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Developing a Provincial Master Plan for Water Supply and Sanitation Services in Quang Nam Province for Period up to year 2030

SUMMARY REPORT

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Map of Vietnam and Project Location

Contents

Executive Summary **5**
Chapter 1: Overview **10**
1.1 Quang Nam province at glance 10
1.2 Status of water supply and sanitation services 11
1.2.1 Water supply 11
1.2.2 Drainage 12
1.2.3 Wastewater management 12
1.3 Impacts of climate change 13
1.4 Existing WSS master plans and investment programs 15
Chapter 2: Key Provisions **15**
2.1 Planning concept 15
2.2 Water Supply 16
2.2.1 Water resources 16
2.2.2 Zoning of water supply services 16
2.2.3 Water demand 19
2.2.4 Treatment technologies 19
2.2.5 Configuration of water supply systems 20
2.3 Storm water drainage 20
2.4 Wastewater management 21
2.4.1 Zoning and wastewater generation 21
2.4.2 Wastewater collection and treatment 21
2.4.3 Sludge collection and treatment 23
Chapter 3. Institutional arrangements **23**
3.1 Sector management 23
3.2 Service delivery 24
Chapter 4. Strategic environmental assessment **26**
4.1 Impact assessment 26
4.2 Mitigation measures 28
Chapter 5. Financing and Cost Benefit Analysis **29**
5.1 Investment cost 29
5.2 Financing models 29
5.3 Cost benefit analysis 29
Chapter 6. Prioritized investment plan **31**
6.1 Water Supply 31

6.2 Drainage and wastewater management.....31
Chapter 7. Recommendations and policy advice..... 33
Annex 1: Existing water treatment plants.....34
Annex 2: Main contents of the approved master plans for water supply.....35
Annex 3: Proposed water treatment plants in approved master plans for water supply.37
Annex 4: Proposed wastewater treatment plants in the approved master plans.....40
Annex 5: Ongoing investment programs.....43
Annex 6: Water sources and water balance.....45
Annex 7: Projected water demand.....47
Annex 8: [Proposed?] Centralized water treatment plants.....48
Annex 9: Main distribution network in Zones I and Zone II.....51
Annex 10: Main distribution networks in Zone III.....52
Annex 11: Drainage Directions.....53
Annex 12: Proposed land elevation for cities/towns.....54
Annex 13: Domestic wastewater generation forecast.....57
Annex 14: Industrial wastewater generation forecast.....59
Annex 15: Agricultural wastewater generation.....60
Annex 16: Proposed wastewater treatment plants.....61
Annex 17: Sludge generation from wastewater.....63
Annex 18: Landfills designated for sludge treatment.....64
Annex 19: Investment costs for water supply.....65
Annex 20: Investment costs for drainage and wastewater management.....67
Annex 21: Costs of technical assistance and capacity building.....69

List of acronyms

DOC	Department of Construction, Vietnam
DPC	District People's Committee
DS	Drainage and Sanitation
FS	Feasibility Study
IZ	Industrial Zone
MARD	Ministry of Agriculture and Rural Development, Vietnam
MOC	Ministry of Construction, Vietnam
MOF	Ministry of Finance, Vietnam
MOLISA	Ministry of Labor, Invalids and Social Affairs
MPI	Ministry of Planning and Investments, Vietnam
NCERWASS	National Center of Environment, Rural Water Supply and Sanitation
O&M	Operation and maintenance
ODA	Official Development Aid
PCERWASS	Provincial Center of Environment, Rural Water Supply and Sanitation
PMU	Project Management Unit
PPC	Provincial People's Committee
TA	Technical Assistance
TPC	Town People's Committee
URENCO	Urban Environment Company
VDB	Vietnam Development Bank
VND	Vietnam Dong
VWSSA	Vietnam Water Supply and Sewerage Association
WS	Water Supply
WSDC	Water Supply and Drainage Joint Stock Company
WSP	Water and Sanitation Program
WSS	Water Supply and Sanitation
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

Executive Summary

Overview

The Provincial Master Plan for Water Supply and Sanitation in Quang Nam Province for the period up to year 2030 (the Quang Nam WSS Master Plan) was developed in response to a request from Quang Nam Provincial Peoples Committee (Quang Nam PPC) and the Ministry of Construction (MOC). Its formulation was conceived as a pilot for implementation of the new Construction Law (Law No. 50/2014/QH13 approved by National Assembly in 2014 and effective from January 1, 2015.

The Plan is a supplement to the Quang Nam Provincial Construction Master Plan for the period 2020-2030 approved by Quang Nam PPC in 2014.

The objectives of the Plan are twofold:

To *improve the effectiveness and sustainability of water supply and sanitation investments in Quang Nam province*

To *gain experience that could be replicated in other provinces of Vietnam through guidance developed by MOC as requested by the new Construction Law.* Both Quang Nam PPC and MOC have expressed their strong commitment to this new type of master plan.

Scope of the Master Plan

The Plan covers all urban, sub-urban and rural residential areas of the province plus industrial zones. Its development was based on a new concept of planning, including the integration of water resources management; not being constrained by administrative boundaries and urban/rural distinctions; sound institutional and financial arrangements for effective and sustainable service delivery; and realistic action planning for the implementation of a long term master plan.

Approach and Methodology

A study for development of the Master Plan was undertaken from April 2015-March 2016 and involved extensive consultation with stakeholders at provincial and central levels. Collection, review of the existing documents/ information and a small household survey were conducted in the first stage of the study during April-May 2015. A workshop for consultation with provincial related departments and localities on the existing status of WSS services of the province was held in early June 2015. Based on the confirmed existing status, different technical alternatives for further detailed study were developed and then presented on a consultative workshop with presence of representatives of provincial departments and MOC in late of July 2015. The most feasible alternatives that incorporated comments from the consultative workshop were presented in the Planning Tasks which was submitted to Quang Nam PPC for formal review and approval. The Planning Tasks have been approved by Quang Nam PPC by it decision Number 97/QD-UBND dated January 12, 2016 and formed a legal basis for further review and approval of the Master Plan. In compliance with the approved Planning Task, the Master Plan was developed and its draft was presented on another consultative workshop with central ministries, provincial departments and localities in late February. The full set of final draft Master Plan that includes full report, summary report, drawings, strategic

environmental assessment, and a draft regulation on implementation of the Master Plan were submitted to Quang Nam PPC for its formal review and approval in late March 2016.

Existing water supply and sanitation services

Quang Nam has relatively high rates of access to water, with 55% of the urban population having access to clean piped water and 93% of the rural population having access to hygienic non-piped water. Service levels are, however, low; many urban households have an intermittent supply and many rural households experience seasonal shortages.

Urban water supply is provided by Quang Nam Water Supply and Drainage Company (WSDC) which manages 84% of production capacity with services areas in main cities and towns, and Quang Nam URENCO, which manages 16% with services areas in few small district towns. Water supply in industrial and economic zones is provided by the infrastructure developers while in rural areas it is mostly developed by Quang Nam PCERWASS then operated by local communities. In the past years, hundreds of small water supply schemes in rural areas were invested from the National Target Program for Rural Environment, Water Supply and Sanitation (NTP), but many of them have stopped operation due to incomplete investment and improper operation and maintenance. In the same time, the urban water supply systems could not expand service to unserved rural areas though there was a surplus in their capacity due to urban/rural classification. In urban areas, while the Quang Nam WSDC was benefited by providing service in relatively better of areas of major cities and towns, the Quang Nam URENCO was struggling with providing service in poor small towns and thus could not improve the service quality and coverage. There was also notable weakness in ensuring quality of the clean water and level of the service due to limited financial and technical resources of Quang Nam URENCO and communities.

Urban drainage networks are under-developed and poorly designed and maintained, leading to frequent floods during the rainy season. While management of the drainage systems in Tam Ky and Hoi An is assigned to the URENCOs, there is no arrangement for maintaining drains in other towns. These constraints plus the impact of climate changes mean that flooding in towns and cities is likely to become worse.

Wastewater management is also inadequate. Construction of the first wastewater treatment plants in Tam Ky and Hoi An cities began only recently. Currently, only the core city areas have sewerage and this consists of combined systems that carry both stormwater and wastewater. Most wastewater is discharged to receiving water bodies untreated. Institutional responsibility for the maintenance of sewers is poorly defined.

Impacts of climate change

A MONRE study in 2011 forecast a rise of sea level by 13cm, a rise of average annual temperature by 0.64 - 0.83^{o}C and a rise rainfall by 1.4% by year 2030. Changes in rainfall pattern may exacerbate flooding problems in the rainy season, droughts in the dry season and saline intrusion into river systems.

Components of the Master Plan

The planning horizon is up to 2030, i.e. 15 years, in accordance with existing policy and regulatory provisions.

Water balance calculations for the Vu Gia – Thu Bon river system and water reservoirs indicate that by year 2030, there would be deficits in water resources in amount of about 305 million cubic meter a year to cover both agricultural irrigation and water supply service. Thus appropriate planning of water use and protecting the water resources became essential. In addition, for water supply, there were also challenges in ensuring water quality and providing an adequate level of service.

Water supply service zoning. Instead of dividing the water supply services on the basis of urban/rural classifications or the economic development orientation only in the current master plans, it is proposed to re-organize service provision on the basis of four zones which take into account available water resources. *Zone 1* includes Hoi An city, Dien Ban and Dai Loc districts located next to Da Nang city, which are characterized by tourism and urban development. *Zone 2* includes Duy Xuyen, Que Son and Thang Binh district and is mostly rural and agricultural. *Zone 3* includes Tam Ky city, Nui Thanh and Phu Ninh districts and is commercial and industrial in character. *Zone 4* includes nine mountainous districts where the main economic activities are forestry and agriculture.

There is limited ground water in Quang Nam but surface water is abundant. The main source for Zone 1 will be Vu Gia River and its tributaries while for Zone 2 it will be the Thu Bon River. For Zone 3, the main source will be Phu Ninh reservoir and Zone 4 will rely on small rivers and streams.

Technical options. In Zones 1-3, the water treatment plants will be developed taking in account sustainability of water sources and economic scale. Starting from year 2020, the current small scale water treatment plants serving isolated small areas will be gradually converting to booster pumping stations and the large water treatment plants with adequate water sources will be expanded to become main sources of supplying treated water. The transmission and distribution network, which will serve both urban and rural populations, will be developed in three phases. In the first phase up to year 2020, the network will be solely associated with the designated water treatment plant with focusing on increase of coverage. In the second phase during year 2020-2025, the network will be extended to connect water treatment plants in each zone to form multi source water supply system to improve security of the service. In the third phase after year 2025, the networks of different zones will eventually be connected to form a single network which will allow further improving security of the service and more optimizing operation of the system. Isolated and mountainous rural residential areas will, as now, be served by small schemes, most of them with no treatment plant and distribution network (decentralized supply).

Storm water drainage. Development of the drainage network will be based on an integrated urban drainage concept. This involves intercepting extreme storm water using retention lakes or reservoirs and forests; land reclamation; construction of drains to divert water to rivers and the sea; and non-construction measures such as developing flood early warning systems, increasing water absorbing capacity of soil and ground greening for reducing runoff. Since the receiving bodies for storm water are rivers of the Vu Gia – Thu Bon river system, which is also the main water supply source, the discharge of storm water must be strictly controlled. It will therefore be important gradually to switch from combined to separate storm water and sewerage systems.

Wastewater management. Wastewater generated in industrial zones will be collected and treated by the site developers. For domestic wastewater management, the same zoning system will be used as for water supply. Wastewater management involves the collection, treatment discharge of wastewater plus the removal and treatment of sludge from septic tanks.

For treatment, a combination of centralized and decentralized treatment facilities is proposed for larger and smaller urban centres respectively. Septic tank sludge will be managed either by collection and safe disposal at solid waste dumping sites or treatment at centralized wastewater treatment plants.

Institutional arrangements

Quang Nam PPC currently has overall responsibility both for the delivery of water supply and sanitation services and for regulation. In addition to the PPC-owned utilities, there are also some private service providers which deliver water supply service in industrial and rural areas. In the Master Plan, it is suggested that the PPC should step back from service provision and focus more on its regulatory role. The PPC is also advised to strengthen it regulatory function by issuing some decisions and regulations to assign the service areas to different service providers, to manage use and protection of water resources, to regulate regional and interregional WSS services, to impose wastewater tariff and to improve accountabilities of service providers by entering service agreement with them. The capacity of provincial departments supporting PPC should also need to be strengthened though technical assistances for effective coordination in implementation of the Master Plan, monitoring the compliance of service quality, accountability of service providers.

In addition, the existing utilities should be reformed to support an increase in service coverage and quality. Since Quang Nam Water Supply and Drainage Joint Stock Company (WSDC) is already delivering the services in major urban areas, it is sensible to assign the responsibility of delivering all networked water supply services, and for wastewater management, to this utility. Private sector participation should be encouraged for the delivery of water supply services in isolated areas such as industrial zones; the production of treated water; and wastewater treatment.

Drainage systems should, as now, be managed by local URENCOs.

To ensure that public and private service providers perform to a satisfactory standard, they should be subject to formal service contracts with the PPC.

Financing investments and service delivery

The total finance required for the period 2016 to 2030 is estimated at VND 13,366 billion (US$ 607 million) based on 2015 prices, of which VND 9,533 billion (US$ 433 million) is for water supply, VND 3,755 billion (US$ 171 million) for drainage and wastewater and VND 78 billion (US$ 3 million) for technical assistance and capacity building. The required finance could come from ODA; the state budget including transfers from central government; provincial infrastructure bonds or loans; and private sector investment. Experience shows that public finance could only cover at most 20% of the required funding, hence private sector particpation may be the only way forward. For mobilizing private finance, the province should develop a clear and attractive mechanism and regulations that could bring private sector to income generating services such as water supply and wastewater collection and treatment. To

ensure service sustainability, the province should also adopt a roadmap for tariff increases which will enable recovery not only of operation and maintenance costs osts but also investment costs. Any subsidy that will need to be provided to assist the poor in accessing the services should be explicitly stated in the tariff structure.

A cost benenit analysis was conducted to assess the economic impacts of the investments proposed in the Master Plan. Potential economic benefits included reduction of losses that relates to floods, unadequate water supply and poor wastewater services and income increase of the province's state budget due to development of trade, industry and tourism. The calculation showed that Economic Internal Rate of Return (EIRR) would be 15.50% for period of 2016-2020, 14.97% for period of 2020-2025 and 14.54% for period of 2025-2030; the benefit/cost ratio would be 1.59, 1.52 and 1.47 for the same periods respectivelly.

Replicability and policy advice

The planning process identified a strong case for amending the existing Decrees on Production and Supply Water in Urban and Industrial Areas; Management of Drainage Service in Urban and Industrial Areas; and Implementation of Law of Planning so as to avoid the adoption of separate water supply and drainage plans. MOC should also issue a circular guiding the provinces in developing a comprehensive provincial water supply and sanitation master plan covering water supply and sanitation in both urban and rural areas.

Chapter 1: Overview

1.1 Quang Nam province at glance

Quang Nam province is located on the central coast of Vietnam. It has two cities: Tam Ky and Hoi An and 16 rural districts, with a total urban population of around 280,000 (2013). It is bordered by Da Nang city to the north, Quang Ngai province to the south and Kon Tum province to the west.

The population of the province is 1.435 million, of which 22% was classified as poor in 2013, based on government criteria. It is one of a number of provinces that require annual budget support from central government; this amounted to about 30% of total provincial expenditure in 2014. In the last few years there has been some progress in in socio-economic development with rapid urbanization in the northern part (Dien Nam – Dien Ngoc urban area) and industrialization in the south (Chu Lai economic zone). It is expected that by 2017 the province will balance its revenue and expenditure and may contribute to the central government budget from 2018.

The province has very diverse terrain with high mountains in the west and low-lying coastal plains in the east, while it is hilly in the middle. The Vu Gia-Thu Bon River system, the biggest in the central region, covers almost all of the province as well as Da Nang city and part of Kon Tum province.

