PROJECT

WATER SUPPLY FOR A PART OF HOA TAN WARD, CHAU DIEN WARD AND CAU KE TOWN – CAU KE DISTRICT TRA VINH PROVINCE

CAPACITY 2.400 M^3/DAY

VOLUME 1 : General Description

(Revised and supplemented)

EMPLOYER

TRA VINH WATER SUPPLY SEWERAGE COMPANY, LTD.

GIÁM ĐỐC

IMPLEMENTED AGENCY

THANH HUNG CONSTRUCTION CONSULTING OF INFRASTRUCTURE AND ENVIRONMENT, LTD.

HCMC, January, 2013

I. GENERAL INTRODUCTION OF PROJECT:

Tra Vinh province is belong to Coast Area at East of Mekong Delta, between 2 large branch of Mekong river is Co Chien and Hau river, the East is adjacent to 65 km of seaside, is a remote province, condition of economic and social development is less advantaged, economic growth is lower than other province. Residential life is still difficult both physically and mentally.

In recent years, leaders and people of Tra Vinh province have promoted potentials of province to economic and social development. Economy of province has been breakthrough developed with national works such as Coast Power Center, waterway traffic system through Quan Chanh Bo channel, Dinh An economic area, ect...

Cau Ke town is belong to Cau Ke district, which is a district at the West of province, is adjacent to Hau river at the West and Vinh Long province at the North. Cau Ke town with highway 54 runs through connection from highway 60, from Tra Vinh city through Vinh Long province. In 2011, economy of province has been developed fairly, growth GDP of whole town has been increased 7.34 percent, in there, aquatic product has been increased 15.02 percent, industry has been increased 17.08 percent, construction has been increased 20.95 percent, service has been increased 19.67 percent. Urbanization of town is more and more growing and expanding

Economic and social development of town with required infrastructure works must synchronous development, in there, there has clean water supply system to serve for daily needs and service production of people. Whereas, current water supply system of town only supply about 50% of minimum demand for daily needs. Coastal town and adjacent area of communes, people have not yet using treated water according to national standard

For meet demand of treated water according to national standard to serve for daily needs and service production for people of Cau Ke town and adjacent area, must invest, upgrade and expand Cau Ke water supply system

Contents of Project investment, upgrades and expansion of Cau Ke water supply system is established in according to Construction Law No.61/2003/QH11 dated 26th November 2009 of National Assembly. Degree No.12/2009/NĐ-CP dated 12th December 2009 about project management of investment and construction works and Degree No.209/2004/NĐ-CP dated 16th December 2004 about quality management of construction works of Government

Investment project has been completed by consultant and submitted for Employer on 20th December 2012. Departments of Tra Vinh province have had comments for project. Consultant has adjusted and supplemented contents all comments of Departments about project and enclosed with explaination written for description of this volume

Main contents of project are summarized as follows:

1. **Name of project:** Investment project of water supply for a part of Hoa Tan Ward, Chau Dien Ward and Cau Ke town, Cau Ke district, Cau Ke province with capacity of 2.400 m3/day
2. **Governing Organization:** People s Committee of Tra Vinh province.

   Address: 52A Le Loi street, ward 1, Tra Vinh City

   Phone number: 07403855892 Facsimile: 074 3855895

   Email: travinh@chinhphu.vn
3. **Employer:** Tra Vinh Water Supply Sewerage Company, LTD.

   Address: 521B Dien Bien Phu street, ward 6, Tra Vinh City

   Phone number: 074 3840215 Facsimile: 074 3840343

   Email:
4. **Agency proposes this project:** Tra Vinh Water Supply Sewerage Sole Member Company, LTD.
5. **Consultant agency for project planning:** Thanh Hung Construction Consulting of Infrastructure and Environment, LTD.

   Address: 439B35 Phan Van Tri street, ward 5, Go Vap district, HCMC

   Phone number: 08 38956139 Facsimile: 08 38956139

   Email: ctythanhhung @ yahoo.com
6. **Capacity of water supply:** 2400 m^3/day
7. **Raw water source:** Groundwater
8. **Location of construction:** Cau Ke town, Cau Ke district, Tra Vinh province.
9. **Type of investment:** Upgrade and expansion
10. **Contents of investment:** including items as follows

- Wells
- Wells Pumping Station
- Self-cleaning filter tank
- Treated water tank
- Treated water pumping station
- Expanding and upgrade for chlorine supply house
- Expanding and upgrade auxiliary works and infrastructure in water plant
- Expanding and upgrade for water supply pipeline network: new installation 6.500 m.
- Additional installation 800 meters and service pipe for households

11. **Total invested capital: 29.960 million Dong**, including costs as follows:

- **Constructed cost**	**: 19.370 million Dong**
+ Constructed works	: 13.120 million Dong
• Constructing works at plant	: 8.120 million Dong
• Precast works (imported)	: 8.120 million Dong
+ Water supply pipeline network	: 6.250 million Dong
• Distribution and transmittion pipeline network	: 4.730 million Dong
• Household connection	: 1.520 million Dong
- **Cost of equipment**	**: 2.540 million Dong**
- **Cost of project management**	**: 360 million Dong**
- **Cost of other constructed consultant**	**: 1.250 million Dong**
- **Other cost**	**: 360 million Dong**
- **Backup cost**	**: 6.080 million Dong**
• Backup for arising quantity	: 2.388 million Dong
• Backup for slippage in prices	: 3.692 million Dong

12. Invested Capital:

Non-refundable grant capital of the Italian Government is 400.000 Euro, equivalent of 10,700 million Dong (in according to exchange rate on 18th December 2012) accounted for 35.7% of total invested capital.

Budget of Viet Nam is 19.260 million Dong, accounted for 64.3% of total invested capital.

13. **Implemented progress:** from the first quarter of 2013 to end of second quarter of 2014.

II. THE BASIS FOR INVESTMENT PROJECT PLANNING

II.1. The legal basis

- Construction Law No. 16/2003/QH11 dated 26/11/2003 of the XI National Assembly, 4th session
- Law on Tendering No. 61/2005/QH11 dated 29/11/2005 of National Assembly.
- Government's Decree No. 12/2009/NĐ-CP dated 12/2/2009 on managing project investment construction, Government's Decree No. 83/2009/NĐ-CP dated 15/10/2009 in amending and supplementing some articles of Government's Decree No. 12/2009/NĐ-CP dated 12/2/2009 on managing project investment construction.

- Government's Decree No. 209/2004/NĐ-CP dated 16/12/2004 on mananing quality of work construction. Government's Decree No. 49/2008/NĐ-CP dated 18/4/2008 in amending and supplementing some articles of Government's Decree No. 209/2004/TT-BXD dated 16/12/2004, Ministry of Construction's (MoC) in guidelines some items in mananing quality of work construction
- Government's Decree No. 112/2009/NĐ-CP dated 14/12/2009 on managing cost of investment and work construction.
- Government's Decree No. 85/2009/NĐ-CP dated 15/10/2009 in guiding the bidding law and the selection of construction contractors under the construction law.
- Prime Minister's Decision No. 1929/QD-TTg on 20/11/2009 on the approval of the development water supply for urban and industrial areas of Vietnam in 2025 and Vision 2050.
- Offical document No. 4194/UBND-KTKT dated 18/12/2012 of the People's Committee of Tra Vinh province about policy, agreement for water supply invested project planning of a part of Tan Hoa ward, Chau Dien ward and Cau Ke town, Cau Ke district

II.2. Standards, rules, and applicable regulations

- Vietnam Standard TCVN 33:2006: "water supply – pipeline network and works – design standard" is issued under Decision No. 06/2006/QĐ-BXD dated 17/03/2006 of Ministry of Construction.
- Branch standard: Sewerage – External network and works. Design Standard 20 TCN – 51 – 84 of Ministry of Construction is issued in 1989
- Vietnam Construction Standard (volume 1, 2, 3).
- Design Standard TCVN 2737 – 1995 load and impact.
- Design Standard TCXD VN 356 – 2005: Reinforced concrete structures.
- Steel structure design Standard: TCXD VN 338 – 2005.
- Design standard of pile foundation: TCVN – 205 – 1988.
- Design standard of foundation and works: TCXD – 45 – 78.
- Design standard of motorway: TCVN – 4054 – 2005.
- Design standard TCVN 5573 – 1991: stone and reinforced stone.
- Flexible pavement design standard: 22 TCVN – 211 – 06.
- Standard of Electrical equip - part 1 General Standard : 11TCVN – 18 – 2006

- Standard of Electrical equip - part 2: Electric conduction system: 11TCVN – 19 – 2006.
- Layout electric equipment in house and public works: TCXD 25 – 91.
- Electrical wiring in house and public works: TCXD 27 – 91.
- Artificial illumination outside public works and infrastructure: TCXD VN 333 – 2005.
- Standard of earth connection: TCVN 4756 – 1989.

II.3. Basis Documents

- Map of premises of Cau Ke town is provided by Employer
- Map of status of Cau Ke water supply system is provided by Employer.
- Map premises about status of water supply station of Cau Ke town.
- Implemented report of economy, society, national defence, security 2011 and goal orientation 2012 of People's committee of Cau Ke town No. 74/BC-UBND dated 13/12/2011.
- Report of geologic survey of works at constructed area of Cau Ke water plant, implemented by Thanh Hung construction consulting of infrastructure and environment, LTD. on 12/2012.
- Report of hydrogeological survey project of Cau Ke town, implemented by The Productive Scientific Union for Geology and Environment of South Vietnam (UGE).

III. NATURAL AND SOCIAL CHARACTERISTIC OF PROJECT AREA

III.1. Natural Characteristic

III.1.1. Geographical location:

Cau Ke town is belong to Cau Ke district, along highway 54, far away from Tra Vinh city about 50 km, is follow highway 60 and highway 54 towards the West and the Northwest.

Cau Ke town is adjacent to following places:

- The East is adjacent to Hoa An ward
- The West is adjacent to Hoa Tan ward
- The South is adjacent to Chau Dien ward
- The North is adjacent to Tam Ngai ward

III.1.2. Climate Characteristics:

The Cau Ke urban area is belong to Southwest Coastal, so it takes full characteristics of a equatorial tropical monsoon climate, there are two seasons every year, the rainy season is begin from May to November, the dry season is begin from December to April of next year. According to monitoring document from 2001 to 2011 of hydrometeorological station of Tra Vinh city for climate characteristics as follows.

a. Temperature: The air temperature in year is fairly high and seasonal changes is low, the average temperature of year is 26.9 °C, the average temperature of highest month 28.6 °C (April), the average temperature of lowest month is 24.6 °C (December), in dry season, temperature is lower from (19.2-24.0) °C, up from (36.0-38.2) °C, in rainy season, temperature is lower from 21.2 °C and up from 32.9 °C, amplitude of temperature fluctuation of months is from (1-2) °C.

Table III -1 : Average temperature (2001 - 2011)

Unit (°C)

Year/month	1	2	3	4	5	6	7	8	9	10	11	12
2001	23,6	24,0	25,6	27,5	27,4	27,1	26,2	26,6	26,2	26,1	25,7	24,2
2002	23,2	25,0	25,8	27,4	27,6	27,5	26,2	26,5	26,9	26,6	26,3	25,6
2003	25,6	25,7	27,1	28,4	29,2	27,8	27,4	26,6	26,4	26,5	25,7	24,5
2004	24,9	24,9	26,8	26,8	25,8	26,3	26,3	26,4	26,8	26,3	25,9	24,1
2005	25,1	25,3	26,4	27,5	27,3	26,7	26,1	26,3	26,6	25,9	25,9	25,5
2006	25,0	25,1	26,7	28,4	27,8	26,5	26,9	26,2	26,9	26,5	25,2	25,1
2007	24,2	24,3	26,1	28,5	28,5	27,3	27,4	26,3	26,7	26,8	26,3	26,4
2008	24,3	25,3	26,9	28,5	27,5	27,1	26,3	26,7	26,3	26,2	26,3	24,6
2009	24,6	24,3	26,5	28,6	28,2	27,0	26,7	26,7	26,5	26,4	26,7	24,8
2010	24,0	25,2	26,4	28,2	28,5	27,5	26,2	26,8	26,6	26,7	26,2	24,9
2011	25,2	25,6	26,6	28,2	27,6	27,0	26,6	26,2	26,3	26,5	27,0	25,3
Average	25,0	25,6	27,1	28,5	28,3	27,3	26,9	26,8	26,8	26,6	26,3	25,3

d. Air Humidity: Humidity is clearly seasonal changes, humidity of dry season is, humidity of rainy season is high, annual average humidity is 82%, average humidity of rainy season is accouted for 90% (August, September, October), average humidity of dry season is accounted for 75% (March, April, May).

Table III – 4 : Monthly average humidity (2001 - 2011)

Unit (%)

Year/month	1	2	3	4	5	6	7	8	9	10	11	12
2001	89	86	85	84	88	90	91	90	92	93	92	90
2002	88	90	87	84	86	88	92	90	90	92	89	97
2003	88	87	84	86	89	88	89	92	92	90	91	90
2004	88	87	88	91	90	90	94	92	89	91	90	85
2005	87	88	85	87	89	90	91	90	90	93	88	93
2006	94	88	85	83	87	89	89	91	89	92	86	91
2007	86	87	86	79	81	88	88	90	90	90	89	88
2008	87	85	81	81	89	88	91	90	91	91	89	86
2009	88	87	83	81	85	89	88	90	91	88	87	87
2010	86	87	82	80	83	89	92	91	91	91	92	87
2011	87	87	86	84	86	90	90	90	91	89	86	86
Average	83	81	80	79	83	86	87	88	88	88	86	85

III.1.3. Topography:

Topography of project area has nature of coastal plains, is influenced by interference between the river and the sea. Relatively flat terrain, altitude ranges from 0.8 to 1.5 m. Town center area with greater elevation than coastal areas. The project area is close to Cau Ke river and Hau river, so it is seldom flooded.

