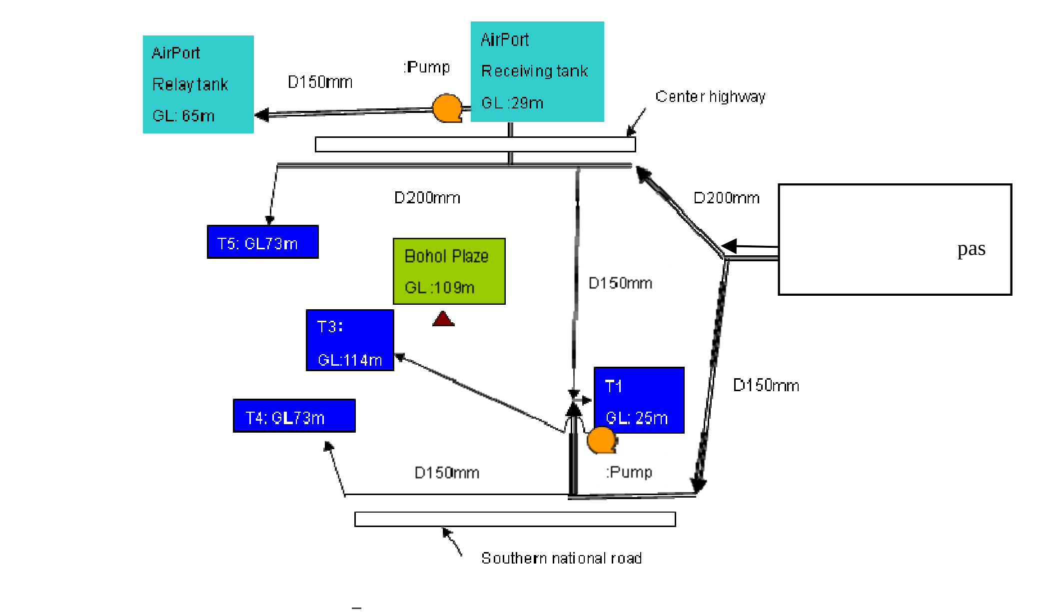
Table 3.1-8 Tank Capacity and Retention Time

Utility No.	BWUI	TCWS	Dauis	Panglao
1	140	38	38	200
2	380	151	38	200
3	380	379	38	123
4	112	379	38	33
5	100	757	38	
6	2,000	47	330	
7	640	43	10	
8			10	
9			97	
10			196	
11			125	
12			150	
13			200	
Total (m^3 ^{3})	3,752	1,793	1,308	556
Daily max. water supply amount (m^3)	20,753	4,632	2,728	1,928
Retention time (hours)	4.3	9.3	11.5	6.9

Source: Questionnaire response of each water corporation

4) Disposition of water tank at the new airport and BWUI tank in Dauis

Figure 3.1-7 shows the relation of disposition and elevation of the existing BWUI tank in Dauis and the tank at the new airport. The water transmitted from R6 BWUI tank in Dampas in Bohol Island is to be received at the following tank in Dauis. Part of the area is supplied by another water source in Dauis (See Figure 3.1-3).



BWUI existing and New Air Port schematic tank system layout in Dauis

Source: JICA Study Team

Figure 3.1-7 Existing Facilities in Dauis

5) Salinization

Saline water has intruded in a wide range in coastal areas and the town center of Panglao. Water tastes salty at some water sources in Dauis. Salinization has exacerbated. Therefore, many existing wells have stopped operation. Under these circumstances, it is considered that the expansion of water supply area is required in the near future.

Water quality tests were conducted for the piped water in Dauis and Panglao. A high concentration of salt was detected from the piped water in the central to northern coastal areas of Dauis.

The test results are summarized in Table 3.1-9 and Attachment-2. The blue color indicates that water quality remains within the standard value, the yellow moderately exceeding, and the red largely exceeding.

Table 3.1-9 Water Testing Results

Sampling place/ Items	Chloride	TDS	Nitrogen/Nitrite	Nitrogen/ Ammonium
Alona Panglao	258>250 mg/l ✔	864>500 mg/l ✔	0.0007<3 mg/l (OK)	0.002 mg/l (OK)
Center Panglao	342>250 mg/l ✔	710>500 mg/l ✔	-	-
North. Panglao	241<250 mg/l (OK)	864>500 mg/l ✔	-	-
Northern Dauis	1,169>250 mg/l ✔	2,822>500 mg/l ✔	-	-

Source : JICA study team ✔: Over standard

6) Related projects in progress

The Bohol Provincial Government is preparing implementation of the M/P prepared by AusAID to solve water concerns in the future. Future water supply concepts in Tagbilaran, Dauis and Panglao are blueprinted in the M/P.

The Master Plan guides developments of water resources for safe domestic, commercial, and industrial use, in order to improve the health of the community and protect the depleting groundwater systems.

The Master Plan proposed seven (7) bulk water systems using river water. The study area includes the Loboc River-1 bulk water system. The proposed Loboc River-1 bulk water system consists of a two staged implementation; the Abatan river water supply system will be developed by 2010 as the first stage and the Loboc river water supply system will be added in 2018 as the second stage.

Although the Panglao Municipality is included in the first stage project, this part of the project has not started yet. (Refer to "Bohol Integrated Water Supply System Master Plan")

a) BWUI Expansion Project

BWUI bases on the M/P prepared by AusAID, with its own financial resources, BWUI has conducted the expansion plan, including Tagbilaran, Dauis, Panglao using a new water source of spring water located in the mountains about 5km north of Cortes from Tagbilaran. In 2012, negotiations for site of pipe installation are going on.

Expansion Project of BWUI water supply system

- Source, amount of source: Ohan Spring, Intake amount; 10,000 m^3/day
- Water supply area: city and town along the pipeline from Cortes-Tagbilaran, Dampas, through R6 Reservoir. Mainly supply in Tagbilaran, Dauis, Panglao
- Budget: 120 million PhP
  Planned facilities: Water Treatment Plant, Reservoir, Transmission Pipe
- Diameter of transmission pipe: D200mm: Cortes-Tagbilaran, Dampas, R6 Reservoir
- Construction schedule: 2013-2014

Source: BWUI

In addition, BWUI has its own future water supply plan for Panglao. BWUI plans to improve transmission pipe operation by gravity flow and to increase diameters of the transmission pipe. (Ground Level is 56m at R6, and Ground Level is 25m at Dauis T1, the transmission pipe can supply water by gravity flow)

Intake point in expansion plan: Uhan Spring (Abatan River), intake amount investigation by BWUI staff.

Source: BWUI: Abatan River Development Plan

3.2. Facility Plan

3.2.1. Water Demand Plan for New Airport

According to the new Panglao Airport, the maximum amount of demand for the airport is estimated to be 383m^3/day.

- Population served: Passengers according to the new Airport Plan
- Water demand of daily maximum in n the new airport: 383m^3/day
  Daily maximum water supply amount: 420m^3/day
  (Receiving amount from BWUI Receiving Water at Dauis including leakage in transmission pipe on the way from Dauis receiving tank to the new airport: 383m^3/d x 10%.)
- Able date of receiving water: According to the instruction by the responsible agent.

Source: JICA Study Team

Each receiving water quantity is shown Table 3.2-1. The yellow cells indicate relevant water amounts.

Table 3.2-1 Receiving Water Quantity

	Water Quantity/Items	Places	Coefficient/ Water Quantity	Remarks
a	Water demand daily average	Airport	325 m^3/day	Basic water demand
b	Load factor		0.85	Seasonal change
c	Water demand daily maximum	Airport	383 m^3/day	c=a/b：use for design in the airport facilities.
d	Water loss		10%	Estimated value
e	Water receiving daily average (supply)	Receiving Tank in Dauis	360 m^3/day	e=a×(100%+d)：Use for receiving water amount calculation. (Water from BWUI)
f	Load factor		0.85	Seasonal change
g	Water receiving daily maximum (supply)	Receiving Tank in Dauis	420 m^3/day	g=e/f：Use for transmission facility calculation.
h	Time factor	Airport	2.5	
i	Hourly maximum flow	Transmission Pipe	1.0	= Water receiving daily maximum

3.2.2. Basic Facility Design

1) Contents of Discussion with BWUI

A meeting was held with the GM of BWUI to discuss the method of water supply to the new airport. After completion of the facility construction, the maintenance and operation of the facility will be transferred to BWUI, and the airport pays fees for their services. The consultation agreements are the preliminary guiding principles. Before the construction of facilities, another agreement between BWUI and DOTC/implementing agency needs to be concluded at a later stage.

The agenda of the meeting is as follows:

a) Receiving amount of water and measuring point of receiving water: installation of a meter at the inlet pipe

A minimum standard fee applies to receiving water. BWUI suggested 10,000m^3 for the minimum receiving water. A receiving water tank (150m^3 effective capacity) will newly be installed at the expansion site (GL+29m) leased from BWUI. This site is located at a side of transmission pipes from R6 distribution tank (Dampas) with the same elevation level (GL+29m) as the receiving tank T1 (GL+25m). Therefore, an equal amount of water can be received to Dauis. This site was purchased 3 years ago by BWUI for the future use at 1000PhP/m^2. BWUI is planning to use this site in the future; therefore, temporal leasing of this site is possible but purchasing for the project is not possible. The project does not limit the choice of site to this location if other adequate sites are found. The amount of receiving water is estimated at 420m^3/day including a 10% leakage loss during transmission and the water demand of 383m^3 at the airport. Typically, water fees are calculated based on the amount of receiving water at the receiving tank. This also applies to the project. Upon completion of facility construction, water needs to be poured into pipelines and facilities to prevent drying out and insects.

- Flow control method in water pipe, transmission pipe route and diameter
- Facility maintenance after the completion (transferred to BWUI)
- Water charge (presented from BWUI)
- Operation start (decided in consultation with the implementing agency)

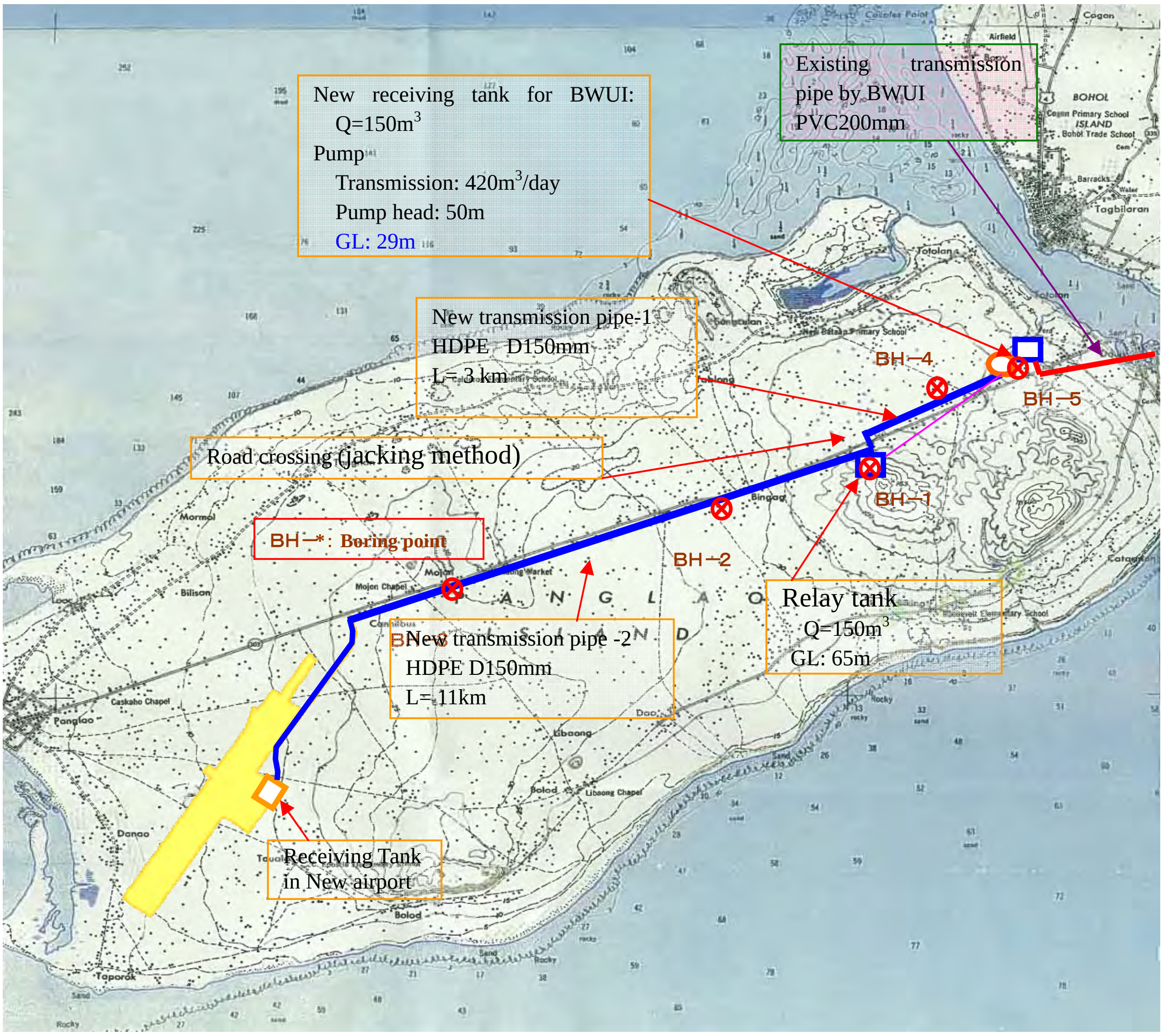
Salinization may be exacerbated if the groundwater at the island is used for construction water. Small amount of water can be transported by truck from outside the island.

The water is pumped up for 3km by pipes (D150mm) from the receiving tank to a transmission water tank at the highest elevated pipes (a high location of Center Highway in Dauis, GL: 65m). The transmission water tank serves as a surge tank to air a valve and also to protect the pump.

The water is fed by gravity through pipes (D150mm) for approximately 11km from the relay tank to the airport. The conditions of inlet water at the airport may cause pressure in the transmission pipe negative. To control the pressure the facility design includes a function to control water level of the relay tank and tank in the new airport. The transmission pipes are placed at the shoulder of Central Highway (right way: 3m from the boundary of the Center Highway, 30m width, 15m halfway). The exact construction locations will be guided by the department of national highway as shown in Figure 3.1-6. High-Density Polyethylene Pipe is used for the project, which is extensively used in the Philippines. The agreed facilities are as follows:

- Receiving tank, GL29m: 1 tank in the site of BWUI, with water pump: 1 pumping station
- Relay tank, GL65m: 1 tank (in the private site, agreed)
- Transmission pipes: through Center Highway between Dauis to New Airport (D150mm, L=14km)

There is another route that runs along the southern national road other than the above-mentioned Center Highway route. The Center Highway route is however more suitable considering the number of curves, distance and the number of obstacles on the way such as houses and hedges. Figure 3.2-1 shows the disposition of facilities for airport water supply. The southern road route is shown in Figure 3.2-4.



Source: JICA Study Team

Figure 3.2-1 New Panglao Airport Water Supply Facilities

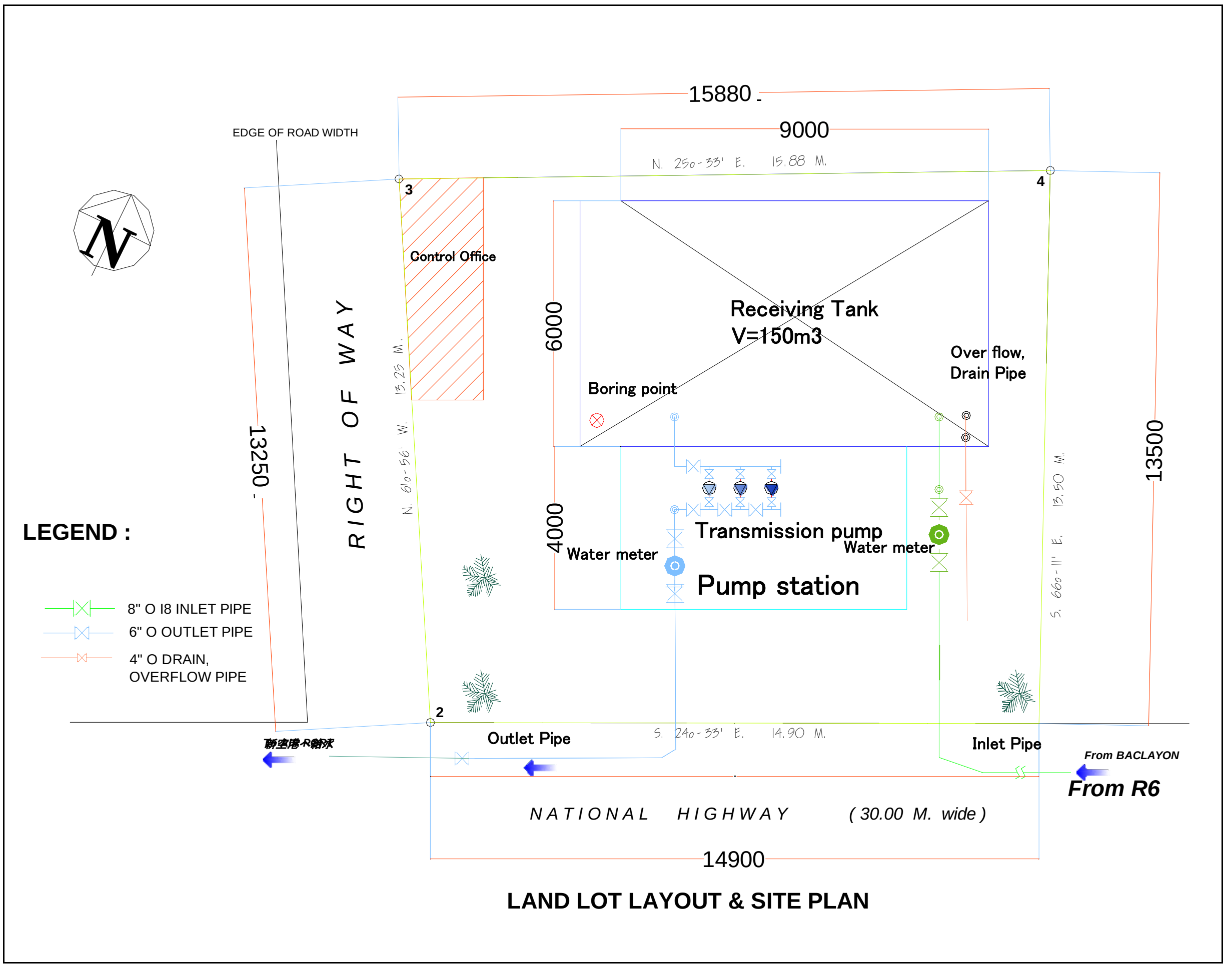
b) General facility arrangement

Each general facility arrangement has been agreed as follows:

- Receiving tank, relay tank, each basin
- Attached pump station 1 in the same site of receiving tank
- Transmission pipe: Dauis-New Airport: D150mm, L=14km

BWUI Site for Receiving Tank (Reservoir). Joint investigation with BWUI staff

Relay Tank-2: Highest point in the transmission pipeline



Source: JICA Study Team

Figure 3.2-2 Facility Layout of Receiving Tank in BWUI Site

2) Specifications and Dimensions of New Facilities

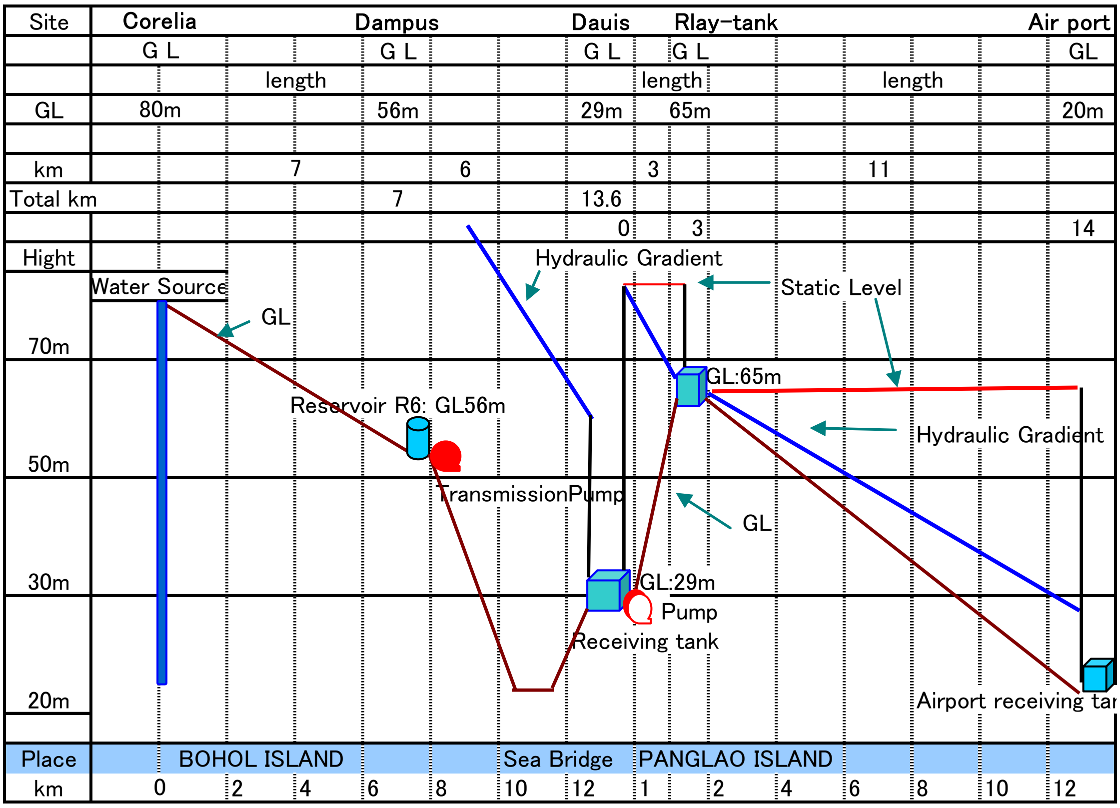
The specification of new facilities is shown below.

Table 3.2-2 Specifications and Dimensions of New Facilities

	Items	Specifications	Remarks
1	Receiving Tank GL29m Receive water from BWUI R6 reservoir in DAMPAS	Capacity: 150 m^3, 8hours of daily receiving amount from BWUI effective depth：3m RC: 1basin Epoxy resin lining	Adjust hourly change of transmission flow rate from Reservoir of BWUI R6 to Dauis. May be designed for electrical power failure. It includes basic 6hours hourly change of demand. The site: in Dauis, BWUI site
	Attached facilities		
	In Inlet ,outlet pipe	Steel Pipe	
	Inlet ,outlet meter	2 meters D150mm、Turbine flow meters	
	Fence, Drainage Operation house	1 set	
2	Transmission pump		
	Horizontal axis volute pump Piping, control valves, check valves	3 pumps (including 1stand by pump), Total:　4 pumps Volume：18m^3/h x 3pumps Pump Head: 45m. 7 kWx3, 5kWx1	
	Transformer; Electric panel; Pump panel; Generator	1 set 75kvA	
	Pomp house	About 40m^2	Brick made
3	Transmission Pipe-1	Capacity：18 m^3/h +(hurly flow change) HDPE: Dia150mm (10KG) Length=3km Minimum soil cover：0.6m-0.9m Average：1m-1.5m Location of Installation pipe: in 3m in the right of the way	PE Pipe can reduce leakage, because of few joints compared to PVC
	Other Facilities	Highest point air valve each 1km-3km: Stop valve: low point drain valve Others: thrust block, marking stake other necessary facilities for pipe maintenance	
4	Relay Tank, GL65m	Effective capacity: 150 m^3 Effective water depth: 3m RC: 1Basin Epoxy resin lining Electric signal wire from here to the receiving tank	Adjust hourly change of demand of new airport Roll of surge tank, air vent, projection of pipeline from pressure impact. HWL、LWL control: Water level site inlet, outlet flow control method is installed connection with transmutation pump operation. Obtained site owners informal consent. At Barng. Tinago
	Attached Facilities		
	In inlet-outlet pipe	Steel Pipe	
	Inlet, outlet meter	2 meters D150mm turbine type	
	Fence, Drainage Operation House	1 set	
5	Transmission Pipe -2	Capacity：18 m^3/h HDPE:Dia150m mm (10KG) Length=3km Minimum soil cover: 0.6m-0.9m Average: 1m-1.5m Location of installation pipe: in 3m of right-of-way	PE Pipe can reduce leakage, because of few joint compare with PVC.
	Other facilities	Highest point: air valve each 1km-3km: Stop valve: low point drain valve Others: thrust block, marking stake, other necessary facilities for pipe maintenance	
6	Chlorine injection	Sodium hypochlorite: injection rate: 0.2mg/l	Injection at new airport
7	Receiving tank in air port	Capacity：288 m^3	Separately constructed from BWUI Receiving water supply

3.2.3. Conformation of water hammer of the pump

Figure 3.2-3 shows the water level differences from the water source in Corella to the receiving tank in Dauis and the water supply facility at the airport.



Source: JICA Study Team

Figure 3.2-3 Hydraulic Chart

1) Pipeline route section

The Pipeline Route Longitudinal Section is shown in Figure3.2-4.

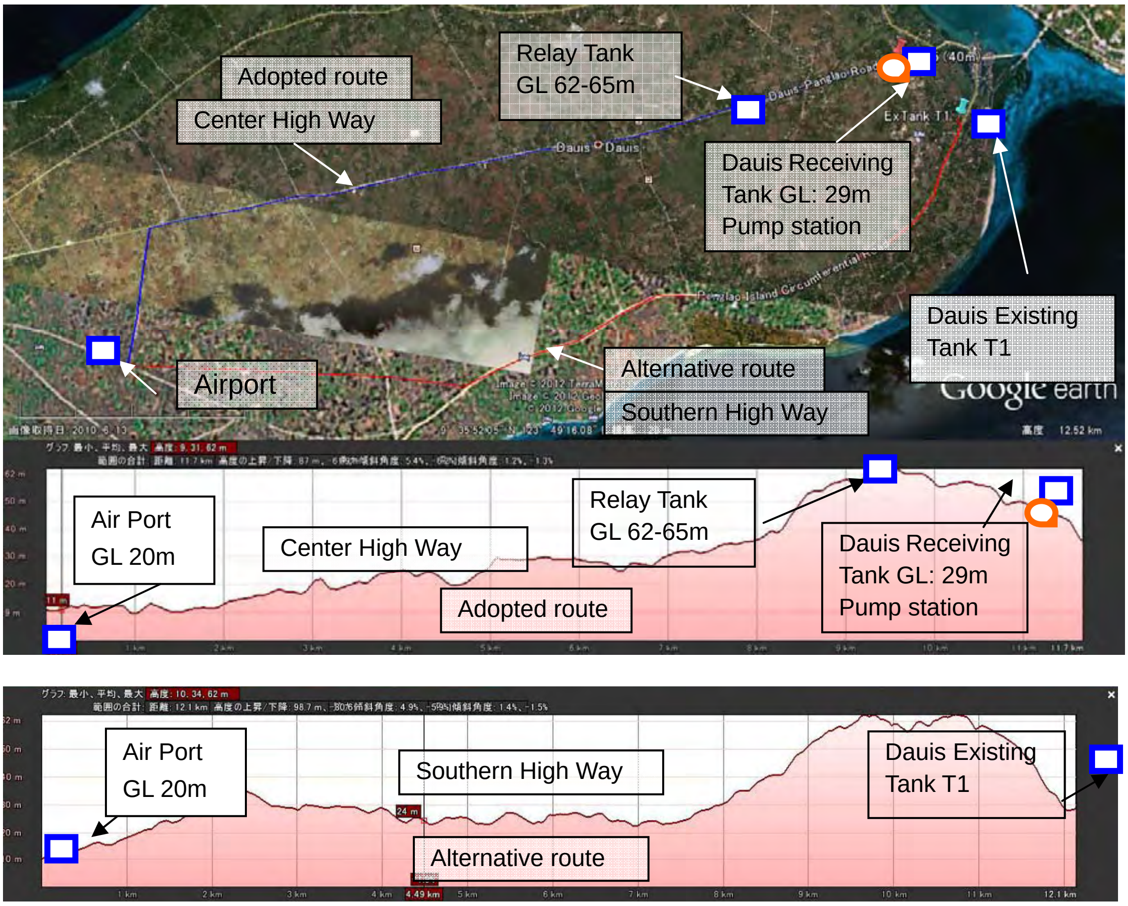
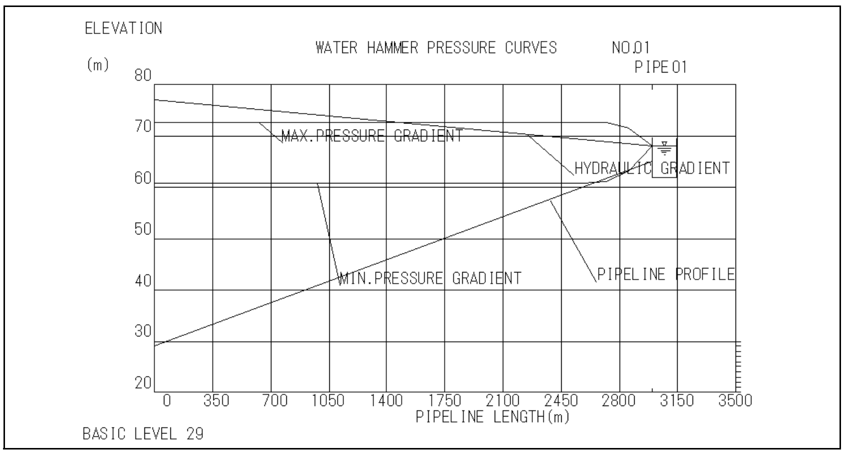


Figure 3.2-4 Pipeline Route Longitudinal Section

2) Water hammer effect by the pump

Effects of water hammer pressure by water pump at the receiving point are estimated. No particular negative pressure or excessive impact and damage on the pipes are expected. The results of estimative calculation are shown in Figure 3.2-5.



Source: JICA Study team

Figure 3.2-5 Calculation of Pump Impact

3.2.4. Basic Design and Standard

1) Rough specifications, standard of facilities

The following criteria primarily related to the design of civil engineering facilities should be noted.

Table 3.2-3 Rough Specification, Standard of Facilities

Items		Design Concept	Remarks
1	Water receiving tank, Relay tank	Adjacent location with pump station. Pump elevation is push-in position in pump suction side.	Foundation: excavation depth is 0.5-1m from the surface, mat foundation on the limestone (according to the result of boring, thickness of surface soil is about 0.5-1m on the limestone. Bearing strength of foundation is 240 kP. If adjustment of foundation level is required; soil cement method shall be adopted.
2	Transmission pump	Pump elevation is push-in position in pump suction side.	Basement is set on limestone.
3	Pump station		Foundation: adjustment of foundation level is required; soil cement method shall be adopted.
4	Transmission pipe	Pressure pipe corresponding to the predetermined pressure. Including impact pressure.	HDPE IS adopted: using pressure 70m-100m (0.7-1.0N/mm^2) pressure pipe shall be adopted Impact pressure: Iron pipe: 1.5 times of using pressure HDPE, PVC: 1.4 times of using pressure If possible, open excavation method is desirable for crossing of national highway. However, (fear of contamination) installation in existing crossing drainage pipe must be avoided. Also, jacking method shall be considered, if necessary.
5	Access road	Use existing road.	
6	Pipeline calculation formula	Flow rate coefficient C = 110-120 Hazen-William formula: (adjusted to more than 75mm diameter)	
7	Structural analysis	Use finite element method	
8	Concrete structures	Concrete strength (specification of strength of cement, in the RC structure 42.5N)	Foundation: excavation depth is 0.5-m from the surface; mat foundation on the limestone (According to the result of boring, thickness of surface soil is about 0.5-m on the limestone. Bearing strength of foundation is 240 kP) If adjustment of foundation level is required, soil cement method shall be adopted.
		Tank structure Other reinforced concrete structures Unreinforced structure	σck =24N (Watertight concrete) σck=21N σck=16N
		Allowable stress for rebar for tank structure	σa=1,600kg/cm^2 σa=2,000kg/cm^2
9	Seismic design	According to predetermined value by horizontal seismic coefficient	
10	Design Criteria Industrial Standards, etc.	International standards required	
11	Others	To adopt common specifications and standards in the Philippines, if possible.	

Source: JICA Study Team

2) Result of soil survey

A boring survey has been carried out at the facility installation site. Limestone appeared in more than 0.75-1m depth at the water tank site. (N value 50 or more, bearing capacity of soil 250 (kPa)) Test results are shown as follows. At the shoulder of a road, the ground level was raised by embankment so that limestone appeared from the depth of 2m.

Tested position (refer to Figure 3.2-1, New Panglao Airport Water Supply Facilities):

Table 3.2-4 Results of Soil Survey (in the site of receiving tank)

BH1 (h=5m)				BH5 (h=5m)			
Relay Tank				Receiving Tank			
Depth (m)	Bearing capacity (kPa)	N value	Type of Soil	Depth (m)	Bearing capacity (kPa)	N value	Type of Soil
0.5	20-25	7	Clay	0.5	250	>50	Limestone
1-2-5	300	>50	Limestone	0.75-2-5	>300	>50	Limestone

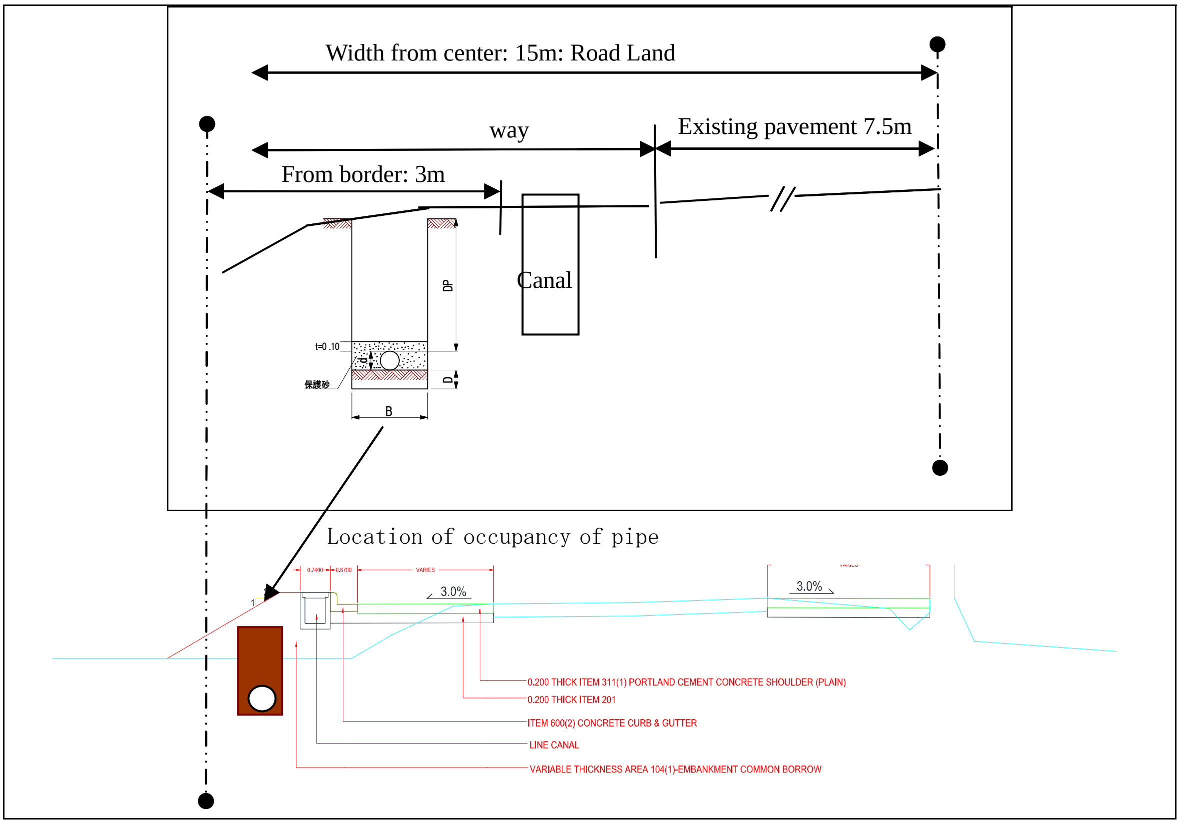
Table 3.2-5 Results of Soil Survey (in the site of pipe installation)

BH2 (h=3m)				BH3 (h=3m)				BH4 (h=3m)			
Highway: Right-of-Way				Highway: Right-of-Way				Highway: Right-of-Way			
Depth (m)	Bearing capacity (kPa)	N value	Type of Soil	Depth (m)	Bearing capacity (kPa)	N value	Type of Soil	Depth (m)	Bearing Capacity (kPa)	N value	Type of Soil
0.5-1.5	175	23	Clay, Silt	0.5-1.5	3-40	6	Clay	0.5	40	8	Clayey Sand
2-3	300	<50	Lime-stone	2-3	125	15	Silt	1-2-3	250	36	Silty Sand

Source: JICA Study Team

3) Pipe installation location in the national highway

The width of one side of Panglao Island Center Highway is 15m. In 2012, construction works to expand the 2-lane to 4-lane is in progress and scheduled to be completed before the opening of the airport. DPWH has instructed installation of pipes between the soak ways in the 3m road at the highway side. There is sufficient space for pipe installation as 0.6-0.7m with the drilling widths. There are a few houses that are extruded to the planned sites, but these will not hinder pipe installation. With regard to the permission for public road works at the detailed design, an application form and designs are to be submitted to DPWH. Operation and maintenance fees have to be paid.



Source: DPWH design of expansion plan of the Center Highway and instruction from DPWH.

Figure 3.2-6 Location of Pipe Installation

<u>**Picture of the Center Highway**</u>

	
Center Highway in Panglao Island under expansion work	Center Highway in Panglao Island before expansion work

3.3. Construction Cost

3.3.1. Estimation of Construction Cost

The estimation of construction cost is 80,500,000 PhP as shown in Table 3.3-1.

Table 3.3-1 Estimation of Construction Cost based on Basic Design

	Description	Specification	Unit	Qty.	Amount (PhP)
1	Water Receiving Tank				**2,300,000**
	Water Tank	$150m^3$ (RC)	No.	1	
	Attached Facilities		Sum	1	
	-Inlet & Outlet Pipe	SP	Sum	1	
	-Water Meter	Impeller Type, D150mm	No.	2	
	-Fence, Drainage		Sum	1	
2	Water Supply Pump (Volute Type)				**10,500,000**
	Pump-1	Q=18m3/h	No.	3	
	Pump-2	Q=9m3/h	No.	1	
	Valves	GV, CV & Strainer	Sum	1	
	Related Electrical Equipment		Sum	1	
	-Transformer		Sum	1	
	-Power Receiving Panel		Sum	1	
	-Electrical Panel for Pumps		Sum	1	
	-Emergency Generator	75kVA	Sum	1	
	Hoist Rail, Wiring & Ventilation Fan		Sum	1	
	Pump Operation Control	Interlock with Water Level Electrode installed on The Relay Tank	Sum	1	
	Pump House	$(\sim 40m^2)$	Sum	1	
3	Water Transmission Pipe-1				**13,000,000**
	Pipes & Fittings	HDPE, Dia. 150mm	m	3,000	
	Lease of Land		Sum	1	
4	Relay Tank				**3,800,000**
	Water Tank	$150m^3$ (RC)	No.	1	
	Attached Facilities		Sum	1	
	-Inlet & Outlet Pipe	SP	Sum	1	
	-Water Meter	Impeller Type, D150mm,	No.	2	
	-Water Gauges		Sum	1	
	-Fence, Drainage		Sum	1	
	Purchase of Land		Sum	1	
5	Water Transmission Pipe-2				**47,800,000**
	Pipes & Fittings	HDPE, Dia. 150mm	m	11,000	
	Leased Land		Sum	1	
6	Chlorination Feeding Equipment				**100,000**
	Sodium Hypochlorite	0.1-0.2mg/l, Re-injection in Water Receiving Tank at Airport	Sum	1	
7	Pump Operation Control Equipment				**3,00,000**
	Instrumentation Works for Water Supply Pumps and Water Level Electrode of Water Receiving Tanks		Sum	1	
	Total				**80,500,000**

Source: JICA Study Team

3.3.2. Tentative implementation Schedule for Construction of Water Supply

The new airport is scheduled to start in service in 2016. In addition, airport water supply facilities are scheduled to be completed by the end of 2015. Tentative implementation Schedule for Construction of Water Supply as shown in Table 3.3-2.

Table 3.3-2 Tentative implementation Schedule for Construction of Water Supply

Items	2013			2014						2015						2016					
	2 8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
Construction Period of Airport Project (30 months)			1 2	3 4	5 6	7 8	9 10	11 12	13 14	15 16	17 18	19 20	21 22	23 24	25 26	27 28	29 30				
Airport Site																		commencement of Airport Operation			
Water Supply and Distribution System																					
Water Tank and Pump House																					
Outside																					
Receiving Tank and Pump (GL:29m)																					
Relay Tank (GL:65m)																					
Transmission Pipe																					

Source: JICA Study Team

3.4. Maintenance Plan

3.4.1. Maintenance System

The pipelines run through Corella, Tagbilaran, Dauis, Panglao municipalities. BWUI was privatized 14 years ago with the Bohol Provincial Government holding 30% of its share to supply water in the area. The provincial government has no water supply engineer in their organization. Therefore, they rely on BWUI in terms of technical subjects or related matters for water supply. For the Bohol provincial government to remain as a major shareholder of BWUI, its public nature and reliability are to be assured through authorized governmental guidance and achievements attained.

Therefore, in order to maintain a good operational condition, it seems reasonable to transfer the operation and maintenance capacity to BWUI. The ownership of facilities still belongs to the new airport. The operation and maintenance is entrusted to BWUI. If the airport agency considers direct maintenance is advantageous, the transfer may not be necessary.

3.4.2. Receiving Water Fees

1) Operation and Maintenance Fees

Maintenance costs should be reflected in the price. Additional fees are set for operation and maintenance of the receiving tanks, water pump, transmission pipeline and other facilities. (Refer to Table 3.4-1, Estimated Maintenance Costs of Water Supply Facilities after the Airport is in Service.)

2) Receiving water rate

BWUI proposed water fees as follows:

- The amount of receiving water at the point of receiving tank: 420 m^3 (Dauis, Mareveles in the site of Brng. BWUI)
- Water fees include the general operation and maintenance of BWUI after transferring the water supply facilities (General operation and repair of receiving tanks, transmission pipes, pump station and water pump)
- The fees are revised according to increase of consumer price by 5% or more. The revision of fees is based on the generally adopted standards for water distribution contract.
- Site use fees: monthly 20 PhP/m2 (206m2 of total site area, revised every 2 years)
- This site may not be used, if a suitable site can be found.

3) Maintenance method after the completion of facility

- Receiving water rate: including ordinal cost of maintenance and operation of facilities after the transfer of maintenance to BWUI.
- Other expenses: costs for operation and maintenance of the airport water supply facilities after receiving of water in Dauis
  - Electricity fees (cost for transmission pump, instrumentation equipment)
  - Major repairs (Crack or bursting caused by earthquake or accident)
  - Cost of renewal of facilities.

Discussions were made on the additional expenses for receiving water. The facility components were presented by the study team. Since BWUI is a profit-making enterprise, it is difficult to set the costs of operation and maintenance prior to operation of facilities that were constructed by an unrelated project. It is also possible to fix water tariffs after the facility starts operation. DOTC and BWUI need to discuss further on this matter. There is also a need to employ new staff for operation and maintenance. Depending on the details of operational services rendered by BWUI, different options for operation should be discussed. For instance, the airport agency may directly operate the water supply facilities.

4) The validity of proposed rates

BWUI is adopting a progressive water fee charging system. Currently, users for more than 30 m3 are charged 30.5PhP/m3. Therefore, the proposed fee of 30PhP/m3 is almost equal to the current fee (See the section of the water current rate of BWUI). Generally, a progressive water tariff is adopted for water service in order to encourage water saving. In this project a progressive water tariff is not mentioned. Additional expenses for operation and maintenance in Dauis are the following:

a) Other expenses: operation and maintenance of water supply facilities to receive water in Dauis

b) Lease of land, renewal of the facilities at cost

All expenses are incurred at cost in addition to general water tariff of BWUI. These are necessary costs but can be included in the water receiving tariff upon discussion.

The additional maintenance costs of water supply facilities after service is estimated to be 5PhP/m3. If 30PhP/m3 of receiving water fee is added, the total cost will be 35PhP/m3. As a reference, BWUI supplies water to most water needs (80%). Water tariff for commercial use is 40-50PhP/m3 for use of water more than 6m3/month. Costs of water at the airport are less expensive than those in Dauis. Estimates are shown below.

Table 3.4-1 Maintenance Cost after the Airport Water Supply System is in Service

(In the case of consumption of 360 m^3/day)

Items	Calculation	Expense (PhP/day)	Remarks
Power Cost	1kWh=8.3 PhP Capacity: 7.0kW x 24h = 168 168kWh x 8.3 PhP/day=1,390 PhP/day	1,390	
Chlorine	Chlorine injection rate: 2mg/L Price of Chlorine :400 PhP/kg 360 m^3/day x 2mg/L = 0.72 kg/day 0.72 kg x 400 PhP/kg=288 PhP/day	288	Re-injected at airport
Major Repairing Cost	Few serious repairs is assumed initially in service	-	Including in ordinal air port maintenance cost
Site Cost (receiving water tank site)	Lease fee: 20PhP/m^2/month. Area of land: 206 m^2 206 m^2 x 20PhP/m^2 /month÷30days/month =137 PhP/day	137	BWUI ownership
Total		1,800 PhP/day	
Unit Cost	1,800 PhP/day/ 360 m^3 /day=5.0 PhP/m^3	5.0 PhP/m^3	5 PhP/m^3
Expense for one month	Unit Cost：5PhP/m^3 x 360 m^3 x 30 days	54,000 PhP/month	

Note: Major repairing cost= 1% per year of construction cost, includes in the ordinal maintenance cost of new airport.

Source: JICA Study Team

3.4.3. Points to Keep in Mind for the Installation of a Dedicated New Airport Water Supply Facilities

The details of the meeting with BWUI (Facility design, operation and maintenance and tariff for receiving water) are treated as guiding principles and have to be discussed further with the implementation agency (DOTC) and BWUI to confirm the following issues.

1) Completion schedule of expansion works of BWUI

Reconfirmation of the completion schedule of "BWUI Uhan Spring Extension Plan" (Water Source: Abatan River) currently 2013 or 2014

- Conformation of overlap with similar other projects in the implementation stage of this project

2) Confirmation of the start of operation

Confirmation of the schedule of receiving water from BWUI with DOTC

3) Maintenance

Details of discussion with BWUI:

- Scope of maintenance

Receiving water fees include general operation and maintenance costs of the facilities, Operation and repair of receiving tank, water pump, pump station and transmission pipes. Other expenses are paid by the airport at actual expense.

- Electric rate, such as power cost for transmission pump, instrumentation equipment
- Chlorination at airport
- Major repairs (Crack or bursting caused by earthquake or accident)
- Cost of renewal of the facilities

- Receiving water fees, revision of tariff

BWUI proposed a water fee of 30PhP/m3 equal to the current general fee. The receiving water fee may be revised if consumer price increases by 5% or more. The tariff of BWUI is charged progressively, i.e., the more water is used, the higher is the charge. The amount of receiving water is as large as 420 m3 but there was no request to charge a progressive tariff. BWUI wishes to charge 10,000m3/month as the minimum.

- Land lease or purchase of water receiving tank and relay tank

For the project implementation options, lease or purchase of land or looking for another site are examined.

These were matters discussed as guiding conceptual framework in consultation with BWUI and the JICA Study Team about the facility planning. It will be necessary for the Philippine side (with DOTC and BWUI) to discuss further at the implementation stage.

Chapter 4

Sewerage Development

Table of Contents

Chapter 4. Sewerage Development

4.1. Sewerage Sector in the Philippines

4.1.1. Jurisdiction Agency for Water Sector

In 1955, after World War II, the National Waterworks and Sewerage Authority (NAWASA) was established to reconstruct the water systems in the Philippines. The changes in the sewerage sector to the current state were implemented in the 1970s. Since then, three specialized agencies; the Metropolitan Waterworks and Sewerage System (MWSS), the Local Water Utilities Administration (LWUA), and the Rural Waterworks Development Corporation (RWDC) have been responsible for providing water supplies and sewerage services to specific areas of the country. The MWSS is responsible to provide the services to Metro Manila and its adjoining areas as per the Republic Act 6234 of 1971, while the LWUA and the RWDC, through separate mandates, take charge in providing services in other parts of the country.

4.1.2. Relevant Policy and Laws

1) Relevant Policy and Laws on Sewerage and Sanitation

Major policies and laws related to sewerage and sanitation are shown below.

a) Presidential Decree no. 1152 (1977), Philippine Environment Code

TITLE II (Water Quality Management) of the code specifies the National Pollution Control Commission to take into account classification of Philippine waters and establishment of water quality standards to protect and improve water quality. TITLE V (Waste Management) requires solid waste to be disposed by sanitary landfill, incineration, composting, and other methods as may be approved by competent government authorities. Furthermore, it requires liquid waste from manufacturing plants, industries, communities, or domestic sources to be treated either physically, biologically or chemically prior to disposal in accordance with the rules and regulations promulgated by the proper government authorities.

b) Republic Act No. 9275, Philippine Clean Water Act of 2004 (CWA)

The CWA provides the policy and regulatory framework of comprehensive water quality management in the country to pursue sustainable development. Major provisions of CWA and its implementing rules and regulations (IRR) are:

- The Department of Environment and Natural Resources (DENR), in coordination with the National Water Resources Board (NWRB) shall designate Water Quality Management Areas (WQMA) across the country.
- DENR shall identify water bodies, where pollutants have exceeded their statutory standards, as 'non-attainment' areas and shall prepare and implement water quality improvement programs that will not allow new sources of exceeded water pollution in non-attainment areas without a corresponding reduction in discharges from existing sources.

- Preparation and implementation of national sewerage and septage management program to manage domestic sewage collection, treatment and disposal in Metro Manila and other Highly Urbanized Cities (HUCs).
- Establishment of National and local area Water Quality Management Funds to be administered by the DENR in coordination with other concerned agencies.
- Implementation of wastewater charge system and discharge permit system.

c) Presidential Decree no. 856 (1975), Code on Sanitation of the Philippines

The Code defines the sanitation facilities to ensure that they are in keeping with modern standards of sanitation and provide a reference and guide for their enforcement.

Implementing Rules and Regulations related to the sewage collection and disposal, excreta disposal and drainage are stated in Chapter 17. The Code obligates the house connections to the sewer in the sewerage system service areas. Any individual sewage disposal system is to be abandoned and house sewer shall be directly connected to the public sewer.

d) Republic Act no. 7160 (1991), Local Government Code[1]

The Code devolves enforcement of laws on sanitation to LGUs. Furthermore, the provision of responsibility for basic services and facilities such as general hygiene and sanitation, beautification and solid waste collection, drainage, sewerage, and flood control are devolved to local governments under the Code.

e) Presidential Decree no. 1067 (1976), the Water Code of the Philippines

The Code establishes the basic principles and framework relating to the appropriation, control and conservation of water resources. The underlying principles of the Code are:

(a) All waters belonging to the State can not be subjected to acquisitive prescriptions.
(b) The State may allow the use or development of waters by administrative concessions.
(c) The utilization, exploitation, development, conservation and protection of water resources shall be subject to the control and regulation of the Government through the National Water Resources Council (currently, National Water Resources Board).
(d) Preference in the use and development of waters shall consider current usages and be responsive to the changing needs of the country.

2) <u>Beneficiaries-pay System for Sewerage System</u>

There is no legislation specifying beneficiary's payments for sewerage service. However, in Manila Water Company Inc, the connection fee (7,406.69 Pesos) is required for a sewerage connection.

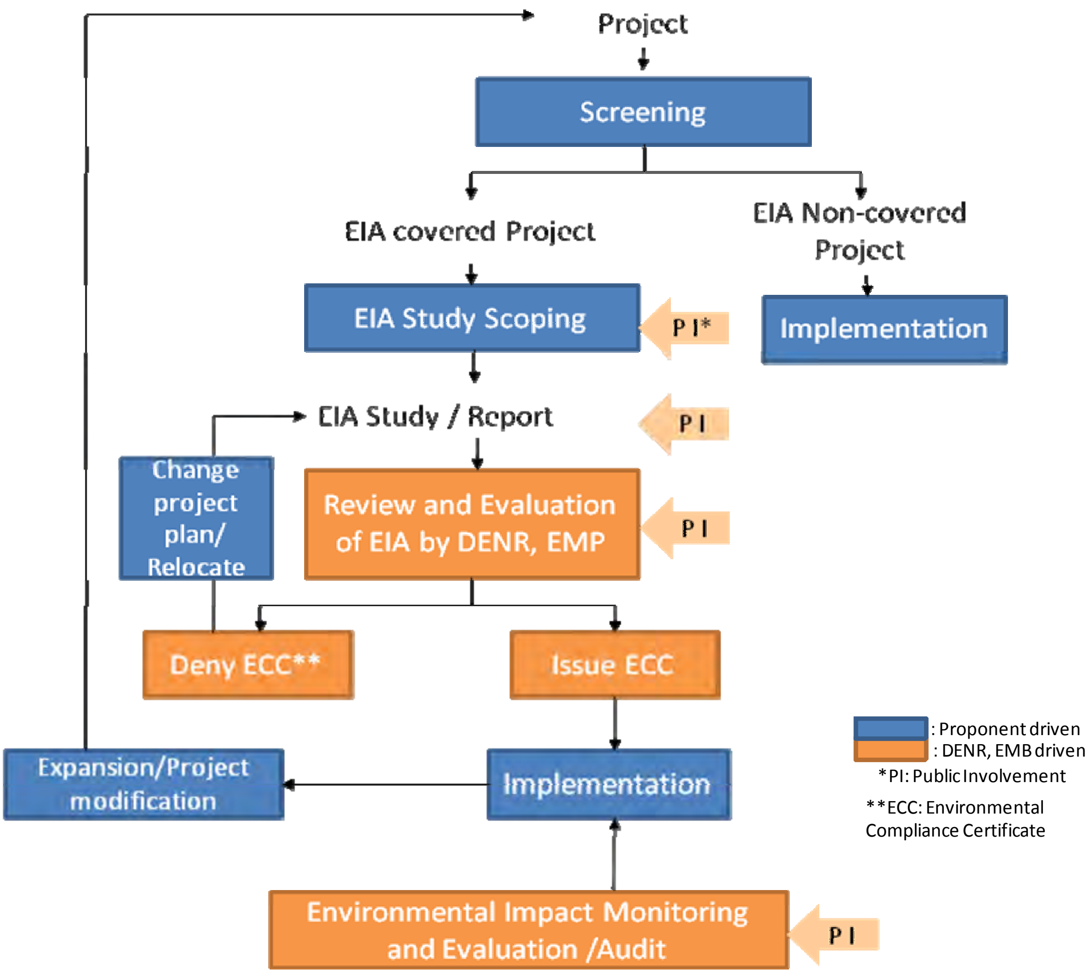
3) <u>Environmental Impact Assessment System</u>

a) The Environmental Impact Statement System in Philippines

Environmental Impact Statement was firstly defined in the Presidential Decree no. 1151 (1977). Since then Philippines Environmental Impact Statement System (PEISS) (the

Presidential Decree no. 1586) was issued in 1978. Since 1992, PEISS has been revised several times by the DENR. The latest edition is DAO 2003-30, which is now operated by the "Revised Procedure Manual of DAO 2003-30" issued under DENR-EMB in Aug. 2007.

Application to the EIS System requires compliance with certain stages of the EIA process. A summary flowchart of the complete process is shown in Figure 4.2-1. [1]



Source: Revised Procedural Manual for DAO 2003-30, August 2007, Environmental Management Bureau (EMB)

Figure 4.1-1 Summary Flowchart of the EIA Process

b) Covered Projects of the Philippine EIS System

The Philippine Environmental Impact Assessment EIA process covers projects that have been declared as Environmentally Critical Projects (ECPs) or as projects in the Environmentally Critical Areas (ECAs). There are four ECP project types; Heavy industries, Major resource extractive industries, Major infrastructure projects and all Golf course projects and 12 ECA Categories; law declared areas such as watershed reserves, wildlife preserves etc., Mangrove areas etc. as defined in "Revised Procedure Manual of DAO 2003-30". Summary list of ECPs and ECAs are shown in the Appendix.

[1] Revised Procedural Manual for DAO 2003-30, August 2007, Environmental Management Bureau (EMB).

All the projects are classified into following three major groups as to their project type, size and location.

Group I : ECPs in either ECAs or Non-Environmentally Critical Areas (NECAs)
Group II : Non-Environmentally Critical Projects (NECPs) in ECAs
Group III: NECPs in NECAs

c) Required EIA Report Types

There are five major EIA report types: (1) Environmental Impact Statement (EIS), (2) Programmatic EIS (PEIS), (3) Initial Environmental Examination Report (IEER) or (4) IEE Checklist (IEEC) and (5) Project Description Report (PDR), required for a new construction project. Required type of report varies depending on the project type, location and magnitude of potential impacts as summarized below.

✓ **EIA-covered projects in Group I and II** are required either of following reports depending on the project type, location, magnitude of potential impacts and the project threshold.
- an Environmental Impact Statement (EIS), or
- a Programmatic EIS (PEIS), or
- an Initial Environmental Examination Report (IEER) or
- an IEE Checklist (IEEC),

✓ **Certain cases in Groups II and III** are required,
- a Project Description Report (PDR)

The PDR is a "must" requirement for environmental enhancement and mitigation projects such as artificial reef, pollution control devices/facilities etc. in both the ECAs (Group II) and the NECAs (Group III) to allow the EMB to confirm the benign nature of proposed operations for eventual issuance of a Certificate of Non-Coverage (CNC).

✓ **All other non-covered projects in Group III** do not need to submit PDRs – application is at the discretion of the Proponent should it need a CNC for its own purposes, e.g. a financing prerequisite

Detail descriptions on other reports types to be submitted are attached in the Appendix.

According to the Project Grouping Matrix, pipeline projects and domestic wastewater treatment facility projects are non-covered projects unless they are not in the ECAs. Therefore, if the locations of these facilities are NECAs, an ECC (Environmental Compliance Certificate) is not required. However, sewerage system projects may say that one of environmental enhancement and environmental mitigation projects so that PDR shall be submitted to DENR.

4.1.3. Existing Sewerage System in Philippines

Currently, 1,600 cities and municipalities in the Philippines, only two cities; namely the City of Manila and Baguio, are operating functioning public sewerage systems.

In 1904, the fist sewerage system covering a service area of 1,800 hectares was constructed in the City of Manila. In 1997, two private operators: the Manila Water Company Inc. (MWCI) for the East Zone and the Maynilad Water Service Inc. (MWSI) for the West Zone signed Concession Agreement with the MWSS. As of 2009, five major Sewage Treatment Plants: Makati South STP (31,200m^3/day), Karangalan STPs (5,600m^3/day), UP STP (3,500 m^3/day), Heroes Hill STP (1,100 m^3/day) and Fort Bonifacio STP (3,200 m^3/day) are operated by MWCI, while two sewerage systems: Manila Central Sewerage System (300km of sewers, 3.5 km ocean outfall, no STP) and Dagat-Dagatan Sewerage System (67 km of sewers, 13,000m^3/day Aerated Lagoon) are operated by MWSI[1].

The Baguio sewage system was constructed in 1984 and it has been in operation since 1986. The designed capacity of the Baguio Sewage Treatment Plant (Oxidation ditch) is 8,600 m^3/day. However, it is currently receiving more than the designed capacity. The BSTP is now serving fully or partially 55 of the 128 Barangys in Baguio.

As a private sewerage system, there is a 2,600m^3 per day wastewater treatment plant operated on Boracay Island. The system composes of an oxidation ditch, disinfection tank and 840m ocean outfall.

4.2. Planning Environment on Water and Sanitation Development

4.2.1. Conditions for Plans for the Water Sector

1) Bohol Integrated Water Supply System Master Plan

The Bohol Integrated Water Supply System Master Plan (The Master Plan) was established in 2008. The Master Plan guides developments of water resources for safe domestic, commercial, and industrial use, in order to improve the health of the community and protect the depleting groundwater systems.

The Master Plan proposed seven (7) bulk water systems using river water. The study area includes the Loboc River-1 bulk water system. The proposed Loboc River-1 bulk water system consists of a two staged implementation; the Abatan river water supply system will be developed by 2010 as the first stage and the Loboc river water supply system will be added in 2018 as the second stage.

Although the Panglao Municipality is included in the first stage project, this part of the project has not started yet.

Any water supply project in Bohol is to conform to the Master Plan.

2) Panglao Tourism Development Guidelines

The Panglao Tourism Development Guidelines were established in 2009 to replace the concept of Tourism Development Zone/ Tourism Estate. To monitor the implementation of this Guideline, the REDCOM (Review and Development Committee) chaired by Office of the Governor was organized. All projects related to tourism more than two million peso in terms of construction cost in Panglao has to be examined by REDCOM. Only eligible projects can proceed to next steps such as application for building permit, business permit and so on.

The water supply/wastewater project also has to follow these Guidelines. The guidelines consist of sections such as reservation conservation of natural and manmade resources, wastes, noise and acoustic levels. Wastewater and sewage disposal is a part of the waste section of the guideline which stipulates that all the wastewater and sewage disposals shall comply with the provisions of E.O. 15, s. 2007 of the Provincial Governor.

4.2.2. Relevant Plan on Water Use and Water Resource

Six major rivers in Bohol are allocated as the water sources of water supply systems in the future. Out of the six rivers, the Abatan River and the Loboc River relate to the future water supply system for the Study Area.

There are two hydropower stations in the Loboc river basin for water use in these river basins. Related to the water balance of these river basins, the Loboc Valley Communal Irrigation Project (150 ha, 300 L/s) has been proposed by NIA Bohol office. Although this project has not stated yet due to budgetary limitation, its intake amount of 300 L/s is taken into consideration in the water balance study in the Water Supply Master Plan.

4.2.3. Plan on Water Environment Conservation

The Water Supply Master Plan is a sort of water environment conservation plan since one of the major purposes is to protect the water resource of groundwater. Aside from the Master Plan, there is no other water environment conservation plan in the Study Area.

4.2.4. Priority of Sewerage Development in Nation and Bohol Province

Importance of sewerage development in the Philippines is recognized by the central government. However the following recent situations and tendencies limits the central government in promoting sewerage projects:

- ✓ Decentralization
- ✓ Budgetary limitation
- ✓ Principal of cost recovery
- ✓ Tendency of privatization on water sector project

Most provincial governments are in the same situations, therefore the top priority projects, development of water supply systems for Tagbilaran, Dauis and Panglao, have not been started yet due to the lack of funding.

4.2.5. Current ODA Project and Private Sector Participation related to Water Sector Project in Bohol

The status of water sector projects in Bohol supported by foreign donors is as follows:

Panglao Island Sewerage and Wastewater Treatment Project

- ✓ Project components are:
  - Solid waste management and sanitation and
  - Sewerage and wastewater treatment facility and drainage system.
- ✓ Funding Source : KOICA and local counterpart fund (P 350 million)
- ✓ Status: No response from KOICA since 2009

Tagbilaran City has the following sewerage project, which also has not started yet:

Centralized Wastewater Treatment Facility in Tagbilaran City

- ✓ Project major components are:
  - Detailed Engineering Design and
  - Construction of Centralized Wastewater Treatment Facility.
- ✓ Funding Source: Private Sector (P 112 million)
- ✓ Status: Pending

4.3. Wastewater Environment and Sanitation

4.3.1. Existing Wastewater Disposal

1) Overview

At present, there is no sewerage system in Bohol province. Mostly only black water (toilet wastewater) is treated by individual septic tank. Sullage (grey water) which is the wastewater resulting from personal washing, laundry, food preparation and the cleaning of kitchen utensils is discharged into ground or sea through a road ditch without treatment.

Aside from above situations, some part of squatter area extending along seashore (refer to Figure 4.3-1), level 3 water system has been served but do not have any wastewater treatment facility. The following photos show conditions of housing located in the Cause Way bridge.

Local restaurant

Local restaurant and houses

Service connection of water system

Squatter area

2) Drainage

There is no river and canal lead to the sea in Tagbilaran City, while a couple of rivers exist in Panglao Island. However, usually there is no water flows in these rivers except in heavy rain. The soil of Panglao Island seems to have a characteristic of high permeability.

Currently, the drainage system covers only city center of Tagbilaran. The location of the existing drainage system is shown in Appendix. The drained water is discharged into the Tagbilaran Gulf from six outfalls (refer to Figure4.3-1). The following photos show the current conditions of rainfall drainage in Tagbilaran city. Drained rainfall could be highly polluted since the rainfall will scour road surfaces.

Drains through existing drainage system (Inlet Manhole in a parking area).

Drains through road surface without drainage system. (intersection of M.H. del Pilar & C. Gallares)

Source of outfall location: Documentation of Sources of Nutrients in the Tagbilaran-Panglao Island Channel, Ma. E. Pajarito, K. Omictin and Bohol Environment Management Office, June 2006.

Figure 4.3-1 Location of Squatter Area and Existing Outfall in Tagbilaran-Panglao Island Channel

4.3.2. Water Quality of Public Water Body

1) Water Quality Standard

a) Water Usage and Classification

All the water bodies in Philippine is classified according to water usages under Administrative Order No. 34. Tagbilaran ocean bay is identified as class SB. Water usage of the class SB is defined as;

1) Recreational Water Class I (Areas regularly used by the public for bathing, swimming, skin diving, etc.)
2) Fishery Water Class I (Spawning areas for Chanos chanos or "Bangus" and similar species).

Other water usage and classifications definitions are shown in Appendix.

b) Water Quality Criteria

The water quality criteria for fresh waters and coastal and marine water are shown in Table 4.3-1.and Table 4.3-2.

Table 4.3-1 Water Quality Criteria (General Items)

Parameter	Unit	Fresh Water Classification					Costal and Marine Water Classification			
		AA	A	B	C	D	SA	SB	SC	SD
Color	PCU	15	50	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Temperature(d) (Max. rise)	°C rise	-	3	3	3	3	3	3	3	3
pH		6.5~8.5	6.5~8.5	6.5~8.5	6.5~8.5	6.0~9.0	6.5~8.5	6.0~8.5	6.0~8.5	6.0~9.0
Dissolved Oxygen (Minimum)	% satn	70	70	70	60	40	70	70	70	50
BOD_5	mg/L	1	5	5	7(10)	10(15)	5	5	5	2
Total Suspended Solid	mg/L	25	50	(f)	(g)	(h)	(f)	(g)	(g)	(h)
Total Dissolved Solid	mg/L	500(i)	1,000(i)	-	-	1,000(i)				
Surfactants (MBAS)	mg/L	Nil	0.2(0.5)	0.3(0.5)	0.5	-	0.2	0.3	0.5	-
Oil/Grease (Petroleum Ether Extract)	mg/L	Nil	1	1	2	5	1	2	3	5
Nitrate as Nitrogen	mg/L	1.0	10	NR	10(j)	-				
Phosphate as Phosphorus	mg/L	Nil	0.1(k)	0.2(k)	0.4(k)					
Phenolic Substances as Phenols	mg/L	Nil	0.002	0.005(l)	0.02(l)	-	Nil	0.01	(l)	-
Total Coliforms	MPN/ 100ml	50	1,000	1,000	5,000	-	70	1,000	1,000	-
Fecal Coliforms	MPN/ 100ml	20	100	200	-	-	Nil	200	-	-
Chloride as Cl	mg/L	250	250	-	350	-				

Parameter	Unit	Fresh Water Classification					Costal and Marine Water Classification			
		AA	A	B	C	D	SA	SB	SC	SD
Copper	mg/L	1.0	1.0	-	0.05	-	-	0.02	0.0	-

Source: DENR
Footnotes:
(a) Except as otherwise indicated, the numerical limits in **Table 5.3-1** are yearly average values. Values enclosed in parentheses are maximum values.
(c) No abnormal discoloration from unnatural causes.
(d) The allowable temperature increase over average ambient temperature for each month.
(e) Sampling taken between 9:00 AM and 4:00 PM.
(f) Not more than 30% increase.
(g) Not more than 30 mg/l increase.
(h) Not more than 60 mg/l increase.
(i) Do not apply if natural background is higher in concentration. The latter will prevail and will be used as baseline.
(j) Applicable only to lakes, reservoirs, the Phosphates as P concentration should not exceed an average of 0.05 mg/l nor maximum of 0.1 mg/l.
(k) When applied to lakes or reservoirs, and similarly impounded water.
(l) Not present in concentration to affect fish flavor/taste.
Nil Extremely low concentration and not detectable by existing equipment.
- Means the standard of these substances are not considered necessary for the present time, considering the stage of the country's development and DENR capabilities, equipment and resources.

Table 4.3-2 Water Quality Criteria (Toxic Substances)

Parameter	Unit	Fresh Water Classification					Costal and Marine Water Classification			
		AA	A	B	C	D	SA	SB	SC	SD
Arsenic(i)	mg/L	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	-
Cadmium	mg/L	0.01	0.01	0.01	0.01	0.05	0.01	0.01	0.01	-
Chromium(i)	mg/L	0.05	0.05	0.05	0.05	0.1	0.05	0.01	0.01	-
Cyanide	mg/L	0.05	0.05	0.05	0.05	-	0.05	0.05	0.05	-
Lead(i)	mg/L	0.05	0.05	0.05	0.05	0.5	0.05	0.05	0.05	-
Total Mercury(i)	mg/L	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	-
Organo-phosphate	mg/L	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	-
Aldrin	mg/L	0.001	0.001	-	-	-	0.001	-	-	-
DDT	mg/L	0.05	0.05	-	-	-	0.05	-	-	-
Dieldrin	mg/L	0.001	0.001	-	-	-	0.001	-	-	-
Heptachlor	mg/L	Nil	Nil	-	-	-	Nil	-	-	-
Lindane	mg/L	0.004	0.004	-	-	-	0.004	-	-	-
Toxaphane	mg/L	0.005	0.005	-	-	-	0.005	-	-	-
Methoxychlor	mg/L	0.10	0.10	-	-	-	0.10	-	-	-
Chlordane	mg/L	0.003	0.003	-	-	-	0.003	-	-	-
Endrin	mg/L	Nil	Nil	-	-	-	Nil	-	-	-
PCB	mg/L	0.001	0.001	-	-	-	0.001	-	-	-

Source: DENR

Footnotes: refer to Table 4.3-1

c) Effluent Regulation (1990)

DENR adopts and promulgates the following rules and regulation known as "Revised Effluent Regulation of 1990". These rules and regulation shall apply to all industrial and municipal wastewater effluents. Table 4.3-3 shows the effluent standard for conventional and other pollutants for effluents discharges into receiving waters classified as Class A, B, C, D, SA, SB, SC and SD. The BOD effluent standard for strong industrial wastes (greater than 3,000 mg/L) discharged into water Class C, D, SC and SD is shown in Appendix. In addition, the effluent standard for heavy metals and toxic substances applied to industrial and other effluents when discharged into water bodies classifieds as Class A, B, C, D, SA, SB, SC and SD is shown in Appendix.

Table 4.3-3 Effluent Standard: Conventional and Other Pollutants

Parameter	Unit	Protected Waters				Inland Waters				Marine Water		Class SD & other Coastal Waters	
		Category I (AA & SA)		Category II (A, B & SB)		Class C		Class D		Class SC		Class SD	
		OEI	NPI	OEI	NPI	OEI	NPI	OEI	NPI	OEI	NPI	OEI	NPI
Color	mg/L	B	B	150	100	200c	150c	-	-	C	C	C	C
Temperature) (Max. rise)	mg/L	B	B	3	3	3	3	3	3	3	3	3	3
pH	mg/L	B	B	6.0-9.0	6.0-9.0	6.0-9.0	6.5-9.0	5.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0	5.0-9.0	5.0-9.0
COD	mg/L	B	B	100	60	150	100	250	200	250	200	300	200
Settleable Solid(1hour)	mg/L	B	B	0.3	0.3	0.5	0.5						
BOD_5	mg/L	B	B	50	30	80	50	150	120	120d	100	150d	120
Total Suspended Solid	mg/L	B	B	70	50	90	70	200	150	200	150	G	F
Total Dissolved Solid	mg/L	B	B	1,200	1,000	-	-	2,000 h	1,500 h	-	-	-	-
Surfactants (MBAS)	mg/L	B	B	5.0	2.0	7.0	5.0	-	-	15	10	-	-
Oil/Grease (Petroleum Ether Extract)	mg/L	B	B	5.0	5.0	10.0	5.0	-	-	15	10	15	15
Phenolic Substances as Phenols	mg/L	B	B	0.1	0.05	0.5	0.1	-	-	1.0 I	0.5 I	5.0	1.0
Total Coliforms	MPN/ 100ml	B	B	5,000	3,000	15,000	10,000	J	J	-	-	-	-

Source: DENR
Notes:
1) "OEI" means Old or Existing Industry. "NPI" means New/Proposed Industry or wastewater treatment plants to be constructed.
2) In cases where the background level of Total Dissolved Solids (TDS) in freshwater rivers, lakes, reservoirs and similar bodies of water is higher than the Water Quality Criteria, the discharge should not increase the level of TDS in the receiving body of water by more than ten percent of the background level.
3) The COD limits in the Tables generally apply to domestic wastewater treatment plant effluent. For industrial discharges, the effluent standards for COD should be on a case to case basis considering the COD – BOD ratio after treatment. In the interim period that this ratio is not yet established by each discharger, the BOD requirements shall be enforced.
4) There are no effluent standards for chloride except for industries using brine and discharging into inland waters, in which case the chloride content should not exceed 500 mg/L.
5) The effluent standards apply to industrial manufacturing plants and municipal treatment plants discharging more than thirty (30) cubic meters per day

Legend:
(A) Except as otherwise indicated, all limiting values in Table 5.2.5 are 90^{th} percentile values. This is applicable only when the discharger undertakes daily monitoring of its effluent quality, otherwise, the numerical values in the tables represent

maximum values not to be exceeded once a year.

(B) Discharge of sewage and/or trade effluents are prohibited or not allowed.
(C) Discharge shall not cause abnormal discoloration in the receiving waters outside of the mixing zone.
(D) For wastewaters with initial BOD concentration over 1,000 mg/l but less than 3,000 mg/l, the limit may be exceeded up to a maximum of 200 mg/l or a treatment reduction of 90 %, whichever is more strict. Applicable to both old and new industries
(E) The parameters Total Suspended Solids (TSS) should not increase the TSS of the receiving water by more than 30 % during the dry season.
(F) Not more than 30 mg/l increase (dry season)
(G) Not more than 60 mg/l increase (dry season)
(H) If effluent is the sole source of supply for irrigation, the maximum limits are 1,500 mg/l and 1,000 mg/l, respectively, for old industries and new industries.
(I) Not present in concentration to affect fish flavor or taste or tainting.
(J) If effluent is used to irrigate vegetable and fruit crops which may be eaten raw, Fecal Coliforms should be less than 500 MPN/100ml.

2) Ground Water Quality in the Study Area

Ground water quality of Tagbilaran city, Dauis and Panglao municipality were surveyed by the provincial government and SWECO (Refer to Report on Inventory of Water Sources and Sanitary Facilities 1998 Population and Water Demand Projections, Water Resources Potential Assessment and Future Requirements and Cost Estimates, July 1999). In the survey, the conditions of well water quality were classified into 3 levels: Good, Not Good and Salty.

The results of the drinking water well survey are summarized in following Table 4.3-4 and Figure 4.3-2. The results show that water quality of drinking water wells are mostly in good condition in Tagbilaran and Dauis (99% and 98% respectively). On the other hand, 35% of drinking wells are salty in Panglao.