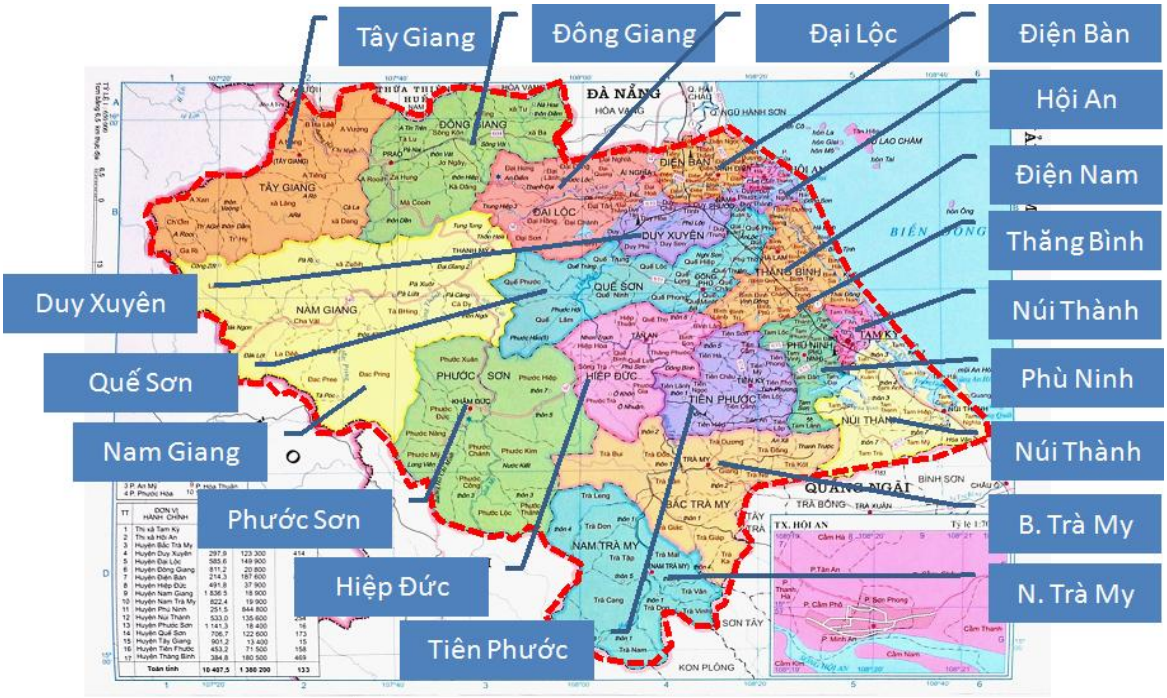


Figure 1.1. Map of Quang Nam province and its administrative subsidiaries

Quang Nam is in the tropical region where the climates of the north and south overlap, and experiences two discrete seasons: rainy from August to December and dry from January to July. Rainfall is highest from October to December, ranging from 356 to 1,075 mm. The lowest rainfall is in February, when it ranges from 0 to 5.2mm.

1.2 Status of water supply and sanitation services

1.2.1 Water supply

Water supply services are organized into three components: urban, rural and industrial/economic zones. Urban water supply is mostly piped with house connections while rural services are mostly small non-piped schemes provided via commune administrations. Water for industrial and economic zones is provided as part of general infrastructure development. The Vu Gia – Thu Bon river system is the main water supply source, and ground water supplies are limited. In recent years, however, with increasing development of hydropower plants upstream, river flow has reduced and the water level has gone down, which may in time affect drinking water supply. Another source for water supply is reservoirs that were originally built for irrigation purposes.

Institutionally, urban water supply is provided by two utilities: Quang Nam Water Supply and Drainage Joint Stock Company (Quang Nam WSDC), which operates nine systems in major cities and towns, and Quang Nam Urban Environment Joint Stock Company (Quang Nam URENCO), which has six in small towns. Rural water supply investments are mostly made under National Target Program for Rural Environment, Water Supply and Sanitation (NTP) implemented by Quang Nam PCERWASS; the schemes are then operated by local communities. Since Quang Nam WSDC is assigned for service provision in large cities and towns, where the consumption is relatively high and there is a large number of commercial customers, it can easily applies progressing block tariff system to generate profits from the service. However, it is not the case with URENCO as it provides service in small towns with low consumption and almost poor domestic customers. Currently URENCO cannot make any profit from providing the service and so it cannot expand the coverage nor increase quality of the service. The similar situation is happening with rural water supply schemes where the local communities cannot properly maintain the service due to their inadequate capacity both technically and financially. Many rural water supply schemes stope operation shortly after construction. In the last few years, Quang Nam PPC already asked Quang Nam WSDC to take over operation of some rural water supply schemes.

Operational water treatment plants in the province are listed in Annex 1; their locations are presented in Figure 1.2 below

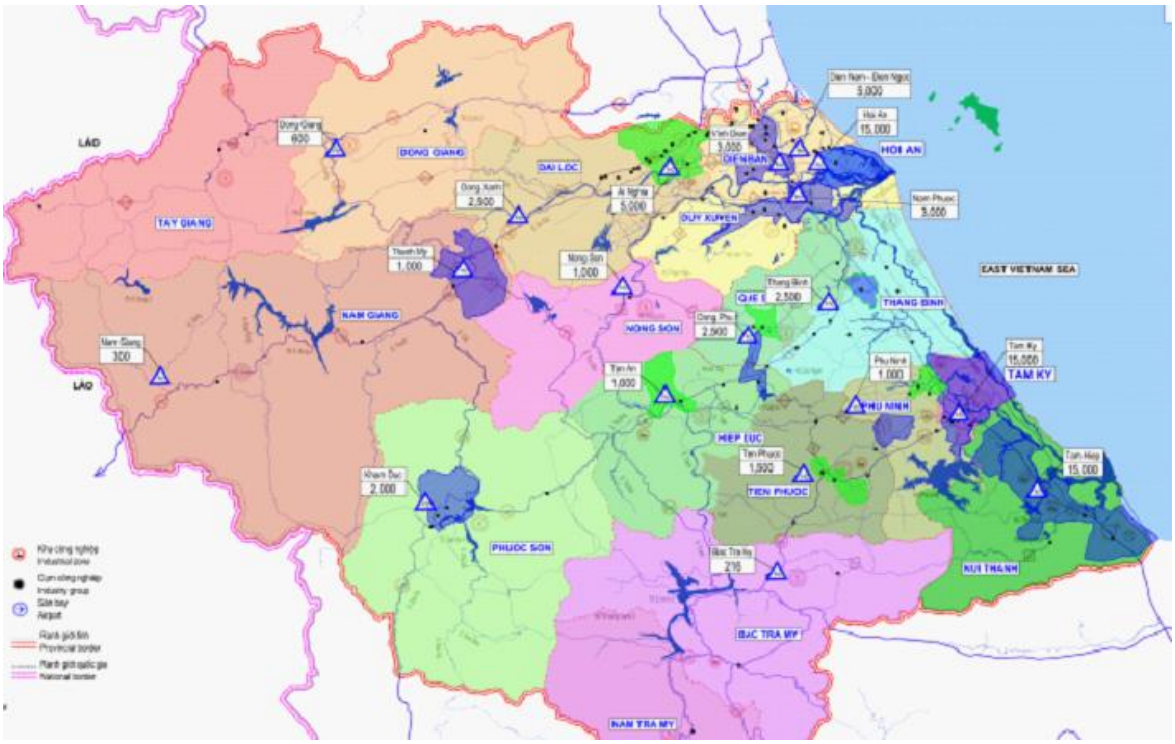


Figure 1.2: Location of existing water treatment plants

1.2.2 Drainage

Urban drainage systems are under-developed, and low drainage combined with heavy seasonal rains cause periodic flooding. Flood damage accounted for 18-20% of the provincial GDP in 2008 (DPI). While drainage systems are mostly associated with the urban road network, they are normally managed by the respective city/town URENCO in cities and large towns. URENCOs are insufficiently resourced both institutionally and financially, and this contributes to poor maintenance of the infrastructure. In small towns, if there is any drainage, it is under maintenance from town's PCs. Each town's PC has a department similarly with URENCO, but in smaller size, that is responsible for different urban infrastructure within the town. Due to limitation of human resources, technical and financial capacity, maintenance of drainage system in these small towns are normally neglected. In rural areas, formal drainages do not exist, thus there is no formal institutional arrangement for service.

1.2.3 Wastewater management

While the wastewater generated in industrial and economic zones is normally collected and treated by the site developers, for other urban areas the provincial government has only recently made investments in wastewater management, including the construction of wastewater treatment plants serving Tam Ky and Hoi An. The Tam Ky wastewater treatment plant (WWTP) has a design capacity of 8,000m^3/day and is expected to be operational by the end of 2016, when it will serve roughly 60% of the city population. The Hoi An WWTP has a design capacity of 6,750m^3/day and will be in operation in 2017, serving about 50% of the city population. Drainage networks in these cities have had combined sewerage overflow (CSO) chambers and interceptors added at the point of discharging stormwater to the environment, to divert wastewater to the treatment plants.

The combined stormwater and wastewater systems used in these cities can give rise to bad odor and on occasion wastewater overflows into the streets. A further concern is that, because nearly all residential properties have septic tanks (or something similar), the bulk of the solids generated remain at household level and need to be removed periodically – yet no public de-sludging service is available and unofficial services are unregulated. The presence of septic tanks also means that, unless households make new direct connections from toilets to sewers, any new WWTPs will be under-utilized and unable to operate efficiently because the wastewater reaching them is very dilute.

Institutional arrangements for wastewater management are fragmented and not fully effective. In particular, while Quang Nam URENCO is responsible for management of the drainage network in Tam Ky city, this includes WWTP; in Hoi An city the Quang Nam WSDC is only responsible for WWTP and Hoi An URENCO remains be responsible for the drainage network. Separating utilities responsible for WWTPs from utilities responsible for the networks creates poor coordination in delivering the service and discourages increasing house connections to the sewers. There is no formal setup for fecal sludge management in the province, though some private vendors are providing desludging service to households based on request. The province has no information about these private vendors and thus there is no control on the service provided.

1.3 Impacts of climate change

Being located in the coastal area of central Vietnam, Quang Nam is particularly vulnerable to the effects of climate change. A study by MONRE forecast an increase in average annual temperature of 0.64 - 0.83^{o}C from 2010 to 2030. Annual rainfall would also increase by 1.4% over the same period and the sea level would rise by 13cm. These impacts could change water use patterns and hydrological conditions and increase the frequency and magnitude of floods and salinity intrusion; see Figures 1.3 and 1.4 below. It would expect that more severe floods might occur in Hoi An and Tam Ky cities, Dien Ban, Dai Loc and Nui Thanh districts. It would be also more salinity intrusion occurred at downstream of Vu Gia - Thu Bon Rivers which will affect the water sources for water supply systems in Dien Ban, Dai Loc, Hoi An, Dien Nam and Thang Binh districts.

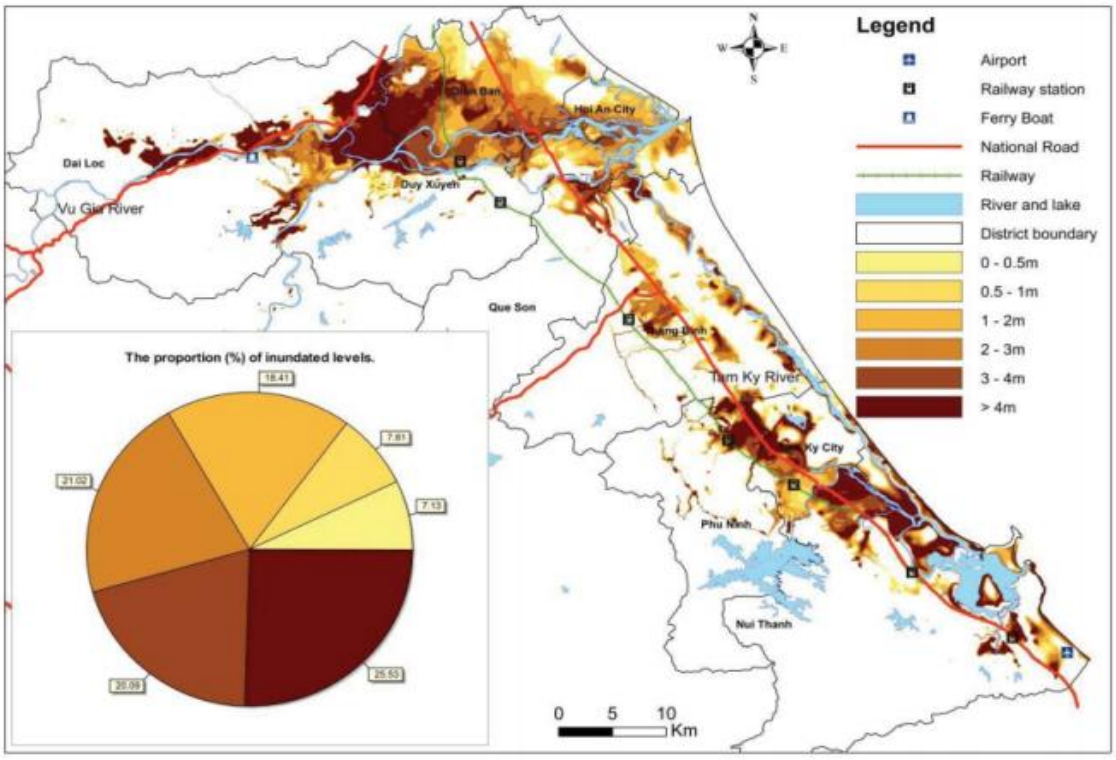


Figure 1.3: Projected floods in Quang Nam by 2030 (source: Vu Ngoc Chau – 2014)

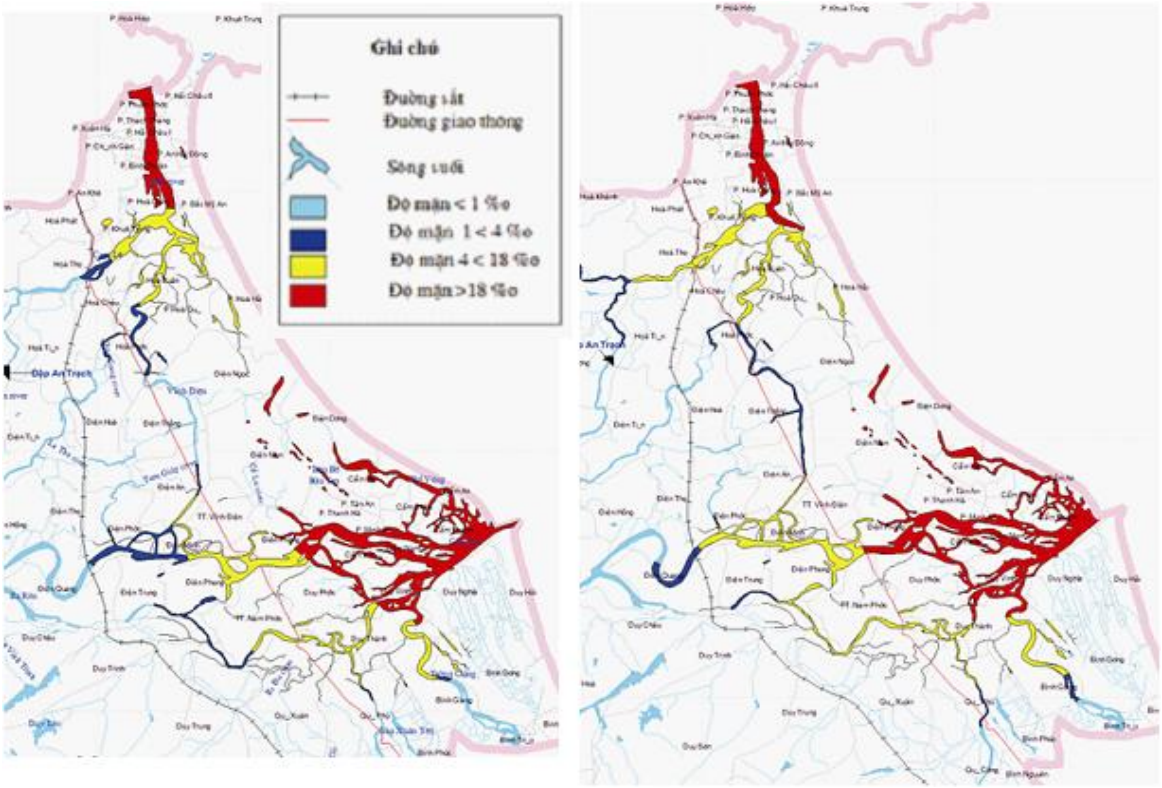


Figure 1.4: Saline intrusion in Vu Gia – Thu Bon river system in 2010 and projected by 2030 (source: Dang Tu Trung -2015)

1.4 Existing WSS master plans and investment programs

In recent years, Quang Nam provincial government has come to recognize the importance of long term planning for the development of water supply and sanitation services and the PPC has approved several master plans including the following:

1. Provincial Construction Master Plan for the period up to year 2030
2. Construction Master Plan for Eastern Region for the period up to year 2020
3. Construction Master Plan for Western Region for the period up to year 2020
4. Master Plan for Urban Water Supply for the period up to year 2020
5. Master Plan for Rural Water Supply for the period up to year 2020.