III.1.4. Geology of works:

Geology of project area is including following layers:

- Layer of lens TK1: dark - grey fine sand
- Layer of lens TK2 : dark color sand mud
- Layer 1a : clay mud, dark – grey sand
- Layer 1b : dark – grey clay mud
- Layer 2 : sepia, tan clay with hard ductile state
- Layer of lens TK4 : tan sand with gravel, ductile state
- Layer 3 : tan clay, hard ductile state
- Layer of lens TK5 : tan sand, ductile state
- Layer 4 : tan clay, semi-solid state

*** Result shows that:**

b. Rainfall: Region has two seasons, dry and rainy season.

- Rainy season is begin from May to November (monthly rainfall ≥100mm) and concentrated to June, July, August, September, October accounted for (85 - 90)% of total rainfall of year, average rainfall of year is 1.547mm, highest is 1.812mm, lowest is 1.360mm. Heavy rain is often concentrated on July, August, September, October, total average number of rainy days of year is 100 days.
- Dry season is begin from December to April of next year (monthly rainfall <100mm, have months without rain), least rain or no rain primarily in March.

Table III -2: Monthly rainfall (2001 - 2011)

Unit (mm)

Year/month	1	2	3	4	5	6	7	8	9	10	11	12	Total
2001	14,0	-	-	158,7	371,8	223,5	250,3	110,8	167,5	30',0	245,1	77,8	1926,5
2002	-	42,6	-	5,3	206,9	121,5	371,4	131,0	235,3	172,3	116,9	0,2	1403,4
2003	-	0,2	-	18,8	190,2	262,5	138,0	270,4	309,5	165,8	157,5	130,7	1643,6
2004	62,7	40,6	85,2	183,0	189,5	295,9	118,0	102,9	195,4	176,2	280,4	47,3	1777,1
2005	6,2	16,5	37,5	151,8	198,7	173,9	204,1	208,6	123,2	499,1	247,0	136,4	2003,0
2006	29,3	28,9	62,1	96,7	207,6	205,6	181,4	234,6	152,8	178,9	11,4	28,2	1417,5
2007	-	-	-	21,1	60,6	195,1	140,3	92,6	115,9	445,5	316,5	62,2	1449,8
2008	54	-	-	32,6	171,8	222,1	302,6	282,8	159,8	243,6	76,5	1,8	1499,6
2009	0,2	-	-	67,9	268,7	135,2	111,4	126,1	257,1	183,1	62,5	15,9	1228,1
2010	-	-	1,1	6,2	188,4	196,3	286,9	139,4	202,2	398,8	345,7	94,9	1859,9
2011	15,5	99,3	17,8	130,6	210,3	268,7	184,1	148,0	360,9	235,7	2,0	40,2	1713,1
Average	10,2	22,0	22,2	70,2	176,3	235,3	204,9	198,7	247,4	284,9	125,5	40,1	1592,8
Highest	62,7	99,3	85,2	191,6	371,8	503,8	371,4	475,5	360,9	698,7	345,7	136,4	2195,2

c. Evaporation: Area with large evaporation and is often seasonal changes according to seasons in year, highest average of daily evaporation is 4.1 mm / day, lowest average of daily evaporation is 1.6 mm / day, annual average evaporation is 741,24mm, highest annual average is 804.9 mm, lowest annual average is 687.9 mm.

Table III – 3: Monthly average evaporation (2001 - 2011)

Unit (mm)

Year/month	1	2	3	4	5	6	7	8	9	10	11	12
2001	2,1	2,9	3,6	3,5	2,4	2,1	2,4	2,4	2,3	1,8	1,6	1,7
2002	2,4	2,5	3,4	3,2	2,7	2,7	1,9	2,4	2,1	2,0	2,3	2,8
2003	3,2	3,1	4,1	3,2	2,2	1,9	1,9	1,6	1,2	1,4	1,3	1,4
2004	1,7	1,7	2,2	1,4	1,6	1,6	1,5	1,4	1,4	1,2	1,4	1,5
2005	2,2	2,4	2,2	1,4	1,8	1,9	1,9	2,3	2,2	1,4	2,3	1,9
2006	2,2	2,5	3,0	3,0	2,6	2,0	2,2	2,1	2,3	1,9	2,1	2,2
2007	2,4	2,6	3,4	3,4	3,8	2,4	2,4	1,8	2,1	1,7	1,8	2,6
2008	2,8	3,5	4,0	4,4	2,5	2,5	2,0	2,4	2,4	1,9	2,4	2,4
2009	3,0	3,6	4,1	4,1	2,8	2,3	2,2	2,5	2,0	2,1	2,1	2,2
2010	2,7	3,5	4,2	4,1	2,6	1,8	1,6	2,1	2,1	1,9	2,2	2,2
2011	2,3	2,9	3,3	2,7	2,3	2,0	2,2	2,5	1,8	2,3	2,7	2,4
Average	2,7	3,4	4,1	4,2	3,1	2,6	2,5	2,4	2,2	2,0	2,2	2,3

- Ground layers Tk1, TK2, layer 1a, layer 1b are soft soil, high soil compressibility, low load capacity.
- Layer 2 is a direct contact layer with soft soil with average compressibility, capacity of load is fairly good for works with average load
- Layers TK4, layer 3, TK5 and layer 4 with small compressibility, good load capacity
- Bottom of layer 44 is undefined

III.1.5. Hydrogeology:

According to explorative projects for groundwater of Cau Ke town, Cau Ke district, Tra Vinh province established by The Productive Scientific Union for Geology and Environment of South Vietnam (UGE), layers containing water within explorative area for groundwater of Cau Ke town are including 8 layers as follows:

- Aquifer vulnerability with sediments Holocen (qh)
- Aquifer vulnerability with sediments Pleistocen above (qp_3)
- Aquifer vulnerability with sediments Pleistocen between– above (qp_{2-3})
- Aquifer vulnerability with sediments Pleistocen below (qp_1)
- Aquifer vulnerability with sediments Pliocen above (n_{2-2})
- Aquifer vulnerability with sediments Pliosen below (n_{2-1})
- Aquifer vulnerability with sediments Miosen above (n_{1-3})
- Aquifer vulnerability with sediments Miosen between – above (n_{2-3})

Aquifer vulnerability with sediments Pleistocen between – above (qp_{2-3}) and Aquifer vulnerability with sediments Pleistocen below (qp_1) is wide distributed on whole area, lithological composition is including fine sand to coarse grain, intermixed gravel. Capacity of aquifer is from medium to weathy, light water, with pressure, however, with an average iron content and can be treatable by technological solutions for standard groundwater for eating and drinking, current activities. Thus, aquifer vulnerability with sediments Pleistocen between– on (qp_{2-3}) and aquifer vulnerability with sediments Pleistocen below (qp_1) are selected as subjects for survey and exploiment for exploitation for raw water supply of project.

III.1.6. Hydrology and River:

Cau Ke River flows through center Cau Ke town, divides Cau Ke town into 2 parts: the East and the West. Cau Ke River derives from Hau River, which is a fairly deep and wide river, large water reserve, but in the dry season, salinity high river water should not be used to water supply for needs of people in the town.

III.2. Social Characteristic of project area

III.2.1. Social Characteristic:

1. Functional location of project area

Cau Ke town is a district capital, political, administrative, economic, sociocultural center of Cau Ke district

Cau Ke town is located on highway 54, connecting towns of the Eastern and Southern district of Tra Vinh province with Vinh Long province

Cau Ke town has an area of approximately 320 hectares that divided into 8 clusters named from cluster 1 to cluster 8. The clusters 1, 2, 3 is located on the East of Cau Ke River, the clusters 4, 5, 6, 7, 8 is located on the West of Cau Ke River

2. Population of project area:

Project area includes Cau Ke town and 2 adjacent ward with town are Chau Dien ward and Hoa Tan ward, which are located at the West and the North of town

The population within in project area includes population of Cau Ke town and approximated 30% population of Chau Dien and Hoa Tan town. According to population statistic 2011, population of project area as follows:

No.	Unit	Whole unit		Project area	
		Households	Population	Households	Population
1	Cau Ke town	1673	6990	1673	6990
2	Hoa Tan ward	2685	10350	806	3110
3	Chau Dien ward	2989	11370	996	3410
	Total	7347	28710	3475	13510

Total population of project area of 2011 is 13,510 people, in there, population is 6,990, accounted for 52%, and population of neighboring communes is 6,520, accounted for 48%.

3. The situation of economic and social development:

The situation of economic and social development in 2011 as follows:

- Growth rate of GDP 13.7% than 2010, in there

+ GDP of agriculture increased by 7.34%

+ GDP of forestry increased by 4.51%

+ GDP of fisheries increased by 15.02%

+ GDP of industry increased by 17.08%

+ GDP of construction increased by 20.95%

+ GDP of service increased by 19.67%

- Per capita income: 15.199 million Dong/person-year
- Reducing poverty rate 3.42%
- Electric using rate 94.7%

4. Characteristic of infrastructure works

- Roads: The main road passing through the project area is highway 54B, which is asphalt road; pavement is wide from 7 -10 m. Many other roads in town have been asphalt or gravel. Some routes have sidewalks. The two sides are constructed far away from edge of road, so advantaged for layout pipe in space between edge and works construction, should facilitate the water tube in the space between the edge of the road and works.
- Sewerage: Currently only some drainage culverts on the main roads of the town and the small roads have not yet had culvert. Because housing is still sparse, there are many vacant areas so rainwater is accumulated absorb so there are no flooding.

IV. SITUATION OF WATER SUPPI Y SYSTEM OF CAU KE TOWN

IV.1. Raw water

- Raw water supply source is grou dwater, which is exploited from wells at depth of 130m.
- Capacity of wells is 30 m^3/h
- Raw water pumping from wells by using underground pump. Capacity of pump is 30 m^3/h.
- Wells and wells pumping station are located at water supply station.
- Quality of raw water is fairly good; almost physiochemical standards are meet standard of drinking water under National standard, excepted criteria of iron content in water about 2-3 mg/l. Currently stable exploitation.

IV.2. Water supply station

- Treated water by pressured filter tank, before raw water is entered into pressured filter tank, it is added chlorine to iron removal, capacity of pressured filter tank is 30 m^3/h, and is made of steel
- Clean water tank: Water after cleared in pressured filter tank is contained in reinforced concrete water tank, with capacity of 60 m3, tank is built on ground
- Pumping station level 2: pumping station level 2 pumps clean water from clean water tank for water supply pipeline network. Clean water pumping station with two centrifugal pumps, capacity of each pump is 4 kW. Pumps are located together in chlorine room, which has area of 7.5 m2 is too cramped for difficult and unsafe operation.
- Chlorine supply room: Chlorine is provided for iron removal and disinfection. Room is equipped with chlorine vase, chlorine magnet machines, continued pressure pumping

IV.3. Auxiliary works

- Water supply station with area of 850 m^2, width from 12,5 -14,8m, length of 61,5 m. Currently, existing works are built on area of over a haft of station's area.
- Executive managed room has an area of 65 m2 consists of 4 rooms and restrooms, solidly built, are using well.
- Infrastruture works: fences, gates, roads, drainage are fully built and quality is still good

IV.4. Water supply pipeline network

- Water supply pipeline network is covered about 70% scope of town, has not yet lead to wards in served project scope
- Total length of pipeline is : 8.042 m

In there:

pipe PVC D168 with length	: 280 m
pipe STK D150 with length	: 55 m
pipe PVC D114 with length	:1.305 m
pipe PVC D90 with length	: 2.512 m
pipe PVC D60 with length	: 1.980 m
pipe PE D63 with length	: 1.340 m
pipe PE D50 with length	: 280 m
pipe PE D40 with length	: 290 m

IV.5. Comment about situation of water supply system

Currently, water supply system of town only supply for approximate 50% population of town, pipeline network covers about 70% scope of town. Area and population of 2 adjacent ward in scope of serve project has not yet had water pipeline and people have not yet used clean water under national standard, because of following reasons:

- Capacity of water supply station is still small, do not have enough water supply capacity for needs.
- Pipeline network is still less so has not yet covered all needs of using clean water in scope of serve project
- Diameter of pipe is small, has not yet enough ability of water transfer under requirement. Pipelines are primarily distribution pipe, service pipe.

V. WATER SUPPLY NEEDS AND SCALE OF CAPACITY OF SYSTEM

V.1. Calculated basis

- Decision of the Prime Minister No. 1929/QD-TTg dated 20/11/2009 approval of the developed orientation of urban water supply and industrial zones in Vietnam to 2025 and vision to 2050.
- Vietnam Standard TCVN 33:2006: "water supply – pipeline network and works – design standard" is issued under Decision No. 06/2006/QĐ-BXD dated 17/03/2006 of Ministry of Construction.
- Population in scope of serve project is calculated to 2025, according to population data and developed rate of population 2011 provided by People's Committee of Cau Ke town.