The results of the washing water well survey are summarized in following Table 4.3-5 and Figure 4.3-3. Water quality of washing wells are not in good condition compare to drinking wells. More than half of the wells are salty/Not good condition as a total of three city/municipalities.

The precise results of the well survey for drinking water and washing water by each Brgy in Tagbilaran, Dauis and Panglao are shown in Appendix.

Table 4.3-4 Summary of Drinking Water Wells in Tagbilaran, Dauis and Panglao

Municipality	Number of **Drinking Water** Well					
	Level			Water Quality		
	I	II	III	Good	Not Good	Salty
Tagbilaran	**74**	**0**	**9**	**82**	**0**	**1**
		-		**99%**	**0%**	**1%**
Dauis	116	1	14	128	0	3
		-		**98%**	**0%**	**2%**
Panglao	141	0	1	92	0	50
				65%	**0%**	**35%**
Total	331	1	24	302	0	54
		-		**85%**	**0%**	**15%**

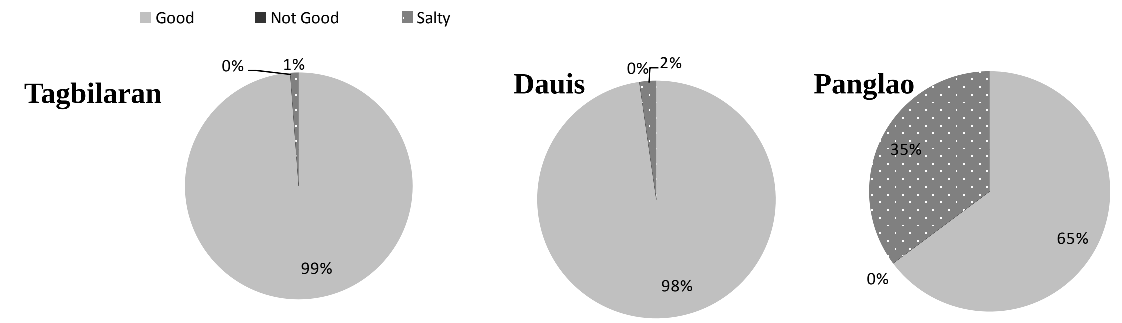


Figure 4.3-2 Water Quality of Drinking Water Wells

Table 4.3-5 Summary of Washing Wells in Tagbilaran, Dauis and Panglao

Municipality	Number of **Washing** Well					
	Level			Water Quality		
	I	II	III	Good	Not Good	Salty
Tagbilaran	57	0	0	39	17	1
				68%	**30%**	**2%**
Dauis	100	0	0	4	29	67
				29%	**67%**	**4%**
Panglao	241	0	0	137	0	104
				57%	**0%**	**43%**
Total	398	0	0	180	46	172
	-			**45%**	**12%**	**43%**

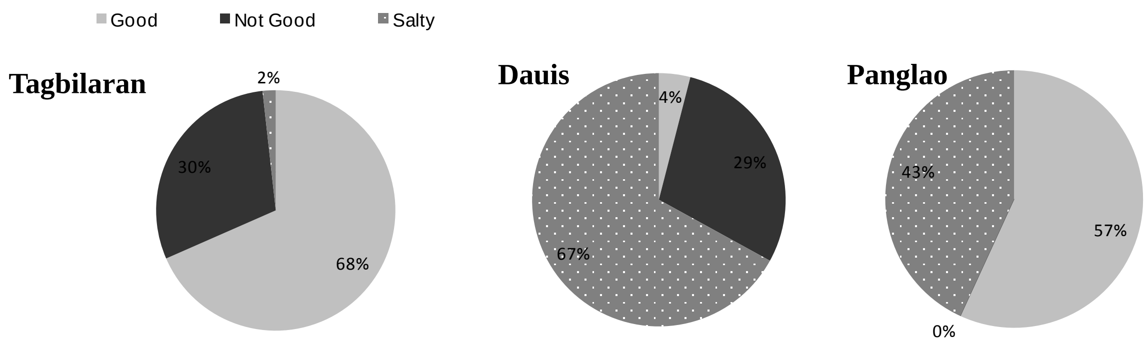
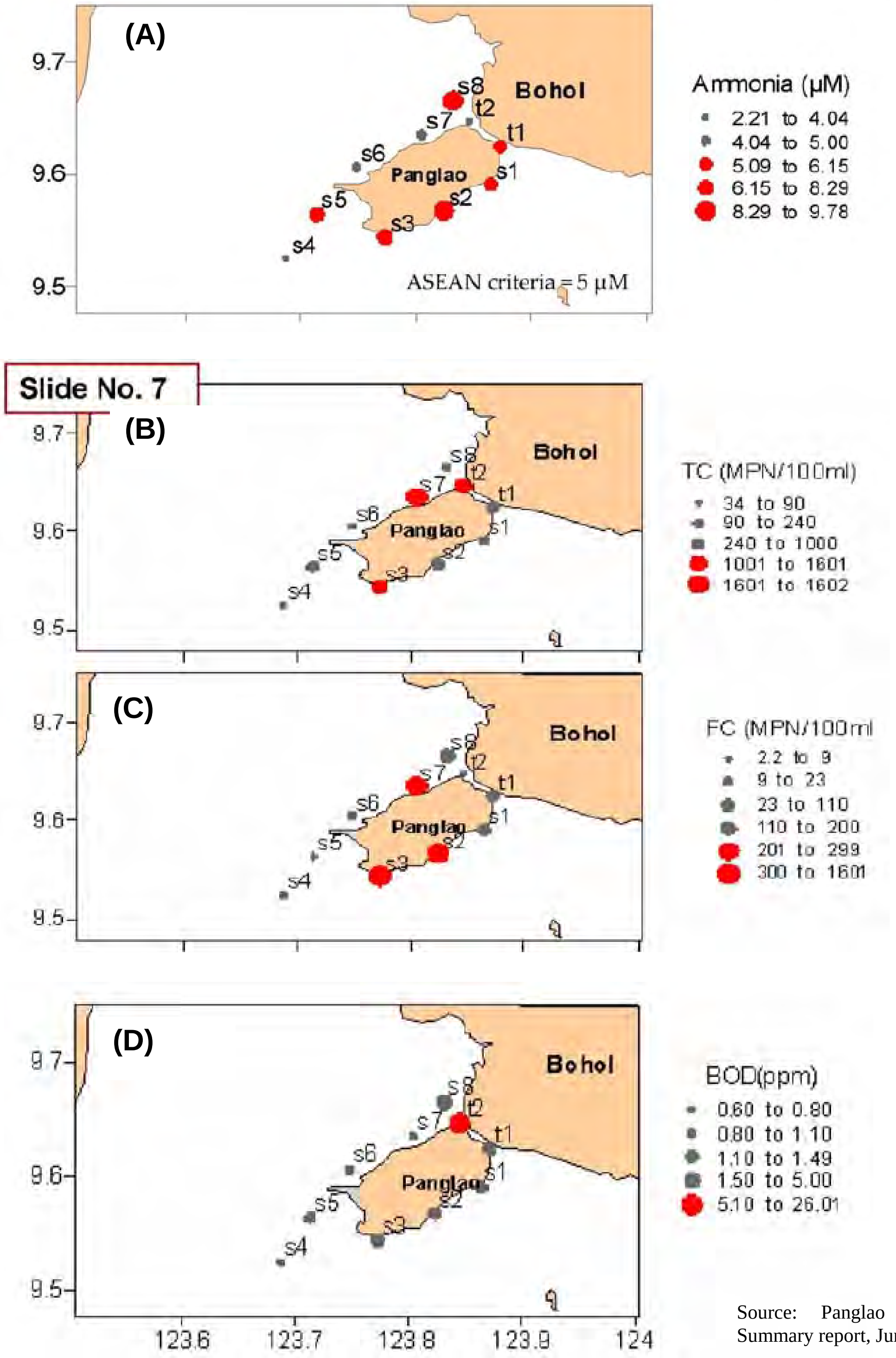


Figure 4.3-3 Water Quality of Washing Wells

3) <u>Sea Water Quality around Panglao Island</u>

a) Results of Panglao Island Assessment Report (2006)

The following figures show the results of sea water quality studies conducted in ten stations around the Panglao Island (refer to Panglao Island Assessment Summary report, June 2006). Results in red circles show the excess point of allowable limits prescribed by DENR DAO 34 for Class SB waters (refer to Table 5.4-1) or ASEAN criteria.



Source: Panglao Island Assessment Summary report, June 2006

Figure 4.3-4 Sea Water Quality around Panglao Island
(A; Ammonia, B; TC, C; FC, D; BOD)

4.3.3. Existing Sanitation Facility

1) Service Coverage of Sanitary toilets of Household

Table 4.3-6 shows number of household by toilet type in Panglao Island in 2000. Majority of households used septic tank i.e. Dauis 81 % (=3448+640/5045)and Panglao 72 % (2550+242/3890).

Table 4.3-6 Household by Toilet Type in Panglao Island(2000)

City/ municipality	Water-sealed				Closed pit	Open pit	Others (Pail system etc.)	None	Total
	Sewer/ ST used exclusively by households	Sewer/ ST used shared with households	Other depository used exclusively by households	Other depository used shared with households					
Dauis	3,448	640	422	78	172	21	91	173	5,045
Panglao	2,550	242	695	47	70	71	8	207	3,890
Total	5,998	882	1,117	125	242	92	99	380	8,935

Source: Panglao Tourism Development Plan

Updated data is only available on No. of water sealed type as shown in Table 4.3-7 and Table 4.3-8. However septic tank is probably dominant treatment facility even now.

Table 4.3-7 Households by Toilet Type in Dauis (2008)

Type of Toilet Facilities	Number of Household
With water sealed type toilet	6,952
Without toilets	404
Total	7,356

Source: MHO

Table 4.3-8 Households by Toilet Type in Panglao (2004)

Type of Toilet Facilities	Number of Household
With water sealed type toilet	4,402
Without toilets	N/A
Total	N/A

Source: MHO

For Tagbilaran city, 2010 survey data of City Health Officer shows sanitary toilet ratio of 98 %. Because out of 18,221 households in total, 17,875 households use sanitary toilet.

2) Sanitation Facility of Selected Hotel

Questionnaire survey about sewage treatment system for selected hotels. Responded hotels are as follows:

- Soledad Suites (Tagbilaran City)

- Bohol Plaza (Dauis municipality)
- Sea Coral Resort (Panglao municipality :only interview)

Each hotel has a septic tank which treats black and grey water. Photo shows the septic tanks of hotels in the Study Area

Hotel in Panglao; ST can be seen under the washbowls

Hotel in Tagbilaran; a manhole cover of ST can be seen)

The result of questionnaire survey is attached in Appendix.

JICA study team also visited to Flushing Meadows Resort in Dauis which is well thought of having advanced wastewater treatment facility. The following photos show the treatment facility using SBR reactor and drying bed. Treated water is reused for gardening and dried sludge is reused as fertilizer for orchard soil within the same property.

SBR

Drying Bed

3) Desludging System

Although majority of toilet type is septic tank (ST), no septage treatment plant is in the Study Area. Basically ST owner has never conducted desludging except getting into some trouble.

The photos below show a typical toilet and upper part of ST.

ST and manhole cover for desludging

Toilet connecting ST

The permit section of Tagbilaran City records the following two companies as desludging company. Desludged septage is disposed to the exiting open dumping site in Tagbilaran City.

① ANORA Septic Tank Service Brgy Manga
P 2,300/3m^3 (within Tagbilaran City)

② RHUVIANS's Septic Tank Service Brgy Mansasa
P 3,000/3m^3

4.4. Preliminary Wastewater Disposal Plan

4.4.1. Planning Policy and Planning Fundamentals for Wastewater Disposal Plan

1) Demarcation of Off-site and On-site Treatment

There are two types of wastewater disposal systems namely, an off-site treatment system called a "sewerage system" and an on-site treatment system otherwise called as an "individual treatment system".

A major criterion for the introduction of a sewerage system to a city/municipality is usually its population density.

For example, an on-site system is more economical than an off-site system under a condition of low population density. The per person total cost of an on-site treatment system is mostly constant regardless of population density. On the other hand, for the per person total cost of off-site system, the higher the population density the cheaper it becomes. Therefore, theoretically there is a turning-point-population density in which both unit total costs becomes equal.

This turning-point-population-density lies between 40 to 60 persons/ha. In this study, the Barangay population density of 60 persons/ha is set as turning-point-population-density for the preliminary sewerage development plan of Tagbilaran City. Also the proposed sewerage service area may include part of the Barangay area as being locate along the proposed sewer and some areas in which wastewater can be collected with low cost due to their topographic condition.

In Panglao, the average population density is 6.5 persons/ha in 2007, while the average population density of Tagbilaran City is 28.4 persons/ha. Therefore on-site treatment system should be recommended for Panglao Island. However, small-scale sewerage systems should be employed for some areas like those congested areas in the Poblacion and/or the tourism-developed area like Alona Beach.

2) Projected Population

a) Relevant Data on Future Population

- **Projected Population by PDPFP**

The Province of Bohol prepared the "Provincial Development & Physical Development Plan (PDPFP 2010-2015)" in 2010. The municipal and city population of Bohol province in 2010-2015 were projected based on the 2007 Population Census.

Table 4.4-1 shows the population data from NSO and Projected Population of Tagbilaran City, Dauis and Panglao Municipalities based on PDPFP.

Table 4.4-1 Existing Population (NSO) and Projected Population from PDPFP

Province/City/Municipality		Census (NSO)					PDPFP			
		Total Population			Annual Growth Rate (%)		Projected Population		Annual Growth Rate (%)	
		Sept 1995	May 2000	Aug 2007	1995 to 2000	2000 to 2007	2010	2015	2007 to 2010	2010 to 2015
	Bohol province	*994,440*	*1,139,110*	*1,230,110*	*2.95*	*1.06*	*1,275,214*	1,349,704	1.21	1.11
1	Tagbilaran	66,683	77,700	92,297	3.33	2.40	98,145	110,501	2.07	2.40
2	Dauis	24,041	27,015	36,525	2.04	4.25	40,387	50,137	3.41	4.42
3	Panglao	18,095	21,337	25,558	3.59	2.52	27,241	30,851	2.15	2.52

Source: NSO and PDPFP

- **Projected Population by Bohol Integrated Water Supply System Master Plan**

The projected population described in the Bohol Integrated Water Supply System Master Plan (BHL-1) is shown in Table 4.4-2. This projection was made from the census 1980-2000. Therefore, the latest census of 2007 is not reflected in that projection. Actually, the population of Dauis based on the NSO 2007 (36,525) is larger than the projected population of 2010 (34,080). Hence, this projected population should be reviewed with the use of updated data.

Table 4.4-3 shows average annual growth rate applied to the population forecast of this Master Plan. These annual growth rates look moderate.

Table 4.4-2 Projected Population by Water Supply System Master Plan (BHL-01)

Province/City/Municpality		Total Population					
		2010	2015	2020	2025	2030	2035
	Bohol province/LGU	*1,362,900*	*1,480,700*	*1,597,100*	*1,707,600*	*1,811,100*	*1,908,200*
1	Tagbilaran	95,518	104,354	113,512	122,292	130,591	138,432
2	Dauis	34,080	38,244	42,283	46,648	50,667	54,520
3	Panglao	25,943	28,360	30,759	33,051	35,211	37,248

Source: Bohol Integrated Water Supply System Master Plan

Table 4.4-3 Average Annual Growth Rate by Water Supply System Master Plan

Province/City/Municpality		Annual Average Growth Rate (%)				
		2010-2015	2015-2020	2020-2025	2025-2030	2030-2035
	Bohol province/LGU	*1.67*	*1.53*	*1.35*	*1.18*	*1.05*
1	Tagbilaran	*1.79*	*1.70*	*1.50*	*1.32*	*1.17*
2	Dauis	*2.33*	*2.03*	*1.98*	*1.67*	*1.48*
3	Panglao	*1.80*	*1.64*	*1.45*	*1.27*	*1.13*

Source: Bohol Integrated Water Supply System Master Plan

b) Projected Population for This Study

- **City and Municipal Population**

At present, there is no available official data from an authorized agency for the projected population until 2035. Therefore, the future population for sewerage planning is forecasted based on the following procedure:

- The projected population of PDPFP is adopted as the City and Municipal population of 2010 and 2015.
- The future population from 2020 to 2035 is projected using annual average growth rate as shown in Table 4.4-4. The results are shown in Table 4.4-5.

Table 4.4-4 Assumption of Annual Growth Rate (%)

City/ Municipality	2015~2020	2020~2025	2025~2030	2030~2035
Tagbilaran	1.7	1.5	1.3	1.2
Dauis	2.5	2.0	1.8	1.6
Panglao	1.6	1.4	1.3	1.2

Source: JICA Study team

Table 4.4-5 Present and Projected Population in Study Area

City/ Municipality	2007	2010	2015	2020	2025	2030	2035
Tagbilaran	92,297	98,145	110,501	120,220	129,150	138,150	146,640
Dauis	36,525	40,387	50,137	56,730	62,630	68,470	74,130
Panglao	25,558	27,241	30,851	33,400	35,800	38,190	40,540

Source: JICA Study team

- **Future Population by Barangay**

The distribution of the city population to Barangay is made with the use of the projected population distribution percentages by Tagbilaran City.

For Dauis and Panglao municipalities, the distribution of the municipal population to Barangay is made with the use of the present population distribution percentages based on the 2007 NSO Census.

The Barangay population in the Study Area is shown in Table 4.4-6 to Table 4.4-8.

Table 4.4-6 Projected Population by Brgy in Tagbilaran City

	Brgy	2007 (NSO)		2010	2015	2020	2025	2030	2035	
		Pop.	% Brgy	Pop.	Pop.	Pop.	Pop.	Pop.	Pop.	% Brgy
1	Bool	4,929	5.34%	5,139	7,570	8,710	9,890	11,100	12,350	8.42%
2	Booy	7,896	8.55%	8,119	8,997	9,610	10,130	10,550	10,890	7.43%
3	Cabawan	1,550	1.68%	2,641	3,462	4,380	5,460	6,730	8,220	5.61%
4	Cogon	17,266	18.71%	17,311	17,382	17,870	18,240	18,380	18,380	12.53%
5	Dao	6,772	7.34%	6,926	7,660	8,160	8,590	8,930	9,210	6.28%
6	Dampas	7,210	7.81%	8,155	10,953	13,650	15,920	18,090	20,330	13.86%
7	Manga	6,081	6.59%	7,060	8,144	9,060	9,940	10,780	11,590	7.90%
8	Mansasa	5,396	5.85%	5,465	6,025	6,400	6,720	6,960	7,150	4.88%
9	Pob 1	3,323	3.60%	3,324	3,337	3,340	3,350	3,360	3,370	2.30%
10	Pob 2	5,856	6.34%	5,862	5,883	5,590	5,600	5,600	5,610	3.83%
11	Pob 3	6,511	7.05%	6,565	6,580	6,610	6,630	6,640	6,650	4.53%
12	San Isidro	4,500	4.88%	4,704	5,240	5,630	5,970	6,250	6,490	4.43%
13	Taloto	6,176	6.69%	6,567	7,357	7,940	8,470	8,920	9,310	6.35%
14	Tiptip	3,956	4.29%	4,475	5,118	5,640	6,140	6,600	7,030	4.79%
15	Ubujan	4,875	5.28%	5,831	6,794	7,630	8,460	9,260	10,060	6.86%
	Total	92,297	100.00%	98,145	110,501	120,220	129,510	138,150	146,640	100.00%

Source: JICA Study Team

Table 4.4-7 Projected Population by Brgy in Dauis Municipality

Brgy	2007 NSO		2010	2015	2020	2025	2030	2035
	Population	% by Brgy						
1. Biking	2,631	7.20%	2,909	3,612	4,090	4,510	4,930	5,340
2. Bingag	4,294	11.76%	4,748	5,894	6,670	7,360	8,050	8,710
3. Catarman	4,152	11.37%	4,591	5,699	6,450	7,120	7,780	8,430
4. Dao	923	2.53%	1,021	1,267	1,430	1,580	1,730	1,870
5. Mayacabac	3,236	8.86%	3,578	4,442	5,030	5,550	6,070	6,570
6. San Isidro	1,129	3.09%	1,248	1,550	1,750	1,940	2,120	2,290
7. Songculan	3,422	9.37%	3,784	4,697	5,310	5,870	6,410	6,950
8. Tabalong	4,027	11.03%	4,453	5,528	6,250	6,910	7,550	8,170
9. Tinago	2,202	6.03%	2,435	3,023	3,420	3,780	4,130	4,470
10. Totolan	4,834	13.23%	5,345	6,636	7,510	8,280	9,060	9,810
11. Marivedes	2,818	7.72%	3,116	3,868	4,380	4,830	5,280	5,720
12. Poblacion	2,857	7.82%	3,159	3,922	4,440	4,900	5,360	5,800
Total	36,525	100.00%	40,387	50,137	56,730	62,630	68,470	74,130

Source: JICA Study Team

Table 4.4-8 Projected Population by Brgy in Panglao Municipality

Brgy	2007 NSO		2010	2015	2020	2025	2030	2035
	Population	% by Brgy						
1. Bilisan	2,800	10.96%	2,984	3,380	3,660	3,920	4,180	4,440
2. Danao	3,296	12.90%	3,513	3,979	4,310	4,620	4,930	5,230
3. Doljo	2,984	11.68%	3,180	3,602	3,900	4,180	4,460	4,730
4. Looc	2,135	8.35%	2,276	2,577	2,790	2,990	3,190	3,390
5. Poblacion	4,608	18.03%	4,911	5,562	6,010	6,460	6,880	7,310
6. Bolod	1,349	5.28%	1,438	1,628	1,760	1,890	2,020	2,140
7. Libaong	1,558	6.10%	1,661	1,881	2,040	2,180	2,330	2,470
8. Lourdes	1,053	4.12%	1,122	1,271	1,380	1,470	1,570	1,670
9. Tangnan	3,046	11.92%	3,247	3,677	3,980	4,270	4,550	4,830
10. Tawala	2,729	10.68%	2,909	3,294	3,570	3,820	4,080	4,330
Total	25,558	100.00%	27,241	30,851	33,400	35,800	38,190	40,540

Source: JICA Study Team

4.4.2. Conceptual Design of Sewerage System

1) Design Period

The following factors influence the design period to be selected: (1) useful life of component structures and equipment; (2) ease or difficulty extending or adding to existing and planned works; (3) population growth and increase wastewater flows including industrial and commercial development; (4) work performance during its early years when these will not be loaded to capacity. Usually, a period of 10-30 years from present is adopted as the design period.

Since a substantial study of sanitation and sewerage development for Tagbilaran City and Panglao Island will take a certain time from the present, year 2035 is set as the target year of the design period for this Study.

Design Period	Year 2035

2) Sewerage Service Area

a) Tagbilaran City

In Tagbilaran City, the future population density of the eight Barangays, namely, Booy, Cogon, Manga, Mansasa, Poblacion 1, Poblacion 2, Poblacion 3, and Ubujan will exceed 60 person/ha (refer Table 4.4-9). Therefore, these Barangays are selected as sewerage service areas. In addition, another three Barangay, namely, Dao, Dampas and Taloto are included in the sewerage service area since the main sewer line passes through these areas.

Table 4.4-9 Population Density by Brgy in Tagbilaran City in 2035

Name of Brgy.	Population in 2007 (NSO)	Population in 3035	Area (ha)	Population Density (per./ha)	
				2007	2035
1. Bool	4,929	12,350	348.8	14.1	35.4
2. Booy	7,896	10,890	146.4	53.9	74.4
3. Cabawan	1,550	8,220	267.3	5.8	30.8
4. Cogon	17,266	18,380	204.4	84.5	89.9
5. Dao	6,772	9,210	443.7	15.3	20.8
6. Dampas	7,210	20,330	390	18.5	52.1
7. Manga	6,081	11,590	117.3	51.8	98.8
8. Mansasa	5,396	7,150	82.9	65.1	86.2
9. Poblacion I	3,323	3,370	25.9	128.3	130.1
10. Poblacion II	5,856	5,610	70.2	83.4	79.9
11. Poblacion III	6,511	6,650	70.7	92.1	94.1
12. San Isidro	4,500	6,490	429.4	10.5	15.1
13. Taloto	6,176	9,310	244.5	25.3	38.1
14. Tiptip	3,956	7,030	282.1	14.0	24.9
15. Ubujan	4,875	10,060	145.6	33.5	69.1
Total	92,297	146,640	3,270.20	28.22	44.8

Source: JICA Study team

b) Dauis Municipality

In the municipality of Dauis, the population density of Poblacion is projected to exceed 60 person/ha in 2035 (refer Table 5.5-10). However, the future situation of Poblacion area is too uncertain to adopt the sewerage system for whole area of Poblacion. Therefore congested area within the Poblacion is selected as a sewerage service area.

Table 4.4-10 Population Density by Brgy in Dauis municipality in 2035

Name of Brgy.	Population in 2007 (NSO)	Population in 3035	Area (ha)	Population Density (per./ha)	
				2007	2035
1. Biking	2,631	5,340	544.89	4.8	9.8
2. Bingag	4,294	8,710	610.20	7.0	14.3
3. Catarman	4,152	8,430	369.00	11.3	22.8
4. Dao	923	1870	564.25	1.6	3.3
5. Mayacabac	3,236	6,570	275.49	11.7	23.8
6. San Isidro	1,129	2,290	390.57	2.9	5.9
7. Songculan	3,422	6,950	394.60	8.7	17.6
8. Tabalong	4,027	8,170	350.22	11.5	23.3
9. Tinago	2,202	4,470	320.30	6.9	14.0
10. Totolan	4,834	9,810	238.10	20.3	41.2
11. Marivedes	2,818	5,720	304.40	9.3	18.8
12. Poblacion	2,857	5,800	95.50	29.9	60.7
Total	36,525	74,130	4,457.52	8.2	16.6

Source: JICA Study team

c) Panglao Municipality

The projected population density in the municipality of Panglao is lower than 60 persons/ha as in all Barangays (refer Table 4.4-11). However, some parts of the congested areas in Poblacion, Doljo and Tawala (Alona beach area) are selected as sewerage service areas. The future population density of the selected areas in Poblacion and Doljo is projected as 97 persons/ha. (Served population 9,205 /Service area 93.76 ha).

For Alona Beach, the number of residents may not be many but a large volume of wastewater is generated by the tourism industry. The Water Supply Master Plan estimates the water demand of 926 m^3/d for the tourism industry for the municipality of Panglao in 2035. Most parts of Alona Beach are located in the Barangay Tawala. In terms of the number of hotels, half of these are located in Barangay Tawala. Therefore, the equivalent population of Alona Beach can be estimated as approximately 3,100 (926 x 0.5/0.15) assuming a production of 150 L/person of wastewater.

Since the equivalent population density is calculated at 75 persons/ha (=3,100/41.36), Alona Beach should be included in the sewerage service area.

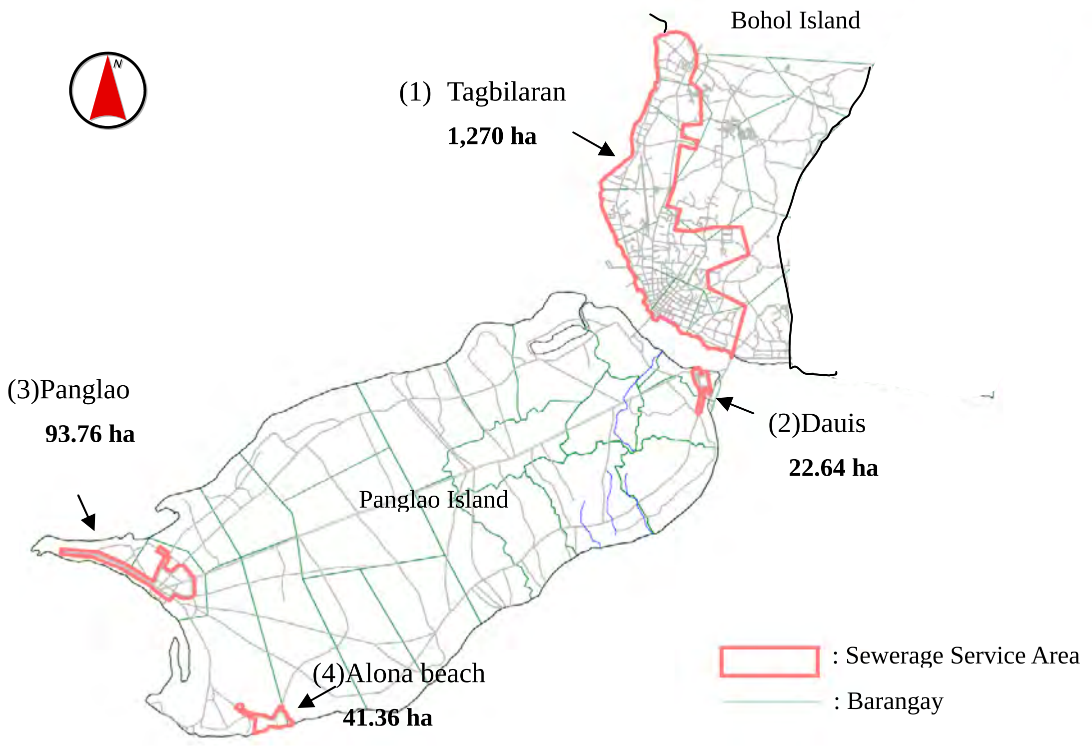
Table 4.4-11 Population Density by Brgy in Panglao municipality in 2035

Name of Brgy.	Population in 2007 (NSO)	Population in 3035	Area (ha)	Population Density (per./ha)	
				2007	2035
1. Bilisan	2,800	4,440	364.37	7.7	12.2
2. Danao	3,296	5,230	789.65	4.2	6.6
3. Doljo	2,984	4,730	109.88	27.2	43.0
4. Looc	2,135	3,390	254.11	8.4	13.3
5. Poblacion	4,608	7,310	287.15	16.0	25.5
6. Bolod	1,349	2,140	597.99	2.3	3.6
7. Libaong	1,558	2,470	423.37	3.7	5.8
8. Lourdes	1,053	1,670	377.39	2.8	4.4
9. Tangnan	3,046	4,830	682.87	4.5	7.1
10. Tawala	2,729	4,330	891.8	3.1	4.9
Total	25,558	40,540	5,049.48	5.1	8.0

Source: JICA Study team

d) Conclusion

As a conclusion, the following four areas shown in Figure 4.4-1 were selected as the sewerage service area by considering population density and intents of the municipal governments; (1) Tagbilaran system: center of city and surrounding of Wastewater Treatment Plant (WWTP), (2) Dauis system: part of Poblacion, (3) Panglao system: part of Poblacion and Doljo and, (4): Alona beach.



Source: JICA Study team

Figure 4.4-1 Location of Sewerage Service Area

3) Projected Sewered Population

a) Projection of Sewered Population for Tagbilaran City and Panglao

In this plan, the sewered population is assumed to be the population served by a level 3-water supply system. The projection of future sewered population in Tagbilaran City and the municipality of Panglao are conducted based on the projected Barangay population as shown in following equation.

Po =Pb x Crw x Crs

where; Po: Sewered Population in 2035
Pb: Population in each Barangay in 2035
Crw: Coverage ratio of level 3
Crs: Coverage ratio of sewerage service.

The coverage ratio of level 3 water supply system in Tagbilaran City and the municipality of Panglao is projected in the Water Supply Master Plan for Bohol province. Coverage ratio of level 3 water supply system is projected by area, namely, urban and rural as shown in Table 4.4-12.

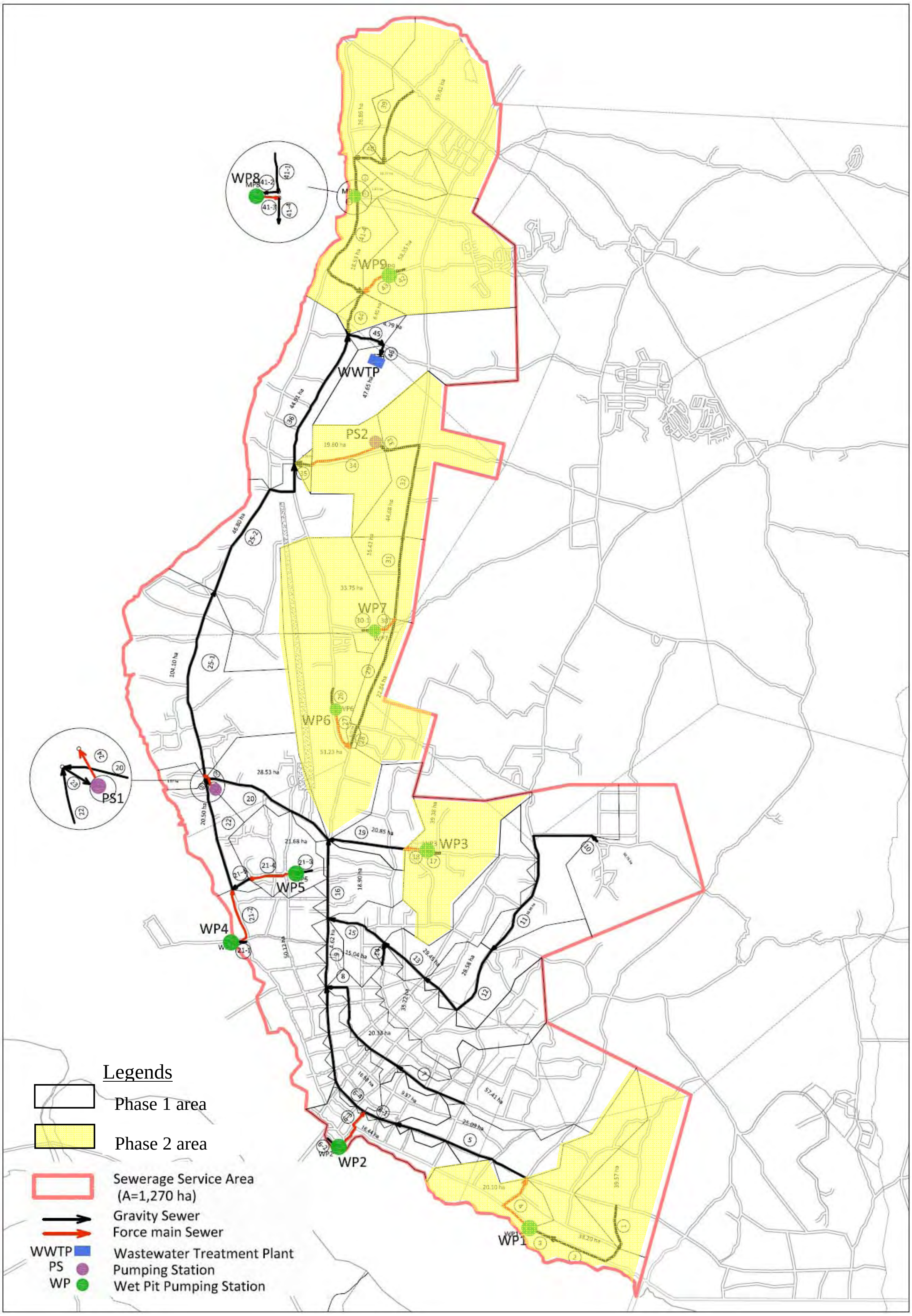
Table 4.4-12 Served Population of Level 3 in 2020 and 2035

Projected Year	City/ Municipalit	Projected Population			Target Served Population of Level 3 water supply					
		Urban	Rural	Total	Urban		Rural		Total	
2020	Tagbilaran	112,924	0	112,924	96,550	85.5%	-		96,551	85.5%
	Panglao	19,578	11,192	30,770	15,810	80.8%	6,566	58.7%	22,377	72.7%
2035	Tagbilaran	137,428	0	137,428	117,501	85.5%	-		117,502	85.5%
	Panglao	25,182	12,112	37,294	21,530	85.5%	7,195	59.4%	28,726	77.0%

Sources: Water Supply Master Plan Final Report Vol.2, Province of Bohol (2008).

Since the service area of Tagbilaran is quite large, part of the service area is recommended to be constructed after 2020 as Phase -2. (See figure 4.4-2 the yellow part is phase 2)

The results of the projected sewered population in 2020 and 2035 in Tagbilaran City are shown in Table4.4-13 and Table 4.4-14 and the sewered population in the Panglao is also shown in Table 4.4-15.



Source: JICA Study team

Figure 4.4-2 Proposed Sewerage Service Area by Phase

Table 4.4-13 Sewered Population in Tagbilaran City in 2020

Barangay	Brgy Population in 2020	Level 3 Water Suppy System		Sewerage	
		Coverage ratio	Served Population	Coverage ratio	Served Population
	[1]	[2]	[3]=[1]*[2]	[4]	[4]=[3]*[4]
1. Bool	8,710	85.5%	7,447	-	-
2. Booy	9,610	85.5%	8,217	40%	3,287
3. Cabawan	4,380	85.5%	3,745	-	-
4. Cogon	17,870	85.5%	15,279	60%	9,167
5. Dao	8,160	85.5%	6,977	-	-
6. Dampas	13,650	85.5%	11,671	40%	4,668
7. Manga	9,060	85.5%	7,746	-	-
8. Mansasa	6,400	85.5%	5,472	5%	274
9. Poblacion I	3,340	85.5%	2,856	90%	2,570
10. Poblacion II	5,590	85.5%	4,779	100%	4,779
11. Poblacion III	6,610	85.5%	5,652	80%	4,522
12. San Isidro	5,630	85.5%	4,814	-	-
13. Taloto	7,940	85.5%	6,789	40%	2,716
14. Tiptip	5,640	85.5%	4,822	-	-
15. Ubujan	7,630	85.5%	6,524	-	-
Total	120,220		102,790	-	31,983

Sewerage Coverage ratio in Tagbilaran city = 31,983 / 120.220= **27%**

Source: JICA Study team

Table 4.4-14 Sewered Population in Tagbilaran City in 2035

Barangay	Brgy Population in 2035	Level 3 Water Suppy System		Sewerage	
		Coverage ratio	Served Population	Coverage ratio	Served Population
	[1]	[2]	[3]=[1]*[2]	[4]	[4]=[3]*[4]
1. Bool	12,350	85.5%	10,559	-	-
2. Booy	10,890	85.5%	9,311	90%	8,380
3. Cabawan	8,220	85.5%	7,028	-	
4. Cogon	18,380	85.5%	15,715	90%	14,144
5. Dao	9,210	85.5%	7,875	10%	788
6. Dampas	20,330	85.5%	17,382	40%	6,953
7. Manga	11,590	85.5%	9,909	90%	8,918
8. Mansasa	7,150	85.5%	6,113	90%	5,502
9. Poblacion I	3,370	85.5%	2,881	100%	2,881
10. Poblacion II	5,610	85.5%	4,797	100%	4,797
11. Poblacion III	6,650	85.5%	5,686	100%	5,686
12. San Isidro	6,490	85.5%	5,549	-	-
13. Taloto	9,310	85.5%	7,960	80%	6,368
14. Tiptip	7,030	85.5%	6,011	-	-
15. Ubujan	10,060	85.5%	8,601	60%	5,161
Total	146,640		125,377	-	69,578

Sewerage Coverage ratio in Tagbilaran city = 69,578 / 146,640 = **47%**

Source: JICA Study team

Table 4.4-15 Sewered Population in the Municipality of Panglao in 2035

Barangay	Brgy Population in 2035	Level 3 Water Suppy System		Sewerage	
		Coverage ratio	Served Population	Coverage ratio	Served Population
	[1]	[2]	[3]=[1]*[2]	[4]	[4]=[3]*[4]
1. Bilisan	4,440		-	-	-
2. Danao	5,230		-	-	-
3. Doljo	4,730	77.0%	3,642	100%	3,642
4. Looc	3,390		-	-	-
5. Poblacion	7,310	85.5%	6,250	70%	4,375
6. Bolod	2,140		-		-
7. Libaong	2,470		-	-	-
8. Lourdes	1,670		-		-
9. Tangnan	4,830		-	-	-
10. Tawala	4,330	77.0%	3,334	20%	667
Total	40,540		34,662		8,684

(3) Poblacion service area

(4) Alona beach service area

Sewerage Coverage ratio in Panglao municipality= 8,684 / 40,540 = **21%**

Source: JICA Study Team

b) Projection of Sewered Population in Dauis

The population density of the proposed sewerage service area in Dauis looks nearly saturated as shown in Figure 4.4-3. Therefore, the population within the service area in 2035 may only increase by 130% based from the 2010 population due to limited land area for new housing.

The future service population in the municipality of Dauis is projected with the following procedures:

- The existing household number is about 200 households in Barangay Poblacion and about 15 households in Barangay Mayacabac. Therefore, there are a total of 215 households.
- The population per one household is estimated to be 5persons/house.
- Therefore, the current population in the proposed service area is estimated to be 215 x 5 = 1,075 pop.
- The future population growth rate in 2035 is estimated to be 30%. Therefore, the service population in 2035 is projected to be 1,400 pop (=1075 x 1.3).

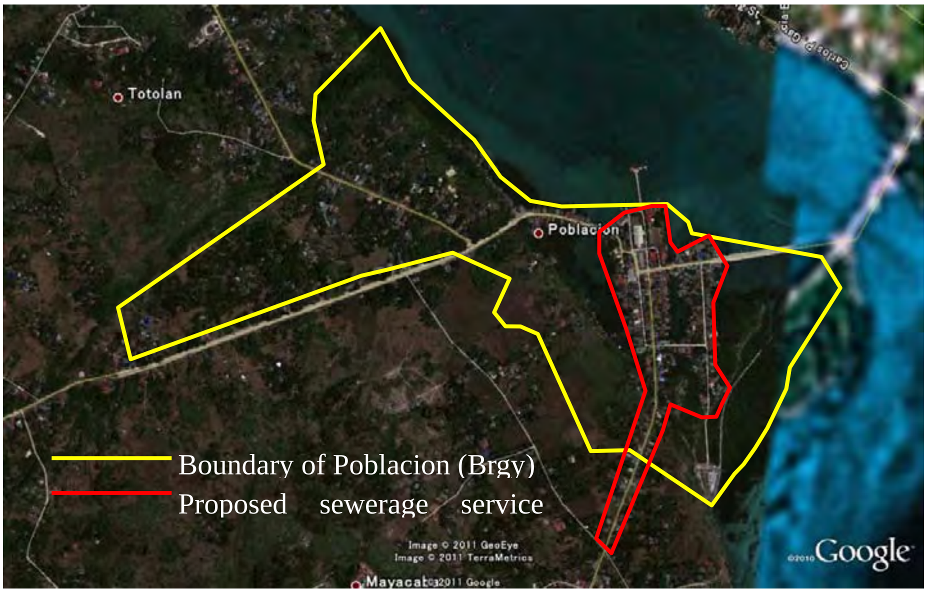


Figure 4.4-3 Location of Sewerage Service Area in Dauis

Summary of Projected Service Coverage

The projected service coverage of the proposed sewerage system in the Study Area is summarized in Table 4.4-16.

Table 4.4-16 Service Coverage in 2035

City/Municipality	2020 (Phase 1)			2035 (Phase 2)		
	Projected Polulation		Service Coverage	Projected Polulation		Service Coverage
	Total	Service area		Total	Service area	
	[1]	[2]	[2]/[1]	[3]	[4]	[4]/[3]
Tagbilaran	120,220	31,983	**27%**	146,640	69,578	**47%**
Dauis				74,130	1,400	**2%**
Panglao				40,540	8,684	**21%**

Source: JICA Study team

4) Design Wastewater Flow

The design wastewater flow consists of domestic flow, non-domestic flow and inflow/infiltration into the sewers. Domestic flow is the estimated by served population and per capita wastewater volume. Non-domestic flow consists of commercial, institutional industrial and tourism wastewater. In this study, the non-domestic flow is estimated from the ratio of non domestic to domestic flow.

a) Per capita Domestic Wastewater Volume

In this study, the per capita wastewater volume is estimated based on per capita water demand for level 3 water supply, which is projected in the Water Supply Master Plan. The conversion rate from water supply to the wastewater is assumed to be 0.8. Therefore, per capita wastewater volume is calculated using the following equation.

Per capita wastewater volume = per capita level 3 water demand x 0.8

The adopted per capita wastewater volume is summarized in Table 4.4-17.

Table 4.4-17 Per Capita Domestic Sewage Volume (Daily Average)

Unit: Lcpd

Sewerage Service Area		Adopted level 3 water demand	Per capita wastewater volume
		[1]	[1]*0.8
(1)Tagbilaran		200	160
(2) Dauis		125	100
(3) Panglao	Poblacion	125	100
	Doljo	120	96
(4) Alona beach		120	96

Source: Water Supply Master Plan Final Report Vol.2, Province of Bohol (2008)

The ratio of daily maximum to daily average water demand in the Water Supply Master Plan is 1.25. The ratio of 1.25 is applied as ratio of daily maximum to daily average wastewater flow.

Daily maximum wastewater flow / Daily average wastewater flow = 1.25

b) Non-Domestic Wastewater Flow

The non-domestic flow is estimated by the ratio of non-domestic to domestic flow in the sewerage service area. The ratio is calculated to be 23% in Tagbilaran city, 20% in the municipality of Dauis and 12% in the municipality of Panglao based on the Water Supply Master Plan as shown in Table 4.4-18.

Table 4.4-18 Ratio of Non-domestic to Domestic Water Demand in 2035

City/ Municipality	[1] Water demand of level 3 Water Supply (urban + rural)	[2] Waster Demand for Non-domestic Water Supply	Adopted Non-domestic wastewater flow rate [2]/[1]
Tagbilaran	23,500	5381.55	**23%**
Dauis	4,401	868.77	**20%**
Panglao	3,455	420	**12%**

Source: JICA Study team

c) Tourism Wastewater Flow

The Projected water demand of the tourism industry in Panglao in 2035 is 926 m^3 per day according to the Water Supply Master Plan. According to BOT data in 2009, Barangay Doljo contributes a total of 6% in terms of the number of hotel rooms in Panglao and Barangay Tawala contributes approximately half (50%) of the total number of hotel rooms.

The share of Barangay Doljo out of the tourism wastewater of Panglao is assumed to be 10% in 2035. Similarly, the share of Alona Beach is assumed to be 50% in 2035. Hence, the design of the tourism wastewater flow by service area is estimated as shown below.

Tourism Wastewater flow in Panglao municipality

- Panglao service area: 926 x 10% x 0.8= **74** m^3 per day
- Alona beach service area: 926 x 50% x 0.8= **370** m^3 per day

d) Infiltration/Inflow Volume

The sanitary sewer design must include an allowance for extraneous water components of infiltration/inflow which inevitably becomes part of the total sewage flow. An unidentified volume rate of 20 % is assumed.

Infiltration/Inflow volume = 20% of daily average flow

e) Peaking Factor

In this study, peaking factor is defined as the ratio of the design of an hourly maximum flow and the design of a daily average flow. The peaking factors by sewerage area in consideration of some scale of sewerage system, are assumed as follows:

Peaking factor by area

- Tagbilaran and Panglao - **2.0**
- Dauis and Alona Beach - **2.5**

f) Design Sewage Flow

The estimated design sewage flow in 2035 is shown in Table 4.4-19 ~ Table 4.4-23.
The daily maximum flow is applied to the WWTP design and an hourly maximum flow to the design of the sewer and the pump station.

Table 4.4-19 Design Wastewater Flow in Tagbilaran Service Area in 2020

	Barangay	(1) Brgy Pop 2020	(2) Served Population of Level 3 =(1) x 0.855	(3) Per Capita Consumption (Lpcd)	(4) Domestic water demand (m3/d)	(5) Non-domestic water demand (m3/d) =(4)*23%	(6) water demand =(4)+(5)	(7) Service coverage for Sewerage	(8) Daily wastewater generation=(6)x(7)x0.8	(9) Inflow/infiltration =(8) x 0.2	(10)Daily sewage flow= (8) + (9) m3/d
1	Bool	8,710	7,447	200	1,489	342	1,831	-			-
2	Booy	9,610	8,217	200	1,643	378	2,021	40%	647	129	776
3	Cabawan	4,380	3,745	200	749	172	921	-		-	-
4	Cogon	17,870	15,279	200	3,056	703	3,759	60%	1,804	361	2,165
5	Dao	8,160	6,977	200	1,395	321	1,716	-			
6	Dampas	13,650	11,671	200	2,334	537	2,871	40%	919	184	1,103
7	Manga	9,060	7,746	200	1,549	356	1,905	-		-	-
8	Mansasa	6,400	5,472	200	1,094	252	1,346	5%	54	11	65
9	Pob 1	3,340	2,856	200	571	131	702	90%	505	101	606
10	Pob 2	5,590	4,779	200	956	220	1,176	100%	941	188	1,129
11	Pob 3	6,610	5,652	200	1,130	260	1,390	80%	890	178	1,068
12	San Isidro	5,630	4,814	200	963	221	1,184	-		-	-
13	Taloto	7,940	6,789	200	1,358	312	1,670	40%	534	107	641
14	Tiptip	5,640	4,822	200	964	222	1,186	-		-	-
15	Ubujan	7,630	6,524	200	1,305	300	1,605	-		-	-
	Total	120,220	102,790		20,556	4,727	25,283		6,294	1,259	7,553

Source: JICA Study team

Table 4.4-20 Design Wastewater Flow in Tagbilaran Service Area in 2035

			Water Consumption					Sewage Flow			
	Barangay	(1) Brgy Pop 2035	(2) Served Population of Level 3 =(1) x 0.855	(3) Per Capita Consumption (Lpcd)	(4) Domestic water demand (m3/d)	(5) Non-domestic water demand (m3/d) =(4)*23%	(6) water demand =(4)+(5)	(7) Service coverage for Sewerage	(8) Daily wastewater generation=(6)x(7)x0.8	(9) Inflow/infiltration =(8) x 0.2	(10) Daily sewage flow= (8) + (9)
1	Bool	12,350	10,559	200	2,112	486	2,598	-			-
2	Booy	10,890	9,311	200	1,862	428	2,290	90%	1,649	330	1,979
3	Cabawan	8,220	7,028	200	1,406	323	1,729	-		-	-
4	Cogon	18,380	15,715	200	3,143	723	3,866	90%	2,784	557	3,341
5	Dao	9,210	7,875	200	1,575	362	1,937	10%	155	31	186
6	Dampas	20,330	17,382	200	3,476	799	4,275	40%	1,368	274	1,642
7	Manga	11,590	9,909	200	1,982	456	2,438	90%	1,755	351	2,106
8	Mansasa	7,150	6,113	200	1,223	281	1,504	90%	1,083	217	1,300
9	Pob 1	3,370	2,881	200	576	132	708	100%	566	113	679
10	Pob 2	5,610	4,797	200	959	221	1,180	100%	944	189	1,133
11	Pob 3	6,650	5,686	200	1,137	262	1,399	100%	1,119	224	1,343
12	San Isidro	6,490	5,549	200	1,110	255	1,365	-	-	-	-
13	Taloto	9,310	7,960	200	1,592	366	1,958	80%	1,253	251	1,504
14	Tiptip	7,030	6,011	200	1,202	276	1,478	-	-	-	-
15	Ubujan	10,060	8,601	200	1,720	396	2,116	60%	1,016	203	1,219
	Total	146,640	125,377		25,075	5,766	30,841		13,692	2,740	16,432
								(10) Design Daily Average Flow (m3/d)			16,400
								(11) Daily Maximum Flow =(10) x 1.25 (m3/d)			20,500
								(12) Design Peak Flow =16,400 x 2.0 (m3/d)			32,800

Source: JICA Study team

Table 4.4-21 Design Wastewater Flow in Dauis Service Area in 2035

	Service Population	Per Capita Inflow Sewage Volume (Lpcd)					Sewage Volume(m^3/d)
		Domestic	Non-domestic	Tourism	Infiltration	Total	
	[1]	[2]	[3]=[2]*0.2	[4]	[5]=([2]+[3])*0.2	[6]	[7]=[1]*[6]*10^{-3}
Daily ave.	1,400	100	20	Included in Non-domestic	24	144	202
Daily max.					144 x 1.25 =	180	252
Hourly max.					144 x 2.5 =	360	504

Source: JICA Study team

Table 4.4-22 Design Wastewater Flow in Panglao Service Area in 2035

		Water Consumption						Sewage Flow			
Barangay	(1) Brgy Pop 2035	(2) Served Population of L3 =(1) x α	(3) Per Capita Consumption (Lpcd)	(4) Domestic water demand (m3/d)	(5) Water demand for Institution, Industrial & Commercial =(4)*12%	(6) Water demand for tourism	(7) Water demand= (4)+(5)+(6)	(8) Service coverage for Sewerage	(9) Daily wastewater generation=(7) x(8)x0.8	(10) Inflow/infiltration = (9) x 0.2	(11) Daily sewage flow= (9) + (10)
Poblacion System		α=0.855									
Poblacion	7,310	6,250	125	781	94	0	875	70%	490	98	588
		α=0.77									
Doljo	4,730	3,642	120	437	52	100	589	100%	471	94	565
									total		1,153
									Design Daily average (m^3/d)		1,150
									Design Daily Max (m^3/d)		1,440
									Design Daily Max (m^3/d)		2,300

Source: JICA Study team

Table 4.4-23 Design Sewerage flow in Alona Service Area in 2035

		Water Consumption						Sewage Flow			
	(1) Brgy Pop 2035	(2) Served Population of L3 =(1) x α	(3) Per Capita Consumption (Lpcd)	(4) Domestic water demand (m3/d)	(5) Water demand for Institution, Industrial & Commercial =(4)*12%	(6) Water demand for tourism	(7) Water demand= (4)+(5)+(6)	(8) Service coverage for Sewerage	(9) Daily wastewater generation=(7) x(8)x0.8	(10) Inflow/infiltration = (9) x 0.2	(11) Daily sewage flow= (9) + (10)
Alona System											
Tawala domestic	4,330	3,334	120	400	48	-	448	20%	72	14	86
Tawala tourism*	-					463	463	100%	370	74	444
									total		530
									Design Daily average (m^3/d)		530
									Design Daily Max (m^3/d)		660
									Design Daily Max (m^3/d)		1,325

Source: JICA Study team

5) Proposed Collection System

a) Design Conditions for Sewer Network

- **Unit Wastewater Design flow per Area**

The design flow of the sewer pipe is obtained through the multiplication of cumulative catchment area (ha) and the unit Wastewater Design flow (WW flow) per area.

This calculation method is applied to this study.

The explanation of cumulative catchment area is shown in Figure 4.4-4. Cumulative area of pipe-F is the total area of each catchment area of A to F. Also, the cumulative area of pumping station is the same area as pipe-F.

The Calculated Unit of WW flow per area of this study is shown in Table 4.4-24.

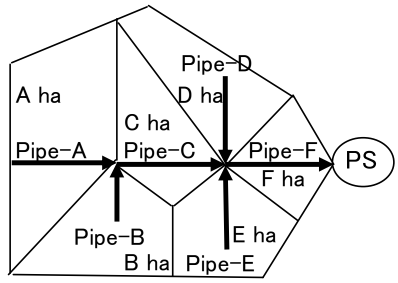


Figure 4.4-4 Catchment Area

Table 4.4-24 Unit Wastewater Design Flow Per Area by Area

Area	Design houly max flow (m3/d)	Design houly max flow (m3/s)	Service Area (ha)	Unit WW design flow per area
	(1)	(2)	(3)	(2)/(3)
Tagbilaran	32,800	0.37962963	1,270.00	0.00029892
Dauis	504	0.00583333	22.64	0.00025766
Panglao	2,300	0.02662037	93.76	0.00028392
Alona	1,325	0.01533565	41.36	0.00037078

Source: JICA Study team

b) Design Considerations for Pumping Station

- **Design Flow**

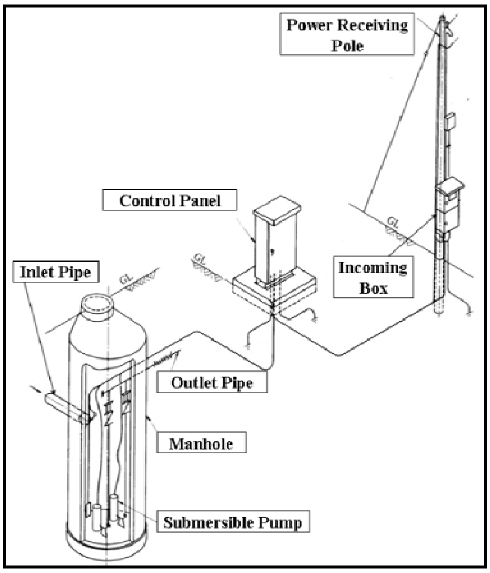
Basically, the pump facility is designed based on the condition of the peak flow which is the same as for the design of the sewer.

- **Type of Pumping Station**

In this study, two types of pumping stations are proposed.

Type 1 Wet pit pumping station

Wet pit pumping stations are small scale pump stations. This type of pumping station is proposed with a condition of a small design flow of up to 3.0 m^3/min. Since most of the equipment is installed in an underground manhole, land acquisitions of wet pit pumping station sites are no longer required. The only facility that needs to be set above the ground is a control panel and power receiving pole as shown in Photo 4.4-1.



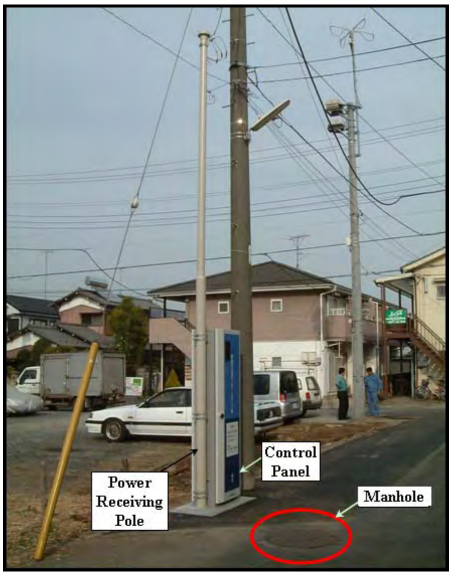


Photo 4.4-1 Component and Sample of Wet Pit Pumping Station

Type 2 Ordinal pumping station

This type of pumping station is proposed if the earth covering depth will be deeper in the sewer design and the design peak flow is larger than 3.0 m^3/min. In this study, ordinal pumping stations are proposed to keep the sewer depth less than 7.0 m in terms of the earth covering depth.

c) Proposed Sewer Network and Pumping Station

- **Tagbilaran Sewerage System**

✓ **Proposed Sewer**

This study proposes gravity trunk sewers with a total length of 17.4 km and with a diameter raging from 250 mm to 900 mm for Tagbilaran City. (Refer to Figure 4.4-5).

Although branch sewers like s secondary or tertiary sewer network is not specified, branch sewer lengths should be included in the project. Branch sewer lengths mostly depend on load length per land area in 2035. It is assumed that the average branch sewer length is 60 m/ ha, total length is estimated at 76,200 m (=1,270 ha x 60).

This study also proposes a force main with a total length of 2.6 km and with a diameter raging from 100 mm to 400 mm.

The proposed sewer lengths of the different diameters are summarized in Table 4.4-25.

Table4.4-25 Proposed Sewer Length in Tagbilaran System

Item	Diameter (mm)	Material	Length			Remarks
			Phase 1	Phase 2	Total	
Trunk	250	PVC	702	673	1,375	
	300		3,205	1,513	4,718	
	350		1,621	1,548	3,169	
	400	RC Pipe	1,383	794	2,177	
	500		826	418	1,244	
	600		1,369	0	1,369	
	700		2,259	0	2,259	
	800		886	0	886	
	900		255	0	255	
	Subtotal [1]		**12,506**	**4,946**	**17,452**	
Force main	100	HDPE,PVC, DCIP, etc	602	146	748	
	150		366	538	904	
	200		0	448	448	
	250		0	452	452	
	400		72	0	72	
	Subtotal [2]		**1,040**	**1,584**	**2,624**	
Branch	200	PVC	129	276	405	
			45,628	30,572	76,200	assumption
	Subtotal [3]		**45,757**	**30,848**	**76,605**	
Total	Gravity Sewer [1]+[3]		58,263	35,794	94,057	
	Force Main Sewer [2]		1,040	1,584	2,624	
	-		**59,303**	**37,378**	**96,681**	

Source: JICA Study team

✓ **Proposed Pumping Station**

In this study, two ordinal pumping stations and 19 wet pit pumping station are proposed. Out of 19 wet pit pumping stations, 10 wet pumping stations are only assumptions. The location of pumping stations is shown in Figure 4.4-5. The main features of the pumping stations are summarized in Table 4.4-26.

Two pumping stations are proposed to reduce the earth cover of the sewer. Photo 4.4-2 shows the proposed sites of pumping station 1 and 2. Currently, the proposed sites of both stations are located in private land so that land acquisitions are required.

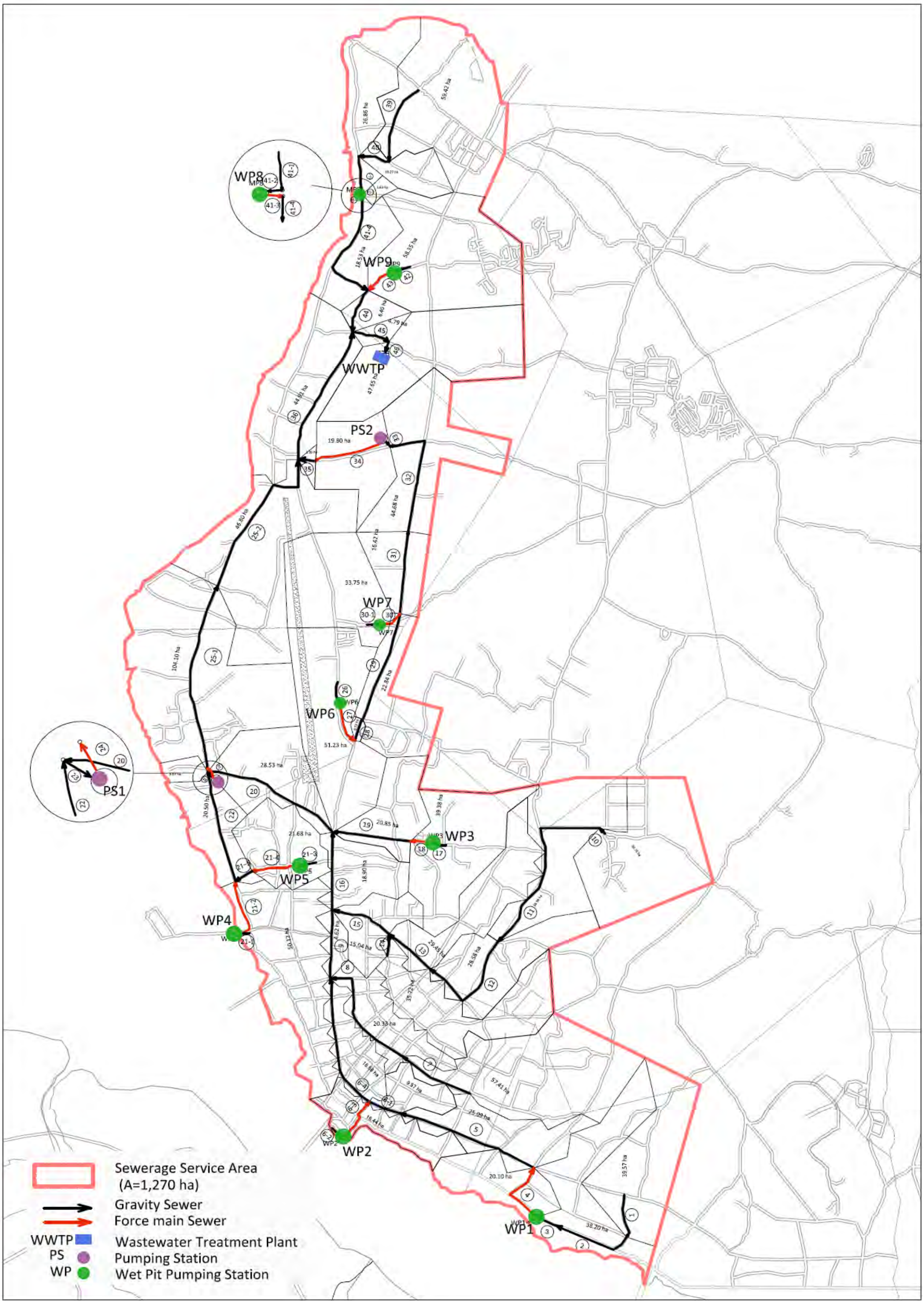
Table 4.4-26 Outline of Proposed Pumping Station

Pump No.	Catchment Area	Flow	Dia. of Force main pipe	Length of Foce main pipe	Velocity
Unit	(ha)	(m3/min)	(mm)	(m)	(m/s)
WP 1	97.87	1.755	200	448	0.93
WP 2	16.44	0.295	100	303	0.62
WP 3	39.38	0.706	150	62	0.67
WP 4	50.12	0.899	150	366	0.85
WP 5	21.68	0.389	100	299	0.83
WP 6	51.23	0.919	150	260	0.87
WP 7	33.75	0.605	100	146	1.29
WP 8	98.18	1.761	150	5	1.66
WP 9	58.35	1.046	150	211	0.98
10 WPs	only assumption				
P1	649.46	11.647	400	72	1.54
P2	189.44	3.397	250	452	1.15

Source: JICA Study team

Photo 4.4-1 Pictures of Proposed Pumping Station Sites (Left: PS 1), (Right: PS2)

The General layout plan of the proposed collection systems for Tagbilaran City is shown in Figure 4.4-5.

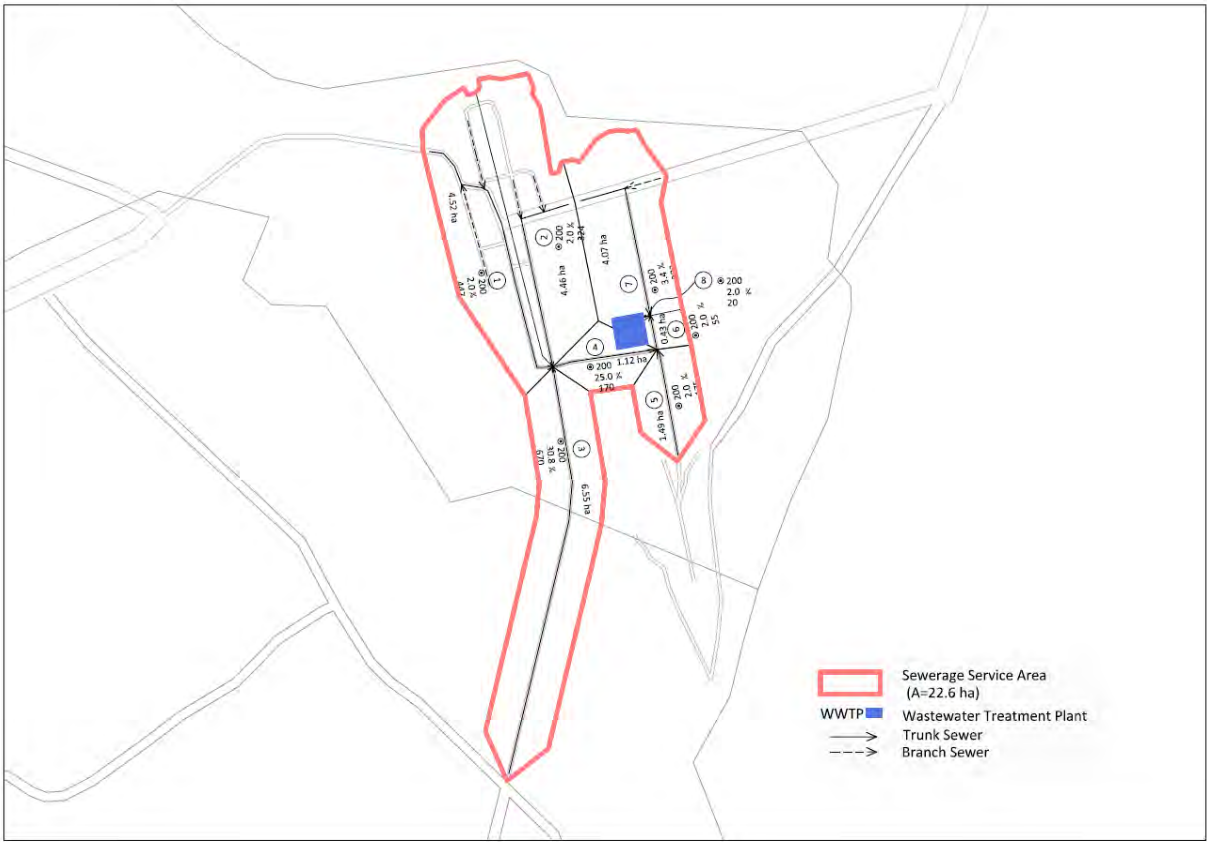


Source: JICA Study team

Figure 4.4-5 General Layout Plan of Tagbilaran Sewerage System

- **Dauis Sewerage System**

Gravity sewers with a diameter of 200mm a length of 2.6 km will be installed (See Figure 4.4-6).



Source: JICA Study team

Figure 4.4-6 General Layout Plan of Dauis Sewerage System

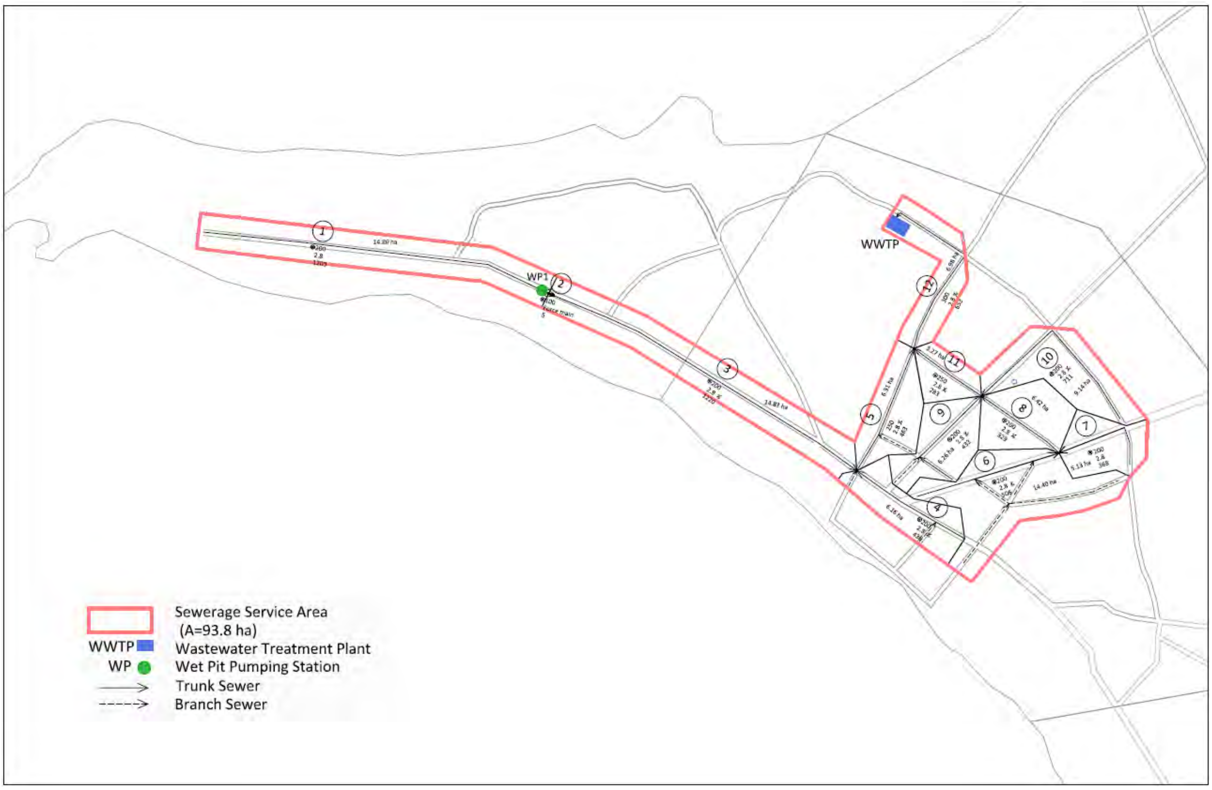
- **Panglao Sewerage System**

Gravity sewers with diameter of 200 to 300mm at a length of 7.6 km will be installed. One wet pit pumping station will be installed to avoid large earth covering depth of the sewer (See Figure4.4-7). The proposed sewer lengths by diameter are summarized in Table 4.4-27.

Table 4.4-27 Proposed Sewers in Panglao Sewerage System

Item	Diameter (mm)	Material	Length (m)
Gravity Sewer	200	PVC	6,170
	250		746
	300		653
	subtotal		7,569
Force main	100		5
	Total		7,574

Source: JICA Study team



Source: JICA Study team

Figure 4.4-7 General Layout Plan of Poblacion Sewerage System

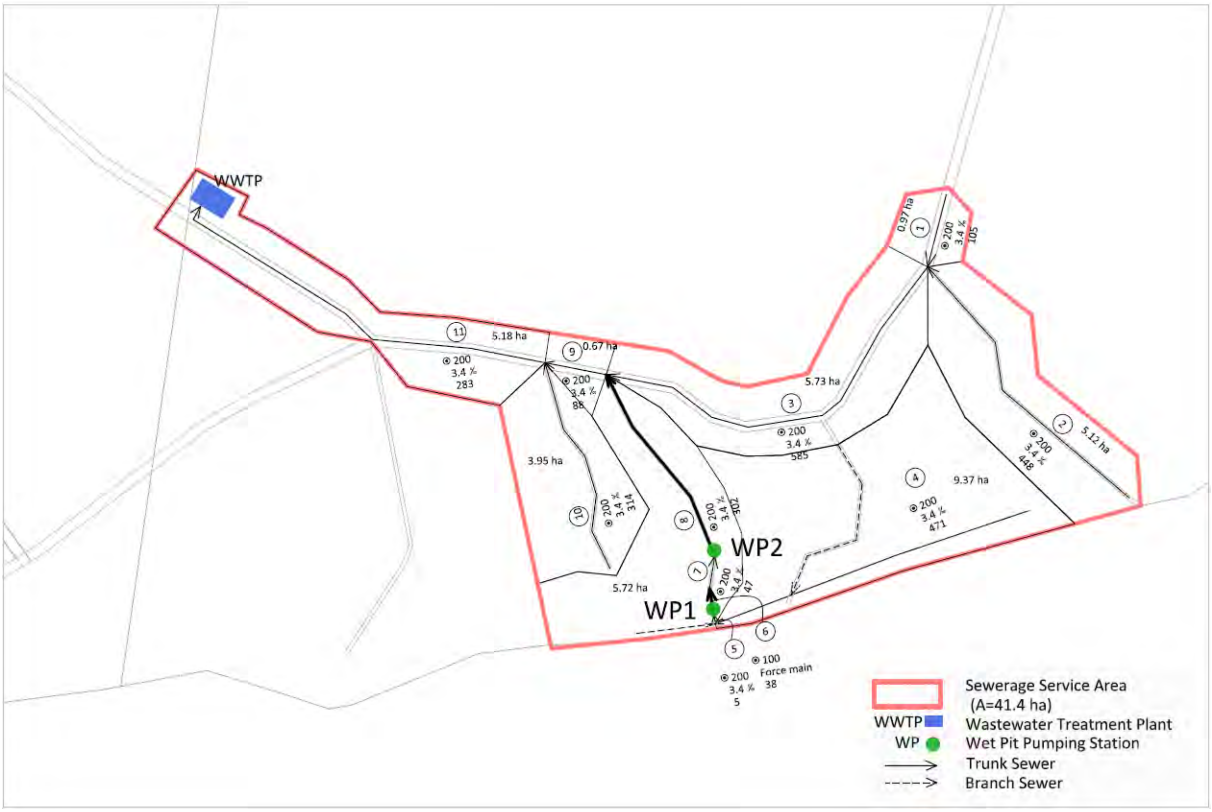
- **Alona Beach Sewerage System**

Gravity sewers with a diameter of 200 to 250mm at a length of 3.1 km will be installed. Force main is required at a length of 340 m for the discharge pipes of two of the wet pit pumping stations. The wet pit pumping stations will be installed to pump up the wastewater from the coastal area. (See Figure 4.4-8). The proposed sewer lengths by diameter are summarized in Table 4.4-28.