These plans, at one side can only provide guidance to service development for relatively short period which is not in compliance with the long term orientation of province's development, and at another side only provide direction on technical issues and crucially do not deal with the institutional, financial and operational aspects of service provision. The main water and sanitation-related content of the plans is summarized in Annexes 2-4.

The province is now implementing several investment programs under these plans; see Annex 5.

Chapter 2: Key Provisions

2.1 Planning concept

The planning tasks that formulates the planning objectives, scopes, approach and methodology were approved by Quang Nam PPC by its decision No. 97/QD-UBND dated January 12, 2016 and included the following components:

Objectives

1. To improve the effectiveness and sustainability of WSS investments in Quang Nam province.

2. To gain experience that could be applied in other provinces via guidance developed by MOC as requested by the new Construction Law.

Scope

Water supply, drainage and wastewater management for the entire province including urban and rural areas plus industrial and economic zones.

Planning horizon

2016 to 2030

Approach

This plan is consistent with the Socio-economic Development Master Plan and Provincial Construction Master Plan. It will encourage and enable sustainable service provision taking into account the impacts of climate change, based on the effective use of water resources and efficient investments across urban and rural areas and administrative boundaries.

The plan will also provide direction and guidance for strengthening institutional and financial arrangements for investment and service delivery.

A number of master plans have already been adopted for the period up to 2020, thus for the period up to year 2020 the new master plan will simply resolve inconsistencies in them without making any major changes. It will instead focus on the development of services for the period beyond 2020 and up to 2030.

Methodology for development of the Master Plan

A study for development of the Master Plan took was undertaken from April 2015-March 2016. It involved a review of documentation; supplementary technical and socio-economic surveys during April – June 2015; extensive consultation with stakeholders at provincial and central levels; and the generation of options during July – December 2015. A formal consultative workshop on the draft of the Master Plan was held in late February 2016 with representatives from cities/ districts, provincial departments /agencies and ministries. Comments received from the workshop were incorporated in the final draft of the Master Plan. The developing of this Master Plan is characterized as a participatory process where different views and opinions of different stakeholders from central, provincial and district levels were collected, reviewed and reflected. In addition, technical options were considered and evaluated not only from technical perspectives, but they were also examined from institutional and financial perspectives to ensure the selected would be the most optimized and feasible.

While this Master Plan was a pilot of a new concept of planning for which there was no existing regulation and guidance from the central ministries, the proposed innovations were introduced at a level and in a form that would not cause serious concerns of province in compliance with the existing regulation and guidance during its review and approval. However, lessons learnt from this pilot will need to be taken and furtherly reviewed by MOC in revising existing or developing of new regulation and guidance on WSS master planning.

2.2 Water Supply

2.2.1 Water resources

Water balance calculations (see Annex 6) indicate that by 2030, the agricultural demand for water would be some 756,093 million cubic meters per year (99.97% of total demand) while the industrial and domestic demand would be roughly 221 million cubic meter per year (just 0.03% of the total). This would result in a supply deficit in the region of 305 million cubic meter, and shortages would be most acute from April to July (the dry season). Proposed remedial measures include ensuring the proper functioning of upstream hydropower plants in compliance with the approved river operational procedures that maintains the required minimum flows; reducing irrigation consumption, for example through changes in agricultural practices; and reducing industrial and domestic consumption. When shortages occur, priority should be given to domestic water supply.

2.2.2 Zoning of water supply services

The Urban Water Supply Master Plan for the period up to year 2020 established three water supply zones: southern (zone 1), central (zone 2) and the remainder (zone 3). The Provincial Construction Master Plan for the period up to 2030 also established three zones but on a

different basis: the northern corridor, central corridor and southern corridor. While the Urban Water Supply Master Plan focused on providing services within administrative boundaries of urban setups (cities, towns and small towns) without looking in to availability of water resources or economy of scales that leaded to scattering the investments, the Provincial Construction Master Plan just focused on dividing the service to the nearby river as assigned water sources without taking in account the differences in socio-economic development as well as topographical conditions, especial ally for the southern corridor, for western part of its there no water source at all. So these zonings were defined primarily on the basis of projected socio-economic status rather than availability of water resources and efficiency of water supply systems. The inconsistency in zoning the service led to a multiplicity of orientations and guidance being issued for service development in some locations while others were totally neglected. The tendency of using nearest water sources for water supply without taking in account their stability and sustainability led to situation in which several water supply systems were not functional as designed due to lacks of water sources.

Taking in account all the related factors including geological and hydrological conditions, plus orientations for development presented in urban and socio-economic development master plans, it is now proposed that provincial water supply services be divided into four zones: three along the eastern coast and one for the western mountainous part of the province. The proposed zoning could be at one side adequately responding to the planned socio-economic development and urbanization, and at other side ensuring appropriateness of using water resources. This proposed zoning the service appears most appropriate – at least for the time of this Master Plan in effect. i.e. until year 2030 and it might need to be revisited for next circle of master planning. The proposed zones would be:

Zone 1 (northern) covering Hoi An city, Dien Ban and Dai Loc districts where tourism and urban development are planned. The proposed water sources are middle sections of Vu Gia river.

Zone 2 (central) covering Duy Xuyen, Que Son and Thang Binh districts where land is reserved for urban development. The proposed water sources are middle section of Thu Bon River.

Zone 3 (southern) covering Tam Ky city, Nui Thanh and Phu Ninh districts where industrial development is planned. The proposed water sources are Phu Ninh reservoir.

Zone 4 covering all remaining districts including North Tra My, Tien Phuoc, South Tra My, Phuoc Son, Hiep Duc, Nong Son, Nam Giang, Dong Giang and Tay Giang districts. These locations are reserved for agriculture and forestry. The proposed water sources are upstream of Vu Gia and Thu Bon rivers and their tributaries.

A comparison of existing and proposed zoning systems is presented in figure 2.1

Urban Water Supply Master Plan	*Provincial Construction Master Plan*	*Proposed in this Master Plan*

Figure 2.1: Water supply zoning under different master plans

The proposed zoning of the service can – at one side – focus on availability of the water resources with river basin perspective, and – at another side – accommodate the different patterns of socio-economic development in different regions of the province without rigid separation urban/ rural setups.

2.2.3 Water demand

Based on government norms, it is projected that consumption of domestic water by 2030 will range from 60 liter/capita/day in rural areas to 120 liter/capita/day for the cities of Tam Ky and Hoi An. However, taking into consideration the availability of alternative water sources in rural areas and reduced urban consumption resulting from water scarcity, plans should assume that consumption is 10 liter/capita/day lower for urban users and 20 liter/capita/day lower for rural users.

While the total provincial population is not expected to grow very much in the next ten to fifteen years, rapid urbanization and industrialization will shift the balance between urban and rural residents dramatically. Currently some 24% of the 1.435 million population is urban, but this is set to reach 45% by 2013 and 57% by 2030.

Industrial demand for water supply is estimated to be roughly 30m3/day per hectare.

In addition to the above, the calculation of water demand takes in account losses and rush hour coefficients based on design standards.

Taking all of these factors into account, Annex 7 sets out the projected water demand over the period up to 2030. From this calculation, the water demand appeared to be dramatically increased during the period 2016-2020 as results from increase of service coverage as well as rapid urbanization and industrialization in the province. Increase in domestic water demand is to cover the remained 30% of current urban population and about a half of million currently rural population, but will be urban population by year 2030, that doesn't have access to piped water supply service.

2.2.4 Treatment technologies

Surface water taken directly from Vu Gia – Thu Bon river system typically has high turbidity during the rainy season and is subject to fecal contamination, hence standard treatment technology based on pre-sedimentation, sedimentation, filtration and disinfection appears appropriate. Surface water taken from reservoirs has lower turbidity, hence pre-sedimentation may not be necessary. Proposed treatment technologies are summarized in Figures 2.2 and 2.3.

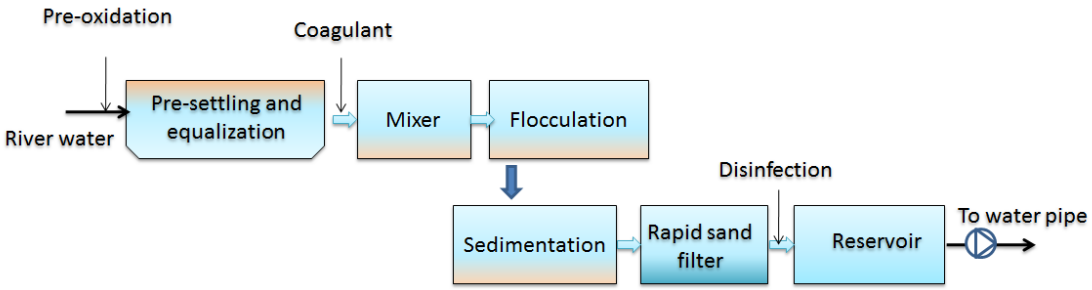


Figure 2.2: treatment technology for surface water from rivers

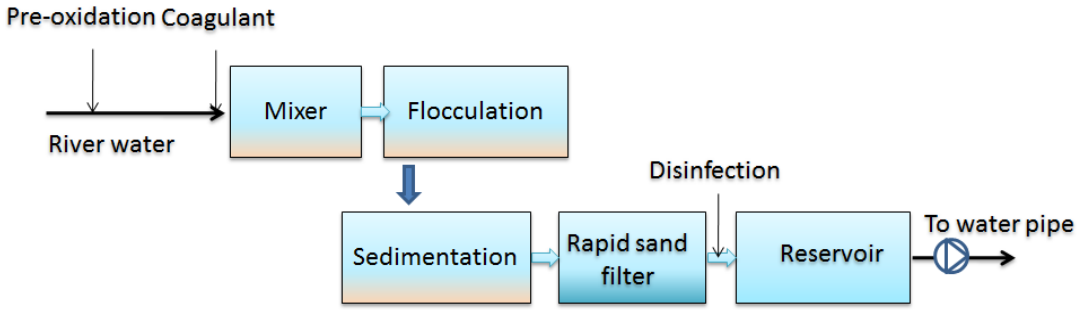


Figure 2.3: Treatment technology for surface water from reservoirs

2.2.5 Configuration of water supply systems

For the period up to 2020, the priority will be to improve service provision in underserved urban areas through a combination of new investments and the augmentation of existing schemes. In this period, the independent water supply systems that includes treatment plants and their associated network will serve independent service areas designated to each system, but without distinct separation between urban and rural areas. The water supply for industrial zones will remain independent from domestic supply and a majority of rural population will still use decentralized water supply service, meaning non-piped water supply.

From 2020 to 2025, however, distribution networks will be extended beyond their assigned service areas and interconnected with others. The small scale water treatment plants in each zone will be gradually operation at reduced capacity and the larger water treatment plants will step in as major water sources of the service. Using of more than one water treatment plant in a water supply system in large scale will increase the reliability and quality of the service as well as efficiency of operation. In rural areas, using of decentralized water supply service will be gradually reduced with more peoples using piped water supply service.

From 2025 to 2030, the distribution network will be expanded over the assigned zone and interconnected with the network in other zones. There will be only large water treatment plants with sustainable and reliable water sources remaining operational while small scale water treatment plants will be phased out and used as booster pumping stations. Using of the network with multiple water treatment plants of large scale will improve the level of the service, efficiency of operation at economic scale.

Proposed treatment plants and distribution networks for each period are presented in Annexes 8, 9 and 10.

2.3 Storm water drainage

For the western mountainous and hilly parts of the province, it appears that natural drainage in combination with roadside stormwater will be adequate for the planning horizon. The investment priority will be to improve drainage in low-lying coastal areas prone to flooding.

The coastal part of the province comprises four drainage basins: Dien Ban, Hoi An, Tam Ky and Nui Thanh-Chu Lai. The main drainage axes for Dien Ban and Hoi An are Vu Gia – Thu Bon rivers while for Tam Ky and Nui Thanh-Chu Lai they are the Truong Giang-Tam Ky-Ban Thach rivers. Proposed measures include protection low-lying land via partial land reclamation and construction of dykes; rehabilitation and expansion of existing drainage networks; increasing

retention capacity within cities and towns via the construction of retention lakes and ponds; and improved operation of upstream reservoirs so as to reduce river water during heavy storms. In addition, a flood early warning system should be introduced

The main drainage directions are presented in Annex 11. Proposed land elevations for urban flood protection are listed in Annex 12.

The quality of stormwater discharged to the rivers will need to be monitored closely to avoid pollution and contamination. In addition the drainage system will gradually be reconfigured so as to keep storm water and wastewater separate.

2.4 Wastewater management

2.4.1 Zoning and wastewater generation

The same four zones are proposed for wastewater as for water supply. Estimated wastewater generation is presented in Annexes 13 - 15.

2.4.2 Wastewater collection and treatment

Wastewater generated in industrial zones will be collected and treated by the producers prior to discharge, as per current regulations. Technology selection and capacity will be tailored to the needs of specific sites. To ensure the quality of the treated wastewater discharged, a monitoring system should be established.

The proposed capacity and locations of industrial wastewater treatment plants are presented in Figure 2.4

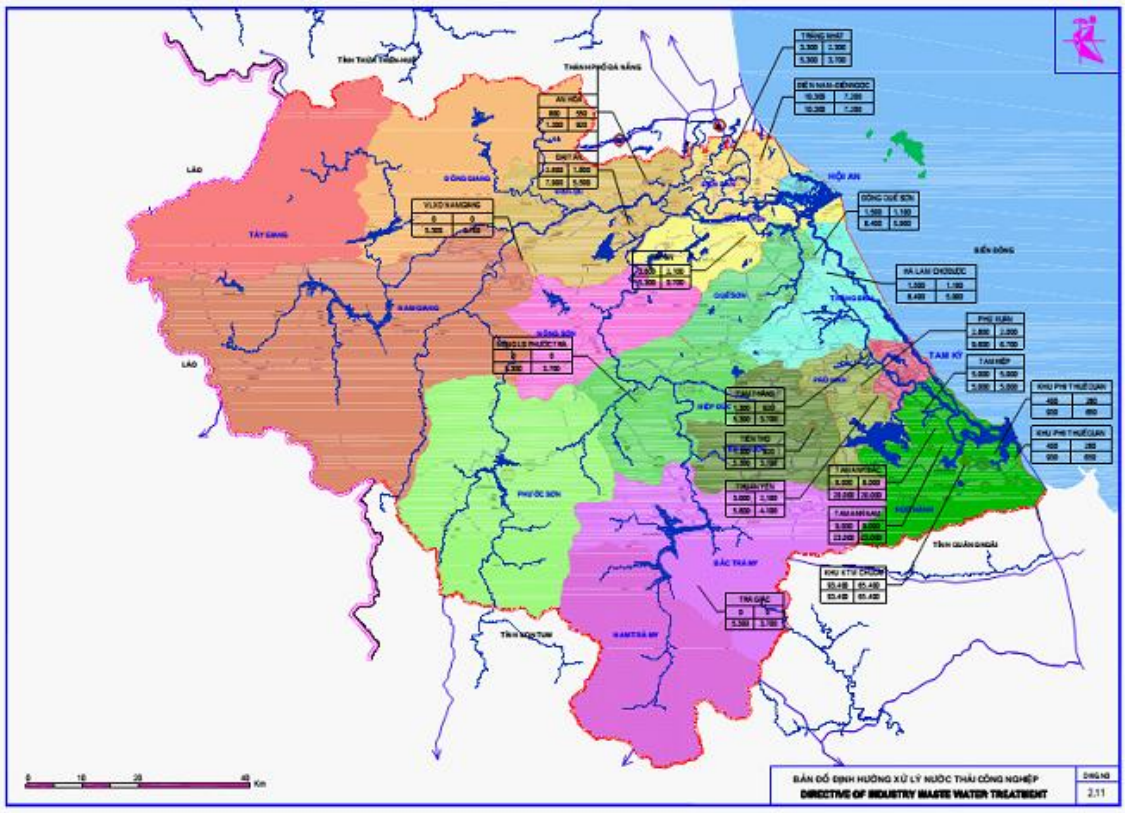


Figure 2.4: Industrial wastewater treatment plans

Up to 2020, sewerage networks in the major urban centres will be expanded and improved through enhancements to existing combined systems. Amongst other things, the improvements will include the construction of additional combined sewerage overflow (CSO) chambers and interceptors to avoid the need for large scale excavation in densely populated areas for construction of new separated sewers. From 2020, however, the focus will be on developing separate systems and these will become dominant by 2025. Separate systems will also be provided for smaller towns and new urban areas. The precondition for using combined systems is that households must construct a preliminary treatment facility - normally a septic tank - in their house to pretreat wastewater before it discharges into drains. Septic tanks will become unnecessary once separate systems are in place.