Calculated criteria are selected on 2020:

+ For Cau Ke town: population rate supplied water is 100%, water supply standard for daily needs is 100 l/person-day
+ For adjacent wards: population rate supplied water is 90%, water supply standard for daily needs is 100 l/person-day
+ Water for manufacture, public works and service is taken by 15% (for town) and 10% (for adjacent wards) water for daily needs
+ Leakage losses water is taken by 20% total water supply for needs.
+ Coefficient of water using is not harmonized/day K^{max} ng = 1,15
+ Water for water supply station is 4% total water supply for pipeline network

V.2. Served scope and population of project

Served scope of project includes:

- Cau Ke town
- Hoa Tan ward and Chau Dien ward are located at the West of Cau Ke river, adjacent to Cau Ke town. Currently, adjacent area of 2 wards with Cau Ke town have not yet water supply, accounted for 30% population of per wards
- Population of project area in 2020:

Calculation for population of project area in 2020 is based on population of served project area in 2011 (calculated at section III.2.1) and developed rate of population is 1,5%/year, as follows:

No.	Name	2011	2015	2020
1	Cau Ke town	6.990	7.420	7.990
2	Hoa Tan ward	3.110	3.300	3.560
3	Chau Dien ward	3.410	3.690	3.900
	Total	13.510	14.410	15.450

V.3. Identified for water supply demand and scale of capacity.

1. Water supply demand.

Water supply demand is water into pipeline network for water demands of town (dialy needs, manufacture, public, service) and leakage losses water on pipeline network

	Unit	Water supply for daily needs	Supply for	Leakage	Demand

No.		Population 2020 (person)	Population is supplied water (person)	Standard (l/day)	Water (m^3/day)	manufacture, public and service (m^3/day)	losses water (m^3/day)	Average day (m^3/day)	Largest day (m^3/day)
1	Cau Ke town	7990	7990	100	799	120	183	1102	1267
2	Hoa Tan ward	3560	3200	100	320	32	70	122	485
3	Chau Dien ward	3900	3510	100	351	35	77	463	533
	Total	15450	14700		1470	187	330	1987	2285

2. Capacity of plant.

Capacity of water supply plant includes water into pipeline network for demands and water for itself

- Water into pipeline network has already calculated above is 2285 m3/day
- Water supply for itself is taken by 4% water supply for pipeline network is 2285 x 0,04 = 91 m^3/day
- Capacity of plant: Q = 2285 + 91 = 2376 m^3/day
- Selected capacity of plant is Q = 2400 m^3/day

Plant works in 24 hours, per hour supply Qh = 100 m^3/h

V.4. Constructed location of project

V.4.1. Constructed location of water plant:

Constructed location of water plant is vacant land of existing water supply station, which is owned by Employer, total erea of whole plant is about 850 m2. Currently, in this site has already had works of existing water supply station, which are operating and will continuously use as managed house. fences, gates, roads, ect...Vacant area of site is enough to construct more works of new plant with capacity of 2400 m^3/day.

Characteristic of the site:

- The front of entrance is adjacent to Tran Phu Street.
- One site is adjacent to headquarters of People's Committee of Cau Ke District
- One site is adjacent to police headquarters of Cau Ke district
- The behind is adjacent to private houses.

Constructed location with following advantages:

- No cost to buy the land, no application for land grant licenses.
- Take full advantage of existing works: fences, managed house, roads.
- Combined with existing works and new constructed works of water plant.

V.4.2. Constructed location of water supply pipeline.

- Water supply pipelines will be laid along roads in project area
- For roads with sidewalk, water supply pipeline will be laid below sidewalk
- For roads have not yet had sidewalk, water supply pipeline will be laid below roadside, that is expected to construct sidewalk
- For highway no sidewalk, water supply pipeline will be laid beyond road edge, from road edge to constructed works 2 roadside and within road boundary of road in order to no compensation and clearance of land and works when constructed water supply pipeline

VI. NECESSITY OF INVESTMENT, SCOPE, PURPOSE AND TYPE OF INVESTMENT

VI.1. Necessity of investment

Area of project includes 2 wards and Cau Ke town is political, administrative, economic, sociocultural center of Cau Ke district, is level 5 urban, so it is necessary to ensure for clean water supply according to Government regulation.

Project area is belong to remote area of the Coastal Mekong Delta, conditions of economic, social development is still difficult, physical life and spirit of people is much lower than other areas, so policy and guideline of the State of Vietnam are raising living standards about spirit for people here

Current water supply system in the project area is only guaranteed to provide 30% of water using demand for whole project area (Cau Ke town and communes)

So the constructed investment of clean water supply system to improve quality of life of people in accordance to the guidelines of State and Government for remote areas is essential

VI.2. Invested scope of project:

- Invested scope of project: about 30% adjacent area with Cau Ke town of Hoa Tan and Chau Dien commune and Cau Ke town with area about 320 hectare
- Population of project area to 2020 about 15.450 people. Beneficial population, that is served clean water of project, is 14.700 people, accounted for 95%.

VI.3. Invested purpose

Invested project for upgrade and expansion of water supply system of Cau Ke town will be achieved following purposes

- To 2020 will supply for 95% population of project area with water supply standard for daily needs is 100 l/person per day and other demand of people in region. Correct implementation of guideline and policy of the State and Government for people in remote areas
- Improving life quality, increasing healthy, reducing disease by using
- Improved quality of life, improve health, reduce disease caused by using unhygienic water for people in project area, to meet aspiration of people.
- Create conditions for people to develop production and services to increase income, improve material and spiritual life, concurrently contributing for economic development of local and community.
- Contributing to implementing of national strategies about water supply for urban and rural areas.
- Contributing to constructing of new rural and modern civilization urban

VI.4. Solution and type of investment

VI.4.1. Invested solution:

Existing water supply system of town includes water supply station with capacity of 30 m^3/h (720 m^3/day) and water supply pipeline network according to capacity of water supply station.

New water supply system includes water plant with capacity of 100 m^3/h (2400 m^3/day) and suitable water supply network.

To reduce invested capital will reuse some of existing works in water supply station and water supply pipeline network. For existing works being reused and synchronous operation of new works convenient control operation, high efficiency and exploit all area of existing water supply station, constructing new items, do not have to buy more land, proposed invested solutions as follows:

+ For water treatment plant:

- Retained items: as managed house, fence and gate, internal roads and drainage system.
- Improving, expanding room of pump level 2 and placing chlorine vase to preparation and chlorine liquid supply with capacity of 2400 m3/day.
- Removing pressured filter tank with capacity of 30 m3 /h to serve for other areas of company in accordance to capacity of tank.
- Keeping wells and existing wells pumps station with capacity 30 m^3/day for provision.

- Floated tank 60m^3/h will be demolished for construct new works suitable with capacity of plant
- New construction some of items to ensure capacity of water plant is 2400 m3/day (100 m3/h) as follows:
    - Constructing 2 wells and wells pump station with capacity of 50 m^3/h, one wells is inside of plant, another is outside of plant.
    - Constructing 2 self-cleaning filter with total capacity of 100 m^3/h.
    - Constructing tank with capacity about 500 m3 to ensure water storage for water supply system with capacity of 2400 m3/day.
    - Constructing level 2 pumping station and house of stand-by generator to ensure capacity of plant is 2400 m^3/day.
    - Constructing dynamic electricity system, control for plant with capacity of 2400 m^3/day
    - Constructing technological pipelines to meet for plant with capacity of m^3/day.

+ For water supply pipeline network:

- New water supply pipeline network includes existing pipe and new installed pipes, is calculated to ensure capacity of suitable transfer with capacity of system is 2400 m^3/day.
- Existing transfer pipelines with small size ia placed more new pipeline for suitable.
- Roads no water supply pipeline will be new installed for enough capacity of all demands in project area
- Existing pipeline with small diameter will change into distributed pipe.
- Installing more meters and service pipe to ensure of water supply for people as calculated.
- Pipe will be decentralized to ensure against leakage and facilitate management.

VI.4.2. Type of investment

With invested solutions above, type of investment of project is constructing upgrade, expand and renovate

VII. WATER SOURCE FOR WATER TREATMENT PLANT

VII.1. Water sources

VII.1.1. Surface water source

Located in project area with Cau Ke river. Cau Ke river connect with Hau river, far away from seaport about 40 km. In months of annual dry season, river water is saline with high concentrations, can not supply for daily needs and manufacture

VII.1.2. Groundwater source

According to draft of groundwater exploration at Cau Ke area , Tra Vinh province, by The Productive Scientific Union for Geology and Environment of South Vietnam (UGE) setting, Cau Ke area, Tra Vinh province with aquifer as follows:

VII.1.2.1. Aquifer vulnerability with sediments Holocen (qh)

Wide distribution, no exposed surface, deep of roof from (19,3 - 40,0)m, deep of bottom from (20,3 - 47,0)m, thickness from (1,0 - 7,0)m, average 3,8m. Main components of lithology is fine sand to regular intercalate with dust sand, vegetable humus. Result of test water pump in bearholes, dug well show that: H_t = (1,00-6,27)m, S = (0,20-10,70)m, Q = (0,02-0,60)l/s, q = (0,002-0,550)l/sm, containing water weak. Water is pure and yellow, no smell and fishy smell, tasteless and salty pH = (5,55-8,36), content of (Na+K) = (40,03-3421,07)mg/l, Ca = (13,03-275,55)mg/l, Mg = (12,77-328,32)mg/l, HCO_3 = (18,31-567,49)mg/l, Cl = (56,72-6336,69)mg/l, SO_4 = (0,00 – 1008.63)mg/l, M = (0,24-10,24)g/l, tasteless water intercalate with salty water. Water no pressure, height of water column in borehole is from (12,23 - 21,50)m, average 18,30m. In order to exploiting, evaluating, storage for serve water supply for Cau Ke town with capacity of exploitation is 2.400 m3/day, project do not choose aquifer Holecen is a subject of exploration and exploitation

VII.1.2.2. Aquifer vulnerability with sediments Pleistocen (qp_3)

Distribution of overall area, depth of roof is from (35,0 - 53,0)m, depth of bottom is from (38,1 - 69,0)m, thickness is from (3,1 - 19,0)m, average 12,5m. Main components of lithology are fine sand to regular intercalate with dust sand, raw intercalate with gravel and dust sand, vegetable humus. Capacity of water storage is from weak to average, static level water 2,00m. Pure water, no smell, tasteless, Ph = (8,23 - 8,33), content of Na = (64,17 - 80,00)mg/l, K = (6,13 – 6,89)mg/l, Ca (32,06 – 37,07)mg/l, Mg = (25,54 - 28,58)mg/l, NH_4 = (0,00 – 0,19)mg/l, HCO_3 = (347,81 - 384,43)mg/l, Cl = (8,15 - 46,09)mg/l, SO_4 = (2,40 - 31,22)mg/l, M = (0,38 - 0,61)g/l. Pressured water, height of pressured column of aquifer's roof is from (51,00-60,00)m, average 55,50m, no hydraulic relation with aquifers located above and below. Because of thin thickness, capacity of water

storage is weak, does not allow exploitation with huge flow, so project does not select research object

VII.1.2.3. Aquifer vulnerability with sediments Pleistocen between - on (qp_{2-3})

Widen distribution, depth of roof is from (79,1 - 88,5)m, depth of bottom is from (115,2 - 133,0)m, thickness is from (36,1 - 47,0)m, average 41.9 m. Main components of lithology are fine sand to regular intercalate with dust sand, raw intercalate with gravel. Static level water H_t = (0,93-9,00)m, low level water S = (5,12-20,56)m, active level water H_d = (6,05-22,76)m, capacity of Q = (12,00-29,05)l/s = (1.037-2.510)m^3/day, capacity rate q = (0,583-3,586)l/s.m, coefficient of permeability K = 11,94m/day, coefficient of water Km = 505m^2/day, coefficient of pressure a = 3,54.$10^6$$m^2$/day with abundant water. Pure water, no smell, tasteless pH = (7,15 - 8,33), content of Na = (42,90 - 122,37)mg/l, K = (6,13 – 9,88)mg/l, Ca = (32,06 – 44,09)mg/l, Mg = (25,54 – 53,75)mg/l, HCO_3 = (274,59 - 384,43)mg/l, Cl = (8,15- 106,35)mg/l, SO_4 = (2,40 - 146,49)mg/l, M = (0,38 – 0,69)g/l. Pressured water, height of pressured column of aquifer's roof is from (81,00-96,30)m, average 88,02m. In general, aquifer is widely distributed, large thickness, capacity of water storage is plentiful, light water, with chemical component in Vietnam Standard 09:2008/BTNMT. In order to exploration, evaluation of reserves, exploitation for water supply for Cau Ke town, this project selects aquifer of Pleistocen between - on (qp_{2-3}) combine with aquifer of Pleistocen below (qp_1) is a subject of research (separated exploitation of each aquifer).

VII.1.2.4. Aquifer vulnerability with sediments Holocen (qp_1)

Distribution of overall area, depth of roof is from (118,2 - 157,0)m, depth of bottom is from (178,0 - 188,0)m, thickness is from (21,0 - 50,0)m, average 40,1 m. Main components of lithology are quartz sand from fine to raw intercalate gravel. Capacity of water storage is plentiful, static level water H_t = (1,70 - 7,05)m, low level water S = (7,00 – 24,4")m, active level water H_d = (14,05 – 26,17)m, capacity Q = (14,26 - 16,60)l/s, capacity rate q = (0,583 - 2,371)l/sm, coefficient of permeability K= 21,75m//day, coefficient of water Km = 920m^2/day, coefficient of pressure a = 3,4.$10^5$$m^2$/day. Pure water, no smell, tasteless, pH = (7,93 - 8,67), content of Na = (92,80 - 238,33)mg/l, K = (5,40 - 15,31)mg/l, Ca = (13,03 - 70,14)mg/l, Mg = (6,69 – 57,15)mg/l, HCO_3 = (274,59 - 445,45)mg/l, Cl = (59,56 - 175,83)mg/l, SO_4 = (70,12 - 98,66)mg/l, M = (0,51 - 0,74)g/l in Vietnam standard 09:2008/BTNMT. Pressured water, static water is away from ground from (1,70 - 7,05)m, height of pressured column from (116,50 - 131,65)m, average 126,36m. In general, aquifer Pleistocen below (qp_1) is widely distributed, large thickness, capacity of water storage is plentiful, light water meet standard of daily needs and dietary needs. Therefore, in order to exploration, evaluation of reserves, exploitation for water supply for Cau Ke town, this project selects aquifer of Pleistocen below (qp_1) combine with aquifer of Pleistocen between - on (qp_{2-3}) is a subject of research (separated exploitation of each aquifer).