Table 4.4-28 Proposed Sewers in Alona Sewerage System

Item	Diameter (mm)	Material	Length (m)
Gravity Sewer	200	PVC	2,463
	250		663
	Sub-total		3,126
Force main	100		340
Total			3,466

Source: JICA Study team



Source: JICA Study team

Figure 4.4-8 General Layout Plan of Alona Beach Sewerage System

6) Proposed Treatment System

a) Treatment Method

In general, major treatment process in developing countries are:

- Stabilization pond,
- Aerated lagoon,
- Oxidation ditch and
- Activated sludge

Table 4.4.29 shows general features of each treatment methods.

Operation and maintenance of stabilization pond and aerated lagoon are less expensive and easier than conventional activated sludge method and oxidation ditch method. For aerated lagoon, its required area is smaller than stabilization pond, however needs some aeration equipment. Activated sludge is widely used worldwide, however requires a certain technical level due to a lot of equipment and complex system.

At present, technical level of the operation body for the sewerage system, the location of WWTP, and the other conditions are uncertain. Therefore, the financial analysis of the this conceptual design is conducted assuming OD process maybe employed. However this treatment process and the financial study should be reviewed in the feasibility study.

Items		Conventional Activated Sludge (CAS)	Oxidation Ditch (OD)	Aerated Lagoon (AL)	Stabilization Pond (SP)
Removal Rate (BOD)		Good (90-95%)	Good (90-95%)	Fair (70%-90%)	Fair (70-90%)
		◎	◎	○	○
Removal Rate (T-N)		Not much	Higher than the others	Not much	Not much
		△	○	△	△
Required Land Area		◎	○	△	× (needs much larger area than the others)
Operation & maintenance	Characteristics	* High performance can be expected regardless of the weather * Need high technology level due to complex system	* Easier than CAS due to less number of equipment	* Easier than OD due to aerator only	* Easier than others due to no equipment
	Cost	* Higher than the others	* Cheaper than CAS	* Maybe cheaper than OD depends on mixing type	* Cheaper than the others
		×	△	○	◎
Construction Cost (excluding land cost)		* Higher than OD and AL	* Cheaper than CAS	* Almost the same as OD	* Probably cheaper than the others, depends on unit cost of earth works
		△	○	○	◎

Table 4.4-29 General Features by Treatment Method

The oxidation ditch is a modified activated sludge treatment process that utilizes longer solids retention times and extended aeration periods to remove bio-degradable organics. In the oxidation ditch process, wastewater will be aerated and mixed with return sludge from a secondary clarifier. Surface aerators are used to circulate the mixed liquids. The mixing process entrains oxygen into the mixed liquids to foster microbial growth and to ensure contact of micro organisms with the incoming wastewater. The aeration sharply increases the dissolved oxygen (DO) concentration of the mixed liquids, but it will gradually decrease as biomass uptakes oxygen during circulating around the ditch. Oxidation ditch effluent is usually settled in a separate secondary clarifier.

A typical process flow diagram for an oxidation ditch is shown in Figure 4.4-9.

b) Proposed WWTP Sites

- **Tagbilaran City**

The site for the wastewater treatment plant is designated by the local government of Tagbilaran City. The site is located in the lowland swamp area between the boundaries of the Barangays Taloto and Ubujan. The treated water of the WWTP will be discharged into the ocean by a force main pipe. However, it can also be discharged into the swamp area near the proposed site which will naturally drain into the ocean. Photo 4.4-3 shows the proposed site and the discharge point of the treated water.

	
Proposed WWTP site in Tagbilaran	**Force main pipe route for discharge of treated water from Tagbilaran WWTP**
	
Proposed discharge point (ocean)	**Alternative discharge point near WWTP**

Photo 4.4-3 Proposed Site of WWTP in Tagbilaran

(ii) Municipality of Dauis

A vacant lot near the cemetery was proposed as a site for the Dauis Waste water Treatment Plant (Photo 4.4.4). The site is located within the residential service area. The candidate point of discharge for treated water is a lagoon which is 100 meters away from the proposed WWTP site. The lagoon currently seems to be polluted because untreated human wastes are discharged into the area. The proposed WWTP site and the lagoon are shown in Photo 4.4-4.

Proposed WWTP site	lagoon

Photo 4.4-4 Proposed Site of WWTP in Dauis

(iii) Municipality of Panglao

The sites of Panglao Waste water Treatment Plant in Barangay Poblacion and Alona beach Wastewater Treatment Plant in Brangay Tawala are designated in the municipality of Panglao. The site of the WWTP in Poblacion is around 700 m away from the municipal hall (See Figure 4.4-7) while the site of Alona WWTP is around 300 m away from the access road to Alona Beach (See Figure 4.4-8). Furthermore, there are no rivers near WWTPs. Therefore, an injection well is proposed to be utilized as a final discharge of treated water of WWTPs. Photo 4.4-5 shows proposed WWTP sites.

Photo 4.4-5 Proposed WWTP site in Panglao (left: Poblacion, Right: Alona)

Treatment Process

The Oxidation ditch is adopted in this study. The detail of the preliminary functional design is attached in the Appendix.

General Layout of WWTP

The general layout plan of the proposed WWTPs is shown in Figure 4.4-9 ~ Figure 4.4-12. The required land area is estimated to be as follows:

- Tagbilaran WWTP: 150 m x 250 m = 3.75 ha
- Dauis WWTP: 47 m x 41 m = 0.2 ha
- Panglao WWTP: 70m x 75 m = 0.6 ha
- Alona beach WWTP: 37m x 71m = 0.3 ha

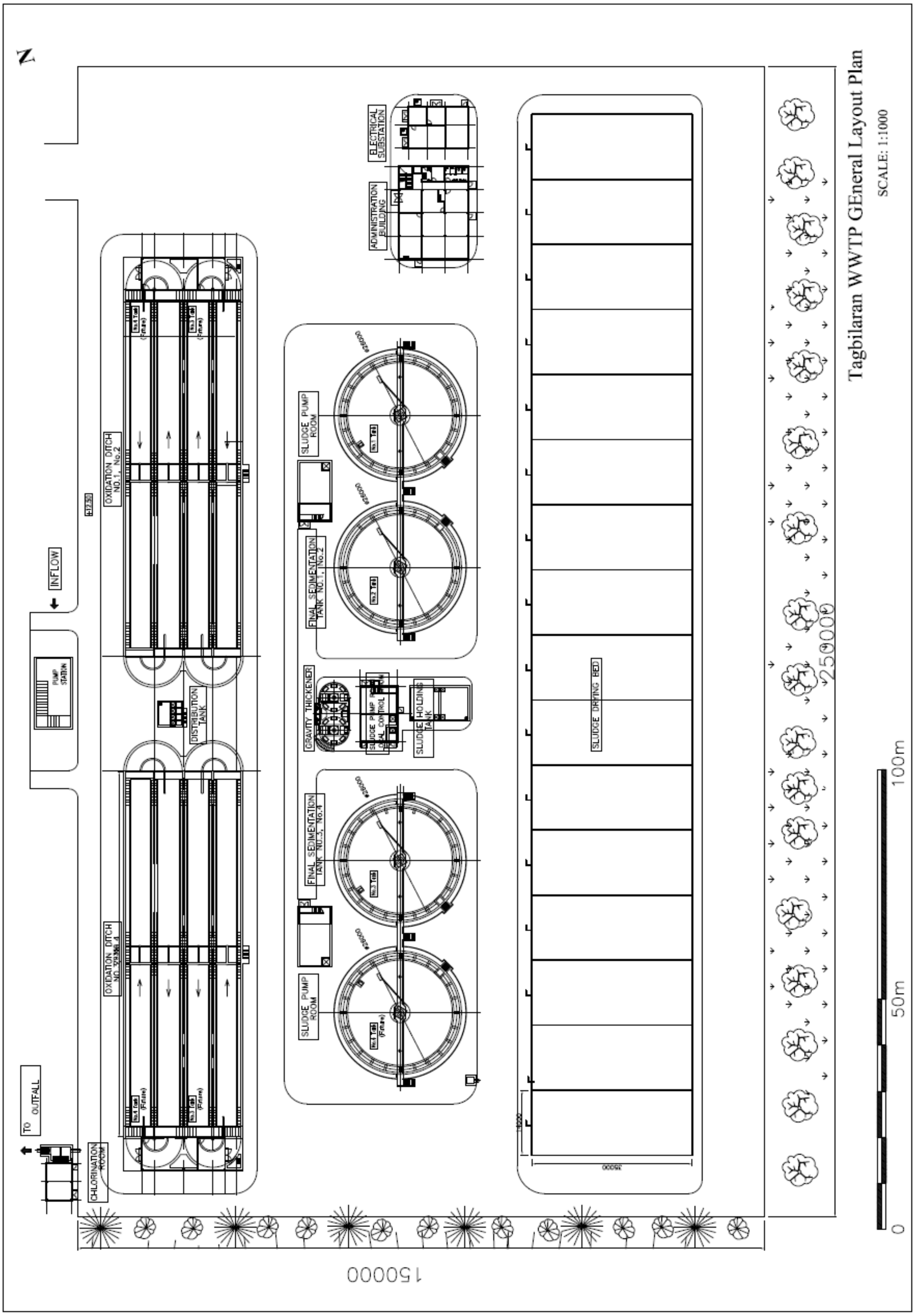


Figure 4.4-9 Layout of Tagbilaran WWTP (Reference)

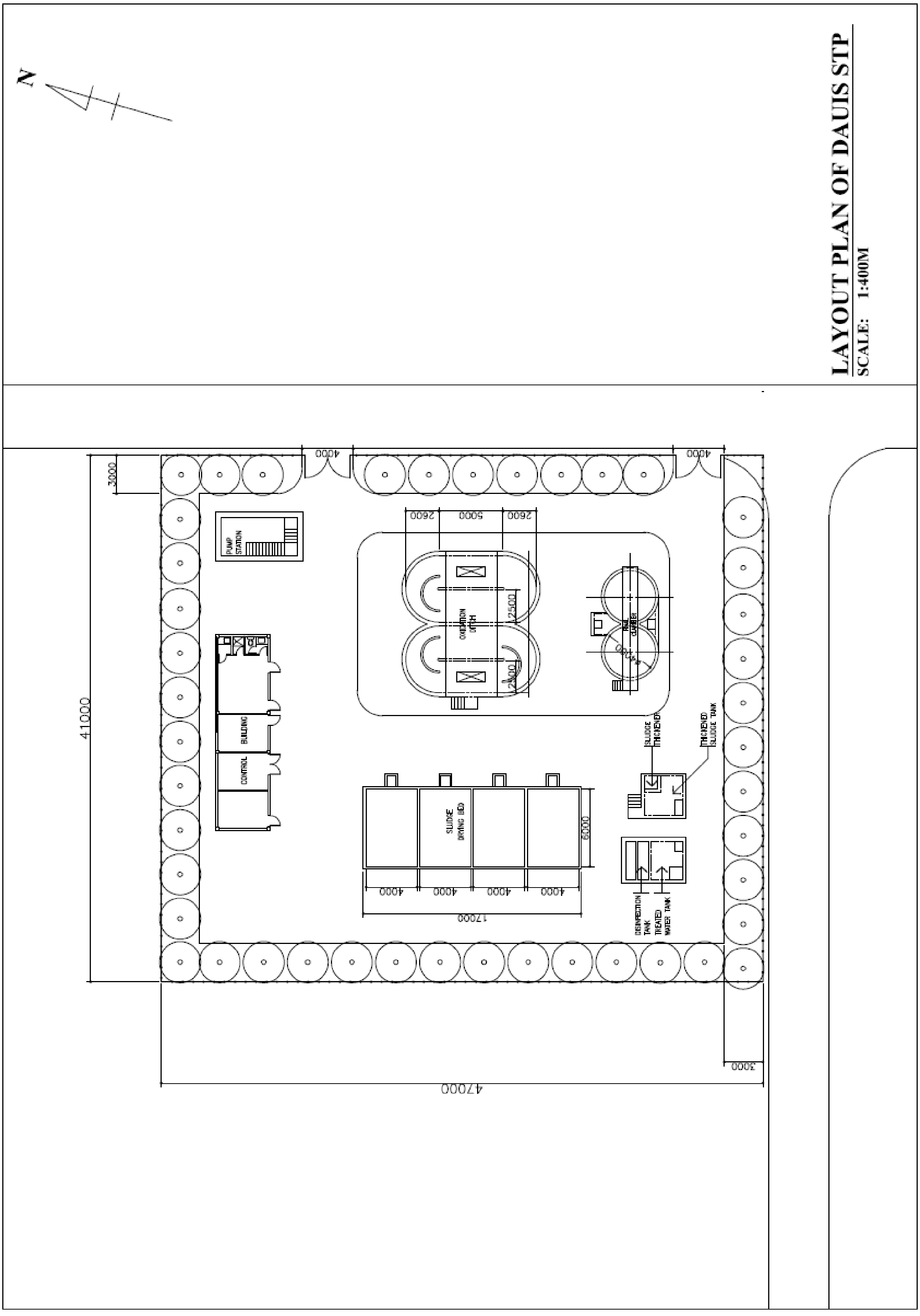


Figure 4.4-10 Layout of Dauis WWTP(Reference)

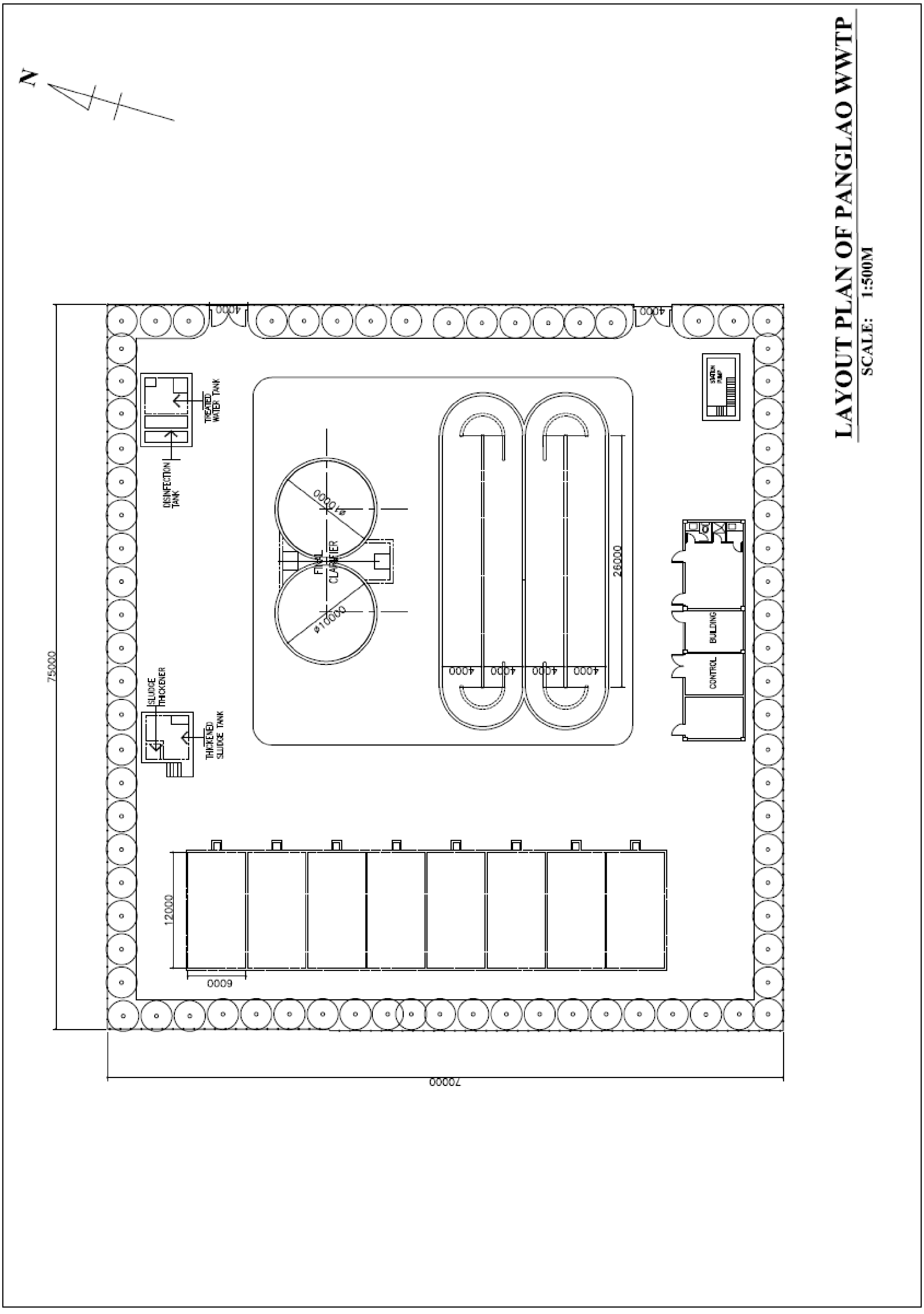


Figure 4.4-11 Layout of Panglao WWTP (Reference)

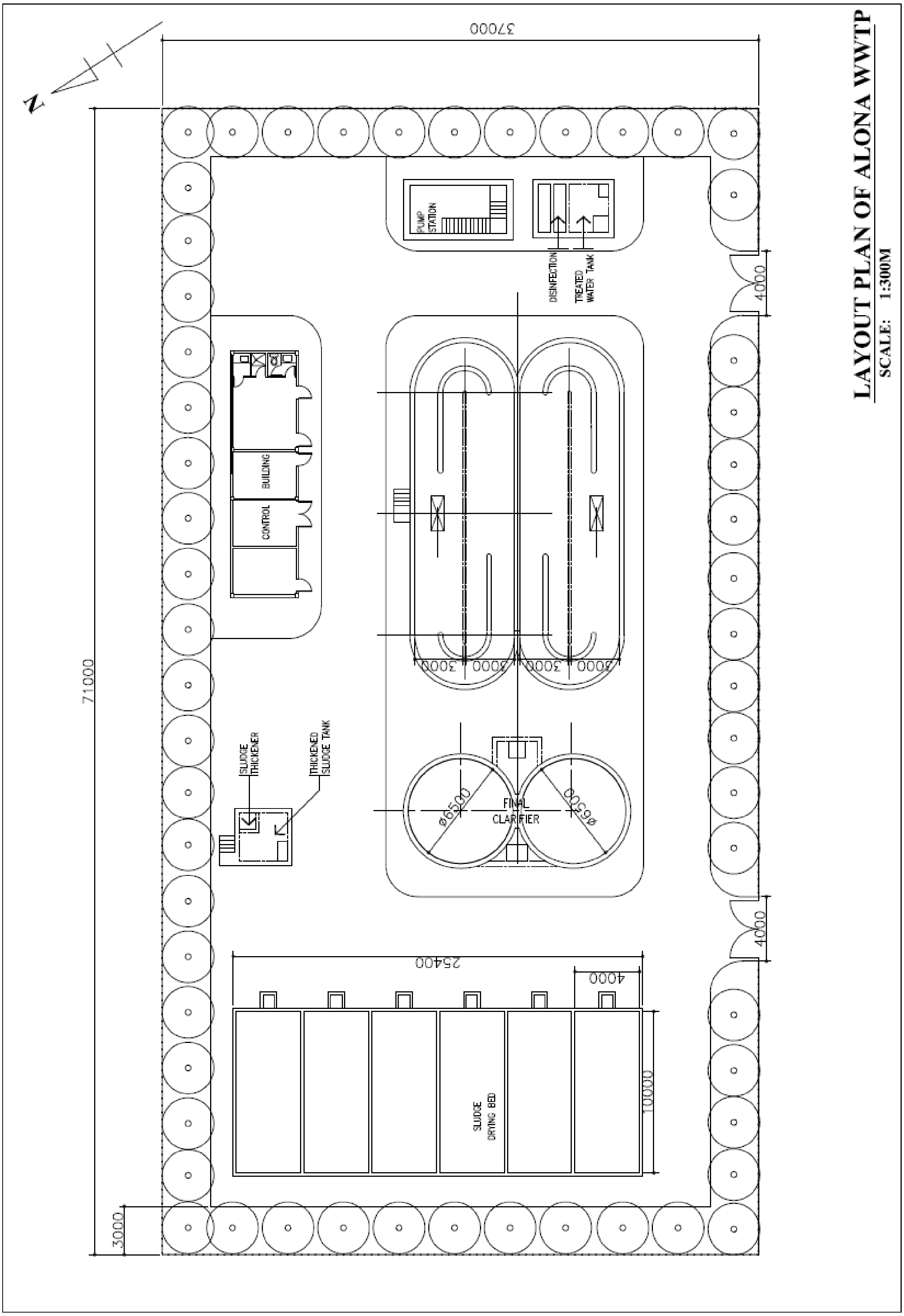


Figure 4.4-12 Layout of Alona Beach WWTP (Reference)

7) Cost Estimates

a) Proposed Facilities

The proposed scope of work for the sewerage project is shown in Table 4.4-30, which is based on the preliminary basic design as described previously.

Table 4.4-30 Major Scope of Work by Sewerage Area

Sewerage Area		Contents
Tagbilaran	(Phase 1)	Gravity sewer Ø200〜Ø900mm, L=58.3 Km Force main pipe Ø100〜Ø400 mm, L=1 Km Pumping Station, N= 1 Wet Pit Pumping Station N=6 (specified N=3, Assumption N=3) House Connections; 6,397 WWTP (Q=10,250 m^3/d)
	(Phase 2)	Gravity sewer Ø200〜Ø500 mm, L=35.8 Km Force main pipe Ø100〜Ø250 mm, L=1.6 Km Pumping Station, N= 1 Wet Pit Pumping Station N=13 (specified N=6, Assumption N=7) House Connections; 7,519 WWTP (Q=10,250 m^3/d)
Dauis		Gravity sewer Ø200 mm, L=2.6 Km House connections; 280 WWTP (Q=252 m^3/d)
Panglao	Poblacion	Gravity sewer Ø200〜Ø300 mm, L=7.6 Km Force main pipe Ø100 mm, L=5 m Wet Pit Pumping Station N=1 House Connections; 1,678 WWTP (Q=1,440m^3/d)
	Alona	Gravity sewer Ø200〜Ø250 mm, L=3.1 Km Force main pipe Ø100 mm, L=0.3 Km Wet Pit Pumping Station N=2 House Connections; 289 WWTP (Q=660 m^3/d)

Source: JICA Study team

b) Basic Construction Cost

➢ **Sewer Installation Cost**

✓ **Unit Construction Cost**

The unit cost of each diameter is prepared by referring to some available documents on the "Construction Costs for Municipal Wastewater Conveyance Systems 1973-1979 USEPA", and "In-place Costs of Water Works Material and Equipment, 2008 Dec LWUA". The unit cost is shown in Table 4.4-31. These costs cover all incidental costs including VAT.

Table 4.4-31 Unit Cost of Sewer Installation

Item	Diameter (mm)	Unit Cost (peso/m)*		
		H <2.4	H=2.4～4.5	H>4.5
Gravity Sewer	200	7,234	8,681	11,574
	250	7,864	9,437	12,582
	300	9,032	10,838	14,451
	350	13,481	16,177	21,570
	400	19,906	23,887	31,850
	500	24,443	29,332	39,109
	600	29,010	34,812	46,416
	700	32,317	38,780	51,707
	800	35,625	42,750	57,000
	900	37,673	45,208	60,277
Force main	100	1,548		
	150	2,799		
	200	4,264		
	250	5,904		
	400	11,724		

Source: JICA Study team

H: Burial depth in meter (road surface to invert elevation)

✓ **Construction Cost for Sewer Installation**

The construction cost for pipe installation by area is shown in Table 4.4-32 to Table 4.4-34.

Table 4.4-32 Construction Cost of Sewer Installation (Tagbilaran Phase 1)

Phase 1					
Item	Diameter	Depth	Length	Unitcost	Construction Cost
	(mm)	(m)	Q_L (m)	(peso/m)	(x1000peso)
Gravity sewer	200	<2.4	22,943	7,234	165,970
		2.4～4.5	22,814	8,681	198,048
		>4.5	0	11,574	-
	250	<2.4	702	7,864	5,521
		2.4～4.5	0	9,437	-
		>4.5	0	12,582	-
	300	<2.4	2071	9,032	18,705
		2.4～4.5	129	10,838	1,398
		>4.5	1005	14,451	14,523
	350	<2.4	1621	13,481	21,853
		2.4～4.5	0	16,177	-
		>4.5	0	21,570	-
	400	<2.4	823	19,906	16,383
		2.4～4.5	489	23,887	11,681
		>4.5	71	31,850	2,261
	500	<2.4	430	24,443	10,510
		2.4～4.5	396	29,332	11,615
		>4.5	0	39,109	-
	600	<2.4	708	29,010	20,539
		2.4～4.5	294	34,812	10,235
		>4.5	367	46,416	17,035
	700	<2.4	1186	32,317	38,328
		2.4～4.5	574	38,780	22,260
		>4.5	499	51,707	25,802
	800	<2.4	0	35,625	-
		2.4～4.5	0	42,750	-
		>4.5	886	57,000	50,502
	900	<2.4	20	37,673	753
		2.4～4.5	157	45,208	7,098
		>4.5	78	60,277	4,702
Force main	100		602	1,548	932
	150		366	2,799	1,024
	200		0	4,264	-
	250		0	5,904	-
	400		72	11,724	844
Sub-total			**59,303**		**678,522**

Source: JICA Study team

Table 4.4-33 Construction Cost of Sewer Installation (Tagbilaran Phase 2)

Phase 2					
Item	Diameter (mm)	Depth (m)	Length Q_L (m)	Unitcost (peso/m)	Construction Cost (x1000peso)
Gravity sewer	200	<2.4	15,562	7,234	112,576
		2.4～4.5	15,286	8,681	132,698
		>4.5	0	11,574	-
	250	<2.4	528	7,864	4,152
		2.4～4.5	145	9,437	1,368
		>4.5	0	12,582	-
	300	<2.4	687	9,032	6,205
		2.4～4.5	545	10,838	5,907
		>4.5	281	14,451	4,061
	350	<2.4	217	13,481	2,925
		2.4～4.5	896	16,177	14,495
		>4.5	435	21,570	9,383
	400	<2.4	72	19,906	1,433
		2.4～4.5	397	23,887	9,483
		>4.5	325	31,850	10,351
	500	<2.4	107	24,443	2,615
		2.4～4.5	0	29,332	-
		>4.5	311	39,109	12,163
Force main	100		146	1,548	226
	150		538	2,799	1,506
	200		448	4,264	1,910
	250		452	5,904	2,669
Sub-total			37,378		**336,126**
Total (pohase1+2)			**96,681**		**1,014,648**

Source: JICA Study team

Table 4.4-34 Construction Cost of Pipe Installation (Dauis & Panglao)

Dauis

Item	Diameter (mm)	Depth (m)	Length Q_L (m)	Unitcost (peso/m)	Construction Cost (x1000peso)
Gravity sewer	200	<2.4	2,312	7,234	16,725
		2.4～4.5	298	8,681	2,587
		>4.5	-	11,574	-
Total			2,610		**19,312**

Panglao

Item	Diameter (mm)	Depth (m)	Length Q_L (m)	Unitcost (peso/m)	Construction Cost (x1000peso)
Gravity sewer	200	<2.4	4,063	7,234	29,392
		2.4～4.5	1,523	8,681	13,221
		>4.5	584	11,574	6,759
	250	<2.4	0	7,864	-
		2.4～4.5	283	9,437	2,671
		>4.5	463	12,582	5,825
	300	<2.4	0	9,032	-
		2.4～4.5	0	10,838	-
		>4.5	653	14,451	9,437
Force main	100		5	1,548	8
Total			7,574		**67,313**

Alona beach

Item	Diameter (mm)	Depth (m)	Length Q_L (m)	Unitcost (peso/m)	Construction Cost (x1000peso)
Gravity sewer	200	<2.4	1,602	7,234	11,589
		2.4～4.5	700	8,681	6,077
		>4.5	161	11,574	1,863
	250	<2.4	0	7,864	-
		2.4～4.5	368	9,437	3,473
		>4.5	295	12,582	3,712
Force main	100		340	1,548	526
Total			3,466		**27,240**

Source: JICA Study team

- **Construction Cost of Pumping stations**

The cost of each pumping station is also prepared by referring to some documents on the "Construction Costs for Municipal Wastewater Conveyance Systems 1973-1979 USEPA" and "In-place costs of water works Material and Equipment, 2008 Dec LWUA".

The Construction Cost of pumping station by area is shown in Table 4.4-35.

Table 4.4-35 Construction Cost of Pumping Station (Tagbilaran and Panglao)

Tagbilaran

Item	FlowQ (m3/min)	TPH (m)	Unit Q_L (unit)	Unitcost (x1000peso)	Construction Cost (x1000peso)
Phase 1					
P1	11.647	9.5	1	36,120	36,120
WP 2	0.295	22.6	1	4,214	4,214
WP 4	0.899	9.4	1	5,435	5,435
WP 5	0.389	10.9	1	3,371	3,371
Provision	<0.2	<12	3	1,789	5,367
Subtotal					54,507
Phase 2					
P2	3.397	16.7	1	20,898	20,898
WP 1	1.755	24.5	1	15,480	15,480
WP 3	0.706	13.8	1	6,794	6,794
WP 6	0.919	8.0	1	5,435	5,435
WP 7	0.605	9.4	1	5,435	5,435
WP 8	1.761	6.1	1	10,320	10,320
WP 9	1.046	5.7	1	7,224	7,224
Provision	<0.2	<12	7	1,789	12,523
Subtotal					84,109
Phase1+2					
Total					**138,616**

Item	FlowQ (m3/min)	TPH (m)	Unit Q_L (unit)	Unitcost (x1000peso)	Construction Cost (x1000peso)
Panglao					
WP1	0.253	7.1	1	3,371	3,371
Total					**3,371**
Alona beach					
WP1	0.336	8.8	1	3,371	3,371
WP2	0.336	12.1	1	4,214	4,214
Total					**7,585**

Source: JICA Study team

- **Construction Cost of Wastewater Treatment Plants (WWTPs)**

The cost of each WWTP is prepared by referring to some documents on the “Construction Costs for Municipal Wastewater Treatment Plants 1973-1977 USEPA” and “In-place costs of water works Material and Equipment, 2008 Dec LWUA”.

The original cost function curve for WWTP as shown in USEPA is as follows:

Y=2.12 x 10^6 x Q^0.88

where Y: cost in USD

Q: design capacity in MGD

In this design, the construction cost is estimated by multiplying EPA cost (=Y) and a coefficient of 1.4.

The adopted construction curve is computed as follows:
WWTP Cost in Peso=1.4 x 43 (conversion rate) x Y (US$)

The cost of each WWTP is shown in Table 5.5-36. These costs cover all incidental costs including VAT.

Table 4.4-36 WWTP Construction Cost

Wastewater Treatment Plant	WWTP Construction Cost (1000peso)	Remarks
Tagbilaran (phase1)	366,851	564,386 x 65 %
(phase2)	197535	564,386 x 35 %
Dauis	11,679	
Panglao	54,524	
Alona beach	27,443	

Source: JICA Study team

- **House Connection**

The estimated cost of a house connection in each sewerage system is shown in Table 4.4-37. The house connection cost per one household is estimated by assuming a per connection cost of P 30,960.

Table 4.4-37 House Connection Cost

Sewerage service area	Domestic Connection	Commercial Connection	Total	House Connection Cost (1000 peso) [3]=[2]*30,960peso
Tagbilaran (phase1)	6,397(=31983/5.0)		6,397	198,051
(phase2)	7,519(=37,595/5.0)		7,519	232,788
Dauis	280(=1,400/5.0)	-	280	8,668
Panglao	1,603(=8,017/5.0)	75	1,678	51,951
Alona beach	133(=667/5.0)	156	289	8,947

Source: JICA Study team

c) Operation Maintenance Cost

The annual operation maintenance cost is assumed to be 1.5 % of construction cost of WWTP as a matter of practical convenience.

4.4.3. Implementation Program

1) Implementation Organization

There are several options on the project implementation organization for sewerage development of Tagbilaran City as shown in Table 4.4-38.

The sewerage development for the municipalities of Panglao and Dauis are rather small scale compared with Tagbilaran City. However, the capacities of these municipalities seems insufficient to be the implementing agencies Therefore, a different implementation structure could be considered as shown in Table 4.4-39.

To select a suitable option from these options, a further study will be needed. It is recommended that a further study must at least contain an evaluation of borrowing capacity and handling capacity of each agency.

Table 4.4-38 Possible Project Implementation Structure for Tagbilaran

	Funding/ Investor	Borrower/ Executing Agency	Implementing Agency	Operating Body	Remarks
(1)	International Funding Agency	LWUA	Tagbilaran City	TCWS	Need agreement between TCWS& BWUI
(2)	“	DOF	Tagbilaran City	TCWS	“
(3)	“	“	Province	TCWS	“
(4)	“	DPWH	DPWH	TCWS	“
(5)	DBP or Land Bank	Bohol Province or Private sector or Tagbilaran City	Province or Private sector or Tagbilaran City	Private Sector or TCWS	
(6)	Private Sector	—	Province or Private sector or Tagbilaran City	Private Sector	

Source: JICA Study team

Table 4.4-39 Possible Project Implementation Structure for Dauis & Panglao

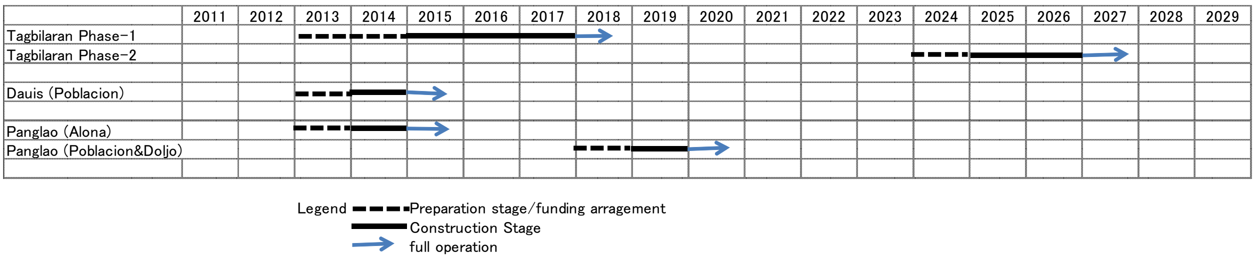
	Funding/ Investor	Borrower/ Executing Agency	Implementing Agency	Operating Body	Remarks
(1)	International Funding Agency	LWUA	Municipality +LWUA	Municipal waterworks or private sector	
(2)	“	DOF	Bohol Province	“	
(3)	“	Bohol Province	Bohol Province	“	
(4)	“	“	Municipality	“	
(5)	“	DOT	TIEZA	“	
(6)	“	DOTC	DOTC	“	Construct as incidental facility of new airport
(7)	DBP or Land Bank	Bohol Province or Private sector	Bohol Province or Private sector	“	
(8)	“	TIEZA	TIEZA	“	
(9)	Private Sector	—	Bohol Province or Private sector	Private Sector	

2) Implementation Schedule

The major assumptions for the setting up of the implementation schedule are as follows:

- A two stage implementation (phase-1, phase-2) for the sewerage development of Tagbilaran City is adopted considering the development scale.
- Construction of phase-1 project and phase-2 project of Tagbilaran City will start in 2015 and 2025, respectively. The two stage implementation for sewerage development of the municipality is adopted considering the locations of sewerage areas and insufficient capacity of the municipality
- Construction of the Dauis sewerage development project will start 2014.
- Construction of the Alona sewerage project and the Poblacion-Doljo sewerage project will start in 2014 and 2019, respectively.

With the above conditions, the following implementation schedule is proposed.



Source: JICA Study team

Figure4.4-13 Implementation schedule for Sewerage Development Project

4.4.4. Financial Analysis

1) General Approach

This part of the report deals with the results of the financial analysis of the project that was conducted. However, economic analysis is not included in this study.

Assuming that no private sector will be an investor nor funding agency, the approach and methodology used in the financial analysis deals with the apportionment of the cost to various stakeholders of the projects such as:
– The Central Government (Capital Expenditures),
– Local Governments Units/Private Sector (Operation and Maintenance)
– Consumers (sewerage Tariffs and connection fee).

For these projects, the central government shall be responsible for the funding of the capital needs and shall require partial capital recovery through the depreciation allowance of the assets arising from the projects. However, full recovery of operation and maintenance is nevertheless mandatory.
All financial computations are carried out in Philippine Peso (PHP) using 2011 price level. For purposes of the financial analysis, inflationary factors are imputed in the cost estimates by using an average inflation rate of 4.5 %.

2) Financial Evaluation

a) Overview

The results of the financial analysis show that the consideration of a full cost recovery under the projects is not an option for implementation. Results of the discounted cash flow analysis show accumulated net cash outflow with a Net Present Value of minus PHP 552 million for Tagbilaran sewerage development project, PHP 14 million for Dauis sewerage development project and PHP 132 million for Panglao sewerage development project with the condition of the same tariff level of water supply and 50%-grant of the project cost. However, the calculation of the financial internal rate of return (FIRR) is not possible as it results to a computational error.

b) Project Cost Estimates

The project cost is estimated under the following conditions:

- All of the costs are estimated under the economic conditions prevailing in Aug, 2011.
- Exchange rate of currency is; USD 1.0 = PHP 43
- Physical contingency and administration cost are assumed to be 10.0 % and 6.0 % of the basic construction cost, respectively.
- Consultancy cost is assumed to be 12 % of the basic construction cost
- Price escalation of 4.5 % per annum

The total project cost including the replacement cost of the recommended development program for Tagbilaran City amounts to PHP 4,519.3 million as presented. The detailed project cost is shown in Table 4.4-40.

Table 4.4-40 Project Cost for Tagbilaran Sewerage System Unit (PHP million)

Items	**Phase-1**	**Phase-2**	Replacement Cost	**Total** (PHP million)
Basic Construction Cost	1,297.9	850.6	126.4	2,274.9
Physical Contingency	129.8	85.0	12.6	227.4
Consultancy cost	155.7	102.1	15.2	273.0
Land Acquisition Cost	20.6	1.8		22.4
Project Administration Cost	77.9	51.0	7.6	136.5
Price Escalation	382.3	974.4	228.4	1,585.1
Total Project Cost	**2,064.2**	**2,064.9**	**390.2**	**4,519.3**

Note: these costs are not committed by any funding agencies

Source: JICA Study team

The total project cost of the recommended development program for Dauis and Panglao is shown in Table 4.4-41.

Table 4.4-41 Project Cost for Dauis and Panglao

Items	Dauis	Panglao		
		Alona System	Poblacion System	Total
Basic Construction Cost	43.2 (incl replace 3.5)	81.7 (incl replace 10.5)	194.5 (incl replace 17.4)	276.2
Physical Contingency	4.3	8.2	19.5	27.6
Consultancy cost	5.2	9.8	23.3	33.2
Land Acquisition Cost	3.8	5.3	3.9	9.2
Project Administration Cost	2.6	4.9	11.7	16.6
Price Escalation	13.1	29.8	136.3	166.2
Total Project Cost	**72.2**	**139.7**	**389.3**	**529.0**

Note: these costs are not committed by any funding agencies

Source: JICA Study team

c) Annual Debt Service Schedule

The following assumptions in the calculation of an annual debt service schedule are set up as follows:

- The central government is a borrower of the fund.
- The project is assumed to be financed through a combination of a loan from a donor and equity contribution by the Government of Philippines. The loan portion and the equity contribution are assumed to be 85 % and 15% of total project cost, respectively.
- Adopted loan conditions are based on the recent loan conditions for a road project in the Philippines are shown below.

Interest rate: 1.4%
Maturity Period: 25 Years
Grace Period: 7 Years

For the purpose of illustrating the financial impact of the repayment terms, a projected annual debt service schedule for the project loan using the above the conditions is presented in Table 4.4-42 to Table 4.4-44.

Table 4.4-42 Annual Debt Service Projection (Tagbilaran Sewerage Project)

Interest Rate	1.40%																										
Capitalized Interest	0%																										
Initial Year of Drawdown	2015																										
Maturity Period, years	25																										
Grace Period, years	7																										
First Amortization	2022																										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
	Year -1	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
Loan Outstanding, beginning		-	-	-	-	-	734,355.6	1,614,252.9	1,754,558.2	1,754,558.2	1,754,558.2	1,754,558.2	1,754,558.2	1,668,172.2	1,580,576.7	1,491,755.0	1,401,689.7	1,310,363.5	1,217,758.8	1,123,857.6	1,028,641.7	932,092.9	834,192.3	734,921.2	634,260.2	532,190.1	428,690.9
	Drawdown (phase-1)			-	-	734,355.6	879,897.3	140,305.3																			
	Capitalized Interest	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Operational Interest	-	-	-	-	5,140.5	16,440.3	23,581.7	24,563.8	24,563.8	24,563.8	24,563.8	24,563.8	23,354.4	22,128.1	20,884.6	19,623.7	18,345.1	17,048.6	15,734.0	14,401.0	13,049.3	11,678.7	10,288.9	8,879.6	7,450.7	6,001.7
	Total Interest	-	-	-	-	5,140.5	16,440.3	23,581.7	24,563.8	24,563.8	24,563.8	24,563.8	24,563.8	23,354.4	22,128.1	20,884.6	19,623.7	18,345.1	17,048.6	15,734.0	14,401.0	13,049.3	11,678.7	10,288.9	8,879.6	7,450.7	6,001.7
	Principal Repayment												86,386.0	87,595.4	88,821.8	90,065.3	91,326.2	92,604.7	93,901.2	95,215.8	96,548.9	97,900.5	99,271.1	100,660.9	102,070.2	103,499.2	104,948.2
	Total Amortization					5,140.5	16,440.3	23,581.7	24,563.8	24,563.8	24,563.8	24,563.8	110,949.8	110,949.8	110,949.8	110,949.8	110,949.8	110,949.8	110,949.8	110,949.8	110,949.8	110,949.8	110,949.8	110,949.8	110,949.8	110,949.8	110,949.8
Loan Outstanding, ending		-	-	-	-	734,355.6	1,614,252.9	1,754,558.2	1,754,558.2	1,754,558.2	1,754,558.2	1,754,558.2	1,668,172.2	1,580,576.7	1,491,755.0	1,401,689.7	1,310,363.5	1,217,758.8	1,123,857.6	1,028,641.7	932,092.9	834,192.3	734,921.2	634,260.2	532,190.1	428,690.9	323,742.7
Loan Outstanding, beginning		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	859,735.2	1,755,197.5	1,755,197.5	1,755,197.5	1,755,197.5	1,755,197.5	1,755,197.5	1,668,780.0	1,581,152.7	1,492,298.5	1,402,200.5
	Drawdown (phase-2)			-	-											859,735.2	895,462.3										
	Capitalized Interest	-	-	-	-				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Operational Interest	-	-	-	-				-	-	-	-				6,018.1	18,304.5	24,572.8	24,572.8	24,572.8	24,572.8	24,572.8	24,572.8	23,362.9	22,136.1	20,892.2	19,630.8
	Total Interest	-	-	-	-				-	-	-	-				6,018.1	18,304.5	24,572.8	24,572.8	24,572.8	24,572.8	24,572.8	24,572.8	23,362.9	22,136.1	20,892.2	19,630.8
	Principal Repayment																						86,417.5	87,627.3	88,854.1	90,098.1	91,359.5
	Total Amortization								-	-	-	-				6,018.1	18,304.5	24,572.8	24,572.8	24,572.8	24,572.8	24,572.8	110,990.3	110,990.3	110,990.3	110,990.3	110,990.3
Loan Outstanding, ending		-	-	-	-	-	-	-	-	-	-	-	-	-	-	859,735.2	1,755,197.5	1,755,197.5	1,755,197.5	1,755,197.5	1,755,197.5	1,755,197.5	1,668,780.0	1,581,152.7	1,492,298.5	1,402,200.5	1,310,841.0
Loan Phase1+Phase2	Total Amortization					5,140.5	16,440.3	23,581.7	24,563.8	24,563.8	24,563.8	24,563.8	110,949.8	110,949.8	110,949.8	116,968.0	129,254.4	135,522.6	135,522.6	135,522.6	135,522.6	135,522.6	221,940.1	221,940.1	221,940.1	221,940.1	221,940.1

Source: JICA Study team

Table 4.4-43 Annual Debt Service Projection (Dauis Sewerage Project)

Interest Rate	1.40%																										
Capitalized Interest	0%																										
Initial Year of Drawdown	2014																										
Maturity Period, years	25																										
Grace Period, years	7																										
First Amortization	2021																										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
	Year -1	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
Loan Outstanding, beginning	-	-	-	-	-	52,979.5	52,979.5	52,979.5	52,979.5	52,979.5	52,979.5	52,979.5	50,371.1	47,726.1	45,044.1	42,324.5	39,566.9	36,770.7	33,935.3	31,060.2	28,144.9	25,188.7	22,191.2	19,151.7	16,069.7	12,944.5	9,775.5
Drawdown			-	-	52,979.5																						
Capitalized Interest	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Operational Interest	-	-	-	-	370.9	741.7	741.7	741.7	741.7	741.7	741.7	741.7	705.2	668.2	630.6	592.5	553.9	514.8	475.1	434.8	394.0	352.6	310.7	268.1	225.0	181.2	136.9
Total Interest	-	-	-	-	370.9	741.7	741.7	741.7	741.7	741.7	741.7	741.7	705.2	668.2	630.6	592.5	553.9	514.8	475.1	434.8	394.0	352.6	310.7	268.1	225.0	181.2	136.9
Principal Repayment												2,608.5	2,645.0	2,682.0	2,719.6	2,757.6	2,796.2	2,835.4	2,875.1	2,915.3	2,956.1	2,997.5	3,039.5	3,082.0	3,125.2	3,168.9	3,213.3
Total Amortization					370.9	741.7	741.7	741.7	741.7	741.7	741.7	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2	3,350.2
Loan Outstanding, ending	-	-	-	-	52,979.5	52,979.5	52,979.5	52,979.5	52,979.5	52,979.5	52,979.5	50,371.1	47,726.1	45,044.1	42,324.5	39,566.9	36,770.7	33,935.3	31,060.2	28,144.9	25,188.7	22,191.2	19,151.7	16,069.7	12,944.5	9,775.5	6,562.2

Source: JICA Study team

Table 4.4-44 Annual Debt Service Projection (Panglao Sewerage Project)

Option 1													
Interest Rate	1.40%												
Capitalized Interest	0%												
Initial Year of Drawdown	2014												
Maturity Period, years	25												
Grace Period, years	7												
First Amortization	2021												
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Phase-1	Year -1	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Loan Outstanding, beginning	-	-	-	-	-	88,284.6	88,284.6	88,284.6	88,284.6	88,284.6	88,284.6	88,284.6	83,937.9
Drawdown (phase-1)			-	-	88,284.6								
Capitalized Interest	-	-	-	-	-	-	-	-	-	-	-	-	-
Operational Interest	-	-	-	-	618.0	1,236.0	1,236.0	1,236.0	1,236.0	1,236.0	1,236.0	1,236.0	1,175.1
Total Interest	-	-	-	-	618.0	1,236.0	1,236.0	1,236.0	1,236.0	1,236.0	1,236.0	1,236.0	1,175.1
Principal Repayment												4,346.7	4,407.6
Total Amortization					618.0	1,236.0	1,236.0	1,236.0	1,236.0	1,236.0	1,236.0	5,582.7	5,582.7
Loan Outstanding, ending	-	-	-	-	88,284.6	88,284.6	88,284.6	88,284.6	88,284.6	88,284.6	88,284.6	83,937.9	79,530.3
Phase-2													
Loan Outstanding, beginning	-	-	-	-	-	-	-	-	-	-	285,388.0	285,388.0	285,388.0
Drawdown (phase2)			-	-	-					285,388.0			
Capitalized Interest	-	-	-	-	-	-	-	-	-	-	-	-	-
Operational Interest	-	-	-	-	-	-	-	-	-	1,997.7	3,995.4	3,995.4	3,995.4
Total Interest	-	-	-	-	-	-	-	-	-	1,997.7	3,995.4	3,995.4	3,995.4
Principal Repayment													
Total Amortization					-	-	-	-	-	1,997.7	3,995.4	3,995.4	3,995.4
Loan Outstanding, ending	-	-	-	-	-	-	-	-	-	285,388.0	285,388.0	285,388.0	285,388.0
Total (phase1+phase2)													
Loan Outstanding, beginning						88,284.6	88,284.6	88,284.6	88,284.6	88,284.6	373,672.5	373,672.5	369,325.8
Operational Interest						1,236.0	1,236.0	1,236.0	1,236.0	3,233.7	5,231.4	5,231.4	5,170.6
Total Interest						1,236.0	1,236.0	1,236.0	1,236.0	3,233.7	5,231.4	5,231.4	5,170.6
Principal Repayment												4,346.7	4,407.6
Total Amortization						1,236.0	1,236.0	1,236.0	1,236.0	3,233.7	5,231.4	9,578.1	9,578.1
Loan Outstanding, ending						88,284.6	88,284.6	88,284.6	88,284.6	373,672.5	373,672.5	369,325.8	364,918.3

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Phase-1	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
Loan Outstanding, beginning	79,530.3	75,061.0	70,529.2	65,933.9	61,274.3	56,549.4	51,758.4	46,900.4	41,974.3	36,979.2	31,914.2	26,778.3	21,570.6	16,289.8
Drawdown (phase-1)														
Capitalized Interest	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Operational Interest	1,113.4	1,050.9	987.4	923.1	857.8	791.7	724.6	656.6	587.6	517.7	446.8	374.9	302.0	228.1
Total Interest	1,113.4	1,050.9	987.4	923.1	857.8	791.7	724.6	656.6	587.6	517.7	446.8	374.9	302.0	228.1
Principal Repayment	4,469.3	4,531.8	4,595.3	4,659.6	4,724.9	4,791.0	4,858.1	4,926.1	4,995.1	5,065.0	5,135.9	5,207.8	5,280.7	5,354.6
Total Amortization	5,582.7	5,582.7	5,582.7	5,582.7	5,582.7	5,582.7	5,582.7	5,582.7	5,582.7	5,582.7	5,582.7	5,582.7	5,582.7	5,582.7
Loan Outstanding, ending	75,061.0	70,529.2	65,933.9	61,274.3	56,549.4	51,758.4	46,900.4	41,974.3	36,979.2	31,914.2	26,778.3	21,570.6	16,289.8	10,935.2
Phase-2														
Loan Outstanding, beginning	285,388.0	285,388.0	285,388.0	285,388.0	271,336.8	257,089.0	242,641.7	227,992.1	213,137.4	198,074.8	182,801.2	167,313.9	151,609.7	135,685.7
Drawdown (phase2)														
Capitalized Interest	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Operational Interest	3,995.4	3,995.4	3,995.4	3,995.4	3,798.7	3,599.2	3,397.0	3,191.9	2,983.9	2,773.0	2,559.2	2,342.4	2,122.5	1,899.6
Total Interest	3,995.4	3,995.4	3,995.4	3,995.4	3,798.7	3,599.2	3,397.0	3,191.9	2,983.9	2,773.0	2,559.2	2,342.4	2,122.5	1,899.6
Principal Repayment				14,051.1	14,247.8	14,447.3	14,649.6	14,854.7	15,062.6	15,273.5	15,487.3	15,704.2	15,924.0	16,147.0
Total Amortization	3,995.4	3,995.4	3,995.4	18,046.6	18,046.6	18,046.6	18,046.6	18,046.6	18,046.6	18,046.6	18,046.6	18,046.6	18,046.6	18,046.6
Loan Outstanding, ending	285,388.0	285,388.0	285,388.0	271,336.8	257,089.0	242,641.7	227,992.1	213,137.4	198,074.8	182,801.2	167,313.9	151,609.7	135,685.7	119,538.7
Total (phase1+phase2)														
Loan Outstanding, beginning	364,918.3	360,449.0	355,917.2	351,321.9	332,611.1	313,638.4	294,400.1	274,892.4	255,111.7	235,054.0	214,715.5	194,092.2	173,180.3	151,975.5
Operational Interest	5,108.9	5,046.3	4,982.8	4,918.5	4,656.6	4,390.9	4,121.6	3,848.5	3,571.6	3,290.8	3,006.0	2,717.3	2,424.5	2,127.7
Total Interest	5,108.9	5,046.3	4,982.8	4,918.5	4,656.6	4,390.9	4,121.6	3,848.5	3,571.6	3,290.8	3,006.0	2,717.3	2,424.5	2,127.7
Principal Repayment	4,469.3	4,531.8	4,595.3	18,710.8	18,972.7	19,238.3	19,507.7	19,780.8	20,057.7	20,338.5	20,623.2	20,912.0	21,204.7	21,501.6
Total Amortization	9,578.1	9,578.1	9,578.1	23,629.3	23,629.3	23,629.3	23,629.3	23,629.3	23,629.3	23,629.3	23,629.3	23,629.3	23,629.3	23,629.3
Loan Outstanding, ending	360,449.0	355,917.2	351,321.9	332,611.1	313,638.4	294,400.1	274,892.4	255,111.7	235,054.0	214,715.5	194,092.2	173,180.3	151,975.5	130,473.9

Source: JICA Study team

3) Estimation of Financial Internal Rate of Return (FIRR)

a) Assumptions

Operation maintenance cost; 1.5 % of WWTP cost aforementioned

Replacement cost; 30 % of total cost of WWTPs and pumping stations,15 years after completion of WWTP and pumping stations

b) Revenue

Revenue of the sewerage operation will be generated from one-time connection charges and water consumption. In this FIRR calculation, per connection fee is assumed to be peso 5,000. The amount of revenue water for sewerage service is described below.

- **Tagbilaran Sewerage Project**

Majority of water supply system for Tagbilaran City is operated by BWUI. The water tariff varies only in consumption amount not in connection type. On the other hand, TCWS collects water tariffs from domestic users and non-domestic users by applying the tariff system by connection type. However, the amount of water revenue from non-domestic connection is negligibly small because of the large share of domestic connection type (more than 98 %). Therefore, the same sewerage tariff regardless the connection type is applied in this financial analysis.

Table 4.4-45 shows the potential amount of water revenue in 2010 sewerage service area of phase-1. Although this amount is only theoretical, it is calculated to interpolate the amount of water revenue for 2015 to 2019.

Table 4.4-46 and 4.4-47 show the basis of daily amount of water revenue in 2020 and 2035, respectively.

Table 4.4-45 Daily Potential Revenue Water in 2010 (Tagbilaran City)

	Barangay	Brgy Pop 2010 (projected)	Served Population	Number of Connections	Per Capita Consumption (Lpcd)	(1) Average Consumption (m3/day)	NRW	Average-Day Demand (m3/day)	Maximum-Day Demand (m3/day)	(2) Coverage in phase 1	Consumption of sewerage service (m3/d) (1) x (2)
	City Waterworks										
1	Bool	5,139	535	107	158	85	26.7%	116	145		
2	Booy	8,119	1,575	315	158	249	26.7%	340	425	40%	99.6
3	Cabawan	2,641	675	135	158	107	26.7%	146	183		
4	Cogon	17,311	245	49	158	39	26.7%	53	66	60%	23.4
5	Dao	6,926	2,765	553	158	437	26.7%	596	745		
6	Dampas	8,155	-						-	40%	0.0
7	Manga	7,060	4,200	840	158	664	26.7%	906	1,133		
8	Mansasa	5,465	-							5%	0.0
9	Pob 1	3,324	-								
10	Pob 2	5,862	-								
11	Pob 3	6,565	-					-	-		
12	San Isidro	4,704	705	141	158	111	26.7%	151	189		
13	Taloto	6,567	3,840	768	158	607	26.7%	828	1,035	40%	242.8
14	Tiptip	4,475	2,600	520	158	411	26.7%	561	701		
15	Ubujan	5,831	4,335	867	158	685	26.7%	935	1,169		
	Sub-total	98,145	21,475	4,295		3,395		4,632	5,791		365.8
	BWUI										
1	Bool	5,139	3,860	772	220	849	25.4%	1,138	1,423		
2	Booy	8,119	3,600	720	220	792	25.4%	1,062	1,328	40%	316.8
3	Cabawan	2,641	-					-		60%	0.0
4	Cogon	17,311	15,860	3,172	220	3,489	25.4%	4,677	5,846		
5	Dao	6,926	5,575	1,115	220	1,227	25.4%	1,645	2,056		
6	Dampas	8,155	6,805	1,361	220	1,497	25.4%	2,007	2,509	40%	598.8
7	Manga	7,060	-					-	-		
8	Mansasa	5,465	4,685	937	220	1,031	25.4%	1,382	1,728	5%	51.6
9	Pob 1	3,324	2,435	487	220	536	25.4%	718	898	90%	482.4
10	Pob 2	5,862	7,035	1,407	220	1,548	25.4%	2,075	2,594	100%	1,548.0
11	Pob 3	6,565	5,360	1,072	220	1,179	25.4%	1,580	1,975	80%	943.2
12	San Isidro	4,704	2,445	489	220	538	25.4%	721	901		
13	Taloto	6,567	295	59	220	65	25.4%	87	109	40%	26.0
14	Tiptip	4,475	310	62	220	68	25.4%	91	114		
15	Ubujan	5,831	-					-			
	Baclayon Muni		1,350	270	220	297	25.4%	398	498		
	Sub-total	98,145	59,615	11,923		13,116		17,581	21,979		3,966.8
	Total		81,090	16,218	204	16,511		22,213	27,770		**4,332.6**

Source: JICA Study team

Table4.4-46 Expected Revenue Water in 2020 (Tagbilaran City)

	Barangay	(1) Brgy Pop 2020	Water Consumption					Sewage Flow				(11) Consumption for Sewerage Service =(6) x (7)
			(2) Served Population of Level 3 =(1) x 0.855	(3) Per Capita Consumption (Lpcd)	(4) Domestic water demand (m3/d)	(5) Non-domestic water demand (m3/d) =(4)*23%	(6) water demand=(4)+(6)	(7) Service coverage for Sewerage	(8) Daily wastewater generation=(6)x(7)x0.8	(9) Inflow/infiltration =(8) x 0.2	(10)Daily sewage flow= (8) + (9) m3/d	
1	Bool	8,710	7,447	200	1,489	342	1,831	-			-	
2	Booy	9,610	8,217	200	1,643	378	2,021	40%	647	129	776	808
3	Cabawan	4,380	3,745	200	749	172	921	-		-	-	
4	Cogon	17,870	15,279	200	3,056	703	3,759	60%	1,804	361	2,165	2,255
5	Dao	8,160	6,977	200	1,395	321	1,716	-				
6	Dampas	13,650	11,671	200	2,334	537	2,871	40%	919	184	1,103	1,148
7	Manga	9,060	7,746	200	1,549	356	1,905	-		-	-	
8	Mansasa	6,400	5,472	200	1,094	252	1,346	5%	54	11	65	67
9	Pob 1	3,340	2,856	200	571	131	702	90%	505	101	606	632
10	Pob 2	5,590	4,779	200	956	220	1,176	100%	941	188	1,129	1,176
11	Pob 3	6,610	5,652	200	1,130	260	1,390	80%	890	178	1,068	1,112
12	San Isidro	5,630	4,814	200	963	221	1,184	-		-	-	
13	Taloto	7,940	6,789	200	1,358	312	1,670	40%	534	107	641	668
14	Tiptip	5,640	4,822	200	964	222	1,186	-		-	-	
15	Ubujan	7,630	6,524	200	1,305	300	1,605	-		-	-	
	Total	120,220	102,790		20,556	4,727	25,283		6,294	1,259	7,553	**7,867**

Source: JICA Study team

Table 4.4-47 Expected Revenue Water in 2035 (Tagbilaran City)

	Barangay	(1) Brgy Pop 2035	Water Consumption (2) Served Population of Level 3 =(1) x 0.855	(3) Per Capita Consumption (Lpcd)	(4) Domestic water demand (m3/d)	(5) Non-domestic water demand (m3/d) =(4)*23%	(6) water demand=(4)+(5)	Sewage Flow (7) Service coverage for Sewerage	(8) Daily wastewater generation=(6)x(7)x0.8	(9) Inflow/infiltration =(8) x 0.2	(10) Daily sewage flow= (8) + (9)	(11) consumption for sewerage Service =(6) x (7)
1	Bool	12,350	10,559	200	2,112	486	2,598	-			-	
2	Booy	10,890	9,311	200	1,862	428	2,290	90%	1,649	330	1,979	2,061
3	Cabawan	8,220	7,028	200	1,406	323	1,729	-		-	-	
4	Cogon	18,380	15,715	200	3,143	723	3,866	90%	2,784	557	3,341	3,479
5	Dao	9,210	7,875	200	1,575	362	1,937	10%	155	31	186	194
6	Dampas	20,330	17,382	200	3,476	799	4,275	40%	1,368	274	1,642	1,710
7	Manga	11,590	9,909	200	1,982	456	2,438	90%	1,755	351	2,106	2,194
8	Mansasa	7,150	6,113	200	1,223	281	1,504	90%	1,083	217	1,300	1,354
9	Pob 1	3,370	2,881	200	576	132	708	100%	566	113	679	708
10	Pob 2	5,610	4,797	200	959	221	1,180	100%	944	189	1,133	1,180
11	Pob 3	6,650	5,686	200	1,137	262	1,399	100%	1,119	224	1,343	1,399
12	San Isidro	6,490	5,549	200	1,110	255	1,365	-	-	-	-	
13	Taloto	9,310	7,960	200	1,592	366	1,958	80%	1,253	251	1,504	1,566
14	Tiptip	7,030	6,011	200	1,202	276	1,478	-	-	-	-	
15	Ubujan	10,060	8,601	200	1,720	396	2,116	60%	1,016	203	1,219	1,270
	Total	146,640	125,377		25,075	5,766	30,841		13,692	2,740	16,432	**17,117**

Source: JICA Study team

Table 4.4-48 Summary of Revenue Water (Tagbilaran)

Items	2010	2020	2035	Remarks
Served Population	(20,341)	31,983	69,578	
(1) Water Consumption (m^3/d)	4,332	7,867	17,117	Table 5.4.44~5.4.46
(2) Water Consumption (1,000 m^3/year)	1,581	**2,871**	**6,248**	(1) x 365
No. of HC	(4,068)*	6,397	7,518 (Add)	*Potential
Existing Tariff	12 peso/m^3	-	-	Average, Water supply

Source: JICA Study team

- **Dauis Sewerage Project**

The Municipal waterworks system applies water tariffs by connection type. Actually, unit water tariffs of commercial/industrial are about two times higher than that of the domestic/institutional connections. However, the majority of the connection type within the proposed sewerage service area is for domestic usage. Therefore, the same sewerage tariff regardless connection type is applied in this financial analysis.

Table 4.4-49 Amount of Water to be charged (Dauis)

Items	2010	2020	2035	Remarks
Served population	1,075	1,290*	1,400*	*assumption
Per capita Consumption	70 Lpcd (actual result)	102 Lpcd*	150 Lpcd (WS Master plan)	*interpolation
(2) Water Consumption (m^3/d)	75	132	210	(1) x (2)
(3) Water Consumption (m^3/year)	27,466	**48,022**	**76,650**	(1) x (2)x 365
Cumulative No. of HC	(215)*	258	280	*potential
Existing Tariff	17 peso/m^3	-	-	Average, Water supply

Source: JICA Study team

- **Panglao Sewerage Project**

The municipal waterworks system of Panglao also applies water tariffs by connection type.

Unit water tariffs of commercial connections are about two times higher than that of the domestic/institutional connections. The proposed sewerage area includes Barangay Doljo and Alona beach in which a lot of tourism accommodations are located. Therefore, applying sewerage tariff by connection type may be reasonable in this financial analysis.

No data regarding the amount of water consumption by connection type is available but the total amount of water consumption and the number of service connections by type is available. Assuming that the amount of water consumption per domestic connection is 12.2 m^3/month, which is the same amount as in the Dauis municipal waterworks, the average unit water consumption of commercial connections can be estimated as shown in Table 4.4-50.

Table 4.4-50 Assumed Water Consumption by Connection Type in 2010

	No. of SC in 2010			Consumption					
				Domestic/ Institutional		Commercial		Total (m3/d)	Remarks
	(1) Domestic/ Institutional	(2) Commercial	(3) Total	(4) Monthly consumption	(5) Consumption =(1) x (4)/30 (m3/d)	(6) daily consumption per SC (m3/SC)	(7) Consumption =(2)x(6)		
Pob	156	27	183	12.2 m3/SC	63	2.25	61	124	
Doljo	335	24	359	12.2 m3/SC	136	2.25	54	190	
Tawala	392	90	482	12.2 m3/SC	159	2.25	203	362	
Othes (7 Brgy)	2,639	53	2,692	12.2 m3/SC	1074		120 (438-3 brgy)	1,194	
Total of MWWS	3,522	194	3,716	12.2 m3/SC	1432		438 (1,870-1432)	1,870	15.1m3/SC per month (actual result in 2010)

Source: JICA Study team

The water consumption of water revenue in 2020 and 2035 is estimated based on the following policy:

- The number of sewerage population is the same as the number of served population by the Level 3-water supply in the sewerage service area.
- The ratio of service coverage by Level 3 is based on the Water Supply Master Plan.
- Domestic per capita consumption is based on the Water Supply Master Plan.
- The ratio of non-domestic consumption amount (institutional and commercial) and domestic consumption amount is also applied as per the one in the Water Supply Master Plan.
- The total water consumption for Tourism industry in the municipality Panglao is based on the Water Supply Master Plan. The share of the total amount is assumed considering the data on the number of hotel rooms by Barangay.

Table 4.4-51 & 4.4-52 show the expected amount of revenue water in 2020 and 2035 of the Poblacion System.

Table 4.4-51 Revenue Water (Panglao Poblacion in 2020)

Barangay	(1) Brgy Pop 2020	Water Supply (L3)		Tariff category (Domestic)		Tariff Category (Commercial)		(8) Total Water Consumption =(4)-(7) (m3/d)	Remarks
		(2) Served Population of L3 =(1) x α	(3) Per Capita Consumption (Lpcd)	(4) Domestic water demand (m3/d)	(5) Instutution & industrial	(6) Commercial	(7) Tourism (Total 924 m3/d)		
		α=0.855(0.95x0.9)							
Poblacion	6,010	5,139	120	617	32	61	0	710	(5)+(6)=(4)x0.12
		α=0.73							α=(15810+6566)/30770
Doljo	3,900	2,847	114	325	25	24	70	444	(5)+(6)=(4)x0.12
Total	9,910	7,986	-	999		155		1,154	
Revenue Water for Sewerage (m3/d)			Poblacion 50% Doljo 100%	**675**		**125**		799	

Source: JICA Study team

Table 4.4-52 Revenue Water (Panglao Poblacion in 2035)

Barangay	(1) Brgy Pop 2035	Water Supply (L3)		Tariff category (Domestic)		Tariff Category (Commercial)		(8) Total Water Consumption =(4)-(7) (m3/d)	Remarks
		(2) Served Population of L3 =(1) x α	(3) Per Capita Consumption (Lpcd)	(4) Domestic water demand (m3/d)	(5) Instutution & industrial	(6) Commercial	(7) Tourism (Total 924)		
		α=0.855(0.95x0.9)							
Poblacion	7,310	6,250	125	781	33	61	0	875	(5)+(6)=(4)x0.12
		α=0.77							α=(21530+7195)/37294
Doljo	4,730	3,642	120	437	26	26	100	589	(5)+(6)=(4)x0.12
Total	12,040	9,892	-	1,277		187		1,464	
Revenue Water for Sewerage (m3/d)			Poblacion 70% Doljo 100%	**1,033**		**169**		1,202	

Source: JICA Study team

Table 4.4-53 shows the potential amount of water revenue in 2010 in sewerage service area of Poblacion. Although this amount is only theoretical, it is calculated to interpolate water revenues for 2015 to 2019.

Table 4.4-53 Potential Revenue Water (Panglao Poblacion in 2010)

Tariff Category	Potential Revenue Water (m^3/d)	Remarks
Domestic	168	Table 5.5-49, (63 x 50%+136 x 100%)
Commercial	85	Table 5.5-49, (61x 50%+54 x 100%)
Total	253	

Source: JICA Study team

Table 4.4-54 & 4.4-55 show the expected amount of water revenue in 2020 and 2035 of Alona System.

Table 4.4-54 Revenue Water (Panglao Alona in 2020)

Barangay	(1) Brgy Pop 2020	Water Supply (L3)		Tariff category (Domestic)		Tariff Category (Commercial)		(8) Total Water Consumption =(4)-(7) (m3/d)	Remarks
		(2) Served Population of L3 =(1) x α	(3) Per Capita Consumption (Lpcd)	(4) Domestic water demand (m3/d)	(5) Instutution & industrial	(6) Commercial	(7) Tourism (Total 924)		
		α=0.73							
Tawala	3,570	2,606	114	297	24	23	324	668	(5)+(6)=(4)x0.12
Revenue Water for Sewerage (m3/d)			Domestic 20% Commercial 95%	**64**		**330**		394	

Source: JICA Study team

Table 4.4-55 Revenue Water (Panglao Alona in 2035)

Barangay	(1) Brgy Pop 2035	Water Supply (L3)		Tariff category (Domestic)		Tariff Category (Commercial)		(8) Total Water Consumption =(4)-(7) (m3/d)	Remarks
		(2) Served Population of L3 =(1) x α	(3) Per Capita Consumption (Lpcd)	(4) Domestic water demand (m3/d)	(5) Instutution & industrial	(6) Commercial	(7) Tourism (Total 924)		
		α=0.77							
Tawala	4,330	3,334	120	400	24	24	463	911	(5)+(6)=(4)x0.12
Revenue Water for Sewerage (m3/d)			Domestic 20% Commercial 96%	**85**		**468**		552	

Source: JICA Study team

Table 4.4-56 shows the potential amount of water revenue in 2010 in the sewerage service area of the Alona System. Although this amount is only theoretical, it is calculated to interpolate water revenues for 2015 to 2019.

Table 4.4-56 Potential Revenue Water (Panglao Alona in 2010)

Tariff Category	Potential Revenue Water (m^3/d)	Remarks
Domestic	32	Table 5.5-49, (159 x 20%)
Commercial	193	Table 5.5-49, (203x 95%)
Total	225	

Source: JICA Study team

Table 4.4-57 summarizes the parameters related to the revenue of sewerage operation for the municipality of Panglao.

Table 4.4-57 Summary of Revenue Water (Panglao)

Items	2010		2020		2035	
	Poblacion System	Alona System	Poblacion System	Alona System	Poblacion System	Alona System
Population of Water Service (Level 3)	5,635	562	7,986	2,749	9,892	3,334
Total	(6197)		10,735		13,226	
Revenue Domestic (m3/d)	168	32	675	64	1,033	85
Total	(200)		739		1,118	
Revenue Commercial (m3/d)	85	193	125	330	169	468
Total	(278)		455		637	
Revenue Domestic (m3/year)	61,320	11,680	246,375	23,360	377,045	31,025
Total	(73,000)		269,735		408,070	
Revenue Commercial (m3/year)	31,025	70,445	45,625	120,450	61,685	170,820
Total	(101,470)		166,075		232,505	
Cummurative No.of HC	–	–	1,139	220	1,678	289
Existing Tariff	Domestic 4.8peso/m3					
	Commercial 9.3peso/m3					

Source: JICA Study team

c) Result

The FIRR is the interest rate that would make the present value of cash inflows equal to the present value of cash outflows. The sum of project revenue inflows would be equal to the sum of project cost outflows when both are discounted over a period of time using the FIRR.

As a rule of thumb, the FIRR should at least be equal to the weighted average cost of capital for the project. The results of the financial forecast show that the projects are not financially viable since the corresponding sewerage charges to be collected in the project area are not sufficient to support a financial internal rate of return that is at least equal to the weighted average cost of capital of the project.

The evaluation formulated three to four scenarios at each sewerage project to assess financial desirability of the project. The scenarios and the results are shown below. In this calculation, the sewerage tariff set up in 2011 is assumed to be raised at 4.5 % annually from 2012 for convenience sake.

The last Scenario of each sewerage project is a trial calculation to estimate how much sewerage tariff is necessary to make the FIRR positive. As a conclusion, the required sewerage tariff is 3.3 - 6.3 times as high as the existing tariff of water supply without any subsidy/grant. (See Table 4.4-58 & 4.4-59)

Table 4.4-58 Conditions of FIRR Calculation by Scenario and Project

Items	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Tagbilaran Sewerage				
Percentage of water tariff (Sewerage Tariff at nominal cost in 2011)	100 % (12peso/m^3)	50 % (6peso/m^3)	330 % (39.6peso/m^3)	-
Grant Portion of construction/ Replacement cost (%)	50 %	85 %	None	-
Dauis Sewerage				
Percentage of water tariff (Sewerage Tariff at nominal cost in 2011)	100 % (17 peso/m^3)	50 % (8.5peso/m^3)	340 % (57.8 peso/m^3)	-
Grant Portion of construction/ Replacement cost (%)	50 %	90 %	None	-
Panglao Sewerage				
Percentage of water tariff (Sewerage Tariff at nominal cost in 2011)				
Domestic	100 % (4.8 P/m^3)	50 % (2.4 P/m^3)	100 % (4.8 P/m^3)	630 % (30.24 P/m^3)
Commercial	100 % (9.3 P/m^3)	50 % (4.65P/m^3)	100 % (9.3 P/m^3)	630 % (58.59 P/m^3)
Subsidy Portion of Construction/ Replacement cost (%)	50 %	95 %	87 %	None

Source: JICA Study team

Table 4.4-59 FIRR and Net Present Value by Scenario

Project	Items	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Tagbilaran Sewerage Project	FIRR NPV (1000 peso)	Negative △551,815	Negative △29,633	1.6% +44,371	-
Dauis Sewerage Project	FIRR NPV (1000 peso)	Negative △14,458	Negative △1,897	1.7% +1,743	-
Panglao Sewerage Project	FIRR NPV (1000 peso)	Negative △132,282	2.2 % +563	1.9% +1,377	1.5 % +2,835

Source: JICA Study team

4.4.5. Preliminary Sanitation Development Plan

1) Overview

Currently, there is no sewerage system in Bohol. Black water from each household is mostly treated by Septic Tanks (ST). According to the 2000 NSO data, the installation rate of ST is 81% in Dauis and 72% in Panglao. The treatment efficiency of a ST is relatively low compared to a sewerage system. Furthermore, operation and maintenance of a ST depends on each household so that if the maintenance is not conducted properly, the treatment efficiency of the ST will be further deteriorated. Meanwhile, grey water is discharged into side ditches or is seeping underground and will normally not be discharged into the ST.

In the case of middle to high class hotels, both black water and grey water are seemed to be treated by septic tanks based on the survey of some selected hotels. However, in small scale hotels or accommodations, they only treat black water by septic tank.

Periodic sludge sacking is important as an appropriate maintenance of on-site treatment systems. However, this is not currently implemented in the study area. Furthermore, there is no sludge treatment facility in Bohol.

The service areas of previously proposed sewerage systems in Tagbilaran, Dauis and Panglao are very limited compared to the whole city/municipality area. Coverage ratio of each sewerage system based on the population is 47%, 2% and 21% in Tagbilaran City, the municipality of Dauis and the municipality of Panglao in 2035, respectively. Specifically, the coverage rate is low (8,684/40,540 =21%) on Panglao island.

Under such circumstances, the reduction of pollution loads through the implementation of a sewerage system is limited due to small service coverage. Therefore, upgrading of on-site treatment systems such as the conversion of existing ST's to upgraded ST systems (black water + grey water treatment), construction of sludge treatment facility, etc., is a much more effective way to reduce the pollution loads of the whole island.