Wastewater treatment facilities will be a combination of centralized treatment plants for large urban centres and decentralized facilities for small towns and rural residential areas, and in the case of using combined system, also onsite household septic tanks. Up to 2025, the technology needed will be relatively simple as the wastewater discharged from septic tanks is dilute and has a relatively weak biological load. Beyond 2025, when separate systems are in place, the wastewater will be more concentrated (so long as households bypass their septic tanks and make direct connections to sewers) and comprehensive treatment will be required.

Details of proposed treatment facilities presented in Annex 16 and locations are indicated in Figure 2.5.

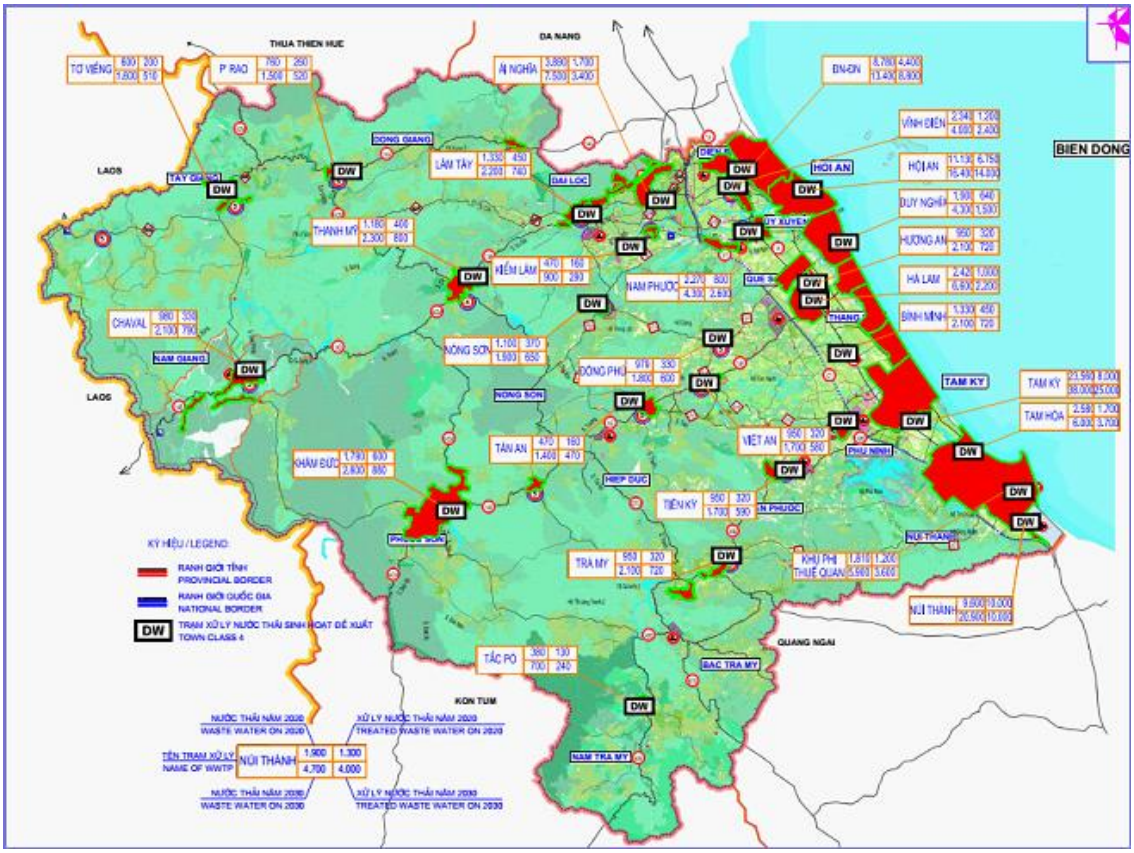


Figure 2.5: Locations of proposed wastewater treatment plants

For agricultural wastewater, small-scale facilities employing simple anaerobic treatment (baffled anaerobic tanks followed by biological filters or wetland) will be sufficient. Facilities will be constructed where the greatest volume of wastewater is generated.

2.4.3 Sludge collection and treatment

At present there is no official de-sludging service for septic tanks and the few existing wastewater treatment plants do not have sludge treatment facilities. The management of fecal sludge therefore faces two key challenges: firstly to introduce de-sludging and removal services that householders will use, and secondly to provide adequate sludge treatment facilities, in appropriate locations. Estimated sludge generation is presented in Annex 17.

Beyond 2020, the proposed new and improved wastewater treatment plans will have the capacity to treat septic sludge, and the treated product could then be disposed of at landfills. A list of proposed sites where treated sludge can be disposed of is provided in Annex 18.

With the anticipated phasing out of septic tanks from 2025 onwards, the volume of sludge generated at household level will gradually reduce, though the volume generated from wastewater treatment plants will increase significantly. However, to encourage households in stopping use of onsite septic tanks and moving to direct connection to sewers, strong political support and publicity; obligations and/or financial incentives; and maybe technical support will need to be required.

Chapter 3. Institutional arrangements

3.1 Sector management

The Quang Nam PPC has legal responsibility for the provision of water supply and sanitation services in the province. Its mandate includes:

1. Issuing necessary regulations and decisions.
2. Assigning service areas to service providers.
3. Approving operational and investment plans.
4. Setting tariffs and (where necessary) subsidies.
5. Coordinating the roles of provincial departments and local governments in implementing approved master plans.

Currently the Quang Nam PPC is owning fully or partly the service providing utilities. It causes a situation of conflict of interests between regulatory functions and business orientation. Thus it advises the PPC to step back from service provision and focus on regulatory function. To strengthen regulatory functions, it is recommended that the PPC issues new regulations on water resources management, regional water supply, drainage and wastewater management (including regulations for household septic tanks, house connections and sludge management) and wastewater service tariffs. In addition, the PPC should also need to enter into service agreements with the designated service providers as regulated by the current Government's regulations. Once the service agreements will be signed, PPCs should enforce their implementation.

Under the PPC, DOC is responsible for urban water supply, drainage and wastewater; DARD is responsible for rural water supply and sanitation; DPI is responsible for planning financial

resources for investments; DOF is responsible for providing the financial resources for investments and appraising the tariff; DONRE is responsible for water resources management and discharge standards to environment; and DOH is responsible for water supply standards. The new Master Plan will create some challenges to the current practices of these departments. Such challengers include working in broader setups (urban/rural and regional/interregional), integrated approach (water/drainage/wastewater) or new service (wastewater service). While the essential mandates of these agencies will remain unchanged, for effectively implementing the Master Plan, capacity of these departments will need to be strengthened under proposed technical assistances, specifically in following aspects:

(i) compliance and consistency of investment plan with the approved Master Plan;
(ii) coordination of investment plans from different ministries, public and private sectors;
(iii) compliance of the service quality with the standards;
(iv) accountability of service providers with their customers; and
(v) effective implementation of regulations and decisions.

3.2 Service delivery

To ensure the quality and sustainability of service provision, institutional arrangements for service delivery need to be streamlined and a higher degree of professionalism developed within the lead organizations. In particular, while water production could be effectively handled by multiple government and/or private sector organizations, management of the distribution network should be assigned to a single agency to enable economies of scale and facilitate cross-subsidies between parts of the service which generate more or less revenue. Since the bulk of water supply services are already provided by Quang Nam WSDC, it is proposed to make this entity fully and solely responsible for the provision of piped water supply services in the province. Quang Nam WSDC can take over the systems in small towns that are currently operated by Quang Nam URENCO and small rural water supply schemes through the transferring the state capital invested by Quang Nam PPC in those systems to Quang Nam WSDC as an increase of PPC's share in the chatter capital of Quang Nam WSDC.

The management and operation of wastewater services, once separate systems are in place, will also require a high degree of professionalism. Given that water supply and wastewater management are closely related in terms of technical demands, the customer base and revenue generation via water bills, it is proposed that this, too, be assigned to the Quang Nam WSDC. The rural sanitation will remain with DARD. The current capacity of WSDC in terms of technical, human and financial will need to be strengthened to be adequately responding to the new assigned responsibilities.

Drainage is closely associated with management of the road network, hence this service should be managed by local government through URENCOs. So long as combined stormwater / wastewater systems are in use, the URENCOs should be responsible managing the drainage network, with Quang Nam WSDC responsible for interceptors, wastewater treatment plants, and sludge collection and treatment. The capacity of Quang Nam URENCO will need to be improved as currently the company is lacking experienced staff and adequate equipment.

Private sector participation in the delivery of water supply and sanitation services is set to increase. To ensure stability of the service, it will be more appropriate to give private

contractors responsibility for service delivery in relatively isolated areas (such as industrial zones) or to focus on water production and wastewater treatment. To incentivize participation of private sector, Quang Nam PPC is advised to issue a clear and transparent policy on supports provided such as site clearance, reducing taxes etc. applied in these investments.

Chapter 4. Strategic environmental assessment

4.1 Impact assessment

In Tables 4.1 and 4.2, potential environmental impacts are assessed against two scenarios: water and sanitation services with and without the proposed master plan.

Table 4.1: Environmental impacts without master plan

No	***Impacts to***	***Type of impacts***
1	Land	Land acquisition for construction of new facilities for WSS services including WTP, WWTPs, pumping stations, pipeline and sewers would cause negative consequences such as losing tenure of land, productivity and interrupting business.
2	Water	Growth in water demand will exceed supply. Water shortages might cause instability in the social life and stagnation of economic growth. Flooding would happen more frequently due to urban development and especially under the impacts of climate change. The discharge of untreated wastewater directly to the environment would cause water pollution (basin of rivers such as Vu Gia - Thu Bon, Truong Giang - Tam Ky and other rivers in the area). Climate change would also exacerbate saline intrusion which would affect water sources, especially the downstream sections of Vu Gia – Thu Bon river system. Increased rainfall and changes in the rainfall pattern might create more floods and inundation in the coastal regions. In addition, prolonged droughts in the dry season could cause more water shortage in dry season.
3	Ecosystem	Discharge of untreated wastewater to the river systems would cause water pollution, which would affect the flora and fauna in the rivers and water bodies. Implementation of a number of existing plans and investment projects without due attention to water resource management could have negative impacts on the ecosystem in project areas. Indiscriminate exploitation of water resources could seriously affect their sustainability.
4	Public health	The use of untreated water could spread disease. Uncontrolled dumping of septic sludge to environment would cause transmission of pollutants and diseases across the areas.
5	Air	Transportation of untreated wastewater in open drains would cause unpleasant odors due to stagnation of wastewater while periodic inundation would cause pathogenic wastewater to spill over into the streets.
6	Landscape, cultural heritage	Flooding including the overflow of untreated wastewater from drains could harm the landscape and cultural heritage both

		physically and socially.
7	Society and Economy	Inadequate water and sanitation services would cause an increase in water-borne diseases, reducing productivity and increasing poverty. This would also damage the potential for economic development, especially in the fields of tourism

Table 4.2: Environmental impacts with the master plan

No	***Impacts to***	***Type of impacts***
1	Land	Land acquisition for construction of new facilities for WSS services including WTP, WWTPs, pumping stations, pipeline and sewers would cause negative consequences such as losing tenure of land, productivity and interrupting business.
2	Water	The quality of water and sanitation services will be improved to meet increased demand. The magnitude of inundation will be reduced. The increased volume of wastewater collected and treated will require proper management. Water sources will be protected and used economically. The negative impacts of climate change are reduced and/or controlled.
3	Ecosystem	Controlled water extraction and discharge will help to improve water quality and this could help restoration and conservation of flora and fauna in the rivers and water bodies. There will be negative impacts during the construction resulting from dredging, leveling and soil excavation.
4	Public health	Wastewater will be properly managed to reduce the risks to environment and health. Septage will be properly managed, reducing public health risks. There will be risks of illegal dumping and improper functioning of treatment facilities.
5	Air	Gradual separation of wastewater and storm water systems will eliminate unpleasant odors.
6	Landscape, Cultural heritage	Reduced inundation and overflows of untreated wastewater will help to improve the landscape and cultural heritage physically and socially.
7	Society and Economy	Improvements in water and sanitation services will contribute to economic development and poverty reduction.

4.2 Mitigation measures

To address the negative impacts identified above, a number of measures are proposed. These will be embedded in the process of investment planning, preparation and implementation.

On the planning and preparation of investments, the following are proposed:

1. Impacts of climate change will be properly taken in account in detailed planning works.
2. All wastewater discharged from industrial / economic zones and industrial clusters will be treated to meet relevant standards.
3. Integrated water resources management will be implemented to address increased competition for water use between different sectors.
4. Regulations will be introduced for the protection of water resources, control and monitoring of wastewater discharges, and the management of septage and wastewater generally.
5. Application of advanced technology that will help to reduce greenhouse effects, while minimizing land acquisition.

On the implementation of new investments:

6. Existing Environmental Codes of Practice (ECOPs) will be used to address any negative impacts from the construction and operation of water and sanitation infrastructure. The relevant ECOPS cover controls on the generation of dust, noise, vibration, wastewater, chemicals, excavated soil and construction materials.
7. Reduce the disruption of vegetative cover and ecological resources.
8. Improve road safety and safety at work.
9. Encourage community participation in the monitoring of environmental and social compliance.

Chapter 5. Financing and Cost Benefit Analysis

5.1 Investment cost

The projected investment cost of the master plan is VND 13,366 billion (US$ 607 million) based on 2015 prices. Of this, VND 9,533 billion (US$ 433 million) is for water supply, VND 3,755 billion (US$ 171 million) is for drainage and wastewater management and VND 78 billion (US$ 3 million) is for technical assistance and capacity building. Further details are provided in Annexes 17-19

5.2 Financing models

The investment cost of implementing the master plan is huge and far exceeds the capacity of the provincial budget. Instead, financing could come from ODA (multilateral and bilateral development partners), transfers from central government, provincial infrastructure bonds or loans, and/or the private sector.

In recent years, public financing (including ODA) was able to contribute at most 20% of the required funds. ODA and state funding will therefore be used primarily for investments in public infrastructure that does not generate revenue, such as water storage capacity and drainage; provincial bonds or loans will be used for the development of services that do generate income (water supply); and the private sector will be encouraged to finance the investment of major income generating infrastructure such as wastewater treatment plants and to participate in the provision and maintenance of water supply and wastewater collection and treatment services, to improve the efficiency and sustainability of service provison. The province will need to set out clear roadmaps for increasing tariffs to ensure that revenue generated recovers full operational costs and a part of financial costs. While the WSS services are considred as public services and access to them may be a dificulty for some groups of population with low income, the PPC is advised to develope a transparent mechanism to provide targeted subsidies that could help service providers in overcoming the financial dificulties of provisioning the services to those groups of population. Those subsidies could be in the form of direct payment of difefrence between service costs and service tariff or grants to utilities for new investments. The support from PPC may also in the form of providing guaranttee for utilities in accessing the commercial loan or exempting taxes.

5.3 Cost benefit analysis

A rought cost benefit analysis (CBA) shows that the Economic Internal Rate of Return (EIRR) would be 15.50% for period of 2016-2020, 14.97% for period of 2020-2025 and 14.54% for period of 2025-2030; the benefit/cost ratio would be 1.59, 1.52 and 1.47 for the same periods respectivelly.

For the purpose of conducting CBA, the following factors were considered:

(i) Reduced floods:

- The level of reduced losses due to reduced floods is VND 10.791m (US$ 607) annualy per households (source: Vietnam Urban Water Supply and Wastewater Project - 2013).
- The number of households benefited from reduced floods resulted from investments proposed in the Master Plan is 31,990 for the period up to year 2020; 31,990 for the period up to year 2025 and 45,727 for the period up to year 2030.

(ii) Improved sanitation

- The level of reduced losses due to improved wastewater service is VND 116,674 (US$ 5.33) annualy per capita. From which VND 74,645 (US$ 3.41) comes from reduced poluttion to water sources, VND 30,865 (US$ 1.41) comes from reduced air and soil polution and VMD 11,164 (US$ 0.51) comes from reduced expenses relating to living opportunities (Economic Sanitation Initiative - WSP's study, 2012).
- The number of population benefited from improved wastewater service resulted from investments proposed in the Master Plan is 703,800 for the period up to year 2020; 703,800 for the period up to year 2025 and 1,006,000 for the period up to year 2030.

(iii) Health care related expenses

- Teh level of reduced losses due to better health conditions resulted from investments proposed in the Master Plan is VND 68,297 (US$ 3.12) annualy per capita (Economic Sanitation Initiative - WSP's study, 2012)
- The number of population benefited from better WSS services is 407,010 for the period up to year 2020; 487,740 for the period up to year 2025 and 1,055,240 for the period up to year 2030.

(iv) The contribution of improved WSS services in to increase of provincial gross domestic products (GDP) accounts for one percent from the everage increase as of 11 percents annually for the period 2013-2015.