VII.1.2.5. Aquifer vulnerability with sediments Pliocen (n_2^2)

Distribution of overall area, depth of roof is from (182,0 - 215,0)m, depth of bottom is from (282,0 - 294,0)m, thickness is from (81,7 - 100,0)m, average 88,2m. Main components of lithology are fine sand to regular, raw intercalate gravel. Capacity of water storage is average, static level water H_t=(2,30-3,43)m, low level water S=18,51m, active level water H_d=21,94m, capacity Q = 4,15l/s, capacity rate q = 0,224l/sm. Pure water, no smell, salty, pH = (7,32 - 11,34), content of Na = (341,54 – 7.203,33)mg/l, K = (158,57 - 161,25)mg/l, Ca = (7,01 – 871,74)mg/l, Mg = (0,00 – 1.155,20)mg/l, HCO_3 = (152,55 - 193,80)mg/l, Cl = (414,77 – 14.286,35)mg/l, SO_4 = (115,27 – 2.281,43)mg/l, M = (1,14 – 26,06)g/l. Pressured water, static water is away from ground from (2,30 - 3,43)m, height of pressured column from (189,07 - 198,70)m, average 193,89m. In Cau Ke town, aquifer Pleistocen between (n_2^2) is widely distributed, large thickness, capacity of water storage is average, saline water, content Cl = (414,77-14.286,35)mg/l, total of mineralization M = (1,14-26,06)g/l, does not meet standard of dietary needs, therefore it is not a subject of research

VII.1.2.6. Aquifer vulnerability with sediments Pliocen below (n_2^1)

Distribution of overall area, depth of roof is from (300,0-340,0)m, depth of bottom is from (370,0-397,0)m, thickness is from (30,0-91,0)m, average 69,8m. Main components of lithology are fine sand to regular, raw, dust sand, sand powder, clay powder. Capacity of water storage is average, static level water H_t = (1,10-4,90)m, low level water S = (3,14-17,22)m, active level water H_d = (8,04-18,32)m, capacity Q = (1,00-9,56)l/s, capacity rate q = (0,318-0,555)l/sm. Pure water, no smell, salty, pH = (7,08 – 8,42), content of Na = (545,45-5.221,05)mg/l, Ca = (18,04-561,12)mg/l, Mg = (21,89-839,04)mg/l, HCO_3 = (195,26-451,52)mg/l, Cl = (572,52-10.280,50)mg/l, SO_4= (146,49-1.488,93)mg/l, total of mineralization M = (1,60-18,61)g/l. Pressured water, static water from (1,10 - 4,90)m, height of pressured column 320,00m, average 193,89m. In Cau Ke town, aquifer Pliocen below (n_2^1) is widely distributed, large thickness, capacity of water storage is average, Ph = (7,08 – 8,42), content Cl = (572,52 – 10.280,50)mg/l, total of mineralization M = (1,60 - 18,61)g/l, saline water does not meet standard of dietary needs, therefore it is not a subject of research

VII.1.2.7. Aquifer vulnerability with sediments Miocen above (n_1^3):

Distribution of overall area, depth of roof is from (406,0 - 430,0)m, depth of bottom is from (475,0 - 476,5)m, average thickness 57,8m. Main components of lithology are fine sand to regular, often intercalate dust sand, sand powder, clay powder. Capacity of water storage is average, static level water H_t = (0,35 – 2,00)m, low level water S = (15,20 – 34,42)m, active level water H_d = (15,55 – 36,42)m, capacity Q = (2,50 - 12,82)l/s, capacity rate q = (0,072 - 0,840)l/sm. Pure water, no smell, salty, pH = (8,30 - 8,58), content of Na = (821,43 – 244,90)mg/l, K = (60,00 – 80,00)mg/l, Ca = (21,04 – 220,44)mg/l, Mg = (31,01 – 370,88)mg/l, HCO_3 = (183,06 - 518,67)mg/l, Cl = (93,43 – 4.608,50)mg/l, SO_4 = (285,78 – 816,51)mg/l, total of mineralization M = (2,71 – 8,67)g/l. Pressured water, static

water from (0,35 – 2,00)m, depth of roof is from (406,0 - 430,0)m, height of pressured column from (404,00 – 429,65)m, average 429,65m. In Cau Ke town, aquifer Miocen above (n_1^3) is widely distributed, large thickness, capacity of water storage is average. Pure water, tasteless, salty, Ph = (8,30-8,58), content Cl = (939,43-4.608,50)mg/l, total of mineralization M = (2,71-8,67)g/l, does meet standard of dietary needs and daily needs, therefore it is not a subject of research

VII.1.2.8. Aquifer vulnerability with sediments Miocen between – above (n_1^{2-3})

Distribution of overall area, depth of roof is from 476,5m or less, depth of bottom is about 550,0m, average thickness 73,5m. Main component of lithology is fine sand intercalate with dust sand. Capacity of water storage is from weak to average. Pure water, no smell, salty, total of mineralization M = (2,50 - 5,00)g/l. Pressured water, height of average pressured column 474,95m. Aquifer is not a subject of exploration, exploitation because saline water.

❖ ***Conclusion:***

In Cau Ke area, Tra Vinh province has 8 aquifers, in there, for water supply purpose for daily needs and manufacture, only aquifer Pleistocen between – above (qp_{2-3}) and aquifer Pleictocen below (qp_1) are subjects to exploring and exploiting for water supply concentrated with large flow, exploiting both of aquifers. There are 2 aquifer with large thickness, capacity of water storage is plentiful, light water, good quality, ability of exploitation with capacity of 1600 m^3/day/borehole. Distribution of these aquifers is not very deep, depth of exploitation is about 230m, so cost of invested exploration is not large. Capacity of water exploitation of 2 above aquifers is about 30.000 m^3/day.

VII.2. Selection of water source

- From analysis of 2 above water source show that, in order to water supply for project area is only used groundwater. Therefore, selection of groundwater source is raw water source for project
- According to design of exploratory borehole and combined with exploiting at Cau Ke town is implemented by The Productive Scientific Union for Geology and Environment of South Vietnam (UGE), Cau Ke area has 2 aquifers, that will be supply clean water with capacity of exploitation 60m3/h are aquifer pleistocen between – above with depth from 79 – 133m and aquifer pleistocen below from 113 – 188m

Therefore, selecting 2 above aquifers for exploitation with depth of well 115m and 170m.

VIII. WATER SUPPLY TECHNOLOGY SOLUTION

VIII.1. Quality of groundwater

Results of chemical analysis of existing water wells in Cau Ke water supply station:

No	Indicator	Unit	Laboratory Result	Standard of Ministry of Health 1329/2002/BYT
1	Turbidity	NTV	10	2
2	pH		8,4	6,0 – 8,5
3	CT	Mg/l	53	≤ 300
4	Total alkalinity	Mg/l	400	-
5	Total hardness	$CaCO_3$	162	≤350
6	Ca^{2+}	Mg/l	18,4	
7	Mg^{2-}	$CaCO_3$	28,2	
8	NO_2	Mg/l	0,004	0,1
9	Total Iron	Mg/l	2,25	≤ 0,5

With natural elements of the well water the iron should be disposed and clarified before supplying to household.

VIII.2. Water supply technology diagram

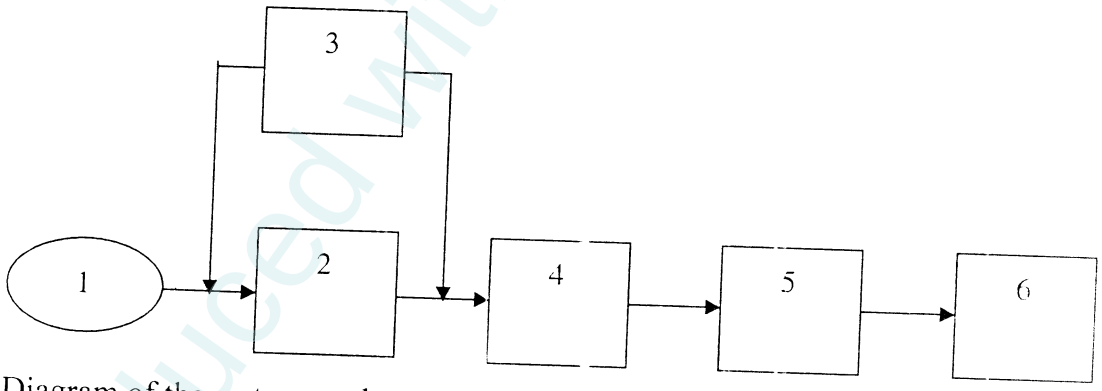

Diagram of the water supply system of the main technologies:

1. Drilled wells and pumping stations
2. Self-cleaning filter tank
3. Chlorine feeding house
4. Treated water tank
5. Treated water pumping station
6. Water supply pipeline

VIII.3. Function and works item

VIII.3.1. Drilled wells and pumping station

a. Drilled wells:

The raw water from underground aquifers to be exploited for treatment works.

Water in the aquifer will be drilling operators by the drilled wells (each drilled wells will exploited in difference aquifer)

The capacity of each drilled wells is 60 m3/h. Two drilled wells will be building for collect the water in different aquifers. Total capacity of the two extraction wells is 120 m3/h sufficient capacity for treatment plant capacity of 100 m3/h and 20% for contingency. The existing drilled wells with a capacity of 30 m3/h are the backup one.

Each drilled wells is include casing pipe, filters pipe, clarify pipe. Filter pipe will be placed in selected aquifers to collect and supply raw water.

b. Wells pumping station

- Wells pumping station was built in the area of water supply plant. The cover house should not be build but a pumping station base should be build for easy installation of pipes and fittings of pump stations, facilitating the transport operating and hygiene. The administrative house, fences, gates, yard, road will be constructed to manage and operate smoothly.
- The wells pump station will using submersible pumps (multistage pumps) dedicated to wells pumping. Pump machine will be placed under the water level of the wells. On the thruster of the pump on the ground will install the valve, pressure gauge, flow meter and other necessary accessories
- Wells pumping station control carbinet will be placed in control room in administrative house.

VIII.3.2. Continuous self-cleaning filter

- Continuoust self-cleaning filter will clarify the water under the standard of Ministry of Health.

- Continuoust self-cleaning filter will be designed and produced by the manufacturers of specialized equipment.

- Self-cleaning filter works as follows: the water needs to be cleaned will be distributed on the surface of the filter material and through the filter material by gravity then water will be concentrated in the lower compartment of filter then lead to treated water tanks. After some time clinging to debris layer filter materials made increase the hydraulic losses in the material, to a time when water in the tank will raise affecting system self-cleaning vacuum filter.

Vacuum system will absorb water from the filter washing, backflow filter material through wash water discharge system, self-cleaning water will wash

fouling layer at the surface layer of filter material and discharged from the filter.

- The advantage of self-cleaning filter is not use the pressure equipment for clean water such as cleaning filter pumps, cleaning filter wind pumps. The other advantages are not use of electricity in the filter cleaning process, reducing off pipe and check valve on the water supply system. Easy in equipment installation, auto workers do not need control, small land area for build, saving water and energy for cleaning filter process.

VIII.3.3. Chlorine feeding house

Chlorine solution is provided for two processing: iron removal and disinfection.

a. Iron disposed:

Source water is very low iron content (2.25 mg / l) and high pH (pH = 8.4). The simplest method for iron disposed is clear on the filter surface or chlorine solution.

With continuous self-cleaning filter the method to clear the surface of the filter can not be applied. Because it is a closed filter. The method uses chlorine should be applied for iron disposed. When put chlorine in water, chlorine oxidizes iron compounds, water-soluble form FeCl3 precipitate as type cotton residue and is retained on the surface layer of filter material

According to TCVN 33-2006 to oxidized 1 mg / l of iron we need 0.7 mg / l of chlorine. The iron content in water is 2.25 mg / l will require about 1.5 mg / l of chlorine. Besides iron disposed effect, chlorine can disinfection for water.

Chlorine will be given at the beginning of the push tube after wells pumping station infront self-cleaning filter

b. Disinfection:

- Disinfectant will be added to the water for kills bacteria, germs remaining in water.

- Disinfectants used are chlorine solution.

- Liquid chlorine is stored in dedicated tanks and feeding to pipeline by the equipment or pumps.

VIII.3.4. Treated water tank:

- Treated water tank used for store water and regulate water between two working modes of the filter (all day) and two working modes of pumping station. It also reserve for fire and for the plant itself. Treated water tank is also disinfectant water after filtration prior to pipeline network

- With the selected self-cleaning filter, tank is placed floating on the ground to facilitate the use and management.

- Floating on the ground tank can made by metal to reduce weight, easy for construction and reduced costs. The project area is also affected by salt water should propose using glass coated steel tanks are resistant both to corrosion and saline water mixed with chlorine for disinfection.