2) On-site Treatment system

Aside from the traditional ST, two types of household-treatment facilities are recommended to reduce pollution load on the whole island; 1) package type household wastewater treatment facility sometimes called as Jokasou and 2) Septic Tanks with up-flow filters.

Septic Tanks with up-flow filter type seem to be more realistic considering their operation and maintenance costs. Treated water from Septic Tanks are discharged to soaking pits or leaching fields. Leaching fields are more desirable compared to soaking pit, however it requires a large land area.

The following measures are recommended to improve the sanitation condition and prevalence of the use upgraded Septic Tanks.

- Although construction of upgraded Septic Tanks and reconnection of the grey water pipes to the upgraded ST's in a short time is the most ideal way, the owner of a newly built or reconstructed house/building must install an upgraded Septic Tank.

- Connection of grey water pipe to the upgraded Septic Tanks or to existing traditional Septic Tanks.
- Inspection of Septic Tanks and piping should be carried out to check whether Septic Tank systems are properly installed.
- Construction of sludge treatment plants and compulsory periodic removal of the sludge from Septic Tanks at least once every five years.

Figure4.4-14 and Figure 4.4-15 show a sample of upgraded Stand soaking pit.

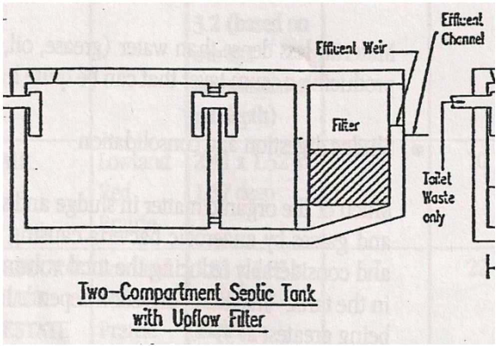


Figure 4.4-14 Septic Tank

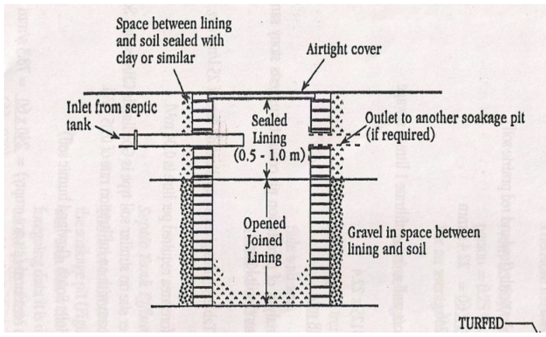


Figure 4.4-15 Soakage Pit

3) <u>Conceptual design of Proposed ST</u>

Upgraded/ traditional ST (V m^3) with a capacity of 3 day-retention is recommended because a large sedimentation volume needed.

Calculation of ST volume (V m^3) 5 persons (assumption):

- for Tagbilaran

  Per capita wastewater volume is set to be 0.2 m^3 therefore, 0.2 x 5 persons x 3 days = 3.0 m^3
- for Panglao Island

Per capita wastewater volume is set to be 0.125 m^3 therefore,
0.125 x 5 persons x 3 days = 1.9 m^3

The projected number of STs required in 2035 is indicated in Table 4.4-60.

Table 4.4-60 Required Number of ST in 2035

City/Municipality	(1)Future Population In 2035	(2)Served Population	(3) ST Population (1)-(2)	(4) No. of ST (3)/5.0
Tagbilaran	146,640	69,578	77,062	15,412
Dauis	74,130	1,400	72,730	14,546
Panglao	40,540	8,684	31,856	6,371
Total	261,310	79,662	181,648	36,329

Source: JICA Study team

The amount of sludge accumulated in the STs is assumed to be 40 L/year/head in this study. The required periodical desludge-time can be calculated by assuming that sludge portion is 1/3 of ST.

- for Tagbilaran: (3.0 m^3x 1/3)/(0.04 L/year/head x 5persons)= 5 years.
- for Panglao Island: (1.9 m^3x 1/3)/(0.04 L/year/head x 5 persons)=3.2 years.

Therefore, the frequency of sludge removal is estimated to be once in every 5 years for Tagbilaran City and once in every 3.2 years for Panglao Island.

4) Planning of Sludge Treatment Plant

In this study, the drying bed was selected as the sludge treatment method. The required drying bed areas in 2010, 2020 and 2035 in Tagbilaran City and in the municipalities of Dauis and Panglao are estimated as shown in Table 4.4-61 to Table 4.4-63, respectively.

The design conditions adopted in this study are:

- ✓ The accumulated dry solid volume per person per day: 25gDs/d (Assumption)
- ✓ Sludge loading rate: 150Kg/m^2 (reference: Wastewater Engineering)
- ✓ Sludge depth on the drying bed: 0.2m
- ✓ Dimension of drying bed per unit: 180 m^2 (6 m x 30 m)
- ✓ Volume of ST per unit: Tagbilaran 3.0m^3 , Dauis/ Panglao 1.9 m^3

Table 4.4-61 Summary of Functional Design on Drying Bed for Tagbilaran City

Items	2010	2020	2035	Remarks
Administrative Population	98,145	120,220	146,640	
Population (sewerage)	-	25,513	69,578	
(1) Population (on-site)	98,145	94,707	77,062	
(2) No.of ST (1)/5.0	11,740*	18,941	15,412	*No.of sanitary toilet in 1998(W4SMP)
(3) No. of desludging per day	-	10.4	8.4	(2)/(5years x 365)
(4) Desludging volume per day	-	31.2	25.2	(3) x 3.0 m3
(5) Dry solid per desludging(kg)	-	228.0	228.0	25g x 5 x 365 x 5yrs/1000
(6)Desludged dry solid per day(kg/d)	-	2,371.2	1,915.2	(3) x (5)
(7) Annual desludged dry solid (kg/yr)	-	865,488	699,048	(6) x 365
(8) Drying bed area (m2)	-	5,770	4,660	(7)/150 kg/m2/year
(9)Per ST bed area per day	-	555	555	(8)/(3)
(10) Required drying bed area per ST	-	15	15	3.0 m3/0.2 (t=0.2m)
(11) Possible average drying time (day)	-	37	37	(9)/(10)
(12) No. of drying bed (8)/180m2	-	32	26	1basin 6 m x 30 m

Source: JICA Study team

Table 4.4-62 Functional Design on Drying Bed for Dauis Municipality

Items	2010	2020	2035	Remarks
Administrative Population	40,387	56,730	74,130	
Population (sewerage)	-	1,290	1,400	
(1) Population (on-site)	40,387	55,440	72,730	
(2) No.of ST (1)/5.0	6,952*	11,088	14,546	*No.ofHH with sanitary toilet in 2007
(3) No. of desludging per day	-	9.5	12.5	(2)/(5years x 365)
(4) Desludging volume per day	-	18.1	23.8	(3) x 3.0 m3
(5) Dry solid per desludging(kg)	-	146.0	146.0	25g x 5 x 365 x 5yrs/1000
(6)Desludged dry solid per day(kg/d)	-	1,387.0	1,825.0	(3) x (5)
(7) Annual desludged dry solid (kg/yr)	-	506,255	666,125	(6) x 365
(8) Drying bed area (m2)	-	3,375	4,441	(7)/150 kg/m2/year
(9)Per ST bed area per day	-	355	355	(8)/(3)
(10) Required drying bed area per ST	-	9.5	9.5	3.0 m3/0.2 (t=0.2m)
(11) Possible average drying time (day)	-	37	37	(9)/(10)
(12) No. of drying bed (8)/180m2	-	19	25	1basin 6 m x 30 m

Source: JICA Study team

Table 4.4-63 Functional Design on Drying Bed for Panglao Municipality

Items	2010	2020	2035	Remarks
Administrative Population	27,241	33,400	40,540	
Population (sewerage)	-	6,402	8,684	
(1) Population (on-site)	98,145	26,998	31,856	
(2) No.of ST (1)/5.0	4,402*	5,400	6,371	*No.of HH with sanitary toilet in 2004
(3) No. of desludging per day	-	4.6	5.5	(2)/(5years x 365)
(4) Desludging volume per day	-	8.7	10.5	(3) x 3.0 m3
(5) Dry solid per desludging(kg)	-	146.0	146.0	25g x 5 x 365 x 5yrs/1000
(6)Desludged dry solid per day(kg/d)	-	671.6	803.0	(3) x (5)
(7) Annual desludged dry solid (kg/yr)	-	245,134	293,095	(6) x 365
(8) Drying bed area (m2)	-	1,634	1,954	(7)/150 kg/m2/year
(9)Per ST bed area per day	-	355	355	(8)/(3)
(10) Required drying bed area per ST	-	9.5	9.5	3.0 m3/0.2 (t=0.2m)
(11) Possible average drying time (day)	-	37	37	(9)/(10)
(12) No. of drying bed (8)/180m2	-	9	11	1basin 6 m x 30 m

Source: JICA Study team

Location of the sludge treatment plant shall be decided by considering the following conditions:

- ✓ At least 500 m away from the producing well of existing water supply system and should be closer to coast line than the well.
- ✓ Lower and closer to the coast than the nearest producing well. This is important especially in Panglao Island since the well is not a deep well (artesian groundwater is not used as a water source).

Following Figure 4.4-16 shows a sample drying bed.

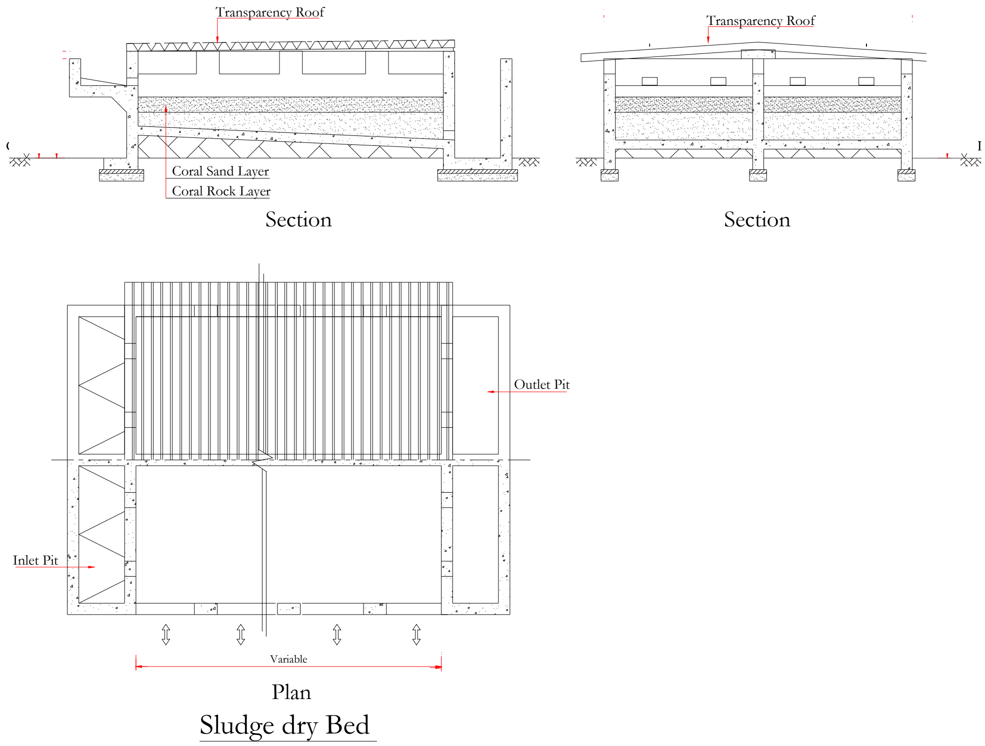


Figure 4.4-16 Typical Sludge Drying Bed

4.5. Project evaluation

4.5.1. Technical Evaluation

The project costs (excluding price escalation), design wastewater flows and number of served populations are summarized below:

City / Municipality	Total Cost incl. O&M cost up to year 2036 (2011 cost) PHP million	Served Population (pop.)	Design flow in daily average (m^3/d)	Unit cost per served population (peso/person)	Unit cost per design flow (peso/ m^3/d)
Tagbilaran	2,934.2	69,578	16,400	42,171	178,915
Dauis	59.1	1,400	202	42,214	292,574
Panglao	362.8	8,684	1,680	41,778	215,952

In comparison between the proposed sewerage system and the on-site treatment system, a household package type waste water treatment plant (HPWWTP) is a competitive system considering its treatment performance. If the HPWWTPs are introduced in the same area of Dauis sewerage service area, 280 HPWWTPs (=1400/5) are required. Assuming the cost of HPWWTP is Peso 300,000, total costs of the on-site treatment system can be estimated as Peso 84 million (=280 x 300,000). Moreover additional costs for periodical desludging should be considered to be included.

Hence, the proposed sewerage project seems to be a more viable project solution from an economical and a technical point of views.

4.5.2. Financial Evaluation

The financial evaluation shows that the project attaining an FIRR at least equal to the interest rate of a loan from a donor, is not possible under the project. Assuming that the government's subsidy equivalent to the annual repayment of the loan is included in the project's cash inflow, even than the total revenues will still be insufficient to cover the recovery of the capital costs.

However, the cash flow analyses conducted for the sewerage projects do show that revenues attributable to the projects can cover the O&M costs. Therefore, if the sewerage systems are granted to the sewerage operation bodies like the city or municipality, they could operate the sewerage systems continuously.

Furthermore, the economical benefits seem to be large considering the tourism benefits and the protection of groundwater resources. Hence, the sewerage project should be executed from an economical and ecological point of view

4.5.3. Environmental Evaluation

Existing on-site wastewater disposal systems could cause groundwater contamination. Moreover, people living in Panglao are in favour of developing a public sewerage system because they are concerned regarding deterioration of the natural environments due to a possible over development of the tourism industry. Therefore, the proposed project can contribute to improve the quality of the existing nature and living environment.

4.5.4. Social Concerns

Land acquisitions for WWTP's and pumping stations are required since all the proposed sites for WWTP and pumping stations are located on private properties.

For Dauis and Panglao, resettlements are not needed at present because no residents are living within the proposed site of the WWTP. For Tagbilaran City, there are some existing households located within the vast swampy area. However, the required land for the WWTP may be able to avoid these existing household areas in the swamp.

The present water tariff in the study area could be raised with the commencement of the sewerage project. For the justification of increase of tariffs, objective information dissemination on the sewerage development and periodical stakeholder meetings should be held from the planning stage onwards.

Chapter 5

Studies for Individual Sewage Treatment Facilities

Table of Contents

Chapter 5 Studies for Individual Sewage Treatment Facilities

5.1. Background and Object of the Study

5.1.1. Background

Centralized sewerage system plans for Tagbiliaran City and Panglao Island (Dauis Municipality and Panglao Municipality) were proposed in Chapter 4. However, as shown in Figure 4.4-1, high-density residential areas, which centralized system is effective are limited to only small part of Panglao Island. Alona beach is one of the most congested areas in Panglao Island. However, the area is heavily occupied with hotels and restaurants up to the seashores, which suggests coordination and negotiation time with the land owners for sewer installation will take a lot of times (refer to Photo 5.1-1). For these reasons, the execution of the feasibility study on centralized sewerage systems in Panglao Island was decided to be premature at the present.

However, appropriate countermeasures for the expected increase of sewage which will be brought by the new airport are necessary to be implemented to mitigate the contamination of water environments in Panglao Island. For this reason, additional studies regarding the individual sewage treatment system (on-site treatment system) including its operation and maintenance method, legal framework and septage management method are conducted in Chapter 5.

Photo 5.1-1 Alona Beach

5.1.2. Aim of the Study

Figure 5.1-1 Panglao Island

The aim of this study is to propose short term countermeasures for domestic wastewater management in Panglao Island (Dauis Municipality and Panglao Municipality), which the new airport will be constructed. Investigation of existing individual sewage treatment facilities, related administrative agencies and private companies, technical and systematic tasks for domestic wastewater management are conducted in this additional survey. A legal system to ensure the appropriate maintenance of sewage treatment facilities in both existing and new facilities are also proposed in this study.

5.2. Related Laws and Guidelines

Philippine laws related to sewage and sanitation is mentioned in Chapter 4.2.2. In this chapter, legal basis and related guidelines of individual sewage treatment facilities and septage treatment facilities are summarized below.

1) Presidential Degree No. 856（1975）, Code on Sanitation of the Philippines

Installation of individual sewage treatment facilities for new buildings is obligated by the Code of Sanitation if there are no public sewage pipes within 100 m of the planned construction site. The acquisition of Sanitation Permit is prescribed for Building Permit. Appropriate toilets and sewage treatment facilities are necessary to apply for the Sanitation Permit.

In addition, a ban on entry of rain water to the Septic Tank (hereinafter mentioned ST), design criteria of ST / leaching tile field facilities, the implementation of at least once a year inspection of ST etc. are stated in the Code. Details are mentioned in Chapter 5.5.1 a).

2) Presidential Degree No. 1096 (1977), The National Building Code

Imhoff Tank or ST must be prepared if wastewater cannot be disposed by public sewage pipes.

3) National Plumbing Code

Standards for ST such as capacity and structure are indicated in Chapter 13 “Building Sewers and Individual Sewage Disposal Systems”. Details are mentioned in Chapter 5.5.1c).

4) Revised Panglao Island Tourism Estate (PITE) Guidelines (2005)

This Guideline (hereinafter mentioned PITE Guideline) was executed by the Province of Bohol in 2000 and revised in 2005. Every tourist and other kinds of establishments in Panglao Island should follow this Guideline. Regulations for wastewater treatment facilities are shown below.

- All facilities should install private STs or other treatment facilities, which are to be more than 25m apart from wells and other water sources.

- Wastewater from kitchen sinks, toilets and bathing facilities should be connected to the ST.
- ST should be 3 chambers type prepared by precast concrete.

5) Operation Manual on the Rules and Regulations Govering Septage Management (2008), Department of Health

This manual (hereinafter mentioned “ST management Manual”) was issued as a guideline of the “Supplemental Implementing Rules and Regulation (IRR) governing the collection, handling, transport and disposal domestic septage (2004)” of the Code of Sanitation of Philippines. This manual shows detailed procedures of implementing septage management programs and gives the basic idea of ST management in Philippines.

5.3. Existing Individual Sewage Treatment Facilities Survey at Major Beaches

5.3.1. Target Facilities and Areas

Following Figure 5.3-1 shows major resort and residential areas of Panglao Island.

Table 5.3-1 shows the total number of existing households and accommodation facilities in Dauis and Panglao municipalities and the sampling number of investigated households and accommodation facilities. A questionnaire survey was conducted to approximately 50 households and accommodation facilities in this study. Accommodation facilities have been categorized into 3 groups; small, middle and large scale depending on the number of guest rooms. Restaurants and Diving Shops are also categorized as accommodation facilities. Until now, many small and middle scale hotels have been constructed, which is not in the list provided by Dauis and Panglao, therefore the actual number of accommodation facilities is larger than shown in Table 5.3-1.

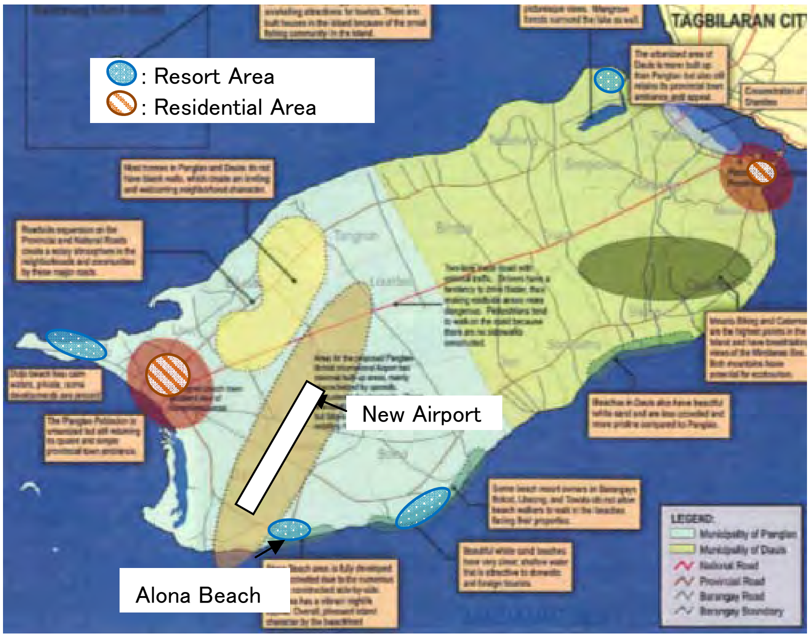


Figure 5.3-1 Present Situation of Target

Table 5.3-1 Total and Sampling Number of Existing Households and Accommodation Facilities in Panglao Island

Category	Dauis		Panglao	
	Total	Investigated	Total	Investigated
Households（2007 NSC）	7,305	10	3,890	10
Sightseeing / Accommodation Facilities*				
Small（under 10 rooms）	3	1	58	10
Medium （11～30 rooms）	4	2	32	10
Large （over 31 rooms）	4	2	9	5

Source: *Dauis; Comprehensive Land Use Plan (2010 data), Panglao; data given MPDC, (2011 Feb data).

5.3.2. Investigation Items and Method

1) Investigated Items

A questionnaire survey for following items was conducted.

- General information (Households: Number of living persons, Hotel: Number of rooms and annual average room occupancy rate etc.)
- Type of water source for drinking water, cooking water and for other purpose such as shower (municipal or private water supply system, water truck, wells, rainwater, etc.)
- Water consumption and its payment (only for water supply system users)
- Drainage conditions (underground discharge, drainage pipe, treatment facility) for rain water and sewage (toilet, kitchen sewage and others)
- Type of toilet (flush type or not)
- Type of treatment facility （ST, Aqua Privy, Unlined Pit, etc.）
- Size and structure of treatment facility (size, number of chamber, outlet etc.)
- Treatment condition (odor, overflow, clog, etc.)
- O&M status of the treatment facility (desludging frequency, cost, etc.)

2) Study Method

The survey was conducted by visual inspections and interviews with the residents and hotel managers/owners or a person who in charge to the maintenance of the treatment facility.

3) Study Area

The questionnaire survey was carried out in the areas shows below.

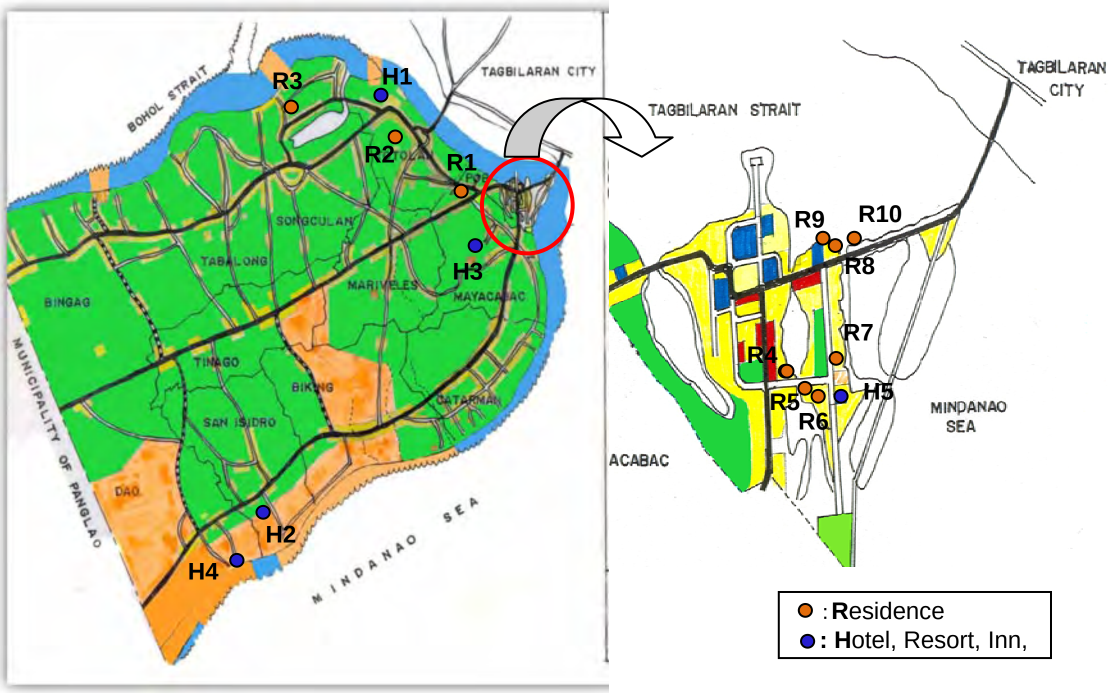


Figure 5.3-2 Location of Surveyed Hotels and Households in Dauis Municipality

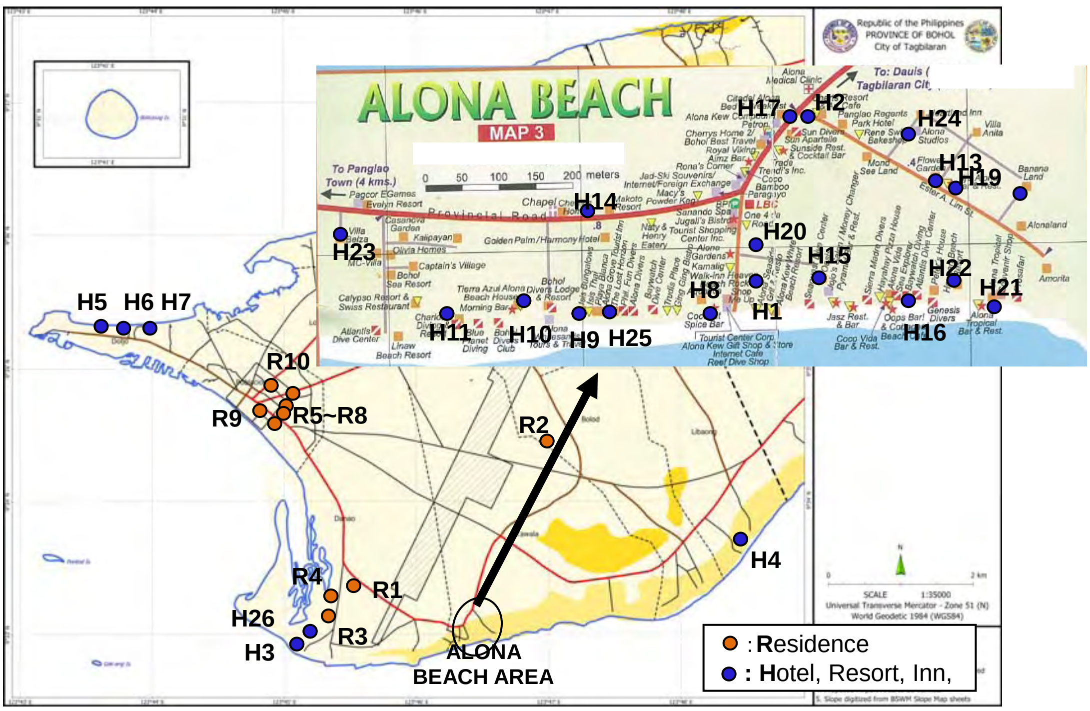


Figure 5.3-3 Location of Surveyed Hotels and Households in Panglao Municipality

5.3.3. Study Results

1) <u>Categorization of Individual Treatment Facilities</u>

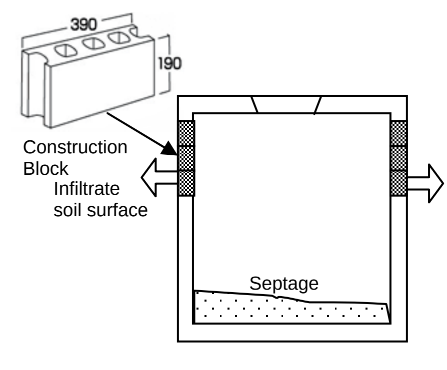
The individual sewage treatment facilities installed in the study area are as shown below.

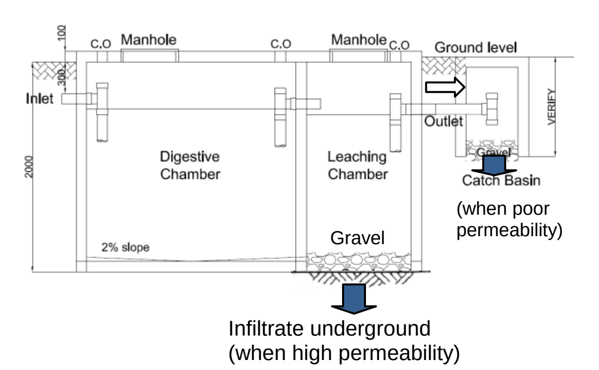
a) Septic Tank (ST)

ST is a watertight sedimentation tank installed underground. Sewage is collected thorough drainage and treated in the sedimentation tank. A layer of scum is formed on the water surface, and sludge is accumulated in the bottom of the tank. One to three chambers STs are mainly installed in Dauis and Panglao municipalities.

One chamber STs are mainly installed in the houses which were built around 10-20 years ago. There is no outlet, the upper part of the tank is made by construction blocks with holes, and the effluent of ST seep to the soil near the ground surface (Figure 5.3-4 left). No infiltration facilities are installed to infiltrate ST effluents to the ground. Normally, ST should be a watertight tank. However, the bottom of ST is often faced to the rock limestone thus generally the bottom is not sealed with cement, especially in Panglao municipality. Therefore, one chamber ST was categorized as “Unlined Pit” in this study.

On the other hand, relatively new houses mainly installed the ST, which has more than 2 chambers and the bottom of the final chamber is unlined gravels layer functioning as an infiltration tank. If the bottom of the tank has poor permeability with rocks, a catch basin is generally installed together with the ST and the effluent will seep underground through the catch basin to the surface-soil as shown in Figure 5.3-4 right. However, the catch basin was not able to see from the outside because usually it has no manhole.





Old Type, One chamber ST	Two chambers ST

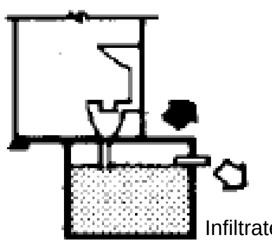
Figure 5.3-4 Typical Drawing of Existing ST

b) Lined Pit (Aqua Privy)

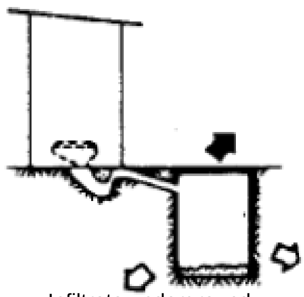
The lined Pit is a watertight sedimentation tank installed underground the wastewater from toilet and bath room is discharged through outlet pipe (refer to Figure 5.3-5, left). Generally, discharge of wastewater from kitchen sinks is not connected to the lined pits. Lined pits are commonly used in households in Barangy Poblacion in Dauis, near the seashore where the soil has high permeability. The line pit is defined as a watertight sedimentation sank but the case in Dauis, the bottom of the tank is not sealed the cement because it is faced to line rock strata. Therefore, a single tank with outlet pipe is categorized as “Lined Pit” in this study. The septage accumulated in the bottom of the tank requires periodic removal, but in the present circumstances, the solids are flushed out with adequate water to the sea through the outlet when the tank is clogged.

c) Unlined Pit

The unlined pit is an infiltration type pit usually installed underneath of outside toilets, kitchens, bath room or at the side of the building (Figure 5.3-5, right). In the rainy season, the tank may get full and desludging is required because the permeability of the soil will drop especially in cases which the gray water is connected the pit.



Lined Pit



Unlined Pit

Figure 5.3-5 Images of Lined Pit and Unlined Pit

2) <u>Sewage Treatment Situation</u>

In this study, wastewater is categorized to 3 groups; from toilets, kitchen sinks and bath rooms, and the treatment method of each wastewater was interviewed in the questionnaire survey. The results are shown below.

a) Dauis Municipality

➢ Households

The results show that human excreta from households seep underground after treated by STs, lined pits or unlined pits. In some households near the ocean or lagoon, ST effluents discharged to the public waters by outlet pipe (Photo 5.3-1 Household No.7). Average ST capacity was 22 m^3, fairly large compared to the standard capacity of ST for 5 persons (3 m^3).

Generally, 2 chambers type ST is installed in newer households (Household No.1, No.4). Especially, due to the Municipal Ordinance in 2002, the installation of ST with more than 2 chambers is necessary for Building Permit. On the other hand, households older than 10 years generally install unlined pits or lined pits underneath or at the side of the house (Household No.2, No.5). In the households located near the ocean or lagoon, effluents of STs or lined pits discharged into the public waters thorough the outlets (Household No.8, No.9).

Various treatment methods are used for grey water. For example, in the new Household No.1, grey water is connected to the 2^{nd} chamber of the ST. In the town house which is under construction, they have STs in each house but the kitchen sink is separately from STs and collected to one collection tank by drain pipe. These systems seem to be adopted since grey water, especially the kitchen wastewater can easily cause clogging of ST because it includes oil and grease. In older households, wastewater from kitchen sinks generally discharged directly to the soil surface without treatment. Meanwhile, for wastewater from bath rooms, there are both cases that connected to STs/pits or discharged directly to the soil surface.

The results of wastewater treatment methods and overview of structure of individual sewage treatment facilities in interviewed 10 households are shown in Table 5.3-2.

Table 5.3-2 Results of Questionnaire Survey of Individual Treatment Facilities in Dauis (Households)

No.	Barangy	Constru-ction Year	Monthly Income (Peso)	Wastewater Disposal			Structure of Treatment Facility				Desludging Frequency	Remarks
				Toilet	Kitchen Waste	Others	No. of chamber	Unit No.	Outlet	Tank size in total (m^3)		
1	Poblacion	2011	90,000	ST	2nd chamber of the ST	2nd chamber of the ST	2	1	No	6.6	None	
2	Totolan	2003	38,000	ST	Seep to underground	ST	1	1	No	32.1	None	
3	Totolan	2001	Retired Japanese house	ST	Seep to underground	ST	2	1	No	18.9	None	
4	Poblacion	2011	50,000	ST	ST	ST	2	1	Yes	16.6	None	No manhole.
5	Poblacion	2000	30,000	Unlined Pit	Unlined Pit	Unlined Pit	1	3	No	10.0	One a year for kitchen waste pit	Two unlined pits were newly constructed in 2004 and 2002.
6	Poblacion	2000	40,000	ST	Seep to underground	ST	2	2	No	49.0	None	Construct new ST. Overflow of first ST flows into nes 2nd ST.
7	Poblacion	1973	50,000	ST	ST	ST	1	1	Yes	21.1	More than 10 years ago	ST is built under building. No manhole.
8	Poblacion	Renovated in 1999	Less than 10,000	Aqua Privy	Seep to underground	Aqua Privy	1	1	Yes	9.0	None	Use many water when the blockage occurred.
9	Poblacion	1998	10,000	Aqua Privy	Seep to underground	Seep to underground	1	1	Yes	8.0	None	
10	Poblacion	2007	90,000	ST	Seep to underground→Sea	Seep to underground →Sea	1	1	Yes	32.4	None	Half of the ST is under building.

Household No. 7. Outlet from the ST

Household No. 6. 2 chamber ST

Household No. 5. Unlined pit

Household No. 10.Lined pit under toilet and washing room

Photo 5.3-1 Individual Treatment Facilities in Dauis (Households)

➢ Tourist Accommodation Facilities

Tourist accommodation facilities install individual sewage treatment facilities, and all except one (1) resort (Flushing Meadows Resort) uses STs to treat human excreta and grey water. For Flushing Meadows Resort, refer to Chapter 5.4.3 (2).

All investigated accommodation facilities has STs with 3 or more chambers, and wastewater including bath room and kitchen wastewater is connected to the STs. Effluents of STs seep underground via the final chamber (refer to Figure 5.3-4).

The STs capacity were evaluated by calculating the required tank volume using following formula.

Required tank volume (V)＝Number of rooms × 2 persons/room × Wastewater flow per person (Q) × Retention time (T) Where, Q[1]: 0.2 (m^3/day/person) in hotels without restaurant, 0.22(m^3/day/person) in hotels with restaurant, T: 3days

[1] Source : According to Code of Sanitation, wastewater per person is 50 gallons（approx.190L/day）, kitchen wastewater for accommodation providing 3 meals a day is 7-10 gallons（26～38L/person/day）

The result is in Table 5.3-3. With the exception of large scale hotel No.3, all accommodations nearly fulfilled the required tank volume. There was no odor on the whole, and maintenance situation seems to be good. Hotel No.3 is a famous large hotel which stands on Mountain in Barangay Mayacalbac. All the wastewater of the hotel is connected to 1 (one) ST, and unlike other accommodations, effluent of the ST is discharged to privately-owned pond at the foot of the mountain through a long outlet pipe. Access to the pond was not easy so that we could not conduct the field survey to the pond (Photo 5.3-1 right).

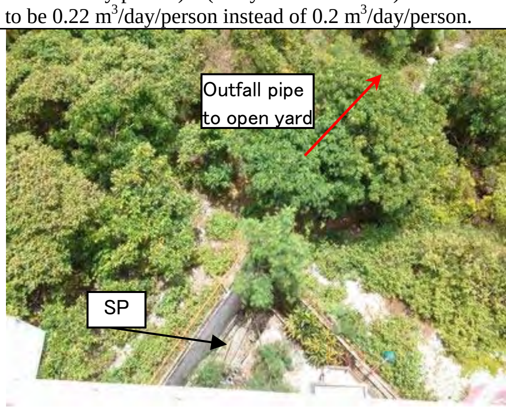
The results of questionnaire survey are shown below.

Table 5.3-3 Results of Questionnaire Survey of Individual Treatment Facilities in Dauis (Tourist Accommodations Facilities)

No.	Name of hotel	Barangy	Const-ruction Year	Room rate per night (Peso)	No. of rooms	Occupacy rate in High season	Structure of Treatment Facility					Riquired tank volume* (m^3)	Maintenance		Remarks
							Type	No. of chamber	No. of ST	Outlet	Tank size in total (m^3)		Desludging Frequency/ reason	Last desludging	
1	Ladaga Inn & Restaurant	Totolan	2005	<1,000	28	25%	ST	4	1	No	28.2	33.6	Tank full	Jan.2011	
2	French Kiss	San Isdro	2010	2,500	4	89%	ST	3	1	No	28	4.8	None	-	
3	Bohol Plaza	Mayacalbac	1999	1,200<	94	90%	ST	3	1	Yes	56.7	124.08	None	-	ST effluent is dicahrged into own open yard
4	Bohol Bee Farm	Dao	2002	3,000-8,000	40	80%	ST	3	3	No	148.4	52.8	Tank full	2011	
5	Coco Grove	Poblacion	2005	1,000	13	90%	ST	3	1	No	13.7	15.6	None	-	

*Required tank volume was calculated by:
(**No. of rooms**) x (**2** persons/room) x (**0.2 or 0.22** wastewater volume m^3/day/person) x (**3** days retention time).
If the hotel has the restaurant, wastewater volume was assumed to be 0.22 m^3/day/person instead of 0.2 m^3/day/person.

Hotel No.4. 3 chambers ST



Hotel No.3. 3 chambers ST outlet pipe to open yard

Photo 5.3-2 Individual Treatment Facilities in Dauis (Tourist Accommodations Facilities)

b) Panglao Municipality

➢ Households

All surveyed household treats human excreta by STs or unlined pits. Households older than 10 years generally installed unlined pit (Table 5.3-4 Household No.1～5). There are some cases that have toilets / bath room in outside the main building and in these cases unlined pits are installed underneath the toilet / bath room (Photo 5.3-3 Household No.1).

On the other hand, recently constructed households have STs with 2 or 3 chambers (Household No.6～8). However, like in Household No.9, some households built in 2010 do not have STs despite the recommendation from Building Office to have 3 chambers ST.

Table 5.3-4 Results of Questionnaire Survey of Individual Treatment Facilities in Dauis (Households)

No.	Barangy	Constru-ction Year	Monthly Income (Peso)	Wastewater Disposal			Structure of Treatment Facility				Desludging Frequency	Remarks
				Toilet	Kitchen Waste	Others	No. of chamber	Unit No.	Outlet pipe	Tank size in total (m^3)		
1	Danao	1997	10,001–20,000	ST/Unline pit	ST	Seep to underground	1	ST: 1 Pit: 1	No	20	None	Unline pit for outside toilet
2	Tawala	1980	Less than 10,000	Unlined Pit	Seep to underground	Seep to underground	1	1	No	3	None	Unline pit for outside toilet
3	Danao	1993	Less than 10,000	Unlined Pit	Seep to underground	Unlined Pit	1	1	No	12	None	
4	Danao	1992	Less than 10,000	Unlined Pit	Seep to underground	Seep to underground	1	2	No	18	None	Unline pit was renovated in 2006
5	Poblacion	1980	30,001–40,000	Unlined Pit	Unlined Pit	Unlined Pit	1	2	No	43	None	Unline pit for kitchen waste was renovated in 2007
6	Poblacion	2009	50,001–60,000	ST	ST	ST	3	1	No	30	None	
7	Poblacion	2006	30,001–40,000	ST	ST	ST	3	1	No	41	None	
8	Poblacion	2010	Less than 10,000	ST	ST	ST	2	1	No	36	None	Top of the ST was 95cm above the ground level
9	Poblacion	2010	10,001–20,000	Unlined Pit	Seep to underground	Seep to underground	1	1	No	9	None	
10	Poblacion	2005	10,001–20,000	Unlined Pit	Seep to underground	Seep to underground	1	1	No	6	None	Renovated in 2008


Household No.1 constructed in 1997. Unlined Pit


Household No.1 Unlined pit for outside toilet


Household No.2 constructed in 2010. 2 chambers ST


Household No.10. Washig waste discharged to soil surface

Photo 5.3-3 Individual Treatment Facilities in Panglao (Households)

- **Tourist Accommodation Facilities**

Tourist accommodation facilities of Panglao Island are obligated to install STs with 3 or more chambers since 2000 by PITE Guidelines (Refer to Chapter 5.2 d). Of the 26 hotels investigated, all hotels had at least one ST with 3 or more chambers. The case of resort facilities and lodges, STs were generally installed by every building, therefore 1 hotel has more than 1 STs and some of them were 2 chamber STs or unlined pits (Hotel No.6, 9, 13, 15, 24, 26).

The outflow of ST is seeped underground from the bottom of the final chamber or from the outlet though the catch basin as with households (Refer to Figure 5.3-4). The required capacities of STs in investigated hotels were calculated with the same method in the case in Dauis. The results show that all the investigated hotels nearly fulfilled the required capacities of the tank. However, overflow of ST from the air outlet at the upper part of the tank was observed in one of the ST in Hotel No.3. In this ST, a kitchen sink of the restaurant was connected as well as toilets. It was expected that inflow of gray water was temporally exceed the infiltration capacity of leaching chamber (final chamber) cause the overflow. As shown in this case, even if the tank capacity is sufficient as a whole, it is necessary to take into consideration that the capacity of the final chamber may not be sufficient especially when it has been connected to grey water discharges.

Table 5.3-5 Individual Treatment Facilities in Panglao (Tourist Accommodations)

No.	Name of hotel	Barangy	Const-ruction Year	Room rate per night (Peso)	No. of rooms	Occupacy rate in High season	Structure of Treatment Facility					Riquired tank volume* (m^3)	Maintenance		Remarks
							Type	No. of chamber	No. of ST	Outlet	Tank size in total (m^3)		Desludging Frequency/ reason	Last desludging	
1	Ladaga Inn & Restaurant	Totolan	2005	<1,000	28	25%	ST	4	1	No	28.2	33.6	Tank full	Jan.2011	
2	French Kiss	San Isdro	2010	2,500	4	89%	ST	3	1	No	28	4.8	None	–	
3	Bohol Plaza	Mayacalbac	1999	1,200<	94	90%	ST	3	1	Yes	56.7	124.08	None	–	ST effluent is dicahrged into own open yard
4	Bohol Bee Farm	Dao	2002	3,000–8,000	40	80%	ST	3	3	No	148.4	52.8	Tank full	2011	
5	Coco Grove	Poblacion	2005	1,000	13	90%	ST	3	1	No	13.7	15.6	None	–	
1	Alona Kew White Bea	Tawala	2010	4,100–15,600	63	100%	ST	4	2	No	80	83.16	None	–	
2	Charts Resort & Art	Tawala	2008	4000<	9	60%	ST	3	2	No	40	10.8	Every 6 month	Oct. 2011	
3	Linaw Beach Resort	Danao	2008	3,400–5,800	14	50%	ST	3	3	No	56.4	18.48	Tank full	Don't remember	Overflow was observed
4	Amarela	Libang	2006	5,800–20,000	25	43%	ST	3	2	Yes	32	33	None	–	ST effluent be treated by Reed Bed System*
5	Sea Corals Hotel	Doljo	1998?	1,000<	17	90%	ST	3	2	Yes	64	22.44	Tank full	2001	
6	Muro Ami Seaside Inn	Doljo	2007	900–2,500	16	50%	ST/Pit	1 or 3	3ST: 3 Pit: 2	No	64.1	21.12	Every 7month	Dec. 2011	Using unlined pit for toilet
7	Ananyana Beach Rsc	Doljo	2000	7,600<	12	80%	ST	3	2	No	62.5	15.84	Tank full	Feb. 2011	
8	Aquatica	Tawala	1992	1,000	16	55%	ST	2	3	No	51.7	21.12	Every 1 years	Mar. 2012	
9	ISIS Bangalows	Danao	2005	2,000–3,000	12	80%	ST	1 or 3	3ST: 1 1ST: 3	No	69.1	15.84	Every 2 month	Apr. 2012	
10	Tierra Azul	Danao	1998	1,500	11	60%	ST	3	1	No	13.9	13.2	Tank full	Feb. 2011	
11	Alona Charlotte Resc	Danao	2002	2500<	6	80%	ST	3	1	No	19	7.2	Tank full	Aug. 2011	
12	Bananaland Cotages	Tawala	1992	1500	4	10%	ST	3	2	No	52.8	4.8	None	–	ST was renovated. Cost P150,00 per unit.
13	Flower Garden	Tawala	1997	1,600–1,900	6	90%	ST/Pit	1,2 or 3	3ST: 3 2ST: 1 Pit: 1	No	51.4	7.2	Tank full	Jan. 2012	ST in each room. 1 unlined pit for toilet
14	Cherry Home 1	Tawala	2006	1000	6	80%	ST	3	1	No	26.4	7.2	Tank full	2012	
15	Oasis Resort	Tawala	1998	3300<	22	Unknown	ST	2 or 3	3ST: 8 2ST: 8	No	309.8	29.04	Tank full, Twice a month	Apr. 2012	Desludge by their own, dump into cave
16	Genesis Divers	Tawala	2006	1000	4	80%	ST	3	1	No	39	5.28	Tank full	Feb. 2011	
17	Citadel Alona Inn	Tawala	2005	750–2,400	12	80%	ST	3	1	No	33.5	14.4	Every 2 years	Jan. 2011	has Self-cook kitchen
18	Evelyn Resort	Danao	2007	1,000–1,400	6	30%	ST	3	2	No	20.7	7.2	None	–	
19	Jas'z Bar & Restaura	Tawala	2007	1,500	4	50%	ST	3	2	No	32	5.28	Tank full	2010	
20	One 4 the Road	Tawala	2008	800	4	60%	ST	3	3	No	63	5.28	None	–	
21	Alona Tropical Beach	Tawala	2007	2,980	62	70%	ST	3 or 6	6ST: 2 3ST: 2	No	239	81.84	Tank full	Nov. 2011	
22	Hennan Resort	Tawa;a	1999	12,320	12	50%	ST	3 or 4	4ST: 4 3ST: 1	No	444.9	15.84	Tank full	Mar. 2009	
23	Vila Belza Resort	Danao	2008	1,000	9	80%	ST	3	1	Yes	96.2	11.88	Tank full	Feb. 2012	
24	Alona Studio	Tawala	2005		38	80%	ST/Pit	1 or 3	3ST: 3 Pit: 1	No	71.2	45.6	Tank full	Apr, 2012	Pit for kitchen waste
25	Lost Horizon Hotel	Danao	1998	2,695	30	85%	ST	3	5	No	175	39.6	Tank full	Sep. 2011	
26	Bita-ug Beach Resor	Danao	2005	1,800	7	70%	ST/Pit	1 or 3	3ST: 2 Pit: 1	No	17.8	9.24	None	–	Unline pit for shower

* A reed beds system is essentially a channel, lined with an impermeable membrane, which is filled with gravel and planted with macrophytes and used to treat wastewater. Refer to Appendix 5.2 for more information.

Hotels No.11 1chamber ST

Hotels No.26 3 chamber ST

Hotels No.4 Reed bed system

Hotels No.4 Effluent of Reed bed system

Photo 5.3-4 Individual Treatment Facilities in Dauis (Accommodations)

3) <u>Maintenance Situation of STs</u>

a) Households

Generally, desludging[2] of STs is not conducted in households. According to the questionnaire survey results, 2 out of 10 households in Dauis municipality and 0 out of 10 households in Panglao municipality answered that they have an experience of desludging in the past. The results suggest that the most of STs and unlined pits do not cause problems such as clogging for many years because the liquid portion of the wastewater is seeped underground by infiltration; the kitchen sink is not usually connected to the STs; and the volume of the tank is very large. Furthermore, it is common to construct a new unlined pit when the old one becomes full.

According to the survey results, the average volume of the 2 or 3 chamber STs built within 10 years is 22 m^3 for Dauis and 35 m^3 for Panglao municipality. If the septage amount is assumed to be 40 L/person/year[3], it will takes a quite long period to reach to the theoretical desludging point; approximately one-third full of tank volume. However, in the reality, maintenance such as periodical desludging of STs is necessary to maintain the treatment

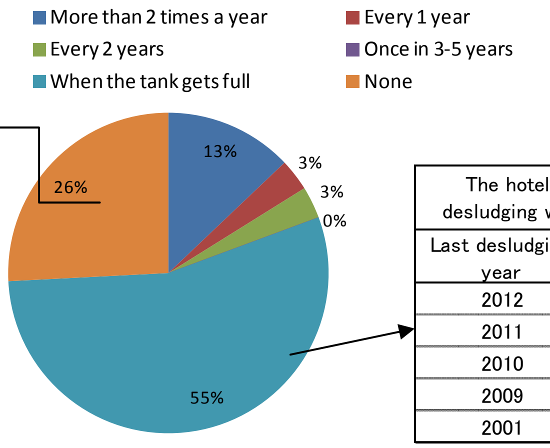
2 Desludging: the process of cleaning or removing the accumulated septage or septage from a septic tank or wastewater treatment facility
3 Reference：Sewage Treatment in Hot Climate, Duncan Mara

function. Especially if oil and grease are discharged to STs, it forms scum and may cause clogging or some other problems.

b) Tourist Accommodation Facilities

Figure 5.3-6 shows the results of questionnaire survey of the investigated 31 facilities (5 in Dauis, 26 in Panglao) regarding desludging frequency of STs.

The hotels have no experience of ST desludging	
Construction year	No. of Hotels
2010	2
2008	1
2007	1
2006	1
2005	2
1999	1



The hotels conduct ST desludging when it gets full	
Last desludging year	No. of Hotels
2012	4
2011	10
2010	1
2009	1
2001	1

Figure 5.3-6 Desludging Frequency of Tourist Accommodation Facilities

Twenty six percent hotels (8 hotels) answered that they have no experience of desludging and 55% or 17 hotels answered that they conduct desludging when the tank gets full. The rest of 19% or 6 hotels answered that they conduct desludging periodically for the maintenance purpose. The results suggest that most of tourist accommodations facilities conduct desludging of STs frequently. This was notable especially for facilities which have a number of STs or have diving shops and/or restaurants.

All accommodations facilities ask the private companies of Tagbilaran city (mainly ANORA, refer to Chapter 5.4) for desludging of STs except Hotel No.15 in Panglao. According to the interview, Hotel No.15 removes the septage by their own every 2 weeks and disposes to a nearby cave. In this case, the pollution of the environment caused by the illegal dumping is a concern.

On the other hand, 26% or 8 hotels answered that they have no experience of desludging are all constructed in the period 2005-2010 except one Hotel No.3 in Dauis built in 1999. The No. 3 hotel is a unique facility which has its own drainage pipe to discharge ST effluents to the pond shown in Photo 5.3-2.

For details of the desludging status of each interviewed tourist accommodation facilities, refer to Table 5.3-3, Table 5.3-5 and Appendix 5.1.

5.3.4. Evaluation for Existing Individual Treatment Facilities

In households, wastewater treatment situations are improving. Treatment methods are shifting from treating only human excreta using unlined pits to treating all wastewater including grey water by 2 or 3 chambers STs. However, unlined pits are sill commonly used wastewater treatment method in Panglao Island. Therefore, it is hard to say that the wastewater has been treated properly as a whole.

In this study, the data of the well and tap water quality tested by Bohol Province Health Office (PHO) since 2000 up to date in Panglao municipality was collected and organized. As a result, fecal coliforms have been detected from all the dug wells samples of the whole area and it have been frequently detected from the samples of deep wells and Level 3 water supply since 2000. The depths of the wells of Panglao municipal waterworks are 9~21m for dug wells, approximately 21~31m for deep wells which are considered shallow (wells cannot be dug deep since sea water will be mixed at Panglao Island). For this reason, the water source tends to be easily affected by household and livestock wastewater discharges. Even if the domestic wastewater treatment situation is improved in the near future, underground water of Panglao Island cannot be recommended as drinking water source, because it is considered to react severely to the condition change of the ground surface. Therefore, the water supply system in Panglao Island is expected be supplied from Bohol main island. Currently, many households purchase bottled water for drinking and owing to this, threats of water related infectious diseases are scarcely reported.

For tourist accommodation facilities, human excreta and grey water are generally connected to 3 chambers STs with sufficient capacities. According to the standard (refer to Figure 5.5-1) the bottom of the final chamber of ST contains filtration layer consisted of gravel, sand and charcoal, but the actual condition is only gravel is used so that secondary treatment in the final chamber cannot be expected. Although the water quality of ST effluents have not been confirmed by water quality testing, since grey water is also connected to STs and the wastewater quantity is larger than households, sufficient treatment with STs cannot be expected.

Recently, establishments or commercial facilities are increasing rapidly as shown in Table 5.3-6. To maintain the high quality of ocean environment which is essential for tourism, it shall be necessary to obligate the increasing commercial facilities to install high-grade wastewater treatment facilities.

Table 5.3-6 Building Permission Records of Households and Commercial Facilities in Panglao Island

Year	Residence		Establishment	
	Yearly No.	cumulative No.	Yearly No.	Cumulative No.
2004	80	4,200	32	32
2005	90	4,290	80	112
2006	84	4,374	45	157
2007	107	4,481	52	209
2008	137	4,618	64	273
2009	88	4,706	76	349
2010	109	4,815	76	425
2011	111	4,926	110	535

Source: Pangloa building office
*1：Refer to No. of total household in 2007 NSO
*2：No. of total establishment in 2009 is 260 according to Comprehensive Land Use Plan, 2011-2020 in Panglao municipality

5.4. Consideration of Maintenance and Management Methods of Individual Wastewater Treatment Facilities

5.4.1. Present Circumstances

1) Administrative Agencies

a) Municipal Engineer / Building Office (MBO)

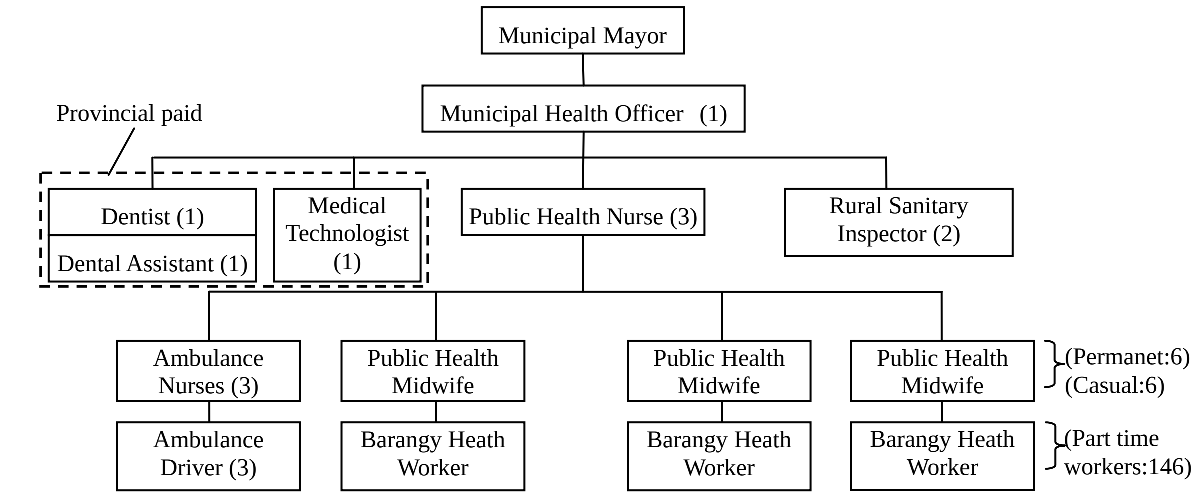
In both Dauis and Panglao municipalities, it is necessary to apply for the Building Permit to MBO before constructing new buildings. The obligation of installing 3 chambers ST for tourist facilities and guidance of installing ST with 2 or more chambers for households are made by MBO when the application is made. For tourist facilities, Sanitary Permit issued by Municipal Health Office is required prior to Building Permit and it will not be given if 3 chambers ST is not installed based on the PITE Guideline. In the case of households in Dauis municipality, installation of STs with 2 or more chambers is necessary since 2002 for Build Permit. Also, when the construction is completed, MBO conduct the Final Inspection. After the construction is approved in the Final Inspection, the lid of ST will be placed. However, in Panglao municipality, the Final Inspection is conducted only for establishments and not for the households.

Tow permanent engineers and 8 casual staffs work at Dauis MBO. For MBO of Panglao, 1 permanent engineer staff, 1 draftsman from Provincial office and 6 casual staffs are working.

b) Municipal Health Office (MHO)

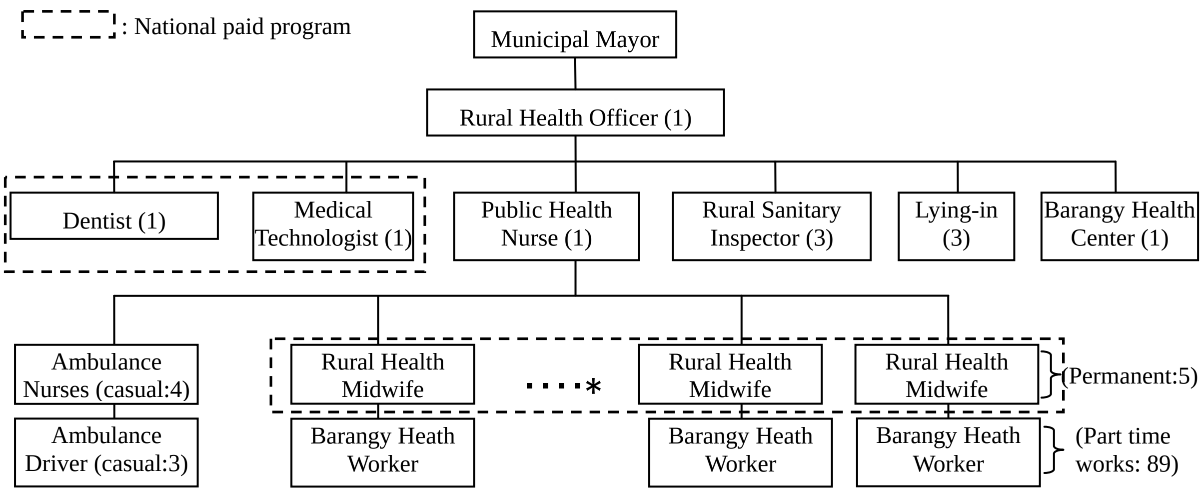
The sanitary facilities including STs fall under the control of MHO in both Dauis and Panglao municipalities. To construct establishments in both Dauis and Panglao, it is regulated by law to acquire Sanitary Permit before applying for Building Permit. Sanitary

Permit is issued by the Sanitation Inspector, after the installation of appropriate wastewater treatment facilities (3 chambers ST) are confirmed. However, the operation and maintenance of ST is left in charge of the building owner, and further observation by administrative agencies is not performed. But in case a problem occurs and it is reported to the MHO, Barangay Health Workers go to correspond[4]. Below are the organization charts of Dauis and Panglao MHOs (as of the end of April, 2012). The parenthesis ( ) shows the number of employee.



＊Rural Health Midwife (Nurse) and Barangy Health Worker are staffs assigned to each Barangy. Each of the 12 Rural Health Midwife staffs are in charge of the Barangy Health Workers of their office.

Figure 5.4-1 Organization of Rural Health Officers in Dauis (As of April, 2012)



＊Rural Health Midwife (Nurse) and Barangy Health Worker are staffs assigned to each Barangy. Each of the 5 Rural Health Midwifes is in charge of the Barangy Health Workers of their office.

Figure 5.4-2 Organization of Rural Health Officers in Panglao (As of April, 2012)

[4] Source: Rural-Sanitary Inspector (RSI) of Dauis Municipal Health Office, Rural-Sanitary Inspector (RSI) of Panglao Municipal Health Office, Interview with Mr. ABELIO A. Ambilo.

2) Private Desludging Companies

There are 2 registered companies (ANORA Septic Tank Service and RHUVIANS's Septic Tank Service) in Tagbilaran city who provide desludgnig service in whole area of Bohol including Panglao Island. The summary of interviews is shown in Table 5.4-1.

ANORA was the first company to start desludging bussiness in Bohol Island nearly 30 years ago, and provides service throughout the year. ANORA owns private land of 3 ha in Barangy Cabawan. The removed septage is sundried there, and afterwards a portion is used as soil conditioner at their fields of mangos and coconuts.

The other company RHUIVIANS also disposes the removed septage on its private land, but the land area is small and has difficulty in searching the place to dispose the septage. According to the interview to RHUIVIANS, their willing payment for disposal of septage to the septage treatment facility is P300 per 3m^3(1 truck).

Table 5.4-1 shows the summary of the 2 companies.

Table 5.4-1 Summary of Septage Treatment Companies

Company Name	ANORA Septic Tank Service	RHUVIANS's Septic Tank Service
Location	Barangy. Manga	Barangy. Mansasa
Number of Employees	4	3
Price (Peso/3 m^3)	P2300 (inside city) P2200～2500 (outside city)	P3000 (Actual fee varies 2500～2800)
Service Area	All Bohol Province	All Bohol Province
Average Service Frequency per Day	2～3	1～2
Annual Working Days	365	200
Number of Removing Trucks	1 (Capacity：3m^3)	1 (Capacity：3m^3)
Annual Collected Septage Amount(Estimate)	2.5 x 365 x 3 m^3=2,740 m^3	1.5 x 200 x 3 m^3=900 m^3
Septage Treatment Method	Dispose in Private Land	Dispose in Private Land
Land Area for Disposal	3ha (in Barangy Cabawan)	0.2ha (in Lourdes. Cortes)

ANORA Septic Tank Service, Septage disposal land

RHUVIANS's Septic Tank Service, Septage removing truck

Photo 5.4-1 Images of the Septage Removing Companies

3) Institution for Water Quality Analysis

At present, water quality monitoring of wastewater or treated wastewater is not conducted for individual treatment facilities. However, due to the future necessity of conducting water quality inspections to the large scale tourist establishments, Study Team made a research of existing institutions which are able to conduct the water quality analysis in Bohol Province. The results are as follows.

a) Provincial Health Office (PHO)

Provincial Health Office (PHO) performs water quality tests regularly for water sources (Waterworks Level 1, 2, 3) and swimming pools in private hotels. Three biological items are tested; tota coliforms, fecal coliform and Heterotrophic Plate Count (HPC). Sanitation Inspectors of each municipal collect the water samples and hand it to the PHO. Each municipal bears the fee for water quality testing (P70/sample) and the facility owner bears the fee for swimming pool testing (P100/sample).

b) Holy Name University Water Testing Laboratory

This laboratory was established in 2007 by the Bohol Province and Philippine Australia Community Assistance Program, and is the only agency which can provide physicochemical analysis. At present, analysis is done for only tap water, river water and sea water, and none is done for wastewater nor treated wastewater. In the interview, the laboratory said that new equipment will be necessary to implement wastewater analysis.

Table 5.4-2 shows the analysis price list of the laboratory. Items not included in this list (BOD, COD, T-N, T-P, etc.) and samples other than tap water, river water and sea water (municipal effluent etc.) are taken to University of San Carlos in Province of Cebu by ship for analysis.

Table 5.4-2 Price List for Water Quality Analysis

Parameters	Price per sample	Parameters	Price per sample	Parameters	Price per sample
Total Coliforms	300	pH	100	Nitrite-N	500
Fecal Coliform	300	Total Dissolve Solids (TDS)	300	Ammonia-N	500
E.Col	300	Chloride	300	Phosphate	400
Heterotrophic Plate Count	300	Hardness as $CaCO_3$	300	Residual Chlorine	300
		Iron	500	Sulfate	400

5.4.2. Septage Management Manual of Philippines

STs maintenance and management method written in The Philippines Septage Treatment Manual (refer to Chapter 5.2 e) are summarized as shown below.

- Septic Permits:

Application for Septic Permits is obligated to all STs which are to be newly constructed or substantial renovated/repaired. Local health authorities deem the plans to be acceptable and verified that the ST can be installed in accordance with the drawing and site conditions.

- Inspection during the construction of ST:

The Local Government Units (hereinafter mentioned LGUs) are to conduct inspection during the construction of ST by either way; Health Inspectors, building officers, or private sectors.

- Final Inspection after construction

A site visit is also conducted after construction of ST to verify that the drawings submitted match the field condition.

- Preparation of Septage Management Plan:

LGUs are to make Septage Management Plans with supporting ordinance to promote periodical desludging.

- Practice of Periodic Desludging:

The ST owner is responsible to remove the septage when; the solid reaches half of the tank volume or once in 3 to 5 years, either opportunity which comes first.

- Removal and Transportation of Septage:

Septage removal, transportation and disposal are to be performed only by operators approved by ESC[5] and Sanitary Permit.

- Appropriate Treatment and Disposal of Septage

Removed septage must be treated appropriately by operators approved by ESC. For treatment and disposal facilities, the project service provider must secure an Environmental Compliance Certificate (ECC) and Wastewater Discharge Permit (WDP) from EMB regional office.

5.4.3. Proposed Operation and Maintenance Methods for Individual Treatment Facilities

1) Establishment of New Organization for Individual Treatment Facility Management

As mentioned before, administration does not take part into operation and maintenance of individual treatment facilities. Municipal Engineer / Building Office and Health Office are related agencies, but both do not have specialized departments or section for wastewater

[5] Environmental Sanitation Clearance：License of environmental sanitation issued by Center for Health Development(CHD. Acquisition is obligated to all agencies which perform ST septage removal, handling and treatment by IRR governing the collection, handling, transport and disposal domestic septage and septage (2004)

management and are short of staffs. Furthermore, existing private desludging companies are small family-owned companies so that it seems to be difficult to contract them to conduct periodical inspection of STs and other maintenance services. For these reasons, Study Team proposes to establish a new organization to manage the individual treatment facilities of whole Panglao Island; Dauis and Panglao municipalities (ex. Assumed name: Panglao Island Waste Water Management Agency, hereinafter mentioned “PIWWM”). Details are stated later in Chapter 5.8.1.

All the management of individual sewage treatment facilities such as admission related to ST (Sanitary Permit, etc.), supervision during construction, final inspection, periodical inspection during operation, on-site inspection, septage treatment and disposal etc. are assumed to be conducted by the proposed new organization PIWWM. Required capital investments, setting up of organization and capacity development of new staffs etc. shall be implemented by assuming the works of PIWWM. It will be ideal to privatize some functions in the future.

Proposed concrete methods of appropriate management of individual wastewater treatment facilities are shown below.

2) Obligate Supervision Responsibility to Contractor

In Dauis and Panglao municipalities, the owner of newly constructed establishment must submit drawings of ST to MBO and shall be investigated before construction. Furthermore, MBO and MHO conduct the inspection after the construction of STs. But at present, there are some cases which the drawings and actual construction are different, which reveal that administration inspection is insufficient. To solve this problem, Study Team proposes to lay supervision responsibility on contractors, as well as the administration. The construction manager (engineer) shall submit a “Septic tank certificate of completion” with signature to the MBO to certify the ST is properly constructed by following the drawings. This system will clarify the responsibility of installing STs matching drawings submitted to MBO. A sample of certification from is shown in Appendix 5.3.

3) Maintenance by Owner and Observation by PIWWM

Operation and maintenance methods of individual wastewater treatment facilities are proposed in the followings.

a) Households

According to the Septage Management Manual of Philippines, the ST owner is responsible to remove the septage when; the septage volume reaches half of the tank capacity or once in

3～5 years, either opportunity which comes first. As results of the studies, the average capacity of STs installed in the households is 22m^3 in Dauis and 35m^3 in Panglao municipality, and this is sufficient to hold septage more than 5 years. Also it is considered from the current capacity of desludging companies that it is not realistic to obligate all households to remove septage every 5 years.

As an alternative suggestion, mandate the owners of individual treatment facilities (hereinafter mentioned the Owners) to conduct periodic inspection once every 5 years. Proposed inspection items are shown in Table 5.4-3. PIWWM is responsible to conduct an awareness campaign and guide owners how to carry out inspections. Owners may be able to ask PIWWM for conducting inspection upon necessity.

The Owners also takes a duty to report the results of periodic inspection by submitting the prescribed reporting form to PIWWM (refer to Appendix 5.4). The PIWWM is in charge keeping the records and to recommend the Owners which have not done the inspection to ensure thorough implantation of periodic inspection.

Table 5.4-3 Proposal of ST Inspection Items

Items	Correspondence
Septage Accumulation	Guide to remove septage when it exceeds 30% of the tank capacity
Scum Accumulation	Guide to remove the septage when the bottom of the scum mat is within 10cm of the bottom of the inlet device and not to discharge oil to ST.
ST Situations	Upon detection of wastewater leakage or overflow, the piping malfunction, insufficient filtration tank and other causes are to be investigated and the repair to be guided

b) Small and Middle Scale Tourist Accommodations

For small and middle scale (less than 50 rooms) tourist accommodation facilities, obligation of periodic inspection once every year is proposed. In the case of commercial facilities, the application of Business Permit is necessary every year so that the inspection of the individual sewage treatment facility is proposed to be included in require conditions for the application of the Business Permit.

PIWWM is to perform on-site inspection fittingly, and to direct the Owners who do not own sufficient treatment facilities, to repair or renovate the ST. If the improvement by the Owners is not done in a given period, the lapse of Business Permit shall be declared to ensure the appropriate maintenance by the Owners.

c) Large Scale Tourist Accommodations

For large scale (more than 50 rooms) tourist accommodation facilities, obligation of every year periodic inspection and reporting to the PIWWM by the responsibility of the Owner is proposed, same as for small and middle scale facilities. In addition, installation of effluent standard regulation to wastewater treatment facilities and enforcing the Owners to conduct water quality monitoring of treated wastewater at least once every year as well as mandatory to report the monitoring results to PIWWM are proposed. Water quality items to be regulated in the effluent standard are COD, BOD, SS and Total coliforms, and addition of T-N and T-P if necessary. Table 5.4-4 shows the present wastewater regulations of Philippines. For details, refer to Chapter 4.4.2.

Furthermore, on-site inspection shall be conducted by PIWWM as same as small and middle scale facilities, and compliance of effluent standard must be strictly observed.

Table 5.4-4 Wastewater Regulations of DNR

Item	Existing facility	Newly constructed facilities
COD (mg/L)	100	60
BOD (mg/L)	50	30
SS (mg/L)	70	50
Total coliforms (NPM/100mL)	5,000	3,000

5.5. Standards Drawing of Individual Treatment Facilities for Households

5.5.1. Standard of Existing ST Structures

1) Philippines

There is no Philippines Standard drawing of ST at the present, but regulations for ST structure are available. The summaries are as follows.

a) Sanitation Code of Philippines

- Individual wastewater treatment system utilizing leaching fields, leaching beds, or leaching wells shall not be permitted where the depth to normal ground water of rock strata is less than 1.2 m
- No leaching tile field or bed shall be installed where percolation rate is less than 2.54 cm fall in water level in the test holes in 30 minutes.
- No seepage pit of leaching well shall be installed where percolation rate is less than 2.54 cm fall in water level in the test holes in 60 minutes.
- Tank capacity of ST may be determined from the quantities of sewage flow.
- In case of multiple-chamber ST, the first chamber shall have the capacity from one half to two thirds of the total volume of the tank.
- The invert of the inlet pipe shall be at a level not less than 5cm above the invert of the outlet pipe.
- Absorption area of leaching field required for residences shall conform to the following:

Table 5.5-1 Absorption area of leaching field required for residences

Average time required for water to fall 2.54cm is indicated by base required percolation test	Suitability of leaching soil	Square meter of trench bottom of leach bed
1 minute or less	Good	6.5
5 minutes	Good	11.61
10 minutes	Good	15.33
15 minutes	Fair	17.65
30 minutes	Fair	23.22
45 minutes	Poor	27.87
60 minutes	Poor	30.66

Source: Sanitation Code

b) National Plumbing Code

This is the Philippines regulation of plumbing equipment structure. Summary of required ST structure prescribed in the Code is shown below.

Table 5.5-2 Location of Sewage Disposal System

(Unit:m)

Minimum Hor, Clear Distance in Required from:	Septic Tank	Disposal Field	Seepage Pit of Cesspool
Building or structures	**1.5**	**2.4**	**2.4**
Property line adjoining private property	1.5	1.5	2.4
Water supply well	**15.2**	**30.4**	**45.7**
Stream	15.2	15.2	30.4
Large trees	3.0	-	3.0
Seepage pits or cesspools	1.5	1.52	3.7
Disposal field	1.5	1.22	1.5
Domestic water line	1.5	1.52	1.5
Distribution box	-	1.52	1.5

Table 5.5-3 Required Capacity of ST

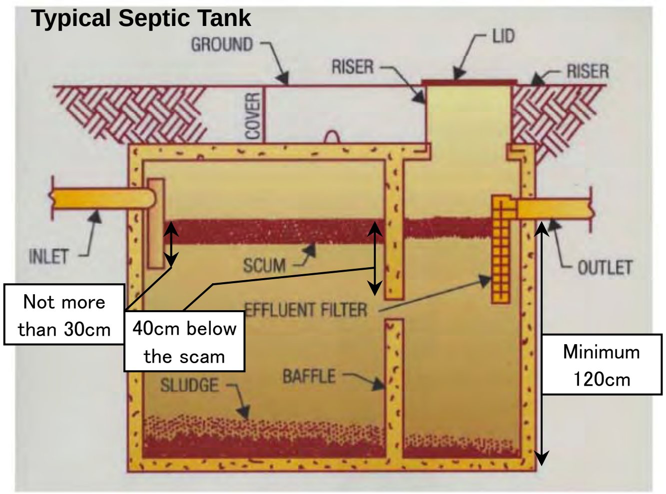
Single Family Dwellings No. of Bedrooms	Multiple Dwelling Units of Apartments (one bedroom each)	Minimum Septic Tank Capacity	
		Gallons	Cubic meters (m^3)
1 or 2		750	2.84
3		1,000	3.79
4	2 units	1,200	4.55
5 or 6	3 units	1,500	5.69
	4 units	2,000	7.58
	5 units	2,250	8.53
	6 units	2,500	9.48
	7 units	2,750	10.42
	8 units	3,000	11.37
	9 units	3,250	12.32
	10 units	3,500	13.27

c) Structure and Valuation of Piping Installation (Plumbing Design and Estimate second edition (2001) by MaxB. Fajardo JR.)

This guide follows the Sanitation Code and National Plumbing Code, and is widely used by Philippine engineers. It mentions about the ST recommended dimension of ST which is not indicated in the National Plumbing Code. The standard regarding ST structure is as shown below.