Chapter 6. Prioritized investment plan

6.1 Water Supply

Prioritized investments for the period up to 2020 are listed in Table 6.1 below. These focus on expanding water supply coverage in both new and existing urban areas where the high rate of urbanization is expected, and improving service quality and improving the operational efficiency of service providers by maximizing utilization of the invested infrastructure.

Table 6.1. Prioritized water supply investments for the period up to year 2020

No	***Investment***	***Objectives***	***Cost (US$m)***	***Completion by***
1	Expansion water supply system in Tam Ky city	Increasing coverage in Tam Ky city and surrounded communes	13.6	2016
2	Water supply system for Dien Nam – Dien Ngoc urban area and water supply for Tam Hiep area	Providing service in newly urban areas in Dien Ban district and Chu Lai economic zone	28.5	2018
3	Phu Ninh water supply system	Providing service to industrial zones and new urban areas in Nui Thanh district	60.5	2020
4	Water supply systems for 3 communes of Dien Ban district	Providing service to rural residential areas of 3 communes	4.1	2016
5	Water supply system for 7 communes of Dai Loc district	Providing service to rural residential areas of 7 communes	20.0	2020
6	Water supply for Ha Lam town, Thang Binh district	Providing service to the town and surrounded communes	1.9	2026

6.2 Drainage and wastewater management

Prioritized investments for the period up to year 2020 are listed in Table 6.2 below. These include works to reduce flood risks in existing densely populated urban areas and improve wastewater collection and treatment in the major cities and towns in which main economic activities are concentrated.

Table 6.2. Prioritized drainage and wastewater investments for the period up to year 2020

No	***Investment***	***Objectives***	***Cost (US$m)***	***Completion by***
1	Drainage and wastewater in Tam Ky city	Improving drainage system and providing wastewater service to 7 core wards of the city	17.4	2016
2	Drainage and wastewater infrastructure in Hoi An city	Reducing flood risks and providing wastewater service in Hoi An city	88.5	2021
3	Drainage and wastewater infrastructure in Nui Thanh town	Reducing flood risks and providing wastewater service in Nui Thanh town	12.8	2019
4	Drainage and wastewater infrastructure in Vinh Dien town	Reducing flood risks and providing wastewater service in Vinh Dien town	15.2	2020
5	Drainage and wastewater infrastructure in Dien Ban district	Reducing flood risks and providing wastewater service in main urban areas of Dien Ban district	10.2	2020

Estimated investment costs for water supply, drainage and wastewater management are set out in Annexes 19 - 20 while Annex 21 outlines the costs of technical assistance and capacity building.

Chapter 7. Recommendations and policy advice

To implement this Master Plan successfully, following actions are recommended:

To Quang Nam PPC:

- Approval of the Master Plan before June 2016
- Enter to service agreements with WSS service providers by end of 2016
- Issuance of a regulation on drainage and sewerage management that includes fecal sludge management in 2017
- Issuance of provincial policy of providing subsidies to WSS service in 2018

To MOC:

An important lesson from the development of this plan is that the current government requirement to formulate separate plans for water supply and for drainage is not appropriate. The existing Decree on Production and Distribution of Clean Water in Urban and Industrial Areas (Decree 117/2007/ND-CP and Decree 124/2012/ND-CP) and Decree on Management of Drainage in Urban and Industrial Areas (Decree 80/2015/ND-CP), both made under the Construction Law, should therefore be revised. MOC is also advised to amend the existing ministerial circular on implementation of the Construction Law and provide detailed guidance to provinces on the formulation of master plans similar to this one. To address the above, MOC through its Administration of Technical Infrastructure (ATI) may need further support and assistance from development partners that includes the World Bank.

Annex 1: Existing water treatment plants

No.	Name of WTP	Capacity m3/day	Công suất vận hành m3/ngđ	Service Area	Water resources
Quang Nam Drainage and Water Supply JS Company		**67,000**	**46,200**		
1	Tam Ky	15,000	15,000	Tam Ky City, Binh Trung, Binh An (Thang Binh), Tam Dan (Phu Ninh), Tam Xuan I, II, Tam Thanh (Nui Thanh)	Phu Ninh Lake
2	Tam Hiep (Nui Thanh)	15,000	7,800	Nui Thanh, Tam Anh Nam, Tam Anh Bac, Tam Quang, Tam Giang, Tam Hiep, Tam Nghia	Thai Xuan Lake
3	Hoi An	21,000	12,000	Hoi An City and Industrial areas	Thu Bon River
4	Thanh My	1,000	800	Thanh My town	Cai River
5	Vinh Dien	6,000	4,800	Vinh Dien town, residents living along Road No.1 (Dien Thang Nam, Trung, Bac) and along road No.608 (Dien An, Dien Phuoc, Dien Minh)	Thu Bon River
6	Kham Duc	2,500	500	Kham Duc	Treo Spring
7	Duy Xuyen	3,000	1,800	Nam Phuoc, Duy Phuoc and Duy Vinh communes (Duy Trung, Duy Son, Quy Xuan in the future)	Thu Bon River
8	Thang Binh	2,500	2,500	Ha Lam town, Binh Nguyen, Binh Quy and Huong An (Que Son)	Ly Ly River
9	Phu Ninh	1,000	1,000	Phu Ninh, Tam Vinh, Tam Dan communes	Phu Ninh Lake
Quang Nam Urban Environment JS Company		**10,000**	**5,200**		
1	Tan An	1,000	290	Tan An town	Tranh River
2	Ai Nghia	5,000	3,300	Ai Nghia, Dai Nghia and Dai Hiep Communes	Vu Gia
3	Dong Phu	2,500	660	Dong Phu town, Binh Lam (Hiep Duc)	Viet An Lake
4	Tien Phuoc (Tien Ky)	1,500	500	Tien Ky town	Tien River
5	Nam Trà My	700	450	Tac Po town	Nước suối Đôi
	Industry	**7,800**	-		
1	Dong Xanh	2,500	-	Dai Tan industrial zone	Vu Gia River
2	Dien Nam- Dien Ngoc	5,000	-	Dien Nam- Dien Ngoc IZ	Underground
3	Nam Giang	300	-	Nam Giang economic zone	Spring
	Others	**1,600**	-		
1	Prao	600	-	Prao town	Spring
2	Que Trung- Nong Son	1,000	-	Que Trung commune	Spring
	Total	**86,750**	**51,400**		

Annex 2: Main contents of the approved master plans for water supply

Description	***Unit***	***Construction Master Plan***	***Eastern Region Master Plan***	***Western Region Master Plan***	***Urban Water Supply Master Plan***	***RUWASE Master Plan***
Design period 1 (2)		2020 (2030)	2020 (2030)	2020 (2030)	2020 (2030)	2020 (2025)
Approved year		2014	2011	2013	2013	
Approving decision		113/QĐ-UBND	389 /QĐ-UBND	4033/QĐ-UBND	450/2013/QĐ-UBND	1831/QĐ-UBND
Planning coverage						
Urban		All urban areas of Quang Nam province	Tam Kỳ, Chu Lai economic zone, Hội An, Điện Bàn, Nam Phước, Duy Nghĩa, Hà Lam, Hương An, Bình Minh	Ái Nghĩa, Vĩnh Phước, Lâm Tây,Thạnh Mỹ, Chaval, Prao, Sông Vàng, Tơ Viêng, A Xam, Đông Phú, Kiểm Lâm, Khâm Đức, Phước Hiệp, Tân An, Việt An, Trung Phước, Phú Thị nh, Tiên Kỳ, Trà My, Tắc Pò	All urban areas of Quang Nam province	NA
Rural			Phú Ninh, Núi Thành, Điện Bàn, Thăng Bình, Quế Sơn, Duy Xuyên	NA		18 cities and districts including 241 wards, communes and towns.
Industrial		Industrial areas, industrial clusters in Quang Nam	Industrial areas, industrial clusters in Eastern Quang Nam	Industrial areas, industrial clusters in Western Quang Nam	Industrial areas, industrial clusters in Quang Nam	NA

Main criteria						
Urban population in period 1 (2)	people	808,000 (1,158,000)	471,000 (644,000)	170,300 (252,000)	672,000 (1,140,000)	
Rural population in period 1 (2)	people	Theo QH CN và VSMT T	405,000 (295,000)	NA		1,442,000
Unit consumption (Urban)	L/capita/day	80-120 (120-150)	90-130 (110-160)	80-100 (120)	120 (150)	
Unit consumption (Rural)	L/capita/day	Following RUWASE MP (2014)	60 (80)	NA	85 (100)	100 (120)
Coverage	%	95% (100%)	85% (95%)	95% (100%)	90% (99%)	60% (100%)
Industrial areas	ha	6,750 (10,700)	4,669 (9,149)	2,145 (5,419)		
Industrial water demand	m3/ha/day	40	40	40	40	
Rate of water connection and area	%	60%	60%	60%	60%	
Water losses	%	NA	NA	NA	NA	NA
Projected water demand						
Urban	m3/day	81,000 (148,000)	43,000 (78,000)	15,000 (30,000)	295,000 (590,000)	
Rural	m3/day		24,000 (24,000)	NA	NA	58,000 (66,000)
Industrial	m3/day	162,000 (257,000)	150,000 (195,000)	69,000 (141,000)		
Tourism (planning periods were not determined)	m3/day		122,000	NA		
Total water demand	**m3/day**	**343,000 (405,000)**	**339,000 (419,000)**	**84,000 (171,000)**	**295,000 (590,000)**	**58,000 (66,000)**

- *NA: not applicable*

Annex 3: Proposed water treatment plants in approved master plans for water supply

No.	*Water treatment plant*	*Water resources*	*Planned capacity in Construction Master Plan (m3/day)*		*Planned capacity in Water supply Master Plan (m3/day)*		*Planned capacity in RUWASE Master Plan (m3/day)*
			By year 2020	*By year 2030*	*By year 2020*	*By year 2030*	
Urban water treatment plants:							
1	Trảng Nhật	Bau Sau River	15,000	30,000	15,000	30,000	
2	Vĩnh Điện 1	Vinh Dien River	1,000	1,000	1,000		
3	Vĩnh Điện 2	Ky Lam River	5,000	5,000	5,000		
4	Điện Nam-Điện Ngọc	Groundwater	Close	Close	Close	Close	
5	Hội An	Vinh Dien and Ky Lam Rivers	21,000	50,000	21,000	50000	
6	Ái Nghĩa,	Vu Gia River	5,000	5,000	5,000		
7	Động Hà Sống	Vu Gia River	50,000	100,000	50,000	100,000	
8	Đông Giang	ChoKe spring	1,500	3,000	1,500	3,000	
9	Tây Giang	Spring	1,000	2,000	1,000	2,000	
10	Thạnh Mỹ	Bung River	3,000	5,000	3,000	5,000	
11	Chà Val	Spring	1,500	3,000	1,500	3,000	
12	Cửa khẩu	Spring	1,000	1,000	1,000	1,000	
13	S. Vàng	Vang River	-	1,500	-	1,500	
14	Nam Phước	Ben Gia River	10,000	10,000	10,000	10,000	
15	Cù Bàn	Thu Bon River	30,000	55,000	30,000	55,000	
16	Đông Phú	Viet An Reservoir	3,000	9,000	3,000	9,000	
17	Thăng Bình	Phu Ninh Reservoir	5,000	21,000	5,000	21,000	
18	Bình Minh	Groundwater	-	4,000	-	4,000	
19	Tân An	Spring	1,000	3,000	1,000	3,000	
20	Khâm Đức	Treo Spring	3,000	6,000	3,000	6,000	
21	Phước Hiệp	Spring	2,000	2,000	-	2,000	

No.	*Water treatment plant*	*Water resources*	*Planned capacity in Construction Master Plan (m3/day)*		*Planned capacity in Water supply Master Plan (m3/day)*		*Planned capacity in RUWASE Master Plan (m3/day)*
			By year 2020	*By year 2030*	*By year 2020*	*By year 2030*	
22	Nông Sơn	Thu Bon River	2,000	5,000	2,000	2,000	
23	Tam Hiệp	Thai Xuan Reservoir	10,000	10,000	10,000	10,000	
24	Tam Kỳ	Phu Ninh Reservoir	30,000	50,000	30,000	50,000	
25	Chu Lai	Phu Ninh Reservoir	95,000	260,000	95,000	260,000	
26	Phú Ninh	Phu Ninh Reservoir	4,000	7,000	4,000	7,000	
27	Tiên Phước	Spring	3,500	5,000	3,500	3,500	
28	Bắc Trà My	Spring	2,500	4,000	2,500	4,000	
29	Nam Trà My	Spring	1,000	1,000	1,000	1,000	
	Total capacity		**307,000**	**658,500**	**305,000**	**643,000**	
Rural small scale water treatment plants:							
1	Cẩm Thanh	River					2,300
2	3 xã Điện Thắng	River					16,000
3	Cẩm Văn	River					1,700
4	Điện Hồng	River					2,000
5	Điện Nam Bắc	Groundwater					1,900
6	Điện Dương	Groundwater					1,000
7	Bình Quý	Groundwater					1,500
8	Bình Nguyên	Groundwater					1,200
9	Cù Bàn	Thu Bon River					1,000
10	Duy Thu	Thu Bon River					2,700
11	Đại Đồng	River					3,000
12	Đại Minh	River					2,500
13	Đại phong	River					1,500

No.	*Water treatment plant*	*Water resources*	*Planned capacity in Construction Master Plan (m3/day)*		*Planned capacity in Water supply Master Plan (m3/day)*		*Planned capacity in RUWASE Master Plan (m3/day)*
			By year 2020	*By year 2030*	*By year 2020*	*By year 2030*	
14	Đại Cường	River					1,200
15	Đại Sơn	River					1,000
16	Đại Chánh	River					2,500
17	Đại Thắng	River					1,500
18	Đại Lãnh	River					1,000
19	Đại Hưng	River					1,200
20	Đại Nghĩa	River					1,200
21	Tam Thăng	River					1,300
22	Tam Ngọc	River					1,000
23	Tam Phú	Phu Ninh lake					1,200
24	Phước Gia	Spring					1,000
25	Tơ Viêng	Spring					1,200
	Total capacity						**53,600**

Annex 4: Proposed wastewater treatment plants in the approved master plans

Description	***Unit***	***Construction Master Plan***	***Eastern Region Master Plan***	***Western Region Master Plan***	***RUWASE Master Plan***
Design period 1 (2)		2020 (2030)	2020 (2030)	2020 (2030)	2020 (2025)
Approved year		2014	2011	2013	
Approved decision		113/QĐ-UBND	389 /QĐ-UBND	4033/QĐ-UBND	1831/QĐ-UBND
Planning coverage					
- Urban		All urban areas of Quang Nam province	Tam Kỳ, Chu Lai economic zone, Hội An, Điện Bàn, Nam Phước, Duy Nghĩa, Hà Lam, Hương An, Bình Minh	Ái Nghĩa, Vĩnh Phước, Lâm Tây,Thạnh Mỹ, Chaval, Prao, Sông Vàng, Tơ Viêng, A Xam, Đông Phú, Kiểm Lâm, Khâm Đức, Phước Hiệp, Tân An, Việt An, Trung Phước, Phú Thị nh, Tiên Kỳ, Trà My, Tắc Pò	All urban areas of Quang Nam province
- Rural			Phú Ninh, Núi Thành, Điện Bàn, Thăng Bình, Quế Sơn, Duy Xuyên	NA	
- Industrial		Industrial areas, industrial clusters in Quang Nam	Industrial areas, industrial clusters in Eastern Quang Nam	Industrial areas, industrial clusters in Western Quang Nam	Industrial areas, industrial clusters in Quang Nam
Main criteria					
- Urban population in period 1 (2)	people	808,000 (1,158,000)	471,000 (644,000)	170,300 (252,000)	672,000 (1,140,000)
- Rural population in period 1 (2)	people	Theo QH CN và VSMT T	405,000 (295,000)	NA	
- Urban water demand	L/capita/day	80-120 (120-150)	90-130 (110-160)	80-100 (120)	120 (150)
- Rural water demand	L/capita/day	Following RUWASE MP (2014)	60 (80)	NA	85 (100)
- Rate of piped water	%	95% (100%)	85% (95%)	95% (100%)	90% (99%)