VIII.3.5. Treated water pump station (Pumping station level 2)

- Treated water pump station use to pump water from the treated water tank into the water supply pipe network.
- Due to treated water tank is laid on the ground so the treated water pumping stations should also laid on the ground for ease of construction, ease of operation and management and reduce investment costs.
- The treated water pumps, inverter cabinet, control cabinet and the pump suction line, push the pipe, the check valve, pressure gauge, flowmeter... are also placed in treated water pump station.
- The treated water pump station is laid on the ground. So the centrifugal pump should be used for easy placed of the pump and pipeline.

VIII.3.6. Distribution and transmission pipelines network:

- Distribution and transmission pipelines network is used to distribute water from the treated water pump station to the point of water use.
- Water supply pipe network is divided into
  - The transmission pipeline: the main water pipelines in the area use large quantities of water. The transmission pipelines often forming a closed loop water supply to ensure safe, stable.
  - The distribution pipeline: the pipelines convey water from the transmission pipeline to each block, often dead-end pipeline.
  - Service pipeline (brach pipeline) : the water from the distribution pipeline to the household (water consumption meter)
- The main transmission pipeline can located under the pavement or sidewalk, depending on the actual conditions such as sidewalk width enough to put the distribution pipelines, the branch pipelines with check valve to control pressure and flow adjustment for each tube.
- The project area in saline areas, so mainly used for HDPE pipe D ≥ 100mm and PE pipe for pipe diameter D ≤ 80mm. The tube placed in a special position such as bridge accross will use steel pipe with high protected against corrosion.
- Proportional number of installation for service pipes and water meters of households will be calculated in Water Supply Demand. Service pipe for household is the PE pipe D27, D15 meter, brass valve.

IX. CALCULATION AND CONSTRUCTION TECHNOLOGY ITEMS

IX.1. Drilled wells

- Drill 2 underground water wells: 170 m deepth wells, a 115 m deepth wells.
- The 170 m deepth wells will drill in deep water aquifers from 140 m to 165 m. The 115 m deepth wells will drill in the deep water aquifer from 80 m to 130 m.
- Composition of soil aquifer mainly is coarse medium gravelly sand.
- The ability extraction of each wells is 60 m3 / h = 1,440 m3/day capacity in accordance with requirements of each extraction wells.

a. Filter pipe:

Filter pipe length: $$L = \frac{Q}{\pi \times D_n \times V}(m)$$

Where:

Q: Flow of extraction each wells; Q = 1440 m^3/day = 60 m^3/h

D: Filter pipe diameter, chose D = 0,168 m

V: Speed of water flow in filter pipe, V =$60\sqrt[3]{K}$

K: soil permeability depends in geological structure of ground water level and effect of the wells. With geolorical structure is coarse gravelly sand, the roughness coefficient K = 25 – 75 m/day, radius of well influence R = 200 – 300 m Chose K = 25 m/day, R = 200 m.

$$V = 60\sqrt[3]{25} = 170 \text{ (m/day)}$$

$$L = \frac{Q}{\pi \times D_n \times V}(m) = \frac{1440}{3.14 \times 0.168 \times 170} = 16(m)$$

Select a filter tube length 18 m, to match the length of each segment filter tube is 3 m.

b. Drilled wells structure

No	Wells structure detail	Wells depth 170 m (Wells No. 1)	Wells depth 115 m (Wells No. 2)
1	Diameter of the hole D=550 mm	60 m from the ground	60 m from the ground
2	Diameter of the hole D=400 mm	From 60 m to 170 m	From 60 m to 115 m
3	Casing pipe PVC D315	From (+0,5m) to (-60m)	From (+0,5m) to (-60m)
4	Casing pipe PVC D168	From (-60m) to (-140m)	From (-60m) to (-85)
5	Steel Filter pipe D168	From (-140m) to (-158m)	From (-85m) to (-103m)
6	Junk substitute PVC D168	From (-158m) to (-164m)	From (-103m) to (-109m)
7	Gravel bag 2-4 mm	From (-140m) to (-170m)	From (-55m) to (-115m)
8	Badding sand 0,5-1 mm	From (135m) to (-140m)	From (-50m) to (-55m)
9	Cementation filling	From (0m) to (-10m)	From (0m) to (-10m)
10	Clay filling	From (-125m) to (-135m)	From (-40m) to (-50m)
		From (-10m) to (-125m)	From (-10m) to (-40m)

IX.2. Wells pumping station

a. Calculation:

- Flow rate of each pump station: Based on the flow rate and capacity of each well Q = 50 m^3/h
- Pressure pumping of wells:

$H_b = Z_1 + Z_2 + \sum h + H_p$ (m)

Where:

Z_1 : High water levels in the self-cleaning filter, Z_1 = 4,4 (m)

Z_2 : Lowest water levels in wells, Z_2 = -30 (m)

$\sum h$: Total losses in the discharge tubes of wells pumping

$\sum h = h_1 + h_2 = 0,36 + 2 = 2,36$ (m)

h_1 : Pressure loss with Qb = 50 m3/h = 14l/s, chose discharge tubes for pump with D = 150 mm, v = 0,89m/s, i = 3.6 m/km, length of discharge tube l = 100 m.

$h_1 = 0,1 \times 3,6 = 0,36$ (m)

h_2 : Local losses in pump and fittings, chose h_2 = 2 (m)

H_p : Pressure reserve, H_p = 3 (m)

$H_b = 4,4 - (-30) + 2,36 + 3 = 39,76$ (m). Chose H_b = 40 (m)

- Wells pump specification : Q_b = 50 (m^3/h); H_b = 40 m

b. Wells pump station

+ Wells pump station No. 1 :

- Pumping Station No. 1 is located in the outside plant, in a separeted land away 100 m of WTP.
- Wells pump station is including fence, gate, administrative house, storage of wells's necessary fitting, control cabinet, yard lines, pressure station for pump.
- Use of specialized submersible pump located in the well, build the pump station out the well to put the pipe, equipment and spare parts, such as pressure gauge, valve, flowmeter...

+ Wells pump station No.2 :

- Wells Pumping Station No. 2 is located in the WTP area. It should not construct administrative house, fence gate, yard lines, substations as Wells pump station No. 1.
- Use submersible pumps, build the pump station out the well to put the pipe, equipment and spare parts lilely Wells pump station No.1

IX.3. Self-cleaning filter tank

- Self-cleaning filter tank designed by the company and will be provided under the orders of the investor, self-cleaning filter equipment supplier will be responsible to investors about the quality of the work, treated water quality and operating manual of the filter.

- Specifications of self-cleaning filter tank:
  + Welded steel tank
  + Diameter of tank D = 3,0 m
  + Heigh of tank H = 4,50 m
  + Heigh of water containing h = 4,10 m
  + Height layer of filter material and support h_d = 1,20 m
  + Inlet water pipe d = 150 mm
  + Outlet water pipe d = 150 mm
  + Water pipe for cleaning filter d = 200 mm

IX.4. Treated water tank

a) Calculation:

Treated water tank: a part to storage the regulated supply water from the filter, a part to storage water for the plant and a reserve for fire fighting. The total amount of this water is often taken by 20% of their capacity, about 480 m3.
The size of the circular cylindrical tank: D = 13m, height of water contaning H = 4.0 m, full tank height H = 4.37 m, inlet water pipe d = 200 mm, suction tube for pump d = 250 mm

b) Structure:

- Treated water tanks are placed on the ground, in accordance with the application of self-cleaning filter.
- Due to the construction sector should adopt salinity, the water contaning of filter tank is glass powder coated steel to prevent corrosion.
- Tank is made by the manufacturer, offer for investors in the form of equipment.
- The tank bottom is in place reinforced concrete, bolts and rubber rings will be connect between the wall tank and the bottom tank.
- All water tanks are located on the frame machine bearing piles.
- The inlet pipe, the suction of the pump level 2 and overflow drain will be put to tank.

IX.5. Chlorine feeding house

a) Calculation:

- Chlorine is provided for iron removal in raw water before the filter and disinfect the water after it has been filtered before to the tank.
- The amount of chlorine to remove iron oxidation according to TCVN 33-2006 is 2.00 x 0.7 = 1.4 mg / l

- The amount of chlorine to disinfect: The amount of bacteria and viruses in groundwater is very small, when put chlorine in water to remove large amounts of iron bacteria in water also destroyed, so the amount of chlorine in water to remove primarily to maintain the same amount of residual chlorine in the water when the water supply network flows, chlorine is put into the water tank. Estimated amount of chlorine for disinfection is 0.6 mg / l

- The total amount of chlorine into the water for iron removal and disinfection of about 2 mg / l. Specific amount of chlorine to be determined exactly when the work is put into operation.

- The amount of chlorine consumed per day: 2400 x 0.002 = 4.8 kg / day.

b) Structure:

- Use liquid chlorine is contained in cylinders of 68 kg (containing 50 kg of chlorine) to provide for the plant. Average number of chlorine is stored in 1 month is 144 kg, fitted with 4 chlorine cylinders, in which 2 for work and 2 for backup.

- The equipment for feeding chlorine:
  - ❖ 2 chlorine feeding machine
  - ❖ 2 feed pump
  - ❖ 1 platform scales 200 kg
  - ❖ 1 detector and alarm chlorine leak.

- The chlorine is divided into two rooms: one room set containers of chlorine; a room set devices such as magnets provides chlorine, feed pumps, piping of chlorine. The chlorine is equiped the safe equipment such as masks, exhaust fans, fire extinguishers

IX.6. Treated water pump station

a) Calculation

- The inverter system will control the water pumping station operation. Working mode is the mode of water consumption of water supply systems.

- Mode of water use with factor of project work without air conditioning is now the largest Khmax = 1.5. Now the largest user of water, pumping water to supply the demand for network use are:

- Mode water use by a factor of conditioning does not work, is now the largest $K_h^{max} = 1,5$. The largest water use hour, water pumping station need supply the volume of water to network with the demand use is:

$$Q^{max}_{tb} = \frac{1}{24} \text{ x } 1,5 \text{ x } 95\% \text{ x } 2400 = 144 \text{ m}^3/\text{h}$$

Choose 2 pumps working, 1 standby pump, when 2 pumps work simultaneously reducing the flow coefficient of 1.9, the flow of one pump is:

$$Q_b = \frac{144}{1.9} = 75\ m^3/h$$

- The pressure of the pump:

$$H_b = H_{ct} + h_b + h_{dp}$$

+ H_{ct}: required pressure of water supply pipe network at the beginning of the network, after pumping clean water. According to calculations, the hydraulic pressure needed in the network to ensure the water pressure in the most unfavorable of 12 m is 19.0 m.

+ h_b: losses through the pump pressure is calculated from the lowest water level in the reservoir to the pipeline network: h_b = 3 n

+ h_{dp}: Pressure reserve h_{dp} = 3m

$$H_b = 19 + 3 + 3 = 25m$$

Choose the pump has the same specifications as Q = 75 m^3/h, H = 25m

- Thruster pipe and pushing pipe of the pump:
  - ❖ General thruster and pushing pipe: flow 144m^3/h = 40l/s. Chose pipe with diameter D = 250 mm, v = 0,81 m/s, i = 2,55 m/km
  - ❖ Separate thruster and pushing pipe: flow 75 m^3/h = 21 l/s. Chose pipe with diameter D = 200 mm, v = 0,67m/s, i = 2,3 m/km

b) Structure

- Pump: Pumping station located on the ground so the centrifugal pump vertical axis should be used. Centrifugal pump thruster of low land requisition facilitates the construction and operation management.
- To control the operation of pumps use inverter cabinets. The pump control and prevention activities to increase longevity rotation of the pump
- The pump pulley set for easy transport when removing the pump assembly and installation.
- House put pumps are built on the ground, solidly, in conjunction with the generator set for power supply redundancy advantages.
- The pumping station was placed control panel, piping, fittings, valves, pressure gauge, flow ...
- Pipeline pump station suction and discharge tubes used steel pipes and flanges connected by bolts.

IX.7. Water supply network

a) Calculation

* Calculation of water supply pipe network according to the following requirements:
  - Based on the current state of the ground service projects

- Water supply line to cover the entire project area, but only the hydraulic calculations for the transfer tube diameter D ≥ 100 mm. the requirements set fire pillars.

- Pipe network hydraulic calculations, including existing pipe and the new pipe installation.

- Pipe diameter is taken as the case the largest water use hour with the dishamonic factor $K^{max}_{h} = 1,5$

* Calculation:

- Determination flow of the largest water use hour $q^{h}_{max} = q^{h}_{tb} \times 1,5$

- Determination of flow units:

$$q_{dv} = \frac{q\,max}{\sum ltt}$$

l_{tt} : calculating length of pipe (m)

- Determination of flow along each pipe

$$q_{dd} = q_{dv} \times l_{tt}$$

- Determination of flow plug

$$q_{nút} = \frac{\sum qdd}{2}$$

- $\sum q_{dd}$: Total flow along the pipe sections focus on plug.
- Enter the parameters: the flow plug, the length of the tube. high level input plug...to the EPANET program in a computer, then adjust the technical parameters to be reasonably calculated results include hydraulic diameter the pipe, the water pressure at the plug, the pressure at the pipeline network

Calculation result:

Pipe D = 200 length 250m
Pipe D = 150 length 300m
Pipe D = 100 length 3250m

b) Structure of water supply pipe networks

- Water supply pipe network including existing water supply pipe and water pipe installation new, a complete water network to provide the country with a capacity of 2400 m3/day for the demand

- Water supply pipe network includes:

+ The transmission pipeline is the main line conveys water from WTP to the distribution pipeline. The transmission pipeline network is made up a circle for safe water supply. The transmission pipeline diameter D ≥ 100 mm will be put the head fire in the necessary position.