Table 5.5-4 ST Structure Guideline

- Minimum Size; 3 m^3
- Minimum width; 90 cm
- Minimum length; 150cm
- Minimum depth of the liquid; 120 cm
- The depth should not be deeper than the natural ground water table.
- The inlet and outlet invert shall be long turn sanitary tee.
- The invert shall be extend down the liquid of the tank not more than 30cm
- Provide a manhole, extended a few cm. above the surface of the soil.
- The baffle plate is extended down the bottom of the tank about 40cm below the scam layer.
- Each compartment shall be provided with manhole.
- The septic tank shall be constructed near the subsoil, not more than 150cm below the surface.



Source: Operation Manual on the Rules and Regulations Governing Septage Management (2008), Department of Health

Source :Plumbing Design and Estimate second edition (2001) by MaxB. Fajardo JR.

Table 5.5-5 Suggested Size of Septic Tank (Unit:cm)

No. of Persons served	Residential				Commercial or Industrial				
	1-5	6-10	11-15	16-20	21-30	31-20	41-50	51-75	75-100
Inside with	90	110	120	150	130	150	150	200	200
Inside length plus leaching well	150	200	270	300	210	250	300	330	360
Depth of liquid	120	120	120	120	120	120	130	130	150
Inside clear height of tank	150	150	150	150	150	150	160	180	200
Tank volume (m^3)	**2.0**	**3.3**	**4.9**	**6.8**	**4.1**	**5.6**	**7.2**	**11.9**	**14.4**

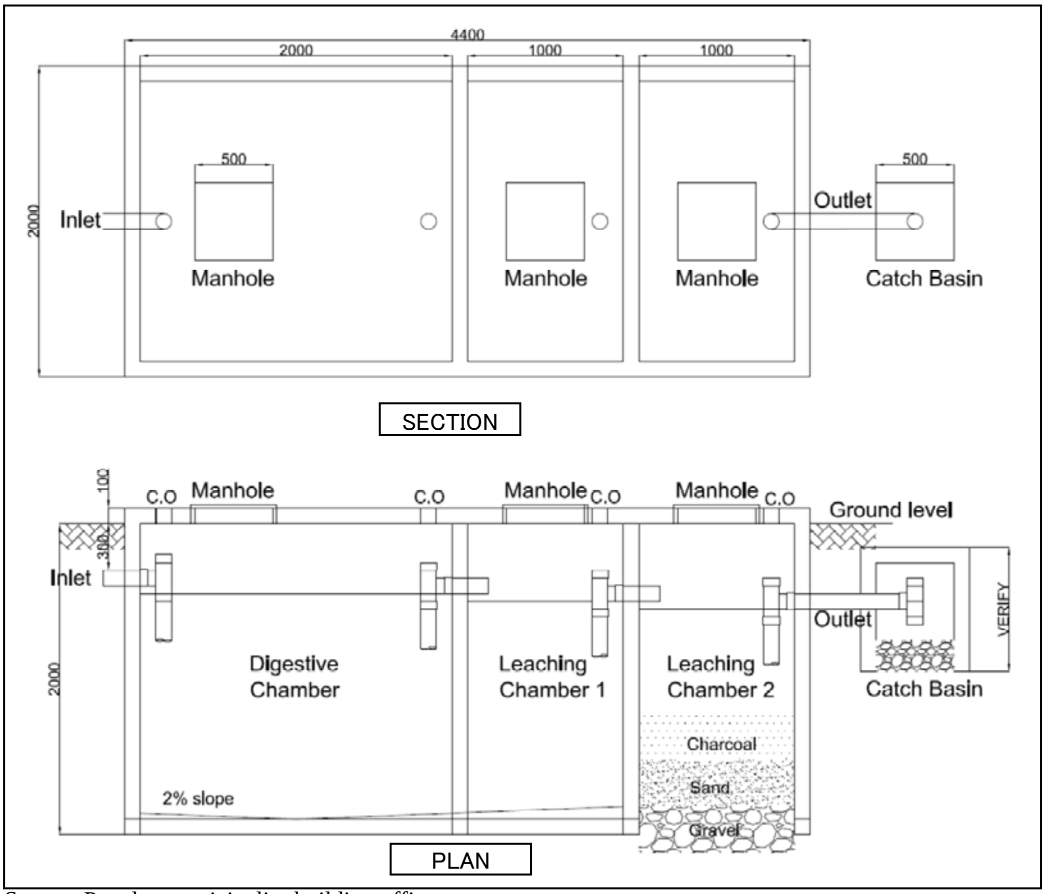
Source:Plumbing Design and Estimate second edition (2001) by MaxB. Fajardo JR.

2) Dauis and Panglao Municipalites

As previously mentioned, installation of 3 chambers ST is obligated for tourist facilities in both Dauis and Panglao municipalities and that of 2 or more chamber ST is obligated for households in Dauis municipality.

Figure 5.5-1 shows the typical drawing of a 3 chambers ST which is recommended in Dauis and Panglao municipalities. The tank depth is normally 2m from the ground surface. However, some STs are half-underground structure; the upper part of the tank is to be above the ground to avoid the bottom of the ST reach to rock strata so that effluent of the ST can seep underground to soil layer. To note, following drawing is not an officially regulated.

- Tank volume (V) :W x L x D = 1.8 m x (2 + 1 + 1) m x 1.8 m= 12.96 m^3



Source: Panglao municipality building office

Figure 5.5-1 Typical Drawing of 3 chamber ST

5.5.2. Present Issue in Standard Drawings of ST

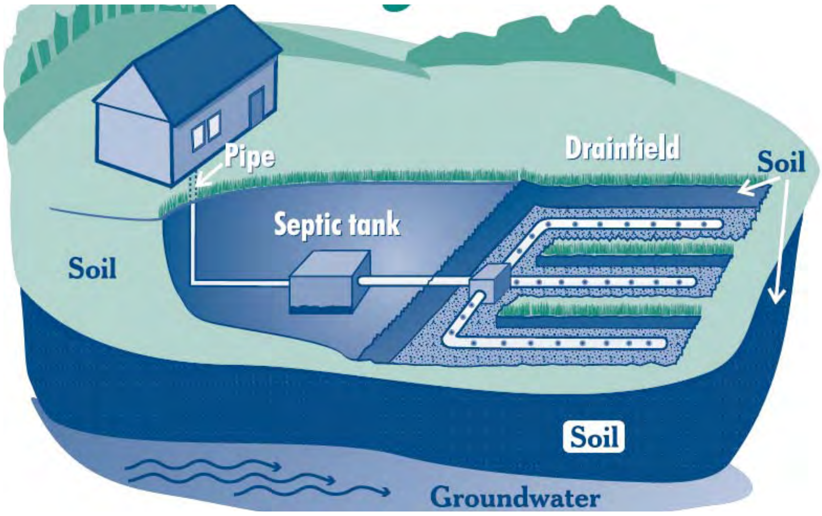
There are national codes regulating the structure of ST, but no standard drawing in Philippines.

As shown in Figure 5.5-1, typical ST recommended in Dauis and Panglao municipalities has large capacity, and the bottom of the final chamber is a filtration tank consists of gravel sank and charcoal. The effects on treatment function caused by a very large tank are not well known. One of references[6] mentions that bacterial activities would be retarded in a very large tank. However, considering current situations in Panglao Island, no particular problems are seemed to be caused by a very large tank.

The problem of the current typical drawings used in Panglao Island is that in an area where the percolation of soil at the bottom of the tank is poor, effluents of ST seep underground through the catch basin from the outlet at the upper part of the ST tank. Therefore, a filtration process of the charcoal, sand, and gravel layer in the final chamber cannot be benefited before seeped underground, and this causes concerns of underground water

[6] Reference：Plumbing Design and Estimate second edition (2001) by MaxB. Fajardo JR.

contamination. In developed country, leaching (drain) field or leaching bed[7] is the most common method of disposal of ST effluent, which is designed to purify ST effluent by the soil and aerobic microorganisms. The soil under leaching fields must be permeable. Currently, a leaching chamber is not used in Panglao Island. An Installation of a leaching field or a leaching bed requires a fair measure of land, construction fee, and the soil must be permeable. Therefore, it may not suit to introduce the same system in Panglao Island. As an alternative, introduction of an up-flow filter type ST is recommended in this study. (Refer to Chapter 5.8.1 for more details)



Source: Onsite Wastewater Treatment Manual published by U.S. Environmental Protection Agency

Figure 5.5-2 Image of Conventional Individual Sewage Treatment System

5.5.3. Proposed Standard Drawing

1) Households

In conformity to municipal ordinance in Dauis, 2 chamber ST is recommended as standard ST. Dimensions of ST shown in Figure 5.5-3 are following the current typical drawing used for the households. The dimensions shall be determined by required volume of ST shown in Table 5.5-3.

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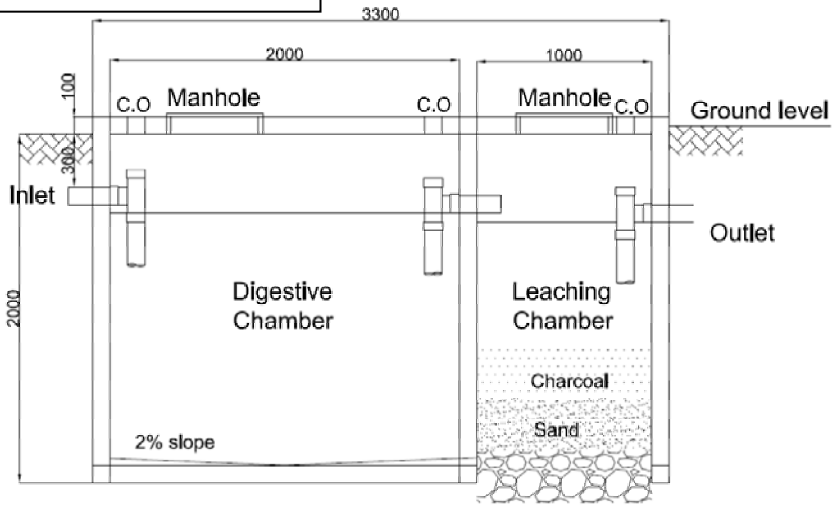
[7] The Philippines Sanitation Code definition regarding Leaching tile field and Leaching bed as below.
Leaching tile field: Trench width 0.45m～0.9ｍ.Leaching bed: Trench width over 0.9ｍ.

A. Case in Permeable Soil layer



B. Case in impermeable rock strata

Recommend to apply up-flow filter type ST (refer to **Figure 5.5-4**)

Figure 5.5-3 Standard Drawing of Two chamber ST for Domestic Households

2) Tourist Accommodations

- Small/Medium-scale Tourism Accommodation Facilities (under 50 rooms)

As shown in Table 5.3-1, 90% of the tourist accommodations are small or medium sized facilities with less than 50 guest rooms. For these accommodations, application of the present 3 chamber ST typical drawing shown in Figure 5.5-1 is proposed to use as a standard drawing. The structure of final chamber consists of gravel, sand, and charcoal in must be strictly follow as shown in the standard drawing.

However, in the area of the rock strata where permeability is poor, Up-flow ST shown below is proposed as a standard. Adoption of Up-flow ST will improve the water quality of ST effluents since the all wastewater will pass through the filtration layer in the final tank. But periodical cleaning of the filtration layer will be essential for Up-flow STs, and appropriate maintenance will be an issue. Therefore, Study Team proposes to first conduct pilot project in some hotels, to establish appropriate structure of Up-slow STs and maintenance method, and to verify its effectiveness. (Refer to Chapter 5.8.1 support 2 for the details)

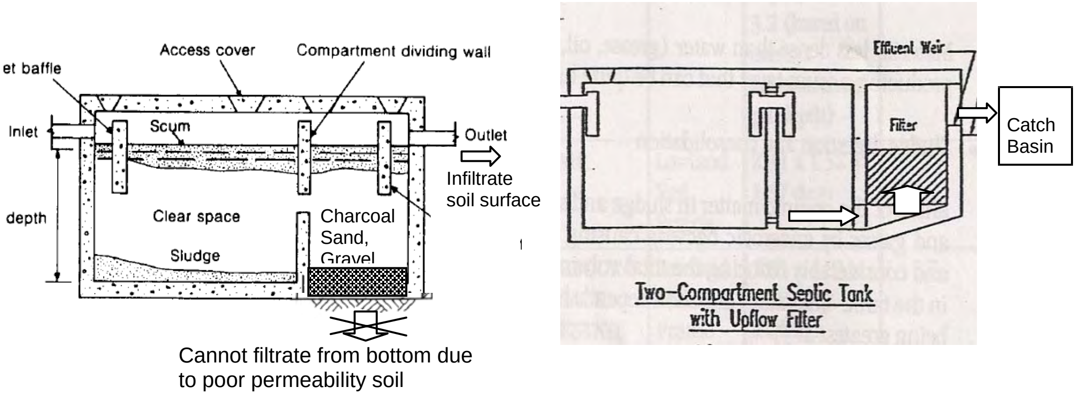


Figure 5.5-4 Cross Section of conventional ST and Up-flow filter ST

- Large-scale Tourism Accommodation Facilities (over 50 rooms)

Treatment of large quantity of grey water (kitchen and bath wastewater) cannot be expected with ST. For this reason, it is proposed to obligate large-scale tourist accommodations facilities (with over 50 rooms) to install secondary wastewater treatment facilities[8]. Furthermore, it is recommended to set effluent standard to regulate the wastewater quality. Installation of secondary treatment facility and compliance of effluent standard shall be a requirement of acquiring Business Permit. The treatment method will not be regulated but it must be able to treat wastewater to meet the effluent standard shown in Table 5.4-4. One of example is the Sequencing Batch Reactor (SBR) which is adopted in Flushing Meadows Resort Hotel, which is the only the hotel introducing mechanized treatment facilities in Panglao Island.

5.6. Consideration of Public Septage Treatment Facilities and its Construction Funding Sources

5.6.1. Consideration of Septage Treatment Facility

1) <u>Situation</u>

Currently, there are no public septage treatment facilities in Bohol Province, and the septage generated from Panglao Island is mainly treated by 2 private companies which are in Tagbilaran city (refer to Chapter 5.4.1). According to the interview to the existing desludging companies, desludeged septage are dumped in their own land. However, it is doubtful whether it is true or not because the dumping site of ANORA has no odor and no septage are seemed in the site survey. Furthermore, some of houses and establishments remove septage by their own and the actual status of septage disposal has not been known.

[8] Primary treatment is done by physically separating solids and liquids (Ex. resettlement), while secondary treatment uses microorganisms to remove organic matters.

However, a health hazard or environmental damages caused by septage dumping has not been reported at the moment.

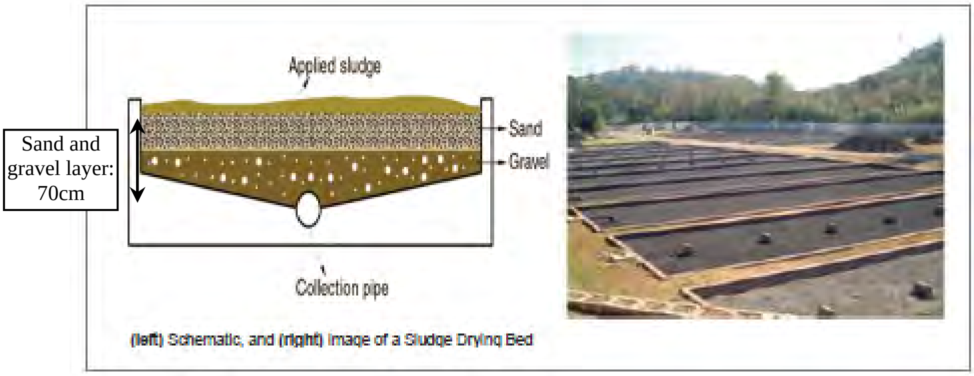
The service area of the 2 desludging companies is the whole Bohol Province including Panglao Island. In the interview, 90% of the surveyed hotels replied that they contract to ANORA for desludging their STs.

Considering the current situations, Tagbilaran city is included in the projection of future septage volumes of STs and the septage management method is considered in this study.

2) <u>Preliminary Design for Septage Treatment Facilities</u>

a) Required Land

Required land area of septage treatment facility for Tagbilaran city, Dauis and Panglao municipality were estimated respectively on the assumption that treats by drying beds shown Figure 5.6-1. The calculation results are shown in Tables 5.6-1 to Table 5.6-2.



Source: Business Model for a Water District Septage Management Program; published with assistance from United Stages Agency for Philippine water revolving fund support program in February 2010.

Figure 5.6-1 Image of Sludge Drying Beds Facility

<u>Conditions used in the estimation</u>

- Target year is fixed upon the completion of the new airport; Intermediate target year 2020 and final target year 2025.
- Target areas: Tagbilaran city, Dauis municipaity and Panglao municipality.
- Treatment facility: Drying beds, for it is most easy and inexpensive to operate and maintain.
- Number of households and population in 2011 are calculated based on NSC (2007) and the number of Building Permit issued for residence since 2007 (Details in Appendix 5.5).
- JICA Study Team estimation is used for future population in 2020 and 2025 (refer to Chapter 4)

- Number of households which has their own STs are estimated by National Statistic Office data in 2000 and assumed that the all houses constructed after year 2000 have installed STs (Details in Appendix 5.5).
- Future tourist population corresponds to the Bohol Integrated Water Supply System Master Plan (BIWSSMP) estimation.
- Dry Solids (DS) per person/day: households 25gDS/day, tourists 40gDS/day
- Septage loading rate：150 kg DS/m^2 / year (Source：Wastewater Engineering, Met Calf)
- Drying bed area per bed : 180 m^2 (with by 6m x 30m long)

Table 5.6-1 Estimation of Future ST Septage Volume (Tagbilaran city)

Item			2011	2020	2025	Remarks
Administrative Plopulation		[1]	93,898	120,220	129,510	Projection of JICA study team
Housholde No.		[2]	18,358	24,044	25,902	=[1]xNo. of population per houehold in 2011
No. of polulation per household			5.11	5.00	5.00	
Estimated % of household with own ST		[3]	80%	80%	80%	Refer to Appendix
No. of Household with own ST		[4]	14,686	19,235	20,722	=[2]x[3]
Turism water demand per day (m3/day)		[5]	195	432.3	617.55	Refer to BIWSSMP
Average No. of overnight visitors per day		[6]	650	1,441	2,059	=[5]/0.3m3 per day
Daily dry solid generated per person	Household	[7]	25	25	25	Source:Sewage Treatment in Hot Climate, Duncan Mara
	Hotels	[8]	40	40	40	
Annual desludged dry solid (DSkg/year)	Household	[9]	685,455	877,606	945,423	=[1]x[3]x[7]x365/1000
	Hotels	[10]	9,490	21,039	30,054	=[6]x[8]x365/1000
	Total	**[11]**	**694,945**	**898,645**	**975,477**	=[9]+[10]
Drying bed area (m2)		[12]	4,633	5,991	6,503	=[11]/150 DSkg/m2
No. of drying bed		[13]	26	33	36	=[12]/180m2 (1basin)
Desludging frequency (time/year)		[14]	1/5	1/5	1/5	Every 5 years
No. of requred desludging times per day by $3m^3$ truck for households		[15]	10	13	14	=[2]x[14]/365

Table 5.6-2 Estimation of Future ST Septage Volume (Dauis)

Item			2011	2020	2025	Remarks
Administrative Plopulation		[1]	39,160	56,730	62,630	Projection of JICA study team
Housholde No.		[2]	7,832	11,346	12,526	=[1]xNo. of population per houehold in 2011
No. of polulation per household			5.00	5.00	5.00	
Estimated % of household with own ST		[3]	67%	77%	79%	Refer to Appendix
No. of Household with own ST		[4]	5,218	8,732	9,912	=[2]x[3]
Turism water demand per day (m3/day)		[5]	98	216.15	309	Refer to BIWSSMP
Average No. of overnight visitors per day		[6]	327	721	1,029	=[5]/0.3m3 per day
Daily dry solid generated per person	Household	[7]	25	25	25	Source:Sewage Treatment in Hot Climate, Duncan Mara
	Hotels	[8]	40	40	40	
Annual desludged dry solid (DSkg/year)	Household	[9]	238,071	398,398	452,235	=[1]x[3]x[7]x365/1000
	Hotels	[10]	4,769	10,519	15,027	=[6]x[8]x365/1000
	Total	**[11]**	**242,841**	**408,917**	**467,262**	=[9]+[10]
Drying bed area (m2)		[12]	1,619	2,726	3,115	=[11]/150 DSkg/m2
No. of drying bed		[13]	9	15	17	=[12]/180m2 (1basin)
Desludging frequency (time/year)		[14]	1/5	1/5	1/5	Every 5 years
No. of requred desludging times per day by $3m^3$ truck for households		[15]	4	6	7	=[2]x[14]/365

Table 5.6-3 Estimation of Future ST Septage Volume (Panglao)

Item			2011	2020	2025	Remarks
Administrative Plopulation		[1]	28,096	33,400	35,800	Projection of JICA study team
Housholde No.		[2]	4,926	5,860	6,281	=[1]xNo. of population per houehold in 2011
No. of polulation per household			5.70	5.70	5.70	
Estimated % of household with own ST		[3]	73%	77%	79%	Refer to Appendix
No. of Household with own ST		[4]	3,596	4,530	4,951	=[2]x[3]
Turism water demand per day (m3/day)		[5]	586	648	926	Refer to BIWSSMP
Average No. of overnight visitors per day		[6]	1,953	2,162	3,088	=[5]/0.3m3 per day
Daily dry solid generated per person	Household	[7]	25	25	25	Source:Sewage Treatment in Hot Climate, Duncan Mara
	Hotels	[8]	40	40	40	
Annual desludged dry solid (DSkg/year)	Household	[9]	187,156	235,603	257,502	=[1]x[3]x[7]x365/1000
	Hotels	[10]	28,519	31,558	45,081	=[6]x[8]x365/1000
	Total	**[11]**	**215,675**	**267,160**	**302,583**	=[9]+[10]
Drying bed area (m2)		[12]	1,438	1,781	2,017	=[11]/150 DSkg/m2
No. of drying bed		[13]	8	10	11	=[12]/180m2 (1basin)
Desludging frequency (time/year)		[14]	1/5	1/5	1/5	Every 5 years
No. of requred desludging times per day by $3m^3$ truck for households		[15]	3	3	3	=[2]x[14]/365

Table 5.6-4 shows the total septage volume and required drying bed area for Tablilaran city, Dauis and Panglao municipalities. Required land area at year 2025 is estimated as 1.11ha for drying bed, and additional 50% for access roads and water treatment facilities for leachade, the total sums to 1.7ha.

According to the interviews to existing desludging companies, the actual amount of septage volumes is estimated 3,649 m^3 (=2,740m^3＋900m^3) in total (refer to Table 5.4-1). An actual septage volume and the calculated septage volume are compared in Table 5.6-5 with the assumption that water content of septage is 92%[9]. As shown in Table 5.6-5, calculated volume in 2011, is approximately 4 times the actual amount. Regarding the service area of existing desludging companies is the whole Bohol, estimation value is to be more than 4 times of the actual value.

The large difference between the estimation value and actual value is considered to have occurred for the following reasons. 1) Septage has not been desludged for decades and is accumulated in each household. 2) Statistical percentage of households have their own ST is 67%~89%, however in actual status most households are still using unlined pits (probably, unlined pits are also counted as ST in the statistic), which do not produce septage because liquid portion of sewage will seep underground.

9 Septage removal for every 5 years and tank liquid capacity $3m^3$;water content estimated =1- 0.025DSkg x 5 person x365 days x5years /3000L = 1-0.076≒92%

Table 5.6-4 Septage Removal Amount and Required Drying Bed Estimation

Item			2011	2020	2025	Remarks
Annual desludged dry solid (DSkg/year)	Tagbilaran	[1]	694,945	898,645	975,477	
	Dauis	[2]	242,841	420,152	389,660	
	Panglao	[3]	215,675	267,160	302,583	
	Total	[4]	1,153,461	1,585,957	1,667,719	=[1]+[2]+[3]
Drying bed area (m2)		[5]	7,690	10,573	11,118	=[4]/150
No. of drying bed		[6]	43	59	62	=[5]/180

Table 5.6-5 Comparison of Actual Deseptaged Septage Volume with Calculation Results in 2011

	Actual volume interviewed to desludging company	Calculation Result in 2011	Notes
Septage m^3/year)	3,649*1	18,913	[1]
Dry Solid (DSt/year)	292	1,153*2	[2]=[1]x(1-[3])
Water Content	92%		[3] footnote 7

*1 Questionnaire to 2 private septage removing companies
*2 JICA Study team estimation value

b) Consideration of implementation scheme and the target area

Following two implantation schemes are considered for septage treatment facility project. In the option 2 which includes Tagbilaran city in the target area, required size of the facility will be quite large, so that the fund procurement is considered to be difficult. Therefore, option 1 is adopted as the near-to-mid term countermeasure in this study. The implementation body is assumed to be PIWWM.

Target area of septage treatment facility: Dauis and Panglao municipalities

Option1

- Service area : Dauis and Panglao municipality
- Implementing body: "PIWWM"
- Septage volume: 34 m^3/day in 2025
- Required land area: 0.7 ha
- Source of construction funds: DOT?

Item		2011	2020	2025
Sluege volume	(m3/year)	5,731	8,451	9,623
	(m3/day)	20	30	34
moisture ratio		92.00%		
Dryed sludge volume	(m3/year)	1,146	1,690	1,925
	(m3/day)	4	6	7
moisture ratio		60%		
Supernatant	(m3/year)	4,585	6,761	7,698
	(m3/day)	**13**	**19**	**21**

Option2

- Service area : Tanbilarn city, Dauis and Panglao municipality
- Implementing body: ?
- Septage volume: 78 m^3/day in 2025
- Required land area: 2.2 ha
- Source of construction funds: ?

Item		2011	2020	2025
Sluege volume	(m3/year)	14,418	19,684	21,817
	(m3/day)	51	70	78
moisture ratio		92.00%		
Dryed sludge volume	(m3/year)	2,884	3,937	4,363
	(m3/day)	10	14	16
moisture ratio		60%		
Supernatant	(m3/year)	11,535	15,747	17,453
	(m3/day)	**32**	**43**	**48**

Figure 5.6-2 Consideration of Project Scheme of Septage Treatment Facility

c) Proposed Sites

A vacant land own by DOTC near the new airport is proposed as septage treatment facility construction site, so that there is no need to acquire lands for the facility. Figure 5.6-3 shows the location of the proposed site.

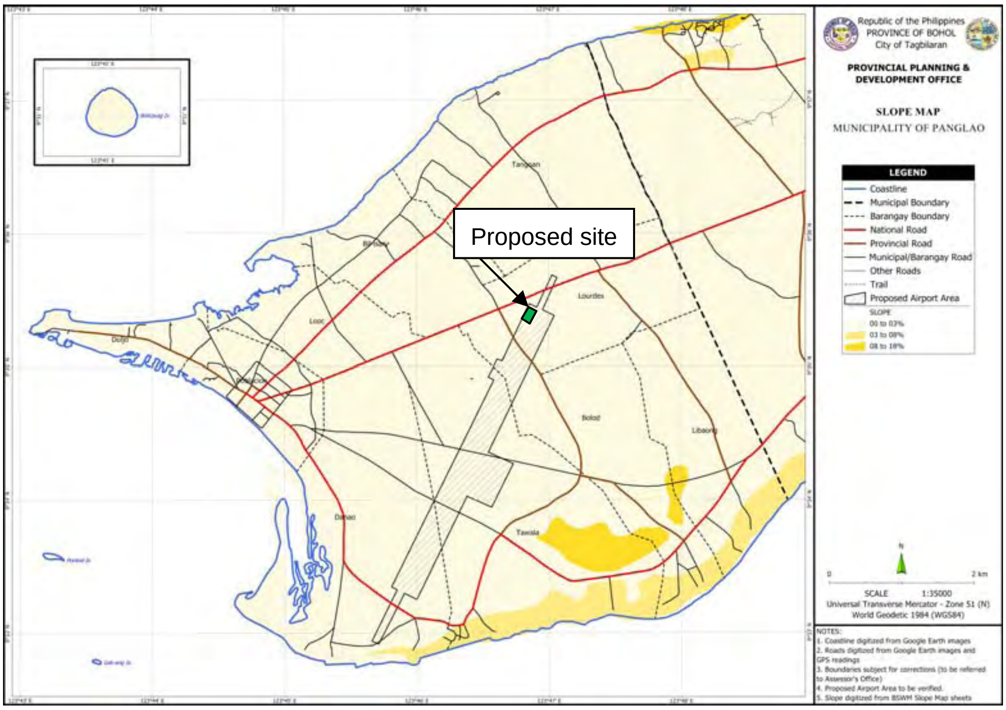


Figure 5.6-3 Location of Proposed Septage Treatment Facility Site

3) Future Subject

Since the estimated septage amount and actual amount differs largely, it is necessary to revise the future septage volume in feasibility study or in design stage. As mentioned in 5.3, single tank STs constructed in more than 10 years before are usually function as unlined pits, so that these STs will not be included in the target of septage treatment facility. The required septage treatment facility size need to be revised by surveying the ST structure of household and dying the number of expected overnight visitors.

In addition, proposed drying bed facility has a possibility to accept dewatered sludge (about 80% water content) generated from the sewage treatment plant constructed in the new air port and treats the dewatered sludge to dried sludge (about 10~20% water content) so that the dried sludge can be reused as planting soil in the airport. Required drying bed area for the sludge of the new air port is estimated to be approximately 130 m^2 [10].

[10] Assumed sludge volume: Sewage volume x (estimated SS of influent – SS of treated water) = 325m^3/day x (220-50 mg/l)/1000 = 55 DSkg/day, Required drying bed area: 55 DSkg/day×365days / 150 DSkg/m^2=130 m^2.

In this study, the project scheme of septage treatment facility is considered on the assumption of implementing the project within few years as near-to-mid term countermeasure, so that the target area is limited to Panglao Island and PIWWM is proposed as the implementation body. However, if Bohol province takes in charge of management of the septag treatment facility, the target area of the facility may include Tagbilaran city and other surrounding municipalities.

Additional studies for the below are also necessary for facility construction.

- EIA
- Approval of ECC and Wastewater Discharge Permit
- Requirement and procedures for getting an approval from Department of Agriculture to use treated septage as soil conditioners or fertilizer.
- Consideration of sludge disposal method (land application to agricultural land, forest land or dedicated disposal sites etc.) and the required additional treatment process (composting, lime stabilization etc.).
- Demand survey for soil conditioners or fertilizer and financial analysis.

Implementation schedule of the septage treatment facility construction project is proposed as shown in Figure 5.6-4. A two stage implementation (50% each in phase-1 and phase-2) is adopted considering the contingency of the septage volume collected from the target area. To realize the project in following schedule, a presentation shall give within year 2012 to the related authorities: such as TIEZA for funding source (discussed in Chapter 5.6.2), DOTC for using the land, and Dauis and Panglao municipalities to explain the necessity of the facility and implementation scheme of the project, and then make an agreement to gain their cooperation.

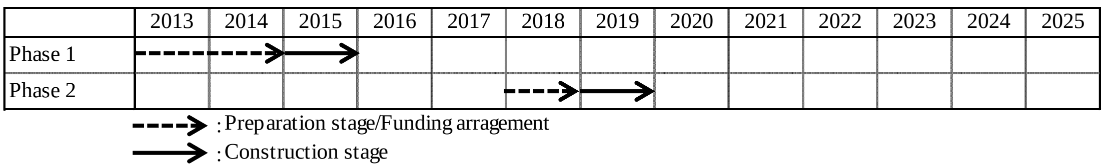


Figure 5.6-4 Proposed Implementation Schedule for Septage Treatment Facility Construction

5.6.2. Finance Survey for Facility Construction Fees

The following possibilities of financing for the septage treatment facility project were studied. According to the interviews with Dauis and Panglao municipalites and Bohol Province, they answered that the investment cannot be made. Thus, there is a little possibility of using financing methods 1) and 2).

Of the remaining 3) and 4), borrowing from 4) (b): Tourism Insrastructure and Enterprise Zone Authority (TIEZA) have most possibilities at the present. The negotiations for financing should be done in the future with related agencies, by sentencing the object of facility construction as "Preservation of the Panglao Island environmental resources by appropriate management of waste (wastewater septage) from tourism facilities and the new airport". As a prerequisite to construct the septage treatment facility, it is important to set up the new organization IWWA who is expected to be the implementation body of the project.

1) Investment by both local governments
2) Investment by both local governments and Bohol Province government
3) Loaning from bank
   (a) Loaning from private bank
   (b) Loaning from national bank
      -Development Bank of Philippines
      -Land Bank of Philippines
4) Loaning from the central government of Philippines
   (a) MDFO (Municipal Development Fund Office) beneath DOF (Department of Finance)
   (b) DOT (Department of Tourism) or PTA（Philippines Tourism Authority)
   (c) DOTC

To be noted, there are no subsidy systems by the central government of Philippines.

5.7. Regulation Studies for Securing Individual Treatments

(1) Existing Regulations

Followings are summaries of the existing laws related to STs. Refer to Chapter 5.2 for details.

1) The Philippines

・ Obligation for ST installation
・ Removal of septage every 3～5 years

2) Dauis Municipality

・ Obligation for installation of STs with 2 or more chambers for households.
・ Obligation for installation of STs with 3 or more chambers for tourism facilities.
・ ST drawing confirmation before construction and final inspection after construction for both establishments and residences according to the Building Permission system.

3) Panglao Municipality

・ Obligation for installation of STs with 3 or more chambers for tourism facilities.
・ ST drawing confirmation before construction and final inspection after construction for establishments according to the Building Permission system

(2) Proposal of new Regulations for Securing Individual Treatments Facility

On the assumption that existing laws are firmly obeyed, new regulations or ordinances are proposed as follows. Refer to Chapter 5.4 for details of the contents.

<u>(Short-term) within 5 years</u>

- Introduction of “On-site sewage treatment facility Certificate of Completion” system which shall submitted by the constructor’s engineer to confirm ST is installed as the drawing.
- For households: Obligation of periodic inspection once every 5 years, and presentation of the result reports.
- For small and middle size tourist estates: Obligation of periodic inspection once every year, and presentation of the result reports.
- For large sized tourist accommodations facility with over 50 rooms: Introduction of effluent standard regulations.
- For large sized accommodations with over 50 rooms: Obligation of water quality test once or more every year, and presentation of the result reports.

<u>(Mid-term) within 10-20 years</u>

- Introduction of septage tracking method such as Manifests system.

(3) Consideration Points for Law Regulating

As mentioned, may laws mentioning appropriate wastewater treatment facility installation and maintenance already exist in the Philippines. It is an important task to keep these laws in strict conditions. For these means, it is necessary to establish a new organization (PIWWM) specialized to individual sewage treatment facilities and to form a public monitoring system (for final inspection after completion, on-site inspection, etc.). Also, financial support system shall be necessary for households which cannot afford the fee for installing proper STs with 2 or more chambers.

5.8. Proposals of Technical Assistance Program by JICA

5.8.1. Content of Proposed Technical Support

To strengthen the individual sewage treatment facility and to conserve the water environment in Planglao Island, Study Team propose following two programs to be implemented by Dauis and Panglao municipalities with JICA technical assistance.

- **Support 1: Establishment of a New Organization for Individual Treatment Facility Management**

At present, acquisition of Building Permit is necessary to construct new buildings. In addition, commercial facilities require Sanitary Permit. Upon the application of these permits, Sanitation Inspector and/or MBO’s Engineer give guidance about required facility and do the final inspection, and if the ST is not confirmed to be installed accordingly, the Permits shall not be authorized. However, there are cases even in the recently constructed buildings or houses installed unlined-pit type toilets or improper ST different from the drawings. Only two engineers and one engineer are working in MBO in Dauis and Panglao respectively. For that the organizations are fragile, and this is considered to be one of the reasons for the current situation.

Thus it is proposed to establish a new organization to manage the individual treatment facilities for the all Panglao Island area (Dauis and Panglao Municipalities) separated from existing MHOs and MBOs, and the technical assistance is aiming on capacity development of new organization and human resources. For the new organization, two civil engineers each shall employed by Dauis and Panglao municipalities respectively. However, employment fee for the 4 engineers is assumed to be paid by the new organization itself after operation.

<u>Activities:</u>

- Establishment of a new Wastewater Treating Facility Management Organization by the investment of Dauis and Panglao (Panglao Island Waste Water Management Agency (assumed name), hereinafter mentioned PIWWM)
- Establishment of organization structure with the new employed engineers
- Establishment of Sustainable business operation system of PIWWM
- Capacity development of engineers of new organization, MBO, MHO and existing desludgning companies
- Establishment of septage management system such as introduction of Manifests system for septage tracking

- **Support 2: Pilot Project for Improving Individual Sewage Treatment Facilities**

Underground watercontamination is a concern in the areas with poor permeability since the wastewater from STs is generally discharged in the near surface grounds without filtration process. For a salvation, this study proposed the introduction of Up-flow filter type ST. As shown in Figure 5.5-4, the final tank in Up-flow filter type ST serve as a filtration tank, and the treated water quality shall be improved since it will be thoroughly filtered before disposal. However, introduction of Up-flow filter type ST requires operation maintenance including periodical cleaning or replace of the filter material. Therefore, it is necessary to carry out a pilot project for households and small/medium sized accommodations to select the suitable filtering material and confirm the facility structure and to establish the operation and maintenance methods. To confirm Up-flow filter type ST introduction plans shall be the final object for the technical assistance.

<u>Activities:</u>

- Evaluation of existing STs treatment performance and proposal of upgrading method to improve the treatment functions of the existing STs
- Specification of Up-flow filter type ST methods for regional characteristics by demonstration tests (selection of filtering material, standard facility detail drawings, improvement evaluations, confirmation of operation and maintenance methods, etc.).
- Confirmation of maintenance methods by performing pilot projects objected to about 8 facilities (cleaning and replacement method, frequency of the filtration materials etc.).
- Preparation of Up-flow filter type ST installation plan for households within Panglao Island.

5.8.2. Proposed Schedule of Technical Assistance Program

Proposed JICA assistance program period is assumed for two years. Figure 5.8.1 shows the proposed schedule of the program.

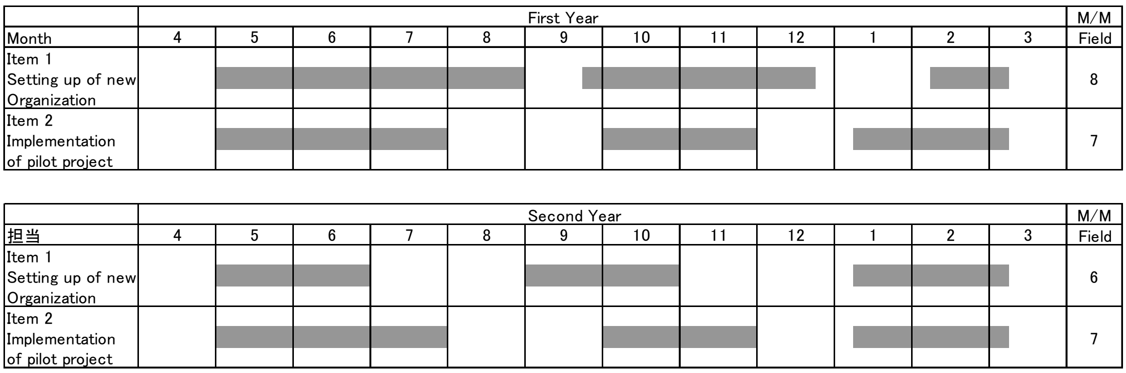


Figure 5.8-1 Proposed Schedule of JICA Technical Assistance Program

Appendixes

Appendix

Chapter 2

Table of Contents

Appendix Chapter 2

2.1. Outline of the Survey

In this study, "Tourists Questionnaire Survey (hereinafter "the Survey")" was conducted to grasp information data of tourism sector because existing data were not enough to analysis the current conditions. The survey conducted for three days in 2011 at an airport and seaports. Outline of the study is as shown in table below.

Table A 2.1-1 Outline of the Survey

Survey Name	Tourist Questionnaire Survey	
Date of the Survey	Peak Season (May)	One day in weekday - 13th May 2011 (Friday) 8:00 – 17:00 (9 hour inc. lunch)
	Ordinary Season (July)	One day in weekend - 9th July 2011 (Saturday) 8:00 – 17:00 (9 hour inc. lunch) One day in weekday - 14th July 2011 (Thursday) 8:00 – 17:00 (9 hour inc. lunch)
Purpose of the Survey	To grasp information date of tourism sector	
Target Place	Tagbilaran Airport Tagbilaran Seaport Tubigon Seaport (only July) Ubay Seaport (only July) Jagna Seaport (only July)	
Method	Face to face individually	
Total Sample	390 Samples - 121 in May - 269 in July	

Source: JICA Study Team

Conducting the survey in Tagbilaran Seaport

Conducting the survey in Ubay Seaport

Source: JICA Study Team

Figure A 2.1-1 Conducting the Survey

2.2. The Survey Sheets (Questionnaire)

Tourist Questionnaire Survey < Not for Residents >

This survey is conducted by Bohol Tourism Office in association with JICA (Japan International Cooperation Agency) to grasp current conditions of tourism. This survey is on a voluntary and anonymous basis, thus your answer will be analyzed statistically and remain anonymous. We highly appreciate your understanding and cooperation.

>>

(1) Your Nationality?

☐ Domestic Visitor ☐ Chinese ☐ U.S.A ☐ Korea <Other [ ] >

(2) Purpose of this trip?

☐ Leisure ☐ Business ☐ VFR ☐ MICE <Other [ ] >

(3) No. of Persons with you?

☐ Alone ☐ Group →How many [ ] persons in total including yourself

>>

(4) How many nights of stay completed in Bohol?

☐ Same day visitor ☐ Overnight →How many [ ] nights in Bohol

(5) Where did you stay mainly in Bohol?

☐ Panglao ☐ Tagbilaran ☐ Anda ☐ Tubigon <Other [ ] >

(6) How much money did you spend in Bohol?

Approximately [ ] ☐ peso ☐ dollar (please specify)

(7) Is this the first time to Visit Bohol?

☐ First Time ☐ Plural Times →How many [ ] times in total

>>

(8) In this trip, did/will you visit only in Bohol? *except other countries

☐ Only Bohol ☐ Not only Bohol

(9) Where will/did you visit in the Philippines? *multiple answer

☐ Cebu ☐Manila ☐Boracay ☐Palawan ☐Mindanao ☐Negros ☐Leyte
<Other [ ] [ ] [ ] [ ] [ ] >

< Only for the Domestic Visitors>

(10) Where is your hometown in Philippines?

☐ Manila ☐ Cebu ☐ Cagayan de Oro ☐ Davao <Other [ ] >

>>

Tag Air☐, Tag Sea☐, Tubi Sea☐, Ubay Sea☐, Jag See☐, 9th July (Sat)☐, 14th July (Thu)☐

>>

(11) Where did you visit and do in Bohol? *multiple answer

Oceans and Beach	*Nature Sites*	*Historic/Cultural Sites*	*Eco-tours*
☐ Diving →(12)	☐ Chocolate Hills	☐ Baclayon Church	☐ Cambuhat Village
☐ Dolphin Watching	☐ Tarsier (Shops)	☐ Panglao Church	☐ Lamanok Island
☐ Panglao Beach	☐ Tarsier (Sanctuary)	☐ Blood Compact	☐ Rajah Sikatuna
☐ Anda Beach	☐ Man-made Forest	☐ Bohol Bee Farm	☐ Danao Adv.-park
☐ Balicasag Island	☐ Hinagdanan Cave	☐ Loboc River Cruise	☐ Ubay Agri-park

<Other [ ] [ ] [ ] [ ] [ ] >

>>

< Only for respondents who did "Diving" in (11) >

(12-1) Where did you enjoy the diving? *multiple answer

☐ Panglao Island ☐ Balicasag Island ☐ Pamilacan Island ☐ Cabilao Island
☐ Anda peninsula ☐ Mahanay Island <Other [ ] >

(12-2) Were you satisfied with the diving in Bohol?

☐ Excellent ☐ Good ☐ Normal ☐ Not so good ☐ Bad

(12-3) How was the coral reef conditions?

☐ Excellent ☐ Good ☐ No problem ☐ Partly Damaged ☐ Much Damaged

(12-4) How did you think about current number of the divers and snorkelers in the site?

☐ Too much volume ☐ Much ☐ No problem ☐ Few (Good)

(12-5) To protect and sustain the coral reef, how much can you pay for donation/entry fee per one dive?

Approximately [ ] ☐ peso ☐ dollar (please specify)

>>

(13) Do you know the concept of "Eco-Tourism"? *This aims sustainability development in good-balance among tourism development, nature conservation and local economic benefit.

☐ Yes much ☐ Yes a little ☐ No

(14) How do you think Bohol is the one of key Eco-Tourism sites in Philippines?

☐ Deeply Agree ☐ Agree ☐ Disagree ☐ No Idea

(15) How do you feel about Bohol's nature environment? *such as Oceans, Beech, Tarsier and Forests

☐ Excellent ☐ Good ☐ No problem ☐ Partly Damaged ☐ Much Damaged

(16) To protect and sustain Bohol's nature, how much can you pay for donation/entry fee per one trip?

Approximately [ ] ☐ peso ☐ dollar (please specify)

>>

>>>

(17) How did you feel about the following current conditions in Bohol?

Sector	No problem	Should be improved	No Idea
Information for Tourists	☐	☐	☐
Accommodation	☐	☐	☐
Restaurants/Shops	☐	☐	☐
Cultural / Historical Sites	☐	☐	☐
Nature and Wildlife (Ocean / Forest)	☐	☐	☐
Road Network	☐	☐	☐
Transportation	☐	☐	☐
Airport	☐	☐	☐
Seaport	☐	☐	☐
Sewerage	☐	☐	☐
Solid Wastes	☐	☐	☐

(18) How do you think about the air and ship service conditions of the port where you are now?

Sector	No problem	Should be improved	No Idea
Trip Frequency (Trip Numbers)	☐	☐	☐
Time Scheduling	☐	☐	☐
Passenger Capacity	☐	☐	☐
Reliability (Punctuality)	☐	☐	☐
Destination Places	☐	☐	☐

>>>

(19) Do you want to / Will you come back to Bohol again?

☐ Yes surely	☐ Yes maybe	☐ Not sure	☐ No	☐ No Idea

(20) If a flight is connected between the airport near your hometown and Bohol, will you use it?

☐ Yes surely	☐ Yes maybe	☐ Not sure	☐ No	☐ No Idea

(21) Do you have any opinions regarding Bohol tourism?

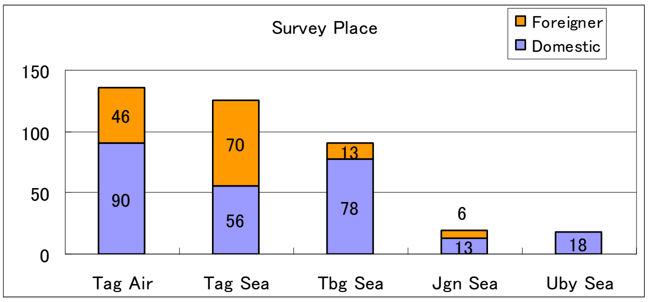
Thank you very much, we appreciate your cooperation

2.3. The Results of the Survey

2.3.1. Survey Place

The table and figure bellows are the sample numbers of the places the survey conducted.

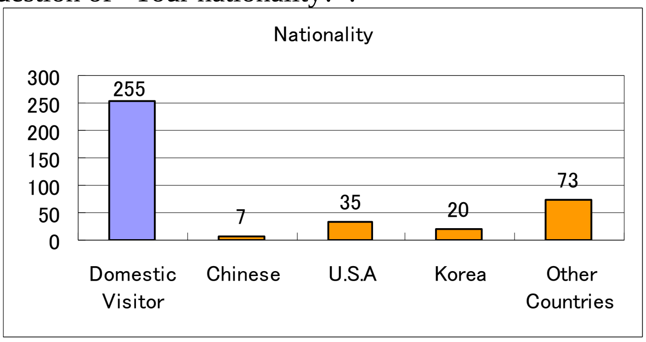
<S.A.> <for all respondents>	No. of Samples	Ratio
Tagbilaran Airport	136	34.9%
Tagbilaran Seaport	126	32.3%
Tubigon Seaport	91	23.3%
Ubay Seaport	19	4.6%
Jagna Seaport	18	4.9%
N/A	0	100.0%
Total	390	34.9%



2.3.2. Nationality

The table and figure bellows are the result of the question of "Your nationality?".

<S.A.> <for all respondents>	No. of Samples	Ratio
Domestic Visitor	255	65.4%
Chinese	7	1.8%
U.S.A	35	9.0%
Korea	20	5.1%
Other Countries	73	18.7%
N/A	0	0.0%
Total	390	100.0%

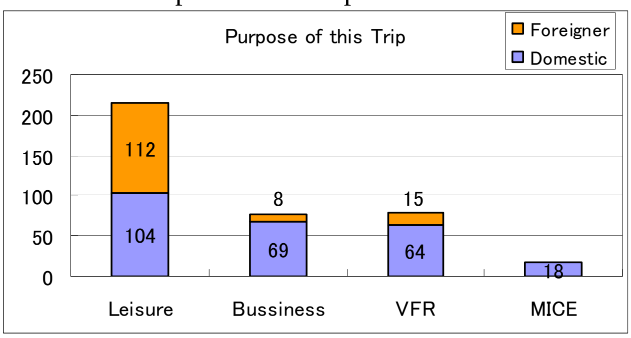


Other Countries: Germany (9 samples), Canada (8), Australia (7), UK (7), Norway (5), Swiss (5), France (4), Japan (4), Russia (4), Denmark (3), Italy (3), Sweden (3), New Zealand (3), Belgium (1), Brazil (1), Greece (1), Ireland (1), Kuwait (1), Malaysia (1), Poland (1), Spain (1)

2.3.3. Purpose of the trip

The table and figure bellows are the result of the question of "Purpose of this trip?".

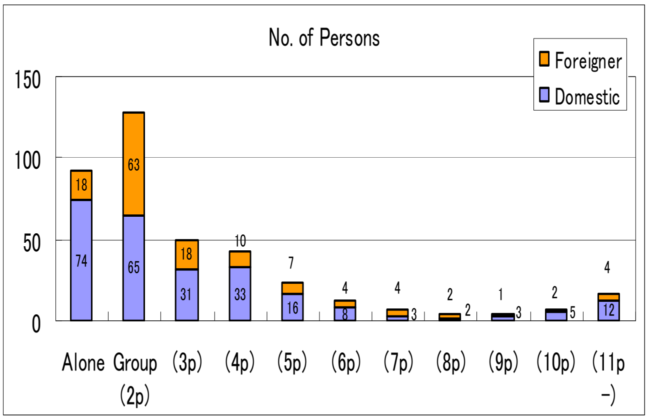
<S.A.> <for all respondents>	No. of Samples	Ratio
Leisure	216	55.4%
Business	77	19.7%
VFR	79	20.3%
MICE	18	4.6%
Others	0	0.0%
N/A	0	0.0%
Total	390	100.0%



2.3.4. Number of Persons of the trip

The table and figure bellows are the result of the question of "No of persons of this trip?".

<S.A.> <for all respondents>	No. of Samples	Ratio
Alone	92	23.6%
Group (2p)	128	32.8%
(3p)	49	12.6%
(4p)	43	11.0%
(5p)	23	5.9%
(6p)	12	3.1%
(7p)	7	1.8%
(8p)	4	1.0%
(9p)	4	1.0%
(10p)	7	1.8%
(11p -)	16	4.1%
N/A	5	1.3%
Total	390	100.0%

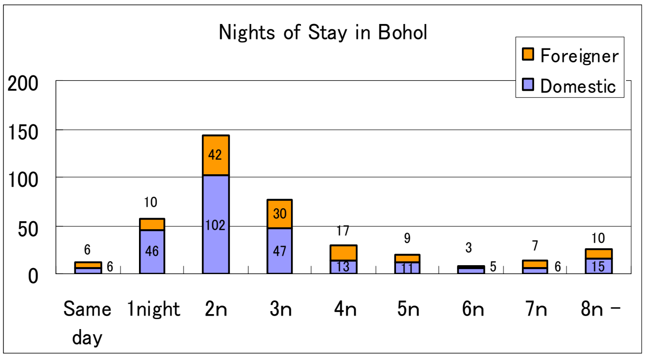


2.3.5. Nights of Stay in Bohol

The table and figure bellows are the result of the question of "How many nights of stay completed in Bohol?".

Average Domestic Visitor	3.71 nights
Average Foreign Visitor	3.92 nights
Average Total	3.78 nights

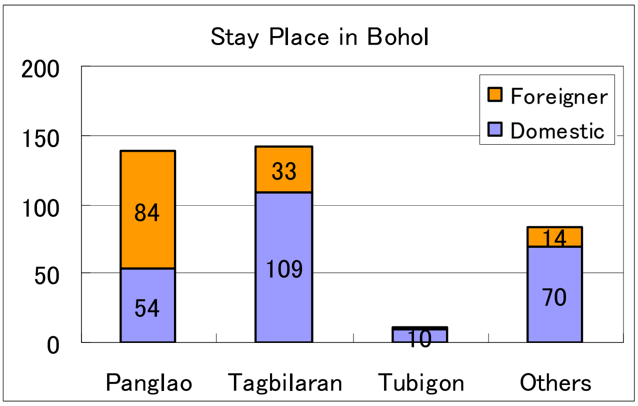
<S.A.> <for all respondents>	No. of Samples	Ratio
Same day	12	3.1%
1night	56	14.4%
2n	144	36.9%
3n	77	19.7%
4n	30	7.7%
5n	20	5.1%
6n	8	2.1%
7n	13	3.3%
8n -	25	6.4%
N/A	5	1.3%
Total	390	100.0%



2.3.6. Stay Place in Bohol

The table and figure bellows are the result of the question of “Where did you stay mainly in Bohol?”.

<S.A.> <for all respondents>	No. of Samples	Ratio
Panglao	138	35.4%
Tagbilaran	142	36.4%
Tubigon	11	2.8%
Others	84	21.5%
N/A	15	3.8%
Total	390	100.0%



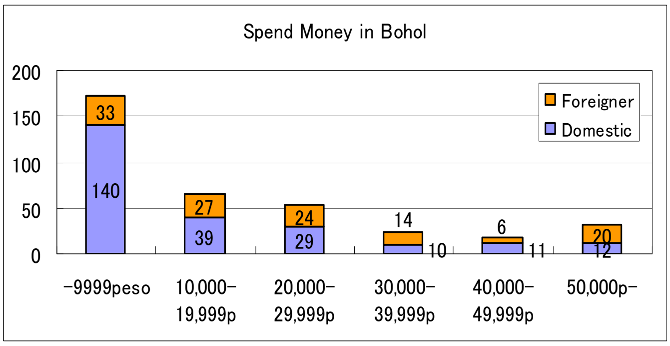
Other Places: Anda (10 samples), Loon (8), Ubay (8), Sagbayan (6), Carmen (4), Loay (4), Alburquerque (3), Buenavista (3), Calape (3), Jagna (3), Mabini (3), Maribojoc (3), San Miguel (3), Dimiao (2), Guindulman (2), Inabanga (2), Lila (2), Talibon (2), Valencia (2), Alicia (1), Baclayon (1), Bienunido (1), Bilar (1), Calape (1), Candijay (1), Duero (1), Getafe (1), Loboc (1), Sierra Bullones (1), Sikatuna (1)

2.3.7. Spend Money in Bohol

The table and figure bellows are the result of the question of “How much money did you spend in Bohol?”.

Total Money (1)	7,014,855 peso
Total - N/A (2)	365 (390-25)
Average Money (1/2)	19,219 peso

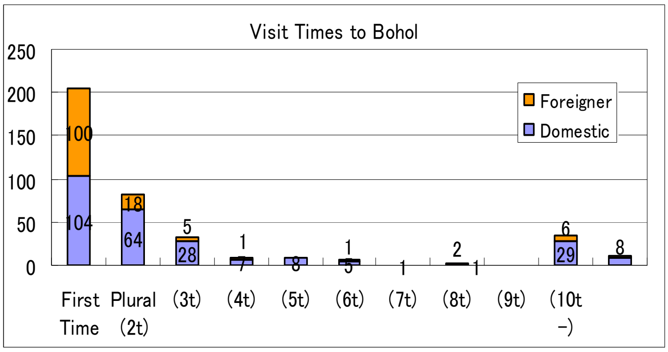
<Categolized> <for all respondents>	No. of Samples	Ratio
-999peso	173	44.4%
10,000-19,999p	66	16.9%
20,000-29,999p	53	13.6%
30,000-39,999p	24	6.2%
40,000-49,999p	17	4.4%
50,000p-	32	8.2%
N/A	25	6.4%
Total	390	100.0%



2.3.8. Visit Times to Bohol

The table and figure bellows are the result of the question of “Is this the first time to visit Bohol?”.

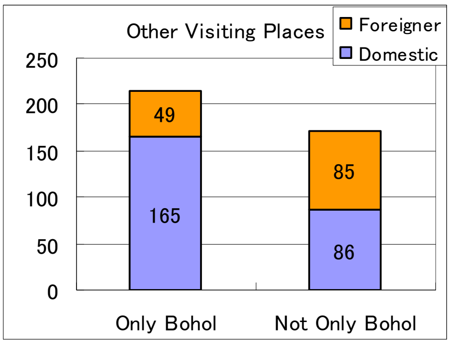
<S.A.> <for all respondents>	No. of Samples	Ratio
First Time	204	52.3%
Plural (2t)	82	21.0%
(3t)	33	8.5%
(4t)	8	2.1%
(5t)	8	2.1%
(6t)	6	1.5%
(7t)	1	0.3%
(8t)	3	0.8%
(9t)	0	0.0%
(10t -)	35	9.0%
N/A	10	2.6%
Total	390	100.0%



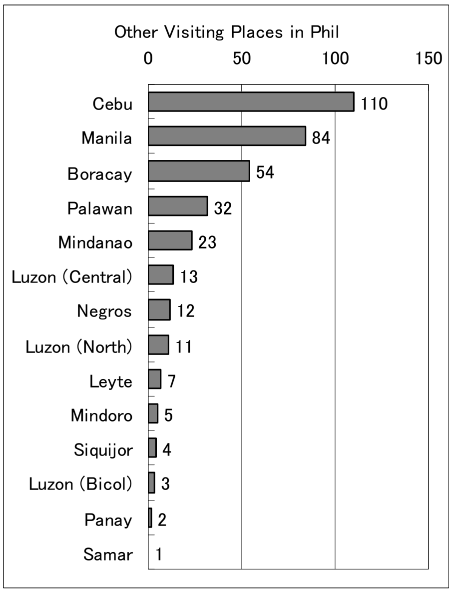
2.3.9. Other Visiting Places in Phil

The table and figure bellows are the result of the question of “In this trip, did/will you visit only in Bohol?” and the additional question of “Where did/will you visit in Philippines?” only to the persons who answered “not only Bohol”.

<S.A.> <for all respondents>	No. of Samples	Ratio
Only Bohol	214	54.9%
Not Only Bohol	171	43.8%
N/A	5	1.3%
Total	390	100.0%



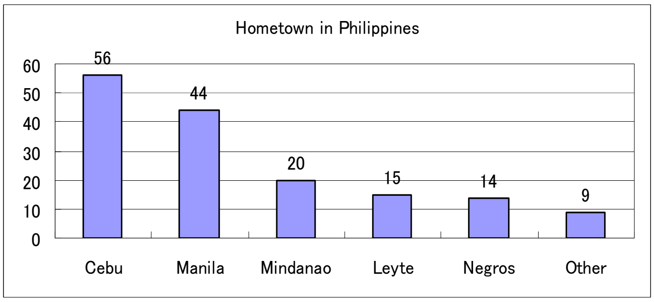
<M.A.> <for “Not Only Bohol” in (9) >	No. of Samples
Cebu	110
Manila	84
Boracay	54
Palawan	32
Mindanao	23
Luzon (Central)	13
Negros	12
Luzon (North)	11
Leyte	7
Mindoro	5
Siquijor	4
Luzon (Bicol)	3
Panay	2
Samar	1



2.3.10. Hometown of Domestic Visitors

The table and figure bellows are the result of the question of "Where is your hometown in Philippines" only to the domestic tourists.

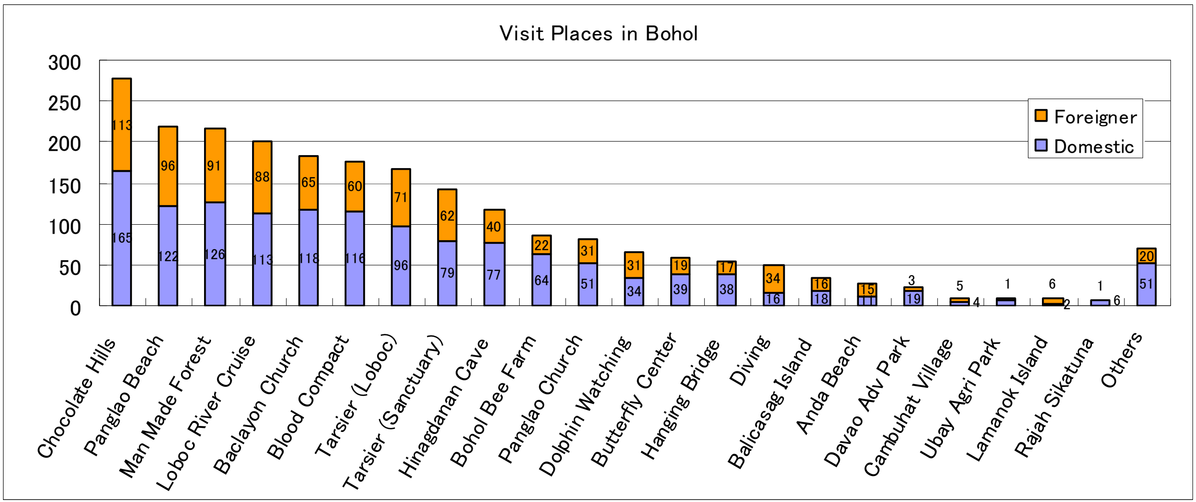
<S.A.> <for "Domestic" in (2)> <Only in July Survey>	No. of Samples	Ratio
Cebu	56	32.2%
Manila	44	25.3%
Mindanao	20	11.5%
Leyte	15	8.6%
Negros	14	8.0%
Other	9	5.2%
N/A	16	9.2%
Total	174	100.0%



2.3.11. Visited Places in Bohol

The table and figure bellows are the result of the question of "Where did you visit and do in Bohol?".

<M.A.> <for all respondents>	No. of Samples	Ratio
Chocolate Hills	278	71.3%
Panglao Beach	218	55.9%
Man Made Forest	217	55.6%
Loboc River Cruise	201	51.5%
Baclayon Church	183	46.9%
Blood Compact	176	45.1%
Tarsier (Loboc)	167	42.8%
Tarsier (Sanctuary)	141	36.2%
Hinagdanan Cave	117	30.0%
Bohol Bee Farm	86	22.1%
Panglao Church	82	21.0%
Dolphin Watching	65	16.7%
Butterfly Center	58	14.9%
Hanging Bridge	55	14.1%
Diving	50	12.8%
Balicasag Island	34	8.7%
Anda Beach	26	6.7%
Davao Adv Park	22	5.6%
Cambuhat Village	9	2.3%
Ubay Agri Park	8	2.1%
Lamanok Island	8	2.1%
Rajah Sikatuna	7	1.8%
Others	71	18.2%
Total	390	100.0%



Samples	Visited Other Places
21	Phyton Snake (Alburquerque)
11	Sagbayan Peak
4	Ubay, Virgin Islands
3	Dauis Church, Mag-Aso Fall, Punta Cruz
2	Alburquerque, Ancestral House, Loon Macaques, Mangrove eco-tourism
1	Bayuyoy, Bbc, Bohol Museum, Cabilao, Churches, Dauis, Island Hopping, Morning Hills, Namulang, San Agustin Watch Tower, Snorkel, Valencia, Village Tour, Visiting Farm

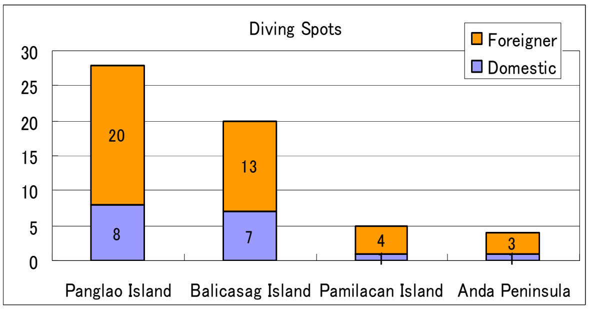
2.3.12. Diving Questionnaire

The questionnaire as followings is only to the person who answered “did diving” in the previous question.

Visited Diving Spot

The table and figure bellows are the result of the question of “Where did you enjoy the diving?”.

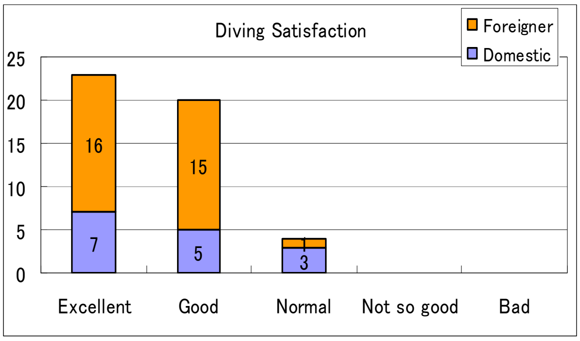
<M.A.> <for “diving” in (11)>	No. of Samples	Ratio
Panglao Island	28	47.5%
Balicasag Island	20	33.9%
Pamilacan Island	5	8.5%
Cabilao Island	4	6.8%
Anda Peninsula	0	0.0%
Mahanay Island	0	0.0%
N/A	2	3.4%
Total	59	100.0%



Diving Satisfaction

The table and figure bellows are the result of the question of “Were you satisfied with the diving in Bohol?”.

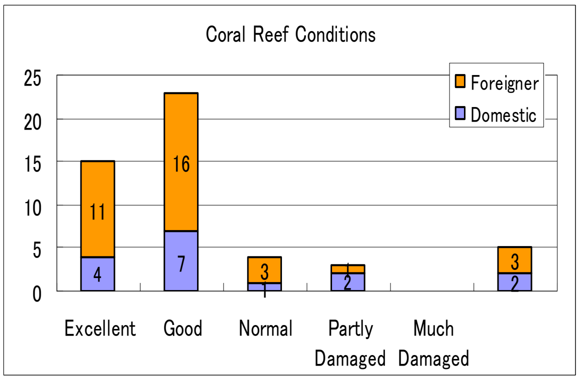
<S.A.> <for “diving” in (11)>	No. of Samples	Ratio
Excellent	23	46.0%
Good	20	40.0%
Normal	4	8.0%
Not so good	0	0.0%
Bad	0	0.0%
N/A	3	6.0%
Total	50	100.0%



Coral Reef Conditions

The table and figure bellows are the result of the question of “How was the coral reef conditions?”.

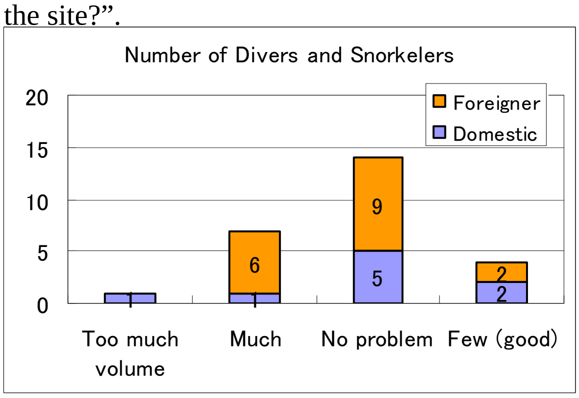
<S.A.> <for “diving” in (11)>	No. of Samples	Ratio
Excellent	15	30.0%
Good	23	46.0%
Normal	4	8.0%
Partly Damaged	3	6.0%
Much Damaged	0	0.0%
N/A	5	10.0%
Total	50	100.0%



Divers and Snorkelers Numbers

The table and figure bellows are the result of the question of “How did you think about current number of the divers and snorkelers in the site?”.

<S.A.> <for “diving” in (11)> <Only in July Survey>	No. of Samples	Ratio
Too much volume	1	3.0%
Much	7	21.2%
No problem	14	42.4%
Few (good)	4	12.1%
N/A	7	21.2%
Total	33	100.0%



Willing to Pay for Coral Reef Conservation

The table is the result of the question of "To protect and sustain the coral reef, how much can you pay for donation/entry fee per one dive?"

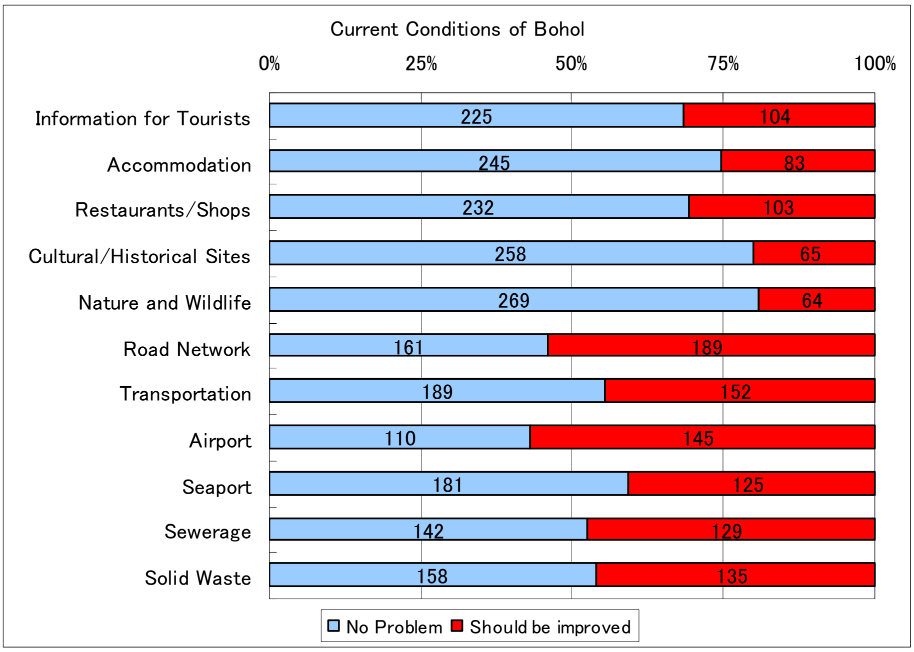
Total Money (1)	11,657 peso
Total - N/A (2)	14 (33-19)
Average Money (1/2)	833 peso

<Only in July Survey>

2.3.13. Current Conditions of Bohol

The table and figure bellows are the result of the question of "How did you feel about the following current conditions in Bohol?".

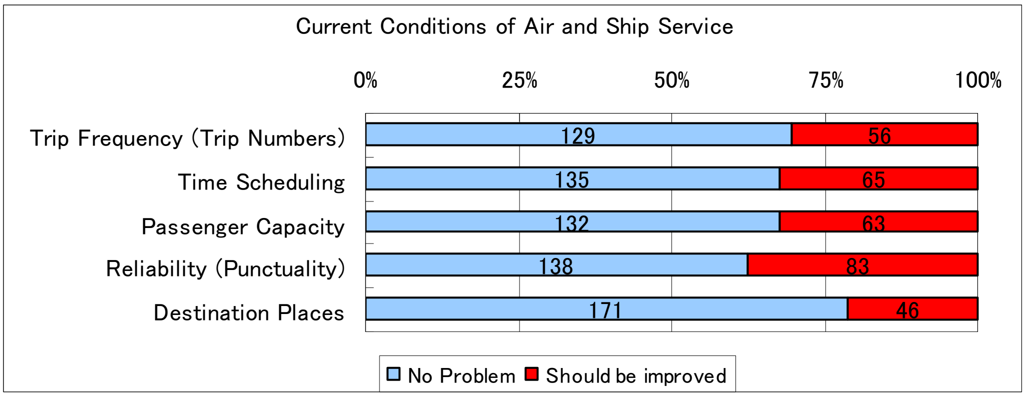
<S.A.> <for all respondents>	No Problem	Should be improved	No Idea	N/A	Total
Information for Tourists	225	104	48	13	390
Accommodation	245	83	41	21	390
Restaurants/Shops	232	103	38	17	390
Cultural/Historical Sites	258	65	46	21	390
Nature and Wildlife	269	64	32	25	390
Road Network	161	189	22	18	390
Transportation	189	152	27	22	390
Airport	110	145	71	64	390
Seaport	181	125	56	28	390
Sewerage	142	129	81	38	390
Solid Waste	158	135	68	29	390



2.3.14. Current Conditions of Air and Ship Service

The table and figure bellows are the result of the question of “How do you think about the air and ship service conditions of the port where you are now?”.

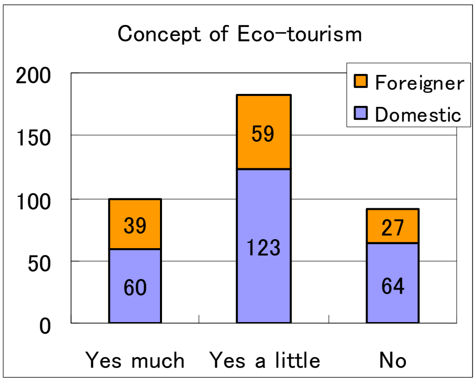
<S.A.> <for all respondents> <Only in July Survey>	No Problem	Should be improved	No Idea	N/A	Total
Trip Frequency	129	56	63	21	269
Time Scheduling	135	65	49	20	269
Passenger Capacity	132	63	50	24	269
Reliability (Punctuality)	138	83	26	22	269
Destination Places	171	46	26	26	269



2.3.15. Well-Known of Concept “Eco-tourism”

The table and figure bellows are the result of the question of “Do you know the concept of “Eco-Tourism?”.

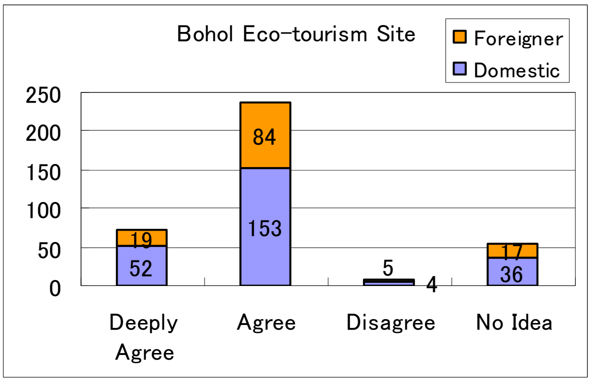
<S.A.> <for all respondents>	No. of Samples	Ratio
Yes much	99	25.4%
Yes a little	182	46.7%
No	91	23.3%
N/A	18	4.6%
Total	390	100.0%



2.3.16. Agreement of Bohol "Eco-tourism"

The table and figure bellows are the result of the question of "How do you think Bohol is the one of key Eco-Tourism sites in Philippines?".

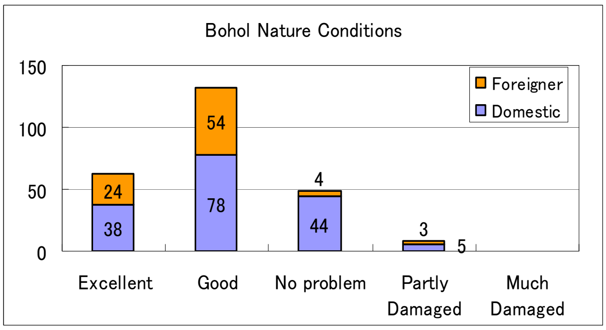
<S.A.> <for all respondents>	No. of Samples	Ratio
Deeply Agree	71	18.2%
Agree	237	60.8%
Disagree	9	2.3%
No Idea	53	13.6%
N/A	20	5.1%
Total	390	100.0%



2.3.17. Nature Environment Conditions

The table and figure bellows are the result of the question of "How do you feel about Bohol's nature environment?".