Description	***Unit***	***Construction Master Plan***	***Eastern Region Master Plan***	***Western Region Master Plan***	***RUWASE Master Plan***
connection					
- Industrial areas	ha	6,750 (10,700)	4,669 (9,149)	2,145 (5,419)	
- Industrial water demand	m3/ha/day	40	40	40	40
Wastewater demand					
- Ratio of wastewater/ drinking water		80%	75-85%	75-85%	NA
- Urban	m3/day	96,000 (185,000)	70,000 (NA)	13,000 (24,000)	
- Rural	m3/day		NA	NA	58,000 (66,000)
- Industrial	m3/day	130,000 (206,000)	197,000 (N.D)	55,000 (113,000)	
- Tourism (planning periods were not determined)	m3/day		98,000	NA	
- Infiltration	m3/day	NA	NA	NA	NA
- Total wastewater demand	m3/day	226,000 (391,000)	365,000 (NA)	68,000 (137,000)	58,000 (66,000)
Solution for wastewater plan					
- Waste collection style		Combined sewers for old urban areas, separated sewers for new urban and industrial zones (I.Z)	Combined sewers for old urban areas, separated sewers for new urban and industrial zones	Combined sewers for old urban areas, separated sewers for new urban and industrial zones	Small scale collection systems
- Wastewater treatment technology		Secondary treatment for urban, I.Z and decentralized systems for rural areas	Secondary treatment for urban, I.Z and decentralized systems for rural areas	Secondary treatment for urban, I.Z and decentralized systems for rural areas	Decentralized systems and household systems for rural areas
- Wastewater treatment plant		Not proposed location and capacity of WWTP	Proposed 11 WWTPs capacity from 2,500 m3/day to 10,000 m3/day, total capacity of 50,000	Not proposed location and capacity of WWTP	Not proposed location and capacity of WWTP

Description	***Unit***	***Construction Master Plan***	***Eastern Region Master Plan***	***Western Region Master Plan***	***RUWASE Master Plan***
			m3/day		

- *NA: not applicable*

Annex 5: Ongoing investment programs

No.	*Project*	*Project areas*	*Scope of the project*	*Project completion*	*Total cost (US$ mil)*
1	Extension of water supply system in Tam Ky City	Industrial zones of tam Ky City and Tam Thanh, Tam Phu, Tam Thang and Tam Ngoc communes	3 components including water supply extension, technical support and Phu Ninh reservoir safety improvement. Water treatment plant will be increased from 15,000 m3/day to 25,000 m3/day	2016	13.64
2	Urban water supply system in Dien Nam – Dien Ngoc and Tam Hiep Towns	Dien Nam Dien Ngoc area: Dien Nam- Dien Ngoc IZ, Trang Nhat industrial areas, coastal tourism areas, Vinh Dien town and 9 of the City. Tam Hiep area: Núi Thành Tam Quang, Tam Giang, Tam Hiệp, Tam Nghĩa, Tam Anh Nam, Tam Anh Bắc, Bắc Chu Lai IZ, Tam Hiệp IZ, Tam Anh IZ, Tam Xuân 1, Tam Xuân 2.	2 components including water supply system of Điện Nam – Điện Ngọc, capacity of 15,000 m3/day and expanding Tam Hiệp WTP from 5,000 m3/day to 20,000 m3/day.	2018	28.50
3	Upgrading and expansion of Ha Lam water treatment plant	Hà Lam, Binh Triều, Bình Phục, Bình Nguyên	Construction of water treatment and pipelines for increasing capacity from 2,500 to 5,000 m3/day	2016	1.65
4	BOO project of Phu Ninh water treatment plant	Chu Lai IZ, Tam Kỳ City, Duy Xuyên, Thăng Bình, Núi Thành districts	Construction of a water supply system, capacity of 100,000 m3/day	Under discussion	58.15
5	Tam Ky City drainage wastewater collection and treatment sub-project- Quang Nam Province	Tam Ky City including 9 wards and 4 communes (Tam Thắng, Tam Thanh, Tam Phú, Tam Ngọc)	Construction a drainage and sewerage system, a wastewater treatment plant of 8,000 m3/day	2016	21.70
6	Water environment improvement of central area- Tam Ky sub-project	Tam Ky City	5 components including flood control, public sanitation, solid waste management and other components	2013	15.40

No.	***Project***	***Project areas***	***Scope of the project***	***Project completion***	***Total cost (US$ mil)***
7	Urban environment and infrastructure development for adaptation to climate change in Hoi An City	9 wards and 4 communes of Hoi An City and neighboring communes of Dien Ban	2 components: environment and infrastructure development for climate change adaptation in Hoi An City and Institutional enhancement and capacity support. Construct Lai Nghi reservoir (1.2 million m3) and improvement of water pipes to reduce water losses	2021	88.50
8	Nui Thanh sewerage drainage and sanitation project	Nui Thanh town	Construction of wastewater collection and treatment with a capacity of 10,000 m3/day and drainage system	2018	12.80 million EUR
9	Wastewater treatment for Tan Hiep IZ	Tam Hiep IZ	Construction of a wastewater treatment plant 4,800 m3/day	2016	
10	Wastewater treatment for Tam Thang IZ	Tam Thăng IZ	Construction of a wastewater treatment plant 20,000 m3/day	2016	

Annex 6: Water sources and water balance

The main water sources for Quang Nam province are surface water of Vu Gia – Thu Bon river system for the northern and central parts and from Phu Ninh reservoir for the southern part of province. Ground water resources are fairly limited: approximately 430,000m3/day according to a study by the General Department of Geology, Ministry of Industry and Trade and of unreliable quality.

For planning purposes a water balance calculation was undertaken based on the flows in the Vu Gia – Thu Bon river system and reservoir capacity and the various demands: including hydropower generation, irrigation and aquaculture, industry and domestic water supply. The calculation started from the operating procedures for reservoirs for hydropower generation on Vu Gia – Thu Bon river systems that were approved by Prime Minister in May 2015. The flow conditions at downstream main check points of Vu Gia – Thu Bon river system under the approve procedures are presented in Table 6.1.

Table 6.1: Regulated flow conditions of Vu Gia – Thu Bon river system

Reservoir	***Discharging condition***	***Discharging flow (m3/s)***	***Discharging regime***
Đăk Mi 4	Water level at Ai Nghia Station <2.67 m 2.67-2.80 m >2.80 m	12.5 >8.0 >3.0	Constant
A Vuong	Water level at Ai Nghia Station <2.67 m	18.0-28.0	Intermittent
Song Bung 4	Water level at Ai Nghia Station <2.67 m	35.0-40.0	Intermittent >12 h/day
Song Tranh 2	Water level at Giao Thuy Station <1.02 m	29.0	Intermittent> 6h/d

Using the software MIKE BASIN, the balance of water source was calculated following a diagram presented in Figure 1 below

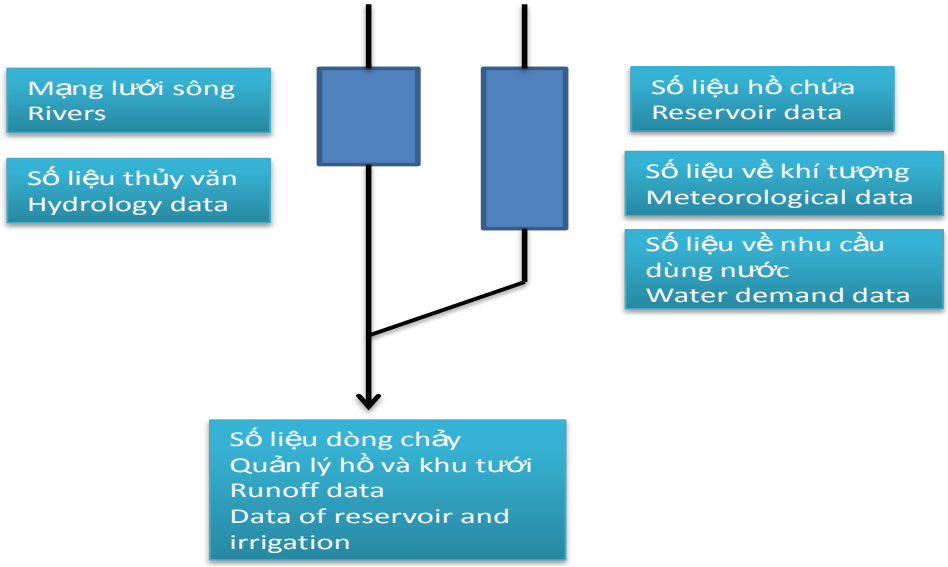


Figure 1. Water balance calculation

Annex 7: Projected water demand

Zone	2014	2020	2025	2030
	m3/day	m3/day	m3/day	m3/day
Total	**127,550**	**305,880**	**425,760**	**604,380**
Urban	45,700	105,300	128,100	204,000
Rural	14,600	34,500	55,500	60,000
Industry	20,050	131,340	213,400	306,020
De-centralized supply	47,200	34,740	28,760	34,360
Zone I	**44,240**	**78,600**	**108,970**	**153,120**
Urban	17,600	42,100	56,100	78,100
Rural	6,100	13,400	11,600	13,500
Industry	6,240	20,500	40,570	60,620
De-centralized supply	14,300	2,600	700	900
Zone II	**23,270**	**45,060**	**83,830**	**150,420**
Urban	5,200	12,700	14,100	26,700
Rural	3,100	7,800	27,800	31,600
Industry	670	8,560	36,430	85,420
De-centralized supply	14,300	16,000	5,500	6,700
Zone III	**42,740**	**149,030**	**171,730**	**222,020**
Urban	19,300	37,400	43,700	76,000
Rural	4,500	9,600	10,800	8,300
Industry	12,940	98,630	112,530	131,720
De-centralized supply	6,000	3,400	4,700	6,000
Zone IV	**17,300**	**33,190**	**61,230**	**78,820**
Urban	3,600	13,100	14,200	23,200
Rural	900	3,700	5,300	6,600
Industry	200	3,650	23,870	28,260
De-centralized supply	12,600	12,740	17,860	20,760

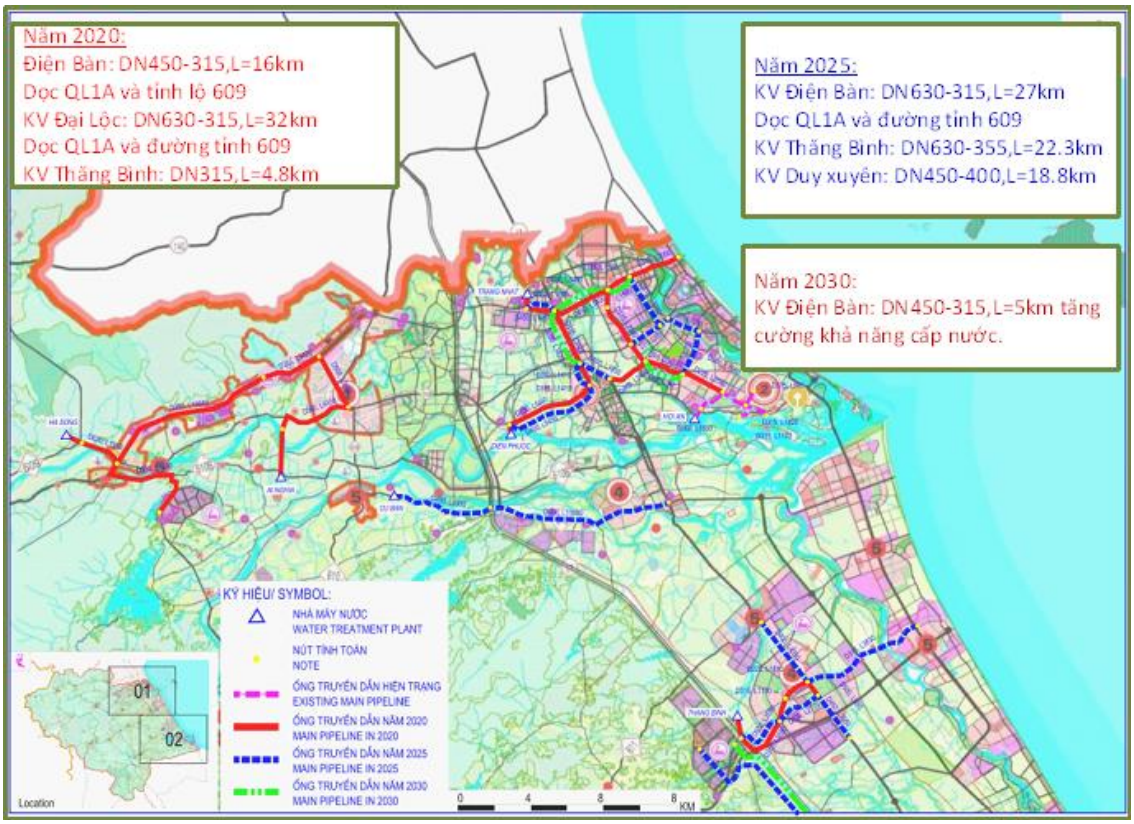
Annex 8: Proposed Centralized water treatment plants

No	*Water treatment plant*	*Capacity (m3/day) in year*			*Service area*
		2014	*2020*	*2030*	
	Zone I: Hội An-Điện Bàn-Đại Lộc	**38,000**	**91,000**	**168,500**	
1	Hội An	21,000	21,000	31,000	Hội An and industrial zones, Duy Nghĩa-Duy Hải (Nam Hội An) urban areas
2	Vĩnh Điện-Phong Thử (Điện Phước)	4,500	9,000	15,000	Communes Vĩnh Điện, Điện An, Điện Phước, Điện Minh, Điện Thọ, Điện Hồng, Điện Phương cùng các CCN Nông Sơn 1, Nhị Dinh 1, Anh Thanh, Phong Nhị
3	Điện Nam-Điện Ngọc	5,000	5,000	-	KCN Điện Nam – Điện Ngọc
4	Gò Nổi	-	3,500	5,000	Điện Phong, Điện Quang, Điện Trung and industrial cluster Vân Ly, Cẩm Phú
5	Trảng Nhật (Điện Nam-Điện Ngọc)	-	30,000	60,000	Remaining commnues of Điện Bàn
6	Ái Nghĩa	5,000	10,000	25,000	Ái Nghĩa town and communes of Đại Nghĩa, Đại Hiệp Đại An, Đại Hòa and industrial clusters.
7	Đồng Xanh	2,500	2,500	2,500	Industrial cluster Đại Sơn, Ethanol Factory Đồng Xanh
8	Động Hà Sống	-	10,000	30,000	Vĩnh Phước-Lâm Tây and communes of Đại Hưng, Đại Lãnh, Đại Đồng, Đại Quang, Đại Hồng, Đại Phong, Đại Chánh, Đại Tân, Đại Cường, Đại Minh Đại Thắng KCN Đại Tân and industrial clusters of Đại Lộc district.
	Zone II: Duy Xuyên-Quế Sơn-Thăng Bình	**8,000**	**23,500**	**52,500**	
1	Nam Phước	3,000	6,000	-	Nam Phước town and communes of Duy Phước, Duy Vinh, Duy Thành and Quế Xuân I-II, Quế Phú (Quế Sơn district), Industrial cluster Lang Châu Nam
2	Cù Bàn	-	-	30,000	Kiểm Lâm urban area and communes of Duy Châu, Duy Trinh, Duy Tân, Duy Thu, Duy Hòa, Duy Sơn, Duy Trung , Industrial cluster Tây An and industrial clusters .