+ The distribution pipelines will receive water from the transmission pipelines then supply for the water service pipe for water demand. Distribution pipes with diameter D ≤ 90 mm.

+ Service pipes for water distribution pipes for the water meter consumption needs of the user. Service pipes with dian eter D = 27 mm

- Water supply pipes are located under the sidewalk or curb, within the roadway from the edge of the road to the road boundary for no compensation. Distribution pipes will be located close to works for easy install the service pipe to the works.

- Pipe materials: The project area is affected by salinity zone so that the HDPE pipe should be proposed to use. HDPE pipe has the advantages of salt water resistant, soft, pliable so little to take the corner fittings at the turning point. With tube diameter D ≤ 250 mm, fitting parts together and welded heat sealed to ensure the durability of joints. The accessories, tee, elbows cone, flanges are manufactured using HDPE material connected with heat welded pipe, should facilitate the installation.

- Depth of tube : pipes are mainly located under the sidewalk and curb less affected large mechanical top down, so the biggest tube depth of 1.5 m degrees from the ground to the top tube to the erection easy installation and reduce construction costs .

- Tubes on the bridge will use steel pipe flange, anchored to the bridge. Reinforcing steel pipes will be protected against corrosion.

- The pipe will be placed through the street protected by reducing impact forces from top to suit each and every type of tube placement.

- On the pipe network the fire head will be located in densely populated areas markets, schools.

- On the water supply pipe the equipment and accessories such as block valve at the top of the pipe, the exhaust valve at the highest point, the residue discharge valve at the point of lowest segment of each tube will be installed in the positions necessary to operate and manage.

- Total pipe length:

  - Pipe HDPE D225 length 250m
  - Pipe HDPE D160 length 300m
  - Pipe HDPE D110 length 3.250m
  - Pipe HDPE D90 length 500m
  - Pipe HDPE D63 length 2.200m

Total: 6.500m

IX.8. Household connection and service pipe:

- Service pipe will connect the distribution pipe to household meter for domestic water use.
- Service pipe is the PE pipe with the diameter D27.
- Water meters for household use in diameter D15.

- The spare use of brass valves.
- The number of connections to ensure 80% of households use water at the time of the water supply system in operation. 800 household water meters will be connected

X. CONSTRUCTION STRUCTURE DESIGN SOLUTION

X.1. Construction structure solution

X.1.1. The standards

- Vietnam construction standards (Volumes 1, 2, 3)
- TCVN 2737-1995: Loads and impact
- TCXD VN 356-2005: Reinforced concrete structures
- TCXD CN 338-2005: Design standards of steel structures
- TCVN-205-1998: Design standards of pile foundation
- TCVN 5573-1991: Brick and stone masonry reinforcement
- TCXD-45-78: Design standards and construction background
- TCVN-4054-2005: Design standards of highways
- 22 TCVN-211-06: Criteria for flexible pavement design
- And others related standards

X.1.2. Solution structures for the construction works

Based on the geological characteristics of the project area soil and the size of the technology works, the construction structure solution of the WTP works in the following:

1. Self-cleaning filter tank:

- Structure: The self-cleaning filter tank will be designed by firms and prefabricated with a diameter of 3 m, wide height 4.5 m, water containing 4.1 m height. The height containing materials (stone, sand) 1.2 m filter. Circular cylindrical steel tank, the roof closed.

- The base and foundation will be designed for filter placed. Tank is placed on the ground leveling, foundation tank is calculated as follows:

+ Calculation loads:

* Steady loads: the works loads itself

* Live load: water, sand, gravel contained inside the tank, piping equipment, wind load, the repair operation.

+ Solution foundation:

The works located on soft ground, so the solution of reinforced concrete piles to process and create a stable foundation for the works.

2. Treated water tank:

- Structure: Treated water tank wil be designed by firms and prefabricated. The tank glass coated steel to resist corr sion with diameter D = 13 m, height 4.37 m of which the height is 4.00 m containi g water, cover with a lid on the tank.

- The tank bottom and foundation bearing system are needed to design to set the tank on the ground. The bottom of the tank and the tank foundation is calculated as follows:

– Calculation loads:

* Steady loads: the works loads itself

* Live loads: Water inside the tank, wind load, tank operators.

+ Structure solution:

* The bottom of the tank with rei nforced concrete

* Tank foundation: Buildings sh uld be placed on soft soil solution using reinforced concrete pile foundation treatment and to create stability for the works.

3. Treated water pump station:

– The dimention of treated water pump station: Bx L x H = 6,5 x 9 x 4,6 (m)

– Structure solution: the treated water pump station is rectangle and divided into 3 rooms, control room set control cabinets, room to put the water pump and room for gener ator. Pumping station will be built on the ground. Foundation, frames, columns, bracing momentum are by reinforced concrete, reinforced concrete roof, brick walls, paint color.

– The water pump station is made of reinforced concrete with concrete stone 10 x 20 M250, standard reinforcement magnitude R_a^{TC} = 3000 kg/cm2 (for steel AII, d ≥ 10) and R_a^{TC} = 2400 kg/cm2 (for AI steel, d <10)

– Load calculation include:

- Steady loads : the works loads itself
- Live loads: Land outside pressure, uplift pressure, girder cranes, equipment, wind load, live load roof repair.

– Foundation solution: The land is very weak construction, the ground should be reinforced by plant pile diameter D = 8-10 cm, length 4.7 to 5 m, 25 tree/m2 density.

4. Administrative house:

Using the existing management, just repainted to match the new construction.

XI. POWER SOLUTIONS

XI.1. Power supply source:

XI.1.1. Power supply source:

- The water supply system wi l be powered by the 3-phase transformers. 22 (15) / 0.4kV, are installed in the water supply station.
- Medium Voltage Power 22 (15) kV will be provided from the existing medium voltage grid.

XI.1.2. Substation:

- Construction of transformers nstalled outdoors.
- Electricity substation will be put into ATS.

XI.1.3. Generator backup:

- To ensure continuous powe supply when the power national grid failure, the generator will be installed to supply water to the power station corresponding plant to ensure safe working and stable
- The automatic switch (ATS) will be installed to automatically switch from the grid through the gene ator and vice versa.
- Standby generators with a capacity greater than required for the entire pump from 25-40%.

XI.2. Wells Pumping Station:

The water supply system have a wells pumping station, installation of pumps with demand capacity. Due of the distance of wells pumping station and treated water pump station or WTP is not large, so the power supply to wells pump station shall comply with the plan of using the power supply from the electrical cabinet TD_TB2.

General characteristics of the powe system for well pumping station as follows:

Wells pump station electrical cabin t size 800x600x210 installed in the room including the management of major equipment: Automatic circuit breakers, & boot from the motor protection relay with overvoltage protection function, low voltage, over download & run dry protecti n. Key features of the pump control panel as follows:

- Boot method: soft launch
- Control: local manually by buttons mounted on the front of the electrical panel. Besides the well pump is also controlled electrical cabinet located at the treated water pump station.
- Measurement: vol check meter & ampere meter for power line inspection.
- Signal: Signal lights indicate the status of the work or engine malfunction.
- Cables: Use insulated copper conductor types XLPE/PVC/DSTA/PVC-0.6-1kV. All the cables are buried underground tube & PVC (except the special cable placement)

XI.3. Water treatment plant(WTP)

WTP will be supplied electricity from a 3-phase transformers outdoors. Electrical substation will be put into electrical cabinet ATS (located in the generator set) with type Cu/XLPE/PVC/DSTA/PVC-0.6/1kV cables, HDPE pipe is threaded in and buried underground with a minimum depth of 700mm.

TD_TB2 electric cabinet has 2 main functions: power supply & control the pumps located in the treated water pump station and also power distribution cabinet level 1 to level 2 distribution cabinets and other items placed in the works .

XI.4. Power cabinet:

- The main power cabinet placed in room for generator is the power distribution cabinet level 1 to the power distribution cabinets level 2 and other items put in the work.
- Power cabinet are installed the major equipment: Automatic circuit breakers, booting and the protection relays with the protection function overvoltage, low voltage, overload.
- The switching and control cabinets are designed of 2 gates with IP55 protection level. Cabinets with ventilation holes, ventilation fan lights for operation and maintenance.
- All the electrical panel breaker must be provided by a manufacturer to ensure uniformity and standardization of parts.

- All electrical switching cabinets to undergo safety testing and certification of an attached unit testing is legally recognized. Electrical switching cabinets to ensure arranged to facilitate inspection and maintenance. Minimum width from the front of the cabinet to ensure not less than 600mm, depth not less than 300 mm.
- The mounting stop device must be large enough so that the adjustment and removable devices inside must be made easy. The maximum height of the installation of electrical equipment not exceeding 2400 mm high from ground operations.
- Under floor electrical panel layout available to cable threaded holes with fixed cable accessories needed and the rubber gasket to prevent the entry of rats or insects in cabinets.
- Cabinet have outfitted hooks necessary for the crane installation. The hook is made, so that after installation of cranes, complete installation can be removed.
- Electric box made of stainless steel, front 2mm, 1.2mm thick for the others
- Electrical cabinets frame stainless steel L40x4mm
- Key features of the pump control panel:
  - Control pump operation.
  - Measurement: vol clock & test voltage amperemeter check current
  - Signal: Signal lights indicate the status of the work or engine malfunction.

XI.5. Cable:

- Use of insulated copper conductor types PVC-450/750V inserted in SP underground pipes in the wall or floor for indoor.

- Use of insulated copper conductor types XLPE/PVC/DSTA/PVC-0.6/1kV plastic tube inserted in an underground HDPE twisted for outdoor.

XI.6. Lighting system:

XI.6.1. Indoor lighting system:

- Lighting systems in the home will use neon lights or compact, voltage 220V.
- The lighting system will be supplied from the distribution cabinet level 2, located in the respective categories.
- Wires: Use wire Cu/PVC-450/750V. The wire will be inserted in plastic tubes in SP and vaginal wall or floor. In areas with a high level of risk, the cable will be inserted in special metal pipe to prevent corrosion.

XI.6.2. Outdoor lighting system:

- System power outdoor lighting will use the 150W sodium lamp, voltage 220V, head lights installed on the hot-dip galvanized iron, 8m high, 3.5mm thick.
- External lighting system will be supplied from the distribution panel located in the second level of protection.
- Cables: using cables Cu/XLPE/PVC/DSTA/PVC-0.6/1kV. The cable is threaded plastic tube bearing twist and vaginal buried deep underground with a minimum of 800mm.

XI.7. Lightning and earthing system

The plant will be installed the system lightning and earthing, including:

- Earthing system and lightning directly with the grounding resistance ≤ 10 Ohm. Use lightning rod type leader obtained rays.
- Earthing system with safety equipment grounding resistance ≤ 4 Ohm
- Earthing system will be placed at a minimum depth of 800mm.

XI.8. Some calculations & selection of basic equipment for WTP

XI.8.1. Power load for WTP:

Power load for WTP are shown in the following table:

Treated water pump	15	3/2	30
Leakage water pump	0.37	1/1	0.37
Sub-total			52.37
Control room	5		5
Generator room	5		5
Sub-total			10

XI.8.2. Calculation of power substation capacity:

$P_{ttζ}$ = 1.1 x P_{tt} = 1.1 x 54.13 = 59.55 kW

Cosζ average of WTP is 0.85 design total output will be:

S_{tt} = $P_{ttζ}$ / 0.85 = 59.55 / 0.85 = 70.054 kVA

Power transformers are identified: $S_{ba} \geq S_{tt}$ = 70.054 kVA

Choose 3-phase transformers with a capacity of 75 kVA, 15 (22) / 0.4kV made by the Vietnamese, for outdoor types, no need power adjustment according to ambient temperature.

XI.8.3. Calculation of power generator capacity:

When the WTP lost electricity from the national grid, the generator will be used to provide the required load as follows:

Choose 3-phase generator, 4-wire 220/380, continuous power 72 kVA (C80 D5). ATS 400V, 3 phase 125A (GT3-0125)

XI.8.4. Compensation capacitor:

Reactive power compensation:

$$Q_c = P * (tg\varphi 1 - tg\varphi 2) \text{ (kVAr)}$$

Where:

- P : load capacity (kW)
- Cos φ_1 : power factor of the load before compensation
- Cos φ_2 : power factor of the load after compensation, as stipulated by the power company: Cos $\varphi_2 = 0.95$

Insert the data:

- P = 54.13 kW
- $Cos\varphi_1 = 0.75 \Rightarrow tg\varphi_1 = 0.88$
- $Cos\varphi_2 = 0.95 \Rightarrow tg\varphi_2 = 0.33$

reactive power compensation is:

$$Q_c = 54.13 * (0.88 - 0.33) = 29.7715 \text{ kVAr}$$

According to the manufacturer's catalog, select 30KVAr capacitor. We need 50 KVAr capacitor. Total reactive power is 1x30 = 30 (KVAr)

XI.9. The control solution:

XI.9.1. Solution 1: Controls in each iten

The control system in the instrument cluster of the water supply station and WTP. The distribution & control cabinets will be installed in place. The device will be selected 1 in 2 operating modes Manual or Automatic

- Manual operation mode:

- Operate local (in electrical panel installed at the site): the operation of equipment will be done by pressing the power button on the cabinet in place.

- Operate Remote control and monitoring equipment will be made in the control cabinet placed in treated water pumping station

- Automatic operating mode:The equipment will be operated automatically based on the control signal as:

- The water level in wells to control the wells pumping

- The water pressure in the treated water supply pipe to control the treated water pump station.

- Water flow on the treated water supply pipe to control the treated water pump.

- PH and chlorine levels on the output of treated water tanks to control the pump fills chemicals.