<S.A.> <Only in July Survey>	No. of Samples	Ratio
Excellent	62	23.0%
Good	132	49.1%
Normal	48	17.8%
Partly Damaged	8	3.0%
Much Damaged	0	0.0%
N/A	19	7.1%
Total	269	100.0%



2.3.18. Willing to Pay for Nature Environment Conservation

The table is the result of the question of "To protect and sustain Bohol's nature, how much can you pay for donation/entry fee per one trip"

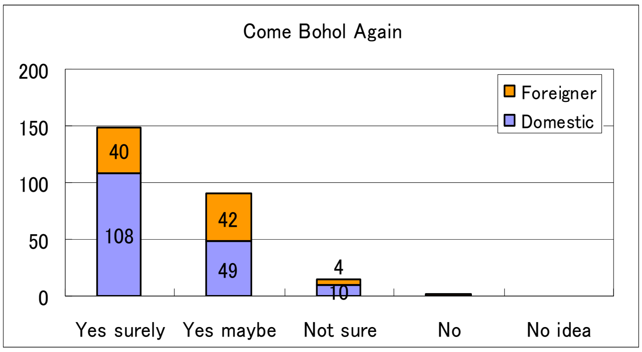
Total Money (1)	169,552 peso
Total - N/A (2)	171 (269-98)
Average Money (1/2)	992 peso

<Only in July Survey>

2.3.19. Come Bohol Again

The table and figure bellows are the result of the question of “Do you want to / Will you come back to Bohol again?”.

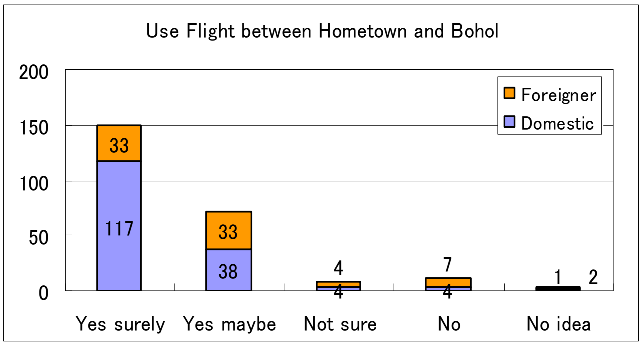
<S.A.> <Only in July Survey>	No. of Samples	Ratio
Yes surely	148	55.0%
Yes maybe	91	33.8%
Not sure	14	5.2%
No	1	0.4%
No idea	0	0.0%
N/A	15	5.6%
Total	269	100.0%



2.3.20. Use Flight between Hometown and Bohol

The table and figure bellows are the result of the question of “If a flight is connected between the airport near your hometown and Bohol, will you use it?”.

<S.A.> <Only in July Survey>	No. of Samples	Ratio
Yes surely	150	55.8%
Yes maybe	71	26.4%
Not sure	8	3.0%
No	11	4.1%
No idea	3	1.1%
N/A	26	9.7%
Total	269	100.0%



Appendix

Chapter 4

Table of Contents

Appendix Chapter 4

4.1. Sewerage Sector in the Philippines

The list of ECP (Environment Critical Project) and ECA (Environment Critical Areas) category is summarized in Table A4.1-1.

Table A4.1-1 List of ECP Types and ECA Categories

A. List of ECPs	
- As declared by Proclamation No. 2146 (1981)	
1.	Heavy Industries – Non-ferrous Metal Industries, Iron and Steel Mills, Petroleum and Petro-chemical Industries including Oil and Gas, Smelting Plants
2.	Resource Extractive Industries – Major Mining and Quarrying Projects, Forestry Projects (logging, major wood processing projects, introduction of fauna (exotic animals) in public and private forests, forest occupancy, extraction of mangrove products, grazing), Fishery Projects (dikes for/ and fishpond development projects)
3.	Infrastructure Projects – Major Dams, Major Power Plants (fossil-fueled, nuclear fueled, hydroelectric or geothermal), Major Reclamation Projects, Major Roads and Bridges
- As declared by Proclamation No. 803 (1996)	
4.	All golf course projects
B. List of ECA Categories - As declared by Proclamation No. 2146 (1981)	
1.	All areas declared by law as national parks, watershed reserves, wildlife preserves, sanctuaries
2.	Areas set aside as aesthetic potential tourist spots
3.	Areas which constitute the habitat of any endangered or threatened species of Philippine wildlife (flora and fauna)
4.	Areas of unique historic, archaeological, or scientific interests
5.	Areas which are traditionally occupied by cultural communities or tribes
6.	Areas frequently visited and/or hard-hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.)
7.	Areas with critical slopes
8.	Areas classified as prime agricultural lands
9.	Recharged areas of aquifers
10.	Water bodies characterized by one or any combination of the following conditions: tapped for domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities
11.	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth of major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood.
12.	Coral reefs characterized by one or any combination of the following conditions: With 50% and above live coralline cover; Spawning and nursery grounds for fish; Act as natural breakwater of coastlines

Source: Revised Procedural Manual for DAO 2003-30 (2007)

The report types and their description related to EIA process are shown in Table A4.1-2-

Table A4.1-2 EIA report types and their description

Report Type	Descriptions
(1) Environmental Impact Statement (EIS)	Document prepared and submitted by the proponent / consultant that serve as an application for an ECC. It is a comprehensive study of the significant impacts of a project in the environment.
(2) Programmatic EIS (PEIS)	Documentation of comprehensive studies on environmental baseline conditions of a contiguous area. It also includes an assessment of the carrying capacity of the area to absorb impacts from co-located projects such as those in industrial estates or economic zones.
(3) Initial Environmental Examination Report (IEER)	Document similar to an EIS, but with reduced details and depth of assessment and discussion.
(4) IEE Checklist (IEEC)	Simplified checklist version of an IEE Report, prescribed by the DENR, to be filled up by a proponent to identify and assess a projects environmental impact and the mitigation/enhancement measures to address such impacts.
(5) Project Description Report (PDR)	Document describes the nature, configuration, use of raw materials and natural resources, production system, waste or pollution generation and control and the activities of a proposed project. It includes a description of the use of human

Report Type	Descriptions
	resources as well as activity timelines, during the pre-construction, construction, operation and abandonment phases.
(6) Environmental Performance Report and Management Plan (EPRMP)	Documentation of the actual cumulative environmental impacts and effectiveness of current measures for single projects that are already operating but without ECC.
(7) Programmatic EPRMP (PEPRMP)	Documentation of actual cumulative environmental impacts of collocated projects with proposals for expansion. The PEPRMP should also describe the effectiveness of current environmental mitigation measures and plans for performance improvement.

Reference: DENR Administrative Order No. 2003-30.

4.2. Wastewater Environment and Sanitation

Existing drainage network for Tagbilaran City is shown in Figure A4.2-1.

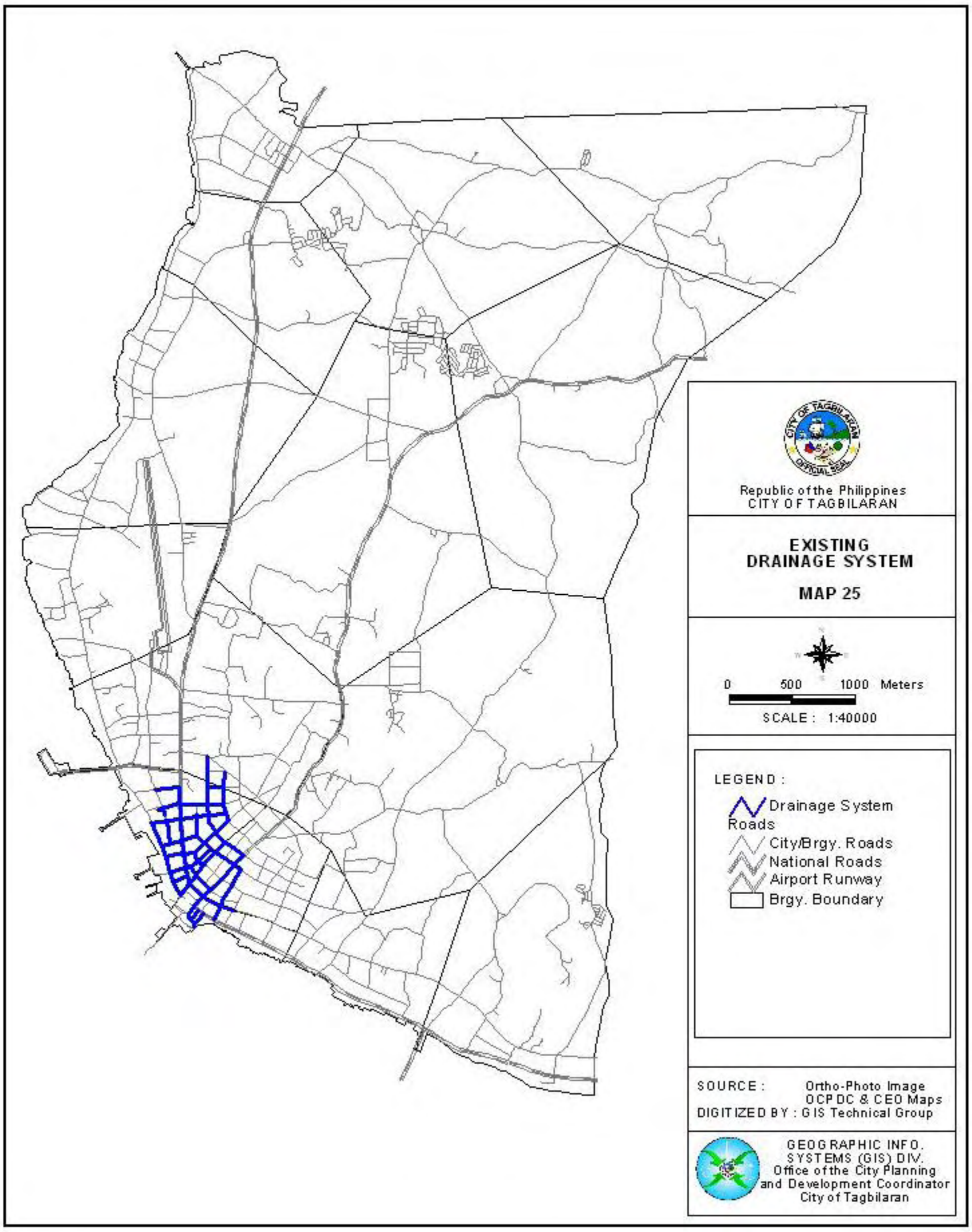


Figure A4.2-1 Existing Drainage Network in Tagbilaran City

The definition of water usage and classification regarding water quality standard is shown in Table A4.2-1.

Table A4.2-1 Water Usages and Classification

Fresh Surface Waters (Rivers, Lakes, Reservoirs etc.)	
Class AA Public Water Supply Class I	This class is intended primarily for water having watershed which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the National Standards for Drinking Water (NSDW) of the Philippines.
Class A Public Water Supply Class II	For sources of water supply that will require complete treatment (coagulation, sedimentation, filtration and disinfection) in order to meet the NSDW.
Class B Recreational Water Class I	For primary contact recreation such as bathing, swimming, skin diving, etc.
Class C	1) Fishery water for the propagation and growth of fish and other aquatic resources; 2) Recreational Water Class Ⅱ (Boating etc.) 3) Industrial Water Supply Class Ⅰ (for manufacturing processes after treatment)
Class D	1) For agriculture, irrigation, livestock watering, etc. 2) Industrial Water Supply Class Ⅱ (for cooling etc.) 3) Other inland waters, by their quality, belong to this classification
Coastal and Marine Waters	
Class SA	1) Waters suitable for the propagation, survival and harvesting of shellfish for commercial purposes; 2) Tourist zones and national marine parks and reserves established under Presidential Proclamation No.1801; existing laws and/or declared as such by appropriate government agency. 3) Coral reef parks and reserves designated by law and concerned authorities.
Class SB	1) Recreational Water Class I (Areas regularly used by the public for bathing, swimming, skin diving, etc.) 2) Fishery Water Class I (Spawning areas for Chanos chanos or "Bangus" and similar species).
Class SC	1) Recreational Water Class Ⅱ (Boating etc.) 2) Fishery Water Class Ⅱ (Commercial and sustenance fishing); 3) Marshy and/or mangrove areas declared as fish and wildlife sanctuaries
Class SD	1) Industrial Water Supply Class Ⅱ (for cooling etc.) 2) Other coastal and marine waters, by their quality, belong to this classification.

The effluent standards by classification are shown in Table A4.2-2 and Table A4.2-3.

Table A4.2-2 Effluent Standard: Heavy Metals and Toxic Substances

Parameter	Unit	Protected Waters[1]				Inland Waters[2]		Marine Waters[3]			
		Category I (AA & SA)		Category II (A, B & SB)		Class C		Class SC		Class SD	
		OEI [4]	NPI[5]	OEI	NPI	OEI	NPI	OEI	NPI	OEI	NPI
Arsenic	mg/L	B	B	0.2	0.1	0.5	0.2	1.0	0.5	1.0	0.5
Cadmium	mg/L	B	B	0.05	0.02	0.1	0.05	0.2	0.1	0.5	0.2
Chromium (hexavalent)	mg/L	B	B	0.1	0.05	0.2	0.1	0.5	0.2	1.0	0.5
Cyanide	mg/L	B	B	0.2	0.1	0.3	0.2	0.5	0.2	-	-
Lead	mg/L	B	B	0.2	0.1	0.5	0.3	1.0	0.5	-	-
Total Mercury[(i)]	mg/L	B	B	0.005	0.005	0.005	0.005	0.005	0.005	0.05	0.01
PCB	mg/L	B	B	0.003	0.003	0.003	0.003	0.003	0.003	-	-
Formaldehyde	mg/L	B	B	2.0	1.0	2.0	1.0	2.0	1.0		

Definition:

1) Protected Waters: means a watercourse or a body of water, or any segment thereof, that is classified as a source of public water supply, propagation and harvesting of shellfish for commercial purposes, or spawning areas for Chanos chanos and similar species, or primary contact recreation, or that which is designated by competent government

authority or by legislation as tourist zone, national marine park and reserve, including coral reef park and reserve.

2) Inland Waters: means an interior body of water or watercourse such as lakes, reservoirs, rivers, streams, creeks, etc., that has beneficial usage other than public water supply or primary contact recreation. Tidal affected rivers or streams are considered inland waters for purposes of these regulations.
3) Marine Waters: means an open body of water along the country's coastline starting from the shoreline (MLLW) and extending outward up to the 200-meter isobath or three-kilometer distance, whichever is farther.
4) OEI: means Old or Existing Industry.
5) NPI: means New/Proposed Industry or wastewater treatment plants to be constructed.

Legend:

(A) The Effluent Standard applies to industrial/manufacturing plants and municipal sewage treatment plants discharging more than 30 cu.m.per day.
(B) Discharge of sewage and/or trade effluents are prohibited or not allowed.

Table A4.2-3 Effluent Standard for BOD for Strong Industrial Wastes in C,D, SC and SD Water

Industrial Classification Based on BOD of Raw Wastewaters Produced	Maximum Allowable Limits in mg/l, according to Time Period and Receiving Water Body					
	Existing Industries affectivity date				**New Industries**	
	Dec. 31, 1991		Jan. 1, 1991-Dec. 31, 1994			
	Inland Waters	Coastal Waters	Inland Waters	Coastal Waters	Inland Waters	Coastal Waters
Classification	C & D	SC & SD	C & D	SC & SD	C & D	SC & SD
1. Industries producing BOD within 3,000 to 10,000 mg/L	320 or 95% removal	650 or 90% removal	200 or 97% removal	320 or 95% removal	130 or 98% removal	200 or 97% removal
2. Industries producing BOD within 10,000 to 30,000 mg/L	1,000 or 95% removal	2,000 or 90% removal	600 or 97% removal	1,000 or 95% removal	200 or 99% removal	600 or 97% removal
3. Industries producing more than or 30,000 mg/L	1,500 or 95% removal	3,000 or 90% removal	900 or 97% removal	1,500 or 95% removal	300 or 99% removal	900 or 97% removal

Note:

1) Use either the numerical limit or percentage removal whichever is lower (or whichever is more strict)
2) For parameters other than BOD, Table 5.3-3 shall apply.

4.3. Conceptual Design of Sewerage System

General layout plan and Profile of trunk sewer by sewerage system are shown in the following Tables and Figures.

(1) Tagbilaran Sewerage System

General Layout Plan –	Figure A4.3-1
Profile of Trunk Sewer-	Figure A4.3-2~19
Flow Computation-	Table A4.3-1~4

(2) Dauis Sewerage System

General Layout Plan-	Figure A4.3-20
Profile of Trunk Sewer-	Figure A4.3-21~22
Flow Computation-	Table A4.3-5

(3) Panglao Sewerage System

General Layout Plan-	Figure A4.3-23
Profile of Trunk Sewer-	Figure A4.3-25~30
Flow Computation-	Table A4.3-6

(4) Alona Beach Sewerage System

General Layout Plan-	Figure A4.3-24
Profile of Trunk Sewer-	Figure A4.3-31~33
Flow Computation-	Table A4.3-7

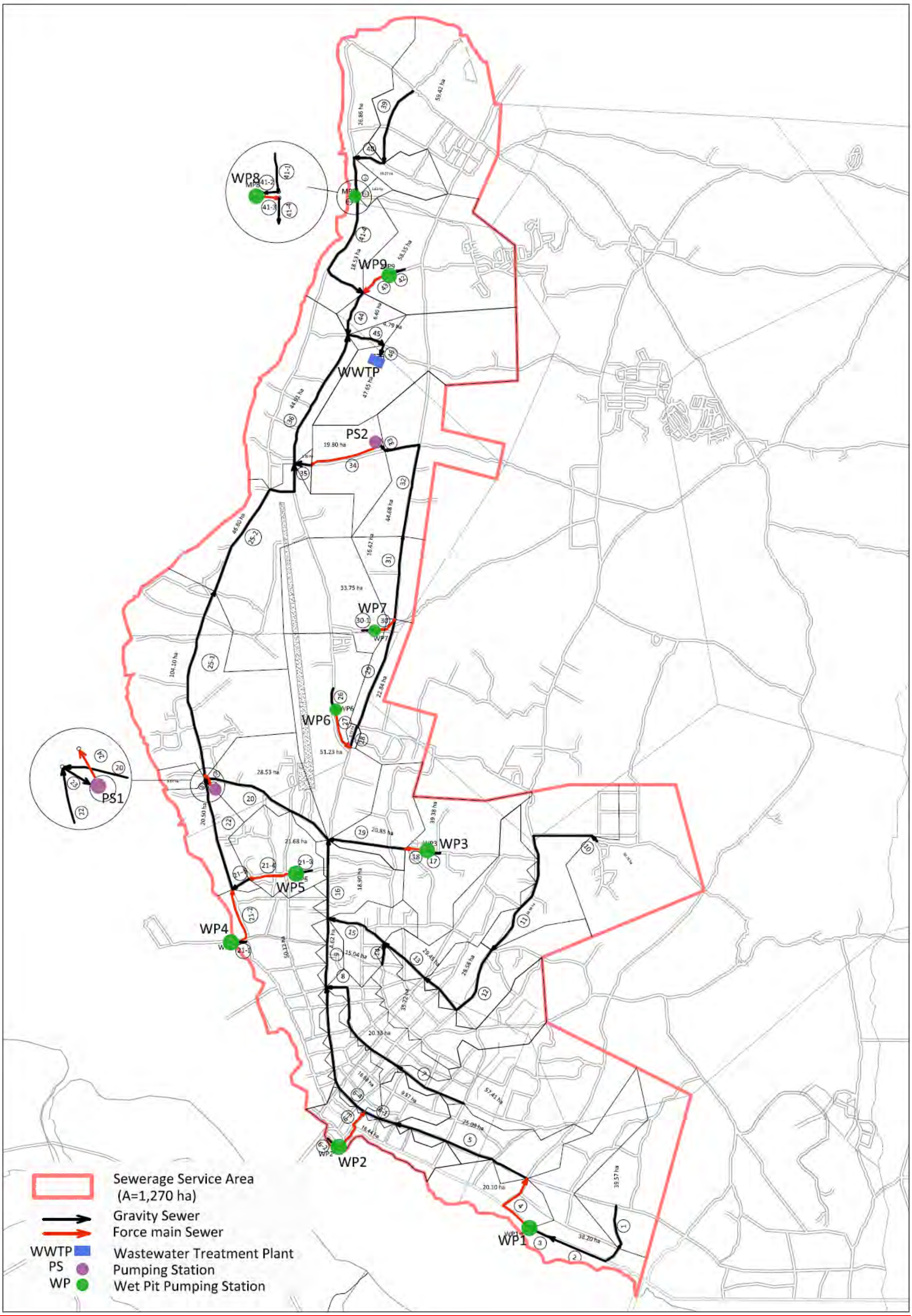


Figure A4.3-1 General Layout Plan of Tagbilaran Sewerage System

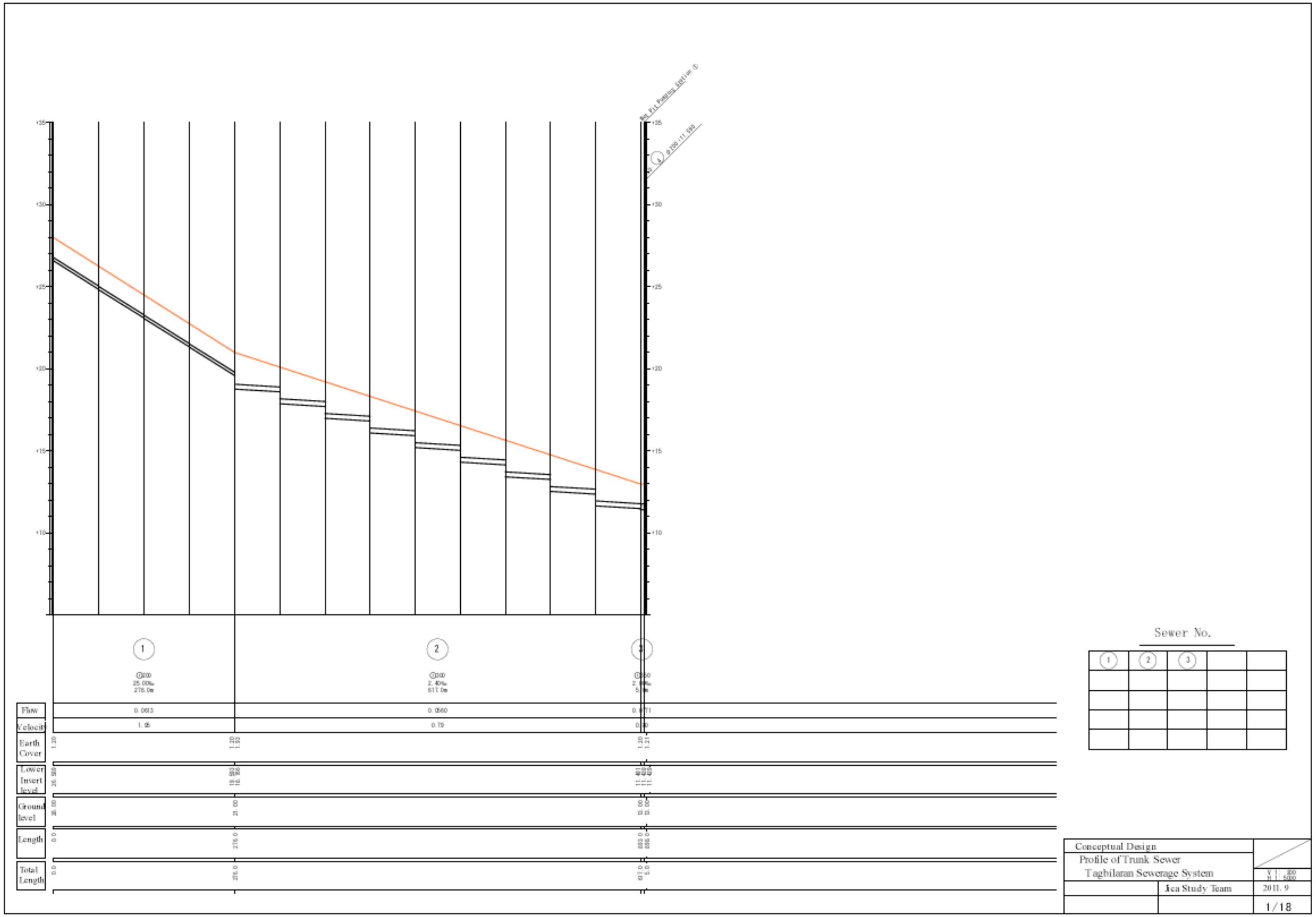


Figure A4.3-2 Profile of Trunk Sewer (Tagbilaran Sewerage System)

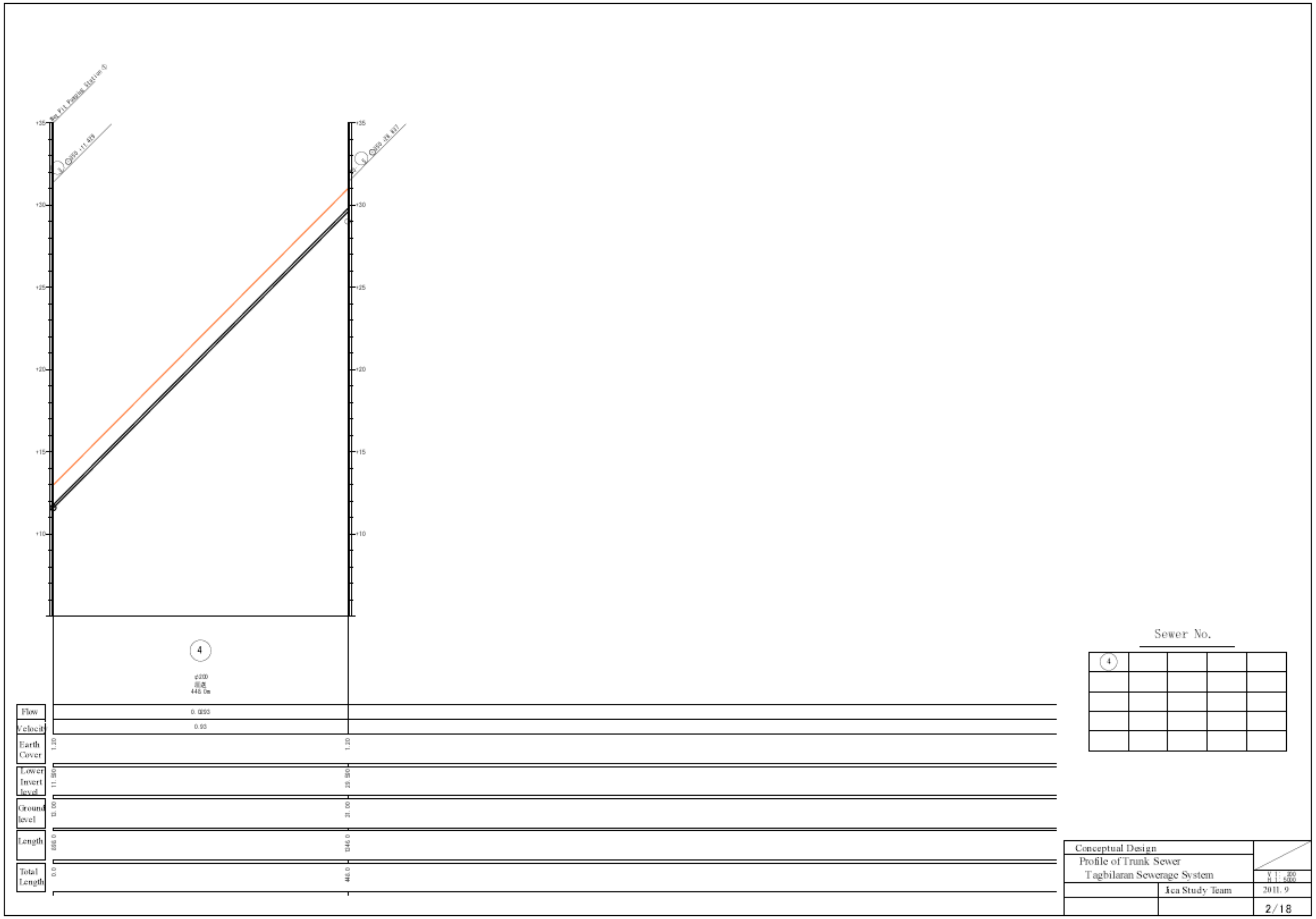


Figure A4.3-3 Profile of Trunk Sewer (Tagbilaran Sewerage System)

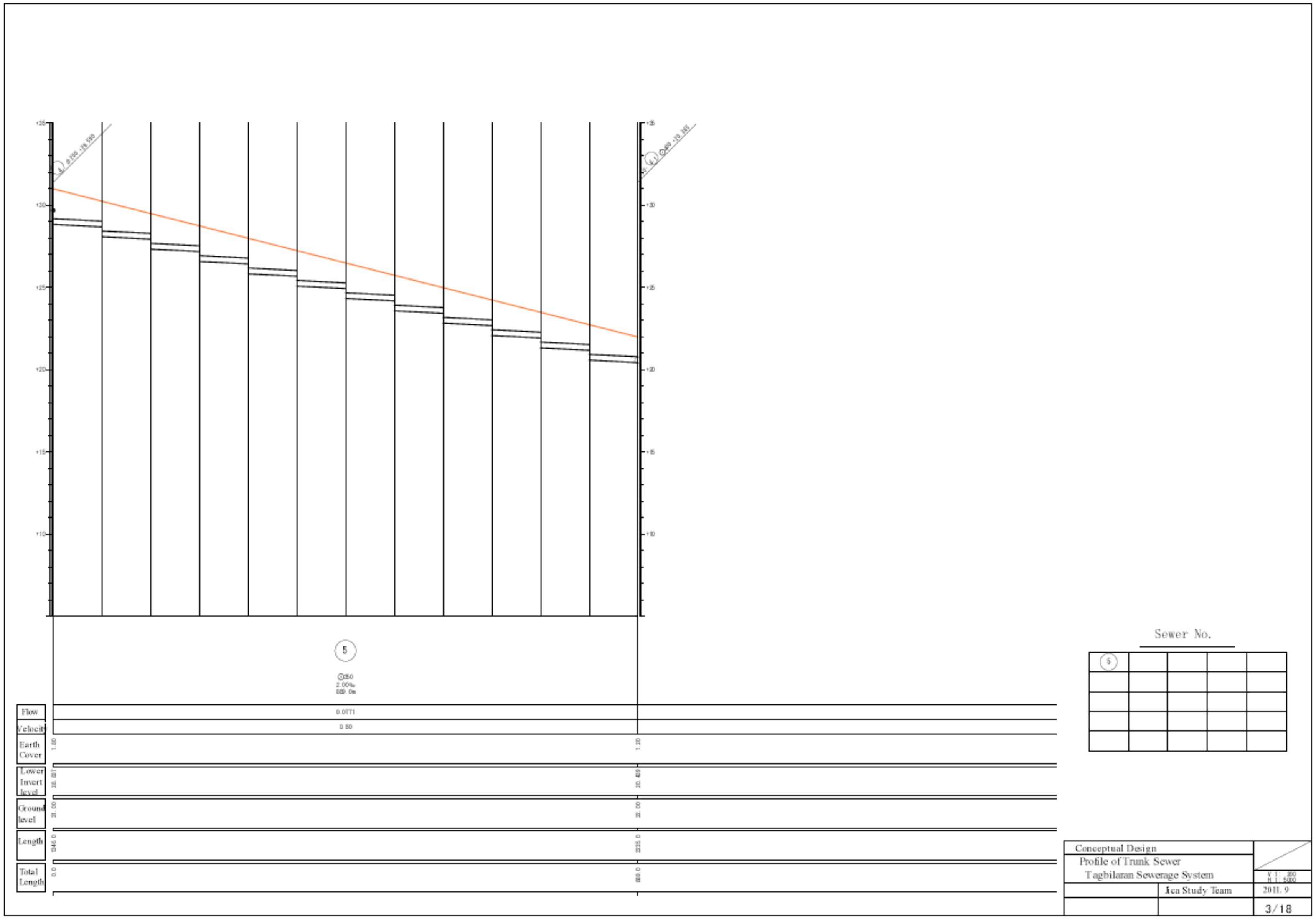


Figure A4.3-4 Profile of Trunk Sewer (Tagbilaran Sewerage System)

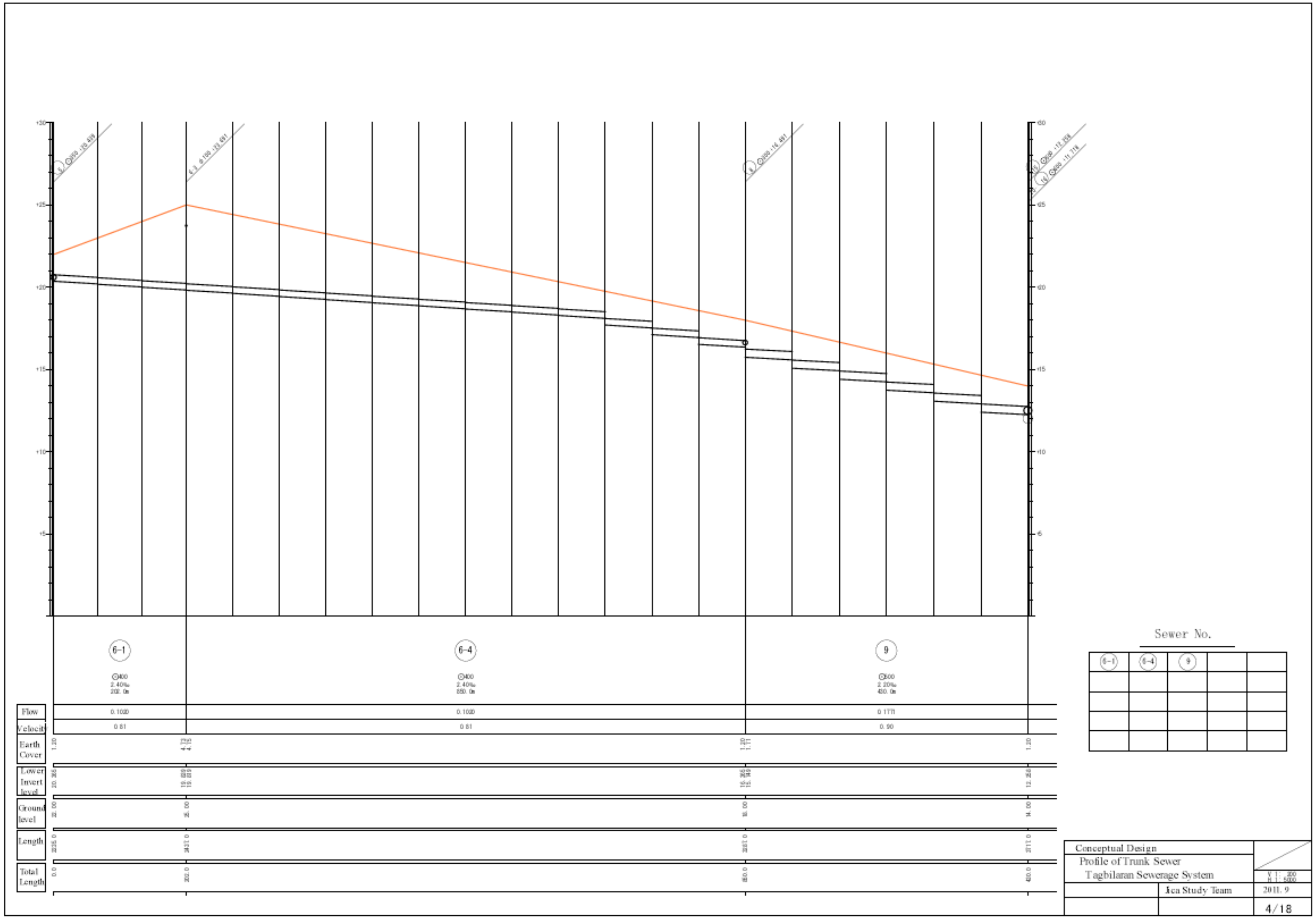


Figure A4.3-5 Profile of Trunk Sewer (Tagbilaran Sewerage System)

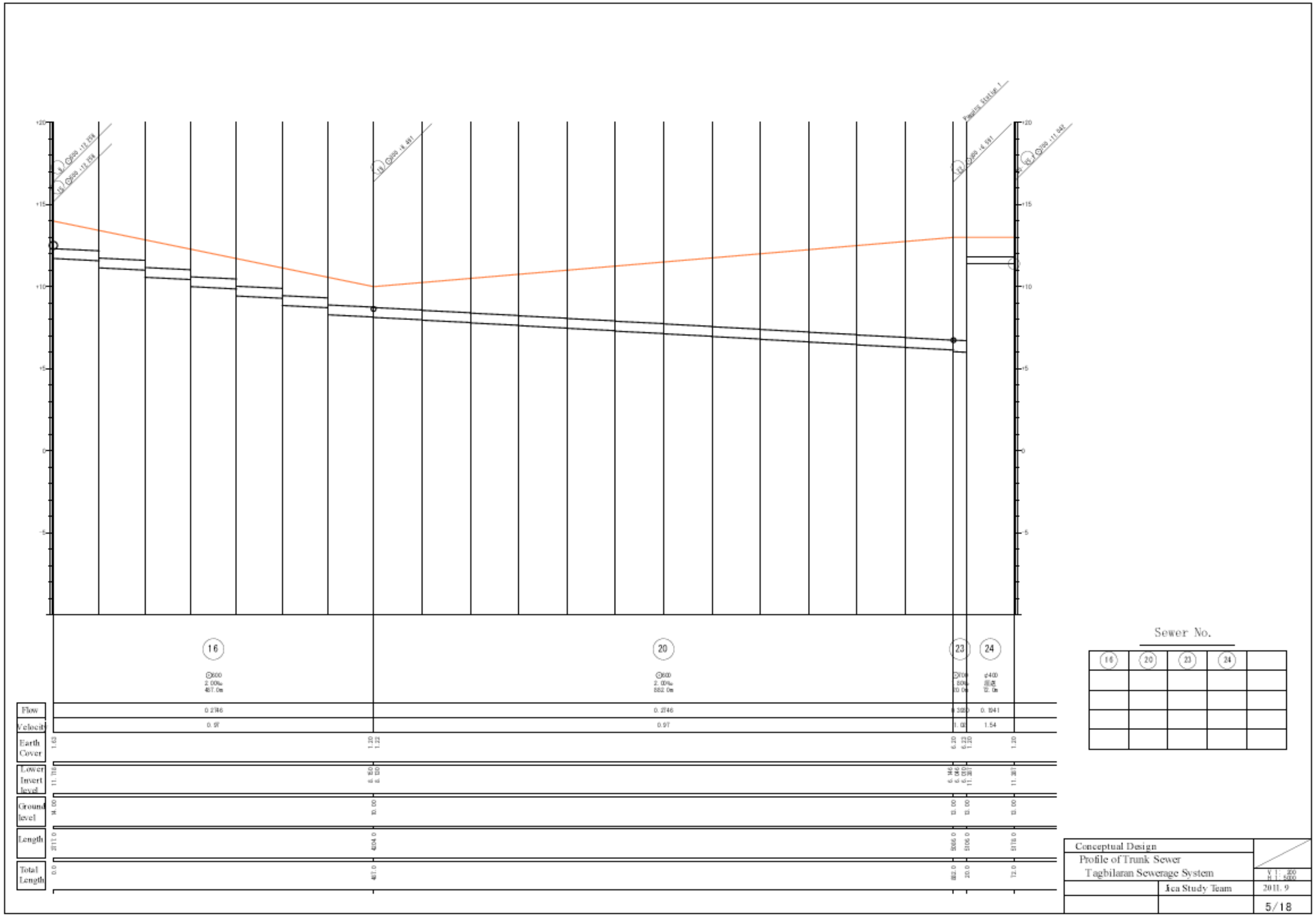


Figure A4.3-6 Profile of Trunk Sewer (Tagbilaran Sewerage System)

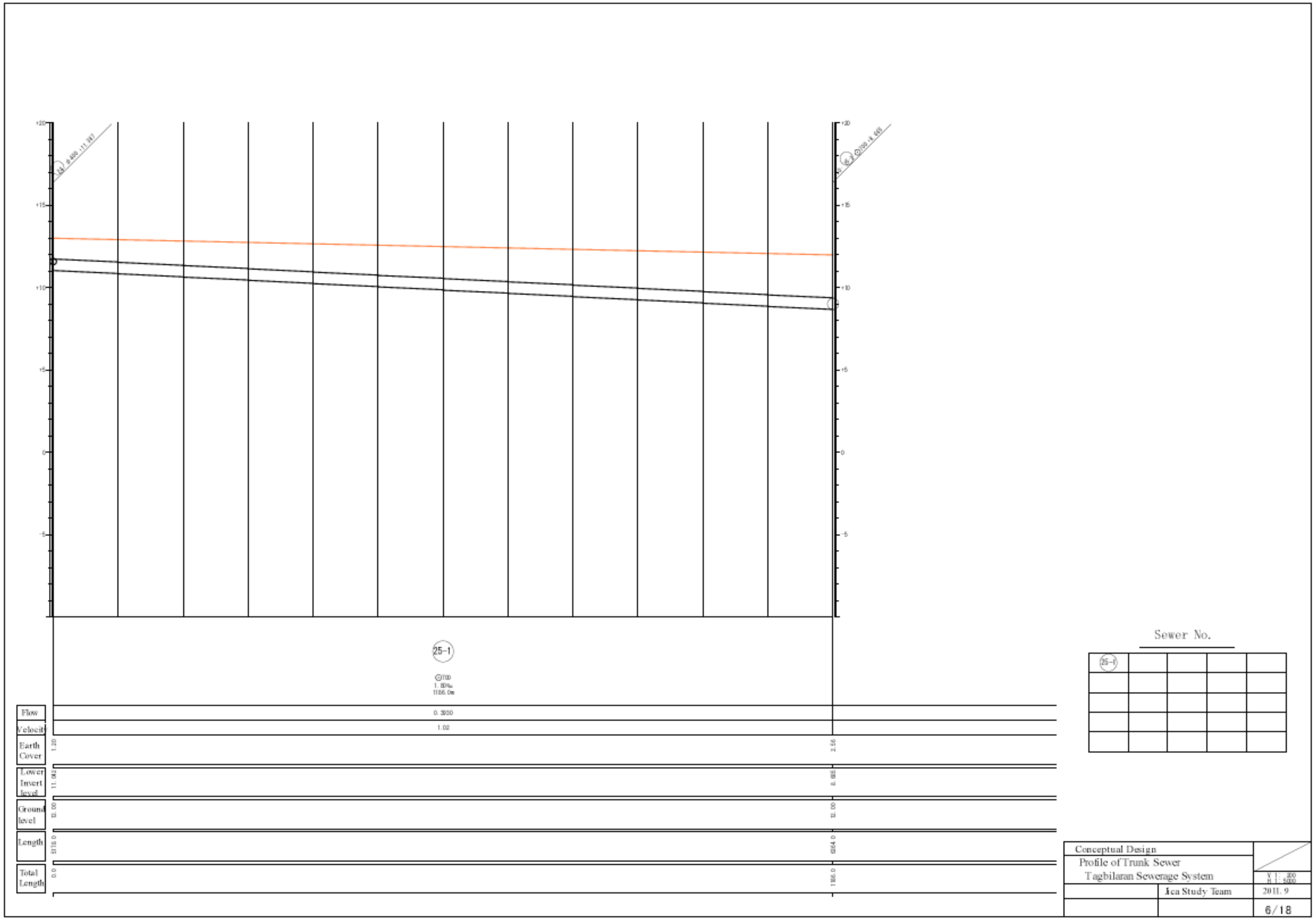


Figure A4.3-7 Profile of Trunk Sewer (Tagbilaran Sewerage System)

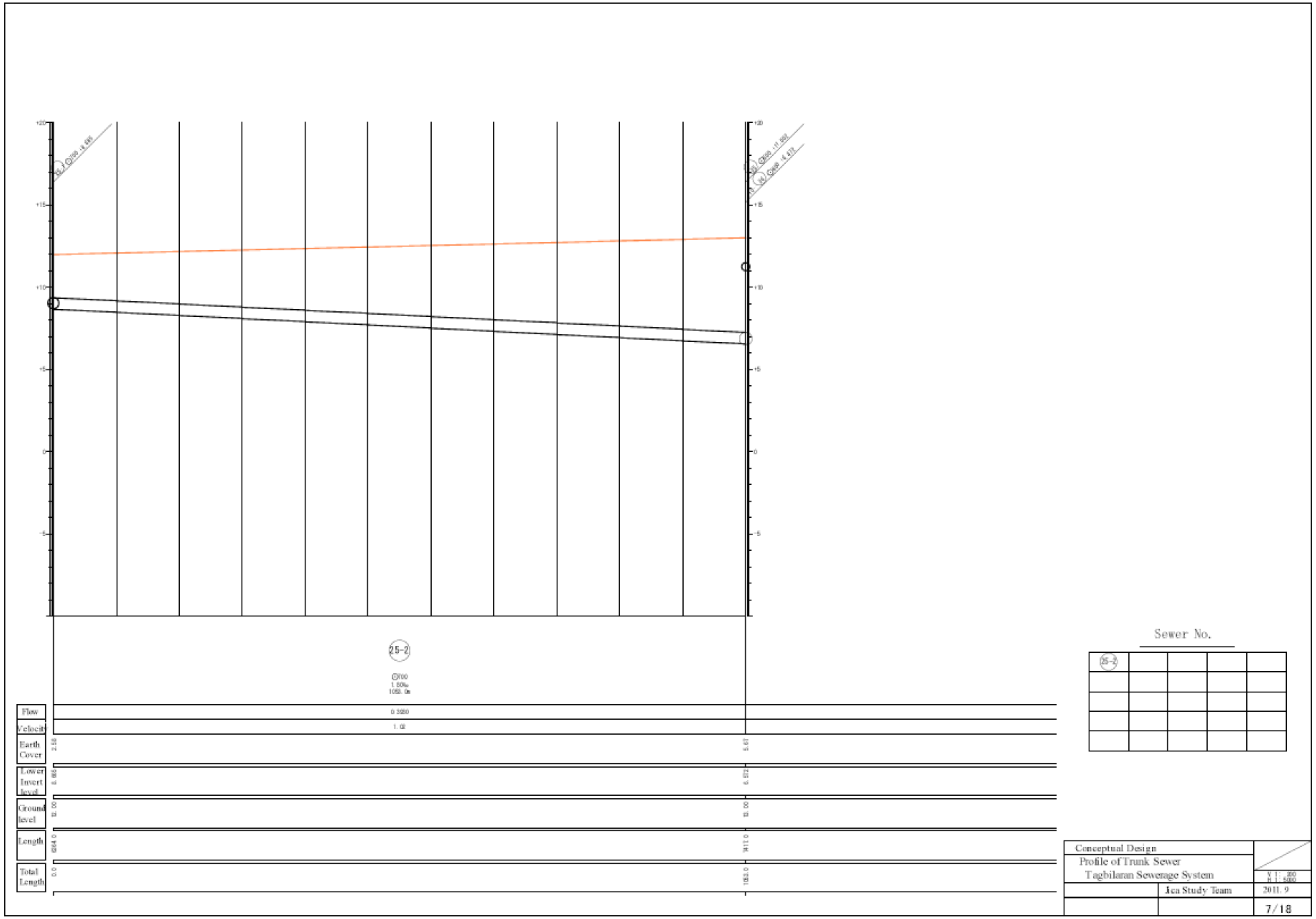


Figure A4.3-8 Profile of Trunk Sewer (Tagbilaran Sewerage System)

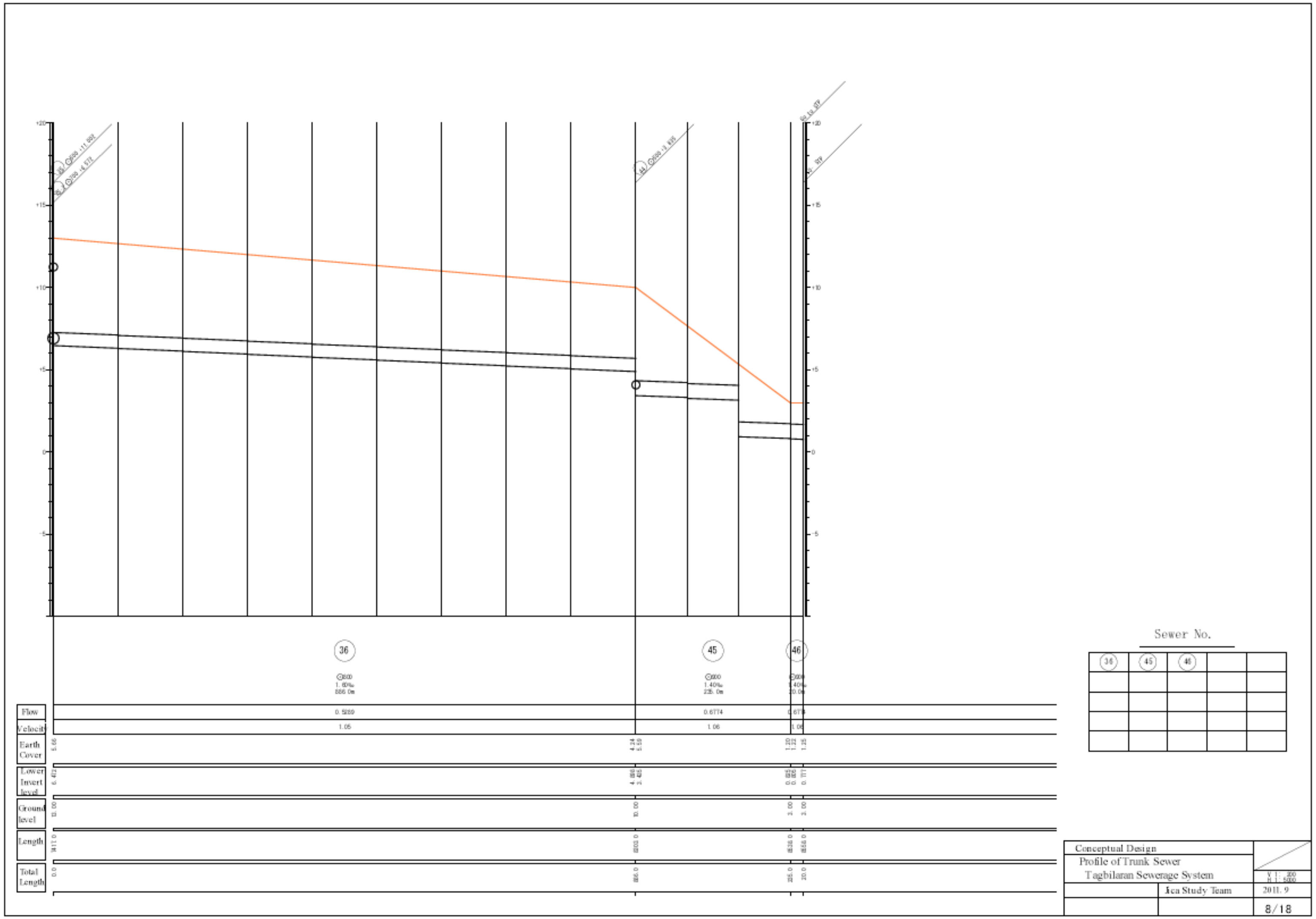


Figure A4.3-9 Profile of Trunk Sewer (Tagbilaran Sewerage System)

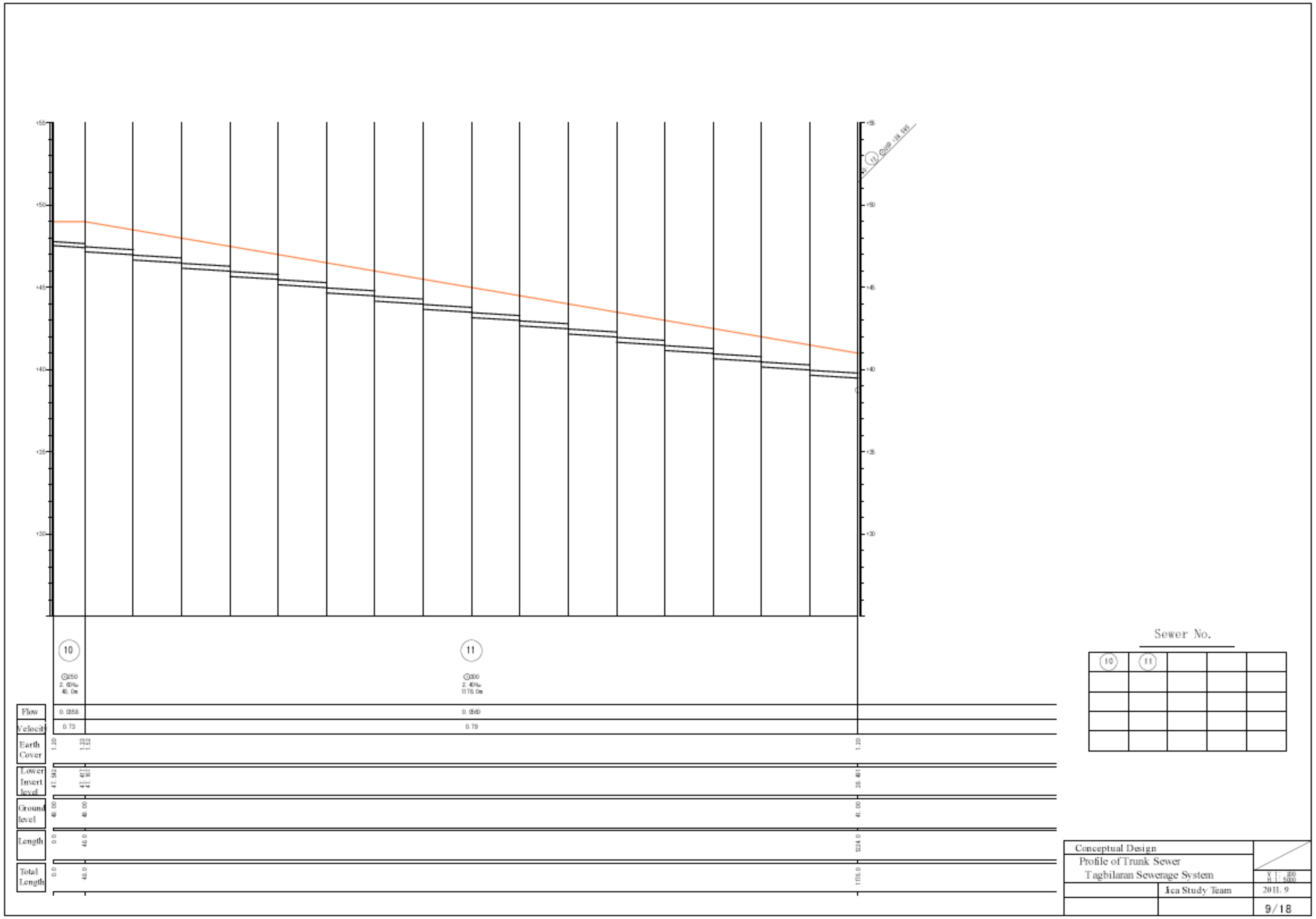


Figure A4.3-10 Profile of Trunk Sewer (Tagbilaran Sewerage System)

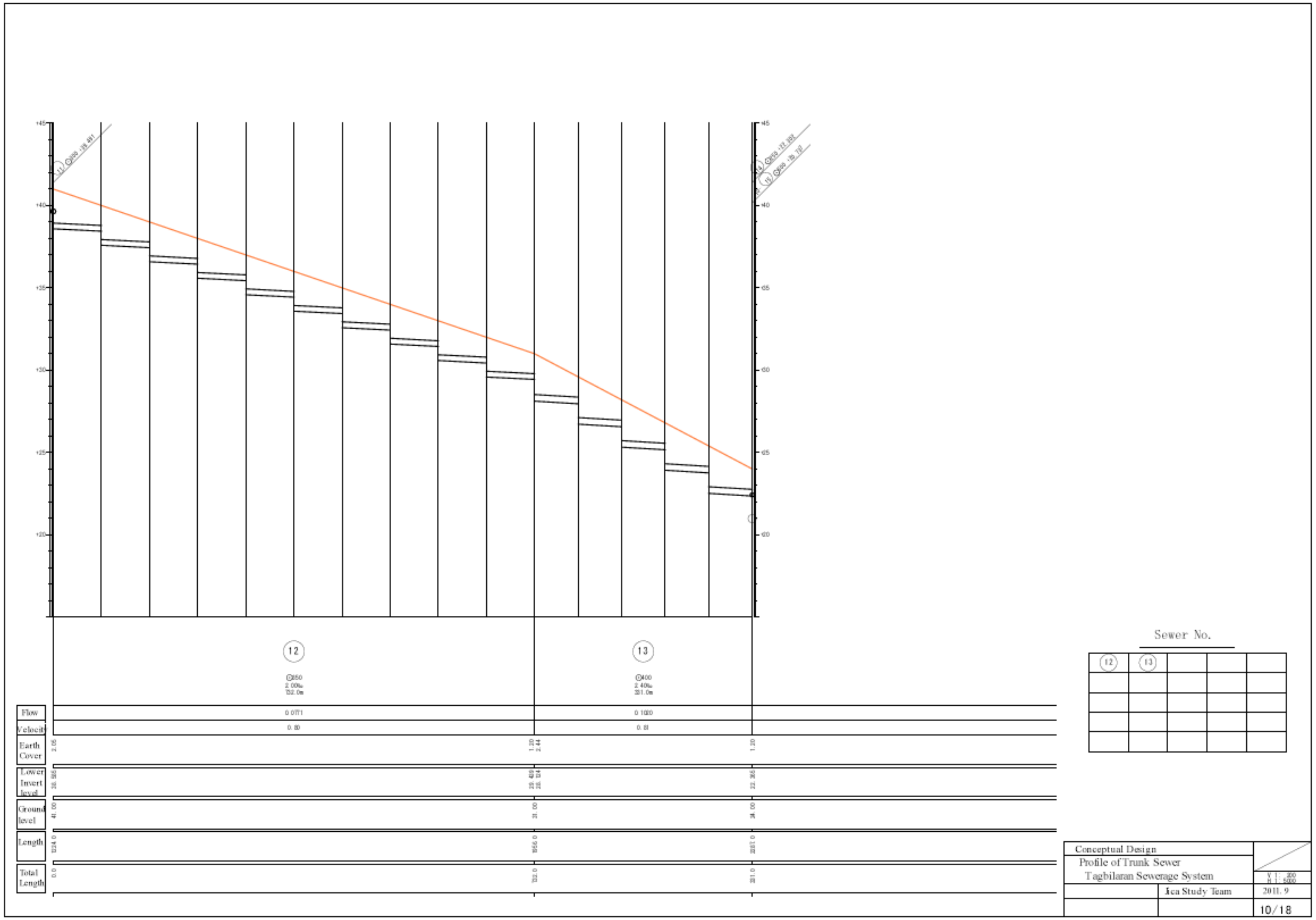


Figure A4.3-11 Profile of Trunk Sewer (Tagbilaran Sewerage System)

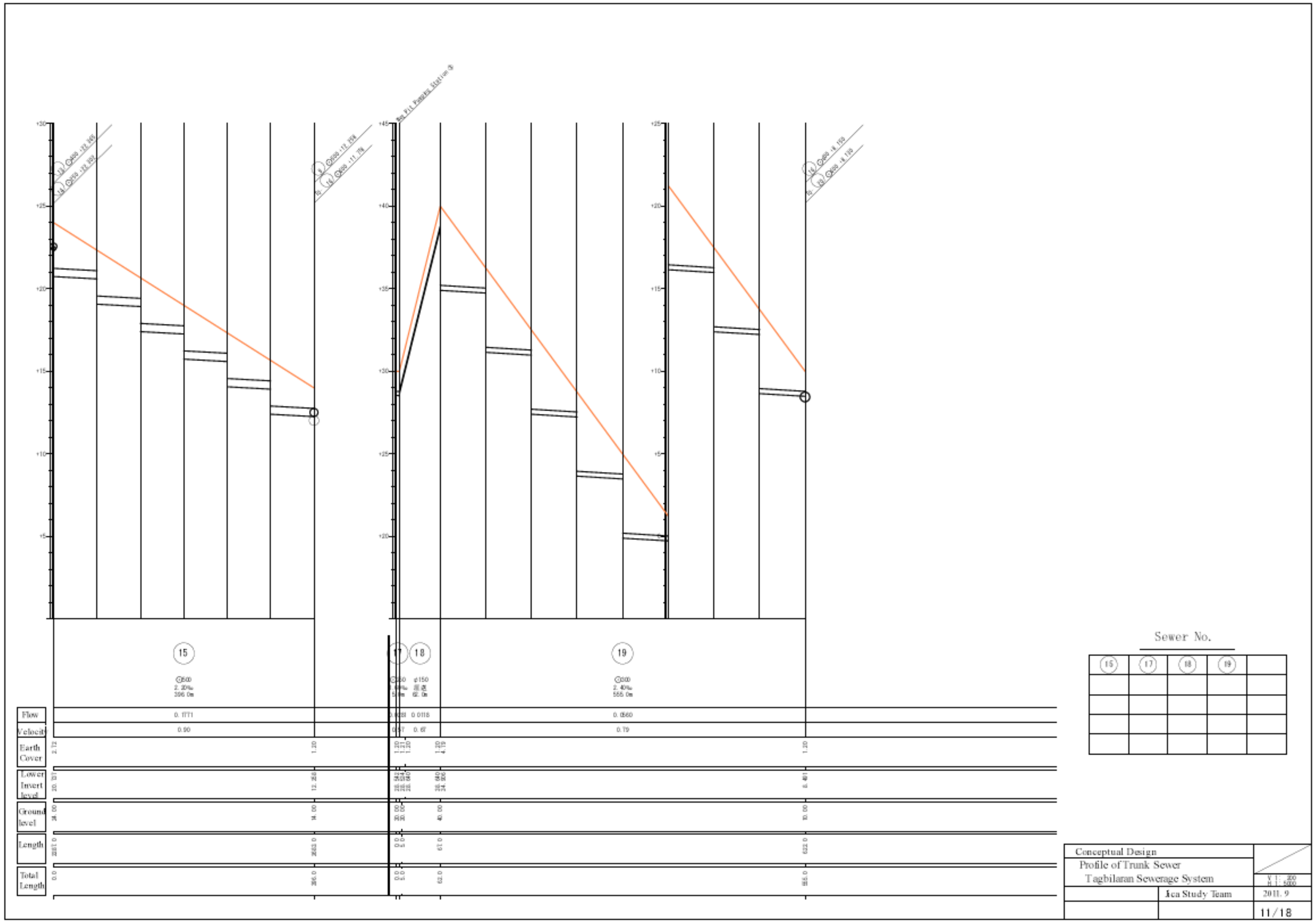


Figure A4.3-12 Profile of Trunk Sewer (Tagbilaran Sewerage System)

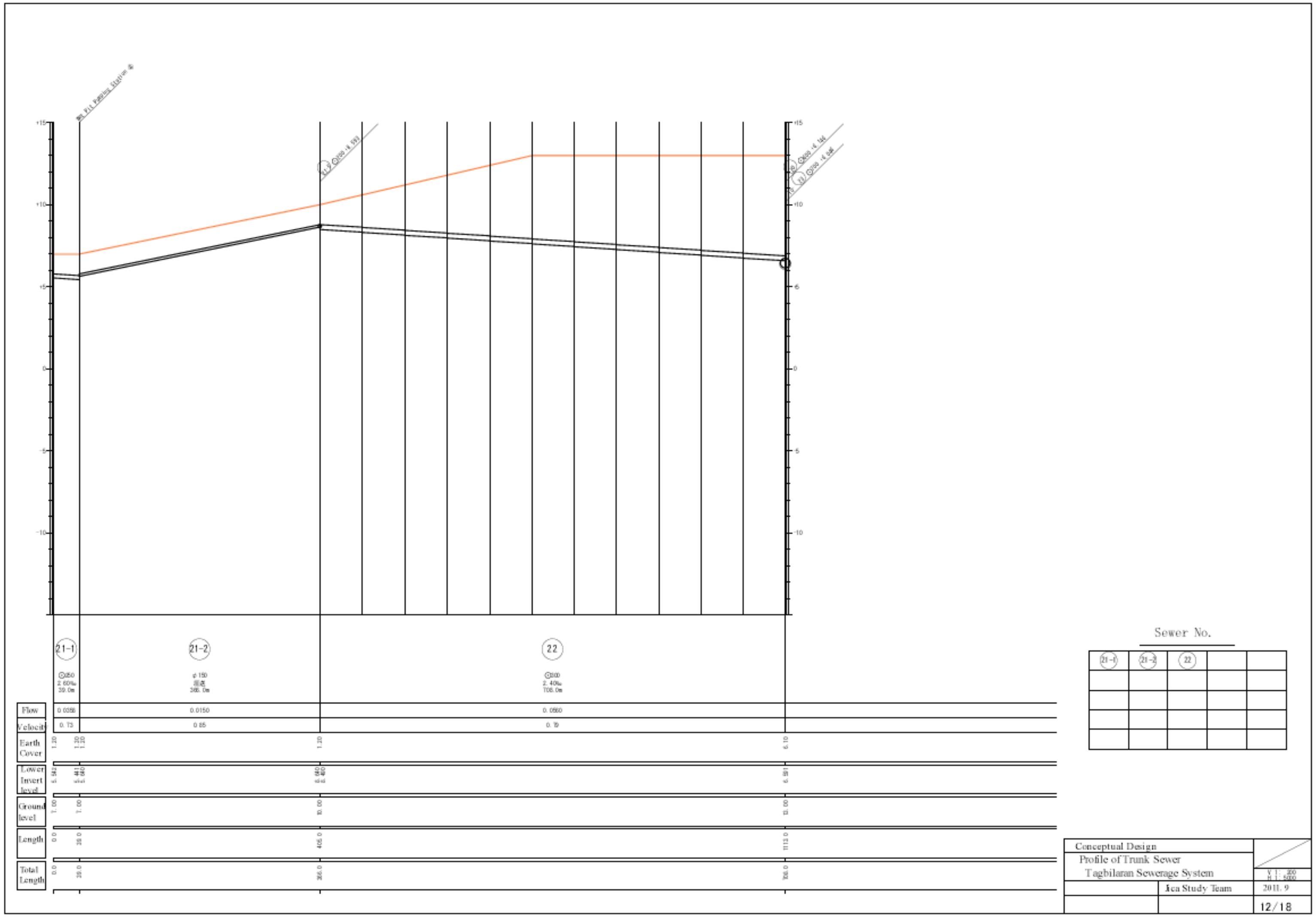


Figure A4.3-13 Profile of Trunk Sewer (Tagbilaran Sewerage System)

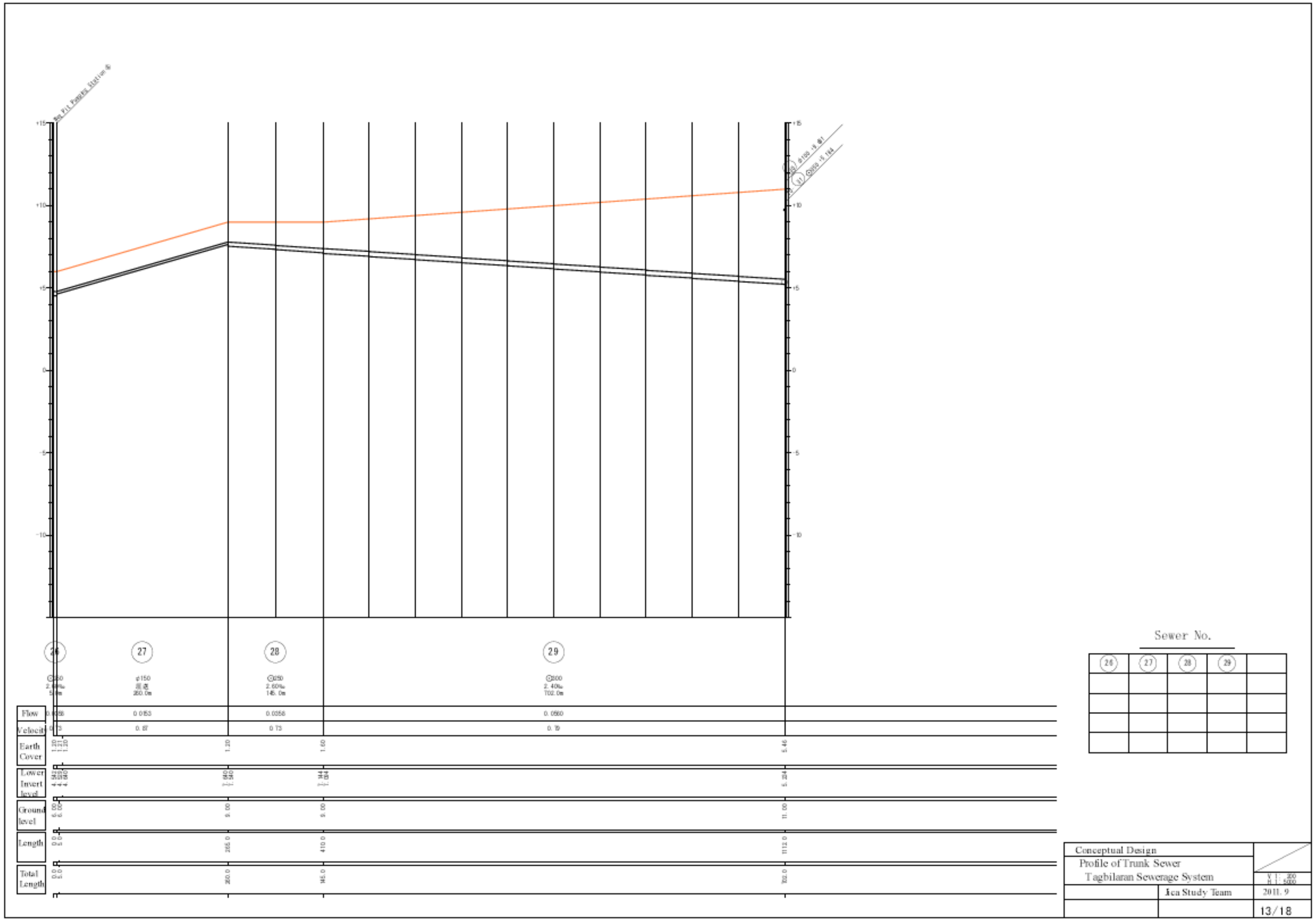


Figure A4.3-14 Profile of Trunk Sewer (Tagbilaran Sewerage System)

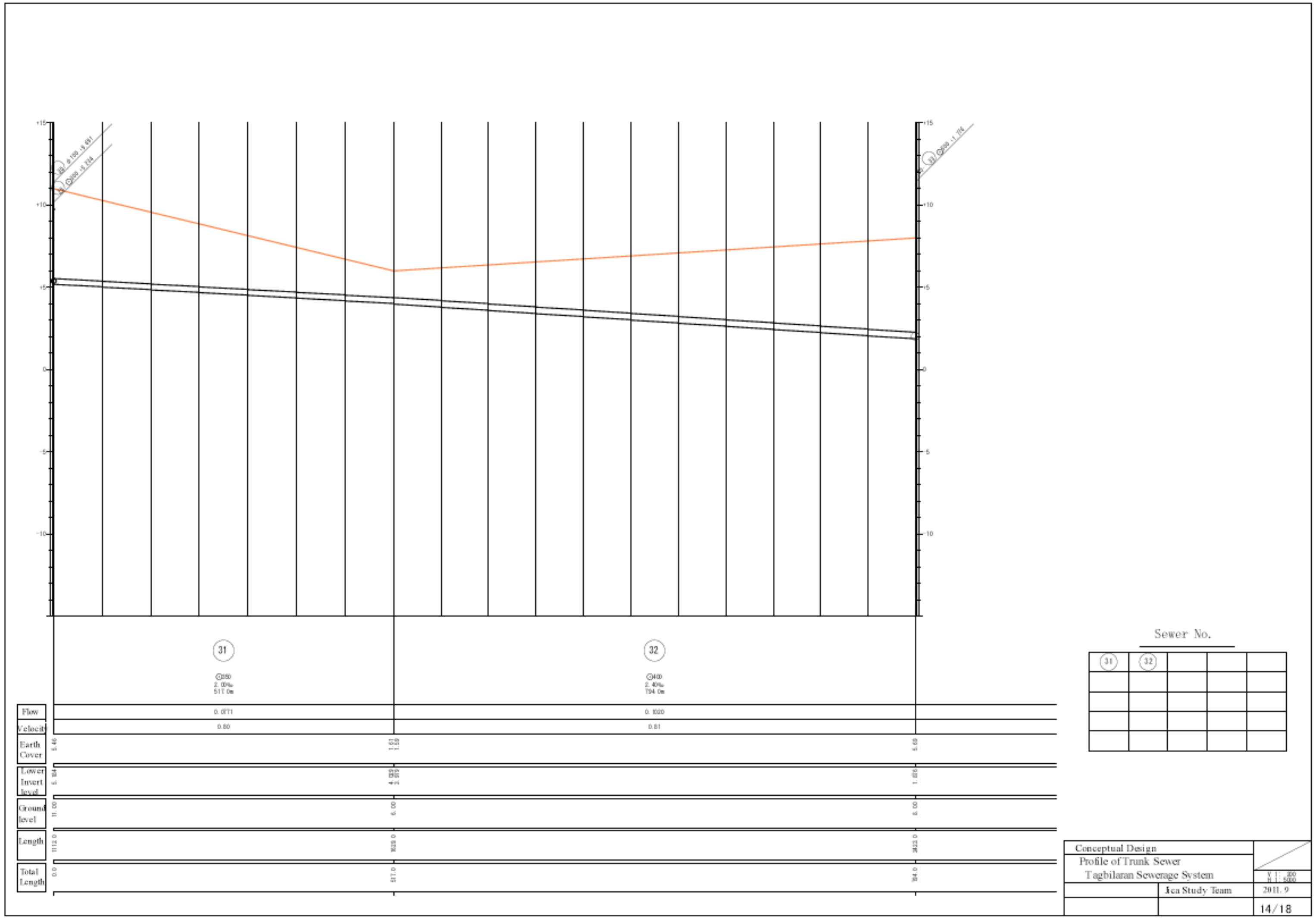


Figure A4.3-15 Profile of Trunk Sewer (Tagbilaran Sewerage System)