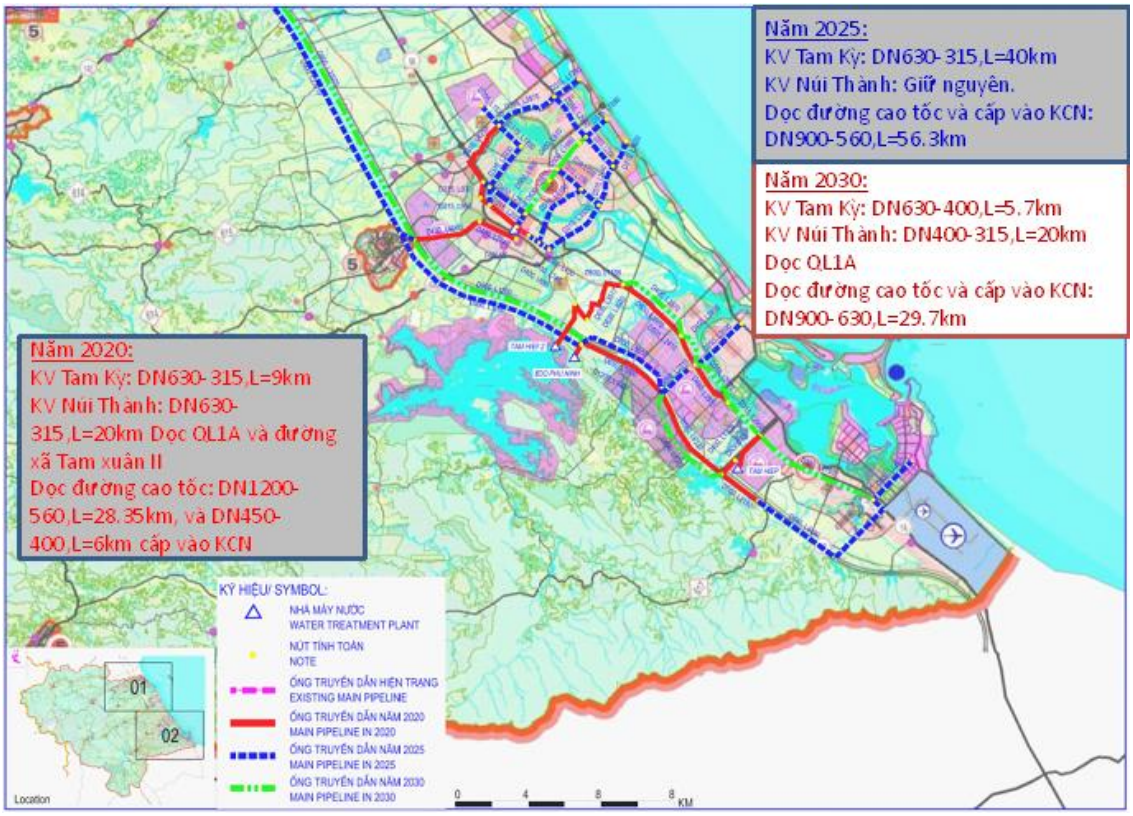
No	*Water treatment plant*	*Capacity (m3/day) in year*			*Service area*
		2014	*2020*	*2030*	
3	Đông Phú	2,500	7,500	12,500	Đông Phú town, Việt An and communes of Bình Lâm, Quế Châu, Quế Minh, Quế An, Bình Lãnh, Bình Trị , and industrial clusters
4	Thăng Bình	2,500	10,000	10,000	Hương An, Hà Lam, Bình Minh, Duy Nghĩa, Bình Dương, Bình Quý, Bình Nguyên, Bình Giang, Bình Phục, Bình Triều, Bình Đào, Bình Sa, Bình Hải, Bình Tú, Bình Định Bắc, Bình Định Nam, IZ Quế Sơn, Thăng Bình
	Zone III: Tam Kỳ-Núi Thành-Phú Ninh	**21,000**	**148,000**	**305,000**	
1	Tam Kỳ	15,000	25,000	50,000	Tam Kỳ, communes Bình Trung, Bình An (Thăng Bình district), Tam Đàn, Tam An (Phú Ninh district), KCN Tam Thăng.
2	Phú Ninh	1,000	3,000	5,000	Phú Thịnh, Tam Vinh, Tam Dân, Tam Phước
3	Tam Hiệp	5,000	5,000	5,000	Núi Thành and communes Tam Anh Nam, Tam Anh Bắc, Tam Quang, Tam Giang, Tam Hiệp, Tam Nghĩa, Tam Hải, Tam Hòa, Tam Hiệp, Tam Tiến, Tam Xuân I, II, Tam Mỹ Đông, Tam Mỹ Tây, Tam Thạnh.
4	Tam Hiệp 2	-	15,000	30,000	
5	BOO Phú Ninh	-	100,000	220,000	Industrial zone Tam Anh, Tam Hiệp, Bắc Chu Lai, Thuận Yên, Phú Xuân, IZ along 14E road. Supply water forTam Kỳ, Thăng Bình.
	Zone IV: Other districts	**7,400**	**17,100**	**59,400**	
1	Tây Giang	-	600	1,200	A Tieng urban area and A Tieng IZ
2	A Xan	-	500	1,000	Axan and Industrial cluster Ch'Nooc
3	Đông Giang	600	1,000	2,000	P'rao town
4	Sông Vàng	-	600	1,200	Song Vang town
5	Thạnh Mỹ	1,000	3,000	9,000	Thạnh Mỹ and IZs
6	Chà Val	-	1,500	3,000	ChaVal and IZ
7	Cửa Khẩu	-	500	2,000	Nam Giang area
8	Nông Sơn	1,000	2,000	3,000	Trung Phuoc and Nong Son IZ
9	Khâm Đức	2,000	2,000	4,000	Khâm Đức and Phuoc Son
10	Phước Hiệp	-	500	1,000	Phuoc Hiep and Phuoc Hoa

No	***Water treatment plant***	***Capacity (m3/day) in year***			***Service area***
		2014	***2020***	***2030***	
11	Tân An	1,000	1,000	7,500	Tân An, Hiệp Thuận, Quế Thọ, Phước Trà, Hiệp Đức
12	Tiên Phước	1,500	5,000	15,000	Tiên Kỳ, Tiên Thọ, Tiên Mỹ, Tiên Châu, Tiên Cảnh, Tiên Lộc, KCN Tiên Thọ
13	Bắc Trà My	300	1,500	3,000	Tra My and IZs
14	Trà Giác	-	500	6,000	Tra Giac
15	Nam Trà My	-	500	1,000	Tac Po

Annex 9: Main distribution network in Zones I and Zone II



Annex 10: Main distribution networks in Zone III



Annex 11: Drainage Directions

No.	*Drainage direction*	*Service area*	*Drainage axes*	*Flow direction*	*Total drainage area (km2)*	*Urban drainage area (km2)*
1	Tam Kỳ - Trường Giang rivers	Tam Kỳ city and districts Phú Ninh, Núi Thành, parts of districts Thăng Bình, Duy Xuyên	Tam Kỳ - Trường Giang river system including Tam Ky, Truong Giang, ban Thach, ta n Ha rivers	To the sea through 3 points Cửa Đại (Hội An city), Cửa Lở (Tam Hải, Nui Thanh district) and Cửa An Hoà (Tam Quang, Nui Thanh district	2,158	Bình Minh town (23.0km2) Tam Kỳ city (88.5km2), Nam Hội An urban area (50.0km2), Phú Ninh town(7.5km2), Núi Thành town (17.0km2)
2	Downstream of Vu Gia-Thu Bồn river	From Ái Nghĩa and Giao Thủy to the sea, including 10 communes of Đại Lộc district (Ái Nghĩa, Đại Hưng, Đại Phong, Đại Minh, Đại Cường, Đại Thắng, Đại Tân, Đại Nghĩa, Đại Hiệp, Đại Hòa), 11 commnues of Duy Xuyên district (Nam Phước, Duy Hòa, Duy Châu, Duy Trinh, Duy Sơn, Duy Trung, Duy Phước, Duy Thành, Duy Vinh, Duy Nghĩa, Duy Hải), Điện Bàn district, Hội An city	Vu Gia, Thu Bồn, Vĩnh Điện, Bà Rén rivers	To the sea through Cửa Đại (Hội An city)	10,965	Lâm Tây town (21.4 km2), Ái Nghĩa town (20.0km2), Điện Bàn district (224.5km2), Hội An city (48.5km2), Kiểm Lâm town (3.1km2), Duy Nghĩa town (49.7km2)
3	Ly Ly river (Vu Gia – Thu Bon river system)	13 eastern communes of Que Son district (Đông Phú, Quế Hiệp, Quế Phú, Quế Cường, Quế Thuận, Phú Thọ, Quế Châu, Quế Ninh, Quế An, Quế Long, Quế Phong, Quế Xuân 1, Quế Xuân 2), Ha Lam town	Ly Ly river	To Thu Bon river and then to the sea	374	Đông Phú urban area (3.7km2), Hương An town (16.2km2), Hà Lam town (25.1km2)

No.	*Drainage direction*	*Service area*	*Drainage axes*	*Flow direction*	*Total drainage area (km2)*	*Urban drainage area (km2)*
		and 6 communes of Thăng Bình district (Bình Lãnh, Bình Trị , Bình Đị nh, Bình Quý, Bình Nguyên, Bình Phúc)				
4	Upstream of Vu Gia river	From upstreatm to Ái Nghĩa including districts Tây Giang, Đông Giang, Nam Giang, Phước Sơn, and 5 communes of Đại Lộc district (Đại Sơn, Đại Lãnh, Đại Đồng, Đại Quang, Đại Hồng)	Upstream of Vu Gia river including tributaries Côn river, A Vương river, Bung river, Đắc Mi river	From the west to Ai Nghia town and then partly flows to Han river in Da Nang city, partly to Vu Gia – Thu Bon river and then to the sea	5,180	Tơ Viêng town (9.3km2), P'rao town (4.0km2), Chà Val town (21.7km2), Sông Vàng town (3.6km2), Thạnh Mỹ town (17.0km2), Khâm Đức town (75.6km2)
5	Upstream of Thu Bon river	From upstream to Giao Thủy including districts Nam Trà My, Bắc Trà My, Tiên Phước, Hiệp Đức, 2 communes of Đại Lộc district (Đại Chánh, Đại Thanh), 5 communes of Quế Sơn district (Quế Lộc, Quế Ninh, Quế Phước, Quế Trung, Quế Lâm), 3 communes of Duy Xuyên district (Duy Phú, Duy Tân, Duy Thu)	Upstream of Thu Bồn river including tributaries Tranh river, Khang river, Trường river	From the west to Giao Thuy and then to the sea through Cửa Đại (Hội An city)	1,145	Tắc Pó town (4.3km2), đô Trà My town (13.6km2), Tân An town (6.3km2), Tiên Kỳ town (5.2km2), Việt An town (3.9km2), Trung Phước town (2.7km2), Phước Hiệp town (4.4km2)

Annex 12: Proposed land elevation for cities/towns

No.	*City/town*	*Natural land elevation (above sea level)*	*Proposed land elevation (above sea level)*
I	**Zone I**		

No.	***City/town***	***Natural land elevation (above sea level)***	***Proposed land elevation (above sea level)***
1	Tam Kỳ city	2.5m - 5.0m	3.00m
2	Chu Lai economic zone, Núi Thành town	2.5m – 10m	3.00m
II	**Zone II**		
1	Hội An city	0.7m – 2.5m	2.50m
2	Điện Bàn district	1.25m – 5.0m	3.30m
3	Duy Xuyên district		
3.1	*Nam Phước town*	1.3m – 5.6m	3.00m
3.2	*Duy Nghĩa town*	4.6m – 5.3m	4.60m
3.3	*Kiểm Lâm town*	5m – 26m	5m - 26m
III	**Zone 3 III**		
1	Phú Thị nh town (Phú Ninh district)	11m – 34m	11.00m
2	Trà My town (Bắc Trà My district)	154m - 505m	180m – 190m
3	Tiên Kỳ town (Tiên Phước district)	56m – 100m	60m - 70m
4	Tắc Pỏ town (Nam Trà My district)	402m – 1376m	530m - 580m
5	Phước Sơn district		
5.1	*Khâm Đức town*	317m – 1008m	450m - 500m
5.2	*Phước Hiệp town*	89m – 300m	89m - 97m
6	Hiệp Đức district		
6.1	*Tân An town*	45m - 241m	48m – 60m
6.2	*Việt An town*	60m – 100m	62m - 80m
7	Trung Phước town (Nông Sơn district)	26m – 310m	30m - 50m
8	Quế Sơn district		
8.1	*Đông Phú town*	36m – 214m	36m - 49m
8.2	*Hương An town*	8m – 13.2m	8.0m
9	Ái Nghĩa town (Đại Lộc district)	6m – 8m	6.5m
10	Nam Giang district		
10.1	*Thanh Mỹ town*	100m – 1018m	100m - 200m
10.2	*Chà Val town*	440m – 700m	440m - 480m
11	Đông Giang district		
11.1	*P'rao town*	300m – 1034m	500m – 550m

No.	***City/town***	***Natural land elevation (above sea level)***	***Proposed land elevation (above sea level)***
11.2	*Sông Vàng town*	368m – 420m	368m – 400m
12	Tơ Viêng + A Xan town (Tây Giang district)	100m – 1034m	630m - 680m
13	Hà Lam town (Thăng Bình district)	7.5m – 10.5m	7.5m

Annex 13: Domestic wastewater generation forecast

No.	*Area*	*By year 2020 (m3/day)*		*By year 2025 (m3/day)*		*By year 2030 (m3/day)*	
		Generated	*Collected*	*Generated*	*Collected*	*Generated*	*Collected*
I	**Zone I: Hội An-Điện Bàn-Đại Lộc**	**38,990**	**24,890**	**46,880**	**29,800**	**65,770**	**45,840**
1	*Hội An*	*12,650*	*9,780*	*13,930*	*10,890*	*18,390*	*14,290*
	Urban	11,130	8,570	12,030	9,370	16,400	12,700
	Rural	1,520	1,210	1,900	1,520	1,990	1,590
2	*Điện Bàn*	*16,400*	*10,420*	*20,640*	*13,060*	*30,190*	*23,420*
	Urban	12,130	7,550	14,960	9,220	22,530	16,990
	Rural	4,270	2,870	5,680	3,840	7,660	6,430
3	*Đại Lộc*	*9,940*	*4,690*	*12,310*	*5,850*	*17,190*	*8,130*
	Urban	4,300	2,150	4,800	2,460	7,900	3,940
	Rural	5,640	2,540	7,510	3,390	9,290	4,190
II	**Zone II: Duy Xuyên-Quế Sơn-Thăng Bình**	**23,480**	**10,520**	**30,330**	**13,540**	**43,970**	**19,830**
4	*Duy Xuyên*	*7,800*	*3,420*	*10,140*	*4,420*	*15,410*	*7,310*
	Urban	3,800	1,460	4,800	1,920	9,000	4,390
	Rural	4,000	520	5,340	700	6,410	2,920
5	*Quế Sơn*	*4,850*	*2,150*	*6,370*	*2,810*	*8,760*	*3,880*
	Urban	1,550	650	1,940	810	3,100	1,320
	Rural	3,300	1,500	4,430	2,000	5,660	2,560
6	Thăng Bình	*10,830*	*4,950*	*13,820*	*6,310*	*19,800*	*8,640*
	Urban	3,100	1,450	3,500	1,660	7,100	2,920
	Rural	7,730	3,500	10,320	4,650	12,700	5,720
III	**Zone III: Tam Kỳ-Núi Thành-Phú Ninh**	**35,160**	**21,100**	**40,260**	**24,470**	**66,090**	**47,970**
7	*Tam Kỳ*	*19,870*	*10,100*	*21,390*	*11,050*	*31,590*	*24,440*
	Urban	17,500	8,850	18,800	9,670	27,600	21,200
	Rural	2,370	1,250	2,590	1,380	3,990	3,240
8	*Núi Thành*	*10,950*	*9,060*	*13,140*	*10,860*	*26,800*	*20,060*
	Urban	6,540	5,230	7,240	5,760	24,200	17,850
	Rural	4,410	3,830	5,900	5,100	2,600	2,210
9	*Phú Ninh*	*4,340*	*1,940*	*5,730*	*2,560*	*7,700*	*3,470*
	Urban	690	290	860	360	1,200	480
	Rural	3,650	1,650	4,870	2,200	6,500	2,990
IV	**Zone IV:**	**18,580**		**24,030**		**34,884**	

No.	*Area*	*By year 2020 (m3/day)*		*By year 2025 (m3/day)*		*By year 2030 (m3/day)*	
		Generated	*Collected*	*Generated*	*Collected*	*Generated*	*Collected*
	Other districts		**8,150**		**10,460**		**14,940**
10	*Tây Giang*	*1,090*	*490*	*1,460*	*630*	*2,300*	*950*
	Urban	380	160	480	200	1,300	510
	Rural	710	330	980	430	1,000	440
11	*Đông Giang*	*1,610*	*720*	*2,100*	*900*	*3,144*	*1,260*
	Urban	920	390	1,150	480	2,044	860
	Rural	690	330	950	420	1,100	400
12	*Nam Giang*	*2,040*	*870*	*2,600*	*1,100*	4,200	1,790
	Urban	1,740	730	2,180	910	3,600	1,510
	Rural	300	140	420	190	600	280
13	*Nông Sơn*	*1,580*	*690*	*2,050*	*870*	*3,000*	*1,250*
	Urban	890	370	1,110	460	1,600	650
	Rural	690	320	940	410	1,400	600
14	*Phước Sơn*	*2,190*	*940*	*2,600*	*1,110*	*3,700*	*1,530*
	Urban	1,450	600	1,590	660	2,100	880
	Rural	740	340	1,010	450	1,600	650
15	*Hiệp Đức*	*2,410*	*1,050*	*3,140*	*1,370*	*4,511*	*1,890*
	Urban	1,150	480	1,440	600	2,511	1,050
	Rural	1,260	570	1,700	770	2,000	840
16	*Tiên Phước*	*3,870*	*1,720*	*5,080*	*2,270*	*6,900*	*3,080*
	Urban	770	320	960	400	1,400	590
	Rural	3,100	1,400	4,120	1,870	5,500	2,490
17	*Bắc Trà My*	*2,260*	*1,000*	*2,980*	*1,300*	*4,128*	*1,860*
	Urban	770	320	960	400	1,728	720
	Rural	1,490	680	2,020	900	2,400	1,140
18	*Nam Trà My*	*1,530*	*670*	*2,020*	*910*	*3,000*	*1,330*
	Urban	310	130	380	160	600	240
	Rural	1,220	540	1,640	750	2,400	1,090
	Total	**116,210**	**63,220**	**141,500**	**76,470**	**210,714**	**128,580**
	Urban	69,120	39,700	79,180	45,500	*135,914*	*88,800*
	Rural	47,090	23,520	62,320	30,970	*74,800*	*39,780*