XI.9.2 Solution 2: Controls in each item, centralized control room in the center console and management of data throughout the water supply system:

Purpose: to monitor, track and control data of pumping wells and water treatment plant located in the center managed through the SCADA system

XII. ENVIRONMENTAL PROTECTION, FIRE EXPLOSIVE PREVENTION

XII.1. Impact of project on environment

XII.1.1. Processing stage of project

a). Impact of project on environment:

Processing stage of project is a most influential stage with environment, namely:

- Impact on adjacent works: when excavation and construction works in plant, digging trench to installing water supply pipelines can be demolish the road, destabilize adjacent works, demolish underground works
- Impact on traffic and daily activities of people: When process, sand, construction material are gathered on the ground, can be encroached both roadway and sidewalk, alley, traffic impediment.
- Impact on air environment, harm to health and daily activities of people: When processing, concentration of dust will be increase because of digging, transportation of sand, material and constructed device, noise is increased because of operation of machineries, construction garbage of worker on site causes air pollution, environmental unsanitary

b). The remedies and mitigation:

- To minimize the impact on adjacent works, there will apply following solutions:
  - When design, there will layout project's works to ensure safety distance for adjacent works, so that when processing, they will not affect.
  - In case have to design with unsafe distance, the solution will apply: excavation, digging trench to installing pipe which will protect pipe edge by apron (steel sheet pile, cloth. wood panel) suitable, ensure absolute safety. When construction on ground, there will have enough high shield to no affect to adjacent works. Before construction of underground works will survey (digging testing) to explore below works, then have suitable measures for protection
  - When constructing culvert segment will fast construction, immediately backfill to return the ground, maximum reduce affected time to adjacent works
- To reduce affect of project to the traffic, people's life, will apply solutions as follows:
  - Install railings for whole construction area until return the ground, put signs at daytime and signal lights at night
  - Organization of temporary road for people at construction area of the encroachment of roads. When construction of pipeline, if the width of remain road is not enough for vehicles and people there will construct

temporary road or appoint a person to guide traffic under most convenient existing road. These segment pipes will concentrate to fastest construction for quickly return transportation.

- Soil excavation, ditch for putting pipe, construction materials to be neat arrangement, right specified places, not to impede traffic.
- The entrance, houses with crossing digging ditches will place temporary bridges suitable with vehicles and quickly construction to return the path.

- To reduce affect of the project to sanitation environment, will apply solutions as follows:
  - Constructing high shield to reduce affect of dust and noise in construction area out to adjacent area
  - Regular watering for the construct on area, especially on dry days, and the construction area arises dust such as digging pouring rock, transporting sandy soil...
  - Specialized vehicles transporting sand, materials will be covered, in order do not generate dust and sand scattered along the road.
  - Choose qualified construction unit, with modern construction machinery to minimize noise due to equipment, machinery when constructing.
  - Equip movable pumps, when stagnated water or mud will right away pump into specified place, do not stagnation to unsanitary and obstruction traffic
  - Wastes on site will collect at specified place, then are transported to pour at rubbish dump or general specified area
  - On concentrative site will construct toilet according to regulation

c). General implemention method:

- The protection of the environment is implement at all stages: design, bidding documents, construction, construction supervision.
- There is a synchronous coordination between the emloyer and consulting contractor, construction contractor along with local agencies.
- Design are estimated affecting factors to the environment to reduce the maximum impact. Bidding document provides provisions, specific provisions on environmental protection for the winning bidder. Construction contractor is responsible fulfill of the requirements of environmental protection during the construction. Consulting supervisor monitors and regularly reminds, that are considered important tasks of monitoring, resolute handling when contractors violate regulations of environmental protection. The employer issues specific terms, regulates, and implements clear award in contract with construction contractor, if any serious violations will be suspended construction to remedy.

- Units and local agencies regularly monitor, detect violations of construction contractor, especially functional departments, to recommend employer requires construction contractor to strictly implement .

XII.1.2. Stage of operating project:

a). Impacts of project to the environment :

- Raw water source is exploited to supply for project is underground water, when exploiting can affect to underground water such as reduce water level at aquifer, pollute underground water because of infiltration of ground water
- Affect to water source because waste in treatment plant discharge such as sludge when cleaning filter, clarifier, wastewater with chemicals, daily wastewater
- Impact to people's life around the plant when operating plant, it causes noise, discharges pollutant into the air
- Affect when operating works arises problems, at treatment plant can arise leak out, explode chlorine

b). Solution to repair and reduce:

- To reduce affect to water source, will apply following solutions:
  - According to assessment, exploited underground water at this area can be up to 10.000 m3/day. With capacity of exploitation for project only 2400 m^3/day, will not considerable affect to underground water of area. To avoid pollute underground water, wells are designed and constructed to ensure technic, according to regulation, absolutely not for surface water infiltrates and aquifers are through together
  - Daily water only has at toilet of managed house. Water will be handled in septic tank with filter chamber, then leading out drainage
- To reduce impacts to people's life around the plant, apply following solution:
  - Selected area to construct the plant at floated island between lake, this area will no people live, far away resident area so when the plant operates almost no affect to people live around.
  - Otherwise, among machineries operate in the water plant only the clean water pumping station causes noise, but existing pumps are manufacture to ensure low noise when operating, at this site also does not hear the noise
  - Almost the operating water plant do not discharge pollutants into the air, because only use chlorine to liquidate, the chlorine is contained in enclosed vase and transfer in completely enclosed system.
- To reduce impact when operation arises problem: the problem of the water plant can be leakage, explosion of chlorine which are endanger for manager and toxic chlorine gas disperse into the environment. When design, there has already equipped the chlorine leak detector, when chlorine leak, alarm will

signal to some extent, staging spray eye will automatically discharge down to chlorine room for neutralize seep out chlorine and not let chlorine explosion. Place the chlorine vase which is separately built with supply equipment room and lead chlorine. In room is equipped masks and protective equipment when arising problem.

XII.2. Fire protection:

XII.2.1. Fire protection for construction stage of the work:

- When construction, fire is often arise at place such as storage petrol area, chemicals (alcohol, oil-paint); area contains coffa wood, plastic, switches;
- To prevent, there will apply following solutions:
  - Warehouse of flammable chemicals such as petroleum benzine, chemicals are placed separately far away from other works. Having warning sign and prohibiting flammable agents operating near this region as the smoker, cross power lines, soldering, substation, generator...
  - Areas can fire such as wood, oil paper... will be neatly piled, with distance with other works, especially kitchen area.
  - Camps of worker will be separately placed with other area.
  - Equip with necessary fire equipment suitable for each type such as fire foam, bucket, water tank, showel...
  - On site arranged water tank for each area, large water tank, pit or reservoir sand (near to petrol area) is always fill to ready use for fire extinguish when arising fire.
  - The technicians always check power transmission lines, immediately replace when detect opened electrical wire, electrical leakage, broken... Immediately checking and replacing electrical switches when detect they are broken, unsafe electrical discharge. Properly using fuse (lead wire), not be replaced by other metals.

XII.2.2. Fire protection for operating stage:

- In this stage, explosion often arises at covered works such as managed house, warehouse, pumping station, chemical house, chlorine house, substation...
- Reason of fire can be from carelessness of people, short – cicuit, explode can arise at chlorine house, substation.
- Solution:
  - Arranged pier for fire extinguishment along routes near flammable works as mentioned above. In addition, around the plant is raw water lake so the extinguishment is convenient, if it occurs.

- Arraged personal fire foam (foam CO2) placed in flammable works.
- Regularly checking electrical supply system to detect problems about wireline and electrical equipment, timely replacing to ensure electrical safety.
- Chlorine house equips detection of seep out chlorine and automatically neutralizing to no explosion of chlorine vase (described in item 6.1)
- Installation of lightning protection system throughout the plant, so there is no lightning in the factory, avoiding transformer explosions

XIII. CONTENTS OF INVESTMENT

XIII.1. Contents of construction investment

1. Construction of 2 wells

- Wells No. 1 is outside of the plant with capacity of 60m3/h, depth of 170m.
- Wells No. 1 is in the plant with capacity of 60m3/h, depth of 170m.

2. Construction of 2 wells pumping stations

- Wells pumping station No. 1 with capacity of 50m^3/h is constructed on separated land far away from the plant about 100m, includes fences, managed house, yard, base for pumping station, electrical system and control, pipeline, shutoff valve, fittings
- Wells pumping station No. 2 with capacity of 50m^3/h, is constructed right in the plant so only invested to construct base for pumping station and install pipeline, shutoff valve and fittings.

3. Self–cleaning filter with capacity of 100m^3/h (2400 m^3/day)

- The filter (on the ground) is manufactured, designed and available by steel to supply and install for employer
- The foundation and base to put the filter is invested to construct at the water plant

4. Clean water tank with capacity of 500 m^3

- The tank is made of by steel coated glassy powder is manufactured, designed to supply and install under the order of employer.
- The pressure-resistant bottom and foundation is invested to construct at the water plant.

5. Clean water pumping station (level 2) and house to put generator

- House to put pumps with space size of: 6x6,5 (m) = 39 m^2
- House to put standby generator: 3 x 6,5 = 19,5 m^2

6. Upgrade to expand chlorine house

- Expanding the size of chlorine house, additional putting equipment to supply chlorine suitable with capacity of the plant 2400 m^3/day.

7. Improving items in the water plant suitable with capacity of 2400 m^3/day : managed house, internal road, drainage.

8. Technical pipeline in the plant

9. Electrical supply system

- Electrical supply at wells pumping station No. 1

- Electrical supply for new works at water plant suitable with capacity of 2400 m3/day: wells, pumping stations level 2, chlorine house, illumination...
- Medium voltage line and substation for the plant and wells pumping station.

10. Transmission and distribution pipeline network:

Quantity of invested pipe installed:

- Pipe HDPE D225 : 250 m
- Pipe HDPE D160 : 300 m
- Pipe HDPE D110 : 3.250 m
- Pipe HDPE D90 : 500 m
- Pipe HDPE D63 : 2.200 m

Total : 6.500 m

11. Connection of meter and service pipe for household: installing for 800 households include meter D15 and service pipe from distribution pipe to the meter in front of household's door.

XIII.2. Investment for procurement of machinery

TT	Type of machinery Technical parameter	Place of installation	Quantity
1	Submersible well pump type Q = 50 m^3/h, H = 40m	Wells pumping station No. 1 and No. 2	02 sets
2	Vertical Centrifugal Pumps Q = 75 m^3/h, H = 25m	Pumping station level 2 (clean water)	03 sets
3	Inverter installs for 3 pumping station Q = 75 m^3/h, H = 25m	Pumping station level 2 (clean water)	01 system
4	Chlorine additional machine (Clorator) 0-2kg/h và ejector	Clo house	02 sets
5	Continued pressure pump Q = 2m^3/h, H = 40m	Clo house	02 sets
6	Clo vase type of 68 kg/vase	Clo house	04 vases
7	Scales type of 0 – 200 kg	Clo house	01 pcs
8	Generator and alarm of seep out Clo	Clo house	01 set
9	Gas mask	Clo house	01 pcs
10	Suction ventilator	Clo house	02 pcs
11	Generator 3 phase, 380V, 62 KVA, cabinet ATS and 500 liter of oil	House to put generator	01 set

12	Generator 3 phase 75 KVA, 15 (22)/0,4KV	Substation	01 set
13	Electromagnetic Watches D200	Technial pipeline behind pump 2	01 set
14	water supply clock for household D15	Distribution pipeline networks	800 sets

XIV. CAPITAL AND INVESTED CAPITAL

XIV.1. Invested capital:

XIV.1.1. Base of calculation for invested capital:

- Base on basic design of invested project of water supply for part of Hoa Tan ward, Chau Dien ward and Cau Ke town, Cau Ke rural district, Tra Vinh province.
- The unit price set for construction works of part construction, installation, survey, prepair are issued accompany with Decision No. 572; 573; 574; 575/SXD-GDXD dated on 12/11/2007 of Department of Construction of Tra Vinh province.
- Announcement of price No. 1 /LSXD-TC dated on 16/11/2012 of associated of Department of Construction – Finance of Tra Vinh province
- Price of equipment, machinery according to quotation of supplier specialized drainage
- Price of materials, pipeline accord ng to quotation of agencies specialized drainage
- Circular No. 04/2010/TT-BXD dated on 26.05.2010 of Ministry of Construction "Guiding formulation and management of costs of investment in work construction".
- Decision No. 957/BXD-VP dated on 29/09/2009 for disclosure of quota for cost quota of project management and cost of consultancy of investment and construction of buildings
- Decree No. 158/2003/ND-CP dated December 10, 2003 of the Government detailing the implementation of the Value Added Tax Law and the Law amending and supplementing a number of articles of the Value Added Tax Law.
- Circular No. 129/2008/TT-BTC of December 26, 2008, guiding the implementation of a number of articles of the Value-Added Tax Law and guiding the implementation of the Government's Decree No. 123/2008/ND-CP of December 8 2008, detailing and guiding the implementation of a number of articles of the Value-Added Tax Law
- Circular No. 109/2000/TT-BTC of November 13, 2000, guiding the regime on the collection, remittance and use of investment evaluation fees.
- Decree No. 85/2009/ND-CP of October 15, 2009, guiding the Bidding Law and the selection of construction contractors under the Construction Law

- Decision No.33/2004/QD-BTC of April 12, 2004, promulgating the construction and installation insurance rules and charge tables.
- Circular No.19/2011/TT-BTC of February 14, 2011, on defining on settlement of completed projects subject to state fund.