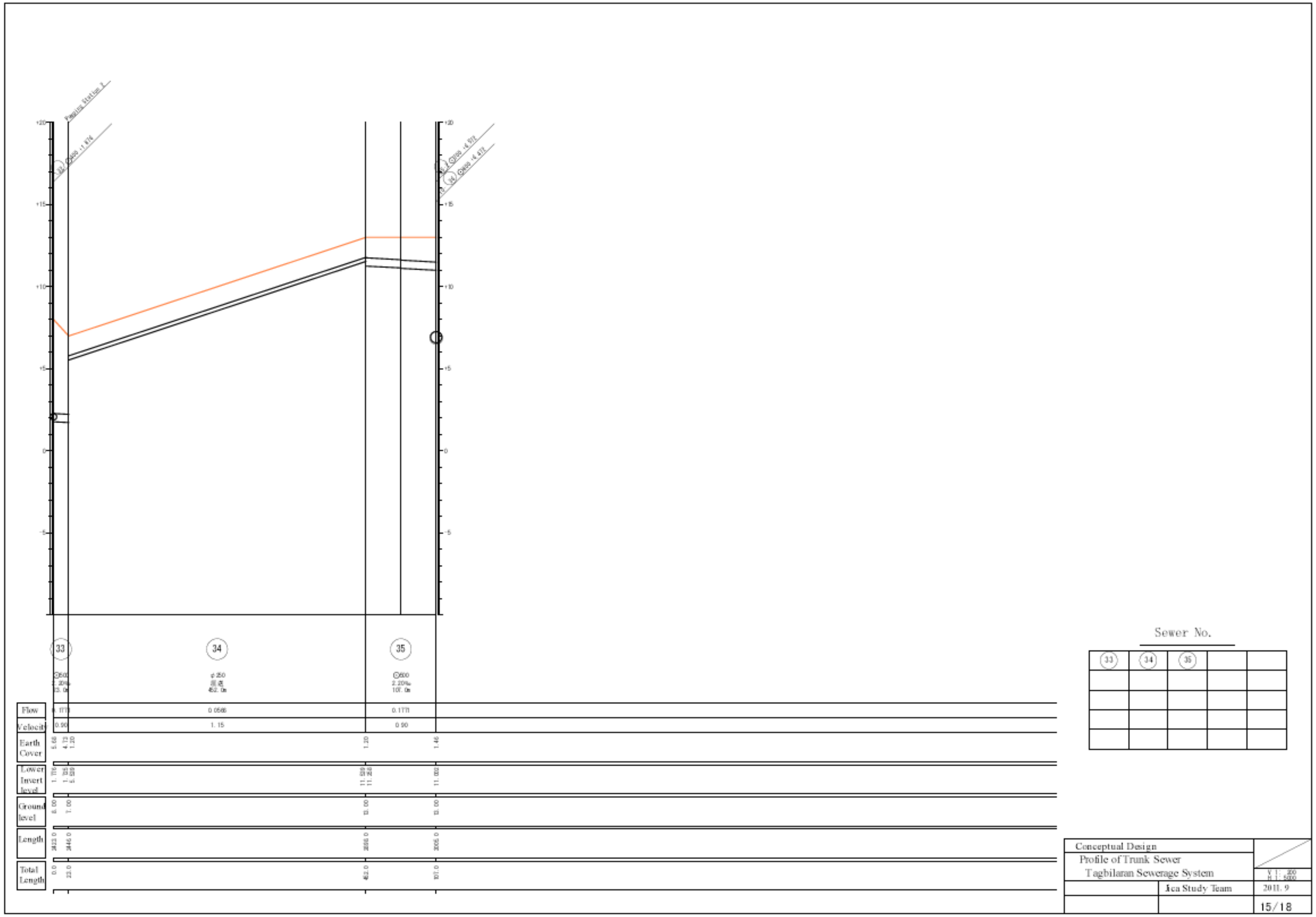


Figure A4.3-16 Profile of Trunk Sewer (Tagbilaran Sewerage System)

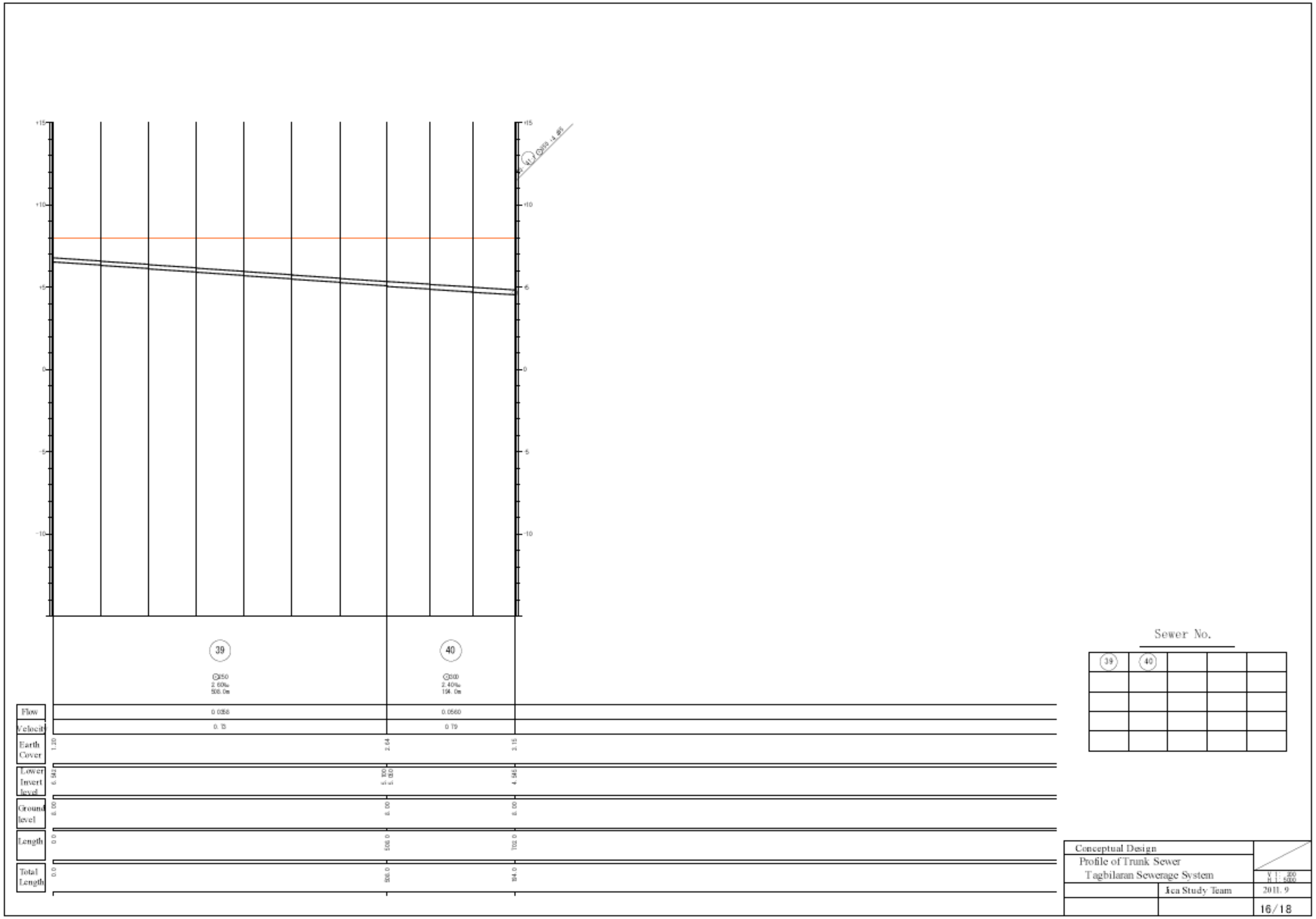


Figure A4.3-17 Profile of Trunk Sewer (Tagbilaran Sewerage System)

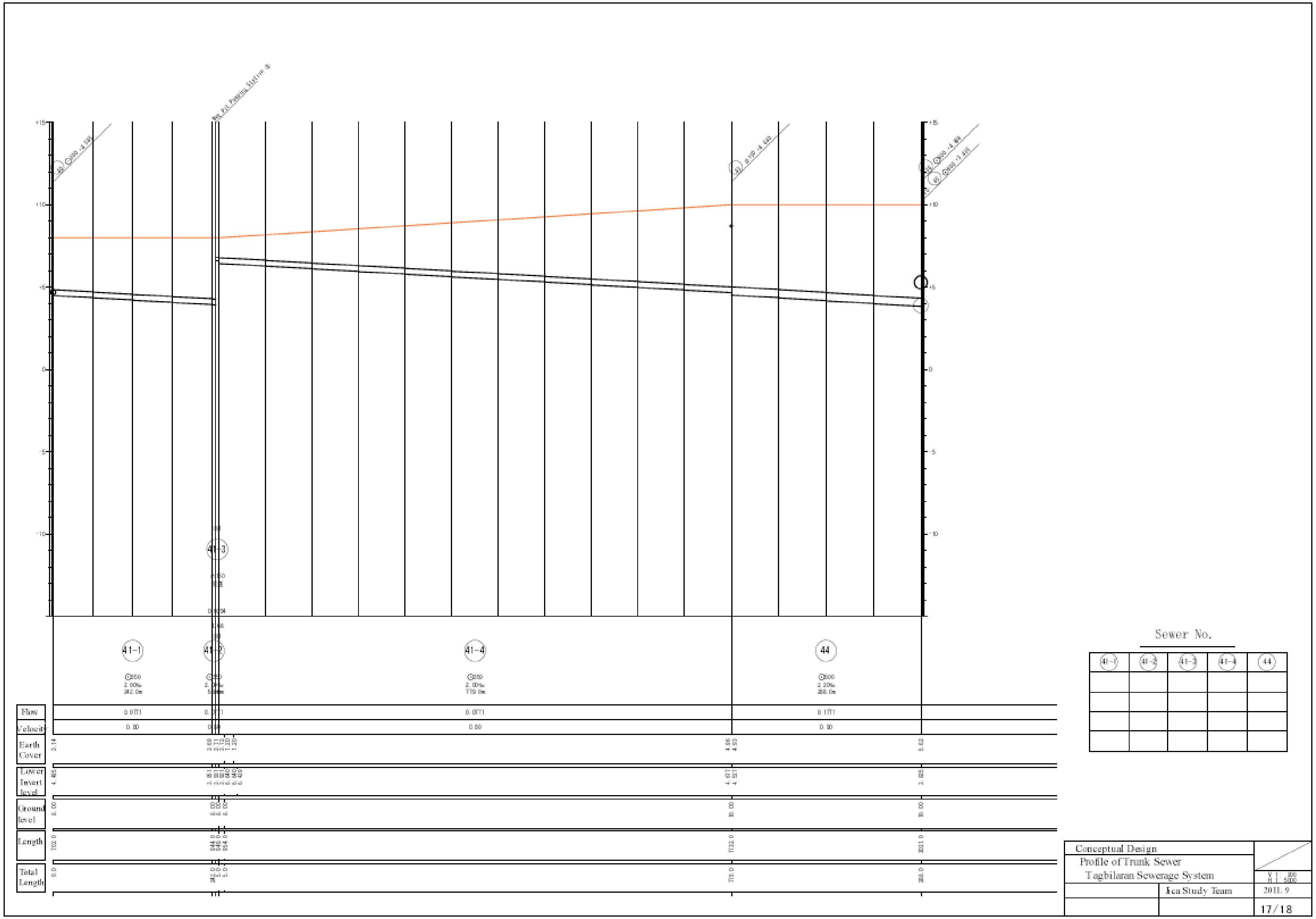


Figure A4.3-18 Profile of Trunk Sewer (Tagbilaran Sewerage System)

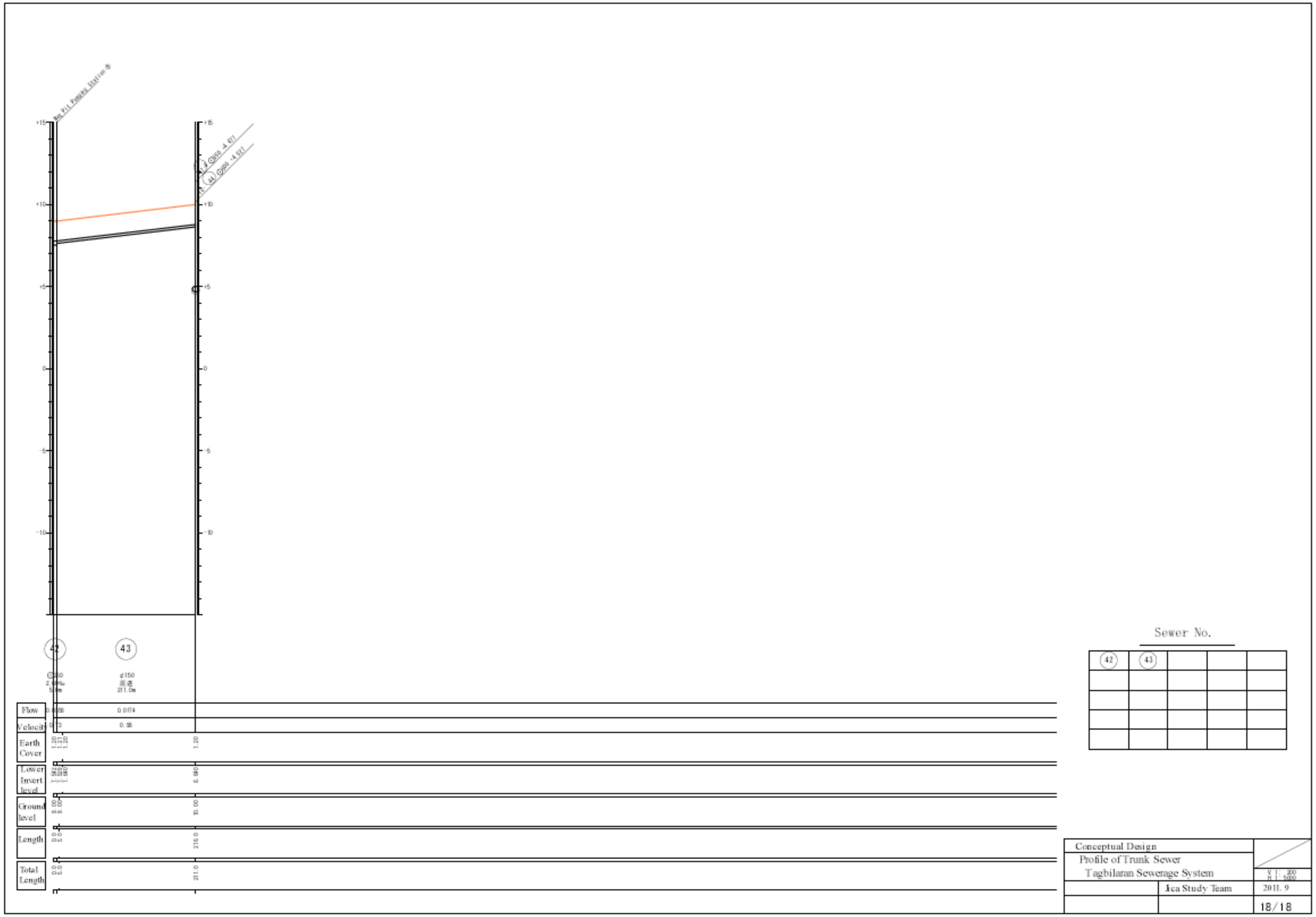


Figure A4.3-19 Profile of Trunk Sewer (Tagbilaran Sewerage System)

Table A4.3-1 Flow Computation of Tagbilaran Sewerage System (1/4)

From	To	Catchment Area				Length		Waste Water Flow					Pipe Design								Remarks
					Total			Unit flow per ha			Other input								Earth		
		Each Sum	Each Sum	Each Sum	Each Sum	Each	Total			0.0002989	Each Sum	Total	Dia.	Slope	Velocity	Flow	G.L	I.L	Cover		
		ha	ha	ha	ha	m	m	m³/sec	m³/sec	m³/sec	m³/sec	m³/sec	mm	‰	m/sec	m³/sec	M	M	m		
1					3957								VU				2800	26589	120		
					3957	276	276			001183		0012	⊙ 200	250	195	0061	2100	19593	120		
2					3820								VU				2100	18766	193		
					7777	617	893			002325		0023	⊙ 300	24	079	0056	1300	11491	120		
3					2010								VU				1300	11439	120		
					9787	5	898			002925		0029	⊙ 350	20	080	0077	1300	11429	121		
4					000									Force			1300	11640	120		Wet Pit Pumping Station
					9787	448	1346			002925		0029	ϕ 150	main	166	0029	3100	29640	120		①
5					2509								VU				3100	28837	180		
					12296	889	2235			003675		0037	⊙ 350	20	080	0077	2200	20439	120		
6	9				4259												2200	20267	130		
					16555	1052	3287			004948		0050	⊙ 400	24	081	0102	1800	16365	120		
7					5741								VU				3600	33862	188		
					5741	478	478			001716		0017	⊙ 250	26	073	0036	3000	28542	120		
8					2033								VU				3000	27568	212		
					7774	766	1244			002324		0023	⊙ 300	24	079	0056	1800	16491	120		
9	16				462												1800	15749	171		
					24791	430	3717			007410		0074	⊙ 500	22	090	0177	1400	12258	120		
10					5075								VU				4900	47542	120		
					5075	48	48			001517		0015	⊙ 250	26	073	0036	4900	47417	133		
11					3898								VU				4900	47167	152		
					8973	1176	1224			002682		0027	⊙ 300	24	079	0056	4100	39491	120		
12					2858								VU				4100	38585	205		
					11831	732	1956			003536		0035	⊙ 350	20	080	0077	3100	29439	120		
13	15				2945												3100	28124	244		
					14776	331	2287			004417		0044	⊙ 400	24	081	0102	2400	22365	120		
14					3572								VU				2400	22542	120		
					3572	137	137			001068		0011	⊙ 250	16	057	0028	2400	22302	144		
15					1504												2400	20737	272		
					19852	396	2683			005934		0059	⊙ 500	22	090	0177	1400	12258	120		

Table A4.3-2 Flow Computation of Tagbilaran Sewerage System (2/4)

From	To	Catchment Area				Length		Waste Water Flow					Pipe Design							Remarks
					Total	Each	Total	Unit flow per ha			Other input	Total	Dia.	Slope	Velocity	Flow	G.L	I.L	Earth Cover	
		Each Sum	Each Sum	Each Sum	Each Sum					0.0002989	Each Sum									
		ha	ha	ha	ha	m	m	m³/sec	m³/sec	m³/sec	m³/sec	m³/sec	mm	‰	m/sec	m³/sec	M	M	m	
16	20				1890												1400	11718	163	
					46533	487	4204			013909		0139	⊙ 600	20	097	0275	1000	8150	120	
17					3938								VU				3100	29542	120	
					3938	5	5			001177		0012	⊙ 250	16	057	0028	3100	29534	121	
18					000									Force main			3100	29691	120	Wet Pit Pumping Station ③
					3938	138	143			001177		0012	φ 100		150	0012	2900	27691	120	
19					2085								VU				2900	24942	375	
					6023	479	622			001800		0018	⊙ 300	24	079	0056	1000	8491	120	
20	23				2853												1000	8130	122	
					55409	882	5086			016562		0166	⊙ 600	20	097	0275	1300	6146	620	
21-3					2168								VU				800	6593	120	
					2168	5	5			000648		0007	⊙ 200	20	055	0017	800	6583	121	
21-4					000									Force main			800	6691	120	Wet Pit Pumping Station ⑤
					2168	299	304			000648		0007	φ 100		083	0007	1200	10691	120	
21-5	22				000								VU				1200	10587	121	
					2168	119	423			000648		0007	⊙ 200	164	158	0050	1000	8593	120	
21-1					5012								VU				700	5542	120	
					5012	39	39			001498		0015	⊙ 250	26	073	0036	700	5441	130	
21-2					000									Force main			700	5640	120	Wet Pit Pumping Station ④
					5012	366	405			001498		0015	φ 150		085	0015	1000	8640	120	
22					2050								VU				1000	8490	120	
					9230	708	1131			002759		0028	⊙ 300	24	079	0056	1300	6591	610	
23					307												1300	6046	620	
					64946	20	5106			019412		0194	⊙ 700	18	102	0393	1300	6010	623	
24					000									Force main			1300	11387	120	
					64946	72	5178			019412		0194	φ 400		154	0194	1300	11387	120	Pumping Station 1
25-1					10410												1300	11042	120	
					75356	1186	6364			022524		0225	⊙ 700	18	102	0393	1200	8685	256	
25-2	36				4680												1200	8665	258	
					80036	1053	7417			023923		0239	⊙ 700	18	102	0393	1300	6572	567	

Table A4.3-3 Flow Computation of Tagbilaran Sewerage System (3/4)

From	To	Catchment Area				Length		Waste Water Flow					Pipe Design							Remarks
					Total			Unit flow per ha			Other input								Earth	
		Each Sum	Each Sum	Each Sum	Each Sum	Each	Total			0.0002989	Each Sum	Total	Dia.	Slope	Velocity	Flow	G.L	I.L	Cover	
		ha	ha	ha	ha	m	m	m³/sec	m³/sec	m³/sec	m³/sec	m³/sec	mm	‰	m/sec	m³/sec	M	M	m	
26					5123								VU				600	4542	120	
					5123	5	5			001531		0015	⊙ 250	26	073	0036	600	4529	121	
27					000									Force main			600	4640	120	Wet Pit Pumping Station ⑥
					5123	260	265			001531		0015	ϕ 150		087	0015	900	7640	120	
28					072								VU				900	7540	120	
					5195	145	410			001553		0016	⊙ 250	26	073	0036	900	7144	160	
29	31				2284								VU				900	7094	160	
					7479	702	1112			002235		0022	⊙ 300	24	079	0056	1100	5234	546	
30-1					3375								VU				900	7542	120	
					3375	5	5			001009		0010	⊙ 250	16	057	0028	900	7534	121	
30					000									Force main			900	7691	120	Wet Pit Pumping Station ⑦
					3375	146	151			001009		0010	ϕ 100		129	0010	1100	9691	120	
31					1642								VU				1100	5184	546	
					12496	517	1629			003735		0037	⊙ 350	20	080	0077	600	4029	161	
32					4468												600	3979	159	
					16964	794	2423			005071		0051	⊙ 400	24	081	0102	800	1876	569	
33					1980												800	1776	568	
					18944	23	2446			005662		0057	⊙ 500	22	090	0177	700	1725	473	
34					000									Force main			700	5539	120	Pumping Station 2
					18944	452	2898			005662		0057	ϕ 250		115	0057	1300	11539	120	
35					139												1300	11258	120	
					19083	107	3005			005704		0057	⊙ 500	22	090	0177	1300	11002	146	
36	45				4491												1300	6472	566	
					103610	886	8303			030969		0310	⊙ 800	16	105	0529	1000	4898	424	
39					5942								VU				800	6542	120	
					5942	508	508			001776		0018	⊙ 250	26	073	0036	800	5100	264	
40					1027								VU				800	5050	264	
					6969	194	702			002083		0021	⊙ 300	24	079	0056	800	4545	315	
41-1					2686								VU				800	4495	314	
					9655	242	944			002886		0029	⊙ 350	20	080	0077	800	3951	369	

Table A4.3-4 Flow Computation of Tagbilaran Sewerage System (4/4)

From	To	Catchment Area				Length		Waste Water Flow					Pipe Design							Remarks
					Total			Unit flow per ha			Other input									
		Each Sum	Each Sum	Each Sum	Each Sum	Each	Total			0.0002989	Each Sum	Total	Dia.	Slope	Velocity	Flow	G.L	I.L	Earth Cover	
		ha	ha	ha	ha	m	m	m³/sec	m³/sec	m³/sec	m³/sec	m³/sec	mm	‰	m/sec	m³/sec	M	M	m	
41-2					163												800	3931	371	
					9818	5	949			002935		0029	VU ⊙ 350	20	080	0077	800	3921	372	
41-3					000												800	6640	120	Wet Pit Pumping Station ⑧
					9818	5	954			002935		0029	ϕ 150	Force main	166	0029	800	6640	120	
41-4	44				1853												800	6439	120	
					11671	779	1733			003488		0035	VU ⊙ 350	20	080	0077	1000	4677	496	
42					5835												900	7542	120	
					5835	5	5			001744		0017	VU ⊙ 250	26	073	0036	900	7529	121	
43					000												900	7640	120	Wet Pit Pumping Station ⑨
					5835	211	216			001744		0017	ϕ 150	Force main	098	0017	1000	8640	120	
44					640												1000	4527	493	
					18146	288	2021			005424		0054	⊙ 500	22	090	0177	1000	3835	562	
45					479												1000	3435	559	
					122235	235	8538			036536		0365	⊙ 900	14	106	0677	300	0825	120	
46					4765												300	0805	122	
					127000	20	8558			037960		0380	⊙ 900	14	106	0677	300	0777	125	

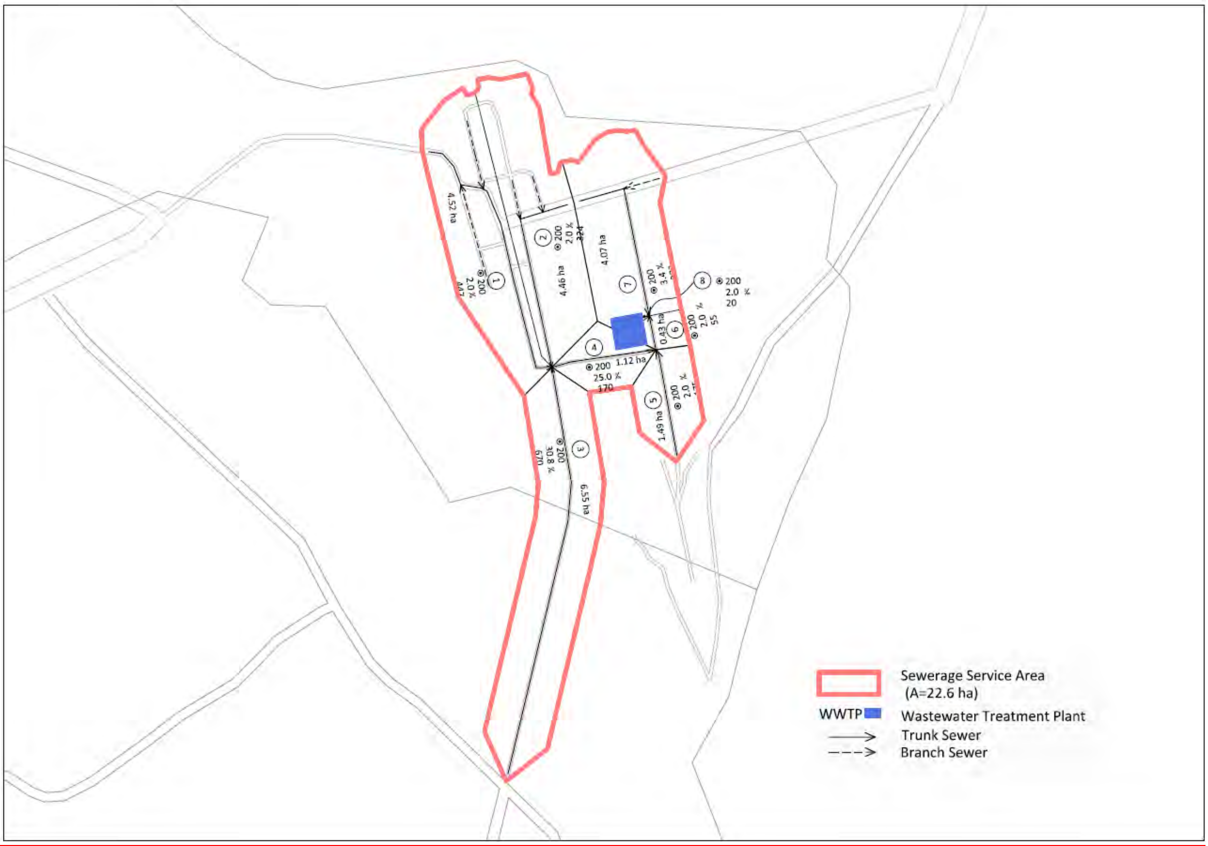


Figure A4.3-20 General Layout Plan of Dauis Sewerage System

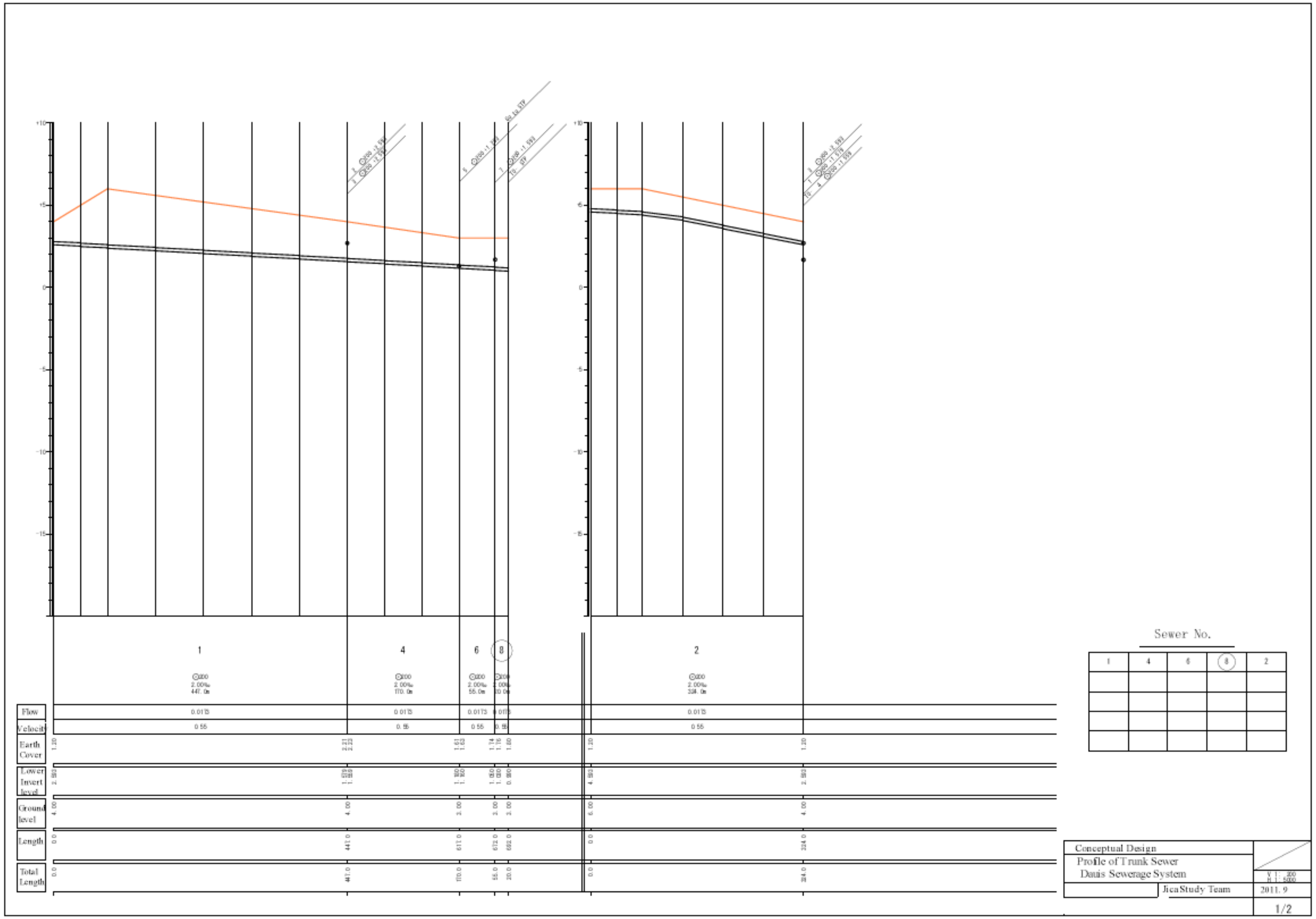


Figure A4.3-21 Profile of Trunk Sewer (Dauis Sewerage System)

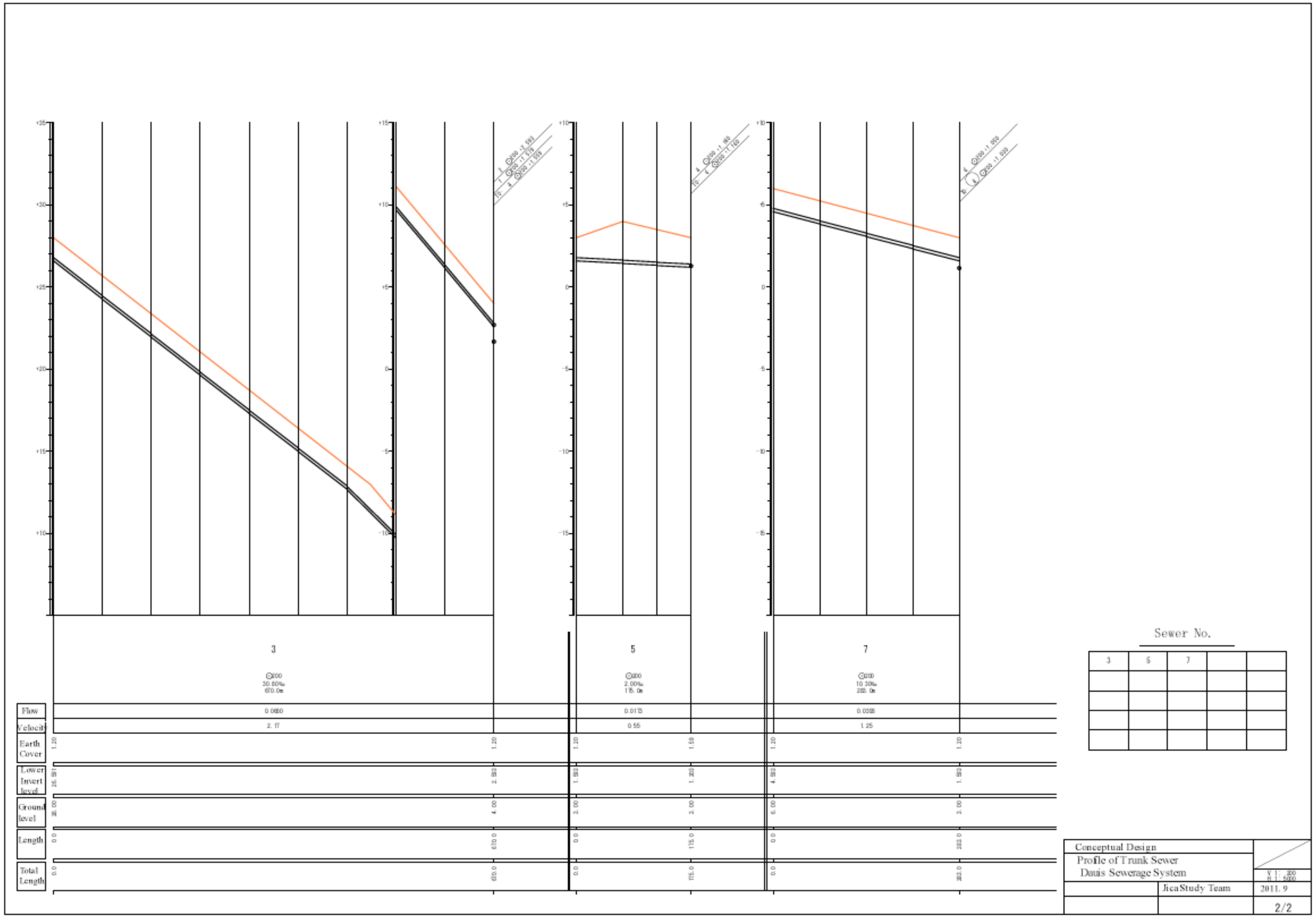


Figure A4.3-22 Profile of Trunk Sewer (Dauis Sewerage System)

Table A4.3-5 Flow Computation of Dauis Sewerage System

From	To	Catchment Area				Length		Waste Water Flow					Pipe Design							Remarks
					Total			Unit flow per ha			Other input								Earth Cover	
		Each Sum	Each Sum	Each Sum	Each Sum	Each	Total			0.0002577	Each Sum	Total	Dia.	Slope	Velocity	Flow	G.L	I.L		
		ha	ha	ha	ha	m	m	m³/sec	m³/sec	m³/sec	m³/sec	m³/sec	mm	‰	m/sec	m³/sec	M	M	m	
3	4				655								VU				2800	26591	120	
					655	670	670			000169		0002	⊙ 200	308	217	0068	400	2593	120	
1	4				452								VU				400	2593	120	
					452	447	447			000116		0001	⊙ 200	20	055	0017	400	1579	221	
2					446								VU				600	4593	120	
					446	324	324			000115		0001	⊙ 200	20	055	0017	400	2593	120	
4	6				112								VU				400	1559	223	
					1665	170	840			000429		0004	⊙ 200	20	055	0017	300	1180	161	
5					149								VU				300	1593	120	
					149	175	175			000038		0000	⊙ 200	20	055	0017	300	1203	159	
6	8				043								VU				300	1160	163	
					1857	55	895			000478		0005	⊙ 200	20	055	0017	300	1050	174	
7					407								VU				600	4593	120	
					407	283	283			000105		0001	⊙ 200	103	125	0039	300	1593	120	
8	WWTP				000								VU				300	1030	176	
					2264	20	915			000583		0006	⊙ 200	20	055	0017	300	0990	180	

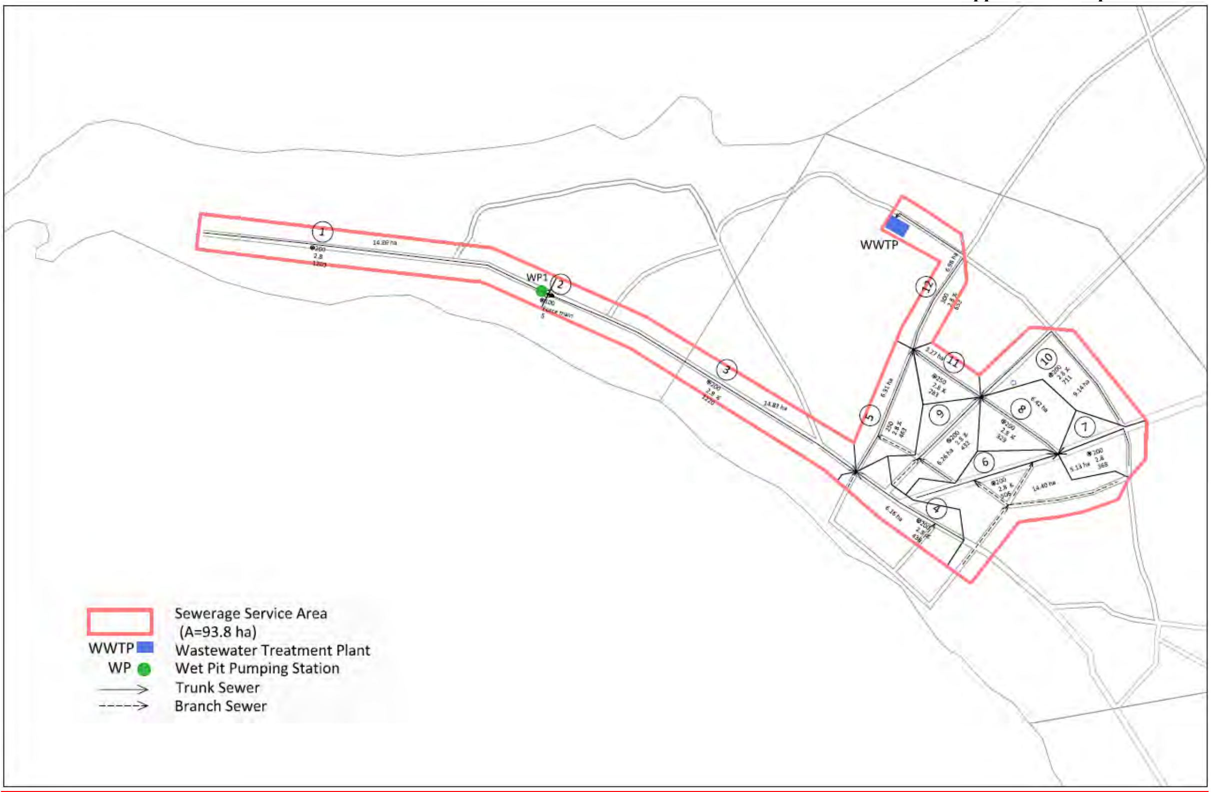


Figure A4.3-23 General Layout Plan (Panglao Sewerage System)

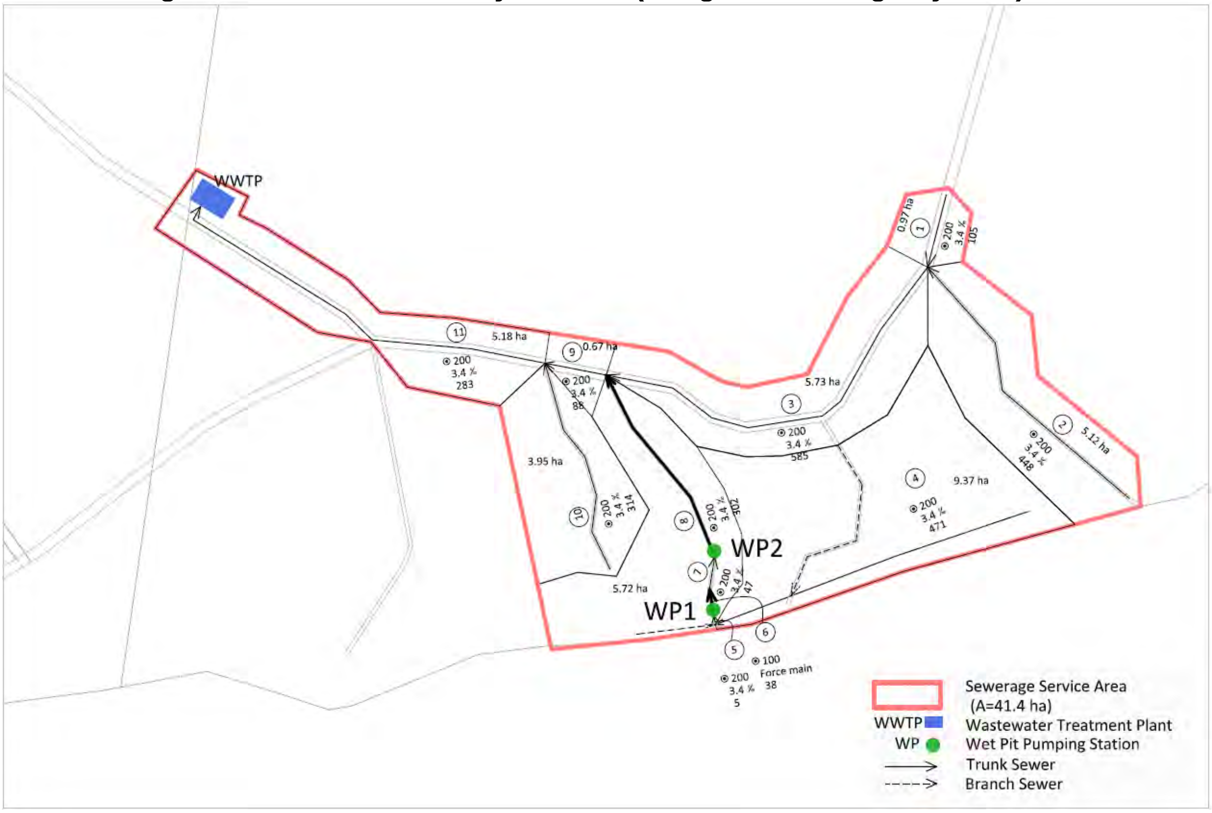


Figure A4.3-24 General Layout Plan (Alona Beach Sewerage System)

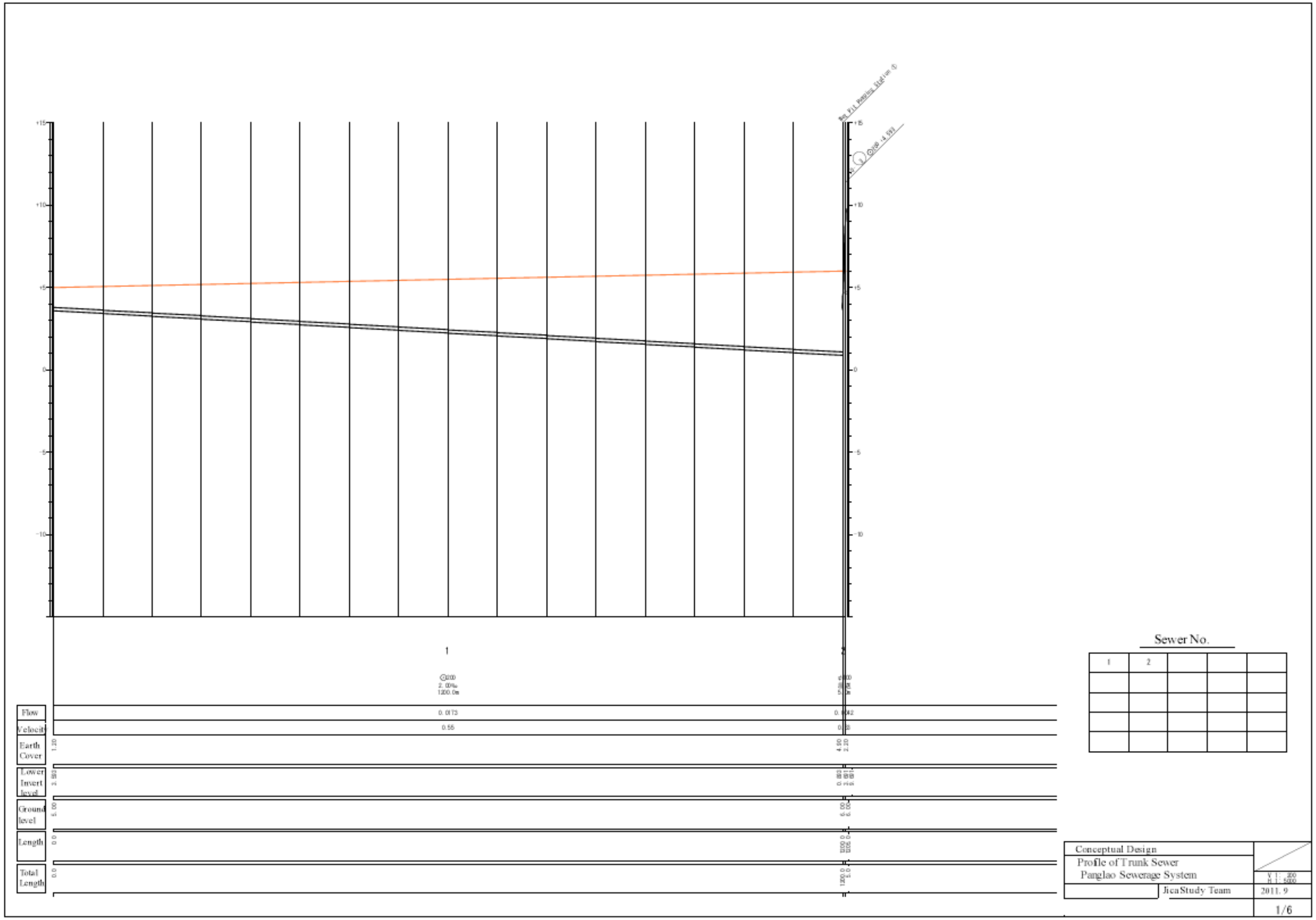


Figure A4.3-25 Profile of Trunk Sewer (Panglao Sewerage System)

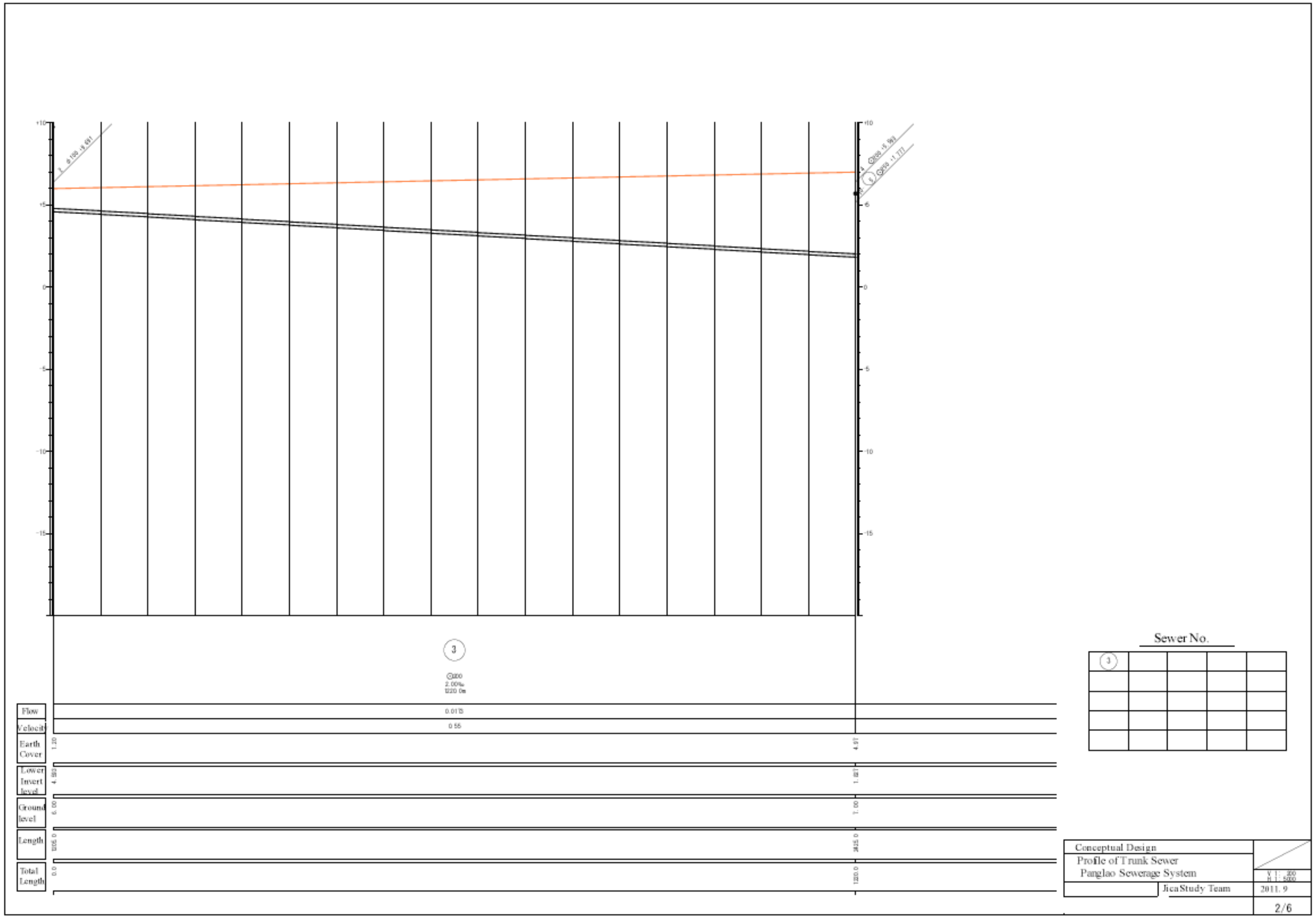


Figure A4.3-26 Profile of Trunk Sewer (Panglao Sewerage System)

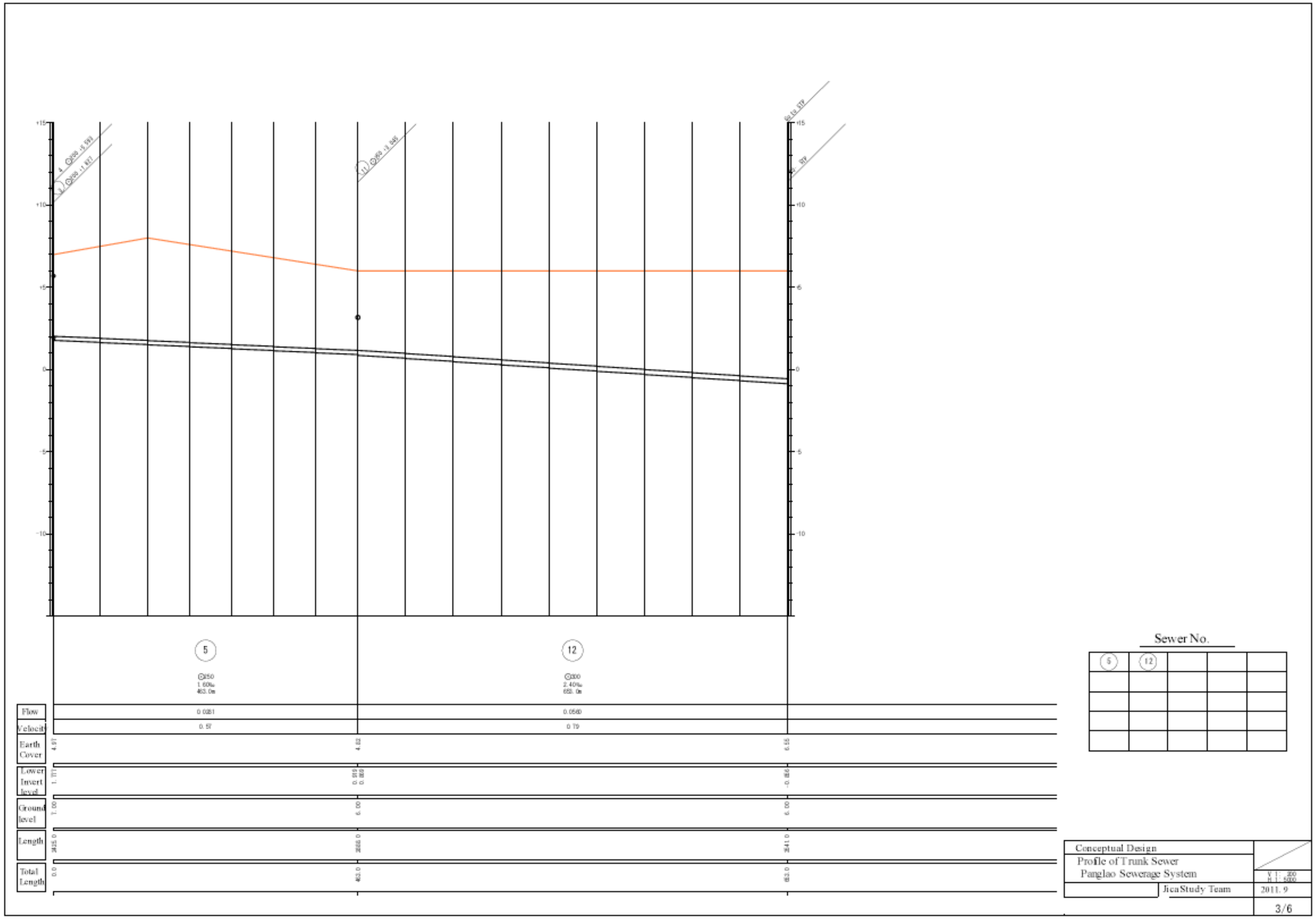


Figure A4.3-27 Profile of Trunk Sewer (Panglao Sewerage System)

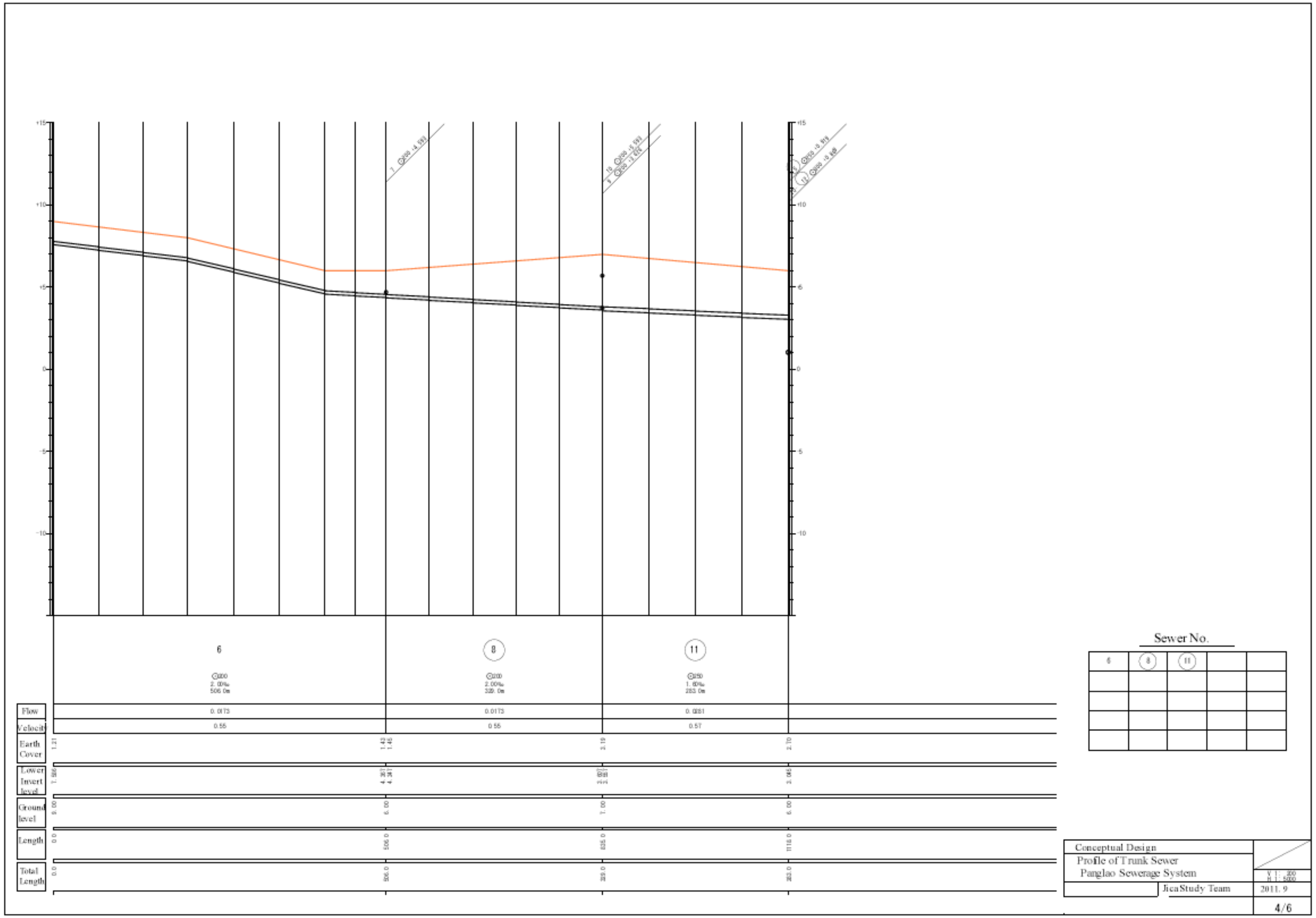


Figure A4.3-28 Profile of Trunk Sewer (Panglao Sewerage System)

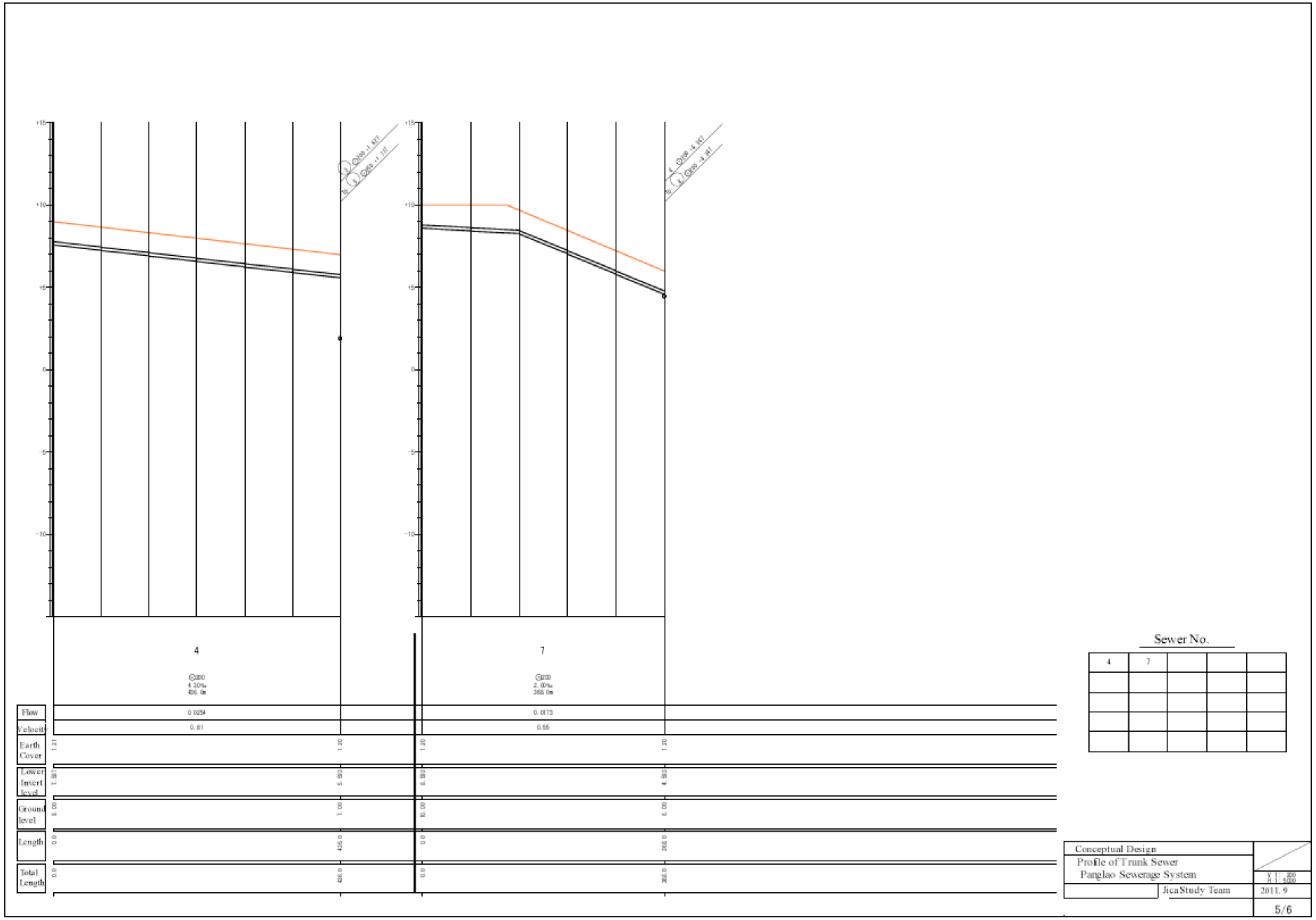


Figure A4.3-29 Profile of Trunk Sewer (Panglao Sewerage System)

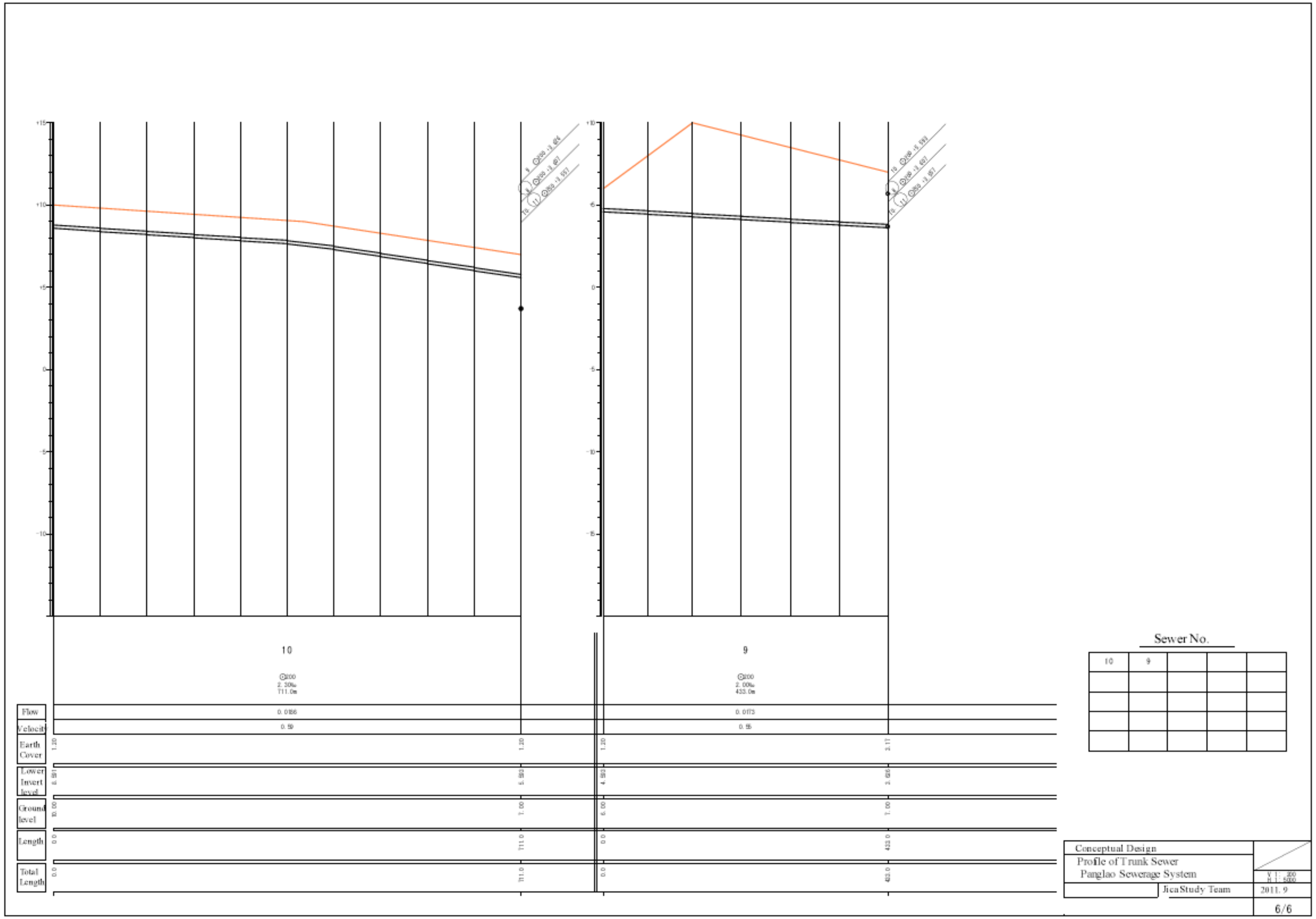


Figure A4.3-30 Profile of Trunk Sewer (Panglao Sewerage System)

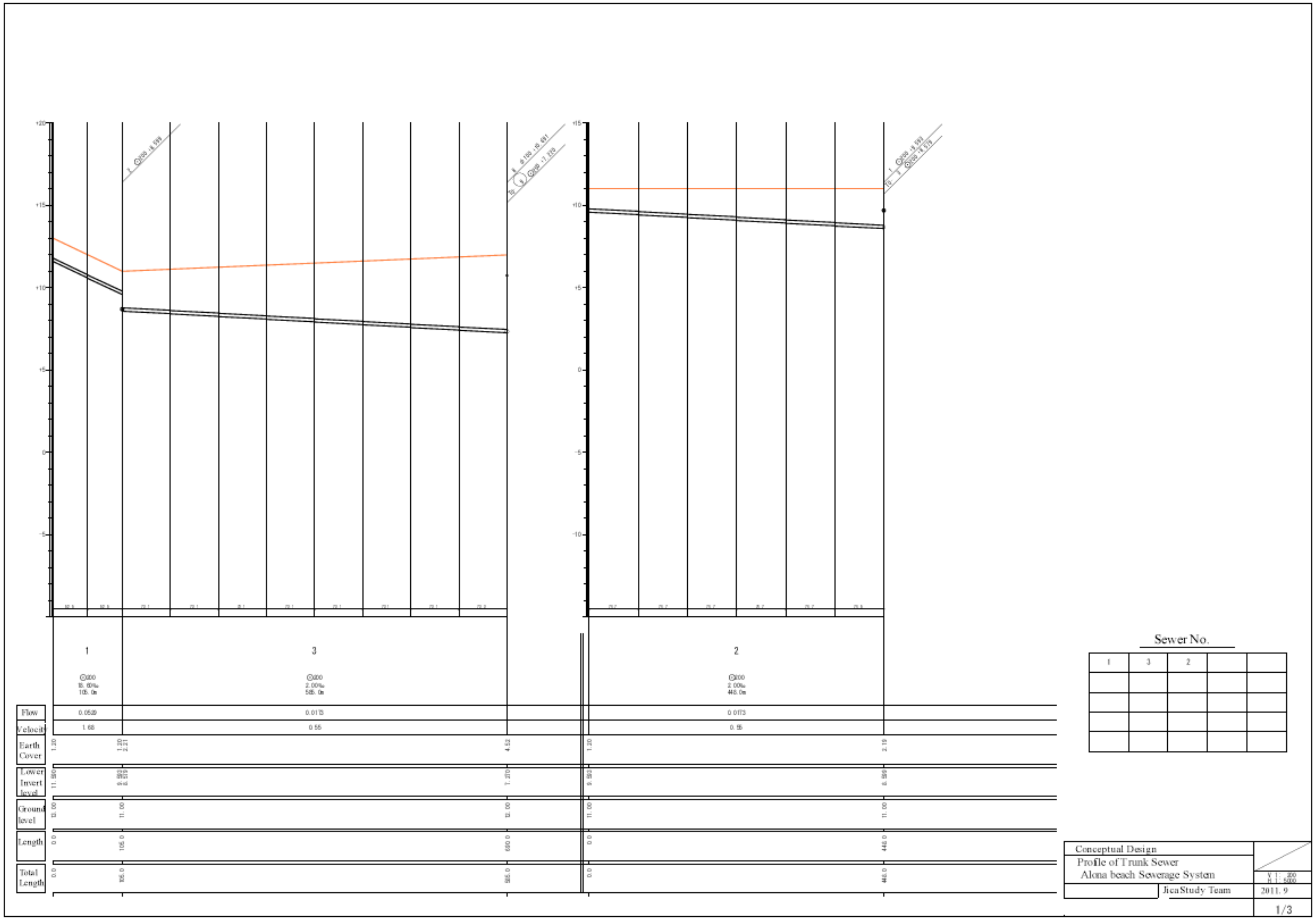


Figure A4.3-31 Profile of Trunk Sewer (Alona Beach Sewerage System)

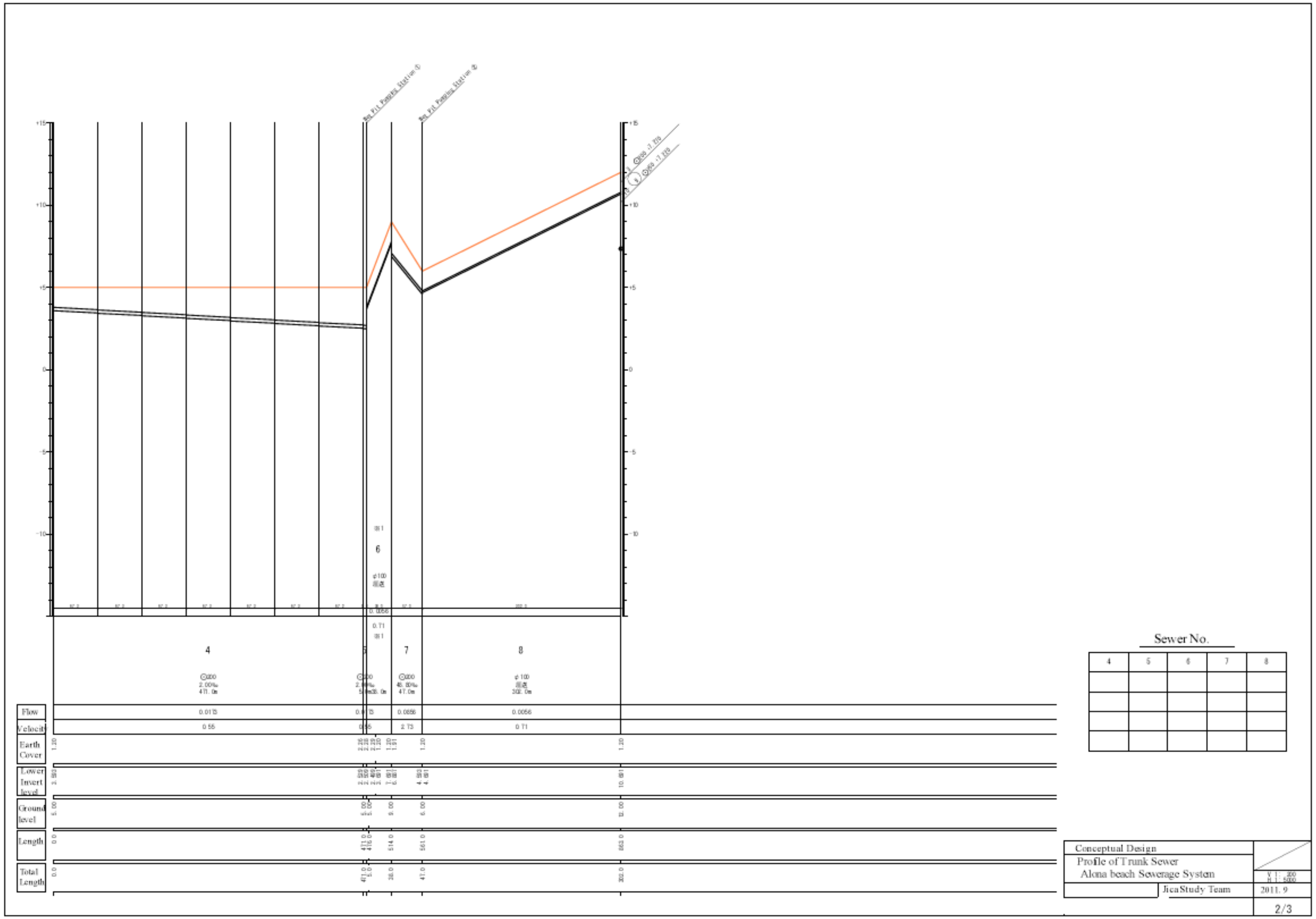


Figure A4.3-32 Profile of Trunk Sewer (Alona Beach Sewerage System)

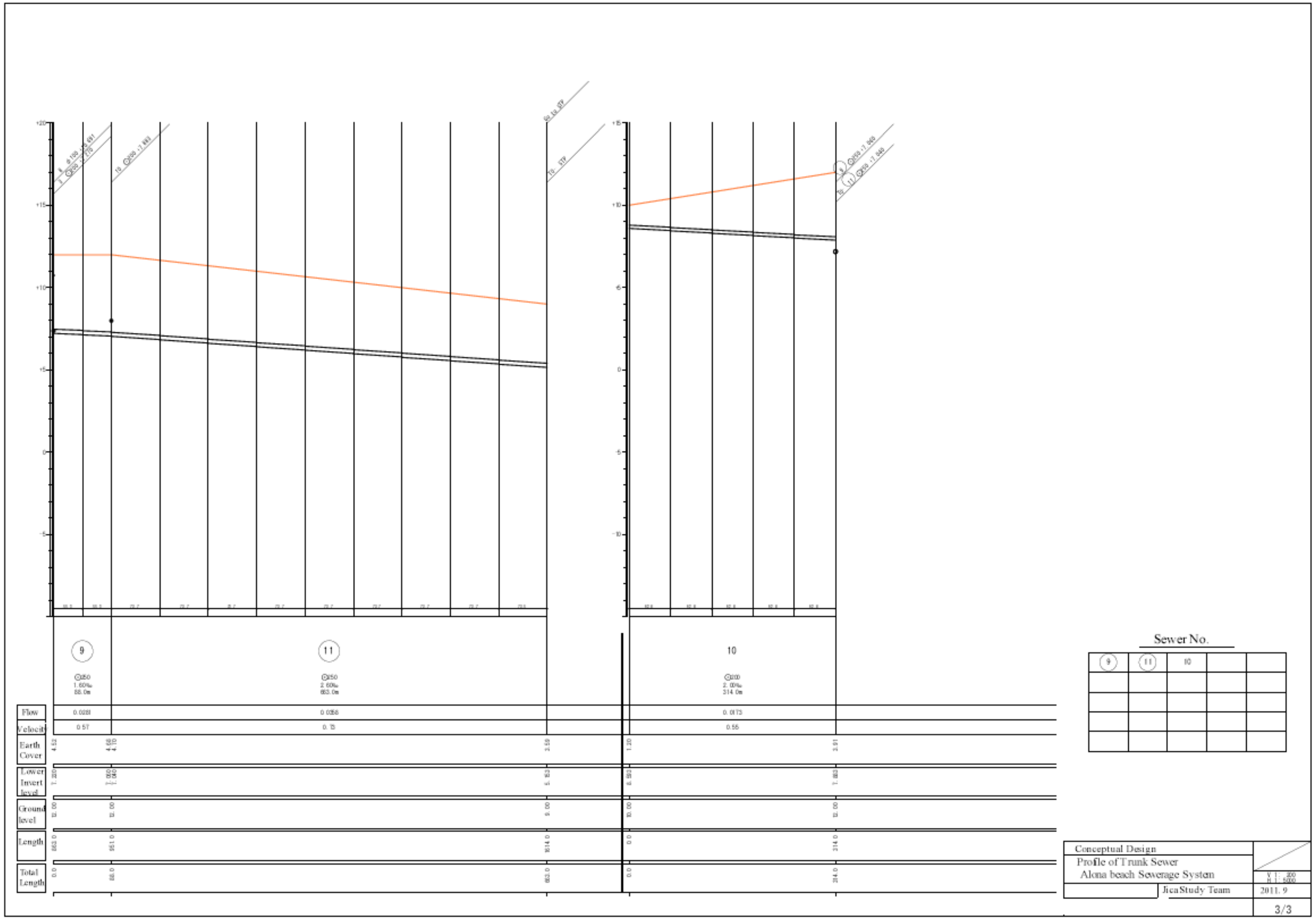


Figure A4.3-33 Profile of Trunk Sewer (Alona Sewerage System)

Table A4.3-6 Flow Computation of Panglao Sewerage System

From	To	Catchment Area				Length		Waste Water Flow					Pipe Design							Remarks
					Total			Unit flow per ha			Other input								Earth	
		Each Sum	Each Sum	Each Sum	Each Sum	Each	Total			0.0002839	Each Sum	Total	Dia.	Slope	Velocity	Flow	G.L	I.L	Cover	
		ha	ha	ha	ha	m	m	m³/sec	m³/sec	m³/sec	m³/sec	m³/sec	mm	‰	m/sec	m³/sec	M	M	m	
1					1486								VU				500	3593	120	
					1486	1200	1200			000422		0004	⊙ 200	20	055	0017	600	0893	490	
2					000									Force			600	3691	220	Wet Pit Pumping Station
					1486	5	1205			000422		0004	ϕ 100	main	053	0004	600	9691	-380	①
3	5				1483								VU				600	4593	120	
					2969	1220	2425			000843		0008	⊙ 200	20	055	0017	700	1827	497	
4					616								VU				900	7587	121	
					616	436	436			000175		0002	⊙ 200	43	081	0025	700	5593	120	
5	12				631								VU				700	1777	497	
					4216	463	2888			001197		0012	⊙ 250	16	057	0028	600	0919	482	
6	8				1440								VU				900	7586	121	
					1440	506	506			000409		0004	⊙ 200	20	055	0017	600	4367	143	
7					513								VU				1000	8593	120	
					513	368	368			000146		0002	⊙ 200	20	055	0017	600	4593	120	
8	11				642								VU				600	4347	145	
					2595	329	835			000737		0007	⊙ 200	20	055	0017	700	3607	319	
10	11				914								VU				1000	8591	120	
					914	711	711			000260		0003	⊙ 200	23	059	0019	700	5593	120	
9					626								VU				600	4593	120	
					626	433	433			000178		0002	⊙ 200	20	055	0017	700	3626	317	
11					327								VU				700	3557	319	
					4462	283	1118			001267		0013	⊙ 250	16	057	0028	600	3045	270	
12	WWTP				698								VU				600	0869	482	
					9376	653	3541			002662		0027	⊙ 300	24	079	0056	600	-0856	655	

Table A4.3-7 Flow Computation of Alona Beach Sewerage System

From	To	Catchment Area				Length		Waste Water Flow					Pipe Design							Remarks
					Total			Unit flow per ha			Other input									
		Each Sum	Each Sum	Each Sum	Each Sum	Each	Total			0.0003708	Each Sum	Total	Dia.	Slope	Velocity	Flow	G.L	I.L	Earth Cover	
		ha	ha	ha	ha	m	m	m³/sec	m³/sec	m³/sec	m³/sec	m³/sec	mm	‰	m/sec	m³/sec	M	M	m	
2	3				512 512	448	448			000190		0002	VU ⊙ 200	20	055	0017	1100 1100	9593 8599	120 219	
1					097 097	105	105			000036		0000	VU ⊙ 200	186	168	0053	1300 1100	11590 9593	120 120	
3	9				573 1182	585	1033			000438		0004	VU ⊙ 200	20	055	0017	1100 1200	8579 7270	221 452	
4					937 937	471	471			000347		0004	VU ⊙ 200	20	055	0017	500 500	3593 2529	120 226	
5					572 1509	5	476			000560		0006	VU ⊙ 200	20	055	0017	500 500	2509 2499	228 229	
6					000 1509	38	514			000560		0006	φ 100	Force main	071	0006	500 900	3691 7691	120 120	Wet Pit Pumping Station ①
7					000 1509	47	561			000560		0006	VU ⊙ 200	488	273	0086	900 600	6887 4593	191 120	
8					000 1509	302	863			000560		0006	φ 100	Force main	071	0006	600 1200	4691 10691	120 120	Wet Pit Pumping Station ②
9	11				067 2758	88	1121			001023		0010	VU ⊙ 250	16	057	0028	1200 1200	7220 7060	452 468	
10					395 395	314	314			000146		0002	VU ⊙ 200	20	055	0017	1000 1200	8593 7883	120 391	
11					983 4136	663	1784			001534		0015	VU ⊙ 250	26	073	0036	1200 900	7040 5153	470 359	
	Go to Sewerage Treatment Plant																			

4.4. Financial Analysis

4.4.1. FIRR and Net Present Value by Scenario by Local government

FIRR and Net Present Value by Scenario by Local government are shown in Table A4.4-1~A4.4-9.