Annex 14: Industrial wastewater generation forecast

No.	Idustrial zones	Water consumption (m3/day)		Wastewater generation (m3/day)	
		By year 2020	By year 2030	By year 2020	By year 2030
	Industrial zones				
1	Zone I	92,268	122,707	64,588	85,895
2	Zone II	17,323	46,358	12,126	19,219
3	Zone III	11,062	97,944	7,743	68,561
	Industrial clusters				
1	Zone I	5,482	5,482	3,837	3,837
2	Zone II	20,487	20,487	4,563	4,563
3	Zone III	37,408	37,408	26,185	26,185
Total		**184,029**	**330,386**	**119,043**	**208,261**

Annex 15: Agricultural wastewater generation

No	Content	Subject				Wastewater capacity (m3/day)
		Quantity of Cow	Quantity of Buffalo	Quantity of Pig	Quantity of Poultry	
1	Tam Ky city	5,114	2,496	12,517	293,000	17,926
2	Hoi An city	2,108	224	4,052	51,000	3,217
3	Tay Giang district	3,194	901	5,246	20,000	1,478
4	Dong Giang district	4,912	1,276	8,191	42,000	2,937
5	Dai Loc district	12,975	4,436	57,343	714,000	44,733
6	Dien Ban district	17,562	943	75,720	1,013,000	63,104
7	Duy Xuyen district	11,733	3,381	46,404	562,000	35,292
8	Que Son district	10,870	4,821	43,763	351,000	22,770
9	Nam Giang district	5,674	1,906	7,640	27,000	2,062
10	Phuoc Son district	4,056	2,336	10,052	49,000	3,428
11	Hiep Duc district	10,756	3,780	12,550	113,000	7,477
12	Thang Binh district	19,569	10,357	101,603	620,000	41,241
13	Tien Phuoc district	10,567	4,452	15,809	358,000	22,049
14	Bac Tra My district	6,346	5,145	16,693	88,000	6,103
15	Nam Tra My district	1,530	870	8,636	37,000	2,577
16	Nui Thanh district	9,146	10,767	36,978	411,000	26,125
17	Phu Ninh district	11,949	10,260	28,199	663,000	40,668
18	Nong Son district	3,188	2,449	6,741	70,000	4,516
Total		**151,249**	**70,800**	**498,137**	**5,482,000**	**347,705**

Annex 16: Proposed wastewater treatment plants

No	*Wastewater treatment plants*	*Capacity (m3/day) by year*				*Service area*	*Location of WWTP*	*Water receiving body*
		2014	*2020*	*2025*	*2030*			
	Zone I	**6,750**	**14,500**	**17,610**	**28,640**			
1	Hoi An	6,750	6,750	9,500	14,000	Whole the city	Cam Thanh, Hoi An	Downstream of Thu Bon River
2	Dien Nam-Dien Ngoc	-	4,400	4,400	8,300	Điện Ngọc, Điện Nam Đông, Điện Dương, Điên Thắng Bắc, Điện Thắng Trung, Điện Thắng Nam, Điện An	Dien Nam-Dien Ngoc	Sea
3	Vinh Dien	-	-	1,200	1,240	Vinh Dien	Dien Phuoc	Vinh Dien river
4	Ai Nghia	-	-	1,700	2,000	Ai Nghia	Ai Nghia	Vu Gia river
5	Lam Tay			450	470	Lam Tay	Lam Tay	Vu Gia river
	Zone II	**-**	**3,700**	**4,360**	**7,530**			
6	Nam Phuoc		800	930	1,500	Nam Phuoc	Nam Phuoc	Thu Bon river
7	Duy Nghia	-	640	720	1,500	Duy Xuyen urban area	Duy Xuyen urban area	Thu Bon river
8	Kiem Lam	-	160	-	290	Lâm Tây urban area, Duy Xuyên	Lâm Tây urban area	Việt An lake
9	Dong Phu	-	330	360	600	Dong Phu	Dong Phu	Phú Ninh reservoir
10	Huong An	-	320	390	720	Dong Phu	Dong Phu	Phú Ninh reservoir
11	Binh Minh	-	450	460	720	Binh Minh	Binh Minh	Phú Ninh reservoir
12	Ha Lam		1,000	1,500	2,200	Ha Lam	Ha Lam	

No	*Wastewater treatment plants*	*Capacity (m3/day) by year*				*Service area*	*Location of WWTP*	*Water receiving body*
		2014	*2020*	*2025*	*2030*			
	Zone III	**8,000**	**20,900**	**25,010**	**45,100**			
12	Tam Ky	8,000	8,000	11,800	25,000	Tam Ky city	Hoa Huong	Bàn Thạch river
13	Tam Hoa	-	1,700	1,940	3,700	Tam Hoa	Tam Hoa	Trau river
14	Free tax zone	-	1,200	1,270	3,600	Tam Xuan	Tam Xuan	Trau river
15	Nui Thanh	-	10,000	10,000	12,800	Nui Thanh Urban area	Van Trai, Tam Hiep	Trau river
	Zone IV	**-**	**3,410**	**3,850**	**6,680**			
16	Tra My		320	390	720	Tra My	Tra My	Spring
17	Tien Ky		320	350	590	Tien Ky	Tien Ky	Spring
18	Tac Po		130	140	240	Tac Po	Tac Po	Spring
19	Kham Duc		600	640	880	Kham Duc	Kham Duc	Spring
20	Tan An		160	220	470	Tan An	Tan An	Thu Bồn river
21	Viet An		320	350	580	Viet An	Viet An	Thu Bồn river
22	Trung Phuoc		370	400	650	Trung phuoc	Trung phuoc	Thu Bồn river
23	Thanh My		400	410	800	Thanh My	Thanh My	Vu Gia river
24	Cha Val		330	400	720	Cha Val, Nam Giang	Cha Van	Vu Gia river
25	P'rao		260	300	520	P'rao, Đông Giang	Prao	ChoKe, A Vương river
26	Tây Giang		200	250	510	District center, Tây Giang	Tay Giang	Suối Tơ Viêng, A Vương river
	Total	**14,750**	**42,510**	**50,830**	**87,950**			

Annex 17: Sludge generation from wastewater

Zone	***Sludge from sewerage network by year (kg/day)***			***Sludge from septic tanks by year (kg/day)***			***Sludge from WWTPs by year (kg/day)***		
	2020	***2025***	***2030***	***2020***	***2025***	***2030***	***2020***	***2025***	***2030***
Zone I	3,589	3,807	6,192	17,400	18,400	19,800	5,500	9,240	13,121
Zone II	2,174	2,200	3,201	13,500	13,600	14,900	1,700	2,856	4,056
Zone III	3,026	3,365	5,539	13,900	15,400	16,400	4,800	8,064	11,451
Zone IV	1,741	1,784	2,562	10,400	10,700	16,400	-	-	-
Total	**10,530**	**11,157**	**17,495**	**55,200**	**58,100**	**67,500**	**12,000**	**20,160**	**28,627**

Annex 18: Landfills designated for sludge treatment

No.	*Name of landfill*	*Area (ha)*	*Service area*
1	Tam Nghia	21.1	Nui Thanh
2	Tam Xuan 2	13.3	Tam Ky, Nui Thanh
3	Dai Hiep	1.9	Dai Hiep, Dien Ban
4	Dong Phu	10.6	Que Son
5	Cam Ha	1.3	Hoi An
6	Trung Phuoc	0.2	Nong Son
7	Que Loc	0.05	Nong Son
8	Tra Mai	5.8	Nam Tra My
9	Tra Son	0.5	Bac Tra My
10	Kham Duc	0.6	Phuoc Son
11	Thanh My	3.4	Nam Giang
12	Prao	0.05	Dong Giang
13	Xa Ba	0.07	Dong Giang
14	A Tieng	4.6	Tay Giang

Annex 19: Investment costs for water supply

No	*Water supply system*	*Period to year*						
		2015	*2020*		*2025*		*2030*	
		Capacity (m3/day)	*Capacity (m3/day)*	*Cost (VND mil)*	*Capacity (m3/day)*	*Cost (VND mil)*	*Capacity (m3/day)*	*Cost (VND mil)*
	Zone I: Hội An-Điện Bàn-Đại Lộc	**38,000**	**91,000**	**853,226**	**121,000**	**749,890**	**168,500**	**1,185,433**
1	Hội An	21,000	21,000	-	26,000	113,258	31,000	129,967
2	Vĩnh Điện-Phong Thử (Điện Phước)	4,500	9,000	78,022	9,000	-	15,000	155,960
3	Điện Nam-Điện Ngọc (nước ngầm)	5,000	5,000	-	-		-	-
4	Gò Nổi	-	3,500	60,684	3,500	-	5,000	38,990
5	Trảng Nhật (Điện Nam-Điện Ngọc)	-	30,000	454,446	45,000	296,856	60,000	340,649
6	Ái Nghĩa	5,000	10,000	86,691	15,000	113,258	25,000	259,933
7	Đồng Xanh	2,500	2,500	-	2,500	-	2,500	-
8	Động Hà Sống	-	10,000	173,383	20,000	226,517	30,000	259,933
	Zone II: Duy Xuyên-Quế Sơn-Thăng Bình	**8,000**	**23,500**	**295,618**	**40,000**	**515,326**	**52,500**	**331,415**
1	Nam Phước	3,000	6,000	57,216	-	-	-	-
2	CùBà n	-	-	-	20,000	453,034	30,000	259,933
3	Đông Phú	2,500	7,500	95,361	10,000	62,292	12,500	71,482
4	Thăng Bình	2,500	10,000	143,041	10,000	-	10,000	-
	Zone III: Tam Kỳ-Núi Thành-Phú Ninh	**21,000**	**148,000**	**1,585,084**	**210,000**	**1,022,903**	**245,000**	**1,543,183**
1	Tam Kỳ	15,000	25,000	173,383	35,000	226,517		-
2	Phú Ninh	1,000	3,000	34,677	5,000	45,303		-
3	Tam Hiệp	5,000	5,000	-	5,000	-		
4	Tam Hiệp 2	-	15,000	227,223	15,000	-	45,000	681,299
5	BOO Phú	-	100,000	1,149,802	150,000	751,082	200,000	861,884

No	*Water supply system*	*Period to year*						
		2015	*2020*		*2025*		*2030*	
		Capacity (m3/day)	*Capacity (m3/day)*	*Cost (VND mil)*	*Capacity (m3/day)*	*Cost (VND mil)*	*Capacity (m3/day)*	*Cost (VND mil)*
	Ninh							
	Zone IV: Other districts	**7,400**	**20,700**	**288,249**	**47,300**	**753,169**	**59,900**	**409,395**
1	Tây Giang	-	600	13,004	1,200	16,989	1,200	-
2	A Xan	-	500	10,836	500	-	1,000	16,246
3	Đông Giang	600	1,000	8,669	1,000	-	2,000	32,492
4	Sông Vàng	-	600	13,004	600	-	1,200	19,495
5	Thạnh Mỹ	1,000	3,000	43,346	9,000	169,888	9,000	-
6	Chà Val	-	1,500	32,509	2,000	14,157	3,000	32,492
7	Cửa khẩu	-	500	10,836	1,000	14,157	2,000	32,492
8	Nông Sơn	1,000	2,000	21,673	2,000	-	3,000	32,492
9	Khâm Đức	2,000	2,000	-	3,000	28,315	4,000	32,492
10	Phước Hiệp	-	500	10,836	500	-	1,000	16,246
11	Tân An	1,000	1,000	-	7,500	184,045	7,500	-
12	Tiên Phước	1,500	5,000	75,855	10,000	141,573	15,000	162,458
13	Bắc Trà My	300	1,500	26,007	2,000	14,157	3,000	32,492
14	Trà Giác	-	500	10,836	6,000	155,730	6,000	-
15	Nam Trà My	-	500	10,836	1,000	14,157	1,000	-
	Total	**74,400**	**283,200**	**3,022,177**	**418,300**	**3,041,287**	**525,900**	**3,469,426**

Annex 20: Investment costs for drainage and wastewater management

No	*Drainage, wastewater system*	*Period to year*						
		2015	*2020*		*2025*		*2030*	
		Capacity (m3/day)	*Capacity (m3/day)*	*Cost (VND mil)*	*Capacity (m3/day)*	*Cost (VND mil)*	*Capacity (m3/day)*	*Cost (VND mil)*
	Zone I: Hội An-Điện Bàn-Đại Lộc	**6,750**	**12,450**	**325,230**	**16,420**	**293,105**	**29,540**	**1,072,159**
1	Hội An	6,750	6,750	-	8,570	121,239	14,000	423,159
2	Đô thị Điện Nam - Điện Ngọc	-	4,500	246,386	4,500	-	9,000	350,684
3	Vĩnh Điện	-	1,200	78,844	1,200	-	2,400	112,219
4	Ái Nghĩa	-		-	1,700	135,894	3,400	158,977
5	Lâm Tây			-	450	35,972	740	27,120
	Zone II: Duy Xuyên-Quế Sơn-Thăng Bình	**-**	**3,370**	**221,419**	**5,160**	**143,089**	**8,630**	**324,500**
1	Nam Phước		800	52,562	1,600	63,950	2,600	93,516
2	Duy Nghĩa	-	640	42,050	640	-	1,500	80,424
3	Kiểm Lâm	-	160	10,512	160	-	290	12,157
4	Đông Phú	-		-	330	26,379	600	25,249
5	Hương An	-	320	21,025	480	12,790	720	22,444
6	Bình Minh	-	450	29,566	450	-	720	25,249
7	Hà Lam		1,000	65,703	1,500	39,969	2,200	65,461
	Zone III: Tam Kỳ-Núi Thành-Phú Ninh	**8,000**	**20,900**	**1,025,539**	**28,150**	**528,921**	**45,100**	**1,379,358**
1	Tam Kỳ	8,000	8,000	528,000	11,800	253,136	25,000	1,028,674
2	Tam Hòa	-	1,700	111,695	2,550	67,947	3,700	107,543
3	Khu phi thuế quan 1, 2, 3	-	1,200	78,844	2,400	95,925	3,600	112,219
4	Núi Thành	-	10,000	307,000	11,400	111,913	12,800	130,922
	Zone IV: Other	**-**	**1,570**	**118,627**	**3,410**	**169,148**	**6,680**	**351,666**

No	***Drainage, wastewater system***	***Period to year***						
		2015	***2020***		***2025***		***2030***	
		Capacity (m3/day)	*Capacity (m3/day)*	*Cost (VND mil)*	*Capacity (m3/day)*	*Cost (VND mil)*	*Capacity (m3/day)*	*Cost (VND mil)*
	districts							
1	Trà My			-	320	29,417	720	43,017
2	Tiên Kỳ			-	320	29,417	590	29,037
3	Tắc Pỏ			-	130	11,951	240	11,830
4	Khâm Đức		600	45,335	600	-	880	30,112
5	Tân An			-	160	14,709	470	33,338
6	Việt An			-	320	29,417	580	27,961
7	Trung Phước		370	27,957	370	-	650	30,112
8	Thạnh Mỹ		400	30,223	400	-	800	43,017
9	Cha Val			-	330	30,336	720	41,942
10	P'rao			-	260	23,901	520	27,961
11	Tây Giang		200	15,112	200	-	510	33,338
	Total	**14,750**	**38,290**	**1,690,814**	**53,140**	**1,134,263**	**89,950**	**3,127,683**

Annex 21: Costs of technical assistance and capacity building

No	***Activity***	***Cost (VND mil)***
1.	Capacity building for sector management agencies, service providers and related local goverments	4,500
2	Establishment of asset sector database, infrastructure management systems	6,500
3	Establishment of sector economic norms for operation and maintenance of drainage and wastewater systems. Development of samples service contracts	650
4	Development of standard operational procedures for operation and maintenance of water supply and drainage, wastewater services	4,500
5	Support in establishing committee for Vu Gia – Thu Bon river basin management	6,500
6	Support in developing water resource monitoring system, inundation maps, flood early warning system and emergency response plans	45,000
7	Support in developing IEC and BCC programs	11,000
	Total	**78,650**