XIV.1.2. Estimated invested cost:

Unit:Million Dong

No.	Item and cost	Construction of pipeline	Construction of works	Installation of equipment	Total
1	**Cost of construction and equipment**				
1.1	2 wells of underground water 60m^3/h	-	2030	-	2.030
1.2	2 well pumping stations 50 m^3/h	400	400	420	1.220
1.3	Self-cleaning filter 100 m^3/h	300	250	3.000	3.550
1.4	Clean water tank 500 m^3	200	800	2.000	3.000
1.5	Clean water pumping station and house to put generator	670	620	1.180	2.470
1.6	Expand, upgrade Chlorine house	-	150	250	400
1.7	Improve items at water plant	-	300	-	300
1.8	Technical pipeline	200	-	325	525
1.9	Electrical supply system	-	1.800	85	1.885
1.10	Transmission and distribution pipeline network	4.730	-	-	4.730
1.11	Connect with meter and service pipe for 800	-	1.520	280	1.800

	households				
	Total	**6.509**	**7.870**	**7.540**	**21.910**
2.	**Managed project cost**	1.804%(Gxdtt+Gtbtt)			**360**
3	**Construction consultancy cost**				*1.250*
3.1	Cost of geologic – topographic survey				280
3.2	Cost of invested project planning.	0.467%(Gxdtt+Gtbtt)*1.1			115
3.3	Cost of design	[1.9%Gxdtt(NM)*1.55+ 1.9%*Gxdtt(ĐÓ)*1.3]*1.1			400
3.4	Verified cost of efficient and feasible project	0.07%(Gxdtt+Gtbtt)*1.1			10
3.5	Verified cost of constructed drawing design	0.152%(Gxdtt)*1.1			22
3.6	Verified cost of estimation, general estimation of works	0.147%(Gxdtt)*1.1			20
3.7	Cost of setup bidding document and evaluation of bidding document for construction	0.152%(Gxdtt)*1.1			40
3.8	Cost of setup bidding document and evaluation of bidding document for equipment	0.236%(Gtbtt)*1.1			20
3.9	Supervised cost of works construction	2.053%(Gxdtt)*1.1			290
3.10	Supervised cost of installation for equipment	0.643%(Gtbtt)*1.1			53
4	**Other costs**				**360**

4.1	Appraisal fee of invested project	0.017%(TMDT)	5
4.2	Appraisal fee of technical design	0.06%(Gxdtt)	10
4.3	Appraisal fee of general estimation	0.064%(Gxdtt)	10
4.4	Insurance of construction time	0.31%(Gxdtt)	42
4.5	Appraisal fee of bidding result	0.01%(Gxdtt)	4
4.6	Appraisal fee of approval of the settlement	0.017%(TMDT)*50%	34
4.7	Cost of audit	0.365%(TMDT)*	120
4.8	Cost of load testing, acceptance and handover ...	1%(Gxdtt)	135
5	**Standby cost**		**6.080**
5.1	Standby for arised quantity	10% (1+2+...4)	2.388
5.2	Standby for slippage	15 46% (1+2+...4)	3.692
	Total (1 +2....5)		**29.960**

** Notes:*

- Cost to buy self-cleaning filter and clean water tank which are availably manufactured and designed, they are not equipment so amortization is calculated as construction works and pipeline. Design cost does not include construction value.
- Construction cost of pipeline include all cost of personnel, construction machine, materials, pipeline, porters transporting... to construction value.
- Works construction cost include all cost of materials, personnel, construction machine... to construction value.
- Cost of equipment include procurement, taxes, porters transporting to warehouse of Unit of project Management
- The values are inclusive of VAT (Net worth).

XIV.2. Invested Capital:

- Total of invested capital: 29.960 million Dong

- Invested capital:

▪ Non refundable grant of Italian government is equivalent to 400,000 euros 10,700 million (the exchange rate on 18.12.2012) accounted for 35.7% of total capital investment.

▪ Capital grant aid of Italian Government is 400.000 EURO equivalent 10.700 million Dong (according to exchange rate dated 18/12/2012) accounted of 35,7% total of invested capital.

▪ Capital of Vietnam is 19.260 Million Dong, accounted of 64,3%.

- Non refundable grant of Italian government is only buy equipment and materials, includes:

▪ Machineries	2.540 Million Dong
▪ Sefl-cleaning filter	: 3.000 Million Dong
▪ Clean water tank	: 2.000 Million Dong
▪ Water supply pipeline	: 3.160 Million Dong
Total	**10.700** ***Million Dong***

XV. ECONOMIC FINANCIAL ANALYSIS

XV.1. Purpose

The purpose of economic financial analysis is determined production price and reasonable business cost of clean water, to ensure efficiency of invested capital and meet demands of using clean water to improve life quality and production development, simultaneous determined suitably economic financial criteria for feasibility of the project.

XV.2. Principle of calculation:

1. Determined the economic targets on the basis of adequate capital investment costs, production costs, operator and management of the entire water supply system.
2. Costs of production, operator, management and water price (manufacturing and trading) are calculated with annual slippage in price to suit with the situation of current price fluctuations of Vietnam and avoid risk for the project.
3. Investment construction project upgrade and expand water supply system for Cau Ke town with capacity of 2400 m^3/day on 2013.
4. Capital cost and managed operated cost are calculated based on:

- Circular No. 203/2009/TT-BTC dated October 20, 2009, of the Ministry of Finance guiding the regime of management, use and depreciation of fixed assets
- Inter-ministerial Circular by MoF-MoC-MARD (no. 95/2009/TTLT-BTC-BXD-BNN on 19/5/2009) guidance for the water tariff framework.
- According to circulars above, depreciation of fixed assets is calculated under principle:

▪ When construction investment capital is equity or budget, depreciation of fixed assets for construction works and pipeline in 25 years, for equipment in 8 years.

▪ When construction investment capital is a loan, depreciation of fixed assets is calculated under time to pay this loan and as required by each lender bank capital

XV.3. Determined economic – financial criteria and water price

XV.3.1. Capital cost:

- Capital cost is daily cost of depreciation of fixed assets, invested capital for project is non refundable grant and budget so cost of depreciation of fixed assets is calculated as budget. That means construction works and pipeline is depreciated in 25 years, equipment is depreciated in 8 years

No.	Type of capital	Value of depreciation of fixed assets		Depreciation of fixed assets	
		Pipeline construction works	Equipment	Pipeline construction works	Equipment
1	Capital grant	8.160	2.540	326,4	317,5
2	Equity	18330	930	733,2	116,5
	Total	**26.490**	**3.470**	**1.059,6**	**434,0**

XV.3.2. Cost of operation management

1. Cost of personnel

Cost of personnel includes salary, insurance of healthy, society, fixed cost... Expected on 2014, the average cost of directed personnel is 5 million Dong/person-month, of indirected staff is 6 million Dong/person-month

- Cost of directed personnel:
  - Quantity of directed personnel: For the plant < 10.000 m^3/day standard of directed worker is 0,0035 person/m^3/day. For the plant 2400 m^3/day, quantity of operating worker is 9 wokers
  - Annual cost of directed worker:

    9 x 5 x 12 = 540 million Dong/year
- Cost of indirected worker : 3 workers
  - Annual cost of indirected worker:

    3 x 6 x 12 = 216 million Dong/year

2. Power cost

- Standard of power cost for 1 m^3 clean water with underground water source about 0,5 KWh/m^3. Power price 1500 Dong/KWh
- Annual cost of power:

  0,5 x 2400 x 1500 x 365 = 657 million Dong/year

3. Cost of Chlorine for iron liquidation and chlorinator

Standard of chlorine for iron liquidation and chlorinator is 2mg/l. Unit of price is 45.000 Dong/kg.

- Annual cost of chlorine:

0,002 x 2400 x 45.000 x 365 = million Dong/year

4. Other costs

- General construction cost is calculated by 3% x total of turnover
- Managed cost is calculated by 3% x total of turnover

Note: The management and operation costs above are calculated at the time in 2014, then increased by 5% every year to match the actual inflation

XV.3.4. Planning of capital supply

The investment project will be implemented in 2013, including the approval of the project, drawing design, construction bidding and construction.

Expected the project duration in 18 months ie 1.5 years. From the first quarter of 2013 to the end quarter of 2014

Expectd the planning of capital supply as follows:

Year	Italian Capital	Vietnam Capital	Total
2013	10.700	10.000	20.700
2014 (6 months)	0	9.260	9.260
Total	**10.700**	**19.260**	**29.960**

XIV.3.5. Planning of project implemention, water supply and consumption

Planning of water production and consumption: Expecting the water supply project will be used from 3th quarter of 2014 (Last 6 months of 2014). Water production meets 70% capacity, water consumption meets 76% of water production, increasing 5% every year until 2020 meet 100% capacity as follows:

Year	% Capacity	Production	Consumption
2015	70	306.600 m^3/year	233.000 m^3/year
2015	75	657.000 m^3/year	499.000 m^3/year
2016	80	708.800 m^3/year	533.000 m^3/year
2017	85	744.600 m^3/year	566.000 m^3/year
2018	90	788.400 m^3/year	599.000 m^3/year
2019	95	832.200 m^3/year	632.000 m^3/year
2020	100	876.000 m^3/year	660.000 m^3/year

XV.5. Economic social criteria of the project

Economic social criteria are calculated at the table in appendix
Result as follows:

- Average production price 25 years: 6.178,91 Dong/m^3

- Trading price in 2014 and 2015: 6.000 Dong/m^3

Then, increasing 5% every year. As follows:

Average from 2015 to 2019: 6.630 Dong/m^3.

Average from 2020 to 2024: 8.480 Dong/m^3.

Average from 2025 to 2029: 10.830 Dong/m^3.

Average from 2030 to 2034: 13.820 Dong/m^3.

Average from 2035 to 2039: 17.640 Dong/m^3.

- Investment return rate IRR : 7,96%
- NPV : 56.447,50
- Payback time: 13 năm 9 tháng
- Benefit charge rate BCR : 2,66

The water price above is suitable with currently average water price of Tra Vinh water supply sewerage Company, LTD. With the average income of an average family of five people in the project area approximately 4 million / month in 2015, used each month approximately 15m3 will pay 90,000 Dong for clean water, accounted of 2.25% income. The water price is suitable with income.

XV.6. Efficiency of finance

According to financial criteria:

- Inner investment return rate IRR = 7,96% : profitable project
- Payback time: 13 years 9 months are less than time of depreciation of fixed assets under regulation of Department of Finance.
- Benefit charge rate: BCR = 2,66 : feasible project
- NPV = 56447 > 0 : feasible project

XVI. Efficiency of the project

XVI.1. Social efficiency

As analysed at item VI – necessity of investment. The construction for water supply a part of Hoa Tan ward, Chau Dien ward and Cau Ke town, Tra Vinh province are necessary to serve for people in this area, almost people here is poor, belong to remote area, the end area of the country, with extremely difficult life. The investment will solve for social efficiency as follows:

- People are used clean water, quality assurance, increase people's life quality, reduce difficulties, lack of people in remote areas, who have been bearing disadvantaged in life daily spiritual culture.
- Helping people improve their health, prevent disease caused by lack of clean water, reducing the amount of money for treatment, increased labor day and so help to the people's income increases raising the living people
- Helping people have condition to organize production and services, create jobs for workers, raise incomes, contributing to improving the living standards of every citizen in the society.
- Contributing to the general development of urban, more and more civilized and modern
- Expressing concern at all levels of leadership for people living in remote areas

XVI.2. Financial economic efficiency

- The social efficiency also greatly shows the economic efficiency for each person in this region and for the whole society. This effect can not be specific, exact cash, but it has great significance
- Financial economic efficiency in whole lifetime of the project calculated for 25 years as follows:
  - Every year submit for budget:
    + Through averaged value-added tax about 240 million Dong
    + Thuế thu nhập doanh nghiệp trung bình khoảng 680 million Dong
  - Annual average turnover about 7.080 million Dong
  - Annual average net profit about 1.920 million Dong
  - Annual average net income about 3.070 million Dong
  - Salary of labor (resolve employment) : average about 1.400 million Dong
  - Stimulus for other production through using materials, fuel serve for operating water supply system.

XVII. CONCLUSION AND RECOMMENDATION

XVII.1. Conclusion

- As analysed above, the water supply investment for part of Hoa Tan, Chau Dien ward and Cau Ke town, Cau Ke rural district, Tra Vinh province is extremely necessary. The project has fully analyzed, evaluated about the technic and economy. We found that selected options to invest construction has been made in project are feasible.
- Therefore, proposing competent authorities of the provinces to consider and approve for the investment project of water supply for part of Hoa Tan, Chau Dien ward and Cau Ke town with specific contents as follows:
  - Project: Water supply for a part of Hoa Tan ward, Chau Dien ward and Cau Ke town – Cau Ke district, Tra Vinh province, capacity 2.400 m3/day
  - Employer : Tra Vinh water supply sewerage Company, LTD.
  - Construction location: Cau Ke town, Cau Ke rural district, Tra Vinh province
  - Total investment: 29.960 million Dong
  - Capital:
- Non-refundable grant capital of the Italian Government is 400,000 Euro, equivalent of 10,700 million Dong (in according to exchange rate on 18th December 2012) accounted for 35.7% of total invested capital.
- Budget of Viet Nam is 19.260 million Dong, accounted for 64.3% of total invested capital.
- Planning to implement: from the first quarter 2013 to the end of 2th quarter 2014

XVII.2. Recommendation

To the project implementation is advantaged meets deadline, we recommend:

- Agencies in the province support capital, electricity to construct works.
- The relevant branches coordinated support to investors for the project implementation.
- There are specific regulations to protect water sources and sanitation.

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