Table A4.4-1 Cash flow in Scenario 1 Tagbilaran

Cash Flow Projection
In PHP 1000

Domestic Inflation Rate	Domestic Escalation Factor	Conversion factor to real prices	Year		Revenue Parameters: H2O Consumption	Revenue Parameters: Sewerage Tariff (100% of Water supply tariff)	Cash Inflow – Revenue (1000 Peso): Domestic	Connection fee (5000	Gov't Subsidy (50%)	other income	Total	Cash Outflow – Costs (1000 peso): Project Cost	O&M Cost	Replace ment Cost	Total	Net Cash Inflow (Nominal)	Net Cash Inflow (Real)
3.00%			2010	Year -1								1.5%of WWTP					
5.14%	1.000	1.000	2011	Year 0		12.00							8,466			-	
4.50%	1.045	0.957	2012	Year 1													
4.50%	1.092	0.916	2013	Year 2											-	-	
4.50%	1.141	0.876	2014	Year 3							-				-	-	-
4.50%	1.193	0.839	2015	Year 4					431,973.9		431,973.9	863,947.8			863,947.8	(431,973.9)	(362,236.6)
4.50%	1.246	0.802	2016	Year 5				19,929.6	517,586.7		537,516.2	1,035,173.3			1,035,173.3	(497,657.1)	(399,345.5)
4.50%	1.302	0.768	2017	Year 6	1,242.3	15.63	19,413.2	20,826.4	82,532.5		122,772.1	165,065.0	4,409.9		169,474.9	(46,702.8)	(35,862.9)
4.50%	1.361	0.735	2018	Year 7	2,613.6	16.33	42,681.1				42,681.1		6,912.5		6,912.5	35,768.6	26,283.8
4.50%	1.422	0.703	2019	Year 8	2,742.7	17.07	46,804.1				46,804.1		7,223.5		7,223.5	39,580.6	27,832.5
4.50%	1.486	0.673	2020	Year 9	2,871.7	17.83	51,211.7				51,211.7		7,548.6		7,548.6	43,663.1	29,381.1
4.50%	1.553	0.644	2021	Year 10	3,097.0	18.64	57,714.6				57,714.6		7,888.3		7,888.3	49,826.3	32,084.6
4.50%	1.623	0.616	2022	Year 11	3,322.0	19.47	64,693.4				64,693.4		8,243.2		8,243.2	56,450.2	34,784.5
4.50%	1.696	0.590	2023	Year 12	3,547.0	20.35	72,183.5				72,183.5		8,614.2		8,614.2	63,569.3	37,484.5
4.50%	1.772	0.564	2024	Year 13	3,772.0	21.27	80,216.7				80,216.7		9,001.8		9,001.8	71,214.9	40,184.5
4.50%	1.852	0.540	2025	Year 14	3,997.0	22.22	88,826.7	34,811.9	505,726.6		629,365.2	1,011,453.2	9,406.9		1,020,860.1	(391,494.9)	(211,396.6)
4.50%	1.935	0.517	2026	Year 15	4,222.0	23.22	98,049.1	36,378.5	526,742.5		661,170.1	1,053,485.1	9,830.2		1,063,315.3	(402,145.2)	(207,796.6)
4.50%	2.022	0.494	2027	Year 16	4,447.0	24.27	107,921.8				107,921.8		17,121.0		17,121.0	90,800.8	44,898.2
4.50%	2.113	0.473	2028	Year 17	4,672.0	25.36	118,484.4				118,484.4		17,891.4	-	17,891.4	100,593.0	47,598.2
4.50%	2.208	0.453	2029	Year 18	4,897.0	26.50	129,779.0				129,779.0		18,696.5		18,696.5	111,082.5	50,298.2
4.50%	2.308	0.433	2030	Year 19	5,122.0	27.69	141,850.3				141,850.3		19,537.9		19,537.9	122,312.4	52,998.2
4.50%	2.412	0.415	2031	Year 20	5,347.0	28.94	154,745.2		195,109.4		349,854.6		20,417.1	390,218.9	410,635.9	(60,781.3)	(25,202.5)
4.50%	2.520	0.397	2032	Year 21	5,572.0	30.24	168,513.4				168,513.4		21,335.8		21,335.8	147,177.6	58,398.2
4.50%	2.634	0.380	2033	Year 22	5,797.0	31.60	183,207.4				183,207.4		22,295.9		22,295.9	160,911.5	61,098.2
4.50%	2.752	0.363	2034	Year 23	6,023.0	33.03	198,915.6				198,915.6		23,299.3	-	23,299.3	175,616.3	63,810.2
4.50%	2.876	0.348	2035	Year 24	6,247.6	34.51	215,617.6				215,617.6		24,347.7	-	24,347.7	191,269.9	66,505.2
4.50%	3.005	0.333	2036	Year 25	6,247.6	36.07	225,320.4				225,320.4		25,443.4	-	25,443.4	199,877.0	66,505.2
													Financial Internal Rate of Return				**#DIV/0!**
													NPV using Disc. Factor of		1.40%		**(551,815)**

Table A4.4-2 Cash flow in Scenario 2 Tagbilaran

Cash Flow Projection
In PHP 1000

Domestic Inflation Rate	Domestic Escalation Factor	Conversion factor to real prices	**Year**		**Revenue Parameters** H2O Consumption	Sewerage Tariff (50 % of water supply tariff)	**Cash Inflow** Revenue (1000 Peso) Domestic	Connection fee (5000	Gov't Subsidy (85%)	other income	**Total**	**Cash Outflow** Costs (1000 peso) Project Cost	O&M Cost	Replace ment Cost	**Total**	**Net Cash Inflow (Nominal)**	**Net Cash Inflow (Real)**
3.00%			2010	Year -1									1.5%of WWTP				
5.14%	1.000	1.000	2011	Year 0		6.00							8,466			-	
4.50%	1.045	0.957	2012	Year 1													
4.50%	1.092	0.916	2013	Year 2											-	-	
4.50%	1.141	0.876	2014	Year 3							-				-	-	-
4.50%	1.193	0.839	2015	Year 4					734,355.6		734,355.6	863,947.8			863,947.8	(129,592.2)	(108,671.0)
4.50%	1.246	0.802	2016	Year 5				19,929.6	879,897.3		899,826.9	1,035,173.3			1,035,173.3	(135,346.4)	(108,608.9)
4.50%	1.302	0.768	2017	Year 6	1,242.3	7.81	9,706.6	20,826.4	140,305.3		170,838.3	165,065.0	4,409.9		169,474.9	1,363.4	1,046.9
4.50%	1.361	0.735	2018	Year 7	2,613.6	8.17	21,340.5				21,340.5		6,912.5		6,912.5	14,428.0	10,602.1
4.50%	1.422	0.703	2019	Year 8	2,742.7	8.53	23,402.0				23,402.0		7,223.5		7,223.5	16,178.5	11,376.5
4.50%	1.486	0.673	2020	Year 9	2,871.7	8.92	25,605.8				25,605.8		7,548.6		7,548.6	18,057.2	12,150.8
4.50%	1.553	0.644	2021	Year 10	3,097.0	9.32	28,857.3				28,857.3		7,888.3		7,888.3	20,969.0	13,502.5
4.50%	1.623	0.616	2022	Year 11	3,322.0	9.74	32,346.7				32,346.7		8,243.2		8,243.2	24,103.5	14,852.5
4.50%	1.696	0.590	2023	Year 12	3,547.0	10.18	36,091.7				36,091.7		8,614.2		8,614.2	27,477.5	16,202.5
4.50%	1.772	0.564	2024	Year 13	3,772.0	10.63	40,108.3				40,108.3		9,001.8		9,001.8	31,106.5	17,552.5
4.50%	1.852	0.540	2025	Year 14	3,997.0	11.11	44,413.3	34,811.9	859,735.2		938,960.4	1,011,453.2	9,406.9		1,020,860.1	(81,899.6)	(44,223.6)
4.50%	1.935	0.517	2026	Year 15	4,222.0	11.61	49,024.6	36,378.5	895,462.3		980,865.4	1,053,485.1	9,830.2		1,063,315.3	(82,449.9)	(42,603.6)
4.50%	2.022	0.494	2027	Year 16	4,447.0	12.13	53,960.9				53,960.9		17,121.0		17,121.0	36,839.9	18,216.2
4.50%	2.113	0.473	2028	Year 17	4,672.0	12.68	59,242.2				59,242.2		17,891.4	-	17,891.4	41,350.8	19,566.2
4.50%	2.208	0.453	2029	Year 18	4,897.0	13.25	64,889.5				64,889.5		18,696.5		18,696.5	46,193.0	20,916.2
4.50%	2.308	0.433	2030	Year 19	5,122.0	13.85	70,925.2				70,925.2		19,537.9		19,537.9	51,387.3	22,266.2
4.50%	2.412	0.415	2031	Year 20	5,347.0	14.47	77,372.6		331,686.0		409,058.6		20,417.1	390,218.9	410,635.9	(1,577.3)	(654.0)
4.50%	2.520	0.397	2032	Year 21	5,572.0	15.12	84,256.7				84,256.7		21,335.8		21,335.8	62,920.9	24,966.2
4.50%	2.634	0.380	2033	Year 22	5,797.0	15.80	91,603.7				91,603.7		22,295.9		22,295.9	69,307.8	26,316.2
4.50%	2.752	0.363	2034	Year 23	6,023.0	16.51	99,457.8				99,457.8		23,299.3	-	23,299.3	76,158.5	27,672.2
4.50%	2.876	0.348	2035	Year 24	6,247.6	17.26	107,808.8				107,808.8		24,347.7	-	24,347.7	83,461.1	29,019.7
4.50%	3.005	0.333	2036	Year 25	6,247.6	18.03	112,660.2				112,660.2		25,443.4	-	25,443.4	87,216.8	29,019.7
													Financial Internal Rate of Return				**0.3%**
													NPV using Disc. Factor of		1.40%		**(29,633)**

Table A4.4-3 Cash flow in Scenario 3 Tagbilaran

Cash Flow Projection
In PHP 1000

Domestic Inflation Rate	Domestic Escalation Factor	Conversion factor to real prices	Year		Revenue Parameters: H2O Consumption	Revenue Parameters: Sewerage Tariff (330% of water supply tariff)	Cash Inflow – Revenue (1000 Peso): Domestic	Connection fee (5000 peso/HC)	Gov't Subsidy	other income	Total	Cash Outflow – Costs (1000 peso): Project Cost	O&M Cost	Replace ment Cost	Total	Net Cash Inflow (Nominal)	Net Cash Inflow (Real)
3.00%			2010	Year -1								1.5%of WWTP					
5.14%	1.000	1.000	2011	Year 0		39.60							8,466			-	
4.50%	1.045	0.957	2012	Year 1													
4.50%	1.092	0.916	2013	Year 2											-	-	
4.50%	1.141	0.876	2014	Year 3							-				-	-	-
4.50%	1.193	0.839	2015	Year 4							-	863,947.8			863,947.8	(863,947.8)	(724,473.2)
4.50%	1.246	0.802	2016	Year 5				19,929.6			19,929.6	1,035,173.3			1,035,173.3	(1,015,243.8)	(814,683.4)
4.50%	1.302	0.768	2017	Year 6	1,242.3	51.57	64,063.6	20,826.4			84,890.0	165,065.0	4,409.9		169,474.9	(84,584.9)	(64,952.4)
4.50%	1.361	0.735	2018	Year 7	2,613.6	53.89	140,847.6				140,847.6		6,912.5		6,912.5	133,935.1	98,419.4
4.50%	1.422	0.703	2019	Year 8	2,742.7	56.32	154,453.4				154,453.4		7,223.5		7,223.5	147,229.9	103,529.9
4.50%	1.486	0.673	2020	Year 9	2,871.7	58.85	168,998.5				168,998.5		7,548.6		7,548.6	161,449.9	108,640.4
4.50%	1.553	0.644	2021	Year 10	3,097.0	61.50	190,458.0				190,458.0		7,888.3		7,888.3	182,569.7	117,561.7
4.50%	1.623	0.616	2022	Year 11	3,322.0	64.26	213,488.3				213,488.3		8,243.2		8,243.2	205,245.1	126,471.7
4.50%	1.696	0.590	2023	Year 12	3,547.0	67.16	238,205.5				238,205.5		8,614.2		8,614.2	229,591.3	135,381.7
4.50%	1.772	0.564	2024	Year 13	3,772.0	70.18	264,715.1				264,715.1		9,001.8		9,001.8	255,713.3	144,291.7
4.50%	1.852	0.540	2025	Year 14	3,997.0	73.34	293,128.1	34,811.9			327,940.0	1,011,453.2	9,406.9		1,020,860.1	(692,920.1)	(374,158.0)
4.50%	1.935	0.517	2026	Year 15	4,222.0	76.64	323,562.2	36,378.5			359,940.7	1,053,485.1	9,830.2		1,063,315.3	(703,374.6)	(363,448.0)
4.50%	2.022	0.494	2027	Year 16	4,447.0	80.09	356,141.8				356,141.8		17,121.0		17,121.0	339,020.8	167,635.4
4.50%	2.113	0.473	2028	Year 17	4,672.0	83.69	390,998.4				390,998.4		17,891.4	-	17,891.4	373,107.0	176,545.4
4.50%	2.208	0.453	2029	Year 18	4,897.0	87.46	428,270.9				428,270.9		18,696.5		18,696.5	409,574.4	185,455.4
4.50%	2.308	0.433	2030	Year 19	5,122.0	91.39	468,106.1				468,106.1		19,537.9		19,537.9	448,568.2	194,365.4
4.50%	2.412	0.415	2031	Year 20	5,347.0	95.50	510,659.2				510,659.2		20,417.1	390,218.9	410,635.9	100,023.3	41,473.9
4.50%	2.520	0.397	2032	Year 21	5,572.0	99.80	556,094.2				556,094.2		21,335.8		21,335.8	534,758.4	212,185.4
4.50%	2.634	0.380	2033	Year 22	5,797.0	104.29	604,584.3				604,584.3		22,295.9		22,295.9	582,288.4	221,095.4
4.50%	2.752	0.363	2034	Year 23	6,023.0	108.99	656,421.4				656,421.4		23,299.3	-	23,299.3	633,122.1	230,045.0
4.50%	2.876	0.348	2035	Year 24	6,247.6	113.89	711,538.2				711,538.2		24,347.7	-	24,347.7	687,190.5	238,938.5
4.50%	3.005	0.333	2036	Year 25	6,247.6	119.02	743,557.4				743,557.4		25,443.4	-	25,443.4	718,114.0	238,938.5
													Financial Internal Rate of Return				**1.6%**
													NPV using Disc. Factor of		1.40%		**44,371**

Table A4.4-3 Cash flow in Scenario 1 Dauis 1

Cash Flow Projection
In PHP1,000

Domestic Inflation Rate	Domestic Escalation Factor	Conversion factor to real prices	Year		Revenue Parameters: H2O Consumption		Sewerage Tariff: Sewerage Tariff 100% of water supply	Cash Inflow – Revenue (1000 Peso): Domestic	Connection fee (5000 peso/HC)	Gov't Subsidy (50%)	Total	Cash Outflow – Costs (1000 PHP): Project Cost	O&M Cost	Replace ment Cost	Total	Net Cash Inflow (Nominal)	Net Cash Inflow (Real)
3.00%			2010	Year -1			17.00					1.5%of WWTP					
5.14%	1.000	1.000	2011	Year 0								-			-	-	
4.50%	1.045	0.957	2012	Year 1											-	-	
4.50%	1.092	0.916	2013	Year 2								-			-	-	
4.50%	1.141	0.876	2014	Year 3					1,227	31,164.4	32,391.2	62,328.8			62,328.8	(29,937.7)	(26,234.3)
4.50%	1.193	0.839	2015	Year 4	37,134		20.30	753.8			753.8	-	208.9		208.9	544.9	456.9
4.50%	1.246	0.802	2016	Year 5	39,200	-	21.20	831.0			831.0		218.3		218.3	612.7	491.7
4.50%	1.302	0.768	2017	Year 6	41,348	-	22.10	913.8			913.8		228.1		228.1	685.7	526.5
4.50%	1.361	0.735	2018	Year 7	43,513	-	23.10	1,005.2			1,005.2		238.4		238.4	766.7	563.4
4.50%	1.422	0.703	2019	Year 8	45,763	-	24.20	1,107.5			1,107.5		249.1		249.1	858.3	603.6
4.50%	1.486	0.673	2020	Year 9	48,027	-	25.30	1,215.1	320		1,534.6		260.3		260.3	1,274.3	857.4
4.50%	1.553	0.644	2021	Year 10	49,802	-	26.40	1,314.8			1,314.8		272.1		272.1	1,042.7	671.4
4.50%	1.623	0.616	2022	Year 11	51,634	-	27.60	1,425.1			1,425.1		284.3		284.3	1,140.8	703.0
4.50%	1.696	0.590	2023	Year 12	53,443	-	28.80	1,539.2			1,539.2		297.1		297.1	1,242.1	732.4
4.50%	1.772	0.564	2024	Year 13	55,269	-	30.10	1,663.6			1,663.6		310.5		310.5	1,353.1	763.5
4.50%	1.852	0.540	2025	Year 14	57,154	-	31.50	1,800.4	204		2,004.1		324.4		324.4	1,679.6	907.0
4.50%	1.935	0.517	2026	Year 15	59,013	-	32.90	1,941.5			1,941.5		339.0		339.0	1,602.5	828.0
4.50%	2.022	0.494	2027	Year 16	60,889	-	34.40	2,094.6			2,094.6		354.3		354.3	1,740.3	860.5
4.50%	2.113	0.473	2028	Year 17	62,828	-	35.90	2,255.5			2,255.5		370.2		370.2	1,885.3	892.1
4.50%	2.208	0.453	2029	Year 18	64,738	-	37.50	2,427.7			2,427.7		386.9	9,904.4	10,291.3	(7,863.7)	(3,560.7)
4.50%	2.308	0.433	2030	Year 19	66,664	-	39.20	2,613.2			2,613.2		404.3		404.3	2,208.9	957.1
4.50%	2.412	0.415	2031	Year 20	68,657	-	41.00	2,814.9			2,814.9		422.5	-	422.5	2,392.4	992.0
4.50%	2.520	0.397	2032	Year 21	70,617	-	42.80	3,022.4			3,022.4		441.5		441.5	2,580.9	1,024.1
4.50%	2.634	0.380	2033	Year 22	72,593	-	44.80	3,252.2			3,252.2		461.4		461.4	2,790.8	1,059.7
4.50%	2.752	0.363	2034	Year 23	74,640	-	46.80	3,493.2			3,493.2		482.1		482.1	3,011.0	1,094.1
4.50%	2.876	0.348	2035	Year 24	76,650	-	48.90	3,748.2			3,748.2		503.8	-	503.8	3,244.4	1,128.1
4.50%	3.005	0.333	2036	Year 25	76,924	-	51.10	3,930.8			3,930.8		526.5	-	526.5	3,404.3	1,132.7
													Financial Internal Rate of Return				**#NUM!**
													NPV using Disc. Factor of		1.40%		**(14,458)**

Table A4.4-4 Cash flow in Scenario 2 Dauis

Cash Flow Projection
In 1,000 PHP

Domestic Inflation Rate	Domestic Escalation Factor	Conversion factor to real prices	**Year**		**Revenue Parameters** H2O Consumption		Sewerage Tariff: Sewerage Tariff 50% of water supply	**Cash Inflow** Revenue (1000 Peso): Domestic	Connection fee (5000 peso/HC)	Gov't Subsidy (90%)	**Total**	**Cash Outflow** Costs (1000 PHP): Project Cost	O&M Cost	Replace ment Cost	**Total**	**Net Cash Inflow (Nominal)**	**Net Cash Inflow (Real)**
3.00%			2010	Year -1			8.50					1.5%of WWTP					
5.14%	1.000	1.000	2011	Year 0								-			-	-	
4.50%	1.045	0.957	2012	Year 1											-	-	
4.50%	1.092	0.916	2013	Year 2								-			-	-	
4.50%	1.141	0.876	2014	Year 3					1,227	56,095.9	57,322.7	62,328.8			62,328.8	(5,006.1)	(4,386.9)
4.50%	1.193	0.839	2015	Year 4	37,134		10.10	375.1			375.1	-	208.9		208.9	166.1	139.3
4.50%	1.246	0.802	2016	Year 5	39,200	-	10.60	415.5			415.5		218.3		218.3	197.2	158.2
4.50%	1.302	0.768	2017	Year 6	41,348	-	11.10	459.0			459.0		228.1		228.1	230.8	177.3
4.50%	1.361	0.735	2018	Year 7	43,513	-	11.60	504.8			504.8		238.4		238.4	266.3	195.7
4.50%	1.422	0.703	2019	Year 8	45,763	-	12.10	553.7			553.7		249.1		249.1	304.6	214.2
4.50%	1.486	0.673	2020	Year 9	48,027	-	12.60	605.1	320		924.7		260.3		260.3	664.3	447.0
4.50%	1.553	0.644	2021	Year 10	49,802	-	13.20	657.4			657.4		272.1		272.1	385.3	248.1
4.50%	1.623	0.616	2022	Year 11	51,634	-	13.80	712.5			712.5		284.3		284.3	428.2	263.9
4.50%	1.696	0.590	2023	Year 12	53,443	-	14.40	769.6			769.6		297.1		297.1	472.5	278.6
4.50%	1.772	0.564	2024	Year 13	55,269	-	15.10	834.6			834.6		310.5		310.5	524.1	295.7
4.50%	1.852	0.540	2025	Year 14	57,154	-	15.70	897.3	204		1,101.0		324.4		324.4	776.6	419.3
4.50%	1.935	0.517	2026	Year 15	59,013	-	16.40	967.8			967.8		339.0		339.0	628.8	324.9
4.50%	2.022	0.494	2027	Year 16	60,889	-	17.20	1,047.3			1,047.3		354.3		354.3	693.0	342.7
4.50%	2.113	0.473	2028	Year 17	62,828	-	18.00	1,130.9			1,130.9		370.2		370.2	760.7	359.9
4.50%	2.208	0.453	2029	Year 18	64,738	-	18.80	1,217.1			1,217.1		386.9	9,904.4	10,291.3	(9,074.3)	(4,108.8)
4.50%	2.308	0.433	2030	Year 19	66,664	-	19.60	1,306.6			1,306.6		404.3		404.3	902.3	391.0
4.50%	2.412	0.415	2031	Year 20	68,657	-	20.50	1,407.5		-	1,407.5		422.5	-	422.5	985.0	408.4
4.50%	2.520	0.397	2032	Year 21	70,617	-	21.40	1,511.2			1,511.2		441.5		441.5	1,069.7	424.4
4.50%	2.634	0.380	2033	Year 22	72,593	-	22.40	1,626.1			1,626.1		461.4		461.4	1,164.7	442.2
4.50%	2.752	0.363	2034	Year 23	74,640	-	23.40	1,746.6			1,746.6		482.1		482.1	1,264.4	459.4
4.50%	2.876	0.348	2035	Year 24	76,650	-	24.40	1,870.3			1,870.3		503.8	-	503.8	1,366.4	475.1
4.50%	3.005	0.333	2036	Year 25	76,924	-	25.50	1,961.6			1,961.6		526.5	-	526.5	1,435.1	477.5
													Financial Internal Rate of Return				**-3.5%**
													NPV using Disc. Factor of		1.40%		**(1,897)**

Table A4.4-5 Cash flow in Scenario 3 Dauis

Cash Flow Projection
In 1,000 PHP

Domestic Inflation Rate	Domestic Escalation Factor	Conversion factor to real prices	Year		Revenue Parameters			Cash Inflow				Cash Outflow				Net Cash	Net Cash
					H2O Consumption		Sewerage Tariff	Revenue (1000 Peso)				Costs (1000 PHP)					
							Sewerage Tariff 340% of water supply	Domestic	Connection fee (5000 peso/HC)	Gov't Subsidy	Total	Project Cost	O&M Cost	Replace ment Cost	Total	Inflow (Nominal)	Inflow (Real)
3.00%			2010	Year -1			57.80					1.5%of WWTP					
5.14%	1.000	1.000	2011	Year 0								-			-	-	
4.50%	1.045	0.957	2012	Year 1											-	-	
4.50%	1.092	0.916	2013	Year 2								-			-	-	
4.50%	1.141	0.876	2014	Year 3					1,227		1,226.8	62,328.8			62,328.8	(61,102.1)	(53,543.5)
4.50%	1.193	0.839	2015	Year 4	37,134		68.90	2,558.5			2,558.5	-	208.9		208.9	2,349.6	1,970.3
4.50%	1.246	0.802	2016	Year 5	39,200	-	72.00	2,822.4			2,822.4		218.3		218.3	2,604.1	2,089.7
4.50%	1.302	0.768	2017	Year 6	41,348	-	75.30	3,113.5			3,113.5		228.1		228.1	2,885.4	2,215.7
4.50%	1.361	0.735	2018	Year 7	43,513	-	78.70	3,424.5			3,424.5		238.4		238.4	3,186.1	2,341.2
4.50%	1.422	0.703	2019	Year 8	45,763	-	82.20	3,761.7			3,761.7		249.1		249.1	3,512.6	2,470.0
4.50%	1.486	0.673	2020	Year 9	48,027	-	85.90	4,125.5	320		4,445.0		260.3		260.3	4,184.7	2,815.9
4.50%	1.553	0.644	2021	Year 10	49,802	-	89.80	4,472.2			4,472.2		272.1		272.1	4,200.2	2,704.6
4.50%	1.623	0.616	2022	Year 11	51,634	-	93.80	4,843.3			4,843.3		284.3		284.3	4,559.0	2,809.2
4.50%	1.696	0.590	2023	Year 12	53,443	-	98.00	5,237.4			5,237.4		297.1		297.1	4,940.3	2,913.1
4.50%	1.772	0.564	2024	Year 13	55,269	-	102.40	5,659.5			5,659.5		310.5		310.5	5,349.1	3,018.3
4.50%	1.852	0.540	2025	Year 14	57,154	-	107.00	6,115.5	204		6,319.2		324.4		324.4	5,994.8	3,237.0
4.50%	1.935	0.517	2026	Year 15	59,013	-	111.90	6,603.6			6,603.6		339.0		339.0	6,264.5	3,237.0
4.50%	2.022	0.494	2027	Year 16	60,889	-	116.90	7,117.9			7,117.9		354.3		354.3	6,763.6	3,344.4
4.50%	2.113	0.473	2028	Year 17	62,828	-	122.20	7,677.6			7,677.6		370.2		370.2	7,307.3	3,457.7
4.50%	2.208	0.453	2029	Year 18	64,738	-	127.70	8,267.0			8,267.0		386.9	9,904.4	10,291.3	(2,024.3)	(916.6)
4.50%	2.308	0.433	2030	Year 19	66,664	-	133.40	8,893.0			8,893.0		404.3		404.3	8,488.7	3,678.2
4.50%	2.412	0.415	2031	Year 20	68,657	-	139.40	9,570.8			9,570.8		422.5	-	422.5	9,148.3	3,793.3
4.50%	2.520	0.397	2032	Year 21	70,617	-	145.70	10,288.9			10,288.9		441.5		441.5	9,847.4	3,907.3
4.50%	2.634	0.380	2033	Year 22	72,593	-	152.20	11,048.7			11,048.7		461.4		461.4	10,587.3	4,020.0
4.50%	2.752	0.363	2034	Year 23	74,640	-	159.10	11,875.2			11,875.2		482.1		482.1	11,393.1	4,139.7
4.50%	2.876	0.348	2035	Year 24	76,650	-	166.20	12,739.2			12,739.2		503.8	-	503.8	12,235.4	4,254.3
4.50%	3.005	0.333	2036	Year 25	76,924	-	173.70	13,361.7			13,361.7		526.5	-	526.5	12,835.2	4,270.7
													Financial Internal Rate of Return				**1.7%**
													NPV using Disc. Factor of		1.40%		**1,743**

Table A4.4-6 Cash flow in Scenario 1 Panglao

Cash Flow Projection
In PHP1000

Domestic Inflation Rate	Domestic Escalation Factor	Conversion factor to real prices	Year		Revenue Parameters				Cash Inflow					Cash Outflow				Net Cash	Net Cash
					H2O Consumption		Sewerage Tariff 100% of water supply		Revenue (1000 Peso)					Costs (1000 Peso)					
					Domestic	Commercial	Domestic	Commercial	Domestic	Commercial	Connection fee (5000 peso/HC)	Gov't Subsidy (50%)	Total	Project Cost	O&M Cost	Replace ment Cost	Total	Inflow (Nominal)	Inflow (Real)
3.00%			2010	Year -1			4.80	9.30						1.5%of WWTP					
5.14%	1.000	1.000	2011	Year 0										Alona	412			-	
4.50%	1.045	0.957	2012	Year 1										Doljo=pob	818				
4.50%	1.092	0.916	2013	Year 2										-			-	-	
4.50%	1.141	0.876	2014	Year 3							1649	55,009.8	56,658.8	110,020			110,019.6	(53,360.8)	(46,759.9)
4.50%	1.193	0.839	2015	Year 4	17,520	95,453	5.70	11.10	99.9	1,059.5			1,159.4		491.3		491.3	668.1	560.2
4.50%	1.246	0.802	2016	Year 5	18,688	100,452	6.00	11.60	112.1	1,165.2			1,277.3		513.4		513.4	763.9	613.0
4.50%	1.302	0.768	2017	Year 6	19,856	105,452	6.30	12.10	125.1	1,276.0			1,401.1		536.5		536.5	864.6	663.9
4.50%	1.361	0.735	2018	Year 7	21,024	110,451	6.50	12.70	136.7	1,402.7			1,539.4		560.7		560.7	978.7	719.2
4.50%	1.422	0.703	2019	Year 8	22,192	115,451	6.80	13.20	150.9	1,523.9			1,674.8		585.9		585.9	1,088.9	765.7
4.50%	1.486	0.673	2020	Year 9	269,735	166,075	7.10	13.80	1,915.1	2,291.8	12,468	164,039.9	180,715.2	328,080	1,827.9		329,907.7	(149,192.6)	(100,392.3)
4.50%	1.553	0.644	2021	Year 10	278,957	170,504	7.50	14.40	2,092.2	2,455.3			4,547.5		1,910.2		1,910.2	2,637.3	1,698.3
4.50%	1.623	0.616	2022	Year 11	288,180	174,932	7.80	15.10	2,247.8	2,641.5			4,889.3		1,996.1		1,996.1	2,893.2	1,782.8
4.50%	1.696	0.590	2023	Year 12	297,402	179,361	8.10	15.80	2,409.0	2,833.9			5,242.9		2,085.9		2,085.9	3,157.0	1,861.5
4.50%	1.772	0.564	2024	Year 13	306,624	183,790	8.50	16.50	2,606.3	3,032.5			5,638.8		2,179.8		2,179.8	3,459.0	1,951.8
4.50%	1.852	0.540	2025	Year 14	315,847	188,218	8.90	17.20	2,811.0	3,237.3			6,048.3		2,277.9		2,277.9	3,770.4	2,035.9
4.50%	1.935	0.517	2026	Year 15	325,069	192,647	9.30	18.00	3,023.1	3,467.6			6,490.7		2,380.4		2,380.4	4,110.3	2,123.9
4.50%	2.022	0.494	2027	Year 16	334,291	197,076	9.70	18.80	3,242.6	3,705.0			6,947.6		2,487.5		2,487.5	4,460.1	2,205.4
4.50%	2.113	0.473	2028	Year 17	343,514	201,504	10.10	19.70	3,469.5	3,969.6			7,439.1		2,599.5	29,705.7	32,305.2	(24,866.1)	(11,766.0)
4.50%	2.208	0.453	2029	Year 18	352,736	205,933	10.60	20.50	3,739.0	4,221.6			7,960.6		2,716.4		2,716.4	5,244.2	2,374.6
4.50%	2.308	0.433	2030	Year 19	361,958	210,362	11.10	21.50	4,017.7	4,522.8			8,540.5		2,838.7		2,838.7	5,701.8	2,470.6
4.50%	2.412	0.415	2031	Year 20	371,181	214,790	11.60	22.40	4,305.7	4,811.3			9,117.0		2,966.4	-	2,966.4	6,150.6	2,550.3
4.50%	2.520	0.397	2032	Year 21	380,403	219,219	12.10	23.40	4,602.9	5,129.7			9,732.6		3,099.9		3,099.9	6,632.7	2,631.8
4.50%	2.634	0.380	2033	Year 22	389,625	223,648	12.60	24.50	4,909.3	5,479.4			10,388.7		3,239.4		3,239.4	7,149.3	2,714.6
4.50%	2.752	0.363	2034	Year 23	398,848	228,076	13.20	25.60	5,264.8	5,838.7			11,103.5		3,385.2	61,185.3	64,570.4	(53,466.9)	(19,427.2)
4.50%	2.876	0.348	2035	Year 24	408,070	232,505	13.80	26.70	5,631.4	6,207.9			11,839.3		3,537.5	-	3,537.5	8,301.8	2,886.6
4.50%	3.005	0.333	2036	Year 25	408,070	232,505	14.40	28.00	5,876.2	6,510.1			12,386.3		3,696.7	-	3,696.7	8,689.6	2,891.3

Financial Internal Rate of Return **#DIV/0!**
NPV using Disc. Factor of 1.40% **(132,282)**

Table A4.4-7 Cash flow in Scenario 2 Panglao

Cash Flow Projection
In PHP1000

Domestic Inflation Rate	Domestic Escalation Factor	Conversion factor to real prices	Year		Revenue Parameters: H2O Consumption Domestic	H2O Consumption Commercial	Sewerage Tariff 50% of water supply Domestic	Sewerage Tariff 50% of water supply Commercial	Cash Inflow: Revenue (1000 Peso) Domestic	Commercial	Connection fee (5000 peso/HC)	Gov't Subsidy (95%)	Total	Cash Outflow: Costs (1000 peso) Project Cost	O&M Cost	Replace ment Cost	Total	Net Cash Inflow (Nominal)	Net Cash Inflow (Real)
3.00%			2010	Year -1			2.40	4.65						1.5%of WWTP					
5.14%	1.000	1.000	2011	Year 0										Alona	412			-	
4.50%	1.045	0.957	2012	Year 1										Doljo=pob	818				
4.50%	1.092	0.916	2013	Year 2										-			-	-	
4.50%	1.141	0.876	2014	Year 3							1649	104,518.6	106,167.6	110,020			110,019.6	(3,852.0)	(3,375.5)
4.50%	1.193	0.839	2015	Year 4	17,520	95,453	2.90	5.50	50.8	525.0			575.8		491.3		491.3	84.5	70.8
4.50%	1.246	0.802	2016	Year 5	18,688	100,452	3.00	5.80	56.1	582.6			638.7		513.4		513.4	125.3	100.5
4.50%	1.302	0.768	2017	Year 6	19,856	105,452	3.10	6.10	61.6	643.3			704.9		536.5		536.5	168.4	129.3
4.50%	1.361	0.735	2018	Year 7	21,024	110,451	3.30	6.30	69.4	695.8			765.2		560.7		560.7	204.5	150.3
4.50%	1.422	0.703	2019	Year 8	22,192	115,451	3.40	6.60	75.5	762.0			837.5		585.9		585.9	251.6	176.9
4.50%	1.486	0.673	2020	Year 9	269,735	166,075	3.60	6.90	971.0	1,145.9	12,468	311,675.9	326,261.1	328,080	1,827.9		329,907.7	(3,646.7)	(2,453.8)
4.50%	1.553	0.644	2021	Year 10	278,957	170,504	3.70	7.20	1,032.1	1,227.6			2,259.7		1,910.2		1,910.2	349.5	225.1
4.50%	1.623	0.616	2022	Year 11	288,180	174,932	3.90	7.50	1,123.9	1,312.0			2,435.9		1,996.1		1,996.1	439.8	271.0
4.50%	1.696	0.590	2023	Year 12	297,402	179,361	4.10	7.90	1,219.3	1,417.0			2,636.3		2,085.9		2,085.9	550.4	324.5
4.50%	1.772	0.564	2024	Year 13	306,624	183,790	4.30	8.20	1,318.5	1,507.1			2,825.6		2,179.8		2,179.8	645.8	364.4
4.50%	1.852	0.540	2025	Year 14	315,847	188,218	4.40	8.60	1,389.7	1,618.7			3,008.4		2,277.9		2,277.9	730.5	394.5
4.50%	1.935	0.517	2026	Year 15	325,069	192,647	4.60	9.00	1,495.3	1,733.8			3,229.1		2,380.4		2,380.4	848.7	438.5
4.50%	2.022	0.494	2027	Year 16	334,291	197,076	4.90	9.40	1,638.0	1,852.5			3,490.5		2,487.5		2,487.5	1,003.0	495.9
4.50%	2.113	0.473	2028	Year 17	343,514	201,504	5.10	9.80	1,751.9	1,974.7		28,220.4	31,947.0		2,599.5	29,705.7	32,305.2	(358.1)	(169.5)
4.50%	2.208	0.453	2029	Year 18	352,736	205,933	5.30	10.30	1,869.5	2,121.1			3,990.6		2,716.4		2,716.4	1,274.2	576.9
4.50%	2.308	0.433	2030	Year 19	361,958	210,362	5.50	10.70	1,990.8	2,250.9			4,241.7		2,838.7		2,838.7	1,403.0	607.9
4.50%	2.412	0.415	2031	Year 20	371,181	214,790	5.80	11.20	2,152.8	2,405.6			4,558.4		2,966.4	-	2,966.4	1,592.0	660.1
4.50%	2.520	0.397	2032	Year 21	380,403	219,219	6.00	11.70	2,282.4	2,564.9			4,847.3		3,099.9		3,099.9	1,747.4	693.3
4.50%	2.634	0.380	2033	Year 22	389,625	223,648	6.30	12.20	2,454.6	2,728.5			5,183.1		3,239.4		3,239.4	1,943.7	738.0
4.50%	2.752	0.363	2034	Year 23	398,848	228,076	6.60	12.80	2,632.4	2,919.4		58,126.0	63,677.8		3,385.2	61,185.3	64,570.4	(892.6)	(324.3)
4.50%	2.876	0.348	2035	Year 24	408,070	232,505	6.90	13.40	2,815.7	3,115.6			5,931.3		3,537.5	-	3,537.5	2,393.8	832.3
4.50%	3.005	0.333	2036	Year 25	408,070	232,505	7.20	14.00	2,938.1	3,255.1			6,193.2		3,696.7	-	3,696.7	2,496.5	830.7
															Financial Internal Rate of Return				**2.2%**
															NPV using Disc. Factor of		1.40%		**563**

Table A4.4-8 Cash flow in Scenario 3 Panglao

Cash Flow Projection
In PHP1000

Year		Revenue Parameters				Cash Inflow					Cash Outflow				Net	Net
		H2O Consumption		Sewerage Tariff 100% of water supply		Revenue (1000 Peso)					Costs (1000peso)				Cash	Cash
		Domestic	Commercial	Domestic	Commercial	Domestic	Commercial	Connection fee (5000 peso/HC)	Gov't Subsidy (87%)	Total	Project Cost	O&M Cost	Replace ment Cost	Total	Inflow (Nominal)	Inflow (Real)
2010	Year -1			4.80	9.30						1.5%of WWTP					
2011	Year 0										Alona	412			-	
2012	Year 1										Doljo=pob	818				
2013	Year 2										-			-	-	
2014	Year 3							1649	95,717.0	97,366.0	110,020			110,019.6	(12,653.6)	(11,088.3)
2015	Year 4	17,520	95,453	5.70	11.10	99.9	1,059.5			1,159.4		491.3		491.3	668.1	560.2
2016	Year 5	18,688	100,452	6.00	11.60	112.1	1,165.2			1,277.3		513.4		513.4	763.9	613.0
2017	Year 6	19,856	105,452	6.30	12.10	125.1	1,276.0			1,401.1		536.5		536.5	864.6	663.9
2018	Year 7	21,024	110,451	6.50	12.70	136.7	1,402.7			1,539.4		560.7		560.7	978.7	719.2
2019	Year 8	22,192	115,451	6.80	13.20	150.9	1,523.9			1,674.8		585.9		585.9	1,088.9	765.7
2020	Year 9	269,735	166,075	7.10	13.80	1,915.1	2,291.8	12,468	285,429.5	302,104.7	328,080	1,827.9		329,907.7	(27,803.0)	(18,708.8)
2021	Year 10	278,957	170,504	7.50	14.40	2,092.2	2,455.3			4,547.5		1,910.2		1,910.2	2,637.3	1,698.3
2022	Year 11	288,180	174,932	7.80	15.10	2,247.8	2,641.5			4,889.3		1,996.1		1,996.1	2,893.2	1,782.8
2023	Year 12	297,402	179,361	8.10	15.80	2,409.0	2,833.9			5,242.9		2,085.9		2,085.9	3,157.0	1,861.5
2024	Year 13	306,624	183,790	8.50	16.50	2,606.3	3,032.5			5,638.8		2,179.8		2,179.8	3,459.0	1,951.8
2025	Year 14	315,847	188,218	8.90	17.20	2,811.0	3,237.3			6,048.3		2,277.9		2,277.9	3,770.4	2,035.9
2026	Year 15	325,069	192,647	9.30	18.00	3,023.1	3,467.6			6,490.7		2,380.4		2,380.4	4,110.3	2,123.9
2027	Year 16	334,291	197,076	9.70	18.80	3,242.6	3,705.0			6,947.6		2,487.5		2,487.5	4,460.1	2,205.4
2028	Year 17	343,514	201,504	10.10	19.70	3,469.5	3,969.6		25,844.0	33,283.1		2,599.5	29,705.7	32,305.2	977.9	462.7
2029	Year 18	352,736	205,933	10.60	20.50	3,739.0	4,221.6			7,960.6		2,716.4		2,716.4	5,244.2	2,374.6
2030	Year 19	361,958	210,362	11.10	21.50	4,017.7	4,522.8			8,540.5		2,838.7		2,838.7	5,701.8	2,470.6
2031	Year 20	371,181	214,790	11.60	22.40	4,305.7	4,811.3			9,117.0		2,966.4	-	2,966.4	6,150.6	2,550.3
2032	Year 21	380,403	219,219	12.10	23.40	4,602.9	5,129.7			9,732.6		3,099.9		3,099.9	6,632.7	2,631.8
2033	Year 22	389,625	223,648	12.60	24.50	4,909.3	5,479.4			10,388.7		3,239.4		3,239.4	7,149.3	2,714.6
2034	Year 23	398,848	228,076	13.20	25.60	5,264.8	5,838.7		53,231.2	64,334.7		3,385.2	61,185.3	64,570.4	(235.8)	(85.7)
2035	Year 24	408,070	232,505	13.80	26.70	5,631.4	6,207.9			11,839.3		3,537.5	-	3,537.5	8,301.8	2,886.6
2036	Year 25	408,070	232,505	14.40	28.00	5,876.2	6,510.1			12,386.3		3,696.7	-	3,696.7	8,689.6	2,891.3
												Financial Internal Rate of Return				**1.9%**
												NPV using Disc. Factor of		1.40%		**1,377**

Table A4.4-9 Cash flow in Scenario 4 Panglao

Cash Flow Projection
In 1000 PHP

Year		Revenue Parameters				Cash Inflow					Cash Outflow				Net Cash	Net Cash
		H2O Consumption		Sewerage Tariff 630% of water supply		Revenue (1000 Peso)					Costs (1000peso)					
		Domestic	Commercial	Domestic	Commercial	Domestic	Commercial	Connection fee (5000	Gov't Subsidy	Total	Project Cost	O&M Cost	Replace ment Cost	Total	Inflow (Nominal)	Inflow (Real)
2010	Year -1			30.24	58.59						1.5%of WWTP					
2011	Year 0										Alona	412			-	
2012	Year 1										Doljo=pob	818				
2013	Year 2										-			-	-	
2014	Year 3							1649		1,649.0	110,020			110,019.6	(108,370.6)	(94,964.8)
2015	Year 4	17,520	95,453	36.10	69.90	632.5	6,672.1			7,304.6		491.3		491.3	6,813.3	5,713.4
2016	Year 5	18,688	100,452	37.70	73.00	704.5	7,333.0			8,037.5		513.4		513.4	7,524.1	6,037.7
2017	Year 6	19,856	105,452	39.40	76.30	782.3	8,045.9			8,828.2		536.5		536.5	8,291.7	6,367.1
2018	Year 7	21,024	110,451	41.20	79.70	866.2	8,802.9			9,669.1		560.7		560.7	9,108.4	6,693.1
2019	Year 8	22,192	115,451	43.00	83.30	954.3	9,617.0			10,571.3		585.9		585.9	9,985.4	7,021.6
2020	Year 9	269,735	166,075	44.90	87.10	12,111.1	14,465.1	12,468		39,044.5	328,080	1,827.9		329,907.7	(290,863.2)	(195,723.1)
2021	Year 10	278,957	170,504	47.00	91.00	13,111.0	15,515.9			28,626.9		1,910.2		1,910.2	26,716.7	17,203.7
2022	Year 11	288,180	174,932	49.10	95.10	14,149.6	16,636.0			30,785.6		1,996.1		1,996.1	28,789.5	17,740.0
2023	Year 12	297,402	179,361	51.30	99.40	15,256.7	17,828.5			33,085.2		2,085.9		2,085.9	30,999.3	18,279.1
2024	Year 13	306,624	183,790	53.60	103.80	16,435.0	19,077.4			35,512.4		2,179.8		2,179.8	33,332.6	18,808.6
2025	Year 14	315,847	188,218	56.00	108.50	17,687.4	20,421.7			38,109.1		2,277.9		2,277.9	35,831.2	19,347.9
2026	Year 15	325,069	192,647	58.50	113.40	19,016.5	21,846.2			40,862.7		2,380.4		2,380.4	38,482.3	19,884.6
2027	Year 16	334,291	197,076	61.20	118.50	20,458.6	23,353.5			43,812.1		2,487.5		2,487.5	41,324.6	20,433.7
2028	Year 17	343,514	201,504	63.90	123.80	21,950.5	24,946.2			46,896.7		2,599.5	29,705.7	32,305.2	14,591.5	6,904.4
2029	Year 18	352,736	205,933	66.80	129.40	23,562.8	26,647.7			50,210.5		2,716.4		2,716.4	47,494.1	21,505.3
2030	Year 19	361,958	210,362	69.80	135.20	25,264.7	28,440.9			53,705.6		2,838.7		2,838.7	50,866.9	22,040.7
2031	Year 20	371,181	214,790	72.90	141.30	27,059.1	30,349.8			57,408.9		2,966.4	-	2,966.4	54,442.5	22,574.2
2032	Year 21	380,403	219,219	76.20	147.70	28,986.7	32,378.6			61,365.3		3,099.9		3,099.9	58,265.4	23,119.0
2033	Year 22	389,625	223,648	79.60	154.30	31,014.2	34,508.9			65,523.1		3,239.4		3,239.4	62,283.7	23,649.2
2034	Year 23	398,848	228,076	83.20	161.20	33,184.2	36,765.9			69,950.1		3,385.2	61,185.3	64,570.4	5,379.7	1,954.7
2035	Year 24	408,070	232,505	87.00	168.50	35,502.1	39,177.1			74,679.2		3,537.5	-	3,537.5	71,141.7	24,736.2
2036	Year 25	408,070	232,505	90.90	176.10	37,093.6	40,944.1			78,037.7		3,696.7	-	3,696.7	74,341.0	24,735.5
											Financial Internal Rate of Return					**1.5%**
											NPV using Disc. Factor of			1.40%		**2,835**

Appendix

Chapter 5

Table of Contents

Appendix Chapter 5

5.1. Results of Questionnaire Survey

Table A 5.1-1 Results of Questionnaire to the Tourist Accommodation Facilities (1/2)

No.	Name of hotel	Barangy	Const-ruction Year	Room rate per night (Peso)	Facilities			No. of rooms	Occupacy Rate			Type of Water Source*1			Water consumption*2		
					Swim ming Pool	Dive shop	Resta urant		Avera ge	High season	Official data Averag e	Drinking	Cooking	Others	Water consump tion (m^3/mon th)	Estimated volume in high season	Pay Amount (Peso/m onth)
Dauis Municipality																	
1	Ladaga Inn & Restaurant	Totolan	2005	<1,000				28	25%	25%	17%	Bottle	Public WS	Public WS	44	92.4	1,500
2	French Kiss	San Isdro	2010	2,500	Yes			4	15%	89%		Bottle	Own well	Own well, Public WS	5	46.992	150
3	Bohol Plaza	Mayacalbac	1999	1,200<	Yes		Yes	94	60%	90%	40%	Bottle	Bottle	Public WS, Own well	1,631	1,117	80,790
4	Bohol Bee Farm	Dao	2002	3,000-8,000	Yes	Yes	Yes	40	50%	80%	6%	Bottle	Bottle	Own well	3,000	422.4	-
5	Coco Grove	Poblacion	2005	1,000				13	70%	90%	30%	Bottle	Public WS	Public WS	62	154.44	2,350
Panglao Municipality																	
1	Alona Kew White Beach Resort	Tawala	2010	4,100-15,600	Yes		Yes	63	80%	100%	33%	Bottle	Bottle	Water truck	1,560	831.6	-
2	Charts Resort & Art Café	Tawala	2008	4000<	Yes			9	35%	60%		Bottle	Filipinas WS	Filipinas WS	125	71.28	3,751
3	Linaw Beach Resort	Danao	2008	3,400-5,800	Yes		Yes	14	30%	50%	16%	Bottle	Water truck	Water truck	120	92.4	20,400
4	Amarela	Libang	2006	5,800-20,000	Yes		Yes	25	43%	43%		Bottle	Water truck	Water truck	470	141.9	58,750
5	Sea Corals Hotel	Doljo	1998?	1,000<			Yes	17	80%	90%	46%	Bottle	Public WS, well	Public WS, well	30	201.96	-
6	Muro Ami Seaside Inn & Restaruant	Doljo	2007	900-2,500		Yes	Yes	16	30%	50%	16%	Bottle	Public, Water truck		103	105.6	-
7	Ananyana Beach Rsort	Doljo	2000	7,600<	Yes	Yes	Yes	12	60%	80%	45%	Bottle	Public WS, Water truck	Public WS, Water truck	158	126.72	-
8	Aquatica	Tawala	1992	1,000			Yes	16	48%	55%		Bottle	Bottle	Public	76	116.16	2,270
9	ISIS Bangalows	Danao	2005	2,000-3,000			Yes	12	30%	80%		Bottle	Bottle	Mactan WS	300	126.72	18,000
10	Tierra Azul	Danao	1998	1,500				11	50%	60%		Bottle	Bottle	Mactan WS	199	87.12	7,910
11	Alona Charlotte Resort	Danao	2002	2500<				6	50%	80%		Bottle		Filipinas WS, Water truck	138	63.36	7,538
12	Bananaland Cotages	Tawala	1992	1500				4	10%	10%		Bottle	Mactan WS	Mactan WS, Own well	133	5.28	4,000
13	Flower Garden	Tawala	1997	1,600-1,900	Yes			6	80%	90%	170	Bottle	Bottle	Mactan WS	127	71.28	3,800
14	Cherry Home 1	Tawala	2006	1000				6	45%	80%		Bottle	Bottle	Own well	-	63.36	-
15	Oasis Resort	Tawala	1998	3300<	Yes	Yes	Yes	22	-	Unkno wn		Bottle	Public	Filipinas WS	500	-	14,000
16	Genesis Divers	Tawala	2006	1000		Yes	Yes	4	70%	80%		Bottle	Public	Filipinas WS	367	42.24	11,000
17	Citadel Alona Inn	Tawala	2005	750-2,400				12	60%	80%		Bottle	Bottle	Own well	-	126.72	-
18	Evelyn Resort	Danao	2007	1,000-1,400	Yes			6	20%	30%		Bottle	Bottle	Own well	-	23.76	-
19	Jas'z Bar & Restaurant	Tawala	2007	1,500		Yes	Yes	4	40%	50%		Bottle	Public WS	Public WS	100	26.4	4,000
20	One 4 the Road	Tawala	2008	800			Yes	4	40%	60%		Bottle	Bottle	Mactan WS	50	31.68	1,500
21	Alona Tropical Beach Resort	Tawala	2007	2,980	Yes	Yes	Yes	62	60%	70%		Bottle	Bottle	Mactan WS	433	572.88	13,000
22	Hennan Resort	Tawa;a	1999	12,320	Yes		Yes	12	30%	50%		Bottle	Bottle	Mactan WS, Own well	167	79.2	5,000
23	Vila Belza Resort	Danao	2008	1,000	Yes		Yes	9	50%	80%		Bottle	Own well	Own well	-	95.04	-
24	Alona Studio	Tawala	2005		Yes			38	50%	80%		Bottle	Bottle	Water supply&O wn well	153	401.28	-
25	Lost Horizon Hotel	Danao	1998	2,695	Yes	Yes	Yes	30	85%	85%		Bottle	Own well	Own well	-	336.6	-
26	Bita-ug Beach Resort	Danao	2005	1,800	Yes		Yes	7	50%	70%		Bottle	Bottle	Water truck	67	64.68	10,070

*1: WS stands for Water Supply System. There is two private water supply company named Philippians water and Mactan rack in Panglao..
*2: Estimated water consumption volume is calculated by: (No. of rooms) x (Occupancy rate in high season) x (2 persons/room) x (0.22 m3/day/person) x 30 days.

Table A 5.1-1 Results of Questionnaire to the Tourist Accommodation Facilities (2/2)

No.	Name of hotel	Barangy	Const-ruction Year	Wastewater Disposal			Structure of Treatment			Riquired tank volume*3 (m^3)	Maintenance		Remarks
				Toilet	Kitchen Waste	Others	No. of chamber	No. of ST	Tank size in total (m^3)		Desludging Frequency/ reason	Last desludging date	
Dauis Municipality													
1	Ladaga Inn & Restaurant	Totolan	2005	ST	ST	ST	4	1	28.2	33.6	Tank full	Jan.2011	
2	French Kiss	San Isdro	2010	ST	ST	ST	3	1	28	4.8	None	–	
3	Bohol Plaza	Mayacalbac	1999	ST	ST	ST	3	1	56.7	124.08	None	–	ST effluent is dicahrged into own open yard
4	Bohol Bee Farm	Dao	2002	ST	ST	ST	3	3	148.4	52.8	Tank full	2011	Hotel grows many vegetables and flowers
5	Coco Grove	Poblacion	2005	ST	ST	ST	3	1	13.7	15.6	None	–	
Panglao Municipality													
1	Alona Kew White Beach Resort	Tawala	2010	ST	ST	ST	4	2	80	83.16	None	–	
2	Charts Resort & Art Café	Tawala	2008	ST	ST	ST	3	2	40	10.8	Every 6 month	Oct. 2011	
3	Linaw Beach Resort	Danao	2008	ST	ST	ST	3	3	56.4	18.48	Tank full	Don't remember	Overflow was observed
4	Amarela	Libang	2006	ST	ST	ST	3	2	32	33	None	–	ST effluent be treated by Reed Bed System*
5	Sea Corals Hotel	Doljo	1998?	ST	ST	ST	3	2	64	22.44	Tank full	2001	
6	Muro Ami Seaside Inn & Restaruant	Doljo	2007	ST	ST	ST	1 or 3	3ST: 3 Pit: 2	64.1	21.12	Every 7month	Dec. 2011	Using unlined pit for toilet
7	Ananyana Beach Rsort	Doljo	2000	ST	ST	ST	3	2	62.5	15.84	Tank full	Feb. 2011	
8	Aquatica	Tawala	1992	ST	ST	ST	2	3	51.7	21.12	Every 1 years	Mar. 2012	
9	ISIS Bangalows	Danao	2005	ST	ST	ST	1 or 3	3ST: 1 1ST: 3	69.1	15.84	Every 2 month	Apr. 2012	
10	Tierra Azul	Danao	1998	ST	ST	ST	3	1	13.9	13.2	Tank full	Feb. 2011	
11	Alona Charlotte Resort	Danao	2002	ST	ST	ST	3	1	19	7.2	Tank full	Aug. 2011	
12	Bananaland Cotages	Tawala	1992	ST	ST	ST	3	2	52.8	4.8	None	–	ST was renovated. Cost P150,00 per unit.
13	Flower Garden	Tawala	1997	ST	ST	ST	1,2 or 3	3ST: 3 2ST: 1 Pit: 1	51.4	7.2	Tank full	Jan. 2012	ST in each room. 1 unlined pit for toilet
14	Cherry Home 1	Tawala	2006	ST	ST	ST	3	1	26.4	7.2	Tank full	2012	
15	Oasis Resort	Tawala	1998	ST	ST	ST	2 or 3	3ST: 8 2ST: 8	309.8	29.04	Tank full, Twice a month	Apr. 2012	Desludge by their own, dump into cave
16	Genesis Divers	Tawala	2006	ST	ST	ST	3	1	39	5.28	Tank full	Feb. 2011	
17	Citadel Alona Inn	Tawala	2005	ST	ST	ST	3	1	33.5	14.4	Every 2 years	Jan. 2011	has Self-cook kitchen
18	Evelyn Resort	Danao	2007	ST	ST	ST	3	2	20.7	7.2	None	–	
19	Jas'z Bar & Restaurant	Tawala	2007	ST	ST	ST	3	2	32	5.28	Tank full	2010	
20	One 4 the Road	Tawala	2008	ST	ST	ST	3	3	63	5.28	None	–	
21	Alona Tropical Beach Resort	Tawala	2007	ST	ST	ST	3 or 6	6ST: 2 3ST: 2	239	81.84	Tank full	Nov. 2011	
22	Hennan Resort	Tawa;a	1999	ST	ST	ST	3 or 4	4ST: 4 3ST: 1	444.9	15.84	Tank full	Mar. 2009	
23	Vila Belza Resort	Danao	2008	ST	ST	ST	3	1	96.2	11.88	Tank full	Feb. 2012	
24	Alona Studio	Tawala	2005	ST	ST	ST	1 or 3	3ST: 3 Pit: 1	71.2	45.6	Tank full	Apr, 2012	Pit for kitchen waste
25	Lost Horizon Hotel	Danao	1998	ST	ST	ST	3	5	175	39.6	Tank full	Sep. 2011	
26	Bita-ug Beach Resort	Danao	2005	ST	ST	ST	1 or 3	3ST: 2 Pit: 1	17.8	9.24	None	–	Unline pit for shower

Table A 5.1-2 Results of Questionnaire to Households

No.	Barangy	Constru-ction Year	Monthly Income (Peso)	No. of living person	Water Source			Water consumption			Wastewater Disposal			Structure of Treatment			Required volume m3	Desludging Frequency	Remarks
					Drinking	Cooking	Others	Water consumption (m3/month)	Estimated volume (m3/month)	Pay Amount per month (Peso/month)	Toilet	Kitchen Waste	Others	No. of chamber	Unit No.	Tank size in total (m^3)			
Dauis																			
1	Poblacion	2011	90,000	2	Bottle	Public water supply	Public water	18	12	300	ST	2nd chamber of the ST	2nd chamber of the ST	2	1	6.6	1.2	None	
2	Totolan	2003	38,000	5	Bottle	Public water supply	Water Truck	32	30	589	Unlined Pit	Seep to underground	Unlined Pit	1	1	32.1	3	None	
3	Totolan	2001	Retired Japanese house	2	Bottle, Rainwater	Public water, Rainwater	Public water, Rainwater	13.6	12	230	ST	Seep to underground	ST	2	1	18.9	1.2	None	
4	Poblacion	2011	50,000	2	Bottle	Public water supply	Public water supply	17.5	12	300	ST	ST	ST	2	1	16.6	1.2	None	No manhole.
5	Poblacion	2000	30,000	6	Bottle	Bottle	Public water supply	23.1	36	400	Unlined Pit	Unlined Pit	Unlined Pit	1	3	10.0	3.6	One a year for kitchen waste pit	Two unlined pits were newly constructed in 2004 and 2002.
6	Poblacion	2000	40,000	9	Bottle	Bottle	Public water supply	27.8	54	485	ST	Seep to underground	ST	2	2	49.0	5.4	Tank full more than 5 years ago	Construct new ST. Overflow of first ST flows into nes 2nd ST.
7	Poblacion	1973	50,000	6	Bottle	Public water supply	Public water supply	28.6	36	500	Aqua Privy	Aqua Privy	Aqua Privy	1	1	21.1	3.6	More than 10 years ago	ST is built under building. No manhole.
8	Poblacion	Renovated in 1999	Less than 10,000	4	Bottle	Bottle	Public water supply	11.9	24	200	Aqua Privy	Seep to underground	Aqua Privy	1	1	9.0	2.4	None	Use many water when the blockage occurred.
9	Poblacion	1998	10,000	5	Bottle	Public water supply	Public water supply	72	30	1,000	Aqua Privy	Seep to underground	Seep to underground	1	1	8.0	3	None	
10	Poblacion	2007	90,000	6	Bottle	Public water supply	Public water supply	17.5	36	300	Aqua Privy	Seep to underground→Sea	Seep to underground→Sea	1	1	32.4	3.6	None	Half of the ST is under building.
Panglao																			
1	Danao	1997	10,001–20,000	2	Bottle	Public water supply	Public water supply	16.7	12	150	ST/Unline pit	ST	Seep to underground	1	ST: 1 Pit: 1	20	1.2	None	Unline pit for outside toilet
2	Tawala	1980	Less than	15	Own well	Own well	Own well	9	90	–	Unlined Pit	Seep to undergro	Seep to undergro	1	1	3	9	None	Unline pit for outside toilet
3	Danao	1993	Less than	8	Bottle	Bottle	Purchase public	2	48	–	Unlined Pit	Seep to undergro	Unlined Pit	1	1	12	4.8	None	
4	Danao	1992	Less than	4	Bottle	Purchase public	Purchase public	1	24	–	Unlined Pit	Seep to undergro	Seep to undergro	1	2	18	2.4	None	Unline pit was renovated in 2006
5	Poblacion	1980	30,001–40,000	6	Bottle	Own well	Own well, Public water supply	13	36	150	Unlined Pit	Unlined Pit	Unlined Pit	1	2	43	3.6	None	Unline pit for kitchen waste was renovated in 2007
6	Poblacion	2009	50,001–60,000	2	Bottle	Bottle	Well	–	12	–	ST	ST	ST	3	1	30	1.2	None	
7	Poblacion	2006	30,001–40,000	4	Bottle	Water supply system	Water supply system, Own Driling water (well with pump)	3	24	70	ST	ST	ST	3	1	41	2.4	None	
8	Poblacion	2010	Less than 10,000	2	Own well	Own well	Own well	–	12	–	ST	ST	ST	2	1	36	1.2	None	Top of the ST was 95cm above the ground level
9	Poblacion	2010	10,001–20,000	4	Bottle	Water supply	Water supply	3	24	70	Unlined Pit	Seep to undergro	Seep to undergro	1	1	9	2.4	None	
10	Poblacion	2005	10,001–20,000	7	Bottle	Water supply	Water supply	23	42	200	Unlined Pit	Seep to undergro	Seep to undergro	1	1	6	4.2	None	Renovated in 2008

*2: Water consumption per month is only by public water supply (m3/month)
Estimated water consumption volume is calculated by (No. of living people) x (0.2 m3/day/person) x 30 days.

5.2. Reeds Bed System

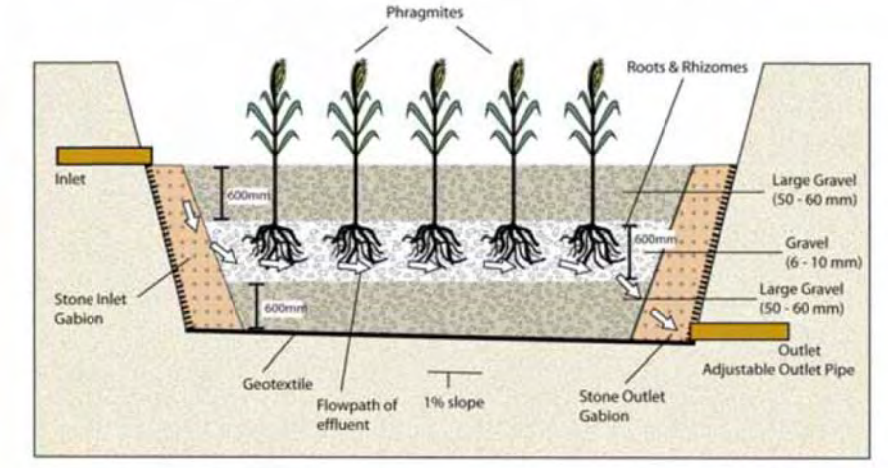
Reed beds system is an option for the secondary treatment of wastewater from a septic tank. A reed bed system is essentially a channel, lined with an impermeable membrane, which is filled with gravel and planted with macrophytes. The most notable of which is the common reed or other plants species used are *iris*, *typha*, *sparganium*, *carex*, *schoenoplectus* and *acorus*. As the ST effluent flows through the wetland, the micro-organisms that are attached to the root system of the reeds purify the wastewater.

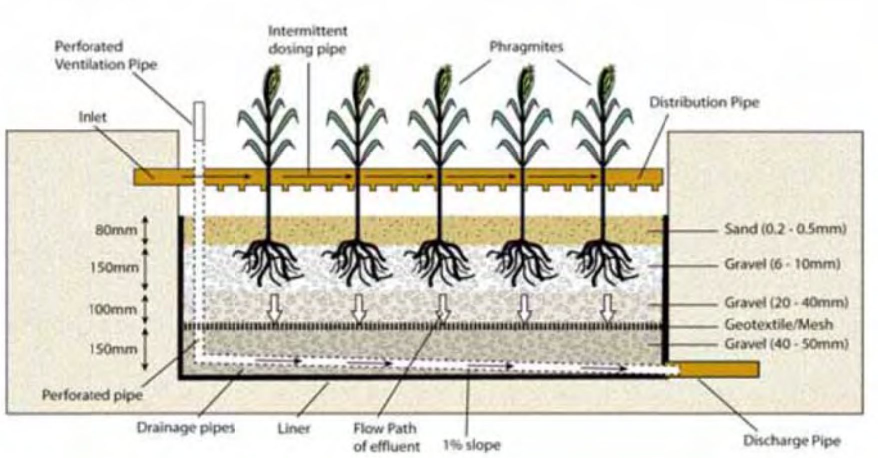
Reeds bed system can be sub divided depending on their media and flow type:

- Sand based Vertical Reeds bed

- Gravel based Vertical Reeds bed
- Gravel based Horizontal Reeds beds

Tow typical drawings of reeds bed systems are shown below.





Reference: Code of practice Wastewater Treatment Systems for single housed, U.S. EPA, 2007

Figure A 5.2-1 Typical Drawing of Reeds Bed System (Upper: Vertical flow reed bed, Down: Sub-surface Horizontal flow reed bed)

5.3. Inspection/Certifications

The engineer or staff engineers of contractor are required to perform inspections during all phases of construction. Furthermore, a Certificate of Completion must be filled out by the engineer and submitted to administrative authorities such as MBO or PIWWM. Once the MBO or PIWWM received the Certificate of Completion, written verification is recommended to send to the engineer and permitte for their records. A sample of form of a Certificate of Completion is shown below.

On site Sewage Treatment Facility
Certificate of Completion

Project Name: ______________________________

Project Site Address: ______________________________

This certificate is to be completed by the engineer who constructed the on site sewage treatment facility and submitted to following administrative after construction complete.

Municipal Building Office Division of Panglao municipality
or PIWWM
Address:*********
Contact number:********

Engineer's Certification

I certify that the on site sewage treatment facility has been constructed in accordance with the approved plans and specifications and that the onsite sewage disposal system is complete and ready for operation. I also certify that a copy of the as-built plans and specification and Operation and Maintenance Manual has been given to the permittee/owner for their use.

Print name: ______________________________
Signature: ______________________________
Date: ____________________
License number: ____________________

Reference: Guidance manual (1.0) On site sewage disposal system for commercial applications, State of Nevada division of environmental protection bureau of water pollution control, 2008.

Figure A 5.3-1 A sample of a Certificate of Completion form

5.4. Operation and Maintenance Record

Check list for inspection of Septic Tank and the maintenance record

Inspection Date:

Item	Guide for desludging	Results
Sludge level Note(1)	when it exceeds 30% of the tank capacity	
Floating solid (scum) level	when the bottom of the scum mat is within 10cm of the bottom of the inlet device	
Structural soundness and watertightness Note(2)	When the water level of the tank is below or above the outlet invert	
Clean effluent filters	-	

Note (1). The depth of sludge can checked using following technique:

Use a 2m pole and wrap the bottom 1.2m with a white rag.

Lower the pole to the bottom of the tank and hold there for several minutes to allow the sludge layer to penetrate the rag.

Remove the pole and note the sludge line, which will be darker coloration caused by the liquid waste.

Note (2). Watertightness can be checked by observing the liquid level, observing joints, and listening for running or dripping water. The liquid level of the tank should be at the outlet invert level. If the liquid level is below the outlet invert, leaking is occurring. If it is above, outlet is obstructed of percolation area is flooded.

Inspection/Desludgning Records:

Date	Implementer/Service provider	Cost	Notes*

*State the contents of maintenance that you have done.
Ex. Inspection, Cleaning, Desludging, Repair the leakage etc.

Reference: Code of practice Wastewater Treatment Systems for single housed, U.S. EPA, 2007

Figure A 5.4-1 A Sample of Check List for Inspection of Septic Tank and the Maintenance Record

5.5. Estimation of Statistical Values Used for Calculation of Drying Bed Facility Size

❖ Estimation of numbers of household and population in 2011

Table A 5.5-1 Estimation of the Number of Household and Population in 2011

		Tagbilaran	Dauis	Panglao	
No. household in 2007	[1]	18,045	7,305	4,481	NSC2007
No. population in 2007	[2]	92,297	36,525	25,558	NSC2007
No. building permit for residence since 2008 to 2011	[3]	313	572	445	Data provided by MBO
No. household in 2011	[4]	18,358	7,832	4,926	[4]=[1]+[3]
No. population in 2011	[5]	93,898	39,160	28,096	[5]=[4]x[2]/[1]

❖ Estimation of the number of households which has their own ST

Table A 5.5-2 Estimation of the Number of Households which has their own ST in 2011

	Dauis		Panglao	
	Total	Incresing No.	Total	Incresing No.
2000	3,448	–	2,550	–
2001	3,598	150	2,630	80
2002	3,745	147	2,710	80
2003	3,982	237	2,790	80
2004	4,185	203	2,870	80
2005	4,378	193	2,960	90
2006	4,540	162	3,044	84
2007	4,691	151	3,151	107
2008	4,820	129	3,288	137
2009	4,968	148	3,376	88
2010	5,078	110	3,485	109
2011	5,218	140	3,596	111

*Source of number of households which has their own ST in 2000: National Statistic Office data in 2000
*Source of increasing number: Data of the number of building permit for residence provided by MBO of Dauis and Panglao municipalities. However, the data in hatching year is assumption value since the data was not available.